Поиск солнечных нейтронов с энергией меньше 100 МэВ в эксперименте PAMELA в вспышках 2006-2014

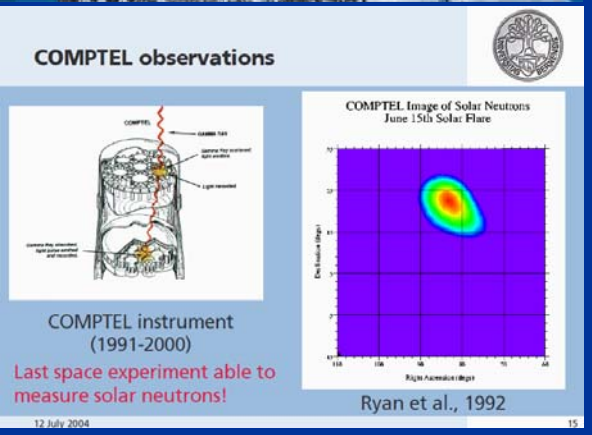
Э.А. Богомолов, Г.И. Васильев, С.Ю. Крутьков
ФТИ им. А.Ф. Иоффе

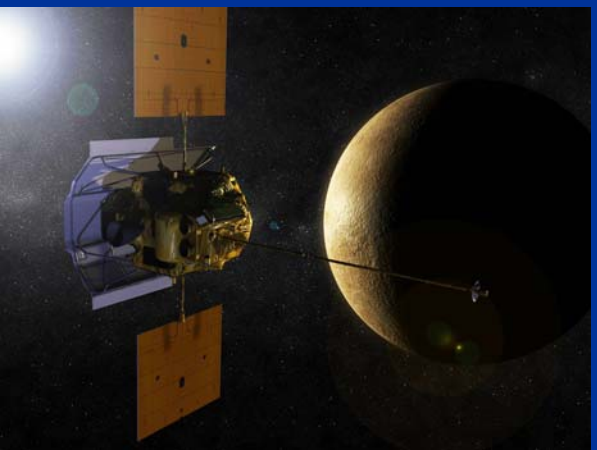
от PAMELA Collaboration

33-я Всероссийская конференция

по космическим лучам (11-15.08.2014, ОИЯИ, Дубна)

Немного истории о солнечных нейтронах.





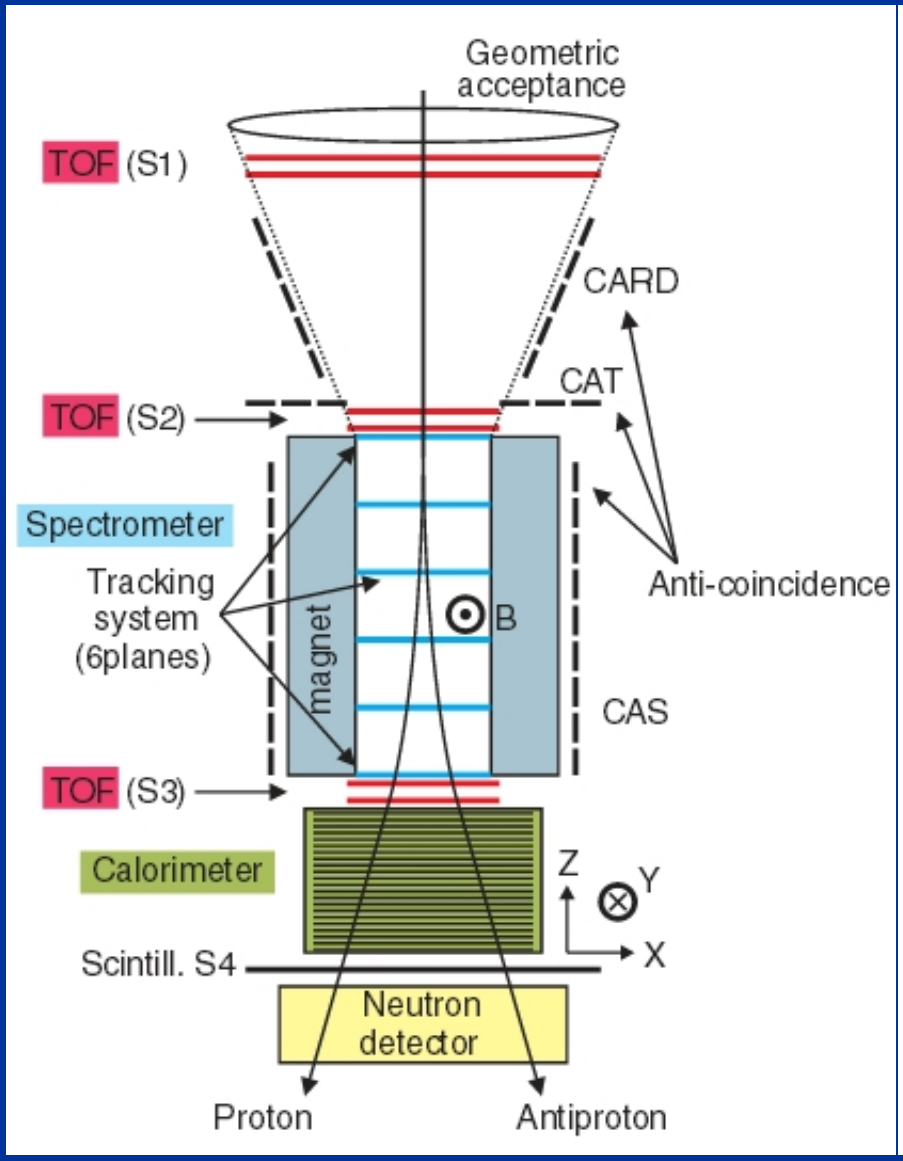
1. SF 21 June 1980, Gamma Ray Spectrometer aboard Solar Maximum Mission, En~100 MeV, Chupp et al. 1982
2. SF 03 June 1982, Neutron Monitor, Jungfraujach, Switzerland, 3570 m, R=4.5 GV, Chupp et al. 1983
3. SF 15 June 1991, COMPTEL aboard GRO, the first Image of SF in Neutrons, En~20=250 MeV, Moser et al.
4. SF 31 December 2007, MESSENGER, 0.48 AU, En=1-8 MeV, Feldman et al. 2010
5. NEM(Japan) on ISS since August 2009, En~40-200 MeV, n-p scattering process, Koda et al. 2011
6. Fermi LAT can measure high energy solar neutrons?...

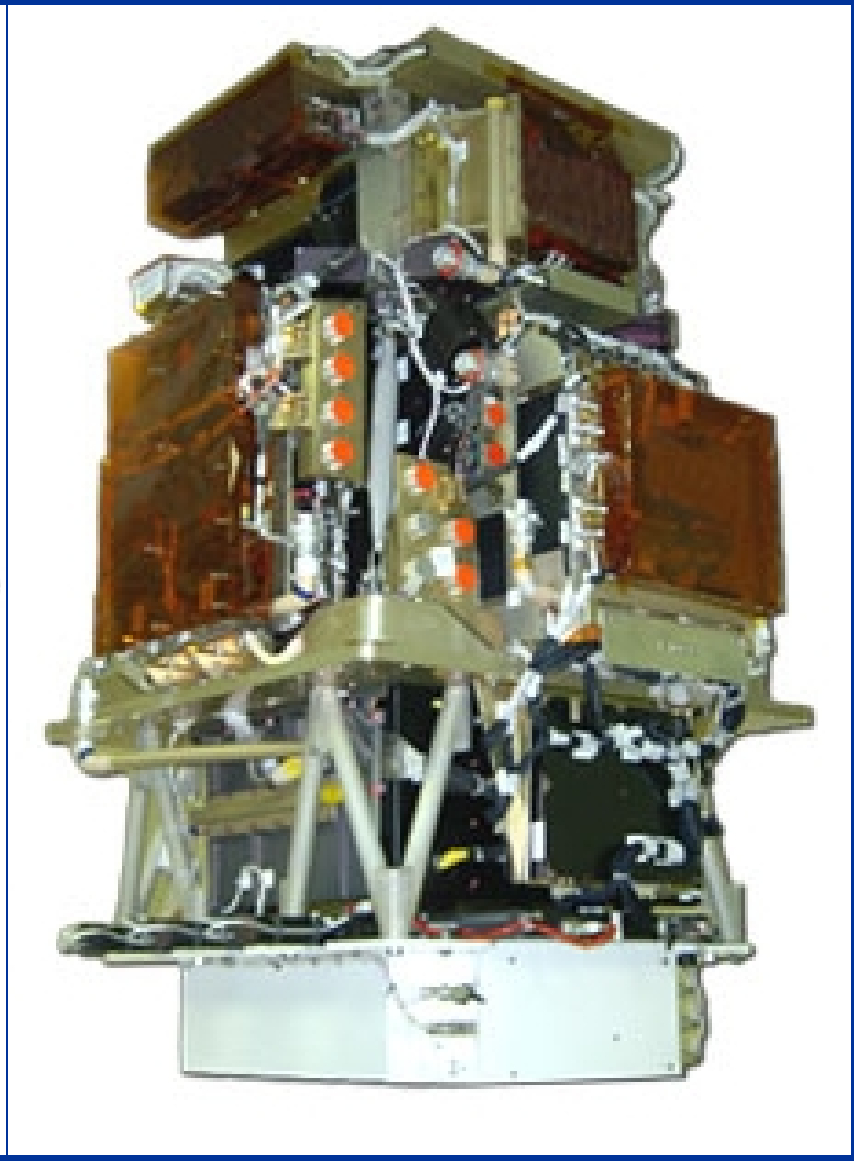
References samples

W.C. Feldman et al., Evidence for extended acceleration of solar flare ions from 1-8 MeV solar neutrons detected with the MESSENGER Neutron Spectrometer, JGR, V115, A01102, 2010.

Lev Dorman, Solar Neutrons and Related Phenomena, 2010, Springer, pp 873

Магнитный спектрометр PAMELA

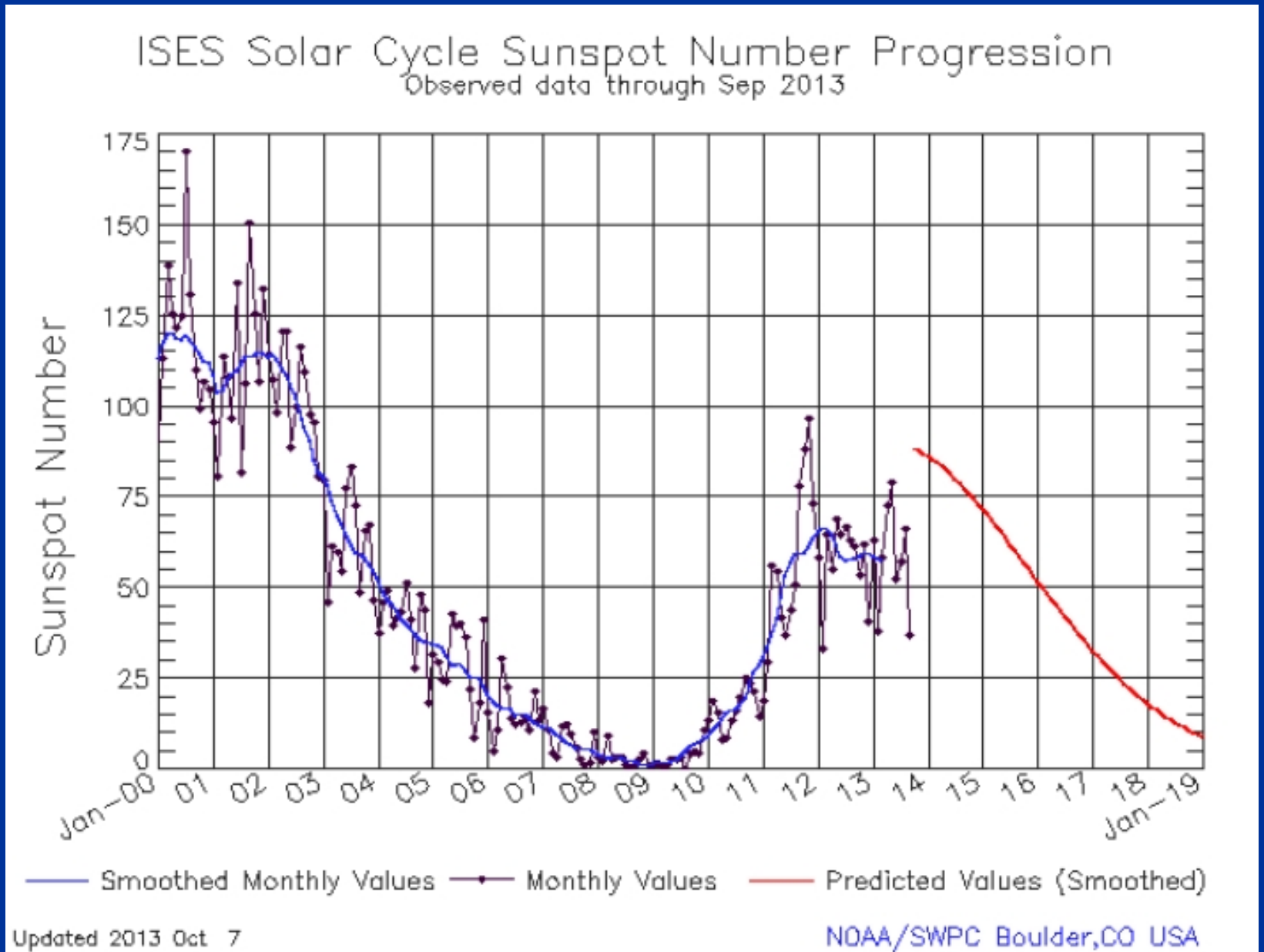




Поиск солнечных нейтронов. Идеи и критерии.

