Ю.И. Логачёв, Г.А. Базилевская, Н.А. Власова, Е.А. Гинзбург, Е.И. Дайбог, В.Н. Ишков, Л.Л. Лазутин, М.Д. Нгуен, Г.М. Сурова, О.С. Яковчук

Каталог

солнечных протонных событий 24-го цикла солнечной активности (2009–2019 гг.)

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Научно-исследовательский институт ядерной физики им. Д.В. Скобельцына
Московского государственного университета им. М.В. Ломоносова
(НИИЯФ МГУ), г. Москва
Физический институт им. П.Н. Лебедева РАН (ФИАН), г. Москва
Институт прикладной геофизики имени Е.К. Федорова (ИПГ), г. Москва
Институт земного магнетизма, ионосферы и распространения радиоволн
им. Н.В. Пушкова РАН (ИЗМИРАН), г. Москва, г. Троицк
Геофизический центр РАН (ГЦ РАН), г. Москва

Авторский коллектив:
Ю.И. Логачёв (НИИЯФ), **Г.А. Базилевская** (ФИАН), **Н.А. Власова** (НИИЯФ), **Е.А. Гинзбург** (ИПГ), **Е.И. Дайбог** (НИИЯФ), **В.Н. Ишков** (ИЗМИРАН, ГЦ РАН), **Л.Л. Лазутин** (НИИЯФ), **М.Д. Нгуен** (НИИЯФ), **Г.М. Сурова** (НИИЯФ), **О.С. Яковчук** (НИИЯФ)

под редакцией **Логачёва Ю.И.**

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Предисловие редактора

Настоящий «Каталог солнечных протонных событий 24-го цикла солнечной активности (2009–2019 гг.)» является продолжением Каталогов предыдущих выпусков [Акиньян и др., 1982; Базилевская и др., 1986, 1990а, 1990б; Сладкова и др., 1998; Логачев и др., 2016], начиная с 1970 г.* [http://www.wdcb.ru/stp/solar/solar_proton_events.ru.html].

В Каталоге собраны и систематизированы данные о солнечных событиях с генерацией протонов, для которых максимальный поток протонов с Ep > 10 МэВ превышал значение Jp = 1 $см^{-2}.с^{-1}.ср^{-1}$ (1 pfu). Таких событий в 24-м цикле солнечной активности оказалось 100. Дополнительно были включены еще 14 событий с Jp (E > 10 МэВ) в интервале 0.1 ÷ 1 pfu с данными обо всех сопутствующих явлениях вспышечной активности, подобных основным 100 событиям. В Каталоге эти события отмечены звёздочкой (*). Такие малые потоки в других Каталогах не представлены.

Отметим, что в 2009 г. и в последние два года 24-го цикла солнечной активности (2018–2019 гг.) протонных событий с выбранным потоком частиц (Jp > 1 pfu) не было, последнее событие, представленное в Каталоге, относится к сентябрю 2017 года.

Кроме данных о потоках протонов, измеренных несколькими космическими аппаратами, в Каталоге приведены сведения об источниках частиц и о связанном с данным событием электромагнитном излучении. Для каждого события приведен интегральный энергетический спектр зарегистрированных протонов в максимуме временного профиля потока протонов. Некоторые события имеют сложный временной профиль потоков протонов с двумя и более максимумами. В этих событиях для каждого из максимумов приведен отдельный энергетический спектр.

На основе построенного энергетического спектра протонов вычисляется значение энергии, при которой поток солнечных космических лучей (СКЛ) равен 0.1 потока галактических космических лучей (ГКЛ). Мы называем эту величину квазимаксимальной энергией СКЛ (Eqm) и рассматриваем ее как некоторое приближение к реальной максимальной энергии протонов (Emax) для данного возрастания потоков протонов.

Каждое событие иллюстрируется обзорными графиками рентгеновского излучения, потоков электронов и протонов, скорости солнечного ветра, напряженности межпланетного магнитного поля и Dst-вариации в околоземном космическом пространстве, что позволяет оценить активность Солнца во временном интервале, охватывающем данное событие.

В число авторов Каталога входят представители разных институтов, сотрудники разных специальностей: космических лучей, солнечной, радио-, геофизики и физики межпланетного пространства, что обеспечило широкий охват явлений, связанных с генерацией частиц на Солнце и их распространением в пространстве и земной магнитосфере.

Опыт работы с ранее выпущенными Каталогами показал, что они востребованы для различных статистических исследований энергичных солнечных частиц, для изучения физических процессов, связанных с их ускорением и распространением в межпланетном пространстве.

Сведения о потоках и энергетических спектрах солнечных частиц необходимы для изучения и мониторинга солнечно-земных связей, в первую очередь для оценки и прогнозировании радиационной обстановки во внутренней гелиосфере. Данные Каталога

будут полезны при изучении проникновения частиц в магнитосферу и атмосферу Земли, при исследовании некоторых геофизических явлений, таких как поглощение космического радиоизлучения в полярной шапке, а также для прогнозирования условий распространения радиоволн. Вторжения энергичных солнечных частиц в земную атмосферу инициируют ион-молекулярные реакции, влияющие на изменение концентрации озона, и вследствие этого на температуру и циркуляцию воздушных масс в стратосфере и тропосфере Земли.

Работа по созданию Каталога поддержана грантом РФФИ № 19-02-00264.

Авторы-составители Каталога выражают благодарность за поддержку работ над Каталогом заведующему Отделом космических наук НИИЯФ МГУ д.ф.-м.н. В.В. Калегаеву, директору ИЗМИРАН профессору В.Д. Кузнецову, директору ИПГ Росгидромет д.ф.-м.н. А.Ю. Репину и заведующему Лабораторией физики Солнца и космических лучей ФИАН д.ф.-м.н. В.С. Махмутову. Обсуждение и благожелательная критика оказали благотворное влияние на качество материалов Каталога, и мы выражаем искреннюю признательность всем нашим коллегам, принявшим участие в обсуждении. Авторы благодарны в.н.с. к.ф.-м.н. Н.А. Сергеевой и с.н.с. Л.П. Забаринской из Мирового центра данных по солнечно-земной физике ГЦ РАН за техническое редактирование Каталога и публикацию на сайте МЦД по СЗФ.

* Ссылки приведены в списке литературы к разделу «Описание материалов Каталога».

Описание материалов Каталога

Введение

В Каталоге представлены данные о потоках энергичных заряженных частиц солнечного происхождения в событиях 24-го цикла солнечной активности (2009–2019 гг.), зарегистрированных на различных космических аппаратах: в точке Лагранжа L1, на геостационарной орбите, низковысотными спутниками Земли и наземными средствами. В 2009 г. и в 2018–2019 гг. в минимуме солнечной активности (СА) событий, отвечающих условиям Каталога, не было, поэтому в Каталоге представлены данные только за 2010–2017 гг.

Солнечным протонным событием (СПС) в данном Каталоге считается такое возрастание потоков частиц на 1 а.е., при котором максимальный поток протонов с энергией Ep > 10 МэВ превышает или равен 1 $см^{-2}{\cdot}с^{-1}{\cdot}ср^{-1}$ = 1 pfu (particle flux unit) или, другими словами, Jp (E > 10 МэВ) ≥ 1 pfu. Как правило, оценка этого критического потока ориентируется на среднечасовые значения показаний прибора Energetic Particle Sensor (EPS) геостационарных спутников NOAA серии GOES. Если данные этих аппаратов недоступны или магнитосфера Земли сильно возмущена, оценка критических потоков проводится по совокупности других представленных в Каталоге космических аппаратов. В Каталог включены не только изолированные возрастания потоков протонов с простым временным профилем, имеющим один максимум, но и некоторые события со сложным временным профилем с несколькими возрастаниями, которые считались одним событием с несколькими максимумами. В событиях с несколькими максимумами для построения спектров выбирались наиболее яркие из них, не более двух. Для каждого выбранного максимума в таблицах, описанных ниже, приведены такие же сведения, как и для событий с одним максимумом.

Краткое описание космических аппаратов (КА) и характеристики приборов даны в **Приложении 1**.

Одним из важнейших моментов изучения солнечного протонного события является определение его источника – вспышечного события на Солнце, генерировавшего энергичные протоны. Мы понимаем под солнечным вспышечным событием весь спектр явлений во всех диапазонах электромагнитного излучения со всеми динамическими явлениями, сопровождающими взрывное выделение энергии в ограниченных областях атмосферы Солнца.

В зависимости от величины магнитного поля, в котором происходят вспышечные события, это могут быть солнечные вспышки или выбросы солнечных волокон. Если вспышечное событие происходит на невидимой полусфере, наблюдаются его проявления в верхних слоях атмосферы Солнца: корональные выбросы вещества (Coronal mass ejection – CME) и явления в радиодиапазоне. Проблема отождествления зарегистрированных на орбите Земли протонных возрастаний со вспышечными событиями на Солнце является актуальной с начала изучения солнечных космических лучей (СКЛ). Методика и использованные критерии для привязки на орбите Земли к Солнцу описаны во всех предыдущих Каталогах [Акиньян и др., 1982; Базилевская и др., 1986, 1990а, 1990б; Сладкова и др., 1998; Логачев и др., 2016], тем не менее, учитывая важность данной процедуры, в данном Каталоге также приведено описание методики, но несколько модифицированной: **«Определение источников возрастаний потоков протонов во вспышечных событиях на Солнце» (Приложение 2)**.

Основным источником информации о релятивистских СКЛ являются наземные установки, нейтронные мониторы (НМ), которые регистрируют солнечные события очень большой энергии, заряженные частицы которых достигают поверхности Земли. Эти возрастания принято называть GLE (Ground Level Enhancement) событиями. В течение 24-го цикла СА произошло 2 GLE события (2012.05.17 – № 71 и 2017.09.10 – № 72).

Переход от показаний НМ к потокам протонов за пределами магнитосферы Земли – сложный процесс, включающий учет механизмов распространения заряженных частиц в магнитном поле Земли и в ее атмосфере, т.е. возникает необходимость решения обратной задачи – восстановление энергетического спектра релятивистских солнечных протонов в межпланетном пространстве по данным НМ. Для решения рассматриваемой задачи с каждым годом используются более совершенные модели распространения частиц, что учитывается в данном Каталоге. Подробнее проблема описана в **Приложении 3** «**Определение потоков и энергетического спектра релятивистских солнечных протонов по данным нейтронных мониторов».**

Отметим, что в 2006–2014 гг. измерение релятивистских частиц осуществлялось орбитальным спектрометром PAMELA, который регистрировал в околоземном космическом пространстве потоки протонов и ядер с энергией в диапазоне от 80 МэВ до нескольких ГэВ. В Каталоге приведены имеющиеся данные PAMELA.

С целью оценки максимальной энергии ускоренных протонов в данном Каталоге используется введенный в Каталоге 23-го цикла СА [Логачев и др., 2016] параметр: квазимаксимальная энергия протонов в событии − Eqm (Quasimaximal energy of protons in the event), характеризующий спектр события в области наибольших зарегистрированных энергий протонов. Параметр Eqm является первым приближением к реальной максимальной энергии наблюдаемых потоков протонов в данном солнечном событии. Квазимаксимальная энергия протонов в событии Eqm определяется как энергия, при которой поток солнечных протонов в данном событии равен 0.1 потока галактических космических лучей (протонов ГКЛ) той же энергии. Методика определения Eqm описана в **Приложении 4** и в [Логачев и др., 2018].

Описание структуры представления материала для отдельного солнечного протонного события

Каждое событие начинается с его наименования, являющегося датой возникновения (начала) события, обозначенного двумя способами:

YYYY.MM.DD – (YYYY-DOY), например, первое событие Каталога, начавшееся 03 августа 2010 года, именуется как **2010.08.03 – (2010-215).** Упоминание значения DOY (порядковый номер дня в году) в названии события часто бывает удобно при сравнении с другими справочными данными. В правой части этой строки дается номер события, нумерация которых ведется с первого события 1970 года, включенного в Каталог солнечных протонных событий 1970–1979 гг. [Акиньян и др., 1982].

Далее идет ЛЕГЕНДА события, включающая некоторые общие сведения о событии. Ниже дан пример легенды и пояснения к её каждой строке.

Event 2012.03.07 – (2012-067) **№ 506**

Particle event: To (Ep>10 MeV) – 07d02^h
Tmax$_1$ (Ep>10 MeV) – 07d17^h, Jmax$_1$ (Ep>10 MeV) – 1440 /cm^2·s·sr
Tmax$_2$ (Ep>10 MeV) – 08d13^h, Jmax$_2$ (Ep>10 MeV) – 4340 /cm^2·s·sr
Duration of the event – 6 days, power-law index: $\gamma_1 = 2.9$, $\gamma_2 = 4.0$
Quasimaximal energy of protons in the event – Eqm$_1$ = 1200 MeV
– Eqm$_2$ = 650 MeV
Sources: ● solar flare 07d00^{h}00^m, X5.4/3B, N17E27, AR11429
Ø solar flare 07d01^{h}05^m, X1.3/SF, N22E12, AR11430
Ø solar flare 09d03^{h}22^m, M6.3/SF, N15W02, AR11429
Ø solar flare 10d17^{h}15^m, M8.4/..., N17W24, AR11429
Main burst X-ray 1–8 Å: onset – 07d00^{h}02^m, max – 07d00^{h}40^m, Φ = 0.67 J/m^2
CME: 07d00^{h}24^m, V = 2684 km/s, Δφ = 360º, dA = 057º
▲SC 07d04^{h}20^m; ▲SC 12d09^{h}15^m;

Здесь:
Event 2012.03.07 – (2012-067) – наименование события и номер события: **№ 506.**

В первой строке:
Particle event: To (Ep>10 MeV) – 07d02^h – день и время начала события, определенное по потоку протонов с Ep>10 МэВ по показаниям прибора EPS геостационарных аппаратов GOES или совокупности других представленных в Каталоге космических аппаратов. Точность указания времени начала события лежит в пределах 1 часа.

Более точно значение To можно определить в электронной версии Каталога [https://swx.sinp.msu.ru/apps/sep_events_cat/index.php?gcm=1&lang=ru]. Для этого нужно открыть файл этого события и найти To с помощью курсора на временном профиле данных GOES. Точное определение времени начала события, даже если использовать данные с более высоким временным разрешением, из-за вариаций фонового счета приборов является затруднительным и может привести к дезинформации о реальном времени начала события в протонной компоненте.

Во второй (второй-a и второй-b) строке:
(a) Tmax$_1$ (Ep>10 MeV) – 07d17^h, Jmax$_1$ (Ep>10 MeV) – 1440 /cm^2·s·sr
(b) Tmax$_2$ (Ep>10 MeV) – 08d13^h, Jmax$_2$ (Ep>10 MeV) – 4340 /cm^2·s·sr

даны день и время максимума (максимумов) потока протонов с энергией >10 МэВ в событии по данным совокупности представленных в Каталоге аппаратов, регистрировавших данное событие, и значение в максимуме (максимумах) потока Jp $(см^2 \cdot с \cdot ср)^{-1}$. В данном примере в событии наблюдалось два максимума, и в ЛЕГЕНДЕ отведено две строки (a и b).

Все представленные потоки частиц в Каталоге являются среднечасовыми значениями, время всюду – UT. Точность указания времени максимального потока протонов Tmax составляет 1 час. Точность определения потока протонов Jmax (Ep > 10 МэВ) – не хуже ± 10%. Невысокая точность фиксации времени максимального потока протонов определяется использованием часовых средних значений потоков частиц на протяжении всего события. Кроме того, время максимального потока протонов предназначено, главным образом, для выделения конкретного максимума потоков в сложных событиях с несколькими максимумами, чтобы значения потоков при построении энергетических спектров по данным различных КА относились к одному и тому же максимуму.

В третьей строке:

Duration of the event – 6 days, power-law index: $\gamma_1 = 2.9$, $\gamma_2 = 4.0$

указана полная длительность события (для сложного события – включая все отмеченные максимумы) и показатель степенного спектра потоков протонов в максимуме (максимумах) события – γ.

В последней строке:

Quasimaximal energy of protons in the event – $Eqm_1 = 1200$ MeV
– $Eqm_2 = 650$ MeV

приведены значения квазимаксимальной энергии протонов в данном событии Eqm, определяемой для каждого максимума данного события. Eqm (max1) и Eqm (max2) вычислены на основе интегрального энергетического спектра протонов для каждого максимума в событии**.** Значение Eqm определено с точностью ± 15%.

Второй раздел ЛЕГЕНДЫ относится к солнечным источникам частиц, наблюдавшихся вблизи Земли. В приведенном примере события **Event 2012.03.07 – (2012-067)** дано:

Sources: ● solar flare $07d00^h00^m$, X5.4/3B, N17E27, AR11429
Ø solar flare $07d01^h05^m$, X1.3/SF, N22E12, AR11430
Ø solar flare $09d03^h22^m$, M6.3/SF, N15W02, AR11429
Ø solar flare $10d17^h15^m$, M8.4/..., N17W24, AR11429
Main burst X-ray 1–8 Å: onset – $07d00^h02^m$, max – $07d00^h40^m$, Φ = 0.67 J/m^2
CME: $07d00^h24^m$, V = 2684 km/s, Δφ = 360º, dA = 057º
▲SC $07d04^h20^m$; ▲SC $12d09^h15^m$

Если источником частиц является солнечное вспышечное событие, то **в первой строке** приведены его основные характеристики: время начала вспышечного события либо в линии Hα (6563 Å), либо рентгеновского всплеска: ($07d00^h00^m$ – день, часы, минуты) в зависимости от того, в каком диапазоне оно началось, что определяет порядок представления рентгеновского и оптического балла этого события (X5.4/3B, в данном случае вспышечное событие раньше проявилось в диапазоне мягкого рентгеновского излучения); координаты вспышки (N17E27) и номер активной области, где произошло вспышечное событие (AR11429). Если для рентгеновского и оптического балла вспышки указана обратная очередность (например, в событии 2012.03.13 – 1B/M7.9), это значит, что начало вспышечного события в оптическом диапазоне отмечено раньше, чем в рентгеновском.

В начале этой строки стоит условный знак, характеризующий причастность вспышки к данному протонному событию и уверенность привязки вспышечного события к данному протонному событию:

●,■ – данная вспышка определенно является источником наблюдаемых протонов;

⊙,⊡ − данная вспышка с большой вероятностью является источником наблюдаемых протонов; знаки ■, ⊡ применяются, когда источник солнечного протонного события осуществляется на прилимбовых и залимбовых гелиодолготах W, E ≥ 80°;

O – вспышка, возможно, является источником протонов данного события, но есть причины, по которым эта возможность подвергается сомнениям;

Ø – вспышка не является основным источником, но внесла (или могла внести) вклад в наблюдаемые потоки протонов.

Если источник протонов на Солнце не отождествляется, то используются следующие обозначения:

□ − вспышка (или активность) за западным или восточным лимбами Солнца;

◊ − активность области на диске Солнца без привязки к конкретному вспышечному событию, либо модуляционные эффекты в межпланетном пространстве.

Методика определения источников частиц во вспышечном событии, приводится в **Приложении 2.** Характеристики активных областей, в которых произошли протонные вспышечные события, приводятся в **Приложении 5.**

Далее в разделе **Sources** даются сведения о всплеске мягкого рентгеновского излучения в диапазоне 1–8 Å (12.5–1 кэВ) по данным КА GOES: начало и максимум всплеска (в данном примере $07d00^h02^m$ и $07d00^h40^m$), Ф – интегральный поток энергии от начала всплеска до момента спада на уровень 0.5 от максимального значения в Дж/м^2 (Ф = 0.67 J/m^2).

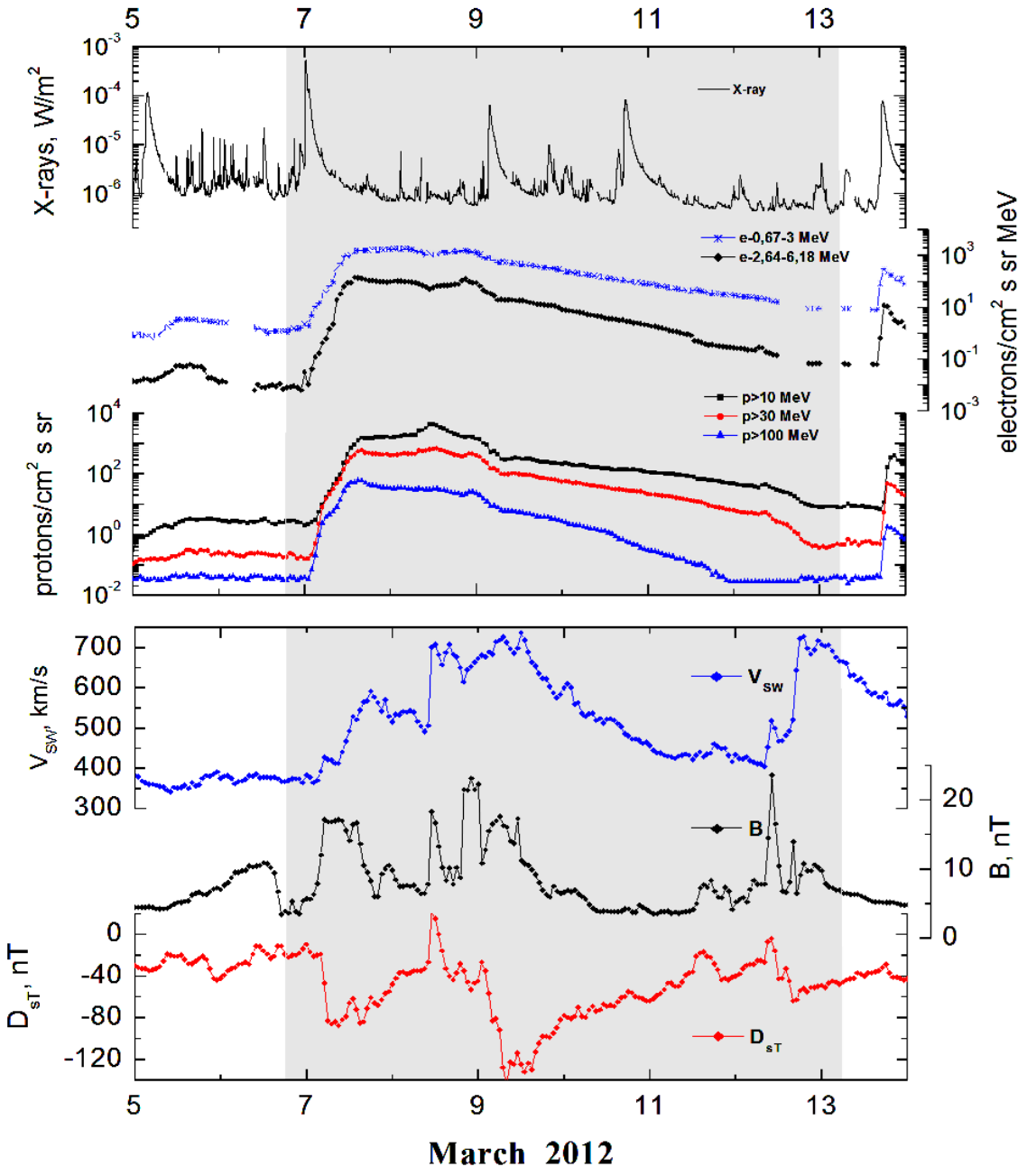
Затем приведены сведения о корональном выбросе вещества (CME), связанном с рассматриваемым событием (если выброс имел место). Приведено: время появления в поле зрения коронографа – в данном примере – $07d00^h24^m$, скорость выброса (2684 км/с), угловая ширина корональных выброса вещества вблизи Солнца (Δφ = 360˚) и позиционный угол первого появления данного CME, обнаруженного коронографом LASCO-SOHO, (dA = 057˚).

В последней строке при наличии одного или нескольких внезапных начал геомагнитных бурь (SC, sudden commencement) после знака ▲ или Δ указываются дата и время SC: ▲ – SC, связанное с ударной волной, внёсшей изменения в потоки частиц, Δ − SC, связанное с ударной волной, не отразившейся на профилях потоков частиц.

После легенды приведены обзорные графики, отражающие ситуацию на Солнце и в околоземном пространстве для описываемых событий.

Представлены (сверху вниз): мягкое рентгеновское излучение Солнца по данным КА GOES с временным разрешением 1 минута, потоки солнечных электронов по данным прибора EPHIN SOHO и протонов с энергией Ep >10, >30 и >100 МэВ по данным КА GOES (среднечасовые значения), скорость солнечного ветра, напряженность межпланетного магнитного поля (ММП) и возмущенность магнитосферы Земли (значения Dst-индекса).

Эти графики захватывают больший промежуток времени, чем длительность рассматриваемого события. Период, относящийся к данному событию, выделен легкой его затушевкой.



Временные профили протонов и электронов в обзорных графиках наглядно демонстрируют ситуацию на Солнце, тип события (одиночное, составное или сложное), число максимумов в сложном событии, вклад ударных волн в потоки частиц, Форбуш-понижения в солнечных частицах. Сопутствующие всплески мягкого рентгеновского излучения свидетельствуют о возможном источнике-вспышке на Солнце и ее мощности.

Описание таблиц потоков частиц

После обзорных графиков расположены таблицы потоков протонов по данному событию. В таблицах приведены значения потоков протонов разных энергий в максимуме события (в двух максимумах), зарегистрированные всеми работавшими космическими аппаратами. Для

космических аппаратов используются общепринятые обозначения, НМ – наземные измерения нейтронными мониторами. Описание приборов дано в **Приложении 1.**

Все обозначения в таблицах потоков частиц – общепринятые. Отметим, что при максимуме в тот же день, что и начало события, день не указывается, при максимуме на следующий день или позже, кроме времени указывается и день (например, 20 – если максимум совпадает с днем начала события и 07d08 – если максимум наступил на следующий день или позже). Если в событии было два максимума, они разделены «слэш»-знаком (например, 11/21 – оба максимума в один день или 21/07d08 – второй максимум на следующий день или ещё позже).

Потоки протонов в максимуме событий приведены без каких-либо поправок в оригинальных данных, кроме вычета фоновых значений. Точность измерения и представления данных в таблице не хуже 10%. Если в событии рассматриваются два максимума, потоки между ними разделены «слэш»-знаком, в соответствии со временем максимумов. Длительность события измеряется в сутках. Отметим, что этот параметр испытывает наибольшие вариации как от прибора к прибору, так и для разных энергий протонов. Точность измерений здесь не хуже ±1 суток.

За таблицами потоков протонов располагаются графики интегральных энергетических спектров протонов. Интегральные спектры строились по максимальным потокам протонов всех энергий, зарегистрированным в данном событии. Дифференциальные потоки протонов, регистрировавшиеся в отдельных интервалах энергии, пересчитывались в интегральные. Если в событии выделено два максимума, то спектры строились для каждого максимума.

Высокоэнергичная часть спектра аппроксимировалась степенной функцией ($Jp \sim E^{-\gamma}$), приведенной на графике для каждого спектра с указанием значения показателя степени γ. Эта процедура, из-за значительного разброса точек, полученных разными приборами, не претендует на высокую точность определения γ, которая оценивается в ± 10%.

На каждом графике кроме спектра солнечных протонов в данном событии приводится интегральный спектр галактических протонов в максимуме солнечного цикла (0.1 часть общего потока), что позволяет видеть место пересечения двух спектров и судить о Eqm.

Далее представлены временные профили потоков протонов по данным различных космических аппаратов в следующей последовательности:

– потоков протонов, измеренных в космическом пространстве на аппаратах ACE и SOHO, находящихся в точке Лагранжа L1 на расстоянии 1.5 млн. км от Земли по направлению к Солнцу;

– потоков протонов, прошедших в магнитосферу Земли в область замкнутых силовых линий геомагнитного поля и измеренных на геостационарных аппаратах GOES и Электро;

– потоков протонов, прошедших в магнитосферу Земли в область открытых силовых линий геомагнитного поля и измеренных на низковысотных полярных аппаратах Метеор и POES.

Описание таблиц по солнечным явлениям

Далее представлены материалы по наблюдаемым солнечным вспышечным явлениям, источникам данного протонного события. Параметры и характеристики данного вспышечного события сведены в таблицу с числовыми значениями и приведен график (графики) частотного радиоспектра на фиксированных частотах. Так как для разных вспышечных событий условия их регистрации и результаты различны, таблицы для разных

событий также несколько различаются. Ниже дан перечень всех сведений во всех событиях, включенных в Каталог.

Все таблицы, как и во всех предыдущих Каталогах [Акиньян и др., 1982; Базилевская и др., 1986, 1990а, 1990б; Сладкова и др., 1998; Логачев и др., 2016], начинаются с заглавной строки, где указаны: дата, степень надёжности отождествления (•, ⊙, ⊡, ○, □ или Ø) солнечного вспышечного события – источника соответствующего протонного события, номер активной области (AR) по данным службы Солнца NOAA США [https://www.swpc.noaa.gov/] и порядковый номер протонного события (с начала выпуска наших Каталогов):

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 March 07

2012 March 07 ● AR 11429 To event 506

Приведенные ниже в таблице сведения относятся именно к этой дате и уверенно отождествлённому (●) источнику. Для других источников в другой день (как, например, в приведенном событии) эта строка повторяется еще раз, и она характеризует уже новый источник с другой датой (даты опять не приводятся), если источник имел место в другой день.

Все обозначения, приведенные в таблице параметров, – общепринятые в солнечной физике, подробности можно найти в описательных томах ежемесячного бюллетеня Solar Geophysical Data [Solar …]. Данные о всплесках в диапазоне мягкого рентгеновского излучения – по КА GOES. Основные данные по жёсткому рентгеновскому излучению, гамма диапазону за 2010–2017 гг. взяты из каталогов солнечных вспышек [https://hesperia.gsfc.nasa.gov/hessidata/dbase/hessi_flare_list.txt] и [https://hesperia.gsfc.nasa.gov/fermi/gbm/qlook/fermi_gbm_flare_list.txt]. Данные по CME выложены в SOHO LASCO CME Catalog [http://cdaw.gsfc.nasa.gov/CME_list/].

Информация в таблицах Каталога организована по блокам, включающим все реально наблюдавшиеся диапазоны электромагнитного излучения (оптика, мягкое, жесткое рентгеновское, гамма и радио), динамические явления, наблюдавшиеся в линии Hα и в непрерывном спектре (WL – в "белом" свете).

Каждый раздел таблицы начинается строкой названий расположенных ниже столбцов, и отделяется от других разделов узкой пустой строкой. Отсутствие каких-либо данных, целых строчек, в ячейках и столбцах таблиц Каталога говорит, что соответствующих явлений или наблюдений в данном событии не было.

1. Блок наблюдений в оптическом и мягком рентгеновском диапазонах группируется по столбцам (1–8) следующим образом:

- Данные в оптическом диапазоне:

(1) – длина волны спектральной линии наблюдения (Hα – 6563 Å); (2) – наблюдаемое динамическое явление в оптическом диапазоне волн: в линии Hα – FL, LPS, DSF (EPL), SPY, BSL, характеристики которых могут занимать несколько последующих строк; (3–5) – время начала, максимума и конца события; (6) – гелиокоординаты, локализация вспышечного события на видимом диске Солнца; (7) – оптический балл вспышечного события; (8) – код вспышки, характеризующий структуру явления по Solar Geophysical Data [Solar …].

- Данные о всплеске в мягком рентгеновском излучении:

(1 и 2) – диапазон энергий и единица измерения; (3–5) время начала, максимума и конца (время, когда интенсивность излучения спадёт до значения 0.5 Imax всплеска);

(6) – гелиокоординаты, локализация рентгеновского всплеска на видимом диске Солнца; (7) – поток излучения в максимуме всплеска (класс всплеска); (8) – флюенс: интегральный поток мягкого рентгеновского излучения в джоулях на квадратный метр, J/m^2.

2. Блок наблюдений в диапазонах жесткого рентгеновского и γ- излучений:

(1 и 2) – диапазон энергий, либо максимальная энергия γ- всплеска и единица измерения; (3–5) – время начала, максимума и конца события; (6 и 7) – интенсивность в максимуме и полный поток изучения; (8) – космический аппарат, на котором производились измерения.

3. Блок наблюдений радиоизлучения на фиксированных частотах:

(1) – частота; (2) – единицы измерения; (3–5) – время начала, максимума и конца радиособытия; (6) – код (см. объяснения ниже); (7) – логарифм потока в единицах 10^{-22}·Вт·м$^{-2}$· Гц$^{-1}$ (более подробно см. в описаниях предыдущих Каталогов).

4. Блок наблюдений динамического спектра радиовсплесков (DS для Солнца, DH для межпланетных):

Характеристики: (1) – тип, частотный диапазон в МГц; (3 и 5) – время начала и конца; (6) – для DS II – расчётная скорость распространения ударной волны в короне Солнца (когда есть данные); (7) – космический аппарат, на котором производились измерения. Данные по межпланетным радиовсплескам II типа взяты из Wind/WAVES type II burst catalog [https://cdaw.gsfc.nasa.gov/CME_list/radio/waves_type2.html].

Тип динамического спектра метровой компоненты и особенности радиовсплеска взяты из Solar Radio Burst: [https://www.ngdc.noaa.gov/stp/space-weather/solar-data/solar-features/solar-radio/radio-bursts/reports/spectral-listings/docs/SPECTRAL.TXT], и для отдельных событий из [https://www.solarmonitor.org/data/].

5. Блок данных о корональном выбросе вещества (CME):

(1) Прибор наблюдений – коронограф LASCO/C2 КА SOHO; (2) – непрерывный спектр (WL); (3) – время первого появления в поле зрения коронографа; (4) – медианное (начальное) значение скорости V (км/с) радиального распространения CME при движении в поле зрения коронографа; (5) – ускорение в км/с^2, может быть положительное, отрицательное или близкое к нулю; (6) – Δφ – угловой раствор (угловая ширина) CME вблизи Солнца в градусах; (7) – dA – позиционный угол первого появления CME.

Необходимо отметить, что отсутствие данных о CME не означает, что в данном вспышечном событии его не было. Возможно, что во время данного вспышечного события на коронографе не было наблюдений («gap»), или локализация вспышки за лимбом Солнца не способствовала возможности его отождествления. Сразу под таблицами могут находиться отмеченные звездочкой (*) примечания и Интернет-адреса, где можно посмотреть развитие данного вспышечного события в УФ-диапазоне и магнитных полях (для особо интересных событий). Например, для выбранного в качестве примера события 7.03.2012 г. это [https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_120306_165417_33724/www/].

После таблиц, описывающих солнечные явления, сопровождающие данное СПС, приведены графики спектров радиоизлучения на волнах дециметрового и сантиметрового диапазонов длин волн. Эти спектры дают возможность оценить и, возможно, выявить закономерности, характерные для вспышечных событий – источников солнечных протонных событий. Эти характерные закономерности обозначены кодом спектра (есть в таблице и в правом верхнем углу спектра), в котором отражается вид частотного спектра, а в

Приложении 5 дано краткое описание этих закономерностей и связанных с ними возможностей ускорения протонов в событии.

Более подробное описание всех обозначений в таблицах приведено в **Приложении 6.**

Замыкает информационную часть материала об источниках в данном событии список кратких ссылок на публикации (не в каждом событии и отнюдь не полный). Подробная информация о публикациях содержится в общем списке публикаций, приведенном в конце описания материалов Каталога после Приложений.

Заключение

В Каталоге представлены данные по 114 событиям (100 событий с Jp (E > 10 МэВ) ≥ 1 pfu и 14 событий с Jp (E > 10 МэВ) < 1 pfu) возрастаний солнечных протонов в 24-м цикле солнечной активности (2009−2019 гг.). Каталог содержит цифровую и графическую информацию о потоках и энергетических спектрах солнечных протонов в окрестности Земли, временные профили потоков протонов для всех включенных в Каталог событий. Приведены обширные данные о сопутствующих солнечных явлениях, радио и рентгеновском излучениях, сведения об активных областях со вспышками и другая дополнительная информация.

Каталог рассчитан на широкий круг специалистов, работающих в области солнечно-земной физики, солнечников, специалистов радиационной безопасности космических полетов и лиц, интересующихся проблемами воздействия солнечной активности на магнитосферу, атмосферу и биосферу Земли.

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Приложение 1

Сведения об аппаратах и приборах, регистрирующих протоны

Главные сведения о СПС представляют потоки протонов, зарегистрированные различными КА на различных орбитах и имеющих различные приборы, использующие различные методики регистрации заряженных частиц. Эти обстоятельства приводят к несколько отличающимся результатам измерений, что надо иметь в виду. Никаких правок полученных результатов не проводилось. В некоторых случаях показания приборов отсутствуют или оказываются недостоверными (сильное отличие от основной группы приборов, сбои в системе передачи информации, процессы калибровок приборов в полете и другие причины), они внимательно рассматривались и эти данные исключались из материалов Каталога. Ниже приводятся основные сведения об использованных в Каталоге аппаратах.

GOES (Geostationary **O**perational **E**nvironmental **S**atellite system) – серия искусственных спутников Земли на геостационарной орбите. **GOES** – проект Национального управления океанических и атмосферных исследований США (National Oceanic and Atmospheric Administration – NOAA). В Каталоге использовались данные приборного комплекса EPS с аппарата GOES-15: об интегральных потоках протонов с пороговыми энергиями >5, >10, >30, >50, >60, >100 МэВ (основанных на показаниях прибора EPEAD в составе EPS) и потоков протонов с энергиями в диапазонах 350–420, 420–510 и 510–700 и >700 МэВ (прибор HEPAD в составе EPS). Подробное описание аппаратов GOES и приборного комплекса EPS можно найти на сайтах: GOES Space Environment Monitor [https://www.ngdc.noaa.gov/stp/satellite/goes/documentation.html] и Goddard Space Flight Center [https://cdaweb.gsfc.nasa.gov/sp_phys/].

Электро – общее название серии Российских метеорологических спутников Земли на геостационарной орбите. В Каталоге использовались данные приборов СКЛ-Э (СКЛ – Спектрометр Космических Лучей) и ГАЛС-Э (ГАЛС – спектрометр ГАЛактических Лучей) с аппаратов Электро-Л №1 и №2. Прибор СКЛ-Э представляет собой узконаправленный телескоп, состоящий из проходного полупроводникового детектора и двух сцинтилляционных детекторов. Регистрация осуществляется в направлении перпендикулярном плоскости орбиты

на юг. В Каталоге использованы данные нескольких дифференциальных каналов прибора СКЛ-Э в диапазоне энергий ~1 ÷ 160 МэВ. Показание прибора СКЛ в каждом из каналов представляло собой полусумму показаний в двух взаимно перпендикулярных направлениях. Прибор ГАЛС-Э представляет собой спектрометр на основе черенковского счетчика, регистрирующий протоны с энергией >600, >800, >1100 МэВ. В Каталоге используется протонный канал >600 МэВ. Основные сведения об аппаратах Электро-Л №1 и №2 и приборах на них можно найти на сайтах Института ядерной физики им. Д. В. Скобельцына МГУ им. М. В. Ломоносова [https://ftp.sinp.msu.ru/] и[http://smdc.sinp.msu.ru/index.py?nav=electro_l1], [http://smdc.sinp.msu.ru/index.py?nav=electro_l2].

Метеор – общее название серии Российских метеорологических спутников Земли на полярной солнечно-синхронизованной орбите на высотах ~800–900 км. Полярные спутники, в частности серии Метеор, регистрируют солнечные протоны во время прохождения полярных шапок Земли. В Каталоге использовались данные спектрометров солнечных и галактических космических лучей СКЛ-М и ГАЛС-М с аппаратов Метеор-М №1 и №2. Спектрометр СКЛ представляет собой телескоп с общим углом обзора 30° из проходного полупроводникового кремниевого детектора и сцинтилляционного детектора на основе кристалла CsI (Tl). Оси телескопов располагались в двух взаимно перпендикулярных направлениях – по вектору скорости КА и радиально от Земли. В Каталоге использованы данные нескольких дифференциальных каналов в диапазоне энергий ~1 ÷ 160 МэВ. Показание прибора СКЛ в каждом из каналов представляло собой полусумму показаний в двух взаимно перпендикулярных направлениях. Прибор ГАЛС состоит из двух газоразрядных счетчиков Гейгера-Мюллера, регистрирующих протоны с энергией >15, >25 МэВ и спектрометра на основе черенковского счетчика для регистрации протонов с энергиями >600, >800 и >1100 МэВ. В Каталоге используется протонный канал >600 МэВ. Основные сведения об аппаратах Метеор-М №1 и №2 и приборах на них можно найти на сайтах: Института ядерной физики им. Д. В. Скобельцына МГУ им. М. В. Ломоносова [https://ftp.sinp.msu.ru/], [http://smdc.sinp.msu.ru/index.py?nav=meteor_m1], [http://smdc.sinp.msu.ru/index.py?nav=meteor_m2] и Института прикладной геофизики им. Е. К. Федорова [http://ipg.geospace.ru/meteor-data.html].

POES (**P**olar **O**rbiting **E**nvironmental **S**atellites) – серия спутников Земли на полярной круговой орбите с солнечной синхронизацией на высотах от 700 до 850 километров, длительность орбитального периода от 98 до 103 минут [Evans and Greer, 2000]. **POES** – проект Национального управления океанических и атмосферных исследований США (National Oceanic and Atmospheric Administration – NOAA). В Каталоге использовались данные измерений потоков протонов с помощью приборов измерительного комплекса MEPED на спутнике POES-19. Подробное описание аппарата POES и приборного комплекса MEPED можно найти на сайтах NOAA [https://www.ngdc.noaa.gov/stp/satellite/poes/] и Goddard Space Flight Center [https://cdaweb.gsfc.nasa.gov/sp_phys/].

ACE (**A**dvanced **C**omposition **E**xplorer**) –** космический аппарат, расположенный в точке Лагранжа L1 на расстоянии 1.5 млн. км от Земли. Описание аппарата и состав экспериментов представлены на сайте Caltech ACE Science Center [http://www.srl.caltech.edu/ACE/]. В Каталоге используются данные прибора **SIS** (**S**olar **I**sotope **S**pectrometer) по потокам протонов с энергией >10 МэВ и >30 МэВ. Данные по потокам частиц и описание аппарата **ACE** и прибора **SIS** можно найти на сайтах: Caltech ACE Science Center [http://www.srl.caltech.edu/ACE/CRIS_SIS/] и Goddard Space Flight Center [https://cdaweb.gsfc.nasa.gov/sp_phys/].

SOHO (**SO**lar & **H**eliospheric **O**bservatory) – космический аппарат, расположенный в точке Лагранжа L1 на расстоянии 1.5 млн. км от Земли. В Каталоге используются данные двух приборов:

– прибор **LION** (**L**ow Energy **ION** and Electron Instrument) предназначен для измерения спектров протонов в интервале энергий 44 кэВ – 6 МэВ. В Каталоге используются протонные каналы 0.75−2 МэВ и 2−6 МэВ.

– прибор **EPHIN** (**E**lectron **P**roton **H**elium **IN**strument). Для Каталога используются каналы, регистрирующие протоны с энергией: 4−8, 8−25, 25−41 и 41−53 МэВ (после года полета два последних канала объединились в один 25−53 МэВ), а также канал INTEGRAL: >10 МэВ (электроны) + >50 МэВ (протоны). Данные по потокам частиц и описание аппарата **SOHO** и приборов **LION** и **EPHIN** можно найти на сайтах: NASA [https://sohowww.nascom.nasa.gov/], COSTEP [http://www.ieap.uni-kiel.de/et/ag-heber/costep/] и Goddard Space Flight Center [http://cdaweb.gsfc.nasa.gov/sp_phys/].

PAMELA (**P**ayload for **A**ntimatter-**M**atter **E**xploration and **L**ight Nuclei **A**strophysics), телескоп-спектрометр работал на орбите Земли с июня 2006 г. по январь 2016 г. Спутник РЕСУРС ДК-1 с прибором **PAMELA** на борту имел квазиполярную орбиту с наклонением 70.4° и высотой 300–600 км, период обращения спутника – 90 минут. Основными задачами эксперимента **PAMELA** являлись исследования галактических космических лучей. Телескоп-спектрометр **PAMELA** позволяет надежно определять энергию, импульс, знак и значение заряда частиц. Дополнительной задачей являлось исследование высокоэнергичной компоненты солнечных протонных событий (от 80 МэВ до нескольких ГэВ). Фоновый счет прибора **PAMELA** определяется потоком галактических космических лучей. Детали эксперимента описаны в [Adriani et al., 2011; Bruno et al., 2018].

Нейтронные мониторы (НМ) – приборы, регистрирующие наземными средствами высокоэнергичный участок энергетического спектра протонов в солнечном событии. Из-за геомагнитного обрезания и поглощения протонов атмосферой Земли (все НМ расположены на поверхности Земли) минимальная энергия протонов, регистрируемых НМ, составляет около 500 МэВ. НМ имеют очень большой геометрический фактор, что позволяет выделять даже небольшие возрастания потоков солнечных протонов. Так как НМ регистрируют вторичные нейтроны, создаваемые в атмосфере Земли и экранах счетчиков НМ, то возникает необходимость пересчета зарегистрированного возрастания скорости счета конкретного НМ к потокам протонов вне магнитосферы Земли. Эта задача решена по показаниям мировой сети станций НМ для всех солнечных событий, получивших название Ground Level Enhancement (GLE), и в Каталоге даны потоки протонов уже вне магнитосферы Земли. Подробно методика пересчета описана в **Приложении 3.**

Космические аппараты и приборы

Космический аппарат	Прибор	E, ΔE, МэВ	Г, $см^2 \cdot ср$ или эффективная площадь и направление (номинальные значения)	Время работы в 24-м цикле СА, гг.
GOES-15	EPS/EPEAD	>5		2010–2017
	EPS/EPEAD	>10		
	EPS/EPEAD	>30		
	EPS/EPEAD	>50		
	EPS/EPEAD	>60		
	EPS/EPEAD	>100		
	EPS/HEPAD	350–420		
	EPS/HEPAD	420–510		
	EPS/HEPAD	510–700		
	EPS/HEPAD	>700		
Электро-Л №1	СКЛ-Э	13.7–23	0.1	2011–2016
	СКЛ-Э	23–42	0.1	
	СКЛ-Э	42–112	0.1	
Электро-Л №2	СКЛ-Э	9–20	0.1	2014–2017
	СКЛ-Э	20–40	0.1	
	СКЛ-Э	40–110	0.1	
Электро-Л №1, №2	ГАЛС-Э	>600	40 $см^2$, 3π	2011–2017
Метеор- М №1 и №2	СКЛ-М	1–100	0.1	2010–2017
	СКЛ-М	3–10	0.1	
	ГАЛС-М	>15	0.8 $см^2$, 2π:СКЛ, 2.3 $см^2$, 2π:ГКЛ	
	ГАЛС-М	>25		
	ГАЛС-М	>600	40 $см^2$, 3π	
POES-19	MEPED	0.24–0.8	0.01	2010–2014
	MEPED	0.8–2.5	0.01	
	MEPED	2.5–6.9	0.01	
	MEPED	>6.9	0.01	
	MEPED	>16		
	MEPED	>35		
	MEPED	>70		
	MEPED	>140		
	MEPED	16–36		2015–2017
	MEPED	36–70		
	MEPED	70–140		
ACE	SIS	>10	≈40	2010–2017
	SIS	>30	≈40	
SOHO	LION	0.75–2	0.32	2010–2017
	LION	2–6	0.32	
	EPHIN	4–8	5.1	
	EPHIN	8–25	5.1	
	EPHIN	25–53	5.1	
	EPHIN	>50	5.1	
PAMELA	PAMELA	>80	20	2010–2014

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Приложение 2

Определение источников протонов во вспышечных событиях на Солнце

Событие в солнечных космических лучах (СКЛ), в Каталоге – солнечное протонное событие – СПС, определяется как популяция энергичных частиц, наблюдаемых в межпланетной среде в результате взрывного энерговыделения на Солнце, наиболее яркими причинами которых являются солнечные вспышки, сопровождаемые определенным набором электромагнитных излучений, и корональные выбросы вещества. Вопрос об относительной роли в ускорении заряженных частиц процессов, связанных со вспышкой и с корональными выбросами вещества, является центральным в проблеме СКЛ в течение многих лет. Для продвижения в этой области необходимо как можно точнее определить вспышку и корональный выброс вещества – главный источник энергичных частиц в большинстве событий СКЛ.

Так как солнечные протоны могут приходить в околоземное космическое пространство даже от далёких залимбовых вспышечных событий, не всегда возможно найти собственно оптическую вспышку как источник СПС.

К сожалению, во многих случаях реальное отождествление вспышек-источников частиц остается субъективным. В описываемом Каталоге эта субъективность сведена к минимуму благодаря комплексному учету обоснованных и проверенных статистических закономерностей, ни одной из которых, однако, не придавалось решающего значения. Рассматривались три вида данных:

- потоки заряженных частиц, их временные профили и энергетические спектры;
- электромагнитное излучение вспышек в рентгеновском, оптическом и радиодиапазонах, их спектральные характеристики, поведение во времени и другие параметры;
- структура магнитного поля и эволюция активных областей, их вспышечная активность [Laurenza et al., 2007].

Первый вид данных давал возможность предварительно оценить локализацию и временной интервал вспышечного события, которое с определённой долей вероятности могло быть источником данного протонного события. Быстрое (часы) нарастание потока протонов с

E >10 МэВ до максимума и жёсткий спектр в интервале энергий 10–100 МэВ (индекс интегрального степенного спектра $\gamma \leq 3$), с большой вероятностью свидетельствует о том, что вспышечное событие произошло на западном полушарии видимого диска Солнца. Медленное нарастание (>10 часов), широкий максимум и, как правило, более мягкий спектр ($\gamma \geq 3$) с большой вероятностью указывают на источник (вспышечное событие) на восточной полусфере видимого диска Солнца [например, Lario, 2005; Laurenza et al., 2007].

Если найдены основания считать источником СПС солнечное вспышечное событие, расположенное на западной полусфере Солнца, то для определения конкретного источника рассматривались все вспышечные события, предшествовавшие началу возрастания частиц в пределах 1–10 часов. В случае восточного вспышечного события, указанный интервал расширялся до 2–3 суток.

В настоящем Каталоге СПС за 24 цикл СА появилась возможность включить данные о динамических явлениях, таких как выбросы солнечных волокон, лимбовые выбросы и другие явления в оптическом диапазоне, сопровождающие солнечные вспышечные события. Наиболее информативным из них являются корональные выбросы вещества, основные характеристики которых приводятся в Каталоге. Если протонное вспышечное событие происходит достаточно далеко за лимбом (обычно за западным), то его единственным свидетельством будет именно СМЕ (корональный выброс вещества) типа «гало» или «частичное гало типов I–III» [Park and Moon, 2012].

При анализе электромагнитного излучения вспышечного события прежде всего обращалось внимание на рентгеновский балл (класс) всплеска (1–8 Å, Ex = 12.5–1 кэВ), который для вспышек на видимом диске Солнца в диапазоне долгот E70÷W70 должен превышать M1, причём вспышки среднего балла (M<5) обычно должны быть большой длительности (>1 часа) и интегральный поток излучения в данном диапазоне рентгена должен быть $\geq 5 \cdot 10^{-2}$ Дж/м^2. Если солнечные вспышечные события небольшого рентгеновского балла расположены на видимом диске Солнца, тогда они сопровождаются всем спектром динамических явлений, как в оптике, так и радиодиапазоне. Данные в оптическом диапазоне в линии водорода Hα (λ = 6563 Å), дающие точную локализацию вспышки, косвенно говорят об энергетике и временной структуре самого процесса вспышки.

Значимым диагностическим фактором является радиоизлучение вспышечного события: протонные вспышки, как правило, сопровождаются динамическими радиовсплесками II и/или IV типа с наличием достаточно интенсивного радиоизлучения на сантиметровых (~9 и 15.4 ГГц) и метровых (~245 МГц) волнах при относительно слабой плотности потока в дециметровом диапазоне. Длительность нарастания микроволнового всплеска обычно ≥ 5 минут и имеет U-образный частотный спектр [Акиньян и др., 1980].

Существенным дополнительным фактором при отождествлении возрастания потока протонов с тем или иным вспышечным событием являются характеристики активных областей (АО) или комплекса активных областей (КАО), которые рассматриваются как источники частиц данного события. Протонные вспышечные события происходят в АО, в которой наблюдается быстрое всплытие нового магнитного потока большой величины, превращающего простую группу пятен в сложную. В таких АО вспышечное энерговыделение обычно реализуется в виде серии вспышек большой и средней мощности в ограниченный промежуток времени [Ishkov, 2003]. Особо необходимо отметить вспышечную активность КАО, состоящих из двух и более соседних групп пятен, связанных общим магнитным полем. Большое вспышечное событие обычно захватывает основные компоненты КАО, а его магнитная структура с большой вероятностью способствует выходу больших потоков протонов.

Особый класс составляют возрастания потока протонов, вызванные залимбовыми вспышечными событиями. Основными признаками, указывающими на связь данного возрастания с залимбовой вспышкой, являются:

– наличие CME и/или метровых радиовсплесков II и (или) IV типа при отсутствии подходящих вспышечных событий на видимой полусфере;

– недавний (до 4 суток) уход за западный лимб вспышечной АО сложной магнитной конфигурации с большой вероятностью скорого всплытия нового магнитного потока или находящейся в периоде реализации больших вспышечных событий;

– ожидаемый выход из-за восточного лимба Солнца (до 3 суток) на видимый диск Солнца АО, которая на прошлом обороте была в высокой степени вспышечно-активной и ушла за западный лимб в полном развитии.

В случае присутствия этих признаков делается вывод, что источник вспышечного события, возрастания частиц, находится на невидимой полусфере Солнца.

Когда в некоторых СПС, чаще небольшой мощности, возрастание протонов не отождествляется ни с какими проявлениями вспышечной или CME активности, тогда приходится делать вывод, что его источник неизвестен.

Для всех событий в Каталоге указана достоверность источника данного СПС, основанная на вышеописанных подходах. Степень уверенности, с которой осуществлена привязка протонного события к источнику, обозначается соответствующими значками, приведенными в описании материалов Каталога, которые совпадают со схемой, разработанной [Dodson and Hedeman, 1975].

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Приложение 3

Определение потоков и энергетического спектра релятивистских солнечных протонов по данным нейтронных мониторов

Источником информации об интенсивности релятивистских СКЛ до последнего времени являлись наземные установки, в основном нейтронные мониторы (НМ), которые регистрируют GLE (Ground Level Enhancements), так называемые наземные возрастания СКЛ. В 24-м цикле появились орбитальные спектрометры, позволяющие прямое измерение высокоэнергичных СКЛ в околоземном пространстве: PAMELA, с порогом регистрации протонов и ядер выше 80 МэВ/н [Adriani et al., 2011; Bazilevskaya et al., 2013; Bruno et al., 2018], и AMS-2 с порогом регистрации выше сотен МэВ [Bindi, 2015]. Тем не менее, НМ остаются непревзойденными по эффективности установками для измерения СКЛ вплоть до энергий десятков ГэВ, благодаря большому геометрическому фактору и использованию глобальной сети станций.

Наземные установки регистрируют вторичные космические лучи, и переход от возрастания темпа счета наземного прибора к потокам СКЛ на границе атмосферы требует знания функций отклика прибора. В последние годы методика получения спектров СКЛ по данным нейтронных мониторов была усовершенствована группой физиков из Оулу (Oulu, Finland) на основе детальных расчетов методом Монте-Карло распространения СКЛ в магнитосфере и атмосфере Земли в работах [Mishev et al., 2014, 2018].

Формула для определения потоков СКЛ по данным НМ имеет вид:

$$\frac{\Delta N(R_{c,t})}{N(t)} = \frac{\int_{R_c}^{R_{max}} J_{\parallel sep}(R,t)Y(R)G(\alpha(R),t)dR}{\int_{R_c}^{\infty} J_{GCR}(R,t)Y(R)dR},$$

где $N(t)$ – скорость счета НМ для ГКЛ; $\Delta N(R_c,t)$ – увеличение скорости счета, вызванное приходом СКЛ в пункт с жесткостью геомагнитного обрезания R_c; $J_{\parallel sep}(R,t)$ и $J_{GCR}(R,t)$ – соответственно спектры СКЛ и ГКЛ; $Y(R)$ – кратность генерации вторичных частиц в атмосфере одной первичной частицей с жесткостью R, $G(\alpha(R,t))$ – питч-угловое распределение частиц СКЛ; R_{max} – максимальная жесткость СКЛ, принятая равной 20 ГВ. В новой методике существенно уточнены кратности генерации и введен учет питч-углового распределения СКЛ, которое меняется со временем.

В 24-м цикле солнечной активности было зарегистрировано всего 2 события, вызвавших возрастание потока частиц на наземных нейтронных мониторах (GLE 71 и GLE 72). В работах [Mishev et al., 2014, 2018] дана аппроксимация дифференциальных спектров по жесткости в форме

$$J_{\parallel sep}(R) = J_0 R^{-(\gamma+\delta\gamma(R-1))},$$

где $J_{\parallel sep}(R)$ – поток частиц с жесткостью R, γ – показатель спектра в степенном представлении, $\delta\gamma$ – коэффициент укручения спектра. Функция углового распределения прибывающих частиц (в данных статьях не зависящая от энергии) приведена в форме суперпозиции двух гауссианов:

$$G \sim exp(-\alpha^2/\sigma_1^2) + B\, exp(-(\alpha-\alpha_1)^2/\sigma_2^2,$$

где α – питч угол, σ_1 и σ_2 характеризуют ширину питч-углового распределения, B и α_1 – параметры возможного направления, отличного от направления на Солнце. Для

антисолнечного направления $\alpha_1=\pi$. Параметры аппроксимаций для разных моментов времени содержатся в статьях [Mishev et al., 2014, 2018]. В Каталоге даны интегральные потоки частиц в максимуме события.

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Приложение 4

Определение квазимаксимальной энергии солнечных протонов в событии

Одним из параметров события, характеризующих его мощность, может служить максимальная энергия зарегистрированных в событии частиц. Но прямая оценка максимальной энергии практически невозможна, нет никакой гарантии, что частиц с энергией, выше зарегистрированной, в данном событии не было. Любое принятое значение максимальной энергии будет условным. Надо принять (назначить) некоторое критическое значение потока протонов Jкрит. Энергию протонов, при которой наблюдается поток Jкрит в данном событии, можно условно считать максимальной, а называть её квазимаксимальной с обозначением Eqm.

Естественным критическим потоком могут служить постоянно присутствующие в пространстве галактические космические лучи. Энергетический спектр протонов ГКЛ очень стабилен, вариации потоков в области энергий, меньших 10 ГэВ, связанные с солнечной активностью, хорошо изучены. Использование потоков ГКЛ позволяет определить «максимальную» (на самом деле – Eqm) энергию ускоренных на Солнце частиц. Такое определение очень наглядно, спектры в событиях СКЛ легко сравнивать с привычным

спектром протонов ГКЛ и приблизительно оценивать возможности Солнца в ускорении протонов в каждом событии.

Оказалось, что применяемые приборы для регистрации солнечных протонов способны измерять потоки протонов гораздо меньшие потоков протонов ГКЛ соответствующих энергий и, чтобы приблизиться к реальным «максимальным» энергиям, в методику определения Eqm включен не полный поток частиц ГКЛ, а только 10 % этого потока. Так как ГКЛ с энергией < 500–1000 МэВ в 11-летнем солнечном цикле испытывают почти двукратную вариацию, в данном определении отправной точкой сравнения принят поток ГКЛ в максимуме солнечной активности. Таким образом, квазимаксимальная энергия Eqm в данном событии определена по сравнению с 10% потока ГКЛ или $0.1 \cdot Jp(Eгкл)$. Отсюда следует, что методика определения Eqm сводится к нахождению точки пересечения двух интегральных энергетических спектров: спектра $0.1 \cdot Jp(Eгкл)$ и спектра данного солнечного события. В этой точке наблюдается равенство $Jp(Eскл) = 0.1 \cdot Jp(Eгкл) = Jp(Eqm)$. Энергия, которая обозначена как Eqm, приводится для каждого события, включенного в Каталог.

Отметим некоторые особенности определения энергии Eqm в солнечных протонных событиях, представленных в Каталоге. Для большинства событий энергетический спектр протонов в интервале энергий 10–100 МэВ хорошо описывается степенной функцией $J(>E) \sim E^{-\gamma}$. Для событий большей мощности степенной спектр простирается до более высоких энергий, но, естественно, при дальнейшем увеличении энергии спектр становится более крутым, описываемым другой зависимостью, например, $J(>E) \sim E^{-\gamma} \cdot \exp(-E/Eo)$.

В случаях наземных возрастаний СКЛ (GLE), когда событие наблюдалось не только высокоширотными НМ с жесткостью геомагнитного обрезания 1 ГВ, лучшим приближением к реальной максимальной энергии следует считать энергию геомагнитного обрезания самой низкоширотной из станций, зарегистрировавших это событие (см. таблицы Каталога), которая больше Eqm.

Приведенные в Каталоге значения Eqm дают представление о мощности солнечных событий, дают еще один единый параметр в событиях СКЛ, позволяющий проводить сравнения с другими характеристиками событий.

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Приложение 5

Характеристики активных областей, в которых произошли протонные вспышечные события

Для эволюционных и вспышечных характеристик активных областей (АО) удобно использовать краткую запись (код, формулу) [Ishkov, 2006]. Она содержит порядковый номер АО (AR) в системе Службы Солнца NOAA (National Oceanic and Atmospheric Administration) США, её абсолютные гелиокоординаты, дату прохождения центрального меридиана Солнца, площадь группы пятен в максимуме развития в миллионных долях полусферы, эволюционные характеристики АО: модифицированный Цюрихский класс группы пятен, который отражает стадию развития группы пятен и содержит информацию о характере полутени и распределении

пятен в группе, магнитный класс по маунт-вильсоновской классификации, отражающий конфигурацию магнитного поля АО, по возможности, время существования группы пятен в оборотах Солнца.

Следующие строки отражают вспышечные характеристики рассматриваемой АО: вспышечный индекс XRI (X-ray region index) группы пятен, введенный П. Мак-Интошем, рассчитывается по сумме вспышек баллов X и M, где вспышки балла X дают единицы (X1.9 дает 1.9), а вспышки балла M дают десятые доли (M7.4 дает 0.74). Вспышечный потенциал АО включает в себя количество солнечных вспышек по рентгеновским и оптическим баллам, причем нижний индекс показывает количество вспышечных событий данного класса (балла), произошедших в АО за всё время её прохождения по видимому диску Солнца, а верхний индекс рентгеновского класса показывает интенсивность самого большого всплеска в диапазоне мягкого рентгеновского излучения:

Proton Active Region

AR11302 (N13L280, CMP 28,7.09.2011,
Sp=1300 msh; EKC, BGD, R2)
XRI=8.73; $X_2^{1.9}+M_{16}^{7.4}+C_{32}\ \ 2_6+1_9+S_{72}$
PFR1 21-22.09 (22^h) $X_1^{1.4}+M_2^{1.8}$
PFR2 24-26.09 (52^h) $X_1^{1.9}+M_{11}^{7.4}$

Выше приведена запись для AR111302 сентября 2011 г. – с гелиокоординатами (**N13L280)**, которая проходила центральный меридиан (**CMP)** видимого диска Солнца 28,7 сентября 2011 г., имела максимальную площадь группы пятен (**Sp)** 1300 миллионных долей полусферы (**msh)**, эволюционный класс (**EKC**), магнитный класс (**BGD** – бета-гамма-дельта), и существовала на видимом диске Солнца 2 оборота (**R2**). Вспышечный индекс **XRI=**8.73. В данной АО осуществились 2 вспышечных события рентгеновского класса X, большее из которых имело класс X1.9, 16 – класса M (M7.4) и 32 – класса C. В системе оптических баллов в этой АО осуществились 6 вспышек балла 2, 9 – балла 1, и 72 – балла S. Для этой АО отмечены 2 интервала времени, когда наблюдалась концентрация вспышечных событий больших и средних баллов **PFR** (Period of Flare Realization). Первый период (**PFR1 21-22.09)** длился 22 часа с 21 по 22.09 и включал в себя 1 вспышечное событие класса X и 2 – класса M. Второй период (**PFR2 24-26.09)** длился 52 часа с 24 по 26.09 и включал в себя 1 вспышечное событие класса X и 11 – класса M.

Здесь уместно напомнить, что у приборов геостационарных спутников серии GOES, по данным которых с 1970 года определяется рентгеновский балл солнечных вспышечных событий, неоднократно менялся порог максимальной измеряемой интенсивности мягкого рентгеновского излучения в диапазоне энергий 1–8 Å (12.5–1 кэВ). До 1976 года порог насыщения приборов соответствовал рентгеновскому баллу X5, и поэтому знаменитые вспышки 4 и 7 VIII 1972 г. имели формальный балл $X > 5$. До начала работы геостационарного спутника GOES-9 порог соответствовал рентгеновскому классу X12.5, а после, в 23 солнечном цикле, порог вырос до X17.5. Соответственно, для самых мощных вспышечных событий, у которых интенсивность потока превышала указанный порог, рентгеновский балл определялся условно: пропорционально времени запирания прибора. Поэтому более объективно было бы характеризовать рентгеновский балл таких вспышечных событий с насыщением не только пороговым значением насыщения прибора, но и длительностью промежутка времени запирания прибора (τ). Какая-либо экстраполяция, например, линейная, для очень сильных вспышек с длительным насыщением вряд ли может быть оправданной. При такой оценке самыми интенсивными за все время наблюдения были рентгеновские всплески 1 и 6 июня 1991 г. ($\tau = 26^m$), а еще у трех вспышек этой же АО $\tau \geq 17^m$. Это хорошо понимали исследователи, первыми получившие информацию о данных всплесках, и всем им был оставлен балл $X > 12.5$ с указанием времени запирания рентгеновского фотометра

[Preliminary …, 1991], хотя потом это обстоятельство было забыто и эти вспышки сейчас имеют рентгеновский балл X12. К сожалению, в литературе не для каждой мощной вспышки можно найти эти данные и в большинстве случаев для таких вспышек указывается оценочный рентгеновский класс (например, для 4 ноября 2003 г. X28⟶ X > 17.5, $\tau = 11^m$). Наибольший индекс XRI за все время наблюдения Солнца в данном диапазоне электромагнитного излучения (с 1970 г. по май 2005 г.) получили три АО: это AR6659 июня 1991 г. (>86.5), AR 10486 октября 2003 г. (>62.56) и AR5395 марта 1989 г. (>55.5).

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Приложение 6

Список обозначений и сокращений по явлениям и событиям, представленным в материалах Каталога

1. Обозначения в легенде события, обзорных графиках и таблицах потоков протонов

To – начало события;
Tmax – время максимума события;
Ep – энергия протонов;
Eqm – квазимаксимальная энергия протонов в событии;
Jmax – максимум потока протонов;
Ф – интегральный поток энергии в рентгеновском диапазоне от начала всплеска до момента спада на уровень 1/2 от максимального значения в Дж/м^2;
pfu – proton flux unit (1 pfu = 1 см$^{-2}$с$^{-1}$ср$^{-1}$) – единицы потока частиц;
●, ■ – данная вспышка определенно является источником наблюдаемых протонов;
⊙, ⊡ – данная вспышка с большой вероятностью является источником наблюдаемых протонов; знаки ■, ⊡ применяются, когда источник солнечного протонного события осуществляется на прилимбовых и залимбовых гелиодолготах W, E≥80°;
O – вспышка, возможно, является источником протонов данного события, но есть причины, по которым эта возможность подвергается сомнениям;
Ø – вспышка не является основным источником, но внесла (или могла внести) вклад в наблюдаемые потоки протонов;
□ – вспышка (или активность) за западным или восточным лимбом Солнца;
◊ – активность области на диске Солнца, модуляционные эффекты в межпланетном пространстве;

SC − внезапное начало магнитной бури, приход межпланетной ударной волны к Земле;
▲ – SC, внёсшее изменения в потоки частиц;
Δ − SC, не отразившееся на профилях потоков частиц;
CME – корональный выброс вещества;
V – медианная скорость CME в км/с;
a – ускорение CME (км/с^2);
Δφ – угловой раствор (угловая ширина) CME вблизи Солнца;
dA – позиционный угол первого появления CME;
gap – отсутствие наблюдений;
Vsw – скорость солнечного ветра;
B – величина магнитного поля в солнечном ветре (нТ);
Dst – индекс геомагнитной активности;
S/C – космический аппарат;
SCR, СКЛ – солнечные космические лучи;
GLE – солнечное протонное событие, зарегистрированное наземными приборами;
Location – гелиокоординаты события;
WL – эмиссия в непрерывном спектре (белом свете);
UT – всемирное время (по Гринвичу)

2. Обозначения в оптической и рентгеновской области излучения

Код Hα-вспышки в виде набора латинских букв
(по системе издания Solar Geophysical Data)**,** обозначающих следующее:
A – эруптивный протуберанец на расстоянии < 90° от центрального меридиана;
B – вероятный конец вспышки большого балла;
D – яркая точка;
E – две или больше ярких точек;
F – несколько эруптивных центров;
G – в окрестности вспышки нет видимых пятен;
H – вспышке сопутствуют высокоскоростные возмущения тёмного (в поглощении) волокна;
K – несколько максимумов интенсивности;
L – признаки внезапной активизации волокна, находящегося вблизи вспышки;
M – вспышка в белом свете;
N – в непрерывном свете присутствуют поляризационные эффекты;
O – наблюдения вспышки велись в линиях K и H CaII;
P – во вспышке наблюдалась эмиссия в линии гелия D3;
Q – во вспышке наблюдалась эмиссия линий бальмеровского континуума;
R – наблюдается асимметрия линии Hα с выбросом вещества с большими скоростями;
S – уярчение, следует за исчезновением волокна;
U – две яркие вспышечные ленты, параллельные или сходящиеся;
V – наличие взрывной фазы вспышки; значительное и внезапное расширение области эмиссии вспышки примерно за 1 минуту;
W – большое увеличение площади эмиссии вспышки после максимума интенсивности;
X – необычно расширена линия Hα;
Y – наблюдались арочные вспышечные системы;
Z – тень большого пятна залита эмиссией вспышки.

Рентгеновский класс (балл) вспышки
в мягком рентгеновском всплеске в диапазоне 1–8 Å (12.5–1 кэВ)
[https://www.sws.bom.gov.au/Educational/2/1/3]:

Classification	Peak Flux Range (0.1-0.8 nm) mks system (W $m^{2)}$	cgs system (erg cm^{-2} s^{-1})
A	$\Phi < 10^{-7}$	$\Phi < 10^{-4}$
B	$10^{-7} \leq \Phi < 10^{-6}$	$10^{-4} \leq \Phi < 10^{-3}$
C	$10^{-6} \leq \Phi < 10^{-5}$	$10^{-3} \leq \Phi < 10^{-2}$
M	$10^{-5} \leq \Phi < 10^{-4}$	$10^{-2} \leq \Phi < 10^{-1}$
X	$10^{-4} \leq \Phi$	$10^{-1} \leq \Phi$

Оптический балл солнечной вспышки, наблюдаемой в линии Hα определяется исправленной площадью вспышки в центре линии в гелиографических квадратных градусах в максимуме яркости (по SGD):
S – субвспышка – (площадь ≤ 2.0 кв.град.)
1 – балл 1 (2.1 ≤ площадь ≤ 5.1 кв.град.)
2 – балл 2 (5.2 ≤ площадь ≤ 12.4 кв.град.)
3 – балл 3 (12.5 ≤ площадь ≤ 24.7 кв.град.)
4 – балл 4 (площадь ≤ 24.8 кв.град.)
Яркость – относительная яркость в максимуме вспышки:
F – слабая; **N** – нормальная; **B** – яркая.

Динамические явления, наблюдаемые в линии Hα (6563 Å):
EPL – эруптивный протуберанец на лимбе;
LPS – система петлевых протуберанцев = арочная система вспышечных волокон;
DSF – выброс (исчезновение) солнечного волокна;
SPY – вспышечный спрей (гигантский выброс на лимбе в месте реализации вспышки;
BSL – яркий выброс на лимбе.

3. Обозначения в области радиоизлучения

Тип солнечного динамического спектра (DS) метровой компоненты радиовсплеска [Illustrated Glossary for Solar and Solar-Terrestrial Physics. Eds. A.Bruzek and C.J.Durrant. Springer. 1977] и [https://www.ngdc.noaa.gov/stp/space-weather/solar-data/solar-features/solar-radio/radio-bursts/reports/spectral-listings/docs/SPECTRAL.TXT];
DS I – шумовая буря;
DS II – медленно дрейфующие всплески;
DS III – быстро дрейфующие всплески;
DS IV – продолжительный радиовсплеск, занимающий широкую полосу частот;
DS V – широкополосное непрерывное излучение на длинных метровых волнах (связано с радиовсплеском III типа);
DS cont – не классифицируемое широкополосное излучение обычно связанное со всплесками IV типа;
DH II – медленно дрейфующие всплески, наблюдаемые в межпланетном пространстве КА WIND (Wind/WAVES type II bursts)

Код вида частотного спектра радиовсплеска на волнах дециметрового и сантиметрового диапазонов:

P5 – спектр имеет максимум на частоте 5 GHz.

P5(2.3) означает, что log максимальной плотности потока на 5 ГГц составляет 2.3 (максимальная плотность потока в приведенном примере равна $200 \cdot 10^{-22}$·Вт·м$^{-2}$·Гц$^{-1}$);

1/9 – плотность потока радиоизлучения минимальна на частоте 1 ГГц и возрастает до частоты 9 ГГц; информация об интенсивности всплеска на более высоких и низких частотах отсутствует;

0.6\9 – спектр характеризуется ростом интенсивности при увеличении частоты от 0.6 до 9 ГГц;

0.6/9 – плотность потока уменьшается при повышении частоты от 0.6 до 9 ГГц;

U2 P7 – плотность потока минимальна на частоте 2 ГГц и возможно достигает максимума на частоте 7 ГГц;

3–9 – плоский частотный спектр в диапазоне 3–9 ГГц.

Если элемент обозначения указан в квадратных скобках (например, [P5]), это означает, что данный параметр определён недостаточно надёжно из-за неполноты или противоречивости исходных данных.

Во многих случаях для описания спектра радиовсплеска приходится использовать различные комбинации этих обозначений.

4. Обозначение источников сведений, используемых в Каталоге

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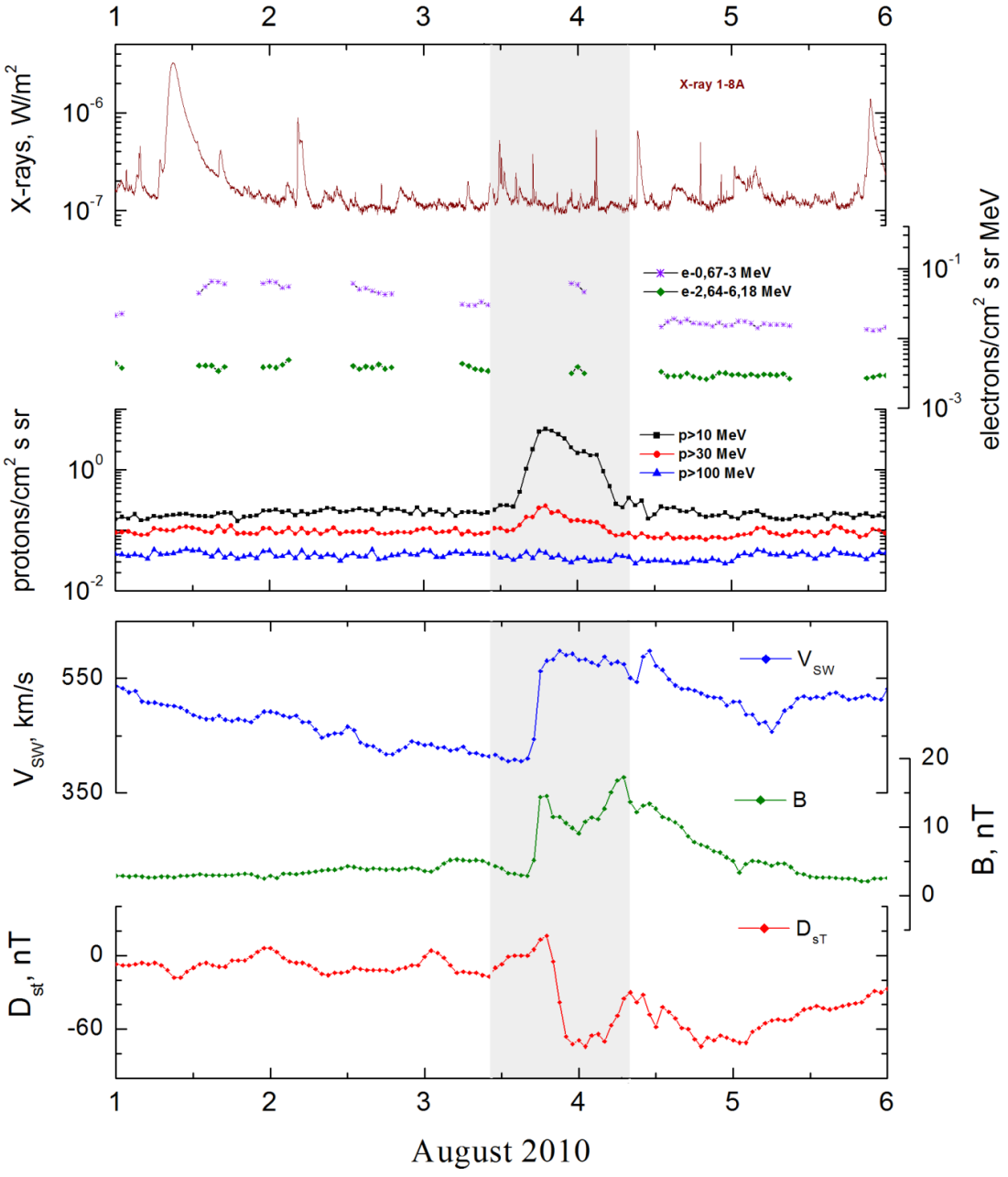
События 2010 года

			Страница
1	Event 2010.08.03 – (2010-215)	№ 477	51
2	Event 2010.08.14 – (2010-226)	№ 478	59
3	Event 2010.08.18 – (2010-230)	№ 479	66

Particle event: To(Ep>10 MeV) –03d10^h
Tmax$_1$(Ep>10 MeV) – 03d19^h, Jmax$_1$(Ep>10 MeV) – 2.7 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ = 3.1
Quasimaximal energy of protons in the event – Eqm = 60 MeV

Sources: ● DSF* 01d 07^{h}50^m, N37W32 42^o
CME: 01d13^{h}42^m, V = 850 km/s, Δφ = 360^o; dA = 84^o
▲SC 03d 17^{h}40^m; ▲SC 04d 10^{h}19^m
*https://aia.cfa.harvard.edu/filament/index.html?search=0073

Particle fluxes and associated phenomena

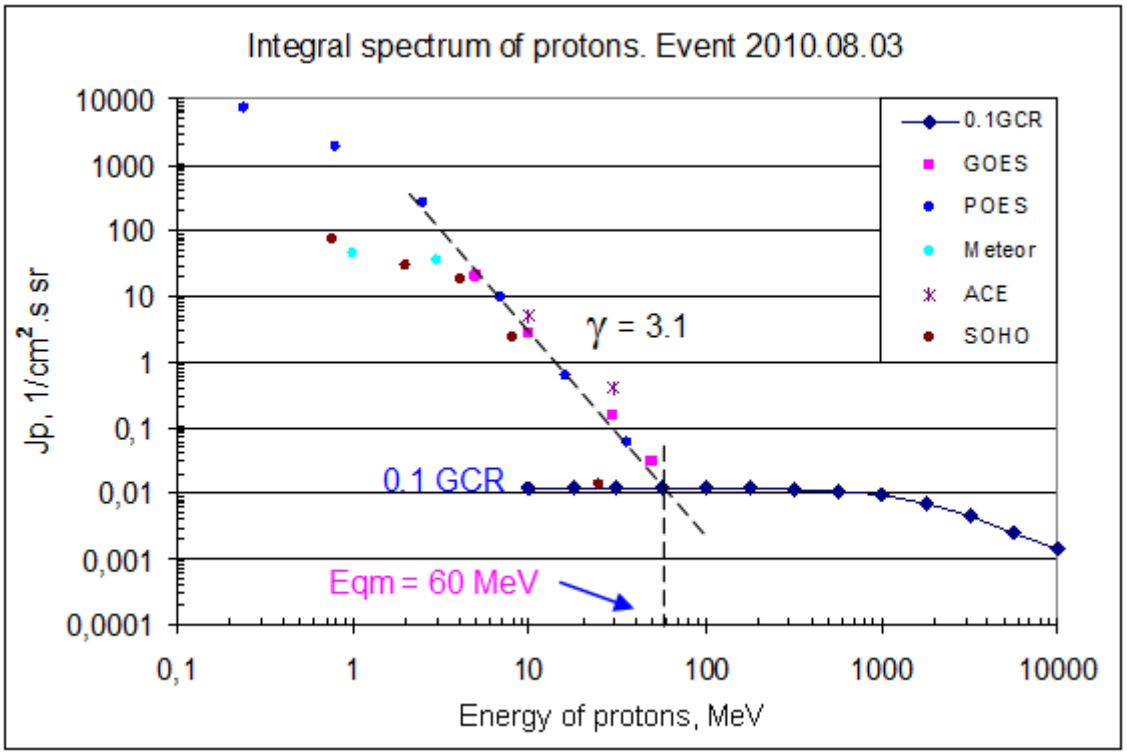


Integral fluxes of protons for the event of 2010 August 03

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	10	20	20.7	1.3	0.3	
EPS	>10	10	19	2.7	1	0.2	
EPS	>30	12	18	0.15	0.7	0.1	
EPS	>50	-	18	0.03	0.3	0.08	
EPS	>60	-	-	-	-	0.07	
EPS	>100	-	-	-	-	0.05	
POES							
MEPED	>0.24	9	18	7450	2.5	110	
MEPED	>0.8	11	18	1880	2	85	
MEPED	>2.5	13	19	270	1	65	
MEPED	>6.9	13	19	10	0.5	55	
MEPED	>16	-	18	0.6	0.5	0.9	
MEPED	>36	-	18	0.06	0.5	1.1	
MEPED	>70	-	-	-	-	1.2	
MEPED	>140	-	-	-	-	1.4	
Meteor-1							
SCR	>1	13	20	44	1	3.6	
SCR	>3	13	20	35	1	3.2	
SCR	>10	-	-	-	-	2.1	
GALS-M	>15	-	-	-	-	1.7	
GALS-M	>25	-	-	-	-	1.7	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	11	18	5	1	1.9	
SIS	>30	11	17	0.4	0.7	1.4	
SOHO							
EPHIN	>50	-	-	-	-	0.35	

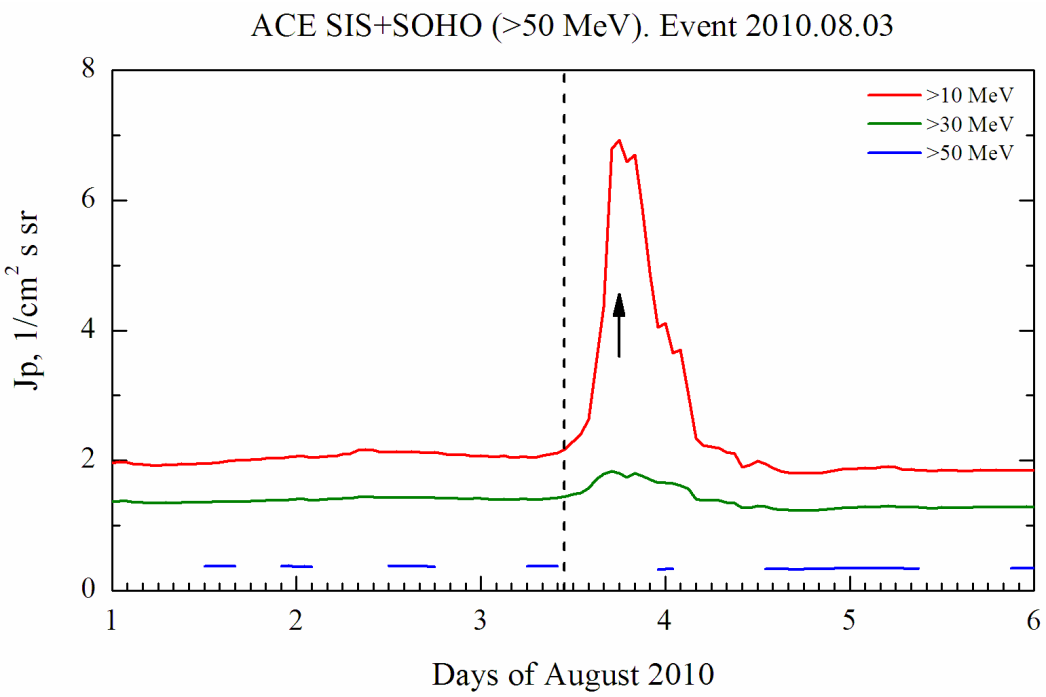
Differential fluxes of protons for the event of 2010 August 03

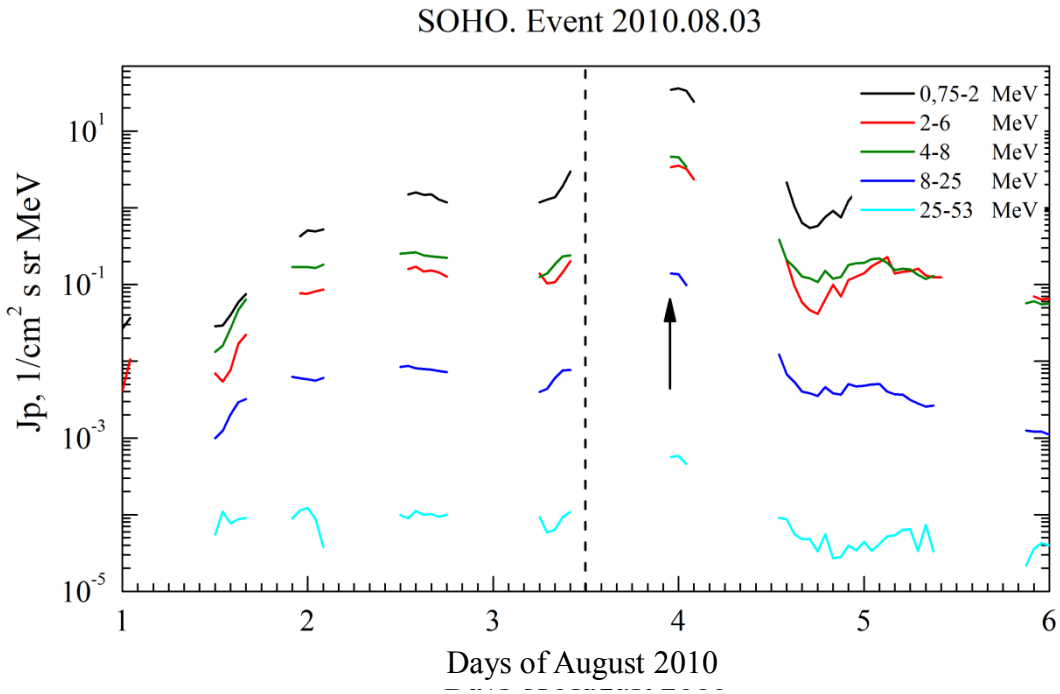
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75-2	-	23	36	1	-	
LION	2-6	-	23	3.9	1	-	
EPHIN	4-8	-	23	4	1	-	
EPHIN	8-25	-	22	0.14	1	-	
EPHIN	25-53	-	22	0.0005	1	0.0001	


Integral spectrum of protons. Event 2010.08.03
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2.s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 3.1
0.1 GCR
Eqm = 60 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO

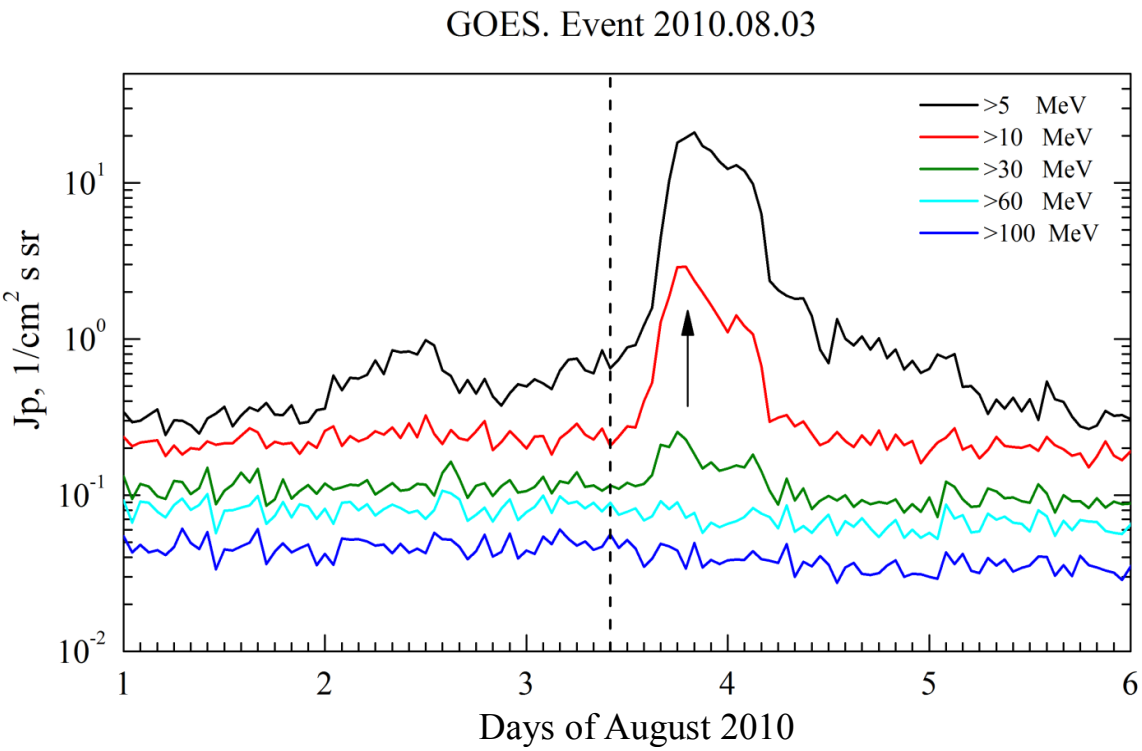
Time profiles of proton fluxes in the event 2010.08.03

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

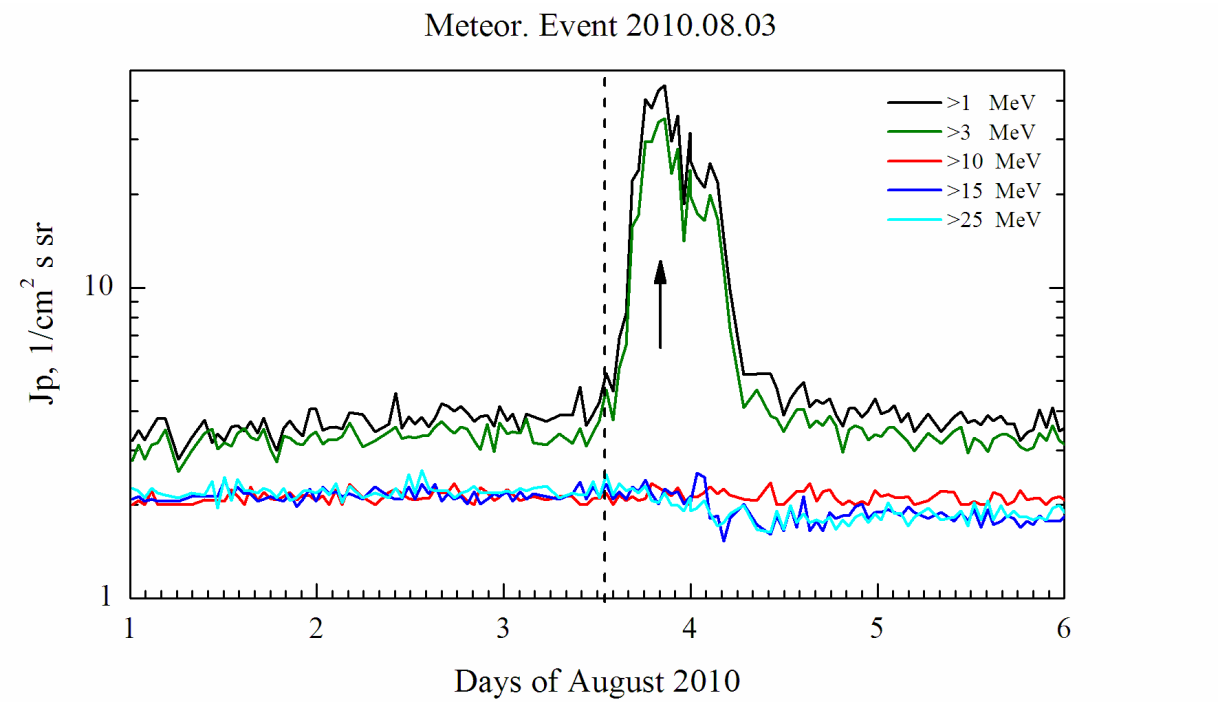


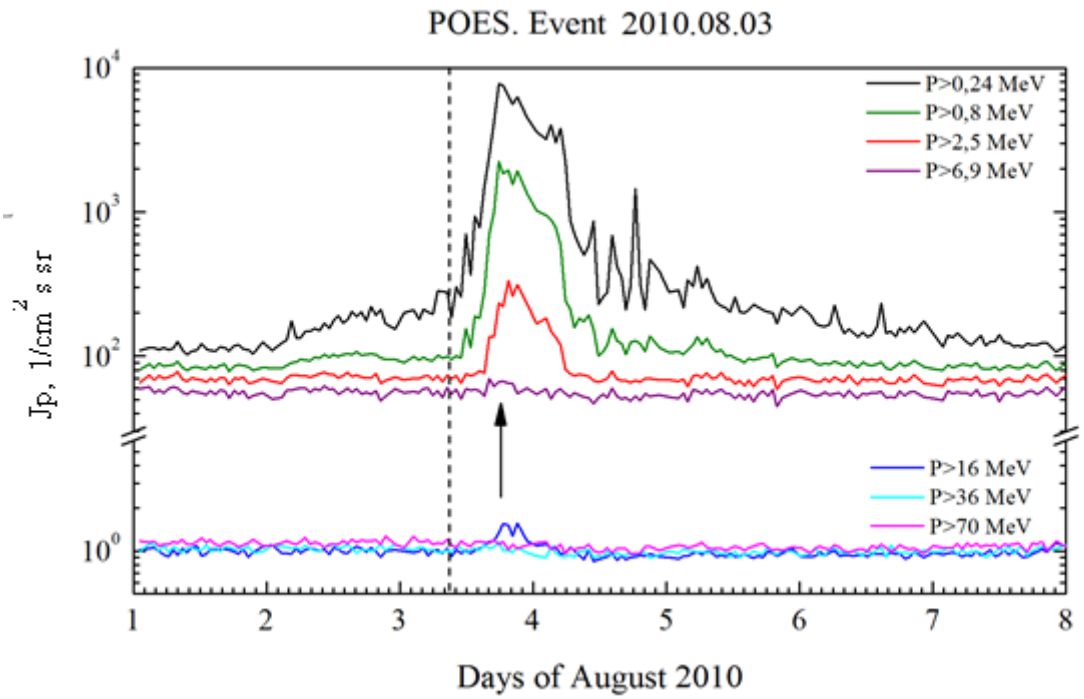


Earth satellites in geostationary orbit. R ≈ 6.6 Re: GOES



Earth satellites in polar orbit. R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2010 August 03

2010 August 01 ● AR XXXX To event 477

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563Å	DSF*	0750	0811	1121	N37W32	42º	
1 – 12	keV	No X-ray event at this time					

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0820:22	0820:26	0853:24	2019	577623	FERMI
12-25	keV	0918:24	0919:06	0952:40	688	4678344	HESSI

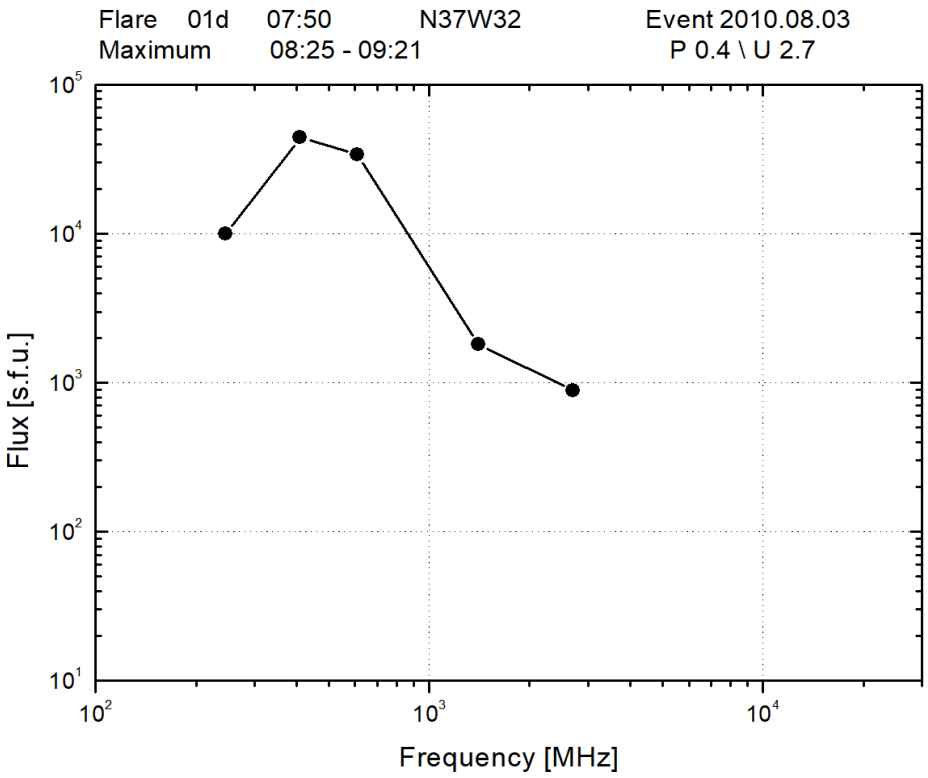
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
2.7	GHz	0811	0913	1052		2.95	
1.4	GHz	0812	0921	1040	P0.4 \ 2.7	3.26	
610	MHz	0801	0825	0946		4.53	
410	MHz	0755	0907	1052		4.64	
245	MHz	0754	0908	1035		4.00	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS IV	025-180	0808		1136		2	
DS III	025-142	0806		0814		1	
DH II	0.7-2	0920		1730			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1342	850	-22.1	360º	84º	SOHO

*https://aia.cfa.harvard.edu/filament/index.html?search=0073

Radio burst frequency spectrum



References:

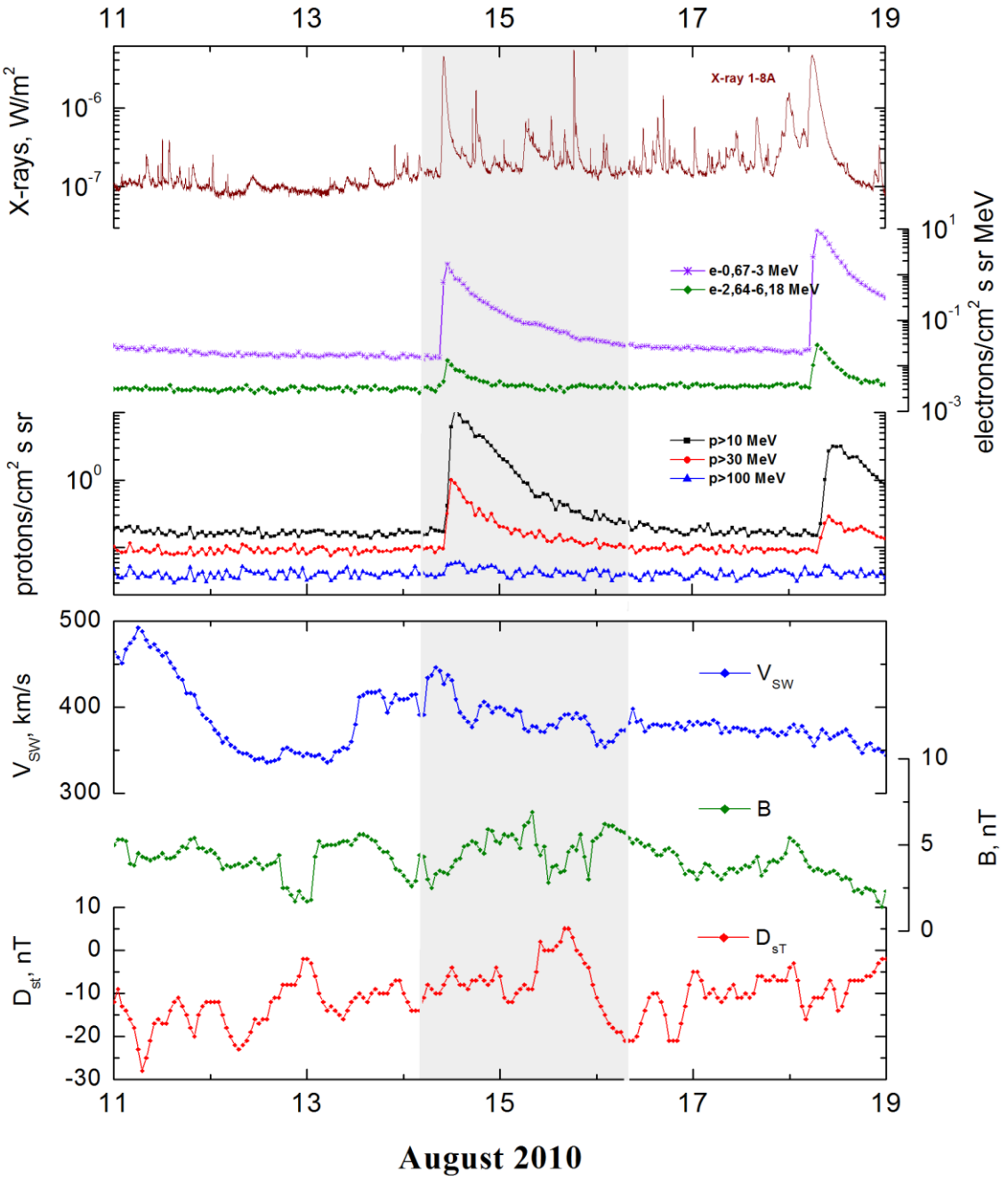
Ameri D., E. Valtonen, 2019.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Luhmann J.G., M.L. Mays, D. Odstrcil et al., 2017.
Winter L.M., and K. Ledbetter, 2015.
Zou Z., X. Xue, W. Yi et al., 2020.

Event 2010.08.14 – (2010-226) **478**

Particle event: To(Ep>10 MeV) – 14d11^h
Tmax (Ep>10 MeV) –14d12^h, Jmax$_1$ (Ep>10 MeV) – 9.4 /cm^2·s·sr
Duration of the event – 1.3 days, power-law index: γ = 2.25
Quasimaximal energy of protons in the event – Eqm = 200 MeV

Sources: ⊡ solar flare 14d10^{h}05^m, C4.4/SF, N17W52, AR11099
Main X-ray burst 1-8 Å: onset – 14d09^{h}38^m, max – 14d10^{h}05^m, Φ = 0.0099 J/m^2
CME: 14d 10^{h}12^m, V= 1205 km/s, Δφ = 360°, dA= 224°

Particle fluxes and associated phenomena

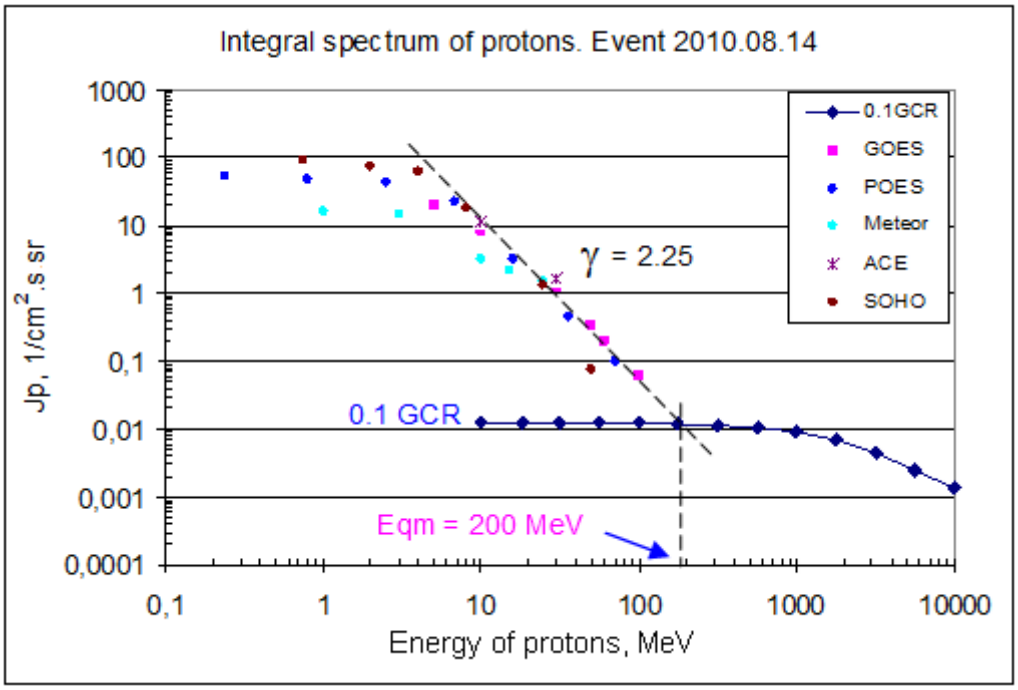


Integral fluxes of protons for the event of 2010 August 14

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	11	13	19.7	1.3	0.3	
EPS	>10	11	12	9.4	1.3	0.2	
EPS	>30	11	12	1.2	1	0.12	
EPS	>50	11	12	0.34	0.5	0.09	
EPS	>60	11	12	0.2	0.3	0.09	
EPS	>100	10	12	0.06	0.2	0.05	
EPS	>700	-	-	-	-		
POES							
MEPED	>0.24	11	13	53	1.5	110	
MEPED	>0.8	11	13	48	1	85	
MEPED	>2.5	11	13	43	1	70	
MEPED	>6.9	11	13	23	0.5	55	
MEPED	>16	11	13	3.2	0.5	0.9	
MEPED	>36	11	13	0.45	0.5	1	
MEPED	>70	11	13	0.12	0.5	1.1	
MEPED	>140	-	-	-	-	1.4	
Meteor-1							
SCR	>1	11	13	16.1	1	3.5	
SCR	>3	11	13	14.6	1	3.2	
SCR	>10	11	12	3.25	0.5	2.1	
GALS-M	>15	11	12	2.2	0.25	1.6	
GALS-M	>25	11	12	1.5	0.25	1.7	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	11	13	10.7	1	1.9	
SIS	>30	11	12	1.7	0.7	1.3	
SOHO							
EPHIN	>50	9	11	0.075	0.3	0.4	

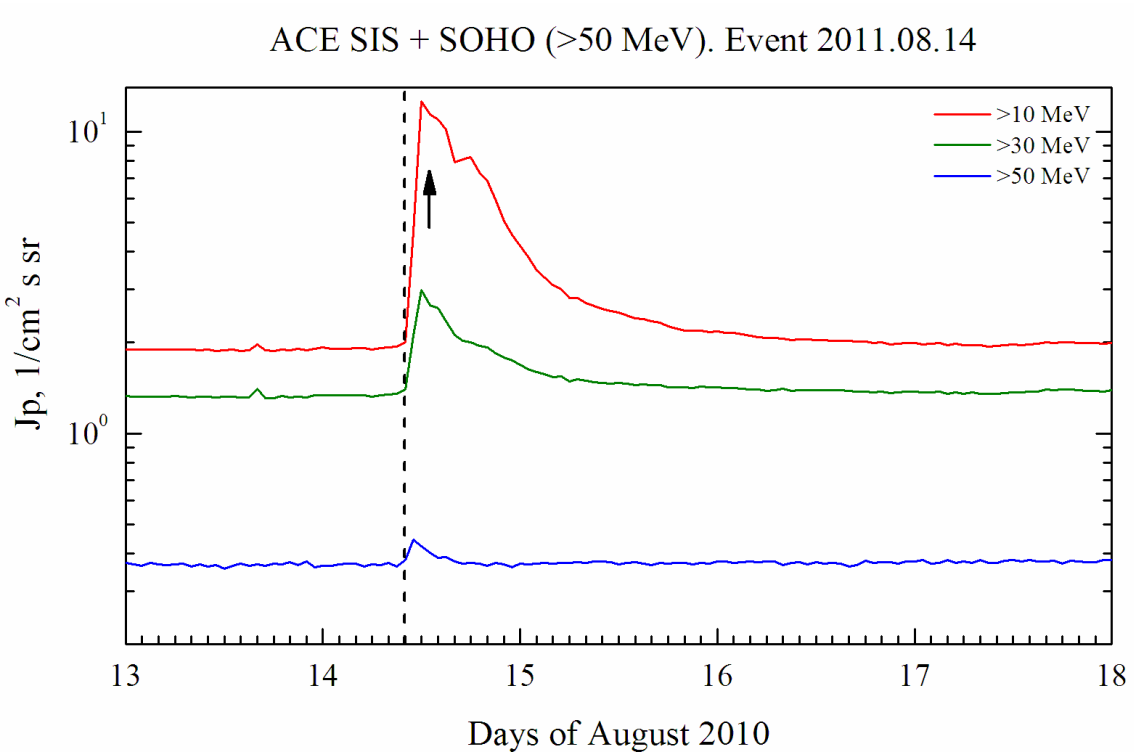
Differential fluxes of protons for the event of 2010 August 14

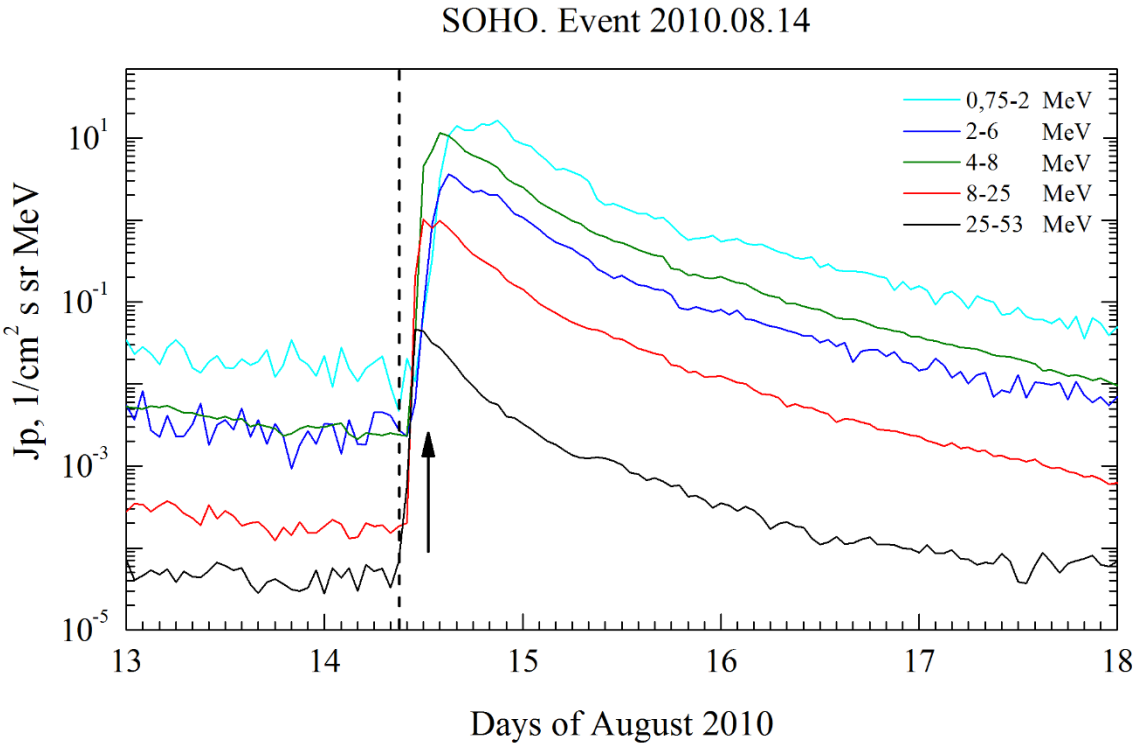
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75-2	9	14	14	3	0.02	
LION	2-6	9	12	3.6	3	0.003	
EPHIN	4-8	9	13	11	2.5	0.003	
EPHIN	8-25	9	12	1	2.5	0.0002	
EPHIN	25-53	9	11	0.045	2	0.00005	


Integral spectrum of protons. Event 2010.08.14
Jp, 1/cm2.s.sr
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.25
0.1 GCR
Eqm = 200 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO

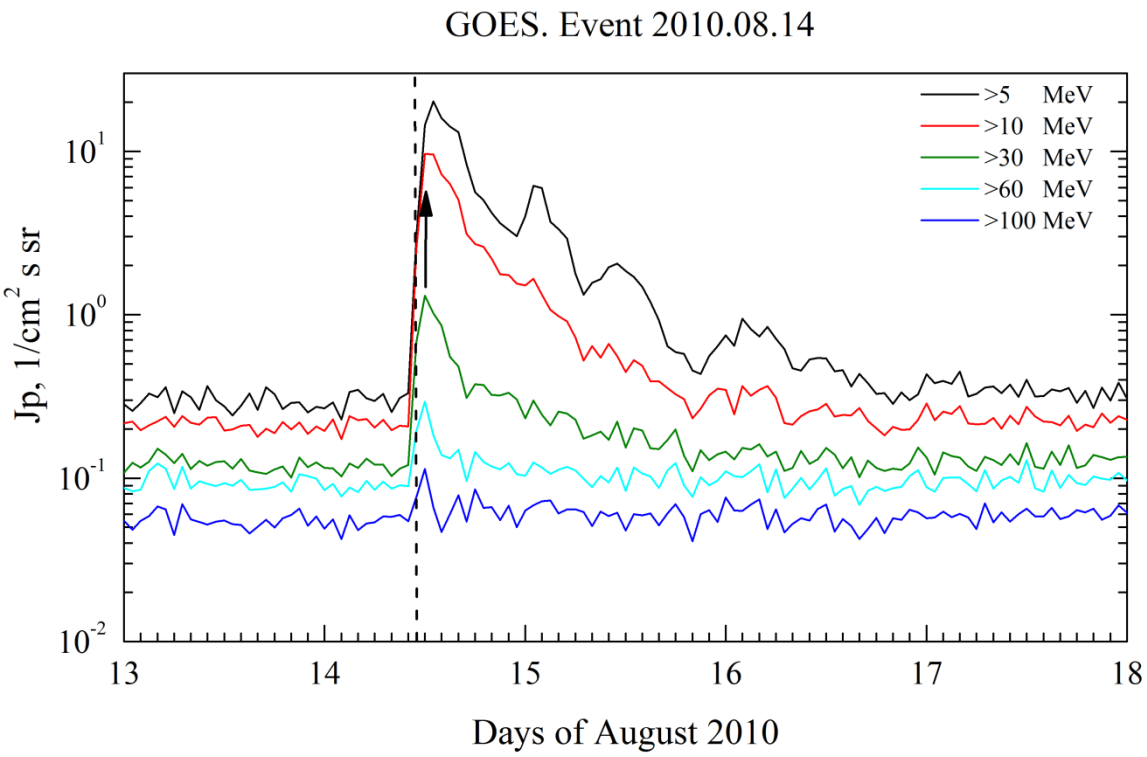
Time profiles of proton fluxes in the event 2010.08.14

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

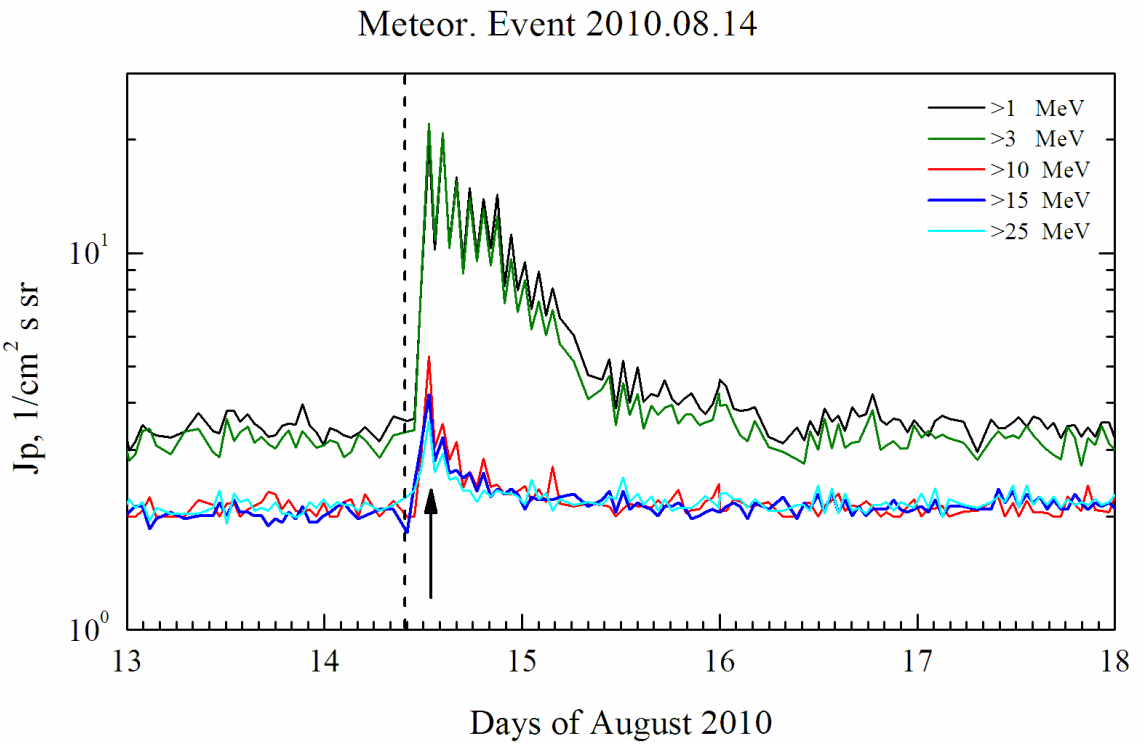


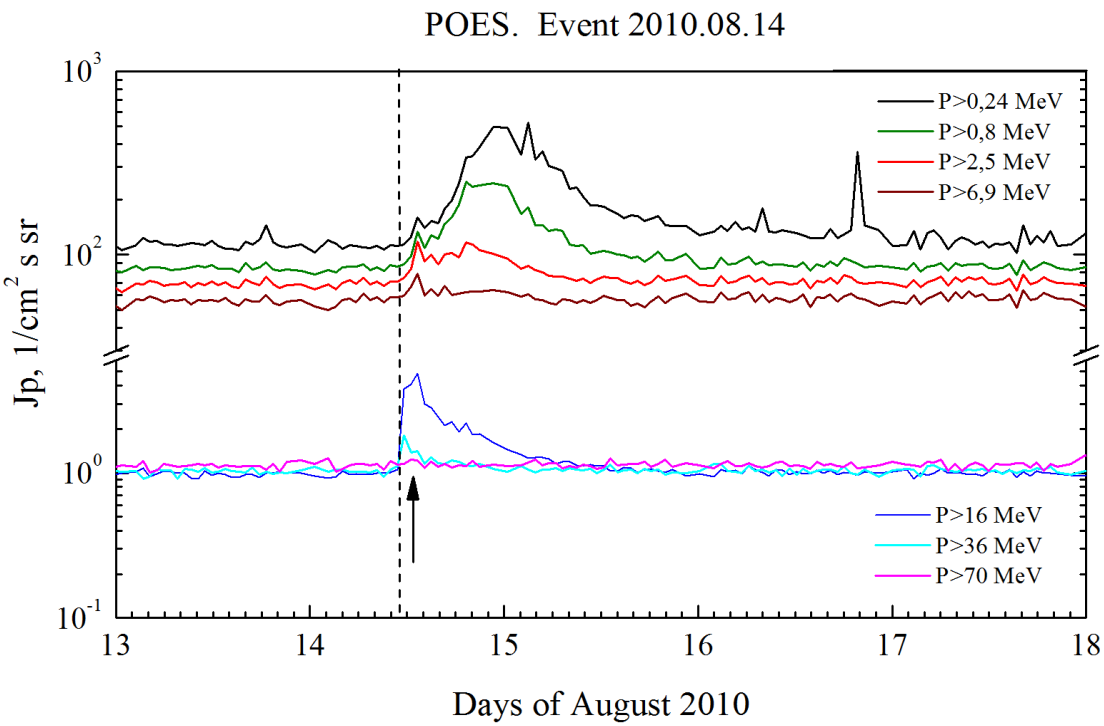


Earth satellites in geostationary orbit. R ≈ 6.6 Re: GOES



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2010 August 14

2010 August 14 ⊡ **AR 11099** **To event 478**

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	0941	0959	1110	N17W52	SF	ERU
1 – 12	keV	0938	1005	>1031	*	C4.4	0.0099
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0925:40	0952:46	0955:28	56	178453	HESSI
12-25	keV	1001:34	1003:13	1031:49	1218	376079	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
610	MHz	1038	1039	1040		2.23	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	0952		1009	406	1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1012	1205	- 43.0	360º	224º	SOHO

* – data gap 20.05.2010 – 20.01.2011

Proton Active Region:

AR11099 (N17L347, CMP 10,5.08.2010,
Sp=090 msh, CRO, B, R1)
XRI=0 C_5 S_9

References:

Alberti T., M. Laurenza, E.W. Cliver et al., 2017.
Bruno A., I.G. Richardson, 2021.
Gopalswamy N., H. Xie, S. Akiyama et al., 2014.
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Le G.-M., X-F. Zhang, 2017.
Ling A.G., and S.W. Kahler, 2020.
Luhmann J.G., M.L. Mays, D. Odstrcil et al., 2017.
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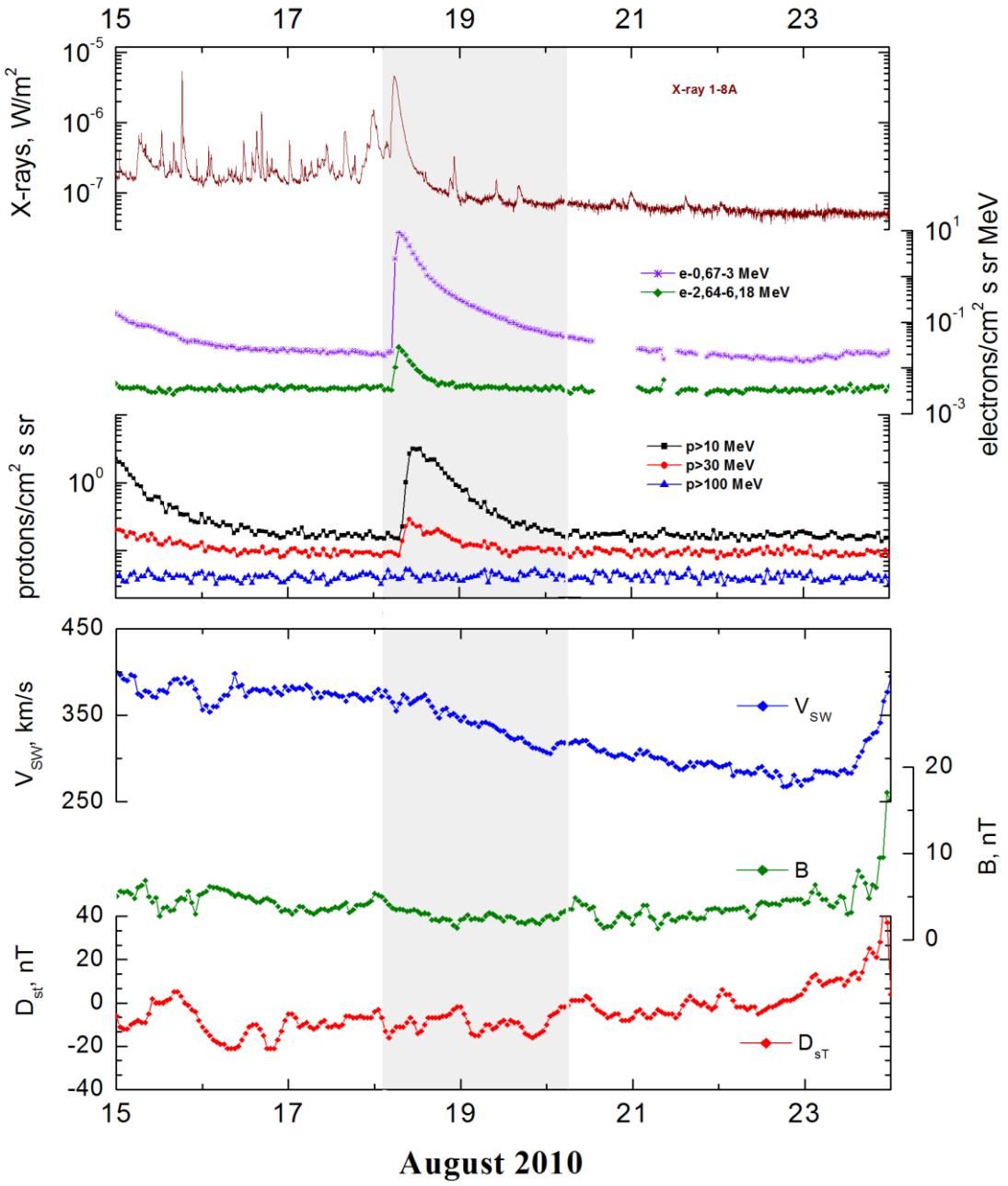
Núñez M., T. Nieves-Chinchilla, and A. Pulkkinen, 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C. St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2010.08.18 – (2010-230) **479**

Particle event: To(Ep>10 MeV) – $18d07^h$
$Tmax_1$(Ep>10 MeV) – $18d11^h$, $Jmax_1$ (Ep>10 MeV) – 2.2 /cm^2·s·sr
Duration of the event – 1.3 days, power-law index: $\gamma = 2.25$
Quasimaximal energy of protons in the event – Eqm = 95 MeV

Sources: ⊡ solar flare $18d04^h45^m$, C4.5/, N18W88, AR11099, 1.5 days behind W_L
Main: X-ray burst 1-8 Å: onset – $18d04^h45^m$, max – $18d05^h48^m$, $\Phi = 0.023$ J/m^2
CME: $18d05^h48^m$, V= 1471 km/s, $\Delta\varphi = 184°$, dA= 230°

Particle fluxes and associated phenomena

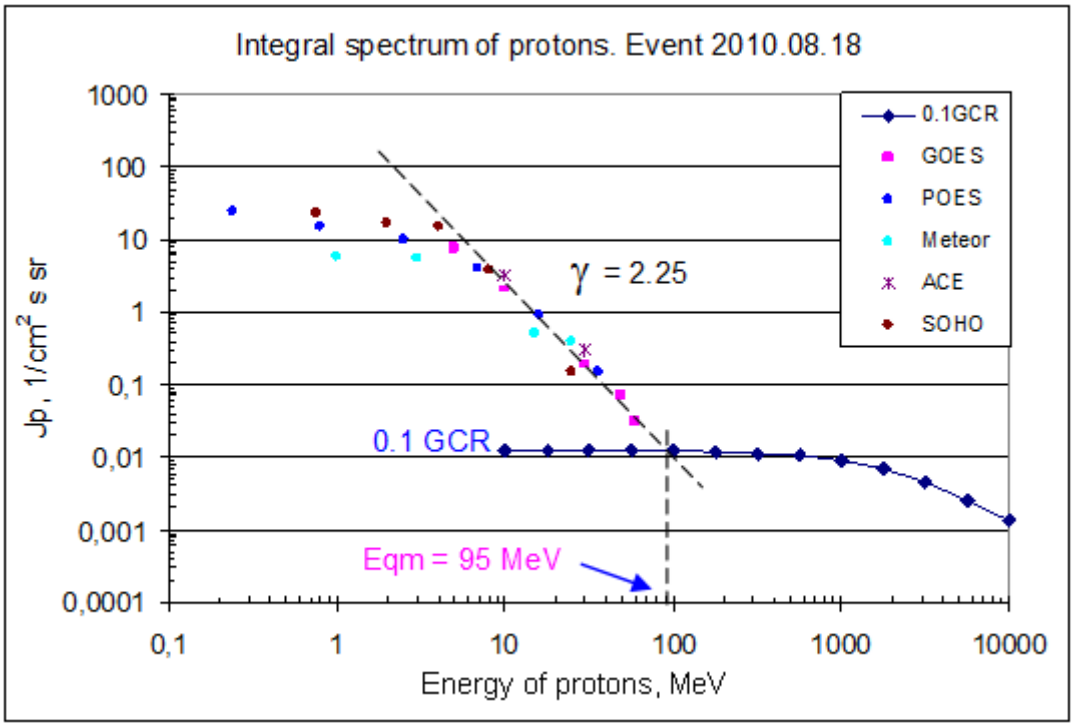


Integral fluxes of protons for the event of 2010 August 18

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	12	7.7	1.5	0.3	
EPS	>10	7	11	2.2	1.3	0.25	
EPS	>30	7	10	0.25	0.5	0.11	
EPS	>50	7	10	0.07	0.3	0.09	
EPS	>60	7	10	0.03	0.3	0.09	
EPS	>100	-	-	-	-	0.06	
POES							
MEPED	>0.24	7	11	25	1.5	110	
MEPED	>0.8	7	12	15	1	85	
MEPED	>2.5	7	12	10	1	70	
MEPED	>6.9	7	12	4	0.5	55	
MEPED	>16	7	11	0.9	0.5	1	
MEPED	>36	7	11	0.15	-	1	
MEPED	>70	-	-	-	-	1.1	
MEPED	>140	-	-	-	-	1.4	
Meteor-1							
SCR	>1	6	14	5.94	1.5	3.5	
SCR	>3	6	14	5.62	1.5	3.2	
SCR	>10	6	-	-	1	2.1	
GALS-M	>15	6	10	0.52	0.5	1.6	
GALS-M	>25	6	10	0.4	0.5	1.7	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	7	12	2.9	1.5	2	
SIS	>30	7	12	0.3	1	1.4	
SOHO							
EPHIN	>50	-	-	-	-	0.35	

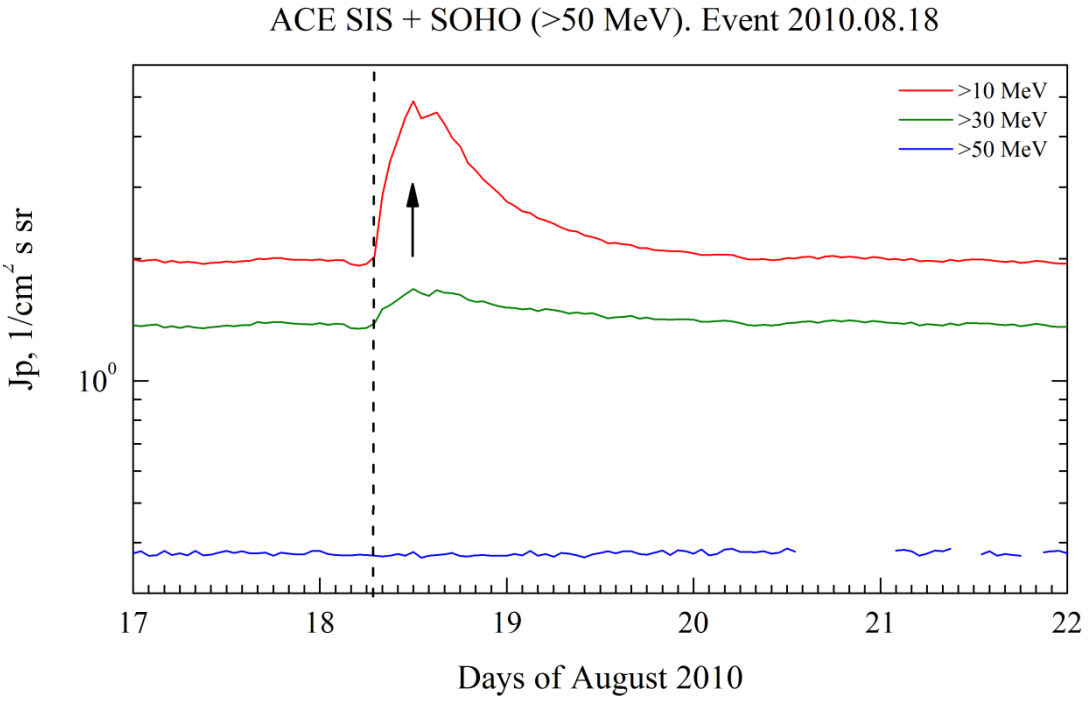
Differential fluxes of protons for the event of 2010 August 18

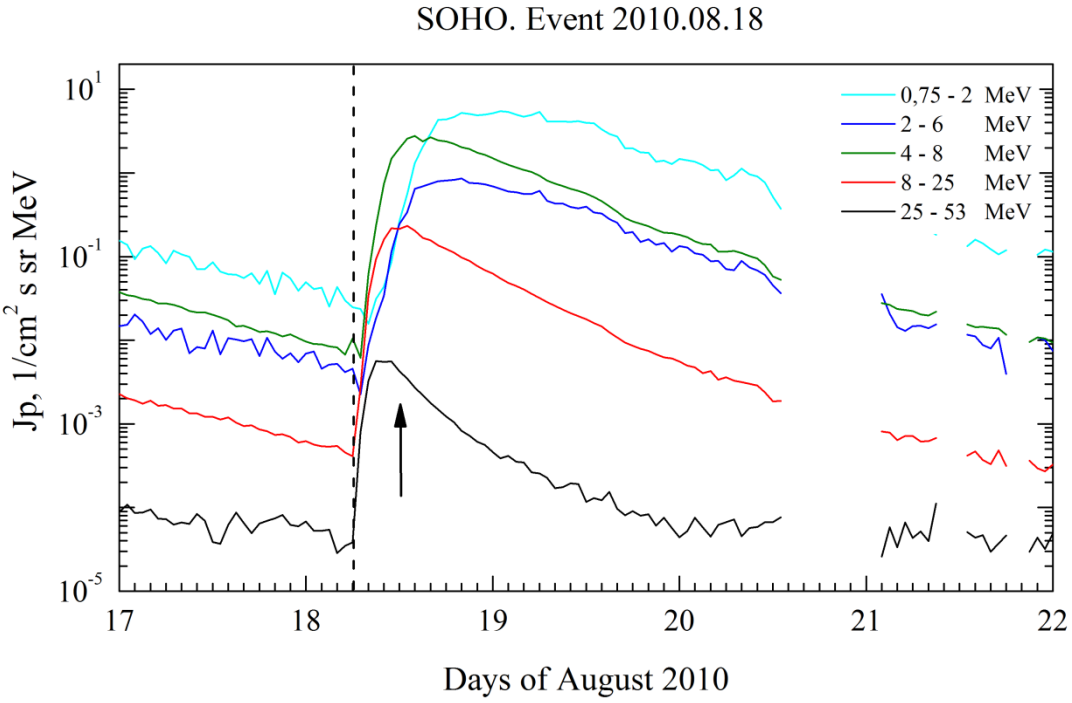
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0,75-2	6	16	4.3	3	0.02	
LION	2-6	6	15	0.7	3	0.003	
EPHIN	4-8	6	13	2.8	2	0,005	
EPHIN	8-25	6	12	0.22	2	0,0005	
EPHIN	25-53	6	10	0.0055	1,5	0,00005	


Integral spectrum of protons. Event 2010.08.18
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
γ = 2.25
0.1 GCR
Eqm = 95 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
0,1
1
10
100
1000
10000
Energy of protons, MeV

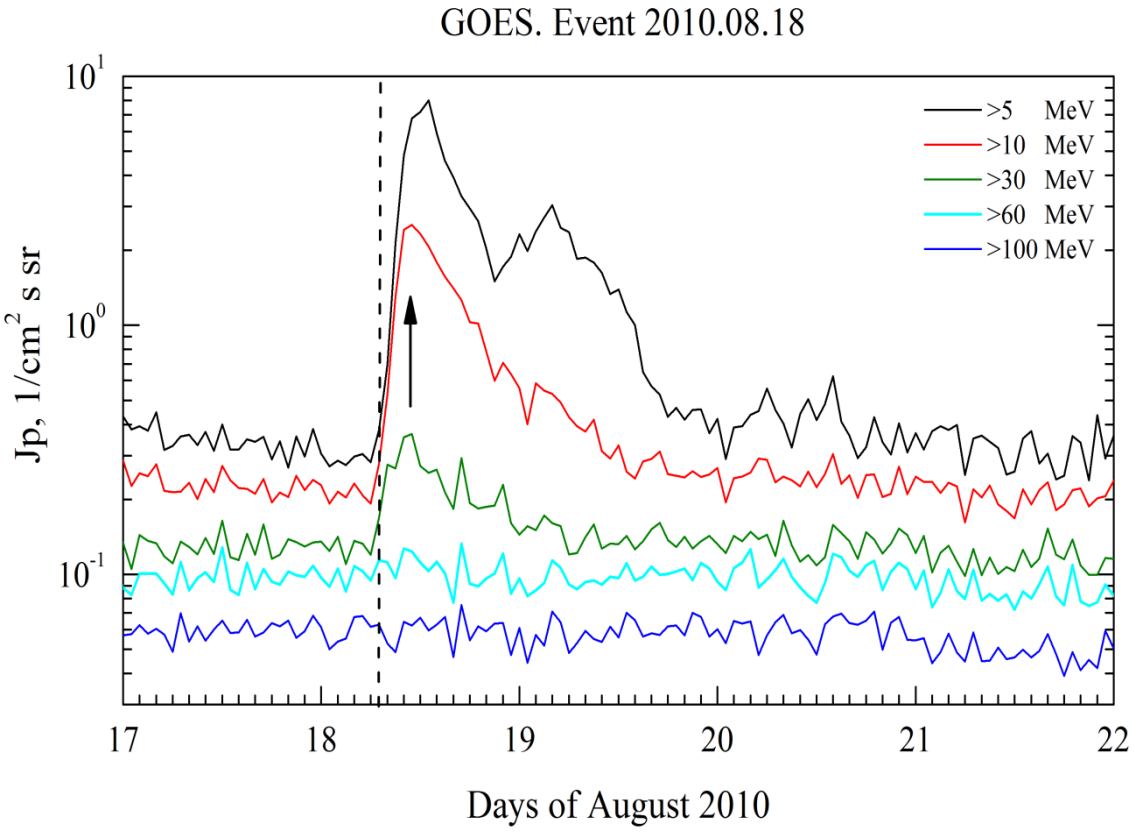
Time profiles of proton fluxes in the event 2010.08.18

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

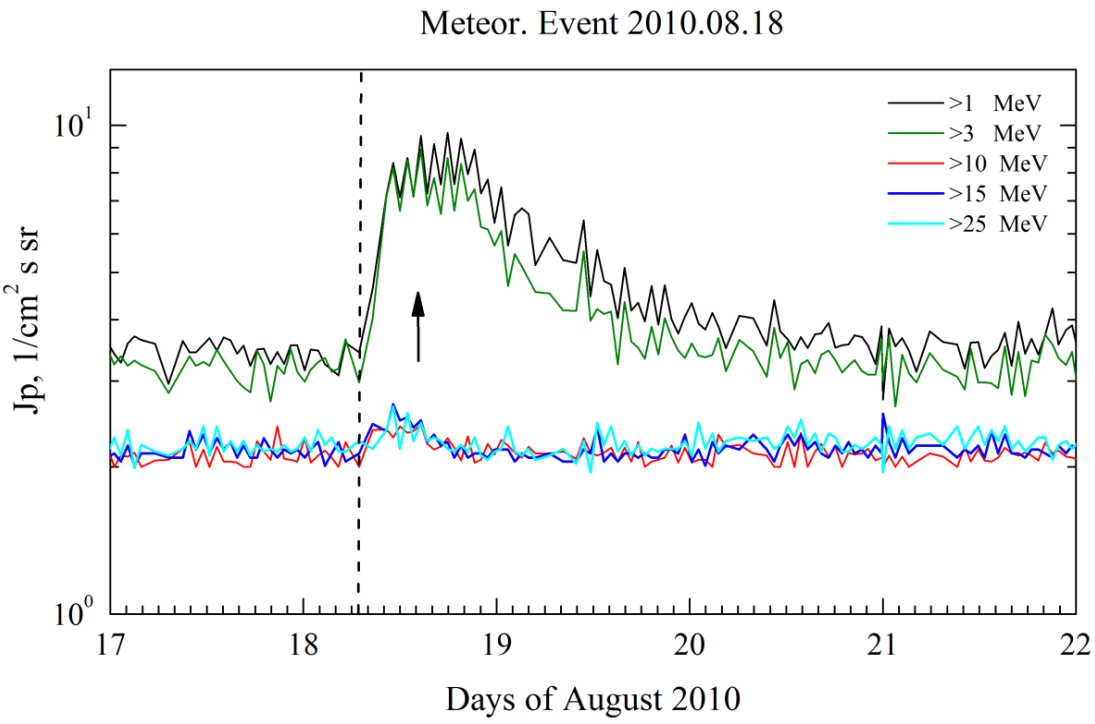


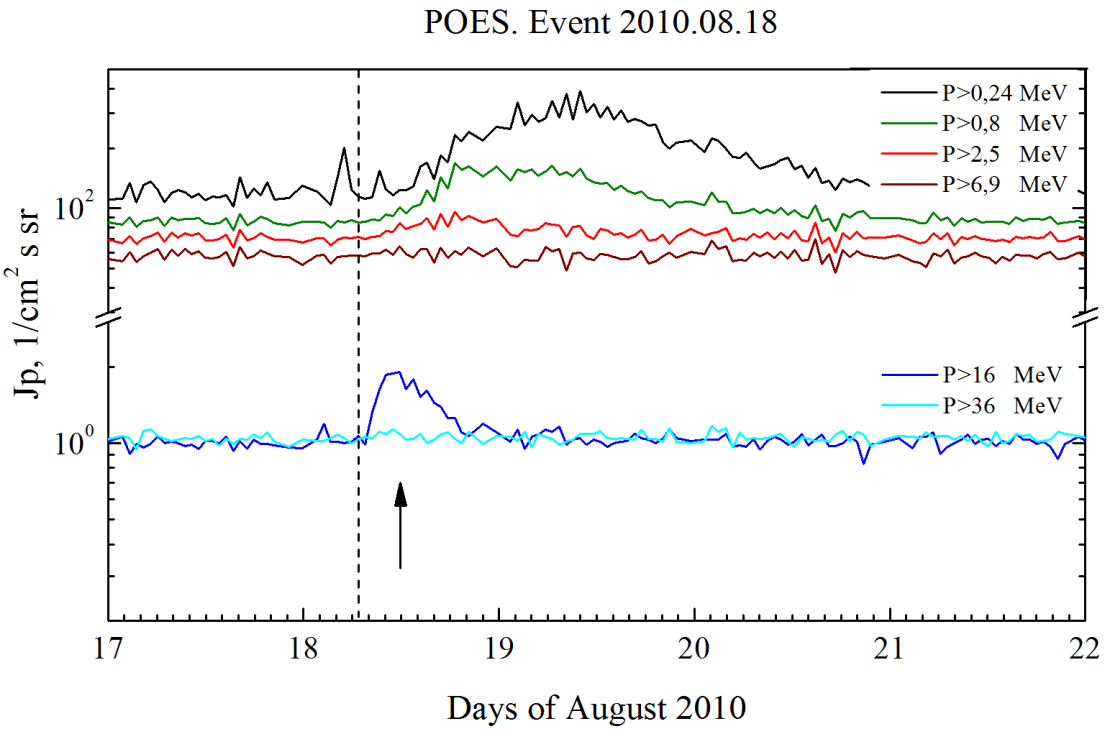


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2010 August 18

2010 August 18 ⊡ AR 11099 To event 479

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	No optical flare on visible disk					
1 – 12	keV	0445	0548	>0651	N18W88	C4.5	0.023
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0436:28	0449:46	0454:40	1092	2452632	HESSI
6-12	keV	0606:20	0606:26	0607:00	49	10949	HESSI
12-25	keV	0506:46	0534:16	0549:38	3105	1057898	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
610	MHz	1038	1039	1040		2.23	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-55	0551		0555	545	1	
DH II	0.7-13	0605		0745			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0548	1471	20.2	184˚	230˚	SOHO

Proton Active Region:

AR11099 (N17L347, CMP 10,5.08.2010,
Sp=090 msh, CRO, B, R1)
XRI=0 C_5 S_9

References:

Bruno A., I.G. Richardson, 2021.
Koleva K., M. Dechev, P. Duchlev, 2021.
Leske R.A., C.M.S. Cohen, R.A. Mewaldt et al., 2012.
Luhmann J.G., M.L. Mays, D. Odstrcil et al., 2017.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.

События 2011 года

			Страница
1	Event 2011.01.28 – (2011-028)	№ 480	74
2	Event 2011.02.15 – (2011-046)	№ 481	81
3	Event 2011.03.07 – (2011-066)	№ 482	89
4	Event 2011.03.21 – (2011-080)	№ 483	98
5	Event 2011.06.05 – (2011-156)	№ 484	107
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7	Event 2011.06.11 – (2011-162)	№ 486	124
8	*Event 2011.06.15 – (2011-166)	№ 487	131
9	Event 2011.06.17 – (2011-168)	№ 488	138
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18	Event 2011.11.04 – (2011-308)	№ 497	211
19	Event 2011.11.26 – (2011-330)	№ 498	219
20	Event 2011.12.25 – (2011-359)	№ 499	226

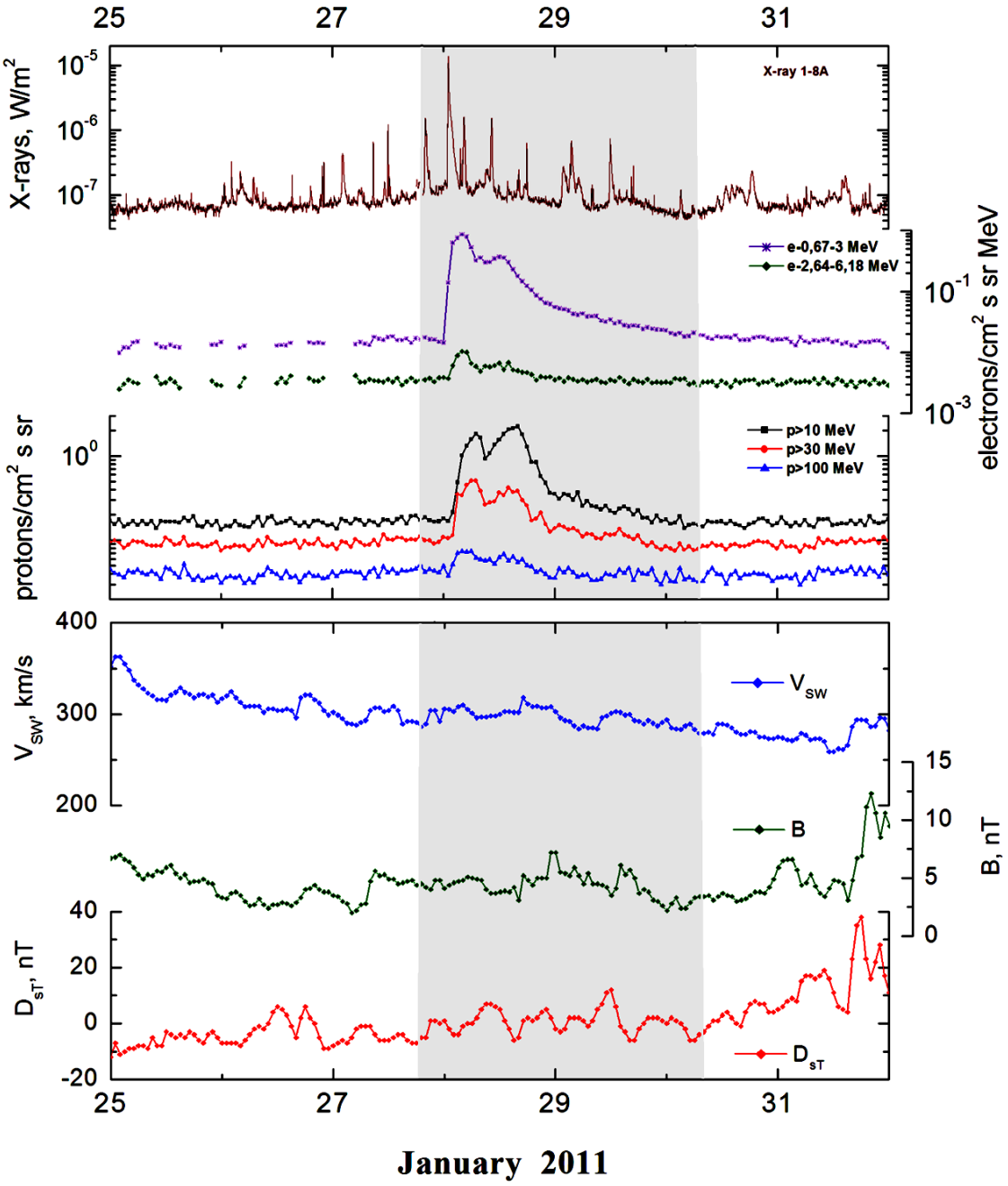
* Здесь и далее в списках событий звездочкой (*) отмечены слабые события с Jp (E > 10 МэВ) в интервале 0.1 ÷ 1 pfu

Event 2011.01.28 – (2011-028) **480**

Particle event: To(Ep>10 MeV) – $28d01^h$
$Tmax_1$(Ep>10 MeV) – $28d07^h$, $Jmax_1$ (Ep>10 MeV) – 1.6 /cm^2·s·sr
$Tmax_2$(Ep>10 MeV) – $28d16^h$, $Jmax_2$ (Ep>10 MeV) – 2.1 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma_1 = 1.8$, $\gamma_2 = 1.8$
Quasimaximal energy of protons in the event – Eqm_1 = 200 MeV
– Eqm_2 = 140 MeV

Sources: ⊡ solar flare event 28d<00^h44^m, M1.3*/, N16W88, AR11149, 1d behind W_L
Main X-ray burst 1-8 Å: onset – $28d00^h44^m$, max – $28d01^h03^m$, Φ = 0.0095 J/m^2
CME: $28d01^h26^m$, V = 606 km/s, Δφ = 119°, dA = 290°
*Large solar flare event behind W_L

Particle fluxes and associated phenomena

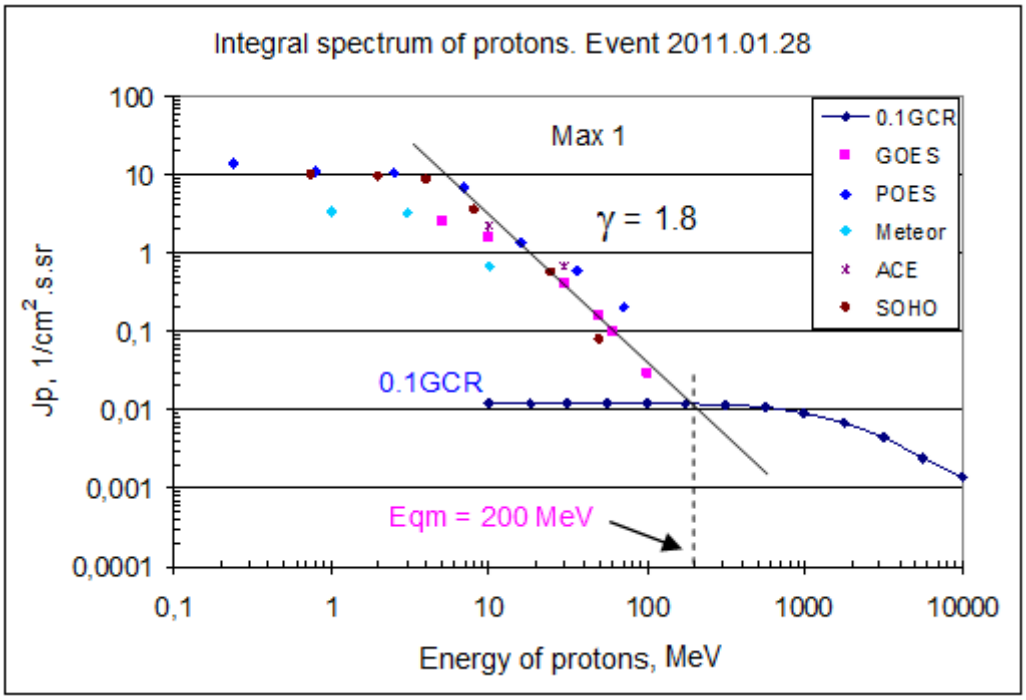


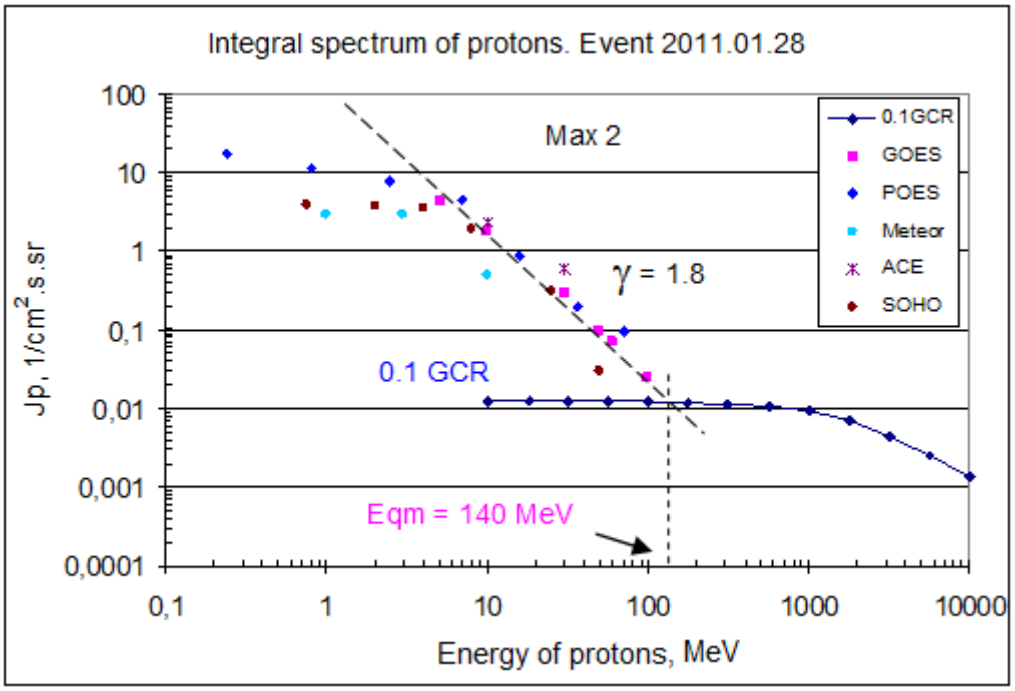
Integral fluxes of protons for the event of 2011 January 28

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	01	08/16	2.6/4.3	2	0.2	
EPS	>10	01	07/16	1.6/2.1	1.5	0.17	
EPS	>30	01	06/14	0.4/0.3	1	0.1	
EPS	>50	01	06/14	0.16/0.1	1	0.07	
EPS	>60	01	05/14	0.1/0.05	1	0.06	
EPS	>100	01	04/13	0.03/0.025	1	0.04	
EPS	>700	-	-	-	-	-	
POES							
MEPED	>0.24	3h	5/18.5	14/18	0.5	110	
MEPED	>0.8	4h	5/18.5	11/11.5	0.5	85	
MEPED	>2.5	4h	5/18.5	10.5/8	0.5	70	
MEPED	>6.9	4h	5/18.5	7/4.5	0.5	55	
MEPED	>16	2h	6/14	1.5/0.9	0.7	0.9	
MEPED	>36	2h	6/14	0.6/0.2	0.7	1	
MEPED	>70	2h	6/14	0.2/0.1	0.7	1.1	
MEPED	>140	2h	-	-	-	1.4	
Meteor-1							
SCR	>1	3	08/ 15	3.4/3	1	3.4	
SCR	>3	3	08/ 16	3.2/3	1	2.7	
SCR	>10	3	04/14	0.7/1	1	2.1	
GALS-M	>15	-	-	-	-	4.7	
GALS-M	>25	-	-	-	-	4.8	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	01	05/13	2.2/2.35	1	1.9	
SIS	>30	01	04/12	0.7/0.6	1	1.3	
SOHO							
EPHIN	>50	02	04/11	0.08/ 0.03	0.5	0.36	

Differential fluxes of protons for the event of 2011 January 28

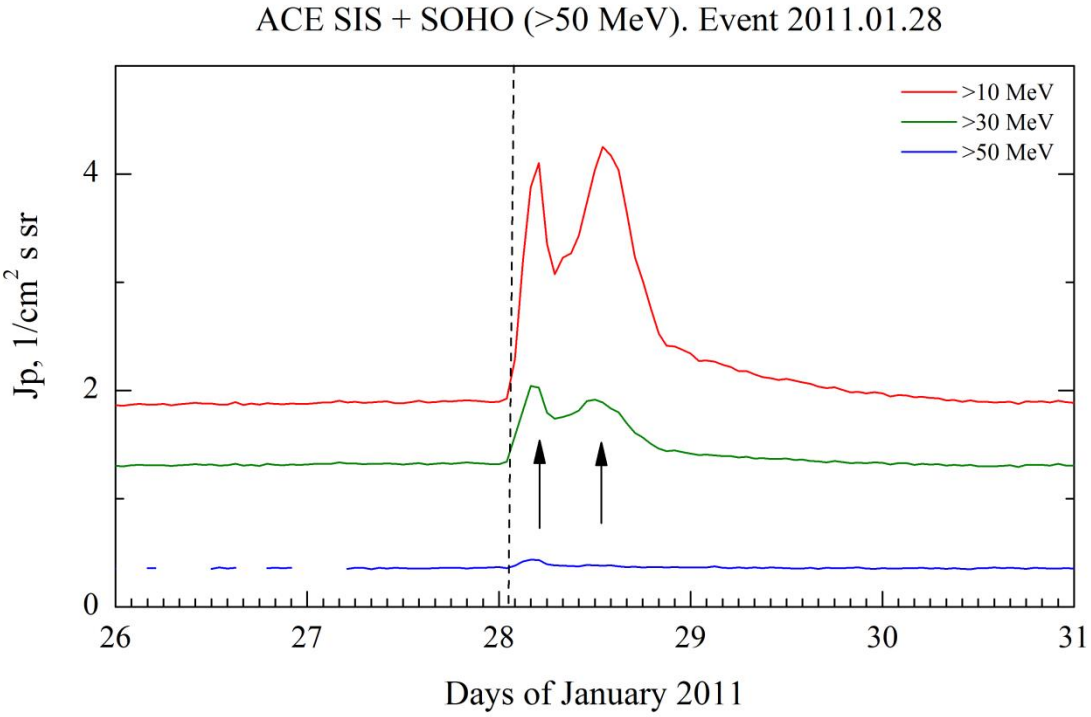
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	01	8/12	0.24/0.17	4.5	0.01	
LION	2 – 6	01	6/12	0.25/.0.07	4.	0.0025	
EPHIN	4 – 8	01	5/11	1.3/0.4	4	0.0004	
EPHIN	8 – 25	01	5/13	0.18/0.1	3	0.00003	
EPHIN	25 – 53	02	5/12	0.018/0.01	2.55	0.00003	

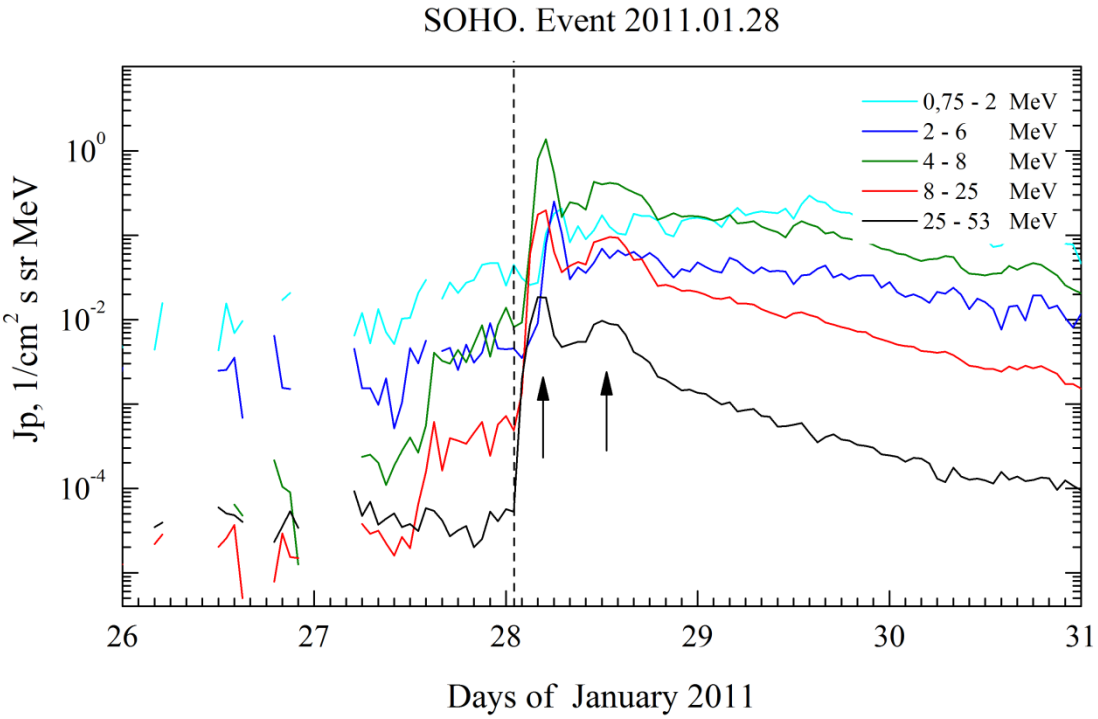

Integral spectrum of protons. Event 2011.01.28
Max 1
γ = 1.8
0.1GCR
Eqm = 200 MeV
Jp, 1/cm2.s.sr
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2011.01.28
Max 2
γ = 1.8
0.1 GCR
Eqm = 140 MeV
Jp, 1/cm2.s.sr
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

Time profiles of proton fluxes in the event 2011.01.28

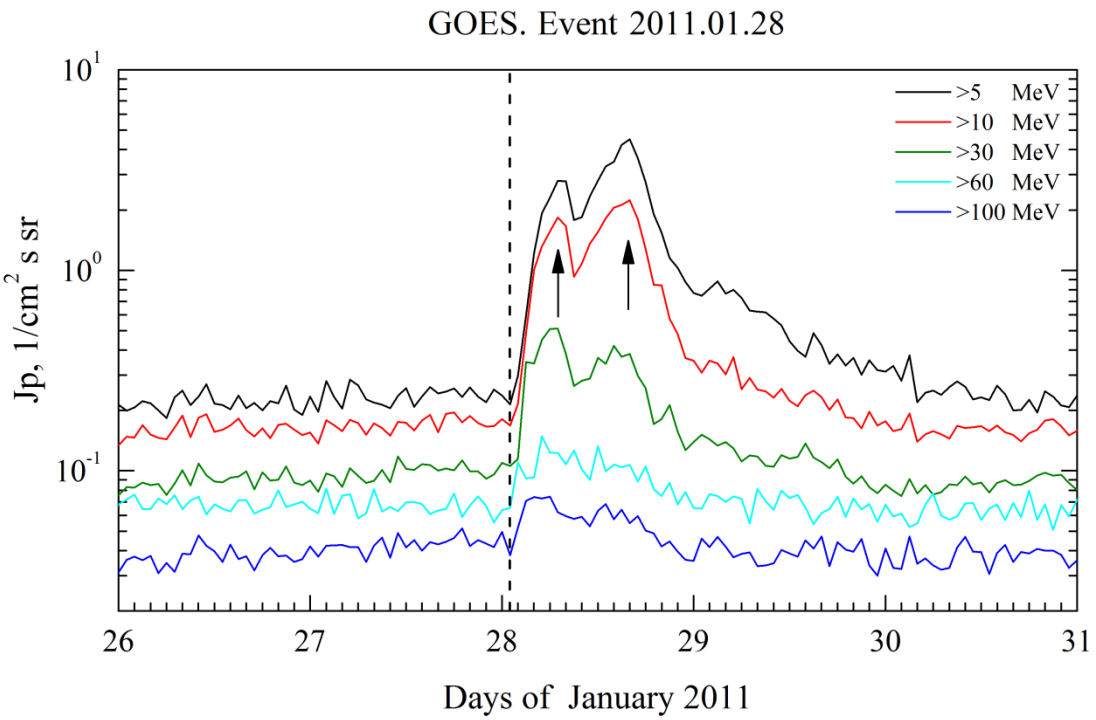
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



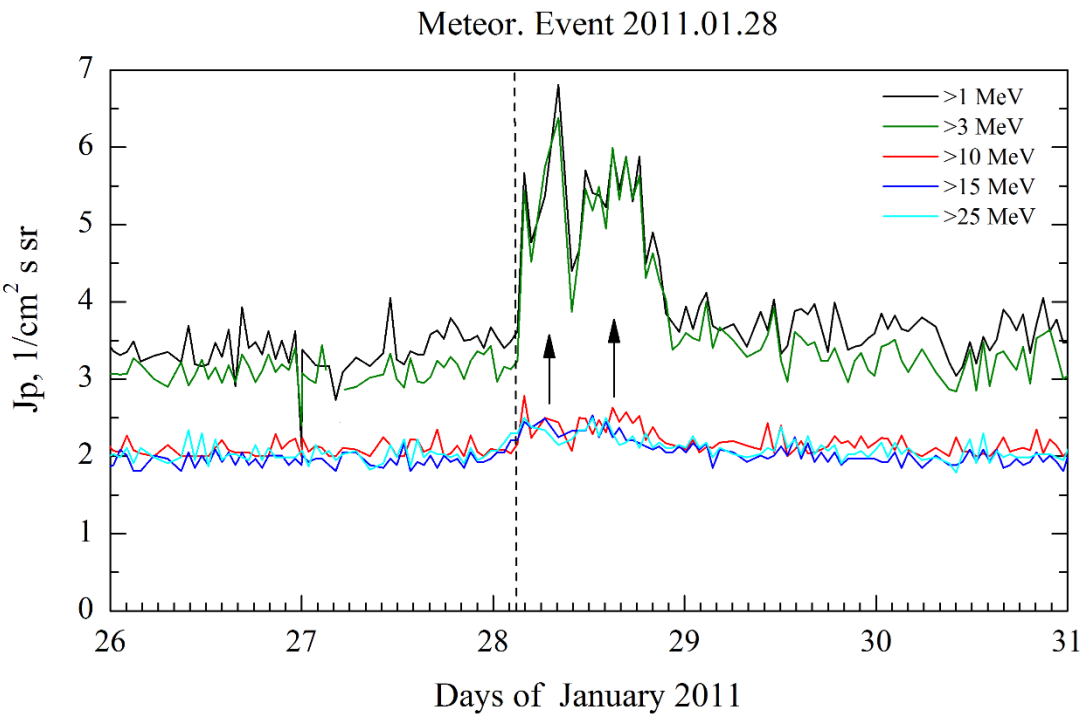


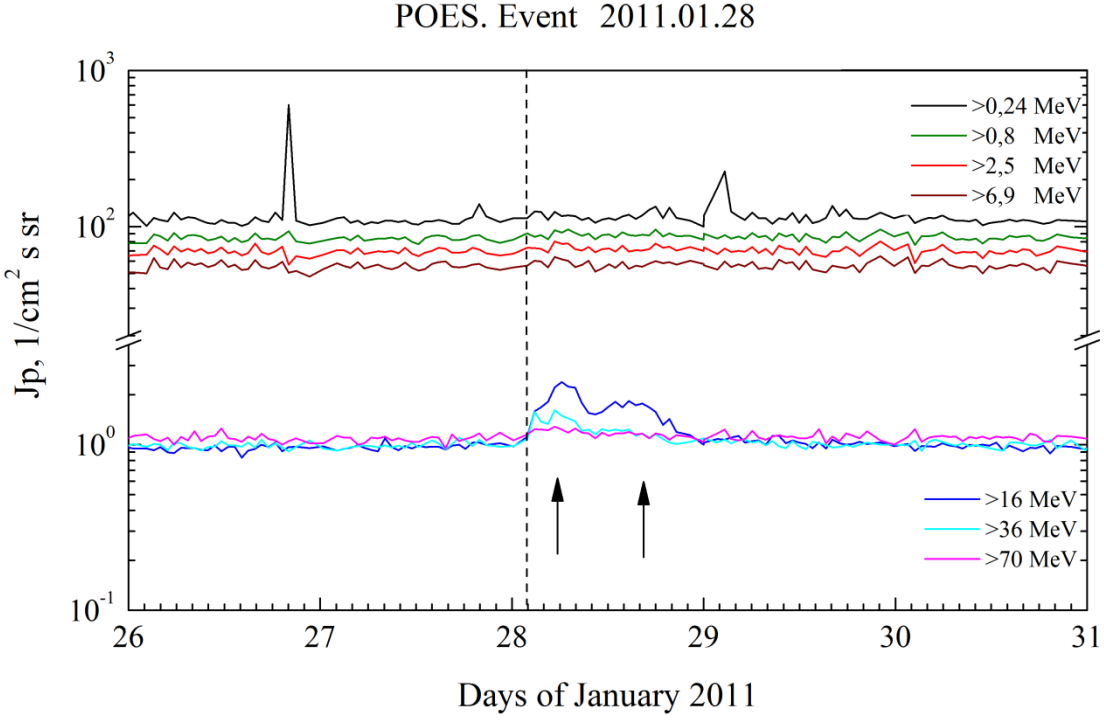
Содержание

Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 January 28

2011 January 28 ⊡ AR 11149 To event 480

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	0044	0103	0245	N16W88	M1.3*	0.0095
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	Sp/c
25 – 50	keV	0046:20	0056:10	0115:40	1968	4826051	HESSI
6-12	keV	0115:40	0118:14	0122:48	30	60707	HESSI
12-25	keV	0048:23	0049:32	0052:29	2386	62231	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
2.8	GHz	0056.5	0108.4	0109		1	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-130	0101		0112	732	1	
DS III	57-200	0057		0059		2	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0126	606	-20.9	119˚	290˚	SOHO

*Large solar flare behind W_L

Proton Active Region:

AR11149 (N17L343, CMP 21.01.2011,
Sp=250 msh BG; R1)
XRI= 0.13; $M_1^{1.3}$+C_8; S_4;
PFR 28.01 – $M_1^{1.3}$

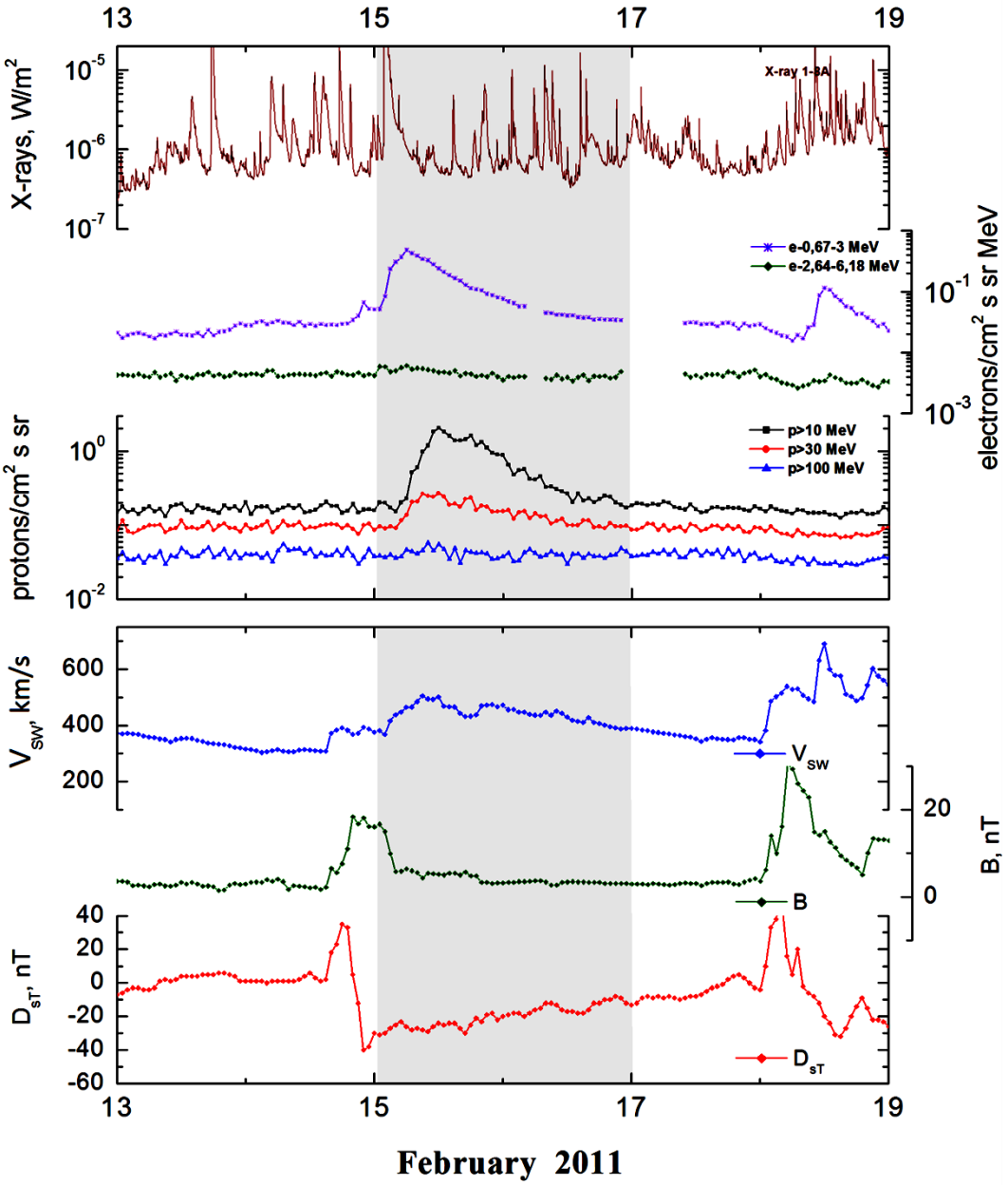
References:

Bučík R., S.M. Mulay, G.M. Mason et al., 2021.
Koleva K., M. Dechev, P. Duchlev, 2021.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.

Particle event: To(Ep>10 MeV) – $15d05^h$
$Tmax_1$(Ep>10 MeV) – $15d12^h$, $Jmax_1$ (Ep>10 MeV) – 1.9 /cm^2·s·sr
$Tmax_2$(Ep>10 MeV) – $15d18^h$, $Jmax_2$ (Ep>10 MeV) – 1.4 /cm^2·s·sr
Duration of the event – 2 days, power-law index: $\gamma_1 = 2.2$, $\gamma_2 = 2.2$
Quasimaximal energy of protons in the event – Eqm_1 = 80 MeV
– Eqm_2 = 80 MeV

Sources: ● solar flare $15d01^h44^m$, X2.2/2B, S20W15, AR11158
Main burst X-ray 1–8 Å: onset – $15d01^h44^m$, max – $15d01^h56^m$, Φ = 0.16 J/m^2
CME: $15d02^h24^m$, V= 669 km/s, Δφ = 360°, dA= 189°

Particle fluxes and associated phenomena

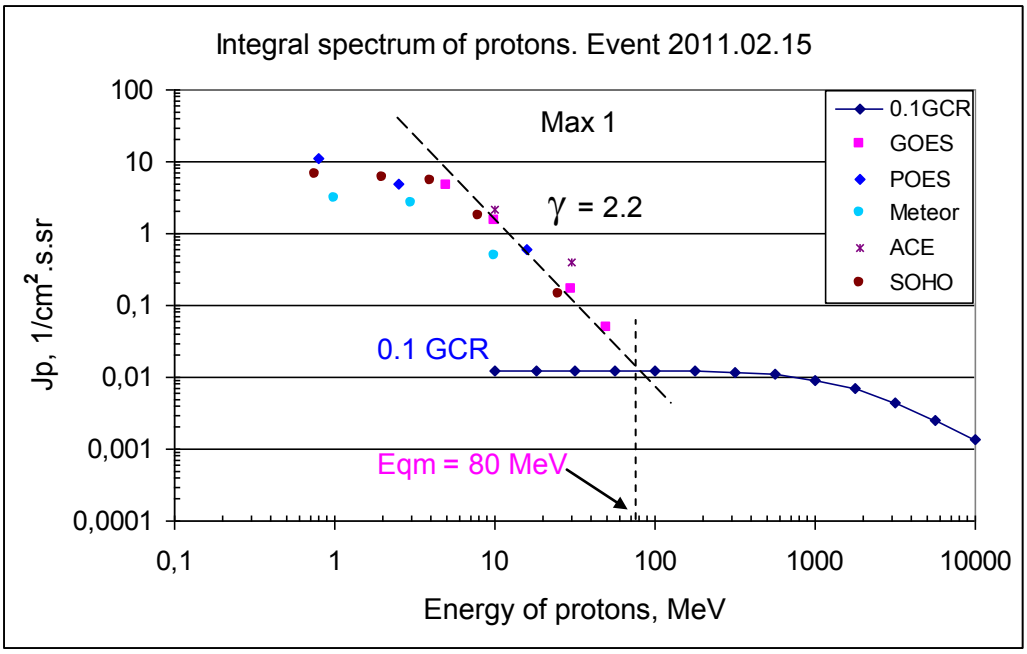


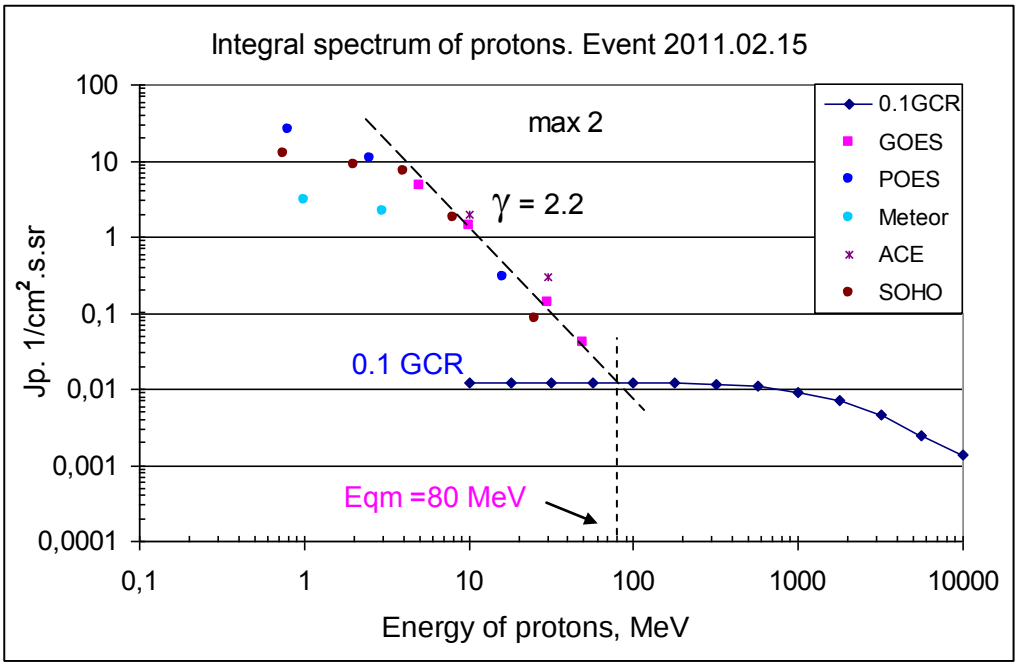
Integral fluxes of protons for the event of 2011 February 15

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	05	12/18	4.75/4.7	2.5	0.25	
EPS	>10	05	12/18	1.9/1.4	2	0.18	
EPS	>30	05	12/18	0.17/0.14	1.5	0.1	
EPS	>50	05	12/18	0.05/0.04	0.7	0.07	
EPS	>60	05	-	-		0.06	
EPS	>100	05	-	-		0.04	
POES							
MEPED	>0.24	-	-	-	-	110	
MEPED	>0.8	4	12/19	11/26	0.5	85	
MEPED	>2.5	4	12/19	5/11	0.5	70	
MEPED	>6.9	-	-	-	-	55	
MEPED	>16	4	12/20	0.6/0.3	0.3	1	
MEPED	>36	-	-	-	-	1	
MEPED	>70	-	-	-	-	1.1	
MEPED	>140	-	-	-	-	1.4	
Meteor-1							
SCR	>1	03	13/20	3.1/3	2	3.4	
SCR	>3	03	13/20	2.7/2.4	2	3	
SCR	>10	0.3	13/-	0.5/-	1	2.1	
GALS-M	>15	-	-	-	-	0.8	
GALS-M	>25	-	-	-	-	0.8	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	04	10/16	2.3/2	1	1.9	
SIS	>30	04	10/16	0.4/0.3	1	1.3	
SOHO							
EPHIN	>50	-	-	-	-	0.35	

Differential fluxes of protons for the event of 2011 February 15

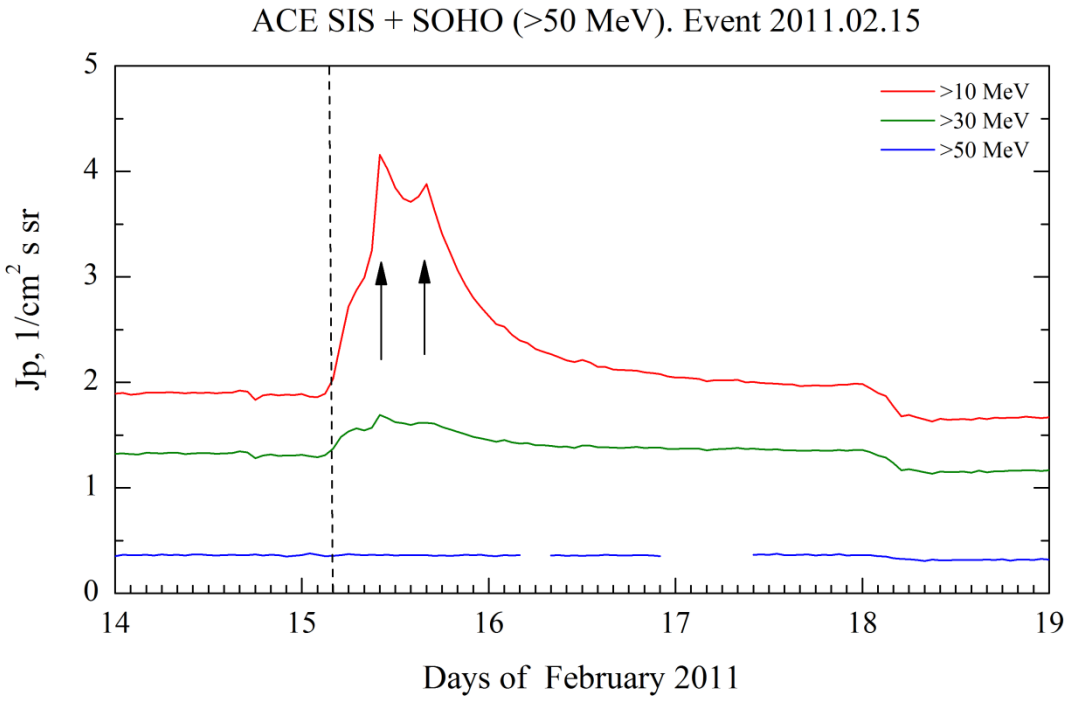
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	02	10/18	0.6/2.8	3.5	0.01	
LION	2 – 6	03	10/18	0.2/0.5	3.5	0.001	
EPHIN	4 – 8	02	10/18	0.9/1.4	3.5	0.0002	
EPHIN	8 – 25	02	10/18	0.1/0.1	3.5	0.0001	
EPHIN	25 – 53	03	10/18	0.005/0.003	3	0.00005	

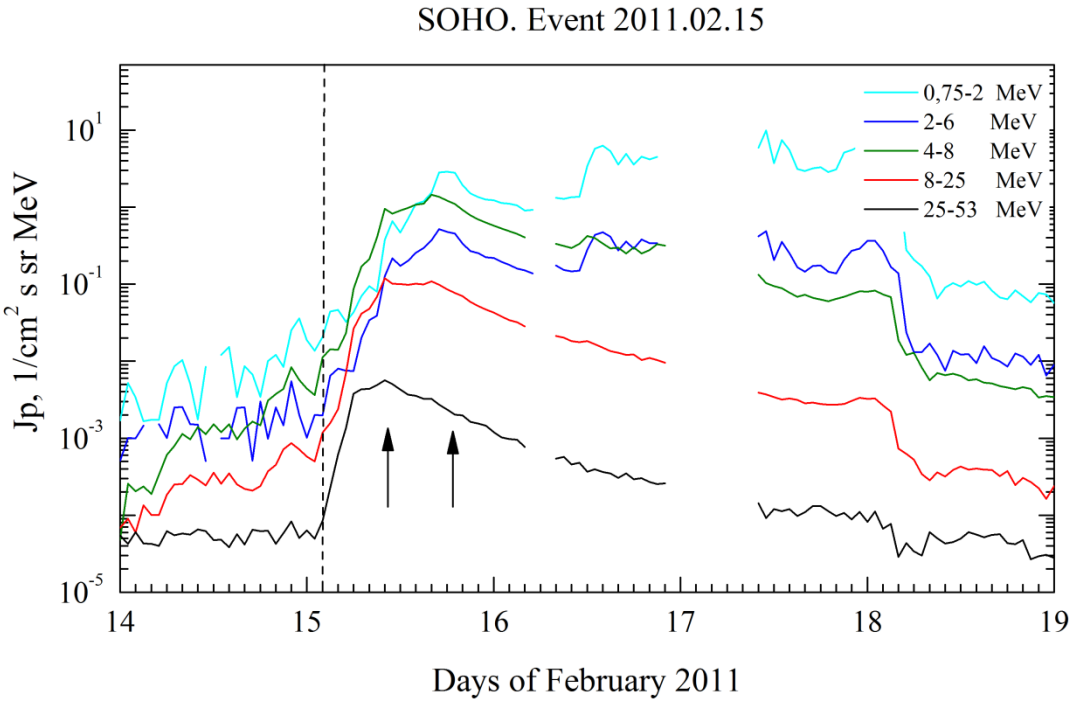

Integral spectrum of protons. Event 2011.02.15
Max 1
γ = 2.2
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm².s.sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2011.02.15
max 2
γ = 2.2
0.1 GCR
Eqm =80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp. 1/cm².s.sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

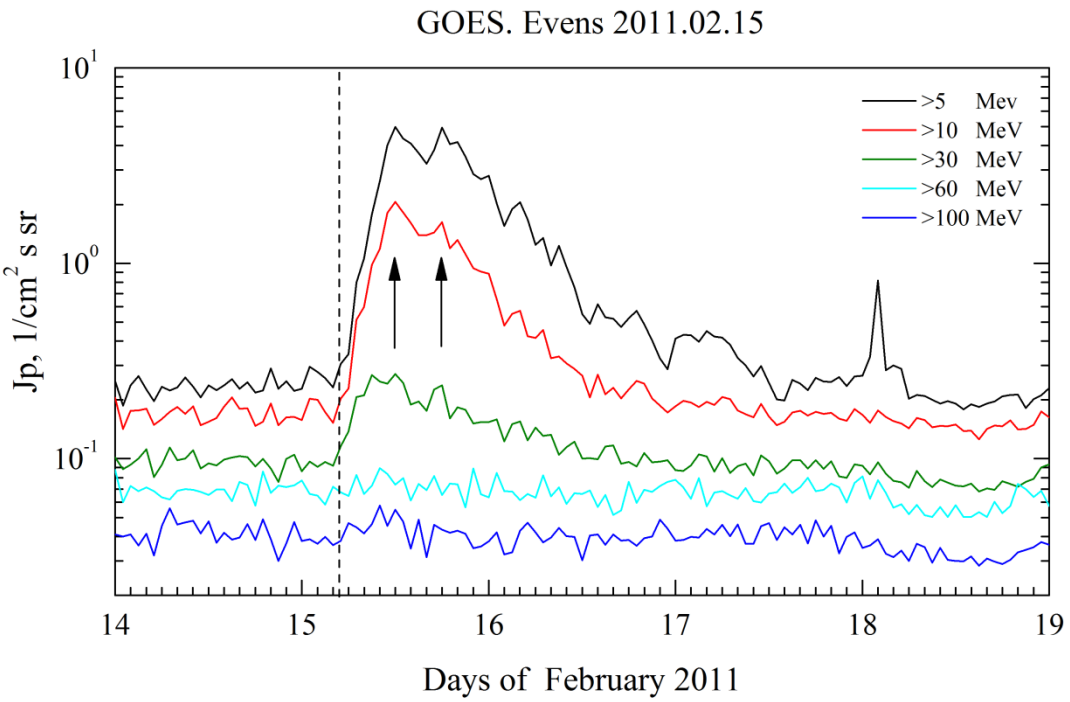
Time profiles of proton fluxes in the event 2011.02.15

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

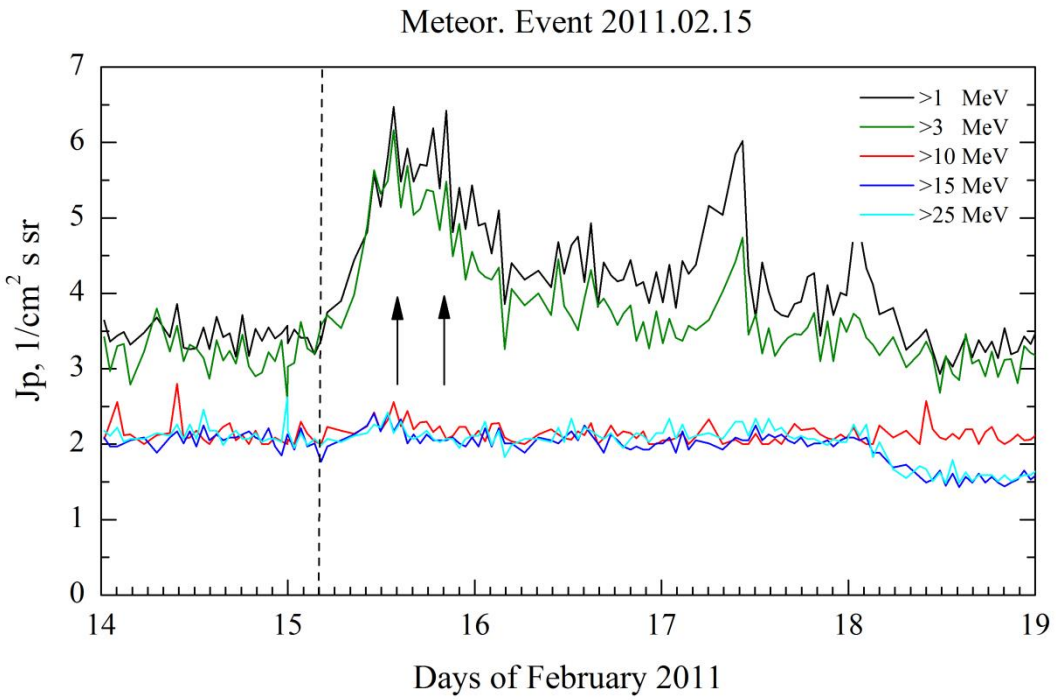


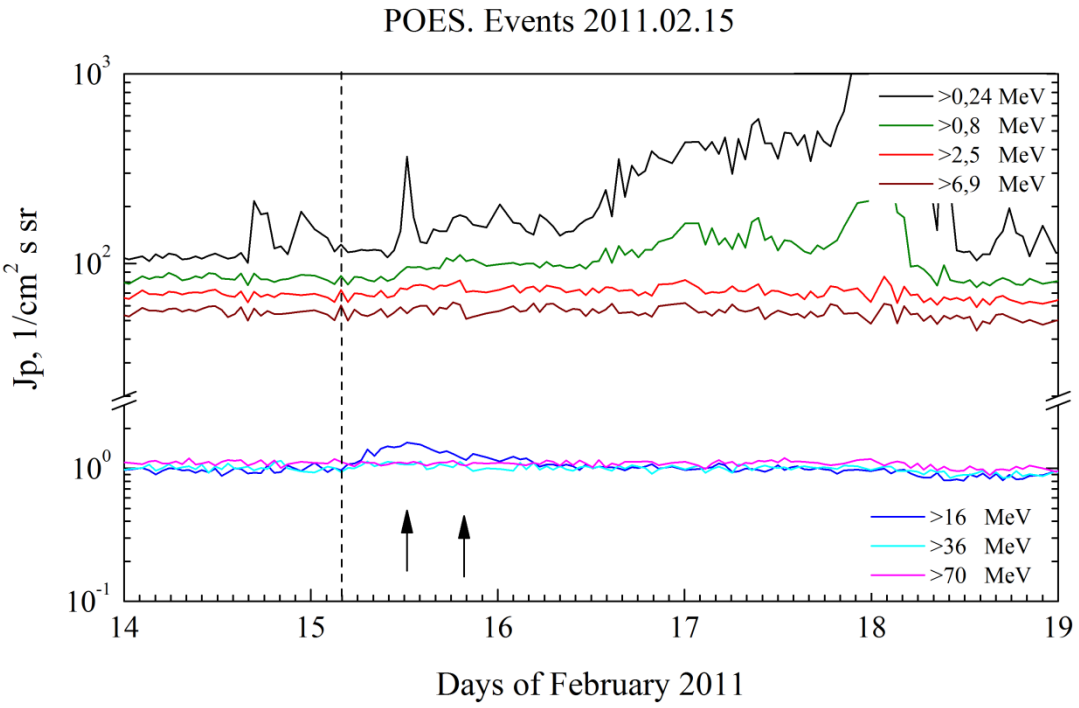


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



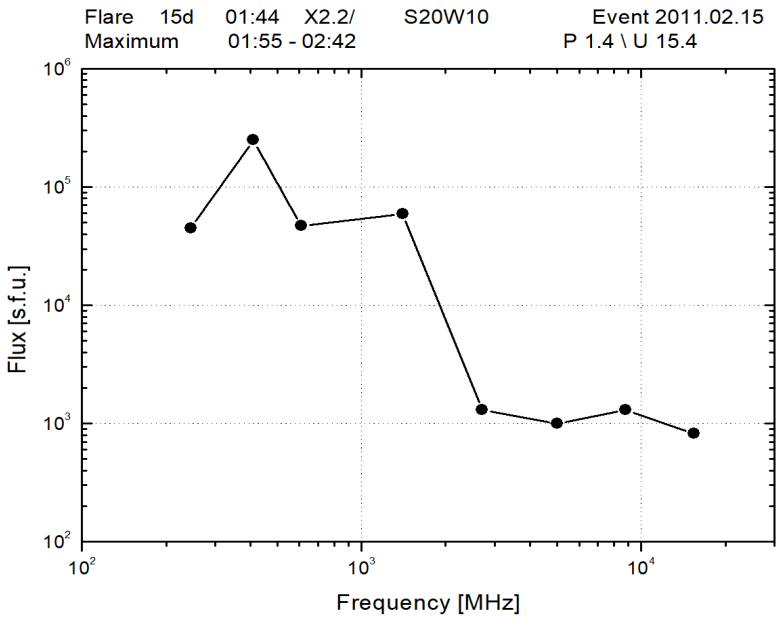


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 February 15

2011 February 15 ● AR 11158 To event 481

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL				S20W15	2B	FH
1 – 12	keV	0144	0156	>0206	S20W10	X2.2	0.16
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
50-100	keV	0143:44	0155:30	0227:32	26868	97891880	HESSI
12-25	keV	0145:26	0159:47	0221:50	877741	403589952	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0148	0155	0211	P1.4 \ U15.4	2.91	
8.8	GHz	0148	0155	0209		3.11	
5	GHz	0149	0155	0209		3.00	
2.7	GHz	0149	0159	0235		3.11	
1.4	GHz	0148	0234	0312		4.77	
610	MHz	0151	0242	0418		4.67	
410	MHz	0152	0224	0418		5.4	
245	MHz	0151	0222	0351		4.65	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	057-260	0152		0200		2	
DS IV	025-180	0155		0158		2	
DS III	057-130	0155		0200	G	3	
DH II	0.4-16	0210		0700			WIND
CME		**UT**	**V,** km/s	**a,** km/s2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0224	669	-18.3	360˚	189˚	SOHO

Radio burst frequency spectrum



Proton Active Region

AR11158 (S19L034, CMP 13.8.02.2011,
Sp=620, EKC, BGD; R1)
XRI=3.59; $X_1^{2.2}$+$M_6^{6.6}$; 1_4+S_{25}
PFR1 13.02 $M_1^{6.6}$
PFR2 14.02 $X_1^{2.2}$+$M_3^{2.2}$
PFR3 18.02 $M_2^{6.6}$

References:

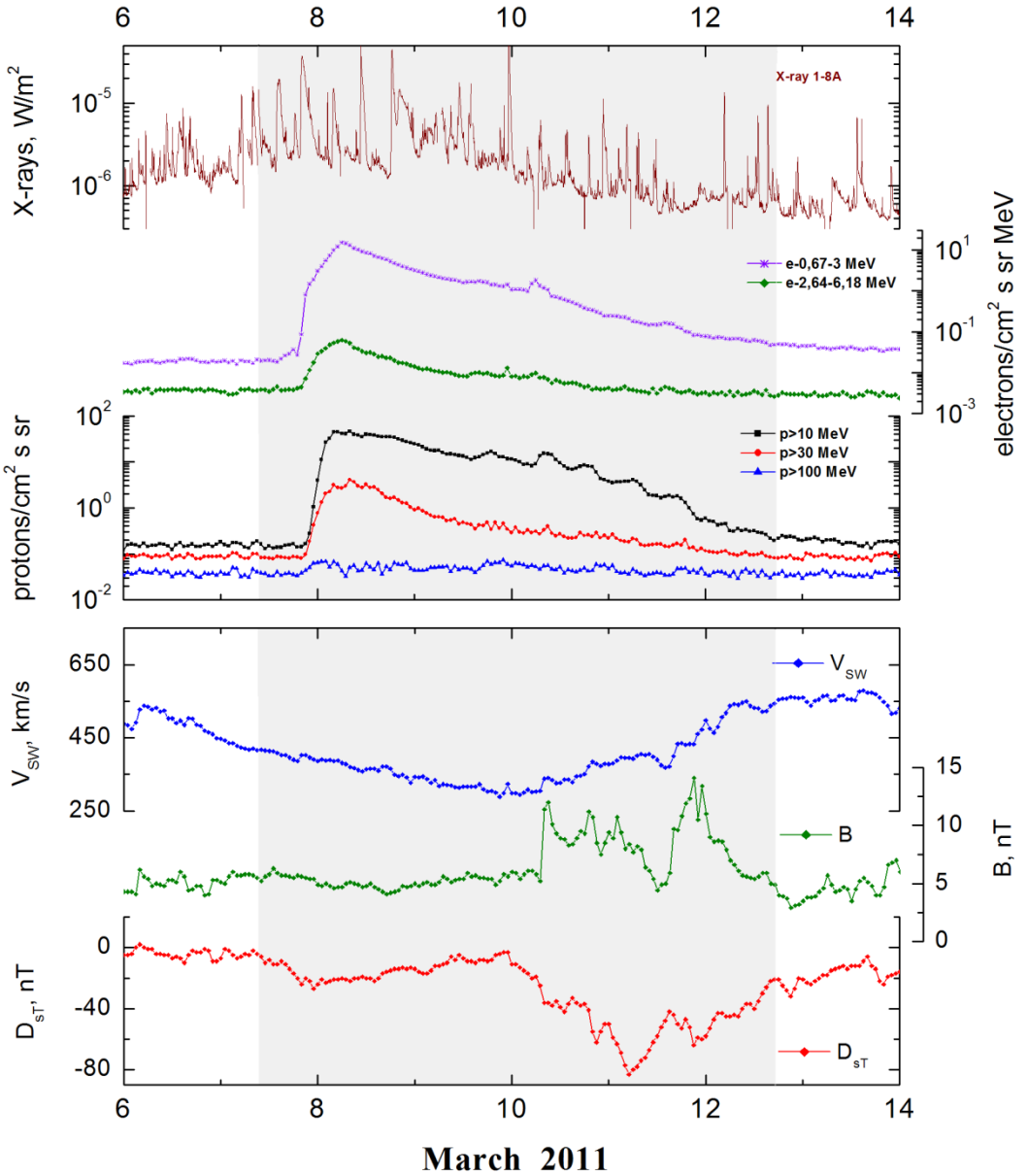
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L. M., and K. Ledbetter, 2015.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.

Event 2011.03.07 – (2011-066) **482**

Particle event: To(Ep>10 MeV) – 07d22^h
Tmax (Ep>10 MeV) – 08d05^h, Jmax (Ep>10 MeV) – 45 /cm^2·s·sr
Duration of the event – 5 days, power-law index: $\gamma = 3.1$
Quasimaximal energy of protons in the event – Eqm = 140 MeV

Sources: ● solar flare 07d19^{h}43^m, M3.7/, S22W67, AR11164
Main burst X-ray 1–8 Å: onset – 07d19^{h}43^m, max – 07d20^{h}12^m, $\Phi = 0.12$ J/m^2
CME: 07d20^{h}00^m, V= 2125 km/s, $\Delta\varphi = 360°$, dA= 313°
▲SC 10d 06^h 32^m

Particle fluxes and associated phenomena

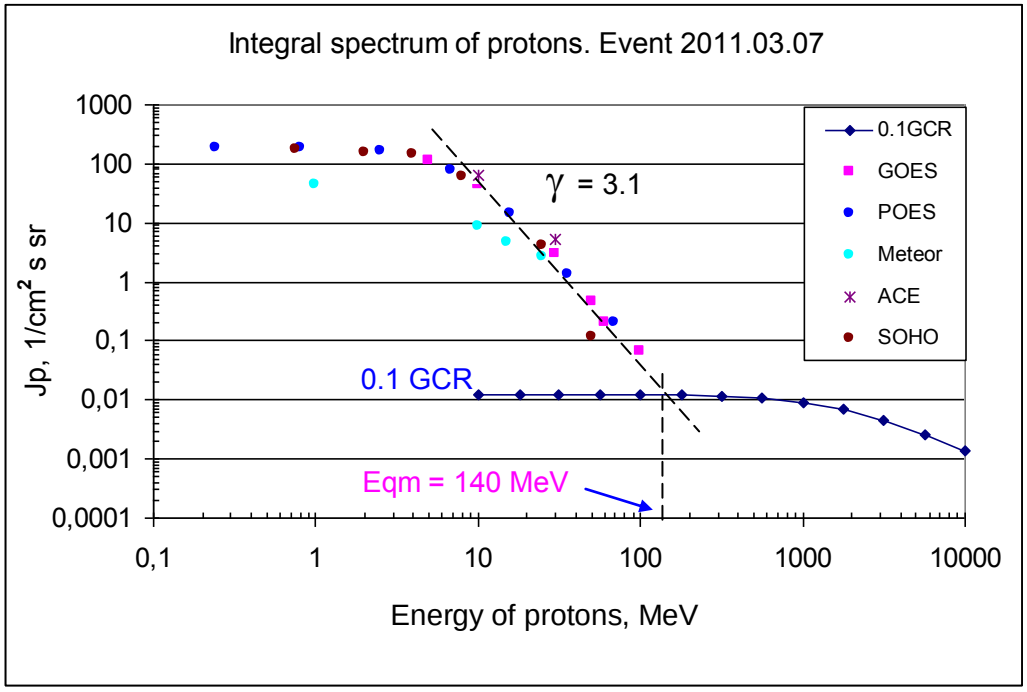


Integral fluxes of protons for the event of 2011 March 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	22	08d05	110	5	0.2	
EPS	>10	22	08d05	45	5	0.16	
EPS	>30	22	08d04	3	3	0.09	
EPS	>50	22	08d04	0.45	2	0.07	
EPS	>60	22	08d03	0.2	1	0.07	
EPS	>100	22	08d04	0.065	0.5	0.04	
EPS	>700						
POES							
MEPED	>0.24	23	08d03	190	5	110	
MEPED	>0.8	23	08d03	185	5	85	
MEPED	>2.5	23	08d03	165	5	65	
MEPED	>6.9	23	08d03	75	2	55	
MEPED	>16	22	08d03	14	3	1	
MEPED	>36	22	08d03	1.3	1	1	
MEPED	>70	22	08d03	0.2	0.5	1.1	
MEPED	>140	22	-	-	-	1.4	
Meteor-1							
SCR	>1	21	08d08	44	5	3.4	
SCR	>3	21	-	-	5	3.2	
SCR	>10	21	08d08	8.7	3	2.1	
GALS-M	>15	21	08d08	4.6	3	1.6	
GALS-M	>25	21	08d08	2.6	2	1.6	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	22	08d04	58.4	4	1.8	
SIS	>30	22	08d04	5.3	3	1.2	
SOHO							
EPHIN	>50	22	8d01	0.12	0.7	0.35	

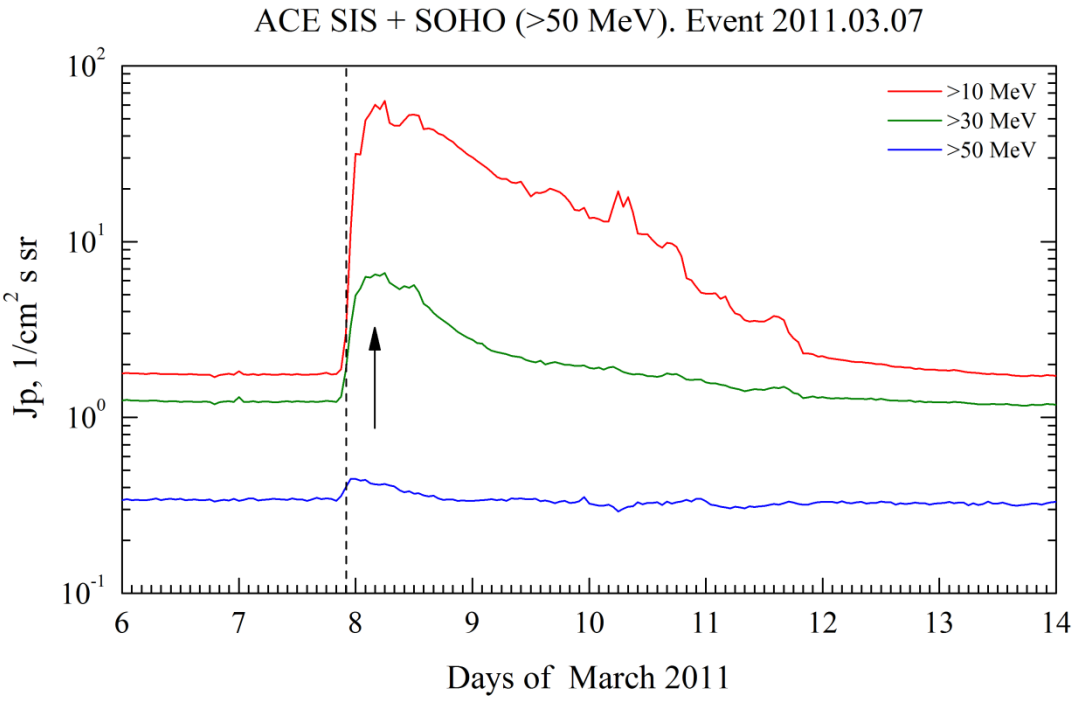
Differential fluxes of protons for the event of 2011 March 07

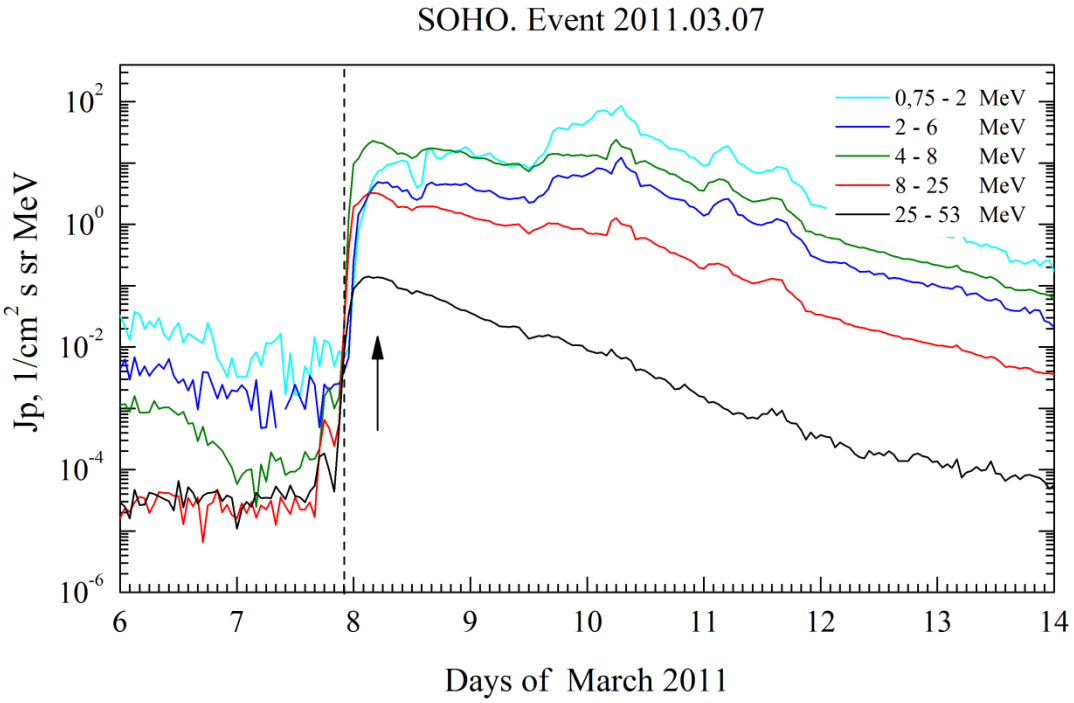
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75– 2	22	8d10	11.1	9	0.01	
LION	2 – 6	22	8d07	4.9	7	0.003	
EPHIN	4 – 8	22	8d05	20.7	7	0.0001	
EPHIN	8 – 25	22	8d05	3.25	6	0.00003	
EPHIN	25 – 53	22	8d05	0.14	5	0.00003	


Integral spectrum of protons. Event 2011.03.07
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
γ = 3.1
0.1 GCR
Eqm = 140 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
0,1
1
10
100
1000
10000
Energy of protons, MeV

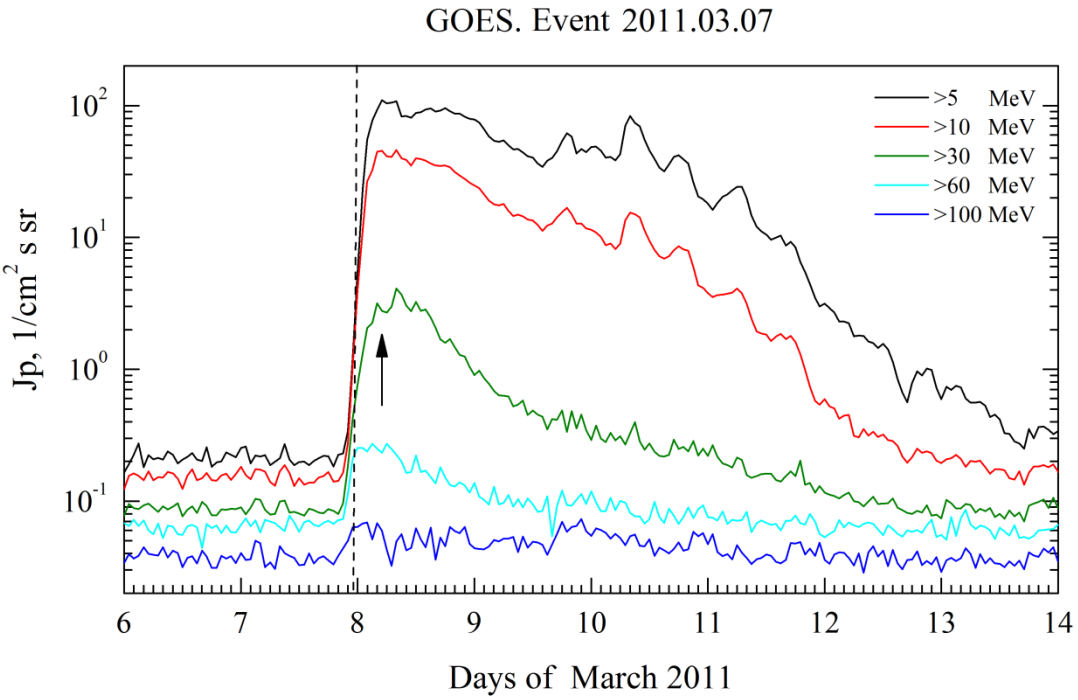
Time profiles of proton fluxes in the event 2011.03.07

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

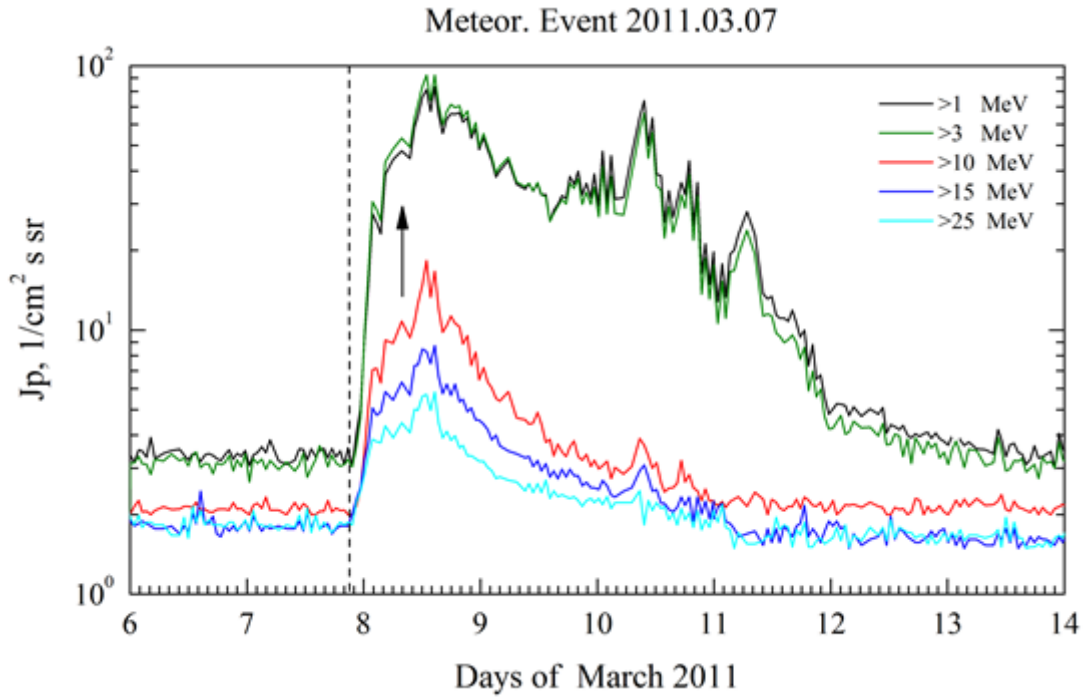


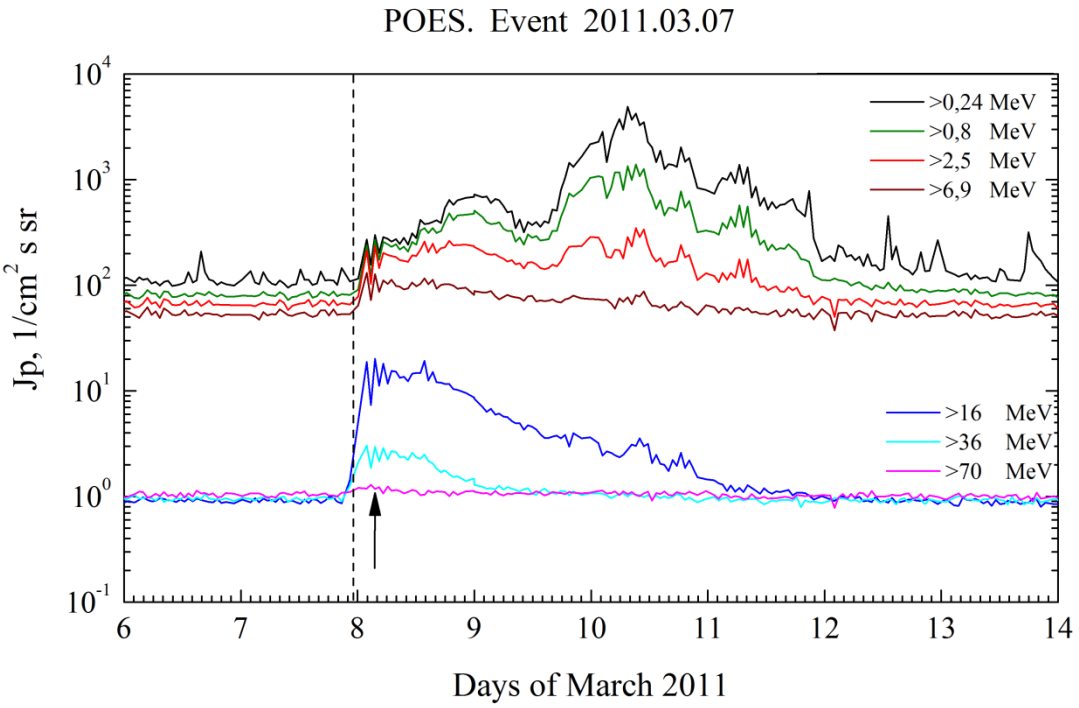


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





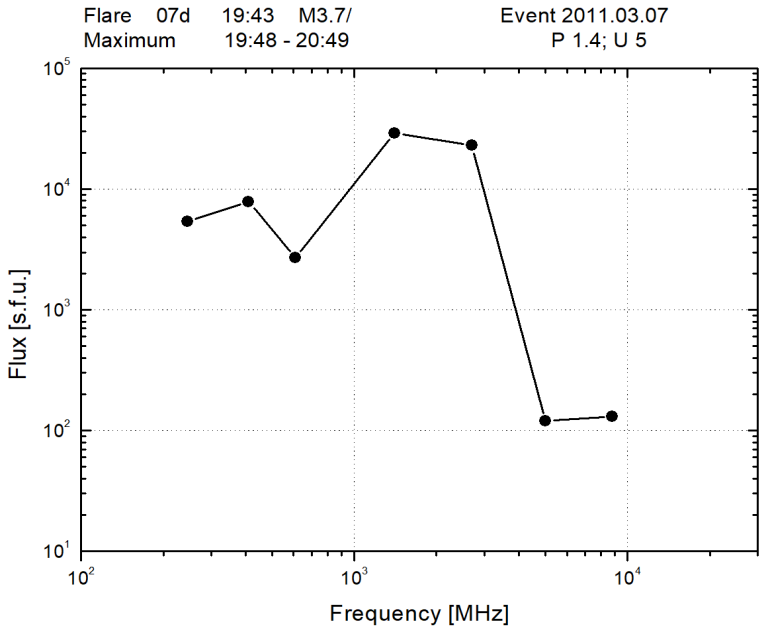
Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 March 07

2011 March 07 • AR 11164 To event 482

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å		No data about optical flare					
1 – 12	keV	1943	2012	2058		M3.7	0.12
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
100-300	keV	1939:24	2004:54	2007:48	1328	5286911	HESSI
12-25	keV	2023:28	2023:30	2032:40	720	1461296	HESSI
>100	MeV	2010:30		20:40:30		2.23E-05*	FERMI
12-25	keV	2002:19	2002:30	21:02:07	116627	78543160	FERMI
12-25	keV	2054:04	2054:12	2102:07	6990	481566	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
8.8	GHz	1947.0	1948.0	1948.0		2.11	
5	GHz	1948.0	1948.0	1948.0		2.08	
2.7	GHz	1953.0	2035.0	2118.0		4.36	
1.4	GHz	1953.0	2016.0	2118.0	P1.4 \ U5	4.46	
610	MHz	1956.0	2038.0	2109.0		4.43	
410	MHz	1950.0	2039.0	2111.0		3.89	
245	MHz	1951.0	2049.0	2112.0		3.73	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	1954		2015	1133	3	
DH II	0.2-16	2000		8/0830			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2000	2125	-63.1	360º	313º	SOHO

*cm^{-2} s^{-1}

Radio burst frequency spectrum



Proton Active Region:

AR11164 (N25L164, CMP02,06.03.2011,
Sp=770 mhs, EKC, BGD, R)
XRI=0.92 $M_5^{3.7}$+C_{38} 1_3+S_{24}
PFR 07.03 (15^h) $M_4^{3.7}$

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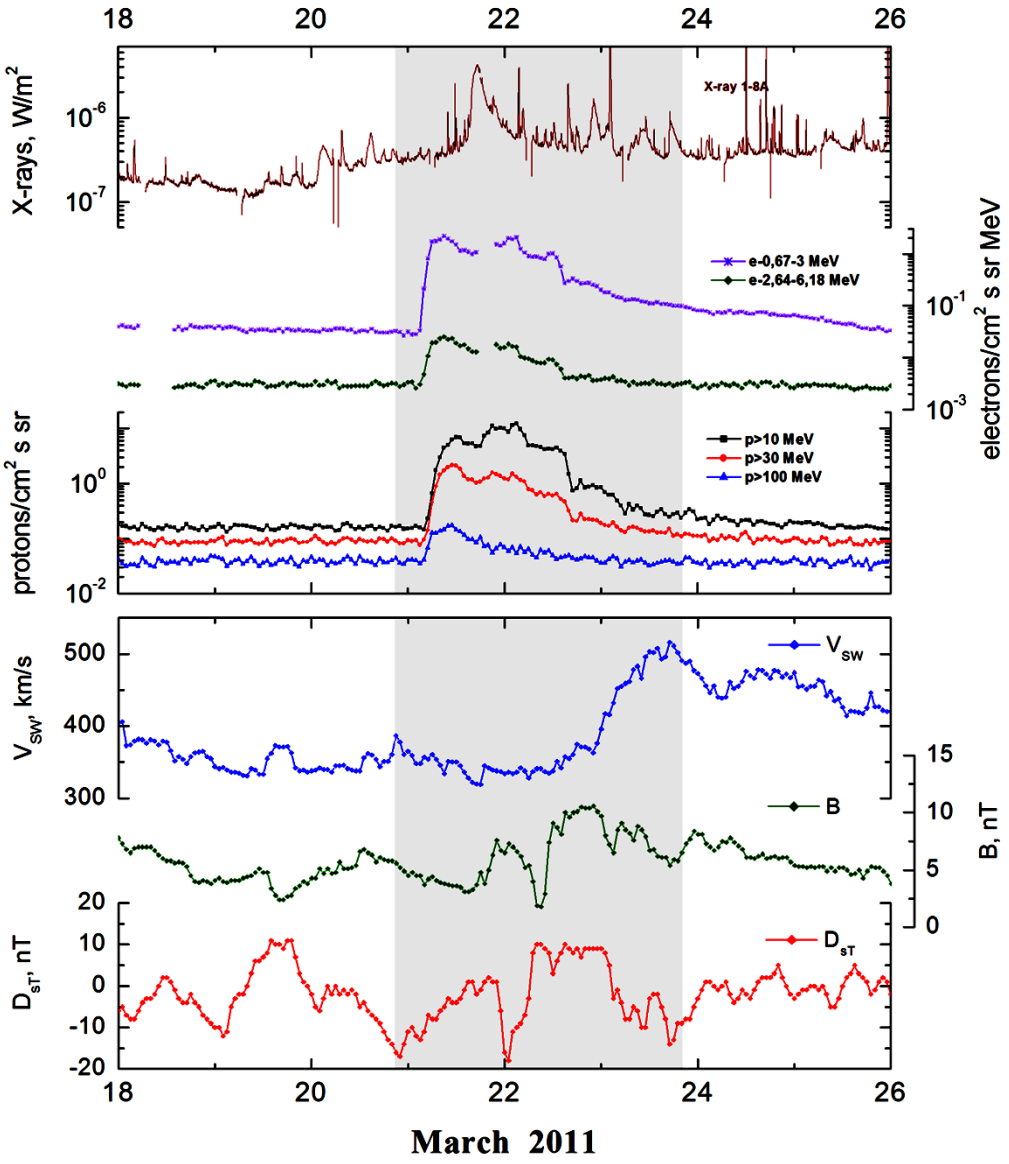
Particle event: To(Ep>10 MeV) – 21d04^h
Tmax$_1$(Ep>10 MeV) – 21d11^h, Jmax$_1$ (Ep>10 MeV) – 6.8 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 21d20^h, Jmax$_2$ (Ep>10 MeV) – 11.1 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ_1 = 2.4, γ_2 = 2.8
Quasimaximal energy of protons in the event – Eqm$_1$ = 250 MeV
– Eqm$_2$ = 140 MeV

Sources: ⊡ back side solar flare event 21d<02^{h}24^m, AR unknown, behind W$_L$
Ø solar flare event 21d 15^{h}31^m, C4.2/, S20E87, AR 11176
CME 21d02^{h}24^m, V= 1341 km/s, Δφ = 360º, dA= 274º

Particle fluxes and associated phenomena

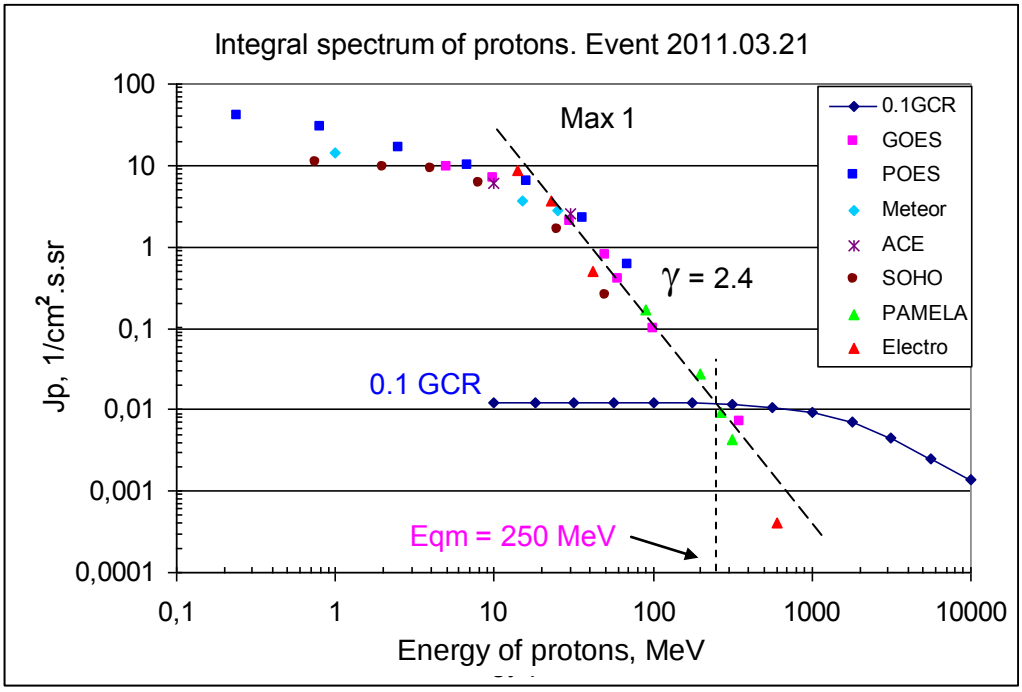


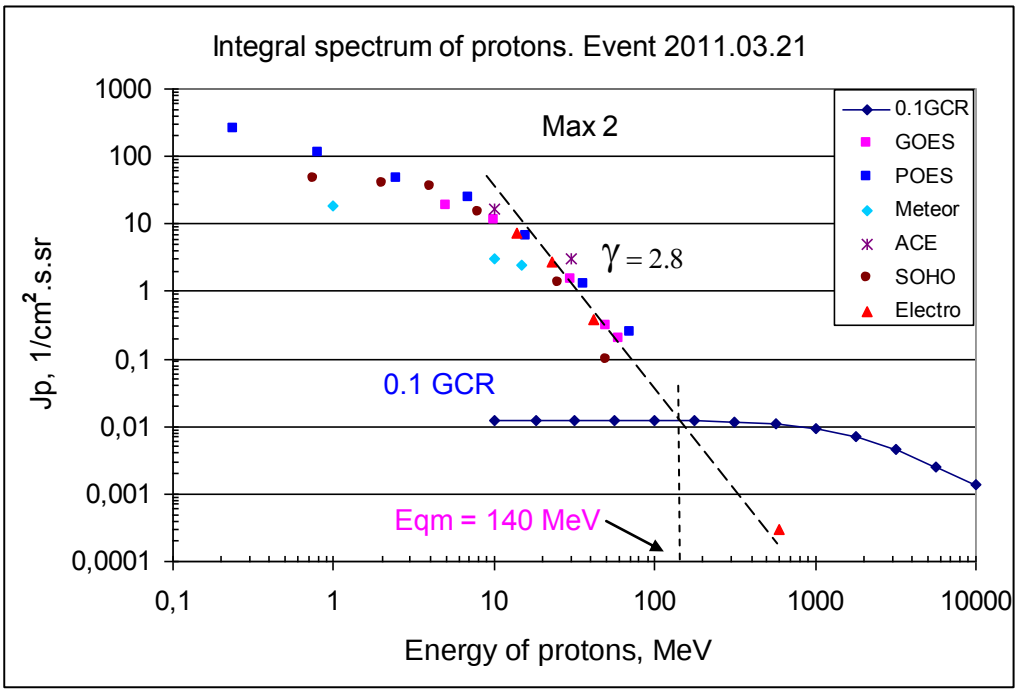
Integral fluxes of protons for the event of 2011 March 21

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	04	12/20	9.3/18.7	3	0.2	
EPS	>10	04	11/20	6.8/11.1	3	0.16	
EPS	>30	04	10/20	2/1.5	2.5	0.09	
EPS	>50	04	10/20	0.8/0.3	2	0.07	
EPS	>60	04	10/20	0.4/0.2	1.5	0.06	
EPS	>100	04	10/ -	0.1/ -	1	0.04	
Electro-1							
GALS-E	>600	4	10/19	0.0004/0.0003	1	0.001	
POES5							
MEPED	>0.24	5	12/20	40/250	1.5	110	
MEPED	>0.8	4	12/20	30/110	1.5	85	
MEPED	>2.5	3	10/20	16/46	1.5	65	
MEPED	>6.9	3	11/20	10/25	1.5	55	
MEPED	>16	3	10/20	6.2/6.7	1.5	1	
MEPED	>36	3	10/20	2.2/1.3	1.2	0.9	
MEPED	>70	4	10/20	0.6/0.25	1	1.1	
MEPED	>140	4	-	-	-	1.4	
Meteor-1							
SCR	>1	5	11/22d00	14/19	2	3.4	
SCR	>3	5	-	-	2	3.1	
SCR	>10	5	- /22	- /3.1	2	2.1	
GALS-M	>15	3	11/22	3.7/2.4	1.5	0.8	
ACE							
SIS	>10	04	10/21	6.1/16.5	2	1.8	
SIS	>30	04	09/21	2.5/3	1.5	1.2	
SOHO							
EPHIN	>50	03	07/22d00	0.25/0.1	1.5	0.35	
PAMELA							
TRACKER	>90	03	04÷10/ -	0.17/ -	2	-	
TRACKER	>200	03	04÷10/ -	0.027/ -	2	-	
TRACKER	>265	03	04÷10/ -	0.0094/ -	2	-	
TRACKER	>312	03	04÷10/ -	0.0043/ -	2	-	

Differential fluxes of protons for the event of 2011 March 21

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	04	11/22d00	1.2/5.6	3	0.02	
LION	2 – 6	04	11/22d01	0.18/1.25	3	0.005	
EPHIN	4 – 8	04	11/22d00	0.75/5.2	3	0.009	
EPHIN	8 – 25	03	11/22d00	0.25/0.8	2	0.0004	
EPHIN	25 – 53	03	11/22d00	0.05/0.045	1	0.00005	
Electro-1							
SCR-E	13.7 – 23	4	10/20'	0.54/0.51	1.5	0.06	
SCR-E	23 – 42	4	10/20'	0.17/0.12	1.5	0.03	
SCR-E	42 – 112	4	10/19'	0.007/0.0055	1.5	0.005	
GOES							
EPS	350–420	-	06/ -	0.0001/ -	0.3	0.0021	
EPS	420–510	-	-	-	-	0.0012	

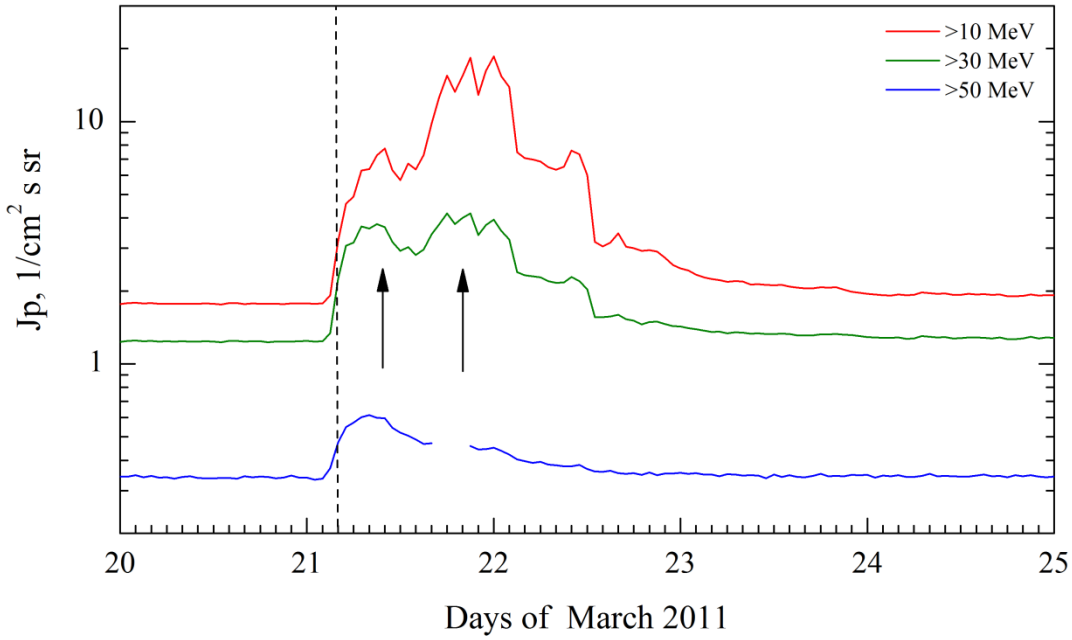

Integral spectrum of protons. Event 2011.03.21
Max 1
γ = 2.4
0.1 GCR
Eqm = 250 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
PAMELA
Electro
Jp, 1/cm².s.sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2011.03.21
Max 2
γ = 2.8
0.1 GCR
Eqm = 140 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm².s.sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

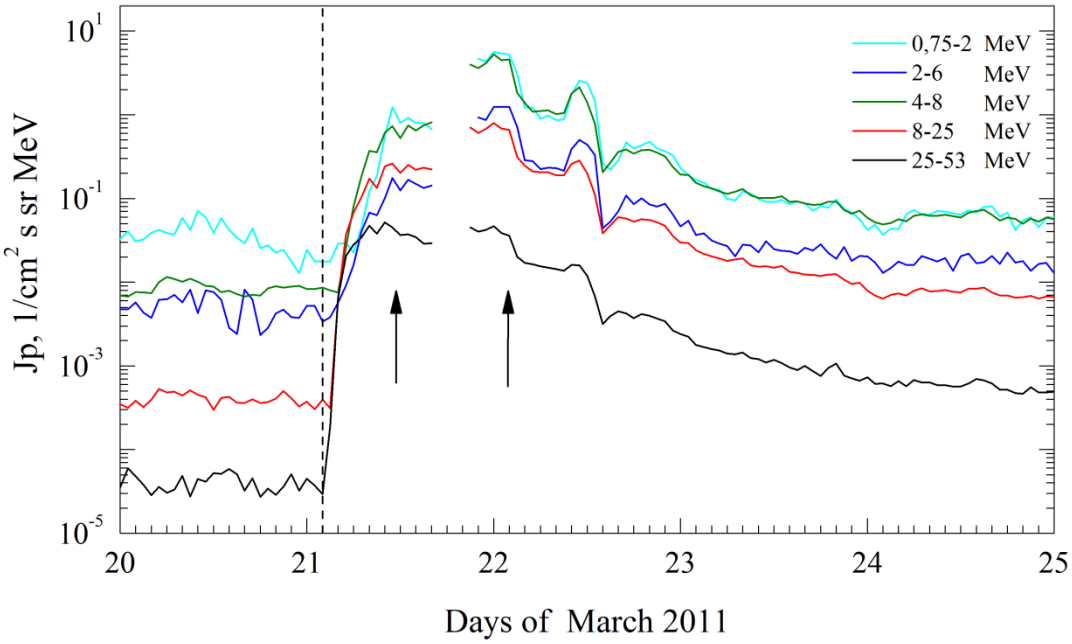
Time profiles of proton fluxes in the event 2011.03.21

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

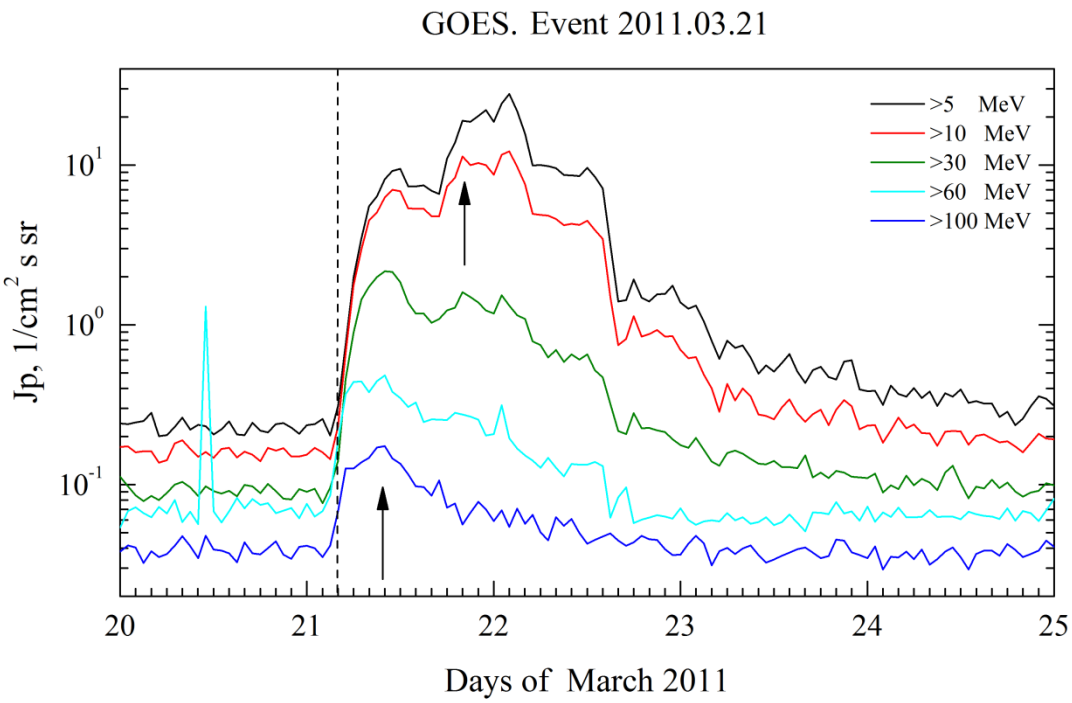
ACE SIS +SOHO (>50 MeV). Event 2011.03.21

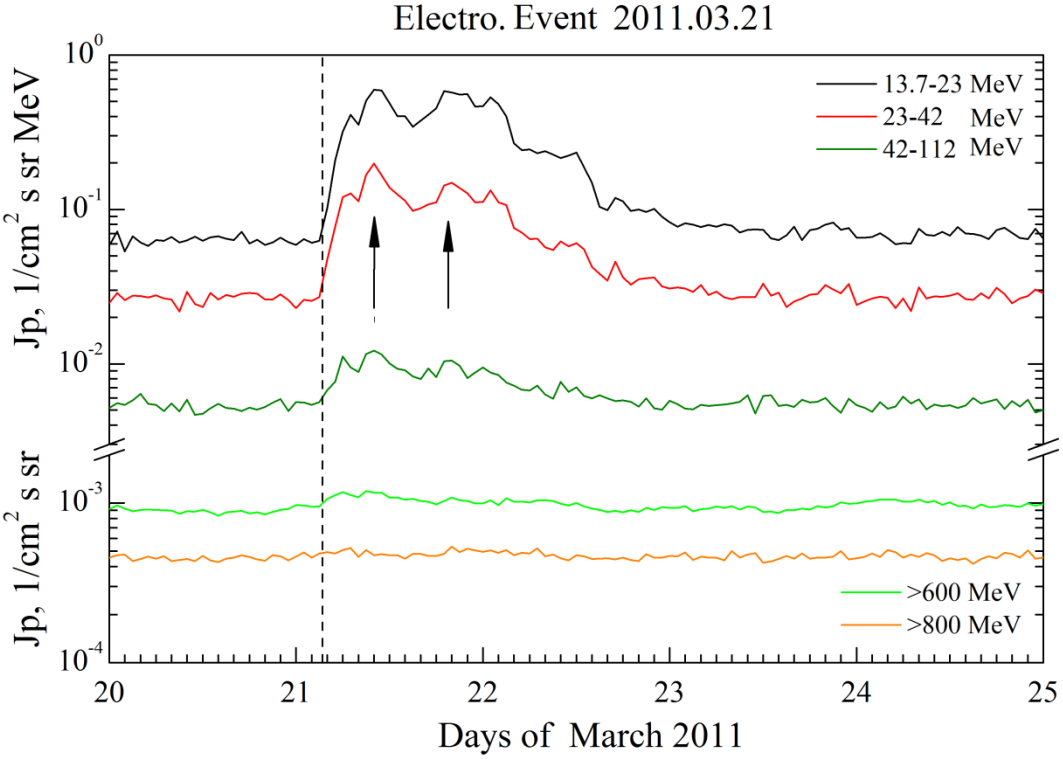


SOHO. Event 2011.03.21



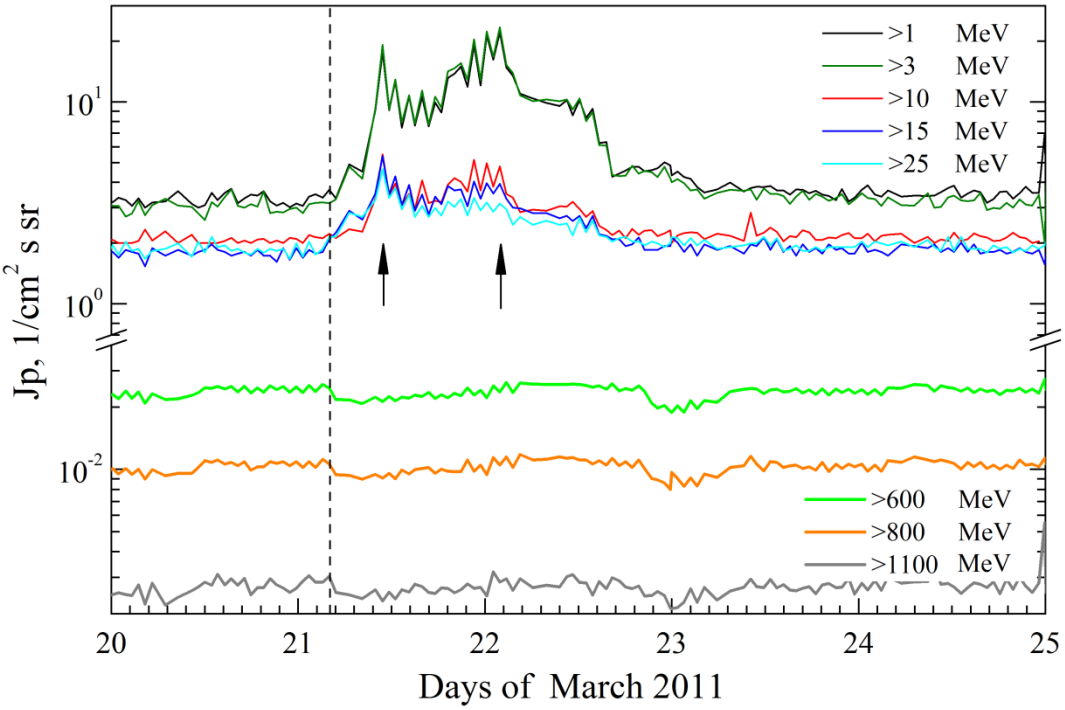
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



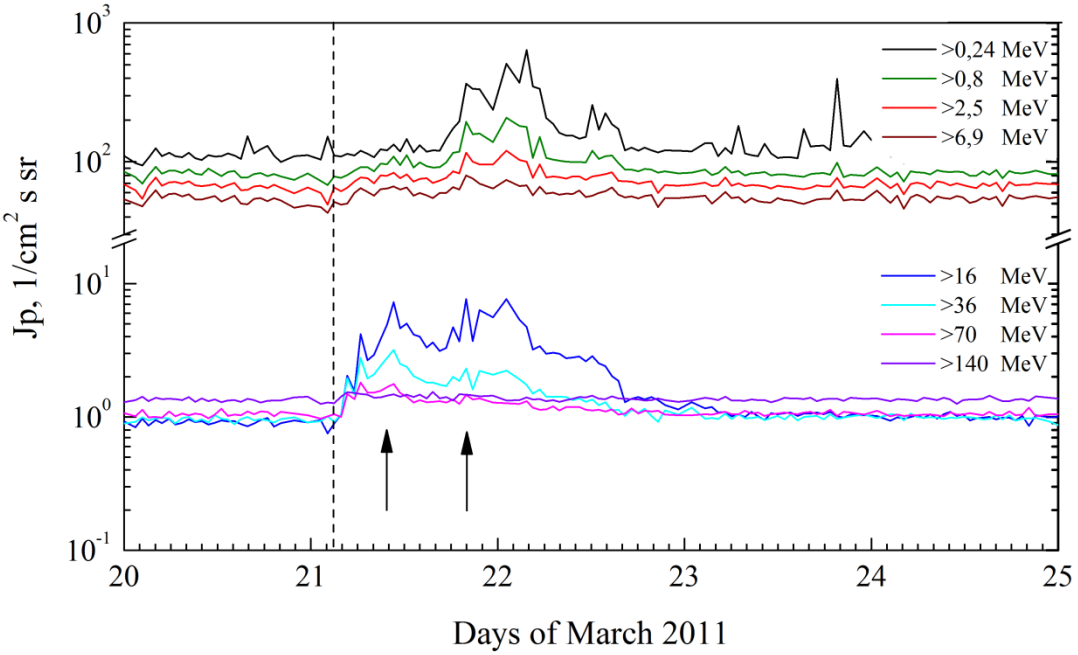


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2011.03.21



POES. Event 2011.03.21



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 March 21

2011 March 21 ⊡ AR XXXXX To event 483

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	No optical event on visible solar disc					
1 – 12	keV	No X-ray event at this time					
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0224	1341	8.0	360º	274º	SOHO

2011 March 21 Ø AR 11176 To event 483

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	No optical event on visible solar disc					
1 – 12	keV	1531	1719	1830	S20E87	C4.2	0.033
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1533:24	1550:34	1551:20	1648	6075408	HESSI
12-25	keV	1551:20	1607:10	1622:52	2833	24630992	HESSI
12-25	keV	1622:52	1623:42	1629:40	2197	4695201	HESSI
12-25	keV	1629:40	1631:42	1633:32	2091	2347680	HESSI
12-25	keV	1709:08	1709:46	1728:52	93	454339	HESSI
12-25	keV	1745:24	1749:30	1804:56	33	96919	HESSI
12-25	keV	1539:58	1550:57	1625:26	2479	914221	FERMI
12-25	keV	1701:57	1708:22	1711:47	996	51110	FERMI
12-25	keV	1713:42	1730:58	1744:49	1812	245338	FERMI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS VI	25-147	1502		1552		2	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1536	963	67.7	019º	092º	SOHO
LASCO	WL	1612	608	31.3	084º	108º	SOHO

Proton Active Region:

AR 11176 (S16L200, CMP 28,02.03 2011,
Sp=440 msh, EKI, BG, R)
XRI=0.34 $M_3^{1.4}$+C_{16} 1_2+S_{15}
PFR 23-25.03 (69^h) $M_3^{1.4}$

References:

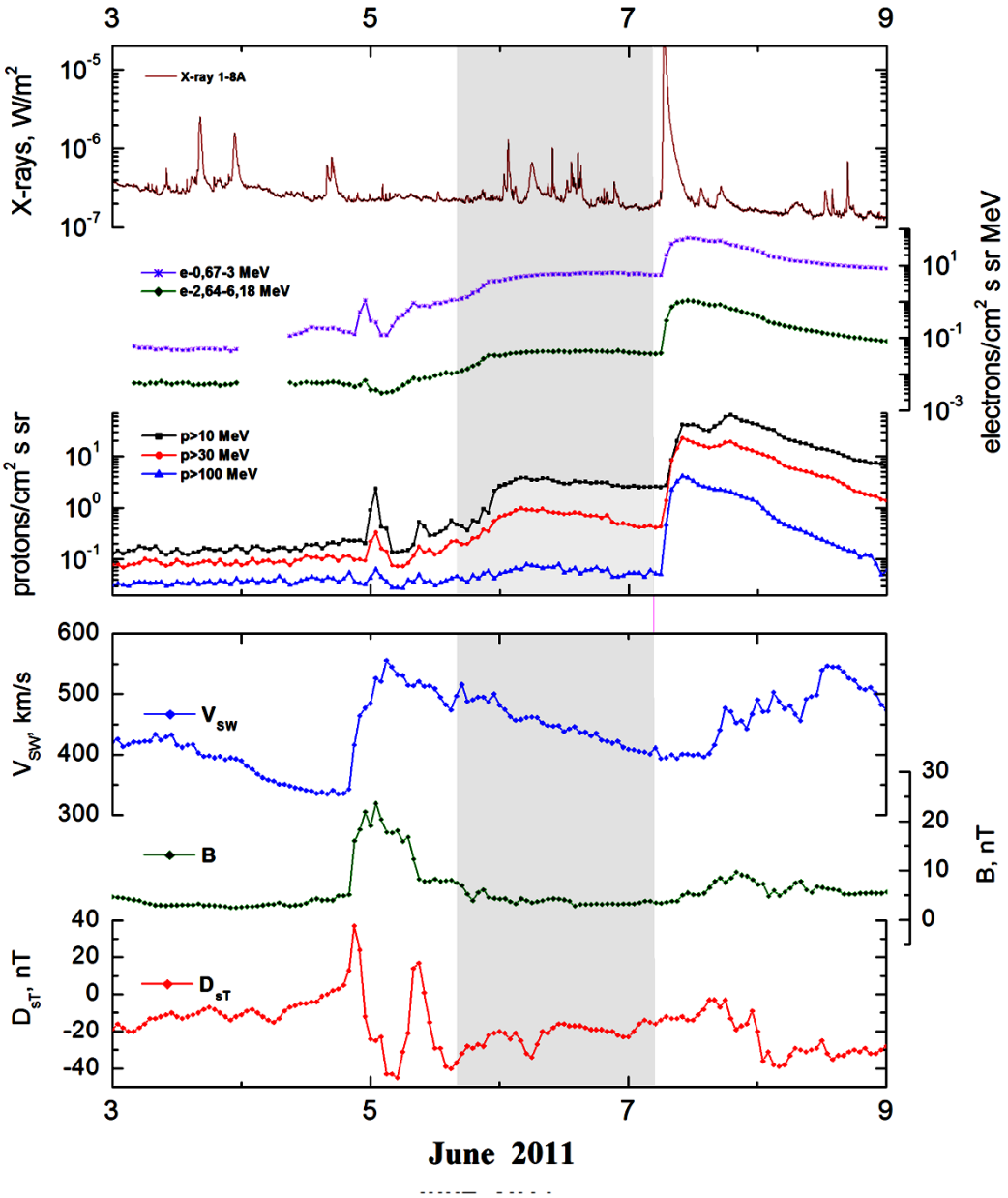
Базилевская Г.А., Майоров А.Г., Малахов В.В. и др., 2013.
Alberti T., M. Laurenza, E.W. Cliveret et al., 2017.
Bazilevskaya G.A., A.G. Mayorov, V.V. Malakhov, V.V. Mikhailov, 2013.
Bruno A., I.G. Richardson, 2021.
Cliver E.W., 2016.
Gopalswamy N., H. Xie, S. Akiyama et al., 2014.
Gopalswamy N., S. Yashiro, N. Thakur et al., 2016.
Lario D., L. Berger, L.B. Wilson III et al., 2018.
NOAA SPE, 2019.
Núñez M., T. Nieves-Chinchilla, and A. Pulkkinen, 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Rouillard A.P., N.R. Sheeley, Jr., A. Tylka et al., 2012.
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2011.06.05 – (2011-156) **484**

Particle event: To(Ep>10 MeV) – 05d18^h
Tmax (Ep>10 MeV) – 06d04^h, Jmax (Ep>10 MeV) – 3.6 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma = 3.25$
Quasimaximal energy of protons in the event – Eqm = 160 MeV

Sources: ⊡ back side solar flare event 04d<22^{h}05^m, AR 11222, 3d behind W_L
⊡ CME 04d22^{h}05^m, V = 2425 km/s, $\Delta\varphi = 360^o$, dA = 300º

Particle fluxes and associated phenomena

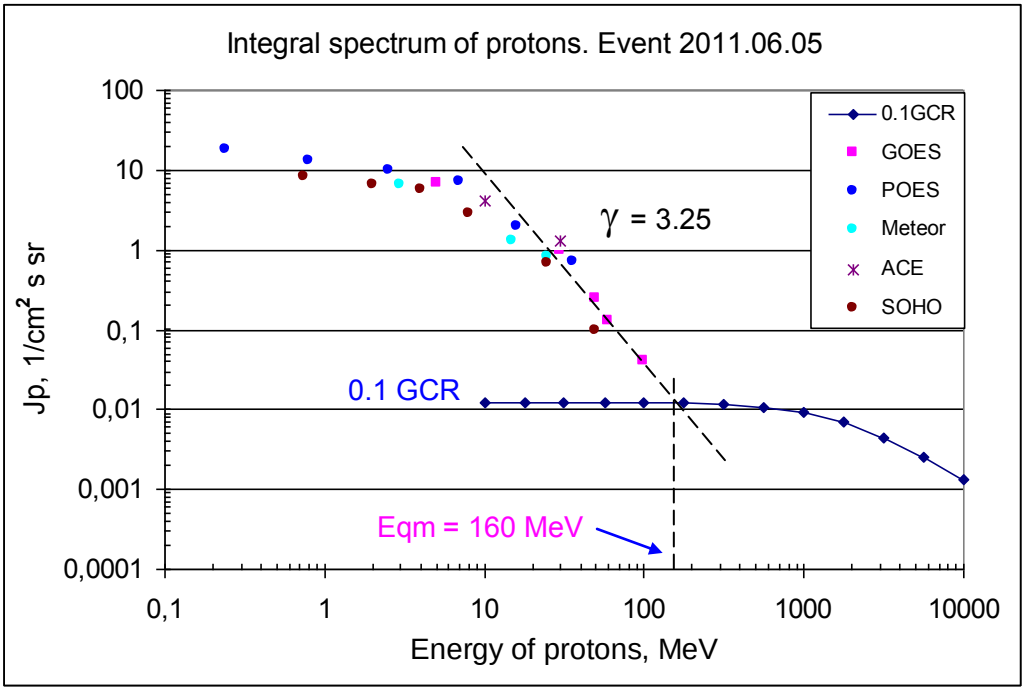


Integral fluxes of protons for the event of 2011 June 05

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	06d04	7	1.5	0.2	
EPS	>10	18	06d04	3.6	1.5	0.17	
EPS	>30	18	06d04	0.97	1.5	0.1	
EPS	>50	18	06d05	0.25	1.5	0.07	
EPS	>60	18	06d02	0.13	1	0.07	
EPS	>100	18	06d05	0.04	1	0.04	
EPS	>700	-	-	-	-	-	
POES							
MEPED	>0.24	18	6d05	18	1.5	190	
MEPED	>0.8	18	6d06	13	1.5	95	
MEPED	>2.5	18	6d06	10	1.5	65	
MEPED	>6.9	18	6d06	7.3	1.5	50	
MEPED	>16	18	6d05	2	1.5	1	
MEPED	>36	18	6d05	0.7	1.5	1	
MEPED	>70	18	-	-	-	1.1	
MEPED	>140	18	-	-	-	1.4	
Meteor-1							
SCR	>1	20	-	-	1.5	3.2	
SCR	>3	20	6d03	6.5	1.5	3	
SCR	>10	20	-	-	1.5	2.1	
GALS-M	>15	20	6d03	1.27	1.5	0.75	
GALS-M	>25	20	6d03	0.8	1.5	0.8	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	17	06d02	4.1	2	2.3	
SIS	>30	17	06d02	1.3	1.5	1.4	
SOHO							
EPHIN	>50	5	06d00	0.1	2.3	0.3	

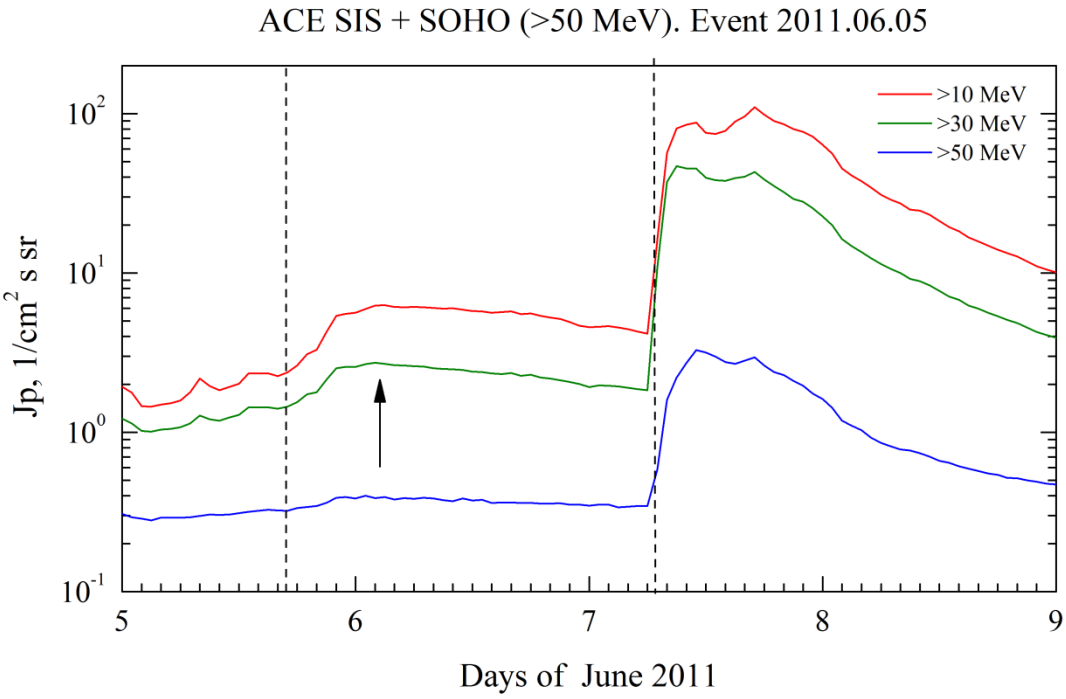
Differential fluxes of protons for the event of 2011 June 05

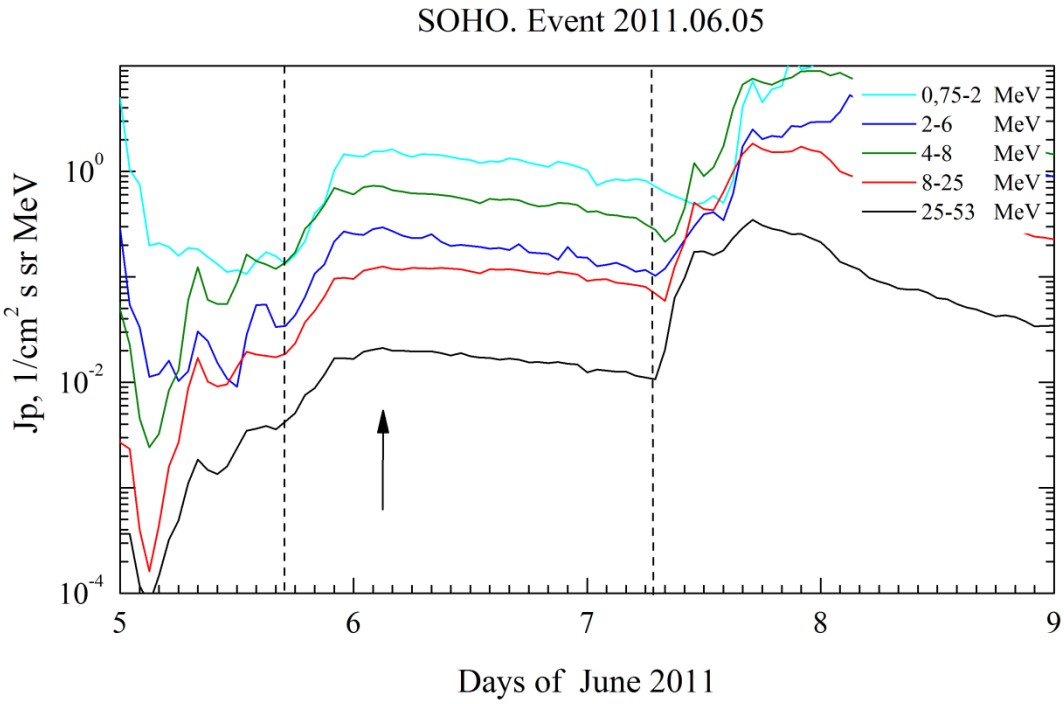
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	14	6d04	1.5	2	0.1	
LION	2 – 6	13	6d03	0.28	2	0.01	
EPHIN	4 – 8	4.5	6d02	0.71	2	0.02	
EPHIN	8 – 25	4.5	6d03	0.125	2	0.0002	
EPHIN	25 – 53	4.5	6d03	0.021	2	0.00008	
Electro-1							
GALS-E	13.7 –23	-	-	-	-	0.061	
GALS-E	23 – 42	-	-	-	-	0.025	
GALS-E	42 – 112	-	-	-	-	0.005	


Integral spectrum of protons. Event 2011.06.05
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 3.25
0.1 GCR
Eqm = 160 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO

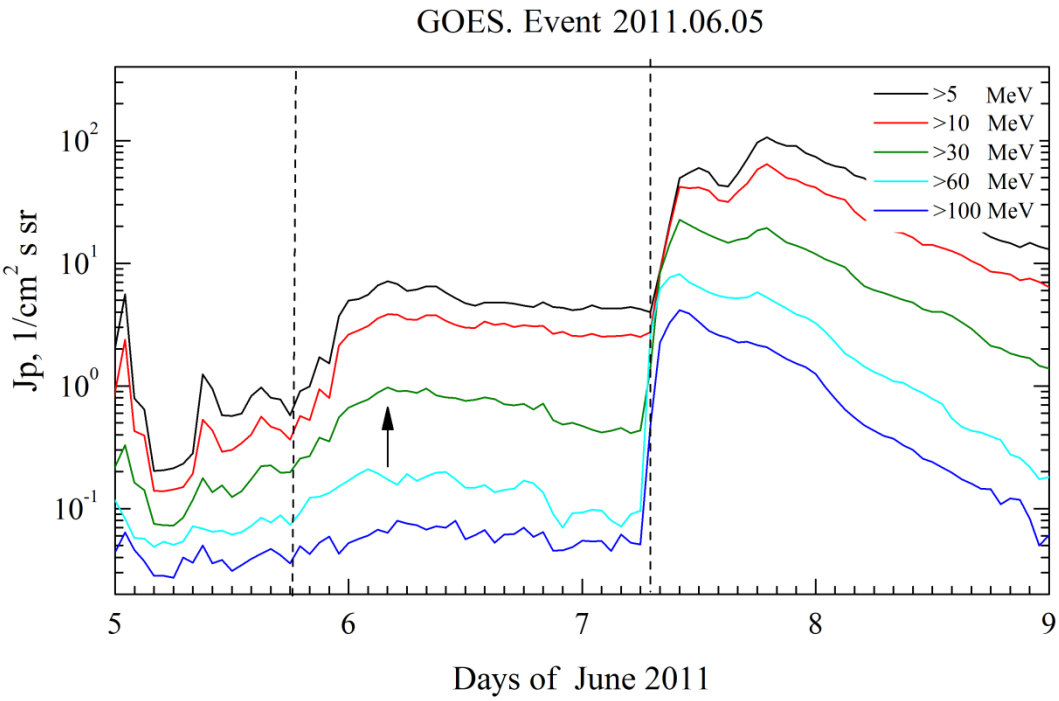
Time profiles of proton fluxes in the event 2011.06.05

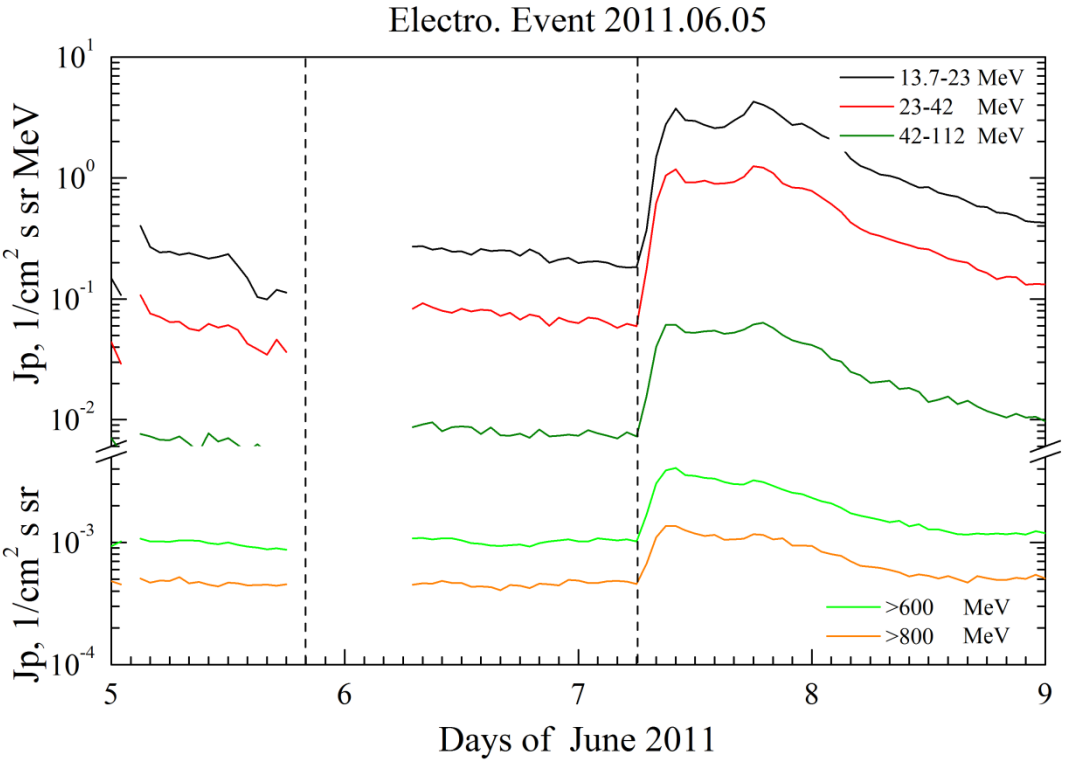
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO





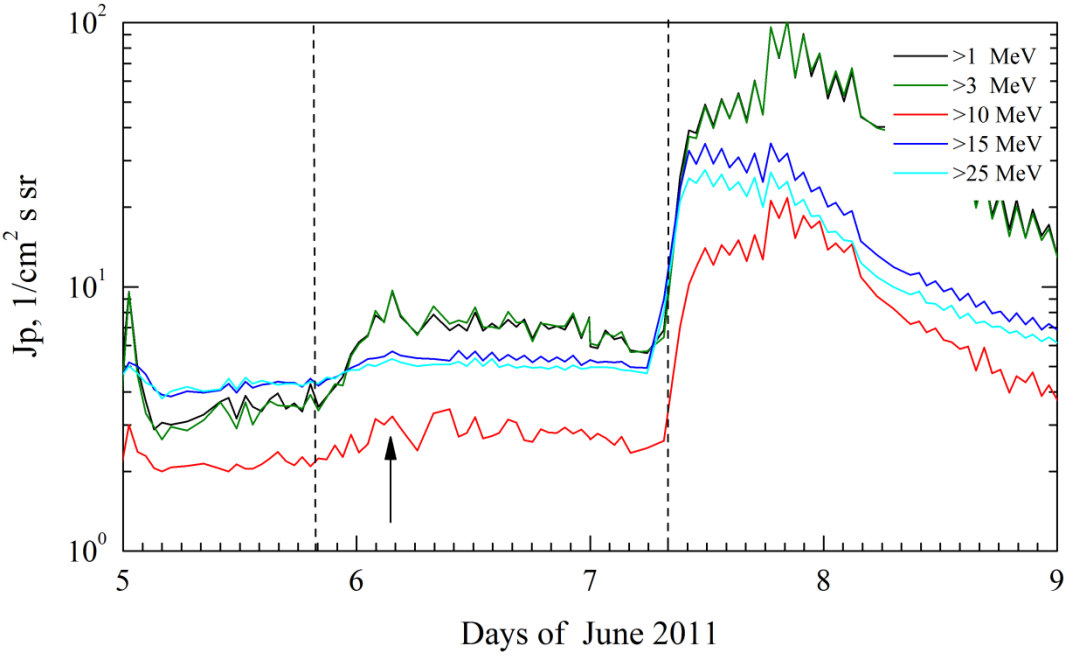
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



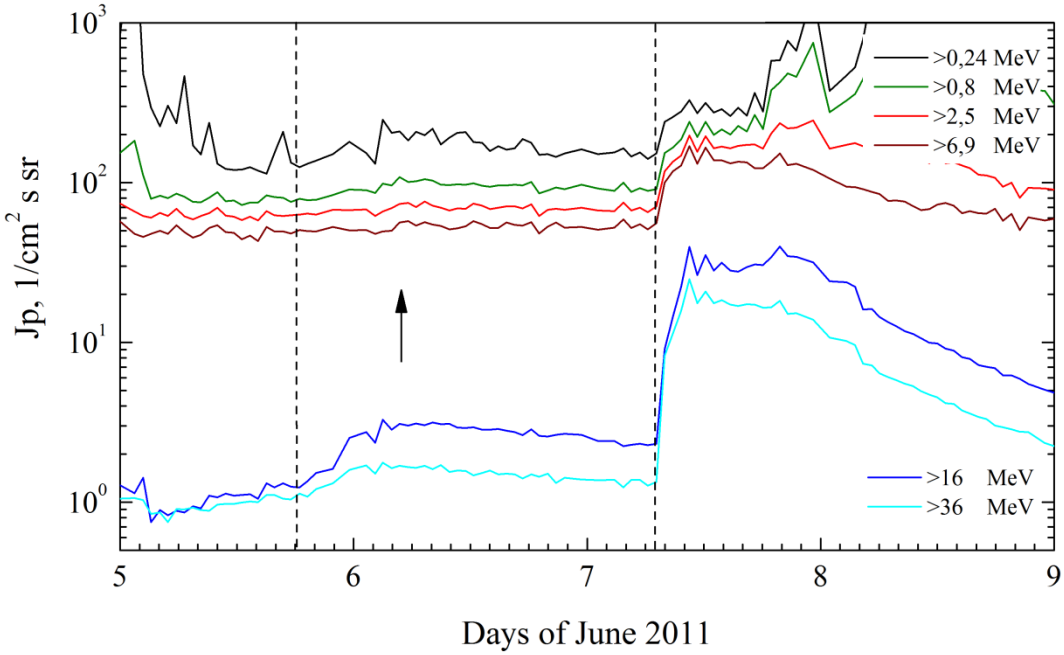


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2011.06.05



POES. Event 2011.06.05



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 June 05

2011 June 04 ⊡ AR 11222 484

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc at this time					
1 – 12	keV	No X-ray event at this time					

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DH II	0.025-16	2200		7/0130			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	2205	2425	- 140.2	360˚	300˚	SOHO

Proton Active Region:

AR11222 (N16L166, CMP* 23,5.06.2011,
Sp=150 msh, DSO, B, R1)
* appearance at 25.05 on W24

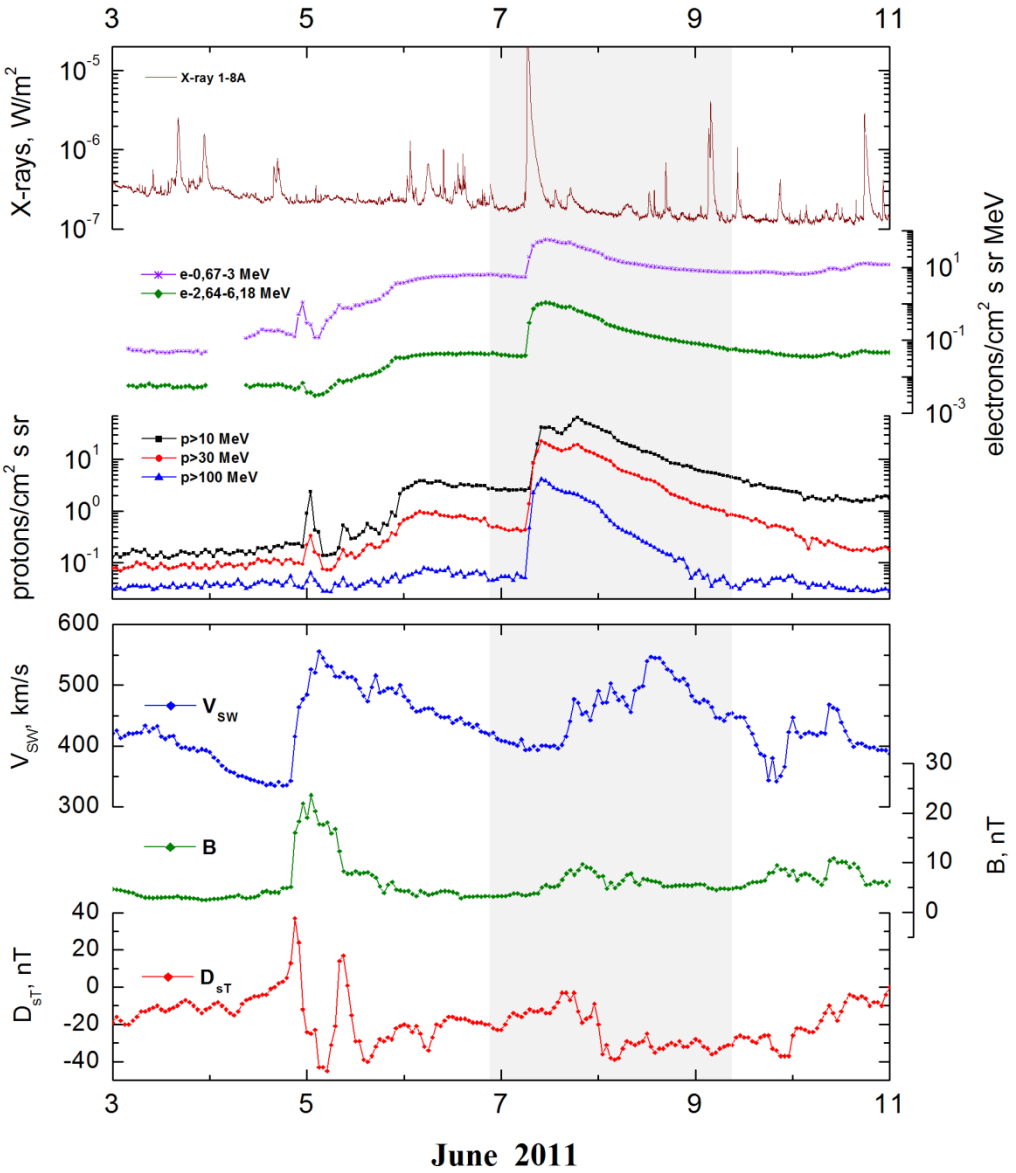
References:

Cohen C.M.S., R.A. Mewaldt, 2018.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Lario D., A. Aran, R. Gomez-Herrero et al., 2013.
Oka M., T. Obara, N.V. Nitta et al., 2021.
Winter L.M., and K. Ledbetter, 2015.

Particle event: To(Ep>10 MeV) – $07d07^h$
$Tmax_1$(Ep>10 MeV) – $07d12^h$, $Jmax_1$ (Ep>10 MeV) – 40 /cm^2·s·sr
$Tmax_2$(Ep>10 MeV) – $07d19^h$, $Jmax_2$ (Ep>10 MeV) – 62.5 /cm^2·s·sr
Duration of the event – 3 days, power-law index: $\gamma_1 = 2.8$, $\gamma_2 = 2.5$
Quasimaximal energy of protons in the event – Eqm_1 = 650 MeV
– Eqm_2 = 650 MeV

Sources: ● solar flare $07d06^h16^m$, M2.5/2N, S21W54, AR11226
Main burst X-ray 1–8 Å: onset – $07d06^h16^m$, max – $07d06^h41^m$, Φ = 0.044 J/m^2
CME: $07d06^h49^m$, V= 1255 km/s, Δφ = 360º, dA= 250º
▲ SC $10d08^h47^m$

Particle fluxes and associated phenomena

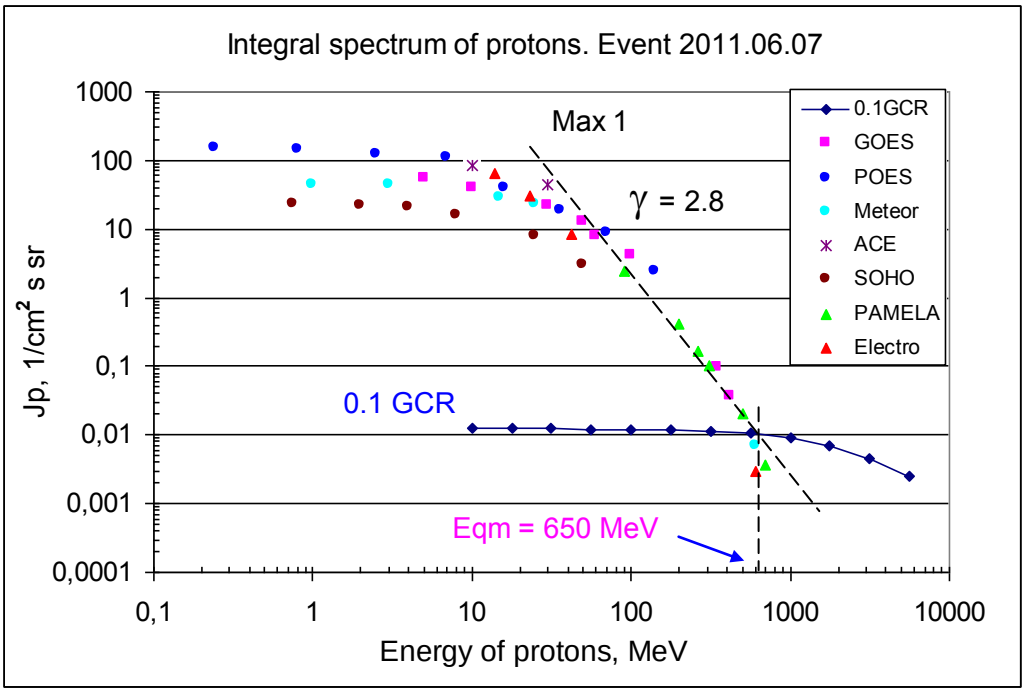


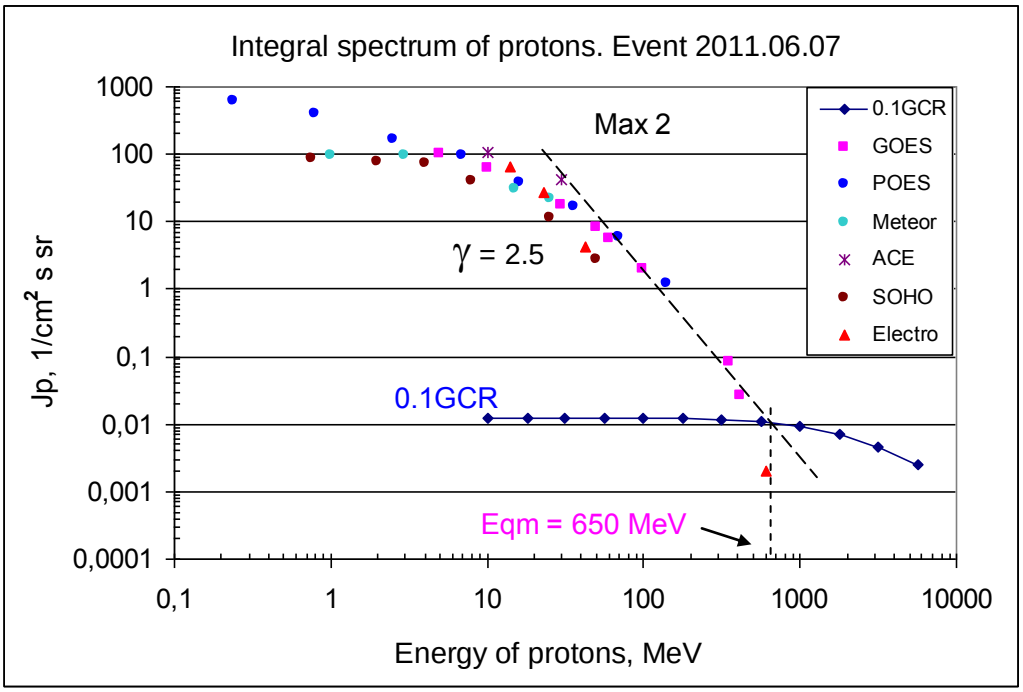
Integral fluxes of protons for the event of 2011 June 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	12/19	56/103	3	4	
EPS	>10	7	12/19	40/62.5	3	2	
EPS	>30	7	10/19	22/17.5	3	0.4	
EPS	>50	7	10/19	12.7/8	2.5	0.15	
EPS	>60	7	10/19	8.1/5.7	2.5	0.09	
EPS	>100	7	10/19	4.1/2	2	0.05	
Electro-1							
GALS-E	>600	7	10/19	0.003/0.002	1	0.001	
POES							
MEPED	>0.24	7	12/20	155/610	3	160	
MEPED	>0.8	7	12/20	145/385	3	95	
MEPED	>2.5	7	12/20	125/165	3	70	
MEPED	>6.9	7	12/20	110/97	3	55	
MEPED	>16	7	12/20	38/38	3	2.3	
MEPED	>36	7	12/20	19.5/17	3	1.4	
MEPED	>70	7	12/20	9/6	2	1.1	
MEPED	>140	7	12/20	2.4/1.2	1.5	1.2	
Meteor-1							
SCR	>1	6	11/19	45/98	3	3.2	
SCR	>3	6	12/19	45/97	3	3	
SCR	>10	6	-	-	3	2.1	
GALS-M	>15	6	10/18	28.3/30.3	3	0.75	
GALS-M	>25	6	10/18	22.8/22.4	3	0.8	
GALS-M	>600	6	11/-	0.007/-	1	0.02	
ACE							
SIS	>10	07	11/17	84/106	3	4.3	
SIS	>30	07	08/17	45/42	2.5	1.6	
SOHO							
EPHIN	>50	07	11/17	3/2.7	3	0.3	
PAMELA							
TRACKER	>90	07	12÷14/ -	2.5/ -	3	-	
TRACKER	>200	07	12÷14/ -	0.41/ -	3	-	
TRACKER	>265	07	12÷14/ -	0.17/ -	3	-	
TRACKER	>312	07	12÷14/ -	0.1/ -	3	-	
TRACKER	>500	07	12÷14/ -	0.02/ -	3	-	
TRACKER	>700	07	12÷14/ -	0.0037/ -	3	-	

Differential fluxes of protons for the event of 2011 June 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	15	18/08d07	0.5 /7	4	0.53	
LION	2 – 6	15	17/08d07	0.4 /2.5	3	0.1	
EPHIN	4 – 8	07	16/21	1.2/7.7	3	0.00001	
EPHIN	8 – 25	03	17/23	0.5/1.7	3	0.00003	
EPHIN	25 – 53	05	18/ -	0.17/ 0.3	3	0.00003	
Electro-1							
SCR-E	13.7 – 23	7	10/19'	3.5/4.1	1	0.2	
SCR-E	23 – 42	7	10/19'	1.1/1.2	1	0.06	
SCR-E	42 – 112	7	10/19'	0.054/0.058	1	0.007	
GOES							
EPS	350 – 420	-	10/18	0.00085/0.0005	1	0.0018	
EPS	420 – 510	-	9/17	0.0004/0.0003	1	0.001	
EPS	510 – 700	-	-	-	-		

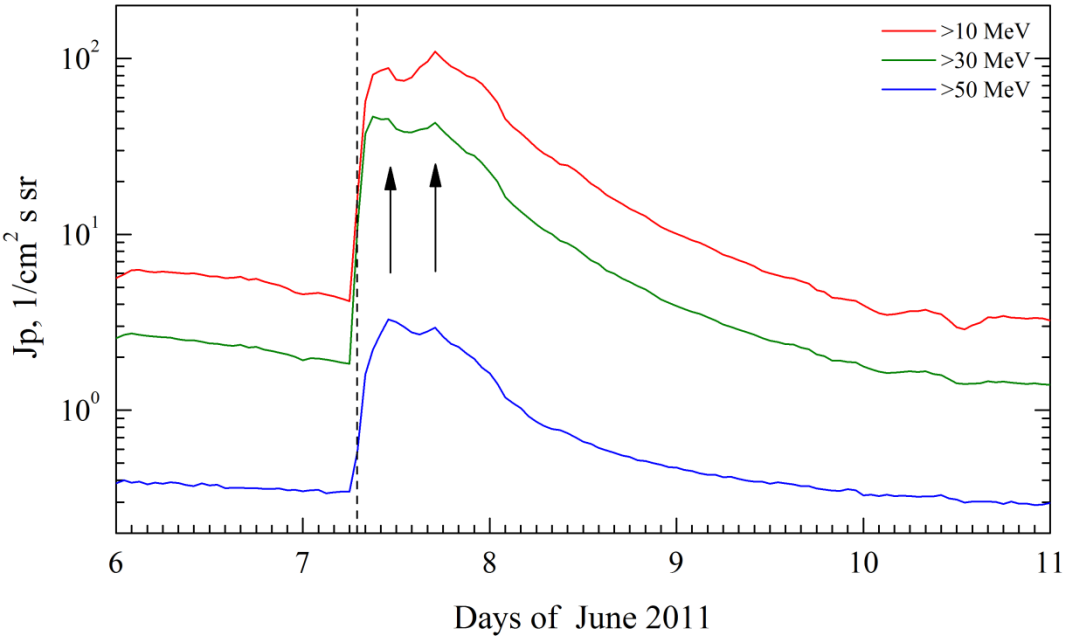

Integral spectrum of protons. Event 2011.06.07
Max 1
γ = 2.8
0.1 GCR
Eqm = 650 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
PAMELA
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2011.06.07
Max 2
γ = 2.5
0.1GCR
Eqm = 650 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

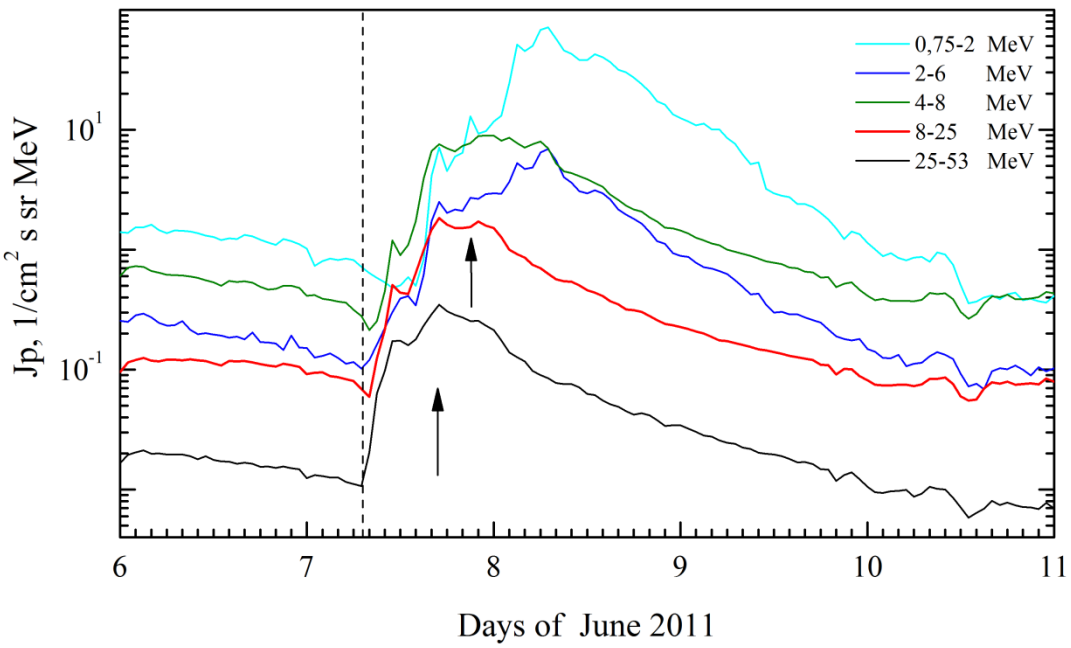
Time profiles of proton fluxes in the event 2011.06.07

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

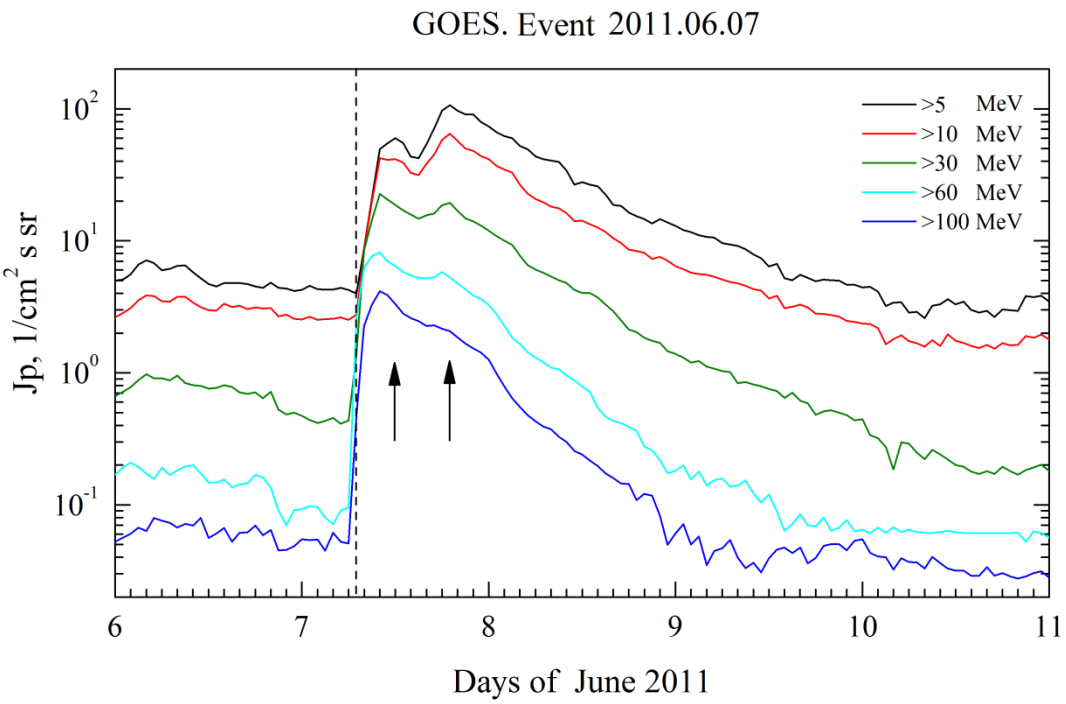
ACE SIS + SOHO (>50 MeV). Event 2011.06.07

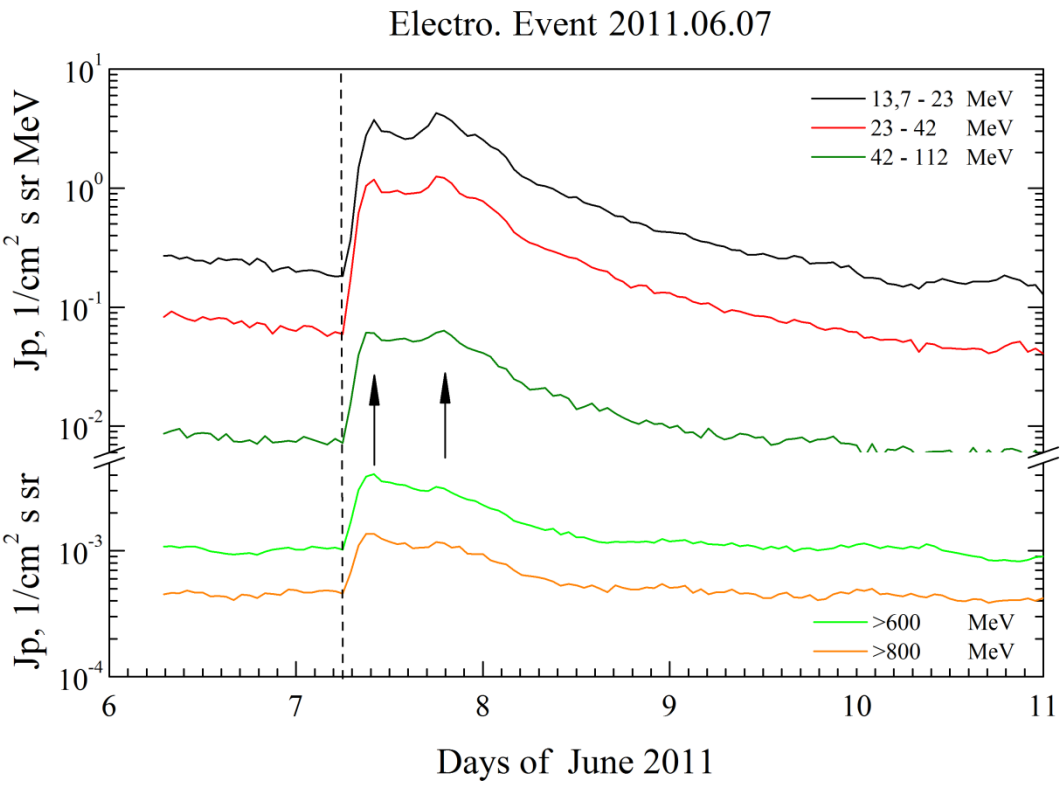


SOHO. Event 2011.06.07

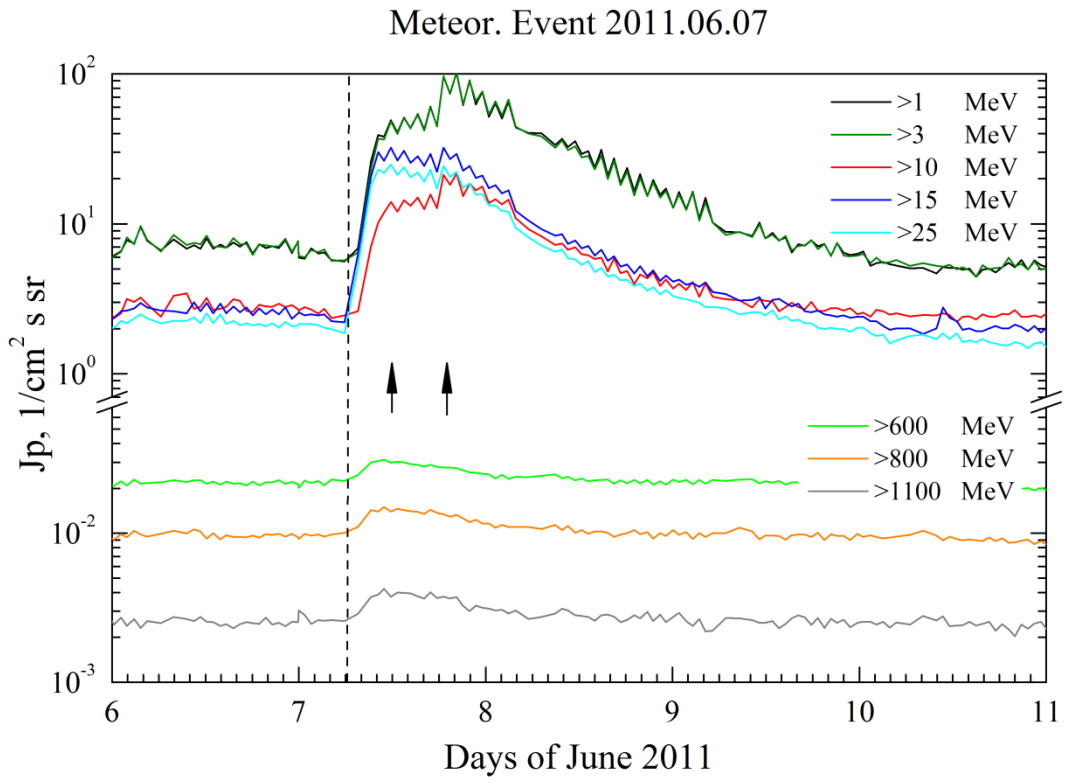


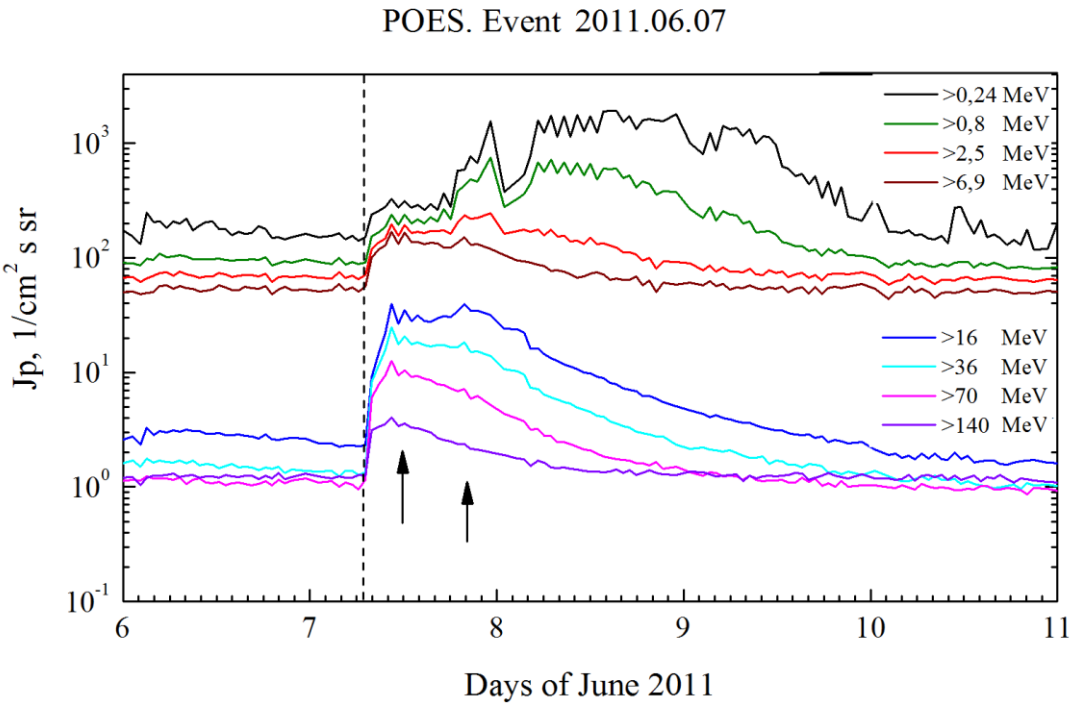
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 June 07

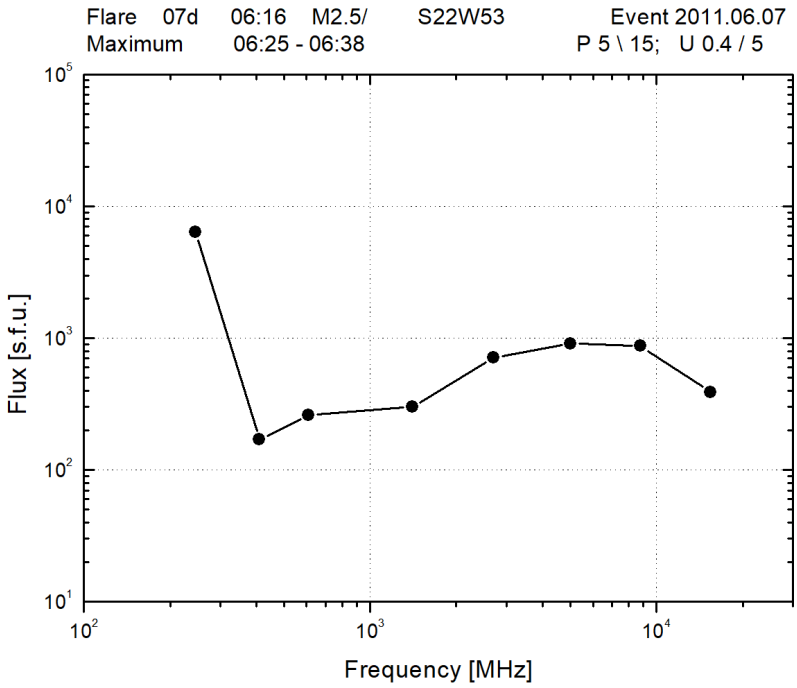
2011 June 07 • AR 11226 To event 485

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	0616	0641	0809	S21W54	2N	
1 – 12	keV	0616	0641	0659	S22W53	M2.5*	0.044
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
50 – 100	keV	0616:32	0637:54	0716:40	944	5147401	HESSI
12 – 25	keV	0751:28	0752:14	08:38:16	616	3770088	HESSI
12-25	keV	0619:39	0625:33	0655:40	69214	44915560	FERMI
100	keV	0747:30		0824:30		4.35E-05**	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0625	0625	0642		2.59	
8.8	GHz	0624	0625	0643		2.94	
5	GHz	0623	0625	0645	P5 \ 15	2.96	
2.7	GHz	0623	0638	0645		2.85	
1.4	GHz	0624	0637	0645		2.48	
610	MHz	0629	0634	0639		2.42	
410	MHz	0624	0625	0625	U0.4 / 5	2.23	
245	MHz	0625	0633	0644		3.81	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-120	0625		0650		2	
DS IV	25-180	0626		0658		2	
DH II	0.25-16	0645		1800			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0649	1255	0.3	360˚	250˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/ssw_client/data/ssw_service_110606_235609_98013/www/

** $cm^{-2} \cdot s^{-1}$

Radio burst frequency spectrum



Proton Active Region:

AR11226 (S21L037 CMP 03,0.06.2011,
Sp=360msh, EKI, BD)
XRI= 0.5 $M_3^{2.5}$+C_{36} 2_1+1_3+S_{32}
PFR1 28-29.05 - $M_2^{1.4}$
PFR2 7.06 – $M_1^{2.5}$

References:

Базилевская Г.А., Майоров А.Г., Малахов В.В. и др., 2013.
Богомолов Э.А., Адриани О., Базилевская Г.А. и др., 2017.
Alberti T., M. Laurenza, E.W. Cliveret et al., 2017.
Bazilevskaya G.A., A.G. Mayorov, V.V. Malakhov, V.V. Mikhailov, 2013.
Bazilevskaya G.A., A.G. Mayorov, V.V. Mikhailov, 2013.
Gopalswamy N., S. Yashiro, P. Mäkelä et al., 2021.
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Le G.-M., X-F. Zhang, 2017.
NOAA SPE, 2019.
de Nolfo G.A., A. Bruno, J.M. Ryan et al., 2019.
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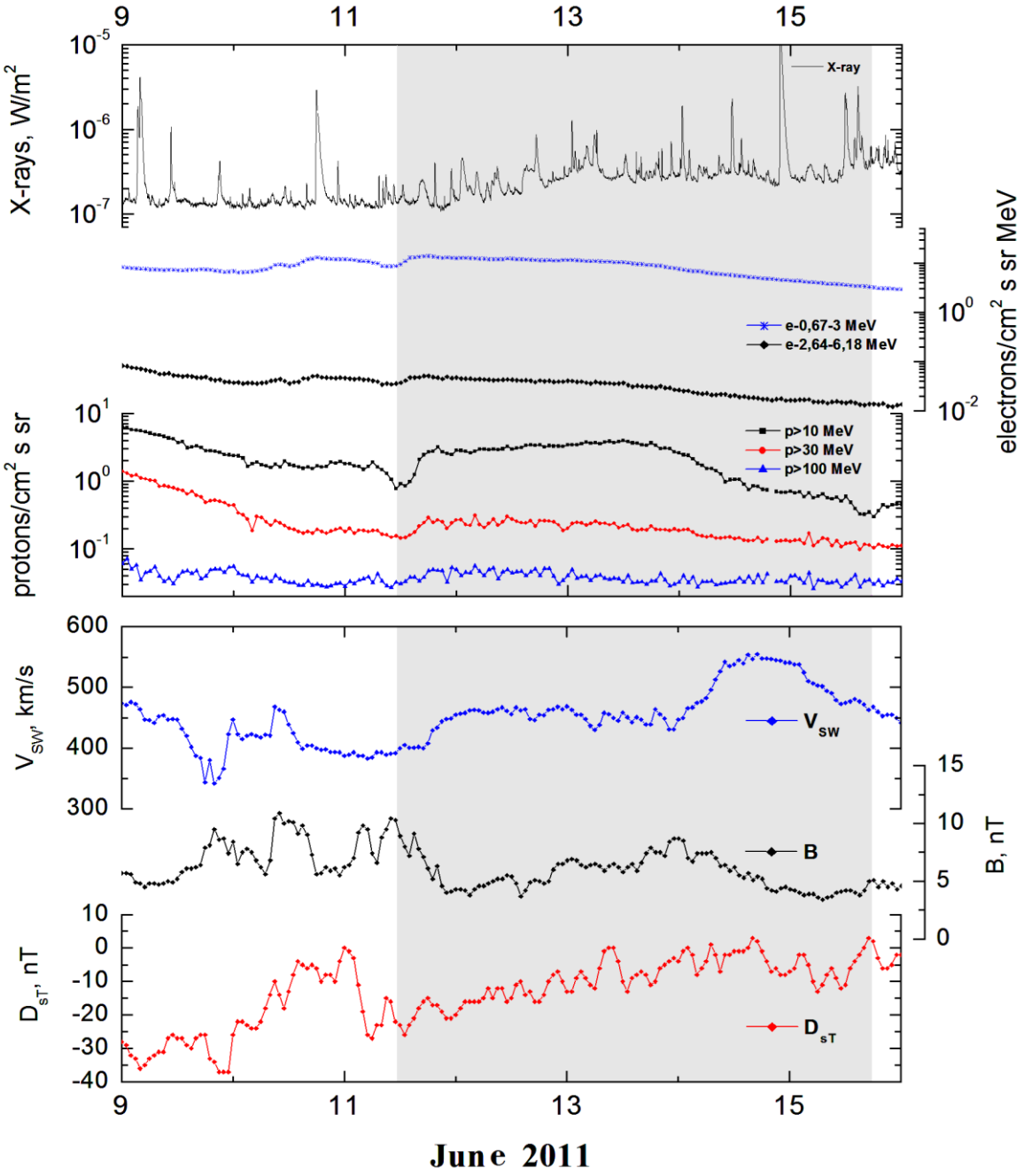
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2011.06.11 – (2011-162) **486**

Particle event: To(Ep>10 MeV) – 11d13^h
Tmax (Ep>10 MeV) – 11d20^h, Jmax (Ep>10 MeV) – 2.4 /cm^2·s·sr
Duration of the event – 4 days, power-law index: $\gamma = 2.8$
Quasimaximal energy of protons in the event – Eqm = 75 MeV

Sources: ○ source unknown

Particle fluxes and associated phenomena

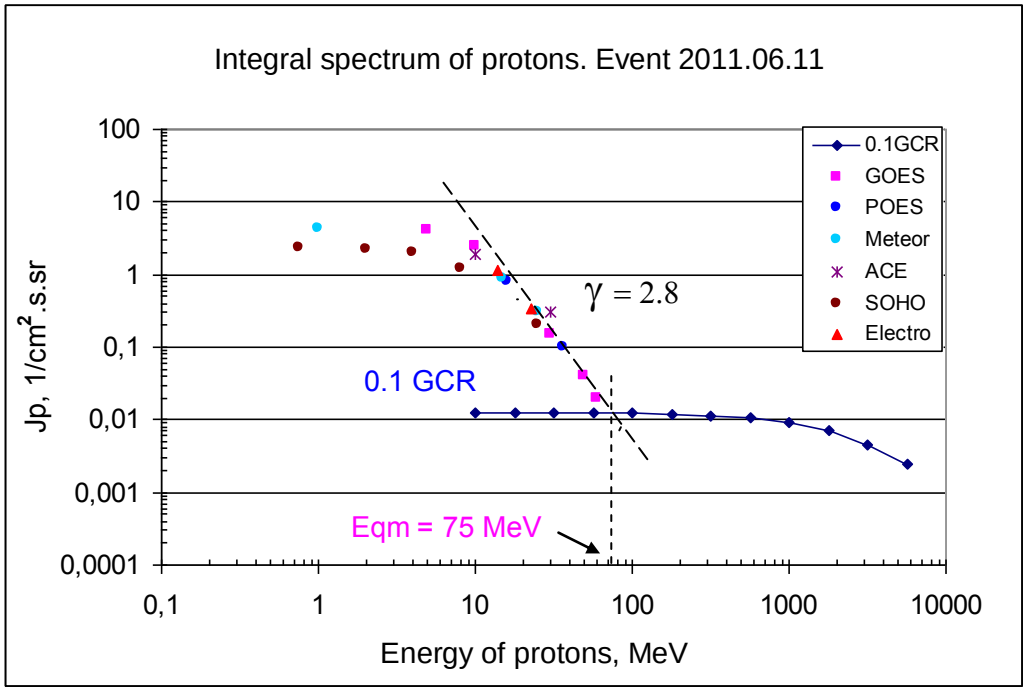


Integral fluxes of protons for the event of 2011 June 11

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	13	20	4	4	1.7	
EPS	>10	13	20	2.4	4	0.8	
EPS	>30	13	20	0.15	3	0.15	
EPS	>50	12	18	0.04	2	0.07	
EPS	>60	12	18	0.02	1.5	0.06	
EPS	>100	12	-	-	-	0.03	
POES							
MEPED	>0.24	12	-	-	-	-	
MEPED	>0.8	12	-	-	-	85	
MEPED	>2.5	12	-	-	-	65	
MEPED	>6.9	12	-	-	-	50	
MEPED	>16	12	21	0.8	3	1.6	
MEPED	>36	12	21	0.1	3	1	
MEPED	>70	12	-	-	-	0.9	
MEPED	>140	12	-	-	-	1.3	
Meteor-1							
SCR	>1	14	20	4.3	3.5	3.2	
SCR	>3	14	-	-	3.5	3	
SCR	>10	14	-	-	3	2.1	
GALS-M	>15	14	19	0.91	2.5	0.75	
GALS-M	>25	14	19	0.31	2.5	0.8	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	12	18	1.9	2	2.6	
SIS	>30	12	18	0.3	1.5	1.3	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

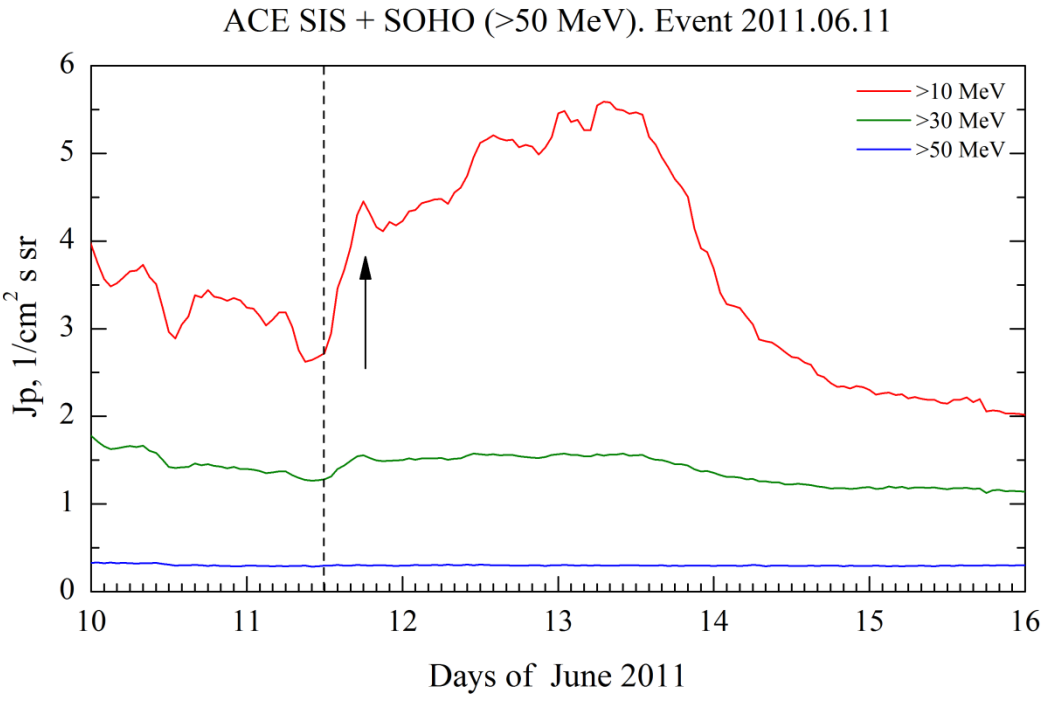
Differential fluxes of protons for the event of 2011 June 11

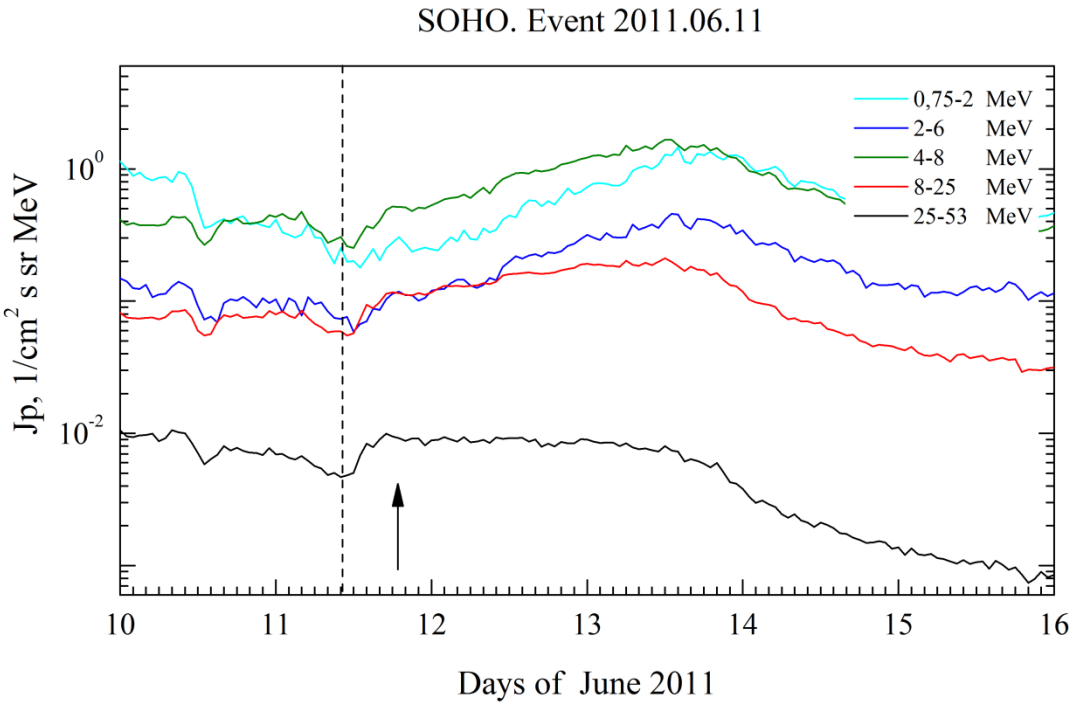
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	10	19	0.1	4	0.1	
LION	2 – 6	10	19	0.05	4	0.07	
EPHIN	4 – 8	10	19	0.2	4	0.3	
EPHIN	8 – 25	10	19	0.06	4	0.05	
EPHIN	25 – 53	10	19	0.007	4	0.003	
Electro-1							
SCR-E	13.7–23	12	20	0.09	0.5	0.1	
SCR-E	23–42	12	19	0.014	0.5	0.035	
SCR-E	42–112	-	-	-	-	0.005	


Integral spectrum of protons. Event 2011.06.11
Jp, 1/cm².s.sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.8
0.1 GCR
Eqm = 75 MeV

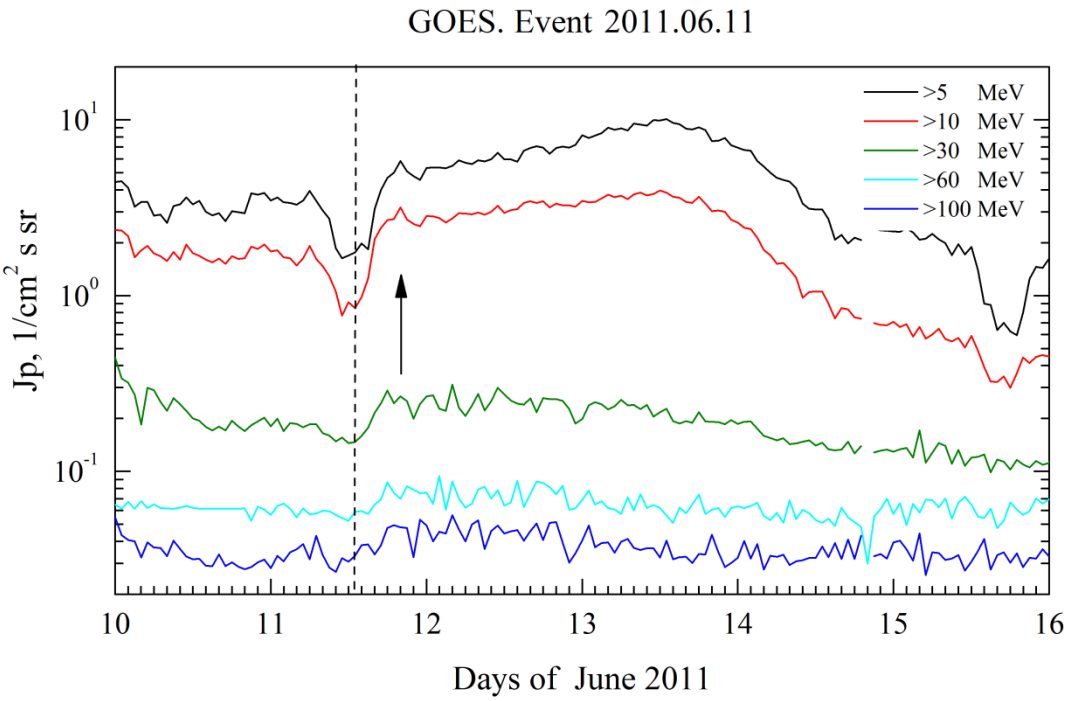
Time profiles of proton fluxes in the event 2011.06.11

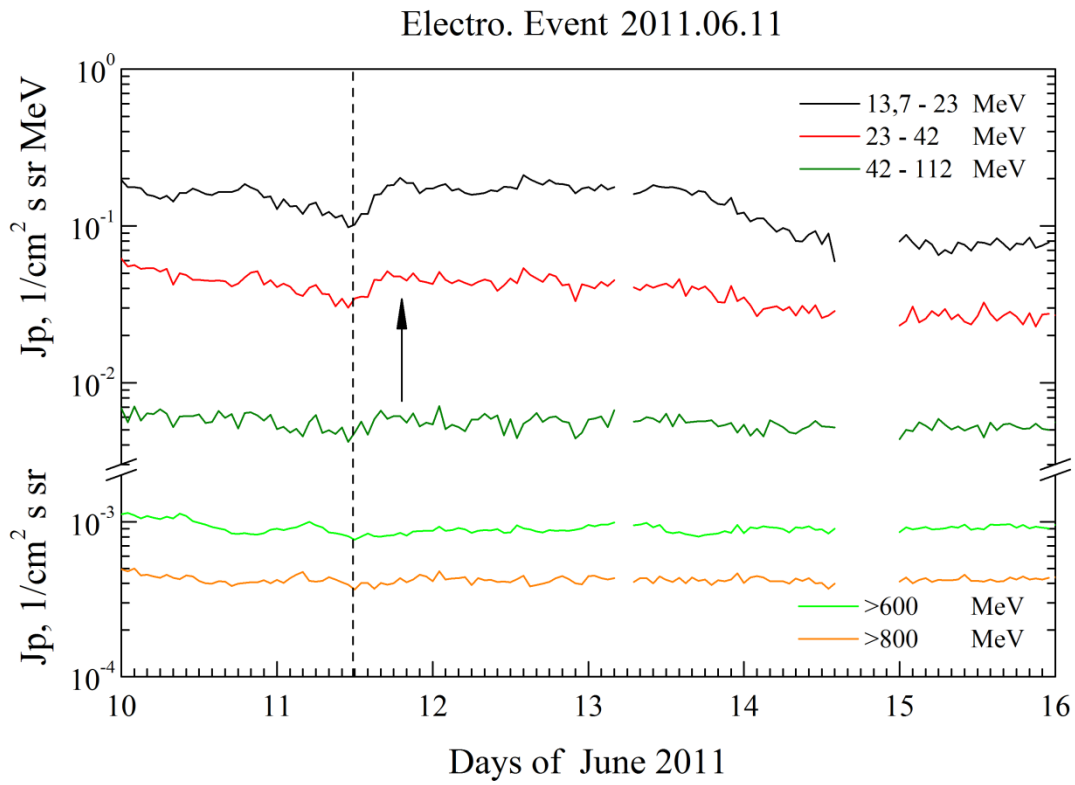
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO





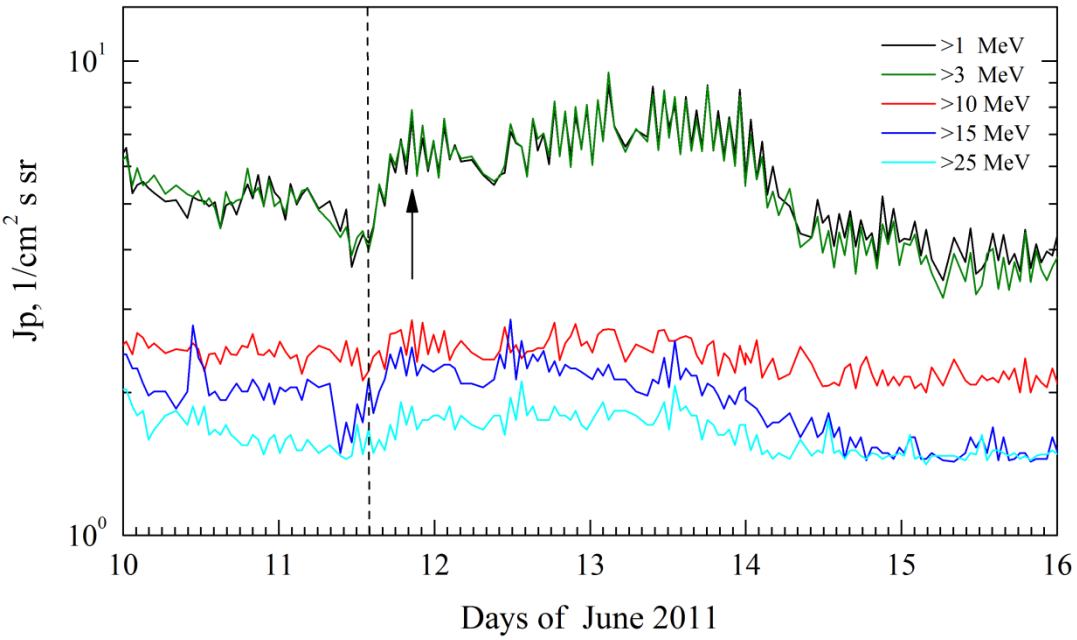
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



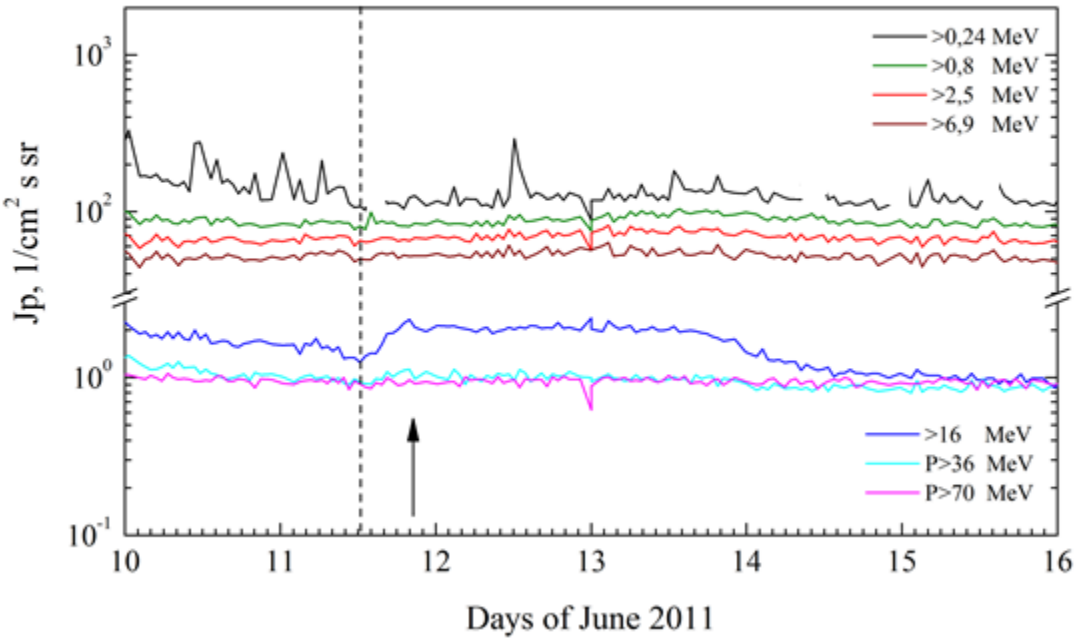


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2011.06.11



POES. Event 2011.06.11



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 June 11

2011	**June 11**	**source unknown**	**To event 486**

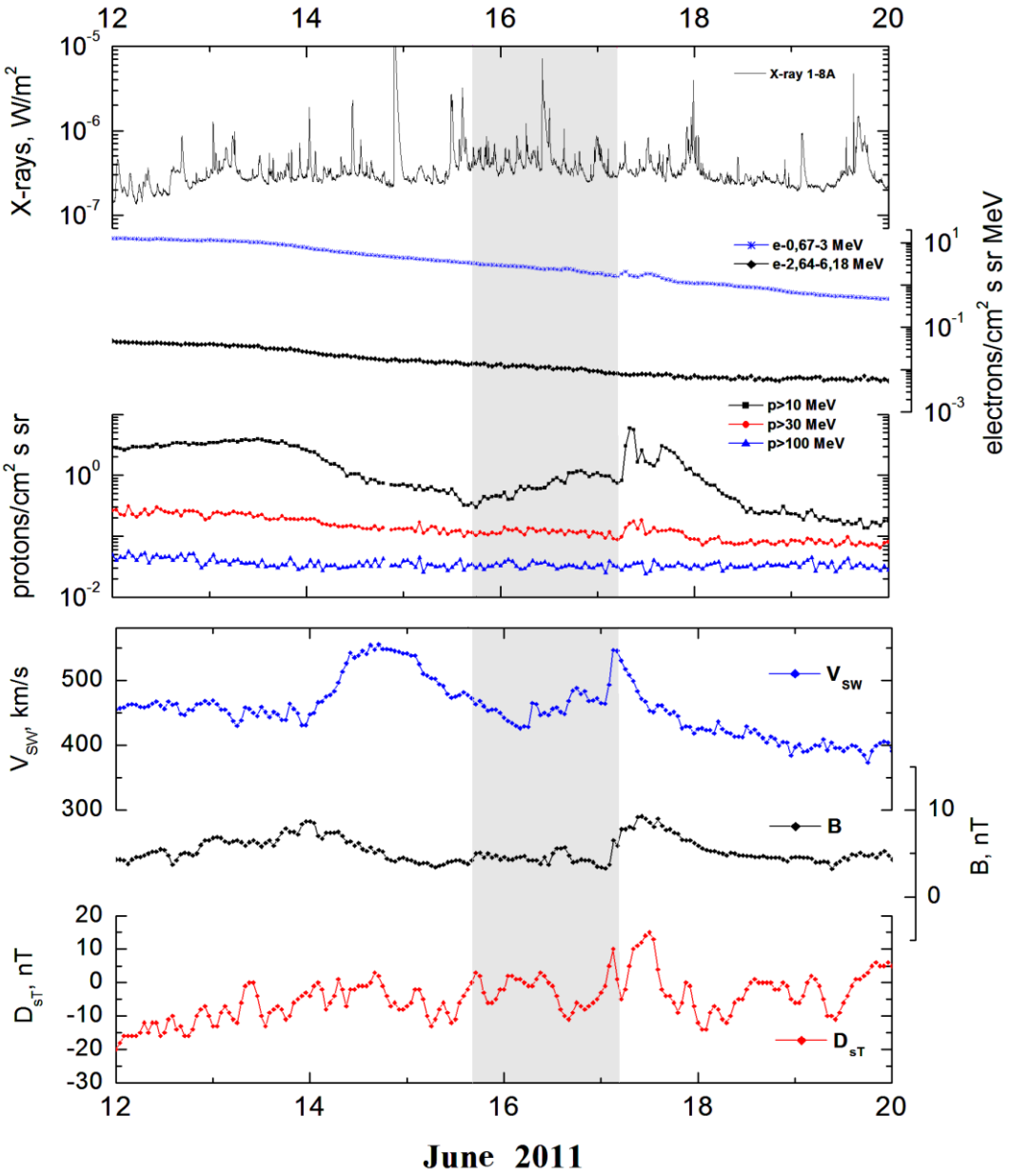
References:

Tsvetkov Ts., R. Miteva, N. Petrova, 2018.

Particle event: To(Ep>10 MeV) – 15d18^h
Tmax(Ep>10 MeV) – 16d20^h, Jmax(Ep>10 MeV) – 0.9 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: γ = 2.1
Quasimaximal energy of protons in the event – Eqm = 80 MeV

Sources: ⊙ solar flare 14d21^{h}36^m, M1.3/SF, N15E77, AR11236
Main X-ray burst 1-8 Å: onset – 14d21^{h}36^m, max – 14d21^{h}47^m, Φ = 0.018 J/m^2
CME: 14d22^{h}36^m, V= 0441 km/s, Δφ = 028°, dA= 135°
▲ SC 17d02^{h}39^m

Particle fluxes and associated phenomena

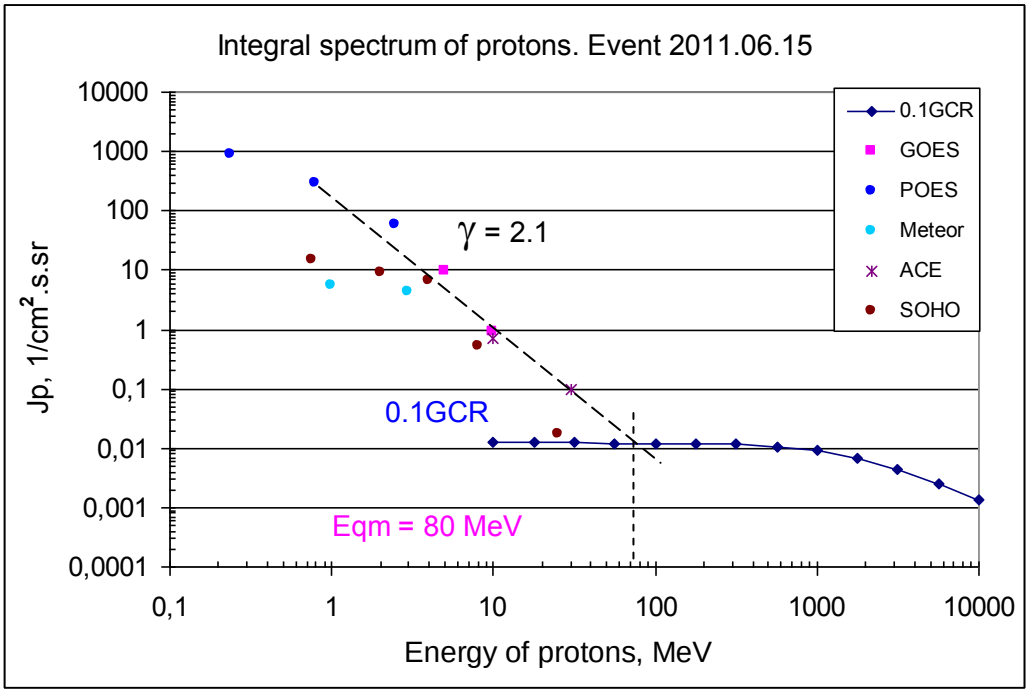


Integral fluxes of protons for the event of 2011 June 15

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	16d19	9.5	1.5	0.6	
EPS	>10	18	16d20	0.9	1.5	0.3	
EPS	>30	-	-	-	-	0.1	
EPS	>50	-	-	-	-	0.07	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
POES							
MEPED	>0.24	16d06	16d20	900	1	110	
MEPED	>0.8	16d06	16d20	300	1	85	
MEPED	>2.5	16d06	16d20	57	1	65	
MEPED	>6.9	-	-	-	-	50	
MEPED	>16	-	-	-	-	1.6	
MEPED	>36	-	-	-	-	1	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1.3	
Meteor-1							
SCR	>1	16d07	16d13	5.6	1	3.2	
SCR	>3	16d07	16d13	4.3	1	3	
SCR	>10	-	-	-	-	2.1	
GALS-M	>15	-	-	-	-	1.5	
GALS-M	>25	-	-	-	-	1.5	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	23	16d10	0.7	1.3	2	
SIS	>30	23	16d10	0.1	1.3	1.2	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

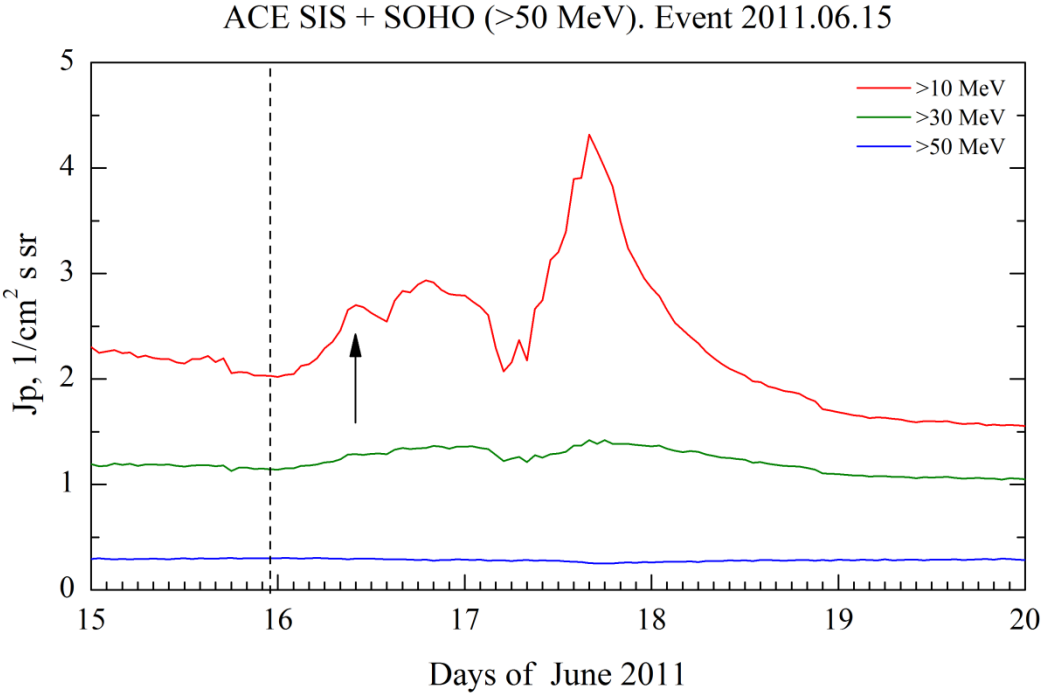
Differential fluxes of protons for the event of 2011 June 15

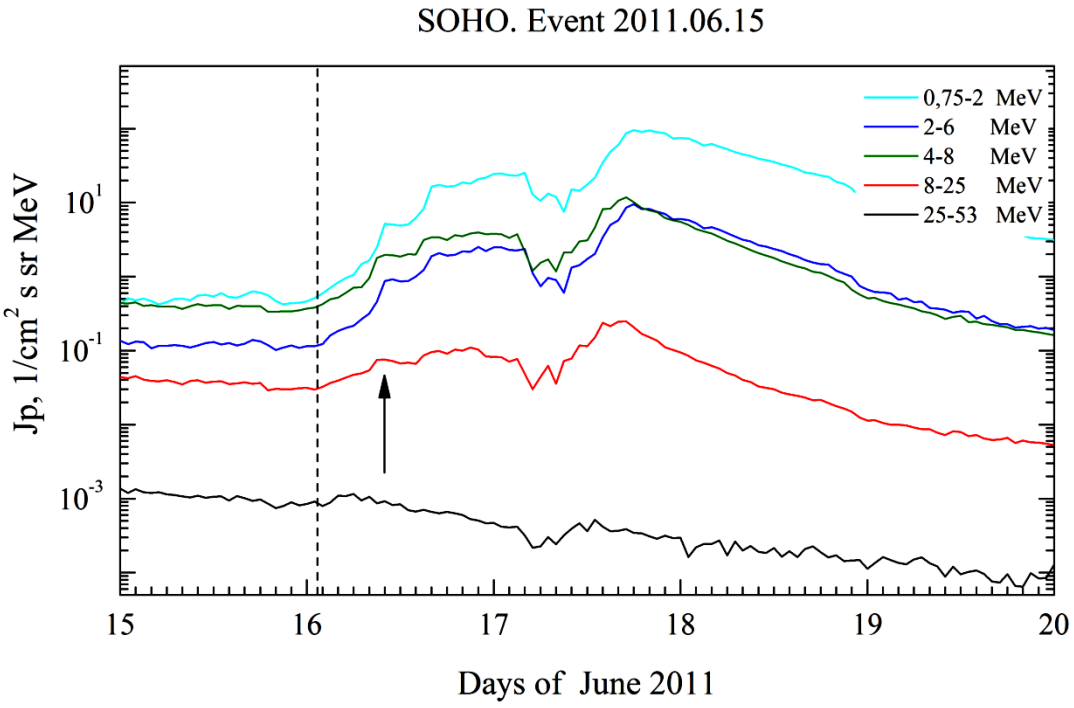
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	23	16d10	4.6	1	0.05	
LION	2 – 6	24	16d10	0.8	1	0.01	
EPHIN	4 – 8	16d01	16d10	1.5	1	0.04	
EPHIN	8 – 25	16d02	16d10	0.03	1	0.0004	
EPHIN	25 – 53	16d03	16d10	0.0006	1	0.00005	
Electro-1							
SCR-E	13.7–23	-	-	-	-	0.07	
SCR-E	23–42	-	-	-	-	0.03	
SCR-E	42–112	-	-	-	-	0.005	


Integral spectrum of protons. Event 2011.06.15
Jp, 1/cm².s.sr
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
γ = 2.1
0.1GCR
Eqm = 80 MeV
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO

Time profiles of proton fluxes in the event 2011.06.15

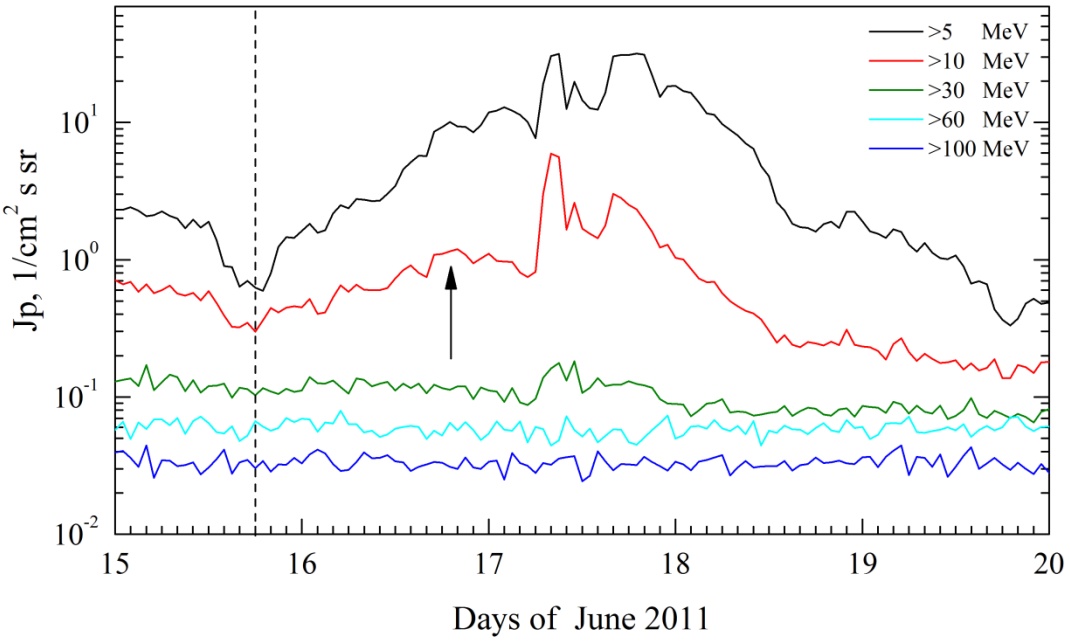
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



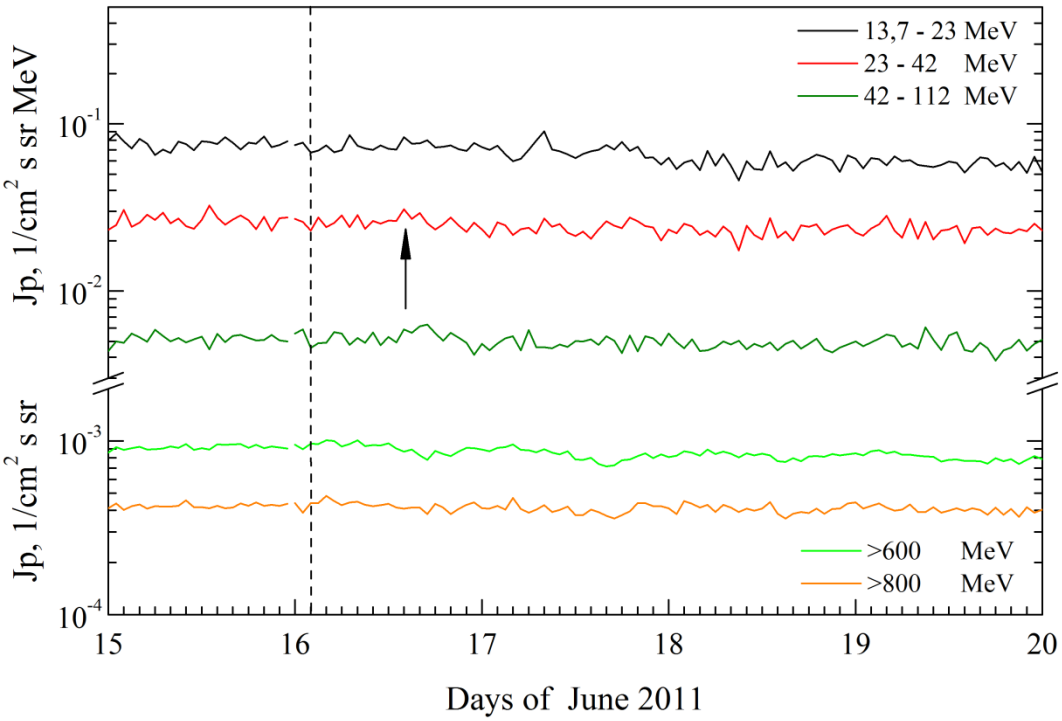


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro

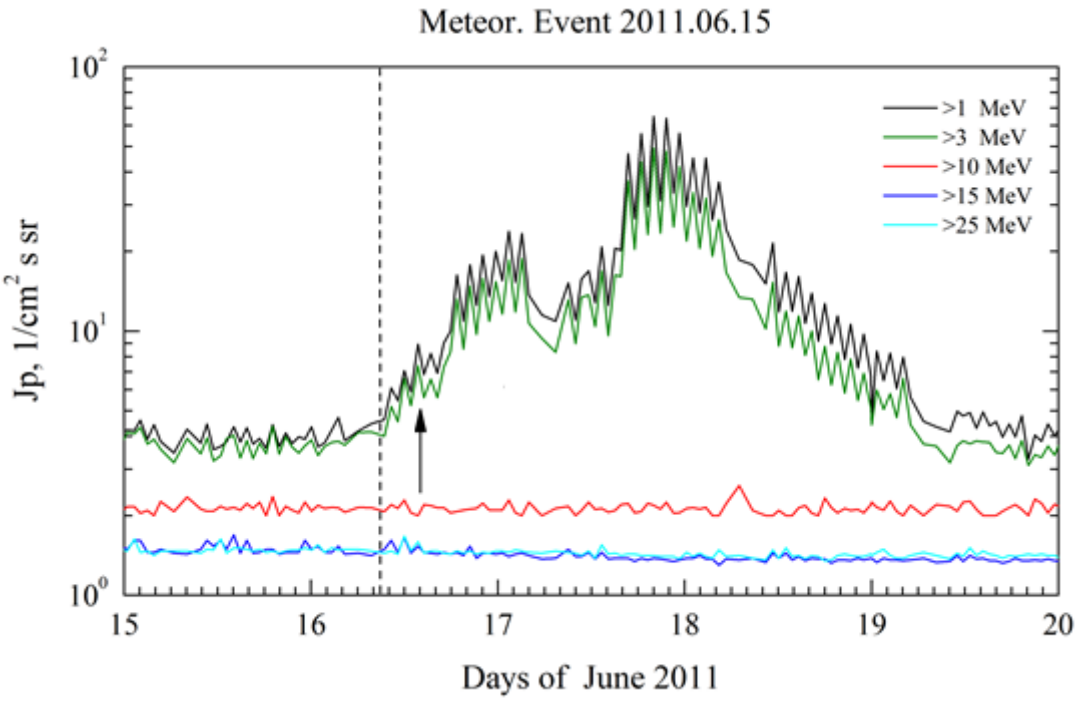
GOES. Event 2011.06.15

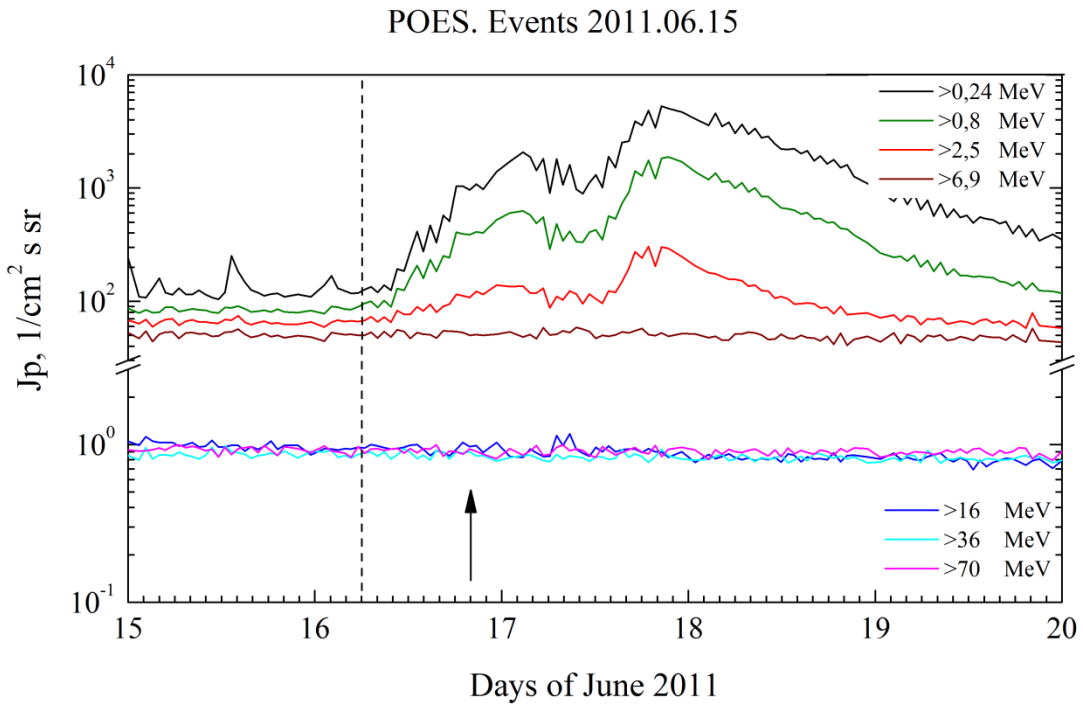


Electro. Event 2011.06.15



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 June 15

2011 June 14 ⊙ AR11236 To event 487

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	2142	2142	2201	N15E77	SF	ERU
1 – 12	keV	2136	2147	2210	N14E78	M1.3	0.018
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	Sp/c
50 – 100	keV	2143:24	2146:14	2222:40	688	1703393	HESSI
12-25	keV	2139:15	2146:11	2207:15	155628	47393372	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
8.8	GHz	2141	2141	2142		2.45	
5	GHz	2145.0	2146.0	2146.0		2.12	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2236	441	5.2	028º	135º	SOHO

Proton Active Region

AR11236 (N17L165, CMP 20,5.06.2011,
Sp=350 msh, ESI, BD)
XRI=0.13 $M_1^{1.3}$+C_7 1_1+S_{11}
PFR 14.06 – $M_1^{1.3}$

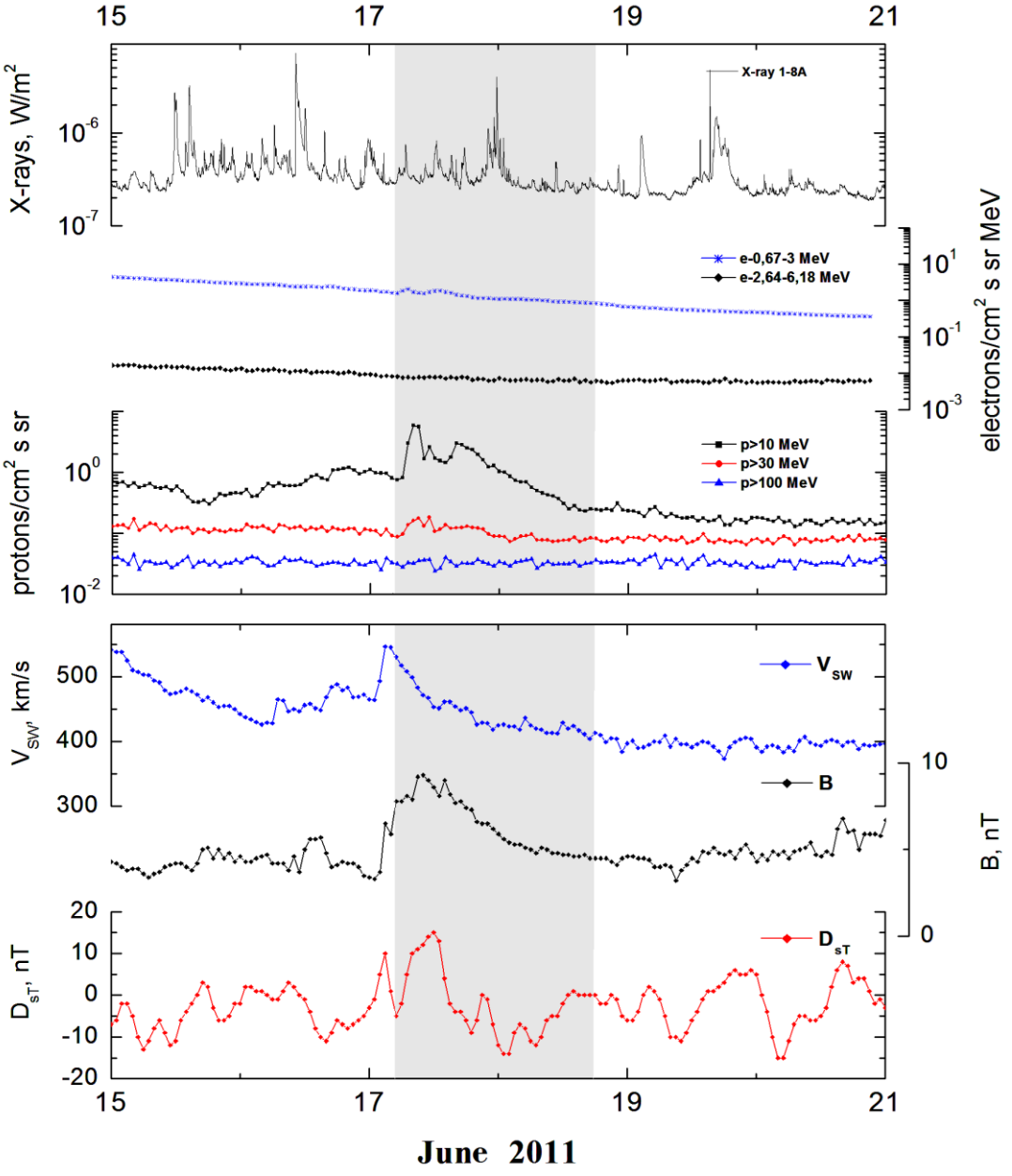
Event 2011.06.17 – (2011-168) **488**

Particle event: To(Ep>10 MeV) – 17d06^h
Tmax$_1$(Ep>10 MeV) – 17d08^h, Jmax$_1$ (Ep>10 MeV) – 5.6 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 17d16^h, Jmax$_2$ (Ep>10 MeV) – 2.7 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma_1 = 2.8$, $\gamma_2 = 2.7$
Quasimaximal energy of protons in the event – Eqm$_1$ = 70 MeV
– Eqm$_2$ = 75 MeV

Sources: ● flare event 14d21^{h}36^m, M1.3/SF, N15E77, AR11236 (**Event 2011.06.15**)
Main X-ray burst 1-8 Å: onset – 14d21^{h}36^m, max – 14d21^{h}47^m, Φ = 0.018 J/m^2
CME: 14d22^{h}36^m, V= 441 km/s, Δφ = 028º, dA= 135º
▲ SC* 17d02^{h}39^m

*** Source**: ▲SC 17d02^{h}39^m – from flare of **Event 2011.06.15**

Particle fluxes and associated phenomena

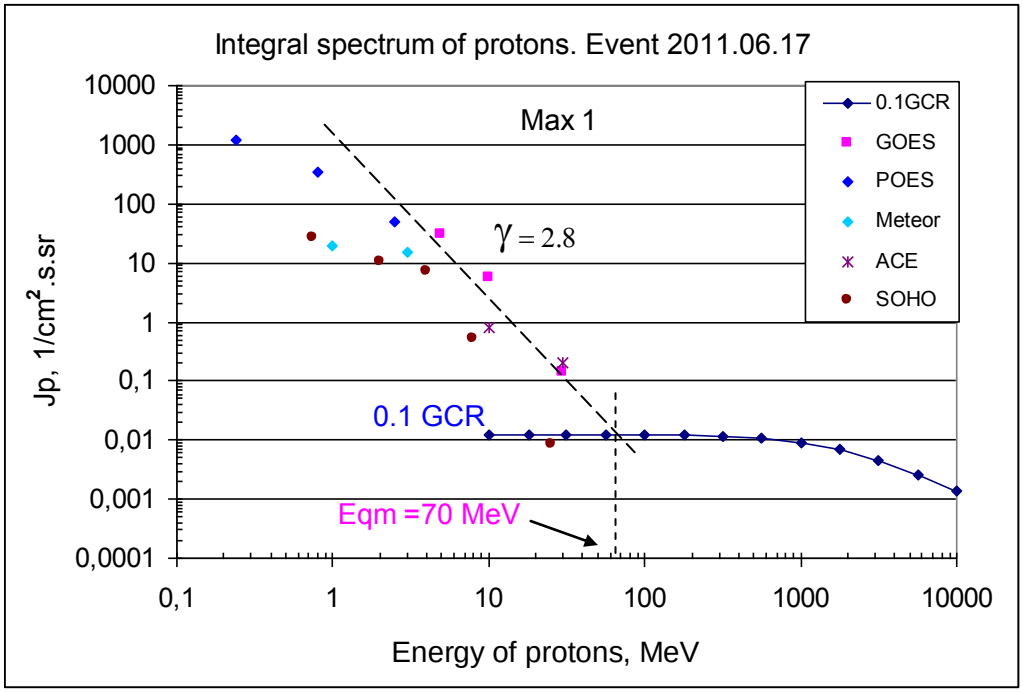


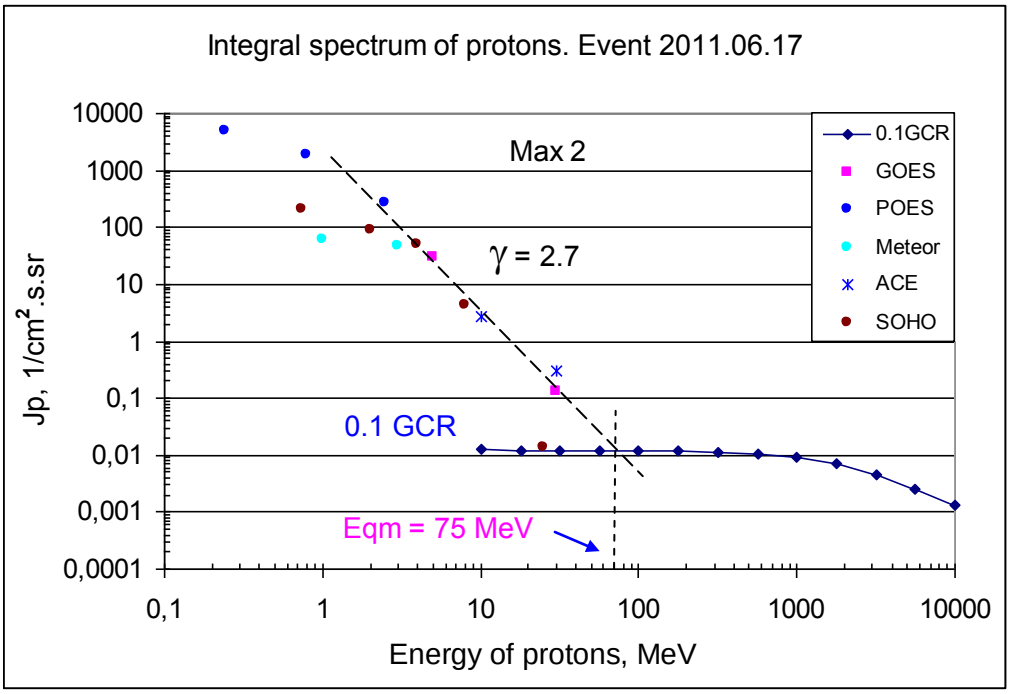
Integral fluxes of protons for the event of 2011 June 17

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	06	09/17	29.9/30.5	2.5	0.6	
EPS	>10	06	08/16	5.6/2.7	1.5	0.3	
EPS	>30	06	09/14	0.17/0.13	0.7	0.1	
EPS	>50	-	-	-	-	0.07	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
POES							
MEPED	>0.24	7	12/20	1200/5300	3	110	
MEPED	>0.8	7	12/20	340/1800	3	85	
MEPED	>2.5	7	11/20	50/237	1.5	65	
MEPED	>6.9	-	-	-	-	50	
MEPED	>16	-	-	-	-	1.6	
MEPED	>36	-	-	-	-	1	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1.3	
Meteor-1							
SCR	>1	7	10/20	20/61	2	4	
SCR	>3	7	10/20	15/46	2	3.2	
SCR	>10	-	-	-	-	2.1	
GALS-M	>15	-	-	-	-	0.75	
GALS-M	>25	-	-	-	-	0.75	
GALS-M	>600	-	-	-	-	0.01	
ACE							
SIS	>10	06	08/16	0.8/2.7	1.5	2	
SIS	>30	06	08/16	0.2/0.3	1	1.2	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

Differential fluxes of protons for the event of 2011 June 17

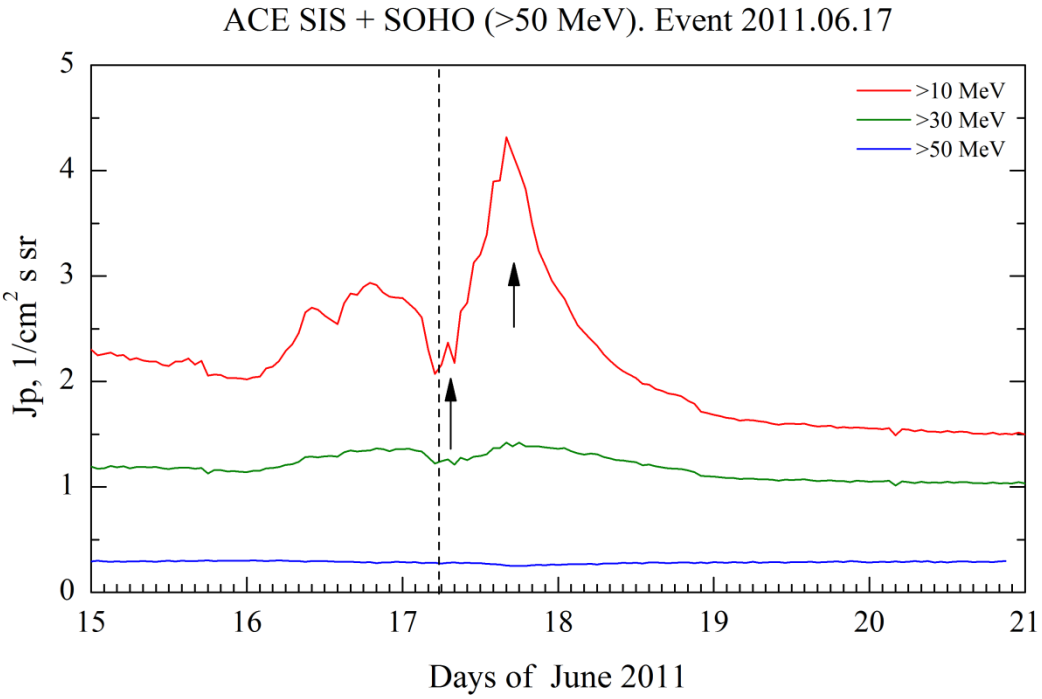
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	6	8/18	13.3/95	5	0.05	
LION	2 – 6	5	8/18	1.1/12	5	0.01	
EPHIN	4 – 8	5	7/18	1.7/11.8	4	0.04	
EPHIN	8 – 25	5	7/17	0.06/0.25	4	0.0004	
EPHIN	25–53	5	7/17	0.0003/0.0005	3	0.00005	
Electro							
SCR-E	13.7–23	-	-	-	-	0.07	
SCR-E	23–42	-	-	-	-	0.03	
SCR-E	42–112	-	-	-	-	0.005	

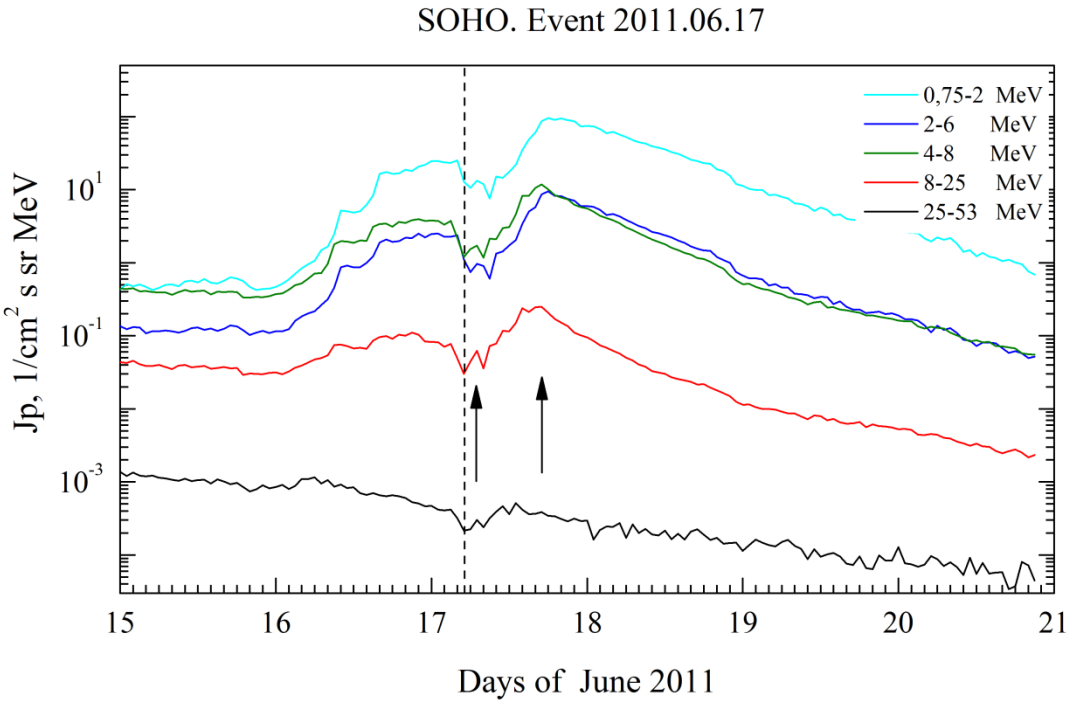

Integral spectrum of protons. Event 2011.06.17
Max 1
γ = 2.8
0.1 GCR
Eqm =70 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm².s.sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2011.06.17
Max 2
γ = 2.7
0.1 GCR
Eqm = 75 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm².s.sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

Time profiles of proton fluxes in the event 2011.06.17

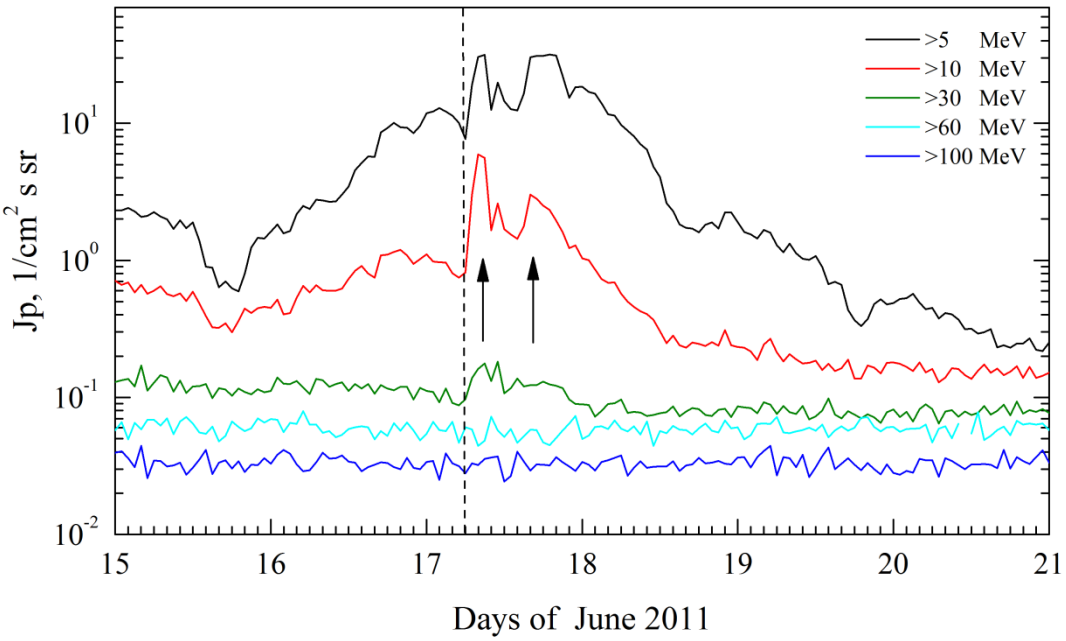
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



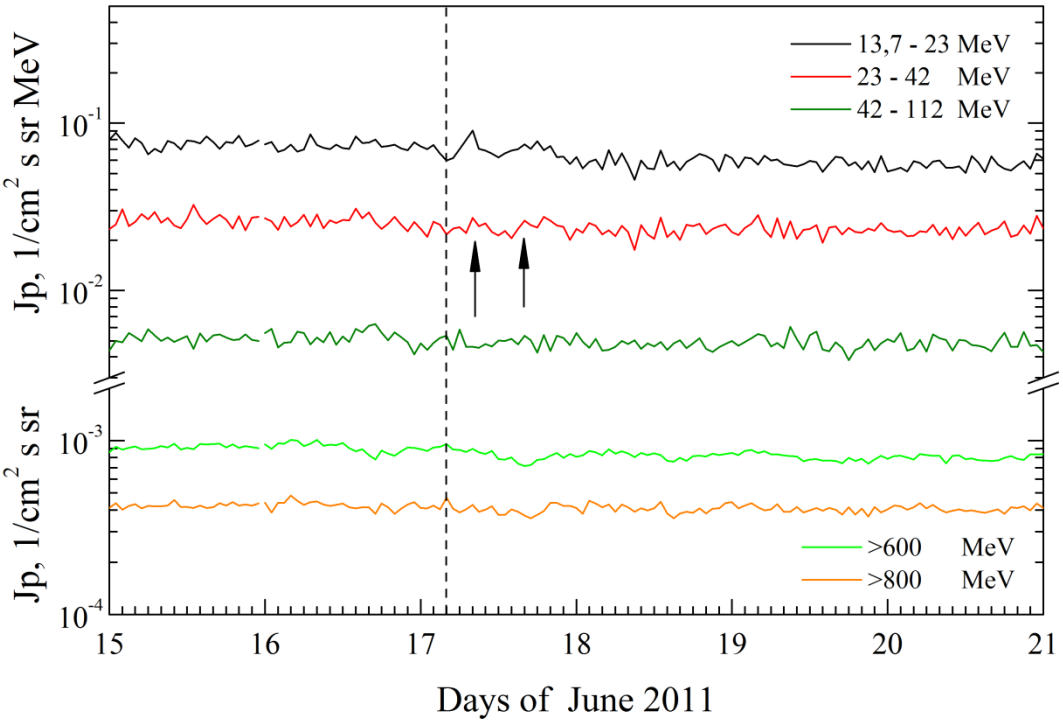


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro

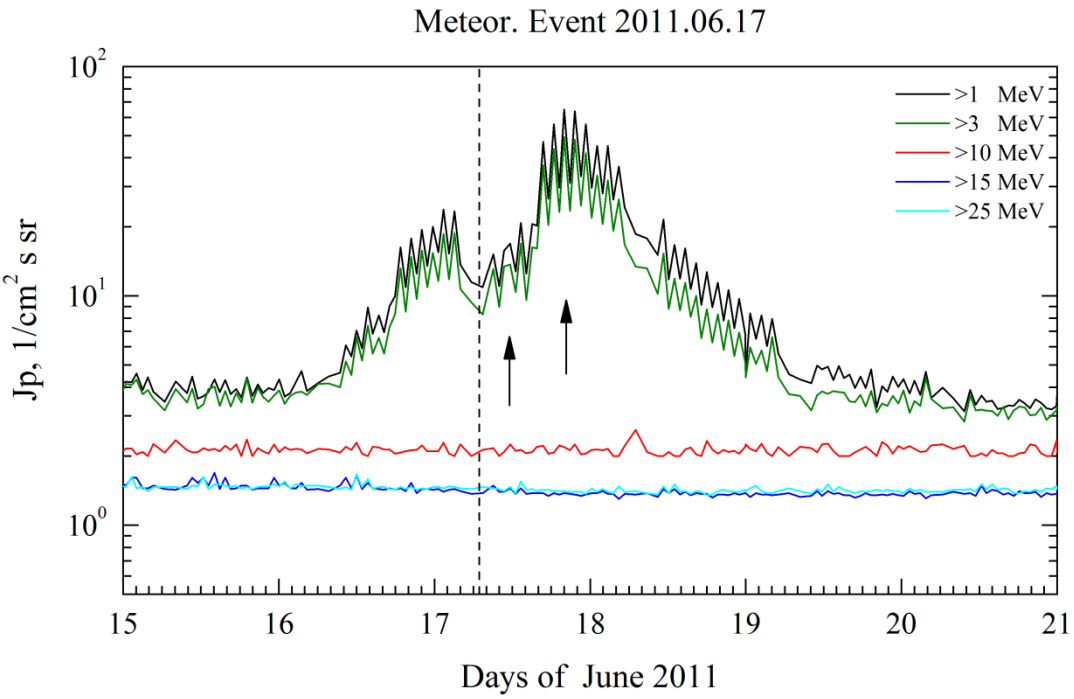
GOES. Event 2011.06.17

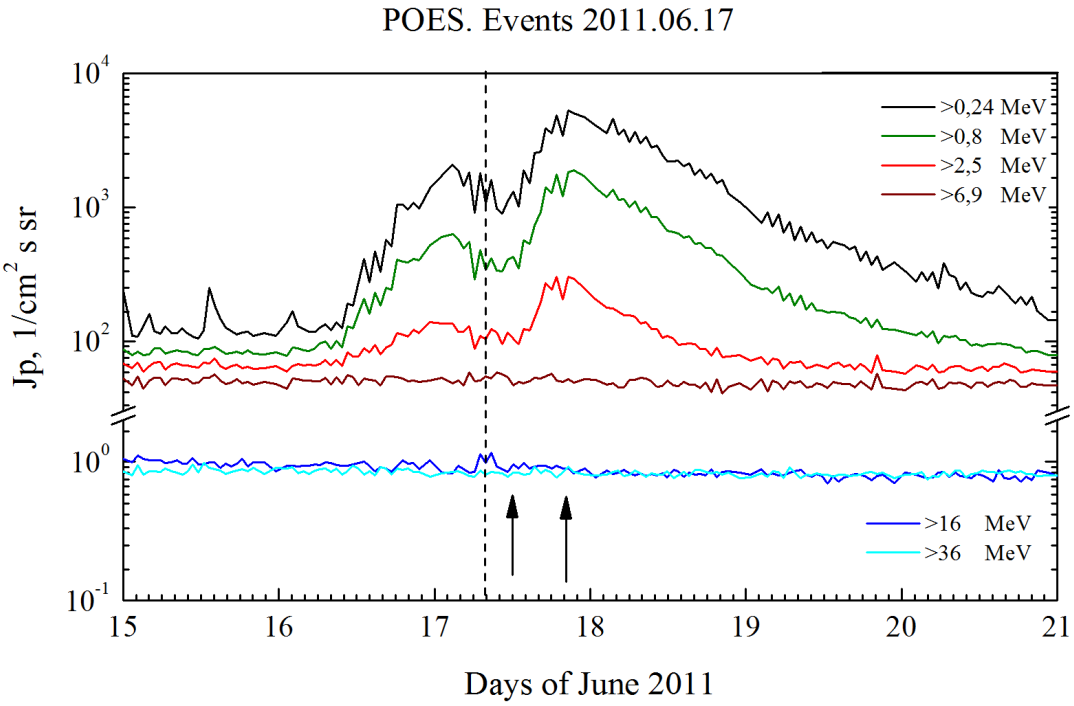


Electro. Event 2011.06.17



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources* and/or accompanying for the event of 2011 June 17

2011 June 14 ● AR11236 To event 488

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	Hα	2142	2142	2201	N15E77	SF	ERU
1 – 12	keV	2136	2147	2210		M1.3	0.018
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
50-100	keV	214324	214614	222240	688	1703393	HESSI
12-25	keV	2139:15	2146:11	2207:15	155628	47393372	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
8.8	GHz	2141	2141	2142		2.43	
5	GHz	2145.0	2146.0	2146.0		2.08	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2236	441	5.2	028º	135º	SOHO

*SC 17d02^{h}39^m from flare event 14.06

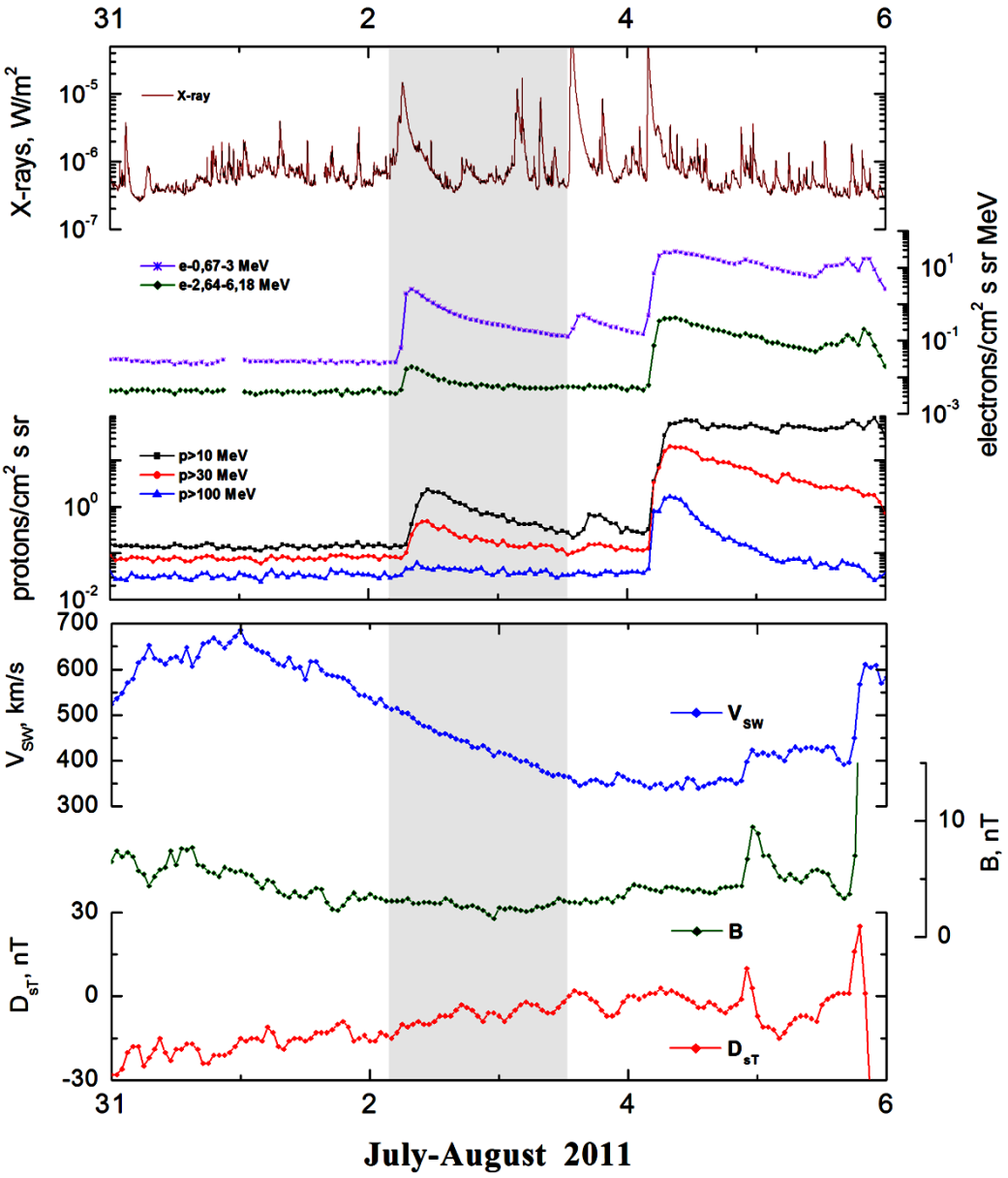
Proton Active Region

AR11236 (N17L165, CMP 20,5.06.2011,
Sp=350 msh, ESI, BD)
XRI=0.13 $M_1^{1.3}$+C_7 1_1+S_{11}
PFR 14.06 – $M_1^{1.3}$

Particle event: To(Ep>10 MeV) – 02d07^h
Tmax$_1$(Ep>10 MeV) – 02d11^h, Jmax$_1$ (Ep>10 MeV) – 2.2 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 03d17^h, Jmax$_2$ (Ep>10 MeV) – 0.55 /cm^2·s·sr
Duration of the event – 2 days, power-law index: $\gamma_1 = 2.2$, $\gamma_2 = 2.1$
Quasimaximal energy of protons in the event – Eqm$_1$ = 120 MeV
– Eqm$_2$ = 70 MeV

Sources: ⊙ solar flare 02d05^{h}19^m, M1.4/1N, N14W15, AR11261
Ø solar flare 03d13^{h}17^m; M6.0/2B, N16W30; AR11261
Main X-ray burst 1-8 Å: onset – 02d05^{h}19^m, max – 02d06^{h}19^m, Φ = 0.039 J/m^2
CME: 02d06^{h}36^m, V= 0852 km/s, Δφ = 268°, dA= 285°

Particle fluxes and associated phenomena

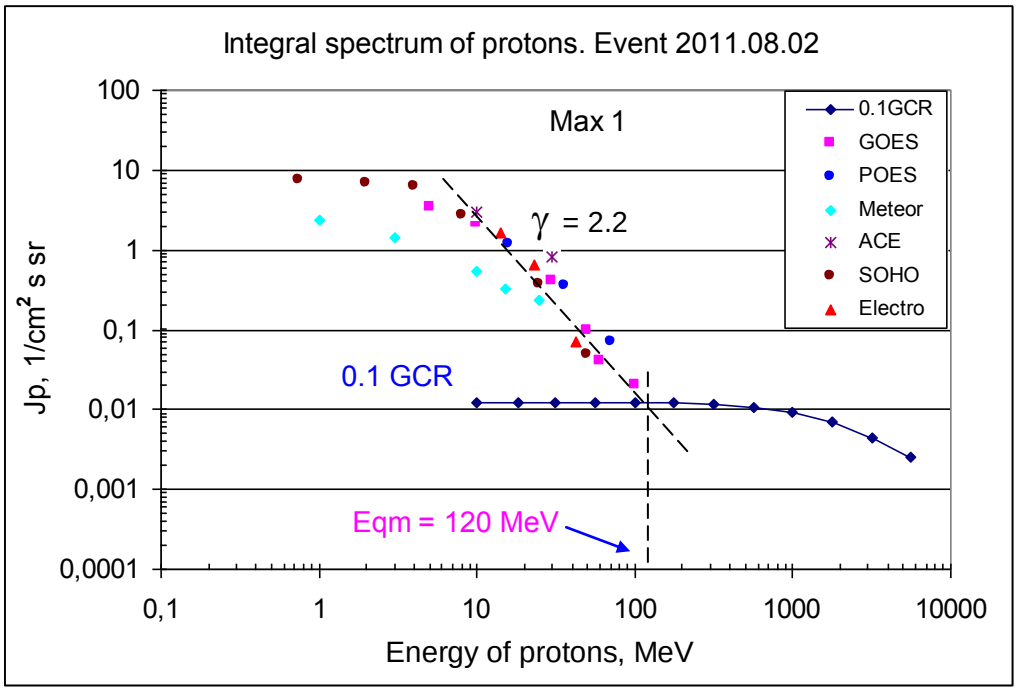


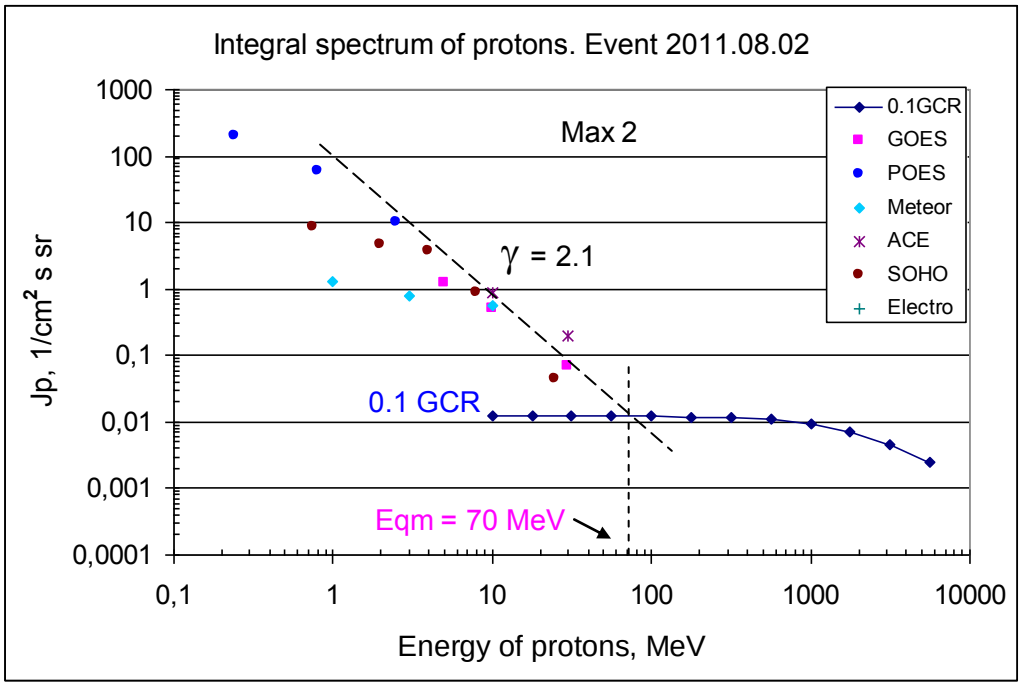
Integral fluxes of protons for the event of 2011 August 02

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	07	11/3d18	3.5/1.2	2	0.2	
EPS	>10	07	11/3d17	2.2/0.55	2	0.15	
EPS	>30	07	10/3d18	0.4/0.07	1.5	0.08	
EPS	>50	07	09/ -	0.1/ -	1.5	0.07	
EPS	>60	07	09/ -	0.04/ -	1	0.06	
EPS	>100	07	09/ -	0.02/ -	1	0.04	
EPS	>700	-	-	-	-	-	
POES							
MEPED	>0.24	-	- /3d18	-/200	-	95	С графика
MEPED	>0.8	-	- /3d18	-/60	-	80	С графика
MEPED	>2.5	-	- /3d18	-/10	-	65	С графика
MEPED	>6.9	-	-	-	-	50	
MEPED	>16	6	11/ -	1.2/ -	0.5	0.8	
MEPED	>36	6	9/ -	0.35/ -	0.5	0.8	
MEPED	>70	6	10/ -	0.07/ -	0.5	0.95	
MEPED	>140	-	-	-	-	1.2	
Meteor-1							
SCR	>1	06	12/ 03d10	2.4/1.3	1.5	3.1	
SCR	>3	06	12/ 03d10	1.4/0.8	1.5	3	
SCR	>10	06	12/ 03d10	0.54/0.57	0.5	2.1	
GALS-M	>15	06	12/ -	0.32/-	0.5	0.7	
GALS-M	>25	06	12/ -	0.24/-	0.5	0.75	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	06	09/03d18	3/0.9	2	1.5	
SIS	>30	06	09/03d18	0.8/0.2	2	1	
SOHO							
EPHIN	>50	06	08/ -	0.05/ -	0.5	0.3	

Differential fluxes of protons for the event of 2011 August 02

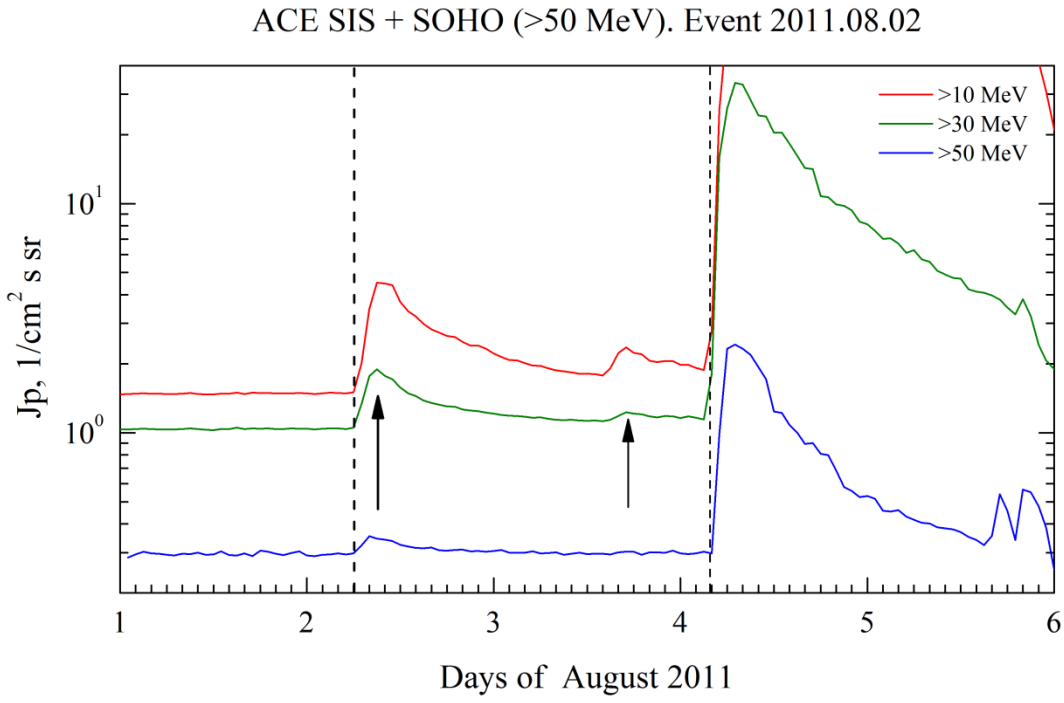
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	7	14/3d16	0.5/3.1	2	0.018	
LION	2 – 6	6	12/3d18	0.22/0.32	2	0.0035	
EPHIN	4 – 8	6	12/3d17	0.9/0.7	2	0.0003	
EPHIN	8 – 25	6	11/3d16	0.14/0.05	2	0.00004	
EPHIN	25 – 53	6	10/3d16	0.011/0.0016	2	0.00004	
Electro-1							
SCR-E	13.7–23	7	10/ -	0.11/ -	1.5	0.07	
SCR-E	23–42	7	10/ -	0.03/ -	1.5	0.03	
SCR-E	42–112	7	10/ -	0.001/ -	0.5	0.005	

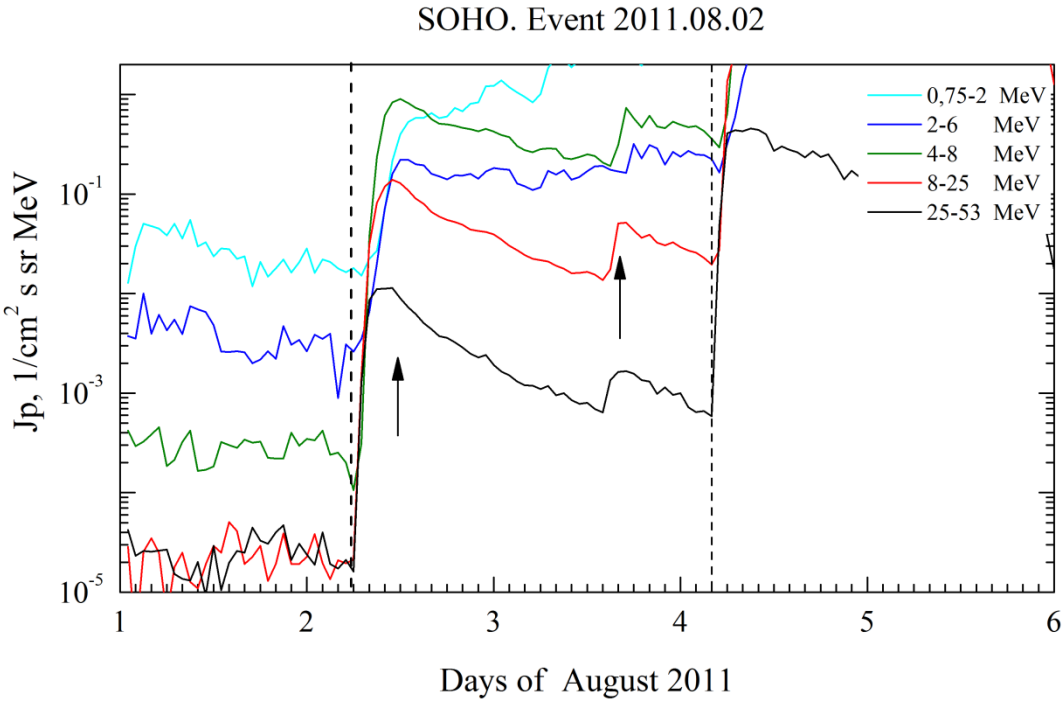

Integral spectrum of protons. Event 2011.08.02
Max 1
γ = 2.2
0.1 GCR
Eqm = 120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2011.08.02
Max 2
γ = 2.1
0.1 GCR
Eqm = 70 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

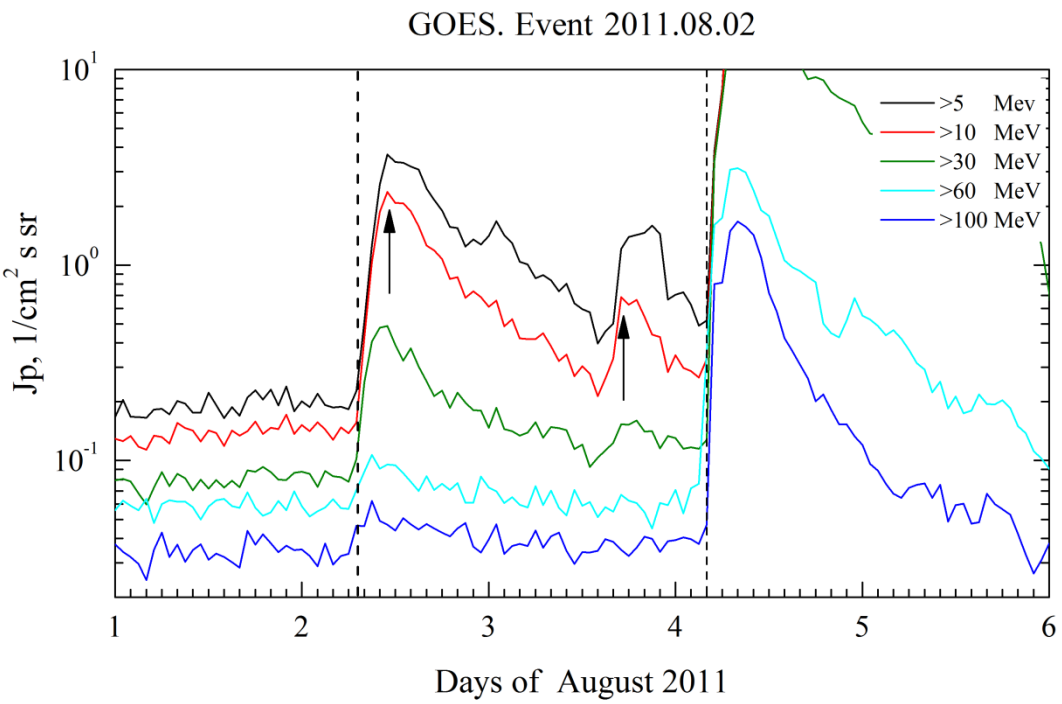
Time profiles of proton fluxes in the event 2011.08.02

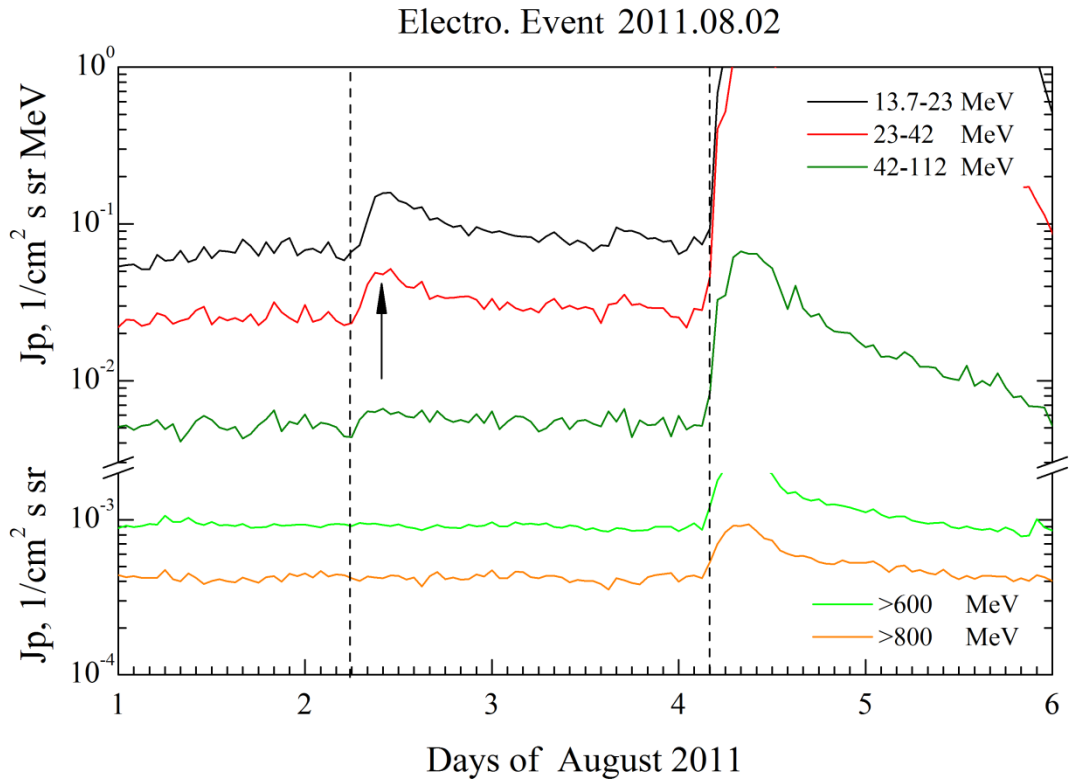
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



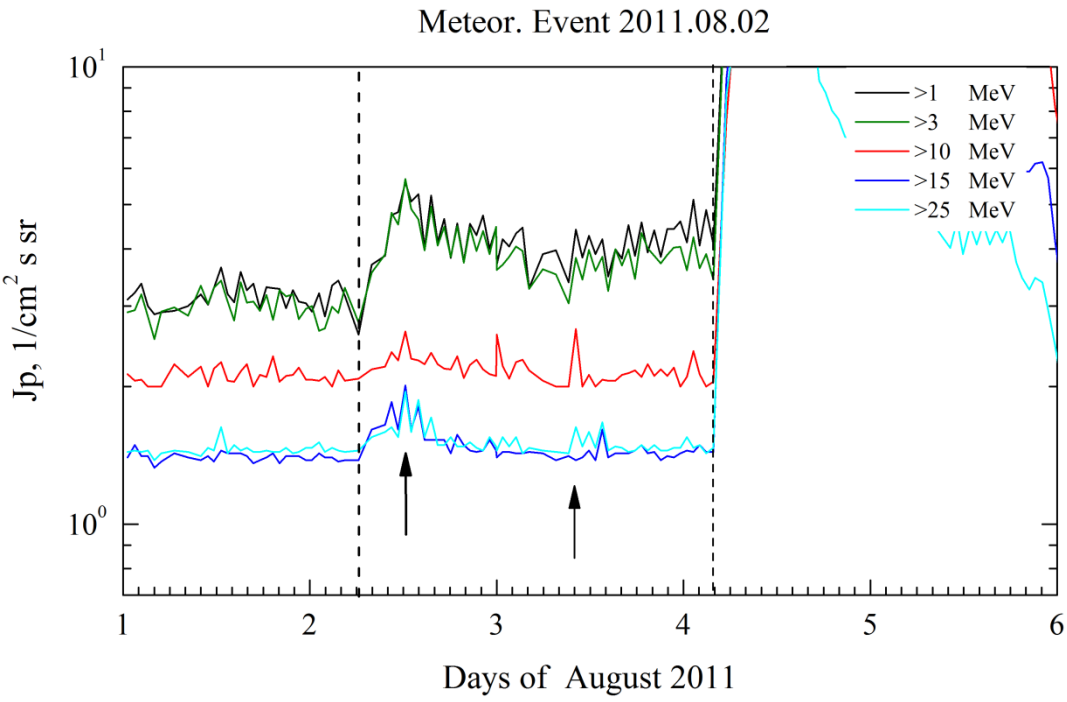


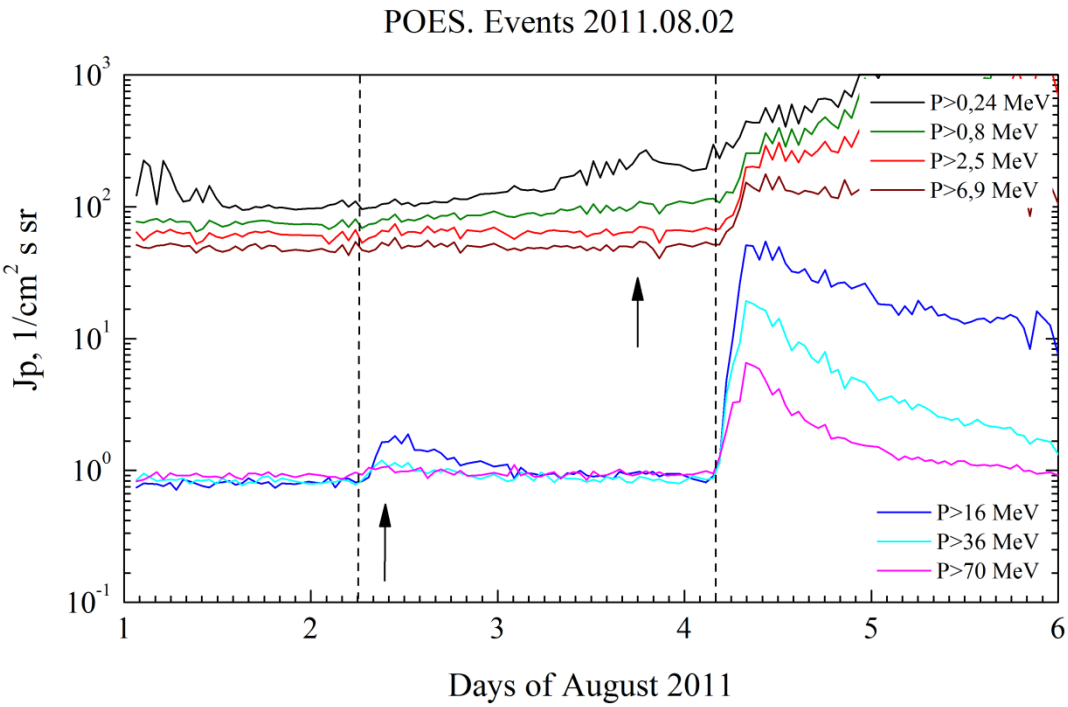
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 August 02

2011 August 02 ⊙ AR11261 To event 489

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	0525	0615	0710	N14W15	1N	
1 – 12	keV	0519	0619	0648	N17W12	M1.4	0.039

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12 – 25	keV	0456:44	0507:26	0517:12	14	48176	HESSI
12 – 25	keV	0517:12	0528:38	0530:00	104	146234	HESSI
12 – 25	keV	0603:12	0603:34	0605:20	1895	209736	HESSI
25 – 50	keV	0605:20	061222	064716	496	2707179	HESSI
6 – 12	keV	0647:16	0648:06	0700:40	76	239880	HESSI
12 – 25	keV	0520:01	0540:05	0558:47	7795	1977947	FERMI
12 – 25	keV	0646:30	0649:13	0722:00	1942	588619	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0608	0608	0609		1.89	
8.8	GHz	0600	0608	0610		2.18	
5	GHz	0600	0600	0625		2.32	
2.7	GHz	0600	0600	0625		2.34	
1.4	GHz	0559	0629	0630.0	P1.4 / 15	2.53	
245	MHz	0559	0609	~ 0649		2.79	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	023-090	0608		0622		2	
DS II	018-057	0617		0628		2	
DS IV	025-200	0612		0946		2	
DS III	100-900	0609		0609		1	
DS III	018-050	0625		0627		2	
DH II	06-15			0730			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0636	852	-15.5	268º	285º	SOHO

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 August 02

2011 August 03 Ø AR11261 To event 489

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	LPS	1320	1350	1538	N16W30	2B	ERU
1 – 12	keV	1317	1348	1410	N17W30	M6.0	0.12

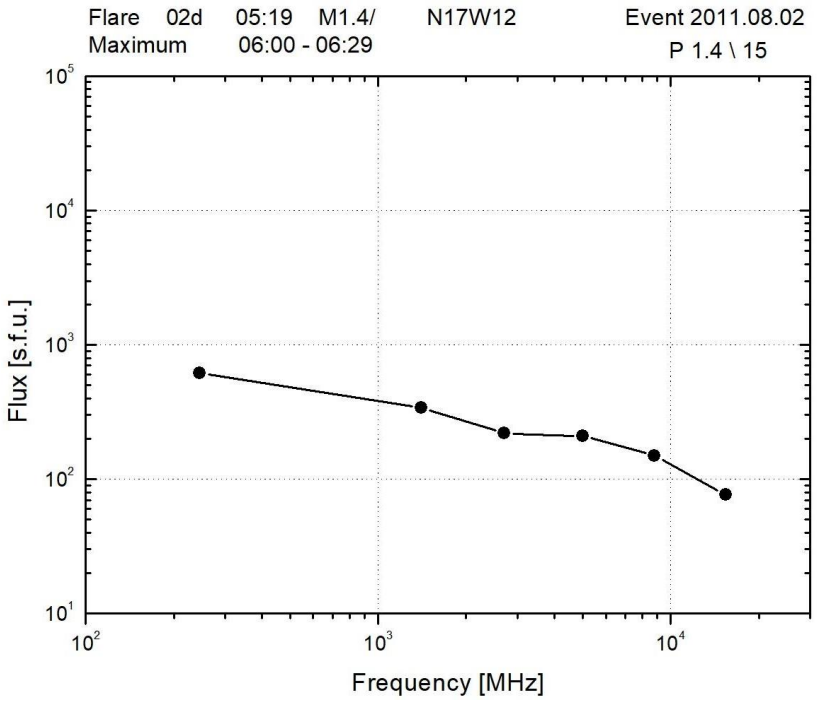
X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12-25	keV	1315:00	1324:46	1325:36	320	213669	HESSI
12-25	keV	1357:40	1358:14	1425:08	1904	4593157	HESSI
6-12	keV	1455:08	1455:26	1501:00	60	89182	HESSI
12-25	keV	1533:24	1534:02	1543:40	1200	2826040	HESSI
12-25	keV	1318:34	1335:06	1350:08	539198	333410368	FERMI
12-25	keV	1425:52	1426:04	1438:54	5207	71401	FERMI
12-25	keV	1456:37	1456:49	1514:13	1611	201501	FERMI

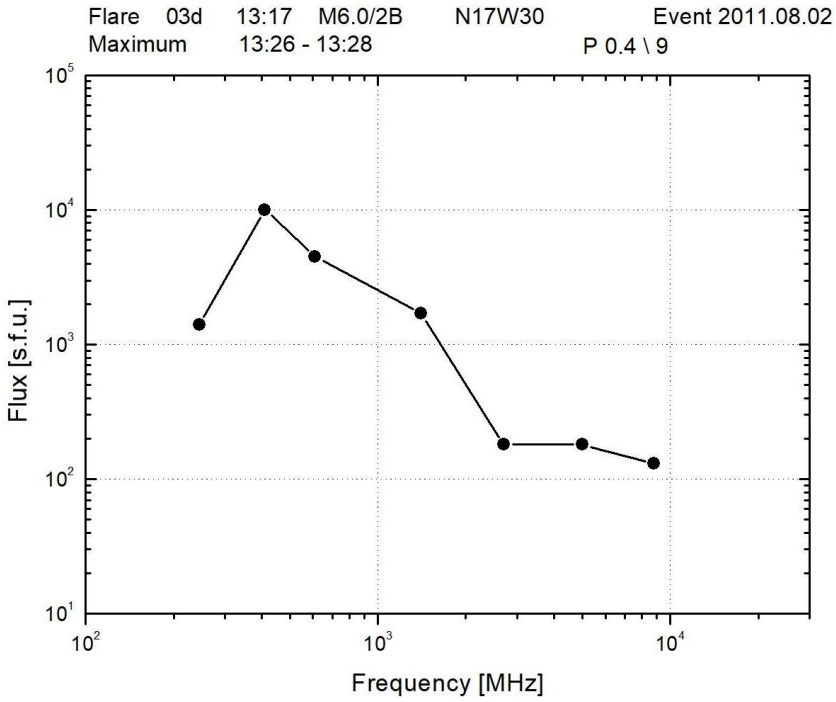
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
8.8	GHz	1327	1328	1335		2.11	
5	GHz	1326	1332	1335		2.26	
2.7	GHz	1332	1332	1335		2.26	
1.4	GHz	1332	1326	1335		3.23	
610	MHz	1323	1333	1339		3.65	
410	MHz	1321	1338	1348	P0.4 \ 9	4.0	
245	MHz	1331	1334	1335		3.15	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	025-081	1352		1344		1	
DS IV	030-080	1330		>2359		2	
DS III	025-180	1341		1341		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1400	610	-12.2	360º	307º	SOHO

Radio bursts frequency spectrum





Proton Active Region

AR11261 (N16L330, CMP 01.4.08.2011,
Sp=390 msh; Fkc; BGD)
XRI=2.71; $M_5^{9.3}$+C_{36} 2_2+1_6 +S_{82}
PFR 2-4.08 (47^h) $M_4^{9.3}$

References:

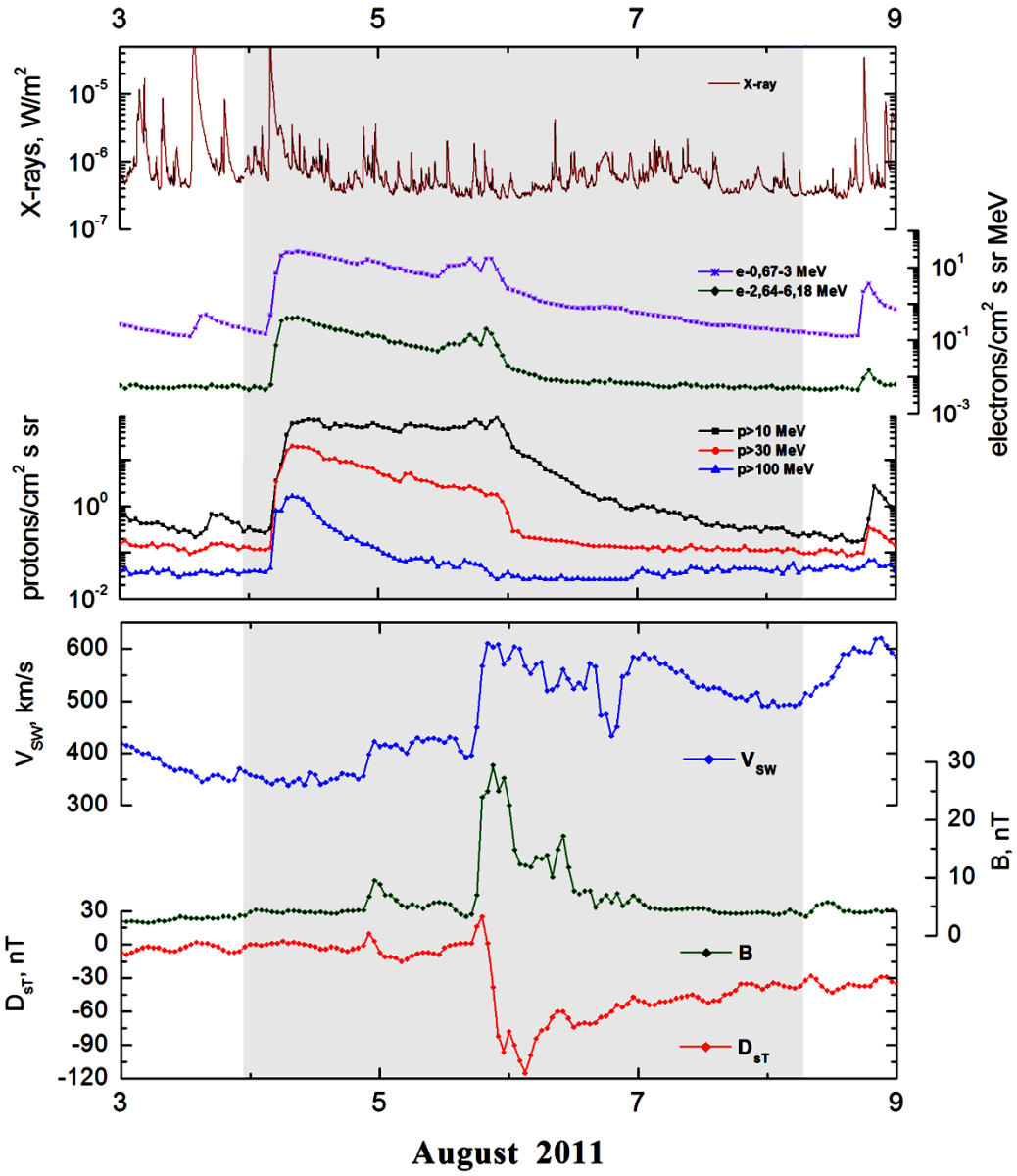
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.