- Солнечные нейтроны должны генерироваться практически в любой вспышке. Вопрос только в пороге чувствительности к потоку нейтронов нейтронного детектора (НД) PAMELA…
- После вспышки в условиях прямой видимости Солнца проводится поиск возрастания счёта НД вблизи экватора в сравнении с счётом НД до вспышки на предыдущем витке орбиты PAMELA (сдвиг орбиты ~25^0 к востоку). Длительность наблюдений до ~ 10 мин.
- Проводится учёт возможного изменения счёта НД из-за различия геомагнитных порогов при сдвиге орбиты ~ 25^0 при идентичном положении орбиты PAMELA за сутки до вспышки.
- Неизменность счёта заряженных частиц после вспышки в сравнении с счётом при спокойном Солнце контролируется в районе экватора данными телескопа сцинтилляционных счётчиков PAMELA.
- Время пролёта на базе Солнце-Земля позволяет оценить энергию регистрируемых солнечных нейтронов. Максимум сигнала в рентгене принимается за начало вспышки (+499 сек.) и генерации солнечных нейтронов.
- Дополнительное свидетельство регистрации солнечных нейтронов – предимпульс протонов от $n > p^+ + e^- + \nu_e$ распада на пути Солнце-Земля в данных телескопа сцинтилляционных счётчиков S1, S2, S3.

Солнечная активность 2006-2014



Солнечные события 2006-2013 (данные GOES)

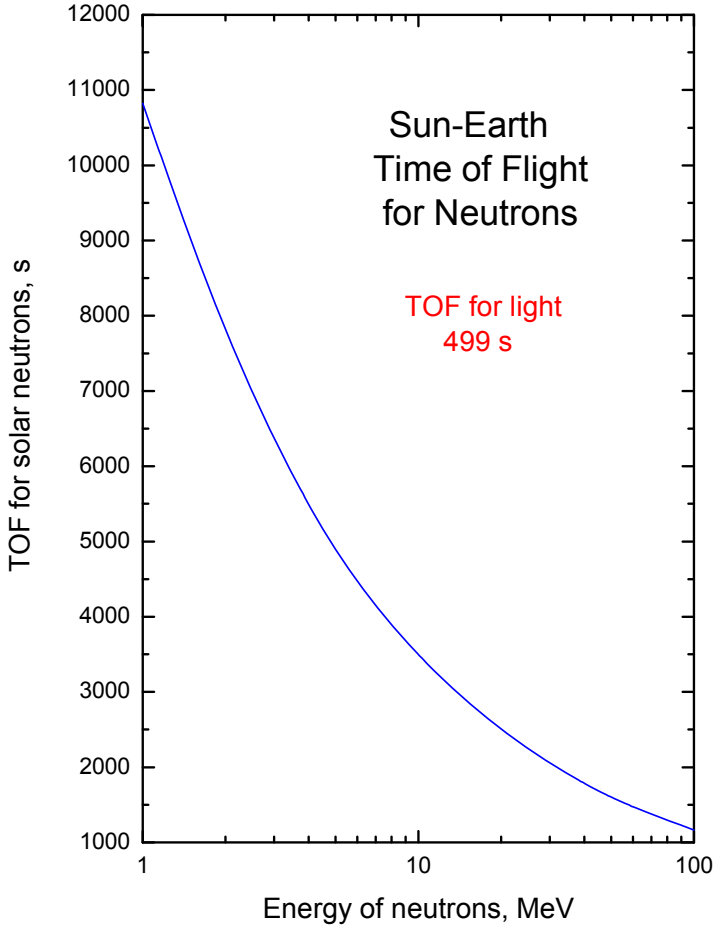
PARTICLE EVENT Start (Day/UT)	Maximum	Proton Flux (pfu @ >10 MeV)	ASSOCIATED CME	FLARE AND ACTIVE REGION Flare Max. (Loc./ Day UT)	Importance (Xray/Opt.)	Location	Region# (SWO)
2006							
Dec 06/1555	Dec 07/1930	1980	Halo	Dec 05/1035	X9/2N	S07E79	930
Dec 13/0310	Dec 13/0925	698	Halo/13 0254	Dec 13/0240	X3/4B	S05W23	930
2007							
none							
2008							
none							
2009							
none							
2010							
Aug 14/1230	Aug 14/1245	14	W/14 1325	Aug 14/1005	C4/0F	N17W52	1099
2011							
Mar 08/0105	Mar 08/0800	50	NW/07 2000	Mar 07/2012	M3/SF	N24W59	1164
Mar 21/1950	Mar 22/0135	14	NW/21 0236	N/A	N/A	N/A	1169
Jun 07/0820	Jun 07/1820	72	SW/08 1750	Jun 07/0803	M2/2N	S21W64	1226
Aug 04/0635	Aug 05/2150	96	NW/06 0515	Aug 04/0412	M9/2B	N15W49	1261
Aug 09/0845	Aug 09/1210	26	NW/09 1710	Aug 09/0805	X6/2B	N17W83	1263
Sep 23/2255	Sep 26/1155	35	NE/27 0430	Sep 22/1101	X1/2N	N11E74	1302
Nov 26/1125	Nov 27/0125	80	NW/28 0145	Nov 26/0710	N/A	N08W49	1353
2012							
Jan 23/0530	Jan 24/1530	6310	NW/23 0400	Jan 23/0359	M8/2B	N28W36	1402
Jan 27/1905	Jan 28/0205	796	NW/27 1827	Jan 27/1837	X1/1F	N27W71	1402
Mar 07/0510	Mar 08/1115	6530	NE/07 0036	Mar 07/0024	X5/3B	N17E15	1429
Mar 13/1810	Mar 13/2045	469	NW/13 1736	Mar 13/1741	M7/	N18W62	1429
May 17/0210	May 17/0430	255	NW/17 0148	May 17/0147	M5/1F	N12W89	1476
May 27/0535	May 27/1045	14	/27 2112	N/A	N/A	N/A	1482
Jun 16/1955	Jun 16/2020	14	SE/14 1430	Jun 14/1435	M1/1N	S17E14	1504
Jul 07/0400	Jul 07/0745	25	SW/06 2312	Jul 06/2308	X1/	S18W50	1515
Jul 12/1835	Jul 12/2225	96	SW/12 1649	Jul 12/1710	X1/2B	S16W09	1520
Jul 17/1715	Jul 18/0600	136	SW/17 1348	Jul 17/1715	M1/	S17W75	1520
Jul 23/1545	Jul 23/2145	12	SW/23 0236			S16W86	1520
Sep 01/1335	Sep 02/0859	59	SE/31 2012	Aug 31/2043	C8/2F	S06E20	
Sep 28/0300	Sep 28/0445	28	NW/28 0018	Sep 27/2357	C3/1F	N08W41	1577
2013							
Mar 16/1940	Mar 17/0700	16	NE/15 0712	Mar 15/0658	M1/1F	N11E12	1692
Apr 11/1055	Apr 11/1645	114	NE/11 0724	Apr 11/0716	M6/3B	N09E12	1719
May 14/1325	May 17/1720	41	NE/15 0148	May 15/0148	X1/2N	N11E51	1748
May 22/1420	May 23/0650	1660	NW/22 1325	May 22/1322	M5/3N	N15W70	1745

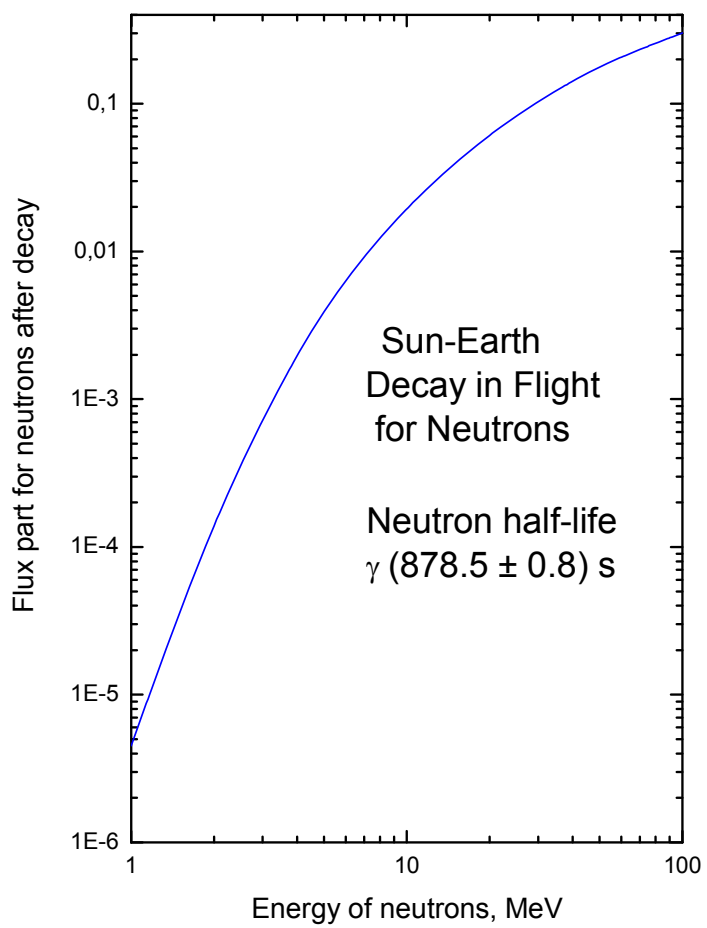
Солнечные вспышки 2006-2014

Дата	Класс	Область	$I_{СКЛ}$(>100 МэВ), $м^{-2}день^{-1}ср^{-1}$
13 December 2006	X3.4	S06 W24	~82000
07 June 2011	M2.5	S22 W53	~42000
23 January 2012	M8.7	N18 W21	~22000
27 January 2012	X1.7	N27 W71	~101000
07 March 2012	X5.4	N17 E27	~75000
17 May 2012	M5.1	N11 W76	~200000
06 July 2012	X1.1	S13 W59	~3000
19 July 2012	M7.7	S13 W88	~7000
11 April 2013	M6.5	N07 E13	~18000
22 May 2013	M5.0	N14 W87	~31000
06 January 2014	C2.1	S15W89	~39000
07 January 2014	X1.2	S12W08	~39000
20 January 2014	M3.0	S15W75	~4800
18 April 2014	M7.3	S20W34	~13000

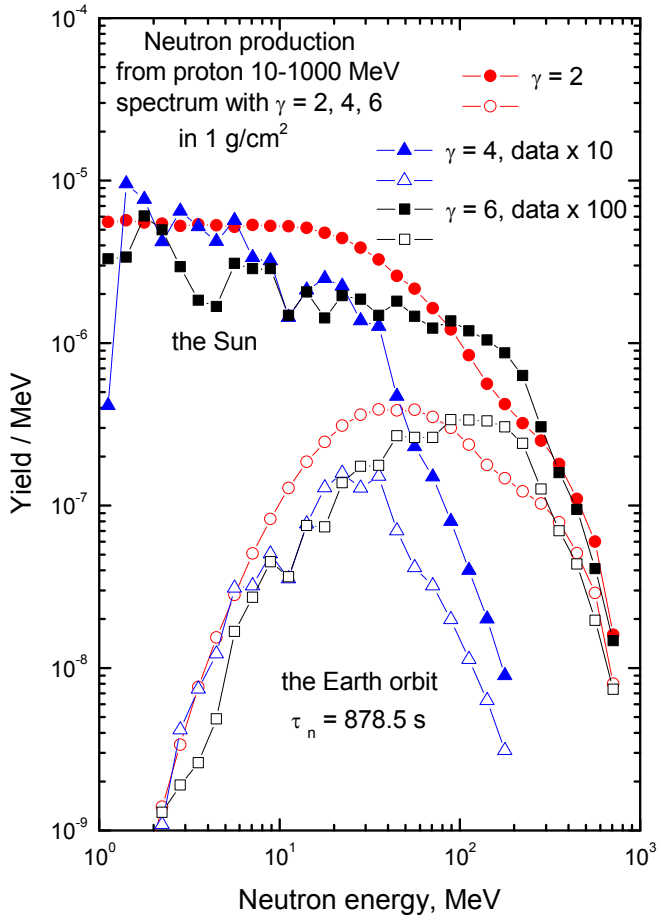
Критерий селекции: поток протонов СКЛ > 100 МэВ > 10^4 $см^{-2}$ $день^{-1}$ $ср^{-1}$

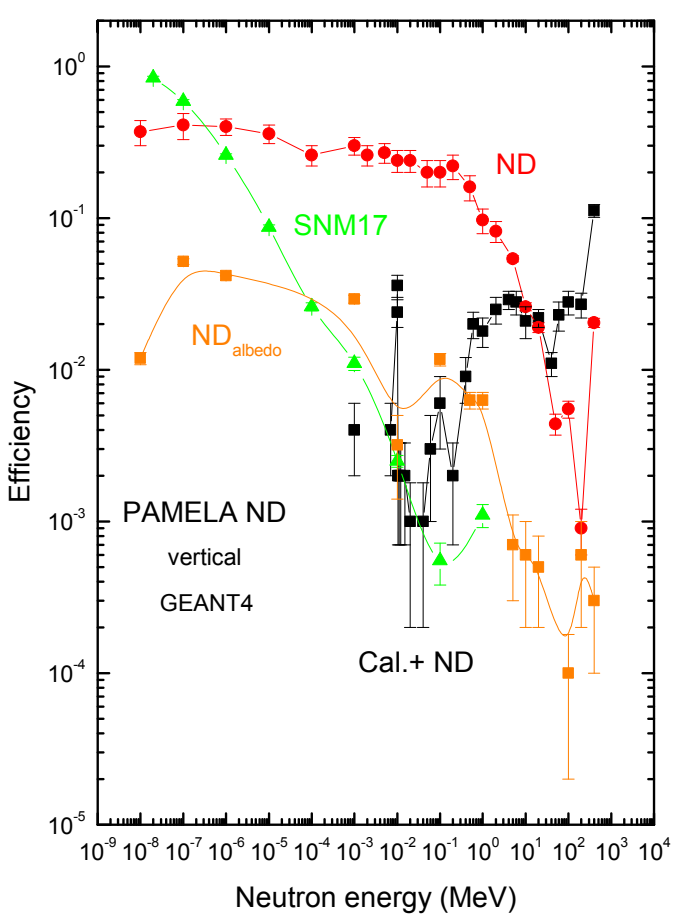
Время пролёта нейтронов на базе Солнце-Земля, вероятность достижения нейтронами орбиты Земли



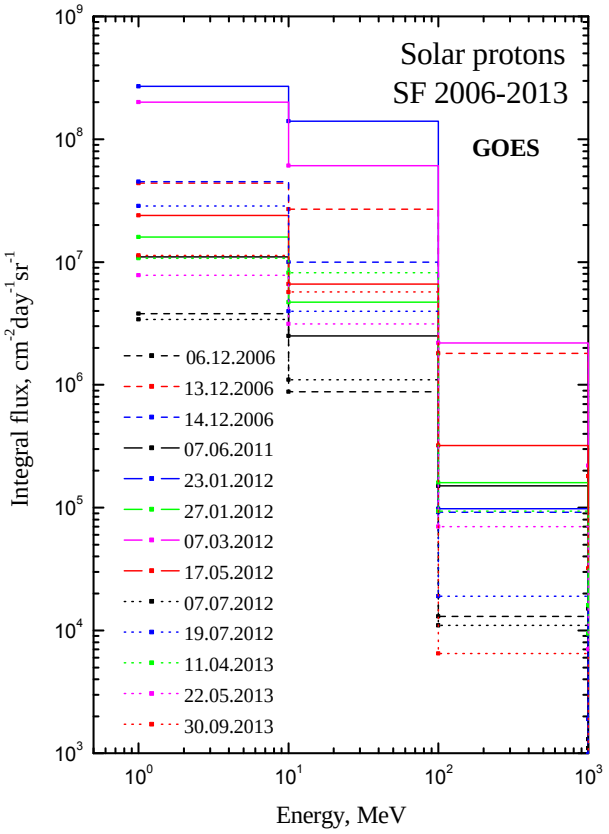


Спектры нейтронов вблизи Солнца и Земли. Эффективность регистрации нейтронов в НД. (Данные GEANT4 моделирования).





GOES11-13. Спектры протонов СКЛ 2006-2013. Карта геомагнитных порогов (эпоха 2000).



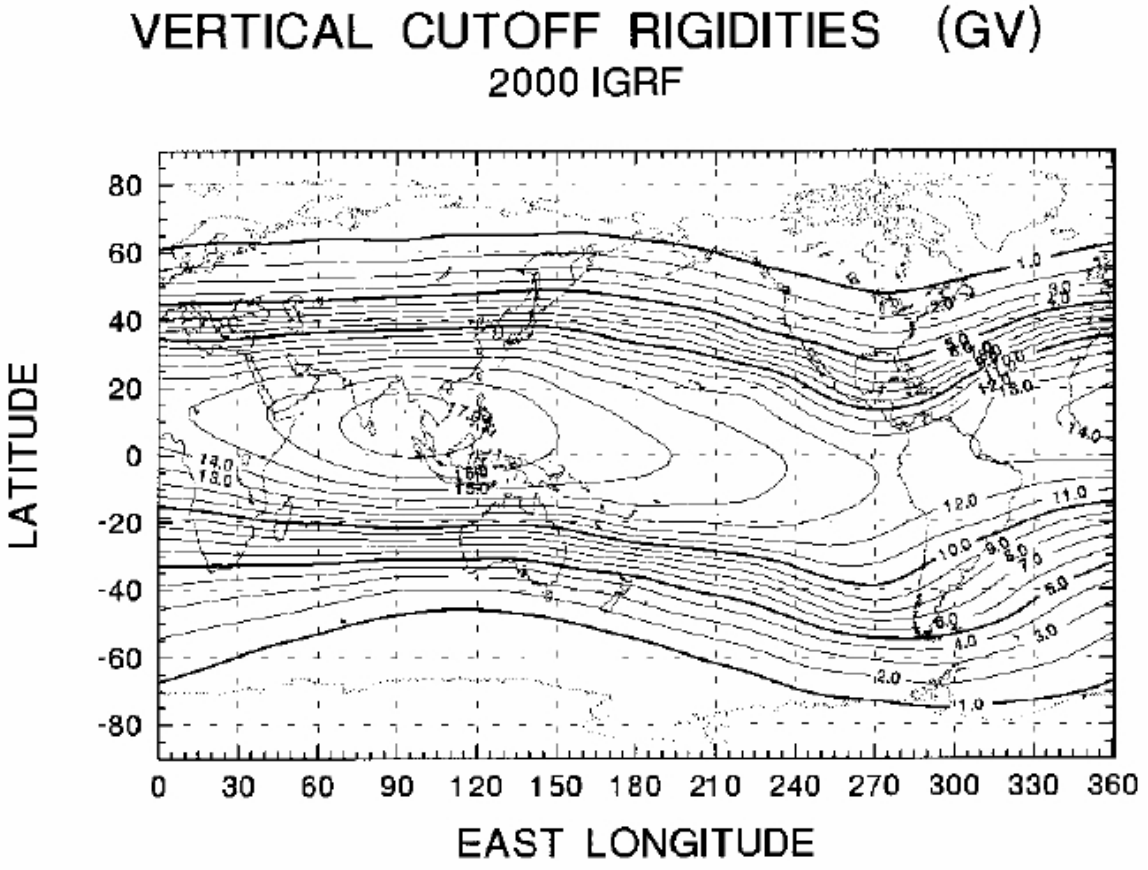
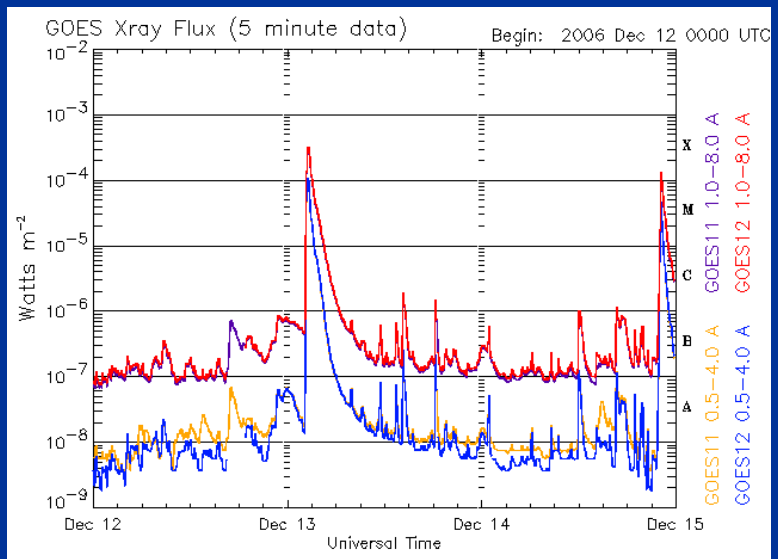
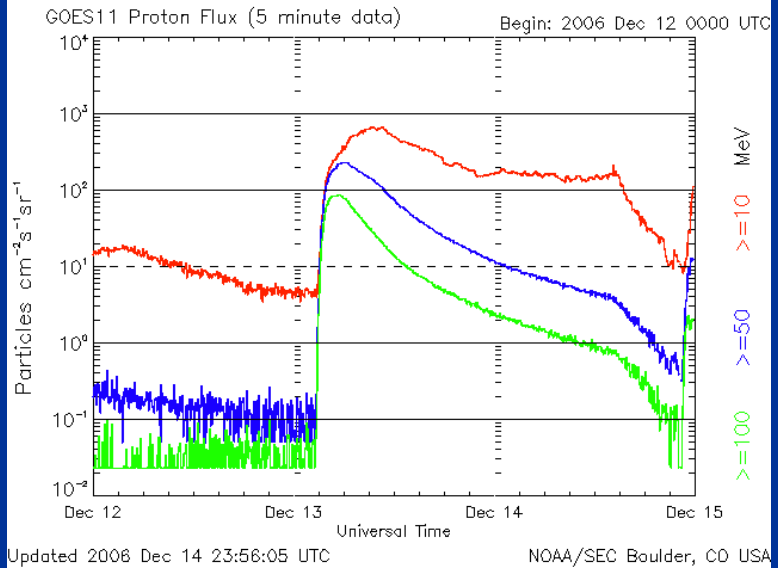
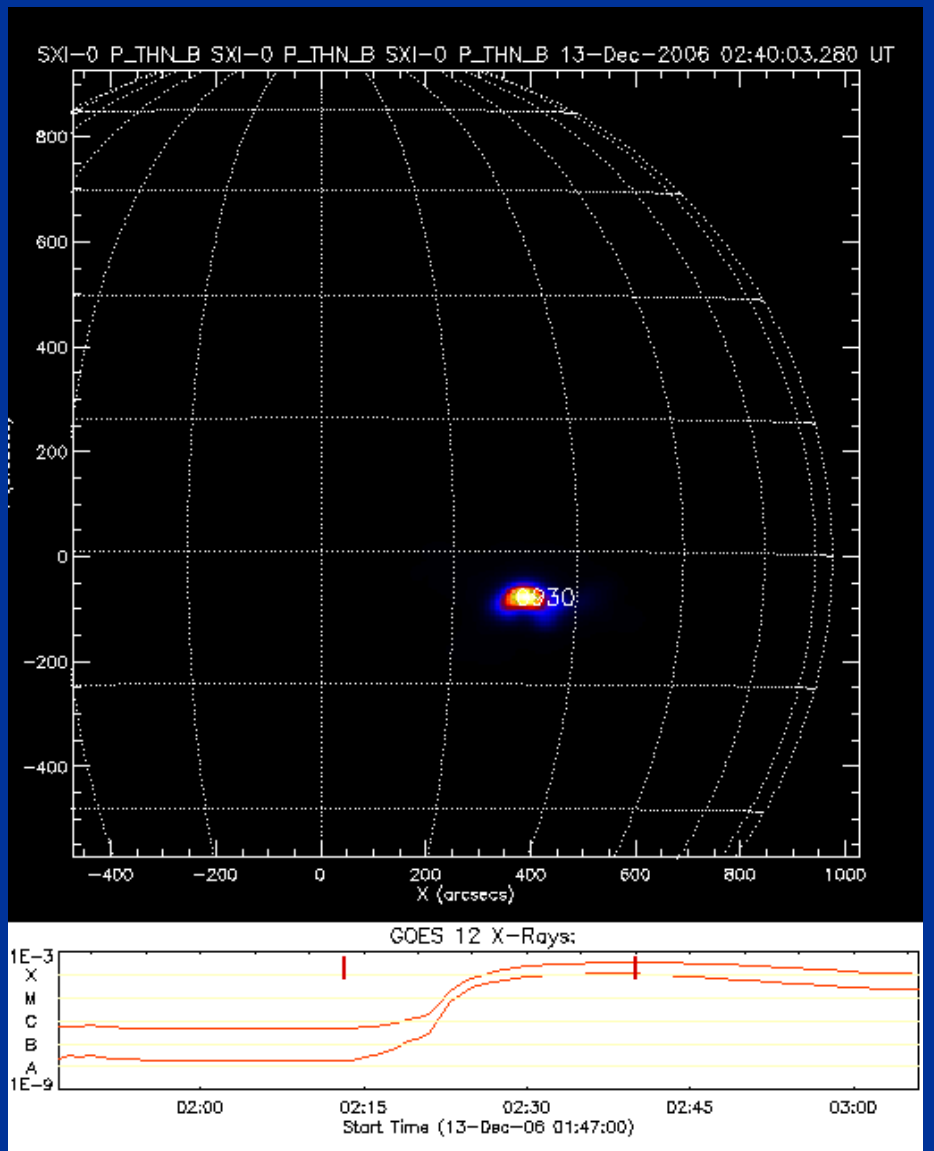


Figure 1: Iso-rigidity contours for vertical geomagnetic cutoff rigidities for epoch 2000.