Event 2011.08.04 – (2011-216) **490**

Particle event: To(Ep>10 MeV) – 04d04^h
Tmax (Ep>10 MeV) – 04d08^h, Jmax (Ep>10 MeV) – 60 /cm^2·s·sr
Duration of the event – 4 days, power-law index: $\gamma = 2.5$
Quasimaximal energy of protons in the event – Eqm = 500 MeV

Sources: ● solar flare 04d03^{h}41^m, M9.3/2B, N19W36, AR11261
Main burst X-ray 1–8 Å: onset – 04d03^{h}41^m, max – 04d03^{h}57^m, $\Phi = 0.056$ J/m^2
CME: 04d04^{h}12^m, V= 1315 km/s, $\Delta\varphi = 360°$, dA= 298°
▲SC04d21^{h}54^m; ▲SC 05d 17^{h}51^m

Particle fluxes and associated phenomena

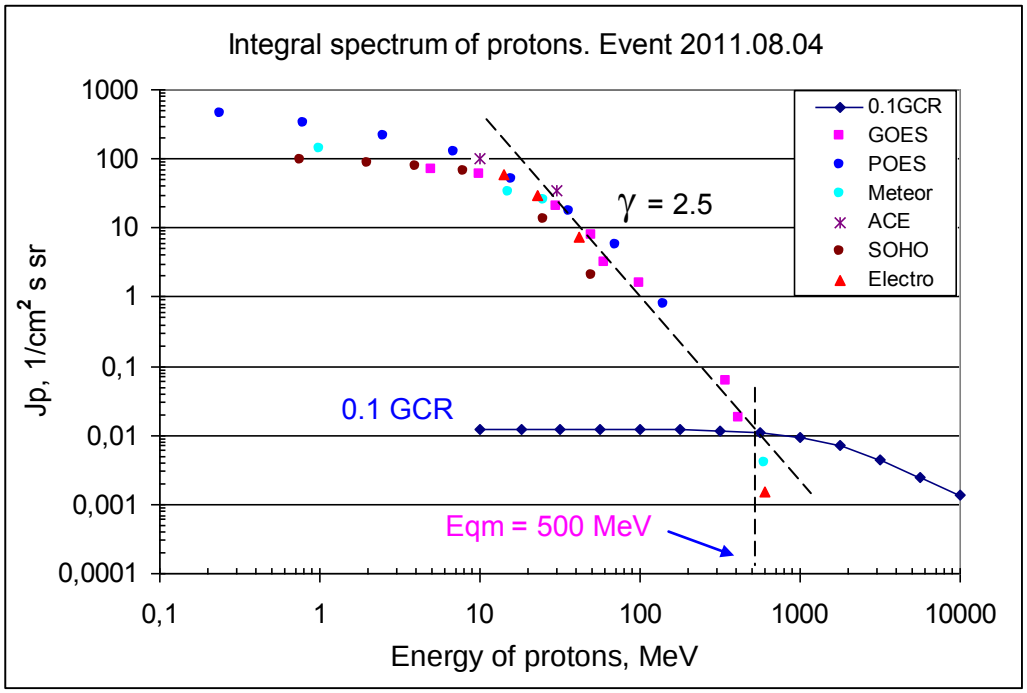


Integral fluxes of protons for the event of 2011 August 04

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	04	08	69	4	0.2	
EPS	>10	04	08	60	4	0.15	
EPS	>30	04	08	19.8	2	0.08	
EPS	>50	04	08	7.8	2	0.07	
EPS	>60	04	08	3.1	2	0.06	
EPS	>100	04	08	1.6	2	0.04	
Electro-1							
GALS-E	>600	4	8	0.0015	1	0.001	
POES-15							
MEPED	>0.24	4	8	455	4	105	
MEPED	>0.8	4	8	320	4	80	
MEPED	>2.5	4	8	210	3	65	
MEPED	>6.9	4	8	125	3	50	
MEPED	>16	4	8	50	2	0.9	
MEPED	>36	4	8	17.5	2	0.9	
MEPED	>70	4	8	5.6	1	0.95	
MEPED	>140	4	8	0.8	1	1.3	
Meteor-1							
SCR	>1	04	10	138	3	3.1	
SCR	>3	04	-	-	3	2.55	
SCR	>10	04	-	-	2	2.1	
GALS-M	>15	04	10	33	2	4.1	
GALS-M	>25	04	10	25	2	4.3	
GALS-M	>600	04	07	0.004	0.3	0.02	
ACE							
SIS	>10	04	08	102	3	1.9	
SIS	>30	04	07	35.5	2.5	1.1	
SOHO							
EPHIN	>50	05	07	2.1	2	0.3	

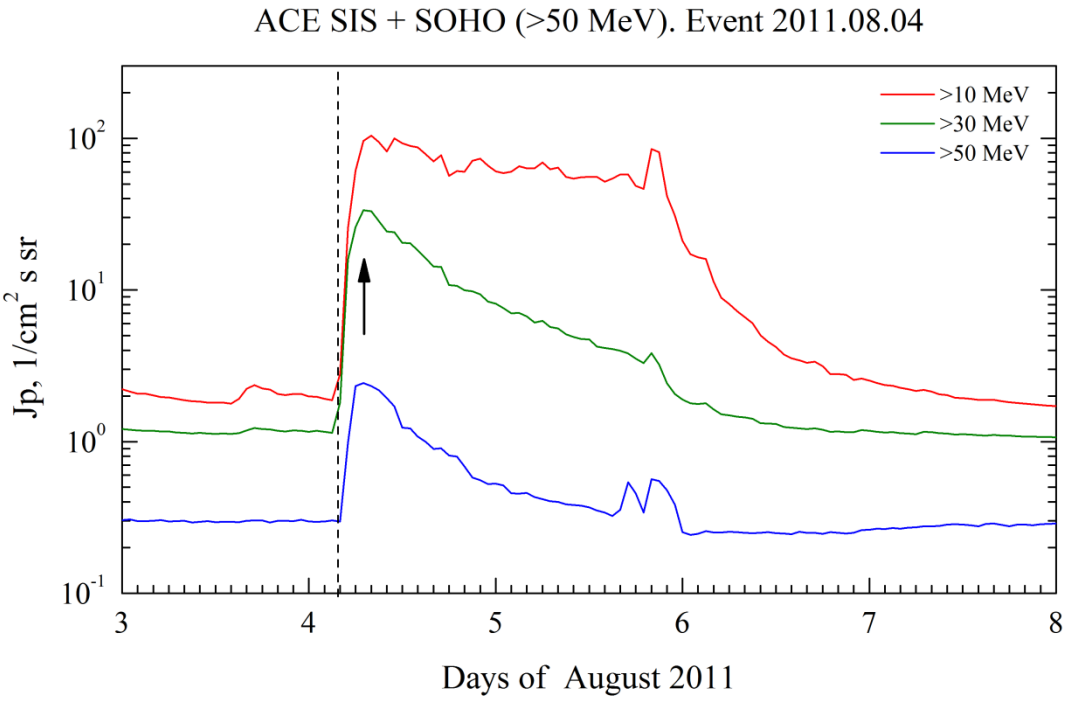
Differential fluxes of protons for the event of 2011 August 04

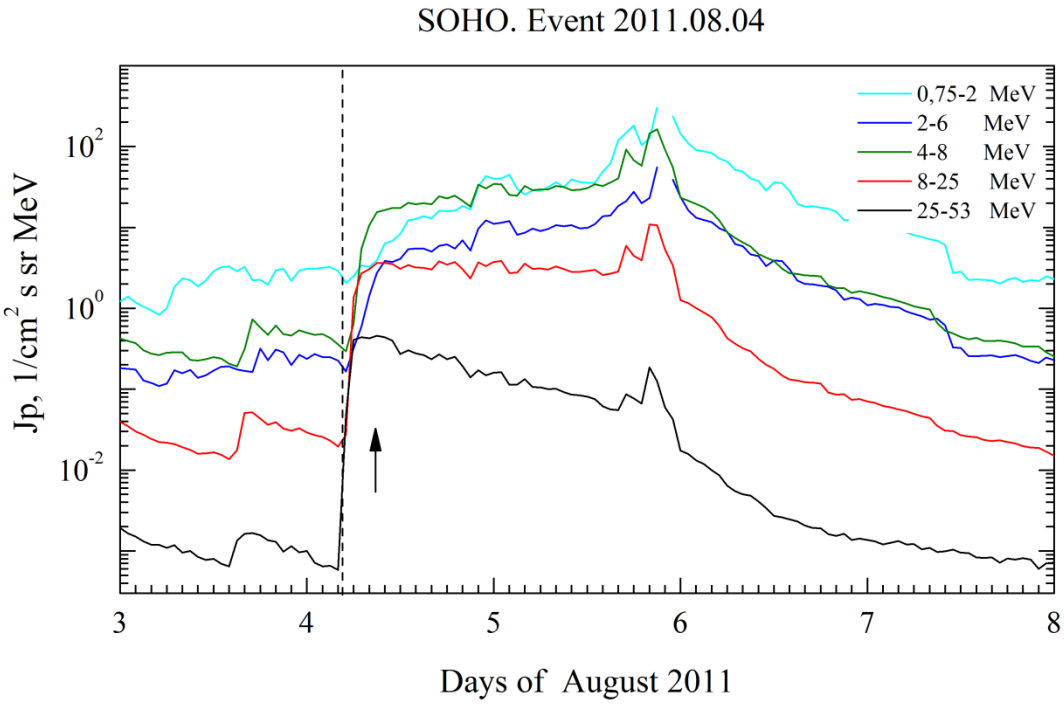
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax,. $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	5	10	5.3	5	0.018	
LION	2 – 6	5	10	3.4	5	0.0035	
EPHIN	4 – 8	5	9	3.3	5	0.0003	
EPHIN	8 – 25	5	8	3	4	0.00003	
EPHIN	25 – 53	5	7	0.4	3	0.00003	
GOES							
EPS	350–420	5	9	0.0006	1.5	0.0016	
EPS	420–510	-	9	0.00018	-	0.001	
EPS	510–700	-	-	-	-	-	
Electro-1							
SCR-E	13.7–23	4	8	3.2	3	0.1	
SCR-E	23–42	4	8	1.2	3	0.03	
SCR-E	42–112	4	8	0.06	2	0.0055	



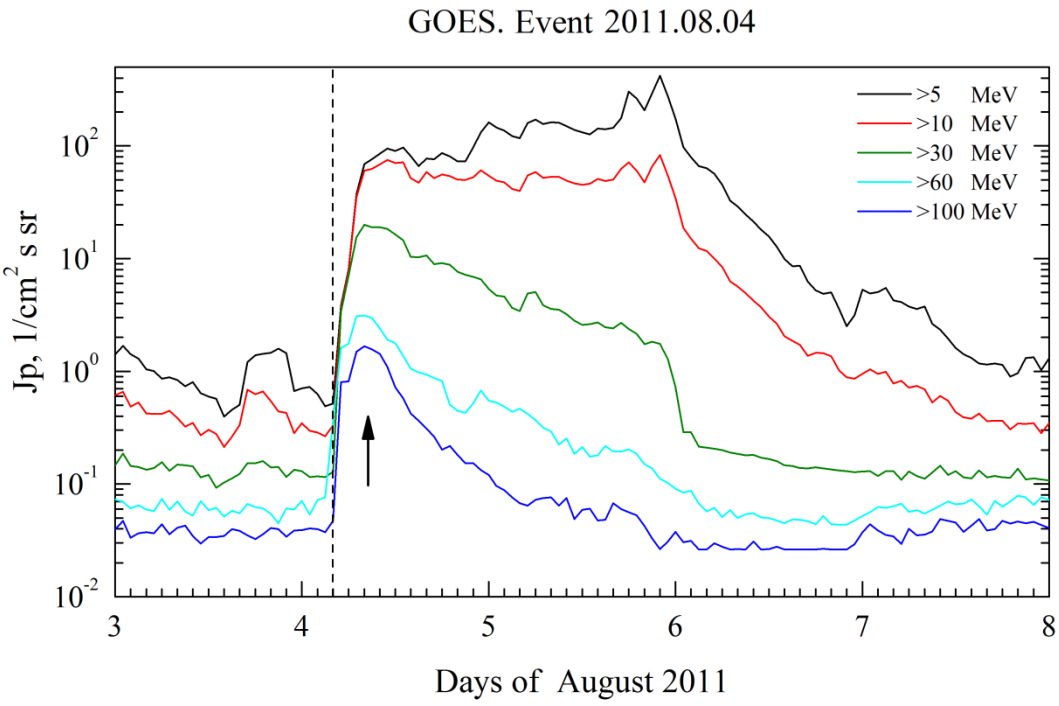
Time profiles of proton fluxes in the event 2011.08.04

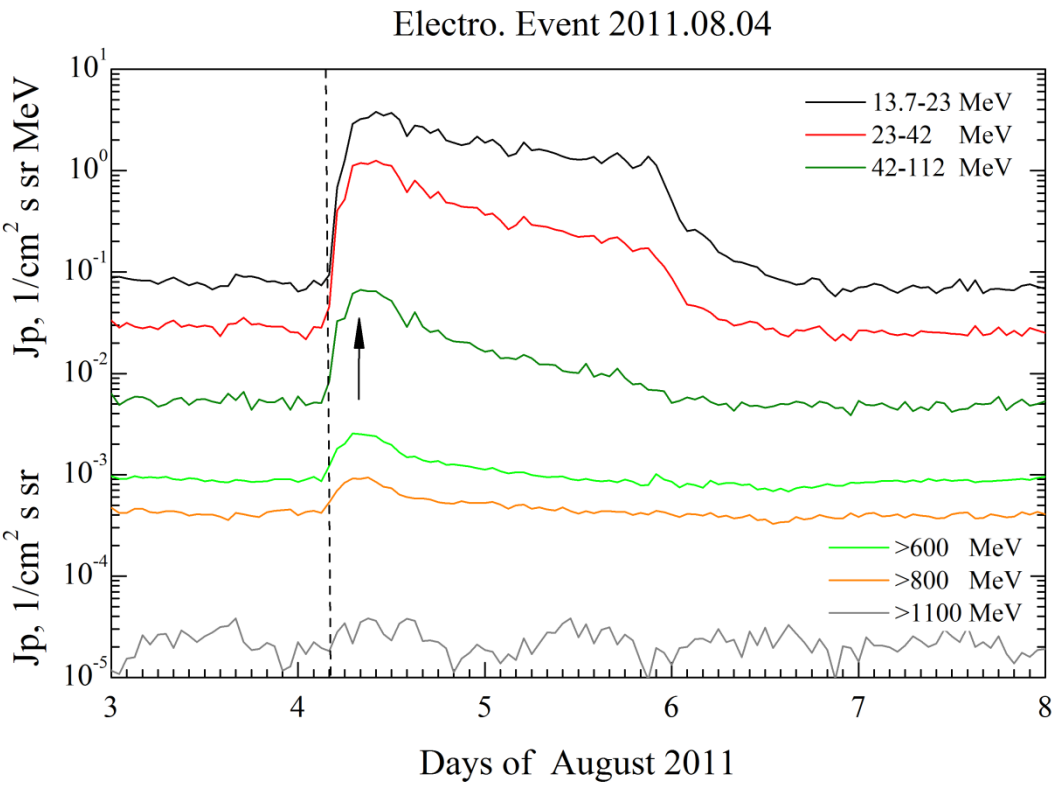
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO





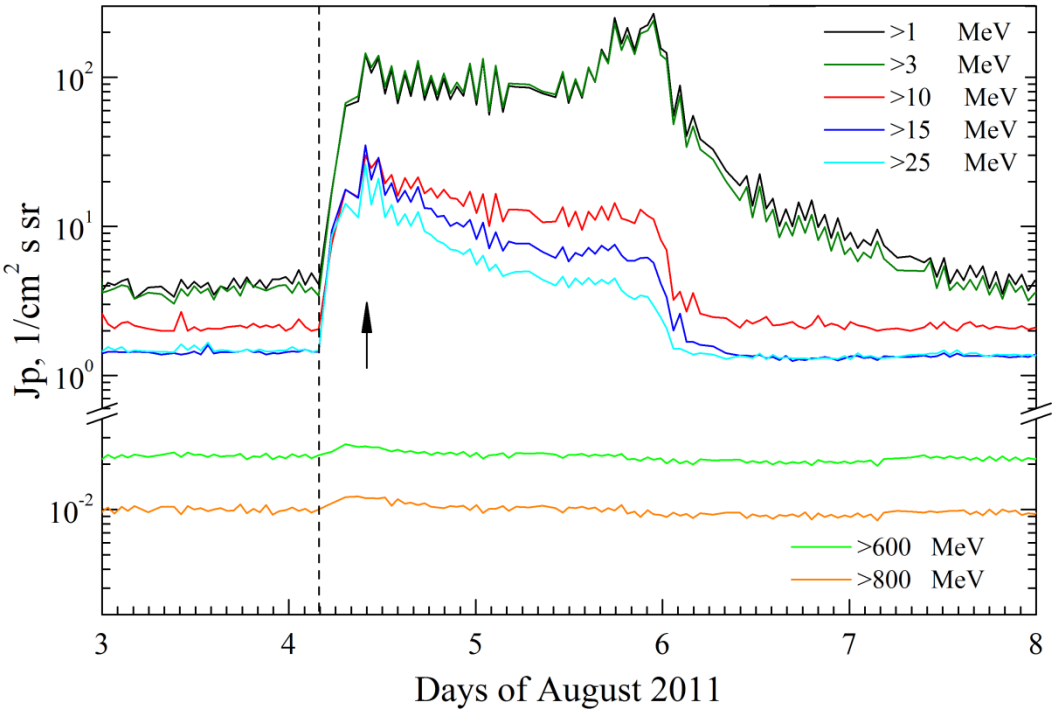
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



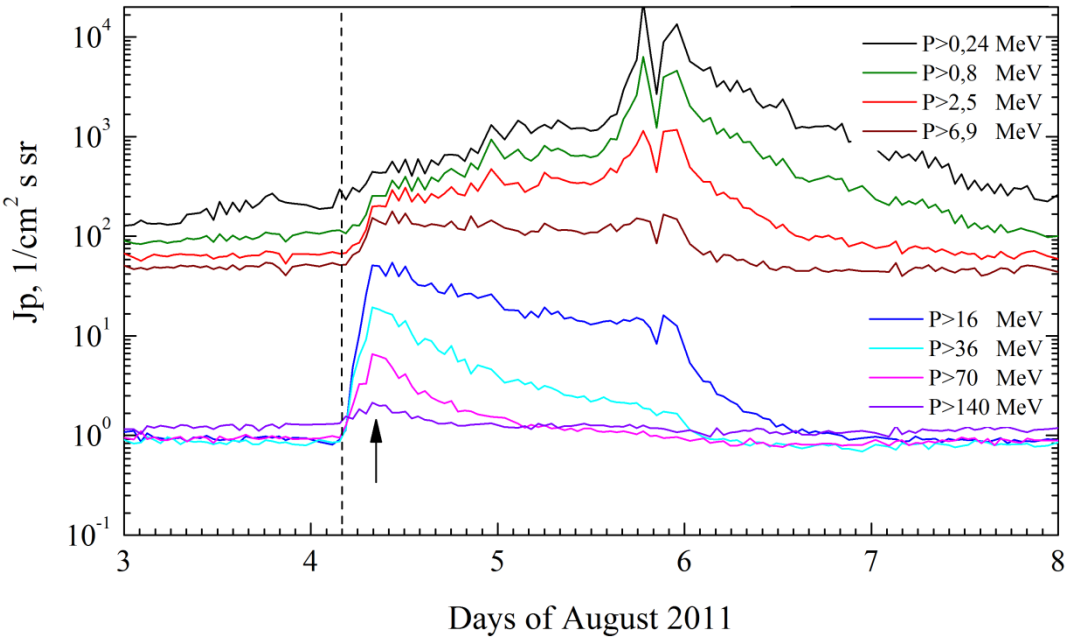


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2011.08.04



POES. Events 2011.08.04



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 August 04

2011 August 04 • AR11261 To event 490

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	0344	0355	0505	N19W36	2B	PRB
6563 Å	DSF						
1 – 12	keV	0341	0357	0404	N16W38	M9.3	0.056

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
50-100	keV	0336:20	0346:58	0347:40	184	90790	HESSI
6-12	keV	0419:12	0419:38	0450:20	1923	901803	HESSI
6-12	keV	0450:20	0451:58	0456:40	36	52280	HESSI
12-25	keV	0343:52	0354:25	0410:09	585570	181062176	FERMI
12-25	keV	0451:31	0452:04	0513:01	1043	180752	FERMI
300	keV	0455:30		0537:30		2.57E-05*	FERMI

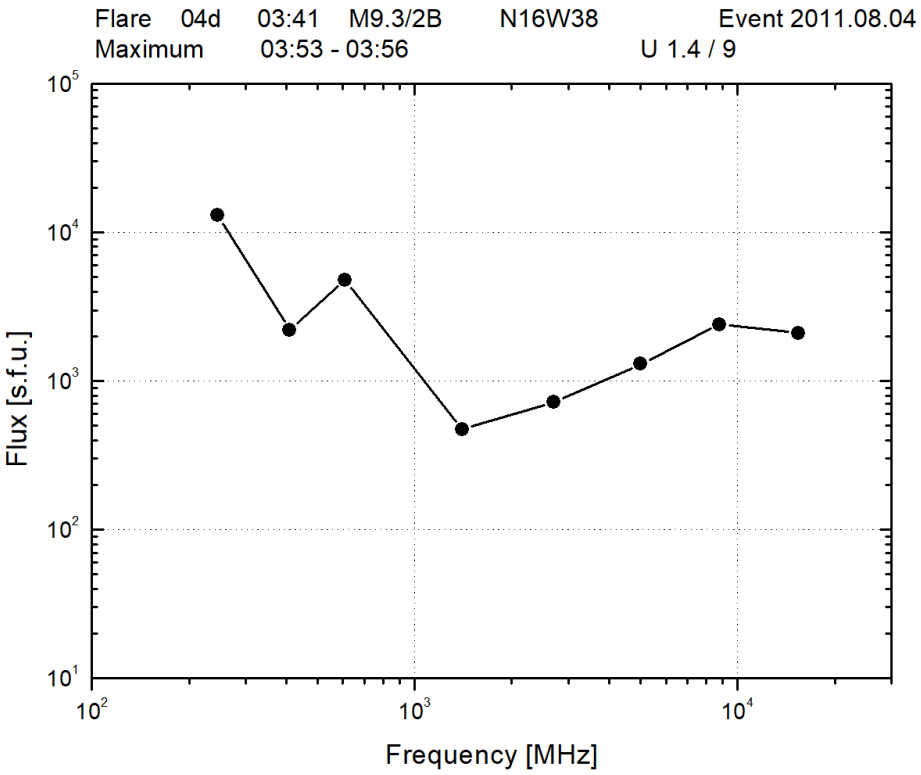
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0349	0353	0402		3.32	
8.8	GHz	0349	0353	0402	U1.4 / P8.8	3.38	
5	GHz	0349	0353	0402		3.11	
2.7	GHz	0349	0351	0401		2.86	
1.4	GHz	0349	0351	0400		2.67	
610	MHz	0351	0356	0422		3.68	
410	MHz	0350	1155	0423		3.34	
245	MHz	0351	1153	1220		4.11	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	066-180	0354		0403	750	2	
DS IV	035-180	0400		1750		1	
DS III	018-600	0350		0353		3	
DS V	025-180	0358		0401	G	3	
DS VI	025-180	0429		0947		2	
DH II	0.06-13	0415		1700			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0412	1315	-41.1	360˚	298˚	SOHO

*cm^{-2}s^{-1}

Radio burst frequency spectrum



Proton Active Region

AR11261 (N16L330, CMP 01.4.08.2011,
Sp=390 msh; Fkc; BGD)
XRI=2.71; $M_5^{9.3}$+C_{36} 2_2+1_6 +S_{82}
PFR 2-4.08 (47^h) $M_4^{9.3}$

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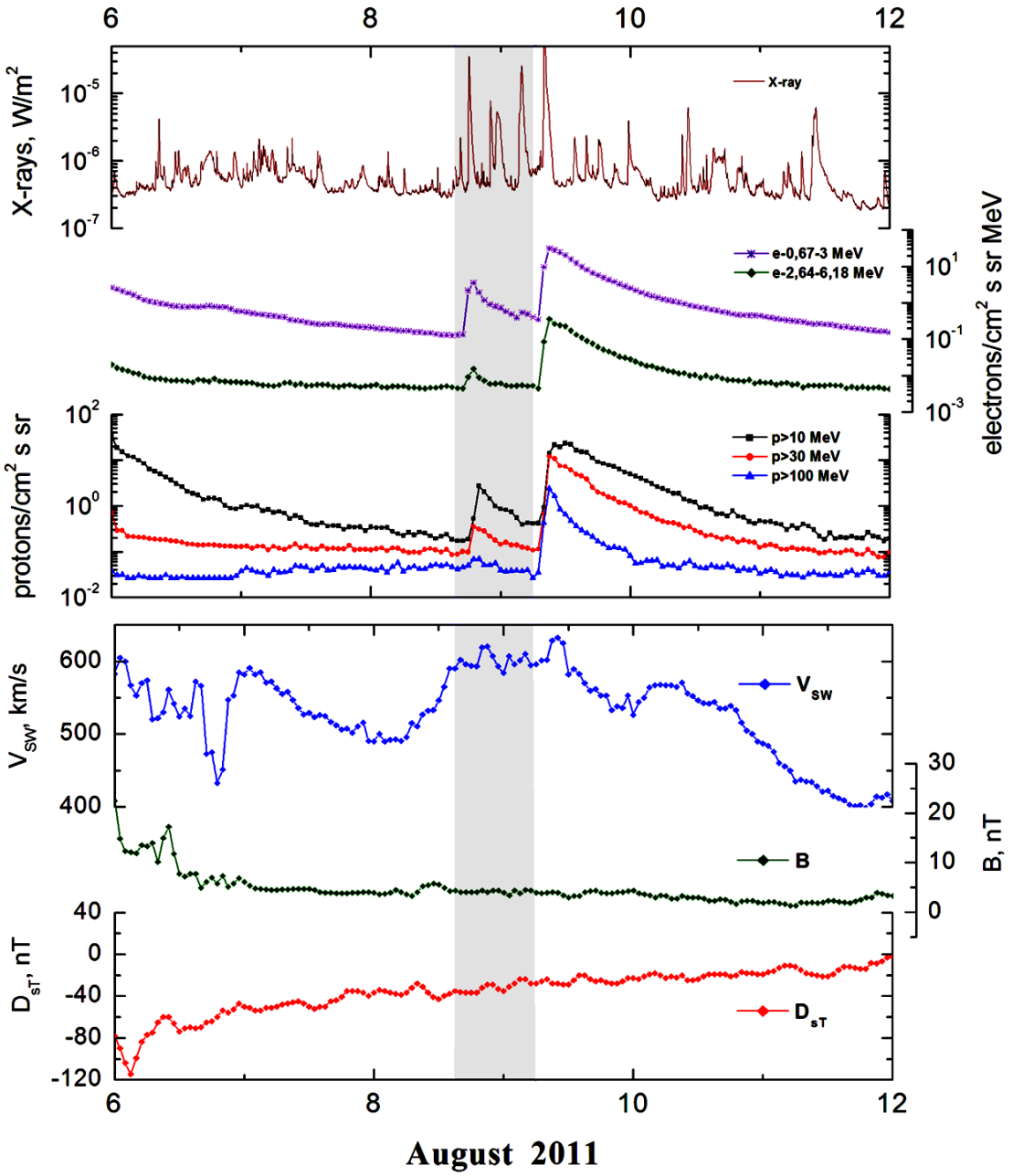
Particle event: To(Ep>10 MeV) – 08d19^h
Tmax(Ep>10 MeV) – 08d20^h, Jmax(Ep>10 MeV) – 2.6 /cm^2·s·sr
Duration of the event – 0.5 days, power-law index: $\gamma = 2.3$
Quasimaximal energy of protons in the event – Eqm = 100 MeV

Sources: ● solar flare 08d18^{h}00^m, M3.5/1B, N16W61, AR11263
Main burst X-ray 1–8 Å: onset – 08d18^{h}00^m, max – 08d18^{h}10^m, $\Phi = 0.022$ J/m^2
CME: 18d18^{h}12^m, V= 1343 km/s, $\Delta\varphi = 237°$, dA= 281°

Particle fluxes and associated phenomena

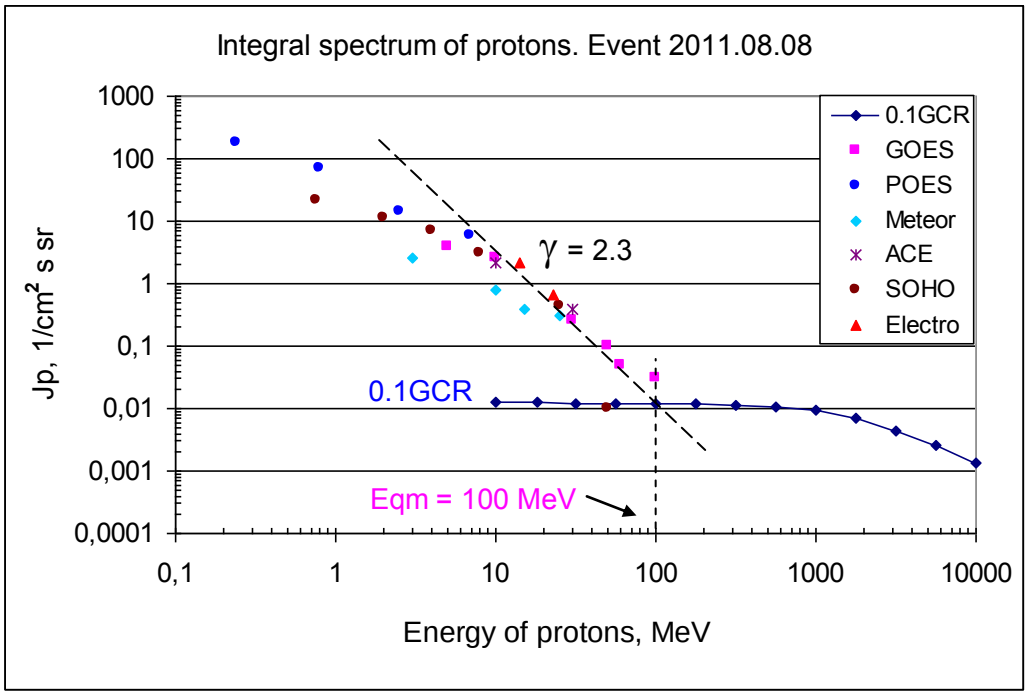


Integral fluxes of protons for the event of 2011 August 08

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	19	21	4	0.5	0.2	
EPS	>10	19	20	2.6	0.5	0.15	
EPS	>30	19	19	0.25	0.5	0.08	
EPS	>50	19	19	0.1	0.5	0.07	
EPS	>60	19	19	0.05	0.5	0.06	
EPS	>100	19	19	0.03	0.5	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	23	9d03	180	0.5	150	
MEPED	>0.8	23	9d03	70	0.5	80	
MEPED	>2.5	23	9d02	14	0.5	60	
MEPED	>6.9	-	9d02	6	0.5	45	
MEPED	>16	-	-	-	-	0.9	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1.2	
Meteor-1							
SCR	>1	18	-	-	0.5	3.1	
SCR	>3	18	19	2.6	0.5	3	
SCR	>10	18	19	0.8	0.5	2.1	
GALS-M	>15	18	19	0.4	0.5	0.7	
GALS-M	>25	18	19	0.3	0.5	0.7	
GALS-M	>600	-	-	-	0.25	0.02	
ACE							
SIS	>10	17	19	2.1	0.5	1.6	
SIS	>30	17	19	0.4	0.5	1.1	
SOHO							
EPHIN	>50	18	19	0.01	06	0.3	

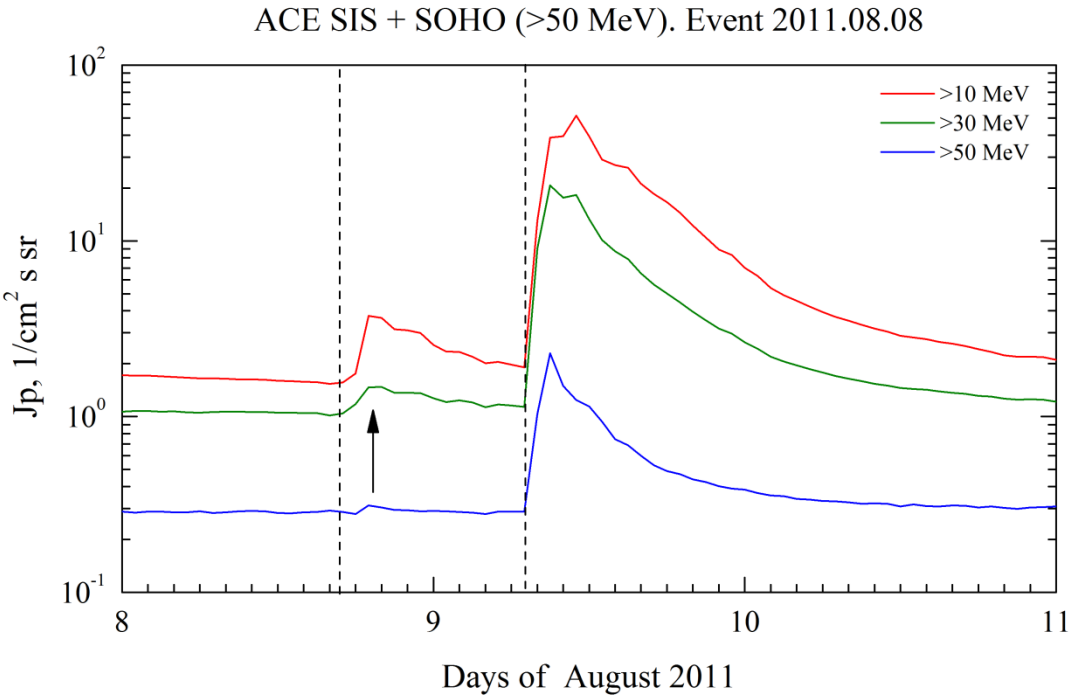
Differential fluxes of protons for the event of 2011 August 08

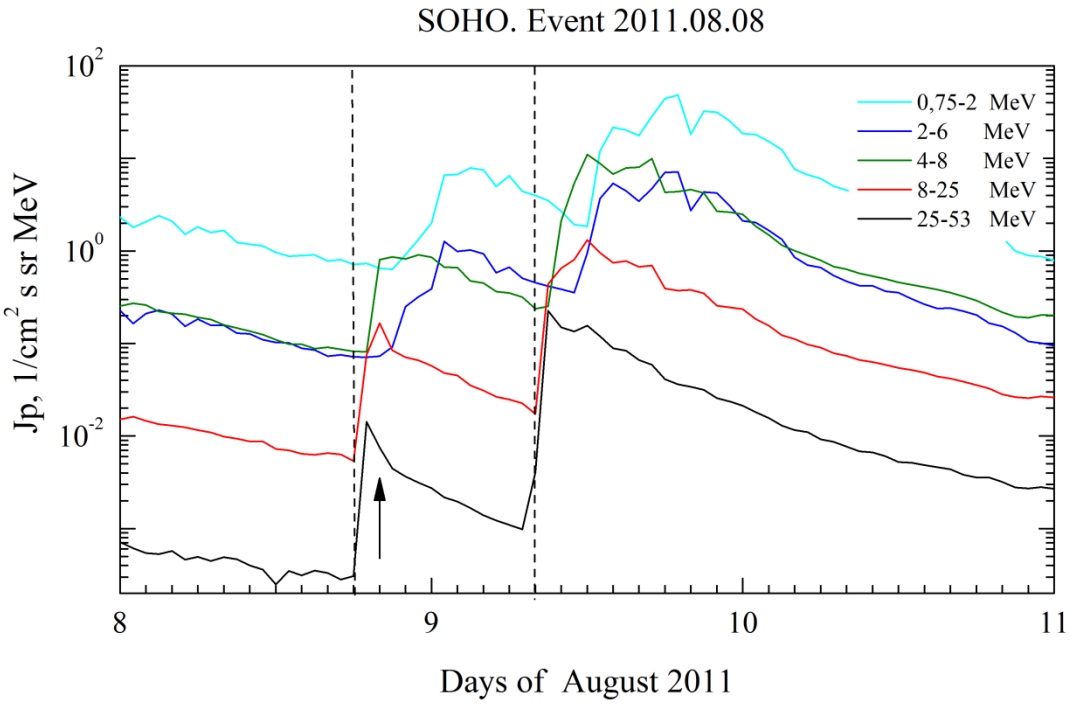
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	21	9d08	7.9	0.6	0.02	
LION	2 – 6	21	9d00	1.27	0.6	0.0035	
EPHIN	4 – 8	19	23	1.0	0.6	0.0003	
EPHIN	8 – 25	19	19	0.16	0.6	0.00003	
EPHIN	25 – 53	18	20	0.015	0.6	0.00003	
Electro-1							
SCR-E	13.7–23	18	19	0.15	0.25	0.025	
SCR-E	23–42	18	19	0.035	0.25	0.05	
SCR-E	42–112	-	-	-	-	0.001	


Integral spectrum of protons. Event 2011.08.08
Jp, 1/cm2 s sr
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.3
0.1GCR
Eqm = 100 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

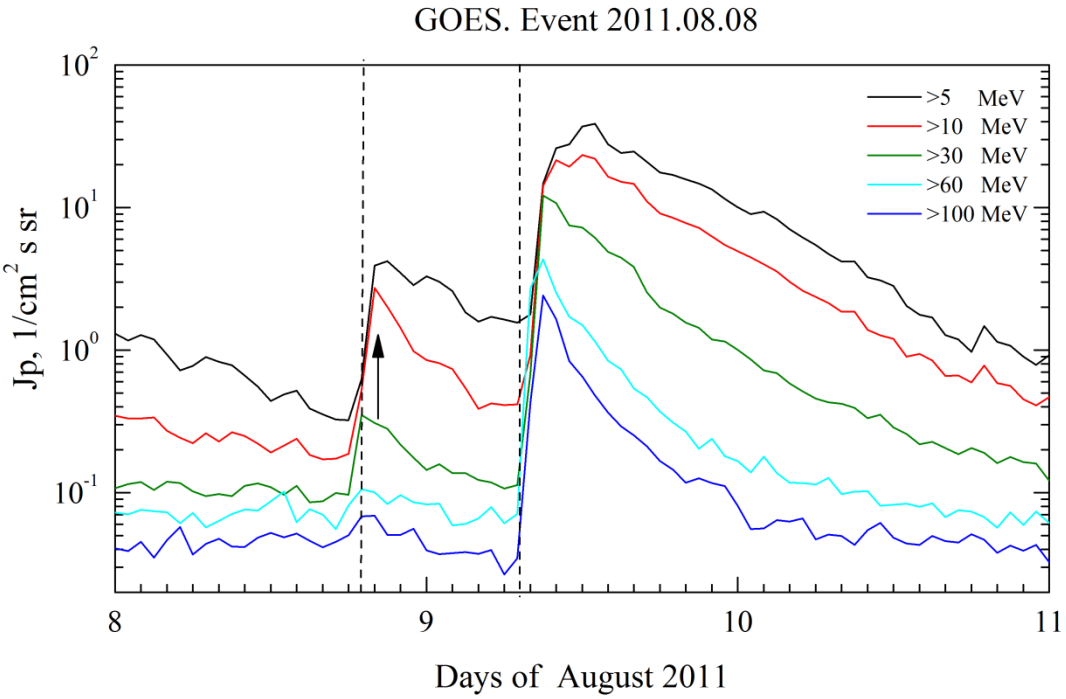
Time profiles of proton fluxes in the event 2011.08.08

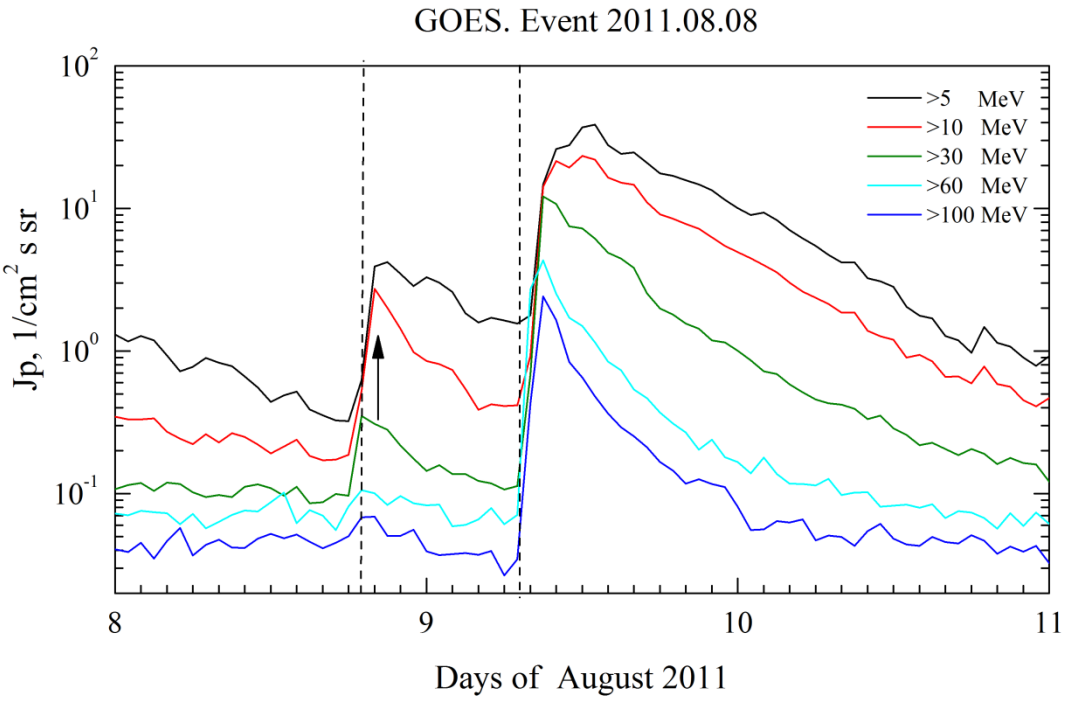
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO





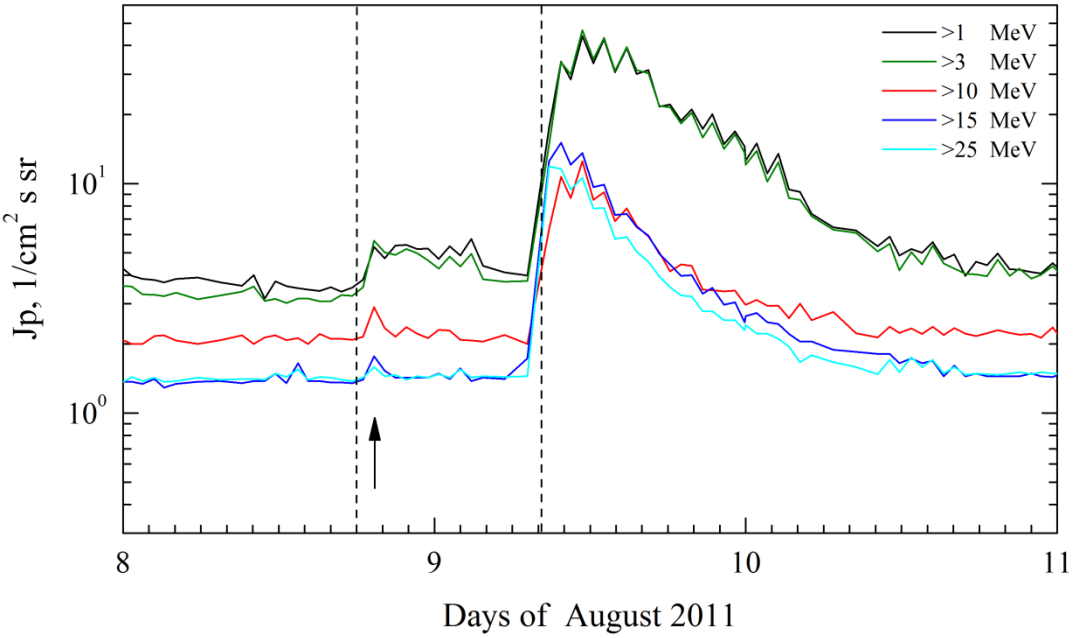
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



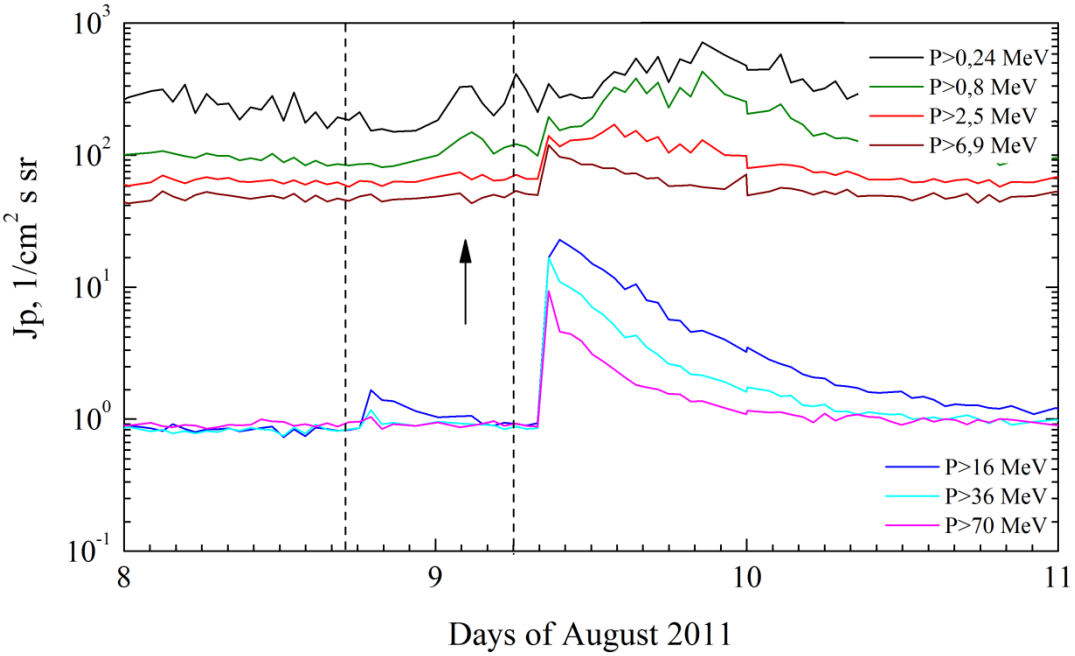


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2011.08.08



POES. Events 2011.08.08

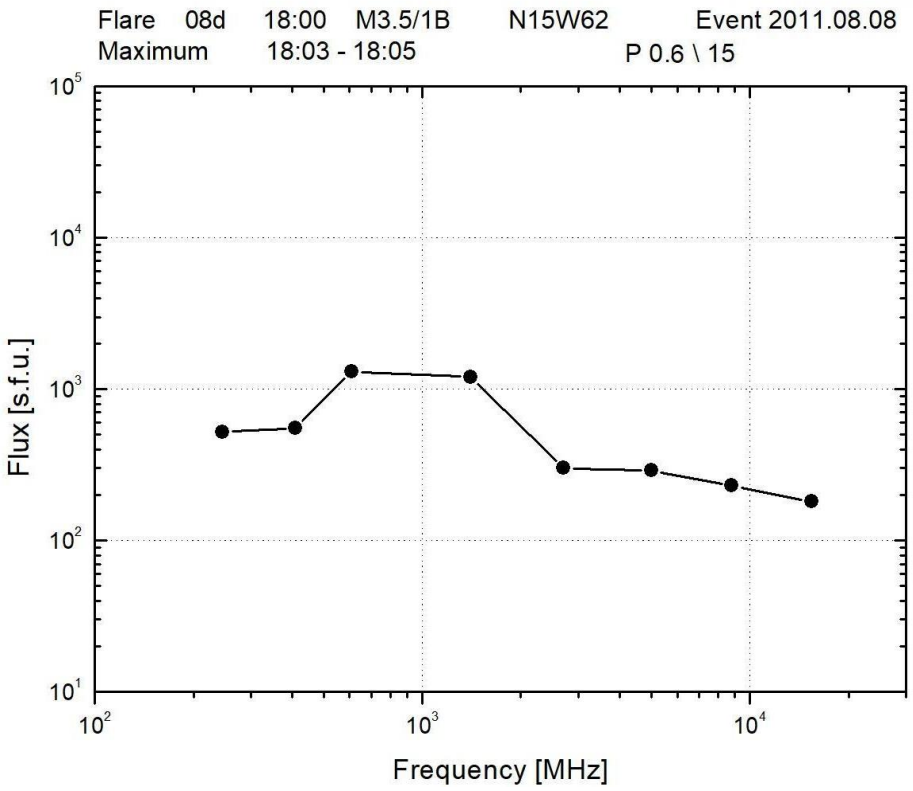


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 August 08

2011 August 08 ● AR 11263 To event 491

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	1804	1810	1855	N16W61	1B	ERU
1 – 12	keV	1800	1810	1818	N15W62	M3.5	0.022
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1826:40	1827:34	1907:12	46	123972	HESSI
12-25	keV	1802:34	1803:48	1804:05	45033	1401419	HESSI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1803	1803	1805		2.25	
8.8	GHz	1803	1803	1805		2.36	
5	GHz	1803	1803	1818		2.46	
2.7	GHz	1803	1805	1818		2.48	
1.4	GHz	1803	1804	1817		3.08	
610	MHz	1803	1805	1812	P0.6 \ 15	3.11	
410	MHz	1803	1804	1808		2.74	
245	MHz	1803	1804	1826		2.72	
410	MHz	1846	1847	1849		2.25	
245	MHz	1832	1833	1849		2.20	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-135	1803		1816		1	
DS IV	025-180	1803		2111		2	
DS VI	025-180	1800		1752		2	
DH II	0.4-6	1810		2010			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1812	1343	-42.3	237˚	281˚	SOHO

Radio burst frequency spectrum



Proton Active Region

AR11263 (N17L301, CMP 03.5.08.2011,
Sp=720 msh; Ekc; BGD)
XRI=7.67, $X_1^{6.9}$+$M_3^{3.5}$+C_{33}; 2_1+1_3+S_{96})
PFR 8-9.08 (14^h) $X_1^{6.9}$+$M_2^{3.5}$

References:

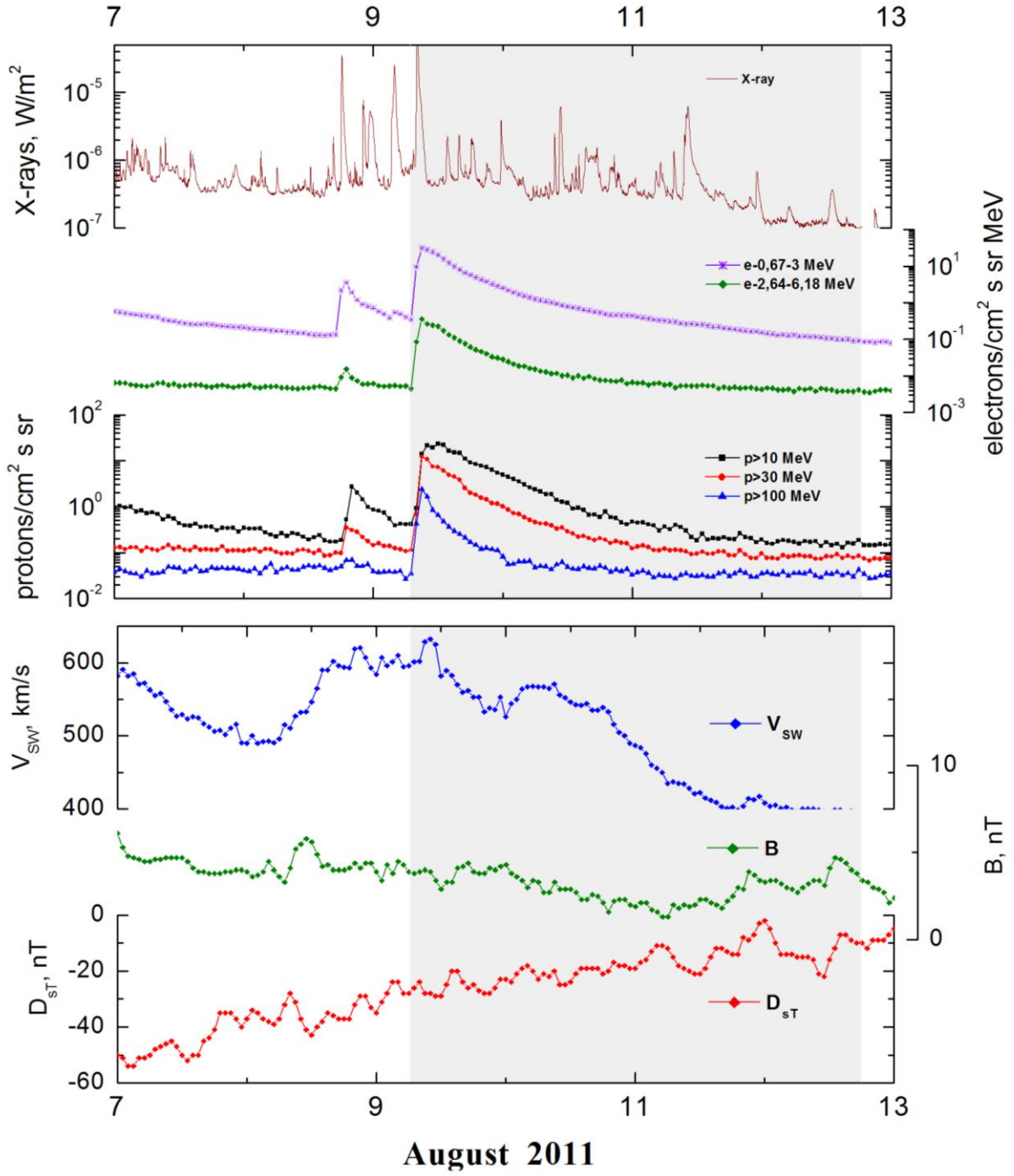
Bruevich E.A., G.V. Yakunina, 2017.
Kahler S.W., D. Brown, 2021.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.

Event 2011.08.09 – (2011-221) **492**

Particle event: To(Ep>10 MeV) – 09d08^h
Tmax(Ep>10 MeV) – 09d10^h, Jmax(Ep>10 MeV) – 21.3 /cm^2·s·sr
Duration of the event – 2.5 days, power-law index: γ = 2.3
Quasimaximal energy of protons in the event – Eqm = 650 MeV

Sources: ● solar flare 09d07^{h}48^m, X6.9/2B, N17W69, AR11263
Main burst X-ray 1–8 Å: onset – 09d07^{h}48^m, max – 09d08^{h}05^m, Φ = 0. 190 J/m^2
CME: 09d08^{h}12^m, V= 1610 km/s, Δφ = 360º, dA= 279º

Particle fluxes and associated phenomena

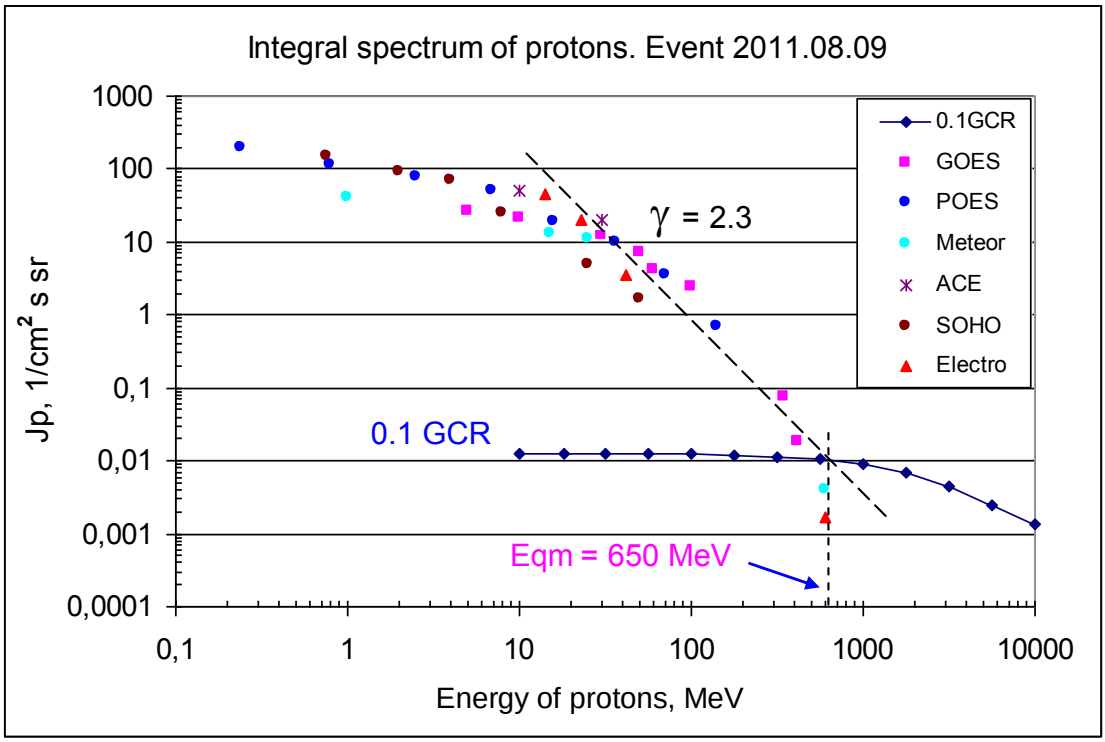


Integral fluxes of protons for the event of 2011 August 09

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	08	10	26	2.5	0.2	
EPS	>10	08	10	21.3	2.5	0.15	
EPS	>30	08	09	12.1	2	0.08	
EPS	>50	08	09	7.2	2	0.07	
EPS	>60	08	09	4.25	1.5	0.06	
EPS	>100	08	09	2.4	1.5	0.04	
Electro-1							
GALS-E	>600	8	9	0.0017	0.5	0.001	
POES							
MEPED	>0.24	6	10	195	2.5	150	
MEPED	>0.8	6	10	115	2	80	
MEPED	>2.5	6	10	80	2	60	
MEPED	>6.9	6	10	50	1.5	45	
MEPED	>16	6	10	19	1.5	0.9	
MEPED	>36	6	10	10	1	0.9	
MEPED	>70	6	10	3.5	0.5	0.9	
MEPED	>140	6	10	0.7	5	1.2	
Meteor-1							
SCR	>1	6	11	40	2	3.1	
SCR	>3	6	-	-	2	2.55	
SCR	>10	6	-	-	1	2.1	
GALS-M	>15	6	9	13	1	0.7	
GALS-M	>25	6	8	11	1	0.75	
GALS-M	>600	6	8	0.004	0.25	0.02	
ACE							
SIS	>10	08	11	50	2.5	1.6	
SIS	>30	08	09	19.6	2	1.1	
SOHO							
EPHIN	>50	06	09	1.7	1	0.3	

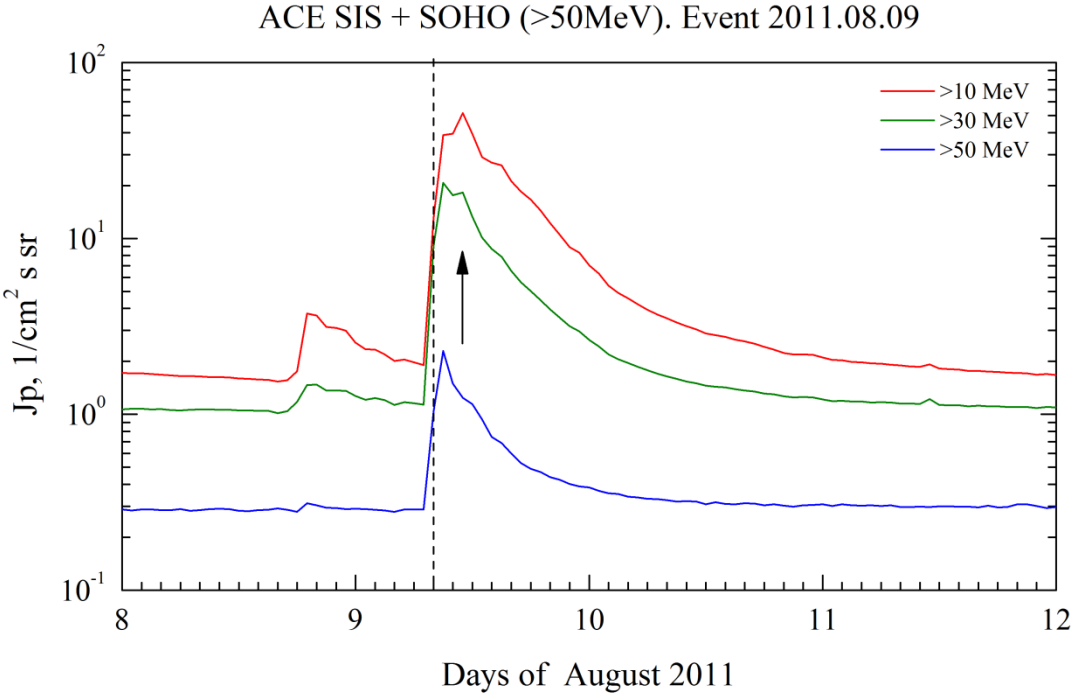
Differential fluxes of protons for the event of 2011 August 09

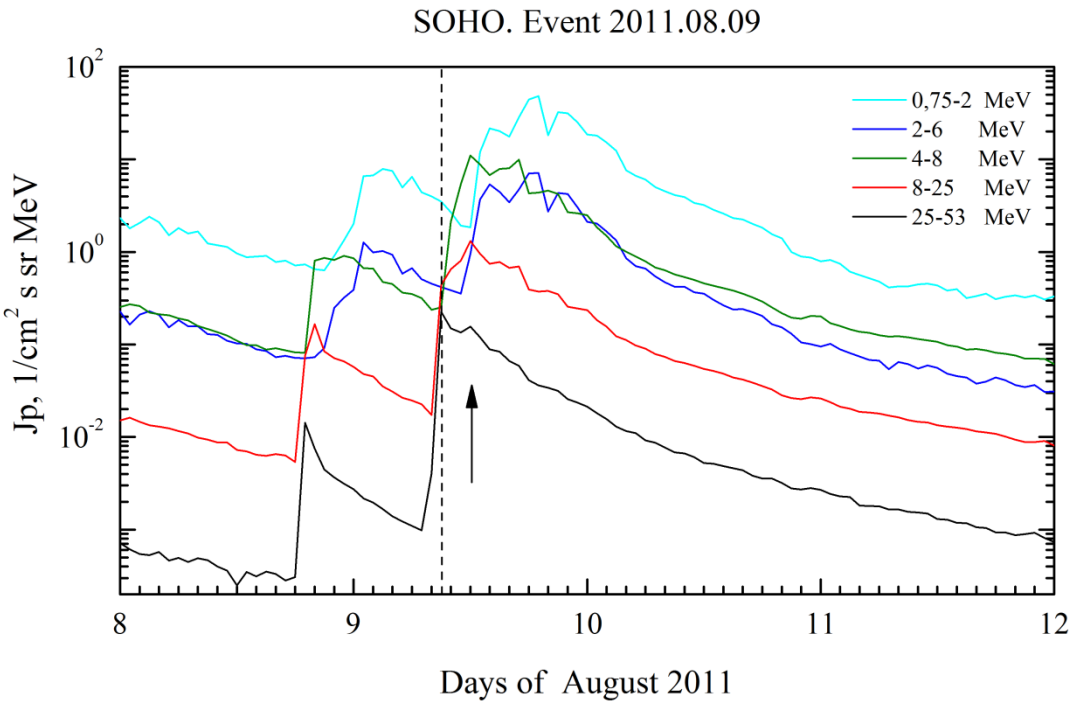
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	12	18	48.4	5	0.018	
LION	2 – 6	11	18	7.15	5	0.0035	
EPHIN	4 – 8	09	12	10.9	7	0.0003	
EPHIN	8 – 25	08	12	1.2	7	0.00003	
EPHIN	25 – 53	08	11	0.11	5	0.00003	
GOES							
EPS	350–420	8	9	0.0008	0.5	0.0016	
EPS	420–510	7	9	0.0002	0.3	0.001	
EPS	510–700	-	-	-	-	0.0001	
Electro-1							
SCR-E	13.7–23	8	9	2.8	1.5	0.068	
SCR-E	23–42	8	9	0.87	1.5	0.026	
SCR-E	42–112	8	9	0.05	1	0.005	



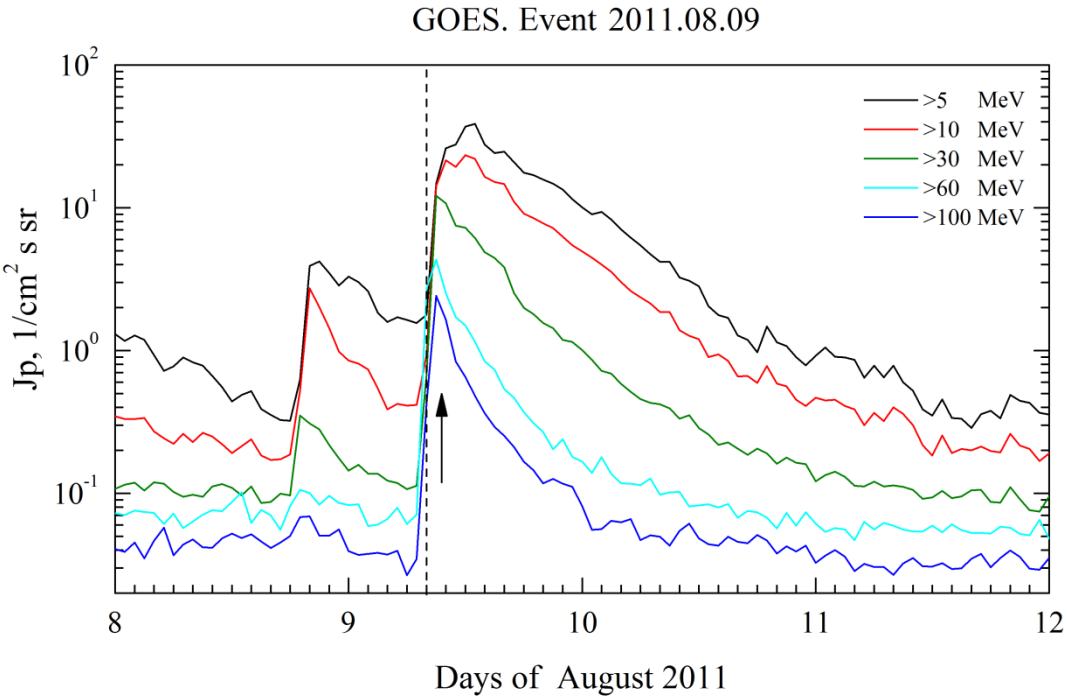
Time profiles of proton fluxes in the event 2011.08.09

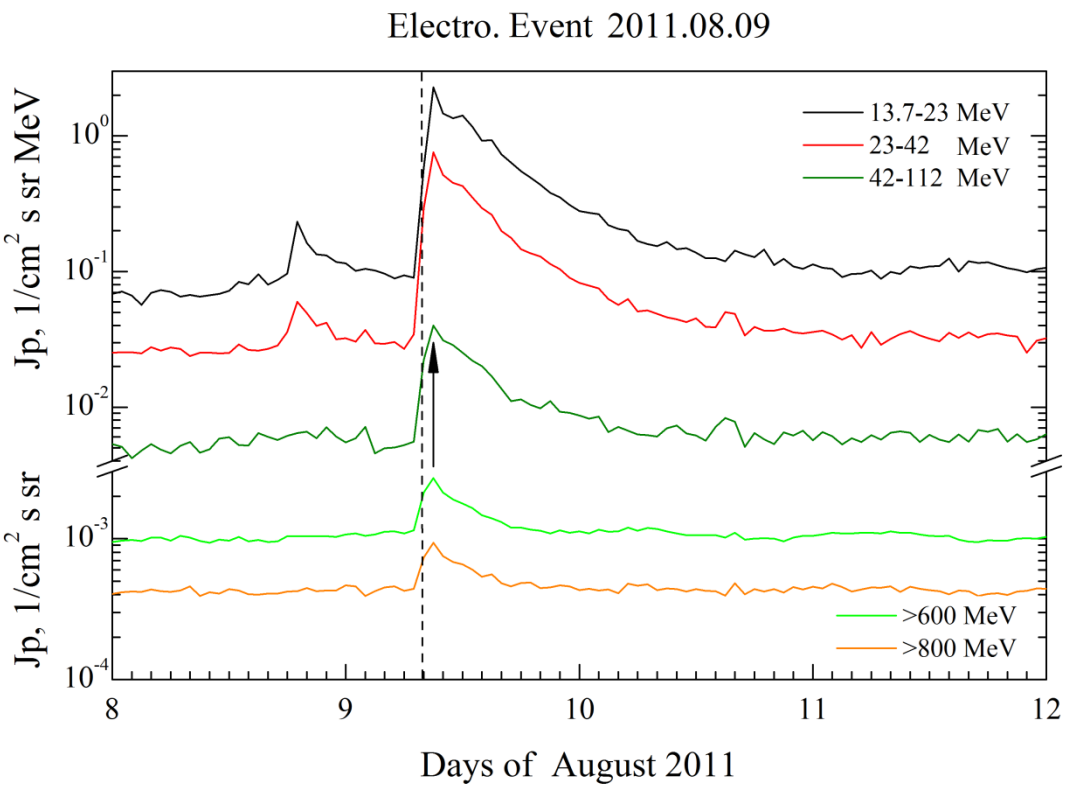
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



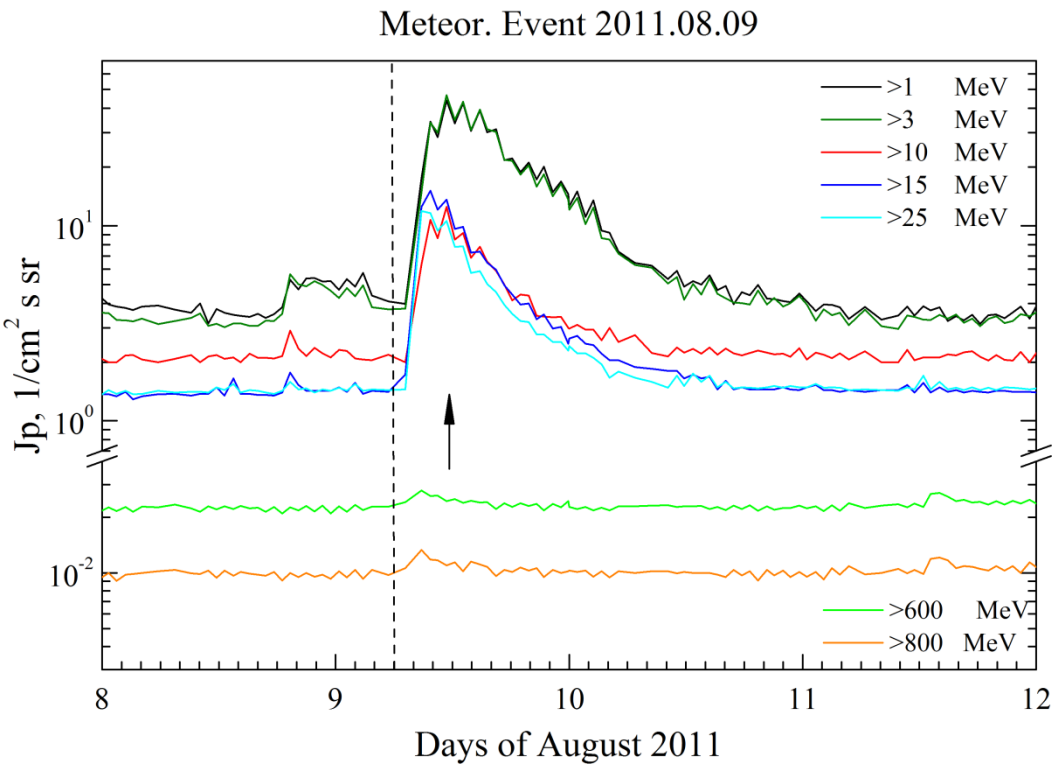


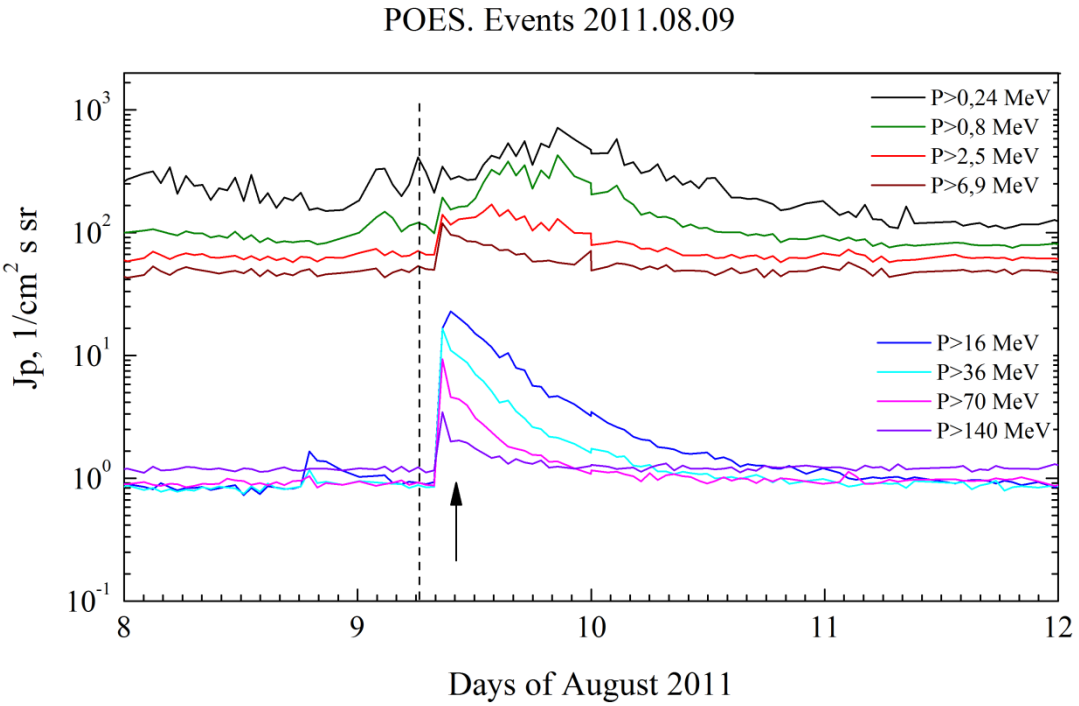
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 August 09

2011 August 09 • AR 11263 To event 492

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	0754	0806	0904	N17W69	2B	ERU
1 – 12	keV	0748	0805	0808	N14W69	X6.9	0.19

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
25-50	keV	0744:36	0804:34	0822:12	53158	73353352	HESSI
12-25	keV	0848:56	0849:42	0900:16	100	188364	HESSI
6-12	keV	0900:16	0901:54	0902:00	40	17440	HESSI
12-25	keV	0749:53	0807:46	0824:10	1192144	454029280	FERMI
300	keV	0748		0808			FERMI*

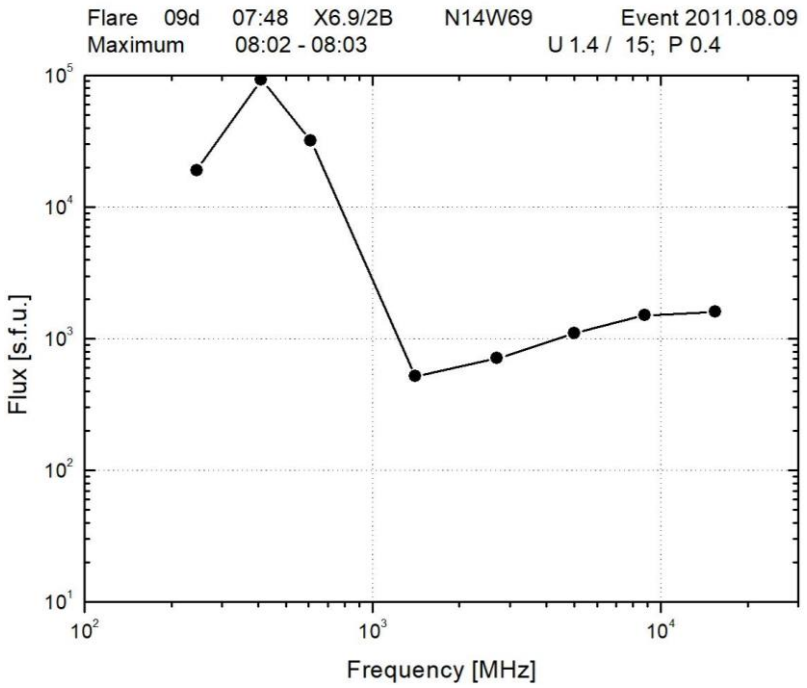
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0801	0803	0807		3.2	
8.8	GHz	0801	0803	0807		3.18	
5	GHz	0801	0802	0807		3.04	
2.7	GHz	0801	0802	0806		2.85	
1.4	GHz	0801	0802	0806	U1.4 / 15	2.72	
610	MHz	0759	0802	0806		4.51	
410	MHz	0800	0802	0808	P 0.4	4.97	
245	MHz	0800	0802	0809		4.28	
5	GHz	0818	0818	0818		2.15	
2.7	GHz	0817	0818	0819		2.41	
1.4	GHz	0817	0818	0819	P0.2 \ 5	2.69	
610	MHz	0818	0818	0819		2.62	
410	MHz	0817	0818	0819		3.15	
245	MHz	0817	0818	0820		3.91	

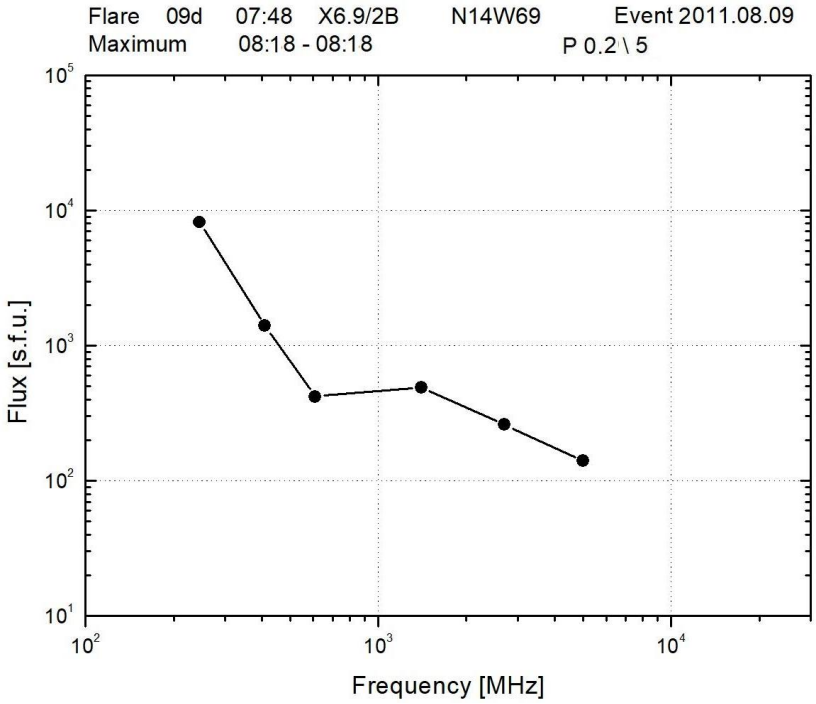
DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	025-180	0801		0816		1	
DS IV	025-084	0820		0840		1	
DS III	025-180	0817		0819	G	1	
DS VI	025-151	0838		0920	G	1	
DH II	4-16	0820		0835			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0812	1610	-40.6	360˚	279˚	SOHO

*Share et al., 2018

Radio bursts frequency spectrum





Proton Active Region

AR11263 (N17L301, CMP 03.5.08.2011,
Sp=720 msh; Ekc; BGD)
XRI=7.67, $X_1^{6.9}$+$M_3^{3.5}$+C_{33}; 2_1+1_3+S_{96})
PFR 8-9.08 (14^h) $X_1^{6.9}$+$M_2^{3.5}$

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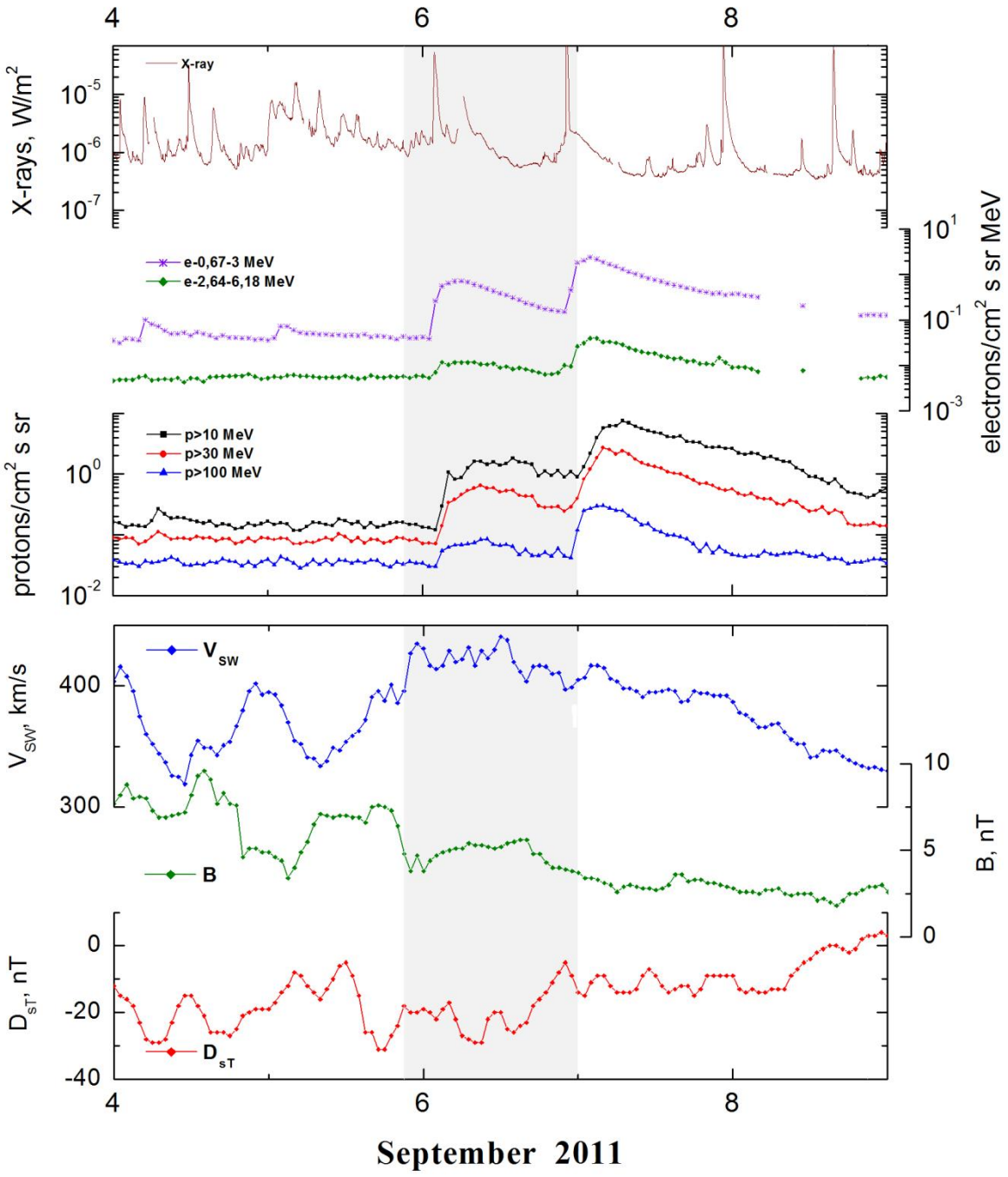
Particle event: To(Ep>10 MeV) – 06d02^h
Tmax (Ep>10 MeV) – 06d09^h, Jmax (Ep>10 MeV) – 1.4 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ= 2.2
Quasimaximal energy of protons in the event – Eqm = 200 MeV

Sources: ● solar flare 06d01^{h}35^m, M5.3/1B, N14W07, AR11283
Main burst X-ray 1–8 Å: onset – 06d01^{h}35^m, max – 06d01^{h}50^m, Φ = 0.54 J/m^2
CME: 06d02^{h}24^m, V= 782 km/s, Δφ = 360º, dA= 70º
▲ SC 09d12^{h}42^m; ▲ SC 09d13^{h}18^m

Particle fluxes and associated phenomena

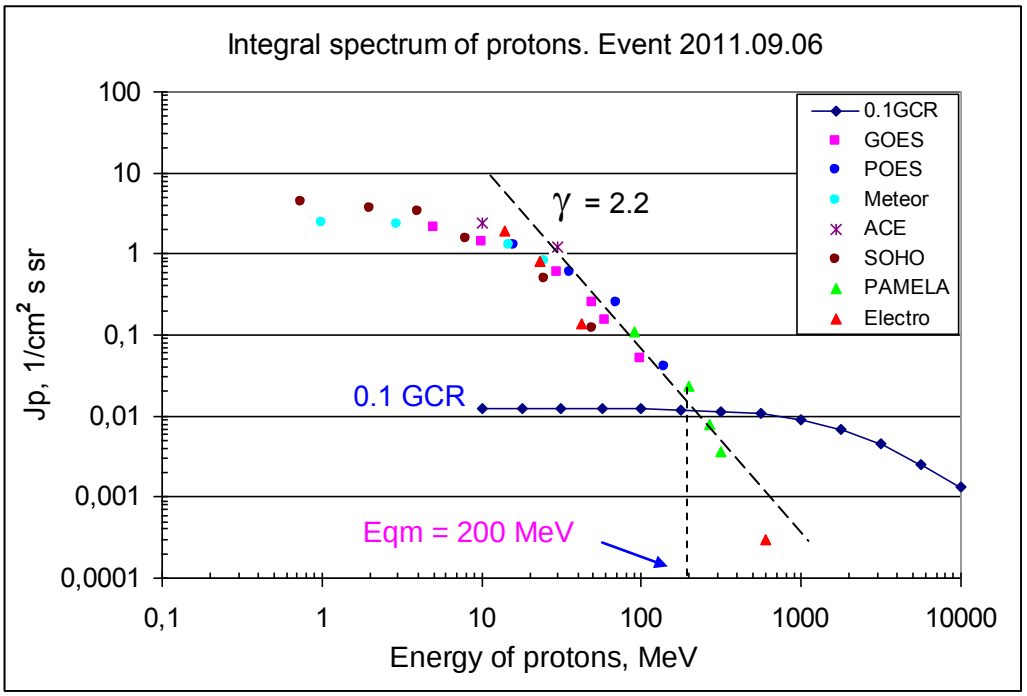


Integral fluxes of protons for the event of 2011 September 06

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	2	9	2.1	1	0.2	
EPS	>10	2	9	1.4	1	0.15	
EPS	>30	2	9	0.6	1	0.08	
EPS	>50	2	9	0.25	1	0.06	
EPS	>60	2	9	0.15	1	0.05	
EPS	>100	2	9	0.05	1	0.04	
Electro-1							
GALS-E	>600	2	11	0.0003	0.5	0.0008	
POES							
MEPED	>0.24	-	-	-	-	100	
MEPED	>0.8	-	-	-	-	80	
MEPED	>2.5	-	-	-	-	60	
MEPED	>6.9	-	-	-	-	55	
MEPED	>16	2	11	1.3	1	0.9	
MEPED	>36	2	11	0.6	1	0.9	
MEPED	>70	2	11	0.25	1	1	
MEPED	>140	2	11	0.04	0.5	1.3	
Meteor-1							
SCR	>1	2	12	2.4	1	3.2	
SCR	>3	2	10	2.3	1	3	
SCR	>10	2	-	-	1	2.1	
GALS-M	>15	2	09	1.3	1	1.45	
GALS-M	>25	2	09	0.8	1	1.5	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	01	08	2.4	1	1.6	
SIS	>30	01	08	1.2	1	1.1	
SOHO							
EPHIN	>50	02	04	0.12	1	03	
PAMELA							
TRACKER	>90	02	05	0.11	1		
TRACKER	>200	02	05	0.023	1		
TRACKER	>265	02	05	0.0078	1		
TRACKER	>312	02	05	0.0036	1		

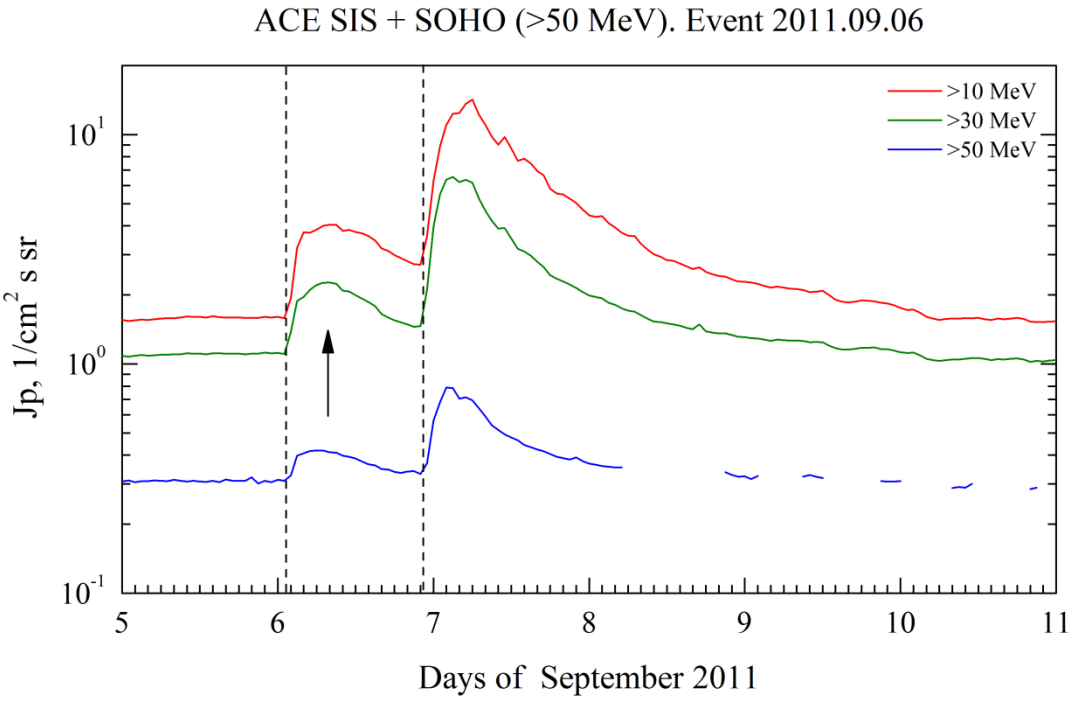
Differential fluxes of protons for the event of 2011 September 06

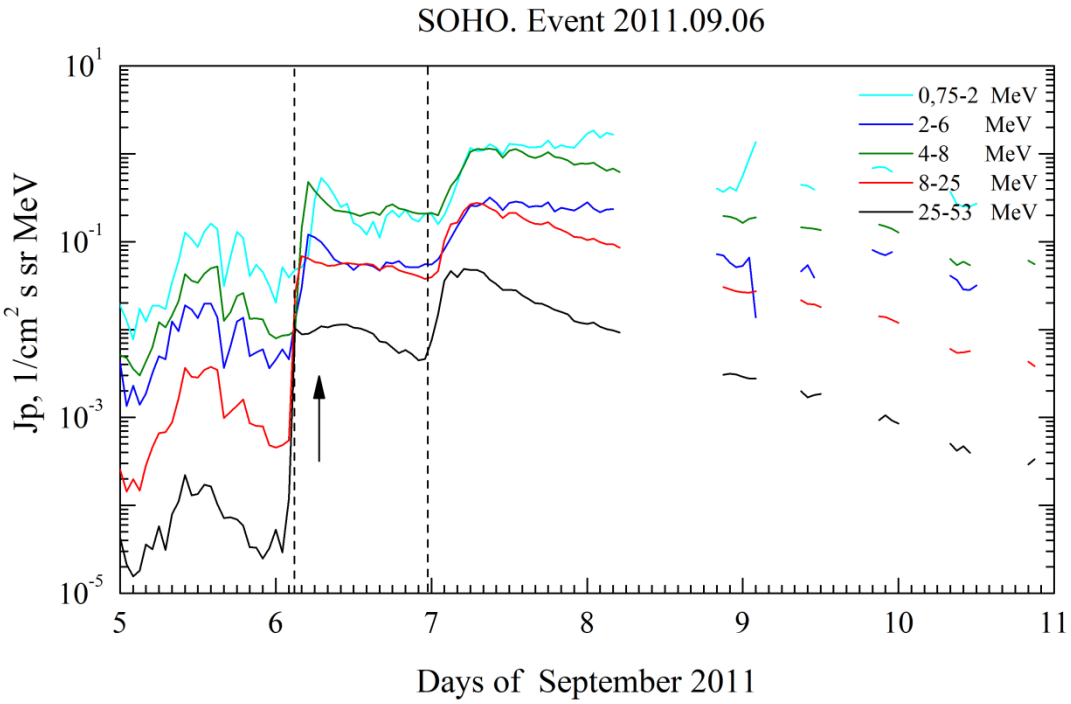
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	3	07	0.53	1	0.01	
LION	2 – 6	3	05	0.12	1	0.002	
EPHIN	4 – 8	3	05	0.45	1	0.0006	
EPHIN	8 – 25	2	04	0.063	1	0.00003	
EPHIN	25 – 53	2	10	0.012	1	0.00003	
Electro-1							
SCR-E	13.7–23	2	12	0.12	1	0.07	
SCR-E	23–42	2	12	0.04	1	0.025	
SCR-E	42–112	2	12	0.002	1	0.005	



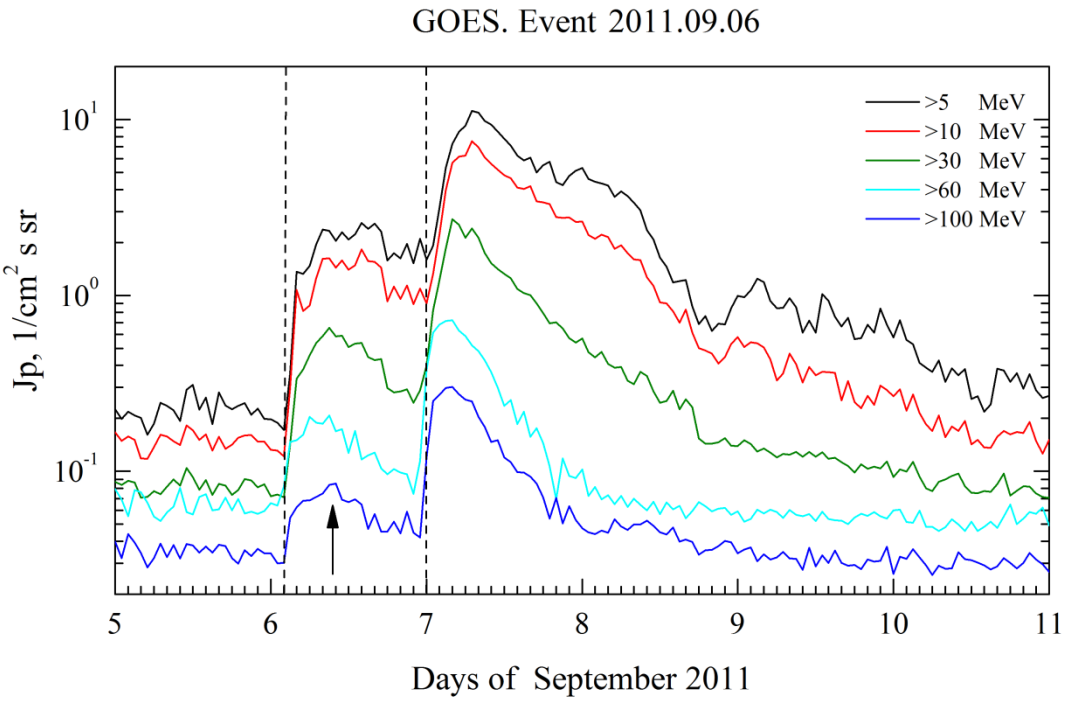
Time profiles of proton fluxes in the event 2011.09.06

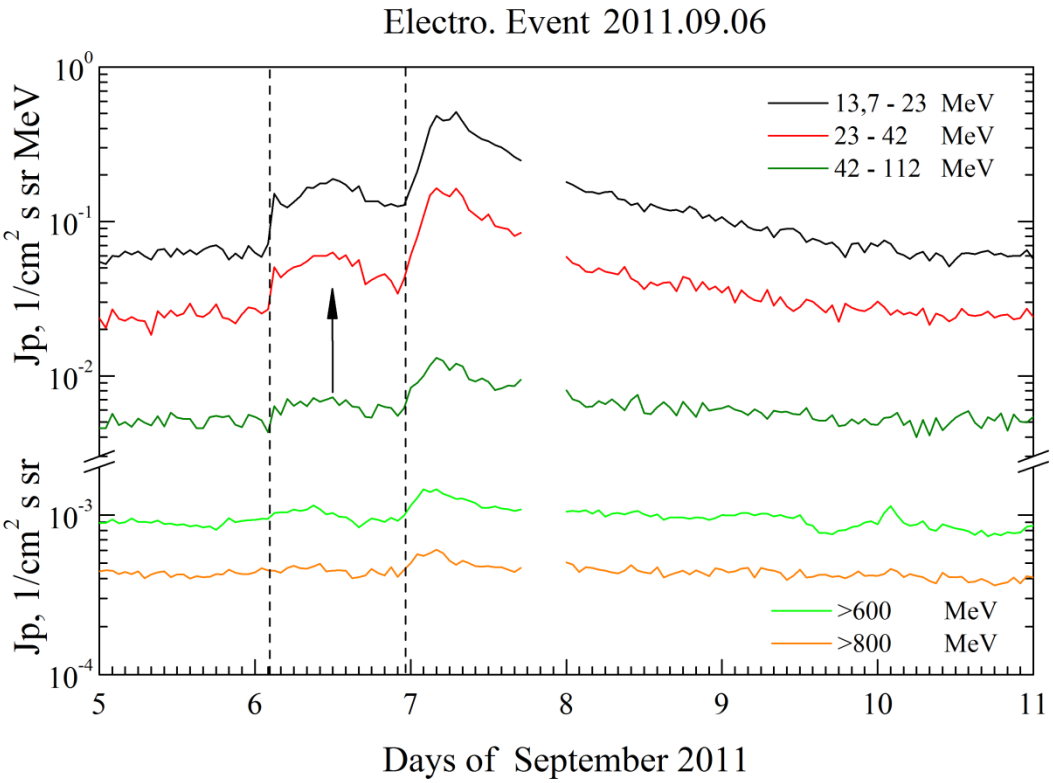
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO





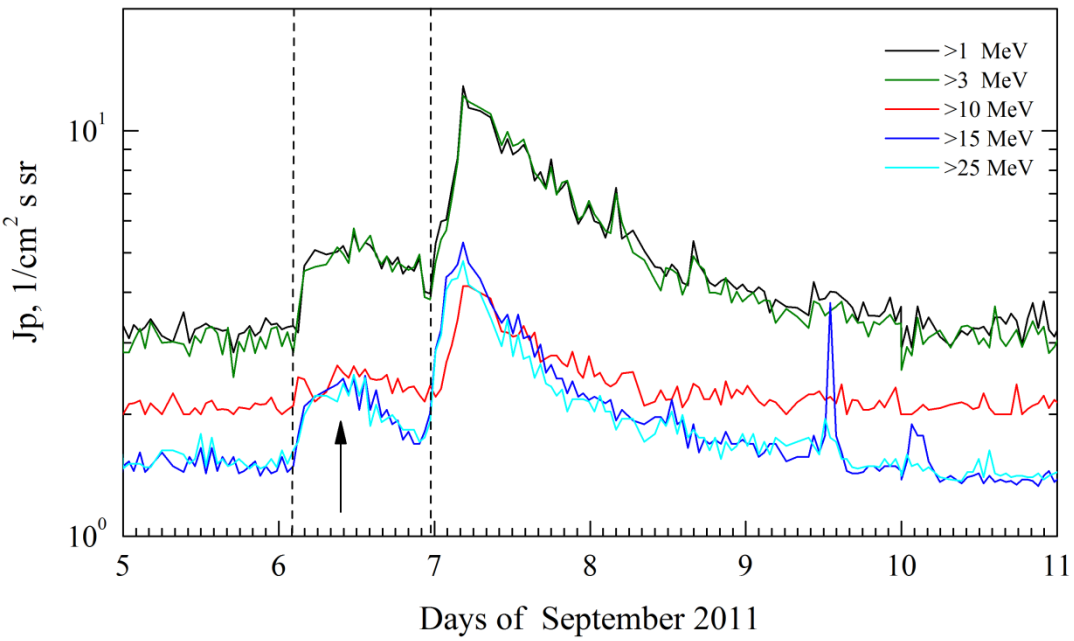
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.



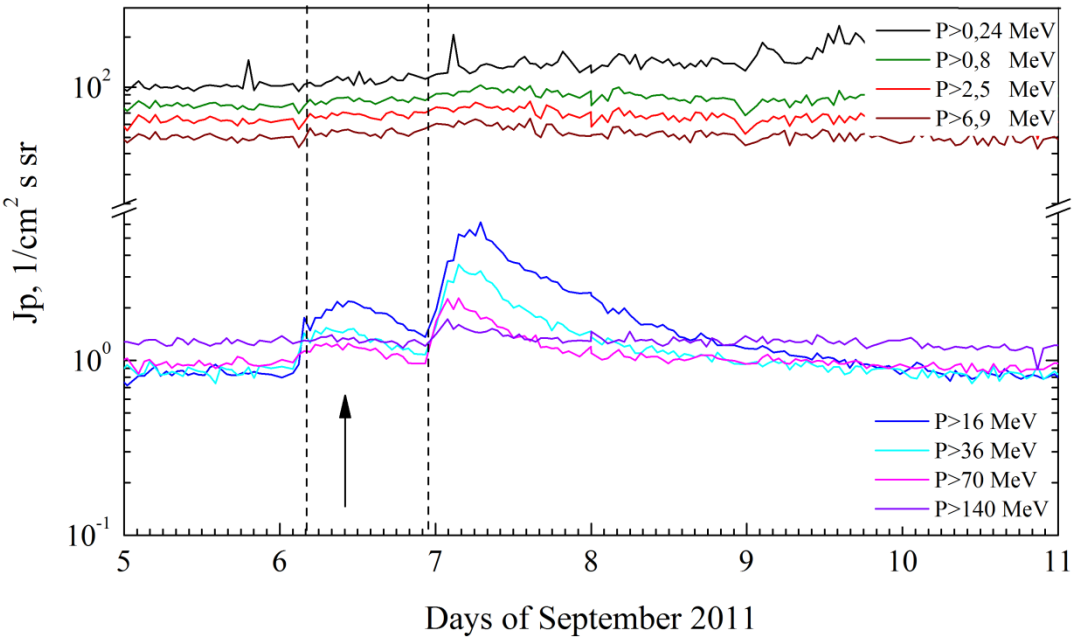


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2011.09.06



POES. Events 2011.09.06



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 September 06

2011 September 06 ● AR 11283 To event 493

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	0143	0149	0236	N14W07	1B	ERU
1 – 12	keV	0135	0150	0205	N13W07	M5.3	0.54

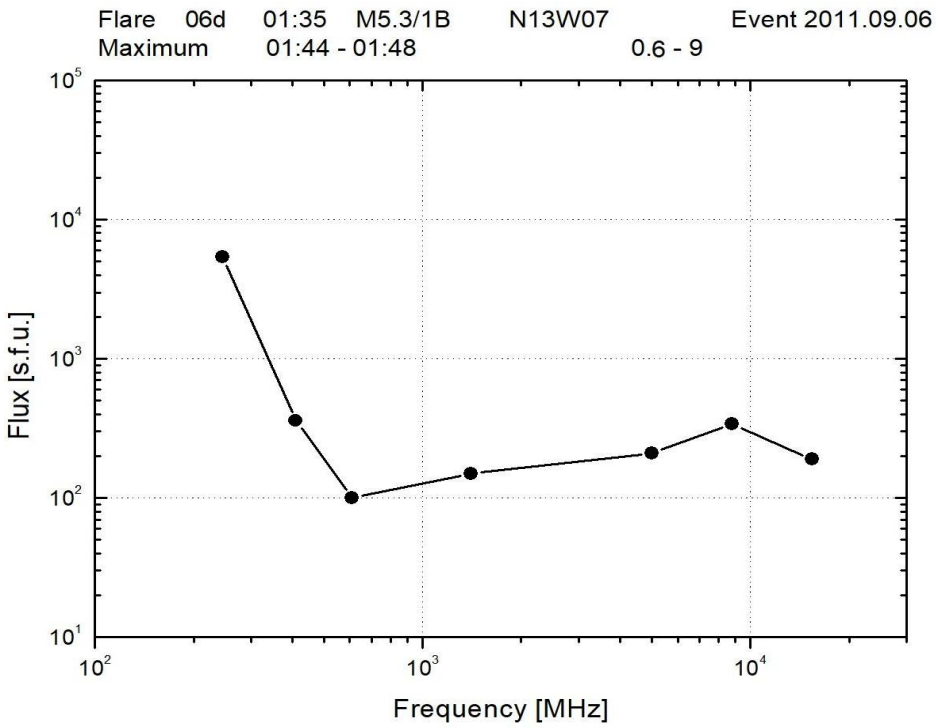
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	0135:44	0146:06	0147:16	4724	3853820	HESSI
12-25	keV	0136:39	0147:37	0217:58	664560	327615040	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0144	0144	0146		2.28	
8.8	GHz	0143	0144	0149		2.53	
5	GHz	0144	0144	0148		2.32	
1.4	GHz	0144	0144	0144		2.18	
610	MHz	0148	0148	0148	0.6 – 9	2.0	
410	MHz	0143	0144	0149		2.56	
245	MHz	0142	0146	0149		4.73	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	050-300	0146		0153		3	
DS IV	034-102	0232		0410		1	
DS III	018-550	0144		0146		1	
DS III	025-119	0224		0229		1	
DS V	025-180	0143		0153		1	
DH II	0.2-14	0200		2340			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0224	782	105.6	360˚	70˚	SOHO

Radio burst frequency spectrum



Proton Active Region

AR11283 (N14L224,CMP 5,7.09.2011,
Sp=230 msh, DAI, BGD)
XRI= 5.60 $X2^{2.1}$+$M_5^{6.7}$+C_{13} 2_1+1_1+S_{27}
PFR 6-8.09 - 61^h $X2^{2.1}$+$M_2^{6.7}$

References:

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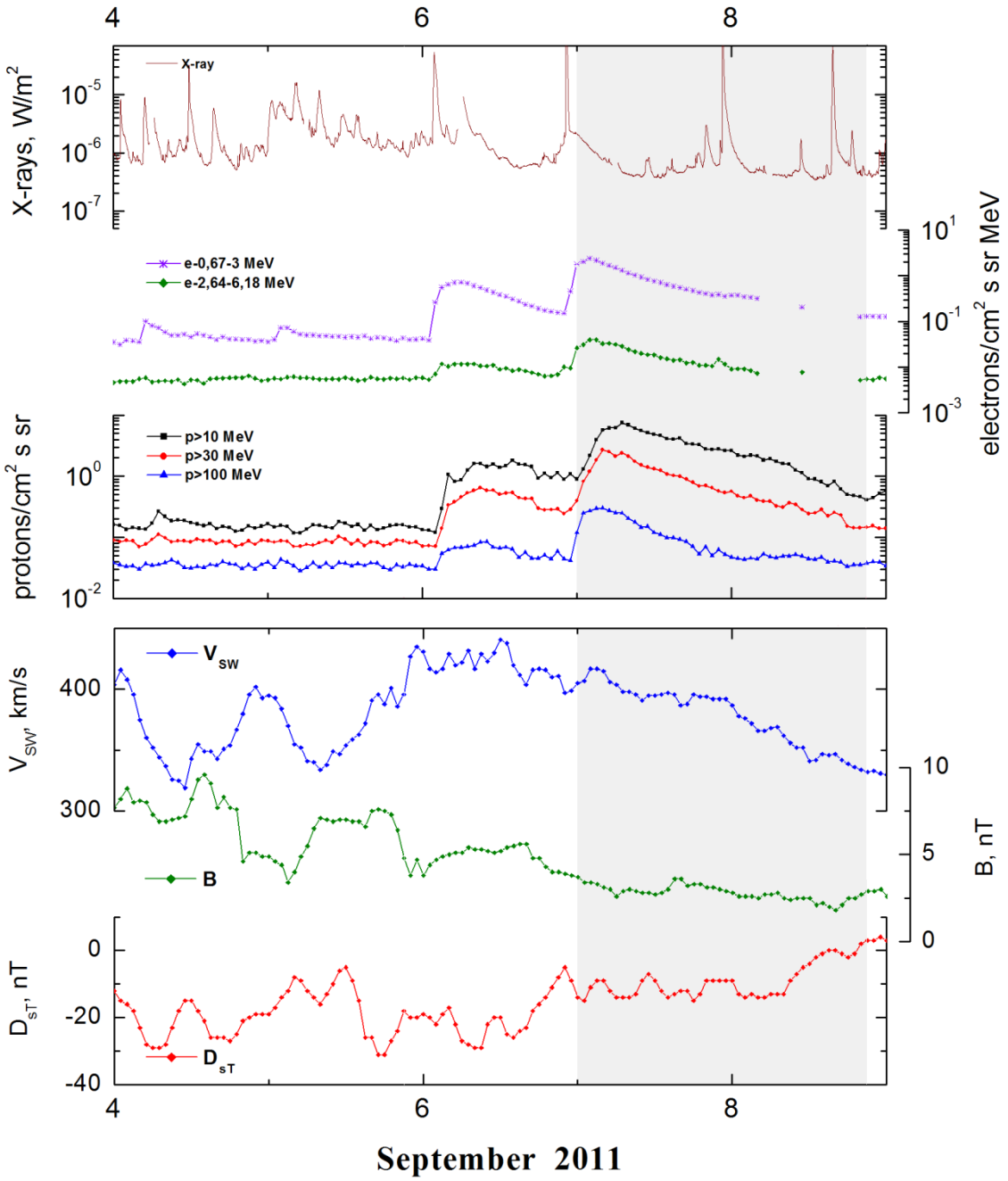
Koleva K., M. Dechev, P. Duchlev, 2021.
de Nolfo G.A., A. Bruno, J.M. Ryan et al., 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Wang Y., D. Lyu, B. Xiao et al., 2021.
Winter L.M., and K. Ledbetter, 2015.
Zuccarello F., I. Ermolli, M.B. Korsos et al., 2021.

Particle event: To(Ep>10 MeV) – 07d02^h
Tmax (Ep>10 MeV) – 07d05^h, Jmax (Ep>10 MeV) – 6 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.1
Quasimaximal energy of protons in the event – Eqm = 420 MeV

Sources: ● solar flare 06d22^{h}12^m, X2.1/2B, N14W18, AR11283
Main burst X-ray 1–8 Å: onset – 06d22^{h}12^m, max – 06d22^{h}20^m, Φ = 0.58 J/m^2
CME: 06d23^{h}05^m, V= 0575 km/s, Δφ = 360º, dA= 300º
▲ SC 09d12^{h}42^m; ▲ SC 09d13^{h}18^m

Particle fluxes and associated phenomena

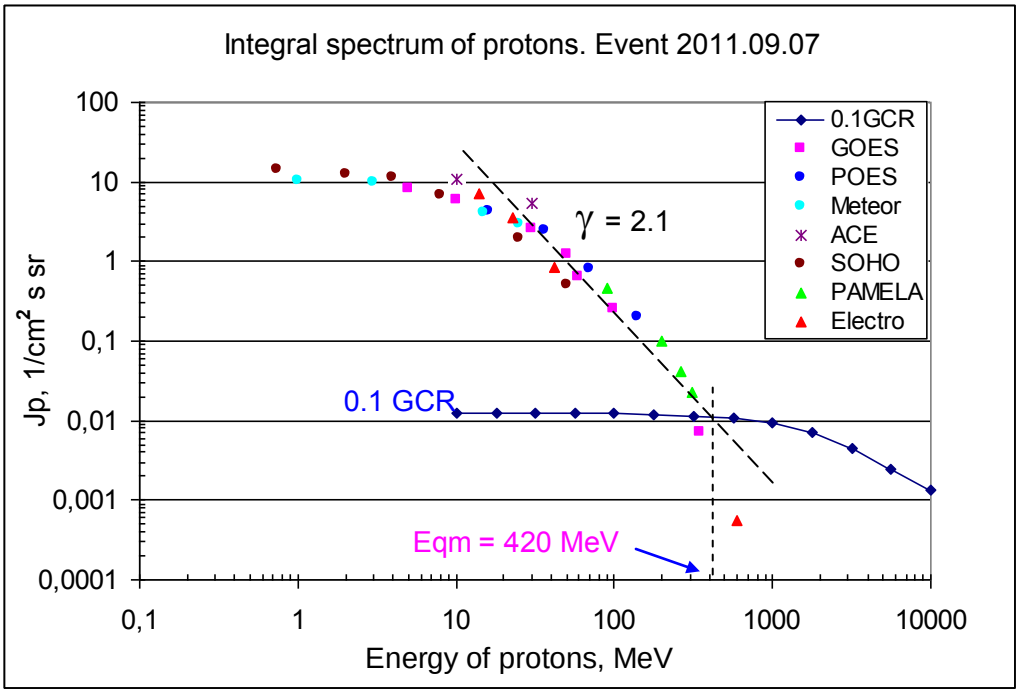


Integral fluxes of protons for the event of 2011 September 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	2	05	8.3	2	0.2	
EPS	>10	2	05	6	2	0.15	
EPS	>30	2	05	2.6	1.5	0.08	
EPS	>50	2	05	1.2	1.5	0.06	
EPS	>60	2	05	0.65	1	0.05	
EPS	>100	2	04	0.25	1	0.04	
Electro-1							
GALS-E	>600	6d22	3	0.00055	1	0.0009	
POES							
MEPED	>0.24	-	-	-	-	100	
MEPED	>0.8	-	-	-	-	80	
MEPED	>2.5	-	-	-	-	60	
MEPED	>6.9	-	-	-	-	55	
MEPED	>16	6d23	3	4.2	2	0.9	
MEPED	>36	6d23	3	2.5	1.5	0.9	
MEPED	>70	6d23	3	0.8	1	1.2	
MEPED	>140	6d23	2	0.2	1	1.3	
Meteor-1							
SCR	>1	00	05	10.2	2	3.2	
SCR	>3	00	05	10	2	2.6	
SCR	>10	00	-	-	1.5	2.1	
GALS-M	>15	00	04	4	1.5	1.4	
GALS-M	>25	00	04	3	1.5	1.5	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	1	04	10.8	2	1.6	
SIS	>30	1	03	5.4	1.5	1.1	
SOHO							
EPHIN	>50	2	02	0.5	1	03	
PAMELA							
TRACKER	>90	2	02	0.46	3		
TRACKER	>200	2	02	0.099	3		
TRACKER	>265	2	02	0.041	3		
TRACKER	>312	2	02	0.023	3		

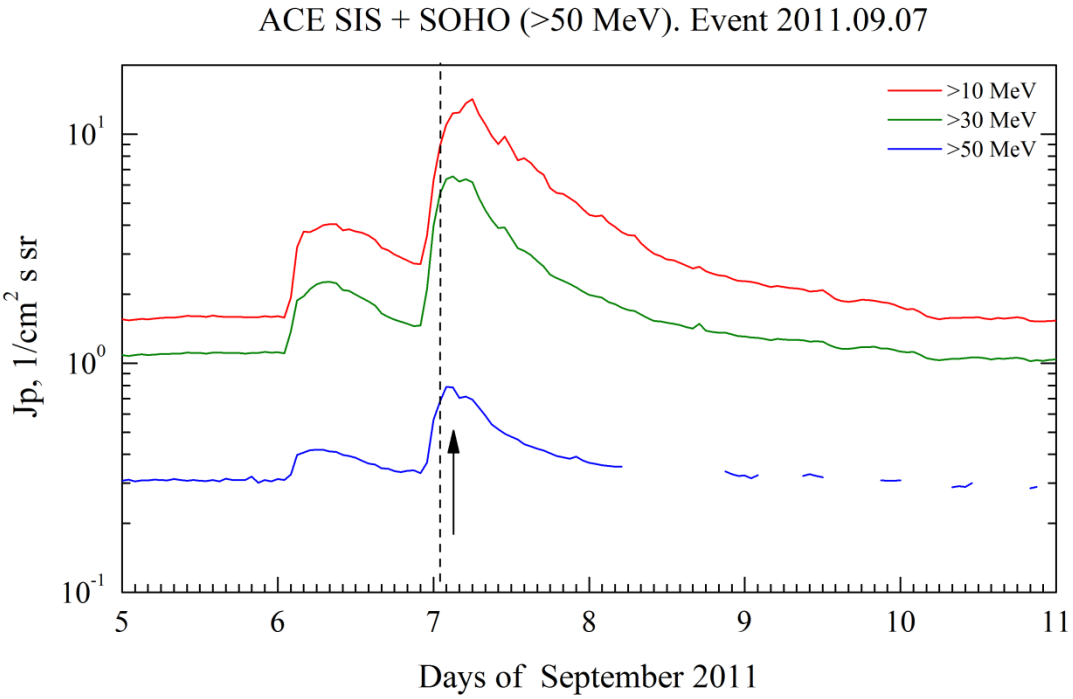
Differential fluxes of protons for the event of 2011 September 07

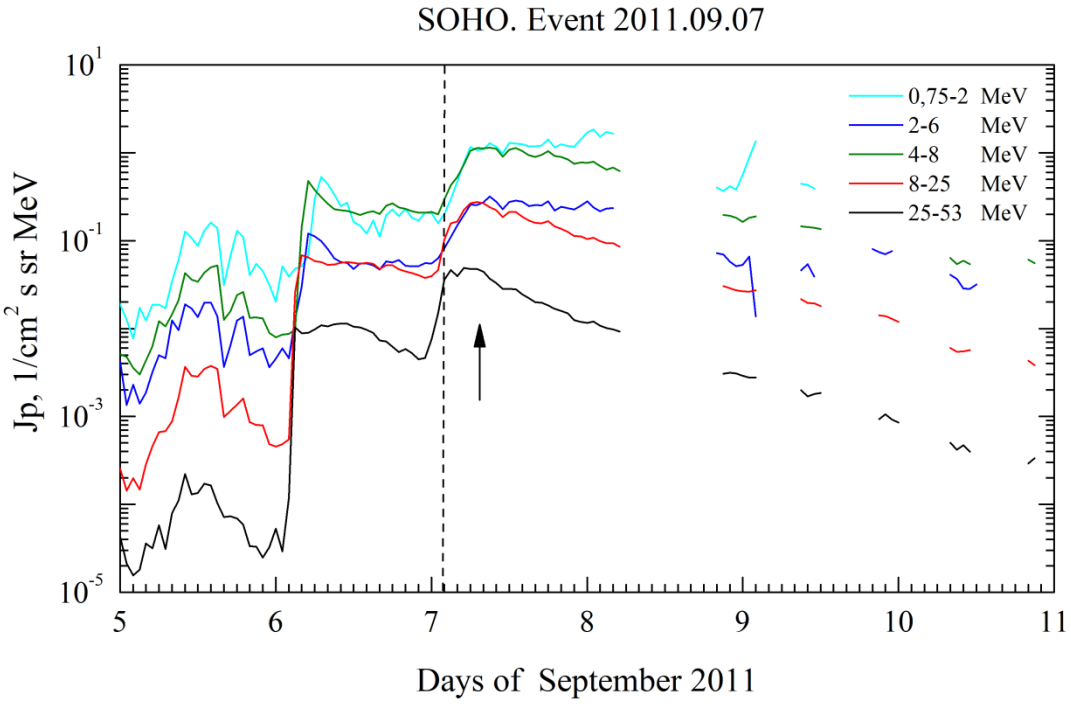
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	2	09	1.3	6	0.01	
LION	2 – 6	2	09	0.32	5	0.002	
EPHIN	4 – 8	2	06	1.2	4	0.0006	
EPHIN	8 – 25	2	06	0.285	4	0.00003	
EPHIN	25 – 53	2	05	0.049	4	0.00003	
GOES							
EPS	350–420	-	16	0.0001	-	0.002	
EPS	420–510	-	-	-	-	0.001	
Electro-1							
SCR-E	13.7–23	6d22	5	0.38	4	0.07	
SCR-E	23–42	6d22	4	0.14	4	0.025	
SCR-E	42–112	6d22	4	0.012	3	0.005	



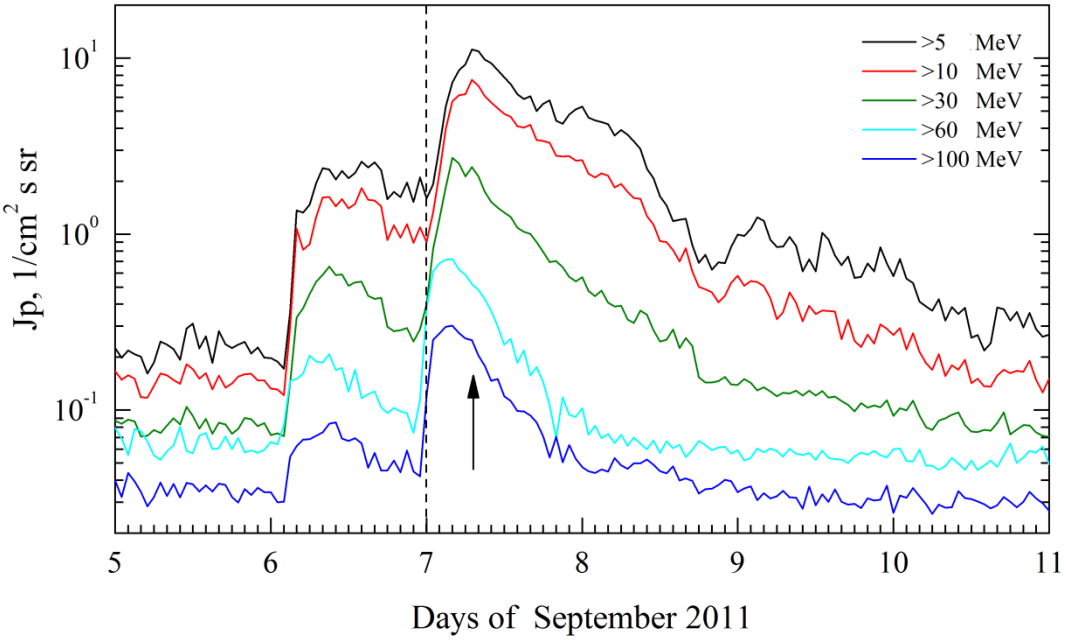
Time profiles of proton fluxes in the event 2011.09.07

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

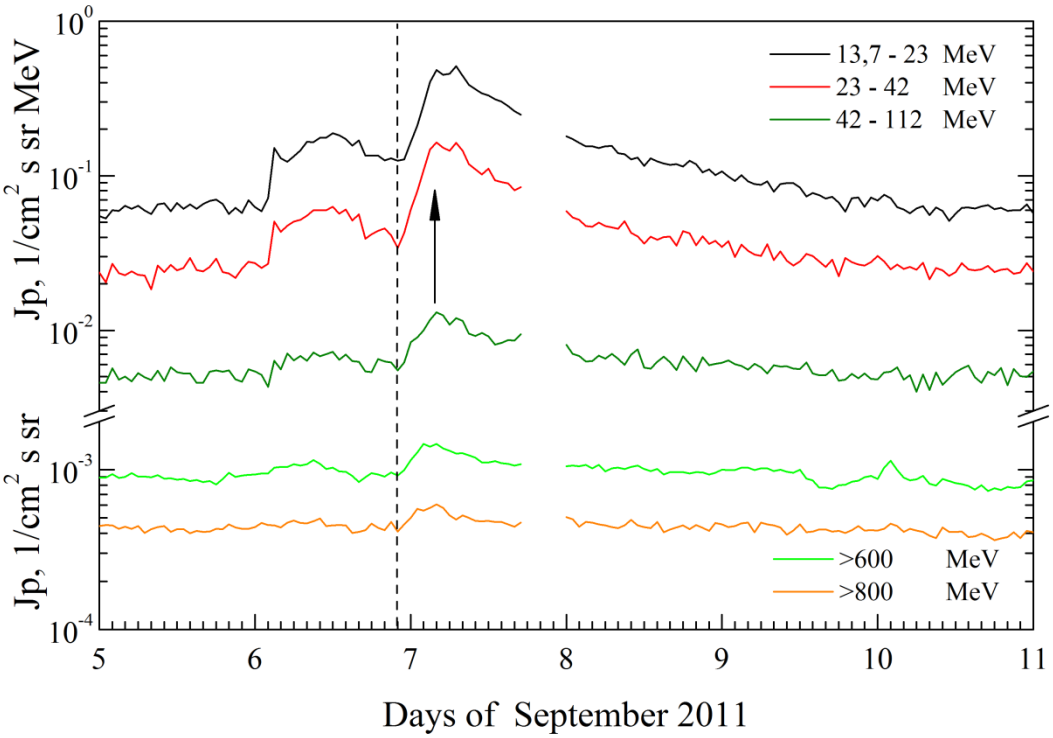




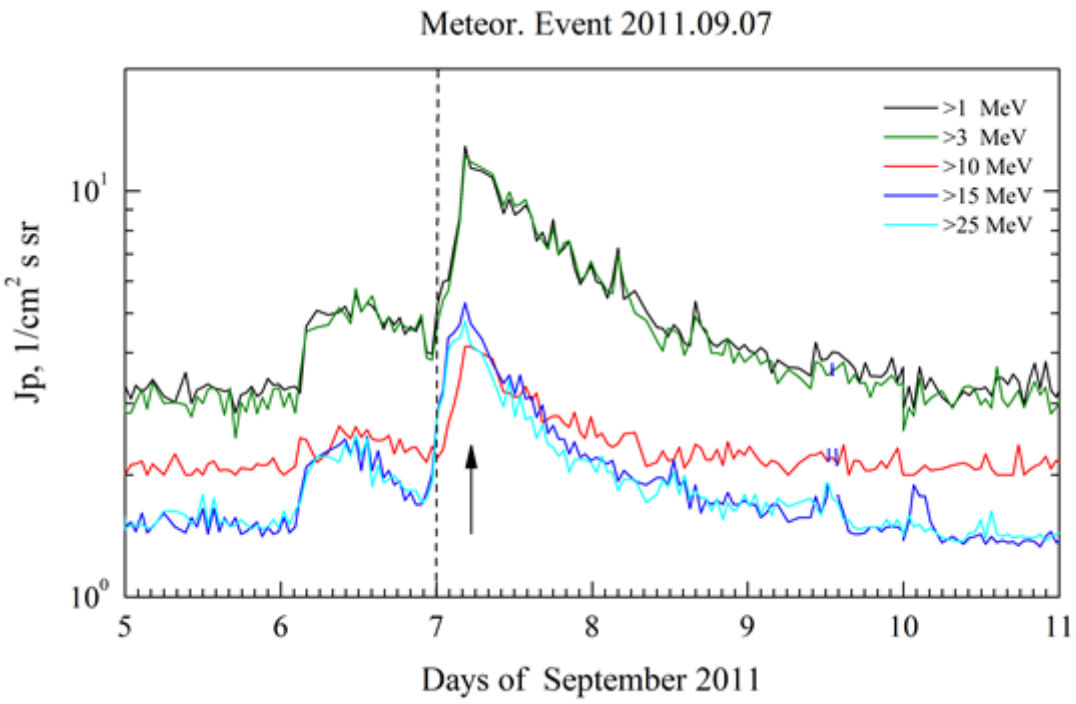
GOES. Event 2011.09.07

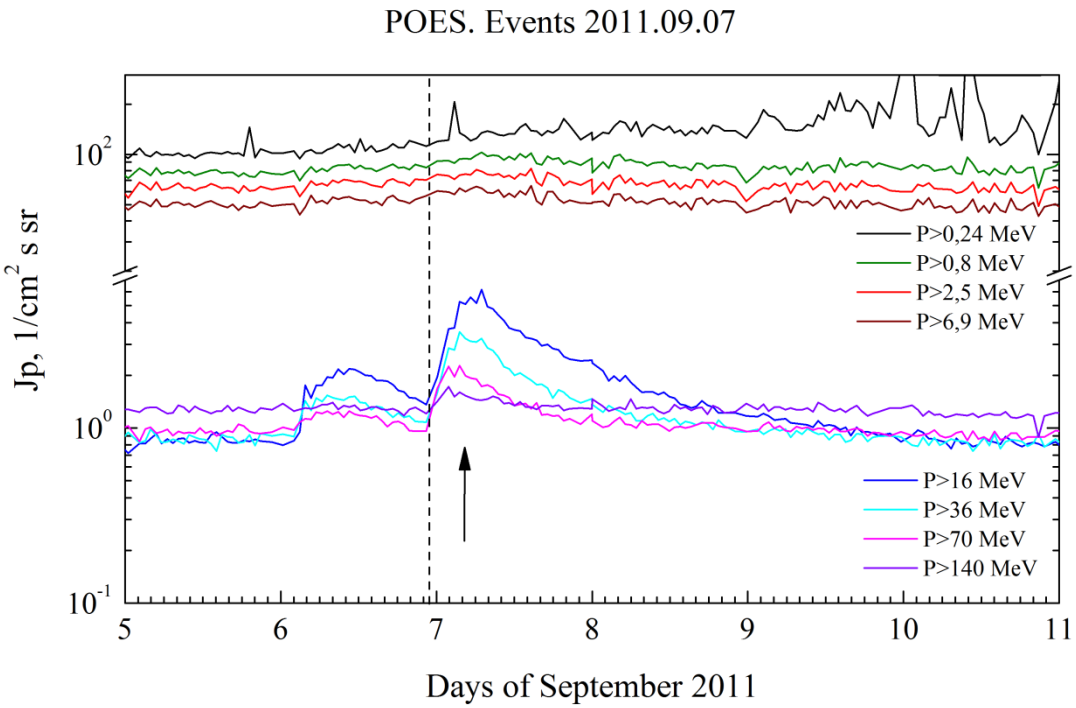


Electro. Event 2011.09.07



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 September 07

2011 September 06 ● AR 11283 To event 494

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	2213	2221	>0029	N14W18	2B	ERU
1 – 12	keV	2212	2220	2224	N14W18	X2.1	0.58

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
100-300	keV	2208:00	2219:46	2225:04	21072	23000110	HESSI
1000	keV	2212		2224		1.42E-04*	FERMI
12-25	keV	2159:48	2220:19	2244:34	865439	495946144	FERMI

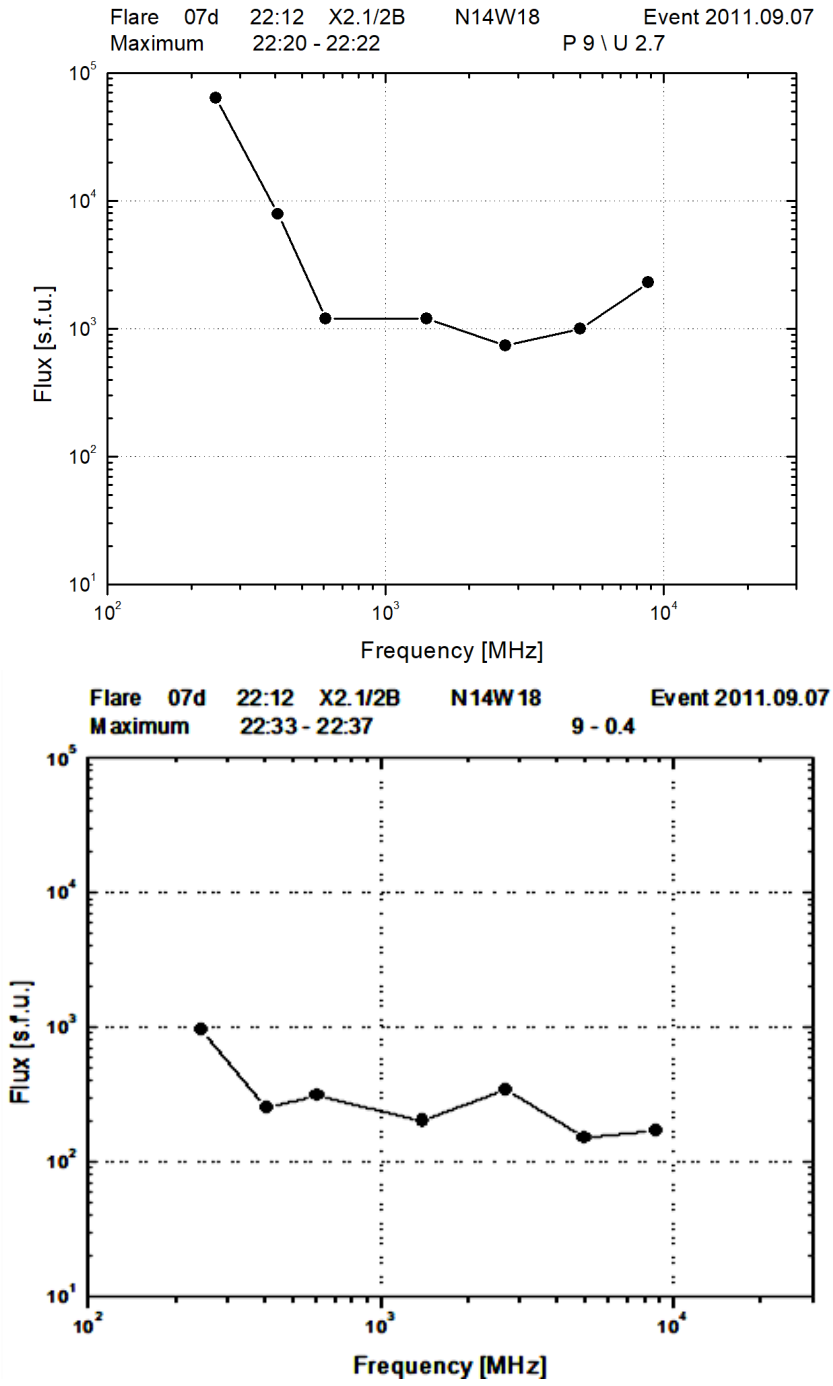
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
8.8	GHz	2220	2220	2226	P9 \ U2.7	3.36	
5	GHz	2220	2220	2225		3.0	
2.7	GHz	2220	2220	2225		2.87	
1.4	GHz	2220	2221	2225		2.91	
610	MHz	2220	2220	2225		3.08	
410	MHz	2220	2221	2226		3.9	
245	MHz	2220	2222	2225		4.81	
8.8	GHz	2231	2236	2237	P9 – 0.4	2.23	
5	GHz	2231	2236	2237		2.18	
2.7	GHz	2236	2236	2237		2.53	
1.4	GHz	2236	2237	2238		2.3	
610	MHz	2236	2237	2239		2.49	
410	MHz	2233	2236	2240		2.4	
245	MHz	2231	2233	2240		2.97	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	040-300	2219		2234		2	
DS II	030-045	2236		2238		1	
DS IV	025-086	2228		2359		3	
DS III	018-800	2222		2222		3	
DS III	025-180	2303		2305		1	
DS III	025-086	2229		2232		1	
DH II	0.15-16	2230		07/1540			WIND

CME		**UT**	**V,** km/s	**a,** **km/s^2**	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2305	575	1.1	360˚	300˚	SOHO

*cm^{-2}s^{-1}

Radio bursts frequency spectrum



Proton Active Region

AR11283 (N14L224,CMP 5,7.09.2011,
Sp=230 msh, DAI, BGD)
XRI= 5.60 $X2^{2.1}+M_5^{6.7}+C_{13}$ $2_1+1_1+S_{27}$
PFR 6-8.09 (61^h) $X2^{2.1}+M_2^{6.7}$

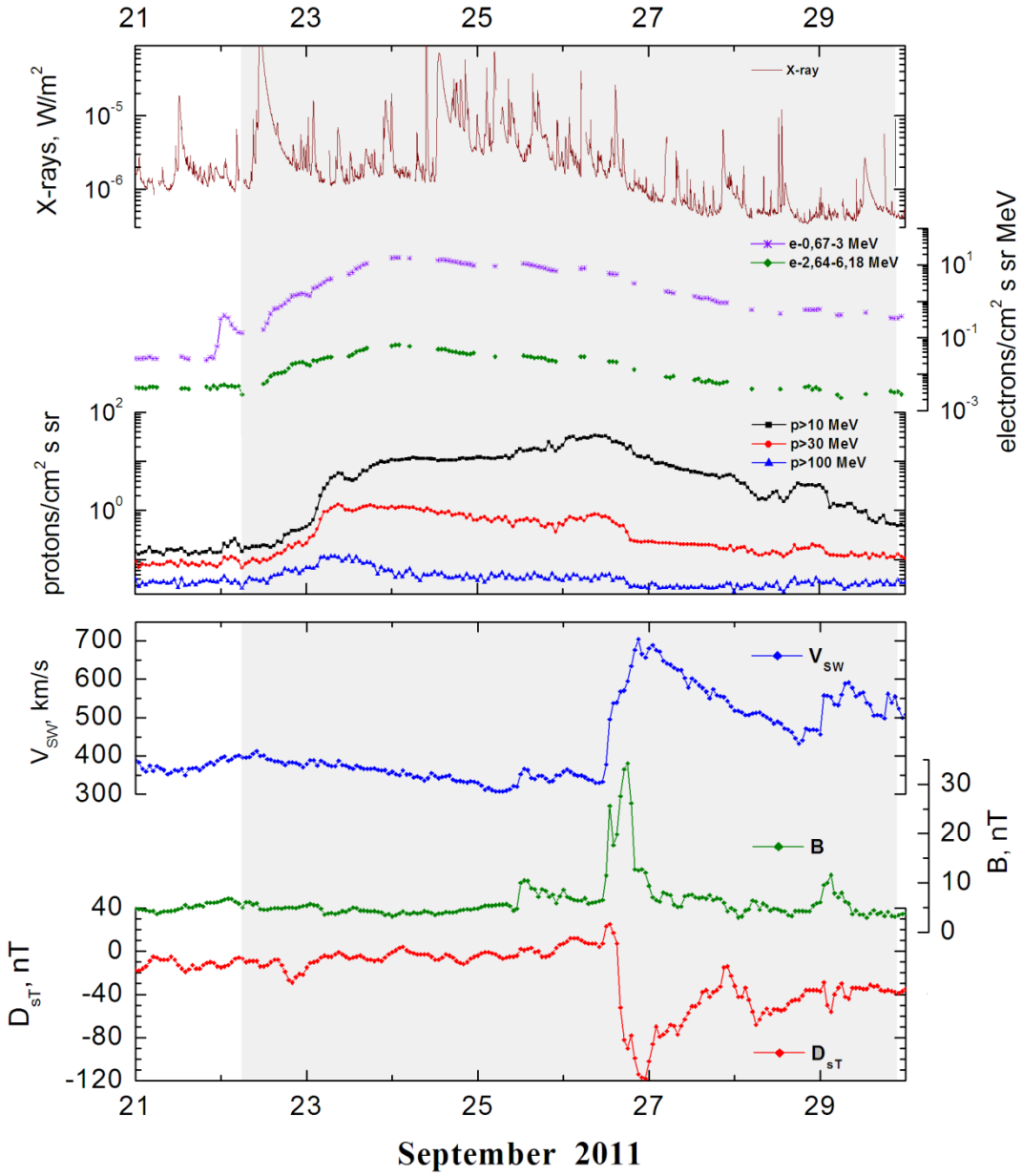
References:

Grechnev V., V. Kiselev, N. Meshalkina, I. Chertok, 2017.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K.Ledbetter, 2015.

Particle event: To(Ep>10 MeV) – 22d13^h
Tmax$_1$(Ep>10 MeV) – 23d09^h, Jmax$_1$ (Ep>10 MeV) – 5.4 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 23d21^h, Jmax$_2$ (Ep>10 MeV) – 9.7 /cm^2·s·sr
Duration of the event – 6 days, power-law index: γ_1 = 2.2, γ_2 = 3.2
Quasimaximal energy of protons in the event – Eqm$_1$ = 200 MeV
– Eqm$_2$ = 140 MeV

Sources: ● solar flare 22d10^{h}29^m, X1.4/2N, N13E78, AR11302
Main burst X-ray 1–8 Å: onset – 22d10^{h}29^m, max – 22d11^{h}01^m, Φ = 0.450 J/m^2
CME: 22d10^{h}48^m, V= 1905 km/s, Δφ = 360º, dA= 72º
▲ SC 25d11^{h}45^m; ▲ SC 26d12^{h}35^m

Particle fluxes and associated phenomena

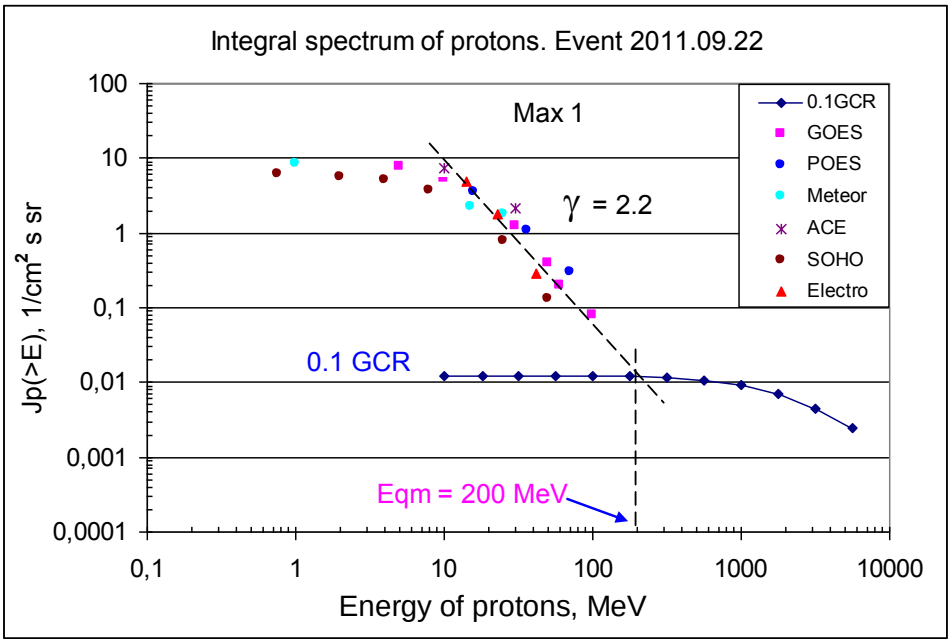


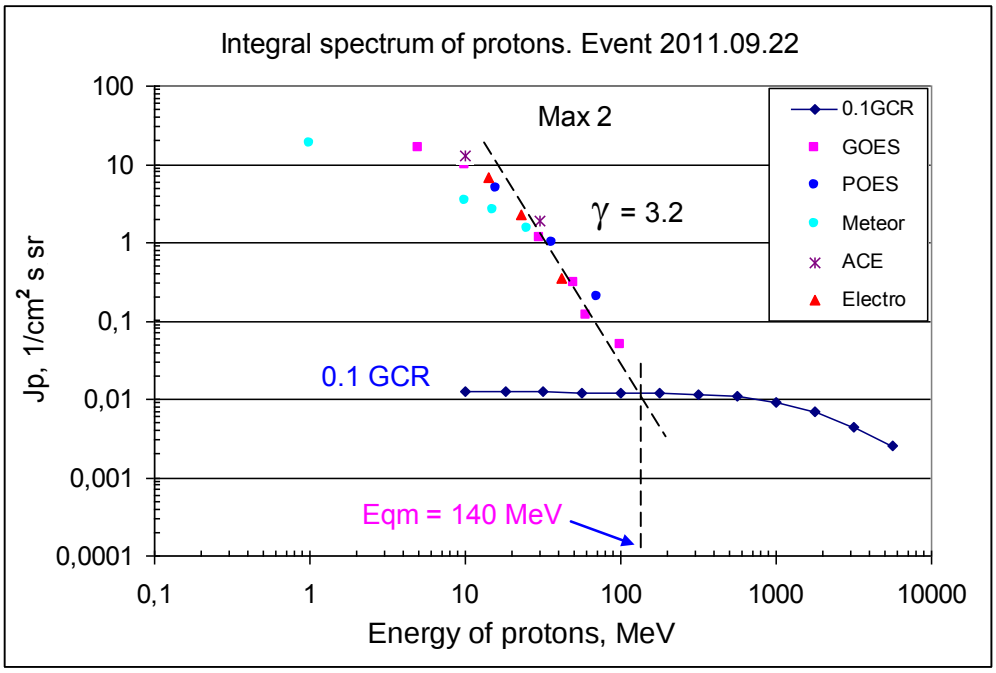
Integral fluxes of protons for the event of 2011 September 22

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	13	23d09/21	7.7/16	6	0.2	
EPS	>10	13	23d09/21	5.4/9.7	6	0.15	
EPS	>30	13	23d09/18	1.25/1.15	6	0.08	
EPS	>50	13	23d09/18	0.4/0.3	4	0.06	
EPS	>60	13	23d09/18	0.2/0.12	4	0.05	
EPS	>100	13	23d09/18	0.08/0.05	4	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	-	-	-	-	100	
MEPED	>0.8	-	-	-	-	80	
MEPED	>2.5	-	-	-	-	60	
MEPED	>6.9	-	-	-	-	55	
MEPED	>16	15	23d09/23	3.6/5	5	0.9	
MEPED	>36	15	23d09/23	1.1/1	4	0.9	
MEPED	>70	15	23d09/23	0.3/0.2	4	1	
MEPED	>140	-	-	-	-	1.3	
Meteor-1							
SCR	>1	23	23d10/24d06	8.3/18.8	8	3	
SCR	>3	23	-	-	8	2.9	
SCR	>10	23	-/24d03	-/3.5	5	2.1	
GALS-M	>15	11	23d10/24d03	2.2/2.6	5	1.3	
GALS-M	>25	11	23d10/24d02	1.8/1.5	4	1.35	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	12	23d07/20	7.4/12.8	6	1.5	
SIS	>30	12	23d07/19	2.1/1.9	6	1.1	
SOHO							
EPHIN (INT)	>50	14	23d07/ -	0.13/ -	4	0.3	

Differential fluxes of protons for the event of 2011 September 22

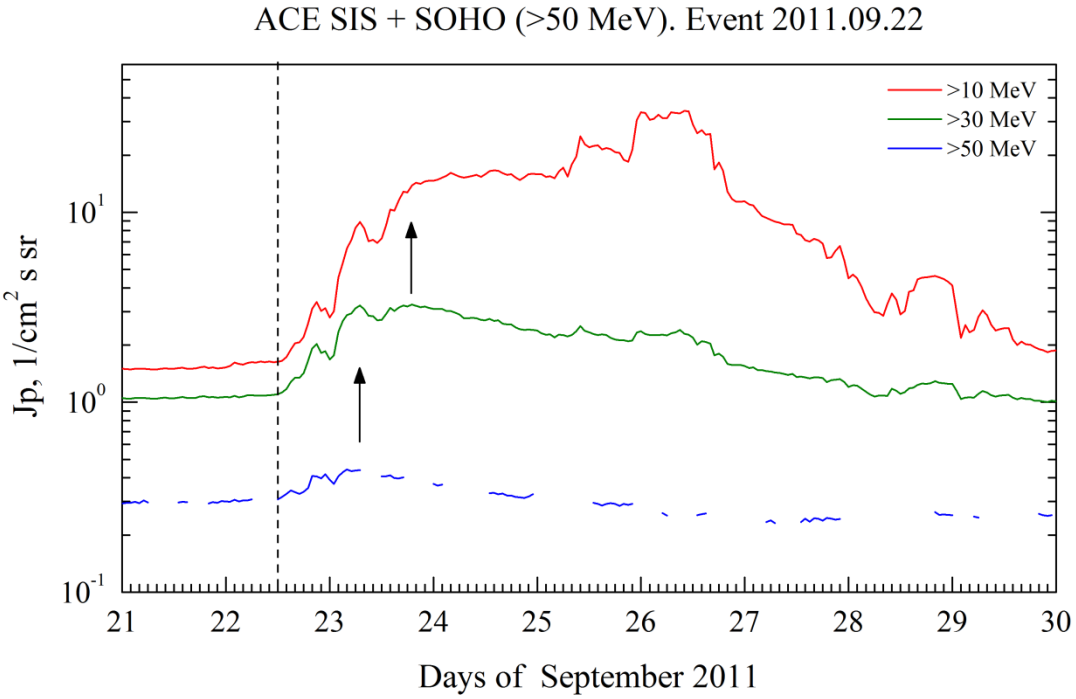
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	14	23d06/ -	0.46/ -	9	0.008	
LION	2 – 6	14	23d07/ -	0.14/ -	9	0.001	
EPHIN	4 – 8	14	23d06/ -	0.37/ -	8	0.0001	
EPHIN	8 – 25	14	23d06/ -	0.17/ -	7	0.00003	
EPHIN	25 – 53	14	23d07/ -	0.024/ -	6	0.00001	
Electro-1							
SCR-E	13.7–23	15	23d09/21	0.32/0.49	7	0.06	
SCR-E	23–42	15	23d09/20	0.08/0.10	6	0.025	
SCR-E	42–112	15	23d07/21	0.004/0.005	5	0.005	

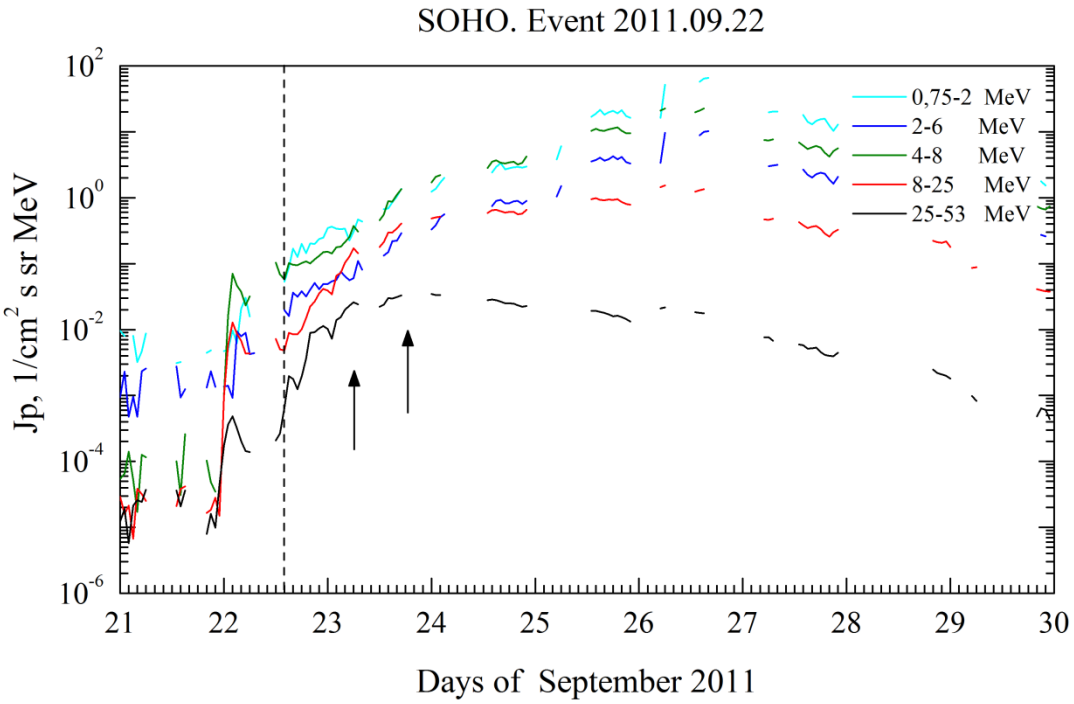

Integral spectrum of protons. Event 2011.09.22
Max 1
γ = 2.2
0.1 GCR
Eqm = 200 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp(>E), 1/cm² s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2011.09.22
Max 2
γ = 3.2
0.1 GCR
Eqm = 140 MeV
0.1GCR
GOES
POES
Meteor
ACE
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

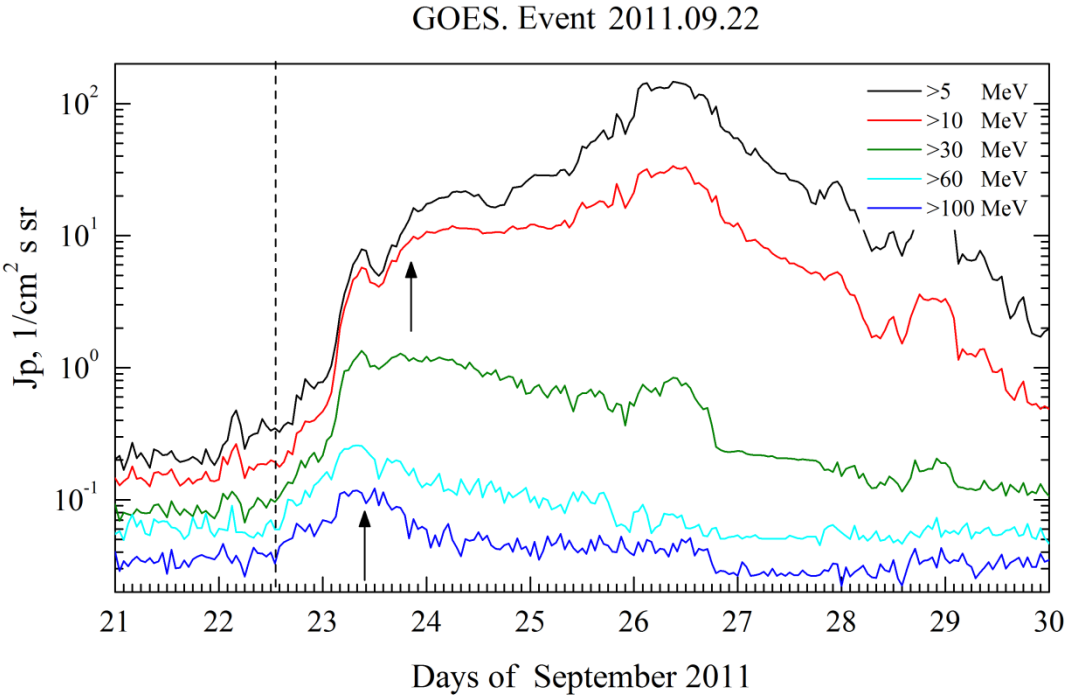
Time profiles of proton fluxes in the event 2011.09.22

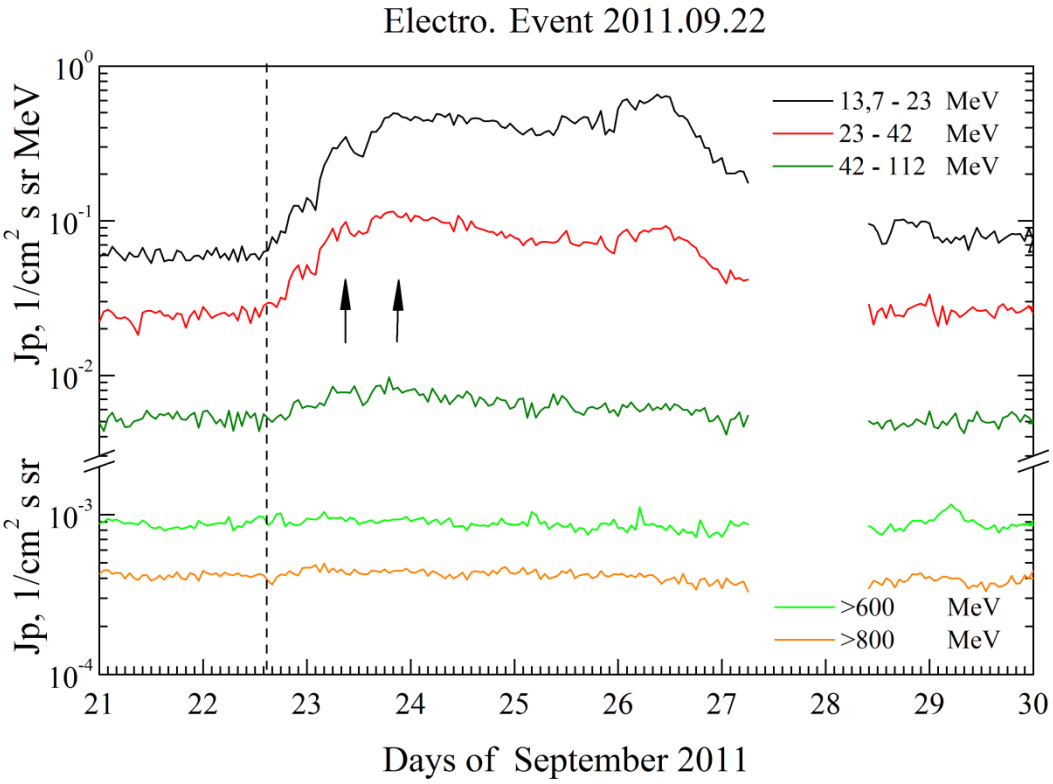
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



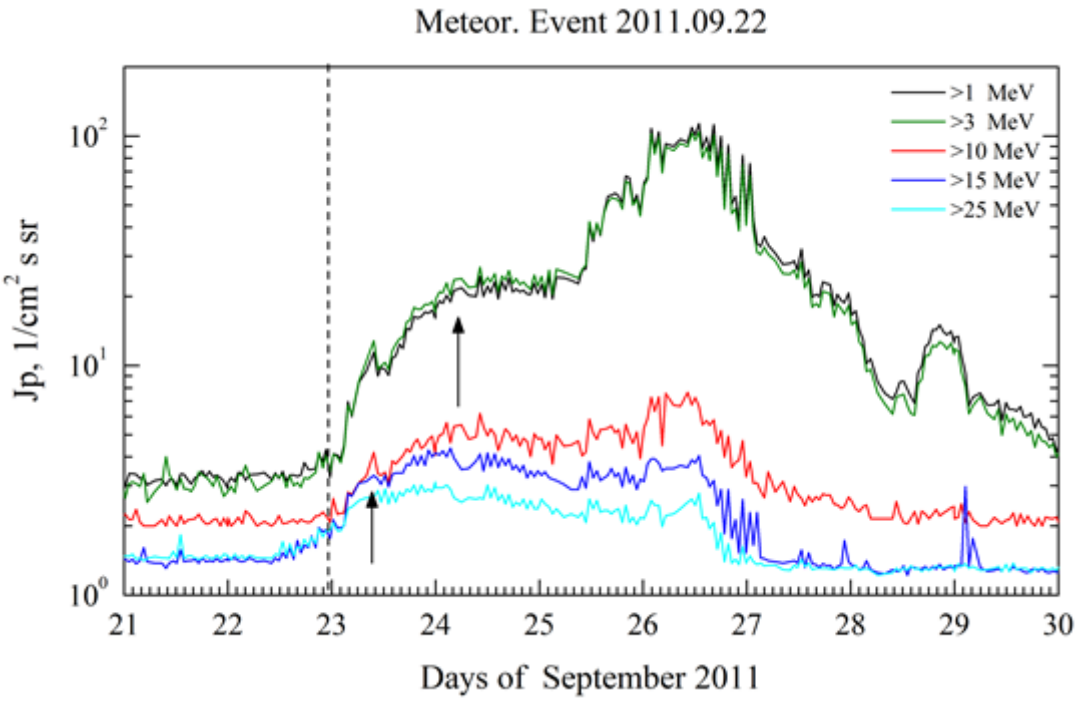


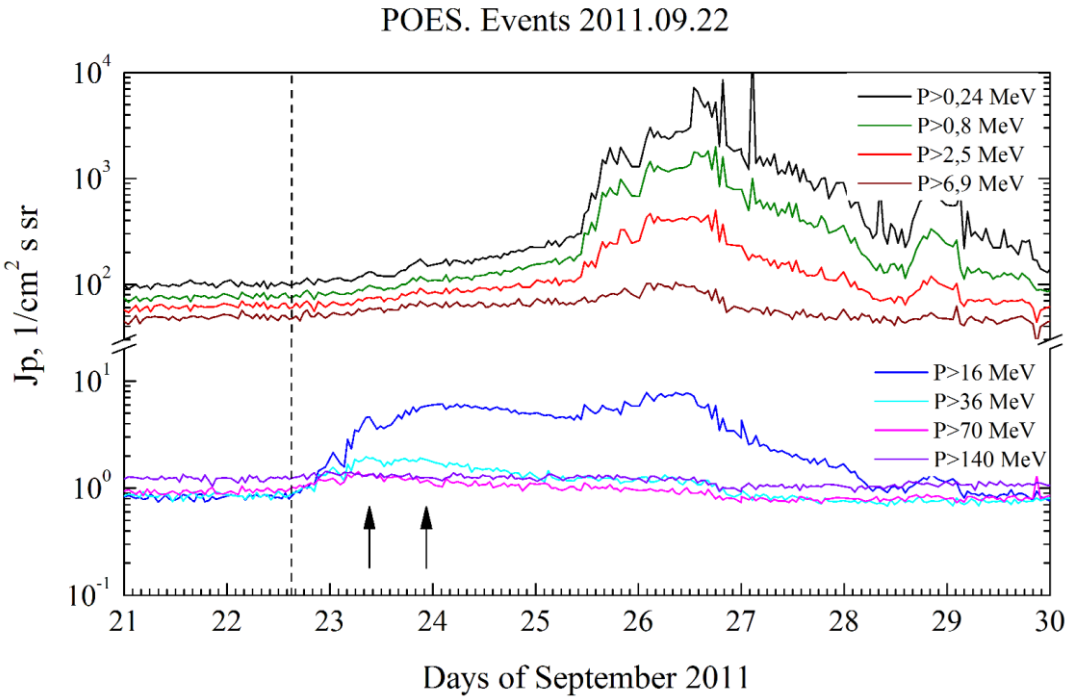
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 September 22

2011 September 22 • AR 11302 To event 495

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	1041	1057	1227	N13E78	2N	ERU
1 – 12	keV	1029	1101	1144	N09E89	X1.4*	0.45

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
25-50	keV	1053:16	1053:38	1106:40	9200	24755012	HESSI
12-25	keV	1106:40	1108:58	1128:56	7068	25138412	HESSI
12-25	keV	1136:04	1136:10	1153:24	1712	6101970	HESSI
12-25	keV	1047:21	1049:16	1049:22	780009	83675024	FERMI
12-25	keV	1109:49	1109:57	1146:32	692210	179296864	FERMI
12-25	keV	1223:00	1230:30	1230:47	11684	1241732	FERMI

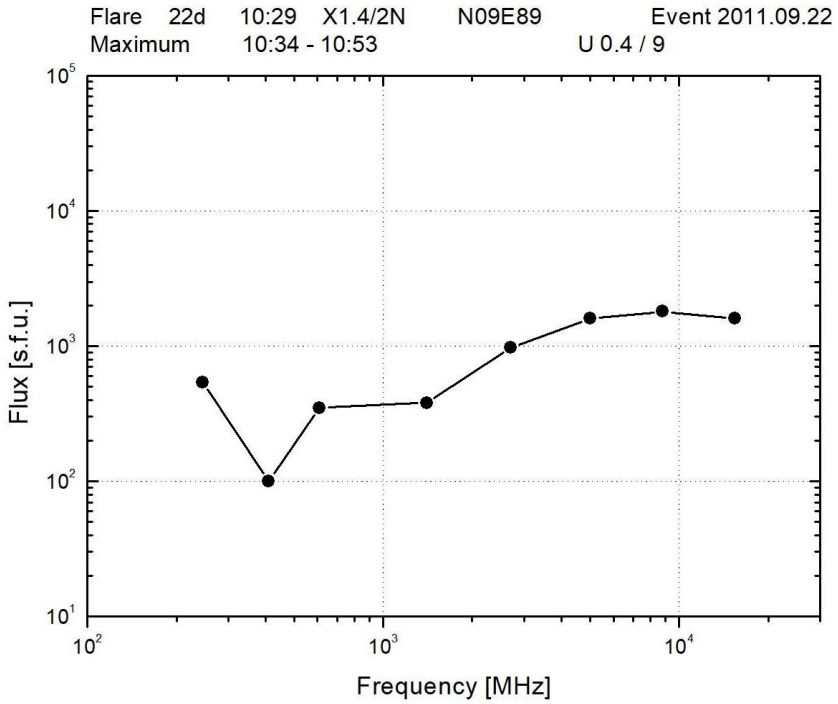
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	1034	1042	1302	U0.4 / 9	3.2	
8.8	GHz	1032	1047	1242		3.26	
5	GHz	1031	1047	1143		3.2	
2.7	GHz	1034	1053	1115		2.99	
1.4	GHz	1032	1034	1106		2.58	
610	MHz	1043	1043	1045		2.54	
410	MHz	1043	1043	1043		2.0	
245	MHz	1040	1049	1056		2.73	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	025-086	1039		1045		2	
DS IV	025-180	1041		1333		3	
DH II	0.07-14	1105		2400			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1048	1905	-68.3	360˚	072˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_110922_045634_11316/www/

Radio burst frequency spectrum



Proton Active Region

AR11302 (N13L280, CMP 28,7.09.2011,
Sp=1300 msh; EKC, BGD, R2)
XRI=8.73; $X_2^{1.9}$+$M_{16}^{7.4}$+C_{32} 2_6+1_9+S_{72}
PFR1 21-22.09 (22^h) $X_1^{1.4}$+$M_2^{1.8}$
PFR2 24-26.09 (52^h) $X_1^{1.9}$+$M_{11}^{7.4}$

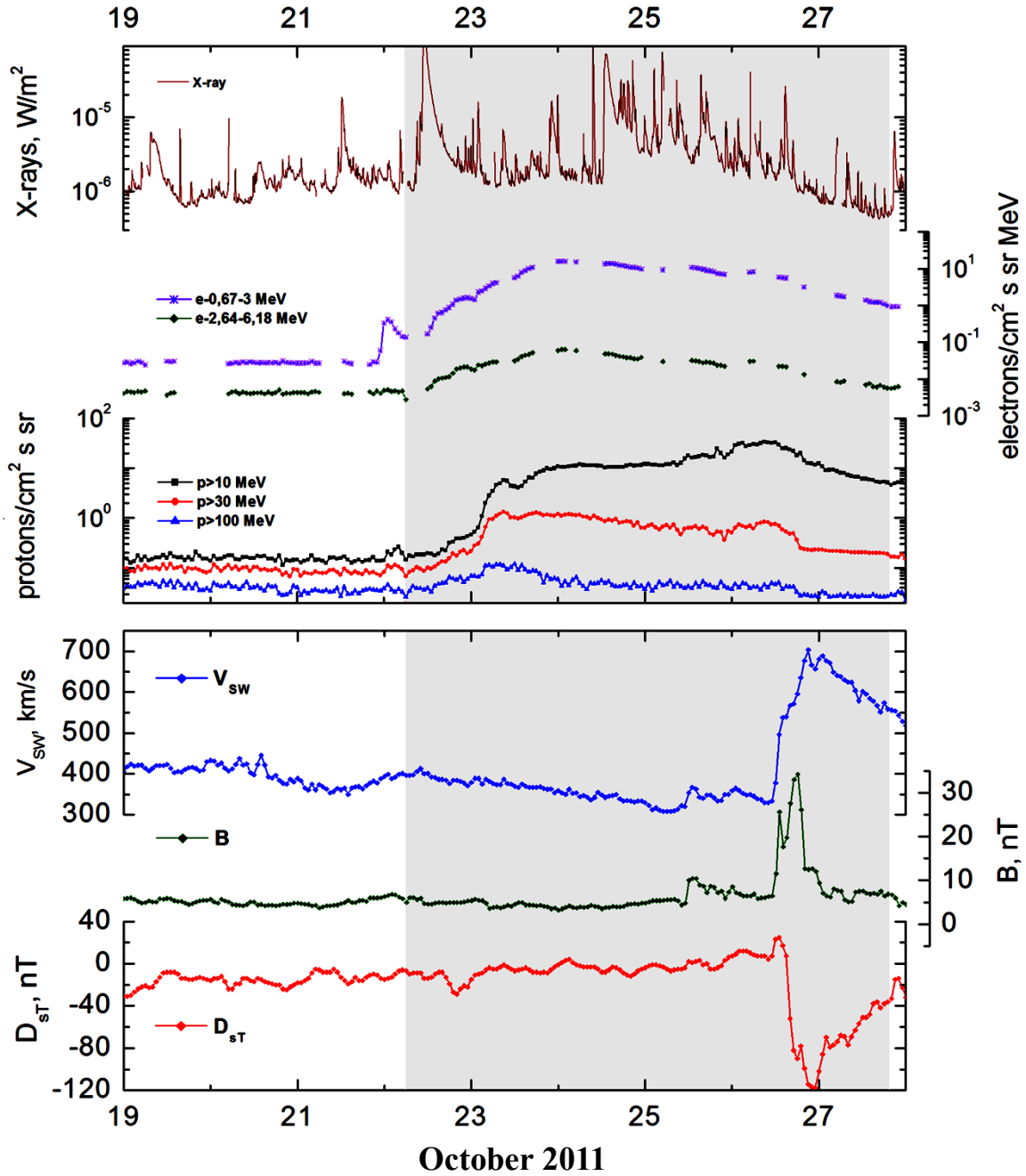
References:

Alberti T., M. Laurenza, E.W. Cliveret et al., 2017.
Bruno A., I.G. Richardson, 2021.
Cohen C.M.S., R.A. Mewaldt, 2018.
Gopalswamy N., H. Xie, S. Akiyama et al., 2014.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Kalaivani P.P., O. Prakash, A. Shanmugaraju et al., 2021.
NOAA SPE, 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Wang Y., D. Lyu, B. Xiao et al., 2021.
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 22d12^h
Tmax (Ep>10 MeV) – 22d23^h, Jmax$_1$ (Ep>10 MeV) – 3.3 /cm^2·s·sr
Duration of the event – 3.5 days, power-law index: γ = 2.8
Quasimaximal energy of protons in the event – Eqm = 75 MeV

Sources: ● solar flare 22d10^{h}00^m, M1.3/SF, N25W77, AR11314
Main burst X-ray 1–8 Å: onset – 22d10^{h}00^m, max – 22d11^{h}10^m, Φ = 0.11 J/m^2
CME: 22d10^{h}24^m, V= 1005 km/s, $\Delta\varphi$ = 360º, dA= 311º
▲ SC 24d18^{h}31^m

Particle fluxes and associated phenomena

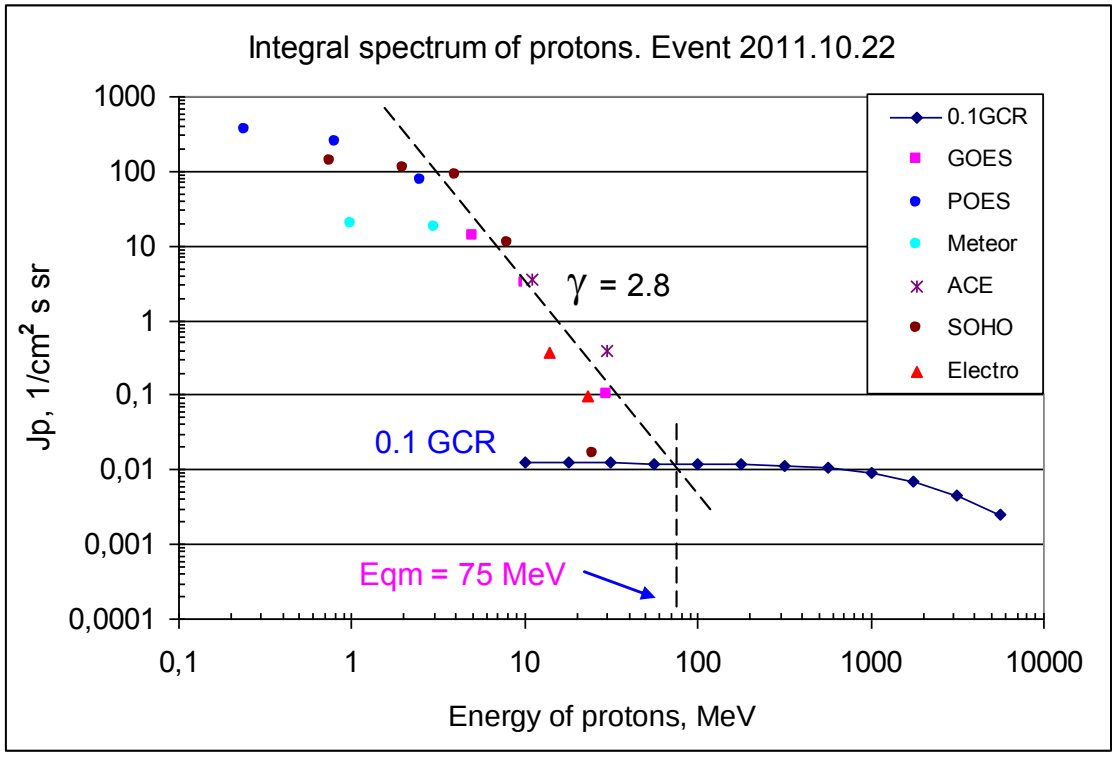


Integral fluxes of protons for the event of 2011 October 22

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	12	23d00	13.3	3.5	0.2	
EPS	>10	12	23	3.3	3.5	0.15	
EPS	>30	12	23	0.1	2.5	0.08	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	18	23	360	4	100	
MEPED	>0.8	18	23	250	4	80	
MEPED	>2.5	18	23	75	3	60	
MEPED	>6.9	-	-	-	-	55	
MEPED	>16	-	-	-	-	0.9	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	1	
MEPED	>140	-	-	-	-	1.3	
Meteor-1							
SCR	>1	15	23d00	17.4	5	3	
SCR	>3	15	23d00	15.1	5	3	
SCR	>10	-	-	-	-	2.	
GALS-M	>15	-	-	-	-	1.35	
GALS-M	>25	-	-	-	-	1.4	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	14	23d02	3.4	2	1.5	
SIS	>30	14	23	0.4	2	1.1	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

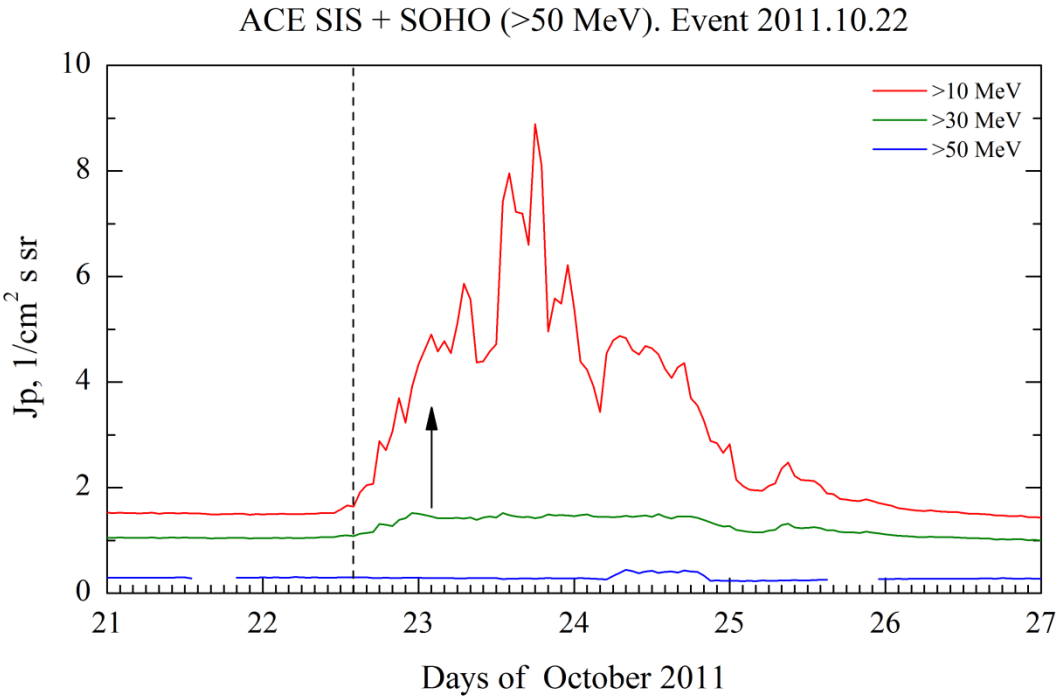
Differential fluxes of protons for the event of 2011 October 22

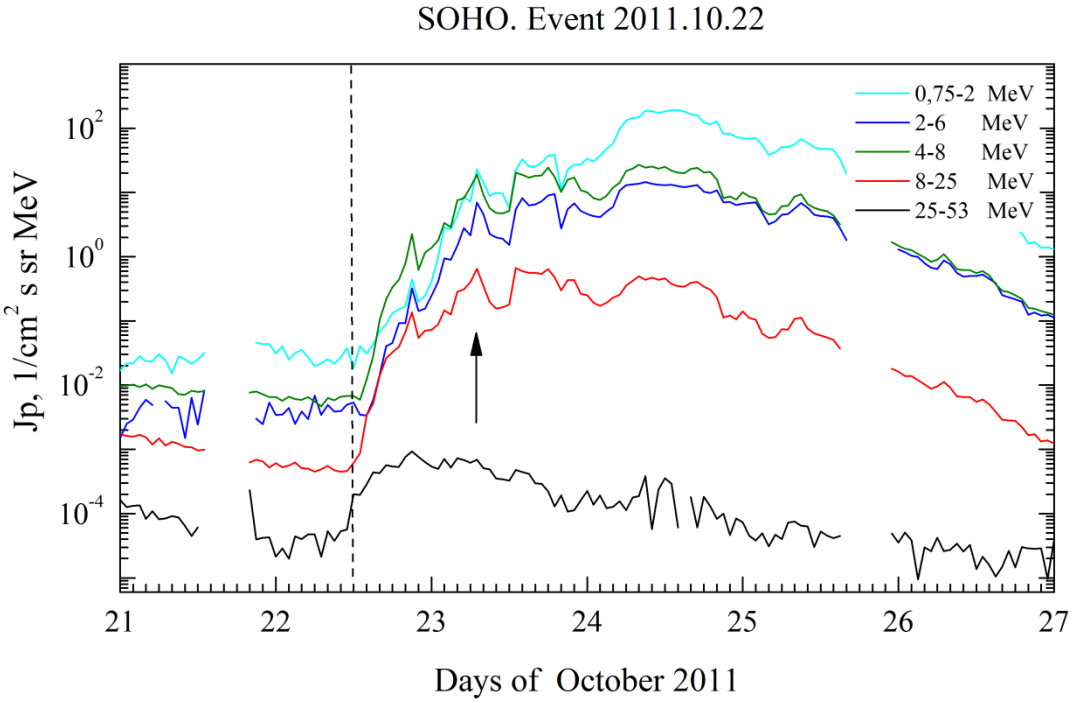
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	12	23d07	23	6	0.03	
LION	2 – 6	12	23d07	6.9	6	0.004	
EPHIN	4 – 8	12	23d07	19	5	0.006	
EPHIN	8 – 25	12	23d07	0.65	5	0.0005	
EPHIN	25–53	12	23d05	0.0006	4	0.00005	
Electro-1							
SCR-E	13.7–23	11	20	0.03	0.5	0.06	
SCR-E	23–42	11	20	0.005	0.5	0.025	
SCR-E	42–112	-	-	-	-	0.005	


Integral spectrum of protons. Event 2011.10.22
Jp, 1/cm2 s sr
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.8
0.1 GCR
Eqm = 75 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

Time profiles of proton fluxes in the event 2011.10.22

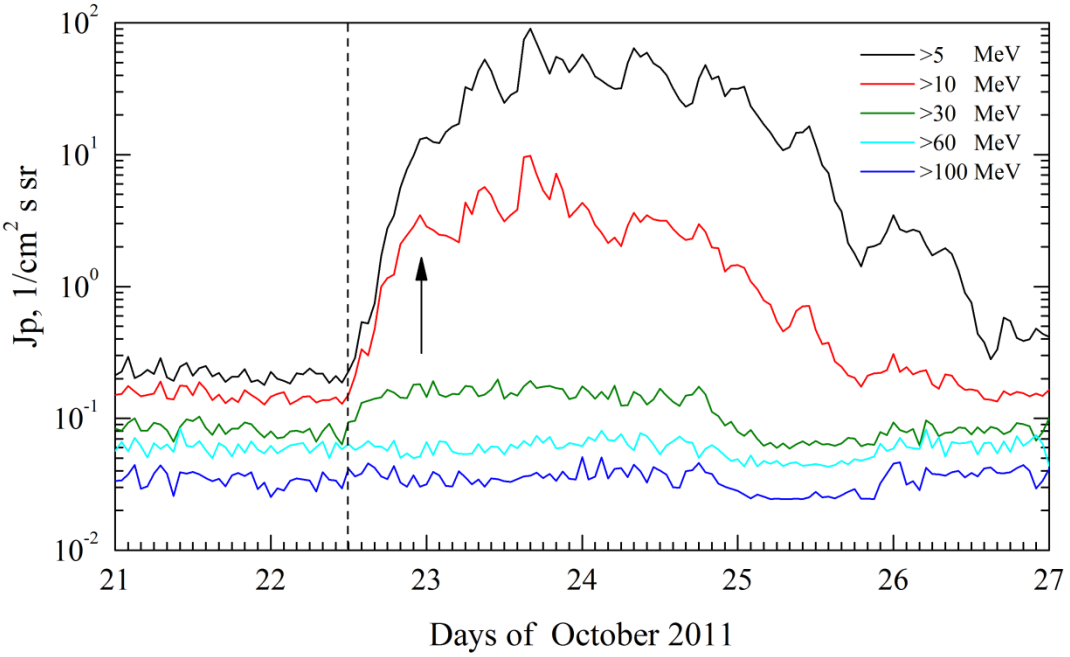
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



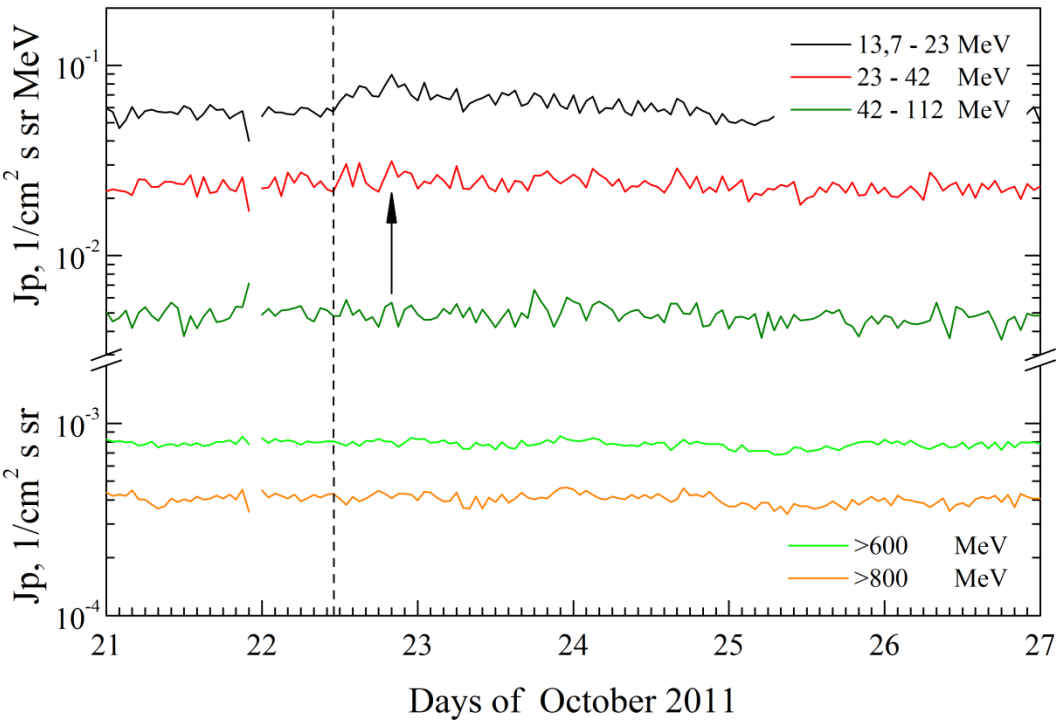


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro

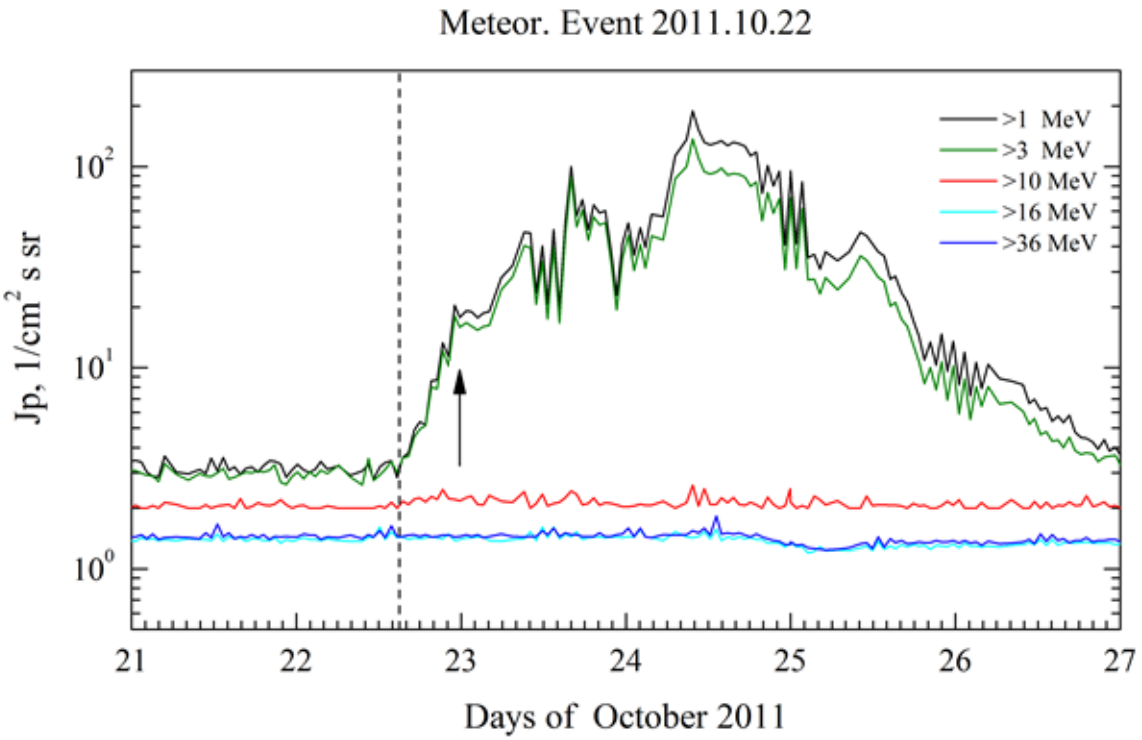
GOES. Event 2011.10.22

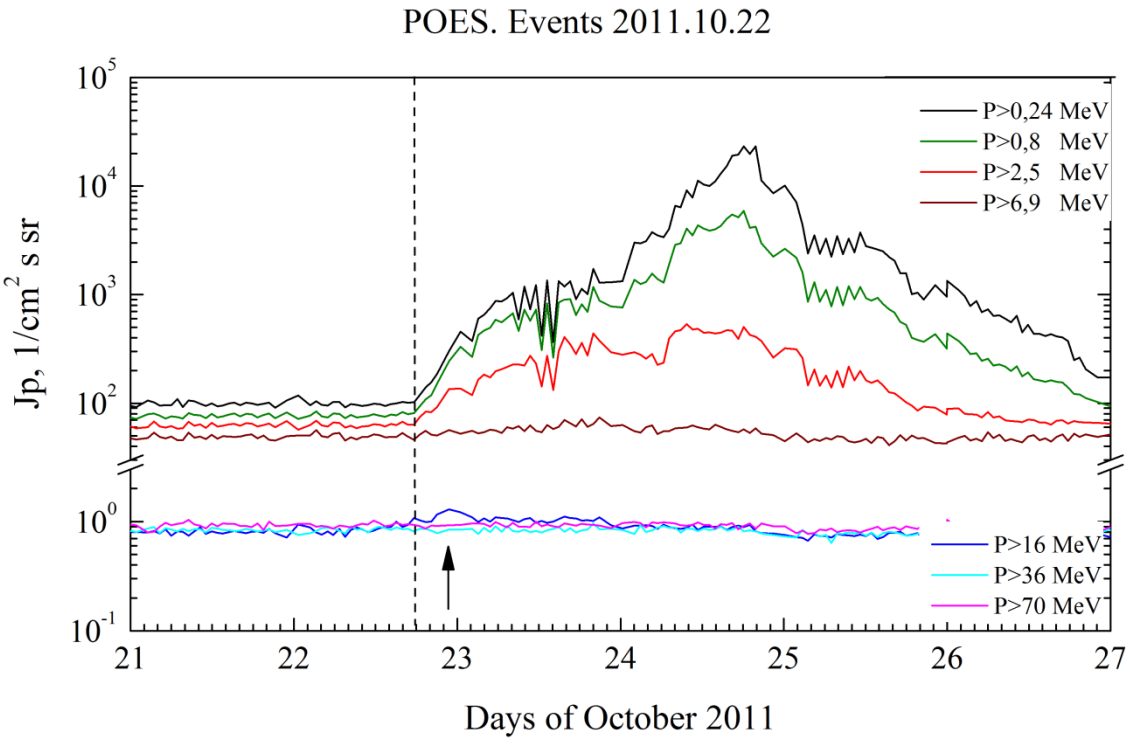


Electro. Event 2011.10.22



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 October 22

2011 October 22 • AR 11314 To event 496

Hα, X-ray		To	Tmax	Te	Location	Importance class	Fl Code Φ, J/m^2
6563 Å	FL	1041	1057	1227	N25W77	SF	ERU
1 – 12	keV	1000	1110	1340	N27W87	M1.3	0.11

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12-25	keV	1023:16	1029:18	1029:28	92	143441	HESSI
6-12	keV	1104:12	1104:34	1113:48	90	187858	HESSI
6-12	keV	1158:40	1159:14	1204:40	600	96366	HESSI
6-12	keV	1204:40	1204:50	1206:16	42	17800	HESSI
12-25	keV	1206:16	1208:02	1209:04	41	30818	HESSI
6-12	keV	1209:04	1210:22	1210:28	46	16000	HESSI

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS cont	069-180	1026		1049		1	
DS III	034-149	1117		1123		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1024	1005	17.7	360˚	311˚	SOHO

Proton Active Region

AR11314 (N27L056, CMP 15,3.10.2011,
Sp=370 msh, HSX, A)
XRI=0.13 $M_1^{1.3}$+C_9 1_1+S_{11}
PFR 22.10 $M_1^{1.3}$

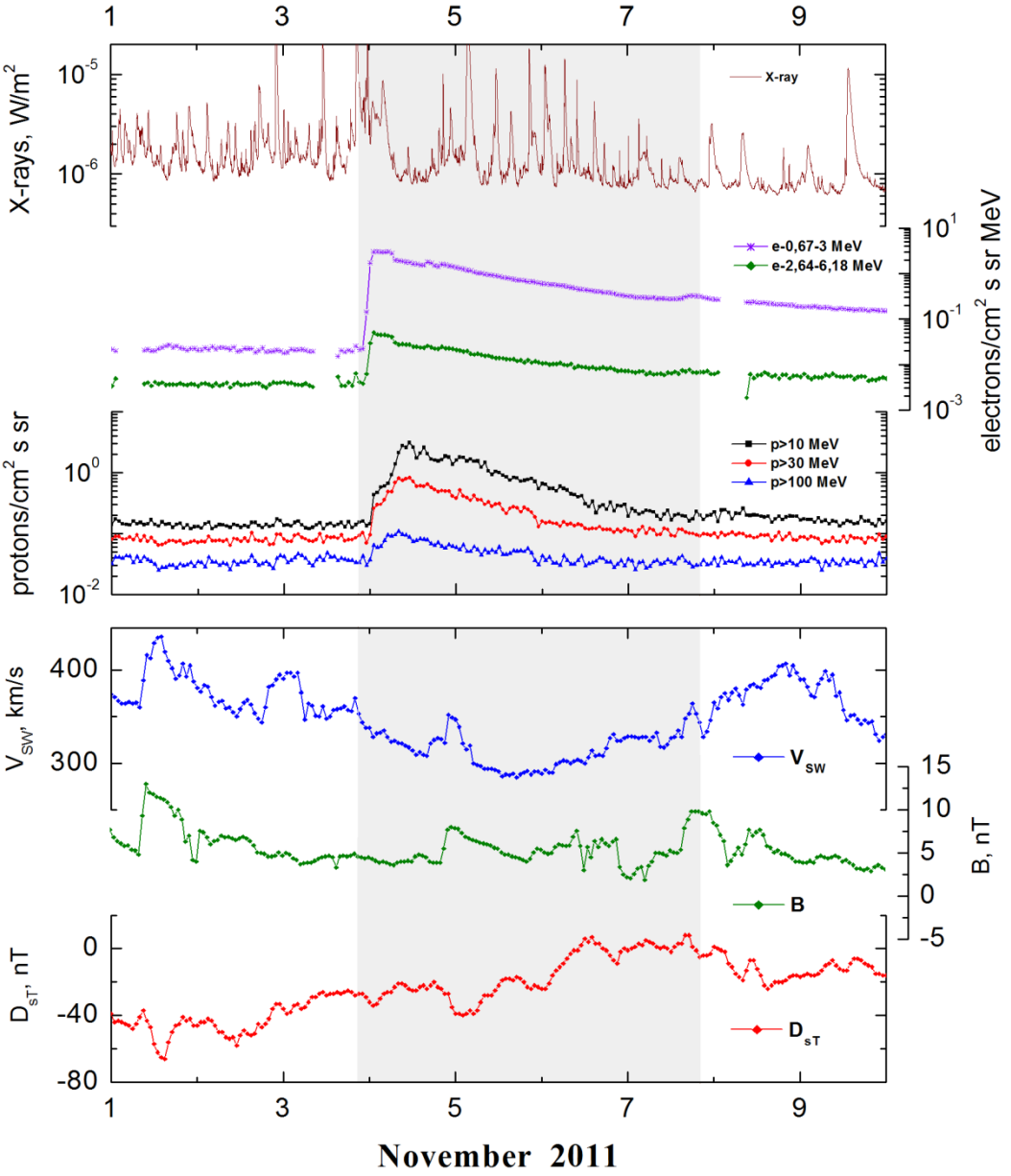
References:

Ameri D., E. Valtonen, 2019.
Bruno A., I.G. Richardson, 2021.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.
Zhuang B., N. Lugaz, T. Gou, L. Ding, 2021.

Particle event: To(Ep>10 MeV) – 04d00^h
Tmax (Ep>10 MeV) – 04d09^h, $Jmax_1$ (Ep>10 MeV) – 2.6 /cm^2·s·sr
Duration of the event – 3 days, power-law index: $\gamma = 2.3$
Quasimaximal energy of protons in the event – Eqm = 190 MeV

Sources: ● solar flare 03d20^{h}16^m, X1.9/2B, N22E63, AR11339
Ø solar flare 03d23^{h}28^m, M2.1/, N22E63, AR11339
Main burst X-ray 1–8 Å: onset – 03d20^{h}16^m, max – 03d20^{h}27^m, $\Phi = 0.1$ J/m^2
CME: 03d23^{h}10^m, V= 991 km/s, $\Delta\varphi = 360^o$, dA= 90º

Particle fluxes and associated phenomena

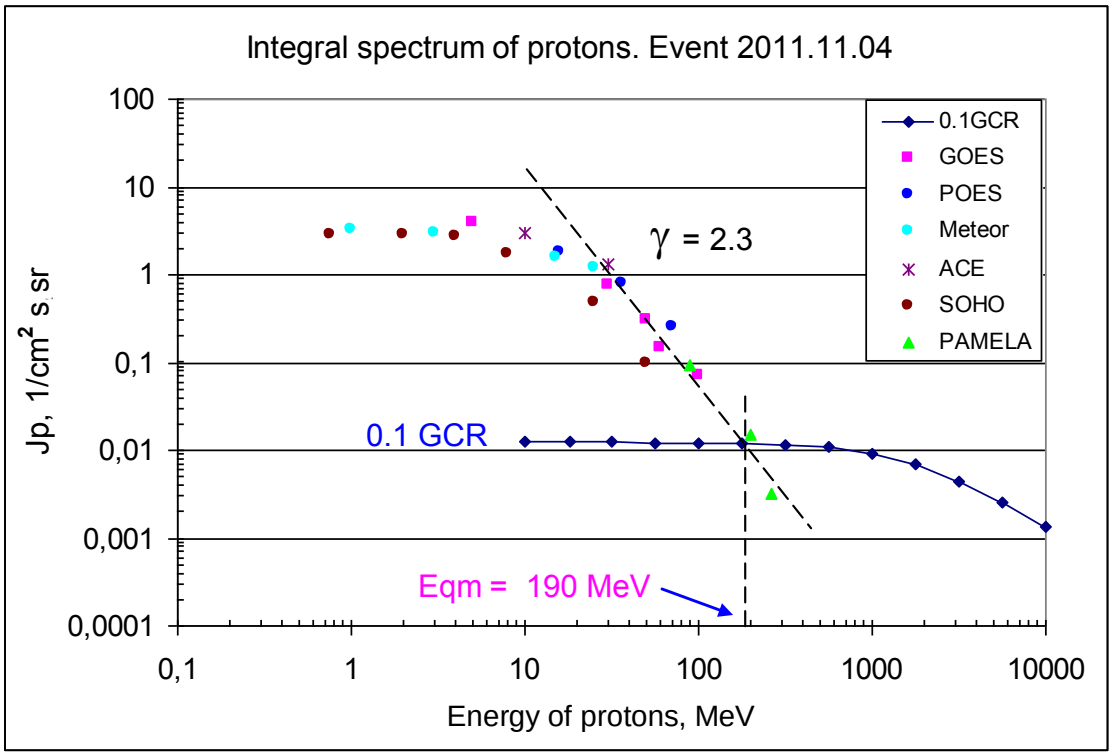


Integral fluxes of protons for the event of 2011 November 04

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	00	09	4	3.5	0.2	
EPS	>10	00	09	2.6	3	0.15	
EPS	>30	00	08	0.75	2.5	0.08	
EPS	>50	00	08	0.3	2	0.07	
EPS	>60	03d23	07	0.15	2	0.06	
EPS	>100	03d23	08	0.07	2	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	-	-	-	-	100	
MEPED	>0.8	-	-	-	-	80	
MEPED	>2.5	-	-	-	-	60	
MEPED	>6.9	-	-	-	-	55	
MEPED	>16	3d23	10	1.8	2	0.85	
MEPED	>36	3d23	10	0.8	2	0.8	
MEPED	>70	3d23	10	0.35	1	0.9	
MEPED	>140	3d23	-	-	-	1.2	
Meteor-1							
SCR	>1	03d23	12	3.3	4	3.1	
SCR	>3	03d23	12	3.0	4	3.05	
SCR	>10	03d23	-	-	4	2.1	
GALS-M	>15	03d23	11	1.6	3	1.35	
GALS-M	>25	03d23	11	1.2	3	1.4	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	03d23	03	3	2	1.5	
SIS	>30	03d23	03	1.3	2	1.1	
SOHO							
EPHIN	>50	0	4	0.1	2	0.3	
PAMELA							
TRECKER	>90	0	07-10	0.095	2	-	
TRECKER	>200	0	07-10	0.015	2	-	
TRECKER	>265	0	07-10	0.0032	2	-	

Differential fluxes of protons for the event of 2011 November 04

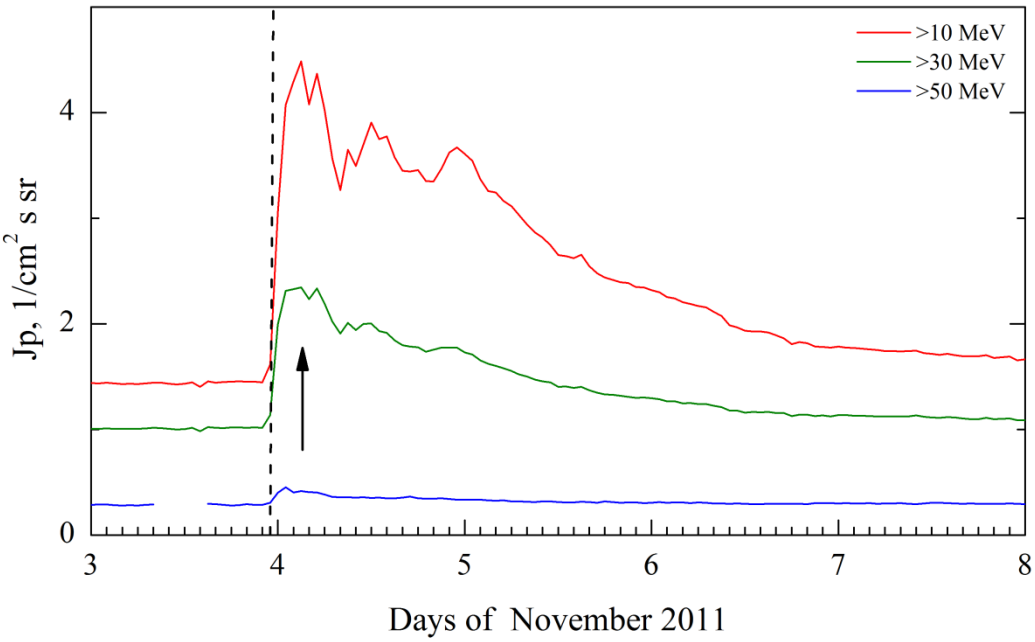
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	0	5	0.04	7	0.01	
LION	2 – 6	0	4	0.046	7	0.001	
EPHIN	4 – 8	0	4	0.25	5	0.0003	
EPHIN	8 – 25	0	4	0.07	5	0.00001	
EPHIN	25–53	0	4	0.014	4	0.00002	
Electro-1							
SCR-E	13.7–23	03d23	-	-	3	0.06	
SCR-E	23–42	03d23	-	-	2	0.025	
SCR-E	42–112	03d23	-	-	1	0.005	



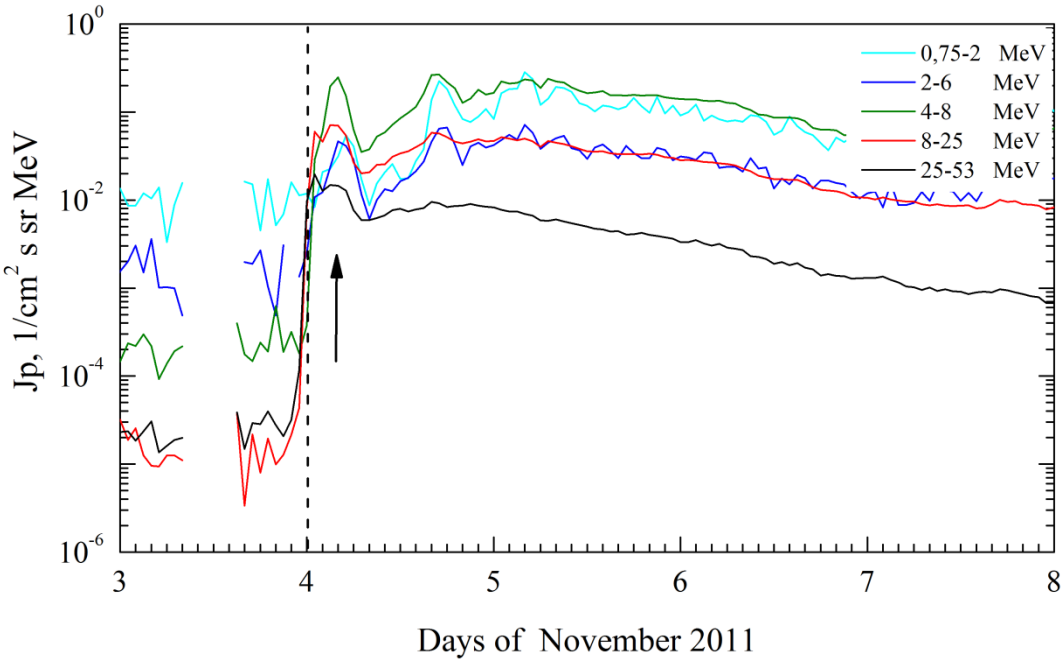
Time profiles of proton fluxes in the event 2011.11.04

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

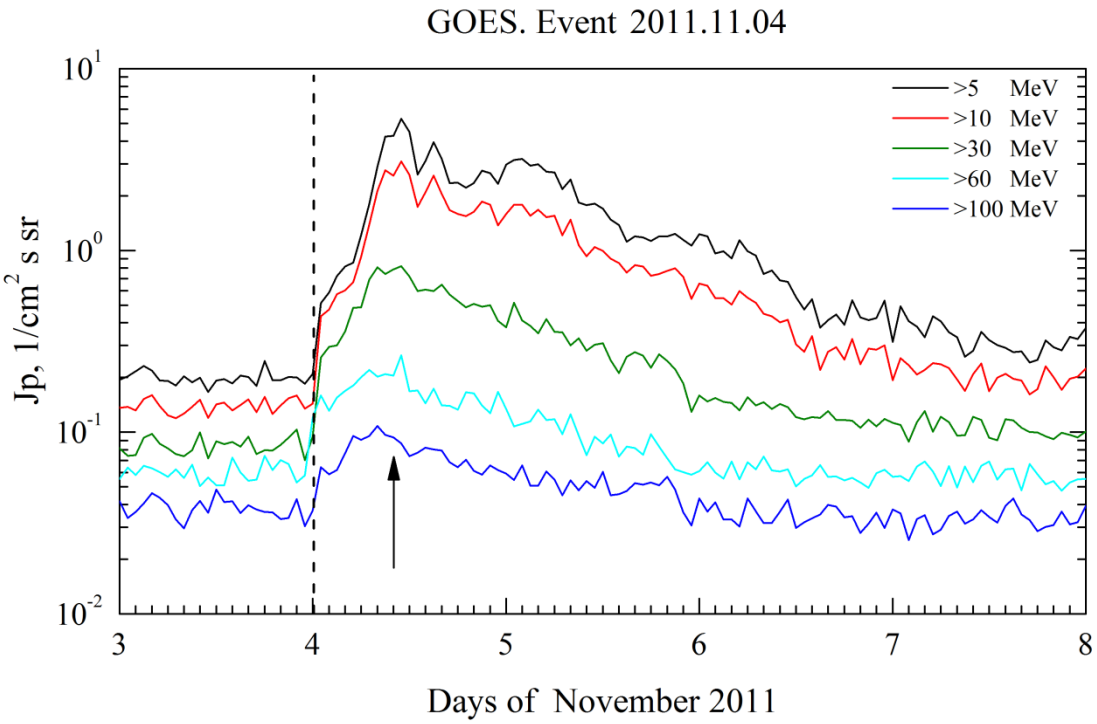
ACE SIS + SOHO (>50 MeV). Event 2011.11.04

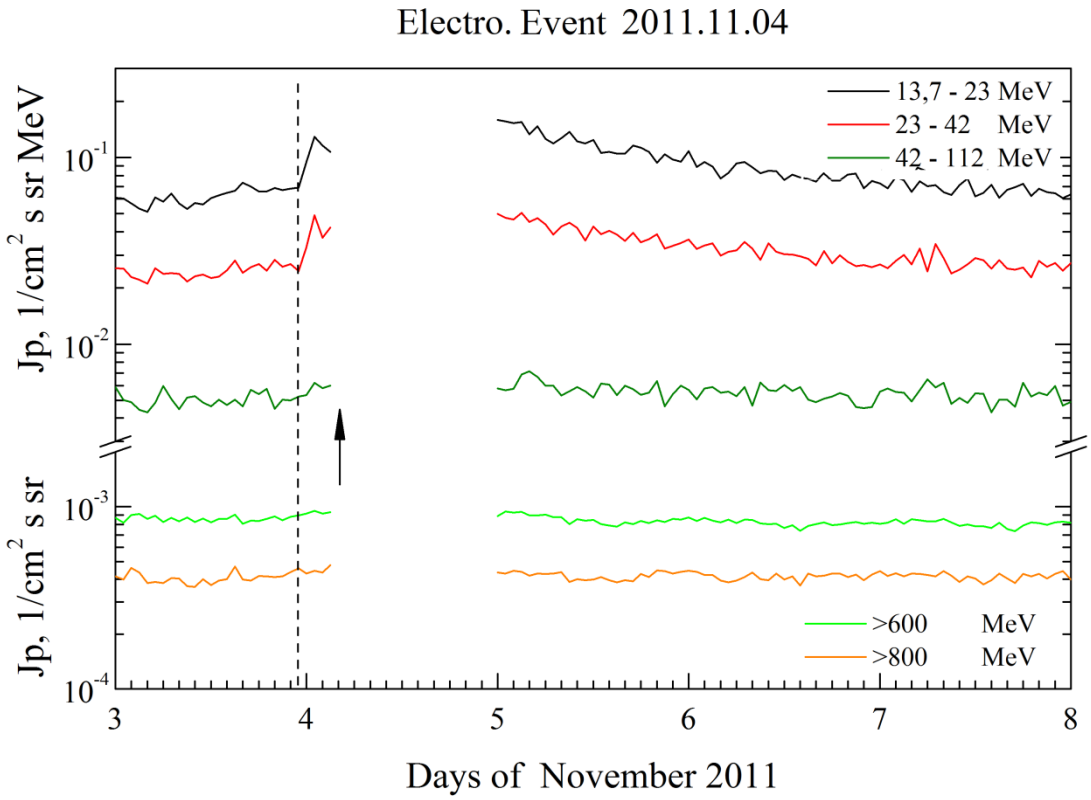


SOHO. Event 2011.11.04



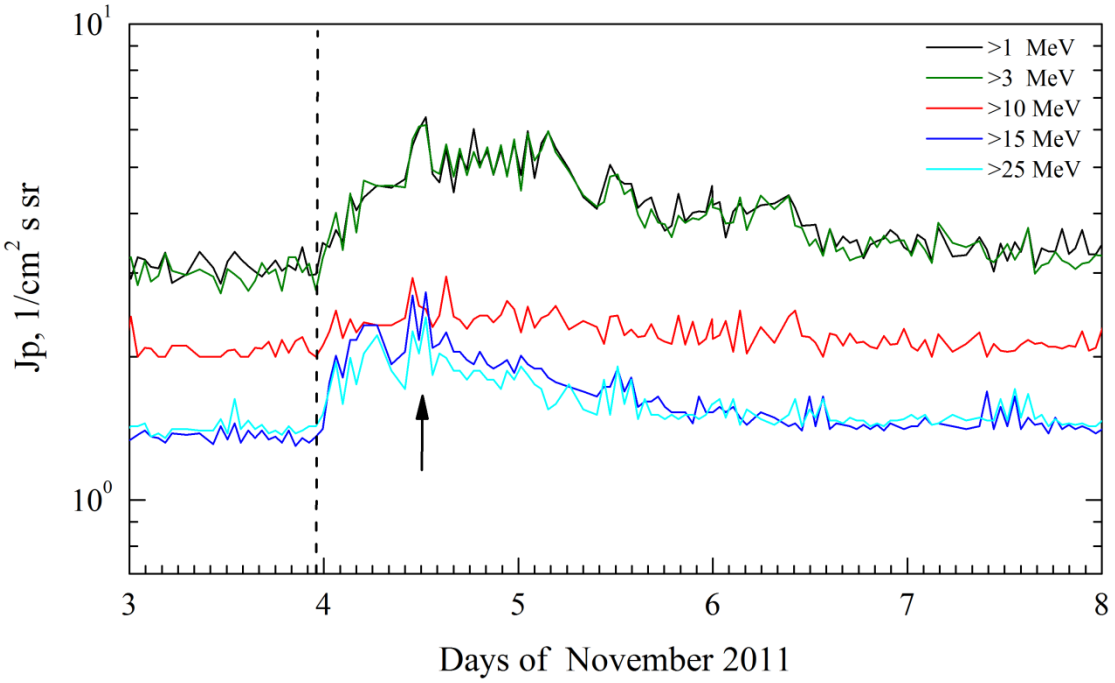
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



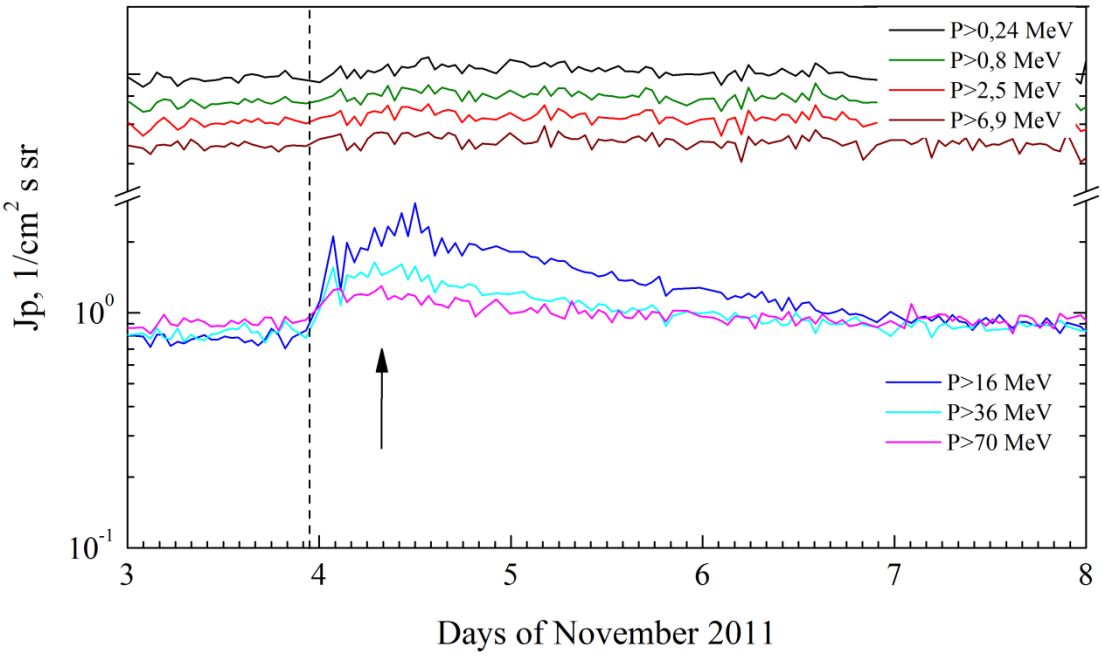


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2011.11.04



POES. Events 2011.11.04



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 November 04

2011 November 03 ● AR 11339 To event 497

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	2019	2023	2140	N22E63	2B	UMB
1 – 12	keV	2016	2027	2032	N21W64	X1.9	0.10

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
6-12	keV	2116:00	2117:38	2119:56	32	28680	HESSI
12-25	keV	2119:56	2123:38	2127:24	38	56160	HESSI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	2020	~2020	2021	U15	2.7	
8.8	GHz	2019	2021	2027	P9 \ 2.7	3.26	
5	GHz	2020	2021	2027		3.11	
2.7	GHz	2020	2021	2024		2.79	
1.4	GHz	2020	2020	2023		2.89	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS III	025-180	2034		2038		1	
DS III	025-087	2053		2100		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	2310	991	-40.5	360˚	090˚	SOHO

2011 November 03 ● AR 11339 To event 497

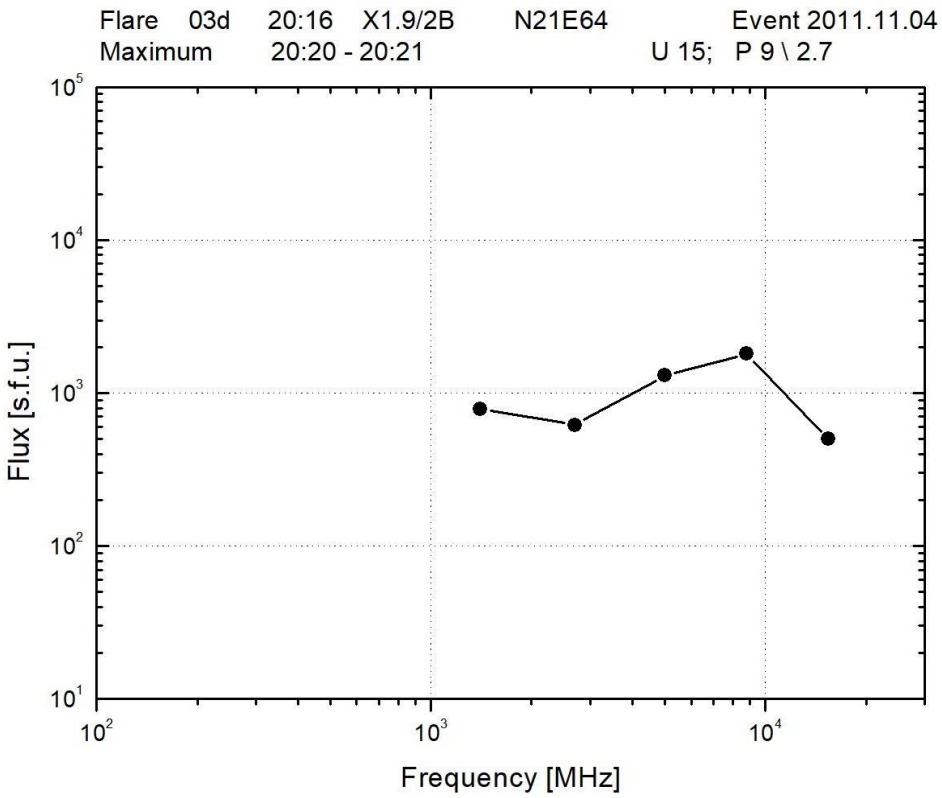
Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å		No flare event on visible solar disc					
1 – 12	keV	2328	2336	2344	N20E62	M2.1*	0.014

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS cont	031-180	4d0000		1019		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	04d0125	756	- 8.0	360˚	084˚	SOHO

* for second maxima

Radio burst frequency spectrum



Proton Active Region

AR11339 (N19L103, CMP 08.11.2011,
Sp=1540 msh, EKC, BGD)
XRI=4.18; $X_1^{1.9}$+$M_9^{4.3}$+C_{38}; 2_1+1_4+C_{30}
PFR 2-3.11 (25^h) $X_1^{1.9}$+$M_3^{4.3}$

References:

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Bazilevskaya G.A., A.G. Mayorov, V.V. Malakhov, V.V. Mikhailov, 2013.
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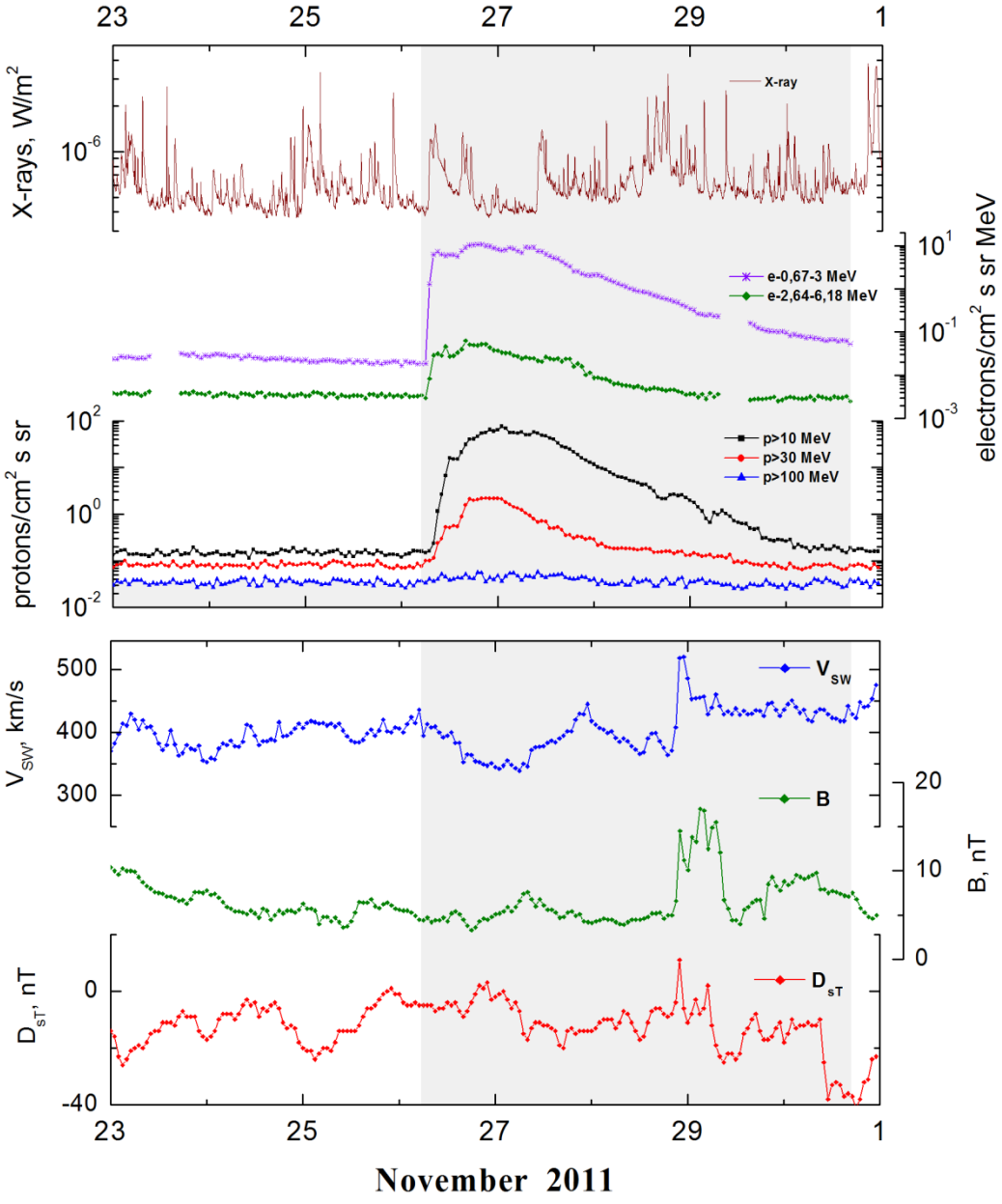
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Wang Y., D. Lyu, B. Xiao et al., 2021.
Winter L.M. and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.

Particle event: To(Ep>10 MeV) – 26d08^h
Tmax (Ep>10 MeV) – 26d17^h, Jmax(Ep>10 MeV) – 40 /cm^2·s·sr
Duration of the event – 3.5 days, power-law index: γ = 3.2
Quasimaximal energy of protons in the event – Eqm = 120 MeV

Sources: ⊙ solar flare 26d06^{h}09^m, C1.2/DSF, N08W49, AR11353
Main burst X-ray 1–8 Å: onset – 26d06^{h}09^m, max – 26d07^{h}10^m, Φ = 0.0053 J/m^2
CME: 26d07^{h}12^m, V= 0933 km/s, Δφ = 360º, dA= 327º
▲SC 28d21^{h}50^m

Particle fluxes and associated phenomena

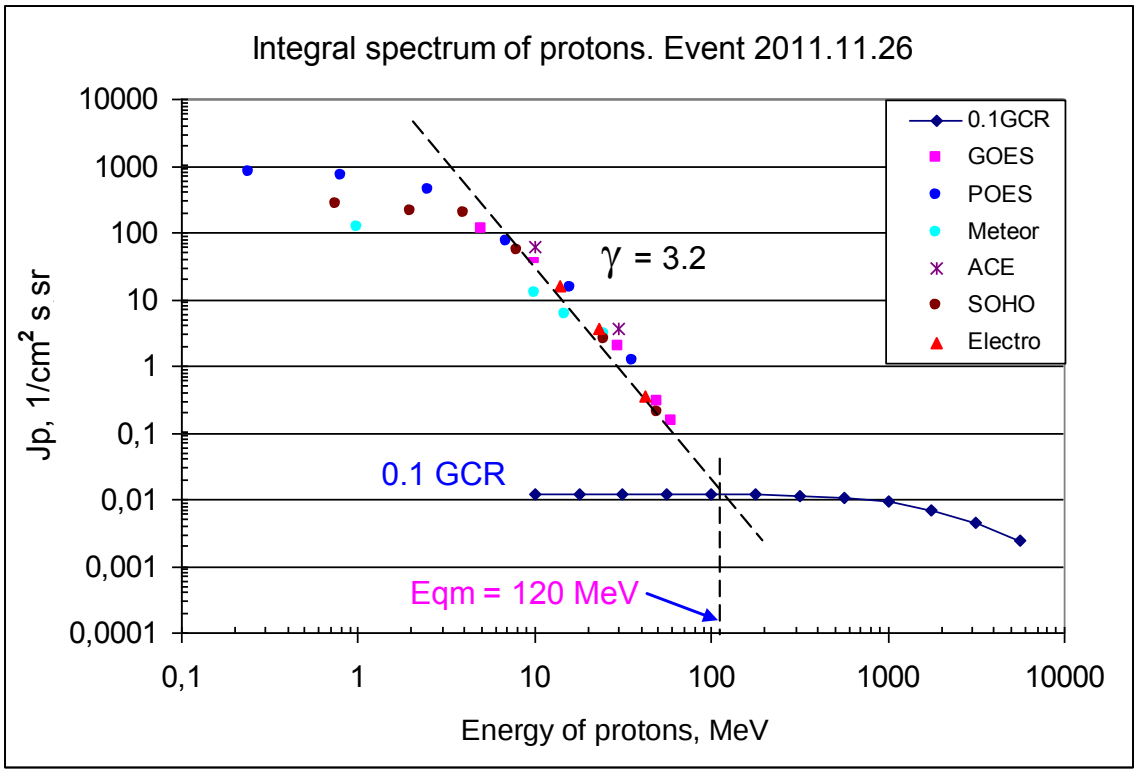


Integral fluxes of protons for the event of 2011 November 26

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	8	17	115	4d	0.2	
EPS	>10	8	17	40	3.5d	0.15	
EPS	>30	8	17	2	3d	0.08	
EPS	>50	8	17	0.3	2d	0.07	
EPS	>60	8	17	0.15	1d	0.06	
EPS	>100	8	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	8	23	800	4	100	
MEPED	>0.8	8	23	700	4	80	
MEPED	>2.5	8	23	440	3	60	
MEPED	>6.9	8	23	75	2	50	
MEPED	>16	8	23	15.3	2	0.85	
MEPED	>36	8	23	1.2	1	0.8	
MEPED	>70	8	-	-	-	0.9	
MEPED	>140	8	-	-	-	1.2	
Meteor-1							
SCR	>1	7	22	123	4	3.2	
SCR	>3	7	-	-	4	3	
SCR	>10	7	22	12.7	2	2.1	
GALS-M	>15	7	21	6	2	1.4	
GALS-M	>25	7	21	3	2	1.45	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	8	18	62	2.5	1.5	
SIS	>30	8	17	3.6	2.5	1.1	
SOHO							
EPHIN	>50	14	17	0.2	2	0.3	

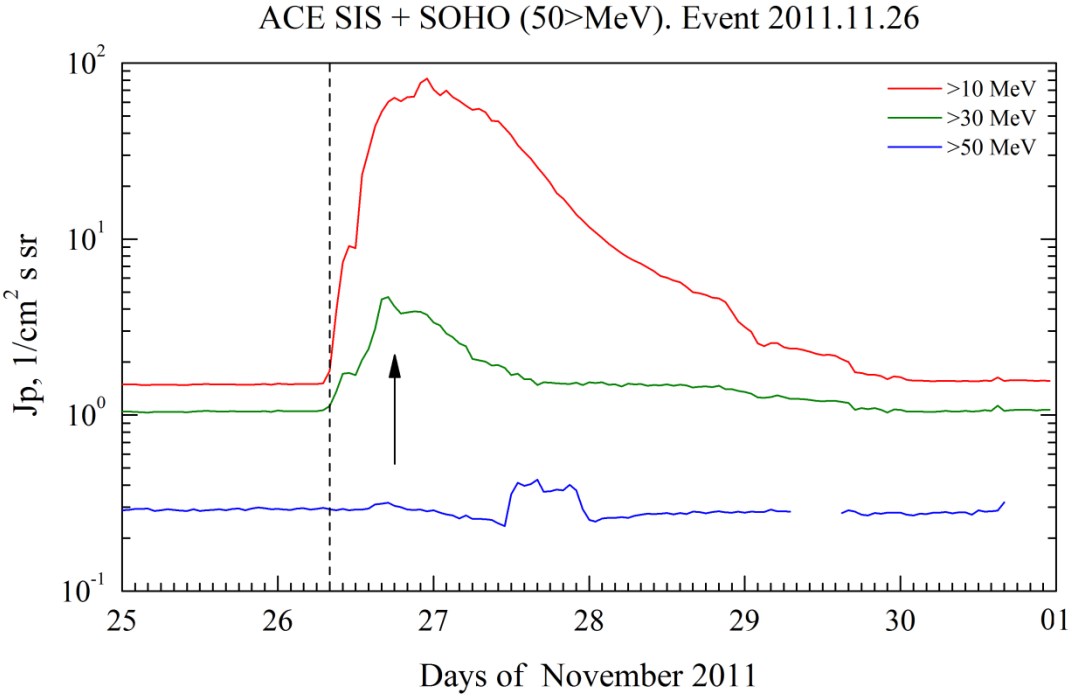
Differential fluxes of protons for the event of 2011 November 26

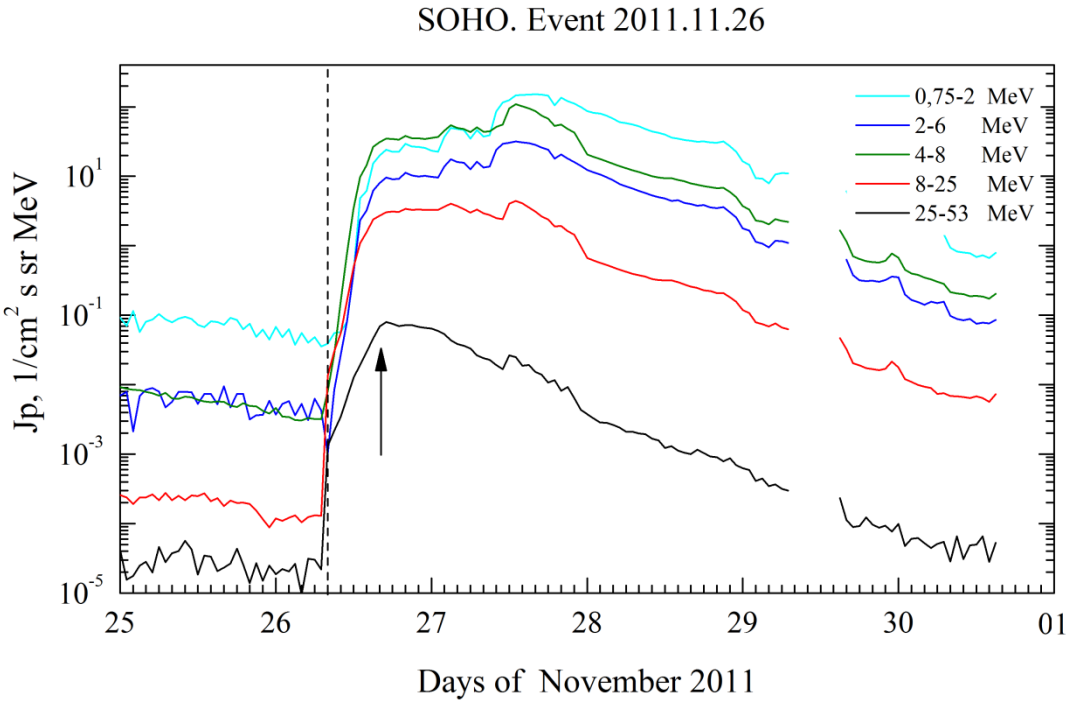
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	8	16	31	4	0.01	
LION	2 – 6	8	17	10	4	0.005	
EPHIN	4 – 8	8	17	34	4	0.003	
EPHIN	8 – 25	8	18	3.1	4	0.0001	
EPHIN	25–53	8	18	0.08	4	0.00002	
Electro-1							
SCR-E	13.7–23	7	21	1.3	2	0.06	
SCR-E	23–42	7	20	0.17	2	0.025	
SCR-E	42–112	7	16	0.005	1.25	0.005	


Integral spectrum of protons. Event 2011.11.26
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
γ = 3.2
0.1 GCR
Eqm = 120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
0,1
1
10
100
1000
10000
Energy of protons, MeV

Time profiles of proton fluxes in the event 2011.11.26

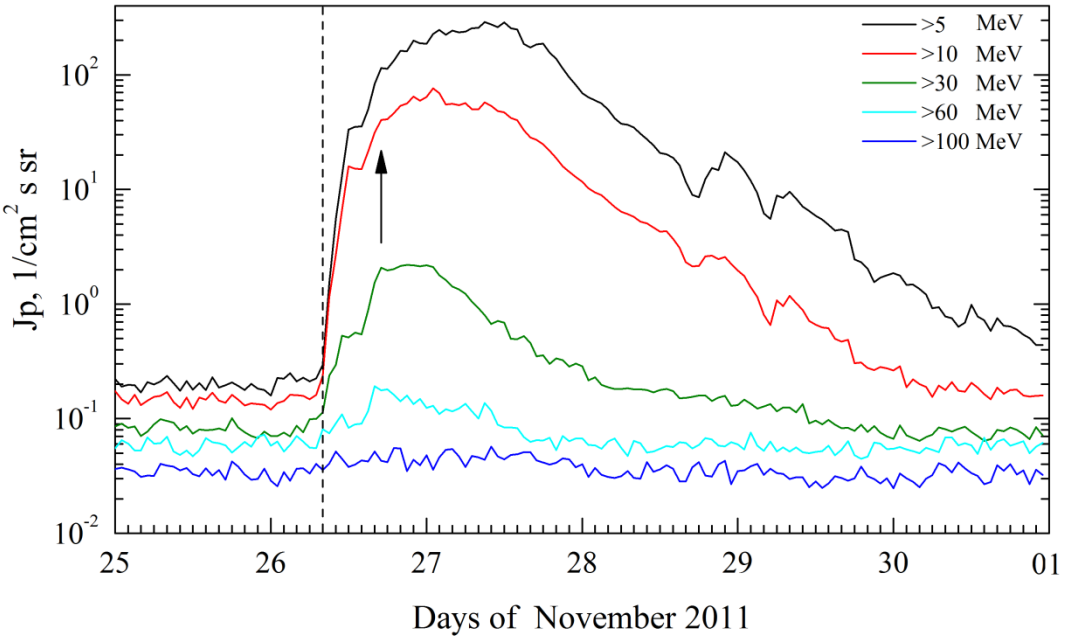
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



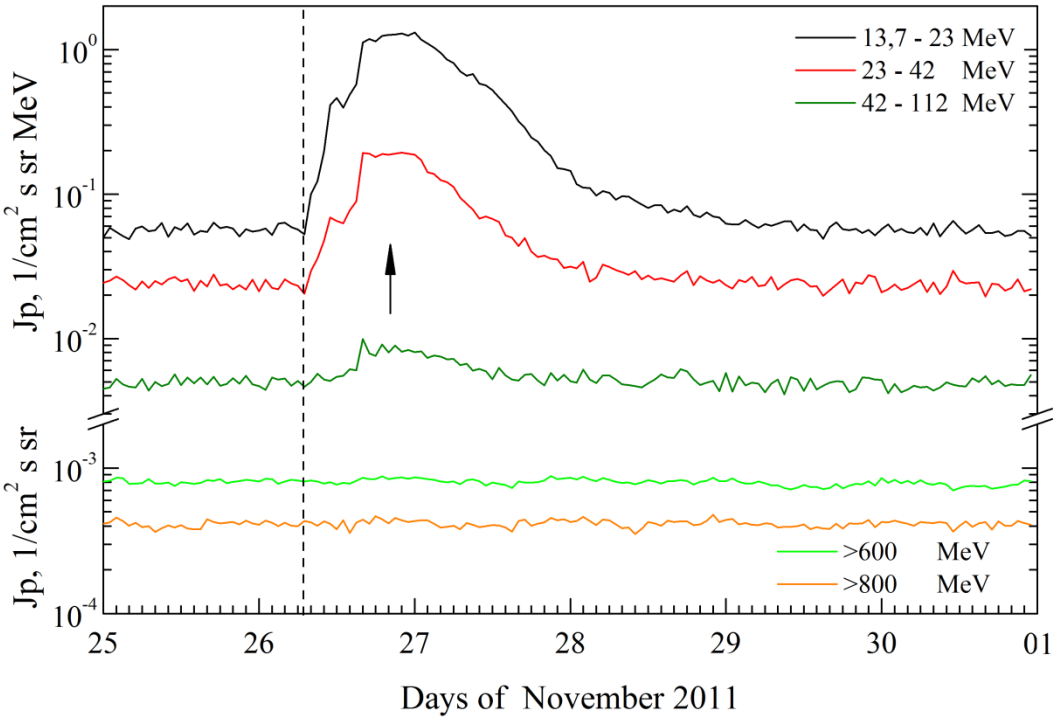


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro

GOES. Event 2011.11.26

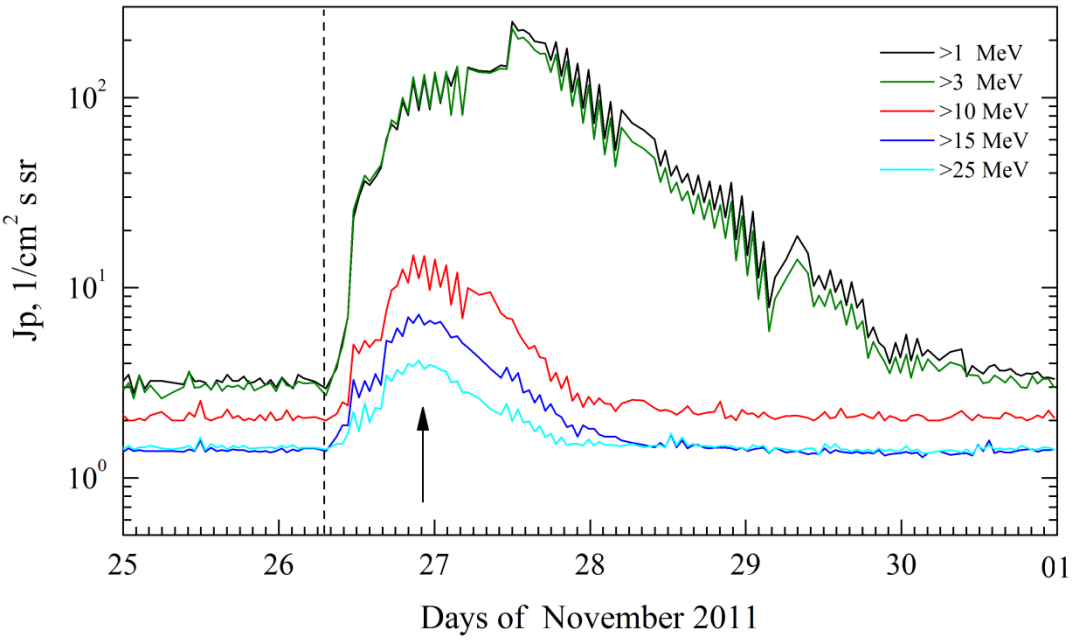


Electro. Event 2011.11.26

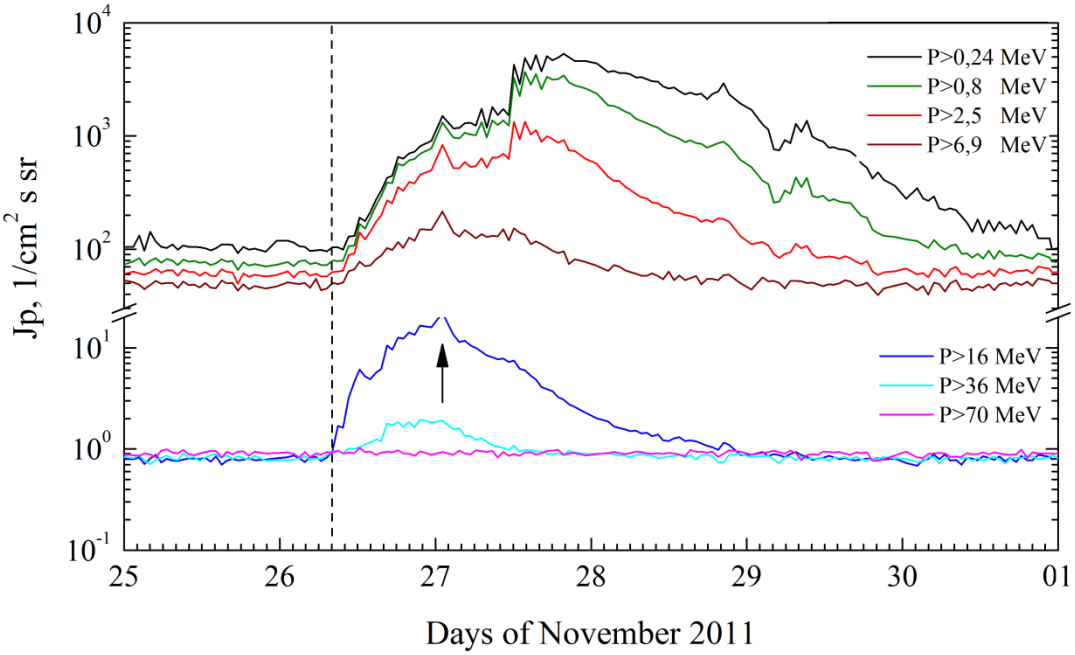


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2011.11.26



POES. Events 2011.11.26



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 November 26

2011 November 26 ⊙ AR 11353 To event 498

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ, J/m^2**
6563 Å	DSF	0530		~0830	N11W49	>10º	
1 – 12	keV	0609	0710	0756	N08W47	C1.2	0.0053
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	0646	0646:34	0648:32	38	22400	HESSI
6-12	keV	0648:32	0700:10	0715:28	84	449120	HESSI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS III	025-180	0703		0704		1	
DH II	0.05-10	0715		27/2400			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0712	933	9.0	360˚	327˚	SOHO

Proton Active Region

AR11353 (N08L267, CMP 23,7.12.2011,
Sp=0490 msh, CRO, B)
XRI=0 C_2 S_2

References:

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Winter L. M., and K. Ledbetter, 2015.
Xie H., O.C. St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.
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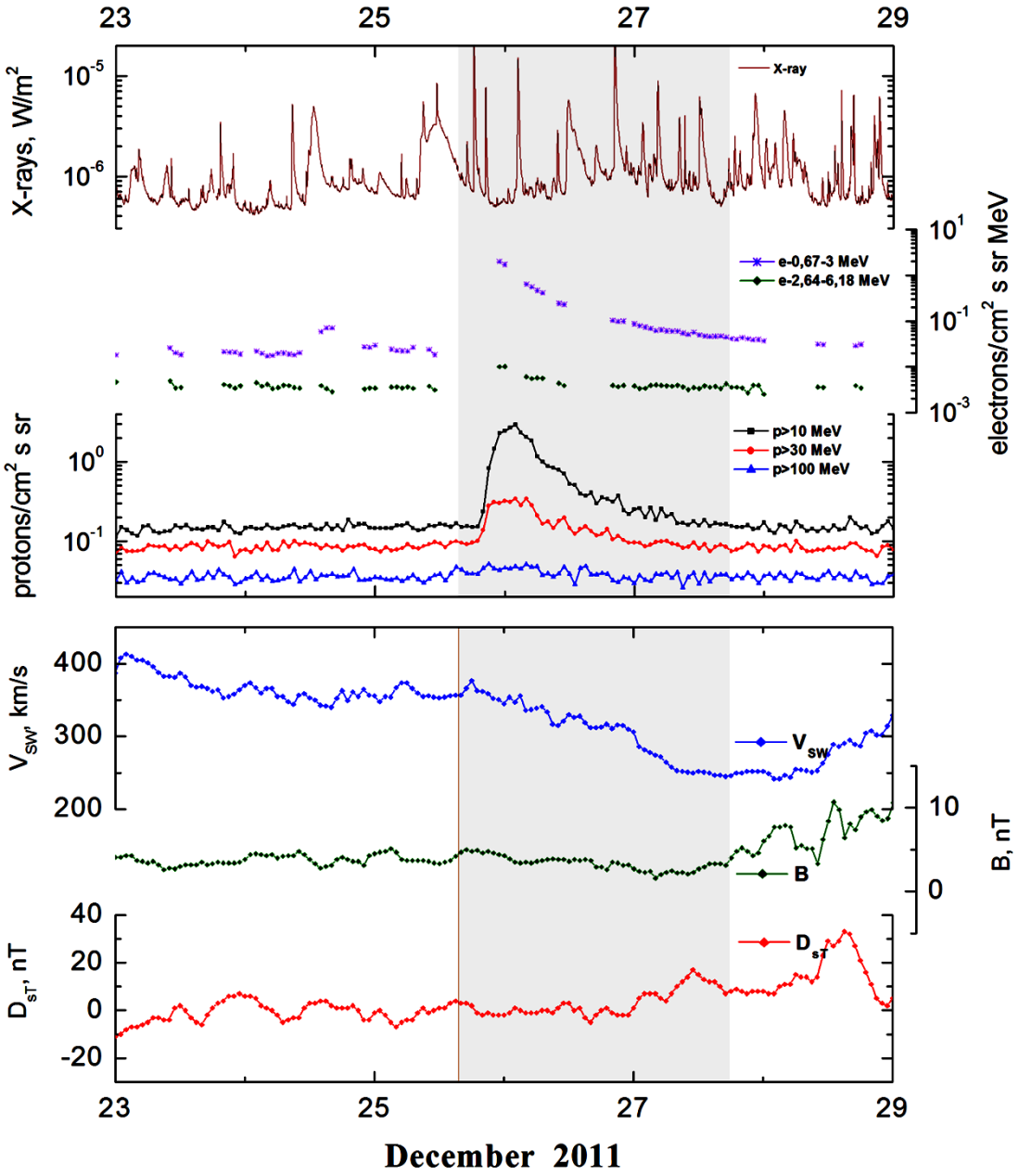
Particle event: To(Ep>10 MeV) – 25d19^h
Tmax (Ep>10 MeV) – 26d01^h, Jmax$_1$ (Ep>10 MeV) – 2.5 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.3.
Quasimaximal energy of protons in the event – Eqm = 100 MeV

Sources: ● solar flare 25d18^{h}11^m, M4.0/1N, S22W26, AR11387
Main burst X-ray 1–8 Å: onset – 25d18^{h}11^m, max – 25d18^{h}16^m, Φ = 0.011 J/m^2
CME: 25d18^{h}48^m, V = 366 km/s, Δφ = 125º, dA = 235º

Particle fluxes and associated phenomena

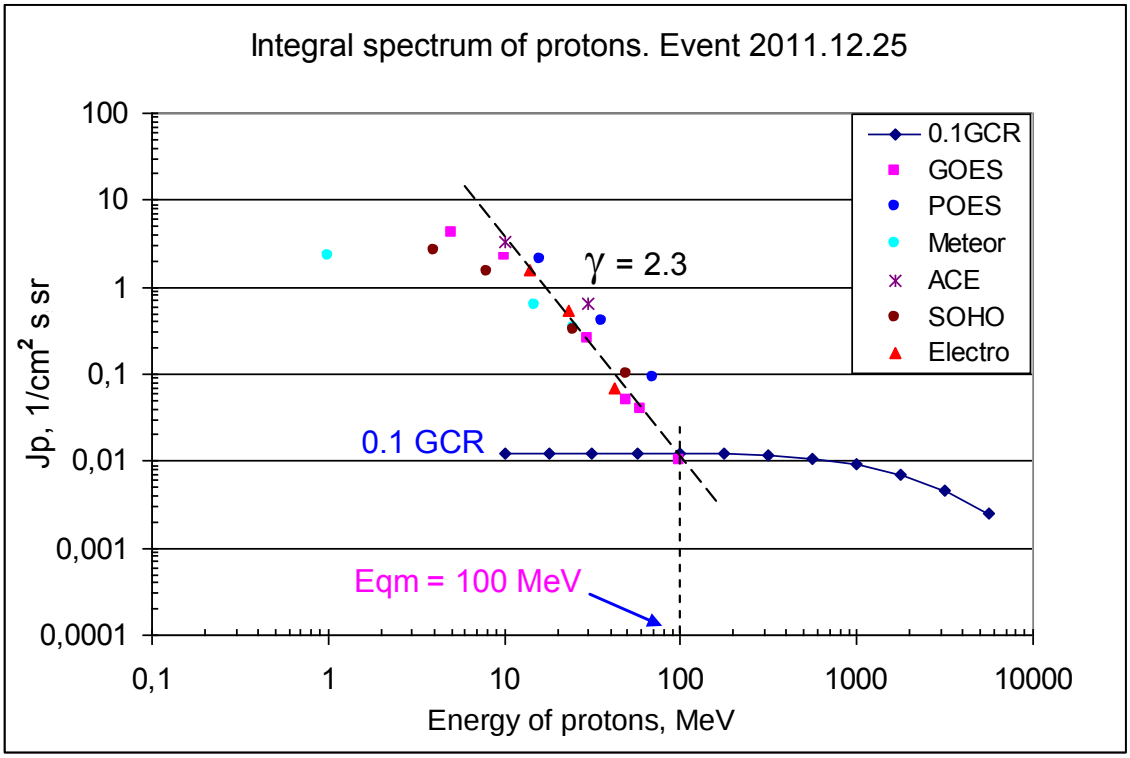


Integral fluxes of protons for the event of 2011 December 25

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	19	26d01	4.1	2	0.2	
EPS	>10	19	26d01	2.5	2	0.15	
EPS	>30	19	26d00	0.25	1	0.08	
EPS	>50	19	26d00	0.05	0.5	0.07	
EPS	>60	19	26d00	0.04	0.5	0.06	
EPS	>100	19	26d00	0.01	0.5	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	-	-	-	-	100	
MEPED	>0.8	-	-	-	-	80	
MEPED	>2.5	-	-	-	-	60	
MEPED	>6.9	-	-	-	-	50	
MEPED	>16	20	23	2.1	0.5	0.85	
MEPED	>36	20	23	0.4	0.5	0.9	
MEPED	>70	20	21	0.09	0.2	1	
MEPED	>140	-	-	-	-	1.2	
Meteor-1							
SCR	>1	19	22	2.27	1.5	3.3	
SCR	>3	19	-	-	1.5	3	
SCR	>10	19	-	-	1	2.05	
GALS-M	>15	19	22	0.61	0.5	1.45	
GALS-M	>25	19	22	0.34	0.5	1.5	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	19	26d00	3.2	1	1.6	
SIS	>30	19	23	0.65	0.5	1.1	
SOHO							
EPHIN	>50	-	23	0.01	-	0.3	

Differential fluxes of protons for the event of 2011 December 25

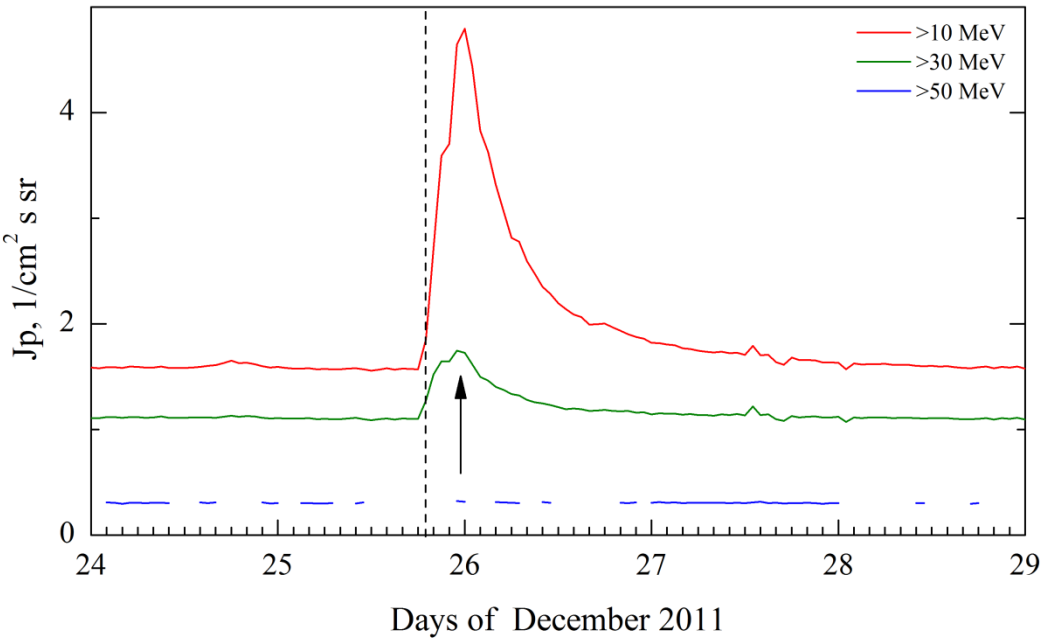
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	3	0.01	
LION	2 – 6	-	-	-	3	0.005	
EPHIN	4 – 8	-	23	0.27	3	0.0003	
EPHIN	8 – 25	-	23	0.07	3	0.00005	
EPHIN	25 – 53	-	23	0.008	3	0.00002	
GOES							
EPS	350–420	14	23	0.0002	1	0.002	
Electro-1							
SCR-E	13.7–23	19	23	0.126	1	0.057	
SCR-E	23–42	19	22	0.034	1	0.024	
SCR-E	42–112	-	-	-	-	0.01	


Integral spectrum of protons. Event 2011.12.25
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.3
0.1 GCR
Eqm = 100 MeV

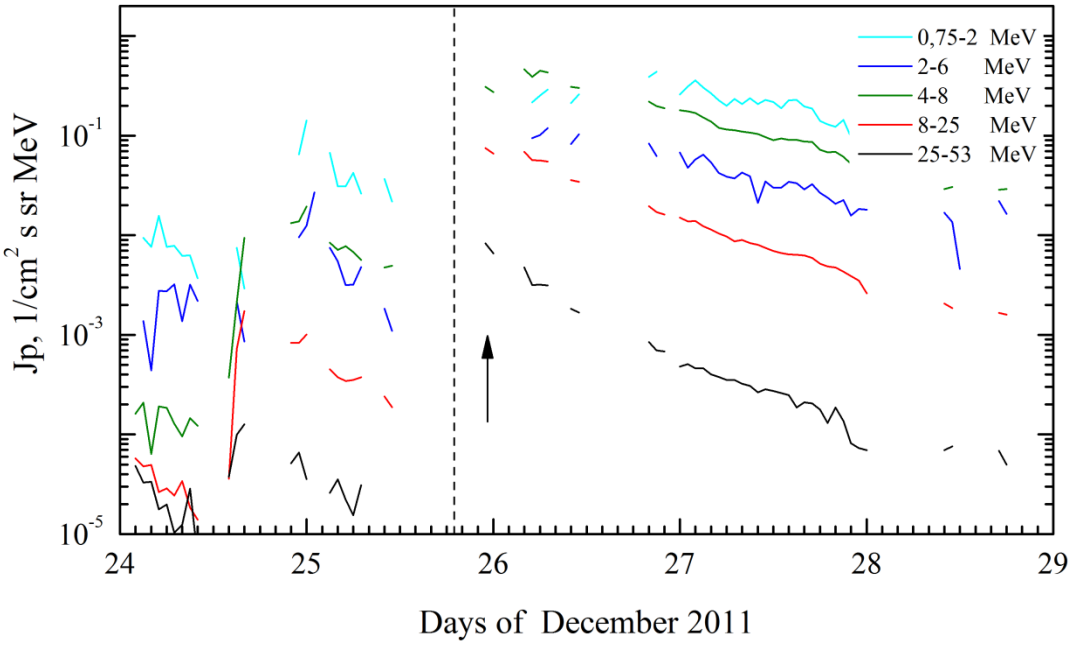
Time profiles of proton fluxes in the event 2011.12.25

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

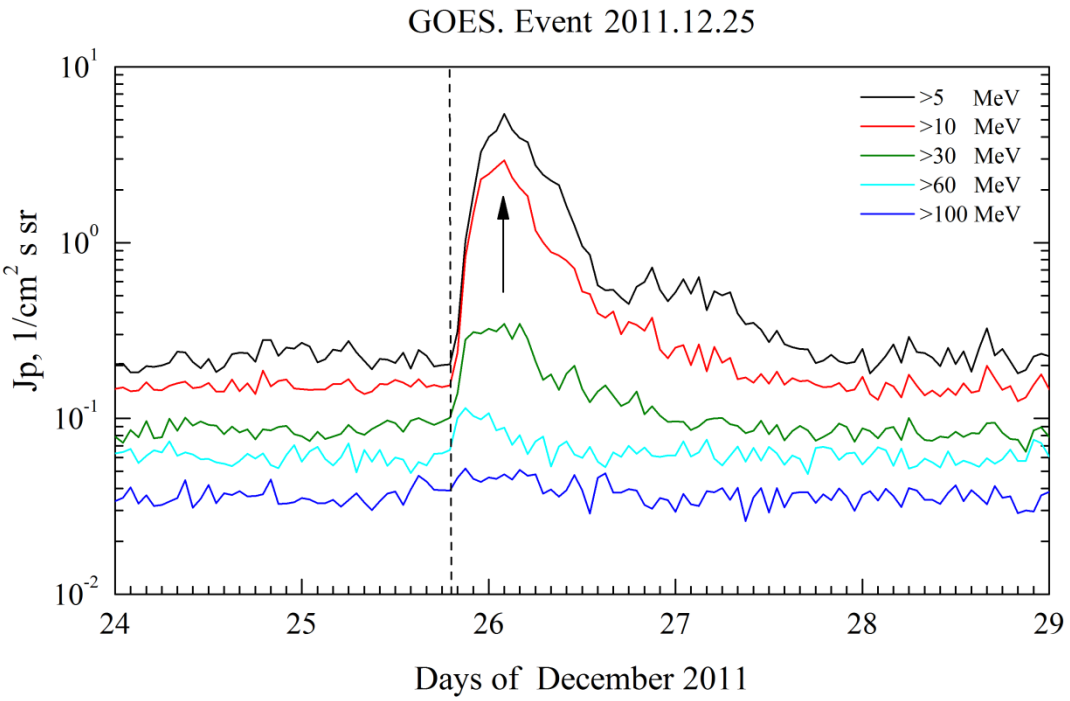
ACE SIS + SOHO (>50 MeV). Event 2011.12.25

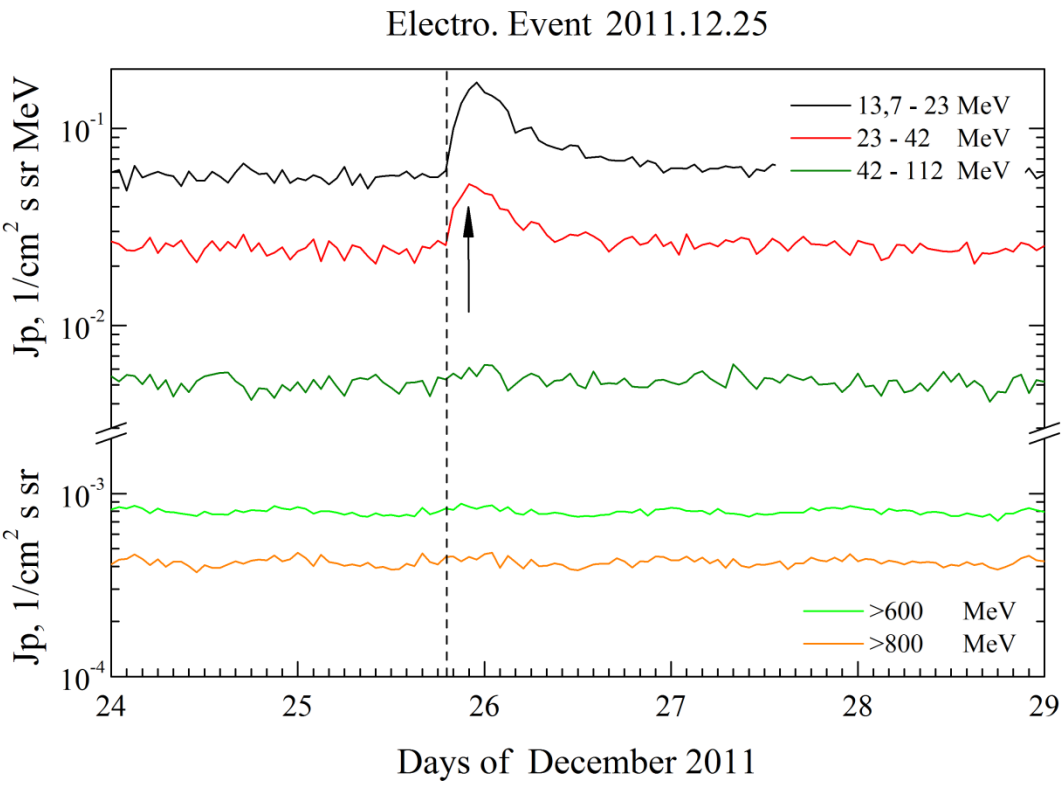


SOHO. Event 2011.12.25

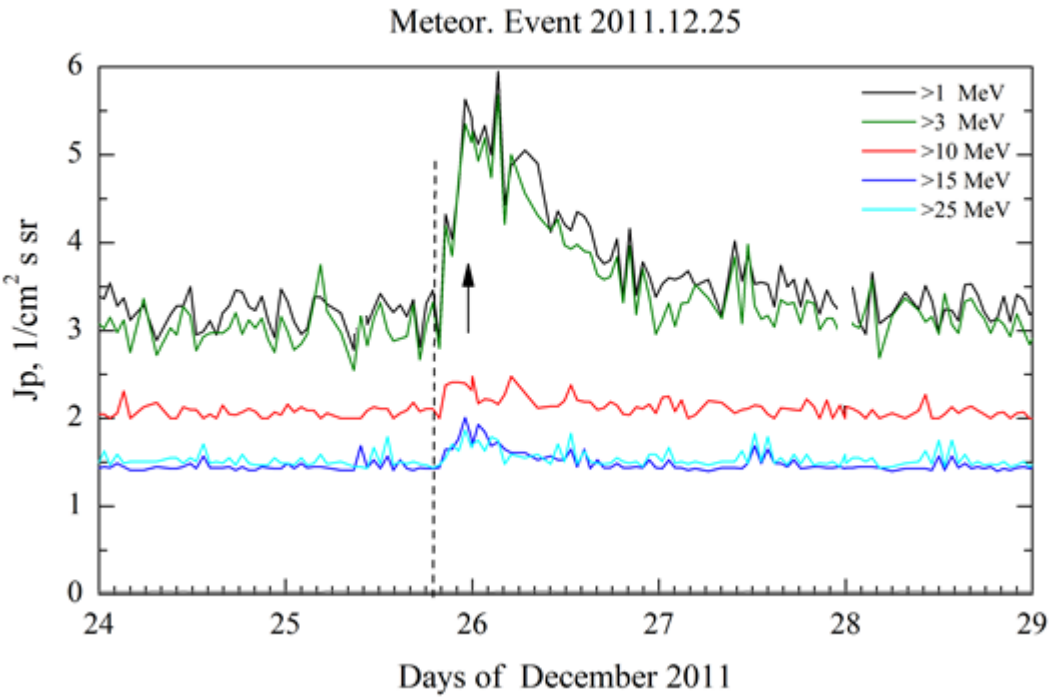


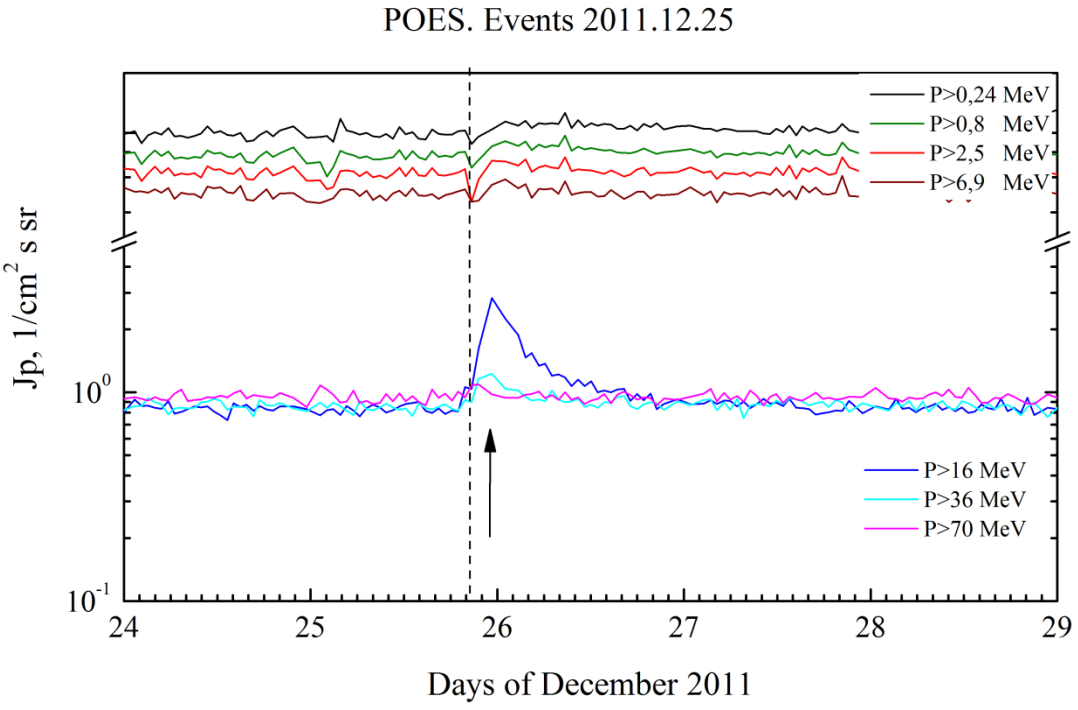
Earth satellites in geostationary orbit, R ≈ 6,6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2011 December 25

2011 December 25 ● AR 11387 To event 499

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	1814	1819	1911	S22W26	1N	ERU
1 – 12	keV	1811	1816	1820	S22W26	M4.0	0.011

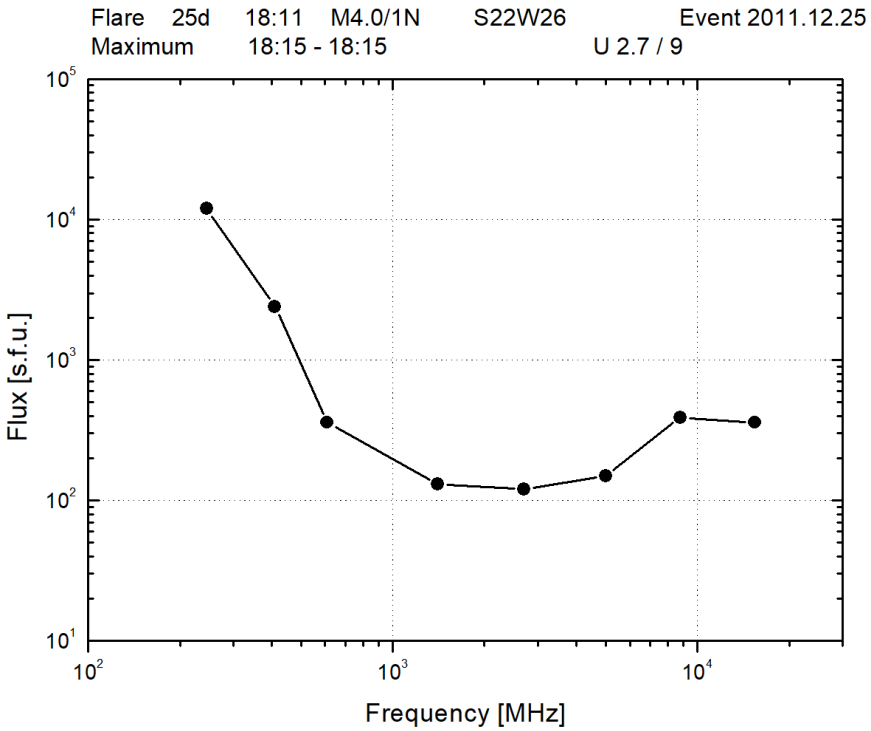
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	1817:12	1818:22	1838:16	784	1235920	HESSI
12-25	keV	1838:16	1838:46	1851:40	4	10017	HESSI
12-25	keV	1812:59	1815:37	1838:39	277312	53683156	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1814	1815	1815	U2.7 / 9	2.56	
8.8	GHz	1814	1815	1816		2.59	
5	GHz	1814	1815	1816		2.18	
2.7	GHz	1814	1815	1815		2.08	
1.4	GHz	1814	1815	1815		2.11	
610	MHz	1814	1815	1816		2.56	
410	MHz	1815	1815	1820		3.38	
245	MHz	1815	1815	1824		4.08	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-062	1820		1831		2	
DS IV	025-180	1817		1857		3	
DS VI	025-180	1817		1847		2	
DH II	7-14	1845		1855			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1848	366	- 4.7	125˚	235˚	SOHO

Radio burst frequency spectrum



Proton Active Region

AR11339 (N19L103, CMP 08.11.2011,
Sp=1540 msh, EKC, BGD)
XRI=4.18; $X_1^{1.9}$+$M_9^{4.3}$+C_{38}; 2_1+1_4+C_{30}
PFR 2-3.11 (25^h) $X_1^{1.9}$+$M_3^{4.3}$

References:

Bazilevskaya G.A., A.G. Mayorov, V.V. Malakhov, V.V. Mikhailov, 2013.
Bučík R., S.M. Mulay, G.M. Mason et al., 2021.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.

События 2012 года

			Страница
1	*Event 2012.01.02 – (2012-002)	№ 500	235
2	Event 2012.01.20 – (2012-020)	№ 501	242
3	Event 2012.01.21 – (2012-021)	№ 502	250
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6	Event 2012.01.27 – (2012-027)	№ 505	273
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8	Event 2012.03.04 – (2012-064)	№ 507	290
9	Event 2012.03.07 – (2012-067)	№ 508	298
10	Event 2012.03.13 – (2012-073)	№ 509	311
11	Event 2012.05.17 – (2012-138)	№ 510	320
12	Event 2012.05.26 – (2012-147)	№ 511	330
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17	Event 2012.07.17 – (2012-199	№ 516	369
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20	*Event 2012.08.02 – (2012-215)	№ 519	394
21	Event 2012.09.01 – (2012-245)	№ 520	401
22	Event 2012.09.28 – (2012-272)	№ 521	409
23	Event 2012.11.08 – (2012-313)	№ 522	416
23	Event 2012.12.14 – (2012-349)	№ 523	424

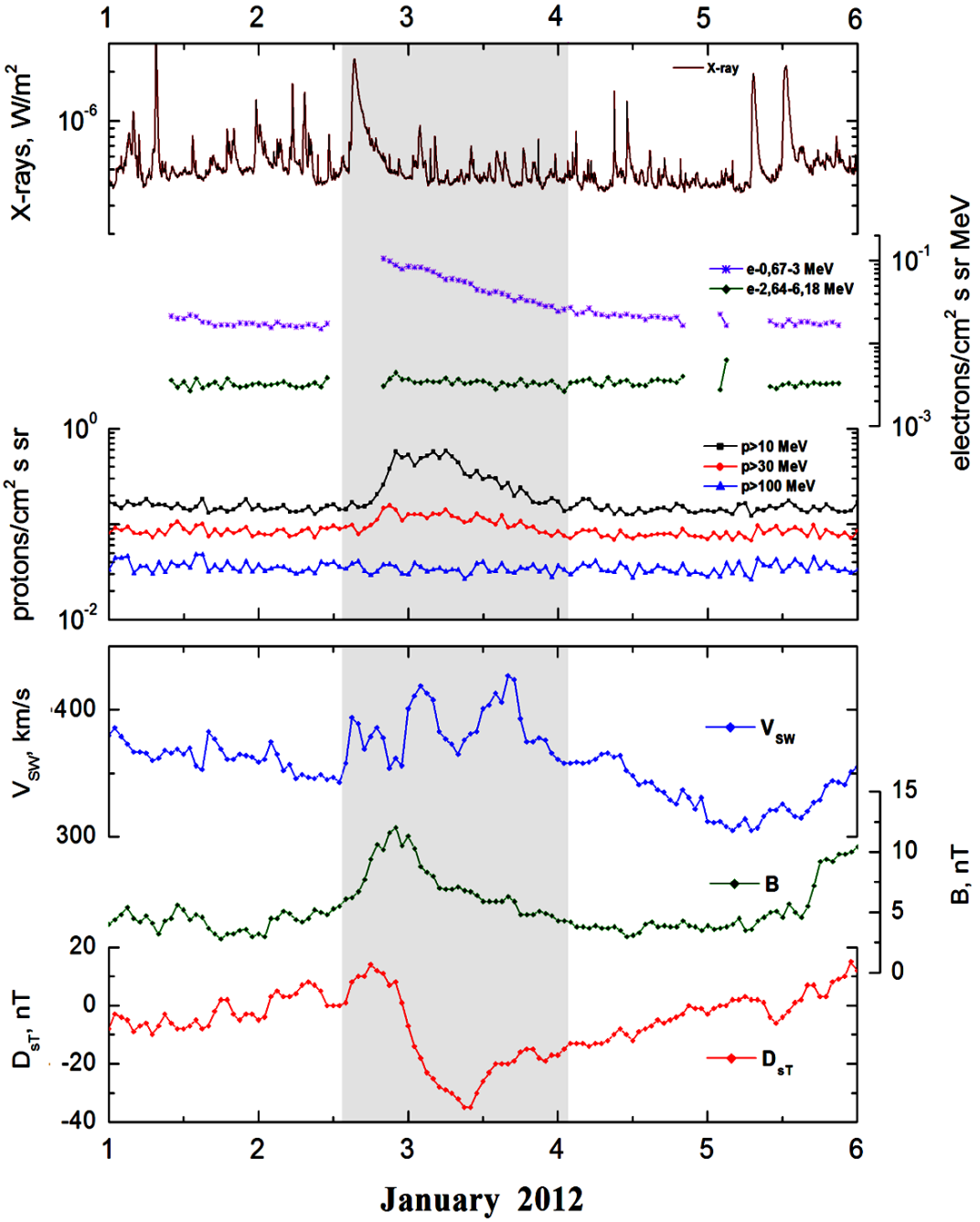
Звездочкой (*) отмечены слабые события с Jp (E > 10 МэВ) в интервале 0.1 ÷ 1 pfu

The small Event 2012.01.02 – (2012-002) **500**

Particle event: To(Ep>10 MeV) – 02d19^h
Tmax$_1$(Ep>10 MeV) – 02d22^h, Jmax$_1$ (Ep>10 MeV) – 0.4/cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 03d06^h, Jmax$_2$ (Ep>10 MeV) – 0.5 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ_1 = 1.6, γ_2 = 1.6
Quasimaximal energy of protons in the event – Eqm$_1$ = 120 MeV
– Eqm$_2$ = 90 MeV

Sources: ⊡ solar flare 02d14^{h}31^m, C2.4/EPL, N07W89, AR11384, 1.5d behind W$_L$
Main X-ray burst 1-8 Å: onset – 02d14^{h}31^m, max – 02d15^{h}24^m, Φ = 0.0087 J/m^2
CME: 02d15^{h}13^m, V = 1138 km/s, Δφ = 360^o; dA=244^o

Particle fluxes and associated phenomena

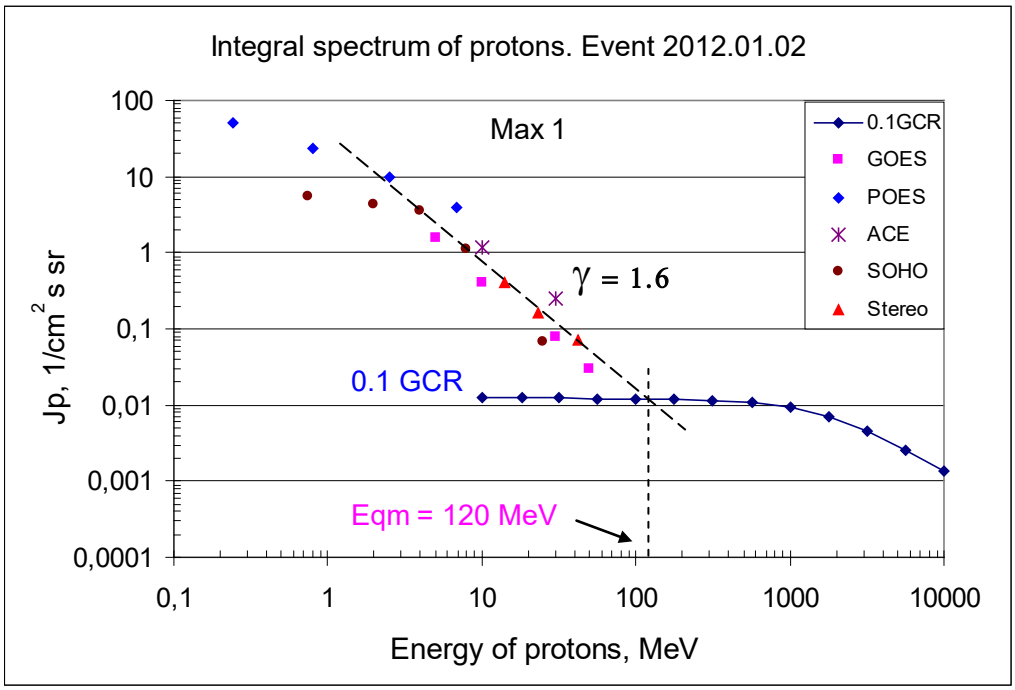


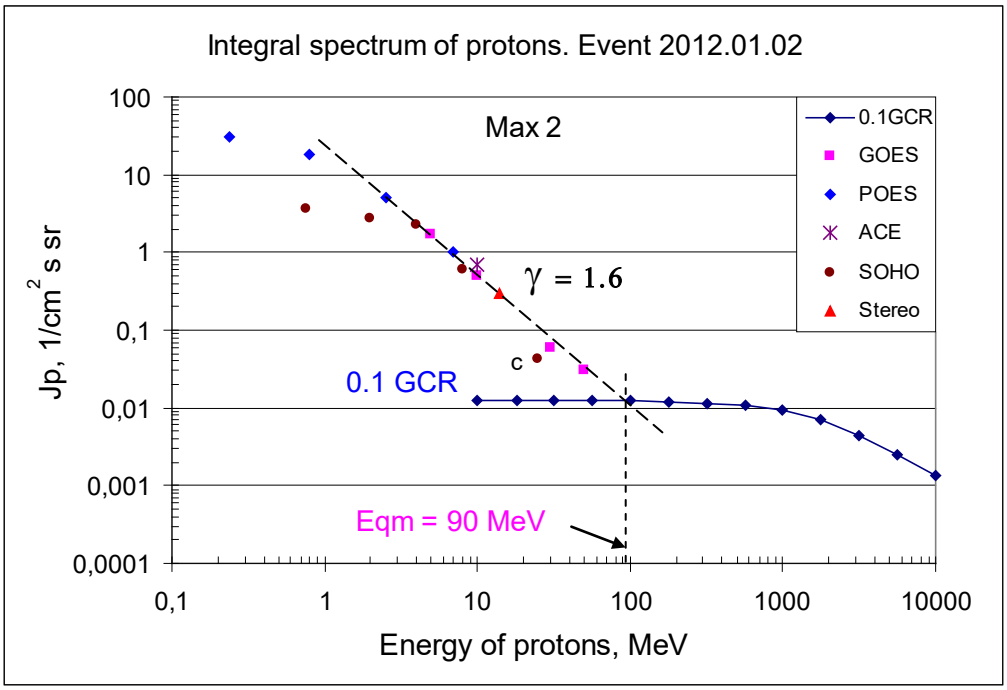
Integral fluxes of protons for the event of 2012 January 02

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	19	23/3d06	1.6/1.7	1	0.2	
EPS	>10	19	22/3d06	0.4/0.5	1	0.16	
EPS	>30	19	21/3d06	0.08/0.06	1	0.08	
EPS	>50	19	21/3d06	0.03/0.015	1	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	23	3d02/3d06	50/40	0.5	100	
MEPED	>0.8	23	3d02/3d06	23/18	0.2	75	
MEPED	>2.5	23	3d02/3d06	10/5	-	60	
MEPED	>6.9	23	3d02/3d06	4/1	-	50	
MEPED	>16	-	-	-	-	0.85	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	1	
MEPED	>140	-	-	-	-	1.2	
ACE							
SIS	>10	17	21/3d03	1.2/ 0.7	1	1.5	
SIS	>30	17	21/ -	0.25/ -	1	1	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

Differential fluxes of protons for the event of 2012 January 02

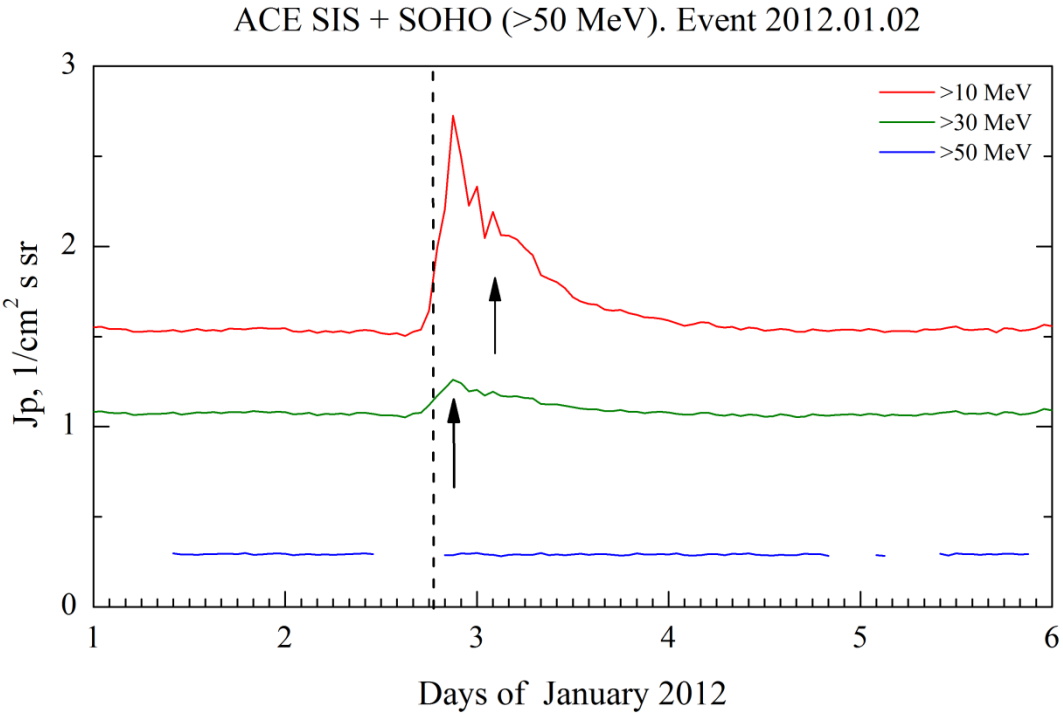
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	22/3d04	1/0.8	1	0.14	
LION	2 – 6	-	22/3d03	0.216/0.14	1	0.017	
EPHIN	4 – 8	-	22/3d03	0.64/0.42	1.7	0.0066	
EPHIN	8 – 25	-	22/3d03	0.06/0.033	3	0.00006	
EPHIN	25 – 53	-	21/3d03	0.0024/0.0015	2.5	0.00002	
Electro-1							
SCR-E	13.7–23	17	23/3d03	0.025/ 0.033	0.5	0.055	
SCR-E	23–42	17	23/ -	0.005/ -	0.5	0.025	
SCR-E	42–112	19	22/ -	0.001/-	0.5	0.005	

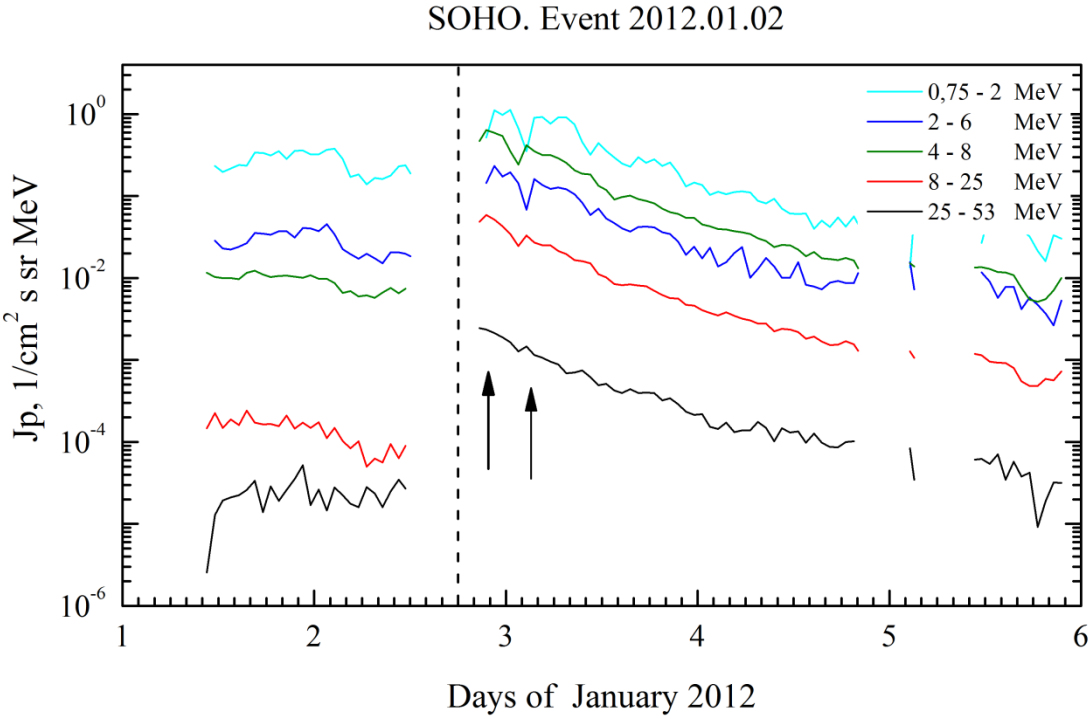

Integral spectrum of protons. Event 2012.01.02
Max 1
γ = 1.6
0.1 GCR
Eqm = 120 MeV
0.1GCR
GOES
POES
ACE
SOHO
Stereo
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.01.02
Max 2
γ = 1.6
c
0.1 GCR
Eqm = 90 MeV
0.1GCR
GOES
POES
ACE
SOHO
Stereo
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

Time profiles of proton fluxes in the event 2012.01.02

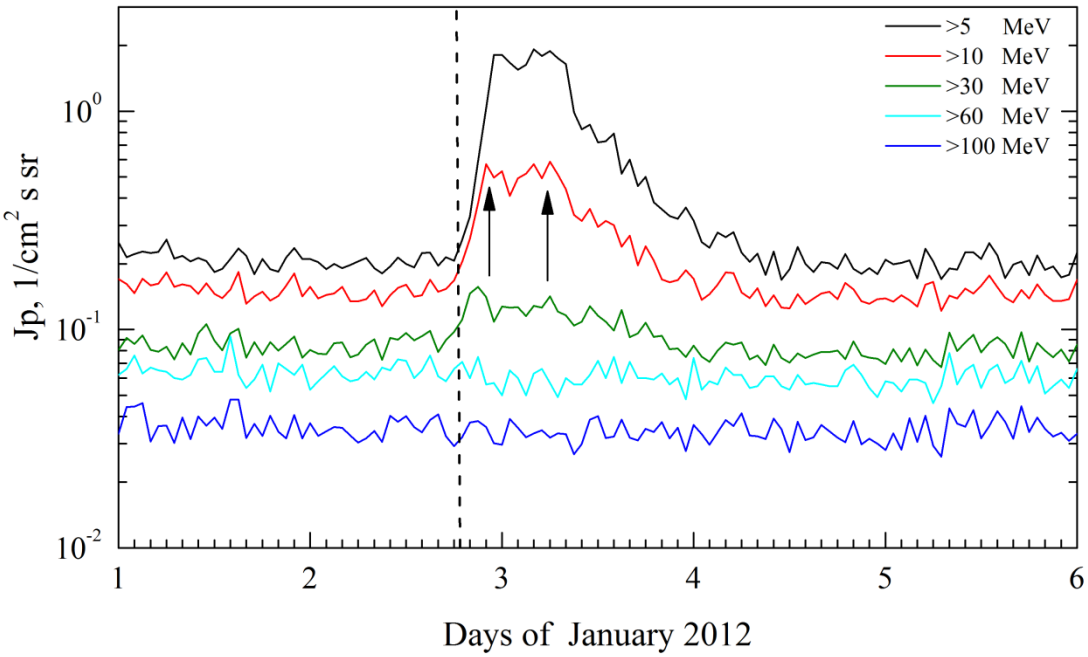
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



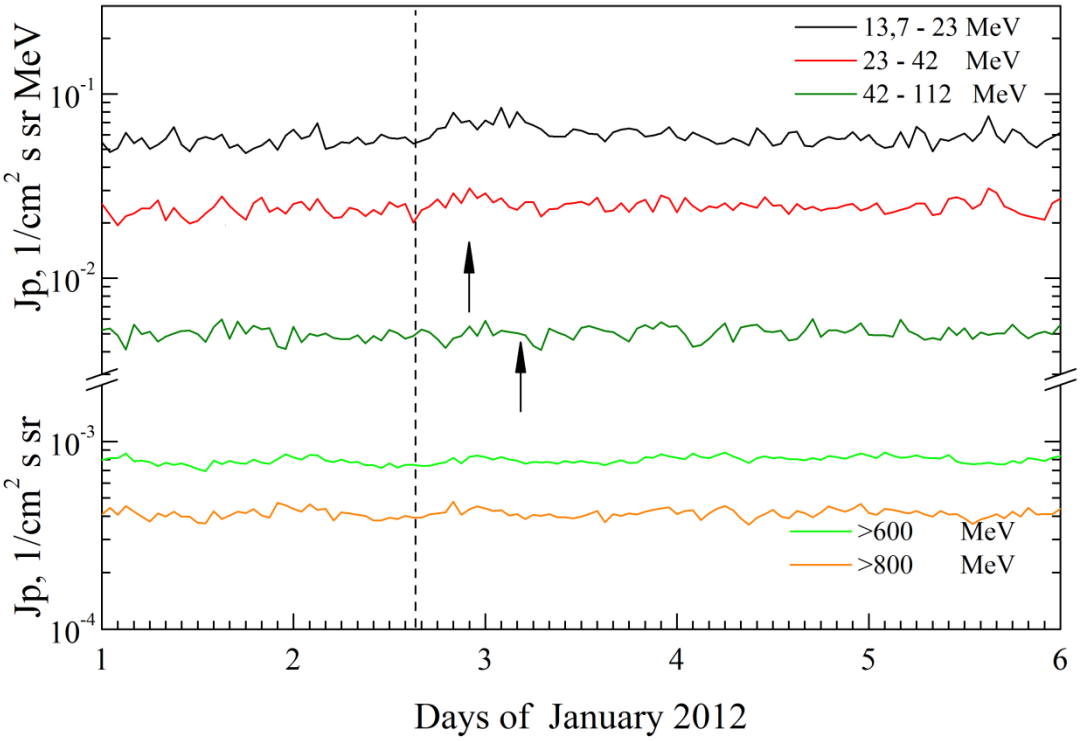


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro

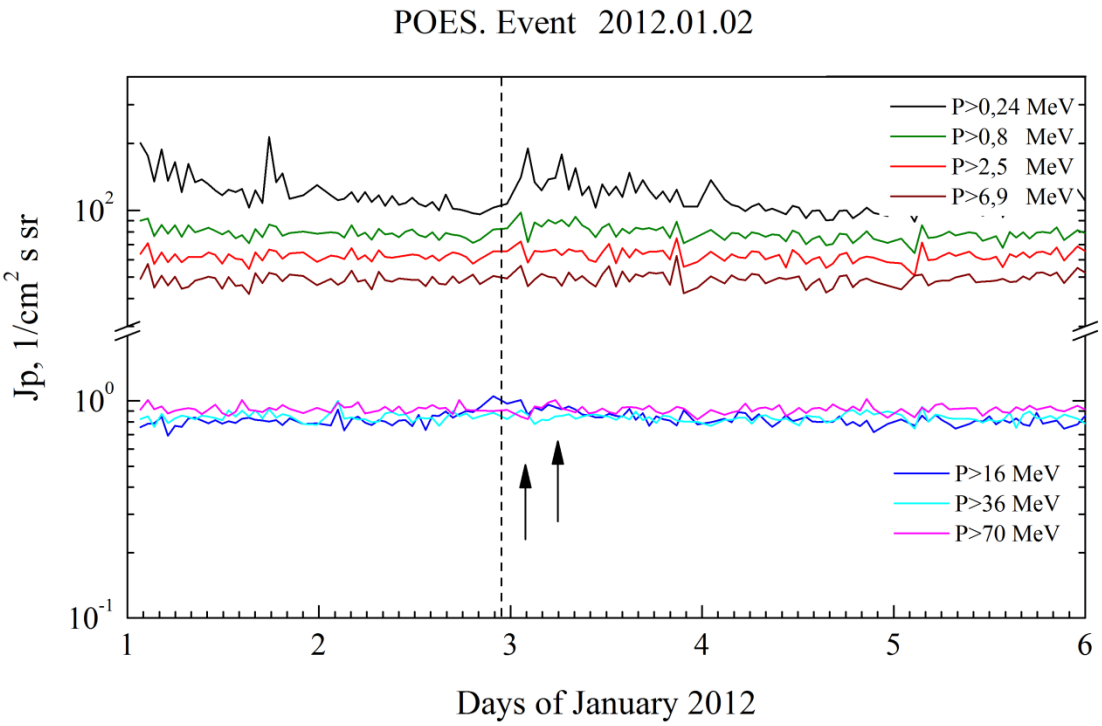
GOES. Event 2012.01.02



Electro. Event 2012.01.02



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 January 02

2012 January 02 ⊡ **AR 11384** **To event 500**

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical event on visible solar disc					
6563 Å	EPL	1452		1506	S17W90	0.28	
1– 12	keV	1431	1524	>1604	N07W89*	C2.4	0.0087

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	Sp/c
12 – 25	keV	1429:36	1434:54	1442:00	624	1086040	HESSI
12 – 25	keV	1517:56	1518:14	1526:24	1584	2937400	HESSI
12-25	keV	1452:07	1500:02	1511:18	2034	289570	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
245	MHz	1456	1457	1457		2.2	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DH II	4-16	1500		1545			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1513	1138	-8.4	360˚	244˚	SOHO

*1.5d behind W_L

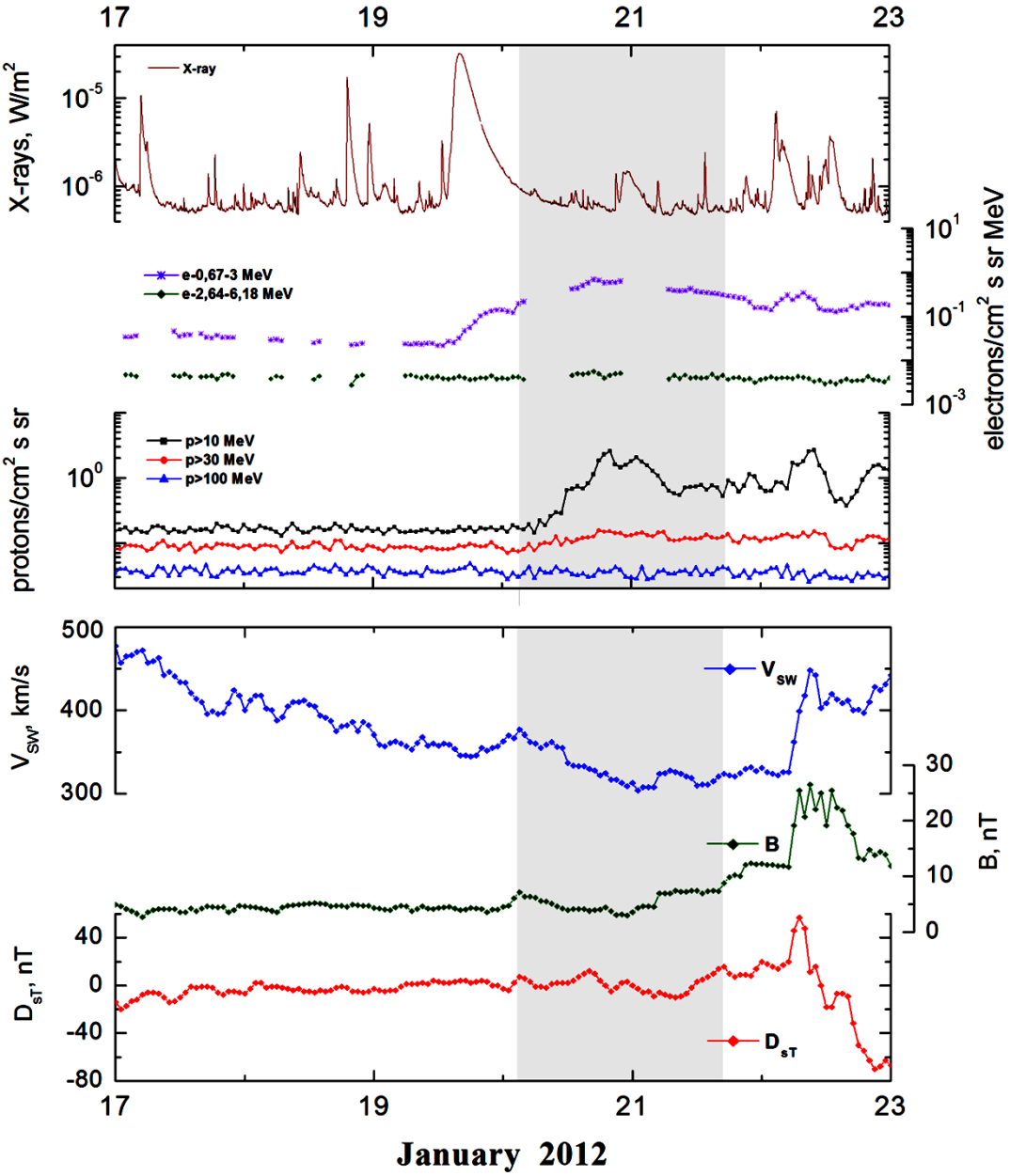
Proton Active Region

AR 11384 (N12L197, CMP 25,9.12.2012,
Sp=500 msh, CKO, B, R)
XRI=0 C_8 S_8

Particle event: To(Ep>10 MeV) – 20d01^h
Tmax$_1$(Ep>10 MeV) – 20d20^h, Jmax$_1$ (Ep>10 MeV) – 2.4 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 21d01^h, Jmax$_2$ (Ep>10 MeV) – 1.9 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: γ_1 = 2.2, γ_2 = 2.2
Quasimaximal energy of protons in the event – Eqm = 100 MeV
– Eqm = 80 MeV

Sources: ● solar flare 19d13^{h}44^m, M3.2/SF, N30E30, AR11402
Main burst X-ray 1–8 Å: onset – 19d13^{h}44^m, max – 19d16^{h}05^m, Φ = 0.27 J/m^2
CME: 19d14^{h}36^m, V= 1120 km/s, Δφ = 360º, dA= 020º
▲ SC 22d06^{h}12^m

Particle fluxes and associated phenomena

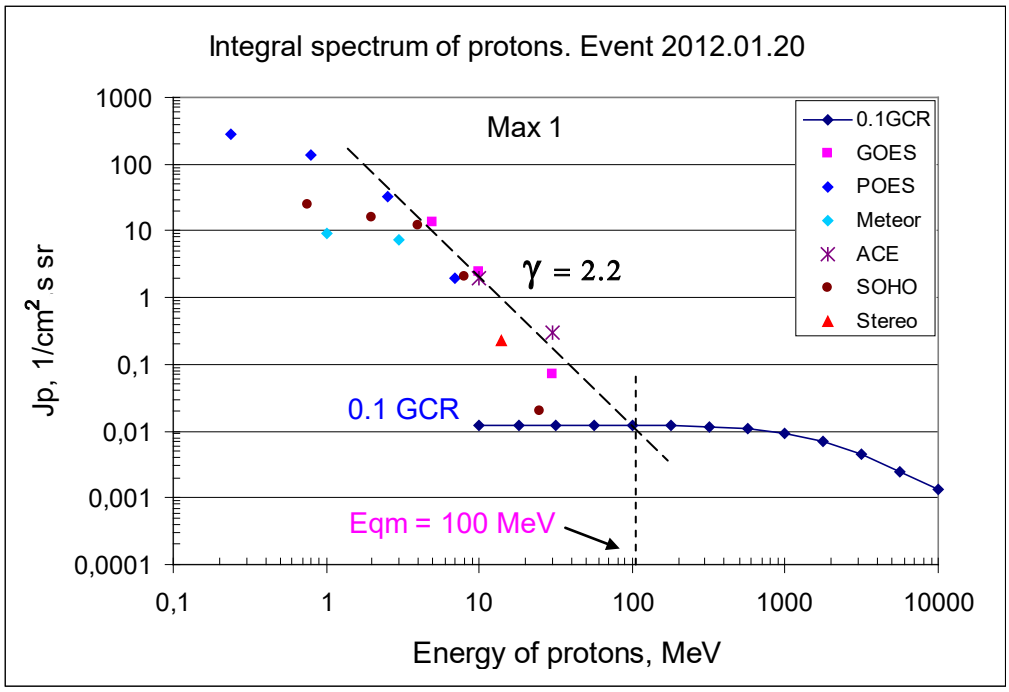


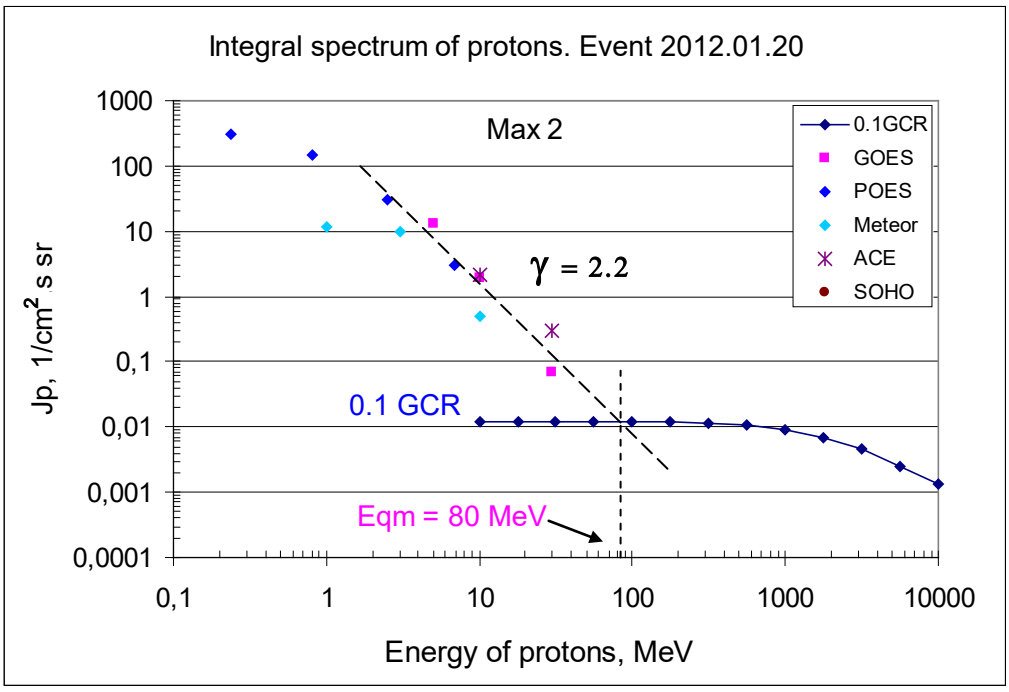
Integral fluxes of protons for the event of 2012 January 20

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	01	20/21d01	13.7/13.3	1.5	0.2	
EPS	>10	01	20/21d01	2.4/1.9	1.5	0.16	
EPS	>30	01	20/21d01	0.07/0.07	1.5	0.08	
EPS	>50	01	-	-	-	0.06	
EPS	>60	01	-	-	-	0.05	
EPS	>100	01	-	-	-	0.04	
POES							
MEPED	>0.24	1	20/21d02	280/310	2	120	
MEPED	>0.8	1	20/21d02	140/145	2	85	
MEPED	>2.5	1	20/21d02	33/31	1.5	60	
MEPED	>6.9	1	20/21d02	44257	-	50	
MEPED	>16	-	-	-	-	0.85	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	1	
MEPED	>140	-	-	-	-	1.2	
Meteor-1							
SCR	>1	00	17/21d00	9.4/11.6	1.5	3.8	
SCR	>3	00	17/21d00	7.3/9.6	1.5	3.8	
SCR	>10	-	-/23	-/0.5	0.2	2.3	
GALS-M	>15	-	-	-	-	1.4	
GALS-M	>25	-	-	-	-	1.4	
GALS-M	>600	-	-	-	-	0.03	
ACE							
SIS	>10	9	17/23	2.2/2.1	1.5	1.6	
SIS	>30	9	17/23	0.3/0.3	1	1.1	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

Differential fluxes of protons for the event of 2012 January 20

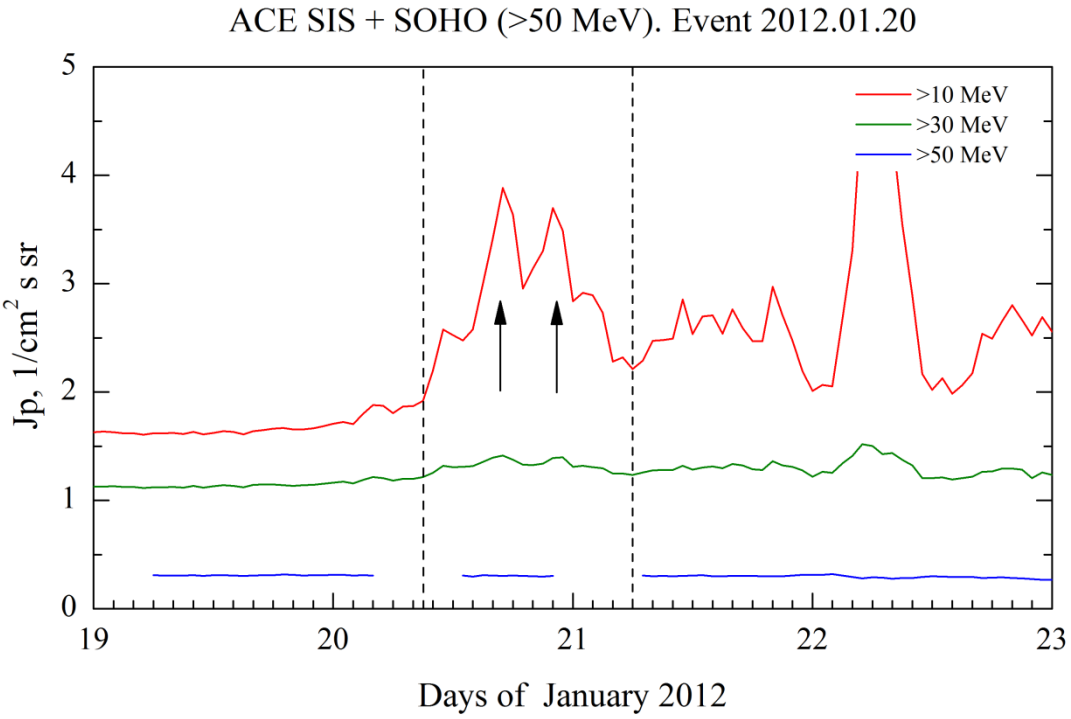
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	3	18/-	7.1/-	1.5	0. 2	
LION	2 – 6	3	18/-	1.2/-	1.5	0.02	
EPHIN	4 – 8	3	18/-	2.5/-	1.5	0.035	
EPHIN	8 – 25	3	18/-	0.125/-	1.5	0.0012	
EPHIN	25 – 53	3	18/-	0.0007/-	1.5	0.0004	
Electro-1							
SCR-E	13.7–23	2	19/ -	0.025/-	0.5	0.055	
SCR-E	23–42	-	-	-	-	0.025	
SCR-E	42–112	-	-	-	-	0.005	

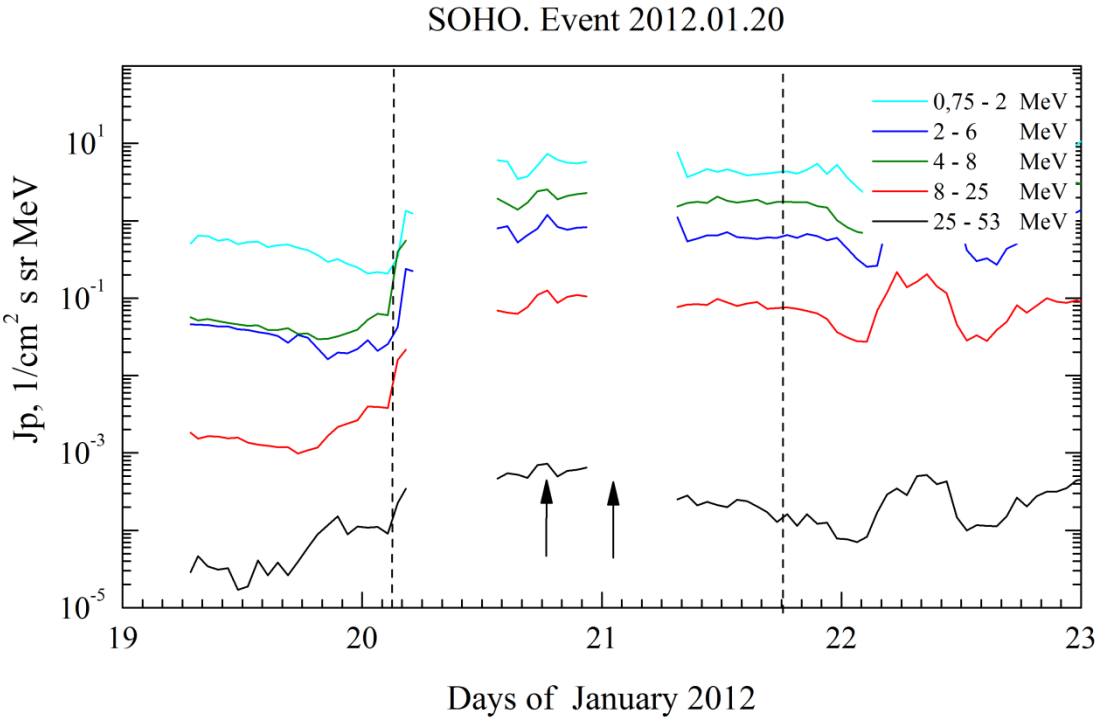

Integral spectrum of protons. Event 2012.01.20
Max 1
γ = 2.2
0.1 GCR
Eqm = 100 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Stereo
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.01.20
Max 2
γ = 2.2
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

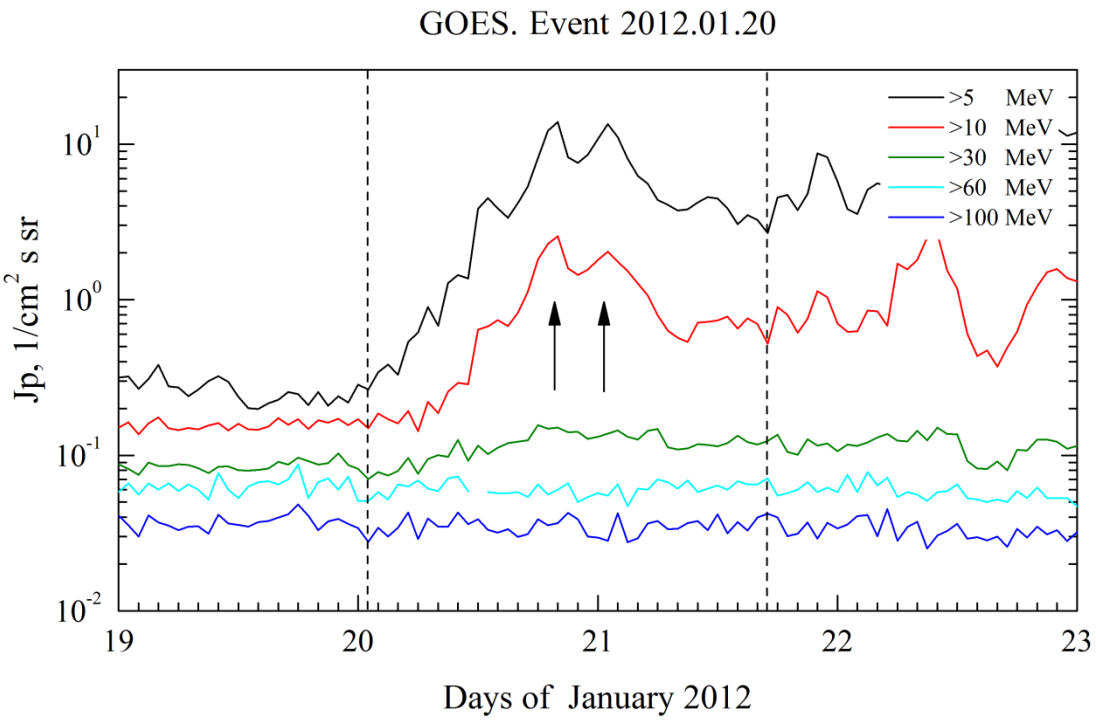
Time profiles of proton fluxes in the event 2012.01.20

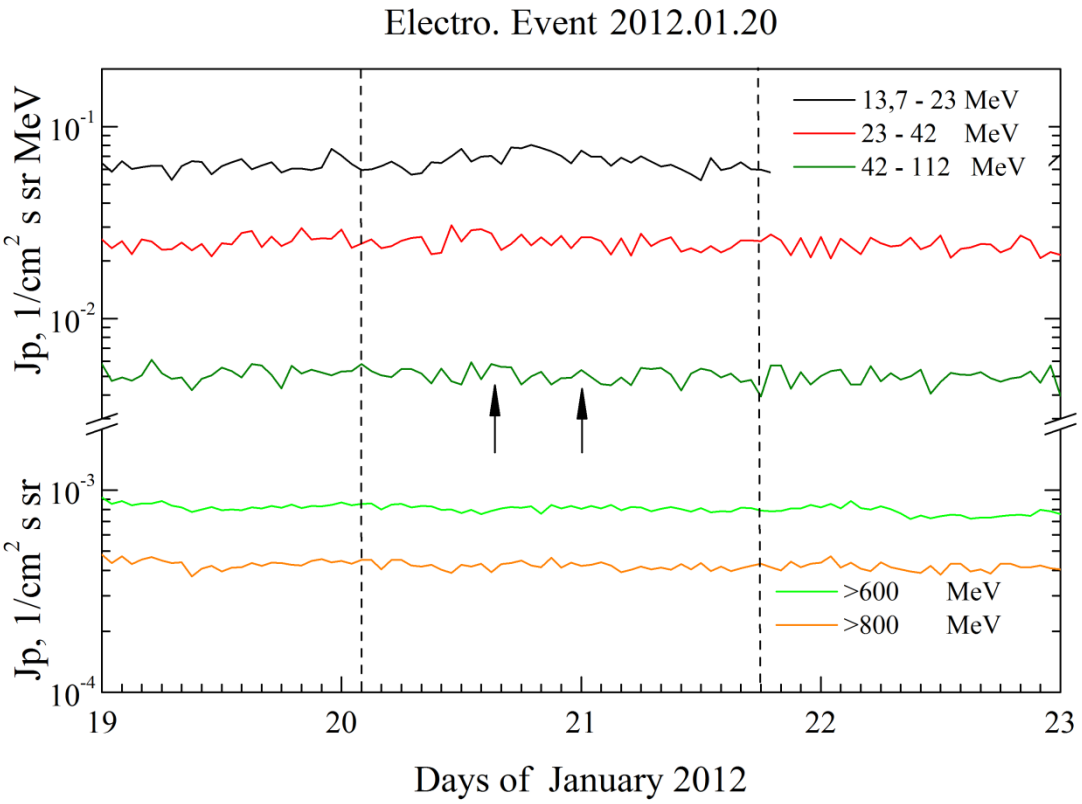
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



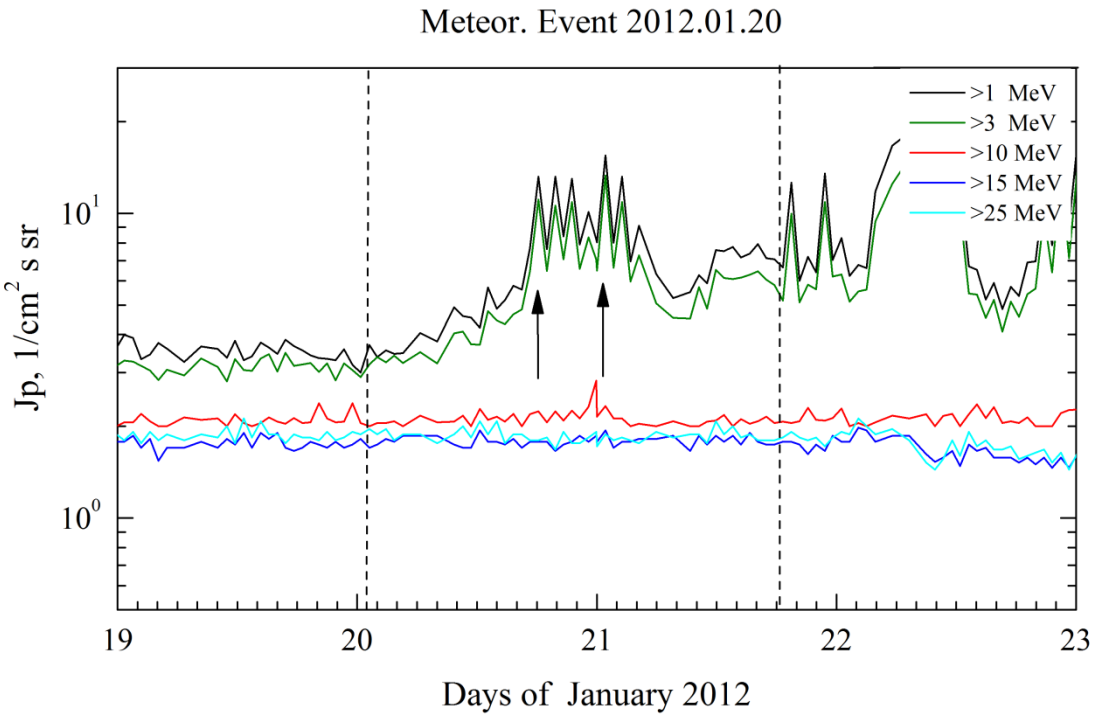


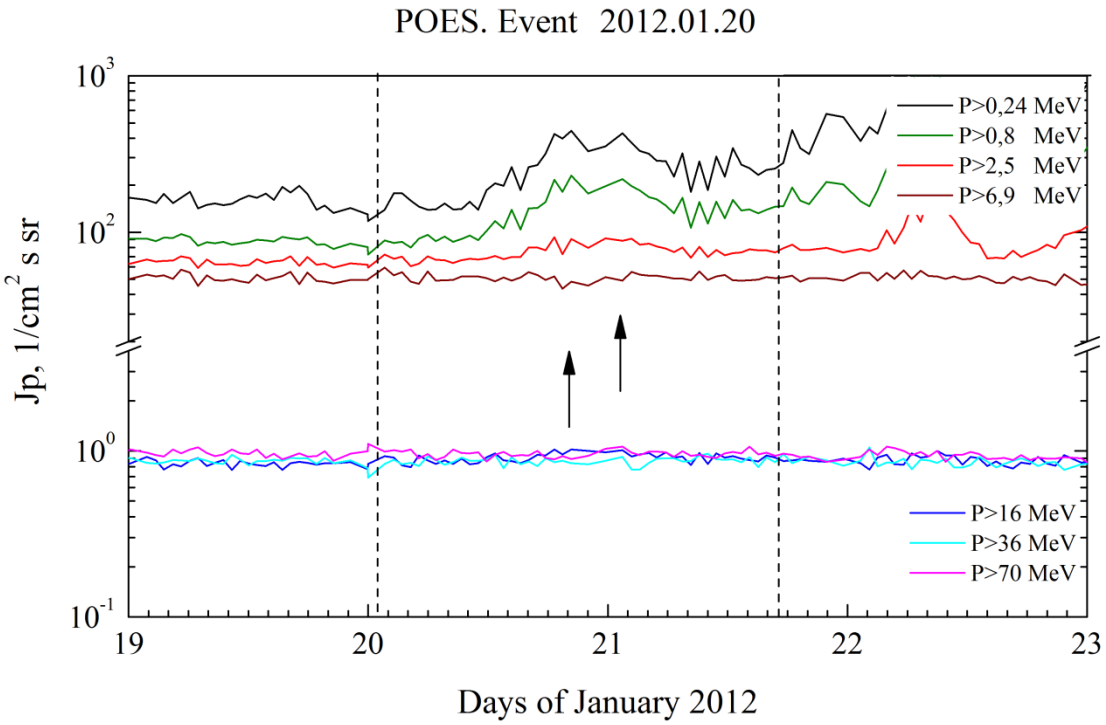
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 January 20

2012 January 19 ● AR 11402 To event 501

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1413	1417	1420	N32E22	SF	
6563 Å	FL	1524	1607	2001	N30E30	2N	UMB
1 – 12	keV	1344	1605	1750	N32E27	M3.2	0.27

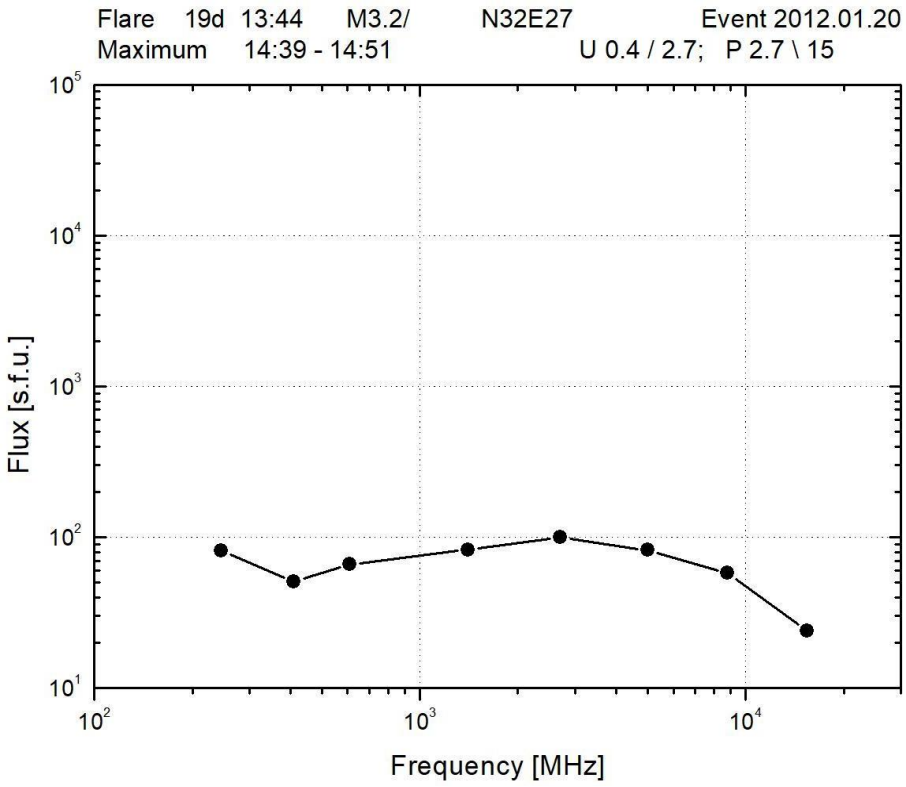
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1437:50	1446:55	1452:35	21468	3421389	FERMI
12-25	keV	1529:10	1549:59	1550:40	50957	14672738	FERMI
12-25	keV	1618:11	1618:15	1628:09	29020	3129106	FERMI
12-25	keV	1704:44	1713:53	1730:24	6413	2086401	FERMI
12-25	keV	1757:51	1758:08	1803:35	1189	66853	FERMI
12-25	keV	1840:15	1908:27	1912:49	1398	531102	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1440	1451	1451		1.38	
8.8	GHz	1438	1445	1451		1.76	
5	GHz	1437	1441	1451		1.91	
2.7	GHz	1440	1441	1446	P2.7 \ 15	2.0	
1.4	GHz	1437	1440	1451		1.92	
610	MHz	1438	1445	1451		1.82	
410	MHz	1437	1443	1451	U0.4 / 2.7	1.71	
245	MHz	1437	1439	1451		1.91	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS IV	25-180	1438		2127		1	
DS IV	36-180	1746		2359		1	
DS CONT	75-180	1438		1538		1	
DH II	0.1-16	1500		20/0245			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1436	1120	54.1	360˚	020˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11402 (N28L211, CMP 21,3.01.2012,
Sp= 630 msh, DKI, BG, R)
XRI=2.89; $X_1^{1.7}$+$M_2^{8.7}$+C_9; 2_2+1_3+C_{20};
PFR1 23.11 $M_1^{8.7}$/2B
PFR2 27.11 $X_1^{1.7}$/2F

References:

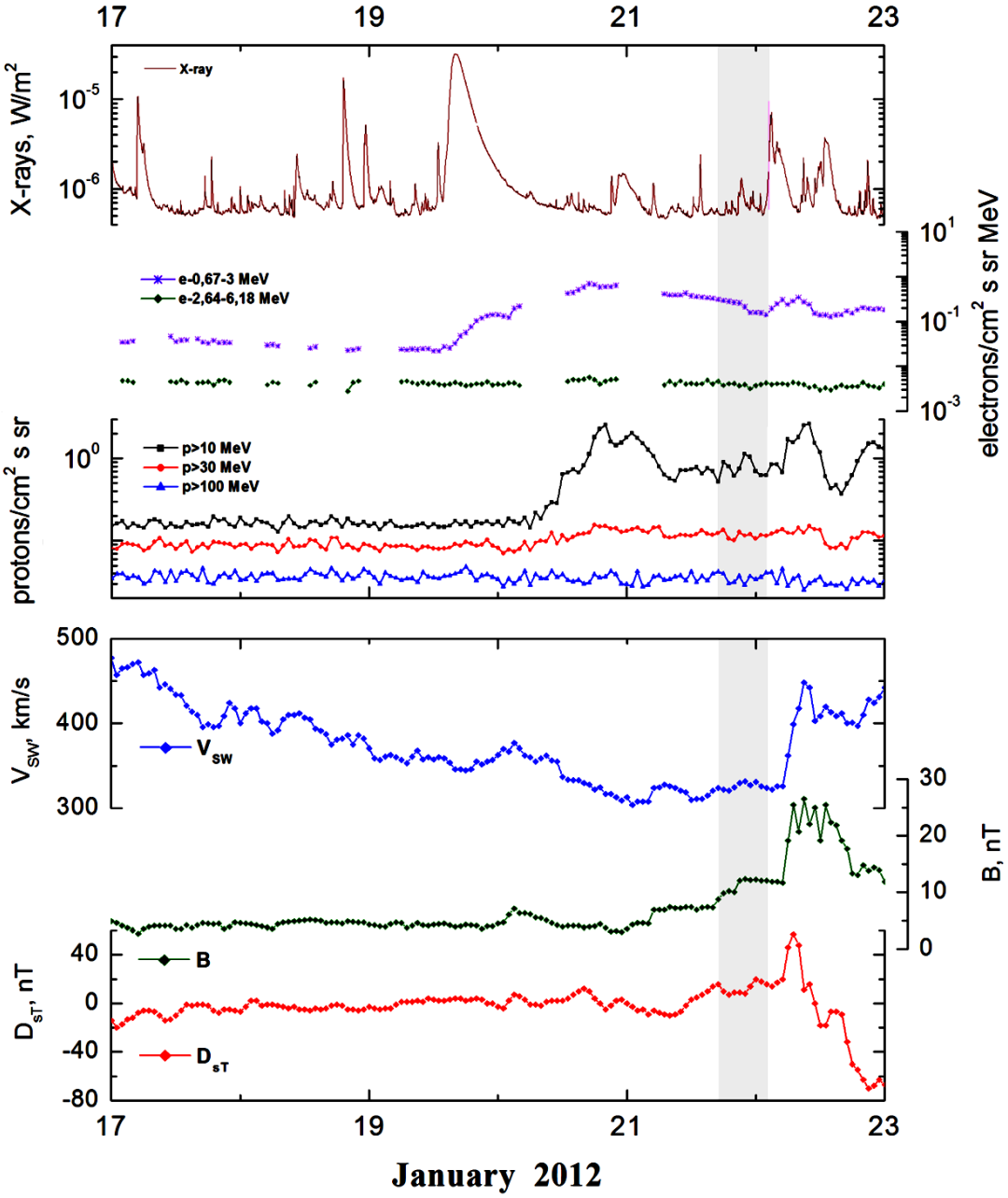
Ameri D., E. Valtonen, 2019.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Koleva K., M. Dechev, P. Duchlev, 2021.
Le G.-M., X-F. Zhang, 2017.
Rodenko S.A., I.K. Troitskaya, A.G. Mayorov, V.V. Malakhov, 2018.

Event 2012.01.21 – (2012-021) **502**

Particle event: To(Ep>10 MeV) – 21d18^h
Tmax (Ep>10 MeV) – 21d22^h, Jmax (Ep>10 MeV) – 1.4 /cm^2·s·sr (ACE)
Duration of the event – 0.5 days, power-law index: $\gamma = 1.8$
Quasimaximal energy of protons in the event – Eqm = 140 MeV

Sources: ⊡ solar flare 21d13^{h}35^m, C2.4/BSL, N25W82, AR11396
Main burst X-ray 1–8 Å: onset – 12d13^{h}35^m, max – 21d13^{h}42^m, Φ = 0.0012 J/m^2
CME: 21d14^{h}00^m, V= 0377 km/s, Δφ = 048º, dA= 266º

Particle fluxes and associated phenomena

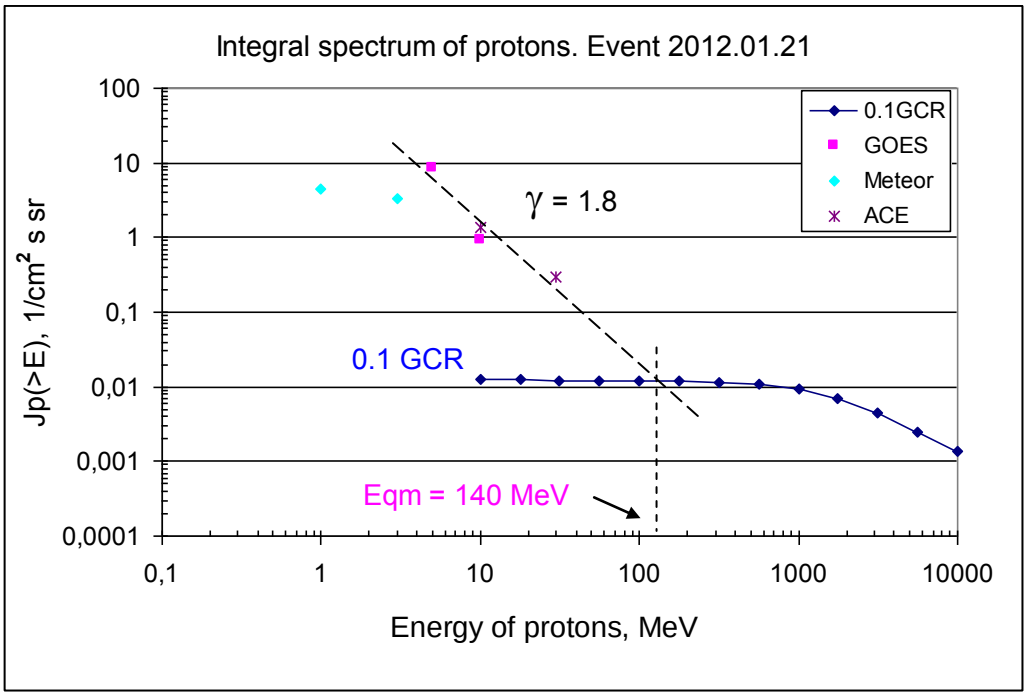


Integral fluxes of protons for the event of 2012 January 21

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	22	8.5	0.5	0.2	
EPS	>10	18	22	0.9	0.5	0.16	
EPS	>30	-	-	-	-	0.1	
EPS	>50	-	-	-	-	0.07	
EPS	>60	-	-	-	-	0.06	
EPS	>100	-	-	-	-	0.04	
Meteor-1							
SCR	>1	18	22	4.35	0.5	3.1	
SCR	>3	18	22	3.4	0.5	3.1	
SCR	>10	-	-	-	-	1.9	
GALS-M	>15	-	-	-	-	1.4	
GALS-M	>25	-	-	-	-	1.45	
GALS-M	>600	-	-	-	-	0.03	
ACE							
SIS	>10	6	22	1.4	0.5	1.6	
SIS	>30	6	22	0.3	0.5	1.1	

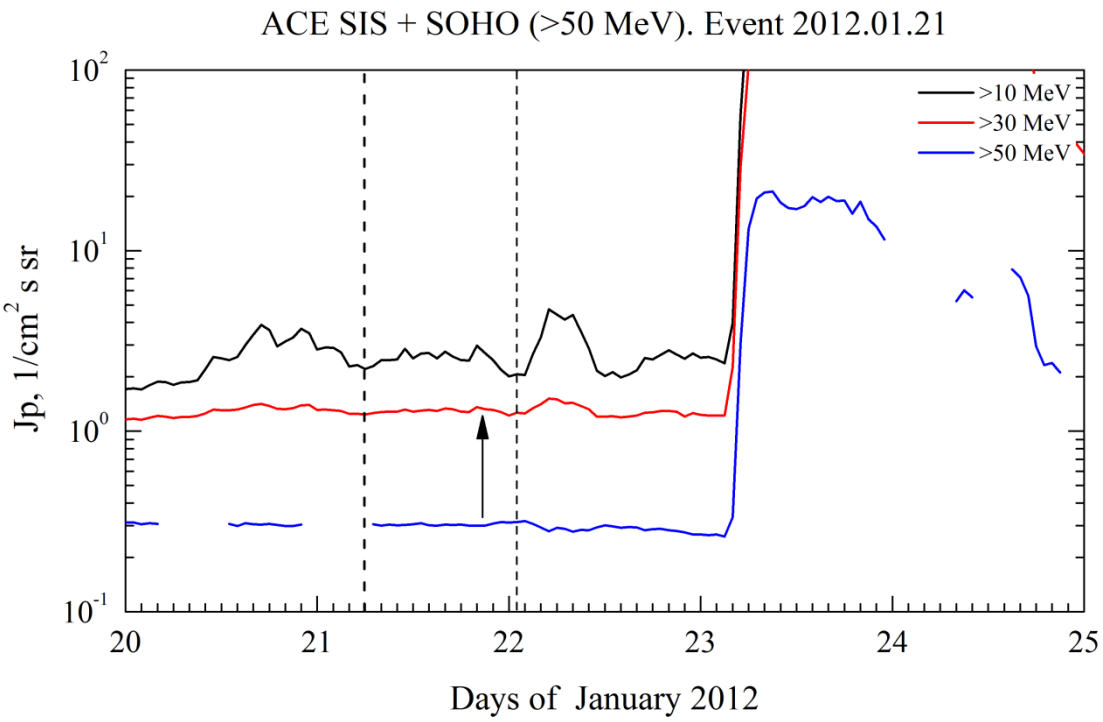
Differential fluxes of protons for the event of 2012 January 21

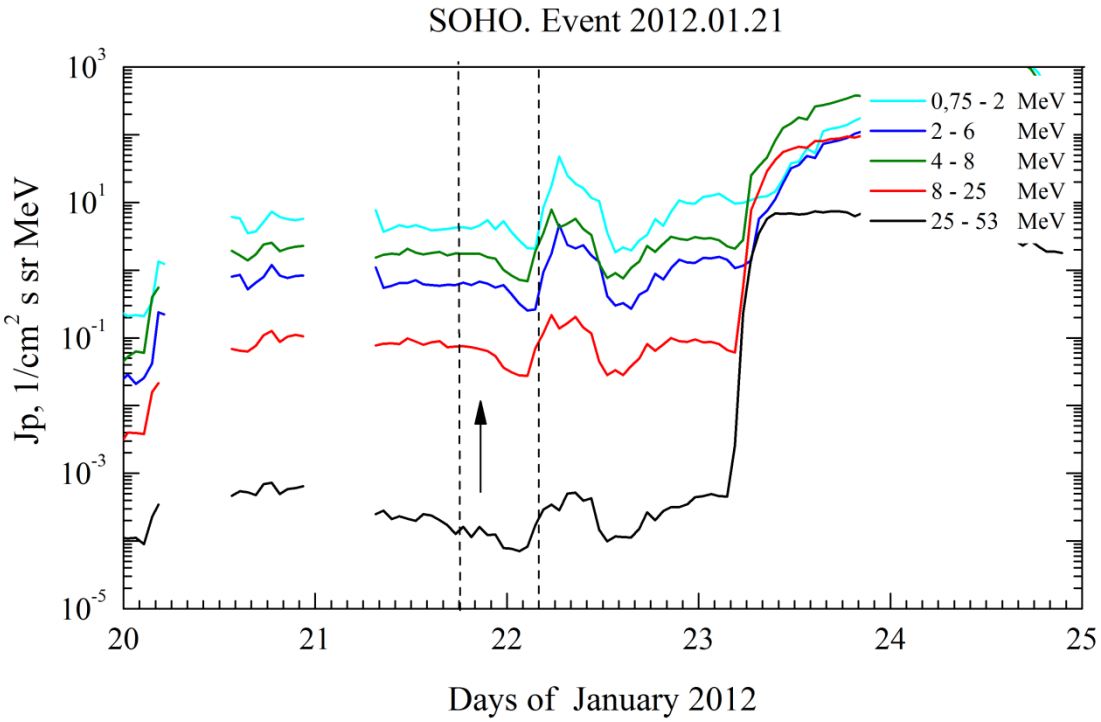
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
Electro-1							
SCR-E	13.7-23	-	-	-	-	0.06	
SCR-E	23-42	-	-	-	-	0.025	
SCR-E	42-112	-	-	-	-	0.005	



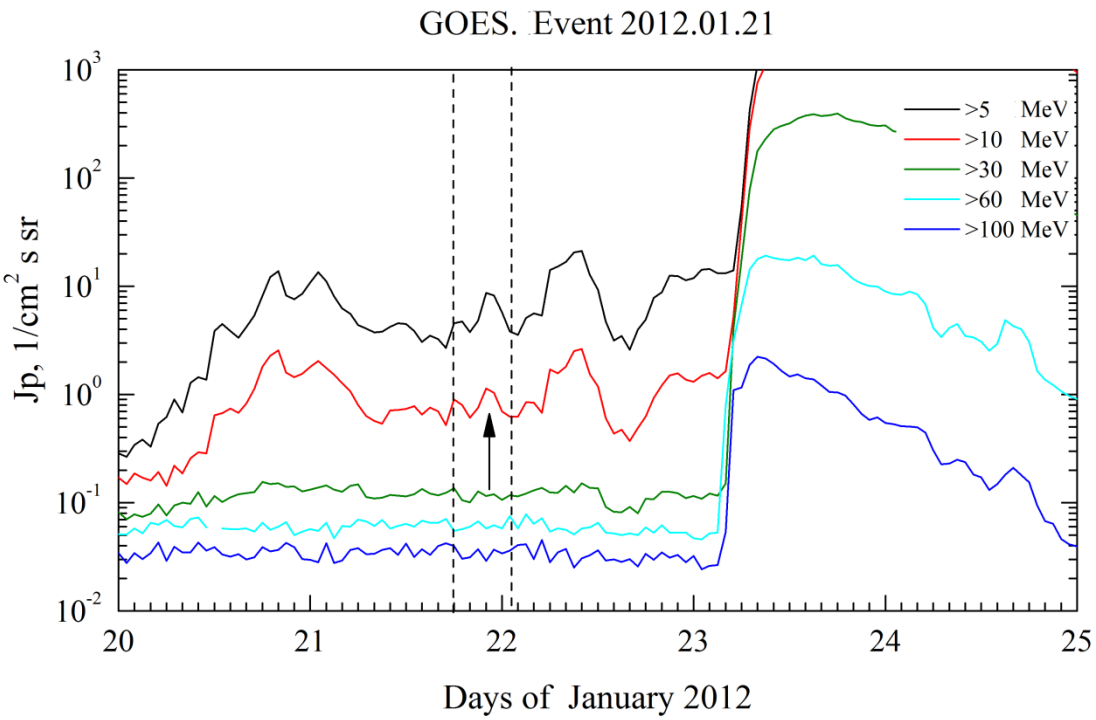
Time profiles of proton fluxes in the event 2012.01.21

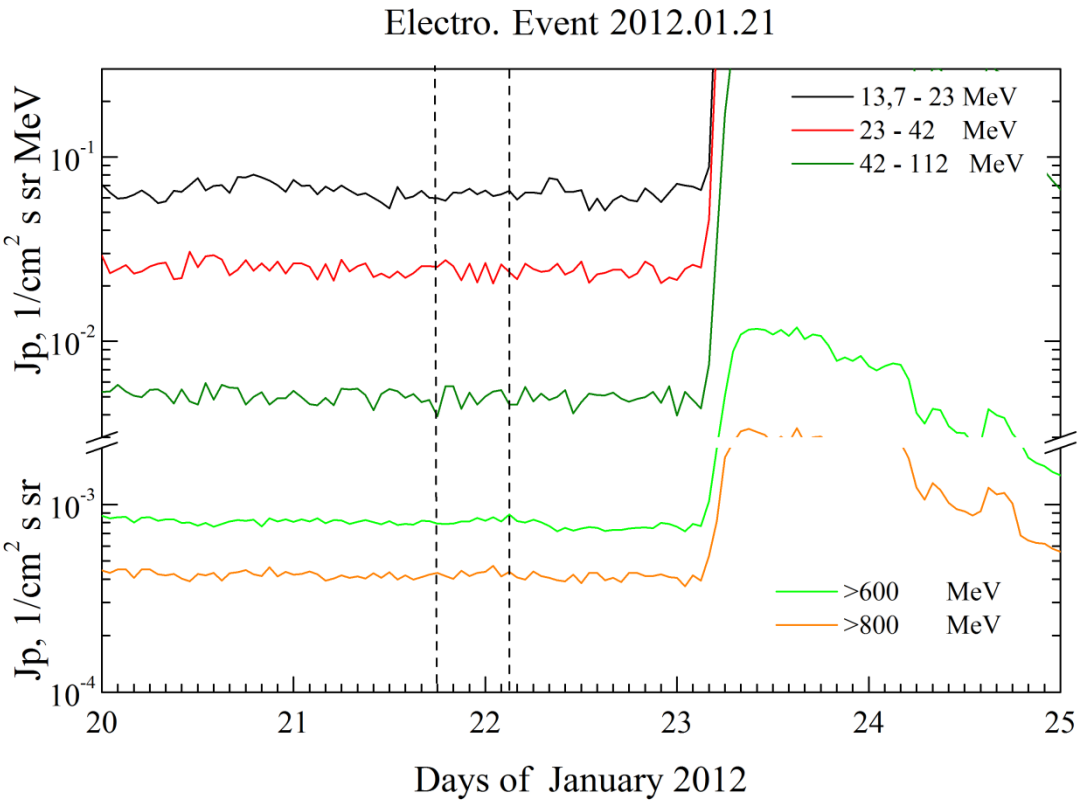
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



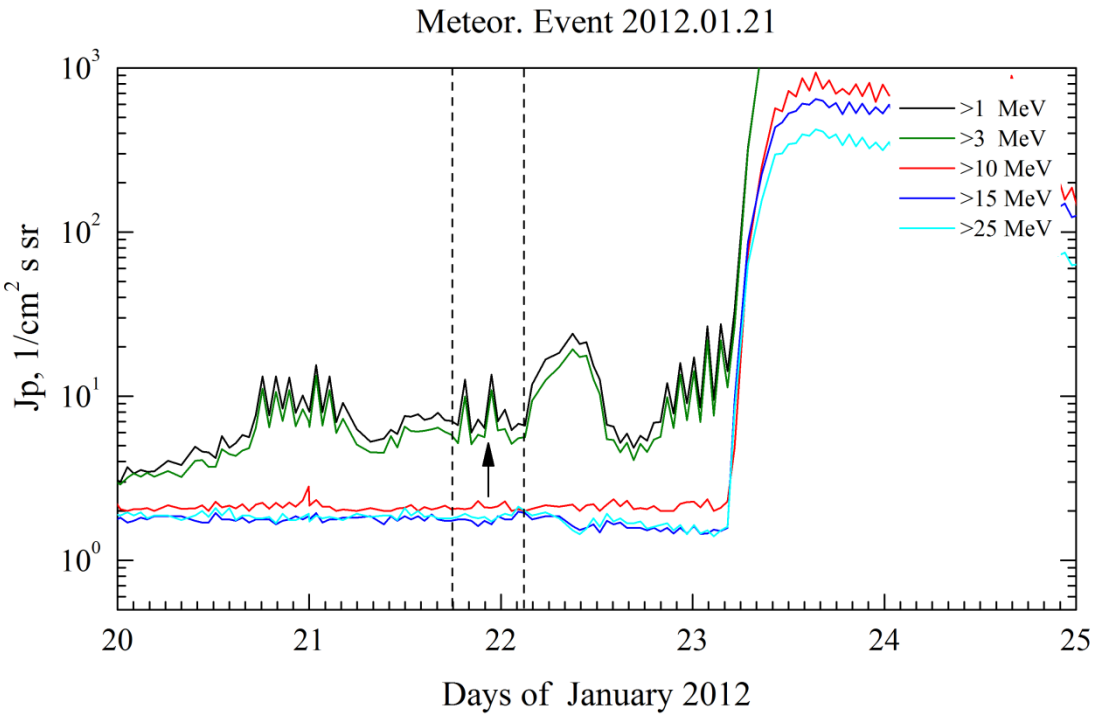


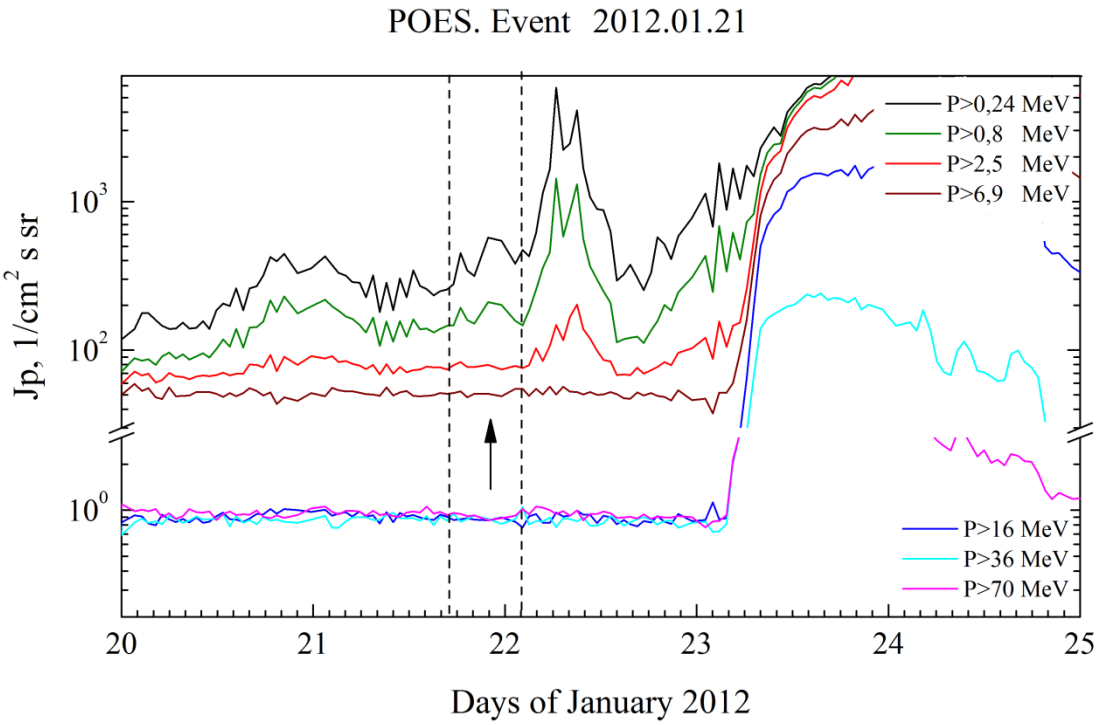
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 January 21

2012 January 21 ⊡ AR 11396 To event 502

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å		No optical flare on visible solar disc					
6563 Å	BSL	1353		1401	0.18	B.9A	
1 – 12	keV	1335	1342	1347	N25W82	C2.4	0.0012
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1400	377	-3.5	048˚	266˚	SOHO

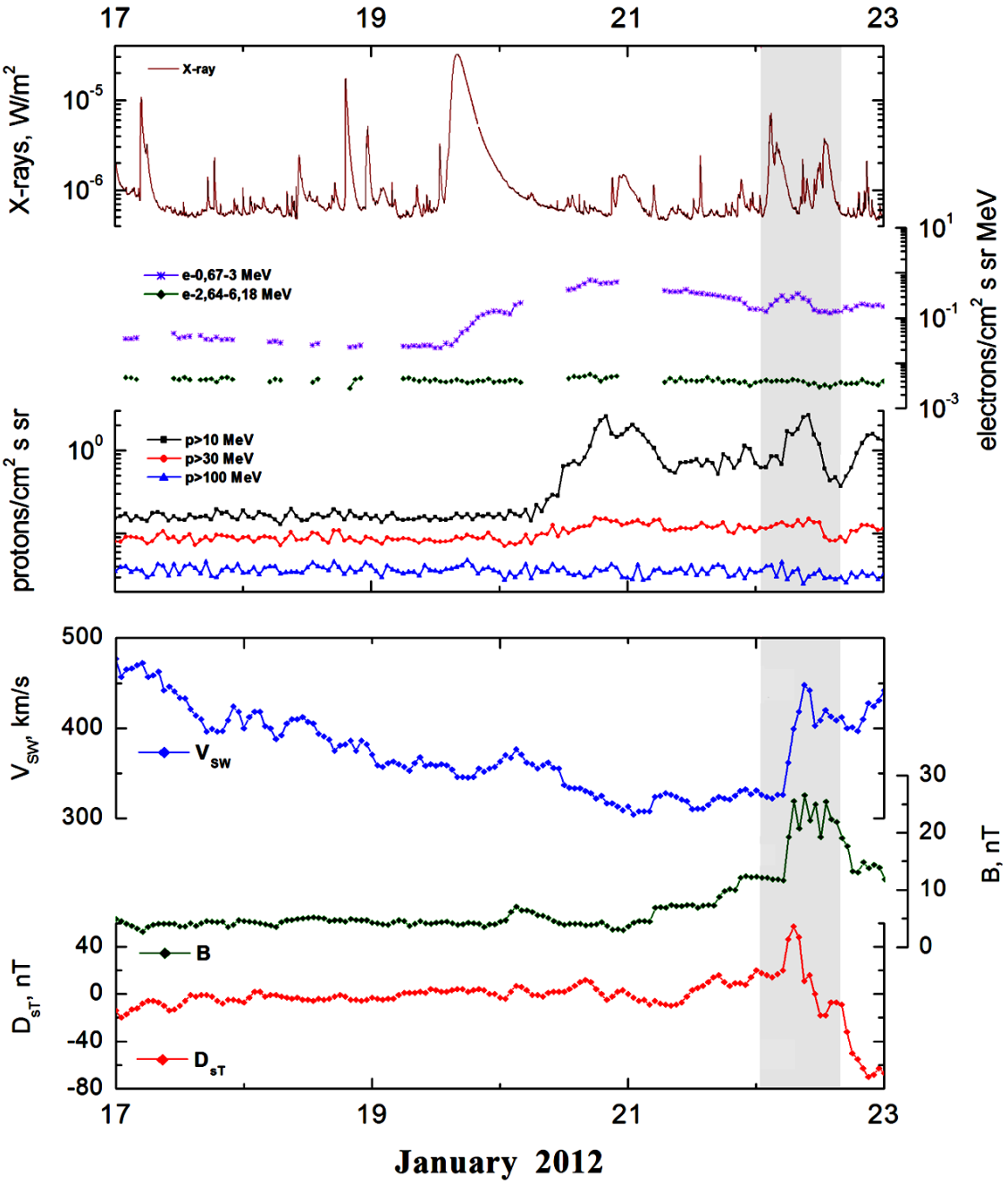
References:

Gopalswamy N., S. Yashiro, H. Xie et al., 2015.

Particle event: To(Ep>10 MeV) – 22d01^h
Tmax (Ep>10 MeV) – 22d10^h, Jmax (Ep>10 MeV) – 2.5 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ = 2.4
Quasimaximal energy of protons in the event – Eqm = 80 MeV

Sources: ⊙ solar flare 22d02^{h}32^m, C7.1/, N17W13, AR11401
Main burst X-ray 1–8 Å: onset – 22d02^{h}32^m, max – 22d02^{h}57^m, Φ = 0.01 J/m^2
CME: 22d06^{h}00^m, V= 0367 km/s, Δφ =085º, dA= 248º
▲ SC 22d06^{h}12^m

Particle fluxes and associated phenomena

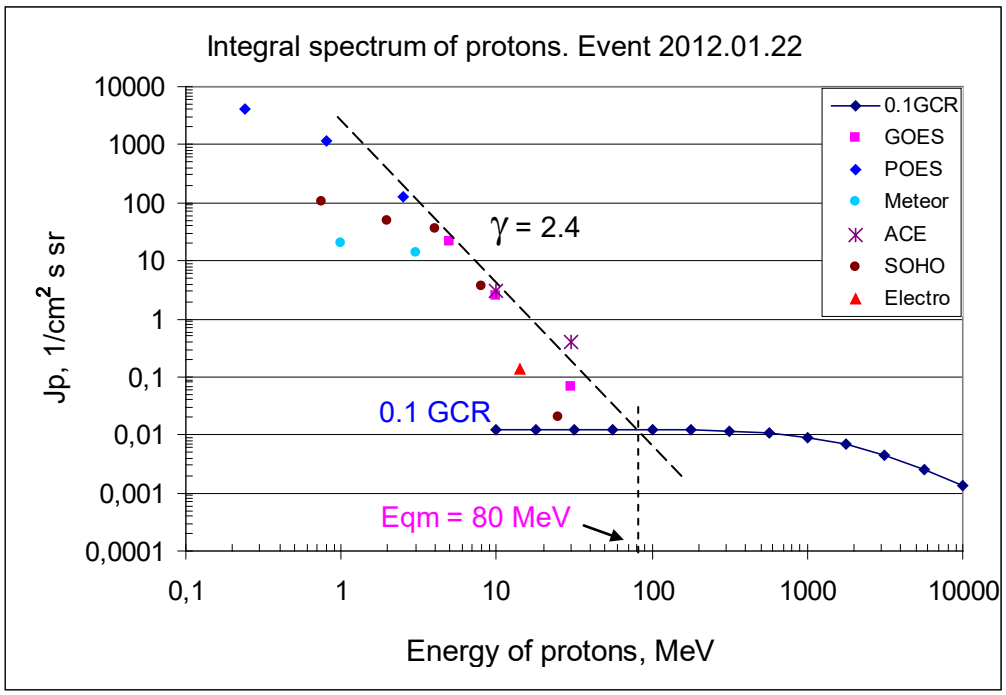


Integral fluxes of protons for the event of 2012 January 22

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	01	10	21	1.5	0.2	
EPS	>10	01	10	2.5	1.5	0.17	
EPS	>30	01	11	0.07	1.5	0.1	
EPS	>50	01	-	-	-	0.07	
EPS	>60	01	-	-	-	0.06	
EPS	>100	01	-	-	-	0.04	
POES							
MEPED	>0.24	02	9	4000	1	120	
MEPED	>0.8	02	9	1180	1	90	
MEPED	>2.5	02	9	130	1	70	
MEPED	>6.9	-	-	-	-	50	
MEPED	>16	-	-	-	-	0.85	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	1	
MEPED	>140	-	-	-	-	1.2	
Meteor-1							
SCR	>1	03	09	20	0.5	3.8	
SCR	>3	03	09	14.1	0.5	3.8	
SCR	>10	-	-	-	-	2.3	
GALS-M	>15	-	-	-	-	1.4	
GALS-M	>25	-	-	-	-	1.4	
GALS-M	>600	-	-	-	-	0.03	
ACE							
SIS	>10	01	05	3.1	1.5	1.6	
SIS	>30	01	05	0.4	1.5	1.1	
SOHO							
EPHIN (INT)	>50	-	-	-	-	0.3	

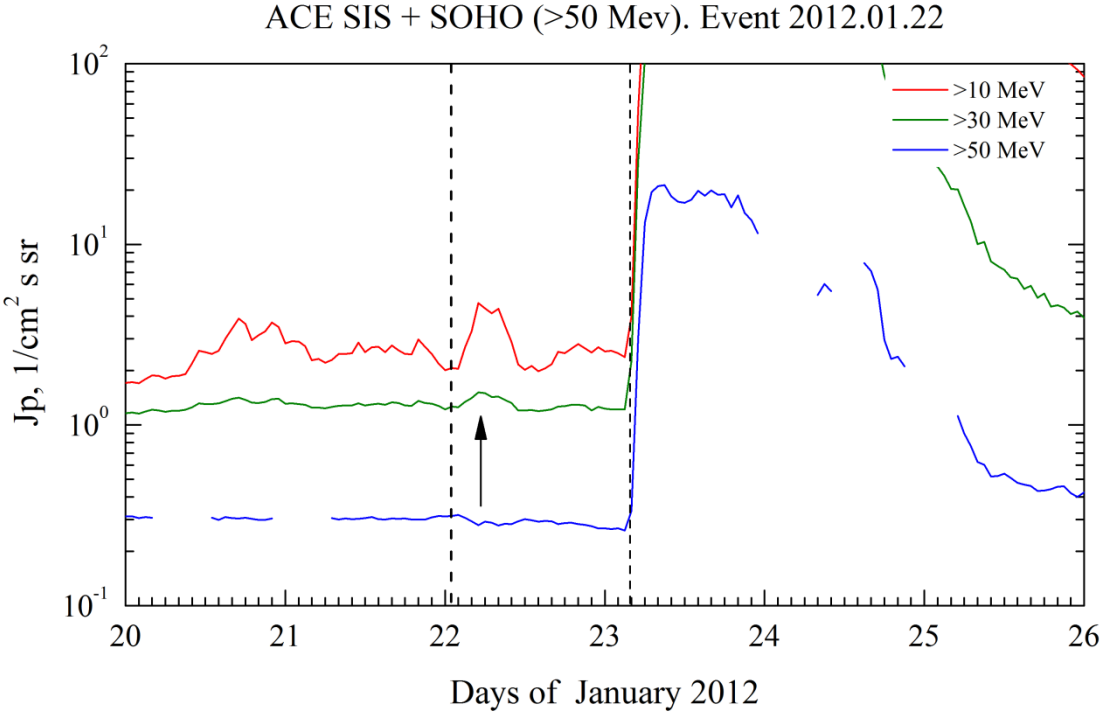
Differential fluxes of protons for the event of 2012 January 22

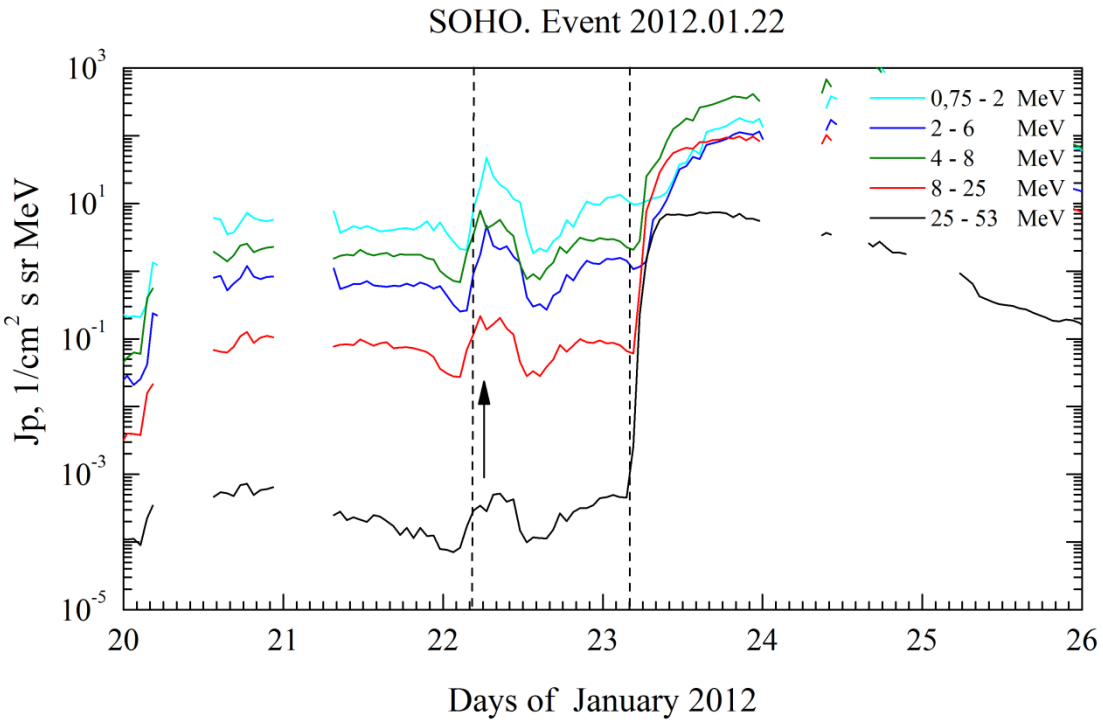
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	04	06	47.3	1	0. 2	
LION	2 – 6	04	06	4.7	1	0.02	
EPHIN	4 – 8	04	06	7.8	1	0.035	
EPHIN	8 – 25	04	06	0.22	1	0.0012	
EPHIN	25 – 53	04	09	0.0007	1	0.00004	
Electro-1							
SCR-E	13.7–23	02	9	0.015	1	0.06	
SCR-E	23–42	-	-	-	-	0.025	
SCR-E	42–112	-	-	-	-	0,005	


Integral spectrum of protons. Event 2012.01.22
Jp, 1/cm2 s sr
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.4
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

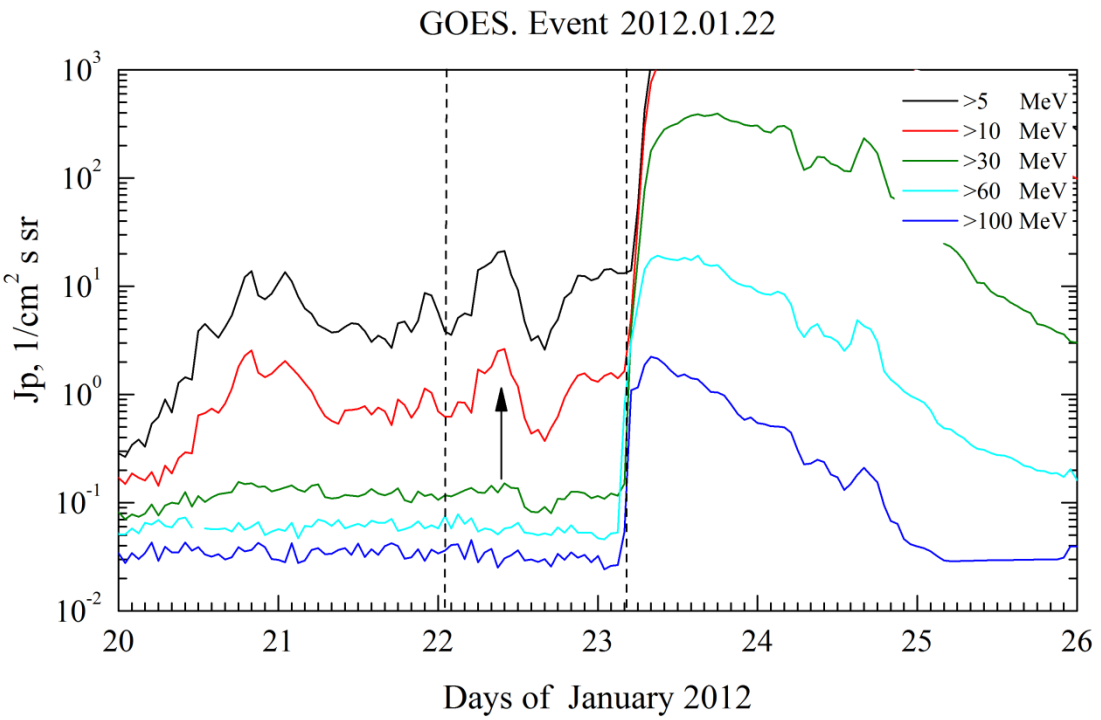
Time profiles of proton fluxes in the event 2012.01.22

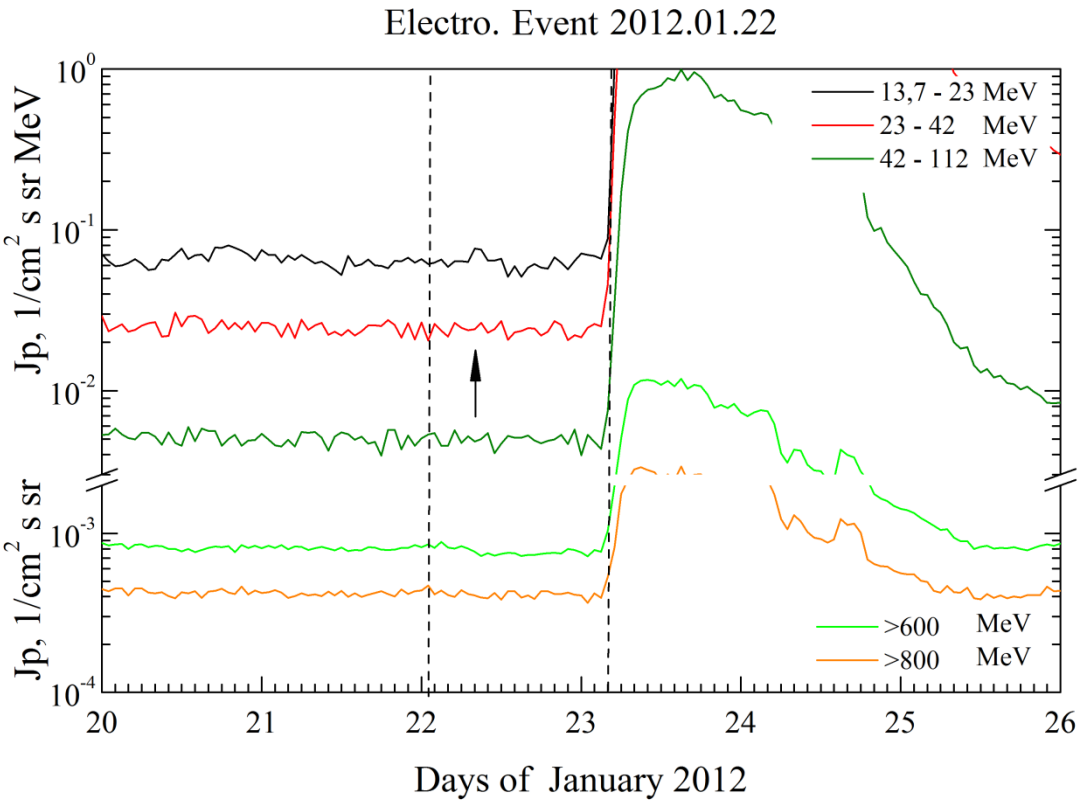
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



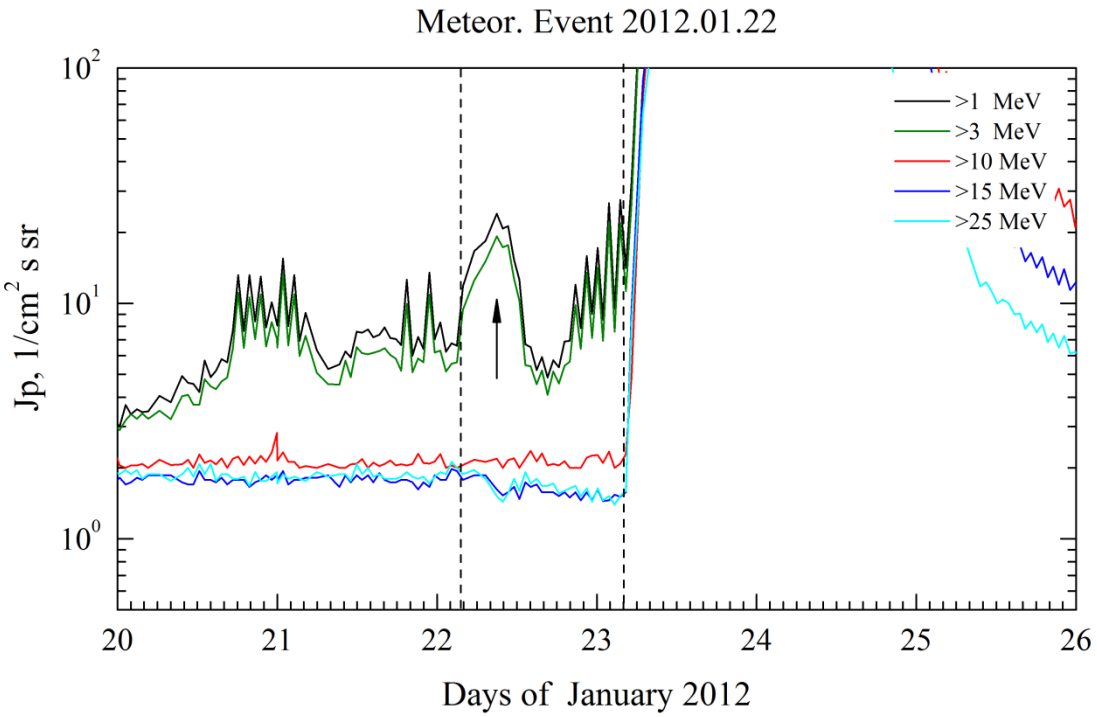


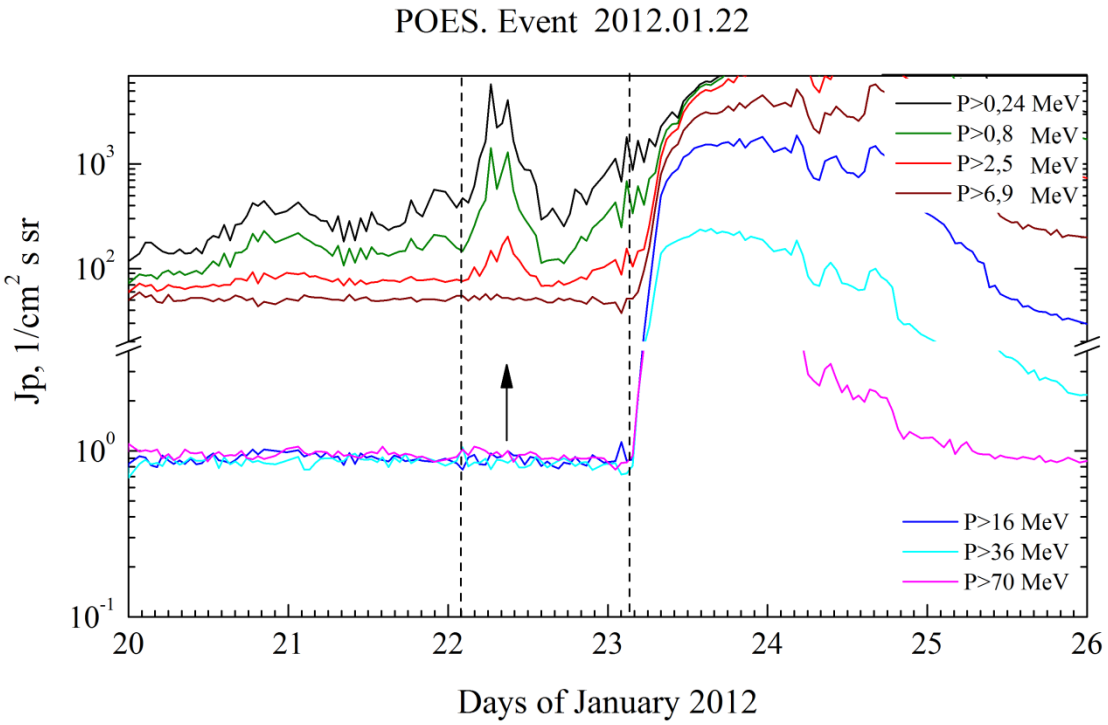
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 January 22

2012 January 22 ⊙ AR 11401 To event 503

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	No optical event on visible solar disc					
1 – 12	keV	0232	0257	0306	N17W13	C7.1	0.01

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0224:09	0242:49	0310:02	51937	6772818	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
5	GHz	0242	0242	0243		2.15	

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0600	0367	10.0	85°	248°	SOHO

Proton Active Region:

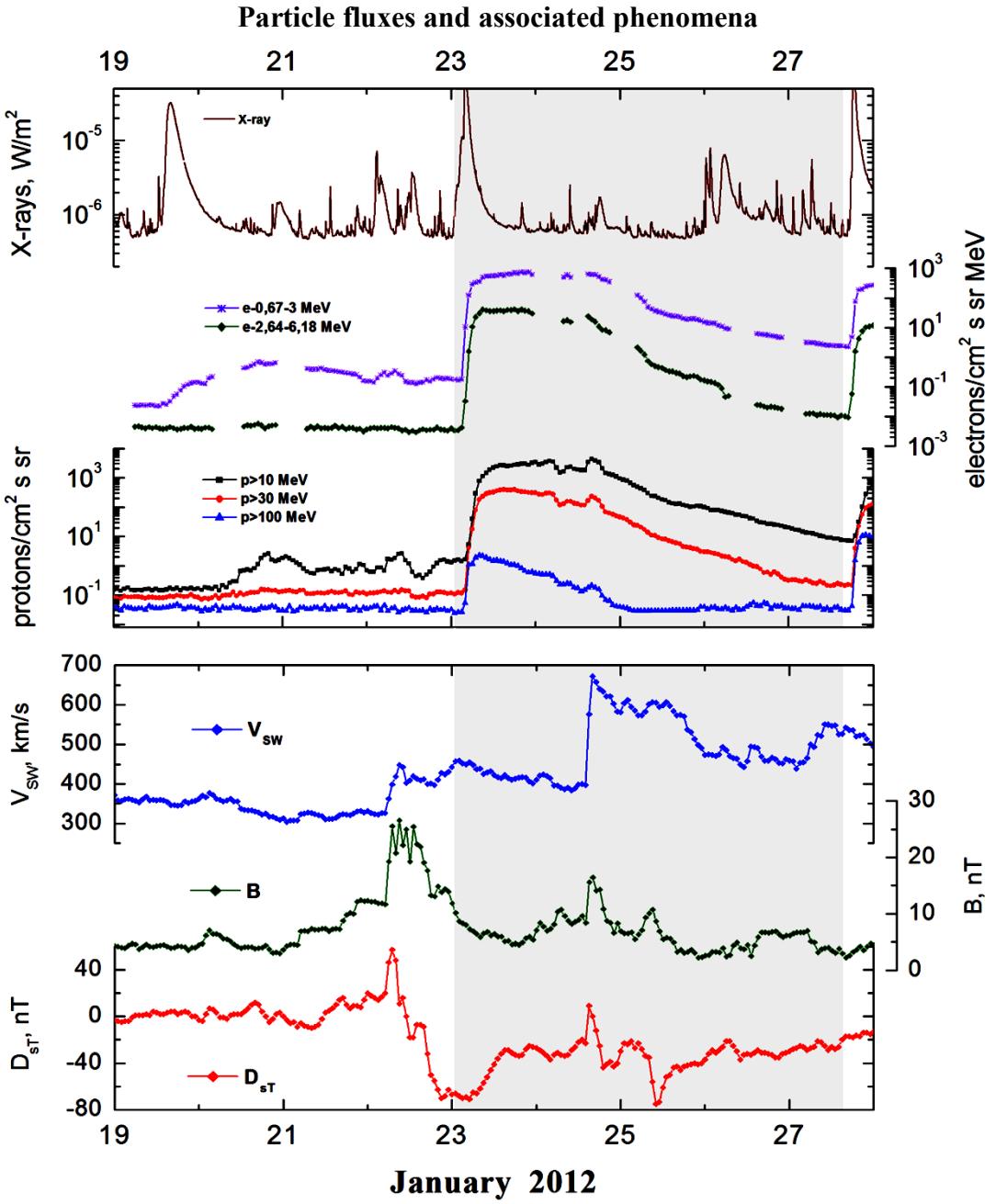
AR11401* (N16L213, CMP 21,0.01.2012,
Sp=540 msh, EKC, BG, R)
XRI=0.41 $M_3^{1.7}$+C_{19} 1_4+S_{16}
PFR 17-18: ($39^{h)}$ $M_2^{1.7}$
*Complex of active regions together AR11402

References:

Bardeen C.G., D.R. Marsh, C.H. Jackman et al., 2016.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Paassilta M., O. Raukunen, R. Vainio et al., 2017.
Roldugin A.V., S.V. Pilgaev, V.C. Roldugin, 2014.
Winter L.M. and K. Ledbetter, 2015.