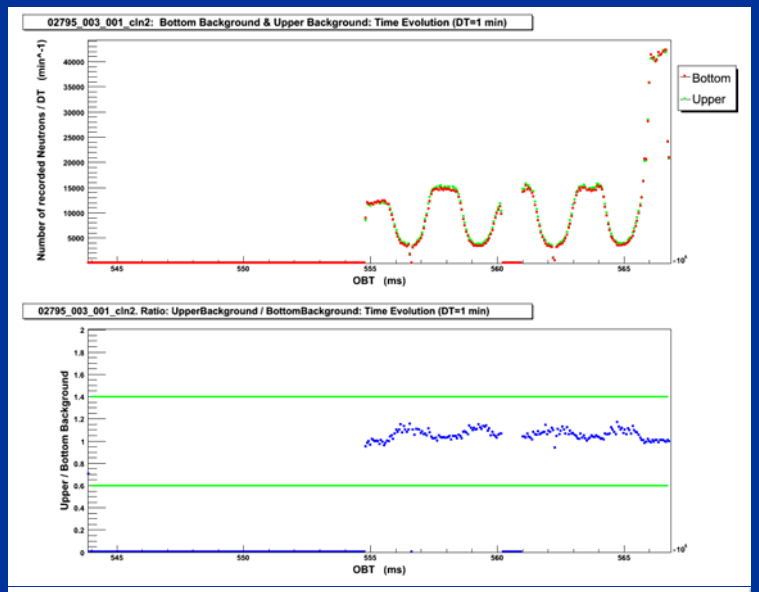
13 December 2006. SF X3.4/4B 02:40 UT
Area 930, S05W23

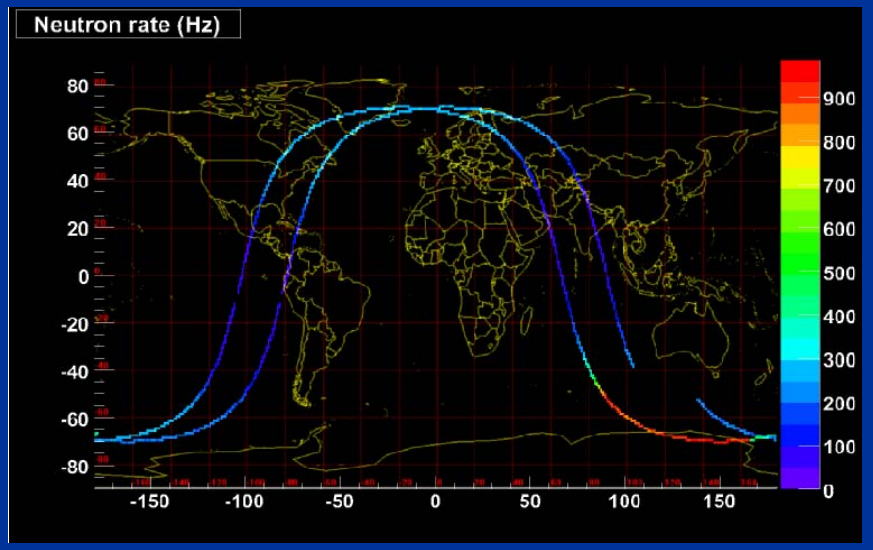


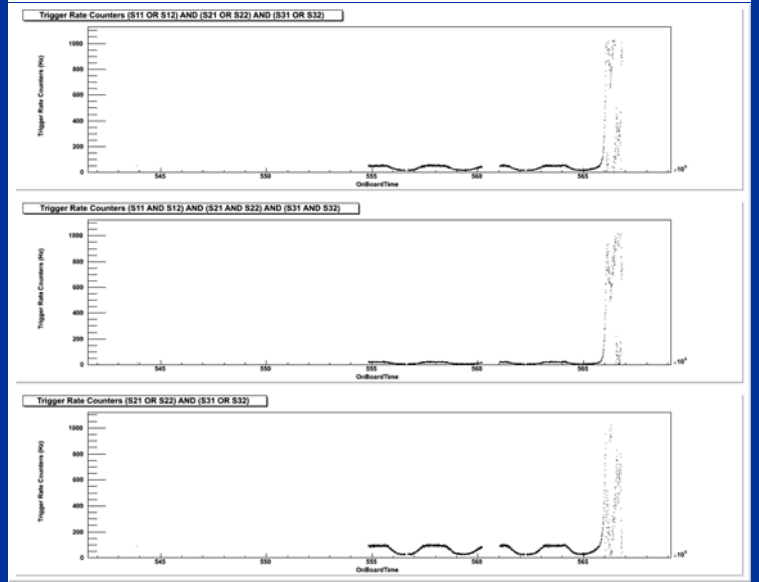




13.12.2006 and PAMELA. QUICKLOOK Data





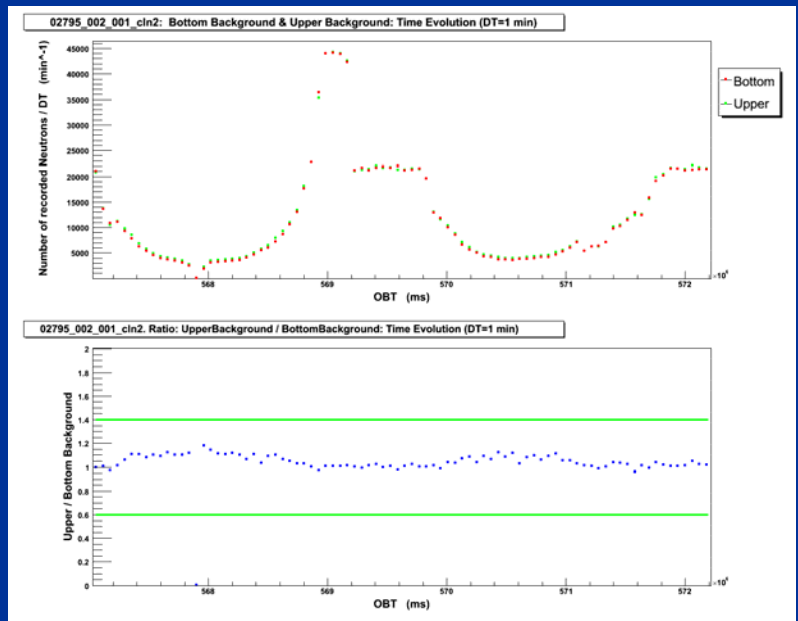


n>p+e$^-$+ ?

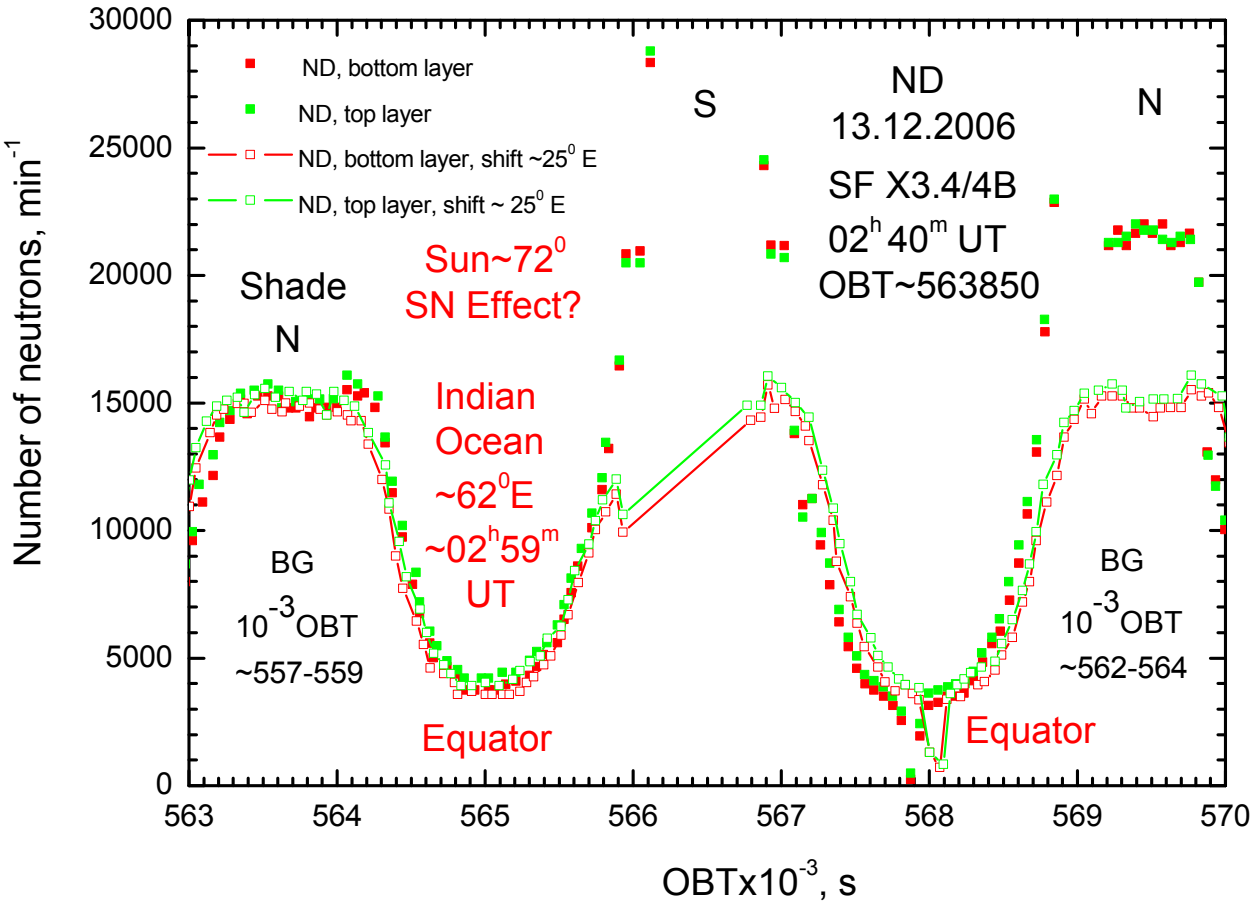
Pre-pulse

near North

in S1-S3



13.12.2006. QUICKLOOK Data Digitization



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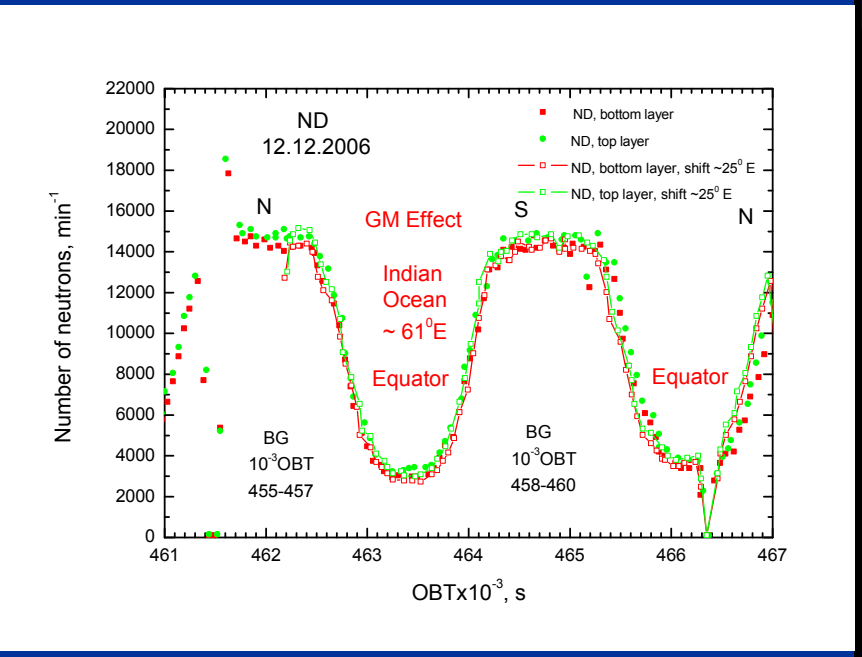
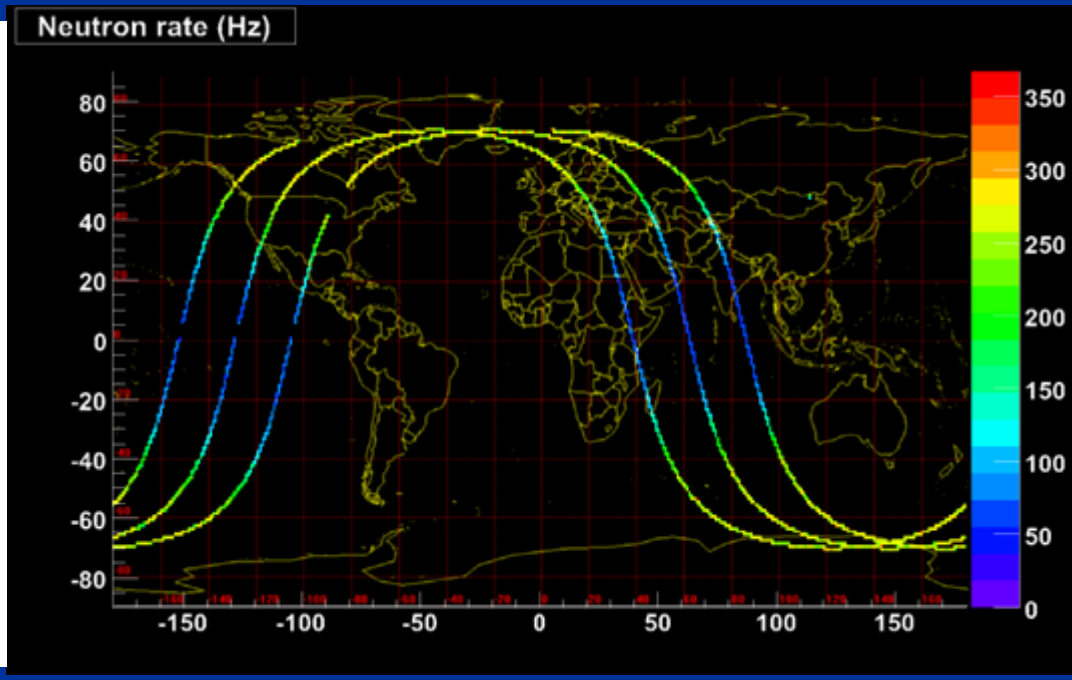