Particle event: To(Ep>10 MeV) – $23d04^h$
$Tmax_1$(Ep>10 MeV) – $23d14^h$, $Jmax_1$ (Ep>10 MeV) – 2700 /cm^2·s·sr
$Tmax_2$(Ep>10 MeV) – $24d17^h$, $Jmax_2$ (Ep>10 MeV) – 3900 /cm^2·s·sr
Duration of the event –5 days, power-law index: $\gamma_1 = 3.55$, $\gamma_2 = 4.1$
Quasimaximal energy of protons in the event – Eqm_1 = 450 MeV
– Eqm_2 = 250 MeV

Sources: ● solar flare $23d03^h38^m$, M8.7/2B, N28W21, AR11402
Main burst X-ray 1–8 Å: onset – $23d03^h38^m$, max – $23d03^h59^m$, Φ = 0.2 J/m^2
CME: $23d04^h00^m$, V= 2175 km/s, Δφ = 360º, dA= 326º
▲SC $24d15^h03^m$

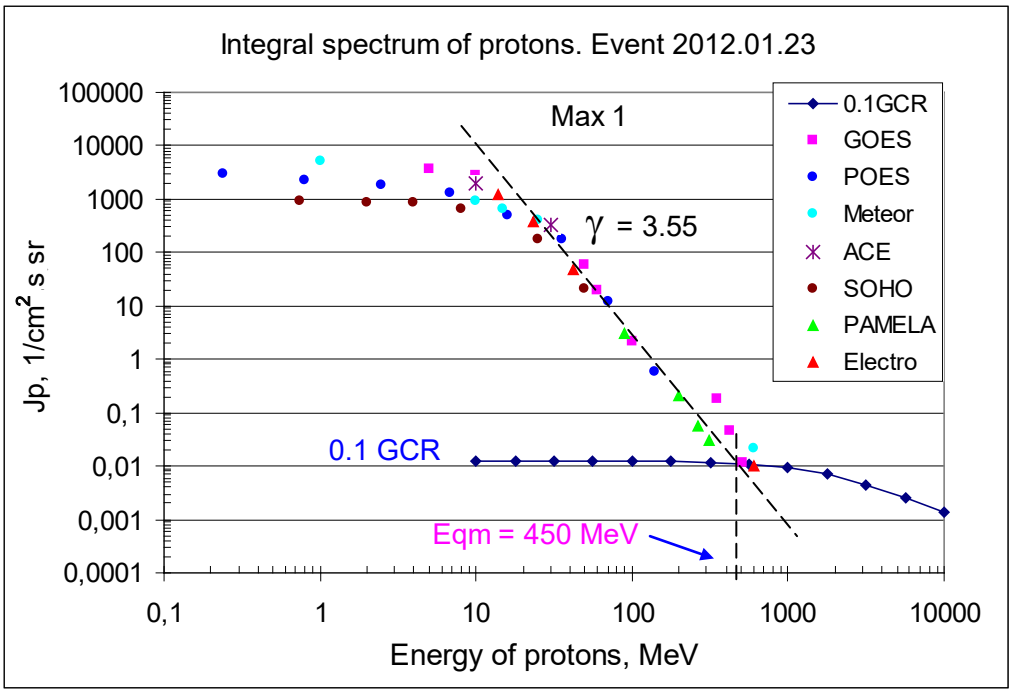


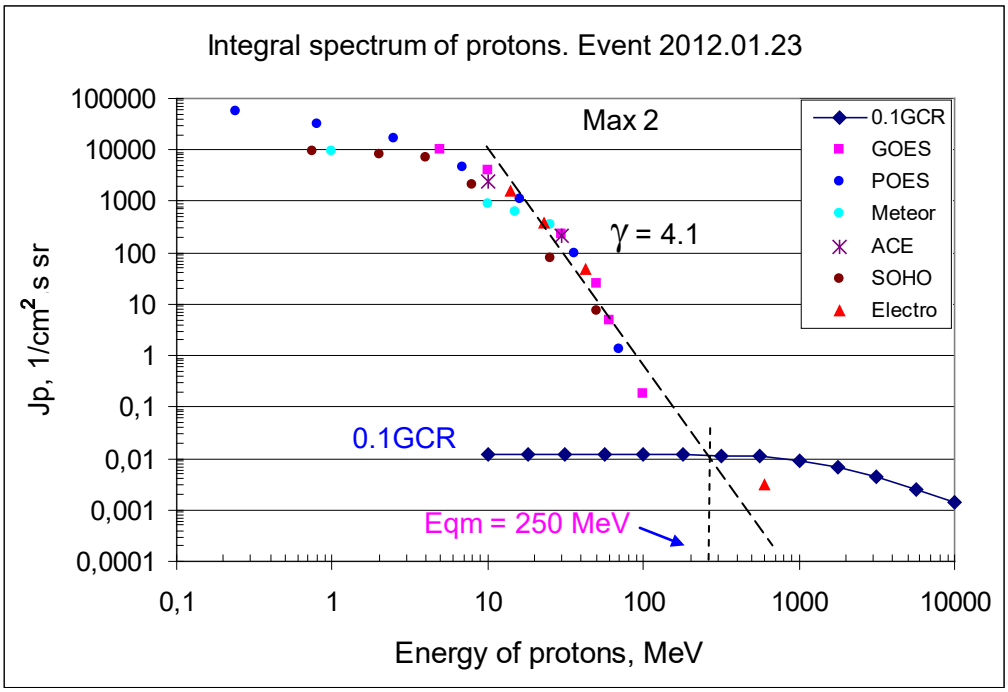
Integral fluxes of protons for the event of 2012 January 23

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	6	14/24d17	3570/10300	5	0.2	
EPS	>10	4	13/24d17	2700/3900	5	0.17	
EPS	>30	4	12/24d17	300/230	5	0.1	
EPS	>50	3	10/24d17	57/24.5	4	0.07	
EPS	>60	3	10/24d17	19.2/4.8	3	0.06	
EPS	>100	3	09/24d17	2.2/0.18	2	0.04	
Electro-1							
GALS-E	>600	4	9/24d16	0.01/0.003	2.5	0.001	
POES							
MEPED	>0.24	3	9/24d16	3000/56400	5	120	
MEPED	>0.8	3	9/24d16	2300/32000	5	90	
MEPED	>2.5	3	9/24d16	1800/17000	5	70	
MEPED	>6.9	3	9/24d16	1300/4700	5	50	
MEPED	>16	3	9/24d16	490/1100	5	0.85	
MEPED	>36	3	9/24d16	175/98	4	0.9	
MEPED	>70	3	9/24d16	12.4/1.3	2	1	
MEPED	>140	3	9/ -	0.6/ -	2	1.2	
Meteor-1							
SCR	>1	4	15/24d16	5300/9130	4	3.2	
SCR	>3	4	-	-	4	2.6	
SCR	>10	4	15/24d16	920/900	3.5	2.1	
GALS-M	>15	4	15/24d16	644/630	2.5	4.2	
GALS-M	>25	4	15/24d16	415/357	2.5	4.3	
GALS-M	>600	4	15/ -	0.022/ -	1	0.03	
ACE							
SIS	>10	4	11/24d15	2000/2450	5	2.5	
SIS	>30	4	10/24d15	330/210	5	1.2	
SOHO							
EPHIN	>50	4	10/24d16	20.7/7.6	3	0.3	
PAMELA							
TRACKER	>90	4	05-10/ -	3/ -	3	-	
TRACKER	>200	4	05-10/ -	0.21/ -	3	-	
TRACKER	>265	4	05-10/ -	0.056/ -	3	-	
TRACKER	>312	4	05-10/ -	0.03/ -	3		

Differential fluxes of protons for the event of 2012 January 23

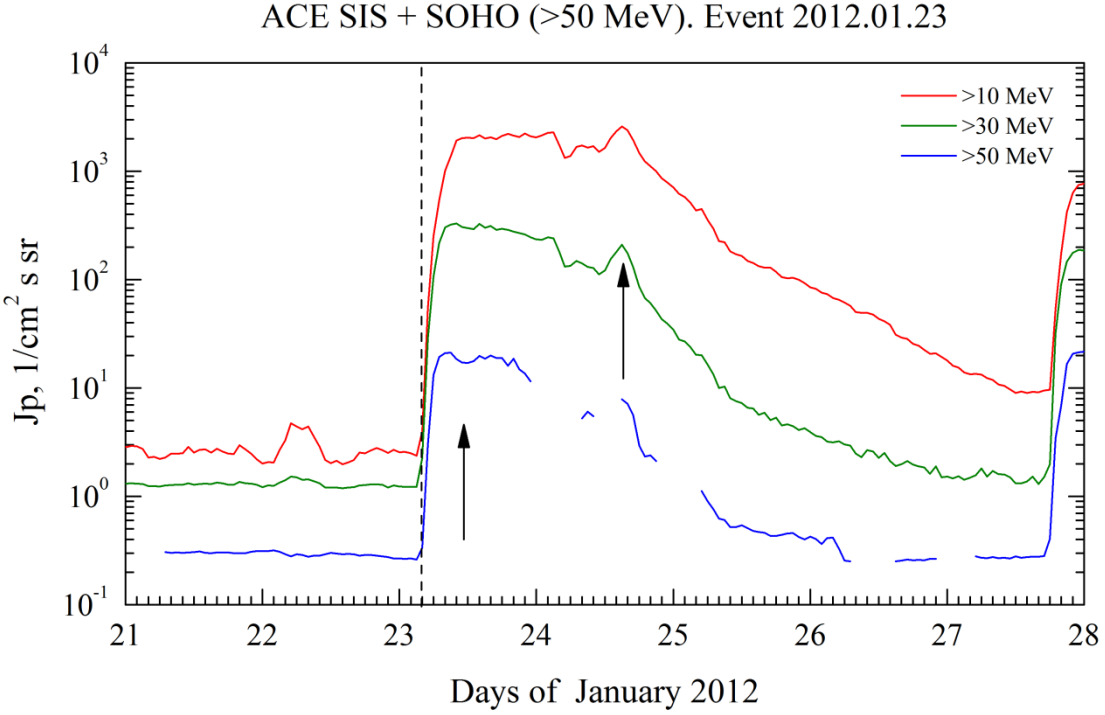
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	03	09/24d16	14.3/1200	5	0. 2	
LION	2 – 6	06	09/24d16	11/370	5	0.02	
EPHIN	4 – 8		09/24d16	47/1200	5	0.035	
EPHIN	8 – 25		09/24d16	29/120	5	0.0012	
EPHIN	25 – 53		09/24d16	5.7/2.6	5	0.00004	
Electro-1							
SCR-E	13.7–23	4	9/24d16	90/130	5	0.065	
SCR-E	23–42	4	9/24d16	17/16.5	5	0.025	
SCR-E	42–112	4	9/24d16	0.7/0.32	4	0.005	
GOES							
EPS	350–420	7	14/ -	0.0019/ -	1.5	0.0016	
EPS	420–510	8	17/ -	0.0004/ -	1.5	0.001	
EPS	510–700	7	18/-	0.00006/ -	1	0.0005	
EPS	>700	-	-	-	-		

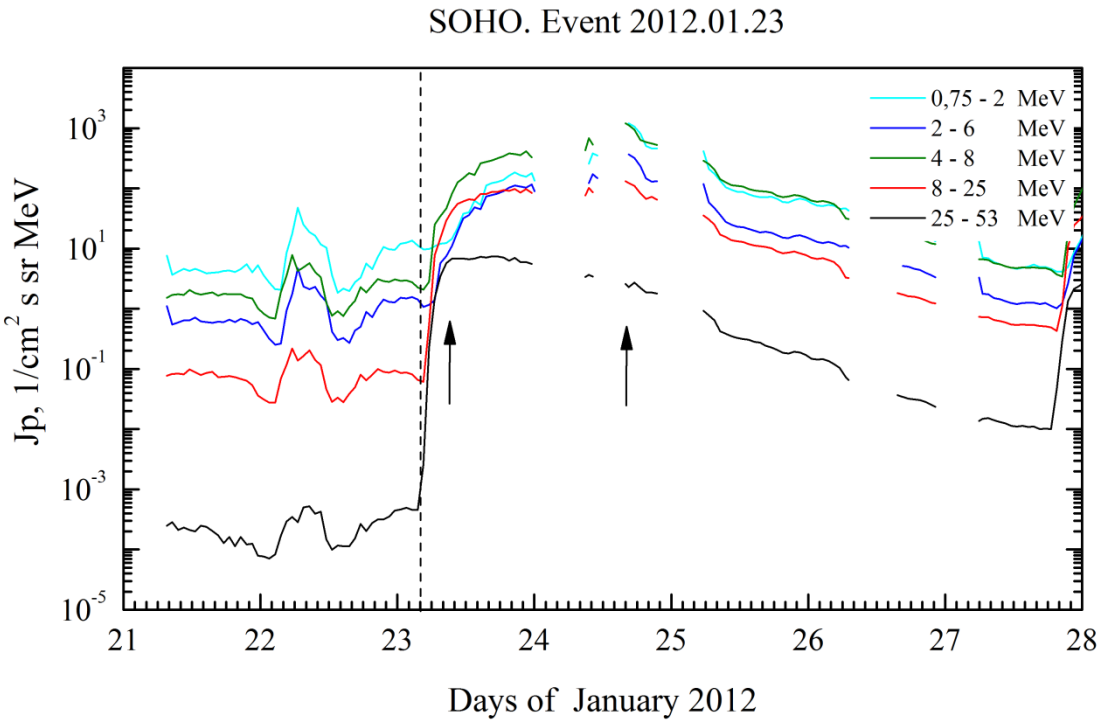

Integral spectrum of protons. Event 2012.01.23
Max 1
γ = 3.55
0.1 GCR
Eqm = 450 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
PAMELA
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

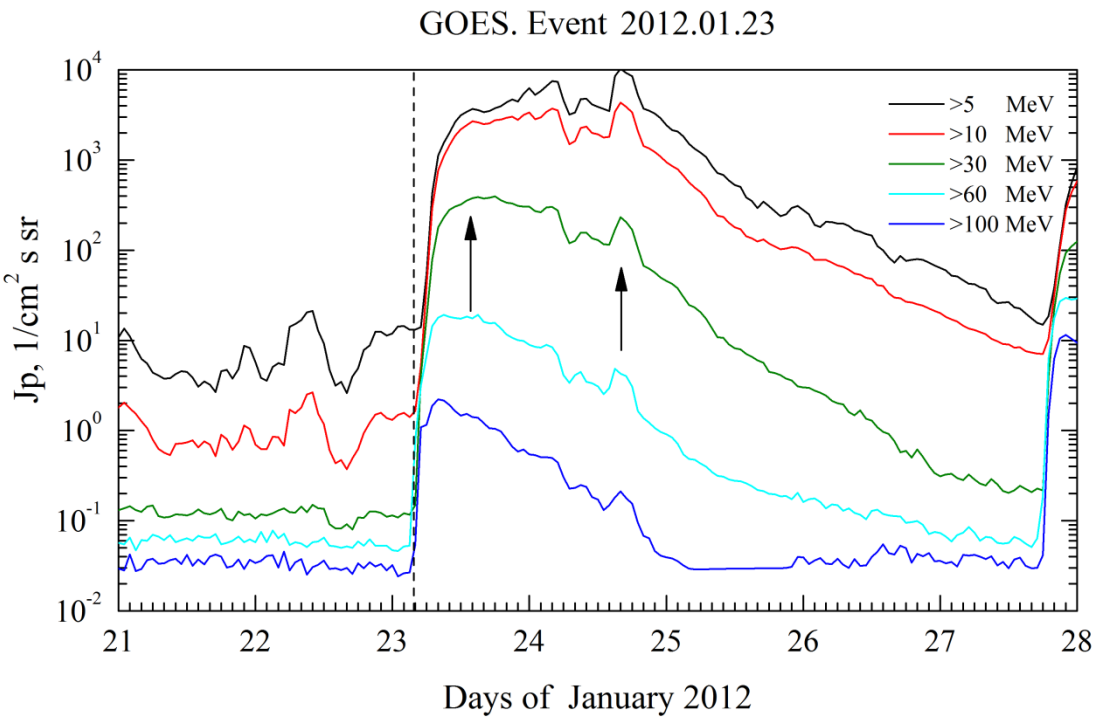

Integral spectrum of protons. Event 2012.01.23
Max 2
γ = 4.1
0.1GCR
Eqm = 250 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

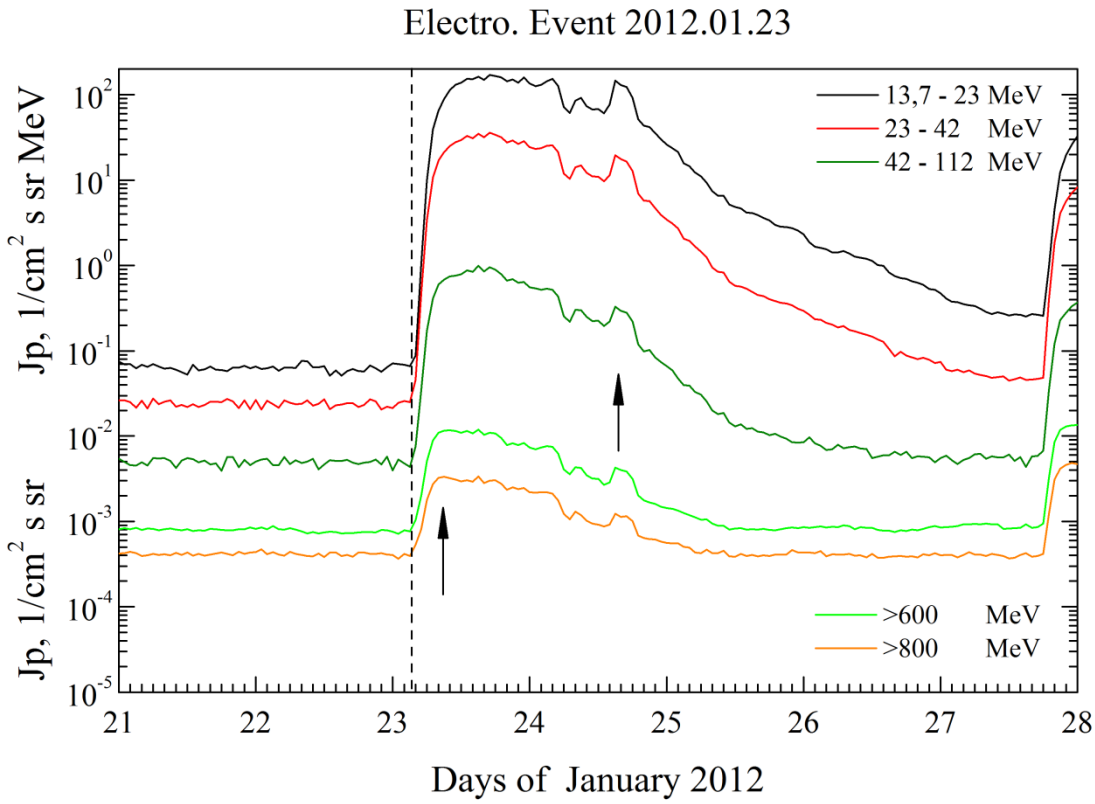
Time profiles of proton fluxes in the event 2012.01.23

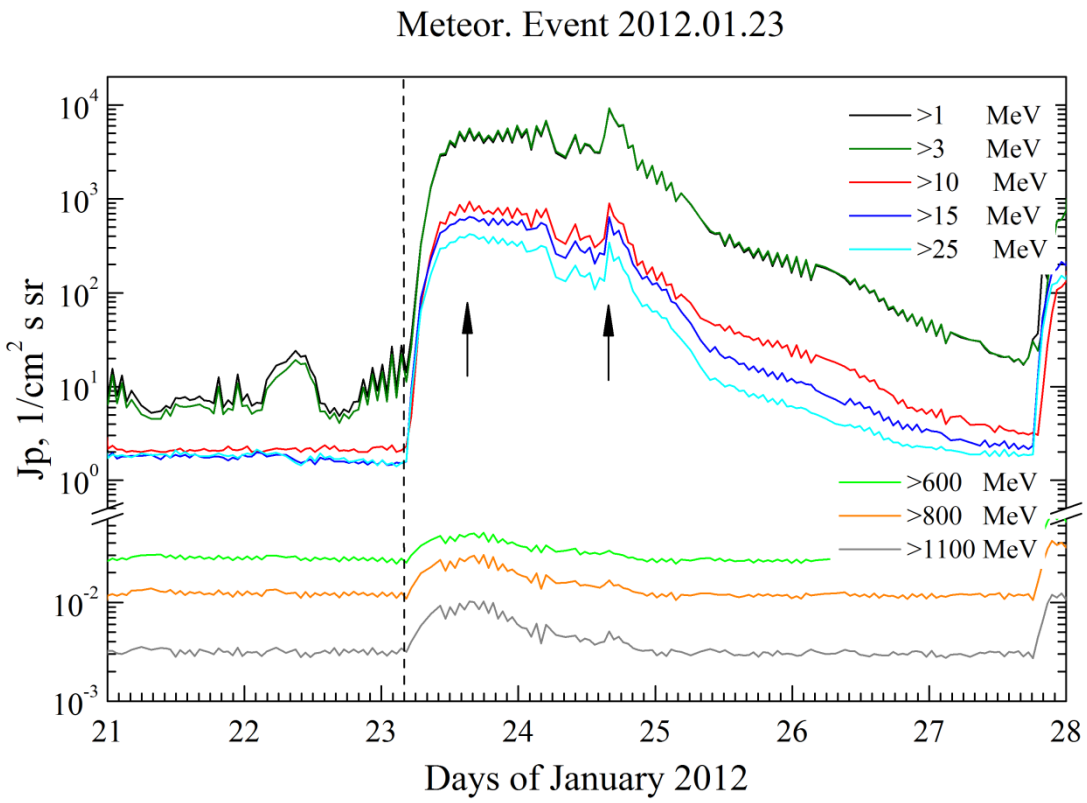
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

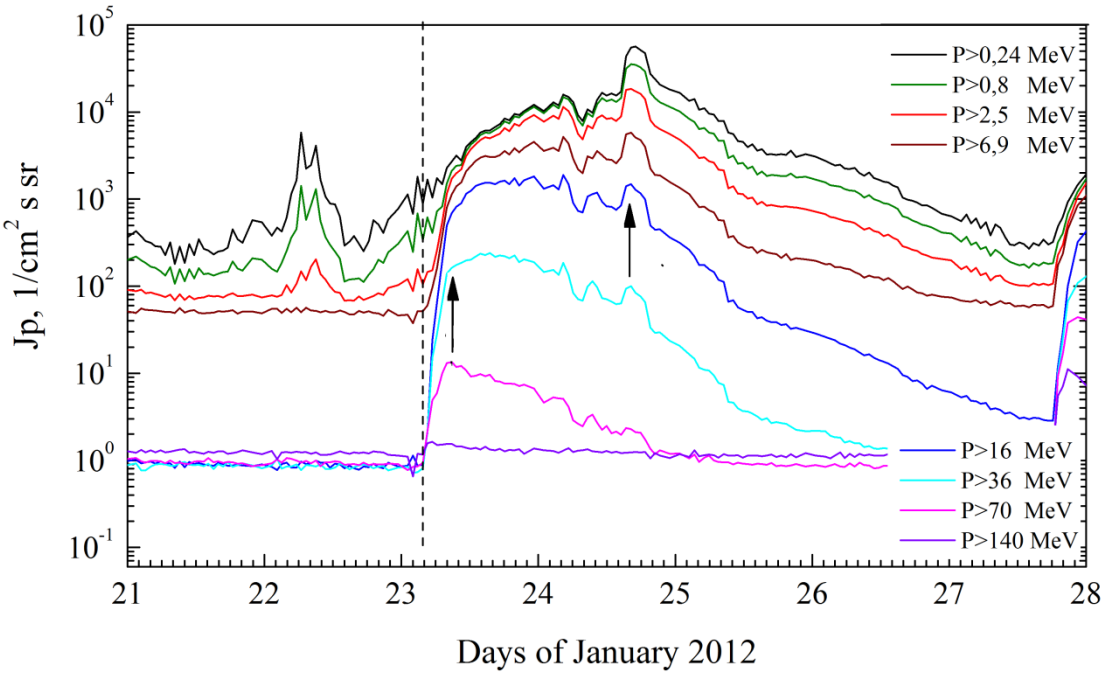





GOES. Event 2012.01.23
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of January 2012


Electro. Event 2012.01.23
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of January 2012


Meteor. Event 2012.01.23
Jp, 1/cm^2 s sr
>1 MeV
>3 MeV
>10 MeV
>15 MeV
>25 MeV
>600 MeV
>800 MeV
>1100 MeV
Days of January 2012


POES. Event 2012.01.23
Jp, 1/cm^2 s sr
P>0,24 MeV
P>0,8 MeV
P>2,5 MeV
P>6,9 MeV
P>16 MeV
P>36 MeV
P>70 MeV
P>140 MeV
Days of January 2012

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 January 23

2012 January 23 ● AR 11402 To event 504

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL	0256	0404	0553	N28W21	2B	
1 – 12	keV	0338	0359	0434		M8.7	0.2

X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
>100	keV	0406:30		0447:30		1.70E-05*	FERMI
>100	keV	0534:30		0623:30		2.40E-05*	FERMI
>100	keV	0719:30		0747:30		2.29E-05*	FERMI
>100	keV	0858:30		0926:30		2.62E-05*	FERMI

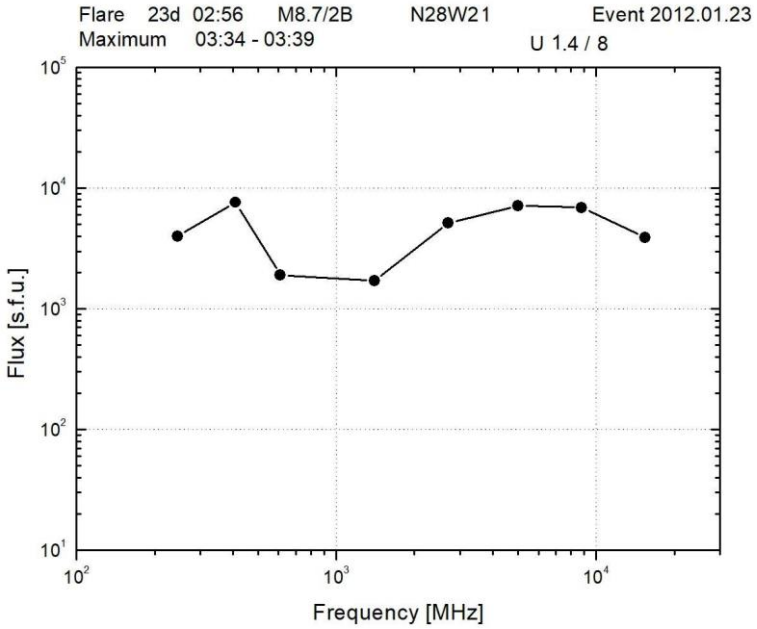
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0339	0350	0425		3.59	
8.8	GHz	0339	0350	0428		3.84	
5	GHz	0339	0350	0430		3.85	
2.7	GHz	0339	0352	0426		3.71	
1.4	GHz	0339	0405	0426	U1.4 / 8	3.23	
610	MHz	0339	0404	0417		3.28	
410	MHz	0339	0401	0413		3.88	
245	MHz	0334	0341	0408		3.6	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS IV	25-180	0339		0901		2	
DS VII	25-180	0333		0405		2	
DH II	0.04-16	0400		24/1500			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0400	2175	28.0	360˚	326˚	SOHO

*cm^{-2} s^{-1}

Radio burst frequency spectrum



Proton Active Region:

AR11402 (N28L211, CMP 21,3.01.2012,
Sp= 630 msh, DKI, BG, R)
XRI=2.89; $X_1^{1.7}$+$M_2^{8.7}$+C_9; 2_2+1_3+C_{20};
PFR1 23.11 $M_1^{8.7}$/2B
PFR2 27.11 $X_1^{1.7}$/2F

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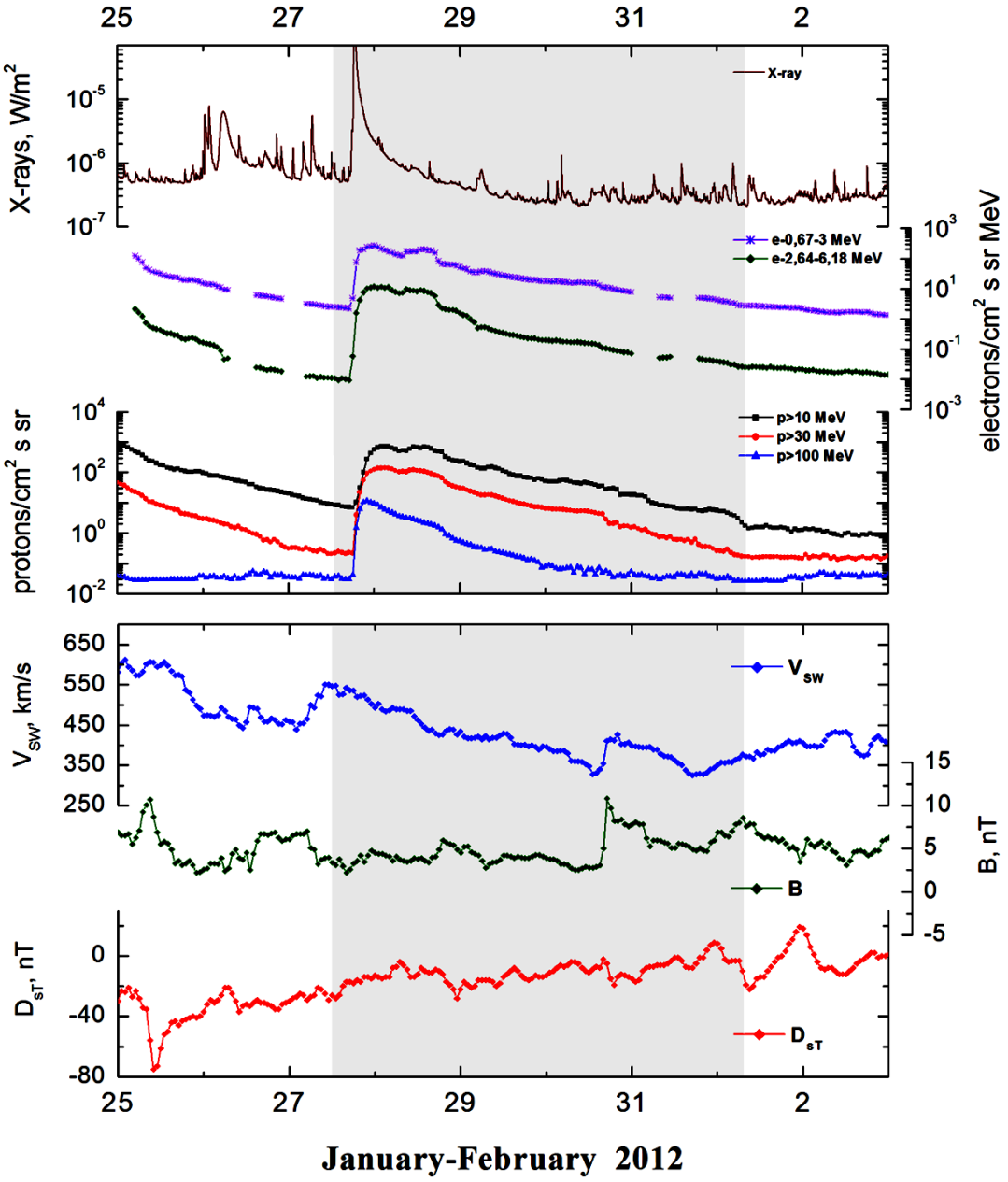
Zou Z., X. Xue, Ch. Shen et al., 2018.

Particle event: To(Ep>10 MeV) – 27d18^h
Tmax$_1$(Ep>10 MeV) – 28d02^h, Jmax$_1$ (Ep>10 MeV) – 740 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 28d12^h, Jmax$_2$ (Ep>10 MeV) – 680 /cm^2·s·sr
Duration of the event – 5 days, power-law index: γ_1 = 3.1, γ_2 = 2.9
Quasimaximal energy of protons in the event – Eqm$_1$ = 900 MeV
– Eqm$_2$ = 600 MeV

Sources: ● solar flare 27d17^{h}37^m, X1.7/1F, N27W71, AR11402
Main burst X-ray 1–8 Å: onset – 27d17^{h}37^m, max – 27d18^{h}37^m, Φ = 0.32 J/m^2
CME: 27d18^{h}28^m, V= 2508 km/s, Δφ = 360º, dA= 296º
▲SC 30d16^{h}24^m

Particle fluxes and associated phenomena

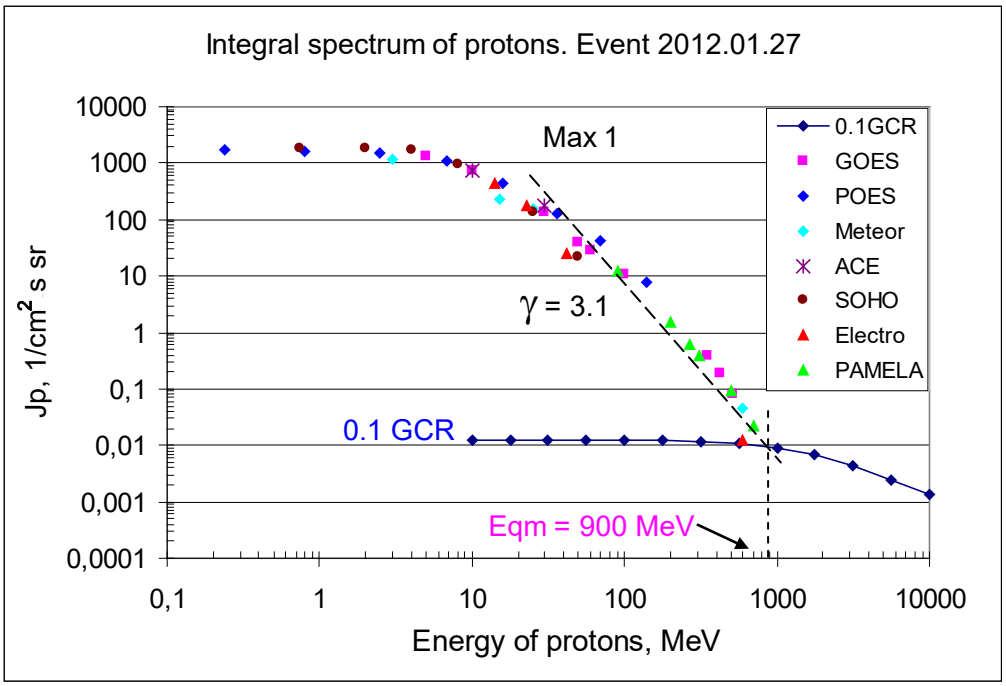


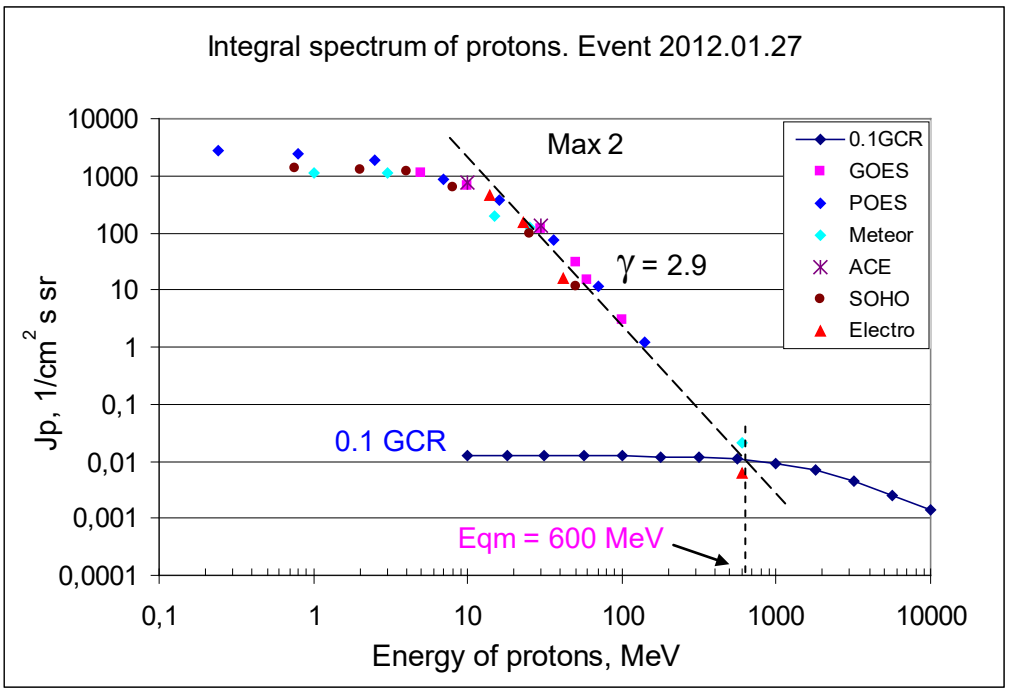
Integral fluxes of protons for the event of 2012 January 27

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	20	28d02/28d12	1300/1150	5	0.2	
EPS	>10	18	28d02/28d12	740/680	5	0.17	
EPS	>30	18	28d01/28d11	135/120	4	0.1	
EPS	>50	18	22/28d10	40/31	4	0.07	
EPS	>60	18	22/28d10	29/15	3	0.06	
EPS	>100	18	22/28d10	11.5/3	3	0.04	
Electro-1							
GALS-E	>600	18	22/28d10	0.012/0.006	2	0.001	
POES							
MEPED	>0.24	18	28d00/14	1730/2680	4	290	
MEPED	>0.8	18	28d00/14	1610/2460	4	180	
MEPED	>2.5	18	28d00/14	1490/1840	4	100	
MEPED	>6.9	18	28d00/14	1070/840	3	60	
MEPED	>16	18	28d00/14	435/385	3	2.9	
MEPED	>36	18	28d00/14	131/75.5	3	0.9	
MEPED	>70	18	23/28d10	43/11.5	2	1	
MEPED	>140	18	23/28d10	8/1.2	1.5	1.2	
Meteor-1							
SCR	>1	17	- /28d11	- /1110	4.5	3.2	
SCR	>3	17	28d02/28d11	1160/1100	4.5	3	
SCR	>10	17	-	-	3.5	2.1	
GALS-M	>15	17	28d00/28d11	226/192	3	1.5	
GALS-M	>25	17	28d00/28d11	160/128	3	1.5	
GALS-M	>600	17	21/28d05	0.045/0.021	1	0.03	
ACE							
SIS	>10	18	23/28d13	740/740	4	10	
SIS	>30	18	23/28d13	175/135	4	1.2	
SOHO							
EPHIN	>50	18	28d00/28d11	21.4/11.2	4	0.3	
PAMELA							
TRACKER	>90	19	19-28d01	12/ -	5	-	
TRACKER	>200	19	19-28d01	1.5/ -	4	-	
TRACKER	>265	19	19-28d01	0.61/ -	4	-	
TRACKER	>312	19	19-28d01	0.39/ -	3		
TRACKER	>500	19	19-28d01	0.09/ -	2		
TRACKER	>700	19	19-28d01	0.022/ -	2		

Differential fluxes of protons for the event of 2012 January 27

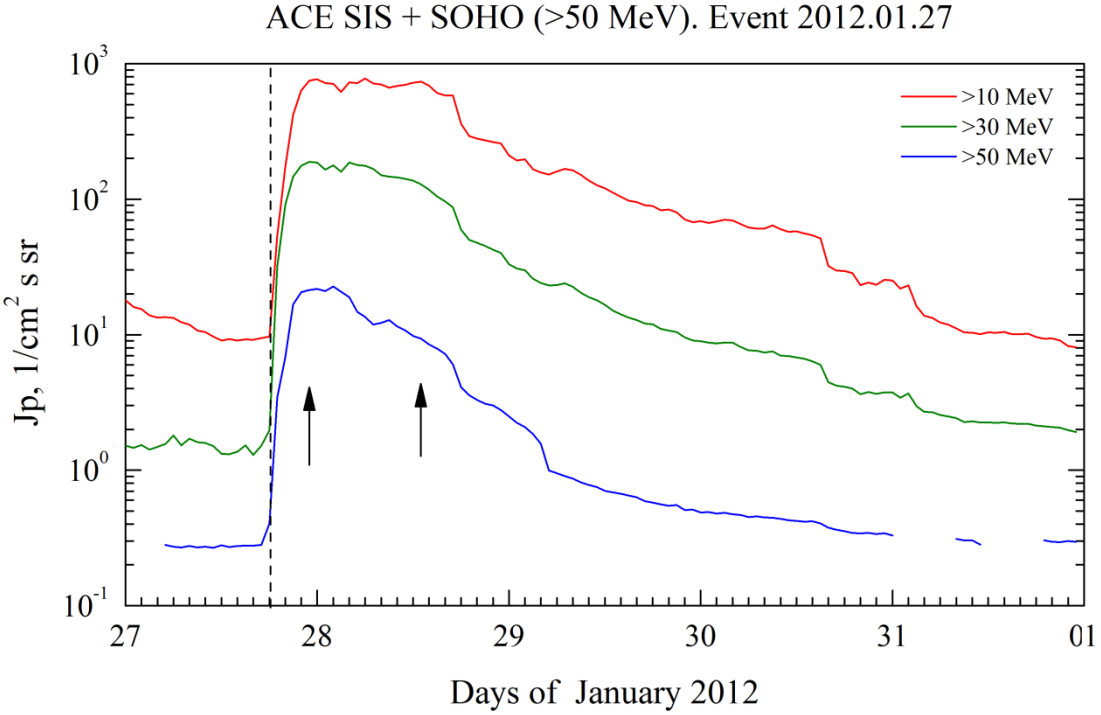
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	20	28d02/28d11	63.4/62.4	7	0. 2	
LION	2 – 6	20	28d02/28d11	34.5/29.4	7	0.02	
EPHIN	4 – 8	22	28d02/28d11	188/145	7	0.035	
EPHIN	8 – 25	22	28d02/28d11	47.6/32.3	7	0.0012	
EPHIN	25 – 53	20	28d04/28d11	4.1/3	7	0.00004	
Electro-1							
SCR-E	13.7–23	18	22/28d10	26.7/38.3	4	0.25	
SCR-E	23–42	18	22/28d10	8/9.2	4	0.05	
SCR-E	42–112	18	22/28d10	0.37/0.27	4	0.005	
GOES							
EPS	350–420	18	21/ -	0.0029/ -	0.5	0.0016	
EPS	420–510	17	20/ -	0.0012/ -	0.5	0.001	
EPS	510–700	17	20/ -	0.00043/ -	0.5	0.0005	
EPS	>700	-	-	-	-		

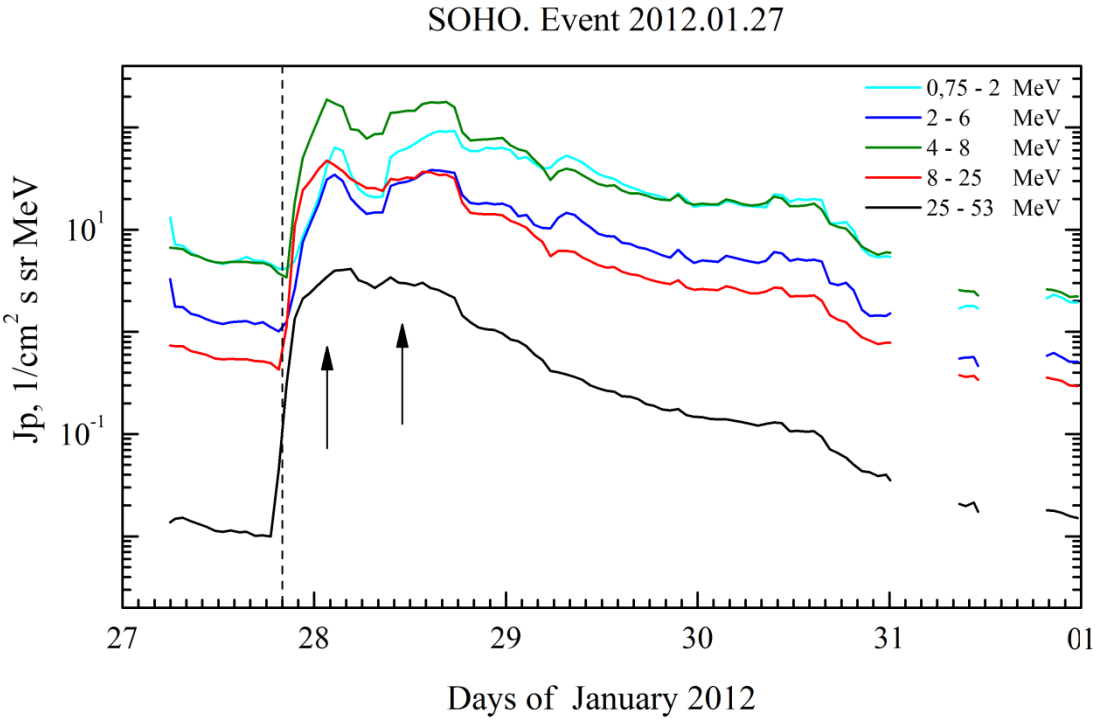

Integral spectrum of protons. Event 2012.01.27
Max 1
γ = 3.1
0.1 GCR
Eqm = 900 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
PAMELA
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.01.27
Max 2
γ = 2.9
0.1 GCR
Eqm = 600 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

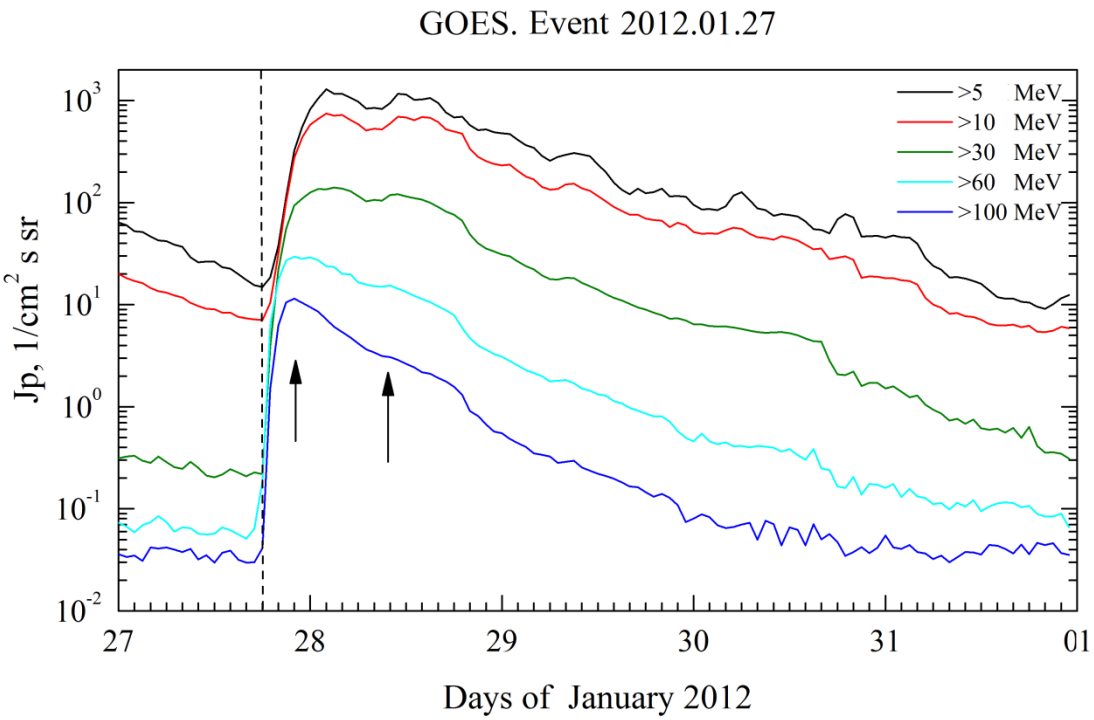
Time profiles of proton fluxes in the event 2012.01.27

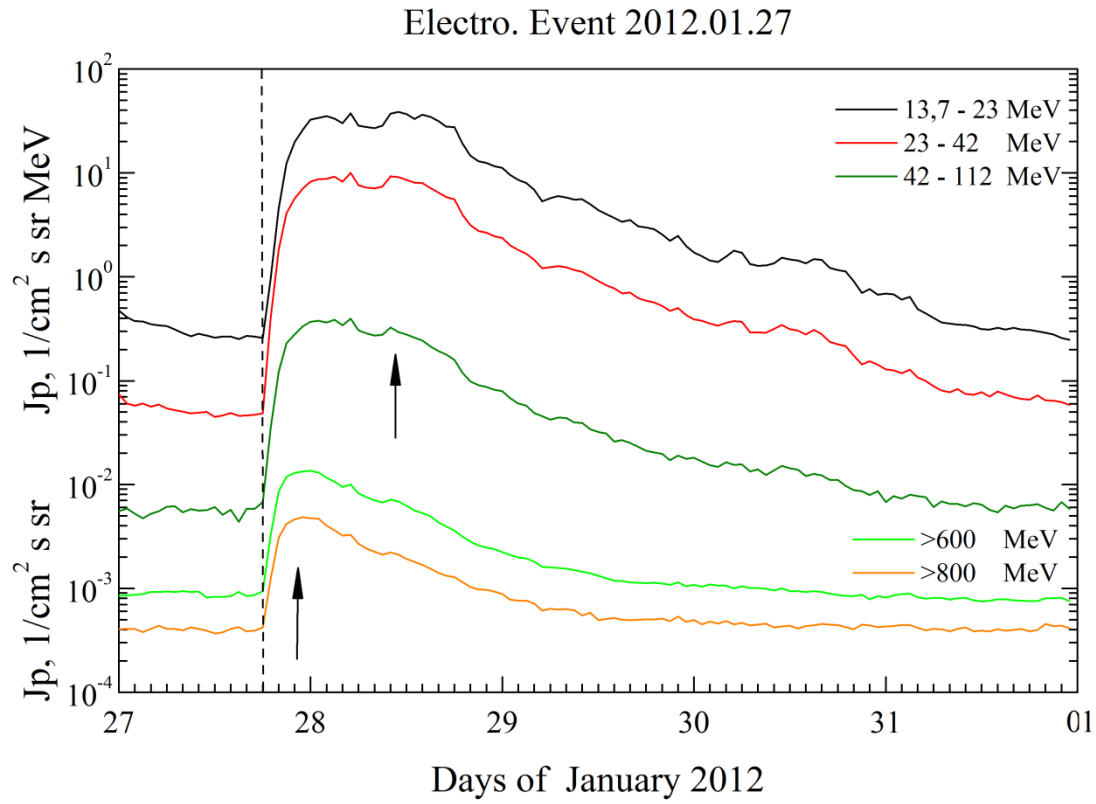
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



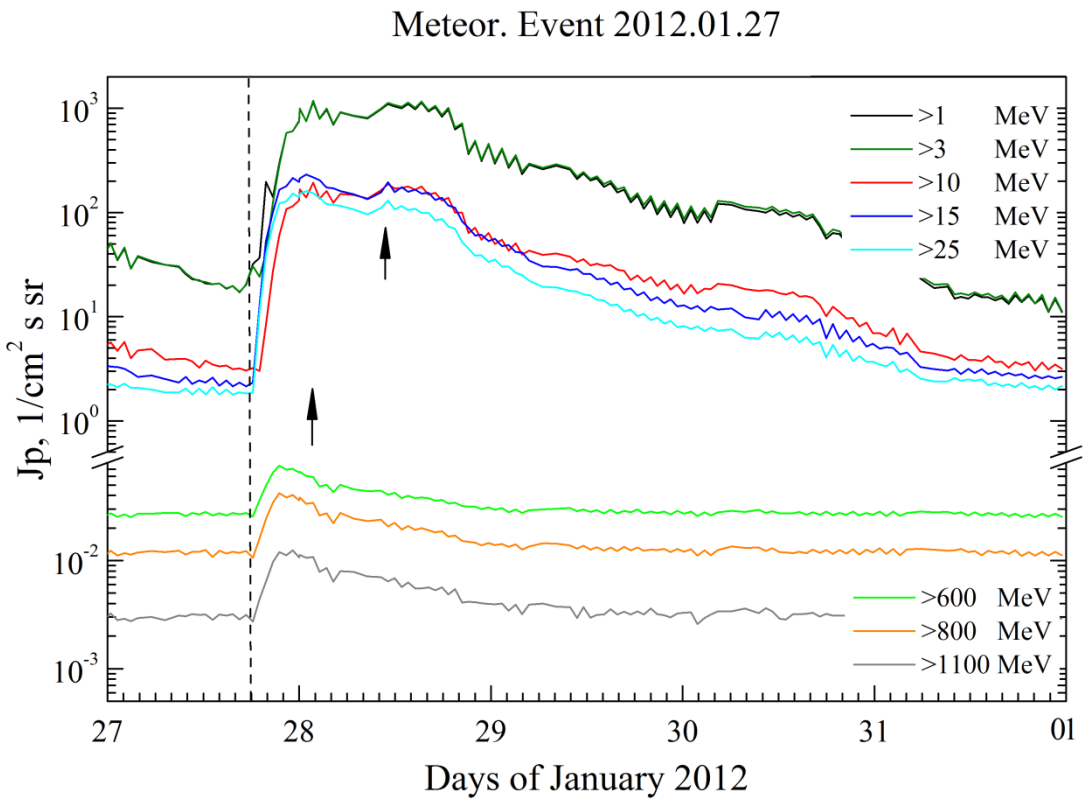


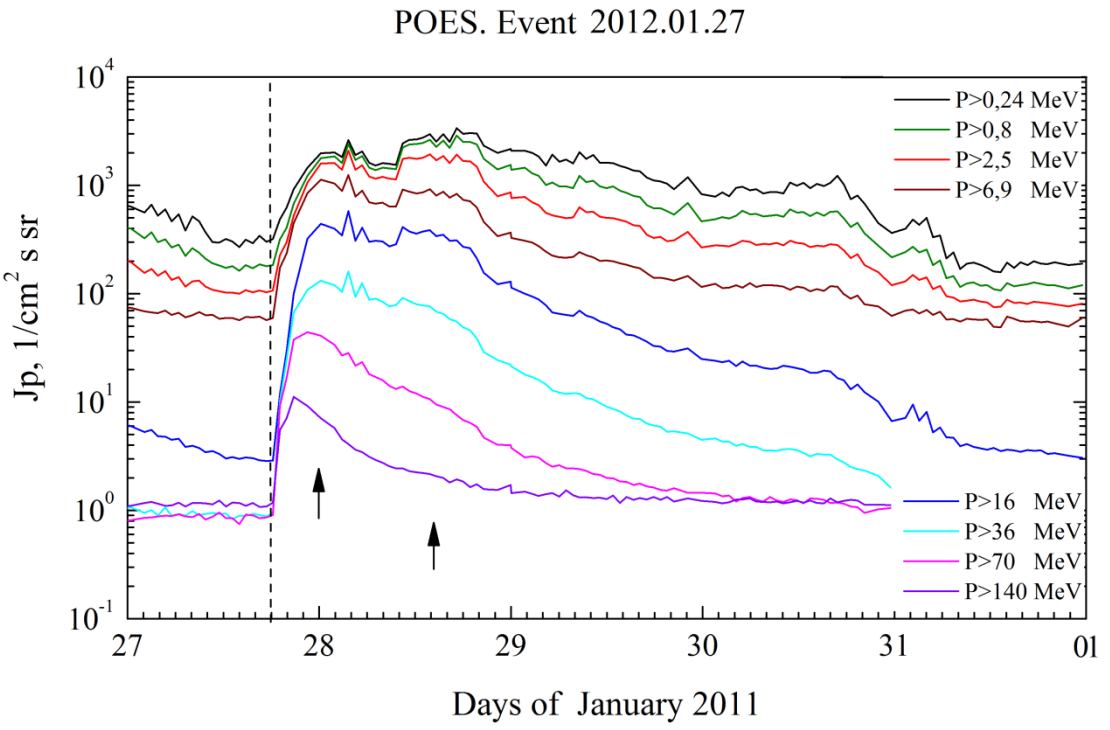
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 January 27

2012 January 27 • AR 11402 To event 505

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	1813	1851	1913	N27W71	1F	
6563 Å	LPS	1846		1952	0.03	B9.A	
1 – 12	keV	1737	1837	1856	N33W85	X1.7	0.32

X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1834:05	1834:09	1844:27	691027	57144256	FERMI
12-25	keV	1921:03	1922:13	1956:12	6650	2805725	FERMI
>100	MeV	1937:30		1956:30		3.02E-05*	FERMI
>100	MeV	2108:30		2137:30		1.29E-05*	FERMI

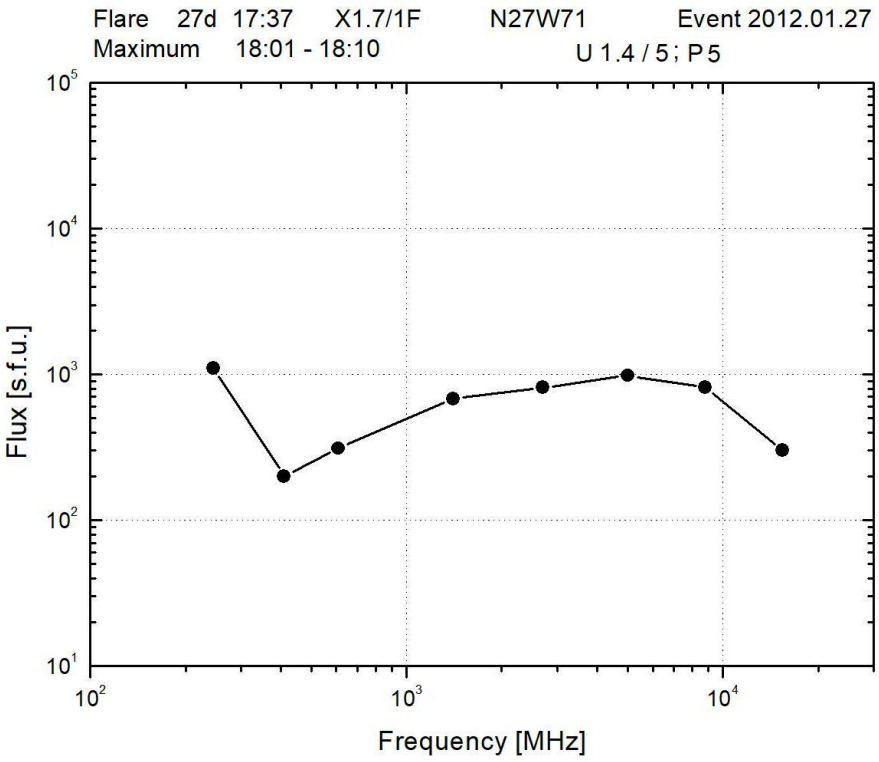
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1801	1816	1914		2.48	
8.8	GHz	1810	1815	1850	P 5	2.91	
5	GHz	1809	1824	1913		2,99	
2.7	GHz	1808	1824	1854		2.91	
1.4	GHz	1808	1811	1849	U0.4 / 5	2.83	
610	MHz	1809	1810	1817		2.49	
410	MHz	1809	1813	1820		2.3	
245	MHz	1810	1819	1823		3.04	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	1810		1825		3	
DS IV	25-180	1814		1844		2	
DH II	0.15-16	1830		28/0445			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1828	2508	165.9	360˚	296˚	SOHO

*cm^{-2} s^{-1}

Radio burst frequency spectrum



Proton Active Region:

AR11402 (N28L211, CMP 21,3.01.2012,
Sp= 630 msh, DKI, BG, R)
XRI=2.89; $X_1^{1.7}$+$M_2^{8.7}$+C_9; 2_2+1_3+C_{20};
PFR1 23.11 $M_1^{8.7}$/2B
PFR2 27.11 $X_1^{1.7}$/2F

References:

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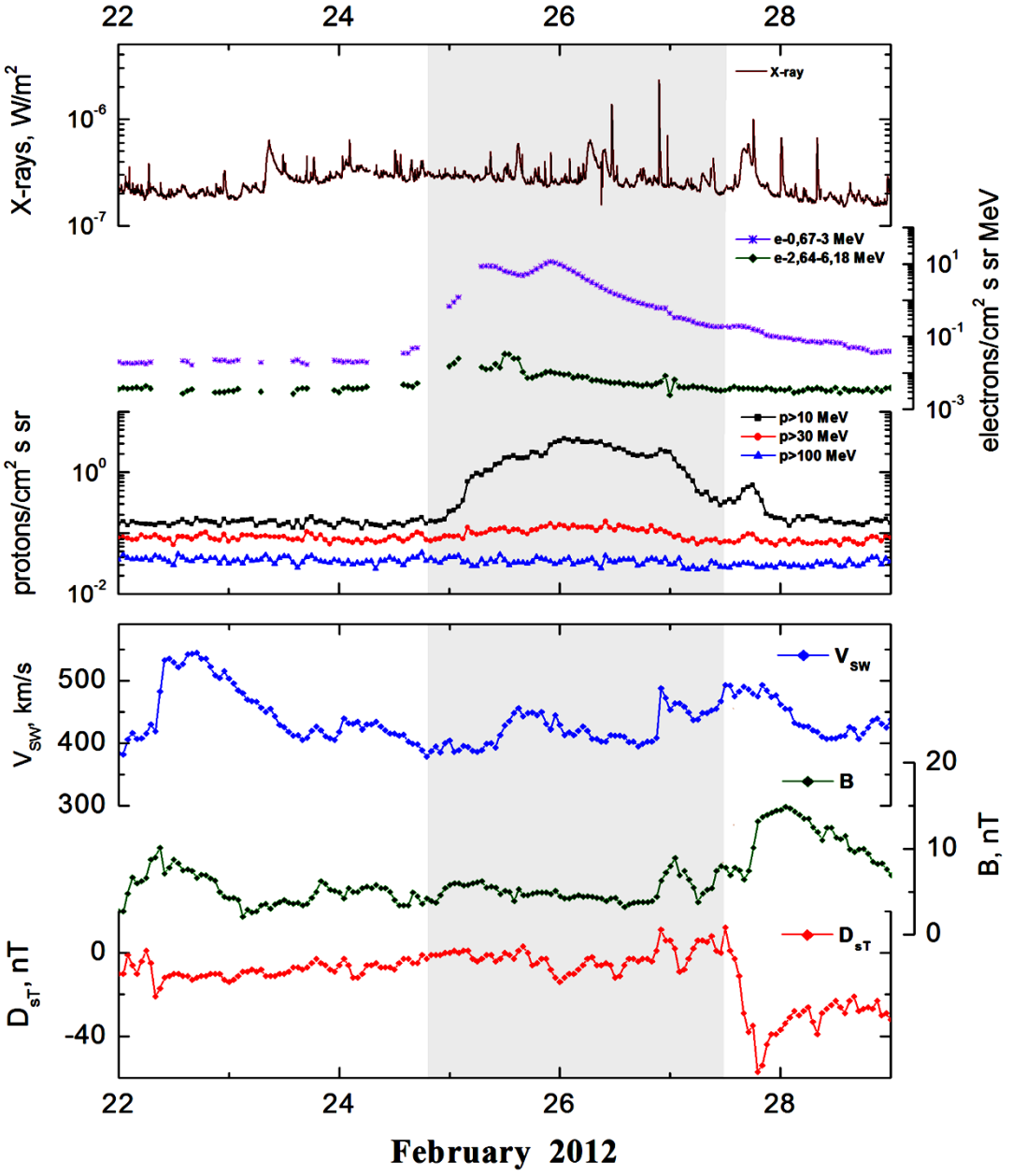
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 24d23^h
Tmax$_1$(Ep>10 MeV) – 26d01^h, Jmax$_1$ (Ep>10 MeV) – 3.5 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 27d00^h, Jmax$_2$ (Ep>10 MeV) – 2.3 /cm^2·s·sr
Duration of the event – 3 days, power-law index: $\gamma_1 = 3.5$, $\gamma_2 = 4.0$
Quasimaximal energy of protons in the event – Eqm$_1$ = 55 MeV
– Eqm$_2$ = 45 MeV

Sources: ⊙ DSF 24d02^{h}25^m, N32E38, 26^o
CME 24d 03^{h}46^m, V = 0800 km/s, Δφ = 189^o, dA = 001 ^{o}
▲SC 26d21^{h}40^m

Particle fluxes and associated phenomena

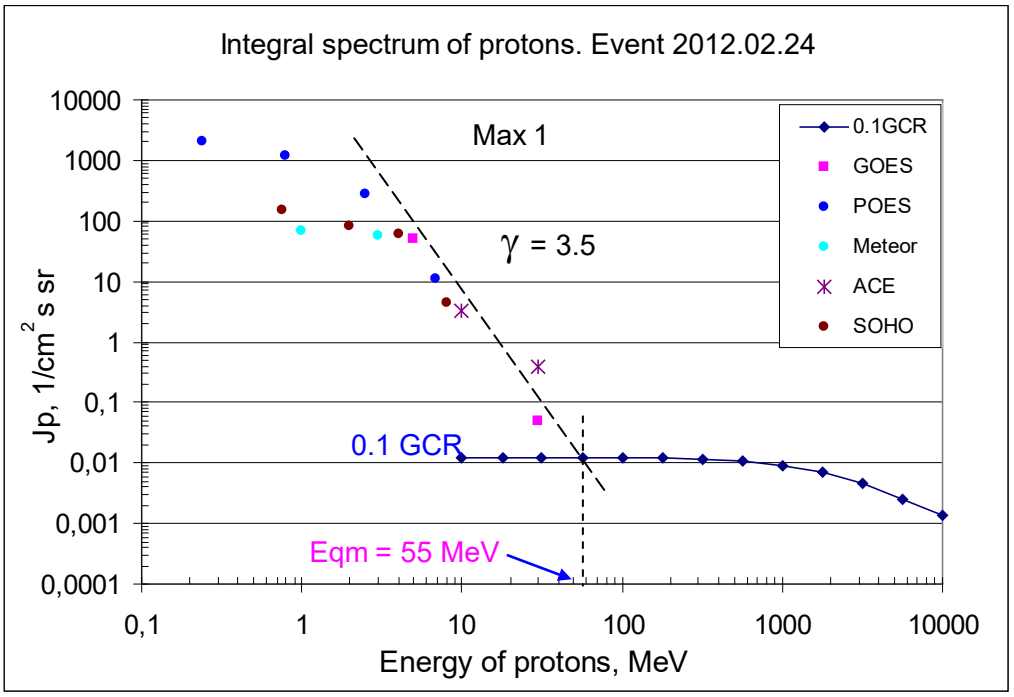


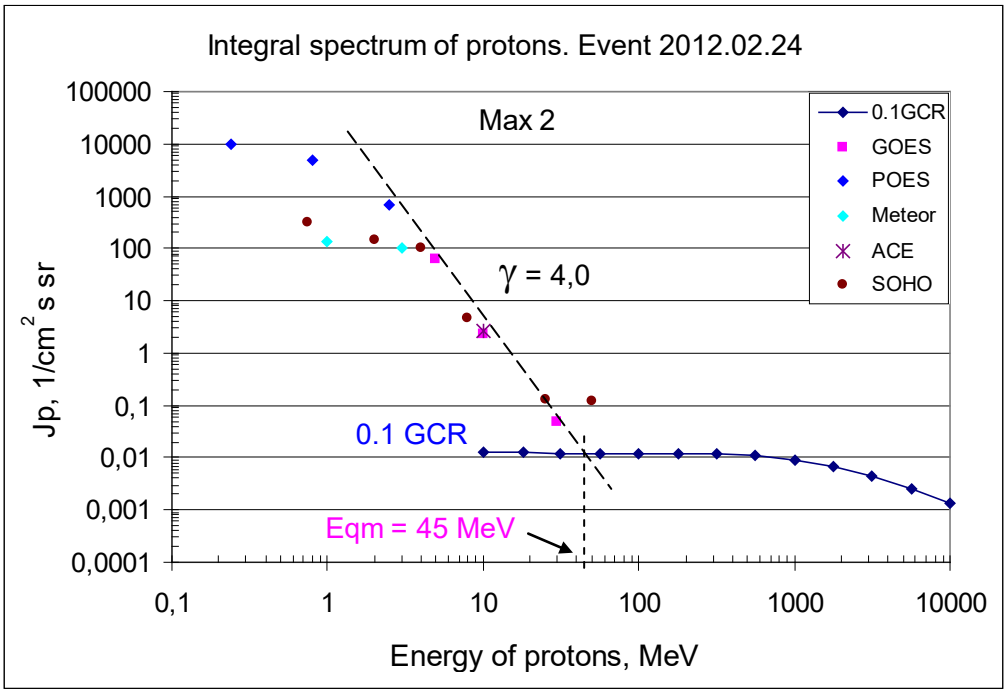
Integral fluxes of protons for the event of 2012 February 24

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	26d01/27d00	50/62	4	0.2	
EPS	>10	23	26d01/26d23	3.5/2.3	3	0.17	
EPS	>30	-	26d01/26d22	0.05/0.05	2	0.1	
EPS	>50	-	-	-	-	0.07	
EPS	>60	-	-	-	-	0.06	
EPS	>100	-	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	22	25d23/27d00	2010/9800	4	110	
MEPED	>0.8	22	25d23/27d00	1190/4790	4	80	
MEPED	>2.5	22	26d01/27d02	273/683	3	60	
MEPED	>6.9	-	26d01/ -	11/ -	-	50	
MEPED	>16	-	-	-	-	0.9	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	1	
MEPED	>140	-	-	-	-	1.2	
Meteor-1							
SCR	>1	18	26d07/27d01	70/132	3	2.8	
SCR	>3	18	26d07/27d00	57/100	3	2.5	
SCR	>10	-	-	-	-	1.6	
GALS-M	>15	-	-	-	-	1.4	
GALS-M	>25	-	-	-	-	1.45	
GALS-M	>600	-	-	-	-	0.03	
ACE							
SIS	>10	23	25d23/26d20	3.3/2.6	3	1.5	
SIS	>30	23	25d23/ -	0.4/ -	3	1.1	
SOHO							
EPHIN	>50	-	- /26d22	- /0.12	0.2	0.3	

Differential fluxes of protons for the event of 2012 February 24

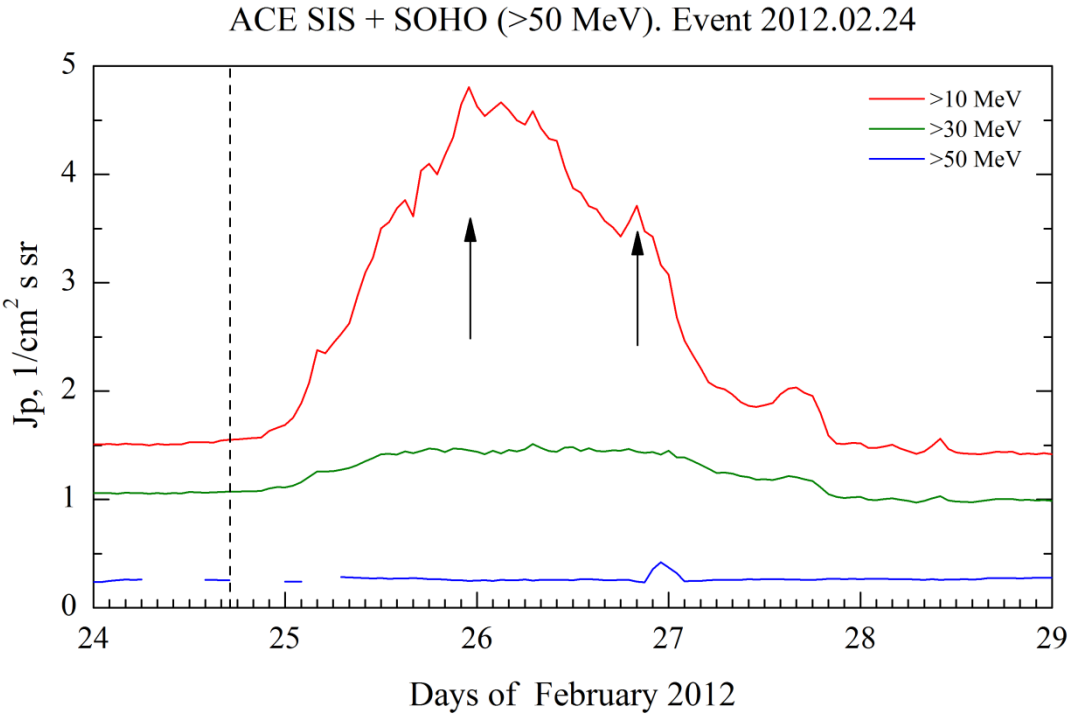
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	-	25d23/26d23	54.6/130	4	0.01	
LION	2 – 6	-	25d23/26d23	8.2/13.3	4	0.0025	
EPHIN	4 – 8	-	25d23/27d00	13.6/25	4	0.0004	
EPHIN	8 – 25	-	25d23/27d00	0.26/0.27	4	0.00003	
EPHIN	25–53	-	- /27d00	- /0.0002	-	0.00002	
Electro-1							
SCR-E	13.7–23	-	-	-	-	0.06	
SCR-E	23–42	-	-	-	-	0.025	
SCR-E	42–112	-	-	-	-	0.005	

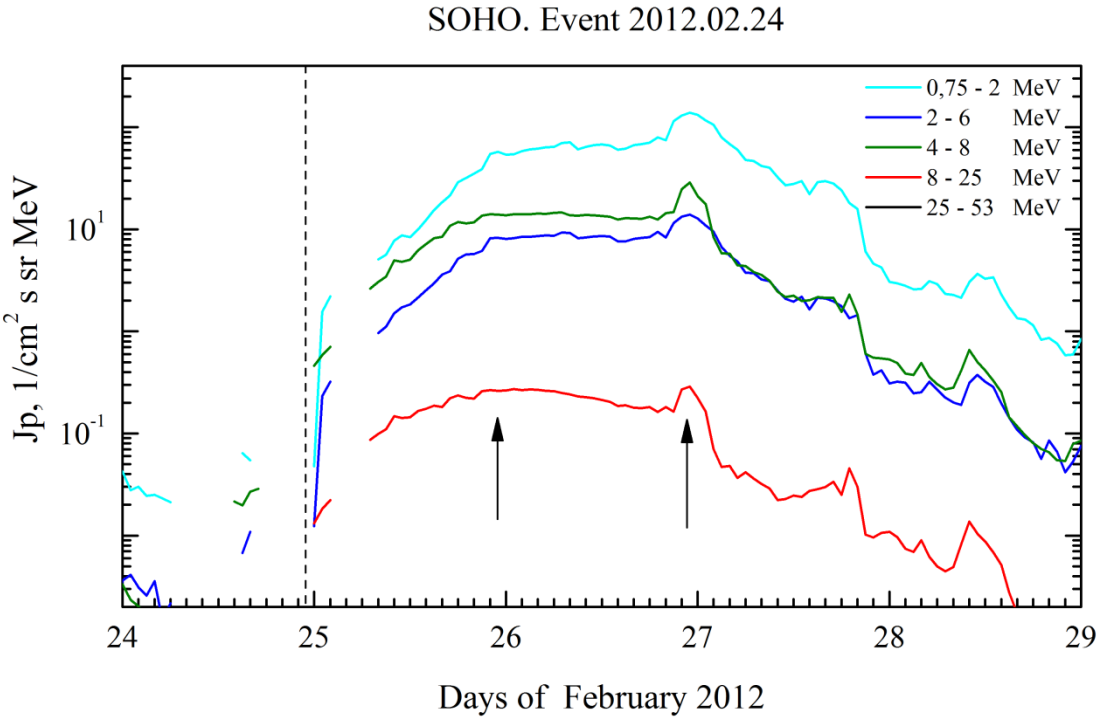

Integral spectrum of protons. Event 2012.02.24
Max 1
γ = 3.5
0.1 GCR
Eqm = 55 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.02.24
Max 2
γ = 4,0
0.1 GCR
Eqm = 45 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

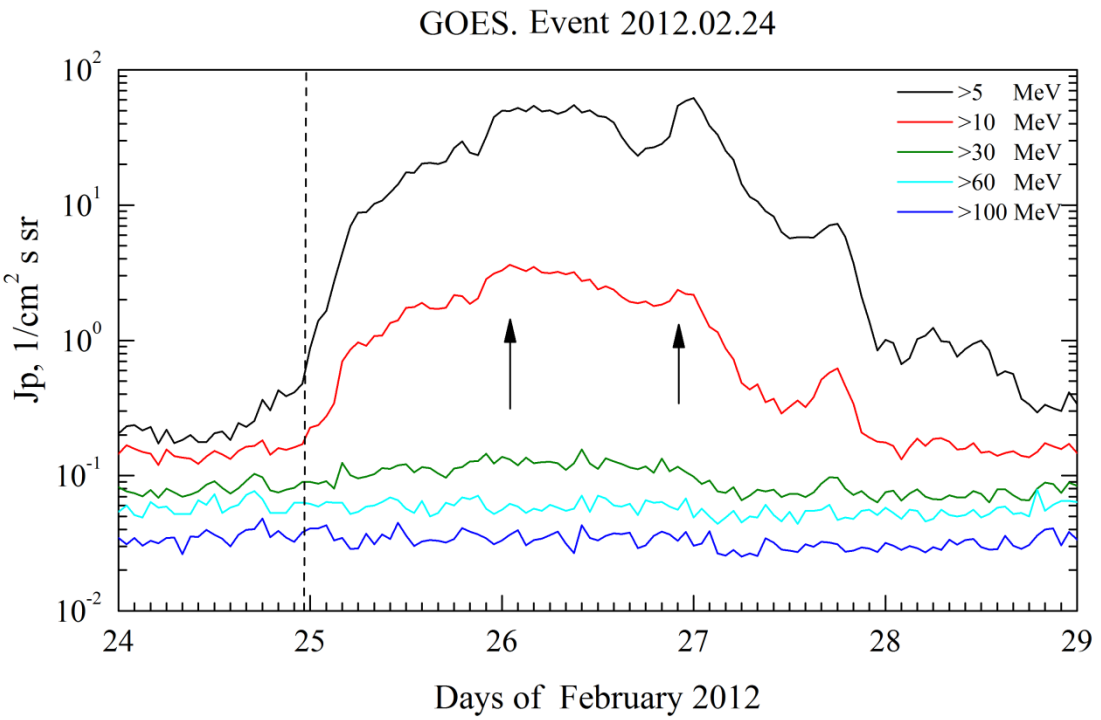
Time profiles of proton fluxes in the event 2012.02.24

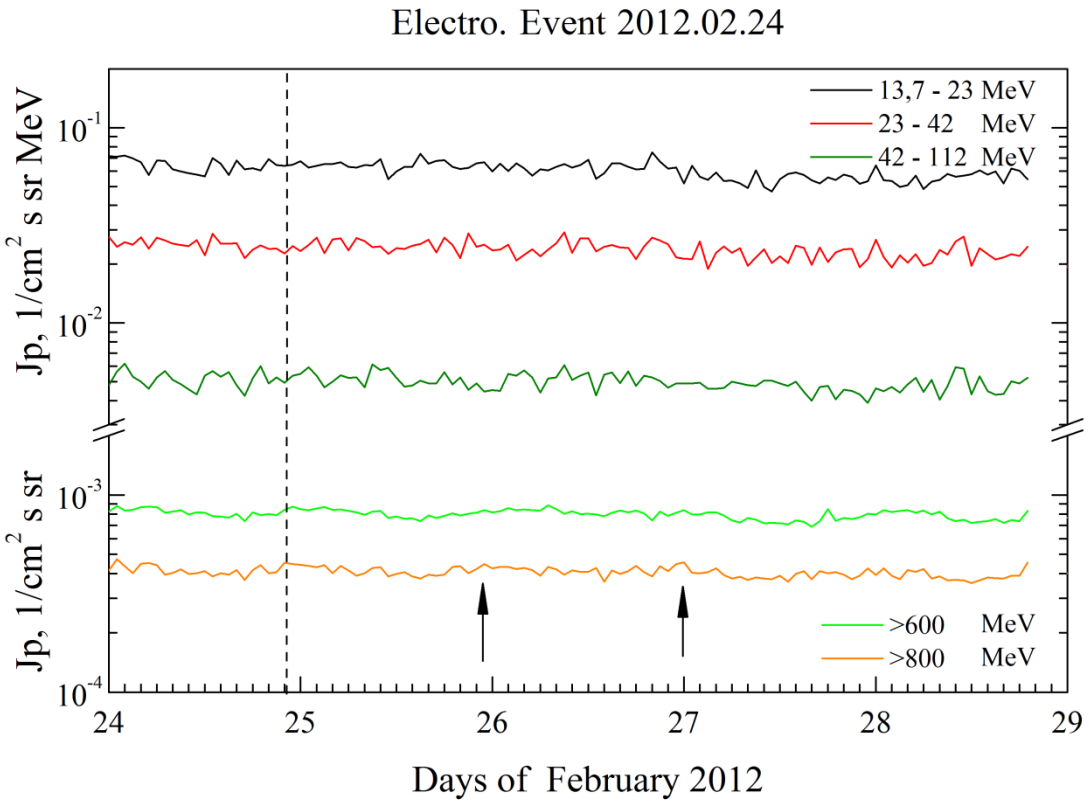
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO





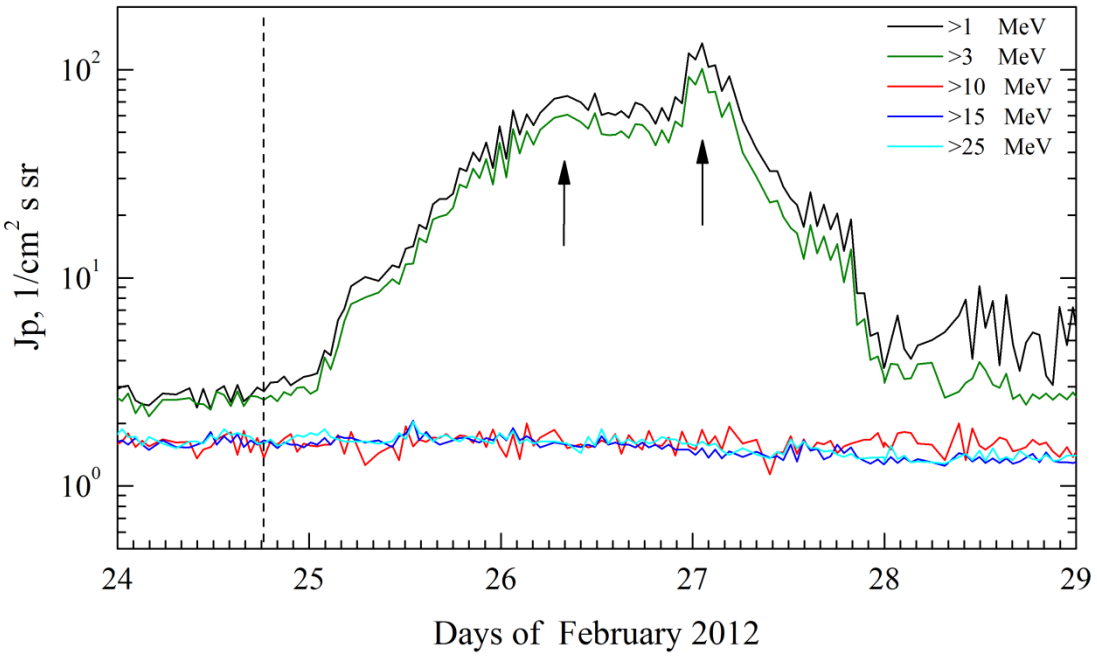
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



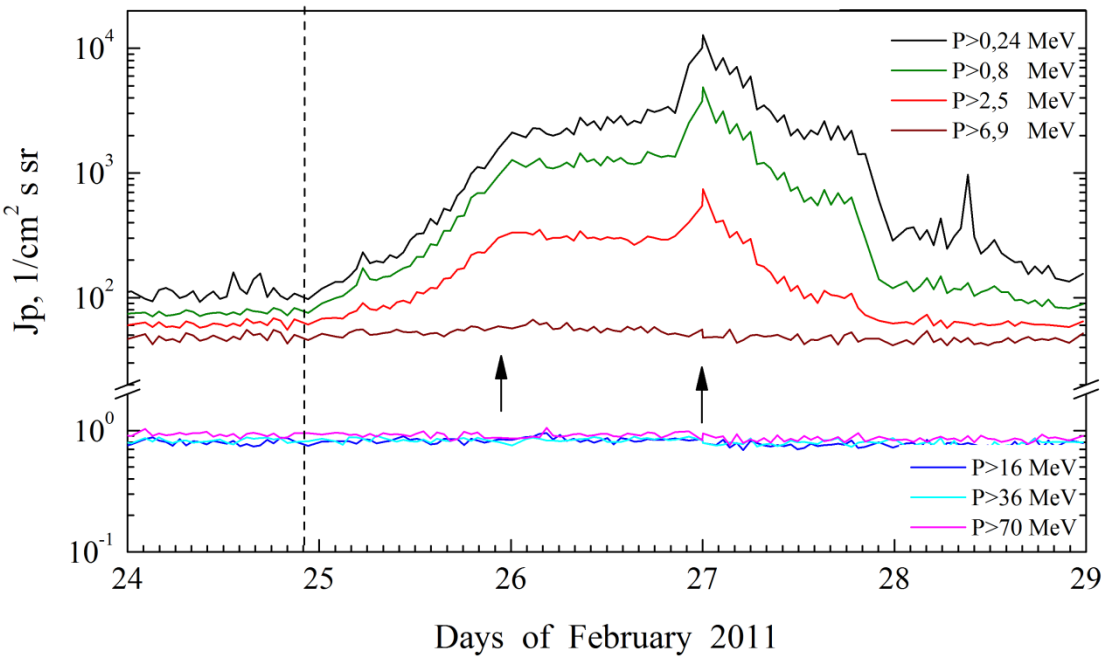


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2012.02.24



POES. Event 2012.02.24



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 February 24

2012 February 24 ⊙ AR To event 506

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	DSF	0225		0348	N32E38	26^o	
1 – 12	keV	No X-ray event at this time ≥ B1					

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0346	800	13.3	189°	1°	SOHO

References:

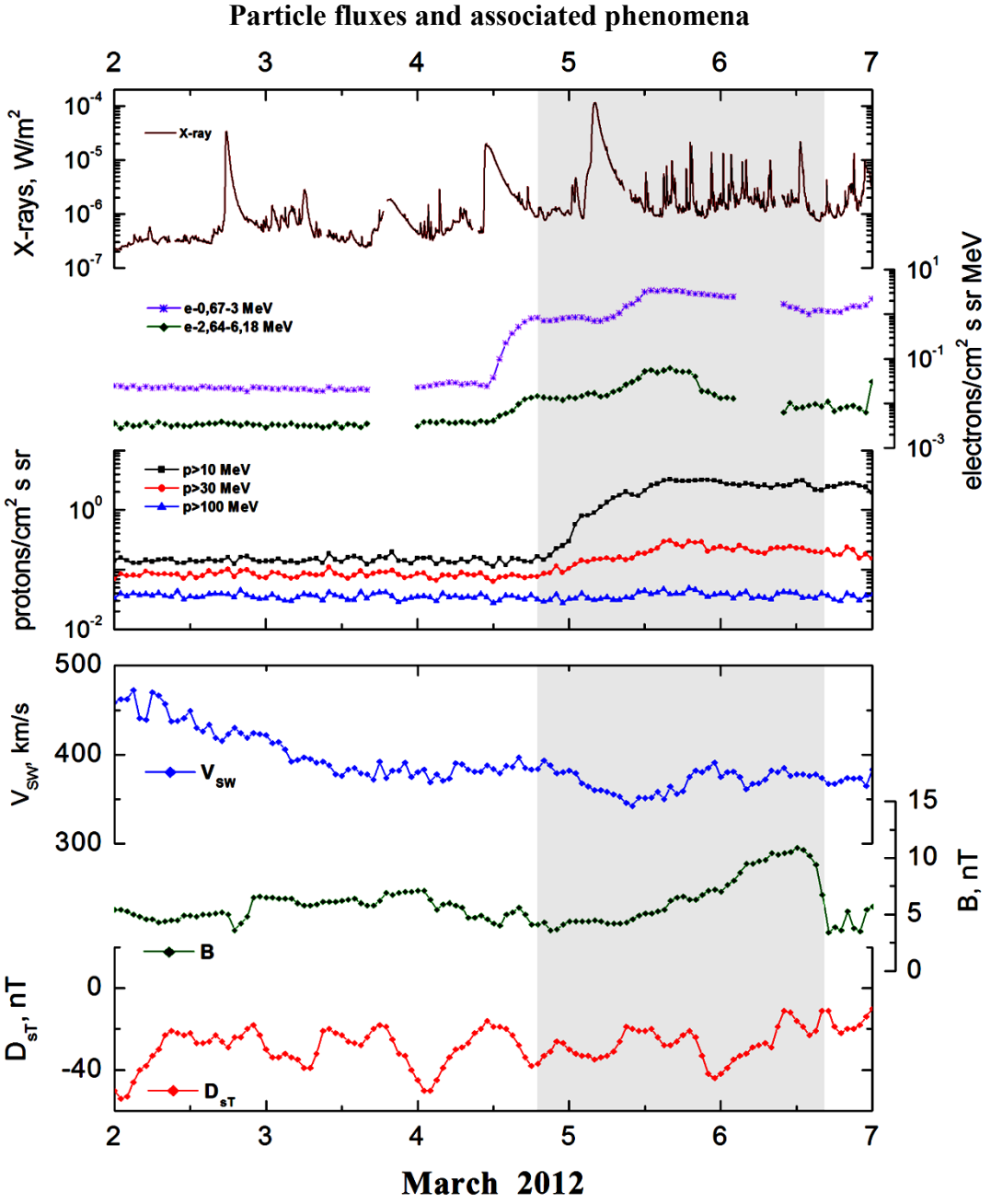
Ameri D., E. Valtonen, 2019.

Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.

Winter L.M., and K. Ledbetter, 2015.

Particle event: To(Ep>10 MeV) – 04d21^h
Tmax (Ep>10 MeV) – 05d16^h, Jmax (Ep>10 MeV) – 3.2 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.25
Quasimaximal energy of protons in the event – Eqm = 90 MeV

Sources: ● solar flare 04d10^{h}29^m, M2.0/1N, N19E61, AR11429
Main burst X-ray 1–8 Å: onset – 04d10^{h}29^m, max – 04d10^{h}52^m, Φ = 0.092 J/m^2
CME: 04d11^{h}00^m, V= 1306 km/s, $\Delta\varphi$ = 360º, dA=052º

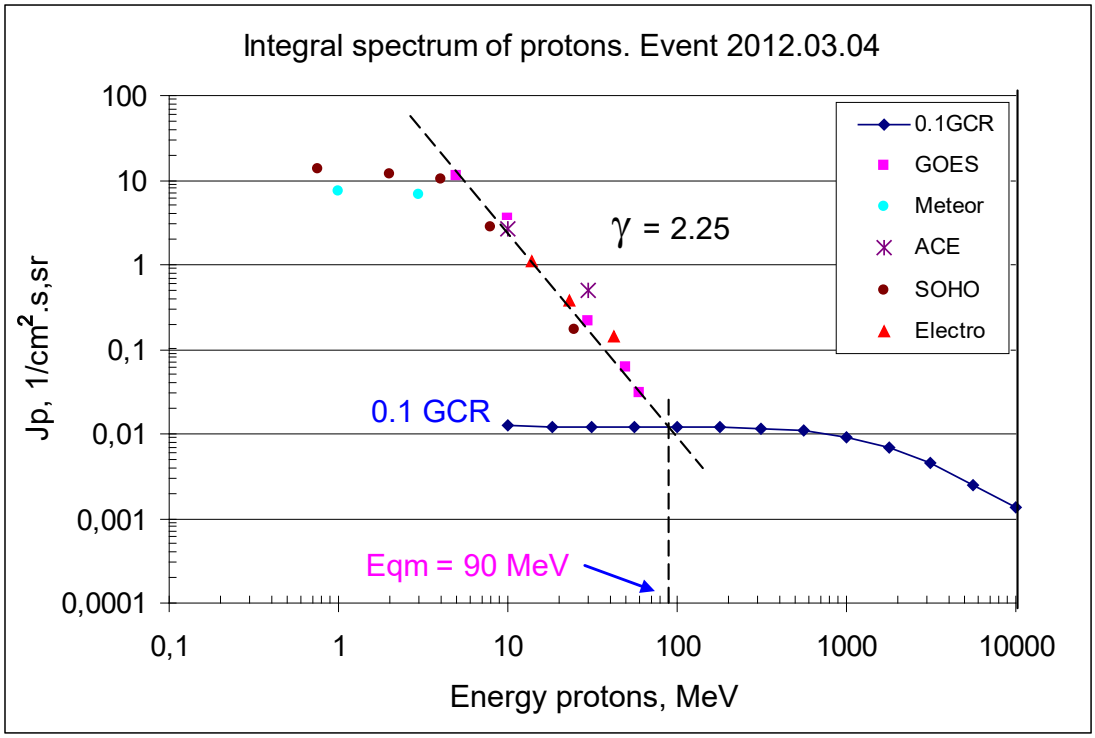


Integral fluxes of protons for the event of 2012 March 04

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	24	5d16	11	2	0.2	
EPS	>10	21	5d16	3,2	2	0.17	
EPS	>30	23	5d16	0,22	2	0.1	
EPS	>50	-	5d15	0,06	2	0.07	
EPS	>60	-	5d1	0,03	2	0.06	
EPS	>100	-	-	-	-	0.04	
Meteor-1							
SCR	>1	20	05d18	7.3	2	2.55	
SCR	>3	20	05d18	6.7	2	2.55	
SCR	>10	-	-	-	-	1.6	
GALS-M	>15	-	-	-	-	1.4	
GALS-M	>25	-	-	-	-	1.4	
GALS-M	>600	-	-	-	-	0.03	
ACE							
SIS	>10	23	5d13	3	2	1.5	
SIS	>30	23	5d13	0.5	2	1	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

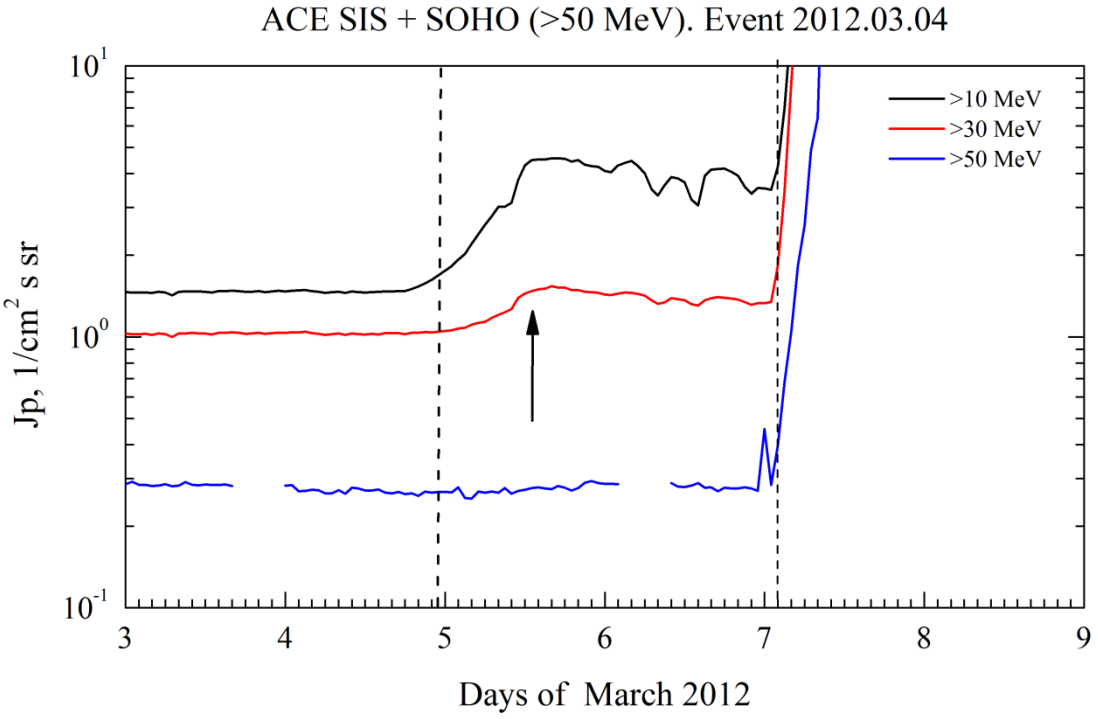
Differential fluxes of protons for the event of 2012 March 04

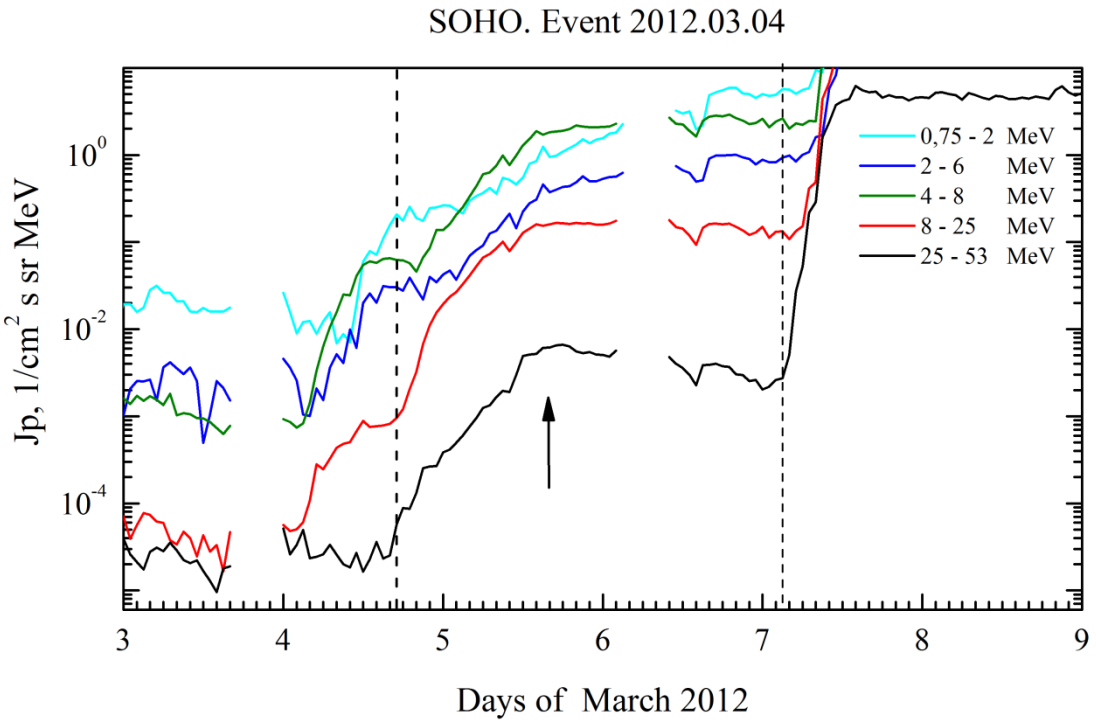
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	11	5d15	1.23	3	0.017	
LION	2 – 6	11	5d15	0.46	3	0.0025	
EPHIN	4 – 8	05	5d16	1.89	3	0.001	
EPHIN	8 – 25	05	5d16	0.155	3	0.00003	
EPHIN	25 – 53	17	5d16	0.006	3	0.00003	
Electro-1							
SCR-E	13.7–23	21	5d18	0.08	1	0.06	
SCR-E	23–42	-	5d18	0.012	1	0.025	
SCR-E	42–112	-	5d18	0.002	0.5	0.005	


Integral spectrum of protons. Event 2012.03.04
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2.s,sr
γ = 2.25
0.1 GCR
Eqm = 90 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
0,1
1
10
100
1000
10000
Energy protons, MeV

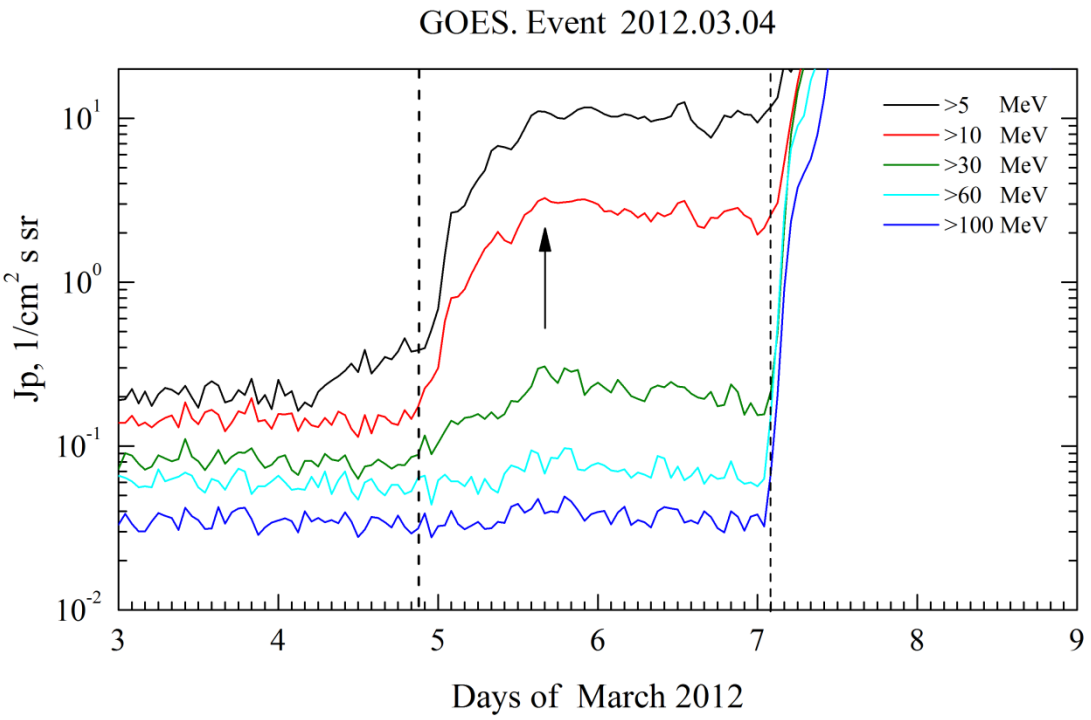
Time profiles of proton fluxes in the event 2012.03.04

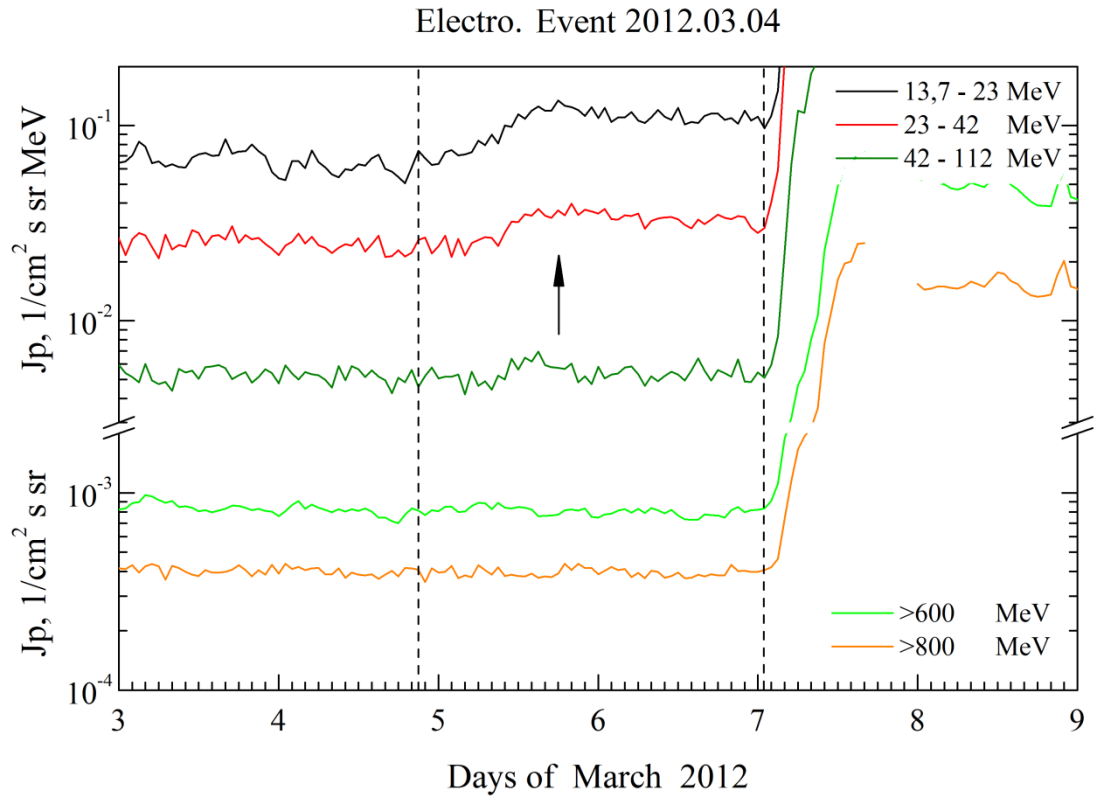
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



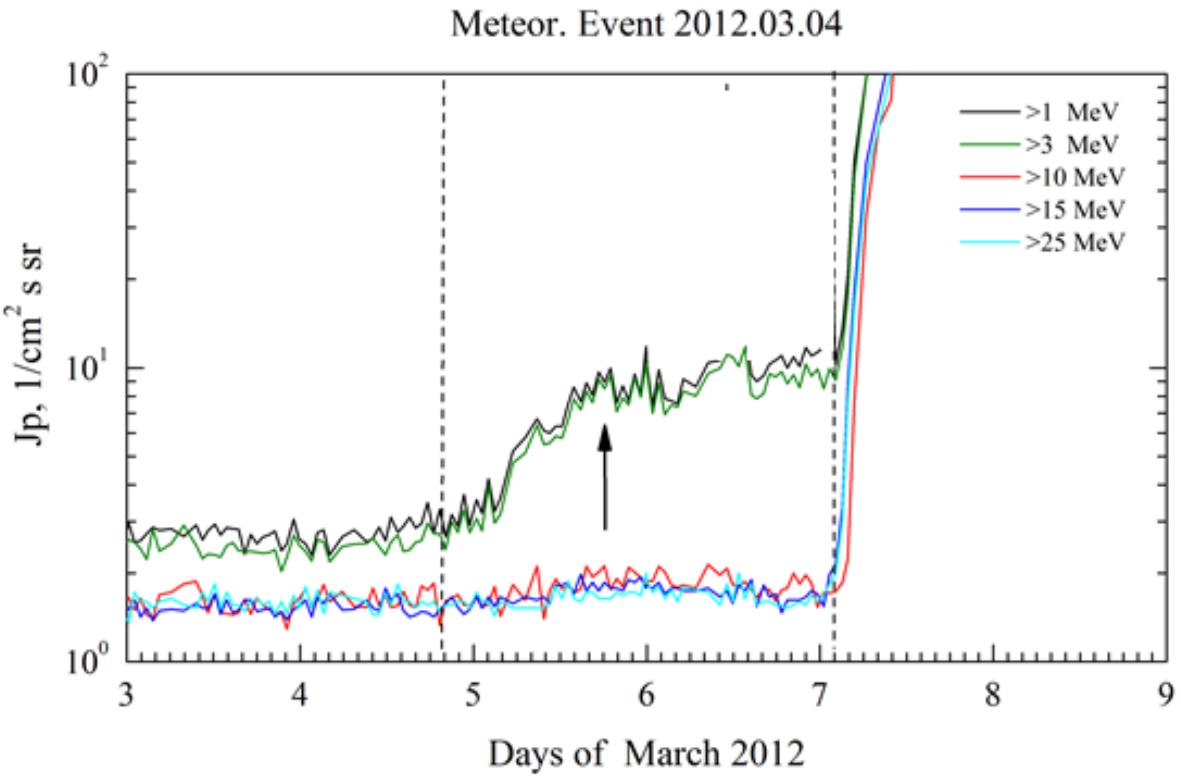


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 March 04

2012 March 04 ● AR 11429 To event 507

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	1032	1110	1324	N19E61	1N	ERU
1 – 12	keV	1029	1052	1216	N16E65	M2.0	0.092

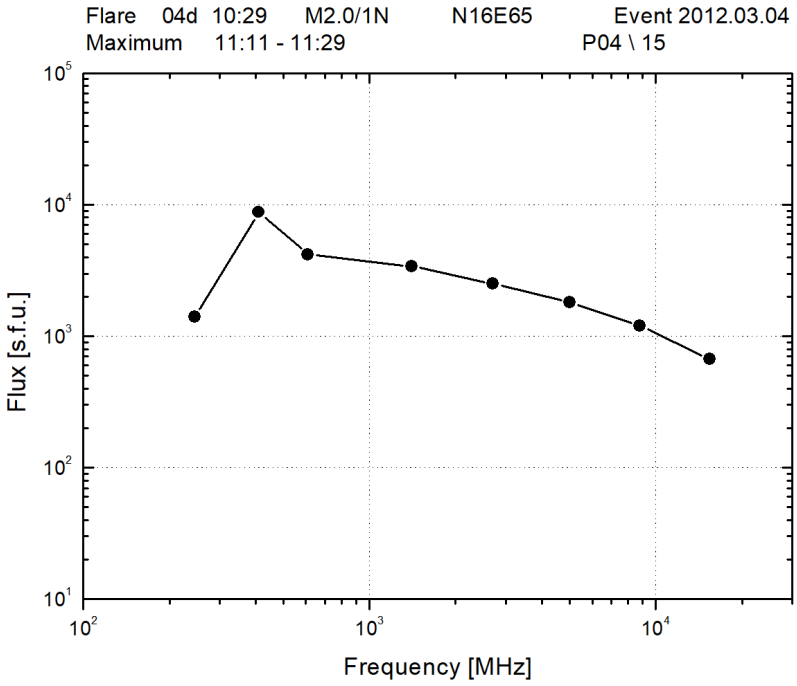
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25 – 50	keV	1024:36	1034:18	1034:24	2032	1235760	HESSI
100-300	keV	1103:32	1104:06	1106:52	20464	18825600	HESSI
100-300	keV	1106:52	1107:30	1110:44	20464	21729824	HESSI
100-300	keV	1110:44	1118:38	11:20:44	20629	56560792	HESSI
12-25	keV	1031:59	1042:31	1124:01	194292	158384560	FERMI
12-25	keV	1200:24	1211:07	1225:27	5167	1681211	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	11039	1112	1205		2.83	
8.8	GHz	1037	1111	1218		3.08	
5	GHz	1036	1111	1229		3.26	
2.7	GHz	1035	1111	1236		3.4	
1.4	GHz	1035	1116	1225		3.53	
610	MHz	1125	1129	1205		3.62	
410	MHz	1035	1119	1206	P0.4 \ 15	3.94	
245	MHz	1038	1119	1204		3.15	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS IV	25-180	1040		1728		3	

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1100	1306	28.3	360˚	52˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11429 (N18L301,CMP 09,1.03.2012,
Sp=1270 мдп, EKC, BGD, R)
XRI=11.92 $X_2^{5.4}$+$M_{14}^{8.4}$+C_{32} 3_1+2_1+1_7+S_{51}
PFR1 5-7.03 (46^h) $X_2^{5.4}$+M_{10}
PFR2 9-10.03 (38^h) $M_2^{8.4}$

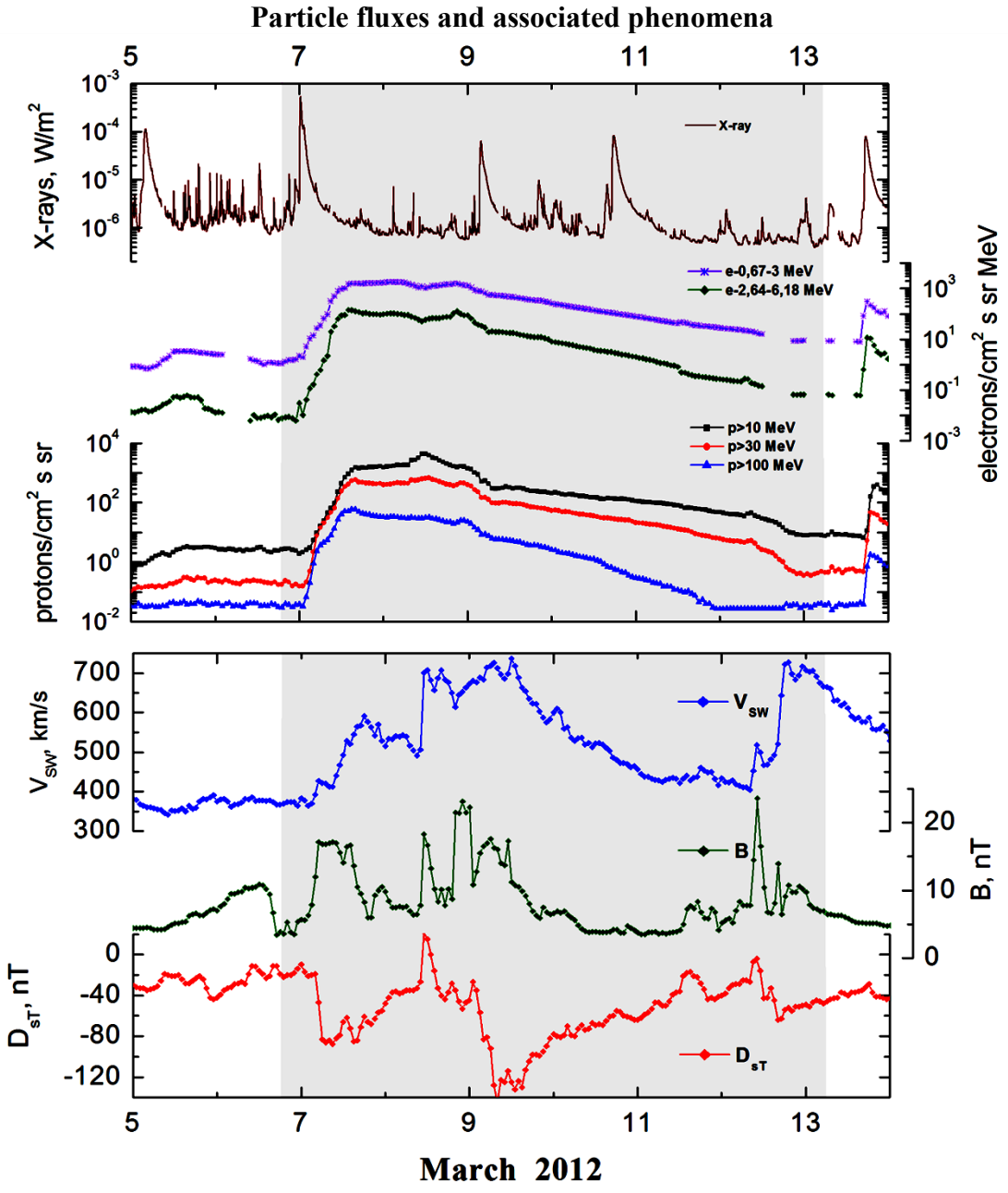
References:

Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Tsvetkov Ts., R. Miteva, N. Petrova, 2018.
Winter L.M. and K.Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou, L. Ding, 2021.

Event 2012.03.07 – (2012-067) **508**

Particle event: To(Ep>10 MeV) – 07d02^h
Tmax$_1$(Ep>10 MeV) – 07d17^h, Jmax$_1$ (Ep>10 MeV) – 1440 /cm^2·s·sr
Tmax2(Ep>10 MeV) – 08d13^h, Jmax$_2$ (Ep>10 MeV) – 4340 /cm^2·s·sr
Duration of the event – 6 days, power-law index: $\gamma_1 = 2.9$, $\gamma_2 = 4.0$
Quasimaximal energy of protons in the event – Eqm$_1$ = 1200 MeV
– Eqm$_2$ = 650 MeV

Sources: ● solar flare 07d00^{h}00^m, X5.4/3B, N17E27, AR11429
Ø solar flare 07d01^{h}05^m, X1.3/SF, N22E12, AR11430
Ø solar flare 09d03^{h}22^m, M6.3/SF, N15W03, AR11429
Ø solar flare 10d17^{h}15^m, M8.4/..., N17W24, AR11429
Main burst X-ray 1–8 Å: onset – 07d00^{h}02^m, max – 07d00^{h}24^m, Φ = 0.67 J/m^2
CME: 07d00^{h}24^m, V= 2684 km/s, Δφ = 360º, dA= 057º
▲SC 07d04^{h}20^m; ▲SC 12d09^{h}15^m

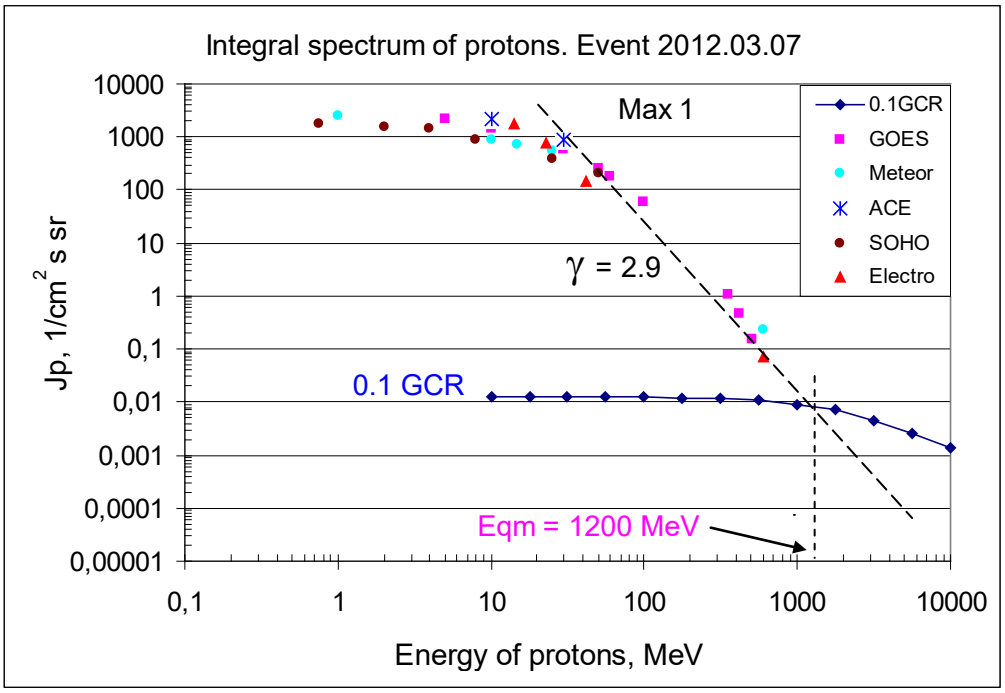


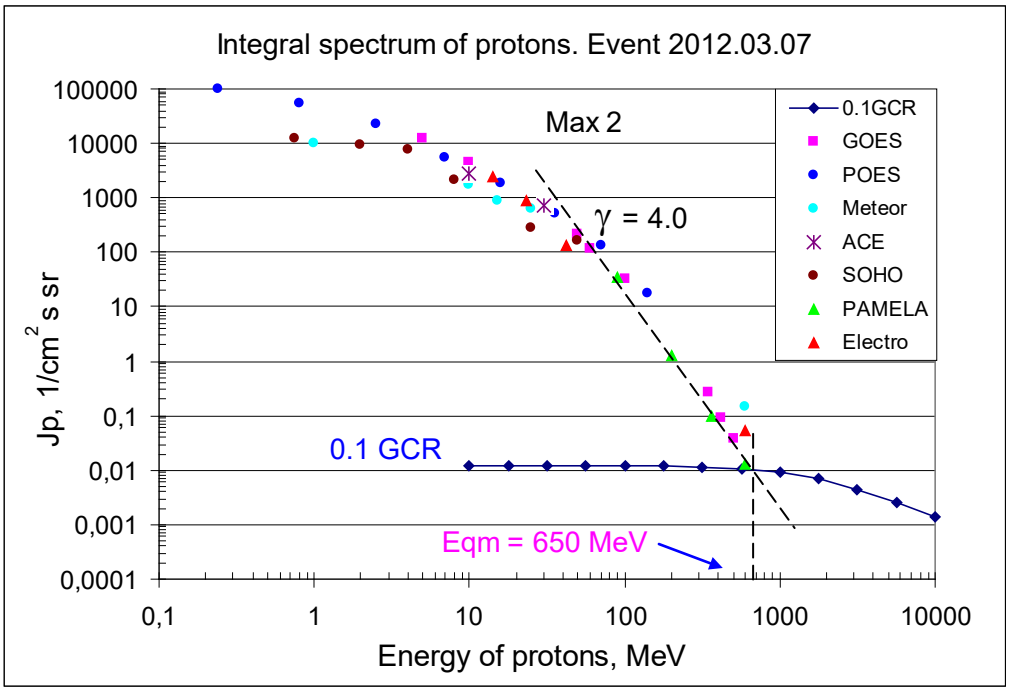
Integral fluxes of protons for the event of 2012 March 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	2	17/08d13	2170/12000	7	0.2	
EPS	>10	2	17/08d13	1440/4340	6	0.17	
EPS	>30	2	16/08d13	580/670	6	0.1	
EPS	>50	2	16/08d13	255/208	6	0.07	
EPS	>60	2	16/08d13	180/115	6	0.06	
EPS	>100	2	16/08d13	58.5/32.5	6	0.04	
Electro-1							
GALS-E	>600	1	16/8d13	0.073/0.055	6	0.0008	
POES							
MEPED	>0.24	-	- / 8d13	- /99800	5	110	
MEPED	>0.8	-	- / 8d13	- /55100	5	80	
MEPED	>2.5	-	- / 8d13	- /23200	5	60	
MEPED	>6.9	-	- / 8d13	- /5500	5	50	
MEPED	>16	-	- / 8d13	- /1860	5	0.9	
MEPED	>36	-	- / 8d13	- /530	5	0.9	
MEPED	>70	-	- / 8d13	- /138	5	1	
MEPED	>140	-	- / 8d13	- /17.4	4	1.2	
Meteor-1							
SCR	>1	2	17/08d12	2500/10200	7	2.7	
SCR1	>3	2	17/08d12	-	7	2.4	
SCR1	>10	2	17/08d12	880/1730	6	1.6	
GALS-M	>15	2	17/08d12	708/890	6	1.4	
GALS-M	>25	2	17/08d12	530/620	6	1.4	
GALS-M	>600	2	17/08d12	0.23/0.15	2.5	0.03	
ACE							
SIS	>10	2	14/08d12	2210/2760	6	4	
SIS	>30	2	14/08d11	890/710	6	1.4	
SOHO							
EPHIN	>50	2	14/08d12	211/163	5	0.3	
PAMELA							
TRACKER	>90	4	- /8d08-9d01	- /34	7		
TRACKER	>200	4	- /8d08-9d01	- /1.3	5		
TRACKER	>360	4	- /8d08-9d01	- /0.095	4		
TRACKER	>600	4	- /8d08-9d01	- /0.013	4		

Differential fluxes of protons for the event of 2012 March 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	8	15/08d12	151/2120	5	0.017	
LION	2 – 6	8	15/08d12	56.5/593	5	0.0025	
EPHIN	4 – 8	9	14/08d12	134/1430	5	0.001	
EPHIN	8 – 25	8	14/08d12	29.5/112	5	0.00003	
EPHIN	25 – 53	5	14/08d12	6.27/4.73	5	0.00003	
Electro-1							
SCR-E	13.7-23	1	16/8d13	103/160	6	0.11	
SCR-E	23-42	1	16/8d13	34/40	6	0.03	
SCR-E	42-112	1	16/8d13	2.1/1.9	6	0.005	
GOES							
EPS	350-420	3	15/8d22	0.0084/0.0026	0.5	0.0016	
EPS	420-510	3	16/8d22	0.0033/0.0006	-	0.001	
EPS	510-700	3	15/8d22	0.0008/0.0002	2	0.00043	
EPS	>700	-	-	-	-	0.00013	

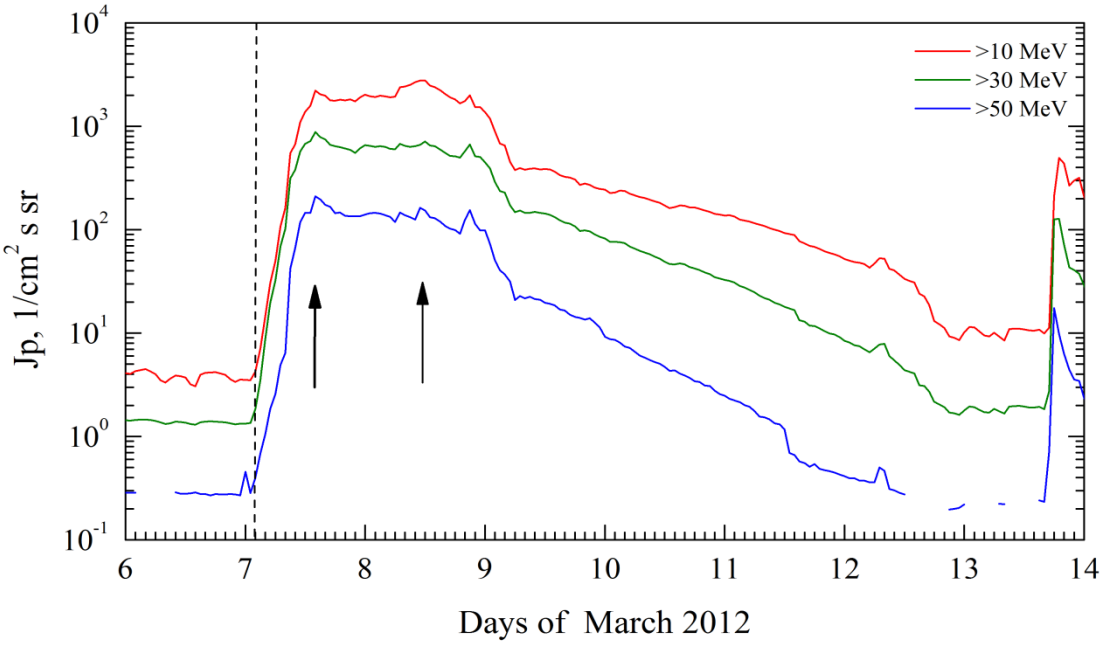

Integral spectrum of protons. Event 2012.03.07
Max 1
γ = 2.9
0.1 GCR
Eqm = 1200 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,00001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.03.07
Max 2
γ = 4.0
0.1 GCR
Eqm = 650 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
PAMELA
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

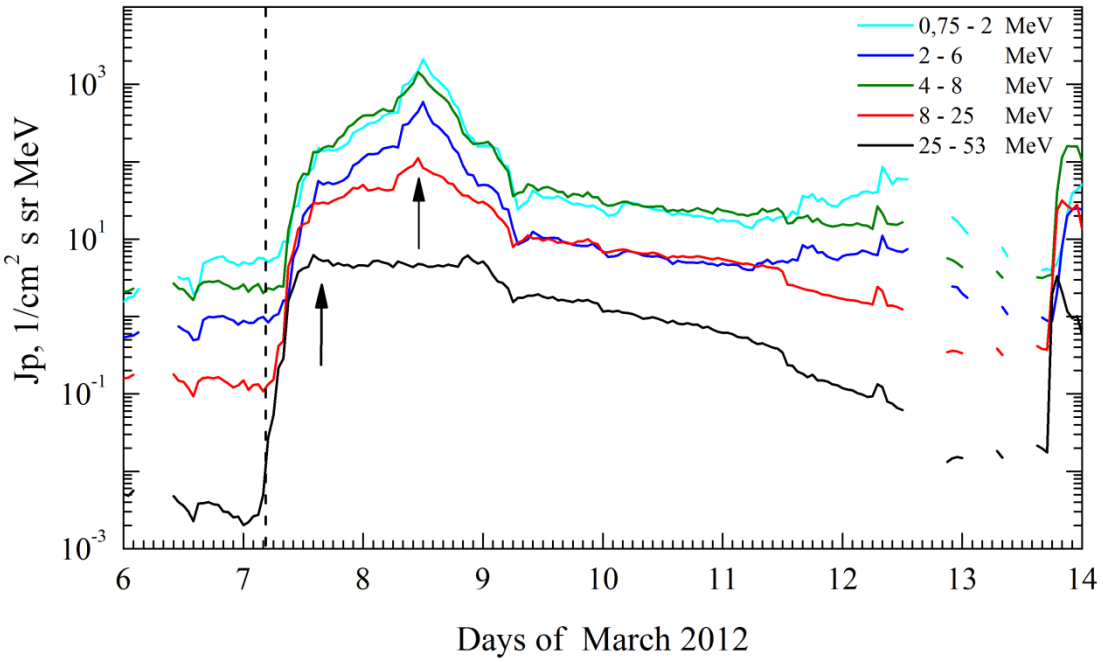
Time profiles of proton fluxes in the event 2012.03.07

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

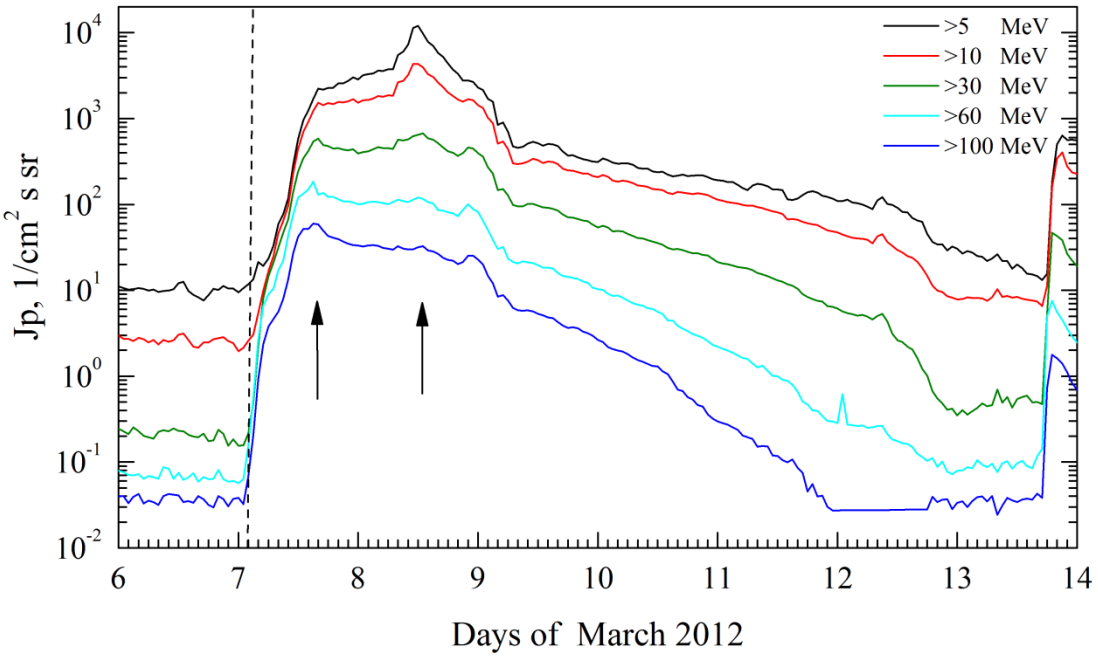
ACE SIS + SOHO (>50 MeV). Event 2012.03.07



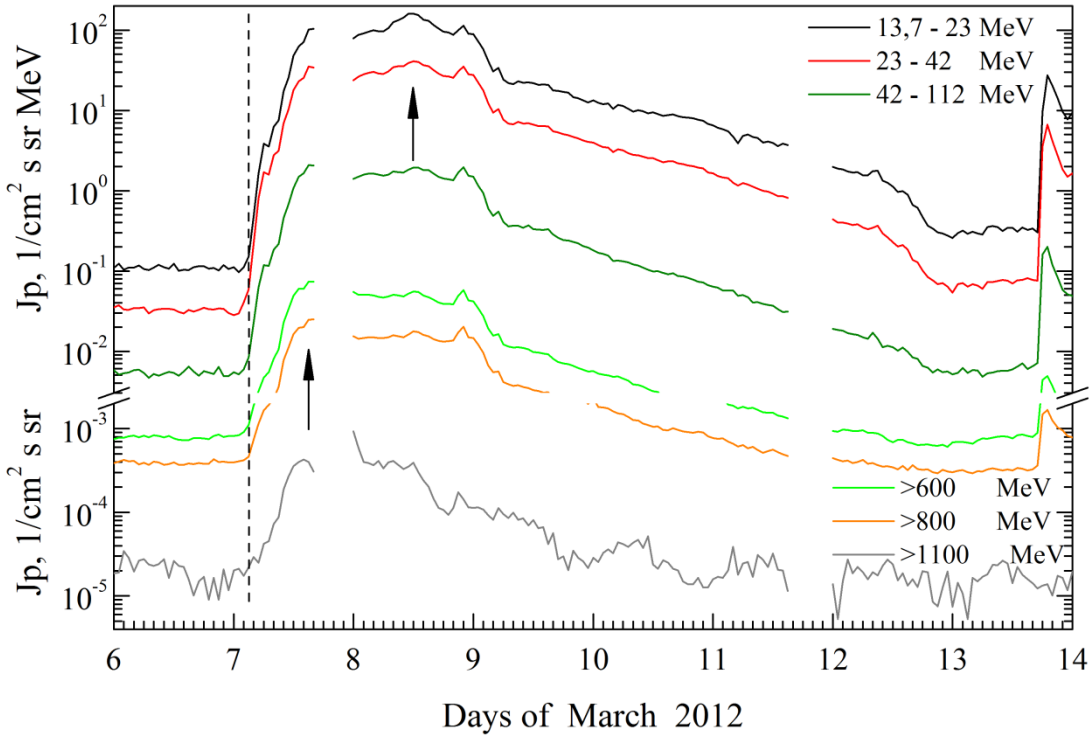
SOHO. Event 2012.03.07



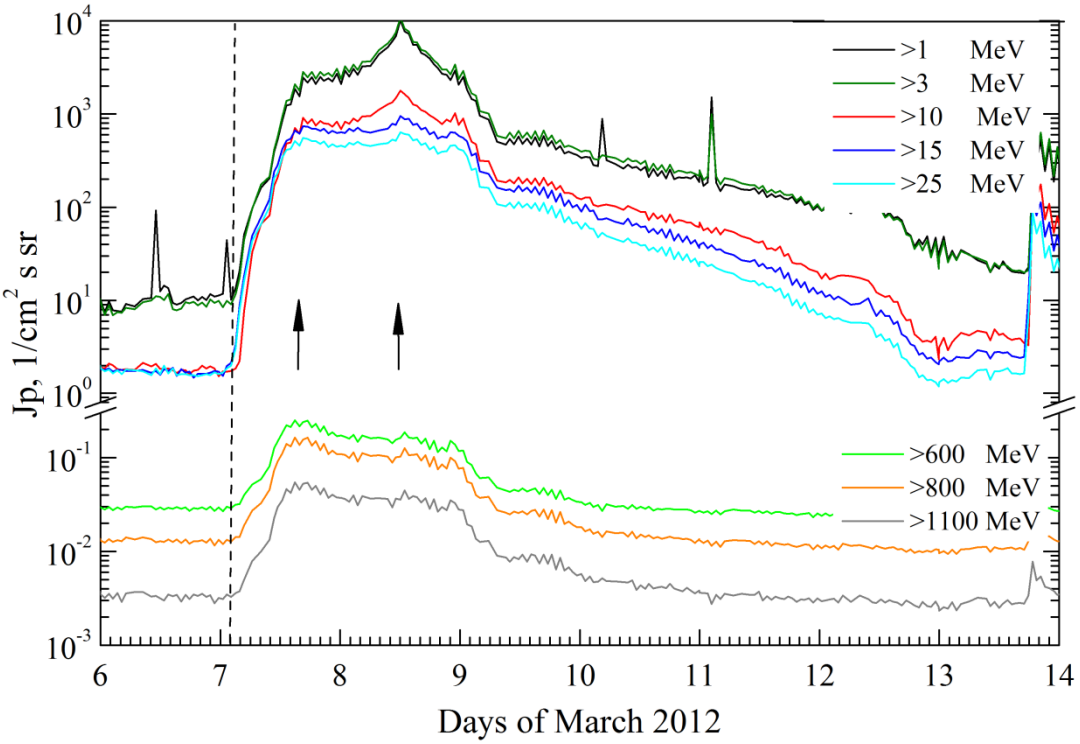
GOES. Event 2012.03.07



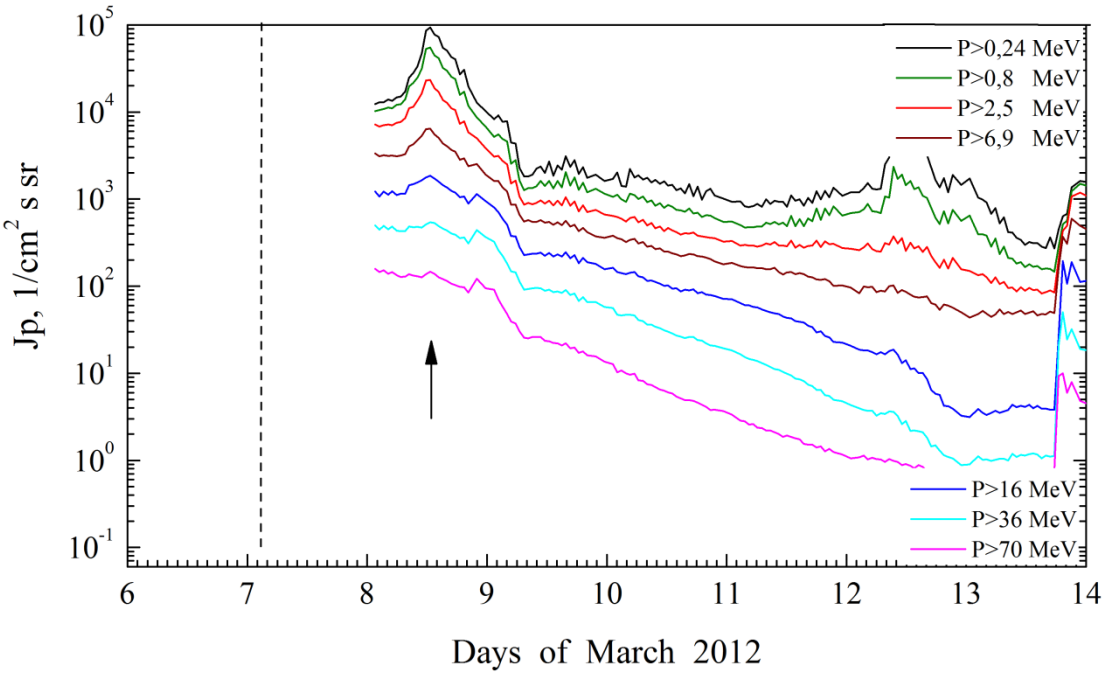
Electro. Event 2012.03.07



Meteor. Event 2012.03.07



POES. Event 2012.03.07



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 March 07

2012 March 07 • AR 11429 To event 508

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL*	<0000	0017	0349	N17E27	3B	PRB
1 – 12	keV	0002	0024	0040	N18E31	X5.4	0.67
1 – 12	keV	0105	0114	0123	N15E26	X1.3	1.5E-01

X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12-25	keV	0030:40	0039:29	0128:24	942049	1449281024	FERMI
12-25	keV	0206:11	0206:36	0305:31	15270	11328235	FERMI
12-25	keV	0341:46	0438:25	0441:05	13144	1302889	FERMI
>1000	keV	0226:30		0245:30		6.67E-04	INTEGRAL
>1000	keV	0351:30		0432:30		9.14E-04	INTEGRAL

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
8.8	GHz	0006	0021	0222	9 \ 1.4	4.3	
5	GHz	0006	0114	0227		4.11	
2.7	GHz	0007	0117	0210		3.86	
1.4	GHz	0012	0129	0209		3.72	
610	MHz	0014	0112	0207		5.63	
410	MHz	0015	0113	0204	P 0.4	5.97	
245	MHz	0015	0126	0203		5.51	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	025-180	0017		0031		2	
DS IV	025-075	0017		1030		2	
DS V	025-180	0017		0019		2	
DS II	025-180	0109		0129		2	
DS IV	025-075	0017		1030		2	
DS V	025-180	0017		0019		2	
DH II	1.9-16	0100		08d1900			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0024	2684	-88.2	360˚	057˚	SOHO
LASCO	WL	0130	1825	-160.9	360˚	082˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_120306_165417_33724/www/

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m2
6563 Å		No optical flare on visible disk					
1 – 12	keV	0322	0353	0418	N15W03	M6.3*	0.13
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	0334:52	0344:50	0418:40	5616	34474328	HESSI
25-50	keV	0418:40	0420:50	0424:36	944	1312320	HESSI
100-300	keV	0424:36	0427:54	0437:12	848	2338460	HESSI
12-25	keV	0327:57	0338:48	0427:33	1276491	835321472	FERMI
>100	keV	0400		1000			FERMI**
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	**lg F,** sfu	
610	MHz	0342	0440	0538		3.62	
410	MHz	0342	0423	0529		3.57	
245	MHz	0343	0423	0541		3.79	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**VII,** km/s	**Importance**	**Sp/c**
DS II	025-180	0343		0345		2	
DS III	025-180	0341		0428		1	
DS V	056-180	0343		0345		2	
DH II	1-14	0410		9d0605			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0426	1032	-13.5	360˚	029˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_120308_202250_7222/www/

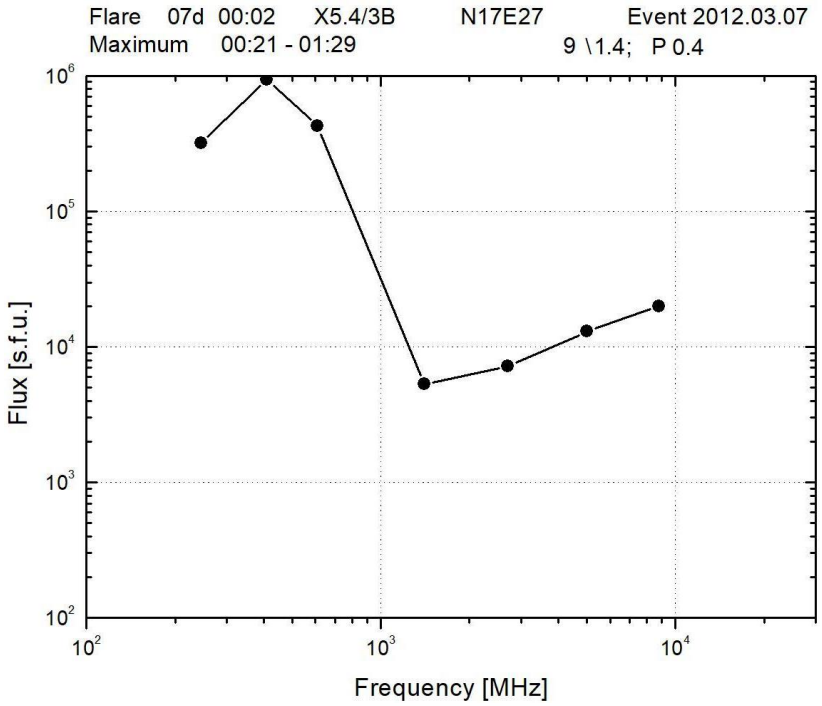
** The first Fermi-LAT solar flare catalog [Ajello et al., 2021]

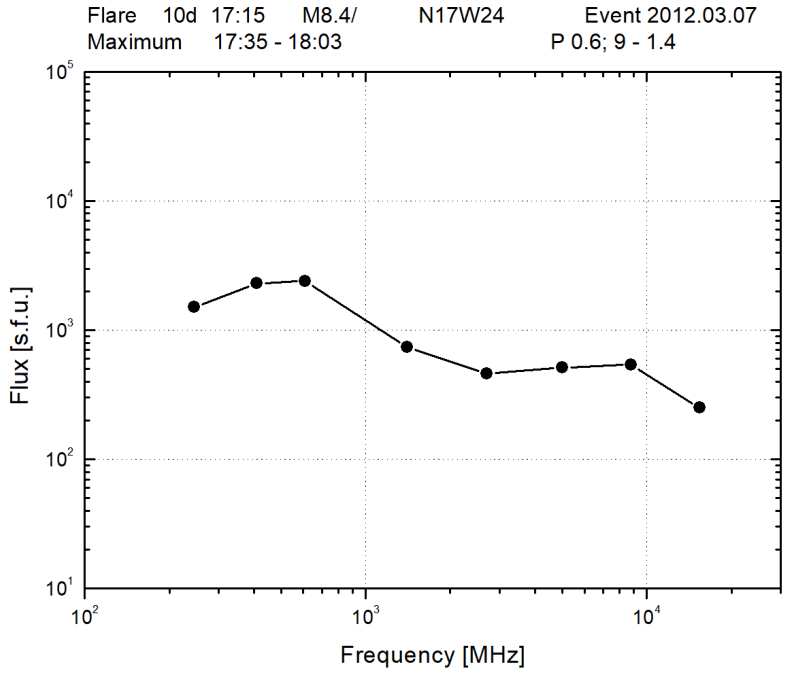
Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical flare on visible disk					
1 – 12	keV	1715	1744	1830	N17W24	M8.4*	0.26
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	1713:00	1715:34	1716:00	28	19833	HESSI
25-50	keV	1750:28	1753:06	1819:20	6102	26697758	HESSI
12-25	keV	1840:28	1840:38	1852:08	496	1205369	HESSI
12-25	keV	1741:02	1742:37	1811:49	653988	480259936	FERMI
12-25	keV	1833:38	1833:46	1840:48	39902	3023805	FERMI
100-300	keV						FERMI**
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1722	1735	1828		2.4	
8.8	GHz	1721	1735	1828	9 – 1.4	2.73	
5	GHz	1721	1735	1828		2.71	
2.7	GHz	1722	1802	1822		2.66	
1.4	GHz	1730	1803	1820		2.87	
610	MHz	1731	1736	1828	P0.6	3.38	
410	MHz	1731	1755	1828		3.36	
245	MHz	1732	1758	1828		3.18	
15.4	MHz	1855	1859	1859		2.2	
1.4	MHz	1842	1842	1843		2.0	
610	MHz	1834	1842	1847		2.6	
410	MHz	1834	1839	1905	P0.4\ 1.4	3.40	
245	MHz	1834	1842	1906		3.0	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS III	025-180	1910		1910		1	
DH II	0.03-14	1755		11d1230			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1800	1296	-10.9	360˚	005˚	SOHO

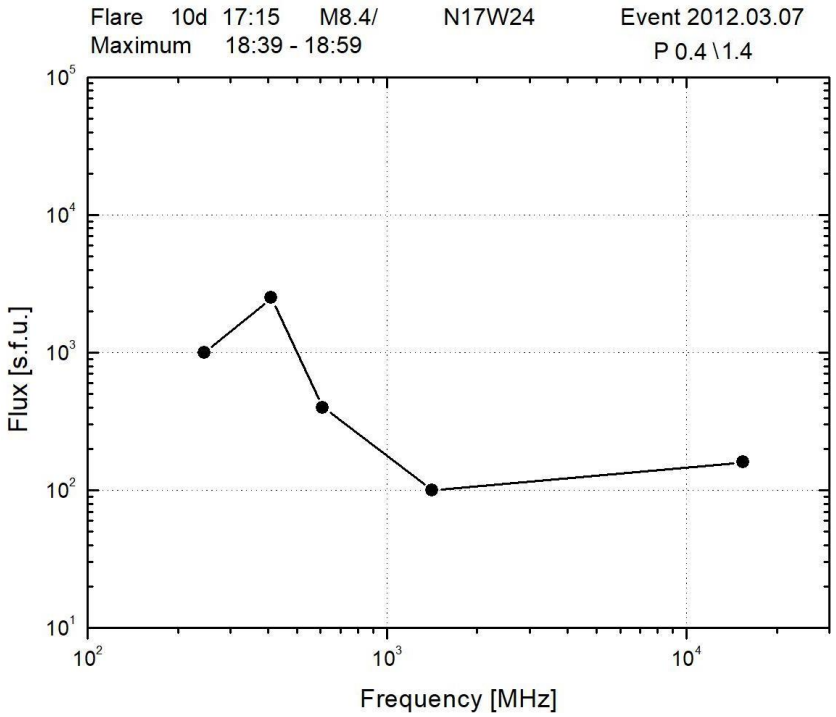
*https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_120310_095354_4989/www/

** The first Fermi-LAT solar flare catalog [Ajello et al., 2021].

Radio bursts frequency spectrum







Proton Active Region:

AR11429 (N18L301, CMP 09,1.03.2012,
Sp=1270 msh, EKC, BGD, R)
XRI=11.92 $X_2^{5.4}$+$M_{14}^{8.4}$+C_{32} 3_1+2_1+1_7+S_{51}
PFR1 5-7.03 (46^h) $X_2^{5.4}$+M_{10}
PFR2 9-10.03 (38^h) $M_2^{8.4}$

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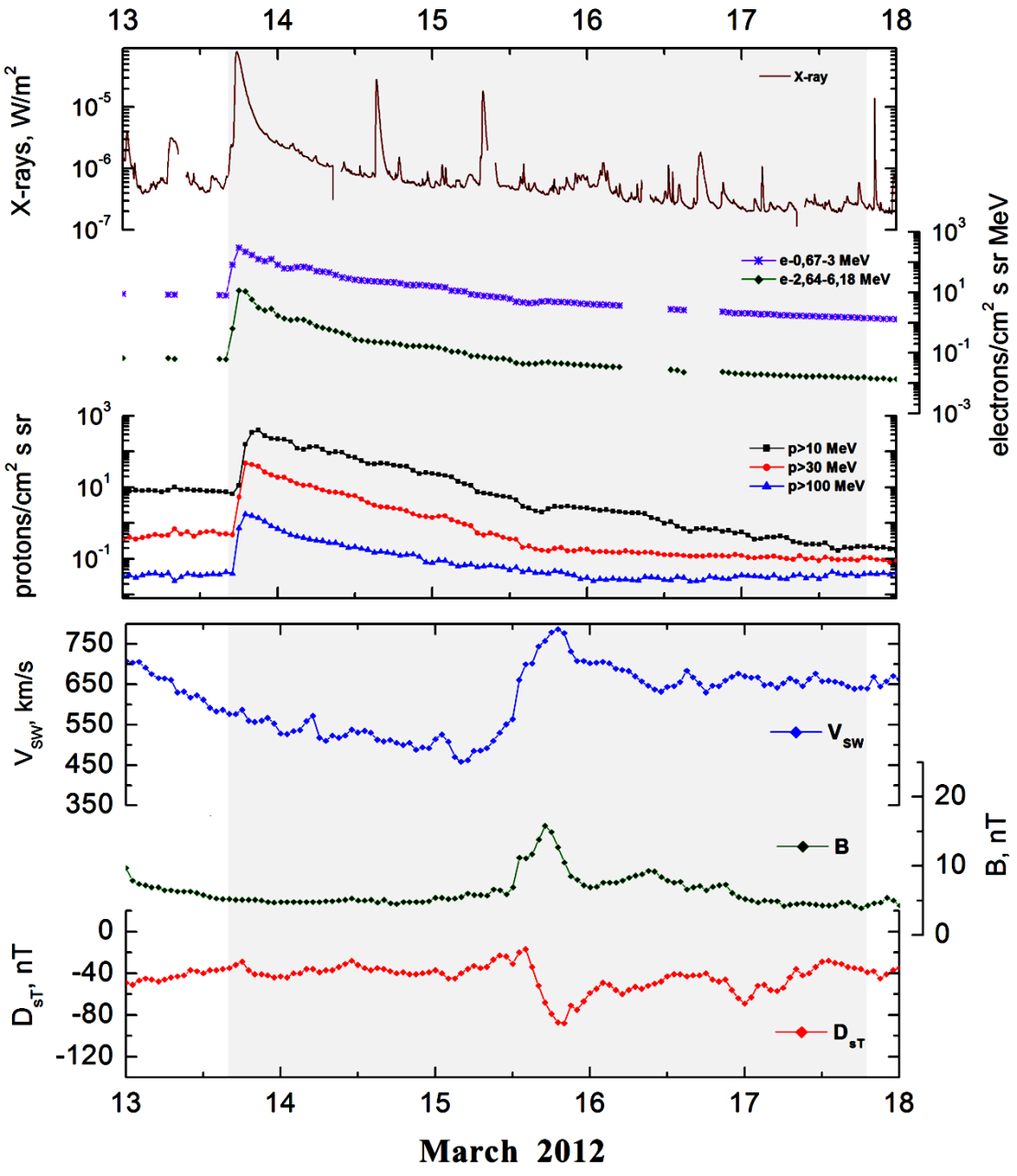
Particle event: To(Ep>10 MeV) – 13d17^{h}
Tmax (Ep>10 MeV) – 17d21^{h}, Jmax (Ep>10 MeV) = 390 /cm^{2}·s·sr
Duration of the event – 3.5 days, power-law index: γ = 2.8
Quasimaximal energy of protons in the event – Eqm = 650 MeV

Sources: ● solar flare 13d16^{h}35^{m}, 1B/M7.9, N19W59, AR11429
Main burst X-ray 1–8 Å: onset – 13d17^{h}12^{m}, max – 13d17^{h}41^{m}, Φ = 0.24 J/m^{2}
CME: 13d17^{h}36^{m}, V= 1884 km/s, Δφ = 360º, dA= 286º
▲SC 15d13^{h}07^{m}

Particle fluxes and associated phenomena

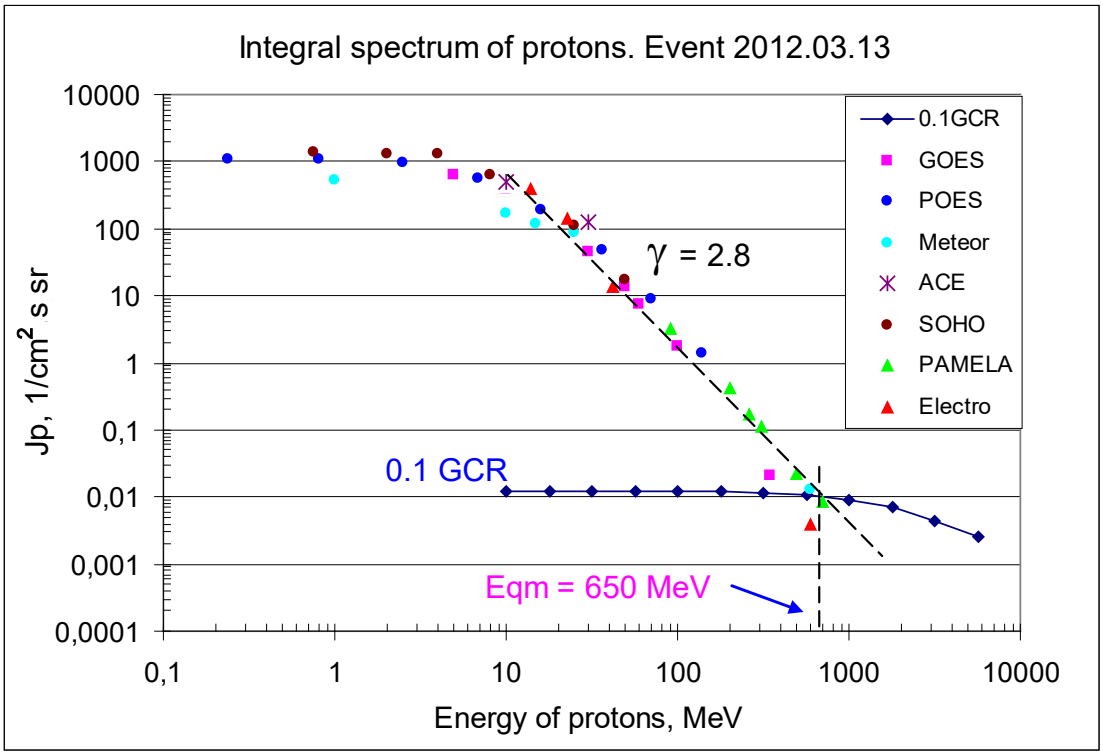


Integral fluxes of protons for the event of 2012 March 13

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	17	21	620	4	15	
EPS	>10	17	21	390	3.5	7	
EPS	>30	17	19	46	2	0.6	
EPS	>50	17	19	14	2	0.1	
EPS	>60	17	19	7.5	2	0.05	
EPS	>100	17	19	1.75	2	0.04	
Electro-1							
GALS-E	>600	17	19	0.004	1	0.001	
POES							
MEPED	>0.24	18	21	1080	2	280	
MEPED	>0.8	18	21	1070	2	160	
MEPED	>2.5	18	21	985	2	85	
MEPED	>6.9	18	21	545	1.5	50	
MEPED	>16	18	21	185	1.5	4	
MEPED	>36	18	20	49	1	1.2	
MEPED	>70	18	20	9	1	0.9	
MEPED	>140	18	20	1.4	1	1	
Meteor-1							
SCR	>1	17	20	524	3	2.7	
SCR	>3	17	-	-	3	2.4	
SCR	>10	17	20	173	2	1.6	
GALS-M	>15	17	18	116	2	1.4	
GALS-M	>25	17	18	85	2	1.4	
GALS-M	>600	17	18	0.013	0.25	0.03	
ACE							
SIS	>10	17	19	485	3	10	
SIS	>30	17	19	125	3	2	
SOHO							
EPHIN	>50	18	19	17.4	3	0.2	
PAMELA							
TRACKER	>90	17	18-21	3.2	2	-	
TRACKER	>200	17	18-21	0.43	1	-	
TRACKER	>265	17	18-21	0.17	1	-	
TRACKER	>312	17	18-21	0.11	1	-	
TRACKER	>500	17	18-21	0.022	1	-	
TRACKER	>700	17	18-21	0.0084	1	-	

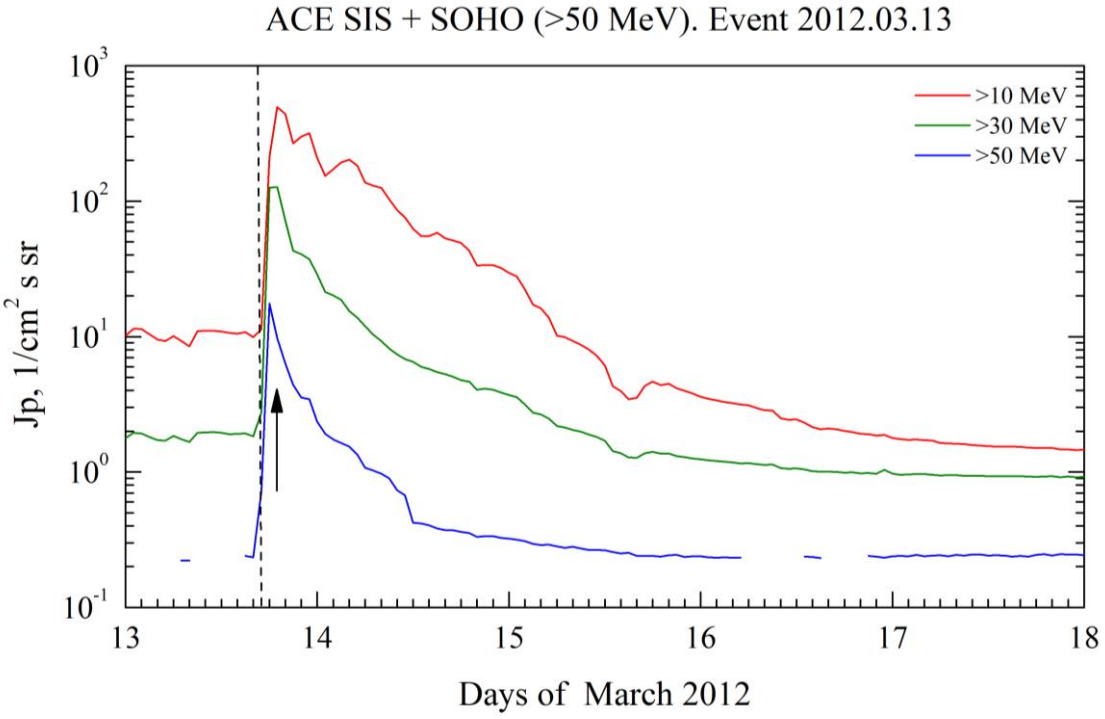
Differential fluxes of protons for the event of 2012 March 13

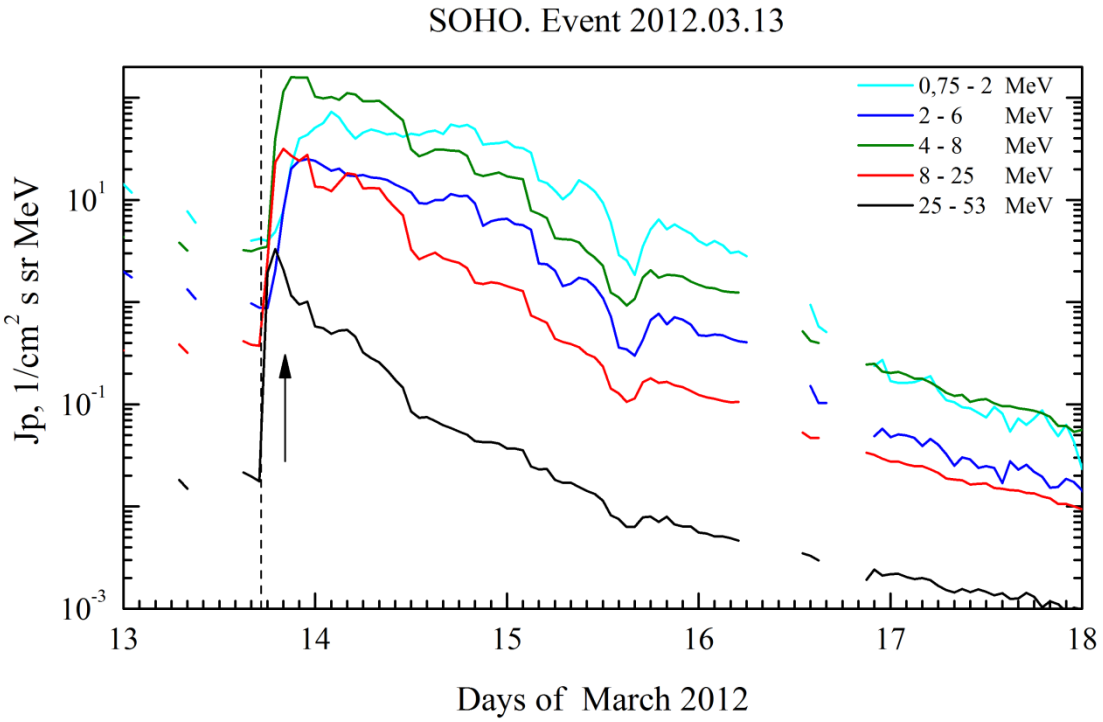
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	19	21	70	4	4	
LION	2 – 6	19	21	26	4	1	
EPHIN	4 – 8	19	21	157	4	3	
EPHIN	8 – 25	19	21	31.3	4	0.4	
EPHIN	25 – 53	19	19	3.26	4	0.03	
Electro-1							
SCR-E	13.7–23	17	19	27	2	0.35	
SCR-E	23–42	17	19	6.6	2	0.07	
SCR-E	42–112	17	19	0.2	1.5	0.005	
GOES							
EPS	350–420	18	19	0.0003	0.3	0.0016	
EPS	420–510	-	-	-	-	0.001	

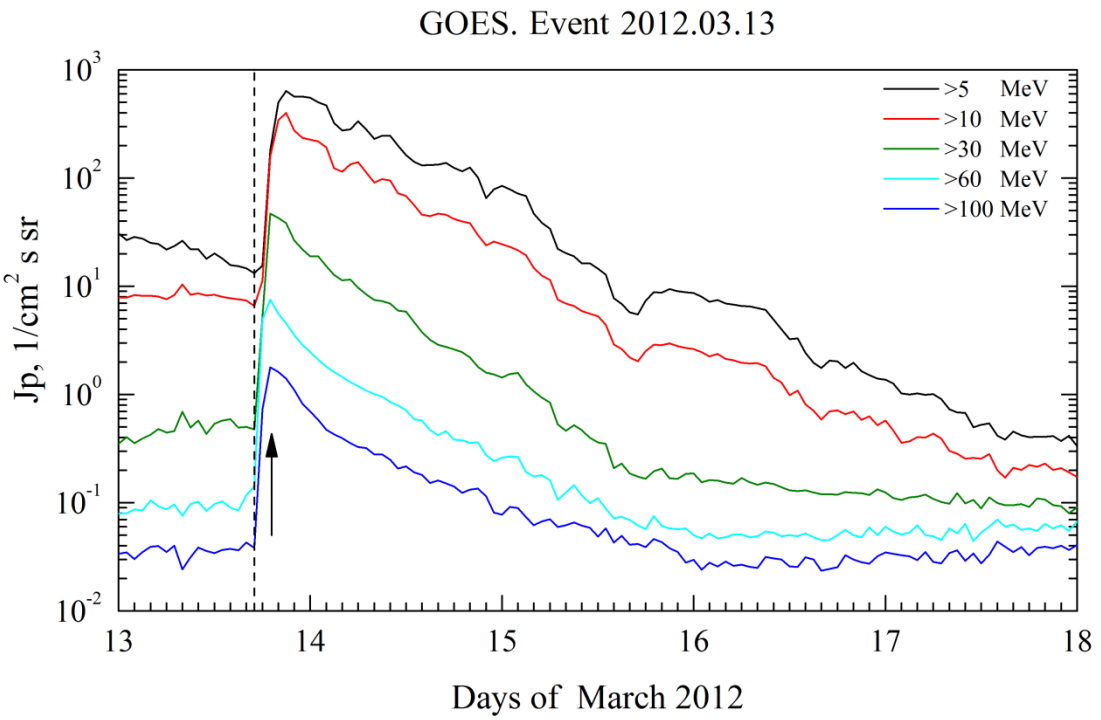


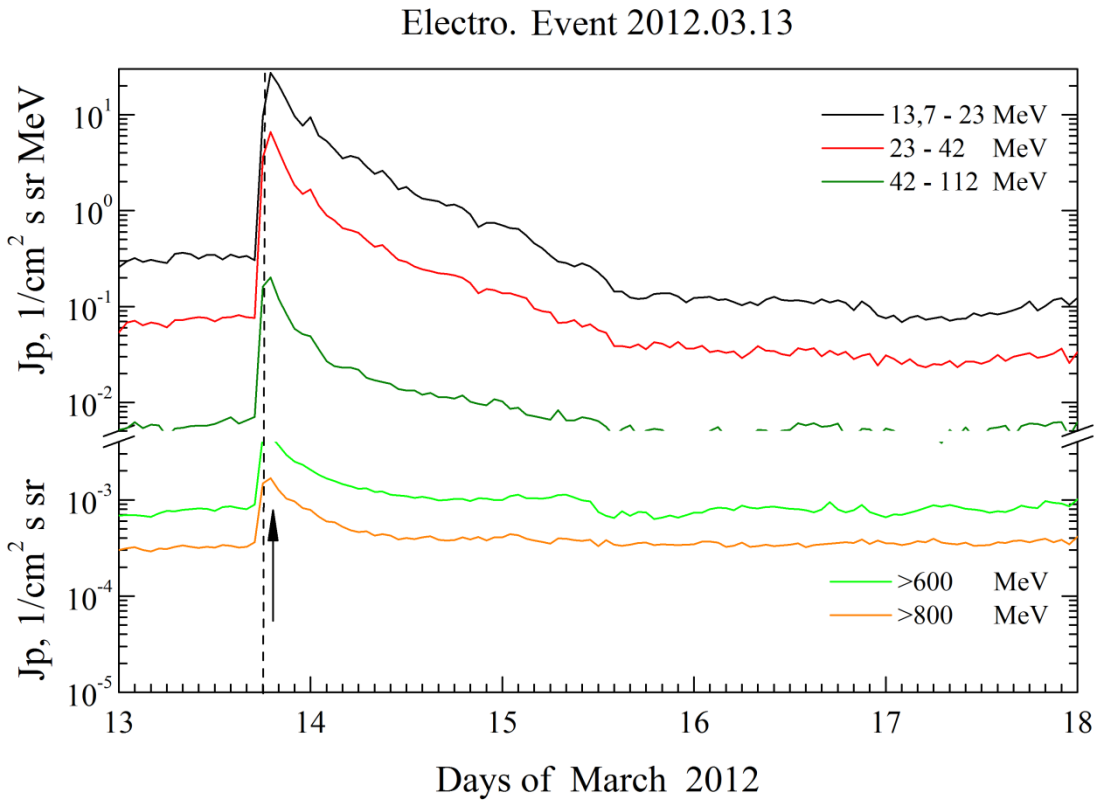
Time profiles of proton fluxes in the event 2012.03.13

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



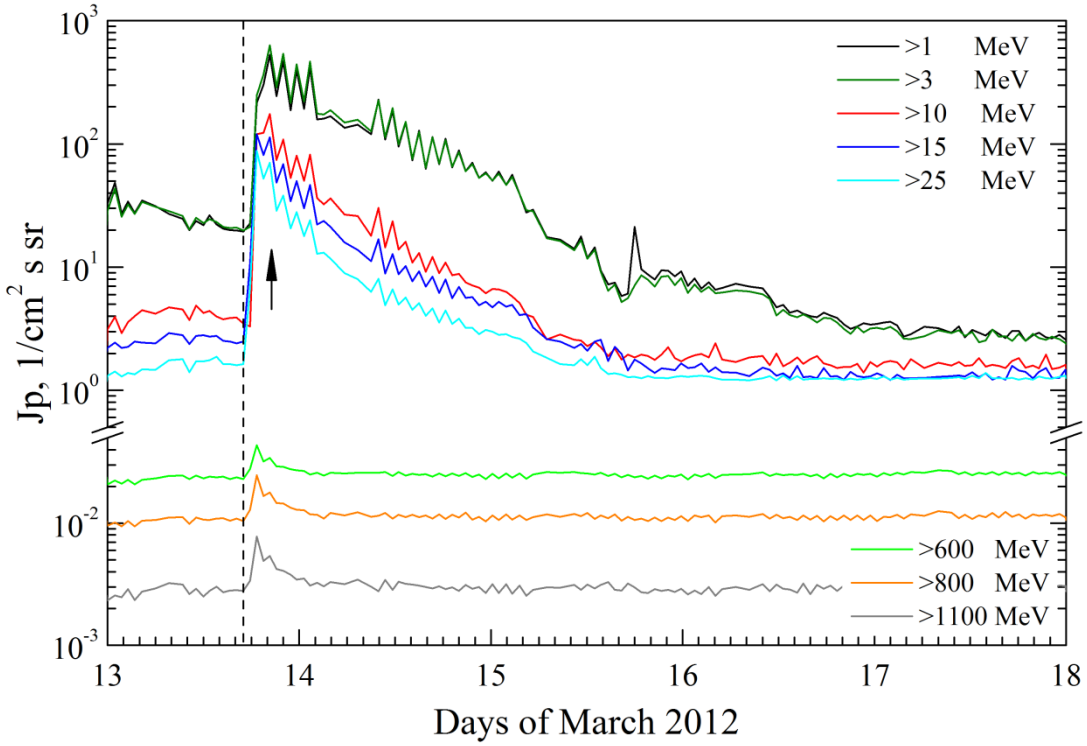



GOES. Event 2012.03.13
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of March 2012

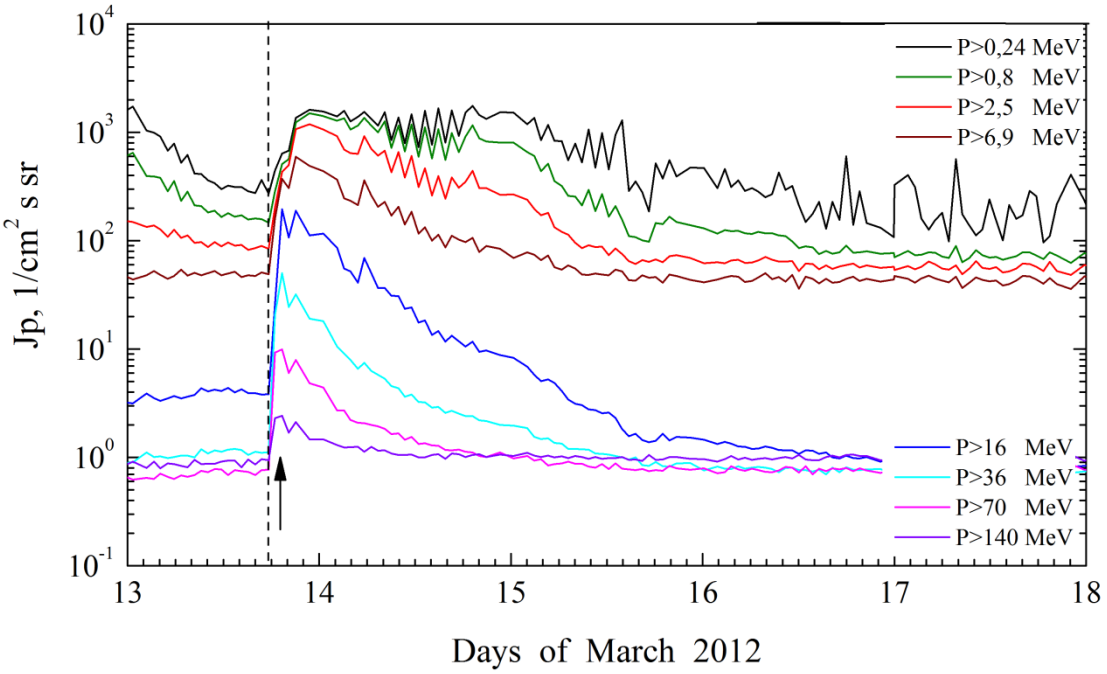

Electro. Event 2012.03.13
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of March 2012

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2012.03.13



POES. Event 2012.03.13



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 March 13

2012 March 13 ● AR 11429 To event 509

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å	FL*	1635	1724	2046	N19W59	1B	UMB
1 – 12	keV	1712	1741	1825	N17W66	M7.9*	0.24

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12-25	keV	1641:32	1644:50	1655:44	2800	8418880	HESSI
12-25	keV	1655:44	1657:46	1659:44	1648	1440000	HESSI
12-25	keV	1818:04	1818:34	1835:00	816	2355762	HESSI
12-25	keV	1720:56	1727:09	1749:39	560520	579008256	FERMI
12-25	keV	1809:38	1809:42	1820:54	58935	5351244	FERMI
12-25	keV	1856:32	1918:10	1930:56	3949	1402667	FERMI

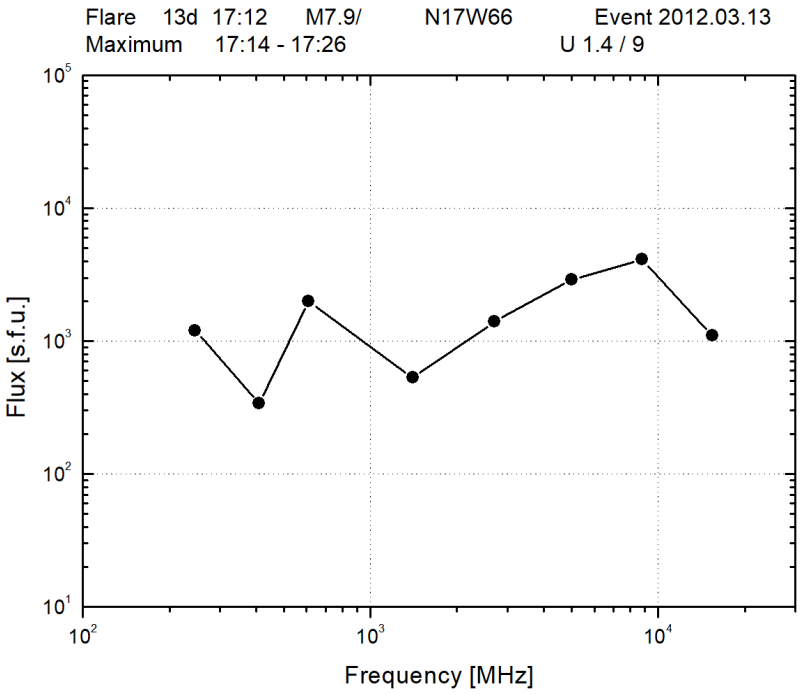
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	1726	1726	1732		3.04	
8.8	GHz	1714	1722	1814	U1.4 / 9	3.61	
5	GHz	1713	1724	1804		3.46	
2.7	GHz	1711	1725	1805		3.15	
1.4	GHz	1712	1722	1805		2.72	
610	MHz	1712	1722	1803		3.3	
410	MHz	1707	1721	1748		2.53	
245	MHz	1714	1714	1747		3.08	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	025-180	1715		1736	1366	3	
DS IV	025-180	1717		1814		3	
DS IV	025-180	1729		1814			
DS III	050-180	1703		1704		1	
DS III	025-180	1728		1728		1	
DS VI	025-180	1718		2172		3	
DS VI	25 - 180	1756		1908			
DH II	0.2-16	1735		2400			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1736	1884	45.6	360˚	286˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_120313_105302_91045/www/

Radio burst frequency spectrum



Proton Active Region:

AR11429 (N18L301,CMP 09,1.03.2012,
Sp=1270 msh, EKC, BGD, R)
XRI=11.92 $X_2^{5.4}$+$M_{14}^{8.4}$+C_{32} 3_1+2_1+1_7+S_{51}
PFR1 5-7.03 (46^h) $X_2^{5.4}$+M_{10}
PFR2 9-10.03 (38^h) $M_2^{8.4}$

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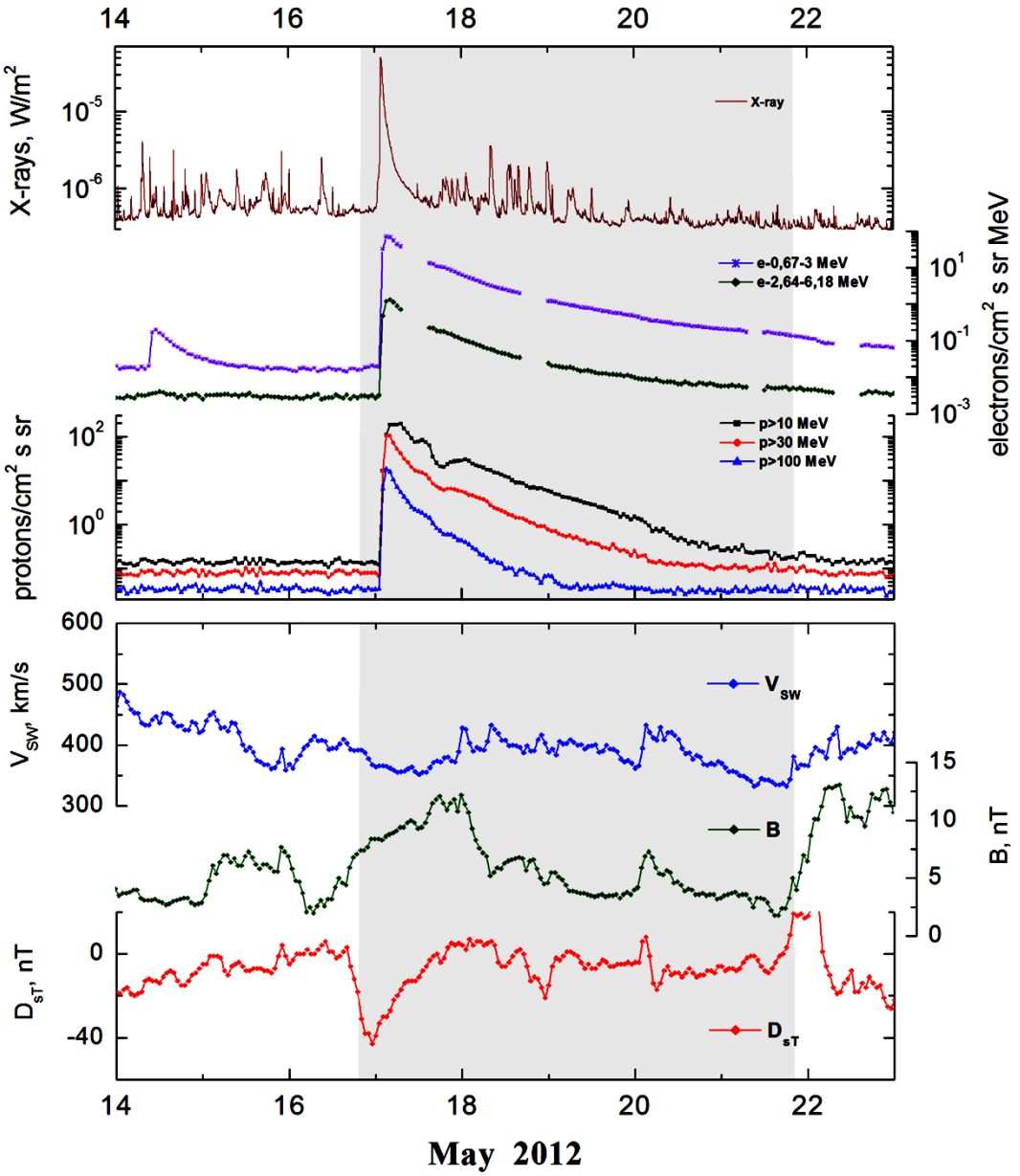
Particle event: To(Ep>10 MeV) – 17d01^h
Tmax$_1$(Ep>10 MeV) – 17d04^h, Jmax$_1$ (Ep>10 MeV) – 180 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 18d02^h, Jmax$_2$ (Ep>10 MeV) – 30 /cm^2·s·sr
Duration of the event – 5 days, power-law index: γ_1 = 2.15 (4.2), γ_2 = 2.05
Quasimaximal energy of protons in the event – Eqm$_1$ = 5000 (1800) MeV
– Eqm$_2$ = 650 MeV

Sources: ● solar flare 17d01^{h}25^m, M5.1/1F, N11W76, 11476
Main burst X-ray 1–8 Å: onset – 17d01^{h}25^m, max – 17d01^{h}47^m, Φ = 0.099 J/m^2
CME: 17d01^{h}48^m, V= 1582 km/s, Δφ = 360°, dA= 261°
▲ SC 21d19^{h}37^m

Particle fluxes and associated phenomena

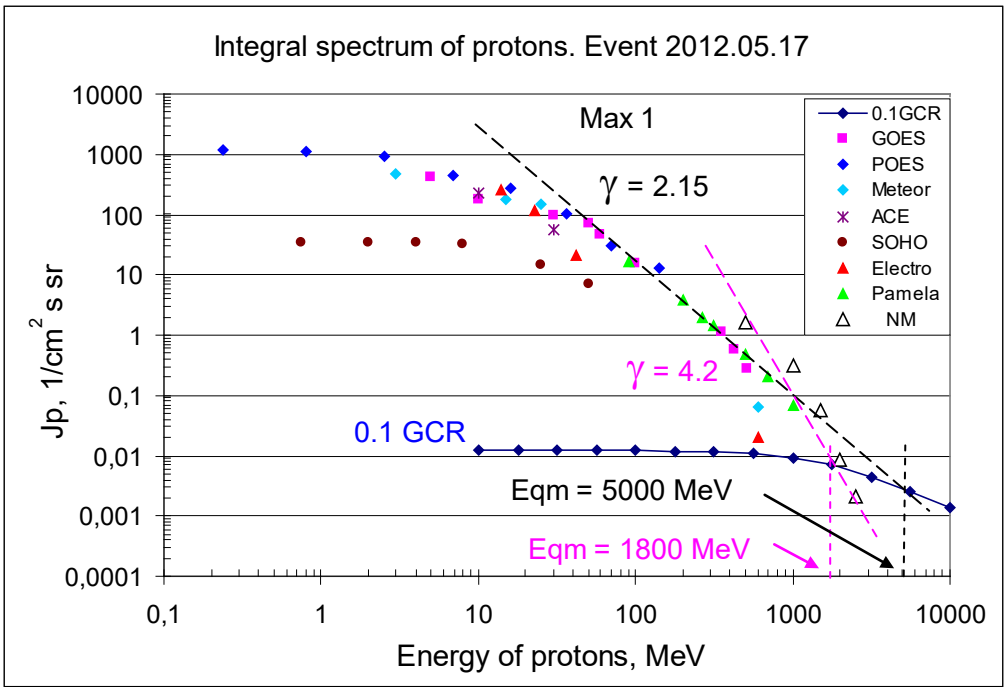


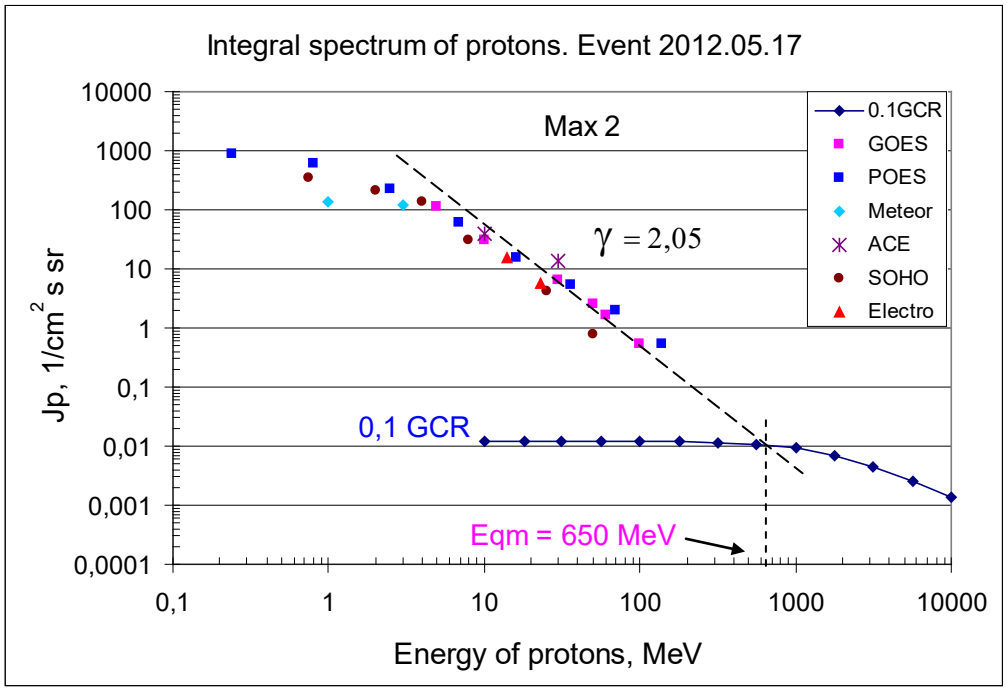
Integral fluxes of protons for the event of 2012 May 17

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	J max, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	1	7/18d02	410/110	5	0.2	
EPS	>10	1	4/18d02	180/30	5	0.14	
EPS	>30	1	3/20	100/6.5	4	0.09	
EPS	>50	1	3/20	69.4/2.5	3	0.06	
EPS	>60	1	3/20	47/1.6	2.5	0.05	
EPS	>100	1	3/20	16/0.55	2.5	0.04	
EPS	>700	1	3/ -	0.000165/ -	0.5	0.00013	
Electro-1							
GALS-E	>600	1	3/ -	0.02/ -	1	0.001	
POES							
MEPED	>0.24	2	17d04/21	1200/900	4	100	
MEPED	>0.8	2	17d04/21	1090/610	4	80	
MEPED	>2.5	2	17d04/21	940/220	3	60	
MEPED	>6.9	2	17d04/21	450/60	3	50	
MEPED	>16	2	17d04/21	271/15.9	3	0.9	
MEPED	>36	2	17d04/21	101/5.5	2.5	0.9	
MEPED	>70	2	17d04/21	30.5/2	2	1	
MEPED	>140	2	17d04/21	13.2/0.55	1.5	1.2	
Meteor-1							
SCR	>1	1	- /18d 2	- /140	4	2.7	
SCR	>3	1	4/18d02	482/119	4	2.45	
SCR	>10	1	-	-	3	1.6	
GALS-M	>15	1	4/ -	181/ -	3	1.35	
GALS-M	>25	1	4/ -	151/ -	3	1.4	
GALS-M	>600	1	4/ -	0.064/ -	1	0.03	
ACE							
SIS	>10	2	8/20	227/40	4	1.4	
SIS	>30	2	7/19	57/14	3	1	
SOHO							
EPHIN	>50	1	2/19	6.85/0.8	2	0.3	
PAMELA							
TRACKER	>90	2	4/ -	17/ -	3	-	
TRACKER	>200	2	4/ -	3.8/ -	2	-	
TRACKER	>265	2	4/ -	2/ -	2	-	
TRACKER	>312	2	4/ -	1.4/ -	2	-	
TRACKER	>500	2	4/ -	0.49/ -	1	-	
TRACKER	>700	2	4/ -	0.21/ -	1	-	
TRACKER	>1000	2	4/ -	0.068/ -	1	-	
NM							
Network	>500	2	3	1.6/ -	-	-	
Network	>1000	2	3	0.32/ -	-	-	
Network	>1500	2	3	0.056/ -	-	-	
Network	>2000	2	3	0.00842/ -	-	-	
Network	>2500	2	3	0.00205/ -	-	-	

Differential fluxes of protons for the event of 2012 May 17

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	02	5/18d02	0.8/117	5	0.01	
LION	2 – 6	02	7/18d02	0.25/24	5	0.0025	
EPHIN	4 – 8	05	- /18d01	0.3/26.3	5	0.0004	
EPHIN	8 – 25	03	7/23	1/1.5	5	0.00003	
EPHIN	25 – 53	03	6/21	0.3/0.12	5	0.00003	
Electro-1							
SCR-E	13.7–23	1	3/21	15.2/1	3	0.06	
SCR-E	23–42	1	3/21	5/0.3	3	0.025	
SCR-E	42–112	1	3/ -	0.3/ -	2	0.005	
GOES							
EPS	350–420	2	3/ -	0.0076/ -	1	0.0017	
EPS	420–510	2	3/ -	0.0033/ -	1	0.00105	
EPS	510–700	2	3/ -	0.0015/ -	1	0.00042	
EPS	>700	1	3/ -	0.000165/ -	0.5	0.00013	

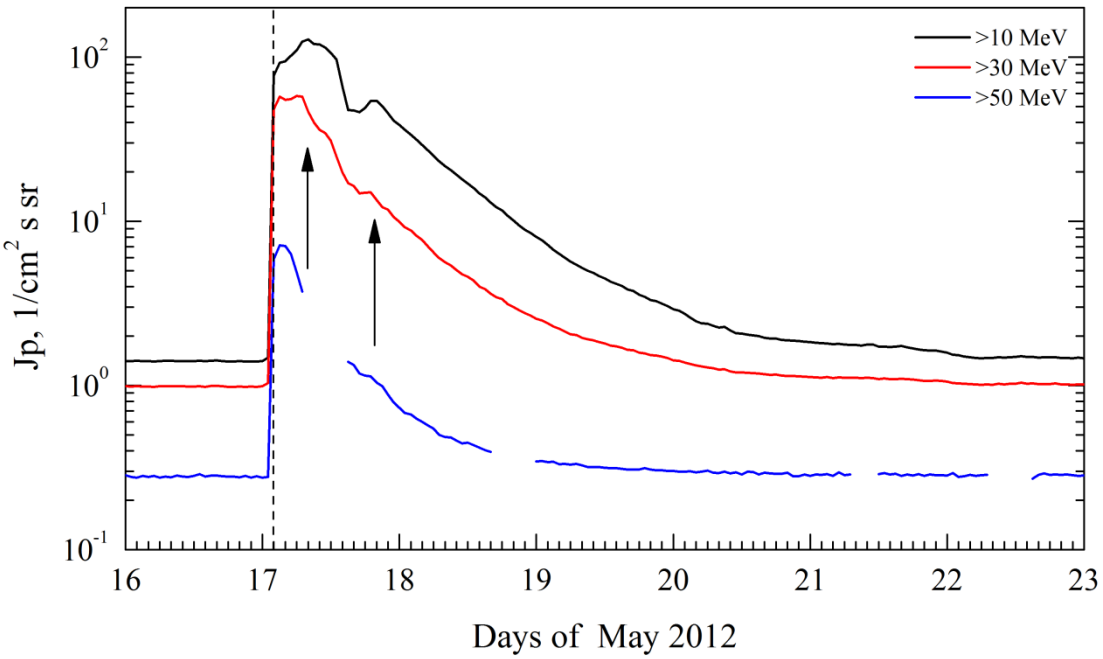

Integral spectrum of protons. Event 2012.05.17
Max 1
γ = 2.15
γ = 4.2
0.1 GCR
Eqm = 5000 MeV
Eqm = 1800 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Pamela
NM
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.05.17
Max 2
γ = 2,05
0,1 GCR
Eqm = 650 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

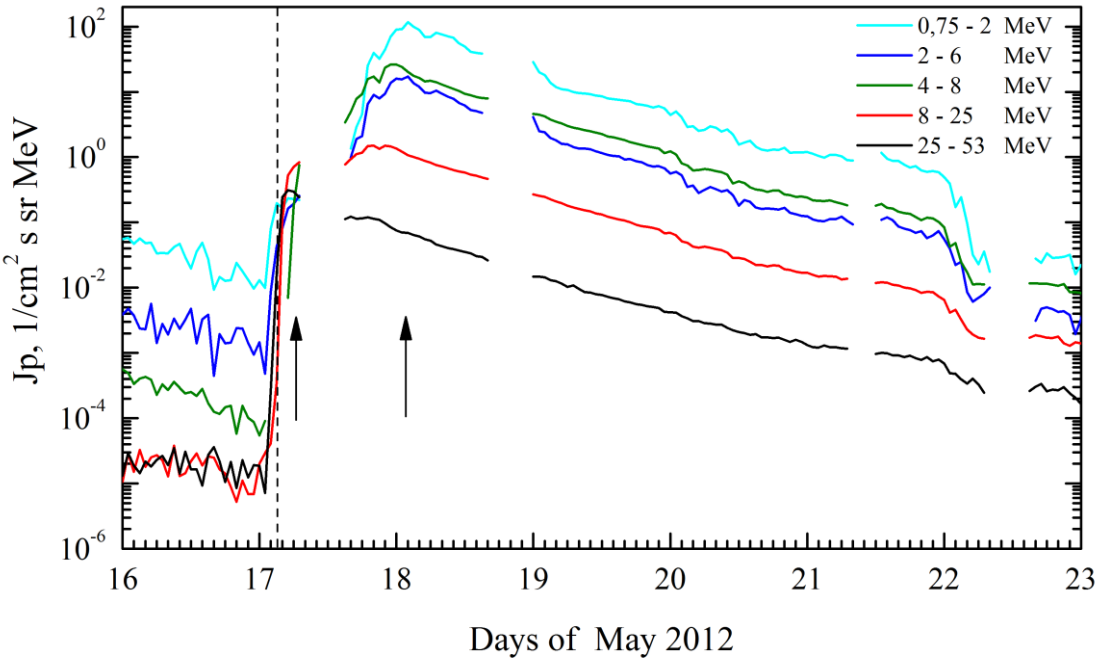
Time profiles of proton fluxes in the event 2012.05.17

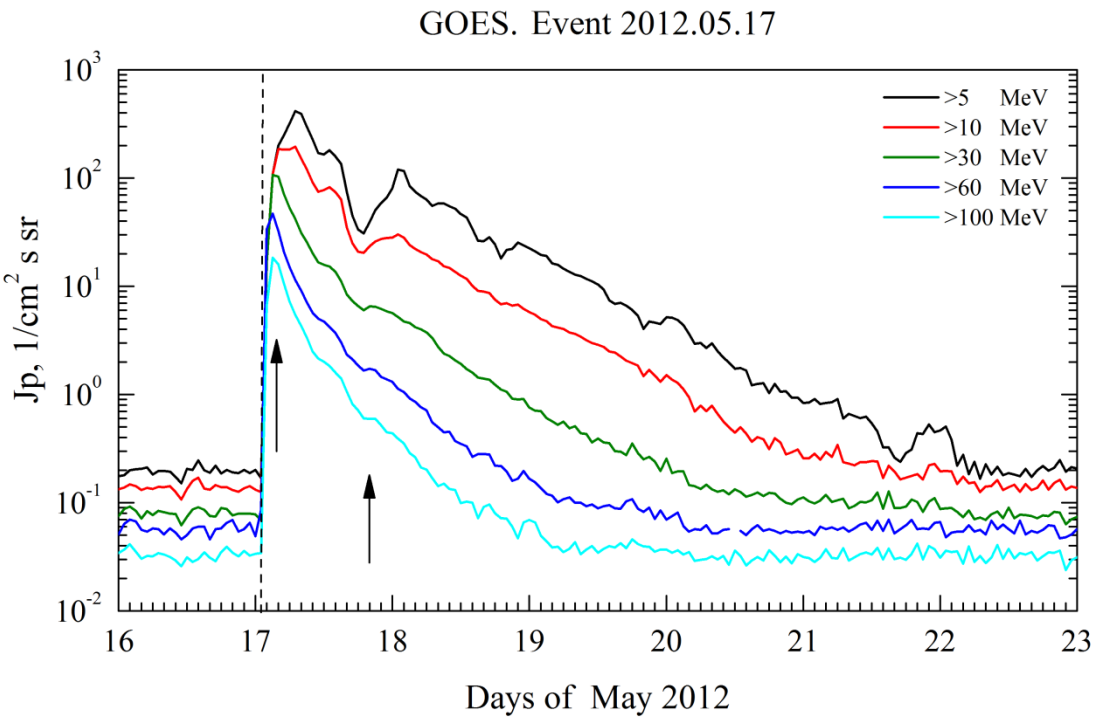
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

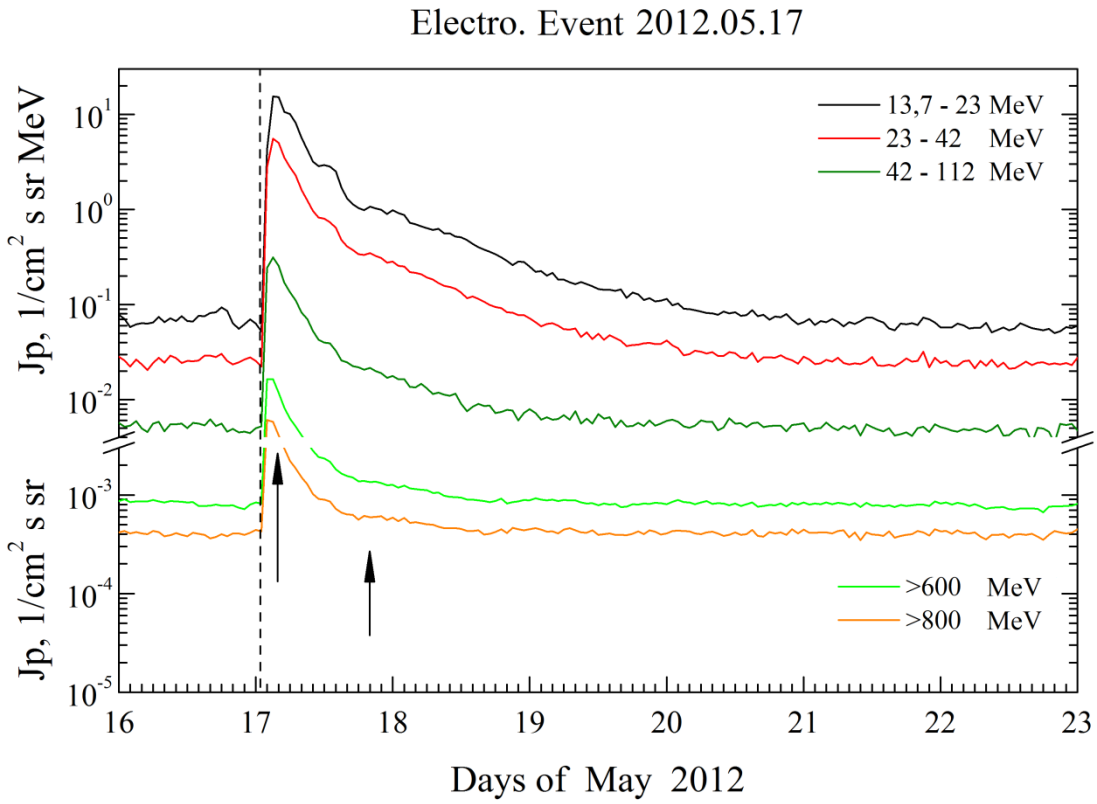
ACE SIS + SOHO (>50 MeV). Event 2012.05.17



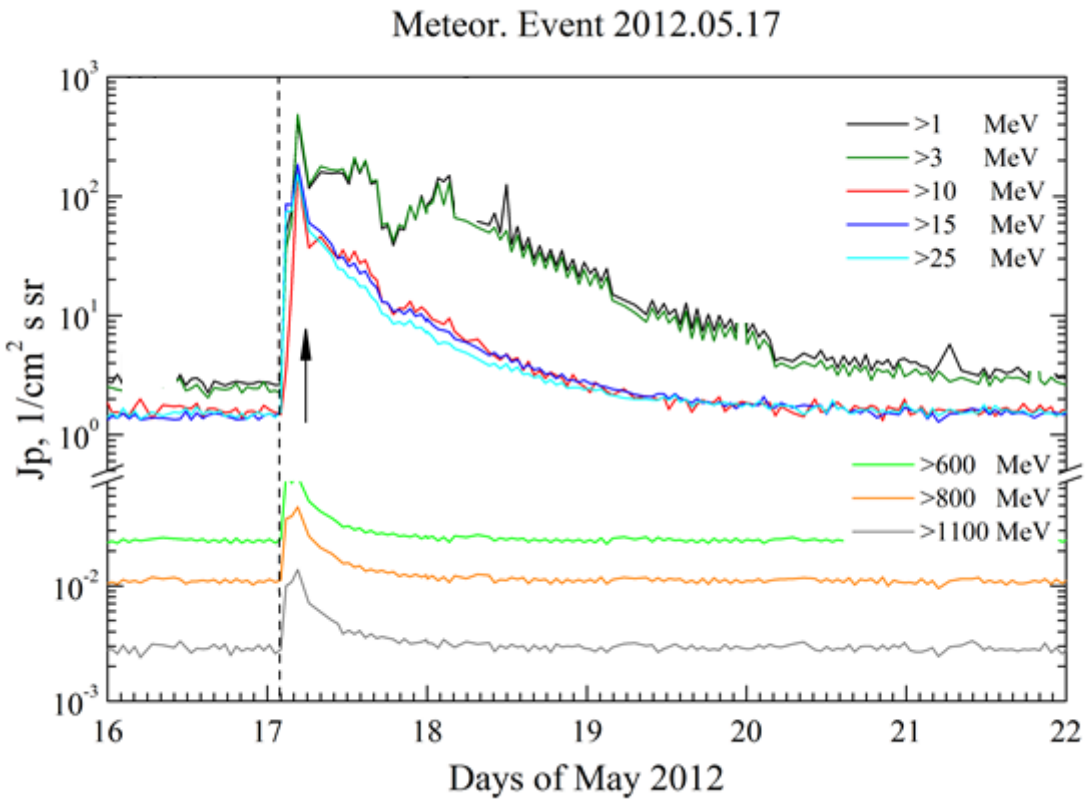
SOHO. Event 2012.05.17

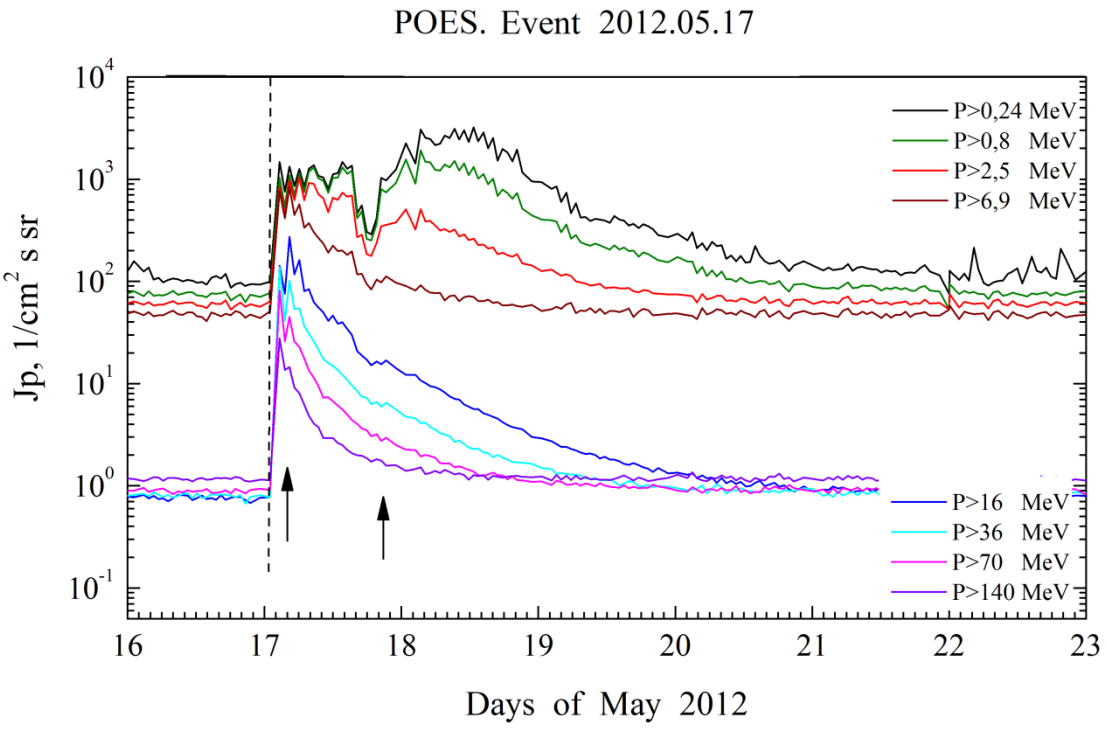



GOES. Event 2012.05.17
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of May 2012


Electro. Event 2012.05.17
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of May 2012

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 May 17

2012 May 17 ● AR11476 To event 510

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance Class**	**Fl Code Φ,** J/m^2
6563 Å	FL	0128	0134	0308	N11W76	1F	BPT
1 – 12	keV	0125	0147	0211	N07W88	M5.1	0.099

X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
100-300	keV	0138:32	0140:38	0223:40	2416	12687325	HESSI
12-25	keV	0158:45	0158:54	0257:32	39931	11434505	FERMI
>100	keV	0212:30		0244:30		1.91E-05*	FERMI

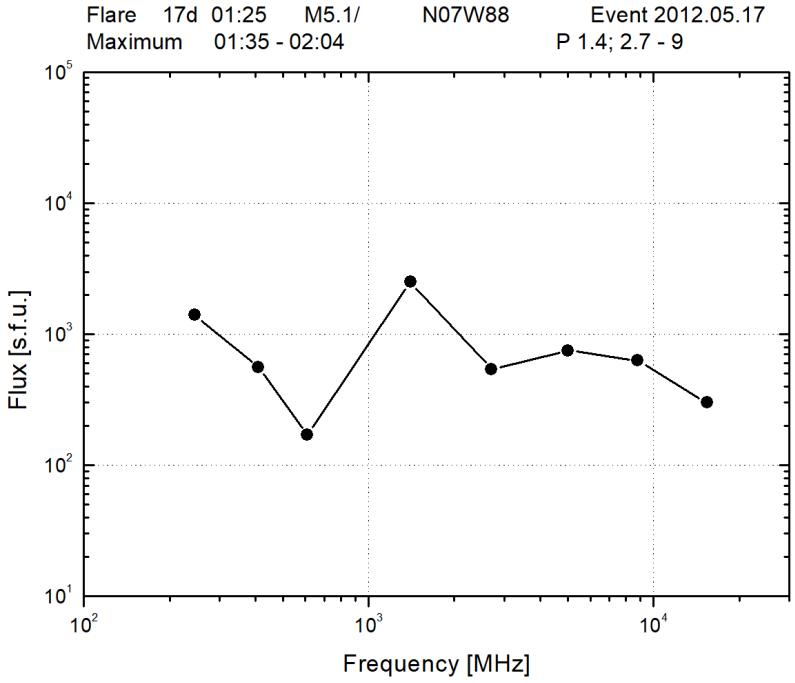
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0130	0136	0144		2.48	
8.8	GHz	0129	0135	0149	2.7 – 9	2.8	
5	GHz	0129	0142	01155		2.88	
2.7	GHz	0129	0142	0158		2.73	
1.4	GHz	0203	0204	0204	P1.4	3.4	
610	MHz	0135	0142	0144		2.23	
410	MHz	0134	0142	0150		2.75	
245	MHz	0129	0153	0220		3.15	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-180	0131		01411216		2	
DS IV	025-180	0132		1728		3	
DS III	40-325	1134		1141		3	
DS III	020-140	0244		0250		1	
DH II	0.3-16	0141		0620			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0148	1582	-51.8	360˚	261˚	SOHO

*cm^{-2}s^{-1}

Radio burst frequency spectrum



Proton Active Region:

AR11476 (N11L182, CMP 11,6.05.2012
Sp=1050 msh, FKC, BGD, R)
XRI=2.91; $M_{11}^{5.7}$+C_{87}; 2_1+1_7+S_{88}
PFR1 8-10.05 (39^h) $M_5^{5.7}$
PFR2 17.05 $M_1^{5.1}$ (W-limb)

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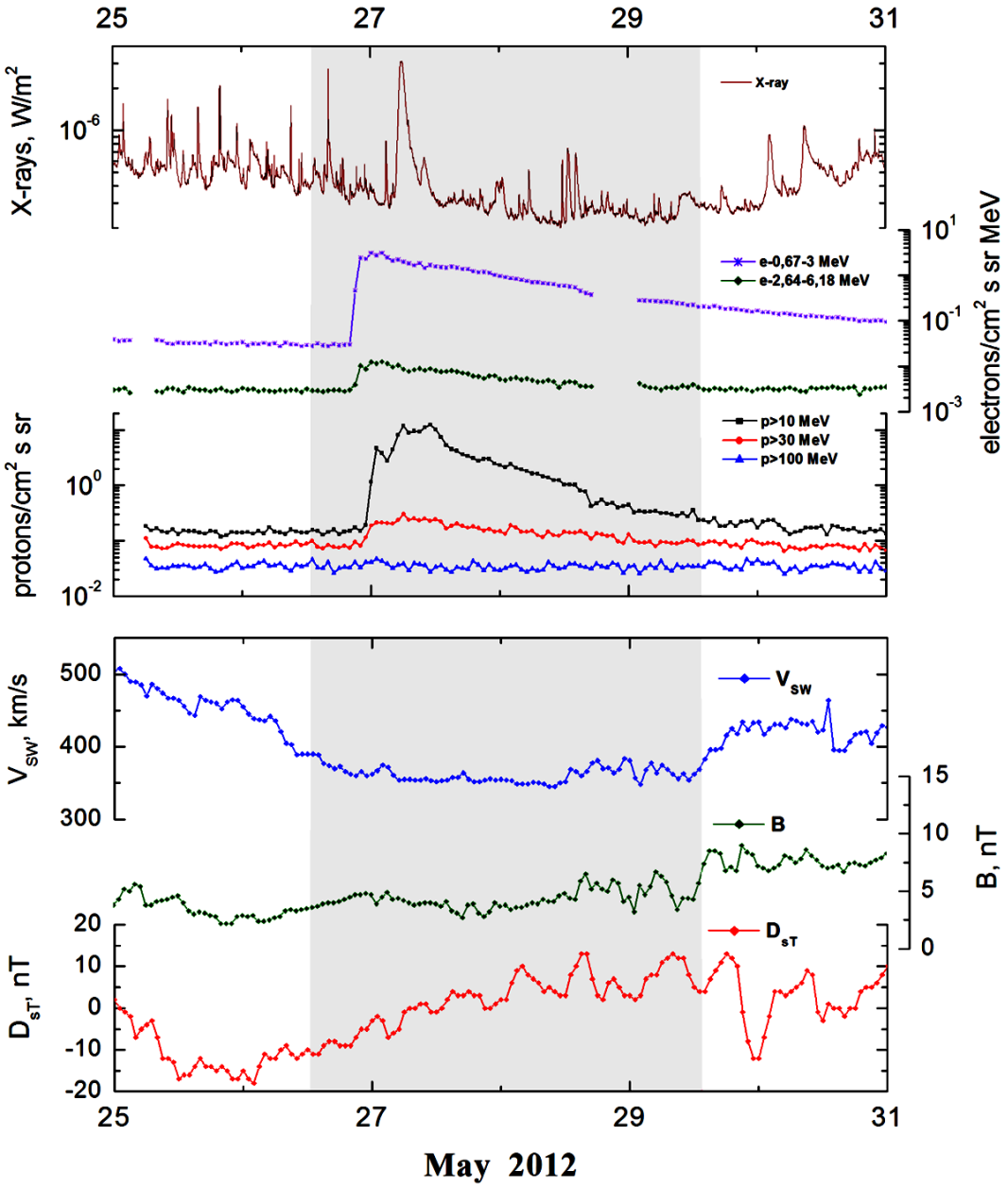
Particle event: To(Ep>10 MeV) – 26d23^h
Tmax$_1$(Ep>10 MeV) – 27d06^h, Jmax$_1$ (Ep>10 MeV) – 11.9 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 27d11^h, Jmax$_2$ (Ep>10 MeV) – 12.5 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ_1 = 3.2, γ_2 = 3.2
Quasimaximal energy of protons in the event – Eqm$_1$ = 70 MeV
– Eqm$_2$ = 70 MeV

Sources: ⊡ back side solar flare 26d<20^{h}57^m, AR unknown, behind W$_L$;
CME: 26d20^{h}57^m, V = 1966 km/s, Δφ = 360°, dA = 291°

Particle fluxes and associated phenomena

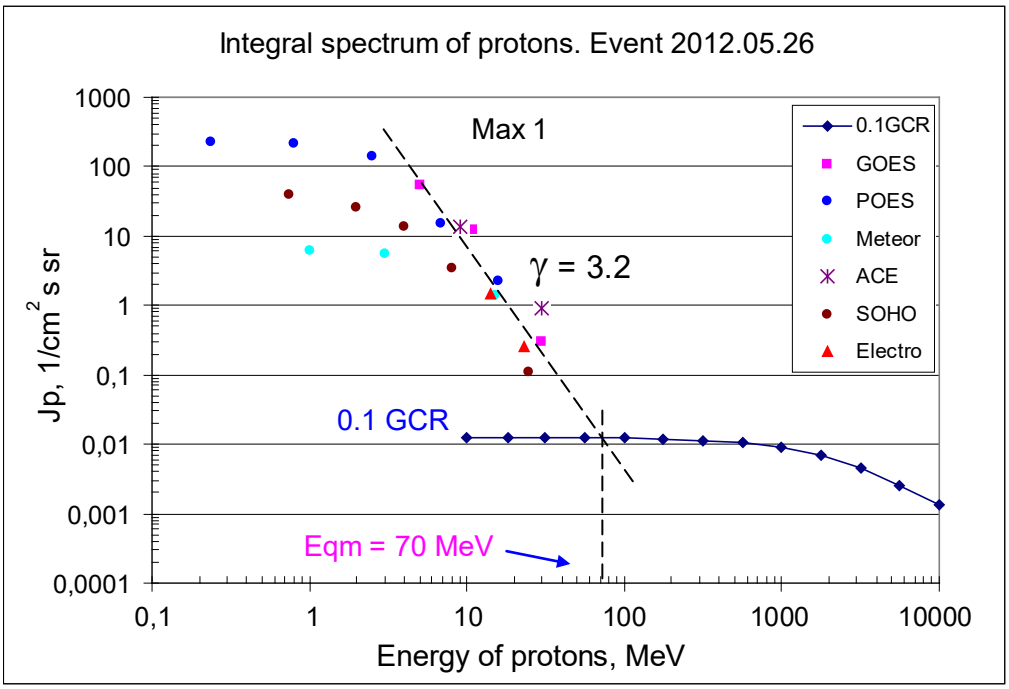


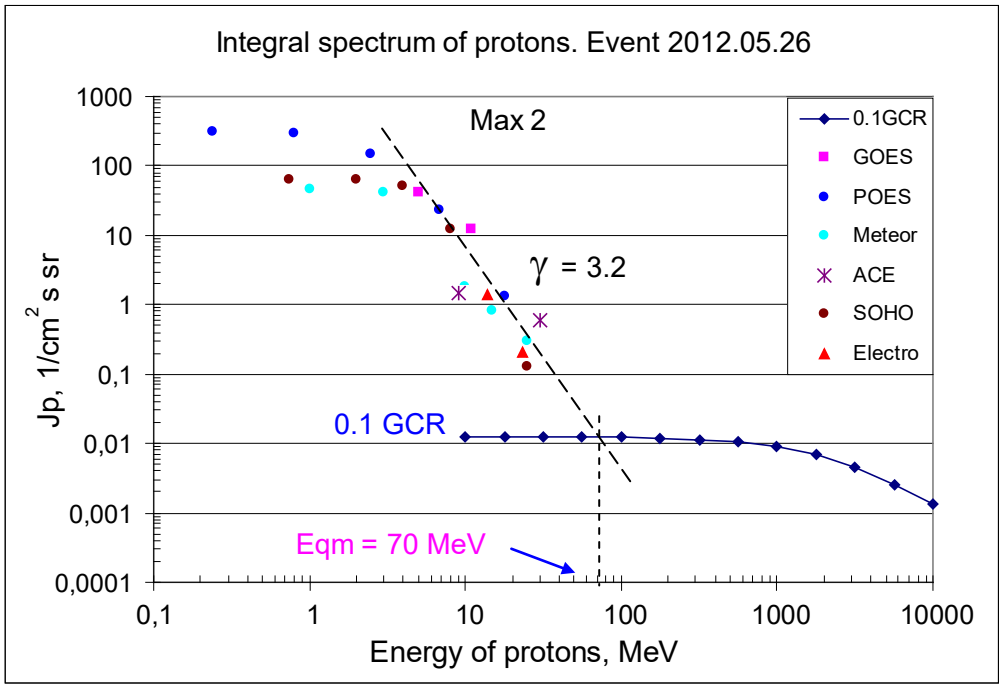
Integral fluxes of protons for the event of 2012 May 26

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	23	27d06/27d11	52.7/41.6	4	0.2	
EPS	>10	23	27d06/27d11	11.9/12.5	3	0.14	
EPS	>30	23	27d06/ -	0.3/ -	2	0.09	
EPS	>50	23	-	-	-	0.06	
EPS	>60	23	-	-	-	0.05	
EPS	>100	23	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	23	27d06/27d13	227/307	2	100	
MEPED	>0.8	23	27d06/27d13	220/295	2	80	
MEPED	>2.5	23	27d06/27d13	137/148	2	60	
MEPED	>6.9	23	27d06/27d12	15.4/22.8	1	50	
MEPED	>16	23	27d06/27d12	2.2/1.3	1	0.9	
MEPED	>36	23	-	-	-	0.9	
MEPED	>70	-	-	-	-	1	
MEPED	>140	-	-	-	-	1.2	
Meteor-1							
SCR	>1	23	27d04/27d11	6/45	3	2.7	
SCR	>3	23	27d04/27d11	5.6/42	3	2.4	
SCR	>10	23	- /27d11	- /1.8	0.5	1.6	
GALS-M	>15	23	27d04/27d11	1.41/0.8	0.5	1.35	
GALS-M	>25	23	- /27d11	-/0.3	0.25	1.4	
GALS-M	>600	-	-	-	-	0.03	
ACE							
SIS	>10	21	27d04/27d09	11.5/15	2	1.5	
SIS	>30	21	27d04/27d09	0.9/0.6	1.5	1	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

Differential fluxes of protons for the event of 2012 May 26

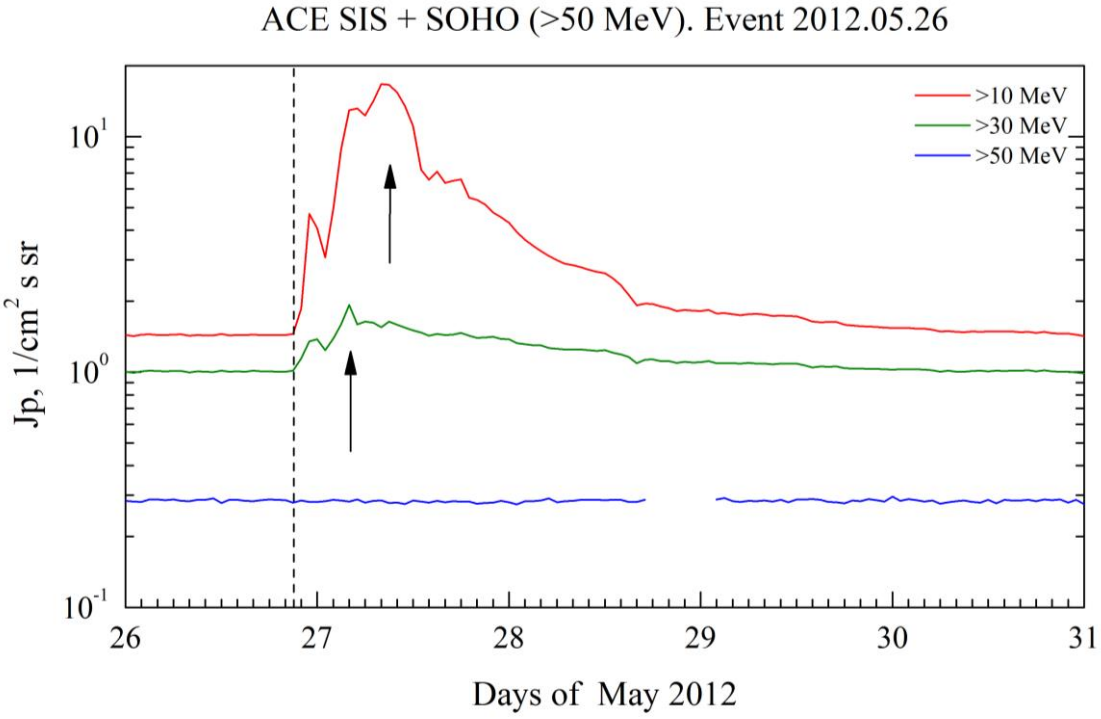
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	27d00	27d10/27d16	11/15.7	5	0.01	
LION	2 – 6	23	27d10/27d16	3.9/3.6	5	0.0025	
EPHIN	4 – 8	23	27d02/27d09	2.6/10	5	0.0004	
EPHIN	8 – 25	23	27d02/27d09	0.2/0.7	5	0.00003	
EPHIN	25 – 53	23	27d02/27d09	0.004/0.0046	5	0.00003	
Electro-1							
SCR-E	13.7–23	23	27d05/27d10	0.13/0.125	1	0.08	
SCR-E	23–42	23	27d05/27d09	0.013/0.011	1	0.025	
SCR-E	42–112			-	-	0.005	

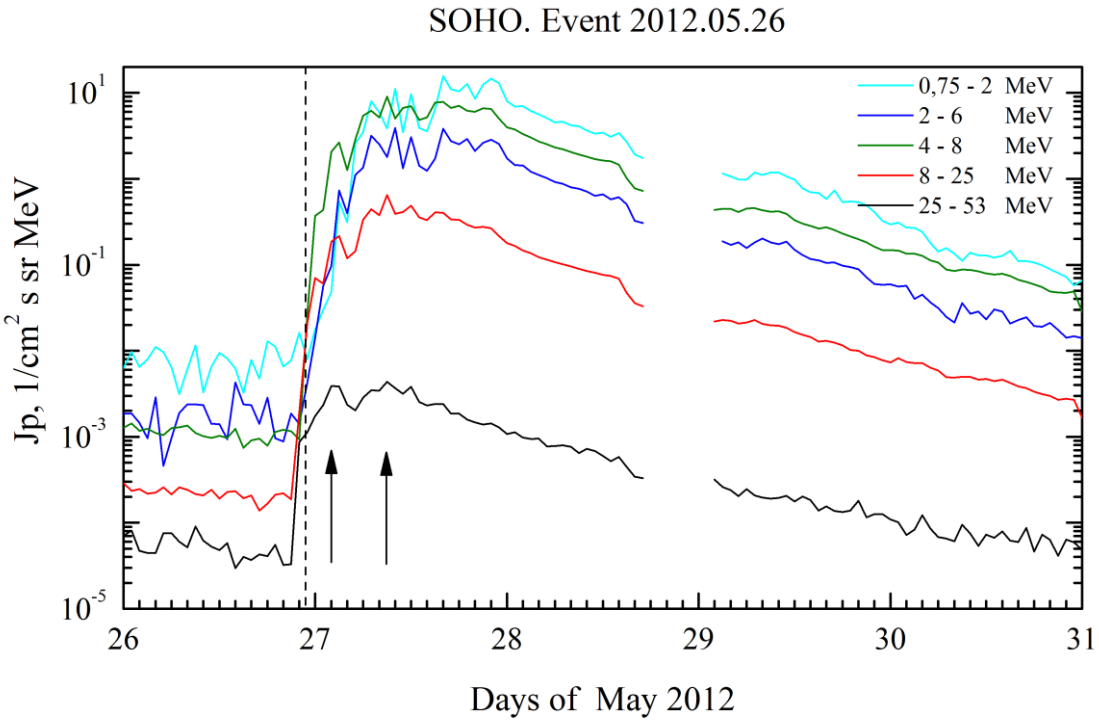

Integral spectrum of protons. Event 2012.05.26
Max 1
γ = 3.2
0.1 GCR
Eqm = 70 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

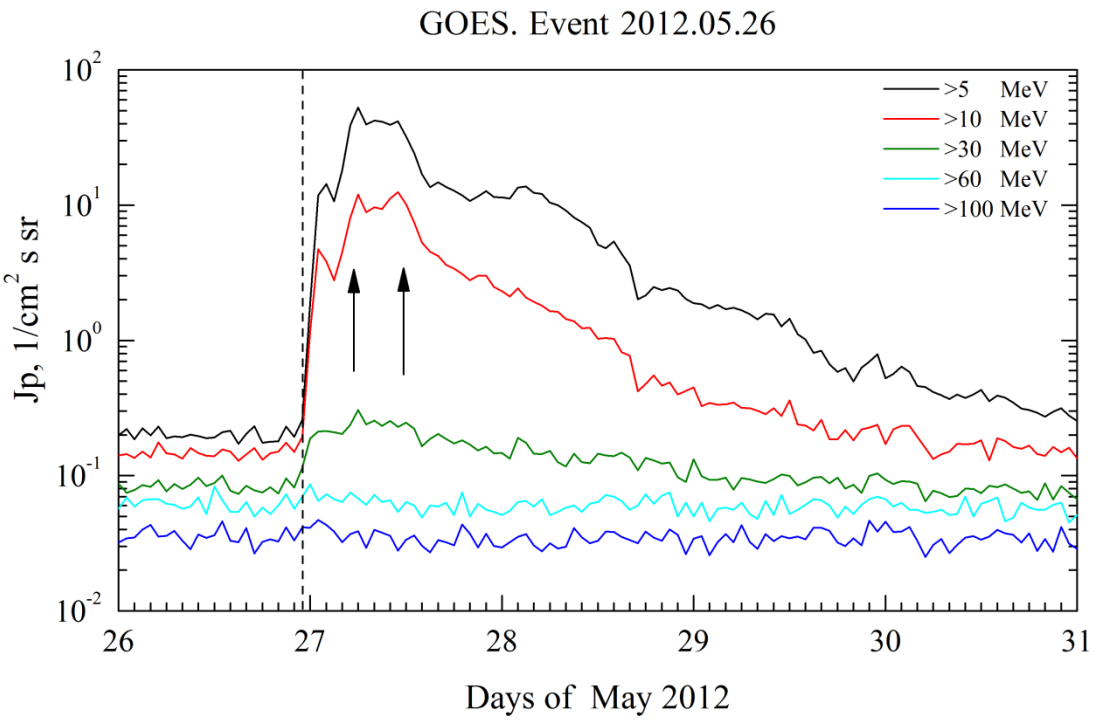

Integral spectrum of protons. Event 2012.05.26
Max 2
γ = 3.2
0.1 GCR
Eqm = 70 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

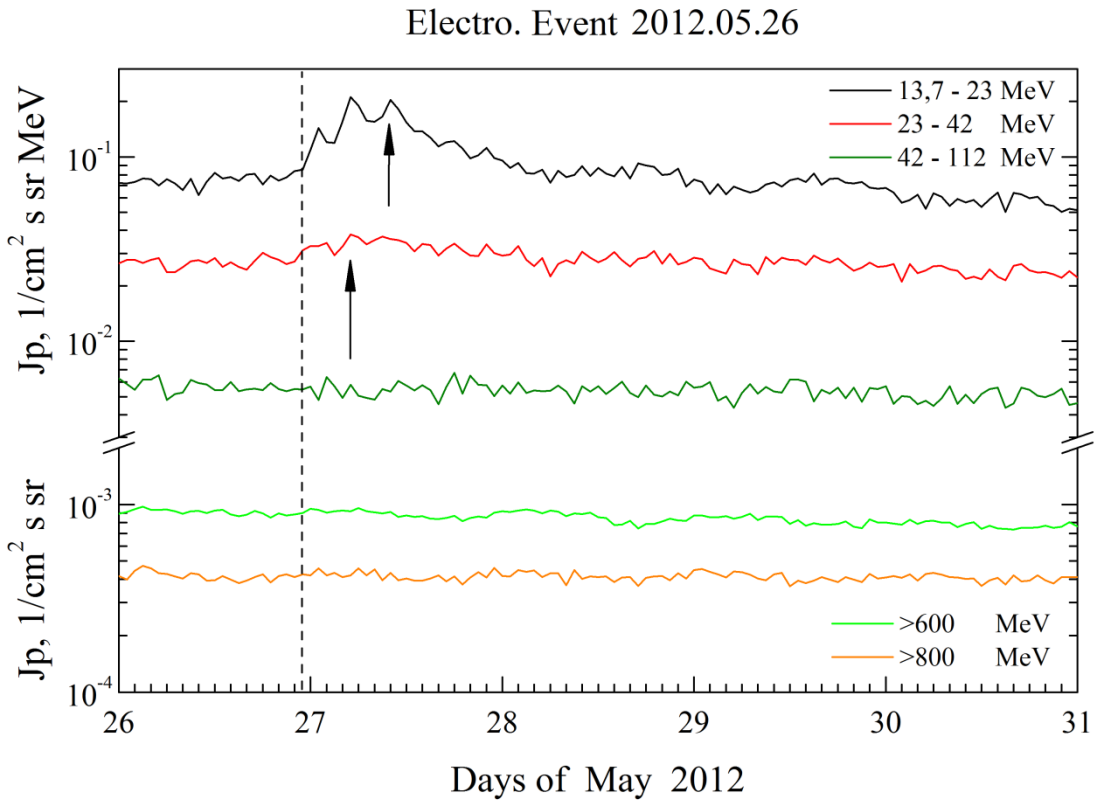
Time profiles of proton fluxes in the event 2012.05.26

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

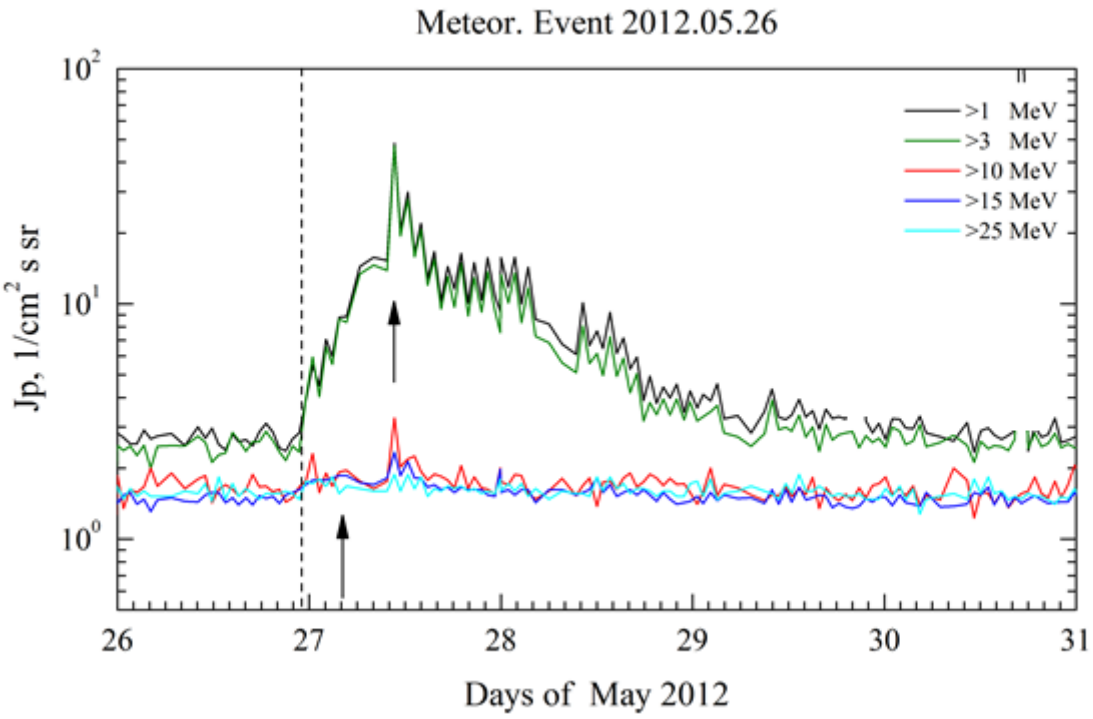


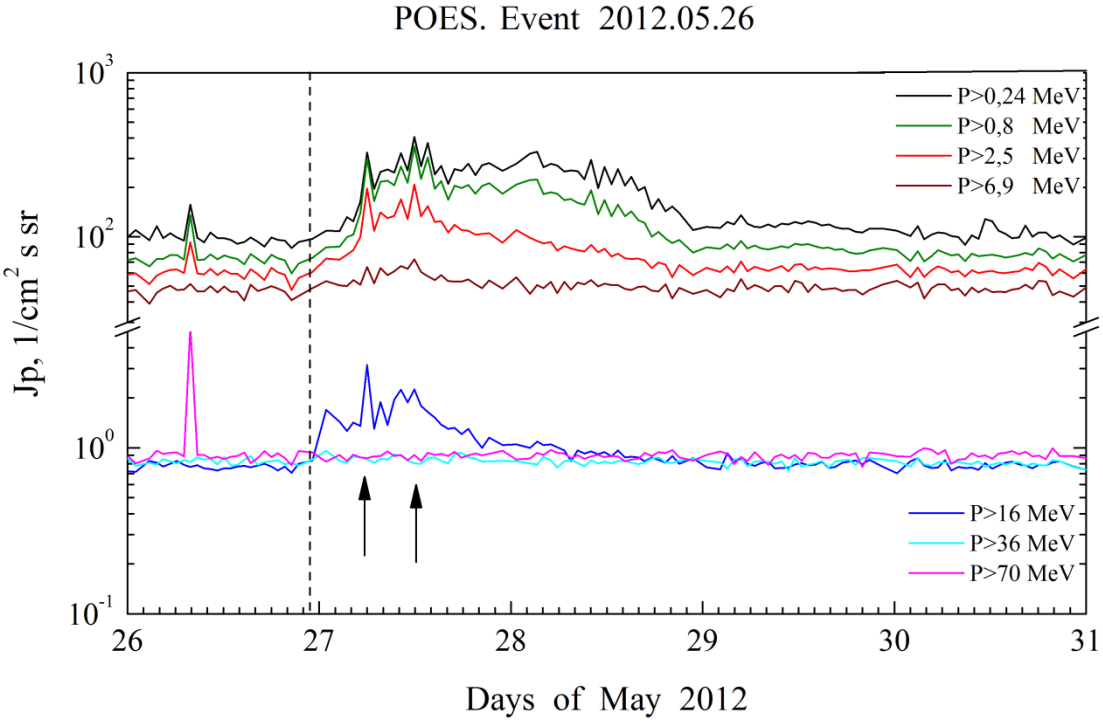



GOES. Event 2012.05.26
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of May 2012


Electro. Event 2012.05.26
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of May 2012

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 May 26

2012 May 26 ⊡ ARXXXXX To event 511

Hα, X-ray		To	Tmax	Te	Location	Importance Class	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event on visible solar disc					

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	2057	1966	-159.2	360˚	291˚	SOHO

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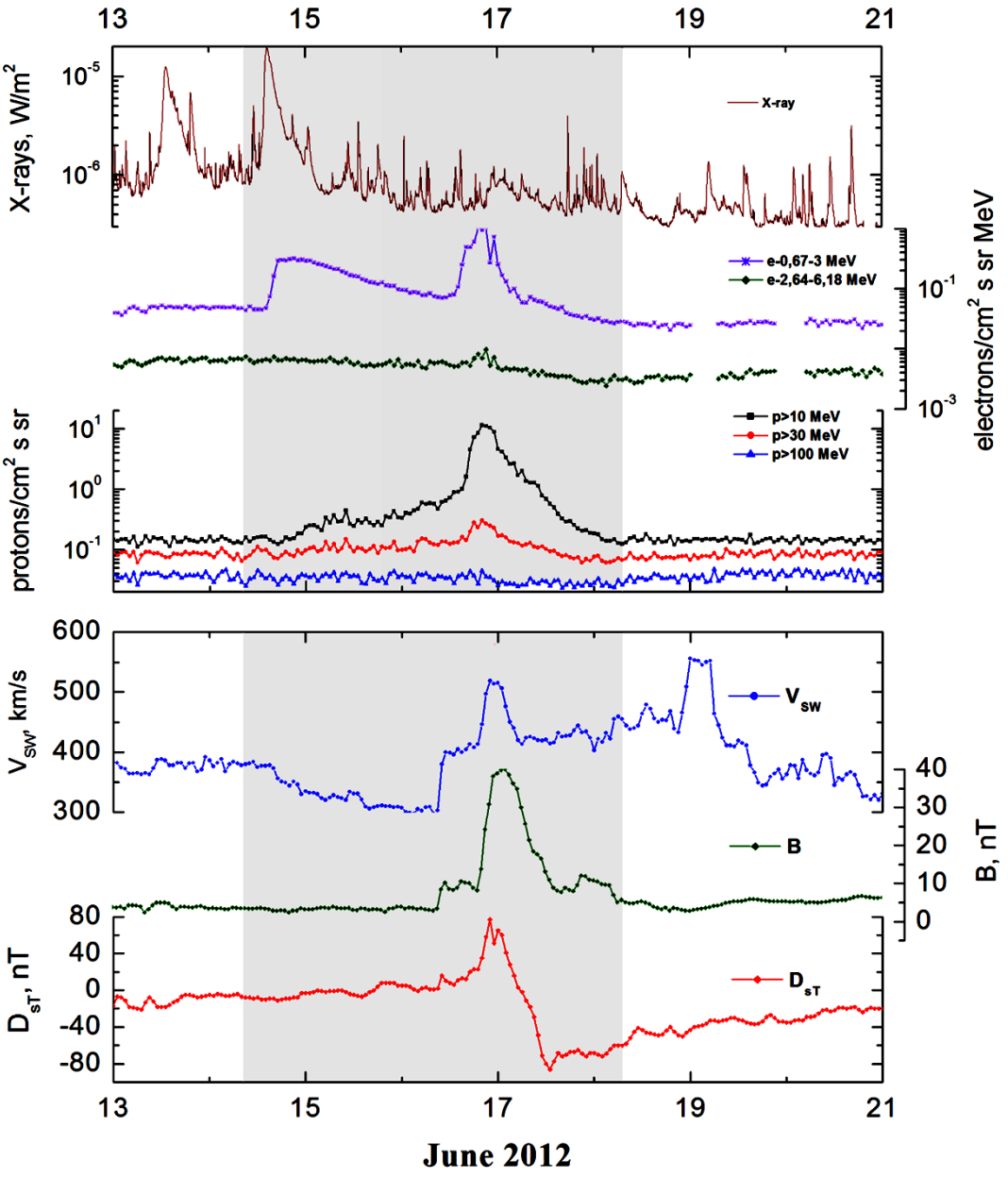
NOAA SPE, 2019.
Núñez M., T. Nieves-Chinchilla, and A. Pulkkinen, 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Wang Y., D. Lyu, B. Xiao et al., 2021.
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2012.06.14 – (2012-166) **512**

Particle event: To(Ep>10 MeV) – 14d18^h
Tmax (Ep>10 MeV) – 16d21^h, Jmax (Ep>10 MeV) – 11 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ = 3.0
Quasimaximal energy of protons in the event – Eqm = 90 MeV

Sources: ● solar flare 14d12^{h}52^m, M1.9/1N, S17E06, AR11504
Main burst X-ray 1–8 Å: onset – 14d12^{h}52^m, max – 14d14h35^m, Φ = 0.12 J/m^2
CME: 14d14^{h}12^m, V= 987 km/s, Δφ = 360º, dA= 144º
▲SC 16d09^{h}56^m; ▲SC 16d20^{h}20^m; ▲SC 16d21^{h}15^m

Particle fluxes and associated phenomena

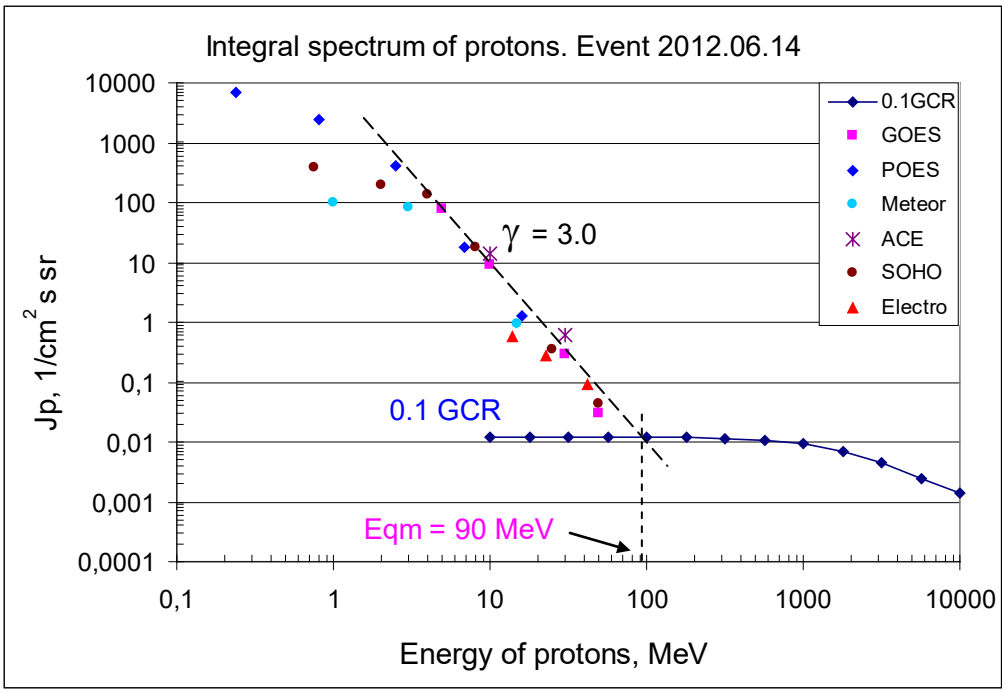


Integral fluxes of protons for the event of 2012 June 14

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	16d21	77.5	3	0.2	
EPS	>10	18	16d21	11	2	0.15	
EPS	>30	18	16d20	0.3	1	0.09	
EPS	>50	18	16d20	0.03	0.5	0.07	
EPS	>60	18	-	-	-	0.05	
EPS	>100	18	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	22	16d20	6800	3	95	
MEPED	>0.8	22	16d20	2430	3	75	
MEPED	>2.5	22	16d20	405	2	60	
MEPED	>6.9	22	16d20	17.8	1	50	
MEPED	>16	-	16d20	1.3	0.5	0.9	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	1	
MEPED	>140	-	-	-	-	1.2	
Meteor-1							
SCR	>1	22	16d22	102	3	2.4	
SCR	>3	22	16d22	82	3	2.4	
SCR	>10	22	-	-	0.5	1.5	
GALS-M	>15	22	16d22	0.92	0.5	1.3	
GALS-M	>25	-	-	-		1.3	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	18	16d18	14	2	1.4	
SIS	>30	18	16d18	0.6	2	1	
SOHO							
EPHIN	>50	-	16d21	0.05	-	0.3	

Differential fluxes of protons for the event of 2012 June 14

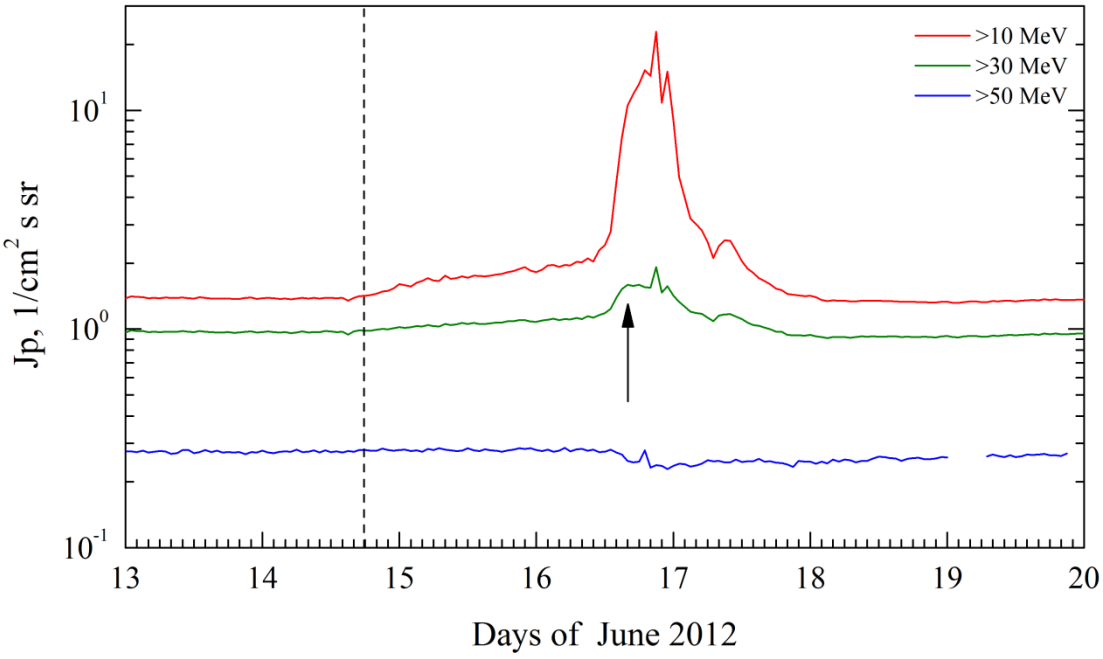
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	16	16d21	154	8	0.01	
LION	2 – 6	16	16d21	19.4	8	0.002	
EPHIN	4 – 8	16	16d20	28.7	8	0.0004	
EPHIN	8 – 25	16	16d20	1.05	8	0.00003	
EPHIN	25 – 53	16	16d21	0.013	3	0.00002	
Electro-1							
SCR-E	13.7–23	-	16d19	0.031	0.5	0.004	
SCR-E	23–42	-	16d19	0.01	0.5	0.025	
SCR-E	42–112	-	16d19	0.0014	0.5	0.005	


Integral spectrum of protons. Event 2012.06.14
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
γ = 3.0
0.1 GCR
Eqm = 90 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

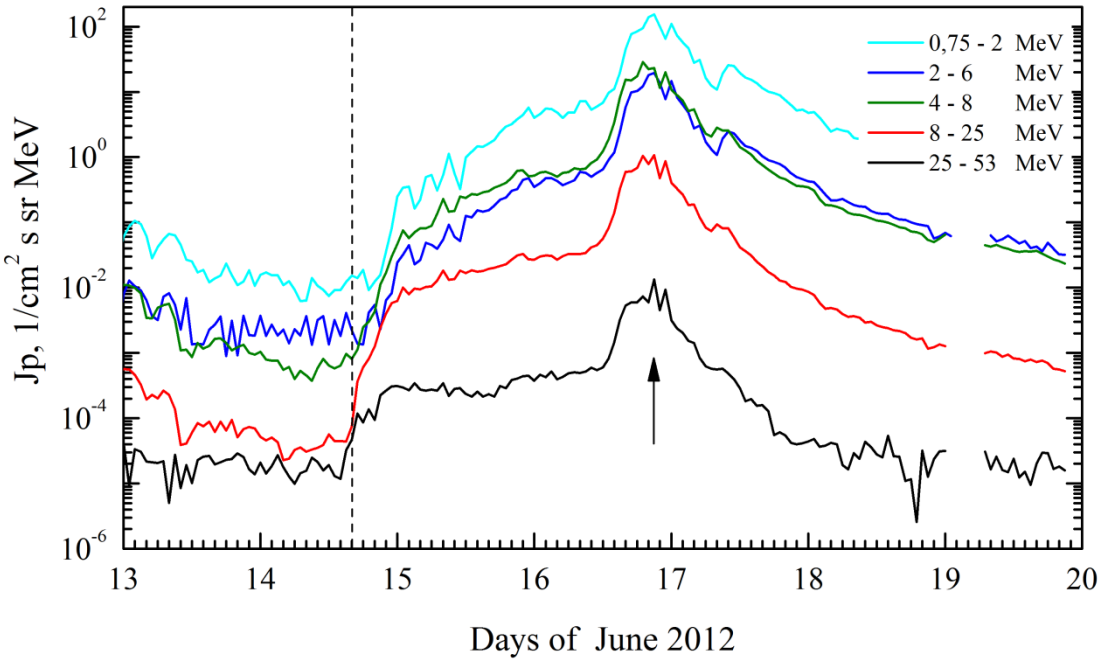
Time profiles of proton fluxes in the event 2012.06.14

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

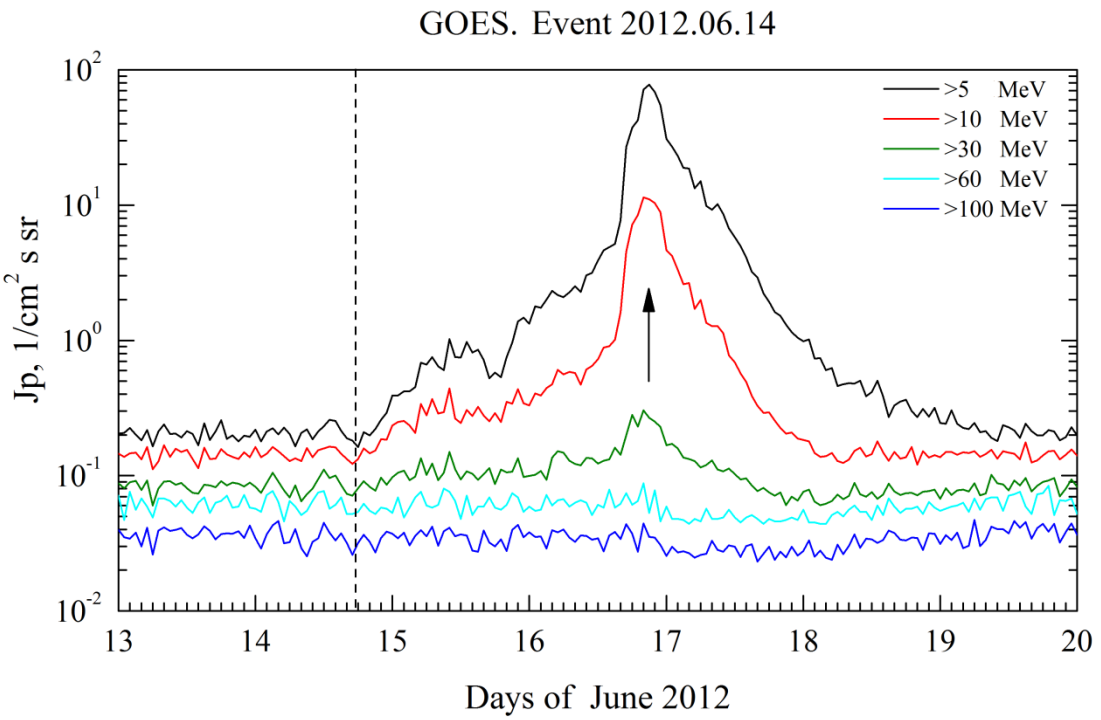
ACE SIS + SOHO (>50 MeV). Event 2012.06.14

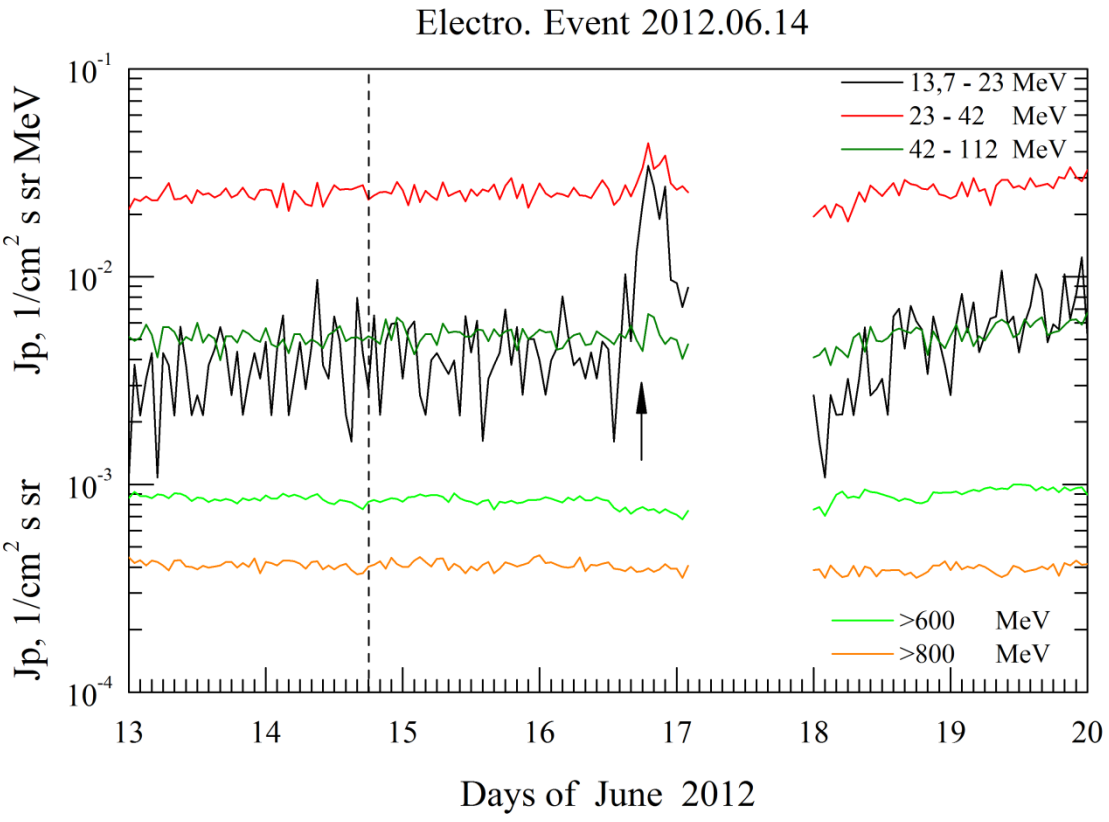


SOHO. Event 2012.06.14

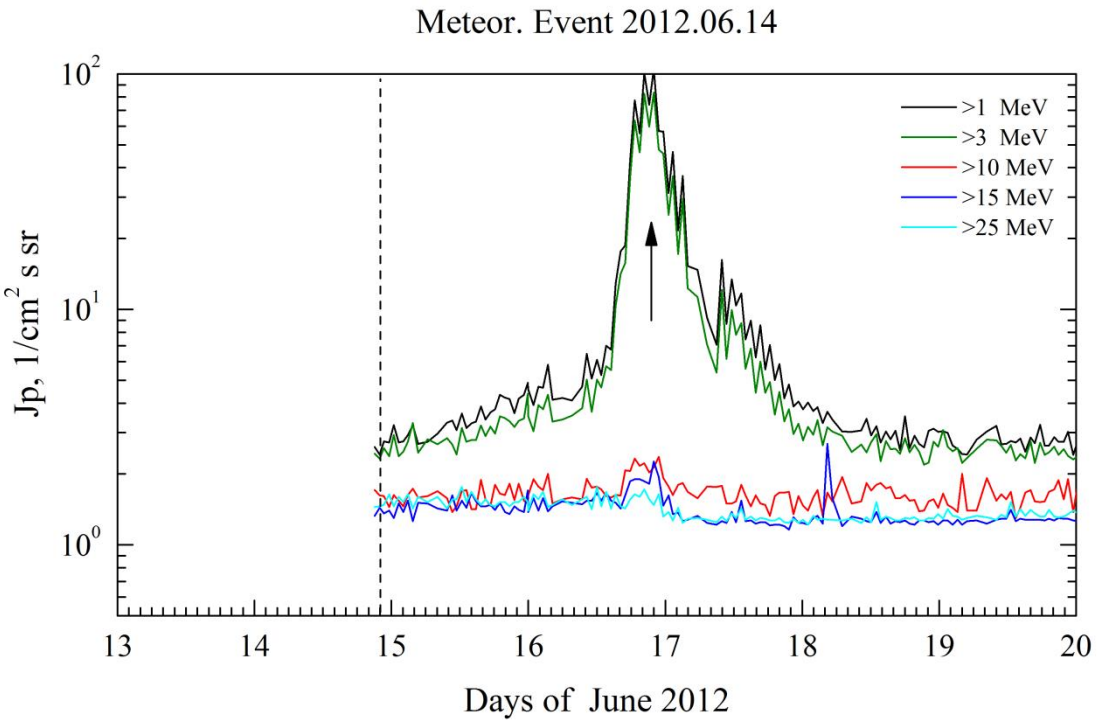


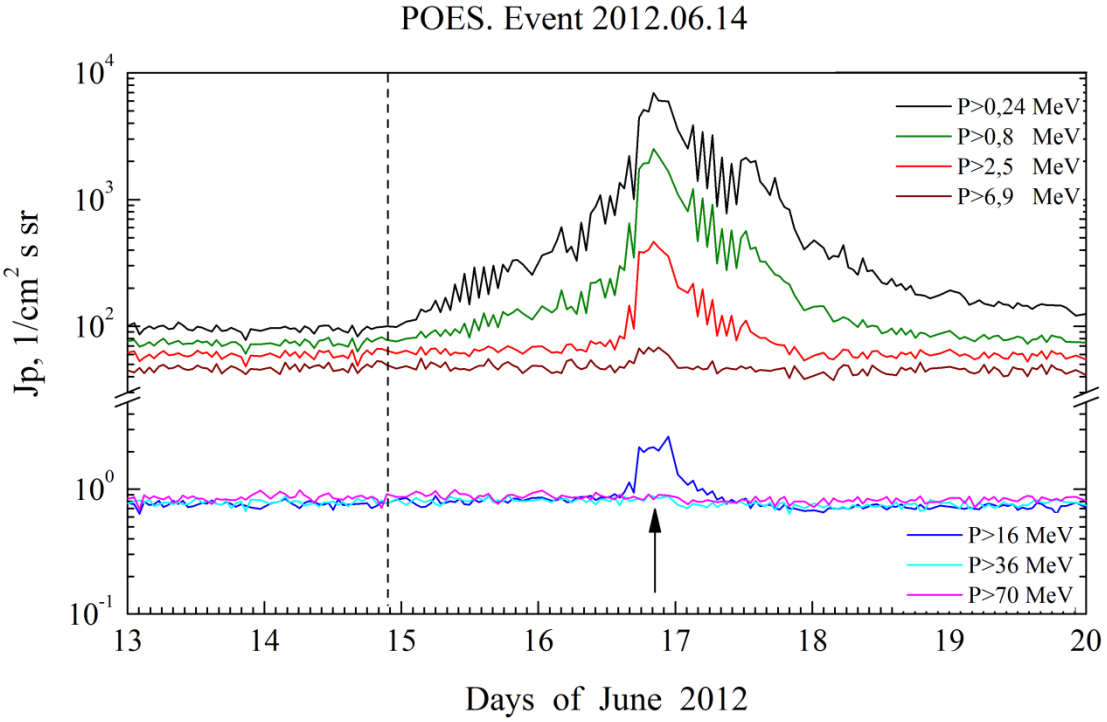
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 June 14

2012 June 14 ● AR 11504 To event 512

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1331	1402	>1724	S17E06	1N	ERU
1 – 12	keV	1252	1435	1556	S19E06	M1.9	0.12

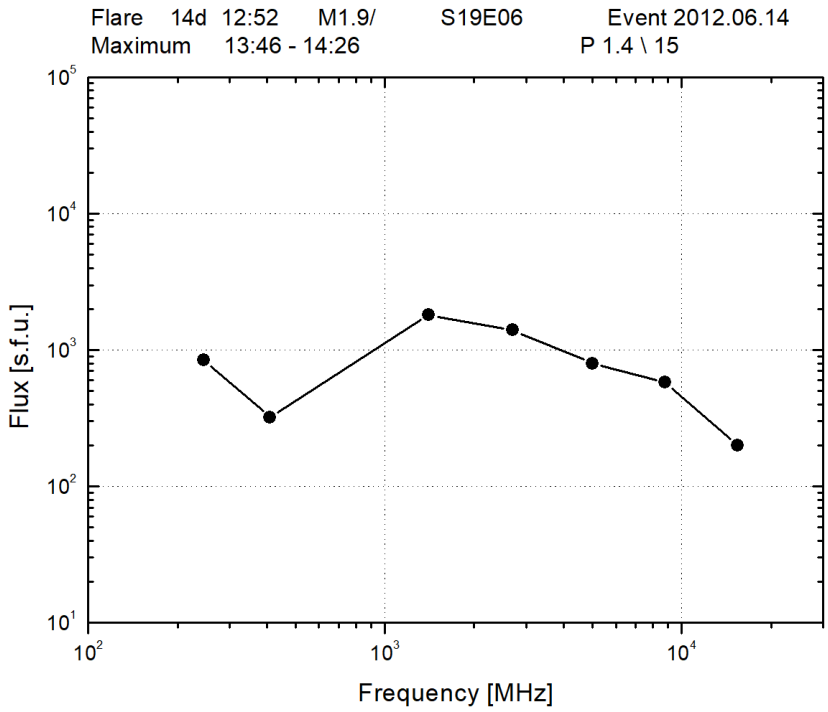
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1343:00	1354:08	1406:41	31309	72309998	FERMI
12-25	keV	1436:56	1448:16	1456:35	13194	2451640	FERMI
12-25	keV	1522:23	1529:00	1542:11	7645	1002322	FERMI
12-25	keV	1622:03	1639:32	1639:48	787	124775	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1353	1426	1452	P1.4 \ 15	2.3	
8.8	GHz	1348	1424	1518		2.76	
5	GHz	1151	1424	1210		2.9	
2.7	GHz	1151	1424	1216		3.15	
1.4	GHz	1341	1409	1510		3.26	
410	MHz	1339	1346	1527		2.5	
245	MHz	1342	1421	1512		2.92	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS IV	025-180	1349		1810		2	

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1412	987	-1.2	360˚	144˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR 11504 (S17L086, CMP 15,1.06.1.2012,
Sp=750 msh, EKC, BGD, R)
XRI=0.81 $M_5^{1.9}$+C_{39} 1_5+S_{42}
PFR1 9-10.06 (19^h) $M_3^{1.9}$
PFR2 13-14.06 (25^h) M_2^{19}

References:

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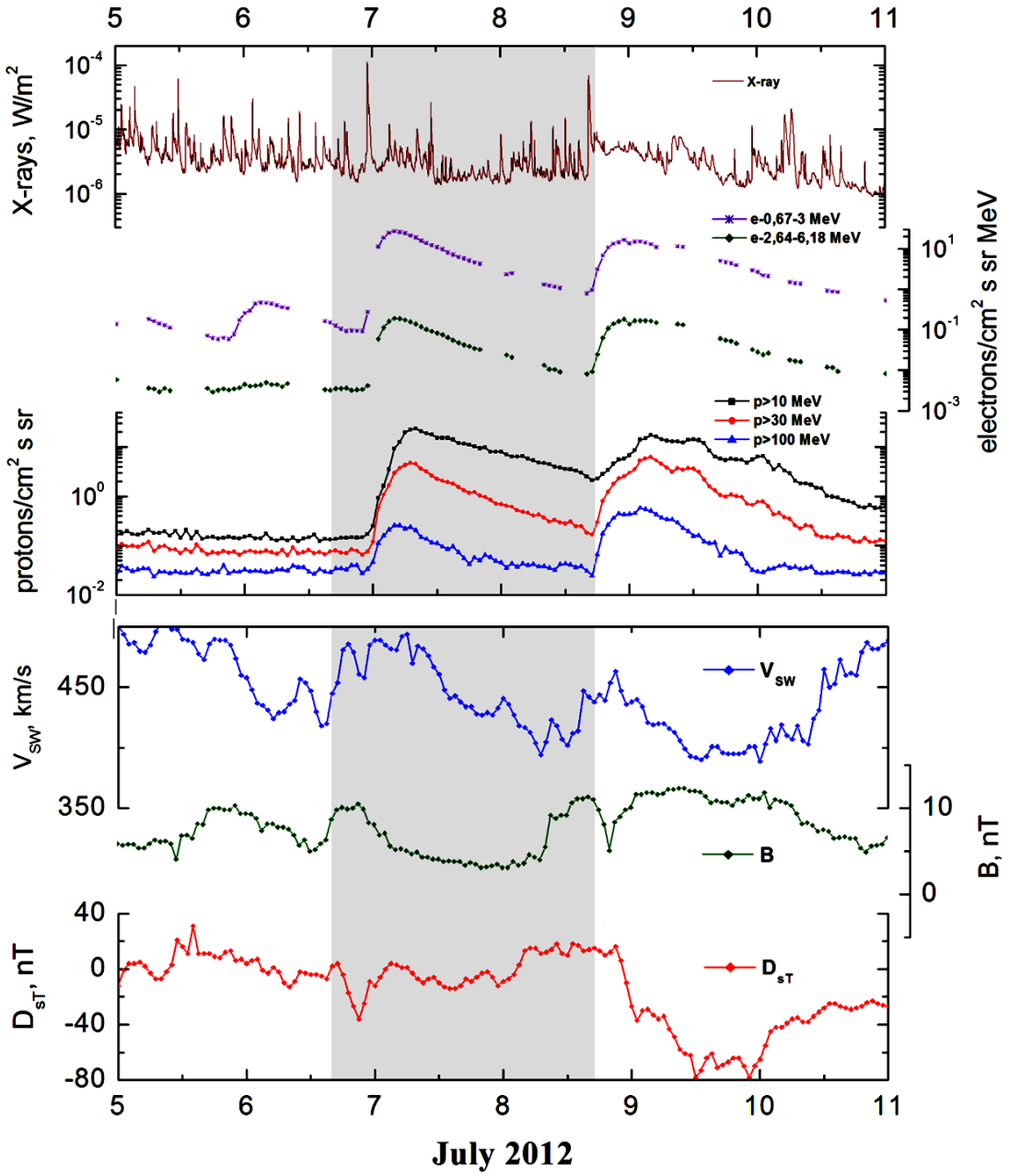
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
NOAA SPE, 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Temmer M., 2021.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 06d23^h
Tmax (Ep>10 MeV) – 07d08^h, Jmax (Ep>10 MeV) – 23 /cm^2·s·sr
Duration of the event – 1.7 days, power-law index: γ = 3.0
Quasimaximal energy of protons in the event – Eqm = 220 MeV

Sources: ● solar flare 06d23^{h}01^m, X1.1/, S13W59, AR11515
Main burst X-ray 1–8 Å: onset – 06d23^{h}01^m, max – 06d23^{h}08^m, Φ = 0.043 J/m^2
CME: 06d23^{h}24^m, V= 1828 km/s, Δφ = 360°, dA= 233°

Particle fluxes and associated phenomena

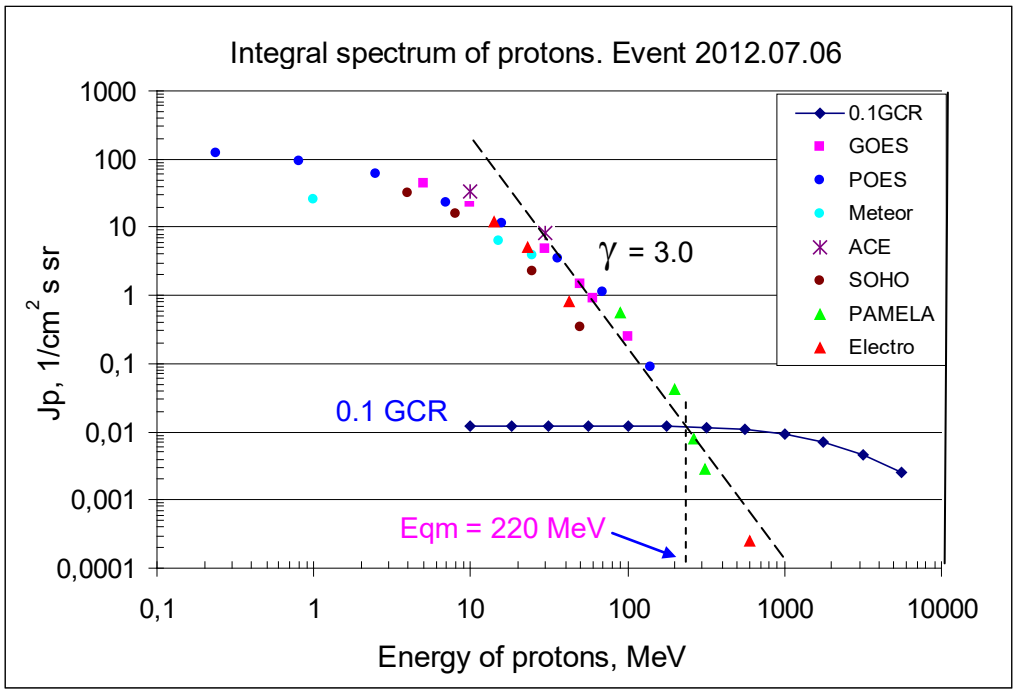


Integral fluxes of protons for the event of 2012 July 06

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	23	07d08	43.5	1.7	0.2	
EPS	>10	23	07d08	23	1.7	0.15	
EPS	>30	23	07d07	4.7	1.7	0.09	
EPS	>50	23	07d07	1.5	1.7	0.07	
EPS	>60	23	07d07	0.9	1.7	0.05	
EPS	>100	23	07d05	0.25	1.7	0.04	
Electro-1							
GALS-E	>600	23	07d04	0.00025	1	0.0009	
POES							
MEPED	>0.24	23	07d08	121	1.5	100	
MEPED	>0.8	23	07d08	94	1.5	75	
MEPED	>2.5	23	07d08	62	1.5	55	
MEPED	>6.9	23	07d08	22.8	1.5	50	
MEPED	>16	23	07d07	11.6	1.5	0.9	
MEPED	>36	23	07d07	3.54	1	0.8	
MEPED	>70	23	07d07	1.1	1	0.8	
MEPED	>140	-	07d07	0.09	0.5	1.1	
Meteor-1							
SCR1	>1	23	07d07	26	1.5	2.7	
SCR1	>3	23	-	-	1.5	2.5	
SCR1	>10	23	-	-	1.5	1.6	
GALS-M	>15	23	07d04	6.2	1.5	1.3	
GALS-M	>25	23	07d04	3.8	1.5	1.4	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	23	07d07	33.5	2	1.4	
SIS	>30	23	07d06	8.2	2	1	
SOHO							
EPHIN	>50	07d01	07d06	0.34	2	0.25	
PAMELA							
TRACKER	>90	23	23-7d01	0.57	1	-	
TRACKER	>200	23	23-7d02	0.041	1	-	
TRACKER	>265	23	23-7d03	0.0078	1	-	
TRACKER	>312	23	23-7d04	0.0029	1		

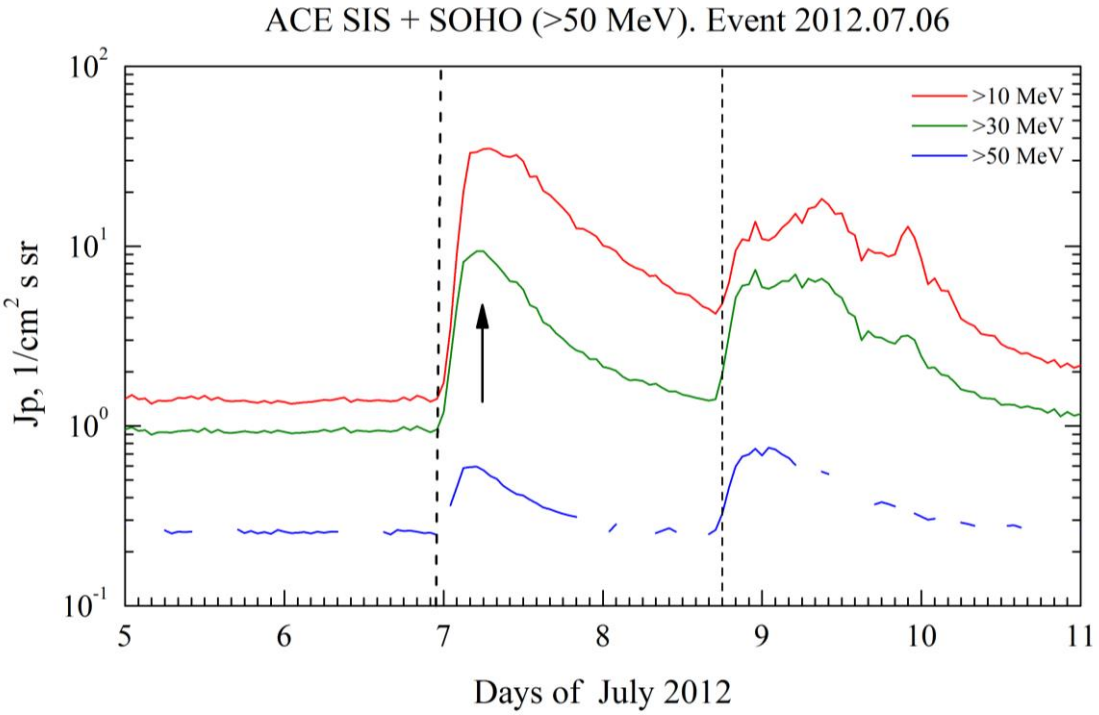
Differential fluxes of protons for the event of 2012 July 06

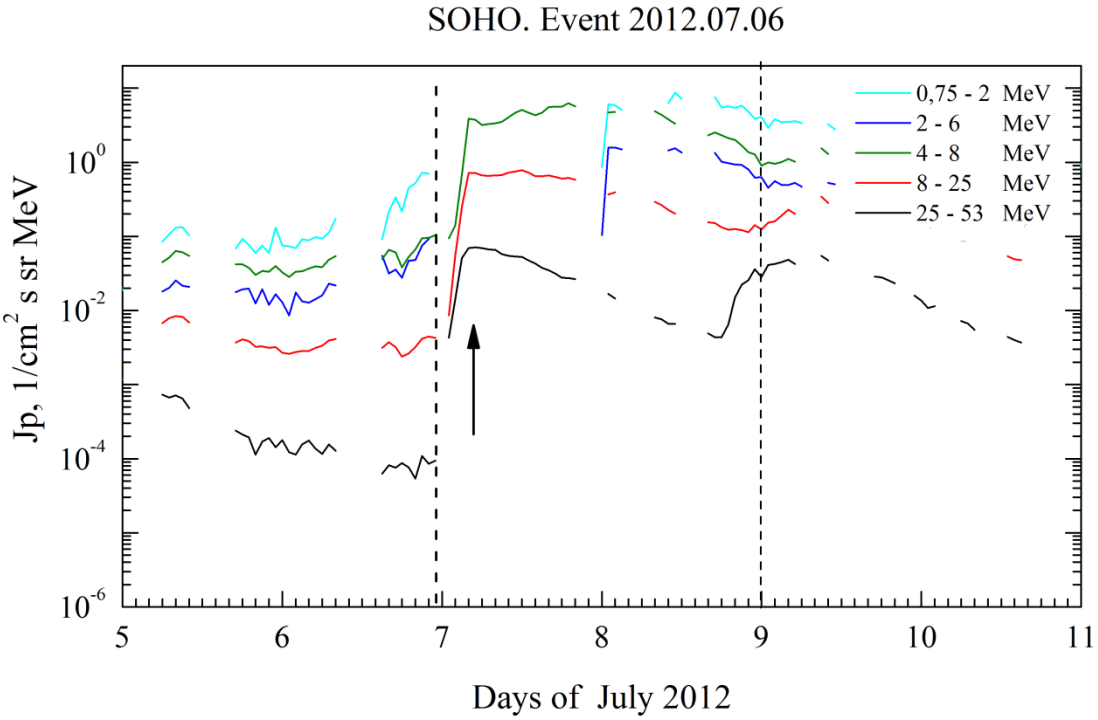
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	16	-	-	2	0.1	
LION	2 – 6	15	-	-	2	0.01	
EPHIN	4 – 8	24	07d05	4.1	2	0.03	
EPHIN	8 – 25	24	07d05	0.8	2	0.003	
EPHIN	25 – 53	07d01	07d07	0.07	2	0.00008	
Electro-1							
SCR-E	13.7–23	23	07d04	0.77	1.5	0.06	
SCR-E	23–42	23	07d04	0.22	1.5	0.025	
SCR-E	42–112	23	07d04	0.0117	1.5	0.005	

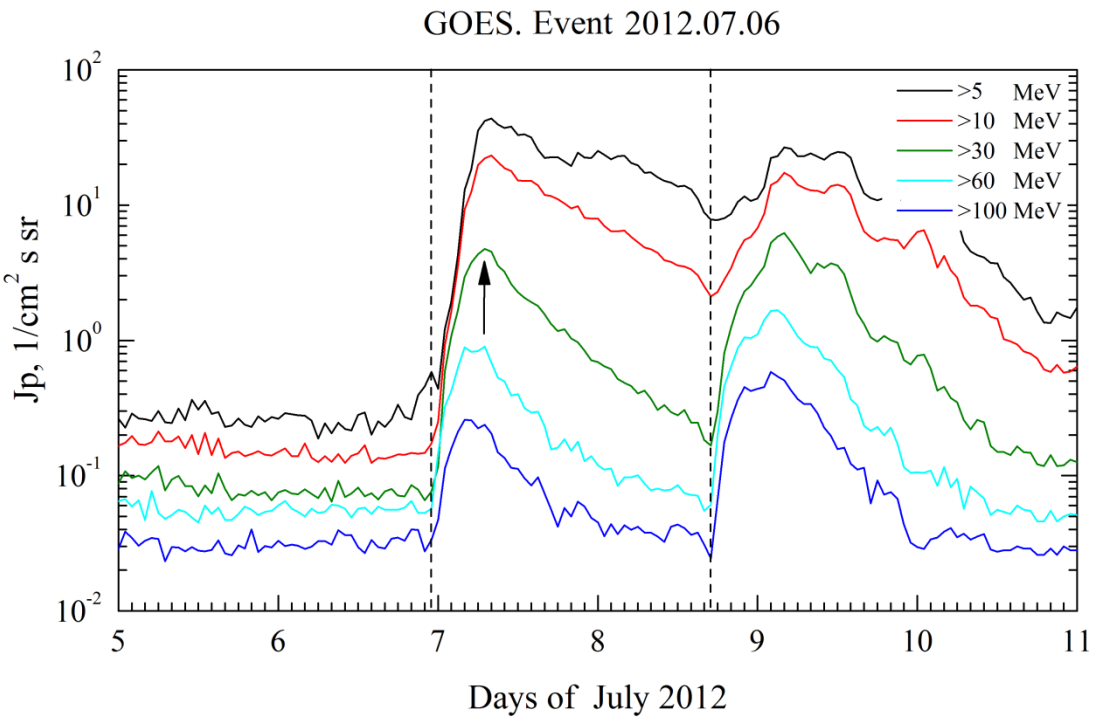


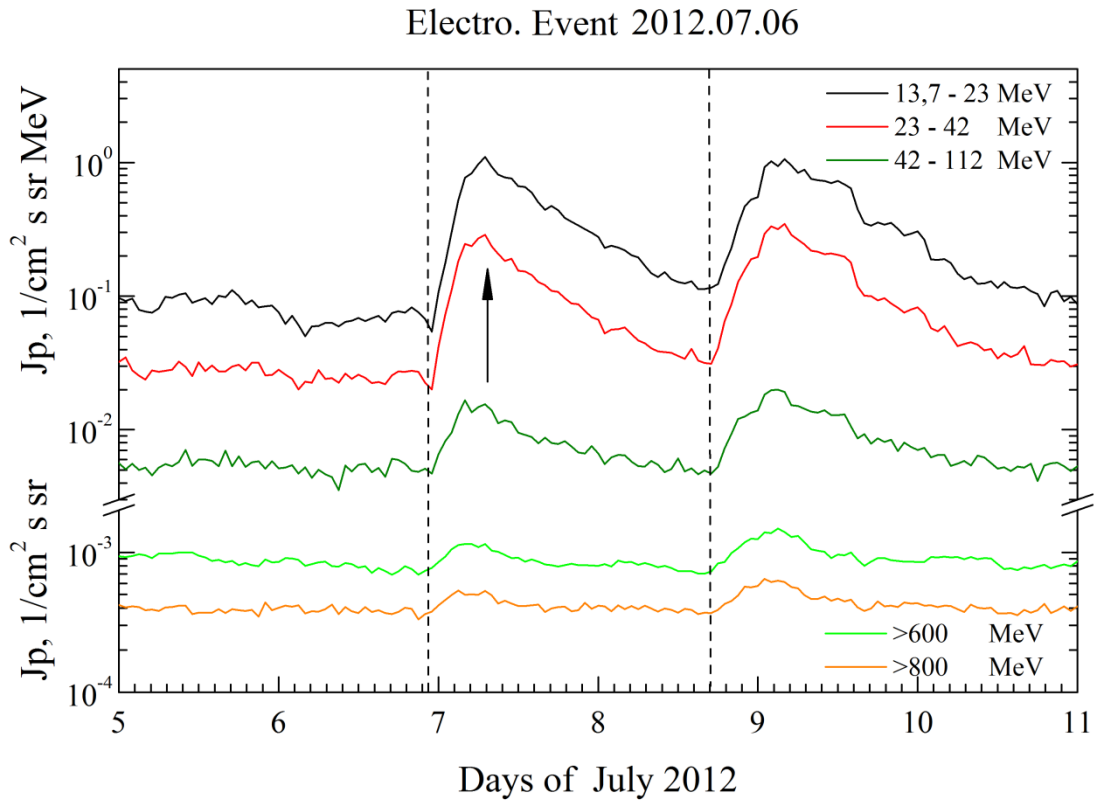
Time profiles of proton fluxes in the event 2012.07.06

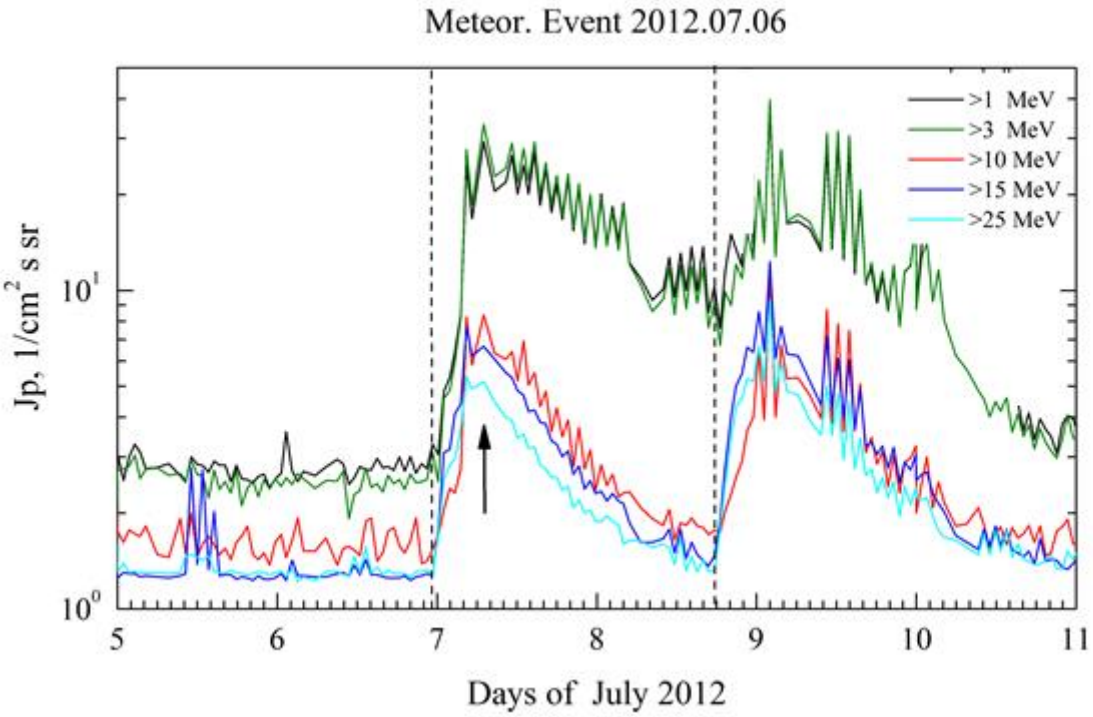
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

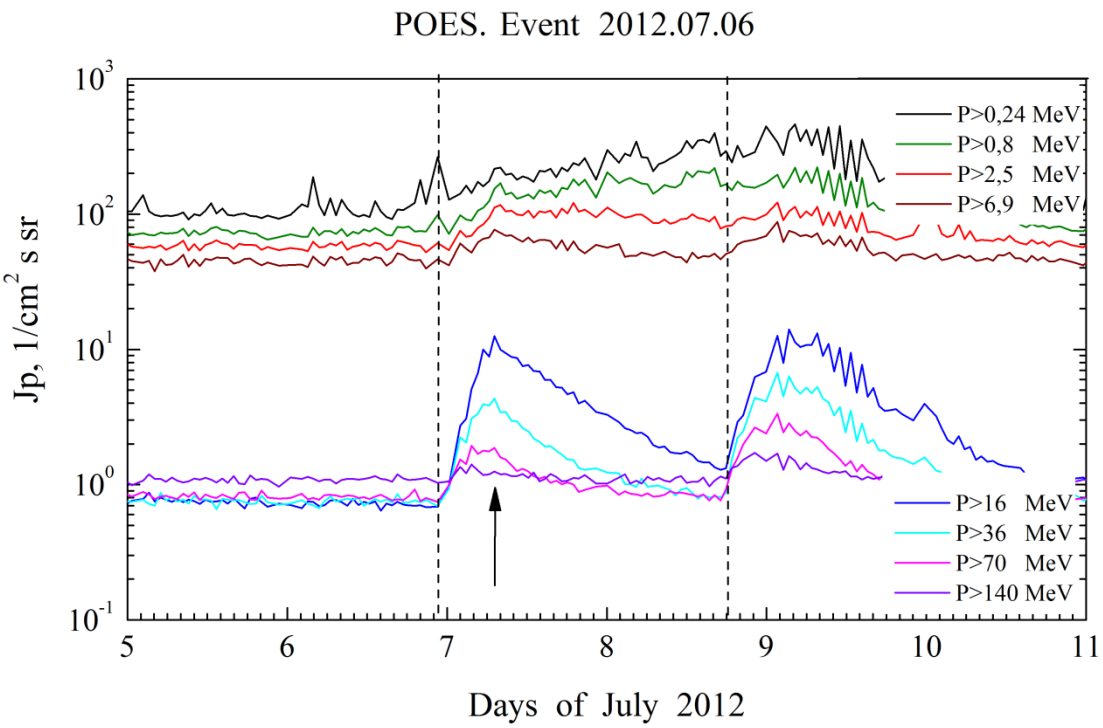





GOES. Event 2012.07.06
Jp, 1/cm² s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of July 2012


Electro. Event 2012.07.06
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of July 2012


Meteor. Event 2012.07.06
>1 MeV
>3 MeV
>10 MeV
>15 MeV
>25 MeV
Jp, 1/cm² s sr
10¹
10⁰
5
6
7
8
9
10
11
Days of July 2012


POES. Event 2012.07.06
P>0,24 MeV
P>0,8 MeV
P>2,5 MeV
P>6,9 MeV
P>16 MeV
P>36 MeV
P>70 MeV
P>140 MeV
Jp, 1/cm² s sr
10³
10²
10¹
10⁰
10⁻¹
5
6
7
8
9
10
11
Days of July 2012

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 July 06

2012 July 06 ● AR 11515 To event 513

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	No optical flare on visible disk					
1 – 12	keV	2301	2308	2314	S13W59	X1.1	0.043

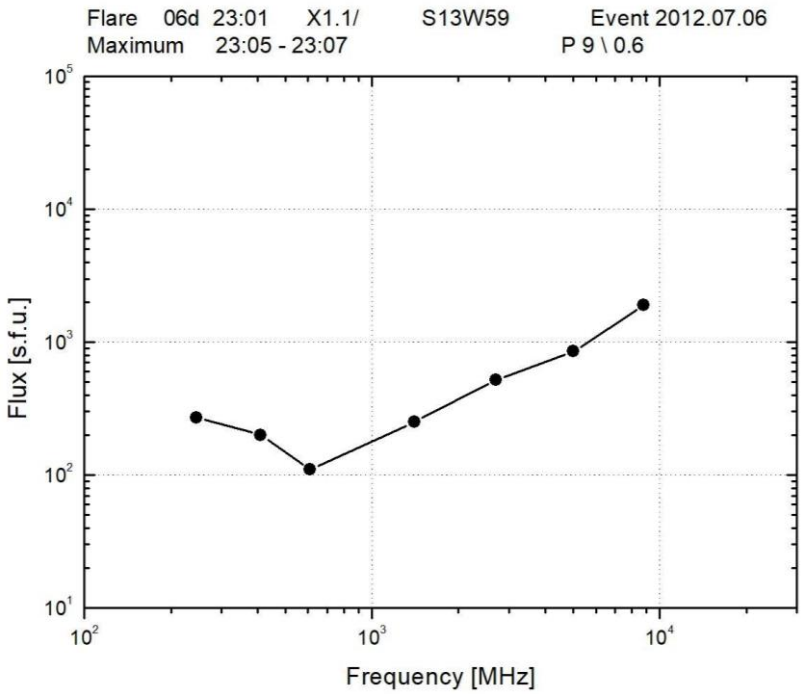
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	2330:52	2331:30	2341:04	336	320339	HESSI
12-25	keV	2341:04	2342:46	2355:32	34	66041	HESSI
12-25	keV	2315:30	2328:53	2349:40	134932	2210129	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
8.8	GHz	2303	2306	2323	P9 \ 0.6	3.28	
5	GHz	2304	2305	2311		2.93	
2.7	GHz	2304	2305	2309		2.72	
1.4	GHz	2304	2305	2309		2.4	
610	MHz	2305	2306	2307		2.04	
410	MHz	2306	2307	2307		2.3	
245	MHz	2305	2306	2307		2.43	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-180	2309		2321	1771	3	
DS IV	052-180	2322		2338		1	
DS III	025-180	2304		2307		2	
DS V	025-180	2304		2309		3	
DH II	0.3-16	2310		07d2314			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2324	1828	-56.1	360˚	233˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11515 (S16L205, CMP 3.3.07.2012,
Sp= 900 msh, FKC, BGD, R)
XRI=8.5; $X_1^{1.1}$+$M_{30}^{6.9}$+C_{72} 3_1+2_5+1_{21}+S_{165}
PFR1 2-5.07 (73^h) $M_{16}^{6.2}$;
PFR2 6-8.07 (9^h) $X_1^{1.1}$+$M_5^{6.9}$

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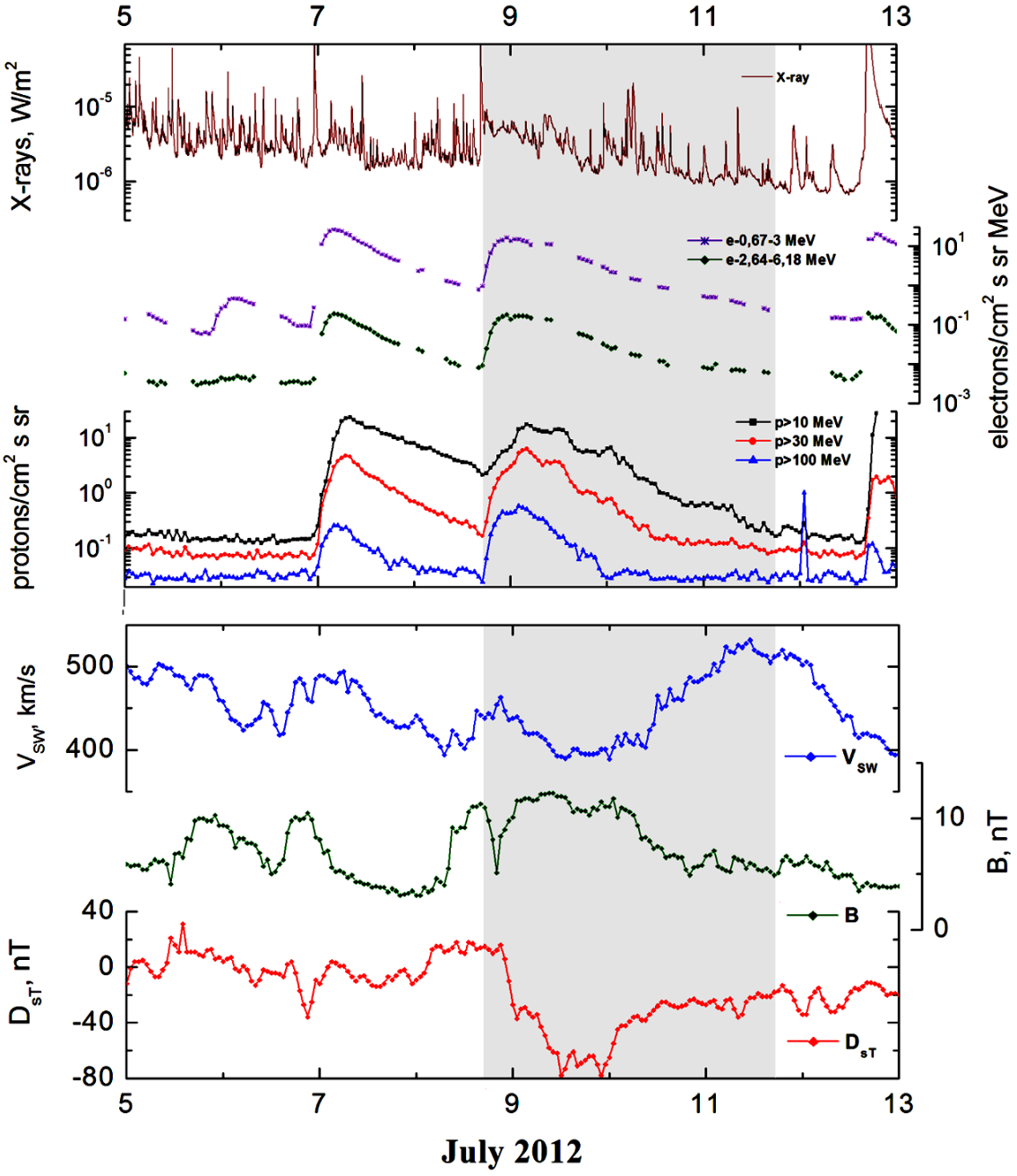
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.
Zuccarello F., I. Ermolli, M.B. Korsos et al., 2021.

Particle event: To(Ep>10 MeV) – 08d16^h
Tmax (Ep>10 MeV) – 09d05^h, Jmax (Ep>10 MeV) – 17 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ = 2.2
Quasimaximal energy of protons in the event – Eqm = 550 MeV

Sources: ■ solar flare 08d16^{h}23^m, M6.9/1N, S14W83, AR11515
Main burst X-ray 1–8 Å: onset – 08d16^{h}23^m, max – 08d16^{h}32^m, Φ = 0.045 J/m^2
CME: 08d16^{h}54^m, V= 1495 km/s, Δφ = 157°, dA= 234°

Particle fluxes and associated phenomena

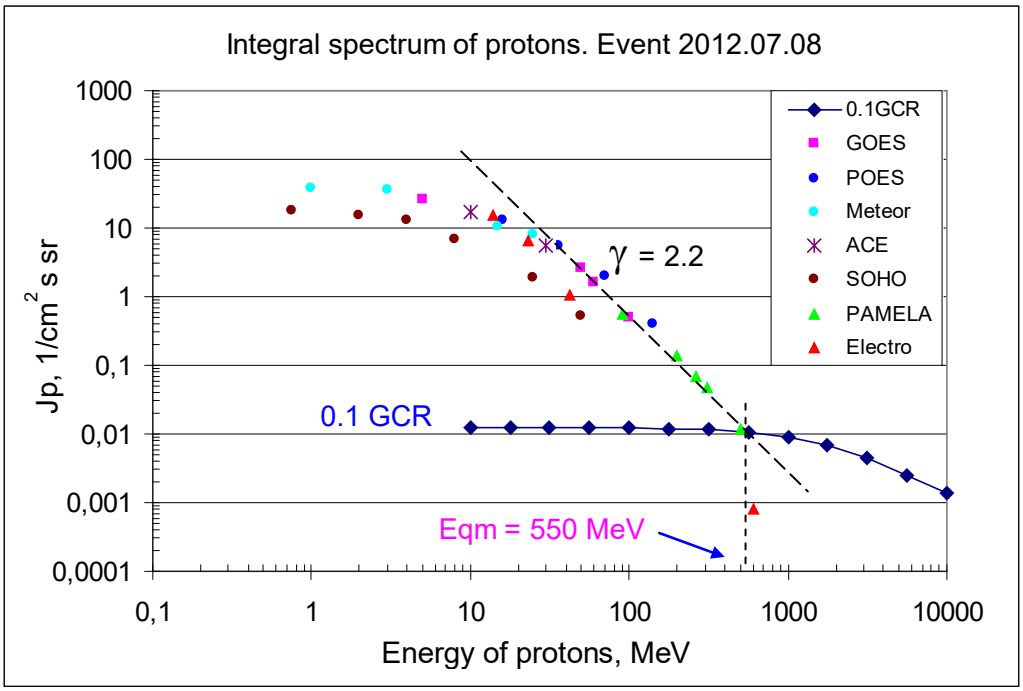


Integral fluxes of protons for the event of 2012 July 08

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	16	09d05	26.8	3	0.2	
EPS	>10	16	09d05	17	3	0.15	
EPS	>30	16	09d05	6.2	2	0.09	
EPS	>50	16	09d04	2.6	2	0.07	
EPS	>60	16	09d04	1.6	2	0.05	
EPS	>100	16	09d02	0.50	1.5	0.04	
Electro-1							
GALS-E	>600	18	09d06	0.0008	1	0.0009	
POES							
MEPED	>0.24	-	-	-	-	100	
MEPED	>0.8	-	-	-	-	75	
MEPED	>2.5	-	-	-	-	55	
MEPED	>6.9	-	-	-	-	50	
MEPED	>16	18	09d03	13.1	1.5	0.9	
MEPED	>36	18	09d03	5.54	1.5	0.8	
MEPED	>70	18	09d03	2.05	1	0.8	
MEPED	>140	18	09d03	0.4	0.5	1.1	
Meteor-1							
SCR	>1	18	09d02	38.9	2	2.7	
SCR	>3	18	09d02	36.7	2	2.5	
SCR	>10	18	-	-	1.5	1.6	
GALS-M	>15	18	09d02	10.5	1.5	1.3	
GALS-M	>25	18	09d02	8.0	1.5	1.4	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	18	09d09	17	2	1.4	
SIS	>30	18	09d09	5.5	2	1	
SOHO							
EPHIN	>50	18	09d02	0.54	2	0.25	
PAMELA							
TRACKER	>90	18	18-9d01	0.56	3	-	
TRACKER	>200	18	18-9d02	0.14	2	-	
TRACKER	>265	18	18-9d03	0.069	1	-	
TRACKER	>312	18	18-9d04	0.048	1		
TRACKER	>500	18	18-9d05	0.012	1		

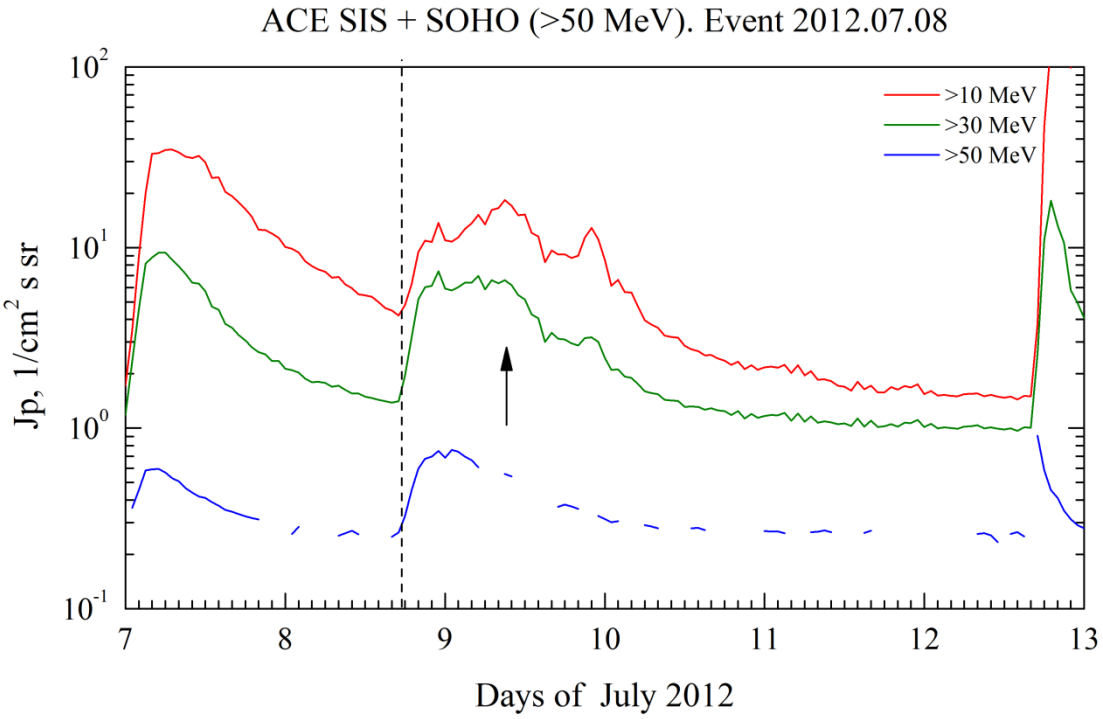
Differential fluxes of protons for the event of 2012 July 08

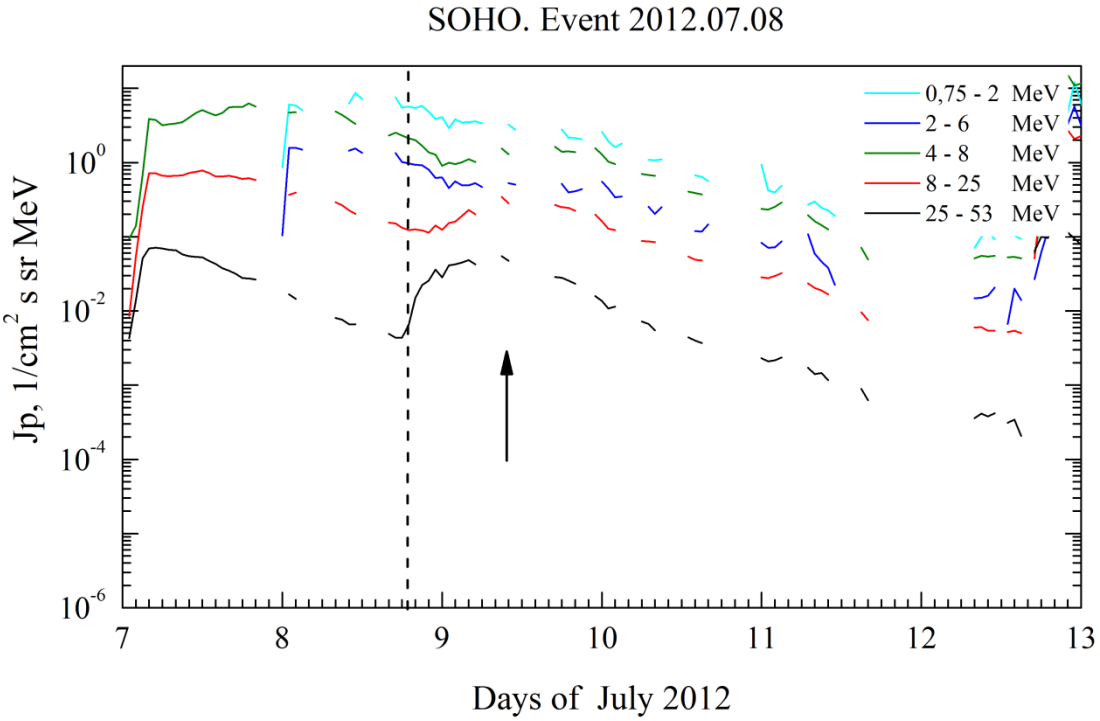
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	09d18	2.7	3	0.1	
LION	2 – 6	-	09d18	0.5	3	0.01	
EPHIN	4 – 8	-	09d18	1.55	3	0.03	
EPHIN	8 – 25	23	09d10	0. 3	3	0.003	
EPHIN	25 – 53	18	09d02	0.05	3	0.00008	
Electro-1							
SCR-E	13.7–23	18	09d06	0.96	1.5	0.06	
SCR-E	23–42	18	09d06	0.29	1.5	0.025	
SCR-E	42–112	18	09d06	0.015	1.5	0.005	

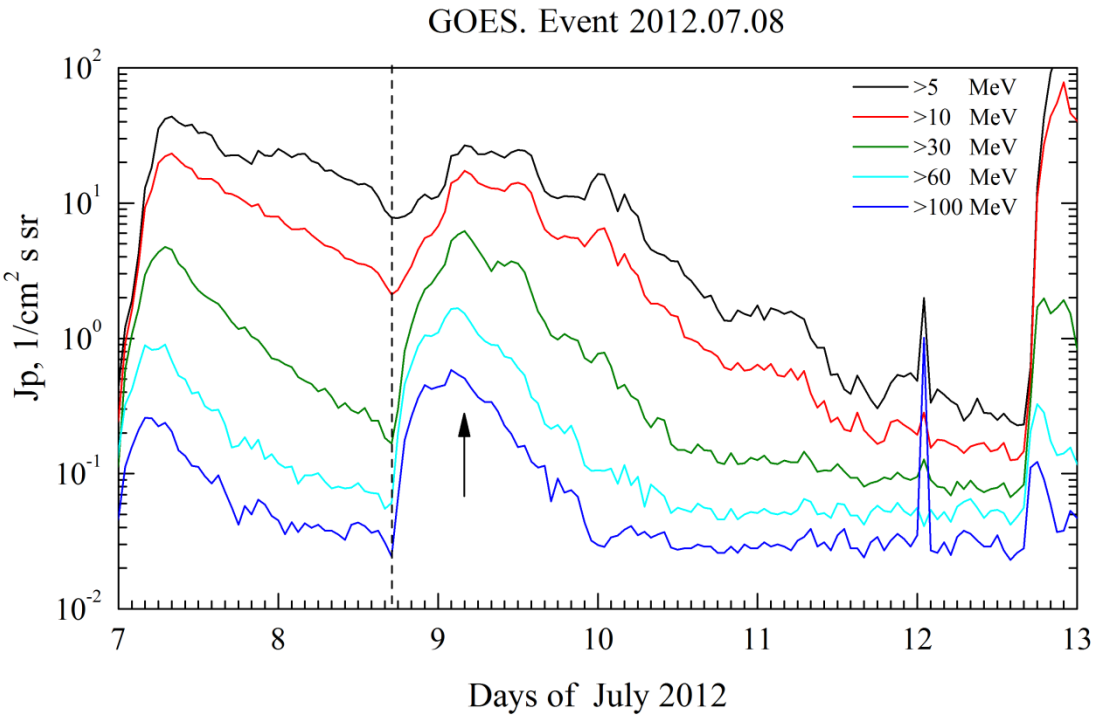


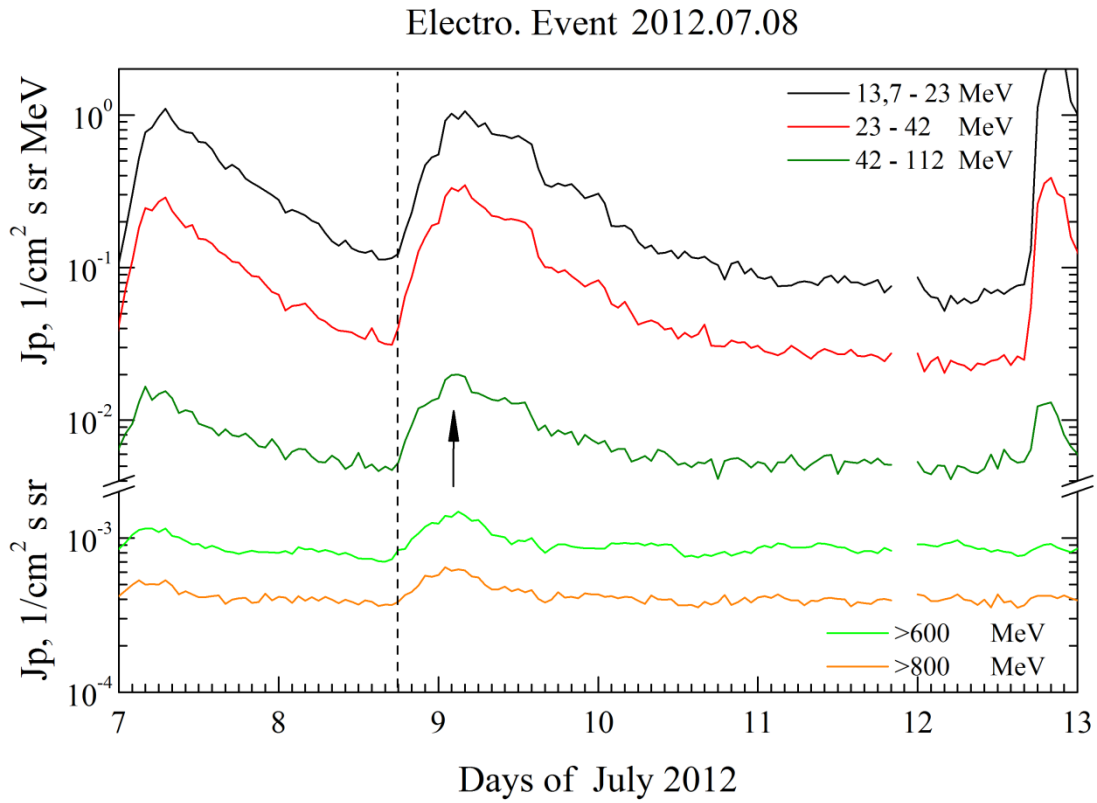
Time profiles of proton fluxes in the event 2012.07.08

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

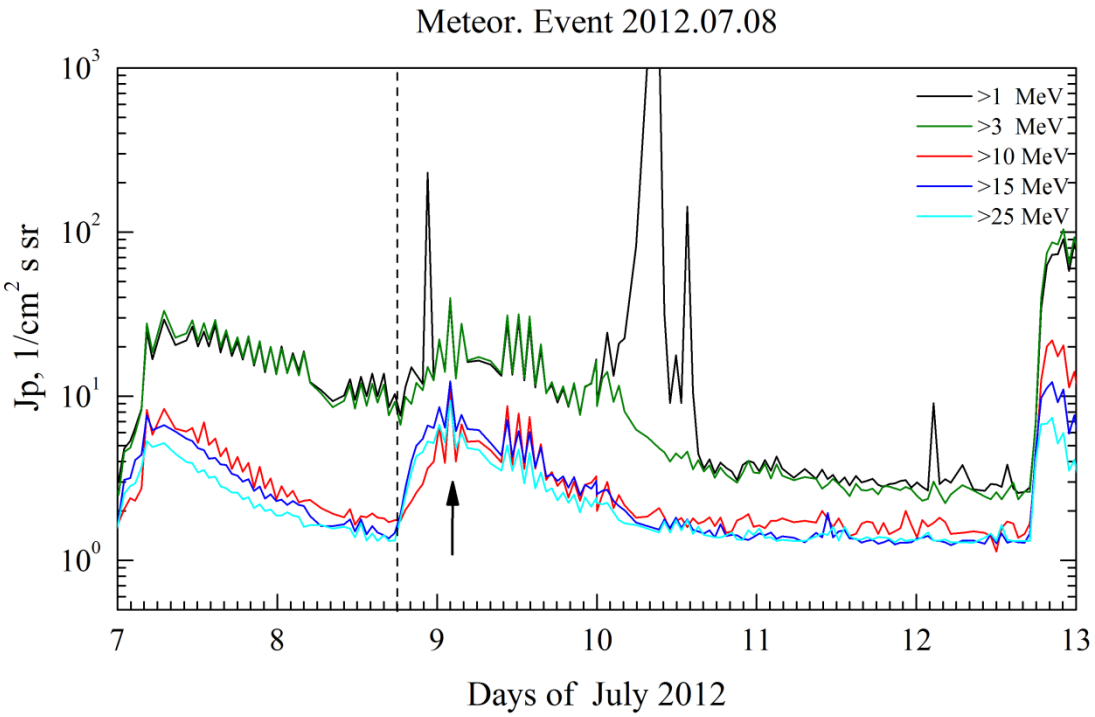


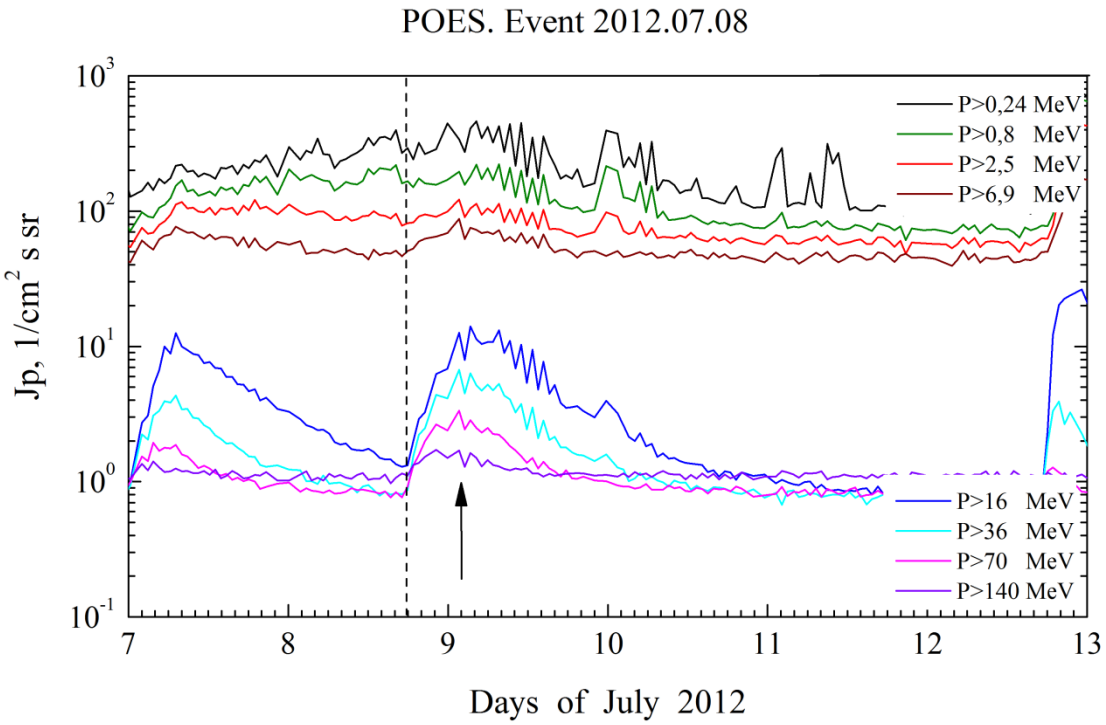



GOES. Event 2012.07.08
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of July 2012


Electro. Event 2012.07.08
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of July 2012

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 July 08

2012 July 08 ■ AR 11515 To event 514

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1623	1632	1646	S14W83	1N	ERU
1 – 12	keV	1623	1632	1642	S14W86	M6.9	0.045

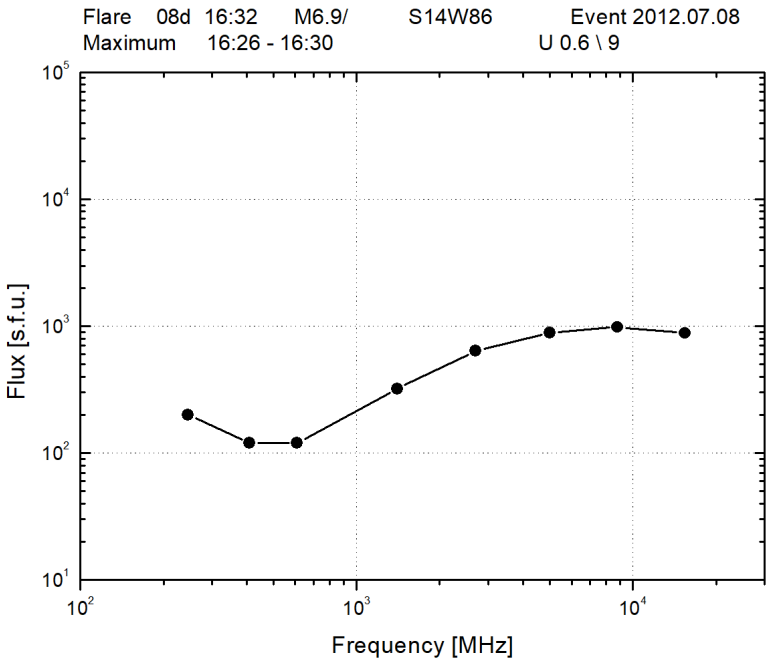
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1639:08	1640:24	1724:07	47563	12755956	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1625	1630	1634	U1.4 / 15	2.94	
8.8	GHz	1624	1627	1638		2.99	
5	GHz	1624	1627	1631		2.95	
2.7	GHz	1624	1627	1631		2.81	
1.4	GHz	1624	1627	1633		2.51	
610	MHz	1625	1627	1632		2.08	
410	MHz	1624	1627	1633		2.08	
245	MHz	1626	1626	1632		2.3	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	1630		1643	2711	2	
DH II	0.3-16	1635		2200			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1654	1495	-85.3	157˚	234˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11515 (S16L205, CMP 3.3.07.2012,
Sp= 900 msh, FKC, BGD, R)
XRI=8.5; $X_1^{1.1}$+$M_{30}^{6.9}$+C_{72} 3_1+2_5+1_{21}+S_{165}
PFR1 2-5.07 (73^h) $M_{16}^{6.2}$;
PFR2 6-8.07 (9^h) $X_1^{1.1}$+$M_5^{6.9}$

References:

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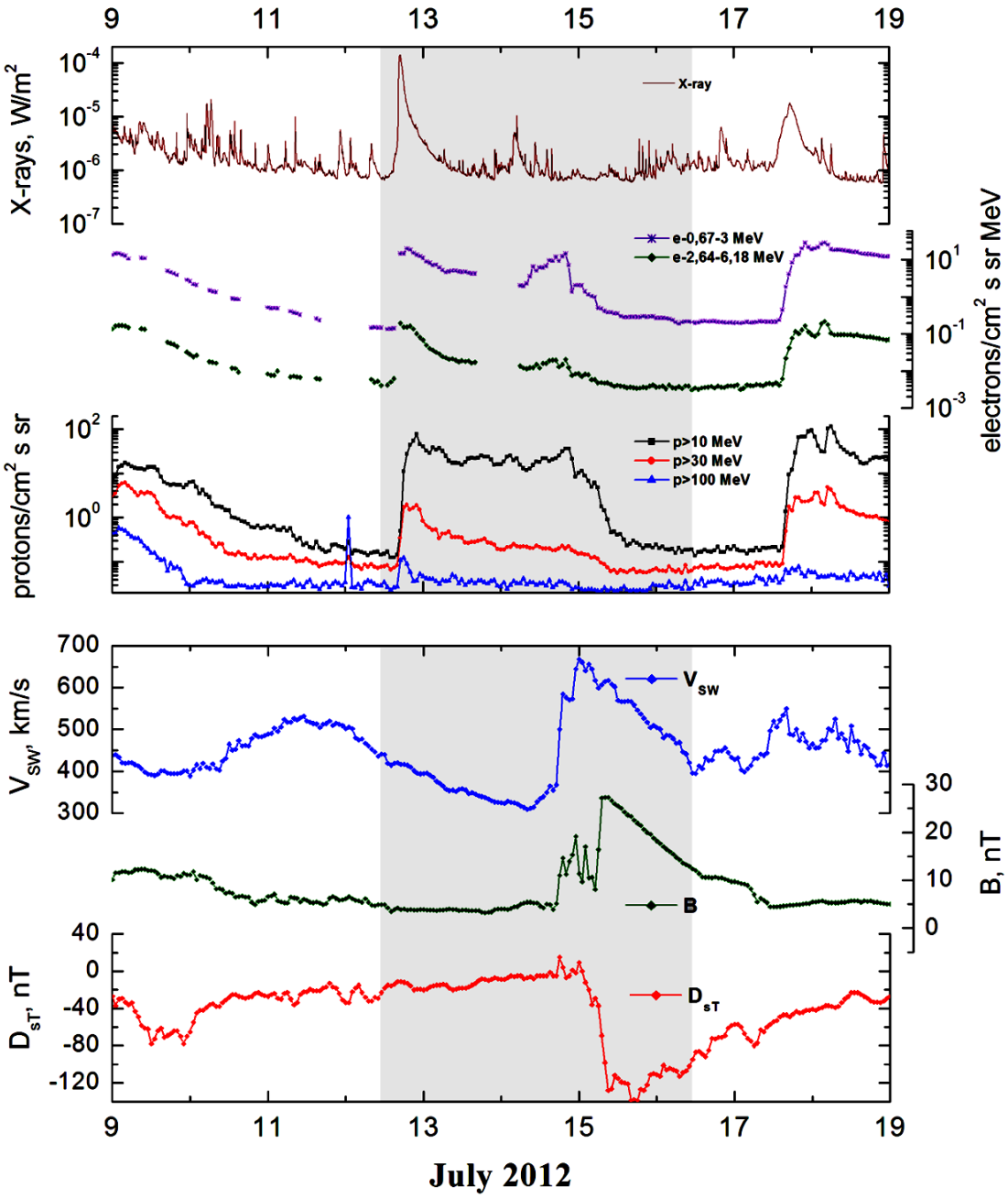
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.
Zhuang B., N. Lugaz, T. Gou, L. Ding, 2021.

Particle event: To(Ep>10 MeV) – 12d16^h
Tmax (Ep>10 MeV) – 12d22^h, Jmax (Ep>10 MeV) – 80 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ = 3.7
Quasimaximal energy of protons in the event – Eqm = 110 MeV

Sources: ● solar flare 12d15^{h}18^m, 2B/X1.4, S14W01, AR11520
Main burst X-ray 1–8 Å: onset – 12d15^{h}37^m, max – 12d16^{h}49^m, Φ = 0.46 J/m^2
CME: 12d16^{h}48^m, V= 0885 km/s, Δφ = 360º, dA= 158º
▲ SC 14d18^{h}09^m

Particle fluxes and associated phenomena

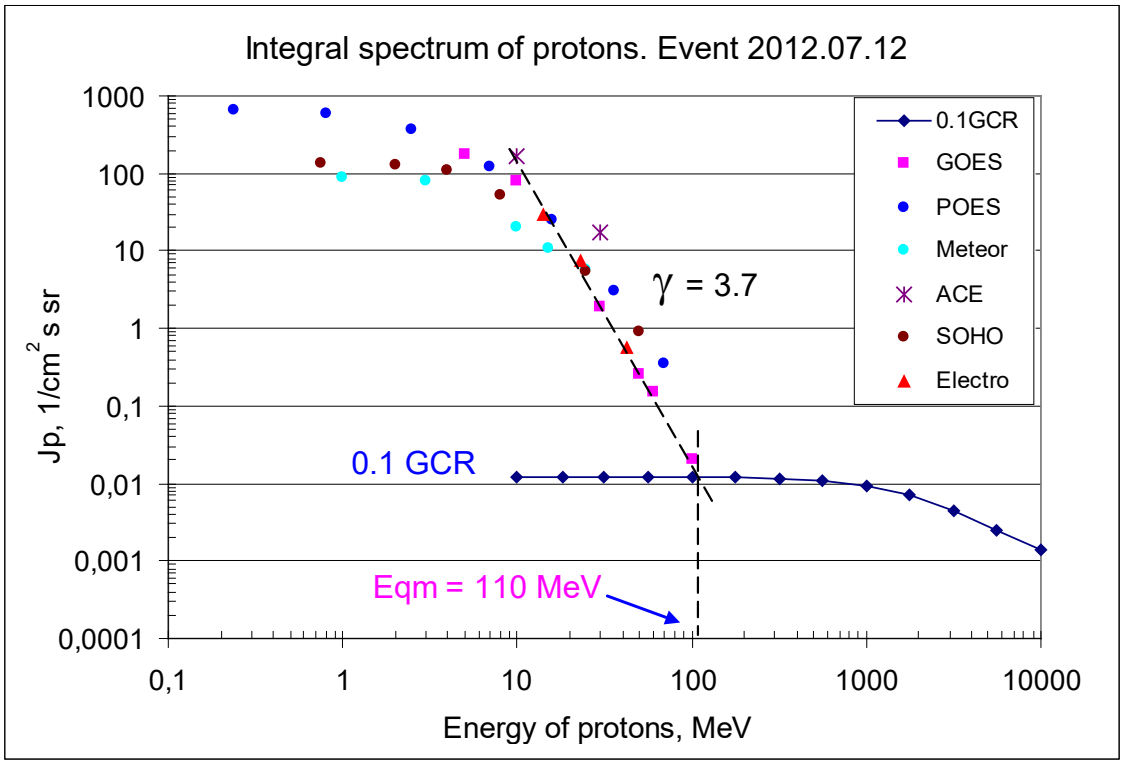


Integral fluxes of protons for the event of 2012 July 12

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	16	22	180	4	0.2	
EPS	>10	16	22	80	3	0.15	
EPS	>30	16	22	1.9	2.5	0.09	
EPS	>50	16	22	0.25	1	0.07	
EPS	>60	16	23	0.2	1	0.05	
EPS	>100	16	23	0.02	1	0.04	
Electro-1							
GALS-MP	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	18	23	640	3	100	
MEPED	>0.8	18	23	595	3	75	
MEPED	>2.5	18	23	375	3	55	
MEPED	>6.9	18	23	122	3	50	
MEPED	>16	18	23	25.5	2	0.9	
MEPED	>36	18	21	3.1	0.5	0.8	
MEPED	>70	18	20	0.36	0.3	0.8	
MEPED	>140	-	-	-	-	1.1	
Meteor-1							
SCR	>1	17	22	88	1.5	2.7	
SCR	>3	17	22	81	1.5	2.1	
SCR	>10	17	20	20	1	1.6	
GALS-M	>15	17	20	10.6	1	1.3	
GALS-M	>25	17	20	5.8	1	1.4	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	16	21	167	2.5	1.4	
SIS	>30	16	19	17	2.5	1	
SOHO							
EPHIN	>50	16	19	0.9	2.5	0.2	

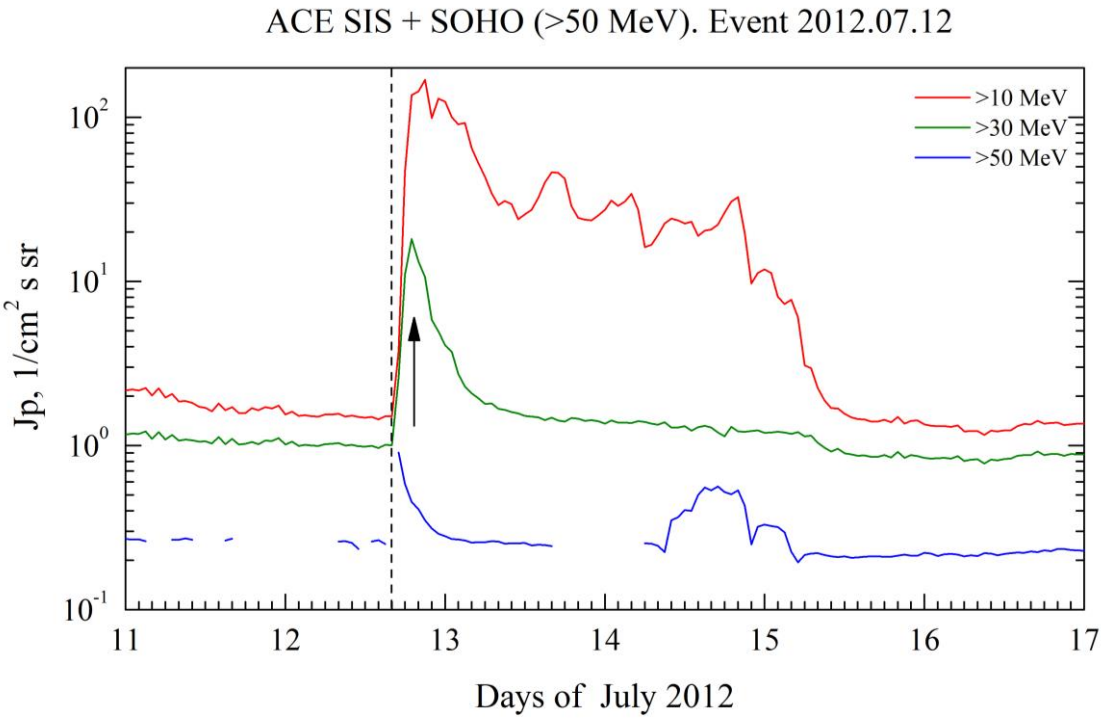
Differential fluxes of protons for the event of 2012 July 12

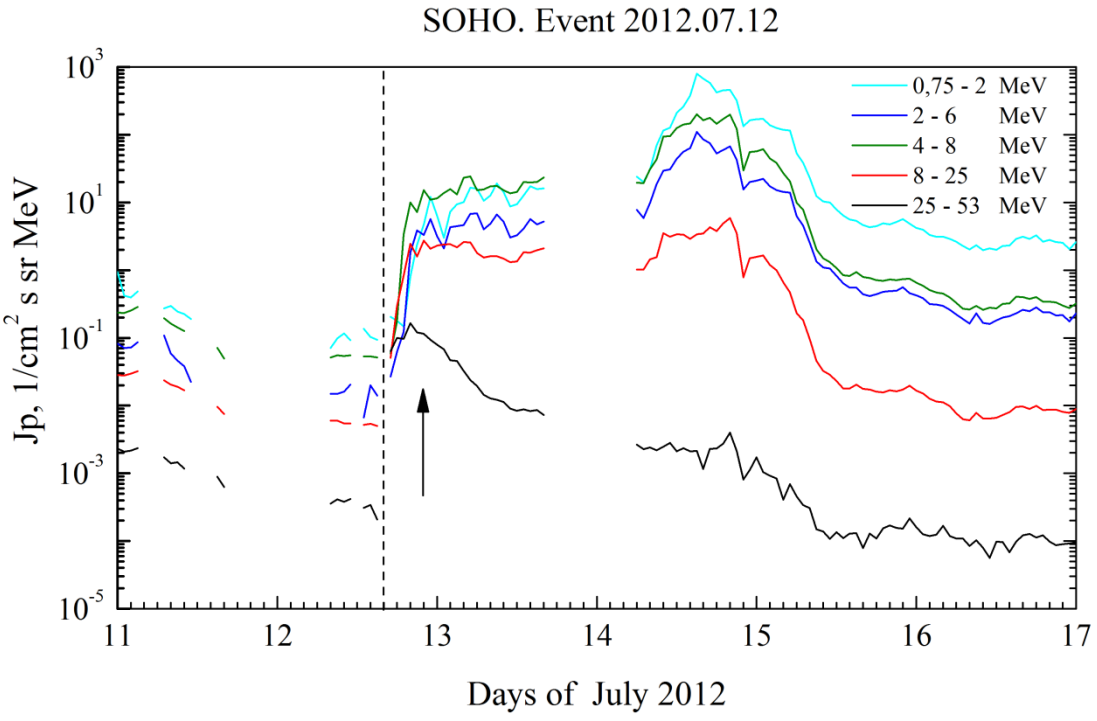
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	16	23	7	3.5	0.1	
LION	2 – 6	16	23	6	3.5	0.015	
EPHIN	4 – 8	16	22	15	3.50	0.05	
EPHIN	8 – 25	16	22	2.7	3.5	0.005	
EPHIN	25 – 53	16	21	0.16	2.5	0.0004	
Electro-1							
SCR-E	13.7–23	16	20	2.3	0.5	0.06	
SCR-E	23–42	16	20	0.36	0.5	0.025	
SCR-E	42–112	16	20	0.008	0.3	0.005	

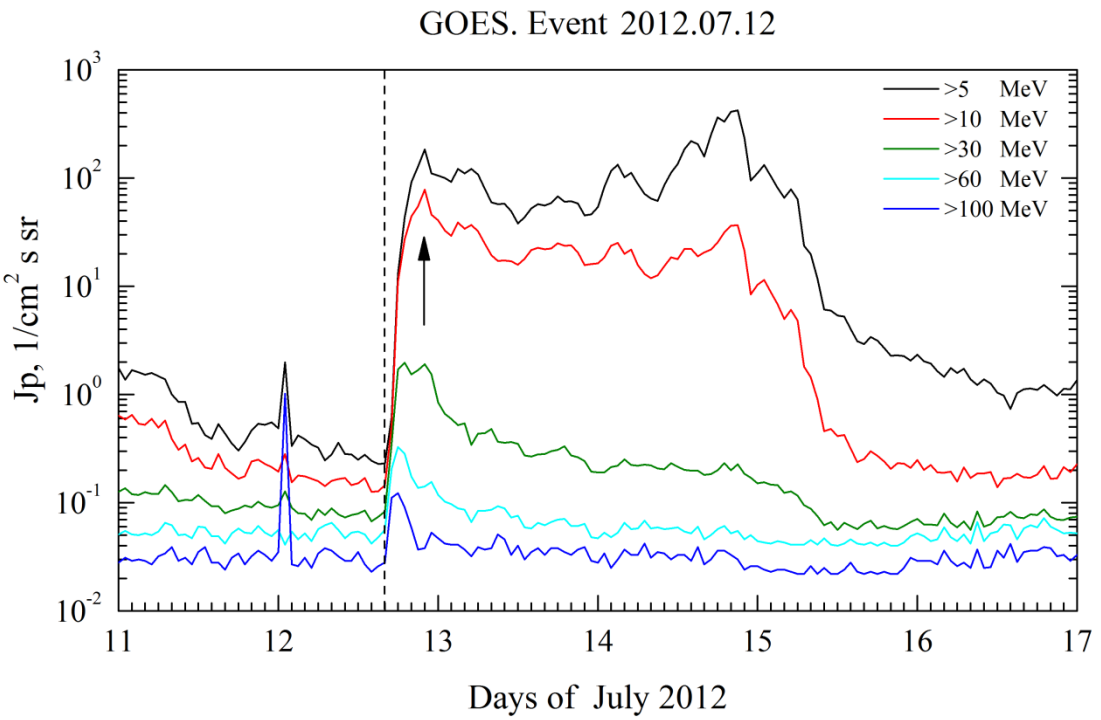

Integral spectrum of protons. Event 2012.07.12
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 3.7
0.1 GCR
Eqm = 110 MeV

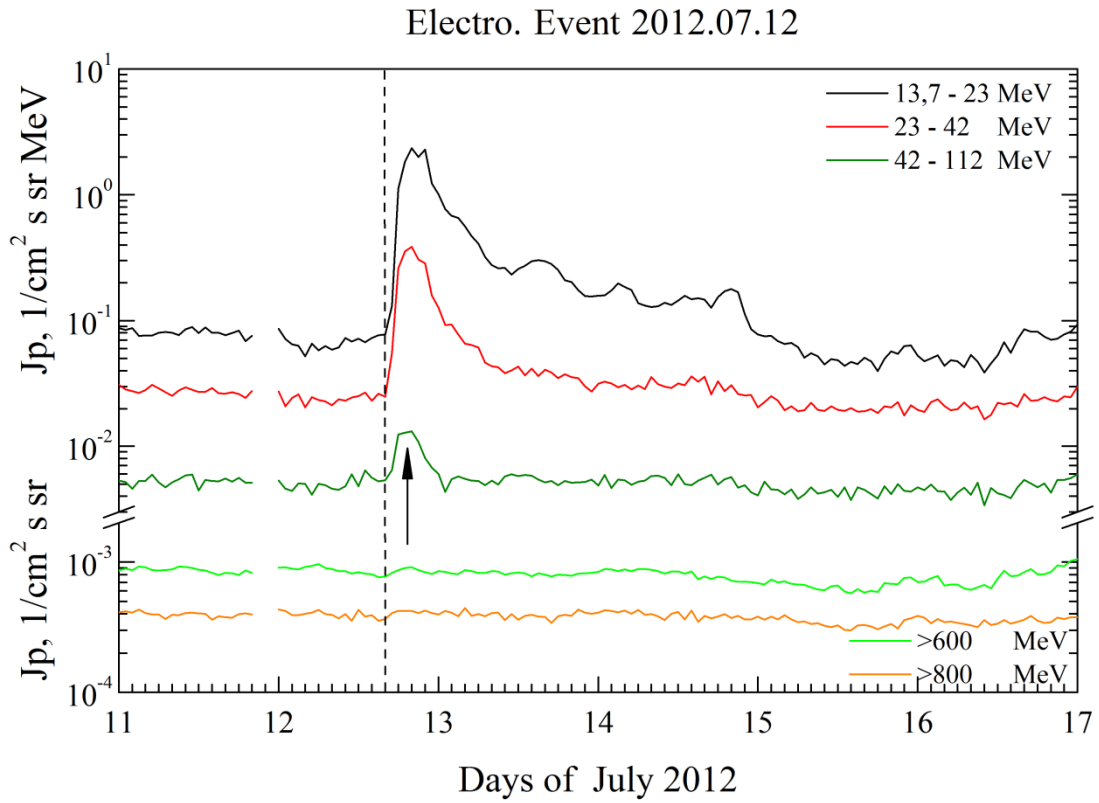
Time profiles of proton fluxes in the event 2012.07.12

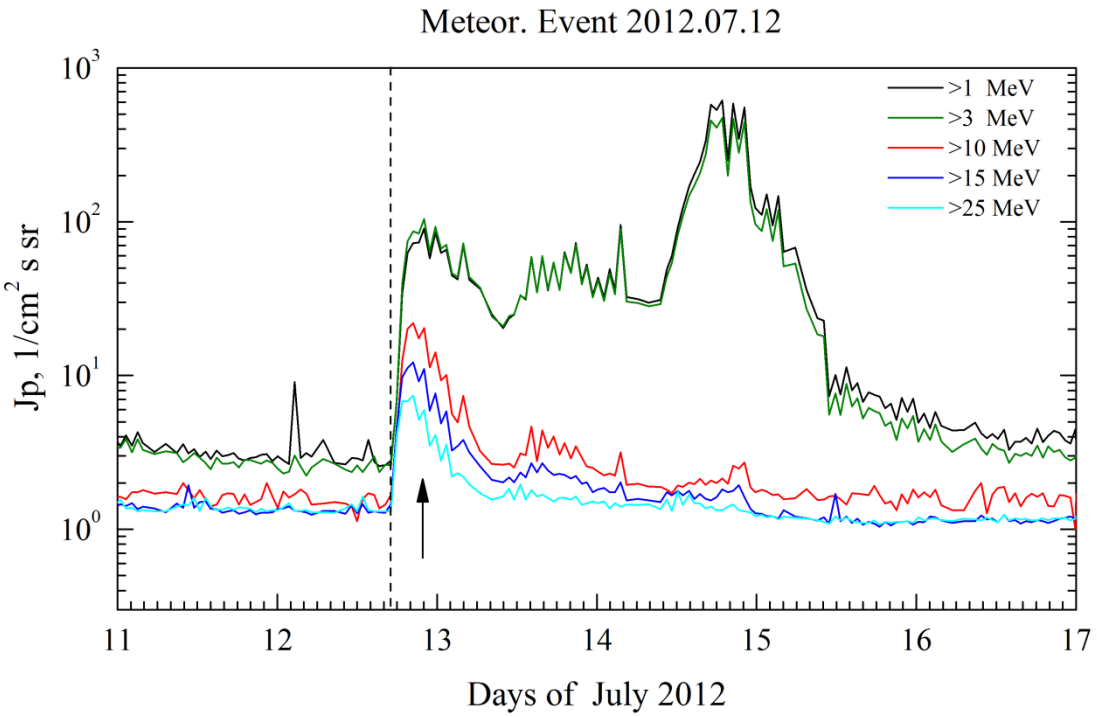
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

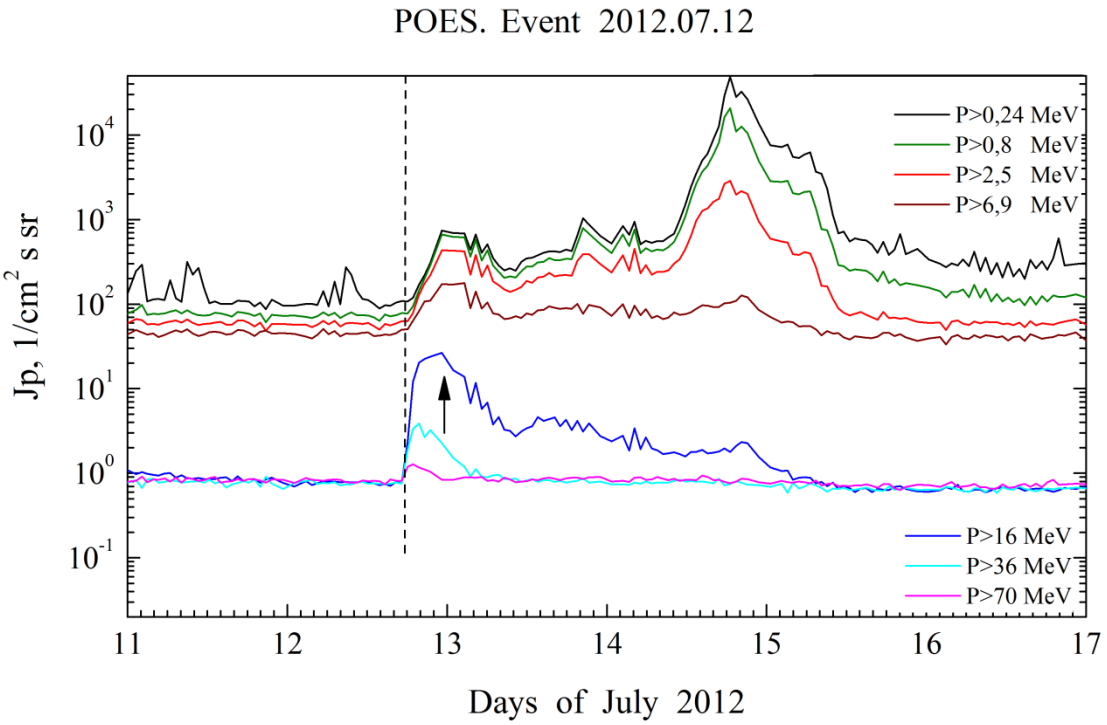





GOES. Event 2012.07.12
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of July 2012


Electro. Event 2012.07.12
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of July 2012


Meteor. Event 2012.07.12
Jp, 1/cm^2 s sr
>1 MeV
>3 MeV
>10 MeV
>15 MeV
>25 MeV
Days of July 2012


POES. Event 2012.07.12
Jp, 1/cm^2 s sr
P>0,24 MeV
P>0,8 MeV
P>2,5 MeV
P>6,9 MeV
P>16 MeV
P>36 MeV
P>70 MeV
Days of July 2012

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 July 12

2012 July 12 ● AR 11520 To event 515

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1539	1625	2041	S15W01	2B	
1 – 12	keV	1537	1649	1730	S13W03	X1.4	0.46

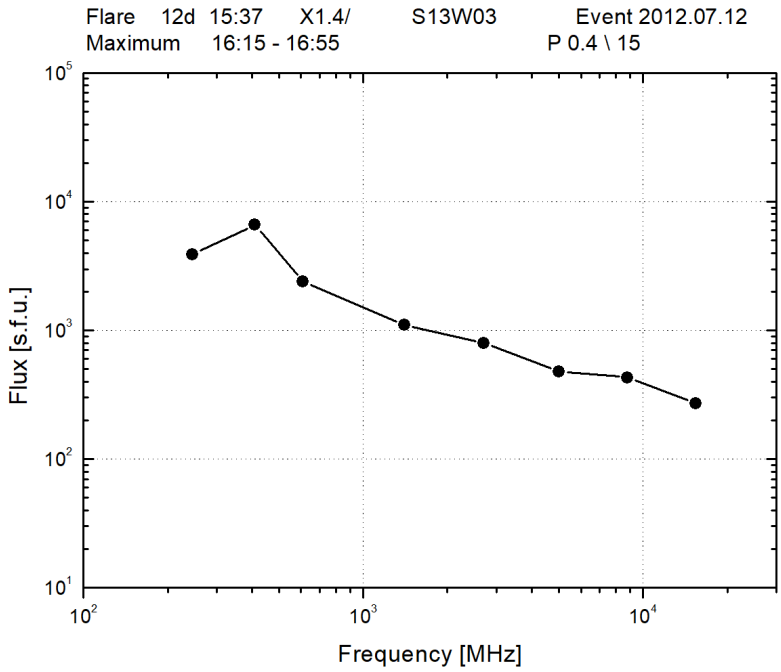
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	1534:12	1550:46	1552:40	1225	4600876	HESSI
25-50	keV	1628:08	16:36:22	1649:52	14335	76898024	HESSI
50-100	keV	1649:52	1650:54	1728:08	9712	81983696	HESSI
12-25	keV	1610:27	1647:06	1709:21	966663	970299008	FERMI
12-25	keV	1745:57	1813:54	1828:06	23993	12127359	FERMI
12-25	keV	1921:29	1946:41	2001:13	3953	1528422	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1621	1654	1815	P0.4 \ 15	2.43	
8.8	GHz	1615	1615	1824		2.63	
5	GHz	1614	1653	1714		2.68	
2.7	GHz	1614	1653	1705		2.9	
1.4	GHz	1614	1652	1706		3.04	
610	MHz	1620	1655	1814		3.38	
410	MHz	1614	1649	1732		3.82	
245	MHz	1615	1652	2010		3.59	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-082	1625		1653		2	
DS IV	025-180	1638		2359		2	
DS VI	025-180	1856		2359		1	
DS CTM	108-180	1610		1638		1	
DH II	0.25-14	1645		13d0900			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1648	885	195.6	360˚	158˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11520 (S16L084, CMP 12.3.07.2012,
Sp=1460 msh, FKC, BGD, R)
XRI=2.82 $X_2^{1.4}$+$M_5^{7.7}$+C_{26} 2_1+1_7+S_{64}
PFR1 12.07 X1.4/2B
PFR2 19.07 $M_1^{7.7}$

References:

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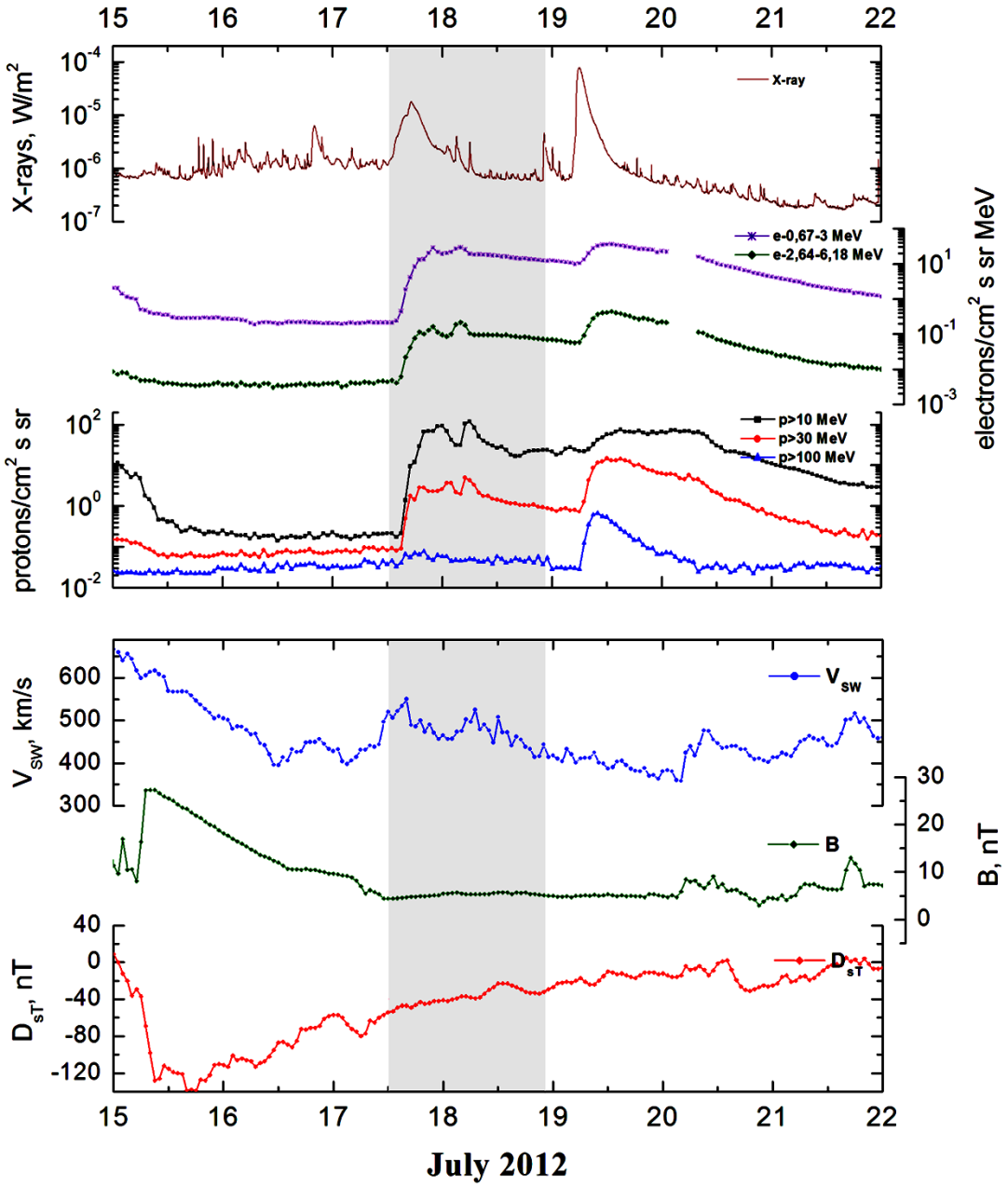
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.
Zuccarello F., I. Ermolli, M.B. Korsos et al., 2021.

Particle event: To(Ep>10 MeV) – $17d15^h$
$Tmax_1$(Ep>10 MeV) – $18d00^h$, $Jmax_1$ (Ep>10 MeV) – 93 /cm^2·s·sr
$Tmax_2$(Ep>10 MeV) – $18d06^h$, $Jmax_2$ (Ep>10 MeV) – 116 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma_1 = 3.2$, $\gamma_2 = 3.2$
Quasimaximal energy of protons in the event – Eqm_1 = 150 MeV
– Eqm_2 = 140 MeV

Sources: ● solar flare $17d12^h03^m$, M1.7/1F, S28W75, AR11520
Main burst X-ray 1–8 Å: onset – $17d12^h03^m$, max – $17d17^h15^m$, $\Phi = 0.21$ J/m^2
CME: $17d13^h48^m$, V= 958 km/s, $\Delta\varphi = 176^o$, dA= 241°

Particle fluxes and associated phenomena

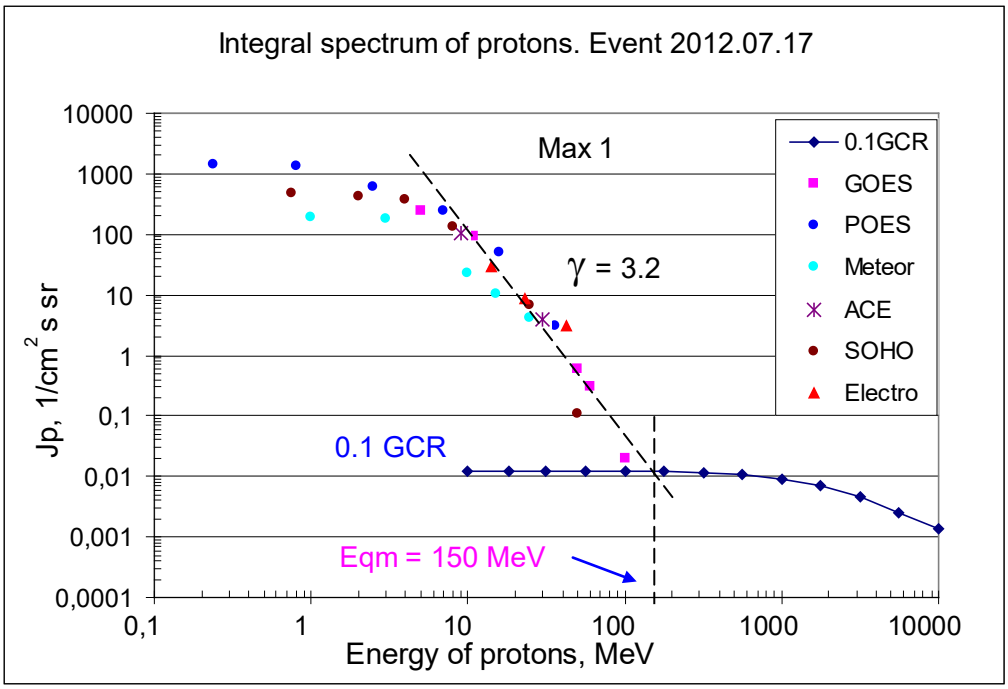


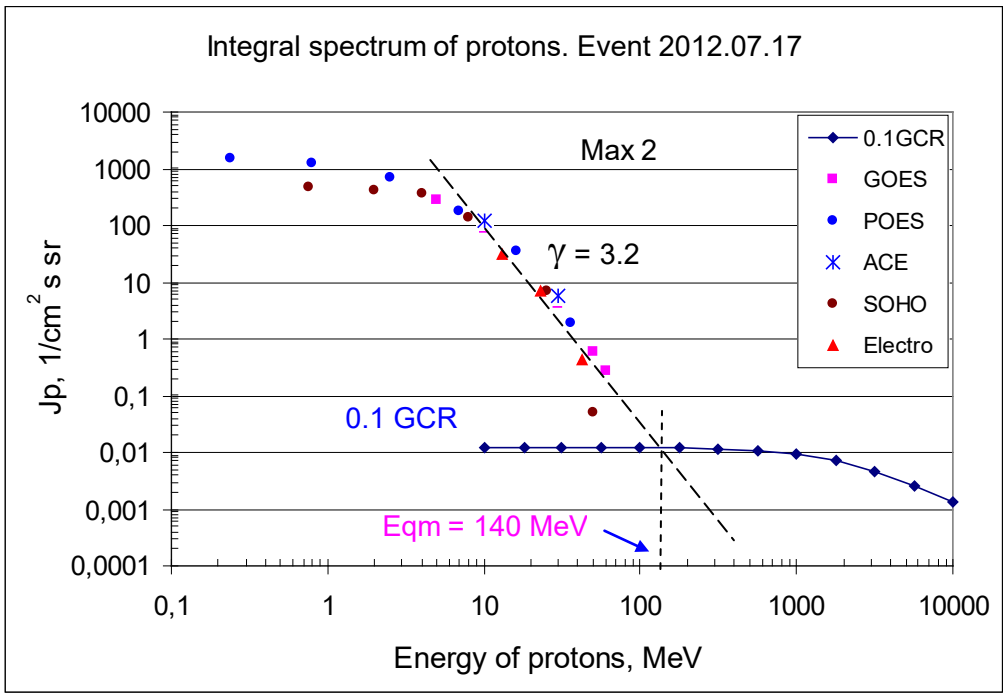
Integral fluxes of protons for the event of 2012 July 17

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	15	18d00/18d06	240/290	1.5	0.2	
EPS	>10	15	18d00/18d06	93/116	1.5	0.15	
EPS	>30	15	18d01/18d06	3.7/4.3	1.5	0.09	
EPS	>50	15	18d02/18d05	0.6/0.6	1.5	0.07	
EPS	>60	15	18d01/18d06	0.3/0.27	1	0.05	
EPS	>100	15	23/ -	0.02/ -	1	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	16	18d00/18d05	1430/1500	2	100	
MEPED	>0.8	16	18d00/18d05	1310/1225	2	75	
MEPED	>2.5	16	18d00/18d05	595/700	2	55	
MEPED	>6.9	16	18d00/18d05	240/180	1	50	
MEPED	>16	16	18d00/18d05	50.3/35.8	1	0.9	
MEPED	>36	16	18d00/18d05	3.1/1.9	0.5	0.8	
MEPED	>70	16	-	-	-	0.8	
MEPED	>140	18	-	-	-	1.1	
Meteor-1							
SCR	>1	15	18d00/ -	196/-	1.5	2.7	
SCR	>3	15	18d00/ -	180/-	1.5	2.1	
SCR	>10	15	18d00/ -	23/-	1.5	1.65	
GALS-M	>15	15	18d00/ -	10.1/-	1.5	1.3	
GALS-M	>25	15	18d00/ -	4.3/-	1.5	1.4	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	15	22/18d04	102/120	1.5	1.4	
SIS	>30	15	22/18d04	3.9/5.9	1.5	1	
SOHO							
EPHIN	>50	16	17/18d04	0.11/0.05	0.6	0.25	

Differential fluxes of protons for the event of 2012 July 17

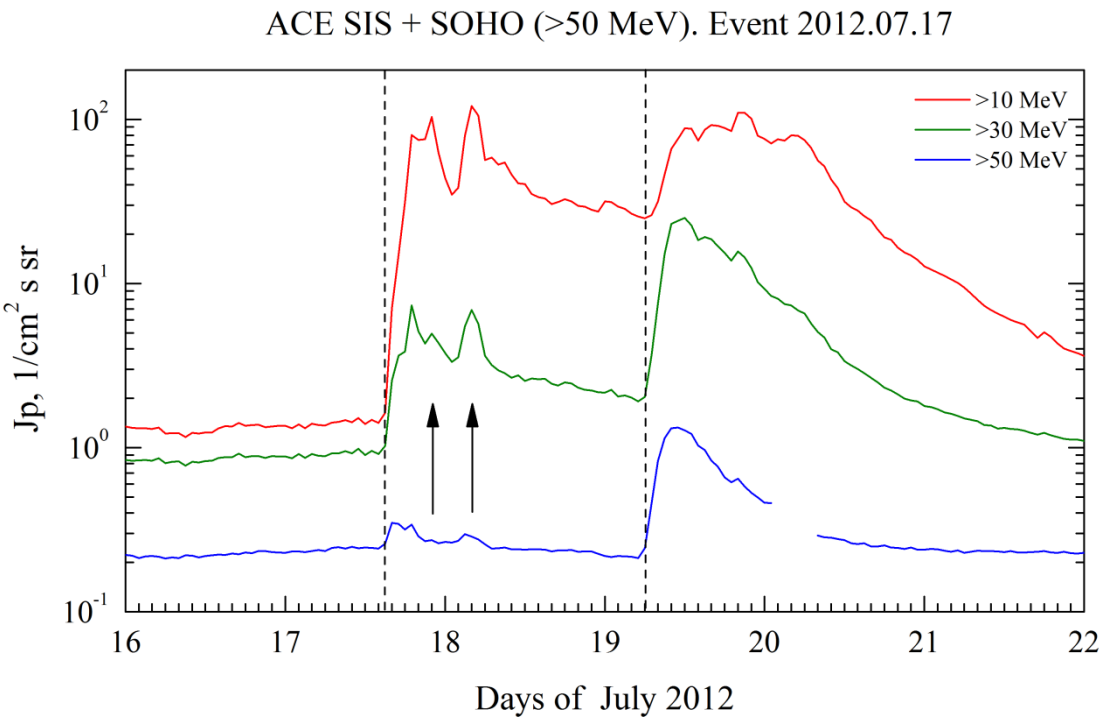
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	18	22/18d04	38/51.8	2	0.1	
LION	2 – 6	18	22/18d04	18/18.3	2	0.01	
EPHIN	4 – 8	17	22/18d05	62/55.7	2	0.03	
EPHIN	8 – 25	16	22/18d05	7.35/7.6	2	0.003	
EPHIN	25 – 53	16	20/18d05	0.24/0.24	2	0.0001	
Electro-1							
SCR-E	13.7–23	16	20/18d05	2.31/2.63	1.5	0.04	
SCR-E	23–42	16	20/18d05	0.3/0.34	1.5	0.02	
SCR-E	42–112	16	20/18d05	0.0043/0.006	1.5	0.005	

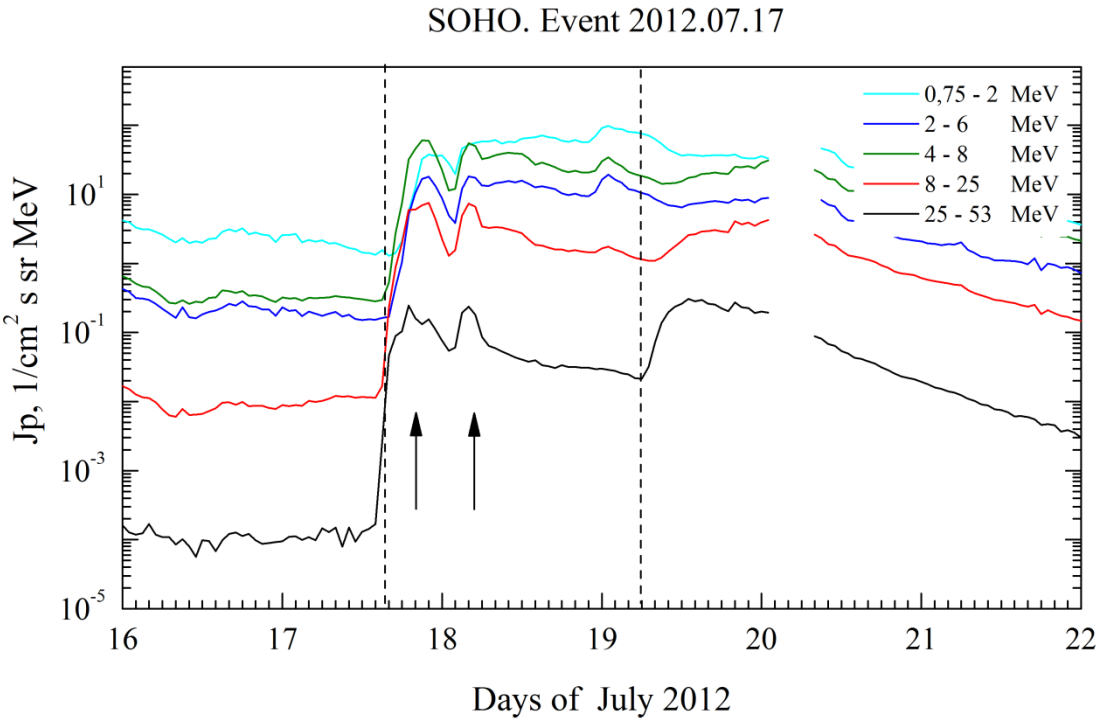

Integral spectrum of protons. Event 2012.07.17
Max 1
γ = 3.2
0.1 GCR
Eqm = 150 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.07.17
Max 2
γ = 3.2
0.1 GCR
Eqm = 140 MeV
0.1GCR
GOES
POES
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

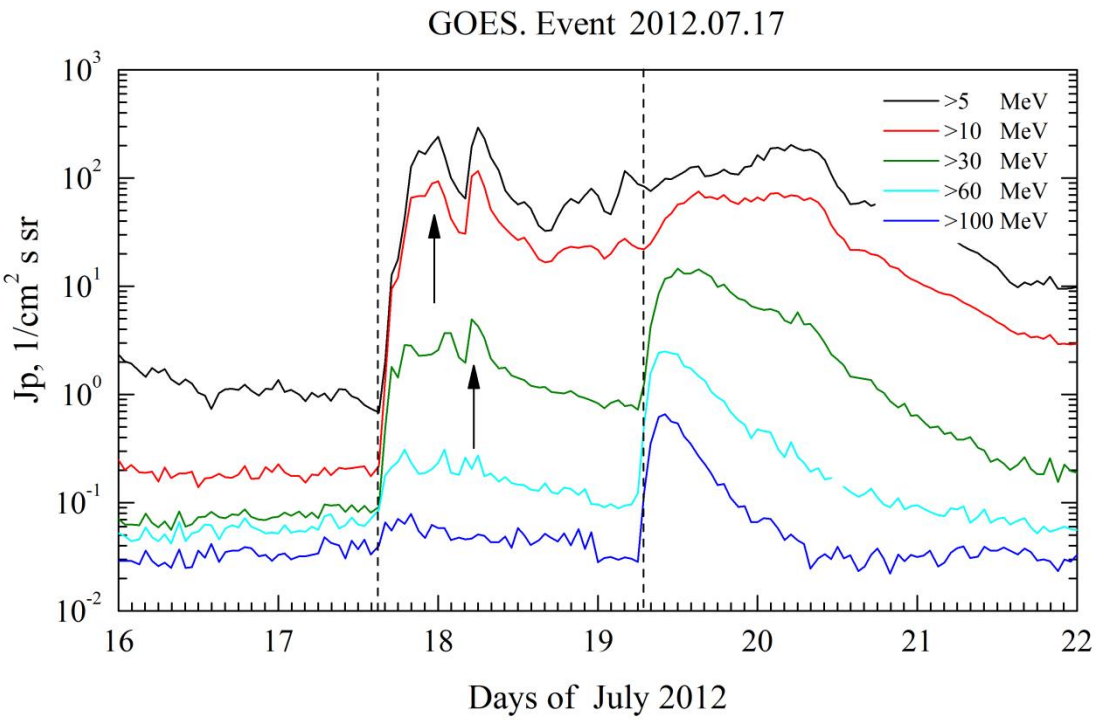
Time profiles of proton fluxes in the event 2012.07.17

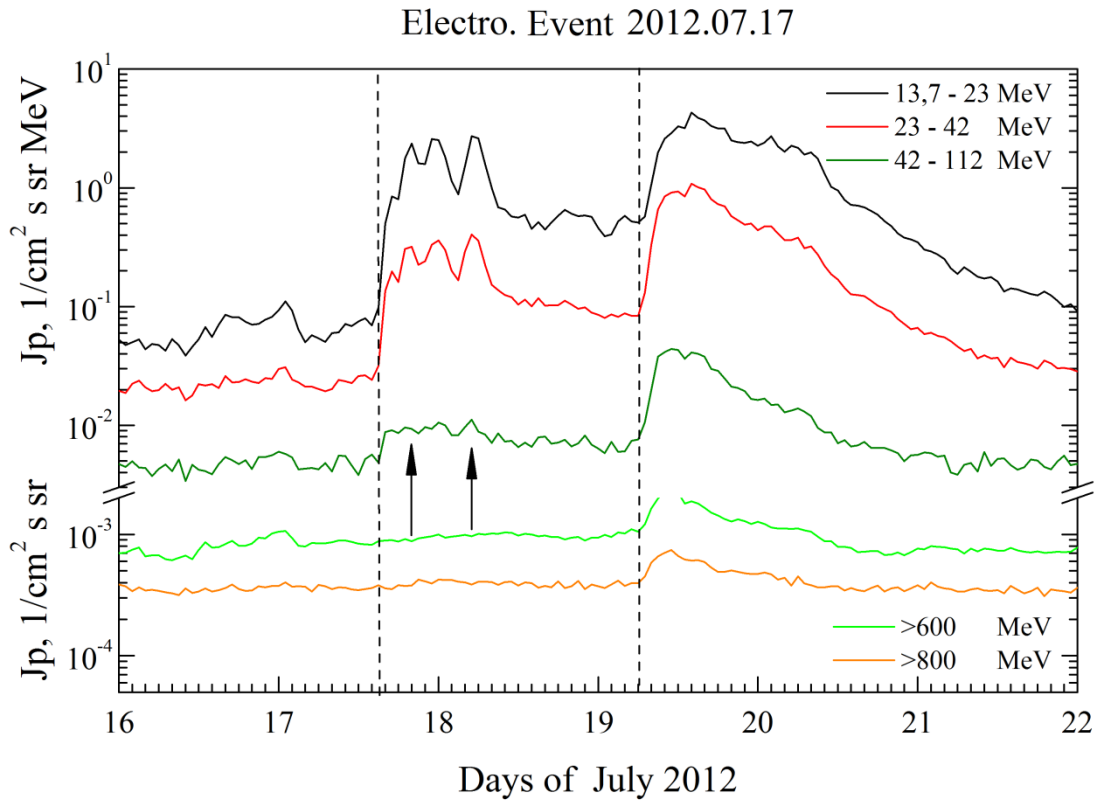
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

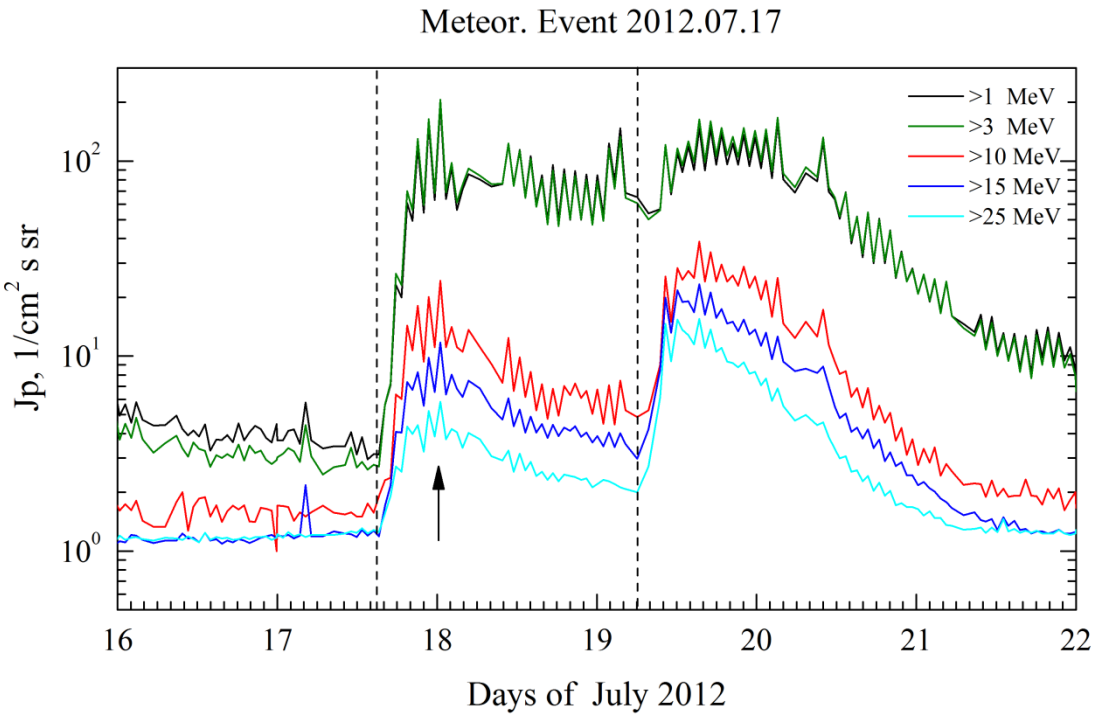


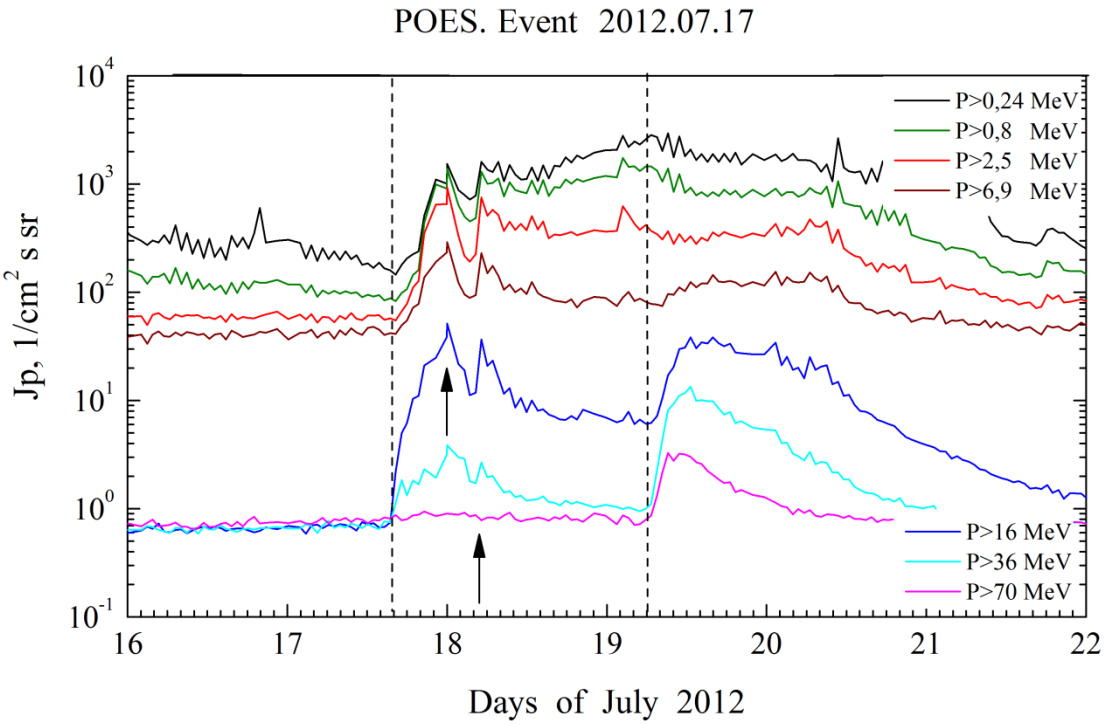


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro






Meteor. Event 2012.07.17
>1 MeV
>3 MeV
>10 MeV
>15 MeV
>25 MeV
Jp, 1/cm2 s sr
Days of July 2012


POES. Event 2012.07.17
P>0,24 MeV
P>0,8 MeV
P>2,5 MeV
P>6,9 MeV
P>16 MeV
P>36 MeV
P>70 MeV
Jp, 1/cm2 s sr
Days of July 2012

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 July 17

2012 July 17 ● AR 11520 To event 516

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1328	1643	1753	S28W75	1F	
1 – 12	keV	1203	1715	>1904	S15W88	M1.7	0.21

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	1244:56	1244:58	1246:32	3	1348	HESSI
6-12	keV	1246:32	1250:10	1253:08	4	6246	HESSI
6-12	keV	1305:08	1305:46	1309:36	3	4073	HESSI
12-25	keV	1309:36	1342:26	1344:24	31	154884	HESSI
6-12	keV	1424:52	1431:30	1433:20	38	90958	HESSI
6-12	keV	1447:52	1458:10	1459:28	64	206736	HESSI
6-12	keV	1509:56	1517:18	1519:40	80	225432	HESSI
12-25	keV	1555:24	1556:42	1608:12	84	287736	HESSI
6-12	keV	1608:12	1612:38	1615:48	74	153250	HESSI
6-12	keV	1615:48	1616:46	1623:04	60	137952	HESSI
12-25	keV	1623:04	1644:50	1647:24	240	1061184	HESSI
12-25	keV	1647:24	1652:14	1655:24	288	604536	HESSI
25-50	keV	1730:52	1731:38	1734:36	184	187816	HESSI
12-25	keV	1734:36	1736:14	1753:48	216	1213498	HESSI
12-25	keV	1753:48	1755:02	1804:40	208	707136	HESSI
12-25	keV	1804:40	1810:30	1830:36	208	1486800	HESSI
12-25	keV	1538:35	1557:29	1607:36	1265	426949	FERMI
12-25	keV	1630:04	1632:35	1633:12	2846	95520	FERMI
12-25	keV	1709:31	1742:4	1745:0	6260	2169032	FERMI
12-25	keV	1844:59	1855:01	1923:21	1833	786621	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
245	MHz	1328	1348	1356		2.41	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS CTM	099-148	1307		1952		1	
DS III	027-041	1607		1608		1	
DS III	025-050	1732		1733		1	
DS III	025-038	1809		1810		1	
DS III	025-068	1821		1822		1	
DS VI	025-117	1716		1955		2	
DS VI	025-112	1716		1733		1	
DS CTM	099-148	1700		1805		1	
DH II	0.15-12	1440		18d0500			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1348	958	63.5	176˚	241˚	SOHO

Proton Active Region:

AR11520 (S16L084, CMP 12.3.07.2012,
Sp=1460 msh, FKC, BGD, R)
XRI=2.82 $X_2^{1.4}$+$M_5^{7.7}$+C_{26} 2_1+1_7+S_{64}
PFR1 12.07 $X_2^{1.4}$
PFR2 19.07 $M_1^{7.7}$

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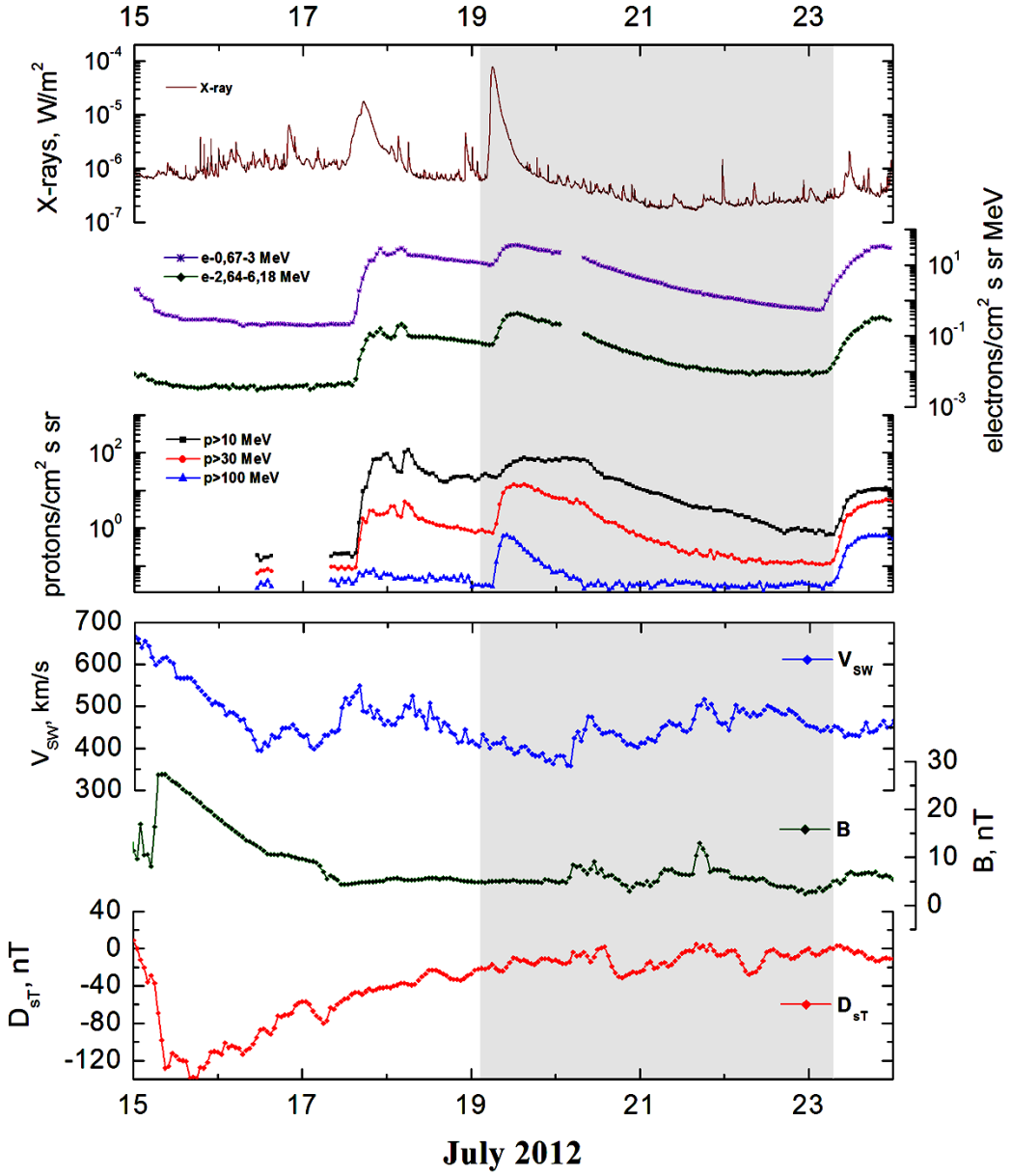
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 19d06^h
Tmax$_1$(Ep>10 MeV) – 19d15^h, Jmax$_1$ (Ep>10 MeV) – 75 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 20d03^h, Jmax$_2$ (Ep>10 MeV) – 72 /cm^2·s·sr
Duration of the event – 4 days, power-law index: $\gamma_1 = 3.5$, $\gamma_2 = 4.4$
Quasimaximal energy of protons in the event – Eqm$_1$ = 280 MeV
– Eqm$_2$ = 120 MeV

Sources: ■ solar flare 19d04^{h}17^m, M7.7/, S16W90, AR11520, 0.5d behind W$_L$;
Main burst X-ray 1–8 Å: onset – 19d04^{h}17^m, max – 19d05^{h}58^m, Φ = 0.36 J/m^2
CME: 19d05^{h}24^m, V= 1631 km/s, Δφ = 360º, dA= 275º
▲ SC 20d04^{h}49^m; ▲SC 21d16^{h}12^m

Particle fluxes and associated phenomena

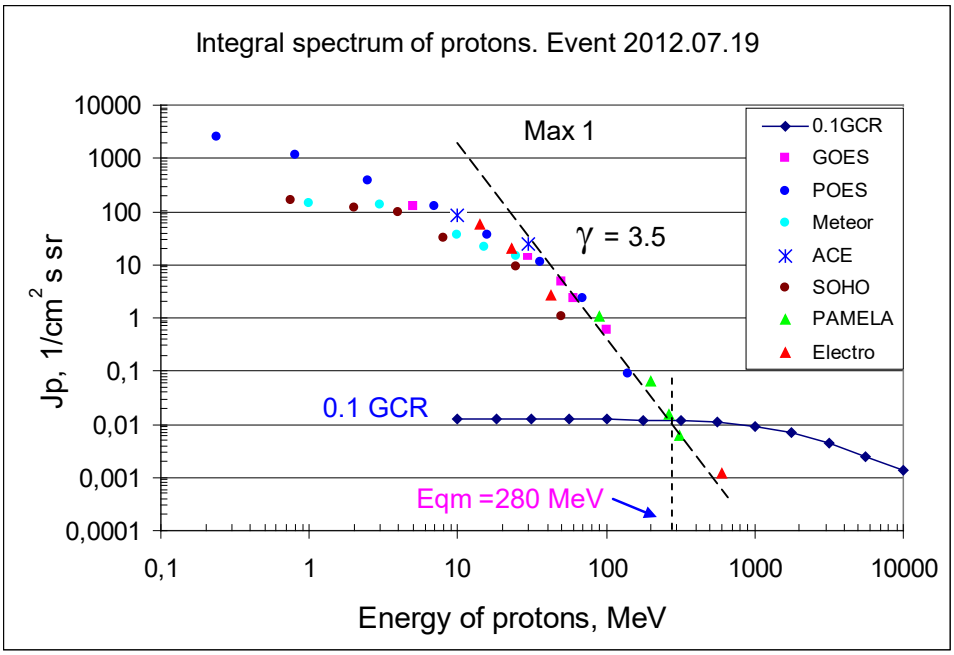


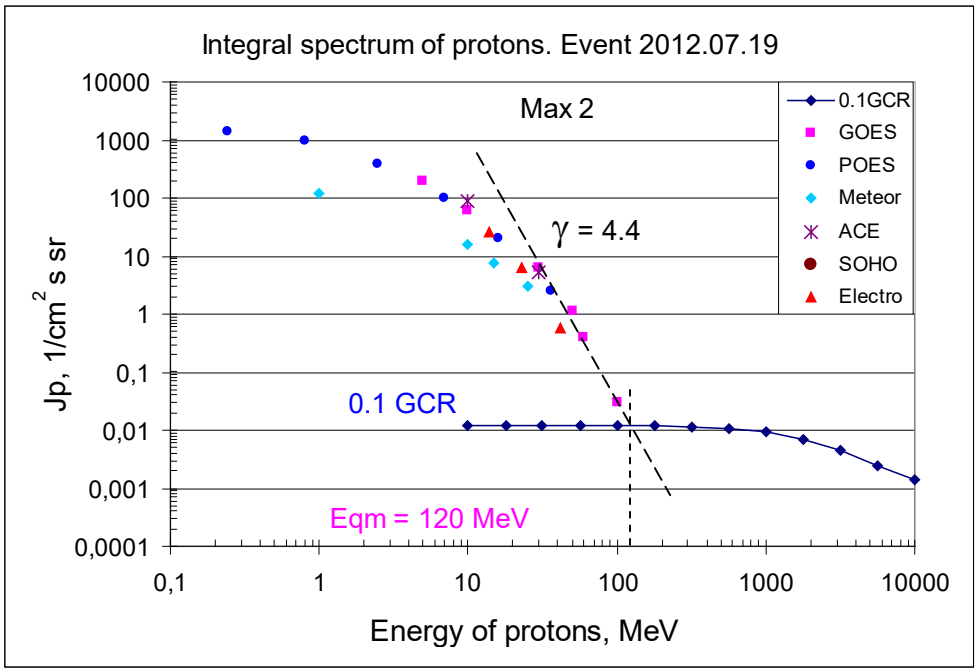
Integral fluxes of protons for the event of 2012 July 19

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	15/20d04	125/200	4	0.2	
EPS	>10	6	15/20d03	75/72	4	0.15	
EPS	>30	6	15/20d03	14.5/5.8	3	0.09	
EPS	>50	6	12/20d02	4.8/1.1	3	0.07	
EPS	>60	6	12/20d02	2.4/0.4	3	0.05	
EPS	>100	6	10/20d02	0.6/0.03	1	0.04	
Electro-1							
GALS-E	>600	18	15/20d06	0.0012/0.0003	1.5	0.0009	
POES							
MEPED	>0.24	-	11/20d07	2610/1390	4	150	
MEPED	>0.8	-	11/20d07	1130/970	4	95	
MEPED	>2.5	-	11/20d07	390/395	3	55	
MEPED	>6.9	6	11/20d07	122/100	3	40	
MEPED	>16	6	12/20d07	37.4/20.2	3	0.9	
MEPED	>36	6	12/20d07	10.9/2.55	2	0.8	
MEPED	>70	6	11/ -	2.4/ -	1	0.8	
MEPED	>140	6	11/ -	0.09/ -	-	1.1	
Meteor-1							
SCR	>1	6	15/20d10	144/123	4	2.7	
SCR	>3	6	15/ -	131/ -	4	2.1	
SCR	>10	6	15/20d10	37/16	2	1.65	
GALS-M	>15	6	15/20d10	22/7.5	2	1.3	
GALS-M	>25	6	15/20d10	14.1/3.1	2	1.4	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	6	13/20d04	86/79	4	1.4	
SIS	>30	6	12/20d04	24/6.4	3	1	
SOHO							
EPHIN	>50	6	11/ -	1.1/ -	2	0.25	
PAMELA							
TRACKER	>90	06	06-12/ -	1.1/ -	1.5	-	
TRACKER	>200	06	06-12/ -	0.063/ -	1	-	
TRACKER	>265	06	06-12/ -	0.015/ -	1	-	
TRACKER	>312	06	06-12/ -	0.006/ -	1		

Differential fluxes of protons for the event of 2012 July 19

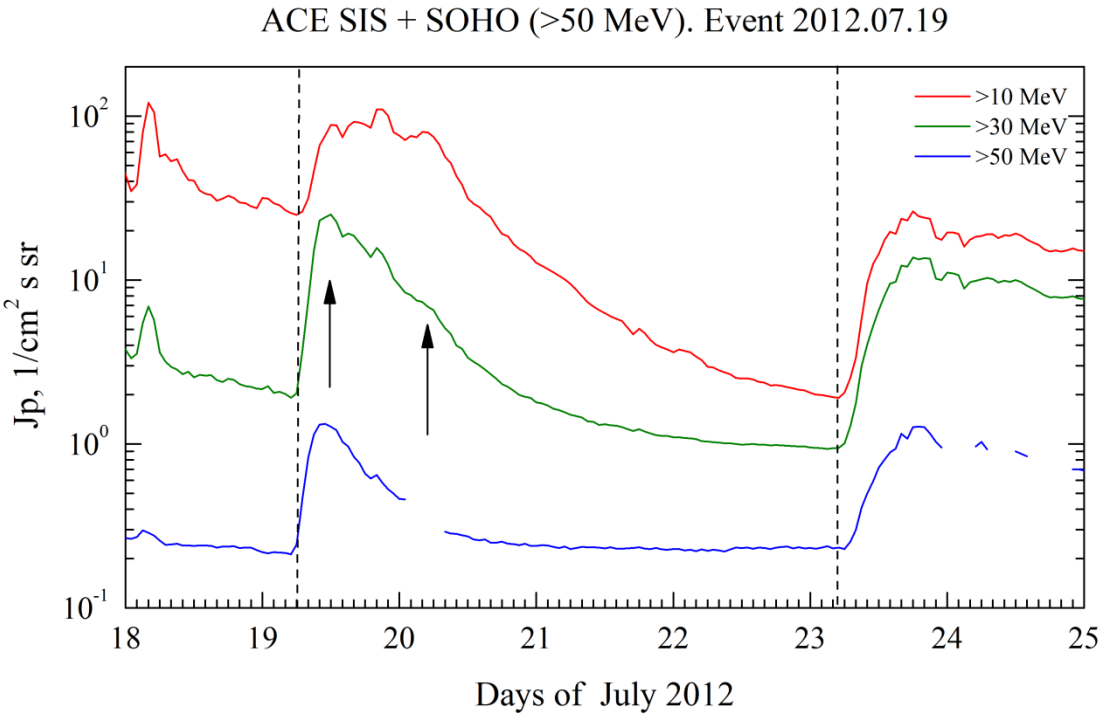
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	13	20/ -	37.7/-	4	0.1	
LION	2 – 6	13	20/ -	8.5/-	4	0.01	
EPHIN	4 – 8	12	13/ -	16.1/-	4	0.03	
EPHIN	8 – 25	12	13/ -	2.26/-	4	0.003	
EPHIN	25 – 53	07	13/ -	0.29/-	4	0.0001	
Electro-1							
SCR-E	13.7–23	18	15/20d06	3.83/2.12	3	0.05	
SCR-E	23–42	18	15/20d06	0.93/0.3	3	0.08	
SCR-E	42–112	18	15/20d06	0.039/0.008	2	0.005	

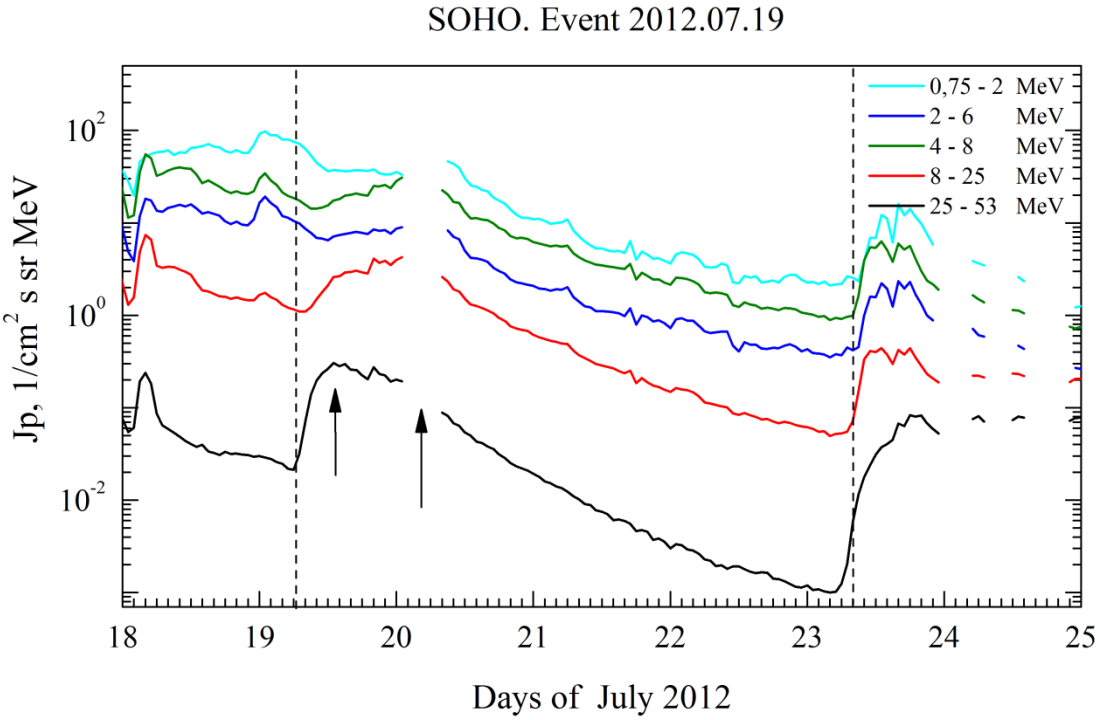

Integral spectrum of protons. Event 2012.07.19
Max 1
γ = 3.5
0.1 GCR
Eqm =280 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
PAMELA
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.07.19
Max 2
γ = 4.4
0.1 GCR
Eqm = 120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

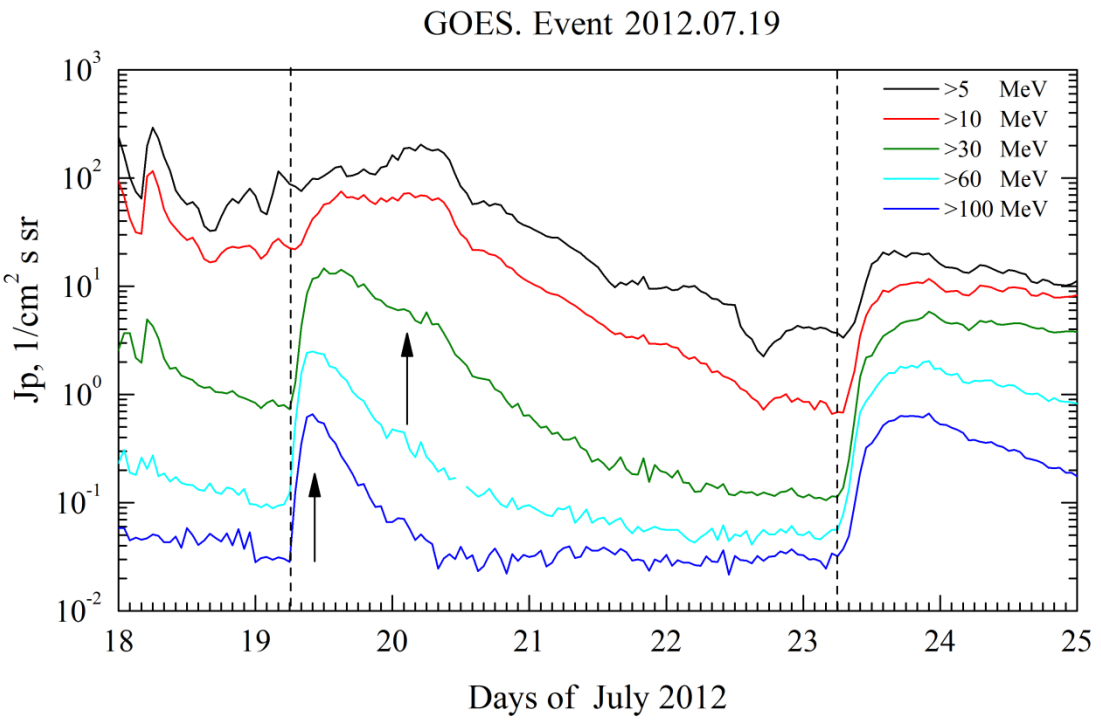
Time profiles of proton fluxes in the event 2012.07.19

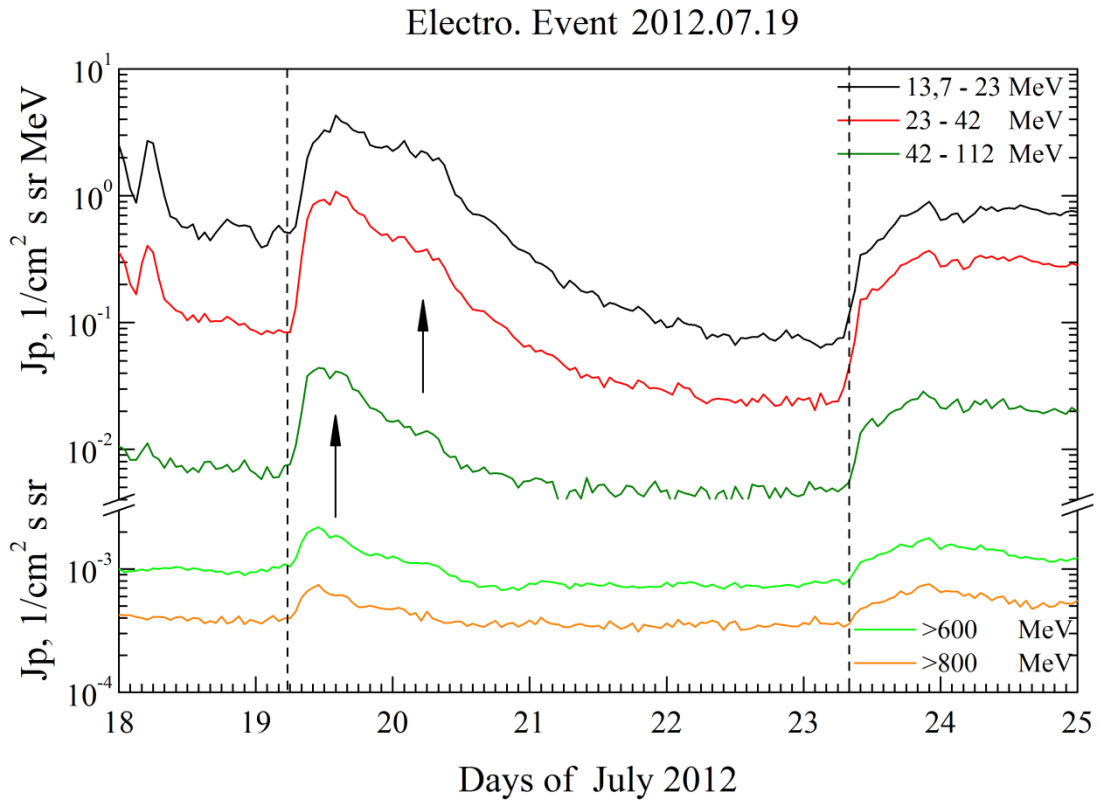
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



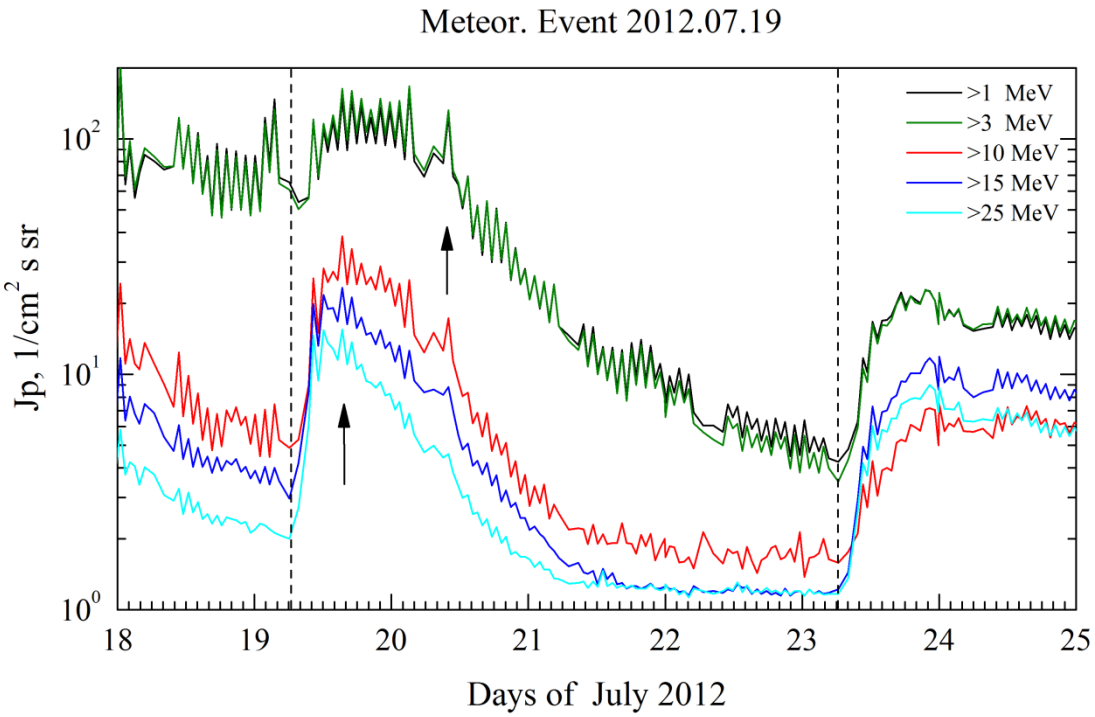


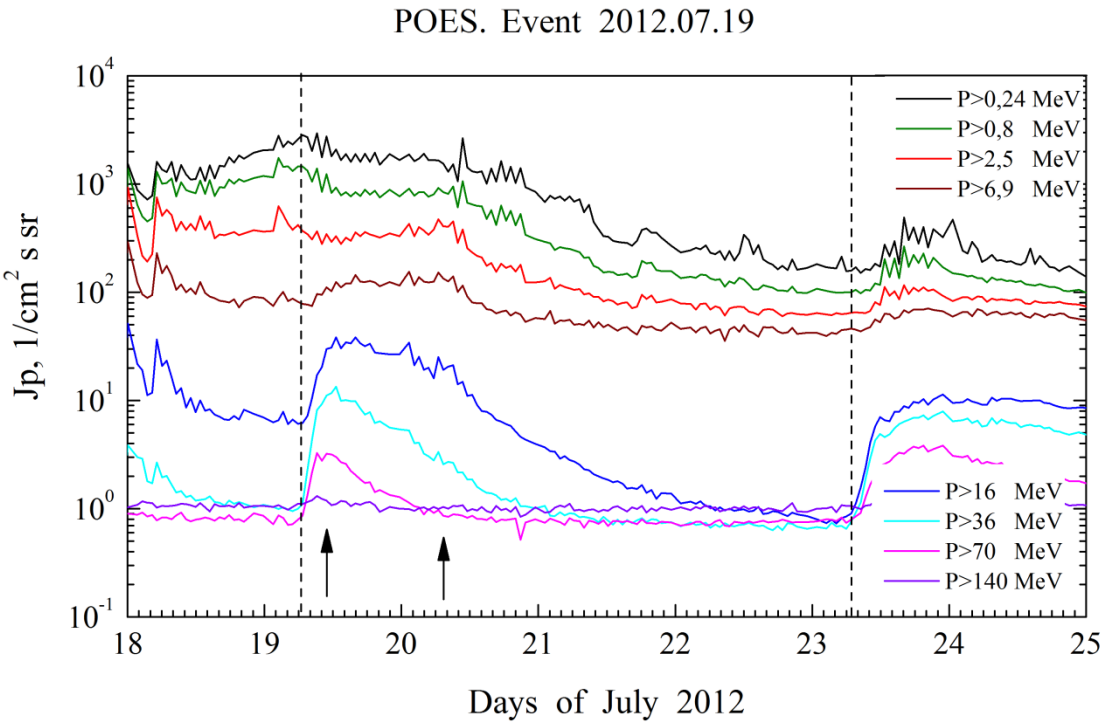
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 July 19

2012 July 19 ■ AR 11520 To event 517

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	No optical flare on visible disk					
6563 Å	LPS	0557		0928	0.12		0557
1 – 12	keV	0417	0558	0656	S13W88	M7.7	0.36

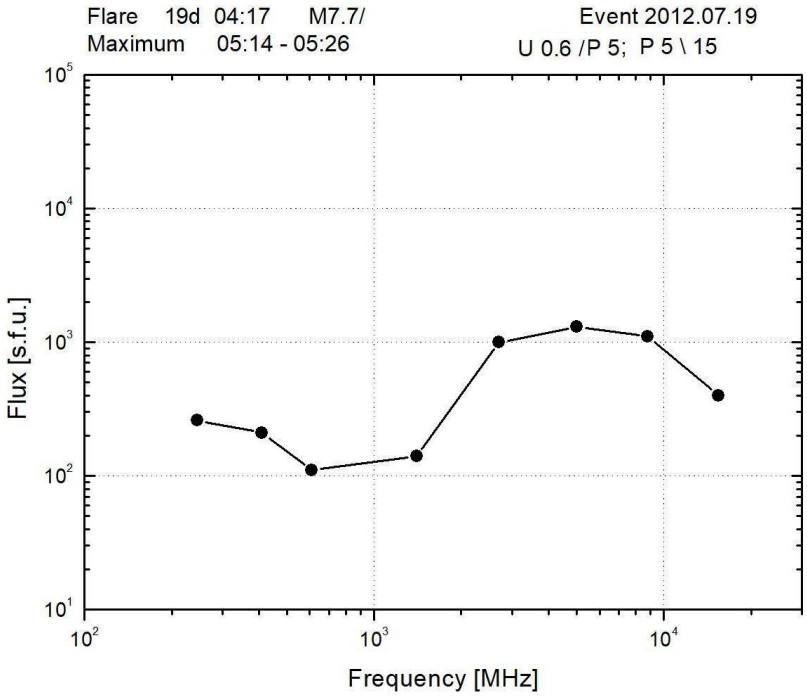
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0434:08	0443:18	0444:52	21	54535	HESSI
12-25	keV	0444:52	0455:22	0458:16	60	169840	HESSI
50-100	keV	0458:16	0529:30	0533:28	3696	13453050	HESSI
6-12	keV	0654:40	0654:46	0655:00	219	23852	HESSI
6-12	keV	0655:08	0655:50	0656:20	248	88601	HESSI
12-25	keV	0451:20	0454:41	0456:39	3057	155950	FERMI
12-25	keV	0504:51	0509:05	0510:14	3774	181865	FERMI
12-25	keV	0546:13	0552:18	0645:49	215053	6704178	FERMI

Radio burst **frequency**		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0520	0526	0538	P5 \ 15	2.6	
8.8	GHz	0518	0526	0602		3.04	
5	GHz	0517	0526	0601		3.11	
2.7	GHz	0517	0521	0601		3.0	
1.4	GHz	0513	0514	0514		2.15	
610	MHz	0516	0516	0517	U0.6 / P5	2.04	
410	MHz	0518	0519	0522		2.32	
245	MHz	0522	0524	0527		2.41	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-100	0524		0538		1	
DS IV	020-750	0523		0630		1	
DS III	020-120	0613		0617		1	
DS III	027-120	0643		0654		1	
DH II	0.6-5	0530		0620			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0524	1631	-8.0	360˚	275˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11520 (S16L084, CMP 12.3.07.2012,
Sp=1460 msh, FKC, BGD, R)
XRI=2.82 $X_2^{1.4}$+$M_5^{7.7}$+C_{26} 2_1+1_7+S_{64}
PFR1 12.07 $X_2^{1.4}$
PFR2 19.07 $M_1^{7.7}$

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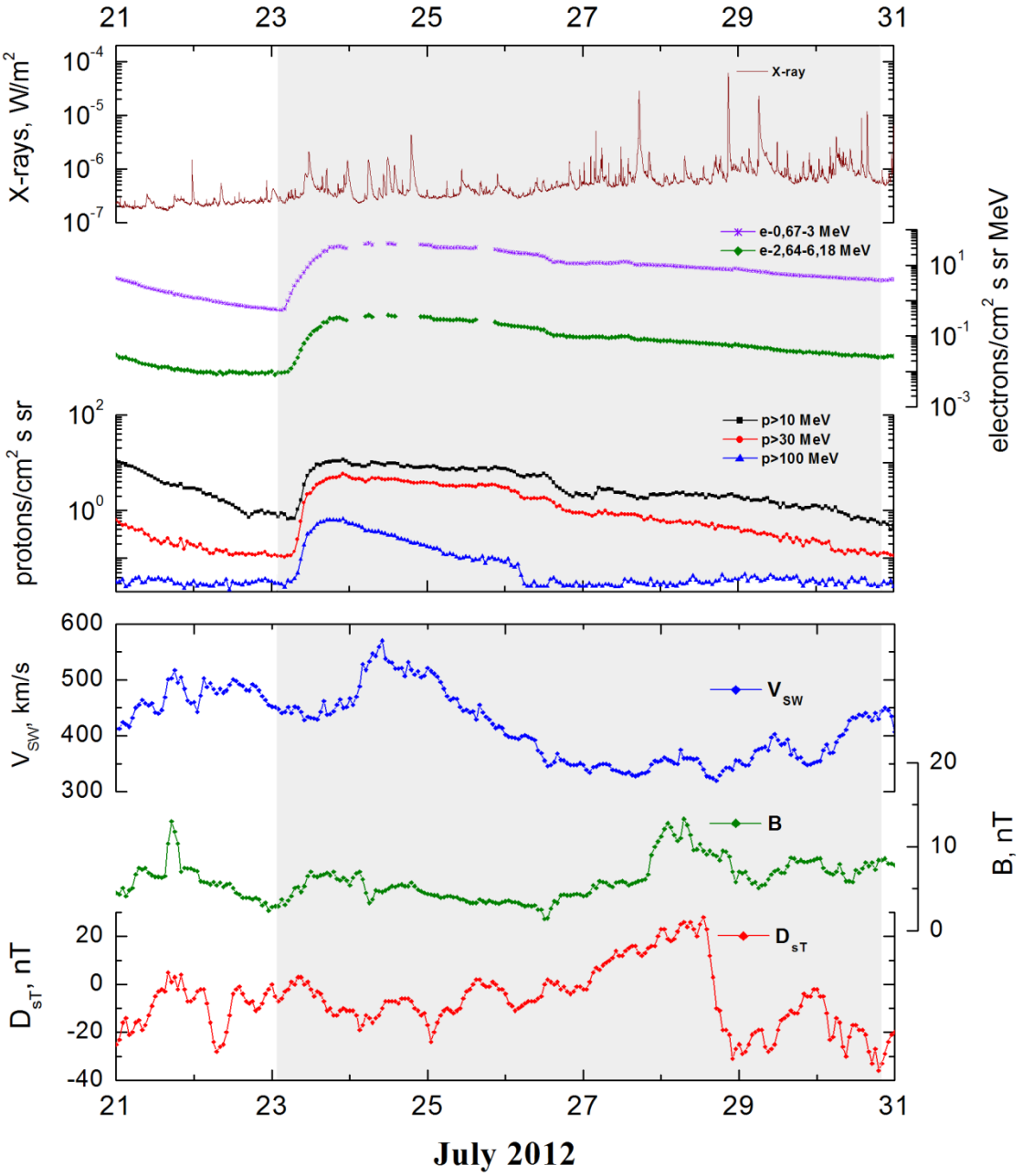
Winter L.M., and K. Ledbetter, 2015.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2012.07.23 – (2012-205) **518**

Particle event: To(Ep>10 MeV) – 23d06^h
Tmax (Ep>10 MeV) – 23d22^h, Jmax (Ep>10 MeV) – 11/cm^2·s·sr
Duration of the event – 8 days, power-law index: $\gamma = 3.6$
Quasimaximal energy of protons in the event – Eqm = 250 MeV

Sources: ⊡ back side solar flare 23d<02^{h}36^m, AR11520, 4d behind W_L
CME: 23d02^{h}36^m, V= 2003 km/s, Δφ = 360º, dA= 286º

Particle fluxes and associated phenomena

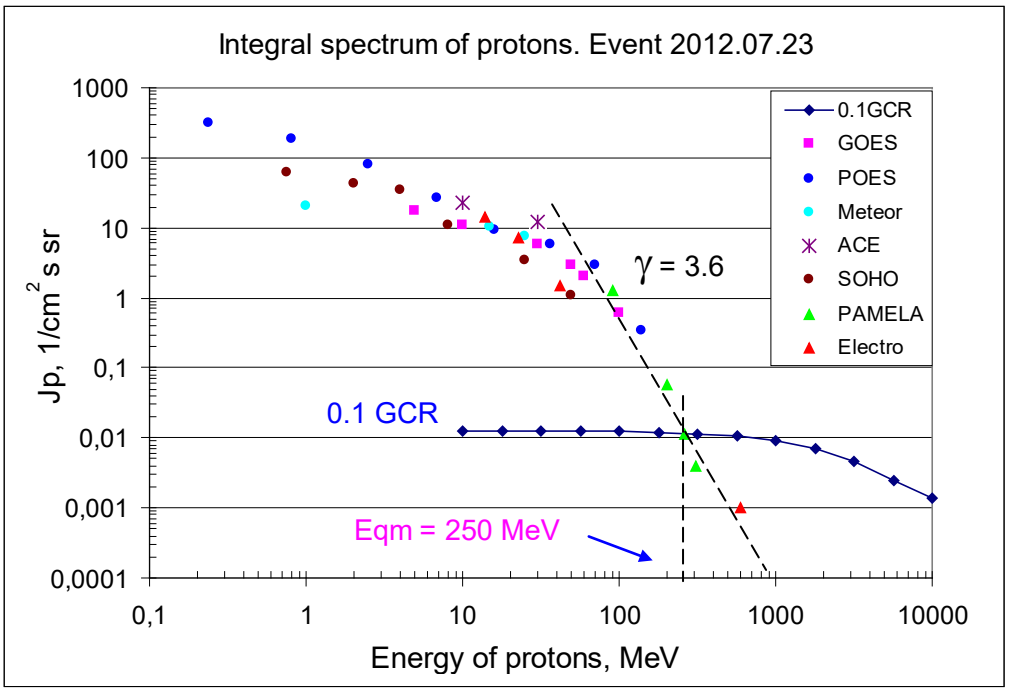


Integral fluxes of protons for the event of 2012 July 23

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	23	17,9	8	0.2	
EPS	>10	6	22	11	8	0.15	
EPS	>30	6	22	5,8	7	0.09	
EPS	>50	6	22	3	7	0.07	
EPS	>60	6	22	2,0	7	0,05	
EPS	>100	6	20	0.6	3	0,04	
Electro-1							
GALS-E	>600	7	22	0,001	3	0,001	
POES							
MEPED	>0.24	9	20	310	4	95	
MEPED	>0.8	9	20	190	4	75	
MEPED	>2.5	9	20	80	4	55	
MEPED	>6.9	9	20	27	4	45	
MEPED	>16	7	20	9.2	4	0.8	
MEPED	>36	7	20	5.8	4	0.8	
MEPED	>70	7	20	2.9	3	0.8	
MEPED	>140	7	20	0.35	1	1	
Meteor-1							
SCR	>1	6	22	20.3	7	2.7	
SCR	>3	6	-	-	7	2.1	
SCR	>10	6	-	-	7	1.65	
GALS-M	>15	6	22	10.4	7	1.3	
GALS-M	>25	6	22	7.5	6	1.4	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	5	19	23	8	1.4	
SIS	>30	5	19	12	7	1	
SOHO							
EPHIN	>50	08	19	1.08	4.5	0.22	
PAMELA							
TRACKER	>90	07	07-17	1.3	>1	-	
TRACKER	>200	07	07-17	0.058	>1	-	
TRACKER	>265	07	07-17	0.011	>1	-	
TRACKER	>312	07	07-17	0.004	>1		

Differential fluxes of protons for the event of 2012 July 23

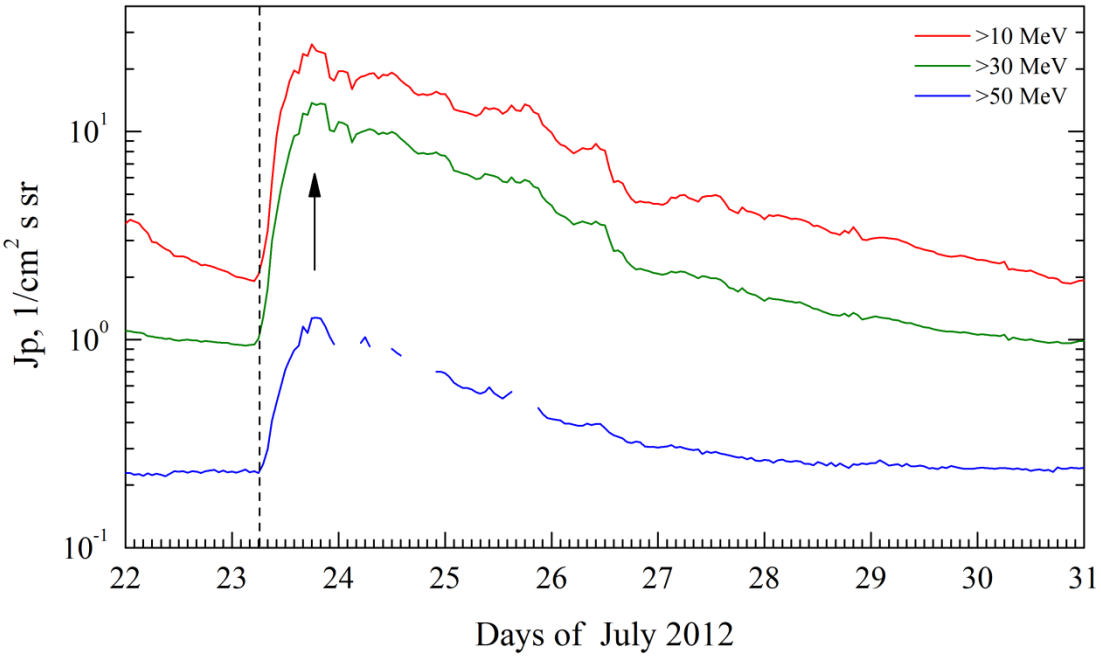
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	08	16	15.9	3.5	0.1	
LION	2 – 6	08	16	2.33	3.5	0.01	
EPHIN	4 – 8	01	18	6	3.5	0.03	
EPHIN	8 – 25	01	18	0.44	10	0.003	
EPHIN	25 – 53	02	18	0.085	10	0.00008	
Electro-1							
SCR-E	13.7–3	7	22	0.72	8	0.06	
SCR-E	23–42	7	22	0.31	8	0.025	
SCR-E	42–12	7	22	0.021	6	0.005	