SN 13.12.2006 OBT~564600-565200 ND(b&t): 84693-81647=3046±408 **3.73±0.50%**

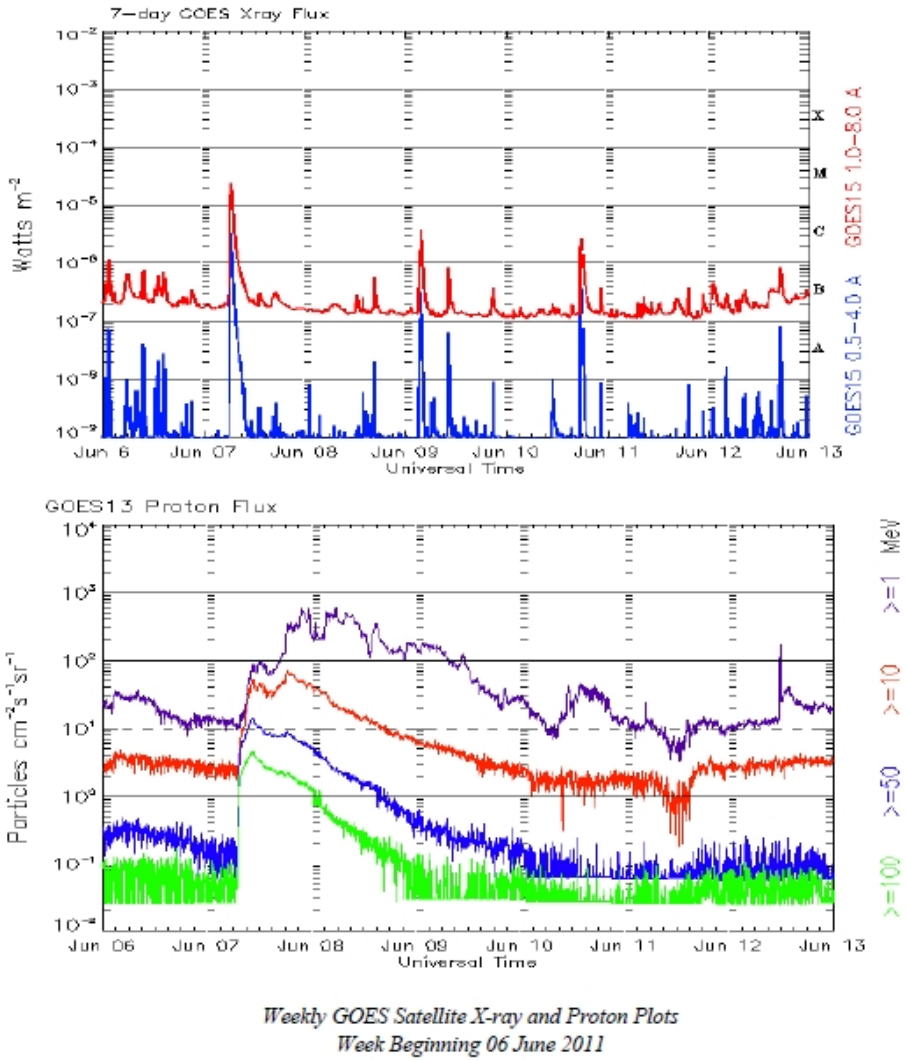
GM 12.12.2006 OBT~463120-463840 ND(b&t): 82886-80947=1939±405 **2.40±0.50%**

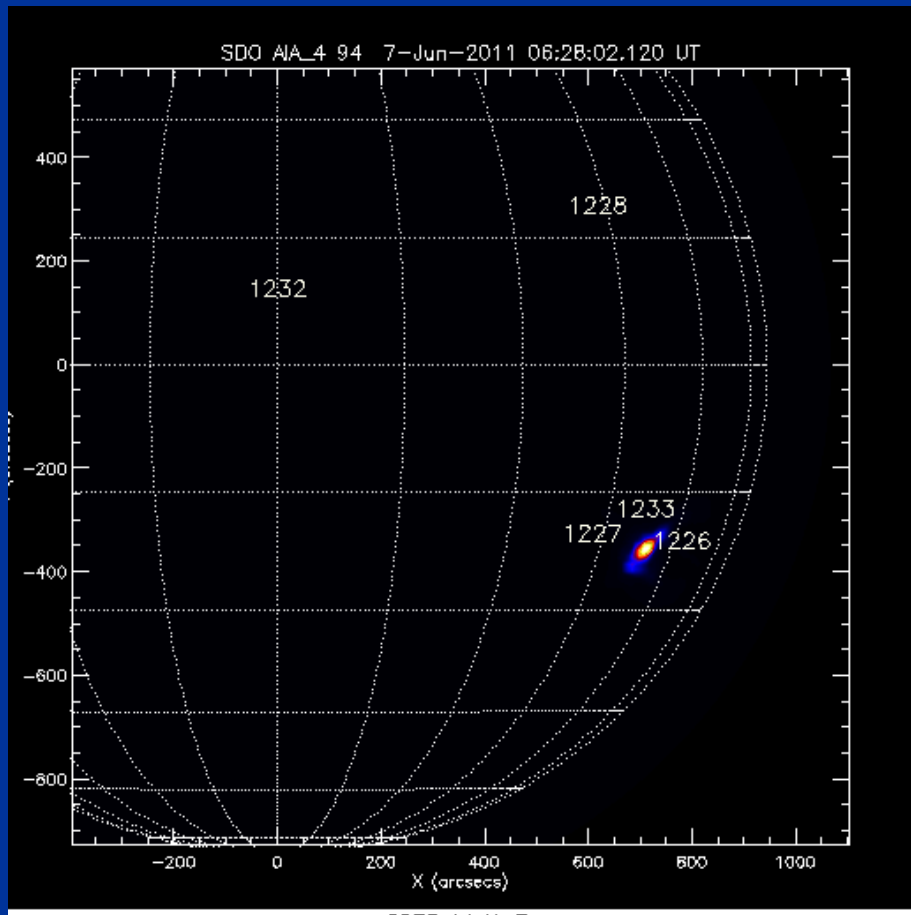
(GM: Cut-off shift ~16.8 - >17.0 GV)

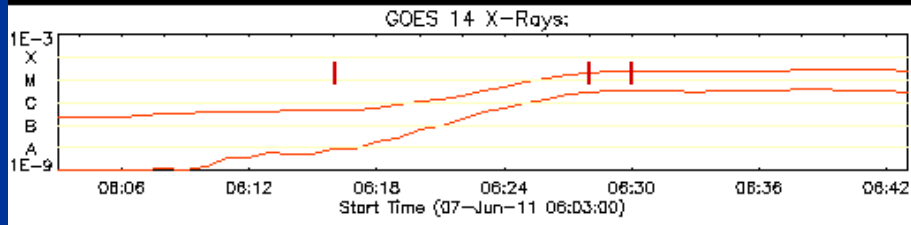
Total Effect SN-GM:+1.33±0.71% for 20-31 min after SF, E_n~38-96 MeV,

Near the Earth I_n(38-96 MeV)~500 n/m^{2}s, on the Sun n/p~0.1… Reasonably

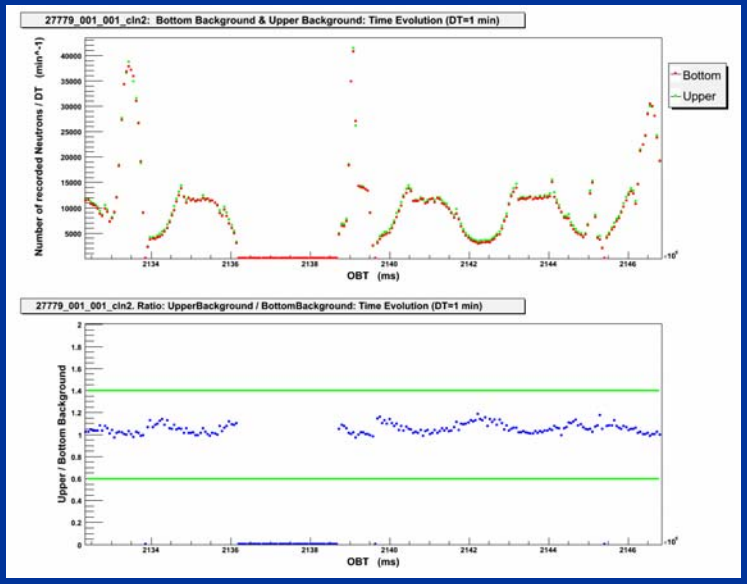
07 June 2011. SF M2.5 06:41 UT
Area 1226, S21W54