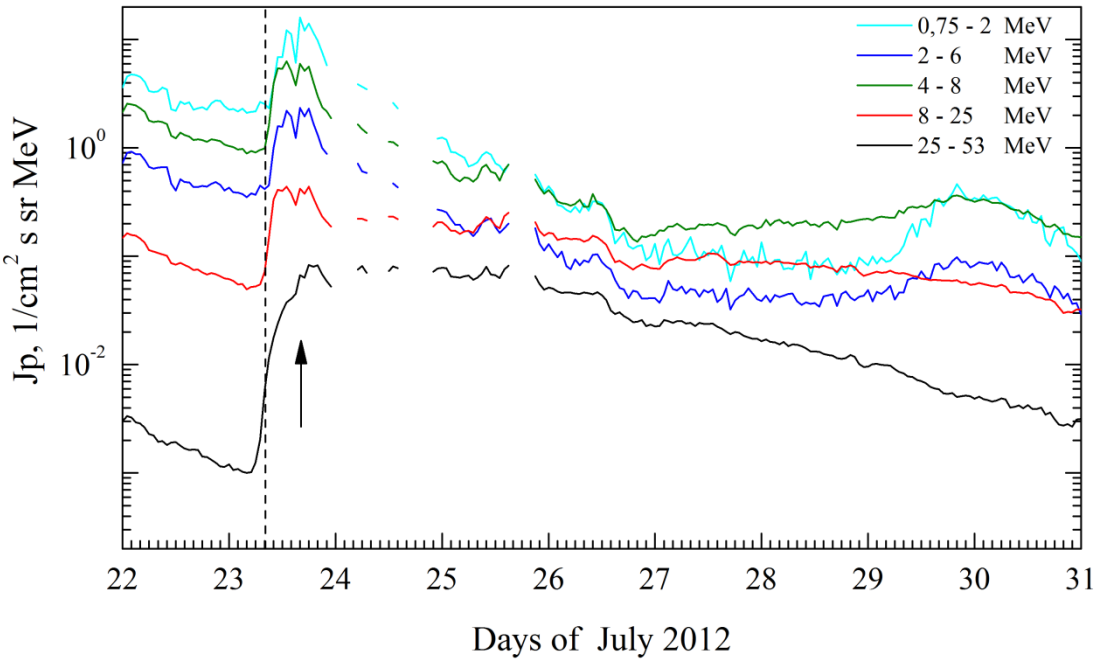
Time profiles of proton fluxes in the event 2012.07.23

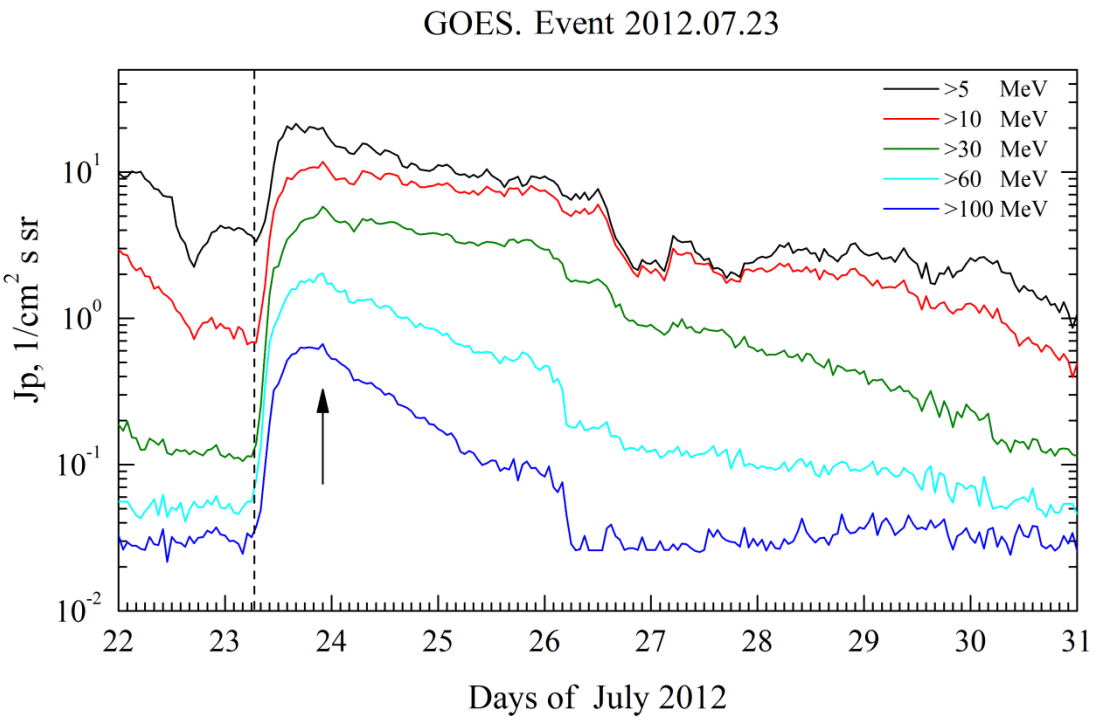
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

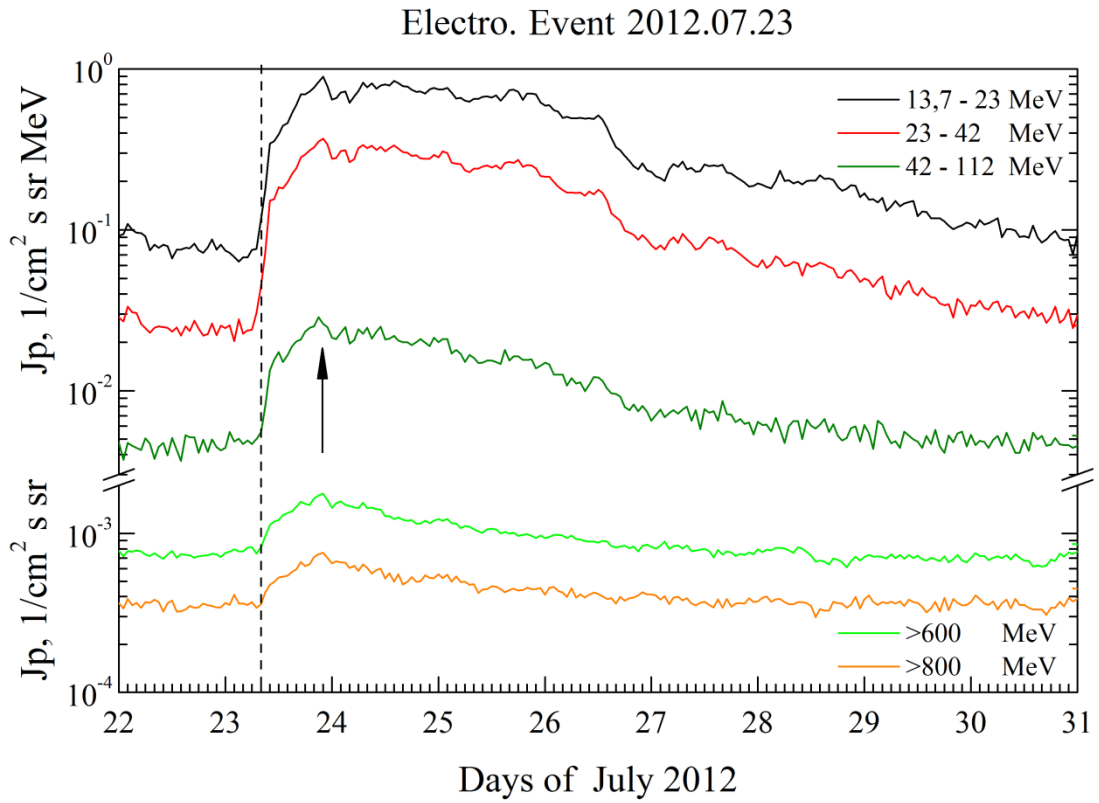
ACE SIS + SOHO (>50 MeV). Event 2012.07.23



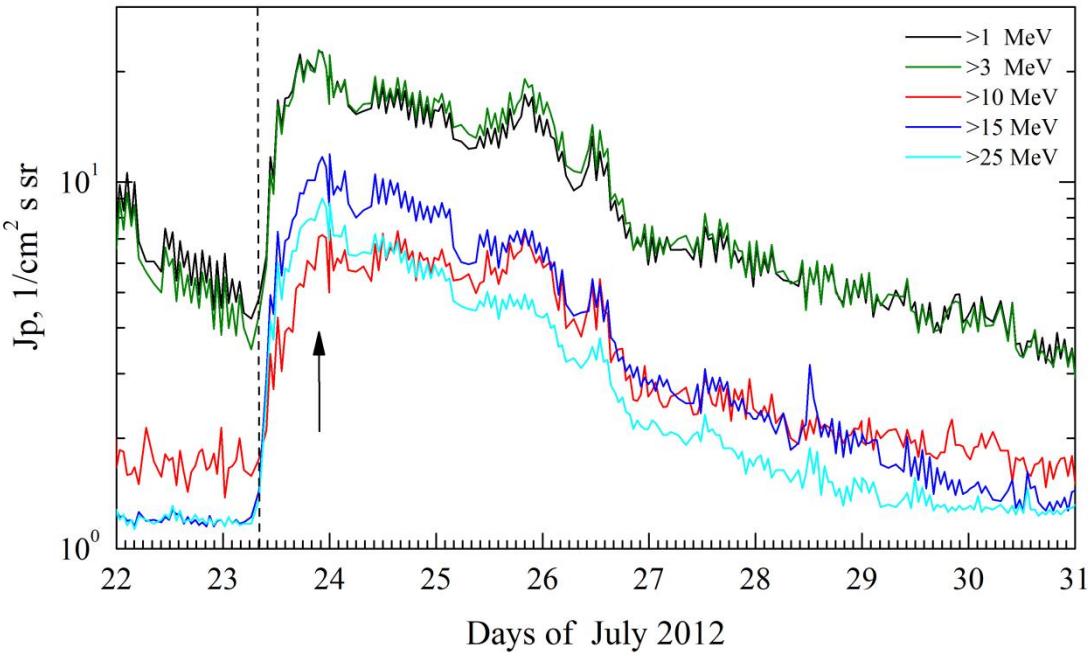
SOHO. Event 2012.07.23



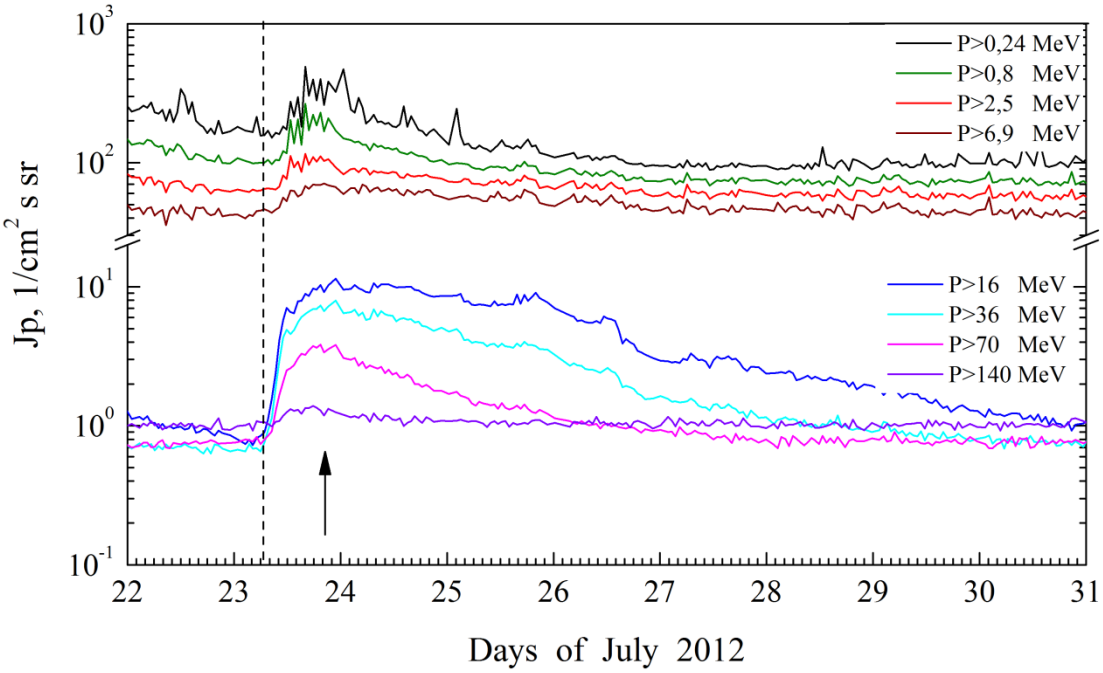

GOES. Event 2012.07.23
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Jp, 1/cm² s sr
Days of July 2012


Electro. Event 2012.07.23
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
Days of July 2012

Meteor. Event 2012.07.23



POES. Event 2012.07.23



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 July 23

2012 **July 23** ⊡ **AR 11520** **To event 518**

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	No optical flare on visible disk					
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
410	MHz	0220	0220	0220		2.0	
245	MHz	0225	0225	0225		2.41	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	020-045	0231		0237		1	
DS III	020-730	0218		0226		1	
DS CTM	075-180	0217		0235		1	
DH II	0.02-16	0230		2140			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0236	2003	- 24.6	360˚	286˚	SOHO

Proton Active Region:

AR11520 (S16L084, CMP 12.3.07.2012,
Sp=1460 msh, FKC, BGD, R)
XRI=2.82 $X_2^{1.4}$+$M_5^{7.7}$+C_{26} 2_1+1_7+S_{64}
PFR1 12.07 $X_2^{1.4}$
PFR2 19.07 $M_1^{7.7}$

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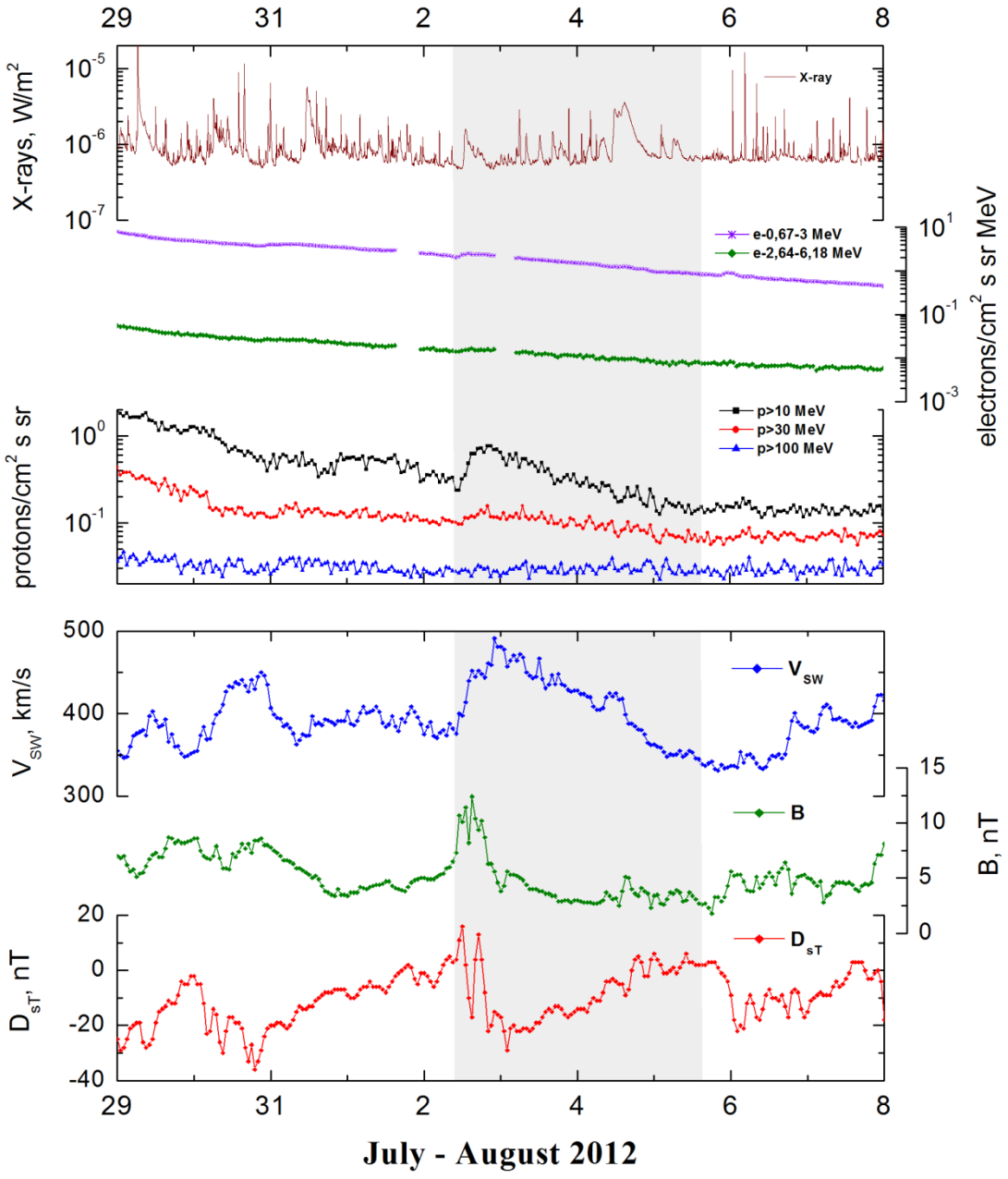
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 02d10^h
Tmax (Ep>10 MeV) – 02d21^h, Jmax (Ep>10 MeV) – 0.6 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ = 2.2
Quasimaximal energy of protons in the event – Eqm = 50 MeV

Sources: ☐ solar flare 02d12^{h}10^m, C1.5/, S20W87, AR11529
Main burst X-ray 1–8 Å: onset – 02d12^{h}10^m, max – 02d13^{h}10^m, Φ = 0.0057 J/m^2
CME: 02d13^{h}26^m, V= 563 km/s, Δφ = 108º, dA= 234º
▲ SC 02d10^{h}50^m

Particle fluxes and associated phenomena

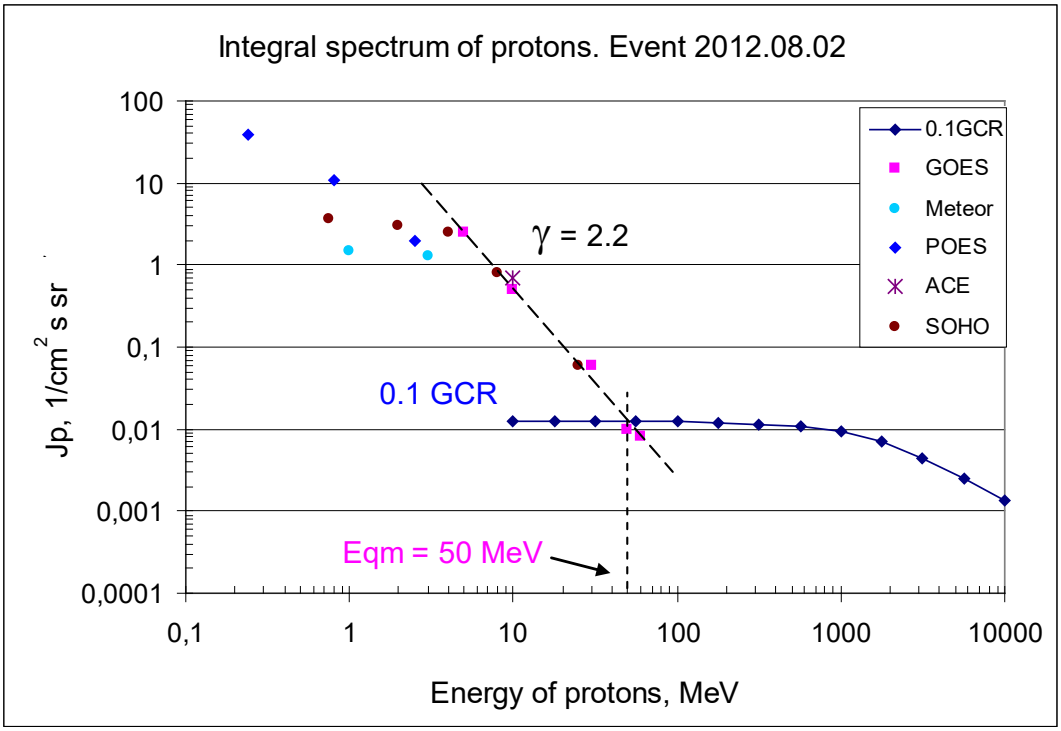


Integral fluxes of protons for the event of 2012 August 02

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	10	21	2.5	3	0.2	
EPS	>10	10	21	0.6	3	0.15	
EPS	>30	10	20	0.06	2	0.09	
EPS	>50	-	20	0.01	-	0.07	
EPS	>60	-	19	0.008	-	0.05	
EPS	>100	-	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	10	16	69	1	100	
MEPED	>0.8	-	16	6	-	75	
MEPED	>2.5	-	16	2	-	60	
MEPED	>6.9	-	-	-	-	45	
MEPED	>16	-	-	-	-	0.9	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	1	
MEPED	>140	-	-	-	-	1.1	
Meteor-1							
SCR	>1	12	20	1.5	3	2.5	
SCR	>3	12	20	1	3	2.5	
SCR	>10	-	-	-	-	-	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	-	-	-	-	-	
GALS-M	>600	-	-	-	-	-	
ACE							
SIS	>10	10	17	0.7	2.5	1.4	
SIS	>30	10	-	-	-	1	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

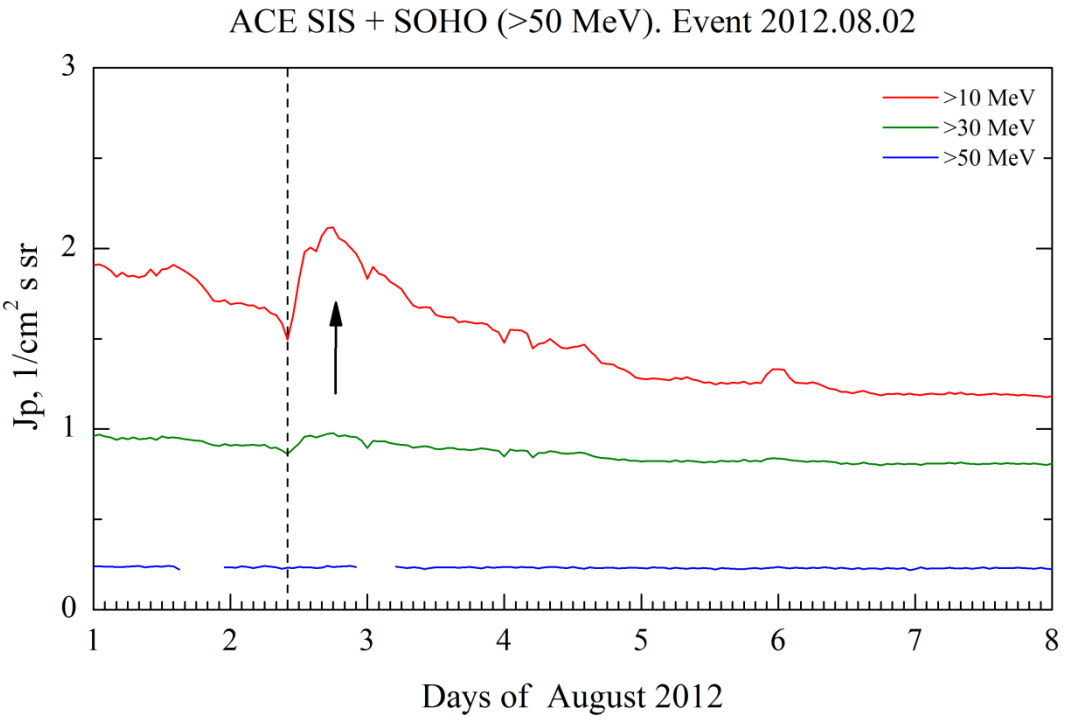
Differential fluxes of protons for the event of 2012 August 02

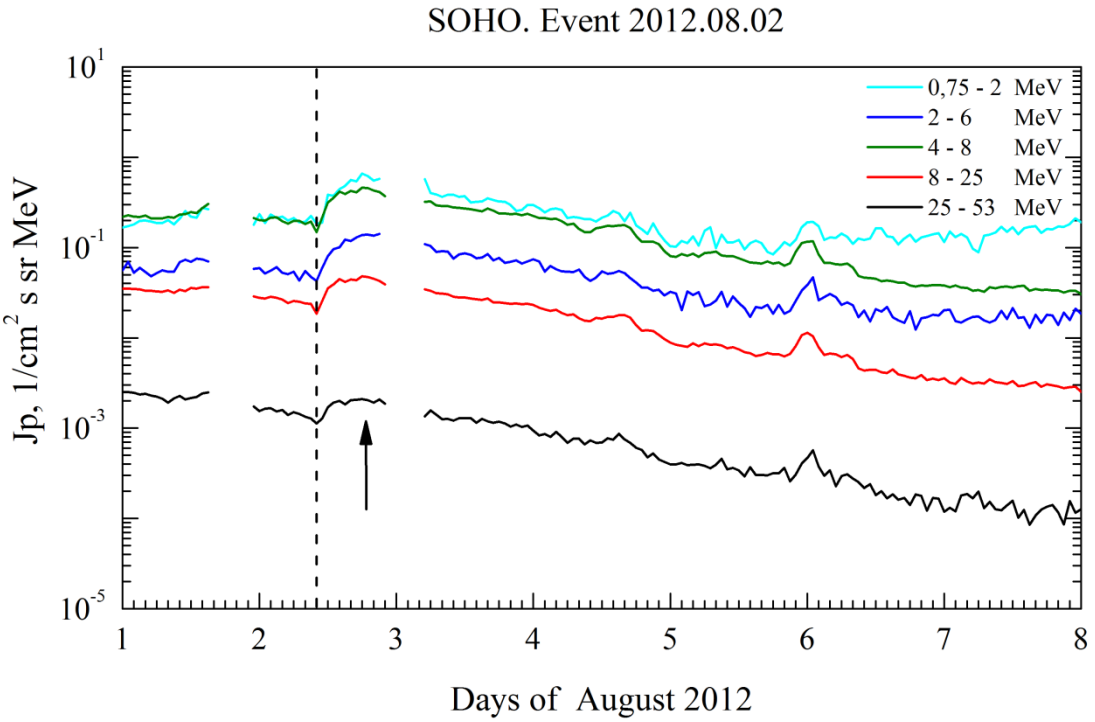
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	12	18	0.6	5	0.1	
LION	2 – 6	12	18	0.14	5	0.01	
EPHIN	4 – 8	12	19	0.43	8	0.03	
EPHIN	8 – 25	12	19	0.045	8	0.003	
EPHIN	25 – 53	12	19	0.002	8	0.00008	
Electro-1							
SCR-E	13.7–23	-	-	-	-	0.06	
SCR-E	23–42	-	-	-	-	0.025	
SCR-E	42–112	-	-	-	-	0.005	


Integral spectrum of protons. Event 2012.08.02
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
γ = 2.2
0.1 GCR
Eqm = 50 MeV
0.1GCR
GOES
Meteor
POES
ACE
SOHO
0,1
1
10
100
1000
10000
Energy of protons, MeV

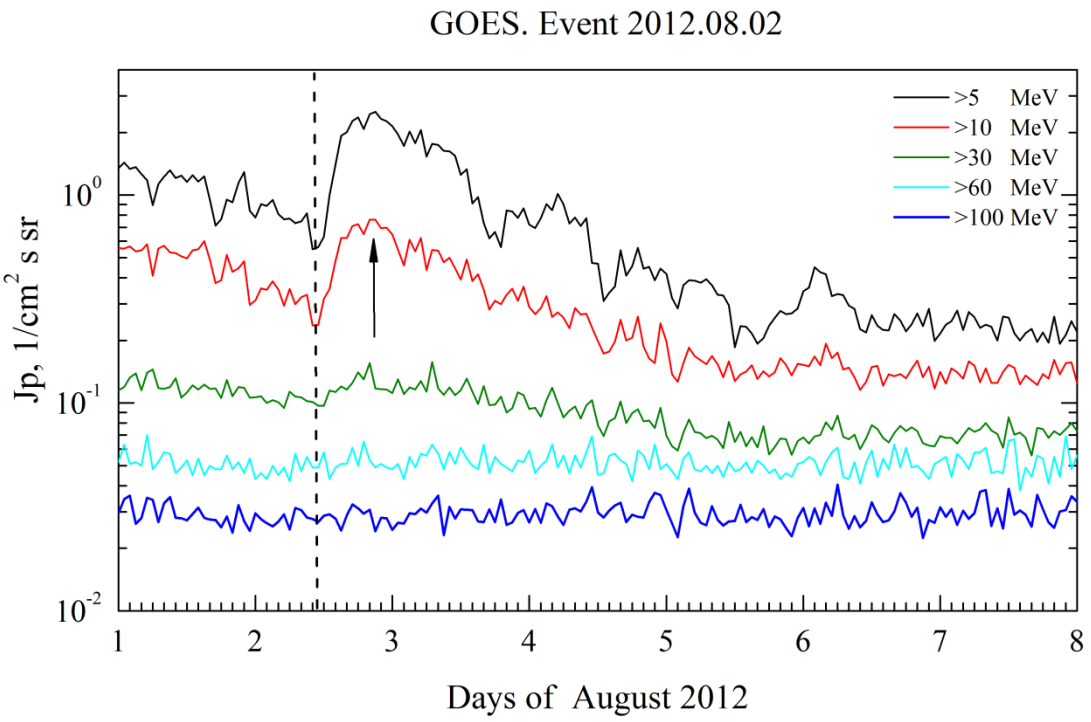
Time profiles of proton fluxes in the event 2012.08.02

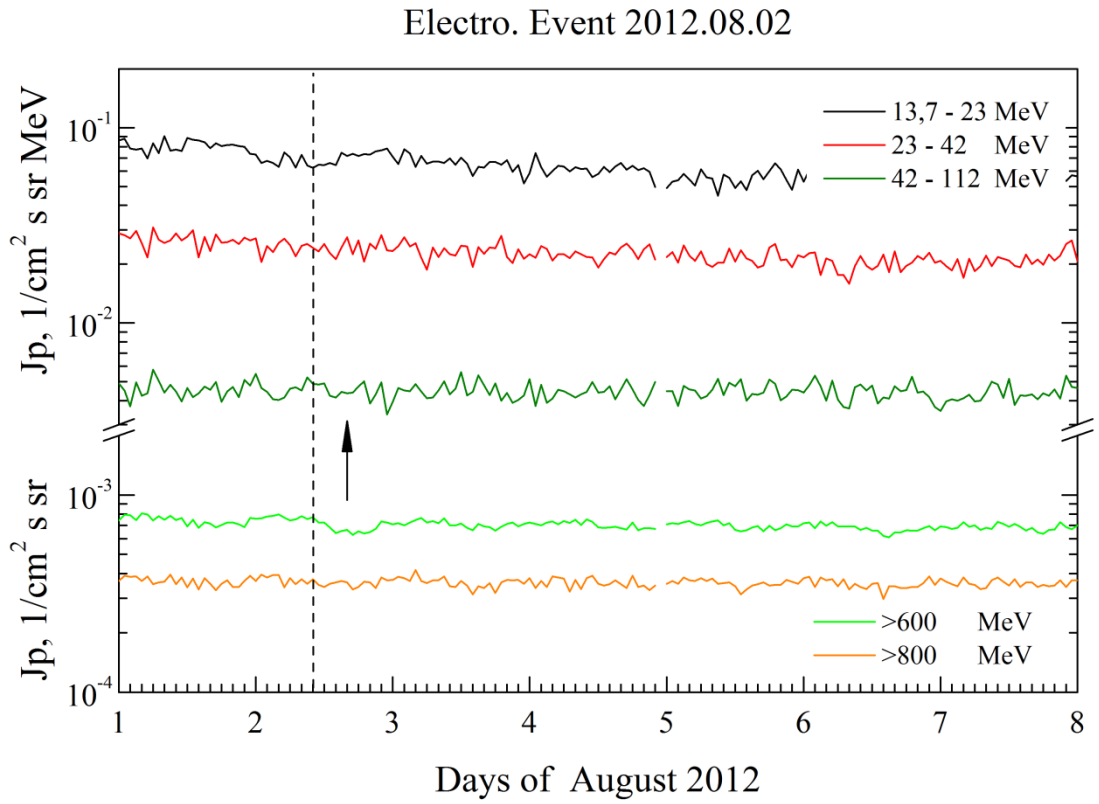
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



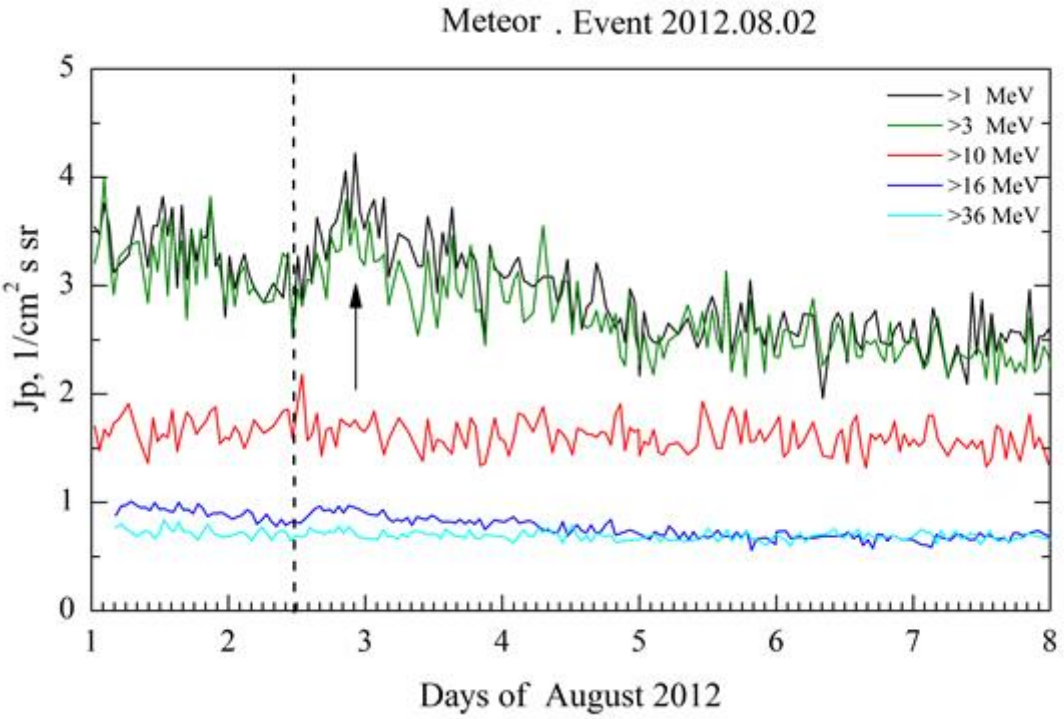


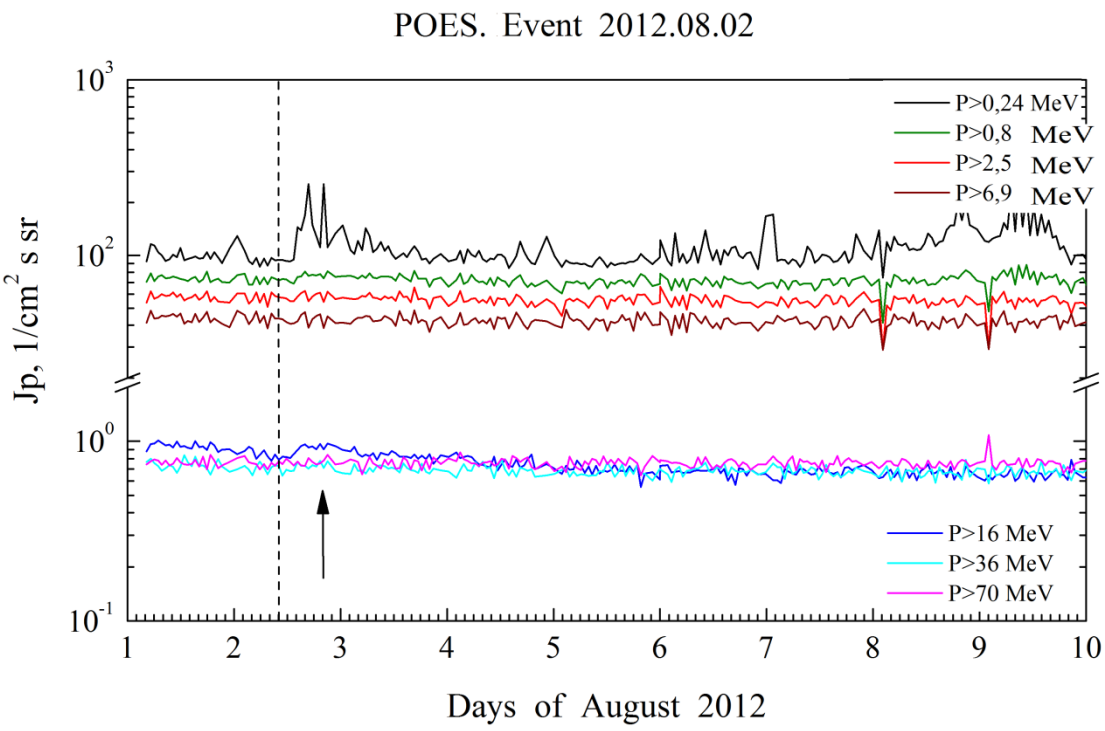
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 August 02

2012 August 02 ☐ **AR 11529** **To event 519**

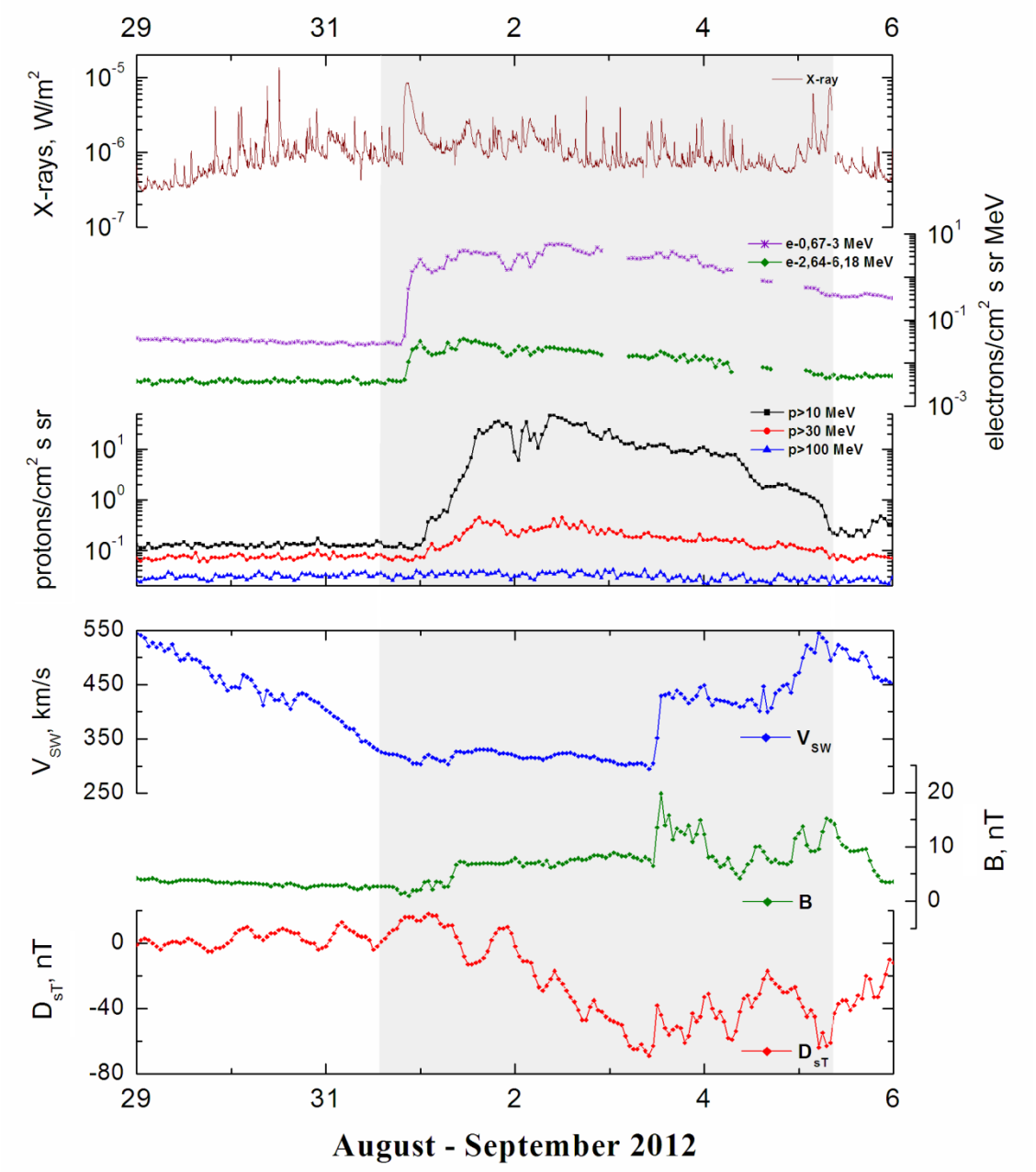
Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	No optical flare on visible disk					
1 – 12	keV	1210	1310	1335	S20W87	C1.5	0.0057
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6 – 12	keV	1230:08	1251:50	1256:48	560	2631768	HESSI
6 – 12	keV	1323:08	1324:18	1331:40	208	468960	HESSI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS VI	025-128	1214		1526		1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1326	563	-0.9	108˚	234˚	SOHO

Event 2012.09.01 – (2012-245) **520**

Particle event: To(Ep>10 MeV) – 01d01^h
Tmax$_1$(Ep>10 MeV) – 01d15^h, Jmax$_1$ (Ep>10 MeV) – 24 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 02d10^h, Jmax$_2$ (Ep>10 MeV) – 47 /cm^2·s·sr
Duration of the event – 5 days, power-law index: γ_1 = 3.4, γ_2 = 4.1
Quasimaximal energy of protons in the event – Eqm$_1$ = 80 MeV
– Eqm$_2$ = 65 MeV

Sources: ● solar flare 31d19^{h}45^m, C8.4/2F, S19E42, AR11562
Main burst X-ray 1–8 Å: onset – 31d19^{h}45^m, max – 31d20^{h}43^m, Φ = 0.051 J/m^2
CME: 31d20^{h}00^m, V= 1442 km/s, Δφ = 360º, dA= 090º
▲ SC 03d12^{h}13^m

Particle fluxes and associated phenomena

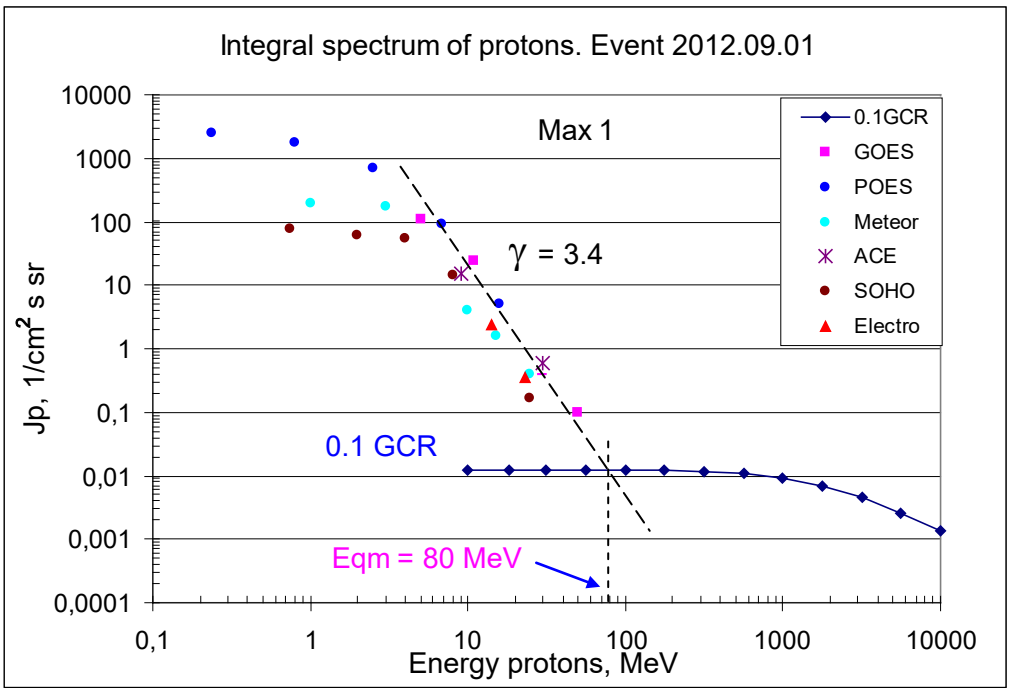


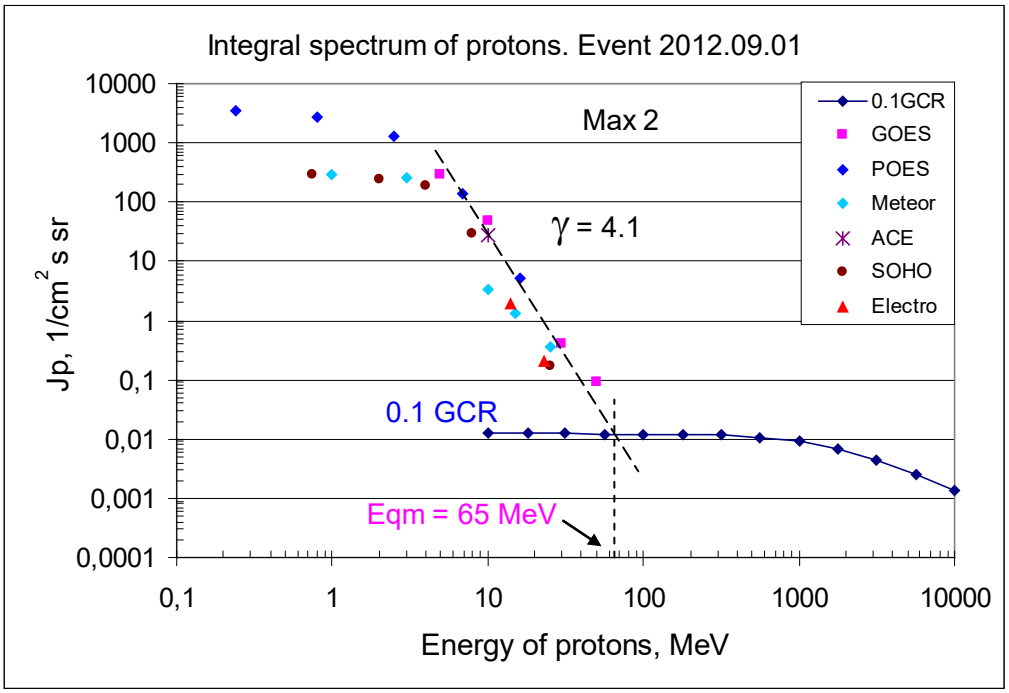
Integral fluxes of protons for the event of 2012 September 01

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	1	15/02d09	110/300	5	0.2	
EPS	>10	1	15/02d10	24/47	5	0.15	
EPS	>30	1	15/02d10	0.45/0.4	4	0.09	
EPS	>50	1	15/02d12	0.1/0.09	4	0.07	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	10	20/2d11	2480/3480	5	100	
MEPED	>0.8	10	20/2d11	1800/2700	5	75	
MEPED	>2.5	10	20/2d11	710/1280	5	60	
MEPED	>6.9	10	20/2d11	90/140	3	45	
MEPED	>16	10	20/2d11	5.1/5.3	2	0.8	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1.1	
Meteor-1							
SCR	>1	2	21/02d13	190/285	5	2.56	
SCR	>3	2	21/02d13	173/254	5	1.99	
SCR	>10	2	21/02d13	4.1/3.4	2.5	1.57	
GALS-M	>15	2	21/02d13	1.6/1.31	2.5	1.20	
GALS-M	>25	2	20/02d12	0.4/0.35	2	1.24	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	2	17/02d09	15/28	4	1.4	
SIS	>30	2	11/ -	0.5/ -	4	1	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

Differential fluxes of protons for the event of 2012 September 01

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	03	17/2d12	11/52	5.5	0.03	
LION	2 – 6	01	17/2d09	2.9/15	5.5	0.003	
EPHIN	4 – 8	00	18/2d14	10/40	5.5	0.001	
EPHIN	8 – 25	00	15/2d11	0.8/1.73	5.5	0.00003	
EPHIN	25 – 53	00	14/2d11	0.006/0.006	5.5	0.00002	
Electro-1							
SCR-E	13.7–23	6	14/2d08	0.22/0.18	2	0.06	
SCR-E	23–42	6	14/2d08	0.019/0.011	2	0.025	
SCR-E	42–112	-	-	-	-	0.005	

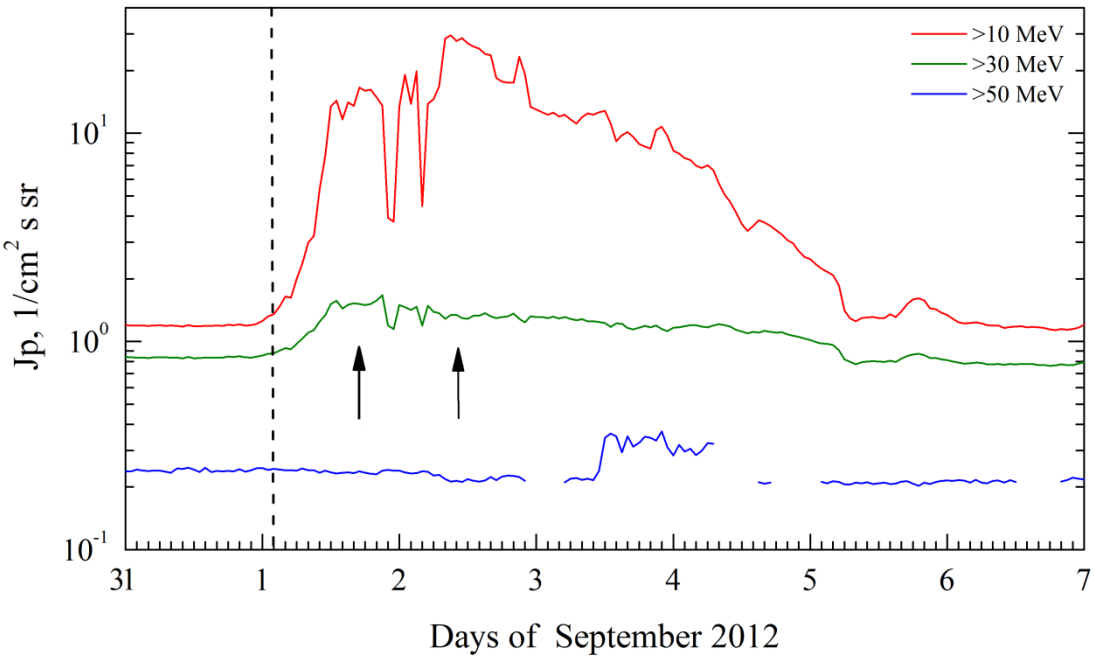

Integral spectrum of protons. Event 2012.09.01
Max 1
γ = 3.4
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2012.09.01
Max 2
γ = 4.1
0.1 GCR
Eqm = 65 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

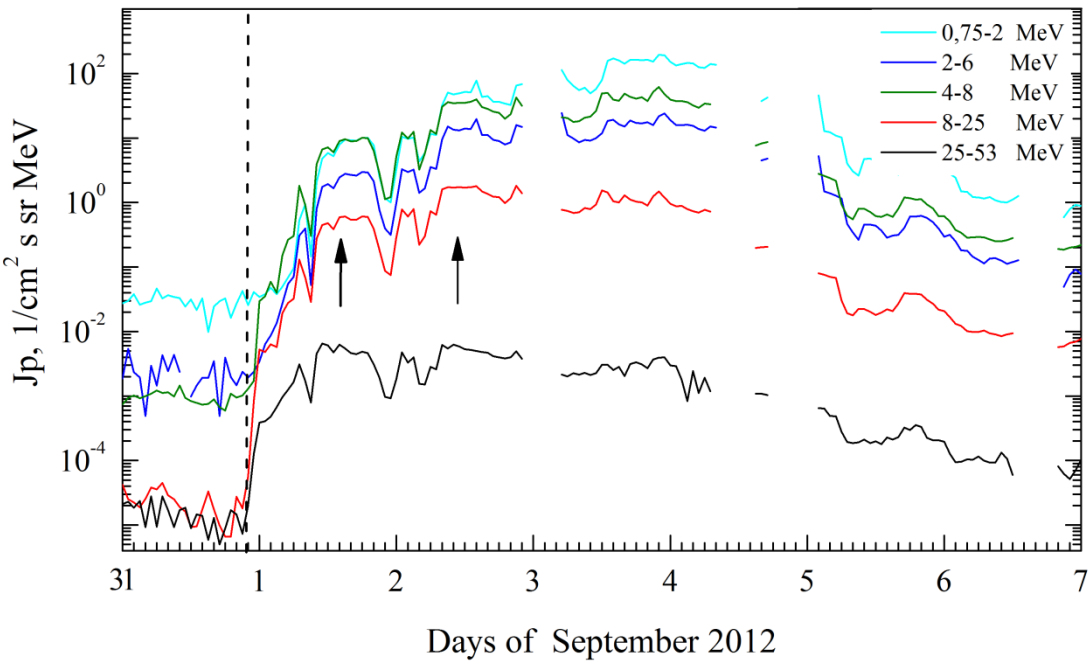
Time profiles of proton fluxes in the event 2012.09.01

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

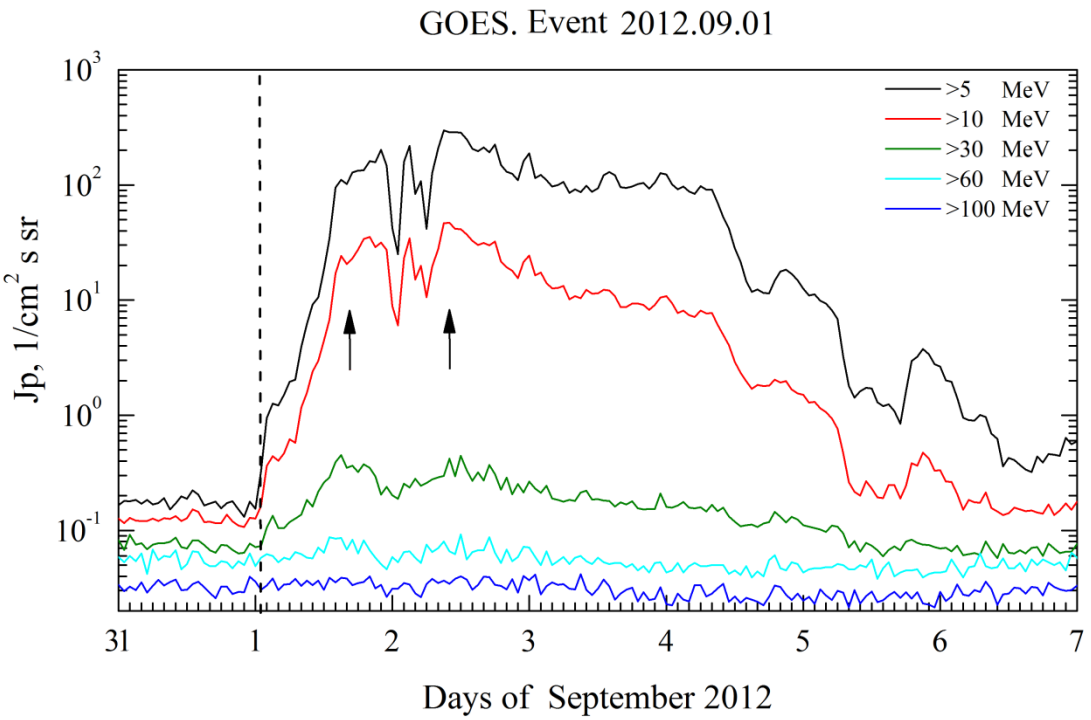
ACE SIS + SOHO (>50 MeV). Event 2012.09.01

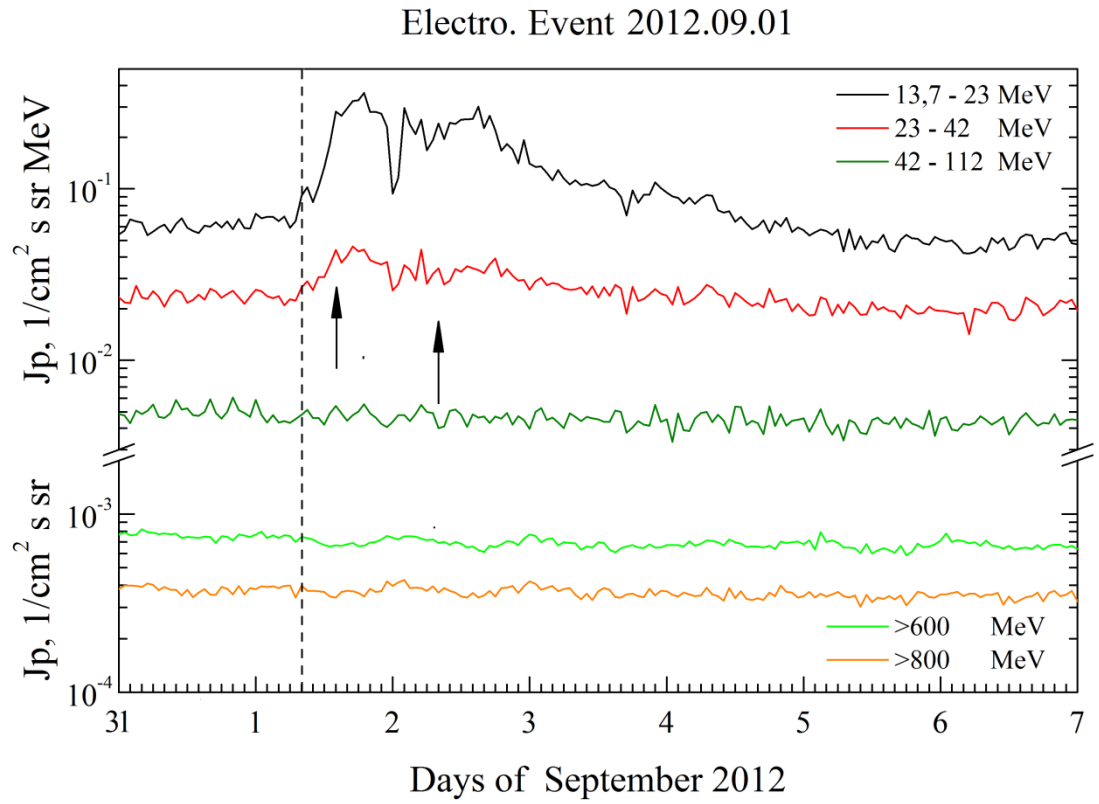


SOHO. Event 2012.09.01

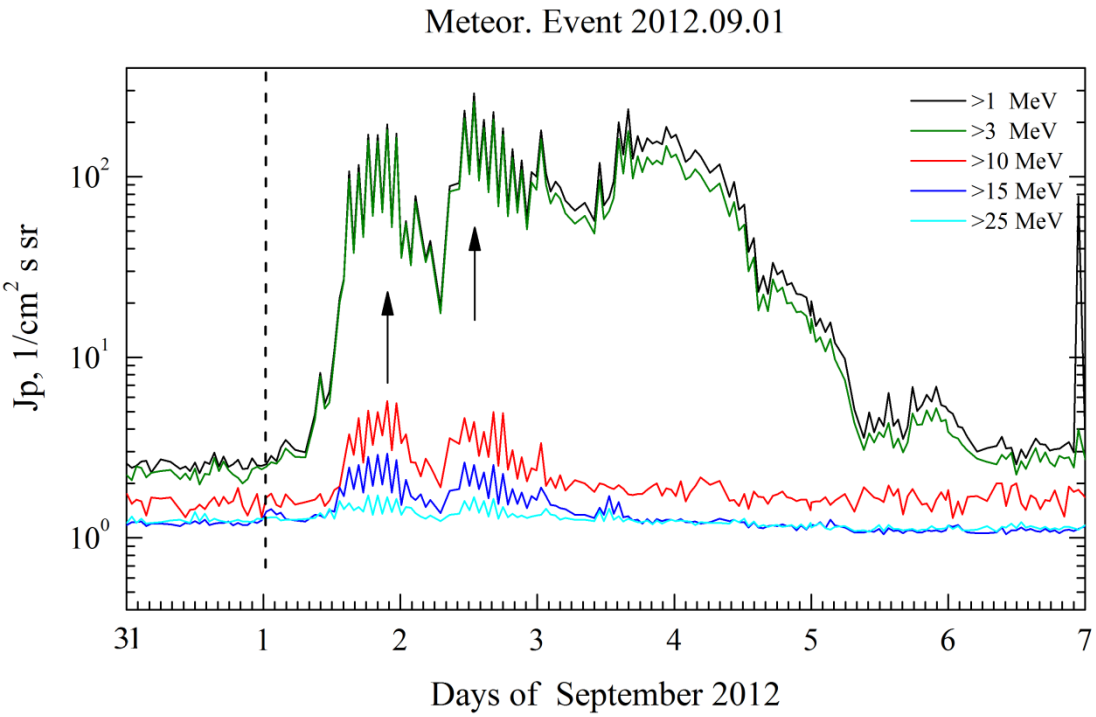


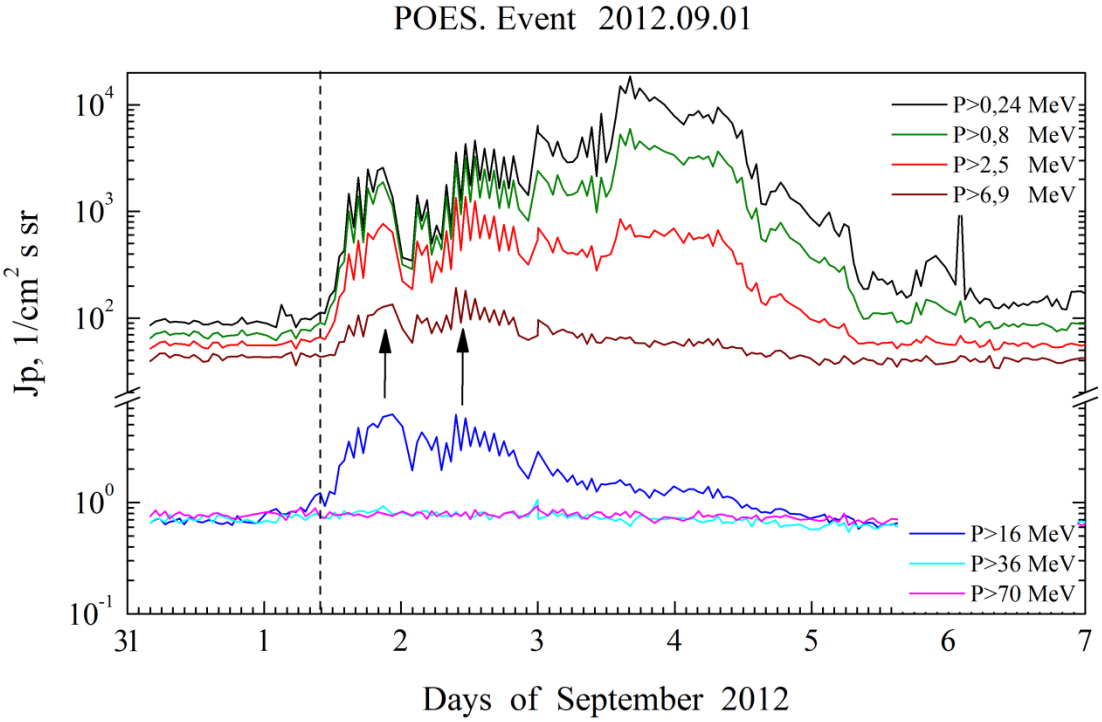
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



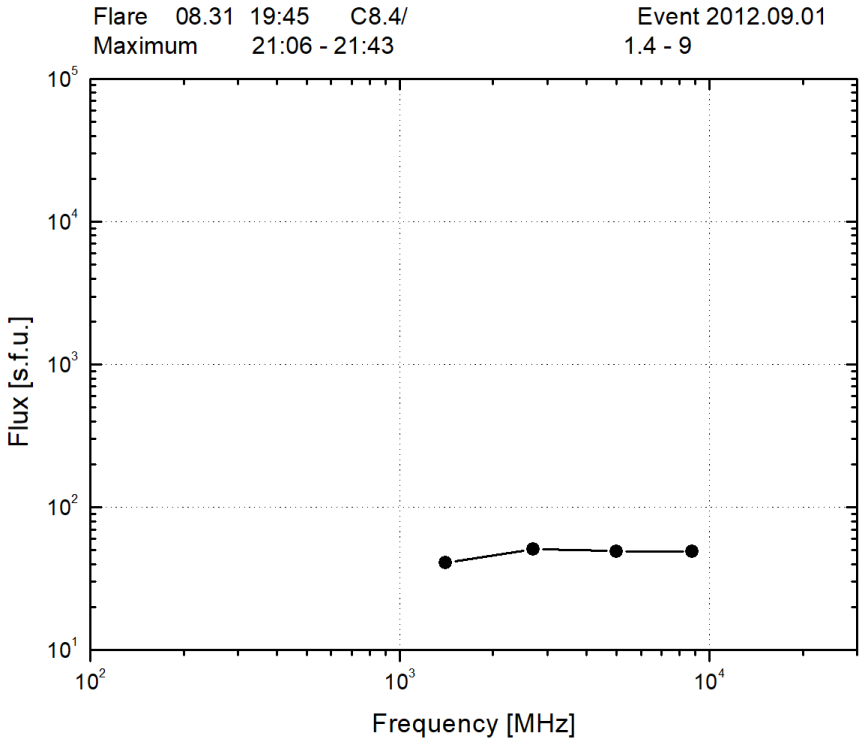


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 September 01

2012 August 31 ● AR 11562 To event 520

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1952	2043	2122	S19E42	2F	ERU
6563 Å	DSF	1700	2043	2218	S17E50	>15º	
1 – 12	keV	1945	2043	>2151		C8.4	0.051
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12 – 25	keV	1935:20	1953:38	1955:04	1456	3713448	HESSI
12 – 25	keV	2001:06	2026:59	2032:22	1457	248562	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
8.8	GHz	2029	2107	2245		1.69	
5	GHz	2026	2108	2300		1.69	
2.7	GHz	2028	2106	2300		1.71	
1.4	GHz	2054	2143	2300	1.4 – 9	1.61	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-131	1942		2000	515	2	
DS IV	025-087	2002		2019		3	
DH II	0.4-16	2000		2345			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2000	1442	2.0	360˚	90˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR 11562 (S19L103, CMP 03,5.09.2012,
Sp=340 msh, DAO, B, R1)
XRI=0.1, $C_3^{8.4}$ 2_1+S_3
PFR DSF 31.08 $C_1^{8.4}$

References:

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Bruno A., I.G. Richardson, 2021.
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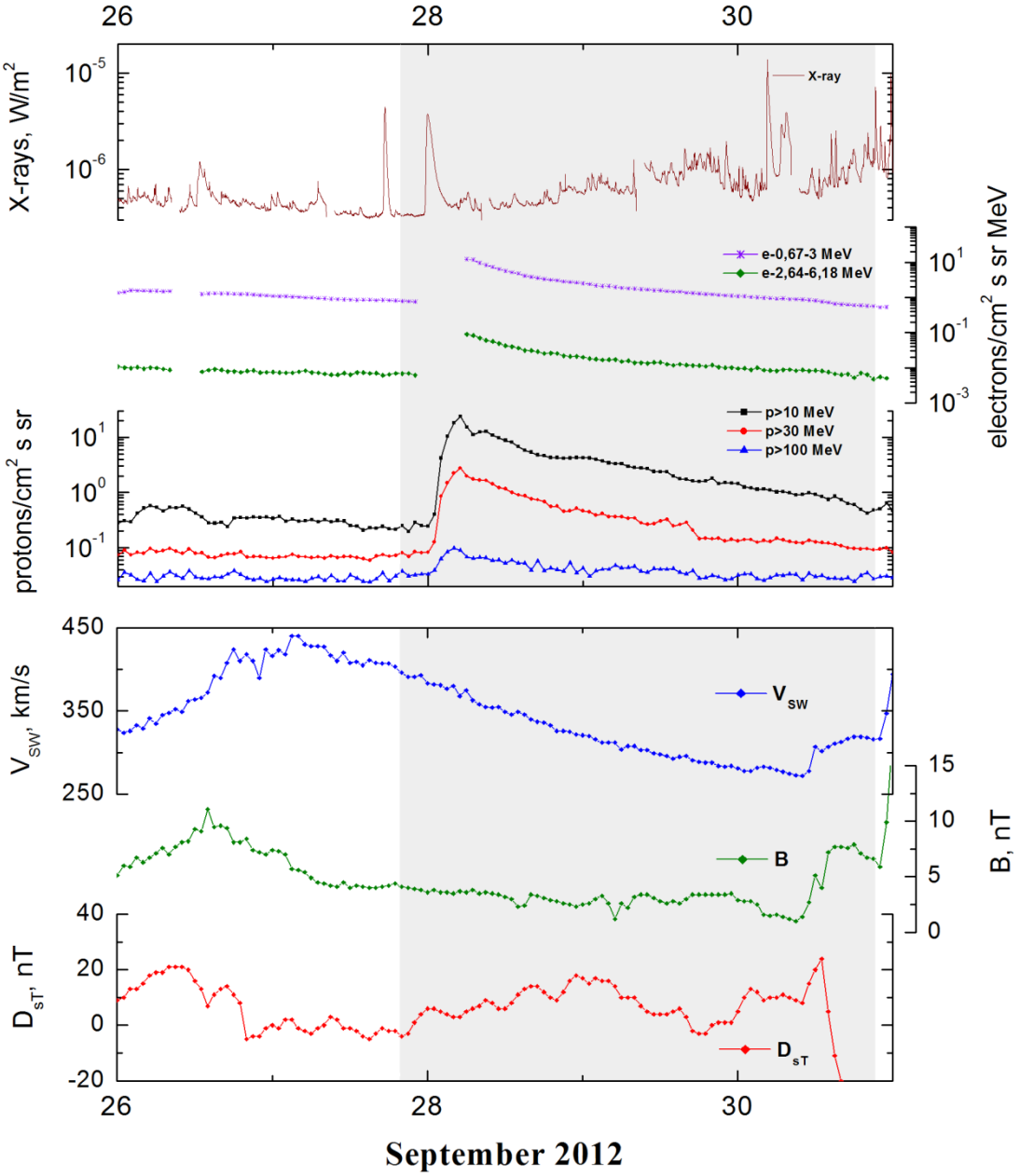
Gopalswamy N., H. Xie, S. Akiyama et al., 2014.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Kalaivani P.P., O. Prakash, A. Shanmugaraju et al., 2021.
Maričić D., B. Vršnak, A.M. Veronig et al., 2020.
NOAA SPE, 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zelina P., S. Dalla, C.M.S. Cohen, R.A. Mewaldt, 2017.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 28d00^h
Tmax (Ep>10 MeV) – 28d05^h, Jmax (Ep>10 MeV) – 23.8 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ = 3.0
Quasimaximal energy of protons in the event – Eqm = 200 MeV

Sources: ● solar flare 27d23^{h}36^m, C3.7/1F, N06W34, AR11577
Main burst X-ray 1–8 Å: onset 27d23^{h}36^m, max – 27d23^{h}57^m, Φ = 0.0094 J/m^2
CME: 28d00^{h}12^m, V= 947 km/s, Δφ = 360°, dA= 251°

Particle fluxes and associated phenomena

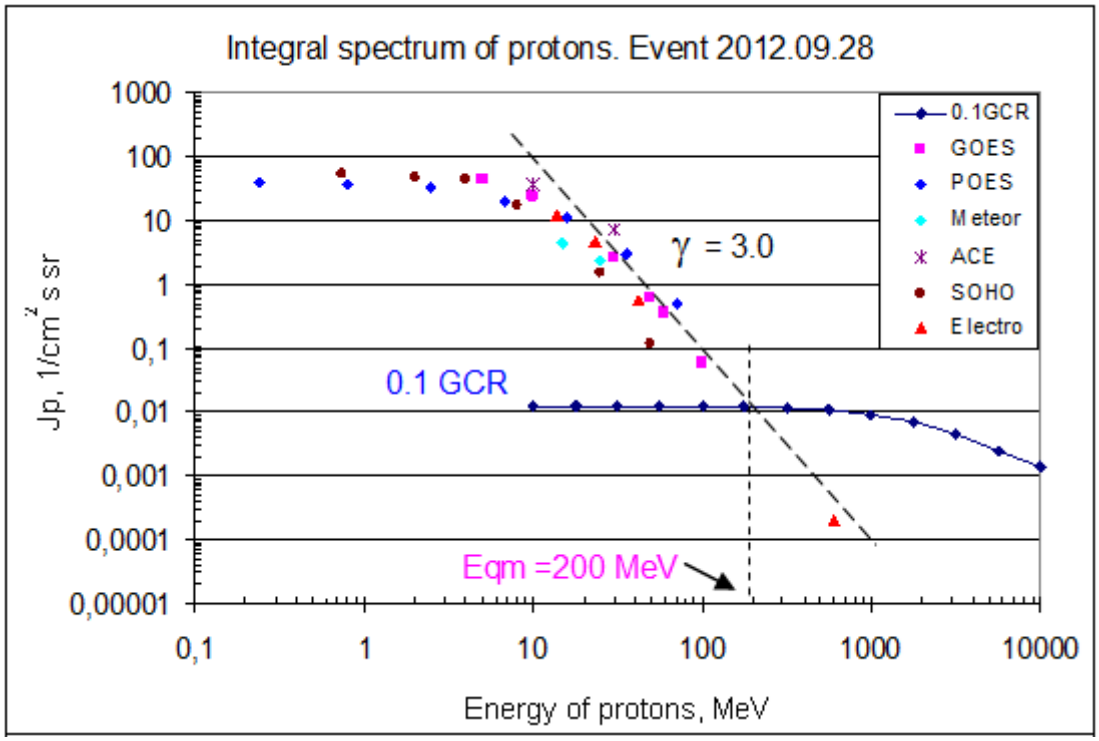


Integral fluxes of protons for the event of 2012 September 28

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	0	5	42.3	3	0.2	
EPS	>10	0	5	23.8	3	0.15	
EPS	>30	0	5	2.7	2	0.09	
EPS	>50	0	5	0.64	2	0.07	
EPS	>60	0	4	0.36	2	0.05	
EPS	>100	0	4	0.06	2	0.04	
Electro-1							
GALS-E	>600	1	3	0.0002	0.5	0.0007	
POES							
MEPED	>0.24	1	4	40	5	135	
MEPED	>0.8	1	4	36	5	100	
MEPED	>2.5	1	4	33	5	65	
MEPED	>6.9	1	4	20	3	45	
MEPED	>16	1	2	11	2	0.8	
MEPED	>36	1	2	3	1	0.9	
MEPED	>70	1	2	0.5	0.3	0.9	
MEPED	>140	-	-	-	-	1.1	
Meteor-1							
SCR	>1	-	-	-	-	2.7	
SCR	>3	-	-	-	-	2.5	
SCR	>10	-	-	-	-	1.6	
GALS-M	>15	0	03	4.5	1	1.25	
GALS-M	>25	0	03	2.4	1	1.3	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	0	3	36.6	3	1.4	
SIS	>30	0	3	7.4	2	1	
SOHO							
EPHIN	>50	-	6	0.12	1	0.24	

Differential fluxes of protons for the event of 2012 September 28

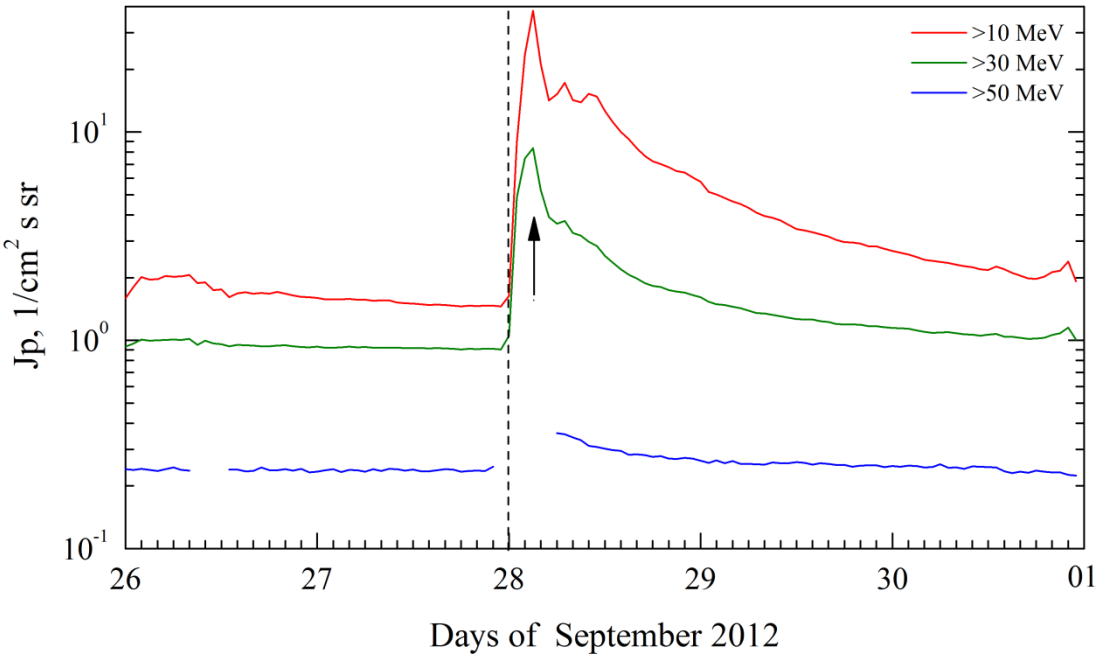
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	11	5	-	1	
LION	2 – 6	-	11	1	-	0.15	
EPHIN	4 – 8	-	9	6.5	3	0.38	
EPHIN	8 – 25	-	8	0.9	3	0.017	
EPHIN	25 – 53	-	7	0.05	3	0.0002	
Electro-1							
SCR-E	13.7–23	01	4	0.82	2	0.06	
SCR-E	23–42	01	4	0.21	2	0.025	
SCR-E	42–112	01	4	0.008	1	0.005	


Integral spectrum of protons. Event 2012.09.28
1000
100
10
1
0,1
0,01
0,001
0,0001
0,00001
Jp, 1/cm² s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 3.0
0.1 GCR
Eqm =200 MeV

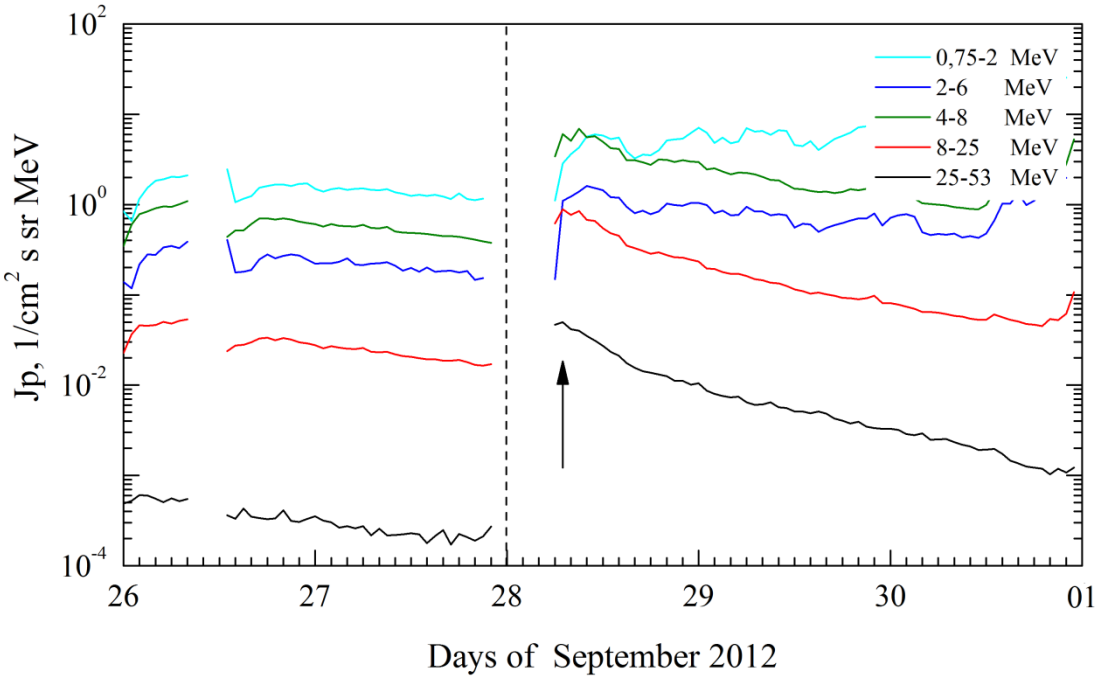
Time profiles of proton fluxes in the event 2012.09.28

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

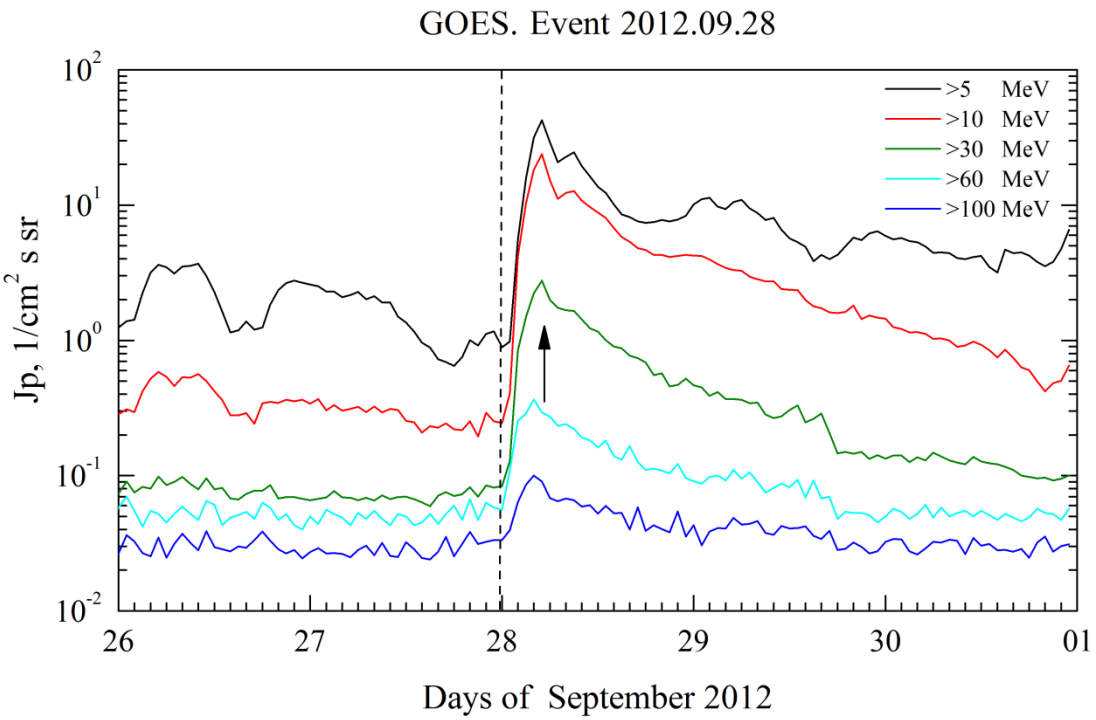
ACE SIS + SOHO (>50 MeV). Event 2012.09.28

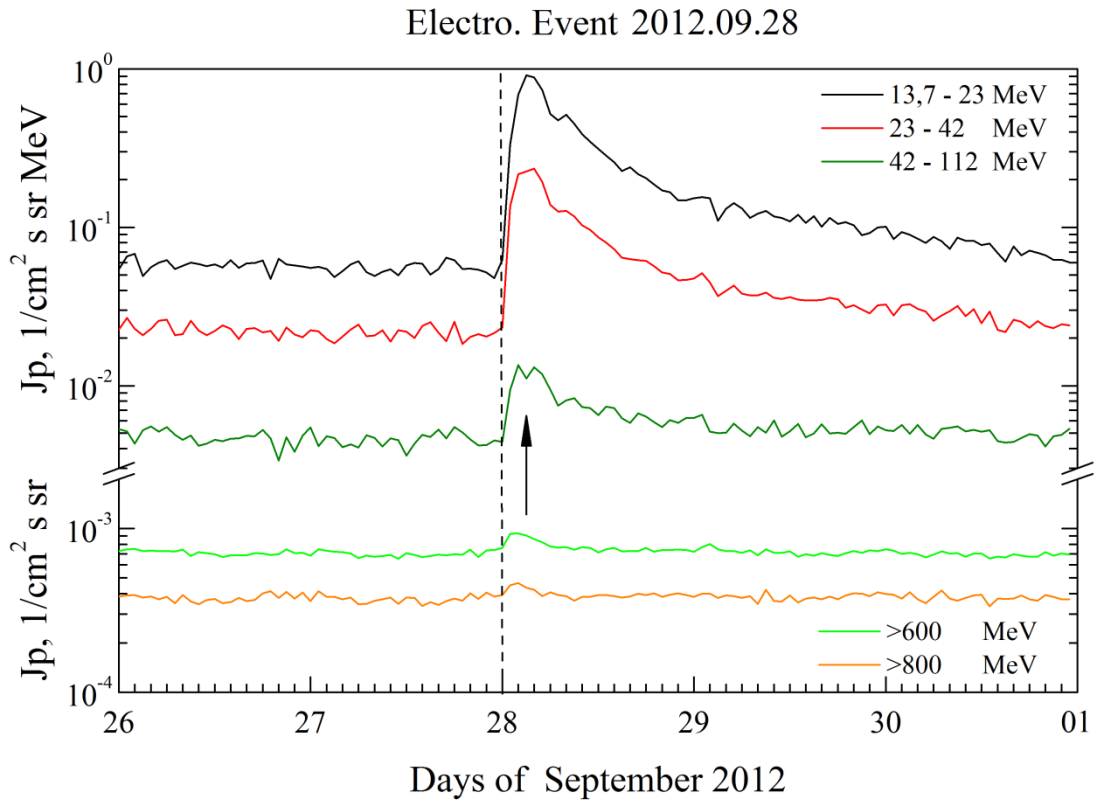


SOHO. Event 2012.09.28

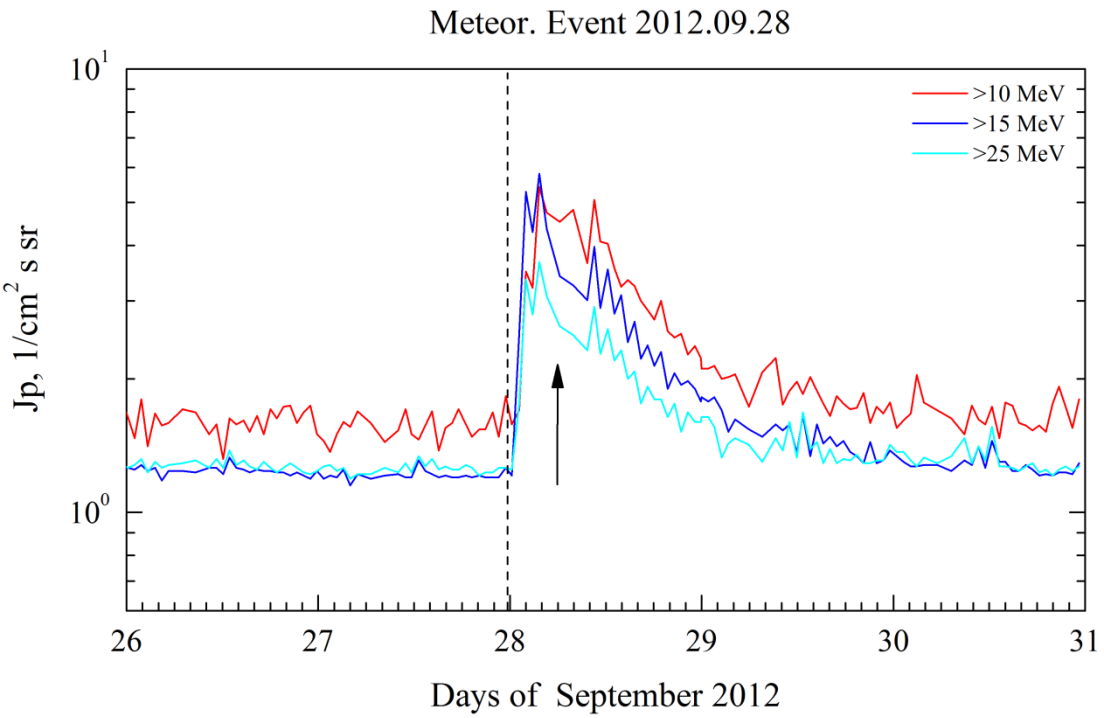


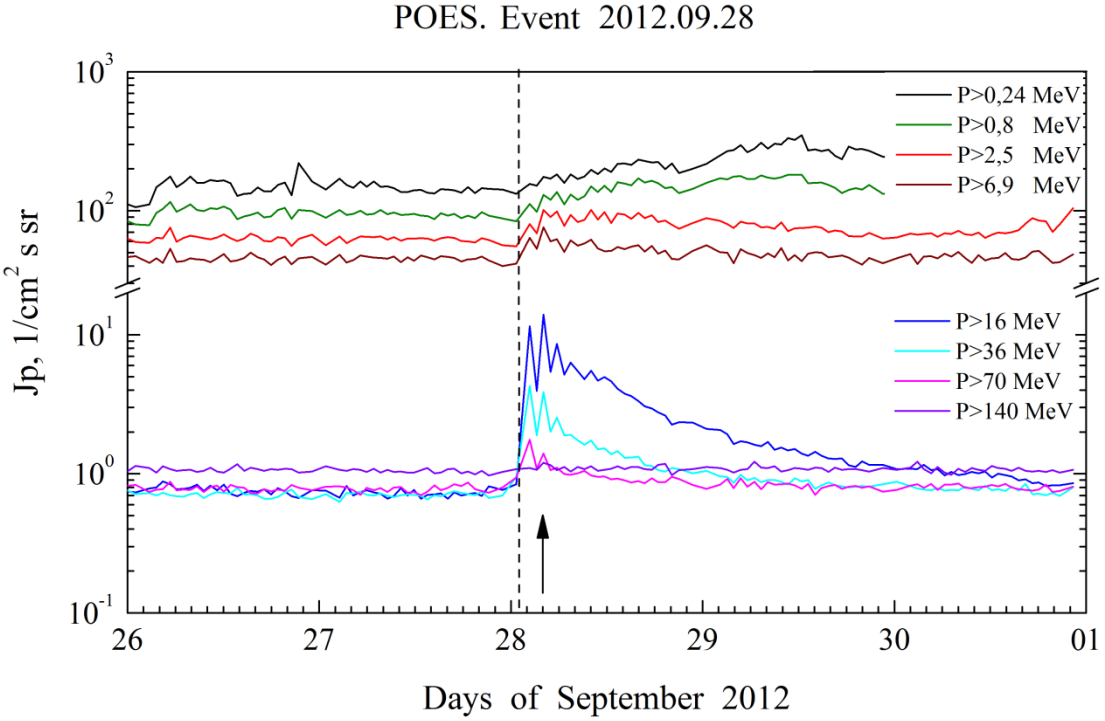
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 September 28

2012 September 27 • AR 11577 To event 521

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	2339	2348	0034	N06W34	1F	PRB
6563 Å	DSF	2336		28d0256	N03W28	14	
1 – 12	keV	2336	2357	0034	N09W32	C3.7	0.0094

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12 – 25	keV	2345:04	2352:26	0041:48	2800	21547104	HESSI

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	027-060	2344		2354		1	
DS III	018-060	0006		0007		3	
DS VI	025-180	0000		0018		2	
DS CTM	025-120	0000		0013		1	
DH II	0.25-16	0255		28d1015			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	28d0012	947	3.7	360º	251º	SOHO

Proton Active Region:

AR11577 (N09, L163, CMP 26,1.09.2012,
Sp=100 msh, CSO, B, R1)
XRI<0.2 C_9 1_1+S_5
PFR DSF 27.09 C_1

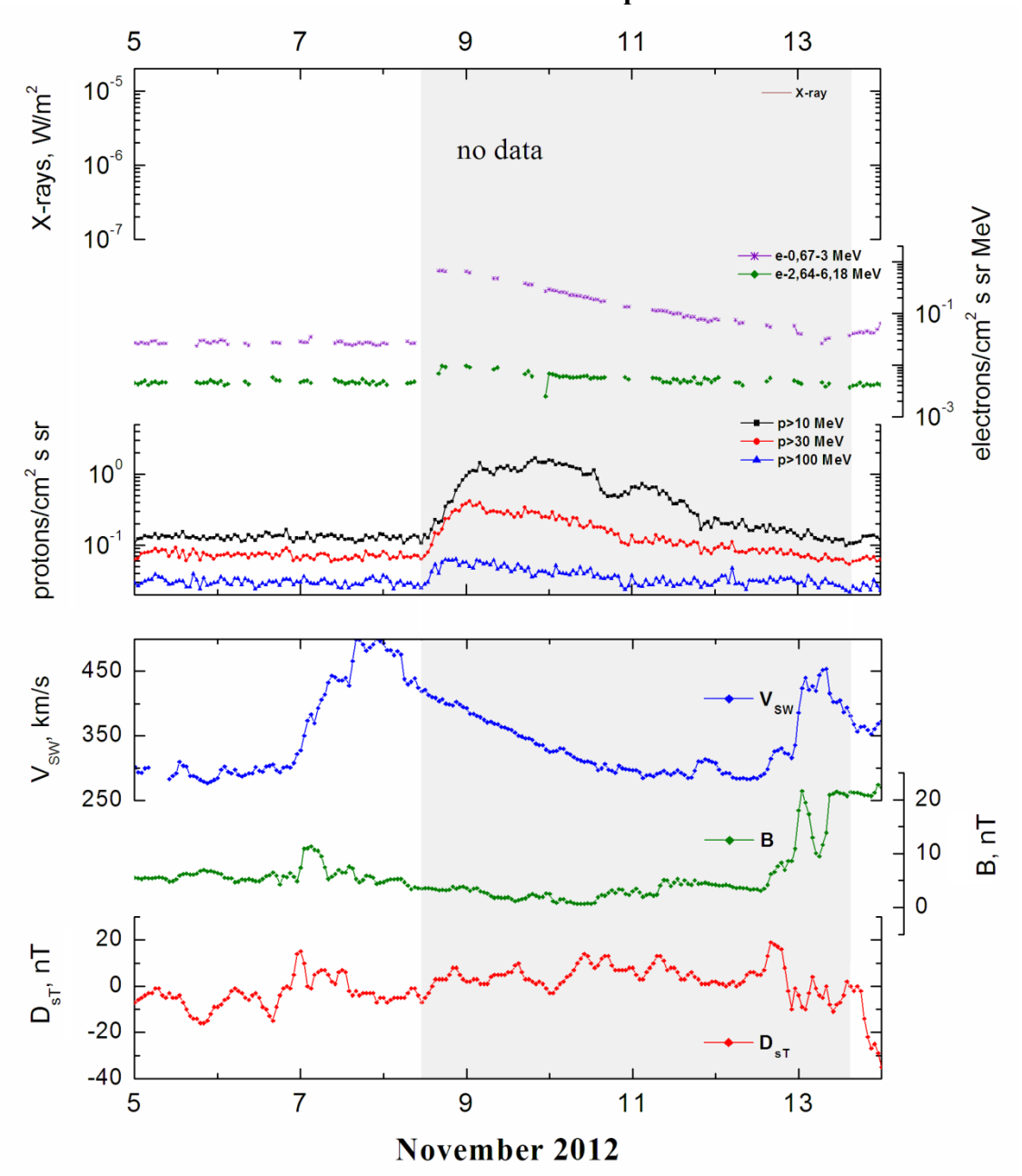
References:

Alberti T., M. Laurenza, E.W. Cliveret et al., 2017.
Gopalswamy N., H. Xie, S. Akiyama et al., 2014.
Gopalswamy N., S. Yashiro, N. Thakur et al., 2016.
Kalaivani P.P., O. Prakash, A. Shanmugaraju et al., 2021.
Koleva K., M. Dechev, P. Duchlev, 2021.
Le G.-M., X-F. Zhang, 2017.
Ling A.G., and S.W. Kahler, 2020.
NOAA SPE, 2019.
Núñez M., T. Nieves-Chinchilla and A. Pulkkinen, 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Wang Y., D. Lyu, B. Xiao et al., 2021.
Winter L.M., and K. Ledbetter, 2015.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 08d12^h
Tmax (Ep>10 MeV) – 09d04^h, Jmax (Ep>10 MeV) – 1.4 /cm^2·s·sr
Duration of the event – 4 days, power-law index: γ = 2.0
Quasimaximal energy of protons in the event – Eqm = 170 MeV

Sources: ■ solar flare 08d02^{h}08^m, M1.7/, N13E89, AR11611
Main burst X-ray 1–8 Å: onset – 08d02^{h}08^m, max – 28d02^{h}23^m, Φ = 0.03 J/m^2
CME: 28d02^{h}36^m, V= 855 km/s, Δφ = 360º, dA= 046º
▲ SC 12d23^{h}12^m

Particle fluxes and associated phenomena

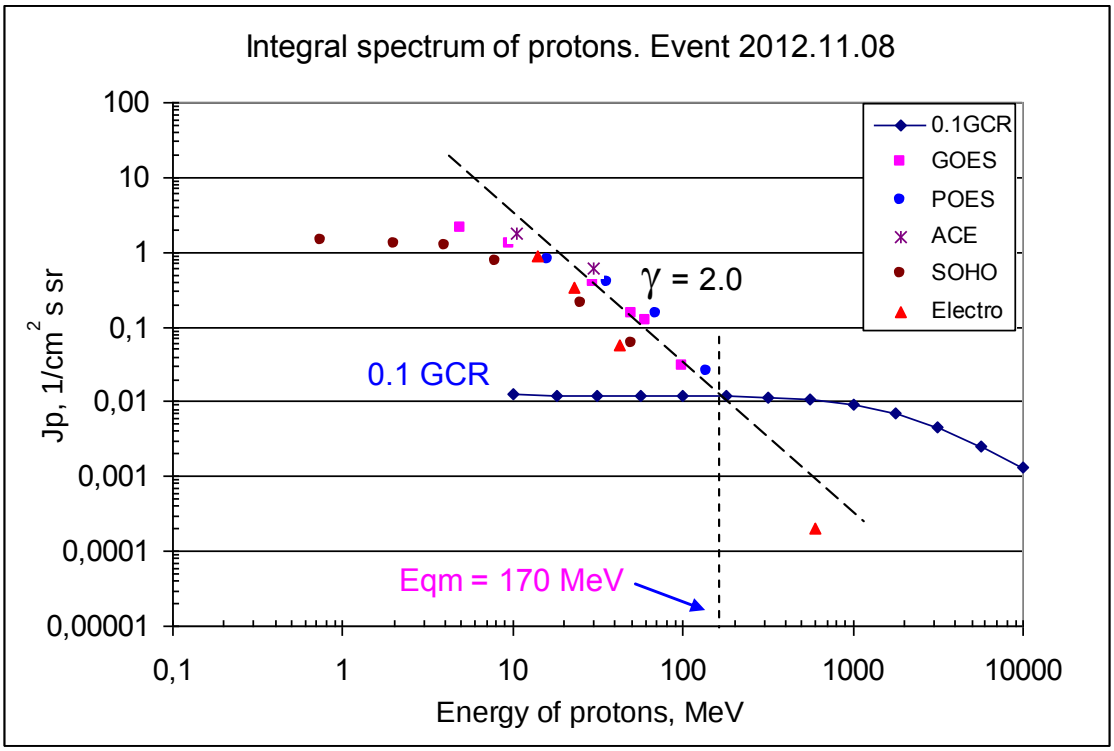


Integral fluxes of protons for the event of 2012 November 08

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	13	09d04	2.1	4	0.2	
EPS	>10	12	09d04	1.4	4	0.15	
EPS	>30	12	09d01	0.4	3	0.09	
EPS	>50	12	09d01	0.15	3	0.07	
EPS	>60	12	09d00	0.12	3	0.05	
EPS	>100	12	09d00	0.03	2	0.03	
Electro-1							
GALS-E	>600	14	23	0.0002	1	0.0007	
POES							
MEPED	>0.24	-	-	-	-	90	
MEPED	>0.8	-	-	-	-	75	
MEPED	>2.5	-	-	-	-	50	
MEPED	>6.9	-	-	-	-	45	
MEPED	>16	12	20	0.8	2	0.7	
MEPED	>36	12	20	0.4	1	0.8	
MEPED	>70	12	20	0.15	0.5	0.9	
MEPED	>140	-	20	0.025	-	1.1	
ACE							
SIS	>10	12	09d01	1.5	3	1.2	
SIS	>30	12	09d01	0.6	2	0.85	
SOHO							
EPHIN	>50	14	09d00	0.06	0.7	0.23	

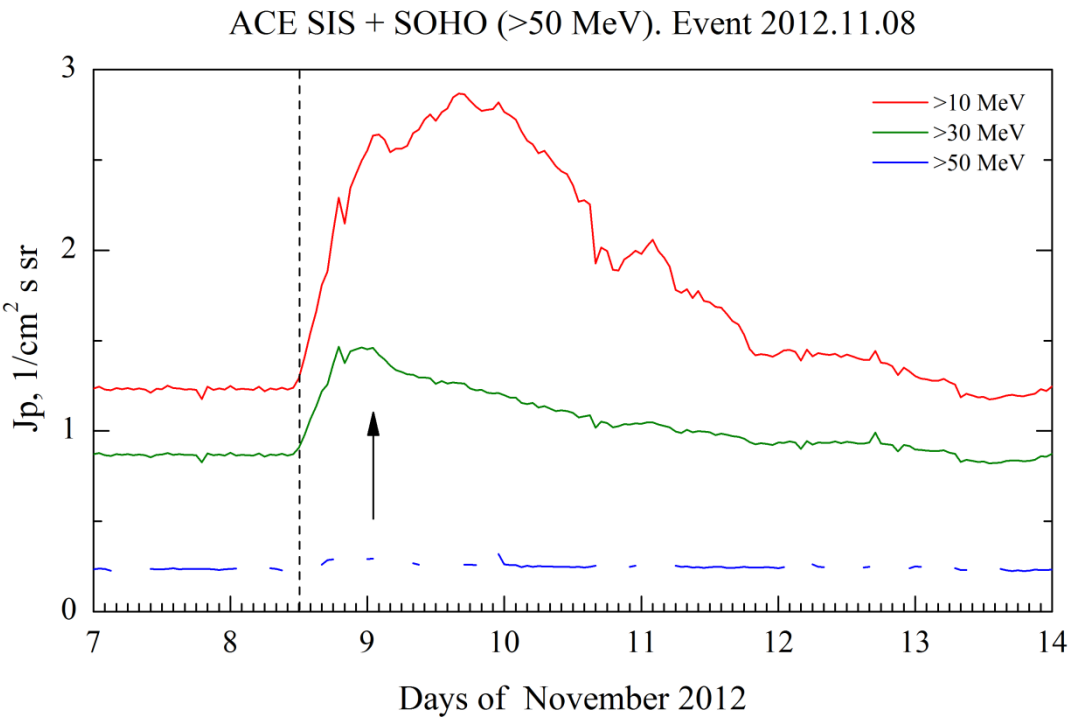
Differential fluxes of protons for the event of 2012 November 08

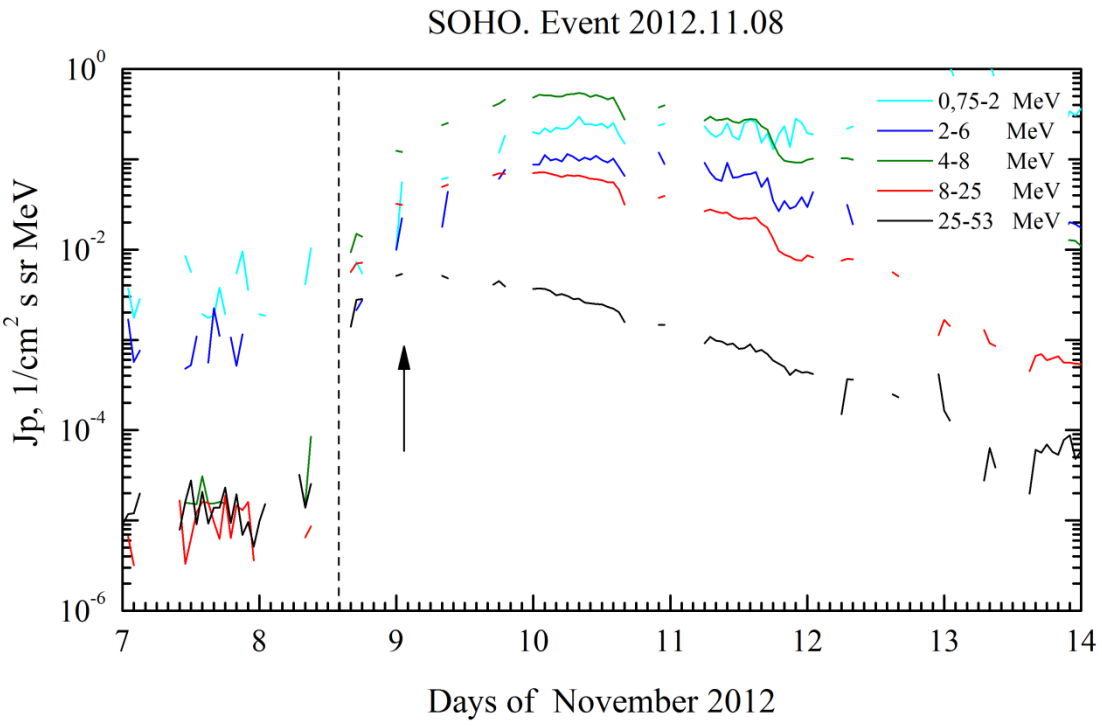
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	14	09d01	0.056	6	0.005	
LION	2 – 6	14	09d01	0.022	6	0.002	
EPHIN	4 – 8	14	09d01	0.124	6	0.00002	
EPHIN	8 – 25	14	09d01	0.032	6	0.00002	
EPHIN	25 – 53	14	09d01	0.0054	6	0.00001	
Electro-1							
SCR-E	13.7–23	14	23	0.06	3	0.06	
SCR-E	23–42	14	23	0.015	3	0.025	
SCR-E	42–112	14	23	0.0008	2	0.005	


Integral spectrum of protons. Event 2012.11.08
Jp, 1/cm 2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,00001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
ACE
SOHO
Electro
γ = 2.0
0.1 GCR
Eqm = 170 MeV

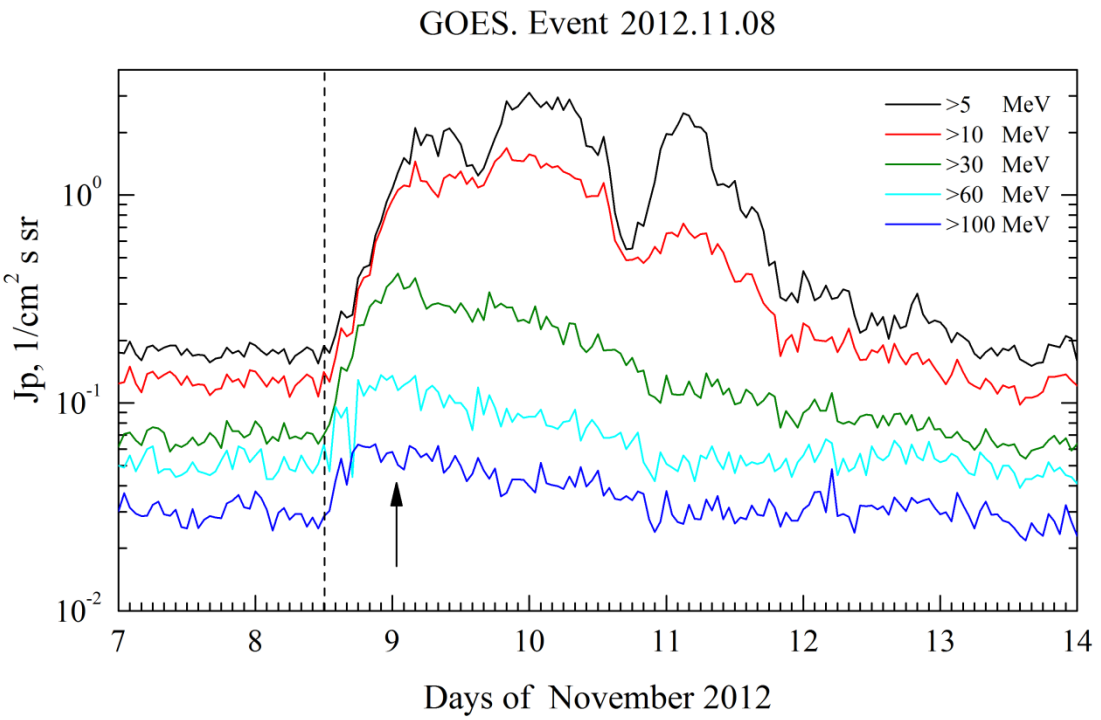
Time profiles of proton fluxes in the event 2012.11.08

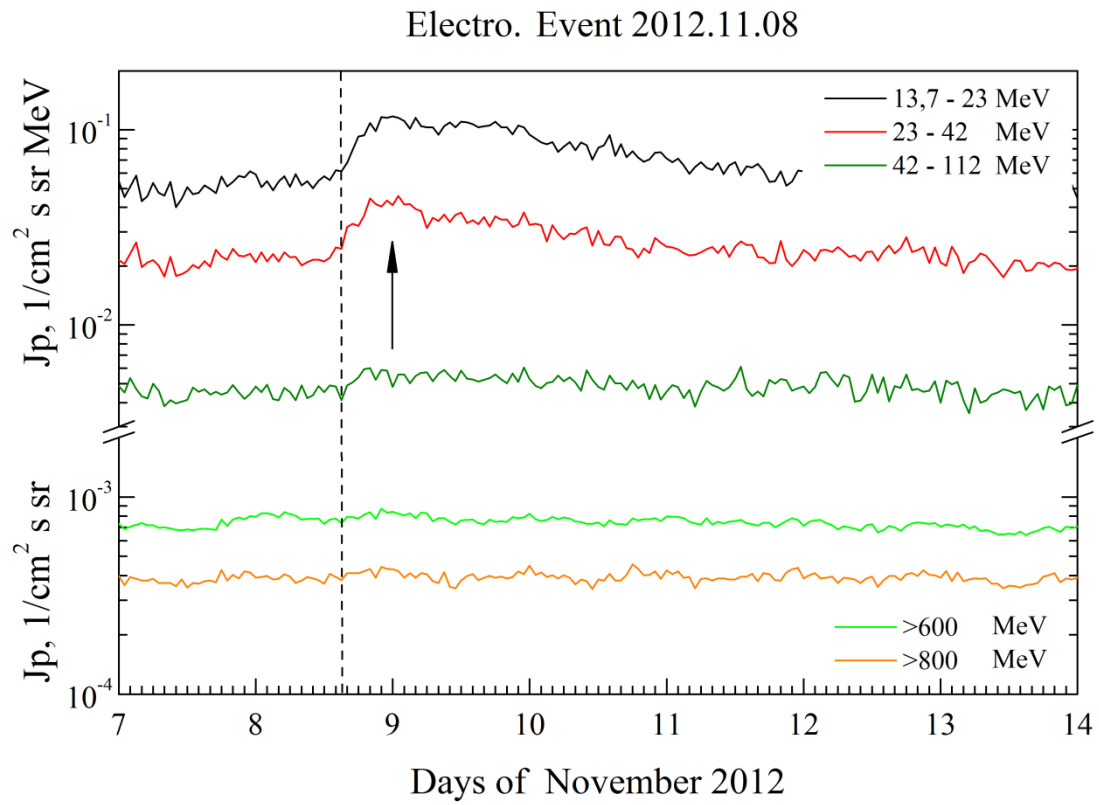
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



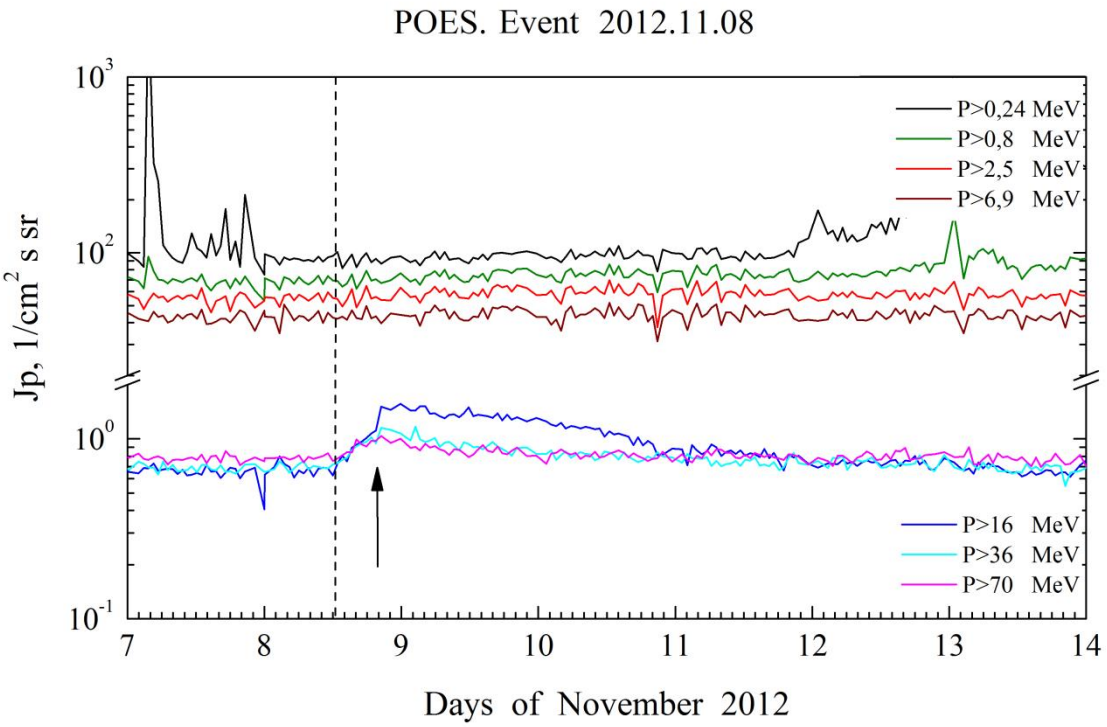


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 November 08

2012 November 08 ■ AR 11611 To event 522

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	No optical flare on visible disk					
1 – 12	keV	0208	0223	>0255	N13E89	M1.7	0.03

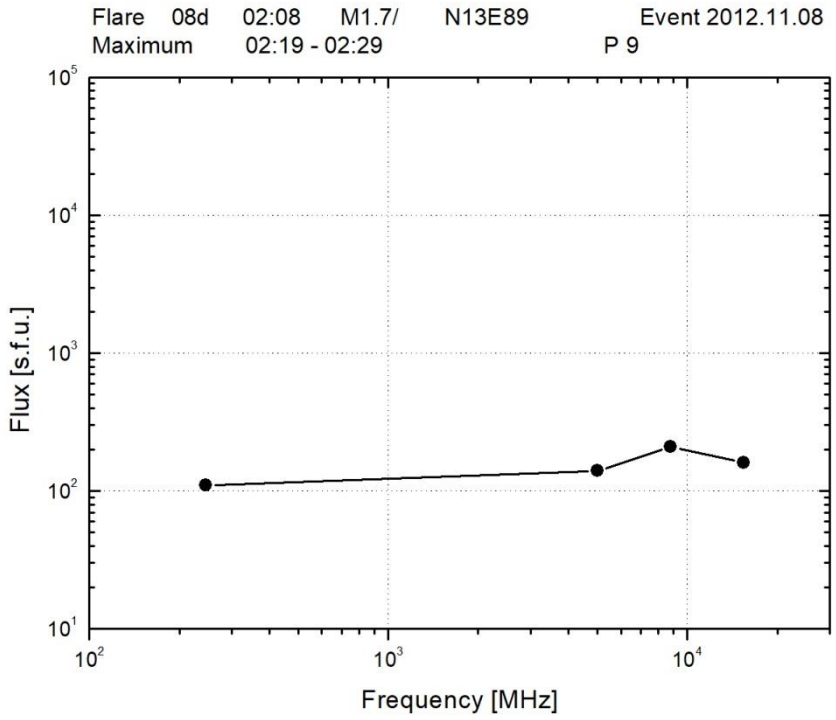
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	0206:12	0217:02	02 0217:12	128	76169	HESSI
12-25	keV	0252:08	0252:38	0316:48	95	359360	HESSI
12-25	keV	0211:03	0219:39	0300:15	65908	17448744	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0219	0219	0222		2.2	
8.8	GHz	0219	0219	0223	P9	2.32	
5	GHz	0219	0222	0222		2.15	
245	MHz	0229	0229	0229		2.04	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	30-120	0221		0242		3	
DS III	18-090	0219		0222		3	
DS V	25-180	0219		0221		2	

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0236	855	- 15.2	360˚	46˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11611 (N12L239, CMP 14,0.11.2012,
Sp=270 msh, DSO, BG, R)
XRI=0.17 $M_1^{1.7}$+C_1 1_1+S_2
PFR 08.11 $M_1^{1.7}$

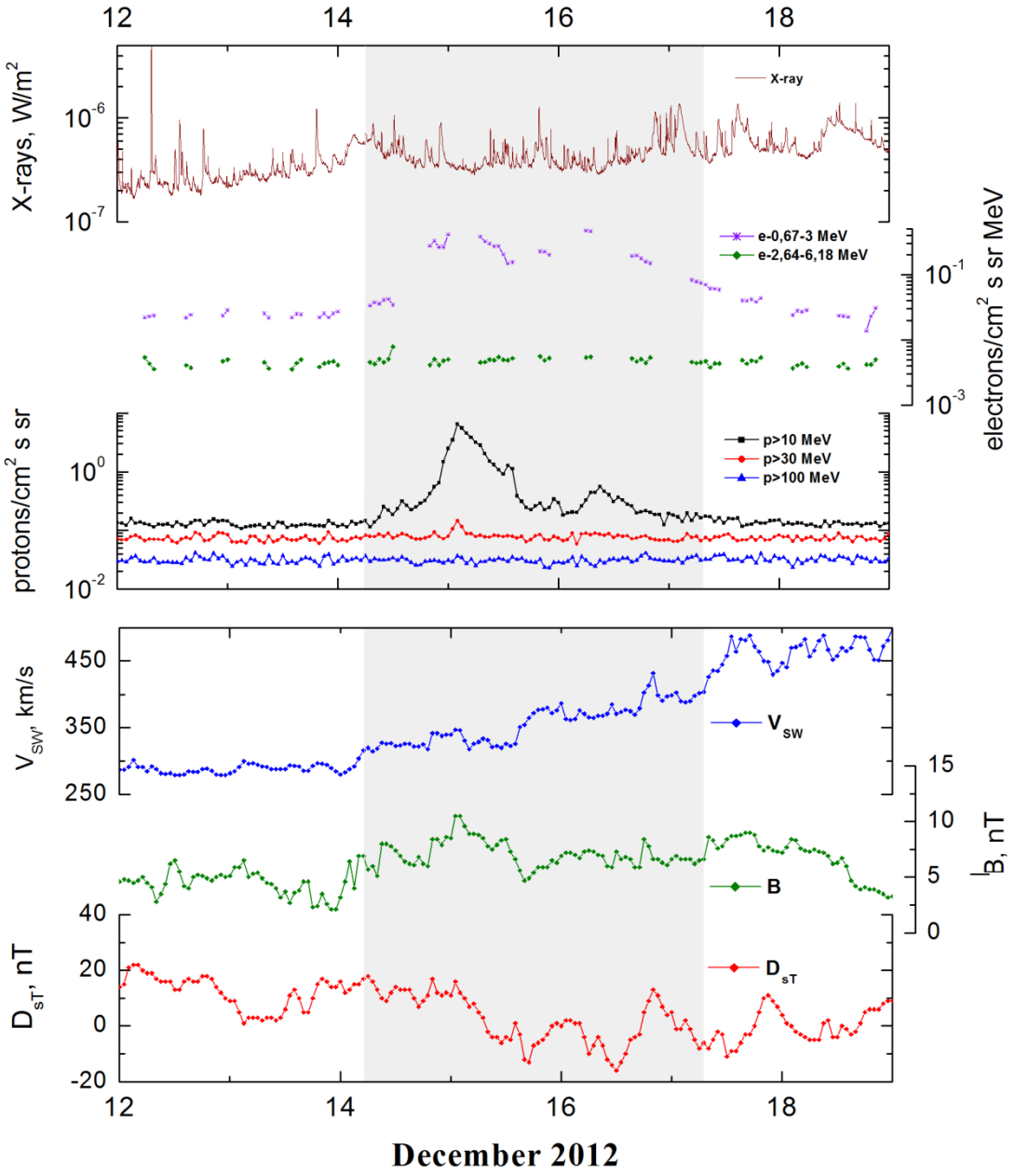
References:

Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Wang Y., D. Lyu, B. Xiao et al., 2021.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.

Particle event: To(Ep>10 MeV) – 14d08^h
Tmax (Ep>10 MeV) – 15d02^h, Jmax (Ep>10 MeV) – 6.5 /cm^2·s·sr
Duration of the event – 3 days, power-law index: $\gamma = 4.1$
Quasimaximal energy of protons in the event – Eqm = 50 MeV

Sources: ⊡ solar flare event 14d<02^{h}00^m, AR unknown, behind W_L
CME: 14d02^{h}00^m, V= 763 km/s, $\Delta\varphi = 149°$, dA= 232°

Particle fluxes and associated phenomena

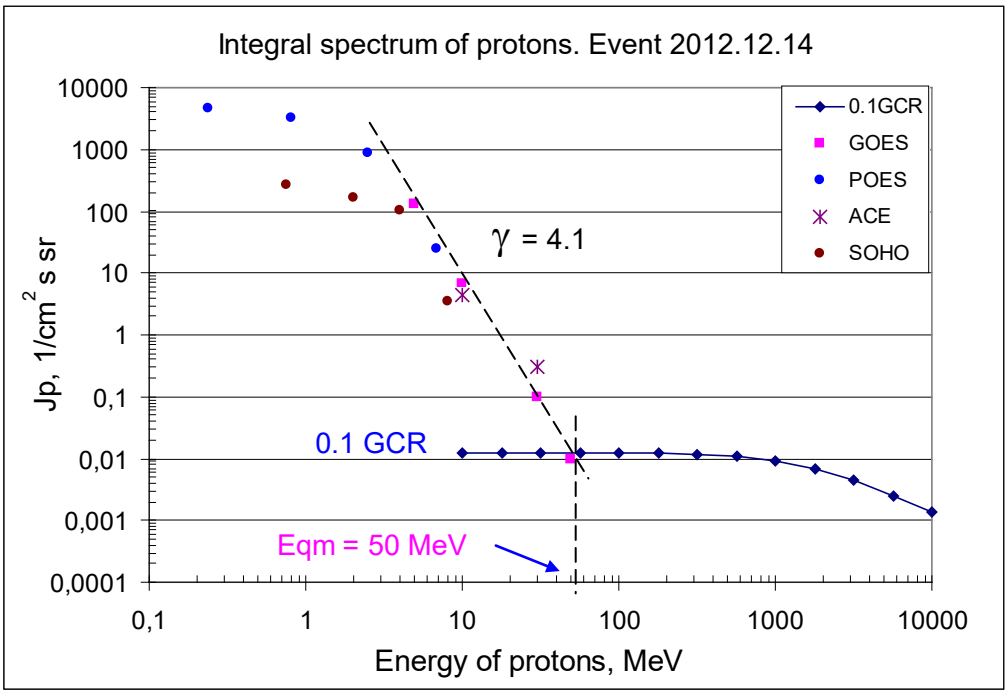


Integral fluxes of protons for the event of 2012 December 14

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	8	15d03	130	4	0.2	
EPS	>10	8	15d02	6.5	3	0.15	
EPS	>30	-	15d02	0.1	0.1	0.09	
EPS	>50	-	15d02	0.01	0.1	0.07	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.04	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	13	15d02	4700	2.5	90	
MEPED	>0.8	13	15d02	3160	2.5	75	
MEPED	>2.5	13	15d02	865	1.5	50	
MEPED	>6.9	-	15d02	25.4	0.5	45	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.8	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1.1	
ACE							
SIS	>10	12	15d03	4.5	2	1.4	
SIS	>30	12	15d01	0.3	1	1	
SOHO							
EPHIN	>50	-	-	-	-	0.24	

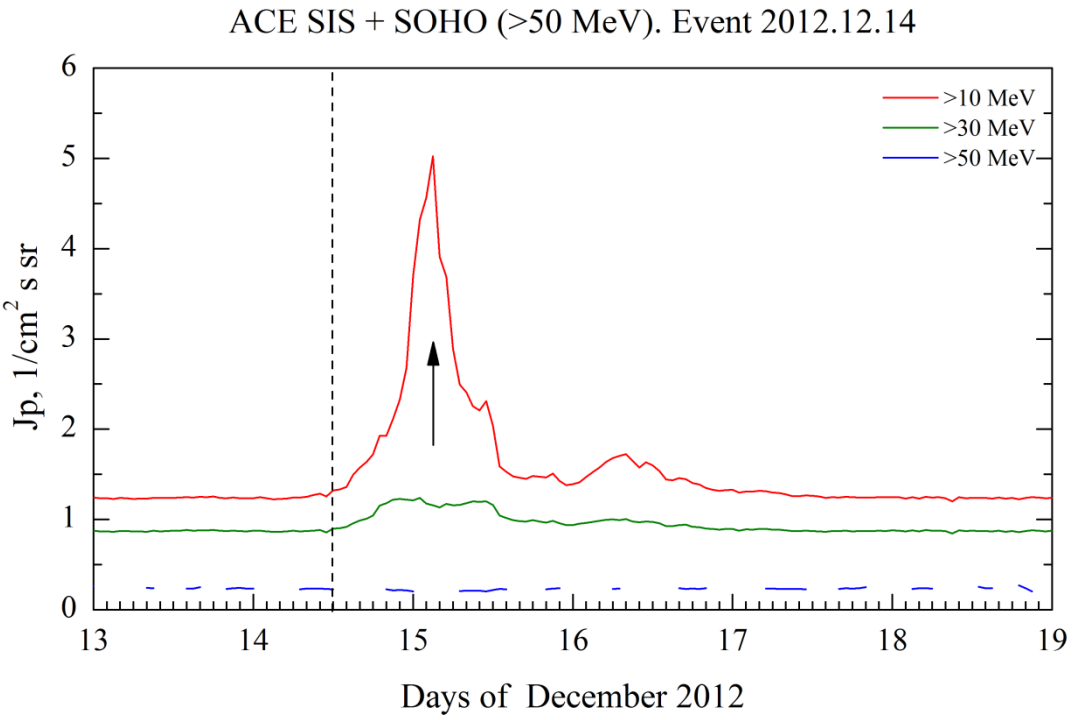
Differential fluxes of protons for the event of 2012 December 14

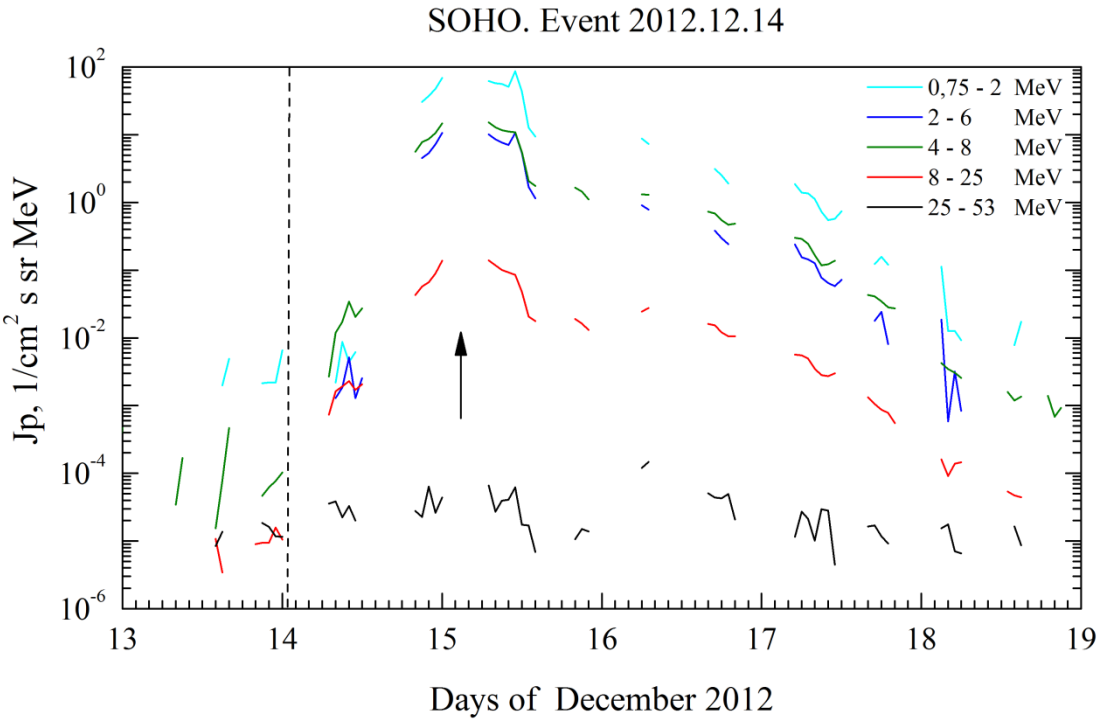
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	01	15d03	80	4	0.01	
LION	2 – 6	01	15d03	20	4	0.002	
EPHIN	4 – 8	01	15d03	25	5	0.00001	
EPHIN	8 – 25	01	15d03	0.2	5	0.00001	
EPHIN	25 – 53	02	15d03	-	5	0.00001	
Electro-1							
SCR-E	13.7–23	-	-	-	-	0.06	
SCR-E	23–42	-	-	-	-	0.025	
SCR-E	42–112	-	-	-	-	0.005	


Integral spectrum of protons. Event 2012.12.14
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
γ = 4.1
0.1 GCR
Eqm = 50 MeV
0.1GCR
GOES
POES
ACE
SOHO
0,1
1
10
100
1000
10000
Energy of protons, MeV

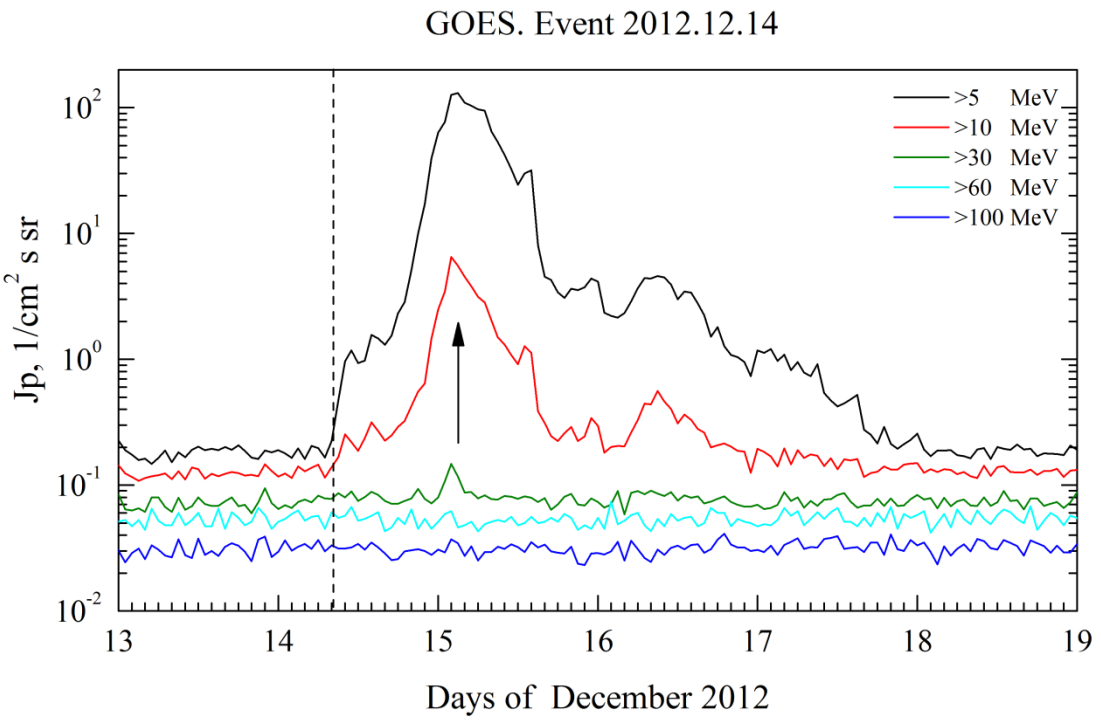
Time profiles of proton fluxes in the event 2012.12.14

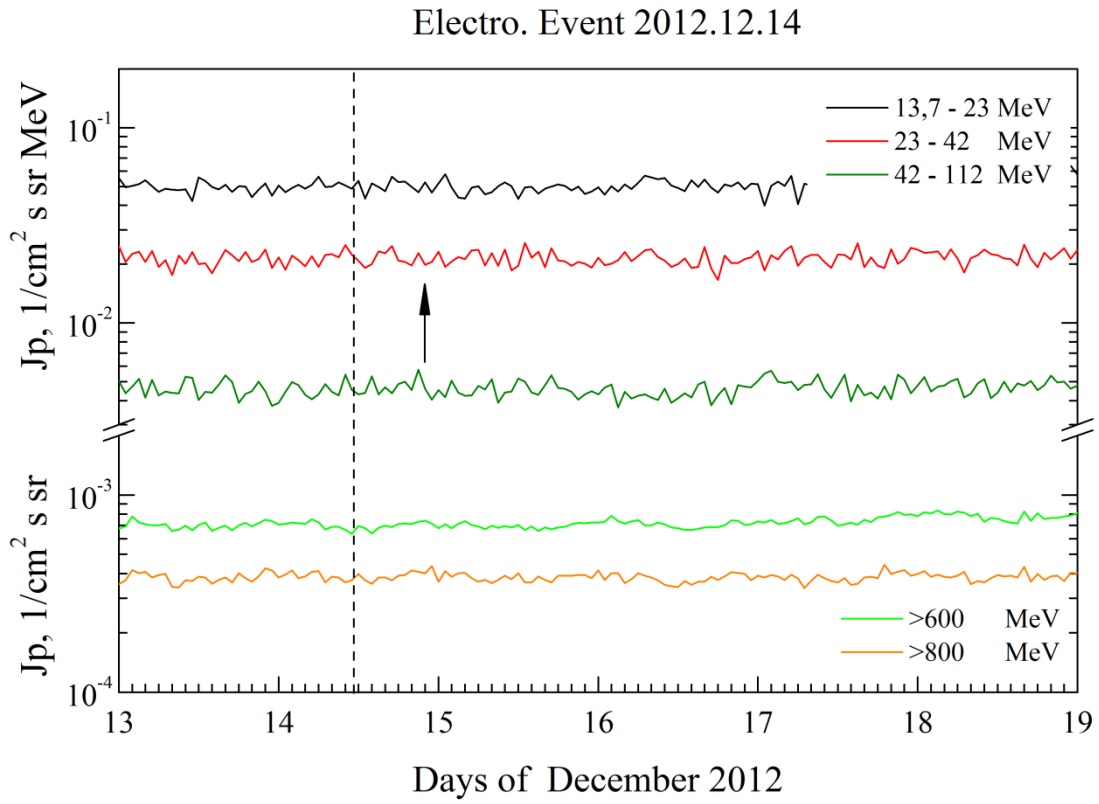
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



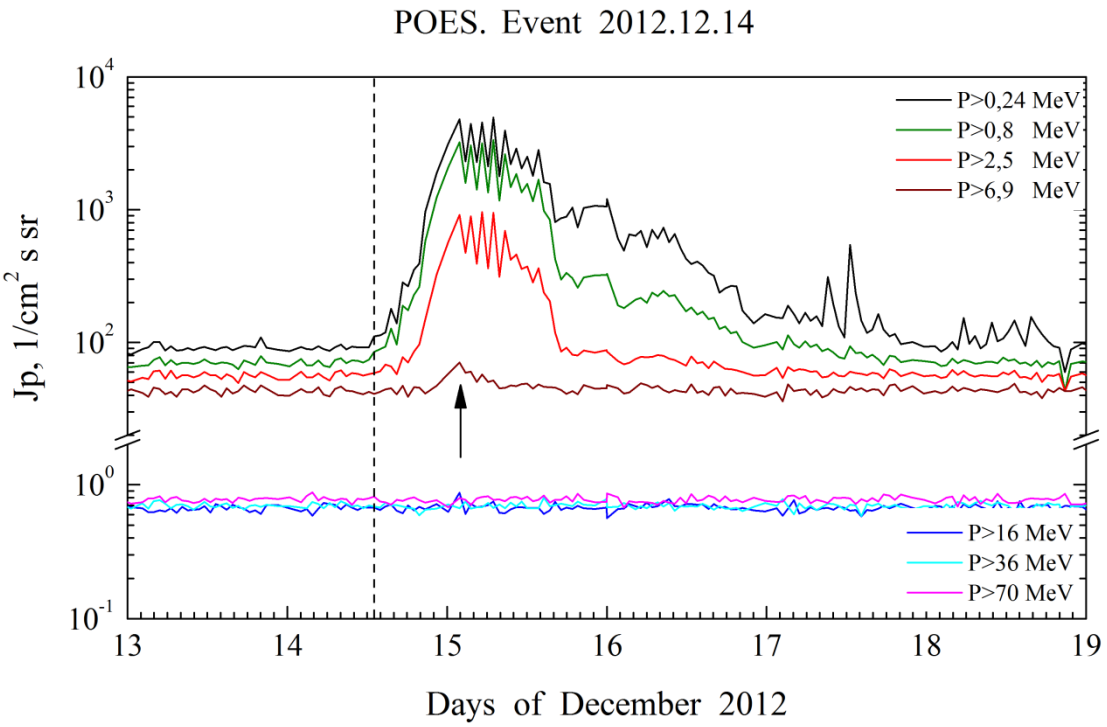


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2012 December 14

2012 December 14 ⊡ AR XXXXX To event 523

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m²
6563 Å		No event on visible solar disc					
6563 Å	EPL	<0025		<0145		0.19	
1 – 12	keV	No X-ray event on visible solar disc					

CME		UT	V, km/s	a, km/s²	Δφ	dA	Sp/c
LASCO	WL	0200	763	20.9	149°	232°	SOHO

References:

Gopalswamy N., S. Yashiro, H. Xie et al., 2015.

События 2013 года

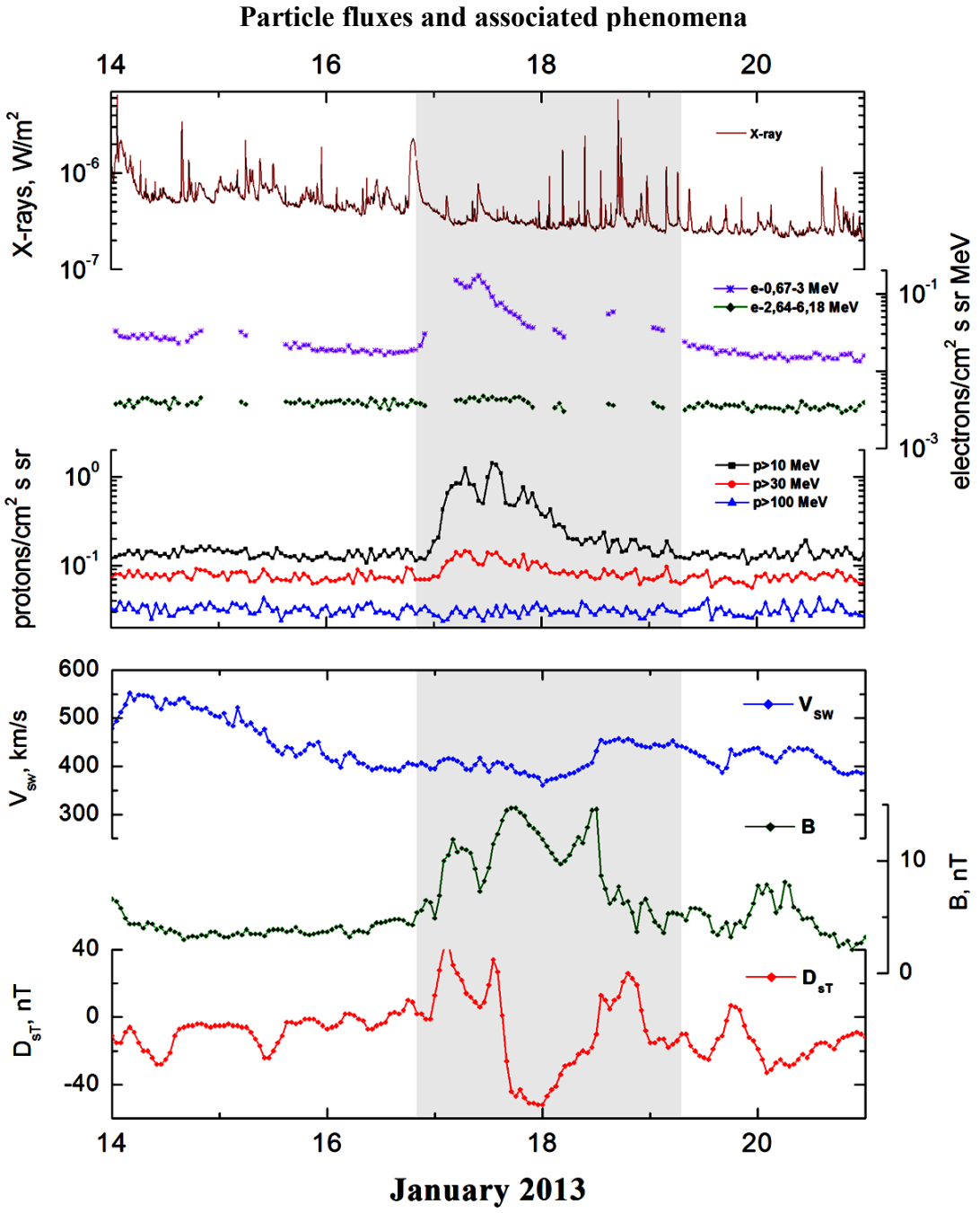
			Страница
1	Event 2013.01.16 – (2013-016)	№ 524	431
2	Event 2013.03.15 – (2013-074)	№ 525	438
3	Event 2013.04.11 – (2013-101)	№ 526	446
4	Event 2013.04.21 – (2013-111)	№ 527	454
5	Event 2013.04.24 – (2013-114)	№ 528	461
6	Event 2013.05.13 – (2013-133)	№ 529	468
7	Event 2013.05.15 – (2013-135)	№ 530	478
8	Event 2013.05.22 – (2013-142)	№ 531	486
9	Event 2013.06.21 – (2013-172)	№ 532	495
10	Event 2013.06.23 – (2013-174)	№ 533	503
11	*Event 2013.08.17 – (2013-229)	№ 534	511
12	Event 2013.08.20 – (2013-232)	№ 535	519
13	Event 2013.09.30 – (2013-273)	№ 536	526
14	Event 2013.10.28 – (2013-301)	№ 537	533
15	Event 2013.10.30 – (2013-303)	№ 538	545
16	Event 2013.11.02 – (2013-306)	№ 539	553
17	Event 2013.11.07 – (2013-311)	№ 540	561
18	*Event 2013.11.08 – (2013-312)	№ 541	568
19	*Event 2013.11.10 – (2013-314)	№ 542	577
20	Event 2013.11.19 – (2013-323)	№ 543	585
21	Event 2013.12.14 – (2013-348)	№ 544	593
22	Event 2013.12.26 – (2013-360)	№ 545	600
23	Event 2013.12.28 – (2013-362)	№ 546	607

Звездочкой (*) отмечены слабые события с Jp (E > 10 МэВ) в интервале 0.1 ÷ 1 pfu

Event 2013.01.16 – (2013-016) **524**

Particle event: To(Ep>10 MeV) – $16d22^h$
$Tmax_1$(Ep>10 MeV) – $17d07^h$, $Jmax_1$ (Ep>10 MeV) – 1.1/cm^2·s·sr
$Tmax_2$(Ep>10 MeV) – $17d13^h$, $Jmax_2$ (Ep>10 MeV) – 1.25 /cm^2·s·sr
Duration of the event – 2 days, power-law index: $\gamma_1 = 2.2$, $\gamma_2 = 2.8$
Quasimaximal energy of protons in the event – $Eqm_1 = 70$ MeV
– $Eqm_2 = 50$ MeV

Sources: ■ solar flare $16d19^h18^m$ C2.2/, S32W87, AR 11650
Main X-ray burst 1-8 Å: onset – $16d19^h18^m$, max – $16d19^h23^m$, $\Phi = 0.011$ J/m^2
CME: $16d19^h00^m$, V = 648 km/s, $\Delta\varphi = 250^o$; dA=236^o
▲ SC $19d17^h32^m$

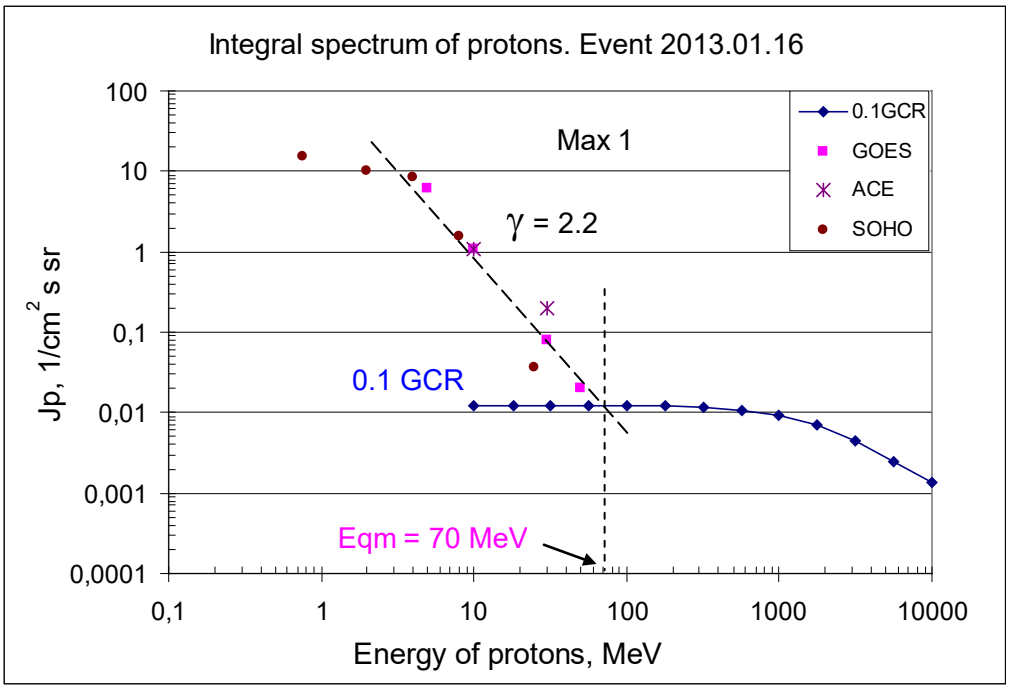


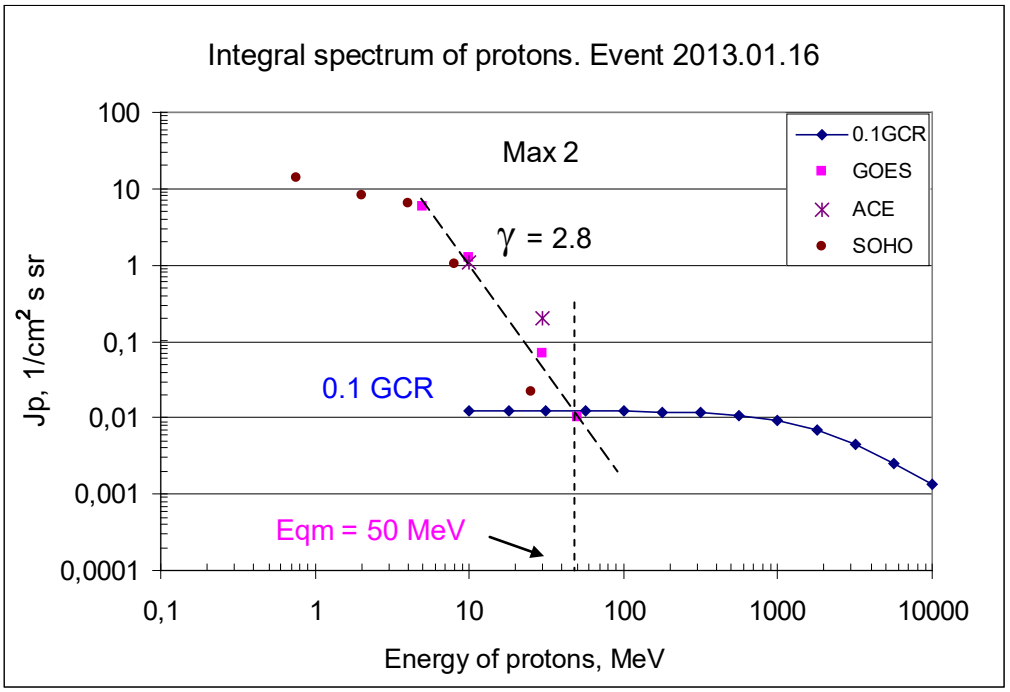
Integral fluxes of protons for the event of 2013 January 16

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	22	17d07/17d13	6/5.8	2.5	0.2	
EPS	>10	22	17d07/17d13	1.1/1.25	2	0.15	
EPS	>30	22	17d07/17d14	0.8/0.7	1.5	0.07	
EPS	>50	22	17d08/17d14	0.02/0.01	1	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	-	-	-	-	95	
MEPED	>0.8	-	-	-	-	75	
MEPED	>2.5	-	-	-	-	50	
MEPED	>6.9	-	-	-	-	45	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.9	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1.1	
ACE							
SIS	>10	23	17d13/17d18	1.1/1.1	1.5	1.3	
SIS	>30	23	17d13/17d18	0.2/0.2	1.5	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

Differential fluxes of protons for the event of 2013 January 16

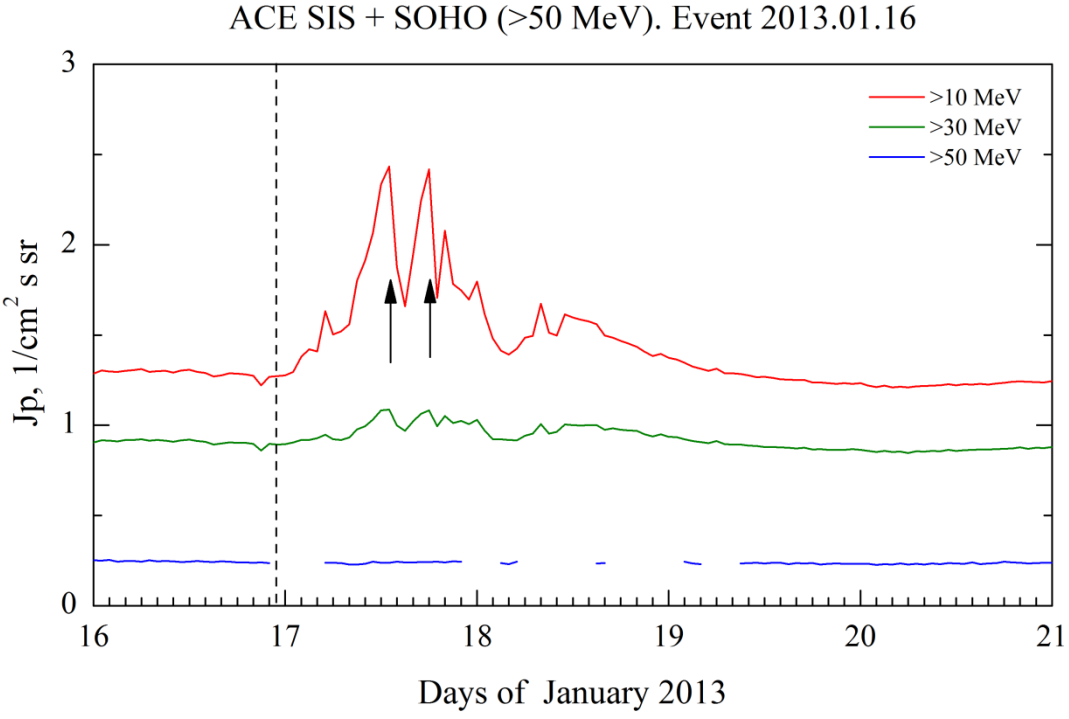
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	17d06	17d13/17d18	3.9/4.68	>0.55	0.01	
LION	2 – 6	17d06	17d12/17d18	0.6/0.6	>0.55	0.001	
EPHIN	4 – 8	17d05	17d12/17d16	1.7/1.33	>0.55	0.001	
EPHIN	8 – 25	17d05	17d12/17d16	0.09/0.06	>0.55	0.00002	
EPHIN	25 – 53	17d05	17d12/17d16	0.0013/0.0008	>0.55	0.00001	
Electro-1							
SCR-E	13.7–23	-	-	-	-	0.06	
SCR-E	23–42	-	-	-	-	0.025	
SCR-E	42–112	-	-	-	-	0.005	

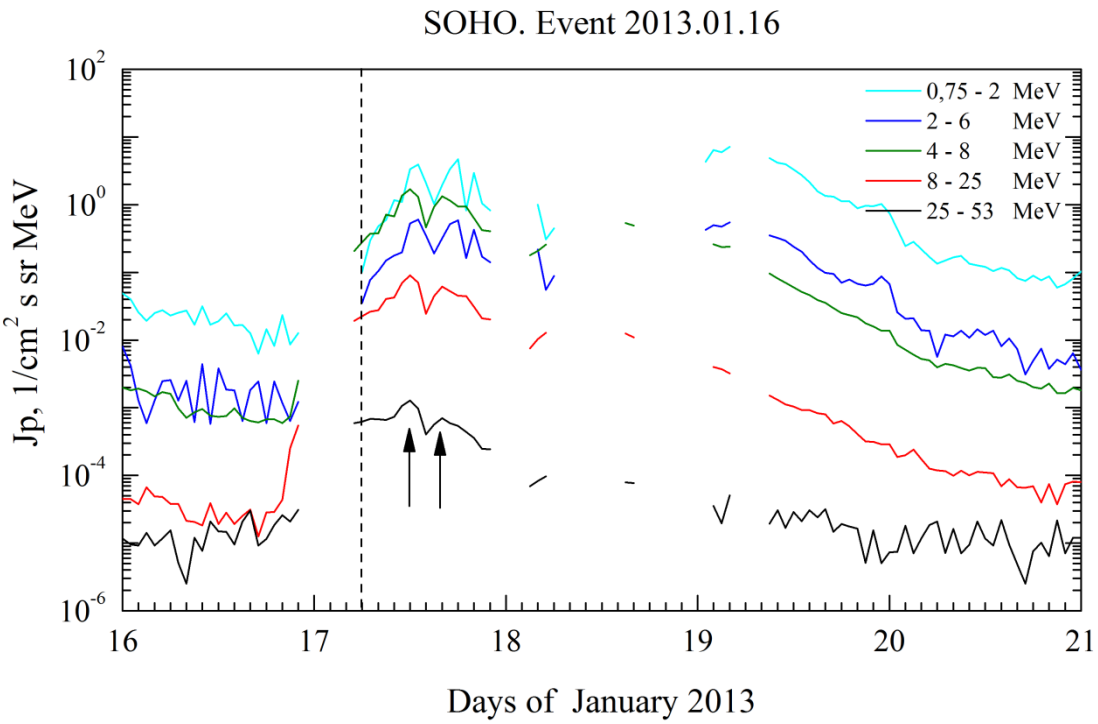

Integral spectrum of protons. Event 2013.01.16
Max 1
γ = 2.2
0.1 GCR
Eqm = 70 MeV
0.1GCR
GOES
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2013.01.16
Max 2
γ = 2.8
0.1 GCR
Eqm = 50 MeV
0.1GCR
GOES
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

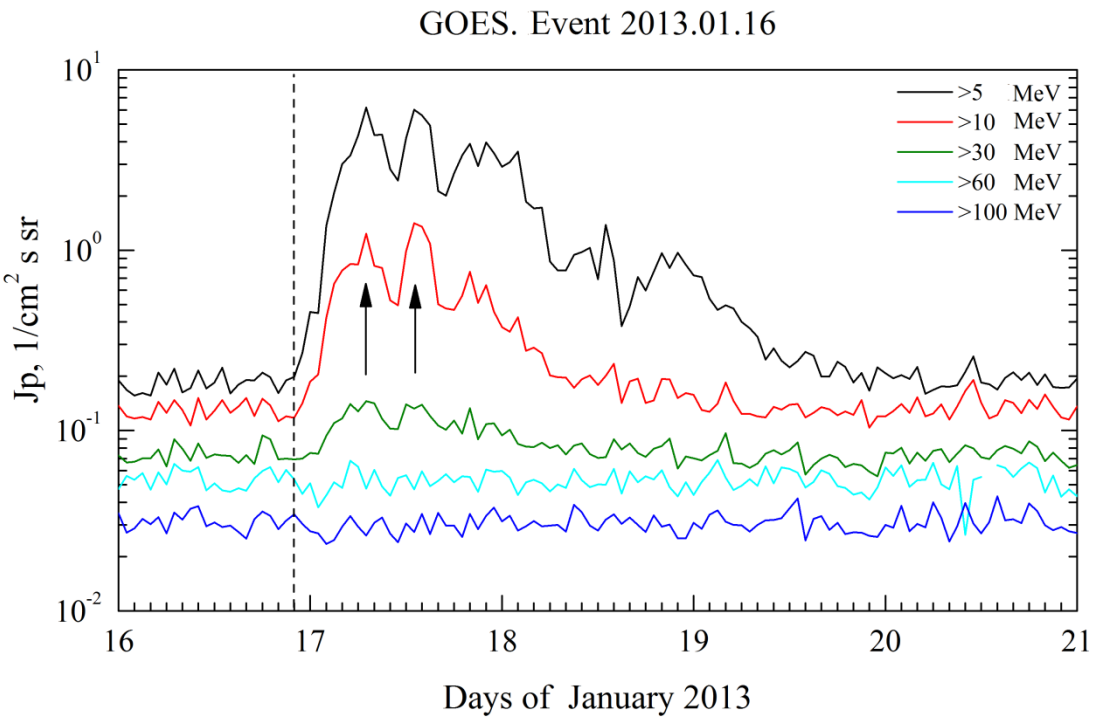
Time profiles of proton fluxes in the event 2013.01.16

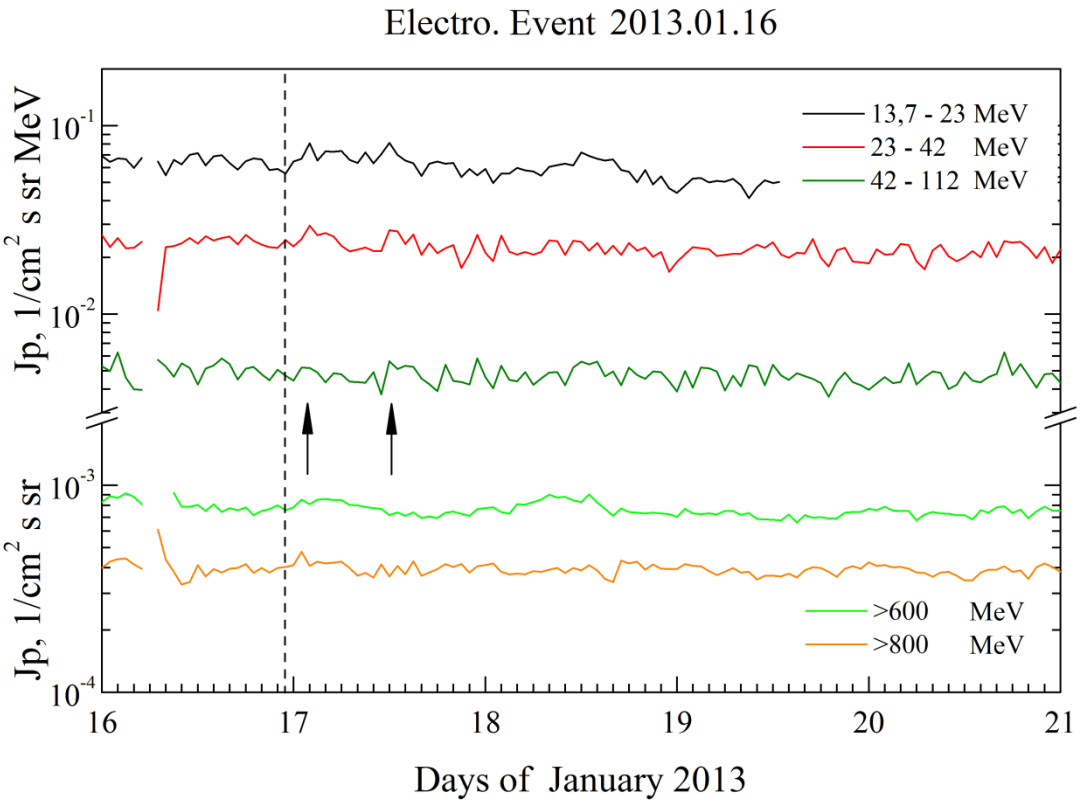
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



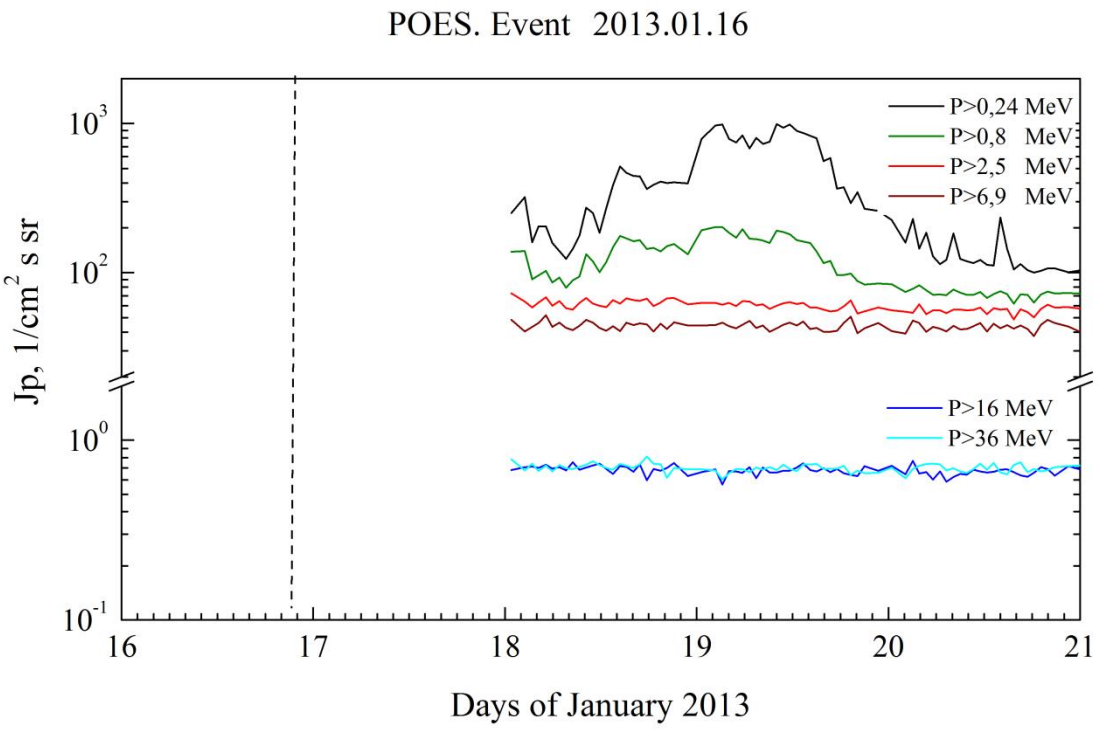


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 January 16

2013 January 16 ■ AR 11650 To event 524

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m²
6563 Å		No event on visible solar disc					
1 – 12	keV	1918	1923	>2020	S32W87	C2.2	0.011
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12 – 25	keV	1925:04	1926:34	20:00:24	816	4022616	HESSI
6-12	keV	2019:00	2019:38	20:24:44	52	83232	HESSI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DH II	1000-200	2200		17/0130		2	WIND
CME		**UT**	**V,** km/s	**a,** km/s²	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1900	648	- 4.9	250°	236°	SOHO

Proton Active Region:

AR 11650 (S29L194, CMP 11.1.01.2013,
Sp=250 msh, EHO, A, R1)
XRI= 0; C_9; S_2

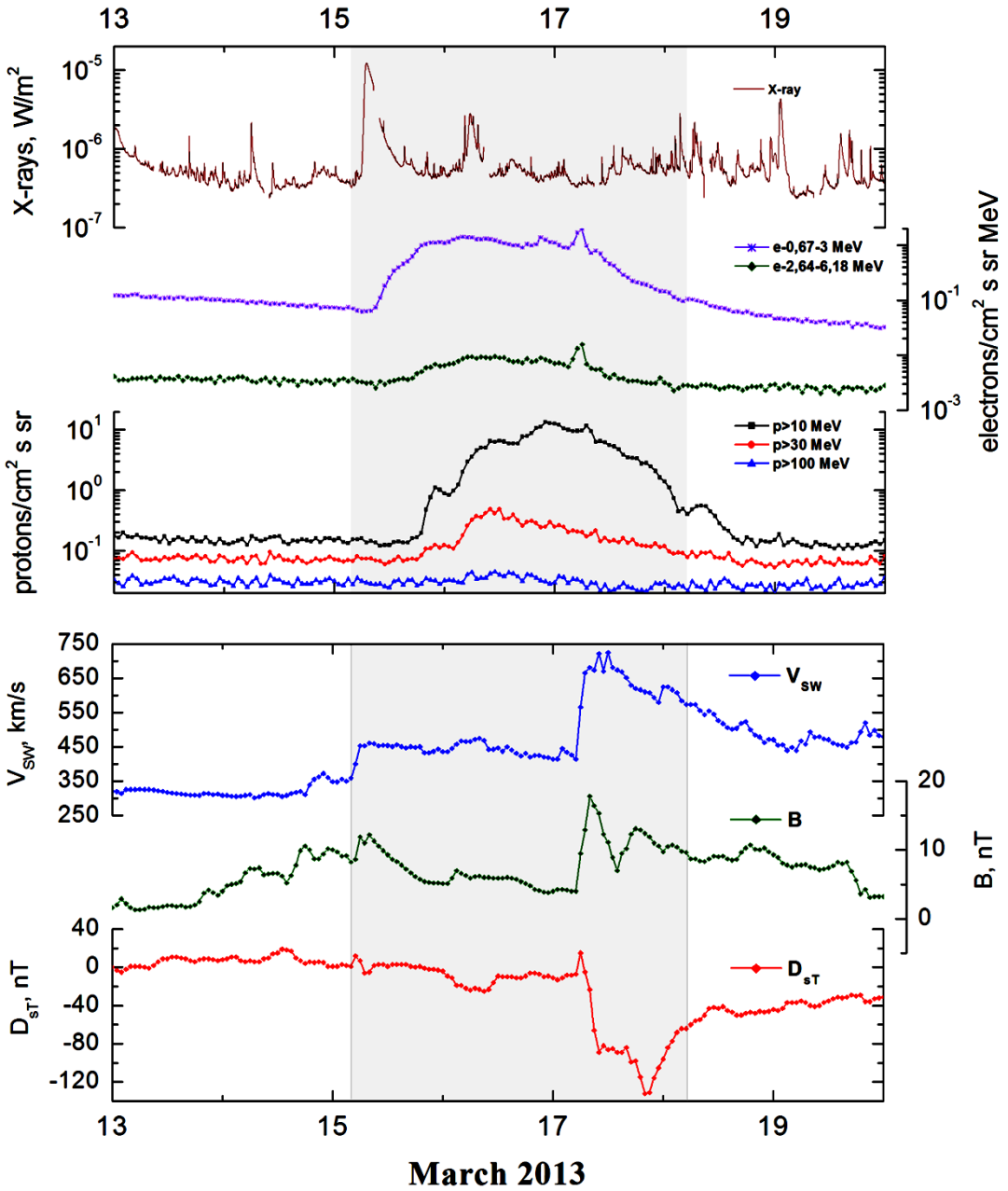
References:

Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.

Particle event: To(Ep>10 MeV) – 15d18^h
Tmax$_1$(Ep>10 MeV) – 15d22^h, Jmax$_1$ (Ep>10 MeV) – 0.9/cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 16d12^h, Jmax$_2$ (Ep>10 MeV) – 6.2 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ_1 = 2.3, γ_2 = 2.5
Quasimaximal energy of protons in the event – Eqm$_1$ = 70 MeV
– Eqm$_2$ = 75 MeV

Sources: ● solar flare 15d05^{h}46^m, M1.1/1F, N09E06, AR11692
Main burst X-ray 1–8 Å: onset – 15d05^{h}46^m, max – 15d06^{h}58^m, Φ = 0.073 J/m^2
CME: 15d07^{h}12^m, V= 1063 km/s, Δφ = 360°, dA= 112°
▲ SC 17d06^{h}00^m

Particle fluxes and associated phenomena

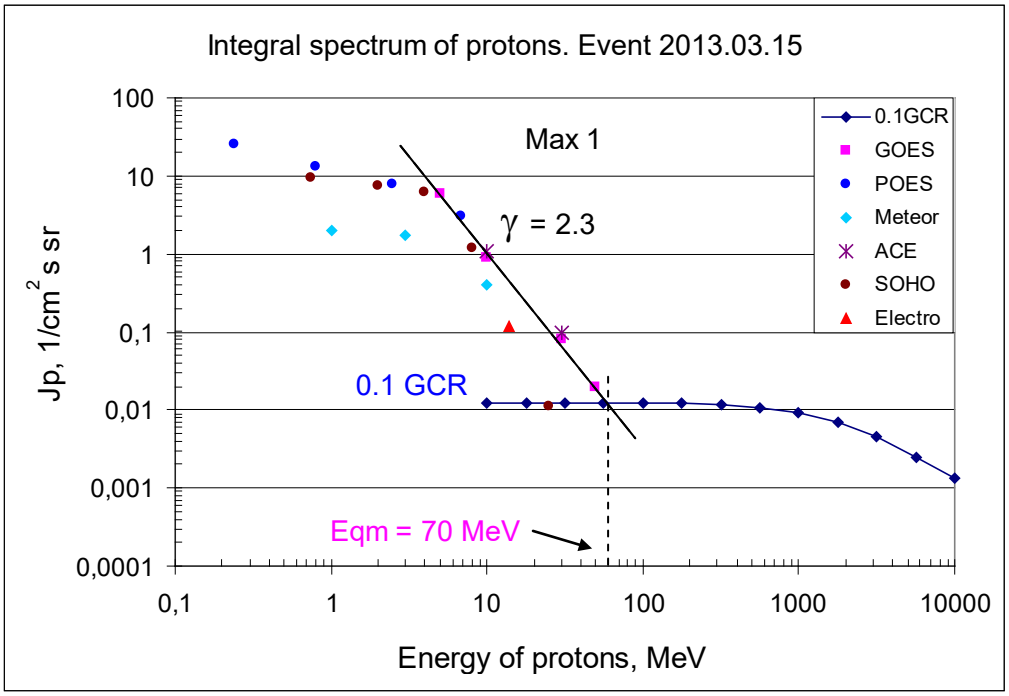


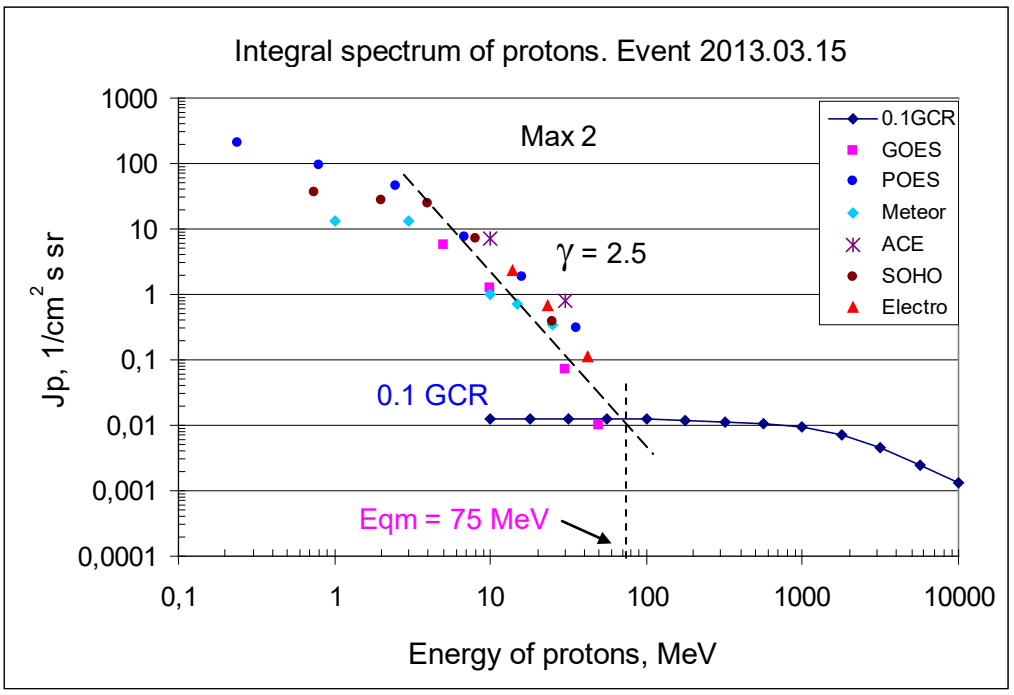
Integral fluxes of protons for the event of 2013 March 15

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	22/16d13	4.2/21	3	0.2	
EPS	>10	18	22/16d12	0.9/6.2	3	0.15	
EPS	>30	18	22/16d12	0.05/0.33	3	0.07	
EPS	>50	18	- /16d10	- /0.08	2	0.06	
EPS	>60	18	- /16d10	-../0.05	2	0.05	
EPS	>100	18	- /16d12	- /0.01	2	0.03	
EPS	>700	-	-	-	-	-	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	18	23/16d09	25/205	3	110	
MEPED	>0.8	18	23/16d09	13/95	3	80	
MEPED	>2.5	18	23/16d09	8/46.5	2	55	
MEPED	>6.9	18	23/16d09	3/7.5	2	45	
MEPED	>16	16d03	- /16d11	- /1.9	2	0.7	
MEPED	>36	16d03	- /16d11	- /0.3	-	0.8	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1.1	
Meteor-1							
SCR	>1	22	23/16d10	2/13.5	4	2.6	
SCR	>3	22	23/16d10	1.7 /13	4	2.4	
SCR	>10	22	23/16d10	0.4/1	2	1.6	
GALS-M	>15	22	- /16d10	-./0.7	1	1.2	
GALS-M	>25	22	- /16d10	- /0.4	1	1.3	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	18	22/16d10	0.8/7.3	2	1.4	
SIS	>30	18	22/16d10	0.1/0.8	2	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

Differential fluxes of protons for the event of 2013 March 15

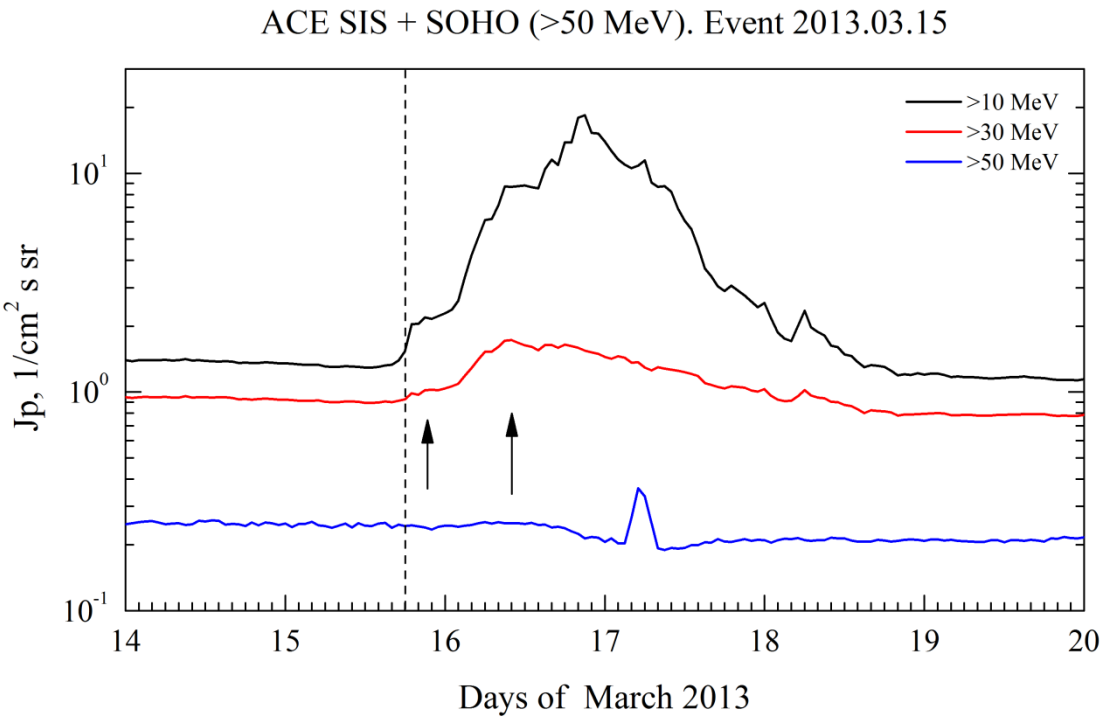
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	18	22/16d10	1.8/6.25	3	0.3	
LION	2 – 6	18	22/16d10	0.4/1.2	3	0.03	
EPHIN	4 – 8	14	22/16d10	1.25/4.3	3	0.04	
EPHIN	8 – 25	14	22/16d10	0.07/0.39	3	0.002	
EPHIN	25 – 53	16	21/16d10	0.0004/0.014	3	0.0001	
Electro-1							
SCR-E	13.7–23	18	23/16d10	0.013/0.18	2	0.05	
SCR-E	23–42	18	23/16d10	- /0,03	2	0,025	
SCR-E	42–112	18	23/16d10	- /0,0016	-	0,005	

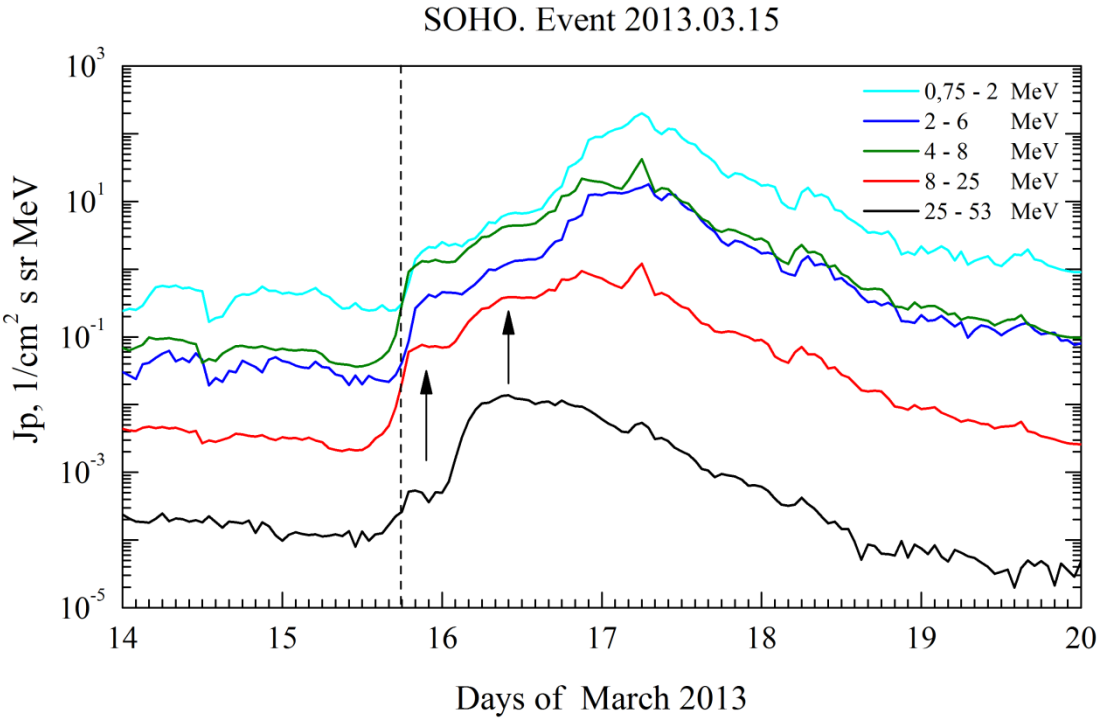

Integral spectrum of protons. Event 2013.03.15
Max 1
γ = 2.3
0.1 GCR
Eqm = 70 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2013.03.15
Max 2
γ = 2.5
0.1 GCR
Eqm = 75 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

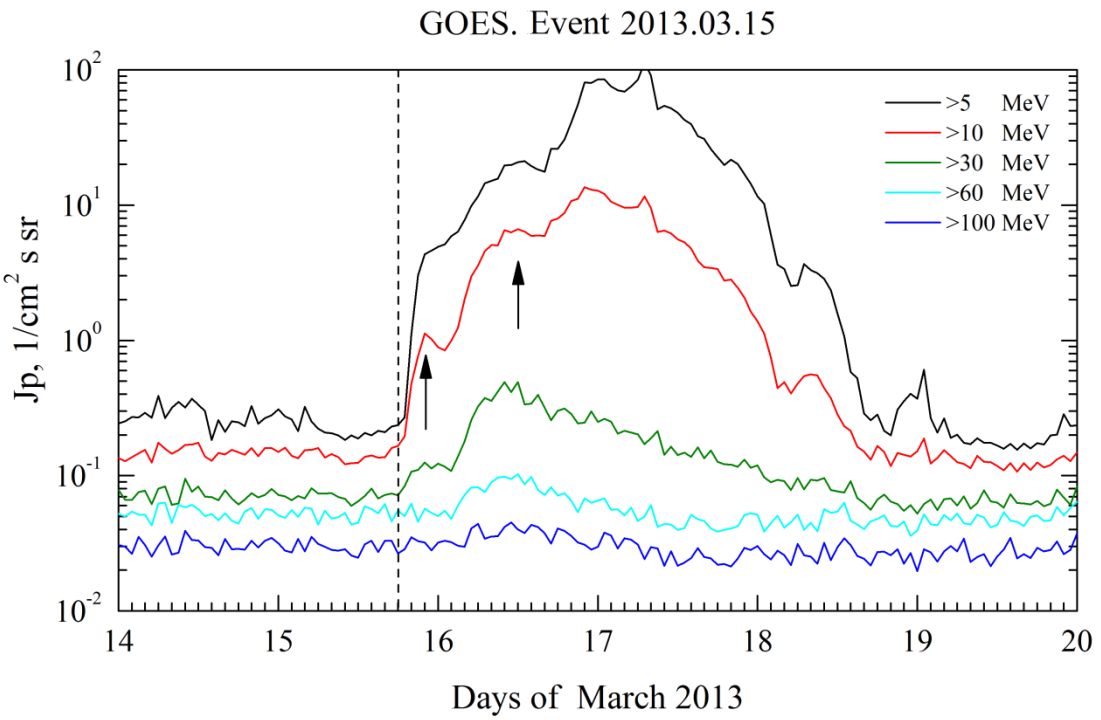
Time profiles of proton fluxes in the event 2013.03.15

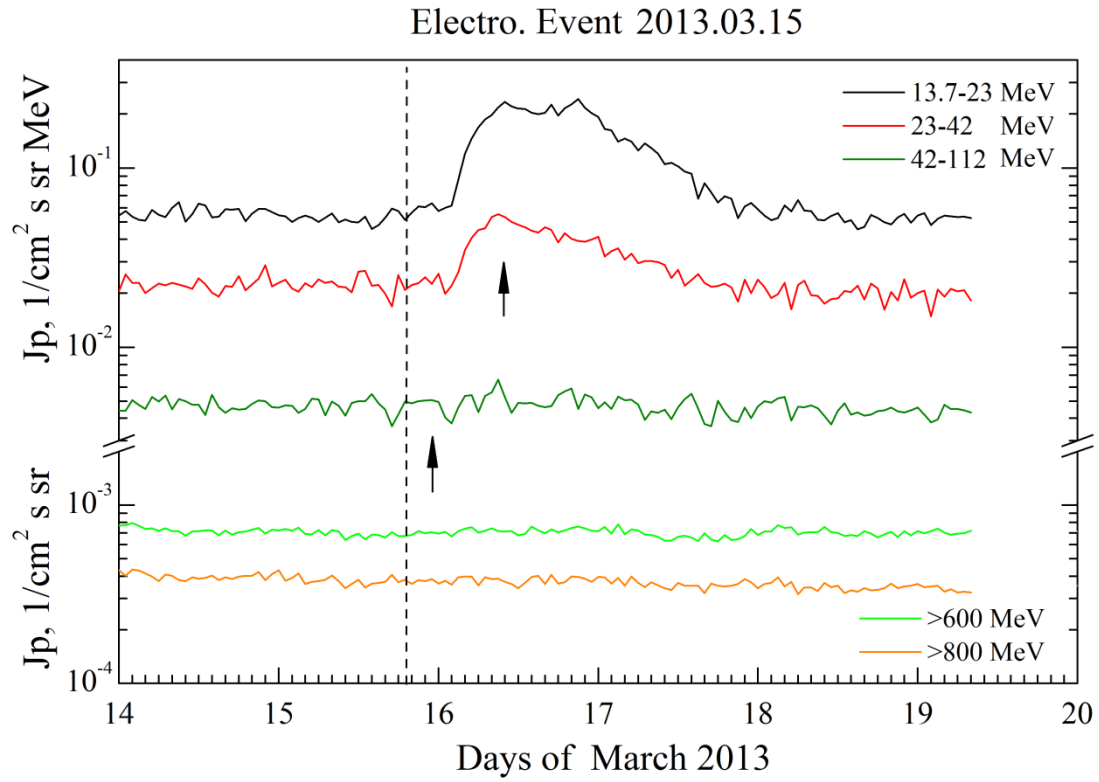
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



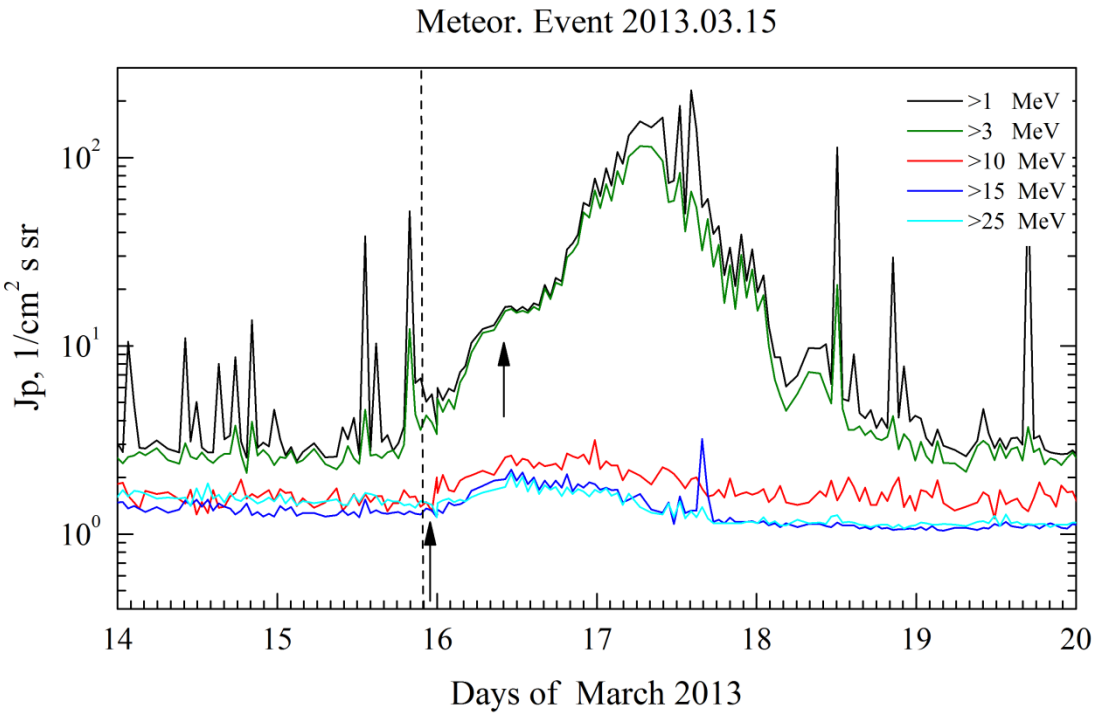


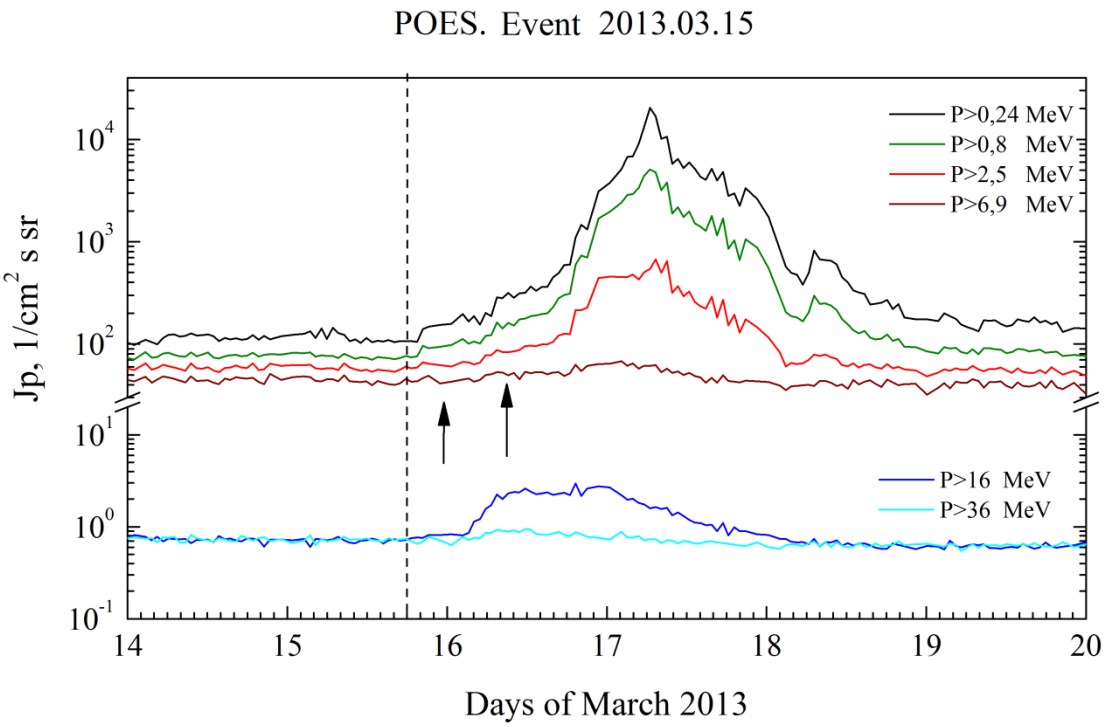
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro.





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 March 15

2013 March 15 ● AR 11692 To event 525

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0613	0637	0833	N11E12	1F	ERU
1 – 12	keV	0546	0658	0835	N09E06	M1.1	0.073

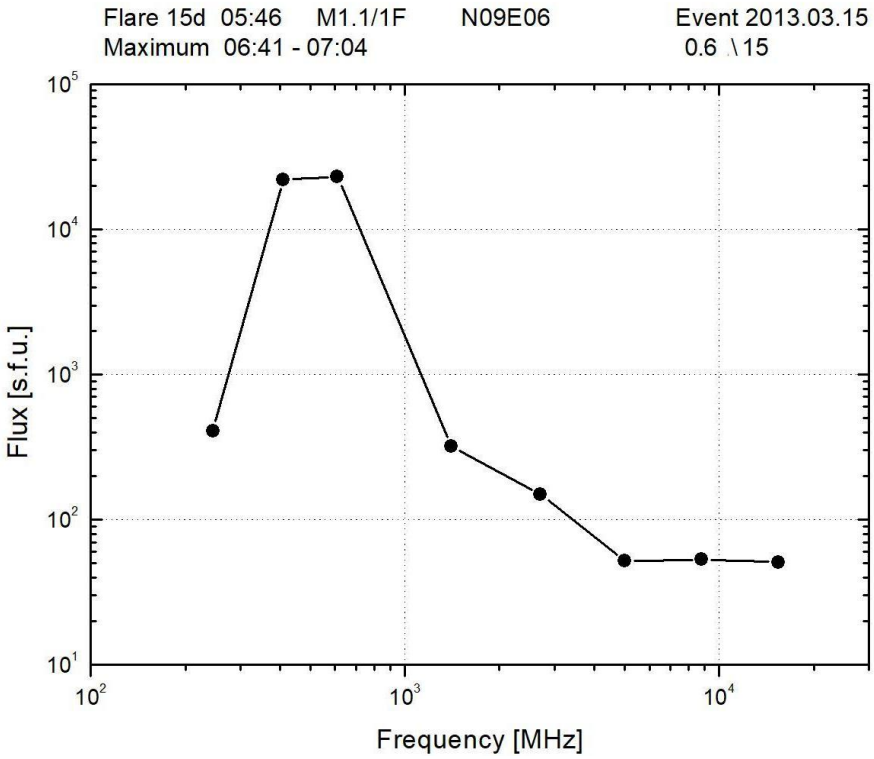
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	0551:52	0611:10	0612:20	1008	2204784	HESSI
12-25	keV	0707:36	0709:22	0728:48	120	697607	HESSI
6-12	keV	0728:48	0729:46	0744:44	84	372167	HESSI
12-25	keV	0615:24	0621:53	0625:38	1313	114548	FERMI
12-25	keV	0701:37	0712:04	0755:57	1577	732825	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0658	0704	0705	0.6 \ 15	1.71	
8.8	GHz	0646	0647	0651		1.72	
5	GHz	0644	0647	0651		1.72	
2.7	GHz	0631	0649	0651		2.18	
1.4	GHz	0627	0652	0704		2.51	
610	MHz	0620	0641	0732		4.36	
410	MHz	0622	0644	0743		4.34	
245	MHz	0620	0647	0732		2.61	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS IV	25-180	0620		1023		2	
DS IV		0632		0800D		3	
DS III		0632		0800D		1	
DS III		0641		0644		3	
DH II	14-0.1	0700		2130			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0712	1063	-25.8	360˚	112˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR 11692(N09L075, CMP 15,7.03.2013,
Sp=340 msh, DKI, B, R)
XRI=0.27, $M_2^{1.6}$+C_9 1_2+S_1
PFR1 15.03 M_1
PFR2 21.03 M_1

References:

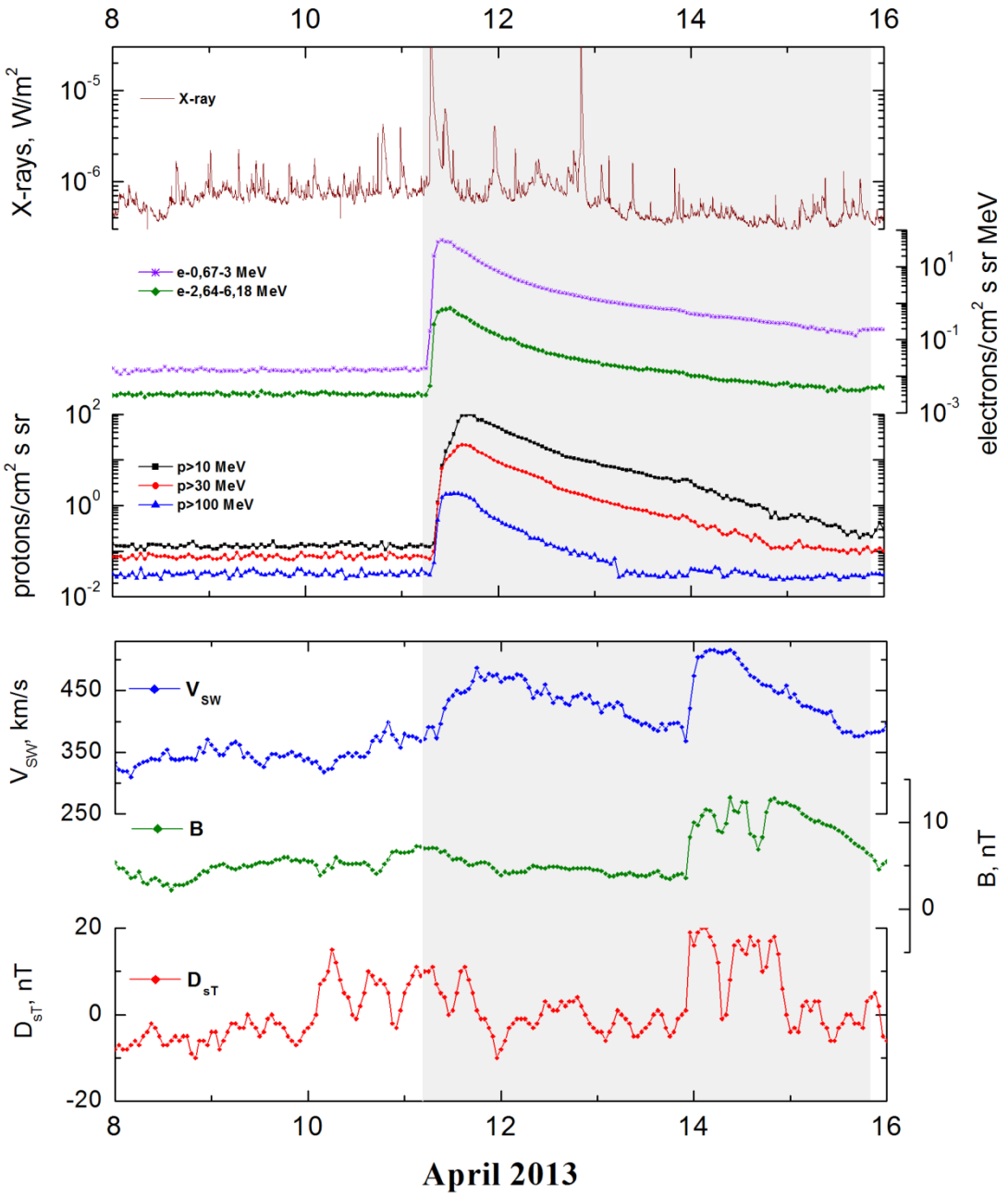
Alberti T., M. Laurenza, E.W. Cliveret et al., 2017.
Ameri D., E. Valtonen, 2019.
Gopalswamy N., H. Xie, S. Akiyama et al., 2014.
Luhmann J.G., M.L. Mays, D. Odstrcil et al., 2017.
Maričić D., B. Vršnak, A.M. Veronig et al., 2020.
NOAA SPE, 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.
Wu C.-C., K. Liou, S.T. Wu et al., 2016.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2013.04.11 – (2013-101) **526**

Particle event: To(Ep>10 MeV) – 11d07^h
Tmax (Ep>10 MeV) – 11d17^h, Jmax (Ep>10 MeV) – 100 /cm^2·s·sr
Duration of the event – 5 days, power-law index: γ = 3.2
Quasimaximal energy of protons in the event – Eqm = 500 MeV

Sources: ● solar flare 11d06^{h}55^m, M6.5/3B, N09E12, AR11719
Main burst X-ray 1–8 Å: onset – 11d06^{h}55^m, max – 11d07^{h}16^m, Φ = 0.074 J/m^2
CME 11d07^{h}24^m, V= 861 km/s, Δφ = 360º, dA= 085º
▲ SC 13d22^{h}54^m

Particle fluxes and associated phenomena

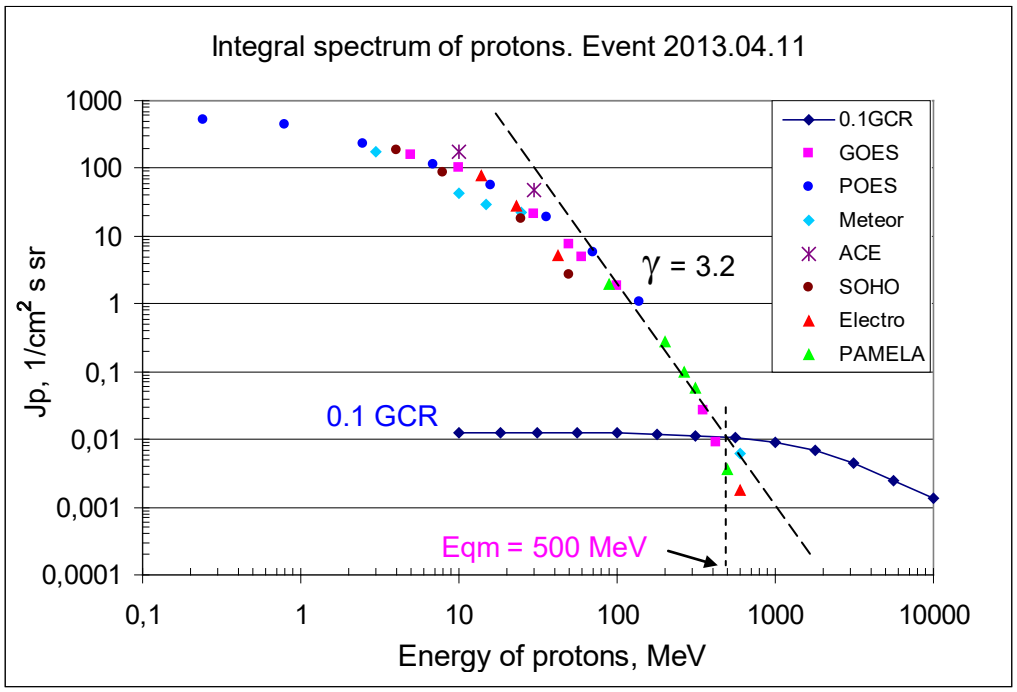


Integral fluxes of protons for the event of 2013 April 11

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	18	158	5	0.2	
EPS	>10	7	17	100	5	0.15	
EPS	>30	7	16	21	4	0.07	
EPS	>50	7	15	7.5	3	0.06	
EPS	>60	7	15	5	2	0.05	
EPS	>100	7	14	1.8	2	0.03	
Electro-1							
GALS-E	>600	7	16	0.0018	2	0.001	
POES							
MEPED	>0.24	8	17	530	4	100	
MEPED	>0.8	8	16	440	3.5	80	
MEPED	>2.5	8	15	225	3	55	
MEPED	>6.9	8	14	117	3	45	
MEPED	>16	8	14	55.5	3	0.7	
MEPED	>36	8	14	19.3	2	0.8	
MEPED	>70	8	14	5.7	1	0.9	
MEPED	>140	8	14	1.1	1	1.1	
Meteor-1							
SCR	>1	7	-	-	5	2.6	
SCR	>3	7	16	173	5	2.35	
SCR	>10	7	16	42	4	1.6	
GALS-M	>15	7	15	30	3	1.2	
GALS-M	>25	7	15	22	3	1.3	
GALS-M	>600	7	12	0.0063	0.5	0.02	
ACE							
SIS	>10	7	13	174	3	1.3	
SIS	>30	7	13	47.5	3	0.9	
PAMELA							
TRACKER	>90	8	08-11	2	>2	-	
TRACKER	>200	8	08-12	0.28	>2	-	
TRACKER	>265	8	08-13	0.1	>1	-	
TRACKER	>312	8	08-14	0.057	>1	-	
TRACKER	>500	8	08-15	0.0035	1	-	
SOHO							
EPHIN	>50	8	12	2.7	3	0.25	

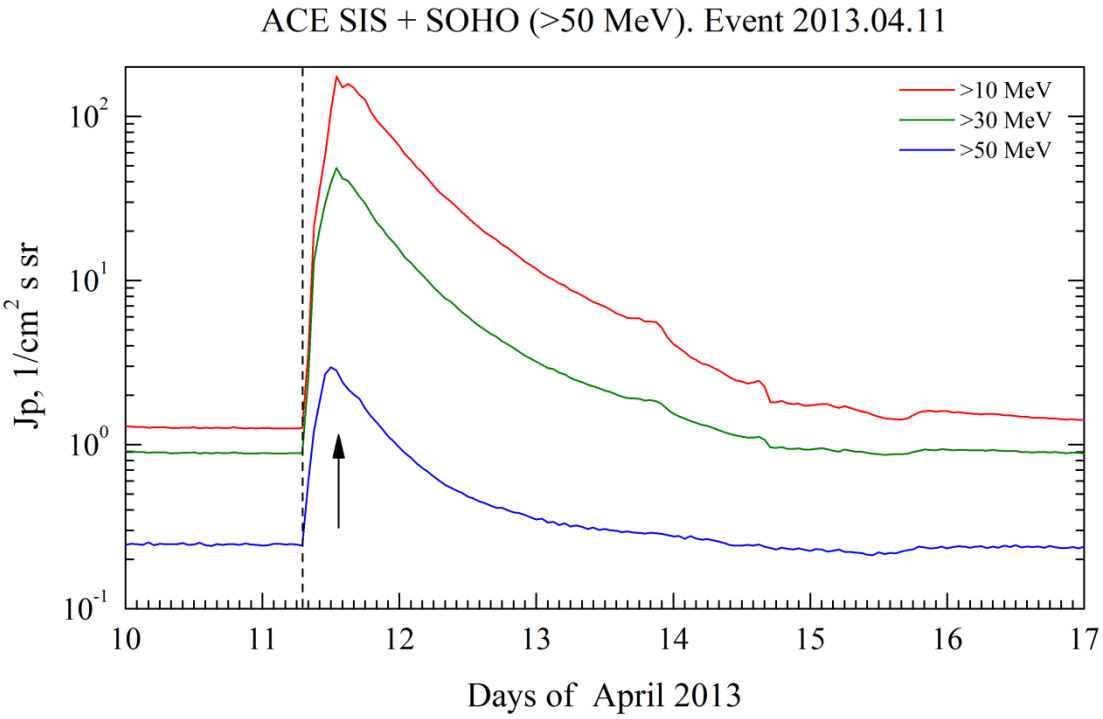
Differential fluxes of protons for the event of 2013 April 11

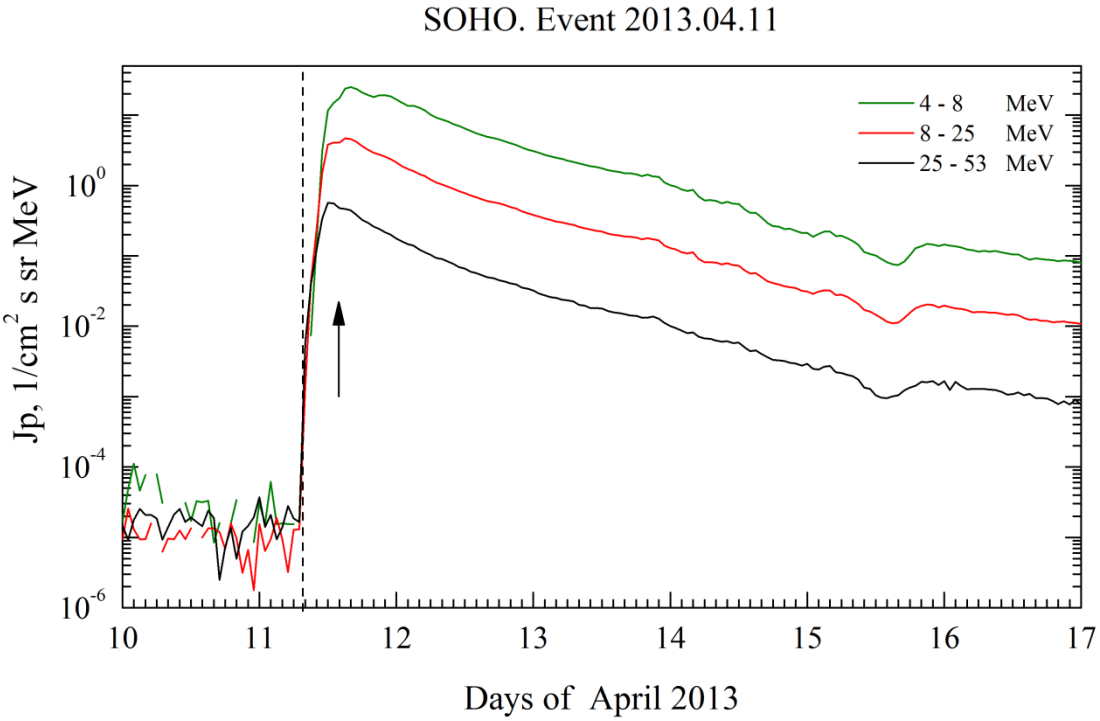
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	8	16	25.1	4	0.00002	
EPHIN	8 – 25	8	14	4.09	4	0.00002	
EPHIN	25 – 53	8	12	0.56	4	0.00002	
Electro-1							
SCR-E	13.7–23	7	15	5.6	5	0.05	
SCR-E	23–42	7	15	1.2	4	0.025	
SCR-E	42–112	7	15	0.058	3	0.005	
GOES							
EPS	350–420	8	14	0.00026	1	0.0017	
EPS	420–510	8	12	0.0001	1	0.001	
EPS	510–700	-	-	-	-	0.0004	

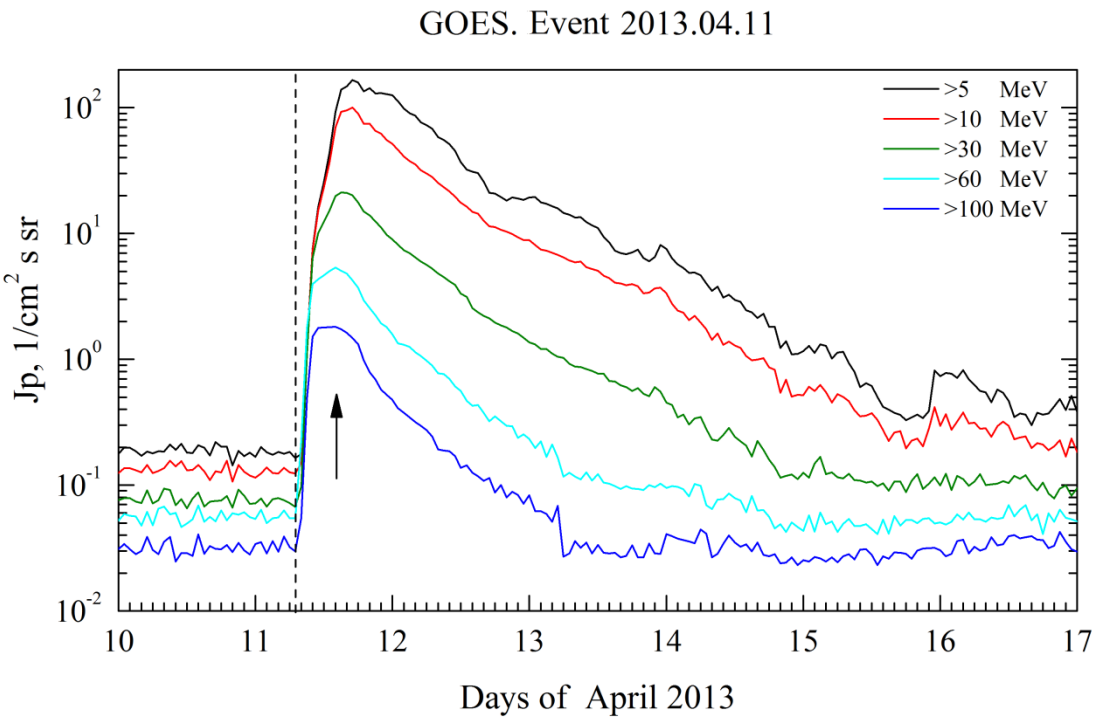


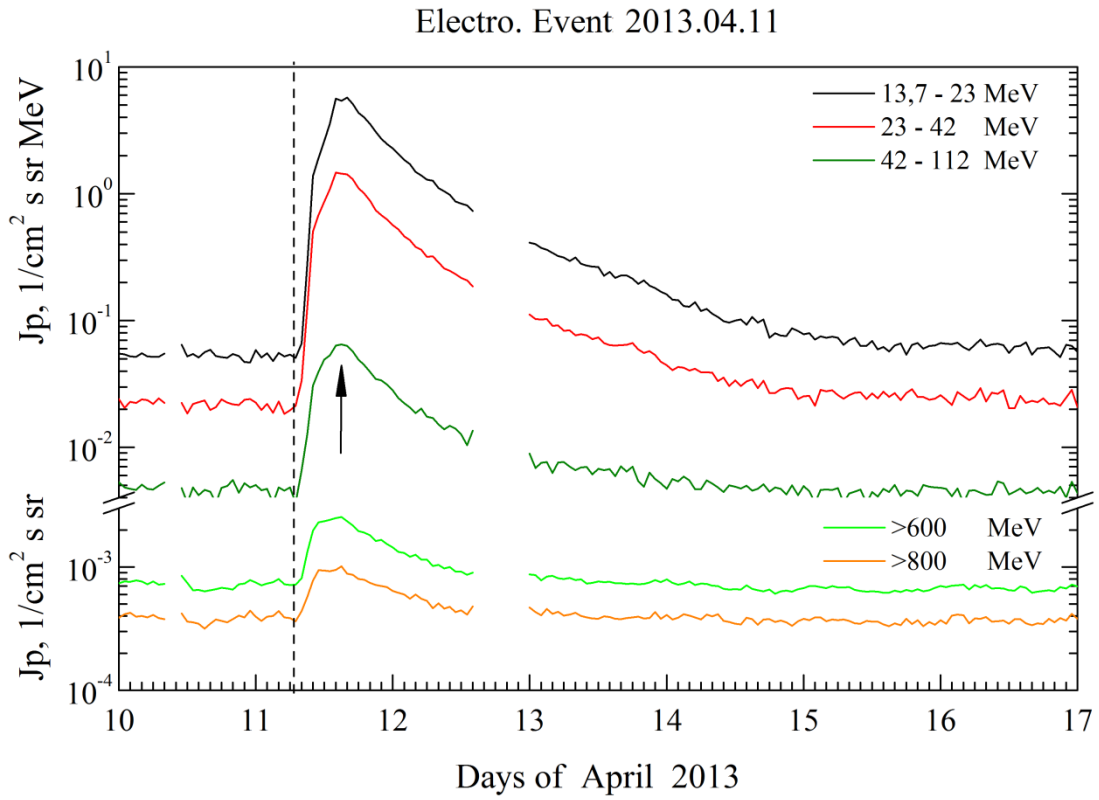
Time profiles of proton fluxes in the event 2013.04.11

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



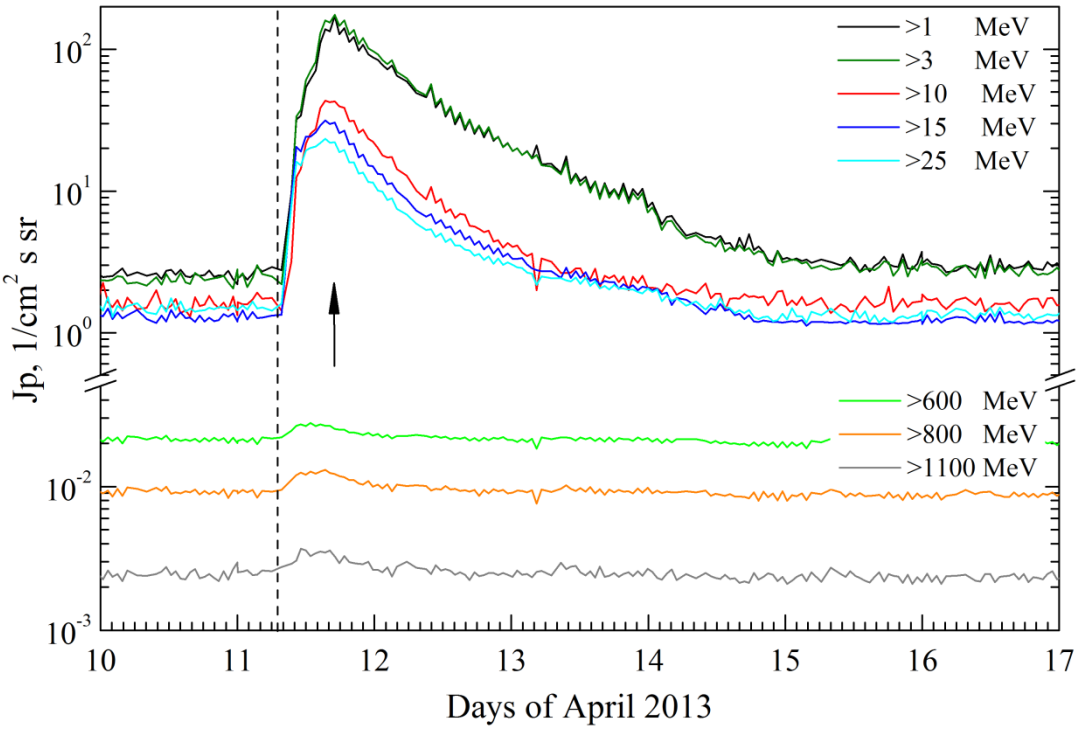



GOES. Event 2013.04.11
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Jp, 1/cm2 s sr
Days of April 2013

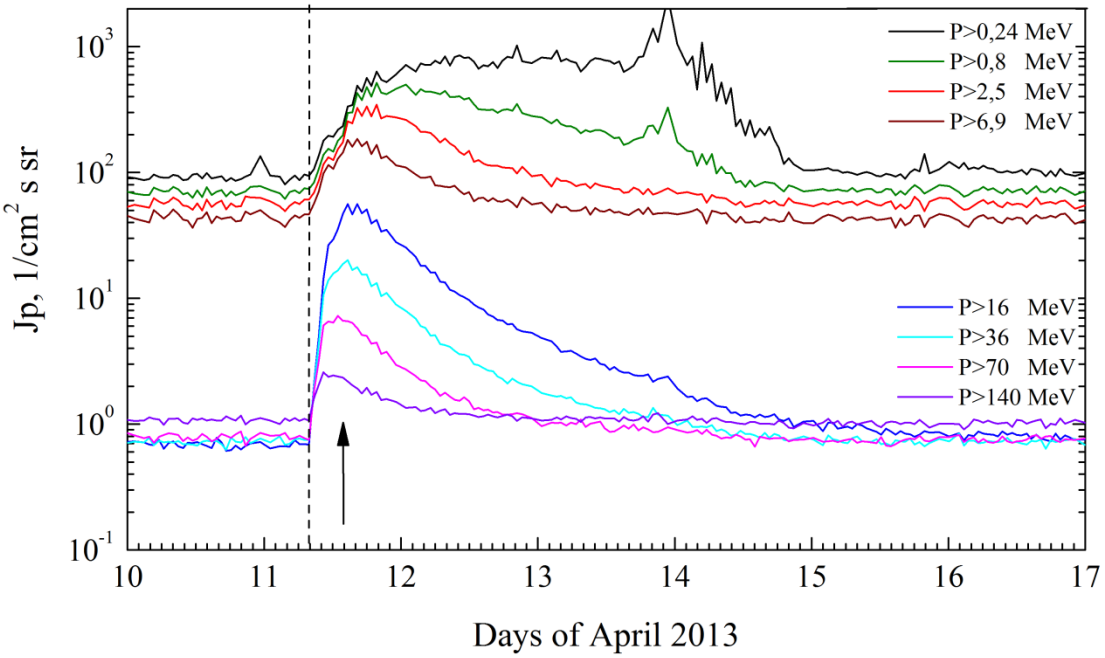

Electro. Event 2013.04.11
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
Days of April 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2013.04.11



POES. Event 2013.04.11



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 April 11

2013 April 11 ● AR 11719 To event 526

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0656	0710	0906	N09E12	3B	UMB
1 – 12	keV	0655	0716	0729	N07E13	M6.5	0.074

X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	0650:44	0707:38	07:08:40	2160	2815919	HESSI
6-12	keV	0803:12	0807:50	0810:52	34	76941	HESSI
12-25	keV	0656:44	0709:45	0746:41	205369	113465544	FERMI
>100	MeV	0720:30		0739:30		4.03E-05*	FERMI

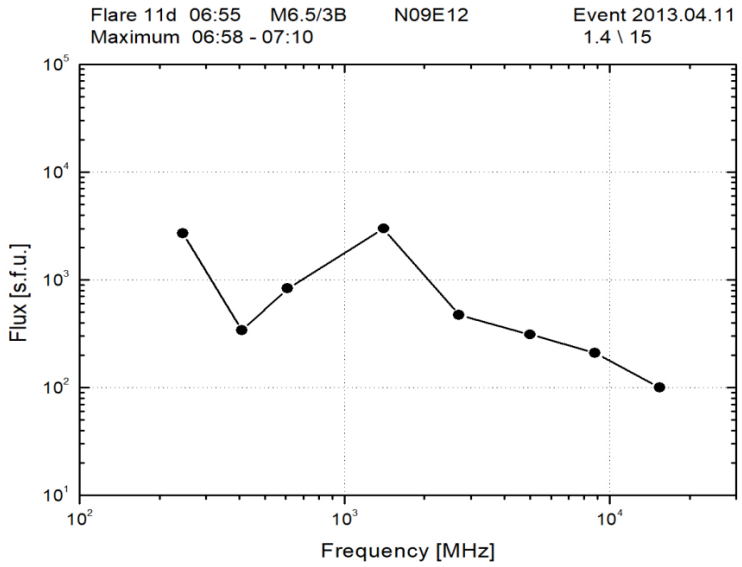
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0710	0710	0710		2.00	
8.8	GHz	0702	0710	0723		2.32	
5	GHz	0658	0710	0716		2.49	
2.7	GHz	0658	0702	0718		2.67	
1.4	GHz	0656	0658	0811	1.4 \ 15	3.48	
610	MHz	0658	0702	0830		2.92	
410	MHz	0657	0707	0845		2.53	
245	MHz	0657	0658	0859		3.43	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	45-160	0702		0709		3	
DS IV	25-180	0702		0712		3	
DS III	25-90	0703		0720		3	
DS VI	25-180	0657		0846		1	
DH II	10-0.2	0710		1500			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0724	861	- 8.1	360˚	85˚	SOHO

* cm^{-2} s^{-1}

Radio burst frequency spectrum



Proton Active Region:

AR 11719 (N10L076; CMP 12,0.04.2013;
Sp=290 msh; EKI; BGD)
XRI=0.87; $M_2^{6.5}$+C_{15}
PFR1 05.04 $M_1^{2.2}$
PFR2 11.04 $M_1^{6.5}$

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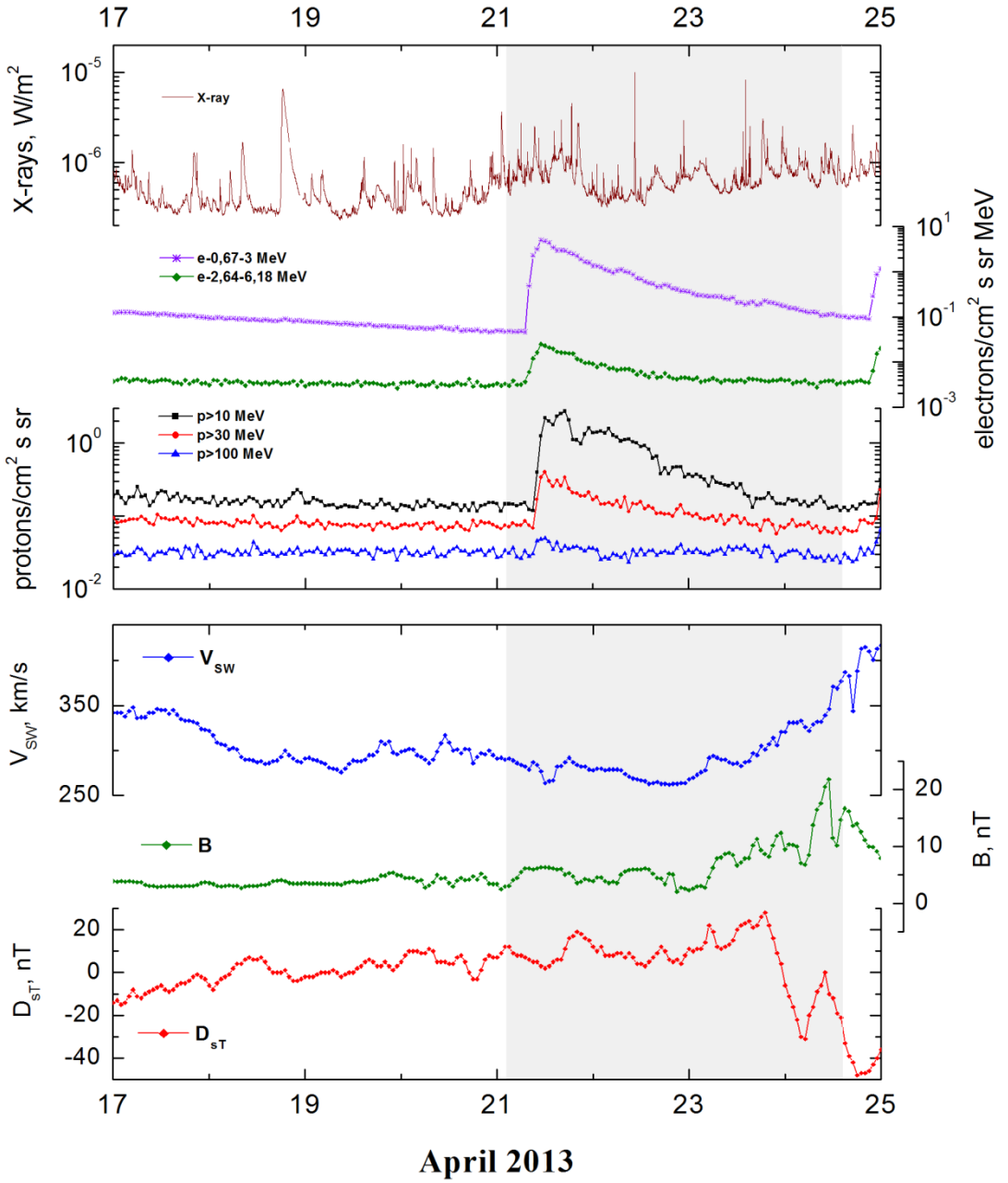
Particle event: To(Ep>10 MeV) – 21d09^h
Tmax$_1$(Ep>10 MeV) – 21d12^h, Jmax$_1$ (Ep>10 MeV) – 2 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 22d02^h, Jmax$_2$ (Ep>10 MeV) – 1.2 /cm^2·s·sr
Duration of the event – 3.5 days, power-law index: γ_1 = 2.3, γ_2 = 2.2
Quasimaximal energy of protons in the event – Eqm$_1$ = 110 MeV
– Eqm$_2$ = 70 MeV

Sources: ⊡ back side solar flare event 21d<07^{h}24^m, AR11719, 2d behind W$_L$
Ø back side solar flare event 21d<20^{h}36^m, AR11719, 2d behind W$_L$
CME 21d07^{h}24^m, V = 919 km/s, Δφ = 360º, dA= 269º
CME 21d20^{h}36^m, V = 561 km/s, Δφ = 212º, dA= 260º

Particle fluxes and associated phenomena

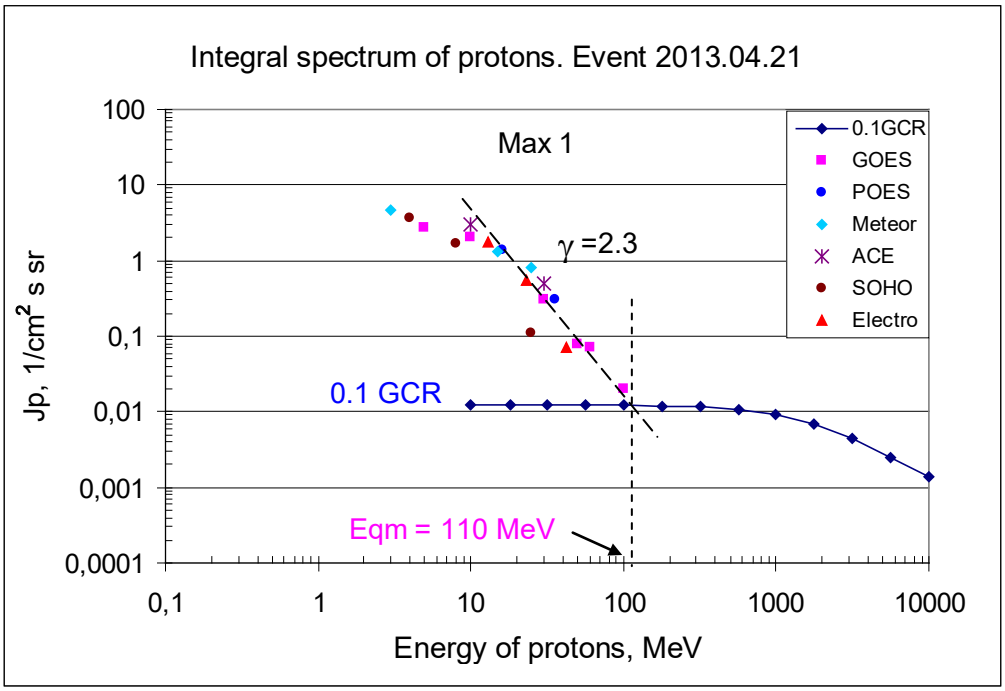


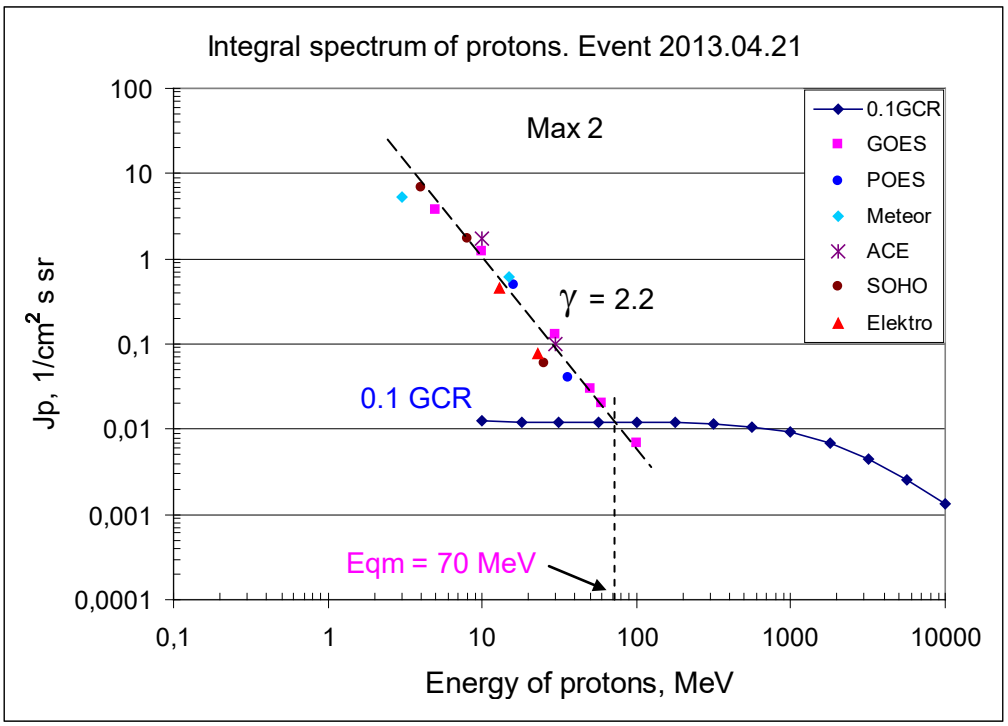
Integral fluxes of protons for the event of 2013 April 21

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	9	12/22d03	2.8/3.7	3.5	0.25	
EPS	>10	9	12/22d02	2/1.2	3.5	0.15	
EPS	>30	9	12/22d01	0.3/0.13	3	0.07	
EPS	>50	9	12/23	0.08/0.03	1	0.06	
EPS	>60	9	12/23	0.07/0.02	1	0.05	
EPS	>100	9	12/23	0.02/0.007	1	0.03	
EPS	>700						
Electro-1							
GALS-MP	>600	-	-	-	-	0,0007	
POES-15							
MEPED	>0.24	5	-	-	-	100	
MEPED	>0.8	5	-	-	-	80	
MEPED	>2.5	5	-	-	-	55	
MEPED	>6.9	5	-	-	-	45	
MEPED	>16	5	12/23	1,4/0,5	1	0,7	
MEPED	>36	5	12/23	0,3/0,04	0,5	0,75	
MEPED	>70	-	-	-	-	0,9	
MEPED	>140	-	-	-	-	1,1	
Meteor -1							
SCR-1	>1	9	-	-	2	2.75	
SCR-1	>3	9	12/17	4.7/5.3	2	2.6	
SCR-1	>10	9	-	-	1	1.6	
GALS-MP	>15	9	12/17	1.3/0.6	1	1.2	
GALS-MP	>25	9	12/-	0.8/-	1	1.25	
GALS-MP	>600	-	-	-	-	0.02	
ACE							
SIS	>10	8	13/22d07	3/1,7	2	1,3	
SIS	>30	8	13/22d07	0,5/0,1	1	0,9	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

Differential fluxes of protons for the event of 2013 April 21

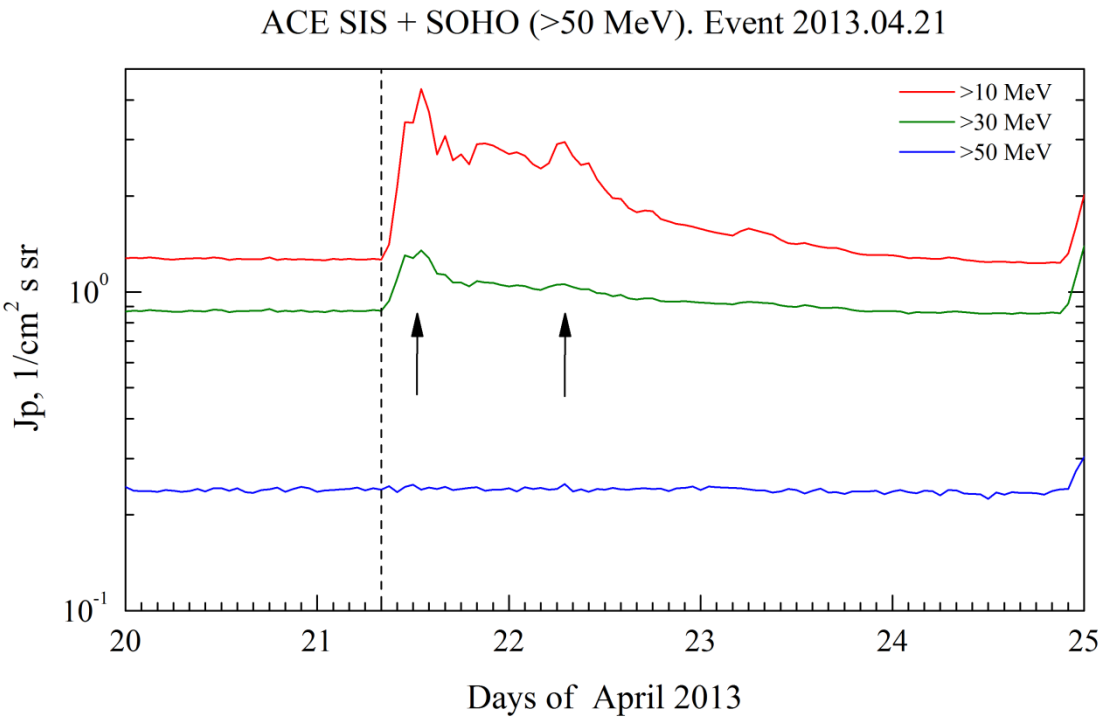
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0,75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	13	20/22d07	0,51/1,3	3,5	0,02	
EPHIN	8 – 25	13	20/22d06	0,09/0,1	3,5	0,002	
EPHIN	25 – 53	13	20/22d06	0,0039/0,0021	3,5	0,0004	
Electro-1							
SCR-E	13.7–23	8	12/22d00	0,13/0,04	5	0,05	
SCR-E	23–42	8	12/22d00	0,025/0,004	4	0,025	
SCR-E	42–112	8	12/22d00	0,001/ -	3	0,005	

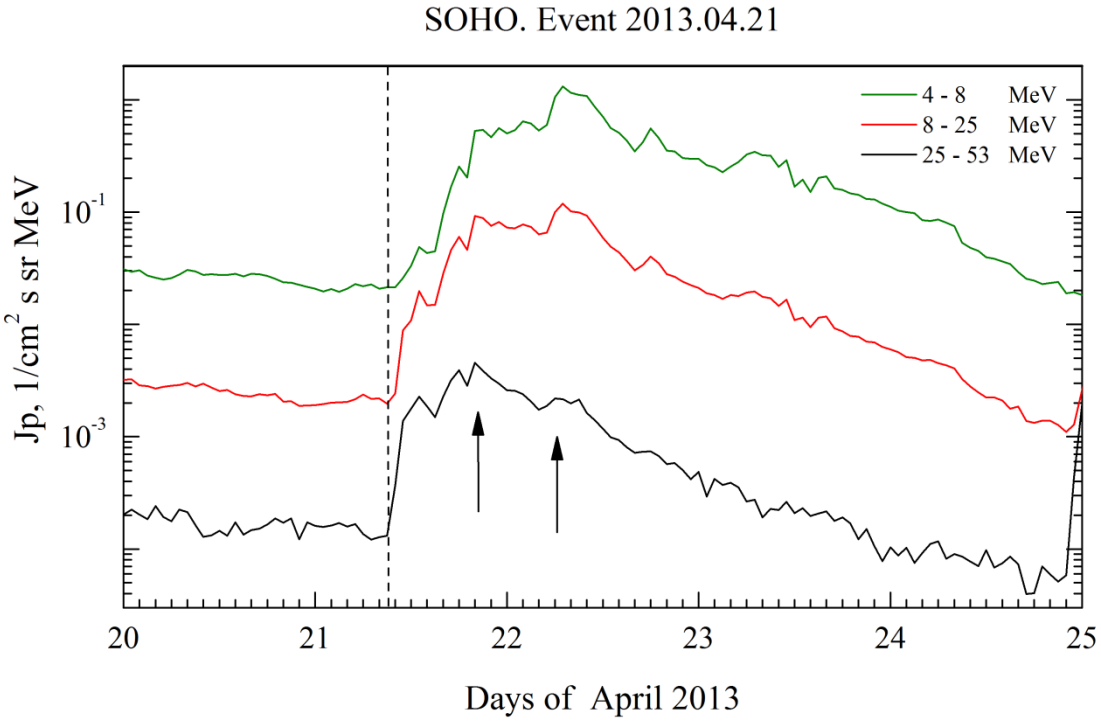

Integral spectrum of protons. Event 2013.04.21
Max 1
γ =2.3
0.1 GCR
Eqm = 110 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

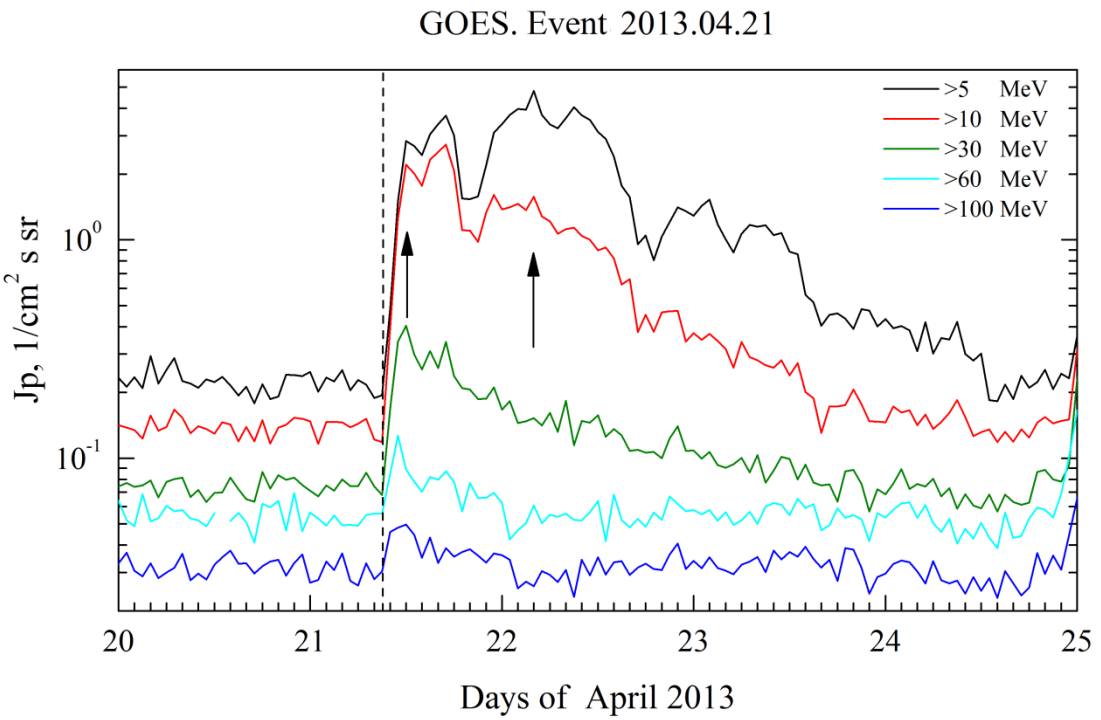

Integral spectrum of protons. Event 2013.04.21
Max 2
γ = 2.2
0.1 GCR
Eqm = 70 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Elektro
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

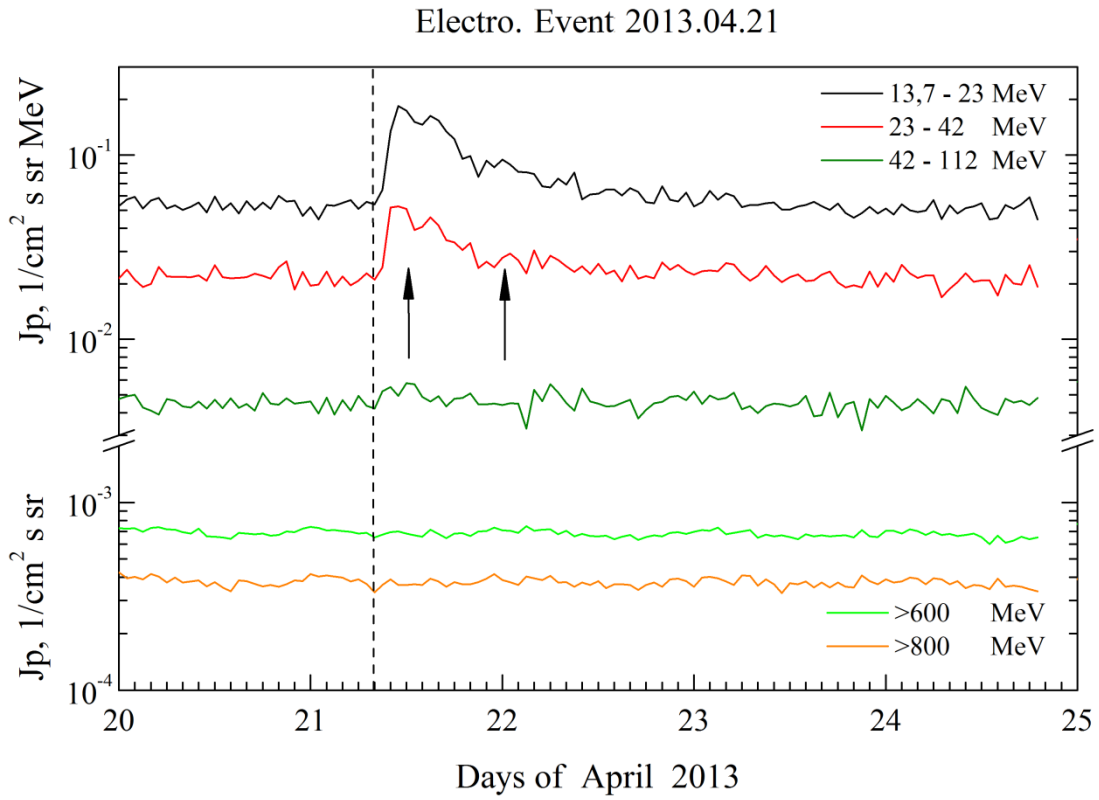
Time profiles of proton fluxes in the event 2013.04.21

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

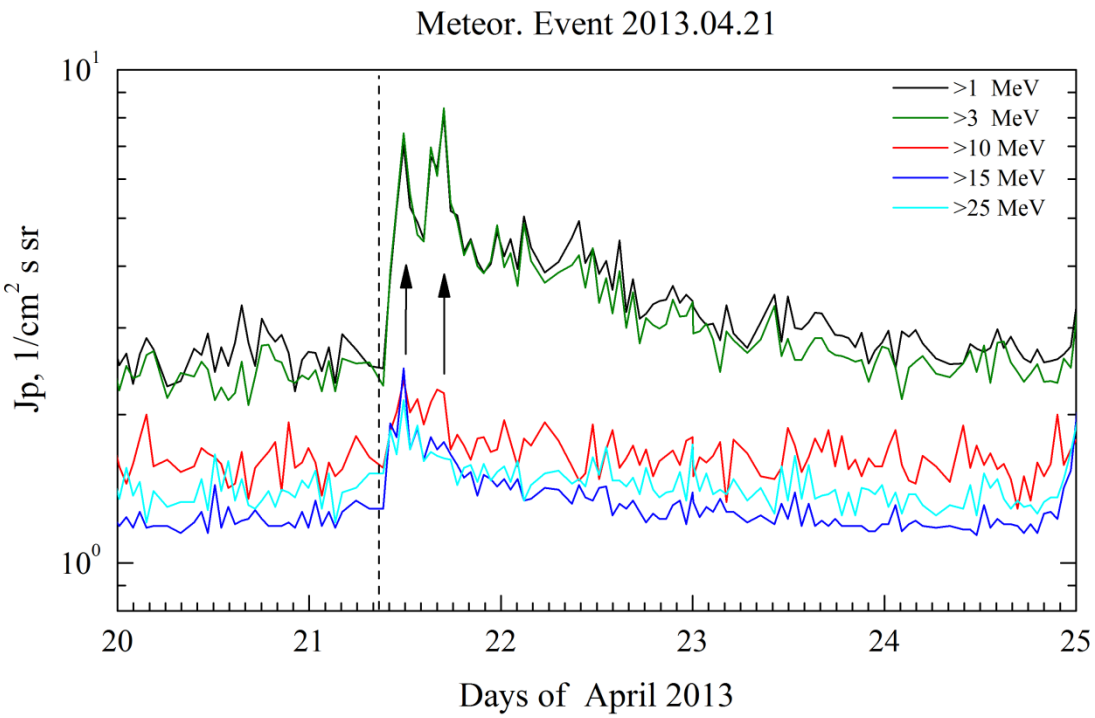


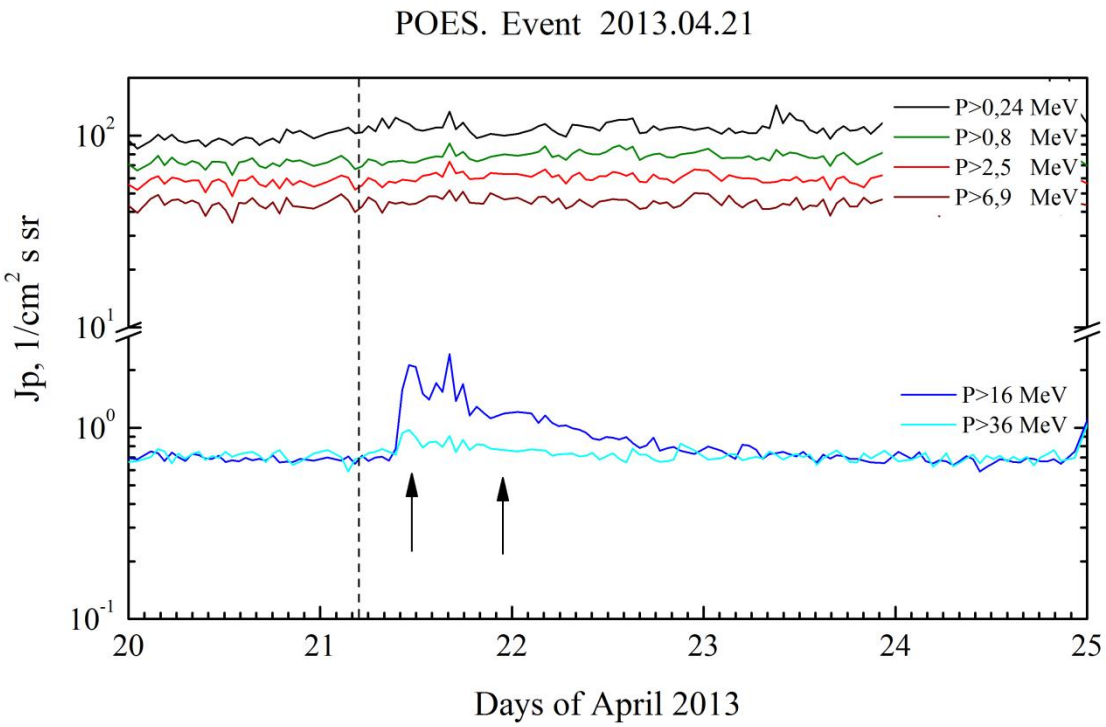



GOES. Event 2013.04.21
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Jp, 1/cm² s sr
10⁰
10⁻¹
20
21
22
23
24
25
Days of April 2013


Electro. Event 2013.04.21
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
10⁻¹
10⁻²
10⁻³
10⁻⁴
20
21
22
23
24
25
Days of April 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 April 21

2013 April 21 ⊡ AR 11719 To event 527

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563Å		No event on visible solar disc					
1 – 12	keV	No X-ray event at this time					
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0724	919	- 4.2	360˚	269˚	SOHO

2013 April 21 Ø AR 11719 To event 527

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event at this time					
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2036	561	- 8.3	212˚	260˚	SOHO

Proton Active Region:

AR 11719 (N10L076; CMP 12,0.04.2013;
Sp=290 msh; EKI; BGD)
XRI=0.87; $M_2^{6.5}$+C_{15}
PFR1 05.04 $M_1^{2.2}$
PFR2 11.04 $M_1^{6.5}$

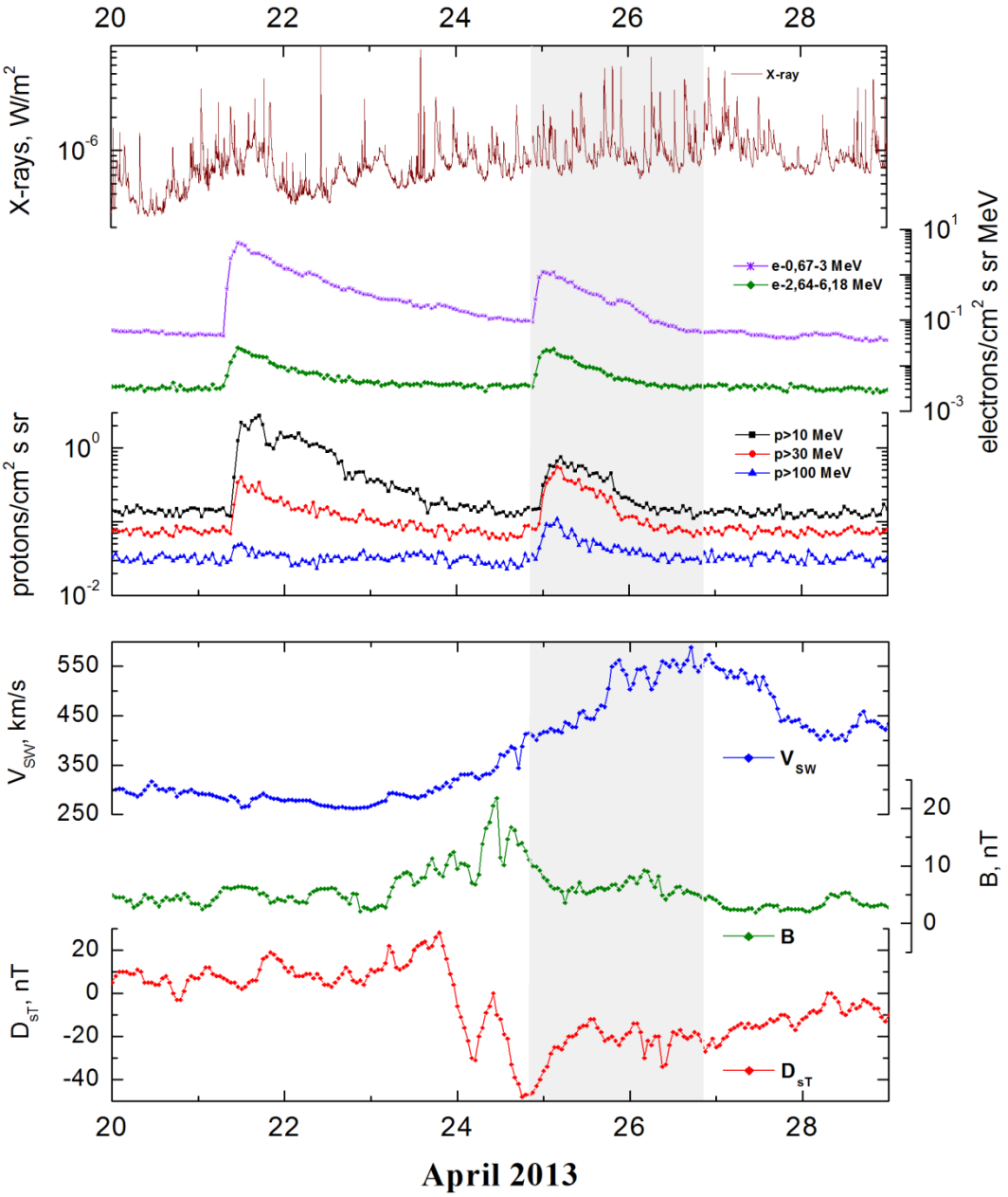
References:

Kalaivani P.P., O.Prakash, A. Shanmugaraju et al., 2021.
Luhmann J.G., M.L. Mays, D. Odstrci et al., 2017.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.

Particle event: To(Ep>10 MeV) – 24d23^{h}
Tmax (Ep>10 MeV) – 25d05^{h}, Jmax (Ep>10 MeV) – 1.3/cm^{2}·s·sr (ACE)
Duration of the event – 1.5 days, power-law index: $\gamma = 2.6$
Quasimaximal energy of protons in the event – Eqm = 140 MeV

Sources: ⊡ back side solar flare 24d<22^{h}12^{m}, AR 11719, 6d behind W_L
CME: 24d22^{h}12^{m}, V = 784 km/s, Δφ = 360°, dA = 241°

Particle fluxes and associated phenomena

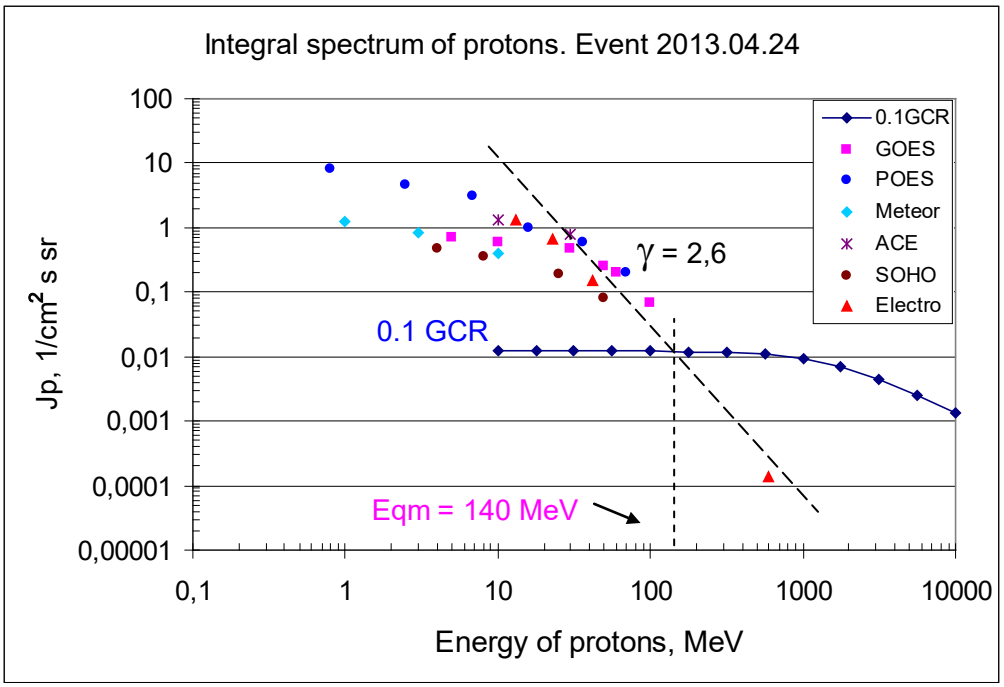


Integral fluxes of protons for the event of 2013 April 24

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)-1$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	23	25d05	0.7	1.5	0.2	
EPS	>10	23	25d05	0.6	1.5	0.15	
EPS	>30	23	25d04	0.48	1.5	0.07	
EPS	>50	23	25d04	0.25	1.5	0.06	
EPS	>60	23	25d03	0.2	1.5	0.05	
EPS	>100	23	25d04	0.07	1.5	0.03	
Electro-1							
GALS-E	>600	23	25d02	0.00014	-	0.0007	
POES							
MEPED	>0.24	-	-	-	0.5	100	
MEPED	>0.8	-	25d05	8	0.5	70	
MEPED	>2.5	-	25d05	4.7	0.5	55	
MEPED	>6.9	-	25d05	3.1	0.5	45	
MEPED	>16	22	25d05	1	0.5	0.7	
MEPED	>36	22	25d05	0.6	0.5	0.75	
MEPED	>70	22	25d05	0.2	-	0.9	
MEPED	>140	-	-	-	-	1.1	
Meteor-1							
SCR	>1	22	25d03	1.25	1.5	2.7	
SCR	>3	22	25d03	0.83	1.5	2.75	
SCR	>10	22	25d03	0.39	1.5	1.6	
GALS-M	>15	22	-	-	0.5	1.2	
GALS-M	>25	22	-	-	0.5	1.25	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	23	25d03	1.3	1	1.3	
SIS	>30	23	25d03	0.8	1	0.9	
SOHO							
EPHIN	>50	22	25d03	0.08	1	0.25	

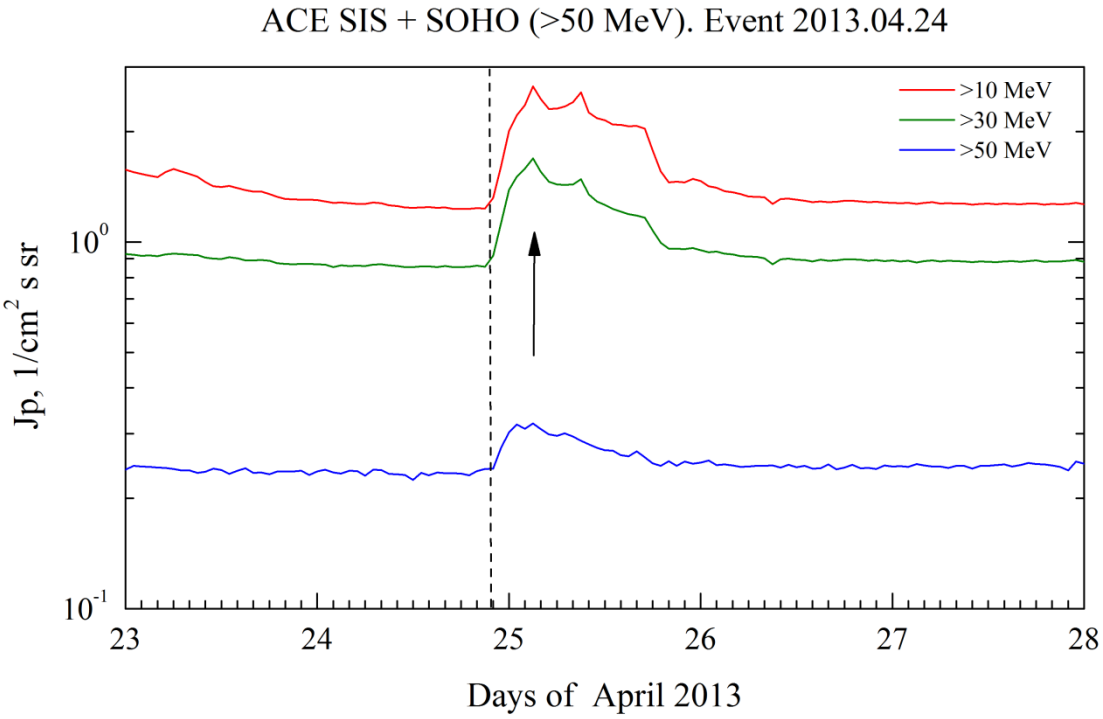
Differential fluxes of protons for the event of 2013 April 24

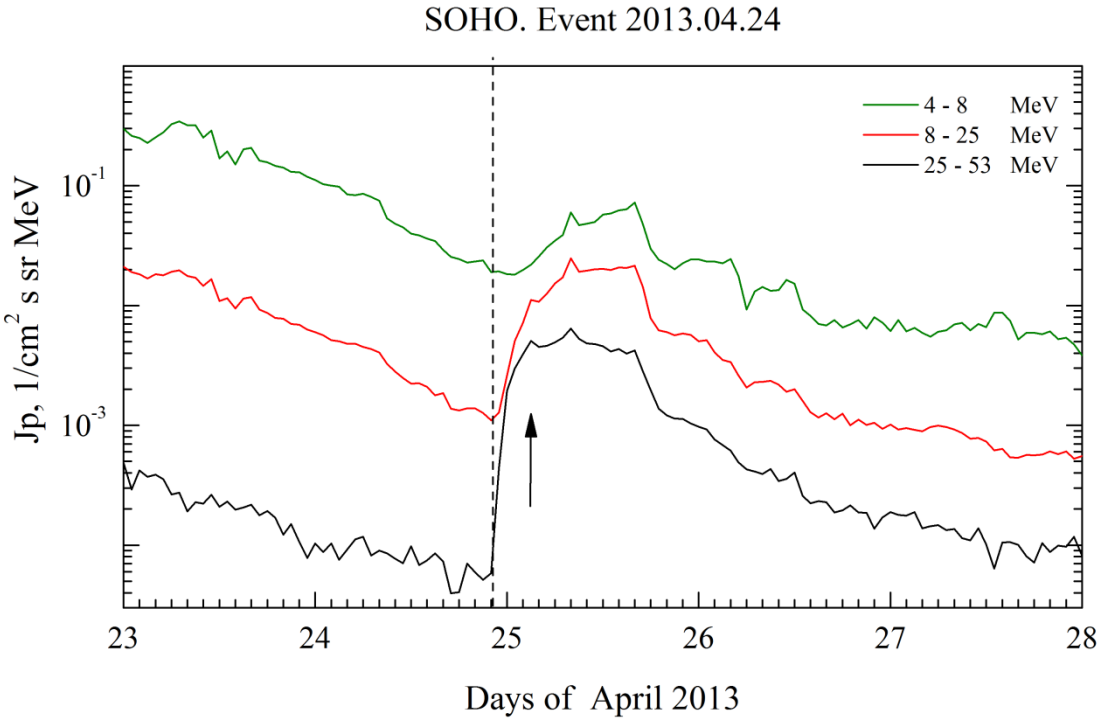
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	22	25d04	0.03	1	0.001	
EPHIN	8 – 25	22	25d03	0.01	1	0.0005	
EPHIN	25 – 53	22	25d03	0.004	1	0.00006	
Electro-1							
SCR-E	13.7–23	23	25d04	0.07	2	0.05	
SCR-E	23–42	23	25d04	0.027	2	0.025	
SCR-E	42–112	23	25do4	0.0022	1	0.0045	

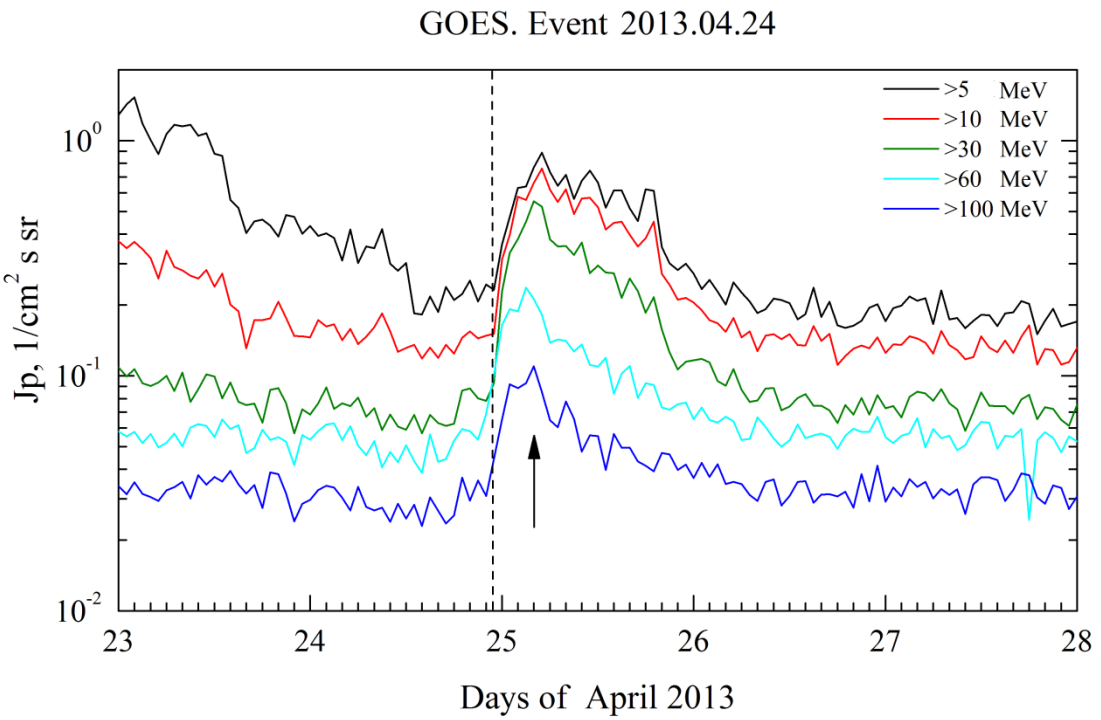

Integral spectrum of protons. Event 2013.04.24
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,00001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2,6
0.1 GCR
Eqm = 140 MeV

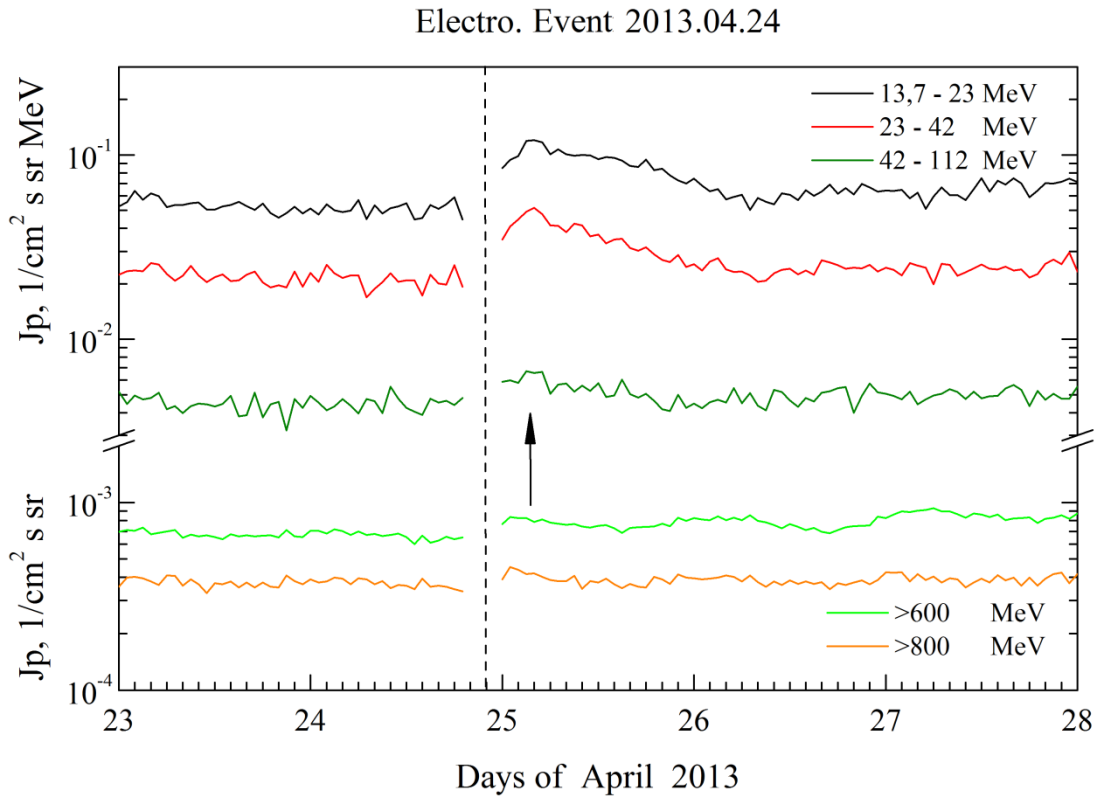
Time profiles of proton fluxes in the event 2013.04.24

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



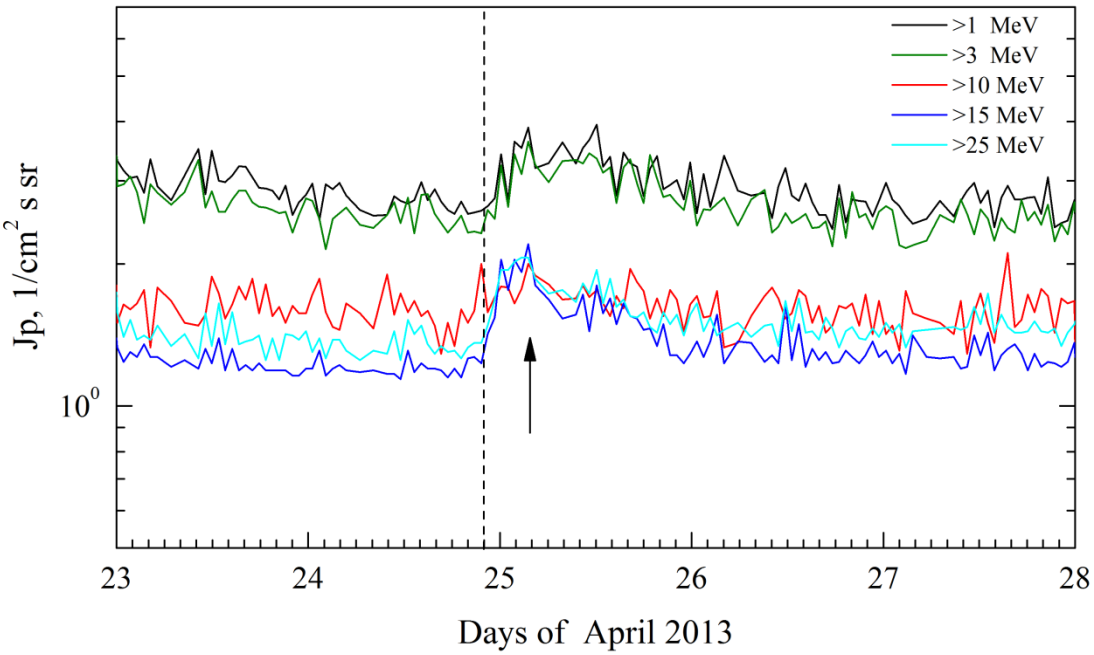



GOES. Event 2013.04.24
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Jp, 1/cm² s sr
10⁰
10⁻¹
10⁻²
23
24
25
26
27
28
Days of April 2013

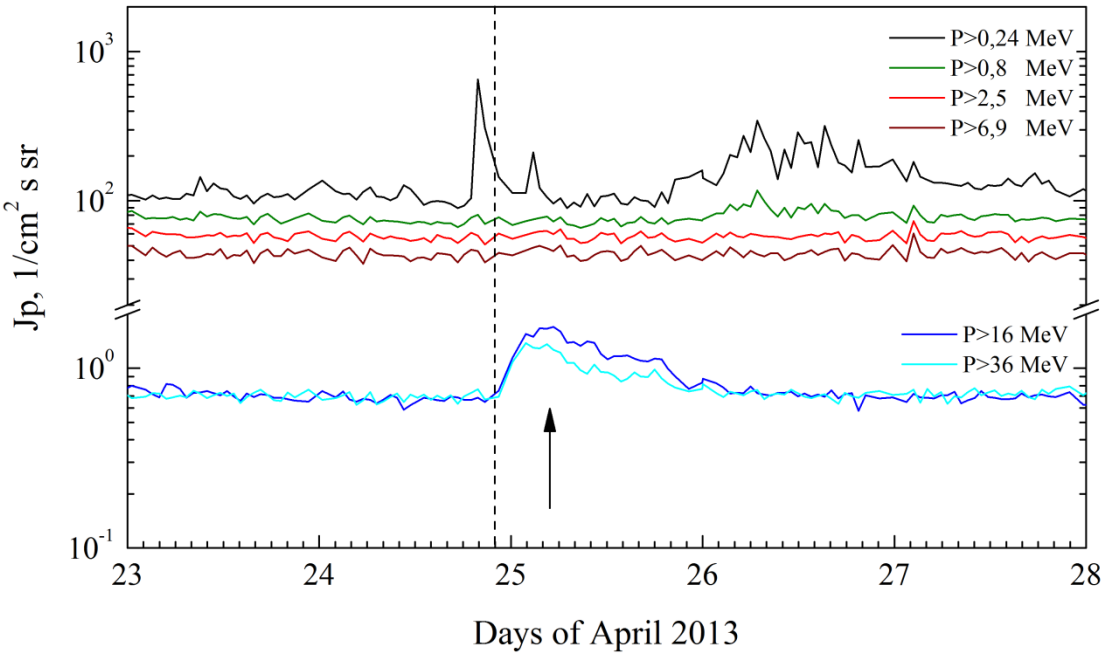

Electro. Event 2013.04.24
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
10⁻¹
10⁻²
10⁻³
10⁻⁴
23
24
25
26
27
28
Days of April 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2013.04.24



POES. Event 2013.04.24



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 April 24

2013 April 24 ⊡ **AR 11719 To event 528**

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event at this time					

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2212	784	- 34.7	360˚	241˚	SOHO

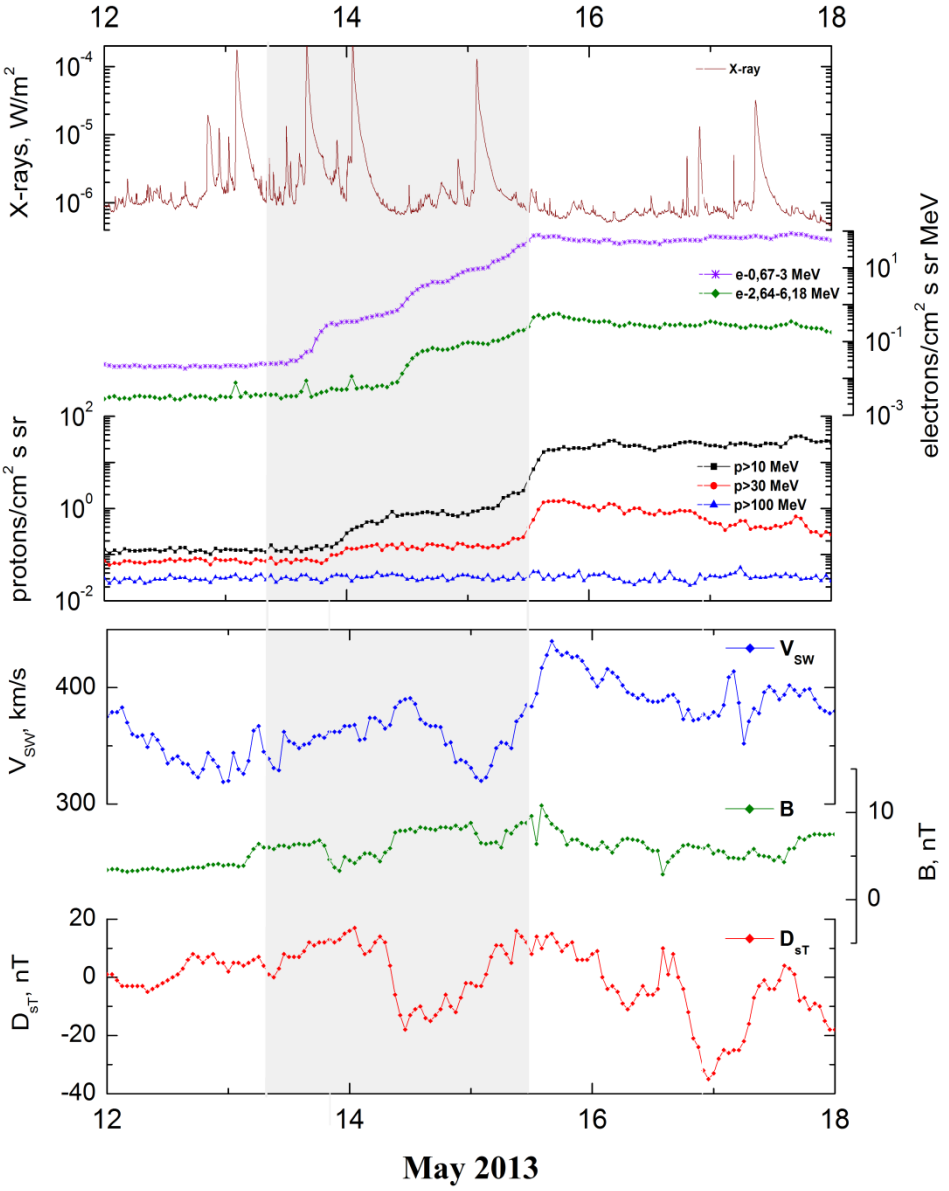
Proton Active Region:

AR 11719 (N10L076; CMP 12,0.04.2013;
Sp=290 msh; EKI; BGD)
XRI=0.87; $M_2^{6.5}$+C_{15}
PFR1 05.04 $M_1^{2.2}$
PFR2 11.04 $M_1^{6.5}$

Particle event: To(Ep>10 MeV) – 13d18^h
Tmax (Ep>10 MeV) – 14d09^h, $Jmax_1$ (Ep>10 MeV) – 1/cm^2·s·sr (ACE)
Duration of the event – 1.5 days, power-law index: $\gamma = 2.2$,
Quasimaximal energy of protons in the event – $Eqm_1 = 70$ MeV

Sources: ■ solar flare 13d15^{h}48^m, X2.8/1N, N14E85, AR11748
Ø solar flare 13d23^{h}59^m, X3.2/2B, N12E77, AR11748
Main burst X-ray 1–8 Å: onset – 13d15^{h}48^m, max – 13d16^{h}05^m, $\Phi = 0.23$ J/m^2
CME: 13d16^{h}08^m, V= 1850 km/s, $\Delta\varphi = 360°$, dA= 063°

Particle fluxes and associated phenomena

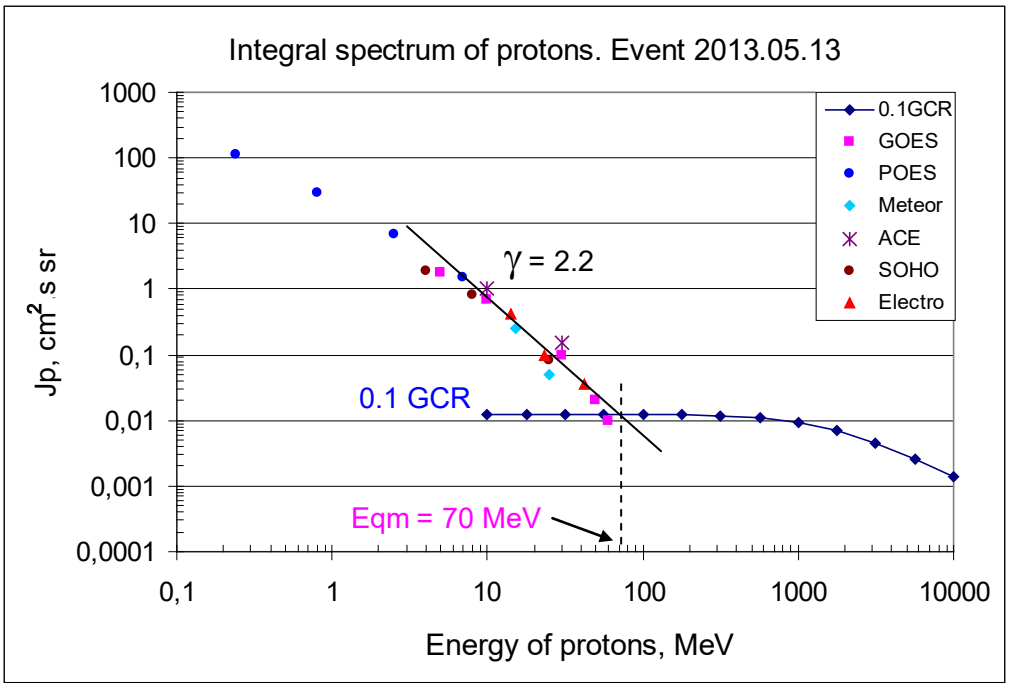


Integral fluxes of protons for the event of 2013 May 13

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	14d09	1.8	1.5	0.2	
EPS	>10	18	14d09	0.7	1.5	0.13	
EPS	>30	18	14d09	0.1	1.5	0.07	
EPS	>50	18	14d09	0.02	0.5	0.06	
EPS	>60	18	14d09	0.01	0.5	0.055	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	14	14d10	110	7	90	
MEPED	>0.8	14	14d10	30	7	65	
MEPED	>2.5	-	14d10	7	6	50	
MEPED	>6.9	-	14d10	1	5	45	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.75	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	-	-	-	-	2.7	
SCR	>3	-	-	-	-	2.5	
SCR	>10	-	-	-	-	1.6	
GALS-M	>15	14	14d12	0.25	1	1.2	
GALS-M	>25	14	14d12	0.05	1	1.2	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	18	14d11	1	1.5	1.2	
SIS	>30	18	14d11	0.15	1.5	0.85	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

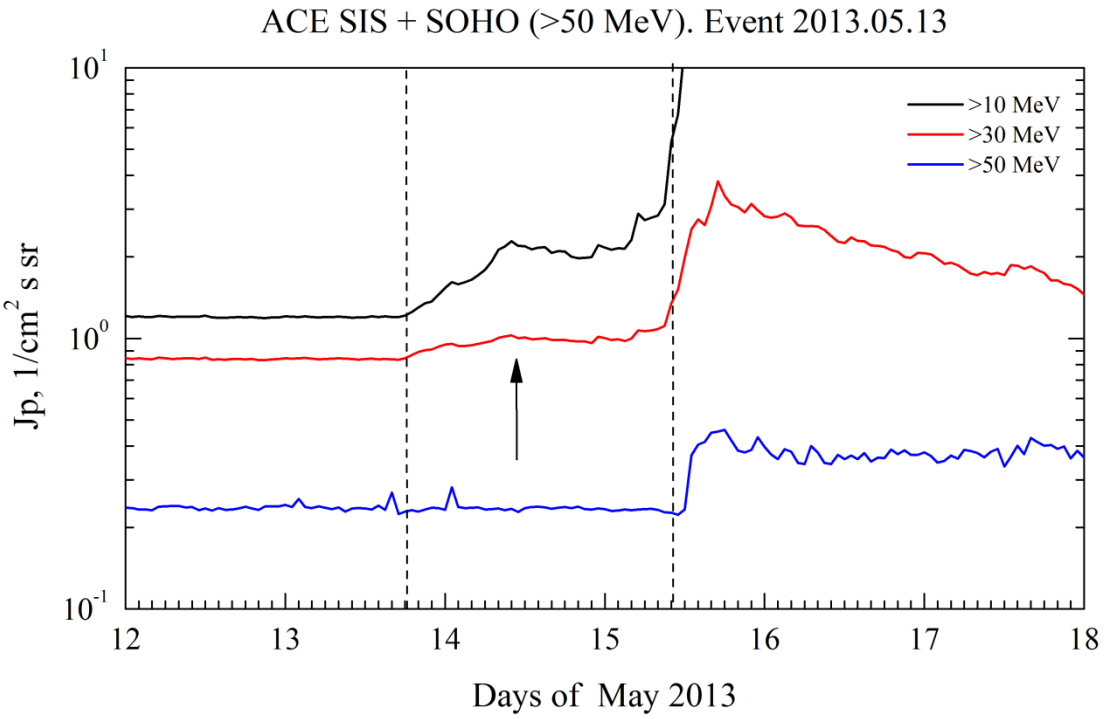
Differential fluxes of protons for the event of 2013 May 13

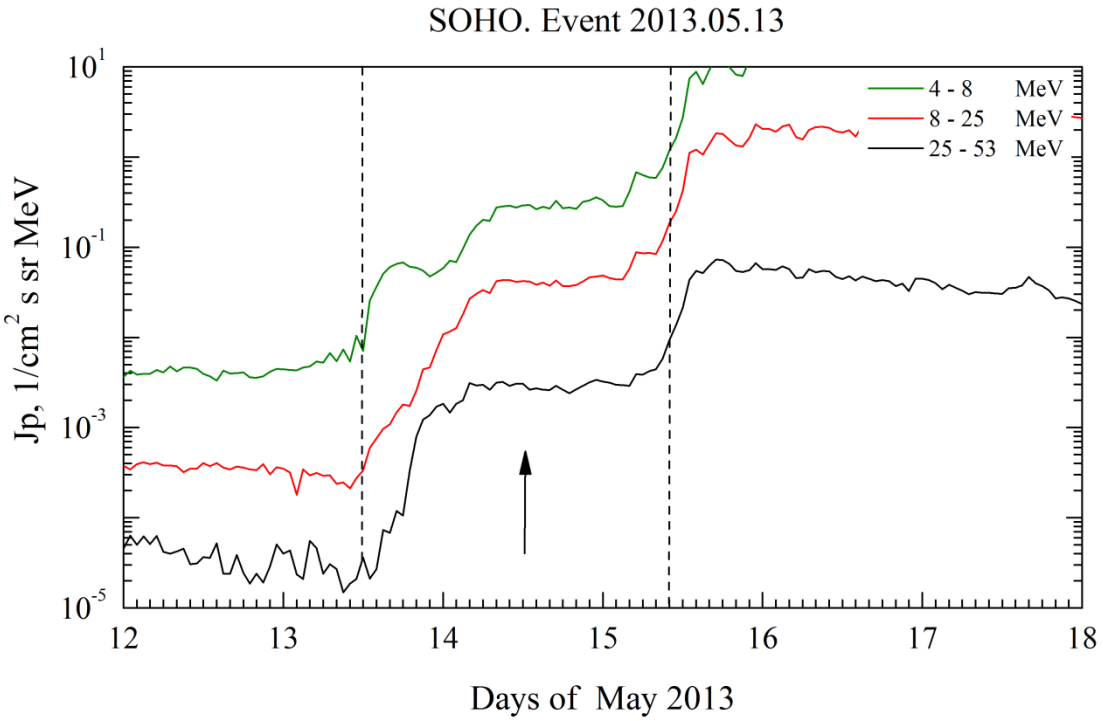
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	12	14d12	0.27	2	0.004	
EPHIN	8 – 25	12	14d12	0.042	2	0.0004	
EPHIN	25 – 53	12	14d12	0.003	2	0.000025	
Electro-1							
SCR-E	13.7–23	20	14d13	0.035	1,5	0.05	
SCR-E	23–42	20	14d13	0.0035	1,5	0.025	
SCR-E	42–112	20	14d13	0.0005	1,5	0.005	


Integral spectrum of protons. Event 2013.05.13
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.2
0.1 GCR
Eqm = 70 MeV

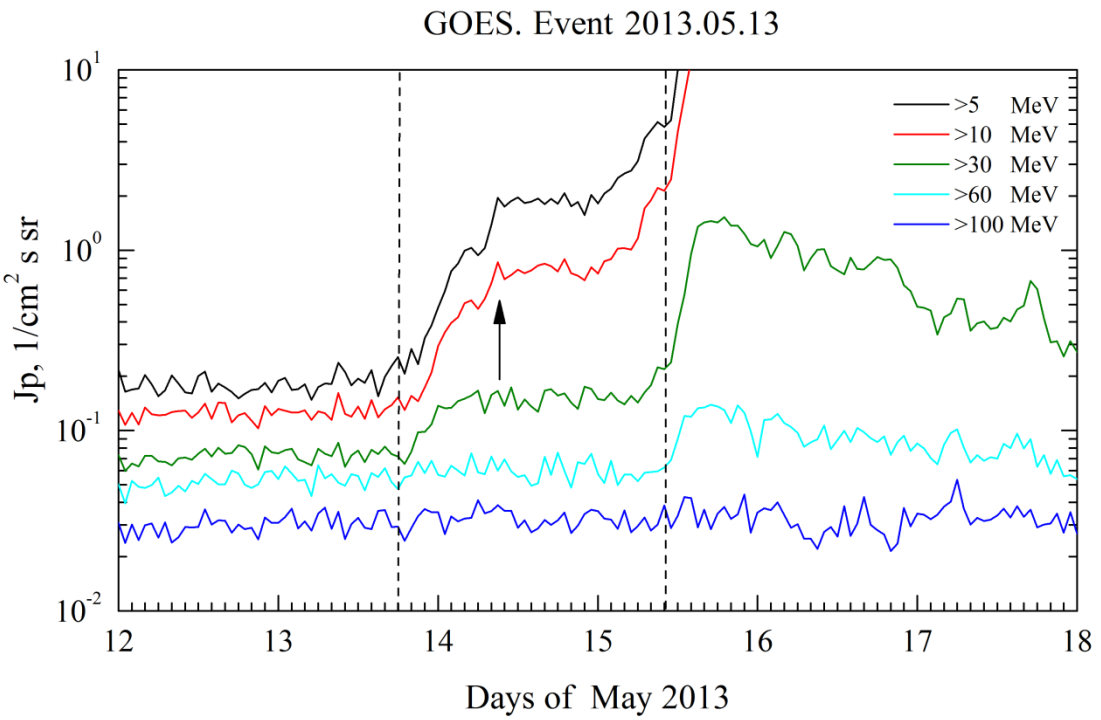
Time profiles of proton fluxes in the event 2013.05.13

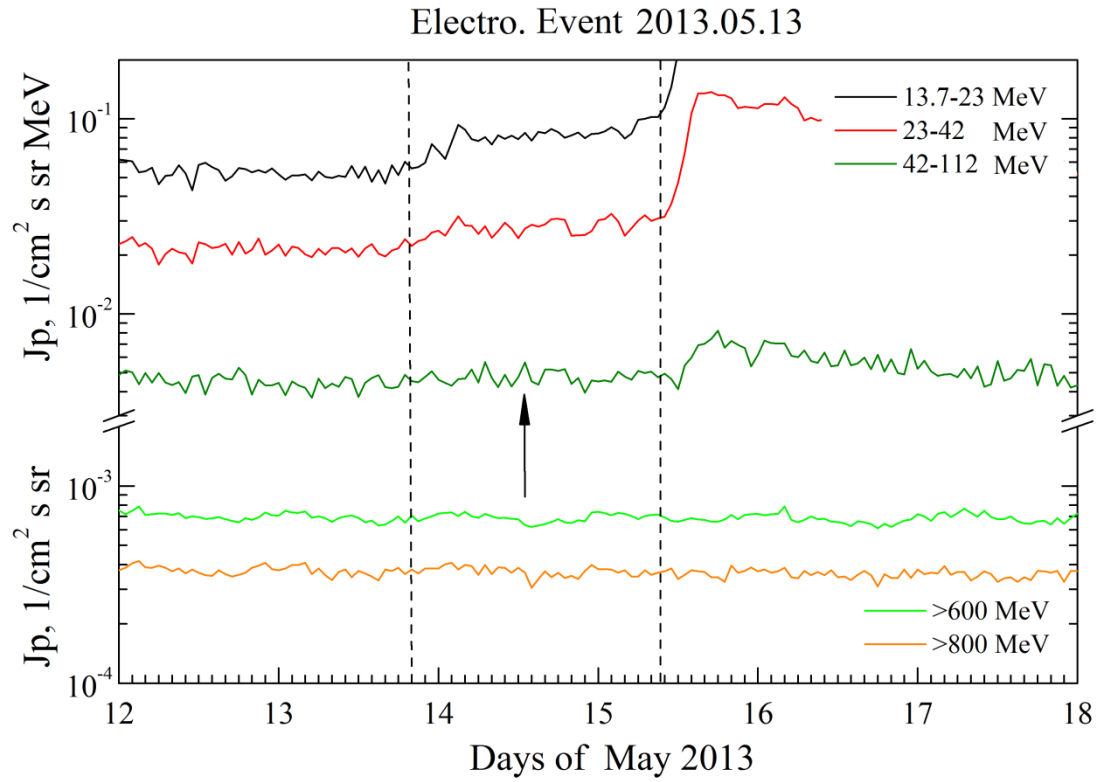
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



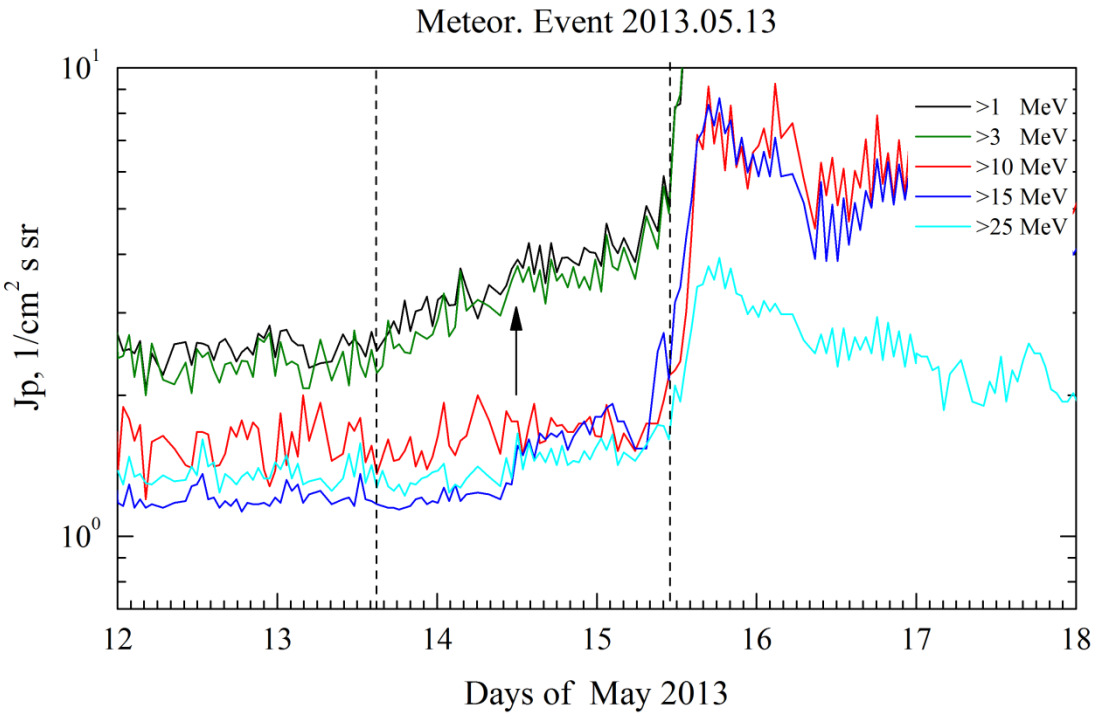


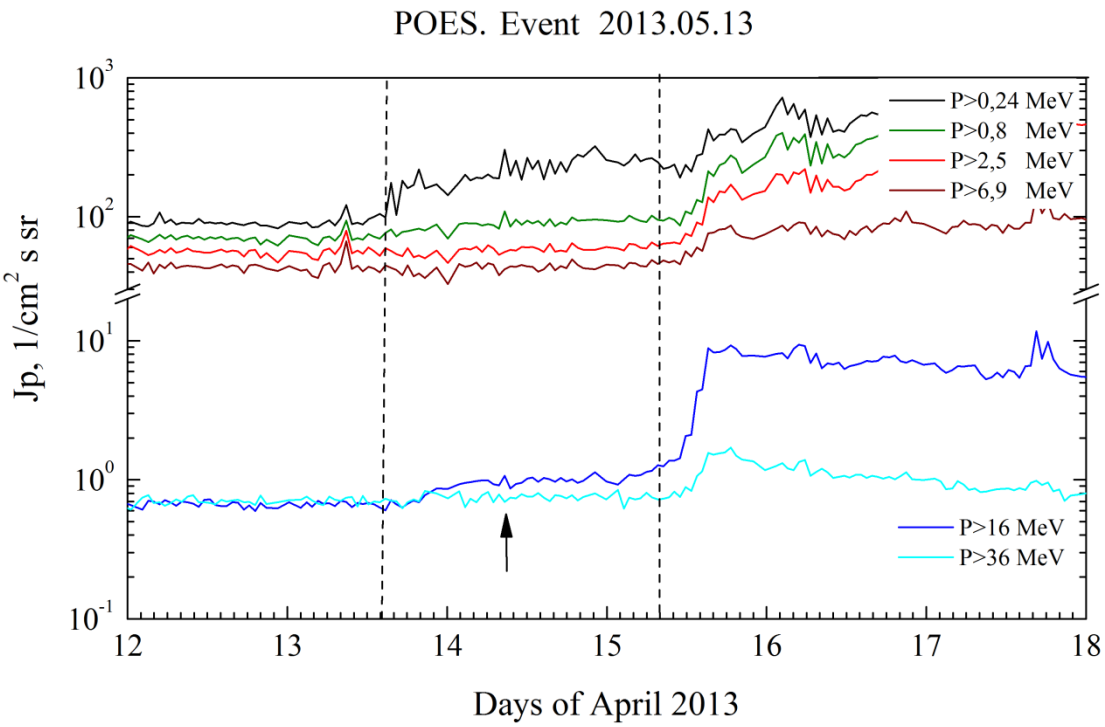
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 May 13

2013 May 13 ■ AR 11748 To event 529

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	1548	1601	1637	N14E85	1N	
6563 Å	FL	1554		1749		0.3	EPL
6563 Å	FL	1614		2340	0.08	B.9A	LPS
1 – 12	keV	1548	1605	1616		X2.8	0.23

X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
300-800	keV	1550:24	1604:26	1607:36	33601	73108112	HESSI
100-300	keV	1615:20	1615:42	1650:24	6487	24453486	HESSI
12-25	keV	1544:58	1546:24	1546:44	858	19256	FERMI
12-25	keV	1604:08	1606:44	1629:31	780890	449654272	FERMI
12-25	keV	1704:24	1713:28	1728:01	7544	1623983	FERMI
12-25	keV	1738:52	1739:54	1804:53	3492	776591	FERMI
>1000	keV	1715:30		1728:30		2.14E-05*	FERMI
>100	keV	1740:30		1758:30		3.20E-05*	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	1551	1603	1625	1.4/15	3.73	
8.8	GHz	1551	1603	1624		3.56	
5	GHz	1551	1559	1620		3.20	
2.7	GHz	1553	1601	1618		2.72	
1.4	GHz	1554	1603	1606		2.00	
245	MHz	1603	1604	1604		1.73	

DS-type	Frequeny, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	25-180	1557		1620	990	2	
DS IV	25-180	1557		1636		2	
DH II	16-0.3	1615		1910			WIND

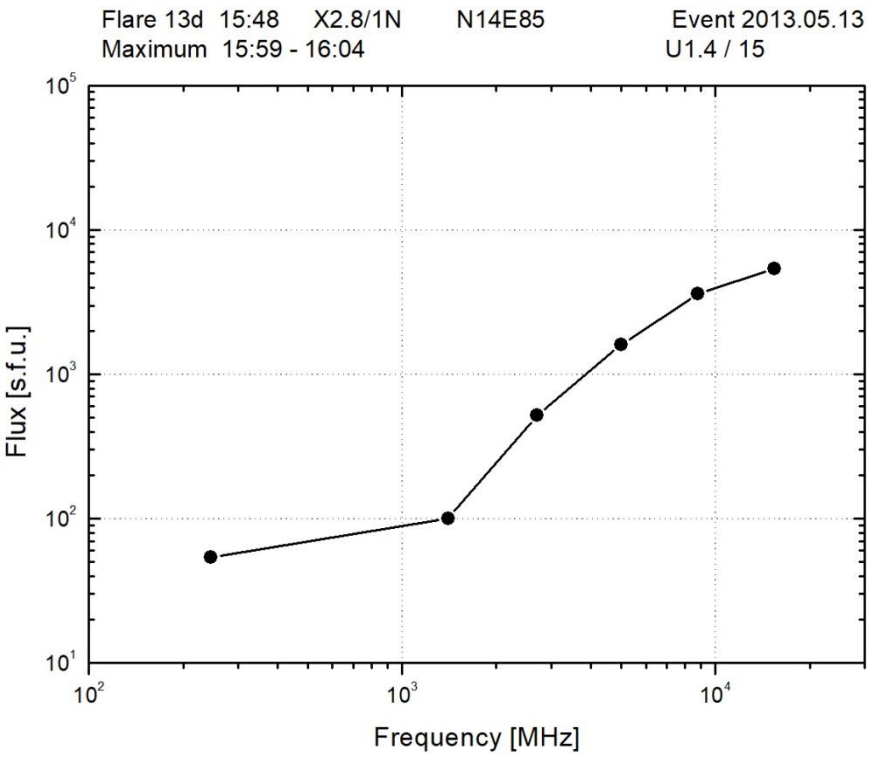
CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1608	1850	- 76.6	360˚	63˚	SOHO

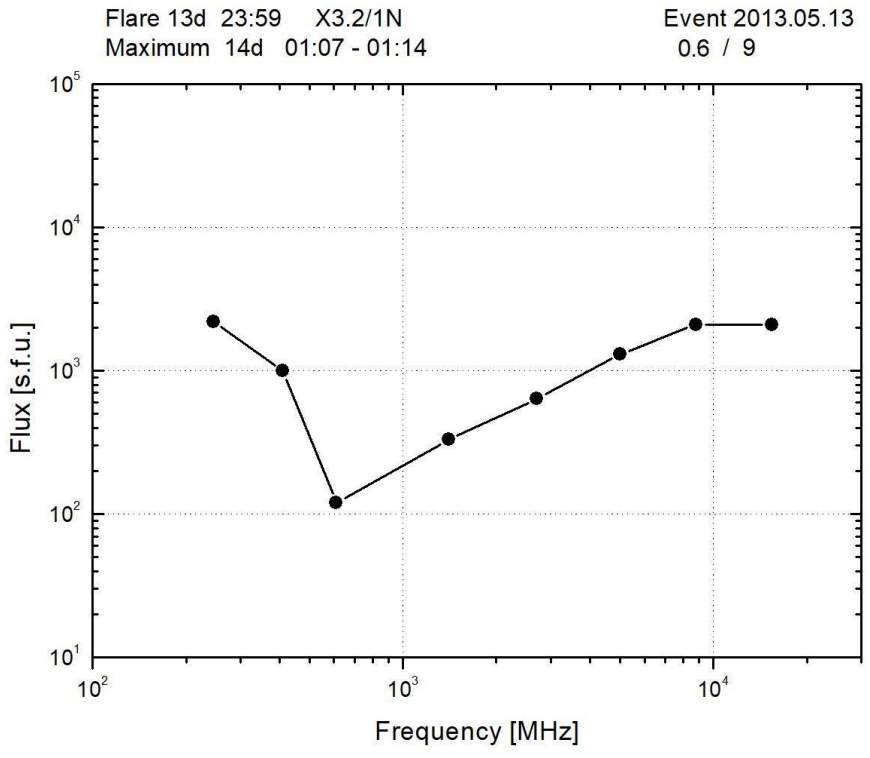
* $cm^{-2} \cdot s^{-1}$

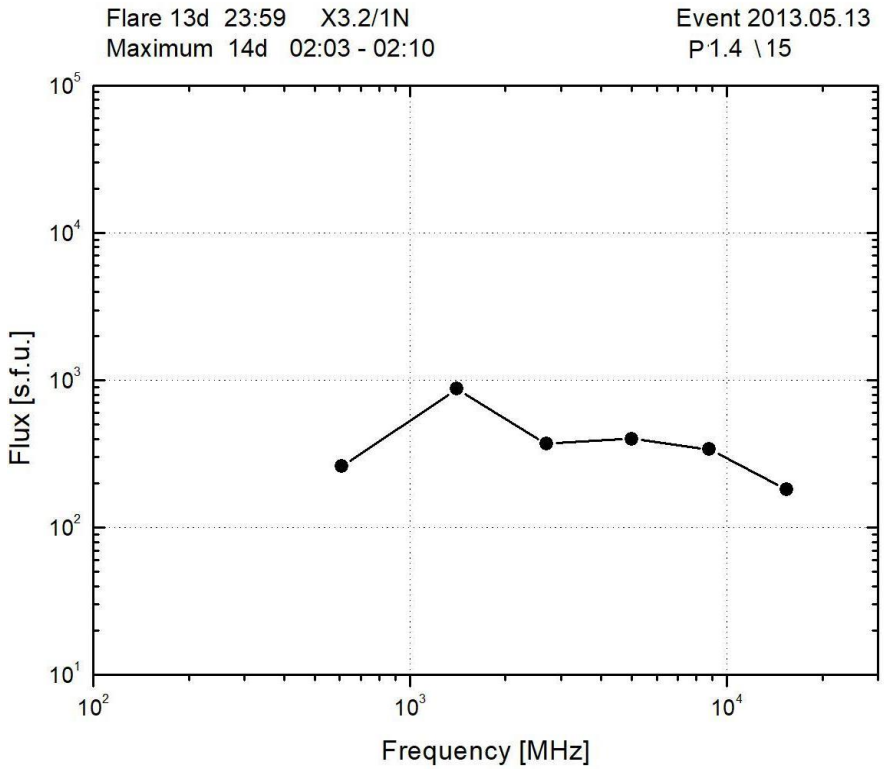
Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical event on visible solar disc					
1 – 12	keV	2359	0111	0120	N08E77	X3.2	0.22
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	2358:00	2358:30	0000:32	6	3822	HESSI
12-25	keV	0000:32	0003:06	0006:04	128	84167	HESSI
12-25	keV	0006:04	0017:46	0047:16	120	929913	HESSI
50-100	keV	0122:44	0124:14	0222:40	4915	26928144	HESSI
12-25	keV	0001:59	0002:57	0026:42	18002	1077621	FERMI
12-25	keV	0101:52	0112:36	0202:20	935633	770058240	FERMI
12-25	keV	0237:20	0237:57	0336:19	3051	952821	FERMI
>100	MeV	0129:30	0237:57	0157:30		1.23E-05*	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0103	0107	0127	0.6 / 9	3.32	
8.8	GHz	0103	0107	0126		3.32	
5	GHz	0103	0114	0126		3.11	
2.7	GHz	0104	0114	0127		2.81	
1.4	GHz	0105	0108	0118		2.52	
610	MHz	0106	0108	0126		2.08	
410	MHz	0106	0107	0126		3.00	
245	MHz	0106	0107	0107		3.34	
15.4	GHz	0125	0125	0126	5 \ 15	2.15	
8.8	GHz	0125	0125	0126		2.50	
5	GHz	0125	0125	0126		2.54	
2.7	GHz	0125	0125	0126		2.04	
610	MHz	0125	0126	0126		2.66	
15.4	GHz	0141	0141	0143	5 \ 15	2.08	
8.8	GHz	0136	0141	0143		2.34	
5	GHz	0135	0141	0143		2.46	
2.7	GHz	0134	0141	0143		2.08	
15.4	GHz	0202	0206	0209	P1.4 \ 15	2.25	
8.8	GHz	0201	0203	0210		2.53	
5	GHz	0201	0203	0210		2.60	
2.7	GHz	0200	0203	0210		2.57	
1.4	GHz	0202	0210	0210		2.94	
610	MHz	0202	0208	0210		2.41	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	35-270	0107		0116		1	
DS IV	70-180	0113		0126		1	
DS III	18-70	0116		0121		3	
DS III	330-750	0126		0126		2	
DS VI	025-097	0152		0216		1	
DH II	16-0.7	0116		0235			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0126	2625	- 51.0	360˚	89˚	SOHO

* cm^{-2}·s^{-}1

Radio bursts frequency spectrum







Proton Active Region:

AR11748 (N12L294, CMP 20.0.05.2013,
Sp=310 msh, DKI, BGD, R)
XRI=9.96; $X_4^{3.2}$+$M_5^{3.2}$+ C_{19} 2_2+1_3+S_{56}
PFR1 12-13.05; (52^h) $X_3^{3.2}$+$M_3^{1.9}$
PFR2 15-17.05 (57^h) $X_1^{1.2}$+$M_2^{3.2}$

References:

Alberti T., M. Laurenza, E.W. Cliveret et al., 2017.
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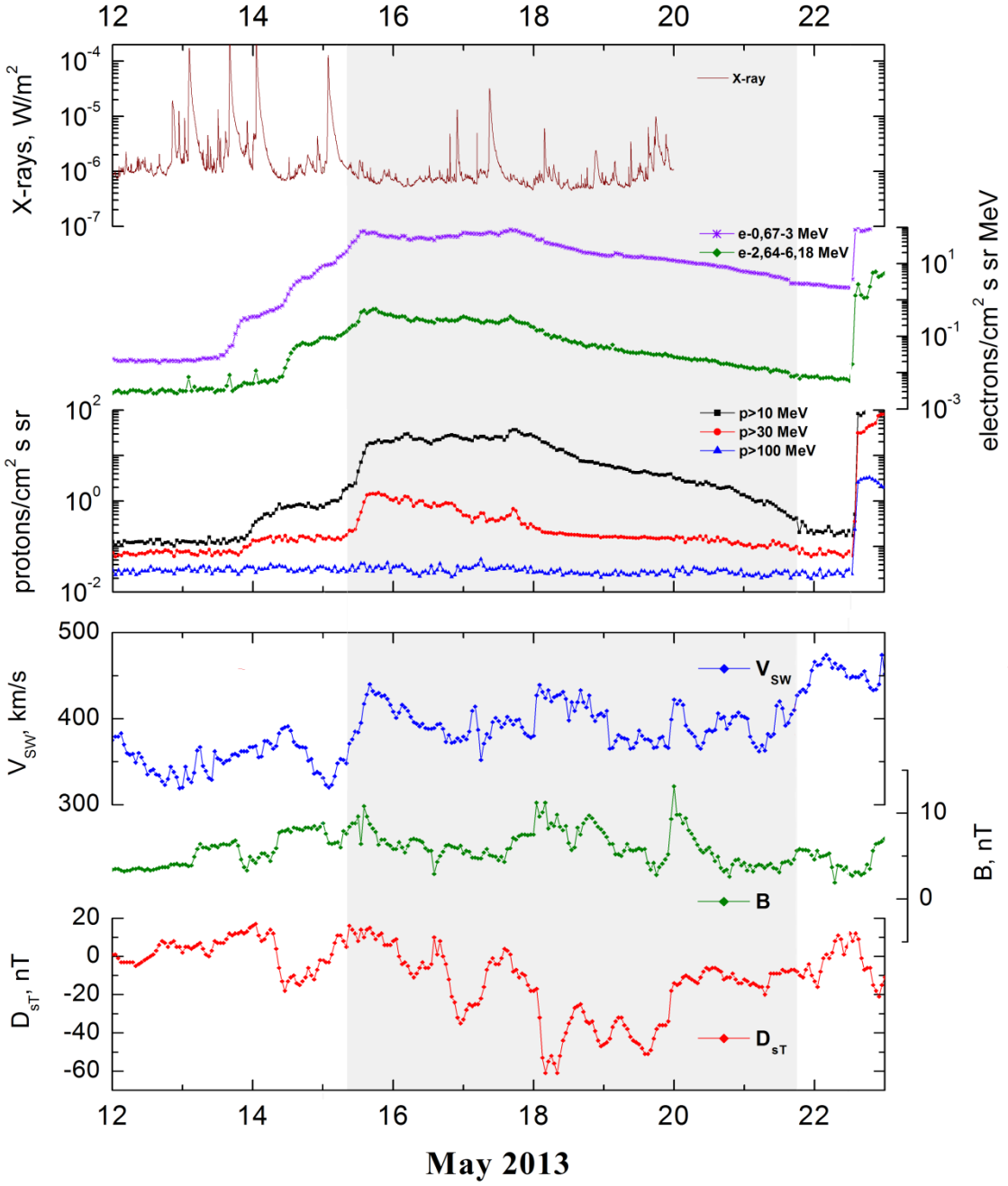
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2013.05.15 – (2013-135) **530**

Particle event: To(Ep>10 MeV) – 15d10^{h}
Tmax (Ep>10 MeV) – 15d21^{h}, Jmax$_2$ (Ep>10 MeV) – 20.5 /cm^2·s·sr
Duration of the event – 6 days, power-law index: γ = 3.5
Quasimaximal energy of protons in the event – Eqm = 110 MeV

Sources: ● solar flare 15d01^{h}24^{m}, 2N/X1.2, N12E64, AR11748
Main burst X-ray 1–8 Å: onset – 15d01^{h}24^{m}, max – 15d01^{h}48^{m}, Φ = 0.12 J/m^2
CME: 15d01 ^{h}48^{m}, V= 1366 km/s, Δφ = 360°, dA= 093°
▲ SC 15d14^{h}13^{m} ; ▲ SC 18d01^{h}10^{m}; Δ SC 19d23^{h}08^{m}

Particle fluxes and associated phenomena

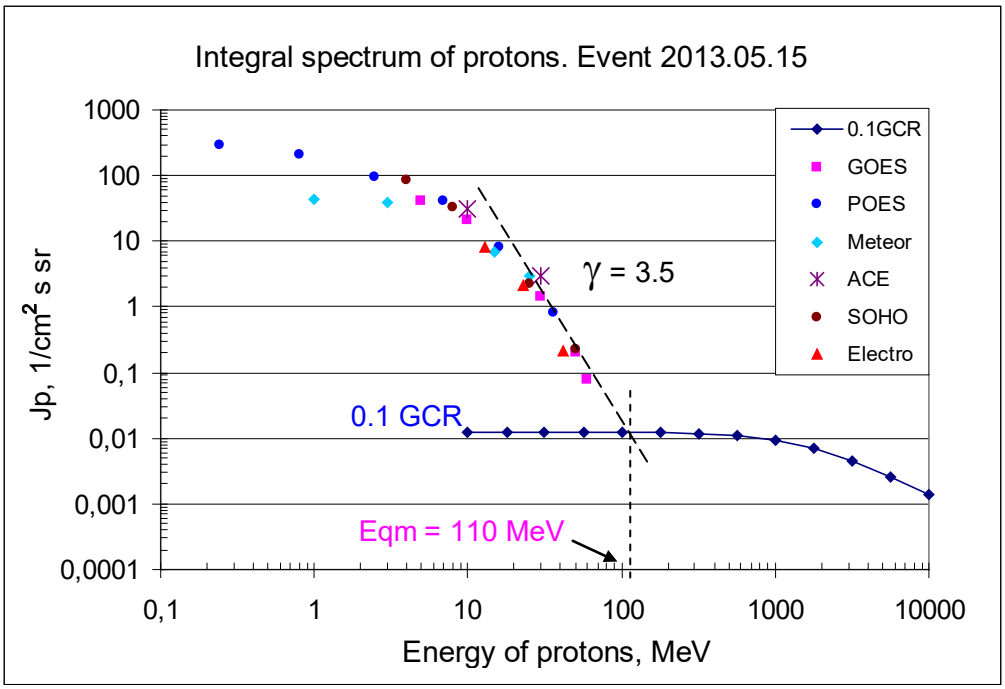


Integral fluxes of protons for the event of 2013 May 15

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	10	21	41	6	0.2	
EPS	>10	10	21	20.5	6	0.15	
EPS	>30	10	20	1.35	4	0.07	
EPS	>50	10	20	0.2	3	0.06	
EPS	>60	10	20	0.08	3	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>0.24	8	19	300	6	90	
MEPED	>0.8	8	19	210	6	65	
MEPED	>2.5	8	19	98	5	55	
MEPED	>6.9	8	19	41	3.5	45	
MEPED	>16	8	19	7.9	3	0.7	
MEPED	>36	8	19	0.81	1	0.75	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	11	17	44	7	2.7	
SCR	>3	11	17	40	7	2.5	
SCR	>10	9	-	-	4	1.6	
GALS-M	>15	7	17	7	4	1.2	
GALS-M	>25	7	17	3	3	1.2	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	10	19	31	6	1.2	
SIS	>30	10	19	3	4	0.85	
SOHO							
EPHIN	>50	10	16	0.22	2	0.25	

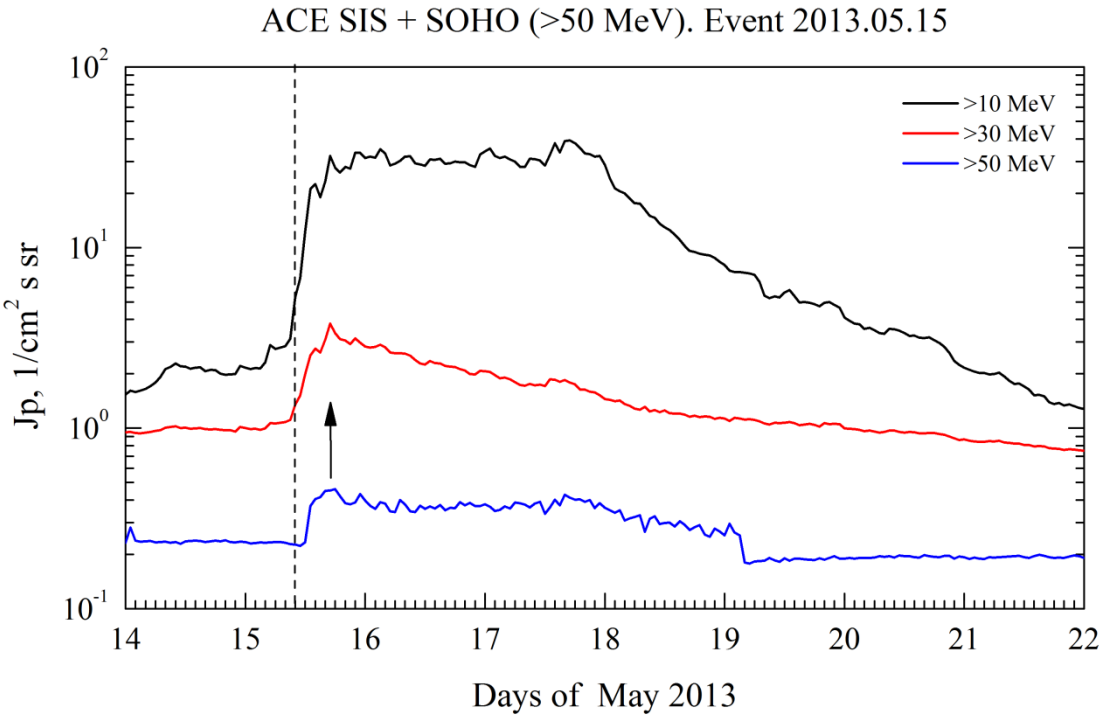
Differential fluxes of protons for the event of 2013 May 15

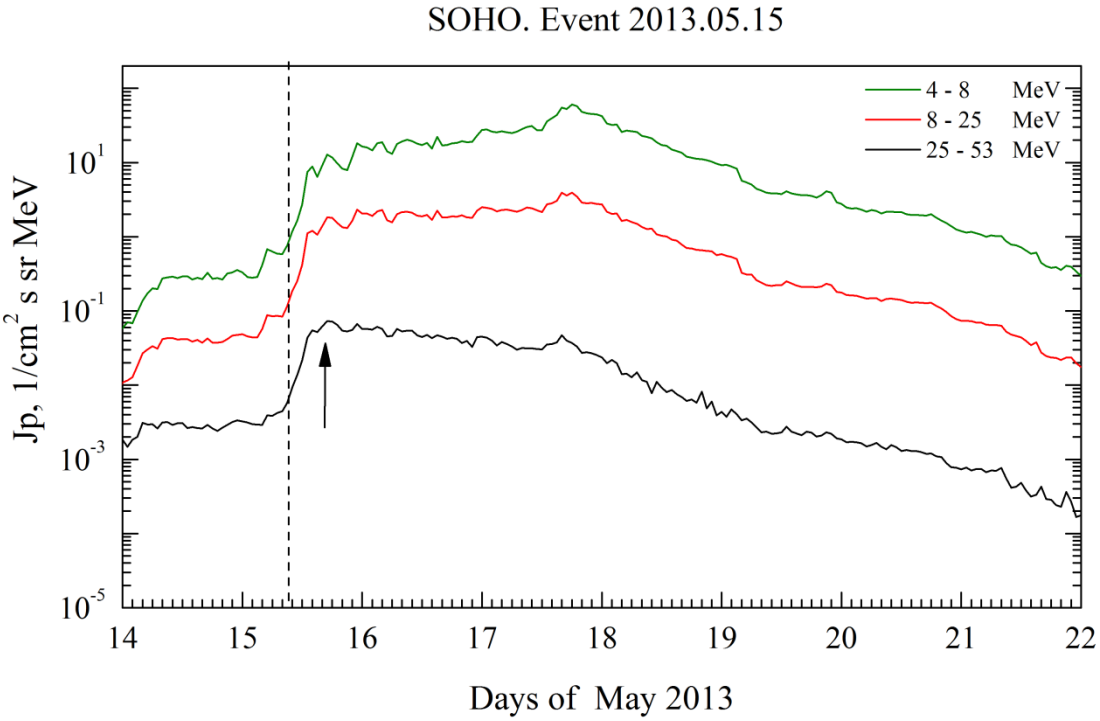
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	10	17	12.8	6	0.005	
EPHIN	8 – 25	10	17	1.83	6	0.0003	
EPHIN	25 – 53	10	17	0.073	6	0.00005	
Electro							
SCR-E	13.7–23	10	18	0.67	5	0.08	
SCR-E	23–42	10	18	0.1	4	0.03	
SCR-E	42–112	10	18	0.003	3	0.005	

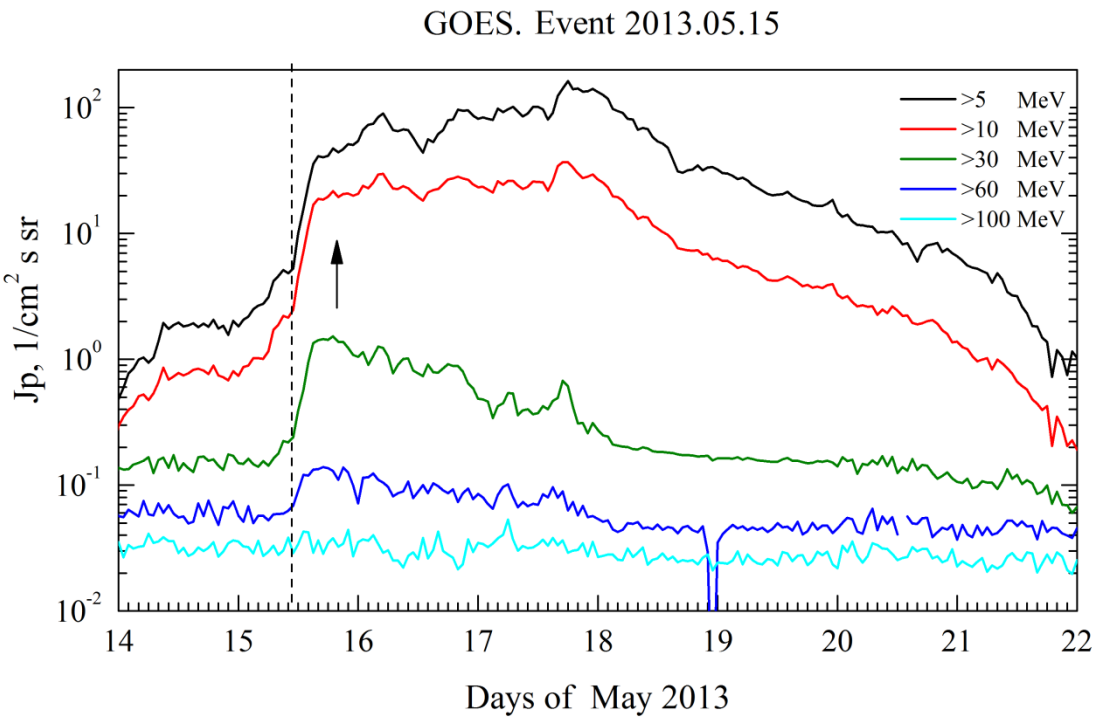

Integral spectrum of protons. Event 2013.05.15
Jp, 1/cm2 s sr
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 3.5
0.1 GCR
Eqm = 110 MeV

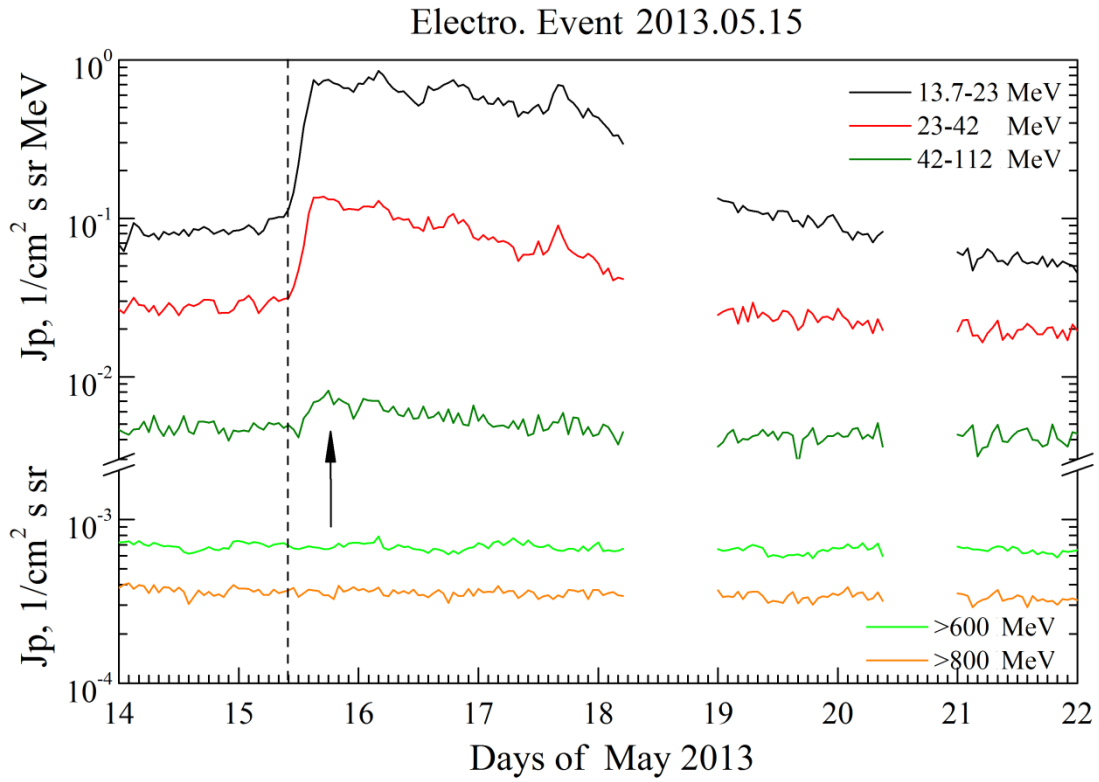
Time profiles of proton fluxes in the event 2013.05.15

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

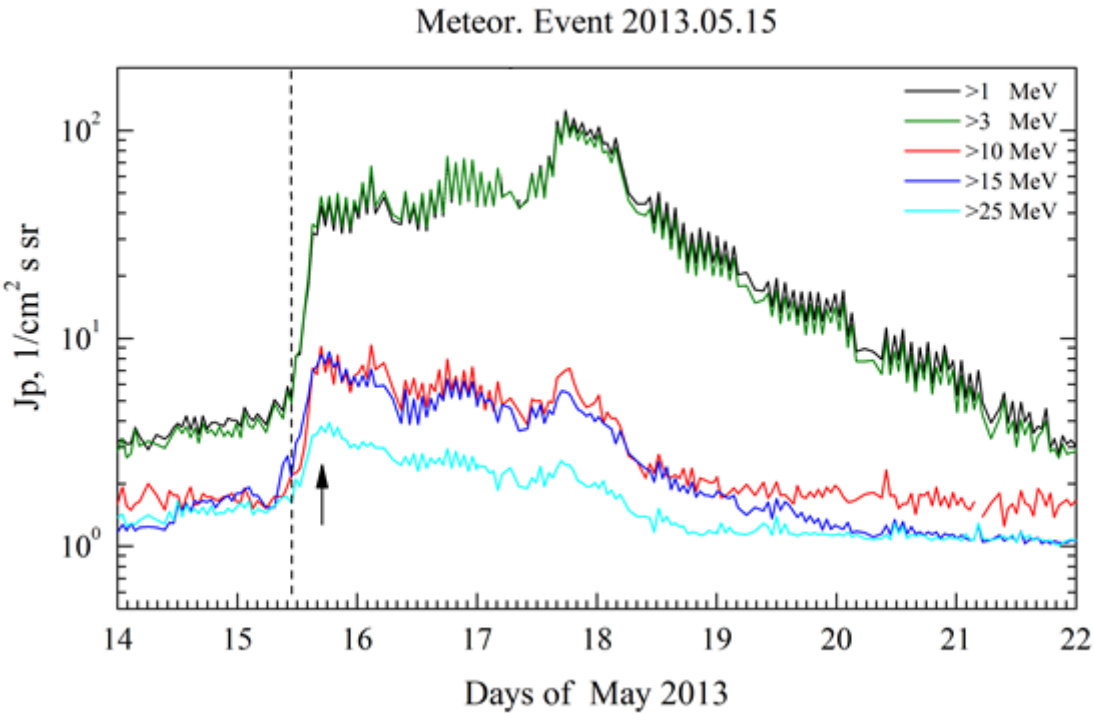


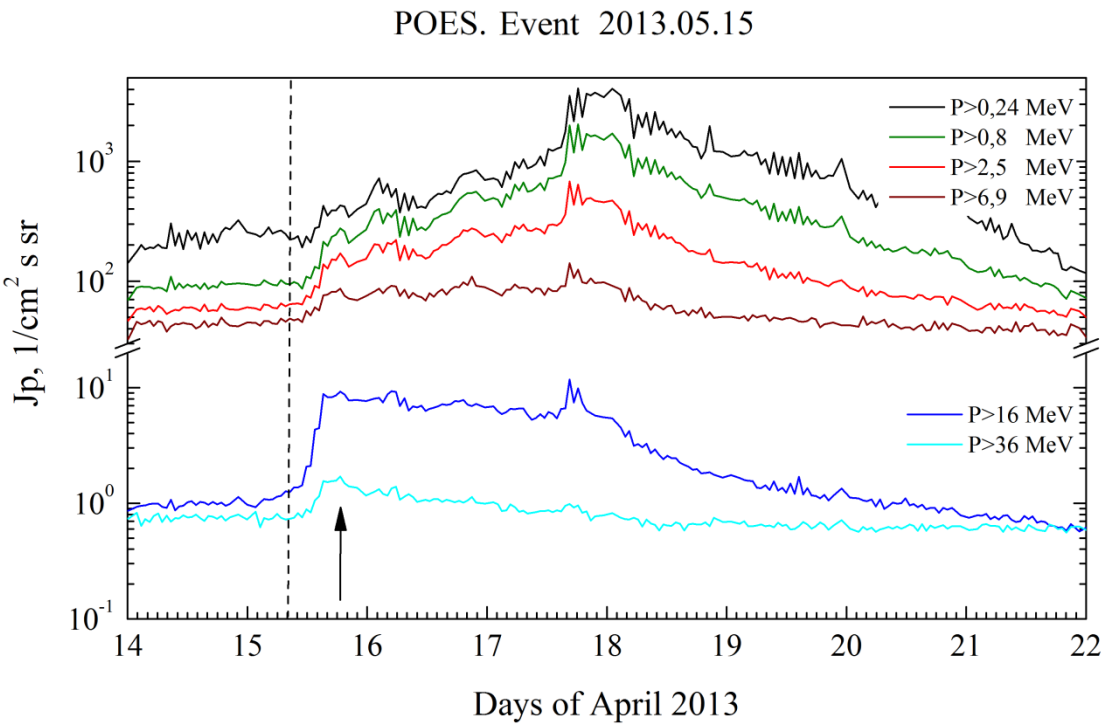



GOES. Event 2013.05.15
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of May 2013


Electro. Event 2013.05.15
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13.7-23 MeV
23-42 MeV
42-112 MeV
>600 MeV
>800 MeV
Days of May 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 May 15

2013 May 15 ● AR 11748 To event 530

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0124	0140	0230	N12E64	2N	ERU
1 – 12	keV	0125	0148	0158		X1.2	0.12

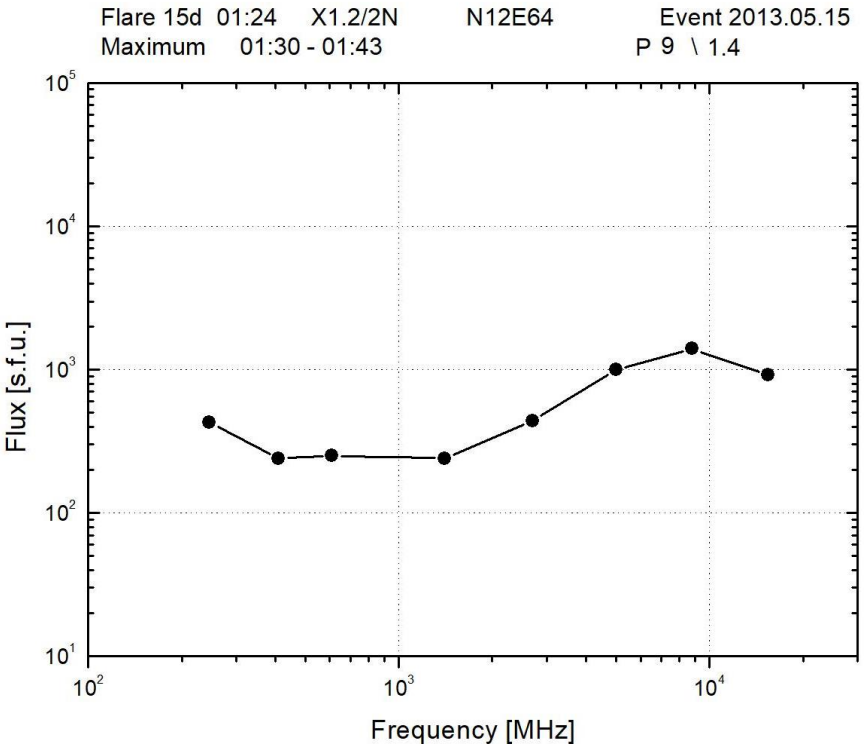
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0118:44	0143:18	0154:20	680871	408274784	FERMI
12-25	keV	0229:43	0230:24	0230:24	6415	2062607	FERMI
50-100	keV	0114:32	0143:34	02:13:16	8656	38809072	HESSI
12-25	keV	1541:18	1621:46	1640:09		805600768	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0136	0141	0154		2.96	
8.8	GHz	0135	0141	0153	P9 \ 1.4	3.15	
5	GHz	0136	0143	0151		3.00	
2.7	GHz	0133	0142	0150		2.64	
1.4	GHz	0129	0134	0146		2.38	
610	MHz	0130	0136	0142		2.40	
410	MHz	0127	0130	0142		2.38	
245	MHz	0133	0133	0146		2.63	

Ds-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	073-180	0137		0145		1	
DS IV	073-180	0127		0148		2	
DH II	16-0.25	0149		0730		2	WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0148	1366	- 52.1	360˚	93˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11748 (N12L294, CMP 20.0.05.2013,
Sp=310 msh, DKI, BGD, R)
XRI=9.96; $X_4^{3.2}$+$M_5^{3.2}$+ C_{19} 2_2+1_3+S_{56}
PFR1 12-13.05; (52^h) $X_3^{3.2}$+$M_3^{1.9}$
PFR2 15-17.05 (57^h) $X_1^{1.2}$+$M_2^{3.2}$

References:

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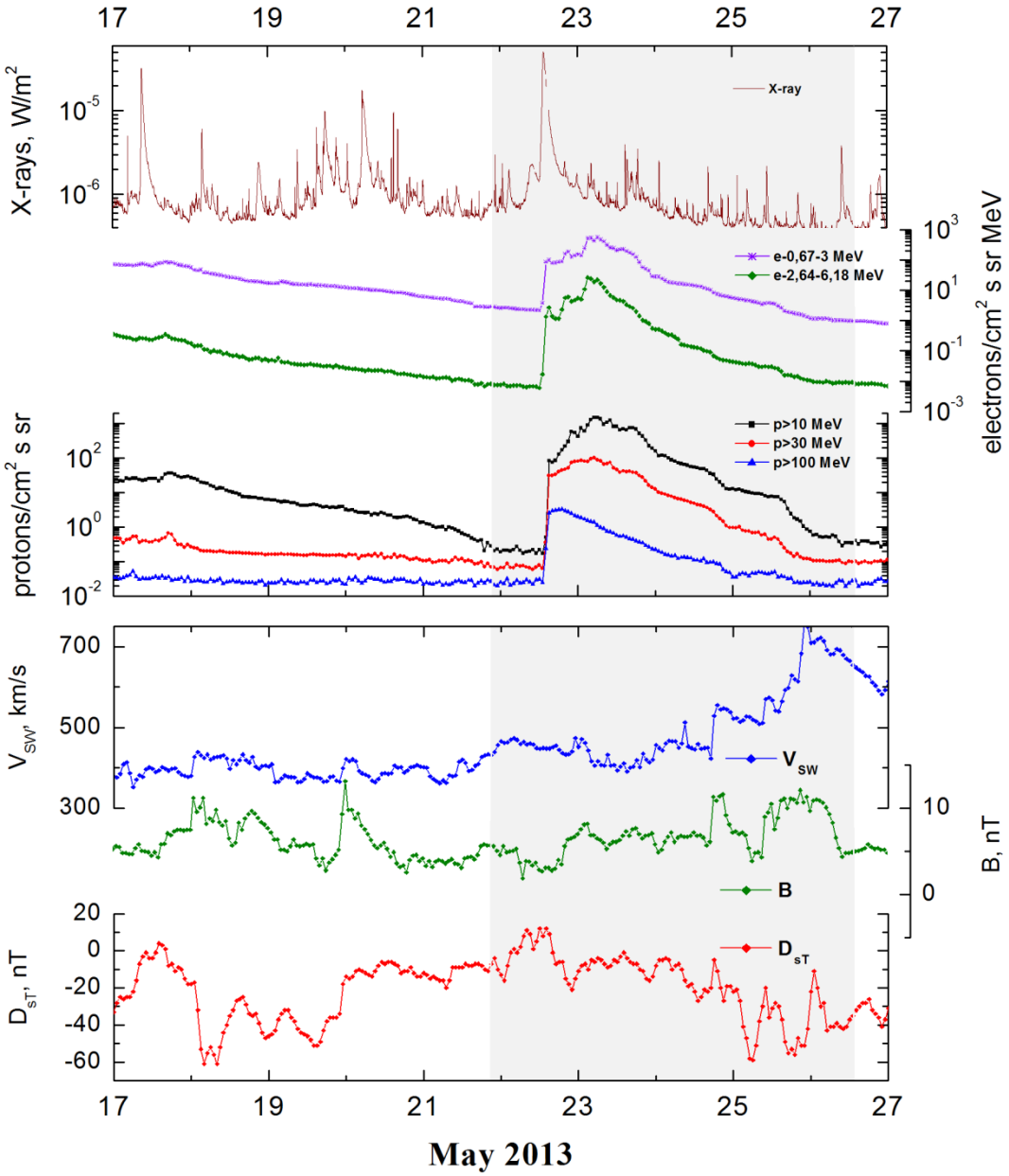
Paassilta M., O. Raukunen, R. Vainio et al., 2017.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Winter L.M., and K. Ledbetter, 2015.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.

Particle event: To(Ep>10 MeV) – 22d13^{h}
Tmax (Ep>10 MeV) – 22d15^{h}, Jmax (Ep>10 MeV) – 83.5/cm^{2}·s·sr
Duration of the event – 4 days, power-law index: γ = 3.0
Quasimaximal energy of protons in the event – Eqm = 500 MeV

Sources: ● solar flare 22d12^{h}35^{m}, 3N/M5.0, N15W70, AR11745
Main burst X-ray 1–8 Å: onset – 22d13^{h}08^{m}, max – 22d13^{h}32^{m}, Φ = 0.14 J/m^{2}
CME: 22d13^{h}26^{m}, V= 1466 km/s, Δφ = 360º, dA= 287º
▲ SC 24d18^{h}10^{m}; ▲ SC 25d 09^{h}48^{m}

Particle fluxes and associated phenomena

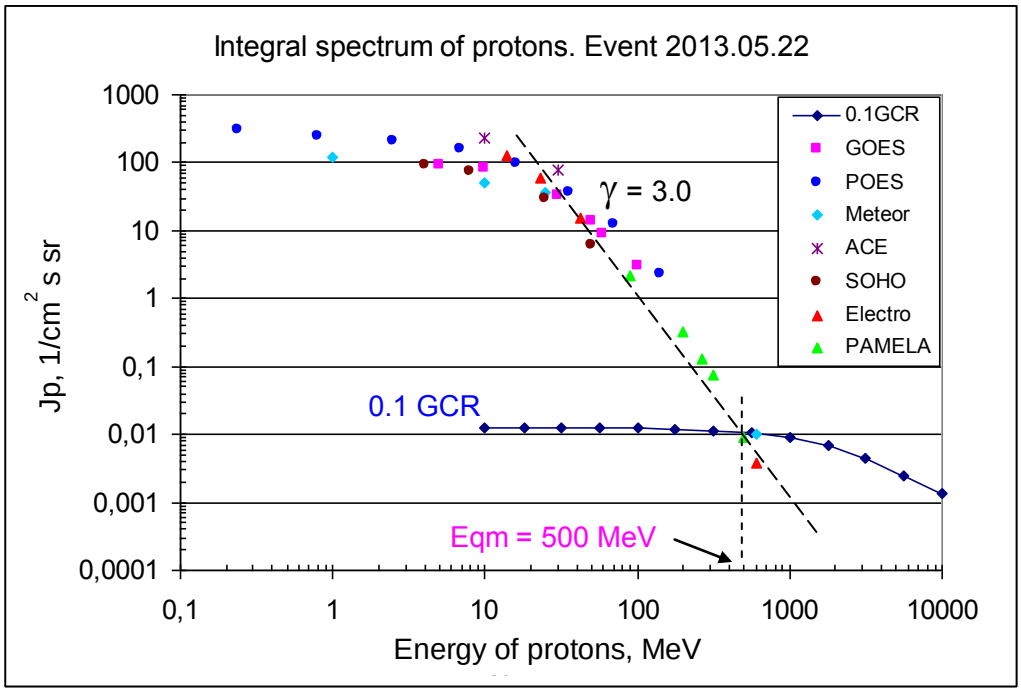


Integral fluxes of protons for the event of 2013 May 22

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	13	15	92	4	1	
EPS	>10	13	15	83.5	4	0.2	
EPS	>30	13	15	31.3	3.5	0.07	
EPS	>50	13	15	14	3.5	0.06	
EPS	>60	13	15	9	3.5	0.05	
EPS	>100	13	15	3.3	3	0.03	
Electro-1							
GALS-E	>600	12	17	0.0037	1.5	0.0007	
POES							
MEPED	>0.24	12	18	300	4	90	
MEPED	>0.8	12	18	250	3.5	80	
MEPED	>2.5	12	18	205	3.5	55	
MEPED	>6.9	12	18	155	3	45	
MEPED	>16	12	18	95	3	0.8	
MEPED	>36	12	18	36.2	2.5	0.8	
MEPED	>70	12	18	12.6	2	0.85	
MEPED	>140	12	18	2.3	1.5	0.9	
Meteor-1							
SCR	>1	13	16	121	3.5	2.5	
SCR	>3	13	-	-	3.5	2.35	
SCR	>10	13	16	50	3	1.6	
GALS-M	>15	12	-	-	3	1.2	
GALS-M	>25	12	16	36	3	1.2	
GALS-M	>600	13	16	0.01	1	0.02	
ACE							
SIS	>10	12	18	227	3.5	1.3	
SIS	>30	12	17	78	3.5	0.8	
PAMELA							
TRACKER	>90	14	19-23d04	2.2	>3		
TRACKER	>200	14	19-23d04	0.32	>2		
TRACKER	>265	14	19-23d04	0.13	>1		
TRACKER	>312	14	19-23d04	0.075	1		
TRACKER	>500	14	19-23d04	0.0089	1		
SOHO							
EPHIN	>50	12	15	6.1	3	0.2	

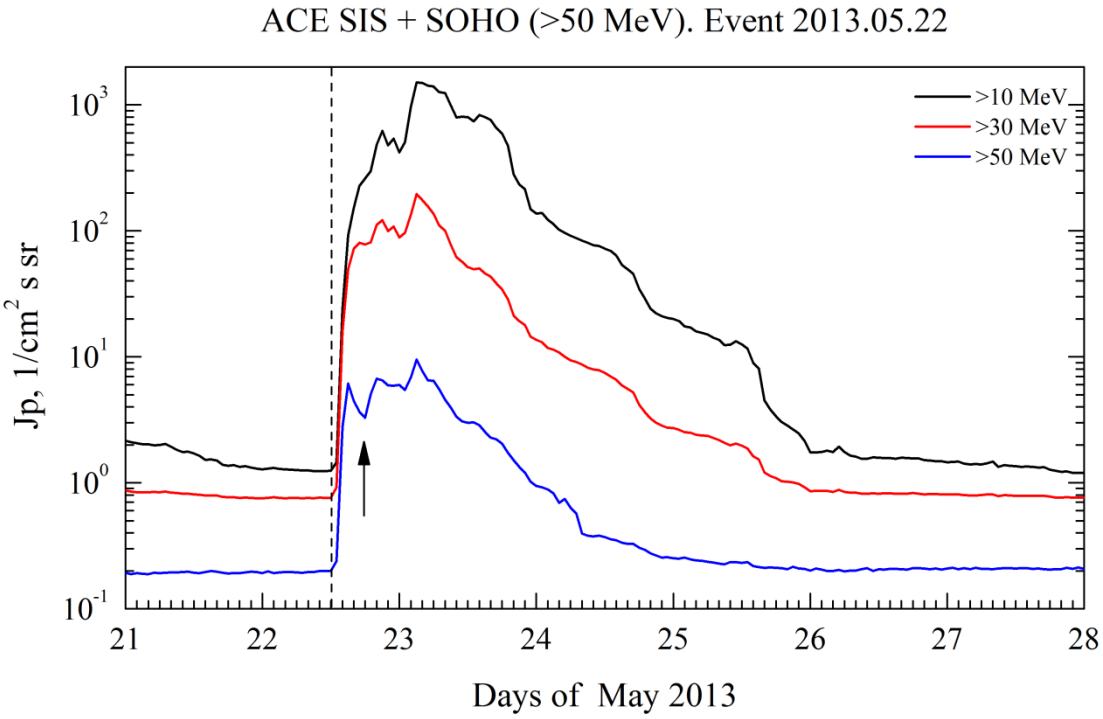
Differential fluxes of protons for the event of 2013 May 22

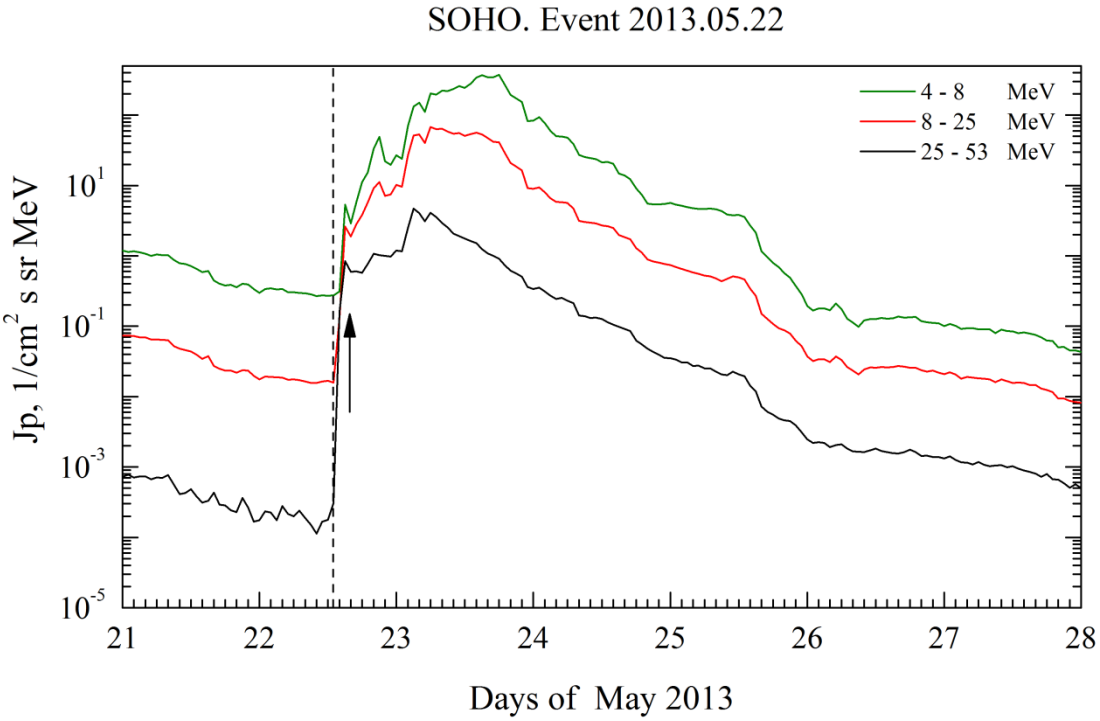
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	13	15	5.1	4	0.3	
EPHIN	8 – 25	13	15	2.6	4	0.015	
EPHIN	25 – 53	12	15	0.84	4	0.0004	
Electro							
SCR-E	13.7–23	12	17	7.1	3.5	0.05	
SCR-E	23–42	12	17	2.35	3.5	0.02	
SCR-E	42–112	12	17	0.135	2.5	0.005	

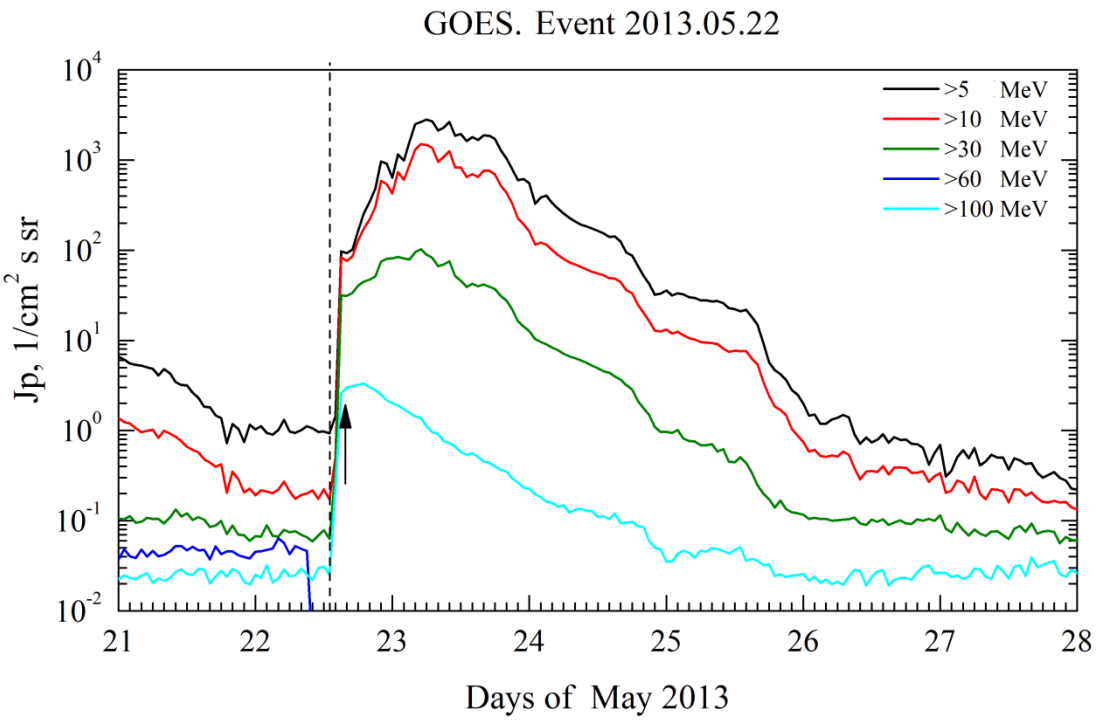


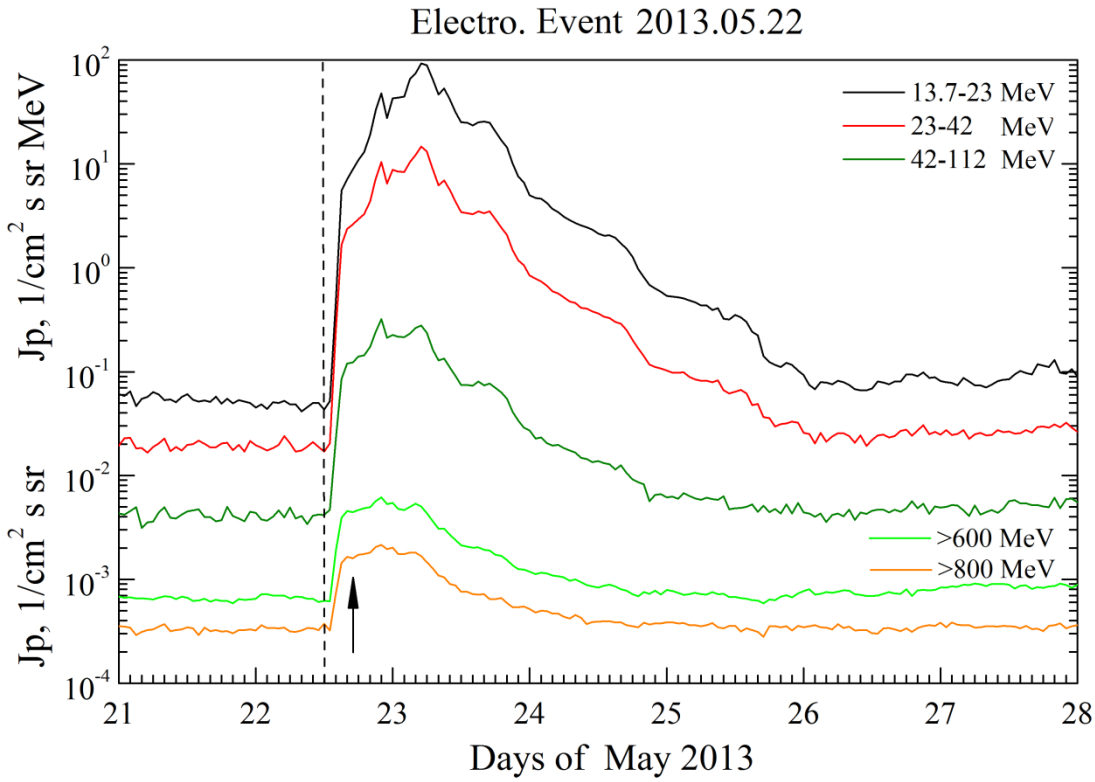
Time profiles of proton fluxes in the event 2013.05.22

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



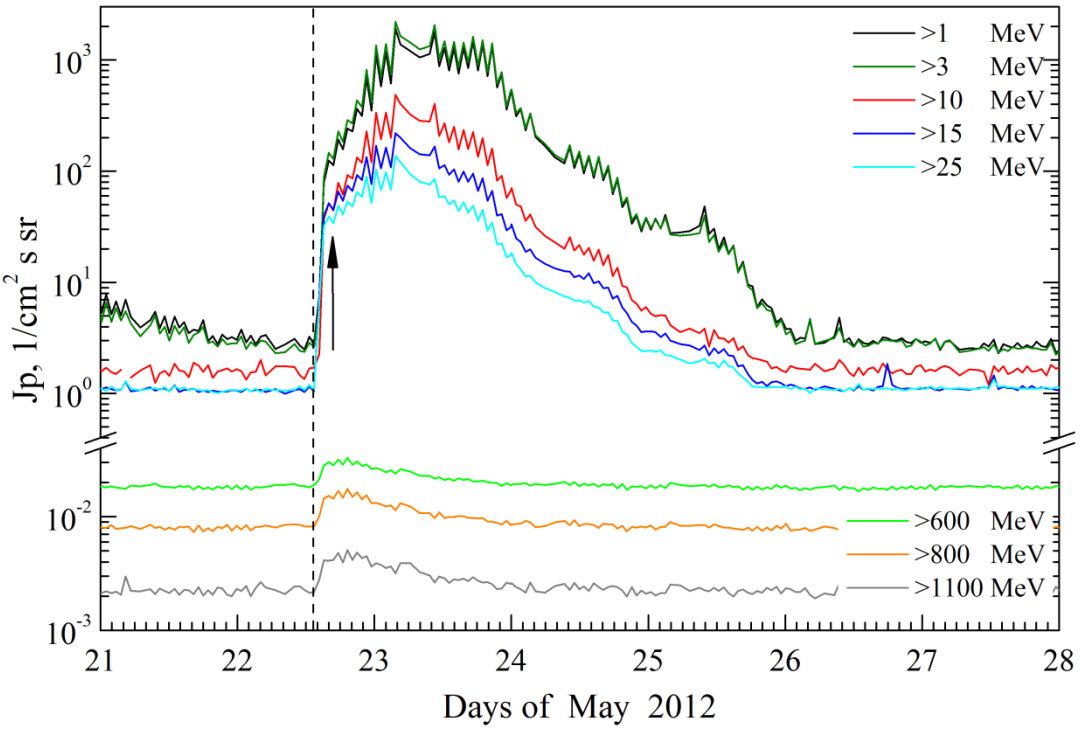



GOES. Event 2013.05.22
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of May 2013

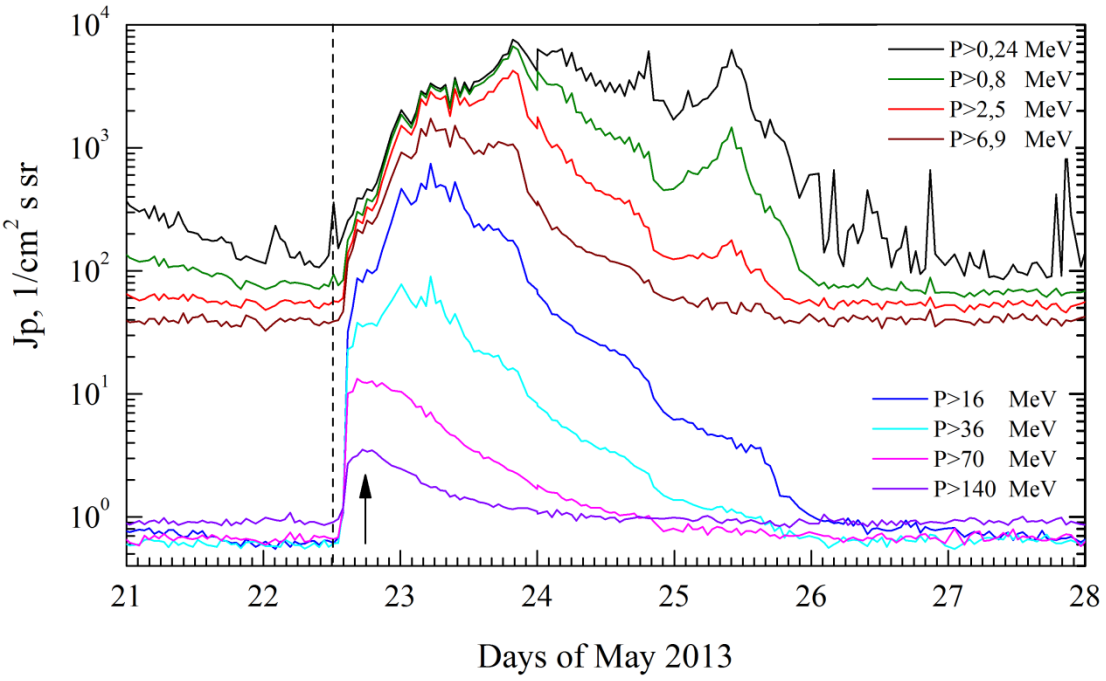

Electro. Event 2013.05.22
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13.7-23 MeV
23-42 MeV
42-112 MeV
>600 MeV
>800 MeV
Days of May 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2013.05.22



POES. Event 2013.05.22



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 May 22

2013 May 22 ● AR 11745 To event 531

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	<1235	1322	1555	N15W70	3N	PRB
1 – 12	keV	1308	1332	1408	N14W87	M5.0	0.14

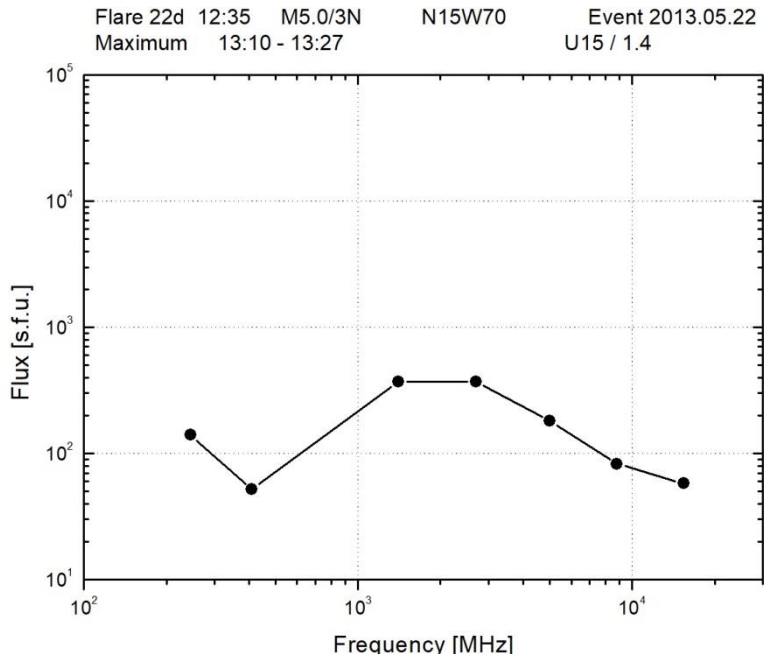
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1245:20	1249:05	1249:09	1413	43623	FERMI
12-25	keV	1252:20	1252:46	1257:52	76	115901	HESSI
50-100	keV	1257:52	1319:58	1352:00	1328	11354487	HESSI
12-25	keV	1429:59	1441:39	1505:00	640	224436	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1319	1327	1331	U15 / 1.4	1.76	
8.8	GHz	1312	1315	1338		1.91	
5	GHz	1310	1313	1338		2.25	
2.7	GHz	1309	1313	1338		2.57	
1.4	GHz	1309	1314	1338		2.57	
410	MHz	1312	1312	1312		1.72	
245	MHz	1310	1310	1310		2.15	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-41	1259		1305	1962	2	
DS IV	25-143	1303		1350		1	
DH II	16-0.15	1310		24/0600		2	WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1326	1466	-13.2	360˚	287˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR 11745 (N13L334, CMP 16,8.05.2013,
Sp=600 mvh, DKC, BG, R)
XRI= 1.2; $M_3^{5.0} + C_{15}$; 3_1+S_{19}.
PFR1 10.05)12^h) – $M_2^{3.9}$.
PFR2 22.05 $M_1^{5.0}$

References:

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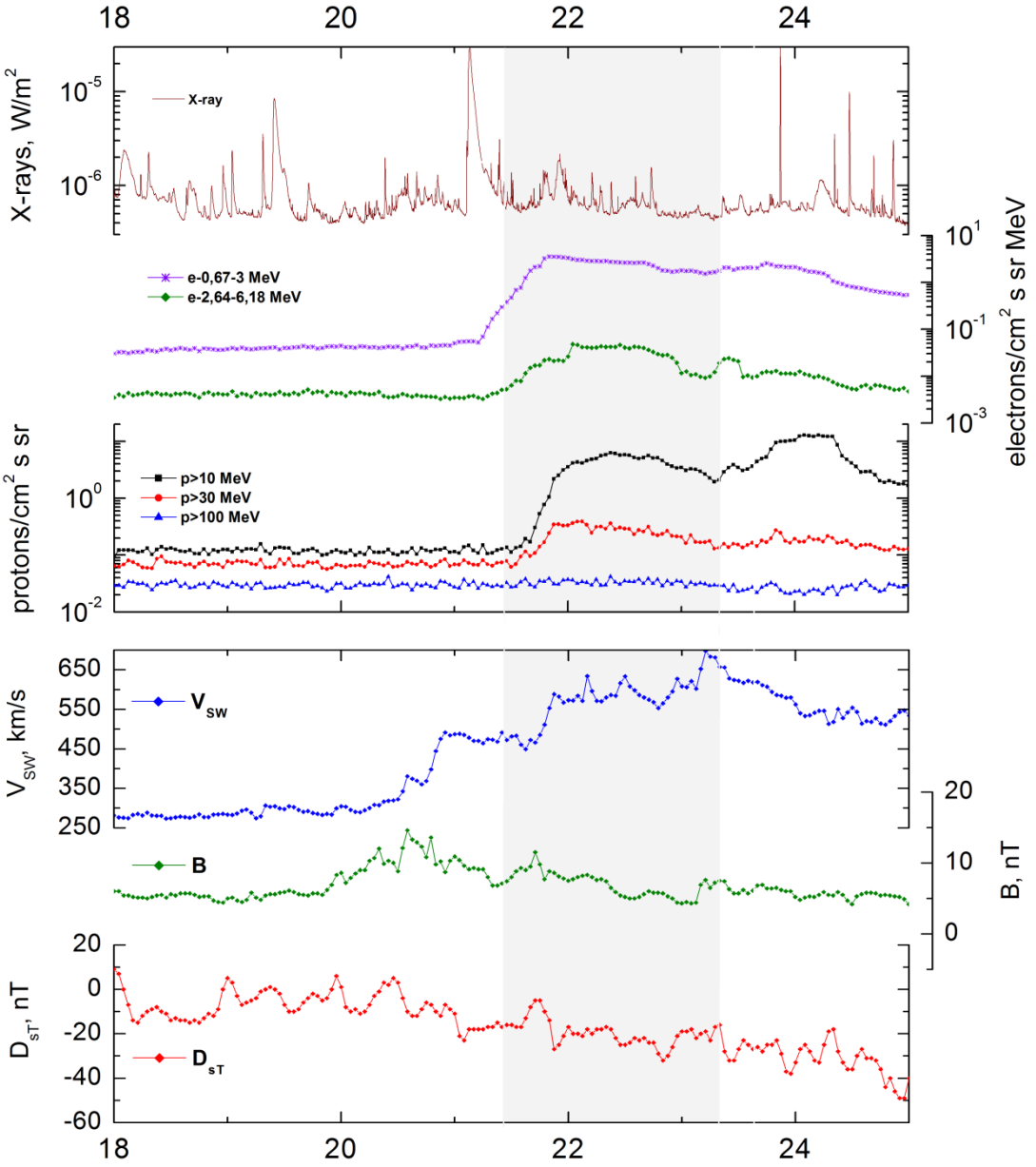
Zhuang B., N. Lugaz, T. Gou, L. Ding, 2021.
Zou Z., X. Xue, Ch. Shen et al., 2018.

Particle event: To(Ep>10 MeV) – 21d14^{h}
Tmax$_1$(Ep>10 MeV) – 22d10^{h}, Jmax$_1$(Ep>10 MeV) – 6 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.3,
Quasimaximal energy of protons in the event – Eqm = 100 MeV

Sources: ● solar flare 21d02^{h}30^{m}, M2.9/1F, S16E73, AR11777
Main burst X-ray 1–8 Å: onset – 21d02^{h}30^{m}, max – 21d03^{h}14^{m}, Φ = 0.069 J/m^2
CME: 21d03^{h}12^{m}, V= 1900 km/s, Δφ = 207°, dA= 107°

Particle fluxes and associated phenomena

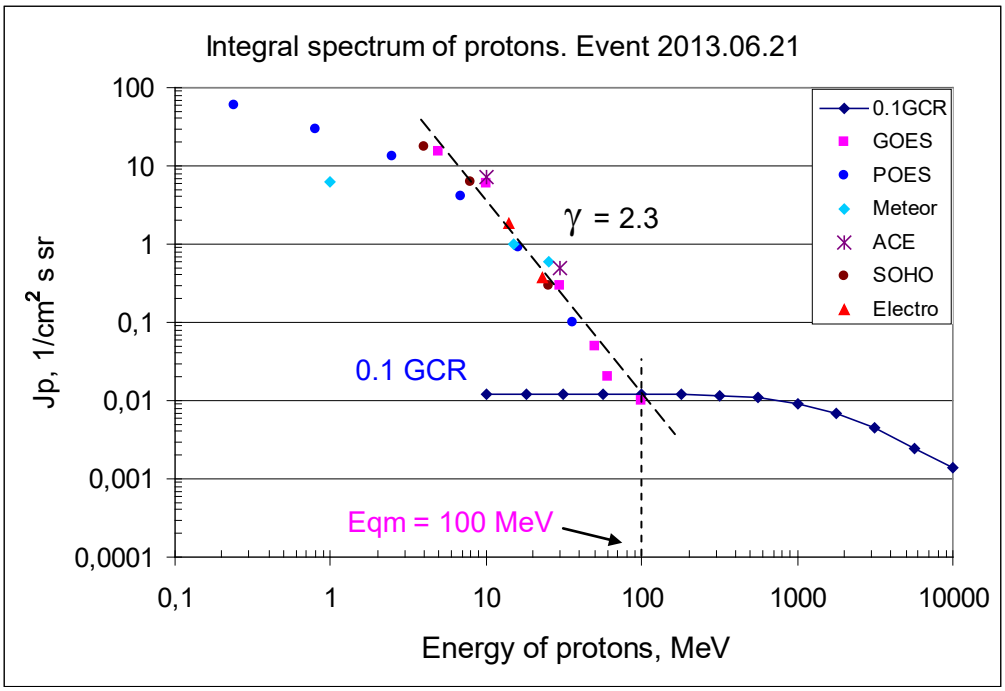


Integral fluxes of protons for the event of 2013 June 21

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	14	22d11	15	2	0.2	
EPS	>10	14	22d10	6	2	0.15	
EPS	>30	14	22d09	0.3	2	0.07	
EPS	>50	14	22d09	0.05	2	0.06	
EPS	>60	14	22d09	0.02	2	0.05	
EPS	>100	-	22d09	0.01	2	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	18	22d10	60	1.5	90	
MEPED	>0.8	18	22d10	30	1.5	70	
MEPED	>2.5	18	22d10	13	1.5	50	
MEPED	>6.9	18	22d10	4	1	40	
MEPED	>16	18	22d13	0.9	1	0.7	
MEPED	>36	18	22d13	0.1	0.5	0.7	
MEPED	>70	-	-	-	-	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	16	22d03	6.3	1.5	2.4	
SCR	>3	16	-	-	1.5	2.3	
SCR	>10	16	-	-	1.5	1.6	
GALS-M	>15	16	22d01	1.0	1.5	1.1	
GALS-M	>25	16	22d01	0.6	1.5	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	14	22d09	7.3	2	1.1	
SIS	>30	14	22d09	0.5	2	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

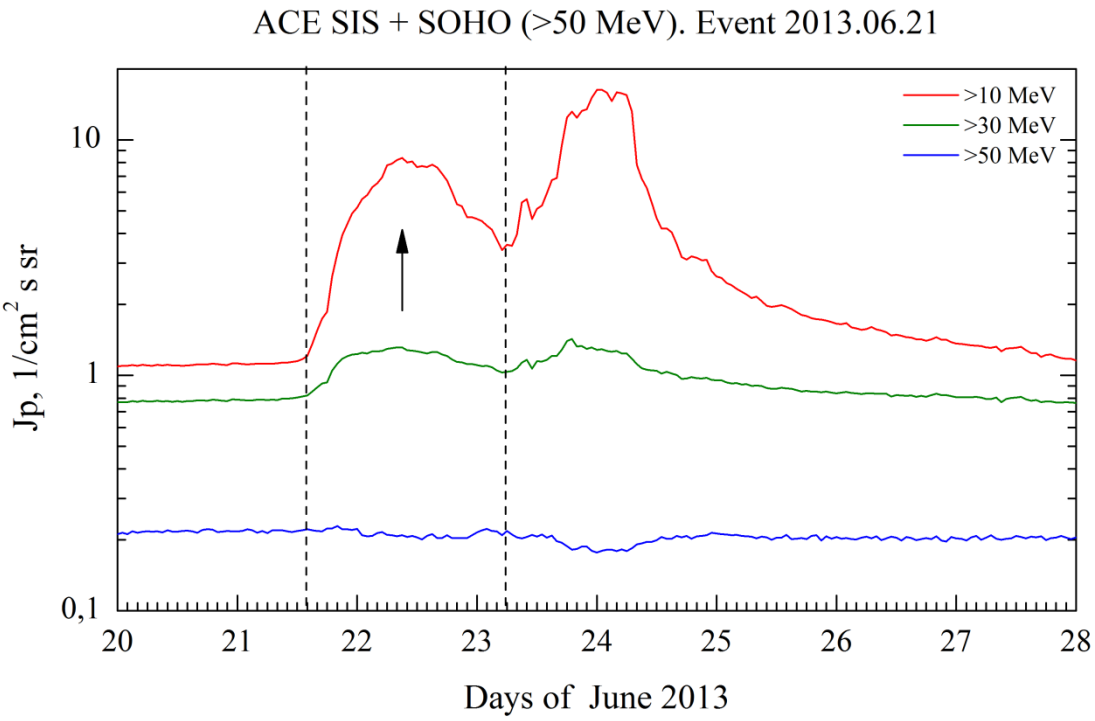
Differential fluxes of protons for the event of 2013 June 21

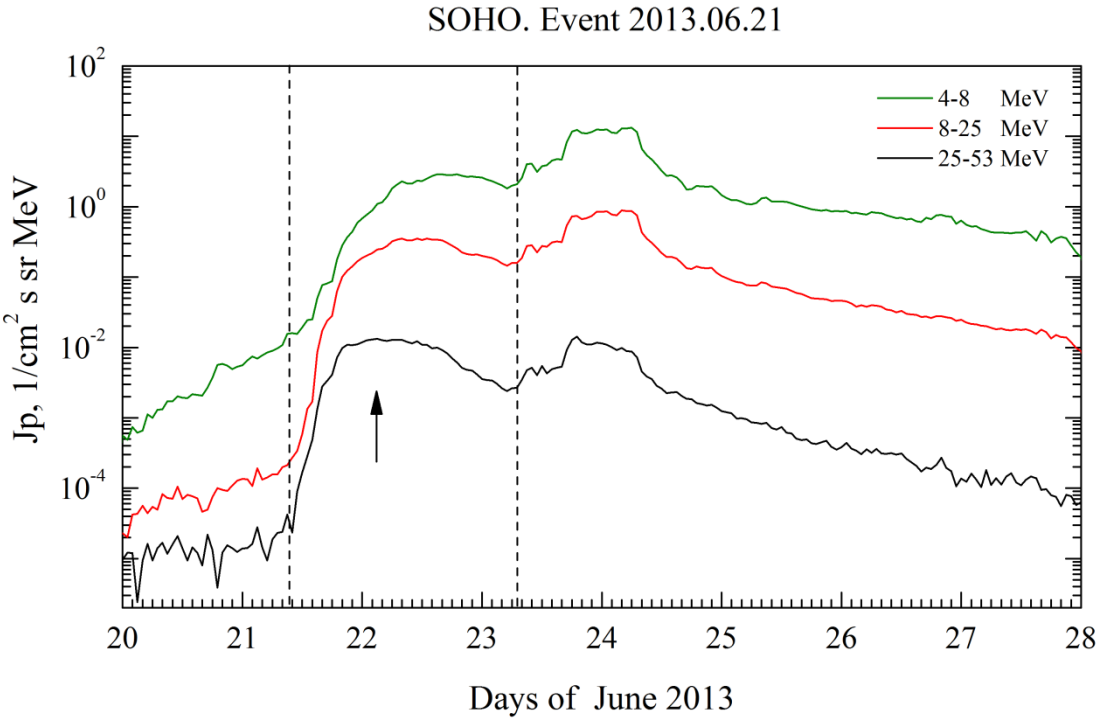
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-round	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	09	22d15	2.88	2	0.002	
EPHIN	8 – 25	09	22d15	0.34	2	0.0001	
EPHIN	25 – 53	09	22d08	0.013	2	0.00001	
Electro-1							
SCR-E	13.7–23	12	22d07	0.16	2	0.05	
SCR-E	23–42	12	22d07	0.024	2	0.02	
SCR-E	42–112	12	-	-	-	0.005	

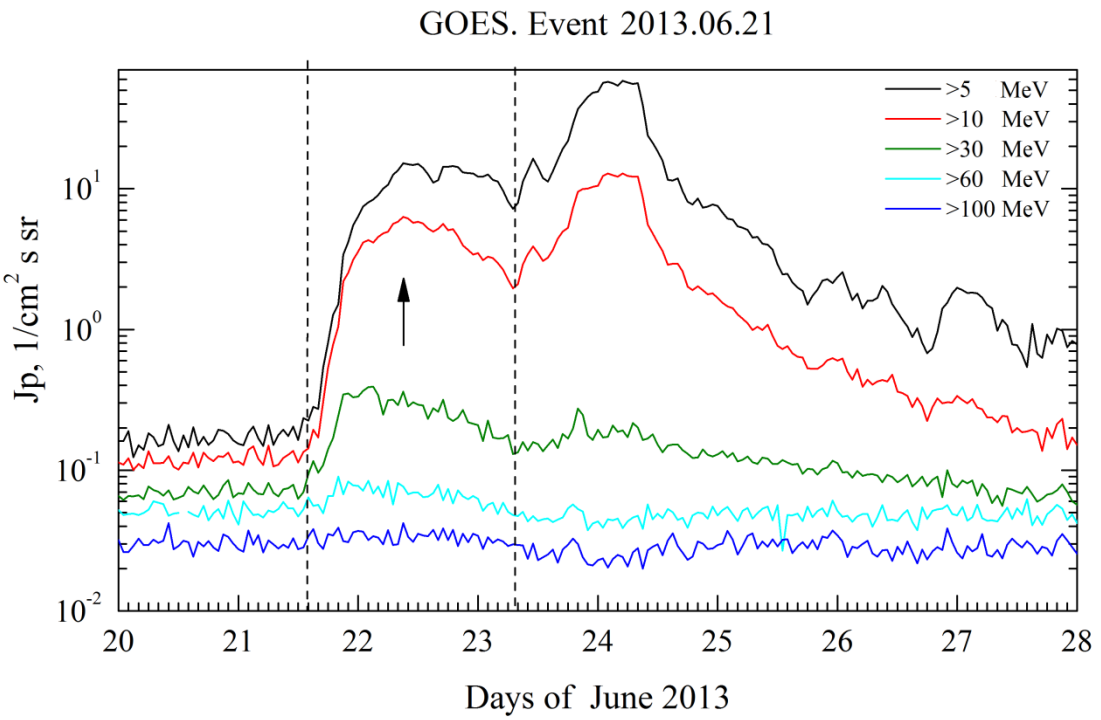

Integral spectrum of protons. Event 2013.06.21
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.3
0.1 GCR
Eqm = 100 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

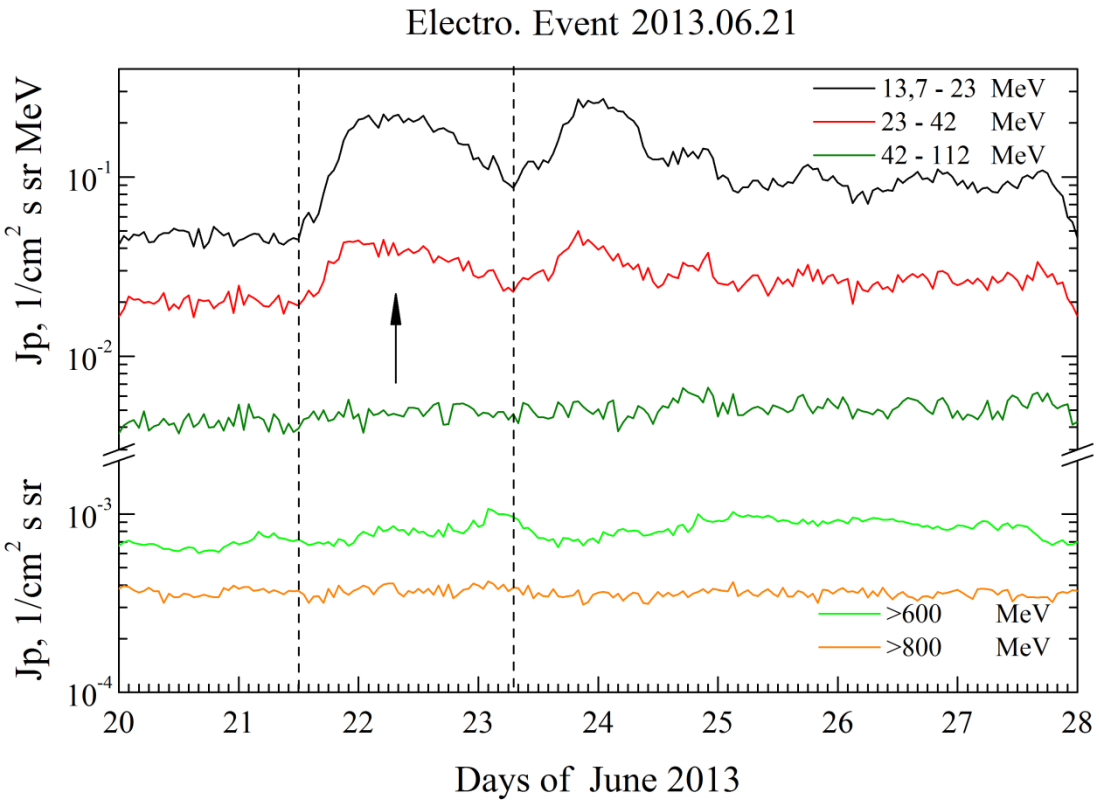
Time profiles of proton fluxes in the event 2013.06.21

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

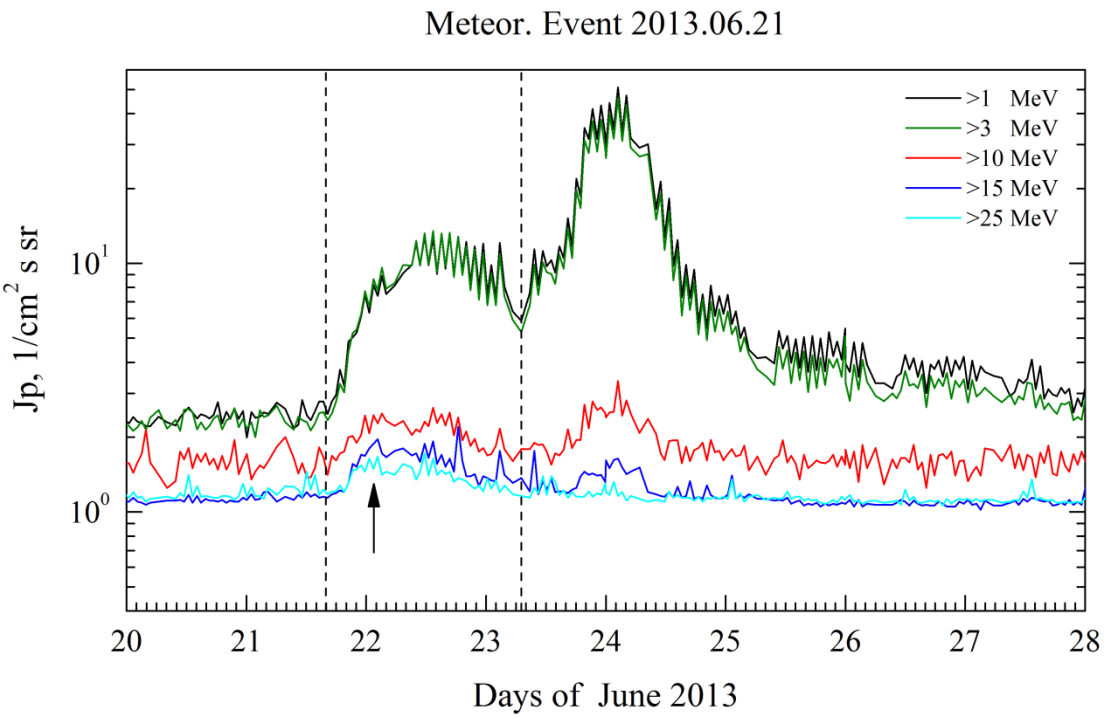


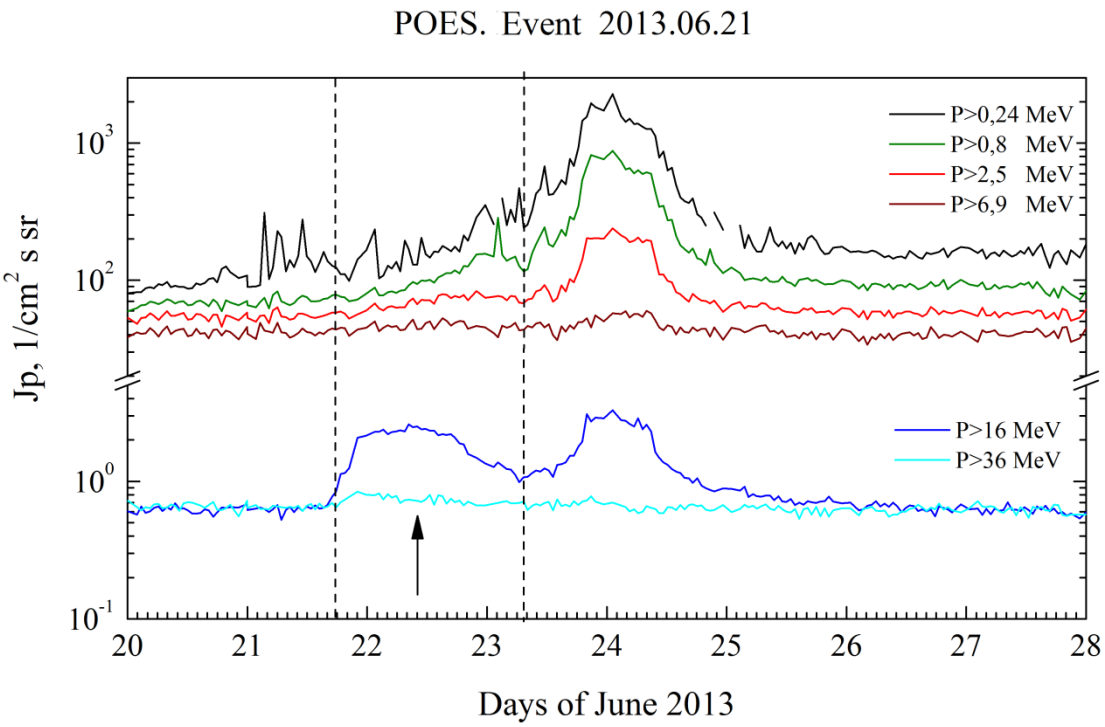



GOES. Event 2013.06.21
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Jp, 1/cm² s sr
10¹
10⁰
10⁻¹
10⁻²
20
21
22
23
24
25
26
27
28
Days of June 2013


Electro. Event 2013.06.21
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
10⁻¹
10⁻²
10⁻³
10⁻⁴
20
21
22
23
24
25
26
27
28
Days of June 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



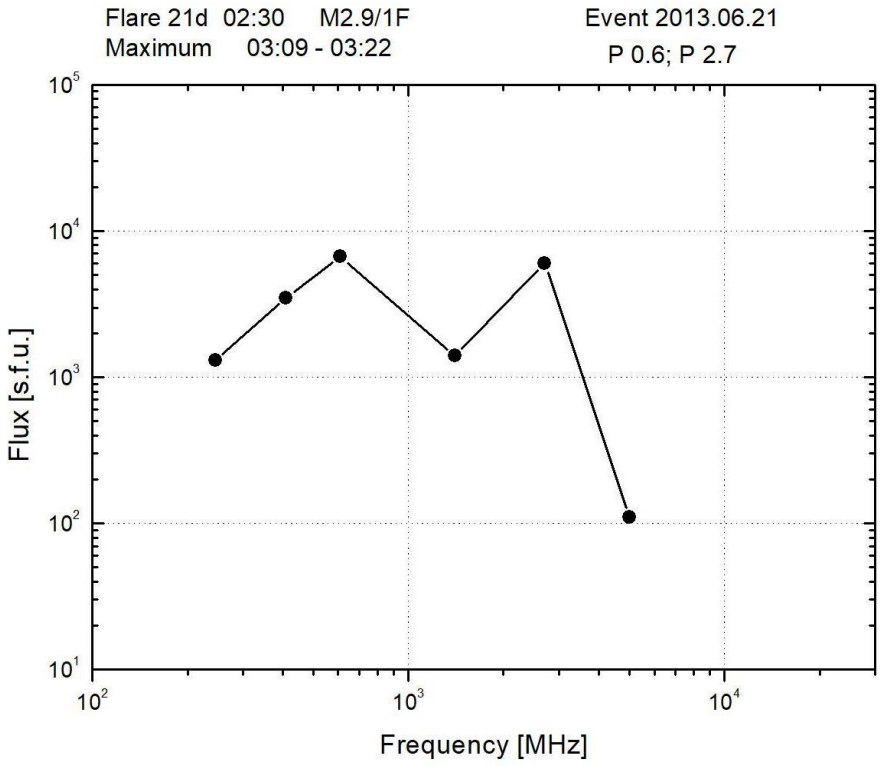


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 June 21

2013 June 21 ● AR 11777 To event 532

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0233	0301	0357	S16E73	1F	ERU
6563 Å	EPL	0252		0310		0.17	
1 – 12	keV	0230	0314	0343	S14E73	M2.9	0.069
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0230:32	0237:26	0245:04	72	123453	HESSI
25-50	keV	0245:04	0303:26	0305:40	912	2347025	HESSI
12-25	keV	0325:24	0327:22	0355:00	256	1250448	HESSI
12-25	keV	0234:28	0237:12	0240:20	4403	211179	FERMI
12-25	keV	0244:38	0303:21	0329:34	33854	8469234	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
5	GHz	0308	0309	0310		2.04	
2.7	GHz	0308	0322	0330	P2.7	3.78	
1.4	GHz	0305	0322	0329		3.15	
610	MHz	0308	0319	0332	P0.6	3.83	
410	MHz	0308	0319	0331		3.54	
245	MHz	0308	0321	0328		3.11	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/**
DS IV	25-180	0256		0336		1	
DS III	18-060	0309		0311		3	
DS VI	25-180	0254		0321		1	
DH II	14-2	0335		0515			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0312	1900	-1.5	207˚	107˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11777 (S16L161, CMP 26,3.06.2013,
Sp=200 msh, HSX, A, R)
XRI= 0.29 $M_2^{2.9}$+C_2 1_1+ S_1
PFR 21.06 $M_1^{2.9}$

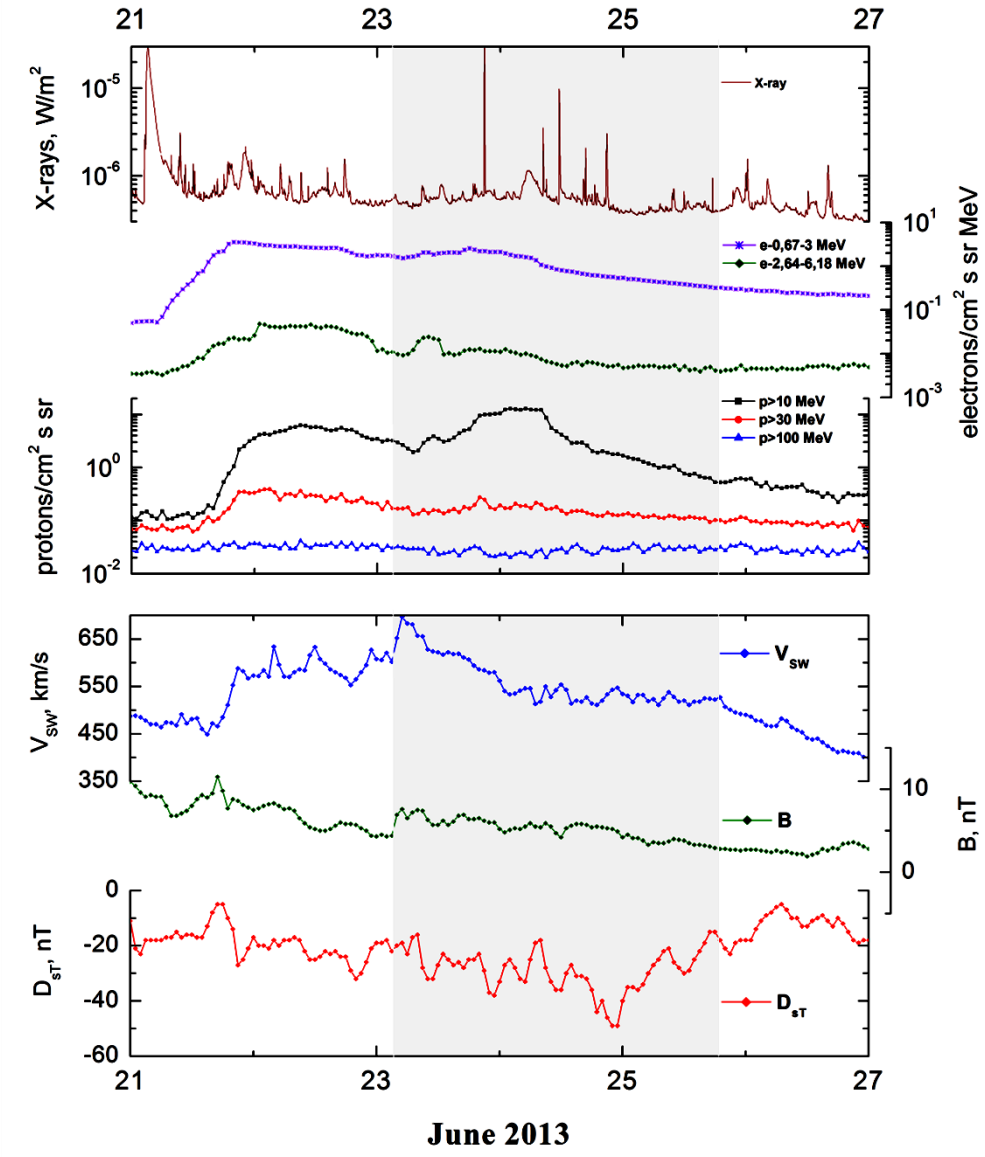
References:

Alberti T., M. Laurenza, E.W. Cliveret et al., 2017.
Bruno A., I.G. Richardson, 2021.
Maričić D., B. Vršnak, A.M. Veronig et al., 2020.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.