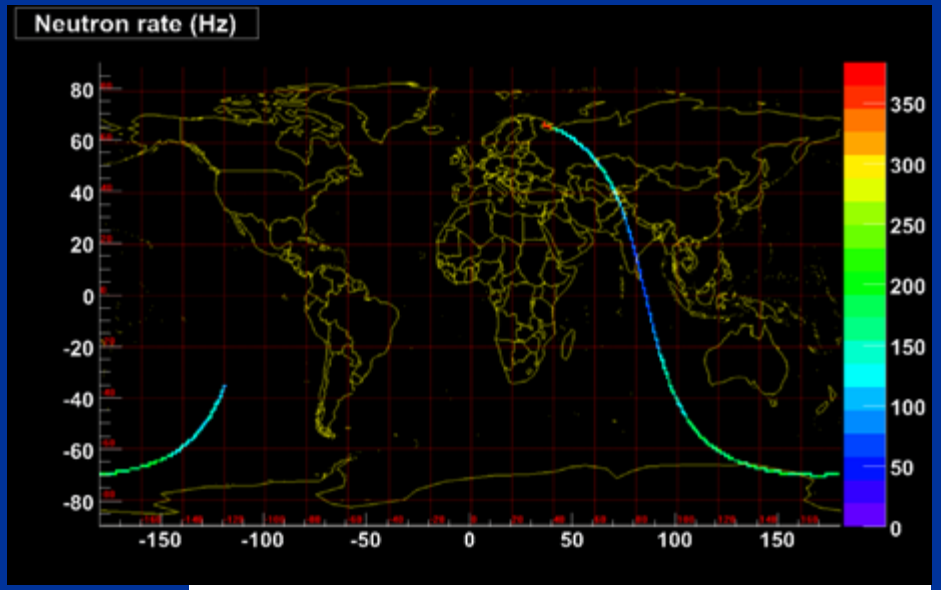


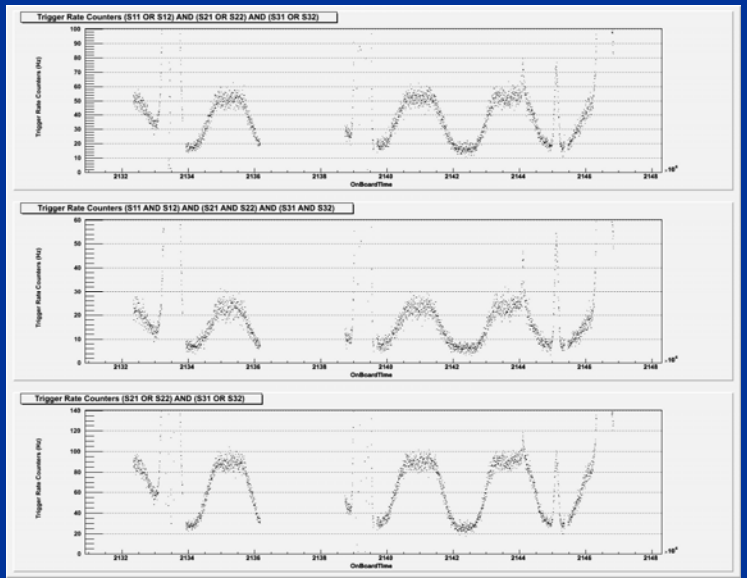




07.06.2011 and PAMELA. QUICKLOOK Data





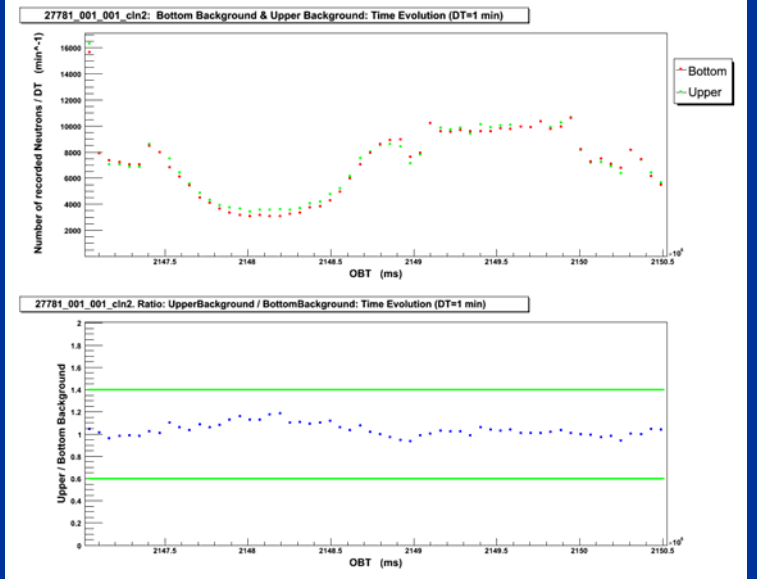


NO

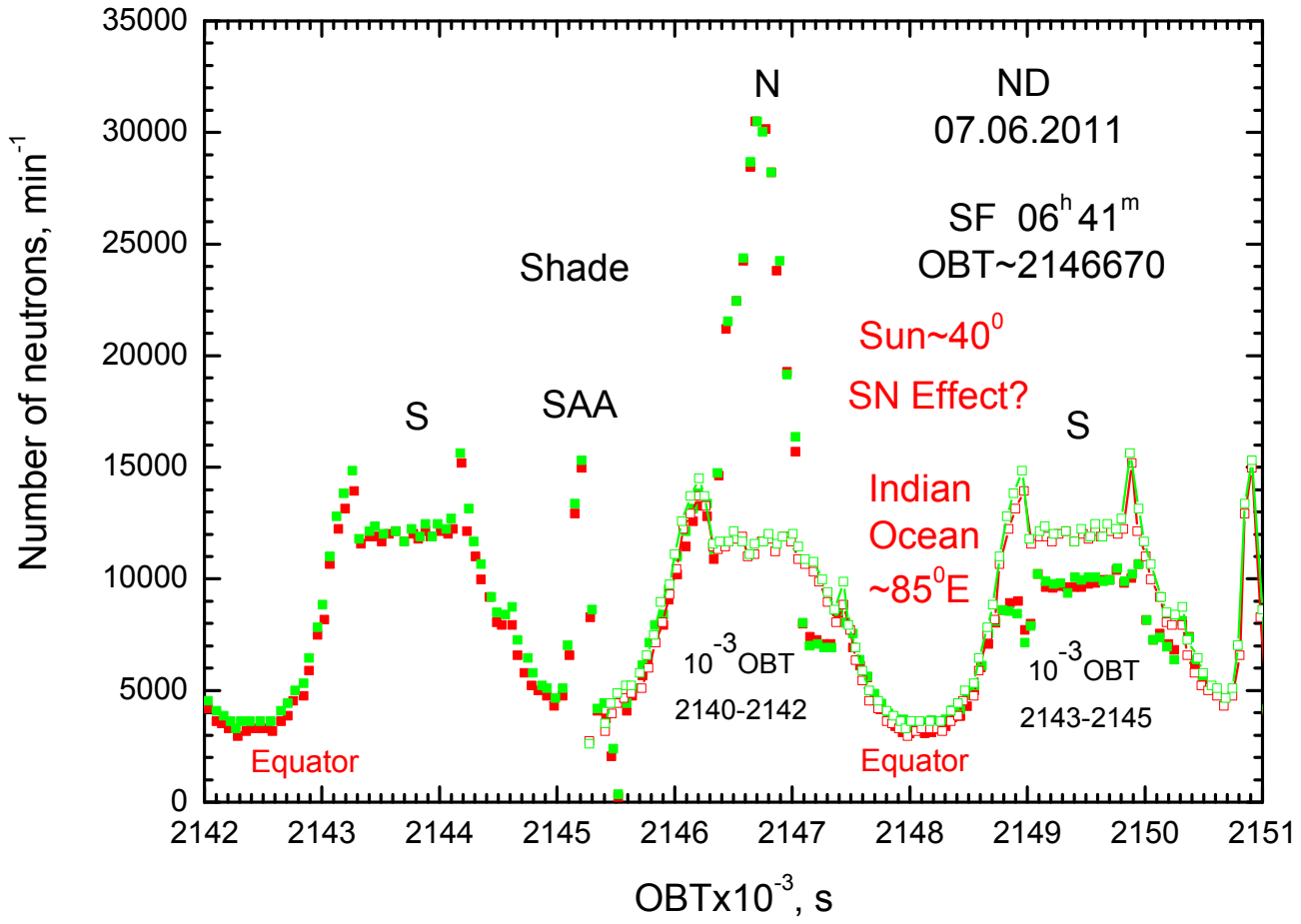
Pre-pulse

Near North

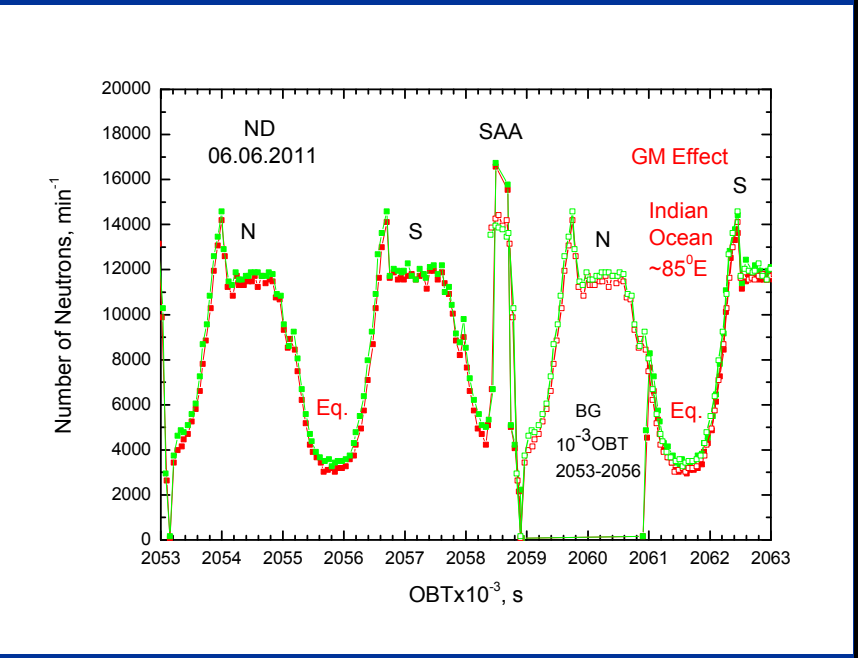
in S1-S3

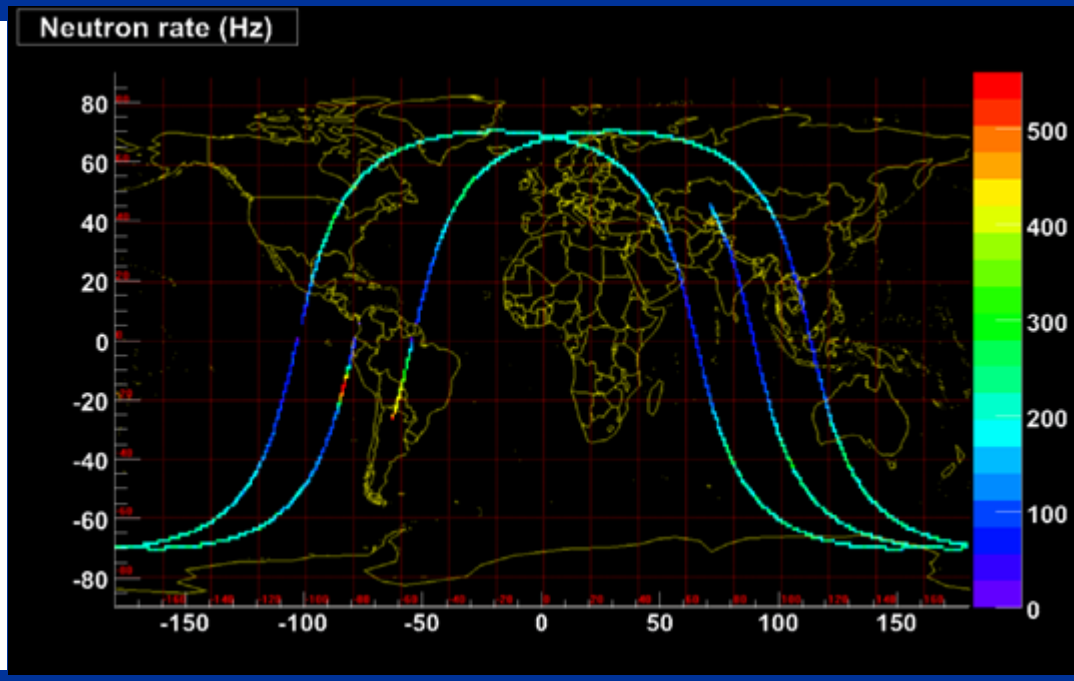


07.06.2011. QUICKLOOK Data Digitization



06.06.2011. QUICKLOOK Data Digitization





SN: 07.06.2011 OBT~2147830-2148430 ND: 70059-71086= - 1027±376, **- 1.44±0.53%**

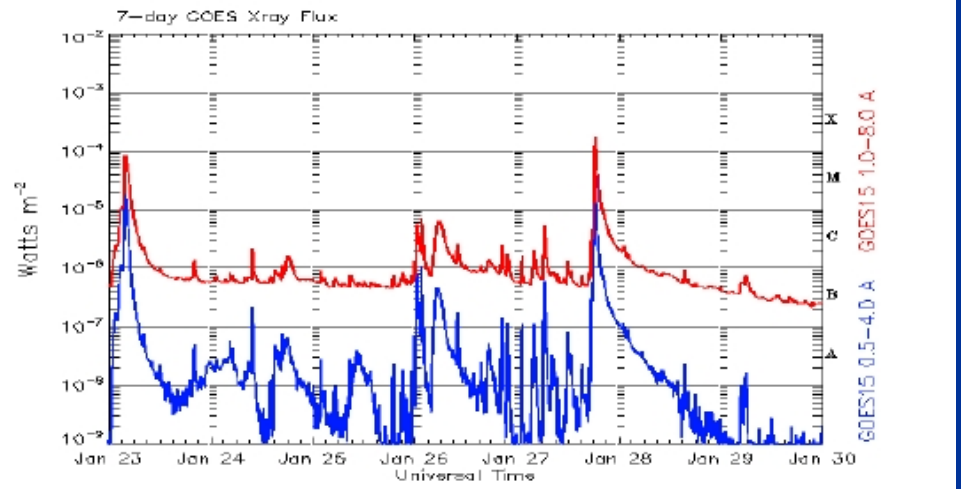
GM: 06.06.2011 OBT~2061320-2061920 ND: 68608-68334= + 274±370, **+ 0.40±0.54%**

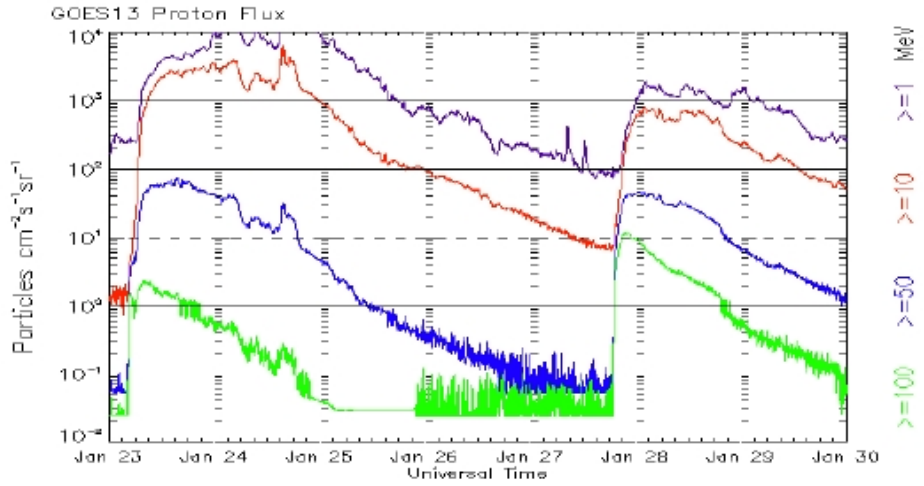
(GM: Cut-off shift ~>17.0 – 17.0 GV)

Total Effect SN-GM: - 1.84±0.76% for 27-37 min after SF, E_n~27-40 MeV

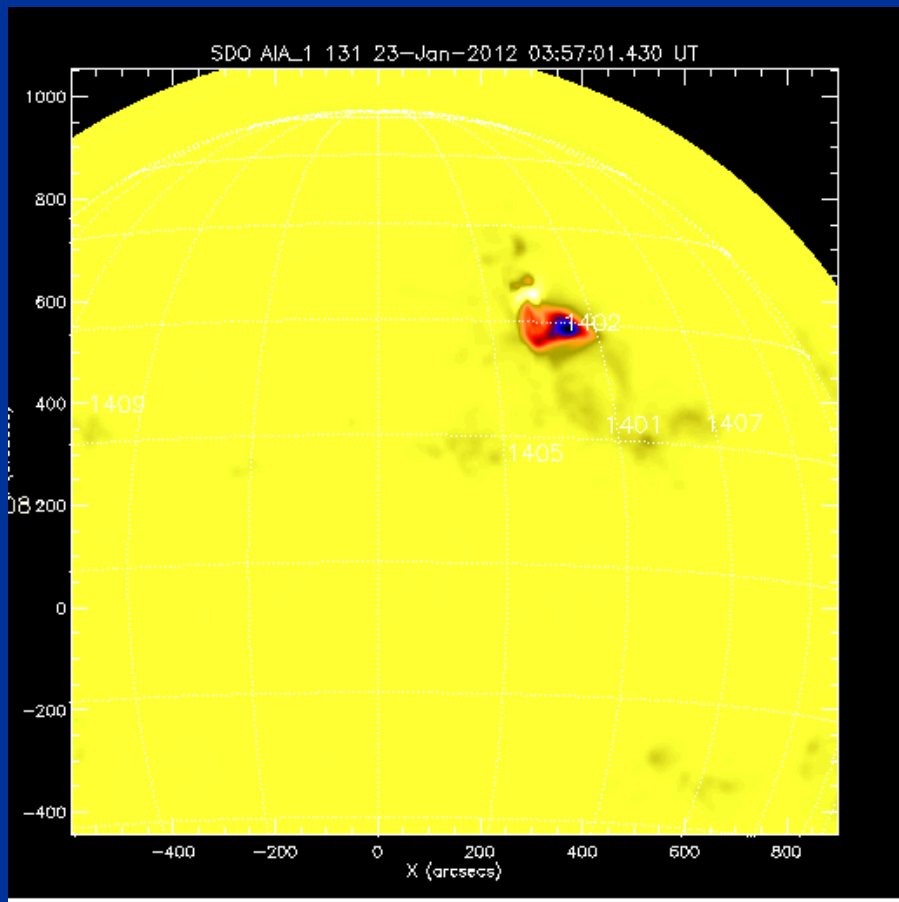
NO SOLAR NEUTRONS. Only upper limit.