Particle event: To(Ep>10 MeV) – $23d07^h$
$Tmax_1$(Ep>10 MeV) – $23d11^h$, $Jmax_1$ (Ep>10 MeV) – 3.7 /cm^2·s·sr
$Tmax_2$(Ep>10 MeV) – $23d20^h$, $Jmax_2$ (Ep>10 MeV) – 9.7 /cm^2·s·sr
Duration of the event – 2.5 days, power-law index: $\gamma_1 = 2.6$, $\gamma_2 = 4.0$
Quasimaximal energy of protons in the event – Eqm_1 = 70 MeV
– Eqm_2 = 60 MeV

Sources: ● solar flare $21d02^h30^m$, M2.9/1F, S16E73, AR11777 (**Event 2013.06.21**)
Ø solar flare $23d20^h48^m$, M2.9/1N, S15E66, AR11778
Main burst X-ray 1–8 Å: onset – $23d20^h48^m$, max – $23d20^h56^m$, $\Phi = 0.0025$ J/m^2
CME: $23d21^h24^m$, V= 339 km/s, $\Delta\varphi = 101°$, dA= 133°
●SC* $23d04^h26^m$
* **Source**: ●SC $23d04^h26^m$ – from flare of **Event 2013.06.21**

Particle fluxes and associated phenomena

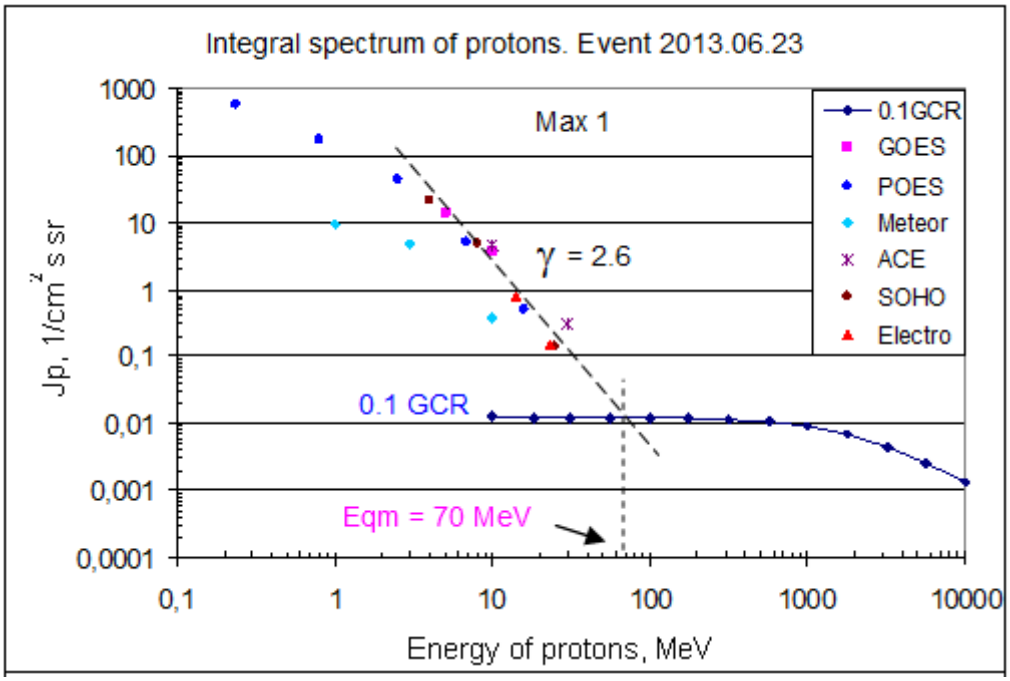


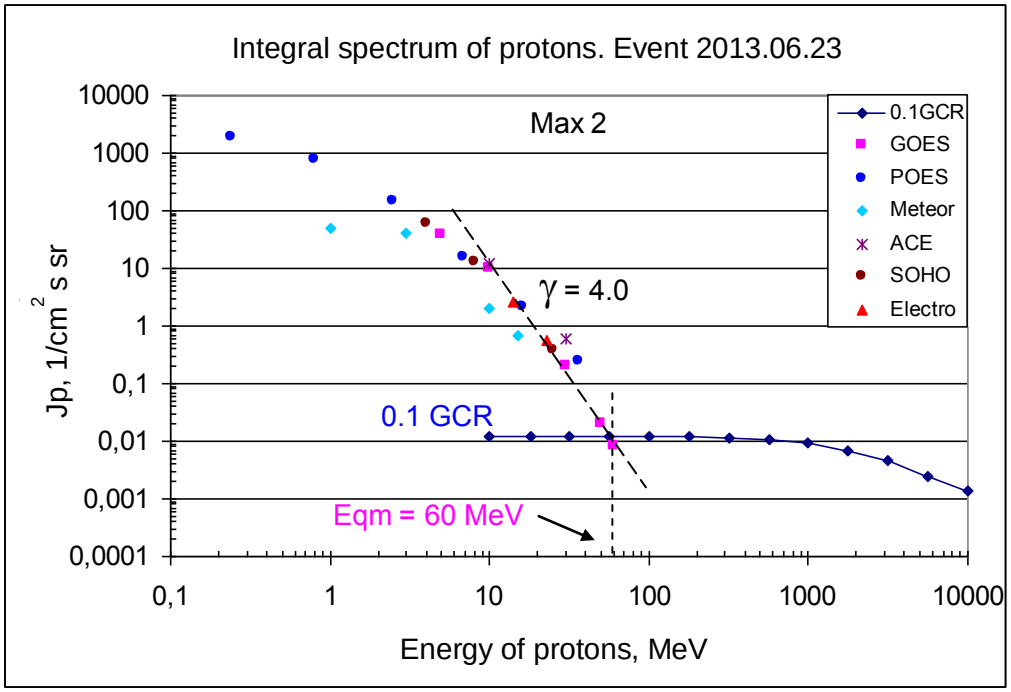
Integral fluxes of protons for the event of 2013 June 23

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	11/20	14/39	2.5	0.2	
EPS	>10	7	11/20	3.7/9.7	2.5	0.15	
EPS	>30	7	- /20	- /0.2	1.5	0.07	
EPS	>50	-	- /20	- /0.02	-	0.06	
EPS	>60	-	-	- /0.008	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	7	11/21	590/1900	2	90	
MEPED	>0.8	7	11/21	170/750	2	70	
MEPED	>2.5	7	11/21	42.5/150	2	50	
MEPED	>6.9	7	11/21	5.2/15.5	2	40	
MEPED	>16	7	11 /21	0.5/2.2	2	0.7	
MEPED	>36	7	- /21	- /0.25	0.5	0.7	
MEPED	>70	-	-	-	-	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	8	09/24d02	9.1/49	2	2.4	
SCR	>3	8	09/24d02	4.8/42	2	2.3	
SCR	>10	8	09/24d02	0.38/2	1	1.6	
GALS-M	>15	8	-/24d01	-/0.7	1	1.1	
GALS-M	>25	-	-	-	-	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	6	10/19	4.5/12	1.5	1.3	
SIS	>30	6	10/19	0.3/0.6	1	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

Differential fluxes of protons for the event of 2013 June 23

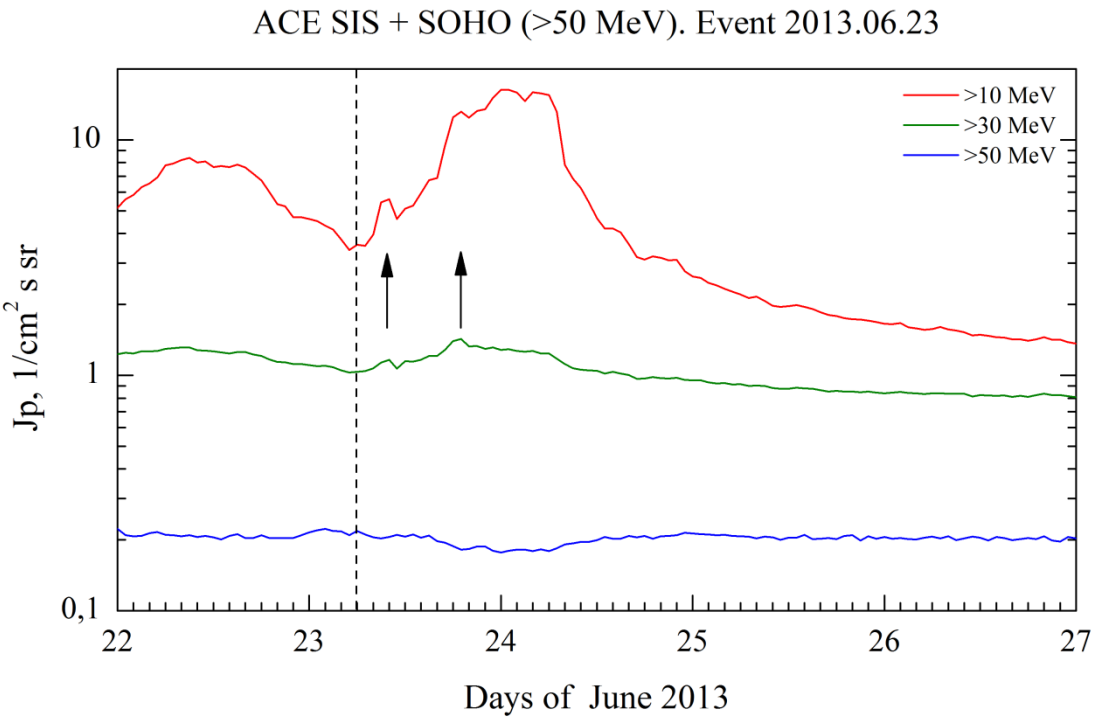
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	03	09/18	4.02/11.6	3.5	0.002	
EPHIN	8 – 25	05	09/18	0.28/0.73	3.5	0.0001	
EPHIN	25 – 53	08	09/18	0.005/0.014	3.5	0.00001	
Electro-1							
SCR-E	13.7–23	7	11/20	0.07/0.22	2	0.05	
SCR-E	23–42	7	11/20	0.008/0.03	2	0.02	
SCR-E	42–112	-	-	-	-	0.005	

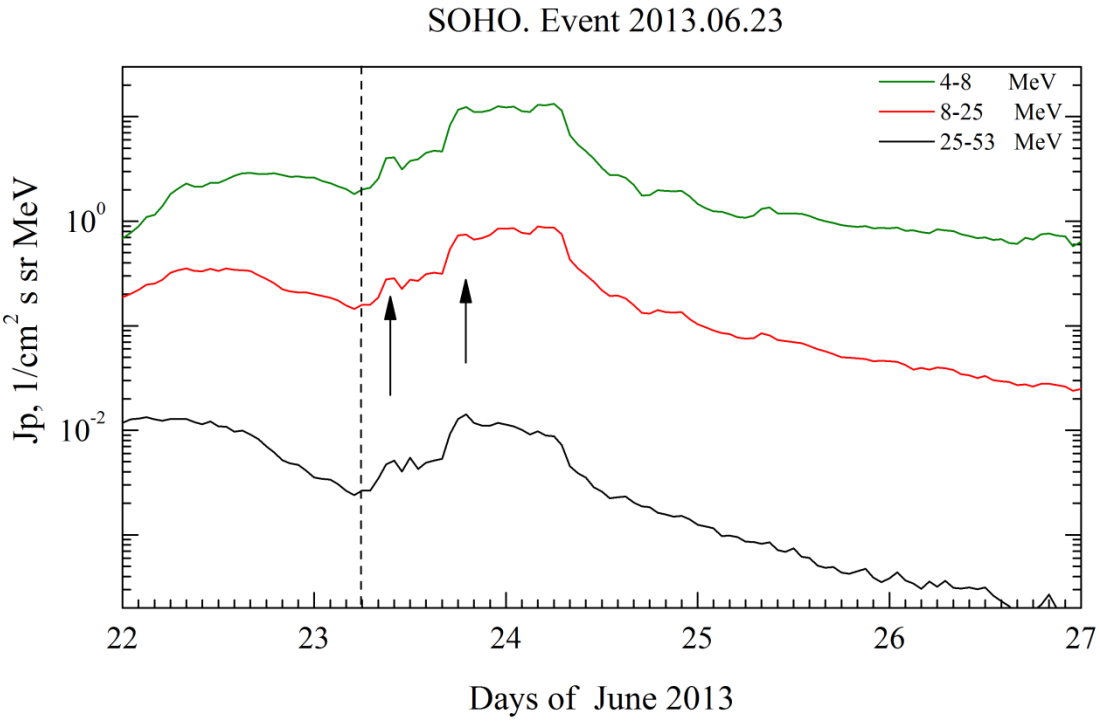

Integral spectrum of protons. Event 2013.06.23
Max 1
γ = 2.6
0.1 GCR
Eqm = 70 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2013.06.23
Max 2
γ = 4.0
0.1 GCR
Eqm = 60 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

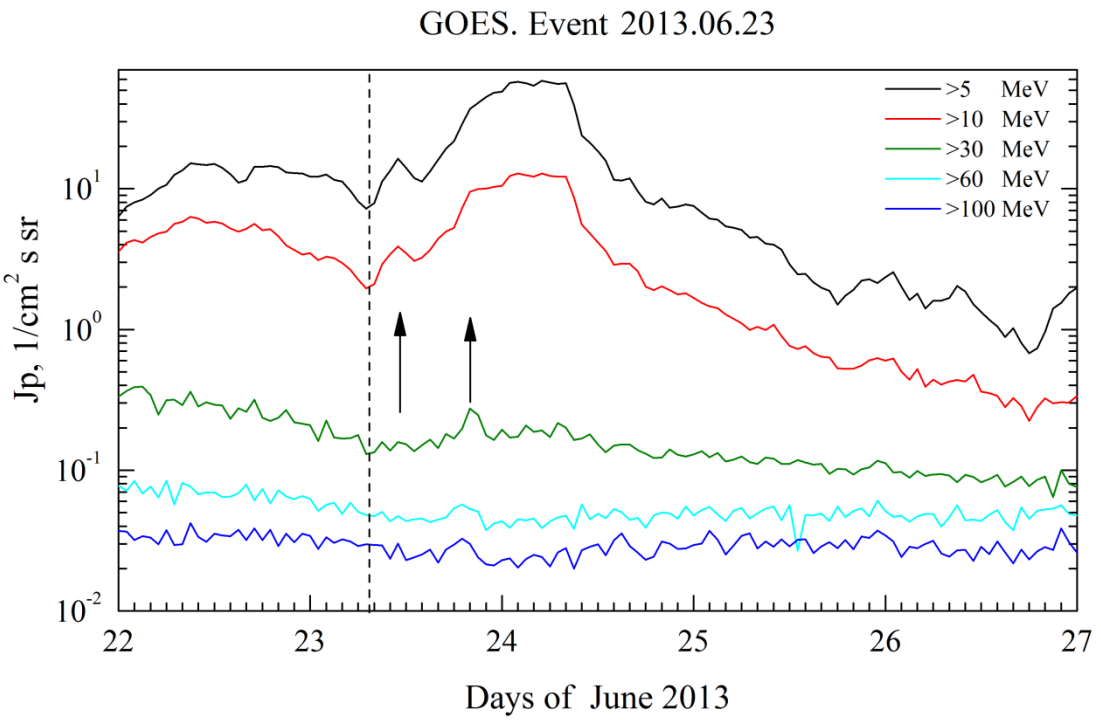
Time profiles of proton fluxes in the event 2013.06.23

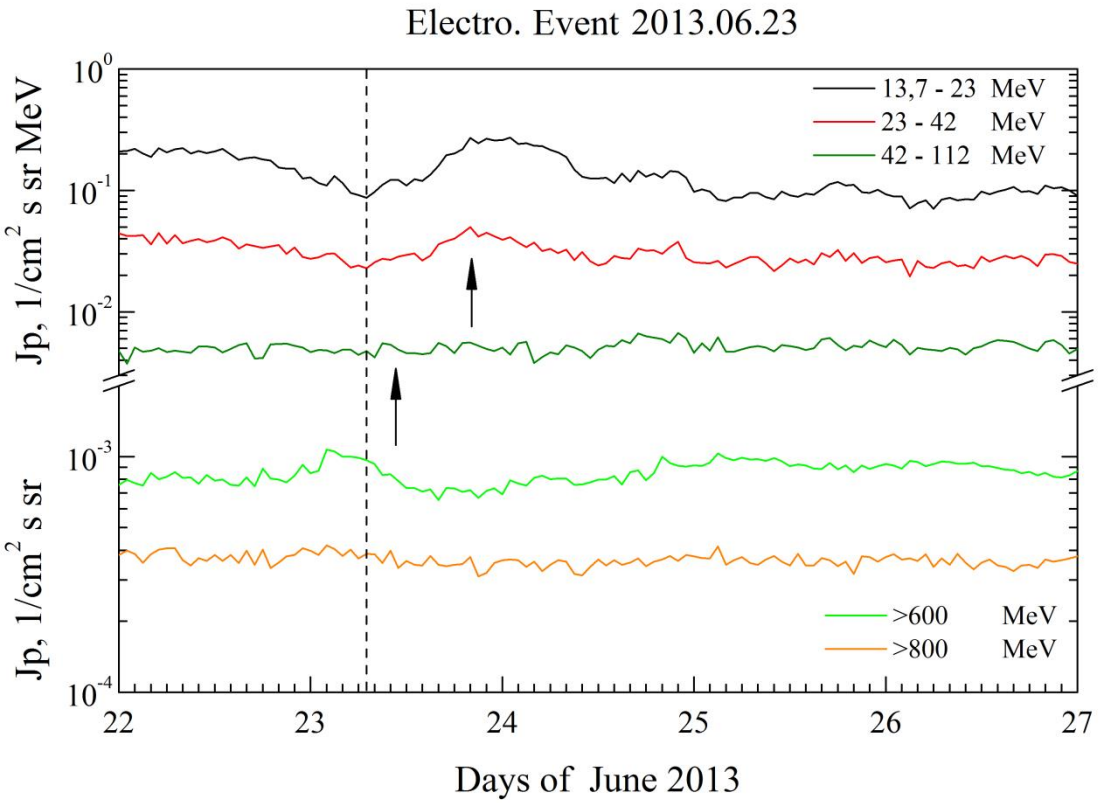
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO





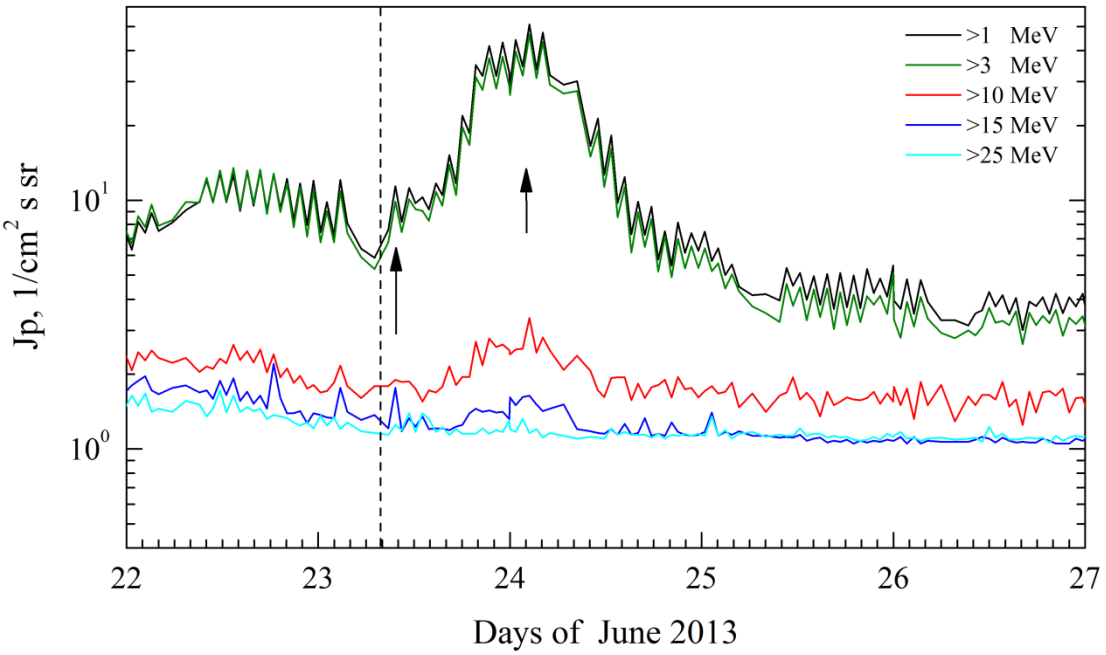
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



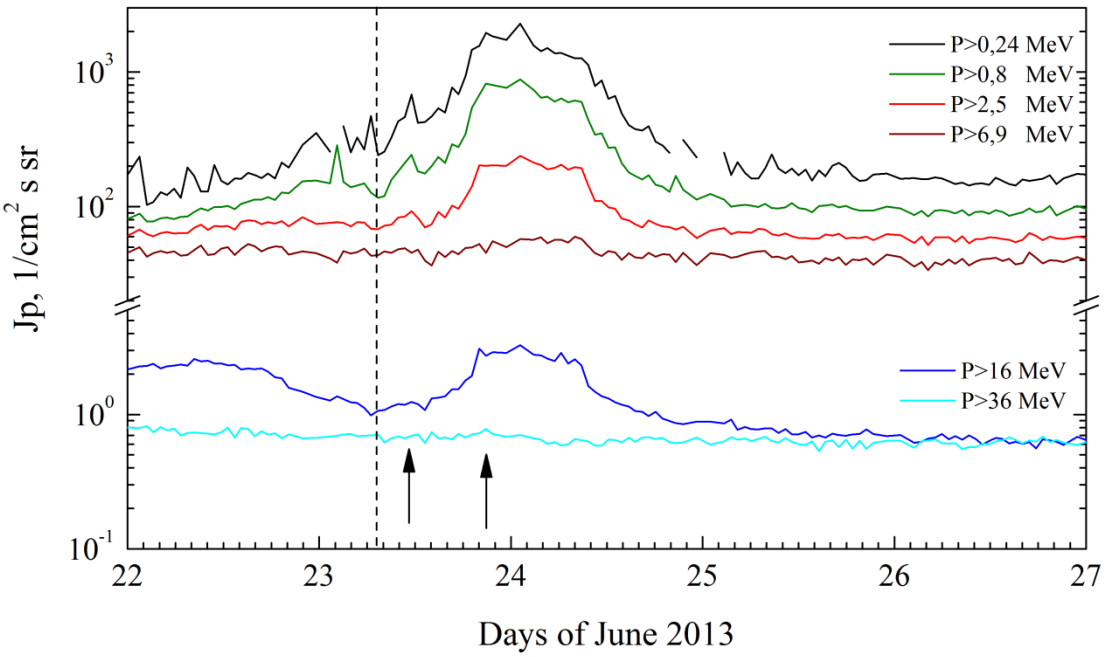


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2013.06.23



POES. Event 2013.06.23

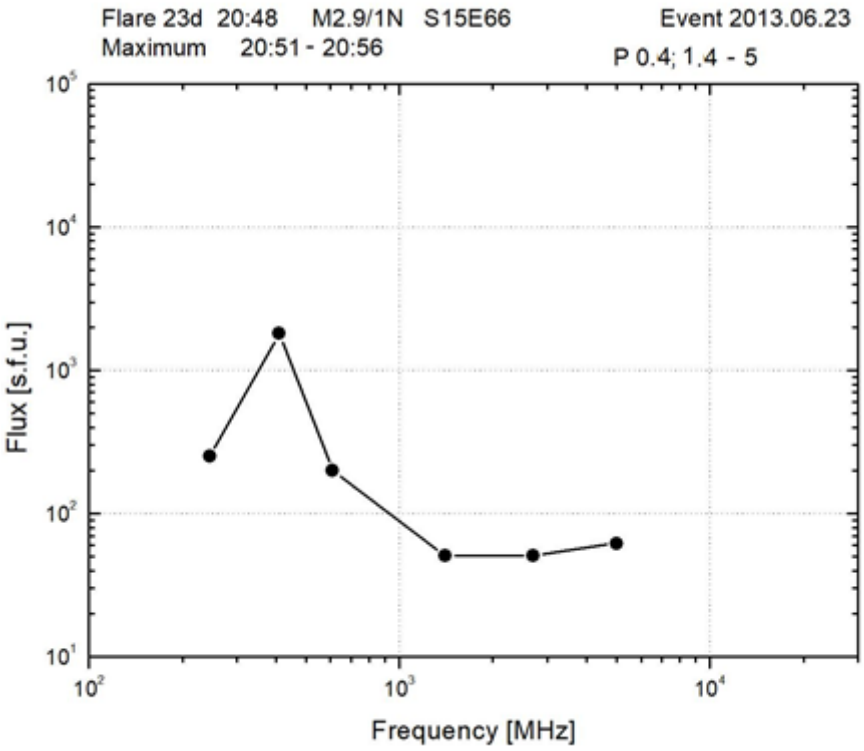


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 June 23

2013 **June 23** Ø **AR 11778** **To event 533**

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	2051	2056	2059	S15E66	1N	BPT
1 – 12	keV	2048	2056	2058	S18E63	M2.9	0.0025
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
50 – 100	keV	2050:16	2053:50	2109:08	2160	2663900	HESSI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
5	GHz	2053	2053	2053		1.8	
2.7	GHz	2053	2053	2053	1.4 – 5	1.71	
1.4	GHz	2053	2053	2053		1.71	
610	MHz	2051	2051	2053		2.3	
410	MHz	2051	2053	2055	P0.4	3.26	
245	MHz	2052	2056	2056		2.4	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS III	25-180	2052		2054		1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2124	339	-3.8	101˚	133˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11778 (S17L125, CMP 28,9.06.2013,
Sp=110 msh, CAO, B)
XRI= 0.29 $M_1^{2.9}$+C_8 1_2+ S_{18}
PFR 23.06 $M_1^{2.9}$

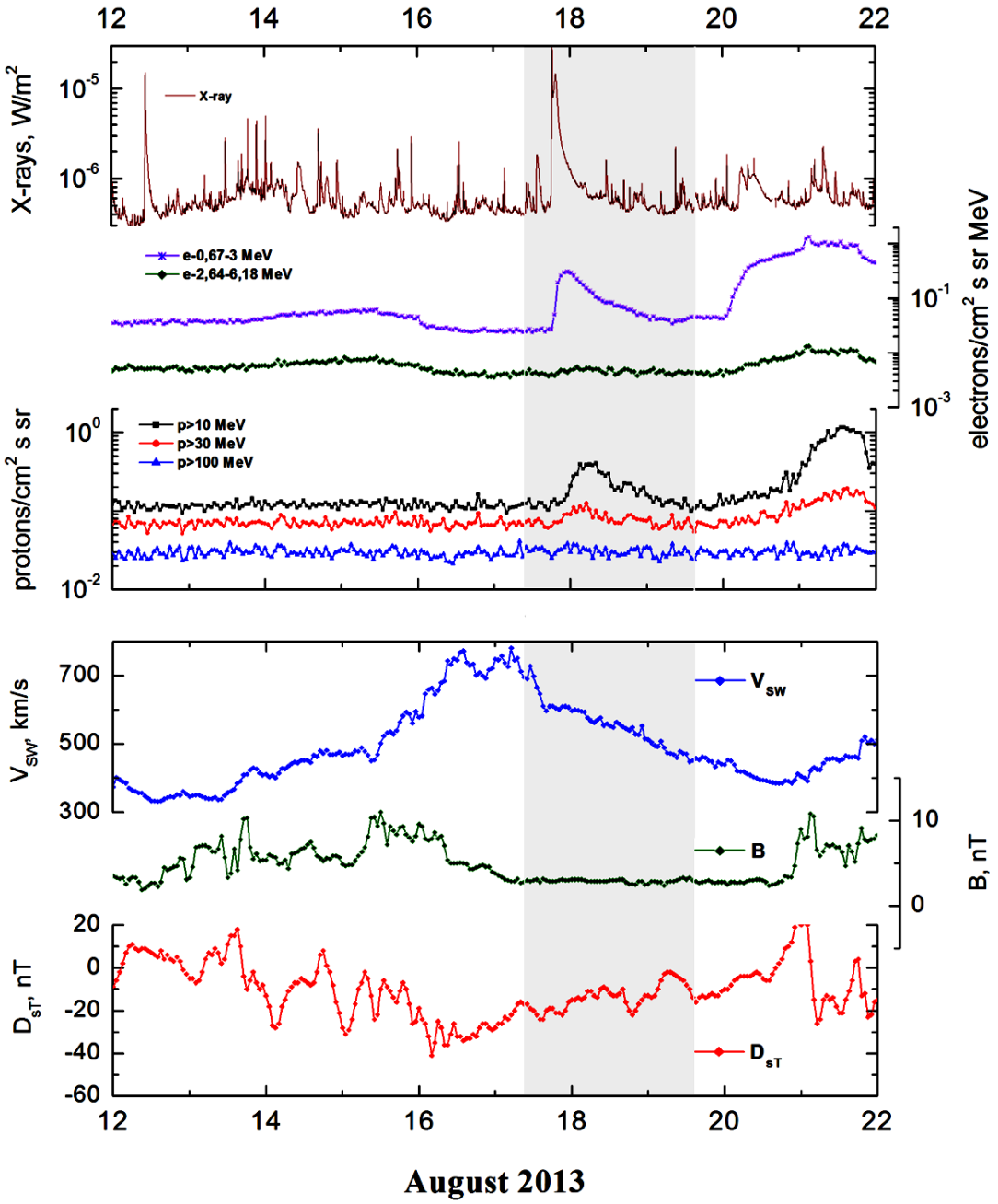
References:

Maričić D., B. Vršnak, A.M. Veronig et al., 2020.
NOAA SPE, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 17d20^h
Tmax (Ep>10 MeV) – 18d06^h, Jmax (Ep>10 MeV) – 0.3/cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 1.8
Quasimaximal energy of protons in the event – Eqm = 60 MeV

Sources: ● solar flare 17d18^{h}16^m, 2B/M3.3, M1.4, S07W30, AR11818
Main burst X-ray 1–8 Å: onset – 17d18^{h}16^m, max – 17d18^{h}24^m, Φ = 0.021 J/m^2
CME: 17d19^{h}12^m, V= 1202 km/s, Δφ = 360º, dA= 274º

Particle fluxes and associated phenomena

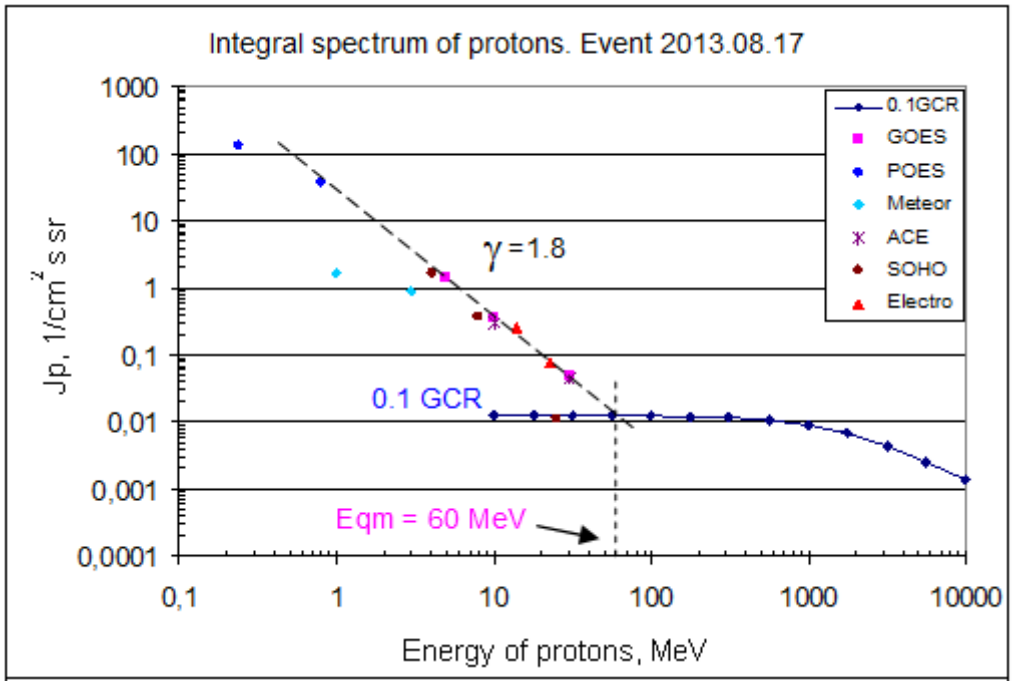


Integral fluxes of protons for the event of 2013 August 17

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	21	18d06	1.4	2	0.2	
EPS	>10	20	18d05	0.3	2	0.12	
EPS	>30	20	18d05	0.052	1	0.07	
EPS	>50	20	-	-	-	0.06	
EPS	>60	20	-	-	-	0.05	
EPS	>100	20	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	18d02	18d11	130	1	90	
MEPED	>0.8	18d02	18d11	38	1	70	
MEPED	>2.5	-	-	-	-	50	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.7	
MEPED	>70	-	-	-	-	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	23	18d10	1.6	1.5	2.4	
SCR	>3	23	18d10	0.9	1.5	2.3	
SCR	>10	-	-	-	-	1.6	
GALS-M	>15	-	-	-	-	1.1	
GALS-M	>25	-	-	-	-	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	20	18d04	0.3	1	1.1	
SIS	>30	21	18d04	0.05	1	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

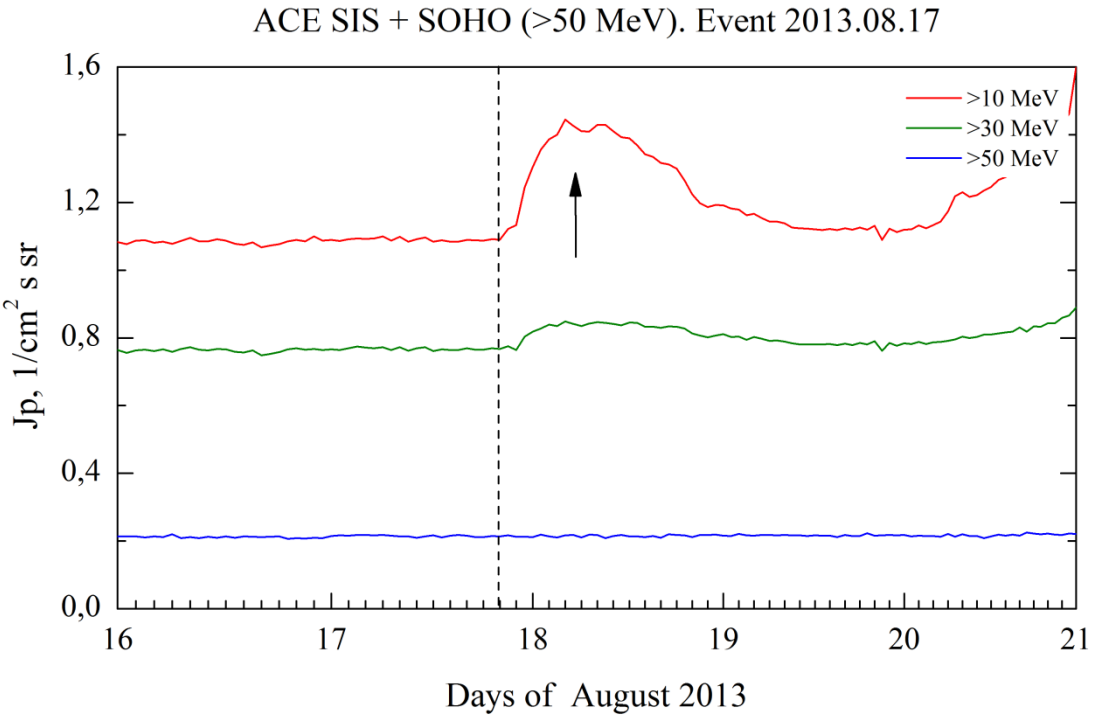
Differential fluxes of protons for the event of 2013 August 17

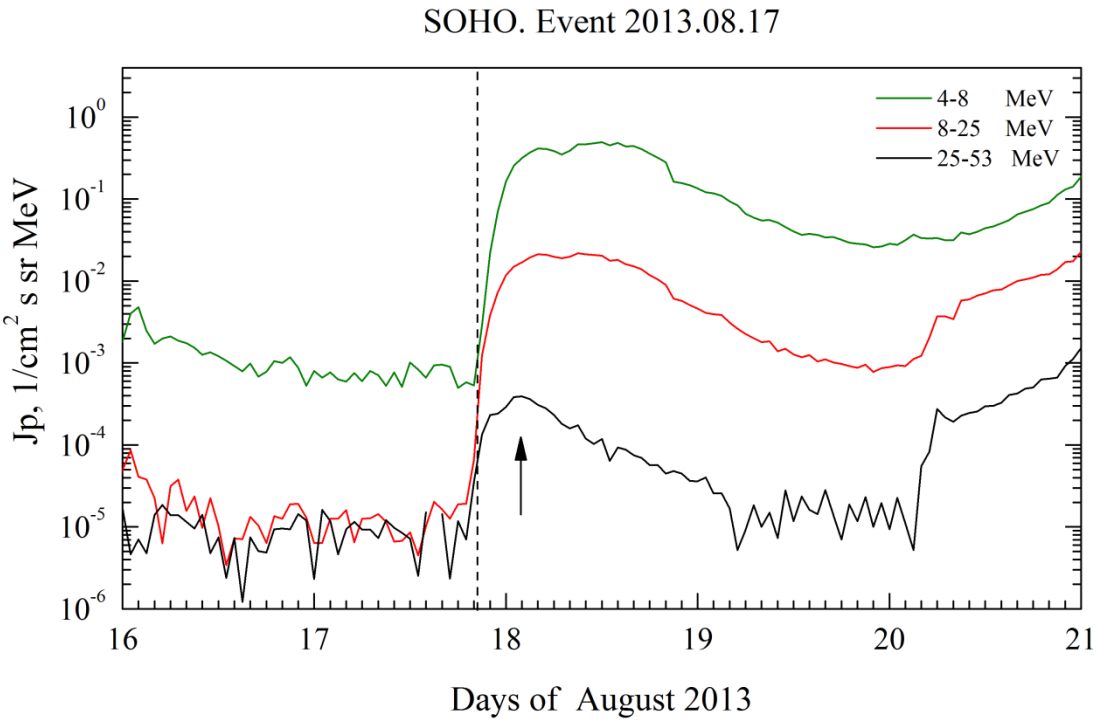
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	21	18d02	0.32	1.5	0.0006	
EPHIN	8 – 25	21	18d05	0.021	1.5	0.00001	
EPHIN	25 – 53	21	18d05	0.0004	1	0.00001	
Electro-1							
SCR-E	13.7–23	18d01	18d05	0.02	0.5	0.05	
SCR-E	23–42	18d01	18d04	0.004	0.5	0.02	
SCR-E	42–112	-	-	-	-	0.005	


Integral spectrum of protons. Event 2013.08.17
Jp, 1/cm² s sr
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ =1.8
0.1 GCR
Eqm = 60 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

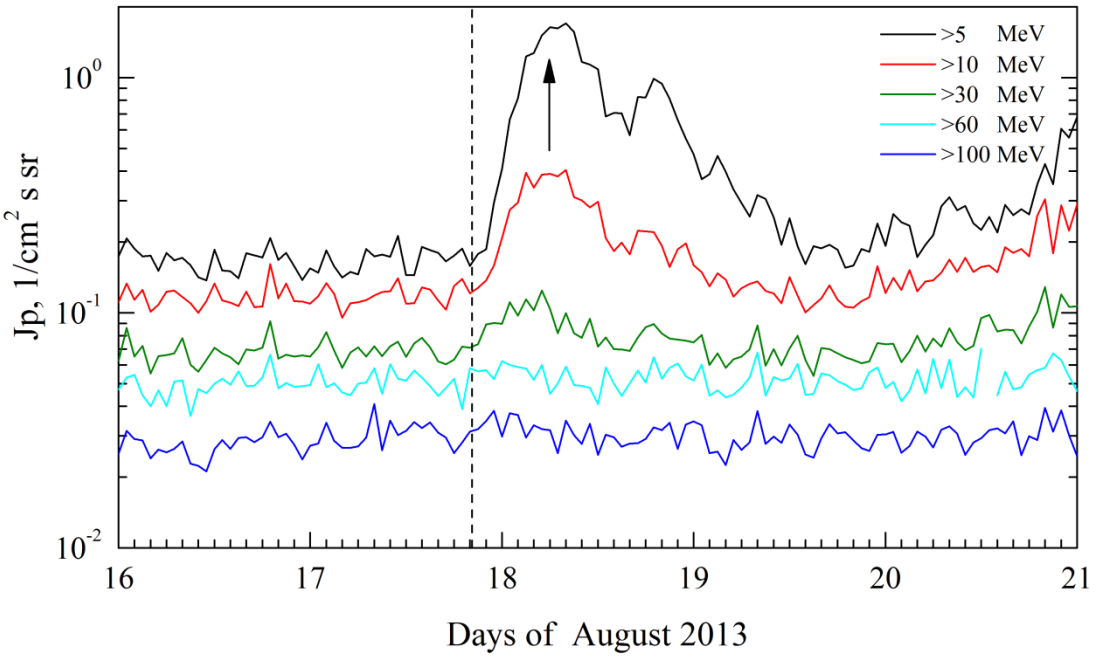
Time profiles of proton fluxes in the event 2013.08.17

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

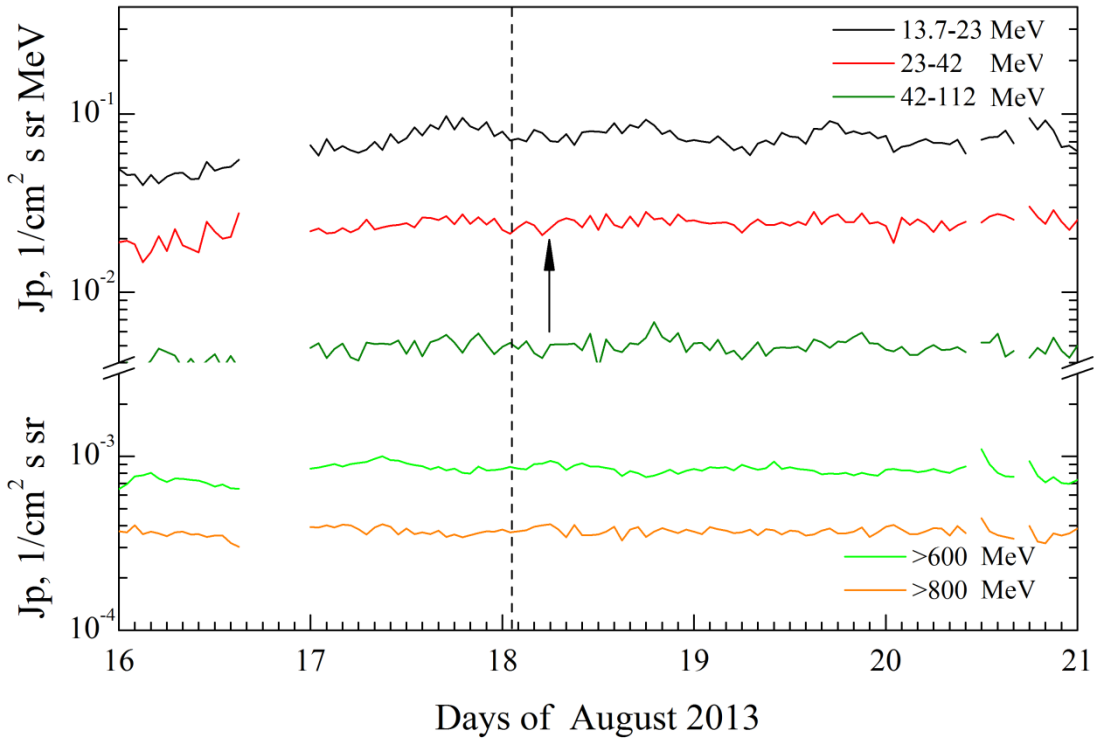




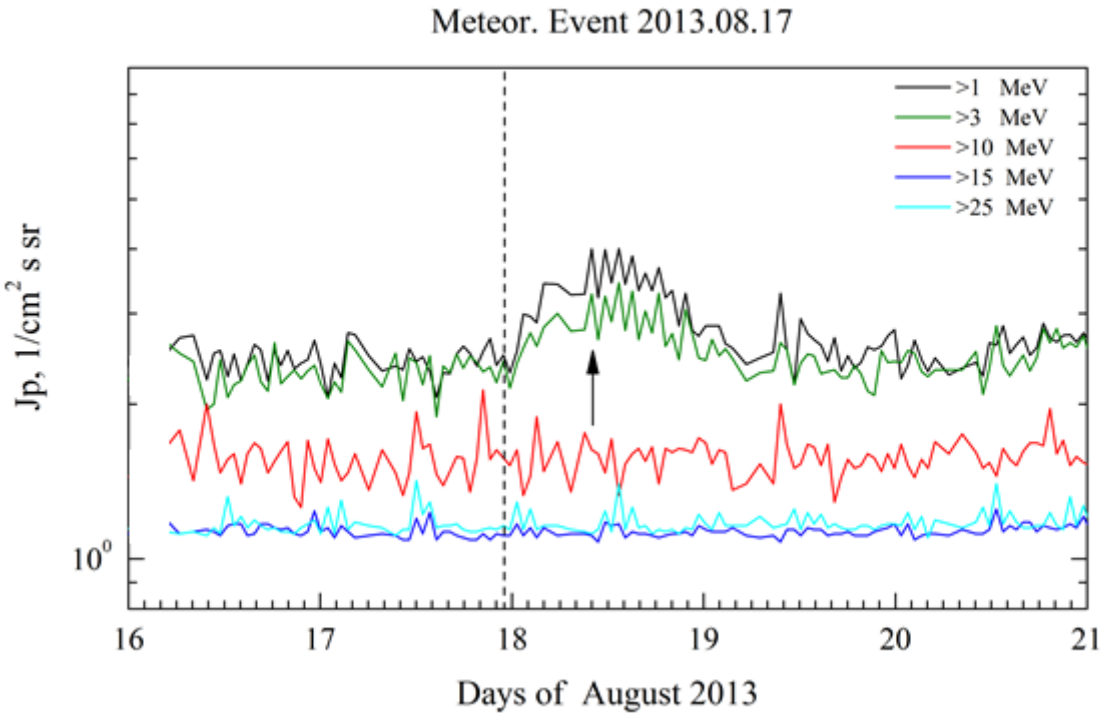
GOES. Event 2013.08.17

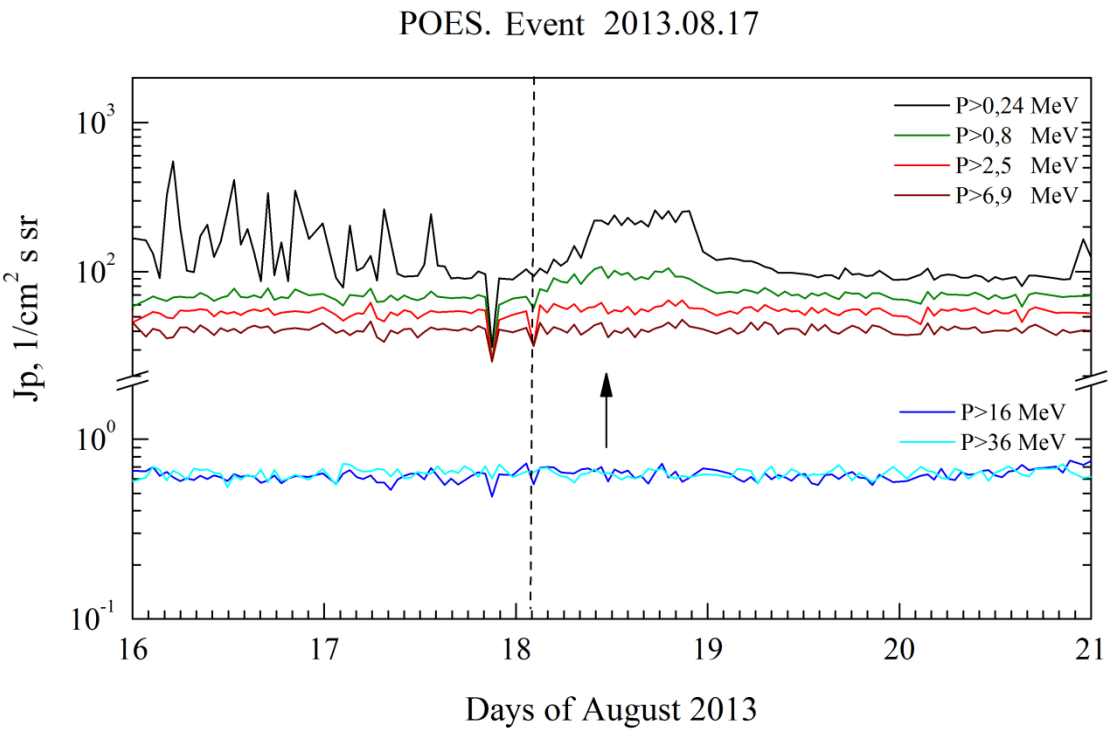


Electro. Event 2013.08.17



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 August 17

2013 August 17 ● AR 11818 To event 534

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	1816	1824	2141	S07W30	2B	YSR
1 – 12	keV	1816	1824	1835		M3.3	0.021
1 – 12	keV	1849	1933	1954		M1.4	0.046

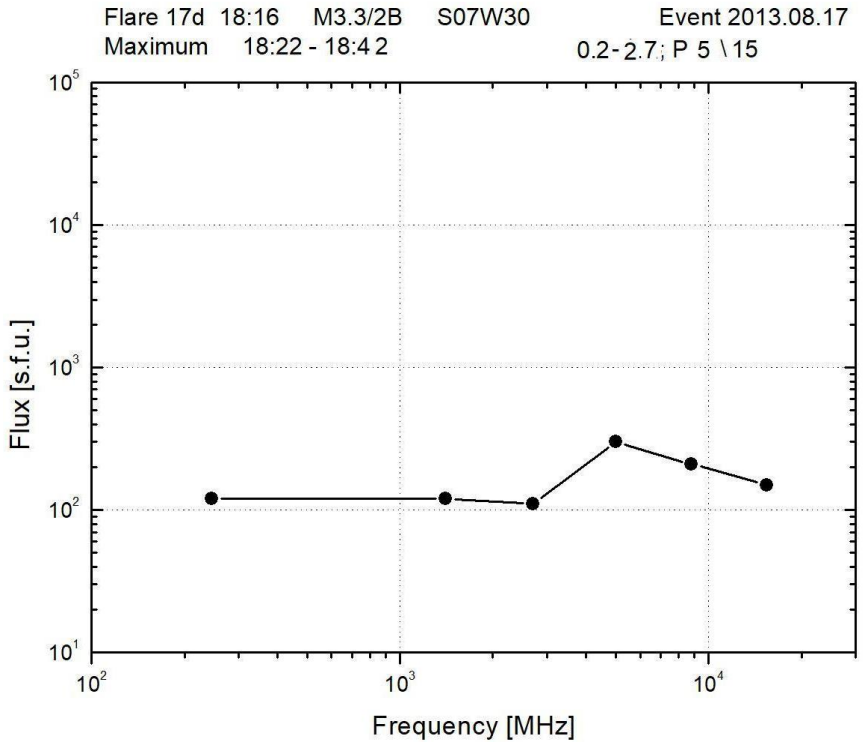
X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12 – 25	keV	1938:48	1938:48	1952:40	2327	202999	FERMI
6-12	keV	2026:20	2026:30	2027:00	21	4603	HESSI
6-12	keV	2140:32	2141:14	2144:52	288	373272	HESSI

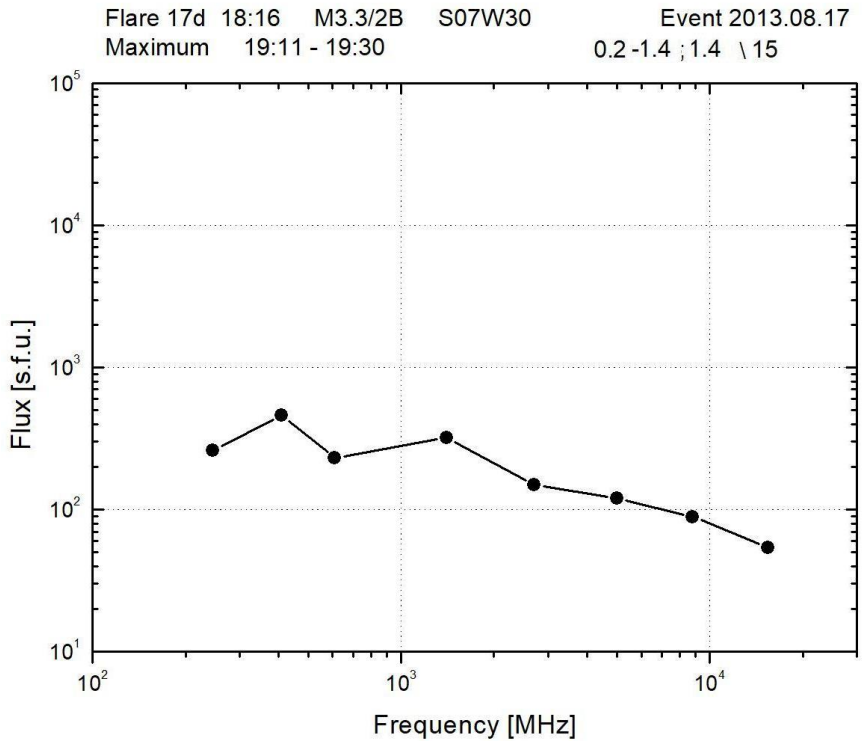
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	1821	1822	1823	P5 \ 15	2.17	
8.8	GHz	1821	1822	1824		2.32	
5	GHz	1821	1822	1824		2.48	
2.7	GHz	1821	1822	1823	0.2 - 2.7	2.04	
1.4	GHz	1823	1823	1823		2.08	
245	MHz	1842	1842	1842		2.08	
15.4	GHz	1915	1915	1929	1.4 \ 15	1.73	
8.8	GHz	1908	1916	1937		1.95	
5	GHz	1908	1911	1932		2.08	
2.7	GHz	1908	1915	1933		2.17	
1.4	GHz	1909	1930	1936	0.2 - 1.4	2.50	
610	MHz	1853	1930	1935		2.36	
410	MHz	1852	1915	1934		2.66	
245	MHz	1850	1914	1932		2.41	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	25-55	1856		1902	1399	2	
DS IV	25-180	1904		1928		2	
DS IV	25-180	1909		1941		1	
DH II	18-0.15	2025		18/0305			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1912	1202	1.7	360˚	274˚	SOHO

Radio bursts frequency spectrum





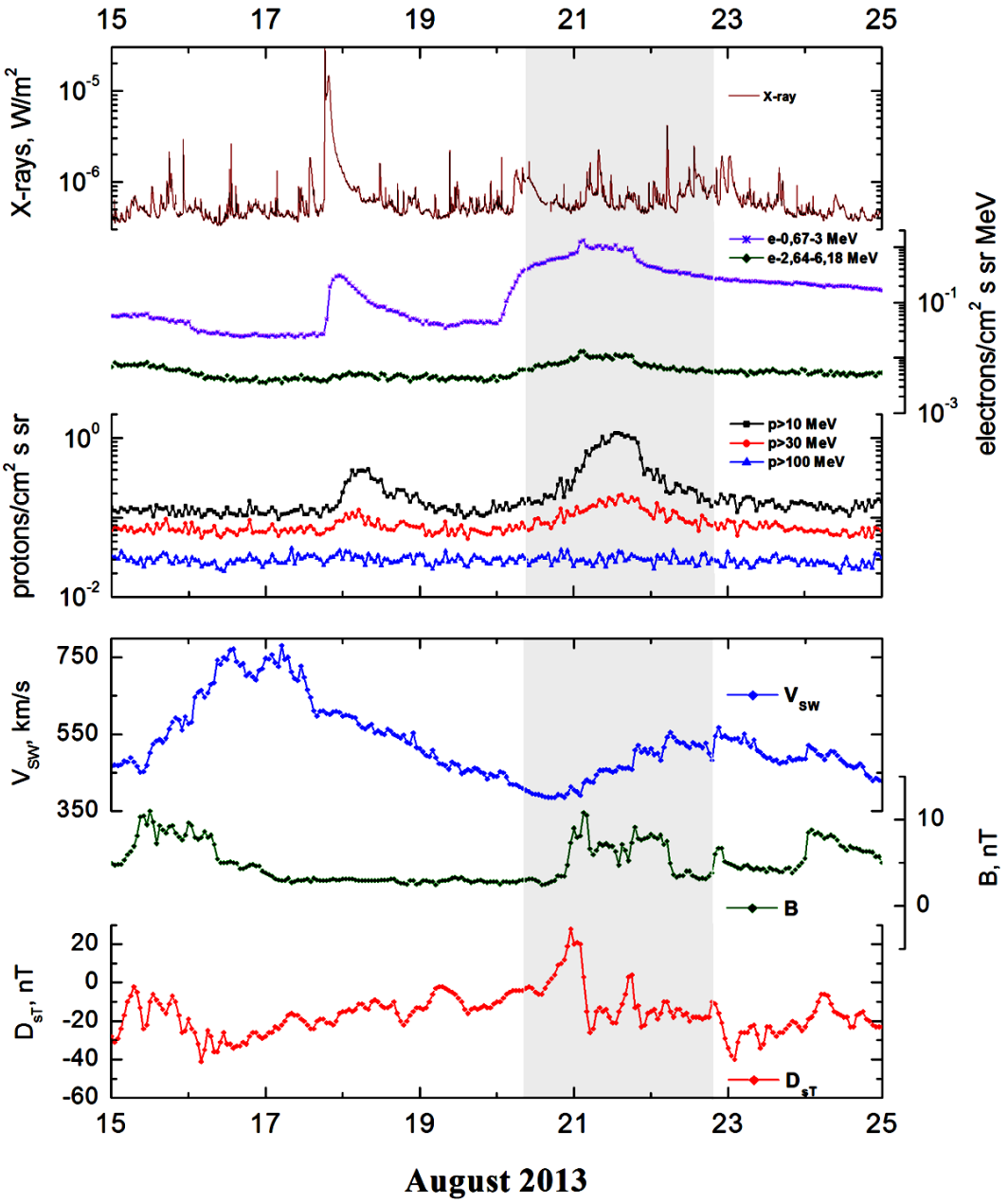
Proton Active Region:

AR1-1818 (S07L214, CMP15,5.08.2013,
Sp=340 msh; DKI; BGD; R)
XRI=0.47 $M_2^{3.3}+C_{12}$ 2_1+S_{23}
PFR 17.08 $M_2^{3.3;1.4}$

Particle event: To(Ep>10 MeV) – 20d16^h
Tmax (Ep>10 MeV) – 21d14^h, Jmax (Ep>10 MeV) – 1 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.15
Quasimaximal energy of protons in the event – Eqm = 80 MeV

Sources: ⊡ solar flare 20d04^{h}54^m, (C1.3;C1.1)*/, S18W87, AR11817, 1d behind W_L
Main X-ray burst 1-8 Å: onset – 20d04^{h}54^m, max – 20d06^{h}08^m, Φ = 0.0055 J/m^2
CME: 20d08^{h}12^m, V= 784 km/s, $\Delta\varphi$ = 360º, dA= 210º
▲ SC 20d22^{h}29^m; ▲ SC 22d19^{h}26^m
* Large flare with double X-ray burst behind W_L.

Particle fluxes and associated phenomena

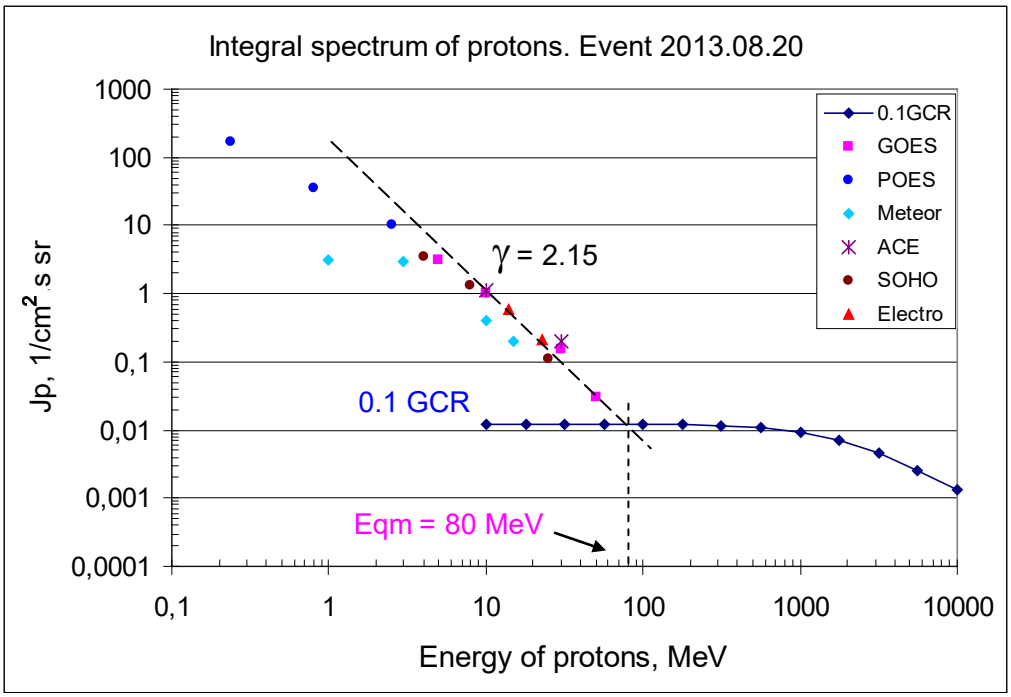


Integral fluxes of protons for the event of 2013 August 20

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	17	21d14	3.2	2	0.2	
EPS	>10	17	21d14	1	2	0.12	
EPS	>30	17	21d15	0.15	2	0.07	
EPS	>50	17	21d15	0.03	1	0.06	
EPS	>60	17	-	-	-	0.05	
EPS	>100	17	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	21d02	21d15	170	1	90	
MEPED	>0.8	21d02	21d15	35	1	70	
MEPED	>2.5	21d02	21d15	10	1	50	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.7	
MEPED	>70	-	-	-	-	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	21d00	21d12	3.14	1.5	2.4	
SCR	>3	21d00	21d12	3.0	1.5	2.3	
SCR	>10	21d09	21d16	0.4	0.5	1.6	
GALS-M	>15	21d09	21d15	0.2	0.5	1.2	
GALS-M	>25	-	-	-	-	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	5	21d14	1.1	2	1.1	
SIS	>30	-	21d14	0.2	2	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

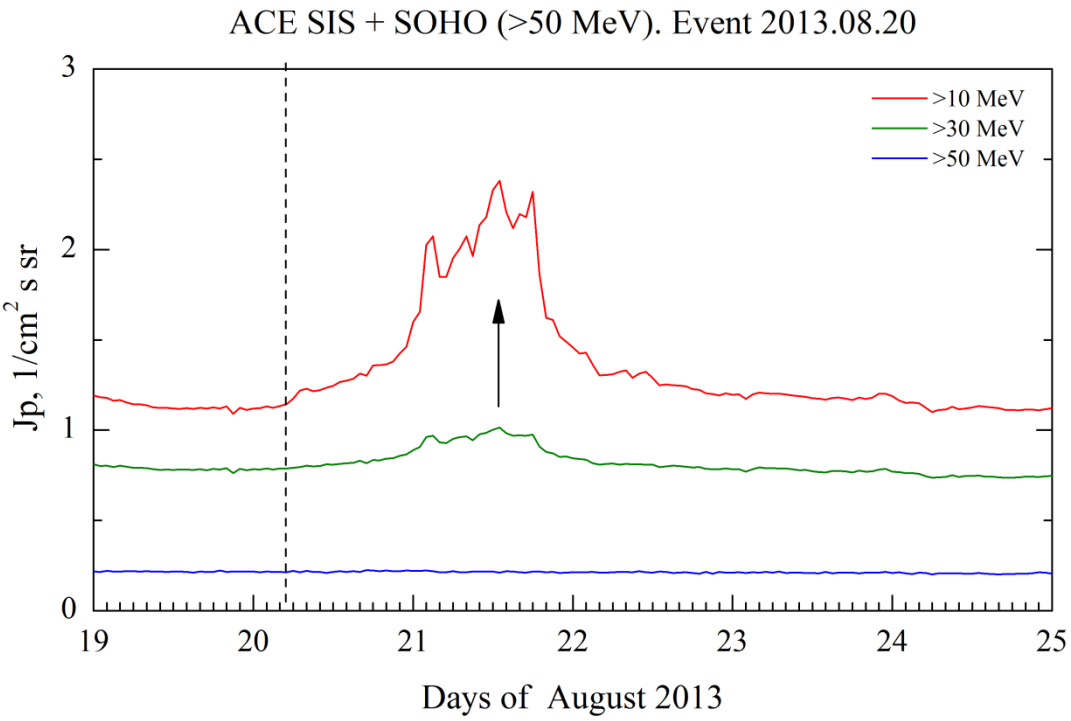
Differential fluxes of protons for the event of 2013 August 20

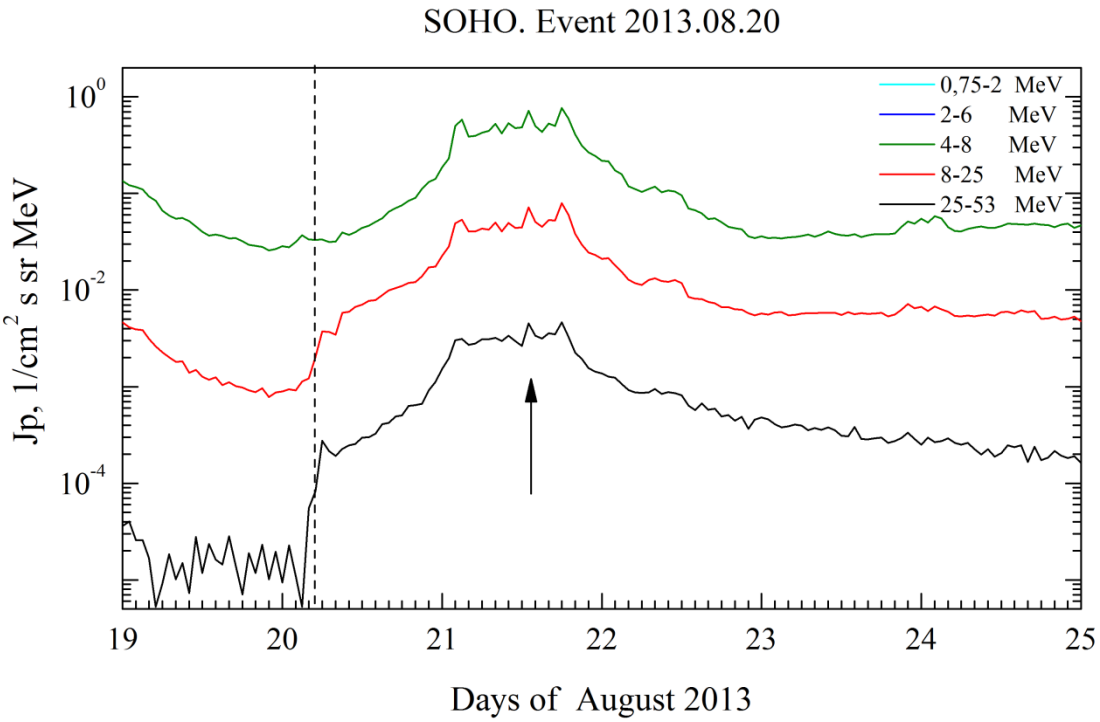
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	05	21d13	0.54	2	0.04	
EPHIN	8 – 25	05	21d13	0.07	2	0.001	
EPHIN	25 – 53	04	21d13	0.004	2	0.00001	
Electro-1							
SCR-E	13.7–23	23	21d16	0.04	1	0.07	
SCR-E	23–42	23	21d16	0.011	1	0.02	
SCR-E	42–112	-	-	-	-	0.005	


Integral spectrum of protons. Event 2013.08.20
Jp, 1/cm2 s sr
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.15
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

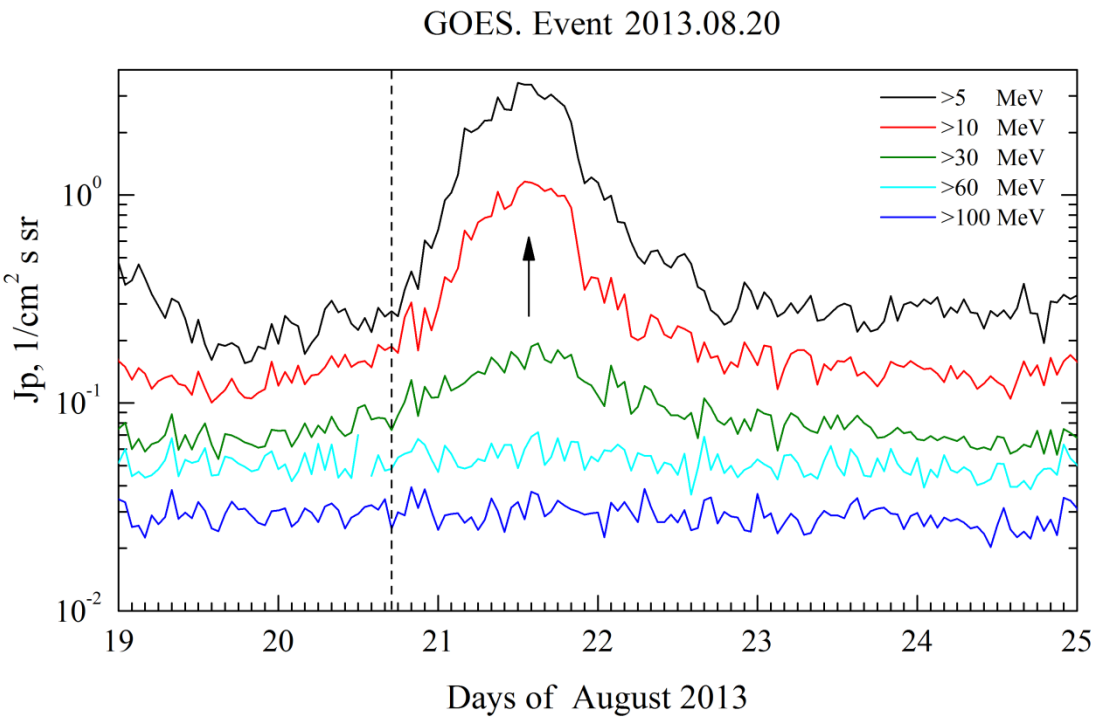
Time profiles of proton fluxes in the event 2013.08.20

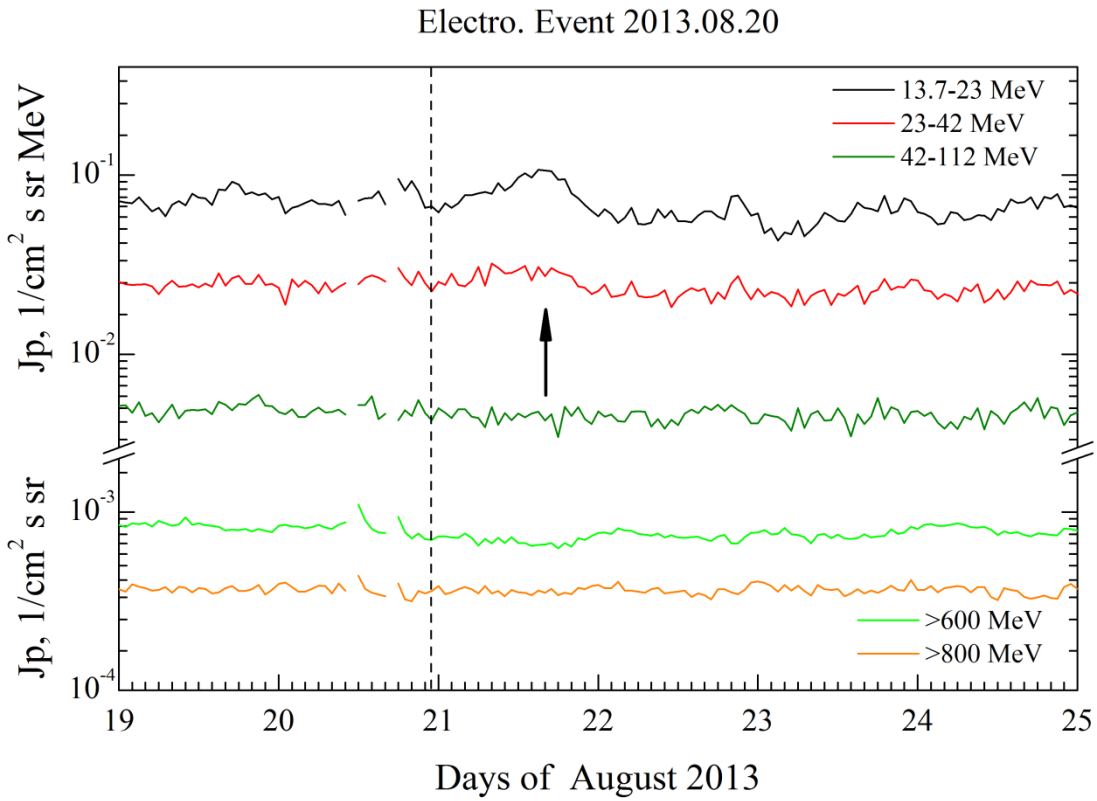
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



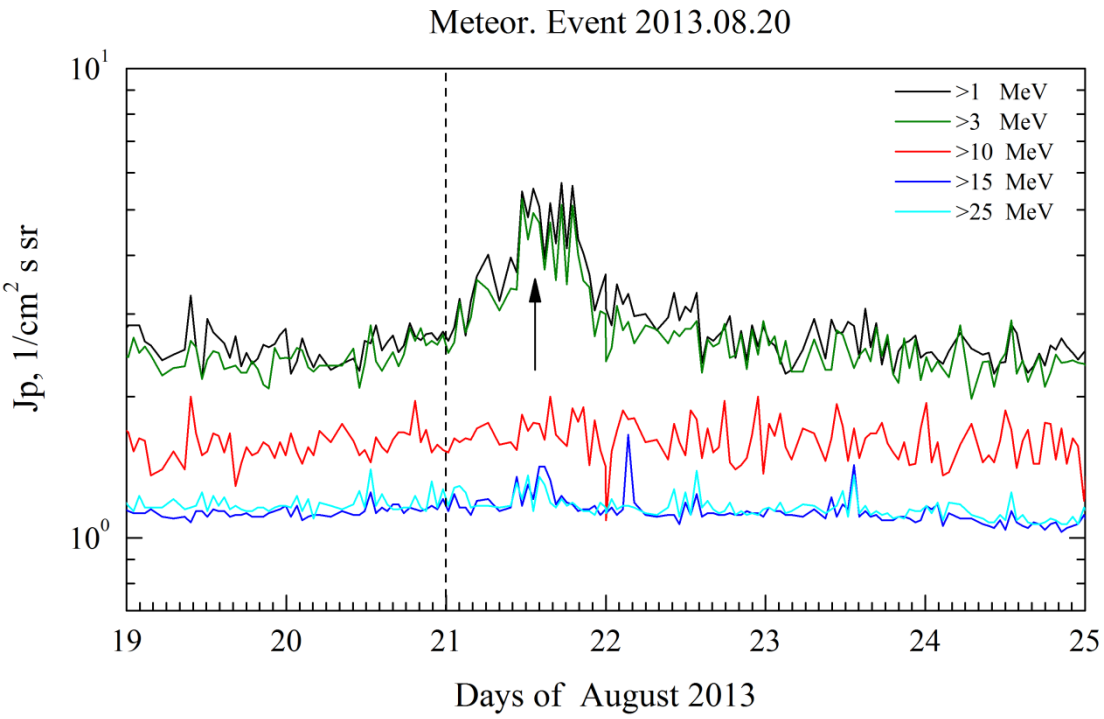


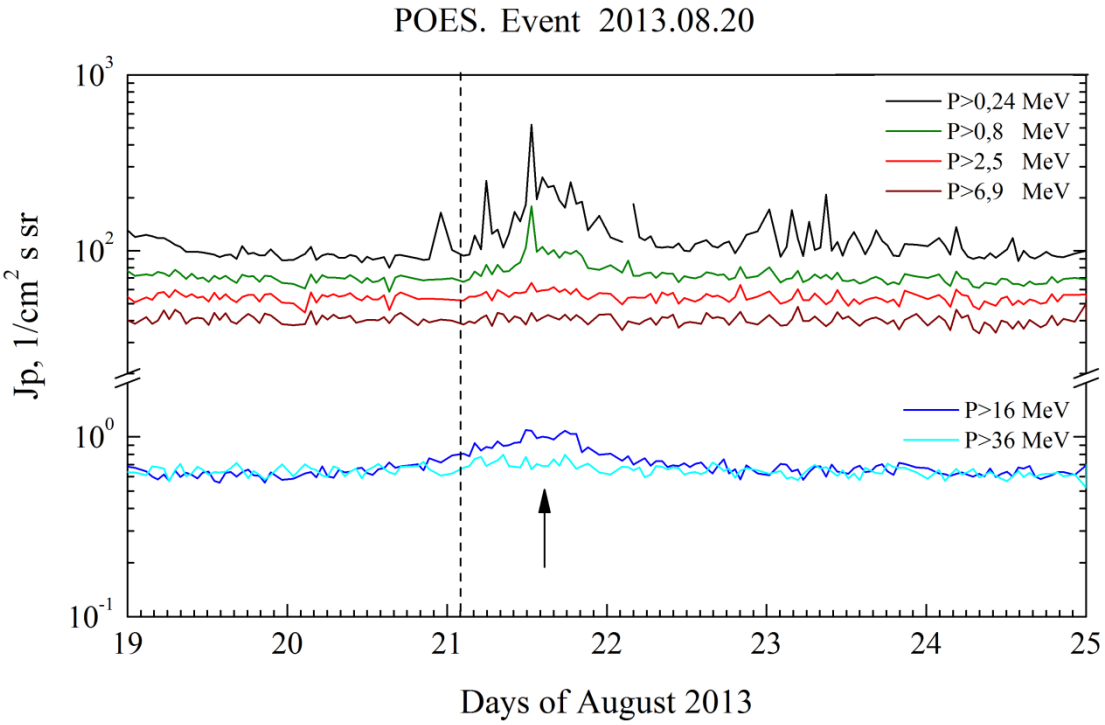
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 August 20

2013 August 20 ⊡ AR 11817 To event 535

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No flare event on visible disk					
LPS	6563 Å	0619		1000	S18W90	0.1	
1 – 12	keV	0454	0608	0623	S18W87	C1.3*	0.0055
1 – 12	keV	0458	0530	0620		C1.1*	

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	0532:32	0534:46	0537:32	160	246720	HESSI
6-12	keV	0537:32	0538:26	0545:12	144	344448	HESSI
6-12	keV	0545:12	0557:14	0602:08	160	728928	HESSI
6-12	keV	0602:08	0605:14	0619:56	176	662520	HESSI

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS III	059-180	0551		0551		1	

CME		**UT**	**V,** km/s	**a,** km/s^2	**$\Delta\varphi$**	**dA**	**Sp/c**
LASCO	WL	0812	784	- 0.6	360˚	210˚	SOHO

*Large flare with double X-ray burst behind W_L.

Proton Active Region:

AR11817(S21L240, CMP 13,7.08.2013,
Sp=260 msh; EKC; BGD; R)
XRI=0.15 $M_1^{1.5}$+C_{15} 1_1+S_{16}
PFR1 12.08 $M_1^{1.5}$
PFR2 20.08 1d behind W-limb

References:

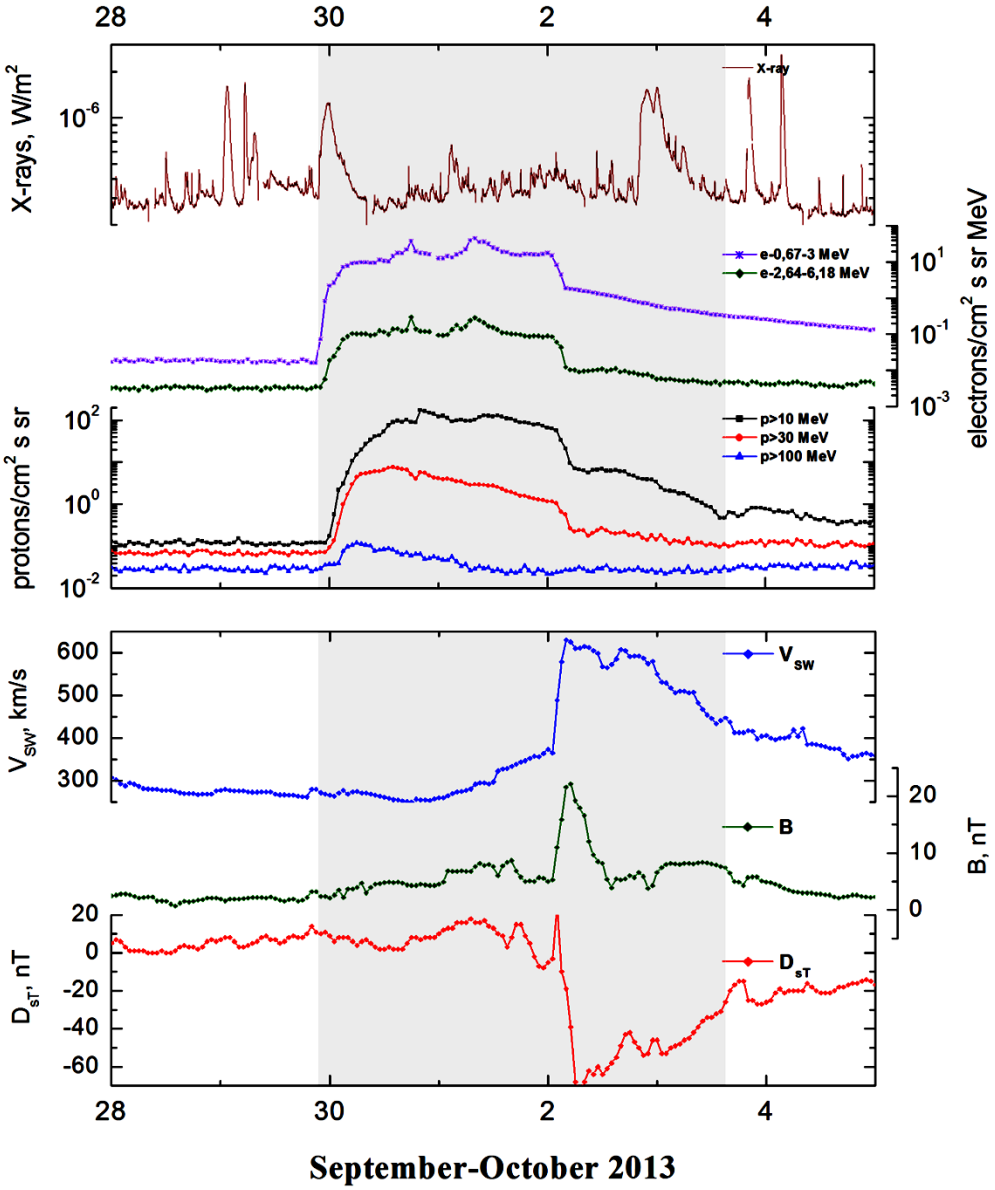
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Rodríguez-García L., R. Gómez-Herrero, I. Zouganelis et al., 2021.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.

Event 2013.09.30 – (2013-273) **536**

Particle event: To(Ep>10 MeV) – 30d00^h
Tmax(Ep>10 MeV) – 30d17^h, Jmax(Ep>10 MeV) – 102/cm^2·s·sr
Duration of the event – 6 days, power-law index: γ = 3.0
Quasimaximal energy of protons in the event – Eqm = 220 MeV

Sources: ● DSF 29d21^{h}45^m N15W40; extent of 35°
● solar flare 29d21^{h}43^m, C1.2/, N15W33, DSF
Main burst X-ray 1–8 Å: onset – 29d21^{h}43^m, max – 29d23^{h}39^m, Φ = 0.011 J/m^2
CME: 29d22^{h}12^m, V= 1179 km/s, Δφ = 360°, dA= 343°
▲SC 02d01^{h}55^m

Particle fluxes and associated phenomena

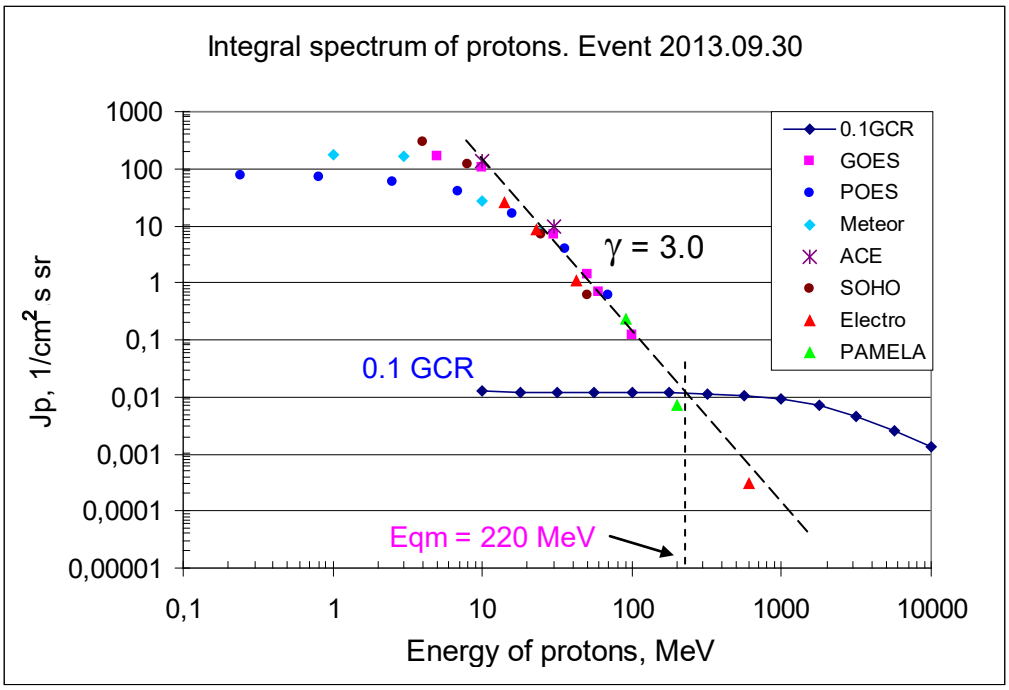


Integral fluxes of protons for the event of 2013 September 30

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	0	18	165	6	0.2	
EPS	>10	0	17	102	6	0.12	
EPS	>30	0	15	7.1	4	0.07	
EPS	>50	0	8	1.4	2	0.06	
EPS	>60	0	7	0.7	2	0.05	
EPS	>100	0	6	0.12	1.5	0.03	
Electro-1							
GALS-E	>600	0	8	0.0003	0.5	0.0007	
POES							
MEPED	>0.24	2	8	75	5	90	
MEPED	>0.8	2	8	71	5	70	
MEPED	>2.5	2	8	58	4	50	
MEPED	>6.9	2	8	39.2	3	40	
MEPED	>16	2	8	16.7	3	0.7	
MEPED	>36	2	8	3.85	2	0.7	
MEPED	>70	2	8	0.6	1	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	1	13	179	6	2.5	
SCR	>3	1	13	170	6	1.9	
SCR	>10	1	13	28	2.5	1.9	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	1	13	8	2.5	1.9	
GALS-M	>600	-	-	-	-	0.01	
ACE							
SIS	>10	0	12	135	4	1.1	
SIS	>30	0	12	10	2	0.8	
PAMELA							
TRACKER	>90	2	6	0.23	<2	-	
TRACKER	>200	2	6	0.0073	<2	-	
SOHO							
EPHIN	>50	0	5	0.6	2	0.2	

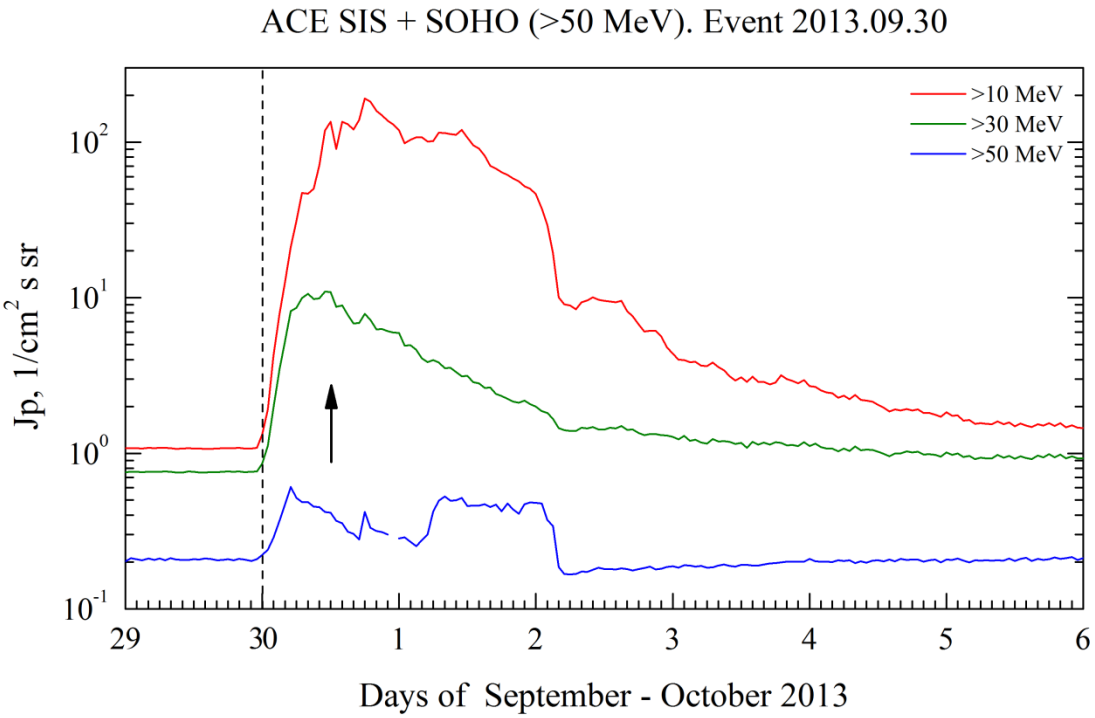
Differential fluxes of protons for the event of 2013 September 30

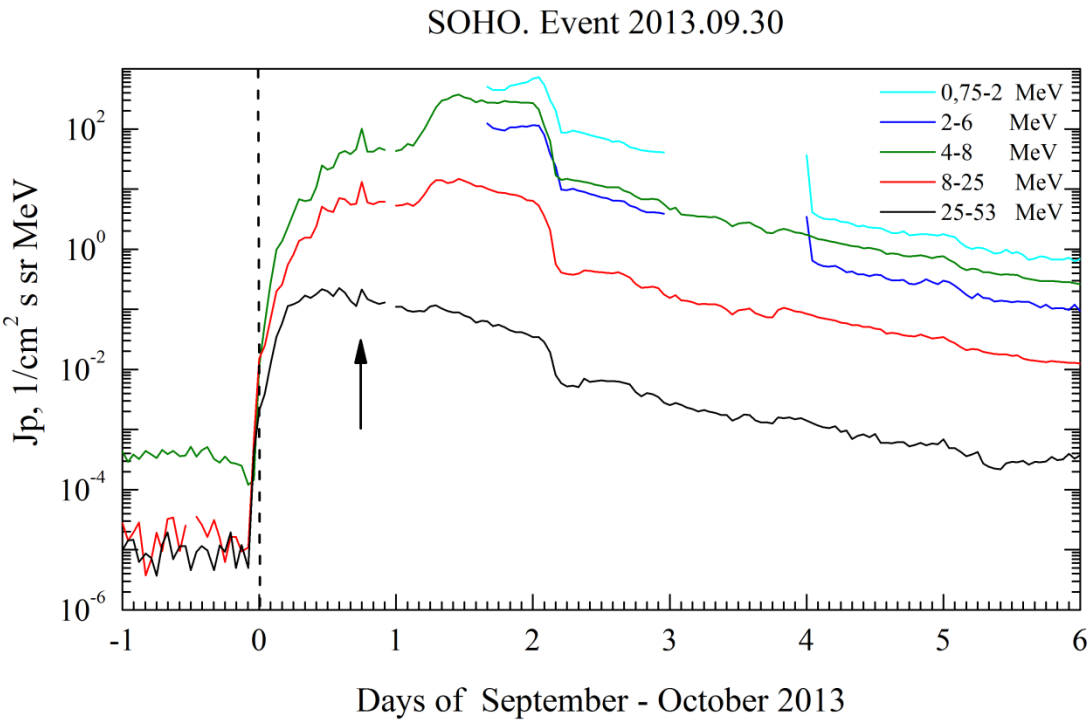
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, (cm^2·s·sr·MeV)-1	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	00	18	43	6	0.0005	
EPHIN	8 – 25	00	18	6.7	6	0.00003	
EPHIN	25 – 53	00	11	0.22	4.5	0.00003	
Electro-1							
SCR-E	13.7–23	0	8	1.85	3	0.05	
SCR-E	23–42	0	8	0.38	3	0.02	
SCR-E	42–112	0	8	0.015	2	0.005	

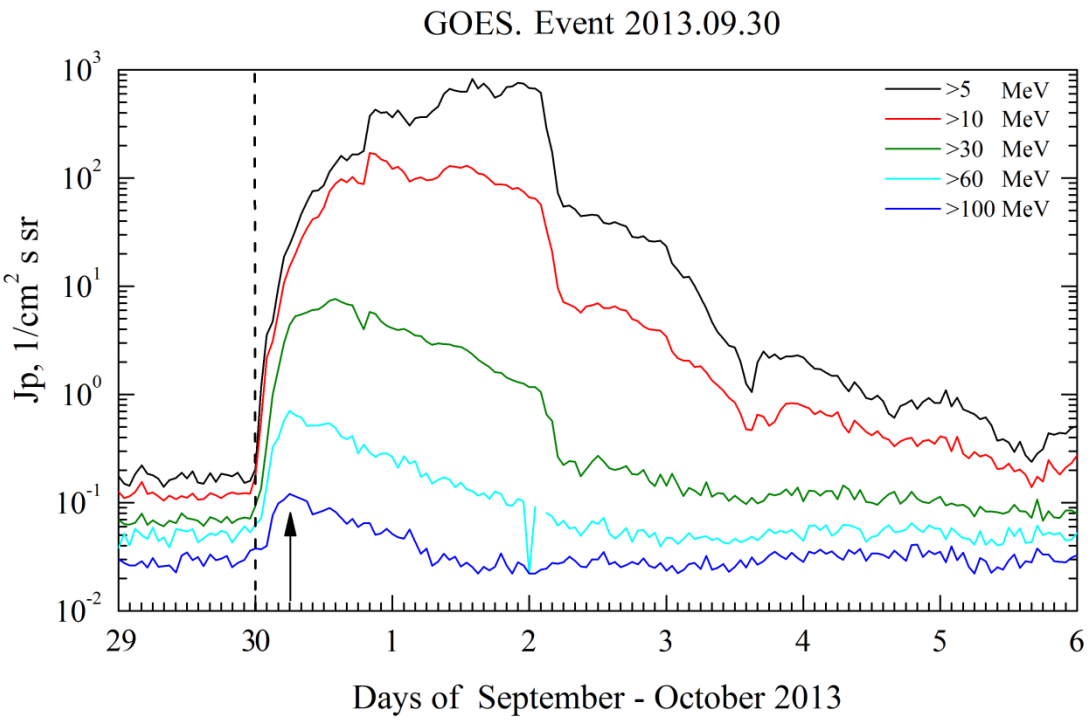


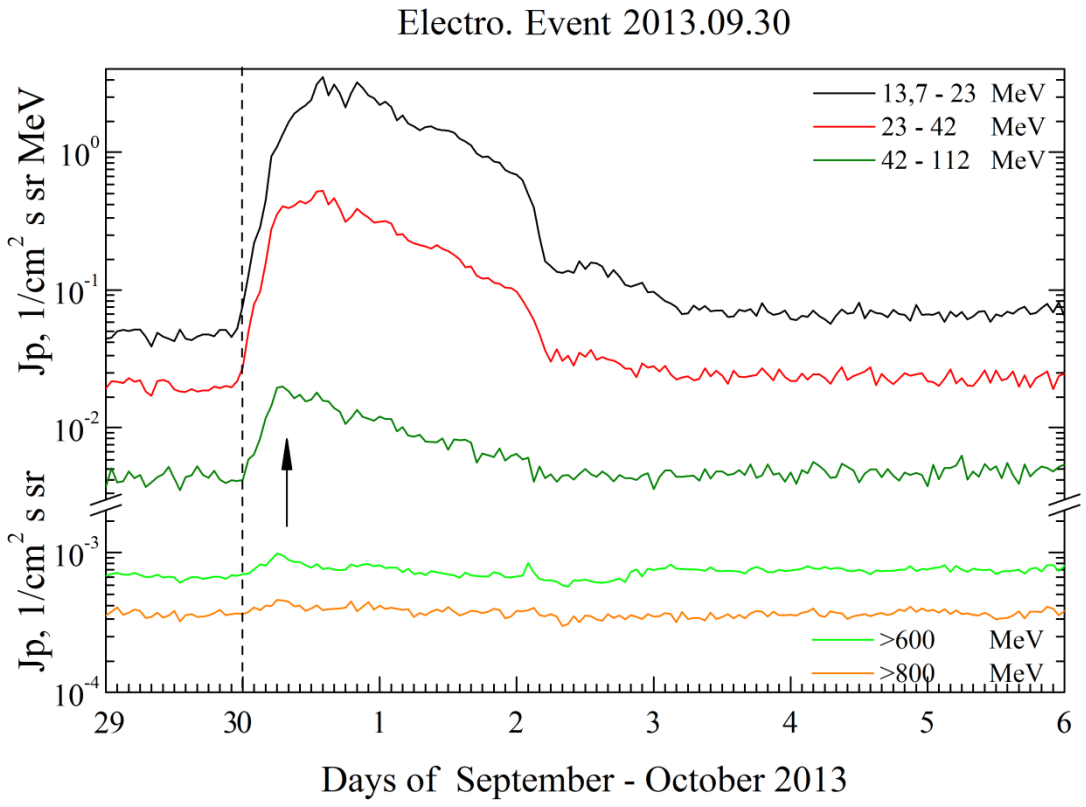
Time profiles of proton fluxes in the event 2013.09.30

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

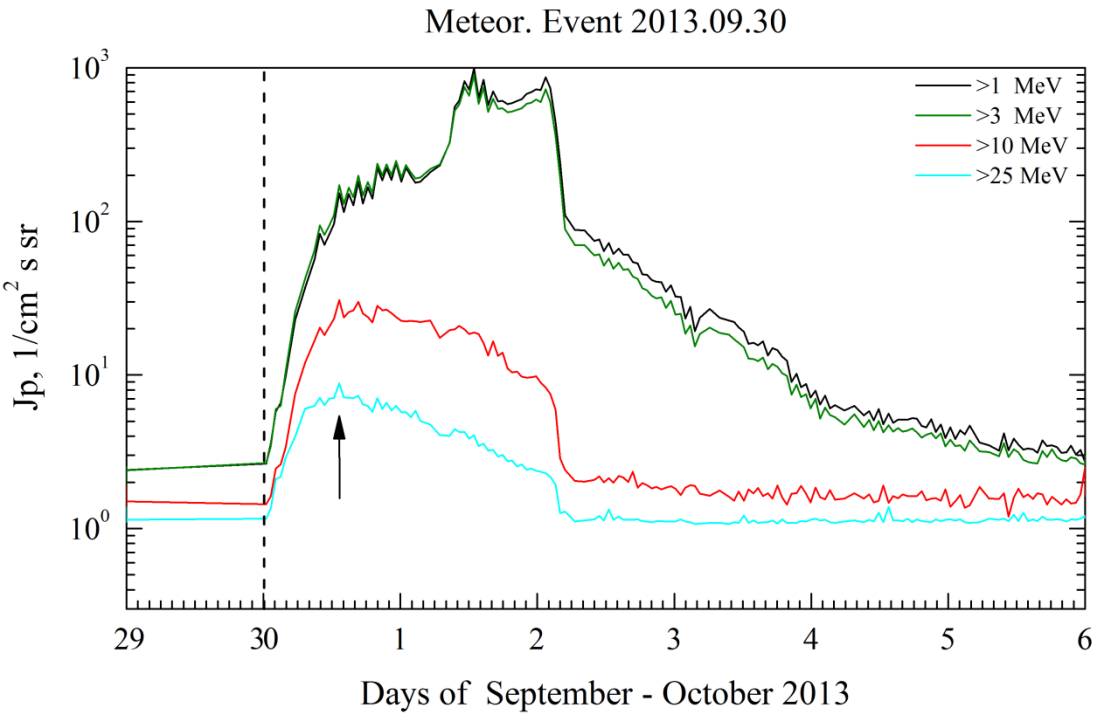


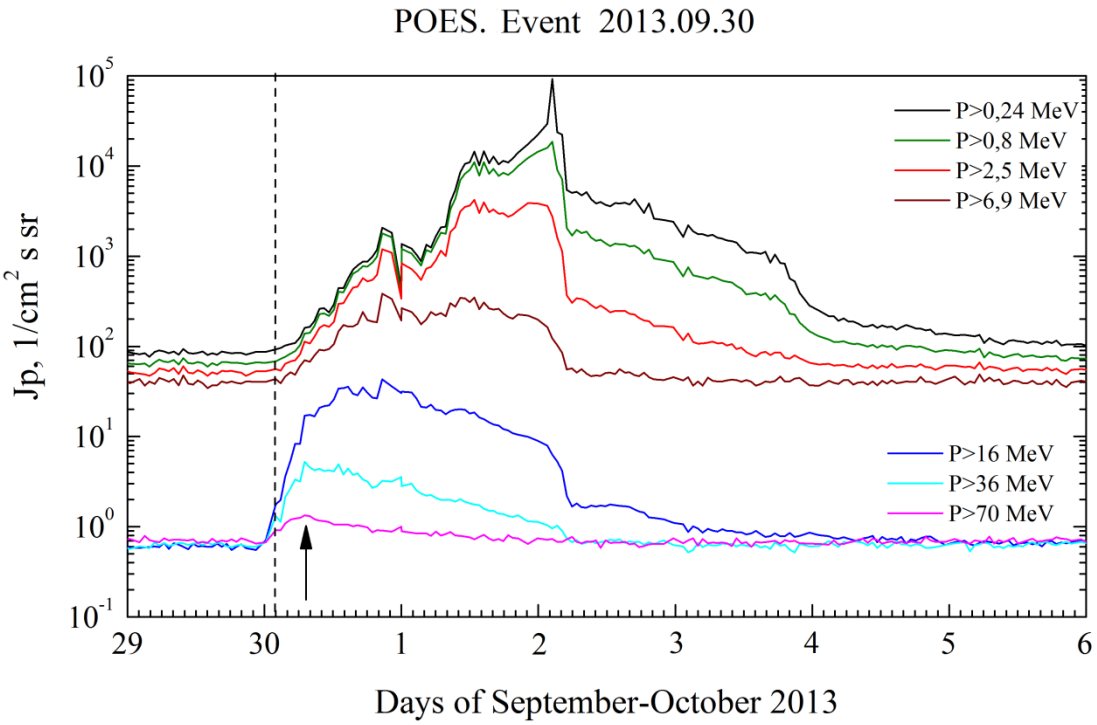



GOES. Event 2013.09.30
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of September - October 2013


Electro. Event 2013.09.30
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of September - October 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 September 30

2013 September 29 • DSF To event 536

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical flare event on visible solar disc					
303 Å	DSF	2145			N15W40	35º	
1 – 12	keV	2143	2339	0103	N10W33	C1.2	0.011
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
245	MHz	2207	2207	2207		2.0	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	0952		1009	406	1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2212	1179	- 5.3	360˚	343˚	SOHO

References:

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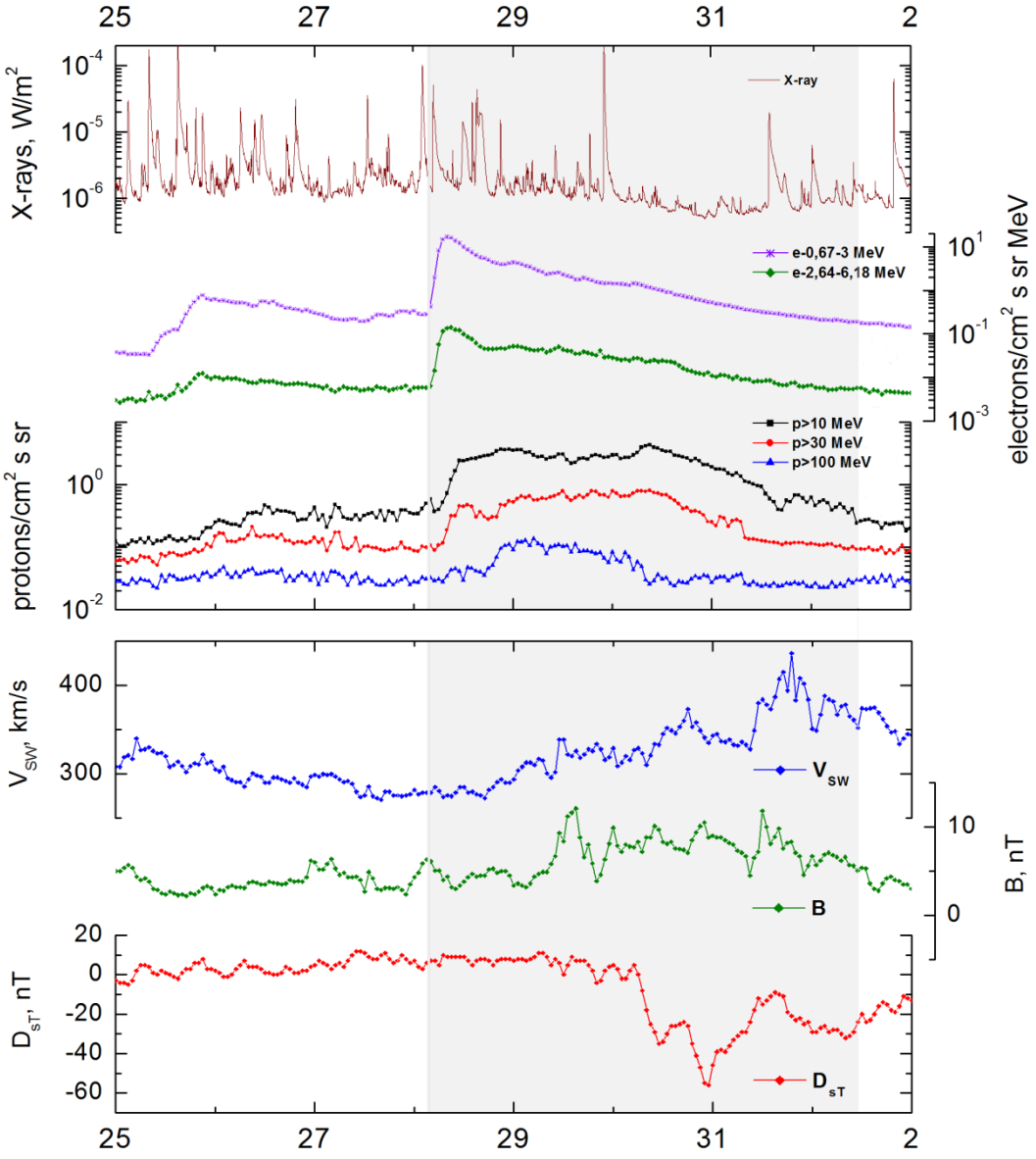
Particle event: To(Ep>10 MeV) – 28d06^{h}
Tmax$_1$(Ep>10 MeV) – 28d11^{h}, Jmax$_1$ (Ep>10 MeV) – 2.3/cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 29d02^{h}, Jmax$_2$ (Ep>10 MeV) – 3.5 /cm^2·s·sr
Duration of the event – 4 days, power-law index: γ_1 = 2.35, γ_2 = 1.7
Quasimaximal energy of protons in the event – Eqm$_1$ = 100 MeV
– Eqm$_2$ = 300 MeV

Sources: ● solar flare 28d01^{h}41^{m}, X1.0/2N, N04W66, AR11875,
Ø solar flare 28d04^{h}32^{m}, M5.1/2B, N08W71, AR11875
Ø solar flare 28d14^{h}45^{m}, 1N/M2.7, M4.4, S06E28; AR11882
Main burst X-ray 1–8 Å: onset – 28d01^{h}41^{m}, max – 28d02^{h}03^{m}, Φ = 0.084 J/m^2
CME: 28d02^{h}24^{m}, V= 695 km/s, Δφ = 360, dA= 296°

Particle fluxes and associated phenomena

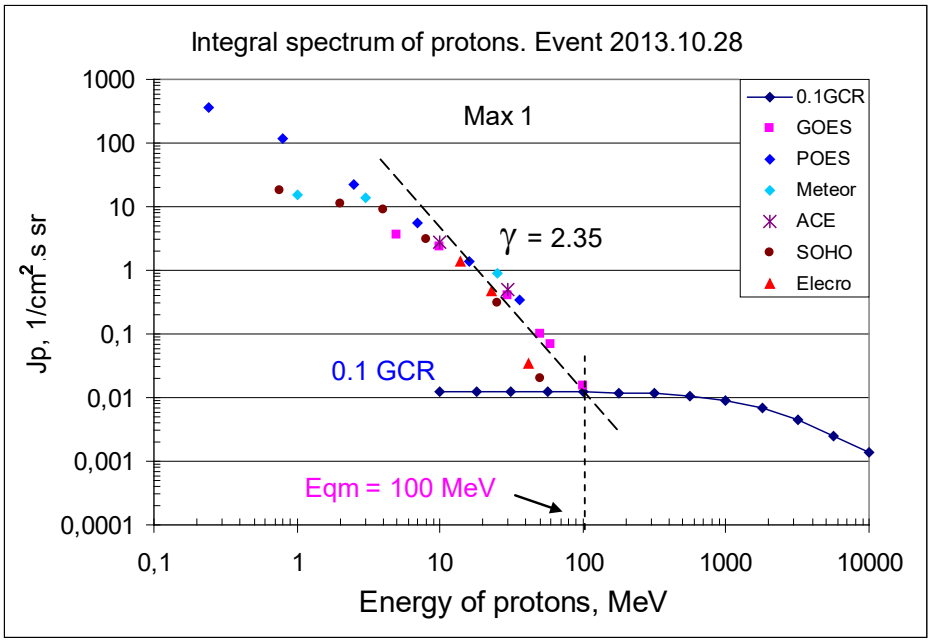


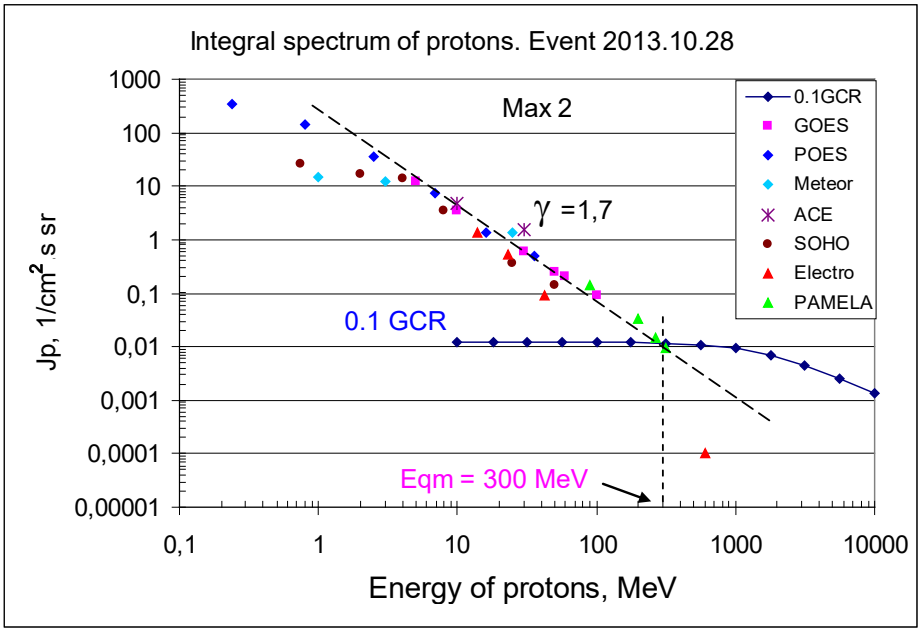
Integral fluxes of protons for the event of 2013 October 28

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	6	11/29d02	3.7/12.2	4	0.2	
EPS	>10	6	11/29d02	2.3/3.5	4	0.12	
EPS	>30	6	11/29d02	0.4/0.6	3	0.07	
EPS	>50	6	11/29d02	0.1/0.25	3	0.06	
EPS	>60	6	10/29d02	0.07/0.2	3	0.05	
EPS	>100	6	10/29d02	0.015/0.09	2	0.03	
Electro-1							
GALS-E	>600	-	- /29d01	- /0.0001	1	0.0007	
GALS-E	>800	-	- /29d01	- /0.00003	1	0.0004	
GALS-E	>1100	-	-	-	-	0.00002	
POES							
MEPED	>0.24	5	12/29d03	360/345	4	90	
MEPED	>0.8	5	12/29d03	115/145	4	70	
MEPED	>2.5	5	12/29d03	22/36	4	50	
MEPED	>6.9	5	12/29d03	5.5/7.2	3	40	
MEPED	>16	5	12/29d03	1.4/1.4	3	0.7	
MEPED	>36	5	12/29d03	0.35/0.5	3	0.75	
MEPED	>70	-	-	-	-	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	7	22/29d11	15.4/15	4	2.62	
SCR	>3	7	22/29d11	14/12.4	4	2.50	
SCR	>10	7	-	-	-	1.67	
GALS-M	>15	-	-	-	-	0.00	
GALS-M	>25	5	12/29d11	0.9/1.4	3	1.16	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	6	13/23	2.7/4.7	3	1.4	
SIS	>30	6	13/29d01	0.5/1.5	3	1	
PAMELA							
TRACKER	>90	18	- /17-29d08	- /0.14	>2		
TRACKER	>200	18	- /17-29d08	- /0.034	2		
TRACKER	>265	18	- /17-29d08	- /0.015	<2		
TRACKER	>312	18	- /17-29d08	- /0.0097	1		
SOHO							
EPHIN	>50	3	12/29d01	0.02/0.14	2	0.2	

Differential fluxes of protons for the event of 2013 October 28

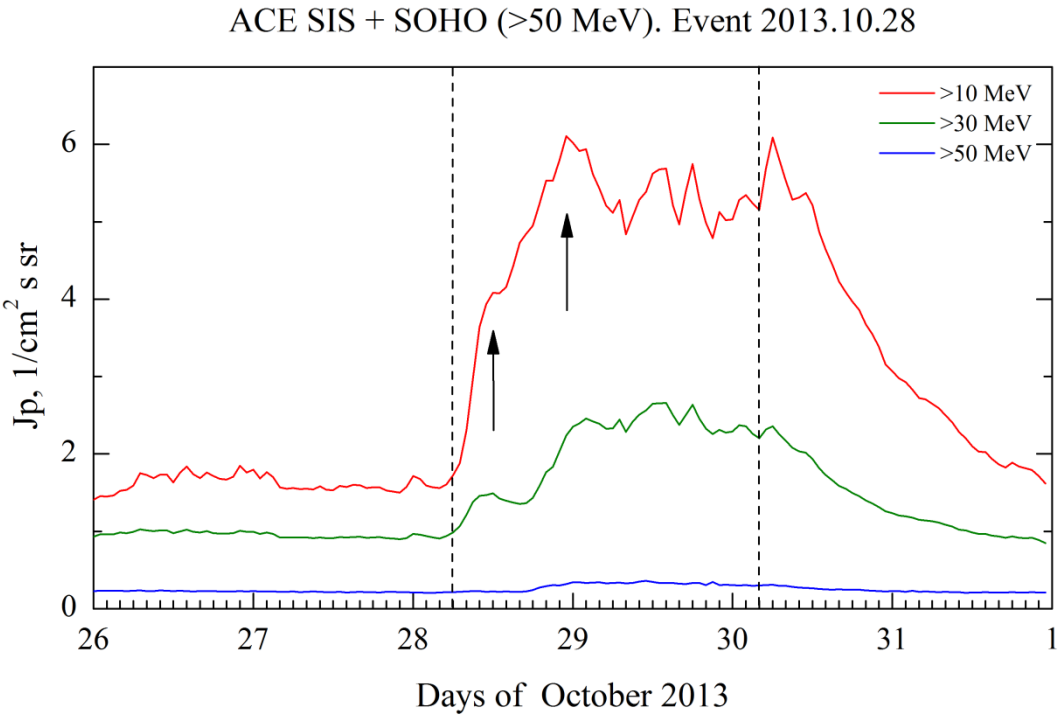
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	7	14/29d01	5.48/7.5	5	0.01	
LION	2 – 6	7	14/29d01	0.55/1.08	5	0.01	
EPHIN	4 – 8	7	14/29d01	1.55/2.65	4	0.01	
EPHIN	8 – 25	7	14/29d01	0.16/0.18	4	0.005	
EPHIN	25 – 53	5	13/29d01	0.01/0.008	4	0.006	
Electro-1							
SCR-E	13.7–23	6	13/29d02	0.1/0.09	3	0.06	
SCR-E	23–42	6	13/29d02	0.023/0.023	3	0.025	
SCR-E	42–112	8	13/29d02	0.0005/0.0013	2	0.005	

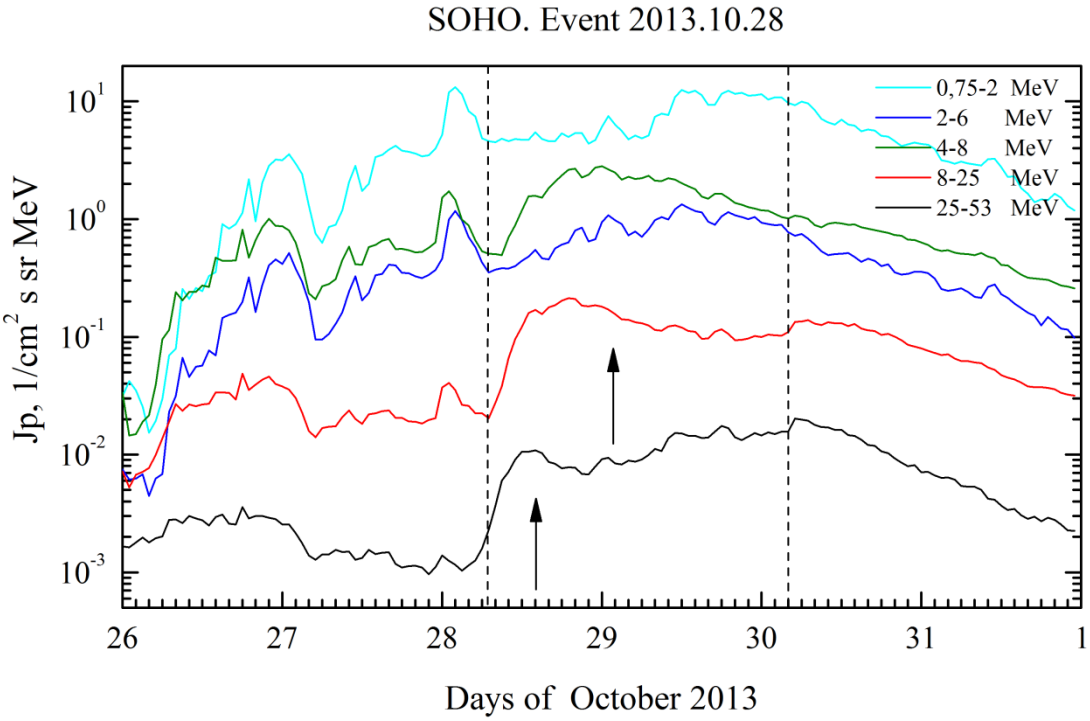

Integral spectrum of protons. Event 2013.10.28
Max 1
γ = 2.35
0.1 GCR
Eqm = 100 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Elecro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2013.10.28
Max 2
γ =1,7
0.1 GCR
Eqm = 300 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
PAMELA
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,00001
0,1
1
10
100
1000
10000

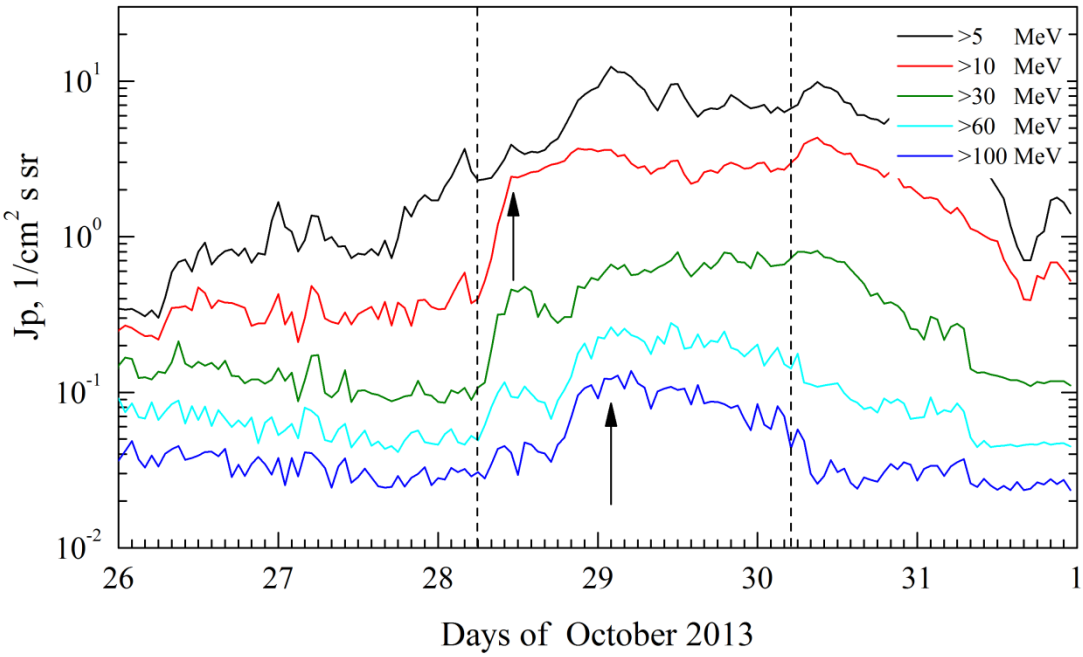
Time profiles of proton fluxes in the event 2013.10.28

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

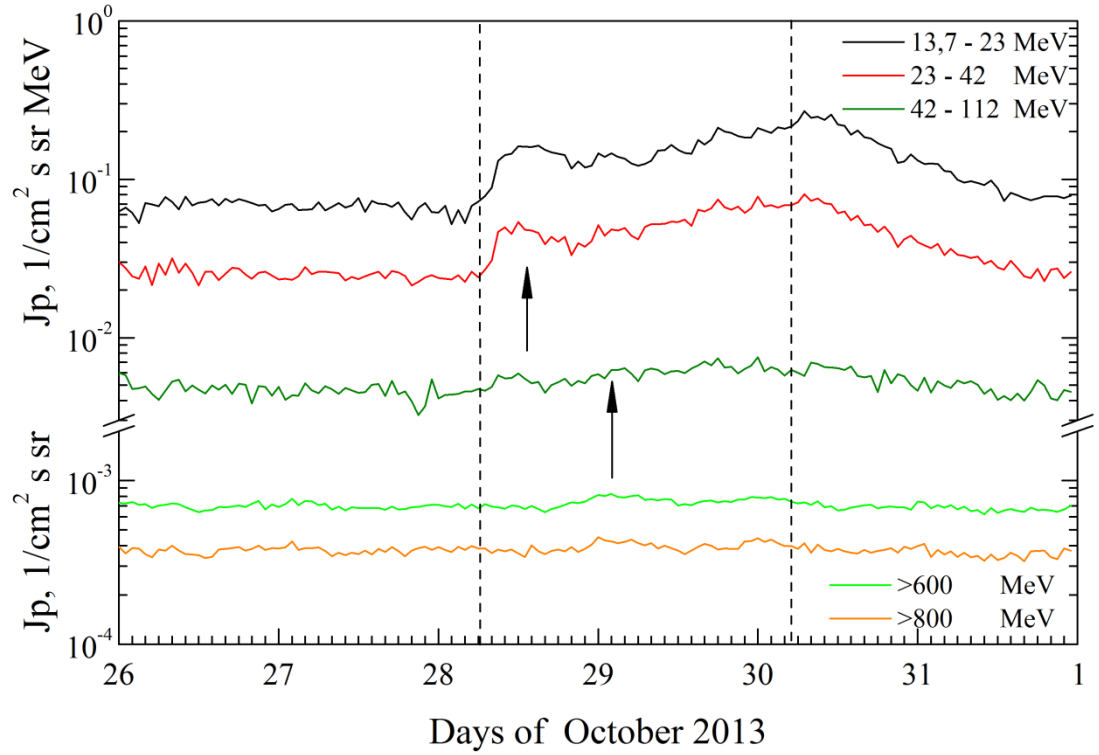




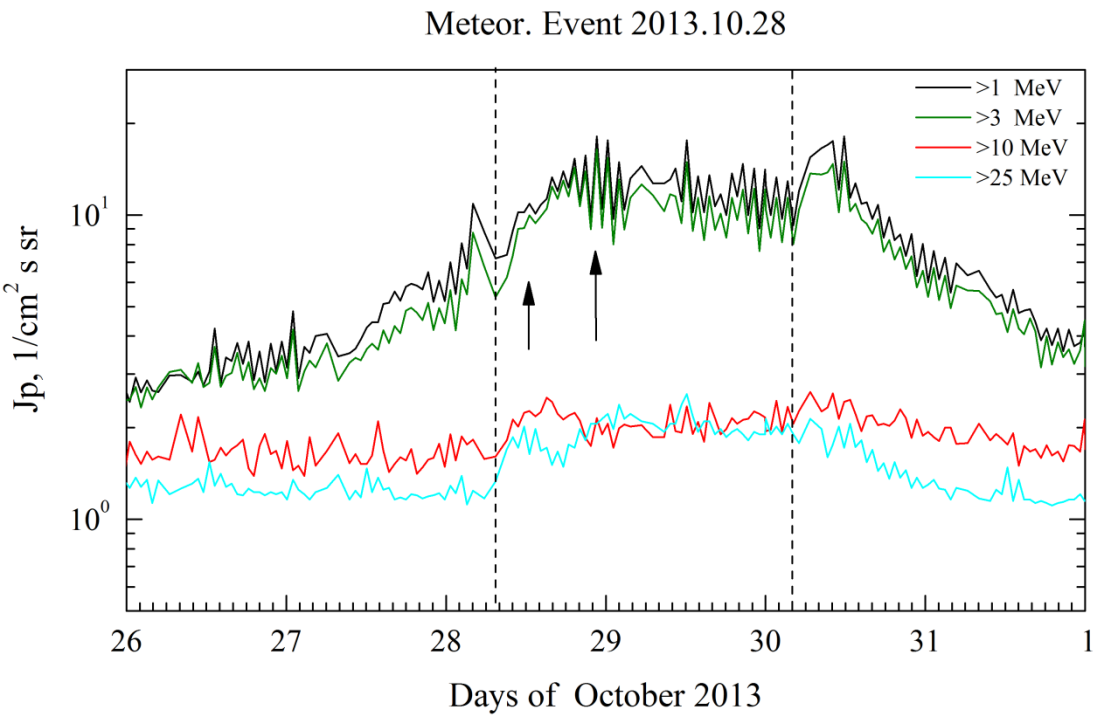
GOES. Event 2013.10.28

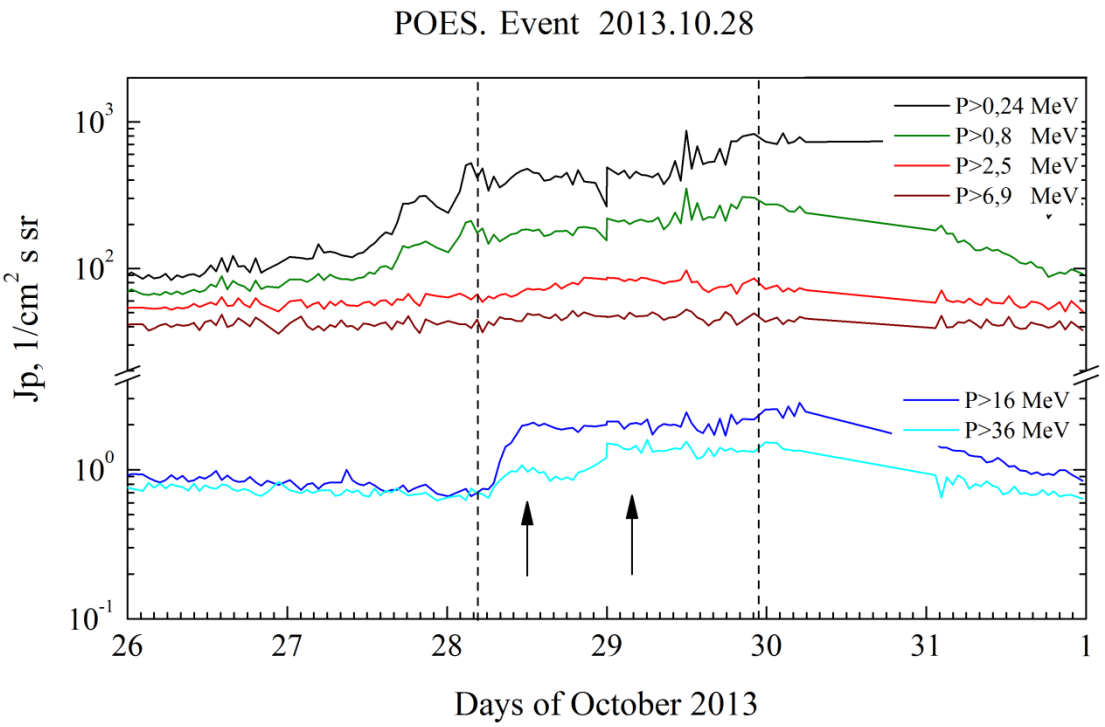


Electro. Event 2013.10.28



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 October 28

2013 October 28 • AR 11875 To event 537

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0149	0156	0231	N04W66	2N	PRB
1–12	keV	0141	0203	0212	N05W72	X1.0	0.084

X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0137:55	02:00:34	02:19:36	538262	289584192	FERMI
100–300	keV	0151:44	0200:34	02:25:00	9863	30720740	HESSI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0155	0159	0208	U2.7 / 15	3.52	
8.8	GHz	0155	0159	0205		3.41	
5	GHz	0155	0159	0202		2.92	
2.7	GHz	0157	0157	0159	0.2 – 2.7	2.08	
1.4	GHz	0158	0158	0158		2.3	
410	MHz	0207	0207	0207		2.08	
245	MHz	0211	0211	0211		2.08	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	80-180	0200		0204		2	
DS III	18-270	0155		0200		2	

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0224	695	- 12.1	360˚	296˚	SOHO

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 October 28

2013 October 28 Ø AR 11875 To event 537

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	0432	0439	0453	N08W71	2B	ERU
1 – 12	keV	0432	0441	0446	N08W72	M5.1	0.021

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12–25	keV	0434:54	0440:15	0527:45	334322	88715960	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0436	0438	0440	U1.4 / 9	3.18	
8.8	GHz	0437	0438	0440		3.00	
5	GHz	0437	0438	0440		2.7	
2.7	GHz	0438	0438	0439		2.23	
1.4	GHz	0439	0439	0439		2.00	
410	MHz	0438	0438	0438		2.34	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	25-117	0437		0441		2	
DS IV	58-180	0437		1016		1	
DS III	18-500	0437		0441		3	
DS V	20-80	0439		0443		3	
DH II	14-0.2	0441		1151			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0448	1202	- 45.2	156˚	313˚	SOHO

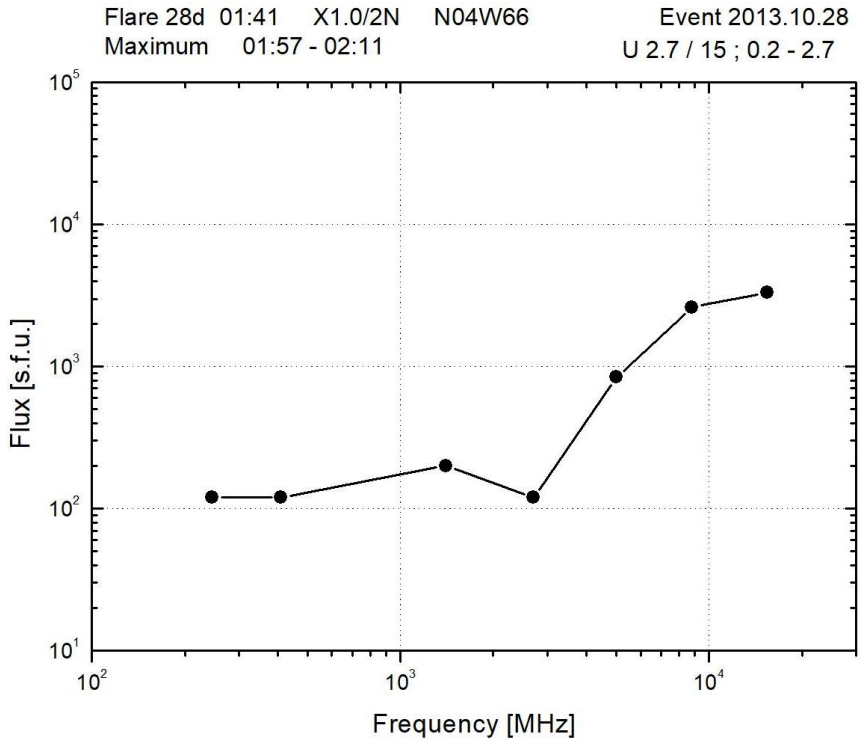
Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 October 28

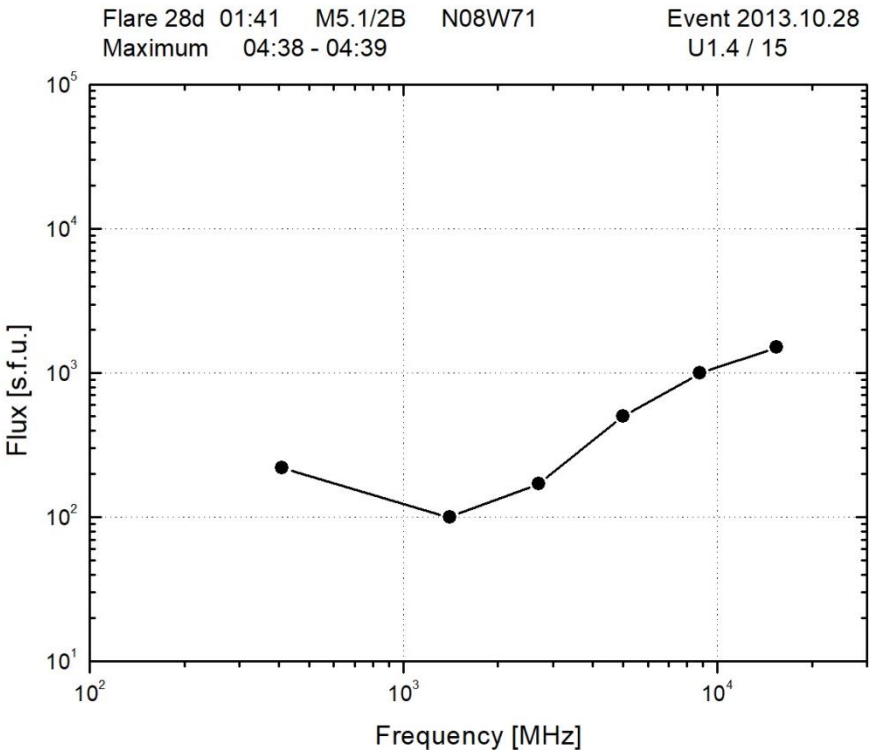
2013 October 28 Ø AR 11882 To event 537

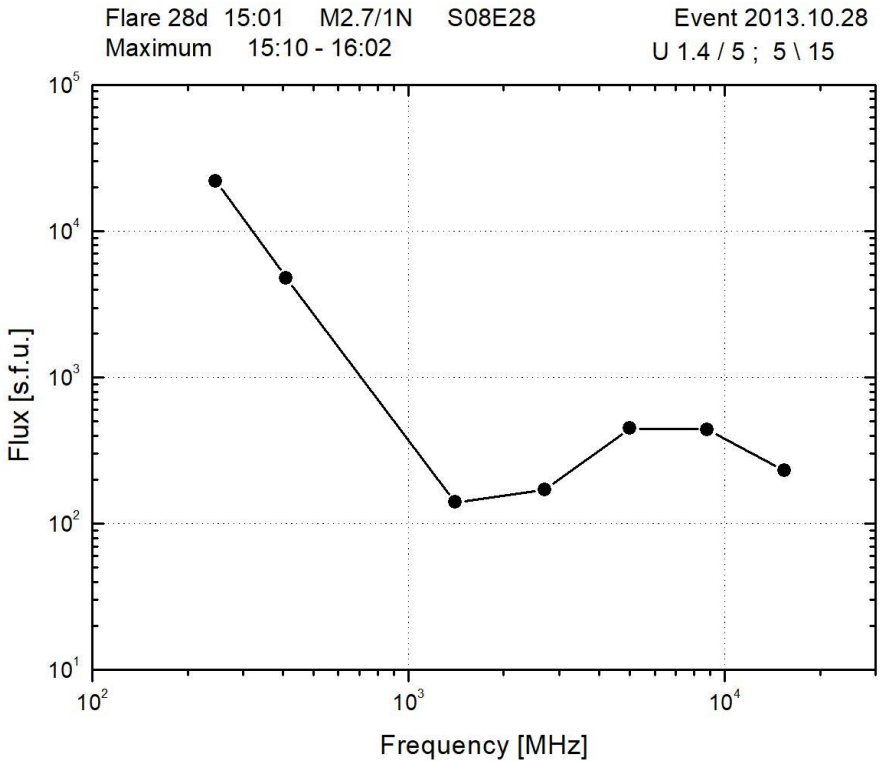
Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	<1450	~1515	>1520	S08E28	1N	ERU
1 – 12	keV	1446	1501	1504	S08E27	M2.7	0.0098
1 – 12	keV	1507	1515	1521	S06E28	M4.4	0.026
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
50 – 100	keV	1445:28	1512:06	1528:48	2288	8849536	HESSI
12-25	keV	1451:24	1459:11	1503:13	155038	26128808	FERMI
12-25	keV	1539:36	1551:09	16:06:26	42072	10449810	FERMI
>100	MeV	1545:30		1606:30		1.44E-05*	FERMI
100–300	keV	1545:30		1606:30		8849536	HESSI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1509	1510	1512		2.36	
8.8	GHz	1508	1510	1514		2.64	
5	GHz	1508	1510	1514	5 \ 15	2.65	
2.7	GHz	1508	1510	1514		2.23	
1.4	GHz	1508	1514	1516	U1.4 / 5	2.15	
410	MHz	1509	1602	1609		3.68	
245	MHz	1506	1511	1613		4.34	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	1510		1529		2	
DS IV	50-180	1515		2129		1	
DS III	25-180	1510		1510	G	1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1536	812	- 17.7	360˚	086˚	SOHO

* cm^{-2}·s^{-1}

Radio bursts frequency spectrum







Proton Active Region:

AR11882 (S09L291, CMP 30.5.10.2013,
Sp=390, DKC, BGD, R)
XRI=9.96; $X_2^{2.1}$+$M_{11}^{4.4}$+ C_9,
PFR1 25.10 (18^h) $X_2^{2.1}$+$M_9^{2.9}$
PFR2 28.10 (1.5^h) $M_2^{4.4}$

AR11875 (N07L027, CMP 22.10.2013,
Sp=420 msh, DKC, BGD, R)
XRI=6.53; $X_2^{2.3}$+$M_{11}^{5.1}$+C_{57}; 2_3+1_8+S_{72};
PFR1 22-24.10 (58^h) - $M_8^{4.2}$;
PFR2 27-29.10, (57^h) $X_2^{2.3}$+$M_4^{5.1}$

References:

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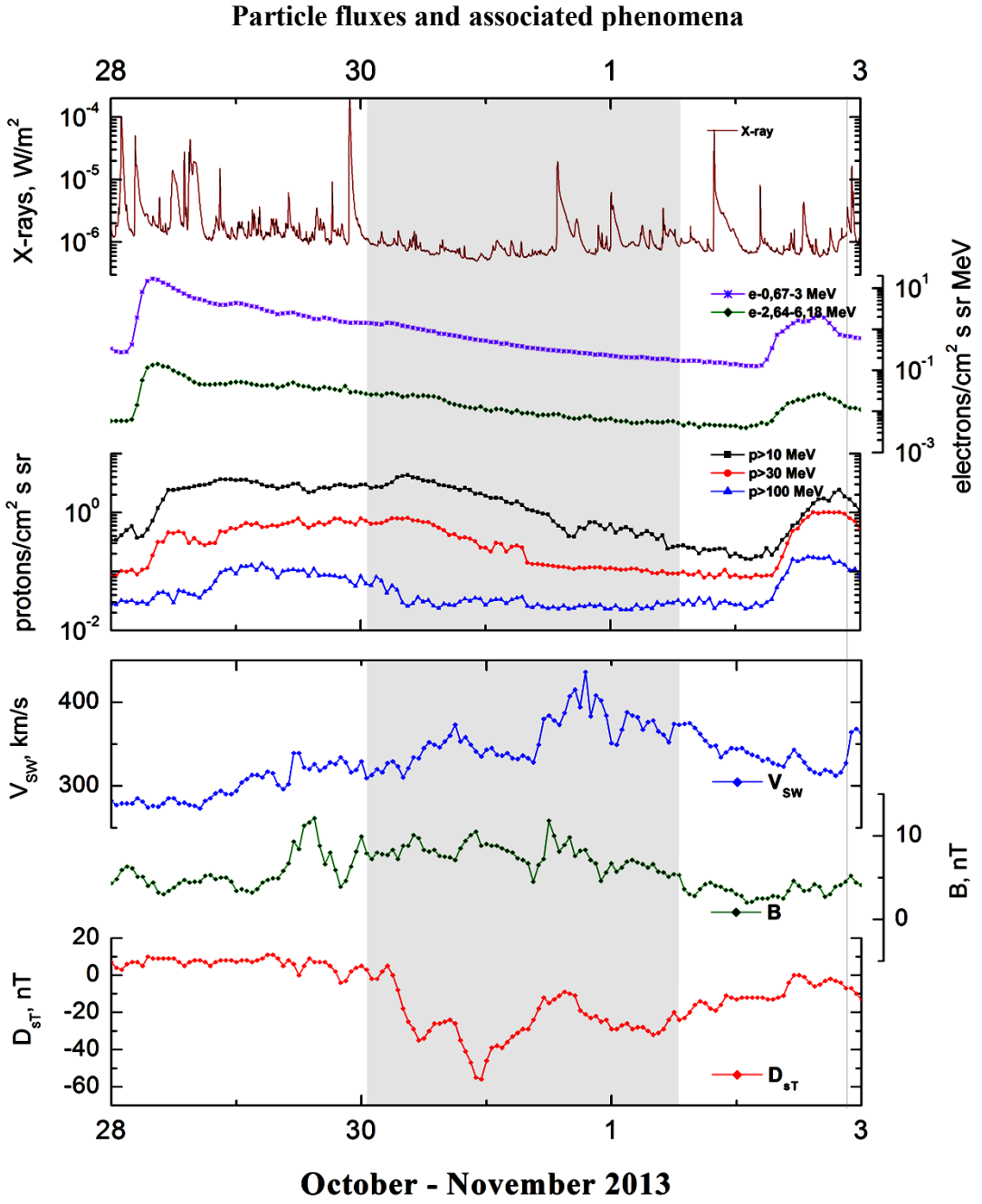
Gopalswamy N., H. Xie, S. Akiyama et al., 2014.
Gopalswamy N., S. Yashiro, P. Mäkelä et al., 2021.
Grechnev V., V. Kiselev, N. Meshalkina, I. Chertok, 2017.
Koleva K., M. Dechev, P. Duchlev, 2021.
de Nolfo G.A., A. Bruno, J.M. Ryan et al., 2019.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Zhuang B., N. Lugaz, T. Gou, L. Ding, 2021.

Event 2013.10.30 – (2013-303) **538**

Particle event: To(Ep>10 MeV) – 30d02^{h}
Tmax (Ep>10 MeV) – 30d05^{h}, Jmax (Ep>10 MeV) – 4.2 /cm^2·s·sr
Duration of the event – 2 days, power-law index: $\gamma = 2.4$
Quasimaximal energy of protons in the event – Eqm = 130 MeV

Sources: ■ solar flare 29d21^{h}42^{m} X2.3/, N05W89 AR11875
Main burst X-ray 1–8 Å: onset – 29d21^{h}42^{m}, max – 29d21^{h}54^{m}, Φ = 0.14 J/m^2
CME: 29d22^{h}00^{m}, V= 1001 km/s, Δφ = 360, dA=249°

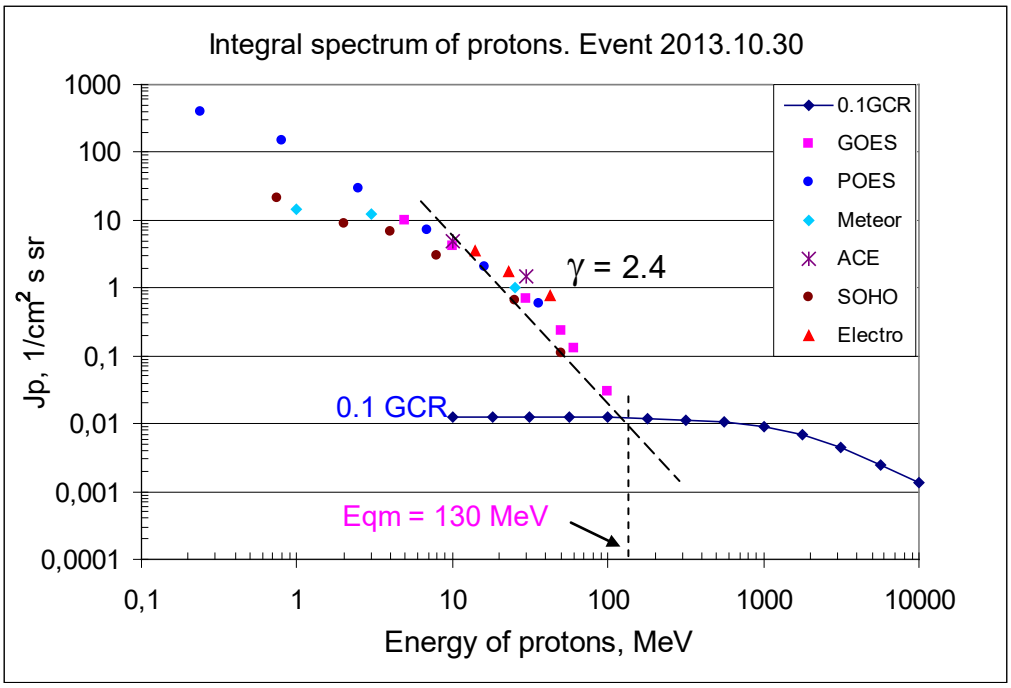


Integral fluxes of protons for the event of 2013 October 30

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	5	10	9.7	1.5	0.2	
EPS	>10	5	10	4.2	1.5	0.12	
EPS	>30	5	10	0.7	1	0.1	
EPS	>50	5	8	0.23	1	0.06	
EPS	>60	5	7	0.13	1	0.05	
EPS	>100	5	7	0.03	1	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	-	2	400	2	400	
MEPED	>0.8	-	2	150	2	120	
MEPED	>2.5	-	2	30	2	50	
MEPED	>6.9	-	2	7	2	40	
MEPED	>16	29d23	2	2.1	2	0.7	
MEPED	>36	29d23	2	0.6	2	0.75	
MEPED	>70	-	-	-	-	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	4	10	14.7	3	2.6	
SCR	>3	4	10	12.2	3	2.5	
SCR	>10	4	-	-	1	1.7	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	-	-	1	?	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	4	6	5	3	1.1	
SIS	>30	4	6	1.5	3	0.8	
SOHO							
EPHIN	>50	4	6	0.11	1	0.2	

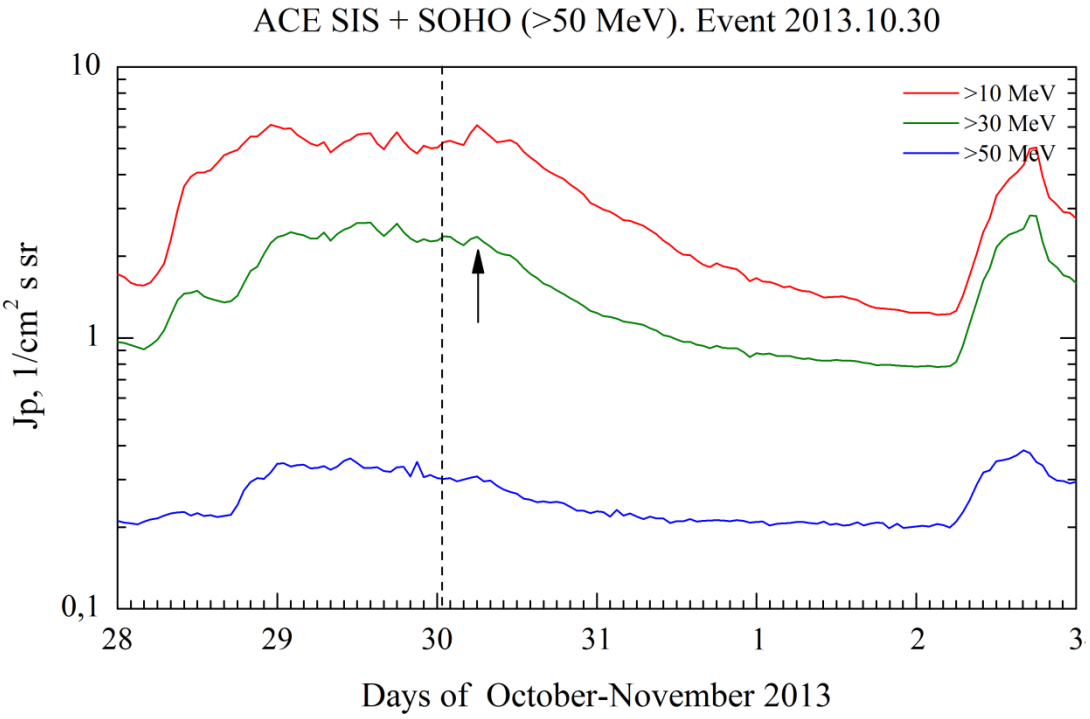
Differential fluxes of protons for the event of 2013 October 30

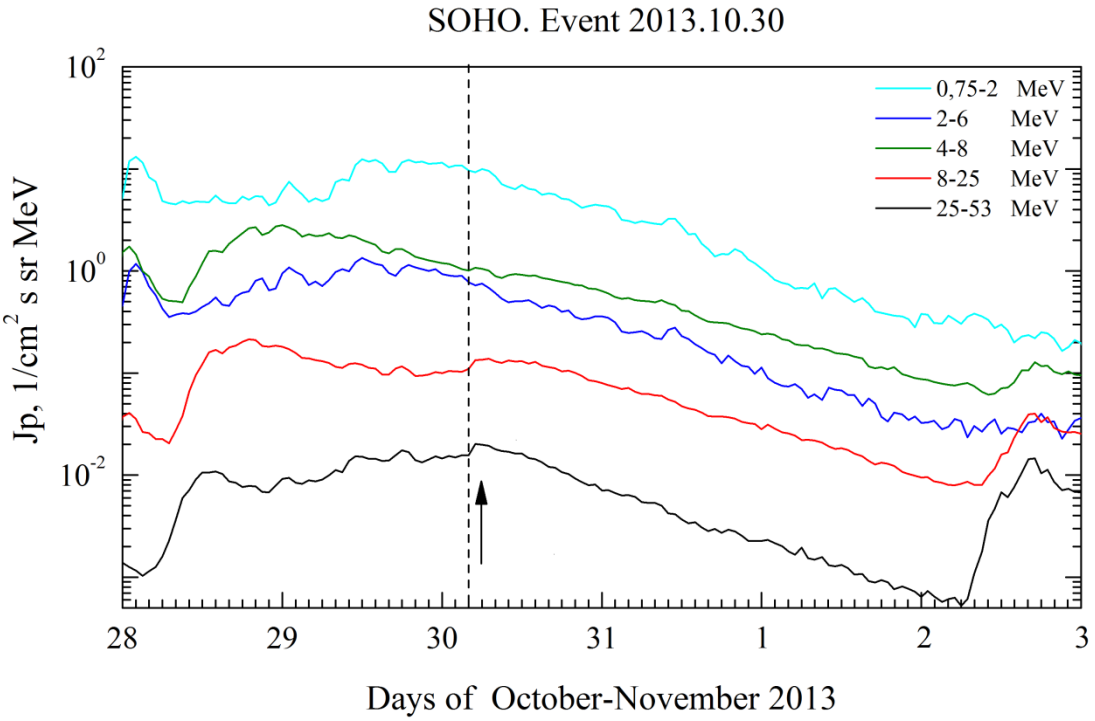
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	4	6	9.5	2.5	0.06	
LION	2 – 6	4	6	0.75	2.5	0.01	
EPHIN	4 – 8	4	6	0.9	2.5	0.01	
EPHIN	8 – 25	4	6	0.14	2.5	0.003	
EPHIN	25 – 53	4	6	0.02	2.5	0.0004	
Electro-1							
SCR-E	13.7–23	5	7	0.2	2	0.06	
SCR-E	23–42	5	7	0.05	2	0.025	
SCR-E	42–112	5	7	0.002	2	0.005	

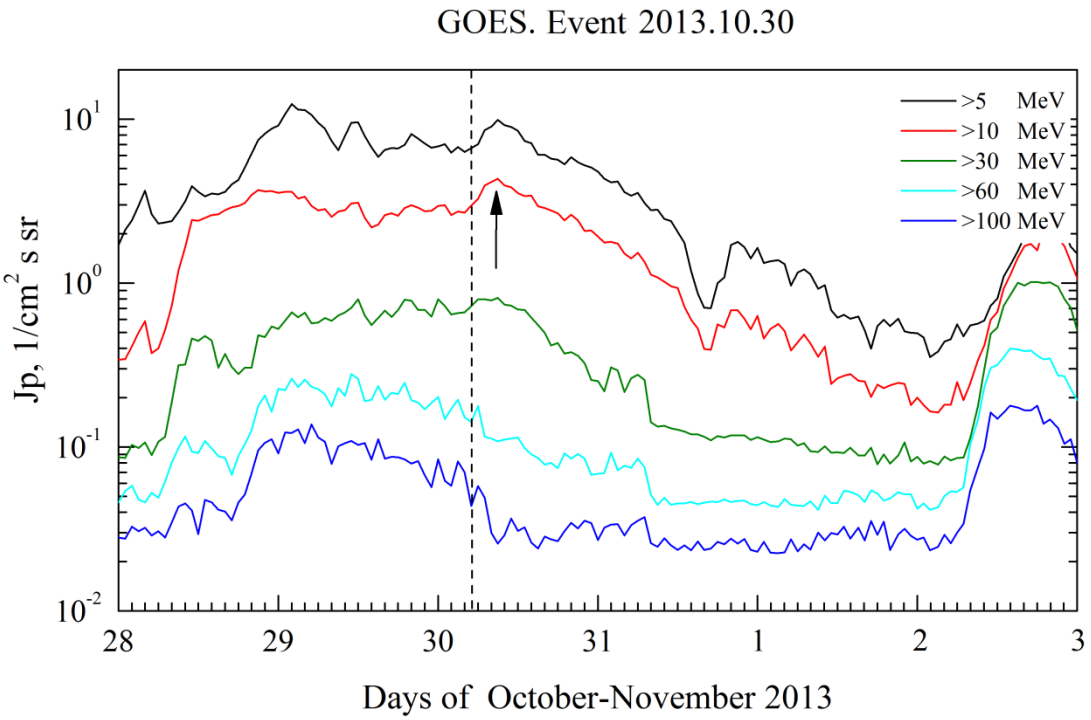

Integral spectrum of protons. Event 2013.10.30
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.4
0.1 GCR
Eqm = 130 MeV

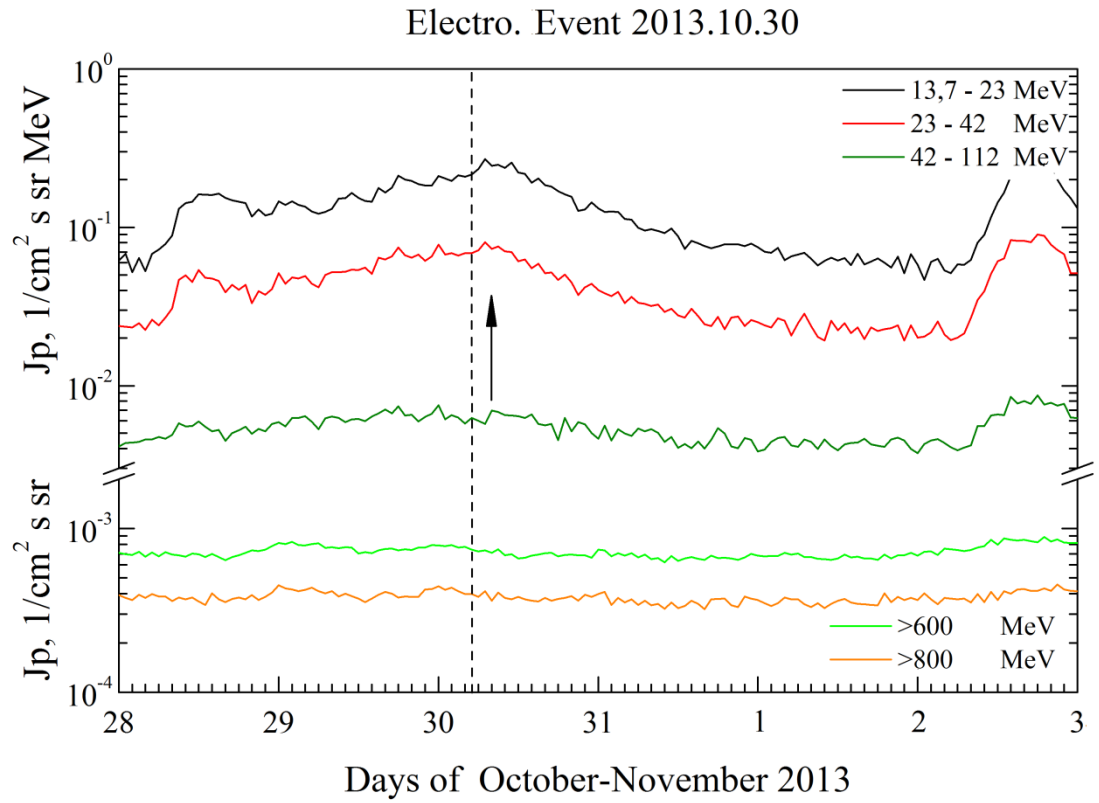
Time profiles of proton fluxes in the event 2013.10.30

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



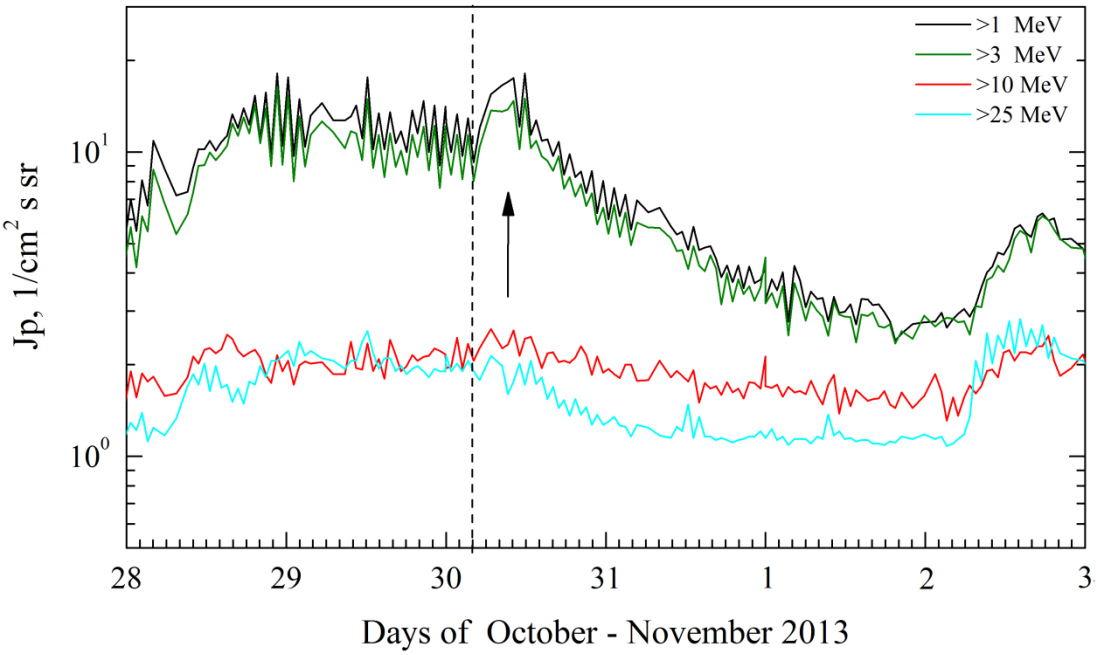



GOES. Event 2013.10.30
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Jp, 1/cm² s sr
10¹
10⁰
10⁻¹
10⁻²
28
29
30
31
1
2
3
Days of October-November 2013

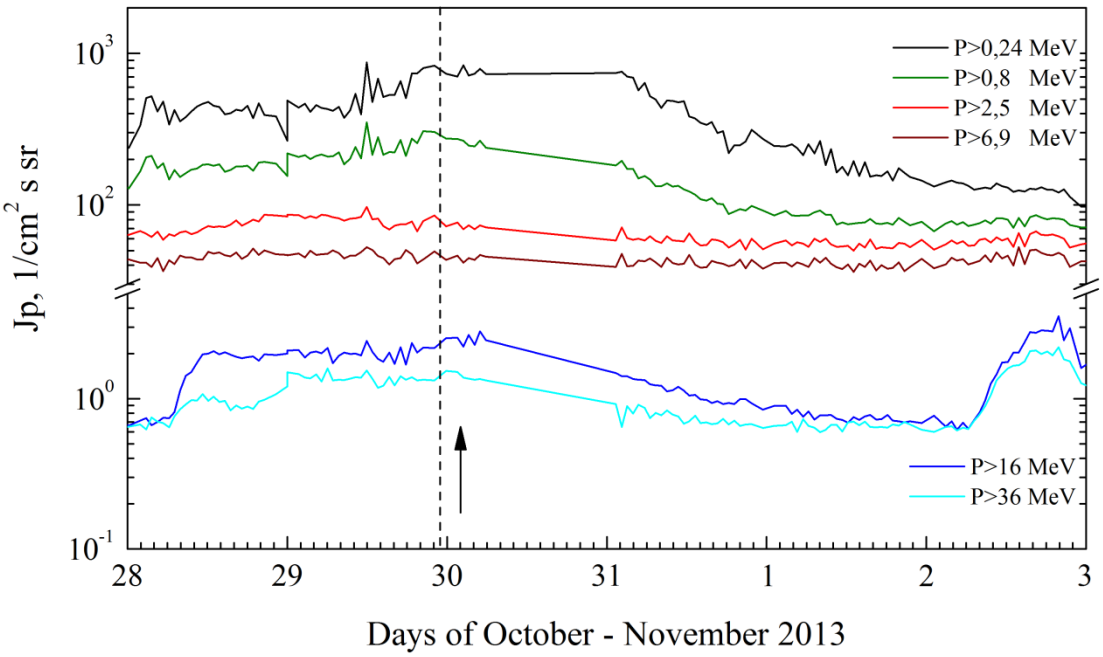

Electro. Event 2013.10.30
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
10⁰
10⁻¹
10⁻²
10⁻³
10⁻⁴
28
29
30
31
1
2
3
Days of October-November 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2013.10.30



POES. Event 2013.10.30

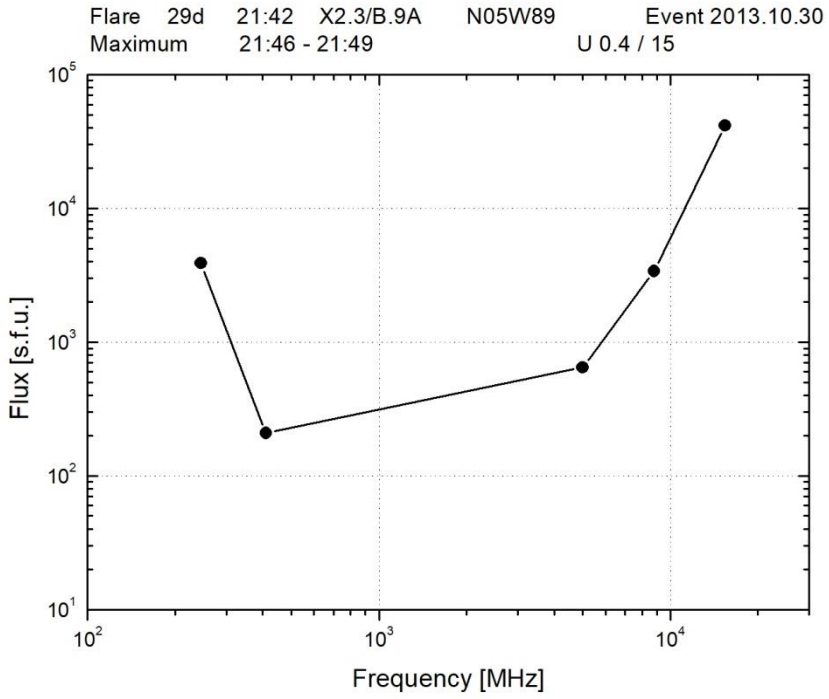


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 October 30

2013 October 29 ■ AR 11875 To event 538

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical flare on visible disk					
6563 Å	LPS	2300	0049	0049	N05W90	B.9A	
1 – 12	keV	2142	2154	2201	N05W89	X2.3	0.14
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	2146	2148	2157	U0.4 / 15	4.62	
8.8	GHz	2146	2148	2157		3.53	
5	GHz	2148	2148	2155		2.81	
410	MHz	2146	2149	2149		2.32	
245	MHz	2146	2146	2151		3.59	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-300	2148		2210		1	
DS IV	25-180	2158		2359		1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2200	1001	- 29.7	360˚	249˚	SOHO

Radio burst frequency spectrum



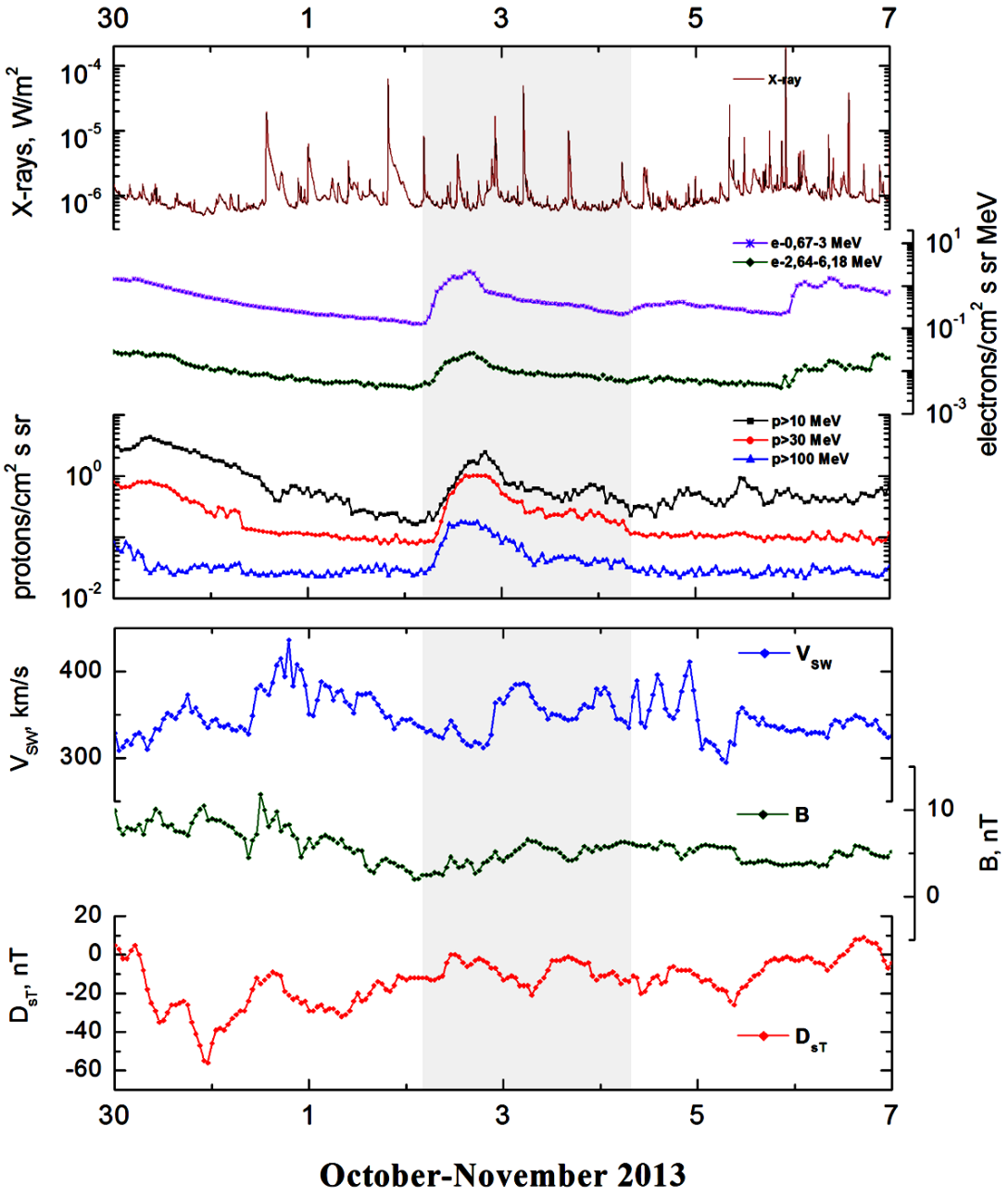
Proton Active Region:

AR11875 (N07L027, CMP 22.10.2013
Sp=420 msh, DKC, BGD, R)
XRI=6.53; $X_2^{2.3}$+$M_{11}^{5.1}$+C_{57}; 2_3+1_8+S_{72}
PFR1 22-24.10 (58^h) - $M_8^{4.2}$
PFR2 27-29.10 (57^h) $X_2^{2.3}$+$M_4^{5.1}$

Particle event: To(Ep>10 MeV) – 02d07^{h}
Tmax(Ep>10 MeV) – 02d16^{h}, Jmax(Ep>10 MeV) – 1.6 /cm^{2}·s·sr
Duration of the event – 2 days, power-law index: γ = 2.2
Quasimaximal energy of protons in the event – Eqm = 300 MeV

Sources: ⊡ solar flare event 02d<04^{h}48^{m}, AR11875, 3d behind W$_{L}$
Ø solar flare 01d19^{h}46^{m}, M6.3/1B, S11E01, AR11884
CME: 02d04^{h}48^{m}, V= 828 km/s, Δφ = 360º, dA= 239º

Particle fluxes and associated phenomena

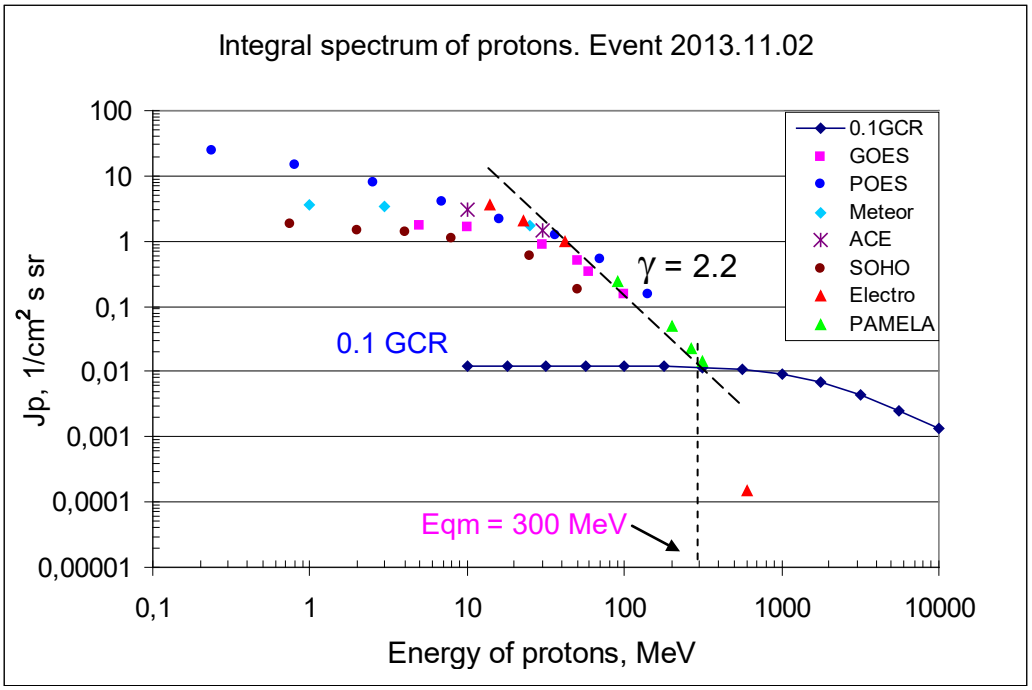


Integral fluxes of protons for the event of 2013 November 02

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	10	16	1.7	2	0.2	
EPS	>10	7	16	1.6	2	0.12	
EPS	>30	7	15	0.9	2	0.07	
EPS	>50	7	15	0.5	2	0.06	
EPS	>60	7	15	0.34	2	0.05	
EPS	>100	7	15	0.15	1	0.03	
Electro-1							
GALS-E	>600	7	15	0.00015	0.5	0.0007	
POES-							
MEPED	>0.24	-	17	25	-	95	
MEPED	>0.8	6	17	15	-	70	
MEPED	>2.5	6	17	8	-	55	
MEPED	>6.9	6	17	4	-	45	
MEPED	>16	6	18	2.15	2	0.7	
MEPED	>36	6	18	1.25	1	0.75	
MEPED	>70	6	18	0.53	1	0.8	
MEPED	>140	6	14	0.15	0.5	1	
Meteor-1							
SCR	>1	7	20	3.6	1.5	2.6	
SCR1	>3	7	20	3.6	1	2.5	
SCR1	>10	7	-	-	1	1.7	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	7	17	1.7	1	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	6	15	3	2	1.2	
SIS	>30	6	15	1.5	2	0.8	
PAMELA							
TRACKER	>90	7	0726-0813	0.24	<2	-	
TRACKER	>200	7	0726-0813	0.051	<2	-	
TRACKER	>265	7	0726-0813	0.022	<2	-	
TRACKER	>312	7	0726-0813	0.014	<2	-	
SOHO							
EPHIN	>50	7	16	0.184	2	0.2	

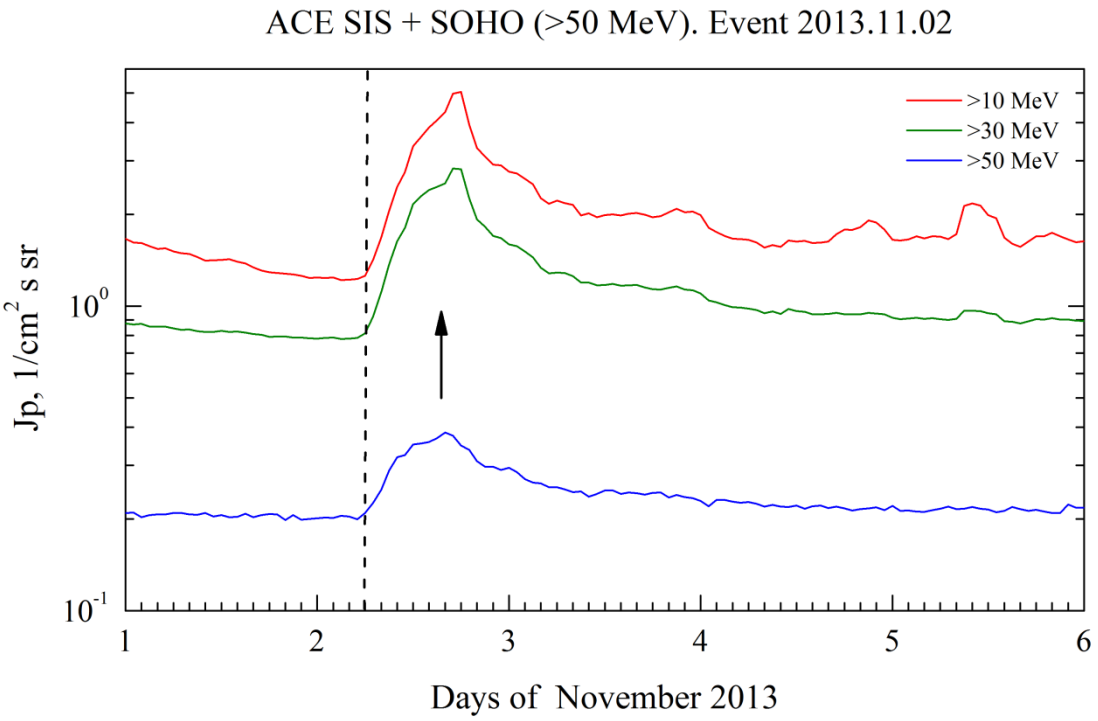
Differential fluxes of protons for the event of 2013 November 02

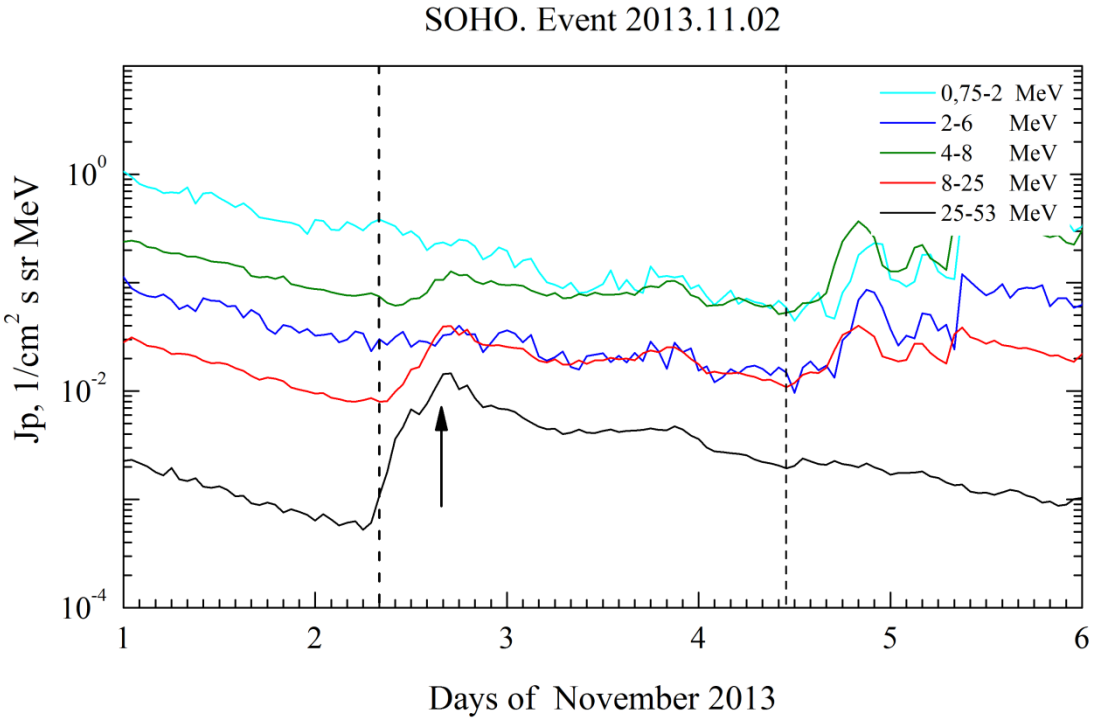
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	12	17	0.245	2	0.06	
LION	2 – 6	12	17	0.033	2	0.007	
EPHIN	4 – 8	12	17	0.07	2	0.06	
EPHIN	8 – 25	11	16	0.03	2	0.008	
EPHIN	25 – 53	8	16	0.0014	2	0.0006	
Electro-1							
SCR-E	13.7–23	7	15	0.16	1	0.06	
SCR-E	23–42	7	15	0.06	1	0.025	
SCR-E	42–112	7	15	0.005	1	0.004	

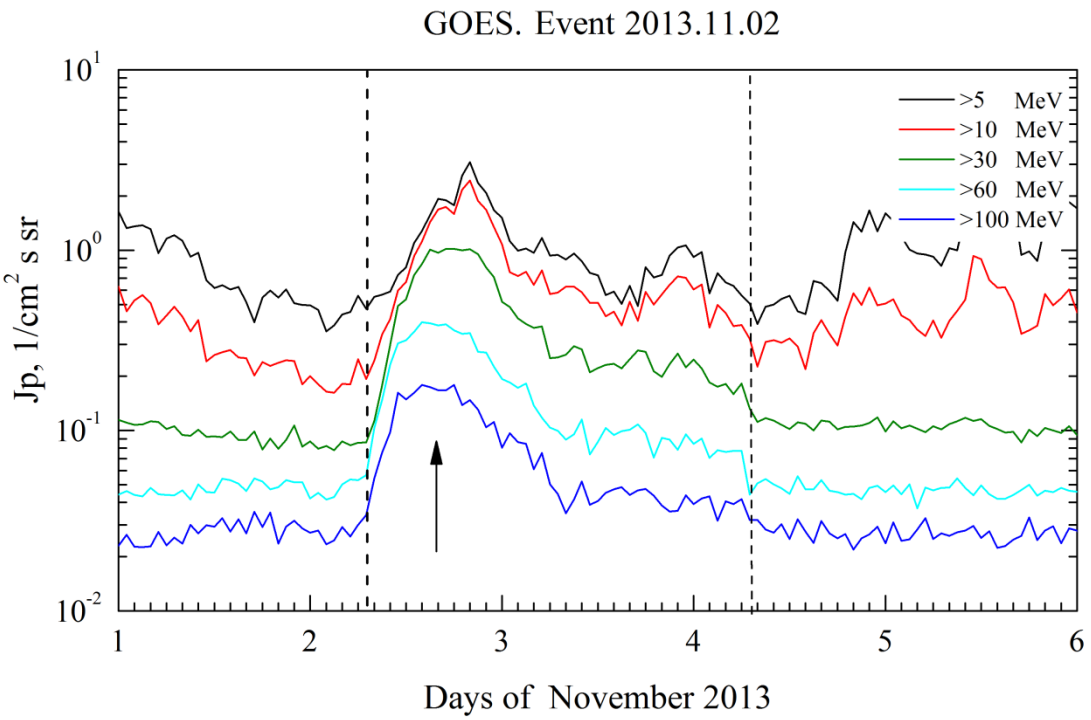


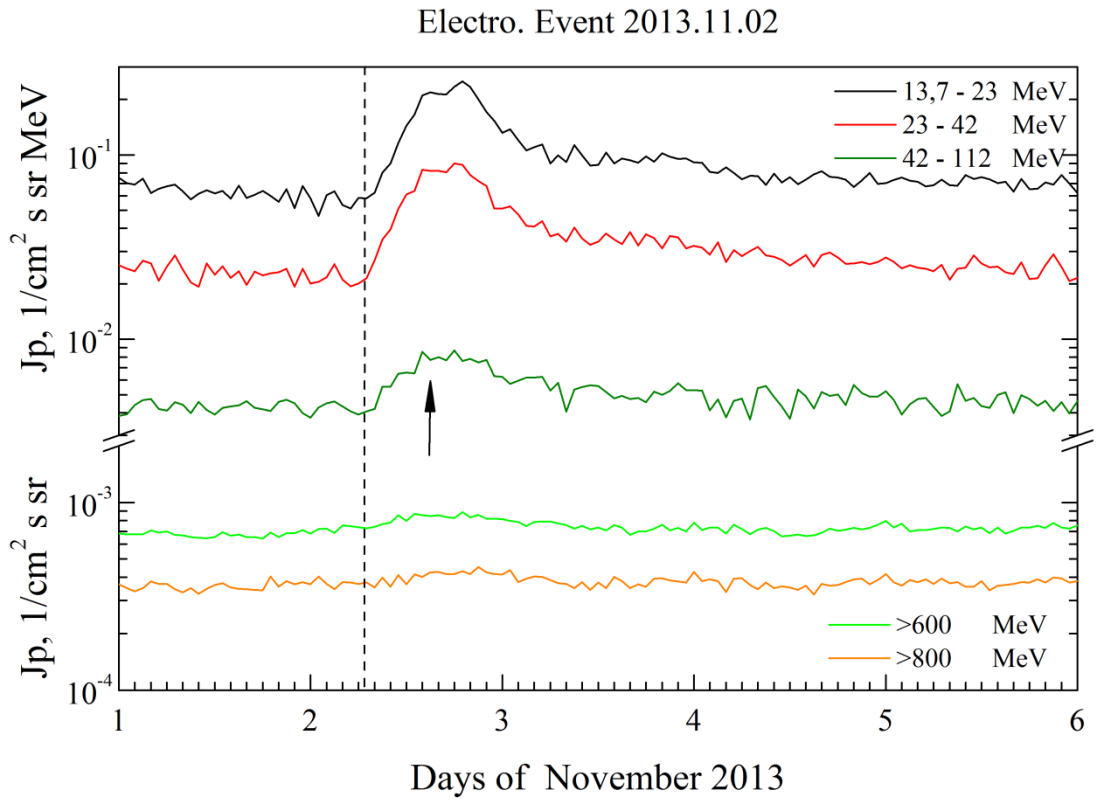
Time profiles of proton fluxes in the event 2013.11.02

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

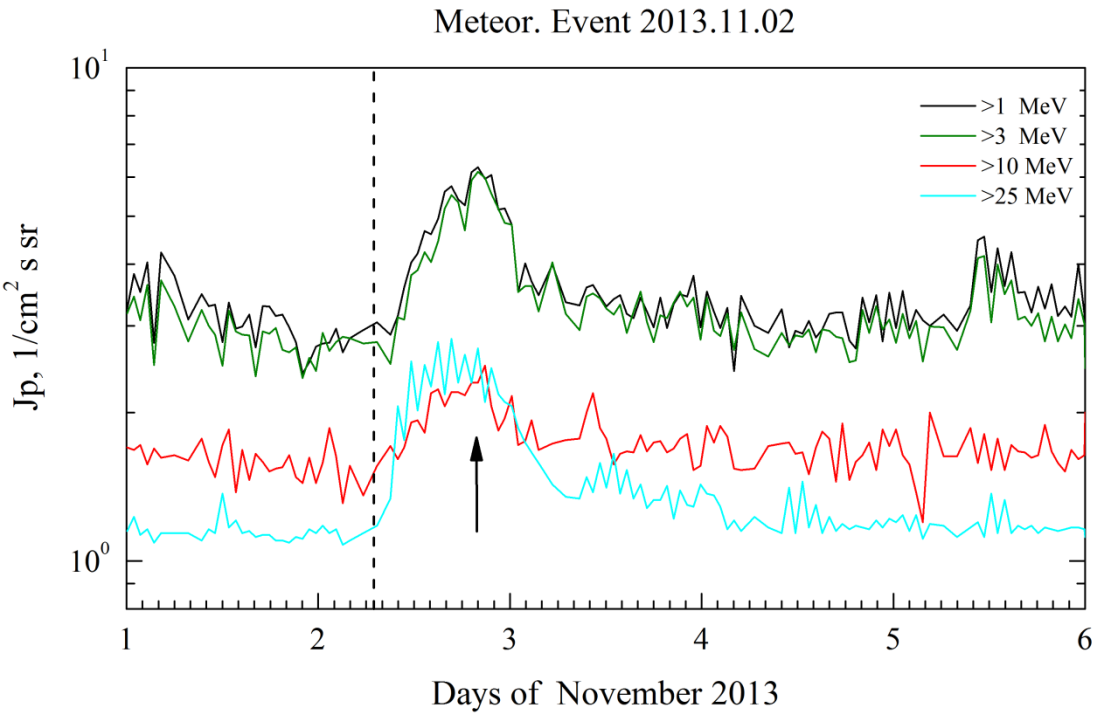


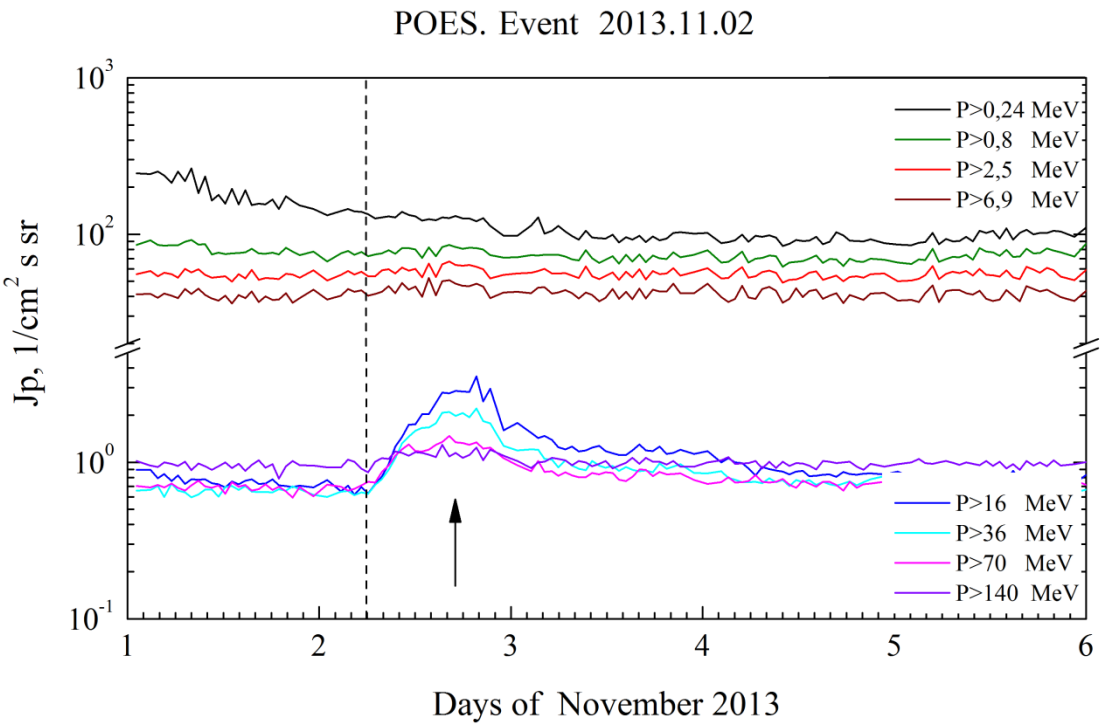



GOES. Event 2013.11.02
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of November 2013


Electro. Event 2013.11.02
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of November 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 November 02

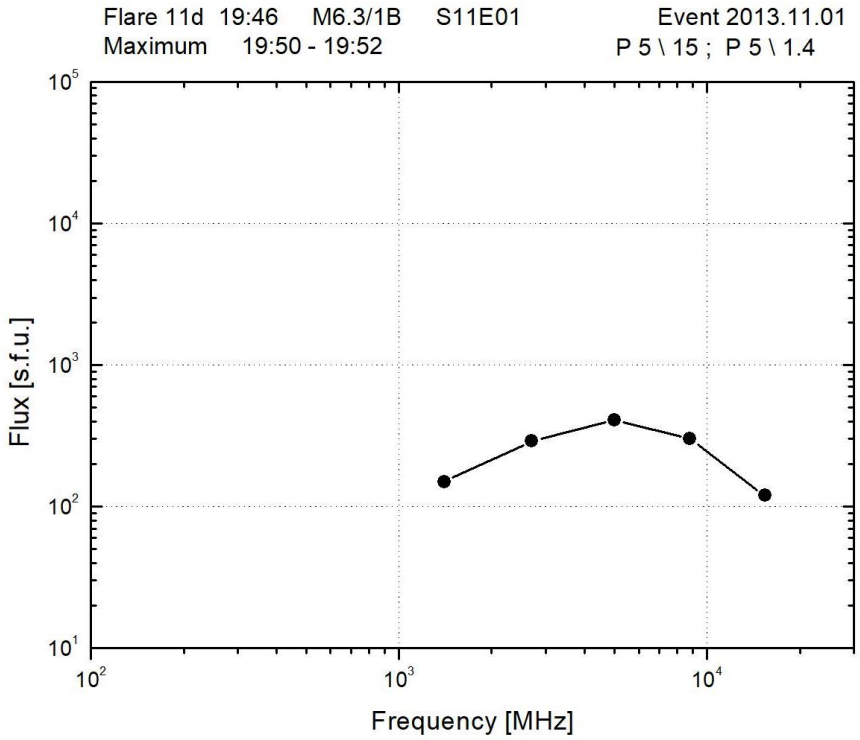
2013 November 02 ⊡ AR 11875 To event 539

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event on visible solar disc					
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0448	828	- 26.4	360˚	239˚	SOHO

2013 November 01 Ø AR 11884 To event 539

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	1949	1952	2055	S11E01	1B	ERU
1 – 12	keV	1946	1952	1958	S12E01	M6.3	0.023
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1952:58	1953:08	2033:17	289647	44193300	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1950	1952	1953	P5 \ 15	2.08	
8.8	GHz	1949	1950	1953		2.48	
5	GHz	1949	1950	1953	P5 \ 1.4	2.61	
2.7	GHz	1949	1950	1953		2.46	
1.4	GHz	1952	1952	1953		2.18	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS III	58-180	2000		2007		1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2024	268	3.7	42º	168º	SOHO

Radio burst frequency spectrum



Proton Active Region

AR11875 (N07L027, CMP 22.10.2013,
Sp=420 msh, DKC, BGD)
XRI=6.53; $X_2^{2.3}$+$M_{11}^{5.1}$+C_{57}; 2_3+1_8+S_{72}
PFR1 22-24.10 (58^h) - $M_8^{4.2}$
PFR2 27-29.10 (57^h) $X_2^{2.3}$+$M_4^{5.1}$

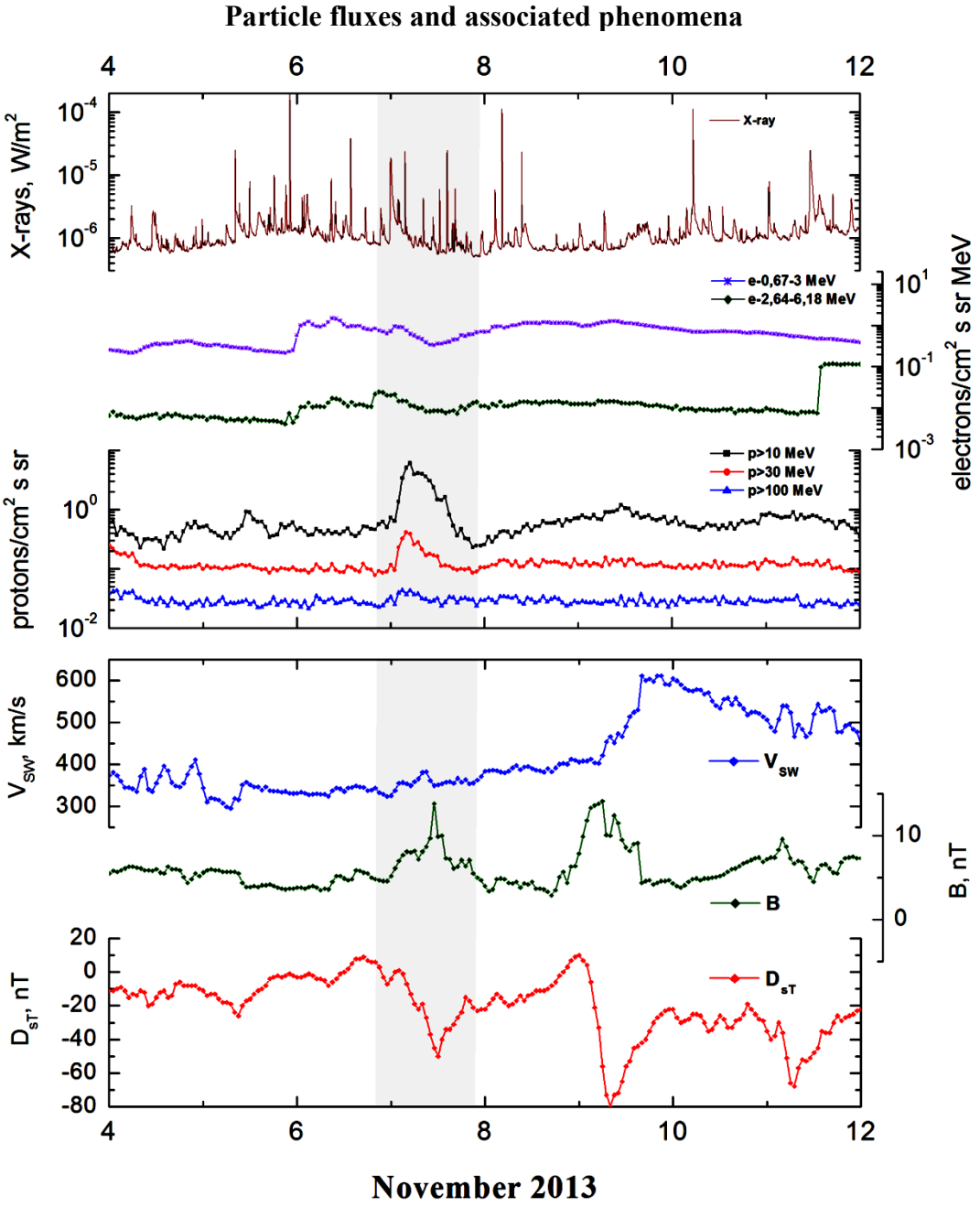
AR11884 (S12L260; CMP 01,9.11.2013;
Sp=460 msh; EKI; BGD)
XRI=1.6 $M_4^{6.3}$+C_{15} 2_1+1_3+S_{18}
PFR1 26.11 M_1
PFR2 1-3.11 (34^h); $M_3^{6.3}$

References:

Bruno A., I. G. Richardson, 2021.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.

Particle event: To(Ep>10 MeV) – 07d01^{h}
Tmax (Ep>10 MeV) – 07d05^{h}, Jmax (Ep>10 MeV) – 5.5 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ_1 = 3.0
Quasimaximal energy of protons in the event – Eqm = 90 MeV

Sources: ■ solar flare 06d23^{h}35^{m}, M1.9, M1.8/SPY, S11W88, AR11882, 1d behind W_L
Main burst X-ray 1–8 Å: onset – 06d23^{h}35^{m}, max – 07d00^{h}02^{m}, Φ = 0.021 J/m^2
CME: 07d00^{h}00^{m}, V= 1033 km/s, Δφ = 360º, dA= 233º

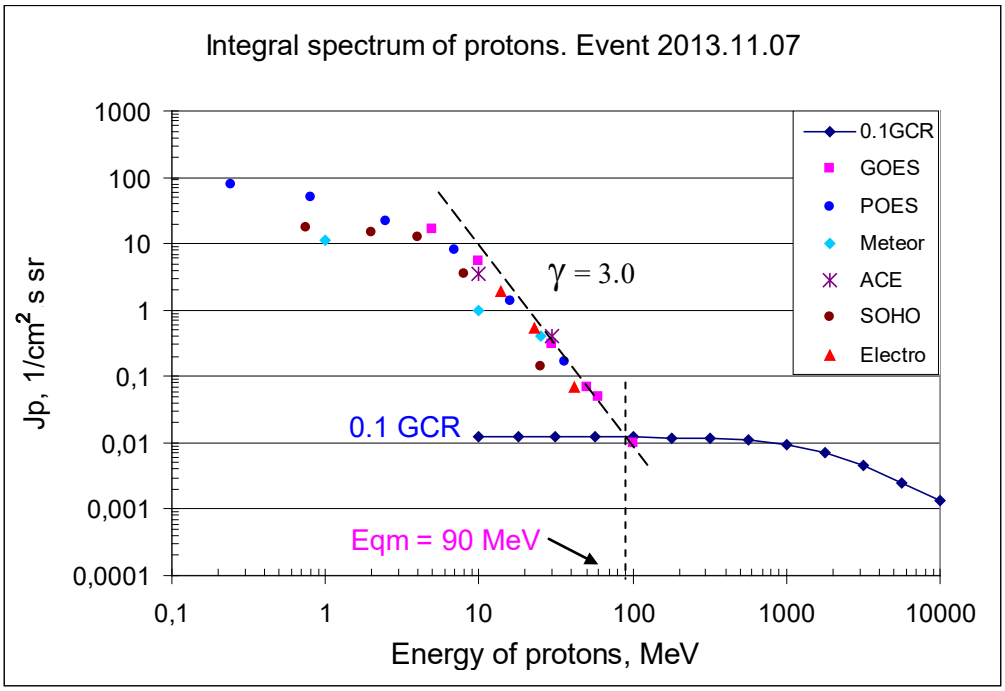


Integral fluxes of protons for the event of 2013 November 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	1	5	16.4	1	1	
EPS	>10	1	5	5.5	1	0.4	
EPS	>30	1	4	0.3	1	0.1	
EPS	>50	1	4	0.07	1	0.06	
EPS	>60	1	4	0.05	1	0.05	
EPS	>100	1	3	0.01	1	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	-	6	80	1	100	
MEPED	>0.8	1	6	50	1	70	
MEPED	>2.5	1	6	22	1	60	
MEPED	>6.9	1	6	8	0.5	40	
MEPED	>16	1	6	1.4	0.5	0.7	
MEPED	>36	1	6	0.17	0.5	0.75	
MEPED	>70	-	-	-	-	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	1	5	11.4	1	2.6	
SCR	>3	1	-	-	1	2.5	
SCR	>10	1	5	1	0.5	1.7	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	1	2	0.4	0.5	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	0	6	3.5	1	1.5	
SIS	>30	0	6	0.4	1	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

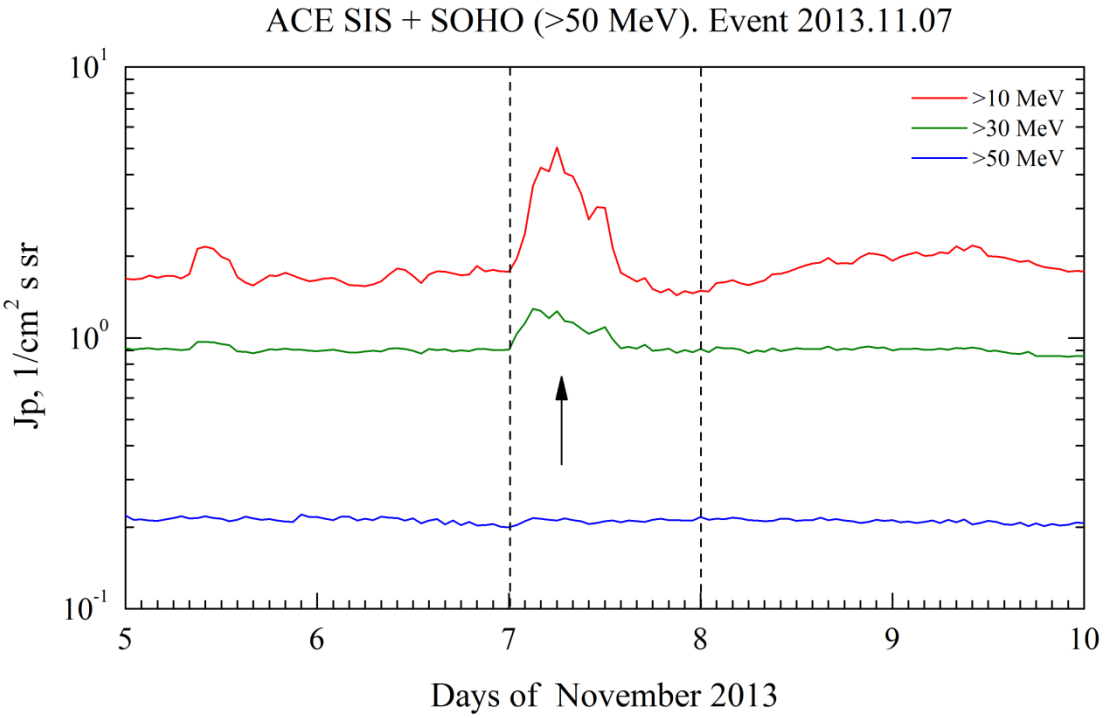
Differential fluxes of protons for the event of 2013 November 07

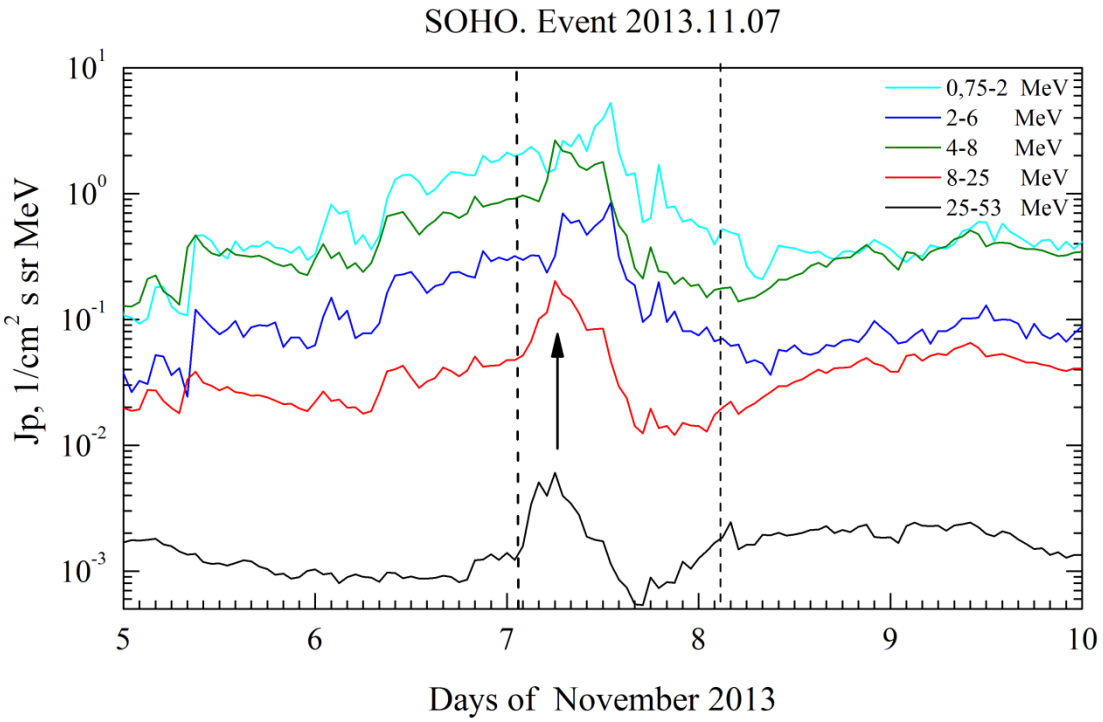
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	6	7	2.6	1	0.37	
LION	2 – 6	6	7	0.6	1	0.09	
EPHIN	4 – 8	3	6	2.3	1	0.3	
EPHIN	8 – 25	3	6	0.2	1	0.02	
EPHIN	25 – 53	3	6	0.005	1	0.001	
Electro-1							
SCR-E	13.7–23	7d00	4	0.15	0.5	0.06	
SCR-E	23–42	7d00	4	0.025	0.5	0.025	
SCR-E	42–112	7d00	3	0.001	0.5	0.005	


Integral spectrum of protons. Event 2013.11.07
Jp, 1/cm2 s sr
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 3.0
0.1 GCR
Eqm = 90 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

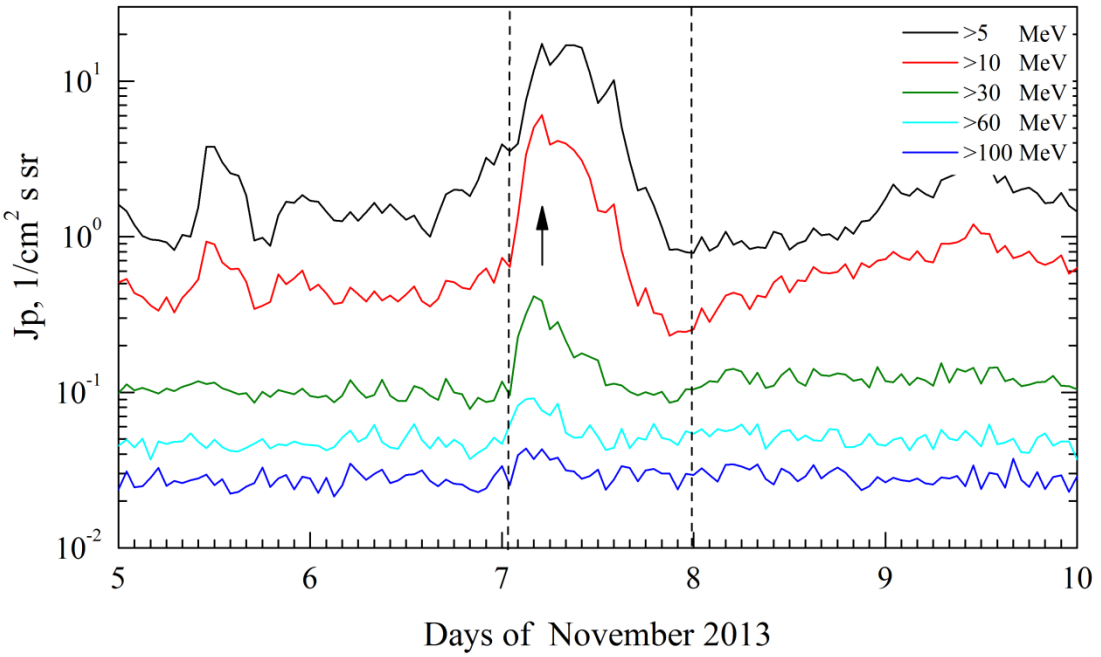
Time profiles of proton fluxes in the event 2013.11.07

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

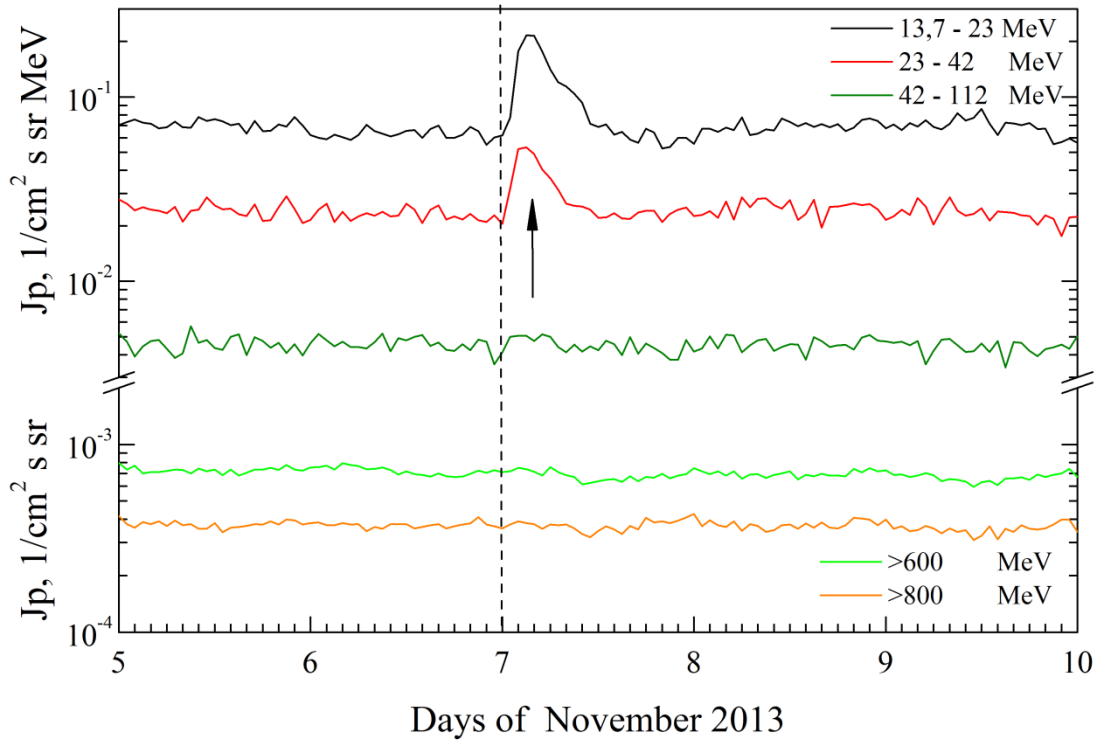




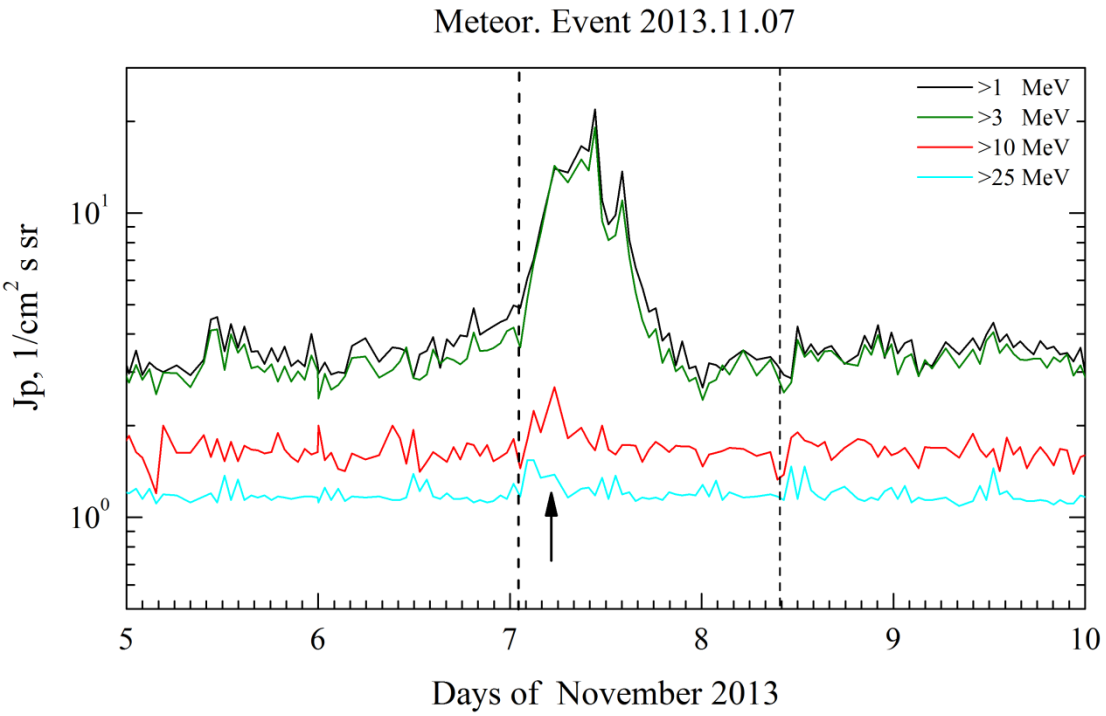
GOES. Event 2013.11.07

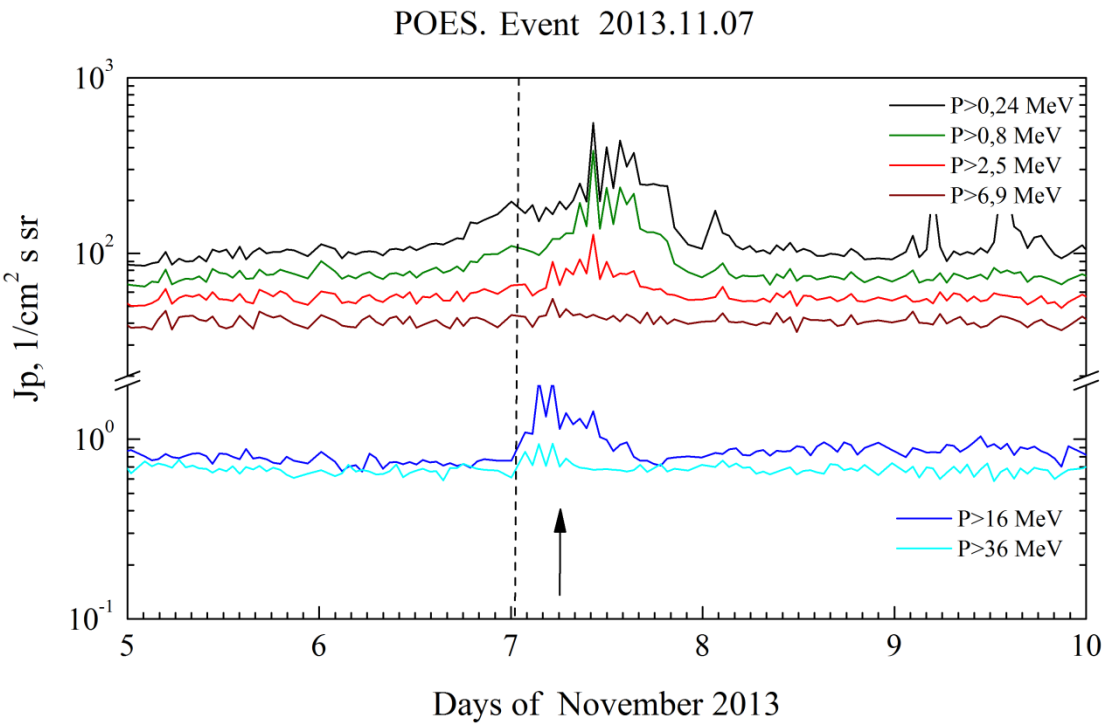


Electro. Event 2013.11.07



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 November 07

2013 November 06 ■ AR 11882 To event 540

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical flare on visible disk					
6563 Å	SPY	2345		2351	S17W90		
1 – 12	keV	2335	0002	0050	S11W88	M1.9*	0.021*
1 – 12	keV	2344	0002	0014	S11W88	M1.8*	

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12 – 25	keV	2358:24	0009:38	0025:56	6070	969474	FERMI
12 – 25	keV	0008:48	0009:38	0025:56	80	250807	HESSI

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS CTM	054-168	0000		0012		1	
DS III	025-041	0000		0000		1	

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	7d0000	1033	- 45.5	360˚	233˚	SOHO

*Total **Φ** for both X-ray bursts

Proton Active Region:

AR11882 (S09L291, CMP 30.5.10.2013,
Sp=390, DKC, BGD, R)
XRI=9.96; $X_2^{2.1}$+$M_{11}^{4.4}$+ C_9
PFR1 25.10 (18^h) $X_2^{2.1}$+$M_9^{2.9}$
PFR2 28.10 (1.5^h) $M_2^{4.4}$

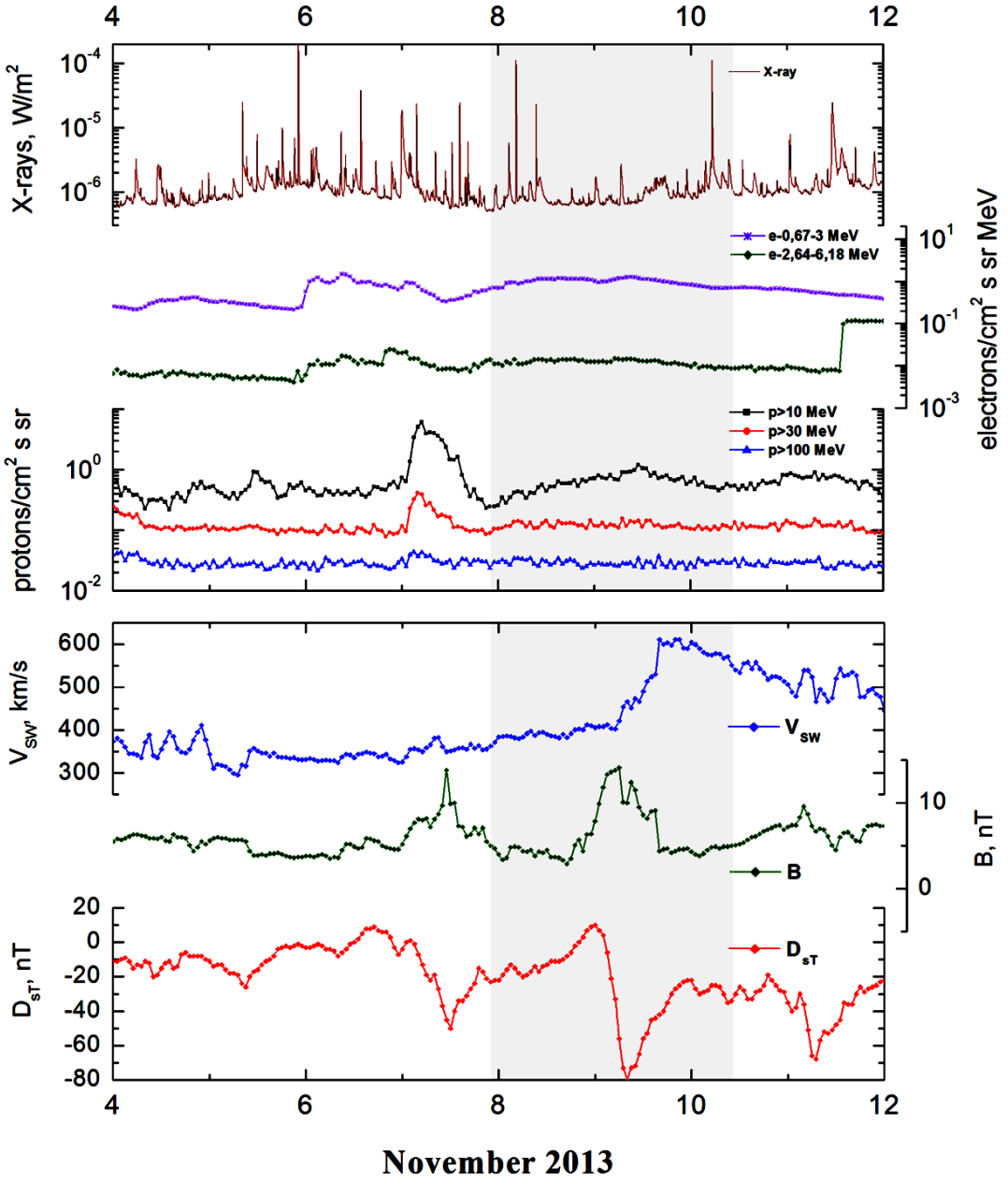
References:

Cohen C.M.S., R.A. Mewaldt, 2018.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.

Particle event: To(Ep>10 MeV) – 08d02^h
Tmax(Ep>10 MeV) – 09d11^h, Jmax(Ep>10 MeV) – 0.6 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.7
Quasimaximal energy of protons in the event – Eqm = 40 MeV

Sources: ⊙ solar flare 08d04^{h}20^m, X1.1/2B, S14E15, AR11890
Ø solar flare 07d14^{h}15^m, M2.4/1N, S13E23, AR11890
Main burst X-ray 1–8 Å: onset – 08d04^{h}20^m, max – 08d04^{h}26^m, Φ = 0.028 J/m^2

Particle fluxes and associated phenomena

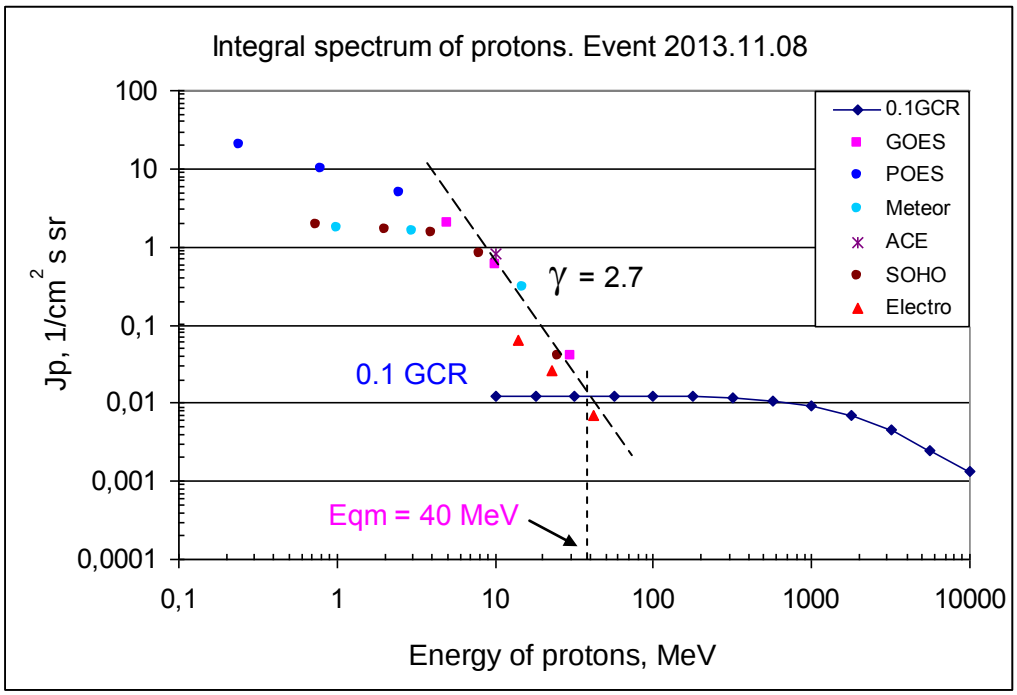


Integral fluxes of protons for the event of 2013 November 08

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	2	09d12	2	2	1	
EPS	>10	2	09d11	0.6	2	0.4	
EPS	>30	2	09d11	0.04	2	0.1	
EPS	>50	2	-	-	-	0.06	
EPS	>60	2	-	-	-	0.05	
EPS	>100	2	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	24	9d12	20	0.5	100	
MEPED	>0.8	24	9d12	10	0.5	70	
MEPED	>2.5	24	9d12	5	0.5	55	
MEPED	>6.9	24	9d12	4	0.5	40	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.75	
MEPED	>70	-	-	-	-	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	10	9d13	1.74	2	2.6	
SCR	>3	10	9d13	1.56	2	2.5	
SCR	>10	10	-	-	2	1.7	
GALS-M	>15	-	9d13	0.3	2	1.7	
GALS-M	>25	-	-	-	-	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	10	09d11	0.8	2	1.2	
SIS	>30	-	-	-	-	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

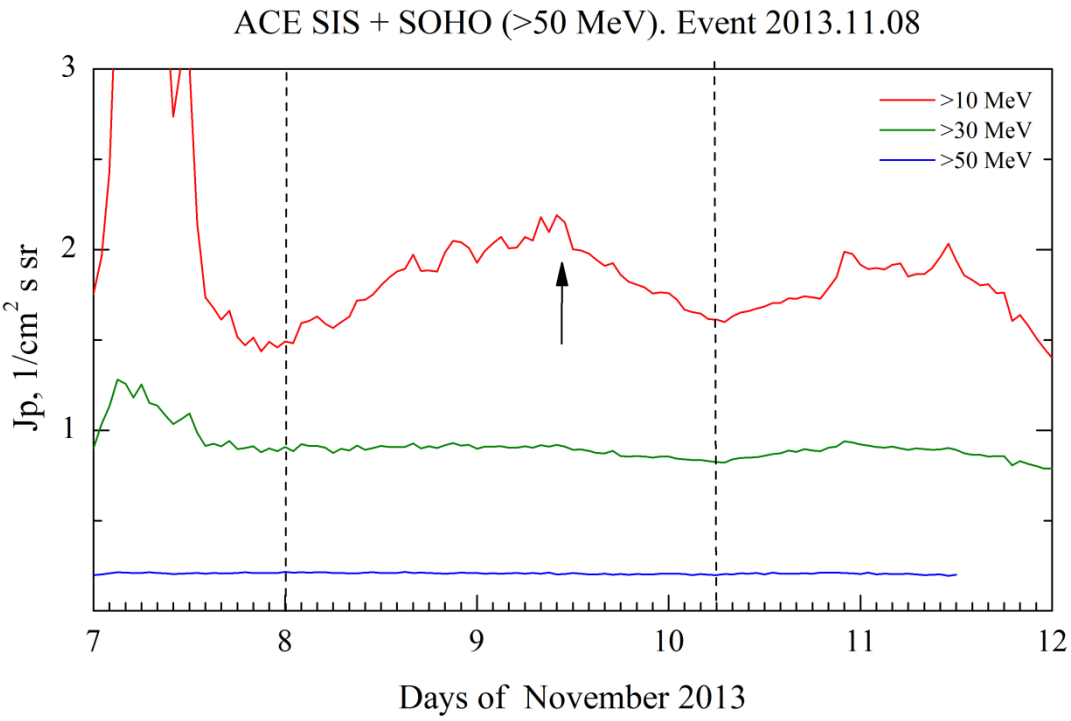
Differential fluxes of protons for the event of 2013 November 08

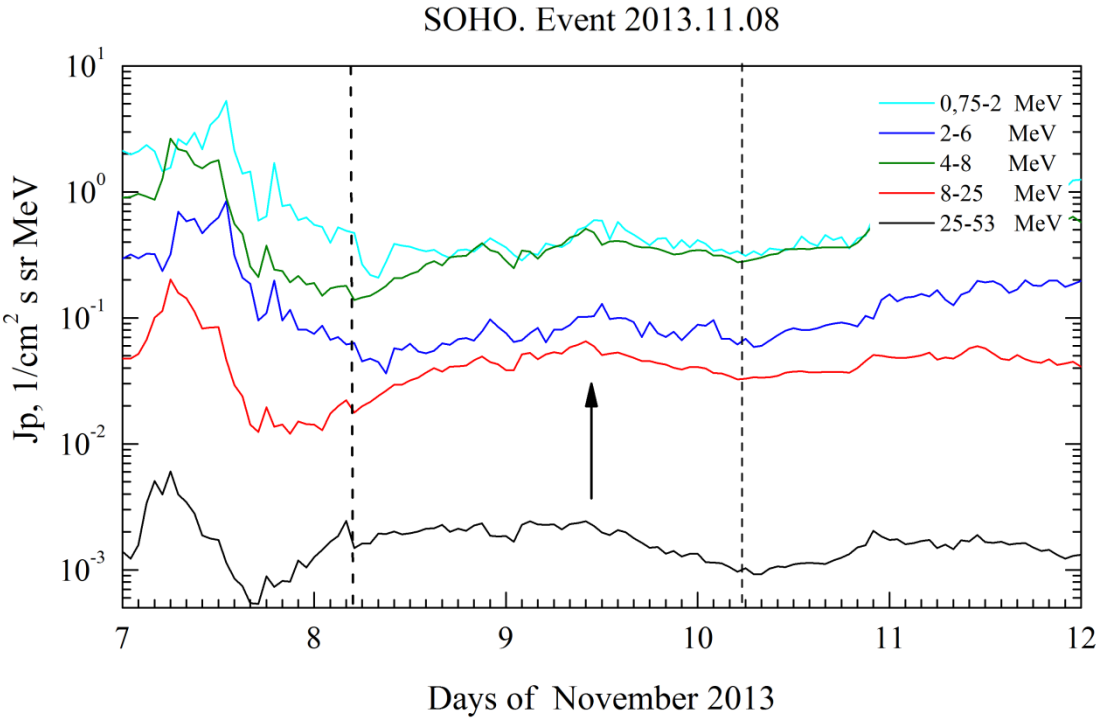
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	9	9d12	0.22	2	0.37	
LION	2 – 6	10	9d12	0.04	2	0.09	
EPHIN	4 – 8	7	9d11	0.18	2	0.3	
EPHIN	8 – 25	2	9d10	0.045	2.5	0.02	
EPHIN	25 – 53	07d21	9d10	0.0014	2.5	0.001	
Electro-1							
SCR-E	13.7 – 23	5	9d10	0.004	0.5	0.07	
SCR-E	23 – 42	5	9d10	0.001	0.5	0.025	
SCR-E	42 – 112	5	9d10	0.0002	0.5	0.005	


Integral spectrum of protons. Event 2013.11.08
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.7
0.1 GCR
Eqm = 40 MeV

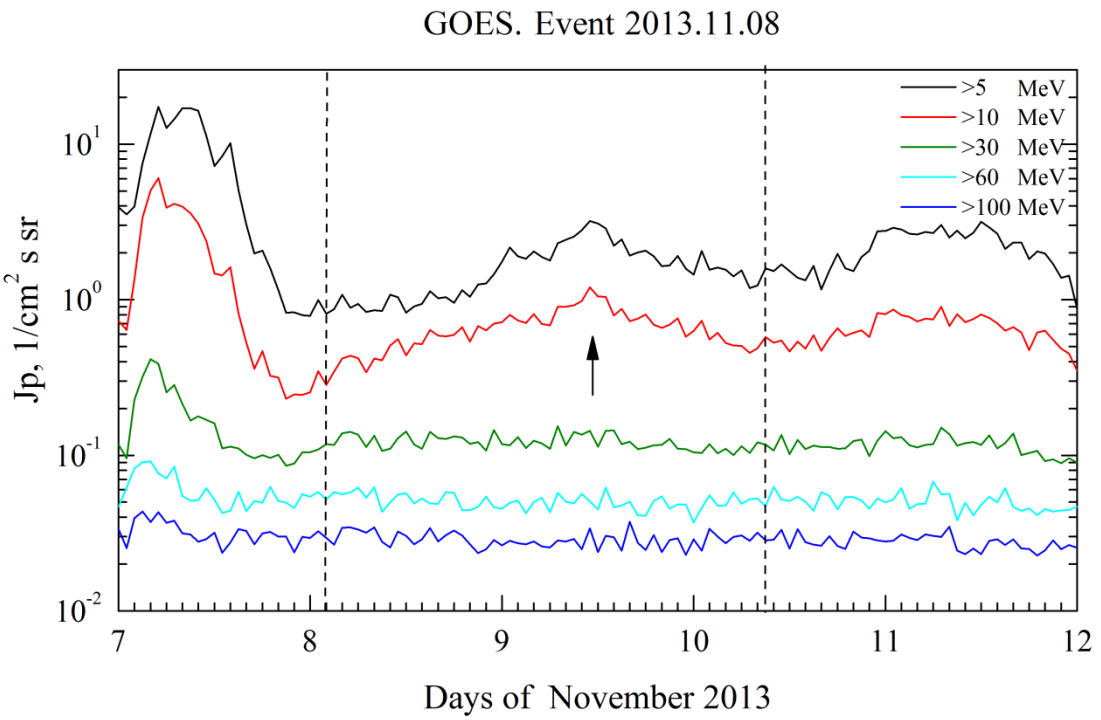
Time profiles of proton fluxes in the event 2013.11.08

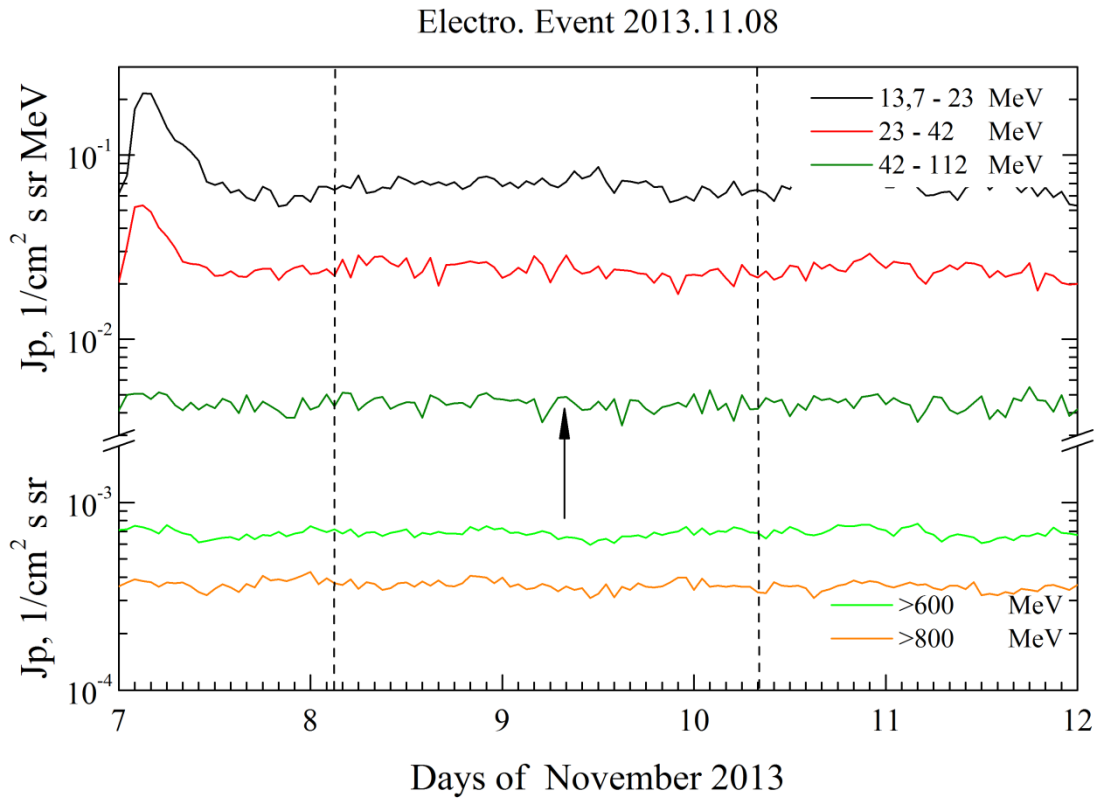
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



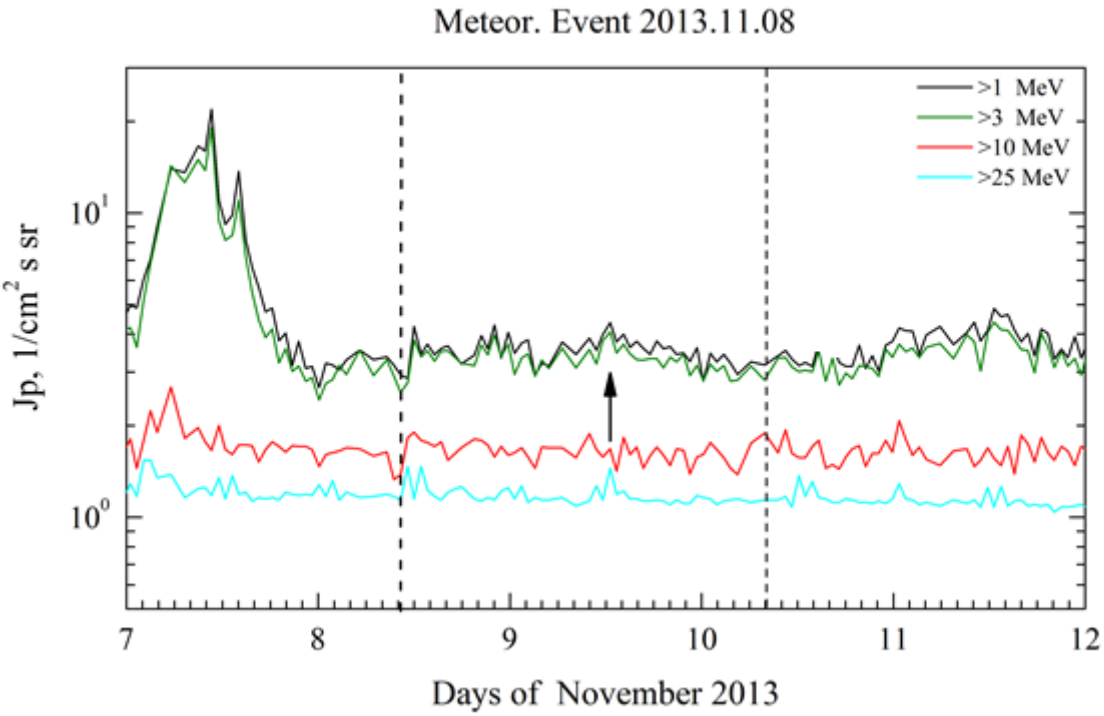


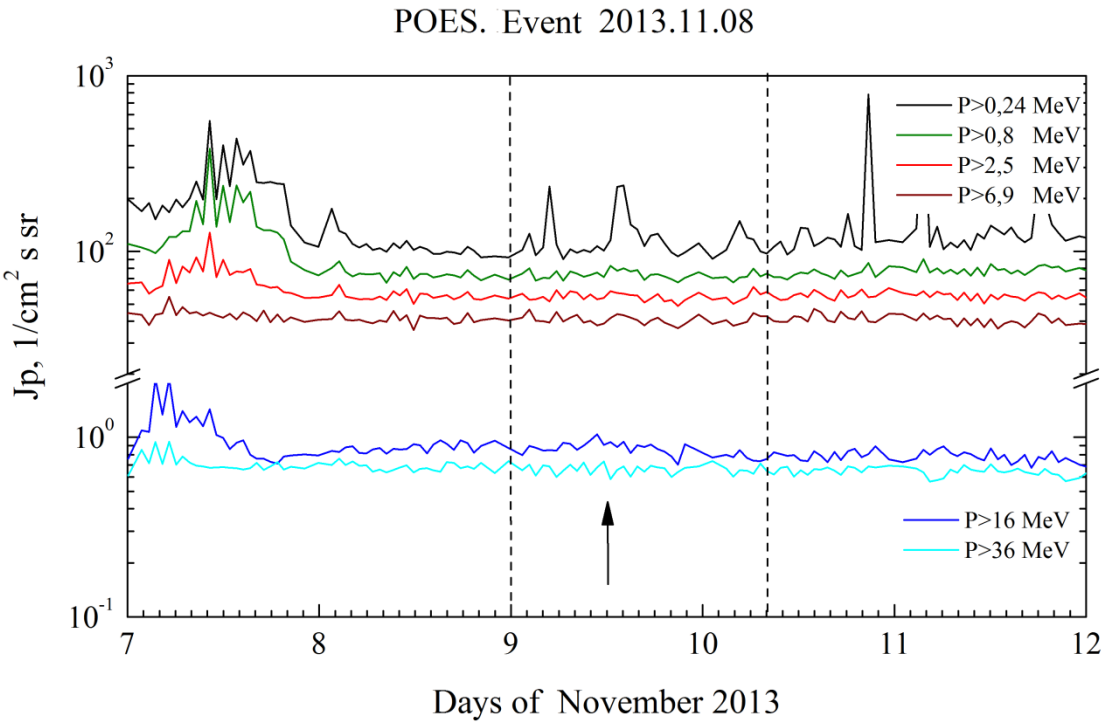
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 November 08

2013 November 08 ⊙ AR 11890 To event 541

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	0424	0425	0442	S14E15	2B	ERU
1 – 12	keV	0420	0426	0429		X1.1	0.028

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12–25	keV	0436:33	0436:42	0439:21	2827	49297	FERMI

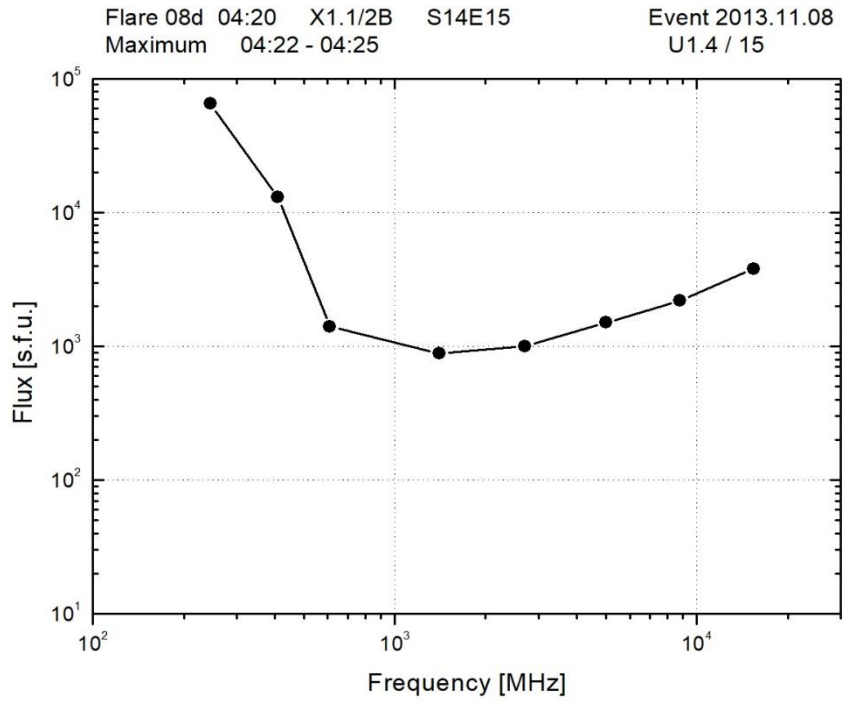
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0423	0424	0427	U1.4 / 15	3.58	
8.8	GHz	0423	0424	0427		3,34	
5	GHz	0423	0424	0428		3.18	
2.7	GHz	0424	0425	0429		3.00	
1.4	GHz	0424	0425	0430		2.95	
610	MHz	0424	0425	0431		3.15	
410	MHz	0423	0422	0429		4.11	
245	MHz	0424	0424	0430		4.81	

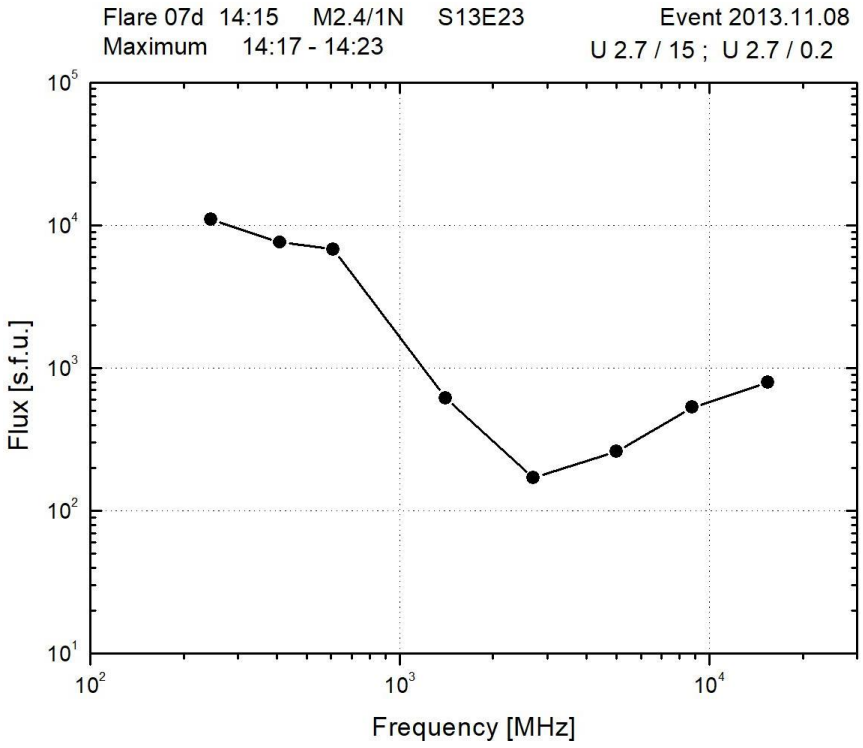
Ds-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	30-80	0424		0436	834	1	
DS IV	30-80	0424		2359		2	
DS III	40-600	0424		0426		3	

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1418	1429	1441	S13E23	1N	ERU
1 – 12	keV	1415	1425	1431		M2.4*	0.012
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12–25	keV	1417:31	1424:29	1433:56	290119	64490320	FERMI
50-100	keV	1426:44	1428:22	1436:00	976	777094	HESSI
6-12	keV	1436:00	1439:06	1454:52	112	364728	HESSI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1417	1423	1429	U2.7 / 15	2.90	
8.8	GHz	1417	1423	1430		2.72	
5	GHz	1418	1423	1430		2.41	
2.7	GHz	1418	1419	1430	U2.7 / 0.2	2.23	
1.4	GHz	1417	1418	1430		2.79	
610	MHz	1418	1419	1430		3.83	
410	MHz	1417	1417	1430		3.88	
245	MHz	1417	1417	1429		4.04	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	1417		1435	633	1	
DS IV	75-180	1435		1527		1	
DS III	25-180	1417		1420		2	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1512	411	- 4.9	360º	130º	SOHO

*contribution to the beginning

Radio burst frequency spectrum





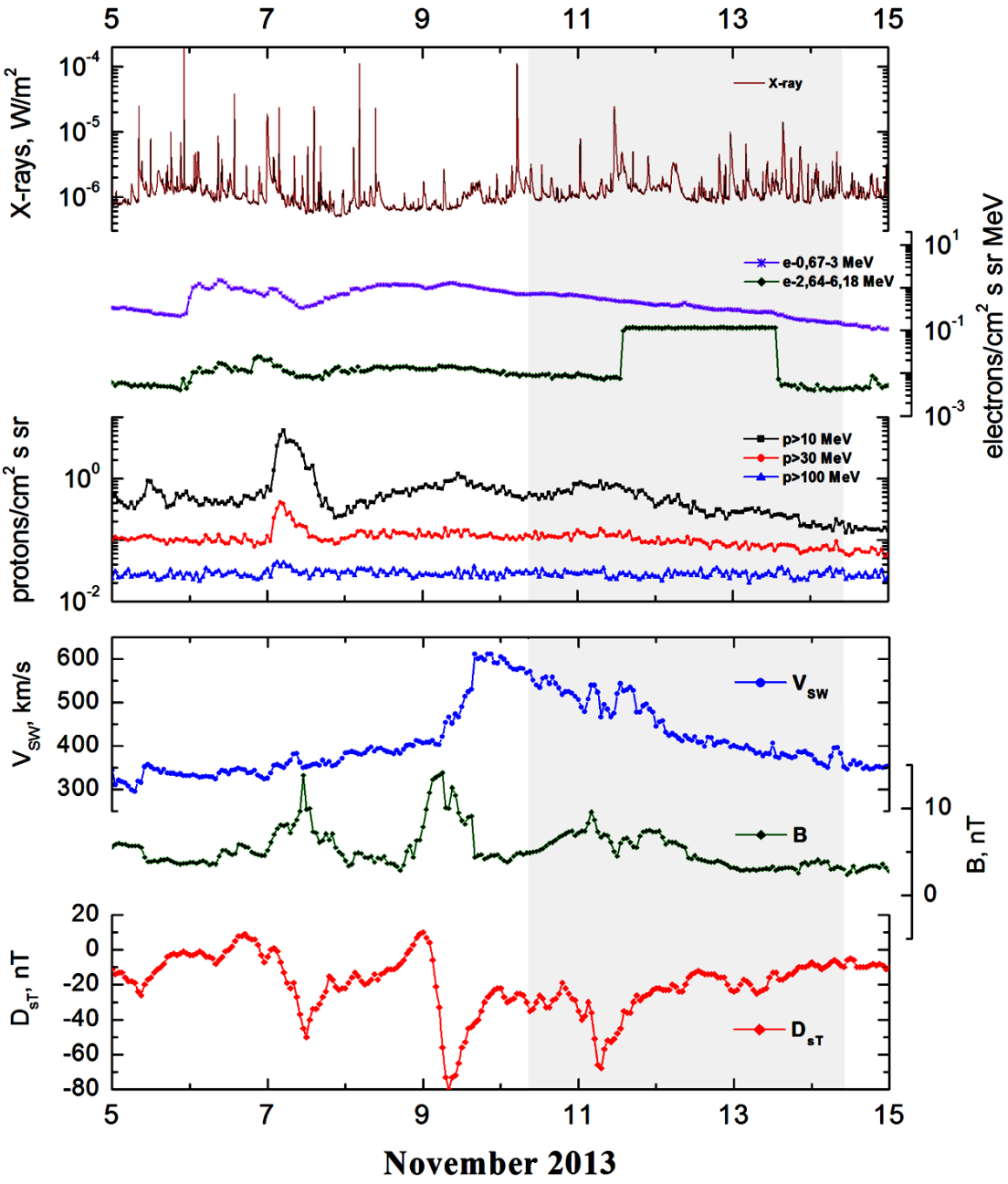
Proton Active Region:

AR11890 (S10L113, CMP 8,7.11.2013
Sp=420 msh; EKC; BGD; R)
XRI=7.38; $X_3^{3.3}$+$M_5^{3.8}$+C_{46} 2_2+1_5+S_{36}
PFR1 5-8.11 (54^h) $X_2^{3.3}$+$M_3^{3.8}$
PFR2 10 $X_1^{1.1}$

Particle event: To(Ep>10 MeV) – 10d08^h
Tmax(Ep>10 MeV) – 11d02^h, Jmax(Ep>10 MeV) – 0.5 /cm^2·s·sr
Duration of the event – 4 days, power-law index: γ = 2.0
Quasimaximal energy of protons in the event – Eqm = 60 MeV

Sources: ● solar flare 10d05^{h}08^m, X1.1/2B, S14W13, AR11890
Main burst X-ray 1–8 Å: onset – 10d05^{h}08^m, max – 10d05^{h}14^m, Φ = 0.035 J/m^2
CME: 10d05^{h}36^m, V= 682 km/s, Δφ = 262º, dA= 198º

Particle fluxes and associated phenomena

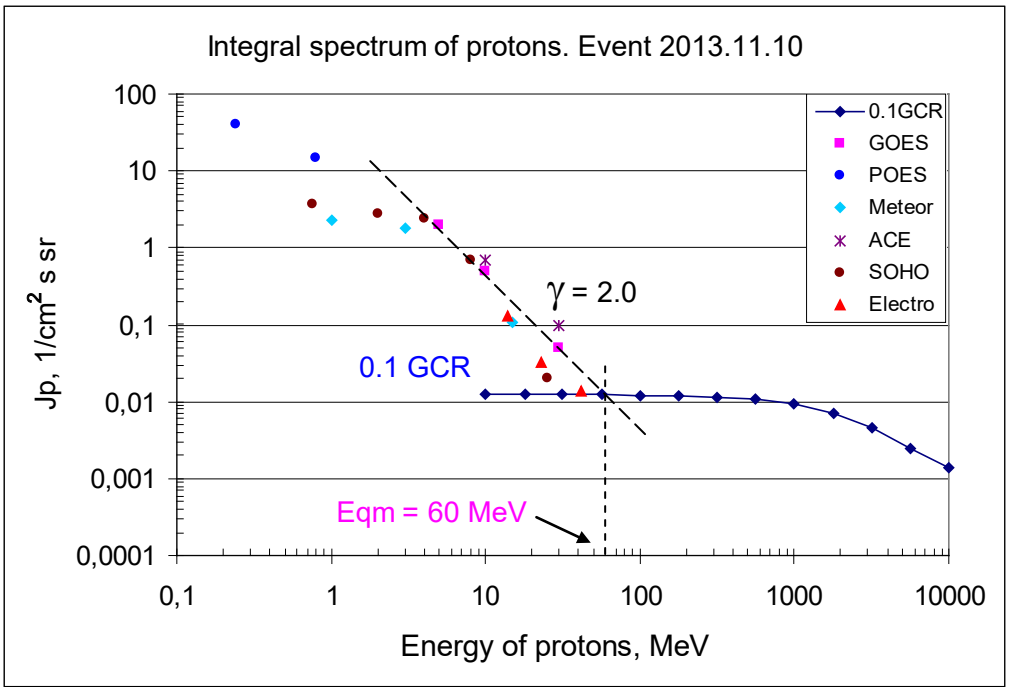


Integral fluxes of protons for the event of 2013 November 10

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	8	11d02	2	4	1	
EPS	>10	8	11d02	0.5	4	0.4	
EPS	>30	8	11d02	0.05	4	0.1	
EPS	>50	8	-	-	-	0.06	
EPS	>60	8	-	-	-	0.05	
EPS	>100	8	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	20	11d12	40	1.5	100	
MEPED	>0.8	20	11d12	15	1.5	70	
MEPED	>2.5	-	-	-	-	55	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.75	
MEPED	>70	-	-	-	-	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	22	11d12	2.26	1	2.6	
SCR	>3	22	11d12	1.83	1	2.5	
SCR	>10	-	-	-	-	-	
GALS-M	>15	22	11d13	0.11	0.5	1.7	
GALS-M	>25	-	-	-	-	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	4	11d07	0.7	4	1.2	
SIS	>30	4	11d07	0.1	4	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

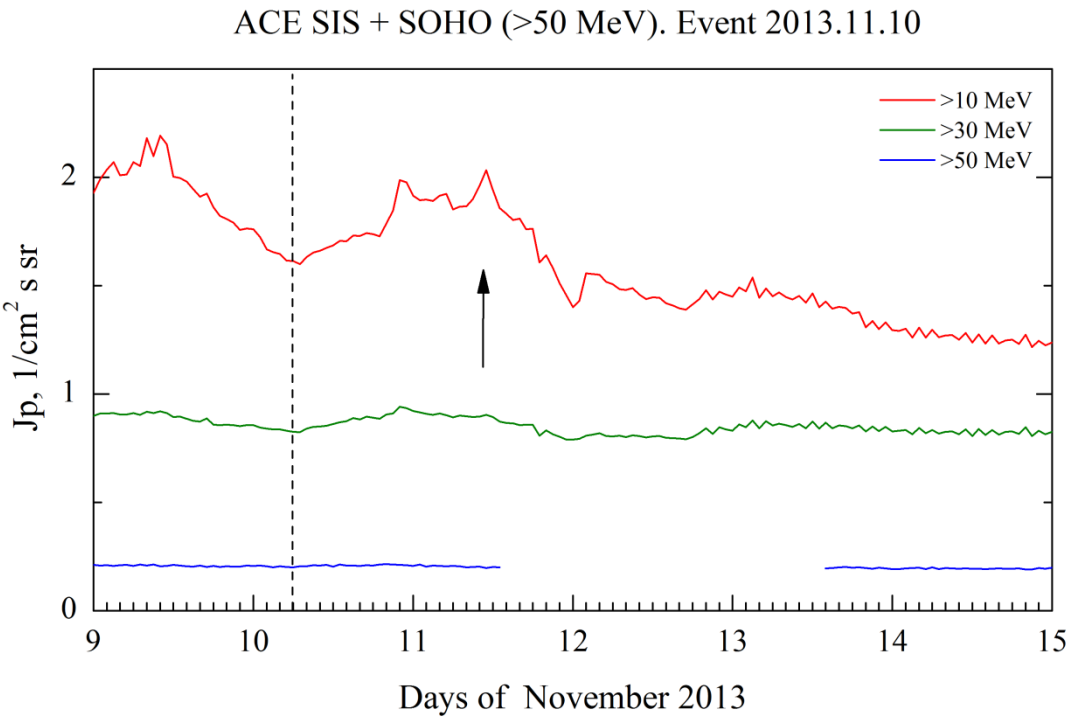
Differential fluxes of protons for the event of 2013 November 10

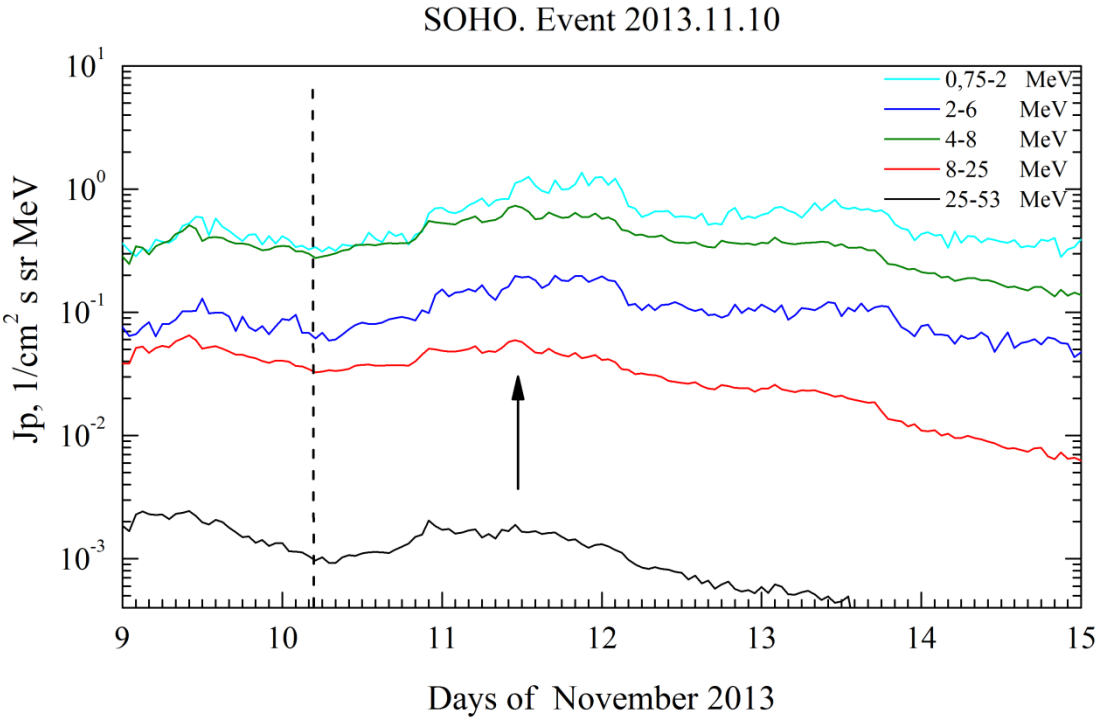
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	05	11d12	0.8	4	0.37	
LION	2 – 6	05	11d11	0.11	4	0.09	
EPHIN	4 – 8	05	11d11	0.43	4	0.3	
EPHIN	8 – 25	05	11d11	0.04	4	0.02	
EPHIN	25 – 53	05	11d11	0.0007	4	0.001	
Electro-1							
SCR-E	13.7–23	18	11 d11	0.01	0.5	0.07	
SCR-E	23–42	18	11d11	0.001	0.5	0.025	
SCR-E	42–112	18	11d11	0.0002	0.5	0.0045	

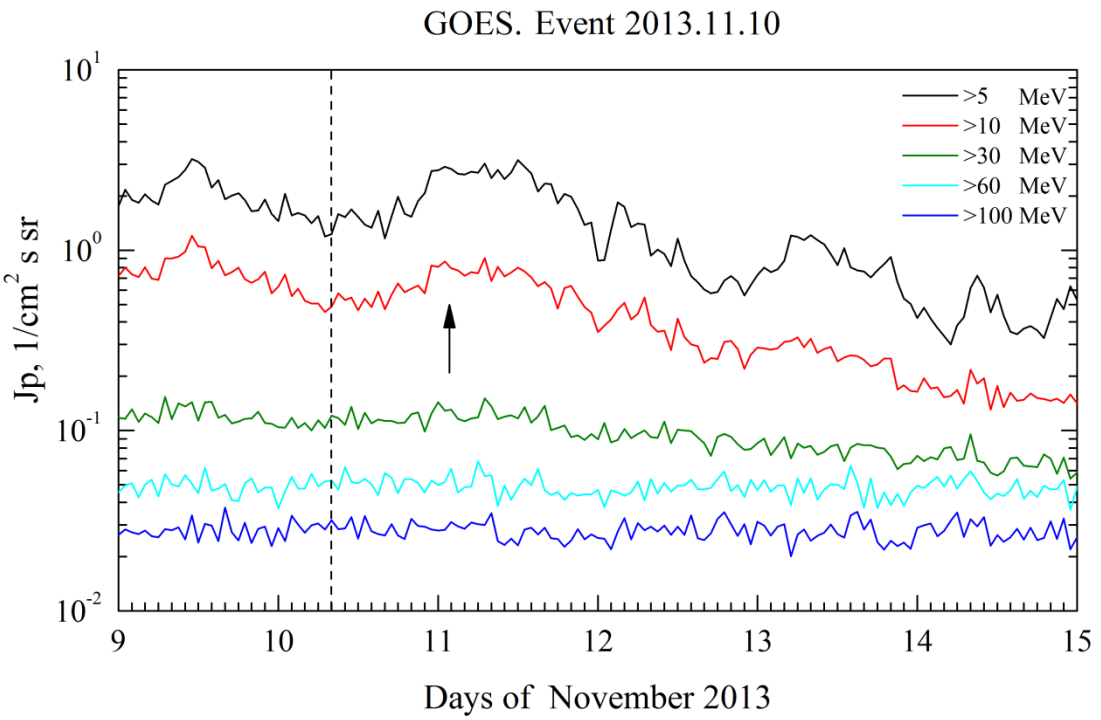

Integral spectrum of protons. Event 2013.11.10
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.0
0.1 GCR
Eqm = 60 MeV

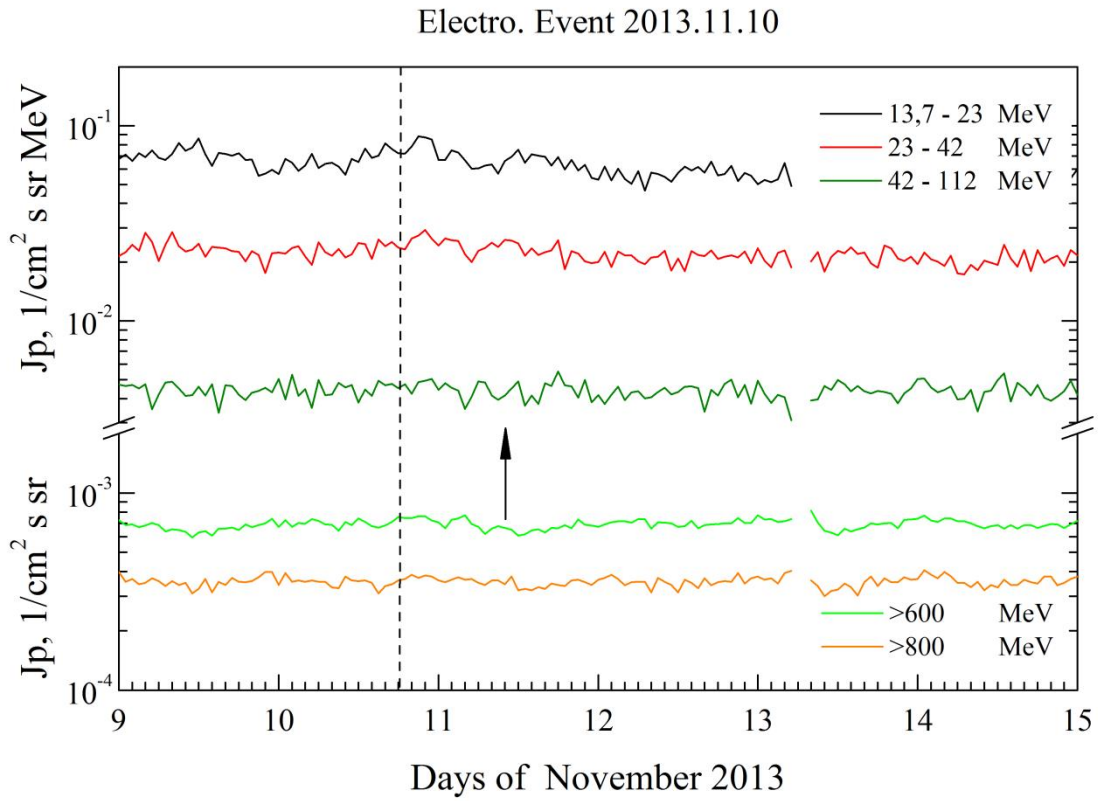
Time profiles of proton fluxes in the event 2013.11.10

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

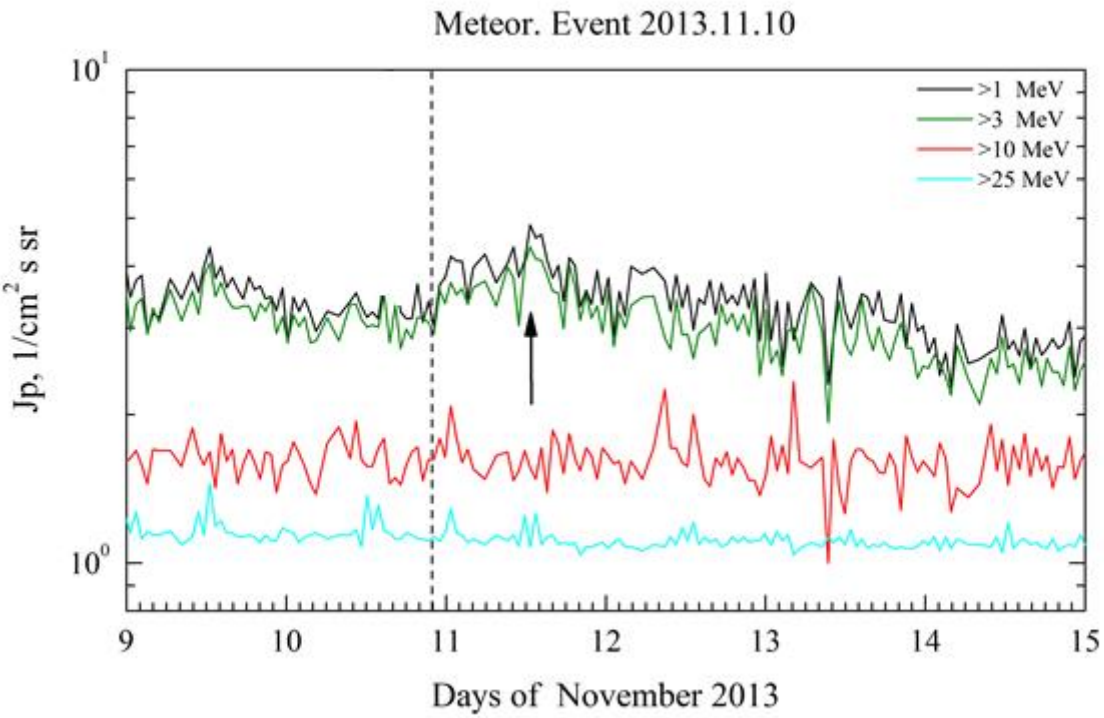


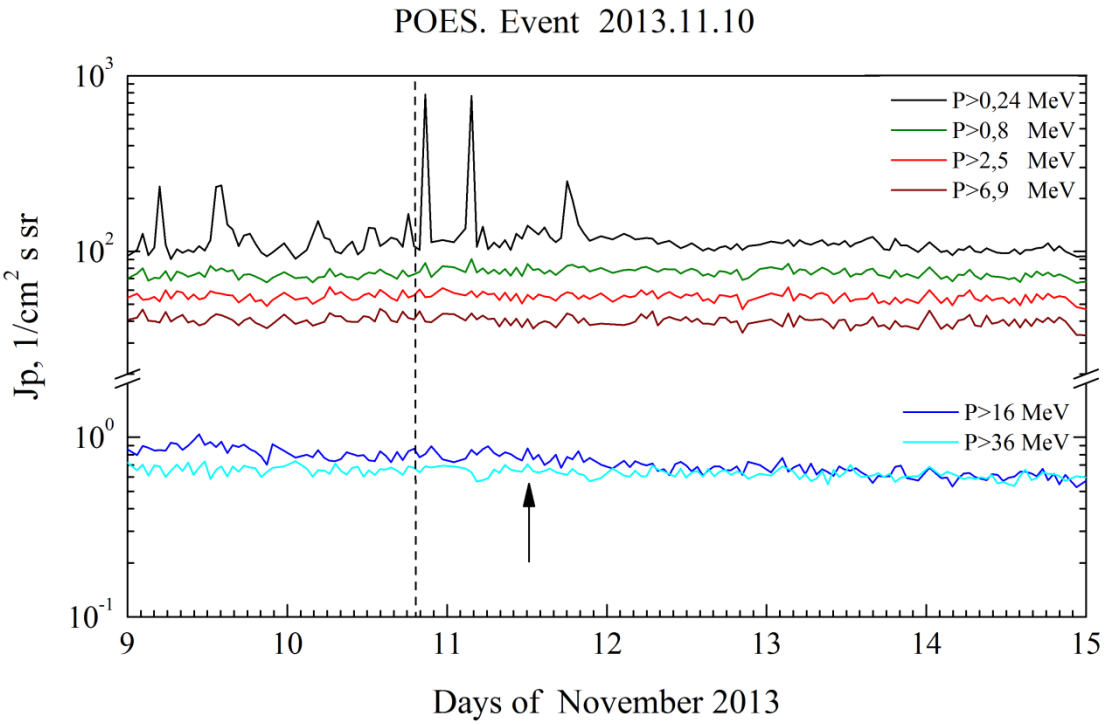



GOES. Event 2013.11.10
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of November 2013


Electro. Event 2013.11.10
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of November 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



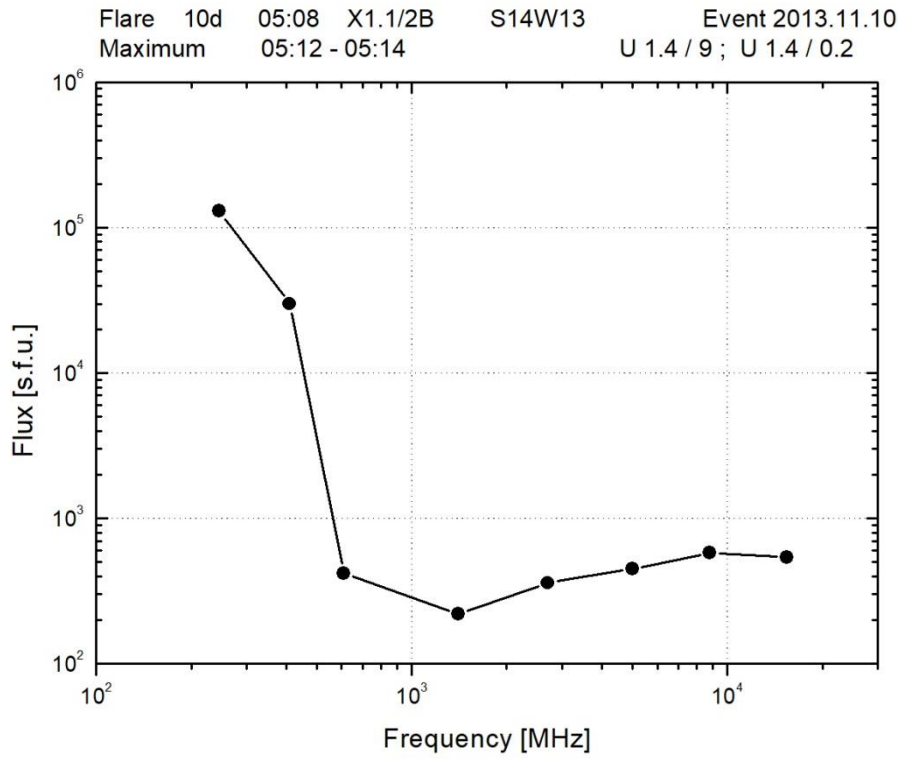


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 November 10

2013 November 10 ● AR 11890 To event 542

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0510	0514	0536	S14W13	2B	ERU
1 – 12	keV	0508	05145	0518		X1.1	0.035
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0507:16	0513:46	0524:00	9303	12815907	HESSI
12-25	keV	0508:34	0513:07	0519:16	750040	173204480	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0510	0512	0514	U1.4 / 9	2.73	
8.8	GHz	0509	0513	0515		2.76	
5	GHz	0509	0513	0514		2.65	
2.7	GHz	0512	0513	0514		2.56	
1.4	GHz	0512	0513	0514	U1.4 / 0.2	2.34	
610	MHz	0513	0514	0514		2.62	
410	MHz	0512	0513	0514		4.48	
245	MHz	0513	0514	0516		5.11	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	0513		0525	1012	2	
DS IV	75-169	0534		1010		1	
DS III	130-00?	0513		0515		3	
DS III	20-160	0520		0523		2	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0536	682	- 41.8	262˚	198˚	SOHO

Radio burst frequency spectrum

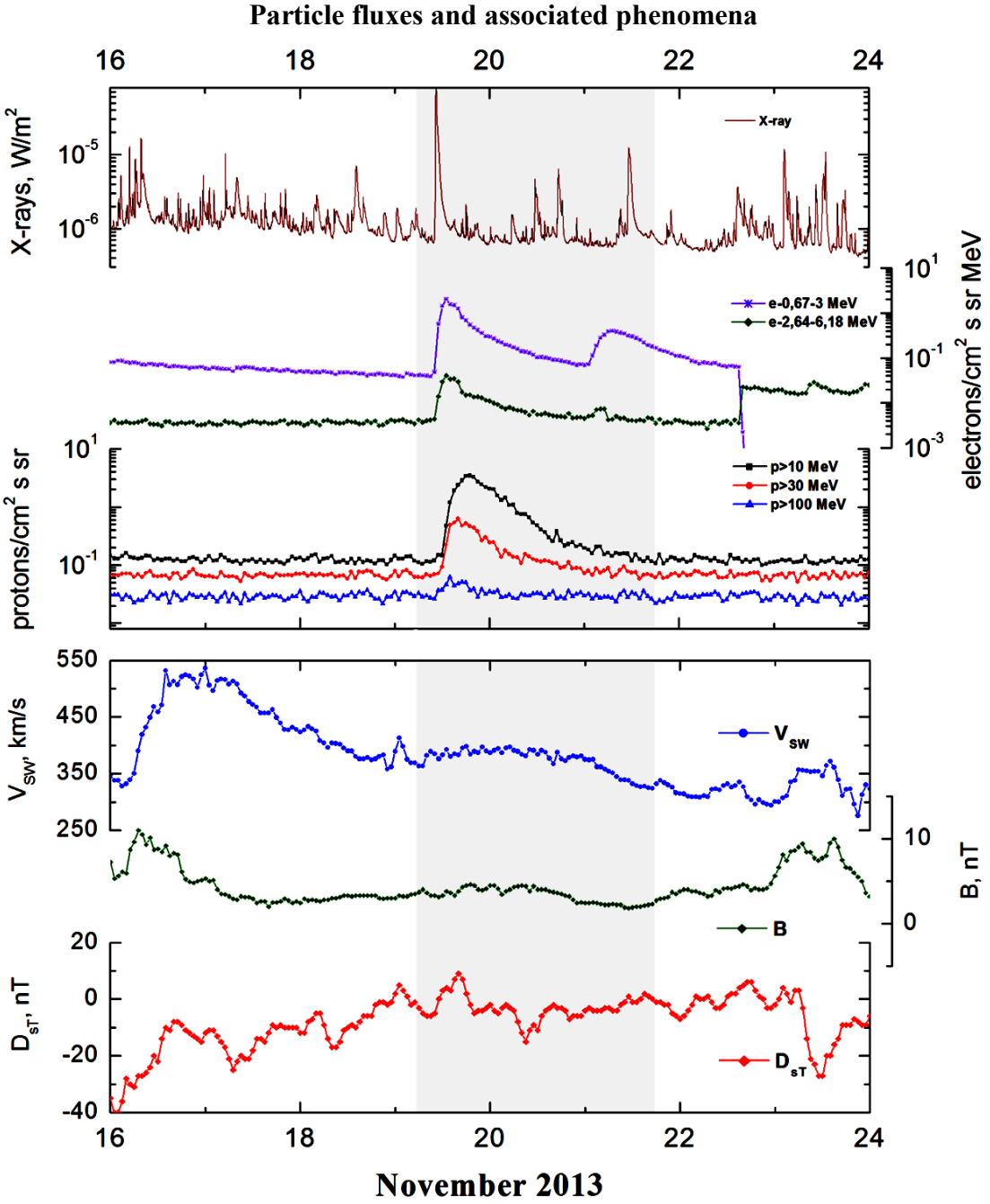


Proton Active Region:

AR11890 (S10L113, CMP 8,7.11.2013,
Sp=420 msh; EKC; BGD; R)
XRI=7.38; $X_3^{3.3}$+$M_5^{3.8}$+C_{46} 2_2+1_5+S_{36}
PFR1 5-8.11 (54^h) $X_2^{3.3}$+$M_3^{3.8}$;
PFR2 10 $X_1^{1.1}$

Particle event: To(Ep>10 MeV) – 19d12^{h}
Tmax(Ep>10 MeV) – 19d19^{h}, Jmax(Ep>10 MeV) – 3.4 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.3
Quasimaximal energy of protons in the event – Eqm = 130 MeV

Sources: ● solar flare 19d10^{h}14^{m}, X1.0/SF, S13W69, AR11893
Main burst X-ray 1–8 Å: onset – 19d10^{h}14^{m}, max – 19d10^{h}26^{m}, Φ = 0.066 J/m^2
CME: 19d10^{h}36^{m}, V= 740 km/s, $\Delta\varphi$ = 360º, dA= 222º

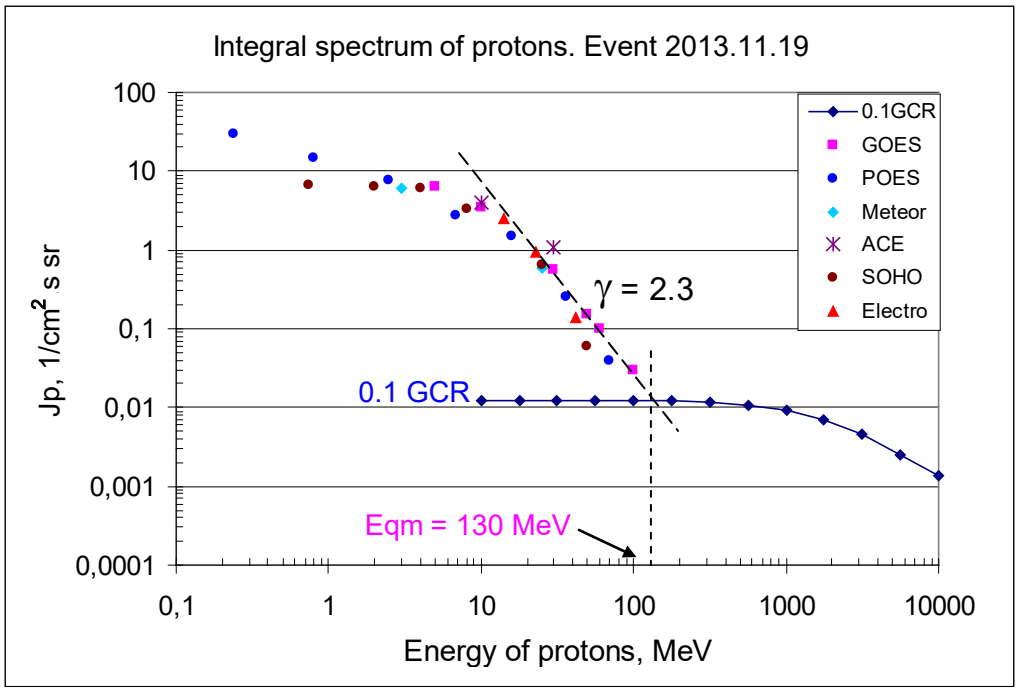


Integral fluxes of protons for the event of 2013 November 19

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	12	20	6.5	2	0.2	
EPS	>10	12	19	3.4	2	0.12	
EPS	>30	12	16	0.55	1.5	0.07	
EPS	>50	12	16	0.15	1.5	0.06	
EPS	>60	12	16	0.1	1	0.05	
EPS	>100	12	14	0.03	0.5	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	15	20	30	1.5	90	
MEPED	>0.8	15	20	15	1.5	70	
MEPED	>2.5	14	20	7.8	15	50	
MEPED	>6.9	13	20	2.8	1	40	
MEPED	>16	12	18	1.5	1	0.7	
MEPED	>36	12	18	0.25	0.5	0.75	
MEPED	>70	12	17	0.04	0.5	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	11	-	-	2	2.6	
SCR	>3	11	19	6	2	2.5	
SCR	>10	11	-	-	1	1.65	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	11	14	0.6	1	1.15	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	10	16	4	1	1.2	
SIS	>30	10	16	1.1	1	0.8	
SOHO							
EPHIN	>50	11	15	0.06	0.5	0.2	

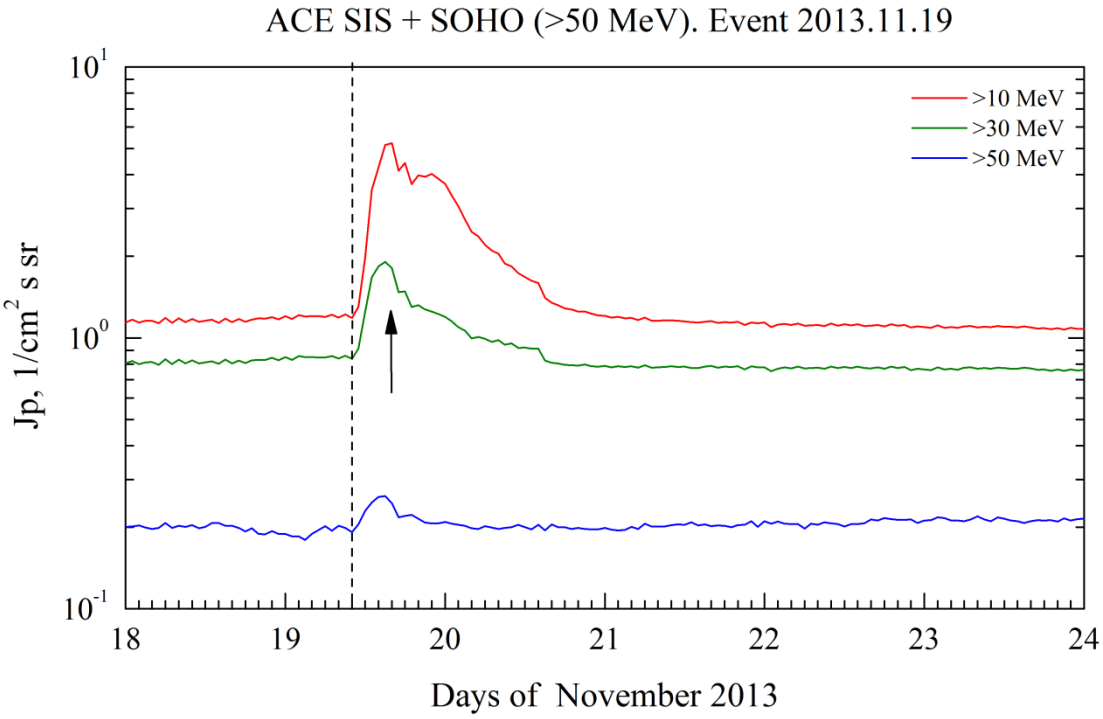
Differential fluxes of protons for the event of 2013 November 19

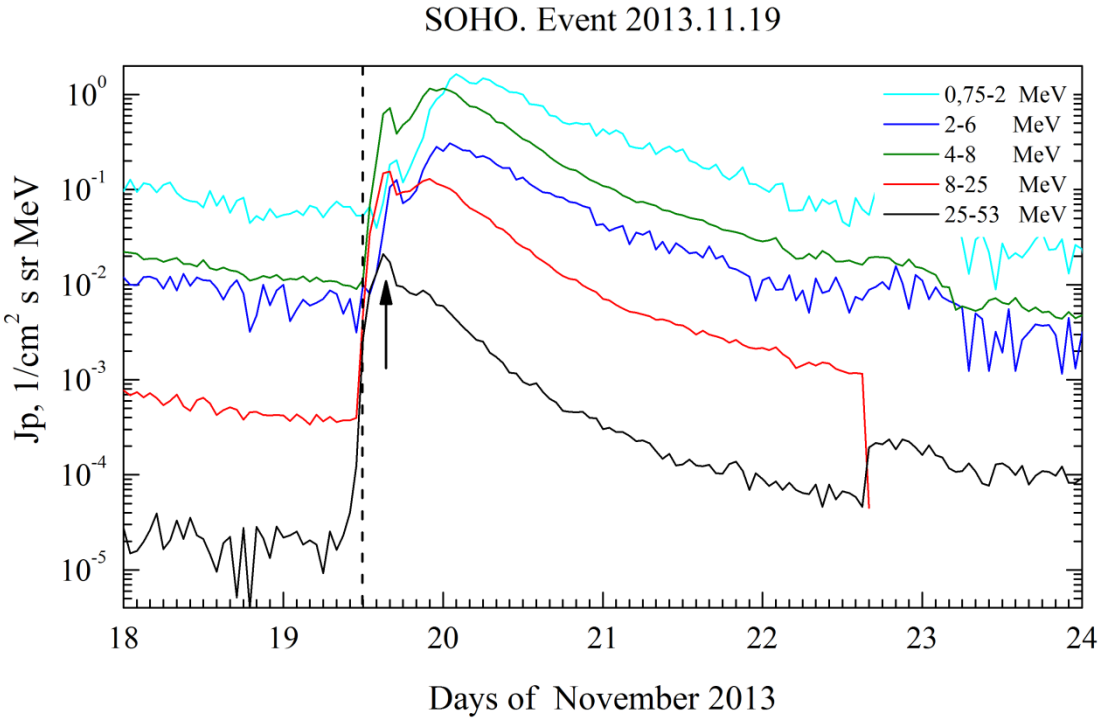
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	15	17	0.14	2.5	0.06	
LION	2 – 6	14	17	0.12	2.5	0.007	
EPHIN	4 – 8	14	16	0.7	2.5	0.01	
EPHIN	8 – 25	12	16	0.155	2.5	0.0003	
EPHIN	25 – 53	11	15	0.021	2.5	0.00002	
Electro-1							
SCR-E	13.7–23	9	16	0.17	1	0.05	
SCR-E	23–42	9	16	0.042	1	0.02	
SCR-E	42–112	-	16	0.002	0.5	0.004	


Integral spectrum of protons. Event 2013.11.19
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.3
0.1 GCR
Eqm = 130 MeV

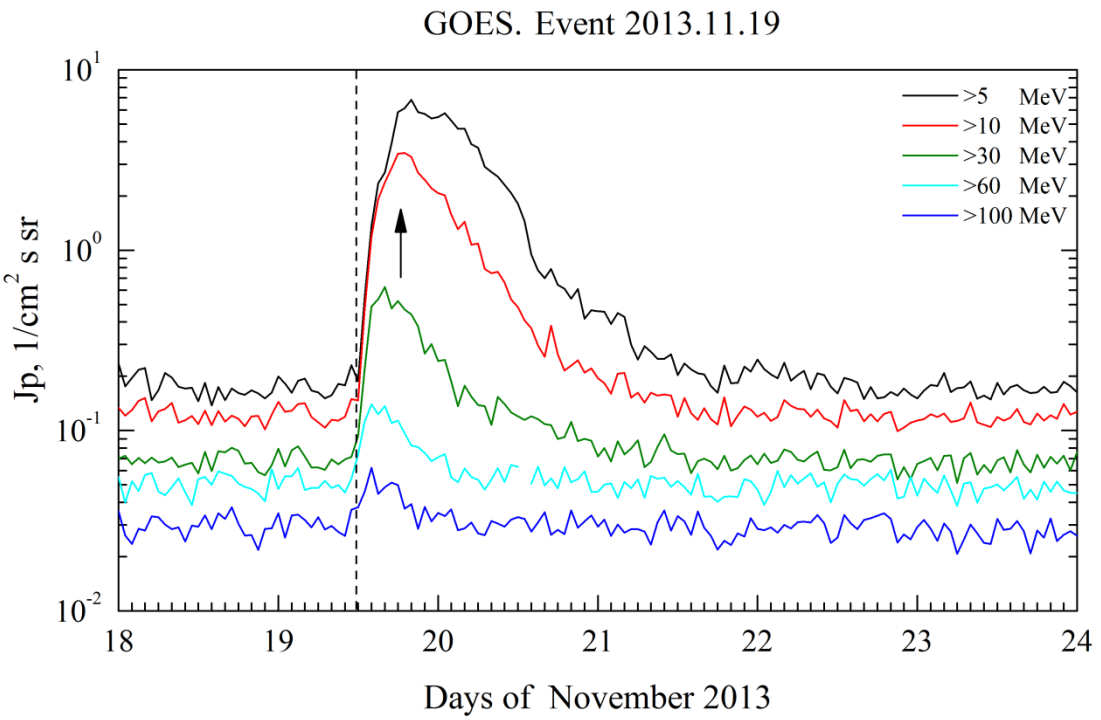
Time profiles of proton fluxes in the event 2013.11.19

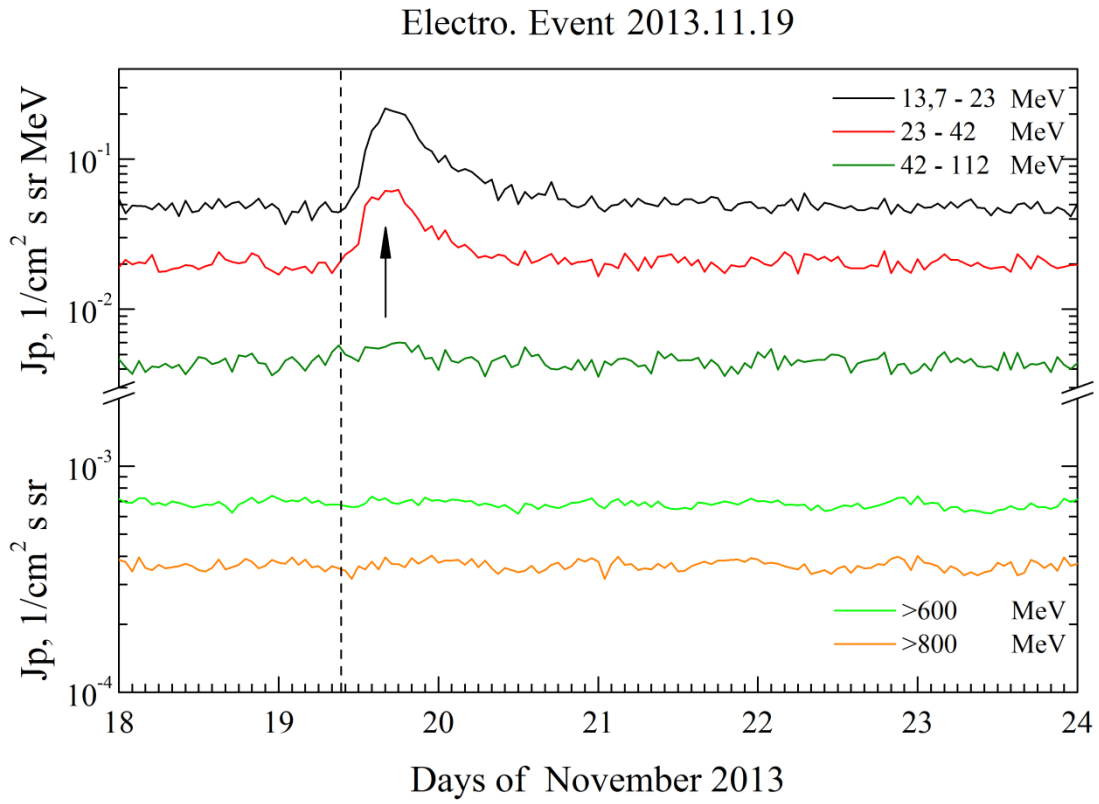
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



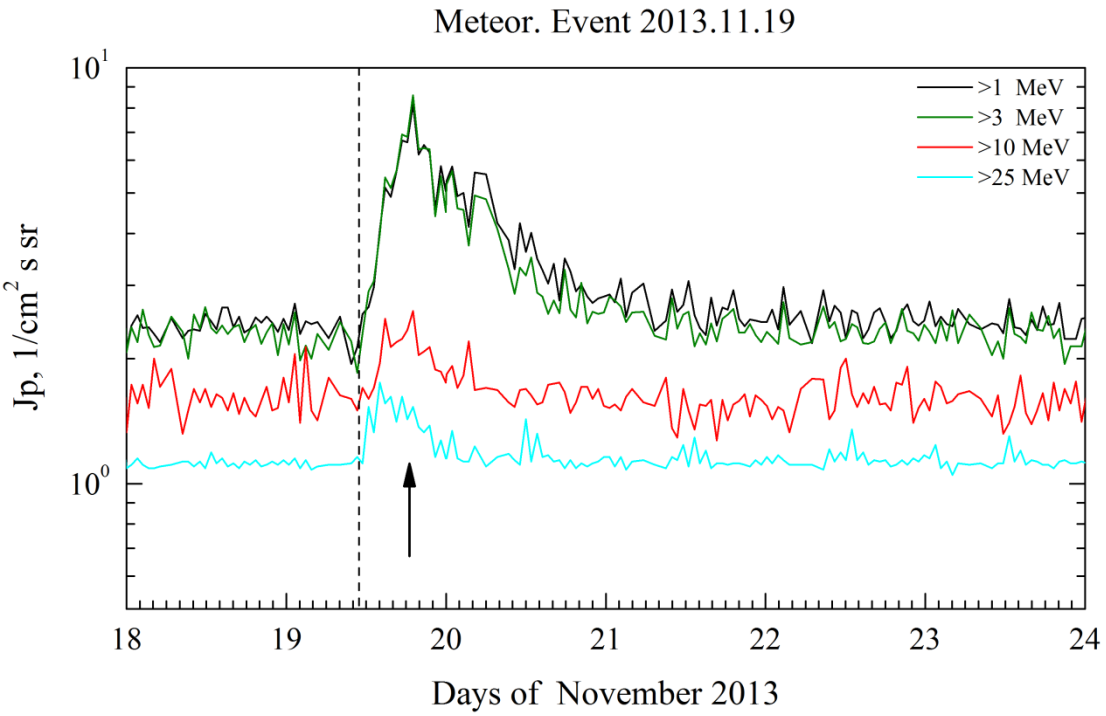


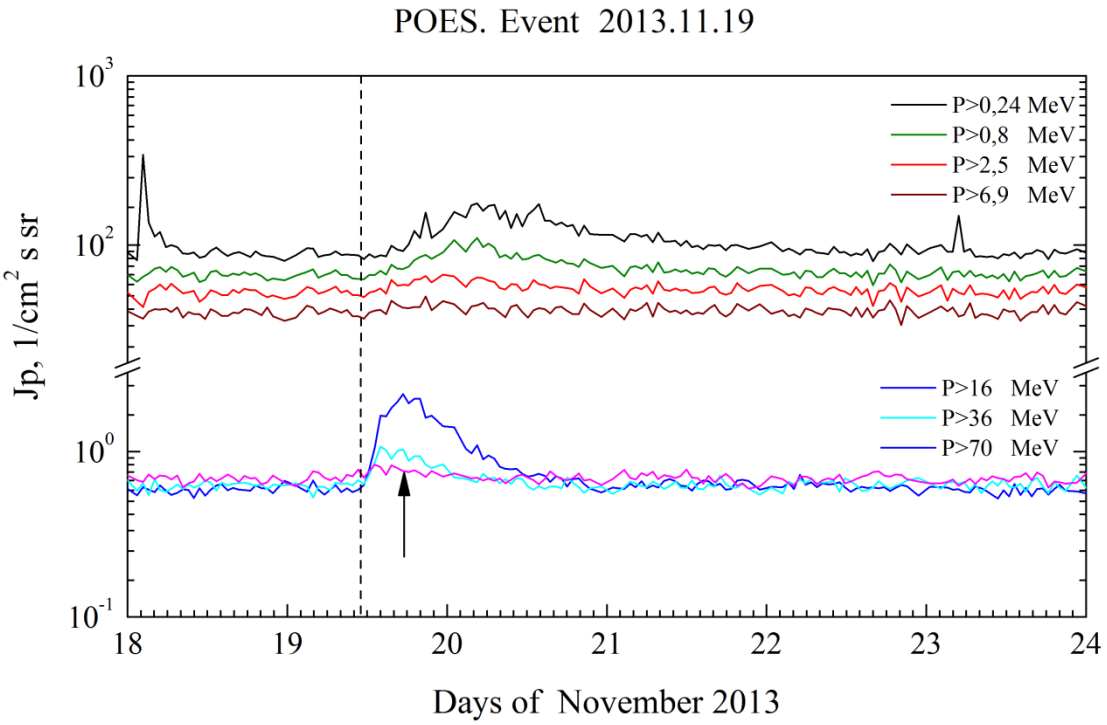
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 November 19

2013 November 19 ● AR 11893 To event 543

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1024	1024	1035	S14W70	SF	
1 – 12	keV	1014	1026	1034	S13W69	X1.0	0.066

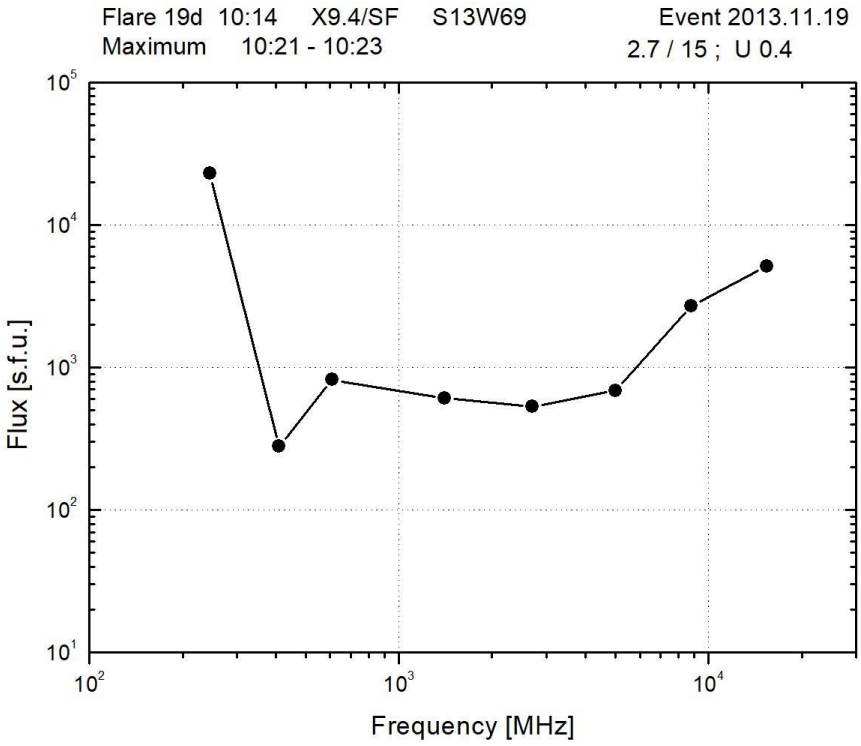
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	1042:28	1043:02	1055:56	656	1988690	HESSI
6-12	keV	1123:12	1123:26	1138:52	30	106456	HESSI
6-12	keV	1140:20	1138:52	1140:36	11	1040	HESSI
12-25	keV	1008:14	1023:07	1025:56	779248	209146912	FERMI
12-25	keV	1101:45	1101:57	1107:49	2516	176309	FERMI
12-25	keV	1128:45	1132:59	1137:53	979	120510	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1017	1022	1029	2.7 / 15	3.71	
8.8	GHz	1018	1023	1029		3.43	
5	GHz	1020	1023	1029		2.84	
2.7	GHz	1020	1021	1027		2.72	
1.4	GHz	1020	1022	1024		2.78	
610	MHz	1020	1021	1024		2.91	
410	MHz	1022	1023	1024	U0.4	2.45	
245	MHz	1022	1023	1025		4.36	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	36-180	1024		1029	1049	1	
DH II	14-0.1	1039		2020			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1036	740	- 2.0	360˚	222˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11893 (S13L098, CMP14,2.11.2013;
Sp=480 msh; EKI; BGD; R)
XRI=1.12 $X_1^{1.0}$+$M_1^{1.2}$+ C_{11}
PFR 19.11 $X_1^{1.0}$

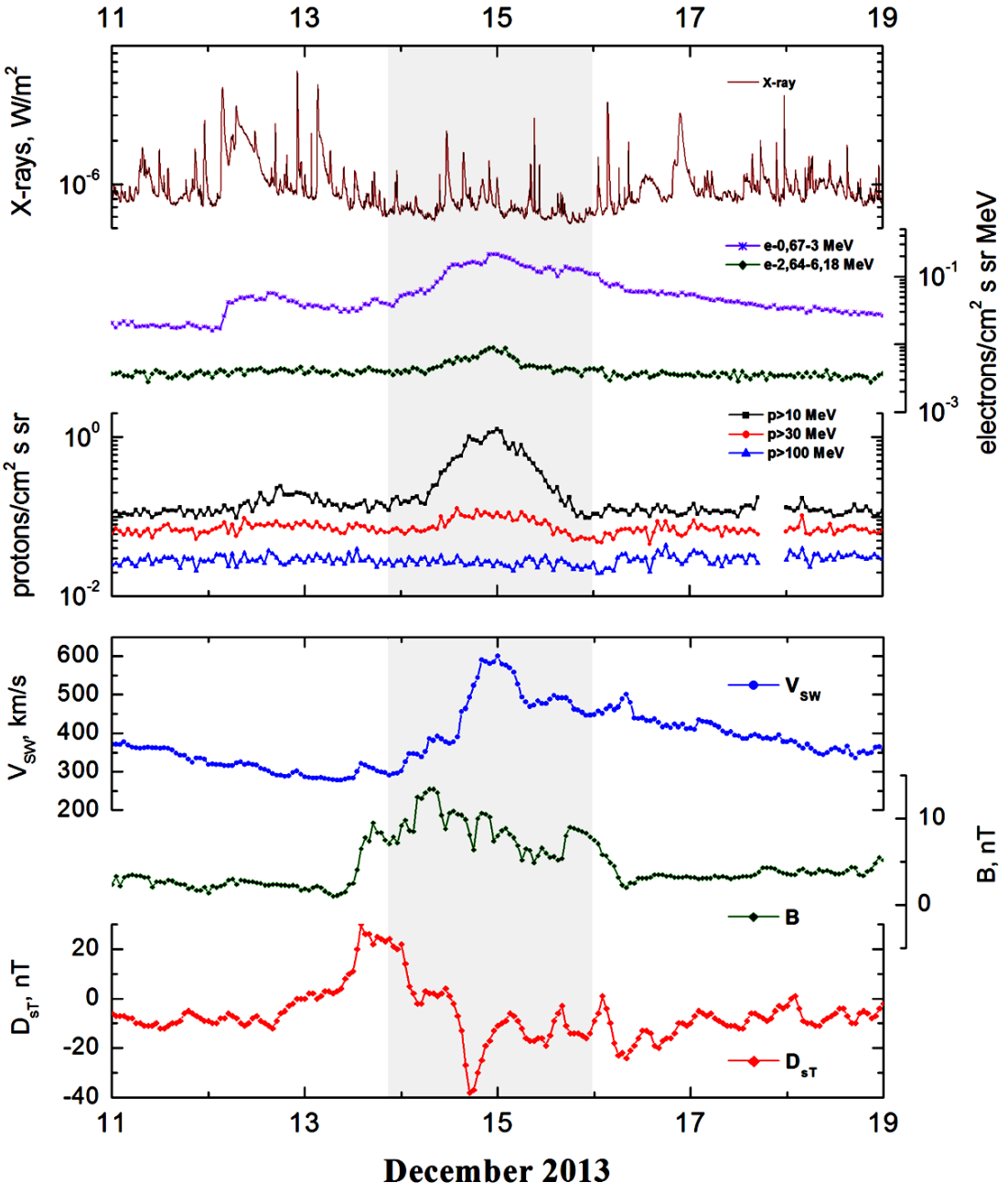
References:

Махмутов В.С., Базилевская Г.А., Стожков Ю.И. и др., 2015.
Мирошниченко Л.И., Ли Ч., Янке В.Г., 2020.
Bruno A., I.G. Richardson, 2021.
Miroshnichenko L.I., C. Li, V.G. Yanke, 2020.
Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.

Particle event: To(Ep>10 MeV) – 14d06^h
Tmax (Ep>10 MeV) – 15d01^h, Jmax (Ep>10 MeV) – 1.1 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma = 2.3$
Quasimaximal energy of protons in the event – Eqm = 60 MeV

Sources: ⊡ back side solar flare 14d<06^{h}36^m, AR unknown, behind E_L
CME: 14d06^{h}36^m, V=611 km/s, Δφ=121°, dA=112°
Ø CME: 14d21^{h}24^m, V=611 km/s, Δφ=360°, dA=169°
▲ SC 15d17^{h}27^m

Particle fluxes and associated phenomena

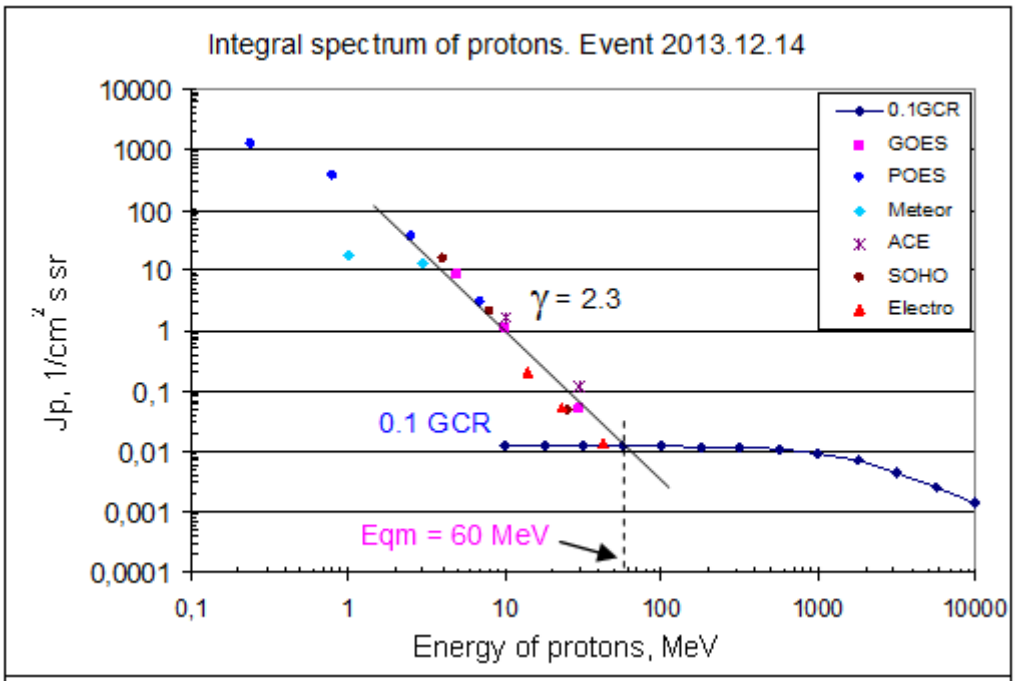


Integral fluxes of protons for the event of 2013 December 14

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	6	15d00	8.5	1.5	0.2	
EPS	>10	6	15d01	1.1	1.5	0.12	
EPS	>30	10	15d00	0.05	1.5	0.07	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	6	24	1230	2	90	
MEPED	>0.8	6	24	375	2	70	
MEPED	>2.5	6	24	37	2	50	
MEPED	>6.9	-	24	3	1	40	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.75	
MEPED	>70	-	-	-	-	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	6	15d00	18	1.5	3	
SCR	>3	6	15d00	13.3	1.5	3.1	
SCR	>10	-	-	-	-	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	-	-	-	-	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	4	23	1.6	1.5	1.2	
SIS	>30	4	23	0.12	1.5	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

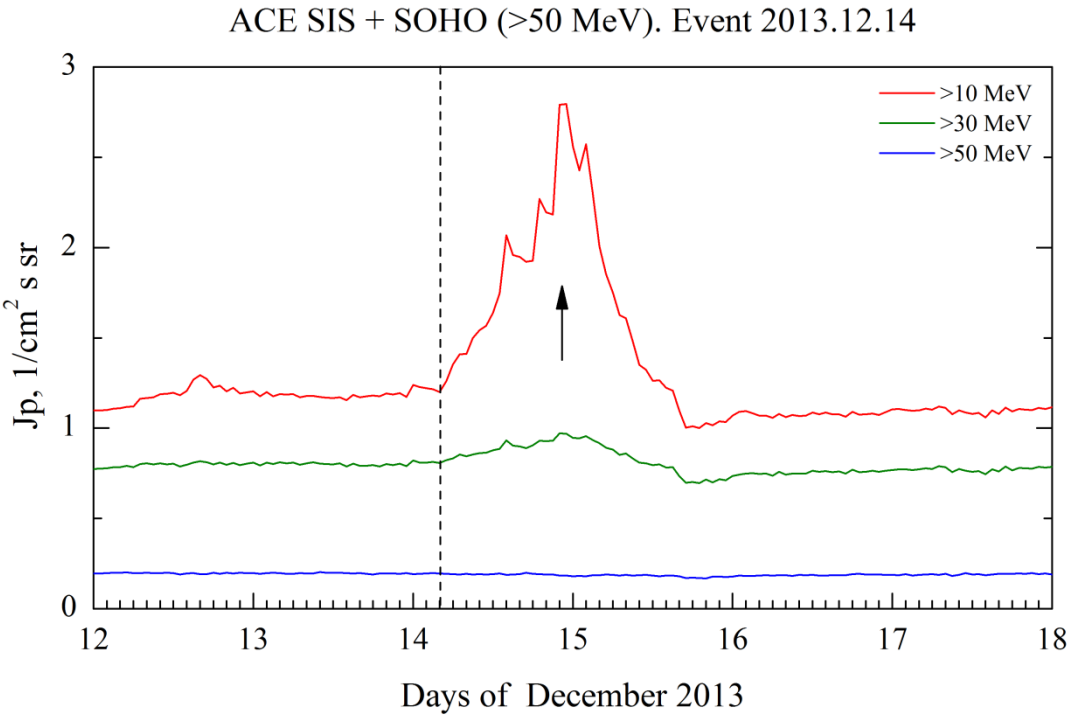
Differential fluxes of protons for the event of 2013 December 14

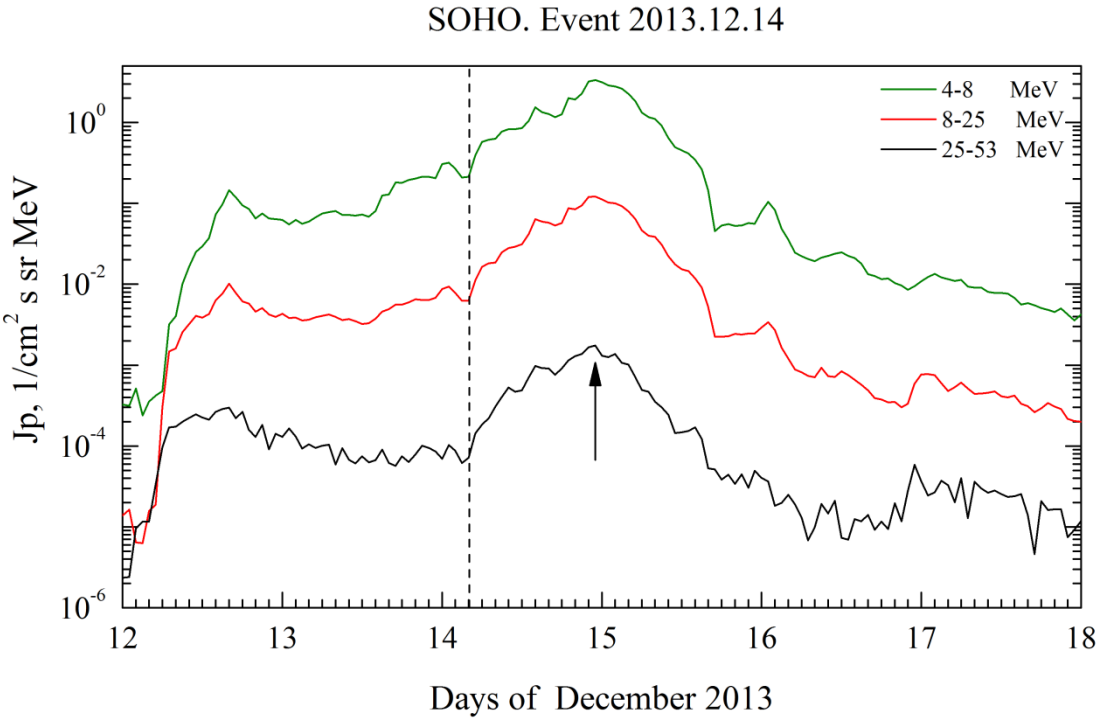
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	5	14d23	3.35	2	0.0003	
EPHIN	8 – 25	5	14d23	0.12	2	0.000006	
EPHIN	25 – 53	5	14d23	0.0017	2	0.000002	
Electro-1							
SCR-E	13.7–23	4	18	0.016	1.5	0.05	
SCR-E	23–42	4	18	0.002	1	0.02	
SCR-E	42–112	-	18	0.0007	-	0.004	

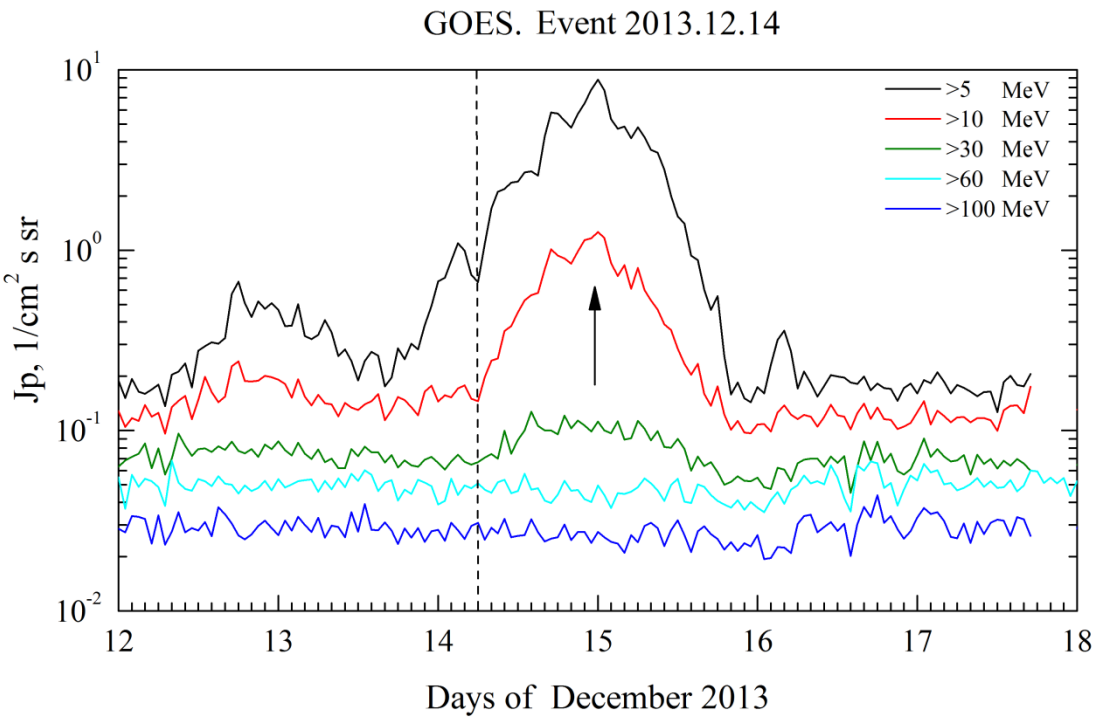

Integral spectrum of protons. Event 2013.12.14
Jp, 1/cm² s sr
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.3
0.1 GCR
Eqm = 60 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

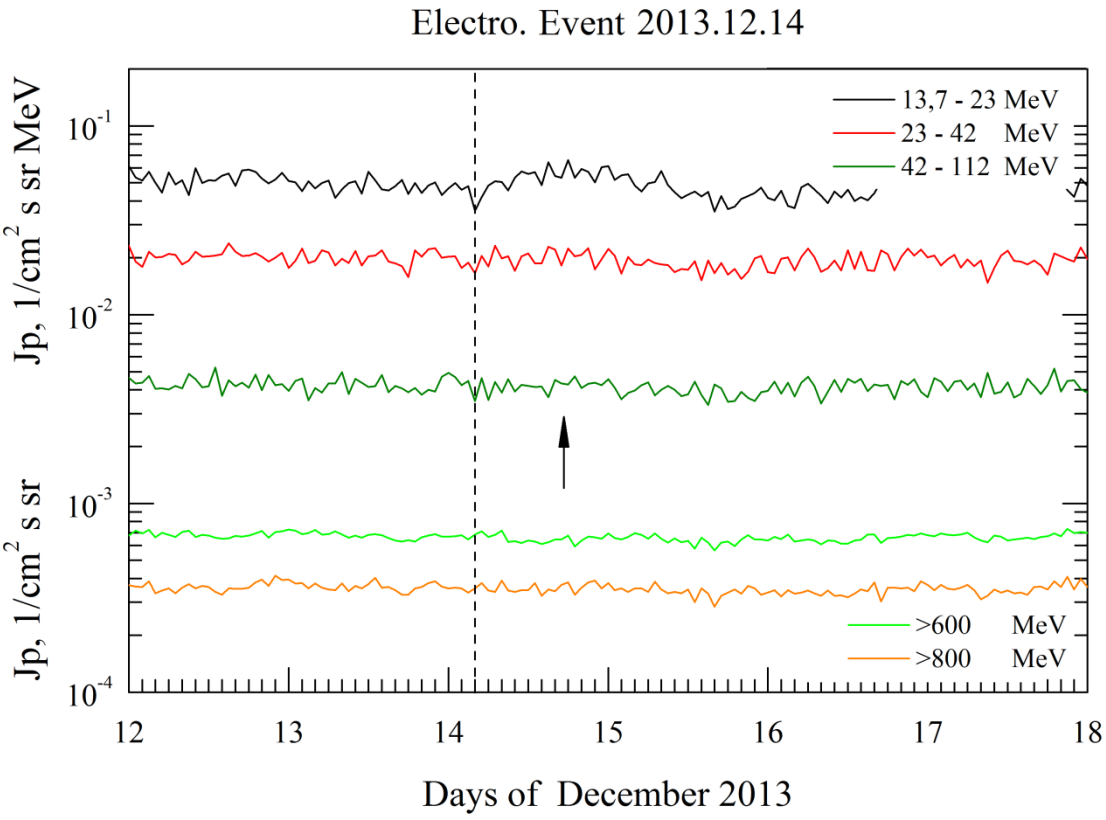
Time profiles of proton fluxes in the event 2013.12.14

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

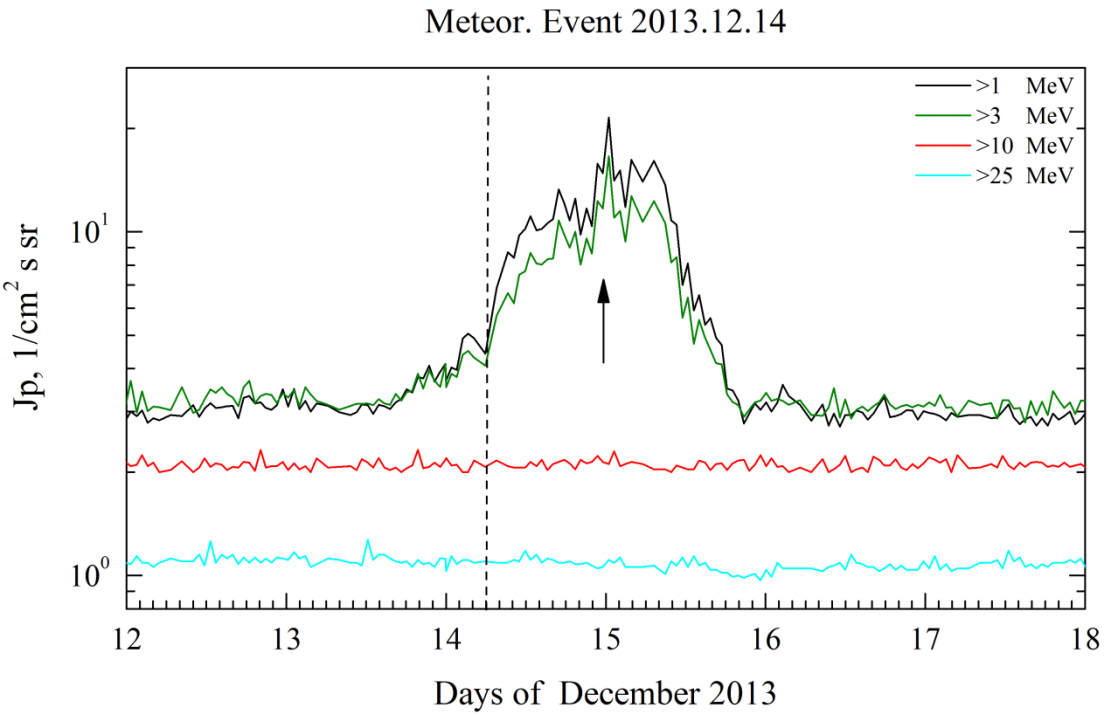


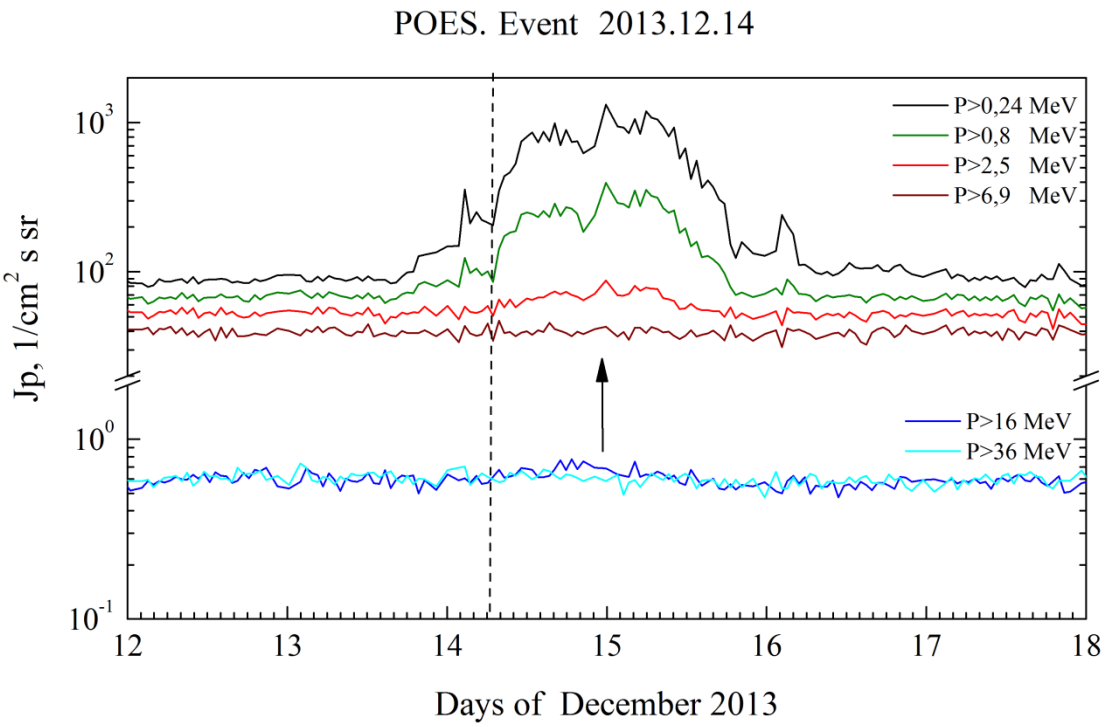



GOES. Event 2013.12.14
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of December 2013


Electro. Event 2013.12.14
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of December 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 December 14

2013 December 14 ⊡ AR XXXXX To event 544

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event on visible solar disc					

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	025-180	0640		0641	500	1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0636	611	- 21.1	121°	112°	SOHO

2013 December 14 Ø AR XXXXX To event 544

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event on visible solar disc					

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	2124	611	- 2.5	360°	169°	SOHO

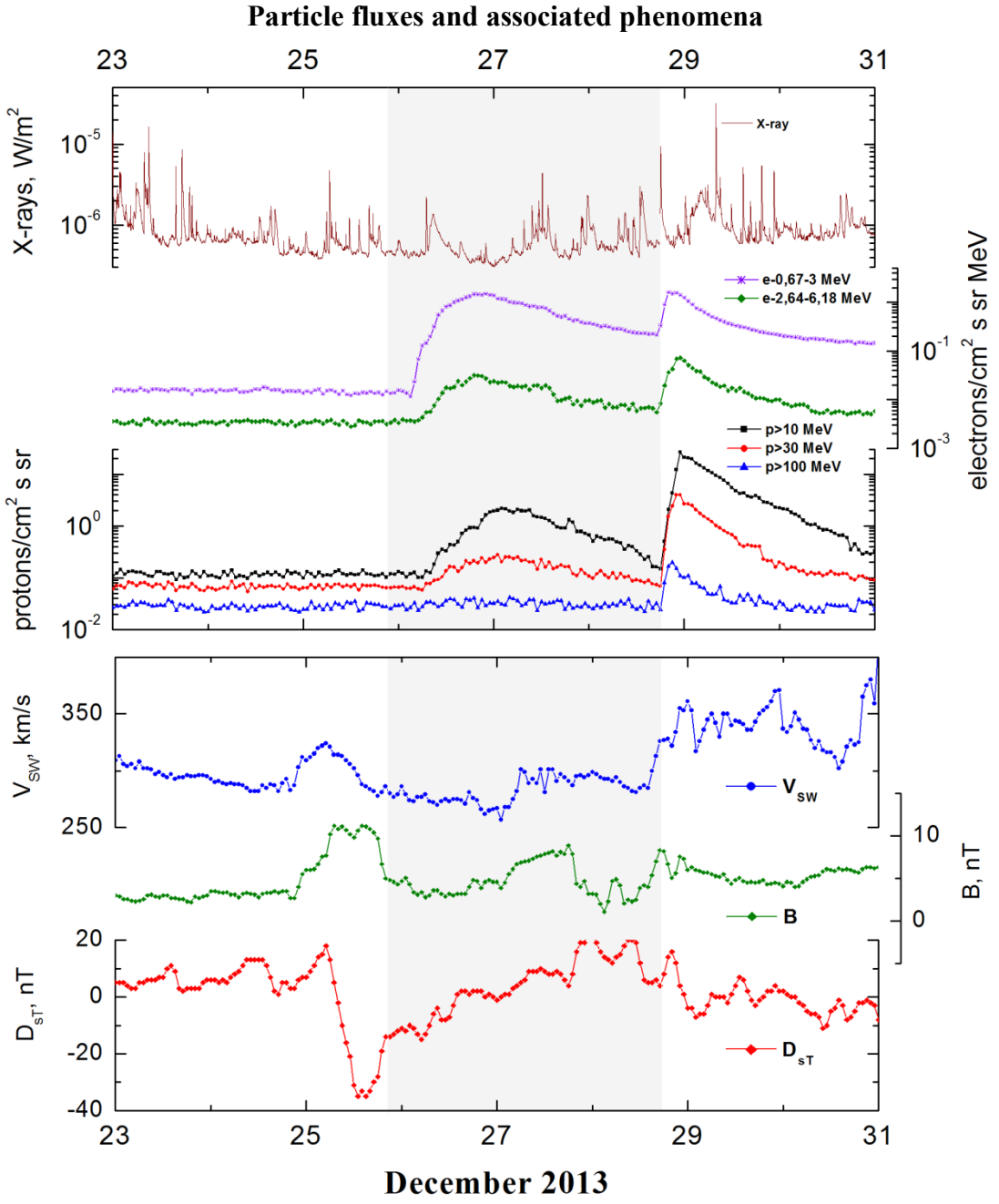
References:

Gopalswamy N., S. Yashiro, H. Xie et al., 2015.

Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.

Particle event: To(Ep>10 MeV) – 26d08^h
Tmax (Ep>10 MeV) – 27d03^h, Jmax (Ep>10 MeV) – 2 /cm^2·s·sr
Duration of the event – 2.5 days, power-law index: $\gamma = 2.3$
Quasimaximal energy of protons in the event – Eqm = 90 MeV

Sources: ⊡ solar flare 26d<03^{h}24^m, AR unknown, behind E_L
CME 26d03^{h}24^m, V = 1336 km/s, Δφ = 360º, dA = 36º

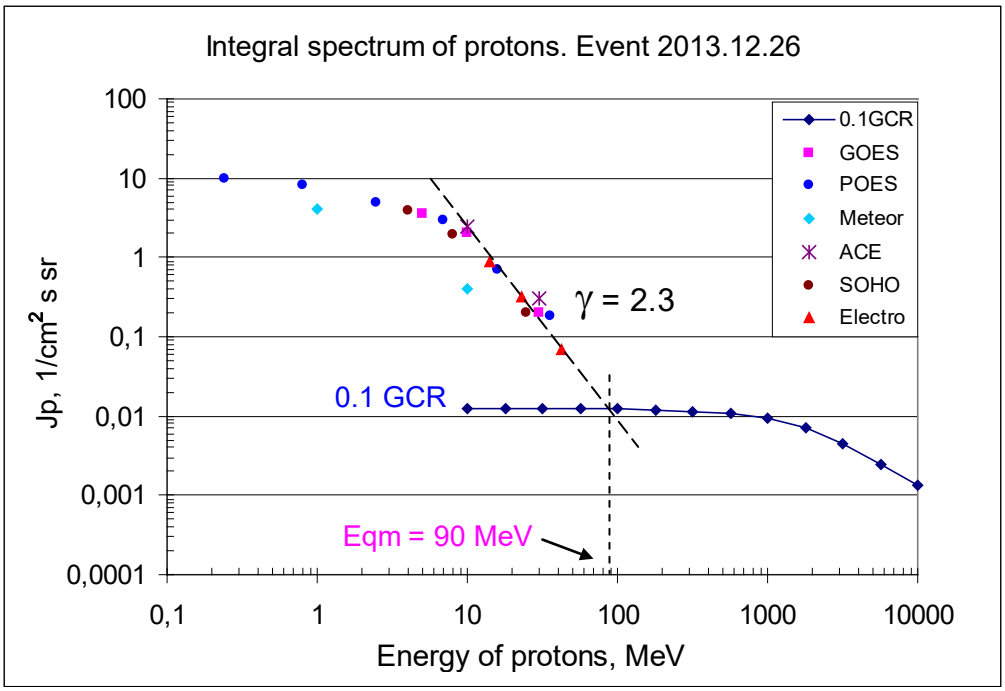


Integral fluxes of protons for the event of 2013 December 26

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	8	27d03	3.5	2.5	0.2	
EPS	>10	8	27d03	2	2.5	0.12	
EPS	>30	6	27d01	0.2	2.5	0.07	
EPS	>50	6	-	-	2	0.06	
EPS	>60	6	-	-	2	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	-	27d06	10	-	90	
MEPED	>0.8	-	27d06	8	-	70	
MEPED	>2.5	-	27d06	5	-	55	
MEPED	>6.9	-	27d06	3	-	42	
MEPED	>16	12	14	0.7	1.5	0.7	
MEPED	>36	12	15	0.18	1	0.75	
MEPED	>70	-	-	-	-	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	9	27d06	4	2	2.9	
SCR	>3	9	-	-	2	2.4	
SCR	>10	9	27d06	0.4	2	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	-	-	-	-	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	8	23	2.5	2	1.2	
SIS	>30	8	23	0.3	2	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

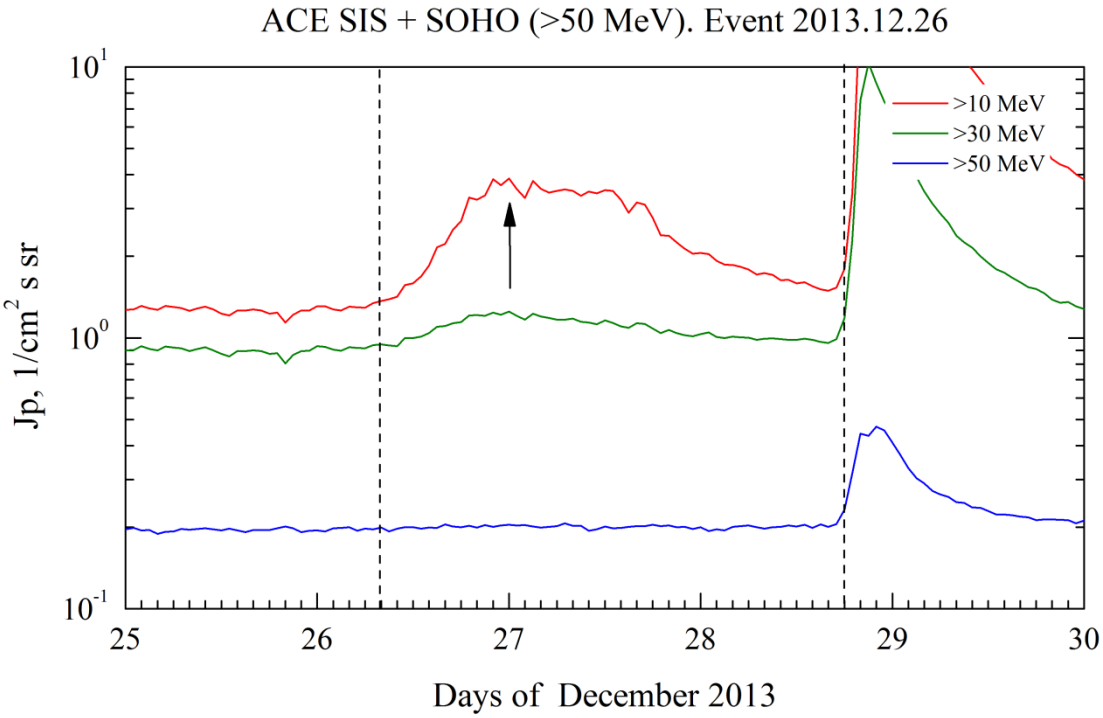
Differential fluxes of protons for the event of 2013 December 26

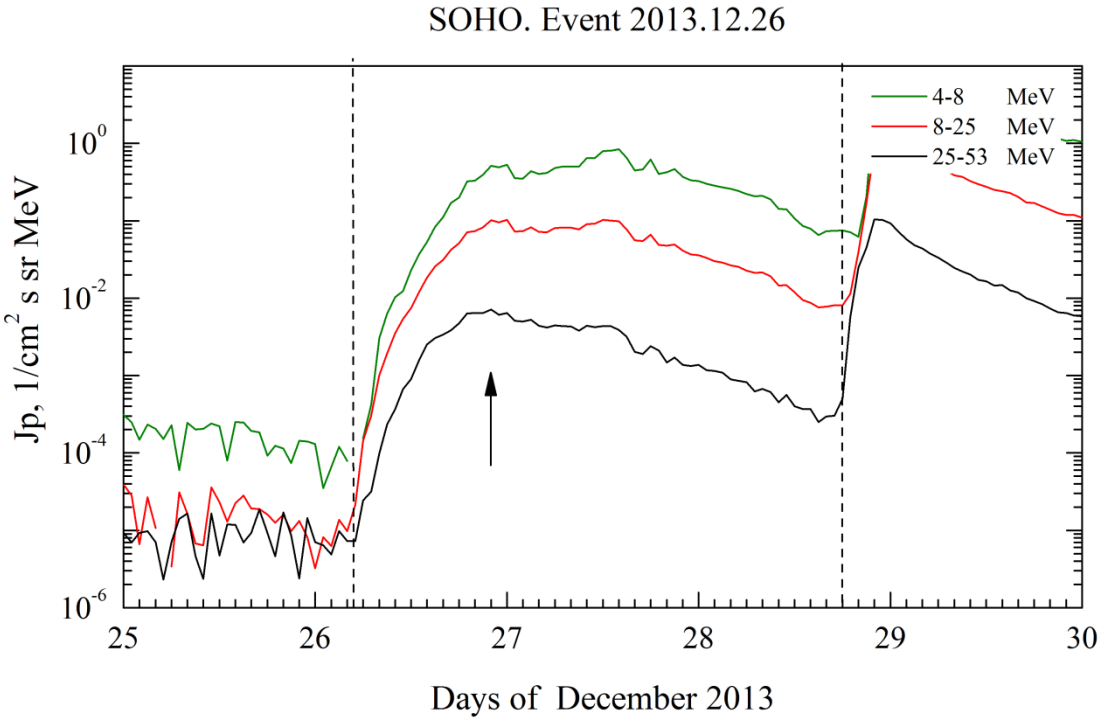
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	06	22	0.51	2.5	0.0001	
EPHIN	8 – 25	05	22	0.1	2.5	0.00001	
EPHIN	25 – 53	06	22	0.007	2.5	0.00001	
Electro-1							
SCR-E	13.7–23	8	22	0.06	2	0.05	
SCR-E	23–42	8	22	0.013	2	0.02	
SCR-E	42–112	8	21	0.001	-	0.004	

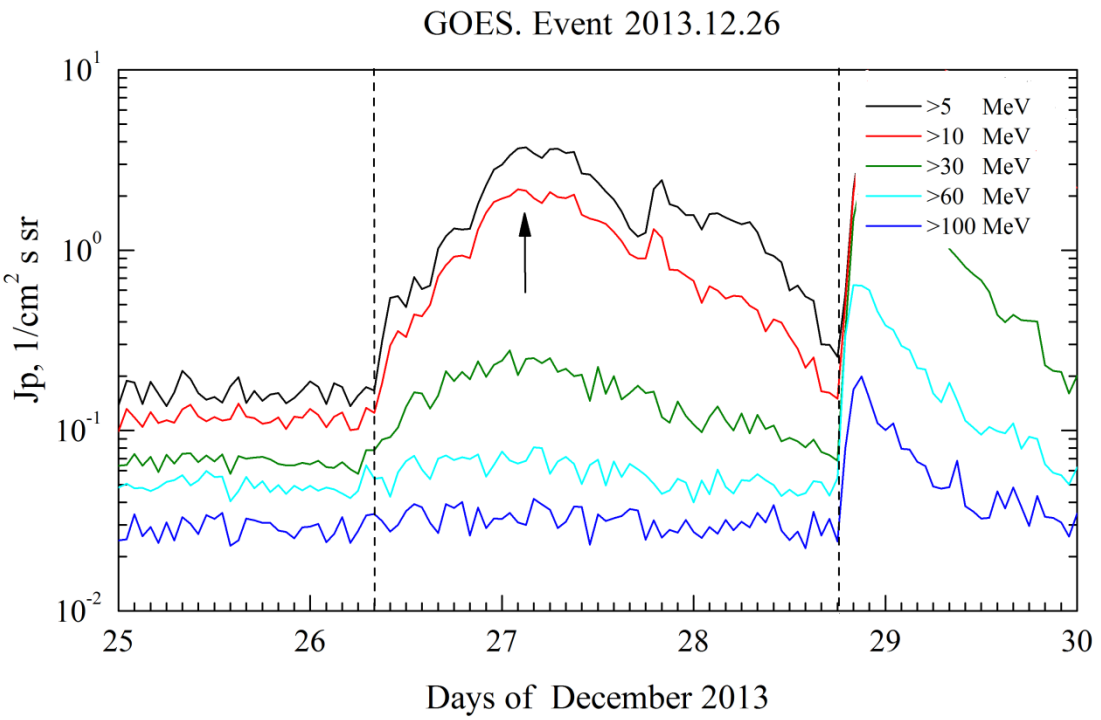

Integral spectrum of protons. Event 2013.12.26
Jp, 1/cm² s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.3
0.1 GCR
Eqm = 90 MeV

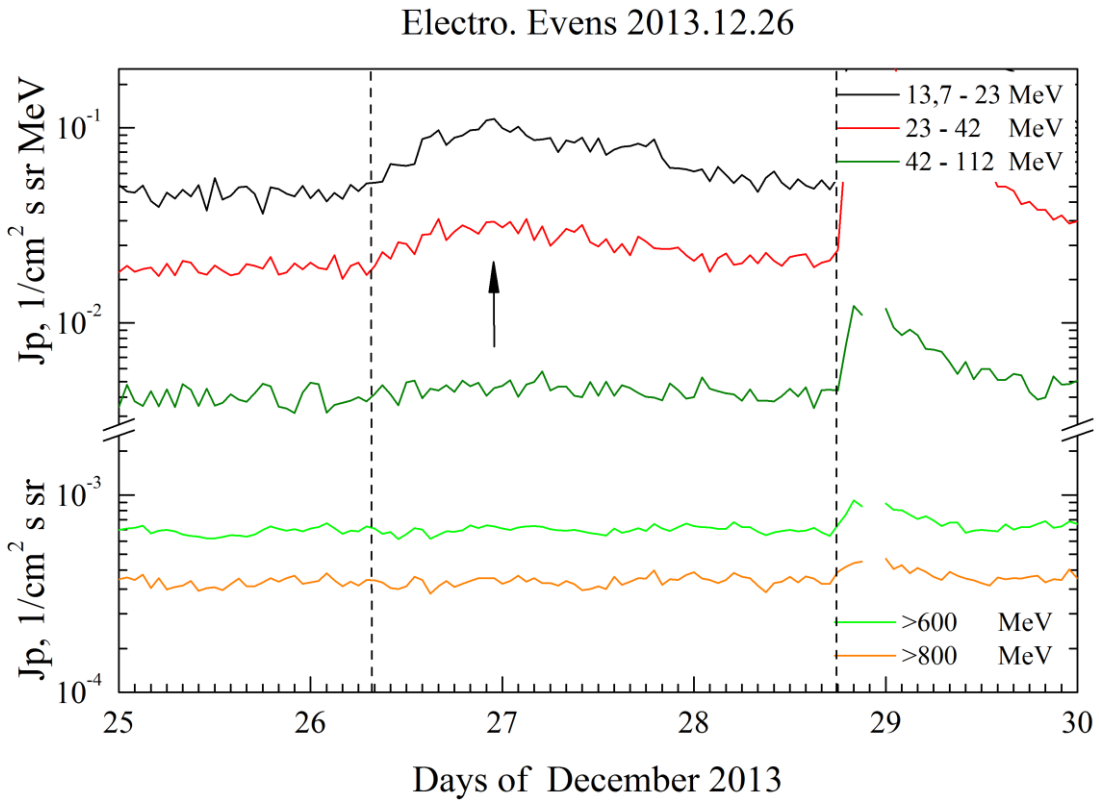
Time profiles of proton fluxes in the event 2013.12.26

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

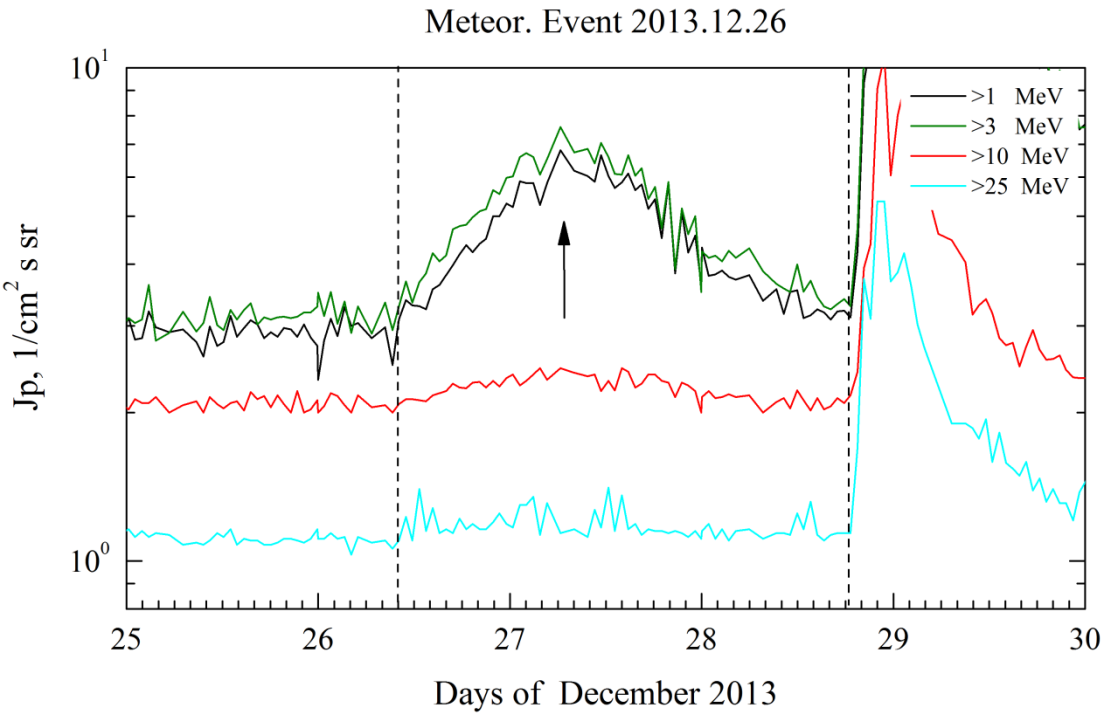


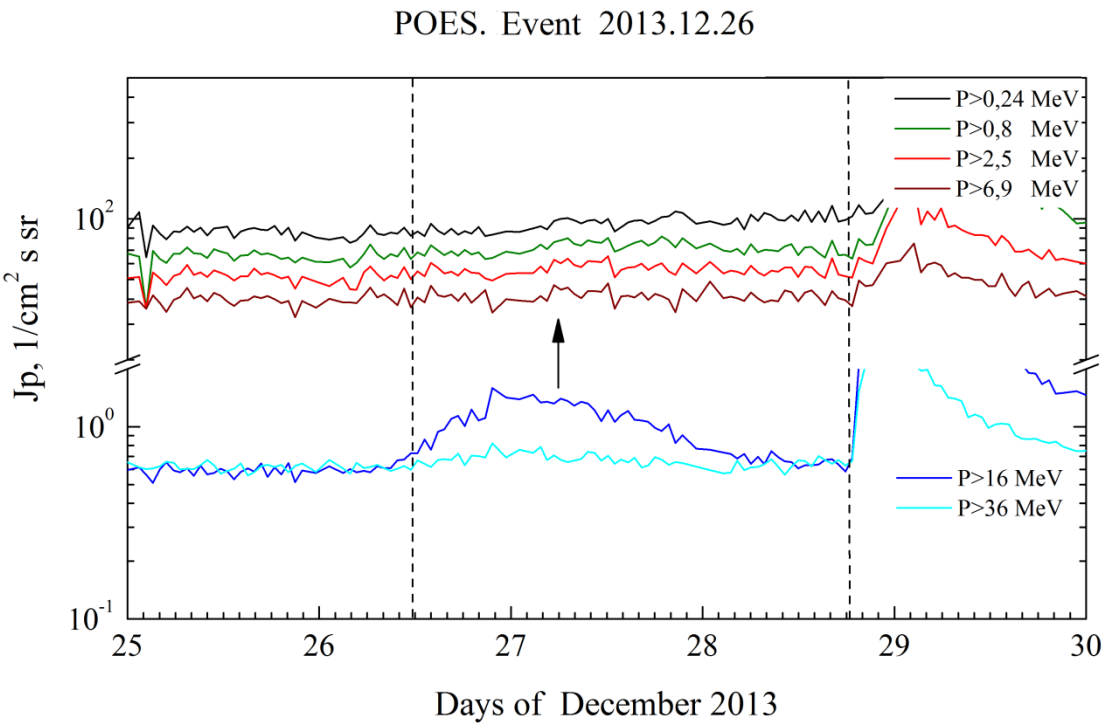



GOES. Event 2013.12.26
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of December 2013


Electro. Evens 2013.12.26
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of December 2013

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 December 26

2013 December 26 ⊡ AR XXXXX To event 545

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event on visible solar disc					
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0324	1336	- 47.9	360º	36º	SOHO

References:

Bruno A., I.G. Richardson, 2021.

Richardson I.G., T.T. von Rosenvinge, H.V. Cane et al., 2014.

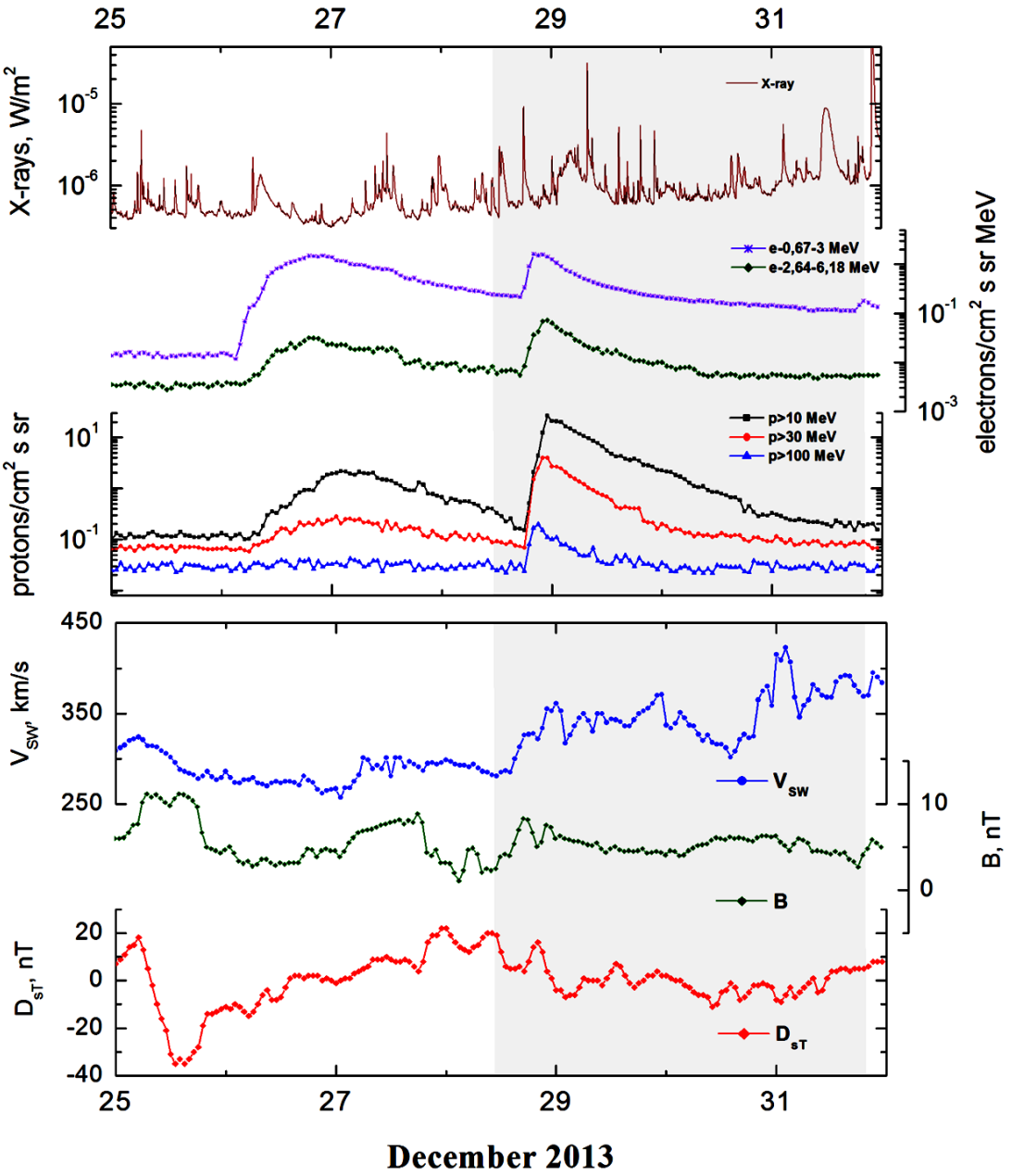
Wang Y., D. Lyu, B. Xiao et al., 2021.

Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.

Particle event: To(Ep>10 MeV) – 28d18^h
Tmax(Ep>10 MeV) – 28d23^h, Jmax(Ep>10 MeV) – 26.5 /cm^2·s·sr
Duration of the event – 3 days, power-law index: $\gamma = 2.6$
Quasimaximal energy of protons in the event – Eqm = 240 MeV

Sources: ⊡ solar flare 28d<17^{h}36^m, AR unknown, behind W_L
CME: 28d17^{h}36^m, V= 1118 km/s, Δφ = 360º, dA= 284º

Particle fluxes and associated phenomena

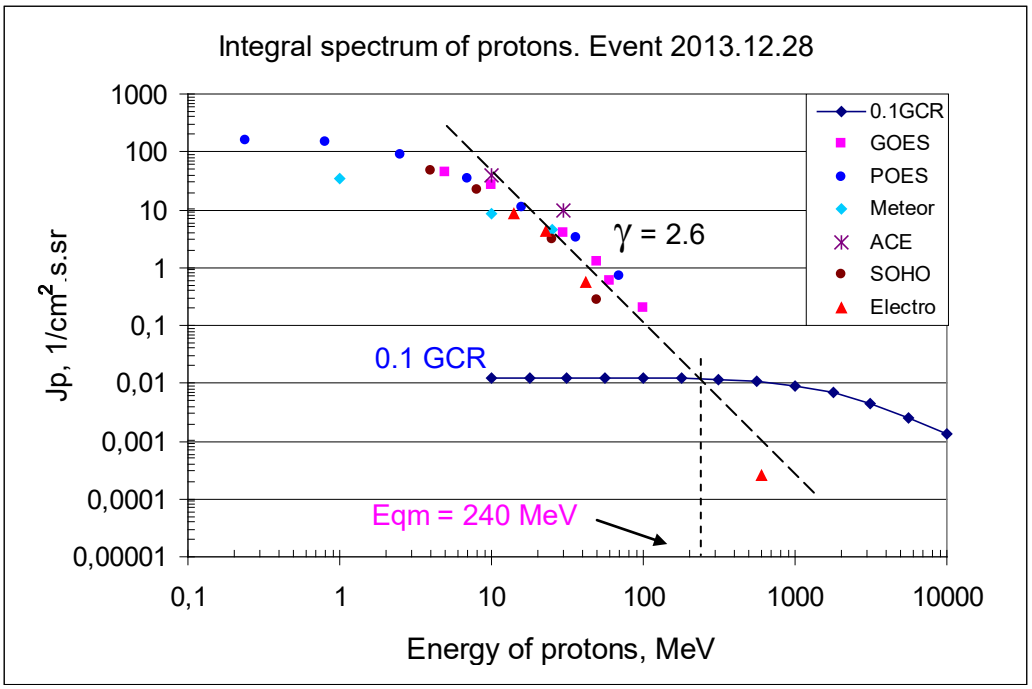


Integral fluxes of protons for the event of 2013 December 28

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	29d01	44.8	3	0.2	
EPS	>10	18	23	26.5	3	0.12	
EPS	>30	18	23	3.9	1.5	0.07	
EPS	>50	18	22	1.3	1	0.06	
EPS	>60	18	21	0.6	1	0.05	
EPS	>100	18	21	0.2	1	0.03	
Electro-1							
GALS-E	>600	18	29d00	0.00025	1	0.00065	
POES							
MEPED	>0.24	18	23	155	2	95	
MEPED	>0.8	18	23	145	2	70	
MEPED	>2.5	18	23	90	2	55	
MEPED	>6.9	18	23	35.5	1.5	40	
MEPED	>16	18	23	11.2	1.5	0.7	
MEPED	>36	18	23	3.35	1.5	0.75	
MEPED	>70	18	23	0.72	1	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	18	23	34.5	2	2.9	
SCR	>3	18	-	-	2	2.4	
SCR	>10	18	23	8.5	1	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	18	23	4.4	0.5	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	17	22	38.4	2	1.2	
SIS	>30	17	21	9.6	2	0.9	
SOHO							
EPHIN	>50	18	22	0.27	1	0.2	

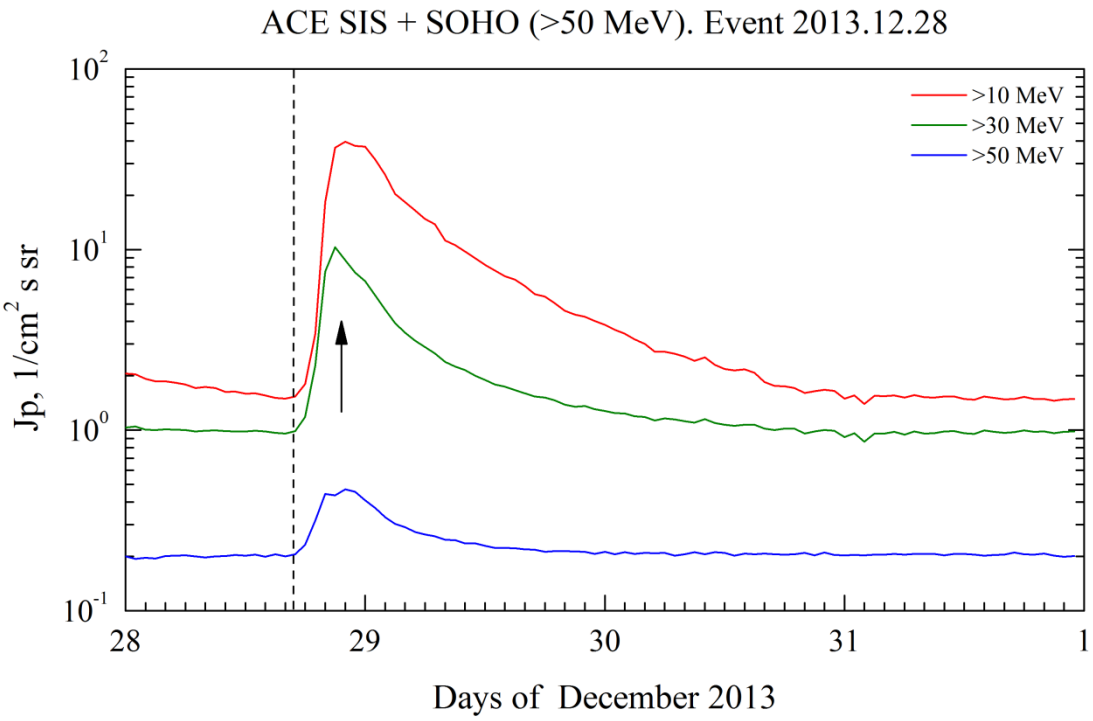
Differential fluxes of protons for the event of 2013 December 28

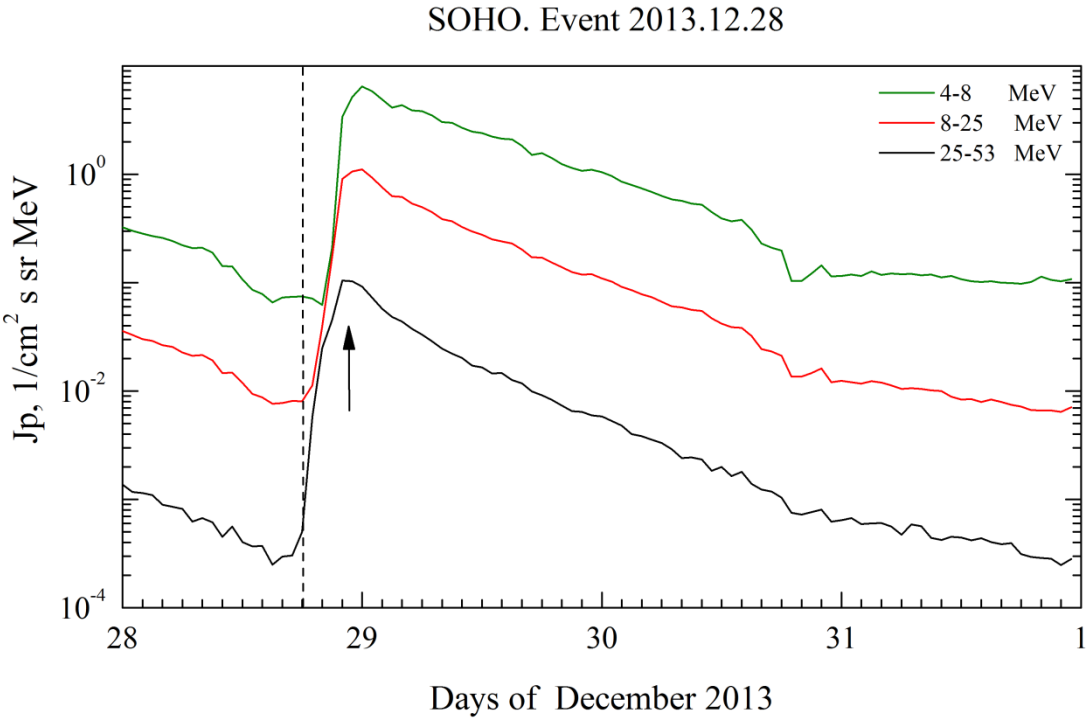
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	21	29d00	6.47	2	0.0001	
EPHIN	8 – 25	20	29d00	1.11	2	0.00001	
EPHIN	25 – 53	18	22	0.1	2	0.00001	
Electro-1							
SCR-E	13.7–23	18	29d00	0.42	2	0.055	
SCR-E	23–42	18	29d00	0.2	2	0.02	
SCR-E	42–112	18	29d00	0.008	1	0.004	


Integral spectrum of protons. Event 2013.12.28
1000
100
10
1
0,1
0,01
0,001
0,0001
0,00001
Jp, 1/cm2.s.sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.6
0.1 GCR
Eqm = 240 MeV

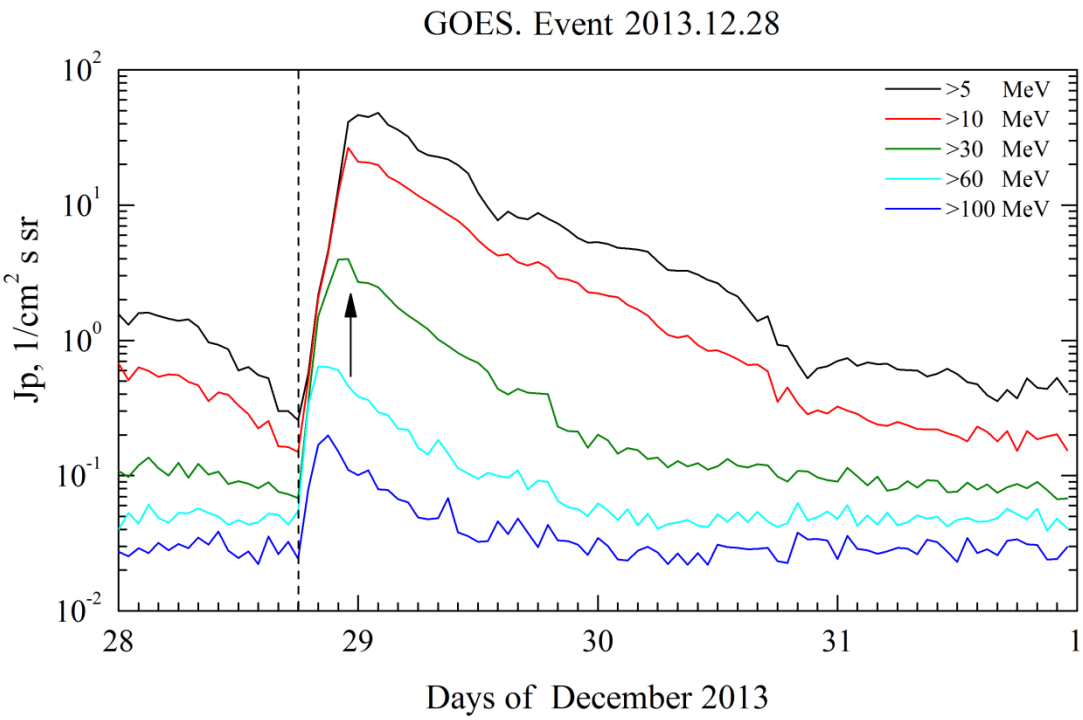
Time profiles of proton fluxes in the event 2013.12.28

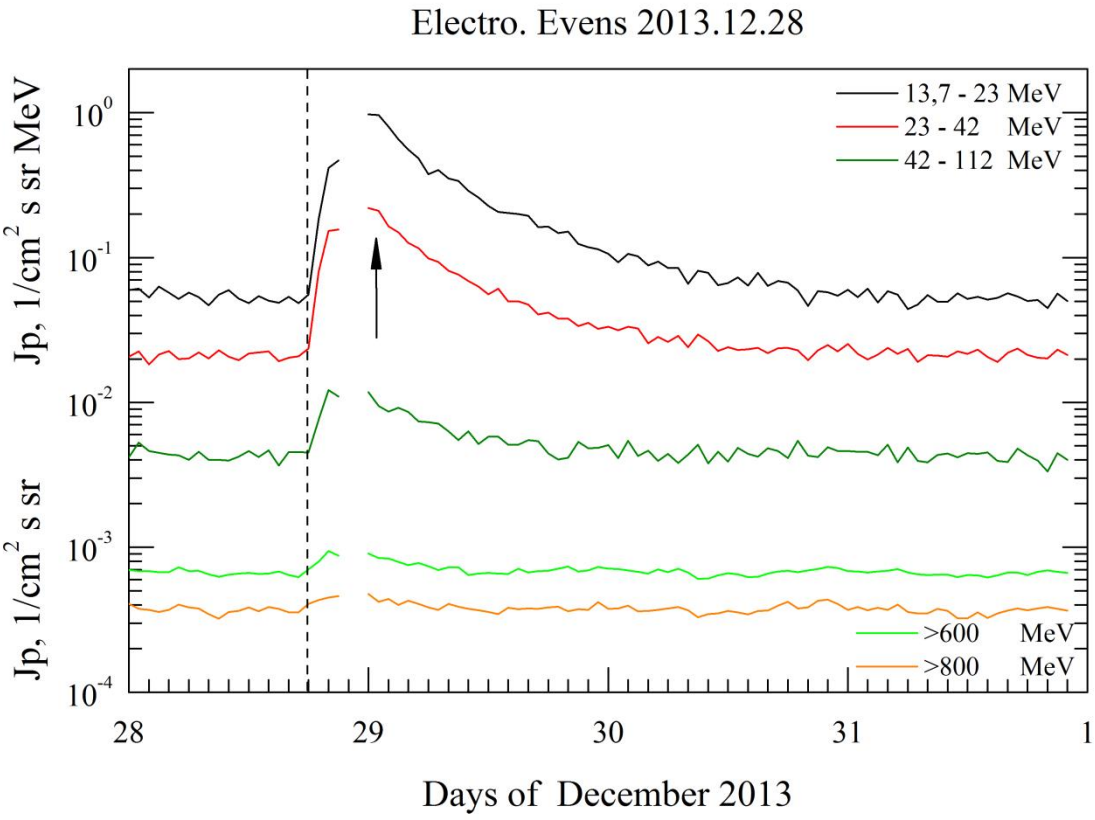
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO





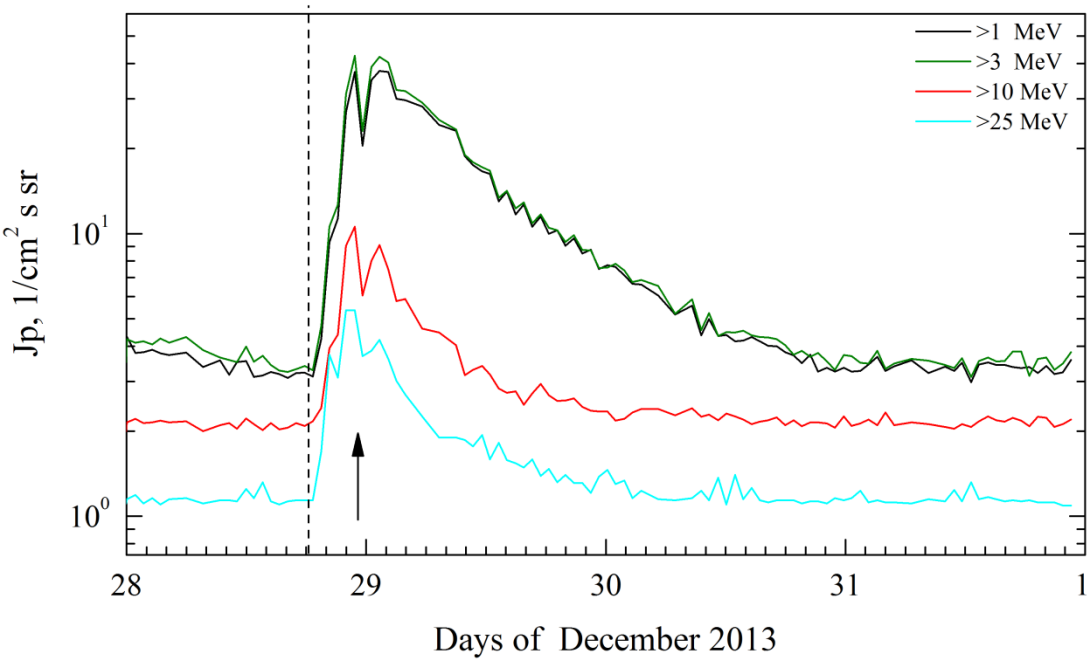
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro



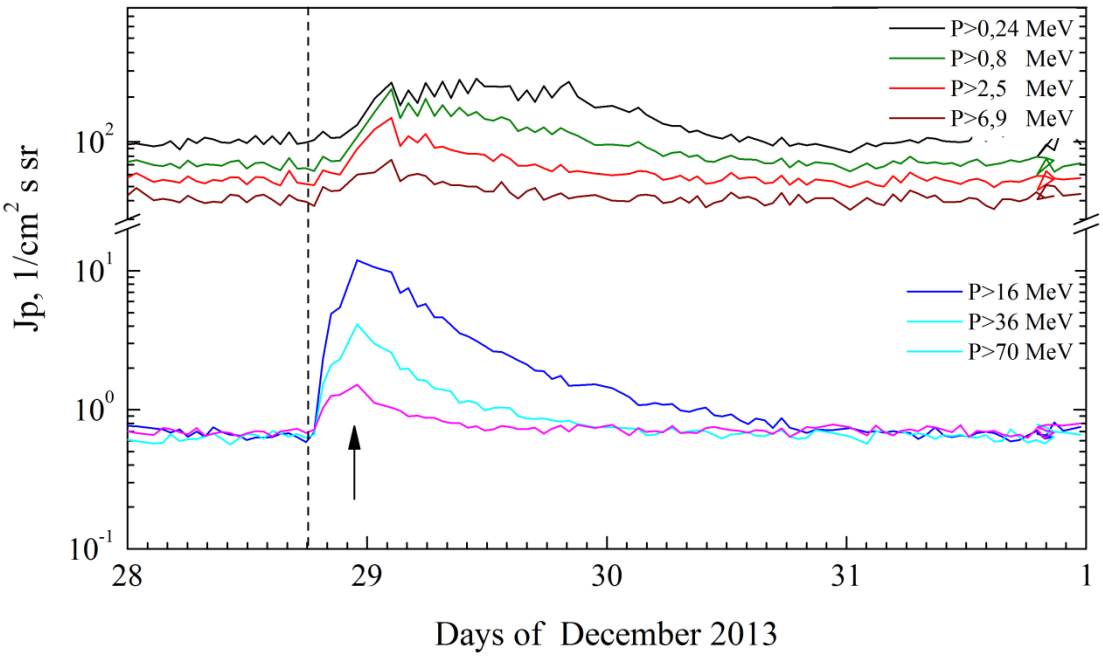


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2013.12.28



POES. Event 2013.12.28



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2013 December 28

2013 December 28 ⊡ AR XXXX To event 546

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No flare event o the visible disk					
1 – 12	keV	No X-ray durst jn the visible disk					
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	1758:16	1801:26	1832:36	352	635063	HESSI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DH II	16-0.5	1731		1805			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1736	1118	- 26.7	360º	284º	SOHO

References:

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Gopalswamy N., H. Xie, S. Akiyama et al., 2014.
Gopalswamy N., S. Yashiro, N. Thakur et al., 2016.
NOAA SPE, 2019.
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Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

События 2014 года

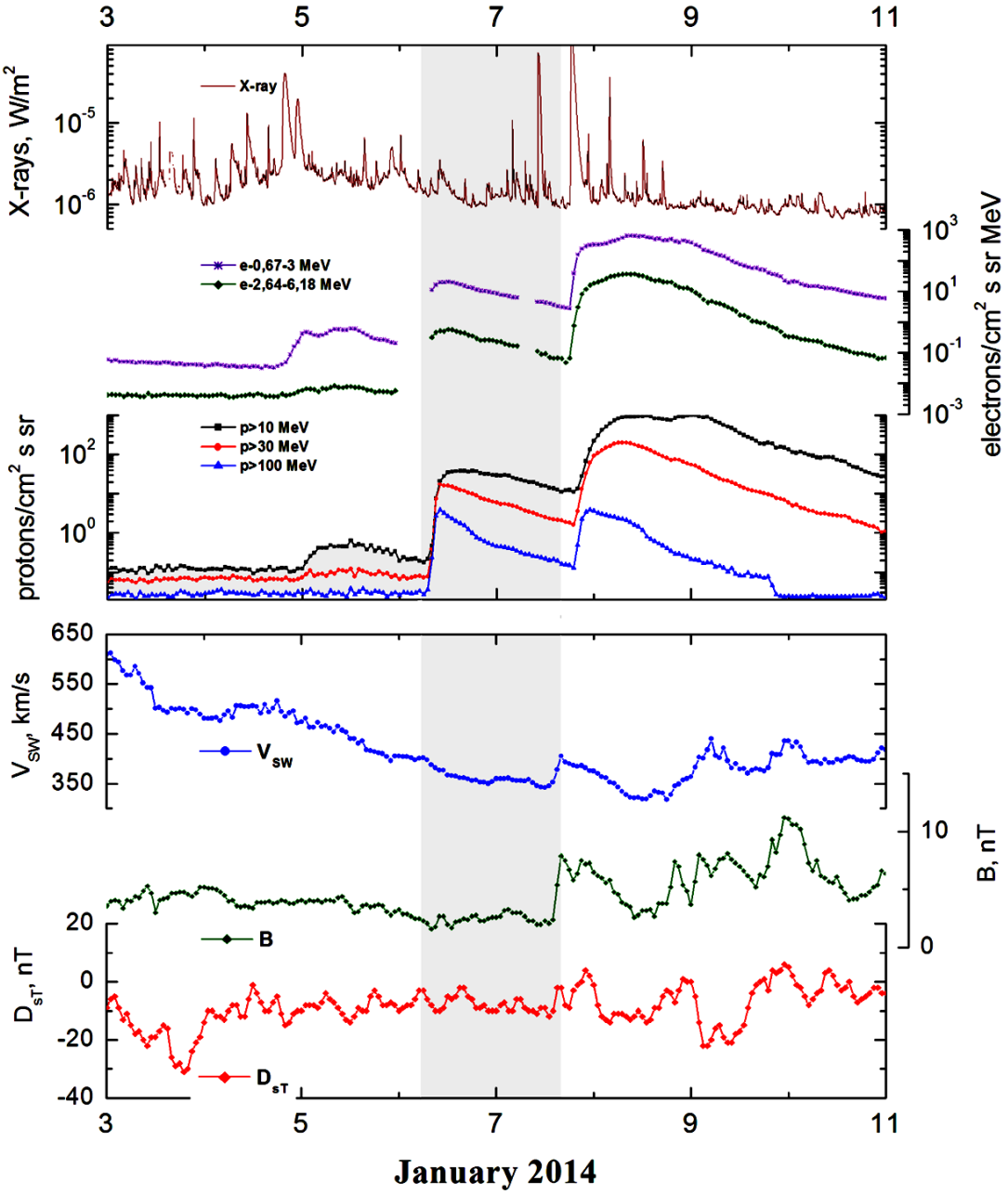
			Страница
1	Event 2014.01.16 – (2014-006)	№ 547	615
2	Event 2014.01.07 – (2014-007)	№ 548	623
3	*Event 2014.02.18 – (2014-049)	№ 549	633
4	Event 2014.02.19 – (2014-050)	№ 550	640
5	Event 2014.02.20 – (2014-051)	№ 551	647
6	Event 2014.02.25 – (2014-056)	№ 552	655
7	Event 2014.02.28 – (2014-059)	№ 553	663
8	*Event 2014.03.25 – (2014-084)	№ 554	670
9	Event 2014.03.29 – (2014-088)	№ 555	677
10	Event 2014.04.18 – (2014-108)	№ 556	685
11	Event 2014.08.25 – (2014-237)	№ 557	693
12	Event 2014.09.01 – (2014-244)	№ 558	701
13	Event 2014.09.10 – (2014-253)	№ 559	709
14	Event 2014.11.01 – (2014-305)	№ 560	719
15	Event 2014.12.13 – (2014-347)	№ 561	726
16	Event 2014.12.21 – (2014-355)	№ 562	733
17	Event 2014.12.23 – (2014-357)	№ 563	742

Звездочкой (*) отмечены слабые события с Jp (E > 10 МэВ) в интервале 0.1 ÷ 1 pfu

Particle event: To(Ep>10 MeV) – 06d07^h
Tmax(Ep>10 MeV) – 06d14^h, Jmax(Ep>10 MeV) – 38/cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma = 2.1$
Quasimaximal energy of protons in the event – Eqm = 1350 MeV

Sources: ■ solar flare 06d07^{h}30^m, C2.1*/EPL, S15W89, AR11936, ~1.5d behind W_L
Main burst X-ray 1–8 Å: onset – 06d07^{h}30^m, max – 06d07^{h}45^m, $\Phi = 0.056$ J/m^2
CME: 06d08^{h}00^m, V= 1402 km/s, $\Delta\varphi = 360^o$, dA= 274°
▲ SC 07d15^{h}14^m
* echo of mostly large flare event

Particle fluxes and associated phenomena

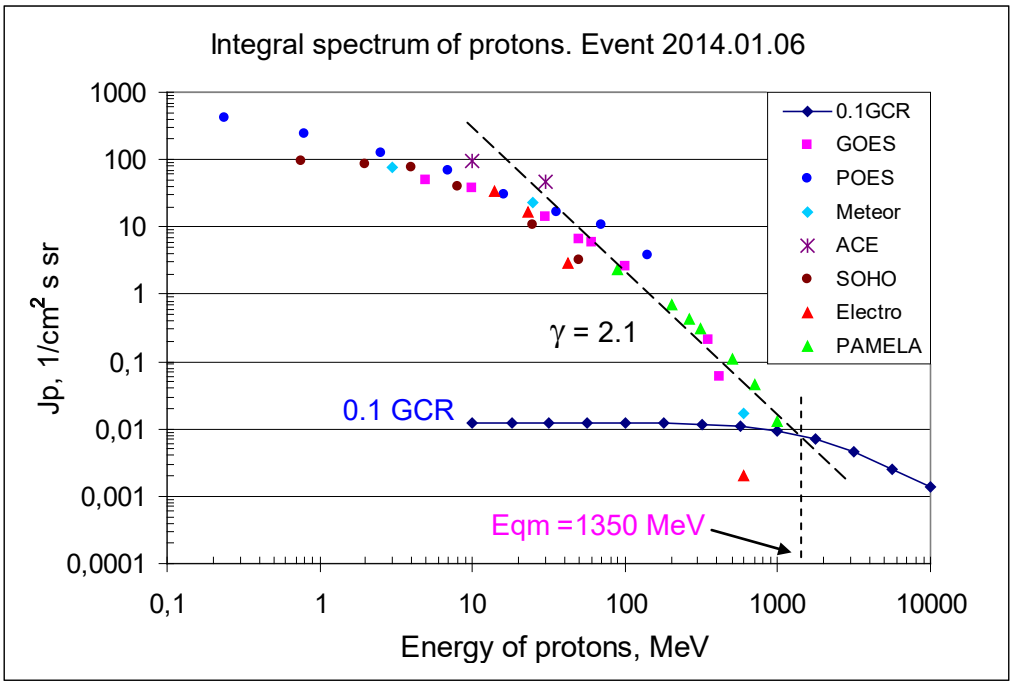


Integral fluxes of protons for the event of 2014 January 06

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	15	49	1.5	0.2	
EPS	>10	7	14	38	1.5	0.15	
EPS	>30	7	13	13.8	1.5	0.07	
EPS	>50	7	12	6.7	1.5	0.06	
EPS	>60	7	12	6	1.5	0.05	
EPS	>100	7	11	2.6	-	0.03	
Electro-1							
GALS-E	>600	7	11	0.0017	1.5	0.0007	
POES							
MEPED	>0.24	8	11	410	1.5	90	
MEPED	>0.8	8	11	245	1.5	65	
MEPED	>2.5	8	11	125	1.5	50	
MEPED	>6.9	8	11	70	1.5	40	
MEPED	>16	8	11	30	1.5	0.7	
MEPED	>36	8	11	16.5	1.5	0.75	
MEPED	>70	8	11	10.6	1.5	0.9	
MEPED	>140	8	11	3.7	1.5	1	
Meteor-1							
SCR	>1	8	-	-	1.7	3	
SCR	>3	8	16	78	1.7	3.2	
SCR	>10	8	-	-	1.7	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	8	10	23	1.7	1.1	
GALS-M	>600	8	10	0.017	0.5	0.02	
ACE							
SIS	>10	7	11	95	1.5	1.1	
SIS	>30	7	9	46	1.5	0.75	
SOHO							
EPHIN	>50	8	9	3.3	1.5	0.2	
PAMELA							
TRACKER	>90	8	9-13	2.3	1.5	-	
TRACKER	>200	8	9-13	0.71	1.5	-	
TRACKER	>265	8	9-13	0.42	1.5	-	
TRACKER	>312	8	9-13	0.31	1.5	-	
TRACKER	>500	8	9-13	0.11	1.5	-	
TRACKER	>700	8	9-13	0.046	1.5	-	
TRACKER	>1000	8	9-13	0.013	1.5	-	

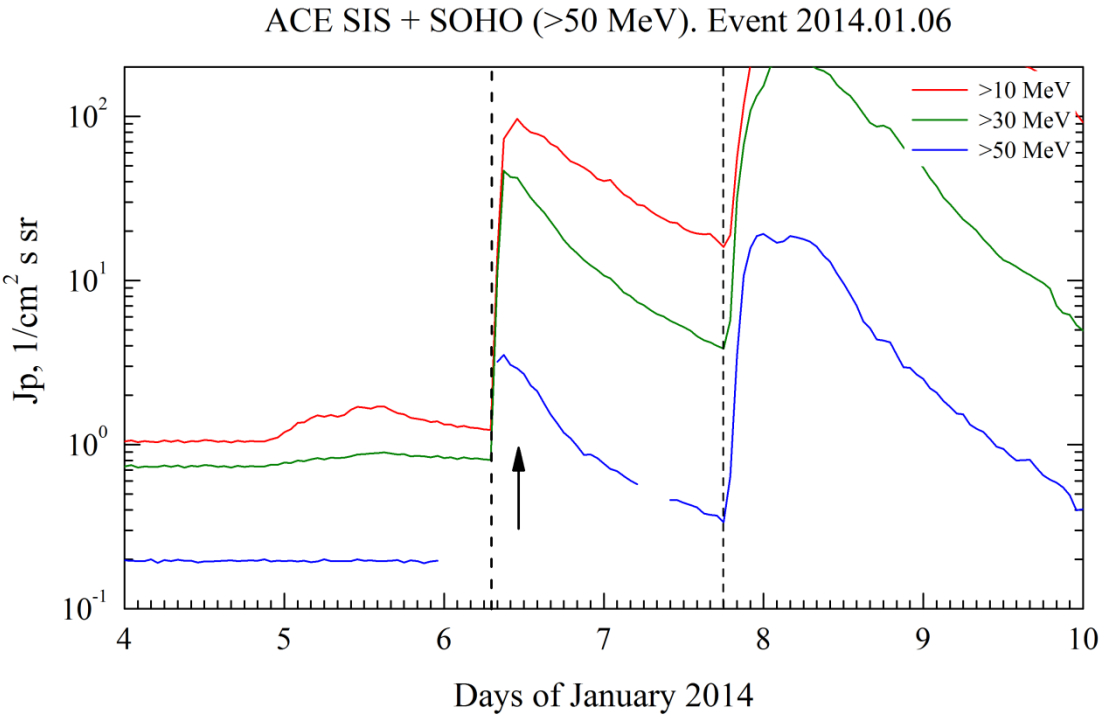
Differential fluxes of protons for the event of 2014 January 06

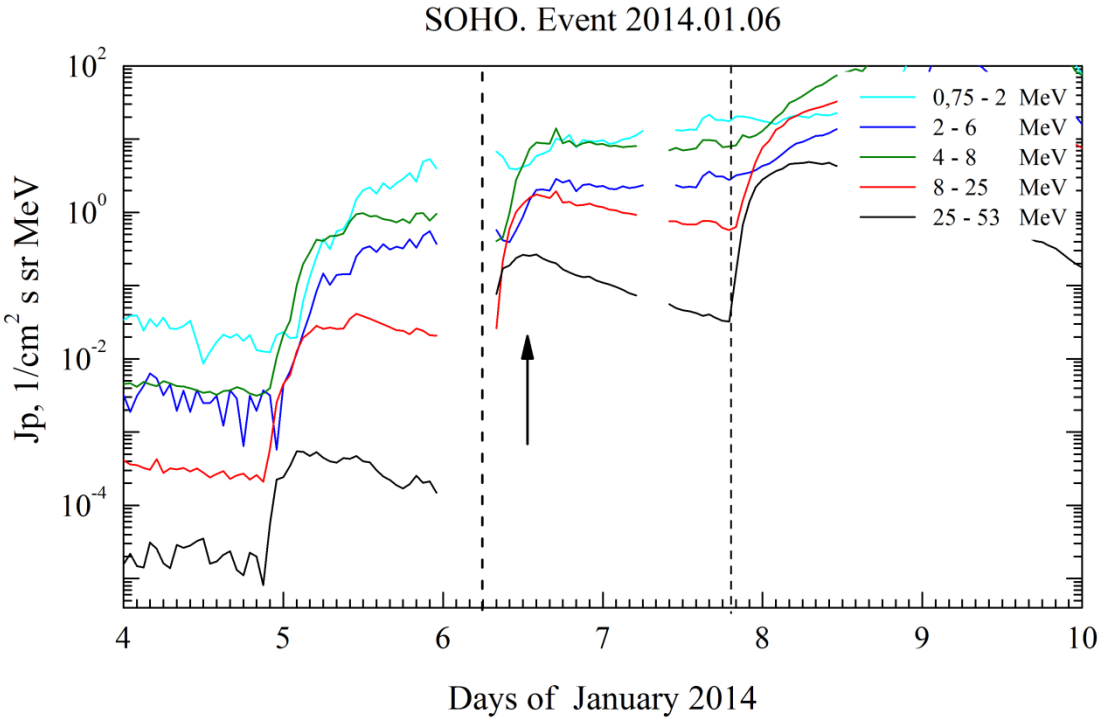
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	8	17	8.7	1.5	0.02	
LION	2 – 6	8	17	2.87	1.5	0.002	
EPHIN	4 – 8	8	17	9	1.5	0.004	
EPHIN	8 – 25	8	15	1.67	1.5	0.0003	
EPHIN	25 – 53	8	12	0.26	1.5	0.00003	
Electro-1							
SCR-E	13.7–23	7	11	1.75	1.5	0.05	
SCR-E	23–42	7	11	0.735	1.5	0.025	
SCR-E	42–112	7	11	0.042	1.5	0.0045	
GOES							
EPS	350–420	9	10	0.0021	1	0.0016	
EPS	420–510	7	9	0.00068	1	0.0009	
EPS	510–700	-	-	-	-	0.0003	



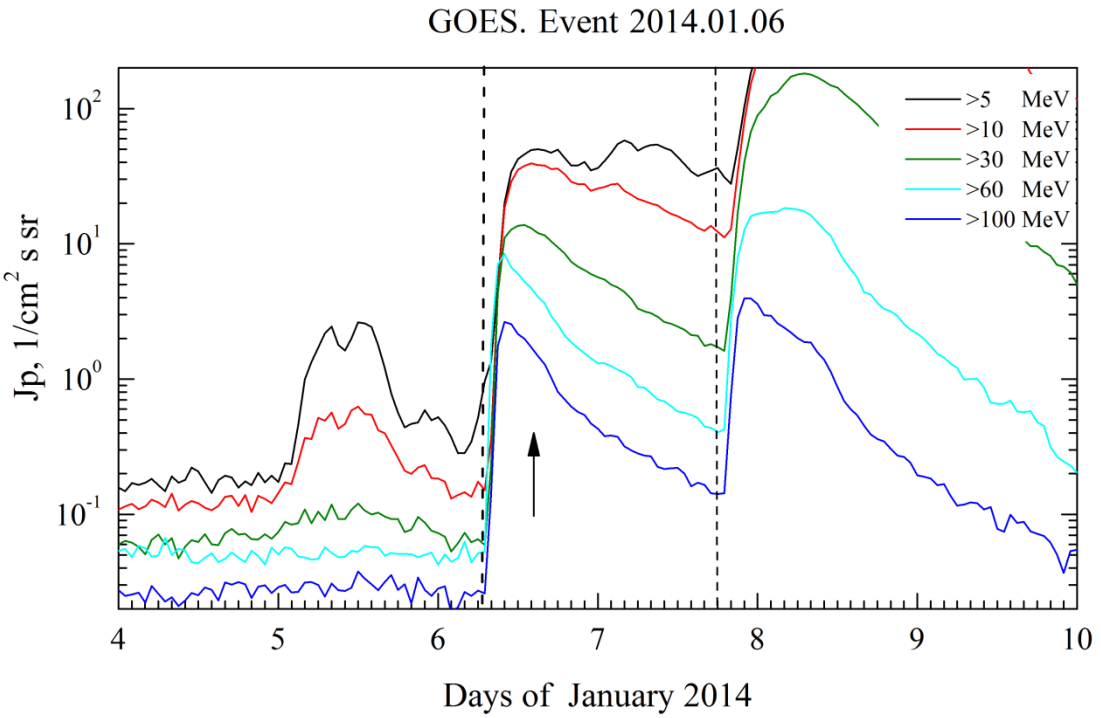
Time profiles of proton fluxes in the event 2014.01.06

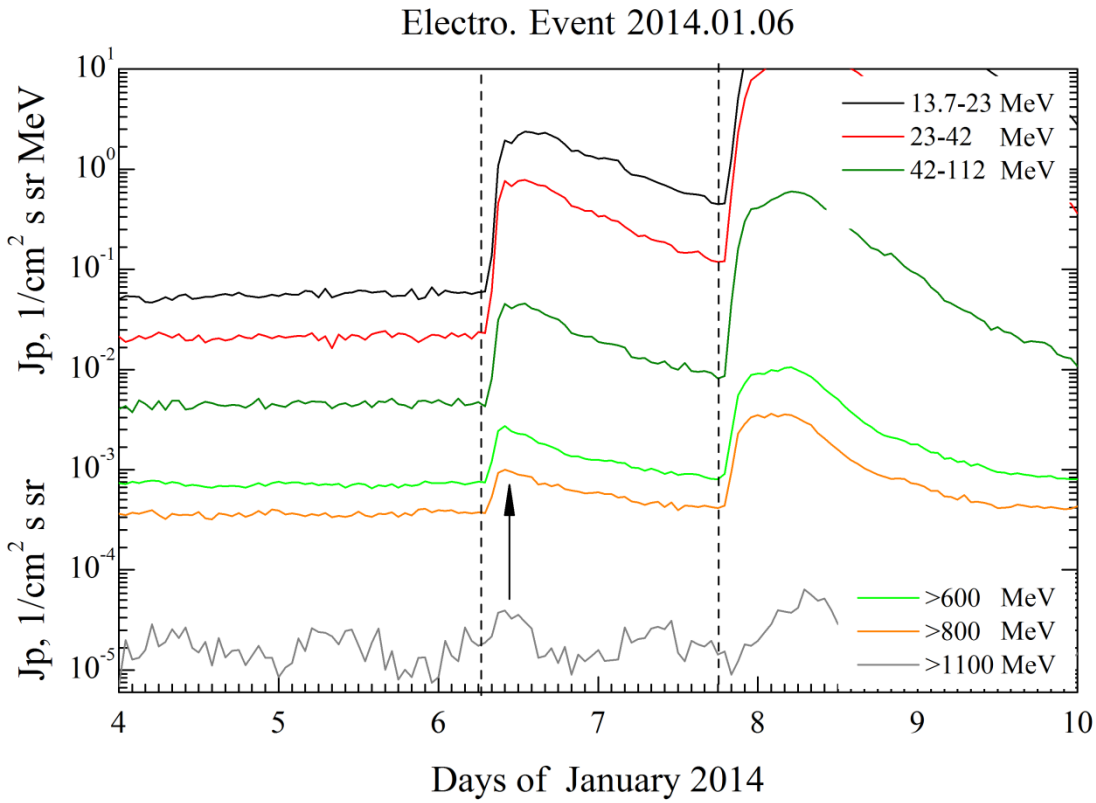
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



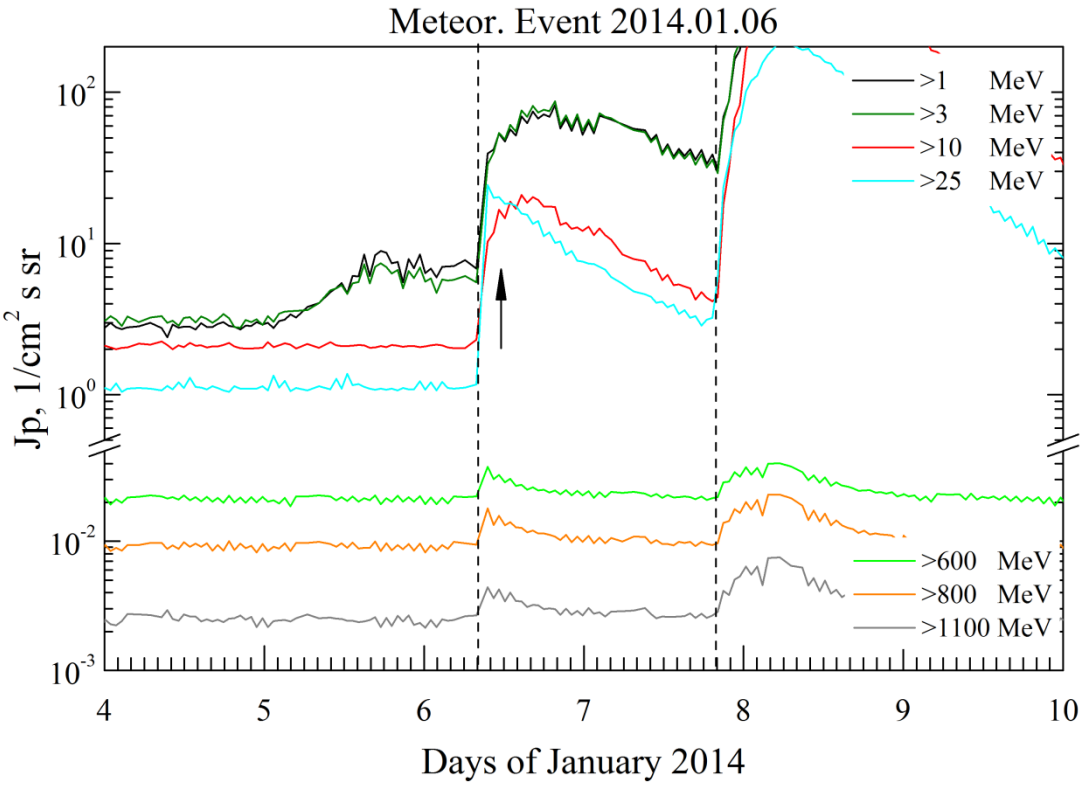


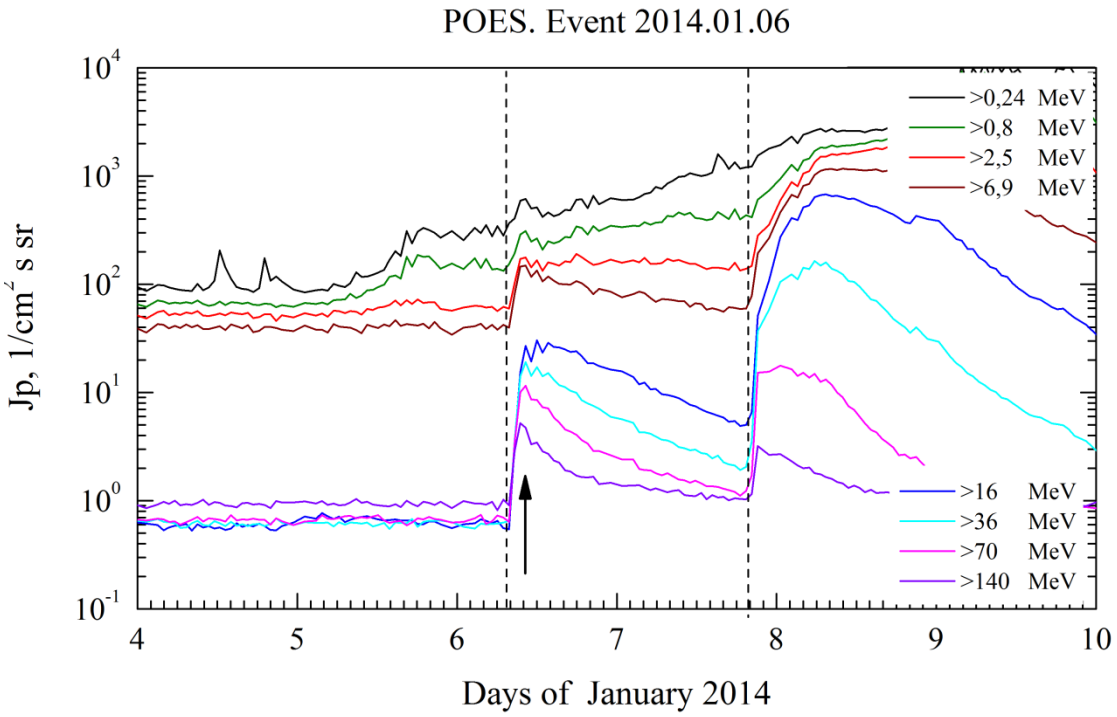
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 January 06

2014 January 06 ■ AR 11936 To event 547

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	EPL*	<0755		<0810	S15W90		
1 – 12	keV	0730	0745	0900	S15W89	C2.1**	0.056
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
410	MHz	0744	0744	0744		2.04	
245	MHz	0747	0747	0747		2.08	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s;	**Importance**	**Sp/c**
DS II	25-180	0745		0808		2	
DS IV	27-180	0653		1525		2	
DH II	0.8-14	0757		2230			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0800	1402	- 7.1	360˚	274˚	SOHO

*https://lmsal.com/hek/her?cmd=view-voevent&ivorn=ivo://helio-informatics.org/FE304_halocme_20140106_153743

** echo of mostly large flare event

Proton Active Region:

AR11936 (S17L223, CMP 29,4.12.2013;
Sp=280 msh EAC; BGD; R)
XRI= 2.13 $M_4^{9.9}$+C_{29} 2_2+1_1+S_{31}
PFR 31-01.01 (21^h) $M_2^{9.9}$

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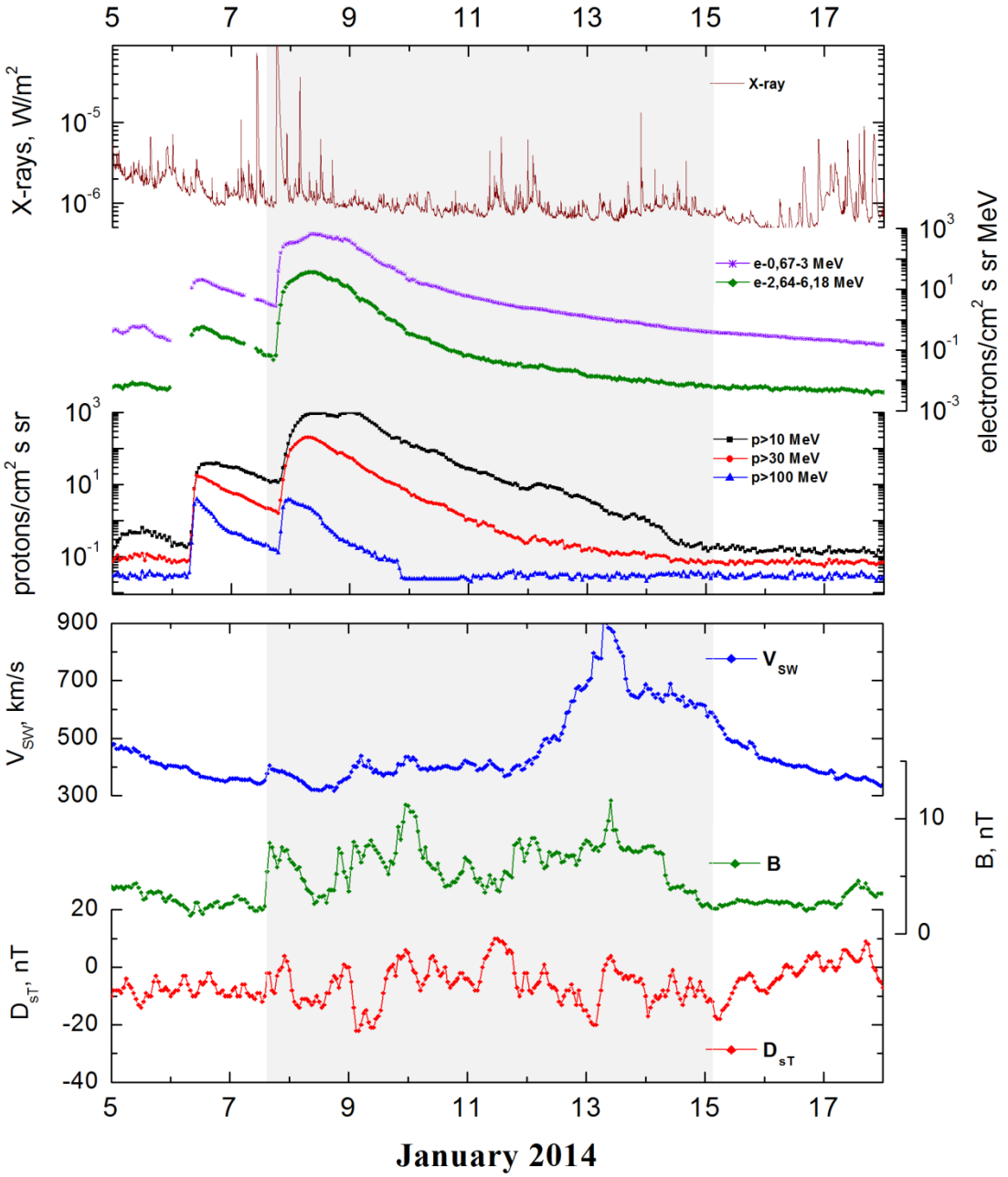
Particle event: To(Ep>10 MeV) – 07d18^{h}
Tmax(Ep>10 MeV) – 08d12^{h}, Jmax(Ep>10 MeV) – 1000 /cm^{2}·s·sr
Duration of the event – 7 days, power-law index: γ = 3.8
Quasimaximal energy of protons in the event – Eqm = 400 MeV

Sources: ● solar flare 07d18^{h}04^{m}, X1.2/2N, S15W11, AR11944
Ø solar flare 07d10^{h}07^{m}, M7.2/2B, S13E11, AR11944
Main burst X-ray 1–8 Å: onset – 07d18^{h}04^{m}, max – 07d18^{h}32^{m}, Φ = 0.25 J/m^{2}
CME: 07d18^{h}24^{m}, V = 1830 km/s, Δφ = 360°, dA = 231°
▲ SC 01d15^{h}14^{m}, ▲ SC 09d20^{h}10^{m}

Particle fluxes and associated phenomena

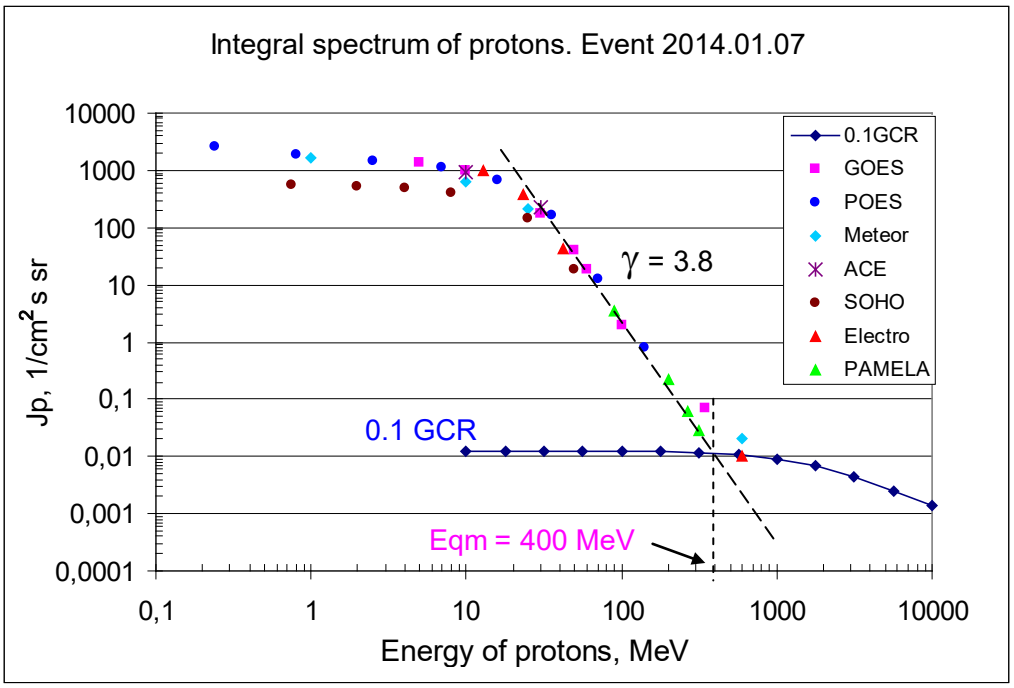


Integral fluxes of protons for the event of 2014 January 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	8d12	1400	7	0.2	
EPS	>10	18	8d12	1000	7	0.15	
EPS	>30	18	8d8	180	4	0.07	
EPS	>50	18	8d8	41	4	0.06	
EPS	>60	18	8d7	18	3	0.05	
EPS	>100	18	8d8	1.9	2	0.03	
Electro-1							
GALS-E	>600	18	8d06	0.01	3	0.0007	
POES							
MEPED	>0.24	20	8d08	2540	5	90	
MEPED	>0.8	20	8d08	1920	5	65	
MEPED	>2.5	20	8d08	1460	4	50	
MEPED	>6.9	20	8d08	1120	4	40	
MEPED	>16	20	8d08	675	4	0.7	
MEPED	>36	20	8d08	160	3	0.75	
MEPED	>70	20	8d08	12.5	1.5	0.9	
MEPED	>140	20	8d08	0.8	1	1	
Meteor-1							
SCR	>1	20	8d08	1700	7	3	
SCR	>3	20	-	-	7	3.2	
SCR	>10	20	8d05	646	4	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	20	8d05	212	3	1.1	
GALS-M	>600	20	8d05	0.02	1	0.02	
ACE							
SIS	>10	18	08d05	910	6	1.1	
SIS	>30	18	08d02	220	5	0.75	
SOHO							
EPHIN	>50	19	08d03	18.5	2.5	0.2	
PAMELA							
TRACKER	>90	19	20-8d04	3.5	>4	-	
TRACKER	>200	19	20-8d04	0.22	>4	-	
TRACKER	>265	19	20-8d04	0.062	>4	-	
TRACKER	>312	19	20-8d04	0.028	>4	-	

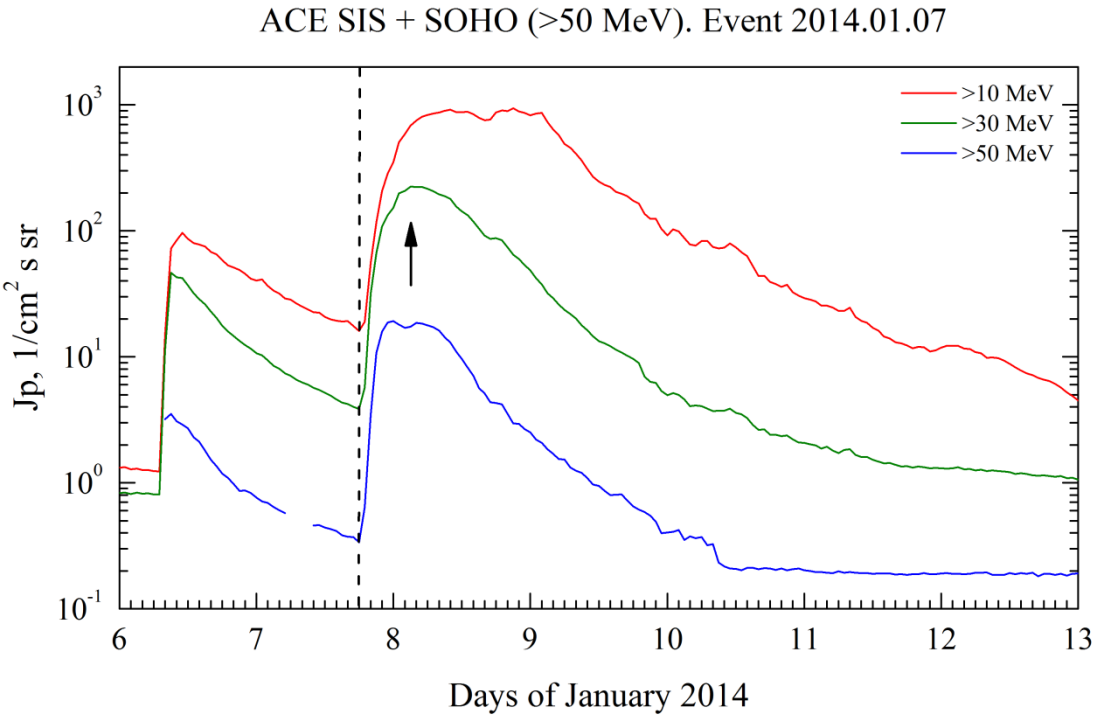
Differential fluxes of protons for the event of 2014 January 07

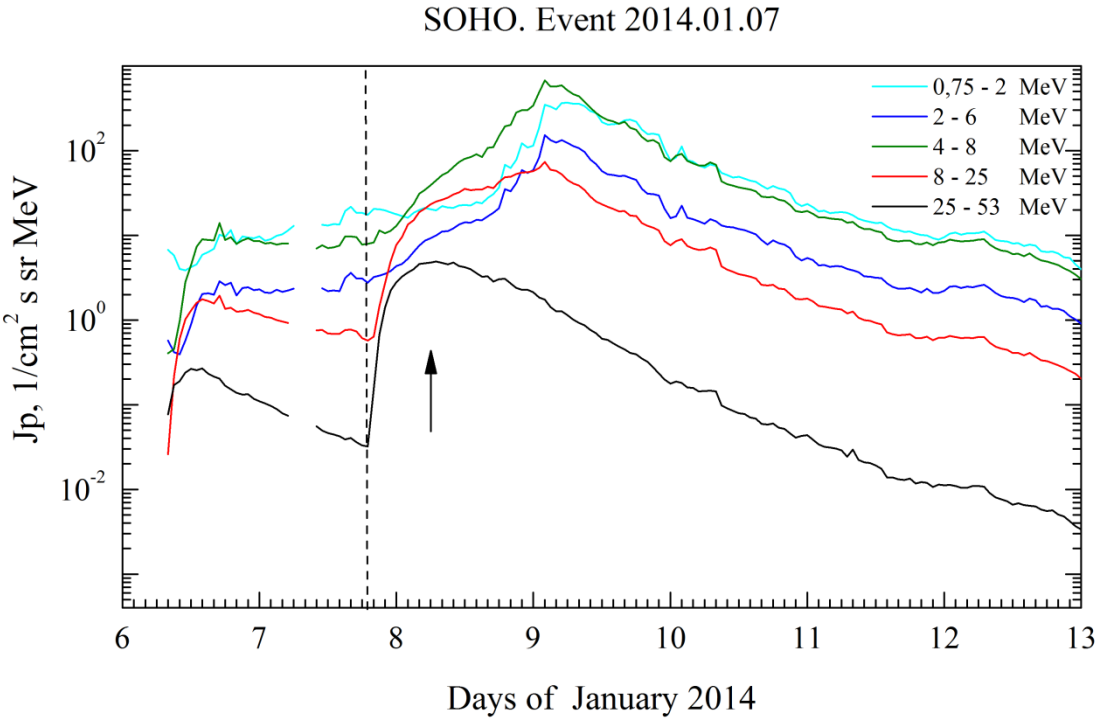
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	19	8d03	17.4	7	0.02	
LION	2 – 6	19	8d03	6.33	7	0.002	
EPHIN	4 – 8	19	8d03	23.4	7	0.004	
EPHIN	8 – 25	19	8d03	15.1	7	0.0003	
EPHIN	25 – 53	19	8d04	4.57	7	0.00003	
Electro-1							
SCR-E	13.7–23	18	8d06	67.8	5	0.05	
SCR-E	23–42	18	8d06	17.2	5	0.025	
SCR-E	42–112	18	8d06	0.6	4	0.0045	
GOES							
EPS	350–420	19	08d03	0.001	1.5	0.0016	
EPS	420–510	-	-	-	-	0.0009	

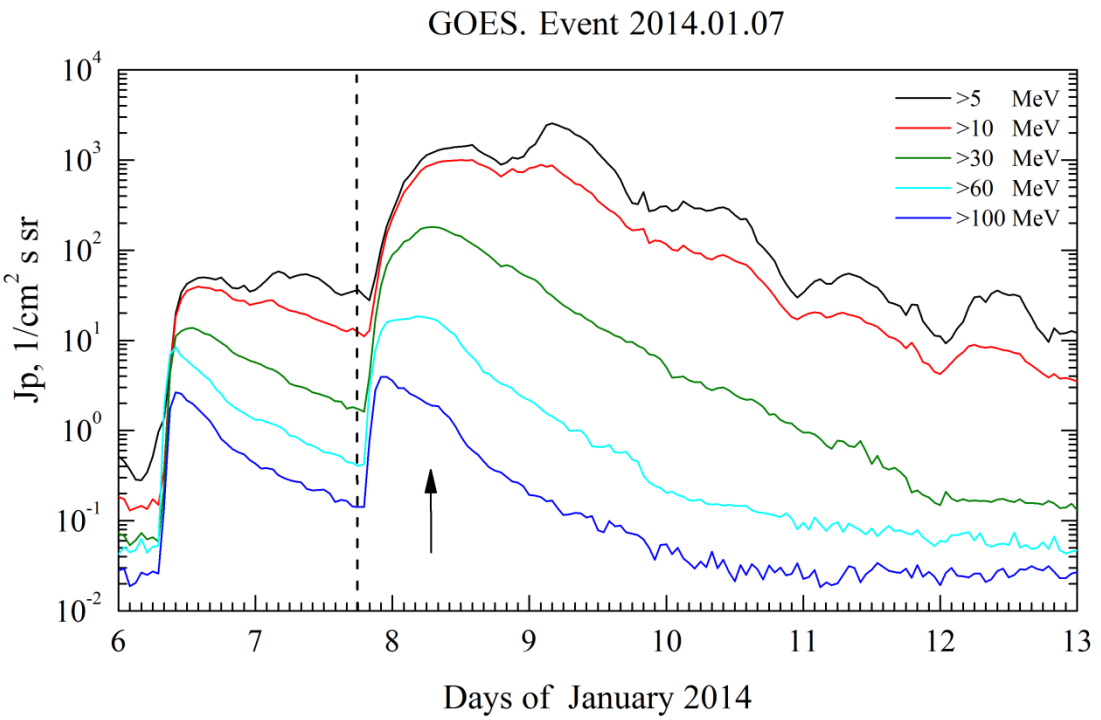


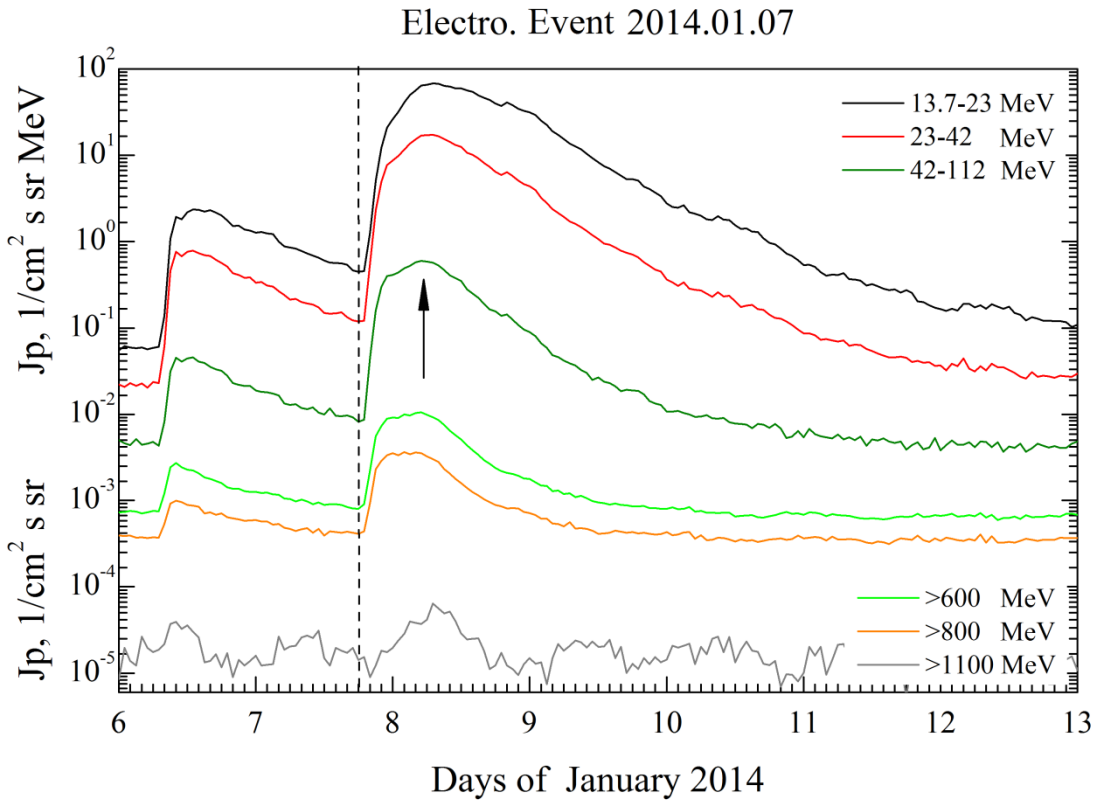
Time profiles of proton fluxes in the event 2014.01.07

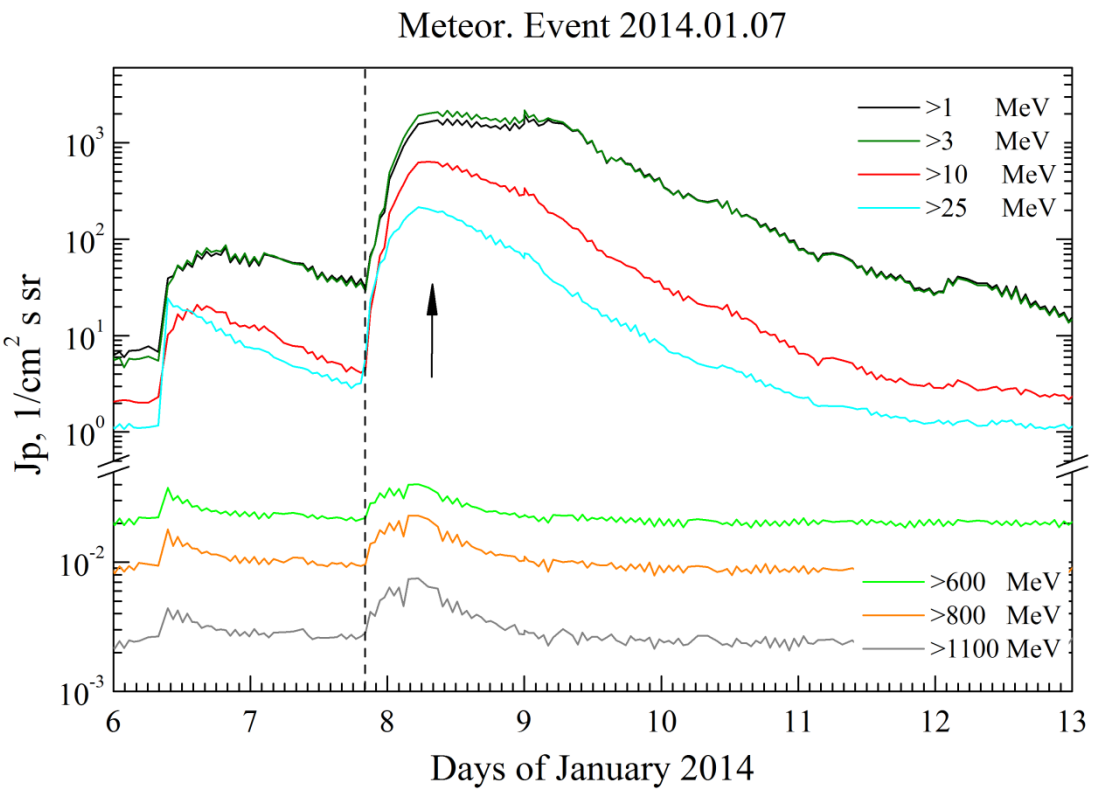
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

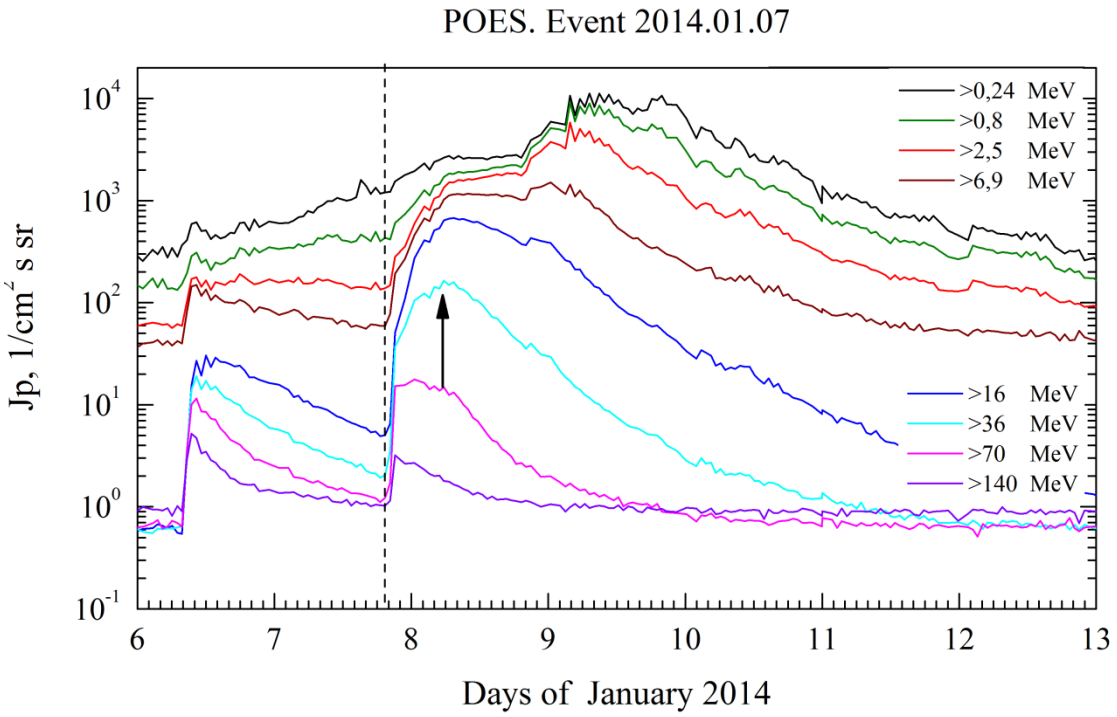





GOES. Event 2014.01.07
Jp, 1/cm² s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of January 2014


Electro. Event 2014.01.07
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
13.7-23 MeV
23-42 MeV
42-112 MeV
>600 MeV
>800 MeV
>1100 MeV
Days of January 2014


Meteor. Event 2014.01.07
Jp, 1/cm² s sr
>1 MeV
>3 MeV
>10 MeV
>25 MeV
>600 MeV
>800 MeV
>1100 MeV
Days of January 2014


POES. Event 2014.01.07
Jp, 1/cm² s sr
>0,24 MeV
>0,8 MeV
>2,5 MeV
>6,9 MeV
>16 MeV
>36 MeV
>70 MeV
>140 MeV
Days of January 2014

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 January 07

2014 January 07 ● AR 11944 To event 548

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	<1825	1857	2054	S15W11	2N	
1 – 12	keV	1804	1832	1858	S12W08	X1.2	0.25

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1835:13	1841:09	1934:03	81605	16973540	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1805	1814	1926	P2.7 \ 15	3.0	
8.8	GHz	18051	1814	1928		3.26	
5	GHz	1806	1815	1919		3.34	
2.7	GHz	1806	1813	1856		3.92	
1.4	GHz	1806	1817	1856		2.99	
610	MHz	1806	1852	1919		3.43	
410	MHz	1807	1857	1900		2.86	
245	MHz	1805	1826	1833		3.86	
245	MHz	1948	1948	1948		3.08	
410	MHz	1954	1954	1954		2.20	
245	MHz	1958	1958	1958		2.32	
410	MHz	2005	2005	2005		2.20	
610	MHz	2011	2011	2013		2.40	
610	MHz	2016	2016	2016		2.20	
245	MHz	2053	2053	2053		2.66	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-67	1817		1848	1064	2	
DH II	0.06-14	1833	08/2100	1624		2	WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1824	1830	- 60.8	360˚	231	SOHO

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	1010	~1011	1124	S13E11	2B	ERU
1 – 12	keV	1007	1013	1037	S13E13	M7.2	0.092

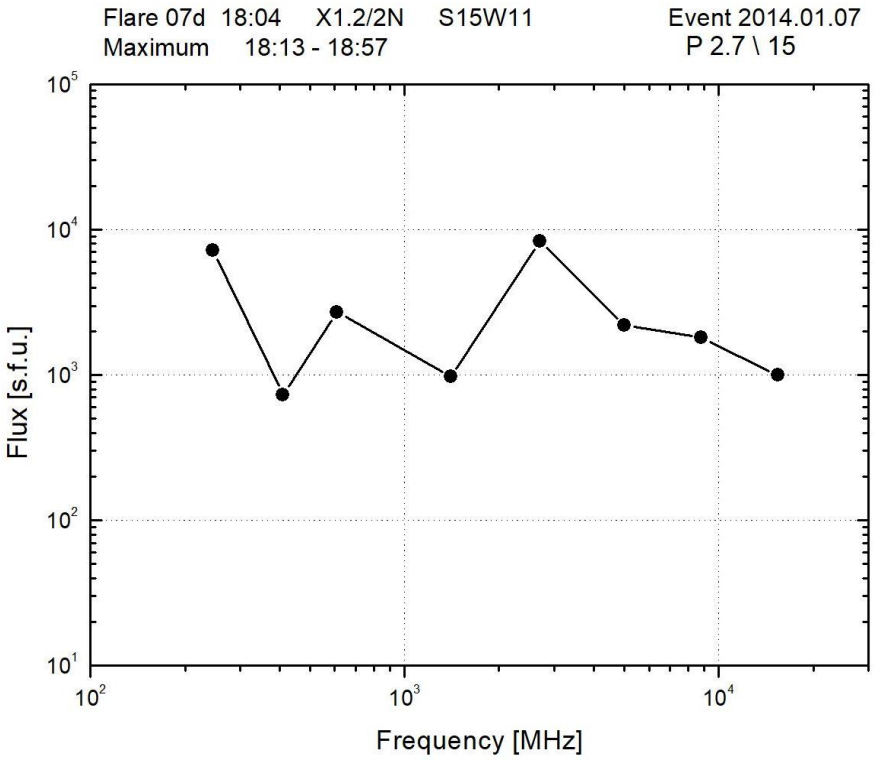
X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
100-300	keV	1008:24	1016:14	1041:44	7967	28294588	HESSI

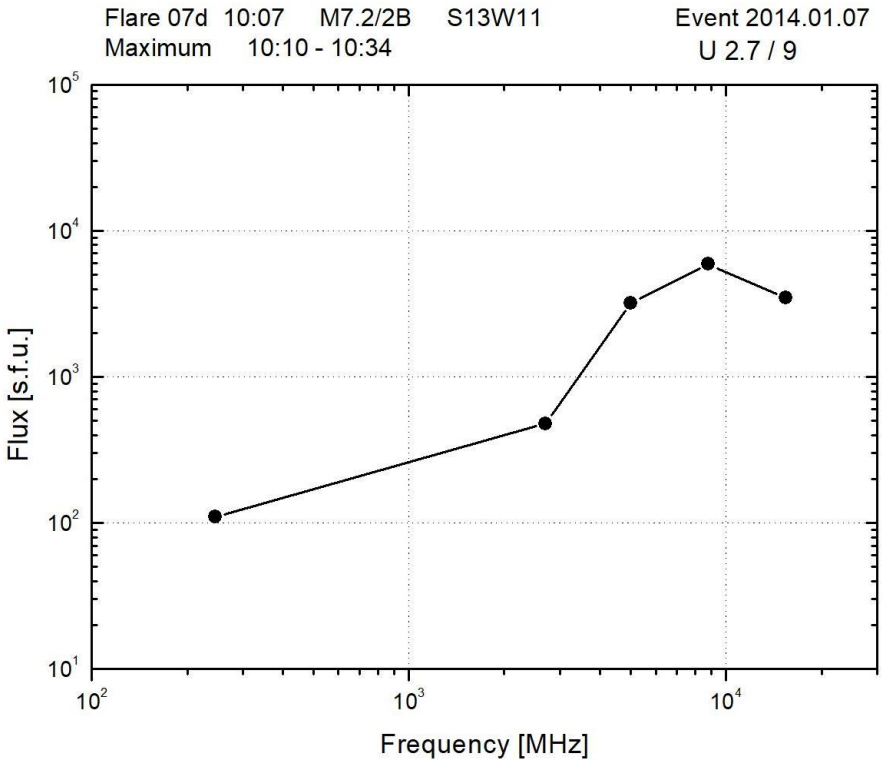
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	1010	1011	1048	U2.7 / 9	3.54	
8.8	GHz	1010	1011	1058		3.77	
5	GHz	1010	1012	1050		3.5	
2.7	GHz	1011	1012	1021		2.68	
245	MHz	1034	1034	1034		2.04	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS III	58-180	2000		2007		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1036	451	6.9	71˚	148˚	SOHO

Radio bursts frequency spectrum





Proton Active Region:

AR11944 (S09L100, CMP 4.8.01.2014;
Sp=1560 msh, FKC, BGD, R)
XRI= 3.08 $X_1^{1.2}$+$M_7^{7.2}$+C_{44} 2_3+1_2+S_{52}
PFR1 2-4.01 (68^h) $M_7^{4.0}$,:
PFR2 7.01 (8^h) $X_1^{1.2}$+$M_1^{7.2}$

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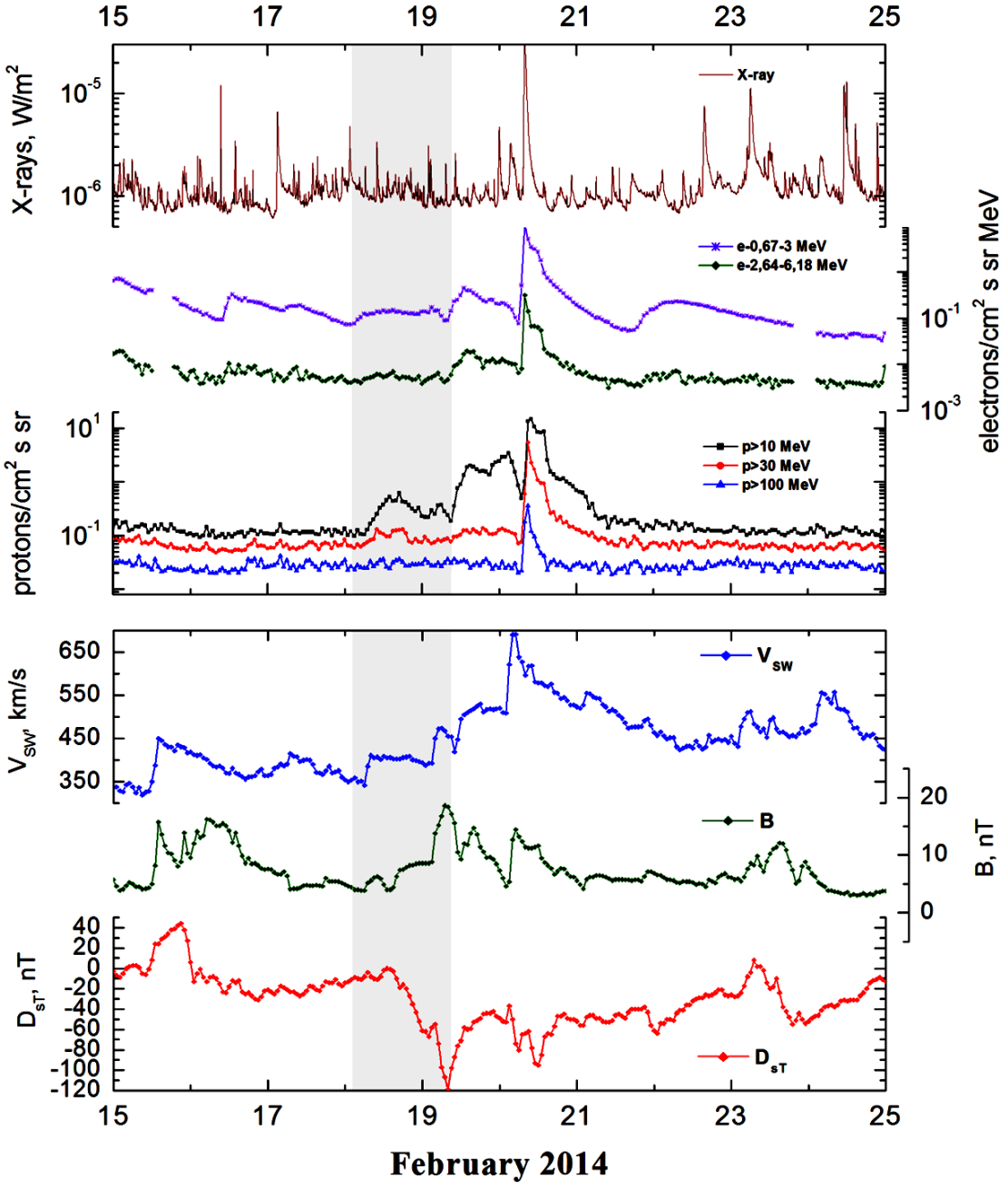
Particle event: To(Ep>10 MeV) – 18d08^{h}
Tmax(Ep>10 MeV) – 18d14^{h}, Jmax(Ep>10 MeV) – 0.4 /cm^{2}·s·sr
Duration of the event – 1 day, power-law index: γ = 3.1
Quasimaximal energy of protons in the event – Eqm = 50 MeV

Sources: ⊙ solar flare 18d01^{h}27^{m}, C4.7/SF, S16W42, AR11976,
Main burst X-ray 1–8 Å: onset – 18d01^{h}27^{m}, max – 18d01^{h}34^{m}, Φ = 0.0025 J/m^{2}
CME: 18d01^{h}36^{m}, V = 779 km/s, Δφ = 360º, dA = 044º

Particle fluxes and associated phenomena

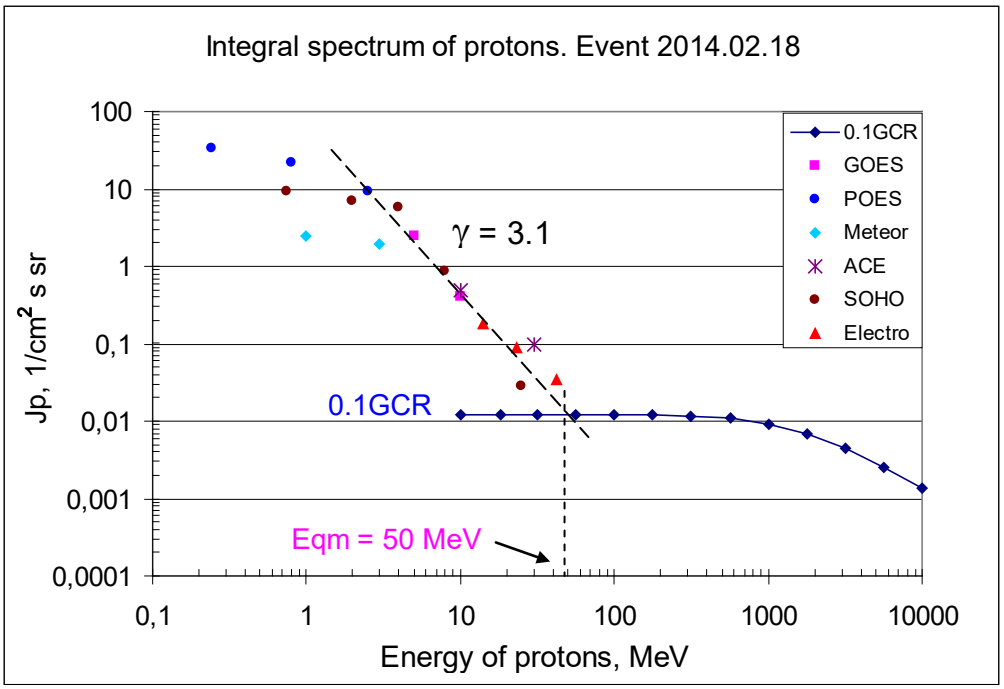


Integral fluxes of protons for the event of 2014 February 18

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	8	14	2.5	1	0.2	
EPS	>10	8	14	0.4	1	0.12	
EPS	>30	8	-	-	-	0.07	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	8	16	33	0.5	90	
MEPED	>0.8	8	16	22	0.5	65	
MEPED	>2.5	8	16	9.3	0.5	50	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.75	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	10	16	2.51	1	2.9	
SCR	>3	10	16	1.96	1	3.15	
SCR	>10	-	-	-	-	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	-	-	-	-	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	6	12	0.6	1	1	
SIS	>30	6	12	0.1	1	0.7	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

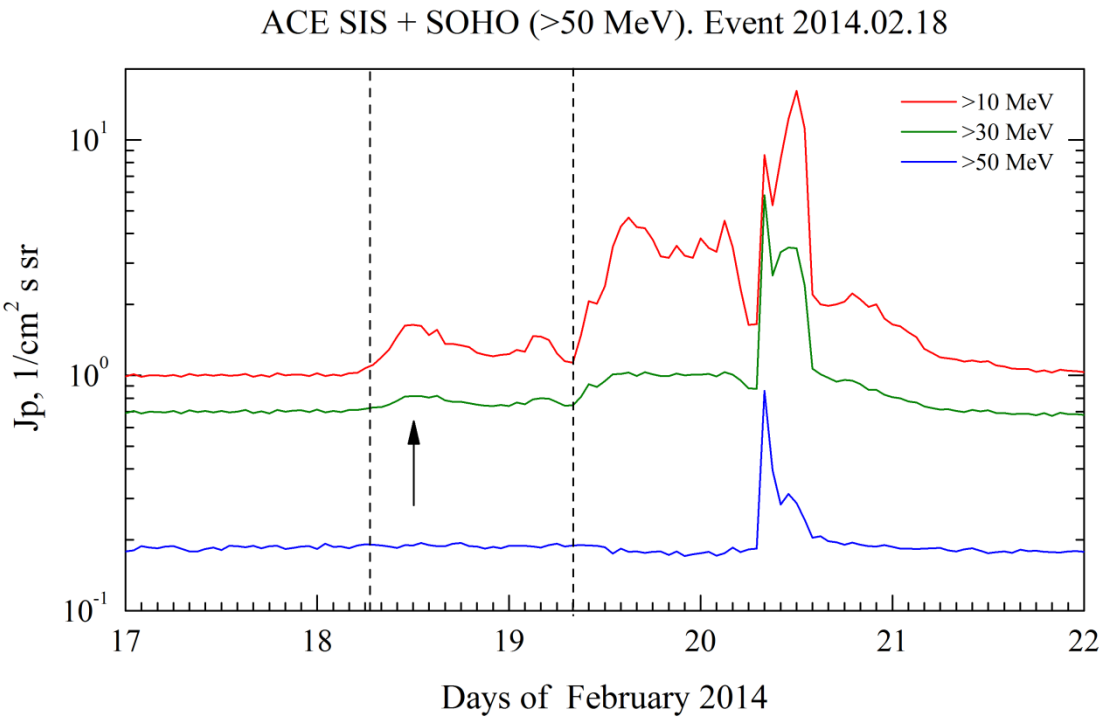
Differential fluxes of protons for the event of 2014 February 18

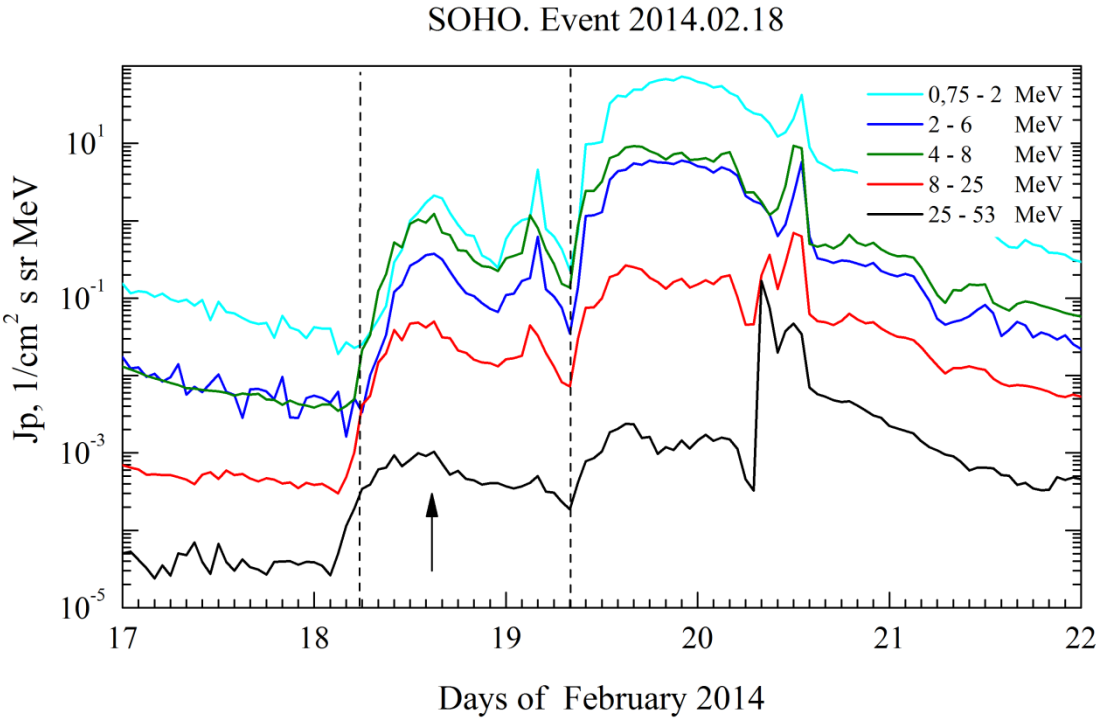
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	09	15	2.07	1.2	0.04	
LION	2 – 6	09	15	0.37	1.2	0.005	
EPHIN	4 – 8	08	15	1.23	1.2	0.004	
EPHIN	8 – 25	08	15	0.05	1.2	0.0004	
EPHIN	25 – 53	07	15	0.001	1.2	0.00004	
Electro-1							
SCR-E	13.7–23	8	15	0.01	0.5	0.045	
SCR-E	23–42	8	15	0.003	0.5	0.02	
SCR-E	42–112	8	15	0.0005	0.5	0.004	

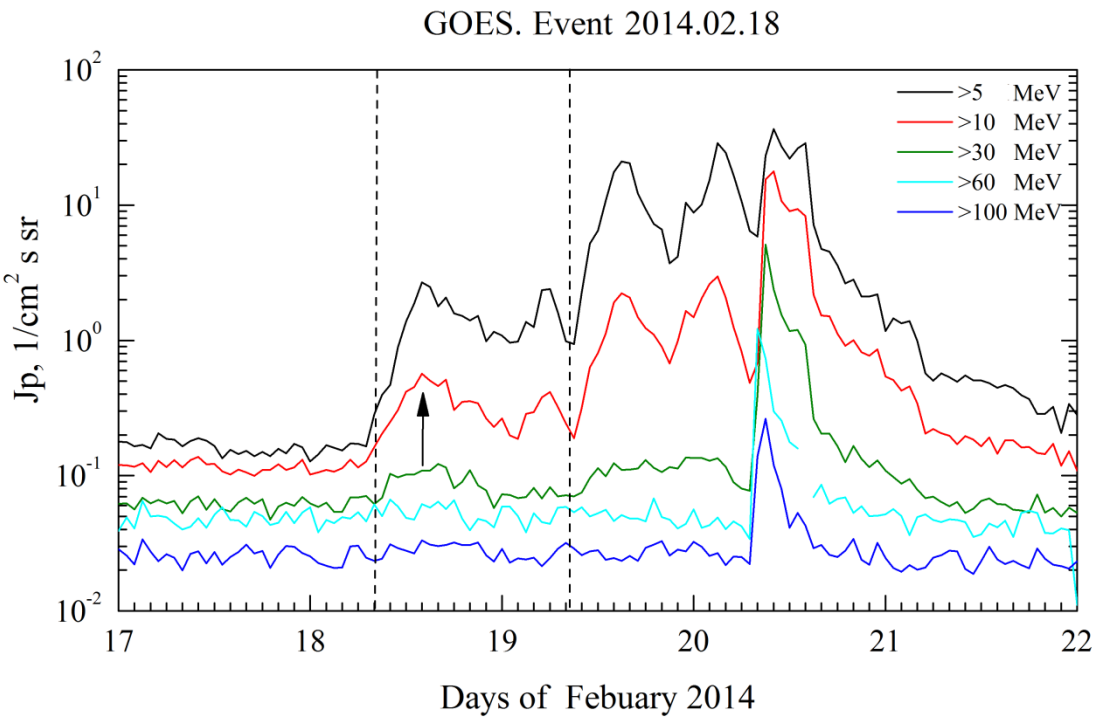

Integral spectrum of protons. Event 2014.02.18
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 3.1
0.1GCR
Eqm = 50 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

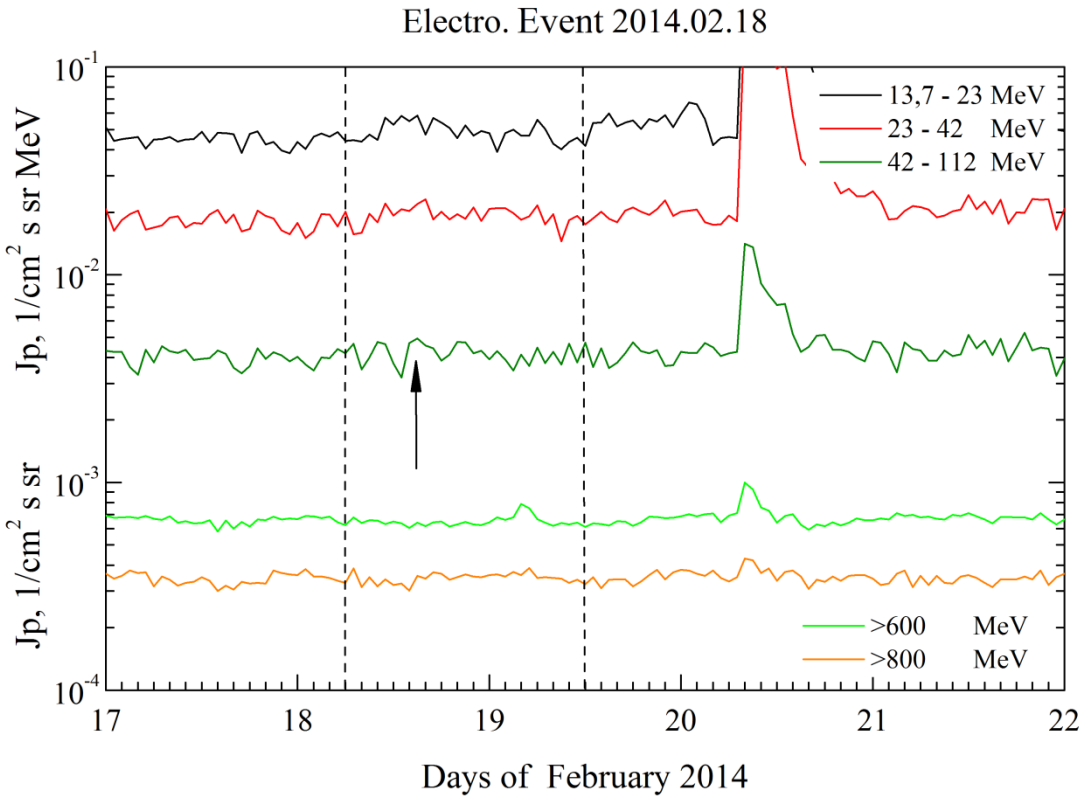
Time profiles of proton fluxes in the event 2014.02.18

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

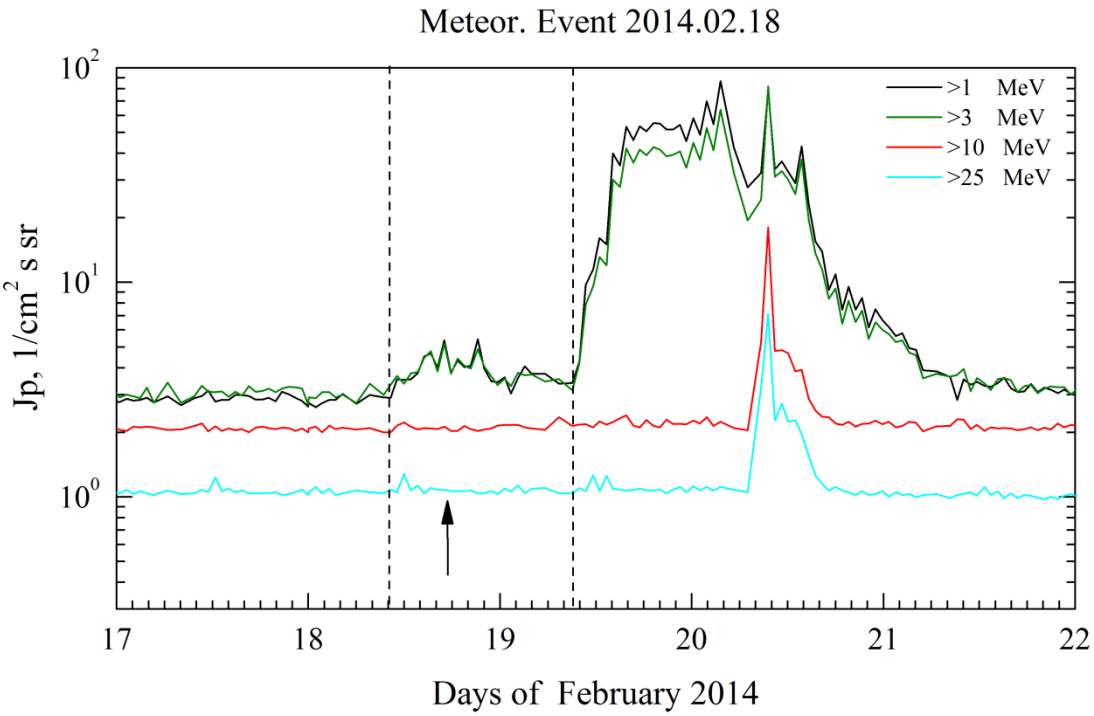


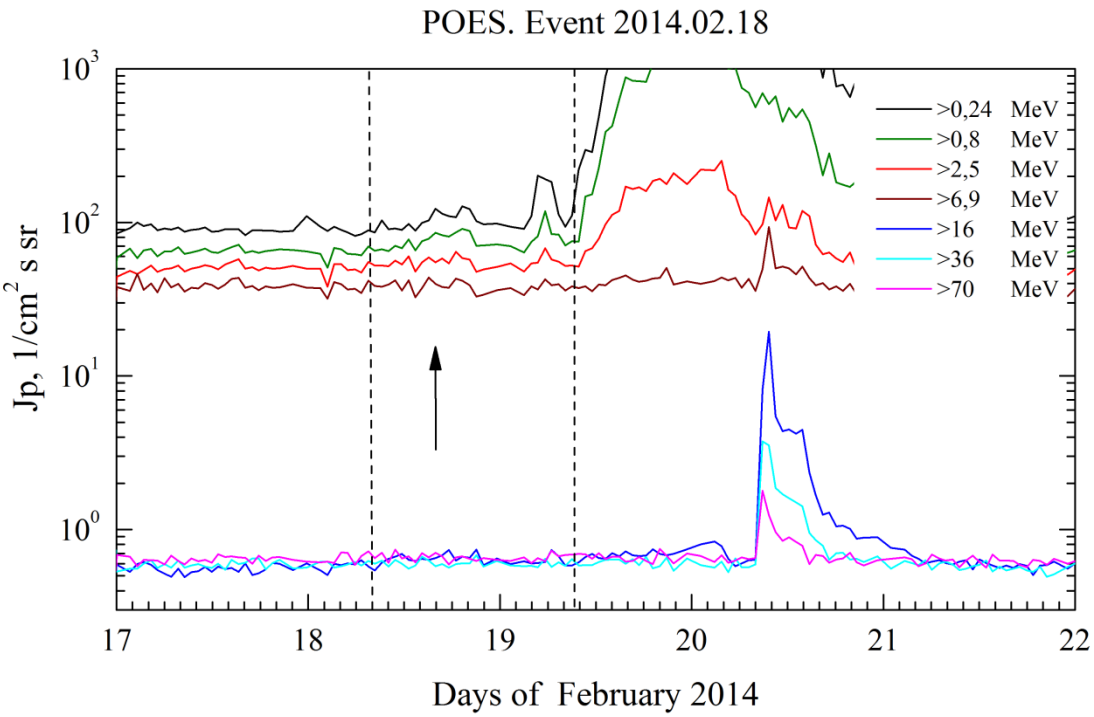



GOES. Event 2014.02.18
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of Febuary 2014


Electro. Event 2014.02.18
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of February 2014

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 February 18

2014 February 18 ⊙ AR 11976 To event 549

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0134	0134	0145	S16W42	SF	ERU
1 – 12	keV	0127	0134	0140	S17W42	C4.7	0.0025
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0135:20	0136:06	0149:32	2288	2672952	HESSI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DH II	2-0.9	0216		0251			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0136	779	- 11.3	360º	044º	SOHO

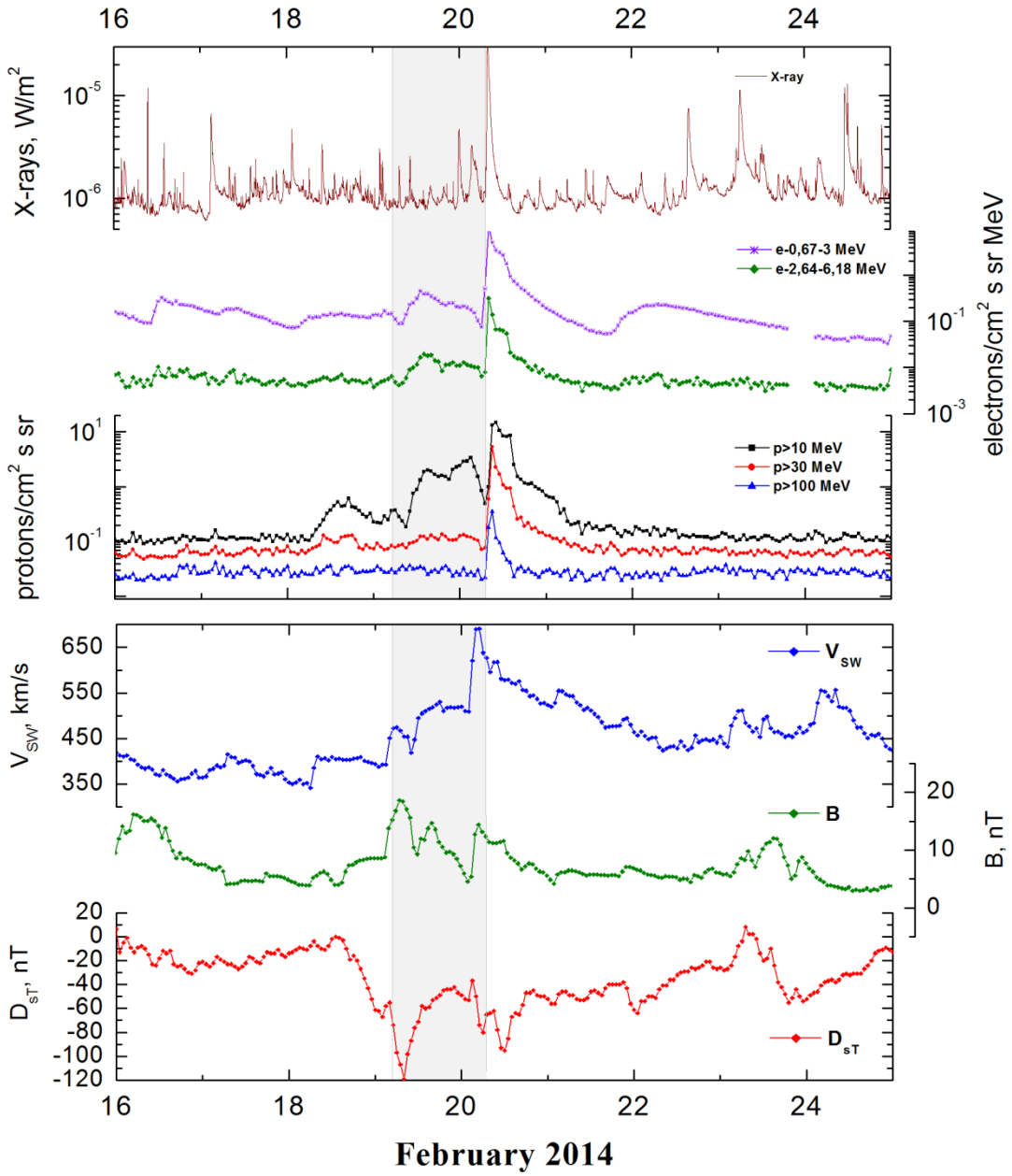
Proton Active Region:

AR11976 (S14L320, CMP 14,8.02.2014,
Sp=390 msh, EKI, BG, R)
XRI=0.3, $M_1^{3.0}$+C_8, S_8
PFR 20.02: $M_1^{3.0}$

Particle event: To(Ep>10 MeV) – 19d09^{h}
Tmax$_1$(Ep>10 MeV) – 19d15^{h}, Jmax$_1$(Ep>10 MeV) – 2 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 20d03^{h}, Jmax$_2$(Ep>10 MeV) – 2.8 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ_1 = 3.3, γ_2 = 2.4
Quasimaximal energy of protons in the event – Eqm$_1$ = 45 MeV
– Eqm$_2$ = 90 MeV

Sources: ⊡ solar flare 19d<04^{h}48^{m}, AR11990, 3d behind E$_L$
CME 19d04^{h}48^{m}, V = 612 km/s, Δφ = 360º, dA= 090º
CME 20d03^{h}12^{m}, V = 993 km/s, Δφ = 360º, dA= 089º
▲ SC 20d03^{h}20^{m}

Particle fluxes and associated phenomena

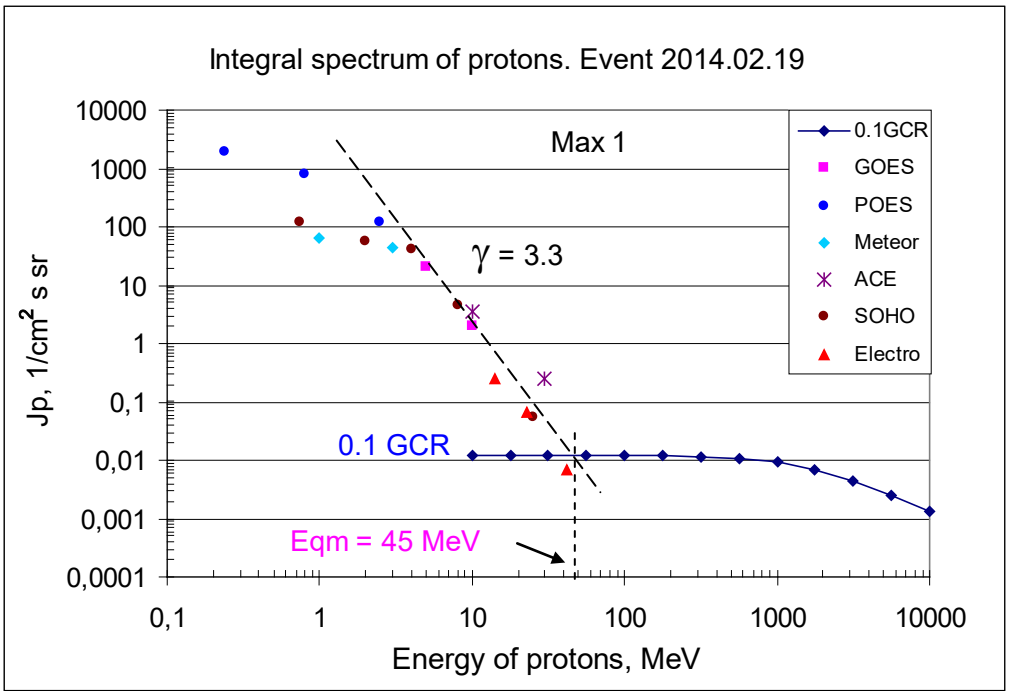


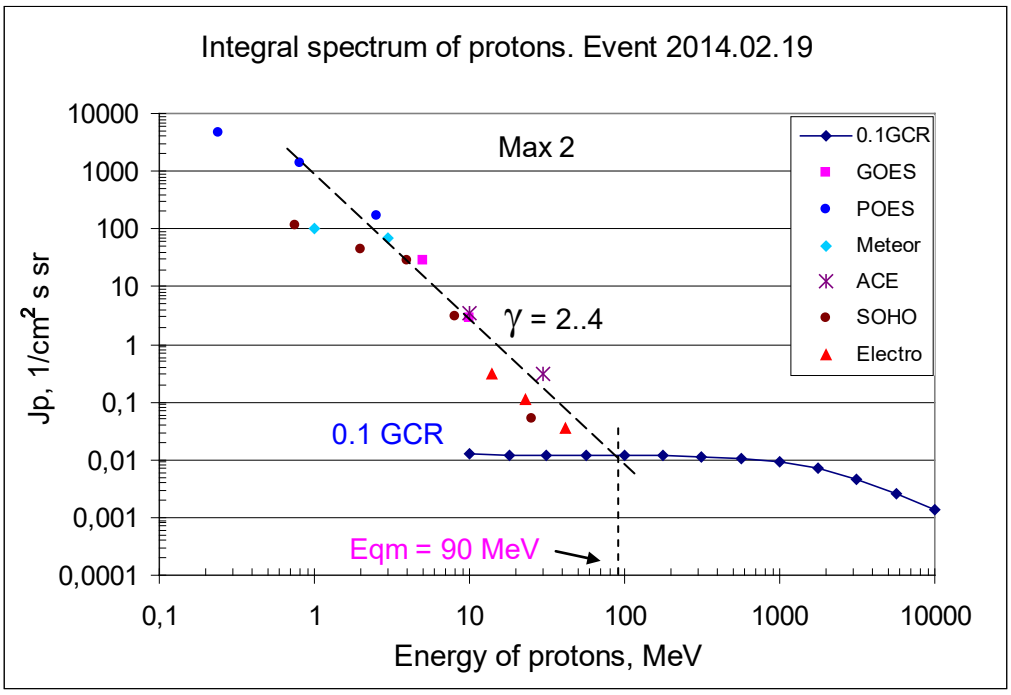
Integral fluxes of protons for the event of 2014 February 19

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	9	15/20d03	21/28.5	1	0.2	
EPS	>10	9	15/20d03	2/2.8	1	0.12	
EPS	>30	9	-	-	-	0.07	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	10	16/20d03	1950/4700	0.5	90	
MEPED	>0.8	10	16/20d03	815/1350	0.5	65	
MEPED	>2.5	10	16/20d03	120/170	0.5	50	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.75	
MEPED	>70	-	-	-	-	0.9	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	9	15/20d03	65/100	0.5	2.9	
SCR	>3	9	15/20d03	45/70	0	3.2	
SCR	>10	-	-	-	-	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	-	-	-	-	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	7	15/20d03	3.6/3.5	1	1.1	
SIS	>30	7	15/20d03	0.25/0.3	1	0.7	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

Differential fluxes of protons for the event of 2014 February 19

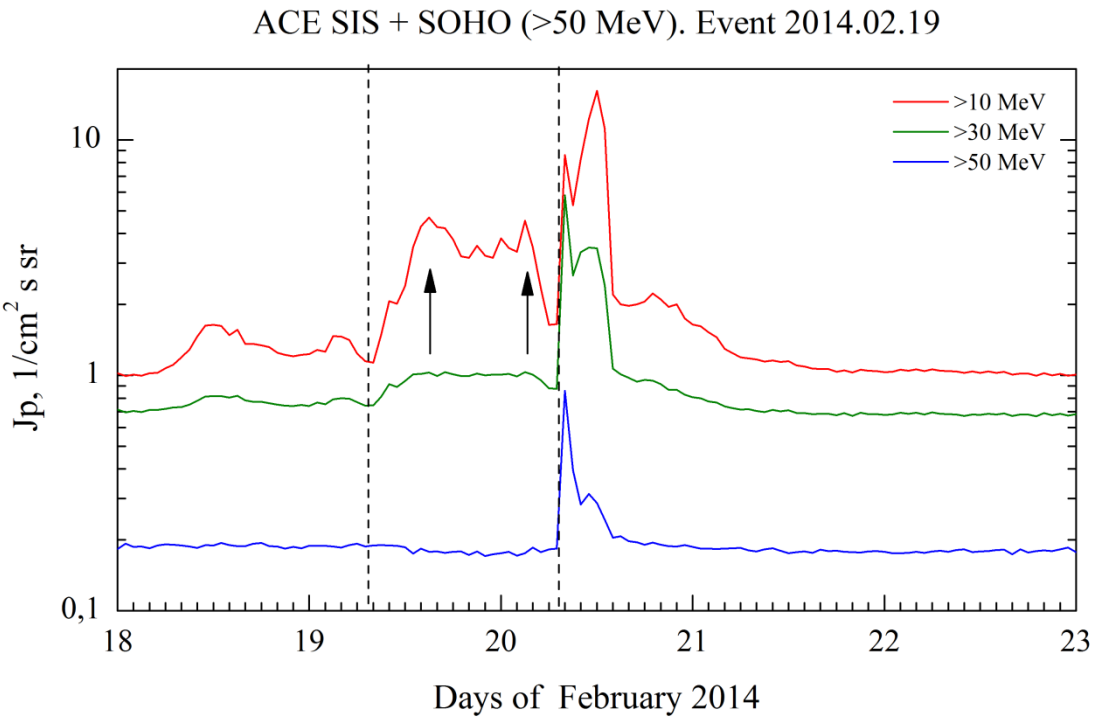
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	9	16/20d01	49.6/59	1	0.04	
LION	2 – 6	9	16/20d01	5.5/4.9	1	0.005	
EPHIN	4 – 8	9	16/20d01	9.2/6.5	1	0.004	
EPHIN	8 – 25	9	15/20d01	0.264/0.17	1	0.0004	
EPHIN	25 – 53	9	15/20d01	0.002/0.0017	1	0.00004	
Electro-1							
SCR-E	13.7–23	11	14/20d01	0.02/0.02	0.5	0.045	
SCR-E	23–42	11	14/20d01	0.003/0.004	0.5	0.02	
SCR-E	42–112	-	14/20d01	0.0001/0.0005	0.5	0.004	

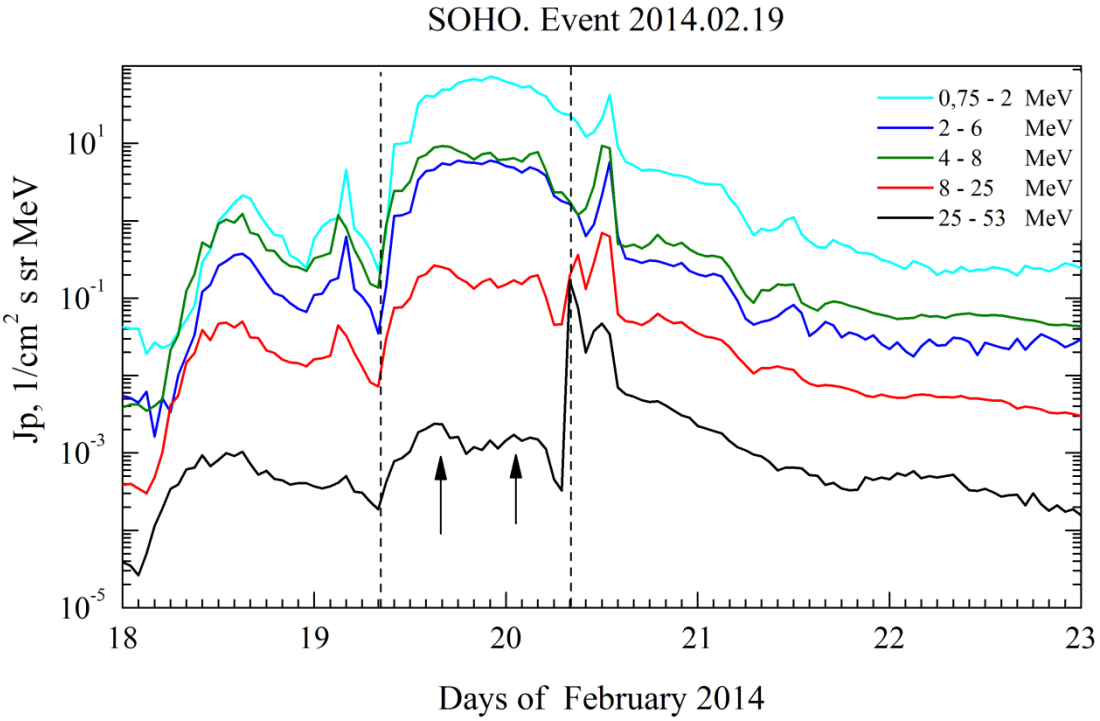

Integral spectrum of protons. Event 2014.02.19
Max 1
γ = 3.3
0.1 GCR
Eqm = 45 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

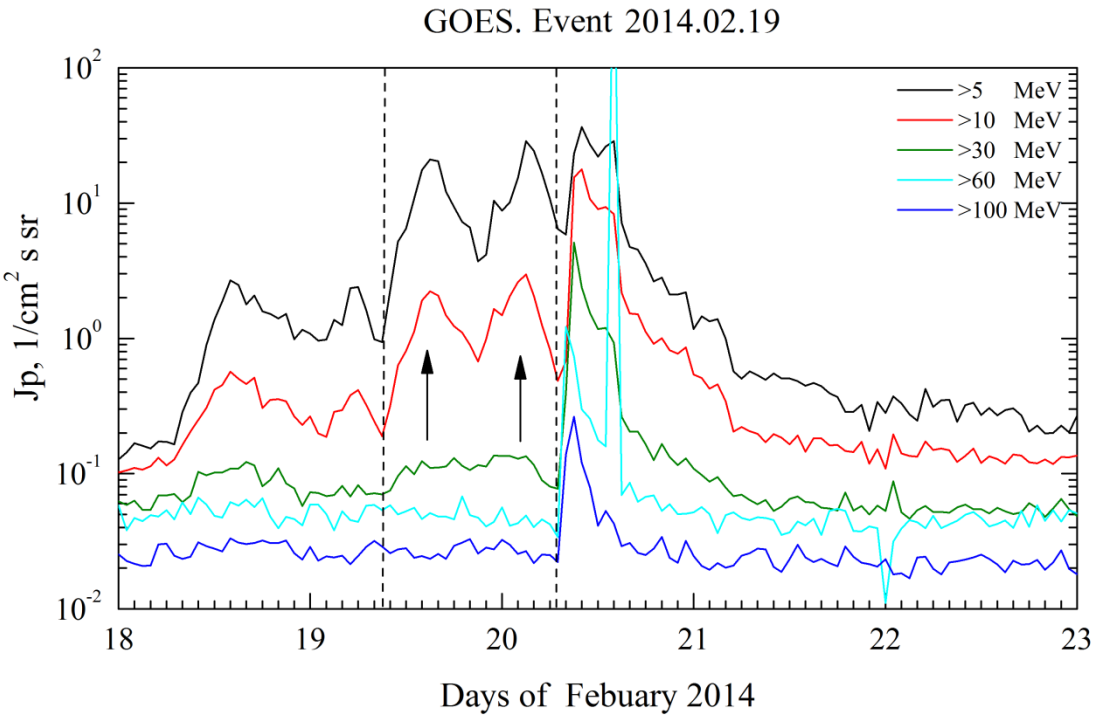

Integral spectrum of protons. Event 2014.02.19
Max 2
γ = 2..4
0.1 GCR
Eqm = 90 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

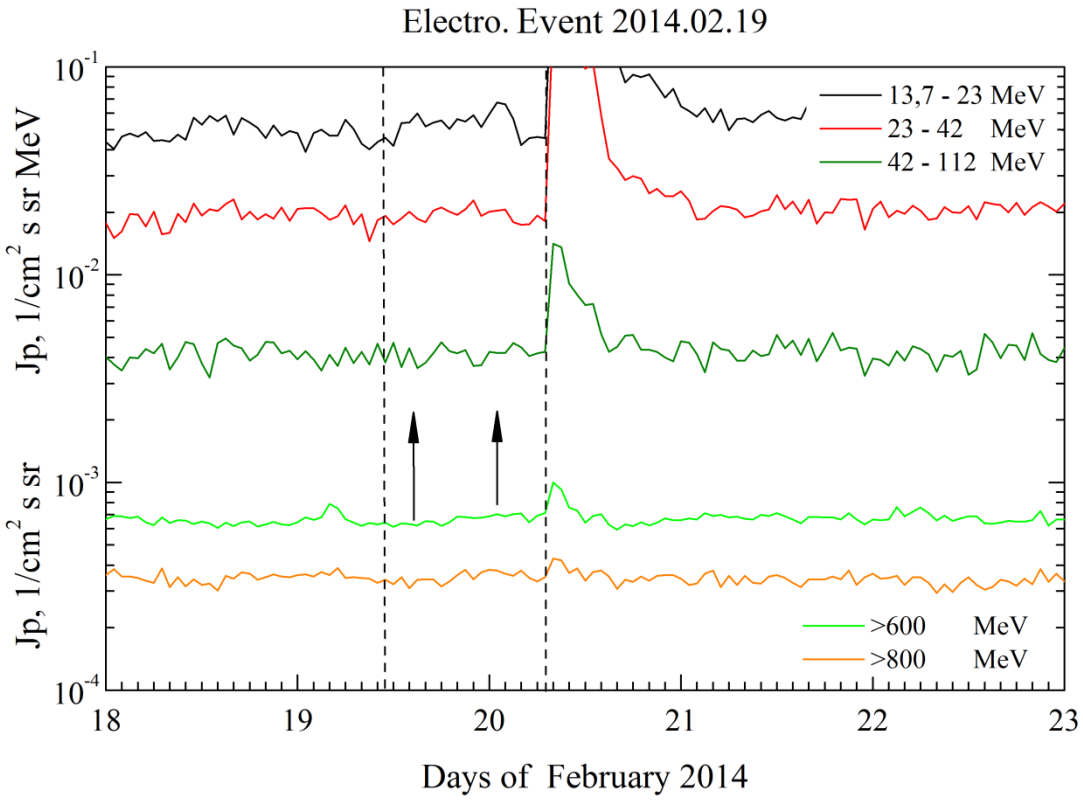
Time profiles of proton fluxes in the event 2014.02.19

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

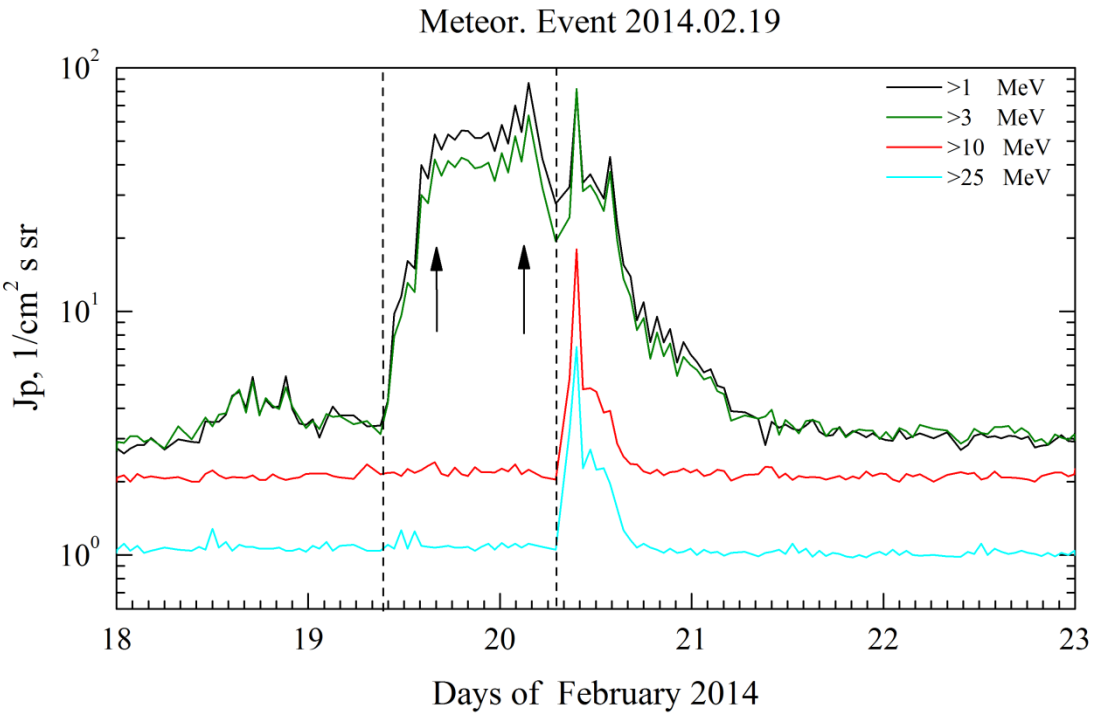


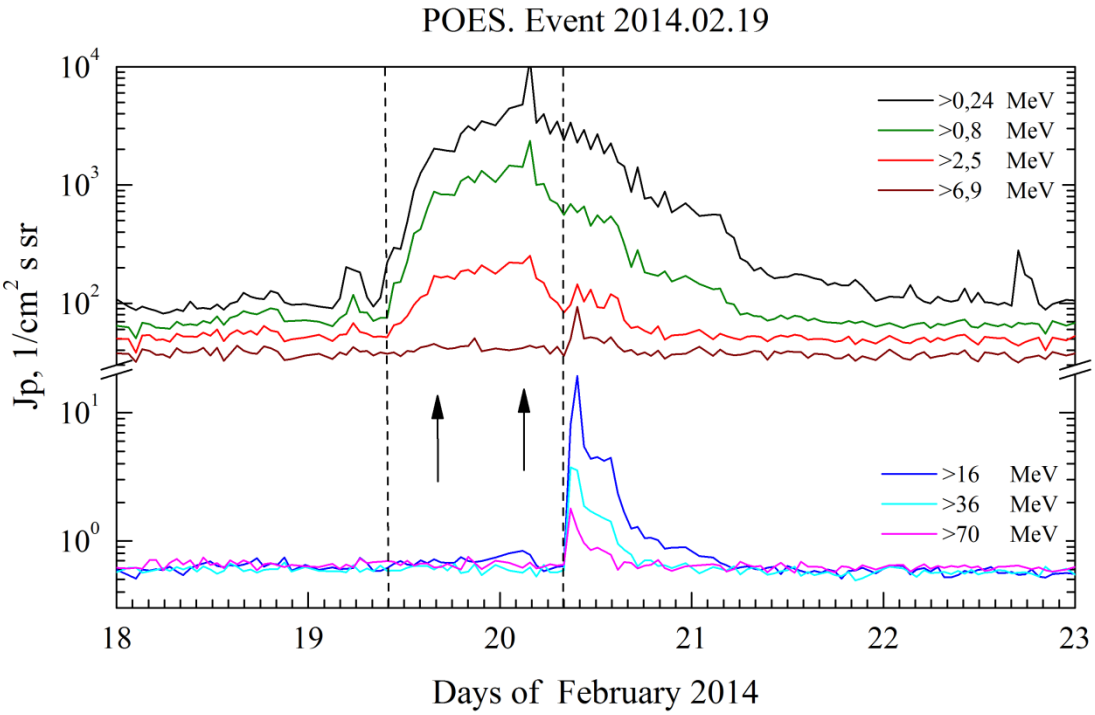



GOES. Event 2014.02.19
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of Febuary 2014


Electro. Event 2014.02.19
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of February 2014

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 February 19

2014 February 19 ⊡ AR 11990 To event 550

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event on visible solar disc					
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0448	612	-30.8	360˚	090˚	SOHO

2014 February 20 Ø AR 11990 To event 550

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No event on visible solar disc					
1 – 12	keV	No X-ray event on visible solar disc					
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0312	993	- 48.8	360˚	089˚	SOHO

Proton Active Region:

AR11990 (S13L110, CMP 03.03.2014,
Sp=420 msh, DKC, BD, R)
XRI= 5.13 $X_1^{4.9}$+$M_3^{1.3}$+C_6 2_1+S_6
PFR 23-25.02 (42^h) $X_1^{4.9}$+M_3

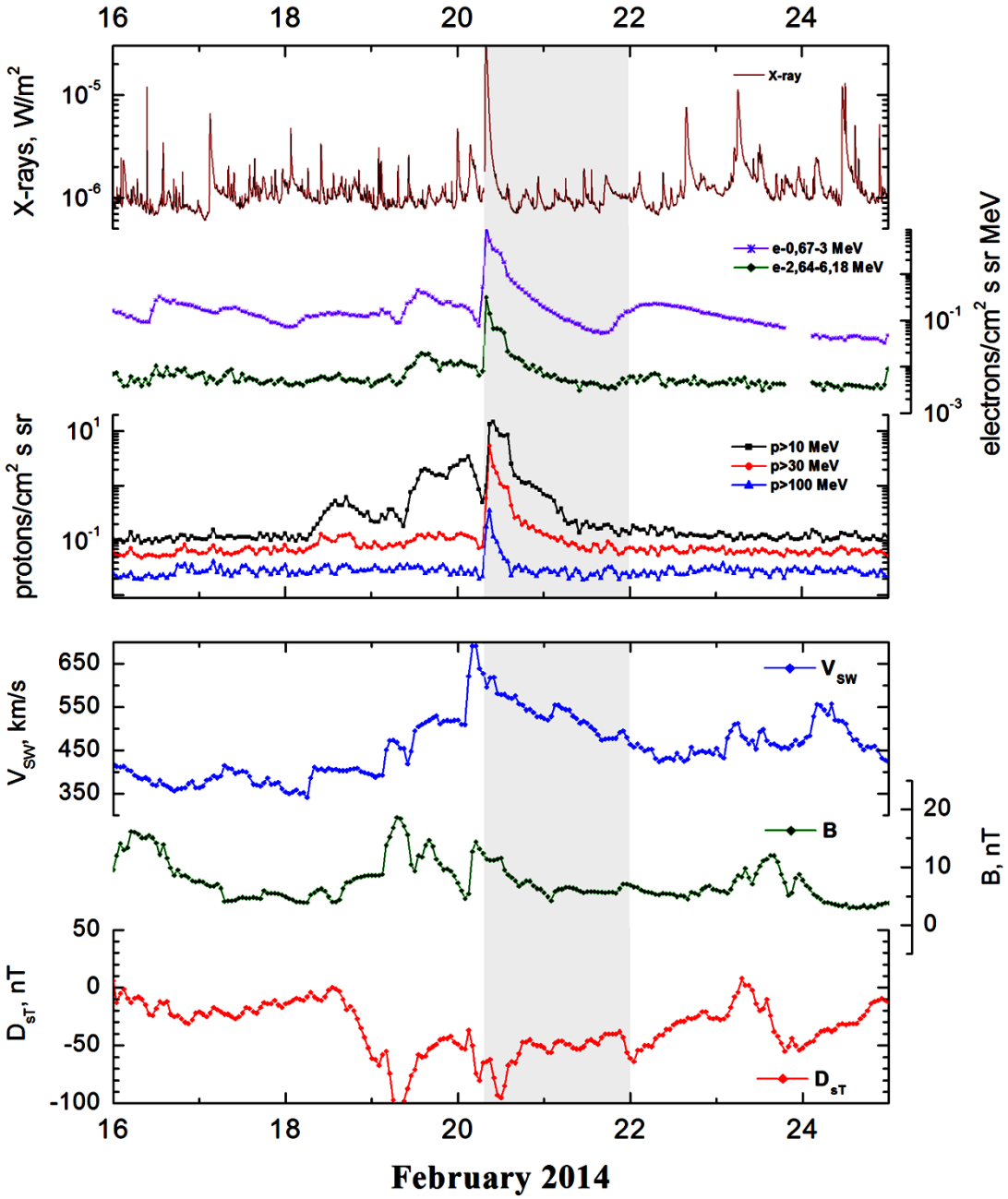
References:

Ameri D., E. Valtonen, 2019.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Kalegaev V., M. Panasyuk, I. Myagkova et al., 2019.

Particle event: To(Ep>10 MeV) – 20d08^{h}
Tmax$_1$(Ep>10 MeV) – 20d10^{h}, Jmax$_1$(Ep>10 MeV) – 17.7 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 20d13^{h}, Jmax$_2$(Ep>10 MeV) – 9.2 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: γ_1 = 2.7, γ_2 = 3.2
Quasimaximal energy of protons in the event – Eqm$_1$ = 250 MeV
– Eqm$_2$ = 110 MeV

Sources: ● solar flare 20d07^{h}26^{m}, M3.0/SN, S15W73, AR11976
Main burst X-ray 1–8 Å: onset – 20d07^{h}26^{m}, max – 20d07^{h}56^{m}, Φ = 0.063 J/m^2
CME: 20d08^{h}00^{m}, V = 948 km/s, Δφ = 360º, dA= 268º
Δ SC 20d03^{h}18^{m}

Particle fluxes and associated phenomena

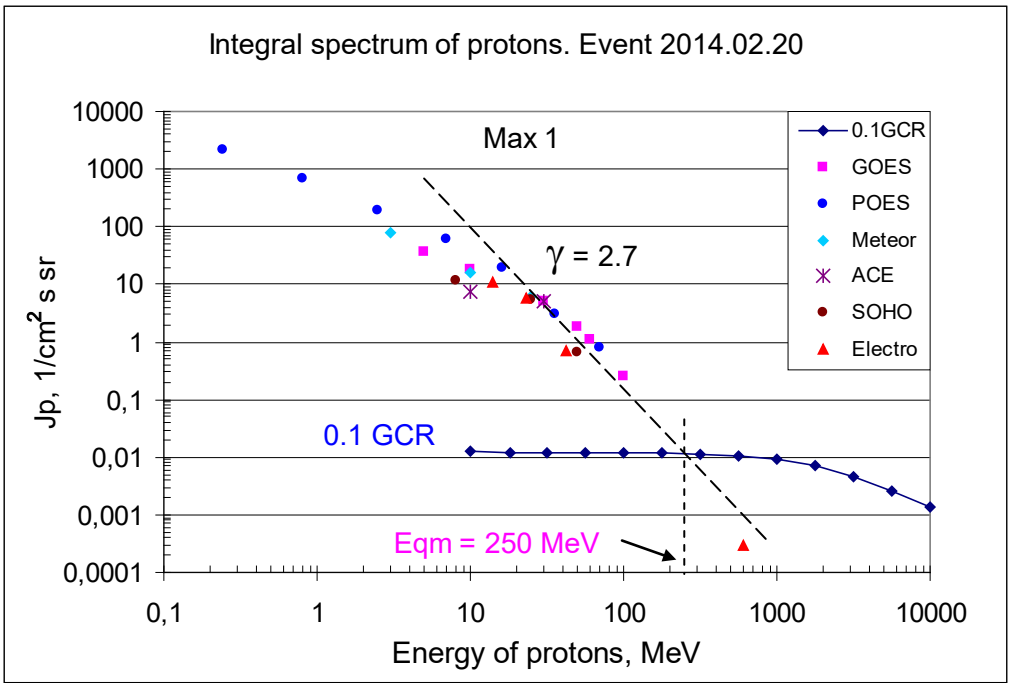


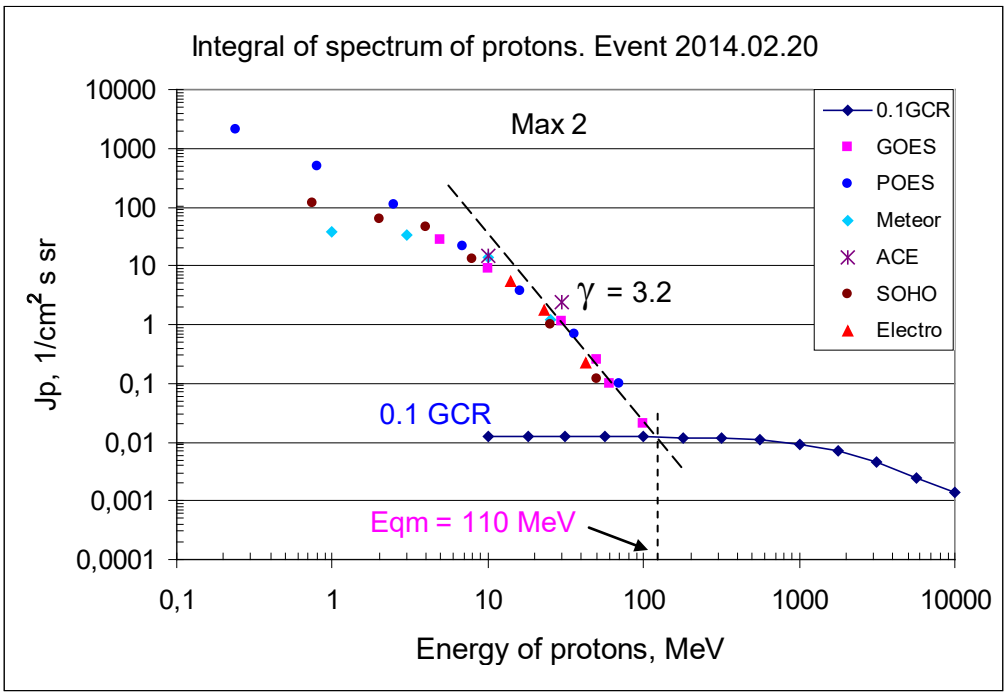
Integral fluxes of protons for the event of 2014 February 20

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	10/14	36/28.5	1.5	0.2	
EPS	>10	7	10/13	17.7/9.2	1.5	0.12	
EPS	>30	7	9/13	5/1.1	1	0.07	
EPS	>50	7	9/13	1.8/0.25	1	0.06	
EPS	>60	7	9/13	1.1/0.1	1	0.05	
EPS	>100	7	9/13	0.25/0.02	0.5	0.03	
Electro-1							
GALS-E	>600	7	9/13	0.0003/ -	0.5	0.0007	
POES							
MEPED	>0.24	8	10/14	2200/2160	2	90	
MEPED	>0.8	8	10/14	690/480	1.5	60	
MEPED	>2.5	8	10/14	95/70	1	50	
MEPED	>6.9	8	10/14	60/11.5	0.5	40	
MEPED	>16	8	10/14	18.7/3.8	0.5	0.7	
MEPED	>36	8	10/14	3/0.7	0.5	0.75	
MEPED	>70	8	10/14	0.9/0.1	0.5	0.8	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	6	- /13	- / 39	1	2.9	
SCR	>3	6	9/ 13	78/34	1	3.15	
SCR	>10	6	10/13	16/14	0.5	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	6	10/12	6.1/1.2	0.5	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	7	8/12	7.5/15	1	1.1	
SIS	>30	7	8/11	5/2.8	1	0.7	
SOHO							
EPHIN	>50	7	8/11	0.65/0.12	0.5	0.2	

Differential fluxes of protons for the event of 2014 February 20

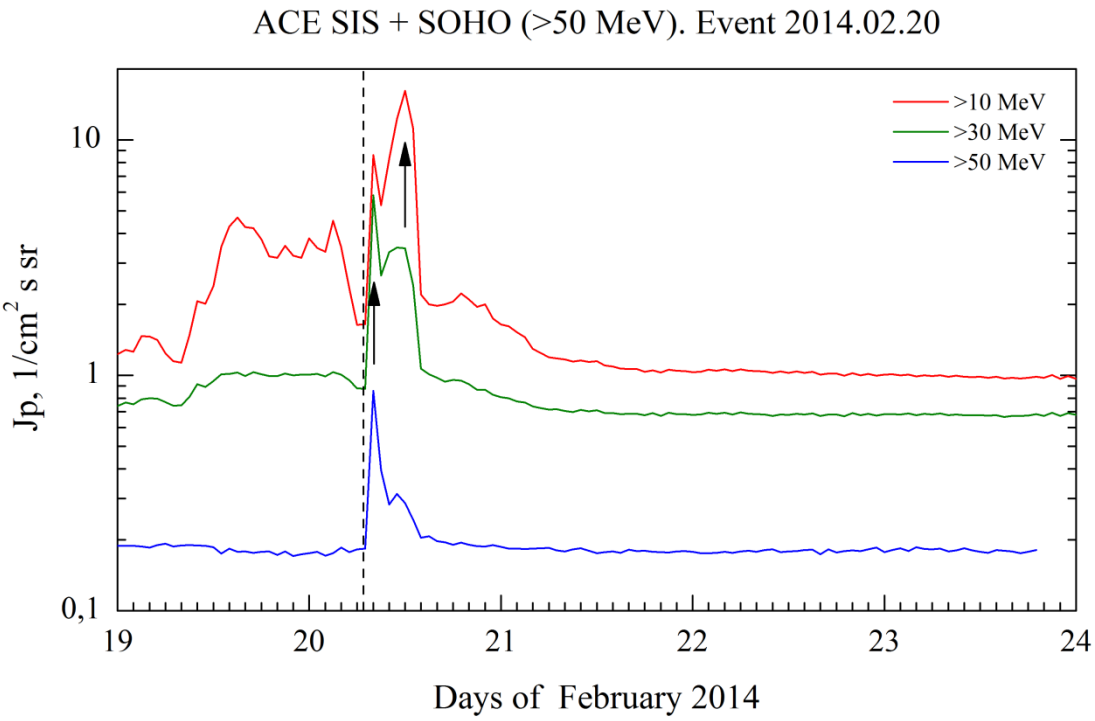
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	7	- /13	- /42	2	0.03	
LION	2 – 6	7	- /13	- /5.7	2	0.005	
EPHIN	4 – 8	7	- /13	- /8.6	2	0.005	
EPHIN	8 – 25	7	9/12	0.36/0.69	2	0.0003	
EPHIN	25 – 53	7	8/12	0.165/0.03	1.5	0.00003	
Electro-1							
SCR-E	13.7–23	7	9/13	0.6/0.4	1	0.045	
SCR-E	23–42	7	9/13	0.26/0.08	1	0.02	
SCR-E	42–112	7	9/13	0.01/0.0032	0.5	0.004	

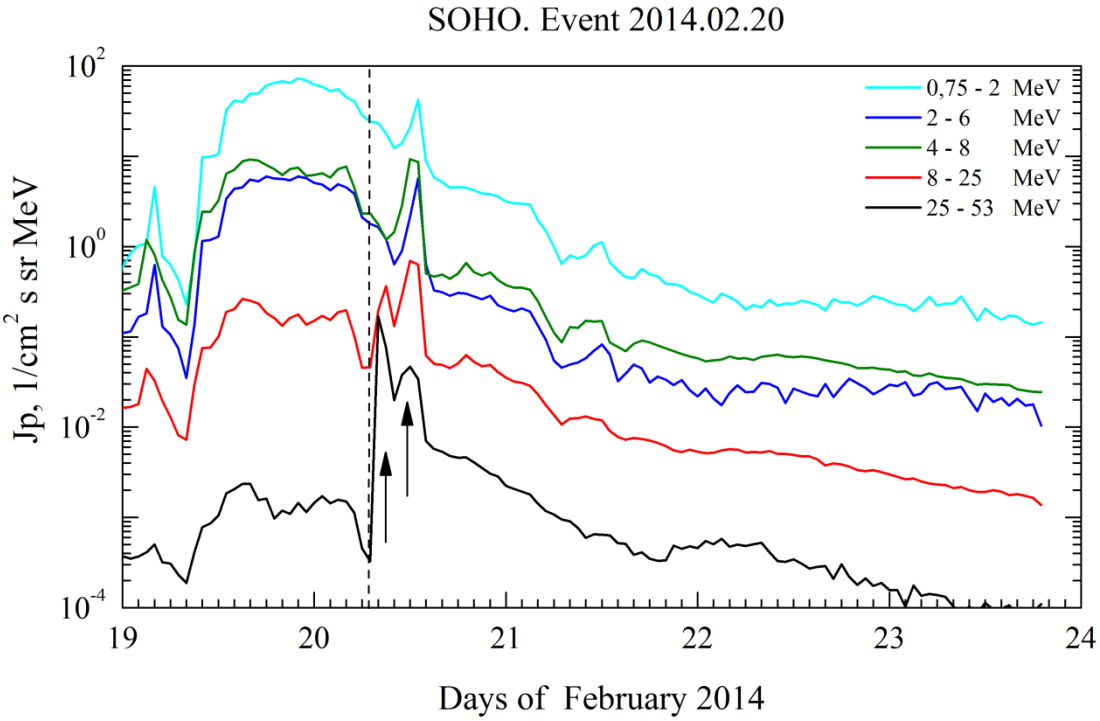

Integral spectrum of protons. Event 2014.02.20
Max 1
γ = 2.7
0.1 GCR
Eqm = 250 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

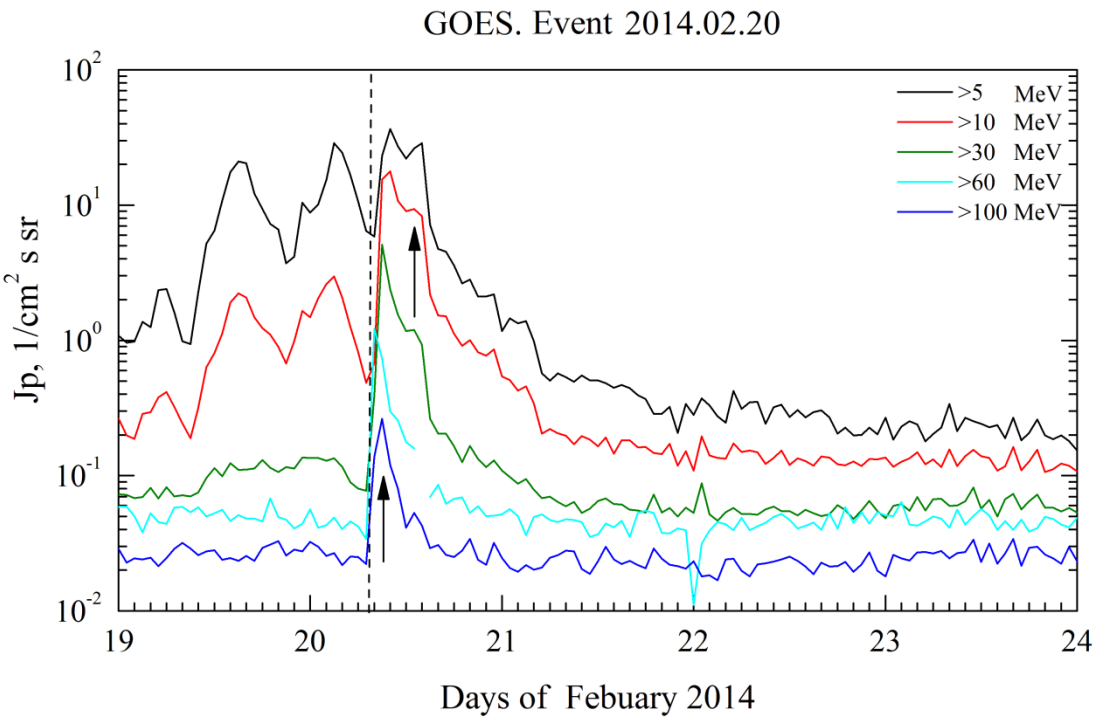

Integral of spectrum of protons. Event 2014.02.20
Max 2
γ = 3.2
0.1 GCR
Eqm = 110 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

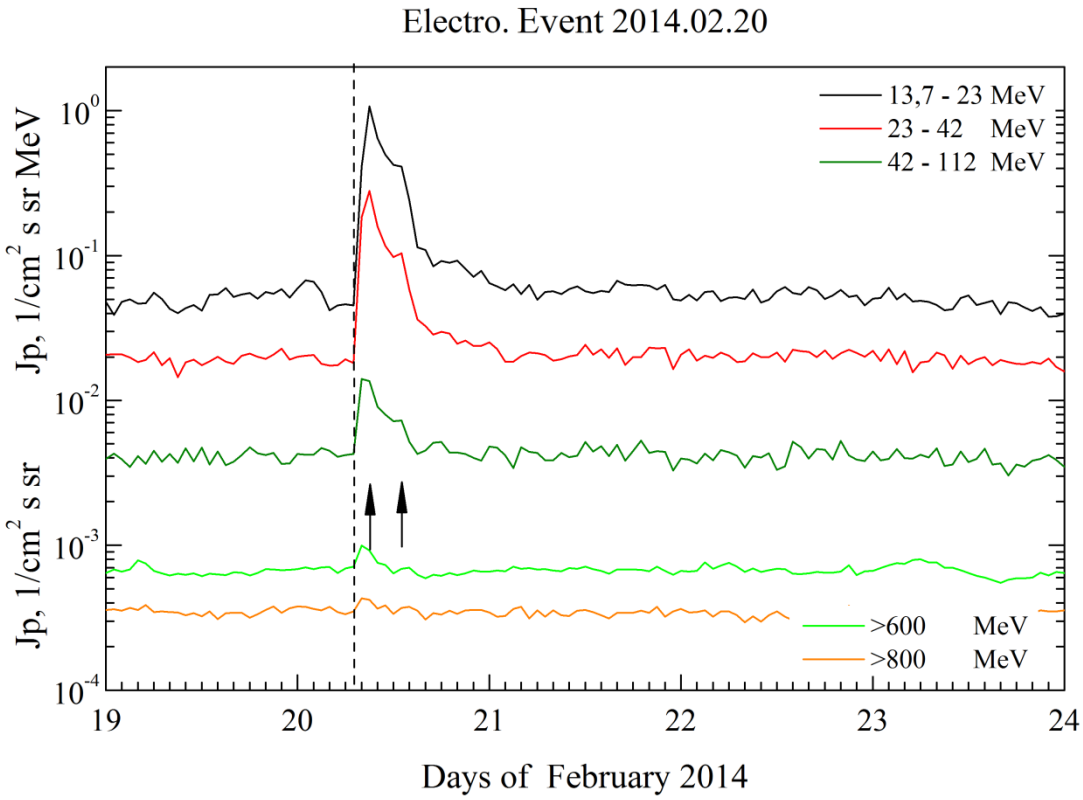
Time profiles of proton fluxes in the event 2014.02.20

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

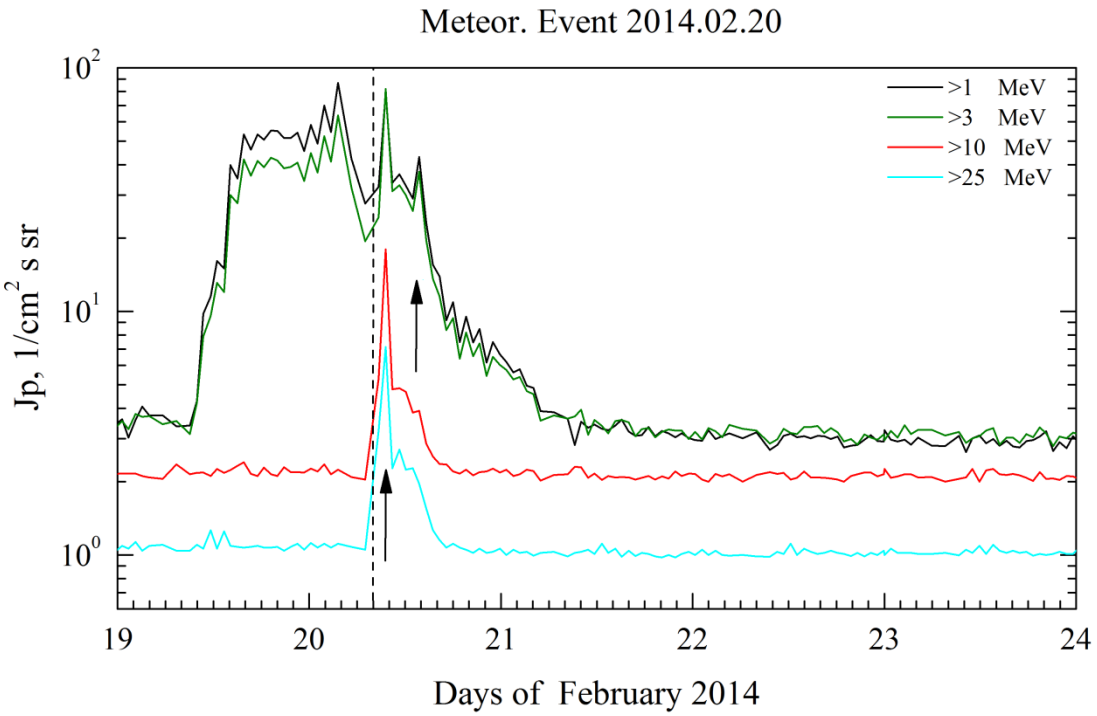


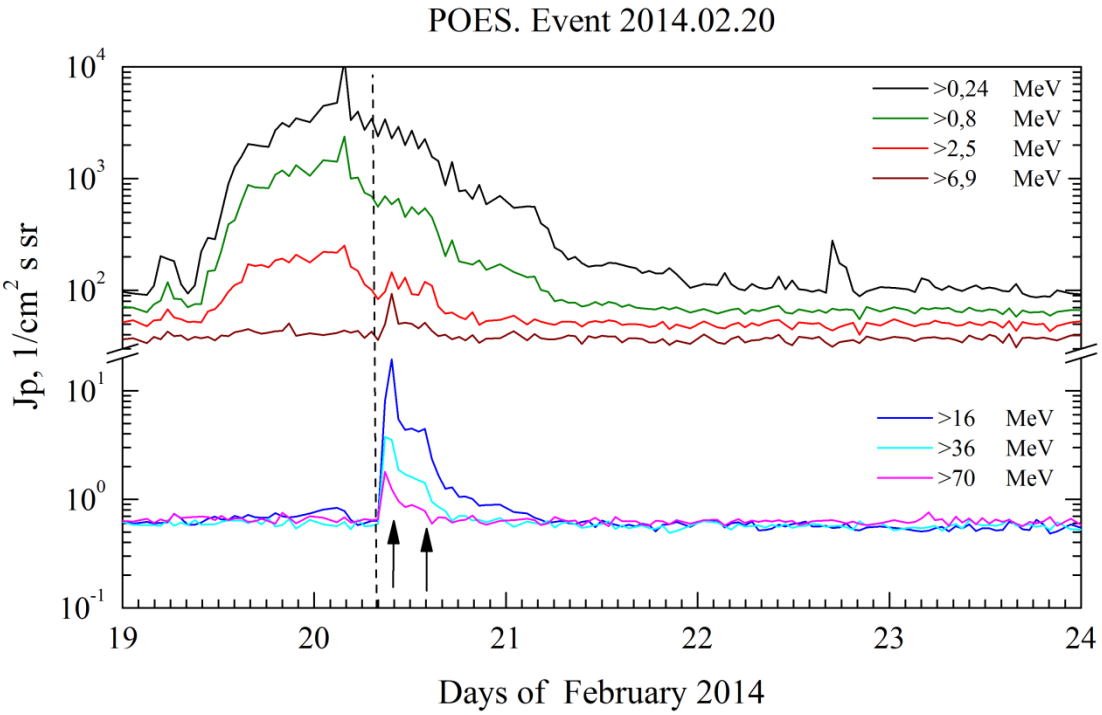



GOES. Event 2014.02.20
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of Febuary 2014


Electro. Event 2014.02.20
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of February 2014

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



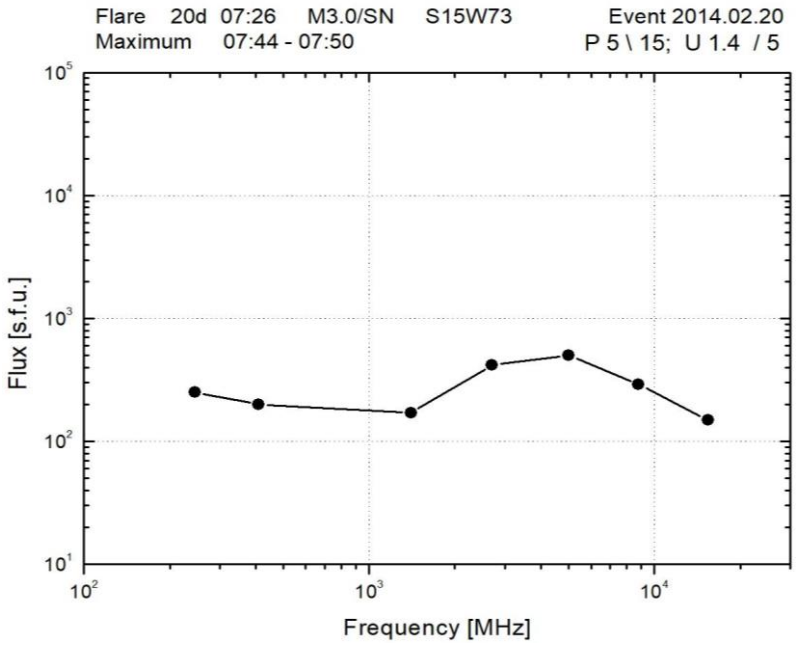


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 February 20

2014 February 20 ● AR11976 To event 551

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0728	0744	0832	S15W73	SN	ERU
1 – 12	keV	0726	0756	0825	S15W75	M3.0	0.063
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0732:32	0733:26	0736:12	19	18428	HESSI
25-50	keV	0736:56	0748:50	0832:16	976	6686966	HESSI
12-25	keV	0756:57	0757:05	0837:21	26418	3108770	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0745	0745	0747	P5 \ 15	2.18	
8.8	GHz	0744	0745	0755		2.46	
5	GHz	0743	0745	0756		2.7	
2.7	GHz	0741	0745	0756		2.62	
1.4	GHz	0744	0750	0756	U1.4 / 5	2.23	
410	MHz	0743	0745	0746		2.3	
245	MHz	0744	0744	0751		2.4	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	26-180	0745		0757		2	
DS III	29-176	0739		0739		2	
DS V	26-80	0730		0731		1	
DH II	7.7-12	0805		0829			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0800	948	- 9.5	360˚	268˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR11976 (S14L320, CMP 14,8.02.2014,
Sp=390 msh, EKI, BG, R)
XRI=0.3, $M_1^{3.0}$+C_8, S_8
PFR 20.02: $M_1^{3.0}$

References:

Богомолов Э.А., Адриани О., Базилевская Г.А. и др., 2017.
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Alberti T., M. Laurenza, E.W. Cliveret et al., 2017.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Gopalswamy N., S. Yashiro, N. Thakur et al., 2016.
Kalaivani P.P., O. Prakash, A. Shanmugaraju et al., 2021.
Kalegaev V., Kaportseva K., Nikolaeva N. et al., 2021.
Kalegaev V., M. Panasyuk, I. Myagkova et al., 2019.
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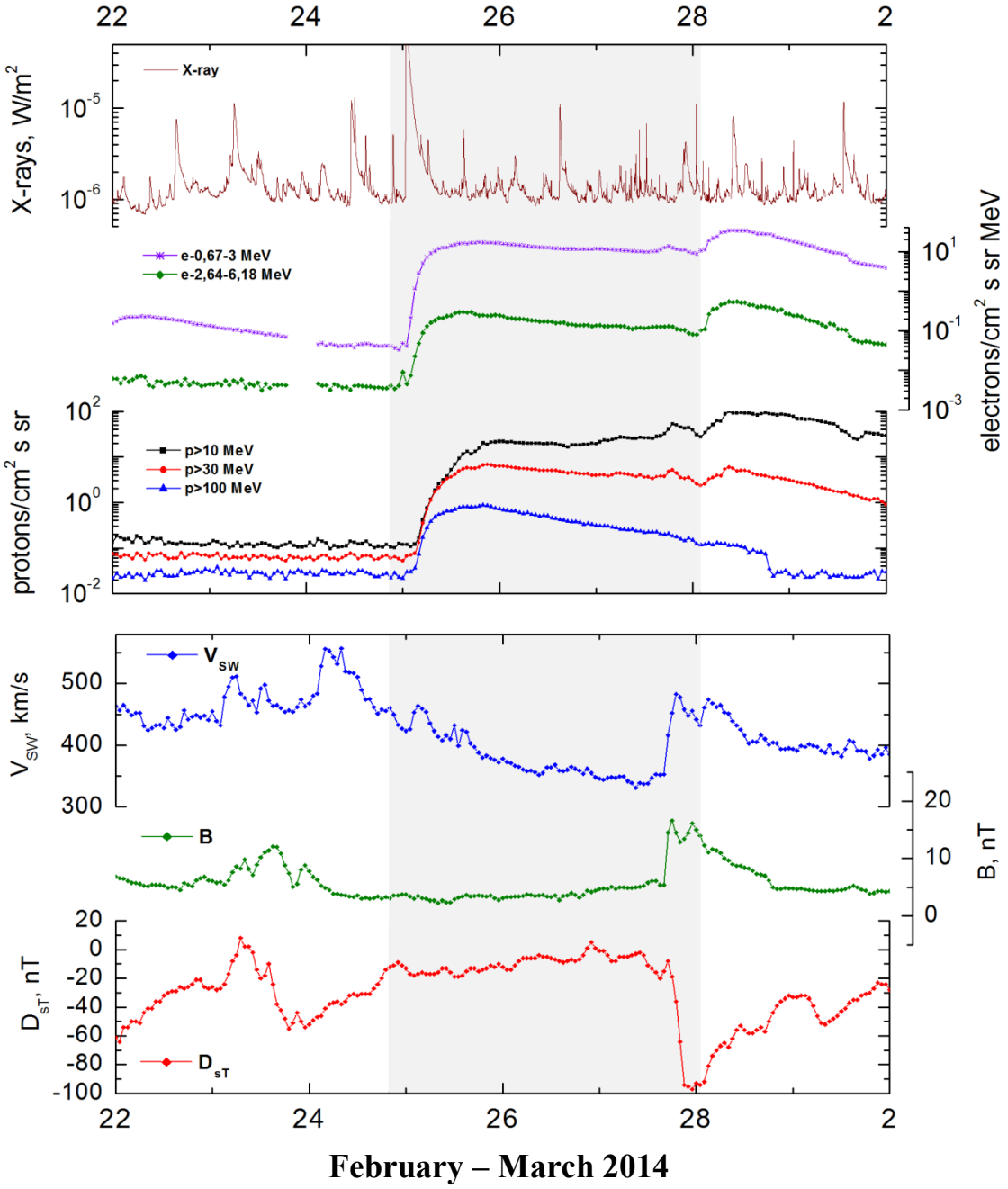
NOAA SPE, 2019.
Núñez M., T. Nieves-Chinchilla, and A. Pulkkinen, 2019.
Vlasova N.A., V.I. Tulupov, V.V. Kalegaev, 2021.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2014.02.25– (2014-056) **552**

Particle event: To(Ep>10 MeV) – 25d04^{h}
Tmax(Ep>10 MeV) – 25d16^{h}, Jmax(Ep>10 MeV) – 13.6 /cm^{2}·s·sr
Duration of the event – 3 days, power-law index: γ = 2.3
Quasimaximal energy of protons in the event – Eqm = 500 MeV

Sources: ● solar flare 25d00^{h}39^{m}, X4.9/2B, S12E82, AR11990
Main burst X-ray 1–8 Å: onset – 25d00^{h}39^{m}, max – 25d00^{h}49^{m}, Φ = 0.43 J/m^{2}
CME: 25d01^{h}25^{m}, V = 2147 km/s, Δφ = 360º, dA= 073º

Particle fluxes and associated phenomena

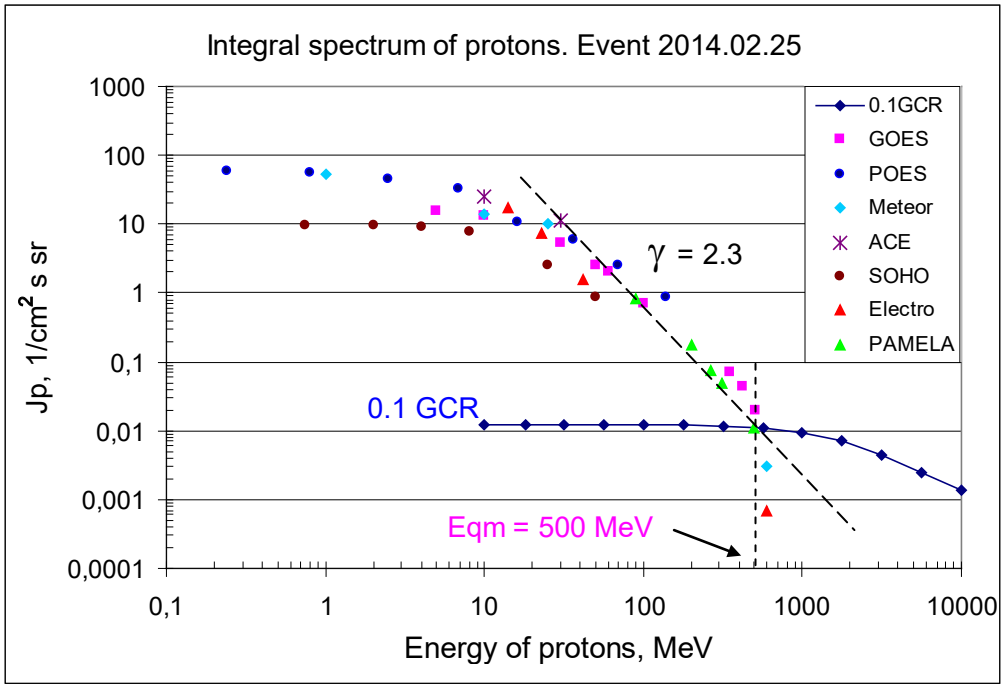


Integral fluxes of protons for the event of 2014 February 25

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	4	16	15.7	3	0.2	
EPS	>10	4	16	13.6	3	0.12	
EPS	>30	4	16	5.4	3	0.07	
EPS	>50	4	16	2.5	3	0.06	
EPS	>60	4	16	2	3	0.05	
EPS	>100	4	16	0.7	3	0.03	
Electro-1							
GALS-E	>600	4	20	0.0007	3	0.0007	
POES							
MEPED	>0.24	4	16	60	3	90	
MEPED	>0.8	4	16	55	3	60	
MEPED	>2.5	4	16	45	3	50	
MEPED	>6.9	4	16	33	3	40	
MEPED	>16	4	16	10.5	3	0.65	
MEPED	>36	4	16	5.8	3	0.7	
MEPED	>70	4	16	2.6	3	0.8	
MEPED	>140	4	16	0.85	3	0.9	
Meteor-1							
SCR	>1	3	21	52	3	2.94	
SCR	>3	3	-	-	3	3.15	
SCR	>10	3	21	14	3	2.09	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	3	21	10	3	1.09	
GALS-M	>600	3	15	0.003	>1	0.02	
ACE							
SIS	>10	2	15	25	6	1.1	
SIS	>30	2	15	11	6	0.7	
PAMELA							
TRACKER	>90	3	12-23	0.83	6	-	
TRACKER	>200	3	12-23	0.18	6	-	
TRACKER	>265	3	12-23	0.075	6	-	
TRACKER	>312	3	12-23	0.05	6	-	
TRACKER	>500	3	12-23	0.011	6	-	
SOHO							
EPHIN	>50	03	14	0.85	3	0.18	

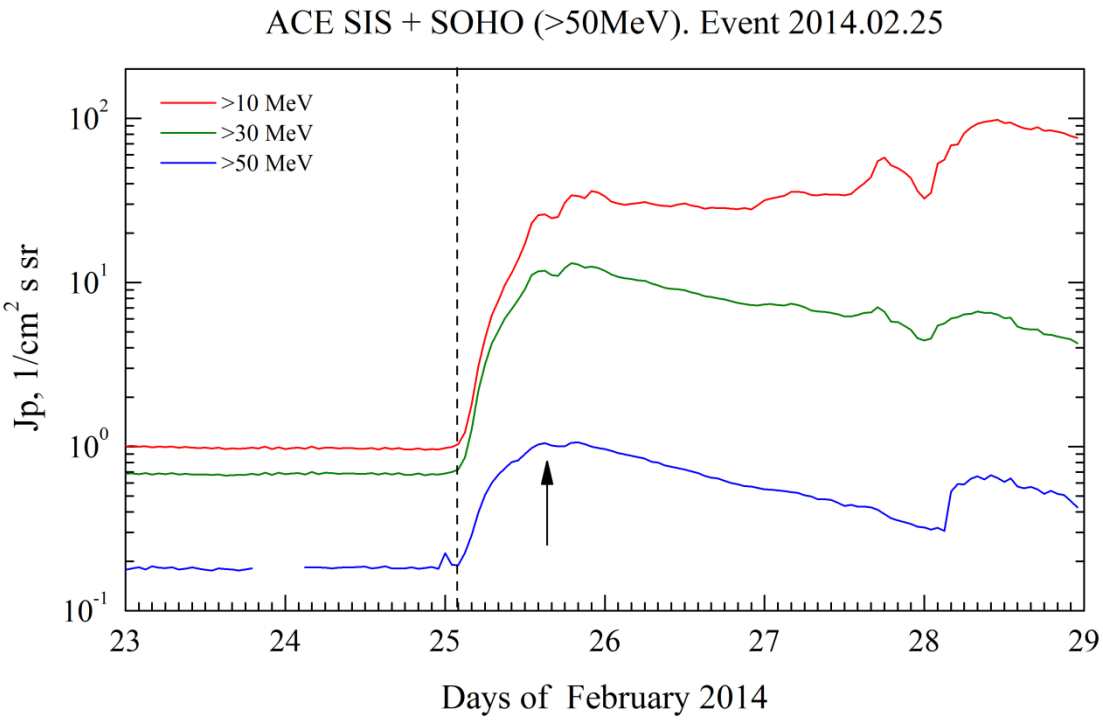
Differential fluxes of protons for the event of 2014 February 25

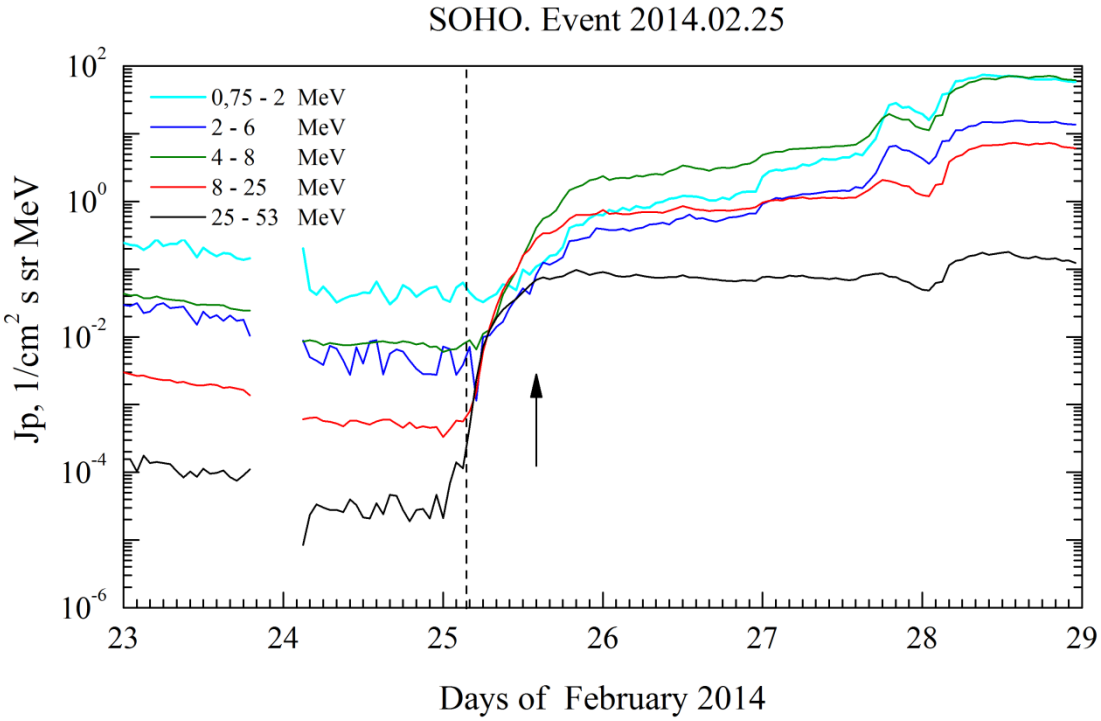
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	3	14	0.07	3	0.04	
LION	2 – 6	3	14	0.081	3	0.002	
EPHIN	4 – 8	3	14	0.404	3	0.008	
EPHIN	8 – 25	3	14	0.28	3	0.0005	
EPHIN	25 – 53	3	14	0.07	3	0.00003	
Electro-1							
SCR-E	13.7–23	4	20	1.1	3	0.045	
SCR-E	23–42	4	20	0.3	3	0.02	
SCR-E	42–112	4	20	0.022	3	0.004	
GOES							
EPS	350–420	2	10	0.0004	2	0.0016	
EPS	42–-510	2	10	0.00025	2	0.0008	
EPS	510–700	5	12	0.00011	1.5	0.0003	
EPS	>700	-	-	-	-		

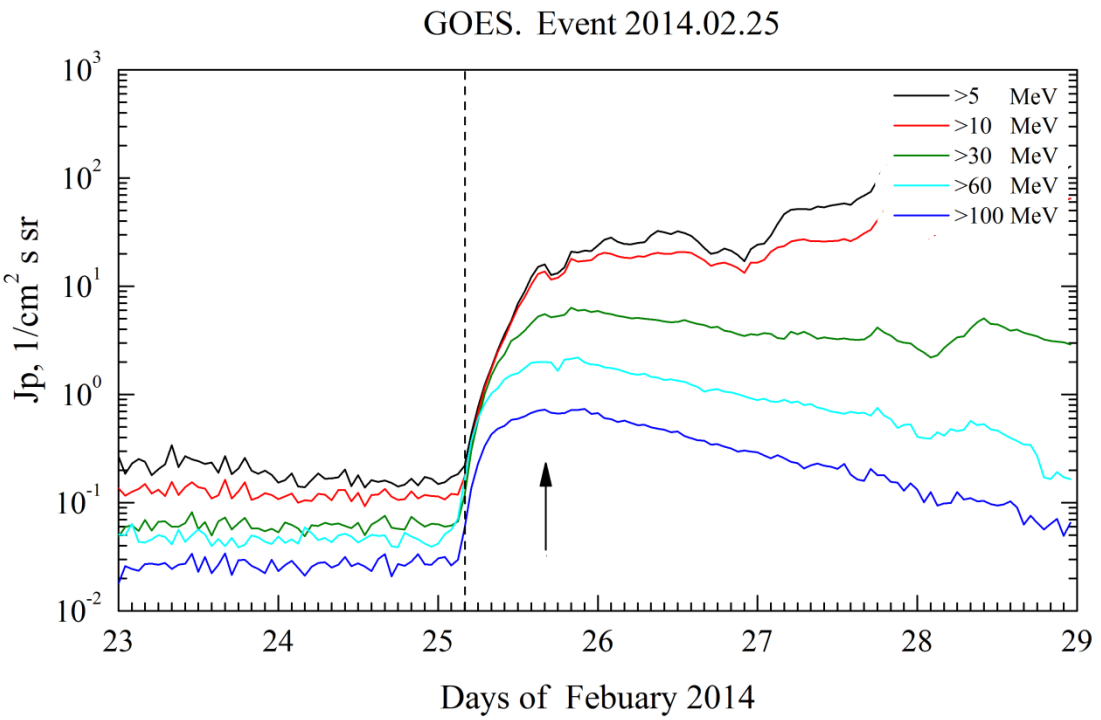


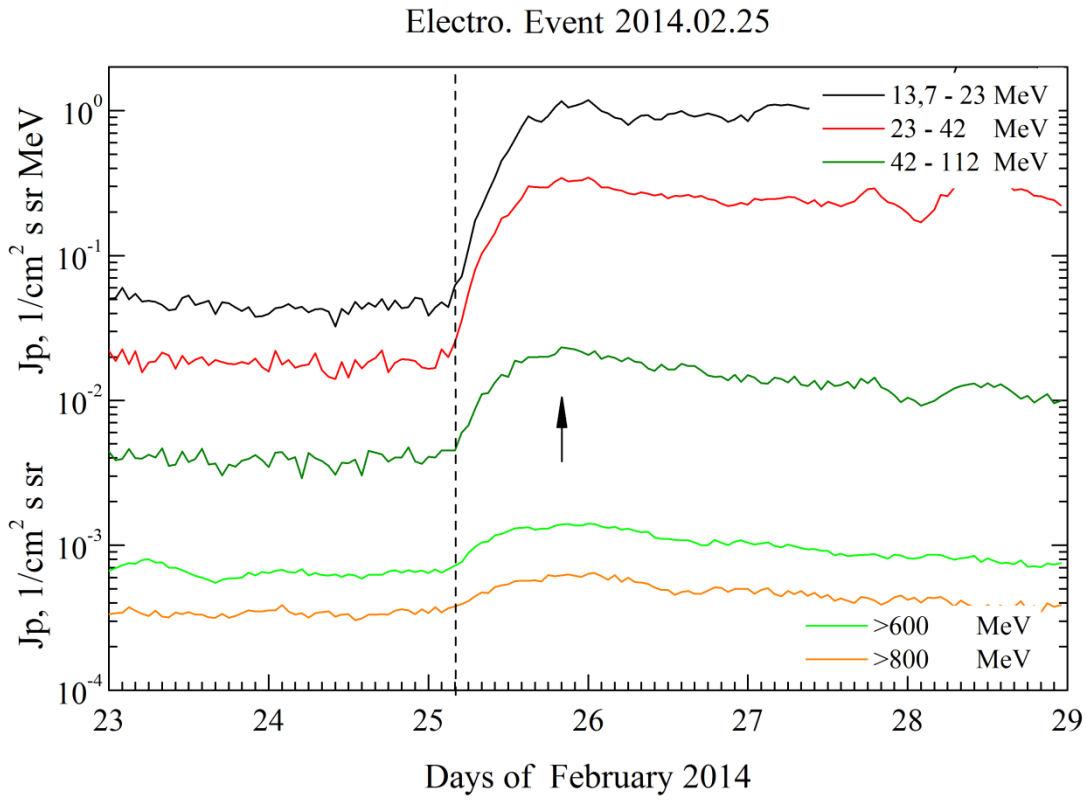
Time profiles of proton fluxes in the event 2014.02.25

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

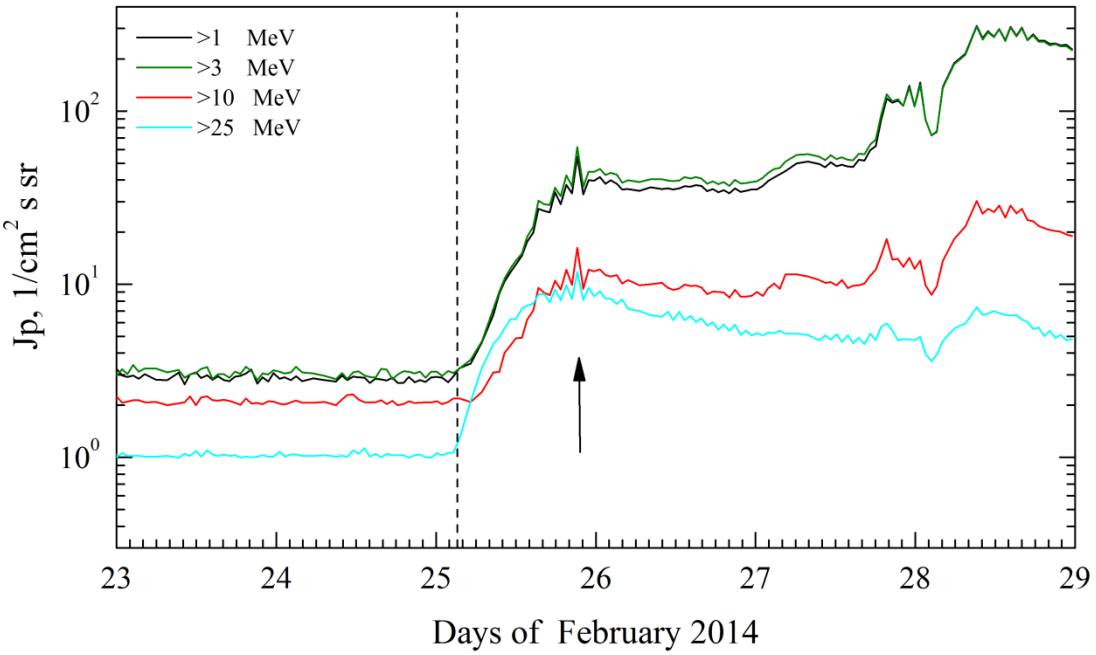




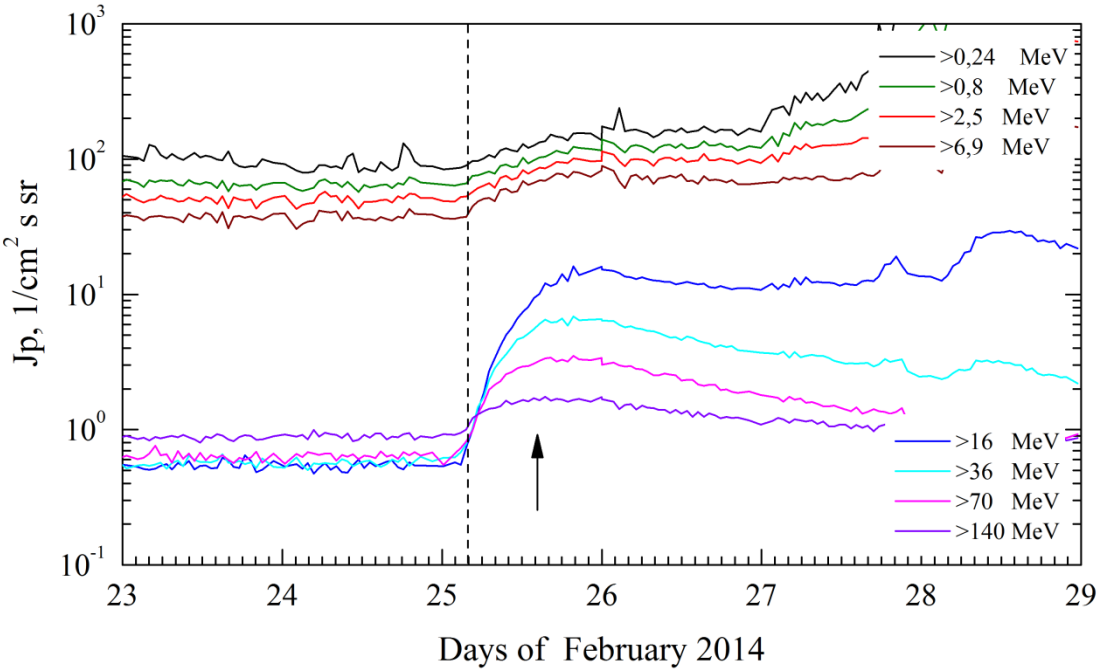

GOES. Event 2014.02.25
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of Febuary 2014


Electro. Event 2014.02.25
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of February 2014

Meteor. Event 2014.02.25



POES. Event 2014.02.25



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 February 25

2014 February 25 ● AR 11990 To event 552

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0043	0047	0210	S12E82	2B	ERU
6563 Å	LPS	0231		0621		0.03	
1 – 12	keV	0039	0049	0103	S12E77	X4.9	0.43

X-ray, gamma ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
300-800	keV	0037:04	0046:54	0104:28	24508	97224896	HESSI
12 – 25	keV	0040:57	0052:58	0136:06	812309	457523104	FERMI
>100	MeV	0110:30		0130:30		1.62E-03*	FERMI
12 – 25	keV	0144:28	0145:02	0153:36	4447	1153703	HESSI
12 – 25	keV	0153:36	0154:46	0231:48	256	1697598	HESSI

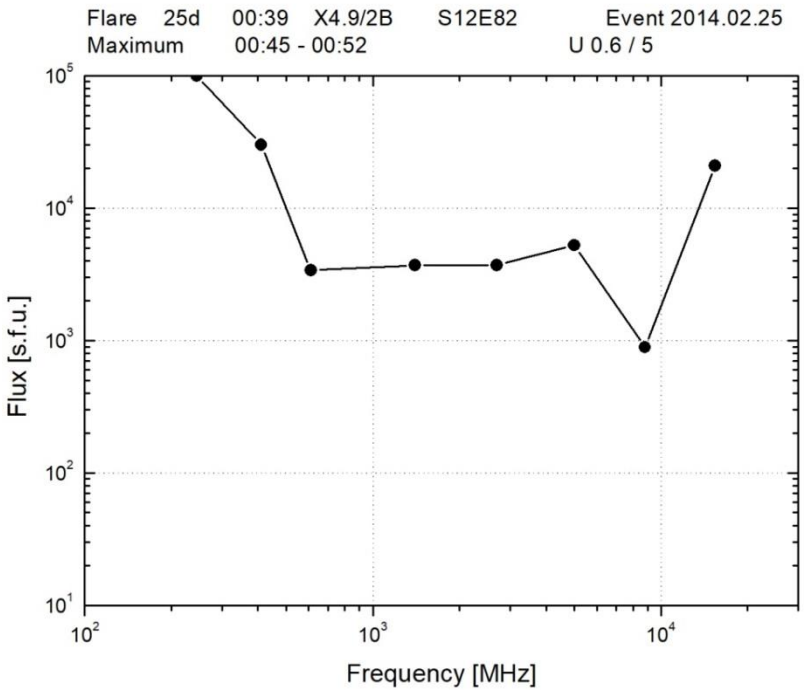
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0041	0049	0118		4.32	
8.8	GHz	0041	0049	0114		2.95	
5	GHz	0042	0052	0110	U0.6 / 5	3.72	
2.7	GHz	0042	0045	0107		3.57	
1.4	GHz	0043	0045	01103		3.57	
610	MHz	0044	0047	0053		3.53	
410	MHz	0045	0046	0053		4.48	
245	MHz	0045	0046	0054		5.0	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	18-57	0056		0102		3	
DS IV	25-180	0045		0134		2	
DS III	18-480	0045		0050		1	
DS III	18-40	0125		0125		1	
DH II	0.1-14	0056		1128			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0125	2147	- 158.1	360˚	073˚	SOHO

*cm^{-2}s^{-1}

Radio burst frequency spectrum



Proton Active Region:

AR11990 (S13L110, CMP 03.03.2014,
Sp=420 msh, DKC, BD, R)
XRI= 5.13 $X_1^{4.9}$+$M_3^{1.3}$+C_6 2_1+S_6
PFR 23-25.02 (42^h) $X_1^{4.9}$+M_3

References:

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Tan L.C., O.E. Malandraki, 2021.
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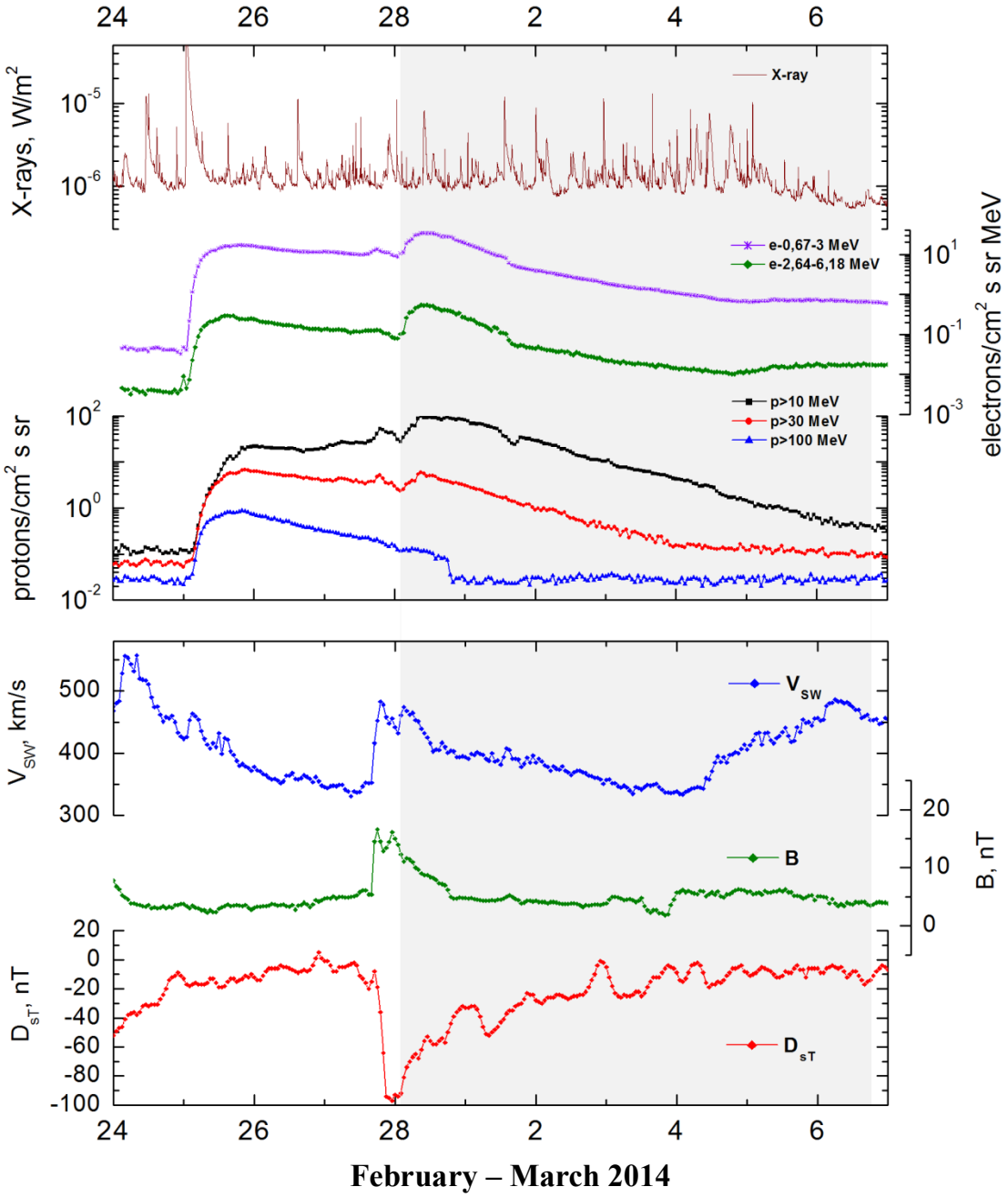
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zelina P., S. Dalla, C.M.S. Cohen, R.A. Mewaldt, 2017.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 28d02^{h}
Tmax(Ep>10 MeV) – 28d10^{h}, Jmax(Ep>10 MeV) – 97 /cm^{2}·s·sr
Duration of the event – 7 days, power-law index: γ = 3.2
Quasimaximal energy of protons in the event – Eqm = 180 MeV

Sources: ⊙ solar flare 27d21^{h}33^{m}, C4.2/SF, S11W63, AR11982
Ø solar flare 28d00^{h}44^{m}, M1.1/SN, S24E53, AR11991
Main X-ray burst 1-8 Å: onset – 27d21^{h}33^{m}, max – 27d22^{h}12^{m}, Φ = 0.012 J/m^{2}

Particle fluxes and associated phenomena

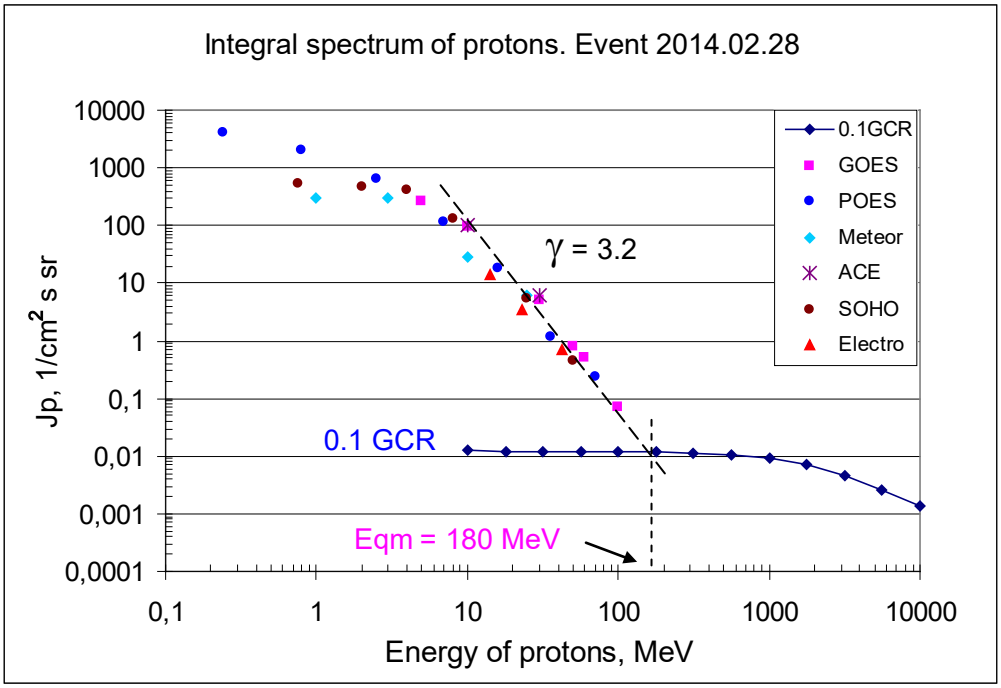


Integral fluxes of protons for the event of 2014 February 28

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	2	10	270	8	0.2	
EPS	>10	2	10	97	7	0.12	
EPS	>30	2	10	5	5	0.07	
EPS	>50	2	10	0.8	4	0.06	
EPS	>60	2	10	0.5	4	0.05	
EPS	>100	2	10	0.07	2	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	2	11	4040	4	160	
MEPED	>0.8	2	11	2070	4	130	
MEPED	>2.5	2	11	635	4	100	
MEPED	>6.9	2	11	115	4	65	
MEPED	>16	2	11	18.5	3	10	
MEPED	>36	2	11	1.2	2	2	
MEPED	>70	2	11	0.24	0.5	1	
MEPED	>140	-	-	-	-	1	
Meteor-1							
SCR	>1	2	9	307	7	2.95	
SCR	>3	2	9	304	7	3.15	
SCR	>10	2	9	28	4	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	2	9	6.3	3	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	1	10	100	7	1.1	
SIS	>30	1	10	6	5	0.7	
SOHO							
EPHIN	>50	4	10	0.45	1.7	0.2	

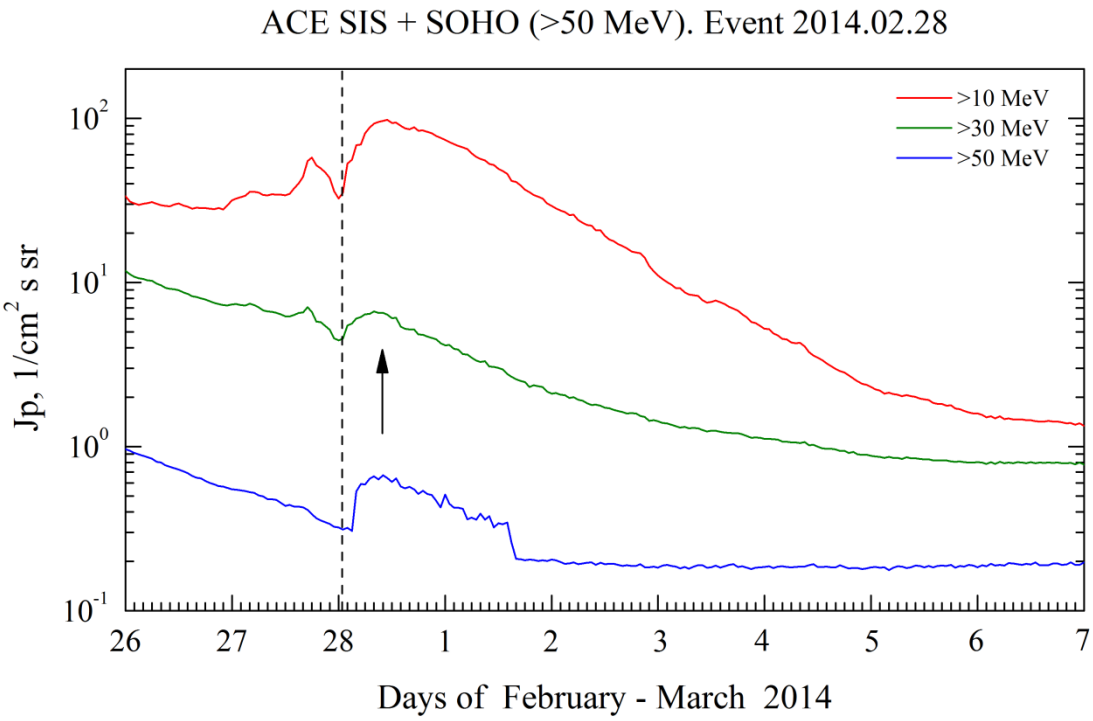
Differential fluxes of protons for the event of 2014 February 28

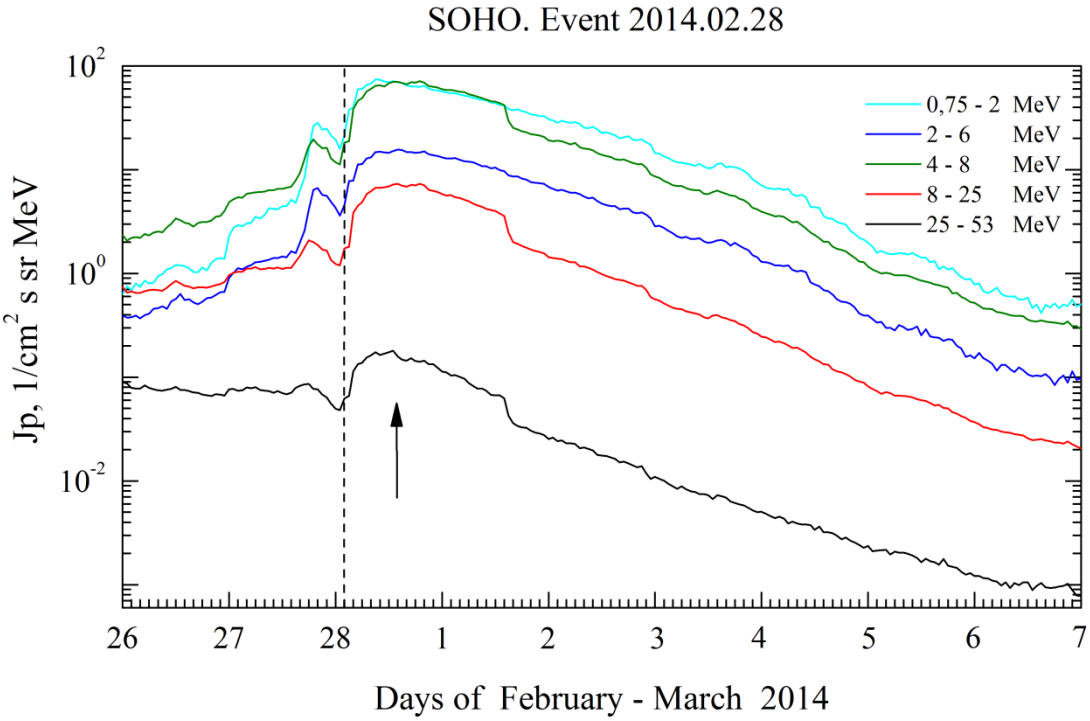
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	2	9	74.1	7	0.04	
LION	2 – 6	2	14	15.6	7	0.002	
EPHIN	4 – 8	2	14	70.4	7	0.008	
EPHIN	8 – 25	2	14	7.29	7	0.0005	
EPHIN	25 – 53	2	13	0.18	7	0.00003	
Electro-1							
SCR-E	13.7–23	2	10	1.2	3	1	
SCR-E	23–42	2	10	0.14	3	0.2	
SCR-E	42–112	2	10	0.01	1	0.004	

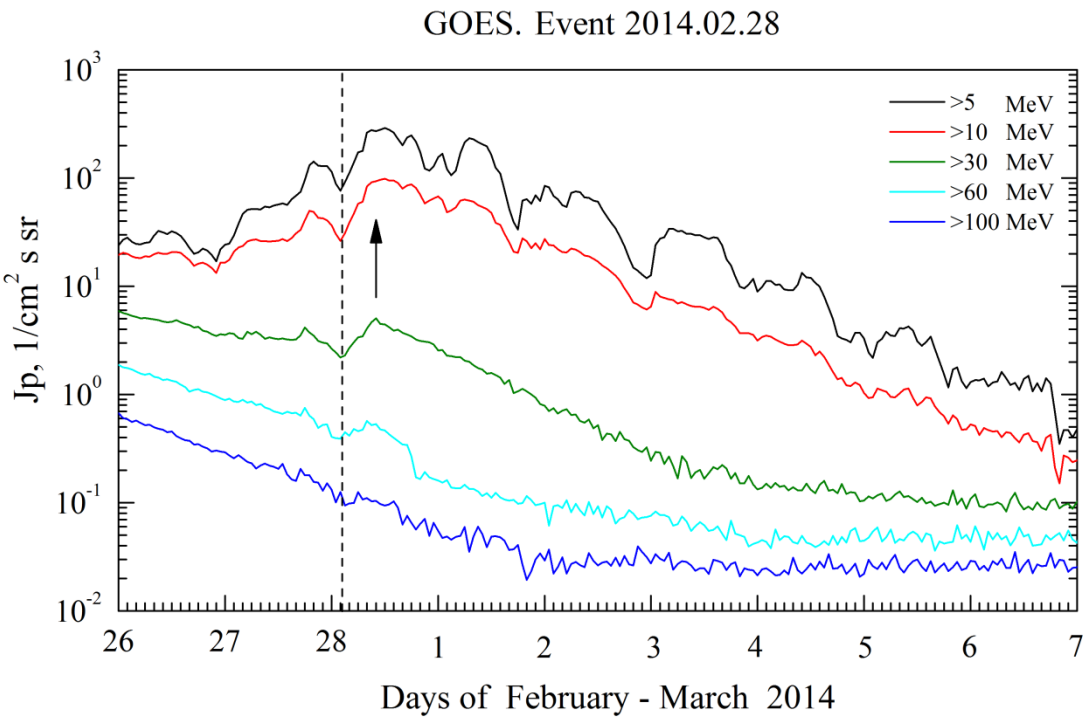

Integral spectrum of protons. Event 2014.02.28
Jp, 1/cm2 s sr
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 3.2
0.1 GCR
Eqm = 180 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

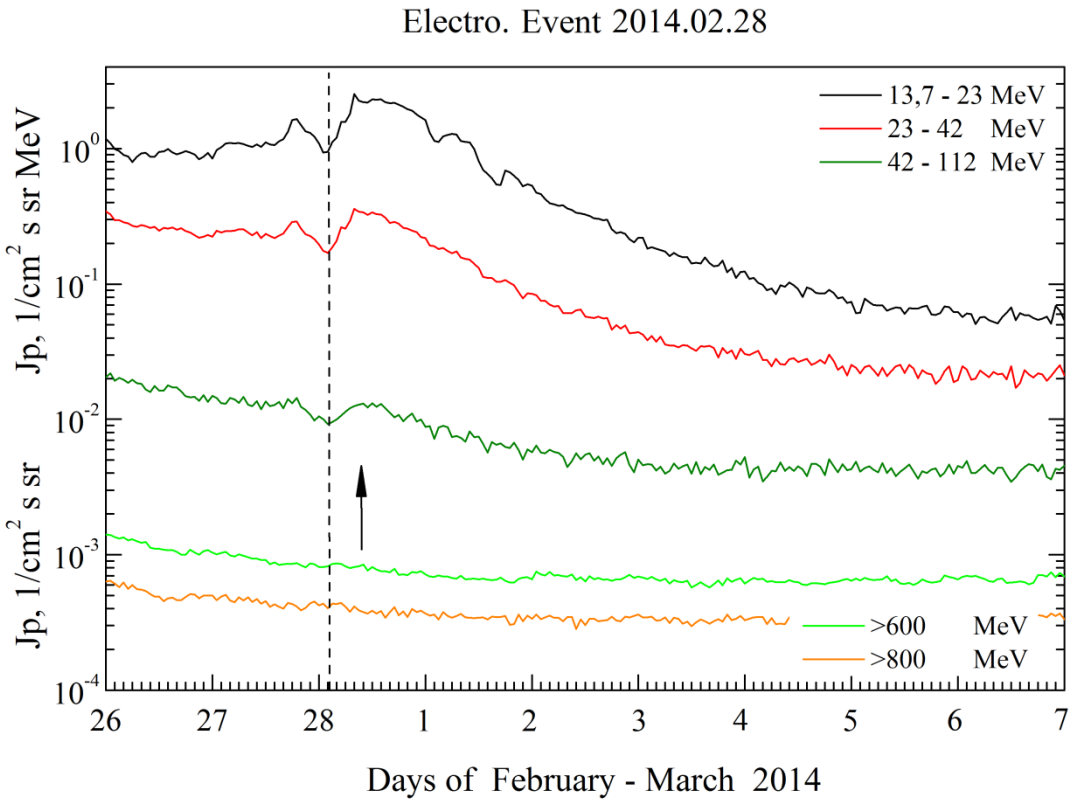
Time profiles of proton fluxes in the event 2014.02.28

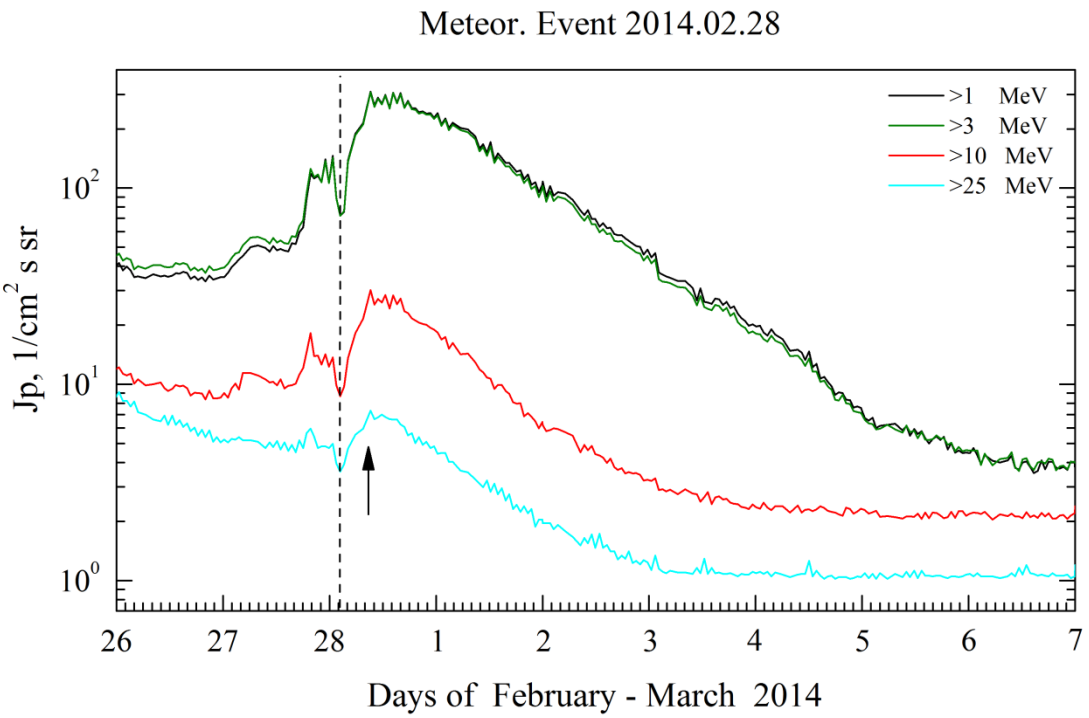
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

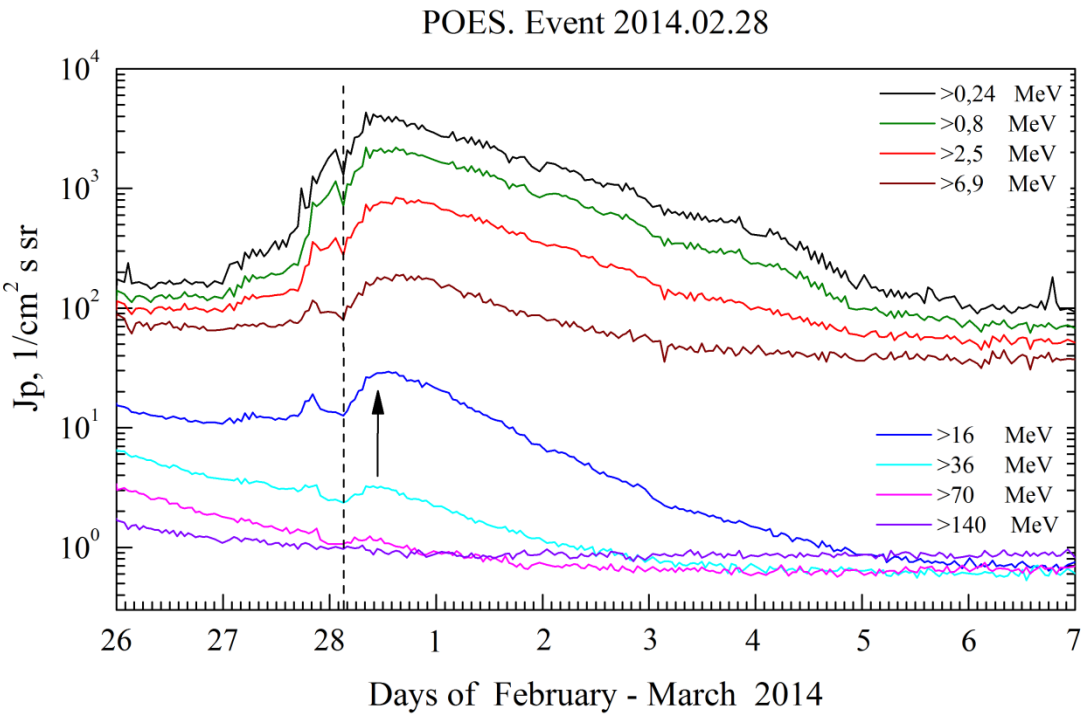





GOES. Event 2014.02.28
Jp, 1/cm² s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of February - March 2014


Electro. Event 2014.02.28
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of February - March 2014


Meteor. Event 2014.02.28
>1 MeV
>3 MeV
>10 MeV
>25 MeV
Jp, 1/cm² s sr
10²
10¹
10⁰
26
27
28
1
2
3
4
5
6
7
Days of February - March 2014


POES. Event 2014.02.28
>0,24 MeV
>0,8 MeV
>2,5 MeV
>6,9 MeV
>16 MeV
>36 MeV
>70 MeV
>140 MeV
Jp, 1/cm² s sr
10⁴
10³
10²
10¹
10⁰
26
27
28
1
2
3
4
5
6
7
Days of February - March 2014

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 February 28

2014 February 27 ⊙ AR 11982 To event 553

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	2134	2135	2152	S11W63	SF	DSD
1 – 12	keV	2133	2212	2237	S11W64	C4.2	0.012
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	2156:28	2205:18	2244:12	2160	12287760	HESSI
12-25	keV	2134:41	2135:35	2138:19	3615	99431	FERMI
12-25	keV	2140:30	2140:50	2141:56	749	12198	FERMI
12-25	keV	2147:07	2147:52	2150:03	1610	34648	FERMI
12-25	keV	2152:26	2152:43	2153:32	544	6189	FERMI

2014 February 28 Ø AR 11991 To event 553

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	0047	0048	0056	S24E53	SN	BPT
1 – 12	keV	0044	0048	0050	S22E52	M1.1	0.0019
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12– 25	keV	0046:38	0048:14	0052:13	58598	3434795	FERMI

Proton Active Region:

AR11982 (S11L207, CMP 23,3.02 2014,
Sp=570 msh, EKC, BGD)
XRI=0.35, $M_3^{1.3}+C_{21}$ $2_1+1_2+S_{39}$

AR1 1991 (S25L093, CMP 03,0.03.2014,
Sp= 370 msh EKO, BG)
XRI=0.38, $M_3^{1.7}+C_{17}$ 1_2+S_{24}

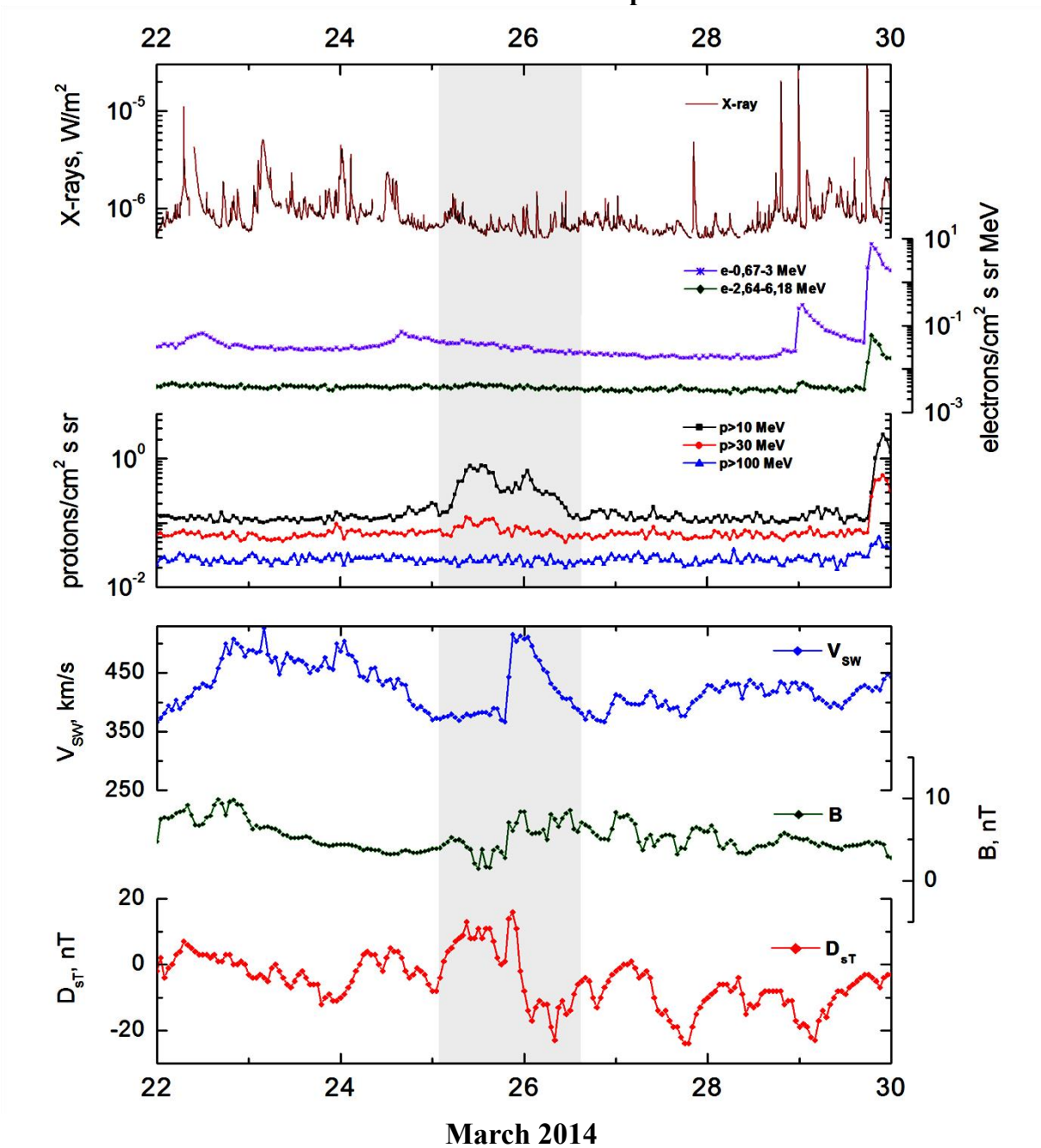
References:

Kalegaev V., M. Panasyuk, I. Myagkova et al., 2019.
Podgorny I.M., A.I. Podgorny, 2018.

Particle event: To(Ep>10 MeV) – 25d04^{h}
Tmax$_1$(Ep>10 MeV) – 25d11^{h}, Jmax$_1$(Ep>10 MeV) – 0.4 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 26d00^{h}, Jmax$_2$(Ep>10 MeV) – 0.2 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: γ_1 = 3.2 γ_2 = 4.0
Quasimaximal energy of protons in the event – Eqm$_1$ = 35 MeV
– Eqm$_2$ = 25 MeV

Sources: ⊡ solar flare 25d<05^{h}36^{m}, AR unknown, behind W$_L$
CME: 25d05^{h}36^{m}, V = 651 km/s, Δφ= 223°, dA= 269°
▲ SC 25d20^{h}04^{m}

Particle fluxes and associated phenomena

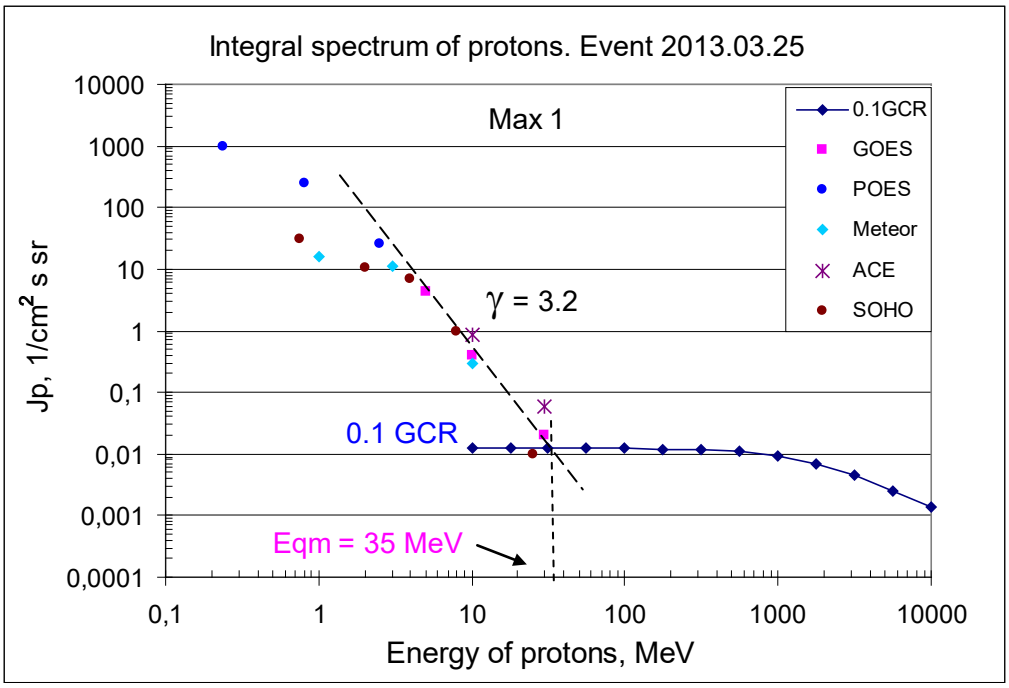


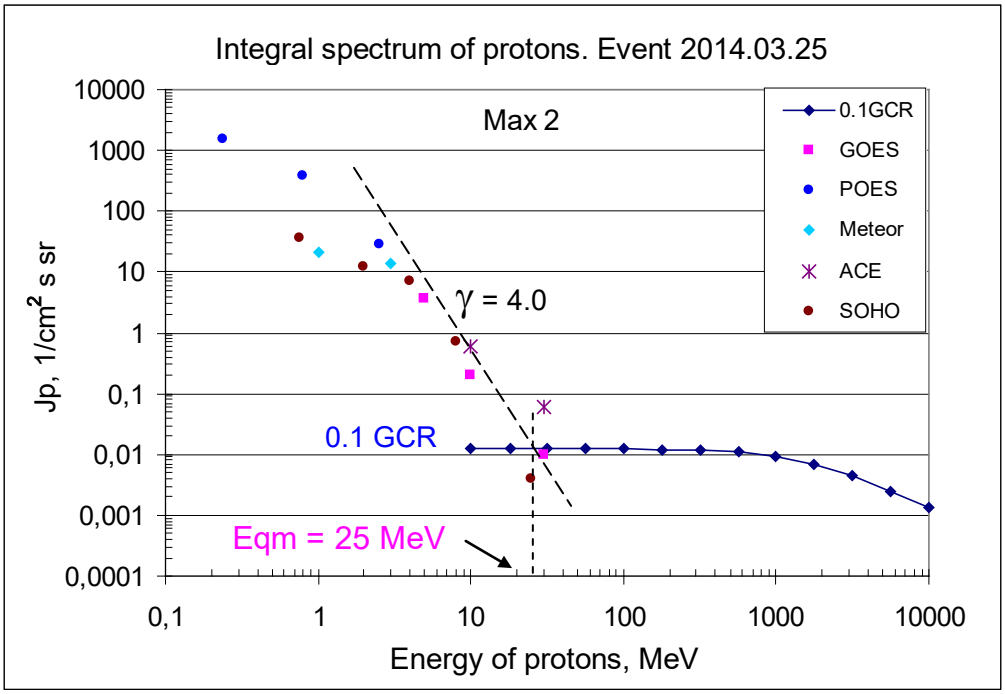
Integral fluxes of protons for the event of 2014 March 25

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	4	11/26d01	4.3/3.7	1.5	0.2	
EPS	>10	4	11/26d00	0.4/0.2	1.5	0.12	
EPS	>30	6	11/26d00	0.02/0.01	1	0.07	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.007	
POES							
MEPED	>0.24	6	12/26d02	990/1500	2	90	
MEPED	>0.8	6	12/26d02	250/390	2	65	
MEPED	>2.5	6	12/26d02	26/28	2	50	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	-	-	-	-	0.7	
MEPED	>36	-	-	-	-	0.8	
MEPED	>70	-	-	-	-	0.85	
MEPED	>140	-	-	-	-	0.9	
Meteor-1							
SCR	>1	1	16/26d01	16/21	2	2.9	
SCR	>3	1	16/26d01	11/14	2	3.1	
SCR	>10	9	16/-	0.3/-	0.25	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	-	-	-	-	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	4	9/26d01	0.85/0.6	1.5	1	
SIS	>30	4	9/26d00	0.06/0.06	1.5	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

Differential fluxes of protons for the event of 2014 March 25

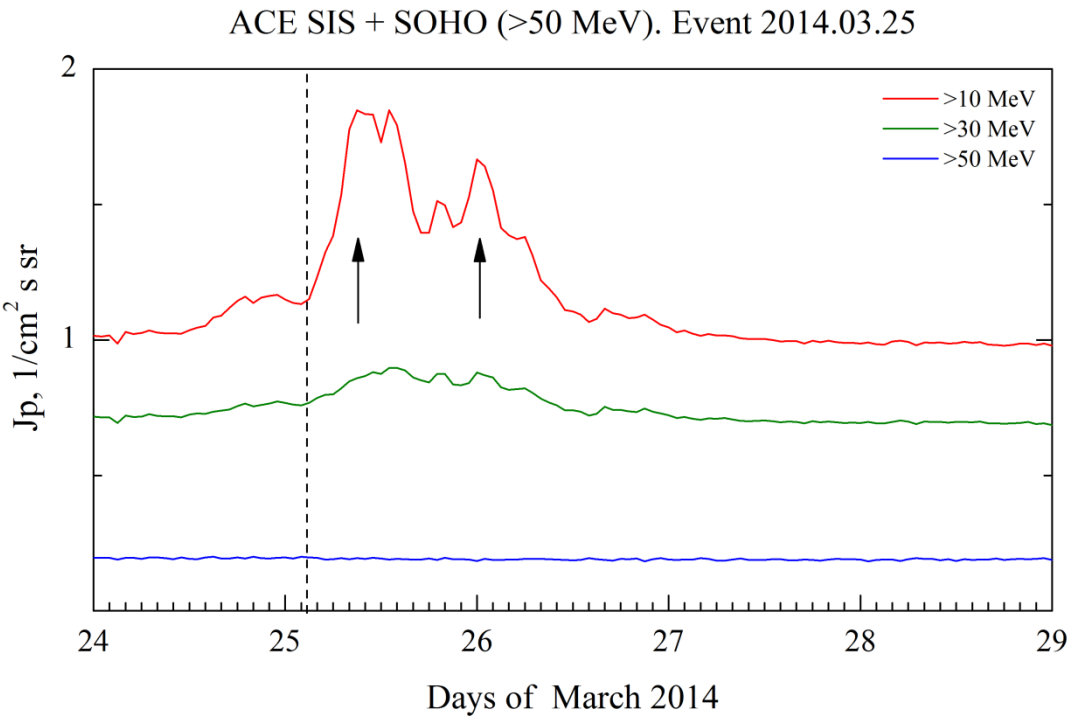
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	3	11/26d02	16.9/20.1	4	0.015	
LION	2 – 6	3	10/26d01	1.1/1.6	4	0.003	
EPHIN	4 – 8	3	10/26d91	1.5/1.6	4	0.003	
EPHIN	8 – 25	3	10/26d01	0.056/0.043	3	0.00012	
EPHIN	25 – 53	3	10/26d00	0.00035/0.00015	2	0.000014	
Electro-1							
SCR-E	13.7–23	-	-	-	-	0.045	
SCR-E	23–42	-	-	-	-	0.02	
SCR-E	42–112	-	-	-	-	0.004	

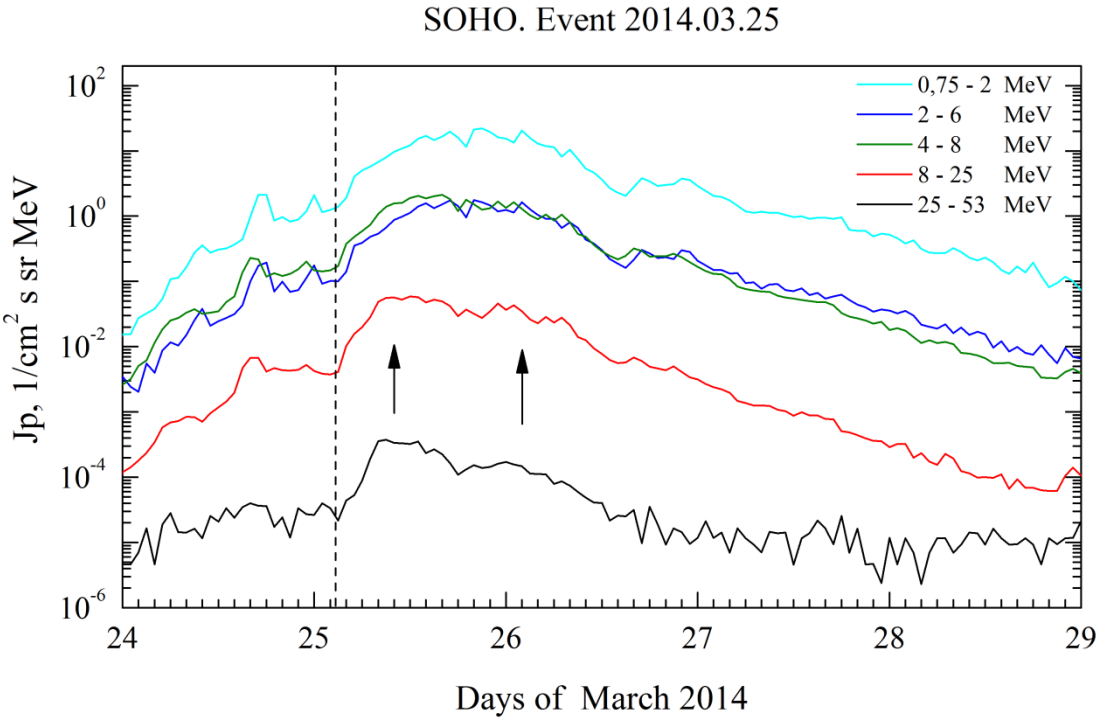

Integral spectrum of protons. Event 2013.03.25
Max 1
γ = 3.2
0.1 GCR
Eqm = 35 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

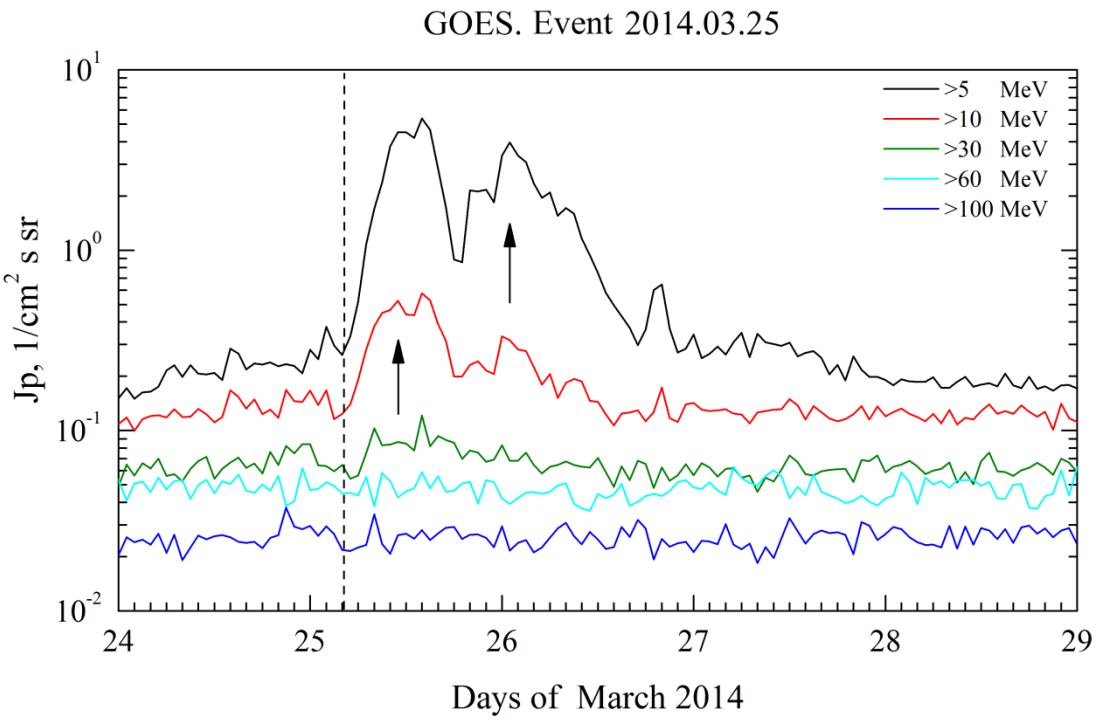

Integral spectrum of protons. Event 2014.03.25
Max 2
γ = 4.0
0.1 GCR
Eqm = 25 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

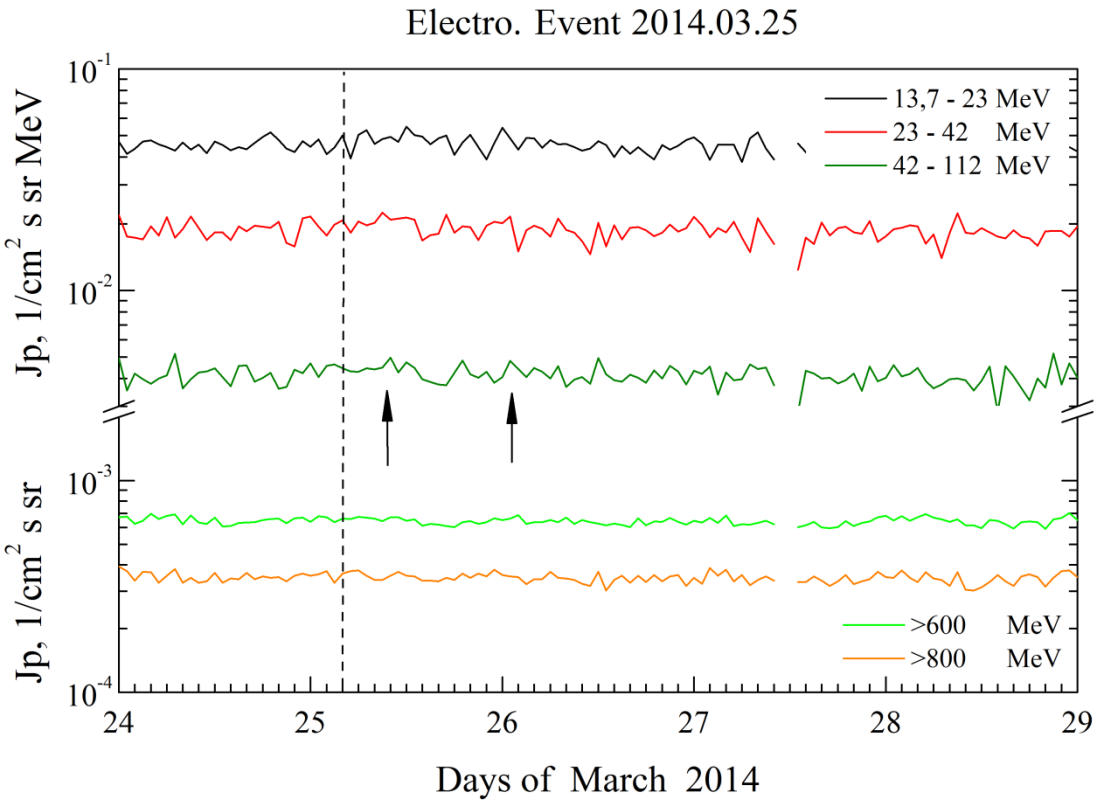
Time profiles of proton fluxes in the event 2014.03.25

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



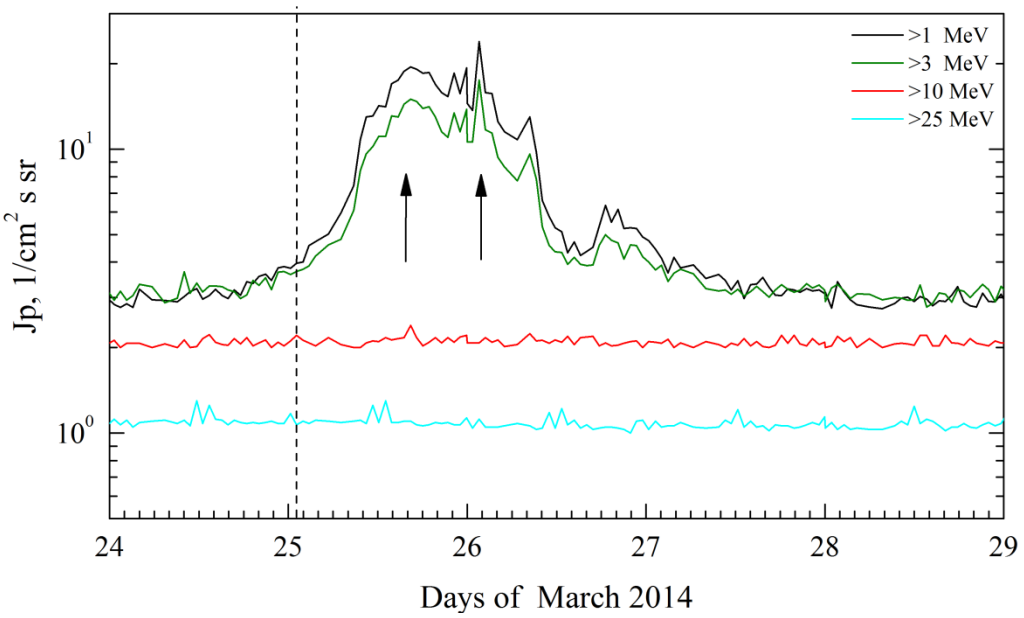



GOES. Event 2014.03.25
Jp, 1/cm² s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of March 2014

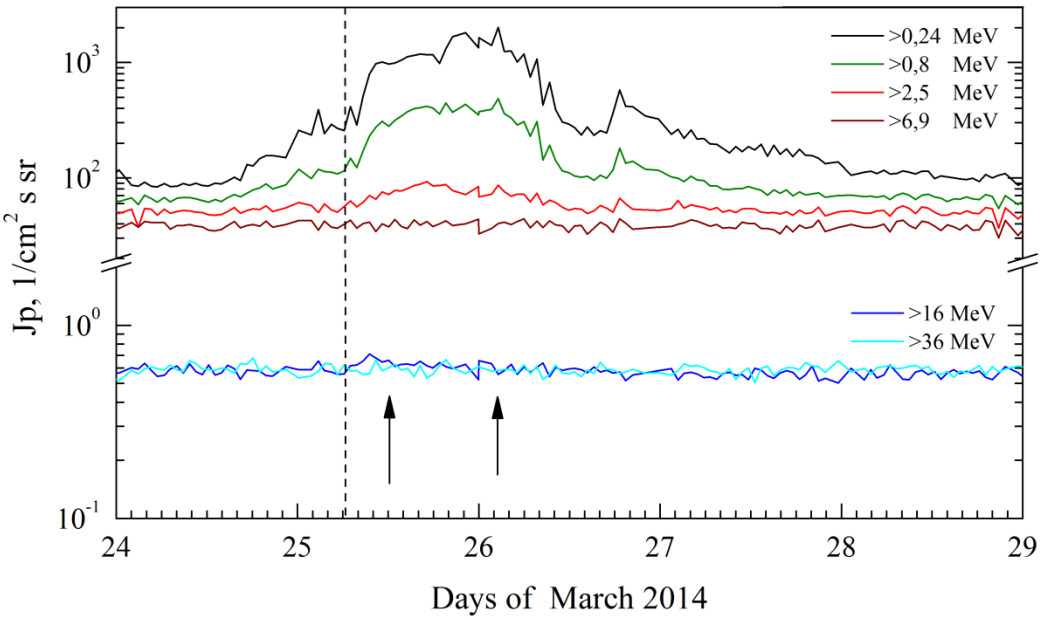

Electro. Event 2014.03.25
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of March 2014

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2014.03.25



POES. Event 2014.03.25



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 March 25

2014 March 25 ⊡ AR XXXX To event 554

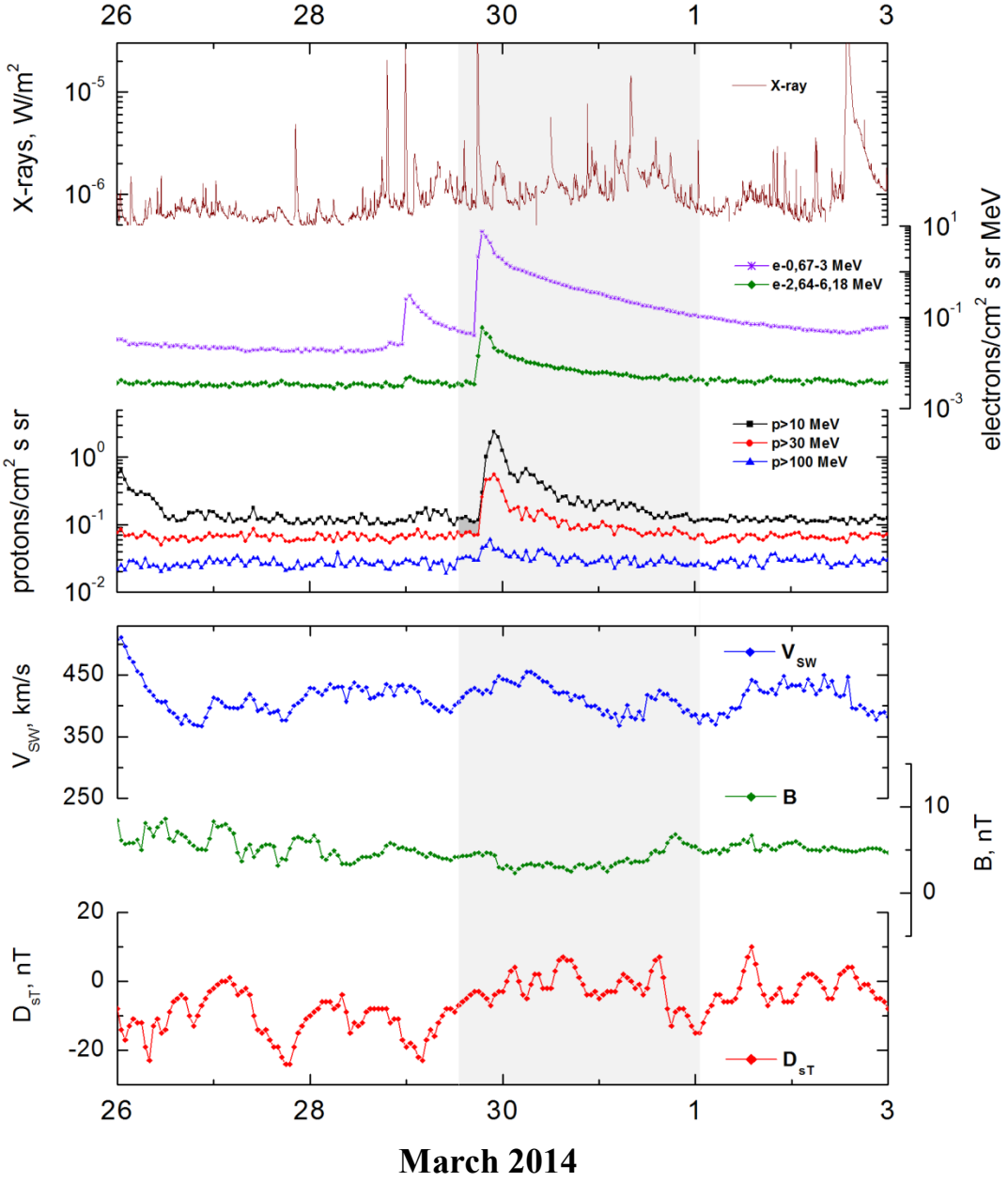
Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	No optical flare on visible solar disc						
1 – 12	No soft X-ray event on visible solar disc						
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS III		0207		0207		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0536	651	3.4	223°	269°	SOHO

Particle event: To(Ep>10 MeV) – 29d18^{h}
Tmax(Ep>10 MeV) – 29d22^{h}. Jmax(Ep>10 MeV) – 1.4 /cm^2·s·sr
Duration of the event – 1 day. power-law index: γ = 2.3
Quasimaximal energy of protons in the event – Eqm = 130 MeV

Sources: ● solar flare 29d17^{h}35^{m}, X1.0/2B, N11W32, AR12017
Main burst X-ray 1–8 Å: onset – 29d17^{h}35^{m}, max – 29d17^{h}48^{m}, Φ = 0.042 J/m^2
CME 29d18^{h}12^{m}, V = 528 km/s, Δφ = 360º, dA=325º

Particle fluxes and associated phenomena

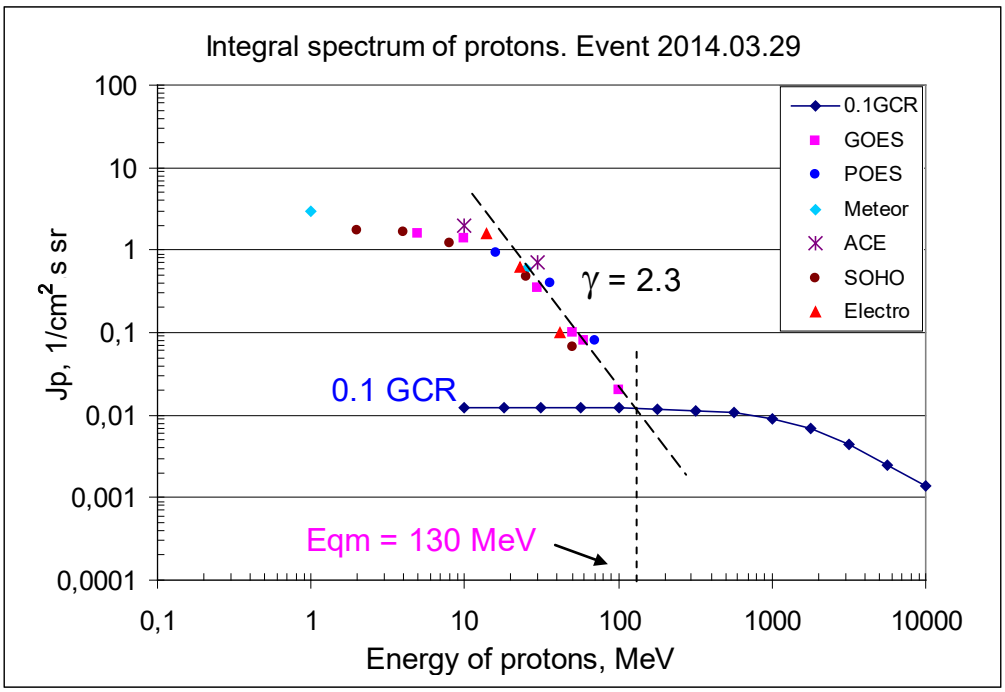


Integral fluxes of protons for the event of 2014 March 29

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	23	1.6	1	0.2	
EPS	>10	18	22	1.4	1	0.12	
EPS	>30	18	22	0.35	1	0.07	
EPS	>50	18	22	0.1	1	0.06	
EPS	>60	18	22	0.08	1	0.05	
EPS	>100	18	21	0.02	1	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES-15							
MEPED	>0.24	-	-	-	-	90	
MEPED	>0.8	-	-	-	-	70	
MEPED	>2.5	-	-	-	-	50	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	18	21	0.92	0.5	0.6	
MEPED	>36	18	21	0.4	0.5	0.65	
MEPED	>70	18	21	0.08	0.5	0.75	
MEPED	>140	-	-	-	-	0.9	
Meteor-1							
SCR	>1	18	21	2.9	1	2.9	
SCR	>3	18	-	-	1	3.1	
SCR	>10	18	-	-	0.5	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	18	21	0.6	0.5	1.1	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	18	20	2	1	1	
SIS	>30	18	20	0.7	1	0.7	
SOHO							
EPHIN	>50	18	19	0.066	3	0.2	

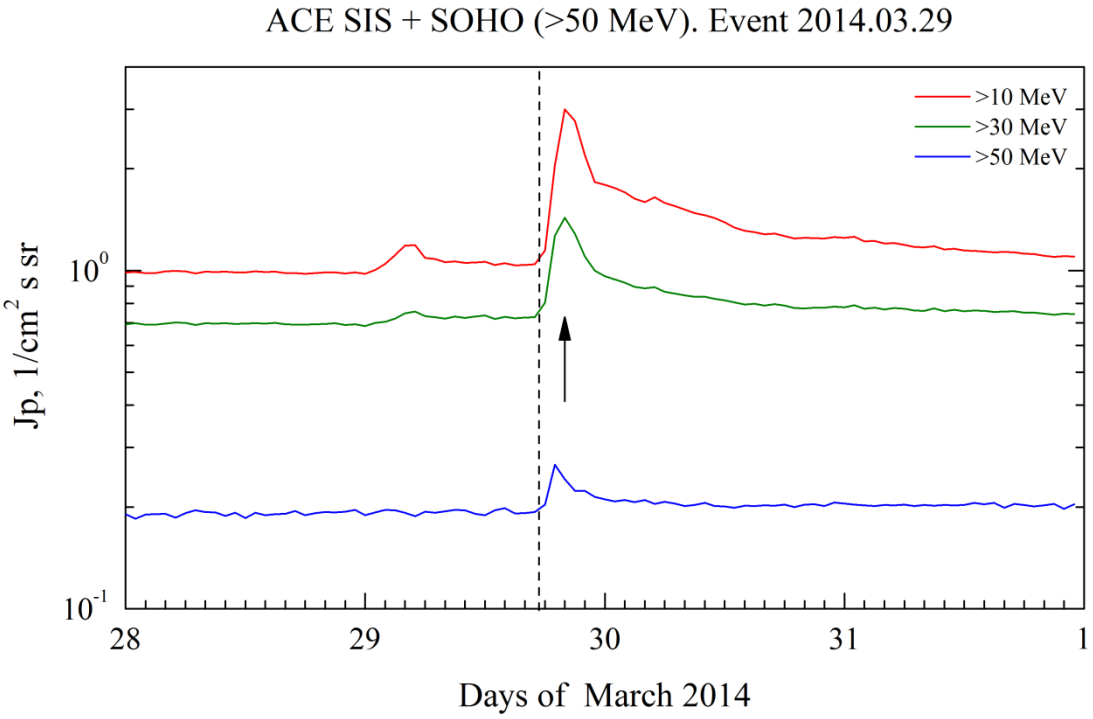
Differential fluxes of protons for the event of 2014 March 29

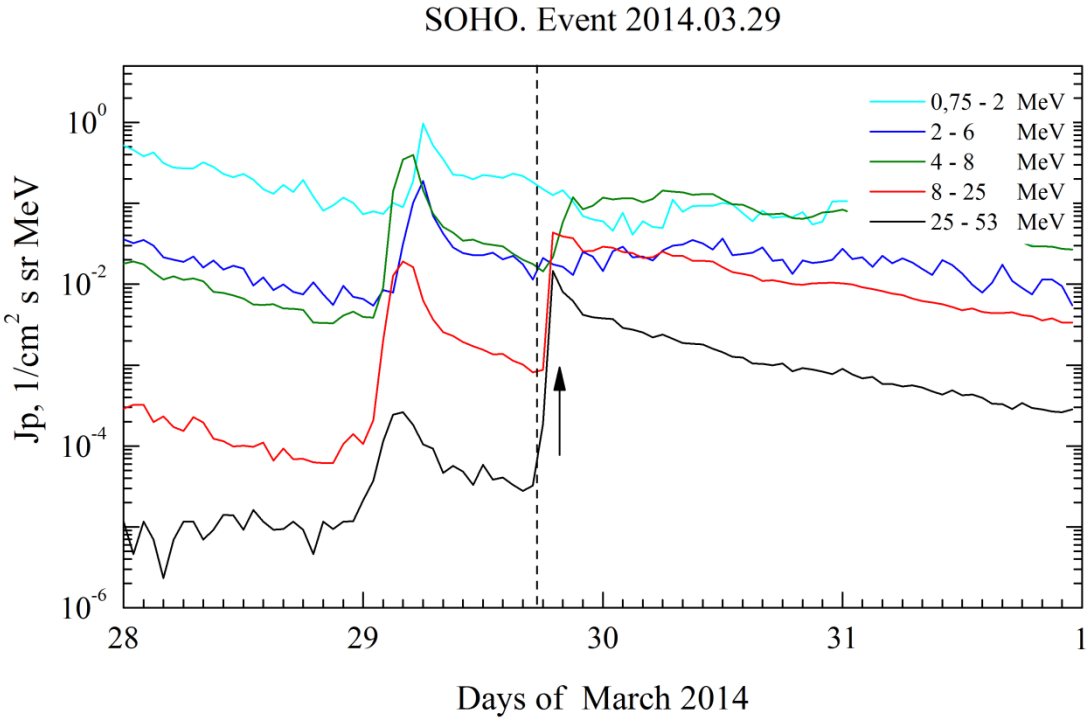
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	0.015	
LION	2 – 6	17	18	0.018	-	0.003	
EPHIN	4 – 8	19	21	0.116	2.3	0.003	
EPHIN	8 – 25	18	19	0.0435	2.3	0.00012	
EPHIN	25 – 53	17	19	0.0146	2.3	0.000014	
Electro-1							
SCR-E	13.7–23	18	21	0.1	0.5	0.045	
SCR-E	23–42	18	21	0.028	0.5	0.02	
SCR-E	42–112	18	21	0.0014	0.5	0.004	


Integral spectrum of protons. Event 2014.03.29
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.3
0.1 GCR
Eqm = 130 MeV

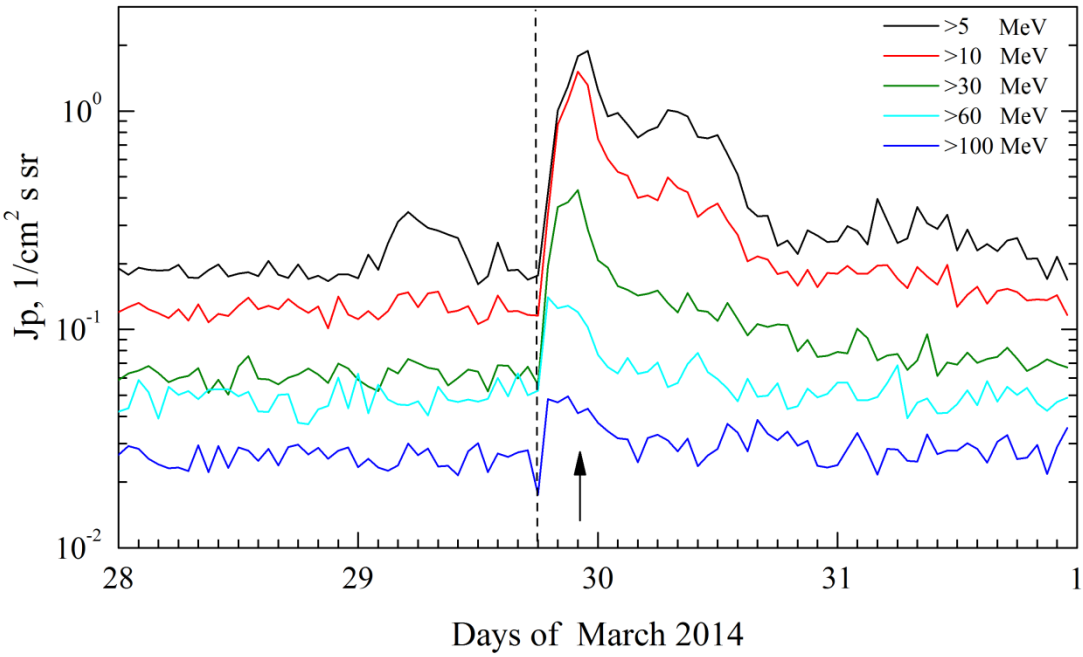
Time profiles of proton fluxes in the event 2014.03.29

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

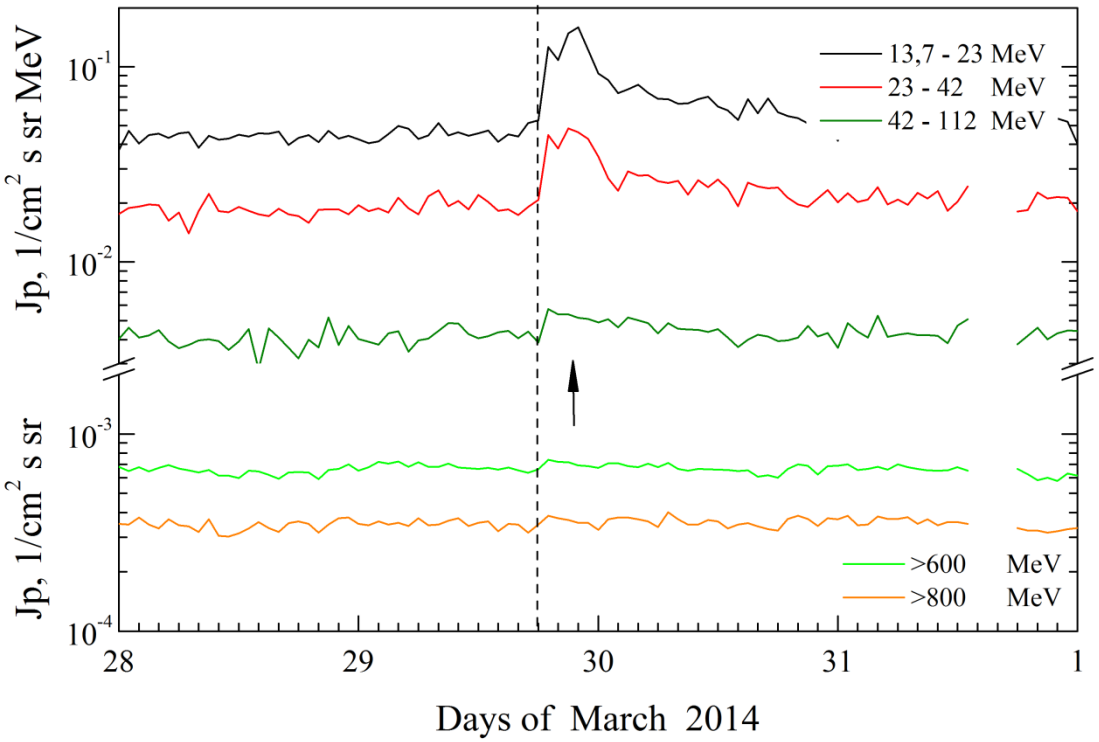




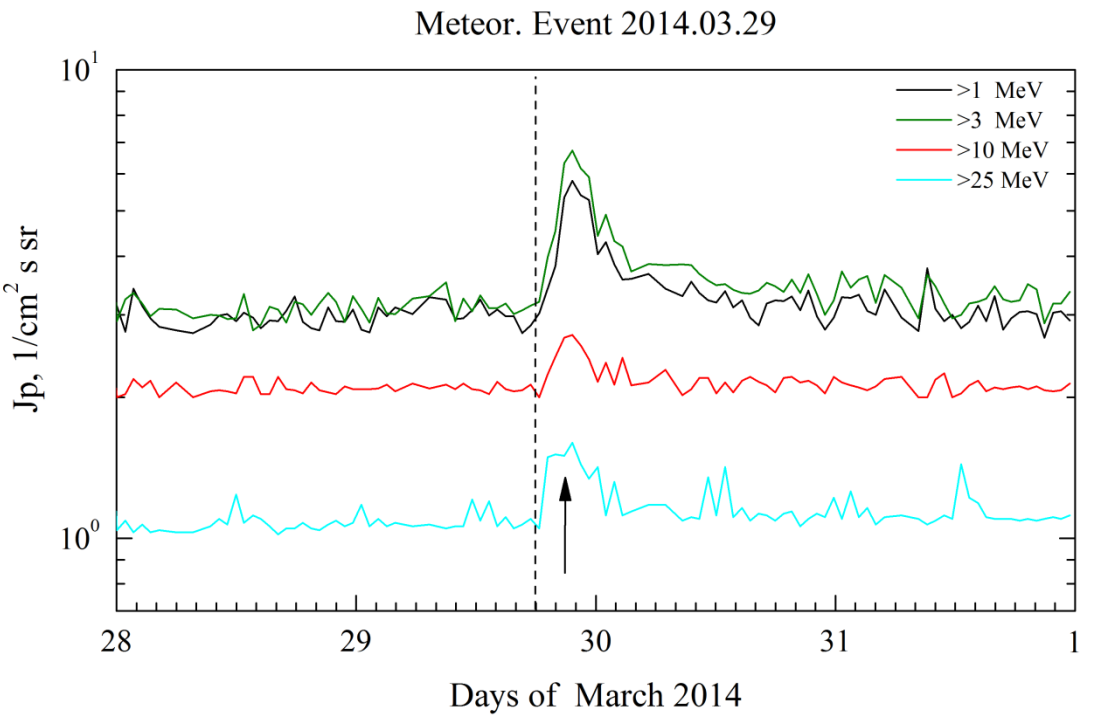
GOES. Event 2014.03.29

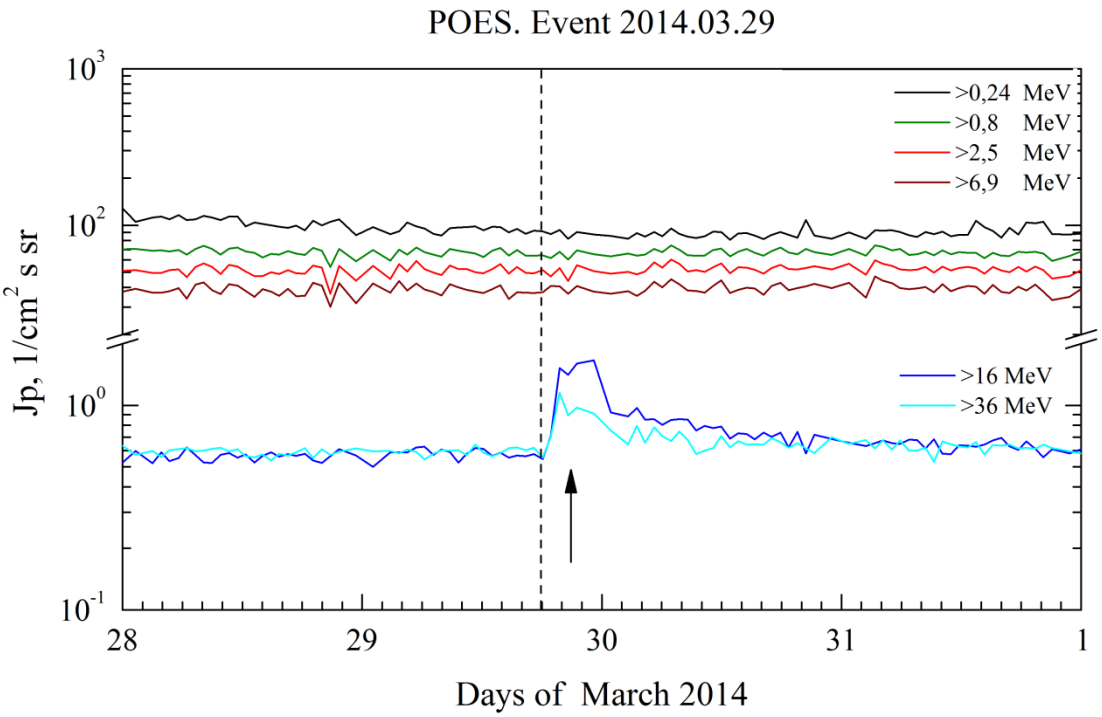


Electro. Event 2014.03.29



Earth satellites in polar orbit. R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 March 29

2014 March 29 ● AR 12017 To event 555

Hα. X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1738	1746	1816	N11W32	2B	ERU
1 – 12	keV	1735	1748	1754	N10W32	X1.0	0.042

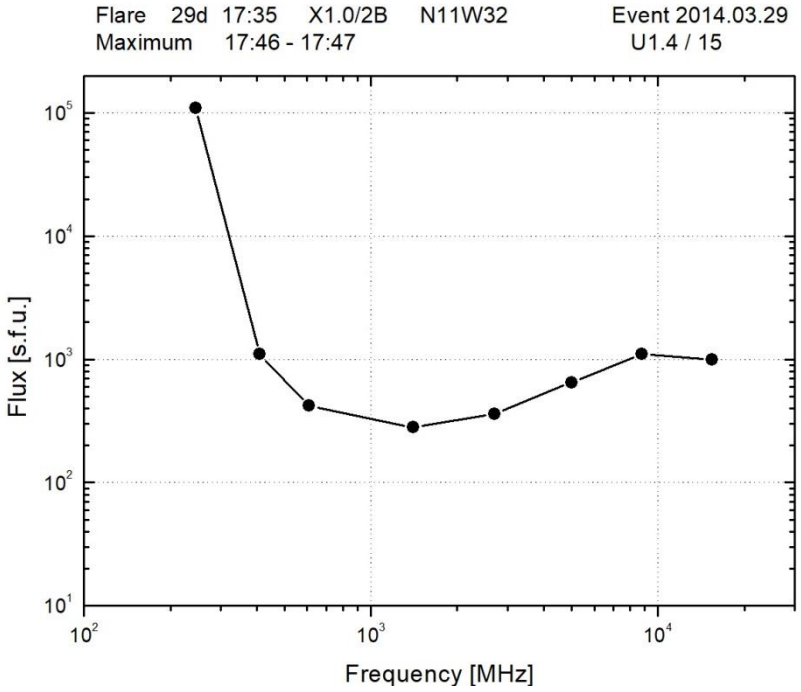
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12 – 25	keV	1739:06	1739:43	1741:01	2087	25410	FERMI
100-300	keV	1735:28	1747:18	1814:36	7017	13089182	HESSI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1745	1746	1748	U1.4 / 15	3.0	
8.8	GHz	1745	1746	1749		3.04	
5	GHz	1745	1747	1748		2.81	
2.7	GHz	1745	1746	1748		2.56	
1.4	GHz	1745	1746	1219		2.45	
610	MHz	1745	1746	1748		2.62	
410	MHz	1745	1747	1749		3.04	
245	MHz	1745	1747	1751		5.04	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	1753		1801		3	
DS III	25-180	1745		1749		3	
DH II	0.2-14	1759		30d/0958			WIND

CME		**UT**	**V,** km/s	**A,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1812	528	- 4.1	360˚	325˚	SOHO

Radio burst frequency spectrum



Proton Active Region

AR12017* (N11L142; CMP 27.05.2014;
Sp=160 msh; DAO; BGD; R1)
XRI= 1.68 $X_1^{1.0}$+$M_3^{2.6}$+C_{19} 2_1+1_2+S_{18}
PFR 28-30.03 (40^h) $X_1^{1.0}$+$M_3^{2.6}$
*Sunspot 22.03 – 1.04. 2014 only

References:

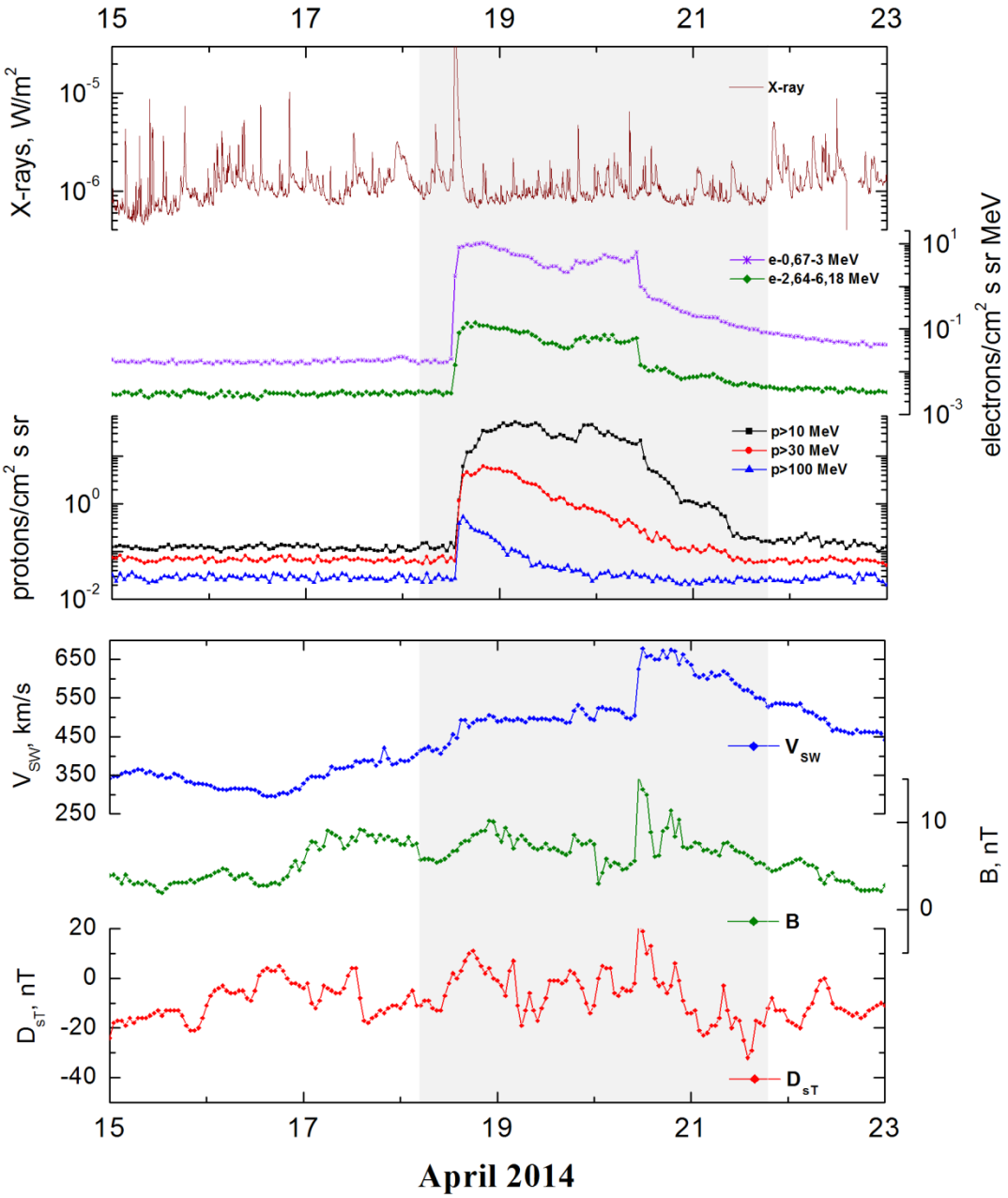
Богомолов Э.А., Адриани О., Базилевская Г.А. и др., 2017.
Bučík R., S.M. Mulay, G.M. Mason et al., 2021.

Event 2014.04.18 – (2014-108) **556**

Particle event: To(Ep>10 MeV) – 18d14^{h}
Tmax(Ep>10 MeV) – 18d16^{h}, Jmax(Ep>10 MeV) – 11.8 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ = 2.3
Quasimaximal energy of protons in the event – Eqm = 500 MeV

Sources: ● solar flare 18d12^{h}31^{m}, M7.3/, S20W34, AR12036
Main burst X-ray 1–8 Å: onset – 18d12^{h}31^{m}, max – 18d13^{h}03^{m}, Φ = 0.11 J/m^2
CME: 18d13^{h}25^{m}, V = 1203 km/s, Δφ = 360°, dA= 238°
▲ SC 19d18^{h}36^{m}; ▲ SC 20d10^{h}56^{m}

Particle fluxes and associated phenomena

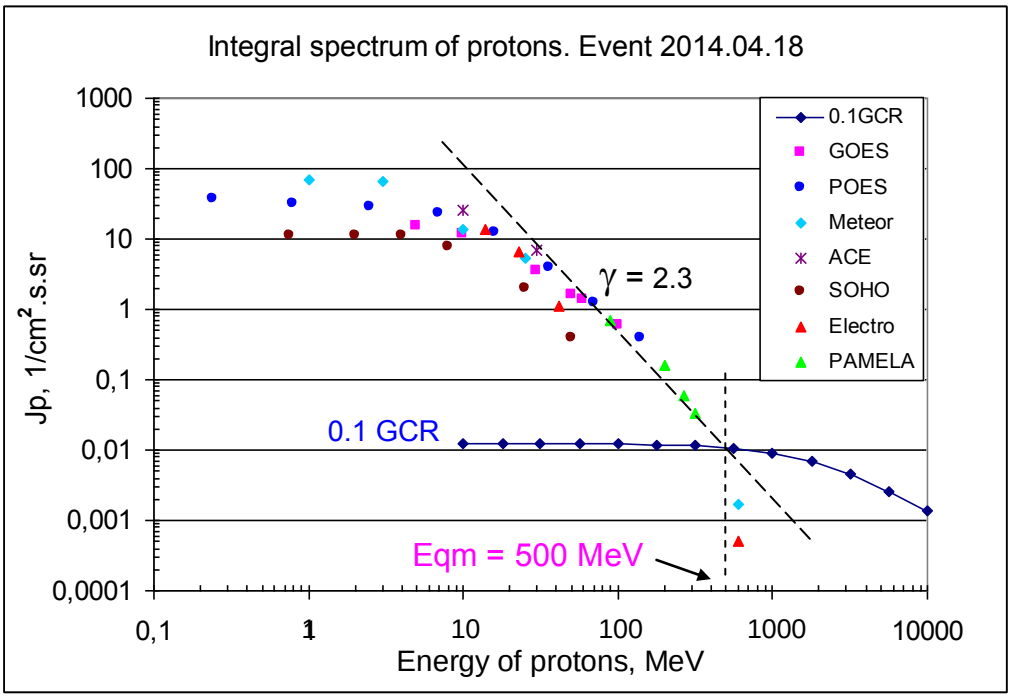


Integral fluxes of protons for the event of 2014 April 18

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration days	Back-ground	Comments
GOES							
EPS	>5	14	16	15	3.5	0.2	
EPS	>10	14	16	11.8	3	0.12	
EPS	>30	14	16	3.5	2	0.07	
EPS	>50	14	15	1.6	1.5	0.06	
EPS	>60	14	15	1.4	1.5	0.05	
EPS	>100	14	15	0.6	1	0.03	
Electro-1							
GALS-E	>600	13	15	0.0005	1	0.0007	
GALS-E	>800	13	15	0.00014	1	0.0004	
GALS-E	>1100	-	-	-	-	0.00002	
POES							
MEPED	>0.24	14	16	37	3	90	
MEPED	>0.8	14	16	32	3	70	
MEPED	>2.5	14	16	29	2	55	
MEPED	>6.9	14	16	22.7	2	40	
MEPED	>16	14	16	12.5	2	0.6	
MEPED	>36	14	16	3.8	1.5	0.65	
MEPED	>70	14	16	1.25	1	0.75	
MEPED	>140	14	16	0.4	0.5	0.9	
Meteor-1							
SCR	>1	13	20	70	3.5	2.9	
SCR	>3	13	20	66	3	3.1	
SCR	>10	13	20	14	2	2.1	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	13	14	5.3	2	1.1	
GALS-M	>600	3	14	0.0017	0.25	0.02	
ACE							
SIS	>10	13	18	26	2.5	1	
SIS	>30	13	17	7	2.5	0.7	
PAMELA							
TRACKER	>90	13	14	0.69	>2	-	
TRACKER	>200	13	14	0.16	>2	-	
TRACKER	>265	13	14	0.06	>2	-	
TRACKER	>312	13	14	0.033	>2	-	
SOHO							
EPHIN	>50	15	16	0.4	2	0.2	

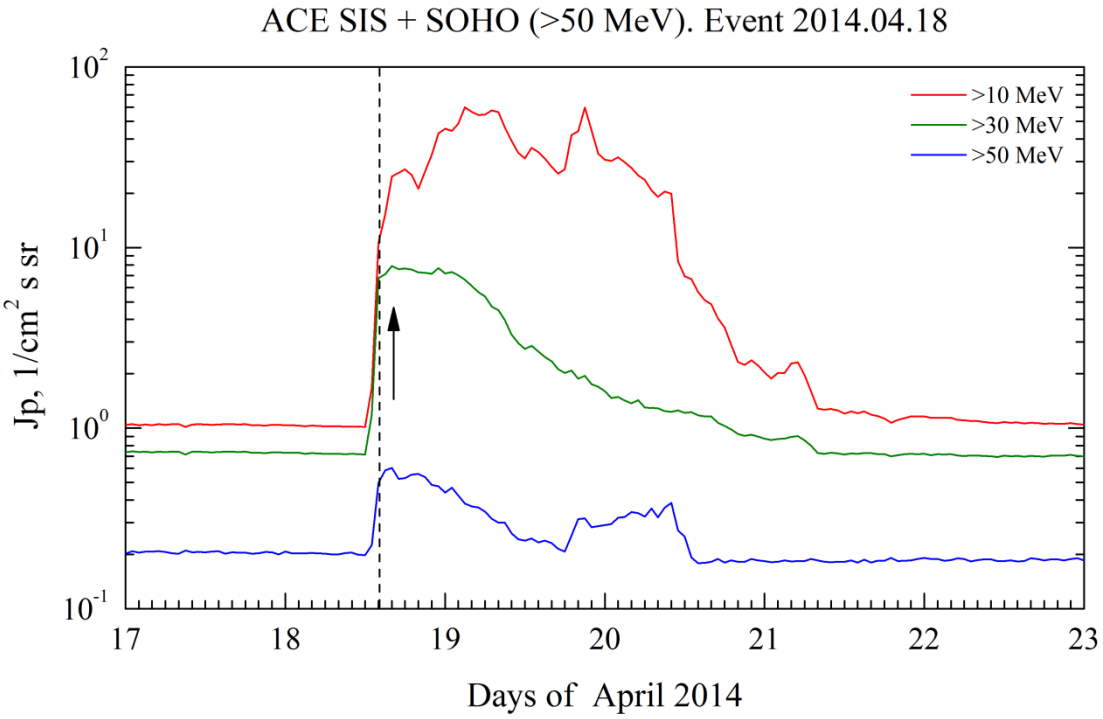
Differential fluxes of protons for the event of 2014 April 18

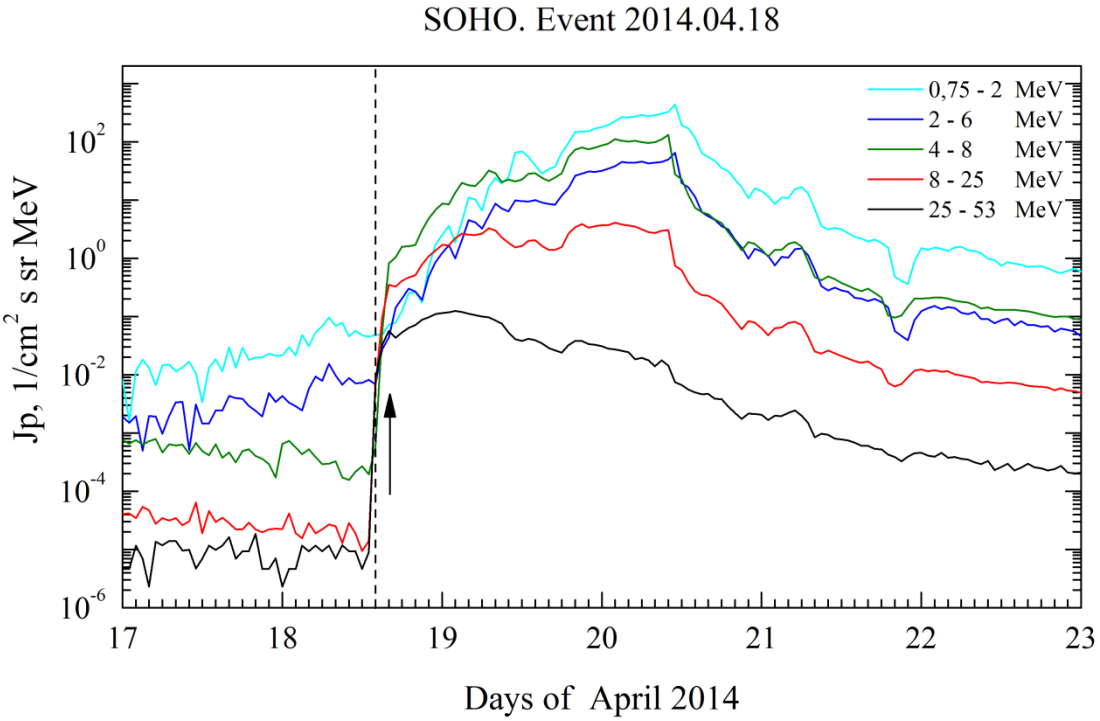
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	14	16	0.04	4	0.03	
LION	2 – 6	14	16	0.005	4	0.005	
EPHIN	4 – 8	14	16	0.8	4	0.005	
EPHIN	8 – 25	14	16	0.34	3	0.0003	
EPHIN	25 – 53	14	16	0.055	3	0.00003	
Electro-1							
SCR-E	13.7–23	13	15	0.75	2.5	0.05	
SCR-E	23–42	13	15	0.28	2	0.02	
SCR-E	42–112	13	15	0.016	1	0.004	



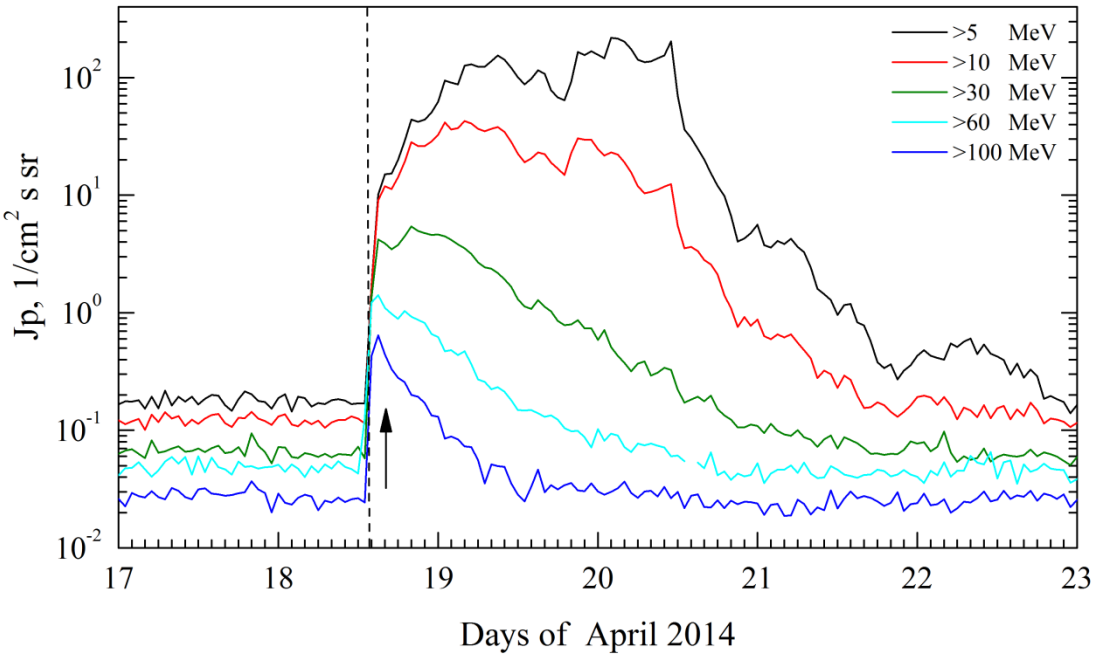
Time profiles of proton fluxes in the event 2014.04.18

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

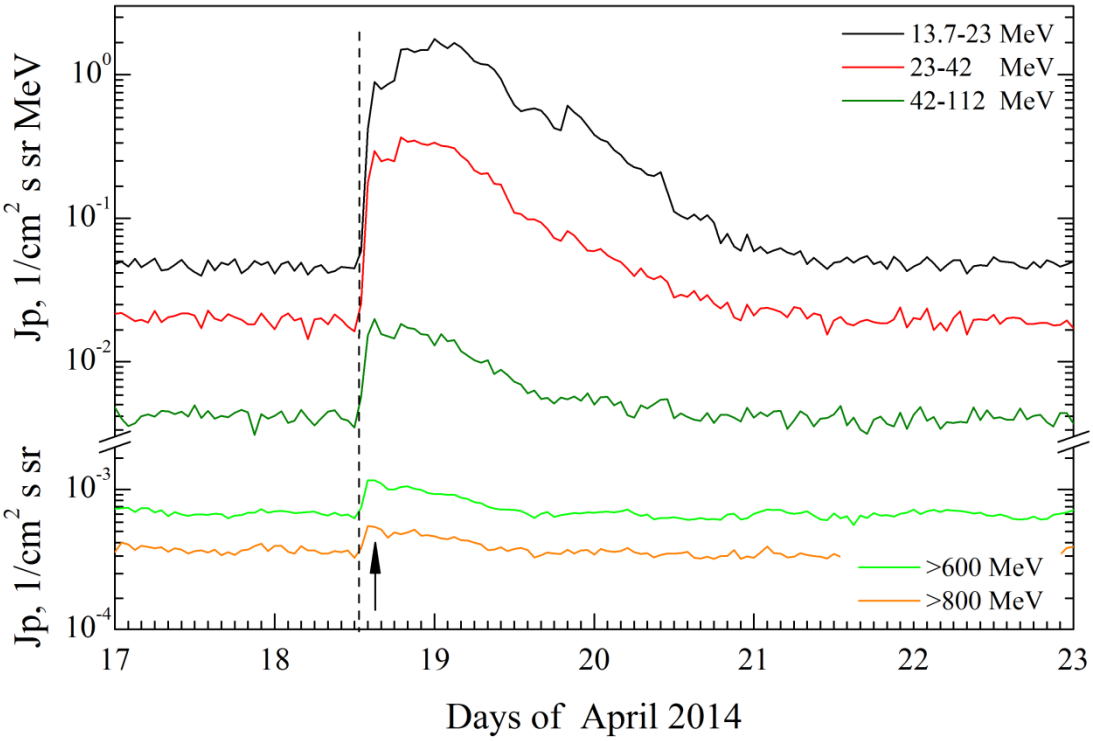




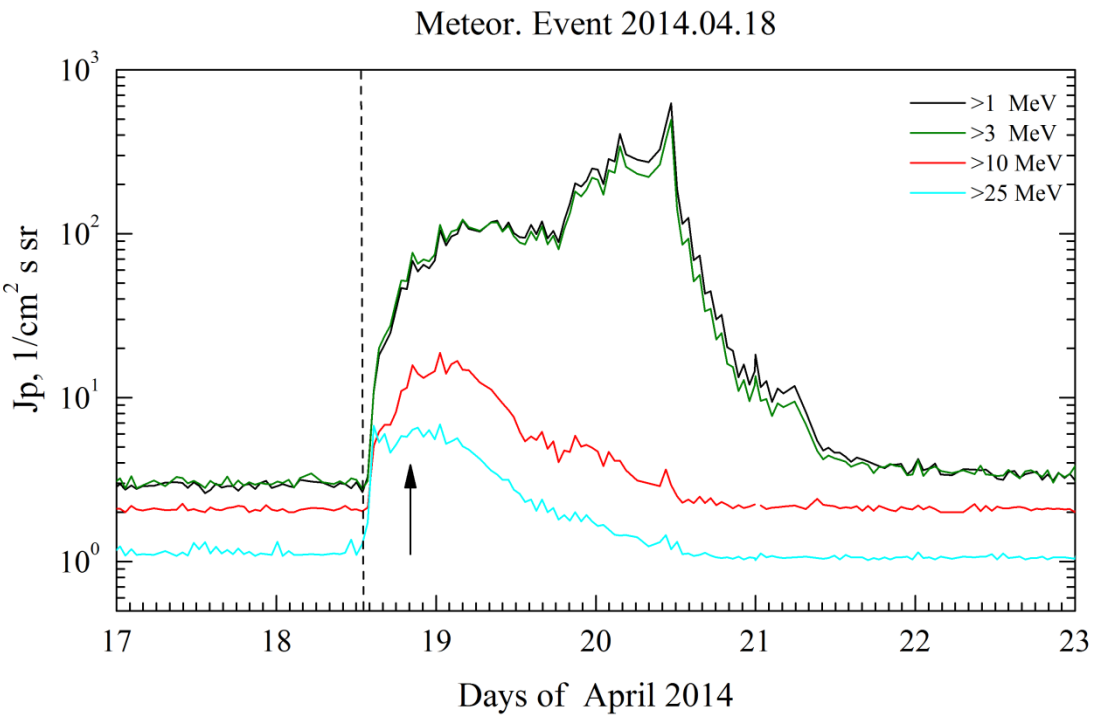
GOES. Event 2014.04.18

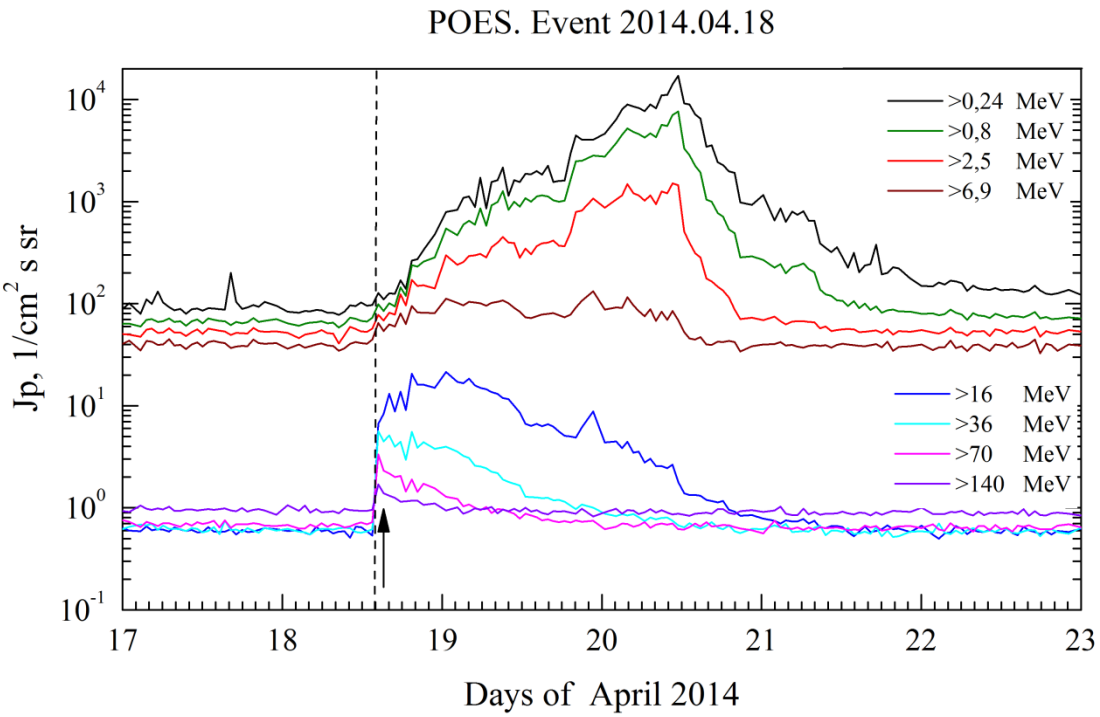


Electro. Event 2014.04.18



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 April 18

2014 April 18 ● AR12036 To event 556

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	No optical flare on visible disk					
1 – 12	keV	1231	1303	1320	S20W34	M7.3	0.11

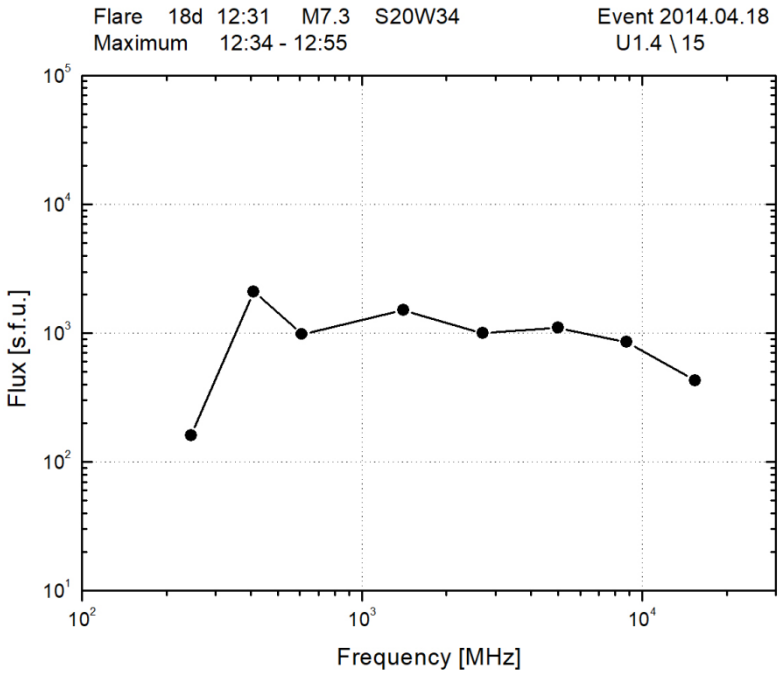
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1234:04	1234:29	1235:5	1896	27508	FERMI
12-25	keV	1236:07	1255:24	1307:50	268408	132936416	FERMI
50-100	keV	1250:08	1255:50	1313:40	2416	13137984	HESSI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1249	1255	1310	U1.4 \ 15	2.63	
8.8	GHz	1245	1254	1316		2.93	
5	GHz	1246	1254	1310		3.04	
2.7	GHz	1243	1255	1307		3.0	
1.4	GHz	1244	1248	1306		3.18	
610	MHz	1245	1250	1300		2.99	
410	MHz	1246	1255	1301		3.22	
245	MHz	1234	1234	1234		2.2	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-172	1255		1314	769	2	
DS IV	25-180	1242		2014		2	
DS III	25-81	1227		1232		1	
DS V	25-180	1234		1236		2	
DS VI	25-180	1243		1257		2	
DS CTM	74-129	1142		1243		1	
DH II	4-14	1520		1602			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1325	1203	13.5	360˚	238˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR12036 (S17L246, CMP 15,9.04.2014,
Sp=510 msh, DKC, BG, R)
XRI=0.73 $M_1^{7.3}$+C_{28} 1_1+S^{26}
PFR 18.04 $M_1^{7.3}$

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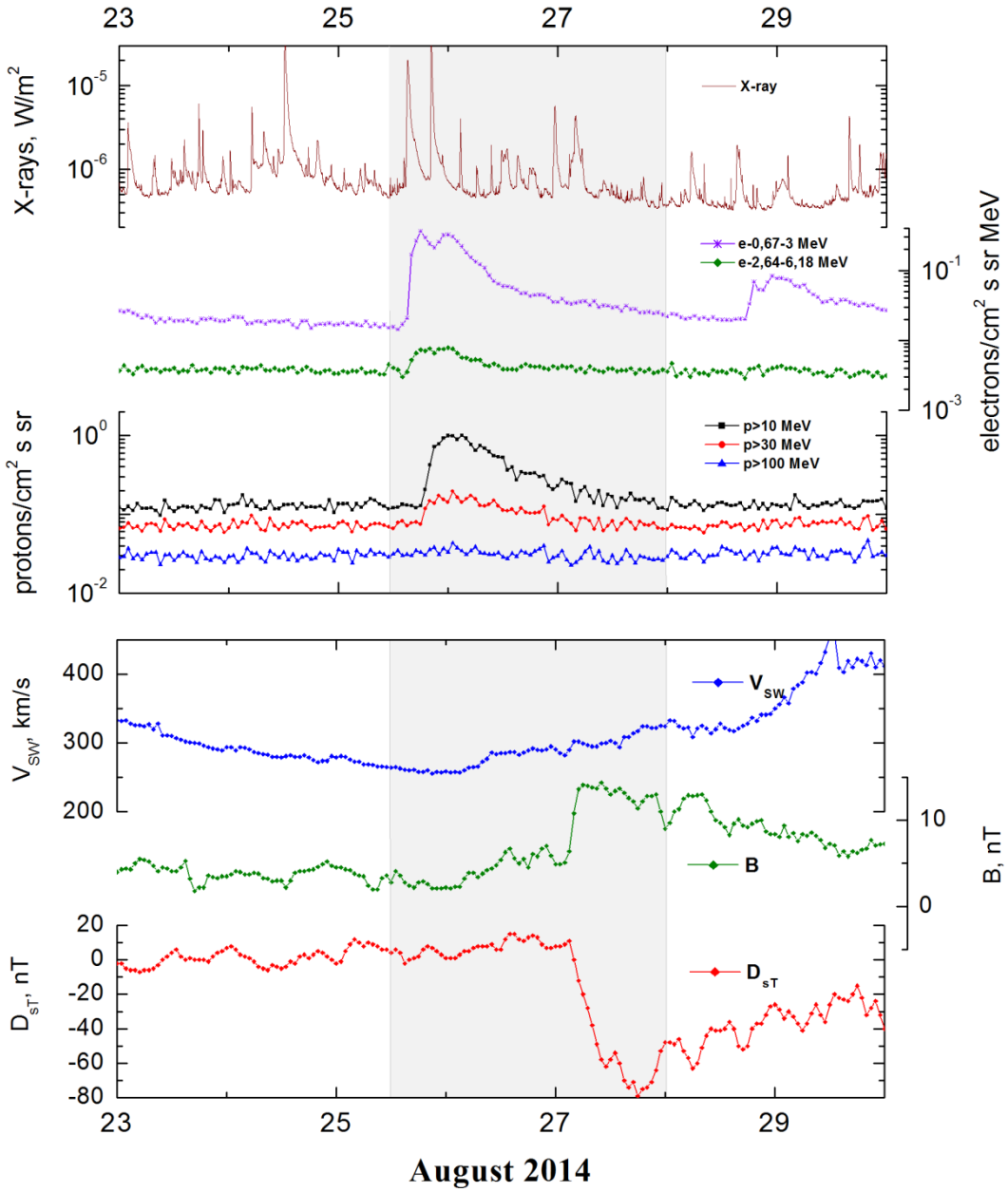
Zhuang B., N. Lugaz, T. Gou, L. Ding, 2021.

Particle event: To(Ep>10 MeV) – 25d18^{h}
Tmax(Ep>10 MeV) – 26d00^{h}, Jmax(Ep>10 MeV) – 1.3 /cm^{2}·s·sr (ACE)
Duration of the event – 1.5 days, power-law index: $\gamma = 2.3$
Quasimaximal energy of protons in the event – Eqm = 75 MeV

Sources: ● solar flare 25d14^{h}46^{m}, M2.0/1B, N05W36, AR12146
Main burst X-ray 1–8 Å: onset – 25d14^{h}46^{m}, max – 25d15^{h}11^{m}, $\Phi = 0.032$ J/m^{2}
CME: 25d15^{h}36^{m}, V = 555 km/s, $\Delta\varphi = 360°$, dA= 270°

Particle fluxes and associated phenomena

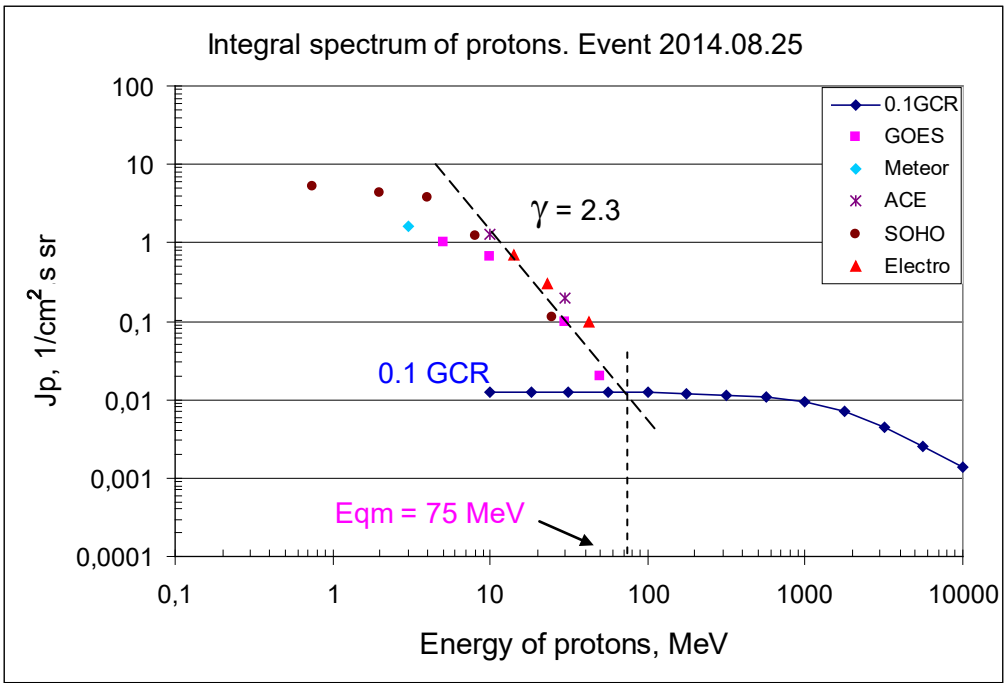


Integral fluxes of protons for the event of 2014 August 25

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	26d01	1	2	0.2	
EPS	>10	18	26d00	0.7	1.5	0.12	
EPS	>30	18	26d00	0.1	1	0.07	
EPS	>50	18	26d00	0.02	1	0.06	
EPS	>60	18	-	-	-	0.05	
EPS	>100	18	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
Meteor-1							
SCR	>1	18	-	-	2	2.75	
SCR	>3	18	26d02	1.65	2	2.85	
SCR	>10	-	-	-	-	1.85	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	-	-	-	-	1.2	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	16	22	1.3	1	1	
SIS	>30	16	22	0.2	1	0.7	
SOHO							
EPHIN	>50						

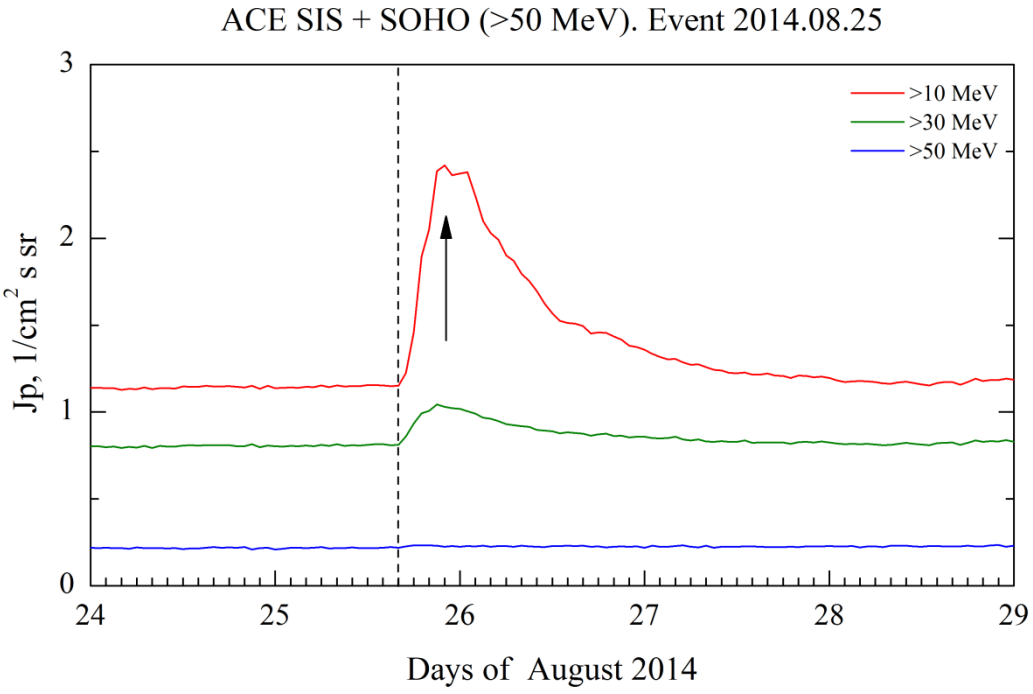
Differential fluxes of protons for the event of 2014 August 25

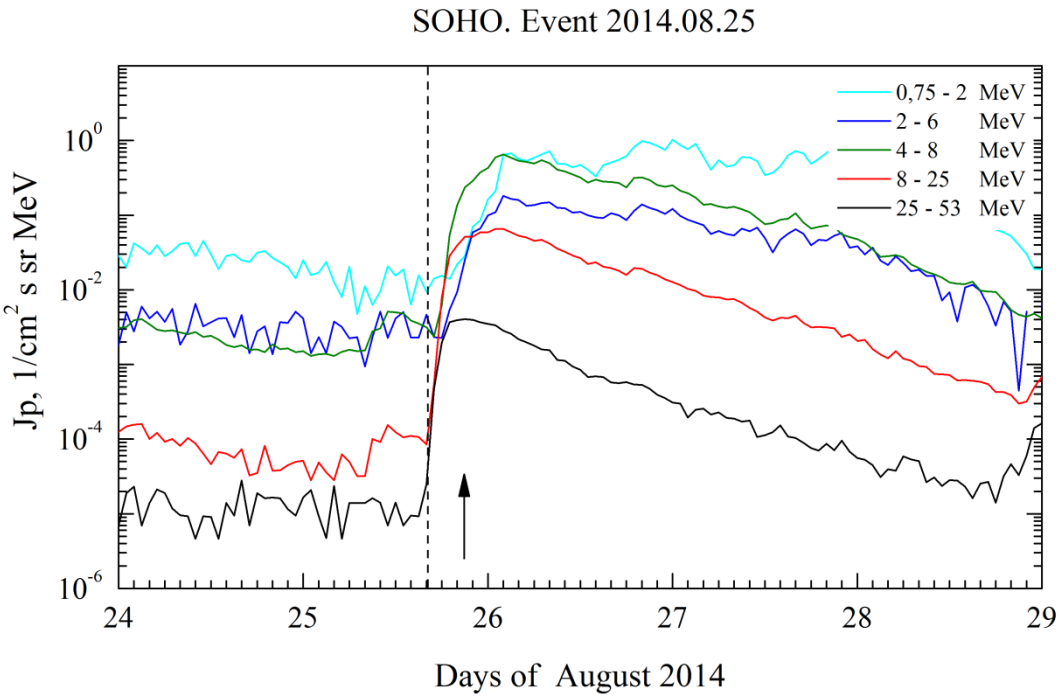
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	20	26d02	0.65	3	0.02	
LION	2 – 6	19	26d02	0.18	3	0.002	
EPHIN	4 – 8	18	26d02	0.65	3	0.0015	
EPHIN	8 – 25	17	26d01	0.065	3	0.0001	
EPHIN	25 – 53	16	21	0.004	3	0.00001	
Electro							
SCR-E	13.7–23	17	21	0.04	0.5	0.05	
SCR-E	23–42	17	21	0.01	0.5	0.02	
SCR-E	42–112	18	21	0.0015	0.5	0.004	


Integral spectrum of protons. Event 2014.08.25
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
γ = 2.3
0.1 GCR
Eqm = 75 MeV
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro

Time profiles of proton fluxes in the event 2014.08.25

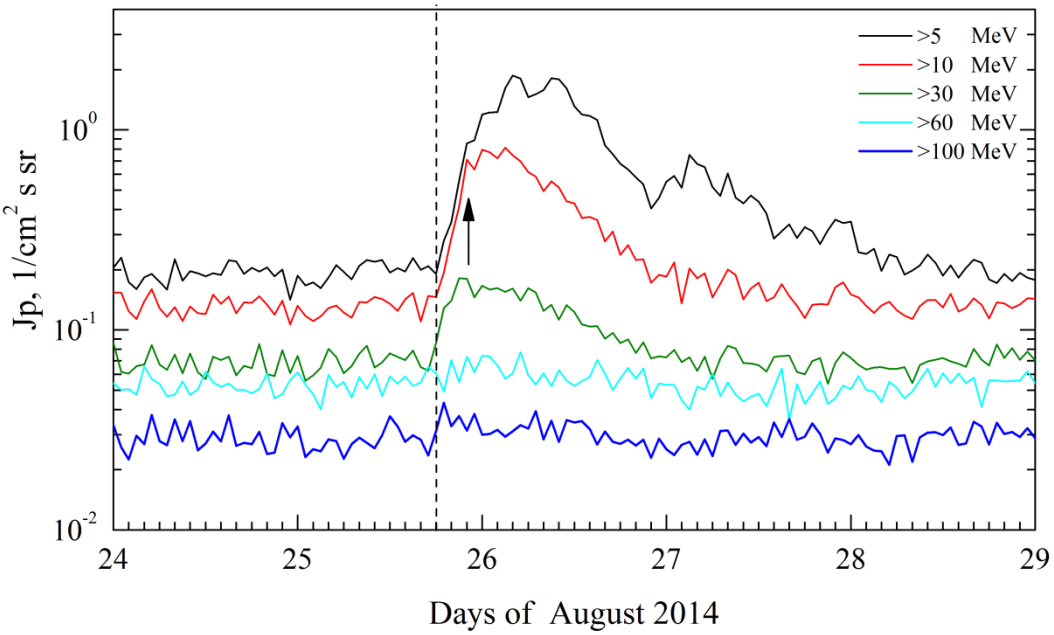
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



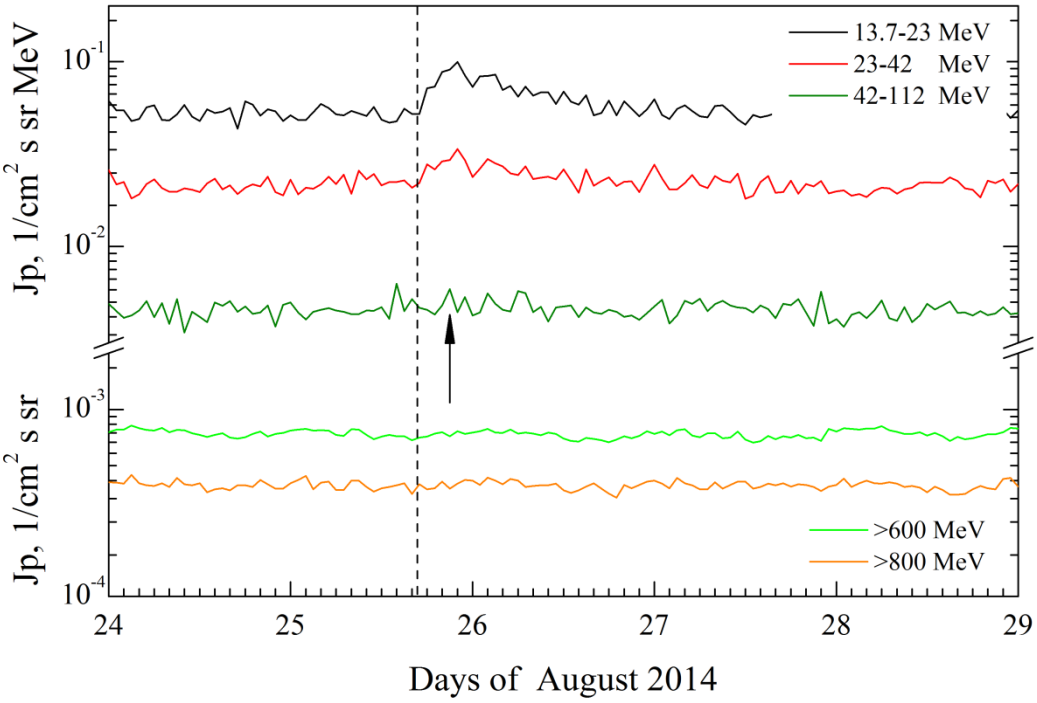


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro

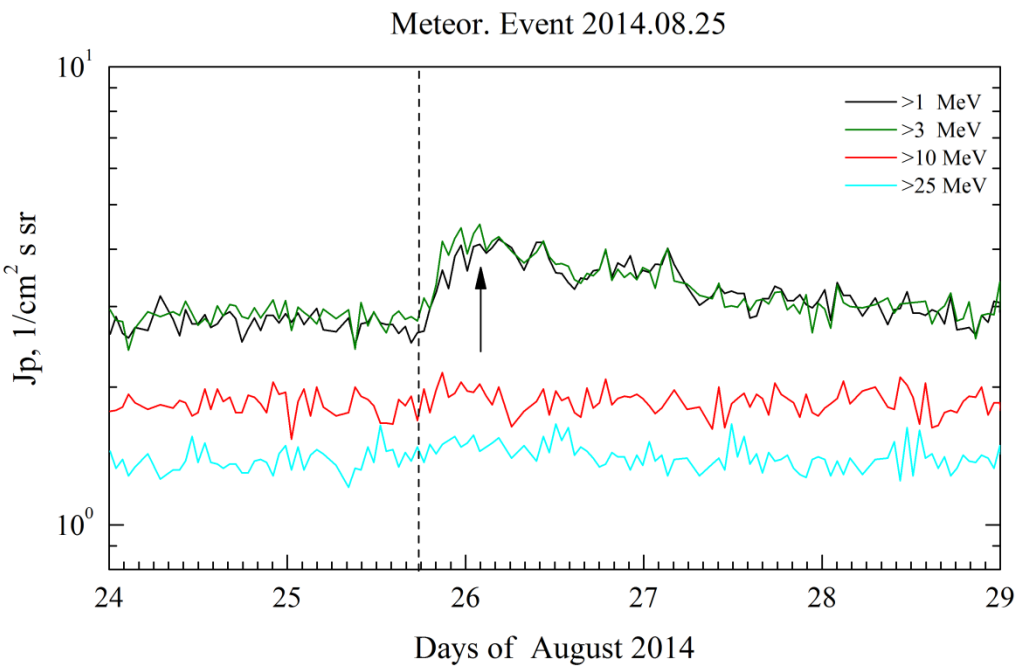
GOES. Event 2014.08.25



Electro. Event 2014.08.25



Earth satellites in polar orbit, R = 800÷1000 km: Meteor



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 August 25

2014 August 25 • AR 12146 To event 557

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1452	1504	1639	N05W36	1B	ERU
1 – 12	keV	1446	1511	1531	N06W39	M2.0	0.032

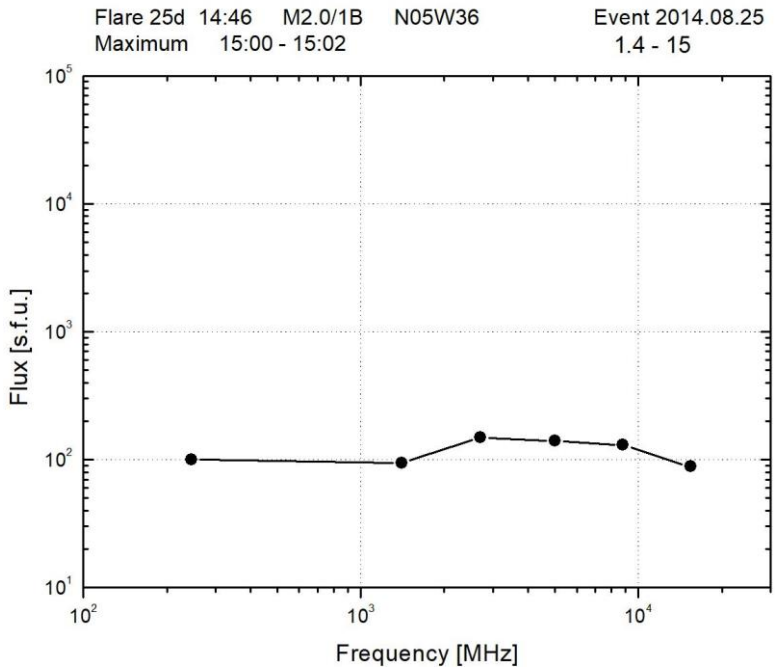
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1456:53	1505:26	1512:16	37277	17642164	FERMI
12-25	keV	1521:32	1521:41	1545:38	6479	551944	FERMI
25-50	keV	1443:28	1504:54	1513:08	1008	255625	HESSI
25-50	keV	1548:56	1549:38	1633:52	135	70141	HESSI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1500	1502	1209	1.4 – 15	1.94	
8.8	GHz	1500	1501	1212		2.11	
5	GHz	1500	1501	1210		2.15	
2.7	GHz	1500	1501	1216		2.18	
1.4	GHz	1500	1501	1219		1.97	
245	MHz	1500	1500	1220		2.0	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS VI		1437		1504		1	
DS II	25-82	1508		1527	707	2	
DS IV	30-80	1518		1721		1	
DH II	4-14	1520		1602			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1536	555	- 12.2	360˚	270˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

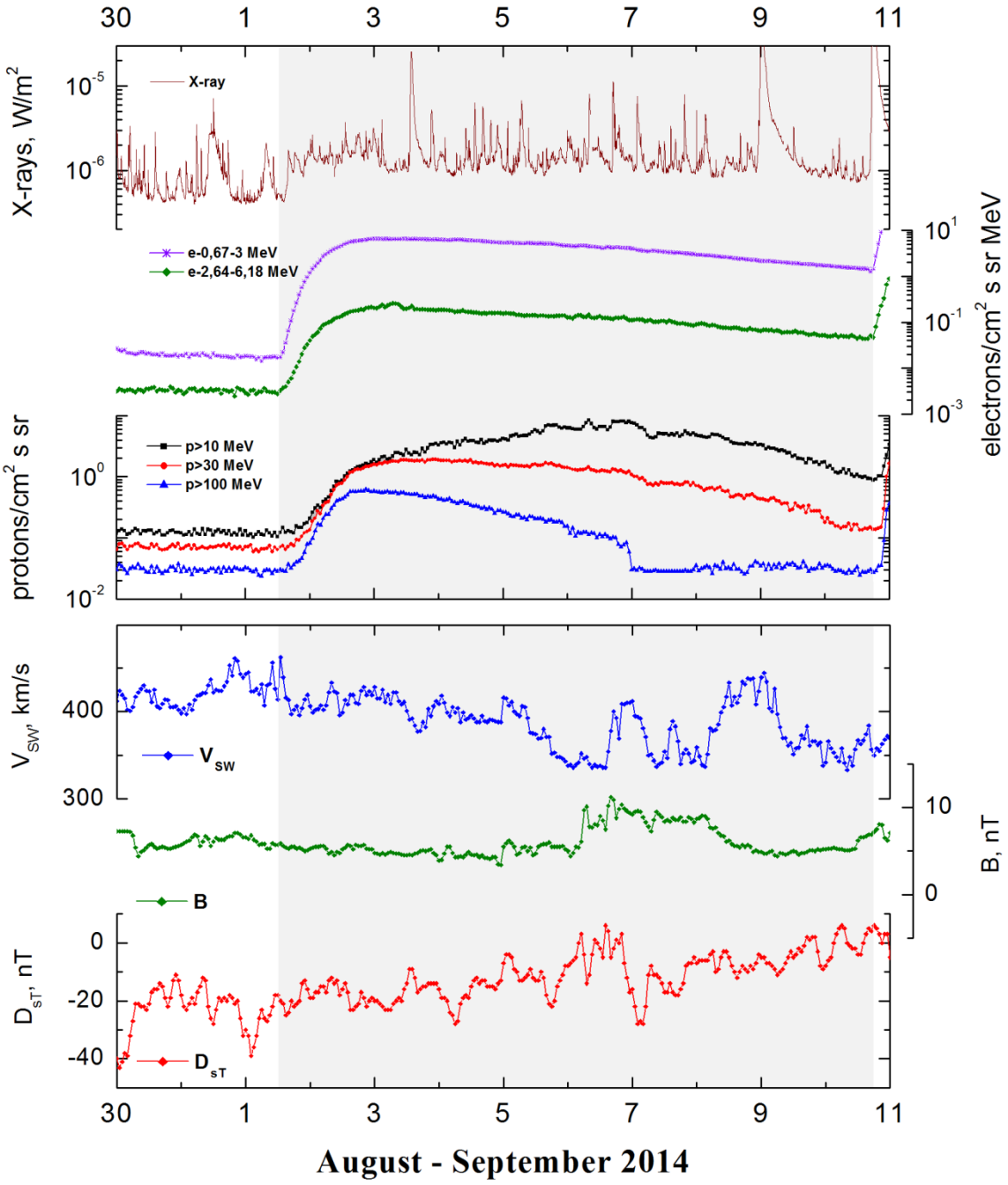
AR12146 (N09L344, CMP 22,5.08.2014,
Sp=300 msh, DKI, BGD, R)
XRI=0.59, $M_2^{3.9}$+C_{14} 1_1+S_{30}
PFR 25.08 (6^h) $M_2^{3.9}$

Event 2014.09.01– (2014-244) **558**

Particle event: To(Ep>10 MeV) – 01d18^{h}
Tmax(Ep>10 MeV) – 03d08^{h}, Jmax(Ep>10 MeV) – 2.5 /cm^{2}·s·sr
Duration of the event – 9 days, power-law index: γ = 2.2
Quasimaximal energy of protons in the event – Eqm = 700 MeV

Sources: ■ solar flare 01d10^{h}55^{m}, B6.2(~X2.4*)/, N14E126*, AR12158, 3d behind E_L
Main burst X-ray 1–8 Å: onset – 01d10^{h}55^{m}, max – 01d~11^{h}05^{m}
CME: 01d11^{h}12^{m}, V = 1901 km/s, Δφ = 360º, dA= 065º
▲ SC 06d15^{h}24^{m}
*restored data

Particle fluxes and associated phenomena

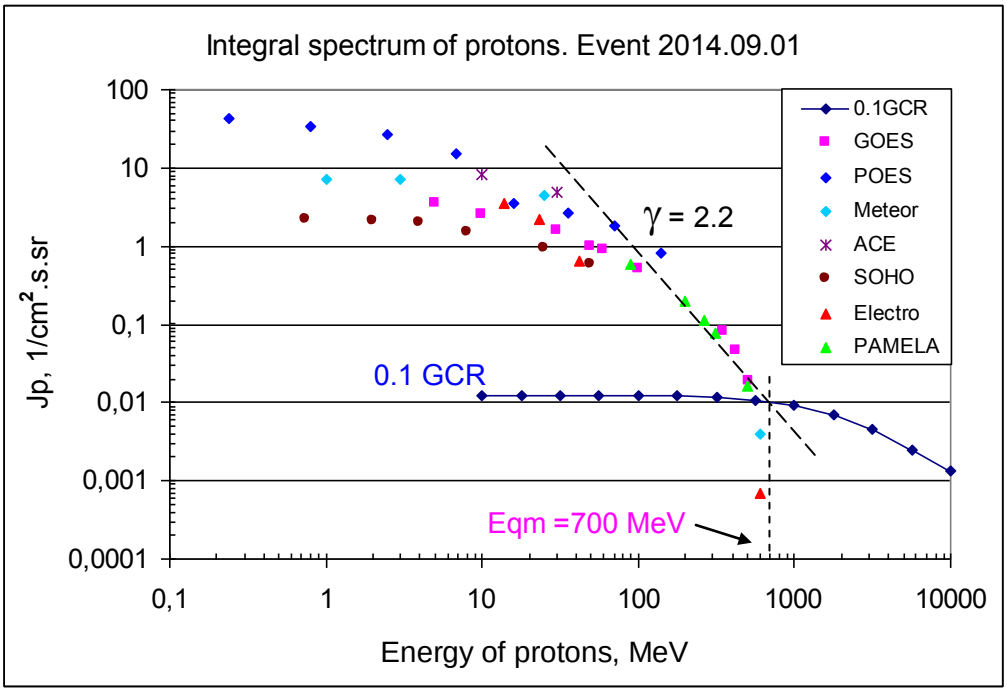


Integral fluxes of protons for the event of 2014 September 01

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	03d12	3.6	9	0.2	
EPS	>10	18	03d08	2.5	9	0.15	
EPS	>30	18	03d06	1.6	9	0.07	
EPS	>50	18	03d03	1	9	0.06	
EPS	>60	18	03d00	0.9	8	0.05	
EPS	>100	18	02d18	0.5	6	0.03	
Electro-1							
GALS-E	>600	22	02d23	0.0007	9	0.0007	
POES							
MEPED	>0.24	20	02d23	43	9	90	
MEPED	>0.8	20	02d23	34	9	70	
MEPED	>2.5	20	02d23	27	8	60	
MEPED	>6.9	20	02d23	15	8	50	
MEPED	>16	20	03d10	3.6	7	0.65	
MEPED	>36	20	03d10	2.7	7	0.7	
MEPED	>70	20	03d06	1.8	7	0.75	
MEPED	>140	20	03d04	0.8	6	1	
Meteor-1							
SCR	>1	18	03d02	7.1	9	2.75	
SCR	>3	18	03d02	7.0	9	2.85	
SCR	>10	18	-	-	7	1.85	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	18	03d02	4.4	7	1.2	
GALS-M	>600	02d02	02d24	0.004	8	0.02	
ACE							
SIS	>10	19	3d12	8.2	9	1.2	
SIS	>30	19	3d06	5	9	0.8	
PAMELA							
TRACKER	>90	17	2d10-3d17	0.58	9	-	
TRACKER	>200	17	2d10-3d17	0.2	9	-	
TRACKER	>265	17	2d10-3d17	0.11	9	-	
TRACKER	>312	17	2d10-3d17	0.076	9	-	
TRACKER	>500	17	2d10-3d17	0.016	9	-	
SOHO							
EPHIN	>50	21	03d01	0.6	8	0.2	

Differential fluxes of protons for the event of 2014 September 01

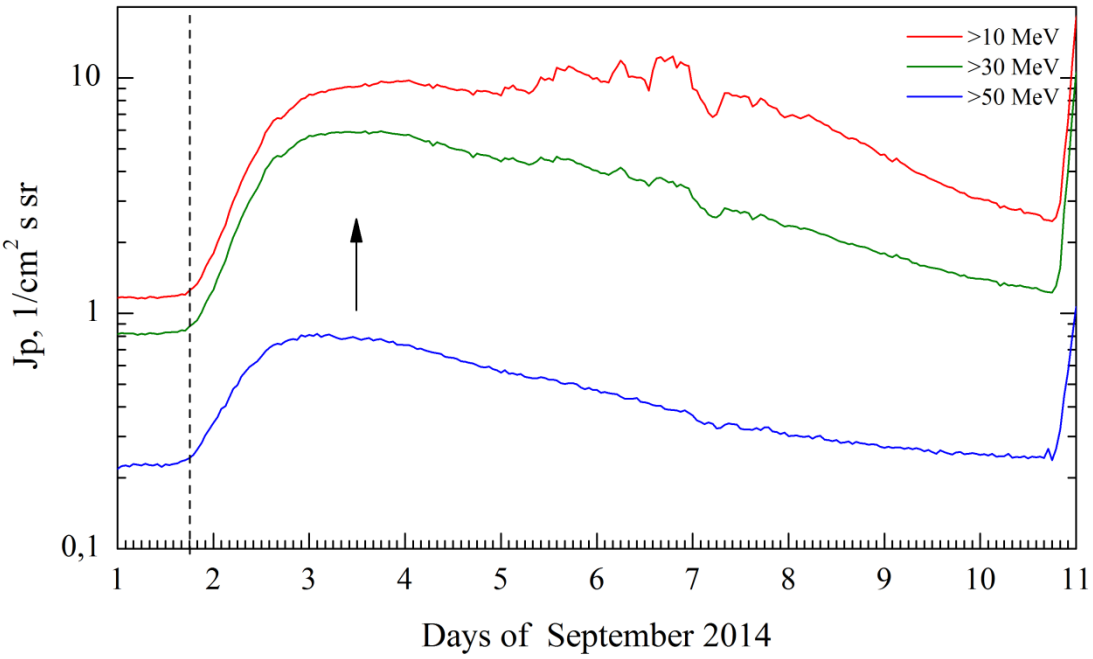
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	21	03d08	0.06	9	0.006	
LION	2 – 6	21	03d08	0.05	9	0.002	
EPHIN	4 – 8	21	03d05	0.12	9	0.001	
EPHIN	8 – 25	21	03d03	0.032	9	0.0002	
EPHIN	25 – 53	21	03d02	0.012	9	0.00003	
Electro-1							
SCR-E	13.7–23	22	02d23	0.15	9	0.05	
SCR-E	23–42	22	02d23	0.08	9	0.02	
SCR-E	42–112	22	02d23	0.009	9	0.004	
GOES							
EPS	350–420	22	02d09	0.0005	1.5	0.0016	
EPS	420–510	22	02d21	0.0003	1.5	0.0009	
EPS	510–700	-	02d20	0.0001	-	0.0004	
EPS	>700	-	-	-	-	0.0001	



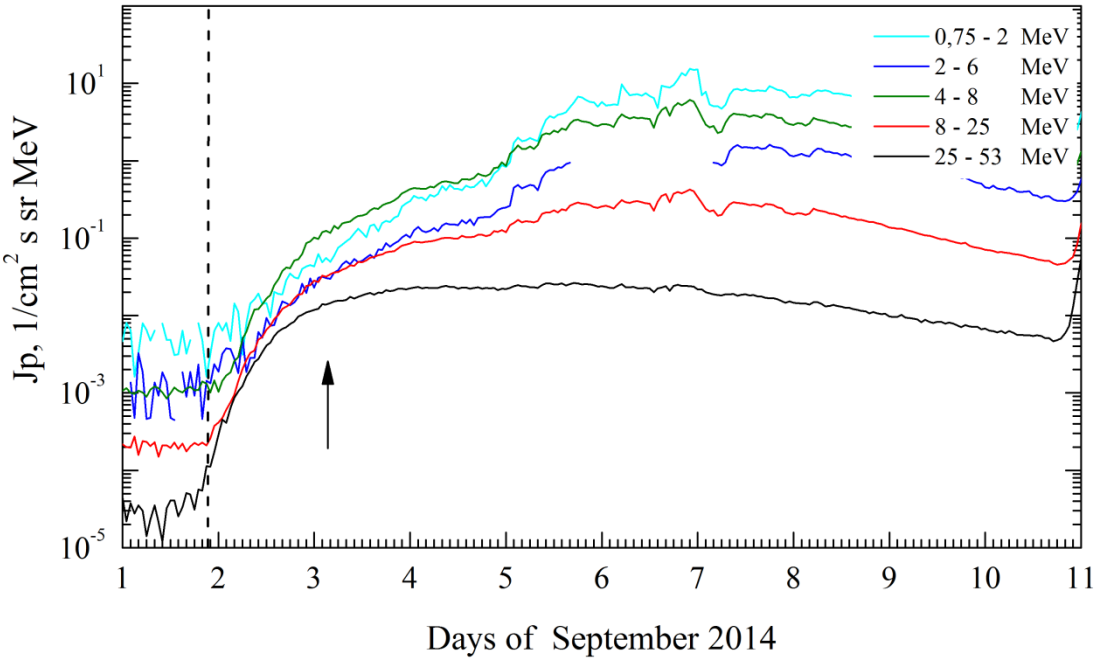
Time profiles of proton fluxes in the event 2014.09.01

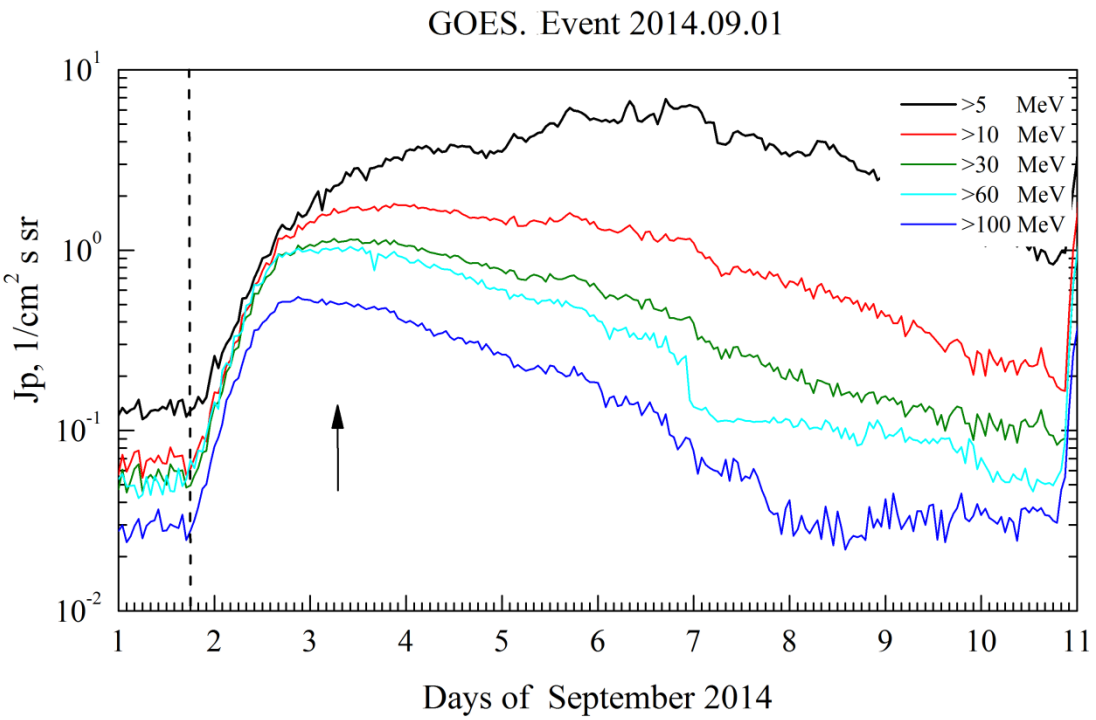
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

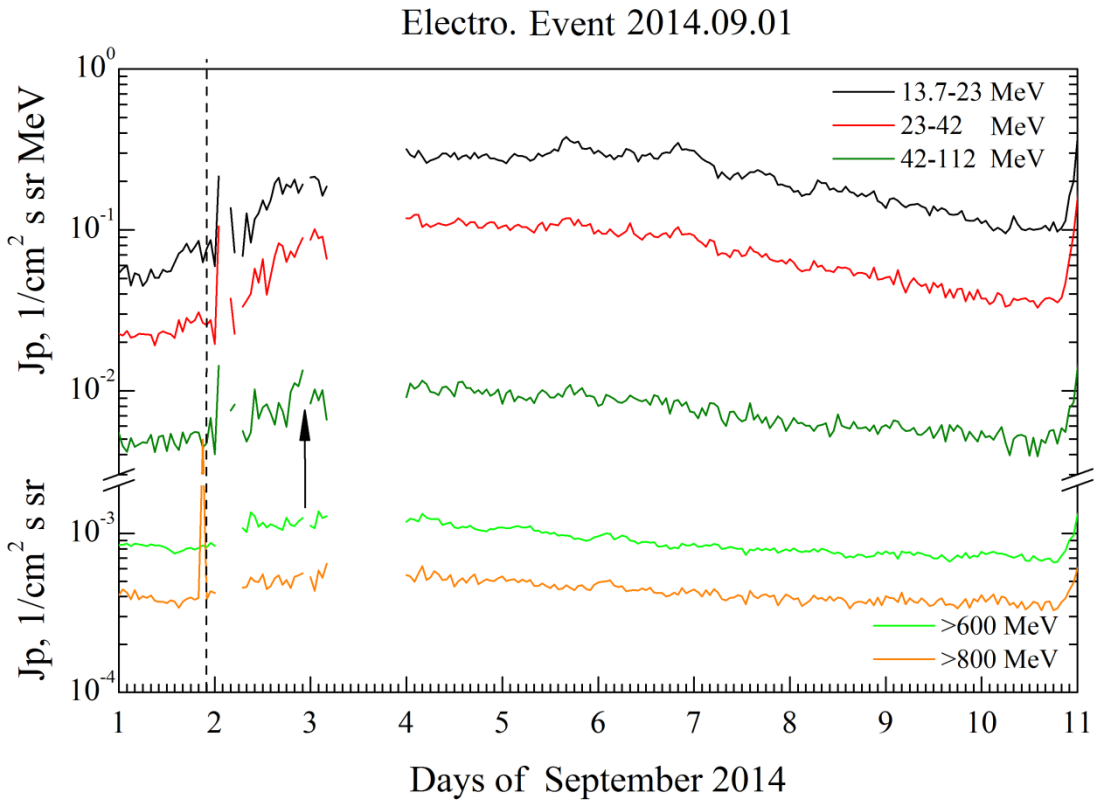
ACE SIS + SOHO (>50 MeV). Event 2014.09.01



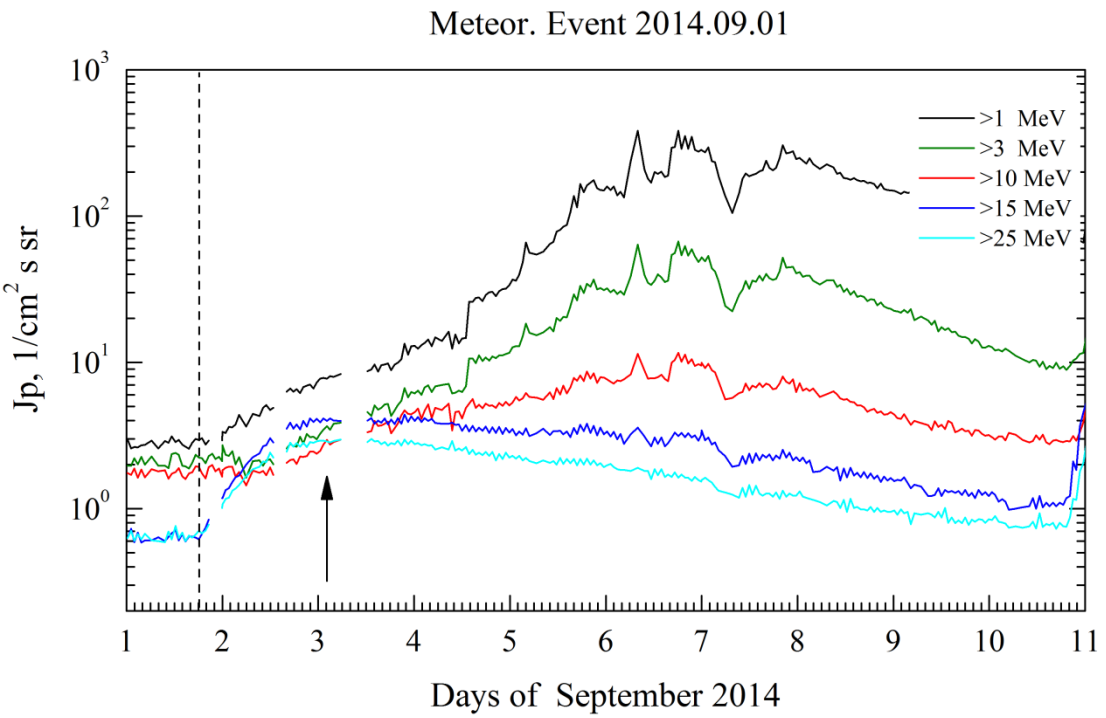
SOHO. Event 2014.09.01

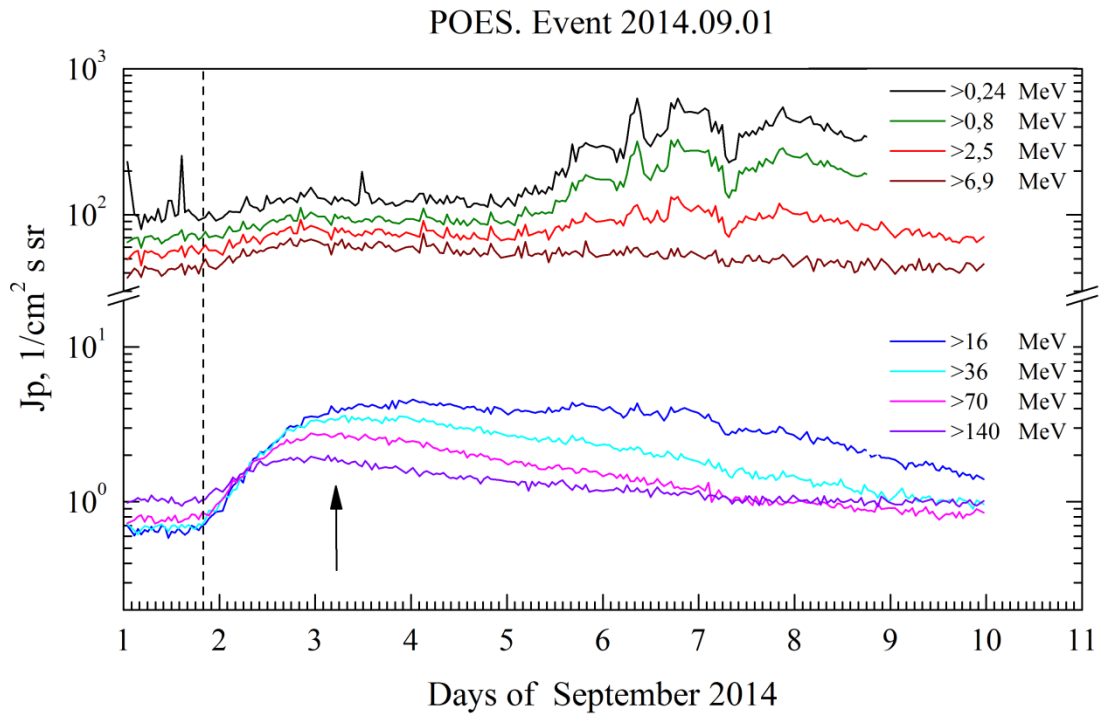



GOES. Event 2014.09.01
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of September 2014


Electro. Event 2014.09.01
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13.7-23 MeV
23-42 MeV
42-112 MeV
>600 MeV
>800 MeV
Days of September 2014

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 September 01

2014 September 01 ■ AR 12158 To event 558

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	No flare on visible disc					
1 – 12	keV	1055	1139	1200	N16W88	B6.2	
1 – 12	keV	1056*	~1101*	~1319*	N14E126*	X2.4*	
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
>100	MeV	1101:30		1118:30		3.17E-03**	FERMI
>100	MeV	1225:30		1257:30		3.04E-05**	FERMI
800-7000	keV	1110:48	1114:06	1122:00	60	105248	HESSI
800-7000	keV	1122:00	1124:02	1133:36	42	79936	HESSI
800-7000	keV	1133:36	1138:42	1145:12	320	200208	HESSI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
2.7	GHz	1106	1153	1216		1.76	
1.4	GHz	1102	1117	1126		2.46	
245	MHz	1101	1102	1106		2.56	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-53	1113		1124		2	
DS V	25-180	1100		1103		2	
DS VI	25-180	1100		2133		2	
DS VI	25-180	1104		1710		2	
DH II	0.6-16	1112		2235			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1112	1901	- 240.1	360˚	065˚	SOHO

* restored data: M. Ackermann, A. Allafort, L. Baldini et al., 2017

** cm^{-2}s^{-1}

Proton Active Region:

AR12158 (N14L089, CMP 10.09.2014,
Sp=440 msh, DKC, BGD, R)
XRI*= 2.05 $X_1^{1.6}+M_1^{4.5}+C_{11}$; $2_1+1_1+S_{29}$
PFR 8-10.09 (41^h) $X_1^{1.6}+M_1^{4.5}$
* excluding the "restored" X2.4 flare

References:

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Wu Y., A.P. Rouillard, A. Kouloumvakos et al., 2021.
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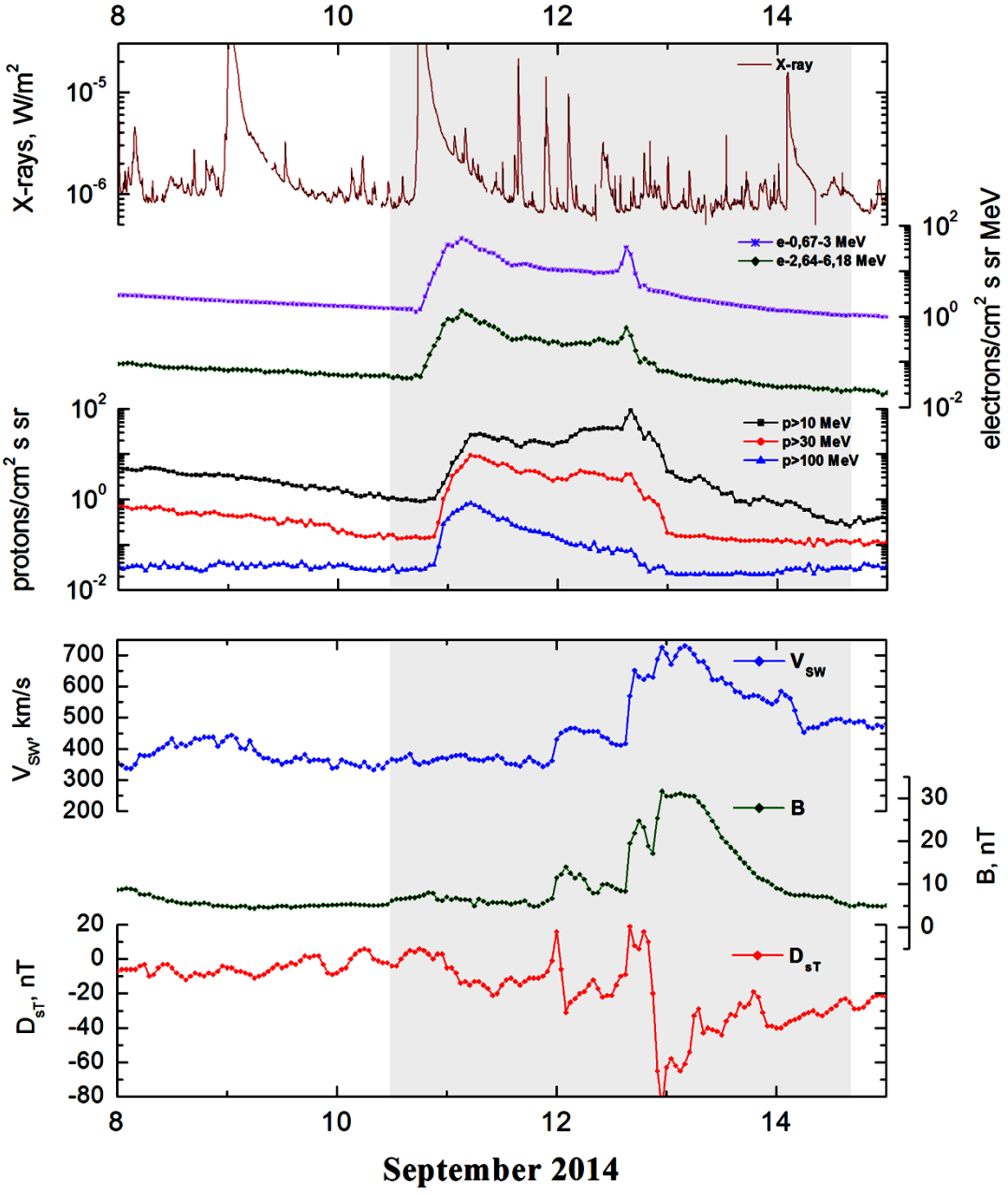
Particle event: To(Ep>10 MeV) – $10d21^h$
$Tmax_1$(Ep>10 MeV) – $11d07^h$, $Jmax_1$(Ep>10 MeV) – 25 /cm^2·s·sr
$Tmax_2$(Ep>10 MeV) – $12d16^h$, $Jmax_2$(Ep>10 MeV) – 67.5 /cm^2·s·sr
Duration of the event – 4 days, power-law index: $\gamma_1 = 2.8$, $\gamma_2 = 3.1$
Quasimaximal energy of protons in the event – Eqm_1 = 400 MeV
– Eqm_2 = 160 MeV

Sources: ● solar flare$10d16^h59^m$, 2B/X1.6, N14E02, AR12158
Main burst X-ray 1–8 Å: onset – $10d17^h21^m$, max – $10d17^h45^m$, Φ = 0.38 J/m^2
CME: $10d18^h00^m$, V = 1267 km/s, Δφ = 360°, dA= 175°
▲ SC $11d23^h45^m$; ▲ SC $12d15^h53^m$

Particle fluxes and associated phenomena

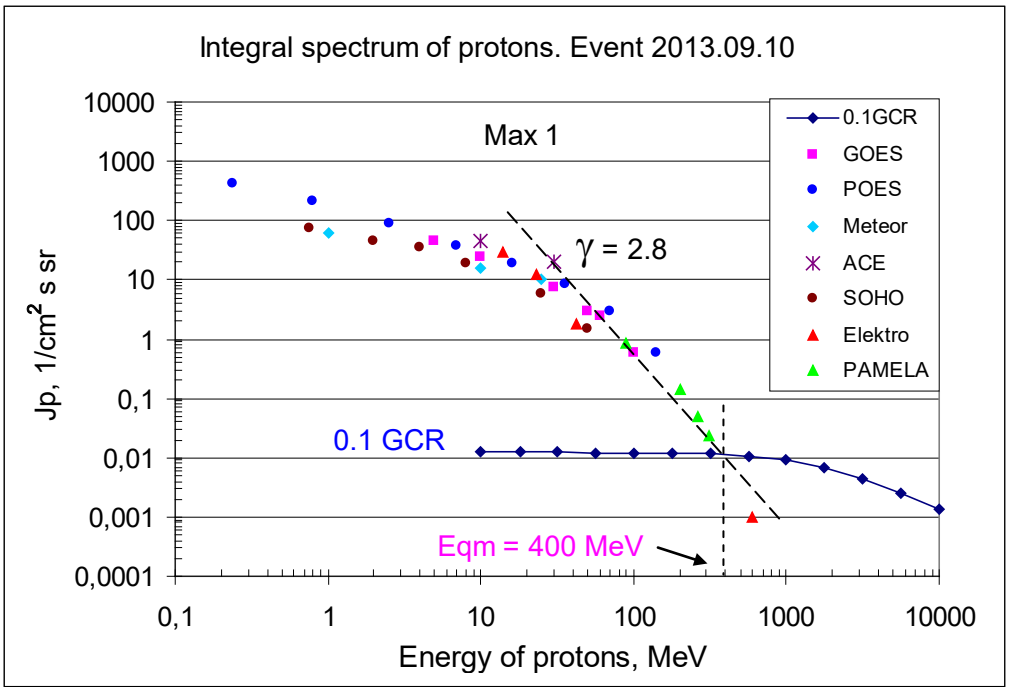


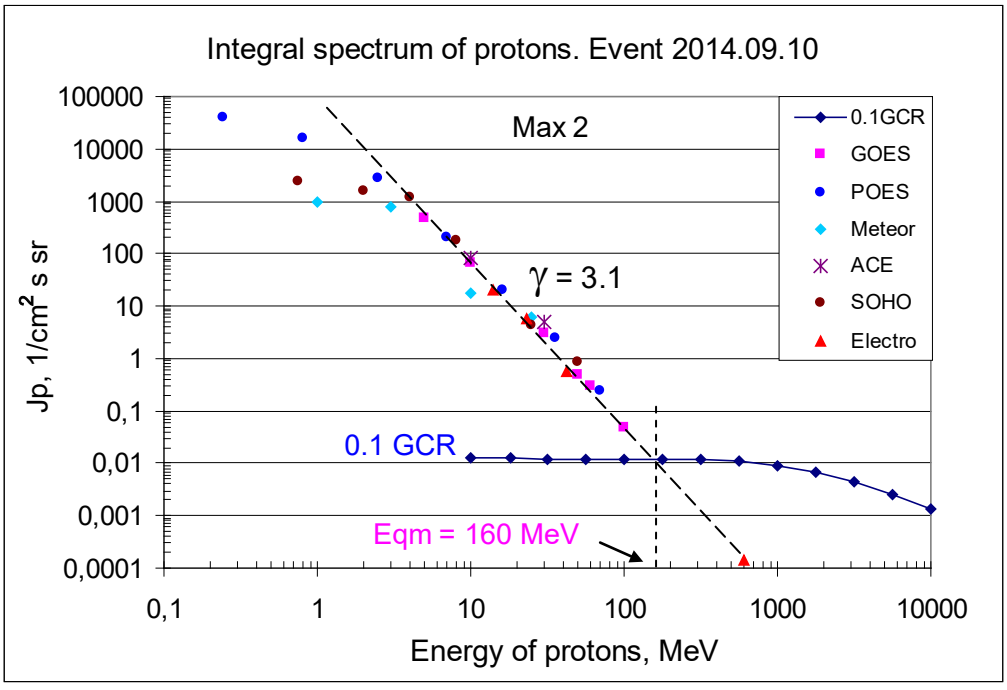
Integral fluxes of protons for the event of 2014 September 10

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	19	11d07/12d16	45.5/475	4	0.2	
EPS	>10	21	11d07/12d16	25/67.5	4	0.12	
EPS	>30	21	11d07/12d16	7.3/3	2	0.07	
EPS	>50	21	11d06/12d16	2.9/0.5	2	0.06	
EPS	>60	21	11d06/12d16	2.4/0.3	2	0.05	
EPS	>100	19	11d05/12d16	0.6/0.05	2	0.03	
Electro-1							
GALS-E	>600	20	11d05/12d15	0.001/0.00014	2	0.0007	
POES							
MEPED	>0.24	-	11d06/12d18	415/40400	2	90	
MEPED	>0.8	-	11d06/12d18	210/15600	2	70	
MEPED	>2.5	-	11d06/12d18	90/2700	2	55	
MEPED	>6.9	-	11d06/12d18	37.5/200	2	50	
MEPED	>16	-	11d06/12d18	19.2/20	2	0.65	
MEPED	>36	-	11d06/12d18	8.6/2.5	2	0.7	
MEPED	>70	-	11d06/12d18	2.9/0.25	1.5	0.75	
MEPED	>140	-	11d06/ -	0.6/ -	1.5	1	
Meteor-1							
SCR	>1	23	11d06/12d17	60/980	2.5	2.75	
SCR	>3	23	- /12d17	- /790	2.5	2.85	
SCR	>10	23	11d06/12d16	16/18	2	1.85	
GALS-M	>15	-	-	-	-	-	
GALS-M	>25	21	11d05/12d16	10/5	2	1.2	
GALS-M	>600	-	-	-	-	0.02	
ACE							
SIS	>10	19	11d03/12d15	44/83	3	1.2	
SIS	>30	19	11d03/12d15	20/5	3	0.8	
PAMELA							
TRACKER	>90	20	11d01-07/ -	0.84/ -	>3		
TRACKER	>200	20	11d01-07/ -	0.14/ -	>3		
TRACKER	>265	20	11d01-07/ -	0.048/ -	>3		
TRACKER	>312	20	11d01-07/ -	0.023/ -	>3		
SOHO							
EPHIN	>50	20	11d03/12d15	1.51/0.84	2	0.2	

Differential fluxes of protons for the event of 2014 September 10

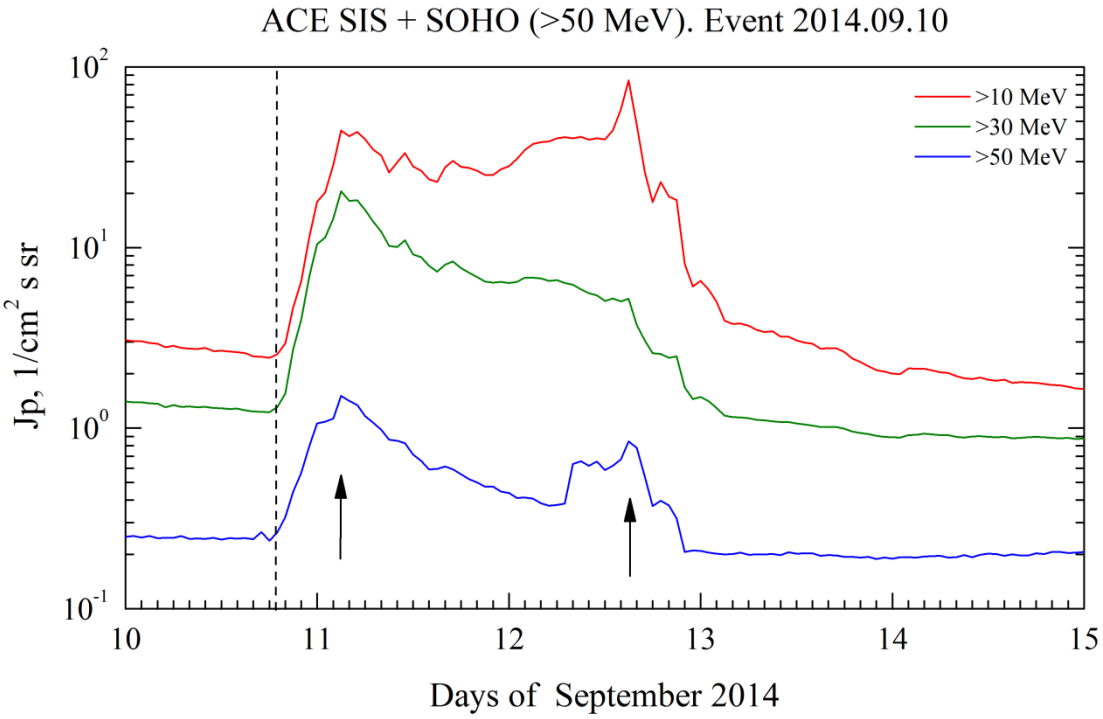
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75-2	22	11d05/12d16	26.4/730	2	2.5	
LION	2-6	21	11d05/12d16	3.1/120	2	0.3	
EPHIN	4-8	21	11d05/12d15	4/260	2	0.6	
EPHIN	8-25	20	11d05/12d15	0.75/10.3	2	0.05	
EPHIN	25-53	20	11d05/12d15	0.162/0.125	2	0.005	
Electro-1							
SCR-E	13.7-23	20	11d05/12d15	1.75/1.65	3	0.1	
SCR-E	23-42	20	11d05/12d15	0.55/0.27	3	0.035	
SCR-E	42-112	20	11d05/12d15	0.025/0.008	2	0.005	

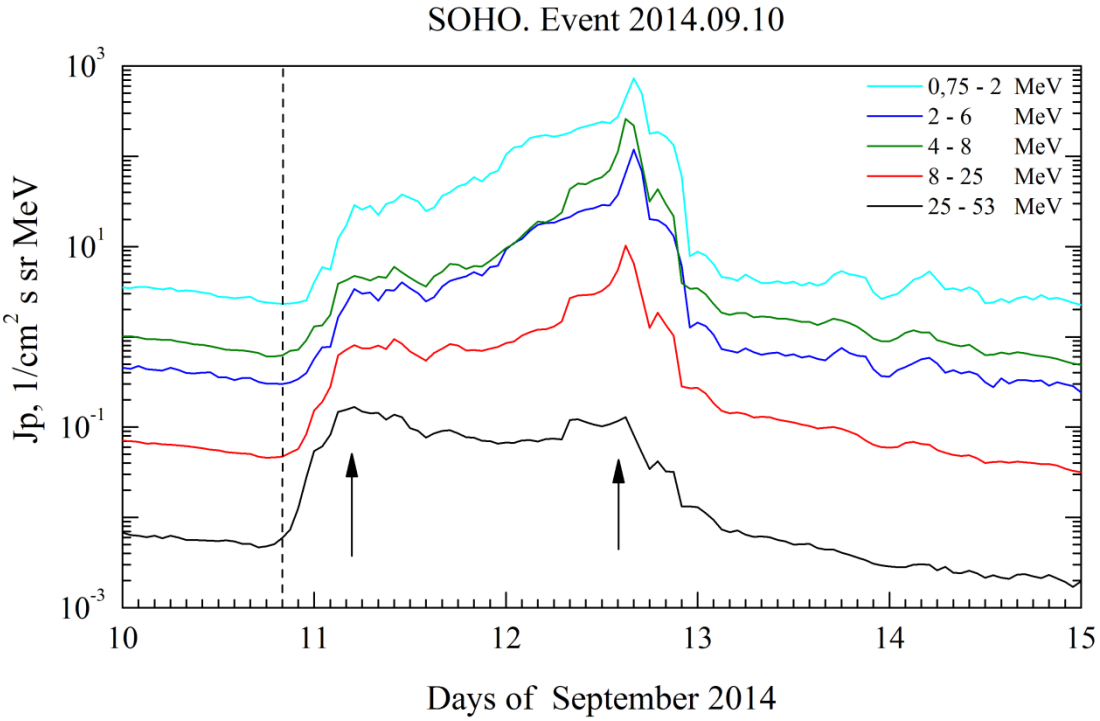

Integral spectrum of protons. Event 2013.09.10
Max 1
γ = 2.8
0.1 GCR
Eqm = 400 MeV
Jp, 1/cm2 s sr
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Elektro
PAMELA
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

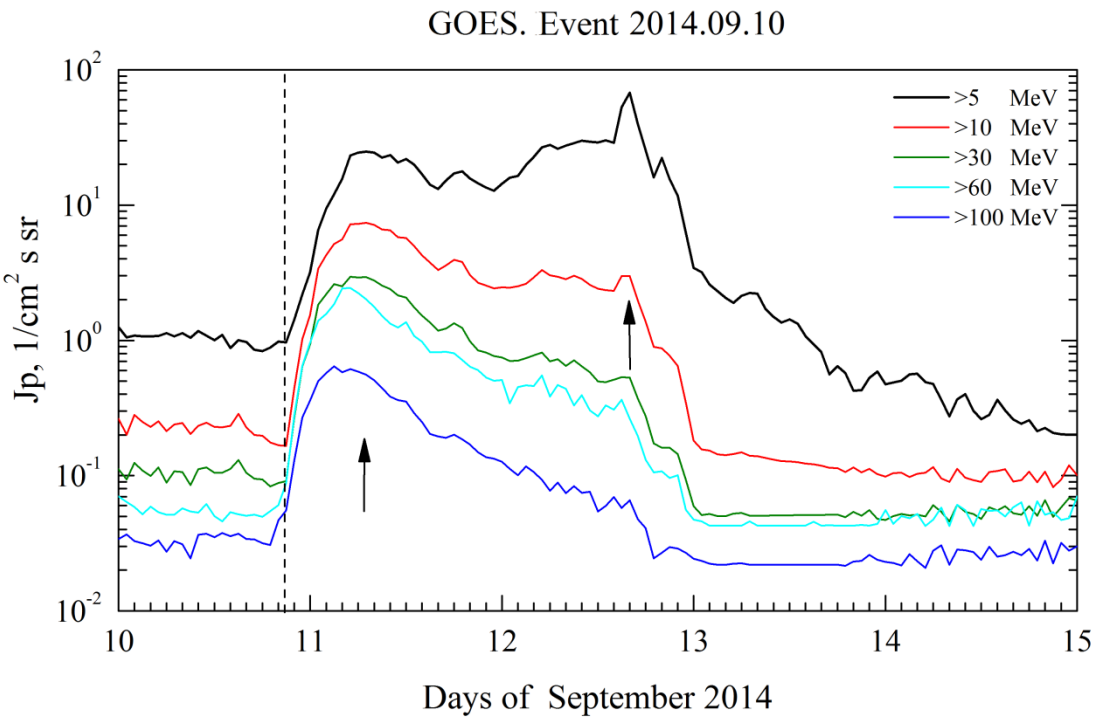

Integral spectrum of protons. Event 2014.09.10
Max 2
γ = 3.1
0.1 GCR
Eqm = 160 MeV
Jp, 1/cm2 s sr
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

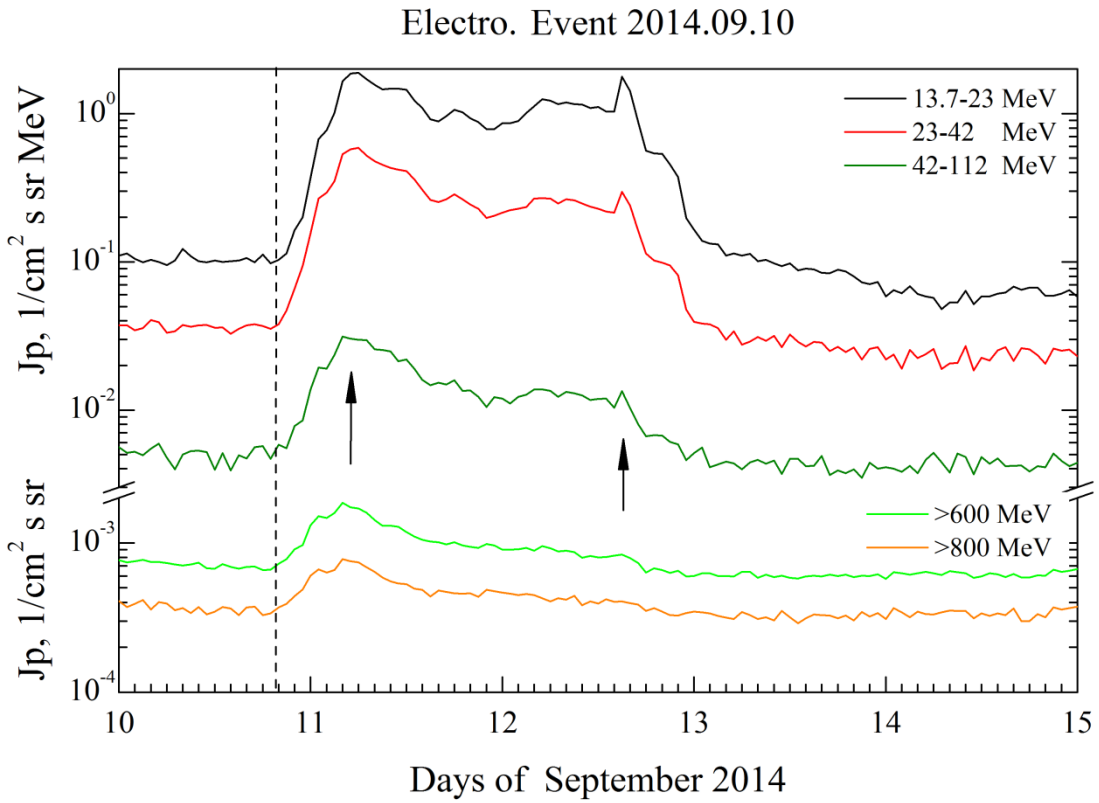
Time profiles of proton fluxes in the event 2014.09.10

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

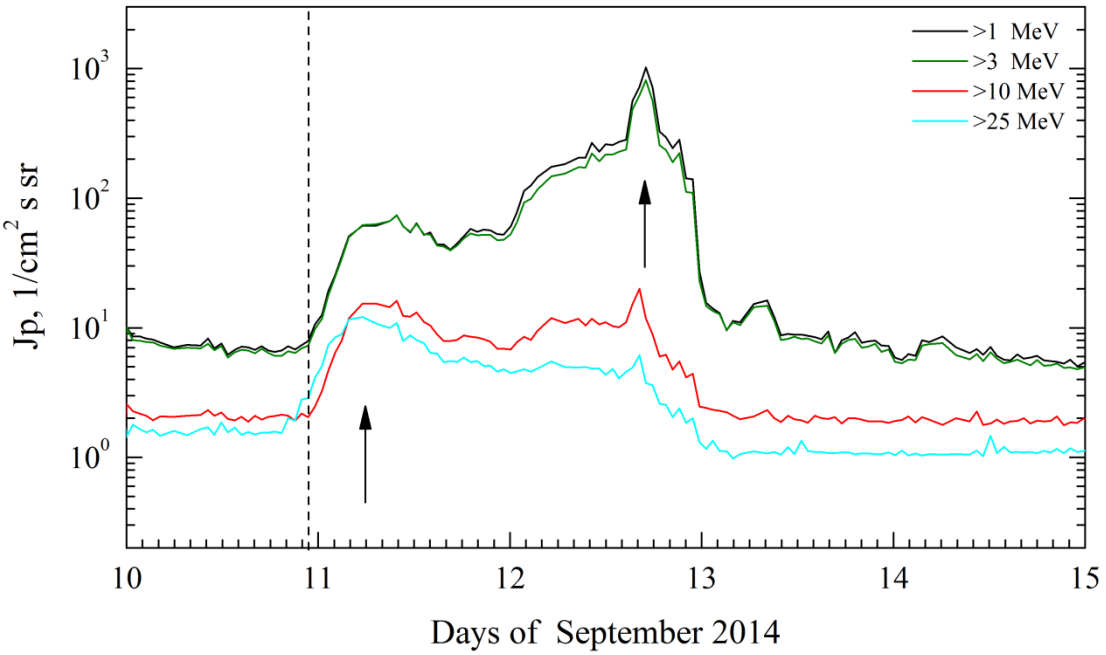




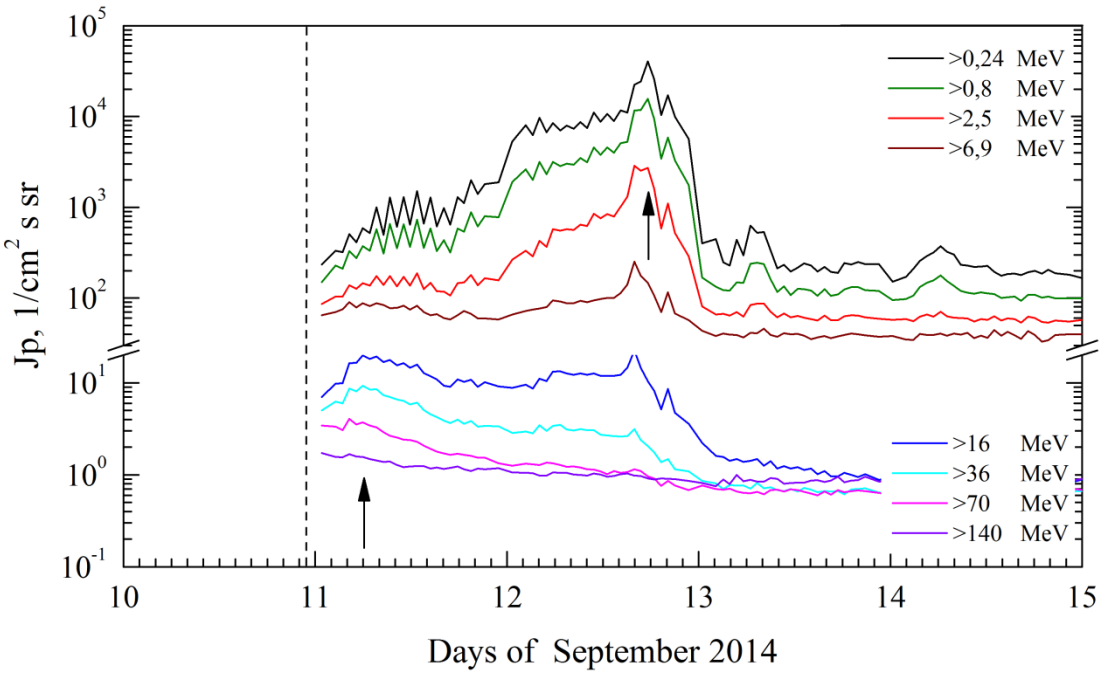

GOES. Event 2014.09.10
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of September 2014


Electro. Event 2014.09.10
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13.7-23 MeV
23-42 MeV
42-112 MeV
>600 MeV
>800 MeV
Days of September 2014

Meteor. Event 2014.09.10



POES. Event 2014.09.10



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 September 10

2014 September 10 • AR 12158 To event 559

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1659	1733	2240	N14E02	2B	UMB
1 – 12	keV	1721	1745	1820	N11E05	X1.6	0.38

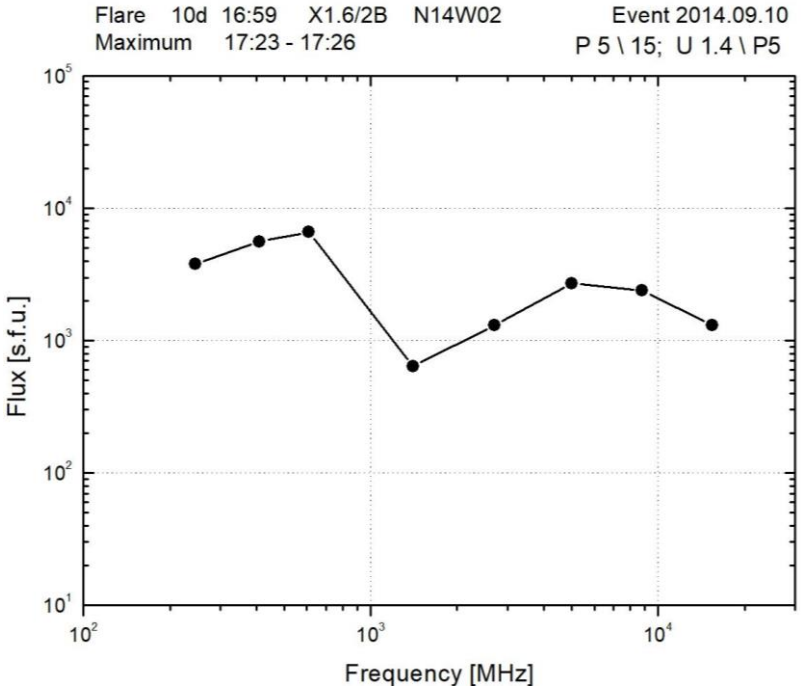
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1850:04	1850:57	1931:39	22135	7013644	FERMI
12-25	keV	2025:29	2047:52	2109:35	1875	951345	FERMI
12-25	keV	2201:23	2241:23	2249:10	958	376540	FERMI
300-800	keV	1645:08	1719:14	1719:44	108	253482	HESSI
50-100	keV	1811:16	1812:38	1825:36	4080	8975020	HESSI
800-7000	keV	1825:36	1827:34	1854:32	2416	8879104	HESSI
25-50	keV	1946:2	1949:40	1949:40	4756	406641	HESSI
25-50	keV	1949:40	1949:54	2016:44	272	1082910	HESSI
800-7000	keV	2016:44	2017:38	2023:32	144	197632	HESSI
7000-20000	keV	2023:32	2025:06	2031:40	136	20000	HESSI
12-25	keV	2121:20	2121:54	2124:44	1988	138747	HESSI
12-25	keV	2124:44	2126:18	2132:40	79	104999	HESSI
12-25	keV	2132:4	2132:46	2146:56	64	154636	HESSI
12-25	keV	2146:56	2147:10	2150:48	46	36064	HESSI
6-12	keV	2155:52	2157:06	2158:20	48	22016	HESSI
6-12	keV	2158:20	2200:06	2204:56	46	56352	HESSI
50-100	keV	2256:20	2258:34	2315:28	2619	9212287	HESSI

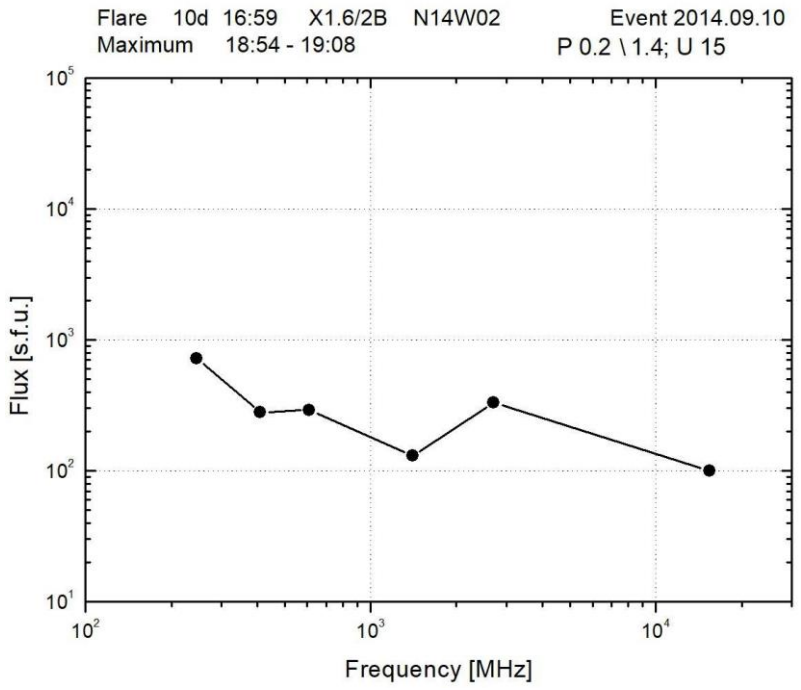
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1724	1733	1847	P5 \ 15	3.11	
8.8	GHz	1723	1732	1842		3.38	
5	GHz	1723	1733	1827		3.43	
2.7	GHz	1723	1733	1855		3.11	
1.4	GHz	1724	1746	1855	U1.4 / P5	2.81	
610	MHz	1724	1747	1910		3.82	
410	MHz	1723	1747	1916		3.75	
245	MHz	1726	1747	1922		3.6	
15.4	GHz	1848	1858	1858	U15	2.0	
2.7	GHz	1854	1854	1855		2.52	
1.4	GHz	1854	1854	1855		2.11	
610	MHz	1853	1855	1910		2.46	
410	MHz	1851	1854	1916		2.45	
245	MHz	1849	1908	1922	P0.2 \ 1.4	2.86	
610	MHz	1943	1943	1943		1.71	
410	MHz	1941	1946	1957		2.3	
245	MHz	1939	1945	2006		2.91	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS IV	25-180	1728		2359		2	
DH II	01-14	1745		11d1200			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1800	1267	- 51.6	360°	175°	SOHO

Radio bursts frequency spectrum





Proton Active Region:

AR12158 (N14L089, CMP 10.09.2014,
Sp=440 msh, DKC, BGD, R)
XRI*= 2.05 $X_1^{1.6}+M_1^{4.5}+C_{11}$; $2_1+1_1+S_{29}$
PFR 8-10.09 (41^h) $X_1^{1.6}+M_1^{4.5}$
* excluding the "restored" X2.4 flare

References:

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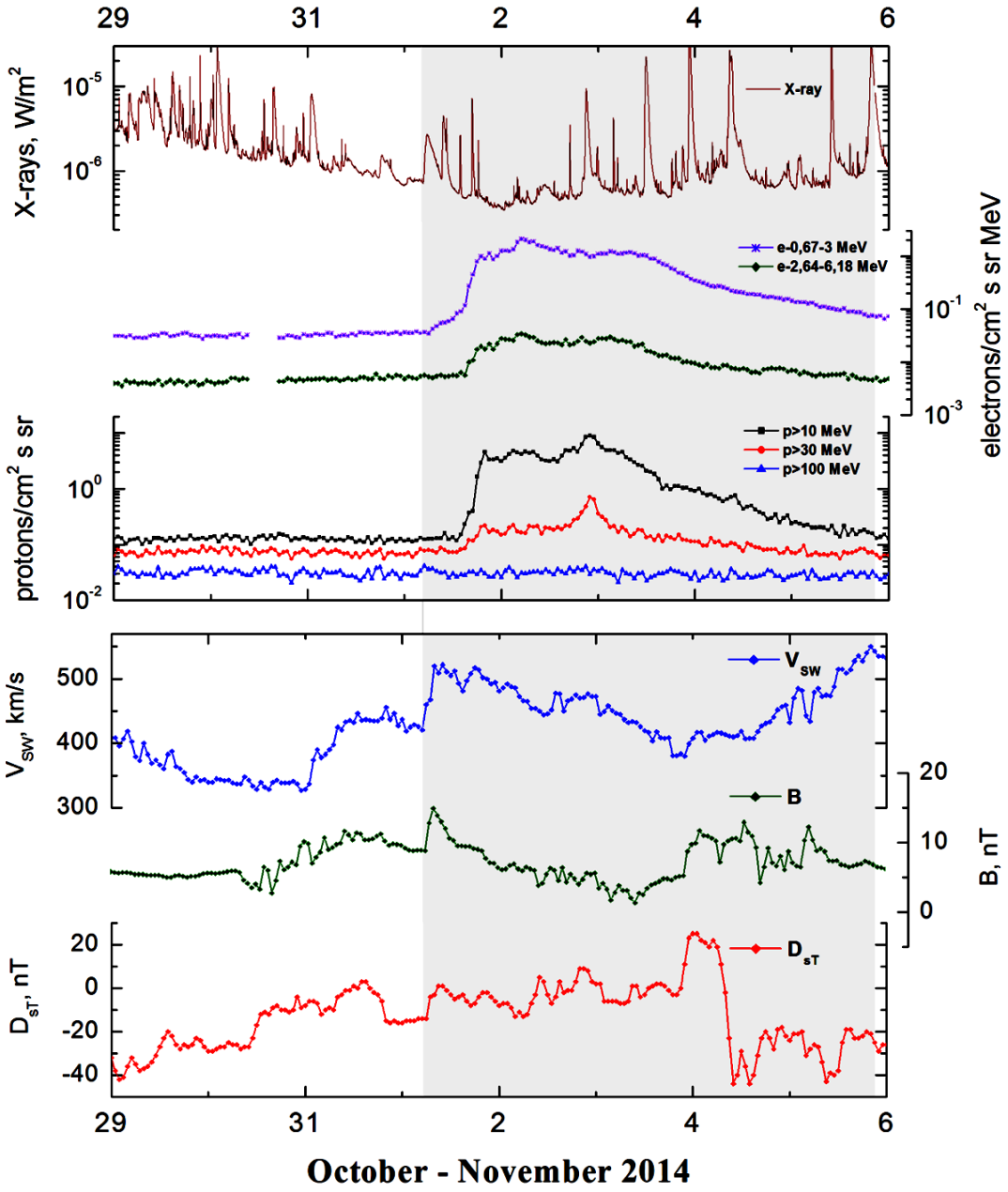
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Event 2014.11.01– (2014-305) **560**

Particle event: To(Ep>10 MeV) – 01d14^{h}
Tmax$_1$(Ep>10 MeV) – 01d20^{h}, Jmax$_1$(Ep>10 MeV) – 3.2 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 02d22^{h}, Jmax$_2$(Ep>10 MeV) – 7 /cm^2·s·sr
Duration of the event – 4 days, power-law index: γ_1 = 3.7, γ_2 = 2.7
Quasimaximal energy of protons in the event – Eqm$_1$ = 50 MeV
– Eqm$_1$ = 120 MeV

Sources: ● solar flare 01d04^{h}44^{m}, C2.7/DSF, S08E52, Spotless AR
Main burst X-ray 1–8 Å: onset – 01d04^{h}44^{m}, max – 04d05^{h}34^{m}, Φ = 0.017 J/m^2
CME: 01d05^{h}00^{m}, V = 1628 km/s, Δφ = 159°, dA= 125°
▲ SC 01d07^{h}05^{m}

Particle fluxes and associated phenomena

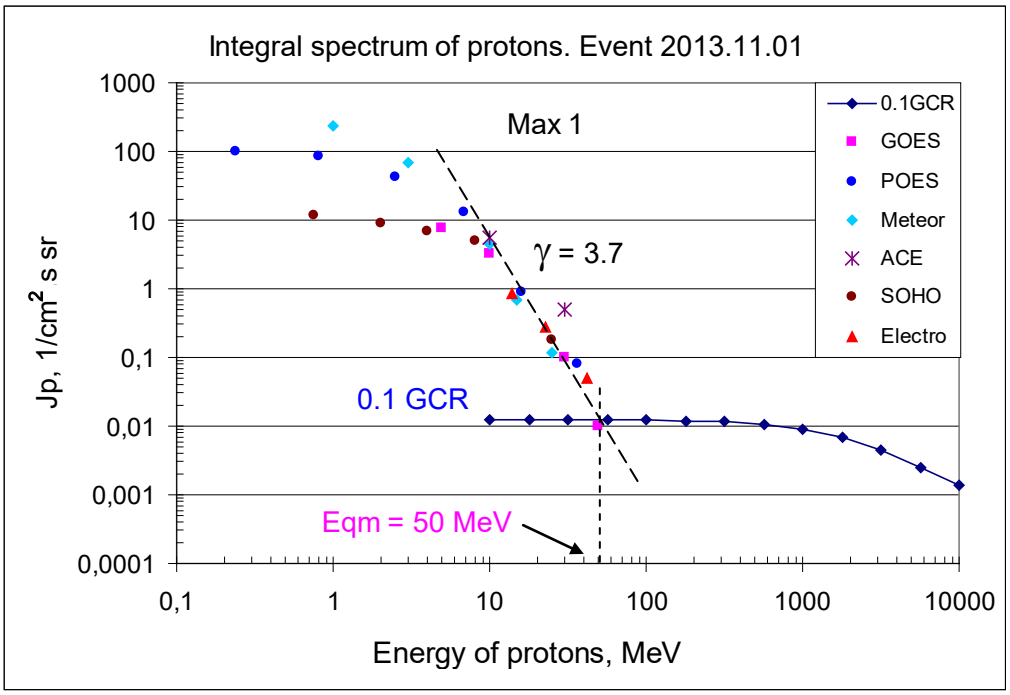


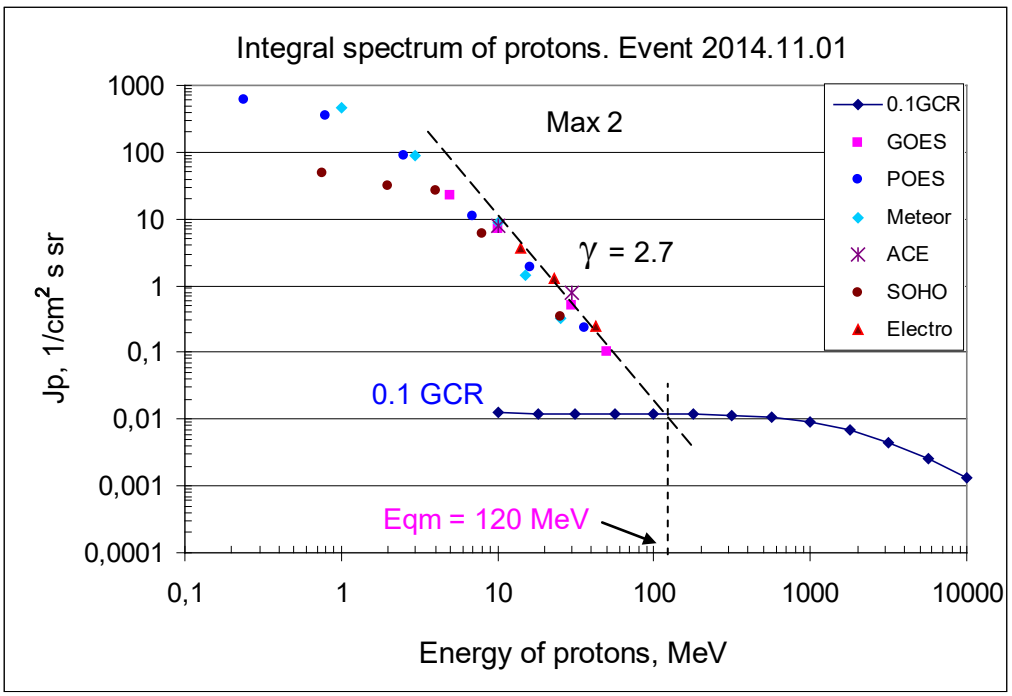
Integral fluxes of protons for the event of 2014 November 01

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration days	Back-ground	Comments
GOES							
EPS	>5	14	20/02d21	7.6/22	4	0.2	
EPS	>10	14	20/02d22	3.2/7	4	0.12	
EPS	>30	14	21/02d22	0.1/0.5	2	0.07	
EPS	>50	14	21/02d22	0.01/0.1	2	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	17	21/02d22	98/625	4	90	
MEPED	>0.8	17	21/02d22	84/350	4	70	
MEPED	>2.5	17	21/02d22	43/90	3	55	
MEPED	>6.9	17	21/02d22	13/11	2	40	
MEPED	>16	17	21/02d22	0.9/1.9	2	0.65	
MEPED	>36	-	21/02d22	0.08/0.24	2	0.7	
MEPED	>70	-	-	-	-	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-2							
SCR	>1	17	20/02d22	241/466	6	3.9	
SCR	>3	17	20/02d22	70/88	4	2.4	
SCR	>10	17	20/02d22	4.5/9	3	1.9	
GALS-M	>15	17	20/02d22	0.7/1.4	2	0.6	
GALS-M	>25	17	20/02d22	0.12/0.32	2	0.6	
GALS-M	>600	-	-	-		0.2	
ACE							
SIS	>10	20	19/02d20	5.5/8	2.5	1.2	
SIS	>30	20	19/02d20	0.5/0.8	2	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

Differential fluxes of protons for the event of 2014 November 01

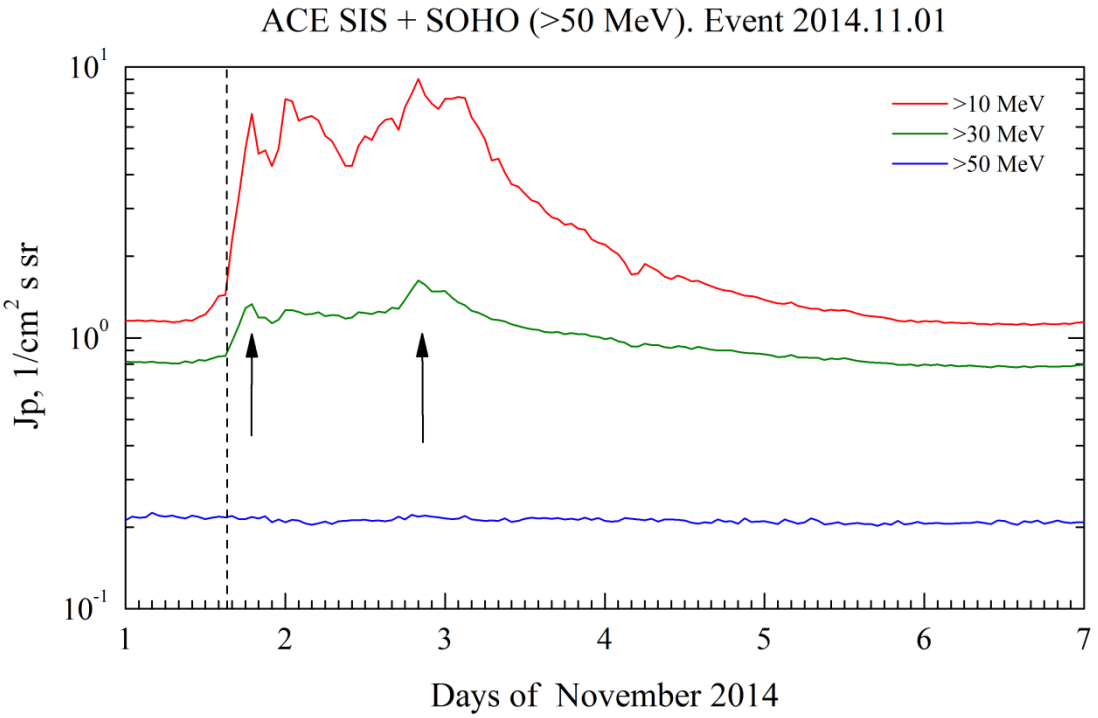
S/c, instruments	Ep, MeV	To, ours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	16	20/02d19	2/13.8	6	0.04	
LION	2 – 6	17	20/02d20	0.82/2.2	6	0.003	
EPHIN	4 – 8	16	21/02d20	0.43/4.9	6	0.003	
EPHIN	8 – 25	16	21/02d20	0.28/0.34	5.5	0.0001	
EPHIN	25 – 53	16	19/02d20	0.0064/0.0125	4.5	0.00001	
Electro-1							
SCR-E	13.7–23	14	20/02d22	0.06/0.25	2	0.045	
SCR-E	23–42	14	20/02d22	0.012/0.057	2	0.02	
SCR-E	42–112	14	20/02d22	0.001/0.0036	2	0.004	

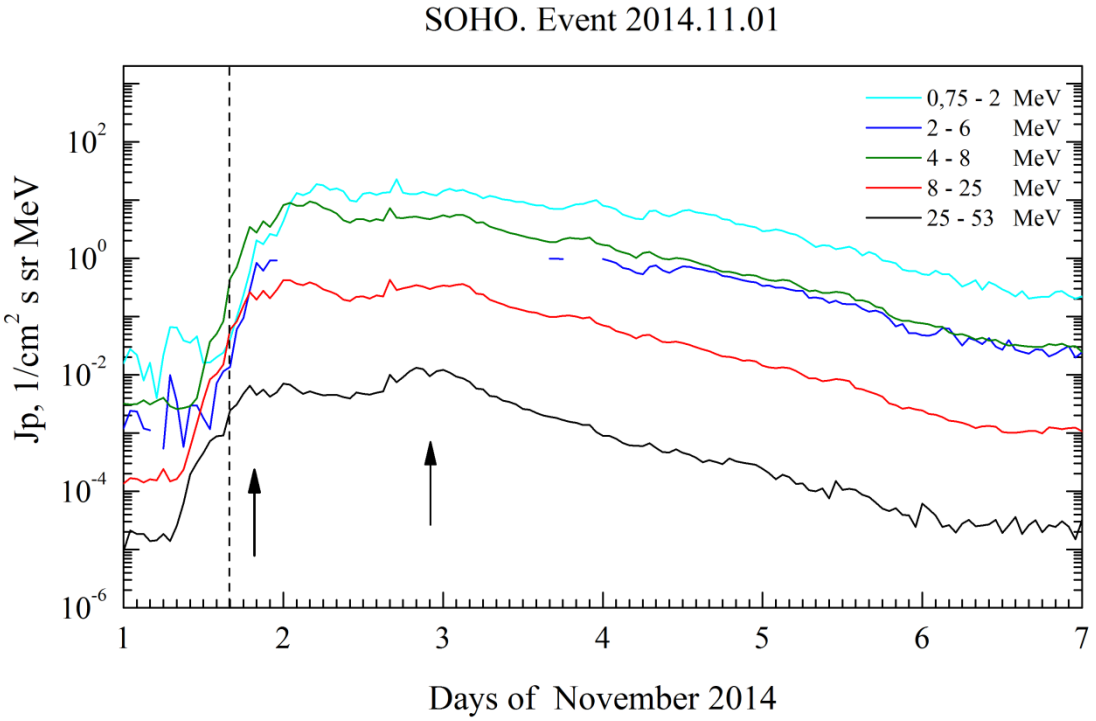

Integral spectrum of protons. Event 2013.11.01
Max 1
γ = 3.7
0.1 GCR
Eqm = 50 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2014.11.01
Max 2
γ = 2.7
0.1 GCR
Eqm = 120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

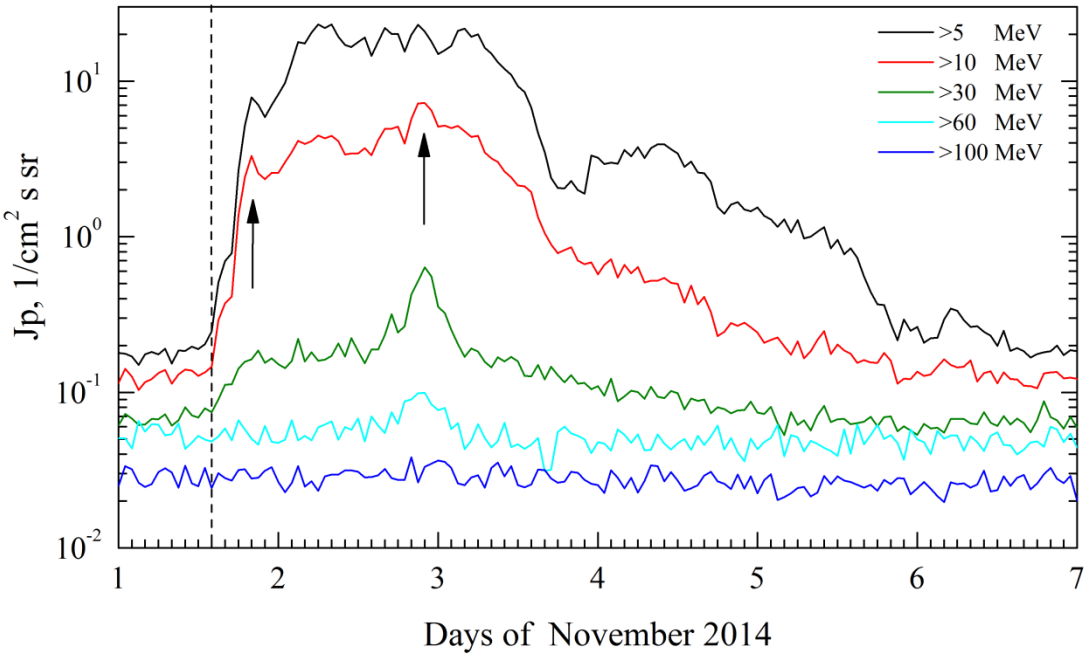
Time profiles of proton fluxes in the event 2014.11.01

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

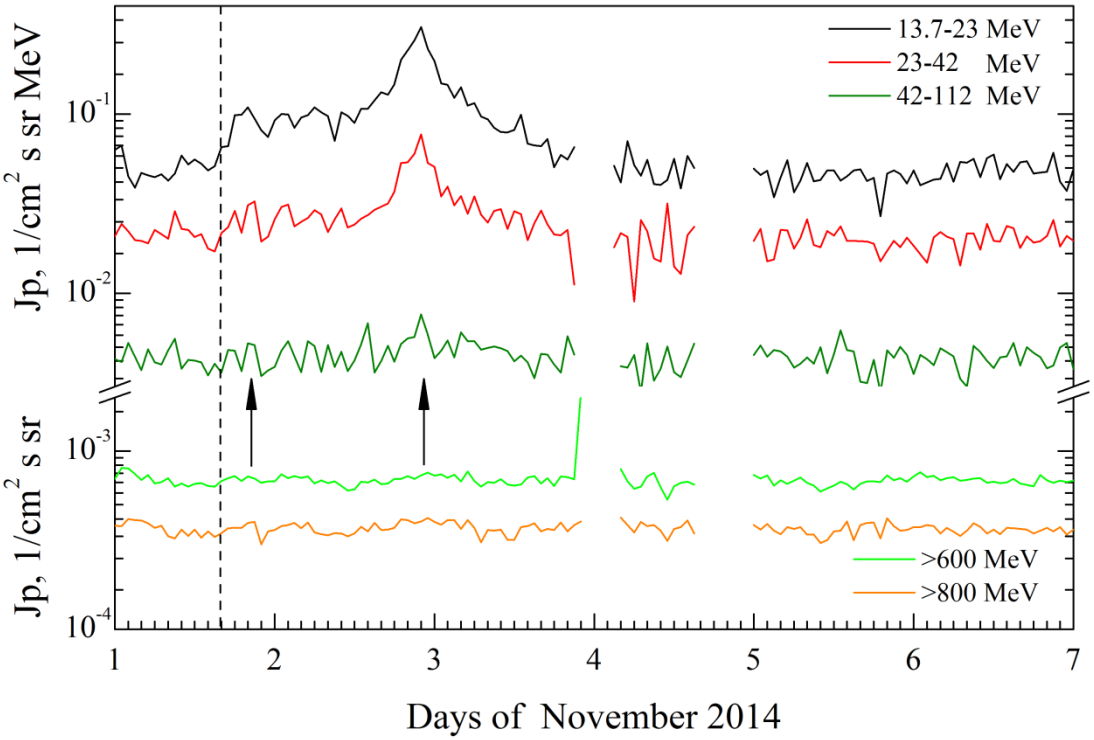


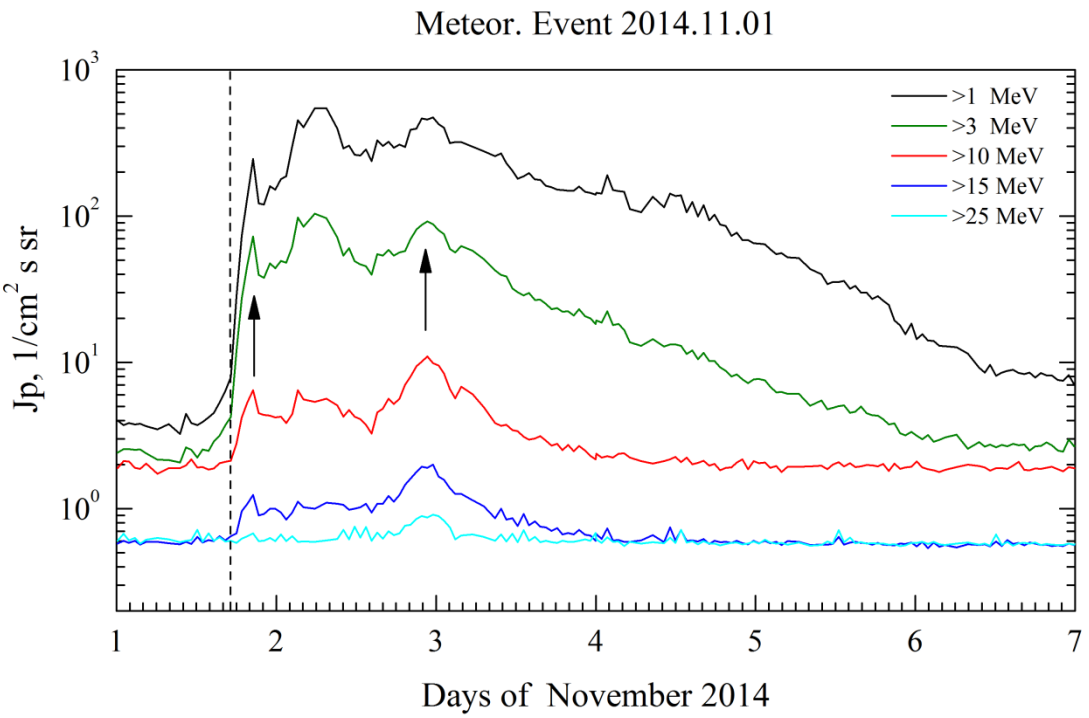


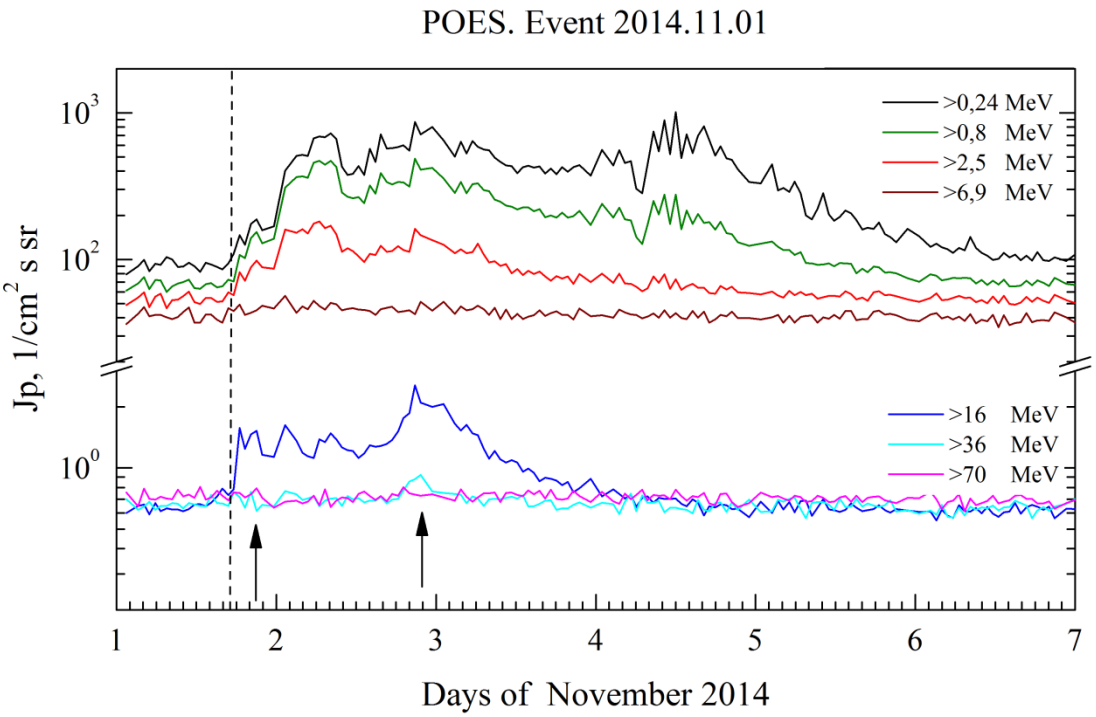
GOES. Event 2014.11.01



Electro. Event 2014.11.01




Meteor. Event 2014.11.01
Jp, 1/cm^2 s sr
10^3
10^2
10^1
10^0
>1 MeV
>3 MeV
>10 MeV
>15 MeV
>25 MeV
1
2
3
4
5
6
7
Days of November 2014


POES. Event 2014.11.01
Jp, 1/cm^2 s sr
10^3
10^2
10^0
>0,24 MeV
>0,8 MeV
>2,5 MeV
>6,9 MeV
>16 MeV
>36 MeV
>70 MeV
1
2
3
4
5
6
7
Days of November 2014

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 November 01

2014 November 01 ● AR XXXXX* To event 560

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	DSF*	0403		0500	S30E54	16^o	
6563 Å	EPL	0405		0515	E90	0.21	
6563 Å	FL	< 0507	0507	0512	S28E54	SF	PRB
6563 Å	FL	0534	0534	0539	S08E50	SF	
1 – 12	keV	0444	0534	0705	S22E52	C2.7	0.017

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS VI	61-180	0648		1007		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0500	1628	7.3	159˚	125˚	SOHO

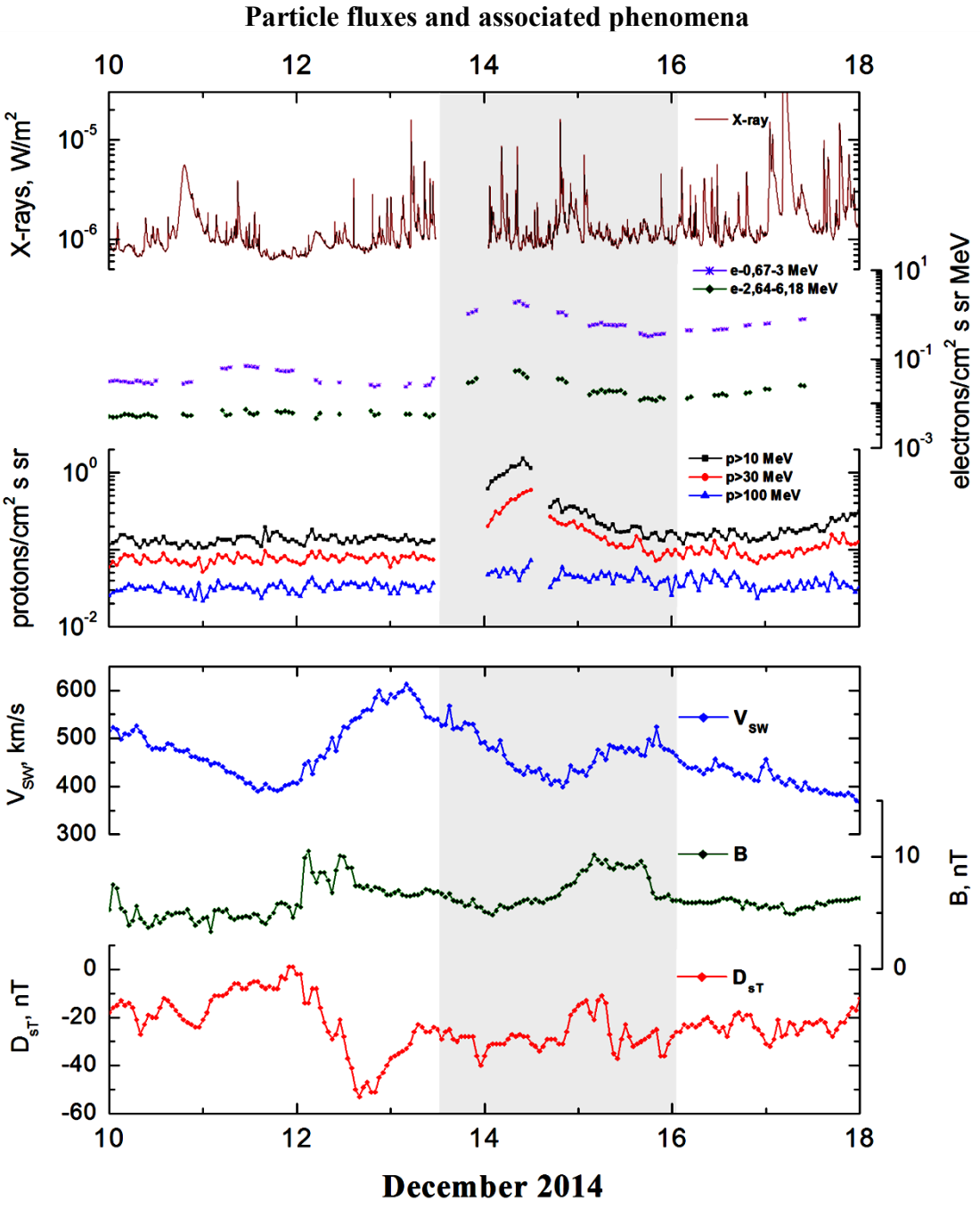
*Spotless AR on SE-quadrant
https://sdowww.lmsal.com/sdomedia/ssw/ssw_client/data/ssw_service_141101_005621_975/www/

References:

Gopalswamy N., S. Yashiro, N. Thakur et al., 2016.
Paassilta M., O. Raukunen, R. Vainio et al., 2017.
Richardson, I.G., T.T., von Rosenvinge, H.V. Cane, 2016.

Particle event: To(Ep>10 MeV) – 13d16^h
Tmax(Ep>10 MeV) – 14d11^h, Jmax(Ep>10 MeV) – 1.7 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma = 2.3$
Quasimaximal energy of protons in the event – Eqm = 130 MeV

Sources: ⊡ solar flare 13d<14^{h}24^m, AR 12222, 3d behind W_L
CME: 13d14^{h}24^m, V = 2222 km/s, $\Delta\varphi = 360°$, dA = 265°

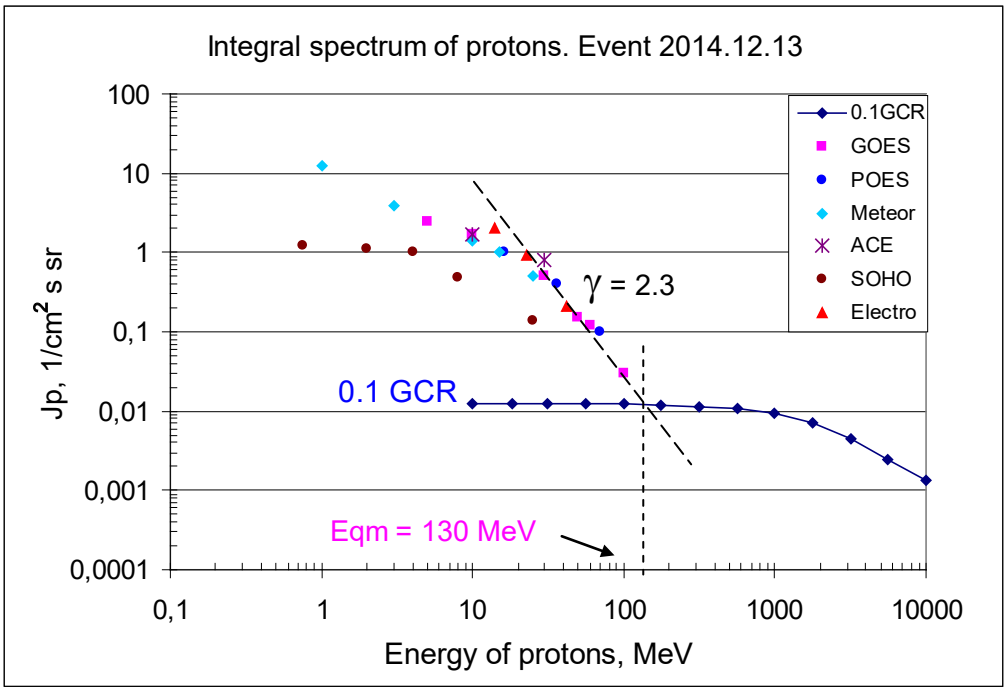


Integral fluxes of protons for the event of 2014 December 13

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	-	14d11	2.5	1.5	0.2	
EPS	>10	-	14d11	1.7	1.5	0.12	
EPS	>30	-	14d11	0.5	1.5	0.07	
EPS	>50	-	14d11	0.15	1.5	0.06	
EPS	>60	-	14d11	0.12	1.5	0.05	
EPS	>100	-	14d11	0.03	1.5	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	-	-	-	-	90	
MEPED	>0.8	-	-	-	-	70	
MEPED	>2.5	-	-	-	-	55	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	22	14d09	1	1	0.65	
MEPED	>36	22	14d09	0.4	1	0.7	
MEPED	>70	22	14d09	0.1	1	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-2							
SCR	>1	16	14d09	12.6	1.5	3.7	
SCR	>3	16	14d11	3.9	1.5	2.5	
SCR	>10	16	14d11	1.4	1.5	1.9	
GALS-M	>15	16	14d11	1	1.5	0.6	
GALS-M	>25	16	14d11	0.5	1.5	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	16	14d10	1.7	1.5	1.2	
SIS	>30	16	14d10	0.8	1.5	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

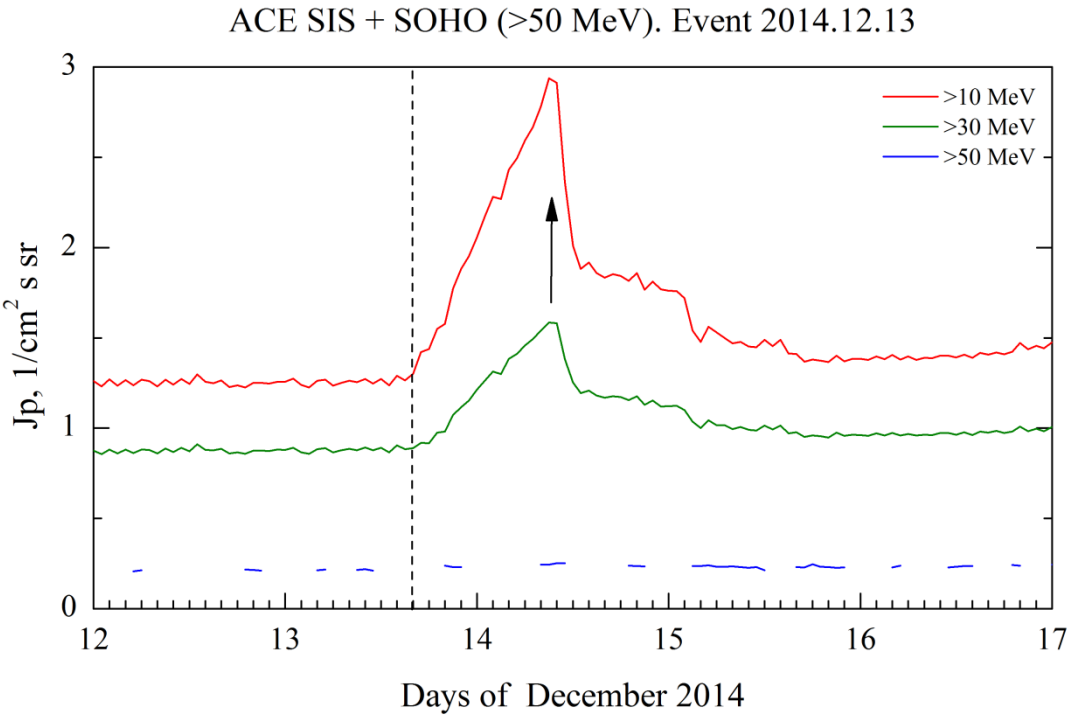
Differential fluxes of protons for the event of 2014 December 13

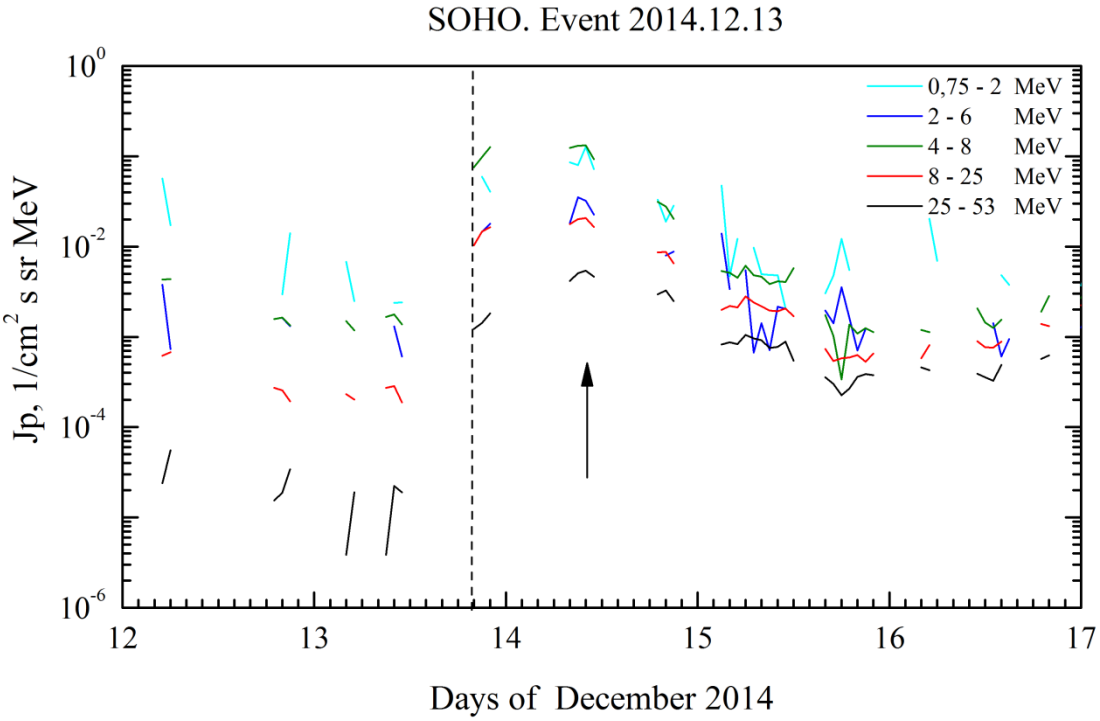
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	14d08	0.086	2	0.002	
LION	2 – 6	21	14d09	0.035	2	0.001	
EPHIN	4 – 8	21	14d10	0.13	2	0.001	
EPHIN	8 – 25	20	14d10	0.02	2	0.0003	
EPHIN	25 – 53	20	14d10	0.005	2	0.00002	
Electro-1							
SCR-E	13.7–23	14	14d10	0.11	2	0.05	
SCR-E	23–42	14	14d10	0.038	2	0.02	
SCR-E	42–112	14	14d10	0.003	1.5	0.004	


Integral spectrum of protons. Event 2014.12.13
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 2.3
0.1 GCR
Eqm = 130 MeV

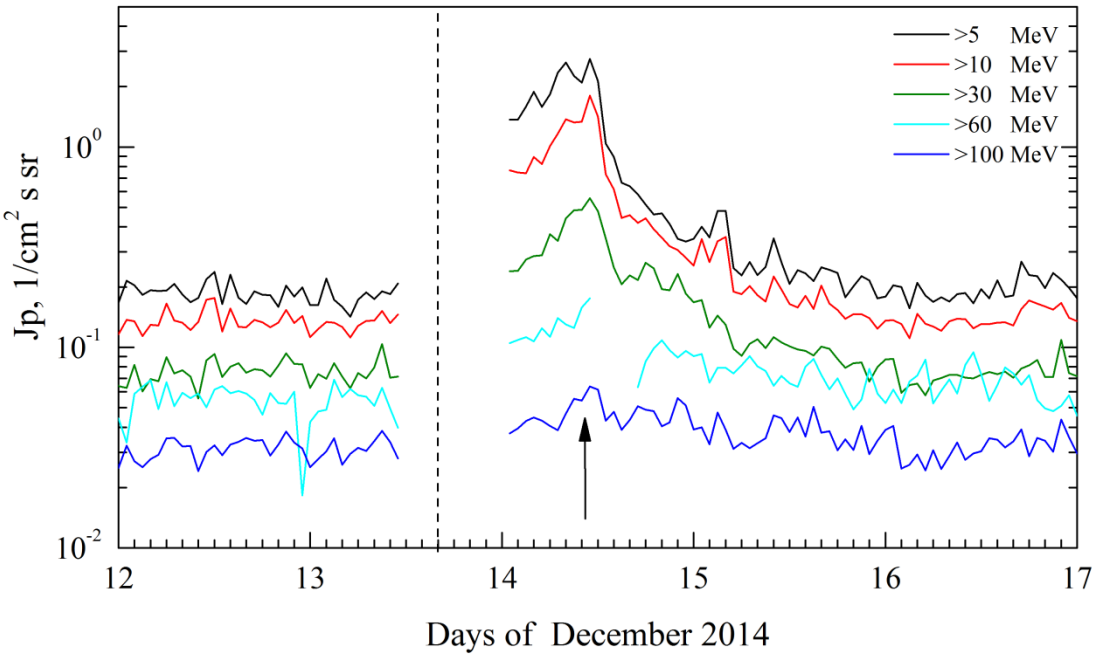
Time profiles of proton fluxes in the event 2014.12.13

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

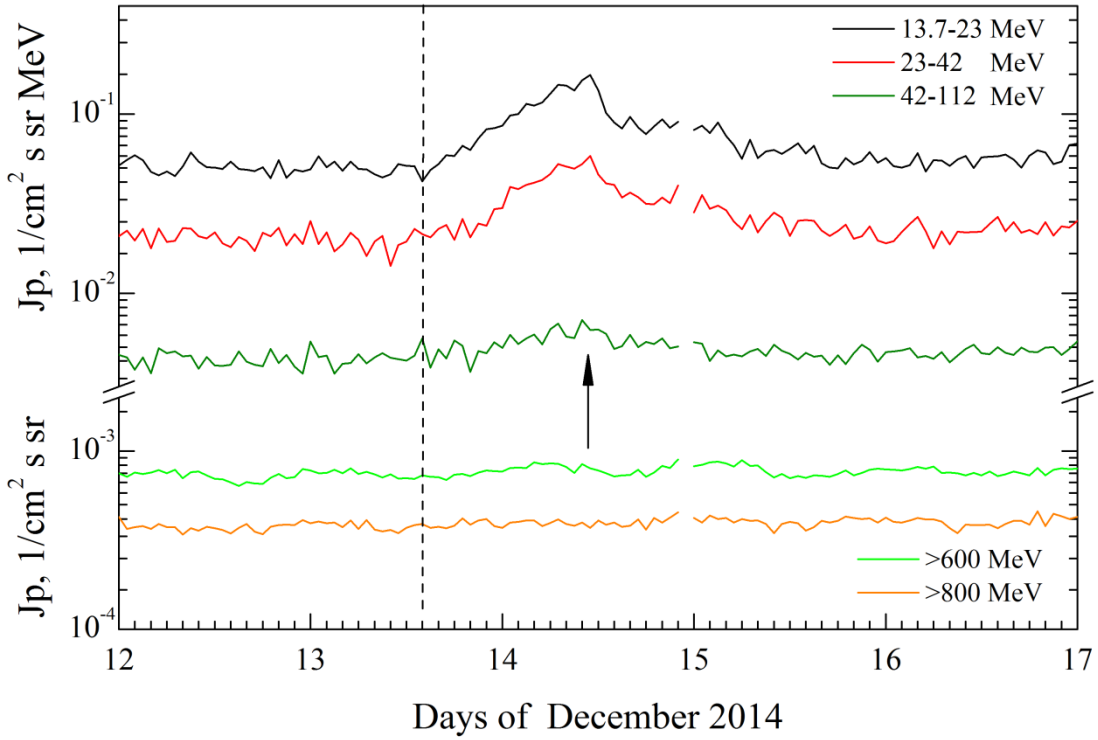




GOES. Event 2014.12.13

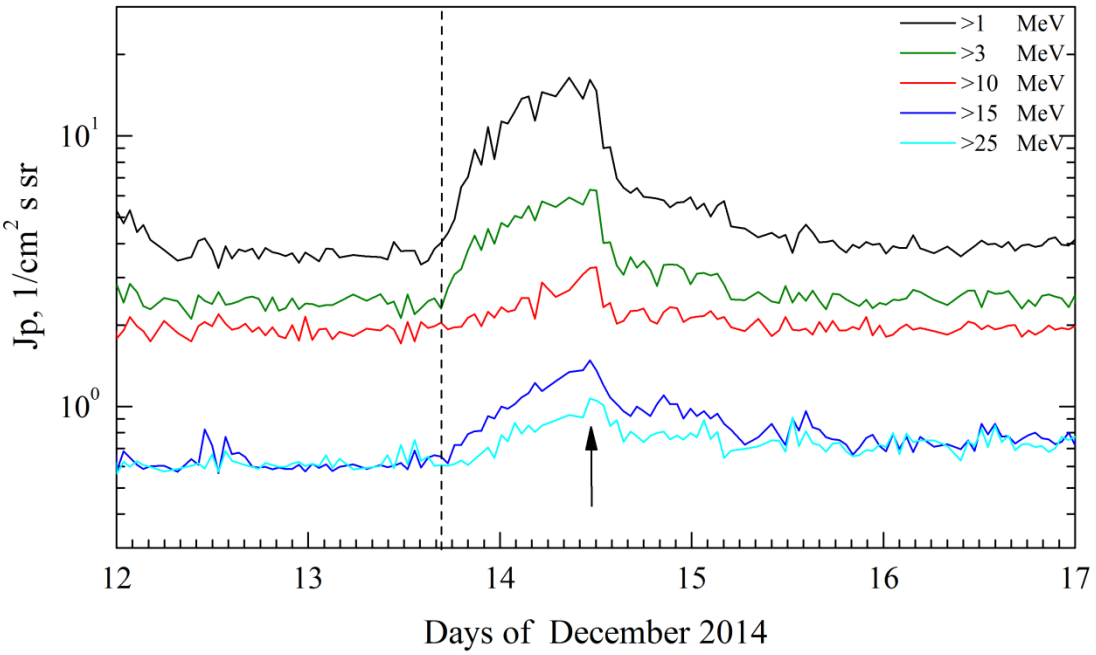


Electro. Event 2014.12.13

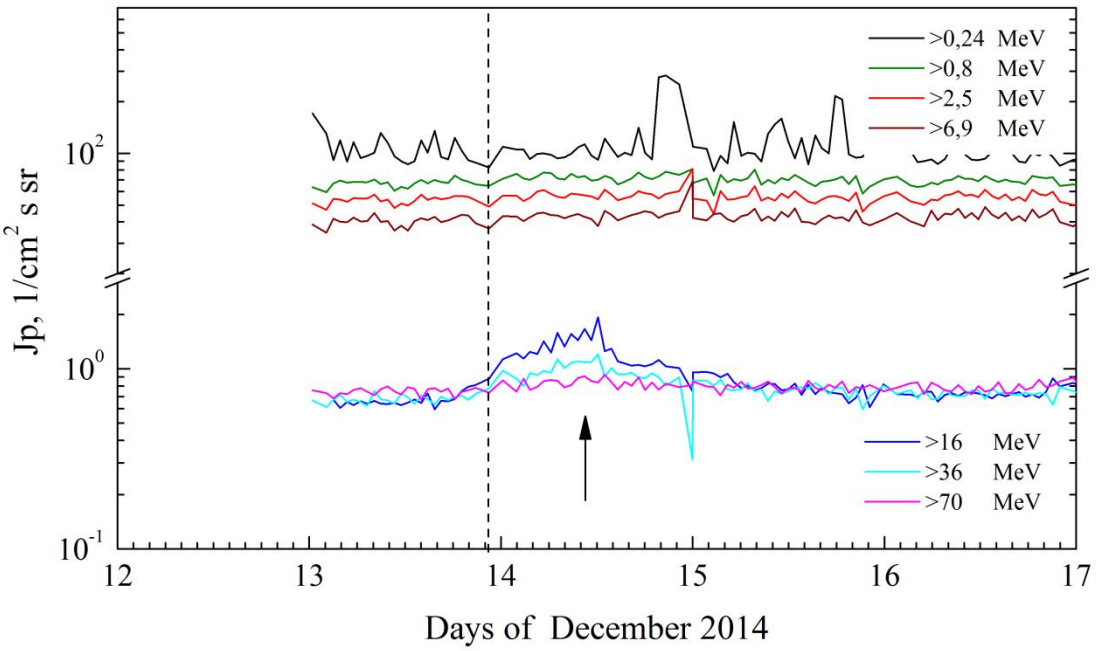


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2014.12.13



POES. Event 2014.12.13



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 December 13

2014 December 13 ⊡ AR 12222 To event 561

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	No optical event on visible solar disc						
1 – 12	No soft X-ray event on visible solar disc						

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
25-50	keV	1421:20	1433:14	1440:20	1179	2353513	HESSI
12-25	keV	1507:56	1509:26	1543:16	42	64884	HESSI

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	107-180	1448		1451	955	2	
DH II	3.9-14	1427		1451			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1424	2222	- 84.4	360˚	265˚	SOHO

Proton Active Regions:

AR 12222 (S20L084, CMP 02,3.11.2014,
Sp=680 msh, EKC, BG)
XRI=1.07 $M_5^{6.1}+C_{55}$ $2_1+1_7+S_{100}$
PFR 4-5.12 (30^h) $M_3^{6.1}$

References:

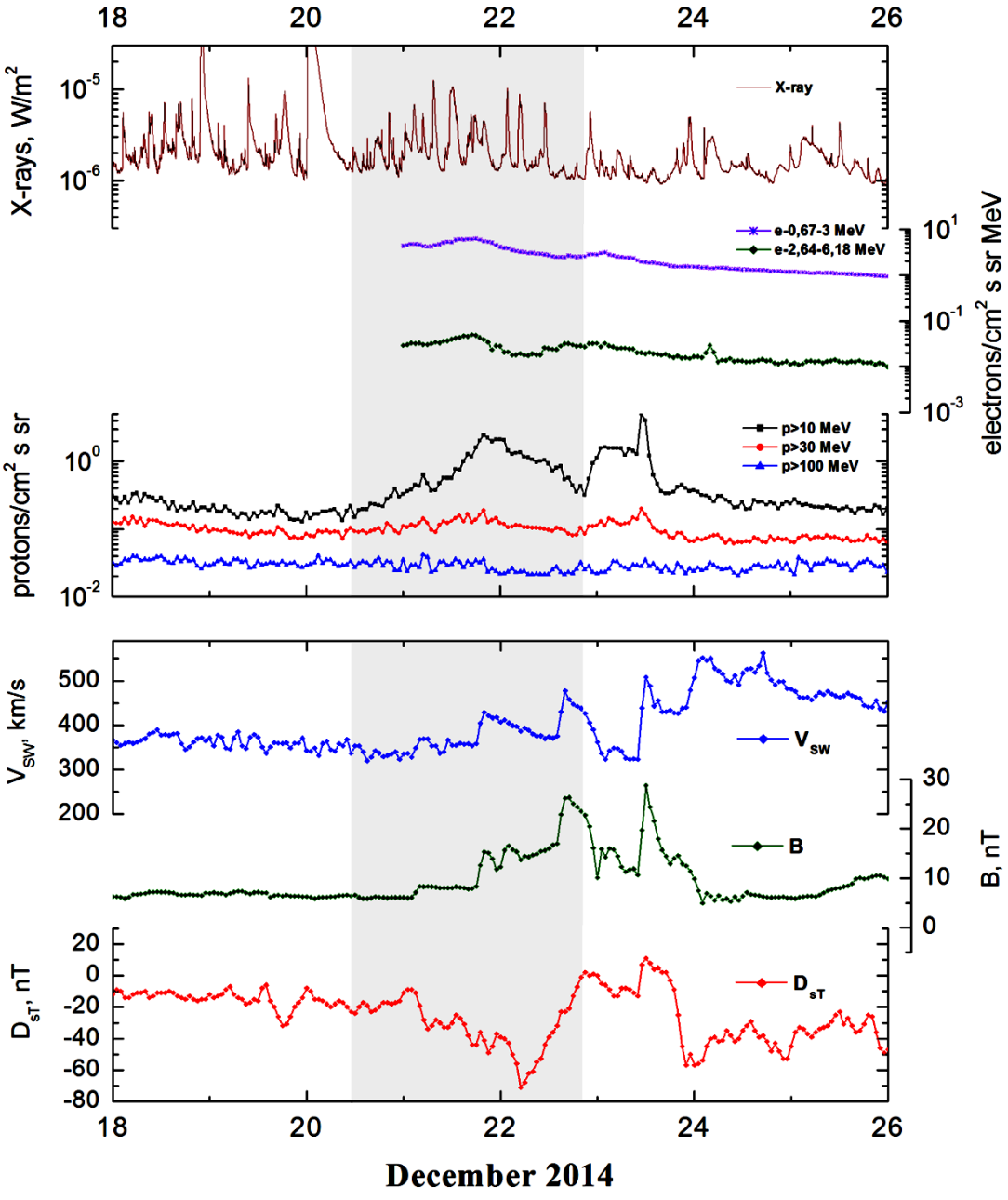
Richardson I.G., T.T. von Rosenvinge, H.V. Cane, 2016.

Event 2014.12.21– (2014-355) **562**

Particle event: To(Ep>10 MeV) – 21d08^{h}
Tmax(Ep>10 MeV) – 21d21^{h}, Jmax(Ep>10 MeV) – 2.4 /cm^{2}·s·sr
Duration of the event – 1.5 days, power-law index: γ = 3.1
Quasimaximal energy of protons in the event – Eqm = 55 MeV

Sources: ● solar flare 21d11^{h}24^{m}, M1.0/, S13W25, AR12241
Ø solar flare 20d00^{h}11^{m}, X1.8/3B, S21W24, AR12242
Main burst X-ray 1–8 Å: onset – 21d11^{h}24^{m}, max – 21d12^{h}17^{m}, Φ = 0.046 J/m^{2}
CME: 21d12^{h}12^{m}, V = 669 km/s, Δφ = 360°, dA = 189°
▲ SC 21d19^{h}11^{m}, ▲ SC 22d15^{h}11^{m}

Particle fluxes and associated phenomena

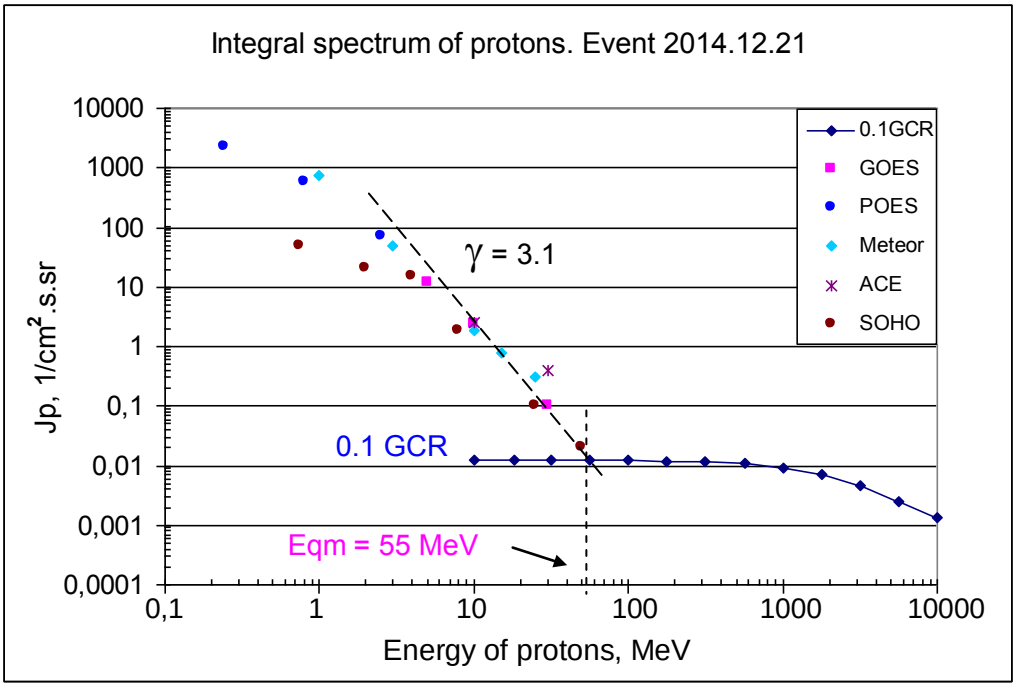


Integral fluxes of protons for the event of 2014 December 21

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	8	22	12	1.5	0.2	
EPS	>10	8	21	2.4	1.5	0.12	
EPS	>30	8	20	0.1	1.5	0.07	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	14	22d04	2200	1	90	
MEPED	>0.8	14	22d04	600	1	70	
MEPED	>2.5	14	22d04	70	1	55	
MEPED	>6.9	-	-	-	-	40	
MEPED	>16	-	-	-	-	0.65	
MEPED	>36	-	-	-	-	0.7	
MEPED	>70	-	-	-	-	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-2							
SCR	>1	9	22d01	755	2.5	3.7	
SCR	>3	9	22d01	50	2.5	2.5	
SCR	>10	9	22	1.9	1.5	1.9	
GALS-M	>15	9	21	0.8	1.5	0.6	
GALS-M	>25	9	21	0.3	1	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	8	20	2.5	1.5	1.2	
SIS	>30	8	19	0.4	1.5	1	
SOHO							
EPHIN	>50	-	17	0.02	-	0.2	

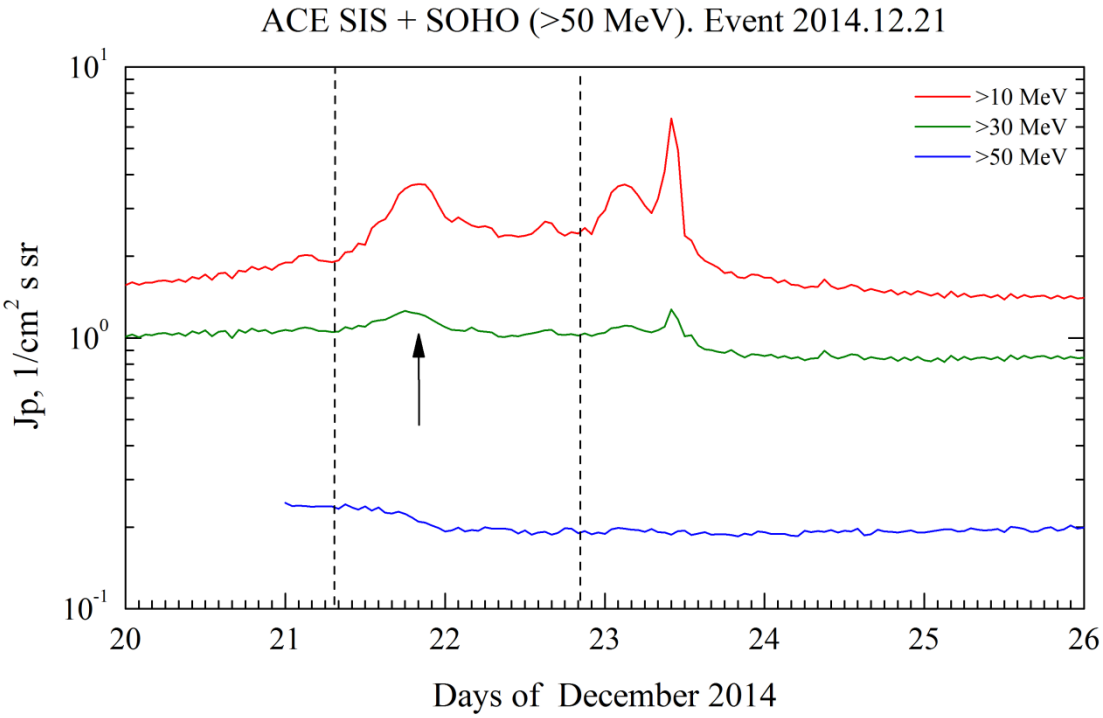
Differential fluxes of protons for the event of 2014 December 21

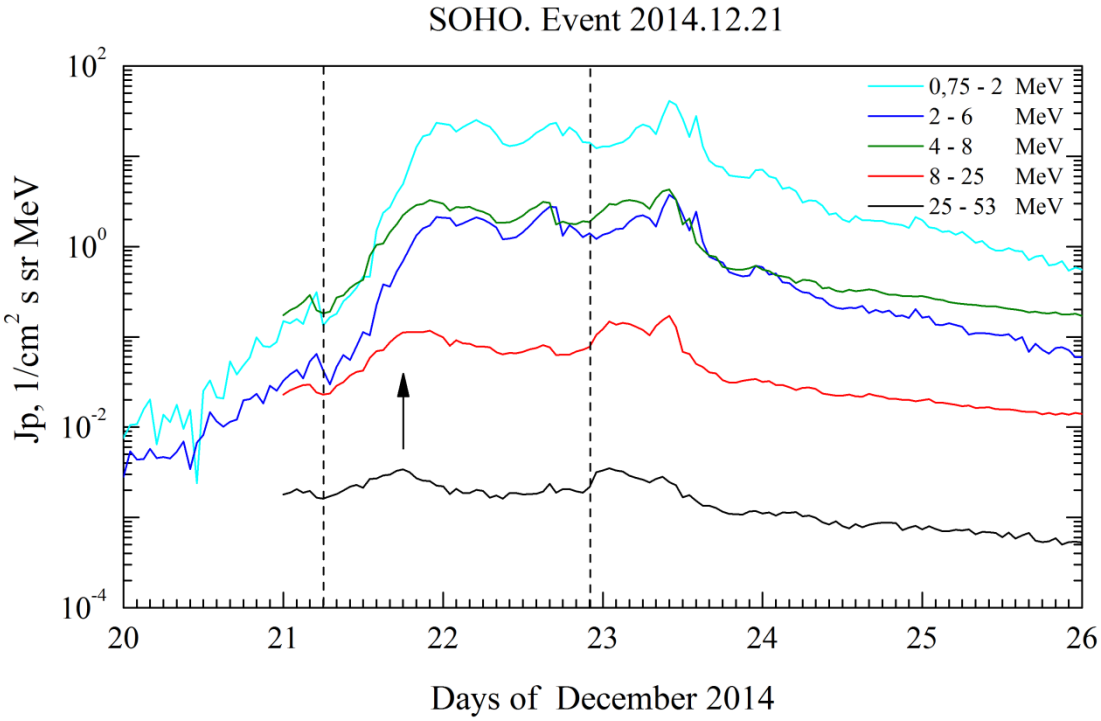
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	20d00	23	23.5	1.5	0.002	
LION	2 – 6	20d00	23	2.12	1.5	0.001	
EPHIN	4 – 8	<21d00	22	3.27	1.5	0.001	
EPHIN	8 – 25	<21d00	17	0.1	1.5	0.0003	
EPHIN	25 – 53	<21d00	17	0.003	1.5	0.00002	
Electro-1							
SCR-E	13.7–23	12	-	-	1	0.05	
SCR-E	23–42	12	-	-	1	0.02	
SCR-E	42–112	12	-	-	1	0.004	


Integral spectrum of protons. Event 2014.12.21
Jp, 1/cm2.s.sr
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 3.1
0.1 GCR
Eqm = 55 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO

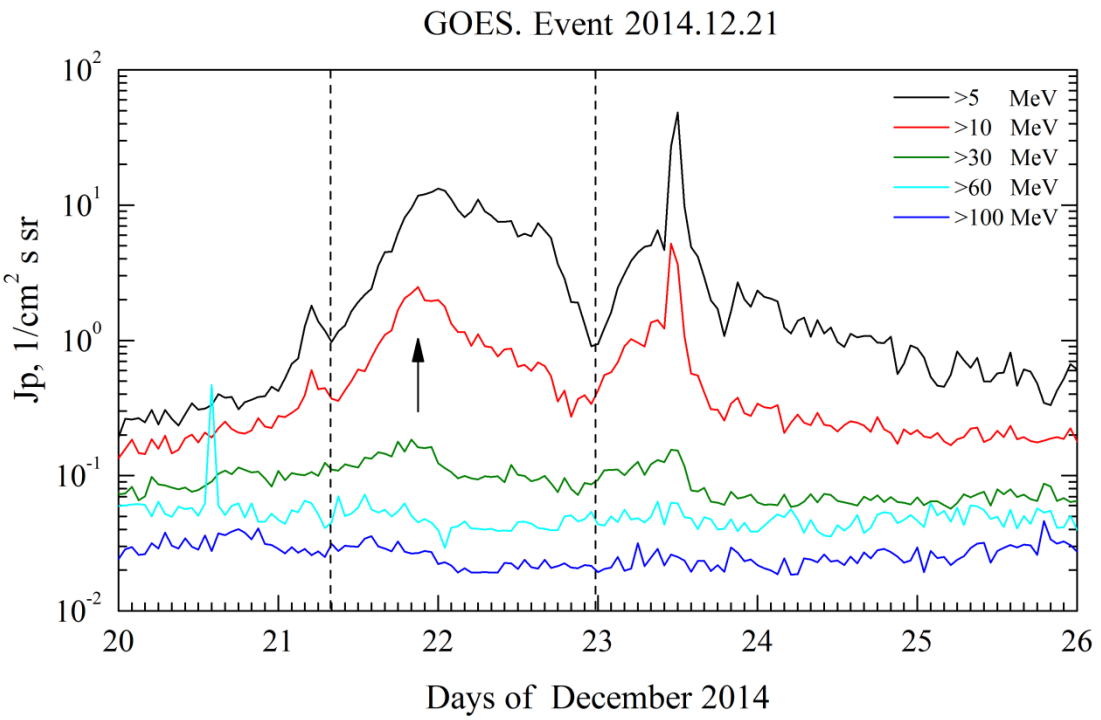
Time profiles of proton fluxes in the event 2014.12.21

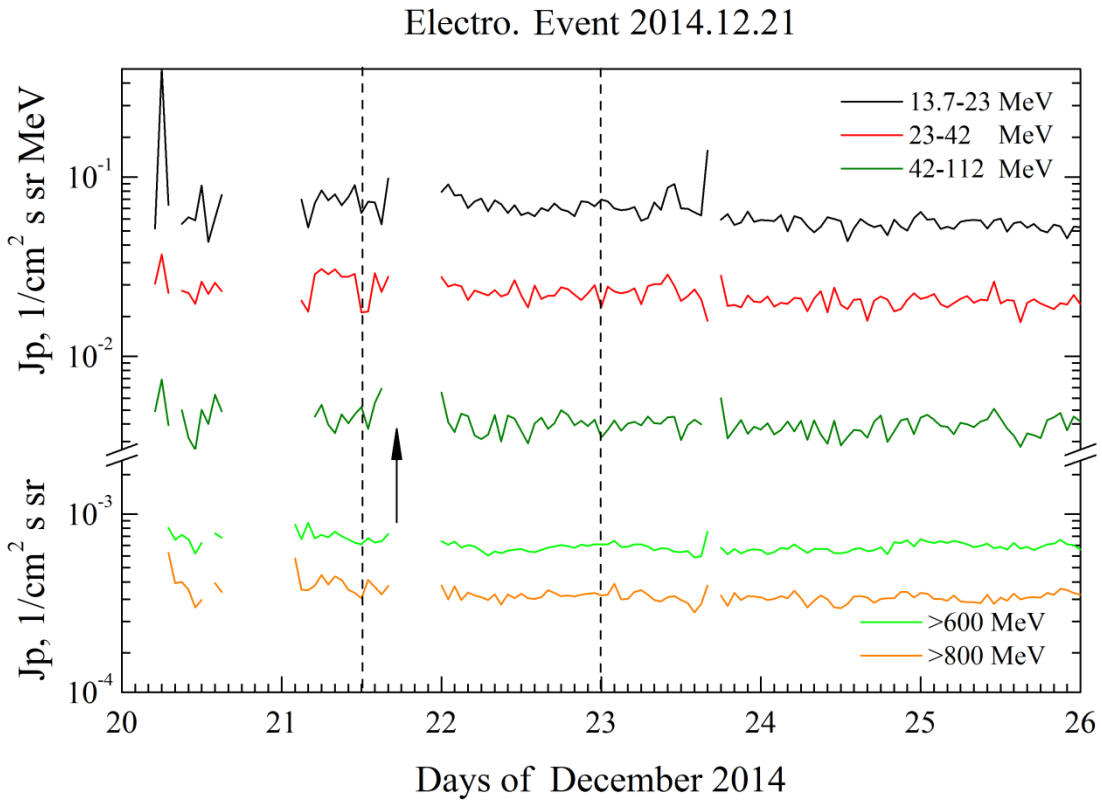
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



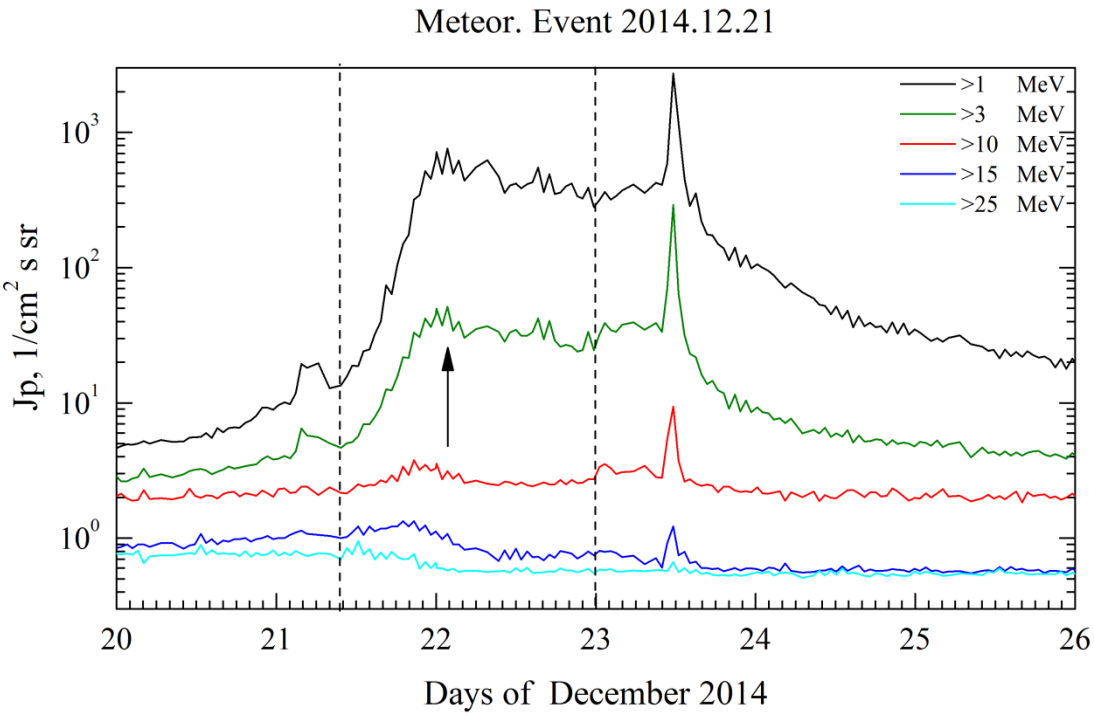


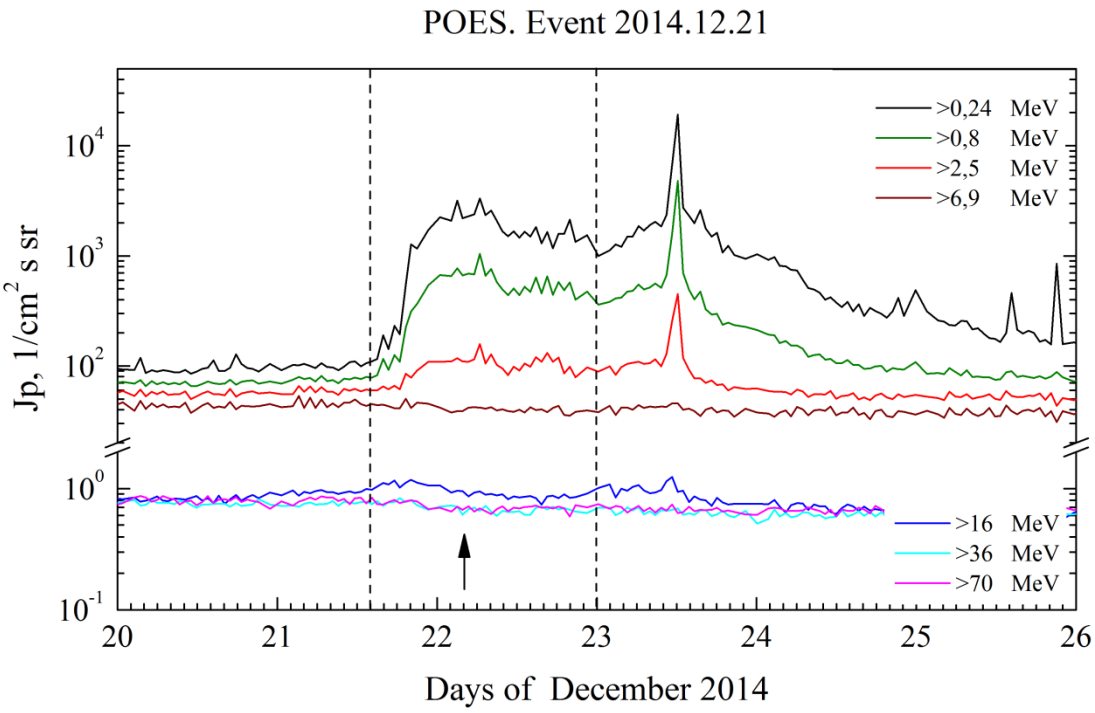
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 December 21

2014 December 21 ● AR 12241 To event 562

WL, X-ray		To	Tmax	Te	Location	Importance	Class; Φ, J/m^2
6563 Å	FL	No optical flare on visible solar disk					
1 – 12	keV	1124	1217	1257	S13W25	M1.0	0.046

X-ray		To	Tmax	Te	Npeak, counts	Total counts	Sp/c
25-50	keV	1151:12	1139:54	1149:28	48	17101	HESSI
25-50	keV	1149:28	1200:10	1233:56	53	406328	HESSI
12-25	keV	11:21:21	1136:10	1139:27	7631	935065	FERMI
12-25	keV	12:15:54	12:24:22	12:35:09	2138	443580	FERMI
12-25	keV	1252:18	1259:44	1307:48	7228	250349	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
1.4	GHz	1209	1209	1210		2.0	
410	MHz	1154	1155	1157		2.52	
245	MHz	1154	1155	1202		2.73	

SP-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS VI	25-180	1121		1202		2	
DS CTM	46-180	1226		2101		2	
DH II	7.4-14	1205		1228			WIHD

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1212	669	- 13.0	360˚	189˚	SOHO

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0012	0026	0241	S21W24	3B*	UMB
1 – 12	keV	0011	0028	0055	S19W29	X1.8	0.27

X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0013:526	0025:22	0036:02	902259	740384704	FERMI
12-25	keV	0118:31	0118:39	0216:53	49897	11627386	FERMI
100-300	keV	0034:44	0042:42	0052:40	8656	29856568	HESSI
100-300	keV	0052:40	0054:34	0140:56	7390	11842462	HESSI
100-300	keV	0210:12	0211:50	0246:48	80	388094	HESSI

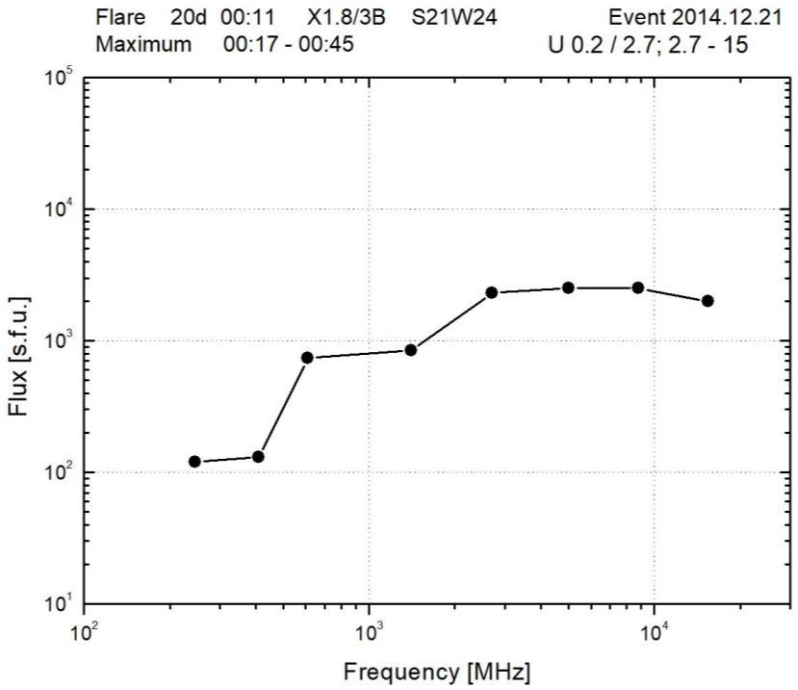
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0017	0022	0222		3.3	
8.8	GHz	0017	0021	0159		3.4	
5	GHz	0017	0022	0109		3.4	
2.7	GHz	0018	0024	0100	2.7 – 15	3.36	
1.4	GHz	0022	0038	0038		2.92	
610	MHz	0027	0030	0039		2.87	
410	MHz	0038	0038	0041		2.11	
245	MHz	0045	0045	0045	U 0.2 / 2.7	2.08	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-75	0050		0107		1	
DS III	25-150	0035		0200		2	

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0126	830	- 8.5	257°	197°	SOHO

*Contribution to the beginning of the event

Radio burst frequency spectrum



Proton Active Region:

AR12241 (S09L217, CMP 19,6.12.2014,
Sp=720 msh, EKC. BGD, R)
XRI=1.19 $M_5^{6.9}$+C_{20} 2_2+1_3+S_{49}
PFR 17-18.12 (27^h) $M_2^{6.9}$

AR 12242 (S18L237, CMP 17,9.12.2014,
Sp=1080 msh, EKC, BGD, R)
XRI=3.39 $X_1^{1.8}$+$M_6^{8.7}$+C_{51} 3_1+2_1+1_{11}+S_{91}
PFR1 17.12 (3^h) $M_2^{8.7}$
PFR2 19-20.12 (14^h) $X_1^{1.8}$+M_1
Complex of active regions: AR12241+ AR 12242

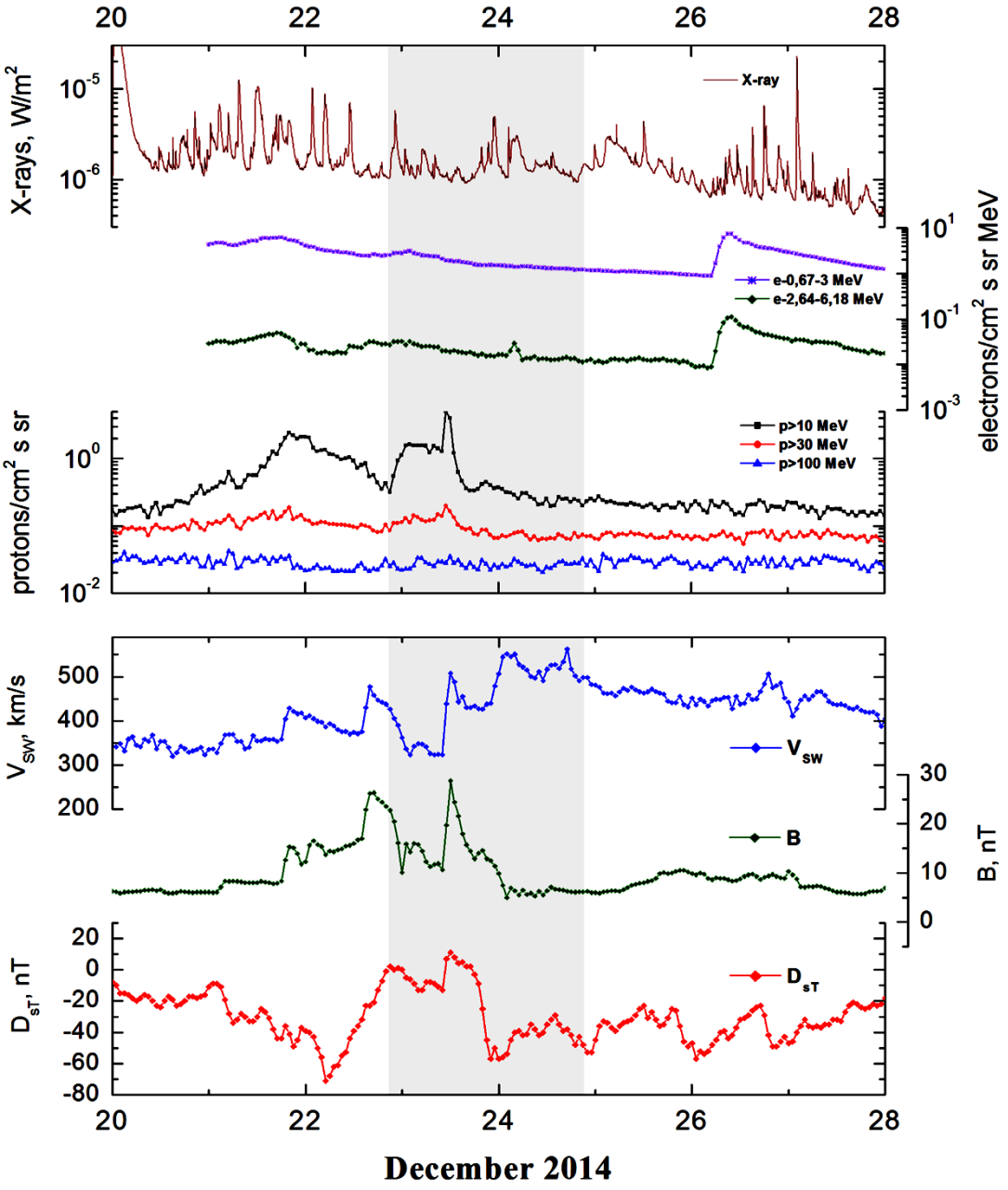
References:

Gopalswamy N., S. Yashiro, H. Xie et al., 2015.