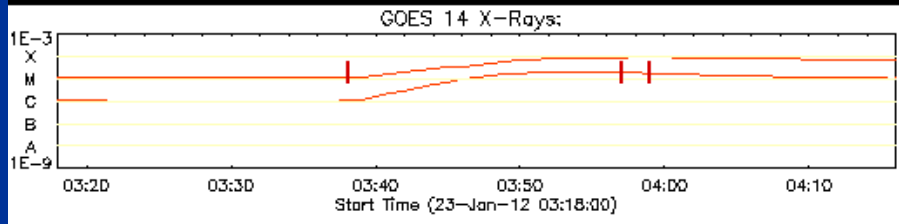
23 January 2012. SF M8.7 03:59 UT
Area 1402, N33W21



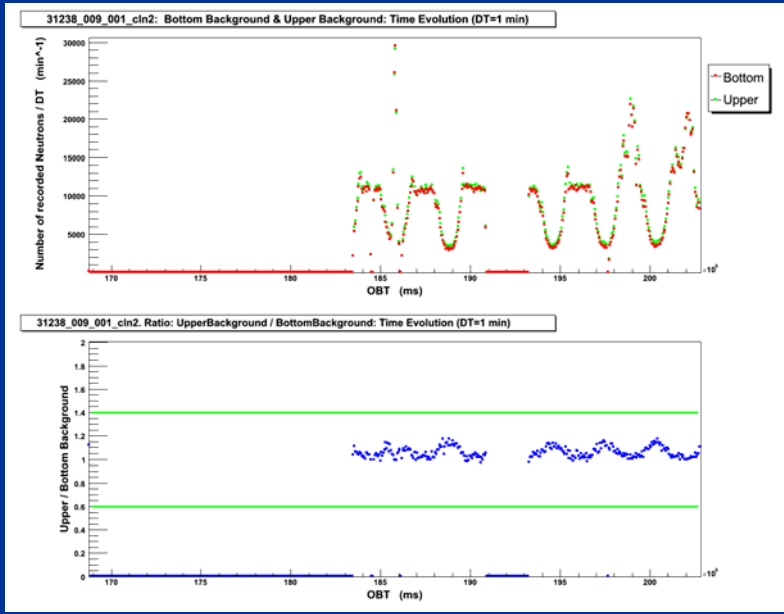


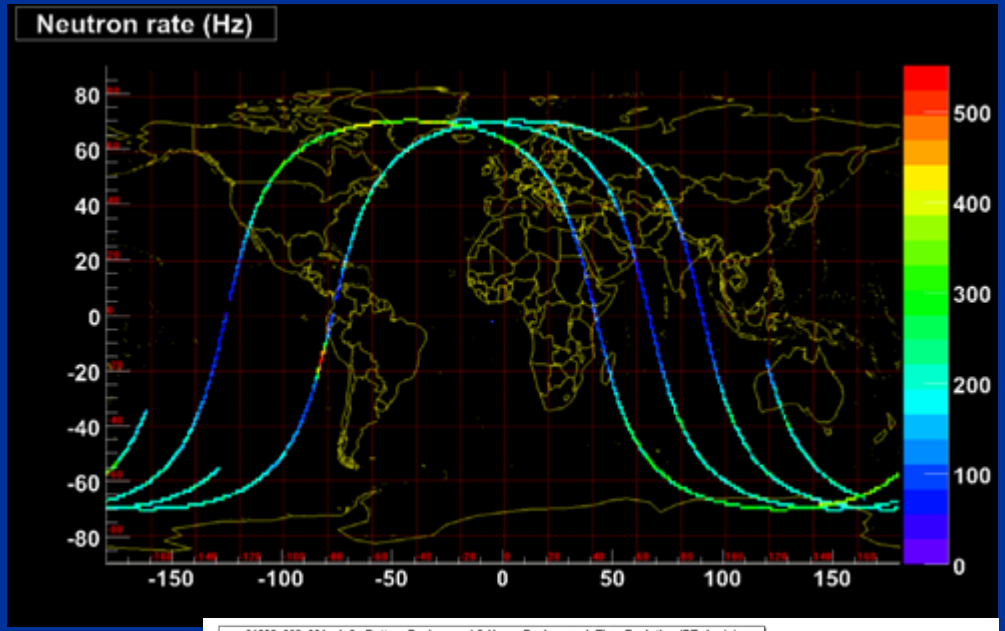
Weekly GOES Satellite X-ray and Proton Plots
Week Beginning 23 January 2012

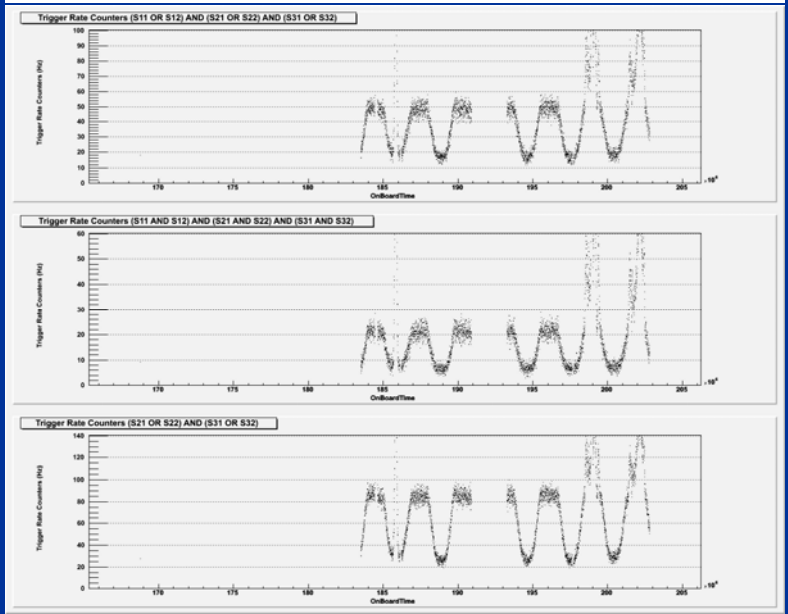




23.01.2012 and PAMELA. QUICKLOOK Data





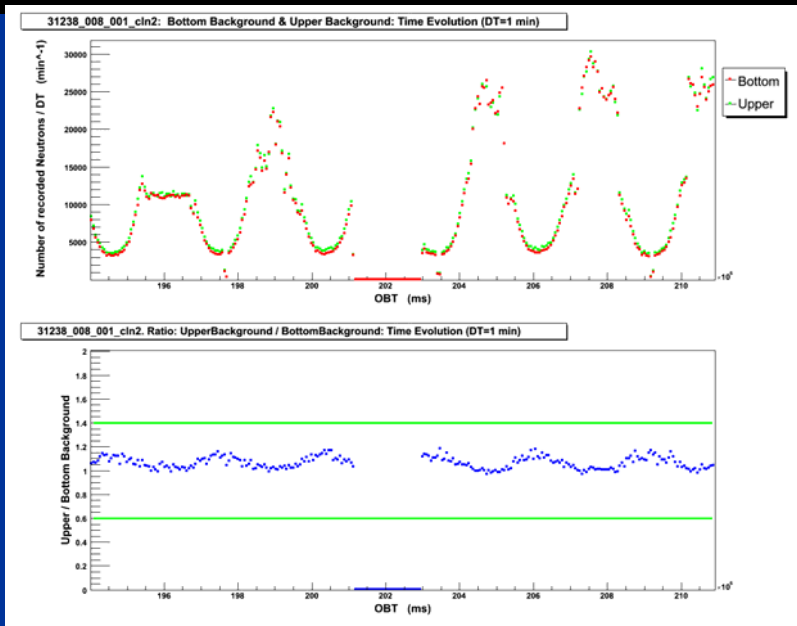


n>p+e+…?