Particle event: To(Ep>10 MeV) – 23d00^{h}
Tmax(Ep>10 MeV) – 23d12^{h}, Jmax(Ep>10 MeV) – 5 /cm^{2}·s·sr
Duration of the event – 2 days, power-law index: γ = 3.4
Quasimaximal energy of protons in the event – Eqm = 50 MeV

Sources: ⊙ solar flare 22d21^{h}15^{m}, C5.7*, S19W71, AR12242
Main X-ray burst 1-8 Å: onset – 22d21^{h}15^{m}, max – 22d22^{h}25^{m}, Φ = 0.015 J/m^{2}
▲ SC 22d15^{h}11^{m}, ▲ SC 23d11^{h}15^{m}
* Long duration flare (> 3^{h})

Particle fluxes and associated phenomena

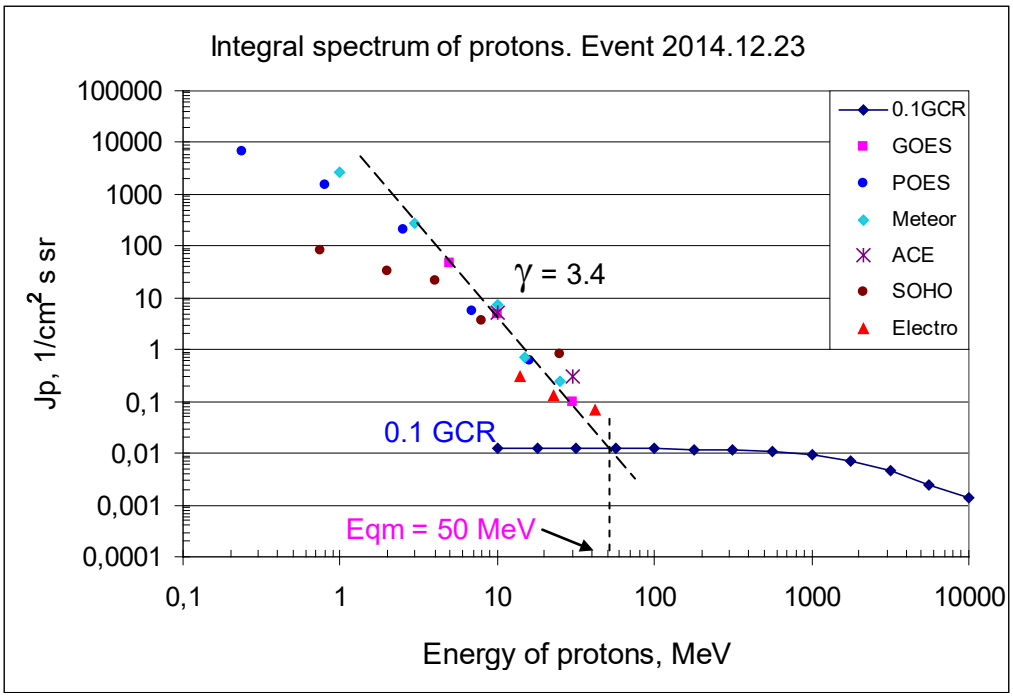


Integral fluxes of protons for the event of 2014 December 23

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	0	12	48	2	0.2	
EPS	>10	0	12	5	2	0.12	
EPS	>30	0	12	0.1	2	0.07	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>0.24	1	11	6550	3	120	
MEPED	>0.8	1	11	1500	2	80	
MEPED	>2.5	1	11	210	1	50	
MEPED	>6.9	1	11	5.6	-	40	
MEPED	>16	1	11	0.6	-	0.65	
MEPED	>36	-	-	-	-	0.7	
MEPED	>70	-	-	-	-	0.75	
MEPED	>140	-	-	-	-	1	
Meteor-2							
SCR	>1	24	12	2640	1	3.7	
SCR	>3	24	12	280	1	2.5	
SCR	>10	24	12	7.4	0.5	1.9	
GALS-M	>15	24	11	0.7	0.5	0.6	
GALS-M	>25	24	11	0.25	0.25	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	22d22	10	5.2	1.5	1.2	
SIS	>30	22d22	10	0.3	1	1	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

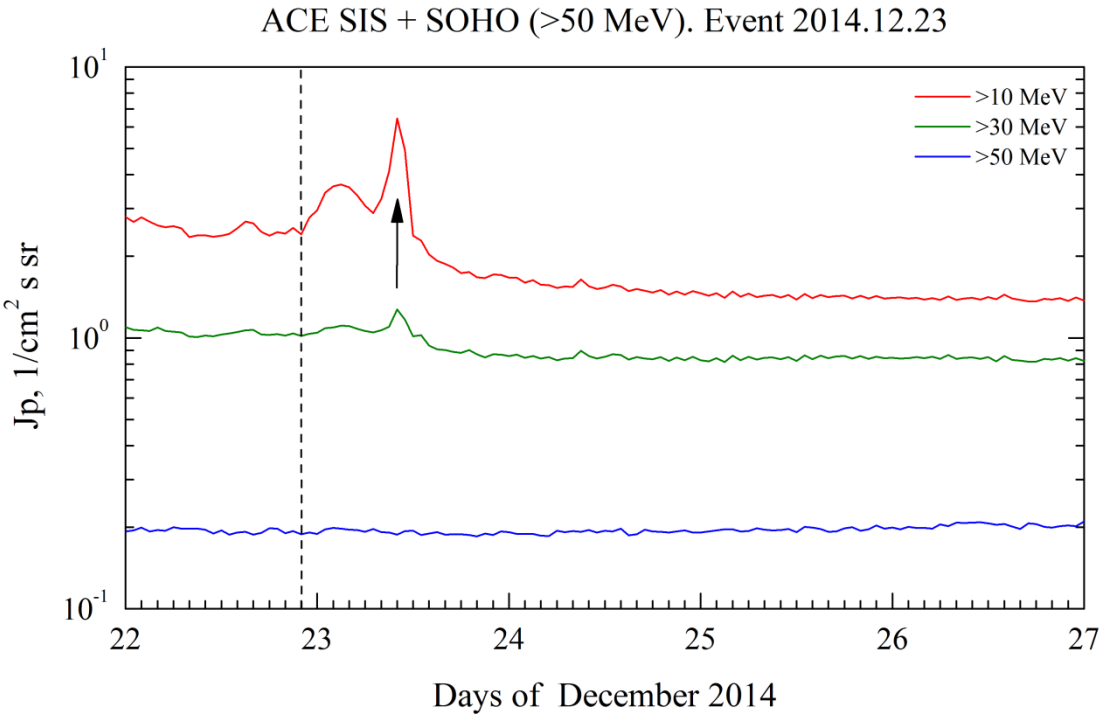
Differential fluxes of protons for the event of 2014 December 23

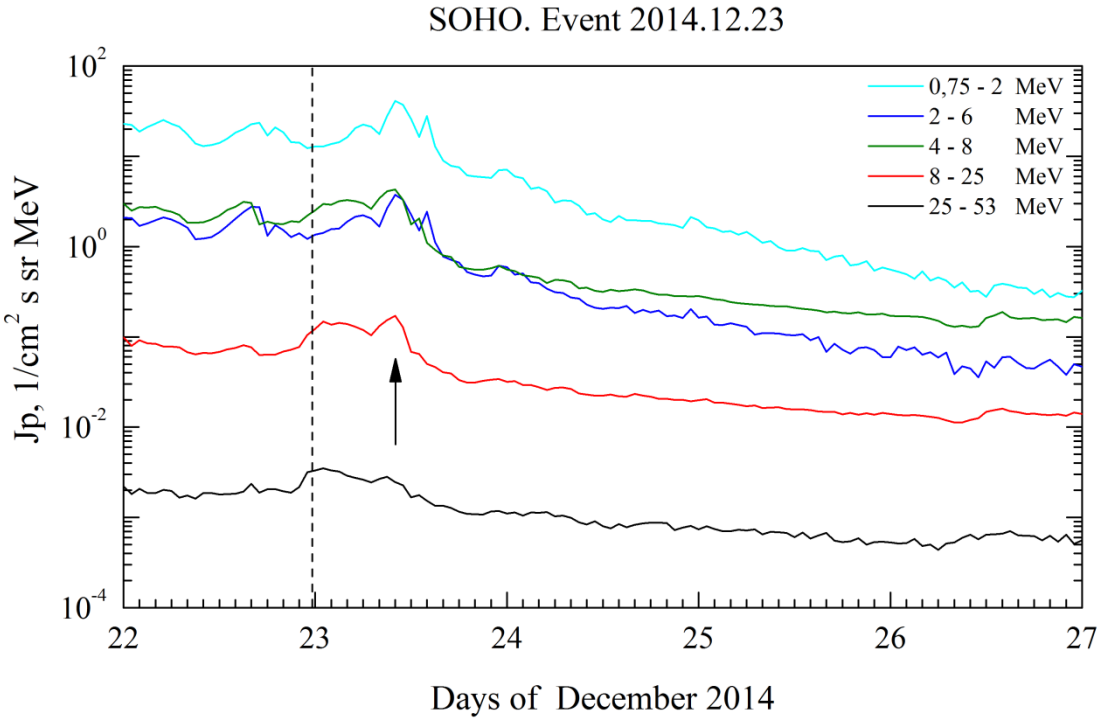
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	00	10	41.2	1	0.002	
LION	2 – 6	00	10	3.74	1	0.001	
EPHIN	4 – 8	00	10	4.28	1	0.001	
EPHIN	8 – 25	00	10	0.17	1	0.0003	
EPHIN	25 – 53	00	09	0.028	1	0.00002	
Electro-1							
SCR-E	13.7–23	5	11	0.02	1	0.07	
SCR-E	23–42	5	11	0.003	1	0.025	
SCR-E	42–112	-	11	0.001	-	0.004	

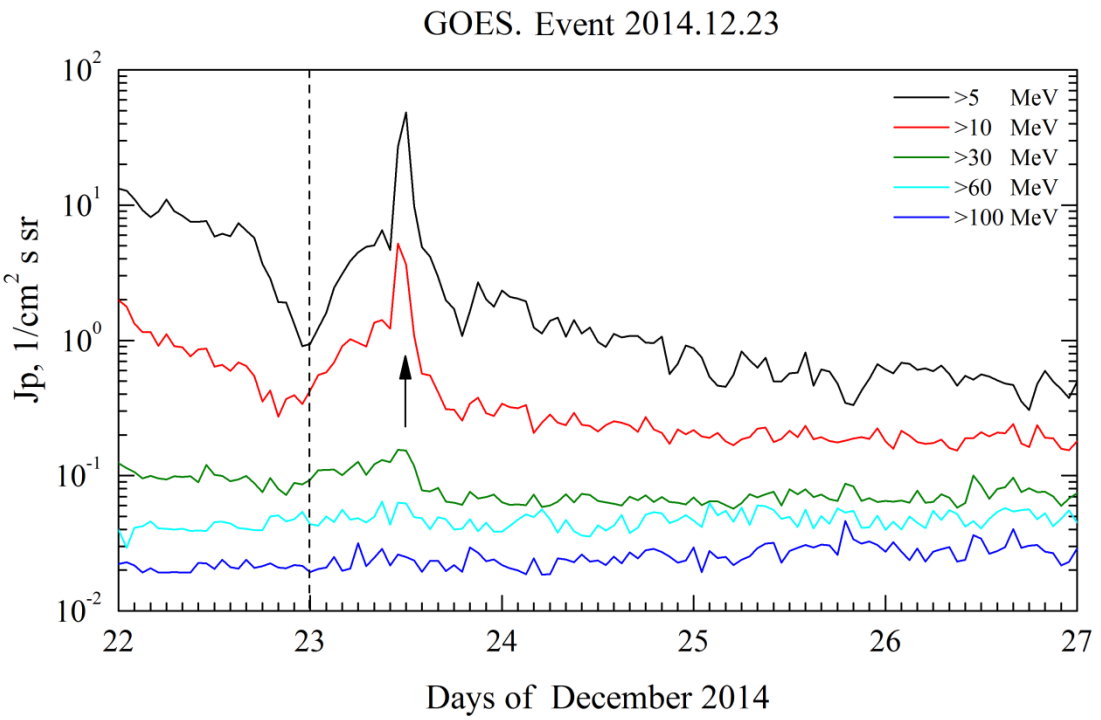

Integral spectrum of protons. Event 2014.12.23
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
γ = 3.4
0.1 GCR
Eqm = 50 MeV
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

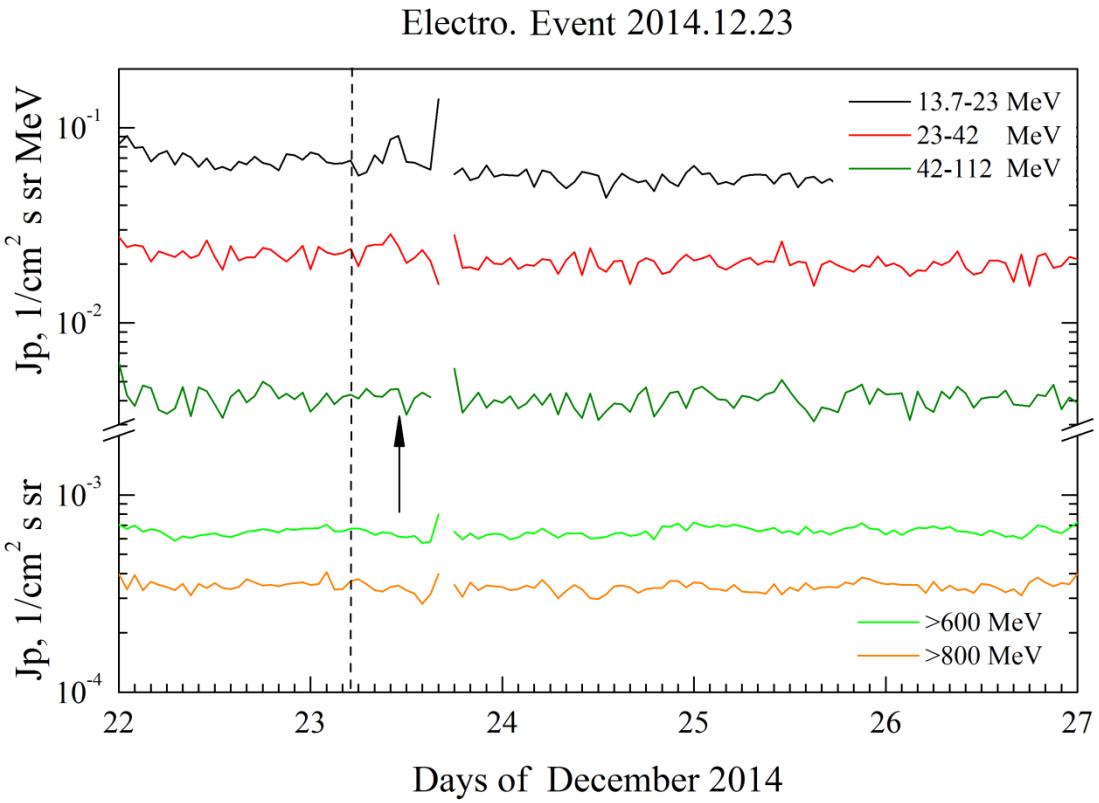
Time profiles of proton fluxes in the event 2014.12.23

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

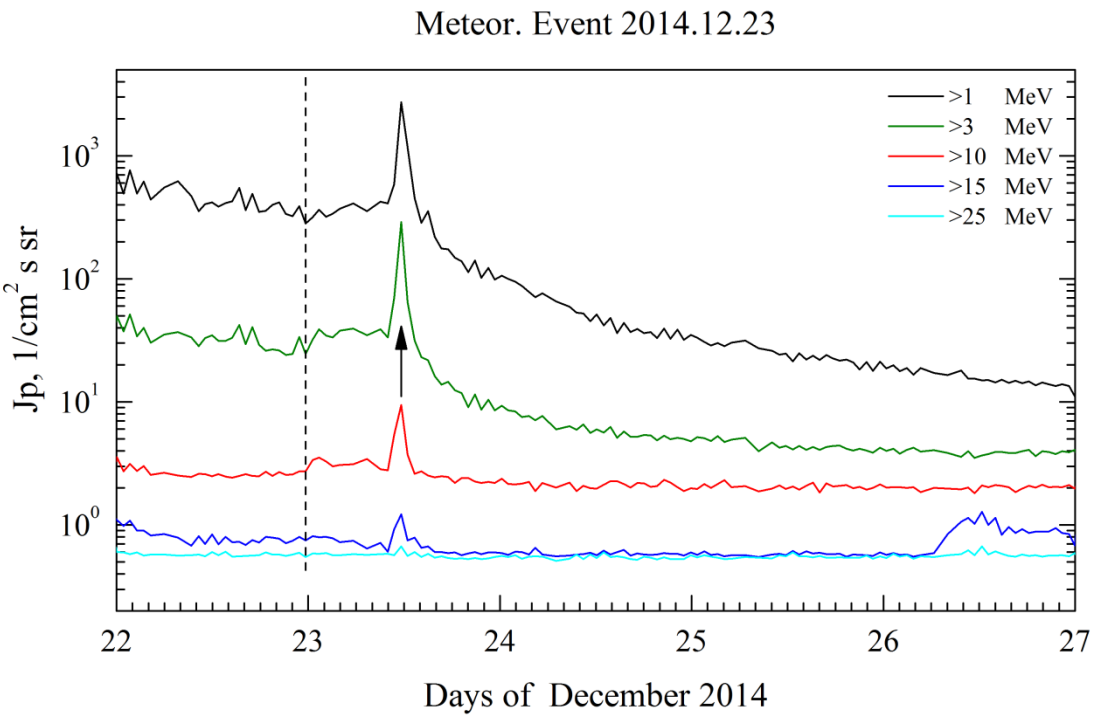


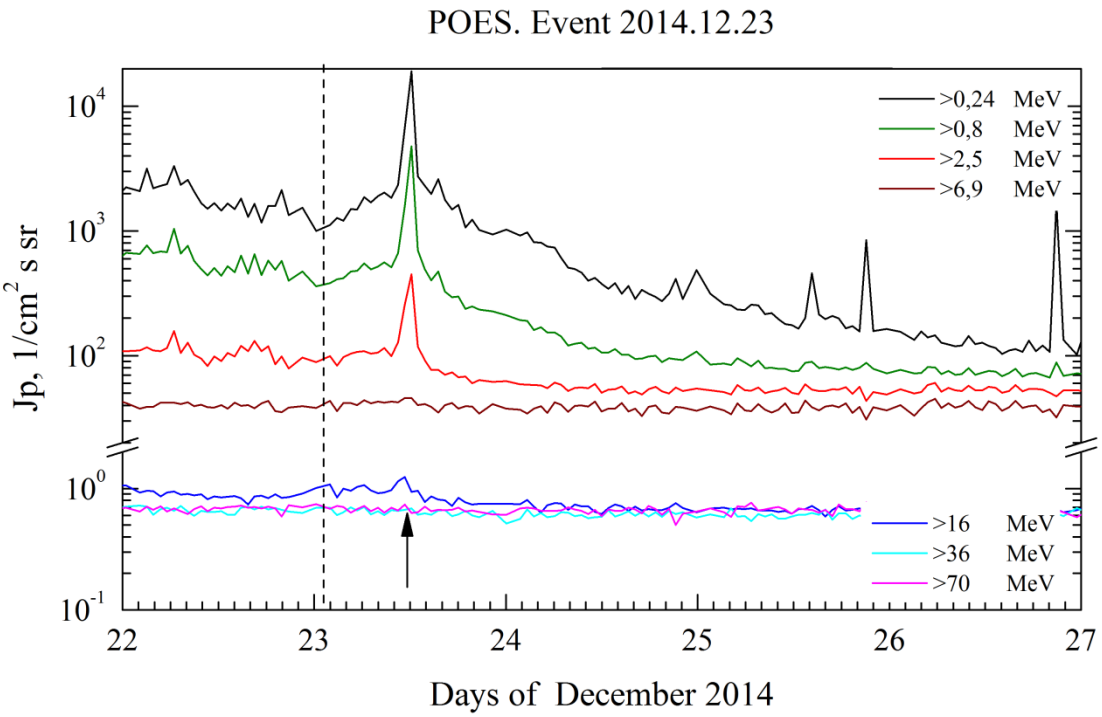



GOES. Event 2014.12.23
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of December 2014


Electro. Event 2014.12.23
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13.7-23 MeV
23-42 MeV
42-112 MeV
>600 MeV
>800 MeV
Days of December 2014

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2014 December 23

2014 December 22 ⊙ AR 12242 To event 563

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No flare on visible disk					
1 – 12	keV	2115	2225	2239	S17W71	C5.7	0.015
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12 – 25	keV	2110:40	2120:38	2123:48	256	458960	HESSI
25 – 50	keV	2213:32	2217:54	2244:04	152	424362	HESSI
12 – 25	keV	2210:03	2218:07	2223:06	6761	678448	FERMI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS CTM	72-180	2156		2359		1	

Proton Active Region:

AR 12242 (S18L237, CMP 17,9.12.2014,
Sp=1080 msh, EKC, BGD, R)
XRI=3.39 $X_1^{1.8}$+$M_6^{8.7}$+C_{51} 3_1+2_1+1_{11}+S_{91}
PFR1 17.12 (3^h) $M_2^{8.7}$
PFR2 19-20.12 (14^h) $X_1^{1.8}$+M_1

События 2015 года

			Страница
1	*Event 2015.01.27 – (2015-027)	№ 564	750
2	Event 2015.02.21 – (2015-052)	№ 565	758
3	Event 2015.03.15 – (2015-074)	№ 566	765
4	Event 2015.03.16 – (2015-075)	№ 567	772
5	*Event 2015.04.22 – (2015-112)	№ 568	780
6	Event 2015.05.12 – (2015-132)	№ 569	787
7	Event 2015.06.18 – (2015-169)	№ 570	794
8	Event 2015.06.21 – (2015-172)	№ 571	801
9	Event 2015.06.25 – (2015-176)	№ 572	811
10	Event 2015.07.01 – (2015-182)	№ 573	820
11	Event 2015.09.20 – (2015-263)	№ 574	827
12	*Event 2015.09.30 – (2015-273)	№ 575	835
13	*Event 2015.10.22 – (2015-295)	№ 576	843
14	Event 2015.10.29 – (2015-302)	№ 577	850
15	Event 2015.11.09 – (2015-313)	№ 578	857
16	Event 2015.12.28 – (2015-362)	№ 579	865

Звездочкой (*) отмечены слабые события с Jp (E > 10 МэВ) в интервале 0.1 ÷ 1 pfu

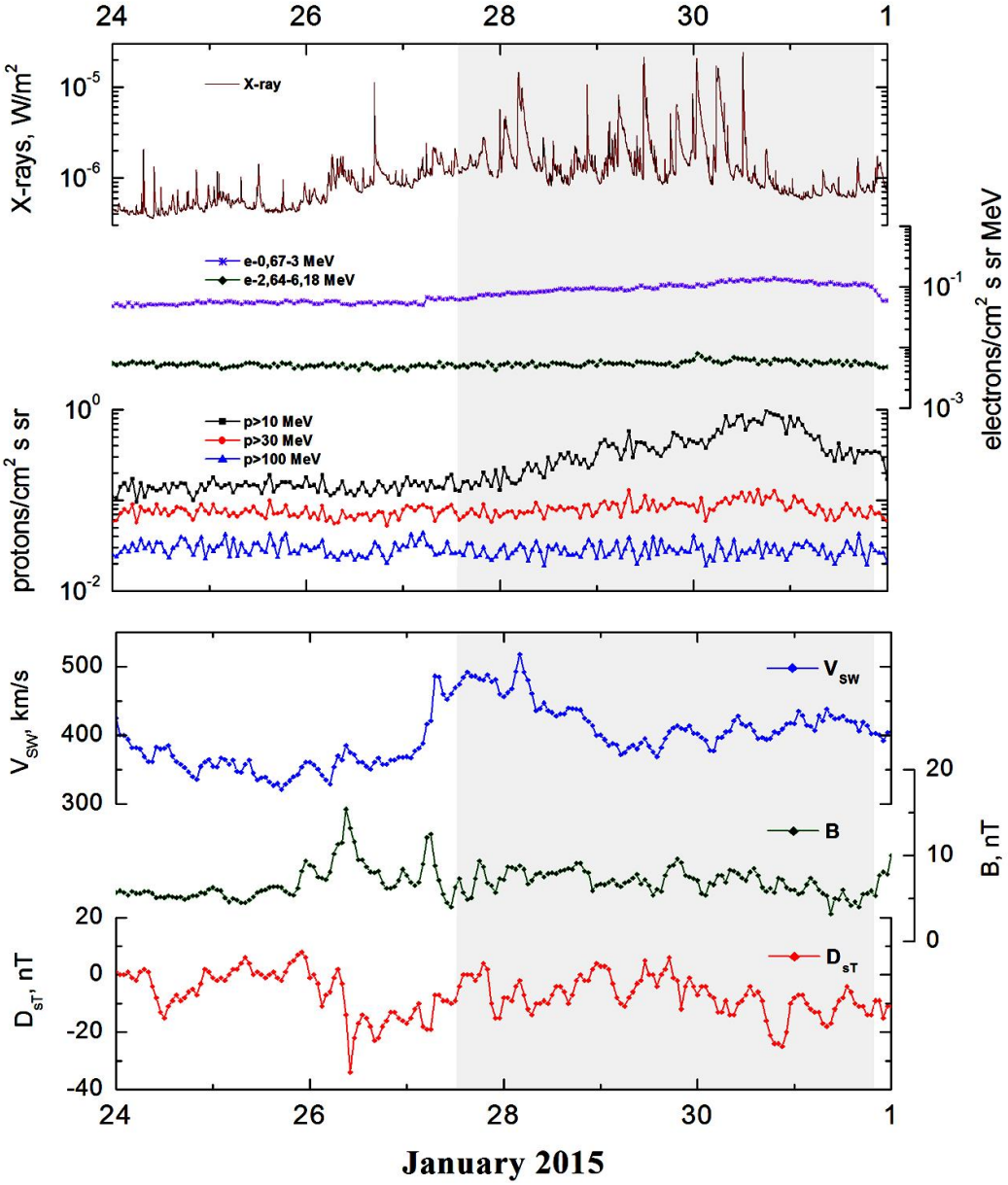
The small Event 2015.01.27 – (2015-027) **564**

Particle event: To(Ep>10 MeV) – 27d19^{h}
Tmax$_1$(Ep>10 MeV) – 29d01^{h}, Jmax$_1$(Ep>10 MeV) – 0.5 /cm^2·s·sr (ACE)
Tmax$_2$(Ep>10 MeV) – 30d19^{h}, Jmax$_2$(Ep>10 MeV) – 1.0 /cm^2·s·sr (ACE)
Duration of the event – 4 days, power-law index: γ_1 = 4.8, γ_2 = 2.4
Quasimaximal energy of protons in the event – Eqm$_1$ = 20 MeV
– Eqm$_2$ = 60 MeV

Sources: ⊡ solar flare 27d07^{h}13^{m}, C2.1/, N07E89, AR12277, 1d behind E$_L$
Ø solar flare 28d21^{h}32^{m}, M1.0/SF, N08E73, AR12277
Ø solar flare 30d12^{h}10^{m}, M2.4/, N07E52, AR12277

Main burst X-ray 1–8 Å: onset – 27d07^{h}13^{m}, max – 27d07^{h}33^{m}, Φ = 0.0086 J/m^2
CME: 27d08^{h}23^{m}, V = 332 km/s, Δφ = 009º, dA = 119º

Particle fluxes and associated phenomena

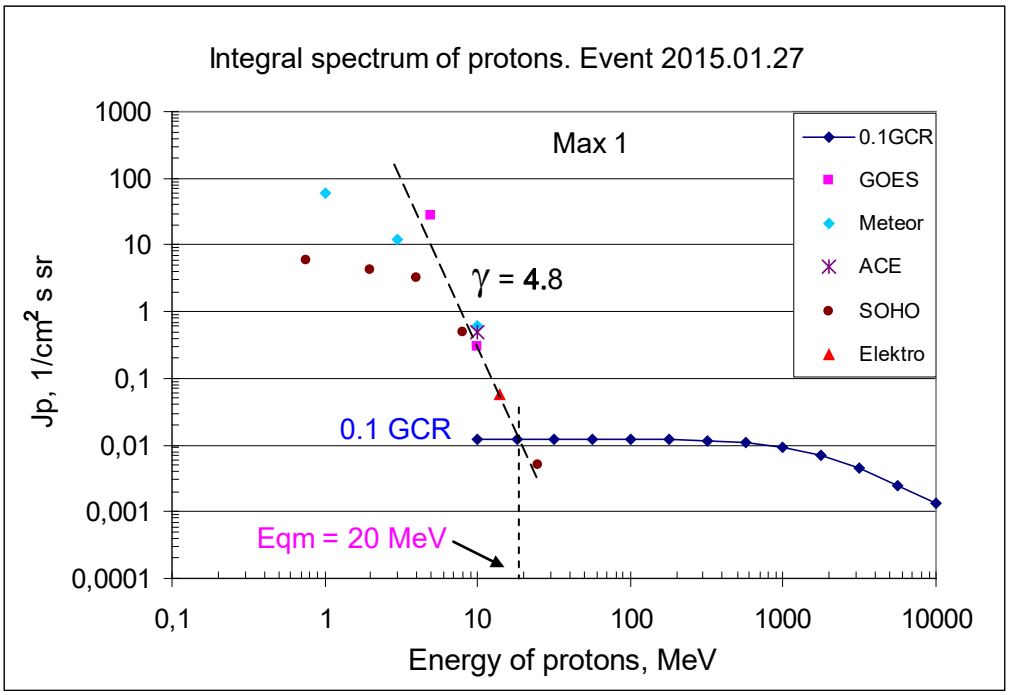


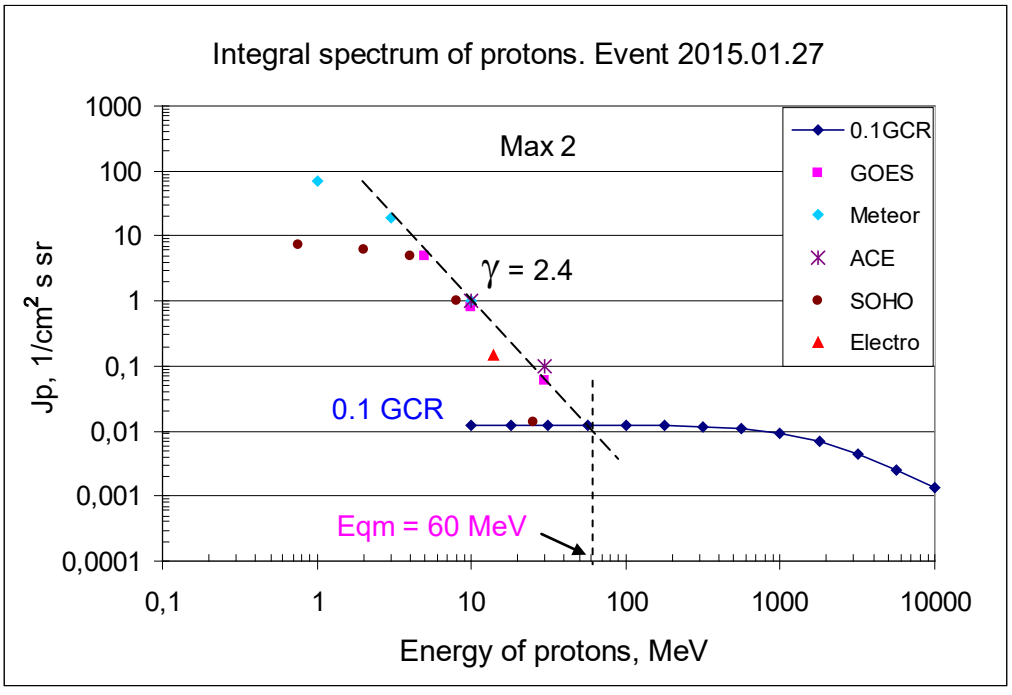
Integral fluxes of protons for the event of 2015 January 27

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	19	29d01/30d19	2.7/5	4	0.2	
EPS	>10	19	29d01/30d19	0.3/0.8	4	0.12	
EPS	>30	-	- /30d18	- /0.06	4	0.07	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	290	
Meteor-2							
SCR	>1	18	29d03/30d16	60/71	5	3.9	
SCR	>3	18	29d03/30d16	11/19	4.5	2.4	
SCR	>10	-	28d23 /30d18	0.6/1.04	-	1.9	
GALS-M	>15	-	-	-	-	0.6	
GALS-M	>25	-	-	-	-	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	17	29d17/30d19	0.5/1	4	1.2	
SIS	>30	17	- /30d19	- /0.1	4	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

Differential fluxes of protons for the event of 2015 January 27

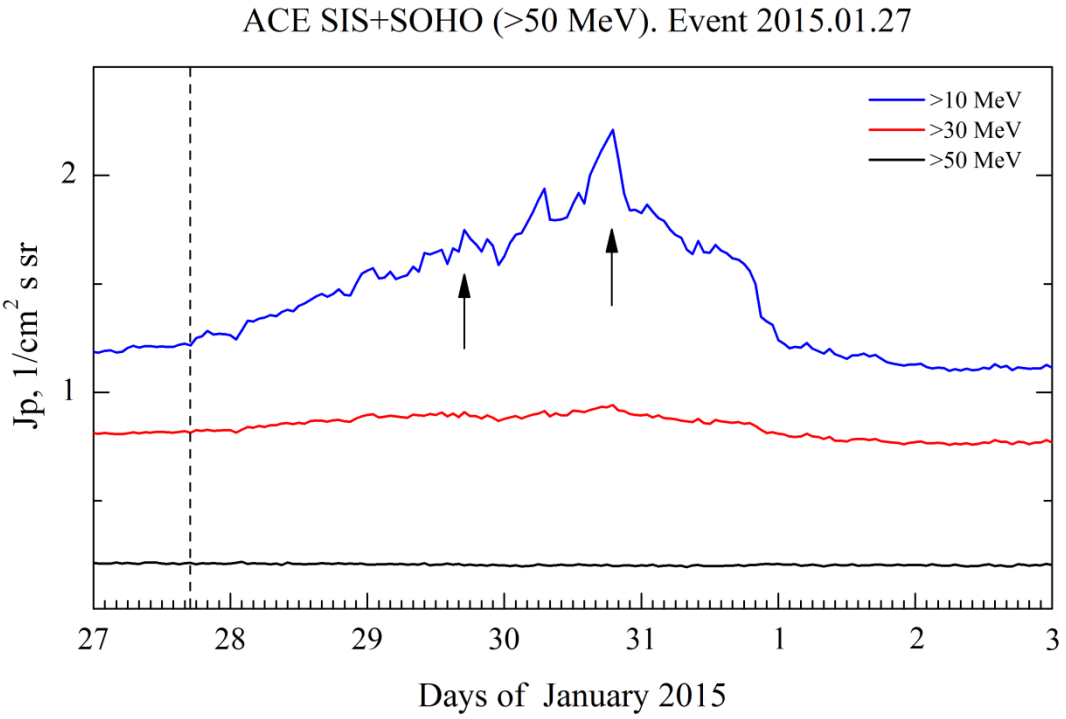
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	17	29d11/30d21	1.5/1.1	4	0.1	
LION	2 – 6	17	29d11/30d21	0.3/0.32	4	0.02	
EPHIN	4 – 8	17	29d12/30d21	0.7/1.02	4	0.05	
EPHIN	8 – 25	17	29d12/30d21	0.031/0.061	4	0.003	
EPHIN	25 – 53	17	29d13/30d11	0.00016/0.0005	4	0.00004	
Electro-1							
SCR-E	13.7-23	16	29d02/ -	0.01/ 0.016	-	0.045	
SCR-E	23-42	-	-	-	-	0.02	
SCR-E	42-112	-	-	-	-	0.004	
POES							
MEPED	16-36	-	-	-	-	0.033	
MEPED	36-70	-	-	-	-	0.005	
MEPED	70-140	-	-	-	-	0.0008	

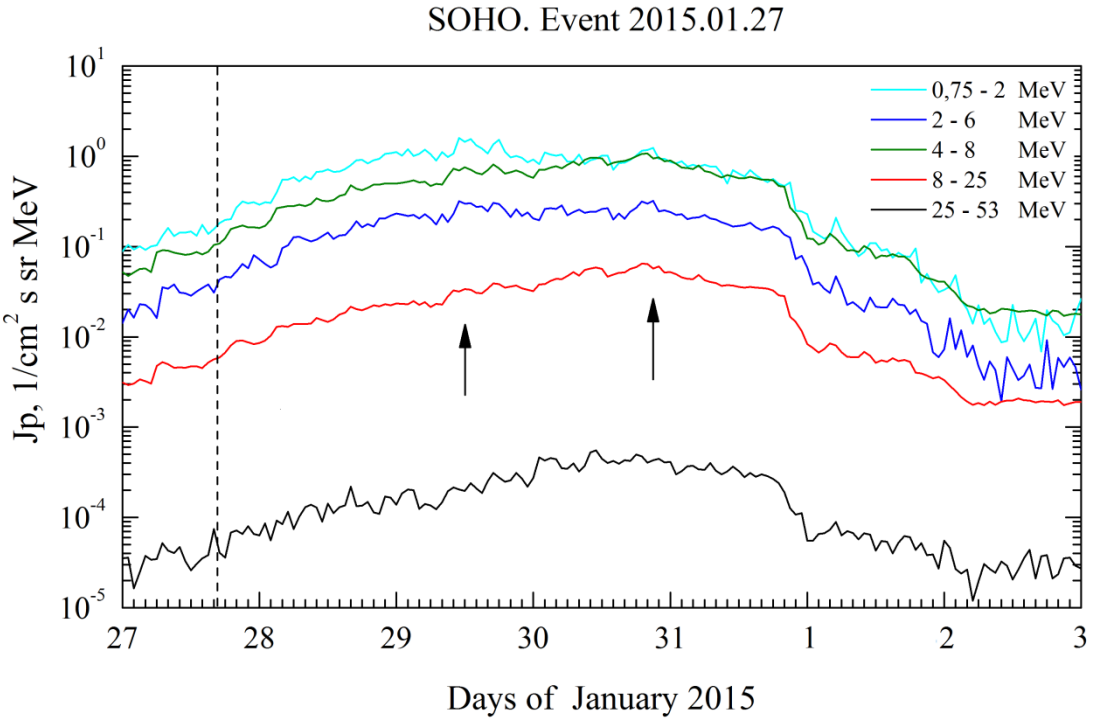

Integral spectrum of protons. Event 2015.01.27
Max 1
γ = 4.8
0.1 GCR
Eqm = 20 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Elektro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

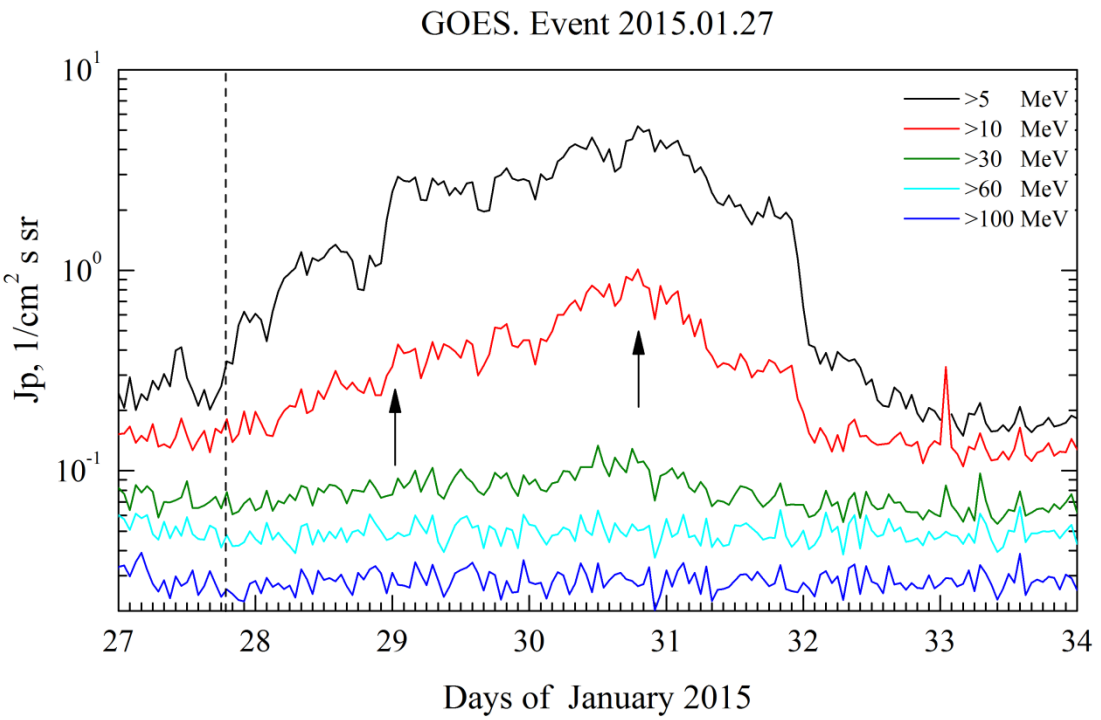

Integral spectrum of protons. Event 2015.01.27
Max 2
γ = 2.4
0.1 GCR
Eqm = 60 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

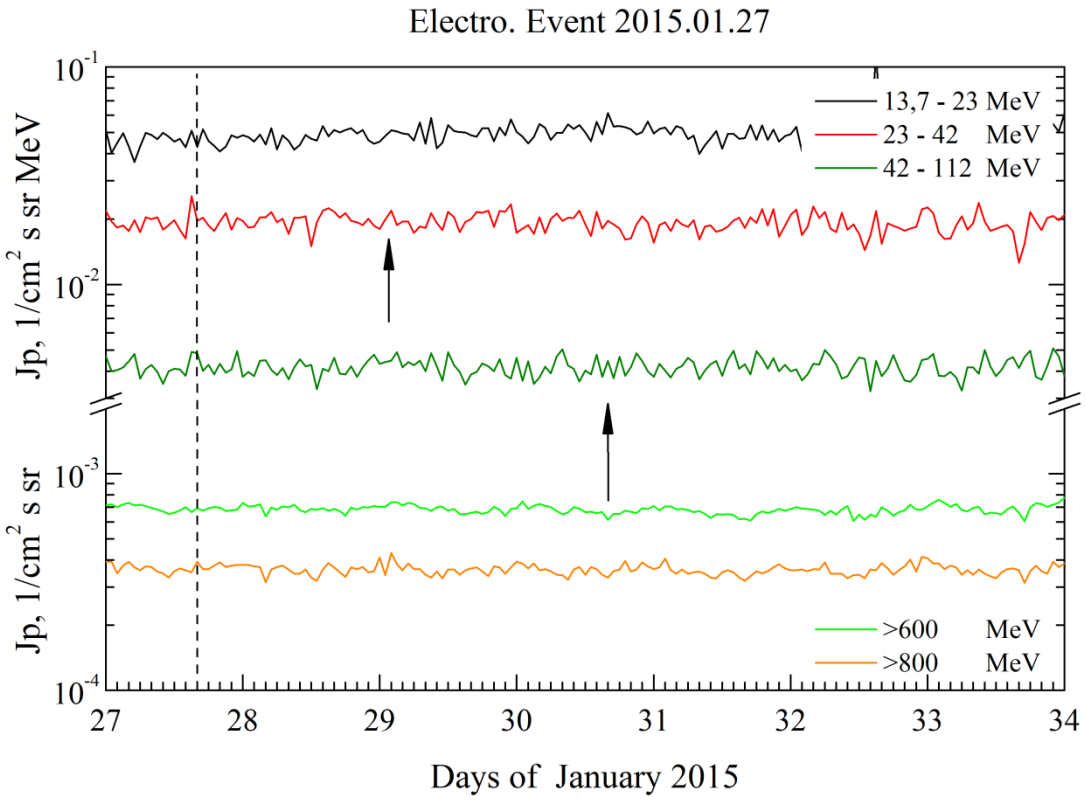
Time profiles of proton fluxes in the event 2015.01.27

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

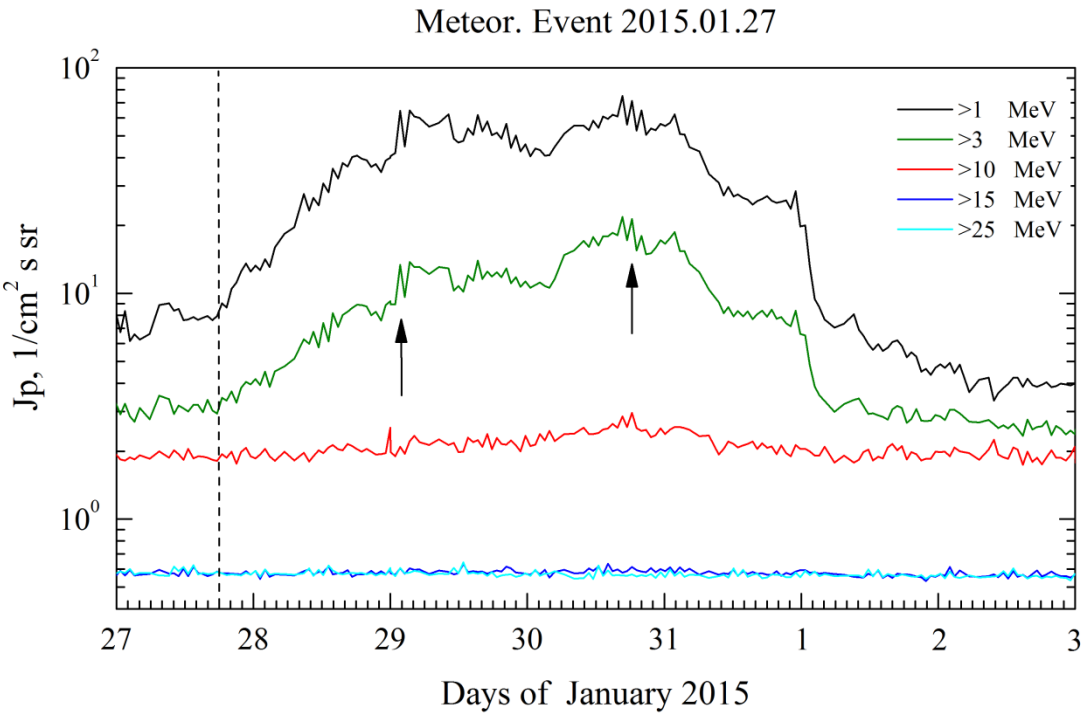


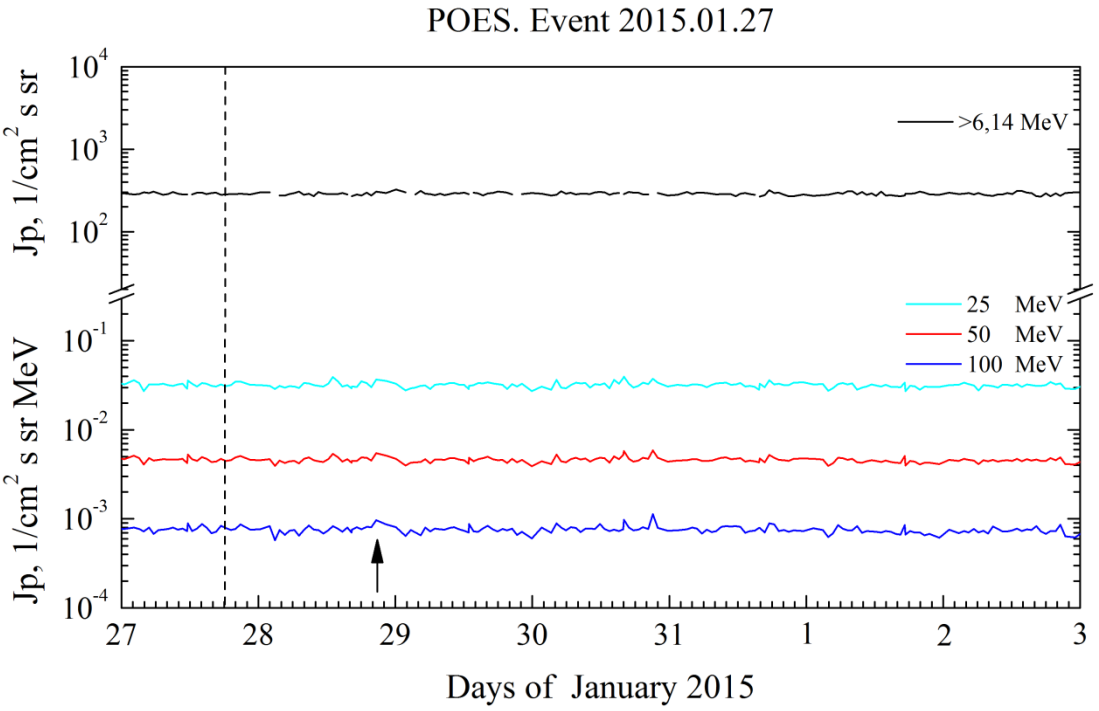



GOES. Event 2015.01.27
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of January 2015


Electro. Event 2015.01.27
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of January 2015

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 January 27

2015 January 27 ⊡ AR 12277 To event 564

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No optic flare on the solar disk					
1 – 12	keV	0713	0733	0827	N07E89	C2.1	0.0086

X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
100 – 300	keV	0710:40	0717:38	0724:28		4159872	HESSI
12 – 25	keV	0724:28	0727:34	0742:44	1328	4663248	HESSI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
245	MHz	0823	0823	0823		2.04	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS III	75-171	0752		0755		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0823	332	- 15.7	9˚	119˚	SOHO

2015 January 28 Ø AR 12277 To event 564

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	2136	2138	2141	N08E73	SF	
1 – 12	keV	2132	2137	2140	N07E74	M1.0	0.0024

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
3 – 6	keV	2131:56	2136:54	2137:52	816	265183	HESSI

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	2200	817	- 19.1	054˚	120˚	SOHO

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	No optic flare on the solar disk					
1 – 12	keV	1210	1216	1221	N07E52	M2.4	0.0087
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
50 – 100	keV	1206:24	1215:30	12:15:36	C	704060	HESSI
12 – 25	keV	1212:37	1214:41	1232:49	123232	18927150	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
5	GHz	1213	1214	1214		2.08	
2.7	GHz	1213	1214	1214		2.04	
CME		**UT**	**V,** km/s	**a** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1326	575	- 15.7	17˚	117˚	SOHO

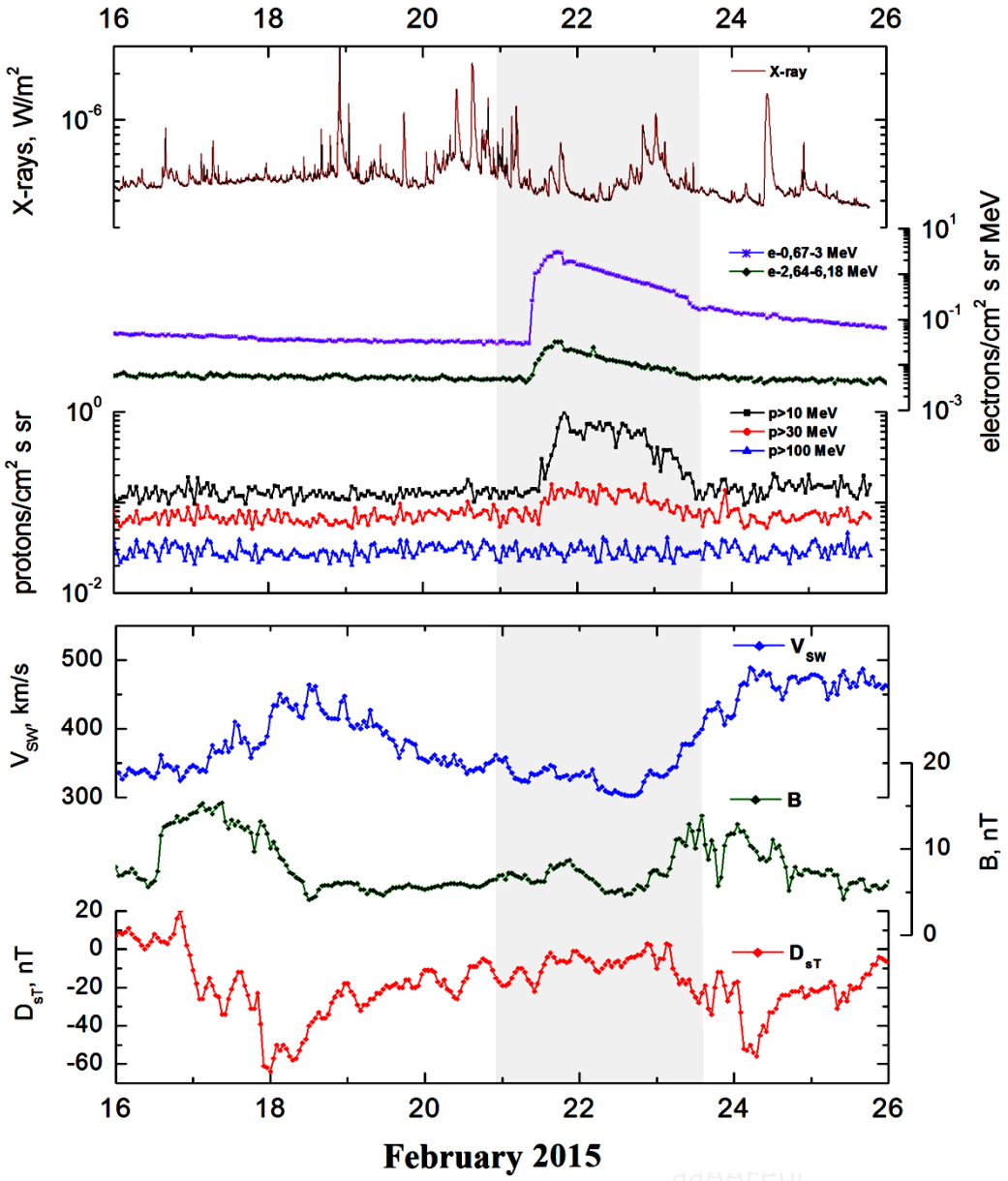
Proton Active Region:

AR 12277 (N08L331, CMP 03,5.02.2015,
Sp=510 msh, FKC, BG, R1)
XRI=0.46 $M_3^{2.4}$+C_{35} 2_1+1_3+S_{58}
PFR 28-30.01 (39^h) $M_2^{2.4}$;

Particle event: To(Ep>10 MeV) – 21d10^{h}
Tmax$_1$(Ep>10 MeV) – 21d19^{h}, Jmax$_1$(Ep>10 MeV) – 1.2 /cm^2·s·sr (ACE)
Tmax$_2$(Ep>10 MeV) – 22d07^{h}, Jmax$_2$(Ep>10 MeV) – 0.7 /cm^2·s·sr (ACE)
Duration of the event – 2 days, power-law index: γ_1 = 2.3, γ_2 = 2.5
Quasimaximal energy of protons in the event – Eqm$_1$ = 60 MeV
– Eqm$_2$ = 70 MeV

Sources: ⊡ DSF, 21d<09^{h}24^{m} – backside event on SW$_L$
CME: 21d09^{h}24^{m}, V= 1120 km/s, Δφ = 360º, dA= 215º

Particle fluxes and associated phenomena

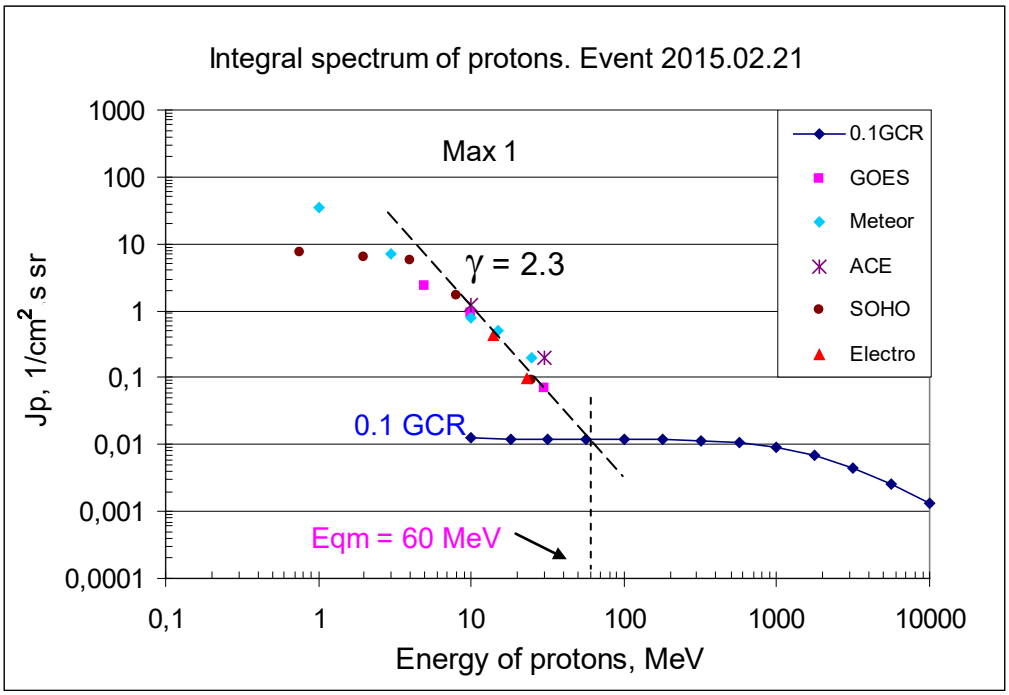


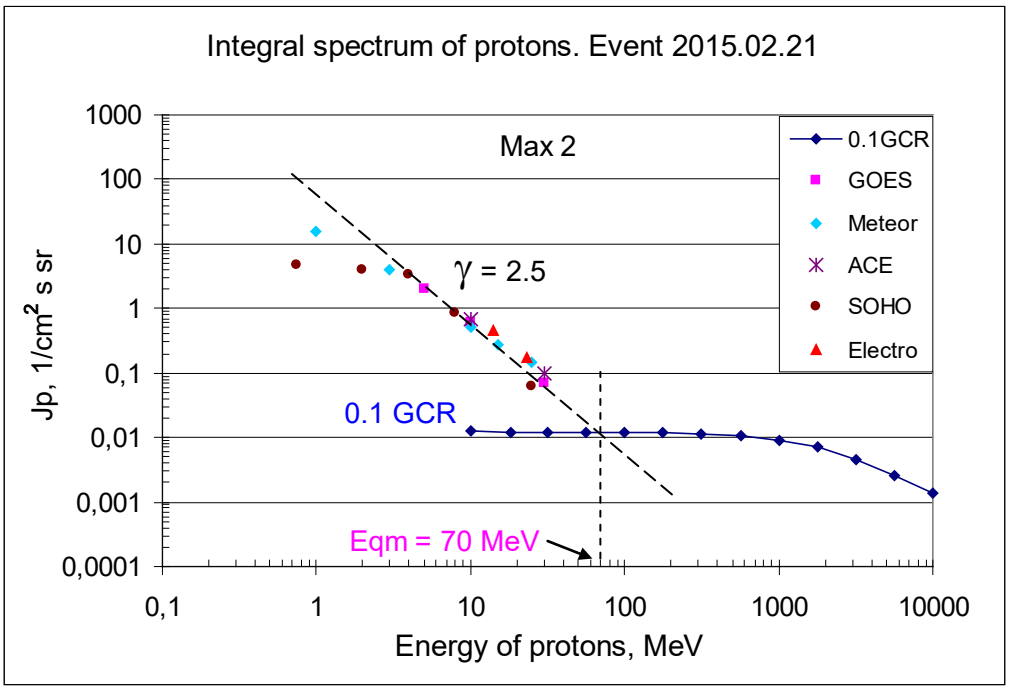
Integral fluxes of protons for the event of 2015 February 21

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	10	20/22d07	2.4/2	2	0.2	
EPS	>10	10	19/22d07	0.9/0.6	2	0.12	
EPS	>30	10	18/22d07	0.07/0.07	2	0.07	
EPS	>50	-	-	-	-	0.06	
EPS	>60	-	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	310	
Meteor-2							
SCR	>1	12	21d24/22d10	35/16	2.5	3.7	
SCR	>3	12	21d24/22d10	7/4	2	2.4	
SCR	>10	12	23/22d10	0.8/0.5	1	1. 9	
GALS-M	>15	12	13/22d10	0.5/0.27	1	0.6	
GALS-M	>25	12	13/22d10	0.2/0.15	0.5	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	12	18/22d08	1.2/0.7	2	1.2	
SIS	>30	12	18/22d07	0.2/0.1	2	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

Differential fluxes of protons for the event of 2015 February 21

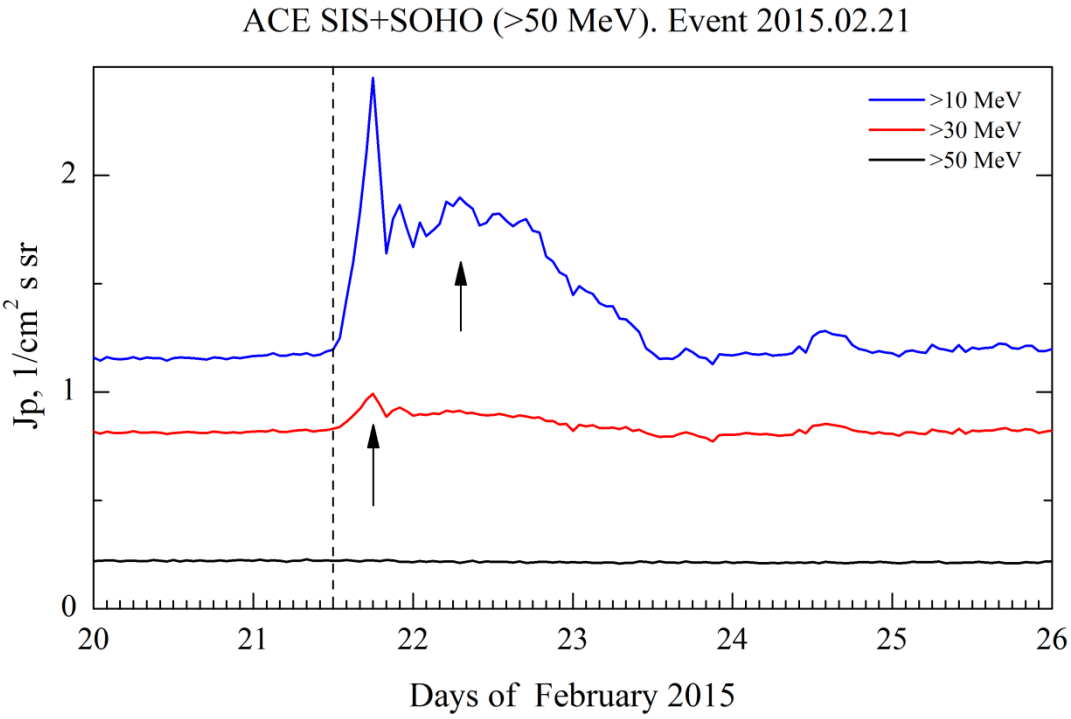
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	14	19/22d07	0.8/0.74	2	0.02	
LION	2 – 6	14	19/22d07	0.27/0.17	2	0.004	
EPHIN	4 – 8	13	19/22d07	1.01/0.62	2	0.003	
EPHIN	8 – 25	11	19/22d07	0.093/0.048	2	0.0001	
EPHIN	25 – 53	11	19/22d07	0.0033/0.0022	2	0.00002	
Electro-1							
SCR-E	13.7–23	10	20/25d06	0.035/ 0.03	2	0.05	
SCR-E	23–42	10	20/25d06	0.005/0.009	2	0.02	
SCR-E	42–112	-	-	-	-	0.0045	
POES							<E>, MeV
MEPED	16–36	-	-	-	-	0.03	25
MEPED	36–70	-	-	-	-	0.005	50
MEPED	70–140	-	-	-	-	0.0008	100

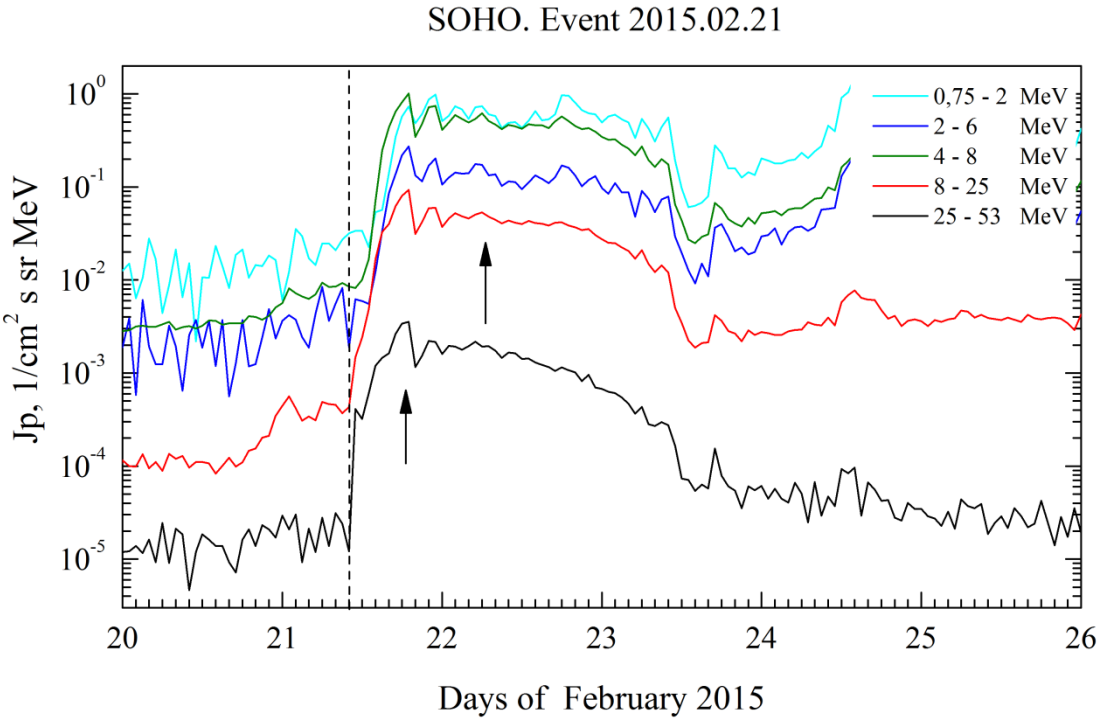

Integral spectrum of protons. Event 2015.02.21
Max 1
γ = 2.3
0.1 GCR
Eqm = 60 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

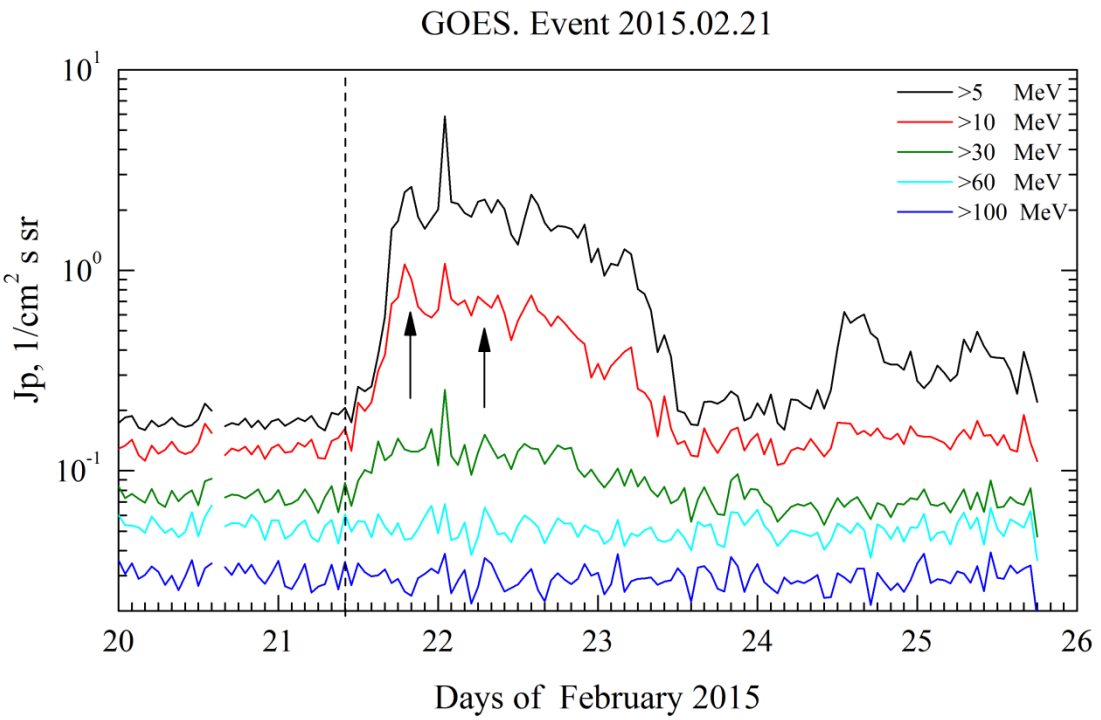

Integral spectrum of protons. Event 2015.02.21
Max 2
γ = 2.5
0.1 GCR
Eqm = 70 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

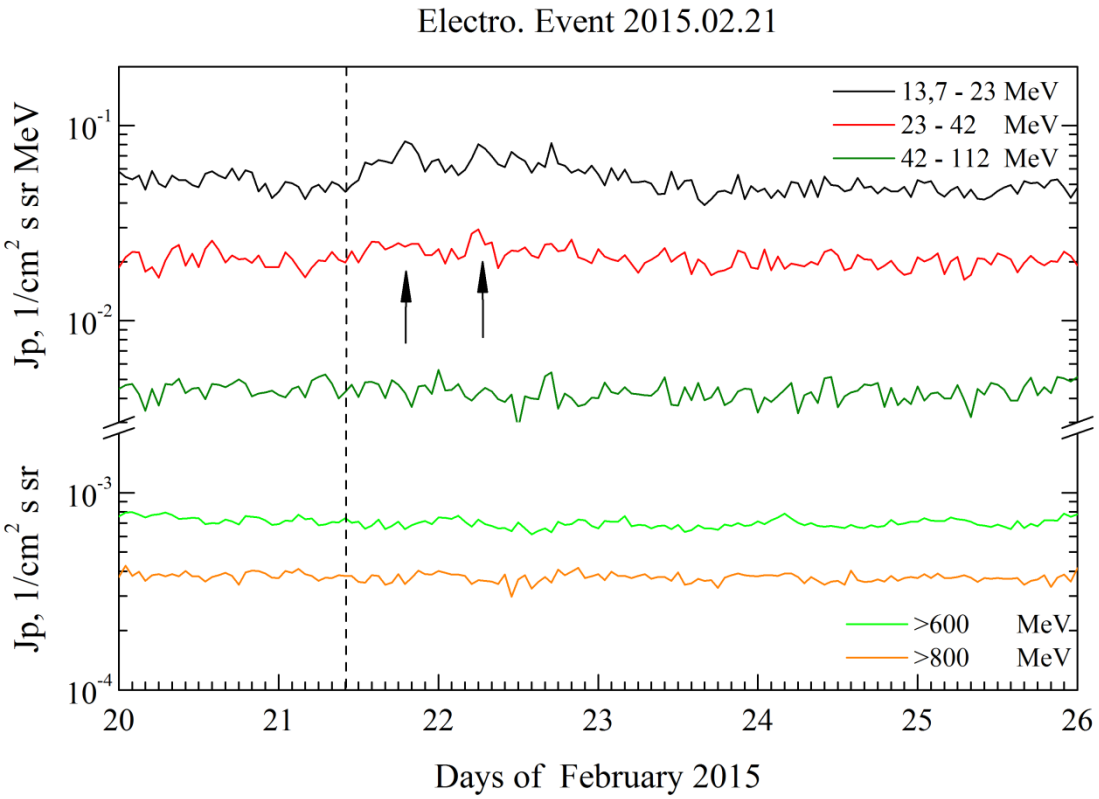
Time profiles of proton fluxes in the event 2015.02.21

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

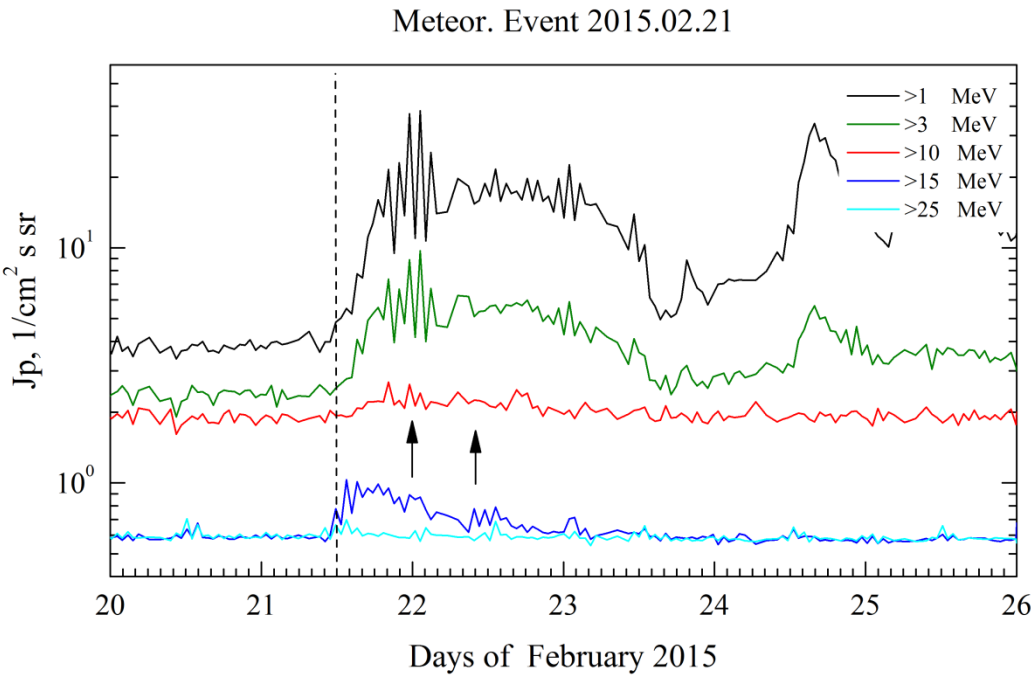


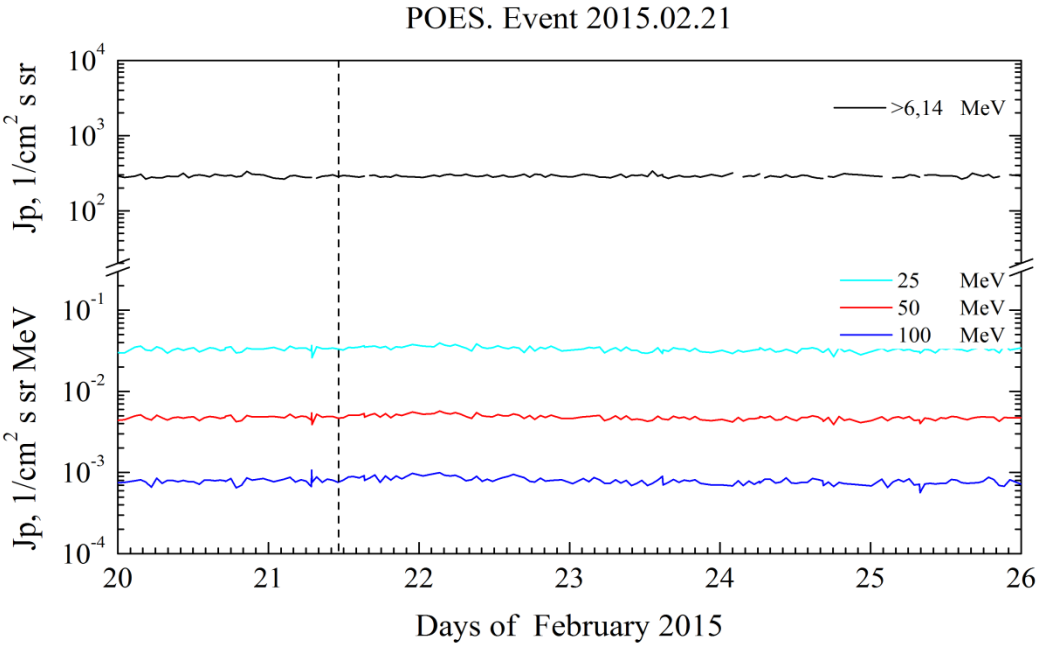



GOES. Event 2015.02.21
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of February 2015


Electro. Event 2015.02.21
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of February 2015

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 February 21

2015 February 21 ⊡ AR XXXX To event 565

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ, J/m^2**
6563 Å	DSF*	<0924			SW_L	>15º	
6563 Å		No flare event on visible solar disk					

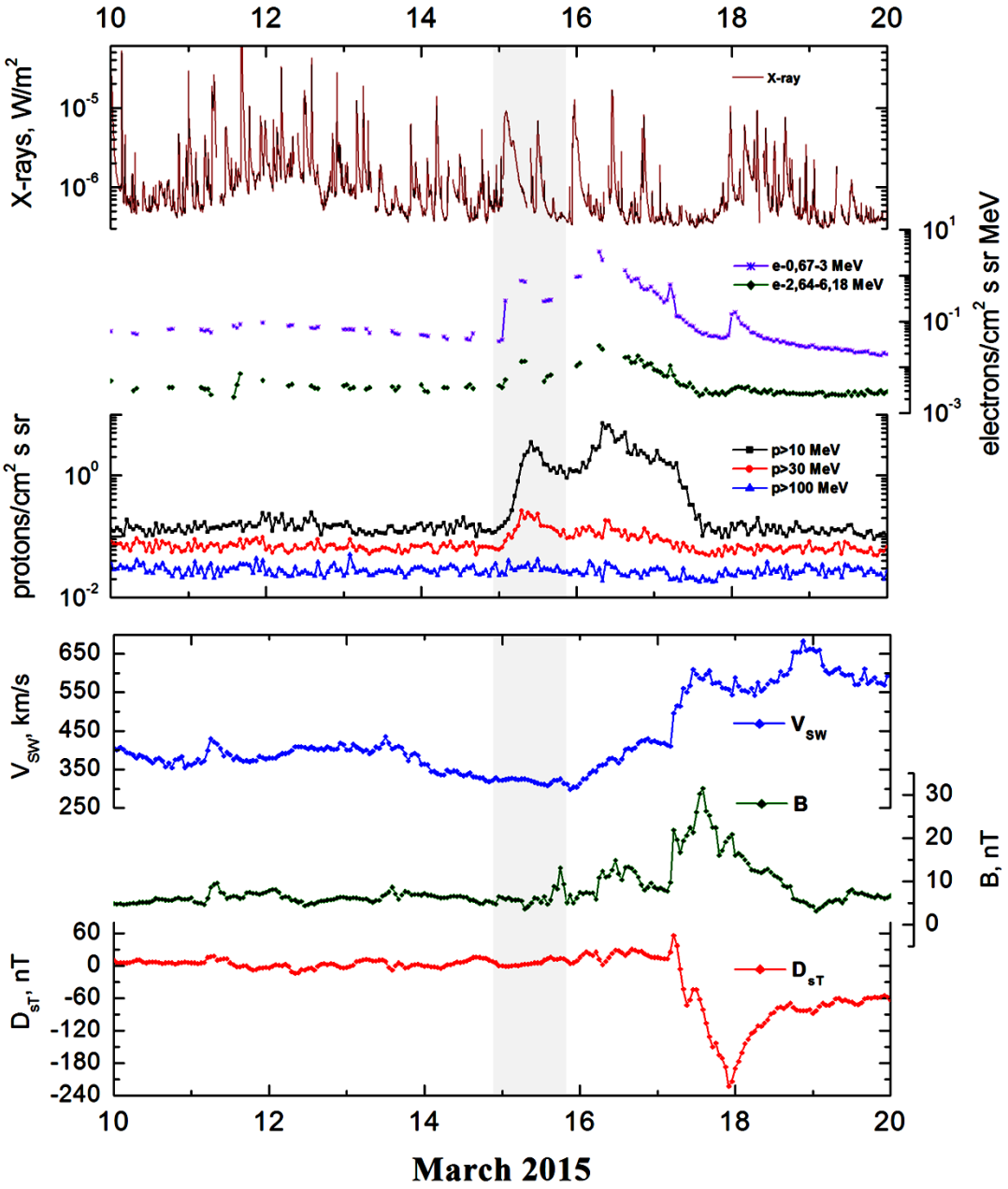
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
1 – 12	keV	No X-ray event on visible solar disk					

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0924	1120	5.5	360˚	215˚	SOHO

Particle event: To(Ep>10 MeV) – 15d02^{h}
Tmax(Ep>10 MeV) – 15d10^{h}, Jmax(Ep>10 MeV) – 2 /cm^2·s·sr
Duration of the event – 1 day, power-law index: $\gamma = 2.2$
Quasimaximal energy of protons in the event – Eqm = 80 MeV

Sources: ⊙ solar flare 15d01^{h}15^{m}, C9.1/1F, S22W25, AR12297
Main burst X-ray 1–8 Å: onset – 15d01^{h}15^{m}, max – 15d02^{h}13^{m}, $\Phi = 0.048$ J/m^2
CME: 15d01^{h}48^{m}, V = 719 km/s, $\Delta\varphi = 360^{o}$, dA = 240°

Particle fluxes and associated phenomena

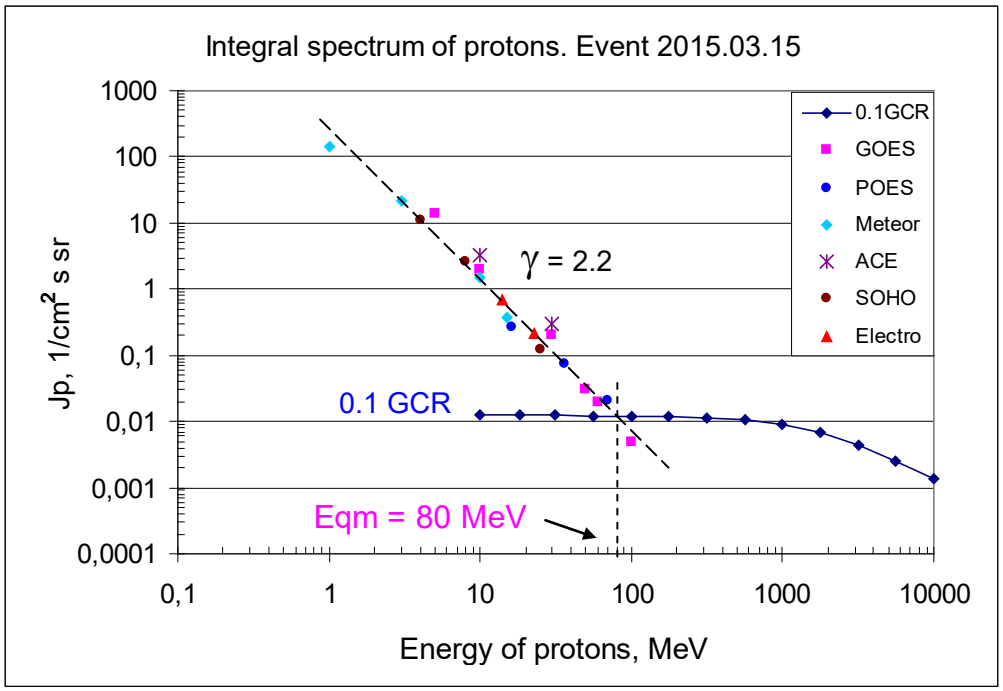


Integral fluxes of protons for the event of 2015 March 15

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	2	10	13.5	1	0.2	
EPS	>10	2	10	2	1	0.12	
EPS	>30	2	9	0.2	1	0.07	
EPS	>50	2	9	0.03	1	0.06	
EPS	>60	2	9	0.02	-	0.05	
EPS	>100	-	9	0.05	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	285	
Meteor-2							
SCR	>1	4	11	141	1	3.8	
SCR	>3	4	12	22	1	2.4	
SCR	>10	4	8	1.5	1	1.9	
GALS-M	>15	2	8	0.38	1	0.6	
GALS-M	>25	-	-	-	-	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	2	9	3.2	1	1.1	
SIS	>30	2	9	0.3	1	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

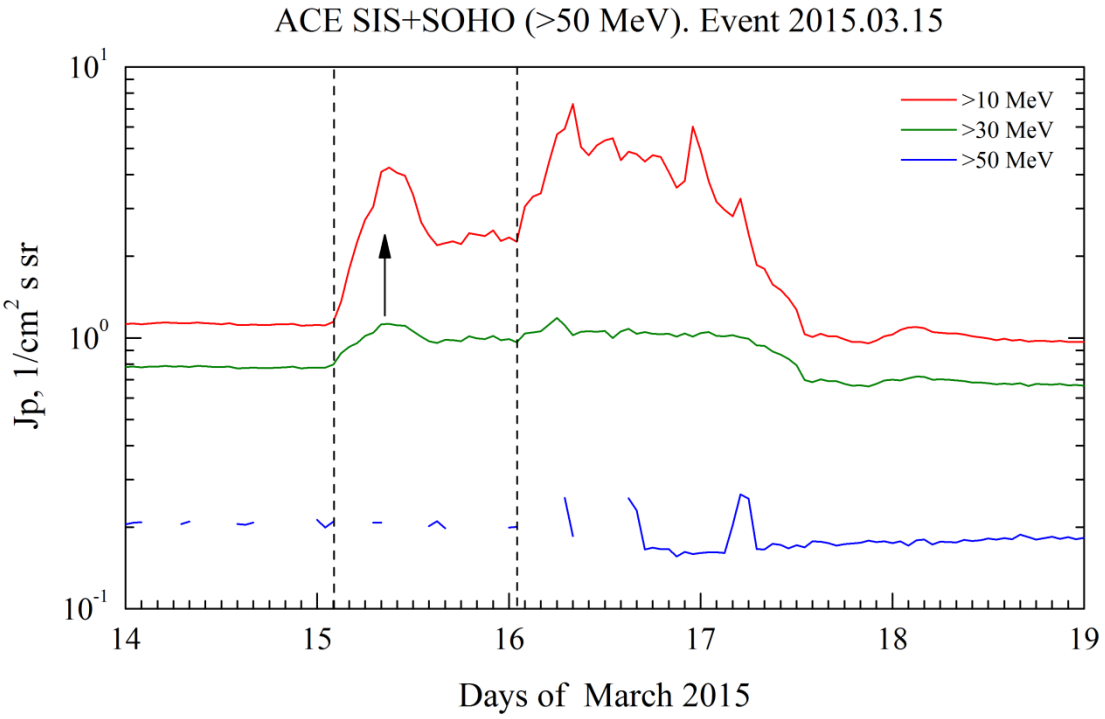
Differential fluxes of protons for the event of 2015 March 15

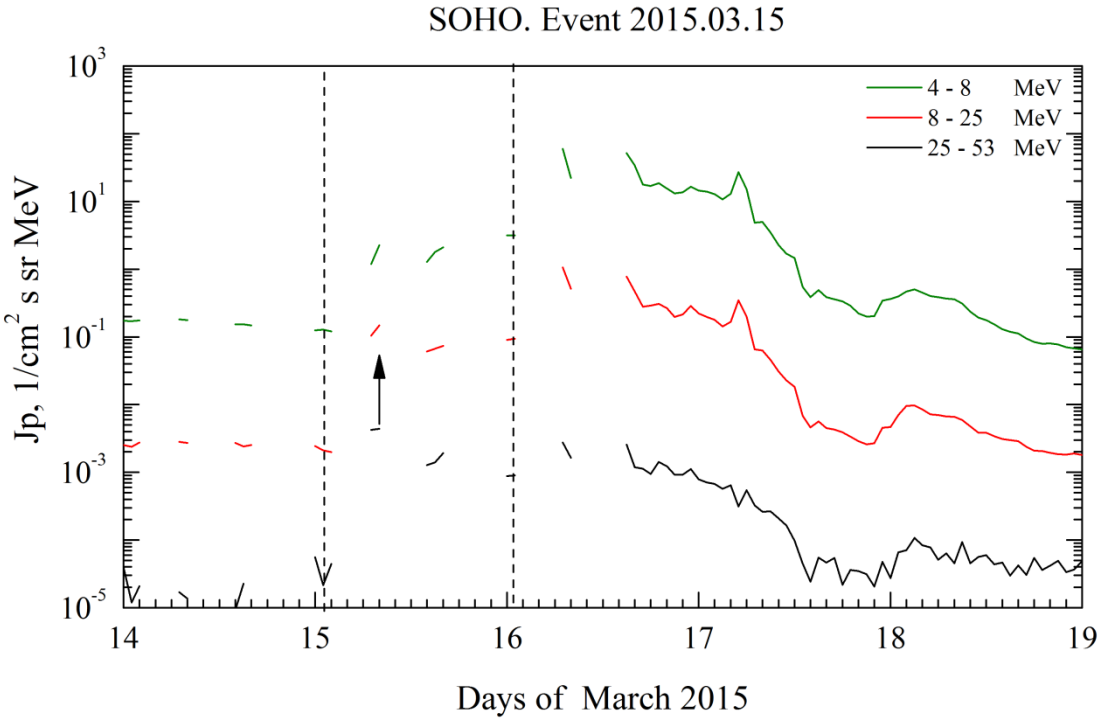
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	-	-	-	-	-	
LION	2 – 6	-	-	-	-	-	
EPHIN	4 – 8	-	8	2.12	1	0.13	
EPHIN	8 – 25	-	8	0.146	1	0.002	
EPHIN	25 – 53	-	8	0.0044	1	0.00001	
Electro-1							
SCR-E	13.7–23	1	8	0.05	1	0.05	
SCR-E	23–42	1	8	0.011	1	0.02	
SCR-E	42–112	-	-	-	-	0.0045	
POES							<E>, MeV
MEPED	16–36	03	11	0.0094	1	0.032	25
MEPED	36–70	03	11	0.0016	1	0.0047	50
MEPED	70–140	03	07	0.0003	1	0.0008	100


Integral spectrum of protons. Event 2015.03.15
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.2
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

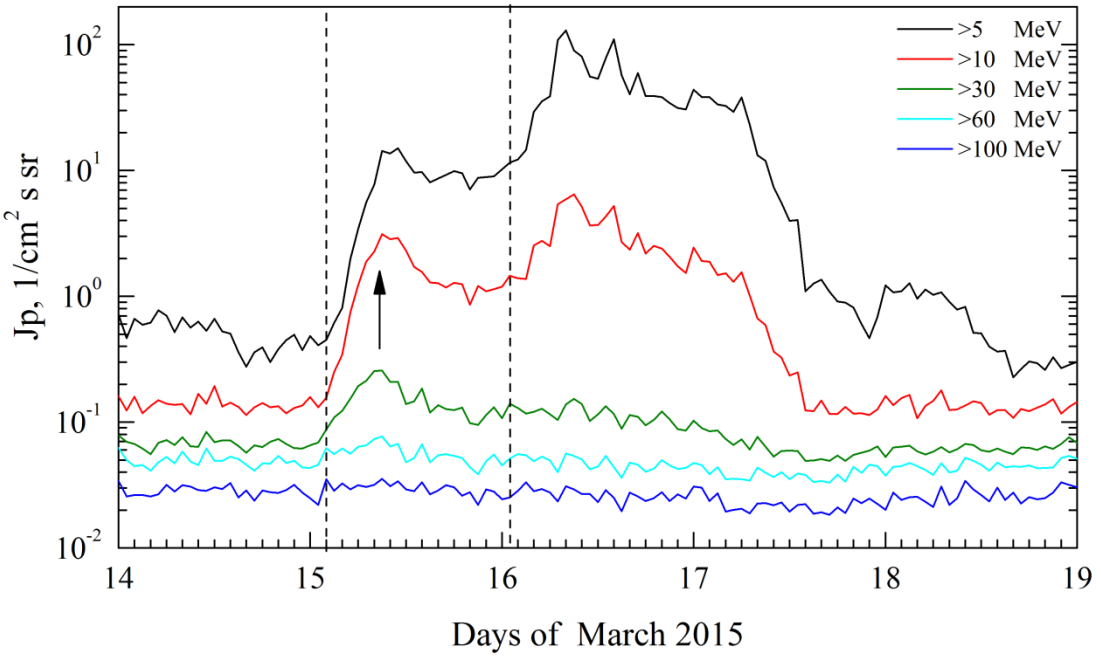
Time profiles of proton fluxes in the event 2015.03.15

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

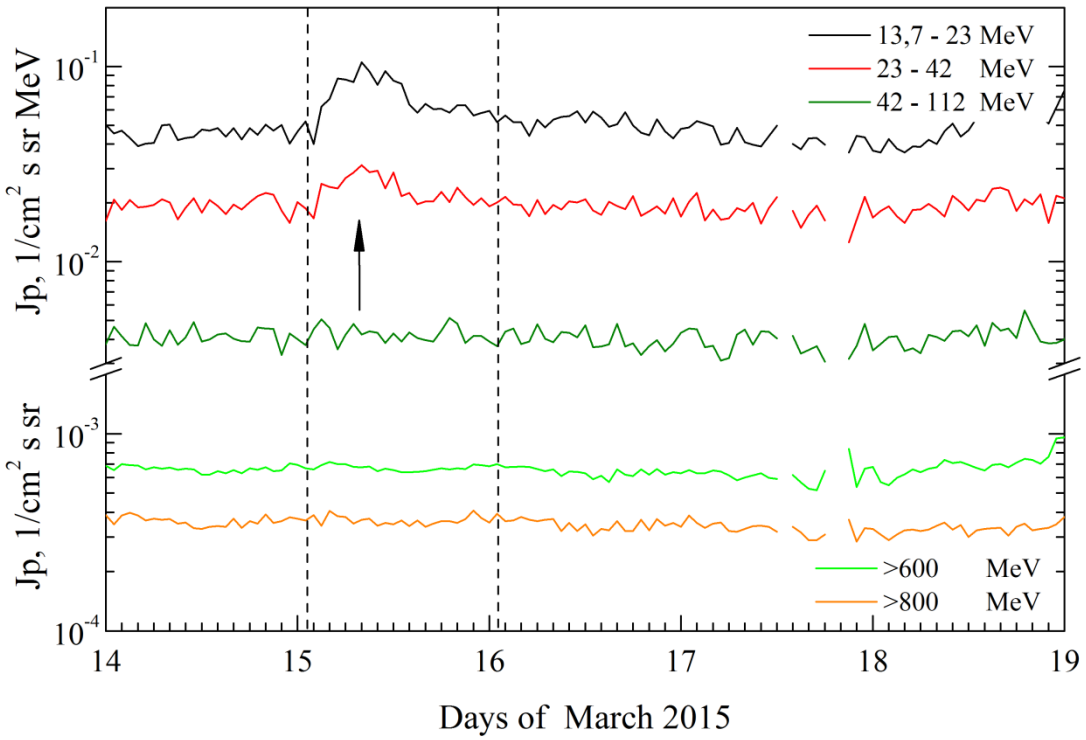




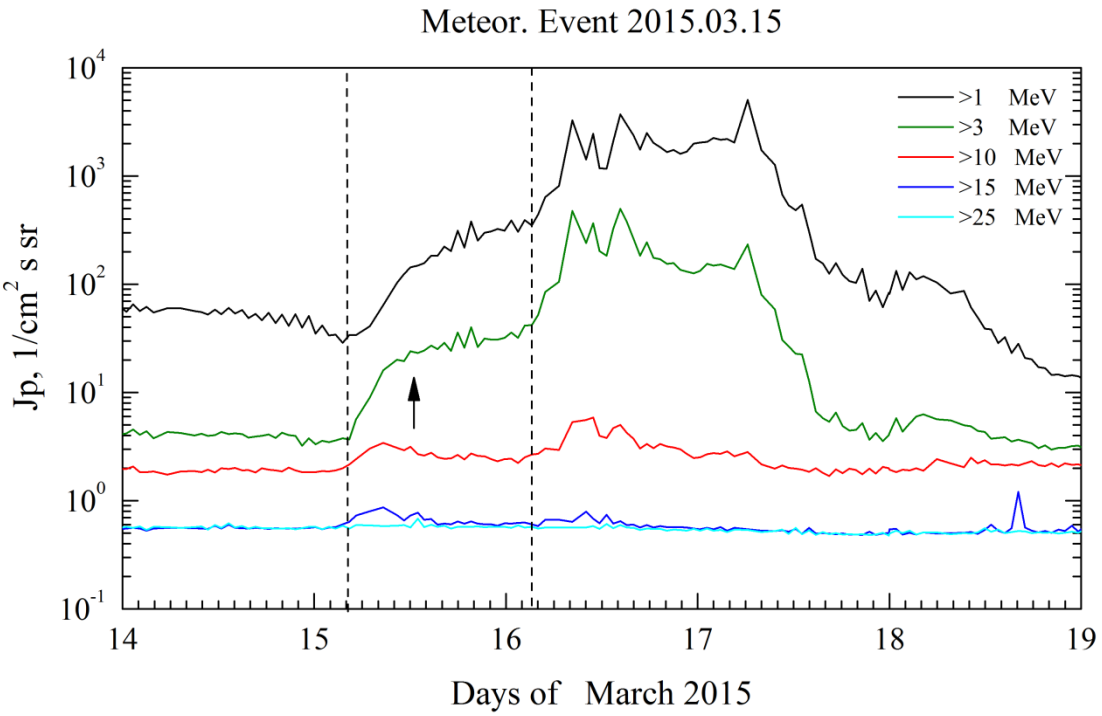
GOES. Event 2015.03.15

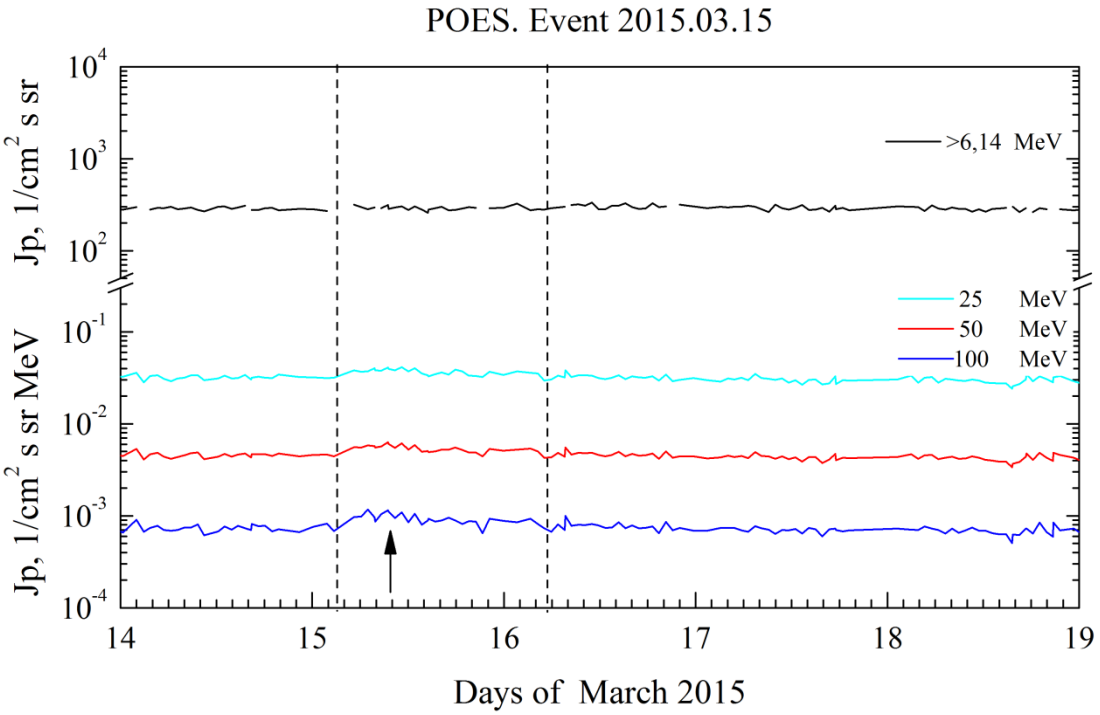


Electro. Event 2015.03.15



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 March 15

2015 March 15 ⊙ AR 12297 To event 566

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	0118	0213	0328	S22W25	1F	DSD
	DSF*						
1 – 12	keV	0115	0213	0320	S22W29	C9.1	0.048

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12-25	keV	0141:48	0143:18	0207:16	68	441320	HESSI
12-25	keV	0207:16	0207:34	0210:08	38	36720	HESSI
12-25	keV	0210:08	0213:14	0217:16	68	91646	HESSI
12-25	keV	0217:16	0217:22	0236:00	32	169326	HESSI
6-12	keV	0236:00	0237:38	0239:32	24	26880	HESSI
12-25	keV	0130:09	0213:17	0221:40	6979	731327	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
610	MHz	0212	0213	0213		2.38	
410	MHz	0115	0225	0238		2.15	
245	MHz	0137	0200	0244		2.26	

SP-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	27-54	0127		0137	745	2	
DS IV	50-500	0115		0136		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0148	719	- 9.0	360˚	240˚	SOHO

*https://www.lmsal.com/solarsoft/latest_events_archive/events_summary/2015/03/15/gev_20150315_0115/index.html

Proton Active Region:

AR12297 (S17L197, CMP13,0.03.2015.
Sp=420 msh, DKC, BGD, R)
XRI=8.28 $X_1^{2.1}$+$M_{23}^{9.2}$+C_{97} 2_7+1_{17}+S_{100}
PFR1 06-07.03: (41^h) – $M_3^{9.2}$
PFR2 09-11.03: (52^h) – $X_1^{2.1}$+$M_7^{5.8}$
PFR3 12-13.03: (25^h) – $M_7^{4.2}$

References:

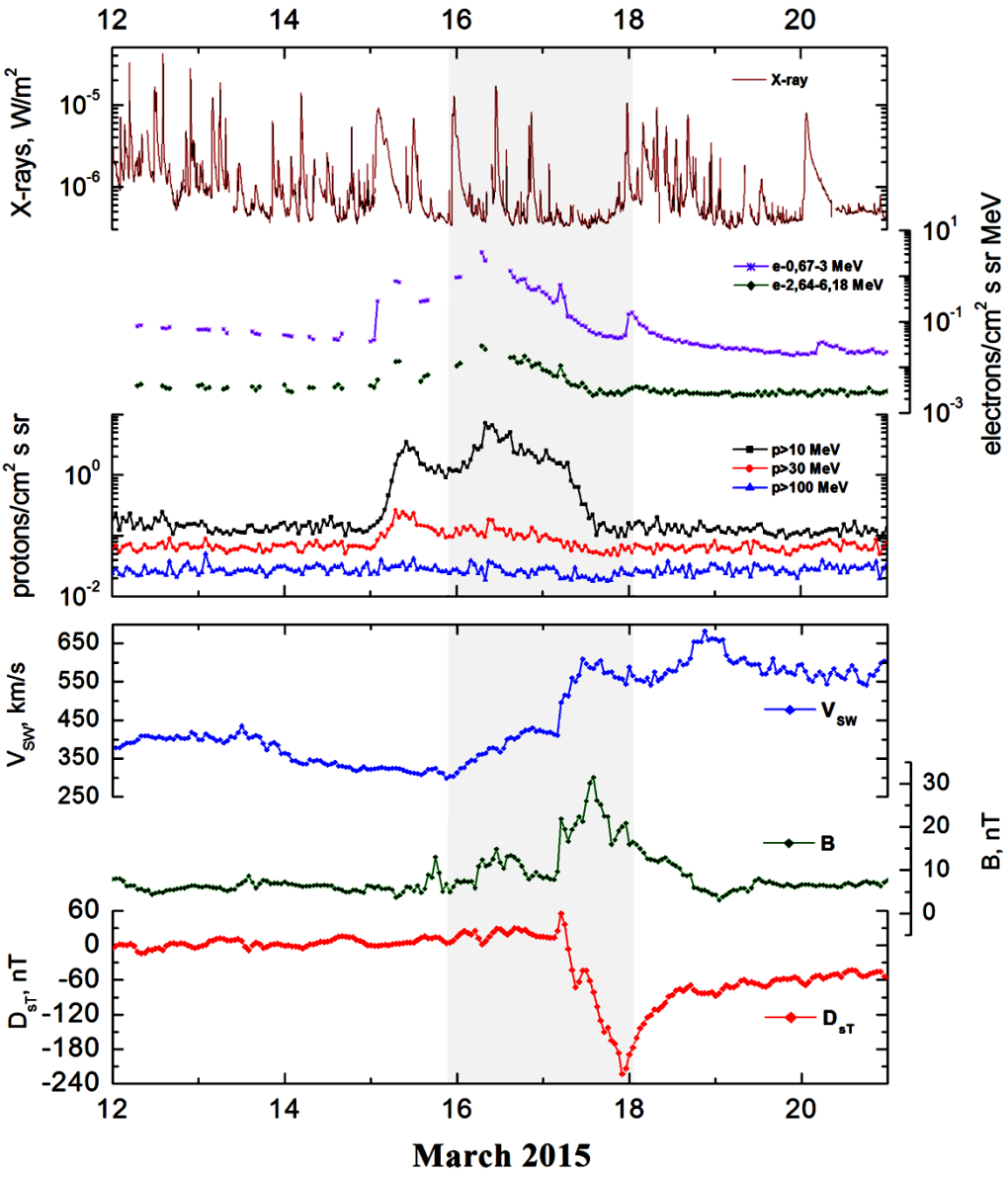
Ameri D., E. Valtonen, 2019.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Luhmann J.G., M.L. Mays, D. Odstrcil et al., 2017.

Particle event: To(Ep>10 MeV) – 16d01^{h}
Tmax$_1$(Ep>10 MeV) – 16d09^{h}, Jmax$_1$(Ep>10 MeV) – 5.2 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 16d14^{h}, Jmax$_2$(Ep>10 MeV) – 4 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ_1 = 3.5, γ_2 = 4.2
Quasimaximal energy of protons in the event – Eqm$_1$ = 50 MeV
– Eqm$_2$ = 35 MeV

Sources: ⊙ solar flare 15d22^{h}42^{m}, M1.2/, S19W32, AR12297
Ø solar flare 16d10^{h}39^{m}, M1.6/2N, S17W39, AR12297
Ø solar flare 16d20^{h}38^{m}, C8.1/1N, S22W48, AR12297

Main burst X-ray 1–8 Å: onset – 15d22^{h}42^{m}, max – 15d23^{h}22^{m}, Φ = 0.027 J/m^2
CME: 15d23^{h}24^{m}, V = 284 km/s, Δφ = 15º, dA= 290º
▲ SC 17d04^{h}45^{m}

Particle fluxes and associated phenomena

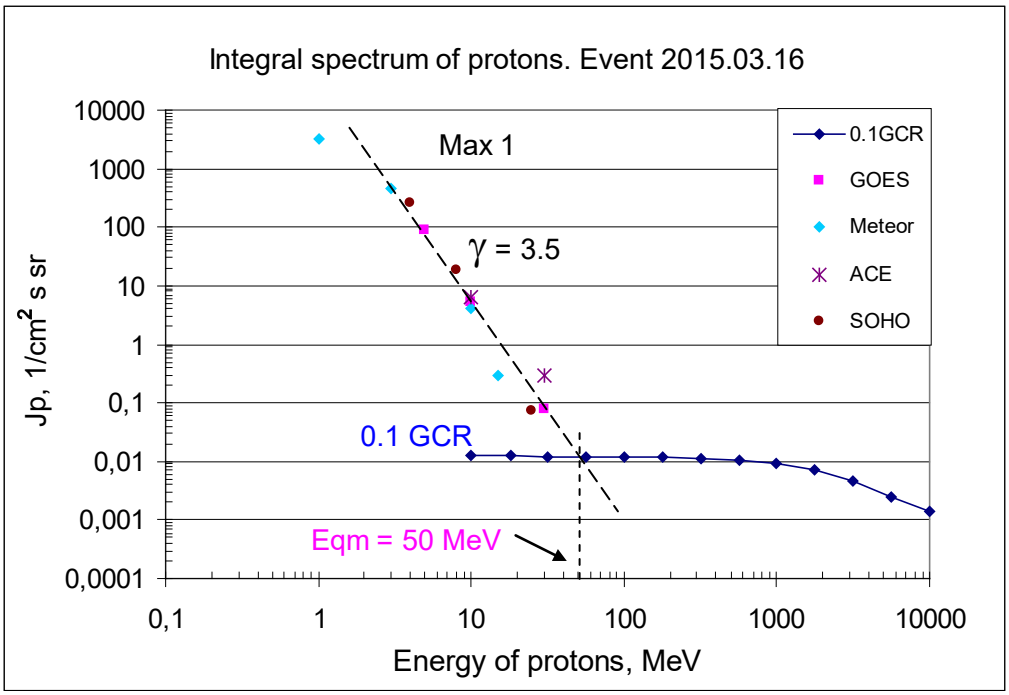


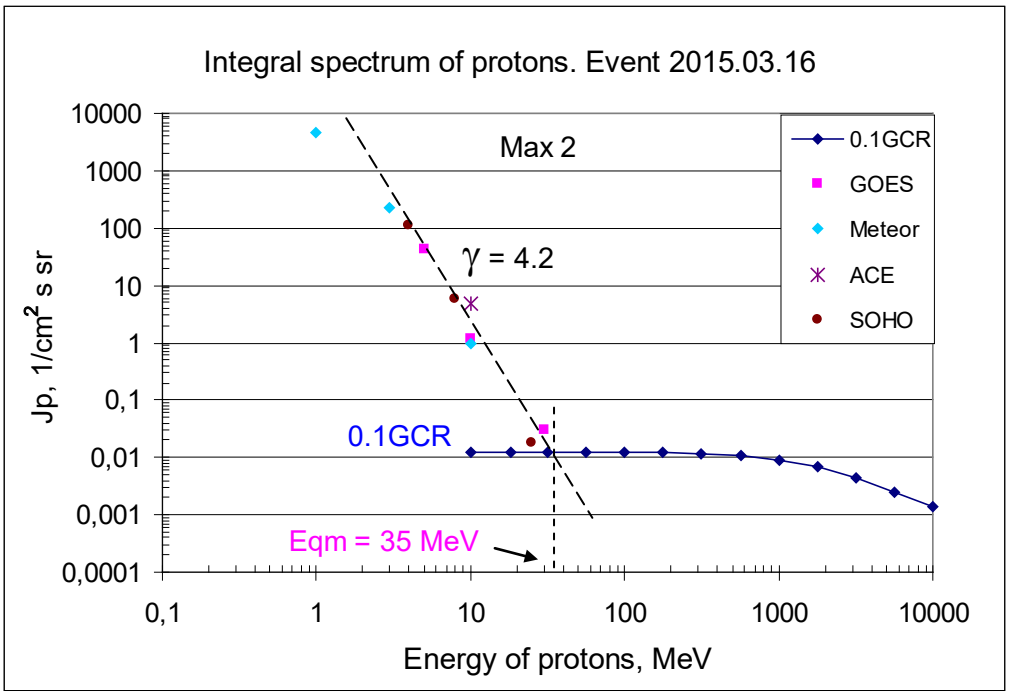
Integral fluxes of protons for the event of 2015 March 16

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	1	9/17d00	89/43.7	2	0.2	
EPS	>10	1	9/17d00	5.2/1.2	2	0.12	
EPS	>30	1	9/17d00	0.08/0.03	2	0.07	
EPS	>50	1	-	-	-	0.06	
EPS	>60	1	-	-	-	0.05	
EPS	>100	1	-	-	-	0.03	
Electro-1							
GALS-MP	>600	-	-	-	-	0.0007	
POES-19							
MEPED	>6.14	-	-	-	-	290	
Meteor-2							
SCR-1	>1	3	08/17d06	3200/4500	2	3.8	
SCR-1	>3	3	08/17d06	460/225	2	2.4	
SCR-1	>10	3	08/17d06	4/1	1	1.9	
GALS-MP	>15	2	08/-	0.3/-	0.5	0.6	
GALS-MP	>25	-	-	-	-	0.6	
GALS-MP	>600	-	-	-	-	0.2	
ACE							
SIS	>10	1	8/23	6,2/4,8	1,5	1,1	
SIS	>30	1	6/ -	0,3/ -	1,5	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0,21	

Differential fluxes of protons for the event of 2015 March 16

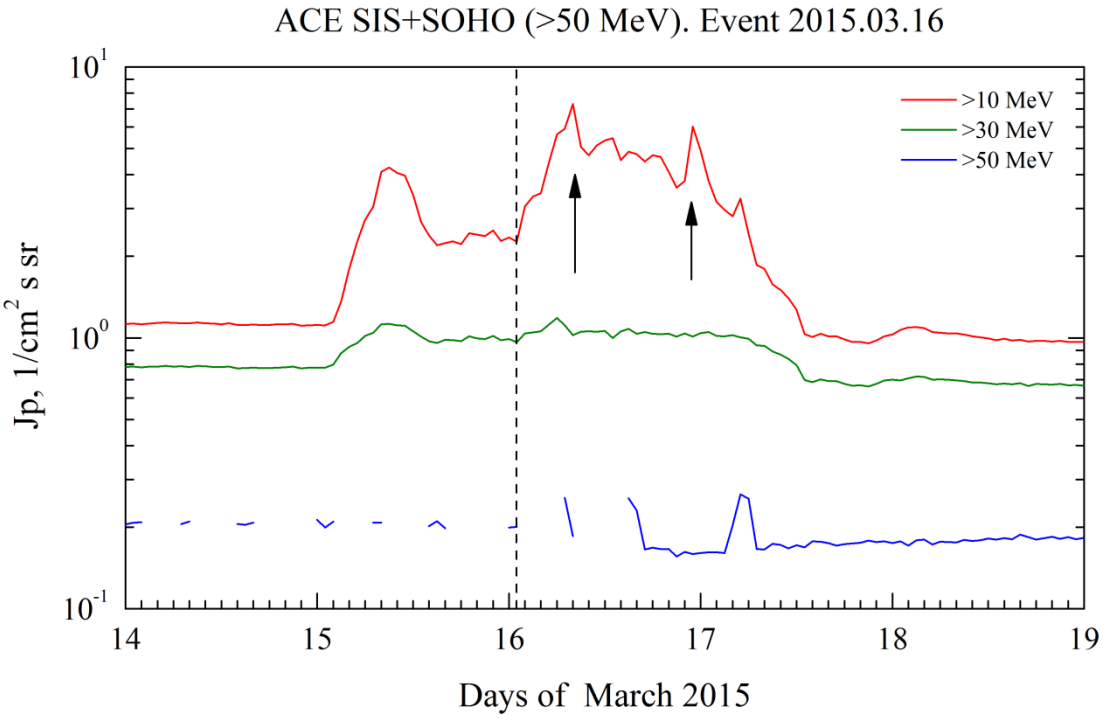
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0,75 – 2						
LION	2 – 6						
EPHIN	4 – 8	1	7/17d05	59,3/26.9	2	0,13	
EPHIN	8 – 25	1	7/17d05	1,06/0,344	2	0,002	
EPHIN	25 – 53	1	7/17d04	0,0027/0,00065	2	0,00001	
Electro-1							
SCR-E	13.7–23	-	-	-	-	0,05	
SCR-E	23–42	-	-	-	-	0,020	
SCR-E	42–112	-	-	-	-	0,004	
POES-19							<E>, MeV
MEPED	16–36	-	-	-	-	0.03	25
MEPED	36–70	-	-	-	-	0.005	50
MEPED	70–140	-	-	-	-	0.0008	100

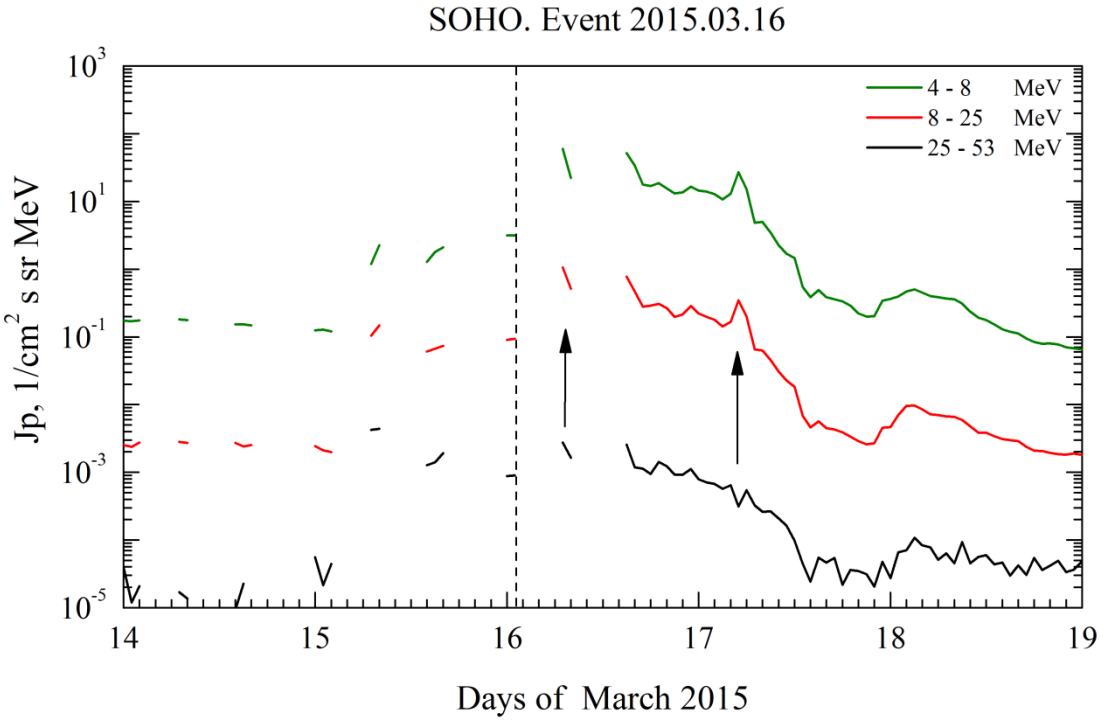

Integral spectrum of protons. Event 2015.03.16
Max 1
γ = 3.5
0.1 GCR
Eqm = 50 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2015.03.16
Max 2
γ = 4.2
0.1GCR
Eqm = 35 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

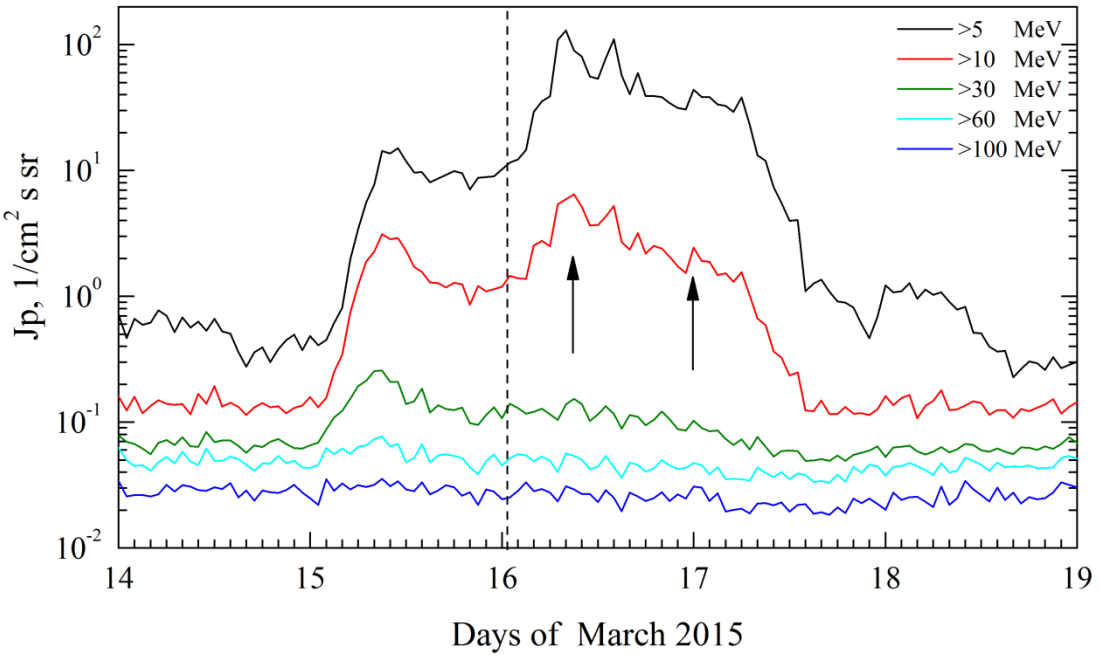
Time profiles of proton fluxes in the event 2015.03.16

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

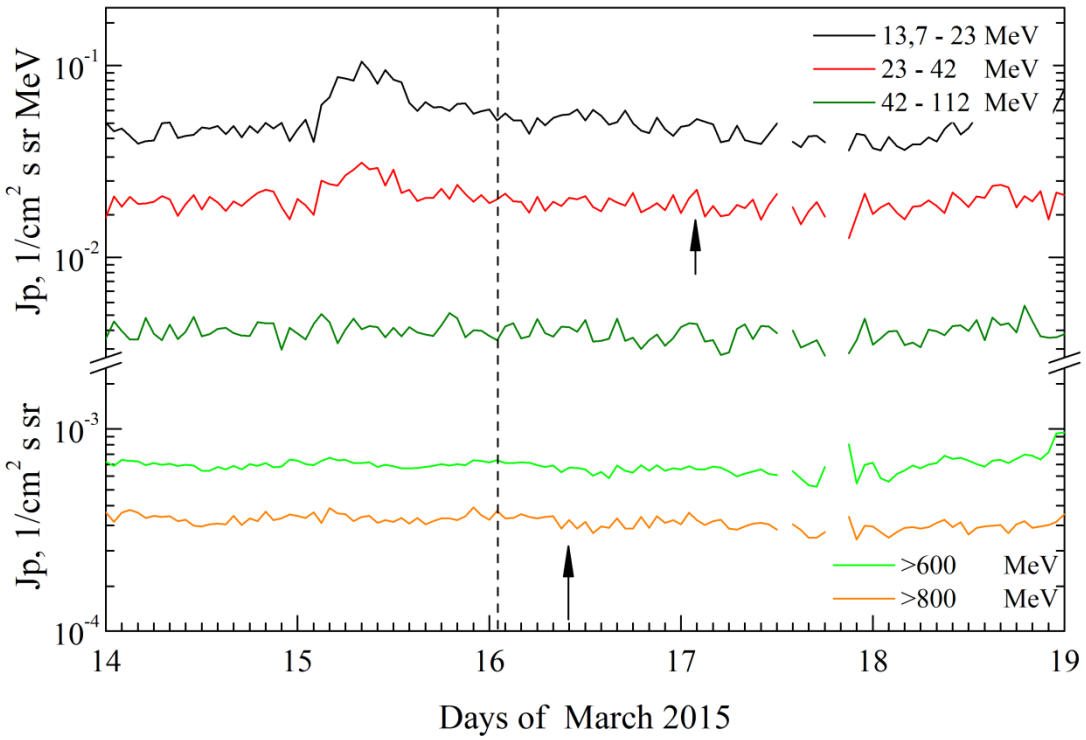




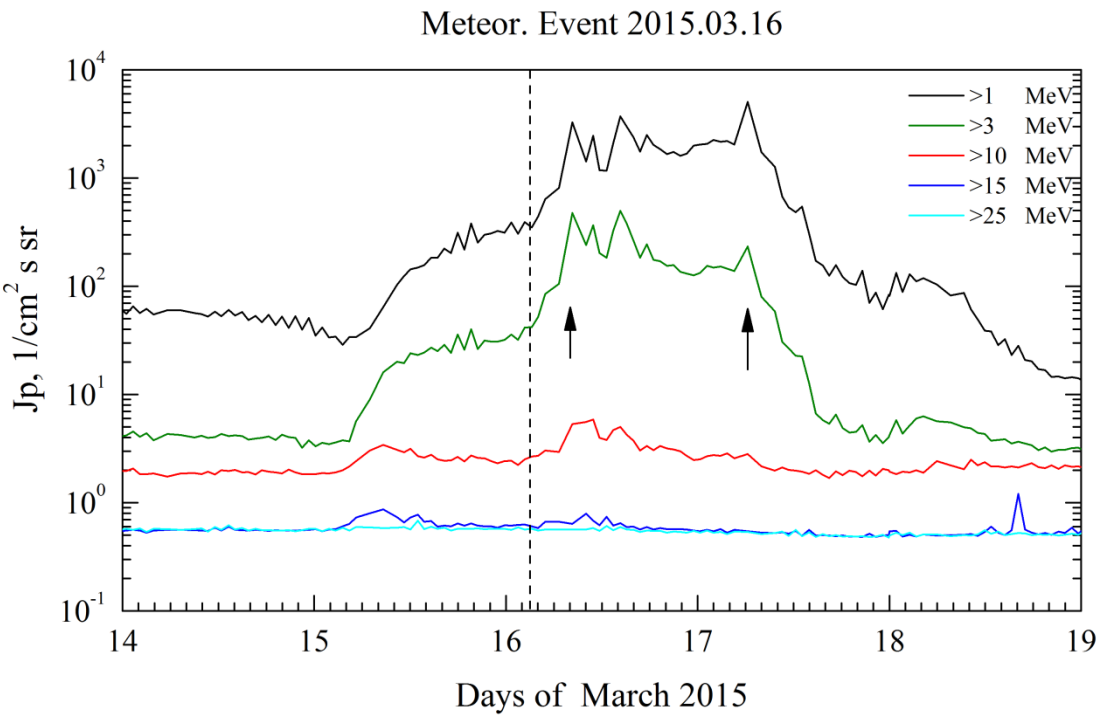
GOES. Evens 2015.03.16

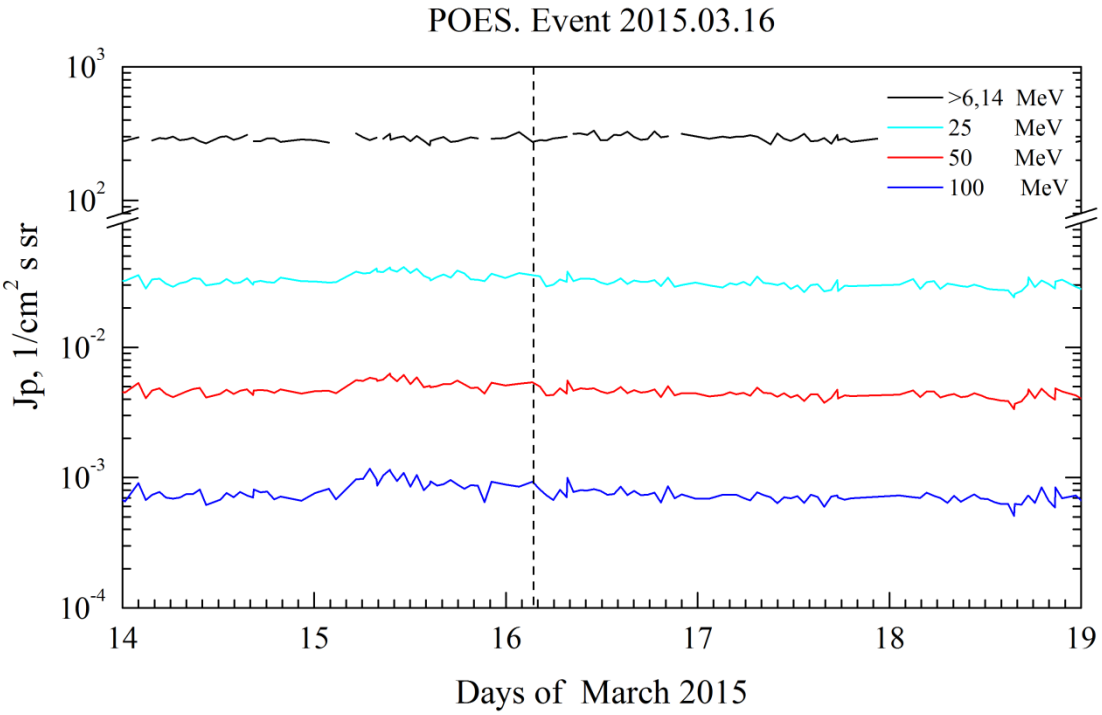


Electro. Evens 2015.03.16



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 March 16

2015 March 16 ⊙ AR 12297 To event 567

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No optical event on visible solar disc					
1 – 12	keV	2242	2322	2338	S19W32	M1.2	0.027

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
50-100	keV	2242:04	2254:18	2302:16	496	1412787	HESSI
25-50	keV	2302:16	2311:02	2311:44	336	791259	HESSI
12-25	keV	2347:28	0000:58	0042:52	68	626978	HESSI
12-25	keV	2244:53	2254:12	2256:33	49889	10399639	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	2245	2245	r/spectrum	U1.4 / 15	2.32	
8.8	GHz	2245	2245	Code of		2.11	
DS-type	**Frequency, MHz**	**To**	**Tmax**	**Te**	**V_{II}, km/s**	**Importance**	**Sp/c**
DS III	40-60	2259		2259		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	2324	284	3.3	15˚	290˚	SOHO

2015 March 16 Ø AR 12297 To event 567

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	1039	~1057	>1151	S17W39	2N	ERU
1 – 12	keV	1039	1058	1117	S17W38	M1.6	0.025

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
25-50	keV	1050:24	1052:02	1052:40	624	332194	HESSI
12-25	keV	1051:53	1059:03	1126:54	31972	5683322	FERMI

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1124	441	31.6	019˚	225˚	SOHO

2015 March 16 Ø AR 12297 To event 567

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	2039	2044	2118	S22W48	1N	PRB
1 – 12	keV	2038	2049	2100	S21W48	C8.1	0.0071
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	2037:28	2045:02	2109:20	432	975928	HESSI
12-25	keV	2039:12	2043:13	2059:23	72682	11870305	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	2042	2043	2044	U1.4 / 15	2.0	
8.8	GHz	2042	2043	2043		1.93	
5	GHz	2043	2043	2043		1.85	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	gap					SOHO

Proton Active Region:

AR12297 (S17L197, CMP13,0.03.2015,
Sp=420 msh, DKC, BGD, R)
XRI=8.28 $X_1^{2.1}$+$M_{23}^{9.2}$+C_{97} 2_7+1_{17}+S_{100}
PFR1 06-07.03: (41^h) – $M_3^{9.2}$
PFR2 09-11.03: (52^h) – $X_1^{2.1}$+$M_7^{5.8}$
PFR3 12-13.03: (25^h) – $M_7^{4.2}$

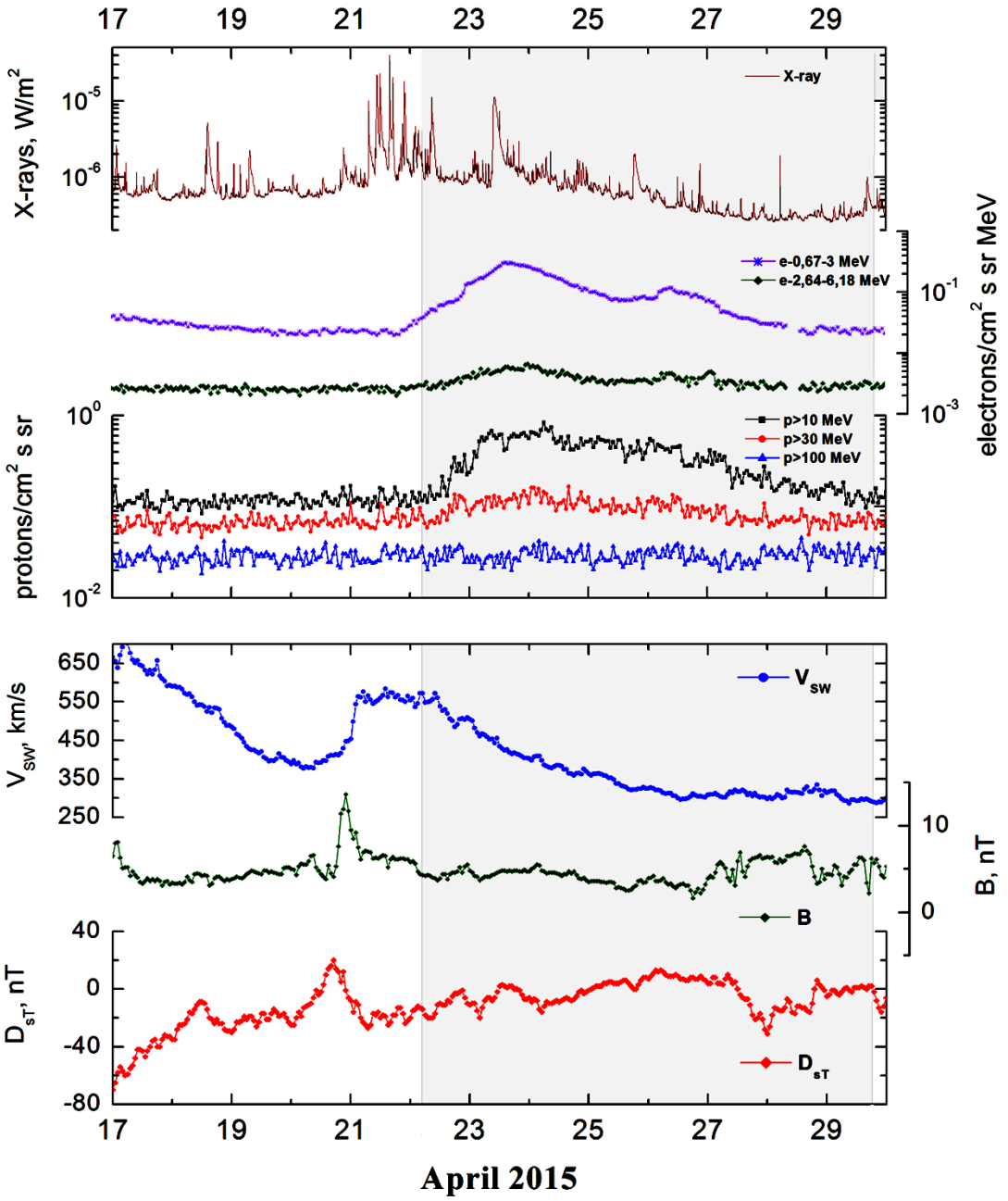
References:

Лукьянова Р.Ю., 2020.
Eroglu E., 2019.
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
Luhmann J.G., M.L. Mays, D. Odstrcil et al., 2017.

Particle event: To(Ep>10 MeV) – 22d06^{h}
Tmax$_1$(Ep>10 MeV) – 23d07^{h}, Jmax$_1$(Ep>10 MeV) – 0.55 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 23d21^{h}, Jmax$_2$(Ep>10 MeV) – 0.6 /cm^2·s·sr
Duration of the event – 8 days, power-law index: γ_1 = 1.6, γ_2 = 2.0
Quasimaximal energy of protons in the event – Eqm$_1$ = 80 MeV
– Eqm$_2$ = 75 MeV

Sources: ⊡ solar flare 21d21^{h}39^{m}, M1.8, M1.2/, N10W80, AR12322
Main burst X-ray 1–8 Å: onset – 21d21^{h}39^{m}, max – 21d21^{h}45^{m}, Φ = 0.011 J/m^2
onset – 21d21^{h}58^{m}, max – 21d22^{h}01^{m}, Φ = 0.0028 J/m^2

Particle fluxes and associated phenomena

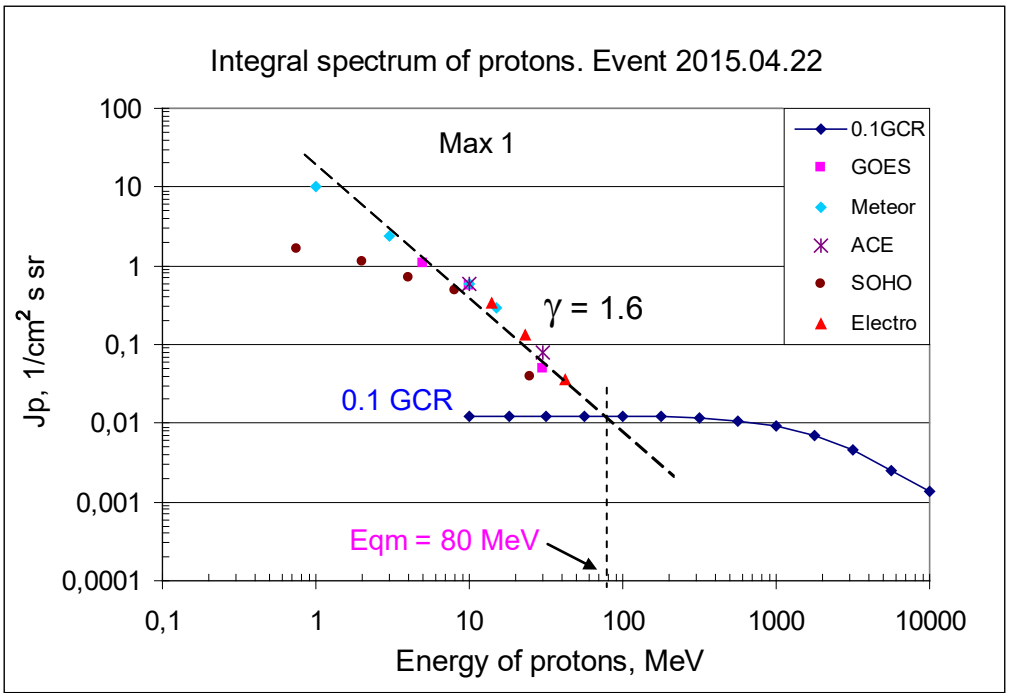


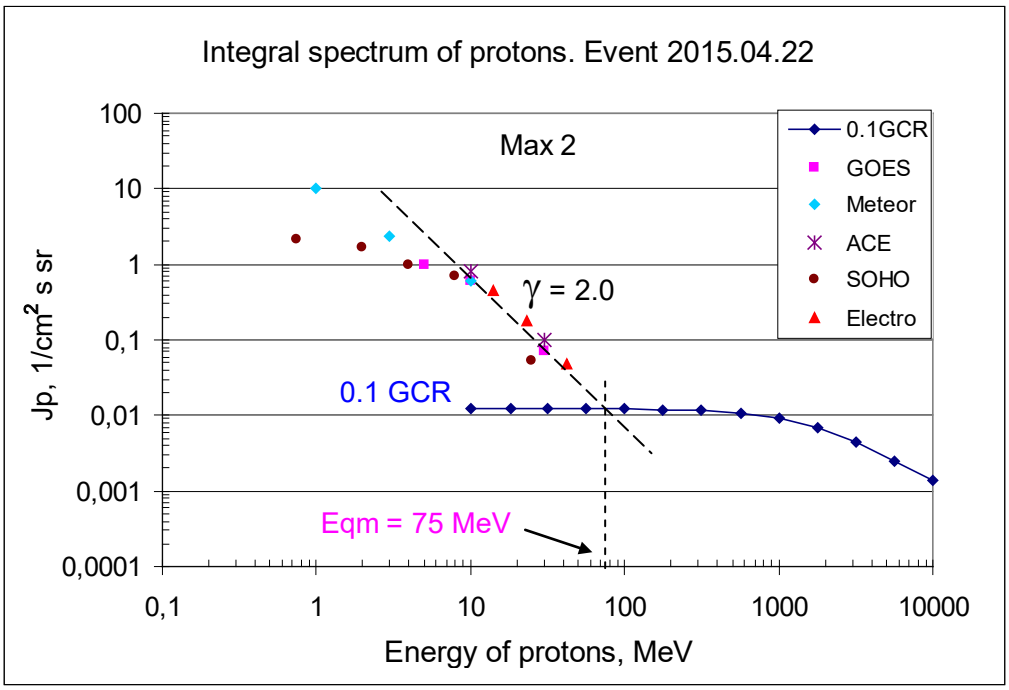
Integral fluxes of protons for the event of 2015 April 22

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	6	23d08/23d22	1.1/1	8	0.2	
EPS	>10	6	23d07/23d21	0.55/0.6	8	0.12	
EPS	>30	7	23d07/23d21	0.05/0.07	5	0.07	
EPS	>50	8	-	-	-	0.06	
EPS	>60	8	-	-	-	0.05	
EPS	>100	8	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0006	
POES							
MEPED	>6.14	-	-	-	-	285	
Meteor-2							
SCR	>1	8	23d05/23d22	10/10	11	3.9	
SCR	>3	8	23d09/23d22	2.34/2.35	7	2.3	
SCR	>10	8	23d09/23d22	0.58/0.6	1	1.9	
GALS-M	>15	23d03	23d05/ -	0.29/-	0.25	0.6	
GALS-M	>25	-	-	-	-	0.5	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	6	23d03/23d22	0.6/0.8	6	1	
SIS	>30	6	23d03/23d22	0.08/0.1	6	0.7	
SOHO							
EPHIN (INT)	>50	-	-	-	-	0.2	

Differential fluxes of protons for the event of 2015 April 22

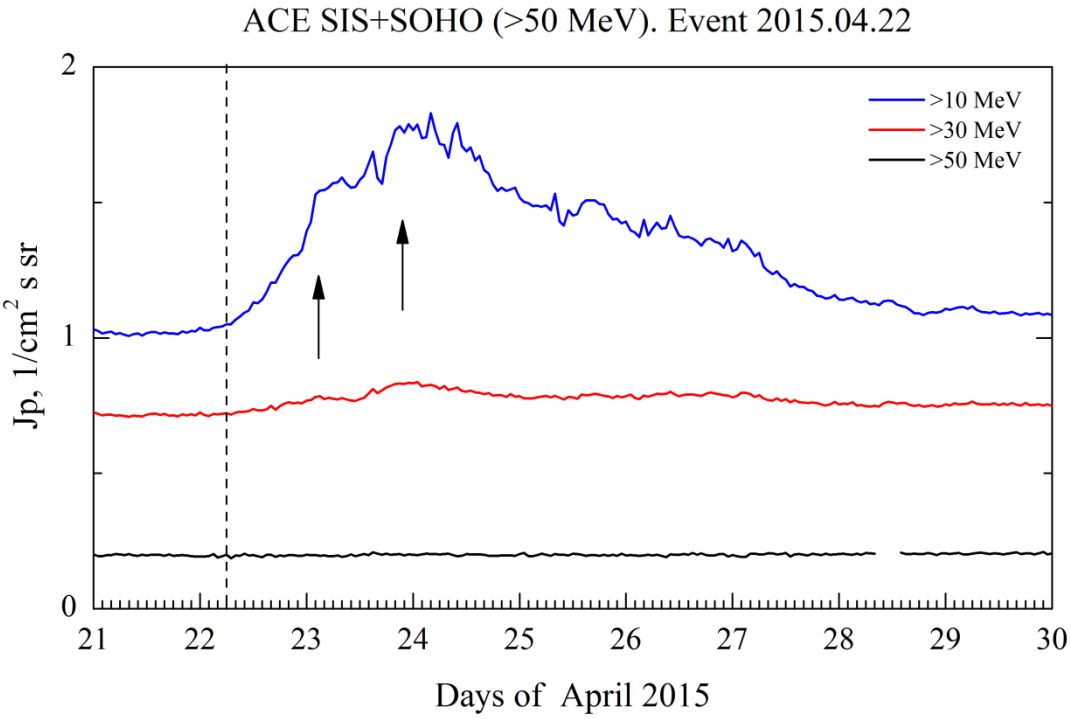
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	21d23	23d04/23d23	0.4/0.37	7	0.02	
LION	2 – 6	21d23	23d06/23d24	0.15/0.224	7	0.003	
EPHIN	4 – 8	21d23	23d06/23d24	0.052/0.07	7	0.004	
EPHIN	8 – 25	21d23	23d04/23d24	0.026/0.038	7	0.0002	
EPHIN	25 – 53	21d23	23d04/24d02	0.0013/0.0019	7	0.00002	
Electro-1							
SCR-E	13.7–23	4	23d03/24d06	0.023/0.029	3	0.05	
SCR-E	23–42	4	23d03/24d06	0.005/0.007	3	0.02	
SCR-E	42–112	4	23d03/24d06	0.0005/0.0007	-	0.004	
POES							<E>, MeV
MEPED	16–36	-	-	-	-	0.032	25
MEPED	36–70	-	-	-	-	0.0046	50
MEPED	70–140	-	-	-	-	0.0007	100

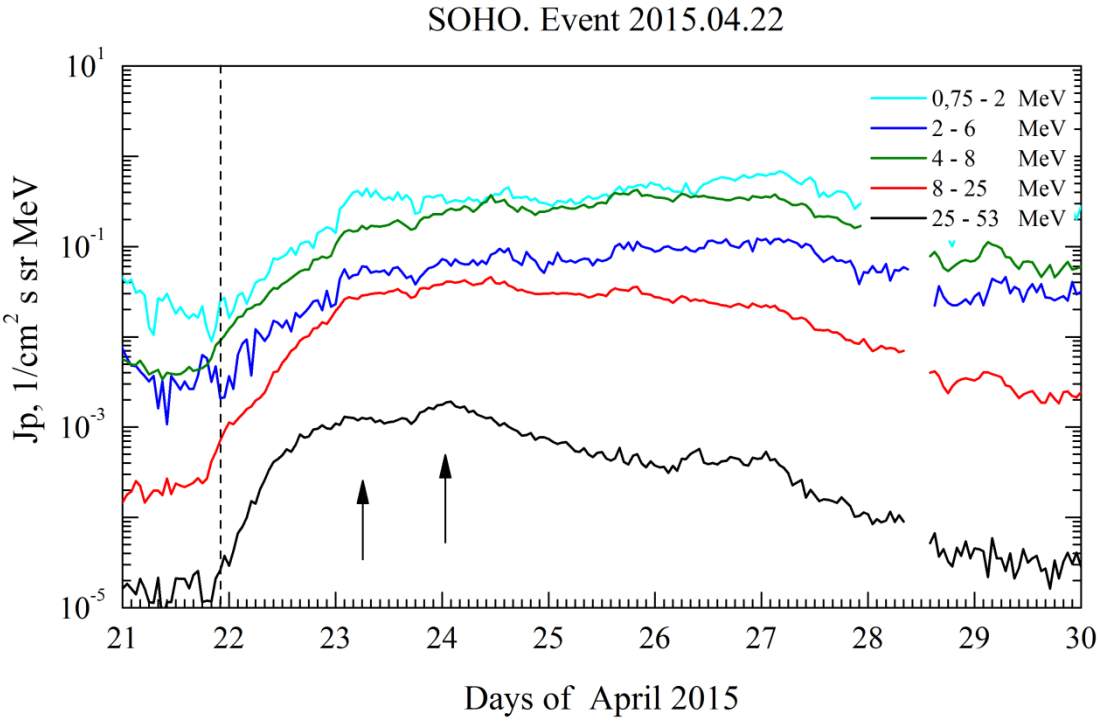

Integral spectrum of protons. Event 2015.04.22
Max 1
γ = 1.6
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2015.04.22
Max 2
γ = 2.0
0.1 GCR
Eqm = 75 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

Time profiles of proton fluxes in the event 20154.04.22

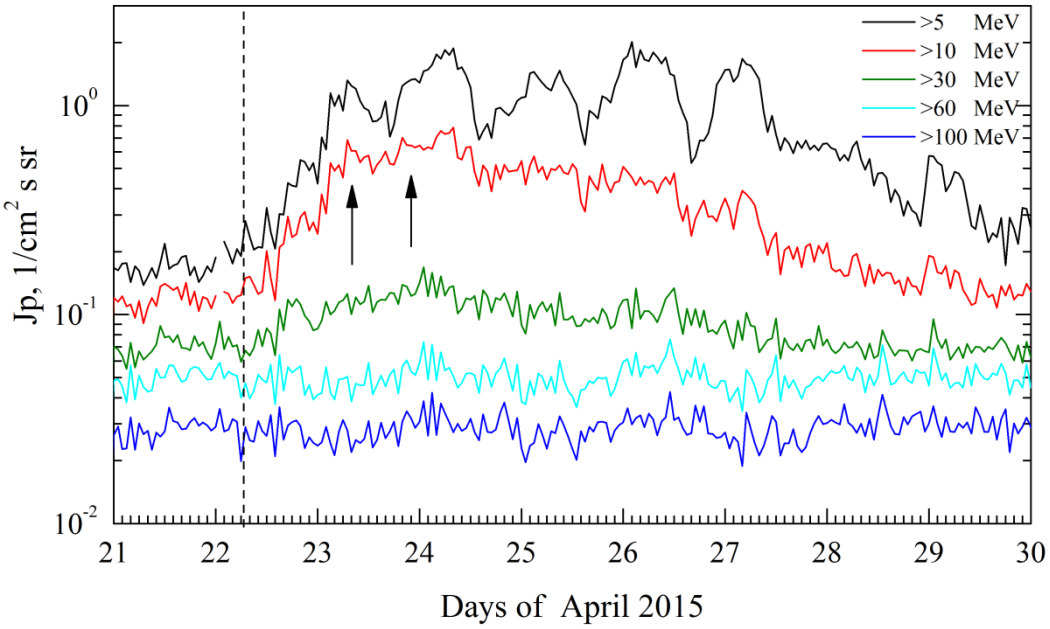
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



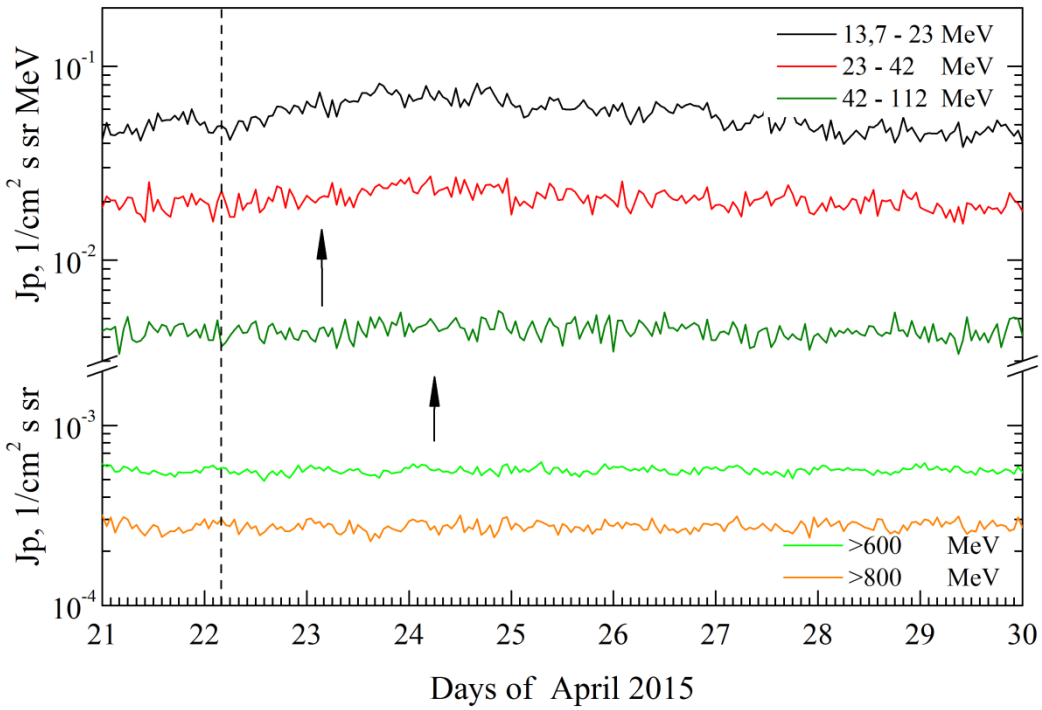


Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro

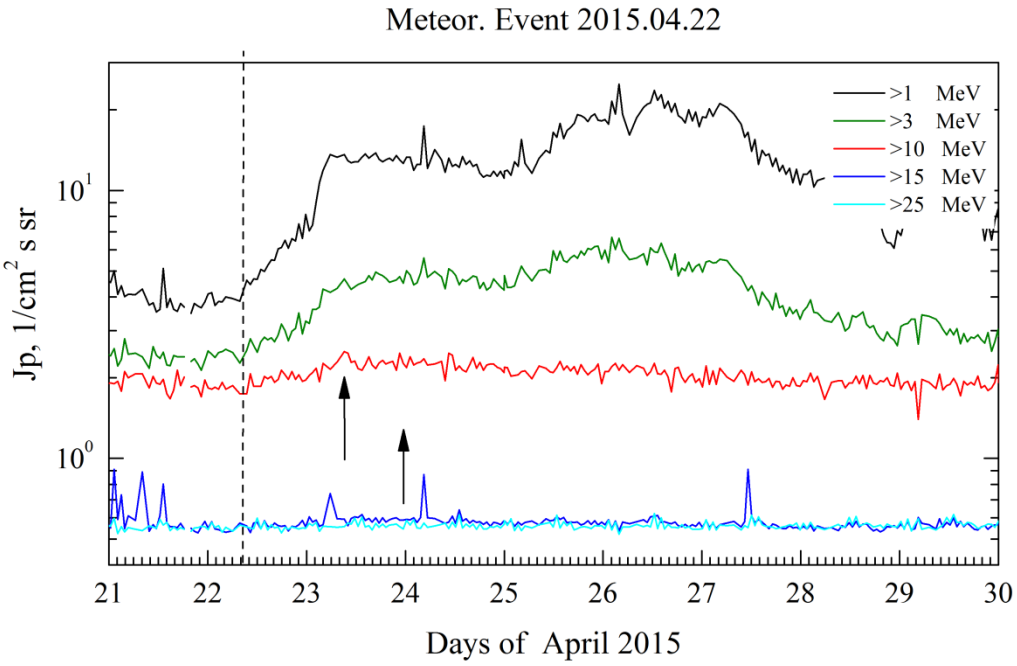
GOES. Event 2015.04.22

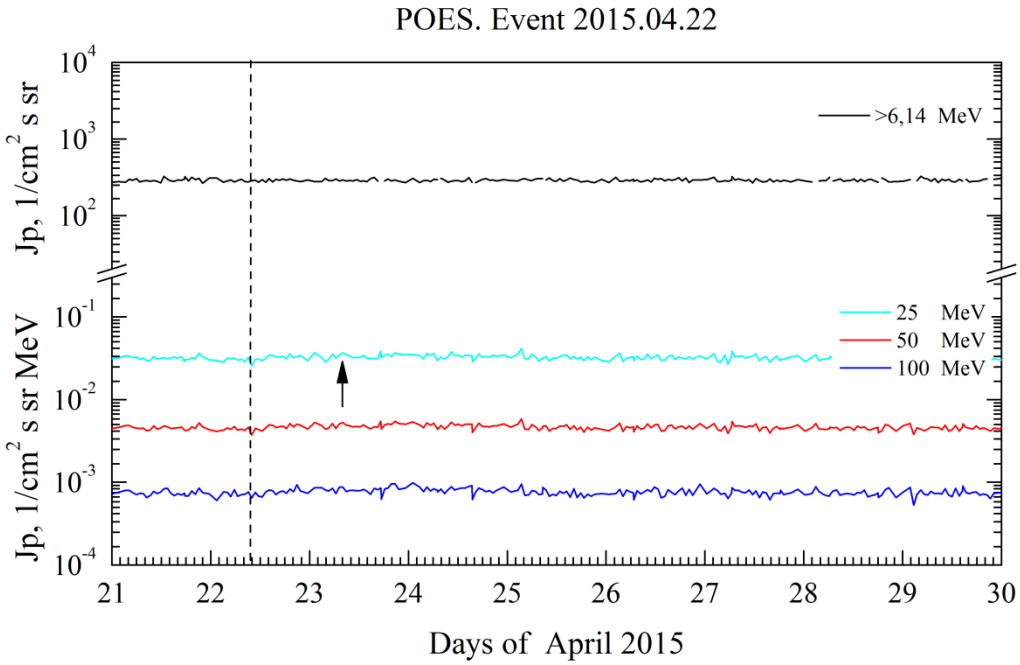


Electro. Event 2015.04.22



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 April 22

2015 April 22 ⊡ AR 12322 To event 568

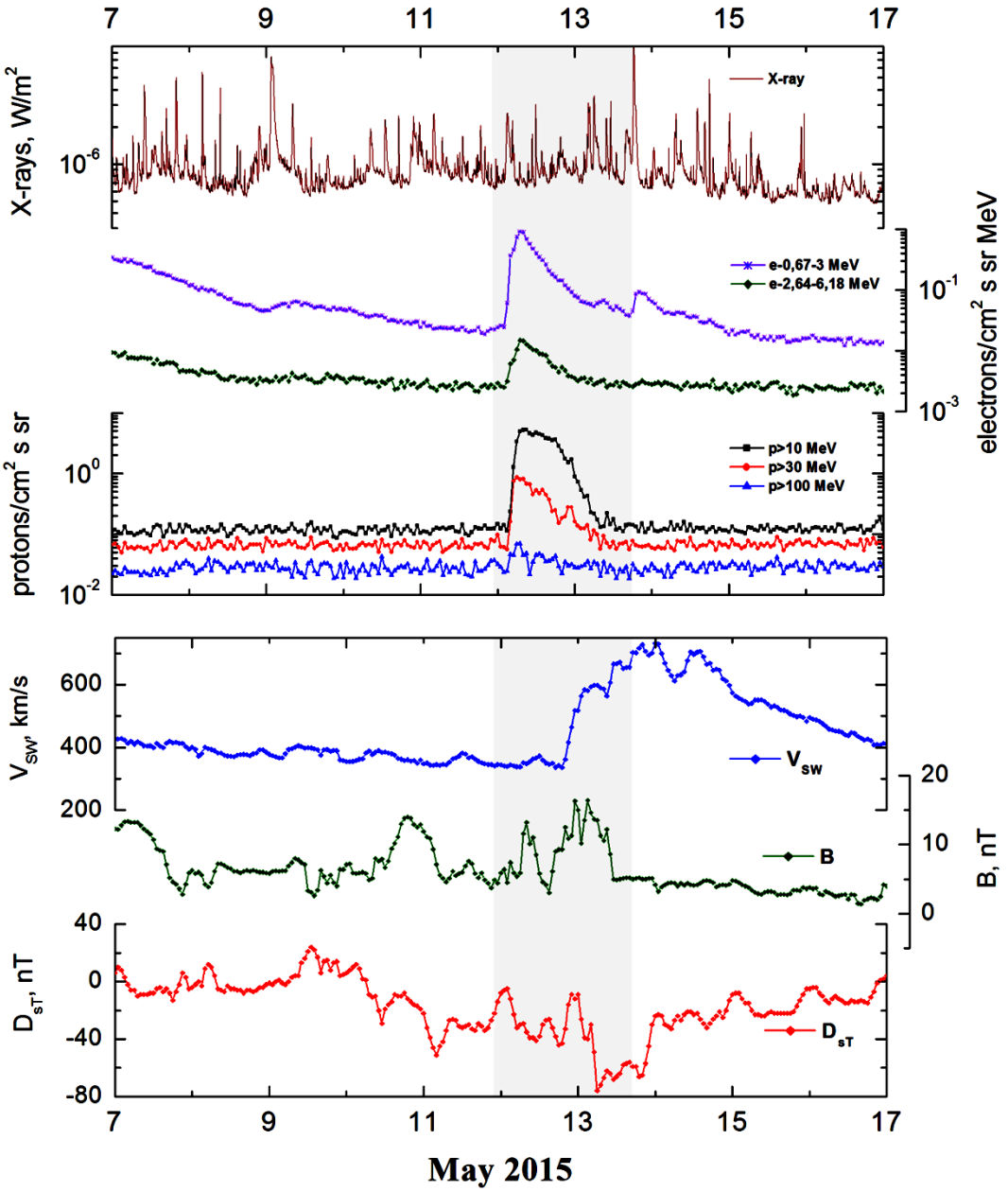
Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ, J/m^2**
6563 Å		No optic flare on the visible disk					
1 – 12	keV	2139	2145	2155	N10W80	M1.8*	0.011
1 – 12	keV	2158	2201	2204	N09W80	M1.2*	0.0028
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	2135:04	2137:30	2139:12	6	5261	HESSI
100-300	keV	2139:12	2143:14	2154:56	1904	3255020	HESSI

*double X-ray burst

Particle event: To(Ep>10 MeV) – 12d04^{h}
Tmax(Ep>10 MeV) – 12d07^{h}, Jmax(Ep>10 MeV) – 5.4 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma = 2.4$
Quasimaximal energy of protons in the event – Eqm = 120 MeV

Sources: ■ solar flare 12d02^{h}15^{m}, C2.6/DSF, S21W83, AR12335
Main burst X-ray 1–8 Å: onset – 12d02^{h}15^{m}, max – 12d03^{h}02^{m}, $\Phi = 0.0094$ J/m^2
CME: 12d02^{h}48^{m}, V = 772 km/s, $\Delta\varphi = 250^{o}$, dA = 283°

Particle fluxes and associated phenomena

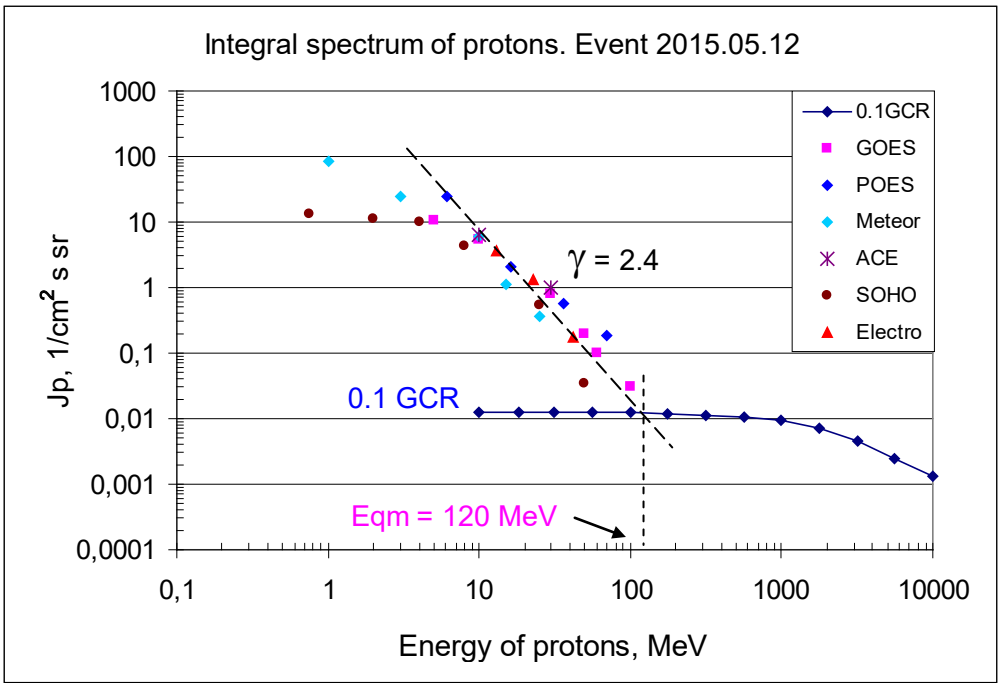


Integral fluxes of protons for the event of 2015 May 12

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	4	7	10.5	1.5	0.2	
EPS	>10	4	7	5.4	1.5	0.12	
EPS	>30	3	7	0.8	1.5	0.07	
EPS	>50	3	7	0.2	1	0.06	
EPS	>60	2	7	0.1	1	0.05	
EPS	>100	2	6	0.03	1	0.03	
Electro-1							
GALS-E	>600	4	6	0.0001	0.5	0.0006	
GALS-E	>800	-	-	-	-	0.0003	
POES							
MEPED	>6.14	-	9	24.4	0.4	280	
Meteor-2							
SCR	>1	4	10	86	1.5	3.8	
SCR	>3	4	10	25	1	2.4	
SCR	>10	4	10	6.3	1	1.9	
GALS-M	>15	3	10	1.1	0.75	0.6	
GALS-M	>25	3	11	0.4	0.75	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	3	8	6.3	1	1	
SIS	>30	3	8	1	1	0.7	
SOHO							
EPHIN	>50	3	8	0.035	1	9.2	

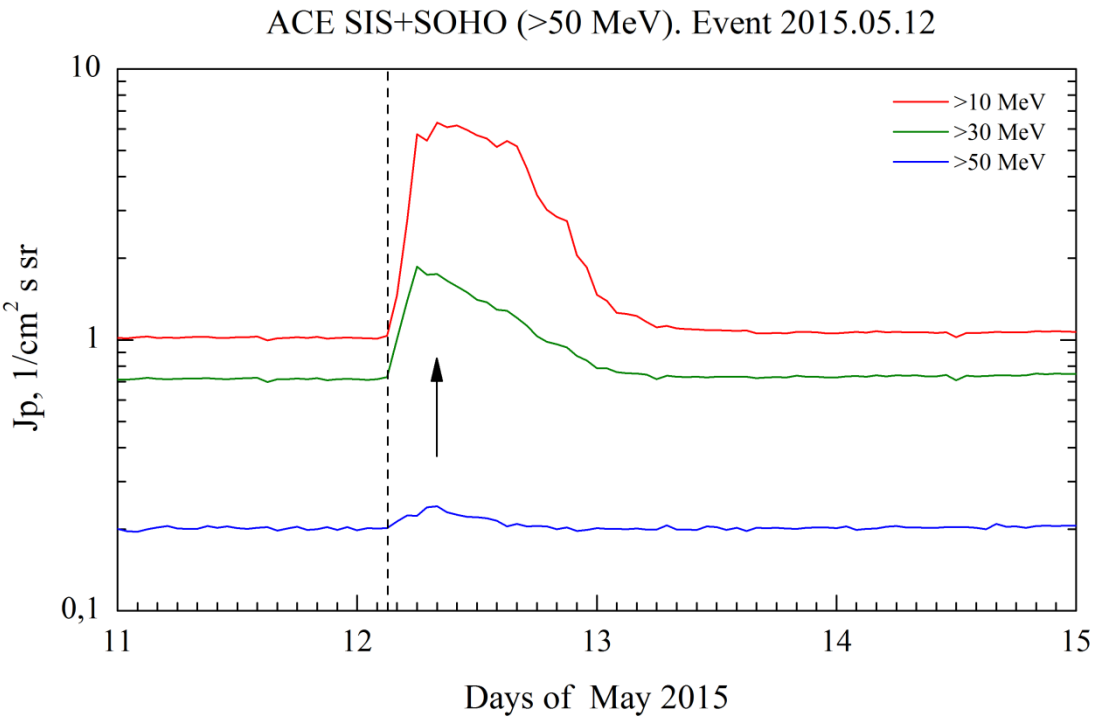
Differential fluxes of protons for the event of 2015 May 12

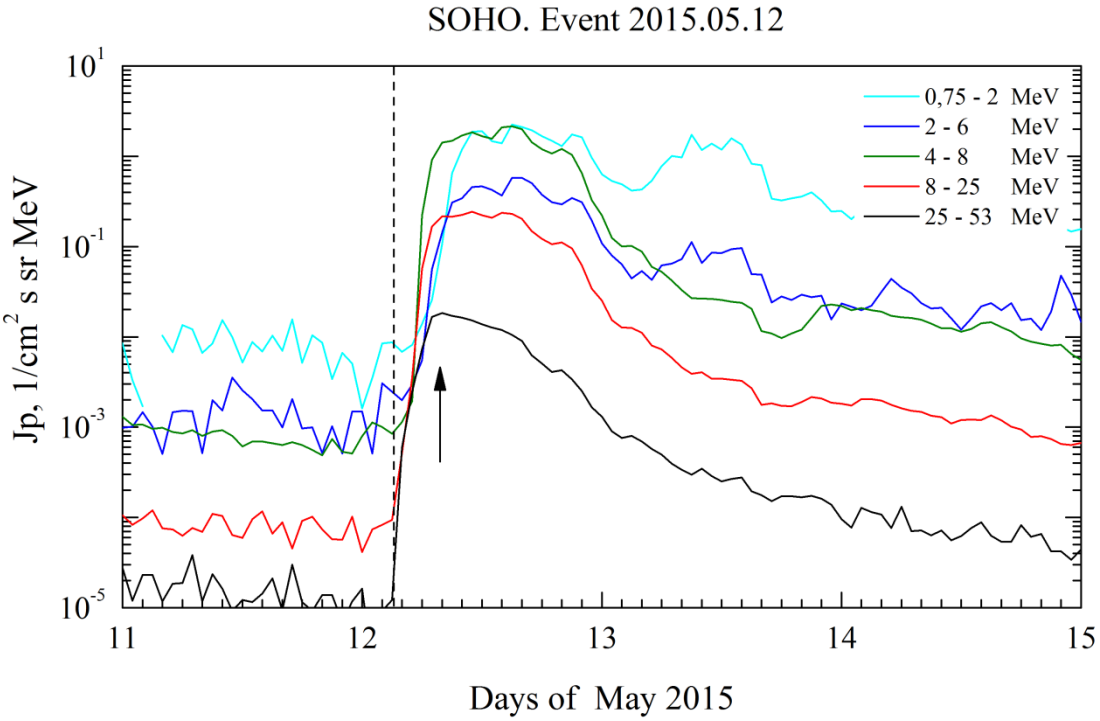
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	5	8	1.9	3	0.01	Logachev
LION	2 – 6	5	8	0.46	3	0.001	
EPHIN	4 – 8	3	8	1.42	3	0.001	
EPHIN	8 – 25	3	8	0.216	3	0.0001	
EPHIN	25 – 53	3	8	0.0183	3	0.00001	
Electro-1							
SCR-E	13.7–23	4	7	0.25	1	0.05	
SCR-E	23–42	4	6	0.06	1	0.02	
SCR-E	42–112	4	6	0.0025	1	0.004	
POES							<E>, MeV
MEPED	16–36	04	6	0.073	0.8	0.032	25
MEPED	36–70	04	5	0.0116	0.8	0.0046	50
MEPED	70–140	04	5	0.0027	0.7	0.00072	100


Integral spectrum of protons. Event 2015.05.12
Jp, 1/cm2 s sr
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.4
0.1 GCR
Eqm = 120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

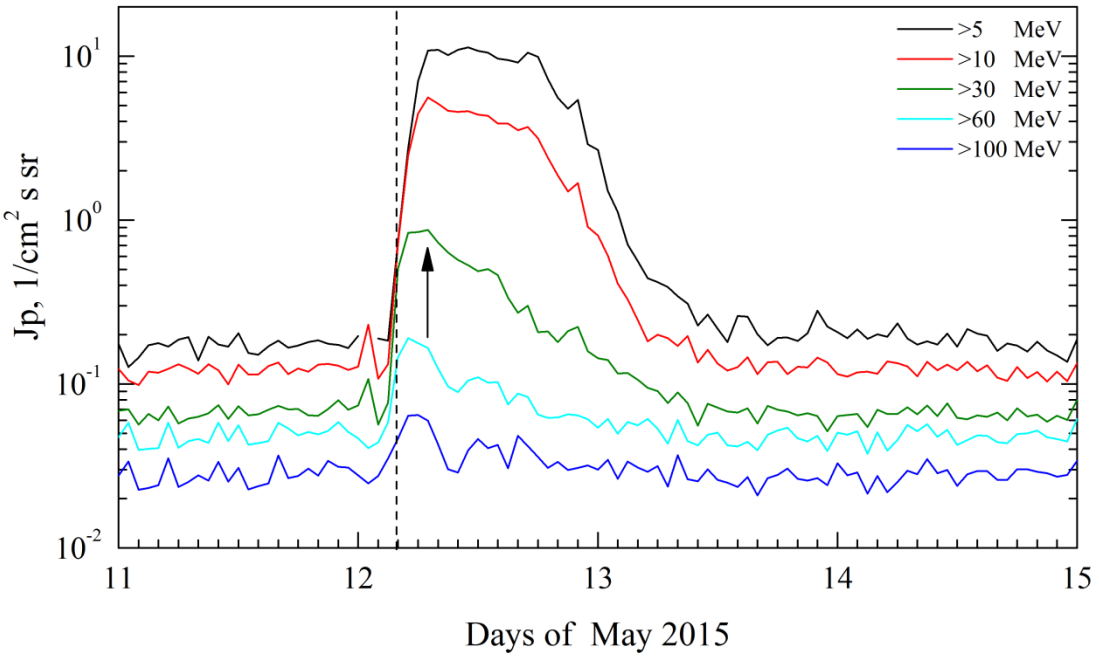
Time profiles of proton fluxes in the event 2015.05.12

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

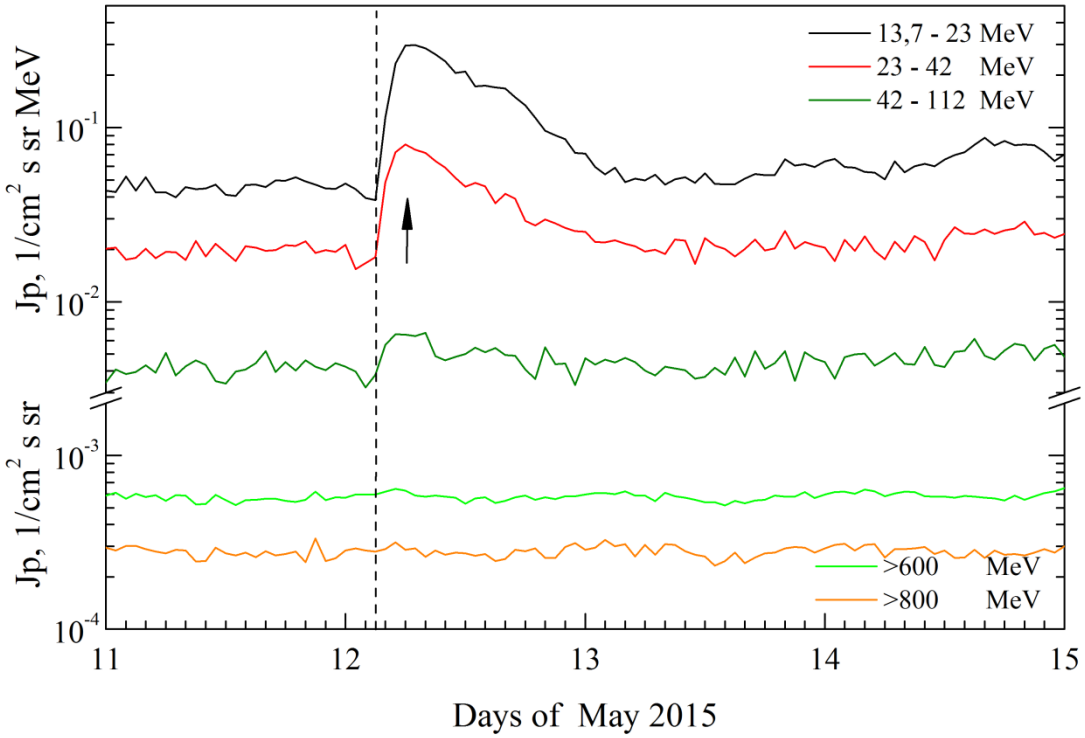




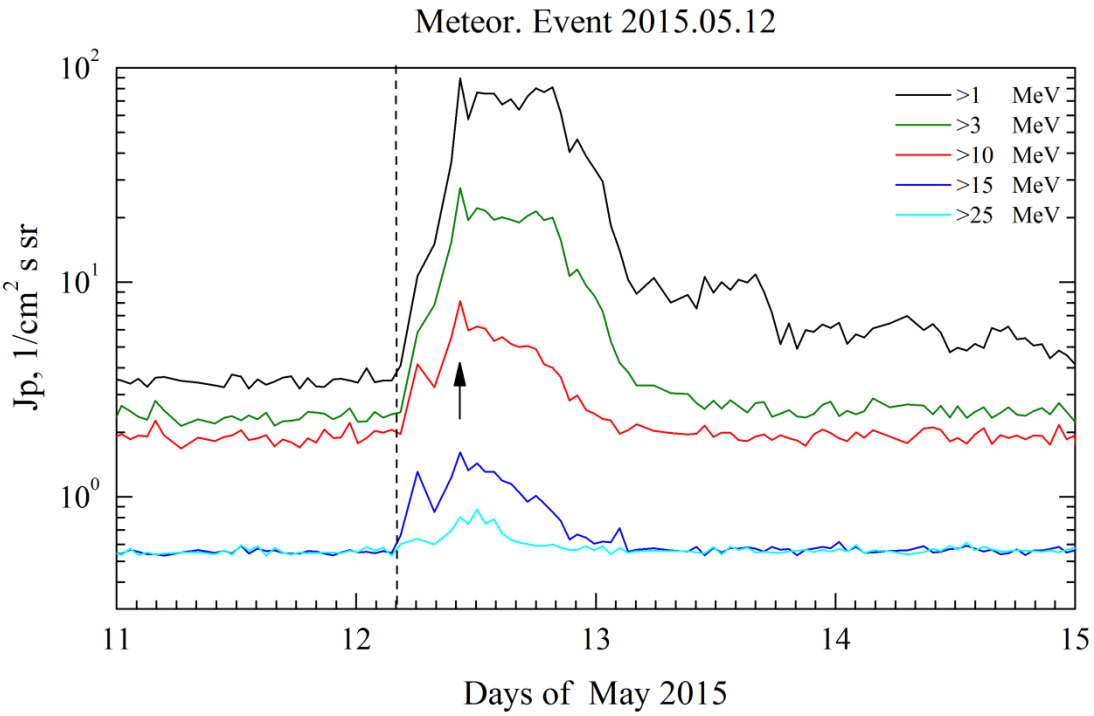
GOES. Event 2015.05.12

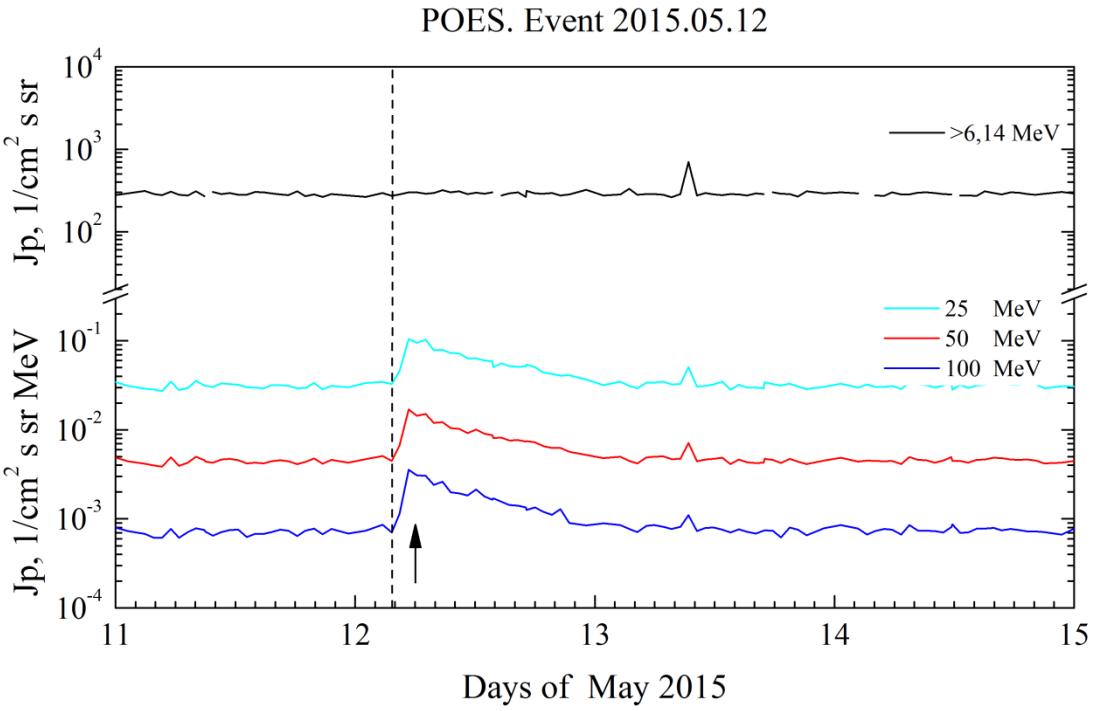


Electro. Event 2015.05.12



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 May 12

2015 **May 12** ■ **AR 12335** **To event 569**

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	DSF*	0226		0248	S21W83	22º	
1 – 12	keV	0215	0302	0342	S21W83	C2.6	0.0094
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	30-45	0247		0252		1	
DS III	75-117	0252		0252		1	
DH II	6.4-14	0300		0304			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0248	772	- 5.9	250˚	283˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_150512_123609_1775_1/www/

Proton Active Region:

AR12335 (S15L193, CMP 06,9.05.2015,
Sp=310 msh, EKC, BG, R)
XRI=0.39 $M_2^{2.6}+C_{23}$ $2_1+1_2+S_{53}$
PFR 5.05: (4^h) $M_2^{2.6}$

References:

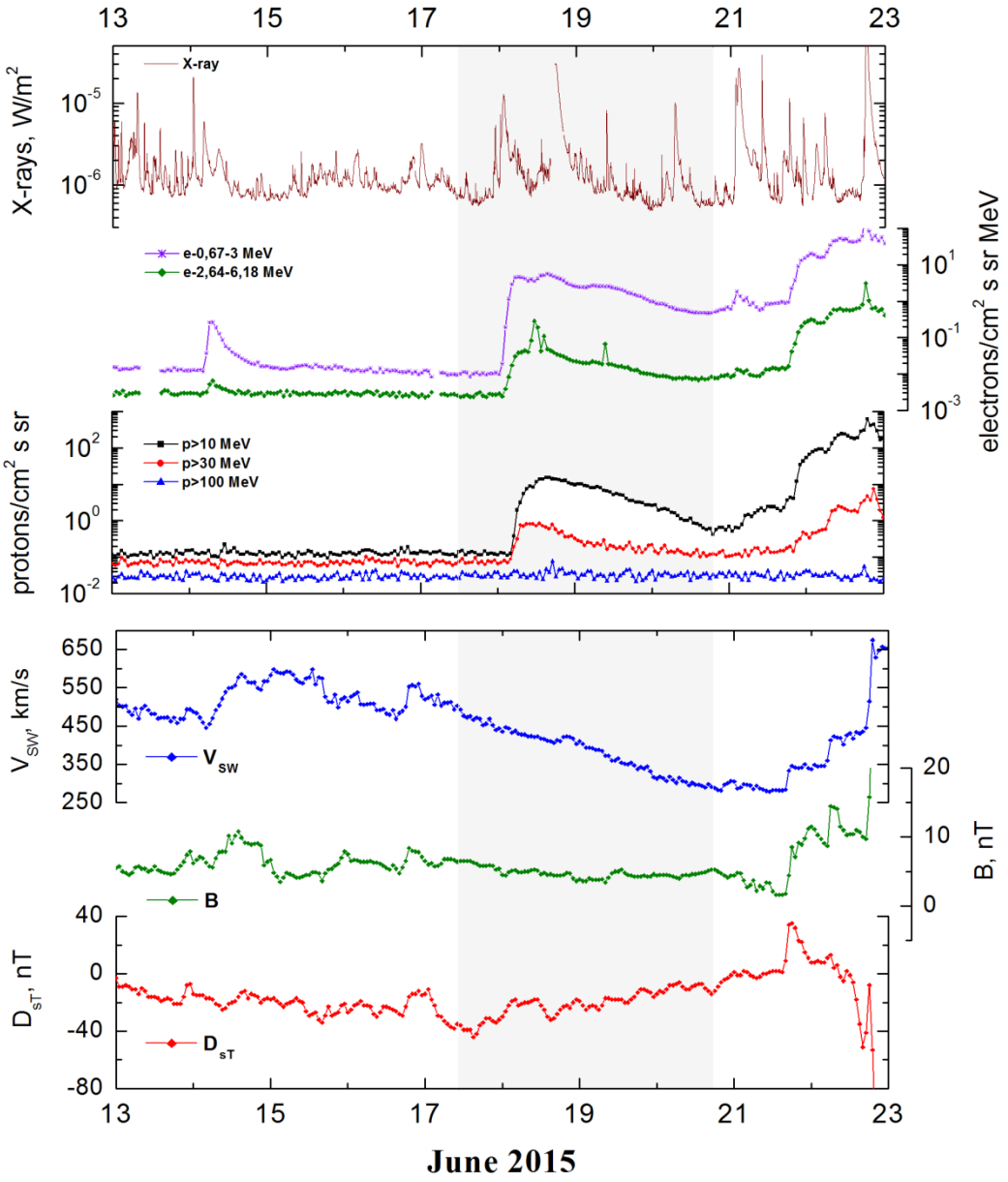
Koleva K., M. Dechev, P. Duchlev, 2021.
Richardson, I.G., T.T., von Rosenvinge, H.V. Cane, 2016.
Tsvetkov Ts., R. Miteva, N. Petrova, 2018.

Event 2015.06.18 – (2015-169) **570**

Particle event: To(Ep>10 MeV) – 18d02^{h}
Tmax(Ep>10 MeV) – 18d14^{h}, Jmax(Ep>10 MeV) – 15.4 /cm^2·s·sr
Duration of the event – 2.5 days, power-law index: γ = 3.2
Quasimaximal energy of protons in the event – Eqm = 100 MeV

Sources: ■ solar flare 18d00^{h}33^{m}, M1.3, S16W81, AR12365
Main burst X-ray 1–8 Å: onset – 18d00^{h}33^{m}, max – 18d01^{h}27^{m}, Φ = 0.04 J/m^2
CME: 18d01^{h}26^{m}, V = 1714 km/s, Δφ = 195º, dA= 270º

Particle fluxes and associated phenomena

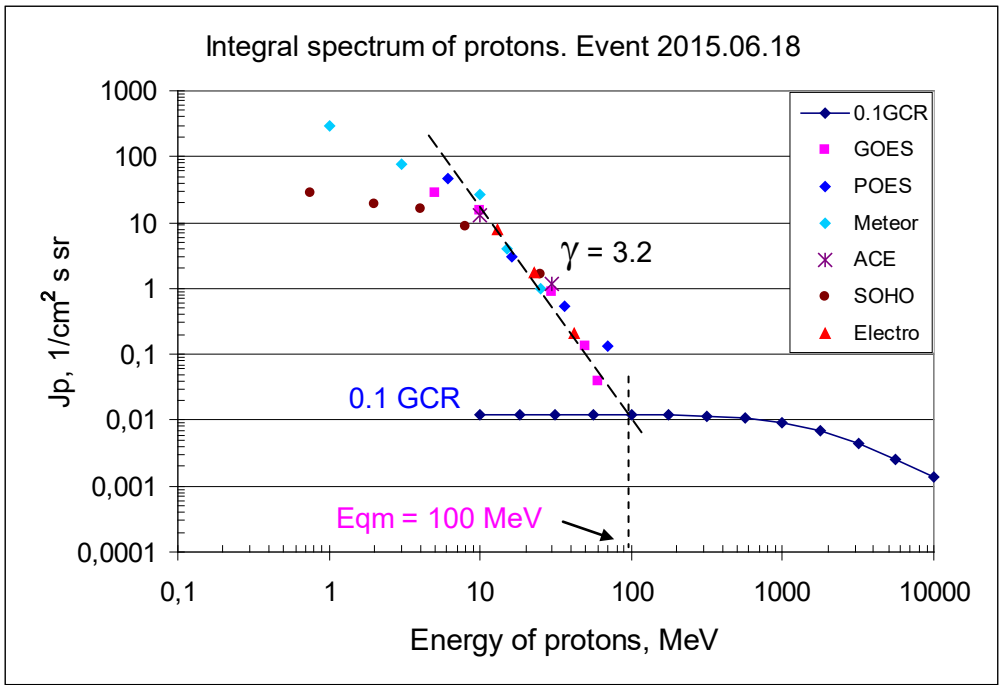


Integral fluxes of protons for the event of 2015 June 18

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	2	15	28.5	2.5	0.2	
EPS	>10	2	14	15.4	2.5	0.12	
EPS	>30	2	12	0.9	1.5	0.07	
EPS	>50	2	12	0.13	1	0.06	
EPS	>60	2	12	0.04	1	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0006	
POES							
MEPED	>6.14	04	23	45.6	2	290	
Meteor-2							
SCR	>1	4	21	300	3	3.9	
SCR	>3	4	18	76	3	2.3	
SCR	>10	4	17	26	2	1.9	
GALS-M	>15	4	17	4	1.5	0.6	
GALS-M	>25	4	13	1	1	0.5	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	3	12	13	3	1.1	
SIS	>30	3	12	1.2	3	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

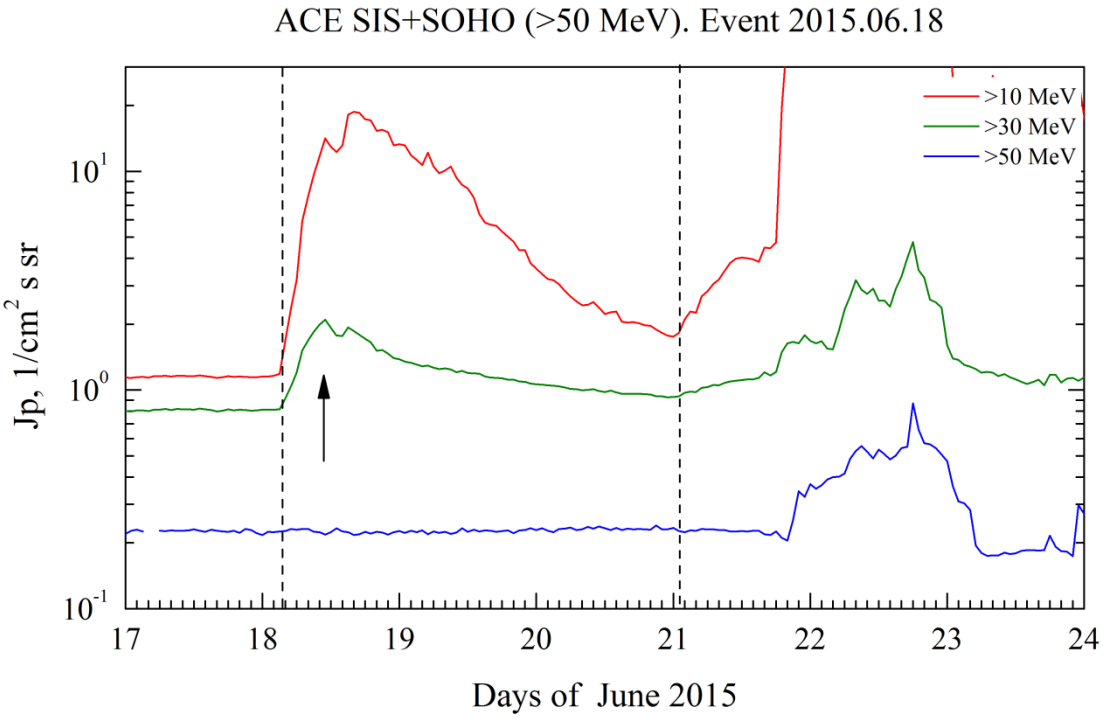
Differential fluxes of protons for the event of 2015 June 18

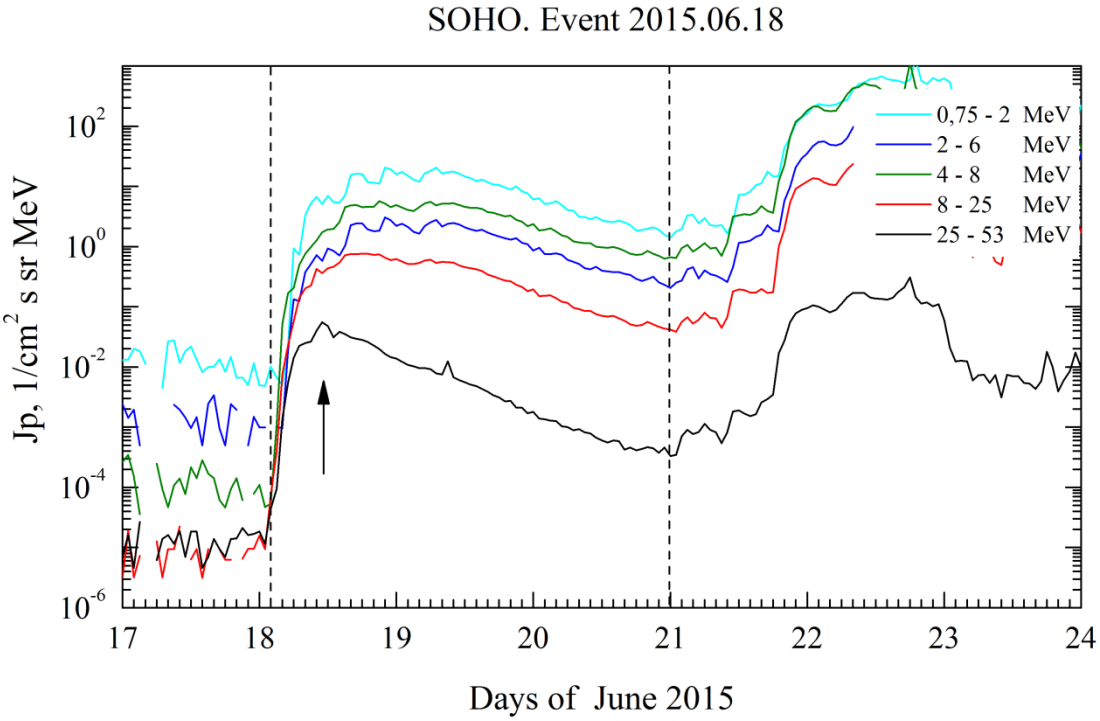
S/c. instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	4	12	6.98	3	0.01	
LION	2 – 6	4	12	0.926	3	0.001	
EPHIN	4 – 8	4	12	1.93	3	0.0001	
EPHIN	8 – 25	4	12	0.43	3	0.00001	
EPHIN	25 – 53	4	11	0.0556	3	0.00001	
Electro-1							
SCR-E	13.7–23	4	11	0.68	1.5	0.05	
SCR-E	23–42	4	11	0.08	1.5	0.02	
SCR-E	42–112	4	9	0.003	0.5	0.004	
POES							<E>, MeV
MEPED	16–36	04	10	0.123	3	0.033	25
MEPED	36–70	04	10	0.0123	3	0.0048	50
MEPED	70–140	04	7	0.0019	3	0.0008	100

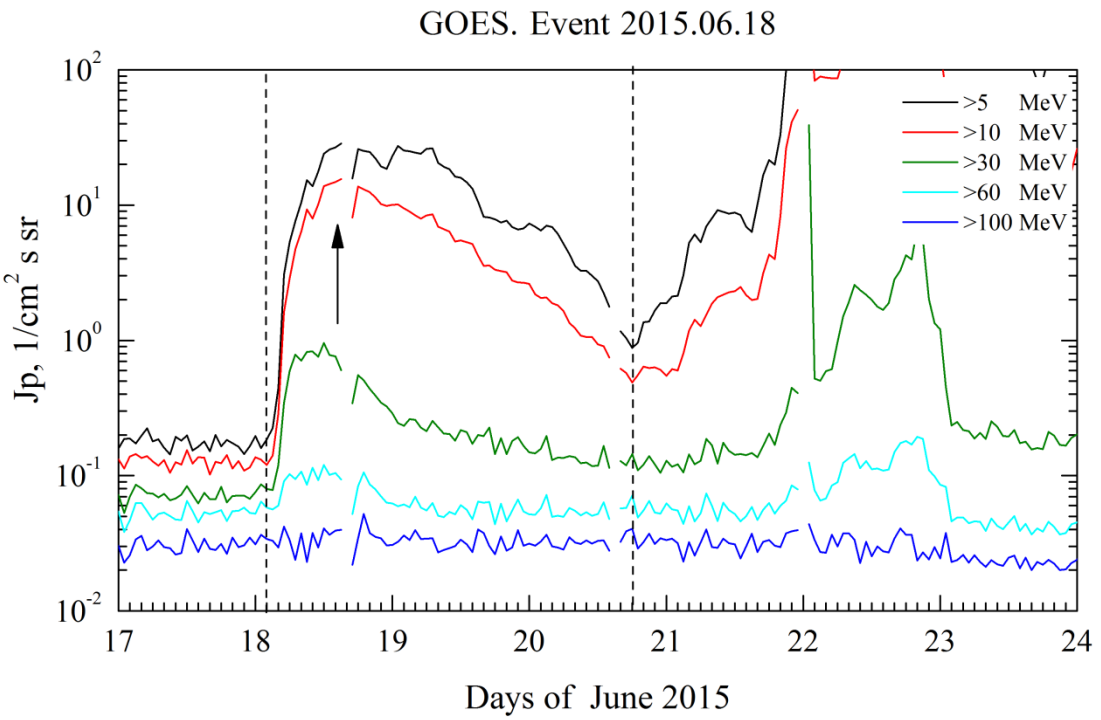

Integral spectrum of protons. Event 2015.06.18
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
γ = 3.2
0.1 GCR
Eqm = 100 MeV

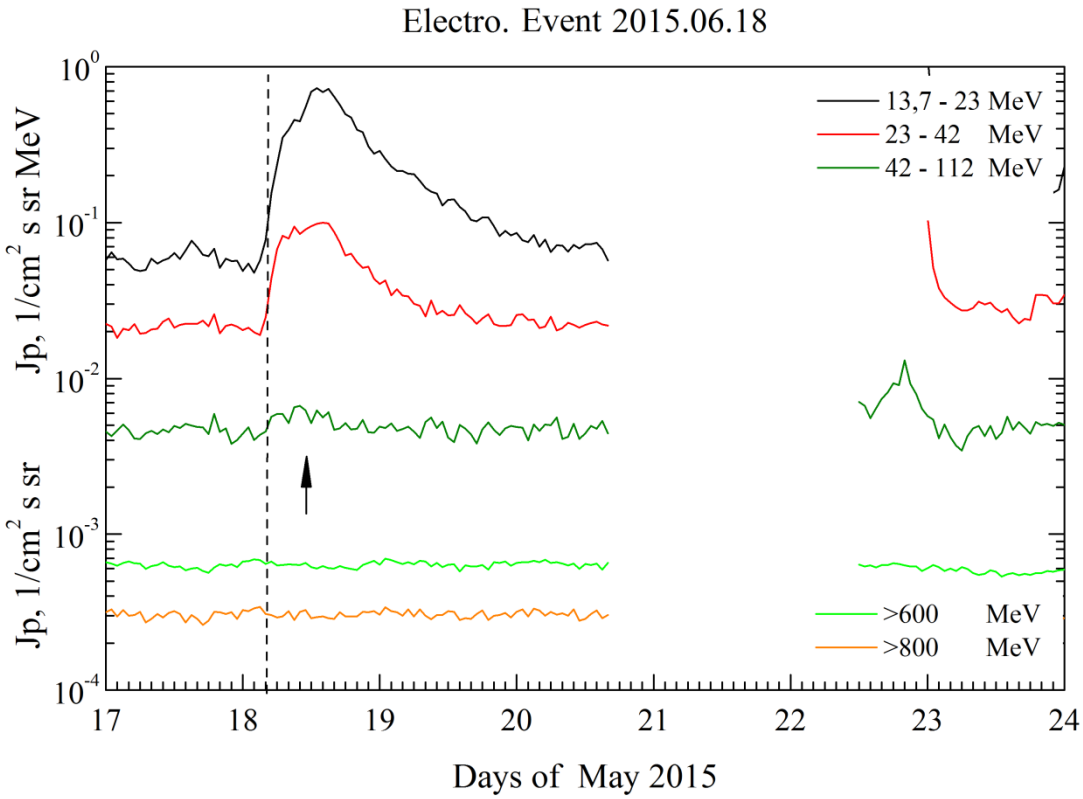
Time profiles of proton fluxes in the event 2015.06.18

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

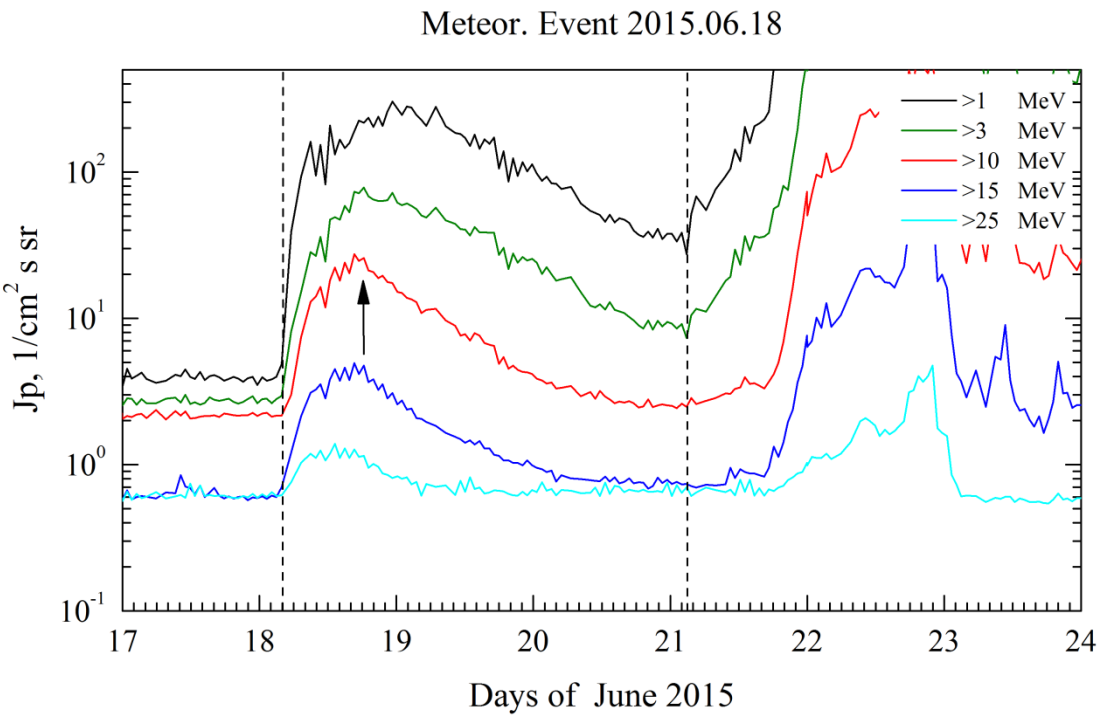


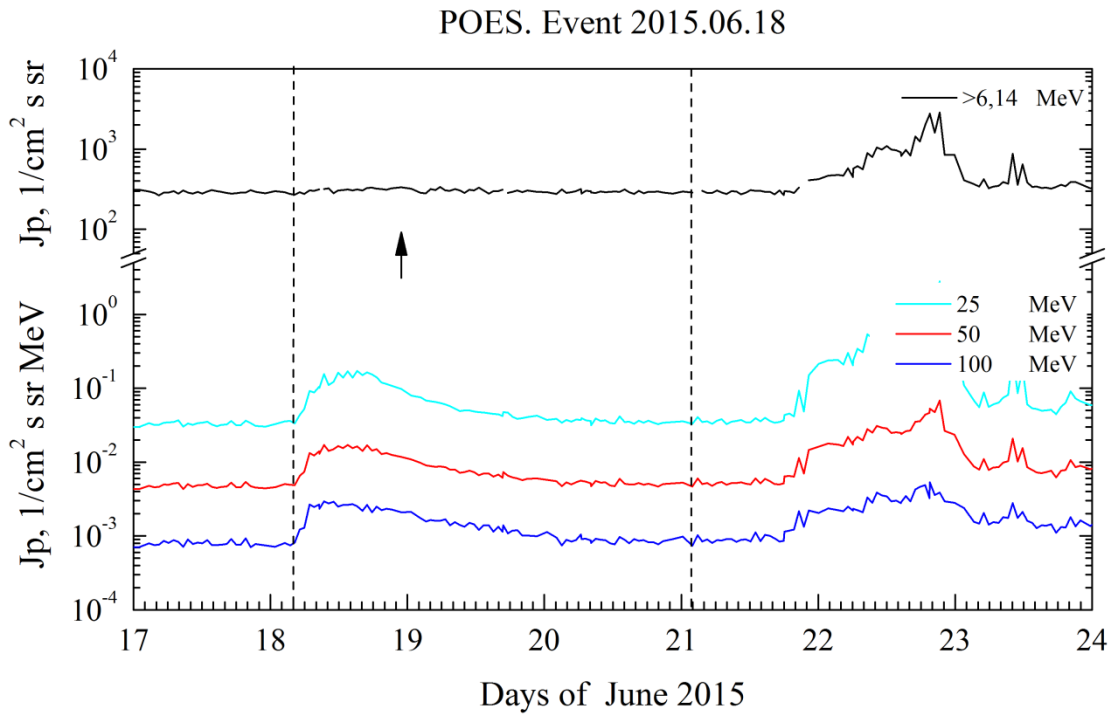



GOES. Event 2015.06.18
Jp, 1/cm² s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of June 2015


Electro. Event 2015.06.18
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of May 2015

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 June 18

2015 June 18 ■ AR 12365 To event 570

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical flare on the visible disk					
1 – 12	keV	0033	0127	0155	S16W81	M1.3	0.04

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	0102:01	0110:29	0146:48		836307	FERMI
12-25	keV	0121:16	0127:10	0137:20	108	353908	HESSI
12-25	keV	0137:20	0141:54	0216:00	56	306206	HESSI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
245	MHz	0147	0147	0147		2.0	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS VI	25-180	0055		0505		1	
DS III	27-80	0104		0111		1	
DS III	70-140	0139		0139		1	
DS III	25-180	0147		0148		1	
DS III	18-250	0148		0149		1	

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0126	1714	27.7	195˚	270˚	SOHO

Proton Active Region:

AR 12365 (S13Ll080, CMP 11,4.06.2021,
Sp=140 msh, HSX, B, R)
XRI=0.12 $M_1^{1.2}$+C_4 S_2
PFR 18.06 $M_1^{1.2}$

References:

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Gopalswamy N., S. Yashiro, N. Thakur et al., 2016.
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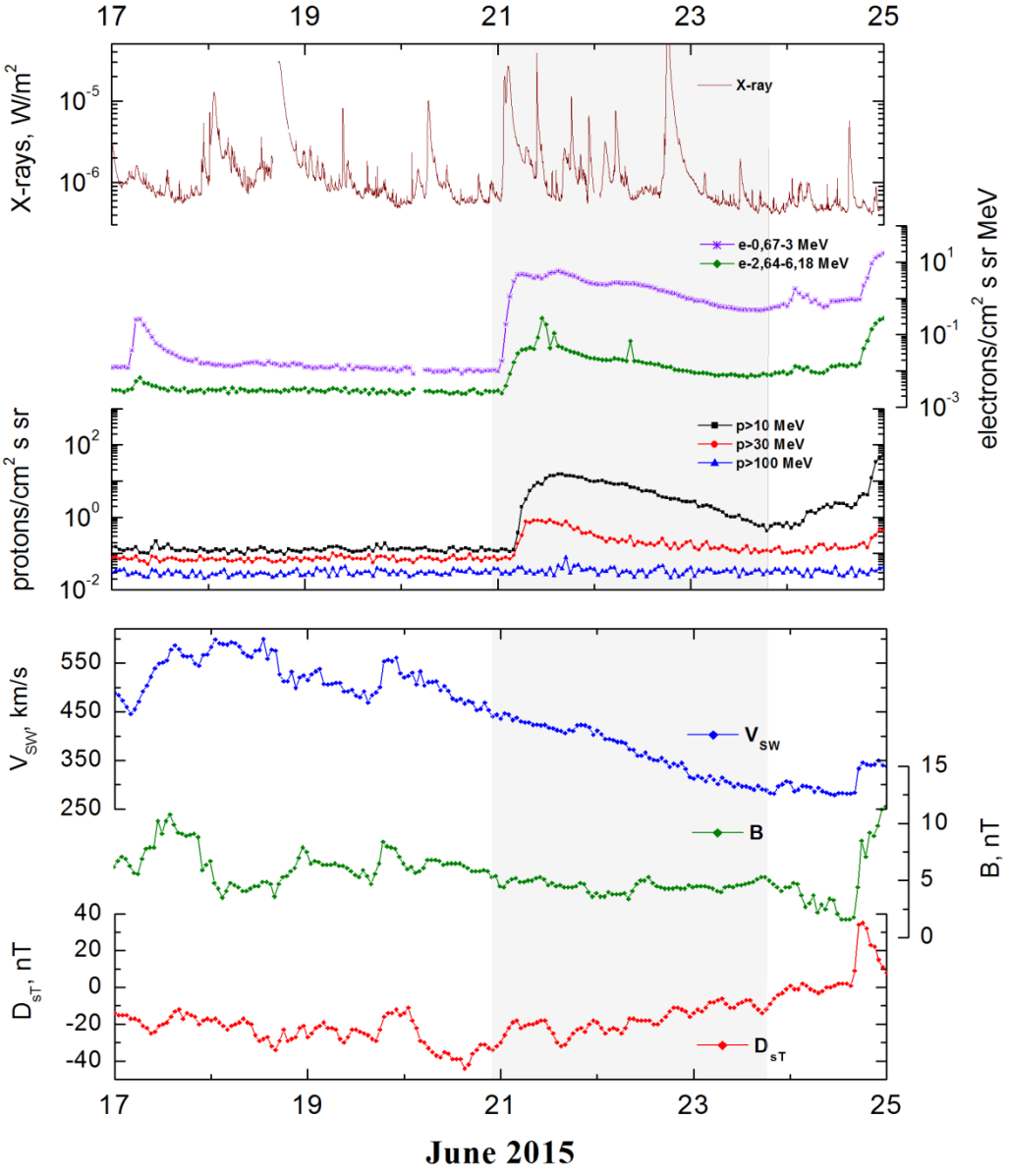
Núñez M., T. Nieves-Chinchilla and A. Pulkkinen, 2019.
Tsvetkov Ts., R. Miteva, N. Petrova, 2018.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.

Particle event: To(Ep>10 MeV) – 21d16^{h}
Tmax$_1$(Ep>10 MeV) – 22d10^{h}, Jmax$_1$(Ep>10 MeV) – 230 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 22d19^{h}, Jmax$_2$(Ep>10 MeV) – 600 /cm^2·s·sr
Duration of the event – 4 days, power-law index: $\gamma_1 = 4.15$, $\gamma_2 = 4.3$
Quasimaximal energy of protons in the event – Eqm$_1$ = 100 MeV
– Eqm$_2$ = 110 MeV

Sources: ● solar flare 21d01^{h}02^{m}, M2.0, M2.7/1N, N12E13, AR12371
Ø solar flare 22d17^{h}23^{m}, 2B/M6.5; N12W08, AR12371
Main burst X-ray 1–8 Å: onset – 21d01^{h}02^{m}, max – 21d01^{h}42^{m}, Φ = 0.032 J/m^2
CME: 21d02^{h}36^{m}, V = 1366 km/s, Δφ = 360°, dA= 72°
▲ SC 21d16^{h}43^{m}, ▲ SC 22d05^{h}45^{m}, ▲ SC 22d18^{h}33^{m}

Particle fluxes and associated phenomena

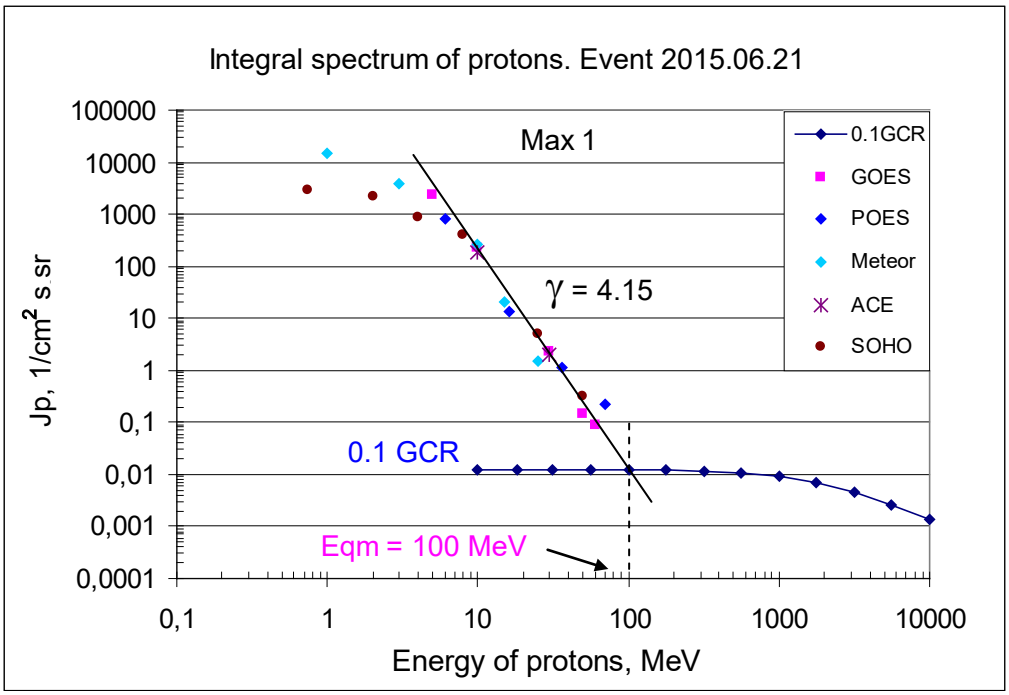


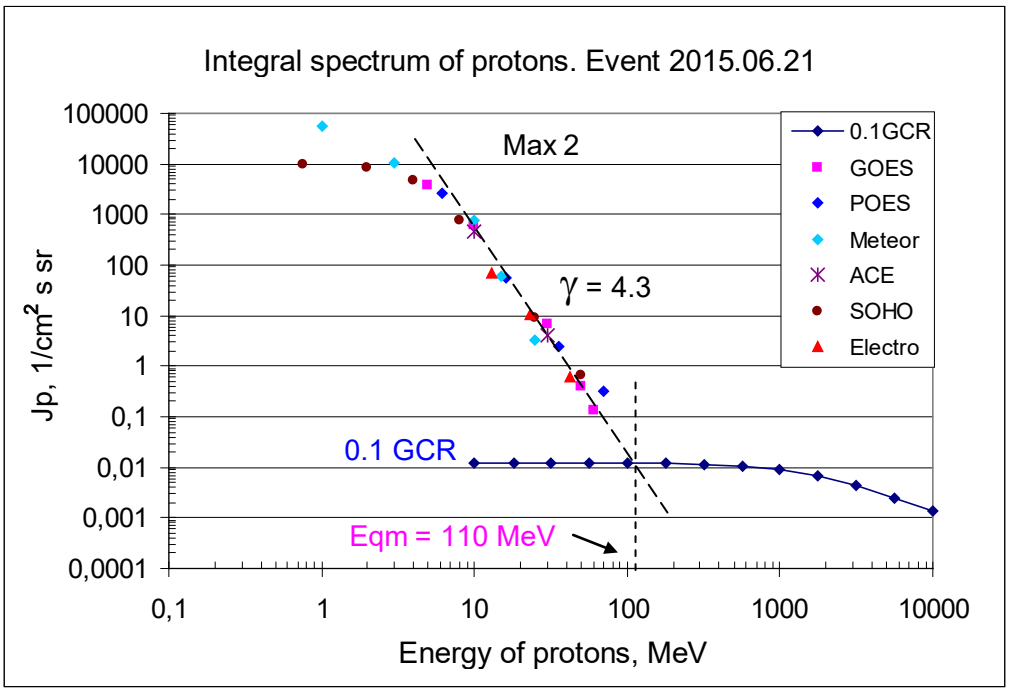
Integral fluxes of protons for the event of 2015 June 21

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	16	22d10/22d19	2290/3930	4	0.2	
EPS	>10	16	22d10/22d19	230/600	4	0.15	
EPS	>30	16	22d10/22d20	2.3/6.7	1.5	0.07	
EPS	>50	16	22d10/22d20	0.15/0.4	1.5	0.06	
EPS	>60	16	22d10/22d20	0.09/0.13	1.5	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	20	22d12/22d22	800/2570	2	290	
Meteor-2							
SCR	>1	3	22d10/22d19	14400/56200	4.5	3.8	
SCR	>3	3	22d10/22d19	3890/10200	4.5	2.7	
SCR	>10	16	22d10/22d19	267/746	4	2.2	
GALS-M	>15	18	22d10/22d19	21/59	2.5	0.6	
GALS-M	>25	22	22d10/22d19	1.5/3.4	2	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	18	22d11/22d18	190/470	4	1.1	
SIS	>30	18	22d09/22d18	2.5/4	4	0.7	
SOHO							
EPHIN	>50	21	22d09/22d18	0.32/0.64	1.5	0.23	

Differential fluxes of protons for the event of 2015 June 21

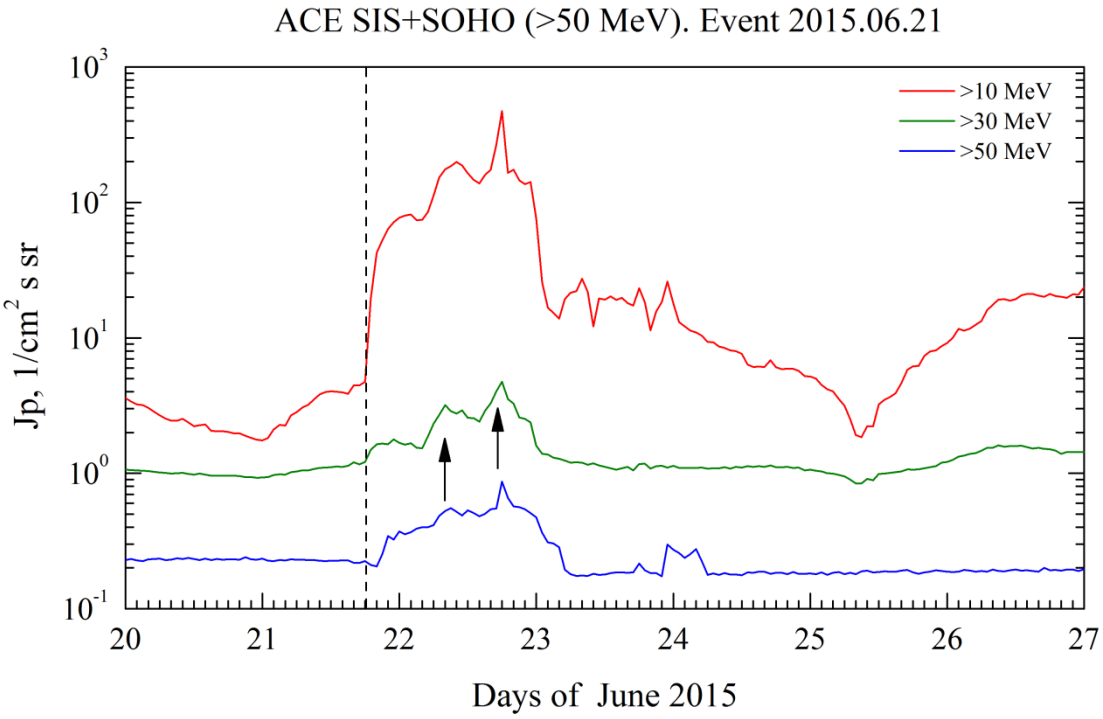
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	11	22d08/22d18	498/1300	4	0.01	
LION	2 – 6	11	22d08/22d18	446/1130	4	0.001	
EPHIN	4 – 8	11	22d08/22d18	123/1000	4	0.0001	
EPHIN	8 – 25	11	22d08/22d18	23.4/44.2	4	0.00001	
EPHIN	25 – 53	11	22d08/22d18	0.17/0.31	4	0.00001	
Electro-1							
SCR-E	13.7–23	-	- /22d19	- /6.2	1	0.07	
SCR-E	23–42	-	- /22d19	- /0.52	1	0.02	
SCR-E	42–112	-	- /22d19	- /0.009	1	0.004	
POES							<E>, MeV
MEPED	16–36	18	22d12/22d22	0.62/2.76	2	0.033	25
MEPED	36–70	18	22d12/22d22	0.026/0.064	2	0.0048	50
MEPED	70–140	18	22d12/22d20	0.0031/0.0045	2	0.0008	100

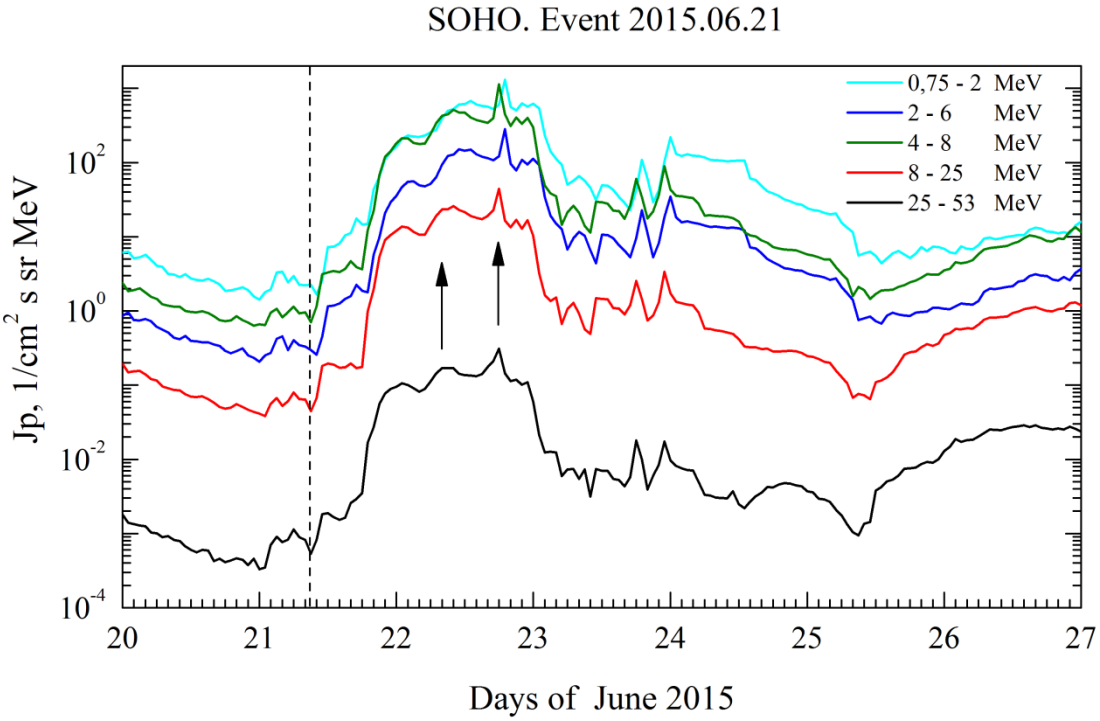

Integral spectrum of protons. Event 2015.06.21
Max 1
γ = 4.15
0.1 GCR
Eqm = 100 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2015.06.21
Max 2
γ = 4.3
0.1 GCR
Eqm = 110 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

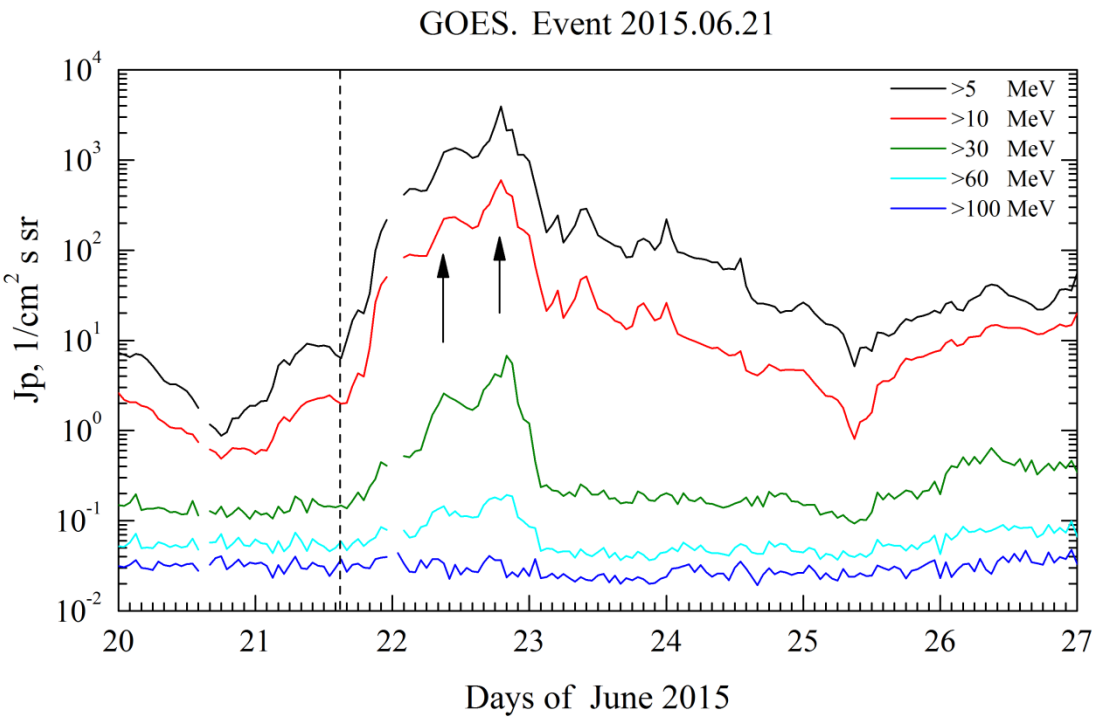
Time profiles of proton fluxes in the event 2015.06.21

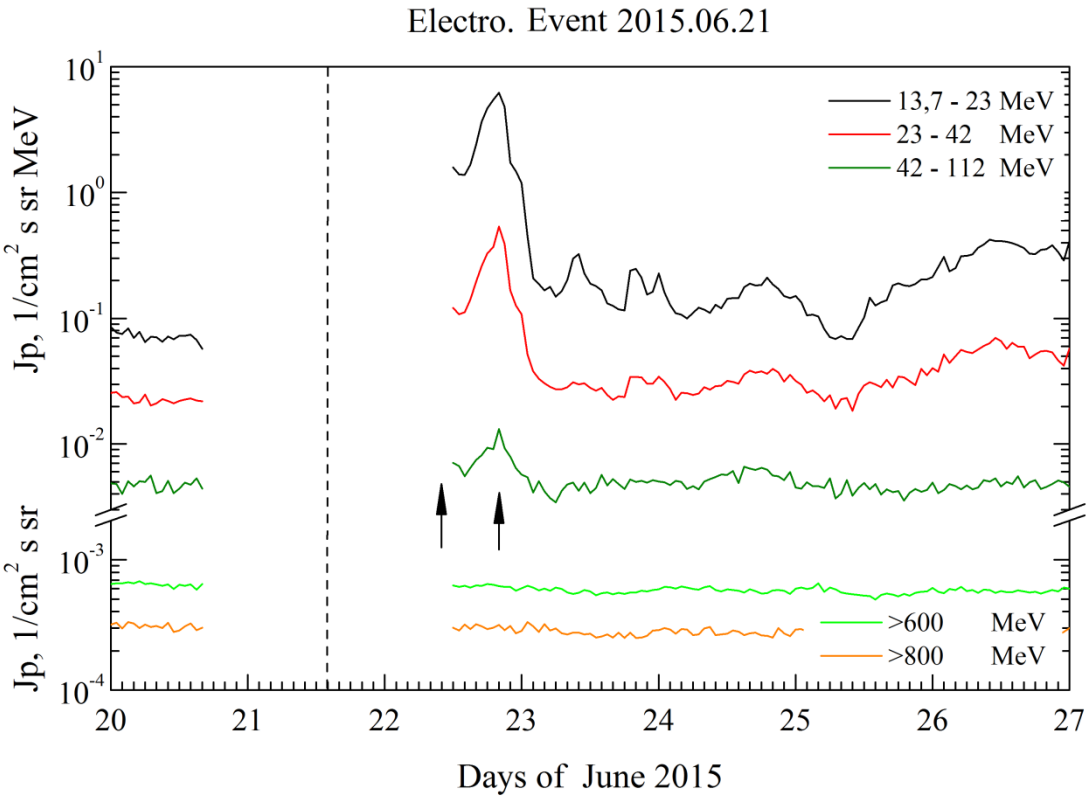
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



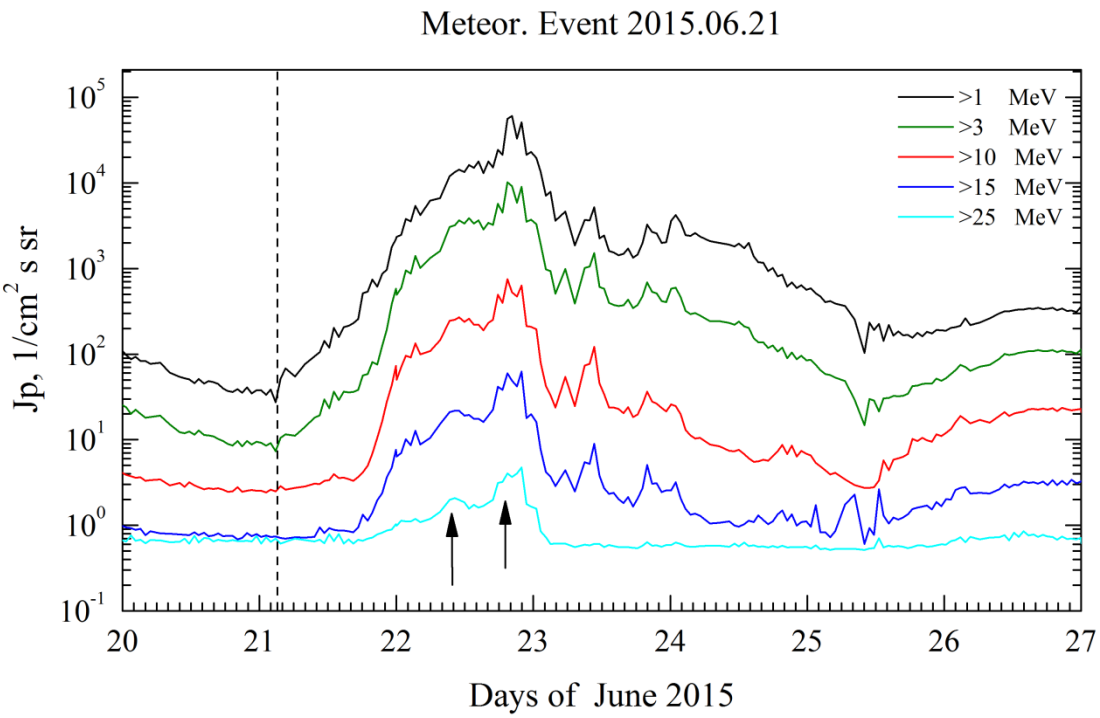


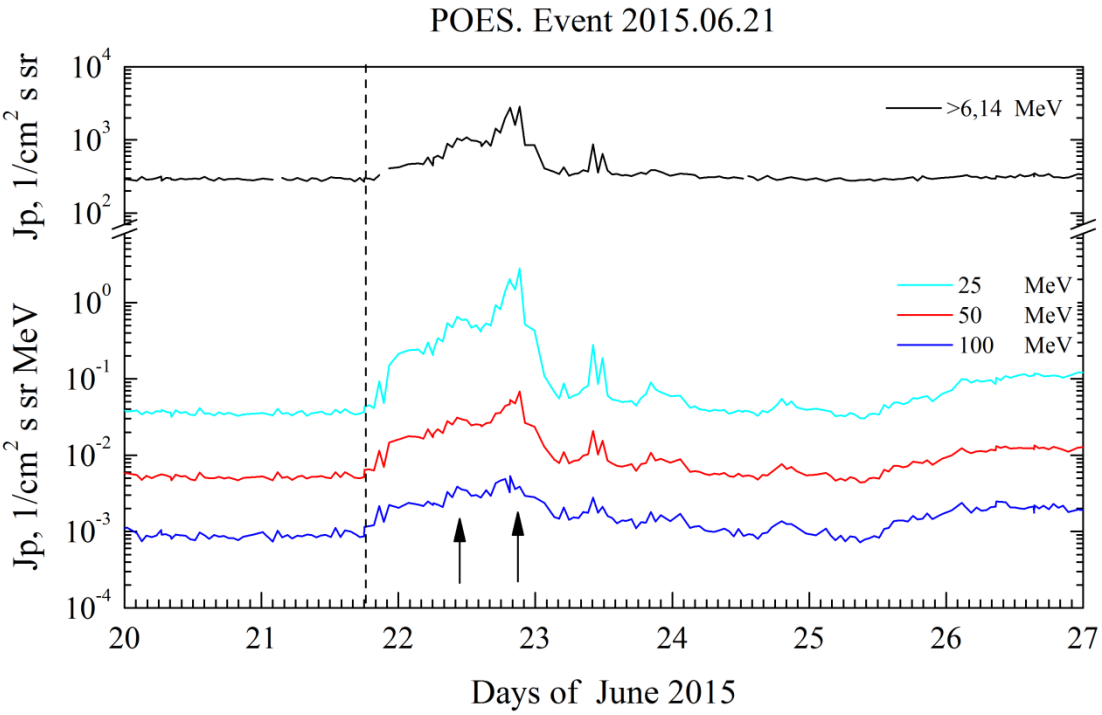
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 June 21

2015 June 21 ● AR12371 To event 571

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0107	0140	0434	N12E13	1N	UMB
1 – 12	keV	0102	0142	0200		M2.0	0.032
1 – 12	keV	0206	0236	0302		M2.7	
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	Total counts	**Sp/c**
12-25	keV	0108:00	0113:46	0118:56	23	45946	HESSI
25-50	keV	0118:56	0127:42	0129:00	368	390275	HESSI
100-300	keV	0158:04	0228:14	0303:08	1264	12931743	HESSI
12-25	keV	0332:44	0333:18	0345:16	339	143652	HESSI
12-25	keV	0345:16	0345:42	0349:20	28	37013	HESSI
12-25	keV	0349:20	0351:02	0401:04	27	92524	HESSI
6-12	keV	0401:04	0401:06	0410:08	20	56736	HESSI
6-12	keV	0410:08	0411:02	0423:44	18	73416	HESSI
12-25	keV	0121:50	0125:15	0125:51	7981	222287	HESSI
12-25	keV	0201:42	0221:09	0301:06	58948	58948	FERMI
12-25	keV	0348:24	0406:42	0413:15	769	212221	FERMI
>100	MeV	0519:30		0553:30		2.66E-05*	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0135	0136	0140		2.89	
8.8	GHz	0129	0129	0130		2.11	
5	GHz	0134	0136	0143		2.95	
2.7	GHz	0152	0152	0152		2.0	
1.4	GHz	0203	0249	0315		2.81	
610	MHz	0136	0137	0137		2.18	
410	MHz	0136	0136	0136	0.4 / 1.4	2.08	
245	MHz	0152	0152	0152		2.56	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS VI	25-180	0151		0425		2	
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0222	0238	0255		2.08	
8.8	GHz	0207	0225	0315		2.48	
5	GHz	0207	0226	0317	P5 \ 15	2.95	
2.7	GHz	0204	0226	0320		2.69	
1.4	GHz	0203	0249	0315		2.81	
610	MHz	0204	0240	0329		2.72	
410	MHz	0205	0205	0326	0.4 / 1.4	2.6	
245	MHz	0233	0250	0329		3.0	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	45-245	1153		1216		2	
DS IV	30-80	1152		1728		3	
DS IV	35-85	1152		1446		3	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0236	1366	21.2	360˚	72˚	SOHO

*cm^{-2}s^{-1}

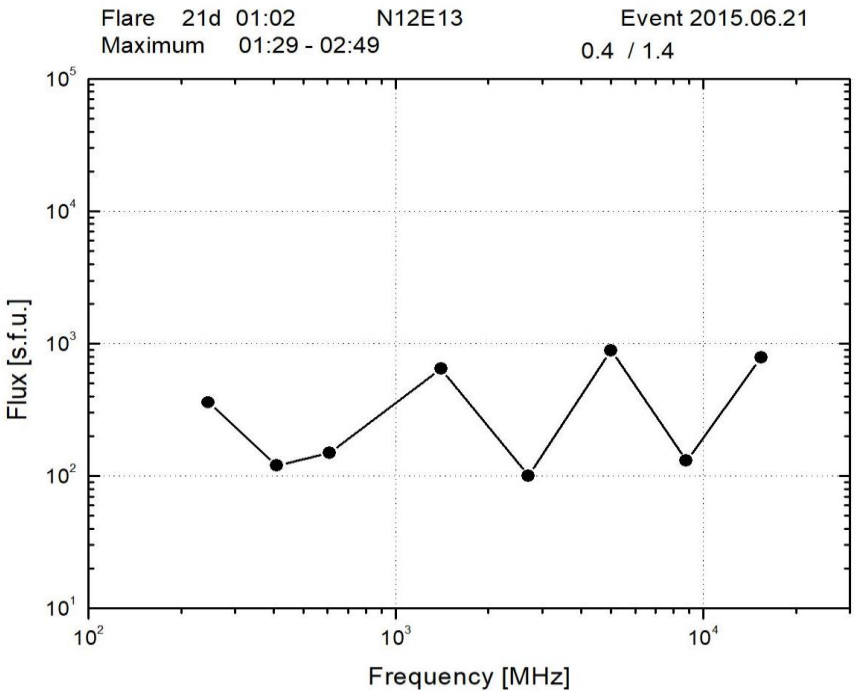
Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1723	1810	2053	N12W08	2B	UMB
6563 Å	LPS	>1754		>0412	N31W32	6º	
1 – 12	keV	1739	1823	1851		M6.5	0.19

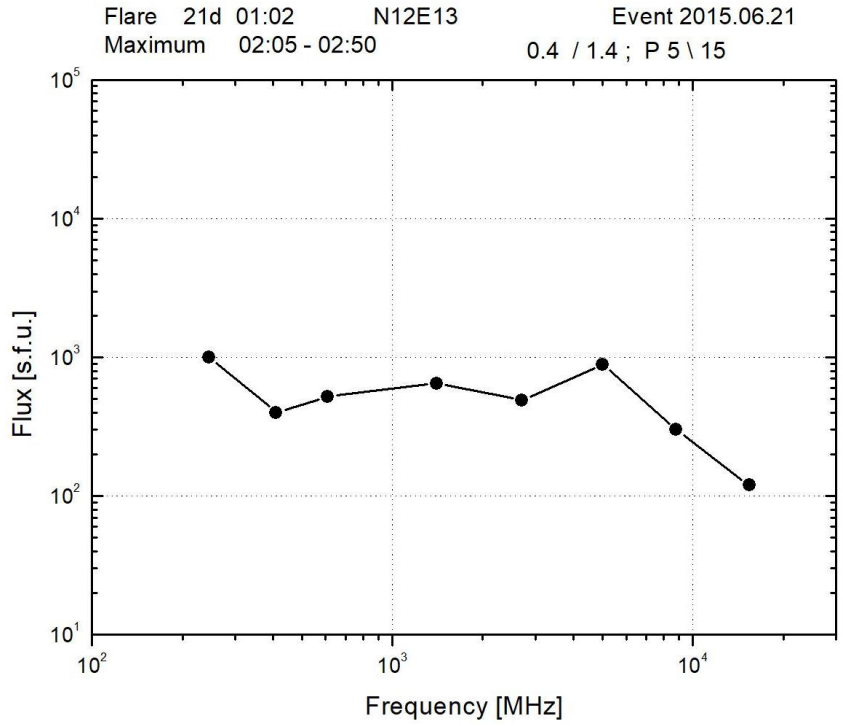
X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	1724:28	1725:30	1735:00	108	139480	HESSI
25-50	keV	1736:00	1743:18	1746:0	432	466635	HESSI
100-300	keV	1803:16	1804:46	1806:56	4609	5439385	HESSI
100-300	keV	1806:56	1815:30	1827:44	6527	35508716	HESSI
12-25	keV	1859:00	1859:30	1927:48	905	1680316	HESSI
100-300	keV	2033:28	2034:34	2052:48	599	2794909	HESSI
100-300	keV	2052:48	2053:38	2108:08	225	505522	HESSI
12-25	keV	1743:34	1759:25	1818:39	458242	487982592	FERMI
12-25	keV	1918:49	1923:23	1959:26	1938	472384	FERMI

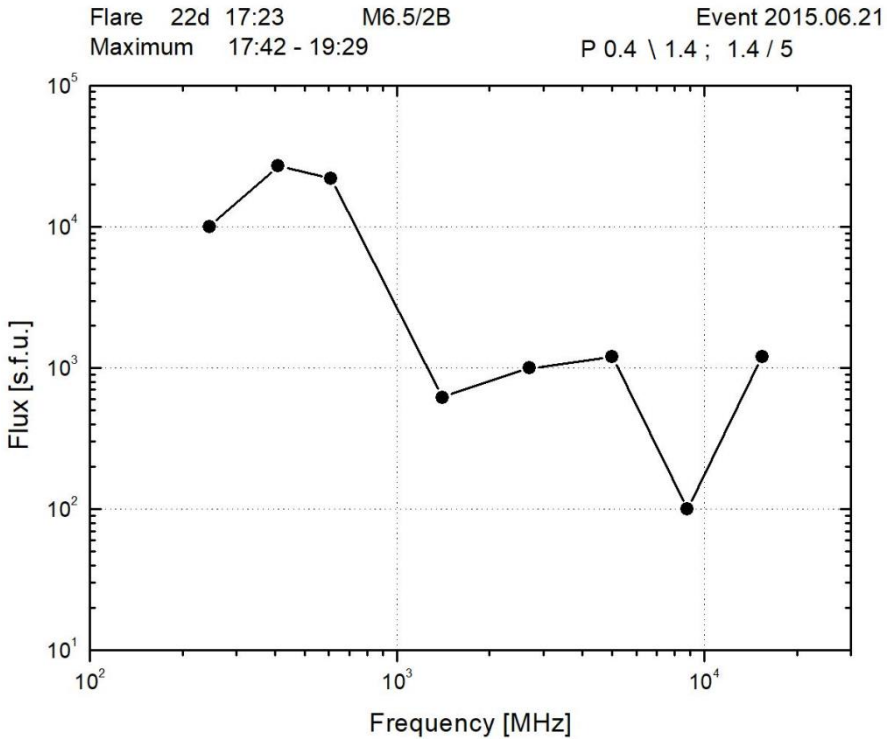
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1752	1752	1849		3.08	
8.8	GHz	1742	1742	1742		2.0	
5	GHz	1752	1804	1938		3.08	
2.7	GHz	1753	1825	1946		3.0	
1.4	GHz	1755	1810	1950	1.4 / 5	2.79	
610	MHz	1803	1929	1955		4.34	
410	MHz	1755	1928	1959	P0.4 \ 1.4	4.43	
245	MHz	1807	1929	2032		4.0	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-180	1805		1826	1480	1	
DS VI	25-180	1907		2335		2	
DH II	0.3-14	1820		2155			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1836	1209	- 25.1	360˚	358˚	SOHO

Radio bursts frequency spectrum







Proton Active Region:

AR12371 (N12L302; CMP 22,0.06.2015;
Sp=1180 msh; FKC; BGD, R)
XRI=2.0; $M_6^{7.9}$+C_{39} 3_1+2_2+1_7+S_{88}
PFR1 20-22.06: (59^h) – $M_4^{6.5}$
PFR2 25.06 : $M_1^{7.9}$

References:

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Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
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Miroshnichenko L.I., C. Li, V.G. Yanke, 2020.
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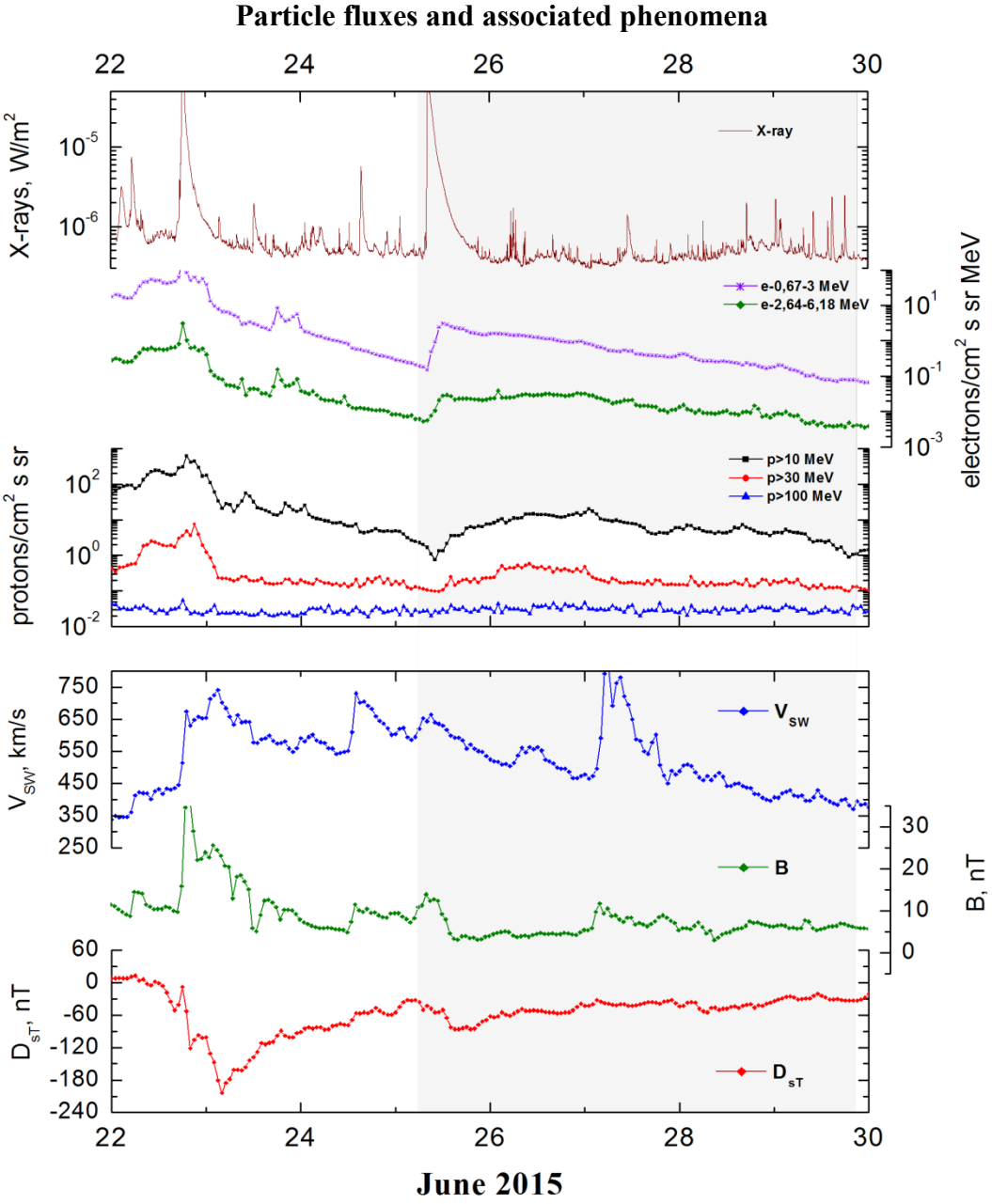
Zou Z., X. Xue, Ch. Shen et al., 2018.

Particle event: To(Ep>10 MeV) – 25d09^{h}
Tmax(Ep>10 MeV) – 26d10^{h}, Jmax(Ep>10 MeV) – 13.5 /cm^2·s·sr
Duration of the event – 5 days, power-law index: γ = 3.3
Quasimaximal energy of protons in the event – Eqm = 80 MeV

Sources: ● solar flare 25d08^{h}02^{m}, M7.9/3B, N09W42, AR12371
Main burst X-ray 1–8 Å: onset – 25d08^{h}02^{m}, max – 25d08^{h}16^{m}, Φ = 0.17 J/m^2
CME: 25d08^{h}36^{m}, V = 1627 km/s, Δφ = 360º, dA= 330º

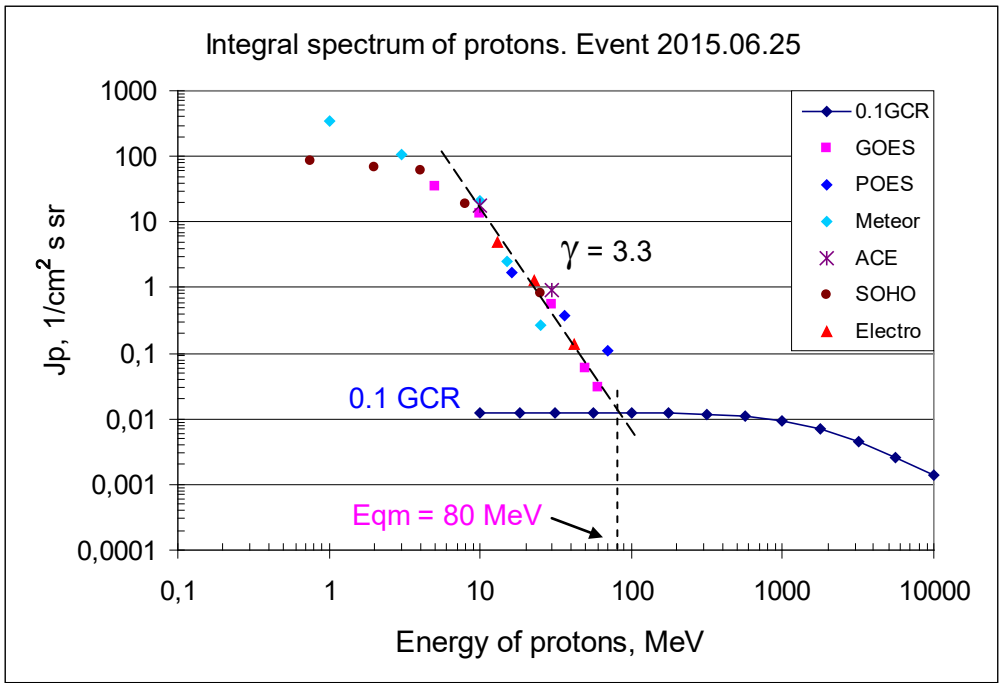


Integral fluxes of protons for the event of 2015 June 25

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	9	26d10	35	5	0.2	
EPS	>10	9	26d10	13.5	5	0.12	
EPS	>30	9	26d10	0.55	4	0.07	
EPS	>50	9	26d10	0.06	2	0.06	
EPS	>60	9	26d10	0.03	2	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	290	
Meteor-2							
SCR	>1	11	26d17	347	5	3.9	
SCR	>3	11	26d17	109	5	2.7	
SCR	>10	11	26d17	21.3	4	2.2	
GALS-M	>15	11	26d17	2.5	5	0.6	
GALS-M	>25	11	26d17	0.26	2	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	8	26d10	18	5	1.1	
SIS	>30	8	26d10	0.9	5	0.7	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

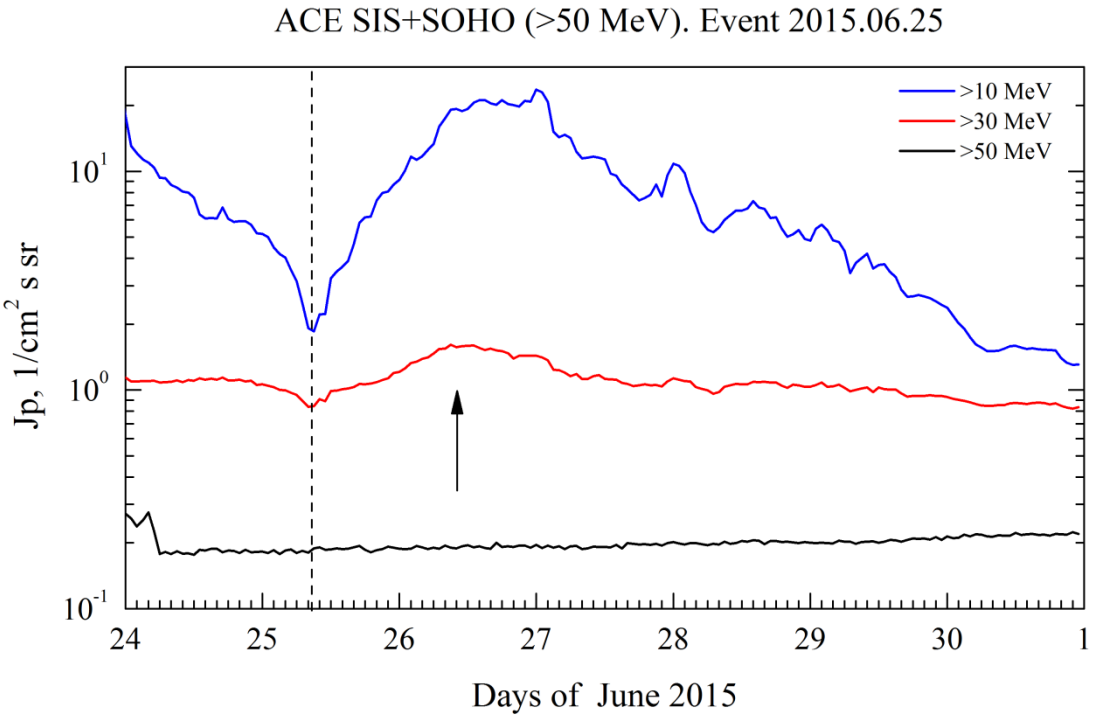
Differential fluxes of protons for the event of 2015 June 25

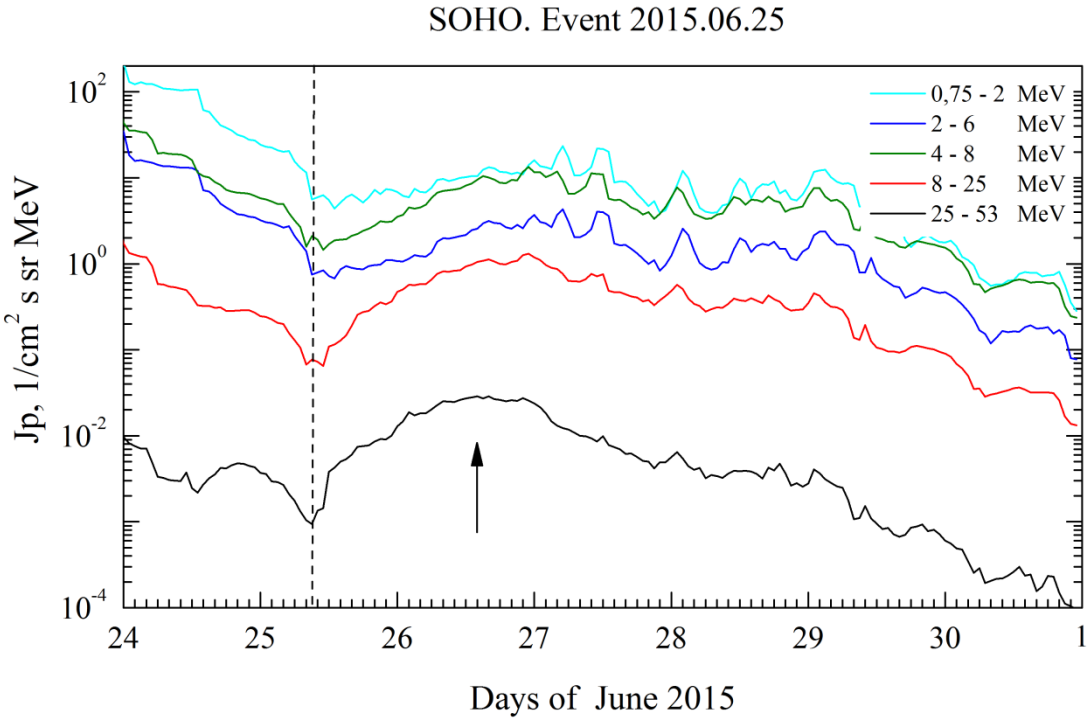
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	13	26d14	13.3	7	0.01	
LION	2 – 6	12	26d14	2.57	7	0.001	
EPHIN	4 – 8	14	26d14	10.52	7	0.0001	
EPHIN	8 – 25	13	26d14	1.06	7	0.00001	
EPHIN	25 – 53	11	26d14	0.0287	7	0.00001	
Electro-1							
SCR-E	13.7–23	10	26d11	0.4	-	0.07	
SCR-E	23–42	10	26d11	0.06	-	0.02	
SCR-E	42–112	10	26d11	0.002	-	0.004	
POES							<E>, MeV
MEPED	16–36	12	26d03	0.067	2	0.033	25
MEPED	36–70	12	26d03	0.0075	2	0.0048	50
MEPED	70–140	12	26d03	0.0016	2	0.0008	100

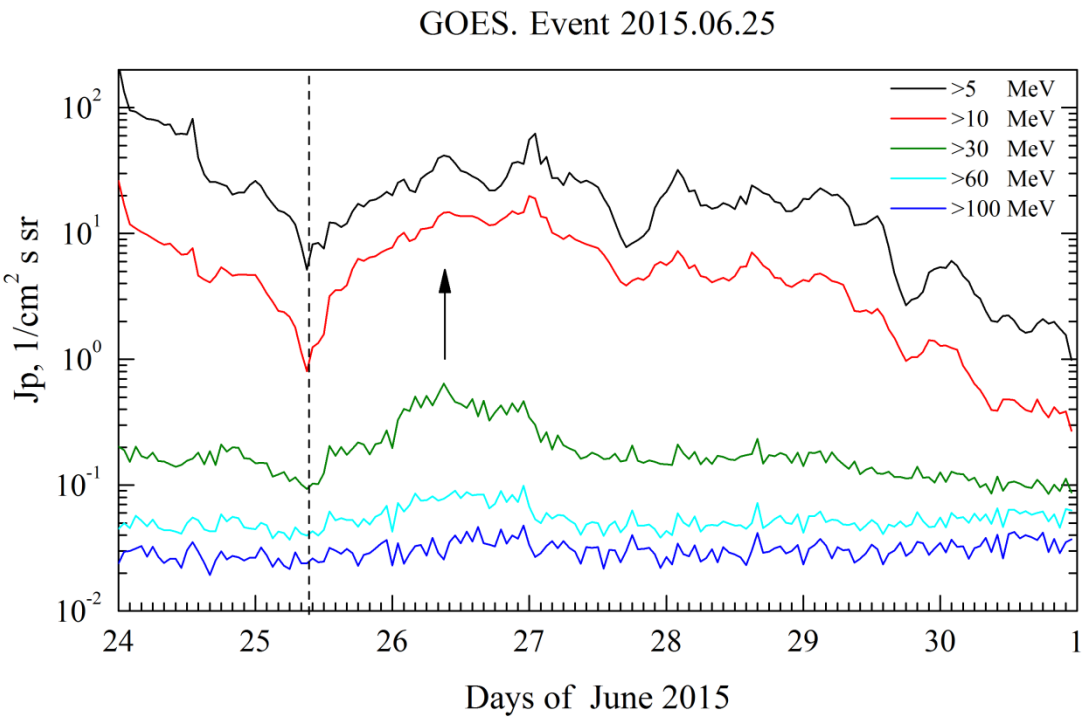

Integral spectrum of protons. Event 2015.06.25
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 3.3
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

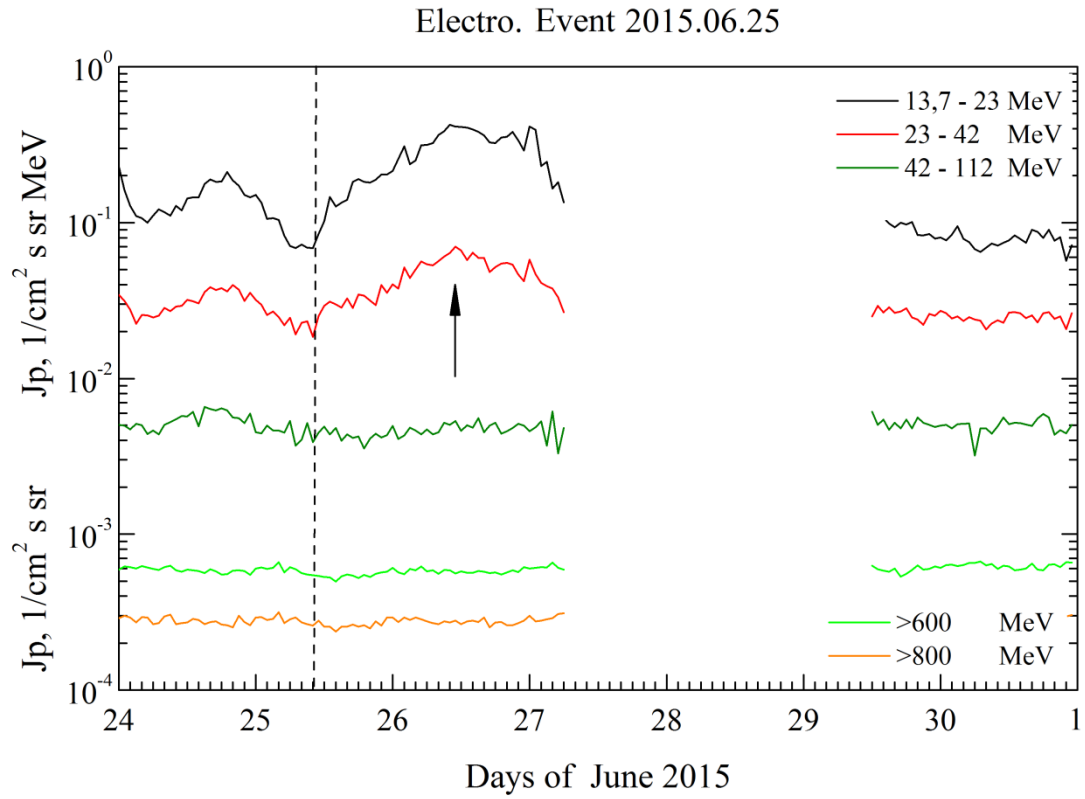
Time profiles of proton fluxes in the event 2015.06.25

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

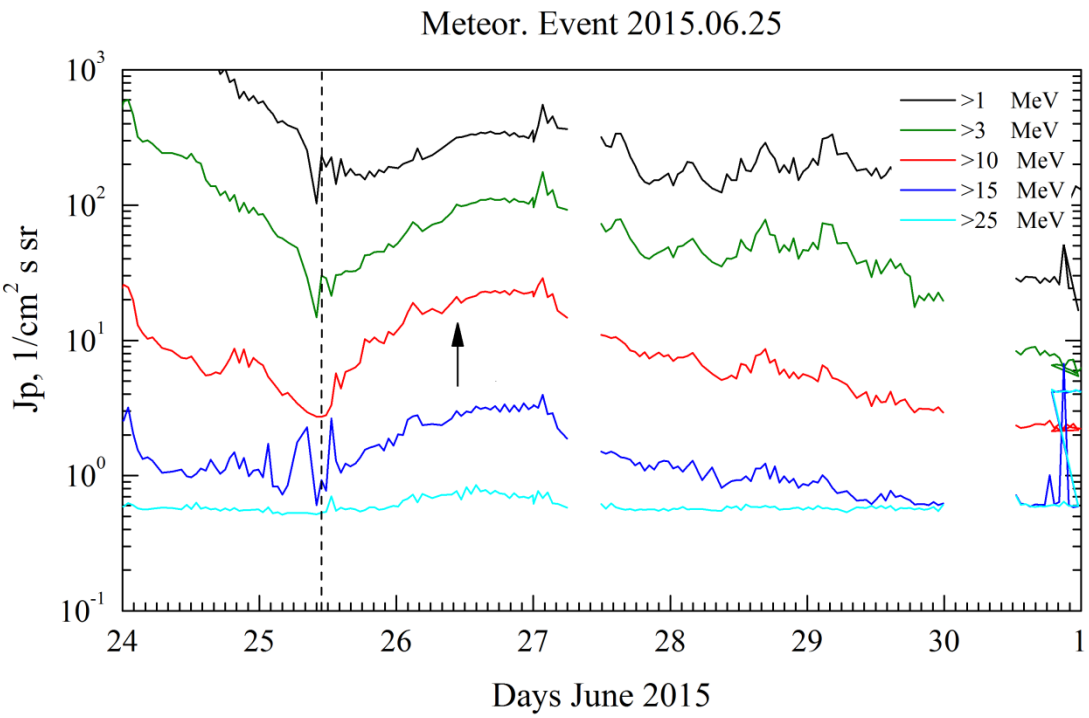


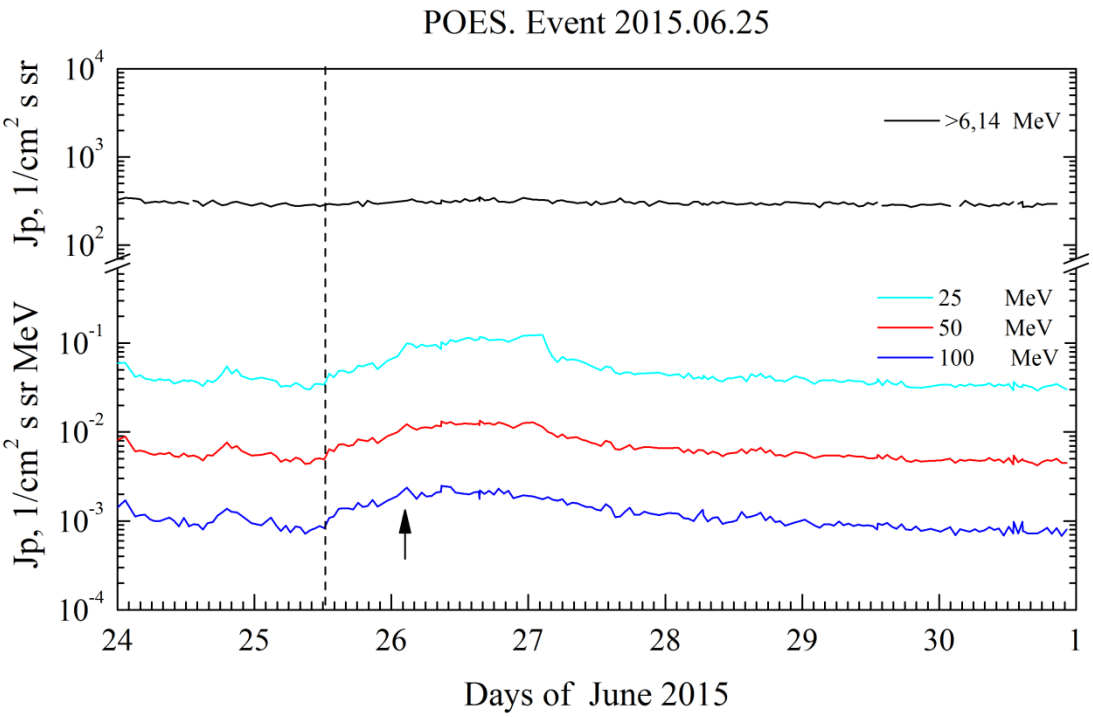



GOES. Event 2015.06.25
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Jp, 1/cm² s sr
Days of June 2015


Electro. Event 2015.06.25
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
Days of June 2015

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 June 25

2015 June 25 ● AR12371 To event 572

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	0802	0814	1235	N09W42	3B	UMB
1 – 12	keV	0802	0816	0905	N12W40	M7.9	0.17

X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
100-300	keV	0847:40	0847:58	0929:44	2283	14190195	HESSI
50-100	keV	1026:48	1026:50	1043:32	52	253987	HESSI
100-300	keV	1043:32	1045:22	1103:28	40	226468	HESSI
12-25	keV	1138:08	1139:06	1139:52	1136	404784	HESSI
12-25	keV	0804:28	0815:36	0840:49	620639	342993408	FERMI
12-25	keV	0914:42	0923:23	1011:58	5768	4358847	FERMI
12-25	keV	1100:02	1120:06	1127:32	751	204914	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0812	0814	0903		3.72	
8.8	GHz	0811	0814	0910		3.75	
5	GHz	0810	0814	0920		3.81	
2.7	GHz	0812	0815	0903	2.7 – 15	3.58	
1.4	GHz	0812	0919	0936		4.23	
610	MHz	0814	0824	0900		2.97	
410	MHz	0814	0824	0902	U 0.4 / 1.4	2.61	
245	MHz	0824	0829	0851		3.0	

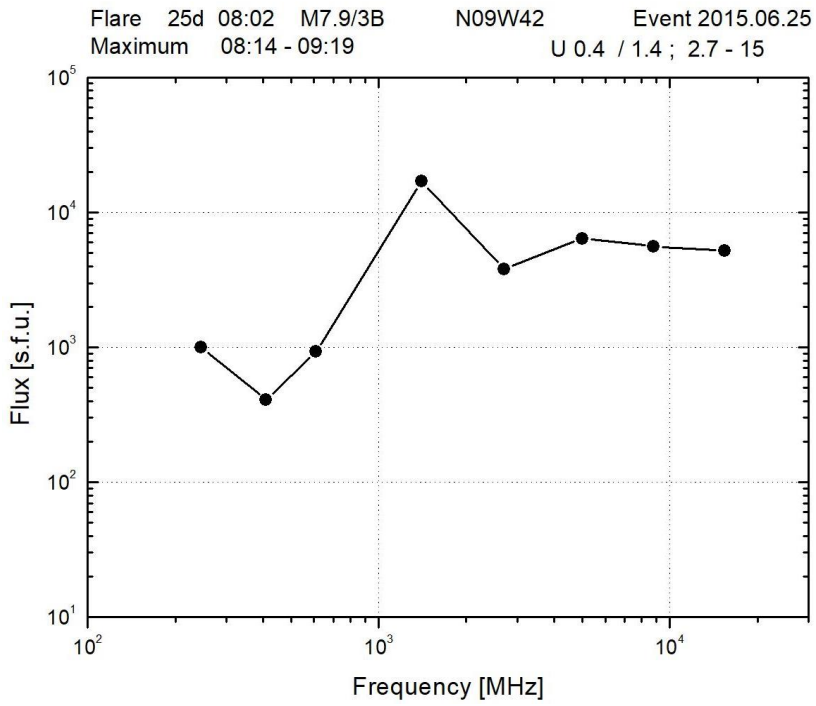
DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	25-79	0816		0833	2056	1	
DS IV	25-180	0821		1124		1	
DH II	0.15-14	0835		1630			WIND

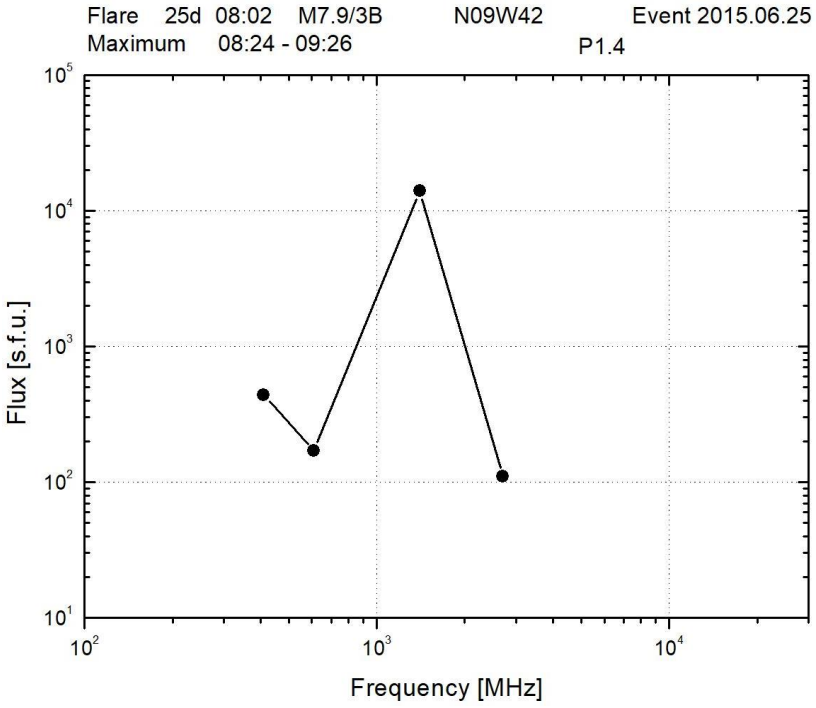
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
2.7	GHz	0926	0926	0926		2.04	
1.4	GHz	0909	0919	0929	P1.4	4.15	
610	MHz	0814	0824	0900		2.23	
410	MHz	0814	0824	0902		2.64	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS IV	25-180	1027		1125		1	
DS VI	25-78	0907		1000		1	
DS VI	25-105	1027		1054		1	
DS III	25-74	1215		1216		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0836	1627	- 24.8	360˚	330˚	SOHO

Radio bursts frequency spectrum





Proton Active Region:

AR12371 (N12L302; CMP 22,0.06.2015;
Sp=1180 msh; FKC; BGD, R)
XRI=2.0; $M_6^{7.9}$+C_{39} 3_1+2_2+1_7+S_{88}
PFR1 20-22.06: (59^h) – $M_4^{6.5}$
PFR2 25.06 : $M_1^{7.9}$

References:

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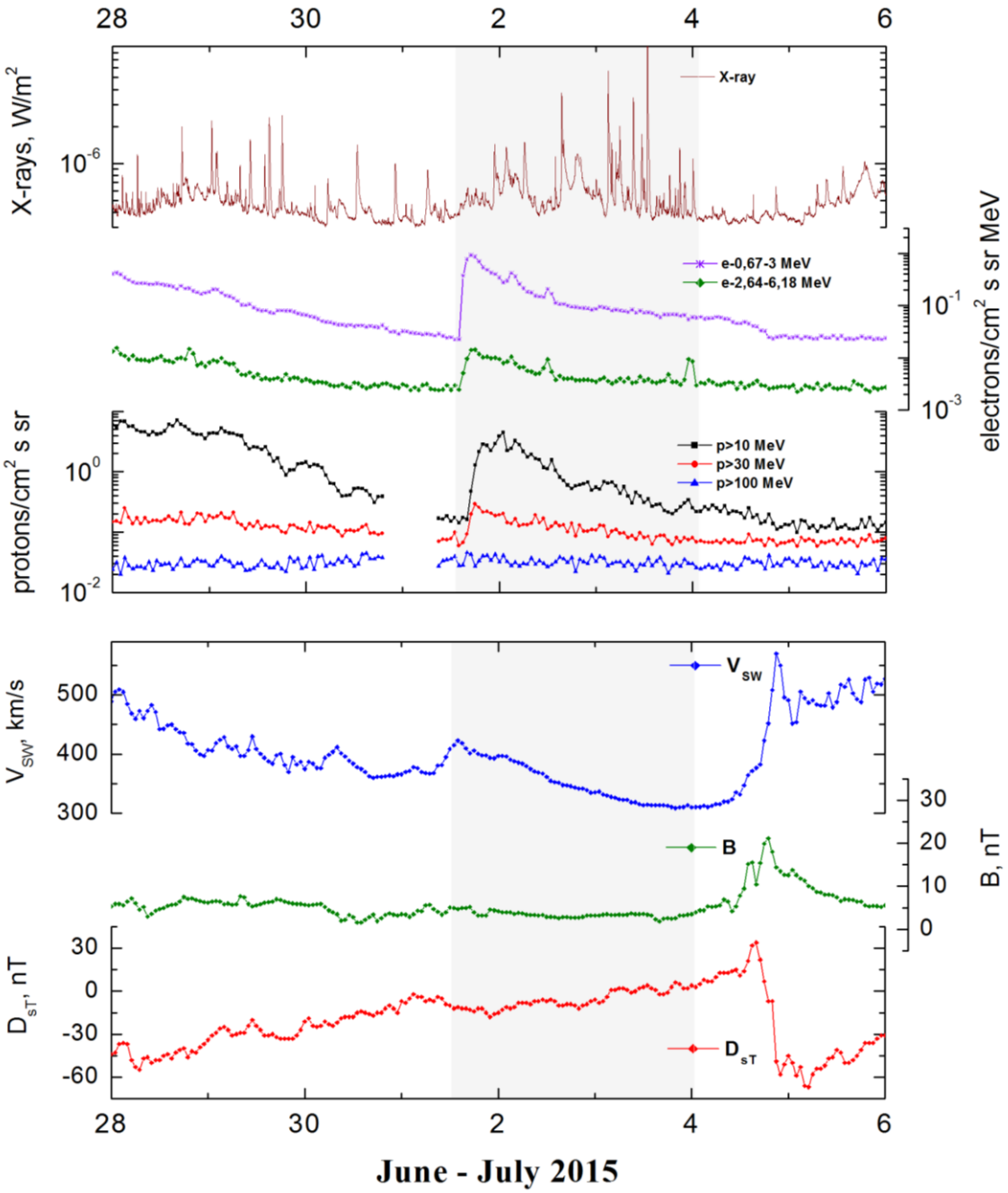
Gopalswamy N., S. Yashiro, H. Xie et al., 2015.
de Nolfo G.A., A. Bruno, J.M. Ryan et al., 2019.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.
Zhdanov D., L.K. Kashapova, R. Miteva, 2018.

Particle event: To(Ep>10 MeV) – 01d18^{h}
Tmax$_1$(Ep>10 MeV) – 01d20^{h}, Jmax$_1$(Ep>10 MeV) – 2.8 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 02d01^{h}, Jmax$_2$(Ep>10 MeV) – 4.5 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ_1 = 2.0, γ_2 = 2.3
Quasimaximal energy of protons in the event – Eqm$_1$ = 130 MeV
– Eqm$_1$ = 90 MeV

Sources: ⟡ Flare activity behind W$_L$
⊡ solar flare 01d<14^{h}36^{m}, AR12731, 2.5d behind W$_L$
CME: 01d14^{h}36^{m}, V = 1435 km/s, Δφ = 360º, dA= 311º

Particle fluxes and associated phenomena

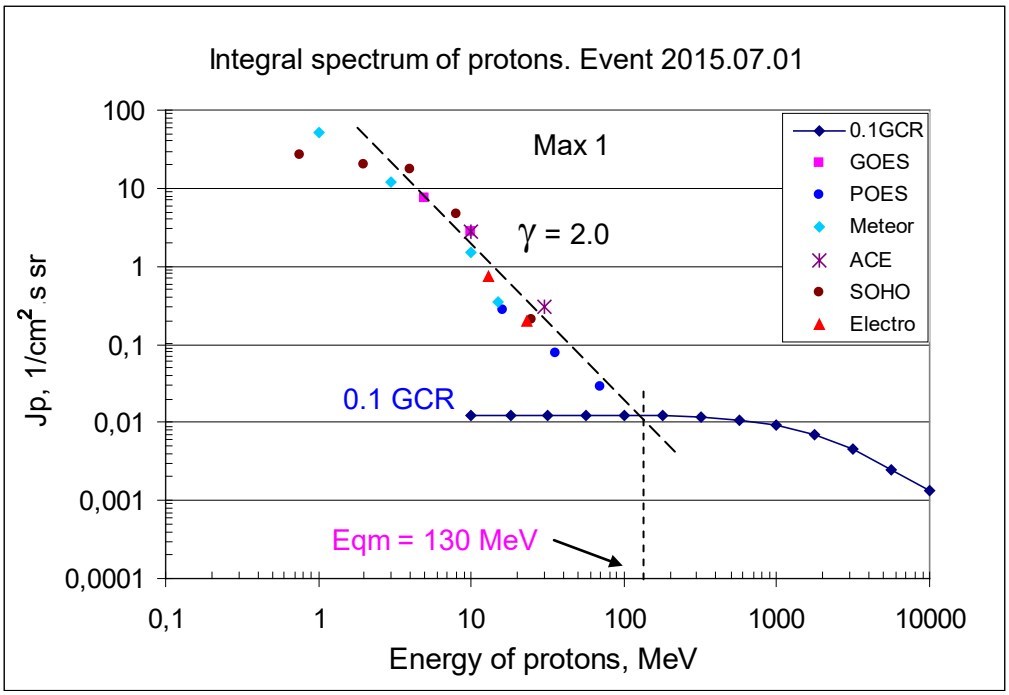


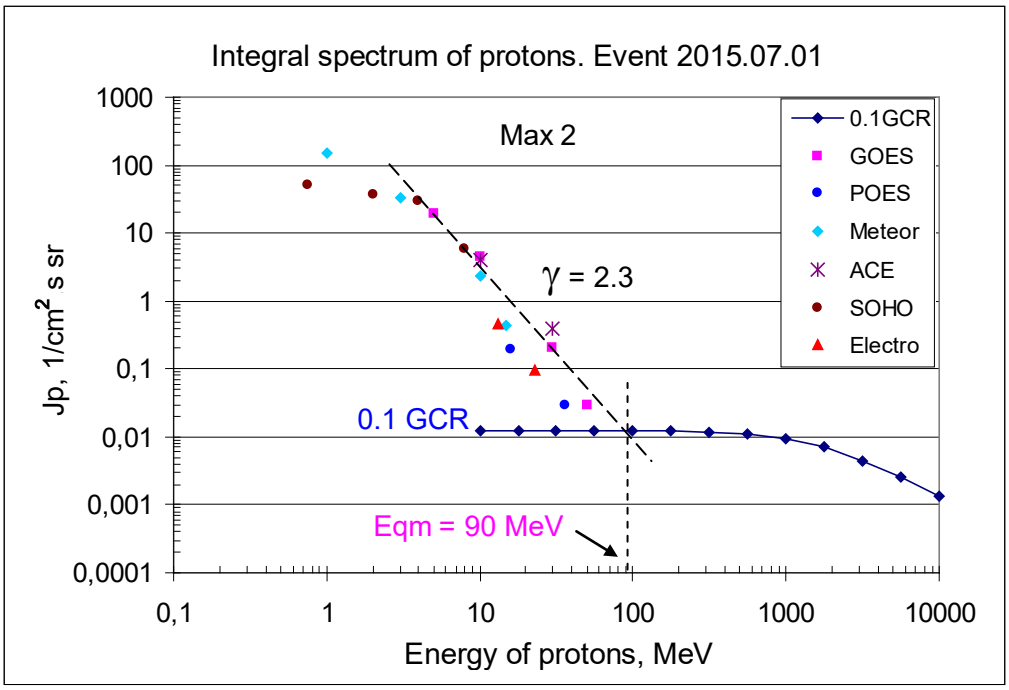
Integral fluxes of protons for the event of 2015 July 01

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	20/02d01	7.5/19.5	2	0.2	
EPS	>10	18	20/02d01	2.8/4.5	2	0.12	
EPS	>30	18	- /02d01	- /0.2	1	0.07	
EPS	>50	18	- /02d01	- /0.03	1	0.06	
EPS	>60	18	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	290	
Meteor-2							
SCR	>1	15	20/02d00	52/151	3	3.9	
SCR	>3	15	20/02d00	12/34	3	2.7	
SCR	>10	15	20/02d00	1.5/2.3	2	2.2	
GALS-M	>15	15	18/02d00	0.35/0.44	1	0.7	
GALS-M	>25	-	-	-	-	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	15	18/22	2.8/4	2	1.2	
SIS	>30	15	18/22	0.3/0.4	1	0.8	
SOHO							
EPHIN	>50	-	-	-	-	0.2	

Differential fluxes of protons for the event of 2015 July 01

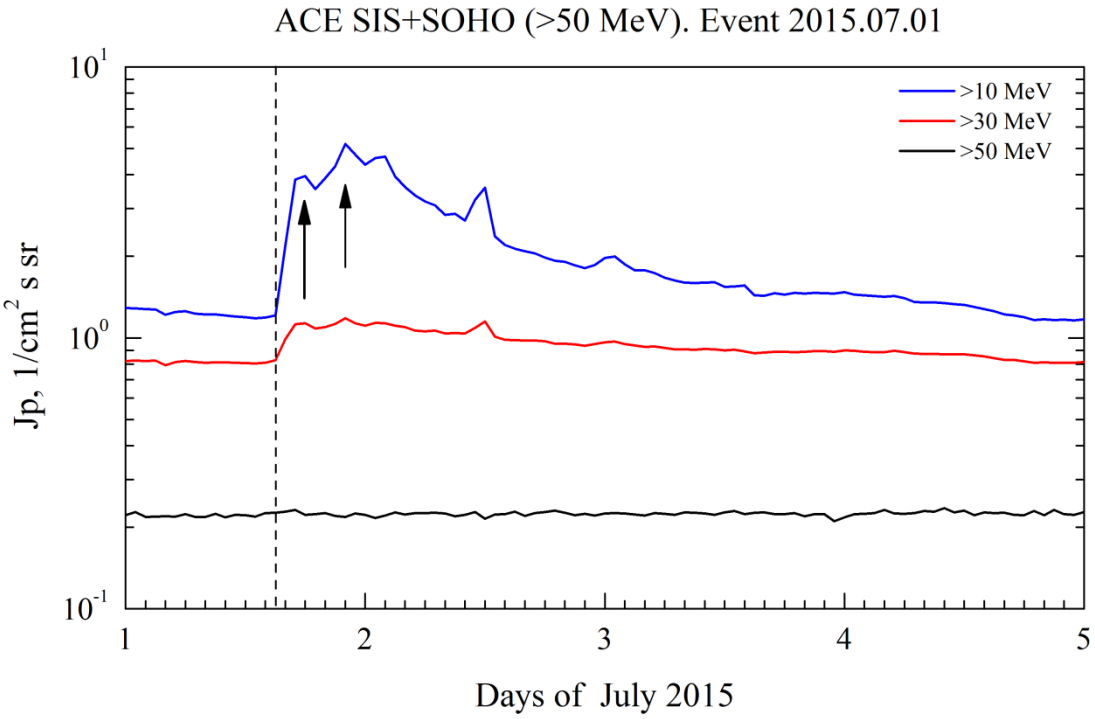
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	18	20/02d00	5.47/12.2	3.3?	0.07	
LION	2 – 6	18	20/02d00	0.98/2.07	3.3?	0.02	
EPHIN	4 – 8	17	19/23	3.12/5.96	3.3?	0.07	
EPHIN	8 – 25	16	19/23	0.26/0.347	3.3?	0.004	
EPHIN	25 – 53	15	17/23	0.0077/ -	3.3?	0.00004	
Electro-1							
SCR-E	13.7–23	15	19/02d00	0,06/0,04	0,5	0,07	
SCR-E	23–42	15	19/02d00	0,01/0,005	0,5	0,02	
SCR-E	42–112	-	-	-	-	0,004	
POES9							<E>, MeV
MEPED	16–36	16	19/2d02	0.0097/0,008	0.5	0.033	25
MEPED	36–70	16	19/2d02	0.0014/0,0009	0.5	0.0048	50
MEPED	70–140	16	22/ -	0.0004/ -	0.5	0.0008	100

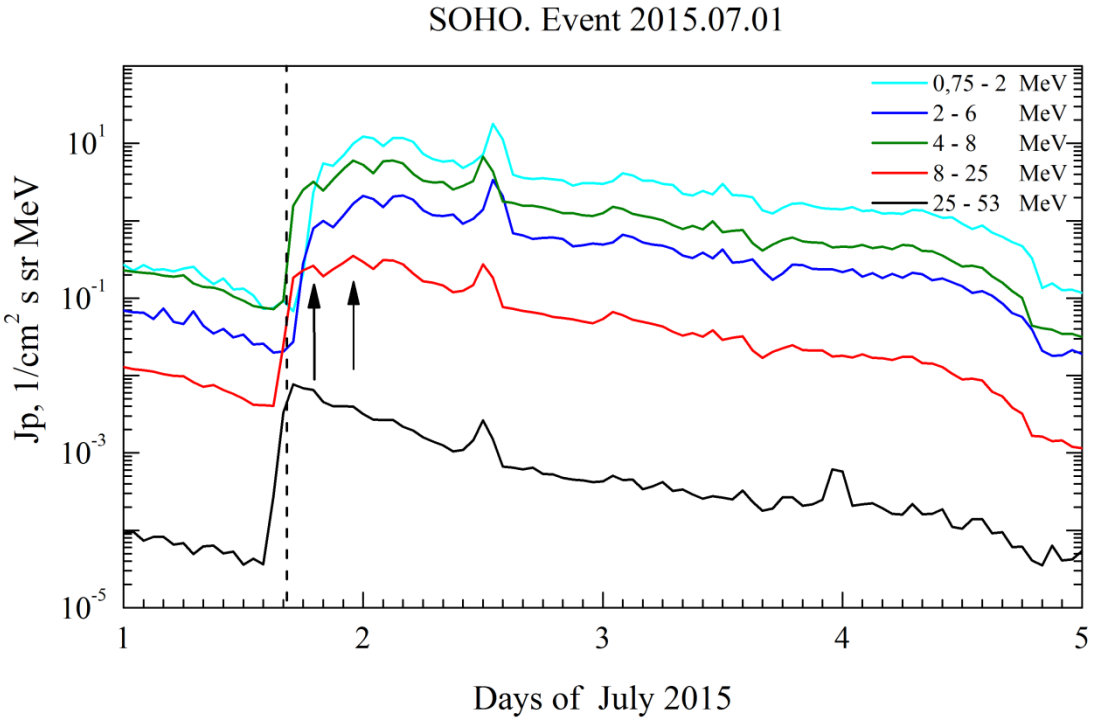

Integral spectrum of protons. Event 2015.07.01
Max 1
γ = 2.0
0.1 GCR
Eqm = 130 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2015.07.01
Max 2
γ = 2.3
0.1 GCR
Eqm = 90 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

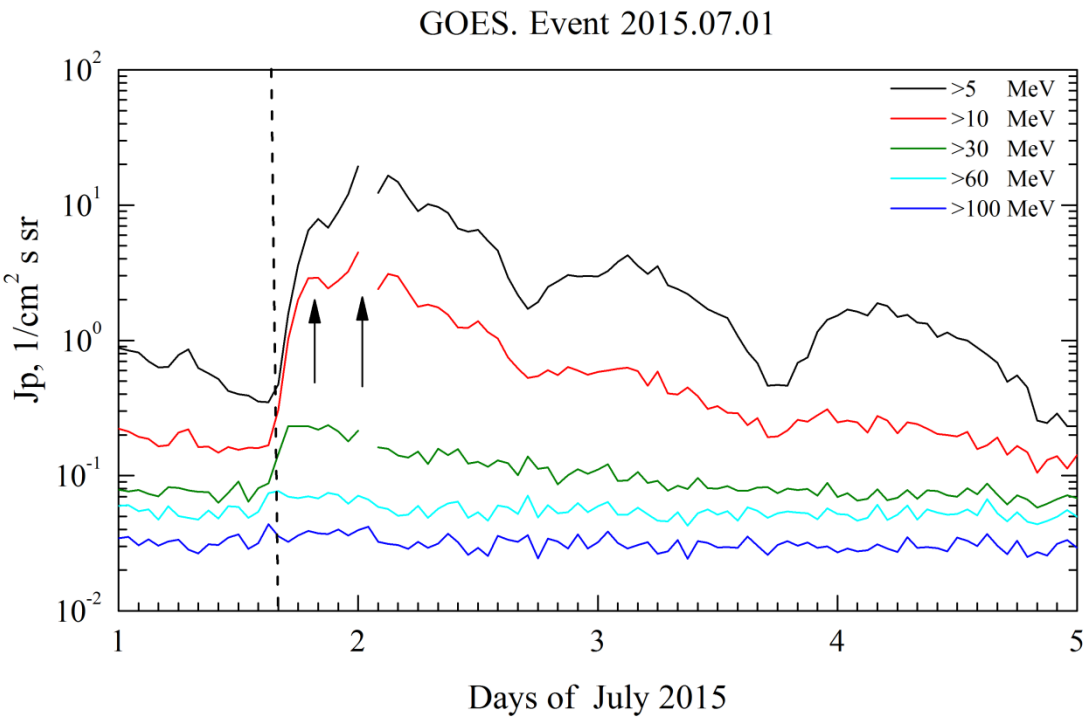
Time profiles of proton fluxes in the event 2015.07.01

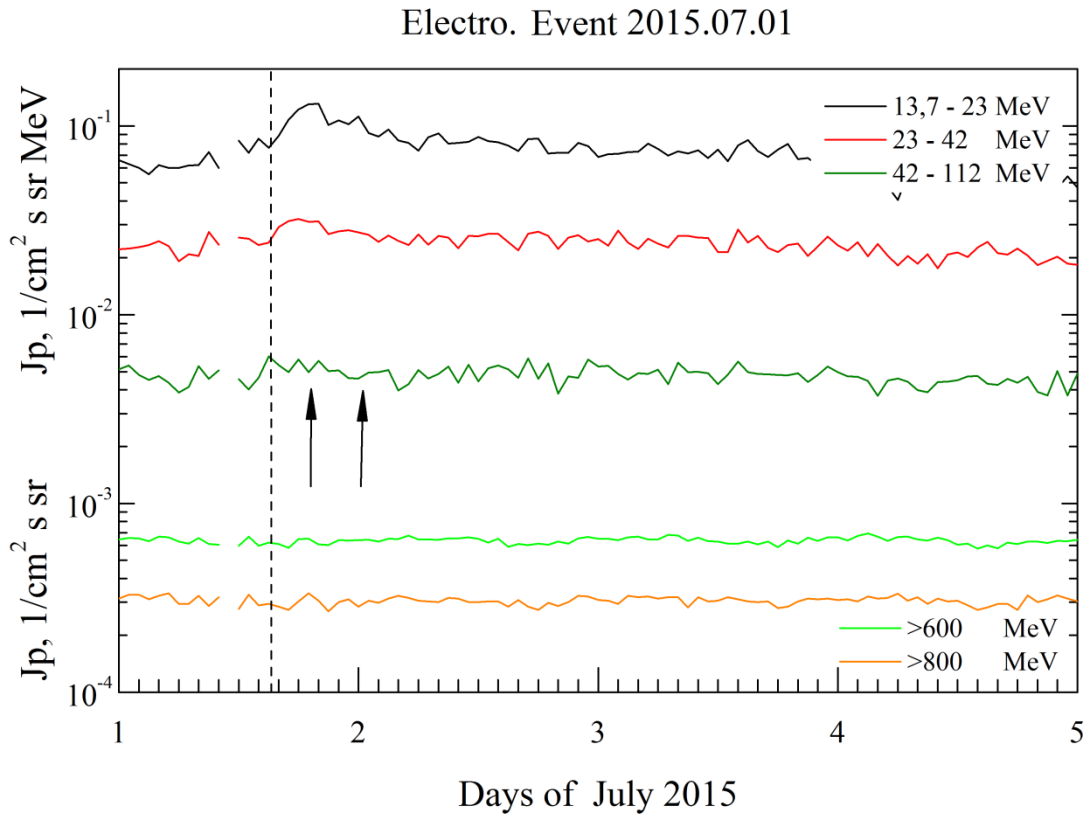
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



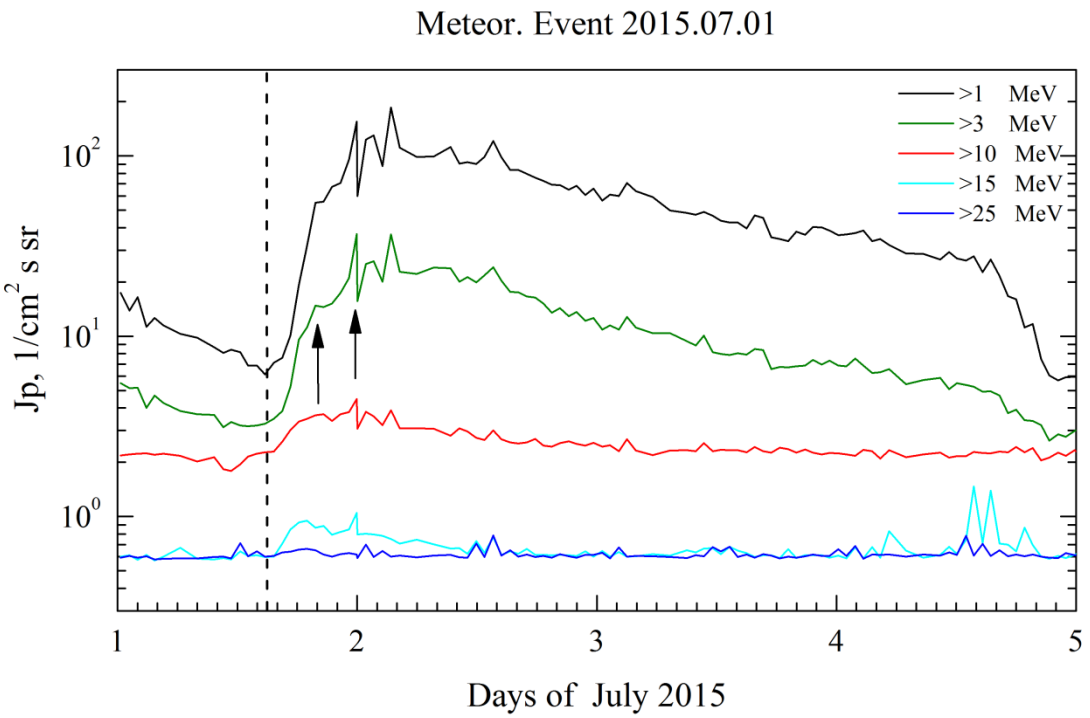


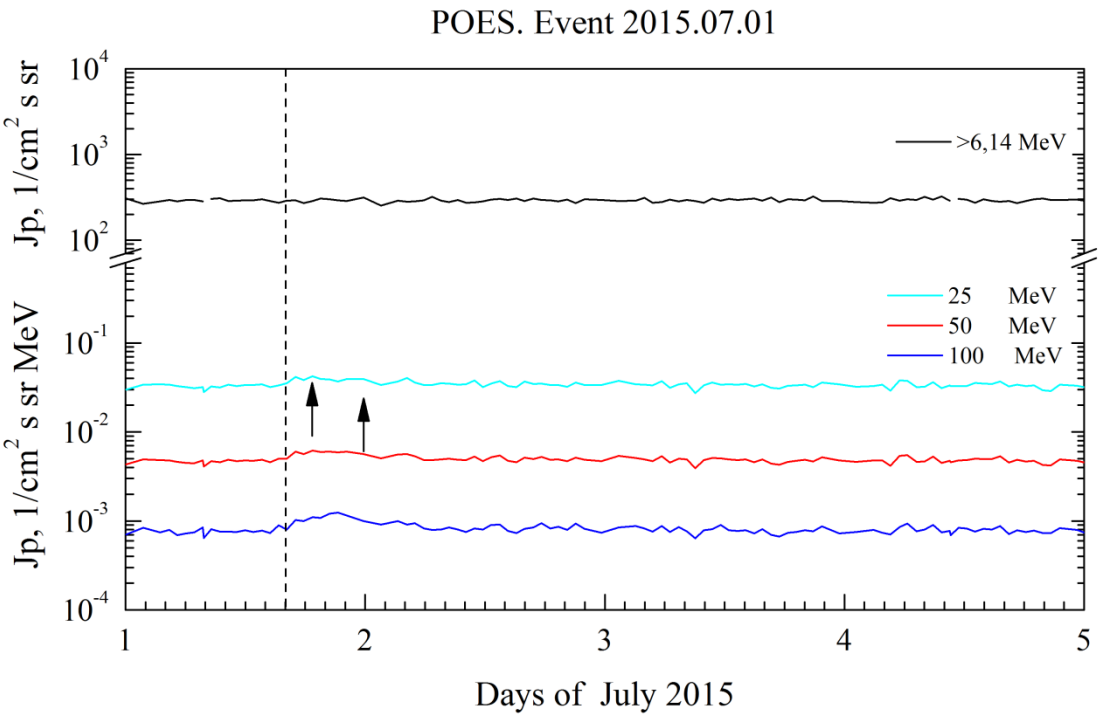
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 July 01

2015 July 01 ⊡ AR 12731 To event 573

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No optical and X-ray flare on visible disk					
1 – 12	keV						
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6-12	keV	1414:20	1423:18	1423:32	32	67440	HESSI
6-12	keV	1436:12	1439:34	1447:24	24	64488	HESSI
6-12	keV	1447:24	1447:26	1449:36	12	8040	HESSI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS VI	25-75	1438		1505		1	
DH II	0.15-1	1608		2047			WIND
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1436	1435	- 19.8	360˚	311˚	SOHO

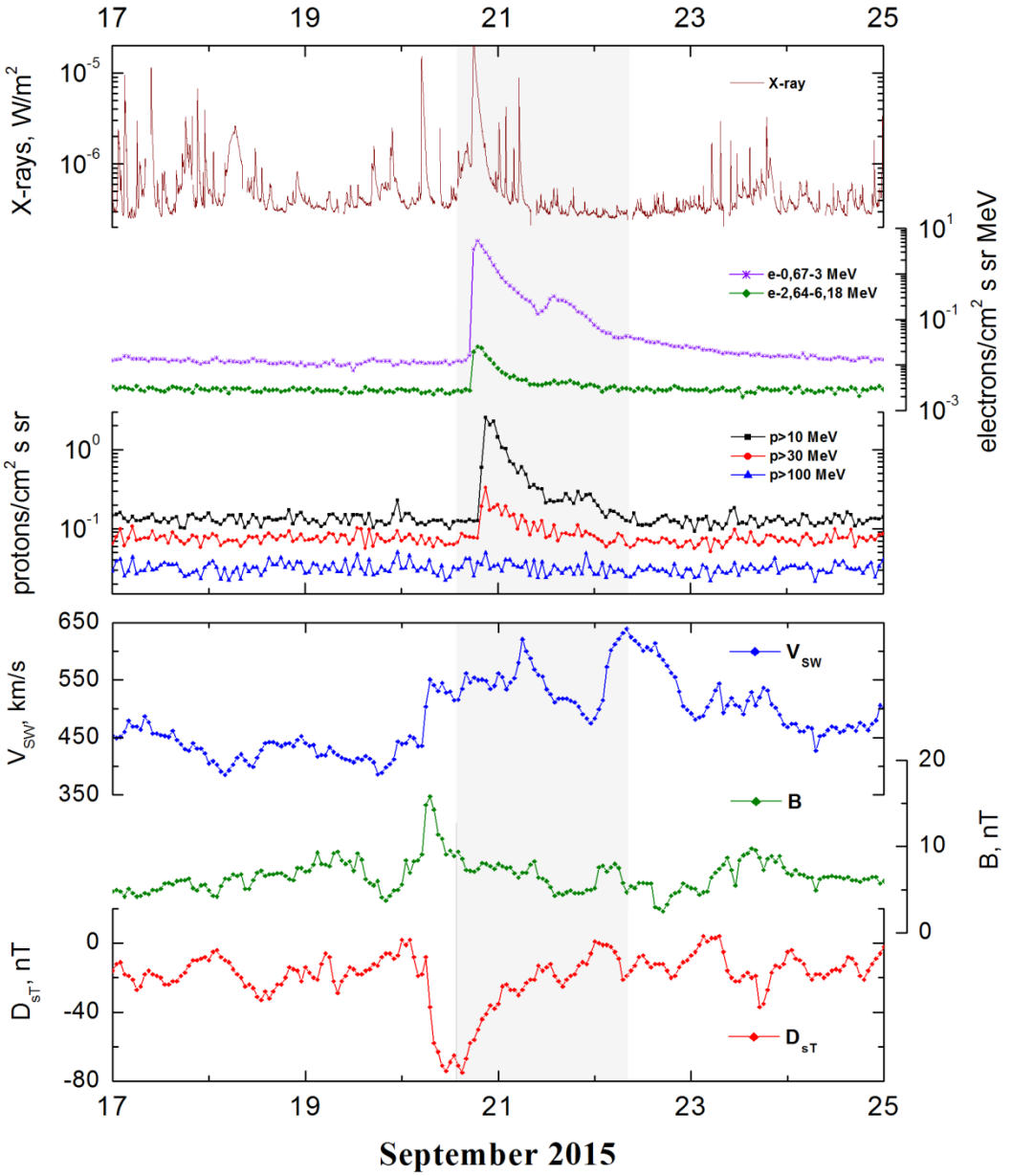
Proton Active Region:

AR12371 (N12L302; CMP 22,0.06.2015;
Sp=1180 msh; FKC; BGD, R)
XRI=2.0; $M_6^{7.9}$+C_{39} 3_1+2_2+1_7+S_{88}
PFR1 20-22.06: (59^h) – $M_4^{6.5}$
PFR2 25.06 : $M_1^{7.9}$

Particle event: To(Ep>10 MeV) – 20d18^{h}
Tmax (Ep>10 MeV) – 20d22^{h}, Jmax(Ep>10 MeV) – 2.2 /cm^2·s·sr
Duration of the event – 2 days, power-law index: $\gamma = 2.2$
Quasimaximal energy of protons in the event – Eqm = 80 MeV

Sources: ● solar flare 20d17^{h}30^{m}, 2N/M2.1, S20W24, AR12415
Main burst X-ray 1–8 Å: onset – 20d17^{h}32^{m}, max – 20d18^{h}03^{m}, $\Phi = 0.045$ J/m^2
CME: 20d18^{h}12^{m}, V = 1239 km/s, $\Delta\varphi = 360°$, dA= 219°
▲ SC 20d06^{h}03^{m}

Particle fluxes and associated phenomena

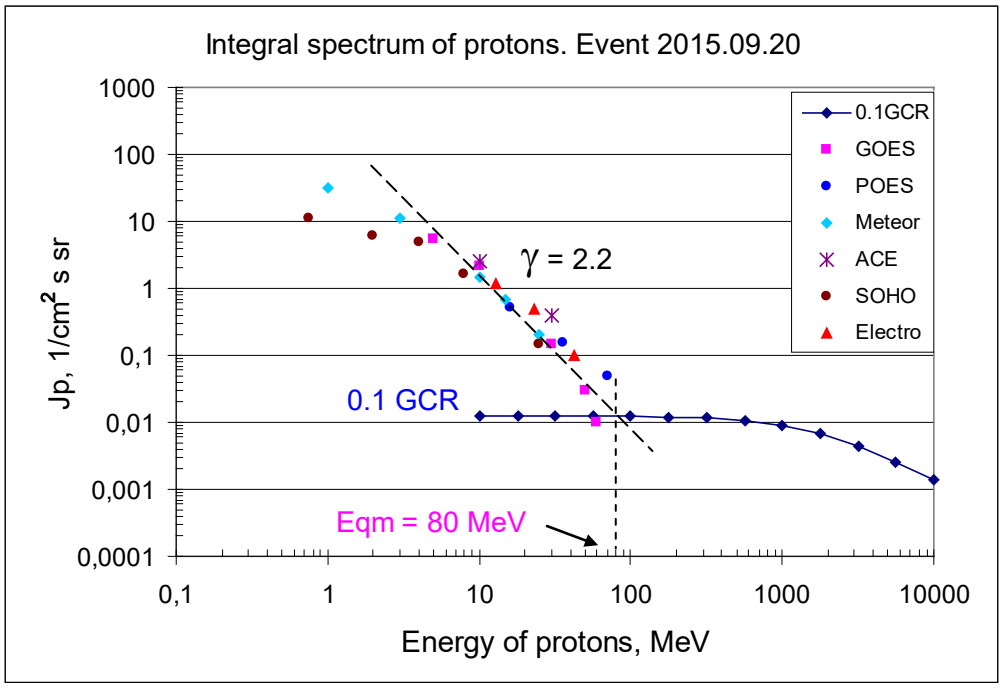


Integral fluxes of protons for the event of 2015 September 20

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	18	22	5.6	2	0.2	
EPS	>10	18	22	2.2	2	0.12	
EPS	>30	18	22	0.15	1	0.07	
EPS	>50	18	23	0.08	1	0.06	
EPS	>60	18	23	0.01	1	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.001	
POES							
MEPED	>6.14	-	-	-	-	300	
Meteor-2							
SCR	>1	19	22	32	2	3.9	
SCR	>3	19	22	11	1.5	2.7	
SCR	>10	19	21	1.5	0.25	2.2	
GALS-M	>15	18	20	0.7	0.25	0.6	
GALS-M	>25	18	20	0.2	0.25	0.6	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	18	20	2.5	2	1.25	
SIS	>30	18	20	0.4	1	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.24	

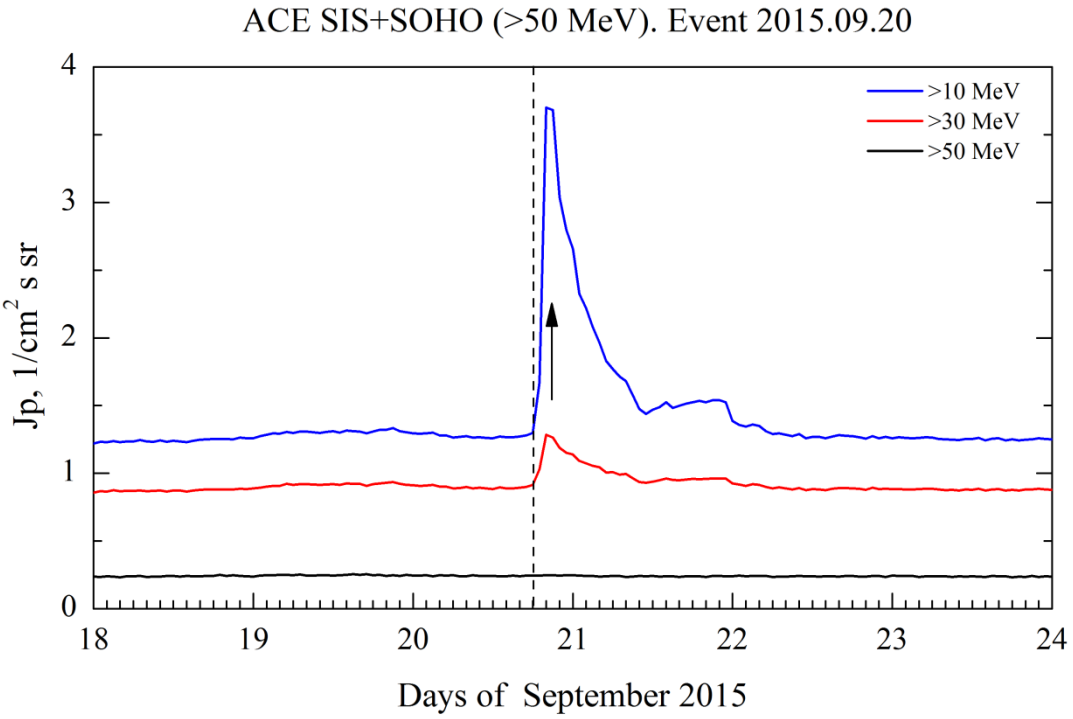
Differential fluxes of protons for the event of 2015 September 20

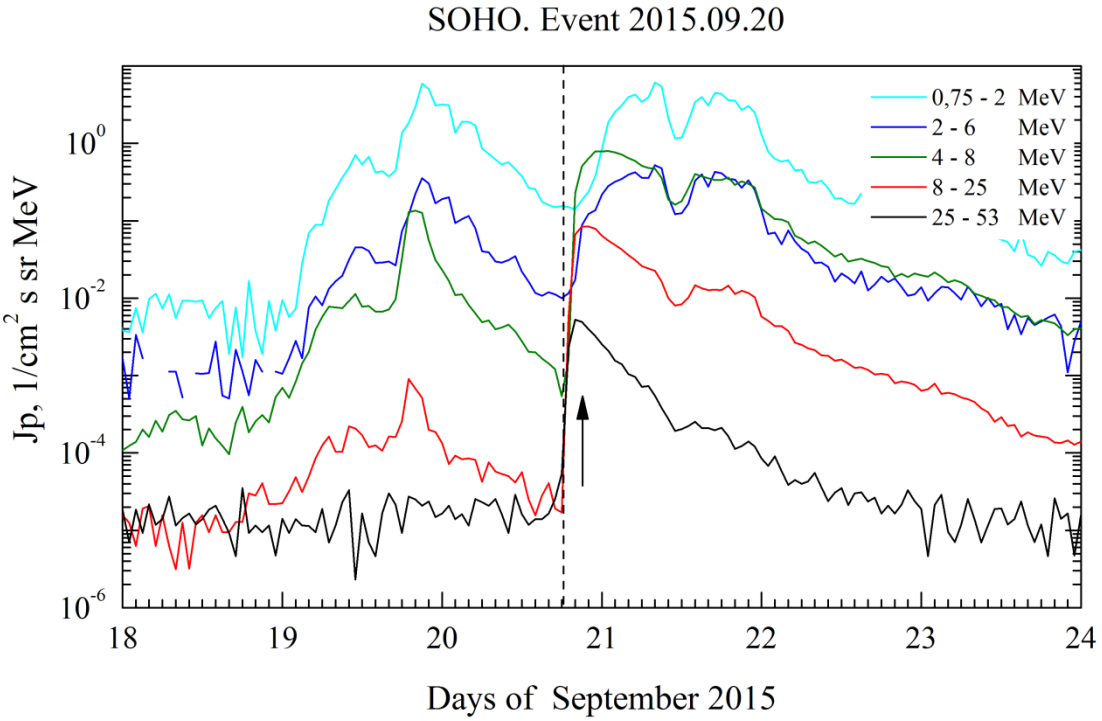
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	21	21d05	4.24	3	0.009	
LION	2 – 6	20	21d05	0.423	3	0.001	
EPHIN	4 – 8	19	21d01	0.797	3	0.0003	
EPHIN	8 – 25	19	22	0.084	3	0.00002	
EPHIN	25 – 53	18	20	0.00528	2	0.00002	
Electro-1							
SCR-E	13.7–23	16	21	0.075	0.5	0.05	
SCR-E	23–42	16	20	0.02	0.5	0.02	
SCR-E	42–112	16	21	0.0015	0.5	0.004	
POES							<E>, MeV
MEPED	16–36	19	20	0.019	0,5	0.032	25
MEPED	36–70	19	19	0.003	0,5	0.0047	50
MEPED	70–140	19	22	0.0007	0,5	0.0008	100

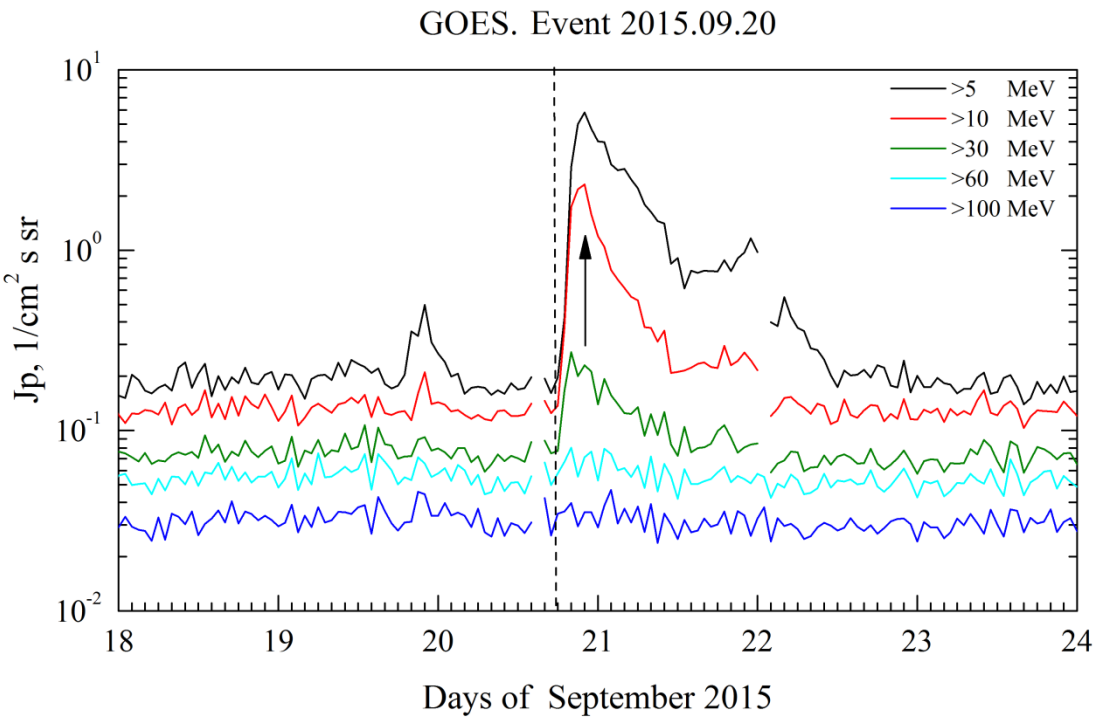

Integral spectrum of protons. Event 2015.09.20
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.2
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

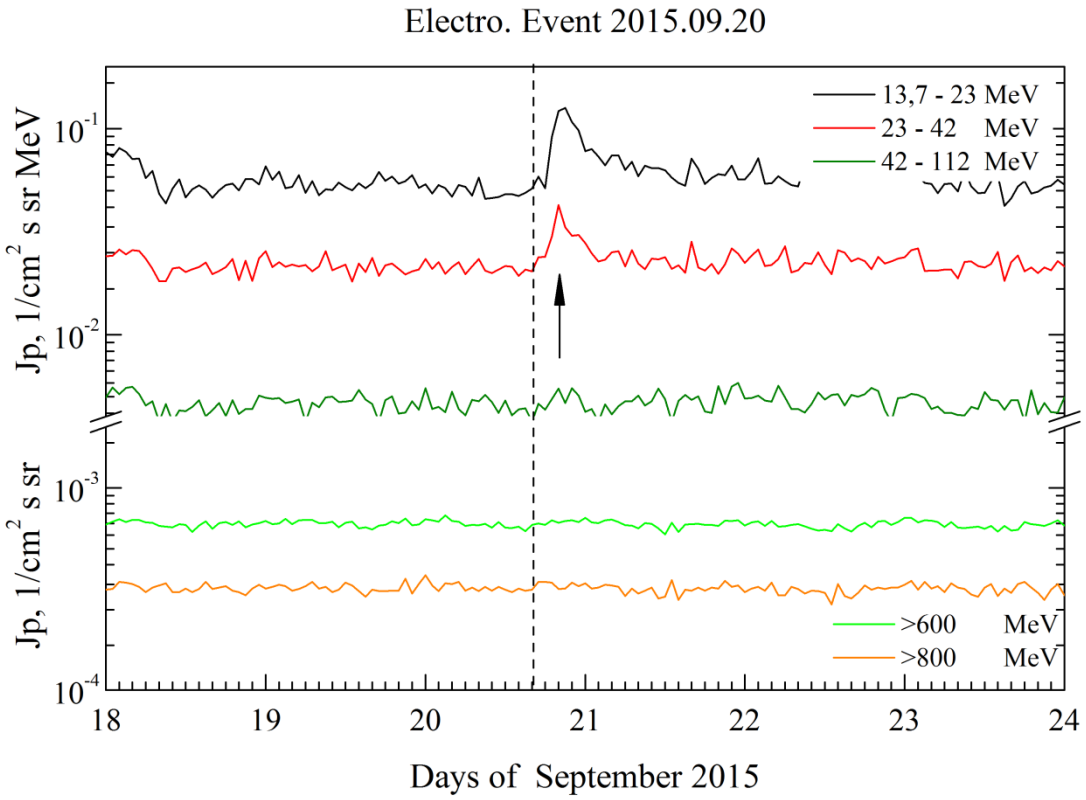
Time profiles of proton fluxes in the event 2015.09.20

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

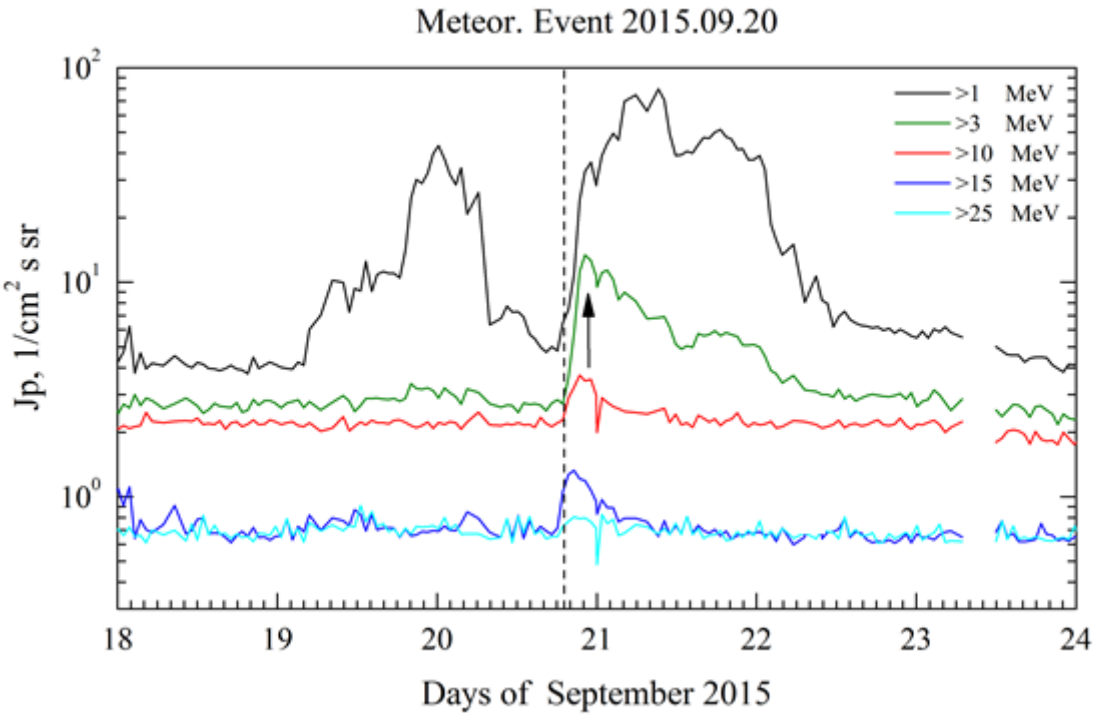


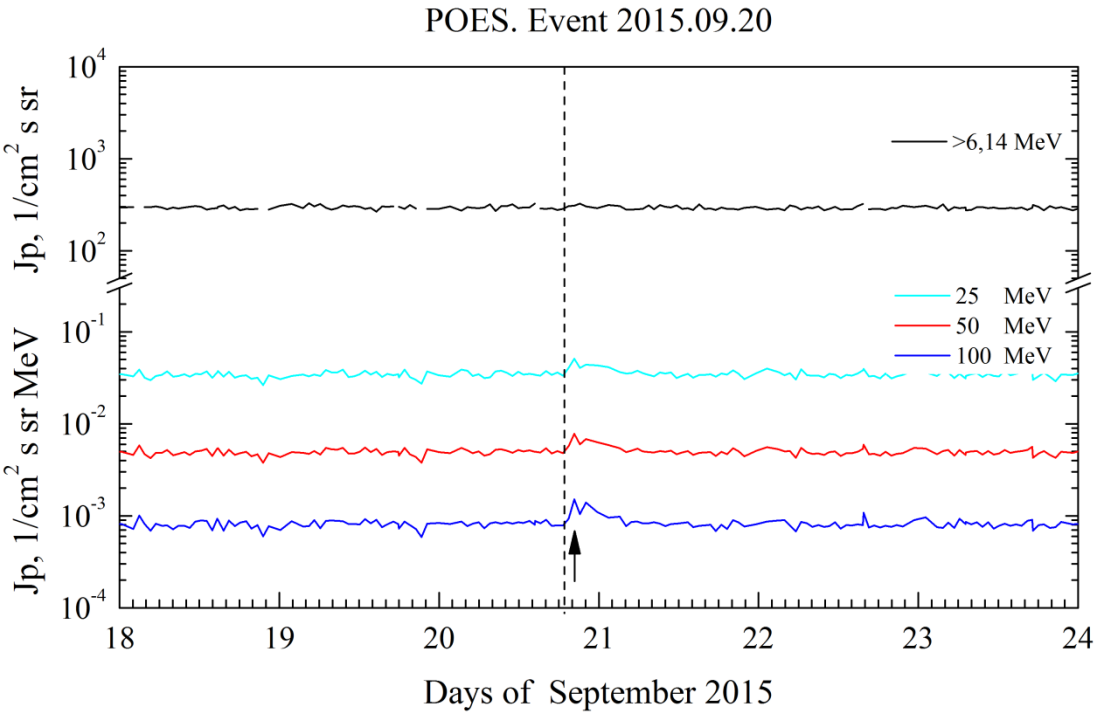



GOES. Event 2015.09.20
Jp, 1/cm^2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of September 2015


Electro. Event 2015.09.20
Jp, 1/cm^2 s sr MeV
Jp, 1/cm^2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of September 2015

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 September 20

2015 September 20 ● AR 12415 To event 574

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1730	1757	1959	S20W24	2N	PRB
1 – 12	keV	1732	1803	1829	S22W50	M2.1	0.045

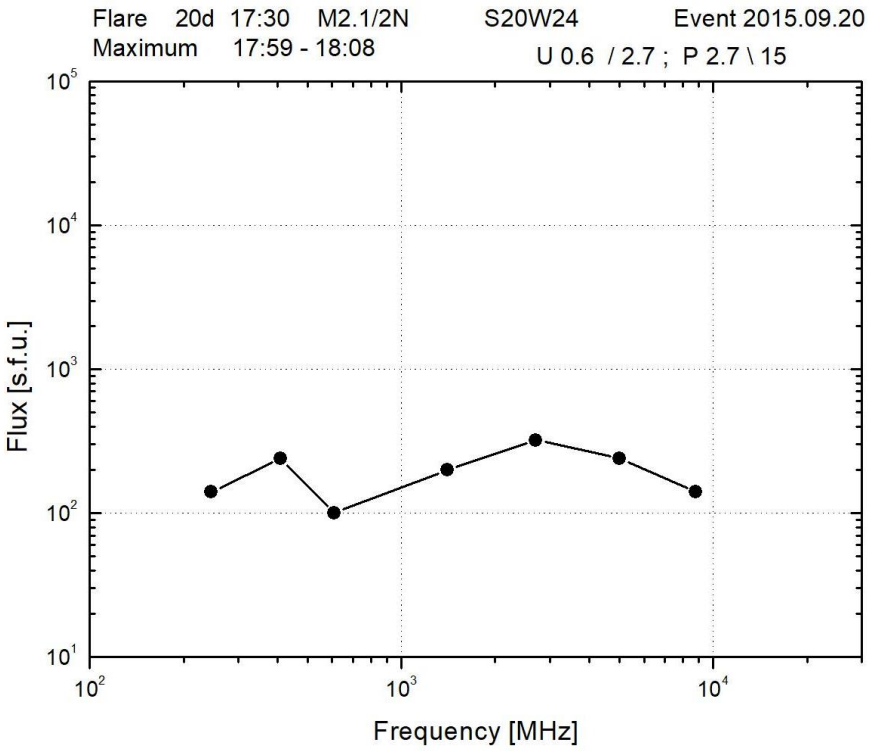
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1814:44	1815:26	1852:28	168	766180	HESSI
12-25	keV	1749:25	1756:10	1823:45	25656	6476539	FERMI

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
8.8	GHz	1756	1804	1811		2.15	
5	GHz	1754	1804	1815		2.38	
2.7	GHz	1754	1804	1817	P2.7 \ 15	2.51	
1.4	GHz	1801	1804	1813		2.30	
610	MHz	1807	1808	1808	U0.6 / 2.7	2.0	
410	MHz	1807	1808	1813		2.38	
245	MHz	1758	1759	1800		2.15	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-39	1816		1822	1304	1	
DS VI	25-180	1756		1845		2	
DS III	25-180	1800		1809		1	
DS III	25-135	1925		1926		13	
DH II	0.3-14	1823		09/0146			WIND

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1812	1239	0.2	360˚	219˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR12415 (S20L234, CMP 16,9.09.2021,
Sp=240 msh, EAC, BG, R)
XRI=0.32, $M_2^{2.1}$+C_{34} 2_1+1_2+S_{55}
PFR 20.09 $M_1^{2.1}$

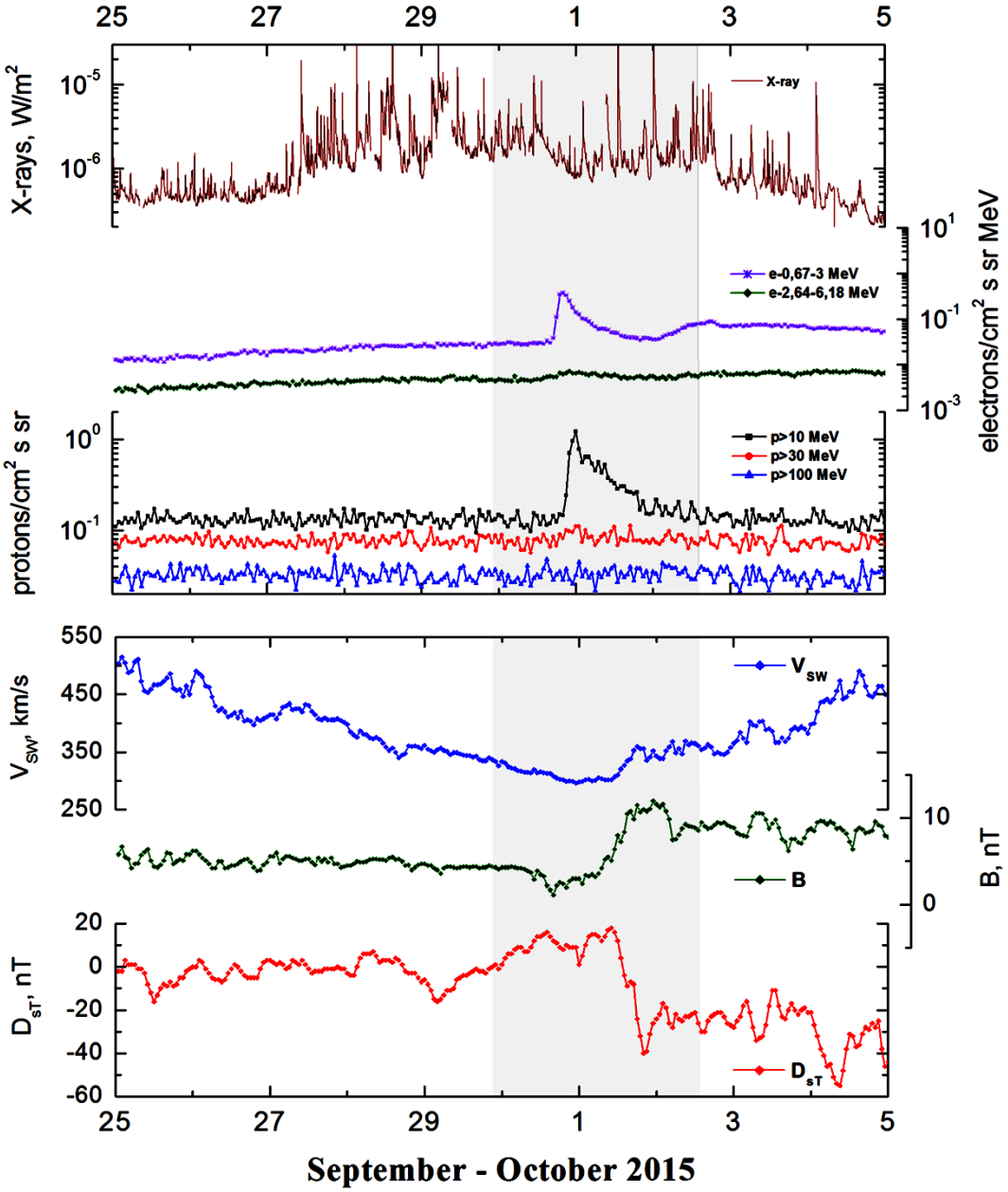
References:

Gopalswamy N., S. Yashiro, H. Xie et al., 2015.

Particle event: To(Ep >10 MeV) – 30d20^{h}
Tmax$_1$(Ep >10 MeV) – 30d23^{h}, Jmax$_1$(Ep >10 MeV) – 0.9 /cm^2·s·sr
Tmax$_2$(Ep >10 MeV) – 01d02^{h}, Jmax$_2$(Ep >10 MeV) – 0.6 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ_1 = 3.0, γ_2 = 3.1
Quasimaximal energy of protons in the event – Eqm$_1$ = 40 MeV
– Eqm$_2$ = 35 MeV

Sources: ⊙ solar flare 30d07^{h}36^{m}, 1N/M1.3, S22W46, AR12422
Ø solar flare 30d13^{h}18^{m}, 1N/M1.1, S23W59, AR12422
Main burst X-ray 1–8 Å: onset – 30d10^{h}49^{m}, max – 30d10^{h}59^{m}, Φ = 0.014 J/m^2
CME: 30d10^{h}00^{m}, V = 602 km/s, Δφ = 128^{o}; dA=304^{o}

Particle fluxes and associated phenomena

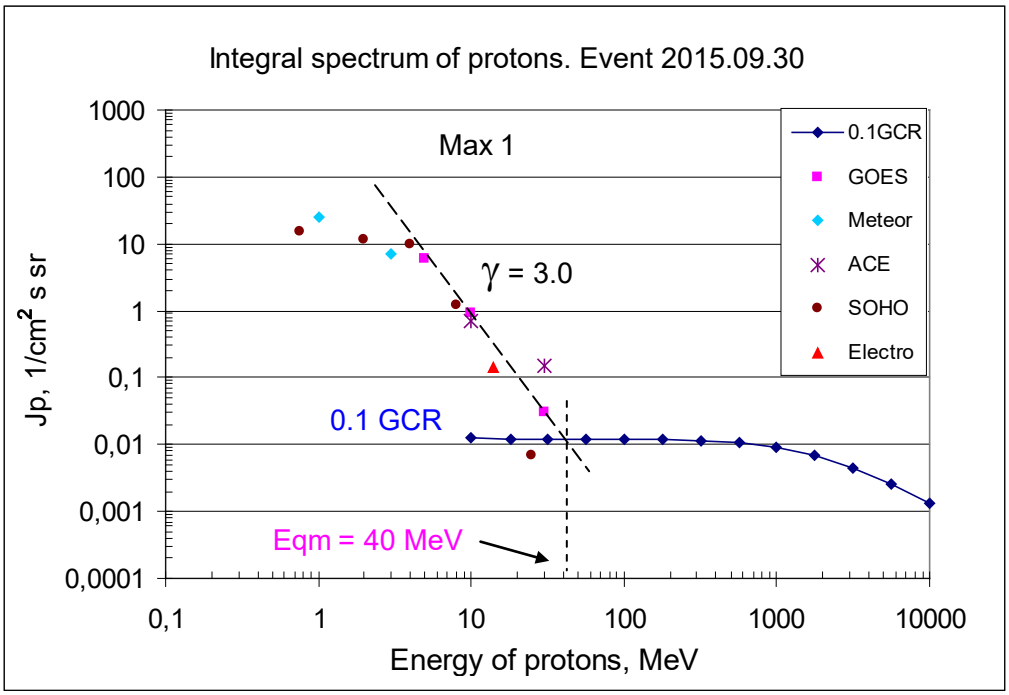


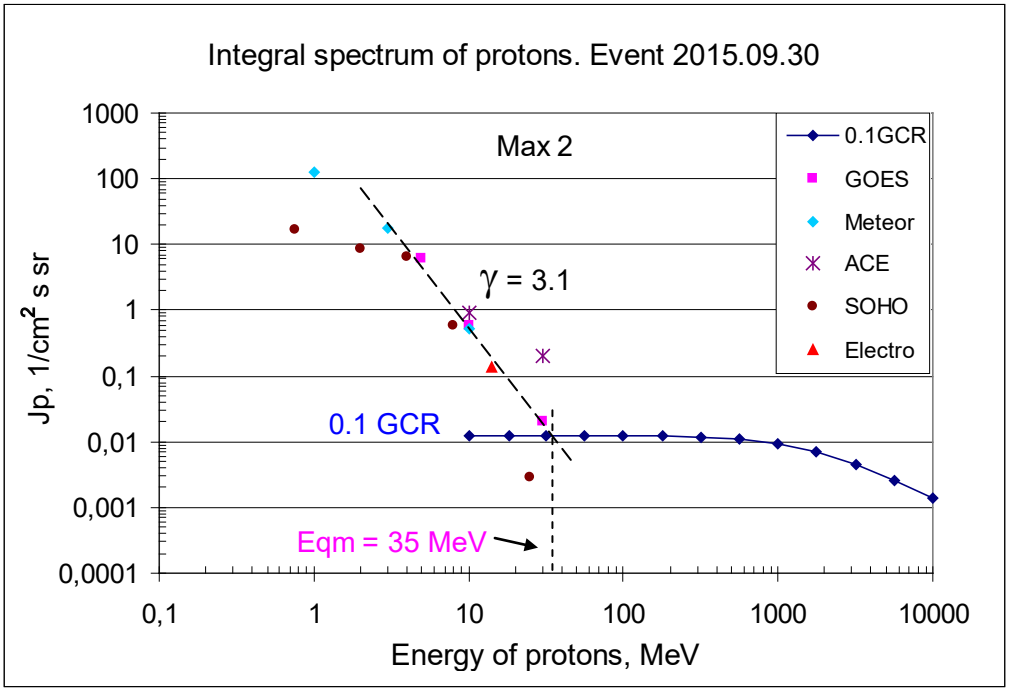
Integral fluxes of protons for the event of 2015 September 30

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	20	23/01d02	6.1/6.2	2	0.2	
EPS	>10	20	23/01d02	0.9/0.6	1	0.12	
EPS	>30	20	23/01d03	0.03/0.02	1	0.07	
EPS	>50	20	-	-	-	0.06	
EPS	>60	20	-	-	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	296	
Meteor-2							
SCR	>1	19	23/01d07	25/125	2.5	3.8	
SCR	>3	19	23/01d04	7/18	2	2.4	
SCR	>10	19	- /01d03	- /0.53	0.5	1.9	
GALS-M	>15	-	-	-	-	0.65	
GALS-M	>25	-	-	-	-	0.65	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	18	20/01d01	0.7/0.9	1	1.25	
SIS	>30	18	20/01d01	0.15/0.2	1	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

Differential fluxes of protons for the event of 2015 September 30

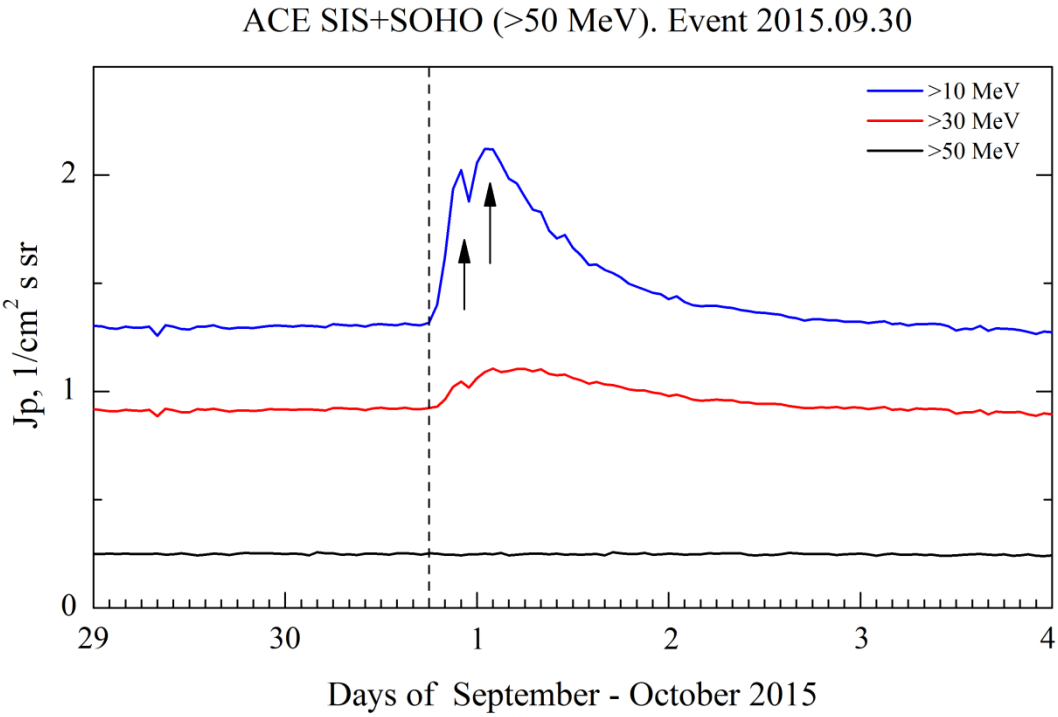
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	20	01d05/01d09	3.3/6.35	3	0.01	
LION	2 – 6	18	01d05/01d09	0.65/0.7	3	0.0017	
EPHIN	4 – 8	16	01d03/01d08	2.1/1.46	3	0.00005	
EPHIN	8 – 25	17	01d03/01d08	0.068/0.035	3	0.00001	
EPHIN	25 – 53	19	23/01d08	0.00025/0.0001	3	0.00002	
Electro-1							
SCR-E	13.7–23	-	01d02/01d06	0.015/0.015	0.2	0.05	
SCR-E	23–42	-	-	-	-	0.02	
SCR-E	42–112	-	-	-	-	0.004	
POES							<E>, MeV
MEPED	16–36	-	-	-	-	0.032	25
MEPED	36–70	-	-	-	-	0.0047	50
MEPED	70–140	-	-	-	-	0.00084	100

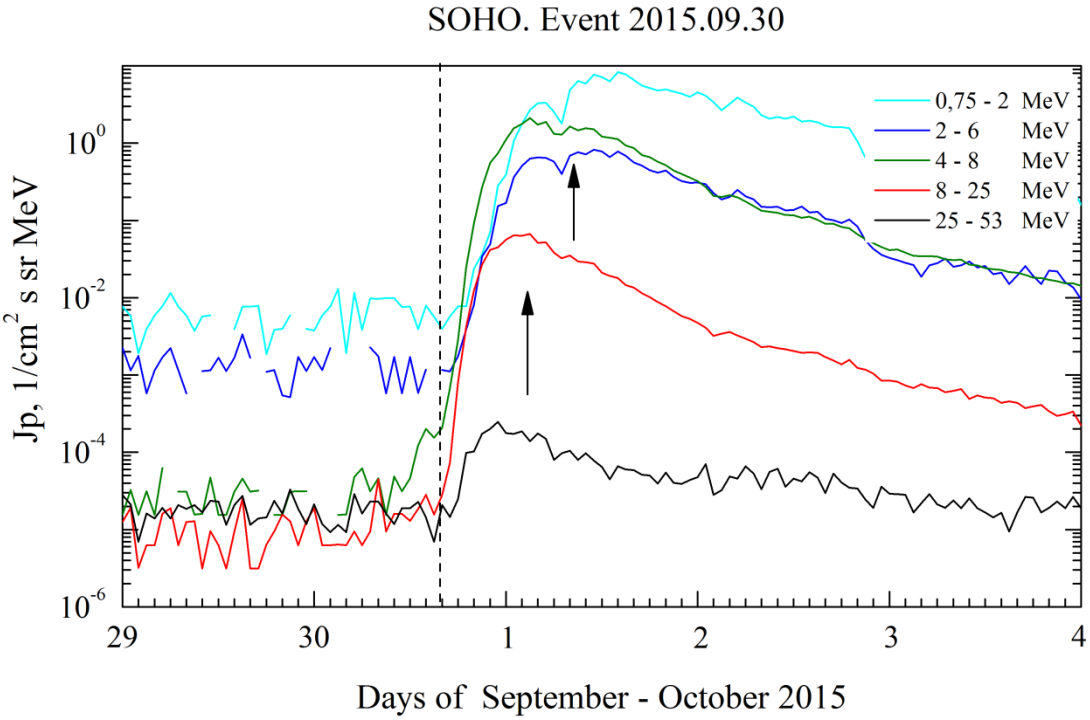

Integral spectrum of protons. Event 2015.09.30
Max 1
γ = 3.0
0.1 GCR
Eqm = 40 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

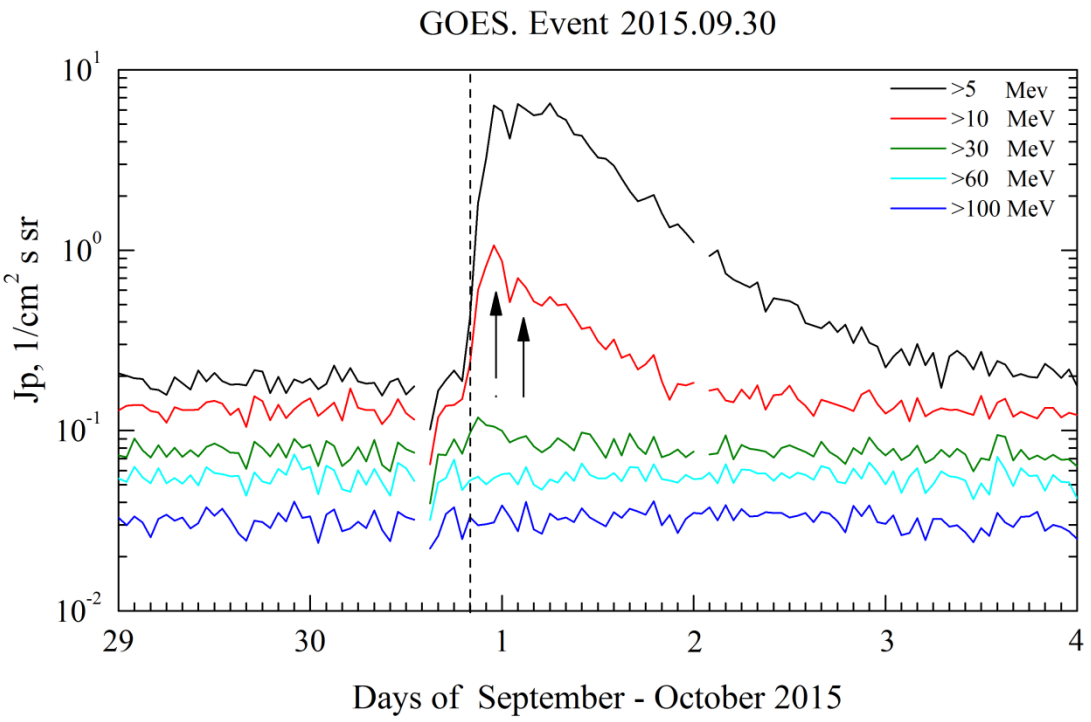

Integral spectrum of protons. Event 2015.09.30
Max 2
γ = 3.1
0.1 GCR
Eqm = 35 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm² s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

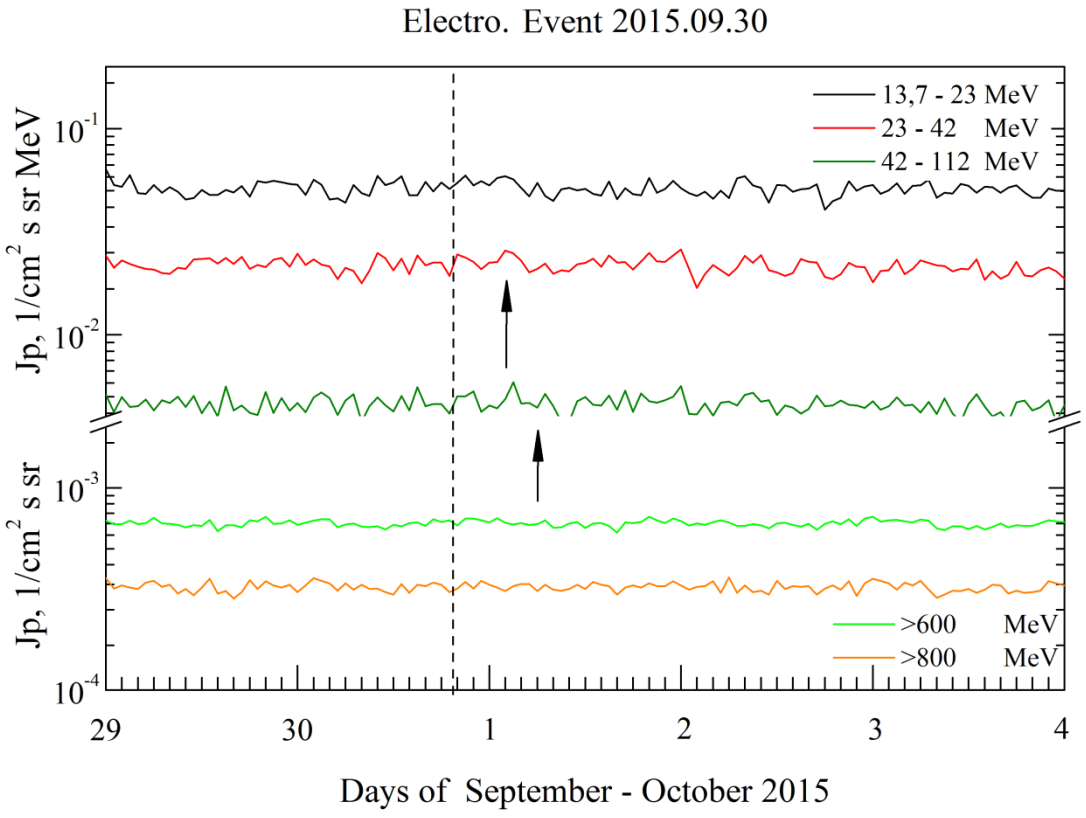
Time profiles of proton fluxes in the event 2015.09.30

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



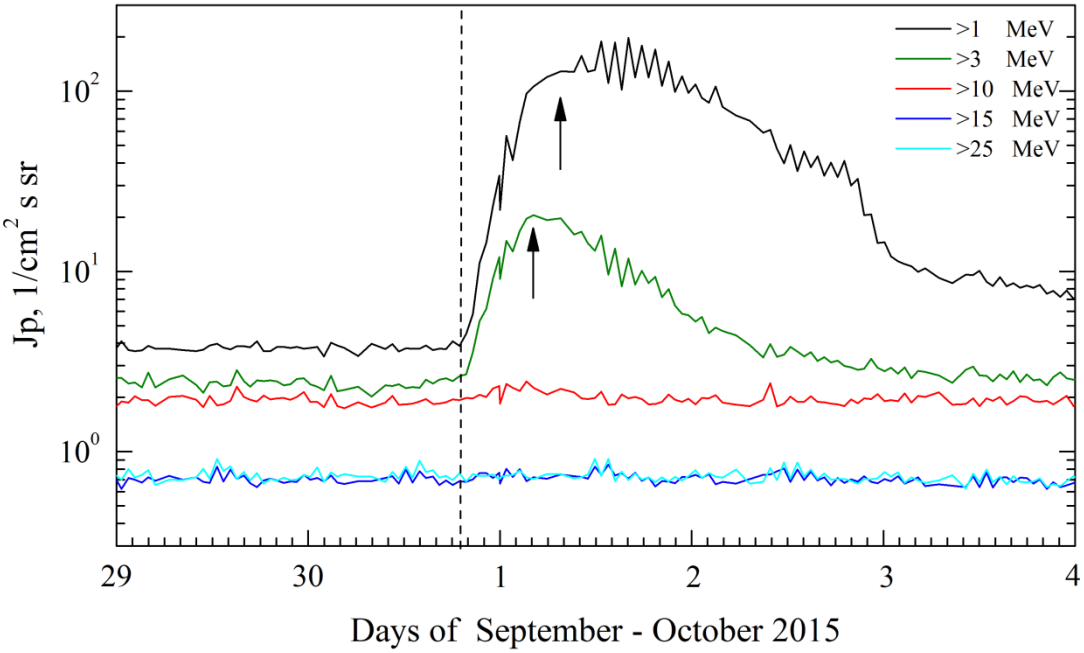



GOES. Event 2015.09.30
Jp, 1/cm² s sr
>5 Mev
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of September - October 2015

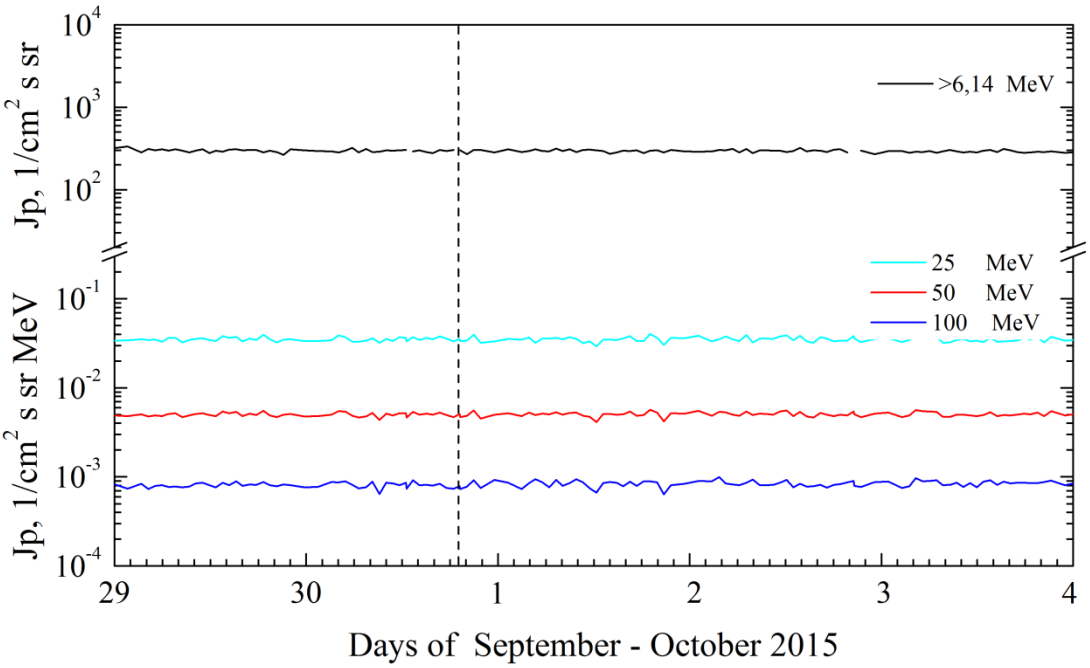

Electro. Event 2015.09.30
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of September - October 2015

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2015.09.30



POES. Event 2015.09.30



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 September 30

2015 September 30 ⊙ AR 12422 To event 575

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	<0736	~1054	>1102	S22W46	1N	ERU
6563 Å	FL	0743	0744	0752	S19W49	SF	
6563 Å	FL	0811	0815	0842	S19W47	SF	
1 – 12	keV	1049	1059	1113		M1.3	0.014

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12 – 25	keV	0852:48	0855:22	0909:08	40	43787	HESSI
6-12	keV	1026:36	1026:50	1028:32	16	4500	HESSI
6-12	keV	1038:00	1040:58	1042:44	20	8863	HESSI
6-12	keV	1042:44	1043:46	1045:00	13	4003	HESSI
50-100	keV	1048:56	1054:02	1055:20	348	471438	HESSI
12 – 25	keV	0814:55	0815:08	0815:36	1013	7870	FERMI
12-25	keV	0948:35	0949:04	0949:37	3524	14253	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
245	MHz	0811	0811	0811		2.88	
245	MHz	0905	0905	0905		2.76	
SP-type	**Frequency, MHz**	**To**	**Tmax**	**Te**	**V_{II}, km/s**	**Importance**	**Sp/c**
DS II	025-043	1608		1612	928	1	
DS IV	025-180	1553		1624		2	
DS III	025-180	1554		1604		2	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1000	602	21.3	128˚	304˚	SOHO
LASCO	WL	0936	586	27.0	102˚	240˚	SOHO

Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 September 30

2015 September 30 Ø AR 12422 To event 575

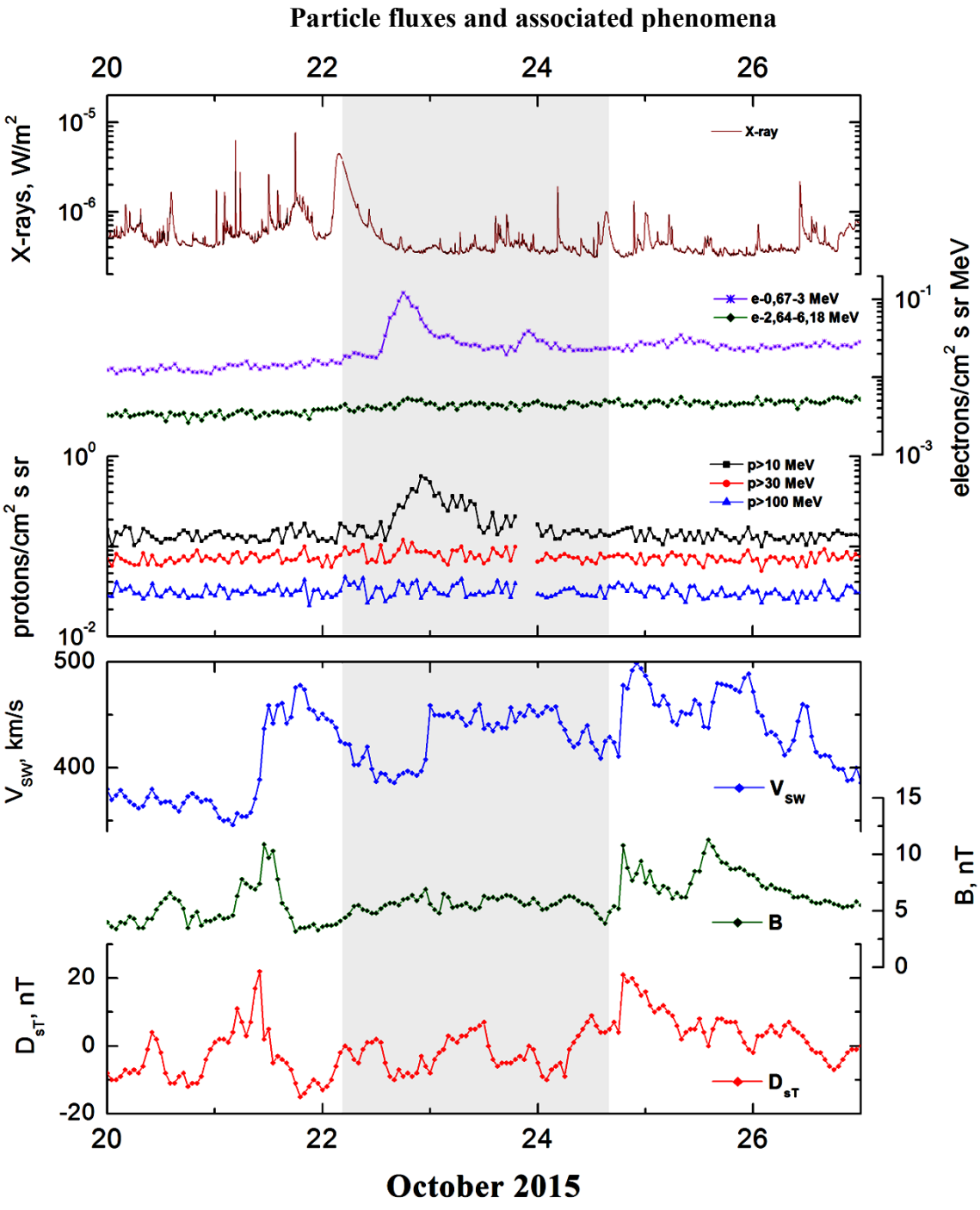
Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	1314	~1320	1328	S23W59	1N	ERU
1 – 12	keV	1318	1320	1321		M1.1	0.0016
X-ray		**To**	**Tmax**	**Te**	**Npeak, counts/s**	**Total counts**	**Sp/c**
12 – 25	keV	1313:52	1315:06	1316:28	42	11699	HESSI

Proton Active Region:

AR 12422 (S20L102, CMP 26,8.09.2015,
Sp=950 msh, FRC, BGD, R1?)
XRI= 3.72 $M_{17}^{7.6}$+C_{62} 2_1+1_{17}+S_{113}
PFR1 28-29.09: (23^h) $M_9^{7.6}$
PFR2 1–2.10: (11^h) $M_2^{5.5}$

Particle event: To(Ep>10 MeV) – 22d13^{h}
Tmax$_1$(Ep>10 MeV) – 22d23^{h}, Jmax$_1$(Ep>10 MeV) – 0.5 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 23d05^{h}, Jmax$_2$(Ep>10 MeV) – 0.2 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ_1 = 3.0, γ_2 = 3.0,
Quasimaximal energy of protons in the event – Eqm$_1$ = 40 MeV
– Eqm$_2$ = 40 MeV

Sources: ● solar flare 22d02^{h}13^{m}, C4.4/SF, S11W27, AR12434
Main burst X-ray 1–8 Å: onset – 22d02^{h}13^{m}, max – 22d03^{h}40^{m}, Φ = 0.036 J/m^2
CME: 22d03^{h}12^{m}, V = 817 km/s, Δφ = 360º, dA = 206º
▲ SC 24d18^{h}55^{m}

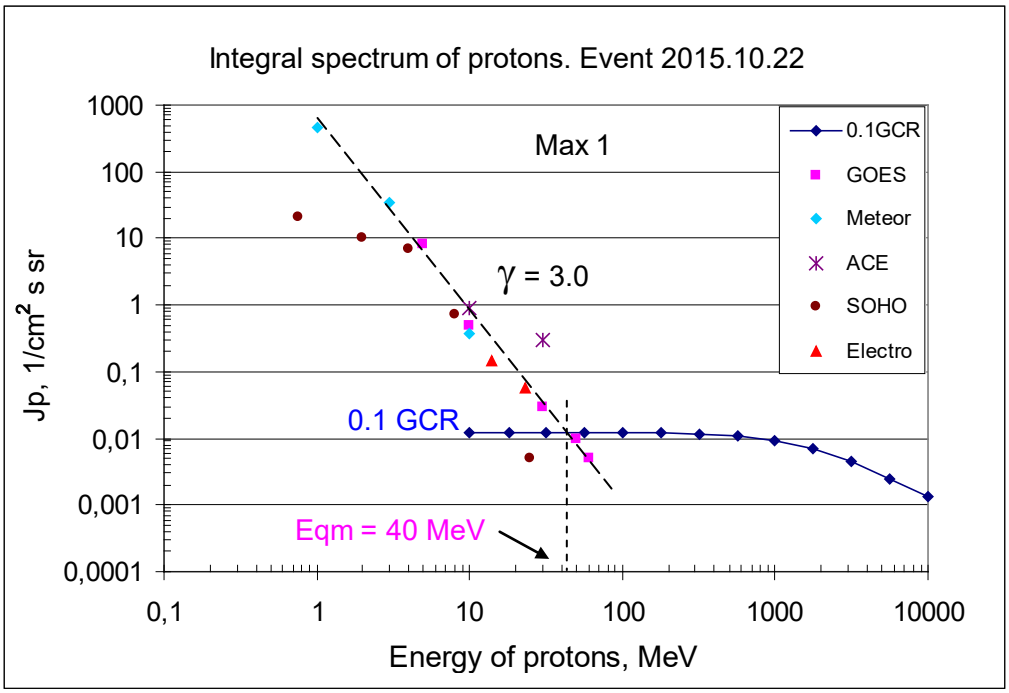


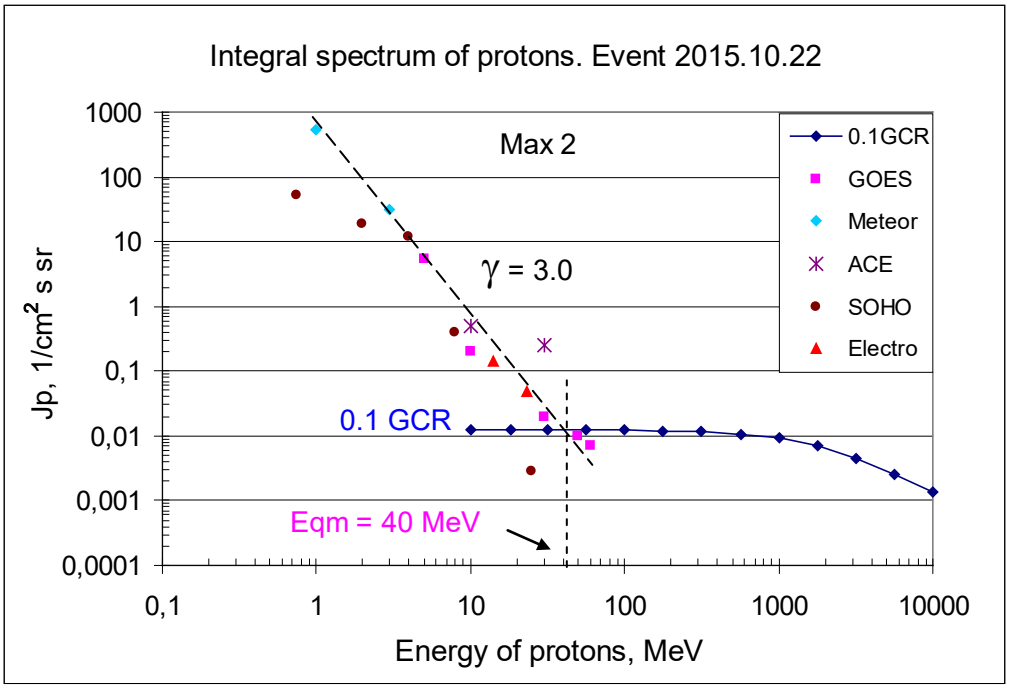
Integral fluxes of protons for the event of 2015 October 22

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	13	23/23dd05	8/5.5	2	0.2	
EPS	>10	13	22/23dd05	0.5/0.2	1	0.12	
EPS	>30	13	22/23dd05	0.03/0.02	-	0.07	
EPS	>50	13	22/23dd05	0.01/0.01	-	0.06	
EPS	>60	13	22/23dd05	0.005/0.007	-	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	295	
Meteor-2							
SCR	>1	12	23d01/23d07	460/526	3.5	3.8	
SCR	>3	12	23d01/23d07	35/31	2	2.4	
SCR	>10	16?	21/-	0.37/-	0.3	1.9	
GALS-M	>15	-	-	-	-	0.65	
GALS-M	>25	-	-	-	-	0.65	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	12	21/23d05	0.9/0.5	1.5	1.25	
SIS	>30	12	21/23d05	0.3/0.25	1.5	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

Differential fluxes of protons for the event of 2015 October 22

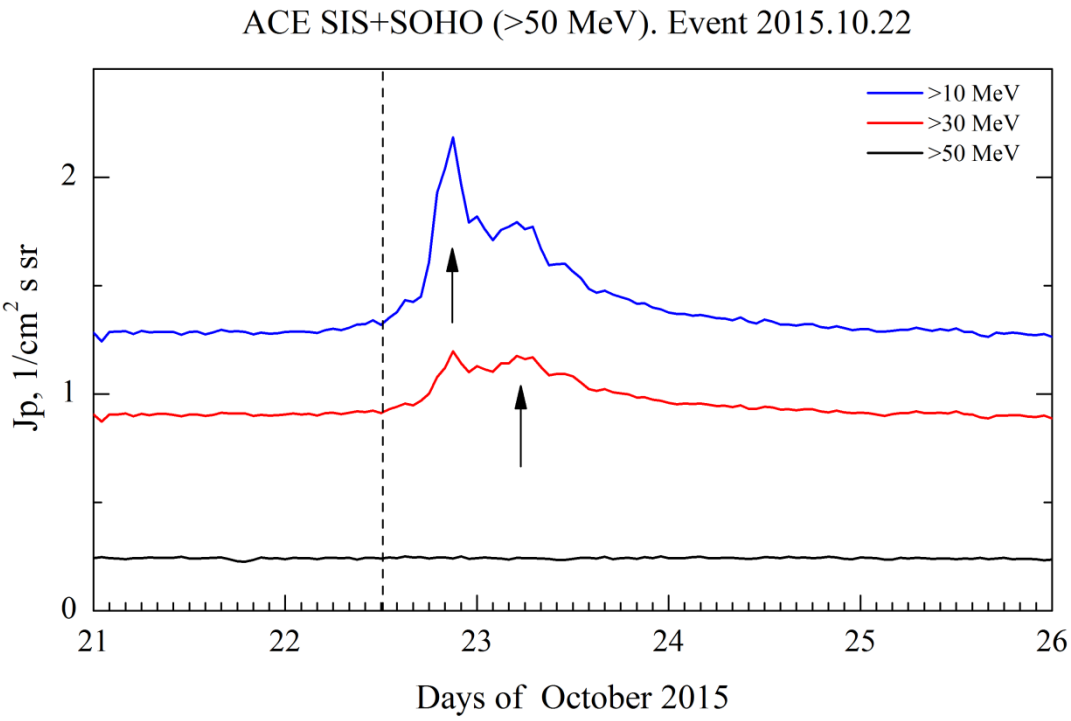
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	8	22/23d04	9/25.4	3.7	0.004	
LION	2 – 6	8	22/23d05	1.1/2.53	3.7	0.001	
EPHIN	4 – 8	7	22/23d04	1.54/2.83	3.7	0.00005	
EPHIN	8 – 25	6	20/23d04	0.042/0.0233	3.7	0.00002	
EPHIN	25 – 53	6	20/23d04	0.00017/0.0001	1.5	0.00002	
Electro-1							
SCR-E	13.7–23	12	23/23d04	0.01/0.01	0.2	0.05	
SCR-E	23–42	12	23/23d04	0.003/0.0025	0.2	0.02	
SCR-E	42–112	-	-	-	-	0.004	
POES							<E>, MeV
MEPED	16–36	-	-	-	-	0.033	25
MEPED	36–70	-	-	-	-	0.0047	50
MEPED	70–140	-	-	-	-	0.0008	100

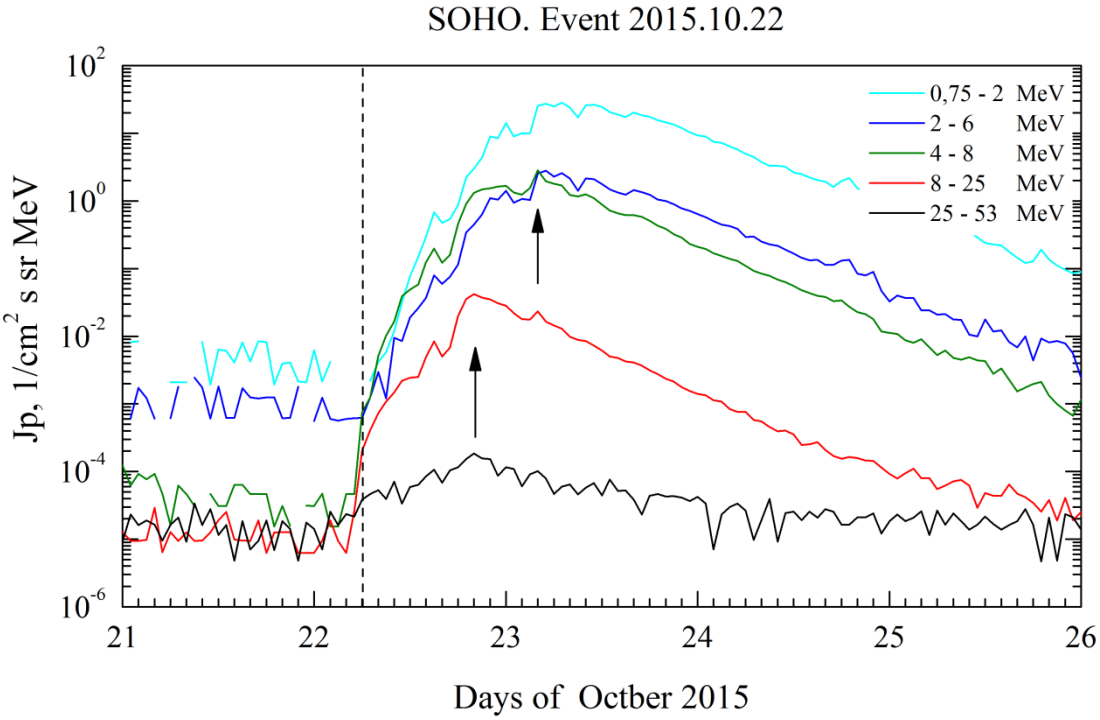

Integral spectrum of protons. Event 2015.10.22
Max 1
γ = 3.0
0.1 GCR
Eqm = 40 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2015.10.22
Max 2
γ = 3.0
0.1 GCR
Eqm = 40 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

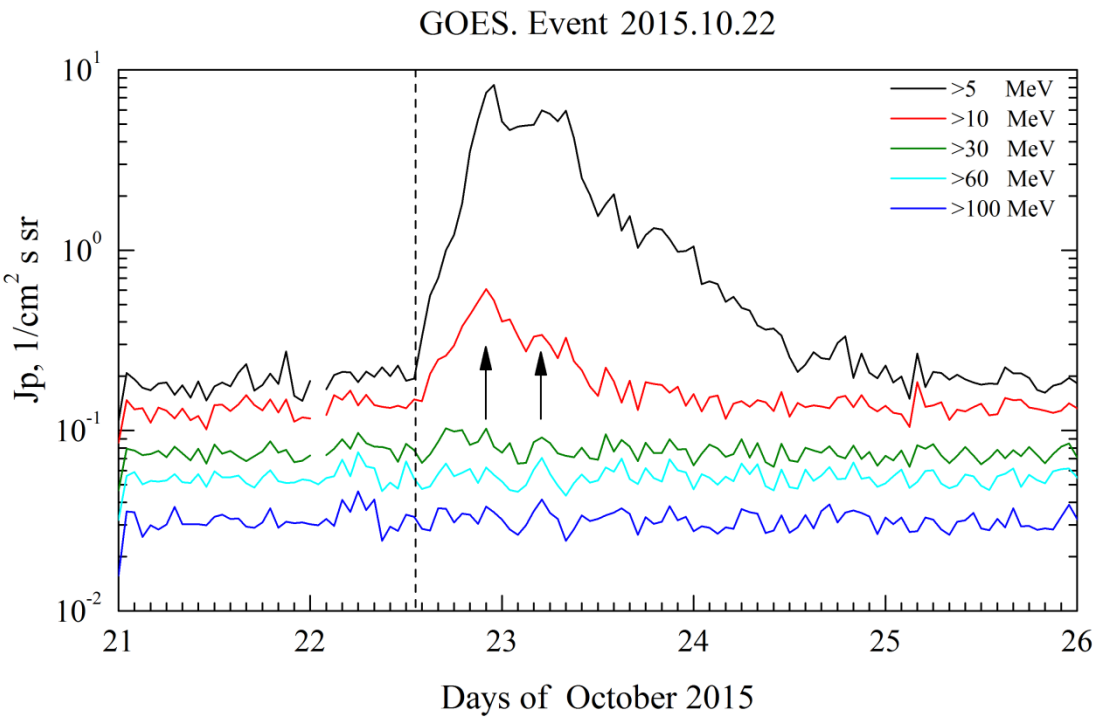
Time profiles of proton fluxes in the event 2015.10.22

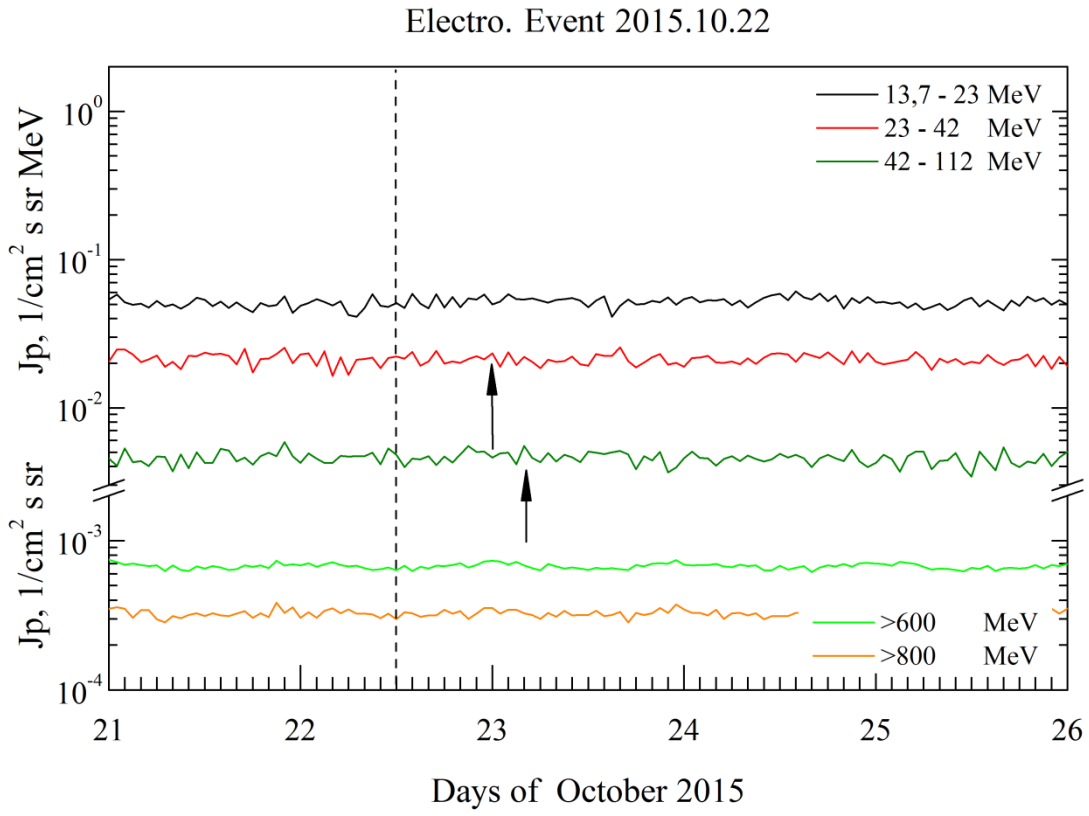
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



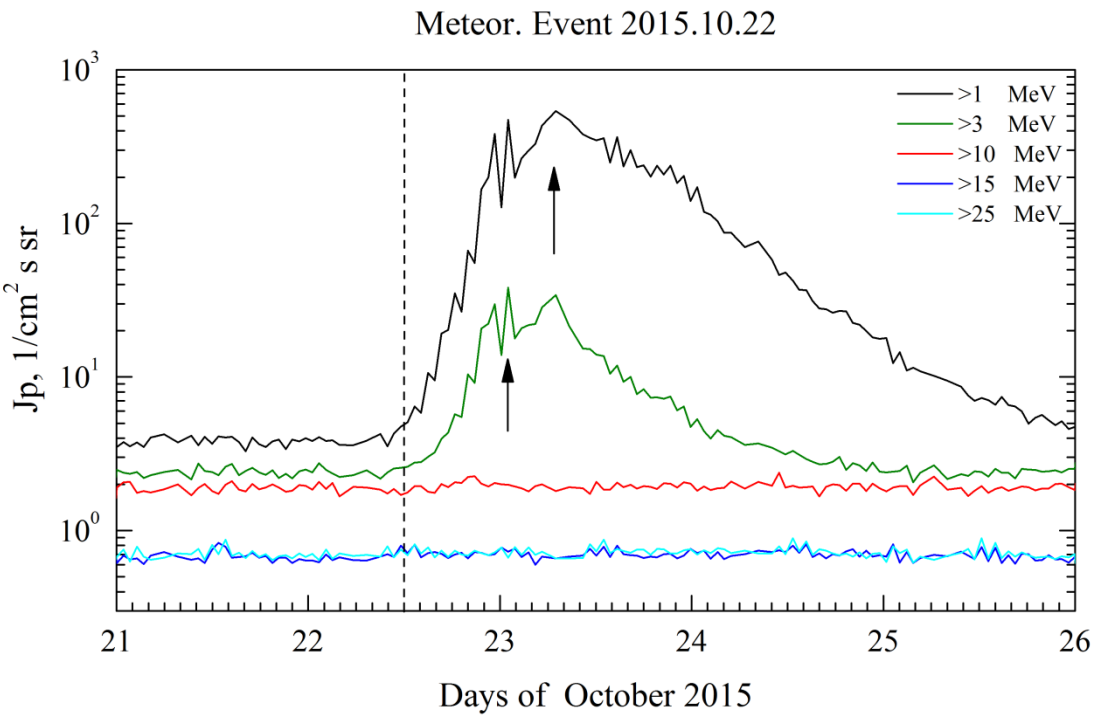


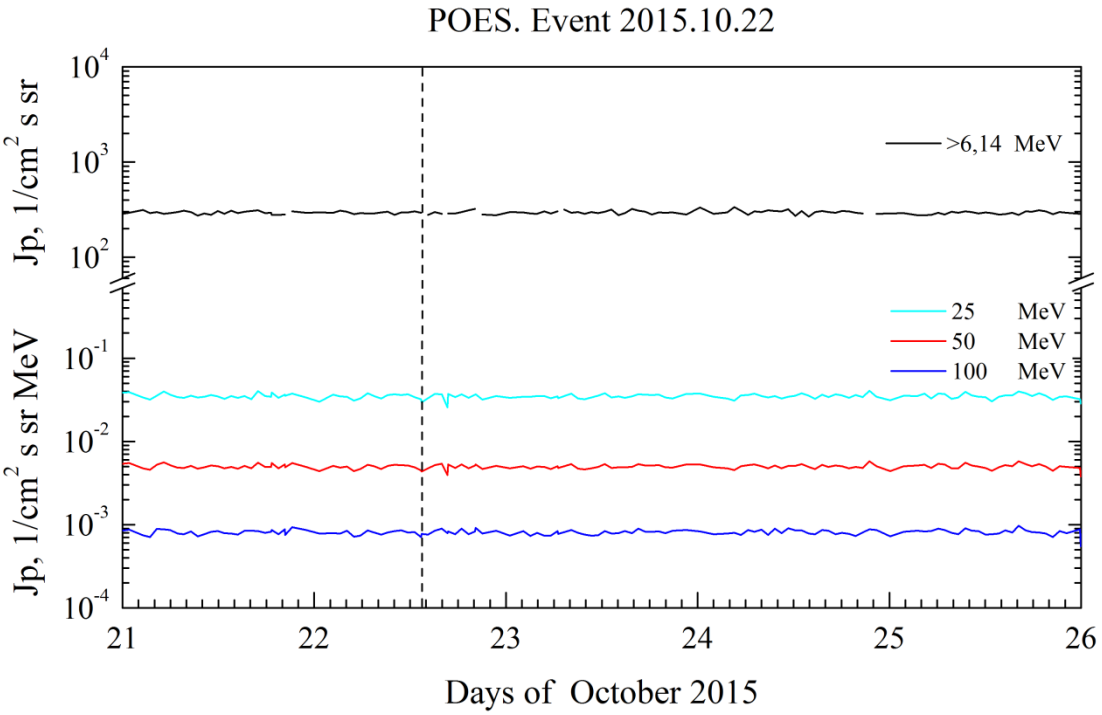
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 October 22

2015 October 22 • AR12434 To event 576

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0239	0303	0515	S11W27	SF	UMB
6563 Å	DSF	0244			S15W40	16°	
1 – 12	keV	0213	0340	0515	S10W34	C4.4*	0.036
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	0220:56	0246:42	0248:32	1584	4178976	HESSI
12-25	keV	0321:24	0321:30	0422:56	2288	15451236	HESSI
6-12	keV	0458:28	0459:02	0517:00	336	851466	HESSI
12-25	keV	0248:44	0307:01	0327:55	999	436093	FERMI
12-25	keV	0425:37	0426:41	0429:27		324670	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
245	MHz	0230	0231	0232		2.46	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS III	25-180	0230		0240		1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0312	817	6.0	360˚	206˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/ssw_client/data/ssw_service_151022_000245_57422/www/

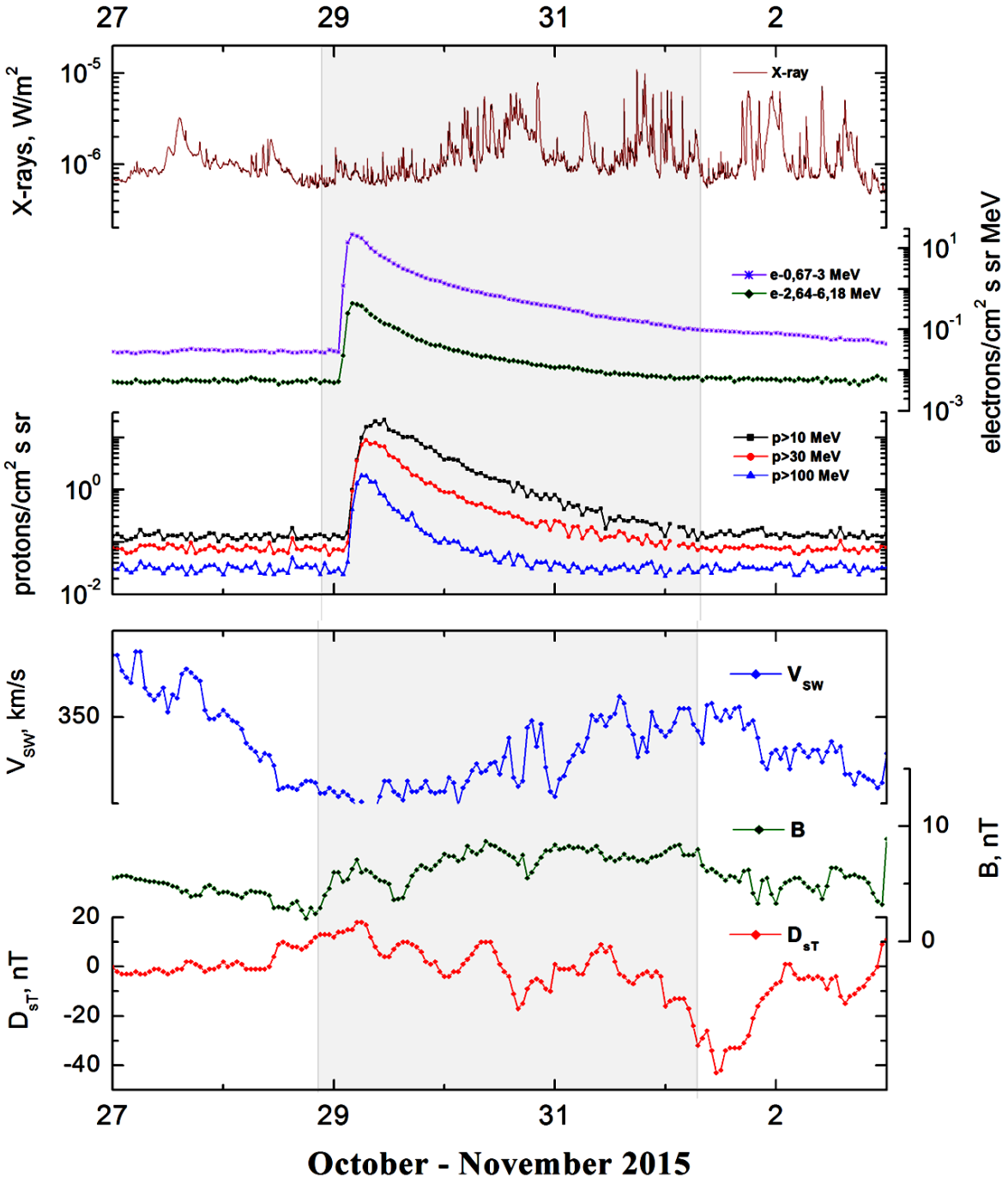
Proton Active Region:

AR12434 (S10L164, CMP 19,4.10.2015,
Sp=260 msh, DKI, BGD, R)
XRI=0.22 $M_2^{1.1}$+C_{41} 1_1+S_{25}
PFR 15-16.10: (7^h) $M_2^{1.1}$

Particle event: To(Ep>10 MeV) – 29d02^{h}
Tmax (Ep>10 MeV) – 29d07^{h}, Jmax(Ep>10 MeV) – 19 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ = 2.3
Quasimaximal energy of protons in the event – Eqm = 900 MeV

Sources: ⊡ solar flare 29d<02^{h}36^{m}, AR12434 – 2d behind W_L
CME: 29d02^{h}36^{m}, V = 530 km/s, Δφ = 202°, dA= 251°

Particle fluxes and associated phenomena

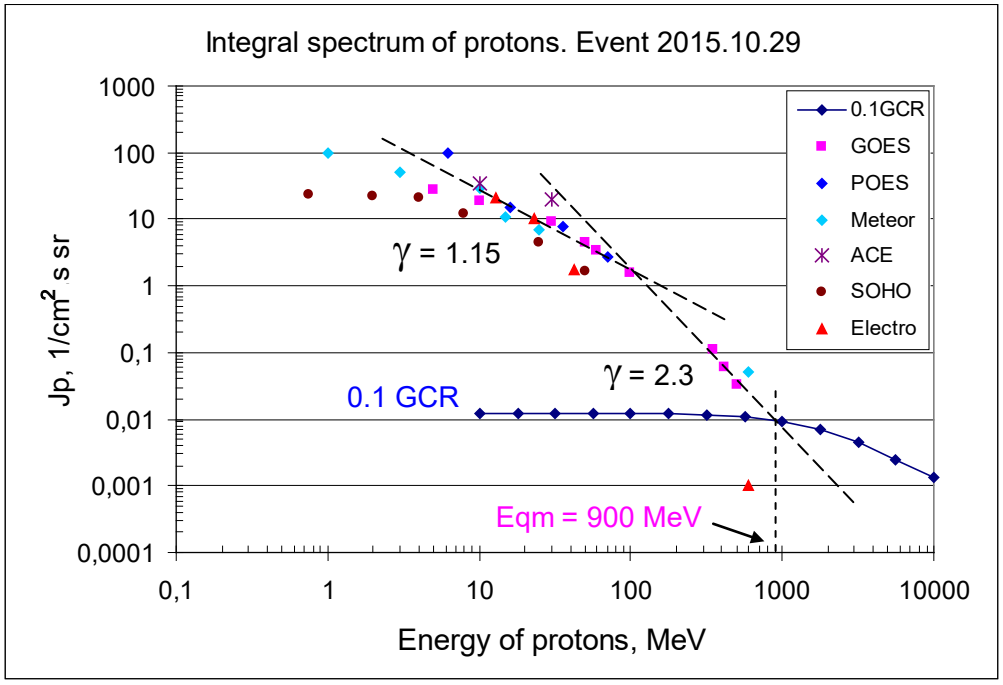


Integral fluxes of protons for the event of 2015 October 29

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	2	8	27.2	3	0.2	
EPS	>10	2	7	19	3	0.12	
EPS	>30	2	6	9	3	0.07	
EPS	>50	2	6	4.5	2	0.06	
EPS	>60	2	6	3.4	2	0.05	
EPS	>100	2	6	1.6	2	0.03	
EPS	>700	-	-	-	-	0.001	
Electro-1							
GALS-E	>600	2	6	0.001	0.5	0.0007	
POES							
MEPED	>6.14	03	06	97	0.4	295	
Meteor-2							
SCR	>1	2	8	100	3	3.8	
SCR	>3	2	8	50	3	1.8	
SCR	>10	2	8	29.5	1.5	1.9	
GALS-M	>15	2	8	10.7	1	0.6	
GALS-M	>25	2	7	6.9	1	0.6	
GALS-M	>600	2	6	0.05	0.5	0.2	
ACE							
SIS	>10	3	5	35	1.5	1.3	
SIS	>30	3	5	20	1.5	0.9	
SOHO							
EPHIN	>50	3	6	1.64	1	0.24	

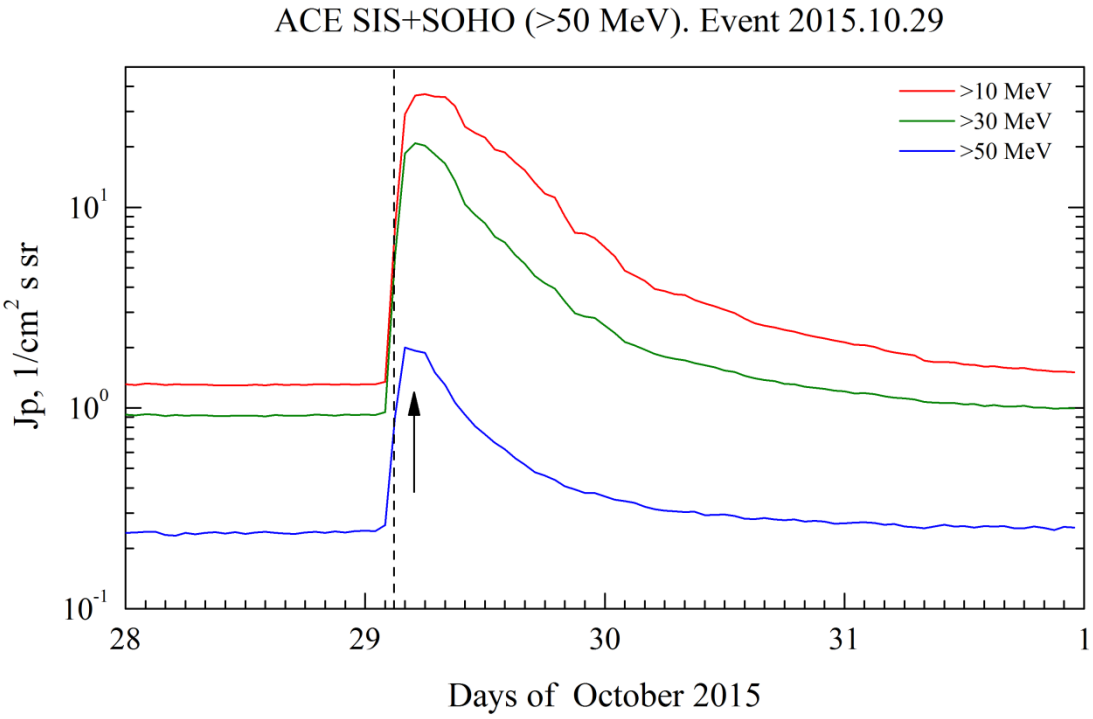
Differential fluxes of protons for the event of 2015 October 29

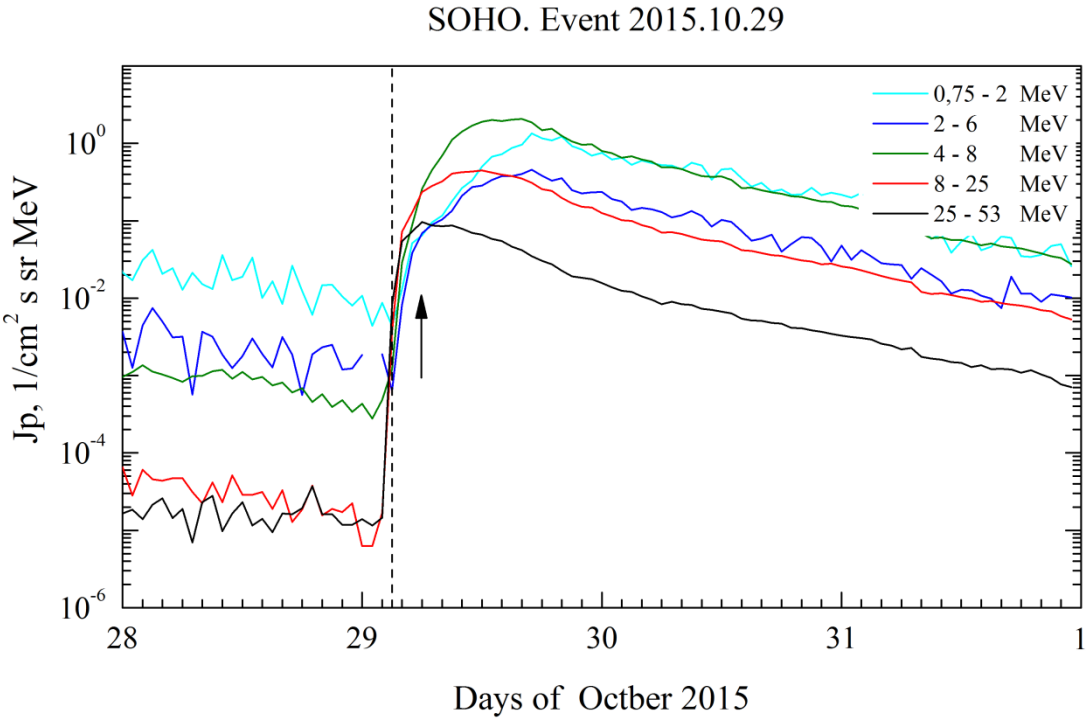
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	4	17	1.34	>3	0.015	
LION	2 – 6	4	17	0.455	>3	0.0023	
EPHIN	4 – 8	3	16	2.1	>3	0.001	
EPHIN	8 – 25	3	12	0.45	>3	0.00003	
EPHIN	25 – 53	3	6	0.1	>3	0.00002	
Electro-1							
SCR-E	13.7–23	2	6	1.2	1	0.05	
SCR-E	23–42	2	6	0.45	1	0.02	
SCR-E	42–112	2	6	0.025	1	0.004	
POES							<E>, MeV
MEPED	16–36	03	06	0.357	2	0.034	25
MEPED	36–70	03	06	0.147	1.5	0.005	50
MEPED	70–140	03	06	0.04	1.5	0.0008	100
GOES							
EPS	350–420	4	6	0.0007	1	0.0016	
EPS	420–510	3	6	0,0003	1	0.001	
EPS	510–700	3	6	0,00017	1	0,0005	

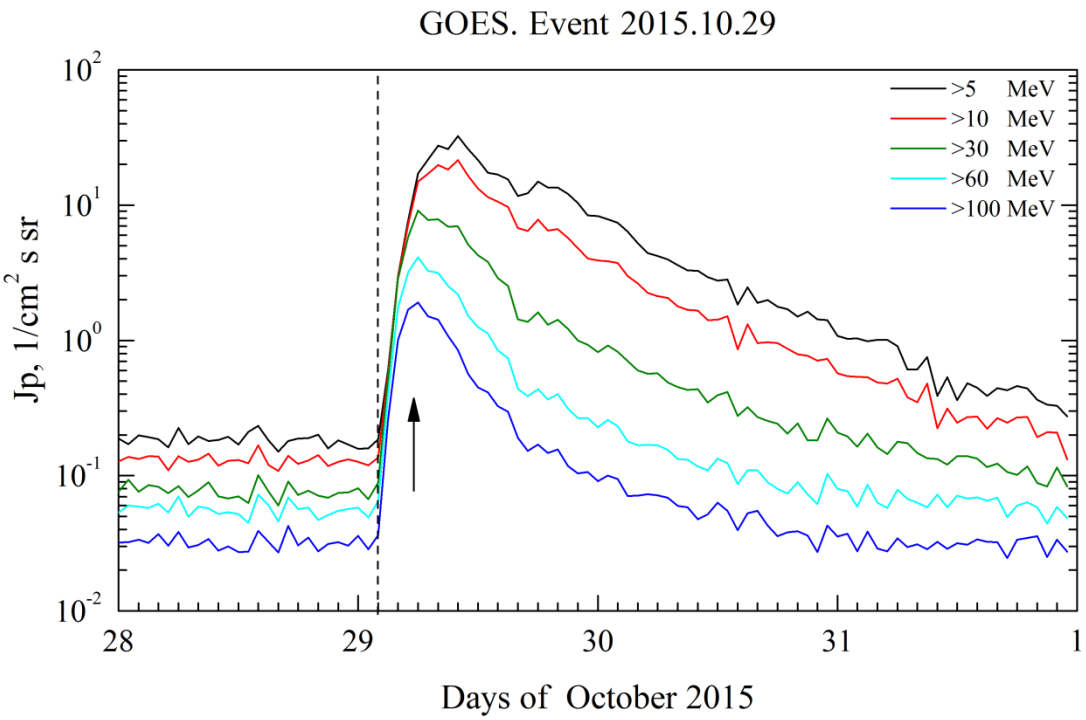


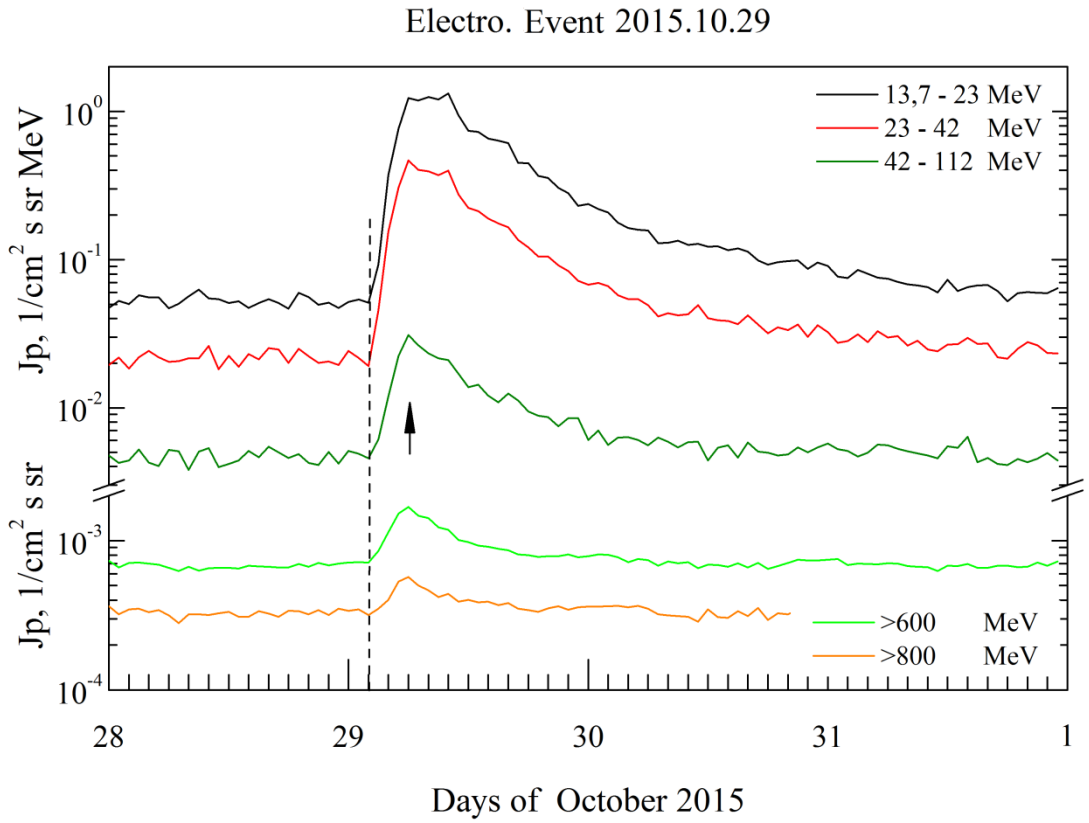
Time profiles of proton fluxes in the event 2015.10.29

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



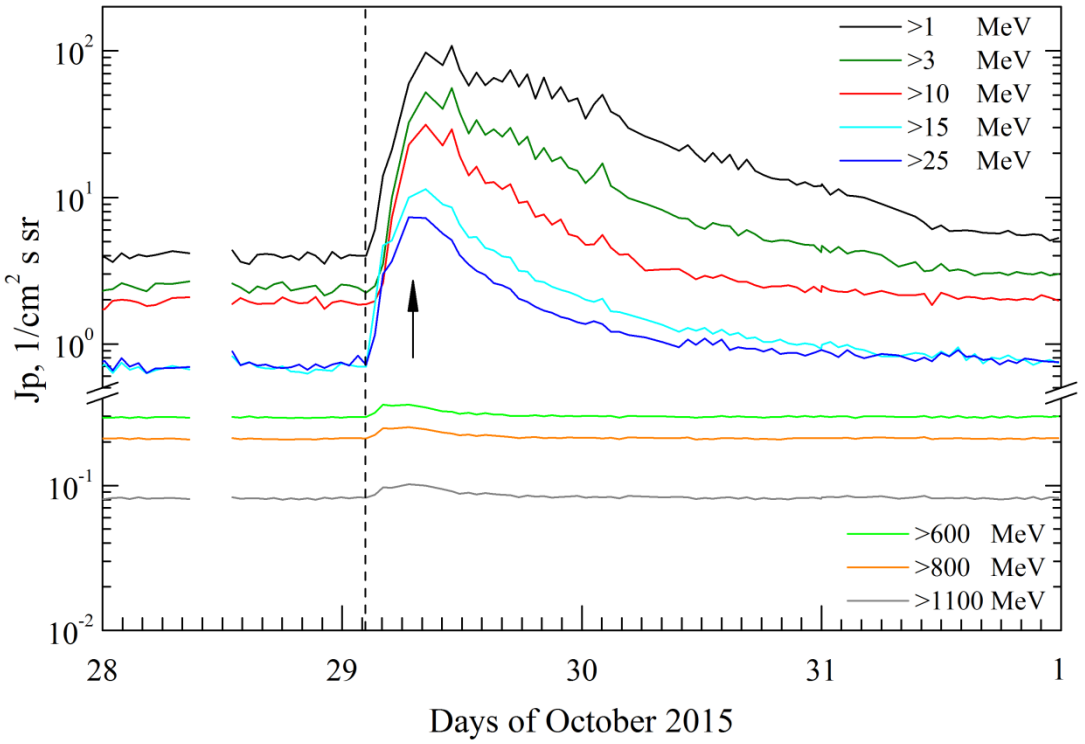



GOES. Event 2015.10.29
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of October 2015

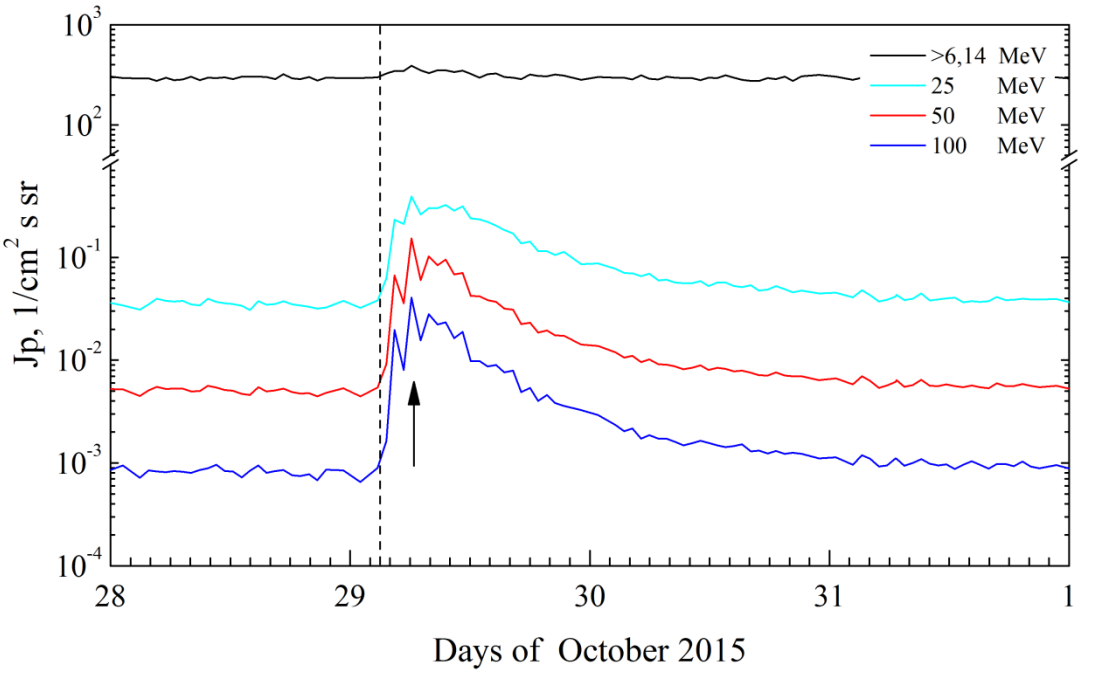

Electro. Event 2015.10.29
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of October 2015

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2015.10.29



POES. Event 2015.10.29



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 October 29

2015 October 29 ⊡ AR 12434 To event 577

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å		No optical and X-ray flare on visible disc					
1 – 12	keV						

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
6 – 12	keV	0241:52	0244:34	0253:24	104	129072	HESSI

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	35-400	0219		0232		1	
DS II	25-180	0219		0230	972	1	
DS II	30-57	0219		0246		1	
DS IV	30-135	0230		0247		1	
DS III	18-75	0227		0231		3	
DS III	43-64	0240		0241		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0236	530	- 7.5	202˚	251˚	SOHO

Proton Active Region:

AR12434* (S10L164, CMP 19,4.10.2015,
Sp=260 msh, DKI, BGD)
XRI=0.22 $M_2^{1.1}$+C_{41} 1_1+S_{25}
PFR 15-16.10: (7^h) $M_2^{1.1}$
*2d behind W_L

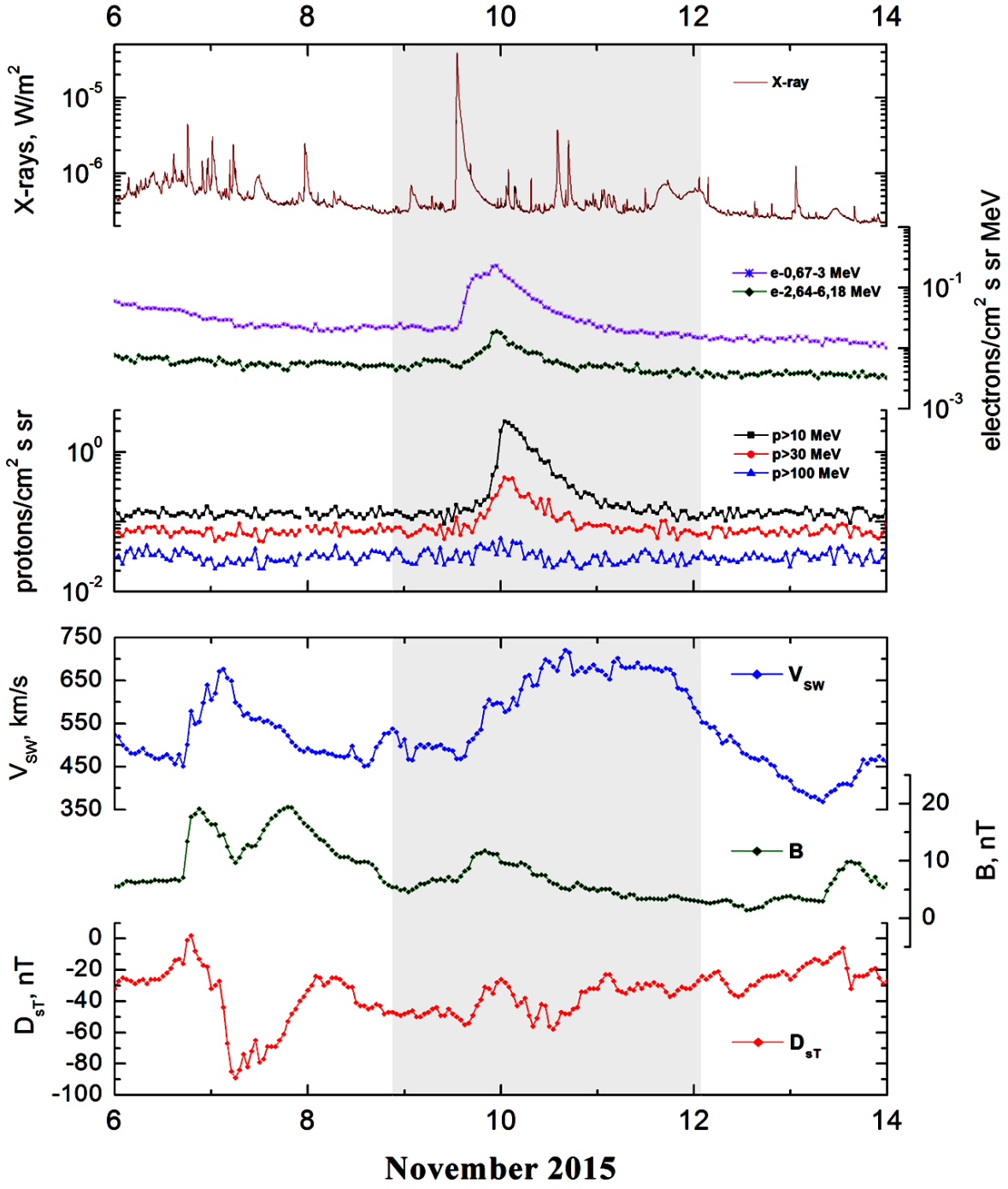
References:

Мирошниченко Л.И., Ли Ч., Янке В.Г., 2020.
Gopalswamy N., S. Yashiro, N. Thakur et al., 2016.
Kahler S.W., D. Brown, 2021.
Miroshnichenko L.I., C. Li, V.G. Yanke, 2020.
NOAA SPE, 2019.
Xie H., O.C.St. Cyr, P. Mäkelä, N. Gopalswamy, 2019.

Particle event: To(Ep>10 MeV) – 09d16^{h}
Tmax (Ep>10 MeV) – 10d02^{h}, Jmax(Ep>10 MeV) – 2.7 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma = 2.2$
Quasimaximal energy of protons in the event – Eqm = 120 MeV

Sources: ● solar flare 09d12^{h}49^{m}, M3.9/2B, 1F, S11E41, AR12449
Main burst X-ray 1–8 Å: onset – 09d12^{h}49^{m}, max – 09d13^{h}12^{m}, $\Phi = 0.047$ J/m^2
CME: 09d13^{h}25^{m}, V = 1041 km/s, $\Delta\varphi = 273°$, dA= 137°

Particle fluxes and associated phenomena

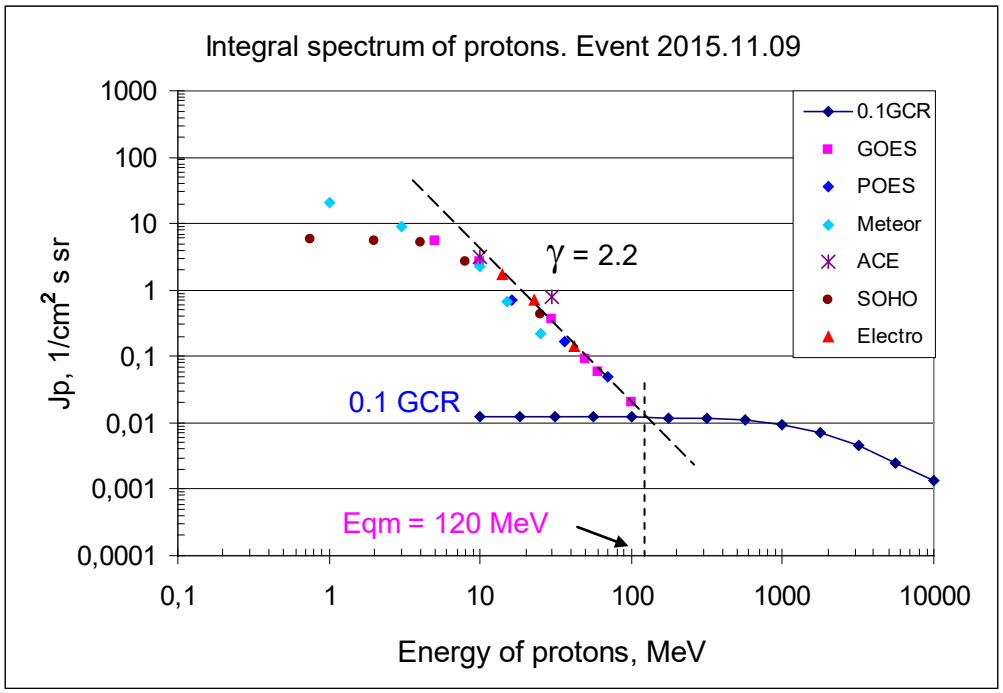


Integral fluxes of protons for the event of 2015 November 09

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	16	10d01	5.6	1.5	0.2	
EPS	>10	16	10d02	2.7	1.5	0.12	
EPS	>30	16	10d03	0.37	1	0.07	
EPS	>50	16	10d00	0.09	1	0.06	
EPS	>60	16	10d00	0.06	1	0.05	
EPS	>100	16	22	0.02	0.5	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	295	
Meteor-2							
SCR	>1	22	10d02	20.5	1.5	3.8	
SCR	>3	22	10d02	9.21	1	1.8	
SCR	>10	22	10d02	2.23	1	1.9	
GALS-M	>15	22	10d02	0.66	0.5	0.7	
GALS-M	>25	22	10d01	0.22	0.4	0.7	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	15	23	3.2	1.5	1.3	
SIS	>30	15	23	0.8	1.5	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.24	

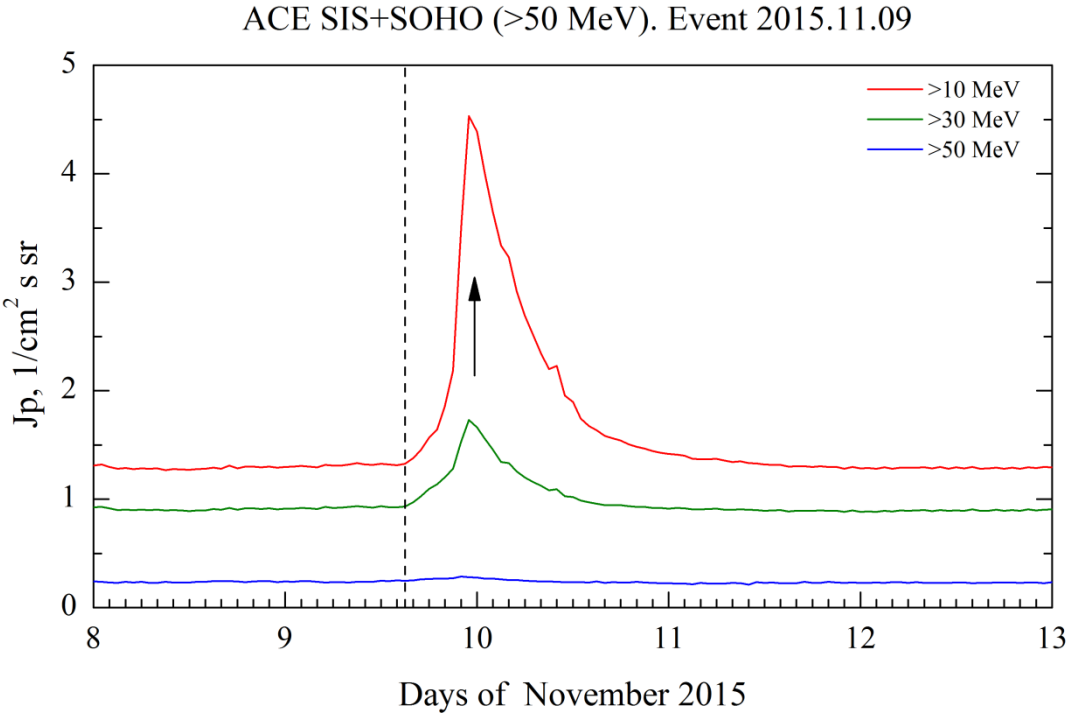
Differential fluxes of protons for the event of 2015 November 09

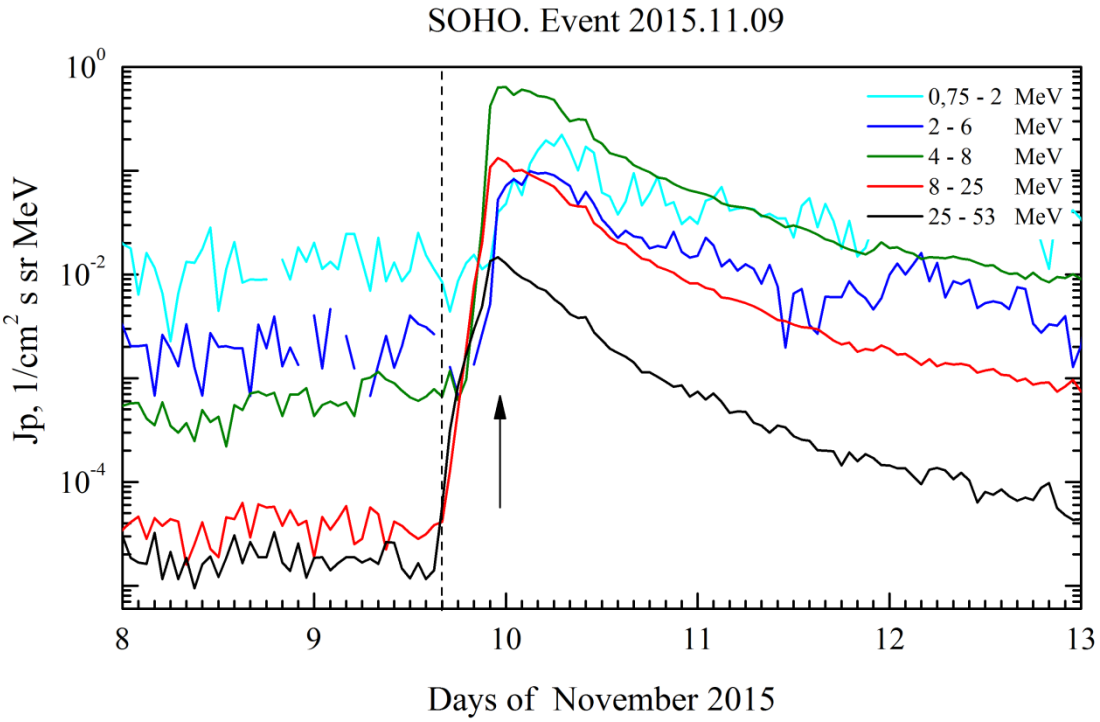
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	18	10d05	0.19	1.5	0.01	
LION	2 – 6	20	10d05	0.093	2.5	0.002	
EPHIN	4 – 8	20	10d00	0.639	5.5	0.0007	
EPHIN	8 – 25	17	23	0.132	5.5	0.00004	
EPHIN	25 – 53	16	23	0.0147	4.5	0.00002	
Electro-1							
SCR-E	13.7–23	16	10d01	0.11	1	0.05	
SCR-E	23–42	16	10d01	0.03	1	0.02	
SCR-E	42–112	16	10d01	0.002	1	0.004	
POES							<E>, MeV
MEPED	16–36	17	10d03	0.027	1	0.034	25
MEPED	36–70	17	10d03	0.0035	1	0.005	50
MEPED	70–140	17	10d01	0.0007	1	0.0008	100

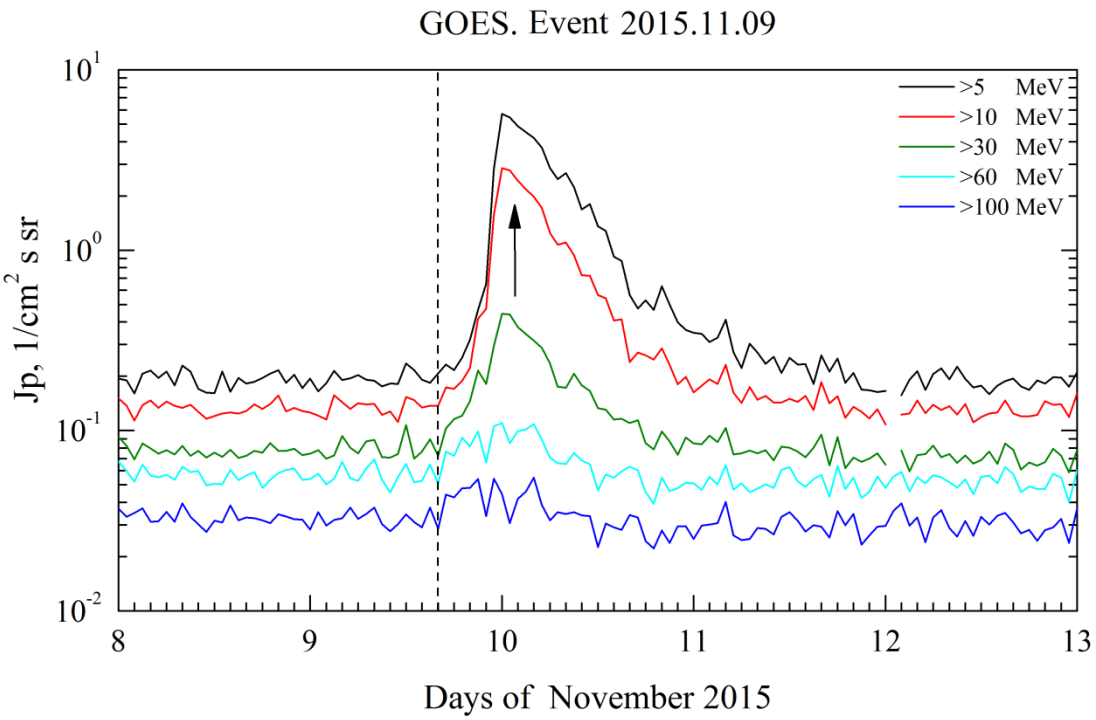

Integral spectrum of protons. Event 2015.11.09
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.2
0.1 GCR
Eqm = 120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro

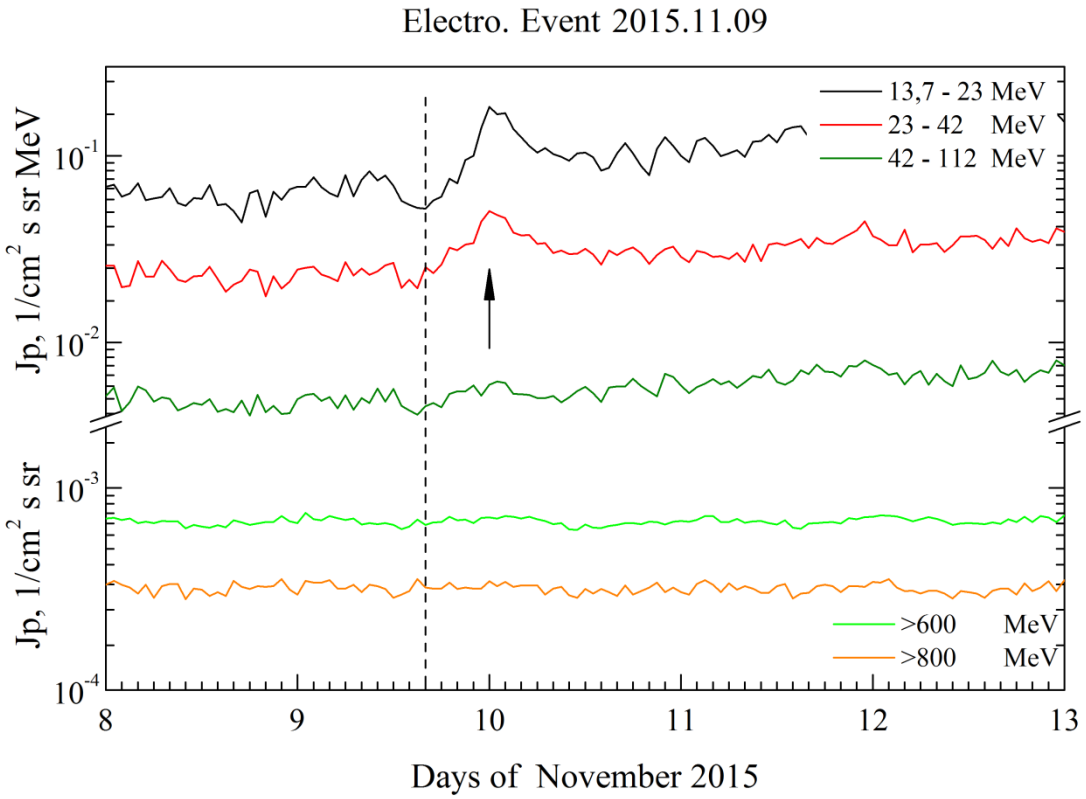
Time profiles of proton fluxes in the event 2015.11.09

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

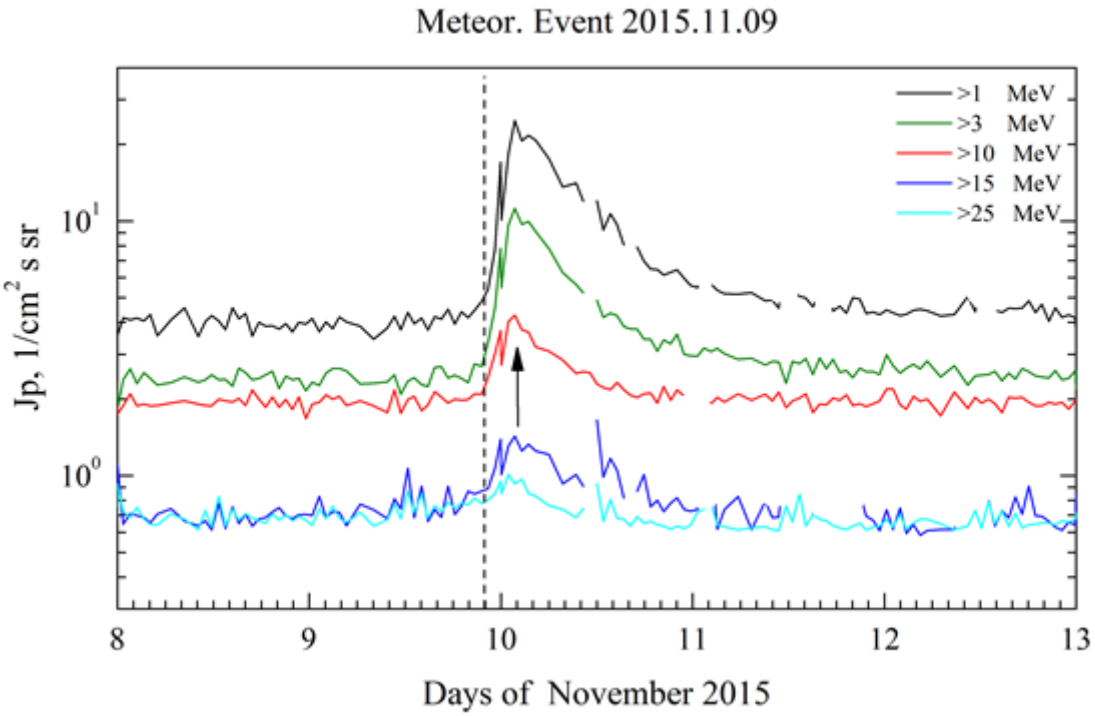


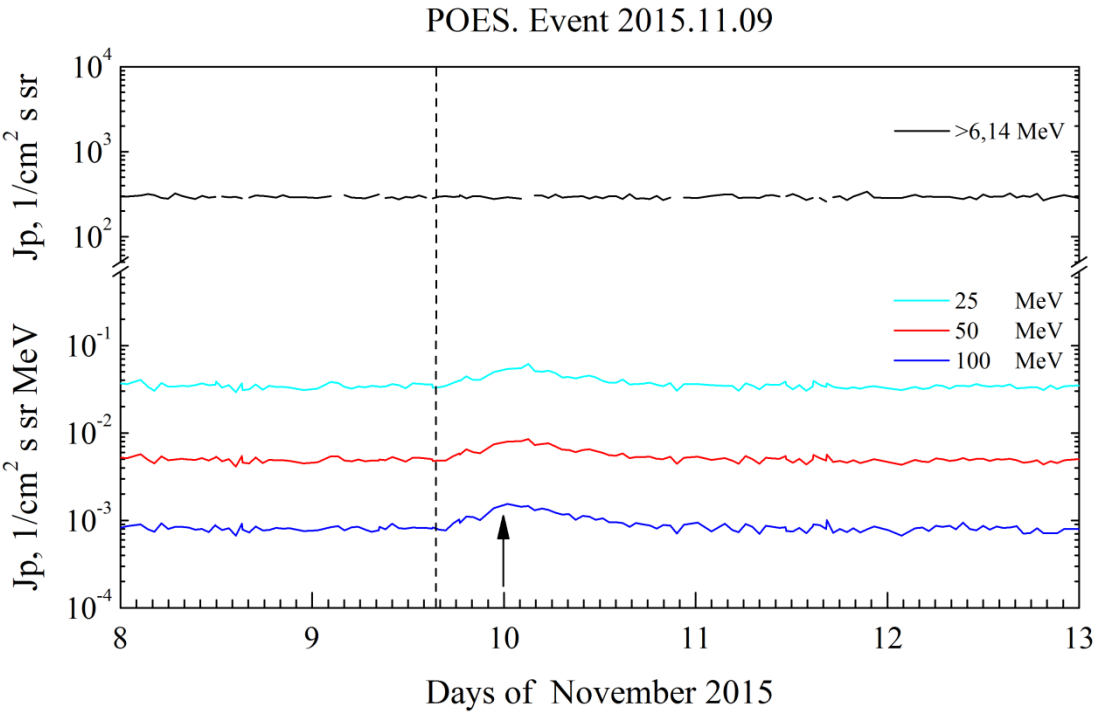



GOES. Event 2015.11.09
Jp, 1/cm² s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of November 2015


Electro. Event 2015.11.09
Jp, 1/cm² s sr MeV
Jp, 1/cm² s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of November 2015

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 November 09

2015 November 09 ● AR 12449 To event 578

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	1252	1304	1510	S11E41	2B	ERU
6563 Å	FL	1346	1350	1538	S12E39	1F	ERU
1 – 12	keV	1249	1312	1328	S13E39	M3.9	0.047

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
6-12	keV	1311:00	1311:06	1323:24	1584	1720464	HESSI
6-12	keV	1359:16	1359:46	1418:52	52	135864	HESSI
12-25	keV	1251:27	1302:23	1305:19	46546	13406465	FERMI
12-25	keV	1341:43	1359:57	1404:39	1147	248323	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	1301	1303	1311		2.34	
8.8	GHz	1300	1303	1328		2.6	
5	GHz	1259	1303	1315	P5 \ 15	2.83	
2.7	GHz	1300	1306	1311		2.83	
1.4	GHz	1300	1306	1317		2.65	
610	MHz	1259	1307	1323	1.4 / 5	3.11	
410	MHz	1259	1307	1328		2.88	
245	MHz	1303	1317	1330		3.28	

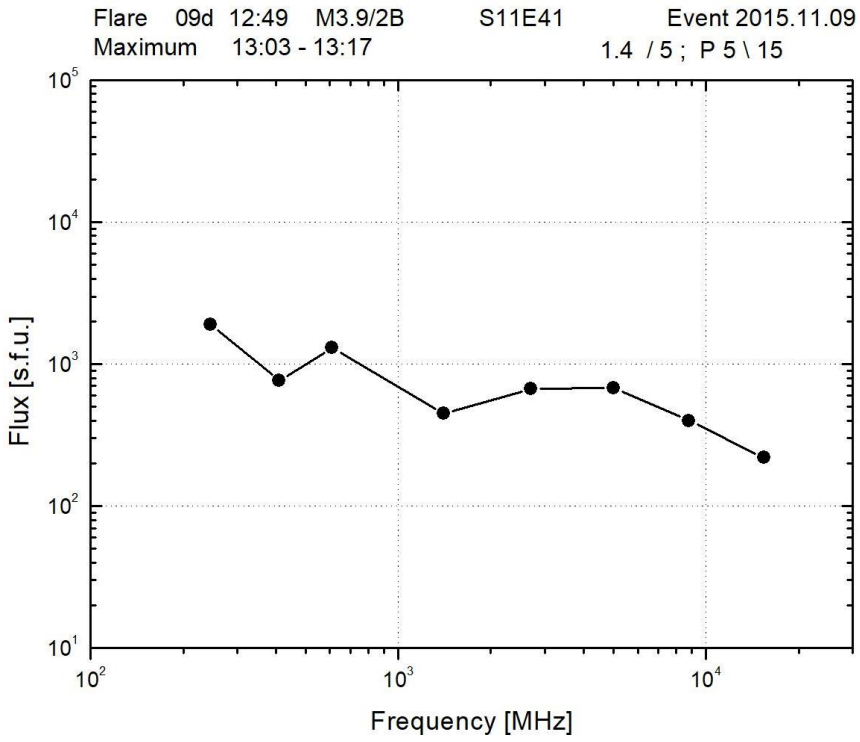
DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	25-180	1305		1319	957	2	
DS IV	100-180	1305		1325		1	
DS III	25-130	1300		1303		2	
DH II	9-14	1321		1327			WIND

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
410	MHz	1349	1352	1353		2.43	
245	MHz	1349	1349	1351		2.08	
610	MHz	1442	1446	1447		2.15	
410	MHz	1441	1446	1449		2.49	
245	MHz	1442	1446	1450		2.23	
610	MHz	1500	1511	1515		2.54	
410	MHz	1455	1512	1516		2.63	
245	MHz	1455	1507	1519		2.52	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS IV	74-180	1459		1538		1	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1325	1041	- 10.2	273°	137°	SOHO

Radio burst frequency spectrum



Proton Active Region:

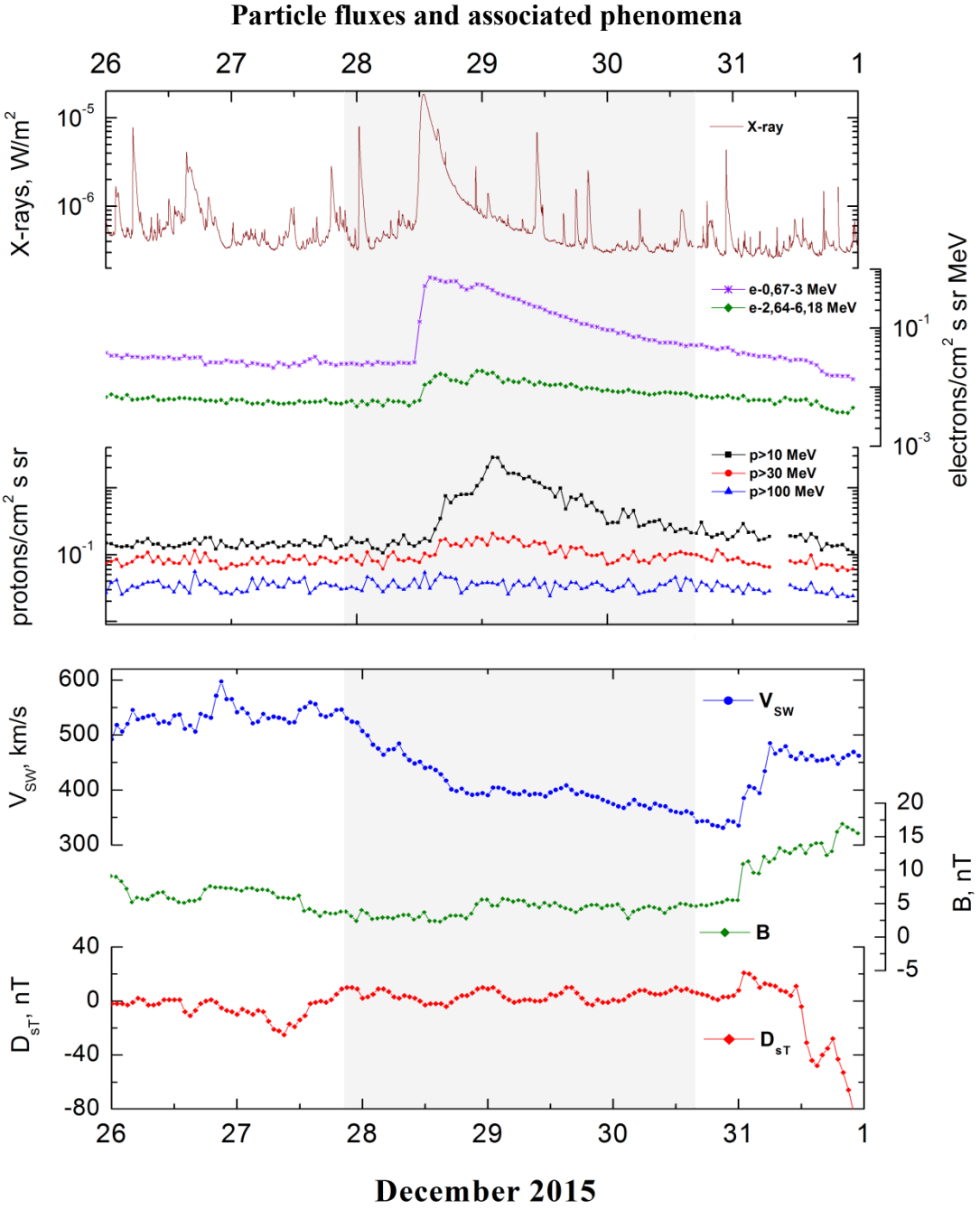
AR 12449 (S11L206, CMP 12,3.11.2015,
Sp=150 msh, DAI, B, R)
XRI=0.39 $M_1^{3.9}$+C_5 2_1+1_1+S_{12}
PFR 09.11 $M_1^{3.9}$

References:

Paassilta M., O. Raukunen, R. Vainio et al., 2017.

Particle event: To(Ep>10 MeV) – 28d14^{h}
Tmax (Ep>10 MeV) – 29d02^{h}, Jmax(Ep>10 MeV) – 1.4 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.3
Quasimaximal energy of protons in the event – Eqm = 80 MeV

Sources: ● solar flare 28d11^{h}20^{m}, M1.8/, S23W11, AR12473
Main burst X-ray 1–8 Å: onset – 28d11^{h}20^{m}, max – 28d12^{h}45^{m}, Φ = 0.11 J/m^2
CME: 28d12^{h}12^{m}, V = 1212 km/s, Δφ = 360°, dA = 163°

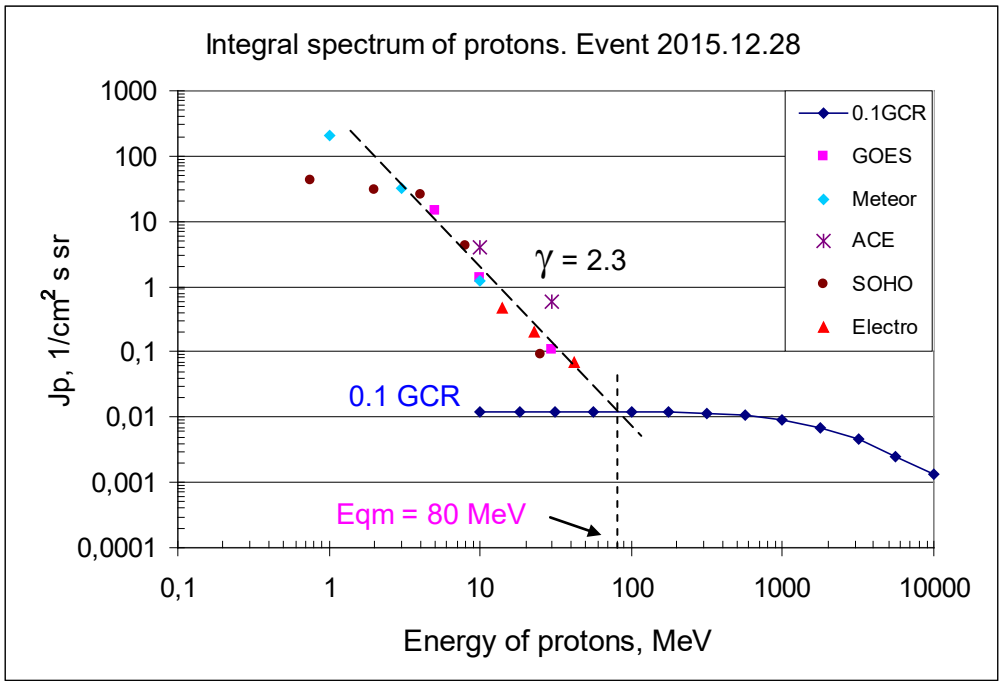


Integral fluxes of protons for the event of 2015 December 28

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	14	29d02	14.7	2	0.2	
EPS	>10	14	29d02	1.4	2	0.12	
EPS	>30	14	29d01	0.11	1	0.07	
EPS	>50	14	-	-	-	0.06	
EPS	>60	14	-	-	-	0.05	
EPS	>100	14	-	-	-	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	-	-	-	295	
METEOR-2							
SCR	>1	14	29d09	205	3.5	4.2	
SCR	>3	14	29d08	32	3	1.8	
SCR	>10	14	29d03	1.2	1	1.95	
GALS-M	>15	-	-	-	-	0.7	
GALS-M	>25	-	-	-	-	0.7	
GALS-M	>600	-	-	-	-	0.24	
ACE							
SIS	>10	13	29d00	3.9	1.5	1.3	
SIS	>30	13	29d01	0.6	1.5	0.9	
SOHO							
EPHIN	>50	-	-	-	-	0.28	

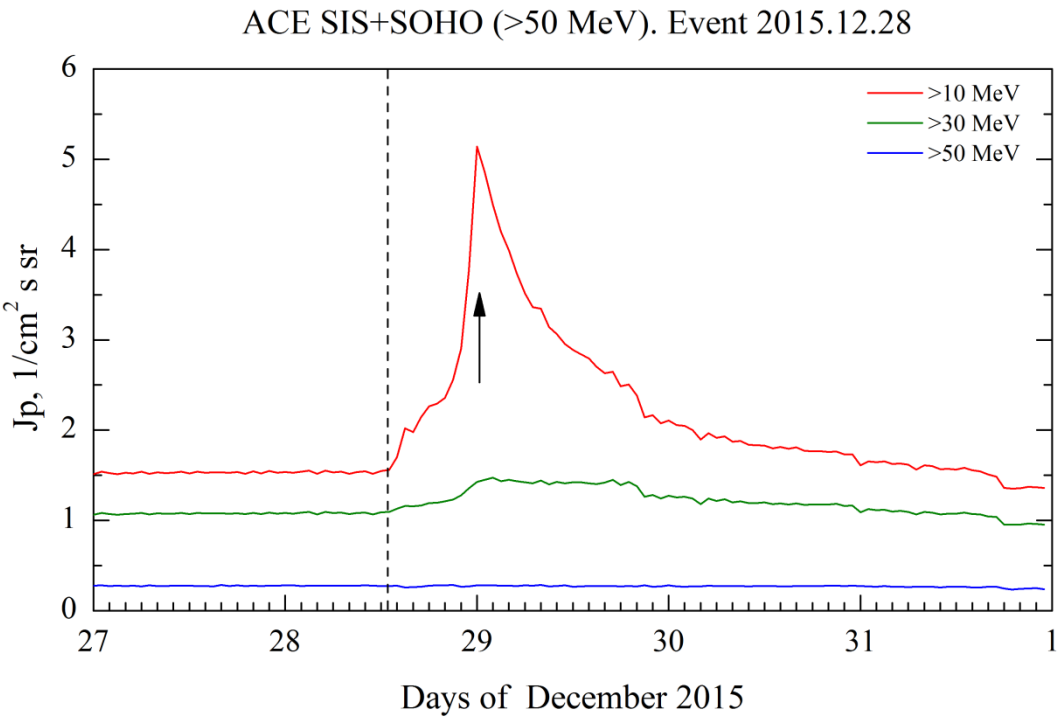
Differential fluxes of protons for the event of 2015 December 28

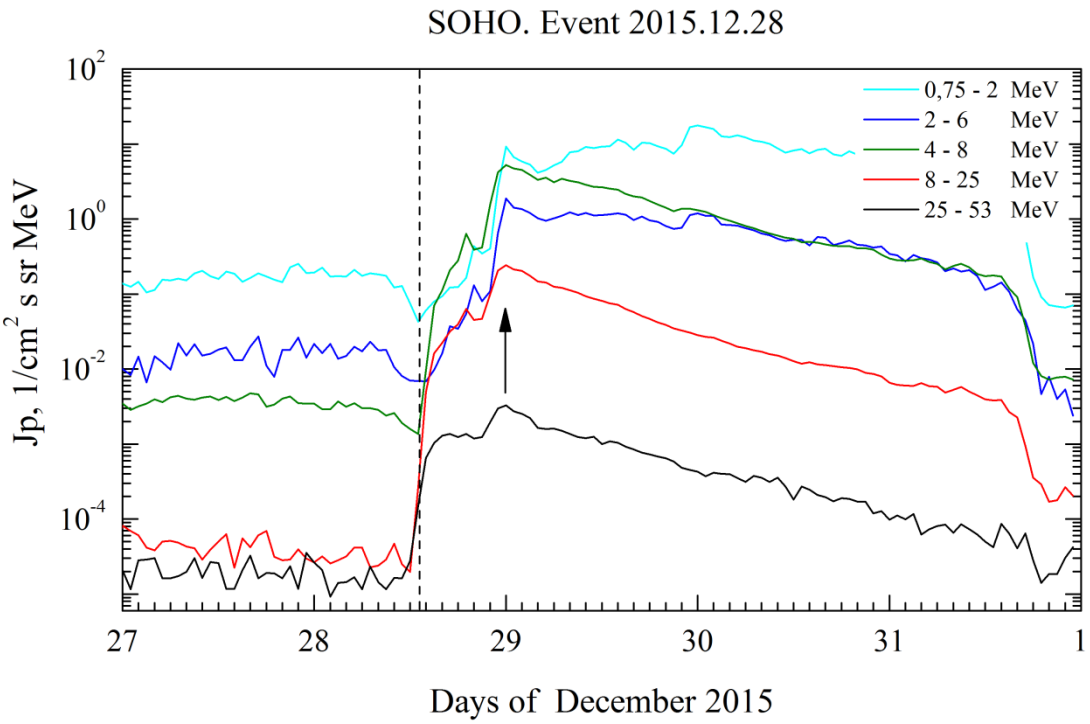
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	16	29d00	9.0	3.2	0.2	
LION	2 – 6	16	29d00	1.86	3.2	0.02	
EPHIN	4 – 8	14	29d00	5.23	3.2	0.003	
EPHIN	8 – 25	13	29d00	0.242	3.2	0.00004	
EPHIN	25 – 53	13	29d00	0.0033	3.2	0.00002	
Electro-1							
SCR-E	13.7–23	12	29d01	0.03	1	0.06	
SCR-E	23–42	12	29d01	0.007	1	0.025	
SCR-E	42–112	12	29d01	0.001	0.5	0.005	
POES							<E>, MeV
MEPED	16–36	-	-	-	-	0.034	25
MEPED	36–70	-	-	-	-	0.005	50
MEPED	70–140	-	-	-	-	0.0008	100


Integral spectrum of protons. Event 2015.12.28
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro
γ = 2.3
0.1 GCR
Eqm = 80 MeV

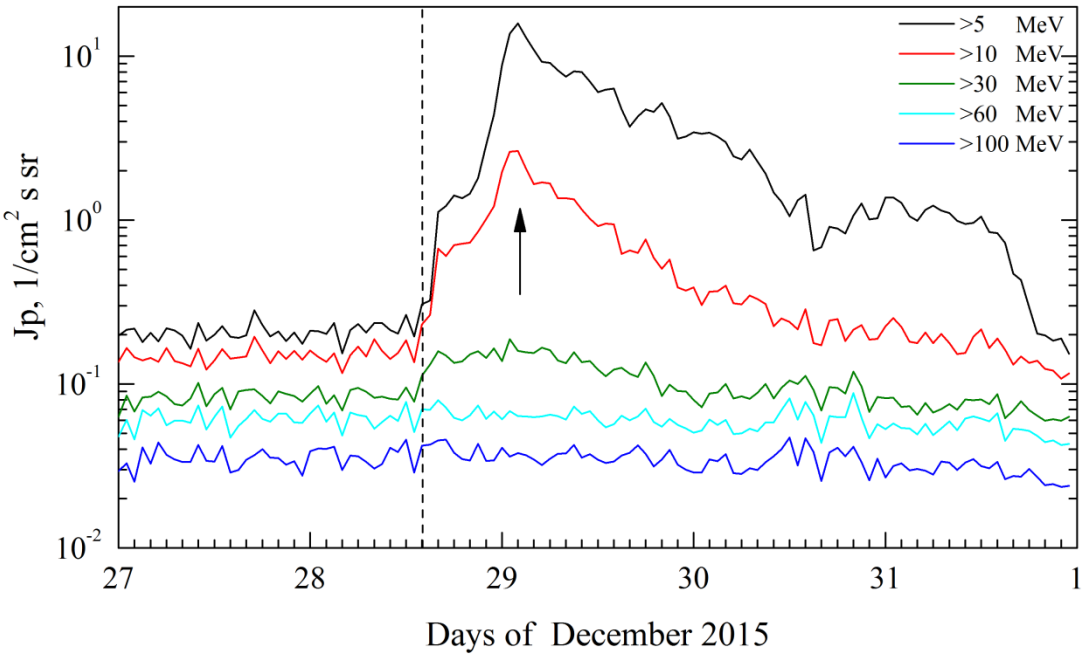
Time profiles of proton fluxes in the event 2015.12.28

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

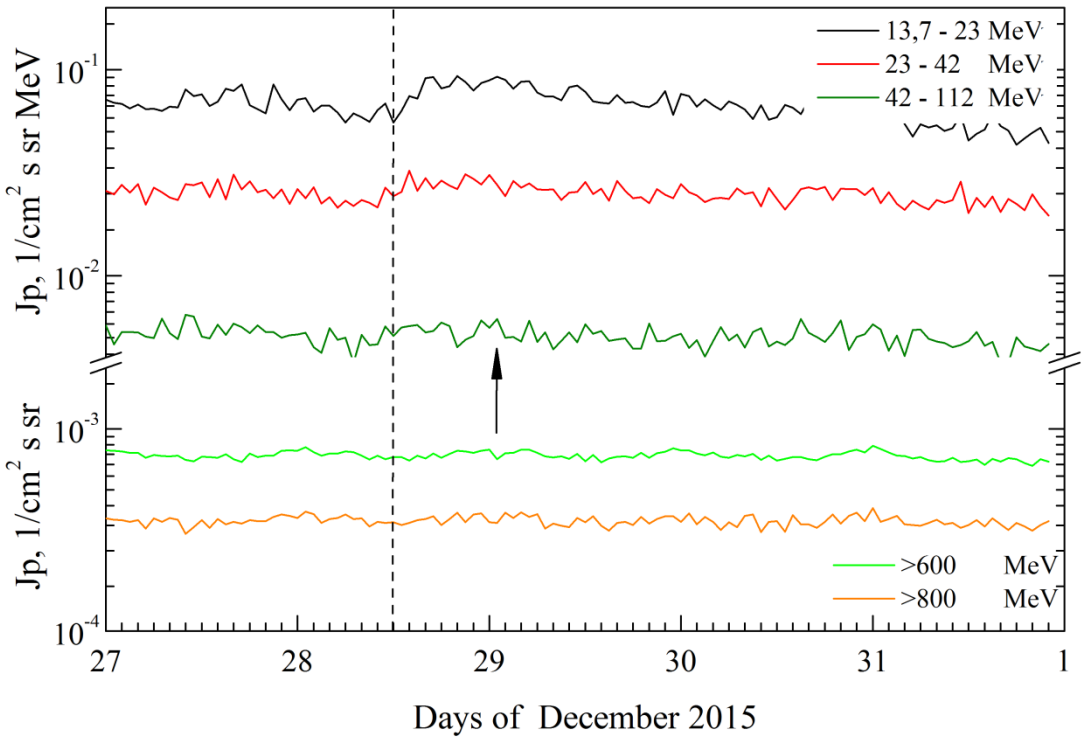




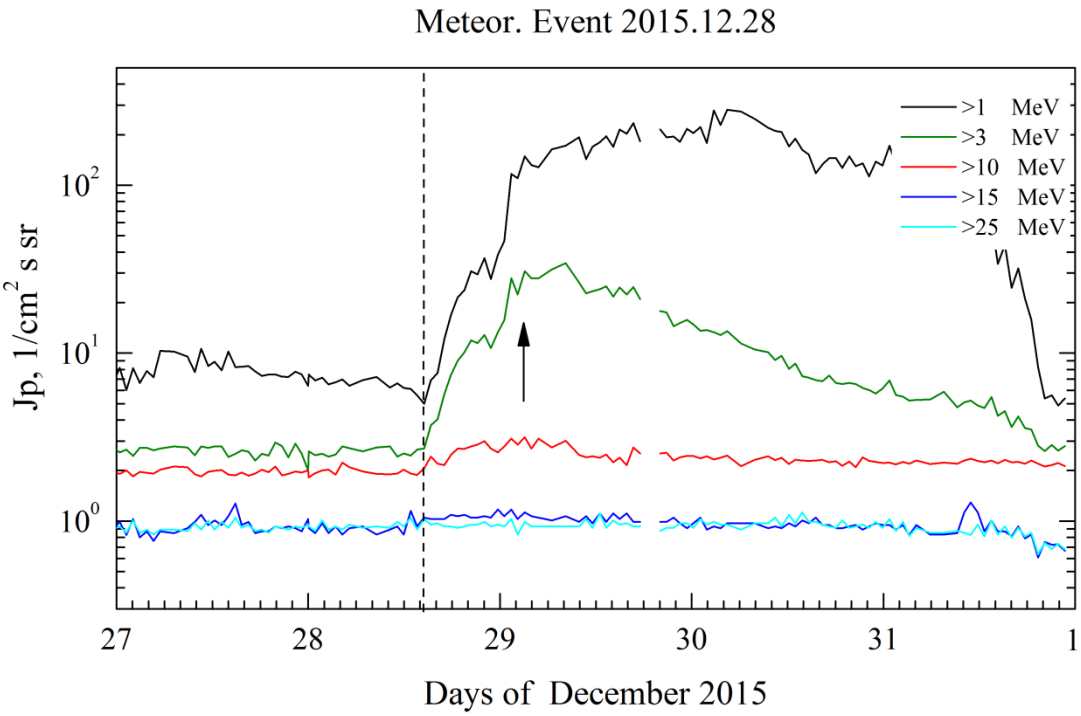
GOES. Event 2015.12.28

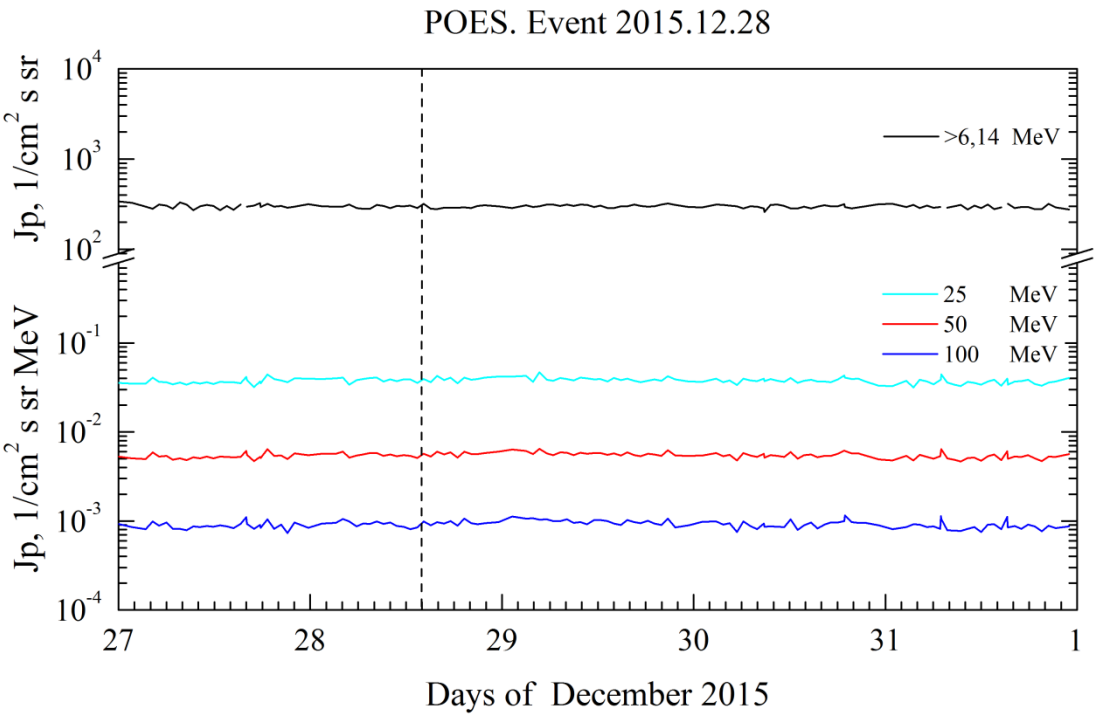


Electro. Event 2015.12.28



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2015 December 28

2015 December 28 • AR12473 To event 579

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	No optical flare on visible disk					
1 – 12	keV	1120	1245	1409	S23W11	M1.8	0.11

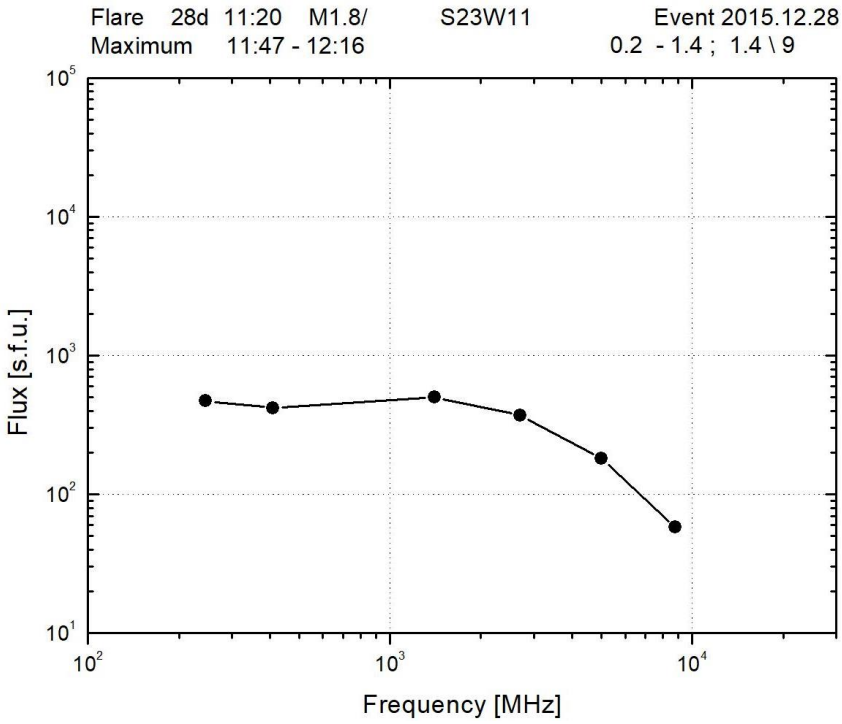
X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
6-12	keV	1123:20	1129:58	1131:16	87	92644	HESSI
12-25	keV	1141:56	1201:02	1201:44	200	367851	HESSI
6-12	keV	1237:40	1238:30	1255:16	3952	624088	HESSI
6-12	keV	1322:44	1322:58	1336:00	76	147948	HESSI
12-25	keV	1146:03	1151:31	1213:09	20715	3652437	FERMI
12-25	keV	1249:49	1301:17	1306:41	1922	369943	FERMI
12-25	keV	1330:13	1330:42	1346:45	1088	148816	FERMI
12-25	keV	1426:12	1443:41	1444:05	834	148867	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
8.8	GHz	1151	1153	1155	1.4 \ 9	1.76	
5	GHz	1148	1206	1222		2.56	
2.7	GHz	1146	1206	1231		2.57	
1.4	GHz	1146	1206	1226		2.7	
410	MHz	1145	1147	1221		2.62	
245	MHz	1145	1216	1223	0.2 – 1.4	2.67	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS IV	25-180	1146		1334		1	
DS CTM	25-180	1123		1146		1	
DH II	0.18-14	1150		2145			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1212	1212	4.6	360˚	163˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR12473 (S22L332, CMP 27,7.12.2015,
Sp=590 msh, EKC, BGD, R)
XRI=0,83 $M_4^{4.7}$+C_{30} 1_4+S_{59}
PFR1 22-24.12: (47^h) $M_3^{4.7}$
PFR2 28.12 $M_1^{1.8}$

References:

Núñez M., T. Nieves-Chinchilla and A. Pulkkinen, 2019.

События 2016 года

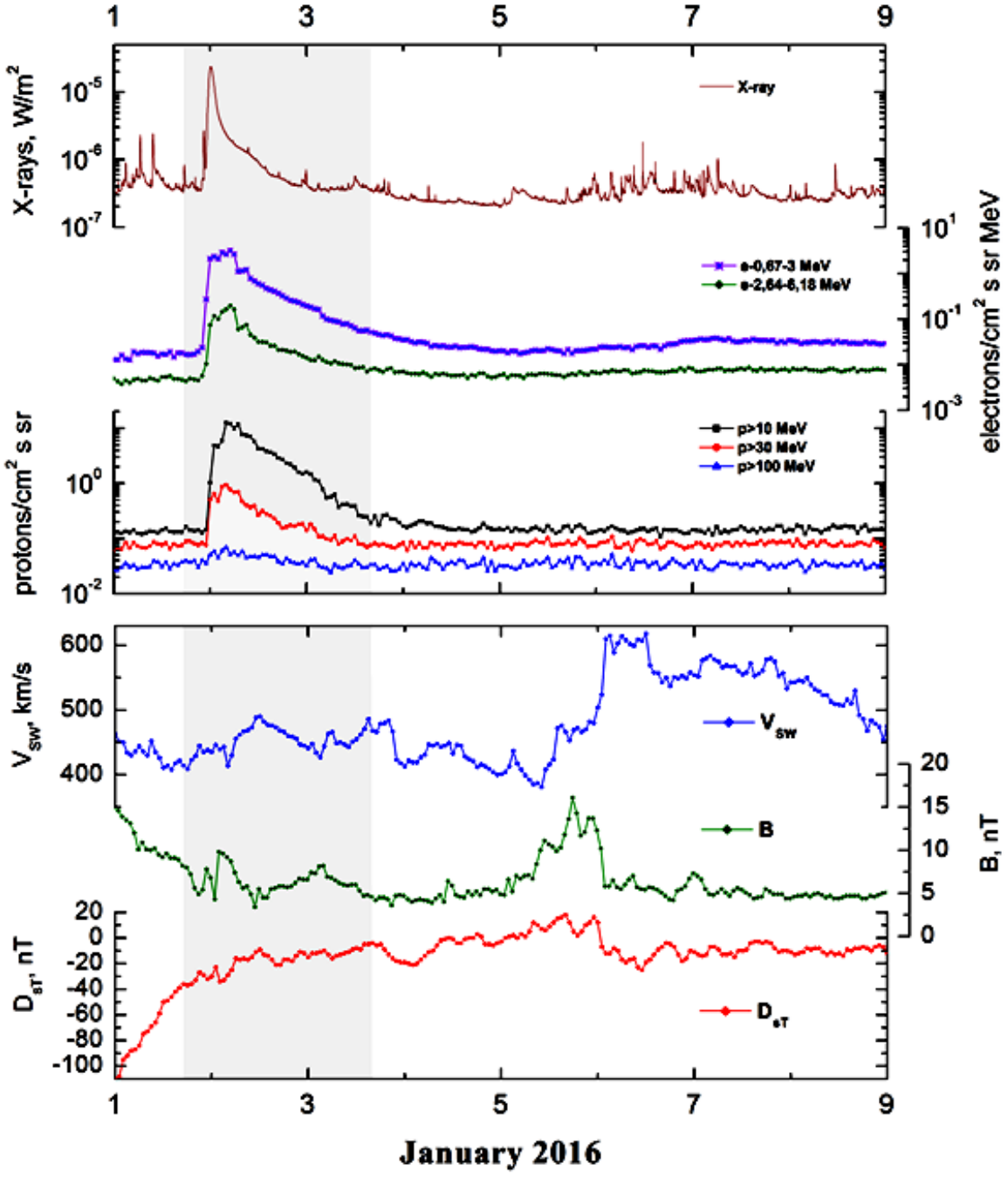
			Страница
1	Event 2016.01.01 – (2016-001)	№ 580	874
2	Event 2016.03.16 – (2016-076)	№ 581	882
3	*Event 2016.04.18 – (2016-109)	№ 582	889
4	Event 2016.05.15 – (2016-136)	№ 583	897
5	*Event 2016.07.23 – (2016-205)	№ 584	904

Звездочкой (*) отмечены слабые события с Jp (E > 10 МэВ) в интервале 0.1 ÷ 1 pfu

Particle event: To(Ep>10 MeV) – 01d23^{h}
Tmax$_1$(Ep>10 MeV) – 02d01^{h}, Jmax$_1$(Ep>10 MeV) – 4.7 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 02d04^{h}, Jmax$_2$(Ep>10 MeV) – 12.4 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: γ_1 = 2.6, γ_2 = 2.5
Quasimaximal energy of protons in the event – Eqm$_1$ = 120 MeV
– Eqm$_2$ = 140 MeV

Sources: ■ solar flare 01d23^{h}10^{m}, M2.3/, S25W82, AR12473
Main burst X-ray 1–8 Å: onset – 01d23^{h}10^{m}, max – 02d00^{h}11^{m}, Φ = 0.11 J/m^2
CME: 01d23^{h}24^{m}, V = 1730 km/s, Δφ = 360º, dA= 227º

Particle fluxes and associated phenomena

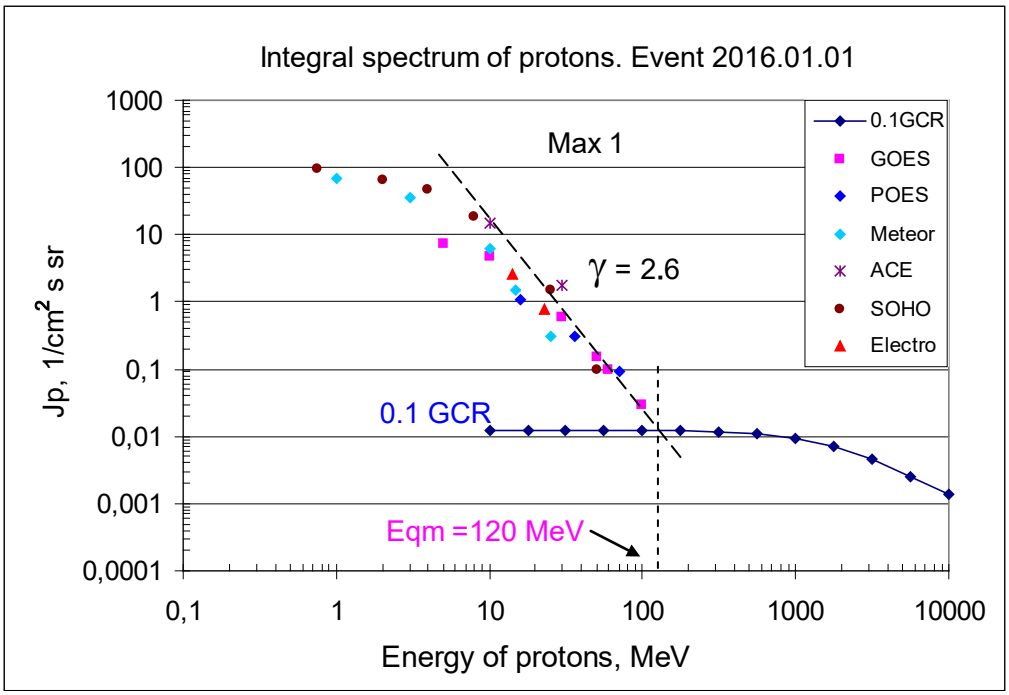


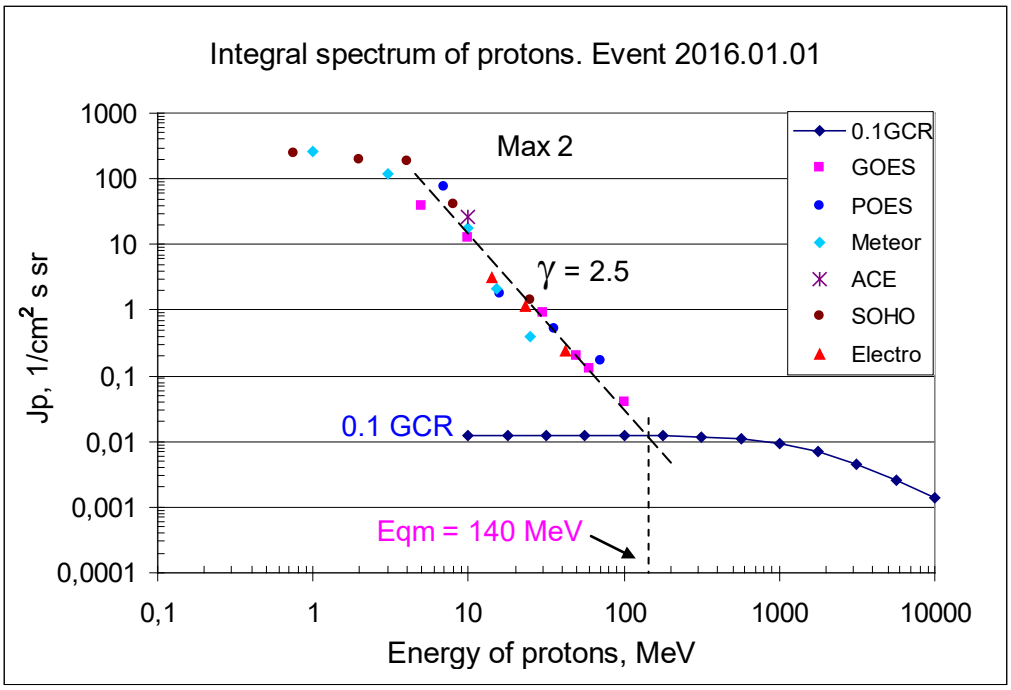
Integral fluxes of protons for the event of 2016 January 01

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	23	02d01/02d05	7.2/38.7	2	0.2	
EPS	>10	23	02d01/02d04	4.7/12.4	1.5	0.12	
EPS	>30	23	02d01/02d04	0.6/0.9	1	0.07	
EPS	>50	23	02d01/02d04	0.15/0.2	0.7	0.06	
EPS	>60	23	02d00/02d04	0.1/0.13	0.7	0.05	
EPS	>100	23	02d01/02d04	0.03/0.04	0.7	0.03	
Electro-1							
GALS-E	>600	-	-	-	-	0.0007	
POES							
MEPED	>6.14	-	- /02d07	- /80	0.5	290	
Meteor-2							
SCR	>1	24	02d02/02d04	70/260	4	4.2	
SCR	>3	24	02d02/02d04	35/120	2.5	2.5	
SCR	>10	24	02d02/02d04	6.3/17	1.5	1.9	
GALS-M	>15	24	02d01/02d04	1.5/2.1	1	0.7	
GALS-M	>25	24	02d01/02d03	0.3/0.4	1	0.7	
GALS-M	>600	-	-	-	-	0.2	
ACE							
SIS	>10	23	02d01/02d04	15.1/26.6	1	1.4	
SIS	>30	23	02d02/ -	1.8/ -	0.5	1	
SOHO							
EPHIN	>50	02d00	02.01	0.1/ -	0.5	0.25	

Differential fluxes of protons for the event of 2016 January 01

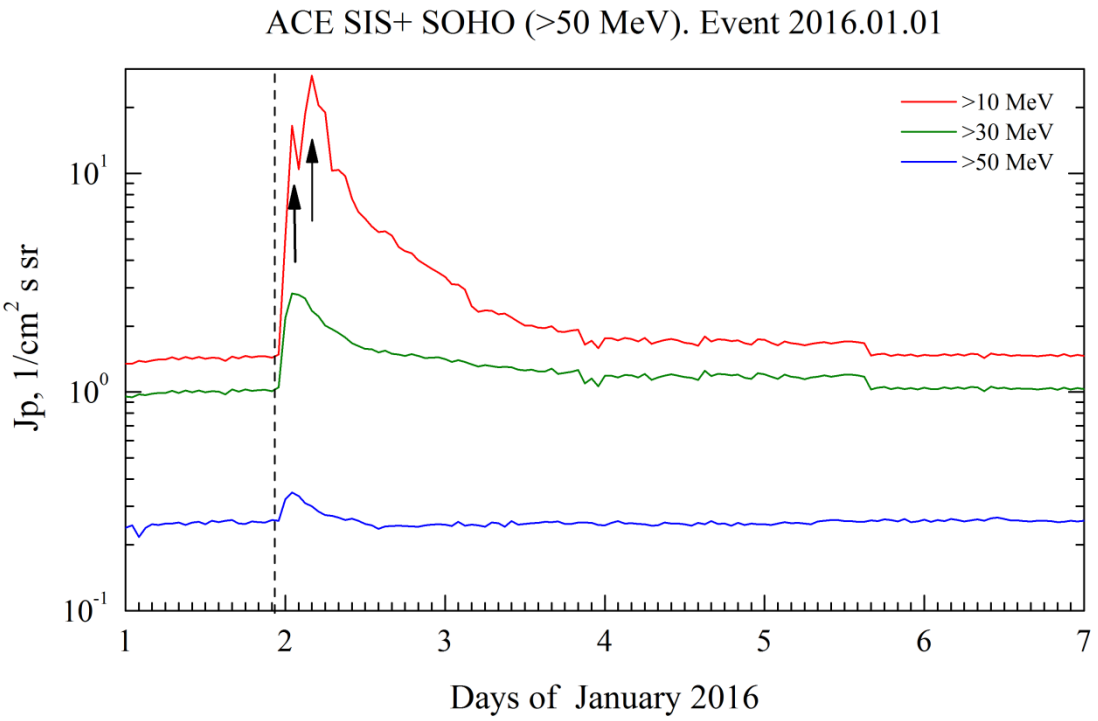
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	02d01	02d06/02d10	22.5/43.1	3.5	0.01	
LION	2 – 6	02d01	02d06/02d10	6.27/5.94	3.5	0.001	
EPHIN	4 – 8	02d00	02d01/02d05	7/35.2	4	0.0004	
EPHIN	8 – 25	02d00	02d01/02d05	1/2.42	4	0.00003	
EPHIN	25 – 53	02d00	02d01/02d03	0.05/0.046	4	0.00002	
Electro-1							
SCR-E	13.7–23	23	02d01/02d04	0.2/0.21	1.5	0.05	
SCR-E	23–42	23	02d01/02d04	0.04/0.053	1.5	0.02	
SCR-E	42–112	23	- /02d03	- /0.003	1	0.0045	
POES							<Δ>, MeV
MEPED	16–36	23	02d01/02d04	0.0394/0.066	1	0.034	25
MEPED	36–70	23	02d01/02d04	0.0065/0.01	1	0.005	50
MEPED	70–140	23	02d01/02d04	0.0013/0.0025	1	0.0008	100

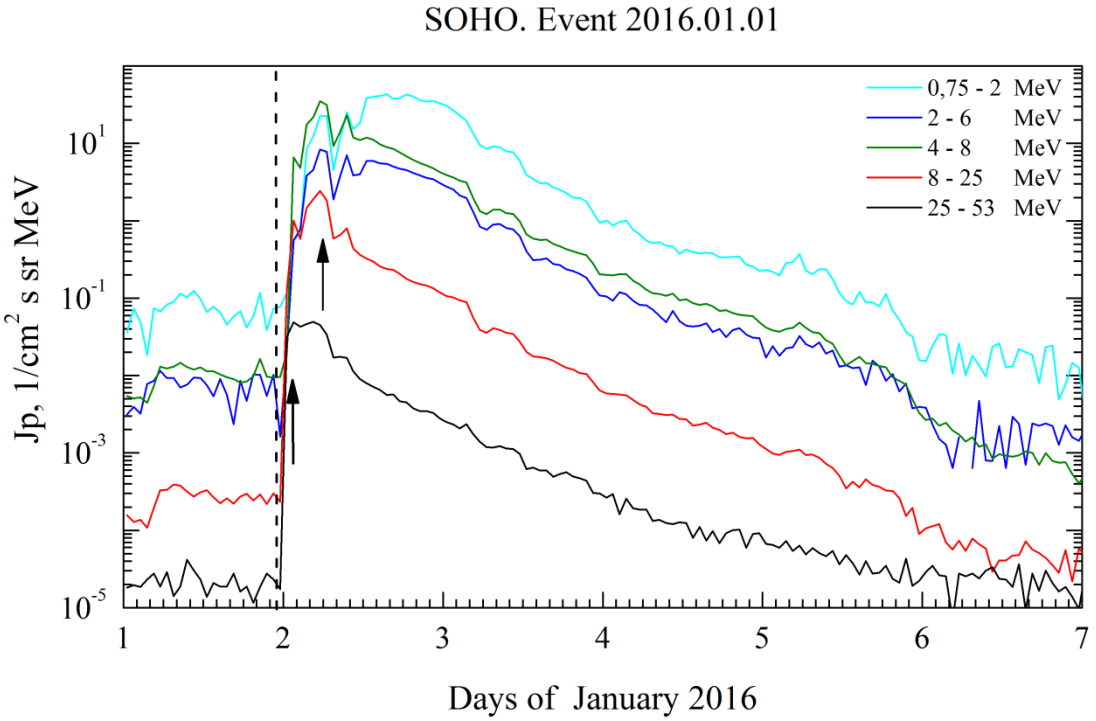

Integral spectrum of protons. Event 2016.01.01
Max 1
γ = 2.6
0.1 GCR
Eqm =120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

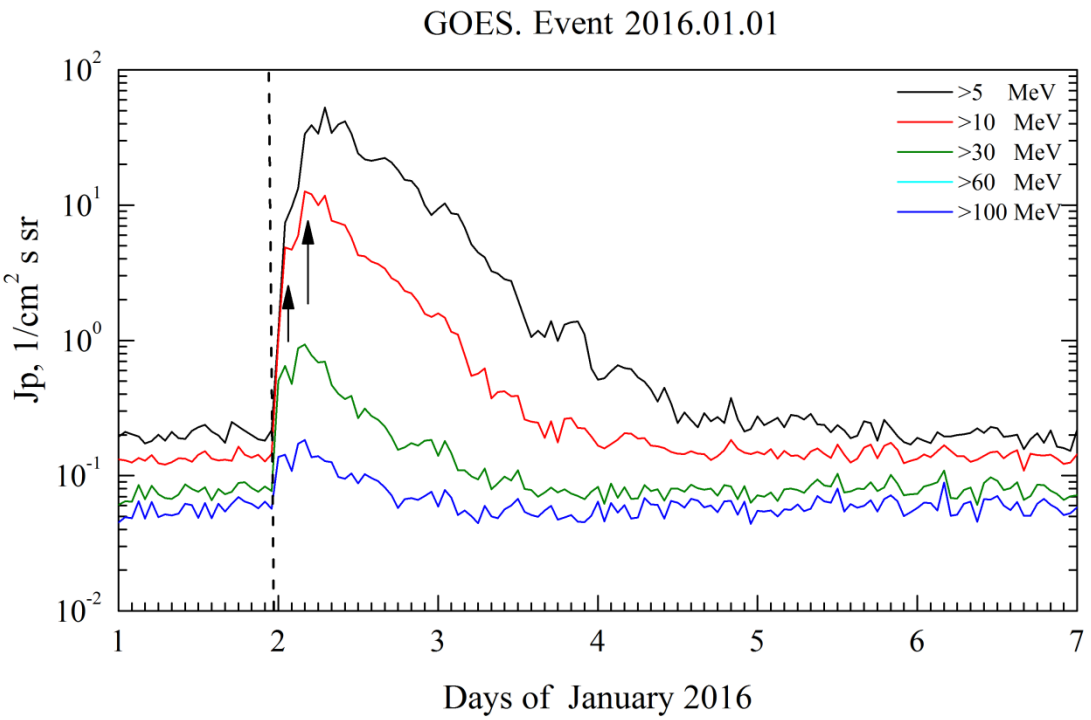

Integral spectrum of protons. Event 2016.01.01
Max 2
γ = 2.5
0.1 GCR
Eqm = 140 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

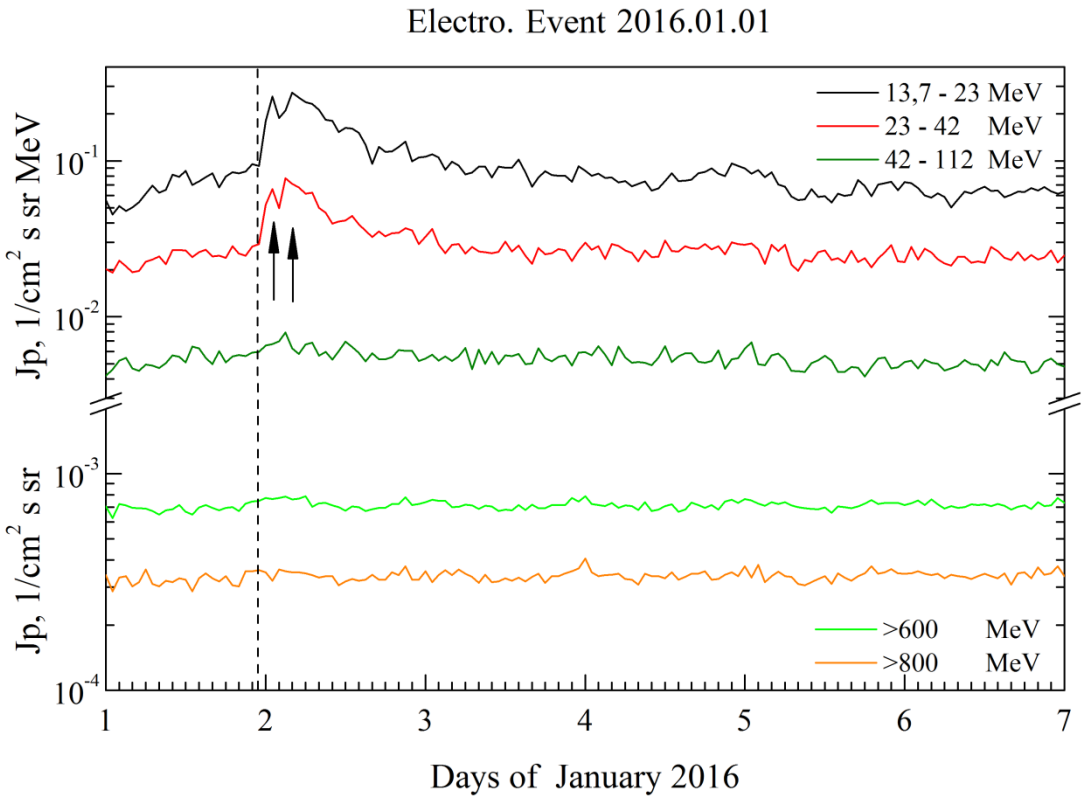
Time profiles of proton fluxes in the event 2016.01.01

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

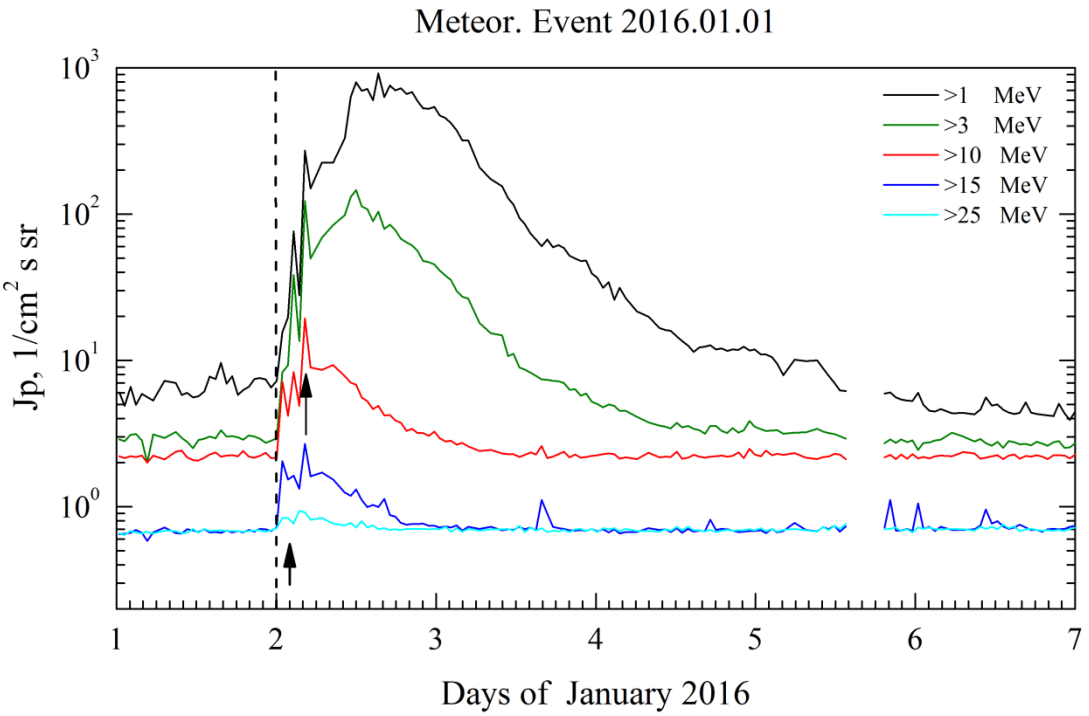


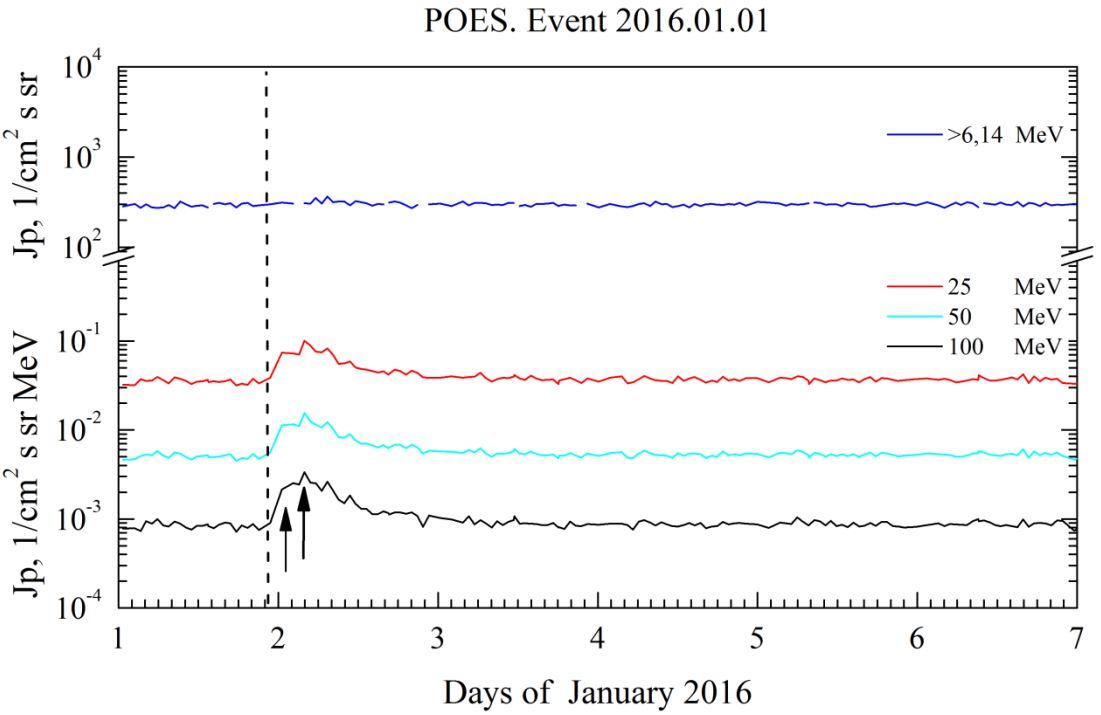



GOES. Event 2016.01.01
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of January 2016


Electro. Event 2016.01.01
Jp, 1/cm2 s sr MeV
Jp, 1/cm2 s sr
13,7 - 23 MeV
23 - 42 MeV
42 - 112 MeV
>600 MeV
>800 MeV
Days of January 2016

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2016 January 01

2016 January 01 ■ AR 12473 To event 580

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical flare on visible disk					
6563 Å	LPS	0226		0655	0.04		
1 – 12	keV	2310	0011	0101	S25W82	M2.3*	0.11

X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	23:38:40	23:39:14	23:40:48	128	255121	HESSI
25-50	keV	23:40:48	23:43:22	00:30:28	10869	3267284	HESSI
25-50	keV	23:12:29	23:42:19	00:10:59	12045	5304185	FERMI
25-50	keV	00:47:47	01:22:56	01:36:44	1071	565736	FERMI

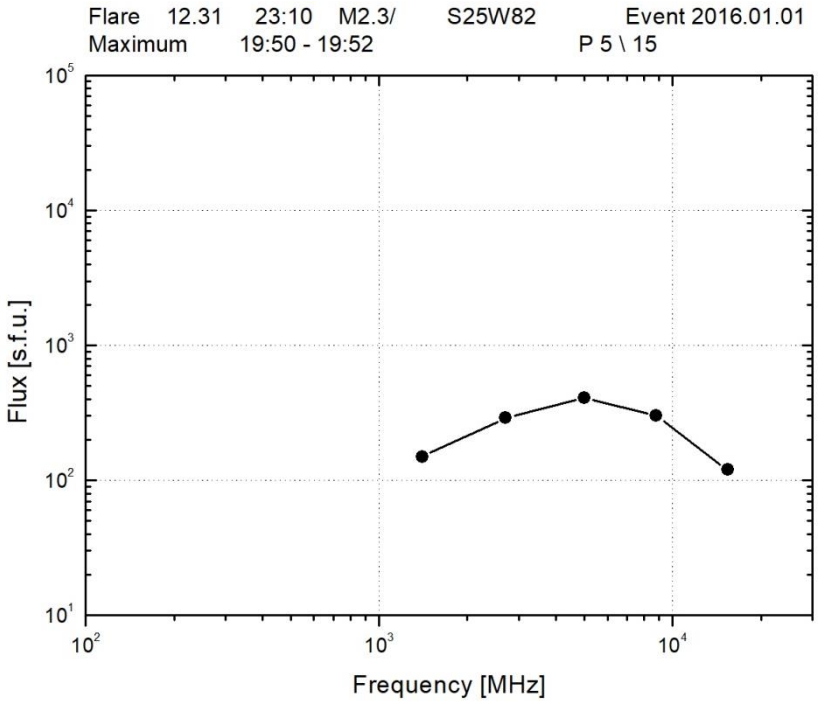
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1950	1952	1953	P5 \ 15	2.01	
8.8	GHz	1949	1950	1953		2.48	
5	GHz	1949	1950	1953		2.61	
2.7	GHz	1949	1950	1953		2.46	
1.4	GHz	1952	1952	1953		2.18	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	030-039	2321		2326	1095	1	
DS IV	036-180	2324		2359		1	
DH II	0.3-1.1	2d/0055		2d/0308			

CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	2324	1730	12.7	360˚	227˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/ssw_client/data/ssw_service_160101_163431_7362/www/

Radio burst frequency spectrum



Proton Active Region:

AR12473 (S22L332, CMP 27,7.12.2015,
Sp=590 msh, EKC, BGD, R)
XRI=0,83 $M_4^{4.7}+C_{30}$ 1_4+S_{59}
PFR1 22-24.12: (47^h) $M_3^{4.7}$
PFR2 28.12 $M_1^{1.8}$

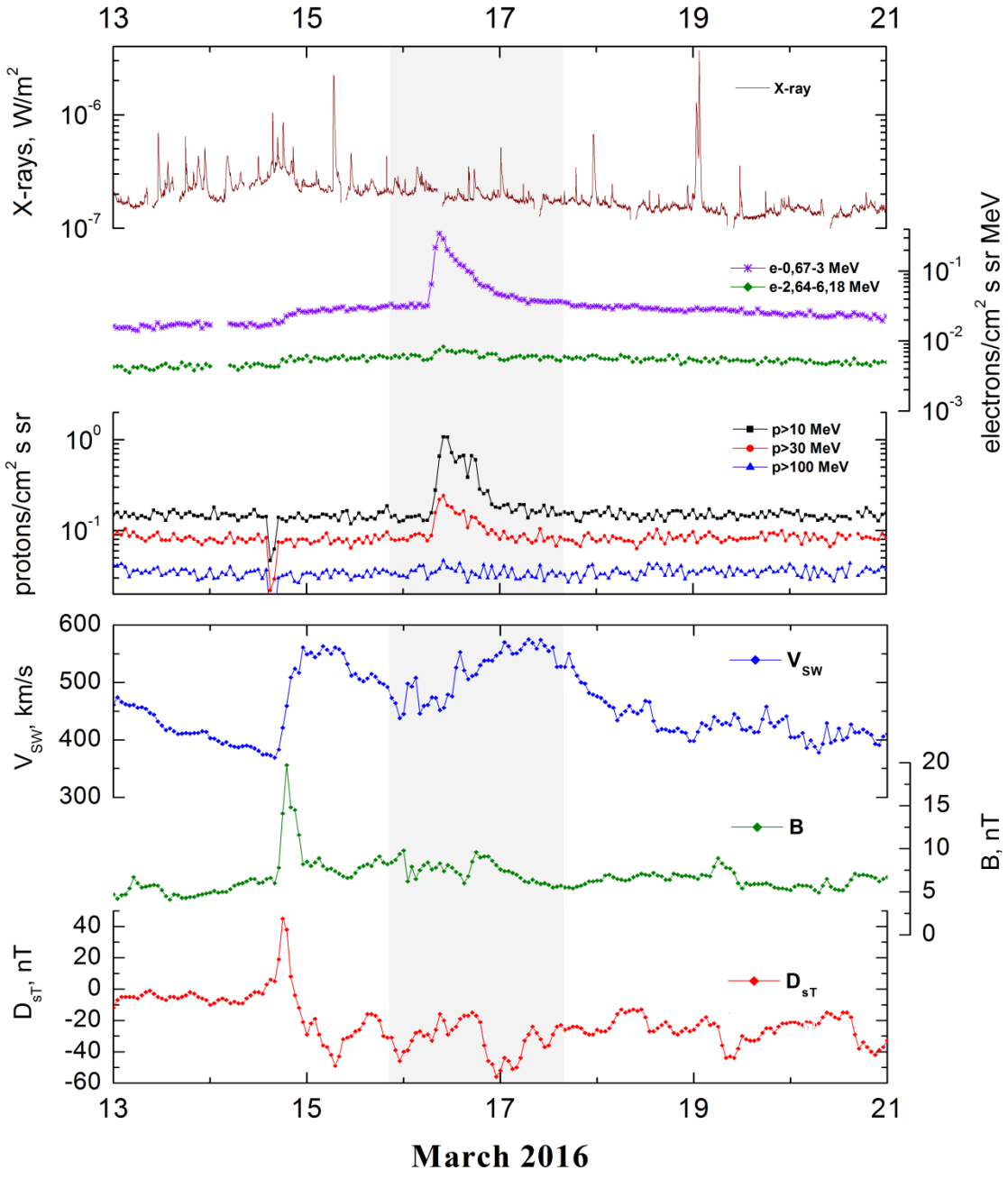
References:

Gopalswamy N., S. Yashiro, N. Thakur et al., 2016.
NOAA SPE, 2019.
Temmer M., 2021.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 16d07^{h}
Tmax$_1$(Ep>10 MeV) – 16d11^{h}, J max$_1$(Ep>10 MeV) – 1,1 /cm^2·s·sr (ACE)
Tmax$_2$(Ep>10 MeV) – 16d17^{h}, J max$_2$(Ep>10 MeV) – 0.8 /cm^2·s·sr (ACE)
Duration of the event – 0.5 days, power-law index: γ_1 = 1.5, γ_2 = 1.7
Quasimaximal energy of protons in the event – Eqm$_1$ = 120 MeV
– Eqm$_2$ = 80 MeV

Sources: ■ solar flare 16d06^{h}34^{m}, C2.2/DSF, N12W88, AR12522
Main burst X-ray 1–8 Å: onset – 16d06^{h}34^{m}, max – 16d06^{h}45^{m}, Φ = 0.0022 J/m^2
CME: 16d07^{h}00^{m}, V = 592 km/s, Δφ = 154º, dA= 265º

Particle fluxes and associated phenomena

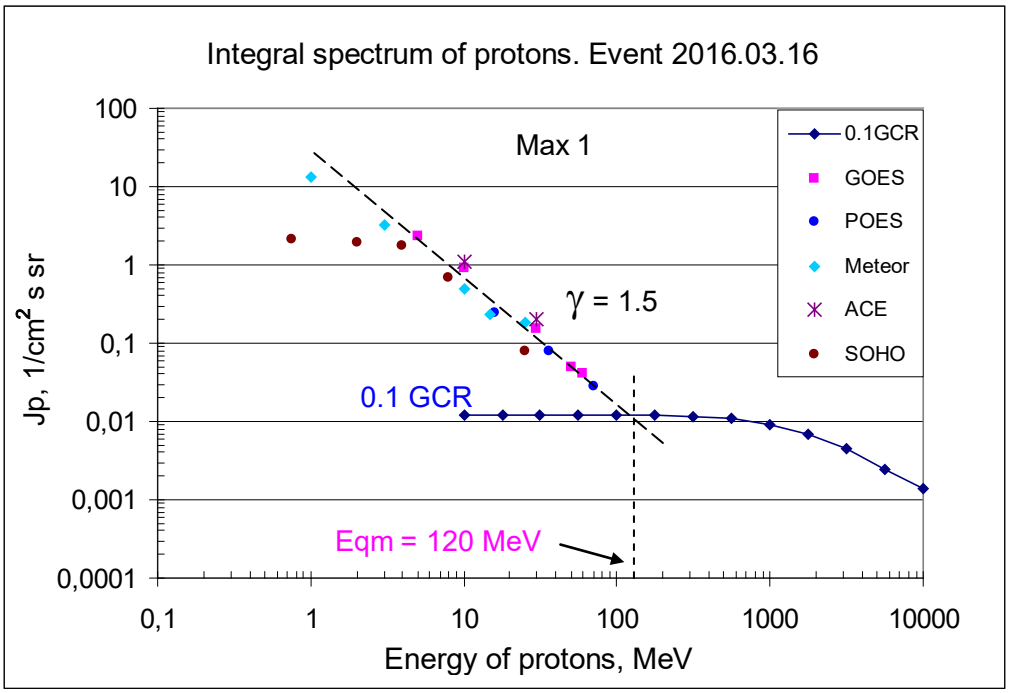


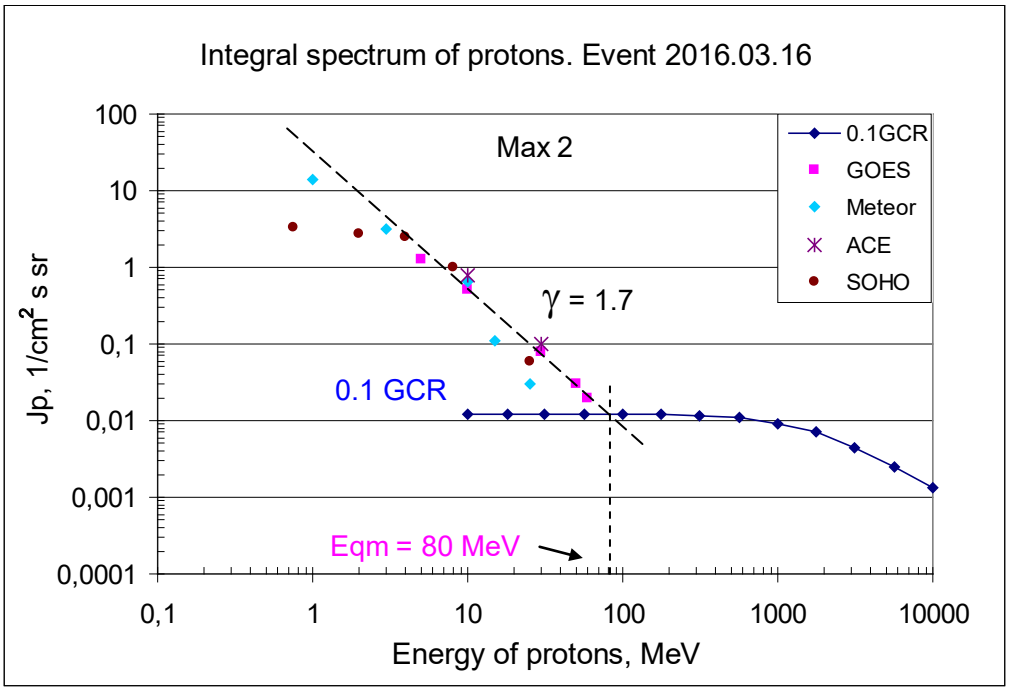
Integral fluxes of protons for the event of 2016 March 16

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	11/18	2.3/1.3	0.5	0.2	
EPS	>10	7	11/17	0.9/0.5	0.5	0.14	
EPS	>30	7	10/17	0.15/0.08	0.5	0.08	
EPS	>50	7	10/18	0.05/0.03	0.3	0.06	
EPS	>60	7	10/18	0.04/0.02	0.3	0.05	
EPS	>100	-	-	-	-	0.03	
Electro-1,-2							
GALS-E	>600	-	-	-	-	-	
POES							
MEPED	>6.14	-	-	-	-	285	
Meteor-2							
SCR	>1	9	12/18	13/14	1	4.3	
SCR	>3	9	11/18	3.3/3.1	1	2.5	
SCR	>10	9	11/18	0.5/0.64	1	1.9	
GALS-M	>15	9	11/16	0.23/0.11	0.5	0.7	
GALS-M	>25	9	11/16	0.18/0.03	0.5	0.8	
GALS-M	>600	-	-	-	-	0.3	
ACE							
SIS	>10	7	10/17	1.1/0.8	0.7	1.5	
SIS	>30	7	10/17	0.2/0.1	0.5	1.1	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

Differential fluxes of protons for the event of 2016 March 16

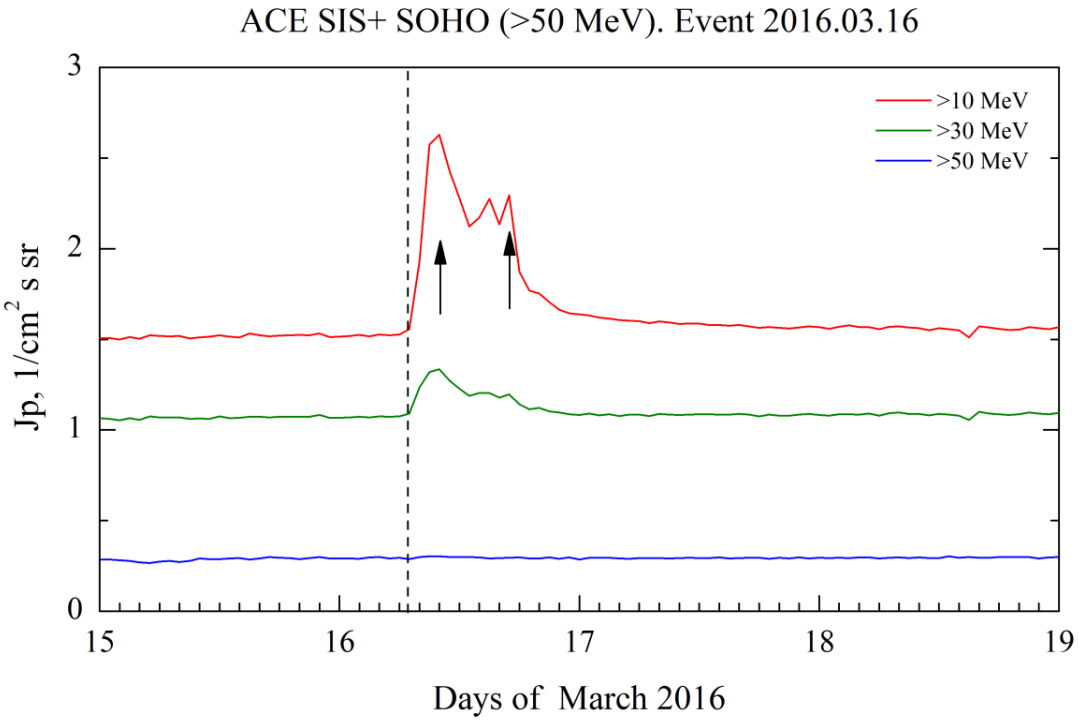
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	10	11/17	0.158/0.433	1	0.004	
LION	2 – 6	09	12/17	0.056/0.117	1	0.001	
EPHIN	4 – 8	07	10/17	0.262/0.358	3	0.0001	
EPHIN	8 – 25	07	10/17	0.0357/0.057	2	0.00003	
EPHIN	25 – 53	08	10/16	0.0027/0.0021	1	0.00003	
POES							<E>, MeV
MEPED	16–36	07	11	0.0085/ -	0.5	0.039	25
MEPED	36–70	07	10	0.0015/ -	0.5	0.0054	50
MEPED	70–140	07	10	0.0004/ -	0.5	0.0009	100

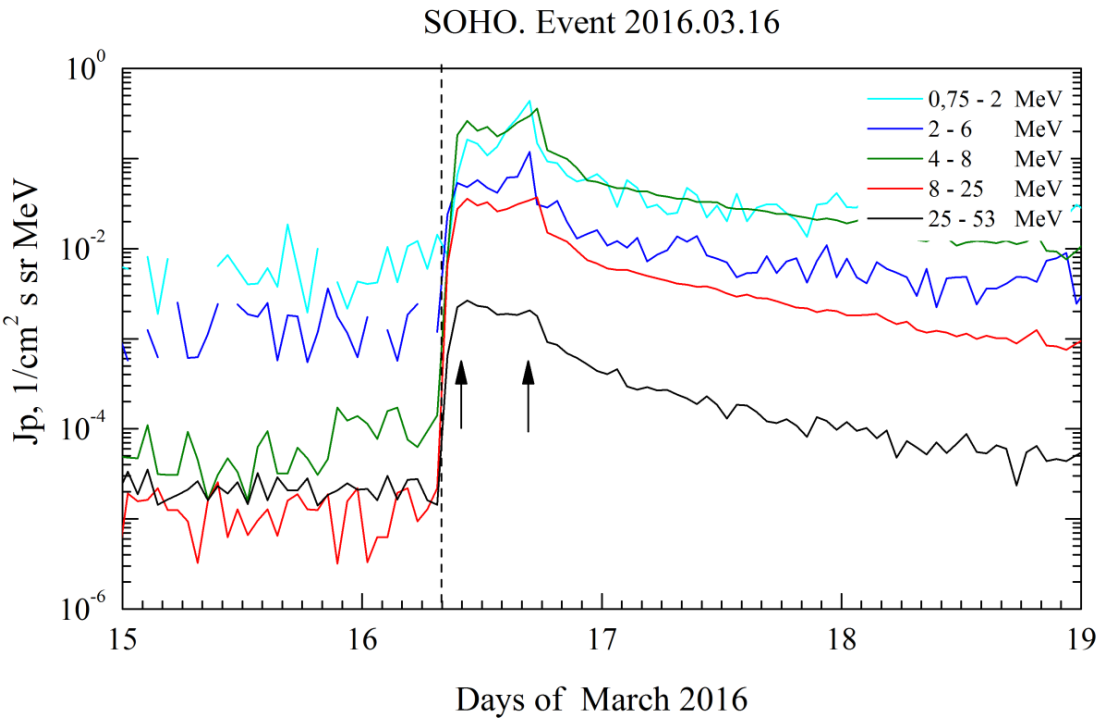

Integral spectrum of protons. Event 2016.03.16
Max 1
γ = 1.5
0.1 GCR
Eqm = 120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2016.03.16
Max 2
γ = 1.7
0.1 GCR
Eqm = 80 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

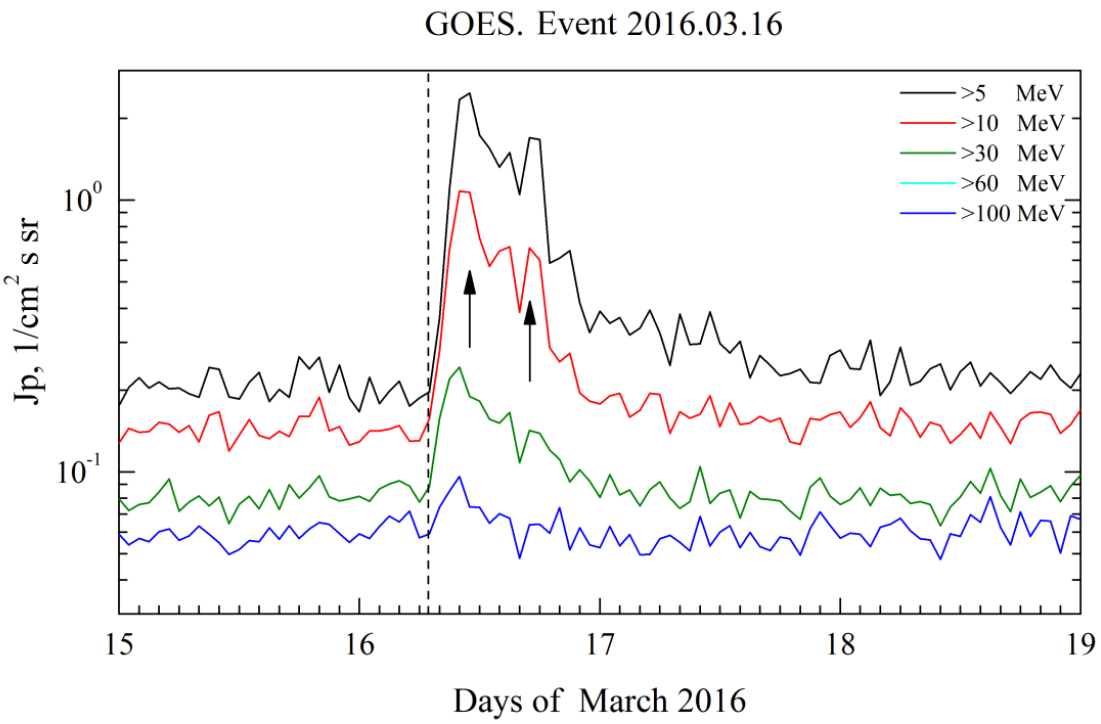
Time profiles of proton fluxes in the event 2016.03.16

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

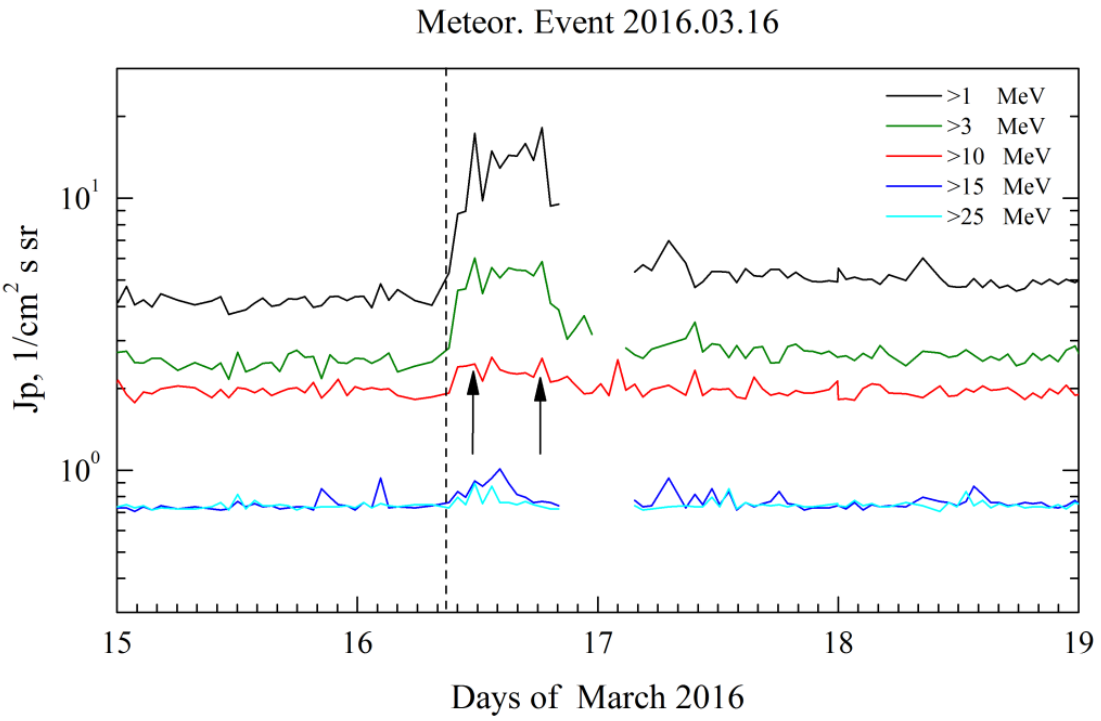


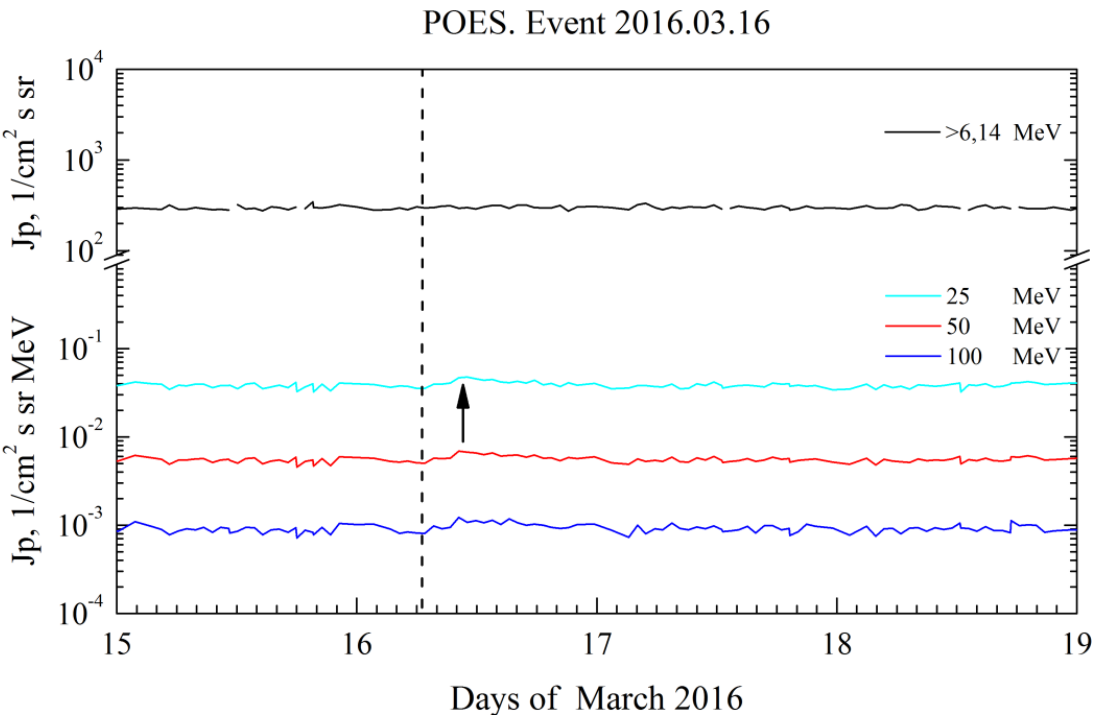


Earth satellite in geostationary orbit, R ≈ 6.6 Re: GOES



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2016 March 16

2016 March 16 ■ AR 12522 To event 581

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	DSF	0634		> 0647	N20 W86	~10˚	
1 – 12	keV	0634	0645	0657	N12W88	C2.2	0.0022
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12 – 25	keV	0637:45	0637:45	0640:05	4274	244986	FERMI
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-132	0645		0711	853	2	
DS V	25-180	0636		0640		3	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0700	592	- 22.4	154˚	265˚	SOHO

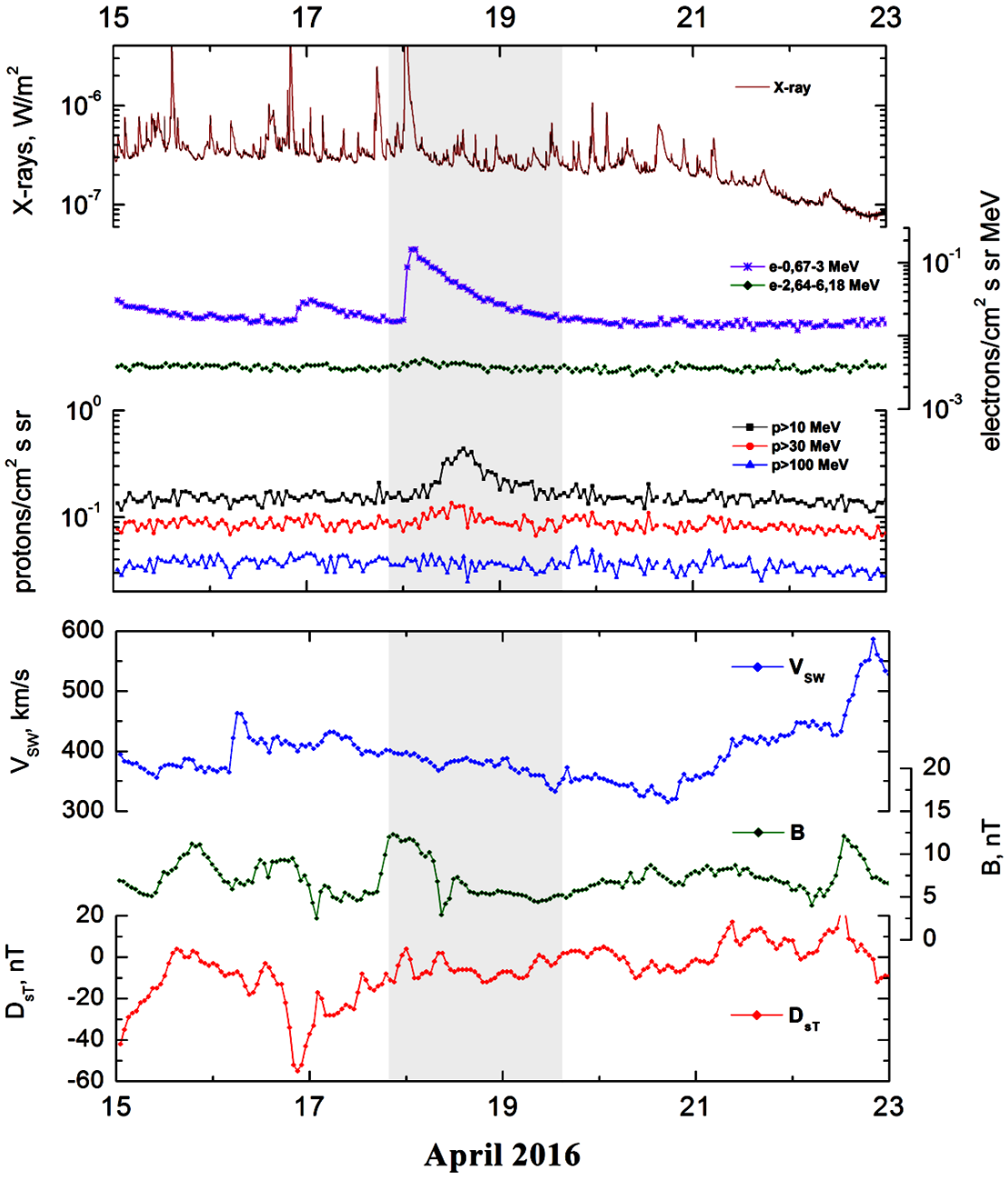
Proton Active Region

AR 12522 (N14L076, CMP no,
Sp= 040, CAO, B, R1)
XRI=<0.1 C_1 S_2
AR appearance at 14.03.2016 on W56

Particle event: To(Ep>10 MeV) – 18d07^{h}
Tmax (Ep>10 MeV) – 18d15^{h}, Jmax (Ep>10 MeV) – 0.3 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ = 2.1
Quasimaximal energy of protons in the event – Eqm_1 = 55 MeV

Sources: ● solar flare 18d00^{h}14^{m}, M6.7/1F, N12W62, AR12529
Main burst X-ray 1–8 Å: onset – 18d00^{h}14^{m}, max – 18d00^{h}29^{m}, Φ = 0.049 J/m^2
CME: 18d00^{h}48^{m}, V = 1084 km/s, $\Delta\varphi$ = 162°, dA= 291°

Particle fluxes and associated phenomena

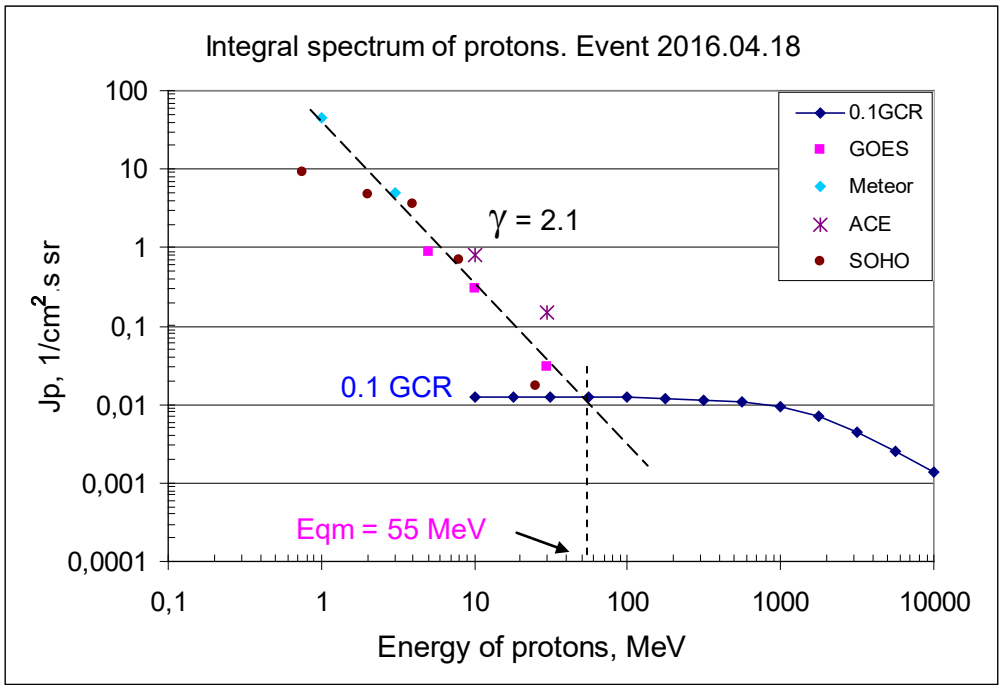


Integral fluxes of protons for the event of 2016 April 18

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	7	14	0.9	1	0.2	
EPS	>10	7	15	0.3	1	0.15	
EPS	>30	7	15	0.03	0.5	0.09	
EPS	>50	7	-	-	-	0.07	
EPS	>60	7	-	-	-	0.06	
EPS	>100	7	-	-	-	0.035	
POES							
MEPED	>6.14	-	-	-	-	300	
Meteor-2							
SCR	>1	2	17	45	2.5	4.4	
SCR	>3	2	16	5	2	2.8	
SCR	>10	-	-	-	-	2.2	
GALS-M	>15	-	-	-	-	0.7	
GALS-M	>25	-	-	-	-	0.8	
GALS-M	>600	-	-	-	-	0.3	
ACE							
SIS	>10	2	13	0.8	1	1.5	
SIS	>30	2	13	0.15	1	1.1	
SOHO							
EPHIN	>50	-	-	-	-	-	

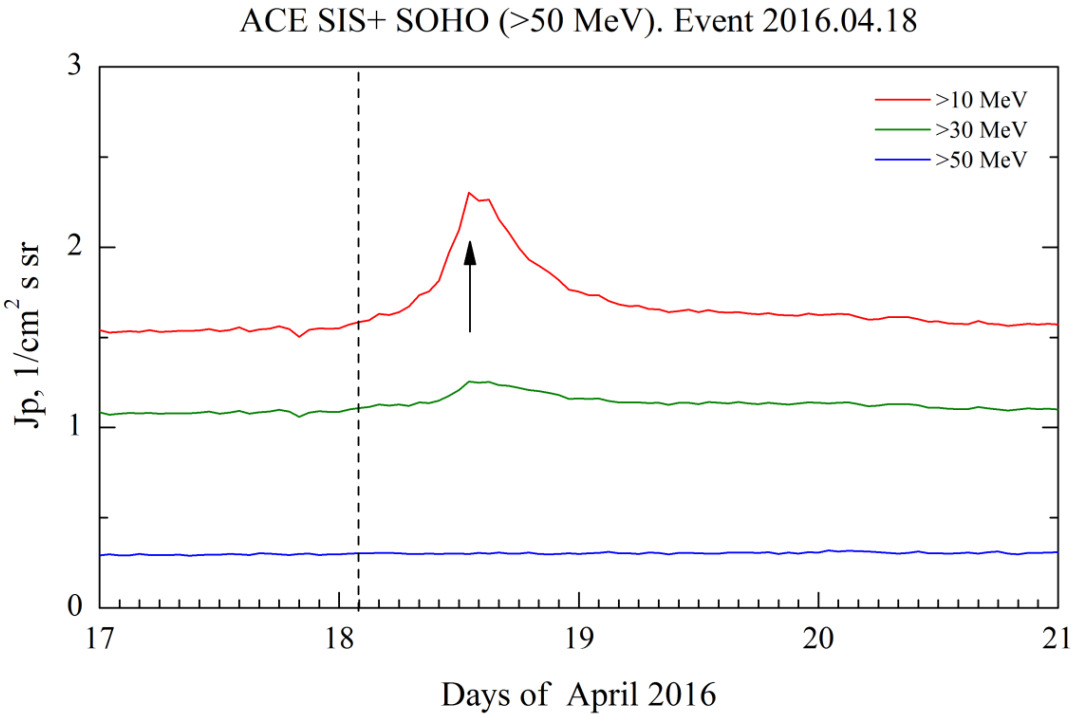
Differential fluxes of protons for the event of 2016 April 18

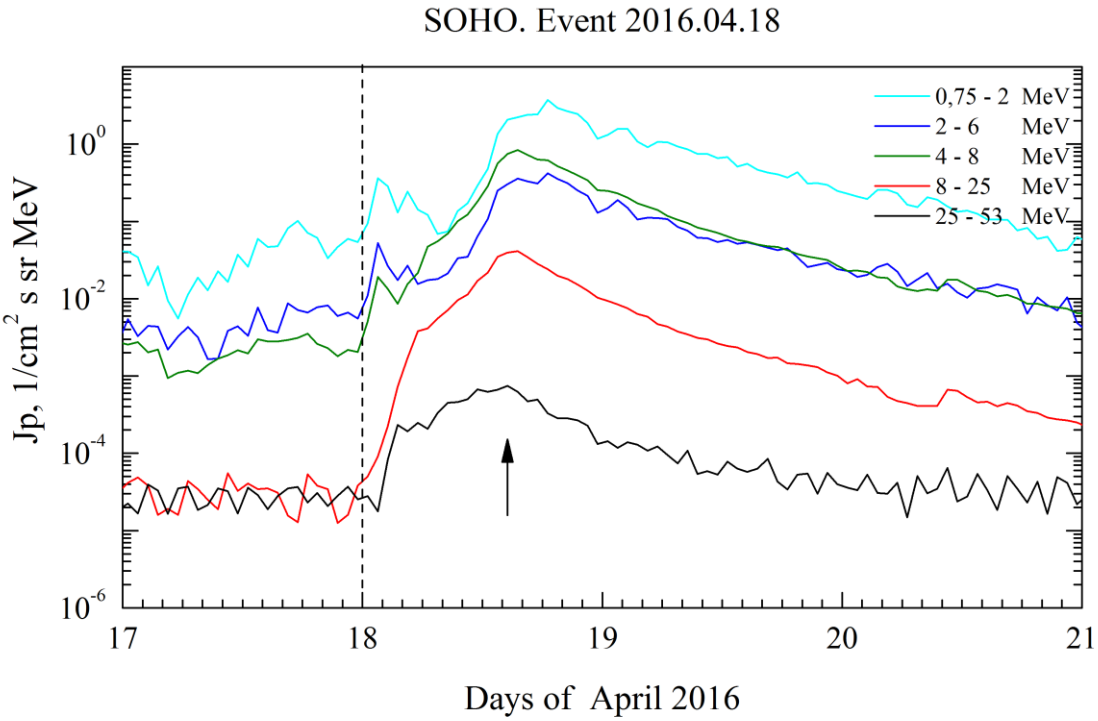
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	09	19	3.65	3.5	0.07	
LION	2 – 6	09	19	0.4	2	0.015	
EPHIN	4 – 8	0	16	0.724	4	0.001	
EPHIN	8 – 25	0	15	0.0414	3	0.00004	
EPHIN	25 – 53	01	15	0.00062	1.5	0.00004	
POES							<E>, MeV
MEPED	16–36	-	-	-	-	0.038	25
MEPED	36–70	-	-	-	-	0.0053	50
MEPED	70–140	-	-	-	-	0.0009	100


Integral spectrum of protons. Event 2016.04.18
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2.s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
Meteor
ACE
SOHO
γ = 2.1
0.1 GCR
Eqm = 55 MeV

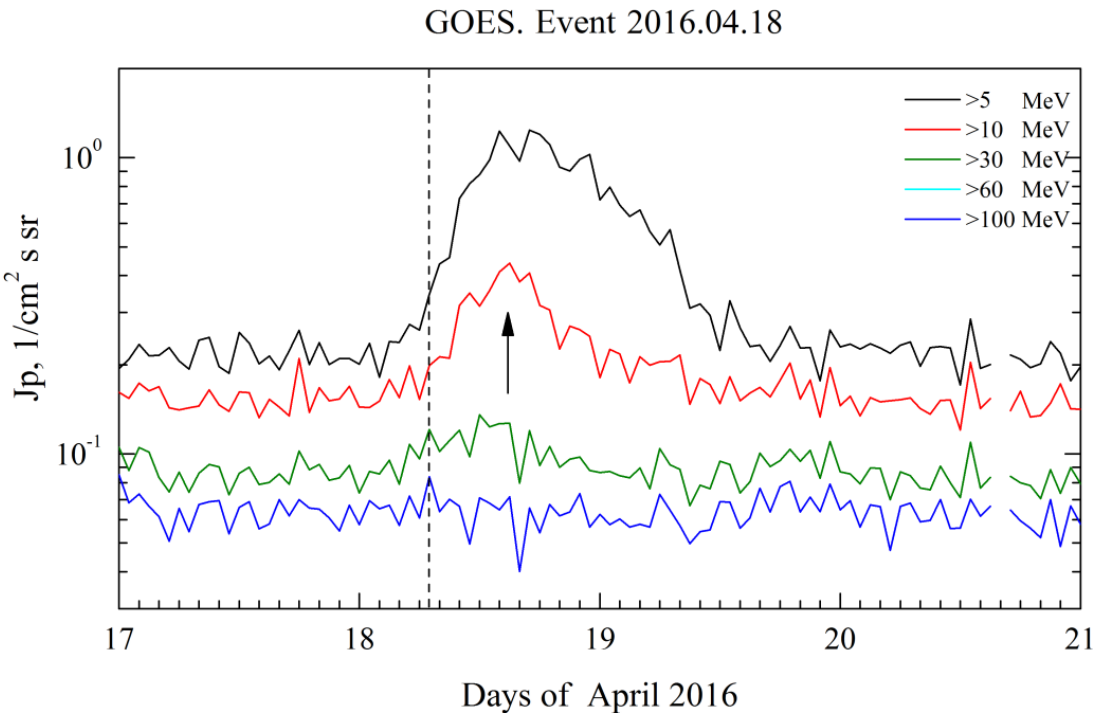
Time profiles of proton fluxes in the event 2016.04.18

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

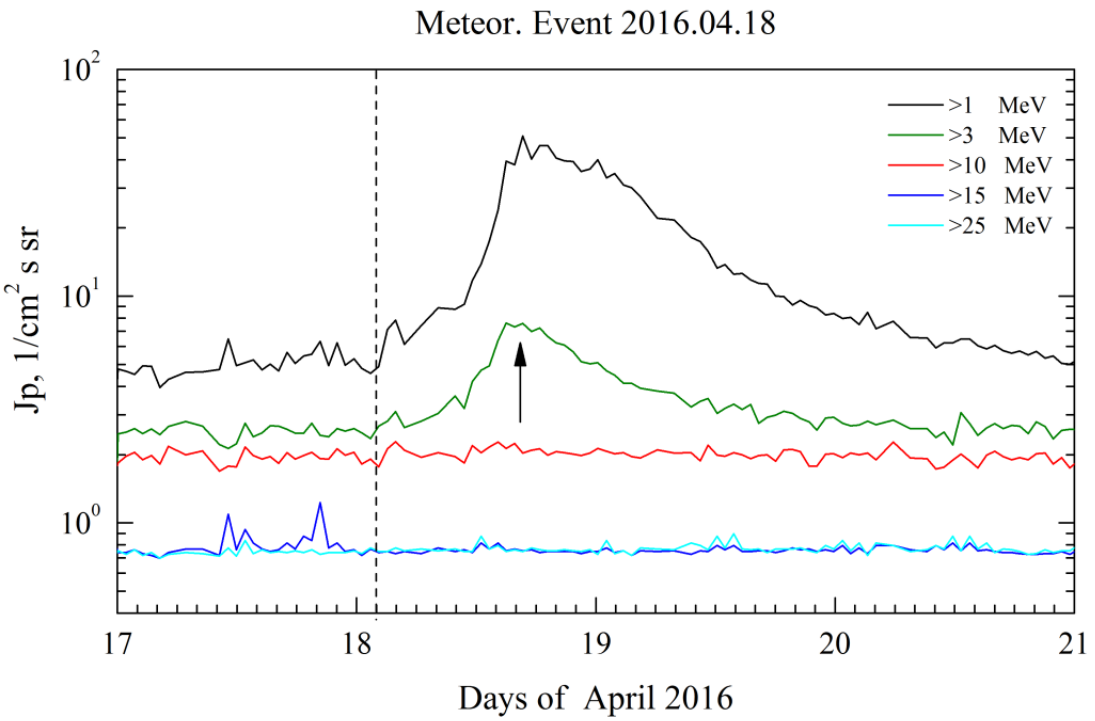


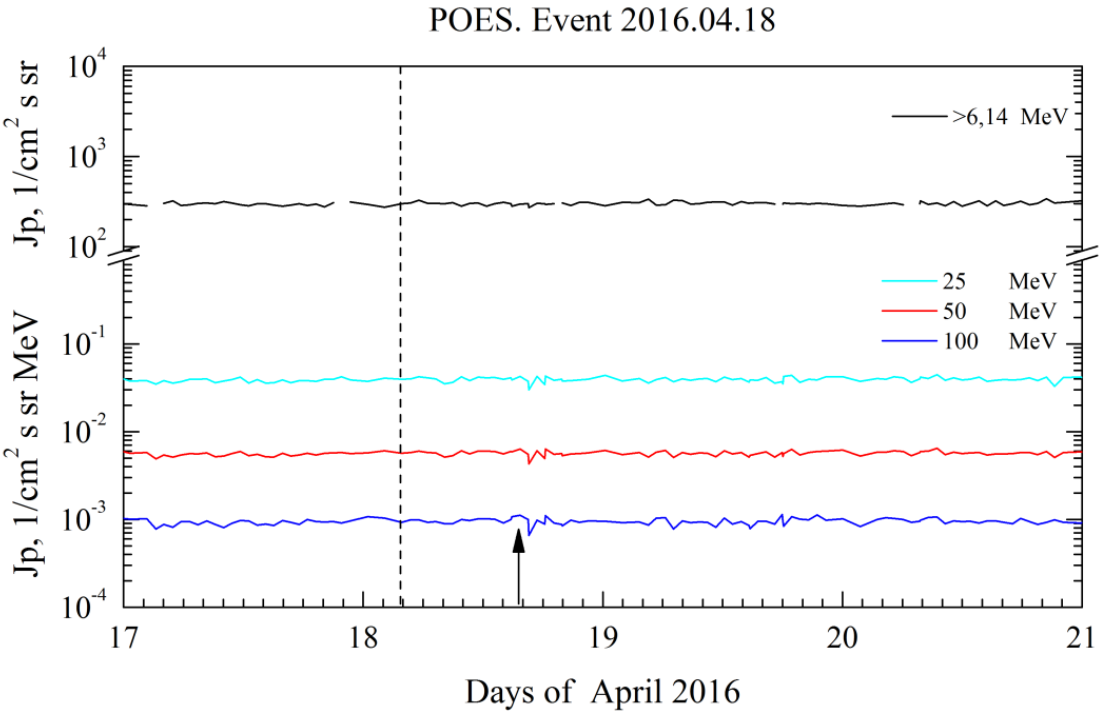


Earth satellite in geostationary orbit, R ≈ 6.6 Re: GOES



Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





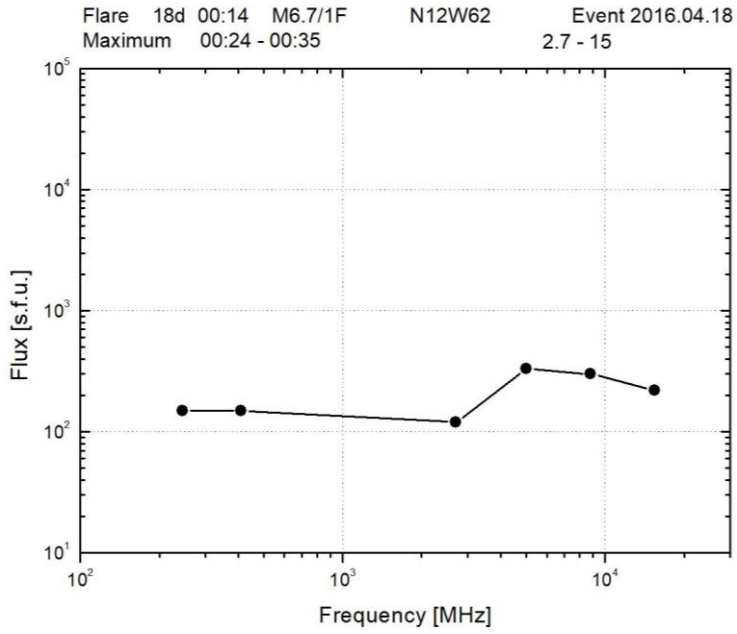
Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2016 April 18

2016 April 18 ● AR 12529 To event 582

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	0022	0043	0102	N12W62	1F	EUR
1 – 12	keV	0014	0029	0039	N11W60	M6.7*	0.049
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12 – 25	keV	0018:27	0026:55	0058:09	510292	196352768	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	0022	0025	0034		2.34	
8.8	GHz	0023	0025	0027		2.48	
5	GHz	0022	0024	0027		2.52	
2.7	GHz	0023	0024	0024	2.7 – 15	2.08	
410	MHz	0026	0026	0026		2.18	
245	MHz	0035	0035	0035		2.18	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	25-152	0030		0033	1869	2	
DS IV	25-180	0034		0244		2	
DS III	25-82	0024		0027		3	
DS CTM	30-180	0000		0029		1	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	0048	1084	- 24.6	162˚	291˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/ssw_client/data/ssw_service_160417_210618_58234/www/

Radio burst frequency spectrum



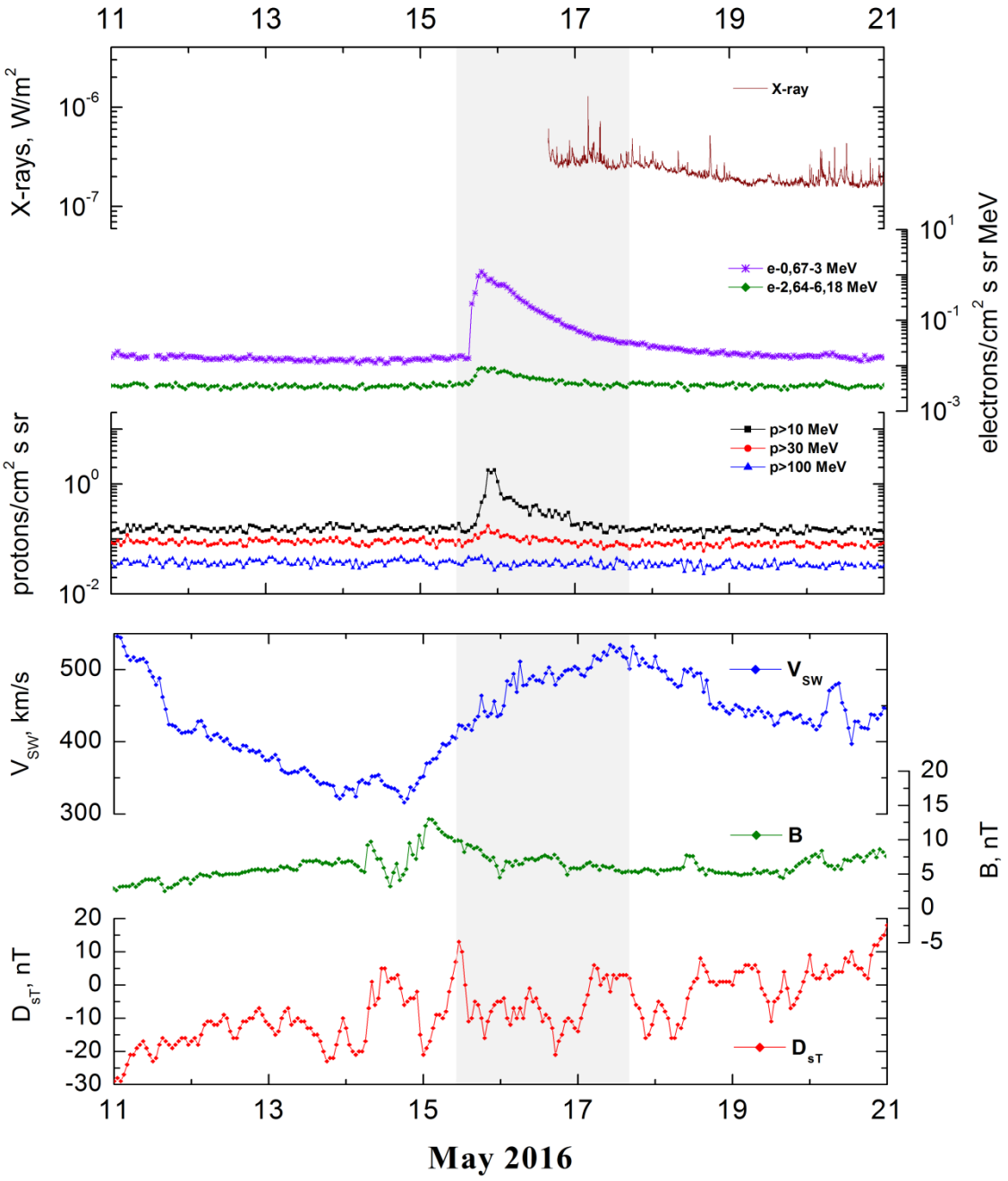
Proton Active Region:

AR 12529 (N10L344, CMP 14,0.04.2016,
Sp=850 msh, EKI, BG, R)
XRI=0.67 $M_1^{6.7}$
PFR 18.04 $M_1^{6.7}$

Particle event: To(Ep>10 MeV) – 15d17^{h}
Tmax (Ep>10 MeV) – 17d21^{h}, Jmax(Ep>10 MeV) – 1.6 /cm^2·s·sr
Duration of the event – 2 days, power-law index: γ = 2.1
Quasimaximal energy of protons in the event – Eqm = 90 MeV

Sources: ● solar flare 15d15^{h}00^{m}, DSF/ C3.2, N10W62, AR12542
Main burst X-ray 1–8 Å: onset – 15d15^{h}19^{m}, max – 15d16^{h}03^{m}, Φ = 0.018 J/m^2
CME: 15d15^{h}12^{m}, V = 1118 km/s, Δφ = 176º, dA= 309º

Particle fluxes and associated phenomena

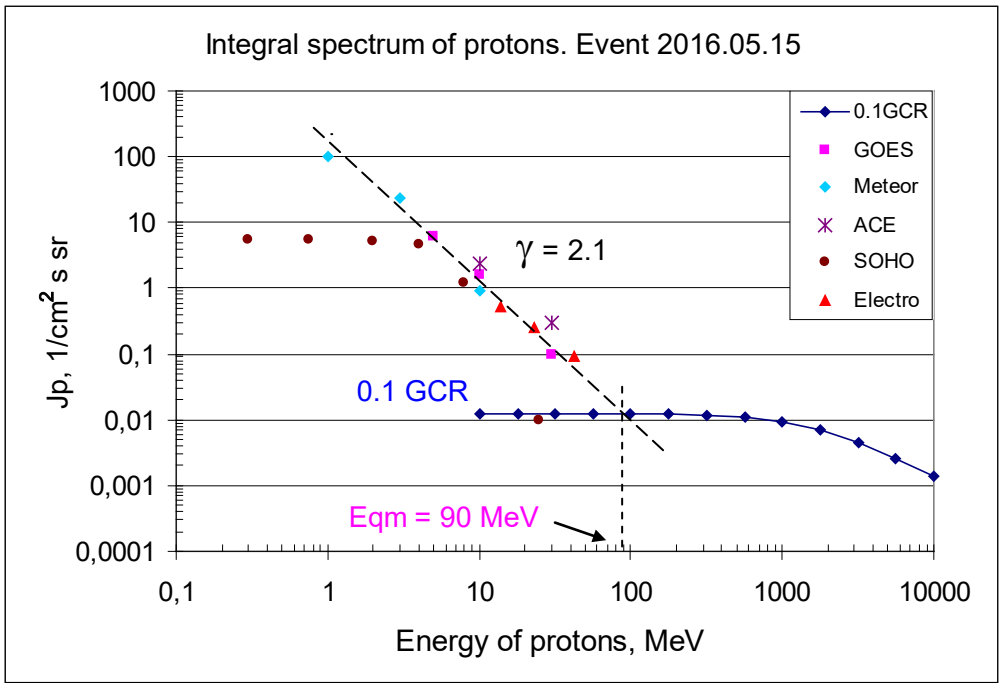


Integral fluxes of protons for the event of 2016 May 15

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	17	21	6	2	0.2	
EPS	>10	17	21	1.6	2	0.15	
EPS	>30	17	21	0.1	1	0.1	
EPS	>50	-	-	-	-	0.08	
EPS	>60	-	-	-	-	0.07	
EPS	>100	-	-	-	-	0.04	
Electro-2							
GALS-E	>600	-	-	-	-	0.0008	
POES							
MEPED	>6.14	-	-	-	-	290	
Meteor-2							
SCR	>1	18	16d00	99	2	4.6	
SCR	>3	18	16d00	24	1.5	2.8	
SCR	>10	18	16d00	0.9	0.5	2.2	
GALS-M	>15	-	-	-	-	0.8	
GALS-M	>25	-	-	-	-	0.8	
GALS-M	>600	-	-	-	-	0.3	
ACE							
SIS	>10	17	21	2.4	1	1.5	
SIS	>30	17	21	0.3	0.3	1.1	
SOHO							
EPHIN	>50	-	-	-	-	0.3	

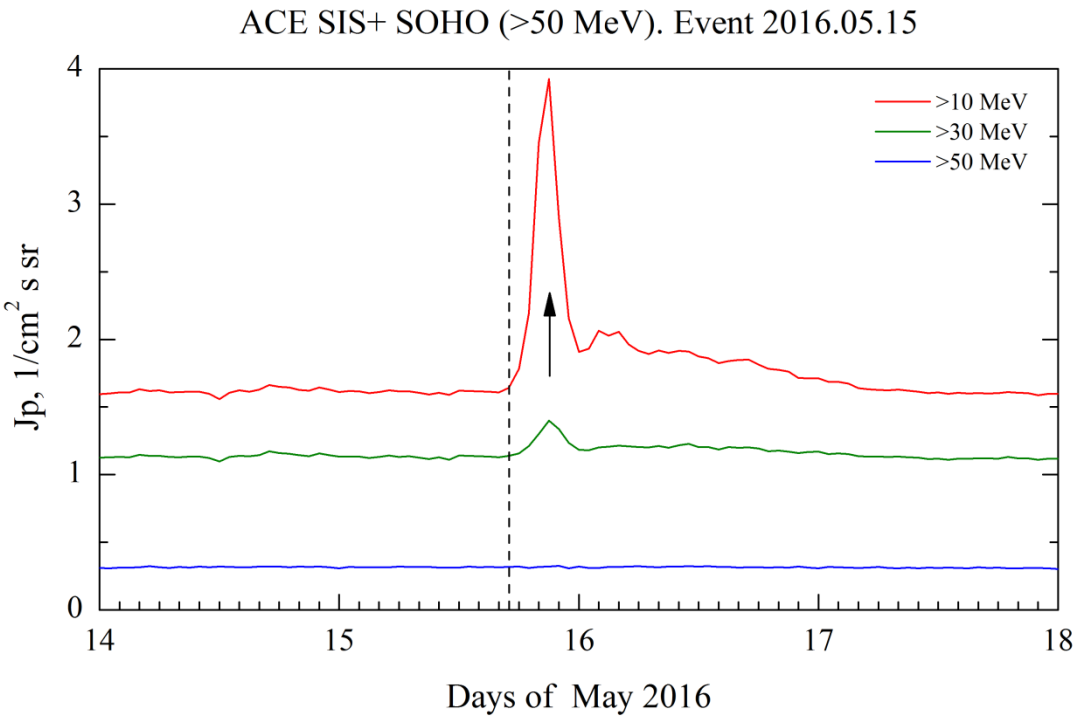
Differential fluxes of protons for the event of 2016 May 15

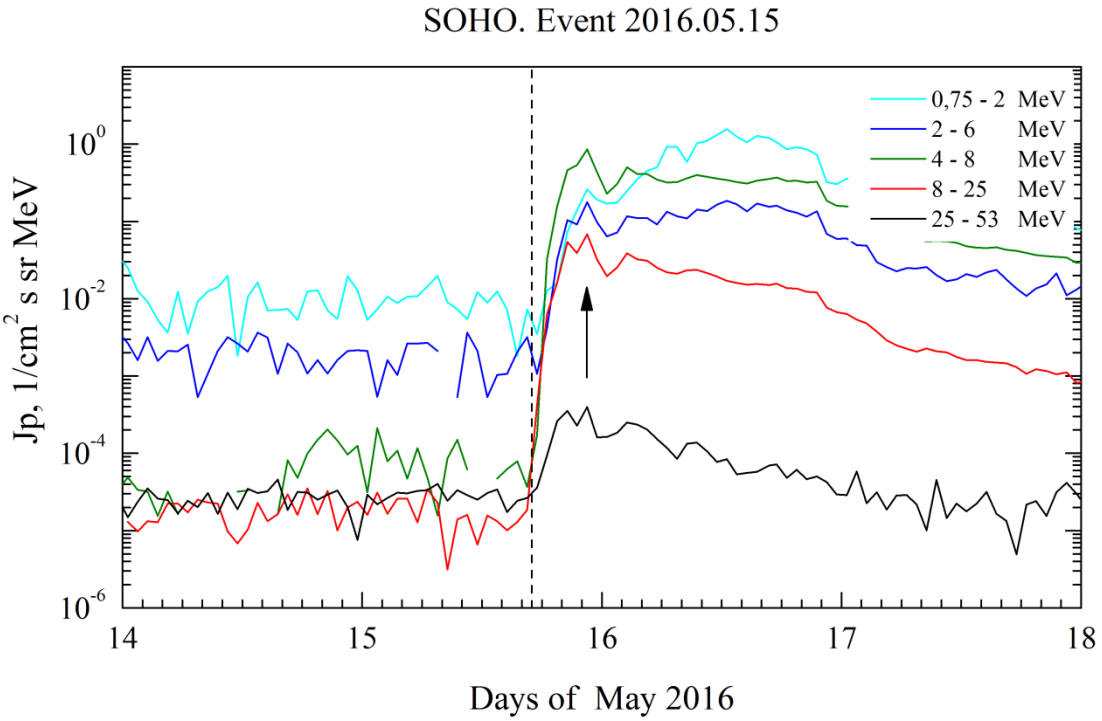
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	19	23	0.25	1.5	0.01	
LION	2 – 6	19	23	0.175	1.5	0.002	
EPHIN	4 – 8	17	22	0.85	1.5	0.0001	
EPHIN	8 – 25	17	22	0.068	1.5	0.00002	
EPHIN	25 – 53	17	22	0.0004	1.5	0.00003	
Electro-2							
SCR-E	13.7–23	18	20	0.03	0.5	0.05	
SCR-E	23–42	18	20	0.008	0.5	0.02	
SCR-E	42–112	18	20	0.001	0.5	0.004	
POES							<E>, MeV
MEPED	16–36	-	-	-	-	0.04	25
MEPED	36–70	-	-	-	-	0.006	50
MEPED	70–140	-	-	-	-	0.0009	100


Integral spectrum of protons. Event 2016.05.15
1000
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
γ = 2.1
0.1 GCR
Eqm = 90 MeV
0.1GCR
GOES
Meteor
ACE
SOHO
Electro

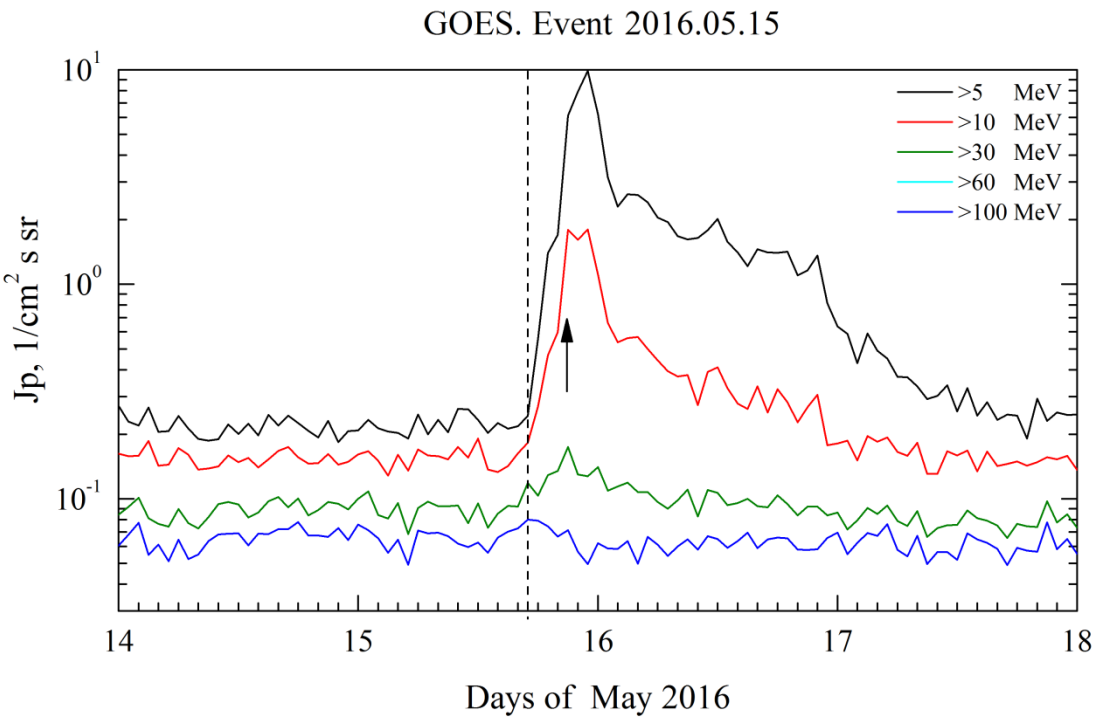
Time profiles of proton fluxes in the event 2016.05.15

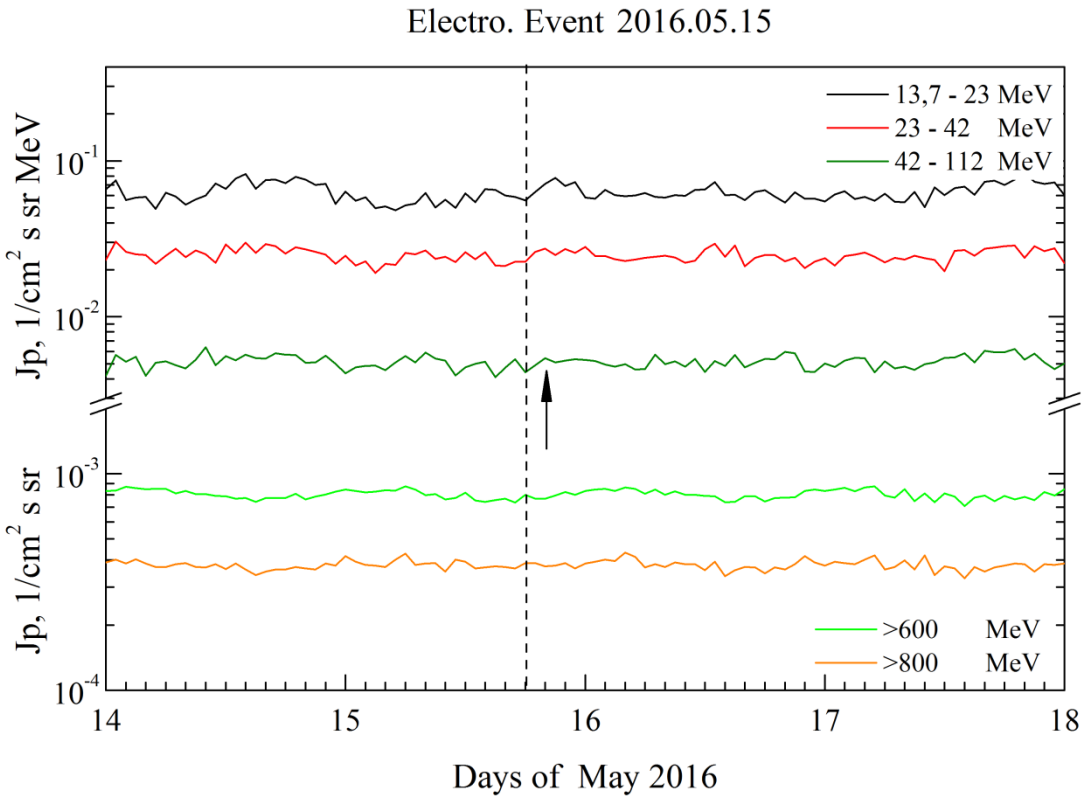
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



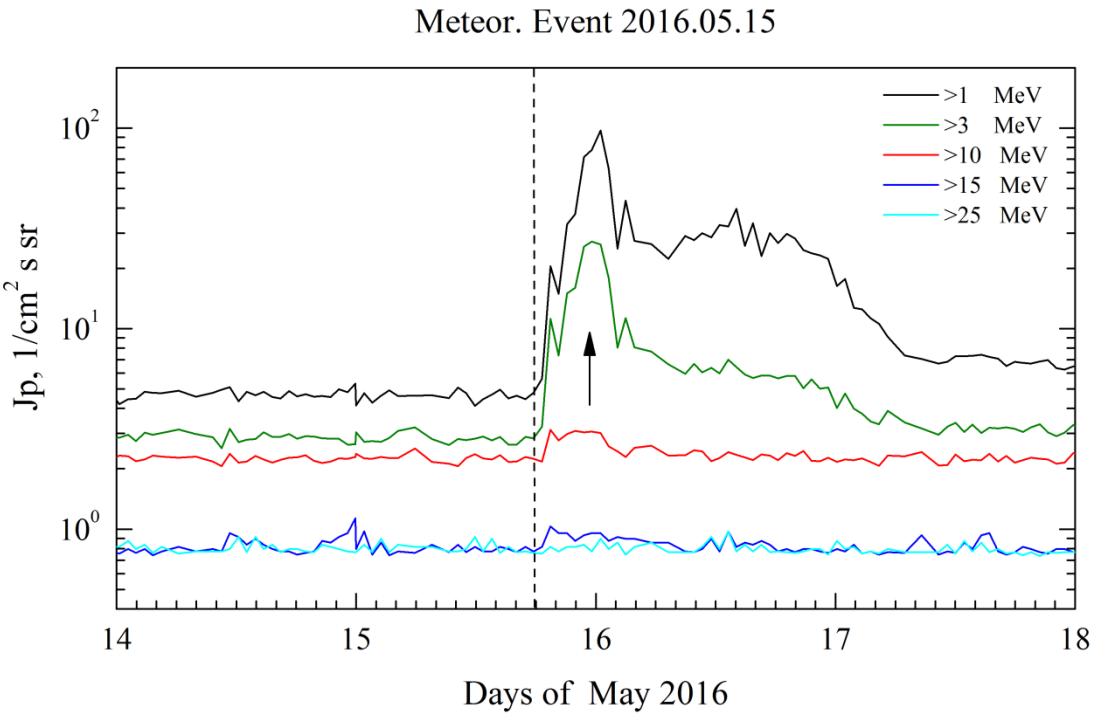


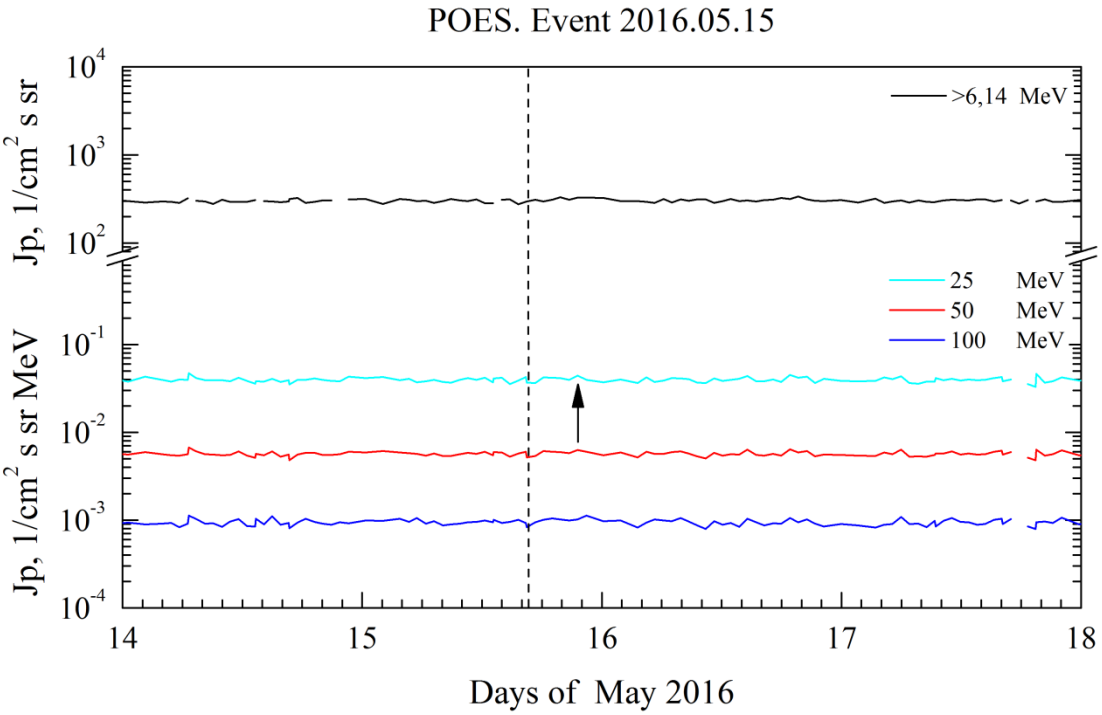
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2016 May 15

2016 May 15 ● AR 12542 To event 583

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	DSF	~1500		~1745	NW (n10 w70)*	>10º	
6563 Å	FL	<1532	~1548	>1633	N10W62	SF	PRB
1 – 12	keV	1519	1603	1733	N10W62	C3.2*	1.8E-02
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
6 – 12	keV	1502:08	1507:54	1513:44		91872	HESSI
6 –12	keV	1513:44	1514:54	1521:52		45096	HESSI
6 –12	keV	1624:32	1625:26	1630:12		25008	HESSI
6 –12	keV	1632:52	1633:46	1638:20		27168	HESSI
12-25	keV	1602:17	1602:46	1603:14	57	7384	FERMI
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1512	1118	35.1	176˚	309˚	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_160515_103023_15238_1/www/

Proton Active Region:

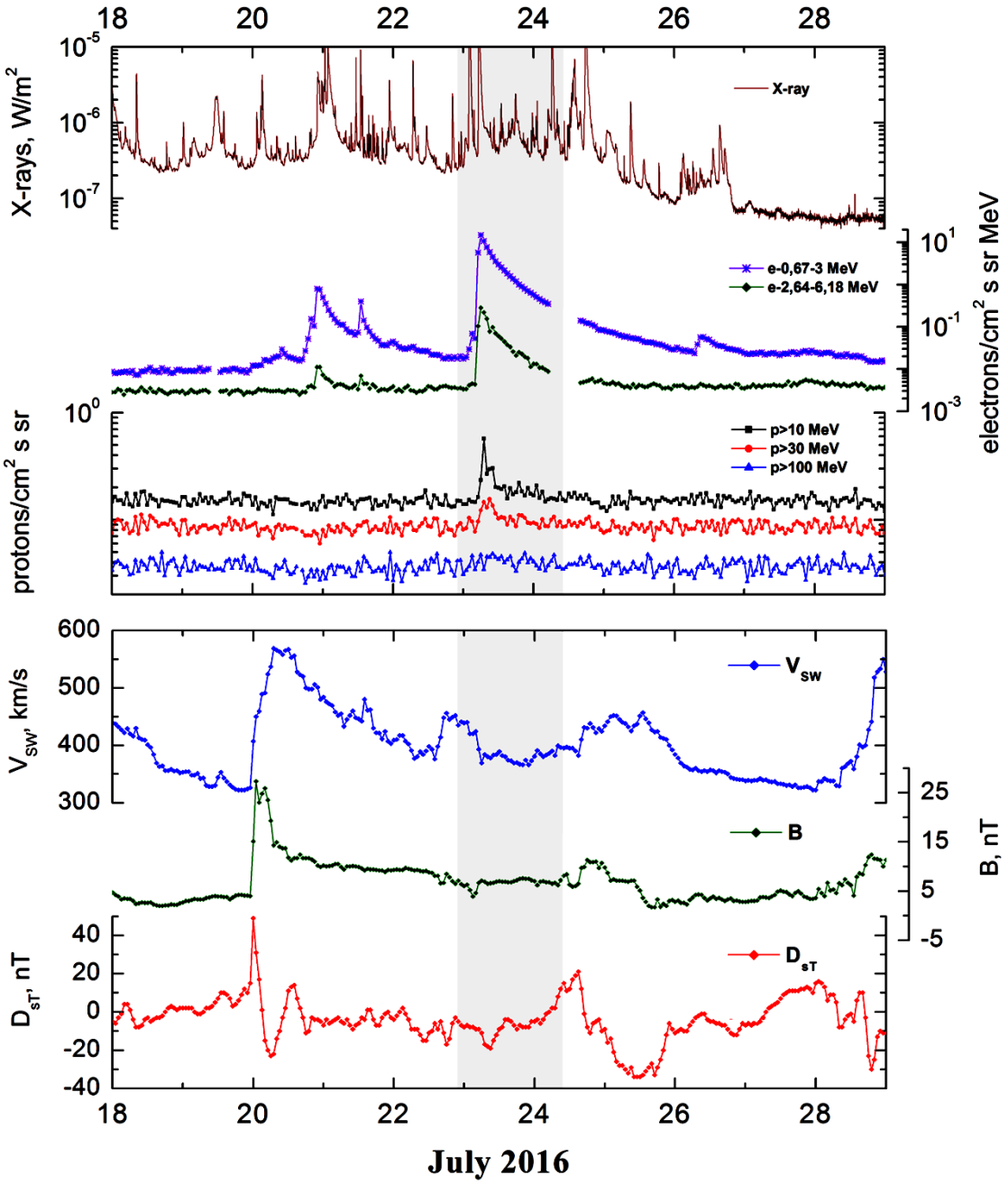
AR12542 (N11L357, CMP 10,2.05. 2016,
Sp=250 msh, DAI, BG, R)
XRI=0 C_2 S_6

The small Event 2016.07.23 – (2016-205) **584**

Particle event: To(Ep>10 MeV) – 23d04^{h}
Tmax (Ep>10 MeV) – 23d07^{h}, Jmax (Ep>10 MeV) – 0.4/cm^2·s·sr
Duration of the event – 0.5 days, power-law index: γ = 1.5
Quasimaximal energy of protons in the event – Eqm = 100 MeV

Sources: ● solar flare 23d05^{h}00^{m}, M7.6, M5.5/3B, N02W74, AR12567
Main burst X-ray 1–8 Å: onset 23d05^{h}00^{m}, max – 23d05^{h}16^{m}, Φ = 0.046 J/m^2
CME: 23d05^{h}24^{m}, V = 835 km/s, Δφ = 117º, dA= 271º
▲ SC 24d15^{h}25^{m}

Particle fluxes and associated phenomena

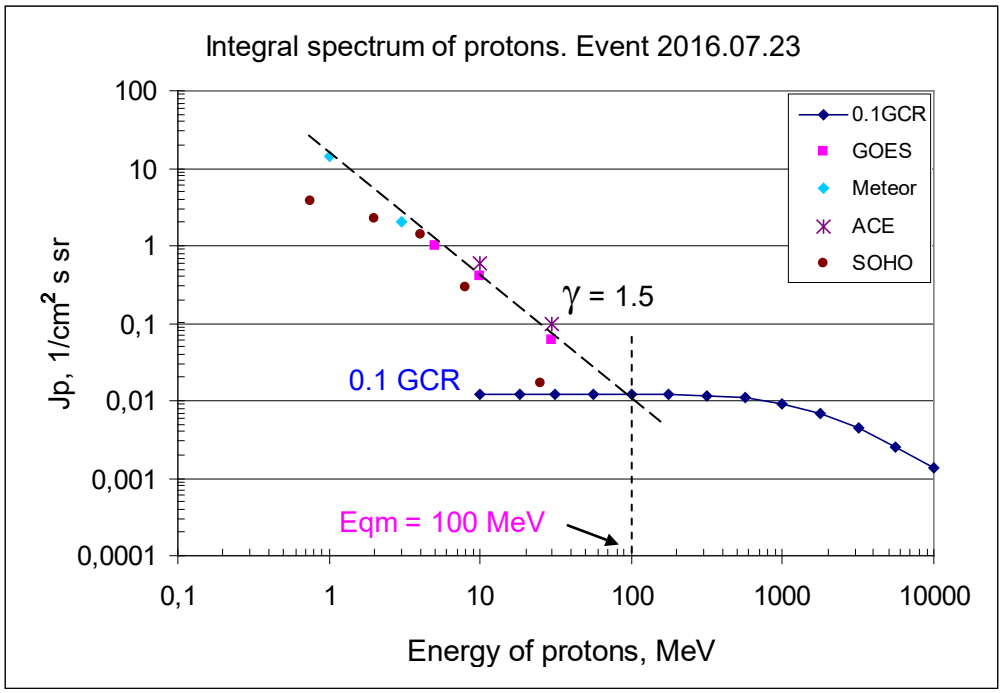


Integral fluxes of protons for the event of 2016 July 23

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	4	7	1	0.5	0.2	
EPS	>10	4	7	0.4	0.5	0.13	
EPS	>30	4	7	0.06	0.5	0.08	
EPS	>50	–	–	–	–	0.07	
EPS	>60	–	–	–	–	0.06	
EPS	>100	–	–	–	–	0.04	
POES							
MEPED	>6.14	-	-	-	-	290	
Meteor-2							
SCR	>1	5	10	14	2	4.5	
SCR	>3	5	10	2	1.5	2.8	
SCR	>10	-	-	-	-	2.2	
GALS-M	>15	-	-	-	-	0.8	
GALS-M	>25	-	-	-	-	0.8	
GALS-M	>600	-	-	-	-	0.3	
ACE							
SIS	>10	4	8	0.6	5	1.5	
SIS	>30	4	8	0.1	0.3	1.1	
SOHO							
EPHIN	>50	-	-	-	-	0.25	

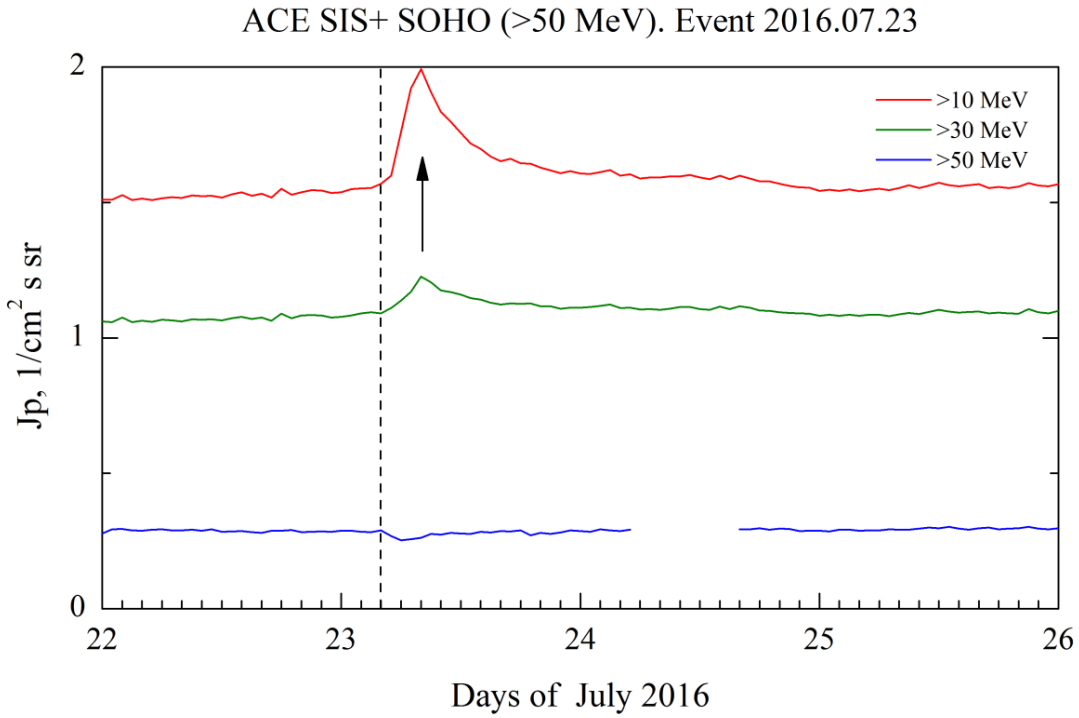
Differential fluxes of protons for the event of 2016 July 23

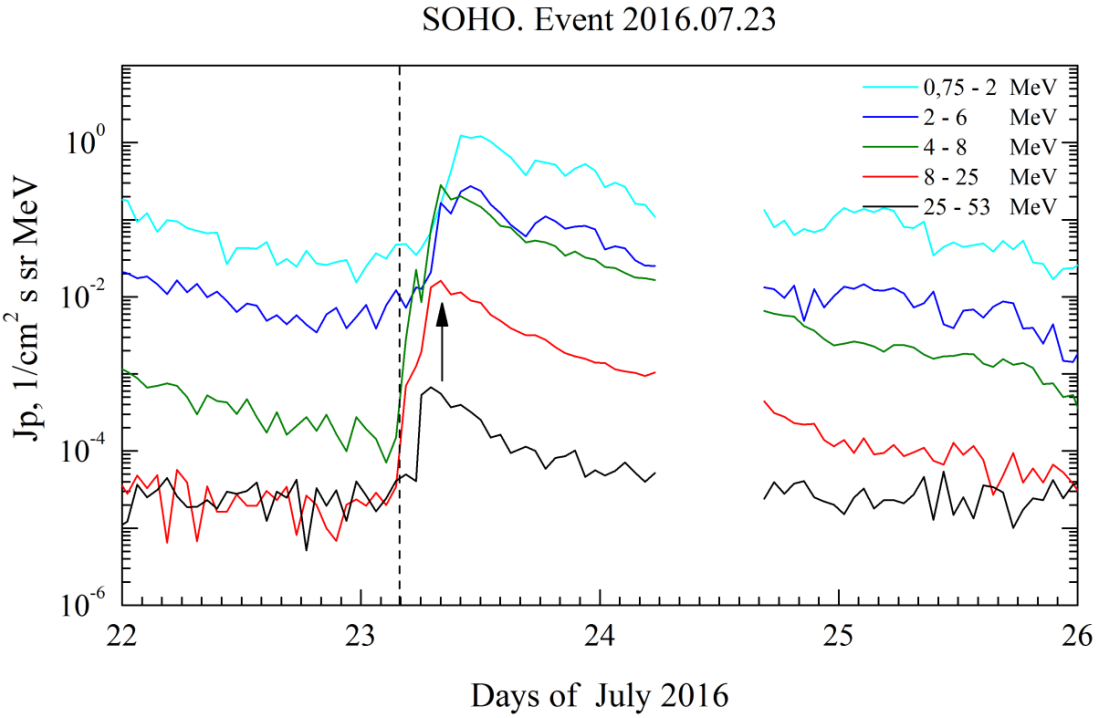
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	08	11	1.21	1	0.026	
LION	2 – 6	08	11	0.26	1	0.01	
EPHIN	4 – 8	04	08	0.281	3	0.0001	
EPHIN	8 – 25	04	08	0.0162	2	0.00003	
EPHIN	25 – 53	04	07	0.00064	1.5	0.00003	
POES-19							<E>, MeV
MEPED	16–36	-	-	-	-	0.04	25
MEPED	36–70	-	-	-	-	0.006	50
MEPED	70–140	-	-	-	-	0.0009	100


Integral spectrum of protons. Event 2016.07.23
100
10
1
0,1
0,01
0,001
0,0001
Jp, 1/cm2 s sr
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
Meteor
ACE
SOHO
γ = 1.5
0.1 GCR
Eqm = 100 MeV

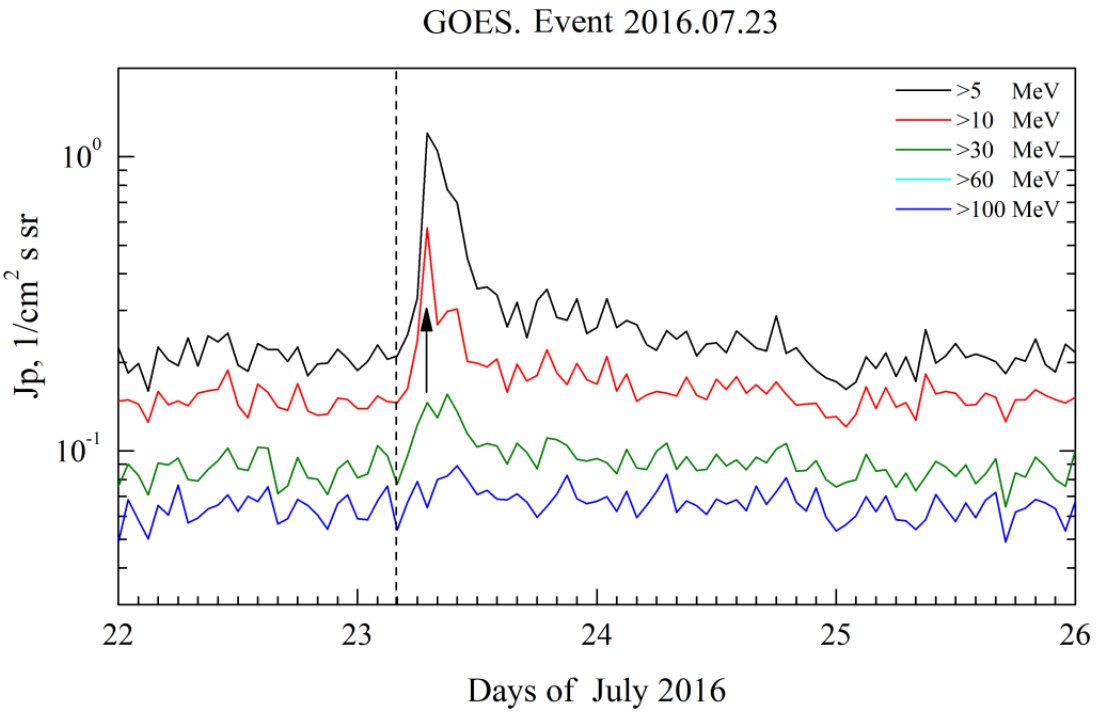
Time profiles of proton fluxes in the event 2016.07.23

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



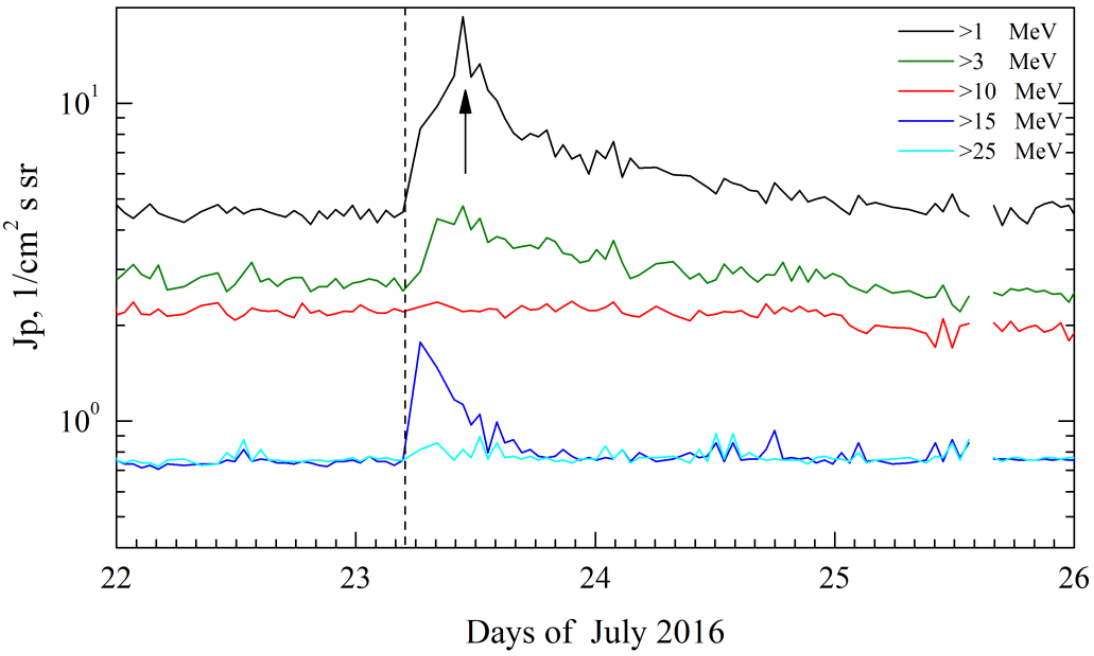


Earth satellite in geostationary orbit, R ≈ 6.6 Re: GOES

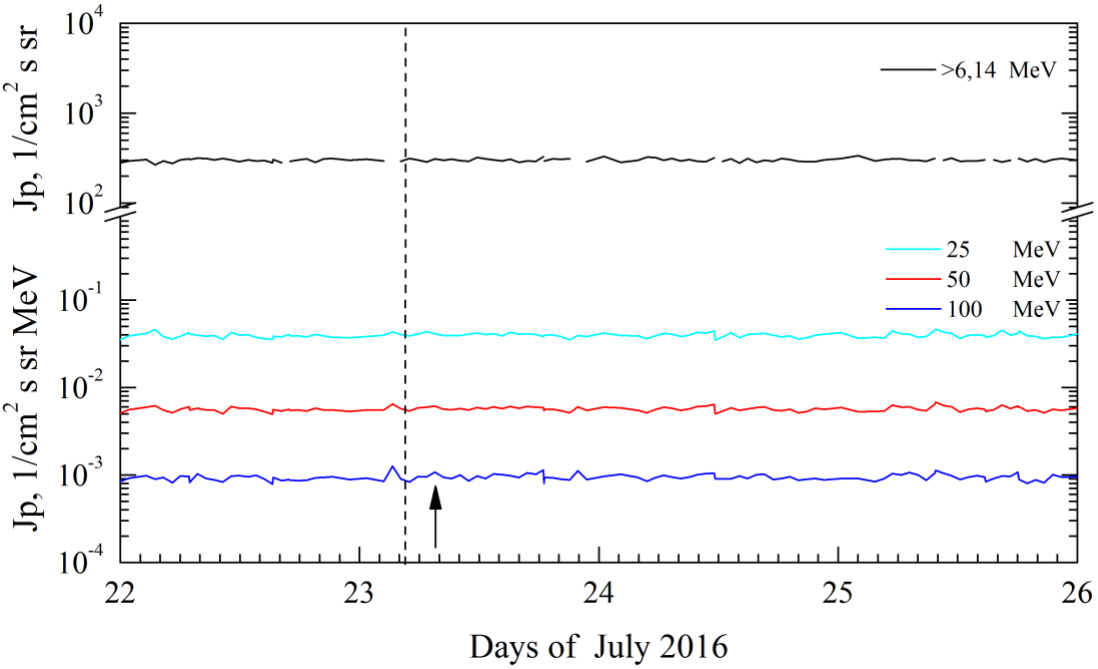


Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2016.07.23



POES. Event 2016.07.23



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2016 July 23

2016 July 23 ● AR 12567 To event 584

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	0509	0531	0633	N02W74	3B	ERU
1 – 12	keV	0500	0516	0524	N05W73	M7.6*	0.046
1 – 12	keV	0527	05:31	05:33	N02W75	M5.5	0.011

X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
50 – 100	keV	0503:20	0504:30	0509:12	317	111394	HESSI
100-300	keV	0509:12	0515:14	0526:32	2527	2191325	HESSI
100-300	keV	0526:32	0531:06	0606:01	1584	697816	HESSI
12-25	keV	0506:27	0514:10	0544:13	523357	211931392	FERMI

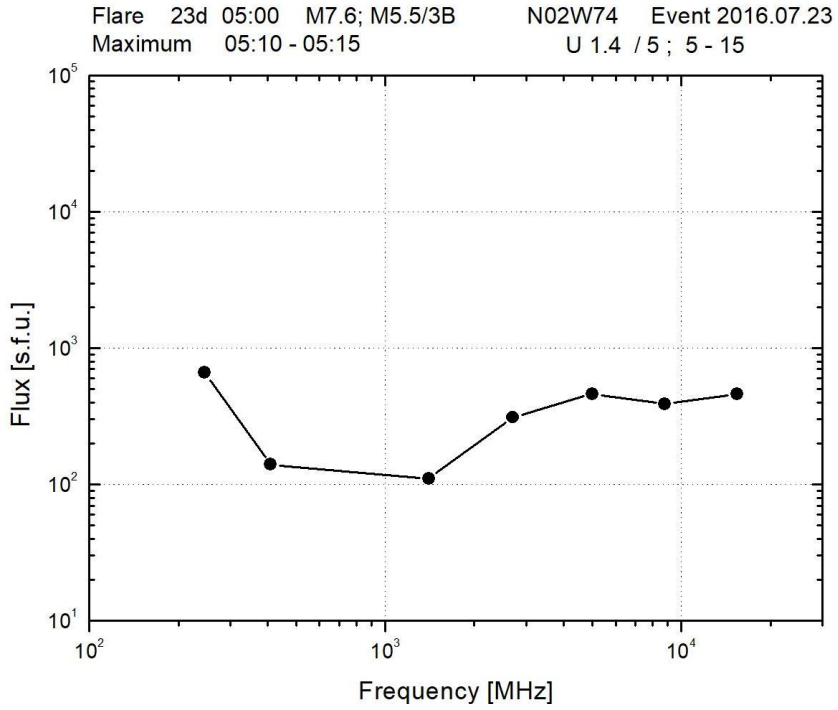
Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0510	0515	0518	5 – 15	460	
8.8	GHz	0510	0515	0516		390	
5	GHz	0508	0510	0515		460	
2.7	GHz	0510	0510	0515		310	
1.4	GHz	0510	0510	0511	U1.4 / 5	110	
410	MHz	0510	0510	0510		140	
245	MHz	0506	0510	0511		660	
15.4	GHz	0527	0528	0528		520	
8.8	GHz	0527	0528	0530	2.7 – 9	970	
5	GHz	0527	0528	0530		800	
2.7	GHz	0527	0528	0530		900	
1.4	GHz	0527	0528	0530		410	
610	MHz	0528	0528	0530	U0.6 / 2.7	180	
410	MHz	0526	0527	0531		400	
245	MHz	0527	0528	0530		1400	

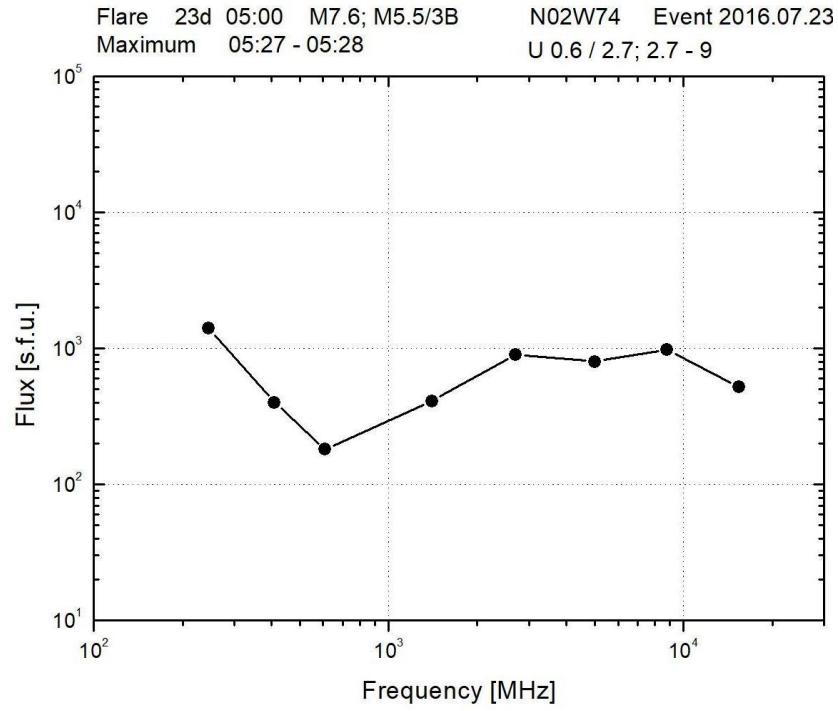
DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS III	25-180	0506		0515		2	
DS II	25-52	0529		0535	729	2	
DS IV	44-180	0529		0942		2	
DS V	25-180	0527		0530		3	
DS VI	25-172	0532		0558		2	

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0524	835	- 15.2	117°	271°	SOHO

*https://sdowww.lmsal.com/sdomedia/ssw/media/ssw/ssw_client/data/ssw_service_160723_043108_18113_1/www/

Radio bursts frequency spectrum





Proton Active Region:

AR 12567 (N05L165, CMP 18,1.07.2016,
Sp=510 msh, DKI, BG, R1)
XRI=2.43: $M_7^{7.6}$+C_{45} 3_1+1_1+S_{55}
PFR 23.07: (4^h) $M_3^{7.6}$

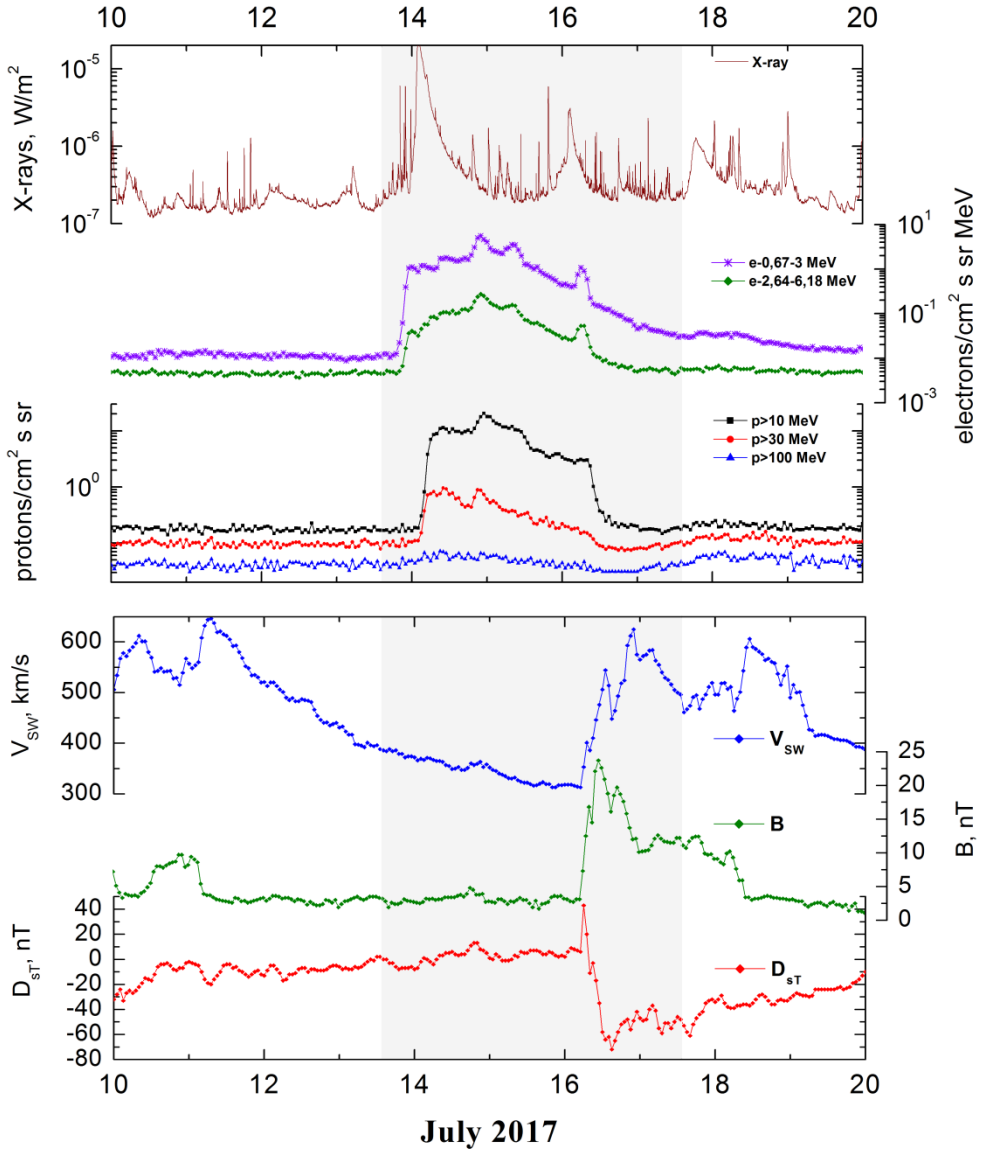
События 2017 года

			Страница
1	Event 2017.07.14 – (2017-195)	№ 585	913
2	Event 2017.07.25 – (2017-206)	№ 586	921
3	Event 2017.09.04 – (2017-247)	№ 587	928
4	Event 2017.09.06 – (2017-249)	№ 588	936
5	Event 2017.09.07 – (2017-250)	№ 589	946
6	Event 2017.09.10 – (2017-253)	№ 590	955

Particle event: To(Ep>10 MeV) – 14d03^{h}
Tmax$_1$(Ep>10 MeV) – 14d10^{h}, Jmax$_1$(Ep>10 MeV) – 11.2 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 14d23^{h}, Jmax$_2$(Ep>10 MeV) – 20.4 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ_1 = 2.6, γ_2 = 2.7
Quasimaximal energy of protons in the event – Eqm$_1$ = 120 MeV
– Eqm$_2$ = 130 MeV

Sources: ● solar flare 14d01^{h}07^{m}, M2.4/1N, S06W29, AR12665
Ø solar flare 14d19^{h}18^{m}, C1.4/1N, S07W44, AR12665
Main burst X-ray 1–8 Å: onset – 14d01^{h}07^{m}, max – 14d02^{h}09^{m}, Φ = 0.13 J/m^2
CME: 14d01^{h}26^{m}, V = 1200 km/s, Δφ = 360º, dA= 230º
▲ SC 16d05^{h}59^{m}

Particle fluxes and associated phenomena

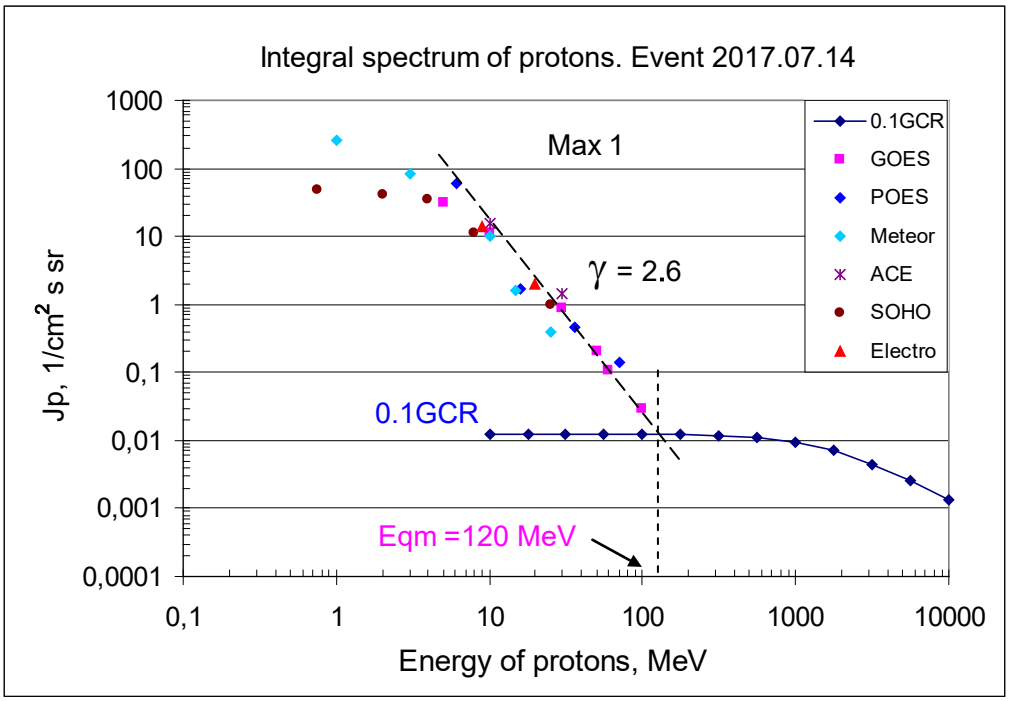


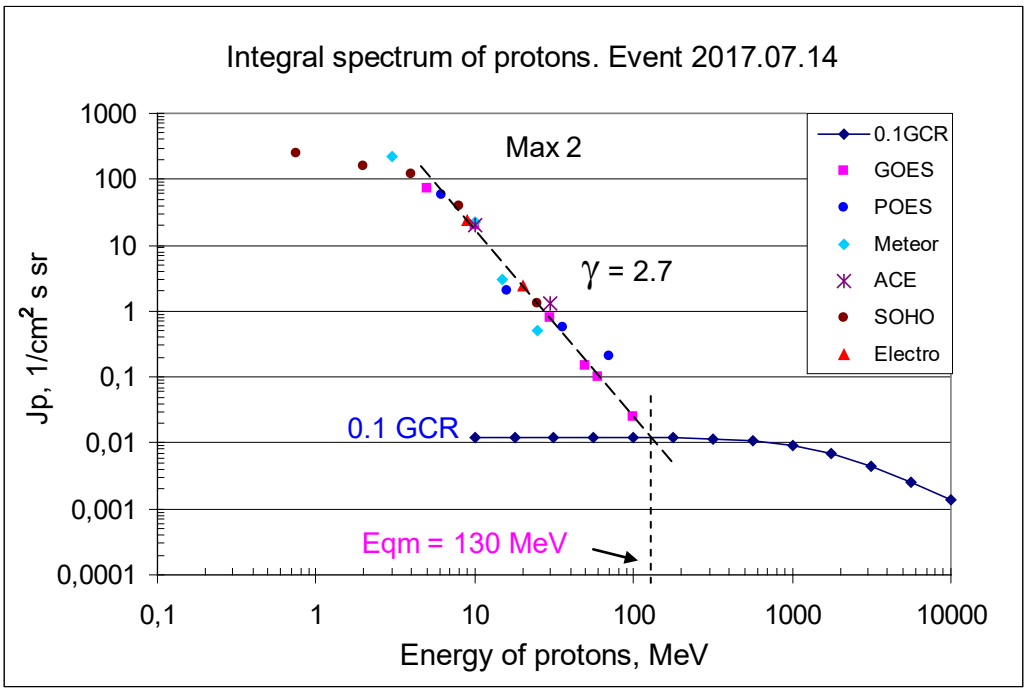
Integral fluxes of protons for the event of 2017 July 14

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	3	10/24	32.2/74.5	3	0.25	
EPS	>10	3	10/23	11.2/20.4	3	0.17	
EPS	>30	3	10/22	0.9/0.8	3	0.08	
EPS	>50	3	10/22	0.2/0.15	2.5	0.07	
EPS	>60	3	10/22	0.11/0.1	2.5	0.06	
EPS	>100	–	10/23	0.03/0.025	2.5	0.04	
Electro-2							
GALS-E	>600	-	-	-	-	0.11	
POES							
MEPED	>6.14	04	8/24	61/57	2	310	
Meteor-2							
SCR	>1	3	09/24	254/1050	6	5.3	
SCR	>3	3	06/23	81/226	2.5	2.9	
SCR	>10	3	07/23	10/23	2.5	2.2	
GALS-M	>15	3	07/23	1.6/3.0	2	0.9	
GALS-M	>25	33	07/23	0.4/0.5	1.5	0.9	
GALS-M	>600	-	-	-	-	0.3	
ACE							
SIS	>10	4	13/22	15.3/20	2	2	
SIS	>30	4	10/22	1.4/1.3	2	1.4	
SOHO							
EPHIN	>50	-	-	-	-	0.35	

Differential fluxes of protons for the event of 2017 July 14

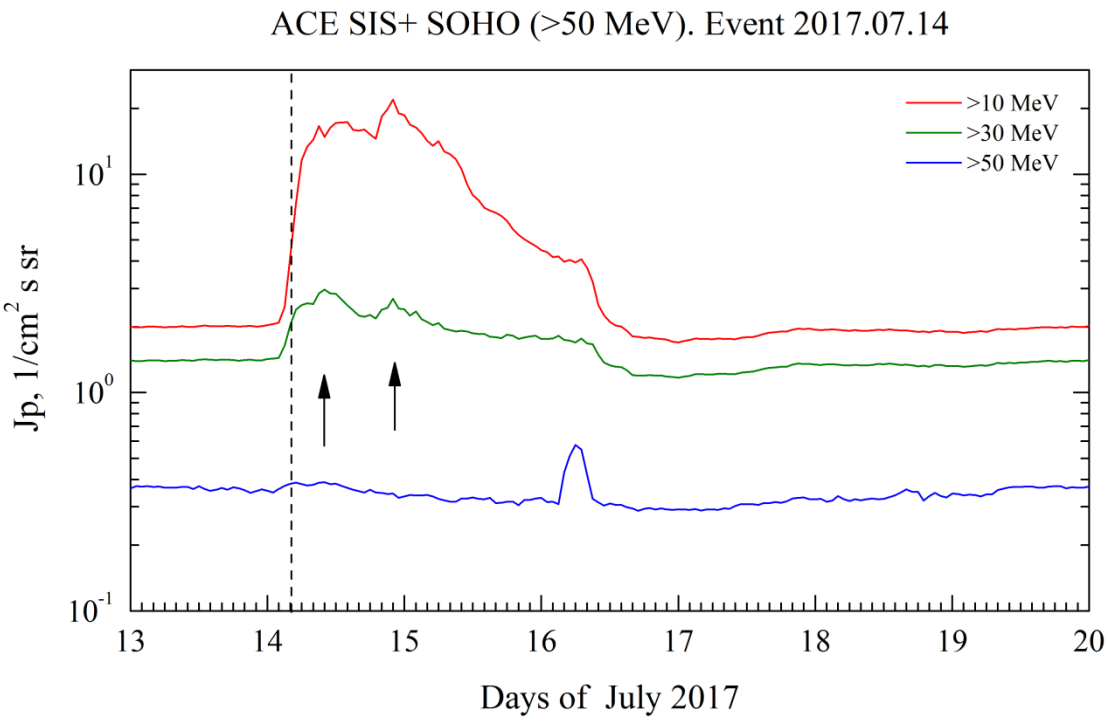
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	4	8/23	2.4/75	3	0.02	
LION	2 – 6	2	8/23	2.2/13.2	3	0.003	
EPHIN	4 – 8	0	8/23	4.6/20.6	3	0.0001	
EPHIN	8 – 25	0	8/23	0.59/2.25	3	0.00005	
EPHIN	25 – 53	0	8/23	0.035/0.047	3	0.00003	
Electro-2							
SCR-E	9–20	3	10/23	1.1/2	2.5	0.08	
SCR-E	20–40	3	10/23	0.1/0.12	2.5	0.03	
SCR-E	40–110	-	-	-	-	0.01	
POES							<E>, MeV
MEPED	16–36	04	8/22	0.063/0.075	2	0.044	25
MEPED	36–70	04	8/22	0.009/0.011	2	0.0063	50
MEPED	70–140	04	8/22	0.002/0.003	2	0.0011	100

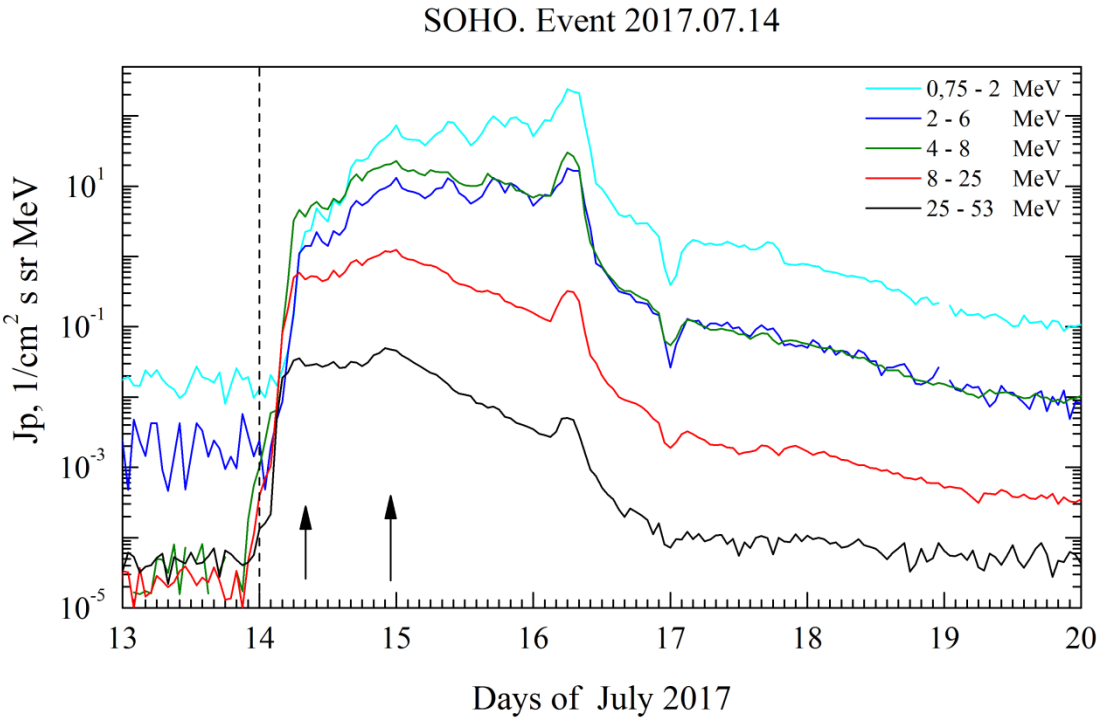

Integral spectrum of protons. Event 2017.07.14
Max 1
γ = 2.6
0.1GCR
Eqm =120 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

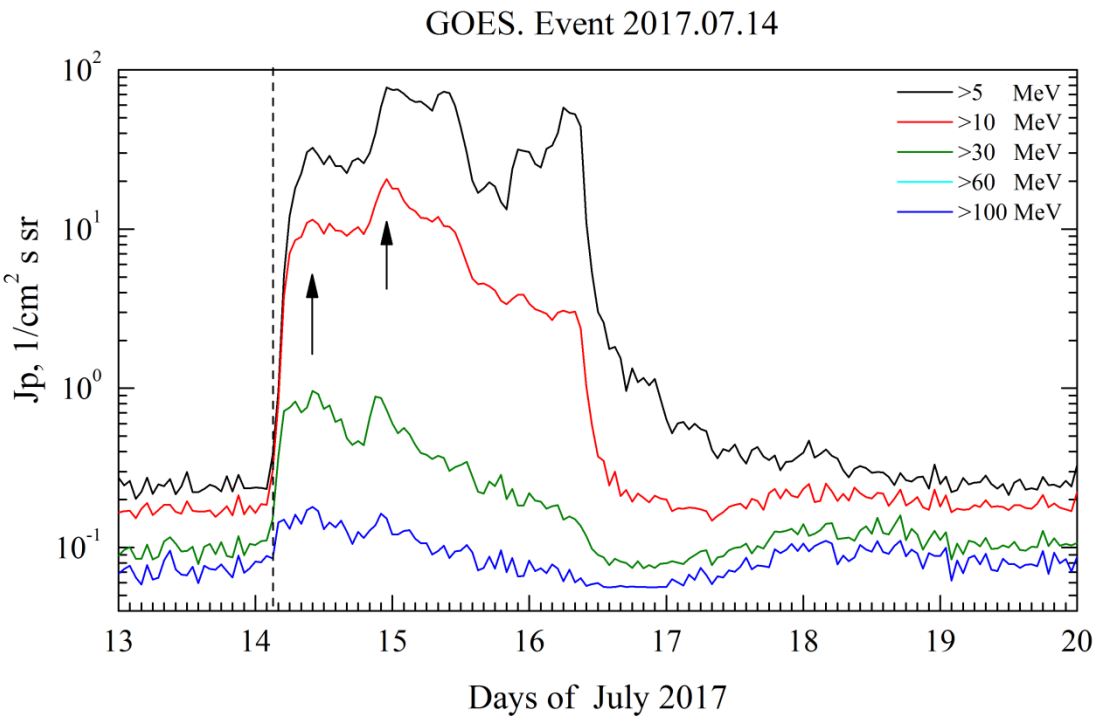

Integral spectrum of protons. Event 2017.07.14
Max 2
γ = 2.7
0.1 GCR
Eqm = 130 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

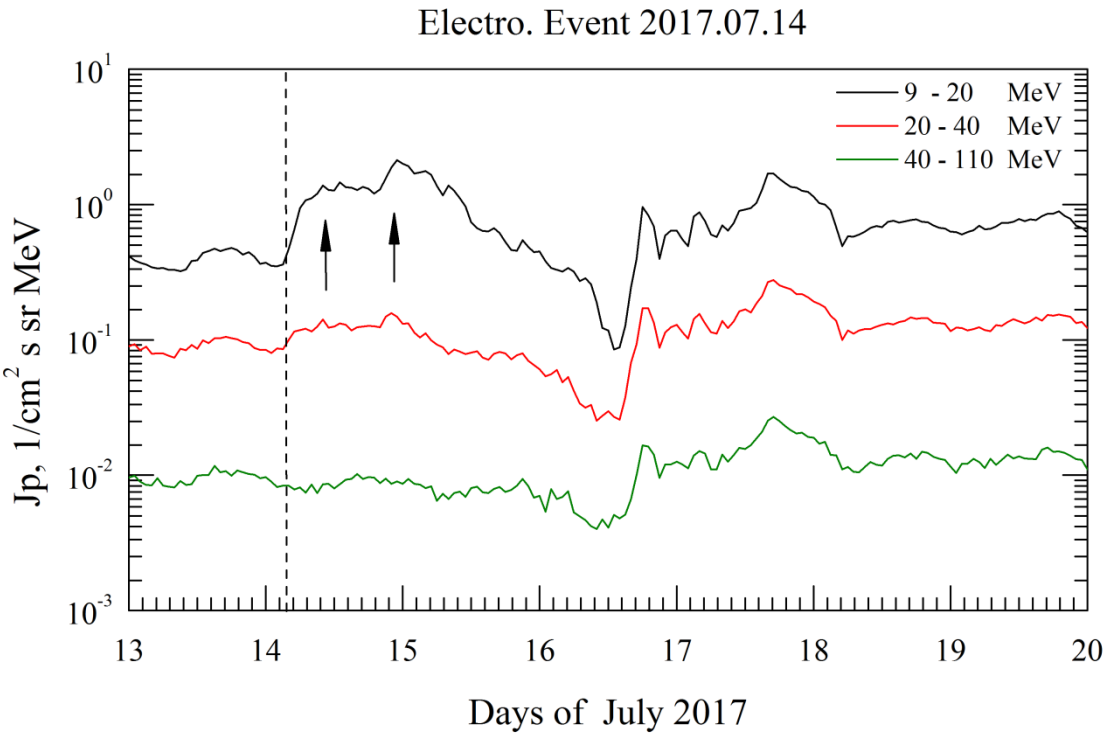
Time profiles of proton fluxes in the event 2017.07.14

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO

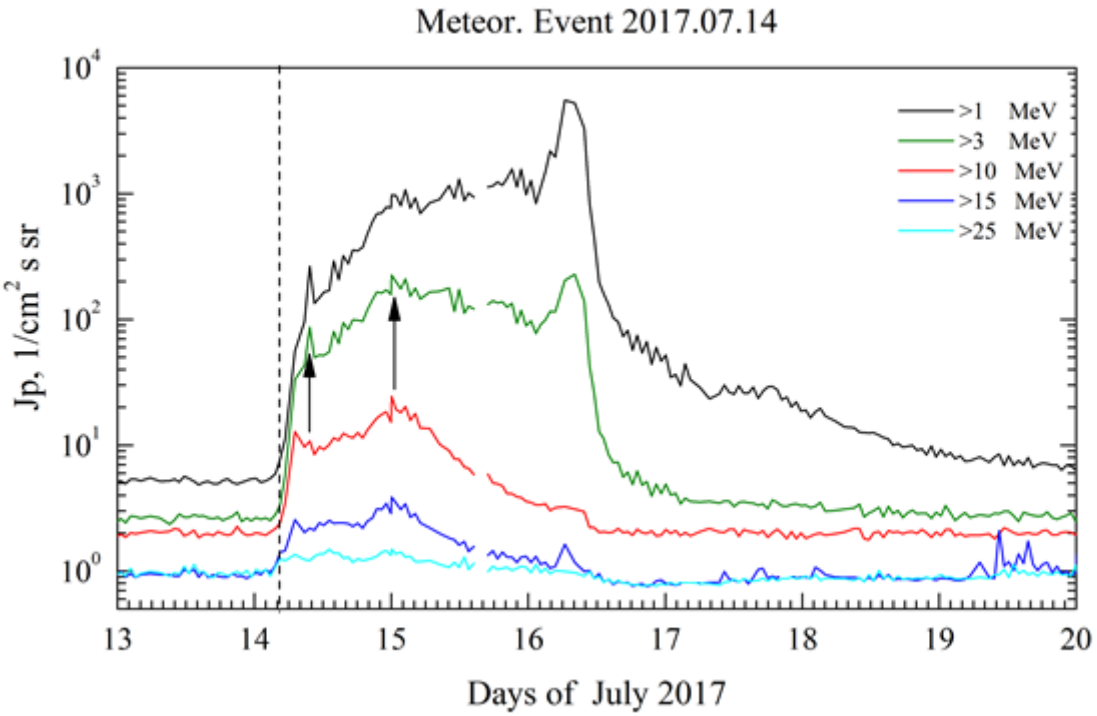


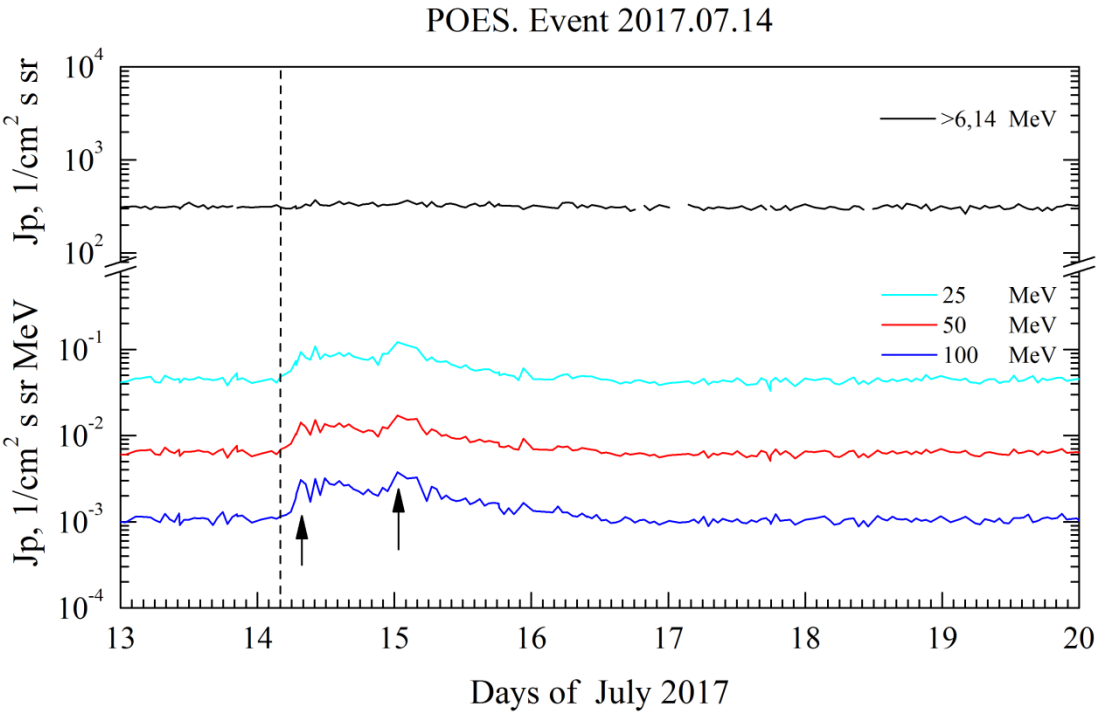



GOES. Event 2017.07.14
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of July 2017


Electro. Event 2017.07.14
Jp, 1/cm2 s sr MeV
9 - 20 MeV
20 - 40 MeV
40 - 110 MeV
Days of July 2017

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2017 July 14

2017 July 14 ● AR 12665 To event 585

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	LPS	0110	0215	0455	S06W29	1N	UMB
1 – 12	keV	0107	0209	0324	S09W33	M2.4	0.13

X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12-25	keV	0121:36	0140:14	0224:36	848	5439907	HESSI
100-300	keV	0255:24	0300:10	0314:20	8827	26473368	HESSI
100-300	keV	0314:20	0314:34	0345:24	7889	32019516	HESSI
50-100	keV	0345:24	0345:38	0359:16	4078	9088848	HESSI
12-25	keV	0429:44	0438:42	0519:24	2032	504	HESSI
12-25	keV	0119:24	0140:40	0222:40	22695	19438122	FERMI
12-25	keV	0254:41	0315:06	0340:09	1074	342950	FERMI
12-25	keV	0430:20	0430:45	0432:11	1139	12646	FERMI
12-25	keV	0432:35	0433:08	0433:24	195	1474	FERMI
12-25	keV	0435:56	0441:32	0459:05	636	177874	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0123	0126	0138		2.15	
8.8	GHz	0114	0126	0131	U9	2.04	
5	GHz	0110	0126	0145		2.51	
2.7	GHz	0110	0151	0154		2.11	
1.4	GHz	0109	0128	0155		2.64	
610	MHz	0107	0113	0218		3.22	
410	MHz	0104	0114	0218		3.22	
245	MHz	0153	0214	0626	P0.2 \ 2.7	3.52	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS IV	037-171	0353		0745		1	
DH II	0.7-14	0118		2130			WIND

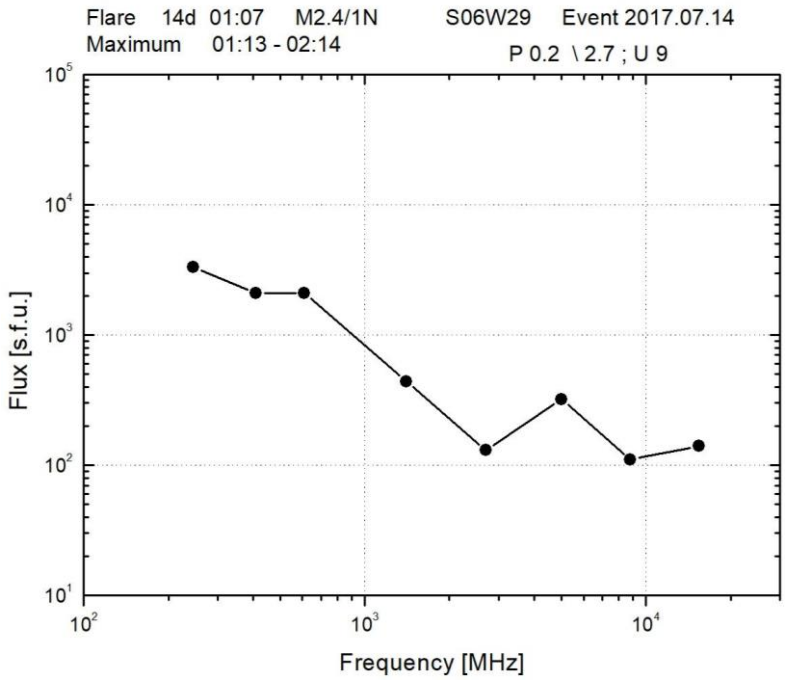
CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	0126	1200	- 0.1	360˚	230˚	SOHO

2017 July 14 Ø AR 12665 To event 585

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	No optical flare on visible disk					
1 – 12	keV	1918	1944	1925	S07W44	C1.4	0.0017

X-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
12-25	keV	1919:08	1920:42	1921:08	136	24264	HESSI

Radio burst frequency spectrum



Proton Active Region:

AR 12665 (S06L111, CMP 11,8.07.2017,
Sp=710 msh, EKC, BG, R)
XRI=0.37 $M_2^{2.4}$+C_{22} 2_3+1_4+S_{83}
PFR1 9.07 $M_1^{1.3}$
PFR2 14.07 $M_1^{2.4}$

References:

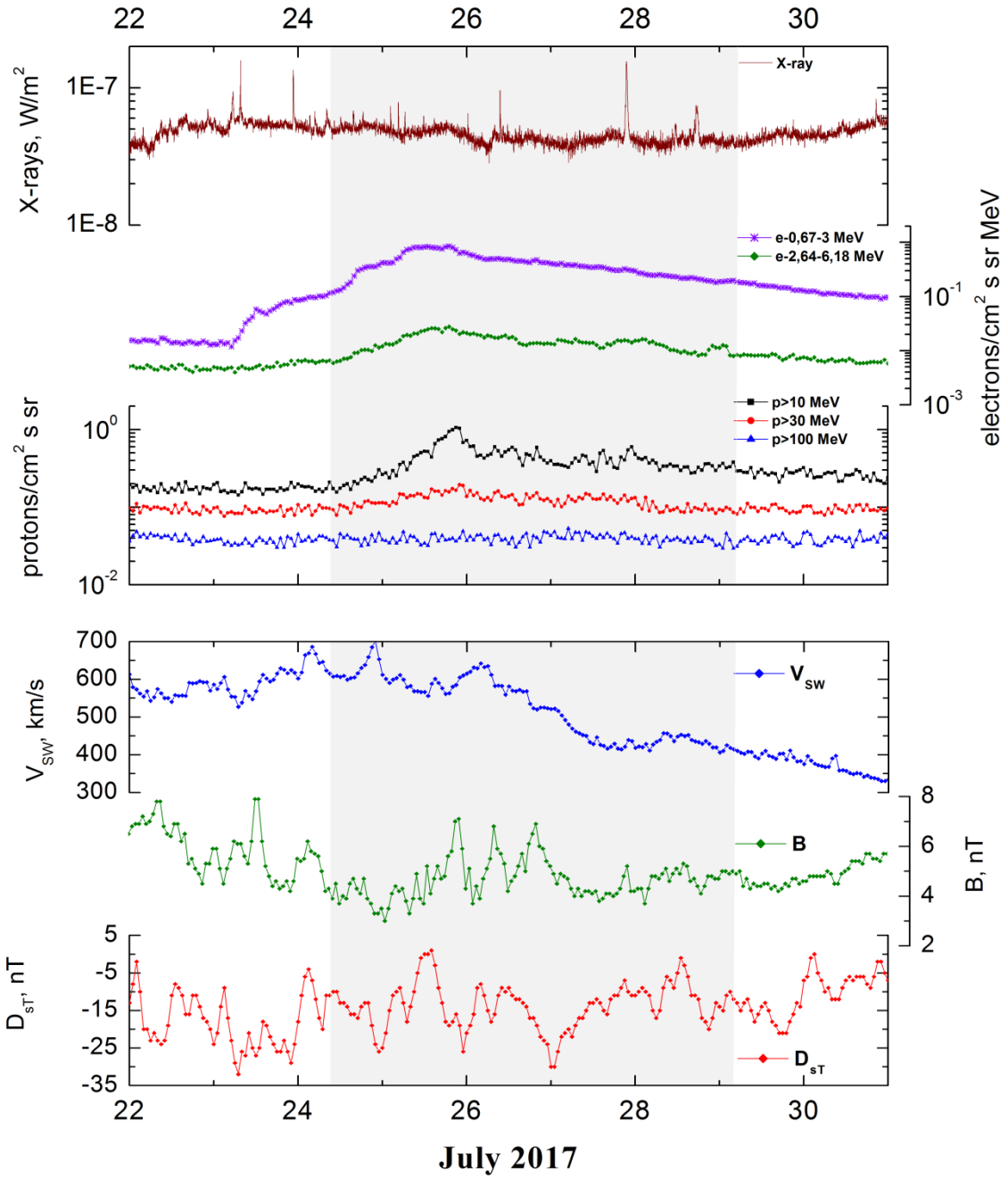
Ameri D., E. Valtonen, 2019.
Núñez M., T. Nieves-Chinchilla and A. Pulkkinen, 2019.

Event 2017.07.25 – (2017-206) **586**

Particle event: To(Ep>10 MeV) – 25d03^{h}
Tmax (Ep>10 MeV) – 25d20, Jmax (Ep>10 MeV) – 1.0 /cm^2·s·sr (ACE)
Duration of the event – 4 days, power-law index: γ = 1.8
Quasimaximal energy of protons in the event – Eqm = 9 MeV

Sources: unknown

Particle fluxes and associated phenomena

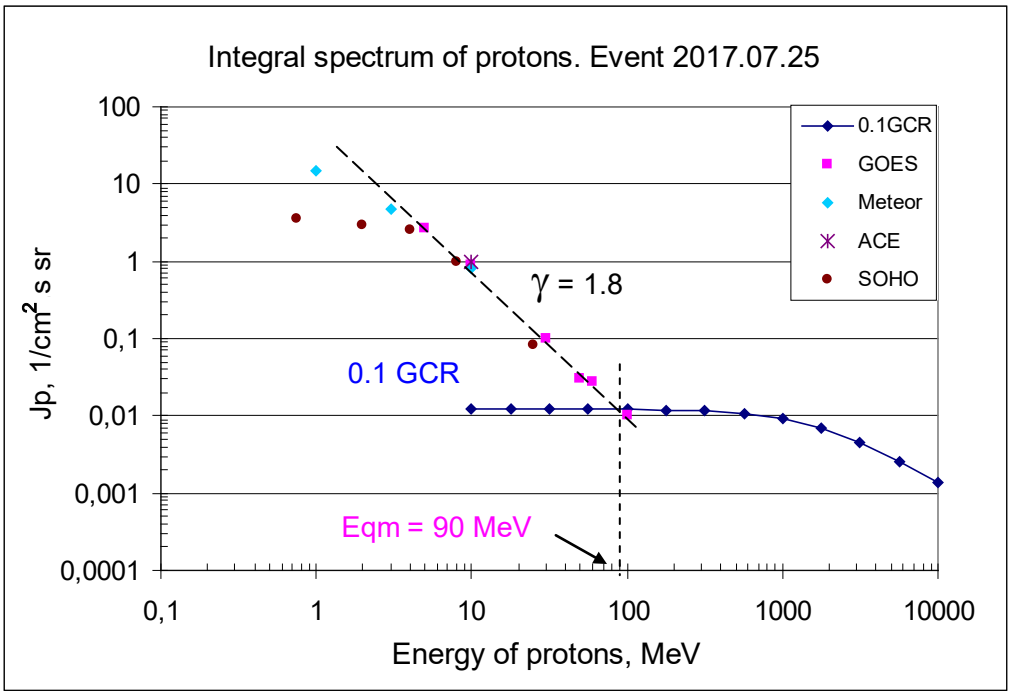


Integral fluxes of protons for the event of 2017 July 25

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	3	21	2.7	5	0.25	
EPS	>10	3	21	0.9	4	0.17	
EPS	>30	3	22	0.1	3	0.1	
EPS	>50	3	23	0.03	–	0.07	
EPS	>60	3	23	0.027	–	0.06	
EPS	>100	3	23	0.01	–	0.04	
EPS	>350	-	-	-	-	-	
Electro-2							
GALS-E	>600	-	-	-	-	0.11	
POES							
MEPED	>6.14	-	-	-	-	310	
Meteor-2							
SCR	>1	5	21	15.1	9	5	
SCR	>3	5	21	4.7	7	3	
SCR	>10	5	23	/0.8	2	2	
GALS-M	>15	6	-	-	1.5	0.9	
GALS-M	>25	6	-	-	0.5	0.9	
GALS-M	>600	-	-	-	-	0.3	
ACE							
SIS	>10	3	20	1	4	1.9	
SIS	>30	-	-	-	-	1.3	
SOHO							
EPHIN	>50	-	-	-	-	0.35	

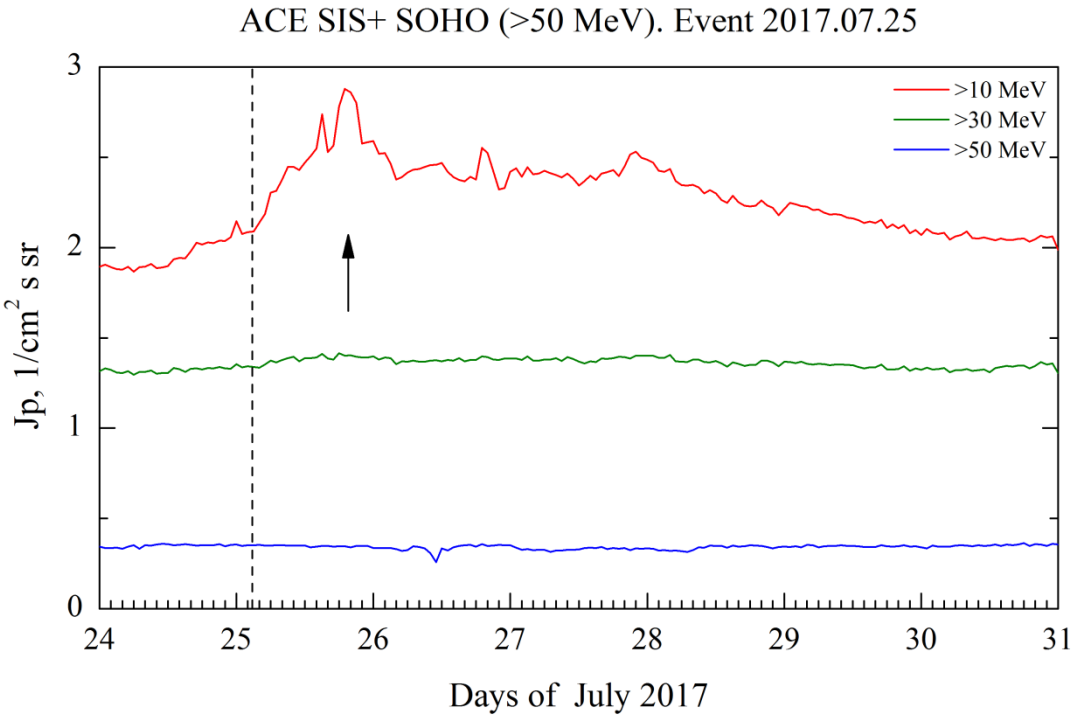
Differential fluxes of protons for the event of 2017 July 25

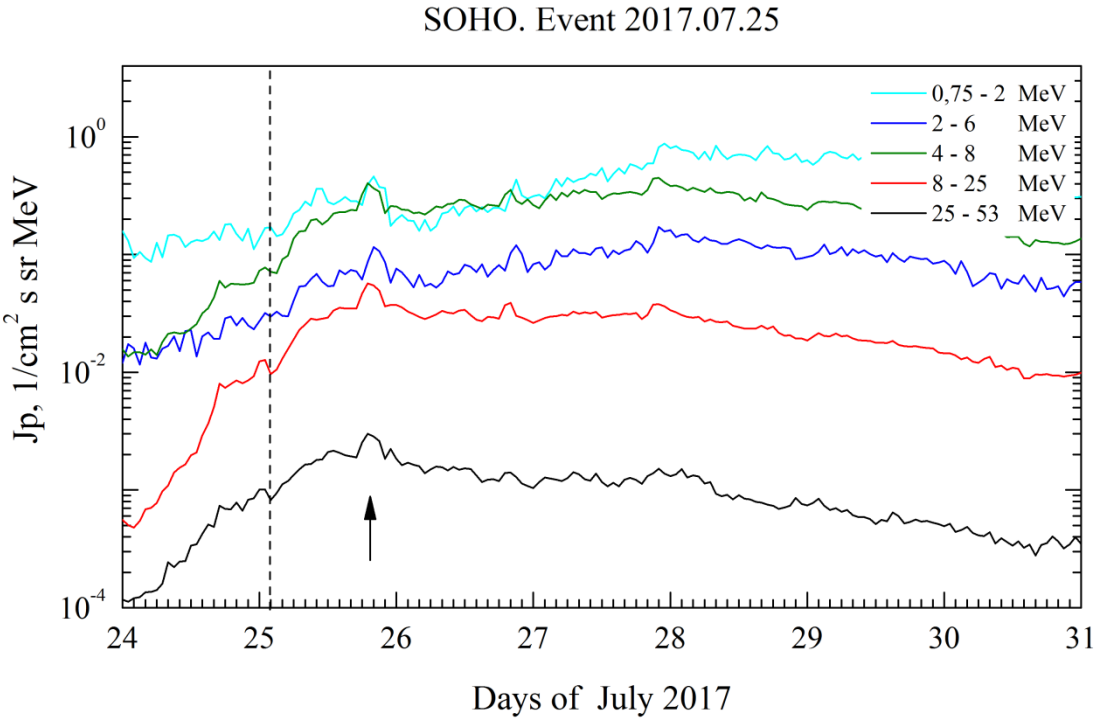
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	2	20	0.46	4	0.02	
LION	2 – 6	2	20	0.12	4	0.003	
EPHIN	4 – 8	2	20	0.4	5	0.0001	
EPHIN	8 – 25	2	20	0.055	5	0.0005	
EPHIN	25 – 53	2	20	0.003	5	0.0001	
Electro-2							
SCR-E	9 – 20	-	-	-	-	0.07	
SCR-E	20 – 40	-	-	-	-	0.03	
SCR-E	40 – 110	-	-	-	-	0.01	
POES							<E>, MeV
MEPED	16–36	-	-	-	-	0.044	25
MEPED	36–70	-	-	-	-	0.0063	50
MEPED	70–140	-	-	-	-	0.0011	100

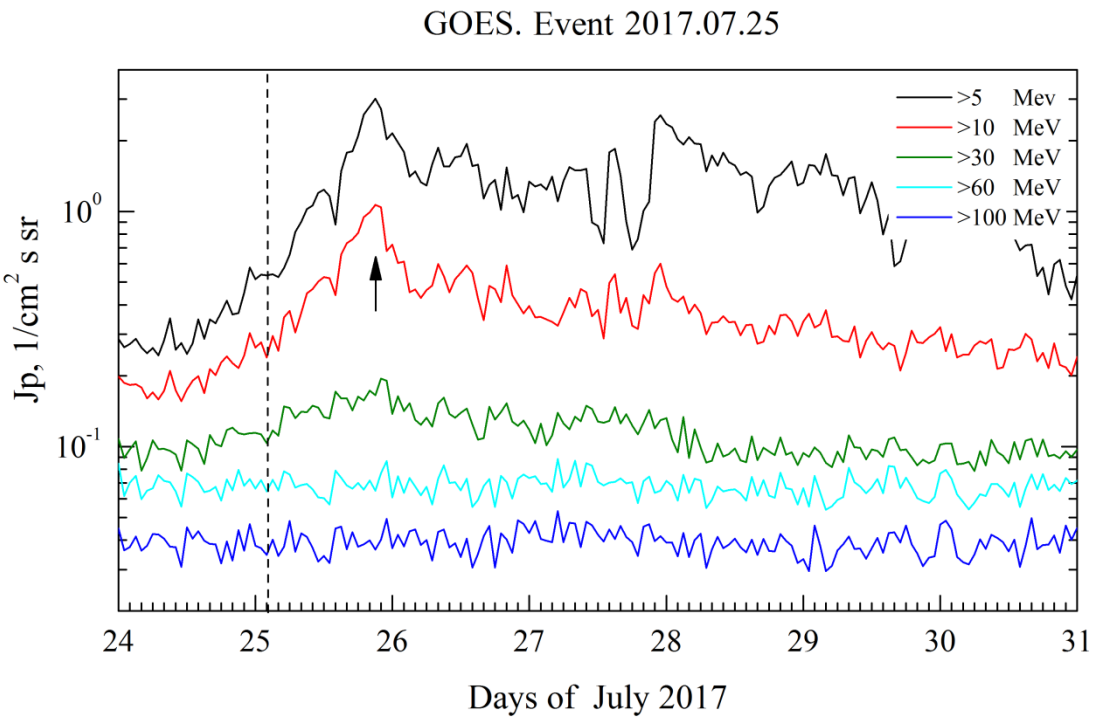

Integral spectrum of protons. Event 2017.07.25
Jp, 1/cm2 s sr
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000
Energy of protons, MeV
0.1GCR
GOES
Meteor
ACE
SOHO
γ = 1.8
0.1 GCR
Eqm = 90 MeV

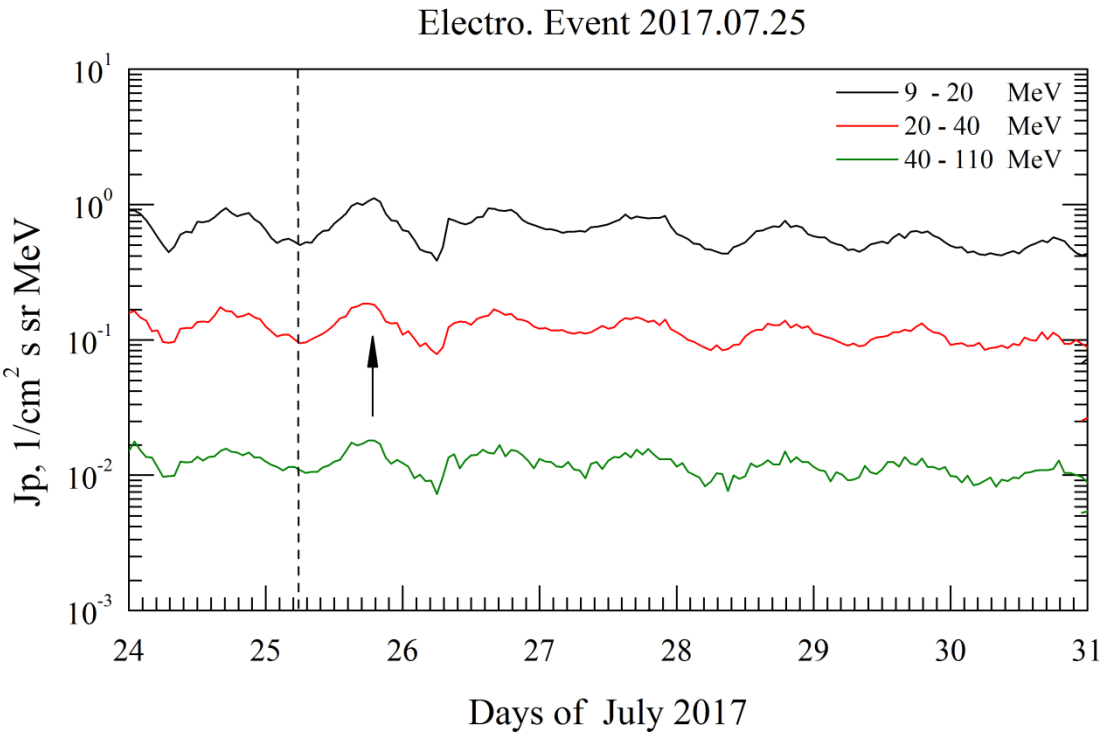
Time profiles of proton fluxes in the event 2016.07.25

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



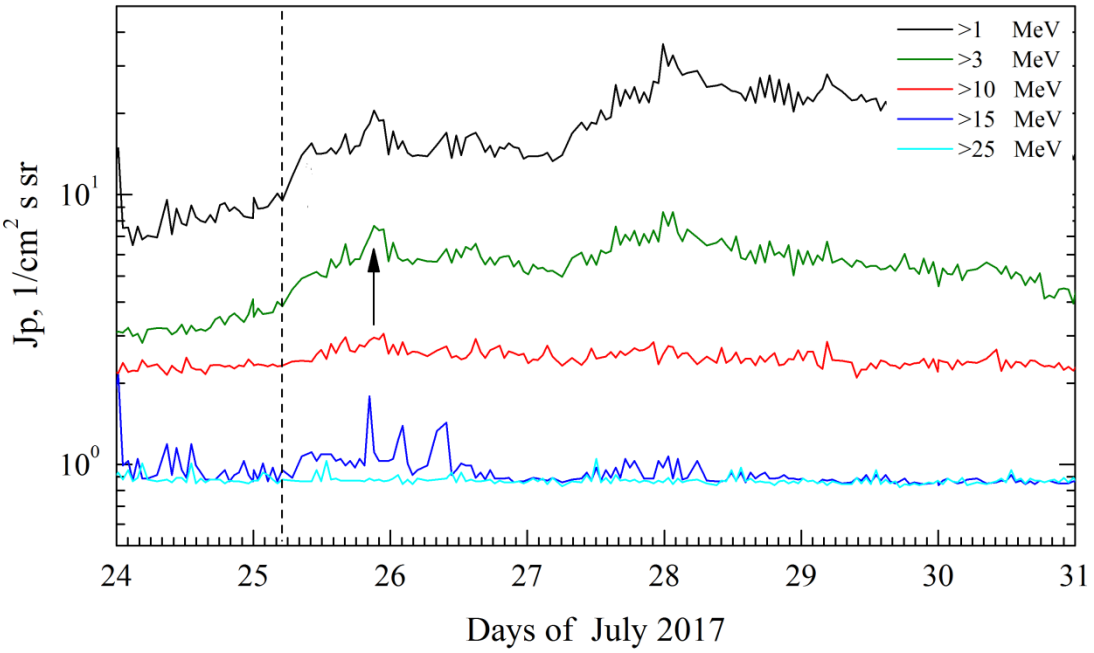



GOES. Event 2017.07.25
>5 Mev
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Jp, 1/cm2 s sr
10^0
10^-1
24
25
26
27
28
29
30
31
Days of July 2017

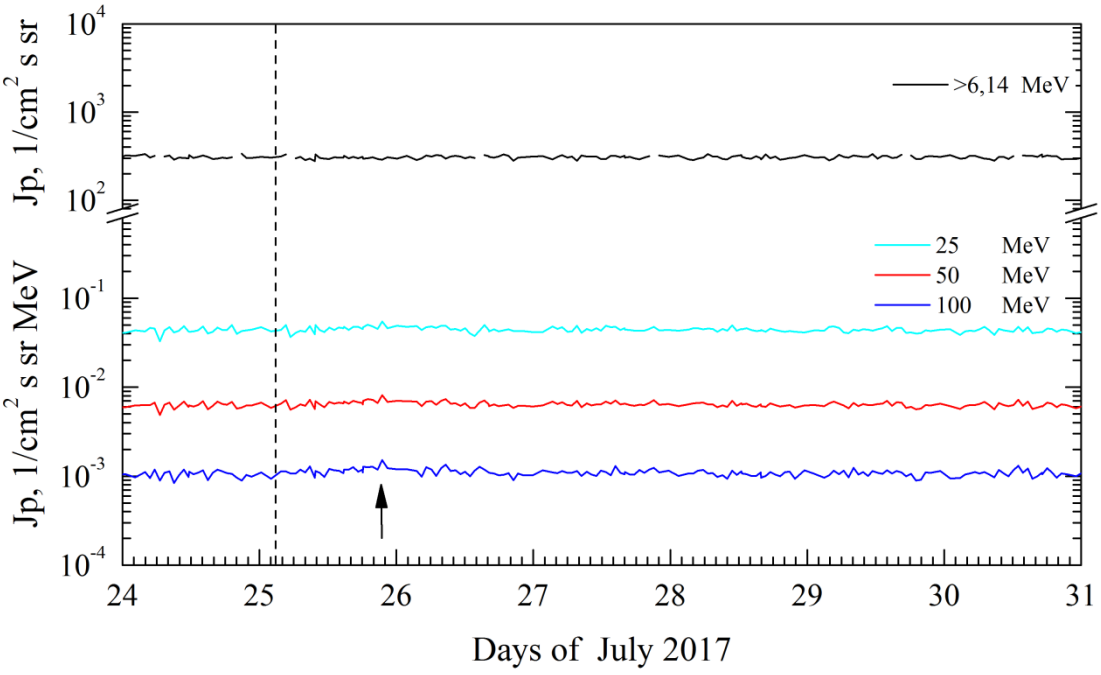

Electro. Event 2017.07.25
9 - 20 MeV
20 - 40 MeV
40 - 110 MeV
Jp, 1/cm2 s sr MeV
10^1
10^0
10^-1
10^-2
10^-3
24
25
26
27
28
29
30
31
Days of July 2017

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2017.07.25



POES. Event 2017.07.25



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2017 July 25

2017	**July 25**	**Sources unknown**	**AR XXXXX**	**To event 586**

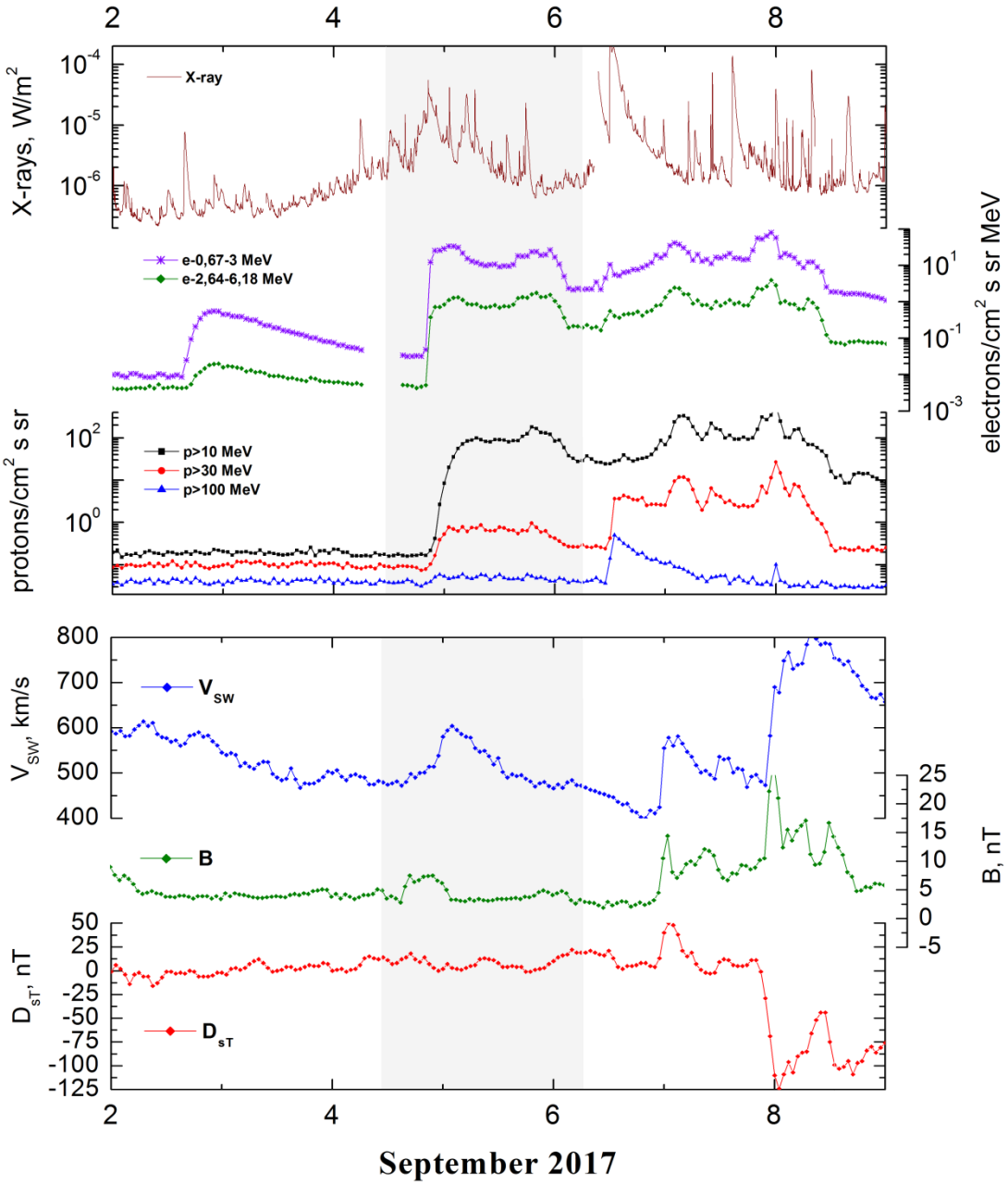
References:

http://newserver.stil.bas.bg/SEPcatalog/index.html

Particle event: To(Ep>10 MeV) – 04d21^{h}
Tmax$_1$(Ep>10 MeV) – 05d07^{h}, Jmax$_1$(Ep>10 MeV) – 99 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 05d19^{h}, Jmax$_2$(Ep>10 MeV) – 167 /cm^2·s·sr
Duration of the event – 1.5 days, power-law index: $\gamma_1 = 3.5$, $\gamma_2 = 4.1$
Quasimaximal energy of protons in the event – Eqm$_1$ = 100 MeV
– Eqm$_2$ = 90 MeV

Sources: ● solar flare 04d13^{h}45^{m},3B/M1.5; M1.0; M1.7; M1.5; M5.5; M2.1/, S11W16, AR12673
Main burst X-ray 1–8 Å: onset – 04d20^{h}28^{m}, max – 04d20^{h}33^{m}, Φ = 0.018 J/m^2
CME: 04d20^{h}12^{m}, V = 1418 km/s, Δφ = 360°, dA= 184°

Particle fluxes and associated phenomena

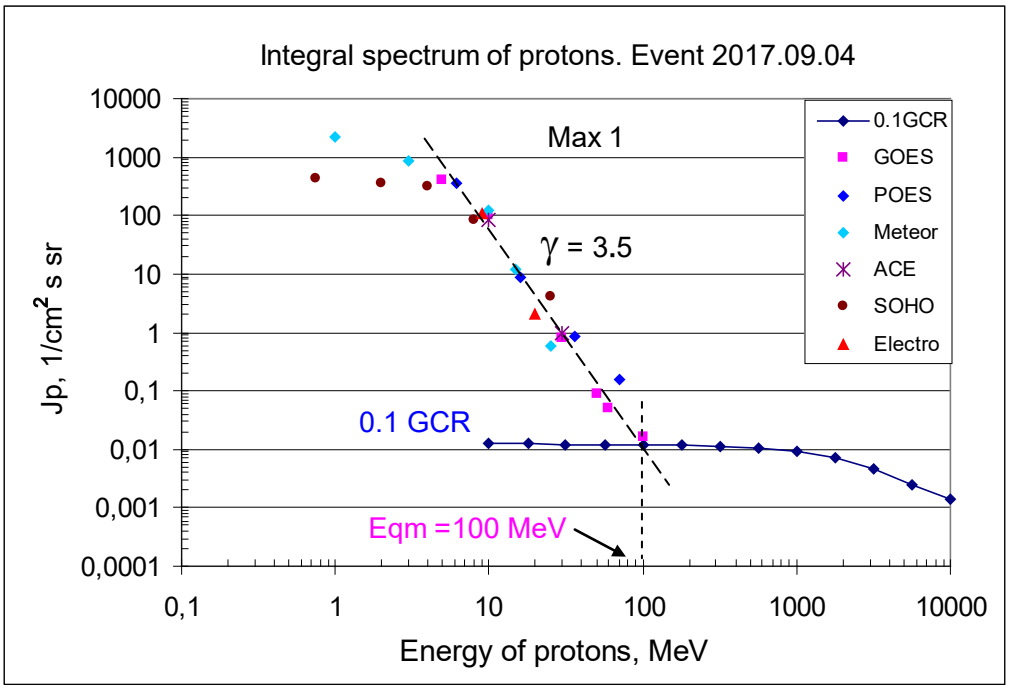


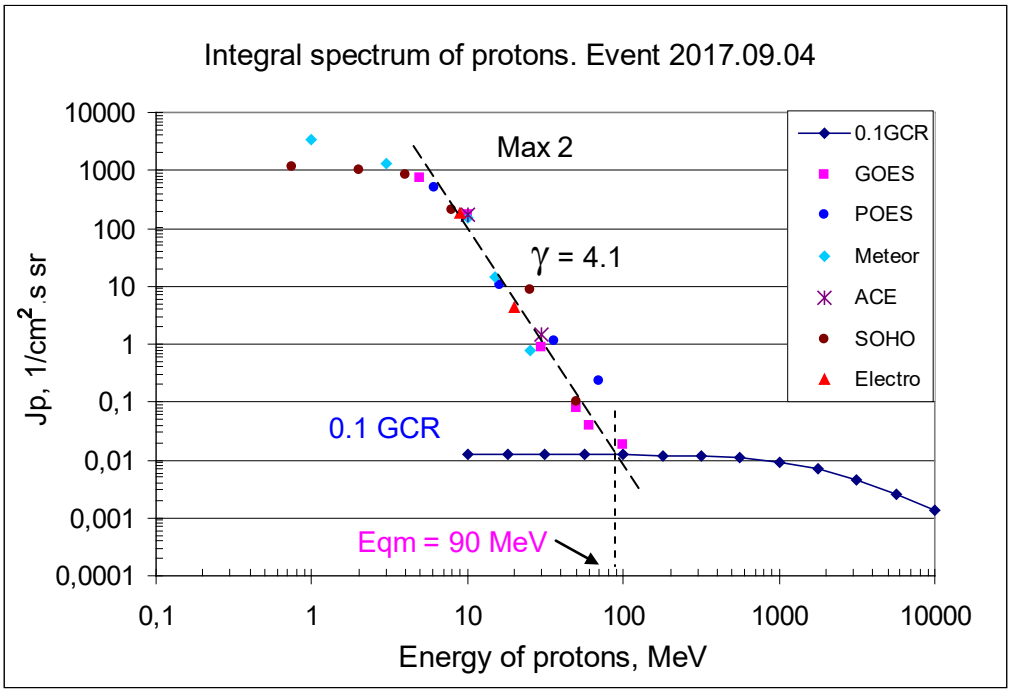
Integral fluxes of protons for the event of 2017 September 04

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	21	5d07/5d20	397/725	1.5	0.25	
EPS	>10	21	5d07/5d19	99/167	1.5	0.2	
EPS	>30	21	5d08/5d19	0.8/0.9	1.5	0.1	
EPS	>50	21	5d08/5d19	0.09/0.08	1	0.08	
EPS	>60	21	5d08/5d19	0.05/0.04	1	0.06	
EPS	>100	21	5d08/5d19	0.016/0.018	1	0.04	
Electro-2							
GALS-E	>600	-	-	-	-	0.11	
POES							
MEPED	>6.14	-	05d08/05d22	354/515	1.5	300	
Meteor-2							
SCR	>1	20	05d8/05d21	2215/3500	1.5	5.0	
SCR	>3	22	05d8/05d21	860/1330	1.5	2.7	
SCR	>10	22	05d6/05d20	125/ 150	1.5	2.0	
GALS-M	>15	20	05d3/05d20	12/14	1.5	0.9	
GALS-M	>25	22	05d1/05d20	0.6/0.76	1.5	0.9	
GALS-M	>600	-	-	-	1.5	0.3	
ACE							
SIS	>10	22	5d08/5d20	86.6/173	1.5	1.9	
SIS	>30	22	5d07/5d20	1/1.5	1.5	1.3	
SOHO							
EPHIN (INT)	>50	-	- /5d21	- /0.1	1.5	0.35	

Differential fluxes of protons for the event of 2017 September 04

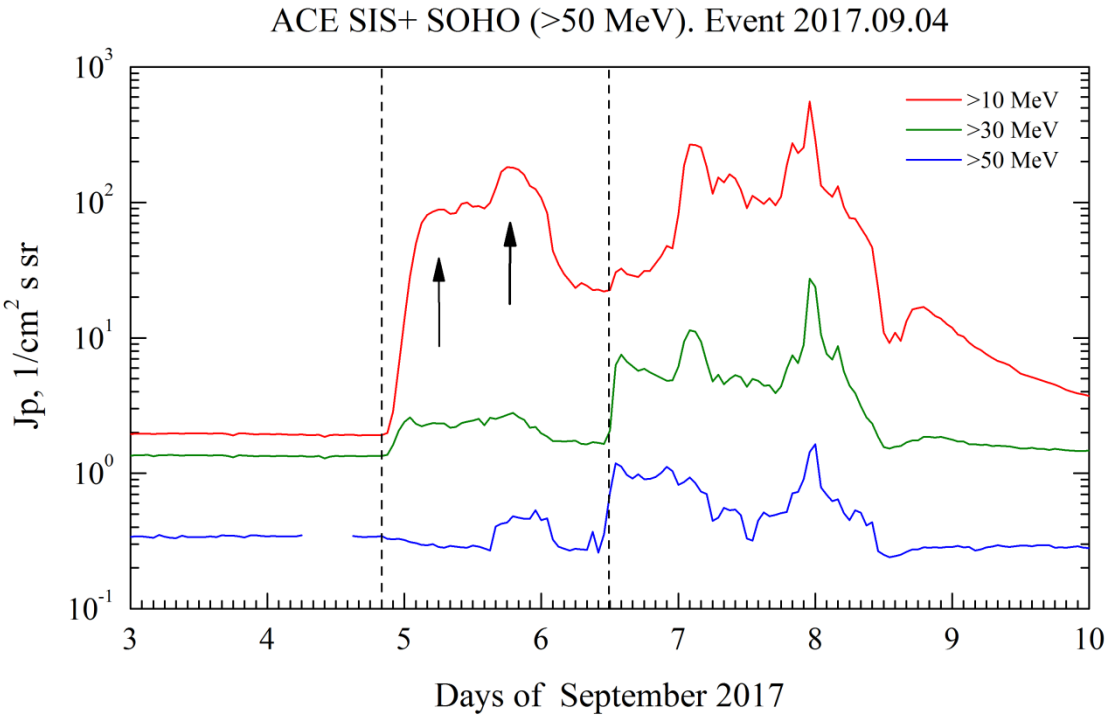
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75-2	20	5d07/5d20	50/110	1.5	0.03	
LION	2 – 6	20	5d07/5d20	19/44	1.5	0.003	
EPHIN	4 – 8	20	5d07/5d20	56/162	1.5	0.0002	
EPHIN	8 – 25	20	5d07/5d20	4.6/12	1.5	0.00005	
EPHIN	25 – 53	20	5d07/5d20	0.15/0.3	1.5	0.00002	
Electro-2							
SCR-1	9–20	21	5d06/5d19	9.6/16.7	1.5	0.3	
SCR-1	20–40	21	5d07/5d19	0.1/0.21	1.5	0.08	
SCR-1	40–110	-	-	-	-	-	
POES							<E>, MeV
MEPED	16–36	22	05d08/05d22	0.36/0.475	1.5	0.043	25
MEPED	36–70	22	05d08/05d22	0.021/0.026	1.5	0.0059	50
MEPED	70–140	22	05d08/05d22	0.0022/0.0033	1.5	0.0011	100

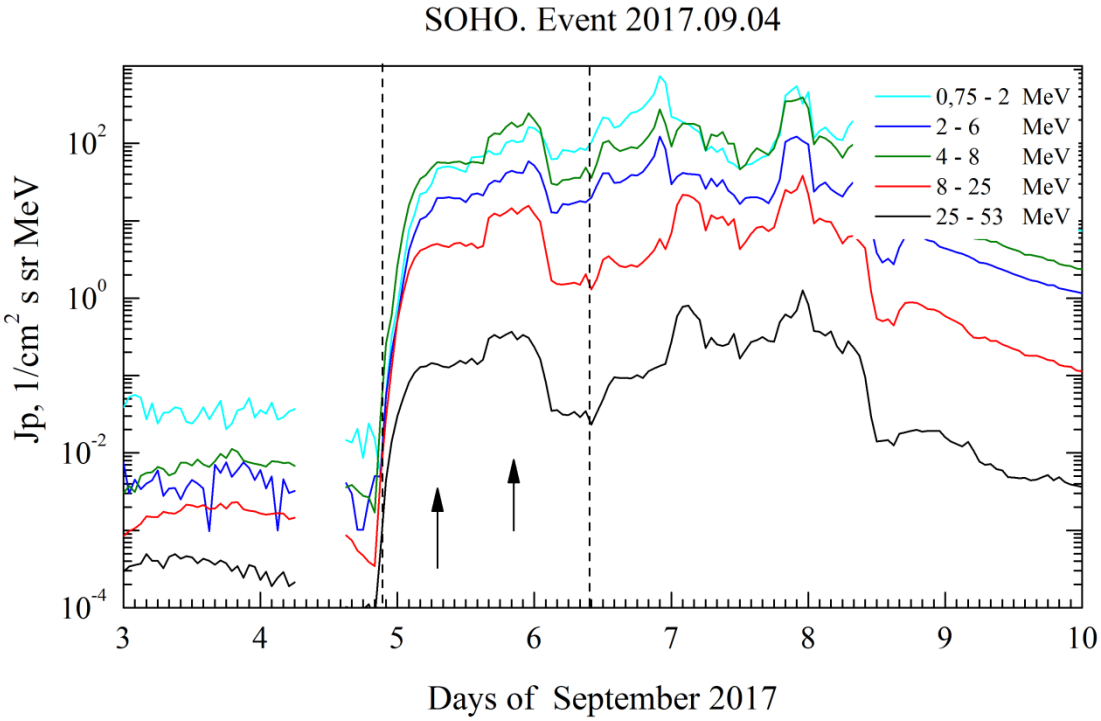

Integral spectrum of protons. Event 2017.09.04
Max 1
γ = 3.5
0.1 GCR
Eqm =100 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2017.09.04
Max 2
γ = 4.1
0.1 GCR
Eqm = 90 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

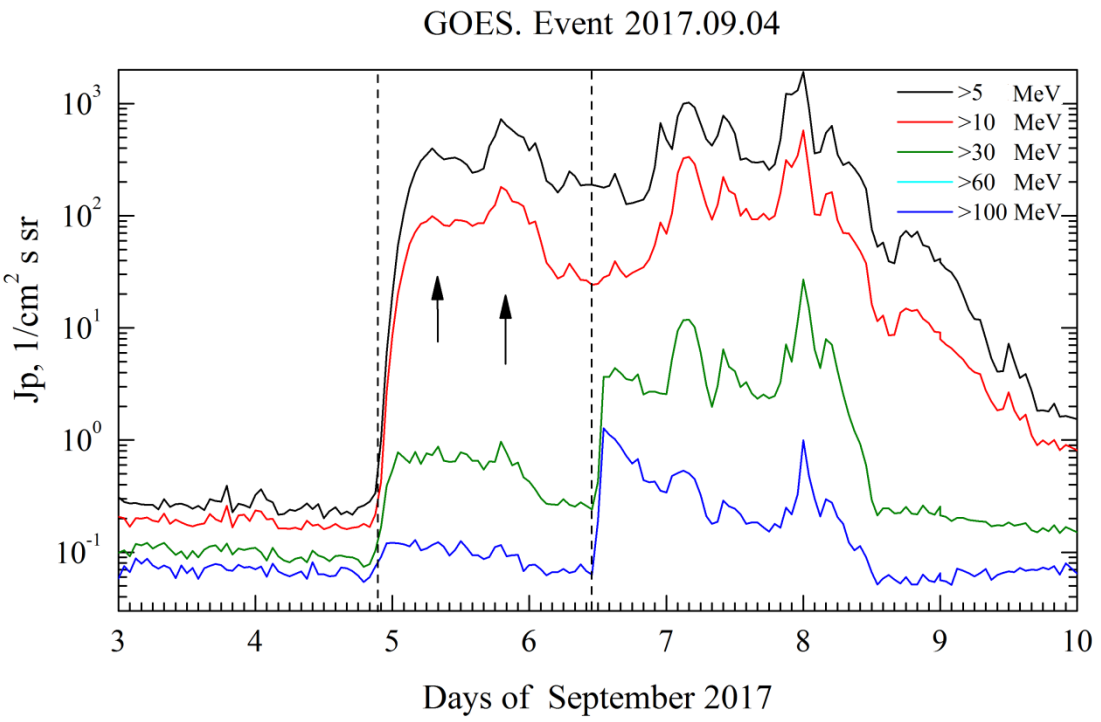
Time profiles of proton fluxes in the event 2017.09.04

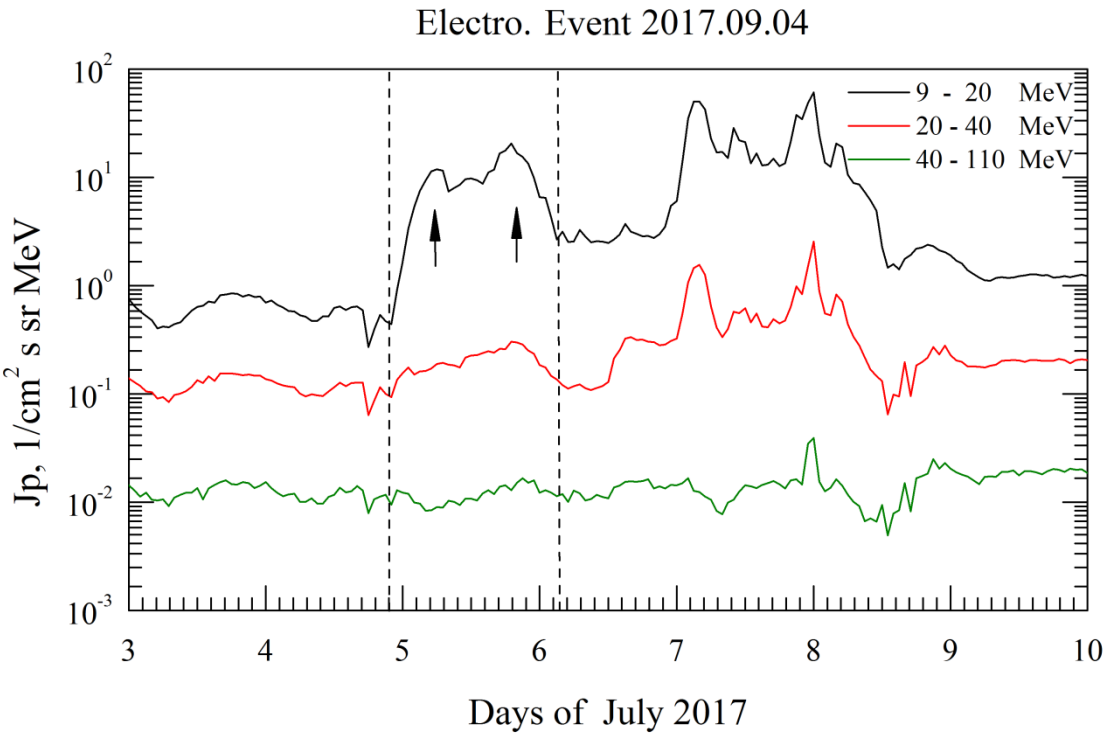
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



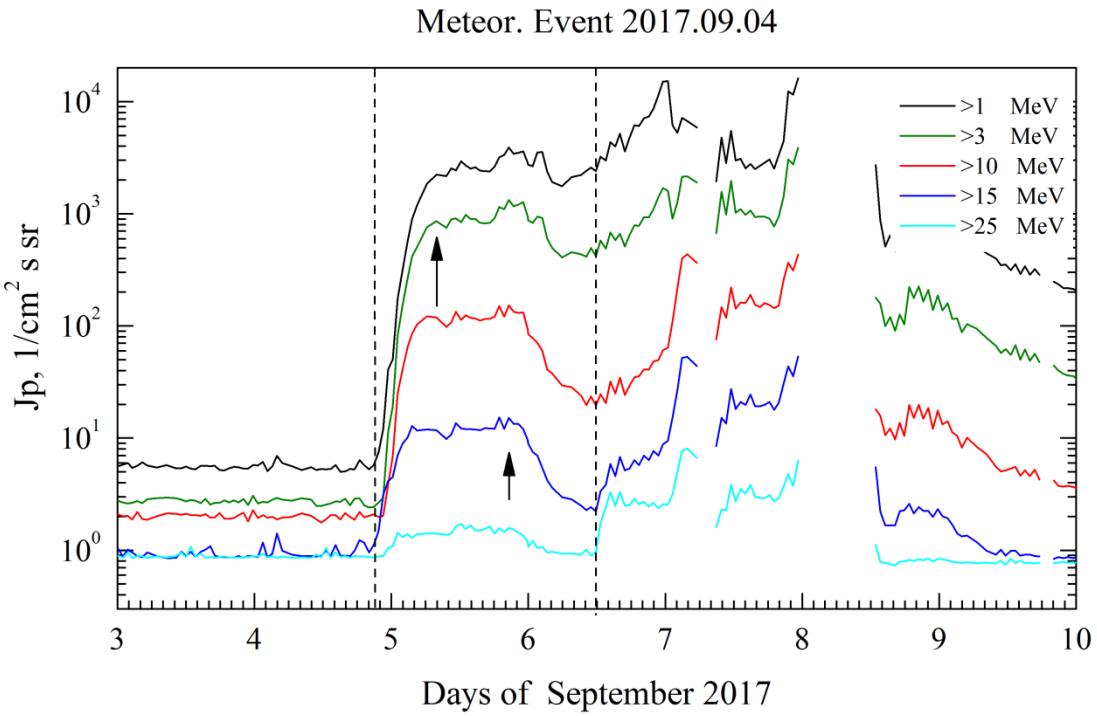


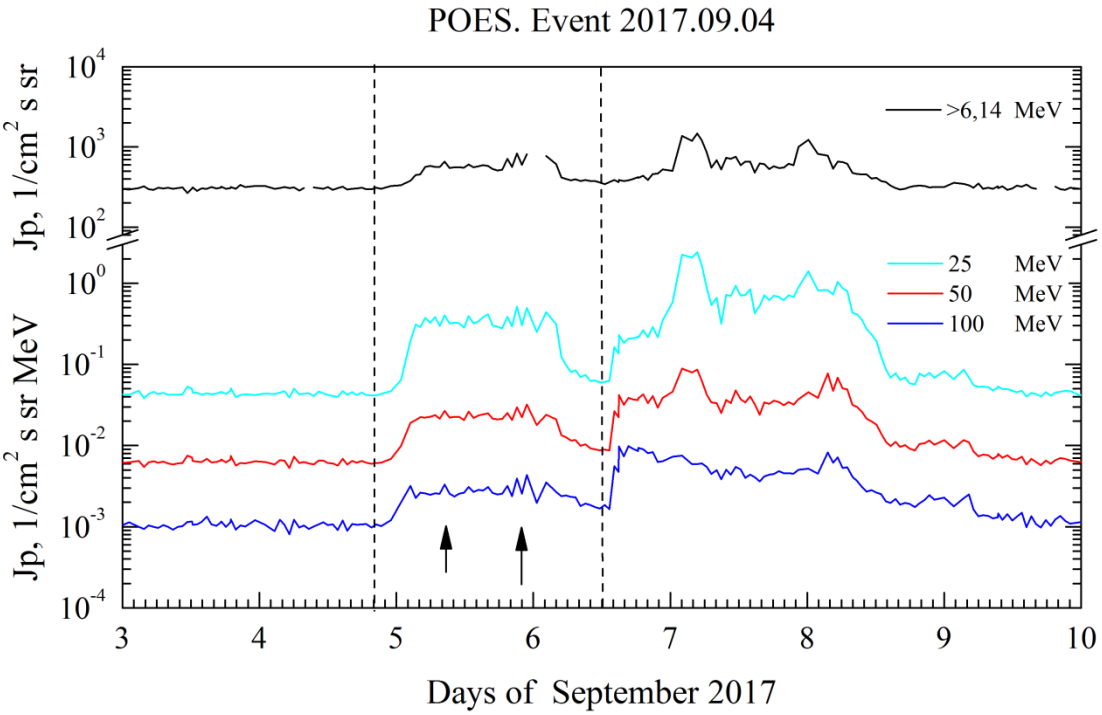
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2017 September 04

2017 September 04 • AR 12673 To event 587

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	1343	2033	>2359	S11W16	3B	ERU
1 – 12	keV	1511	1530	1533	S10W08	M1.5	0.0064
1 – 12	keV	1805	1822	1831	S07W11	M1.0	0.011
1 – 12	keV	1846	1937	1952	S09W11	M1.7	0.045
1 – 12	keV	1959	2002	2006	S10W11	M1.5	0.0042
1 – 12	keV	2028	2033	2037	S10W11	M5.5	0.018
1 – 12	keV	2210	2214	2219	S09W12	M2.1	0.0084

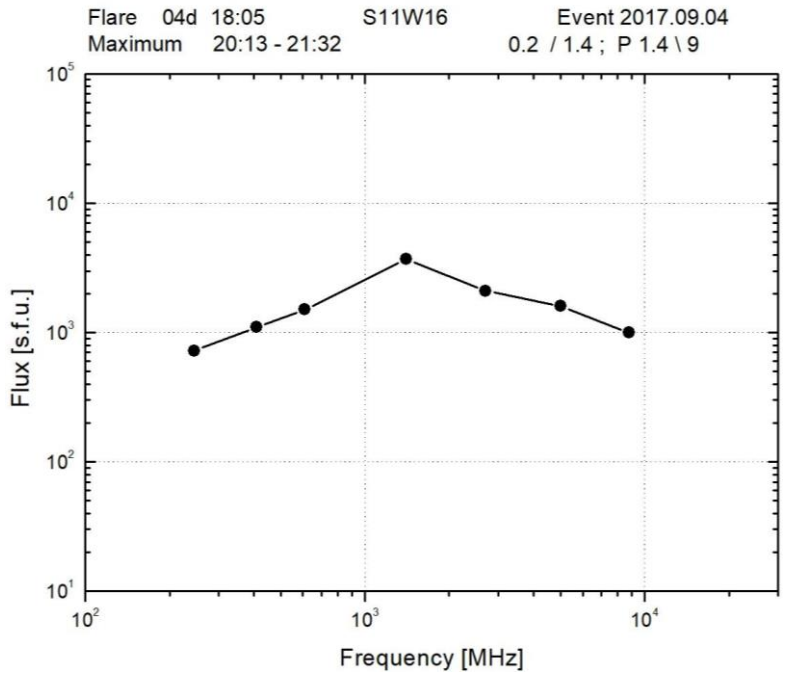
X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
100-300	keV	1526:00	1530:02	1546:12	160	91391	HESSI
50-100	keV	1713:44	1728:18	1733:32	1136	2108352	HESSI
12-25	keV	1844:12	1852:58	1902:40	1840	5259840	HESSI
25-50	keV	1902:40	1912:50	1913:28	1904	3298944	HESSI
6-12	keV	2009:20	2032:14	2052:40	848	1314863	HESSI
12-25	keV	1412:19	1413:08	1415:44	24851	248743	FERMI
12-25	keV	1515:57	1515:57	1517:35	654	10262	FERMI
12-25	keV	1525:26	1529:54	1533:23	96559	10276245	FERMI
12-25	keV	1613:39	1614:16	1614:49	5695	25751	FERMI
12-25	keV	1657:20	1657:29	1658:01	1362	7753	FERMI
12-25	keV	1723:51	1738:31	1748:54	6244	581960	FERMI
12-25	keV	1826:23	1858:56	1925:17	3279	1378001	FERMI
12-25	keV	2001:37	2032:20	2100:41	509993	109992256	FERMI
12-25	keV	2136:52	2214:33	2231:37	43135	3154991	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
8.8	GHz	2011	2048	2142		3.0	
5	GHz	2013	2050	2122		3.2	
2.7	GHz	2011	2050	2119		3.32	
1.4	GHz	2026	2044	2120	P1.4 \ 9	3.57	
610	MHz	2008	2013	2136		3.18	
410	MHz	2011	2132	2135		3.04	
245	MHz	2009	2009	2009	0.2 / 1.4	2.86	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	025-056	2042		2050	1472	1	
DS IV	025-108	1908		2126		1	
DS III	025-180	1719		1720		2	
DS V	025-180	0017		0019		2	
DS VI	025-048	1649		2221		1	
DH II	0.21-14	2027		5d/0454			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1900	597	52.9	205˚	240˚	SOHO
LASCO	WL	2012	1418	47.5	360˚	184˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR12673 (S08L117, CMP 04.09.2017,
Sp=1060 msh, EKC, BGD, R3),
XRI=18.97, $X_5^{9.3}$+$M_{26}^{8.1}$+C_{54}), 3_2+2_4+1_{13}+S_{84}
PFR1 4–5.09 (12^h): $M_8^{5.5}$;
PFR2 6–8.09 (12^h): $X_3^{9.3}$+$M_{15}^{8.1}$;
PFR3 9–10.09 (17^h): $X_1^{8.2}$+M_1

References:

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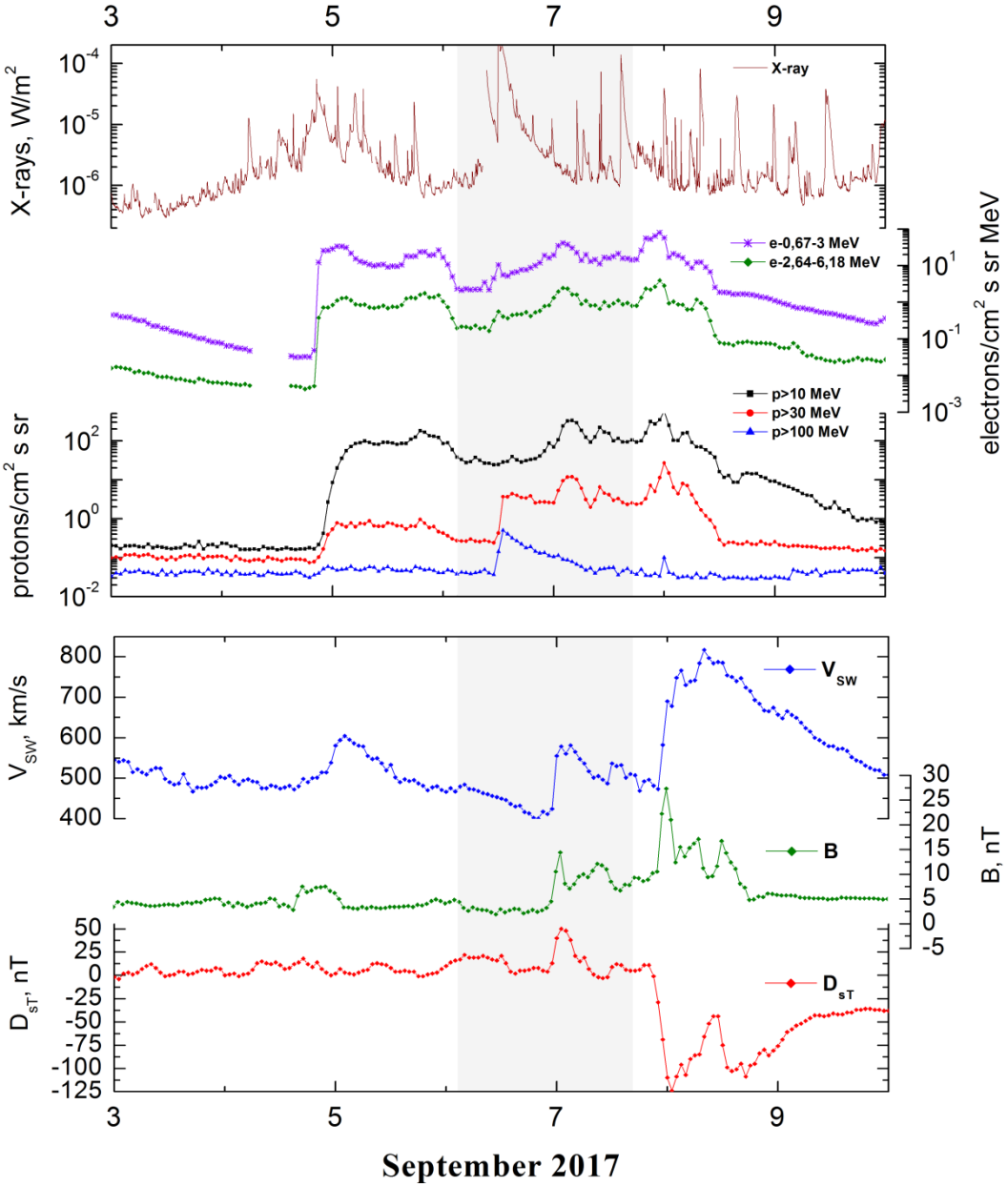
Zhuang B., N. Lugaz, T. Gou, L. Ding, 2021.

Event 2017.09.06 – (2017-249) **588**

Particle event: To(Ep>10 MeV) – 06d11^{h}
Tmax$_1$(Ep>10 MeV) – 06d15^{h}, Jmax$_1$(Ep>10 MeV) – 39 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 07d04^{h}, Jmax$_2$(Ep>10 MeV) – 334 /cm^2·s·sr
Duration of the event – 1 day, power-law index: γ_1 = 2.1, γ_2 = 3.8,
Quasimaximal energy of protons in the event – Eqm$_1$ = 450 MeV
– Eqm$_2$ = 140 MeV

Sources: ● solar flare 06d08^{h}52^{m}, 2B/X2.2, X9.3, S07W33, AR12673
Ø solar flare 06d13^{h}54^{m}, 3N/M2.5, S08W38, AR12673
Main burst X-ray 1–8 Å: onset – 06d11^{h}53^{m}, max – 06d12^{h}02^{m}, Φ = 0.57 J/m^2
CME 06d 12^{h}24^{m}, V = 1571 km/s, Δφ = 360°, dA= 201°
▲SC 06d 23^{h}44^{m}

Particle fluxes and associated phenomena

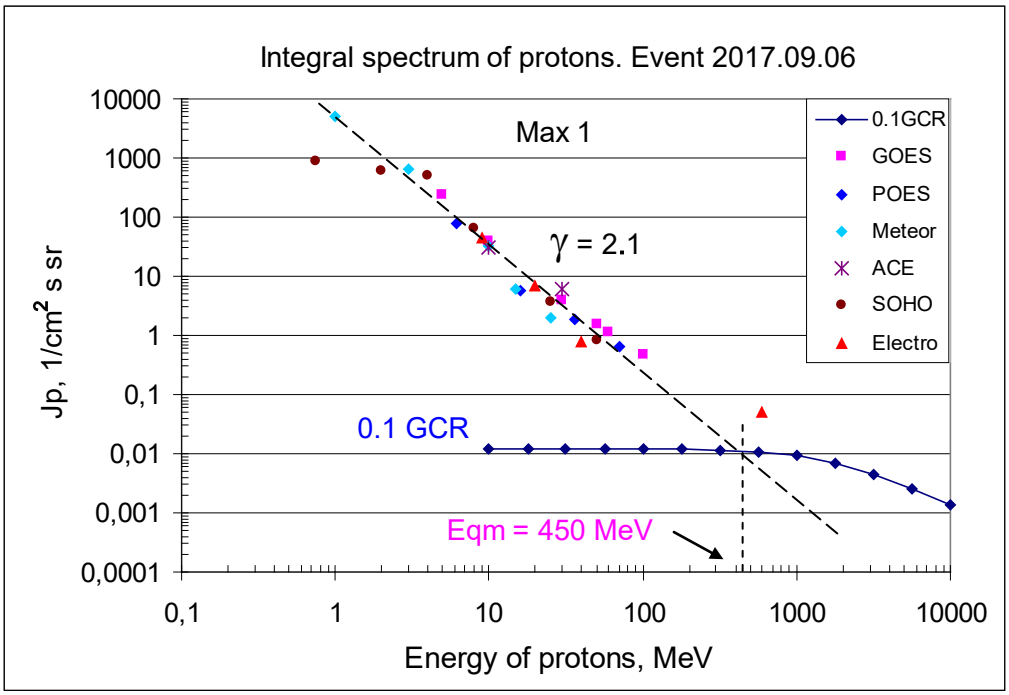


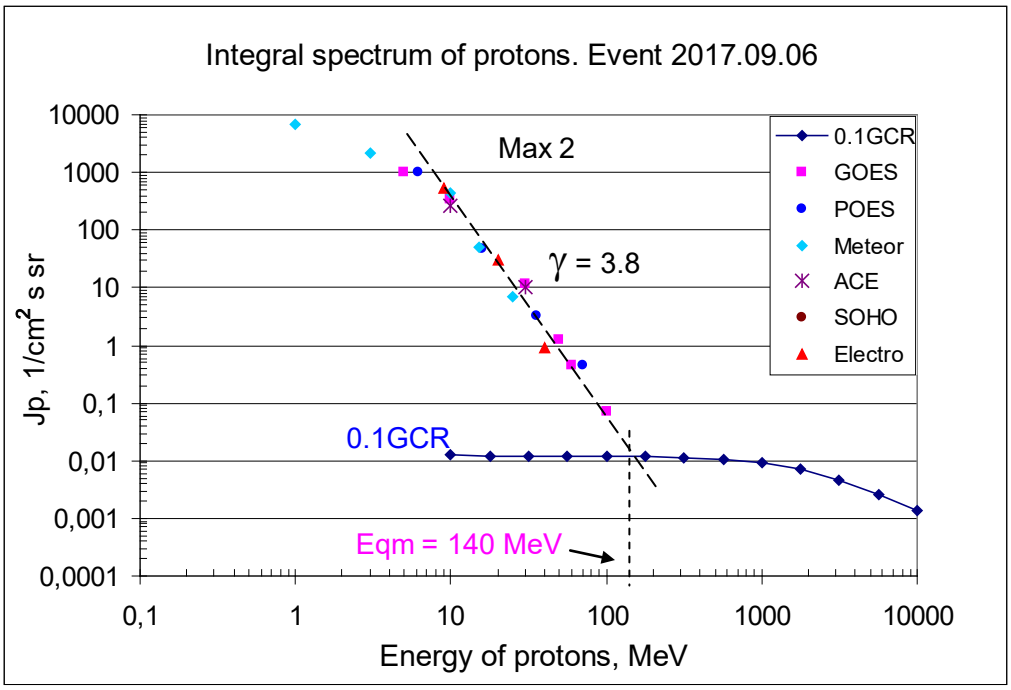
Integral fluxes of protons for the event of 2017 September 06

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	11	15/07d04	237/1020	1	0.25	
EPS	>10	11	15/07d04	39/334	1	0.18	
EPS	>30	11	15/07d04	3.9/11.7	1	0.1	
EPS	>50	11	14/07d04	1.55/1.23	1	0.08	
EPS	>60	11	14/07d04	1.1/0.45	1	0.06	
EPS	>100	11	13/07d04	0.46/0.07	1	0.04	
EPS	>350	-	-	-	-	-	
Electro-2							
GALS-E	>600	12	13/ -	0.05/ -	0.25	0.11	
POES							
MEPED	>6.14	13	15/07d03	80/1040	2	310	
Meteor-2							
SCR	>1	12	16/07d03	5080/6860	4	5.0	
SCR	>3	12	16/07d03	648/2200	4	2.7	
SCR	>10	12	16/07d03	32/440	4	2.0	
GALS-M	>15	12	16/07d03	6/50	3	0.9	
GALS-M	>25	12	16/07d03	2/7	3	0.9	
GALS-M	>600	-	-	-	-	0.3	
ACE							
SIS	>10	12	14/7d06	30.6/265	1.25	1.9	
SIS	>30	12	14/7d06	6.2/10.1	1.25	1.3	
SOHO							
EPHIN (INT)	>50	11	13/7d03	0.8/0.6	1.5	0.3	

Differential fluxes of protons for the event of 2017 September 06

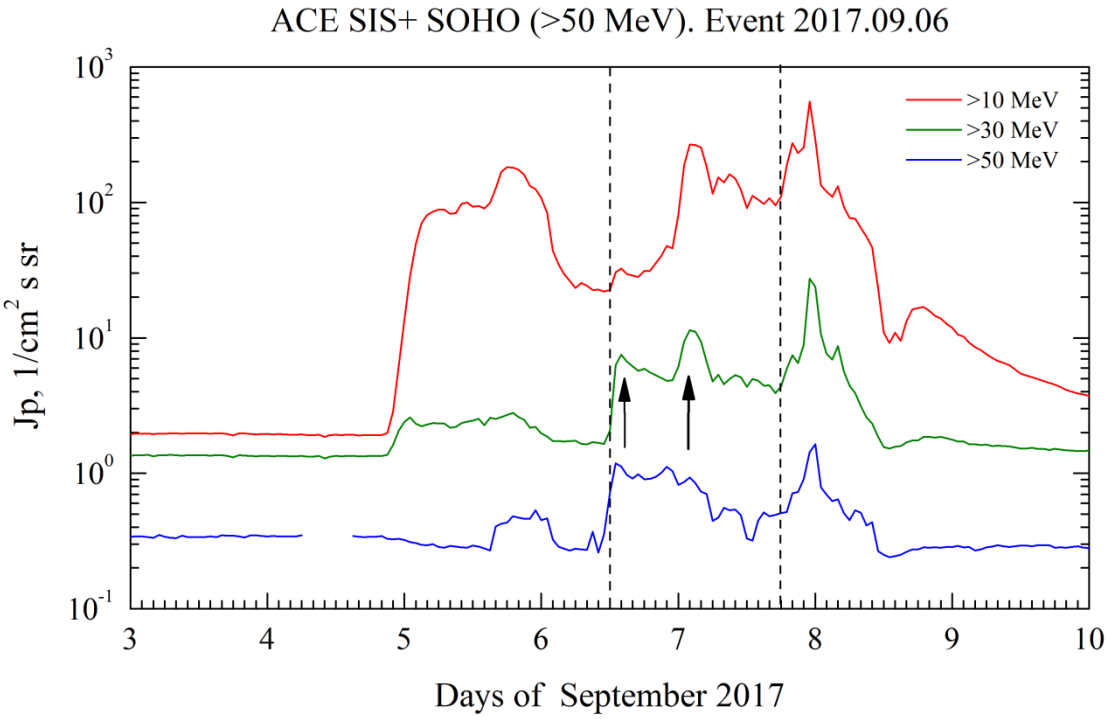
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	11	13/7d03	210/180	1.5	0.03	
LION	2 – 6	11	13/7d03	41/40	1.5	0.003	
EPHIN	4 – 8	11	13/7d03	110/180	1.5	0.0002	
EPHIN	8 – 25	11	13/7d03	3.5/21.3	1.5	0.00005	
EPHIN	25 – 53	11	13/7d03	0.1/0.3	1.5	0.00002	
Electro-2							
SCR-1	9–20	12	15/07d04	3.4/46.5	1	0.04	
SCR-1	20–40	12	15/07d04	0.3/1.5	1	0.02	
SCR-1	40–110	12	15/07d04	0.011/0.013	1	0.004	
POES							<E>, MeV
MEPED	16–36	13	15/7d03	0.187/2.2	2.6	0.043	25
MEPED	36–70	13	15/7d03	0.036/0.083	2.7	0.006	50
MEPED	70–140	13	15/7d03	0.009/0.0064	2.8	0.001	100

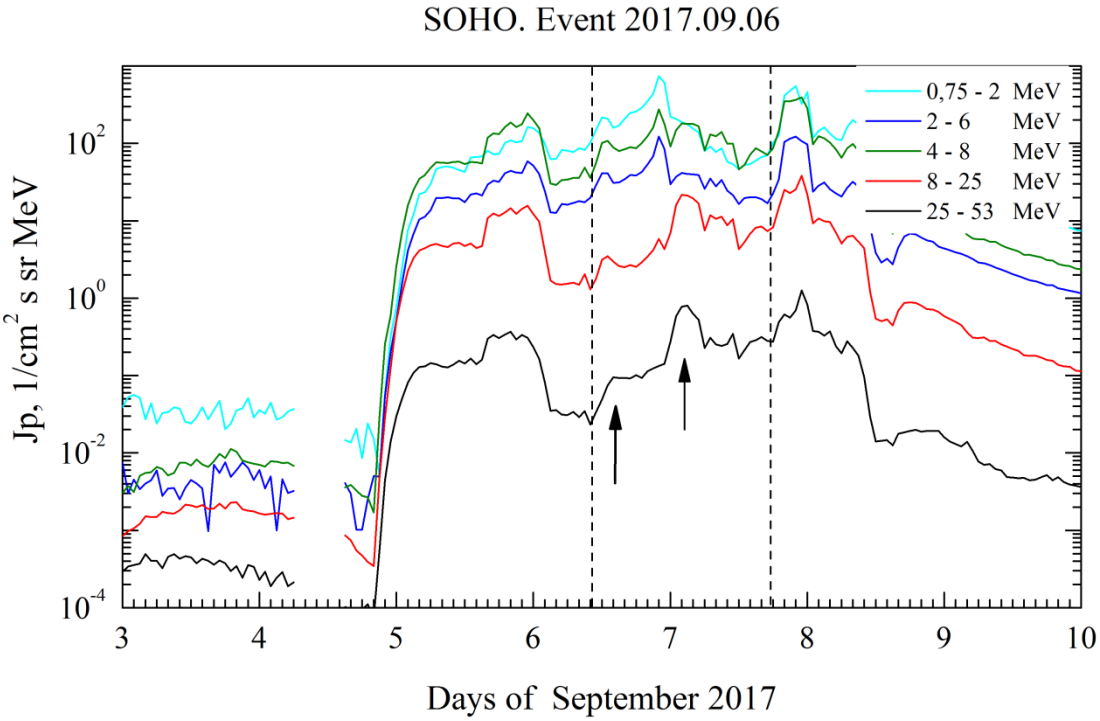

Integral spectrum of protons. Event 2017.09.06
Max 1
γ = 2.1
0.1 GCR
Eqm = 450 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000


Integral spectrum of protons. Event 2017.09.06
Max 2
γ = 3.8
0.1GCR
Eqm = 140 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

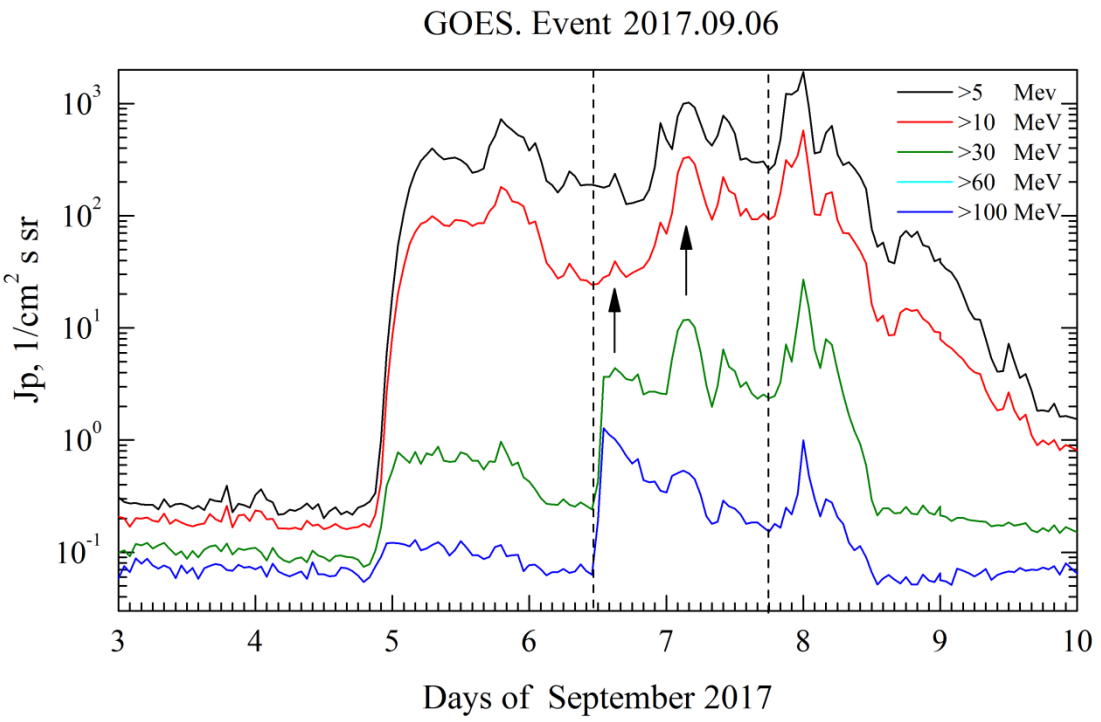
Time profiles of proton fluxes in the event 2017.09.06

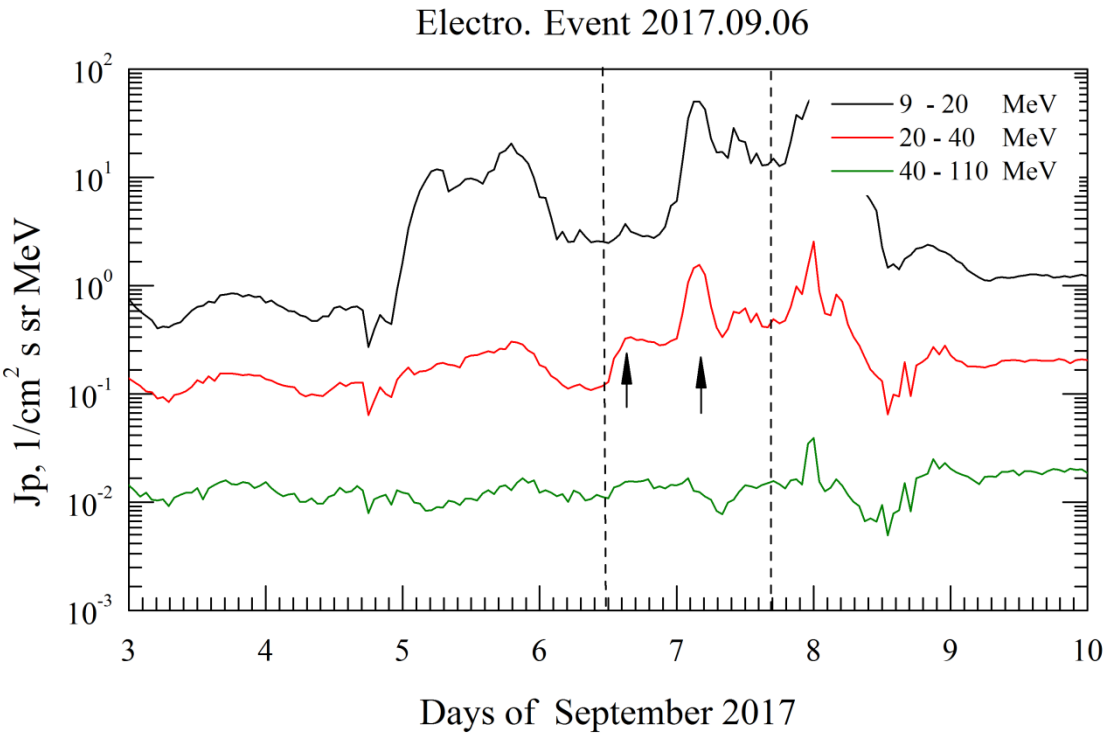
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



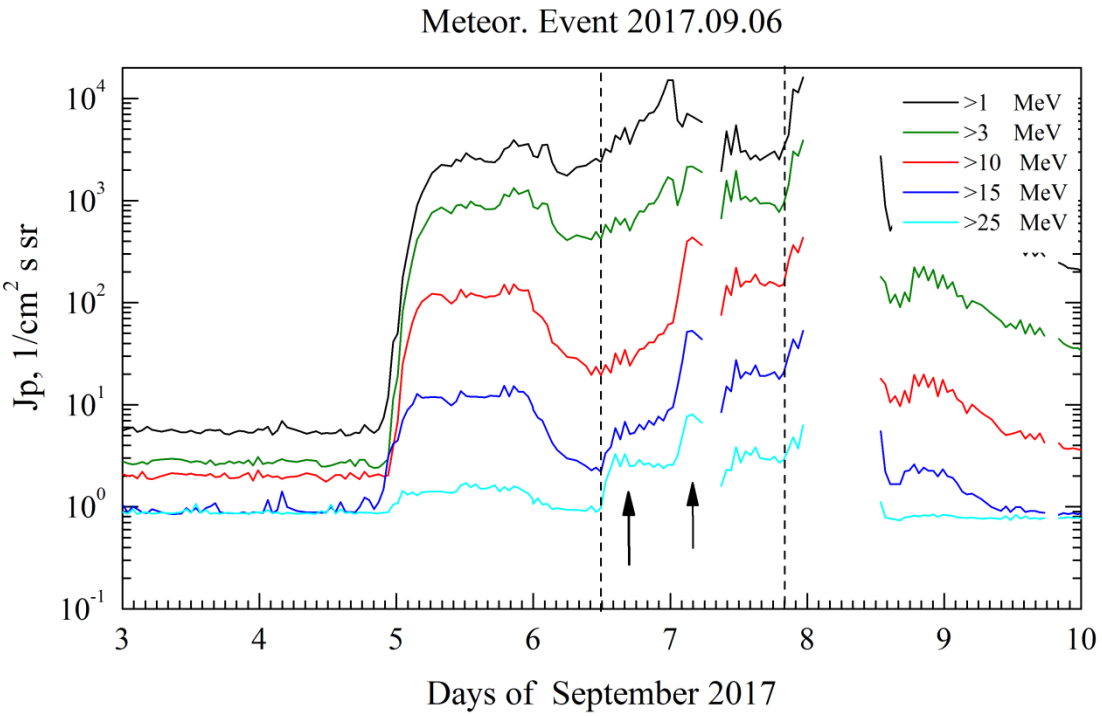


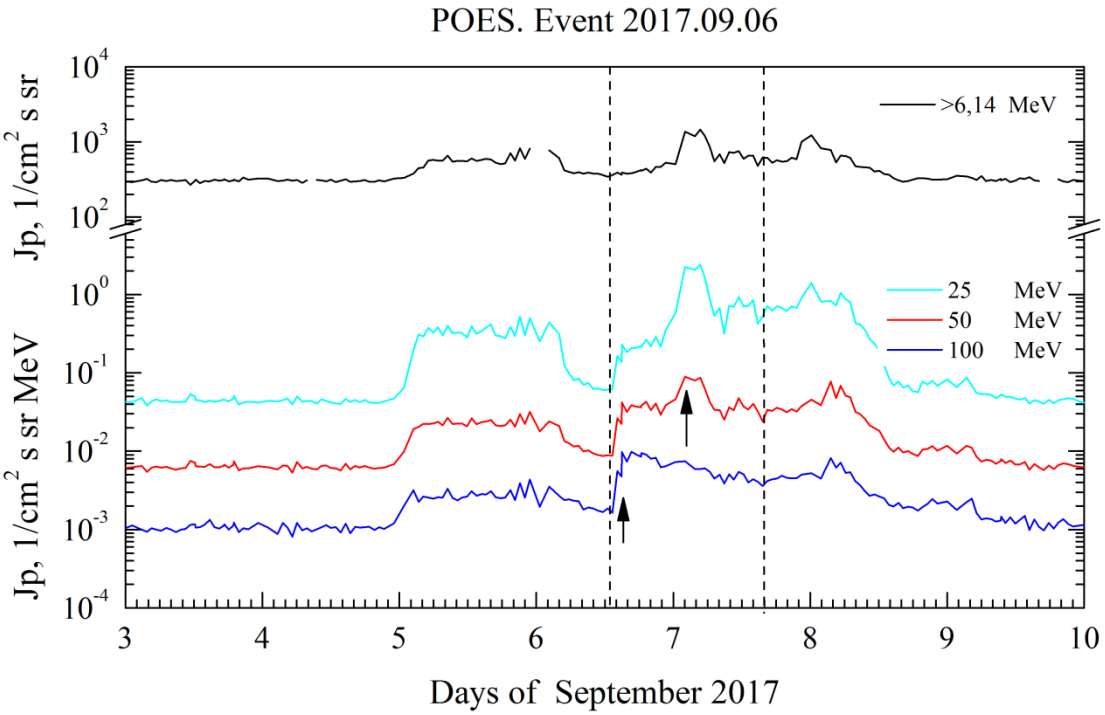
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES





Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2017 September 06

2017 September 06 ● AR 12673 To event 588

Hα, X-ray		To	Tmax	Te	Location	Importance	Fl Code Φ, J/m^2
6563 Å	FL	0852	~1159	>1553	S07W33	2B	ERU
1 – 12	keV	0857	0910	0917	S08W32	X2.2	0.13
1 – 12	keV	1153	1202	1210	S09W34	X9.3	0.57

X-ray, gamma-ray		To	Tmax	Te	Npeak, counts/s	Total counts	Sp/c
6-12	keV	0848:12	0908:58	0917:08	3171	5491588	HESSI
12-25	keV	0949:08	0949:46	1000:44	144	220019	HESSI
6-12	keV	1028:28	1030:30	1036:44	20	21888	HESSI
50-100	keV	1123:20	1128:38	1137:08	560	1097436	HESSI
50-100	keV	1207:44	1216:18	1225:12	1778	3902514	HESSI
50-100	keV	1257:16	1259:14	13:12:44	976	2173851	HESSI
12-25	keV	1344:44	1345:06	1359:16	192	378470	HESSI
25-50	keV	1431:48	1440:54	1450:04	256	413074	HESSI
12-25	keV	1450:04	1451:42	1454:12	72	46512	HESSI
12-25	keV	0925:11	0925:15	0930:38	711534	155488256	FERMI
12-25	keV	1028:34	1103:56	1105:47	10468	746583	FERMI
12-25	keV	1452:46	1506:23	1508:29	33874	3128196	FERMI
>100	MeV	1349:30		1412:30		2.70E-05*	FERMI

Radio burst frequency		To	Tmax	Te	Code of r/spectrum	lg F, sfu	
15.4	GHz	0900	0909	1050	P15	3.15	
8.8	GHz	0901	0903	1034		2.88	
5	GHz	0902	0904	0936		2.93	
2.7	GHz	0903	0903	0931		2.61	
1.4	GHz	0903	0928	0928	1.4 – 9	2.95	
410	MHz	0922	0922	0922		2.28	
245	MHz	1122	1136	1148		3.04	
15.4	GHz	1154	1156	1351		3.91	
8.8	GHz	1155	1156	1356		3.81	
5	GHz	1156	1157	1405		3.77	
2.7	GHz	1154	1156	1432		4.15	
1.4	GHz	1156	1202	1424	P1.4 \ 5	4.28	
610	MHz	1158	1202	1232		3.97	
410	MHz	1155	1202	1232		3.8	
245	MHz	1202	1203	1411	0.2 / 1.4	3.5	

DS-type	Frequency, MHz	To	Tmax	Te	V_{II}, km/s	Importance	Sp/c
DS II	025-081	1202		1221	1765	2	
DS IV	025-180	1201		1515		2	
DS III	025-170	1157		1202		2	
DS VI	025-061	1202		1208		1	
DH II	16-0.07	1205		09d/0708			WIND

CME		UT	V, km/s	a, km/s^2	Δφ	dA	Sp/c
LASCO	WL	1224	1571	25	360°	201°	SOHO

*cm^{-2}s^{-1}

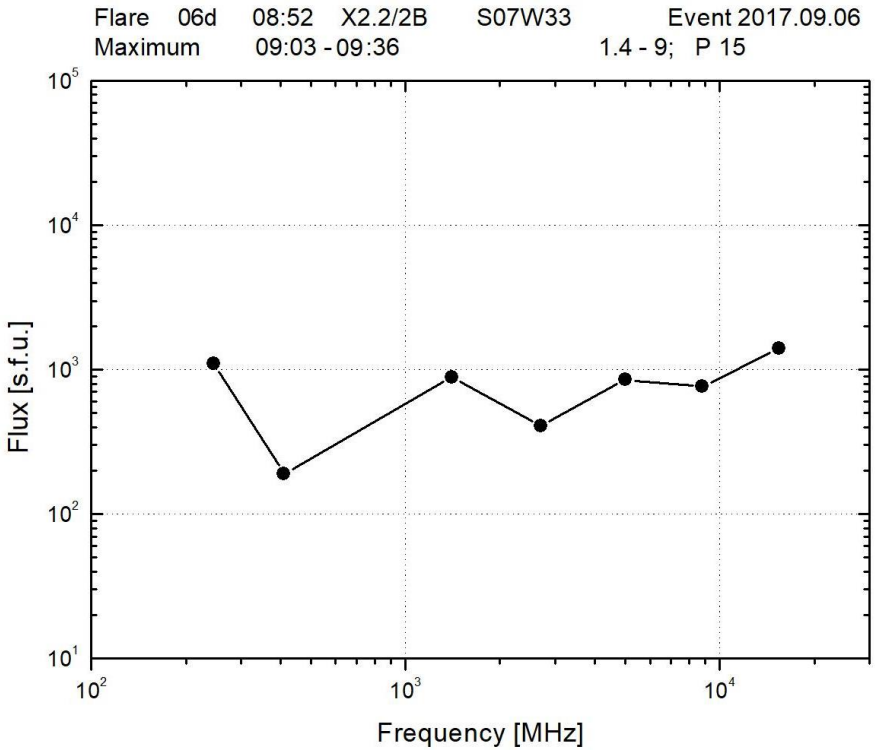
Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1354	1554	1752	S08W38	3N	UMB
1 – 12	keV	1551	1556	1603	S08W36	M2.5	0.014

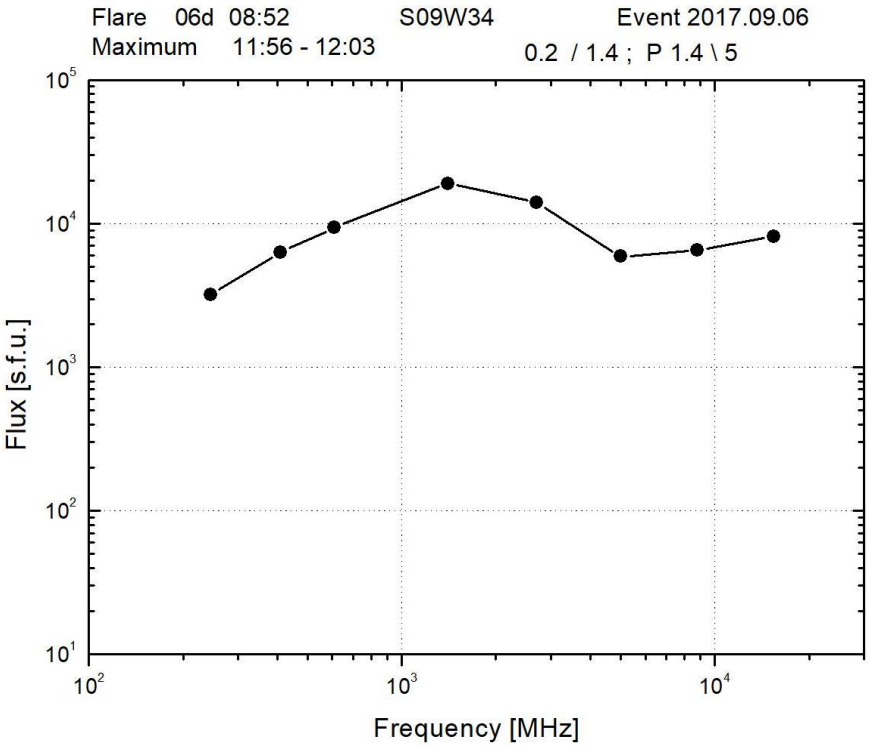
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
25-50	keV	1431:48	1440:54	1450:04	256	413074	HESSI
12-25	keV	1450:04	1451:42	1454:12	72	46512	HESSI
25-50	keV	1605:40	1606:38	1615:08	202	245174	HESSI
50-100	keV	1615:08	1617:06	1633:12	133	245742	HESSI
50-100	keV	1739:52	1742:06	1754:40	587	1388233	HESSI
12-25	keV	1452:46	1506:23	1508:29	33874	3128196	FERM

Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
410	MHz	1648	1648	1649		2.43	
245	MHz	1648	1648	1650		3.0	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS IV	104-180	1733		2157		1	
DS CTM	103-171	1604		1701		1	
DS III	48-079	1653		1653		1	
DS V	25-180	1732		1733		2	
DS VI	25-180	1735		2256		1	

Radio bursts frequency spectrum





Proton Active Region:

AR12673 (S08L117, CMP 04.09.2017,
Sp=1060 msh, EKC, BGD, R3)
XRI=18.97, $X_5^{9.3}$+$M_{26}^{8.1}$+C_{54}), 3_2+2_4+1_{13}+S_{84}
PFR1 4–5.09 (12^h): $M_8^{5.5}$;
PFR2 6–8.09 (12^h): $X_3^{9.3}$+$M_{15}^{8.1}$
PFR3 9–10.09 (17^h): $X_1^{8.2}$+M_1

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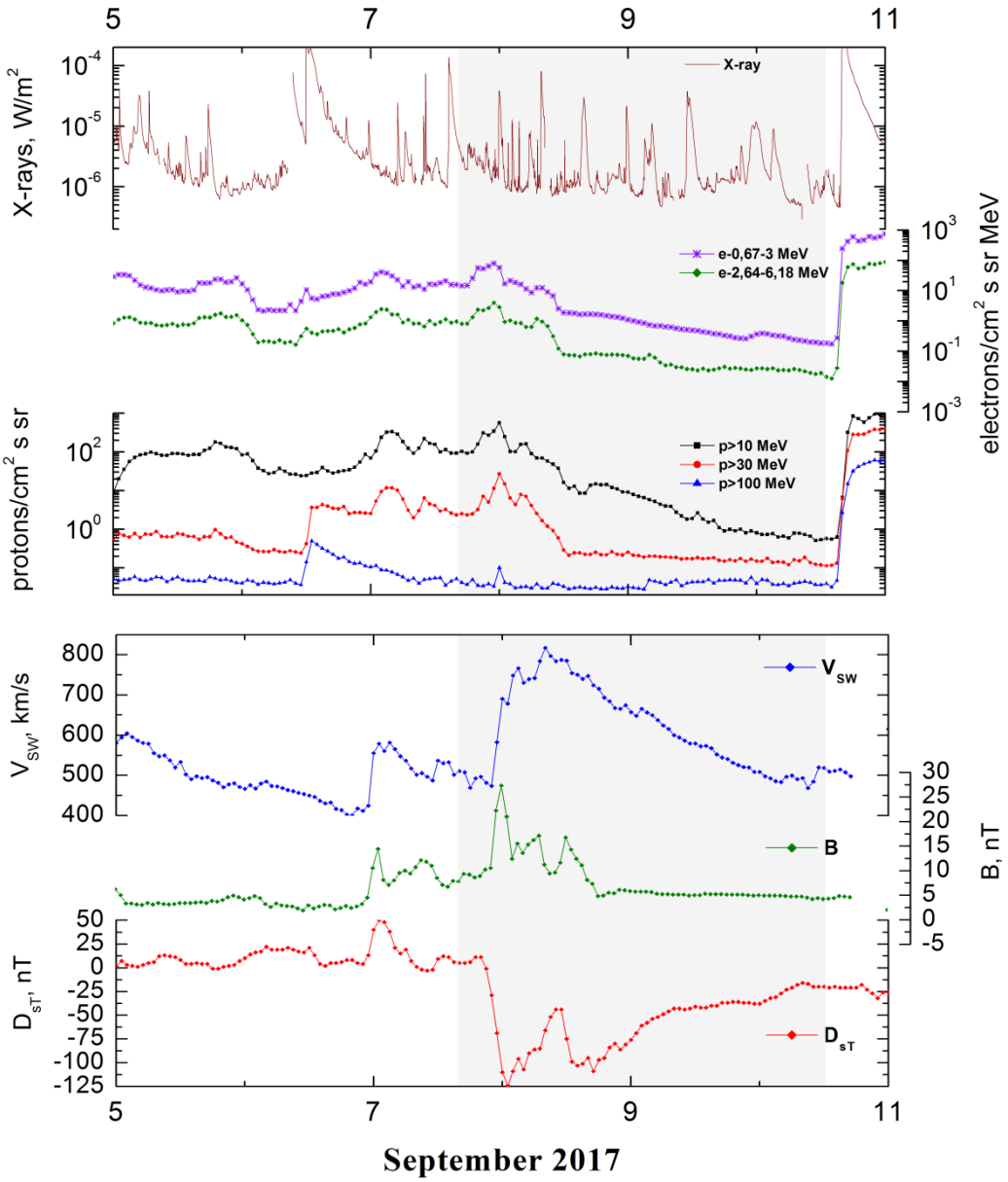
Kahler S.W., D. Brown, 2021.
Katz S., U. Goldvais, C. Price, 2021.
Pandya, M., V. Bhaskara, 2021.
Struminsky A.B., I.Yu. Grigorieva, Yu. I. Logachev, A.M. Sadovskii, 2020.
Temmer M., 2021.
Zhuang B., N. Lugaz, T. Gou et al., 2020.

Particle event: To(Ep>10 MeV) – 07d20^{h}
Tmax$_1$(Ep>10 MeV) – 08d00^{h}, Jmax$_1$(Ep>10 MeV) – 575 /cm^2·s·sr
Tmax$_2$(Ep>10 MeV) – 08d20^{h}, Jmax$_2$(Ep>10 MeV) – 14.3 /cm^2·s·sr
Duration of the event – 3 days, power-law index: γ_1 = 4.0, γ_2 = 2.5
Quasimaximal energy of protons in the event – Eqm$_1$ = 150 MeV
– Eqm$_2$ = 130 MeV

Sources: ● solar flare 07d14^{h}20^{m}, X1.3/2B, S11W49, AR12673
Main burst X-ray 1–8 Å: onset – 07d14^{h}20^{m}, max – 07d14^{h}36^{m}, Φ = 0.12 J/m^2
CME: 07d15^{h}12^{m}, V = 433 km/s, Δφ = 058º, dA= 246º
▲ SC 7d23^{h}00^{m}

Particle fluxes and associated phenomena

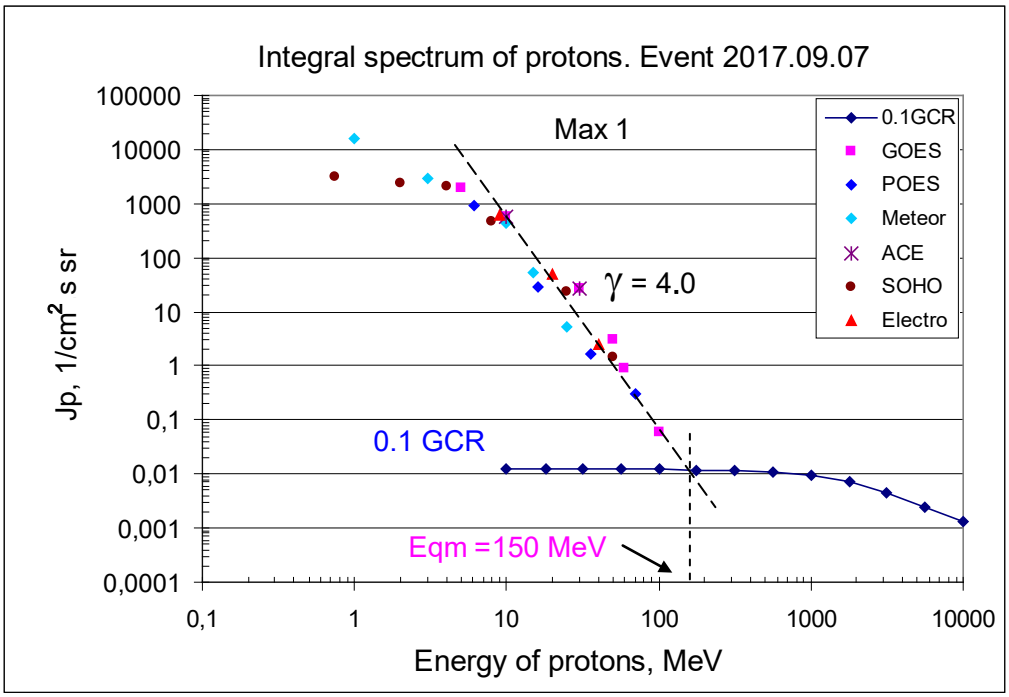


Integral fluxes of protons for the event of 2017 September 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	20	8d00/8d20	1920/72	3	0.25	
EPS	>10	20	8d00/8d20	575/14.3	3	0.18	
EPS	>30	20	8d00/ -	27/ -	1	0.1	
EPS	>50	20	8d00/ -	3.15/ -	1	0.08	
EPS	>60	20	8d00/ -	0.93/ -	1	0.06	
EPS	>100	-	8d00/ -	0.06/ -	-	0.04	
Electro-2							
GALS-E	>600	-	-	-	-	0.11	
POES							
MEPED	>6.14	20	23/08d05	920/352	0.75	310	
Meteor-2							
SCR	>1	19	23/08d20	16100/1225	2.5	5.0	
SCR	>3	19	23/08d20	3877/223	2.5	2.7	
SCR	>10	19	23/08d20	430/18	2.5	2.0	
GALS-M	>15	19	23/08d20	52/2	2	0.9	
GALS-M	>25	19	23/ -	5.4/ -	1	0.9	
GALS-M	>600	-	-	-	-	0.3	
ACE							
SIS	>10	18	23/8d19	553/15	3	1.9	
SIS	>30	18	23/8d20	26/0.6	2	1.3	
SOHO							
EPHIN	>50	18	23/ -	1.4/ -	3	0.25	

Differential fluxes of protons for the event of 2017 September 07

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75 – 2	18	22/8d19	550/42.5	3	0.03	
LION	2 – 6	18	22/8d19	120/6.5	3	0.003	
EPHIN	4 – 8	18	22/8d19	400/14.5	3	0.0002	
EPHIN	8 – 25	18	22/8d19	25.5/0.85	3	0.00005	
EPHIN	25 – 53	18	22/8d19	0.8/002	3	0.00002	
Electro-2							
SCR-1	9–20	19	08d00/ -	51/ -	1.5	0.3	
SCR-1	20–40	19	08d00/ -	2.4/ -	1.5	0.1	
SCR-1	40–110	19	08d00/ -	0.035/ -	1.5	0.01	
POES							<E>, MeV
MEPED	16–36	20	23/8d20	1.36/0.036	1.25	0.043	25
MEPED	36–70	20	8d01/8d20	0.04/0.0056	1.25	0.006	50
MEPED	70–140	20	8d01/8d20	0.0042/0.0015	1.25	0.001	100


Integral spectrum of protons. Event 2017.09.07
Max 1
γ = 4.0
0.1 GCR
Eqm =150 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Electro
Jp, 1/cm2 s sr
Energy of protons, MeV
100000
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
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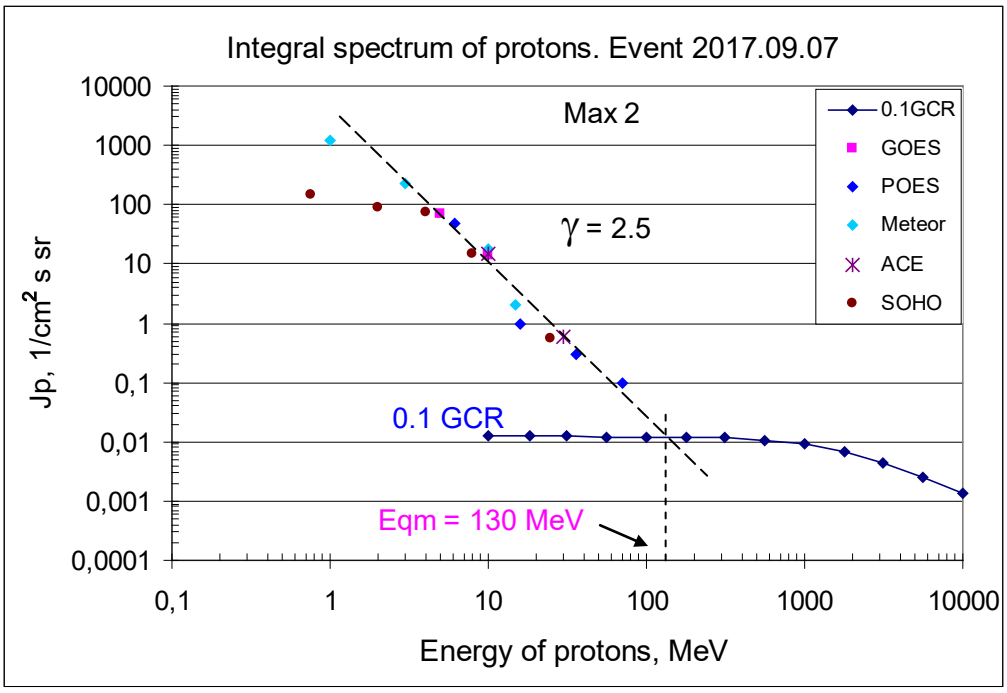
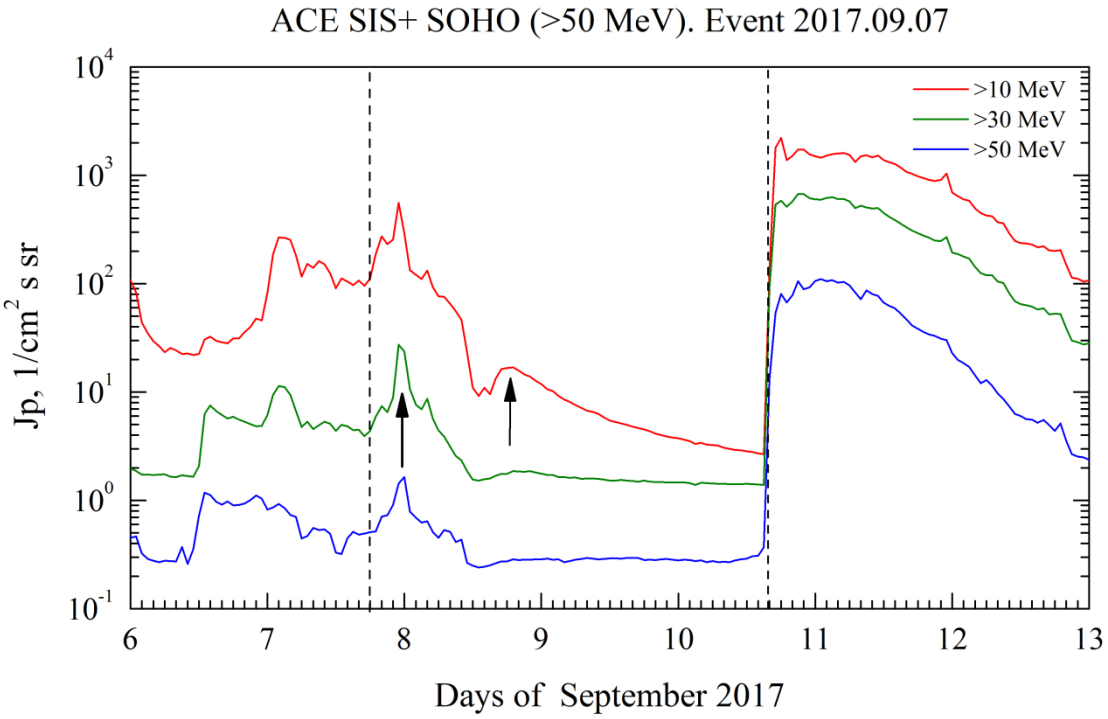
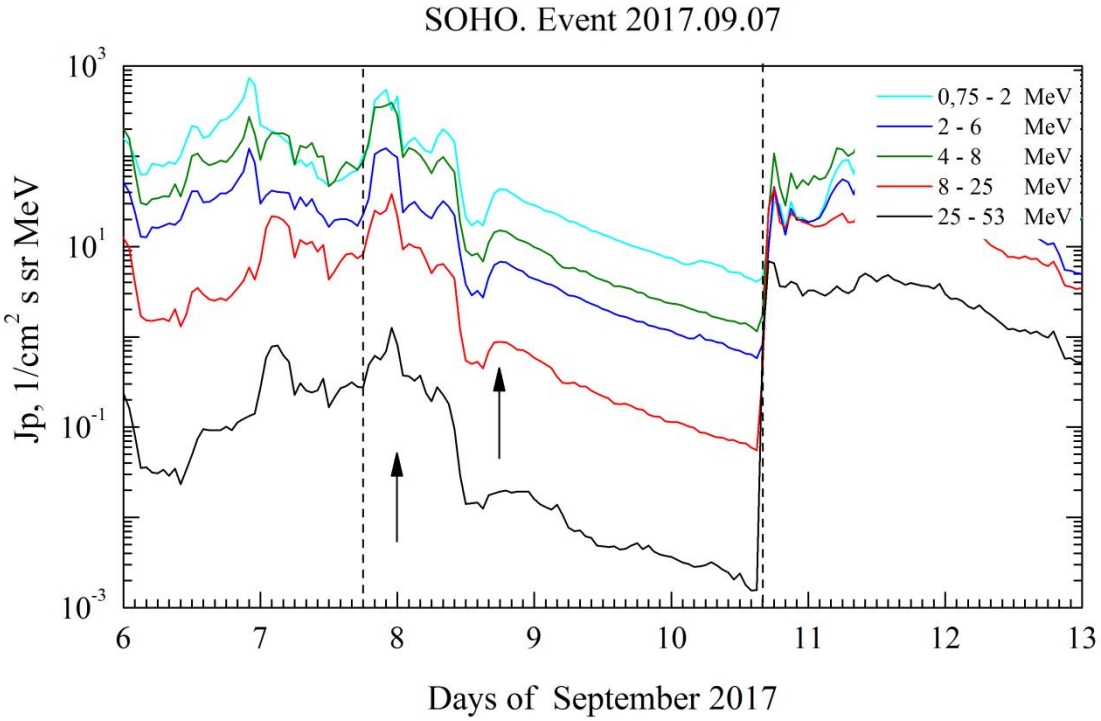
1
10
100
1000
10000


Integral spectrum of protons. Event 2017.09.07
Max 2
γ = 2.5
0.1 GCR
Eqm = 130 MeV
0.1GCR
GOES
POES
Meteor
ACE
SOHO
Jp, 1/cm2 s sr
Energy of protons, MeV
10000
1000
100
10
1
0,1
0,01
0,001
0,0001
0,1
1
10
100
1000
10000

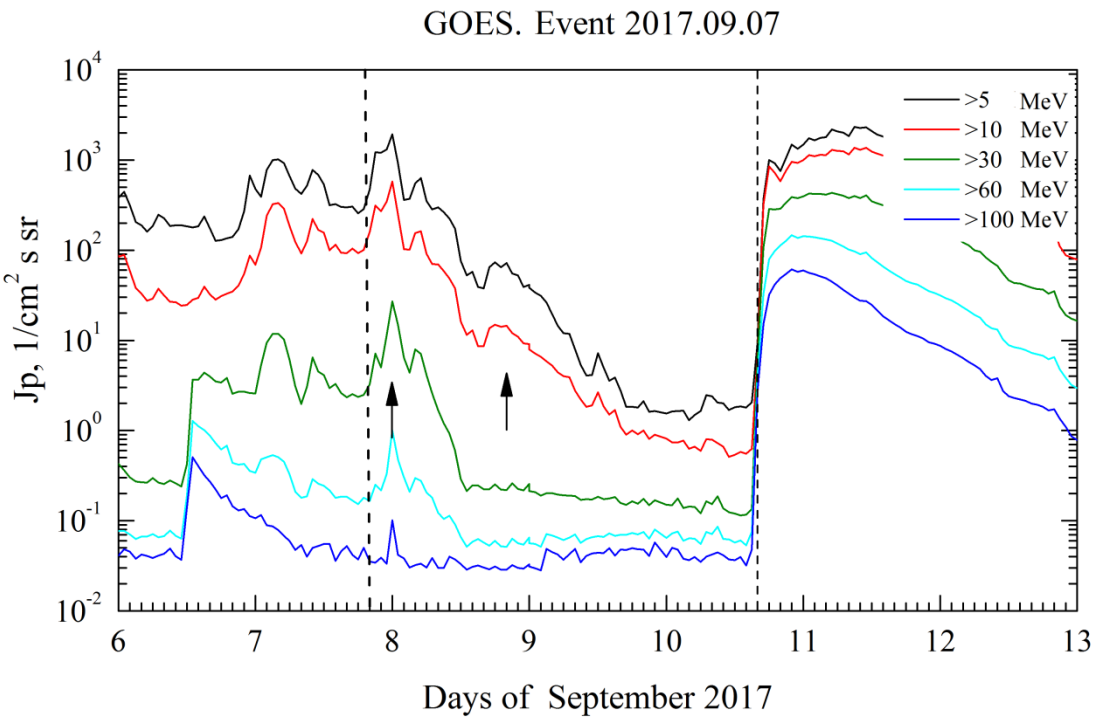
Time profiles of proton fluxes in the event 2017.09.07

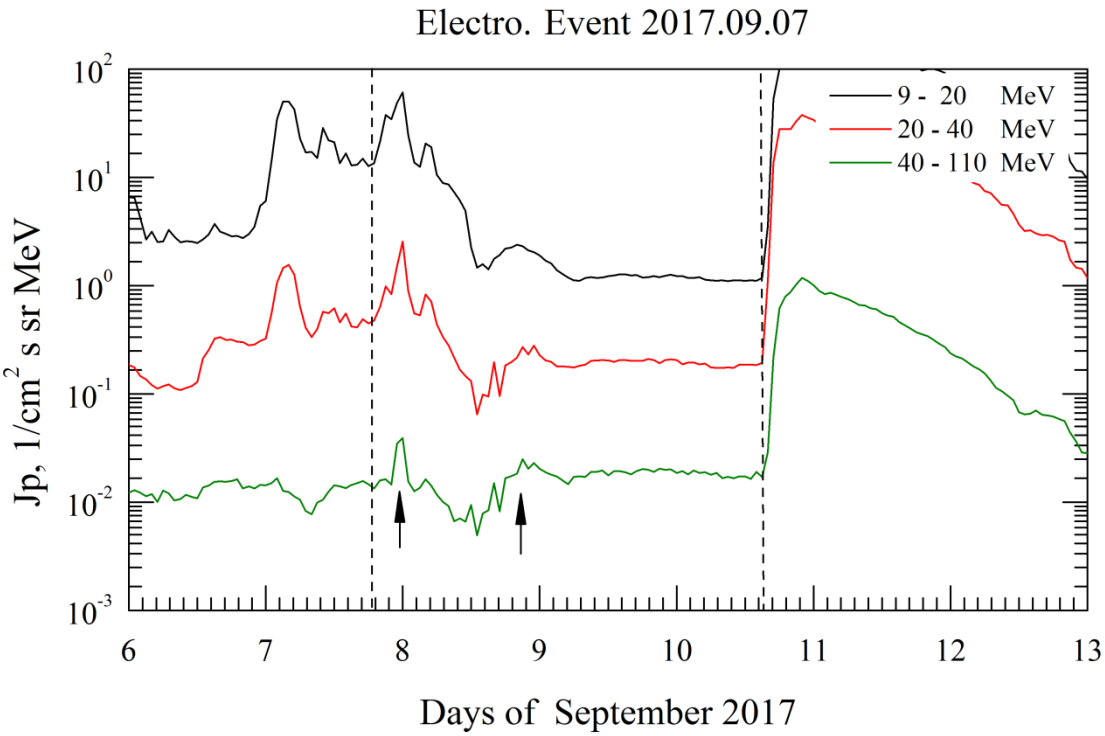
Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



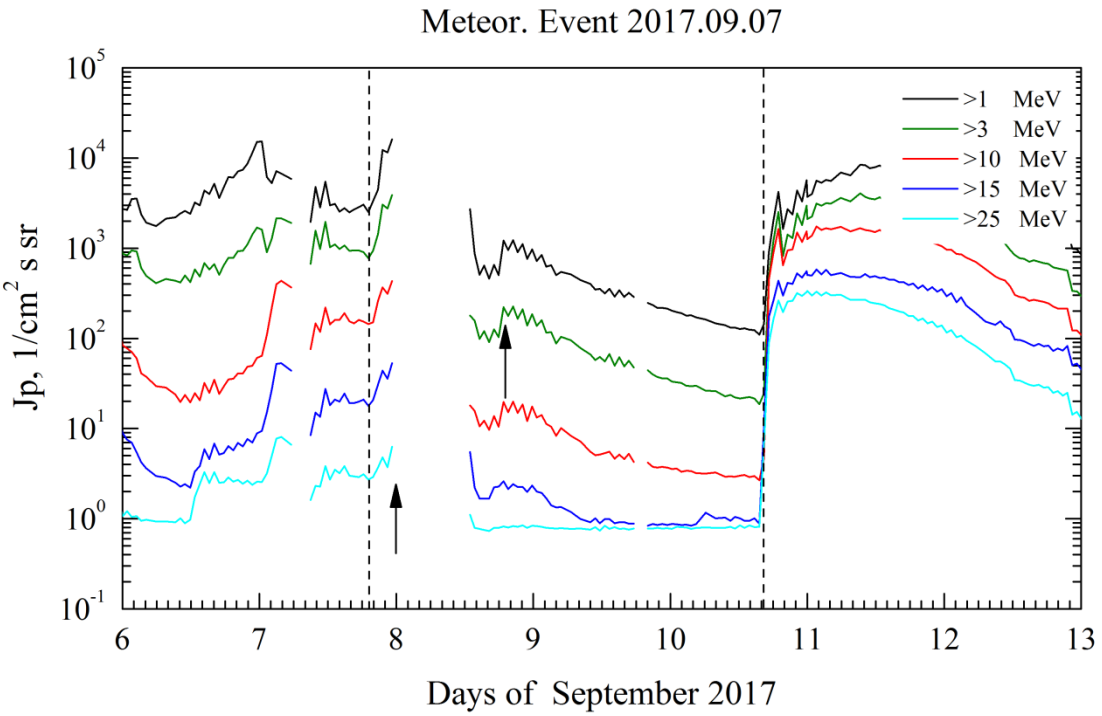


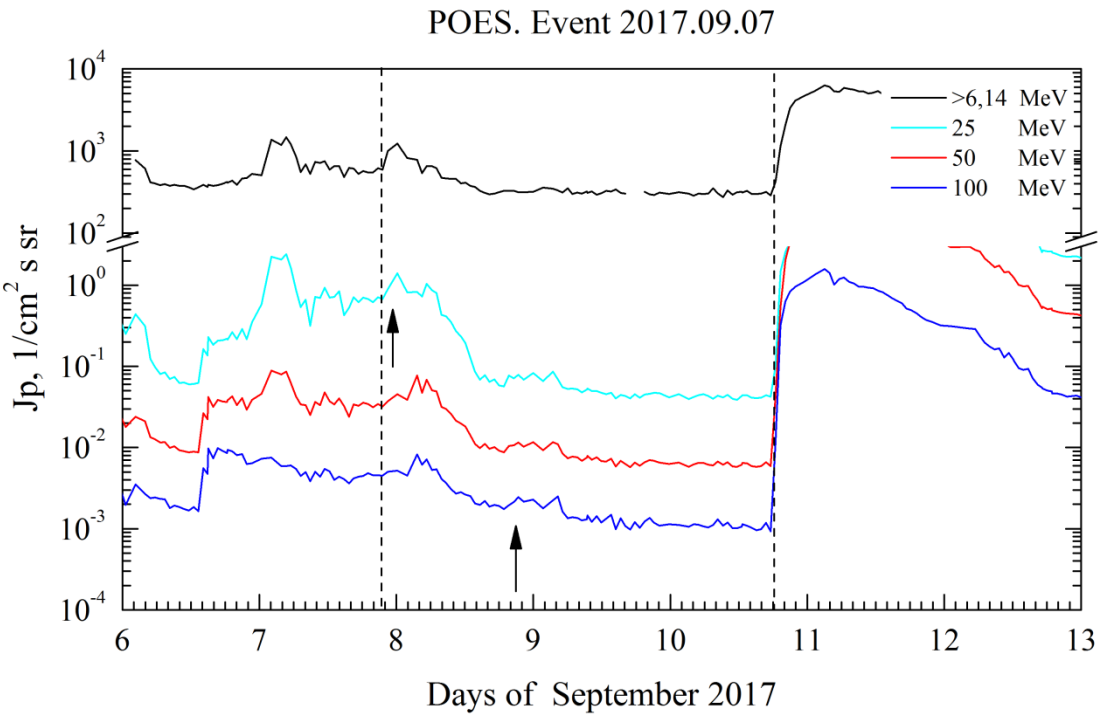
Earth satellites in geostationary orbit, R ≈ 6.6 Re: GOES and Electro





Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES



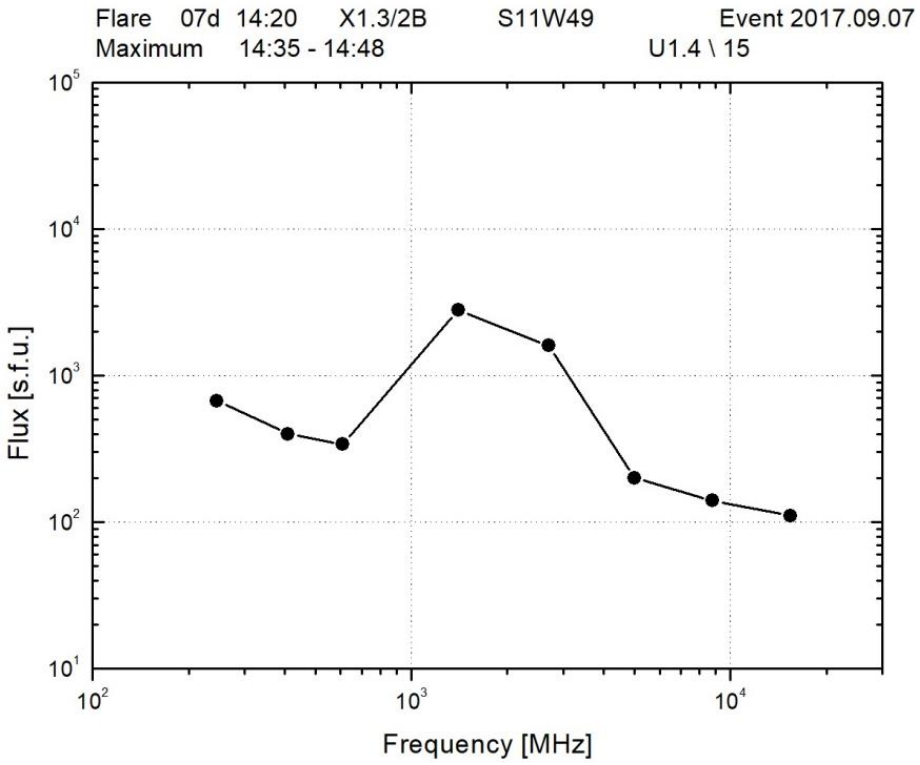


Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2017 September 07

2017 September 07 ● AR12673 To event 589

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å	FL	1423	1423	1426	S11W49	2B	ERU
1–12	keV	1420	1436	1455	S08W48	X1.3	0.12
X-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
12-25	keV	1417:04	1422:50	1500:04	594	158970	HESSI
25–50	keV	1455:00	1455:22	1500:04	656	431217	HESSI
25–50	keV	1500:04	1500:06	1506:44	374	264926	HESSI
6-12	keV	1538:44	1539:46	1605:24	1008	2531280	HESSI
12-25	keV	1441:06	1448:48	14:56:02	514599	226376992	FERMI
12-25	keV	1509:44	1509:52	1539:38	12503	1044038	FERMI
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15.4	GHz	1448	1448	1452	P1.4 \ U15	2.04	
8.8	GHz	1448	1448	1449		2.15	
5	GHz	1448	1448	1449		2.3	
2.7	GHz	1434	1435	1441		3.2	
1.4	GHz	1446	1448	1456		3.45	
610	MHz	1448	1448	1448		2.53	
410	MHz	1448	1448	1453		2.6	
245	MHz	1448	1448	1448		2.83	
DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-043	1608		1612	928	1	
DS IV	025-180	1553		1624		2	
DS III	025-180	1554		1604		2	
CME		**UT**	**V,** km/s	**a,** km/s^2	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1512	433	- 9.9	058˚	246˚	SOHO

Radio burst frequency spectrum



Proton Active Region:

AR12673 (S08L117, CMP 04.09.2017,
Sp=1060 msh, EKC, BGD, R3),
XRI=18.97, $X_5^{9.3}$+$M_{26}^{8.1}$+C_{54}), 3_2+2_4+1_{13}+S_{84}
PFR1 4–5.09 (12^h): $M_8^{5.5}$;
PFR2 6–8.09 (12^h): $X_3^{9.3}$+$M_{15}^{8.1}$;
PFR3 9–10.09 (17^h): $X_1^{8.2}$+M_1

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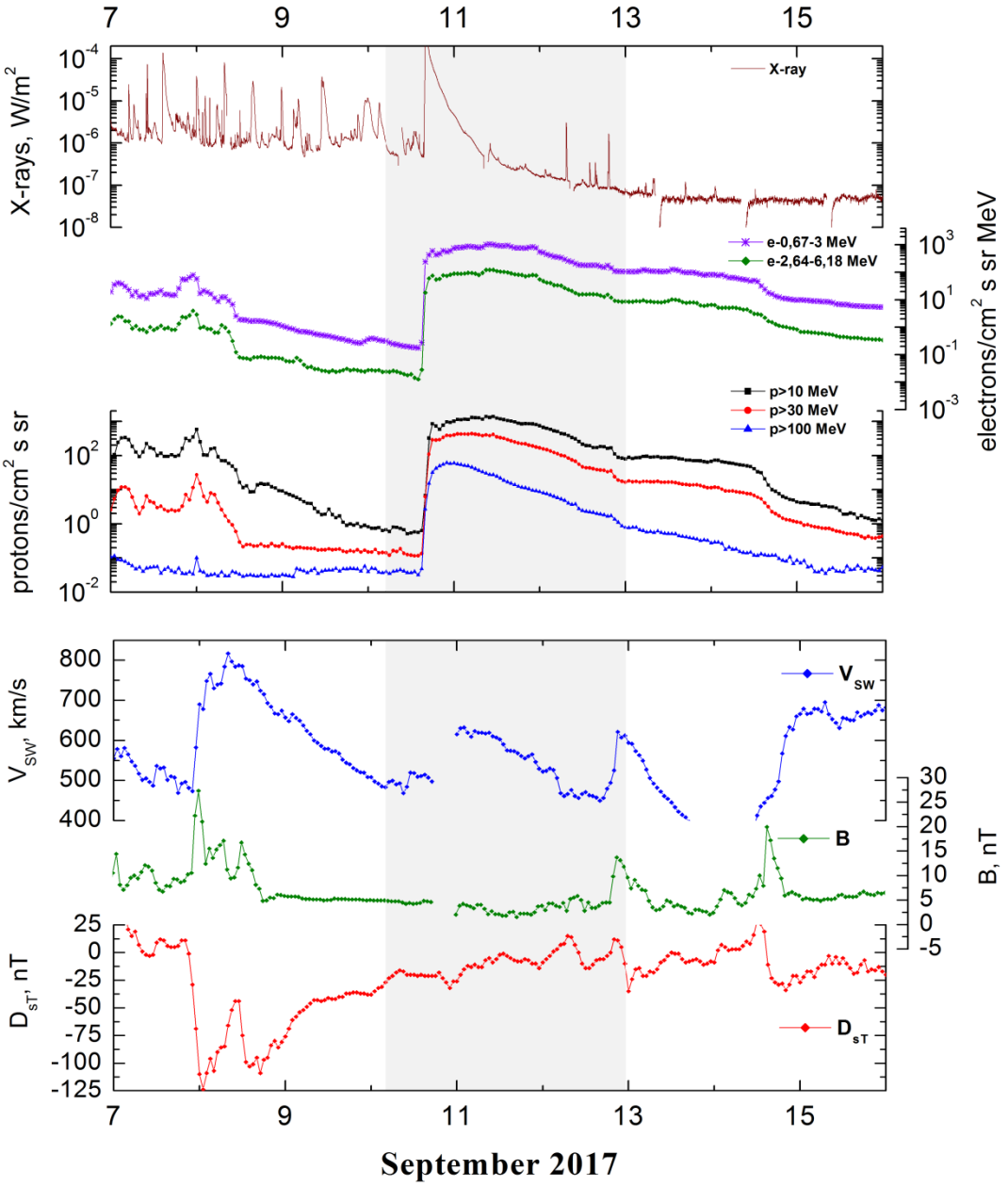
Event 2017.09.10 – (2017-253) **590**

Particle event: To(Ep>10 MeV) – 10d16^{h}
Tmax (Ep>10 MeV) – 10d19^{h}, Jmax (Ep>10 MeV) – 850/cm^2·s·sr
Duration of the event – 4 days, power-law index: γ = 2.1 (4.2)
Quasimaximal energy of protons in the event – Eqm = 1200 MeV

Sources: ■ solar flare 10d15^{h}35^{m}, X8.2/, S08W88, AR12673
Main burst X-ray 1–8 Å: onset – 10d15^{h}35^{m}, max – 10d16^{h}06^{m}, Φ = 1.4 J/m^2
CME: 10d16^{h}00^{m}, V = 3163 km/s, Δφ = 360°, dA= 262°
▲SC 12d 20^{h}04^{m}; ▲SC 14d 11^{h}16^{m}

Particle fluxes and associated phenomena

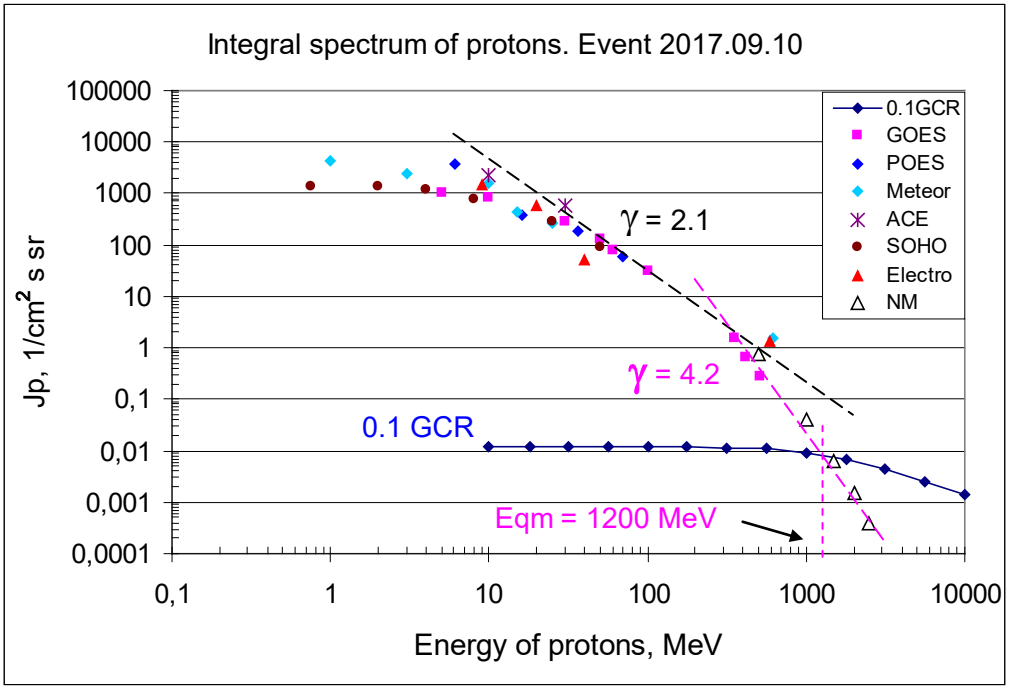


Integral fluxes of protons for the event of 2017 September 10

S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr)^{-1}$	Duration, days	Back-ground	Comments
GOES							
EPS	>5	16	19	1000	5	1.5	
EPS	>10	16	19	850	5	0.5	
EPS	>30	16	19	283	5	0.1	
EPS	>50	16	19	132	4	0.08	
EPS	>60	16	18	80	4	0.06	
EPS	>100	16	18	32	4	0.04	
EPS	>700	-	-	-	-	0.0002	
Electro-2							
GALS-E	>600	15	18	1.3	2.5	0.11	
POES							
MEPED	>6.14	16	20	3790	4	310	
Meteor-2							
SCR	>1	15	18	4200	5	5.0	
SCR	>3	15	18	2520	5	2.7	
SCR	>10	15	18	1627	5	2.0	
GALS-M	>15	15	18	433	4	0.9	
GALS-M	>25	15	18	262	4	0.9	
GALS-M	>600	15	18	1.5	2	0.3	
ACE							
SIS	>10	16	18	2220	5	1.9	
SIS	>30	16	18	585	5	1.3	
NM							
Network	>500	16	18	0.768	-	-	
Network	>1000	16	18	0.041	-	-	
Network	>1500	16	18	0.00627	-	-	
Network	>2000	16	18	0.00146	-	-	
Network	>2500	16	18	0.00039	-	-	
SOHO							
EPHIN	>50	16	19	90	4	0.3	

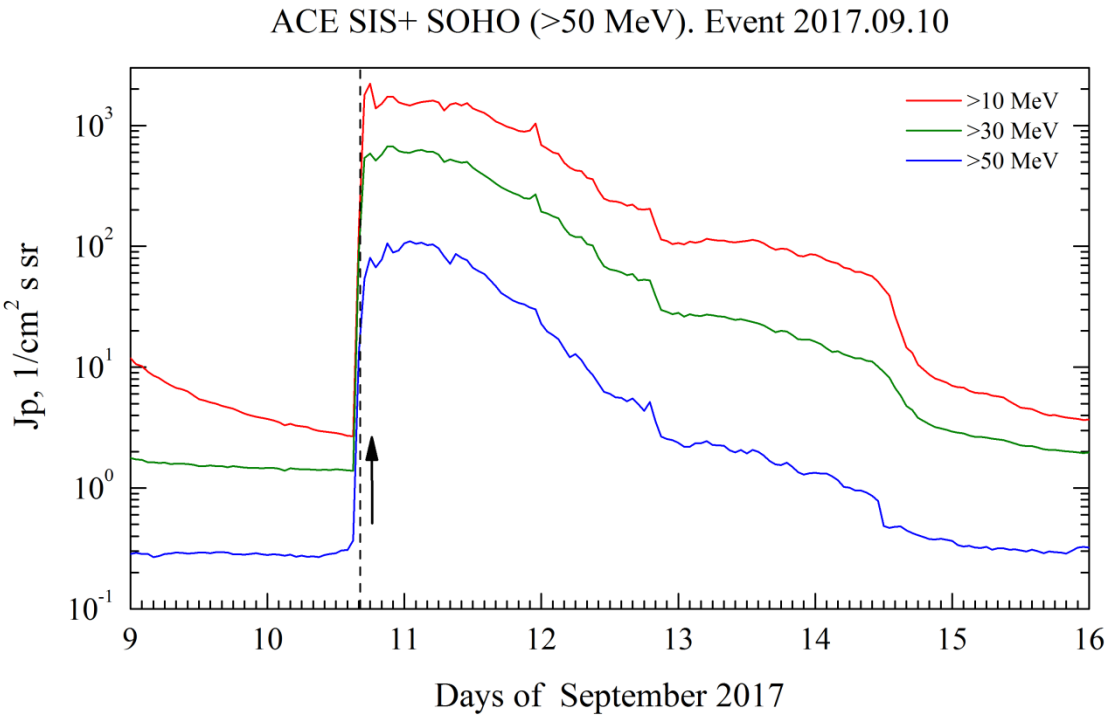
Differential fluxes of protons for the event of 2017 September 10

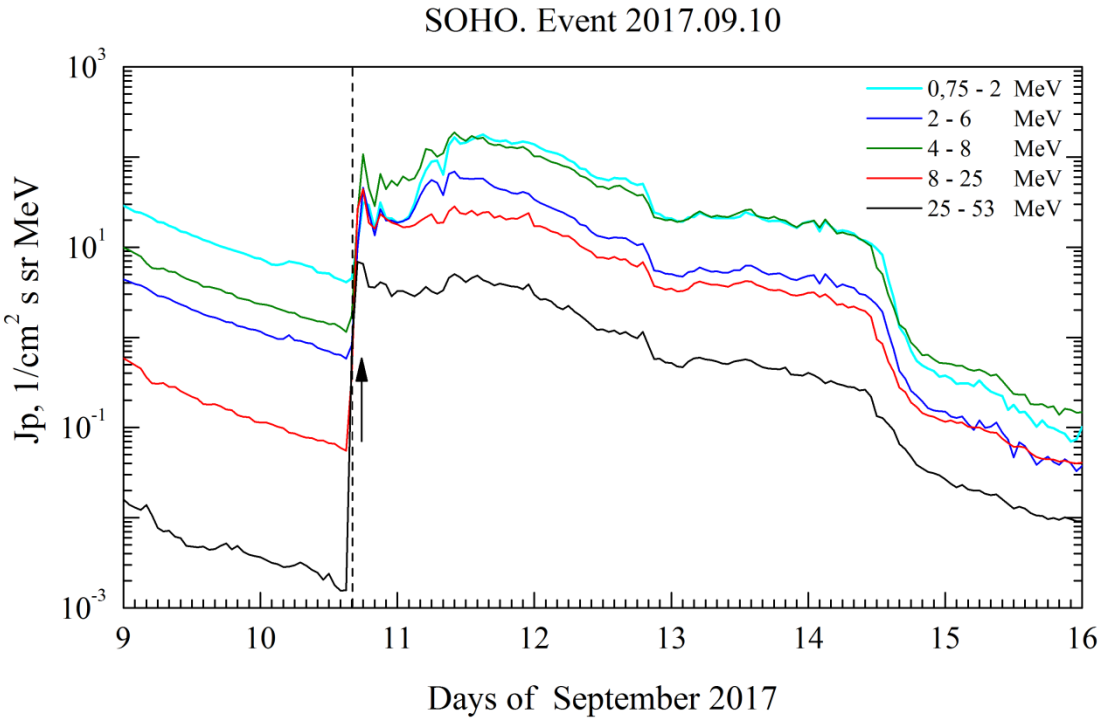
S/c, instruments	Ep, MeV	To, hours	Tmax, hours	Jmax, $(cm^2 \cdot s \cdot sr \cdot MeV)^{-1}$	Duration, days	Back-ground	Comments
SOHO							
LION	0.75–2	16	19	28.5	4	0.03	
LION	2–6	16	19	43.8	4	0.003	
EPHIN	4–8	16	19	110	4	0.0002	
EPHIN	8–25	16	19	28	4	0.00005	
EPHIN	25–53	16	19	6.5	4	0.00002	
Electro-2							
SCR-1	9–20	15	18	84	4	0.3	
SCR-1	20–40	15	18	27	4	0.1	
SCR-1	40–110	15	18	0.7	2.5	0.01	
GOES							
EPS	350–420	16	21	0.013	2	0.002	
EPS	420–510	16	21	0.0044	2	0.0012	
EPS	510–700	16	21	0.0015	1.5	0.0005	
POES							<E>, MeV
MEPED	16–36	16	19	9.46	5.5	0.043	25
MEPED	36–70	16	19	3.72	5.5	0.006	50
MEPED	70–140	16	19	0.85	5.5	0.001	100

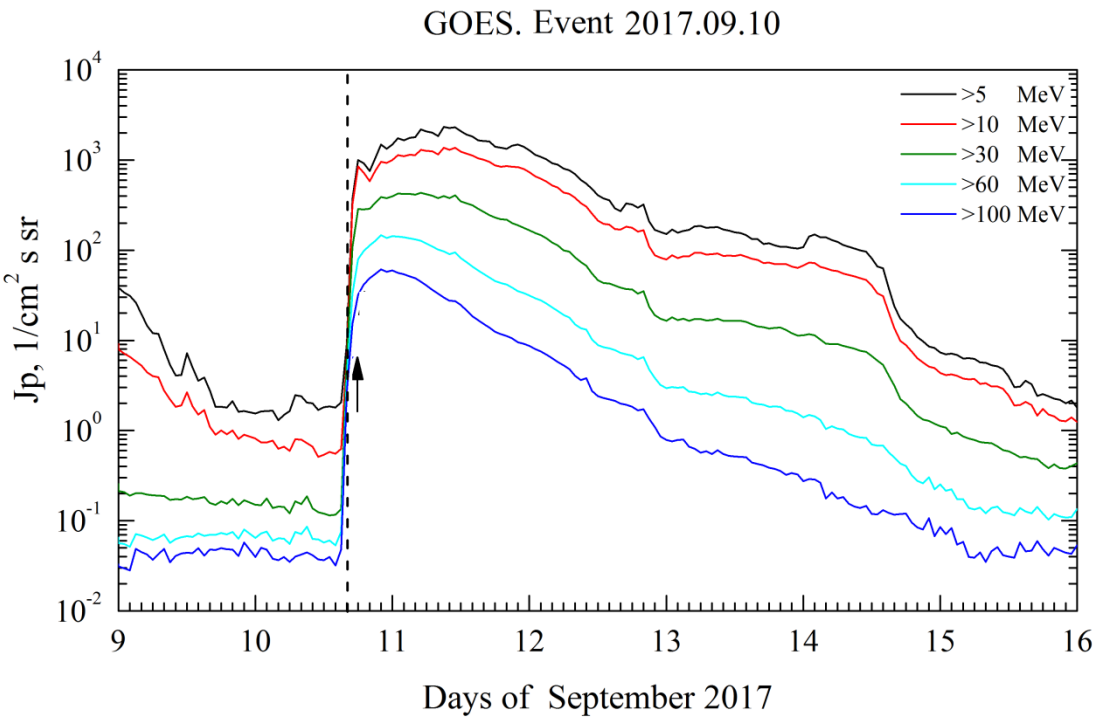


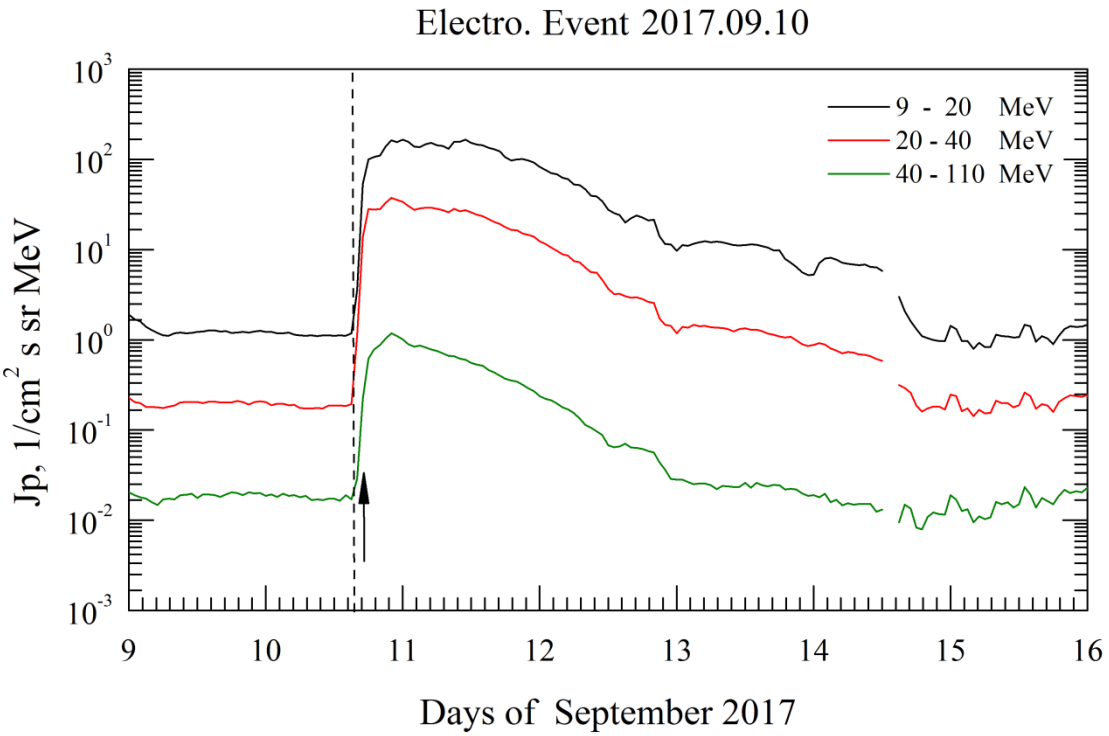
Time profiles of proton fluxes in the event 2017.09.10

Spacecrafts at point L1: ACE + SOHO (> 50 MeV) and SOHO



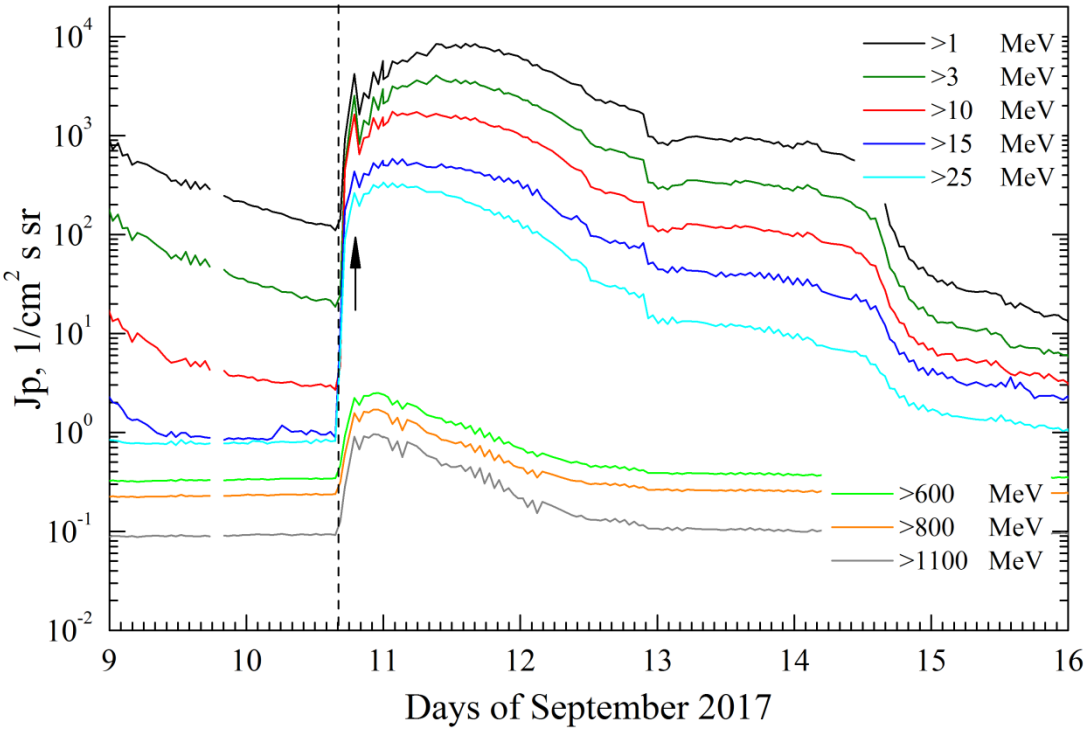



GOES. Event 2017.09.10
Jp, 1/cm2 s sr
>5 MeV
>10 MeV
>30 MeV
>60 MeV
>100 MeV
Days of September 2017

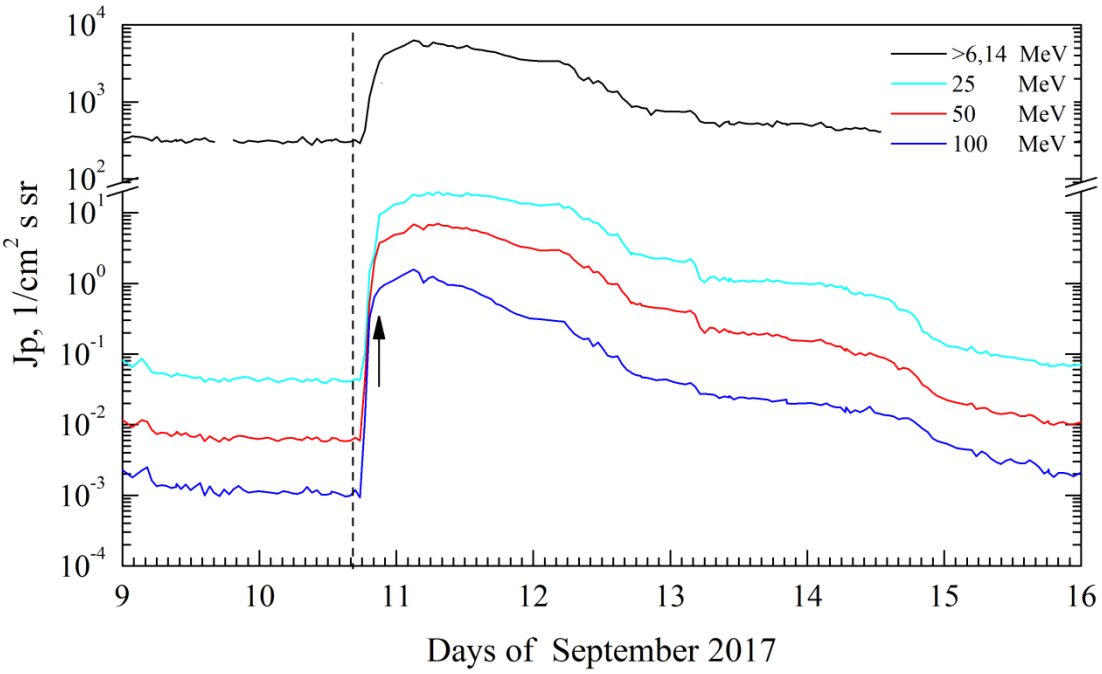

Electro. Event 2017.09.10
Jp, 1/cm2 s sr MeV
9 - 20 MeV
20 - 40 MeV
40 - 110 MeV
Days of September 2017

Earth satellites in polar orbit, R = 800÷1000 km: Meteor and POES

Meteor. Event 2017.09.10



POES. Event 2017.09.10



Electromagnetic and other phenomena that are sources and/or accompanying for the event of 2017 September 10

2017 September 10 ■ AR 12673 To event 590

Hα, X-ray		**To**	**Tmax**	**Te**	**Location**	**Importance**	**Fl Code Φ,** J/m^2
6563 Å		No optical flare on visible disk					
6563 Å	LPS	1756		2359		0.07	
1 – 12	keV	1535	1606	1631	S08W88	X8.2	1.4

X-ray, gamma-ray		**To**	**Tmax**	**Te**	**Npeak,** counts/s	**Total counts**	**Sp/c**
100-300	keV	1552:36	1557:50	1617:28	4806	10273221	HESSI
100-300	keV	1639:36	1640:30	1648:44	1698	2196080	HESSI
50-100	keV	1648:44	1649:18	1654:48	1200	1042140	HESSI
25-50	keV	1726:48	1756:28	1756:28	624	2719924	HESSI
12-25	keV	1541:18	1621:46	1640:09	996883	805600768	FERMI
>100	MeV	1733:30		1758:30		7.62E-04*	FERMI

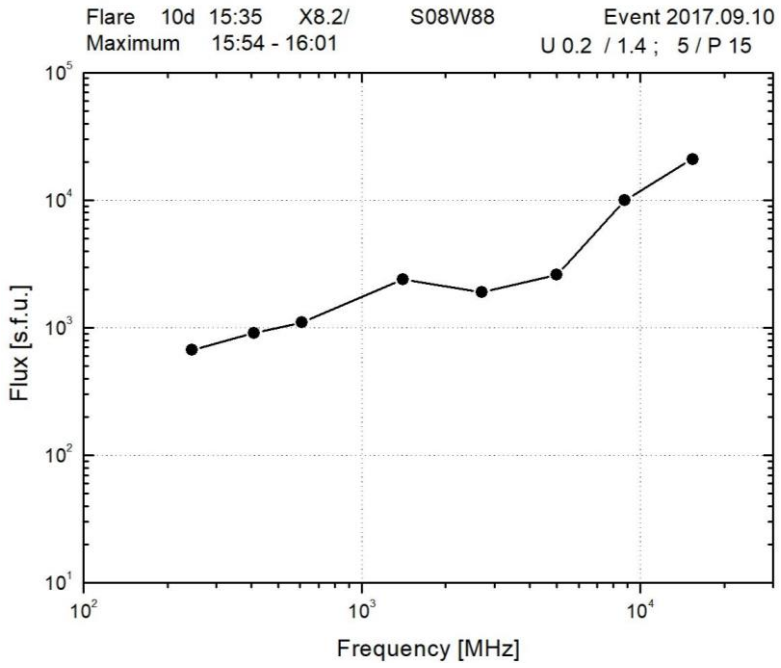
Radio burst frequency		**To**	**Tmax**	**Te**	**Code of r/spectrum**	lg **F,** sfu	
15400	GHz	1552	1558	1706	5 / P15	4.32	
8.8	GHz	1552	1559	1706		4.00	
5	GHz	1551	1601	1706		3.41	
2.7	GHz	1550	1554	1706		3.28	
1.4	GHz	1550	1554	1608		3.38	
610	MHz	1553	1555	1606		3.04	
410	MHz	1554	1556	1607		2.96	
245	MHz	1553	1558	1604	U0.2 / 1.4	2.83	

DS-type	**Frequency,** MHz	**To**	**Tmax**	**Te**	**V_{II},** km/s	**Importance**	**Sp/c**
DS II	025-043	1608		1612	928	1	
DS IV	025-180	1553		1624		2	
DS III	025-180	1554		1604		2	

CME		**UT**	**V, km/s**	**a, km/s2**	**Δφ**	**dA**	**Sp/c**
LASCO	WL	1600	3163	- 232	360˚	262˚	SOHO

*cm^{-2}s^{-1}

Radio burst frequency spectrum



Proton Active Region:

AR12673 (S08L117, CMP 04.09.2017,
Sp=1060 msh, EKC, BGD, R3),
XRI=18.97, $X_5^{9.3}$+$M_{26}^{8.1}$+C_{54}), 3_2+2_4+1_{13}+S_{84}
PFR1 4–5.09 (12^h): $M_8^{5.5}$;
PFR2 6–8.09 (12^h): $X_3^{9.3}$+$M_{15}^{8.1}$;
PFR3 9–10.09 (17^h): $X_1^{8.2}$+M_1

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Сводная таблица солнечных протонных событий 24 цикла солнечной активности (2009–2019 гг.)

Логачёв Ю.И.[1], Базилевская Г.А.[2], Дайбог Е.И.[1], Гинзбург Е.А.[3], Ишков В.Н.[4, 5], Лазутин Л.Л.[1], Нгуен М.Д.[1], Сурова Г.М.[1], Власова Н.А.[1], Яковчук О.С.[2]

[1] НИИЯФ МГУ, [2]ФИАН, [3]ИПГ РОСГИДРОМЕТ, [4]ИЗМИРАН, [5]ГЦ РАН

Обозначения:

N – порядковый номер события; □–знак выделяющий "the small event"
Event name – имя события - (yyyy.mm.dd–doy – год.месяц.день–день года)
To – час начала события, дата совпадает с датой в имени события
Tmax – время первого, второго и третьего (если есть) максимумов
Jmax – поток протонов с энергией 10 МэВ в первом, втором и третьем (если есть)
γ – показатель степени интегрального спектра ($J(E) \sim E^{-\gamma}$) для области высоких энергий протонов
Eqm – квазимаксимальная энергия протонов в данном событии;
Обозначения, относящиеся к вспышкам, – общепринятые;
CME – ставится в Source, если CME является единственным отражением вспышечного события (залимбовое событие) источника СПС, и не ставится для вспышечного события на видимом диске;
CME data – медианная скорость (км/с), угловая ширина (градусы), угол первого появления отсчитывается против часовой стрелке от Северного полюса (градусы);
Условные знаки, характеризующие причастность вспышки к данному протонному событию и уверенность её привязки:
●, ■ – данное вспышечное событие определенно является источником наблюдаемых протонов: ● – на видимом диске Солнца;
■ – вблизи и за солнечным лимбом;
⊙, ⊡– данное вспышечное событие с большой вероятностью является источником наблюдаемых протонов: ⊙ – на видимом диске Солнца; ⊡– вблизи или за солнечным лимбом;
○ – данное вспышечное событие, возможно, является источником протонов данного события, но есть причины, по которым эта возможность подвергается сомнениям;
Ø – данное вспышечное событие не является основным источником, но внесла (или могла внести) вклад в наблюдаемые потоки протонов.
Если источником протонов является не отождествлённое вспышечное событие, то используются следующие обозначения:
□ − вспышечное событие вблизи и за западным (W) или восточным (E) лимбом Солнца;
▲SC − внезапное начало геомагнитного возмущения, совпадает с прибытием к Земле межпланетной ударной волны, которая может приносить в околоземное космическое пространство заряженные частицы от солнечного вспышечного события;
W_L (E_L) -1d – 1 сутки за западным (восточным) лимбом;
DFS – выброс (исчезновение) солнечного волокна (длина выброшенной части в градусах отражается в столбце "X-ray class";
AR – NOAA SWPC номер активной области.

N	Particles enhancements						Solar flares or CME – the particle sources				
	Event name	To	Tmax	Jmax, pfu	γ	Eqm, MeV	Sour-ce	To (UT) To (CME)	X-ray class, importance	Localization, CME data	AR
1	2010.08.03-215	10^h	19^h	2.7	3.1	60	DSF	●01d07^h50^m 01d13^h42^m	42°	N37W32 0850/360/084	
2	2010.08.14-226	11^h	12^h	9.4	2.25	200	FL	⊡14d10^h05^m 14d10^h12^m	C4.4/SF	N17W52 1205/360 /224	11099
3	2010.08.18-230	07^h	11^h	2.2	2.25	95	FL	⊡18d04^h45^m 18d05^h48^m	C4.5/	N18W88 1471/184/230	11099,1.5d behind W_L
4	2011.01.28-028	01^h	07^h 16^h	1.6 2.1	1.8 1.8	200 140	FL	⊡28d<00^h44^m 28d01^h26^m	M1.3/	N16W88 0606/119/290	11149, 1d behind W_L
5	2011.02.15-046	05^h	12^h 18^h	1.9 1.4	2.2 2.2	80 80	FL	●15d01^h44^m 15d02^h24^m	X2.2/2B	S20W15 0669/360/189	11158
6	2011.03.07-066	22^h	08d05^h	45	3.1	140	FL	●07d19^h43^m 07d20^h00^m	M3.7	S22W67 2125/360/313	11164
7	2011.03.21-080	04^h	11^h 20^h	6.8 11.1	2.4 2.8	250 140	FL CME FL	⊡21d<02^h24^m 21d02^h24^m Ø21d15^h31^m	C4.2/	1341/360/274 S20E87	unknown, behind W_L 11176
8	2011.06.05-156	18^h	06d04^h	3.6	3.25	160	FL CME	⊡ 04d<22^h05^m 04d22^h05^m		2425/360/300	11222, 3d behind W_L
9	2011.06.07-158	07^h	12^h 19^h	40 62.5	2.8 2.5	650 650	FL	●07d06^h16^m 07d06^h49^m	M2.5/2N	S21W54 1255/360/250	11226
10	2011.06.11-162	13^h	20^h	2.4	2.8	75	Unknown				
□11	2011.06.15-166	18^h	16d20^h	0.9	2.1	80	FL	⊙14d21^h36^m 14d22^h36^m	M1.3/SF	N15E77 0441/028/135	11236
12	2011.06.17-168	06^h	08^h 16^h	5.6 2.7	2.8 2.7	70 75	SC (FL 486)	17d02^h39^m ●14d21^h36^m 14d22^h36^m	M1.3/SF	N15E77 0441/028/135	11236
13	2011.08.02-214	07^h	02d11^h 03d17^h	2.2 0.55	2.2 2.1	120 70	FL FL	⊙02d05^h19^m 02d06^h36^m Ø03d13^h17^m 02d14^h00^m	M1.4/1N M6.0/2B	N14W15 0852/268/285 N16W30 0610//360/307	11261 11261
14	2011.08.04-216	04^h	08^h	60	2.5	500	FL	●04d03^h41^m 04d04^h12^m	M9.3/2B	N19W36 1315/360/298	11261
15	2011.08.08-220	19^h	20^h	2.6	2.3	100	FL	●08d18^h00^m 18d18^h12^m	M3.5/1B	N16W61 1343/237/281	11263
16	2011.08.09-221	08^h	10^h	21.3	2.3	650	FL	●09d07^h48^m 09d08^h12^m	X6.9/2B	N17W69 1610/360/279	11263
17	2011.09.06-249	02^h	09^h	1.4	2.2	200	FL	●06d01^h35^m 06d02^h24^m	M5.3/1B	N14W07 0782/360/070	11283
18	2011.09.07-250	02^h	05^h	6	2.1	420	FL	●06d22^h12^m 06d23^h05^m	X2.1/2B	N14W18 0575/360/300	11283
19	2011.09.22-265	13^h	23d09^h 23d21^h	5.4 9.7	2.2 3.2	200 140	FL	●22d10^h29^m 22d10^h48^m	X1.4/2N	N13E78 1905/360/072	11302
20	2011.10.22-295	12^h	23^h	3.3	2.8	75	FL	●22d10^h00^m 22d10^h24^m	M1.3/SF	N25W77 1005/360/311	11314
21	2011.11.04-308	00^h	09^h	2.6	2.3	190	FL	●03d20^h16^m 03d23^h10^m	X1.9/2B	N22E63 0991/360/090	11339
22	2011.11.26-330	08^h	17^h	40	3.2	120	FL	⊙26d06^h09^m 26d07^h12^m	C1.2/DSF	N08W49 0933/360/327	11353
23	2011.12.25-359	19^h	26d01^h	2.5	2.3	100	FL	●25d18^h11^m 25d18^h48^m	M4.0/1N	S22W26 0366/125/235	11387

N	Particles enhancements						Solar flares or CME – the particle sources				
	Event name	To	Tmax	Jmax, pfu	γ	Eqm, MeV	Sour-ce	To (UT) To (CME)	X-ray class, importance	Localization, CME data	AR
□24	2012.01.02-002	19^h	22^h $03d06^h$	0.4 0.5	1.6 1.6	120 90	FL	⊡$02d14^h31^m$ $02d15^h13^m$	C2.4/EPL	N07W89 1138/360/244	11384, 1.5d behind W_L
25	2012.01.20-020	01^h	20^h $21d01^h$	2.4 1.9	2.2 2.2	100 80	FL	●$19d13^h44^m$ $19d14^h36^m$	M3.2/SF	N30E30 1120/360/020	11402
26	2012.01.21-021	18^h	22^h	1.4	1.8	140	FL	⊡$21d13^h35^m$ $21d14^h00^m$	C2.4/BSL	N25W82 0377/048/266	11396
27	2012.01.22-022	01^h	10^h	2.5	2.4	80	FL	⊙$22d02^h32^m$ $22d06^h00^m$	C7.1/	N17W13 0367/085/248	11401
28	2012.01.23-023	04^h	14^h $24d17^h$	2700 3900	3.55 4.1	450 250	FL SC	●$23d03^h38^m$ $23d04^h00^m$ $24d15^h03^m$	M8.7/2B	N28W21 2175/360/326	11402
29	2012.01.27-027	18^h	$28d02^h$ $28d12^h$	740 680	3.1 2.9	900 600	FL	●$27d17^h37^m$ $27d18^h28^m$	X1.7/1F	N27W71 2508/360/296	11402
30	2012.02.24-055	23^h	$26d01^h$ $27d00^h$	3.5 2.3	3.5 4.0	55 45	DFS SC	⊙$24d02^h25^m$ $24d03^h46^m$ ▲$26d21^h40^m$	26°	N32E38 0800/189/001	
31	2012.03.04-064	21^h	$05d16^h$	3.2	2.25	90	FL	●$04d10^h29^m$ $04d11^h00^m$	M2.0/1N	N19E61 1306/360/052	11429
32	2012.03.07-067	02^h	17^h $08d13^h$	1440 4340	2.9 4.0	1200 650	FL FL	●$07d00^h00^m$ $07d00^h24^m$ Ø$07d01^h05^m$	X5.4/3B X1.3/SF	N17E27 2684/360/057 N22E12	11429 11430
33	2012.03.13-073	17^h	21^h	390	2.8	650	FL	●$13d16^h35^m$ $13d17^h36^m$	1B/M7.9	N19W59 1884/360/286	11429
34	2012.05.17-138	01^h	04^h $18d02^h$	180 30	2.15 (4.2) 2.05	5000 (1800) 650	FL	●$17d01^h25^m$ $17d01^h48^m$	M5.1/1F	N11W76 1582/360/261	11476
35	2012.05.26-147	23^h	$27d06^h$ $27d11^h$	11.9 12.5	3.2 3.2	70 70	FL CME	⊡$26d<20^h57^m$ $26d20^h57^m$		1966/360/291	Flare activity behind W_L
36	2012.06.14-166	18^h	$16d21^h$	11	3.0	90	FL SC SC	●$14d12^h52^m$ $14d14^h12^m$ ▲$16d20^h20^m$ ▲$16d21^h15^m$	M1.9/1N	S17E06 0987/360/144	11504
37	2012.07.06-188	23^h	$07d08^h$	23	3.0	220	FL	●$06d23^h01^m$ $06d23^h24^m$	X1.1/	S13W59 1828/360/233	11515
38	2012.07.08-190	16^h	$09d05^h$	17	2.2	550	FL	■$08d16^h23^m$ $08d16^h54^m$	M6.9/1N	S14W83 1495/157/234	11515
39	2012.07.12-194	16^h	22^h	80	3.7	110	FL	●$12d15^h18^m$ $12d16^h48^m$	X1.4/2B	S14W01 0885/360/158	11520
40	2012.07.17-199	15^h	$18d00^h$ $18d06^h$	93 116	3.2 3.2	150 140	FL	●$17d12^h03^m$ $17d13^h48^m$	M1.7/1F	S28W75 0958/176/241	11520
41	2012.07.19-201	06^h	15^h $20d03^h$	75 72	3.5 4.4	280 120	FL SC	■$19d04^h17^m$ $19d05^h24^m$ ▲$20d04^h49^m$	M7.7/	S16W90 1631/360/275	11520, 0.5d behind W_L
42	2012.07.23-205	06^h	22^h	11	3.6	250	FL CME	⊡ $23d<02^h36^m$ $23d02^h36^m$		2003/360/286	11520, 4d behind W_L
□43	2012.08.02-215	10^h	21^h	0.6	2.2	50	FL SC	□ $02d12^h10^m$ $02d13^h26^m$ ▲$02d10^h50^m$	C1.5/	S20W87 0563/108/234	11529
44	2012.09.01-245	01^h	15^h $02d10^h$	24 47	3.4 4.1	80 65	FL	●$31d19^h45^m$ $31d20^h00^m$	C8.4/2F	S19E42 1442/360/090	11562
45	2012.09.28-272	00^h	05^h	23.8	3.0	200	FL	●$27d23^h36^m$ $28d00^h12^m$	C3.7/1F	N06W34 0947/360/251	11577

N	Particles enhancements						Solar flares or CME – the particle sources				
	Event name	To	Tmax	Jmax, pfu	γ	Eqm, MeV	Sour-ce	To (UT) To (CME)	X-ray class, importance	Localization, CME data	AR
46	2012.11.08-313	12^h	09d04^h	1.4	2.0	170	FL	■08d02^{h}08^m 28d02^{h}36^m	M1.7/	N13E89 0855/360/046	11611
47	2012.12.14-349	08^h	15d02^h	6.5	4.1	50	FL CME	⊡14d<02^{h}00^m 14d02^{h}00^m		0763/149/232	unknown, behind W_L
48	2013.01.16-016	22^h	17d07^h 17d13^h	1.1 1.25	2.2 2.8	70 50	FL	■16d19^{h}18^m 16d19^{h}00^m	C2.2/	S32W87 0648/250/236	11650
49	2013.03.15-074	18^h	22^h 16d12^h	0.9 6.2	2.3 2.5	70 75	FL	●15d05^h 46^m 15d07^{h}12^m	M1.1/1F	N09E06 1063/360/112	11692
50	2013.04.11-101	07^h	17^h	100	3.2	500	FL	●11d06^{h}55^m 11d07^{h}24^m	M6.5/3B	N09E12 0861/360/085	11719
51	2013.04.21-111	09^h	12^h 22d02	2 1.2	2.3 2.2	110 70	FL CME FL CME	⊡21d<07^{h}24^m 21d07^{h}24^m Ø 21d<20^{h}36^m 21d20^{h}36^m		0919/360/269 0561/212/260	11719, 2d behind W_L
52	2013.04.24-114	23^h	25d05^h	1.3	2.6	140	FL CME	⊡24d<22^{h}12^m 24d22^{h}12^m		0784/360/241	11719, 6d behind W_L
53	2013.05.13-133	18^h	14d09^h	1	2.2	70	FL	■13d15^{h}48^m 13d16^{h}08^m	X2.8/1N	N14E85 1850/360/063	11748
54	2013.05.15-135	10^h	21^h	20.5	3.5	110	FL	● 15d01^{h}24^m 15d01^{h}48^m	2N/X1.2	N12E64 1366/360/093	11748
55	2013.05.22-142	13^h	15^h	83.5	3.0	500	FL	●22d12^{h}35^m 22d13^{h}26^m	3N/M5.0	N15W70 1466/360/287	11745
56	2013.06.21-172	14^h	22d10^h	6	2.3	100	FL	●21d02^{h}30^m 21d03^{h}12^m	M2.9/1F	S16E73 1900/207/107	11777
57	2013.06.23-174	07^h	11^h 20^h	3.7 9.7	2.6 4.0	70 60	FL SC FL	●21d02^{h}30^m ●23d04^{h}26^m Ø23d20^{h}48^m 23d21^{h}24^m	M2.9/1F M2.9/1N	S16E73 S15E66 0339/101/133	11777 11778
□58	2013.08.17-229	20^h	18d06^h	0.3	1.8	60	FL	●17d18^{h}16^m 17d19^{h}12^m	2B/ M3.3,M1.4	S07W30 1202/360/274	11818
59	2013.08.20-232	16^h	21d14^h	1	2.15	80	FL	⊡20d04^{h}54^m 20d08^{h}12^m	C1.3,C1.1/	S18W87 0784/360/210	11817, 1d behind W_L
60	2013.09.30-273	00^h	17^h	102	3.0	220	DSF FL	● 29d21^{h}45^m ●29d21^{h}43^m 29d22^{h}12^m	35° C1.2/	N15W40 N15W33 1179/360/343	spotless AR
61	2013.10.28-301	06^h	11^h 29d02^h	2.3 3.5	2.35 1.7	100 300	FL	●28d01^{h}41^m 28d02^{h}24^m	X1.0/2N	N04W66 0695/360/296	11875
62	2013.10.30-303	02^h	05^h	4.2	2.4	130	FL	■29d21^{h}42^m 29d22^{h}00^m	X2.3/	N05W89 1001/360/249	11875
63	2013.11.02-306	07^h	16^h	1.6	2.2	300	FL CME	⊡ 02d<04^{h}48^m 02d04^{h}48^m		0828/360/239	11875, 3d behind W_L
64	2013.11.07-311	01^h	05^h	5.5	3.0	90	FL	■06d23^{h}35^m 07d00^{h}00^m	M1.9,M1.8/ SPY	S11W88 1033/360/233	11882, 1d behind W_L
□65	2013.11.08-312	02^h	09d11^h	0.6	2.7	40	FL FL	⊙08d04^{h}20^m Ø07d14h15m	X1.1/2B M2.4/1N	S14E15 S13E23	11890 11890
□66	2013.11.10-314	08^h	11d02^h	0.5	2.0	60	FL	●10d05^{h}08^m 10d05^{h}36^m	X1.1/2B	S14W13 0682/262/198	11890
67	2013.11.19-323	12^h	19^h	3.4	2.3	130	FL	●19d10^{h}14^m 19d10^{h}36^m	X1.0/SF	S13W69 0740/360/222	11893
68	2013.12.14-348	06^h	15d01^h	1.1	2.3	60	FL CME CME	⊡14d<06^{h}36^m 14d06^{h}36^m Ø14d21^{h}24^m		0611/121/112 0611/360/169	Flare activity behind E_L

N	Particles enhancements						Solar flares or CME – the particle sources				
	Event name	To	Tmax	Jmax, pfu	γ	Eqm, MeV	Sour-ce	To (UT) To (CME)	X-ray class, importance	Localization, CME data	AR
69	2013.12.26-360	08^h	$27d03^h$	2	2.3	90	FL CME	⊡$26d<03^h24^m$ $26d03^h24^m$		1336/360/036	Flare activity behind E_L
70	2013.12.28-362	18^h	23^h	26.5	2.6	240	FL CME	⊡$28d<17^h36^m$ $28d17^h36^m$		1118/360/284	Flare activity behind W_L
71*	2014.01.06-006	07^h	14^h	38	2.1	1350	FL	■$06d07^h30^m$ $06d08^h00^m$	C2.1/EPL	S15W89 1402/360/274	11936, ~1.5d behind W_L
72	2014.01.07-007	18^h	$08d12^h$	1000	3.8	400	FL	●$07d18^h04^m$ $07d18^h24^m$	X1.2/2N	S15W11 1830/360/231	11944
□73	2014.02.18-049	08^h	14^h	0.4	3.1	50	FL	⊙$18d01^h27^m$ $18d01^h36^m$	C4.7/SF	S16W42 0779/360/044	11976
74	2014.02.19-050	09^h	15^h $20d03^h$	2 2.8	3.3 2.4	45 90	FL CME SC	⊡$19d<04^h48^m$ $19d04^h48^m$ ▲$20d03^h20^m$		0612/360/090	11990, 3d behind E_L
75	2014.02.20-051	08^h	10^h 13^h	17.7 9.2	2.7 3.2	250 110	FL	●$20d07^h26^m$ $20d08^h00^m$	M3.0/SN	S15W73 0948/360/268	11976
76	2014.02.25-056	04^h	16^h	13.6	2.3	500	FL	●$25d00^h39^m$ $25d01^h25^m$	X4.9/2B	S12E82 2147/360/073	11990
77	2014.02.28-059	02^h	10^h	97	3.2	180	FL	⊙$27d21^h33^m$	C4.2/SF	S11W63	11982
□78	2014.03.25-084	04^h	11^h $26d00^h$	0.4 0.2	3.2 4.0	35 25	FL CME	⊡$25d<05^h36^m$ $25d05^h36^m$		0651/223/269	Flare activity behind W_L
79	2014.03.29-088	18^h	22^h	1.4	2.3	130	FL	●$29d17^h35^m$ $29d18^h12^m$	X1.0/2B	N11W32 0528/360/325	12017
80	2014.04.18-108	14^h	16^h	11.8	2.3	500	FL	●$18d12^h31^m$ $18d13^h25^m$	M7.3/	S20W34 1203/360/238	12036
81	2014.08.25-237	18^h	$26d00^h$	1.3	2.3	75	FL	●$25d14^h46^m$ $25d15^h36^m$	M2.0/1B	N05W36 0555/360/270	12146
82 **	2014.09.01-244	18^h	$03d08^h$	2.5	2.2	700	FL	■$01d10^h55^m$ $01d11^h12^m$	B6.2/(~X2.4)	N14E126 1901/360/065	12158, 3d behind E_L
83	2014.09.10-253	21^h	$11d07^h$ $12d16^h$	25 67.5	2.8 3.1	400 160	FL SC	●$10d16^h59^m$ $10d18^h00^m$ ▲$12d15^h53^m$	2B/X1.6	N14E02 1267/360/175	12158
84	2014.11.01-305	14^h	20^h $02d22^h$	3.2 7	3.7 2.7	50 120	FL	●$01d04^h44^m$ $01d05^h00^m$	C2.7/DSF	S08E52 1628/159/125	Spotless AR***
85	2014.12.13-347	16^h	$14d11^h$	1.7	2.3	130	FL CME	⊡$13d<14^h24^m$ $13d14^h24^m$		2222/360/265	12222, 3d behind W_L
86	2014.12.21-355	08^h	21^h	2.4	3.1	55	FL	●$21d11^h24^m$ $21d12^h12^m$	M1.0/	S13W25 0669/360/189	12241
87	2014.12.23-357	00^h	12^h	5	3.4	50	FL	⊙ $22d21^h15^m$	C5.7	S19W71	12242
□88	2015.01.27-027	19^h	$29d01^h$ $30d19^h$	0.5 1.0	4.8 2.4	20 60	FL	⊡$27d07^h13^m$ $27d08^h23^m$	C2.1/	N07E89 0332/009/119	12277, 1d behind E_L
89	2015.02.21-052	10^h	19^h $22d07^h$	1.2 0.7	2.3 2.5	60 70	DSF CME	⊡$21d<09^h24^m$ $21d09^h24^m$	>15°	1120/360/215	backside event on SW_L
90	2015.03.15-074	02^h	10^h	2	2.2	80	FL	⊙$15d01^h15^m$ $15d01^h48^m$	C9.1/1F	S22W25 0719/360/240	12297

N	Particles enhancements						Solar flares or CME – the particle sources				
	Event name	To	Tmax	Jmax, pfu	γ	Eqm, MeV	Sour-ce	To (UT) To (CME)	X-ray class, importance	Localization, CME data	AR
91	2015.03.16-075	01^h	09^h 14^h	5.2 4	3.5 4.2	50 35	FL	⊙15d22^h42^m 15d23^h24^m	M1.2/	S19W32 0284/015/290	12297
□92	2015.04.22-112	06^h	23d07^h 23d21^h	0.55 0.6	1.6 2.0	80 75	FL	⊡21d21^h39^m	M1.8, M1.2/	N10W80	12322
93	2015.05.12-132	04^h	07^h	5.4	2.4	120	FL DSF	■12d02^h15^m 12d02^h48^m 12d02^h26^m	C2.6/DSF 22°	S21W83 772/250/283 S21W83	12335
94	2015.06.18-169	02^h	14^h	15.4	3.2	100	FL	■18d00^h33^m 18d01^h26^m	M1.3/	S16W81 1714/195/270	12365
95	2015.06.21 - 172	16^h	22d10^h 22d19^h	230 600	4.15 4.3	100 110	FL SC	●21d01^h02^m 21d02^h36^m ▲22d18^h33^m	M2.0,M2.7/ 1N	N12E13 1366/360/072	12371
96	2015.06.25-176	09^h	26d10^h	13.5	3.3	80	FL	●25d08^h02^m 25d08^h36^m	M7.9/3B	N09W42 1627/360/330	12371
97	2015.07.01-182	18^h	20^h 02d01^h	2.8 4.5	2.0 2.3	130 90	FL CME	⊡01d<14^h36^m 01d14^h36^m		1435/360/311	12731, 2.5d behind W_L
98	2015.09.20-263	18^h	22^h	2.2	2.2	80	FL	●20d17^h30^m 20d18^h12^m	2N/M2.1	S20W24 1239/360/219	12415
□99	2015.09.30-273	20^h	23^h 01d02^h	0.9 0.6	3.0 3.1	40 35	FL	⊙30d07^h36^m 30d10^h00^m	1N/M1.3	S22W46 0602/128/304	12422
□ 100	2015.10.22-295	13^h	23^h 23d05^h	0.5 0.2	3.0 3.0	40 40	FL	●22d02^h13^m 22d03^h12^m	C4.4/SF	S11W27 0817/360/206	12434
101	2015.10.29-302	02^h	07^h	19	2.3	900	FL CME	⊡29d<02^h36^m 29d02^h36^m		0530/202/251	12434, 2d behind W_L
102	2015.11.09-313	16^h	10d02^h	2.7	2.2	120	FL	●09d12^h49^m 09d13^h25^m	M3.9/2B, 1F	S11E41 1041/273/137	12449
103	2015.12.28-362	14^h	29d02^h	1.4	2.3	80	FL	●28d11^h20^m 28d12^h12^m	M1.8/	S23W11 1212/360/163	12473
104	2016.01.01-001	23^h	02d01^h 02d04^h	4.7 12.4	2.6 2.5	120 140	FL	■01d23^h10^m 01d23^h24^m	M2.3/	S25W82 1730/360/227	12473
105	2016.03.16-076	07^h	11^h 17^h	1.1 0.8	1.5 1.7	120 80	DSF FL	■16d06^h34^m ■16d06^h34^m 16d07^h00^m	10° C2.2/DSF	N20W86 N12W88 0592/154/265	12522
□ 106	2016.04.18-109	07^h	15^h	0.3	2.1	55	FL	●18d00^h14^m 18d00^h48^m	M6.7/1F	N12W62 1084/162/291	12529
107	2016.05.15-136	17^h	17d21^h	1.6	2.1	90	DSF FL	●15d15^h00^m ●15d15^h19^m 15d15^h12^m	>10° C3.2/SF	NW N10W62 1118/176/309	12542
□ 108	2016.07.23-205	04^h	07^h	0.4	1.5	100	FL	●23d05^h00^m 23d05^h24^m	M7.6,M5.5/ 3B	N02W74 0835/117/271	12567
109	2017.07.14-195	03^h	10^h 23^h	11.2 20.4	2.6 2.7	120 130	FL	●14d01^h07^m 14d01^h26^m	M2.4/1N	S06W29 1200/360/230	12665
110	2017.07.25-206	03^h	20^h	1.0	1.8	9	unkn own				
111	2017.09.04-247	21^h	05d07^h 05d19^h	99 167	3.5 4.1	100 90	FL	●04d13^h45^m 04d20^h12^m	3B/M1.5; M1.0; M1.7; M1.5; M5.5; M2.1/	S11W16 1418/360/184	12673
112	2017.09.06-249	11^h	15^h 07d04^h	39 334	2.1 3.8	450 140	FL	●06d08^h52^m 06d12^h24^m	2B/X2.2, X9.3	S07W33 1571/360/201	12673

N	Particles enhancements						Solar flares or CME – the particle sources				
	Event name	To	Tmax	Jmax, pfu	γ	Eqm, MeV	Sour-ce	To (UT) To (CME)	X-ray class, importance	Localization, CME data	AR
113	2017.09.07-250	20^h	08d00^h 08d20^h	575 14.3	4.0 2.5	150 130	FL	●07d14^h20^m 07d15^h12^m	X1.3/2B	S11W49 0433/058/246	12673
114	2017.09.10-253	16^h	19^h	850	2.1 (4.2)	1200	FL	■10d15^h35^m 10d16^h00^m	X8.2/	S08W88 3163/360/262	12673

*** – C2.1, возможно, эхо от солнечной вспышки X~3.5 в AR11936 с вероятными координатами S8W110 (1.5d за E_L).**

**** – вероятный источник: солнечная вспышка класса X2.1 в AR12158 с вероятными координатами N14E126 (2.5^d за E_L).**

***** – Беспятенная AR в юго-восточном квадранте согласно** [Pesce-Rollins, M, Omodei, N. Petrosian, V at al. Fermi Large Area Telescope observations of high-energy gamma-ray emission from behind-the-limb solar flare, The 34th International Cosmic Ray Conference, 30 July- 6 August, 2015 The Hague, The Netherlands, https://arxiv.org/pdf/1507.04303v2.pdf]

При поддержке гранта РФФИ № 19-02-00264