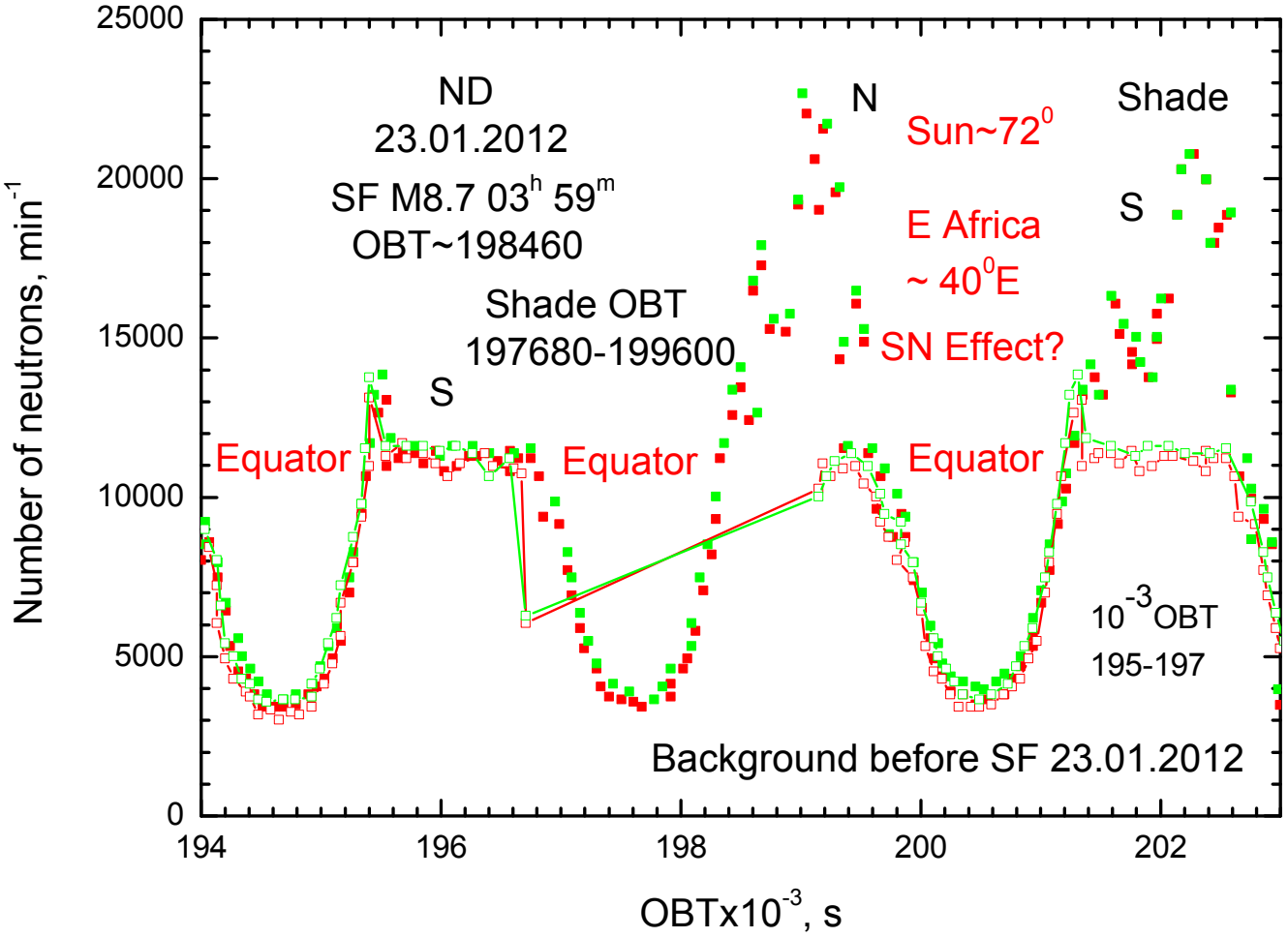
Pre-pulse

near North

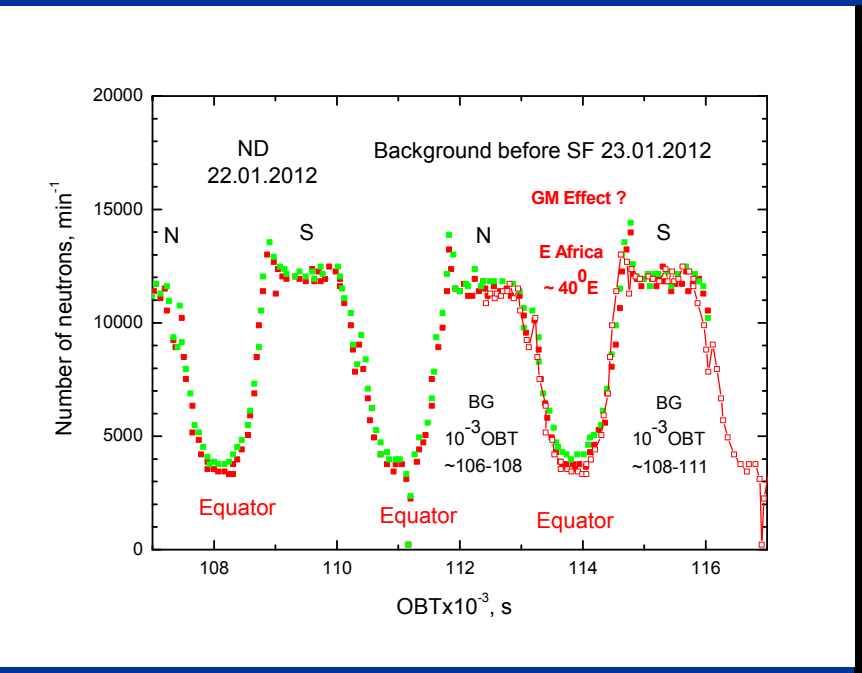
in S1-S3

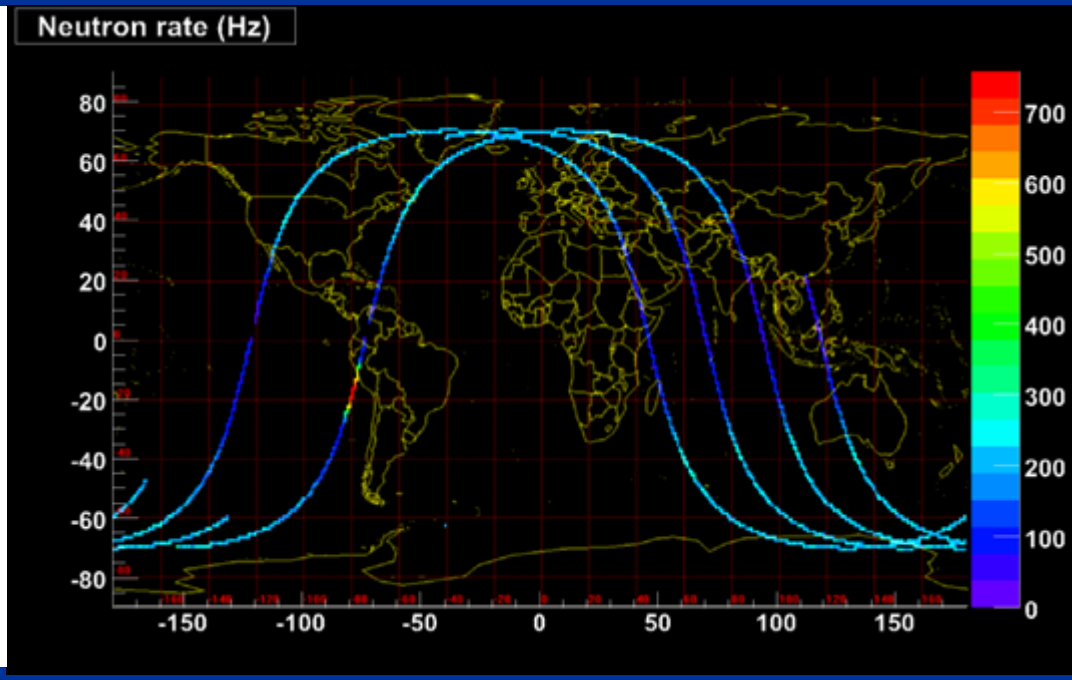


23.01.2012. QUICKLOOK Data Digitization



22.01.2012. QUICKLOOK Data Digitization





SN: 23.01.2012 OBT~200100-200700 ND: 80107-73959=6148±393, **8.31±0.53%**

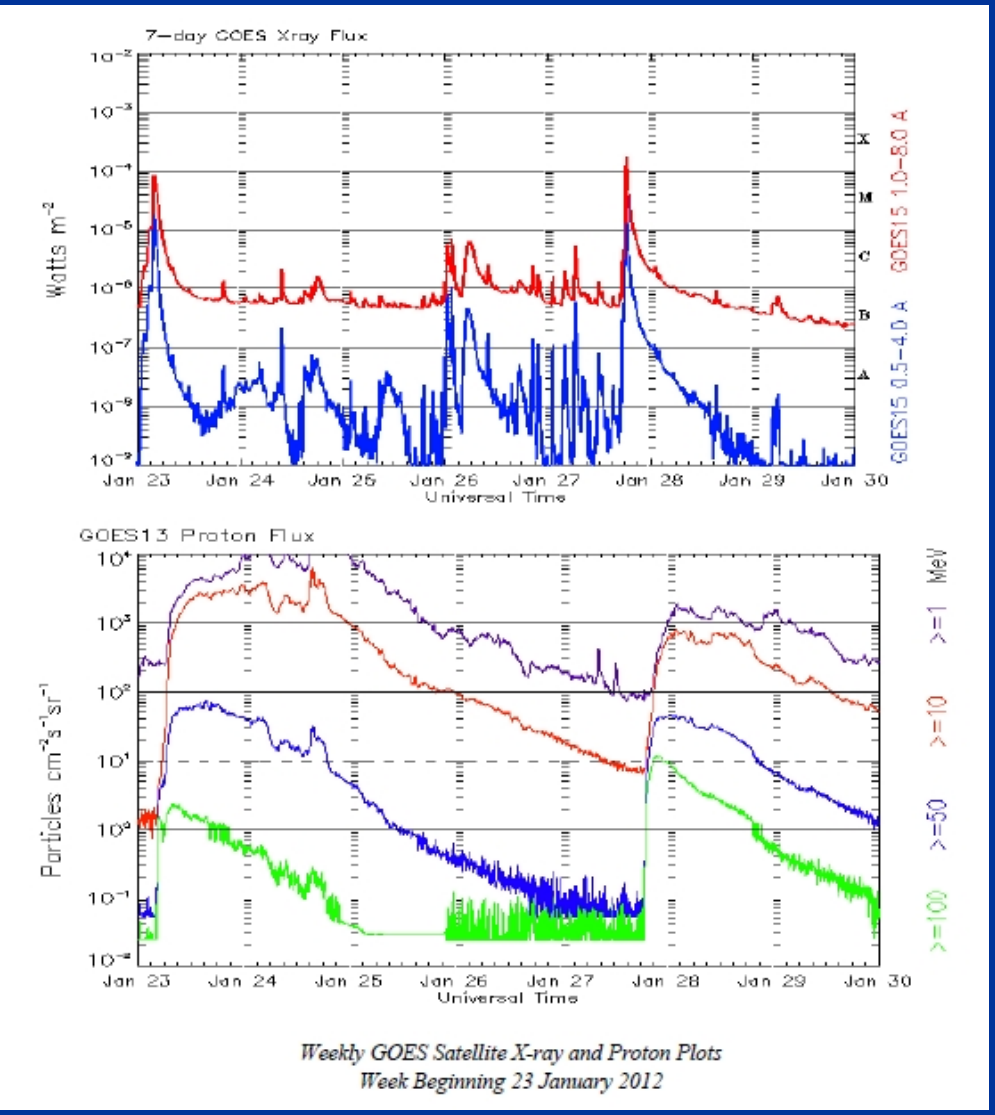
GM: 22.01.2012 OBT~113510-114110 ND: 81226-76074=5152±397, **6.77±0.72%**

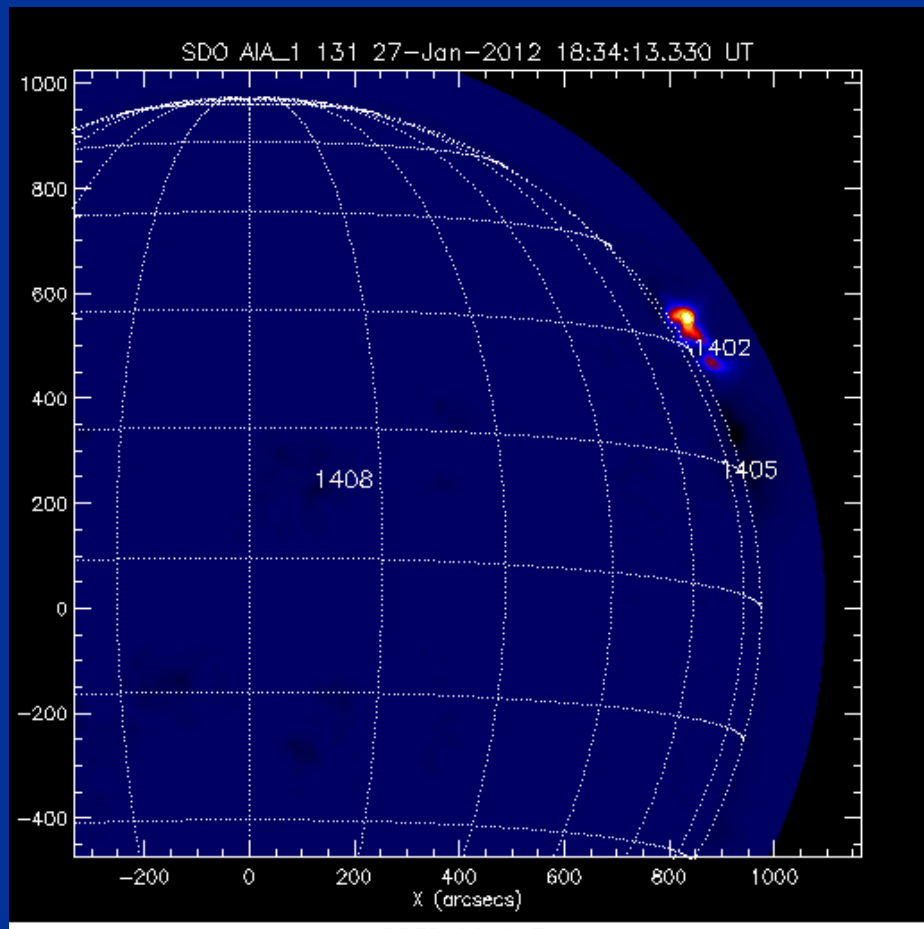
(GM: Cut-off shift ~ 16.0-16.6GV)

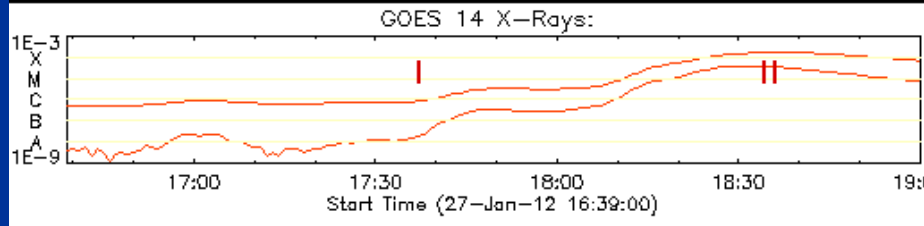
Total effect SN-GM:+1.54±0.74% for ~34-44 min after SF, E_n~18-23 MeV

Near the Earth I_n(18-23 MeV)~530 n/m^{2}s

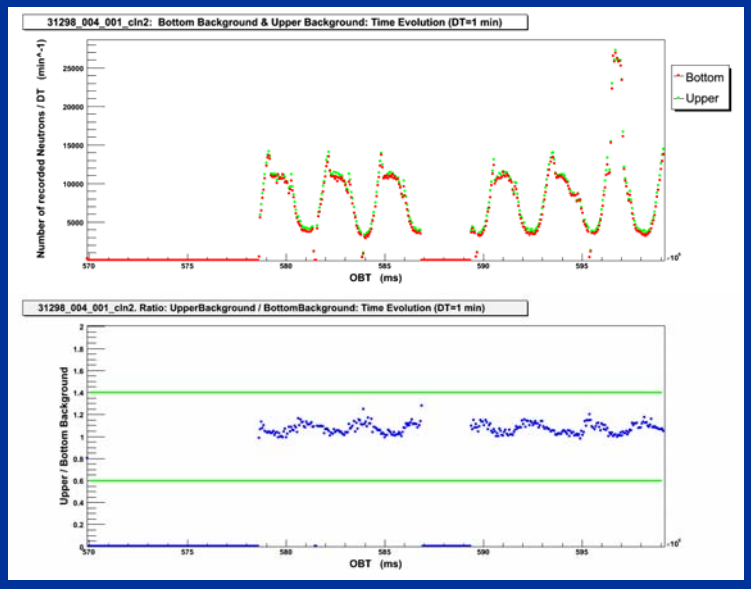
27 January 2012. SF X1.7 18:36 UT
Area 1402, N27W71

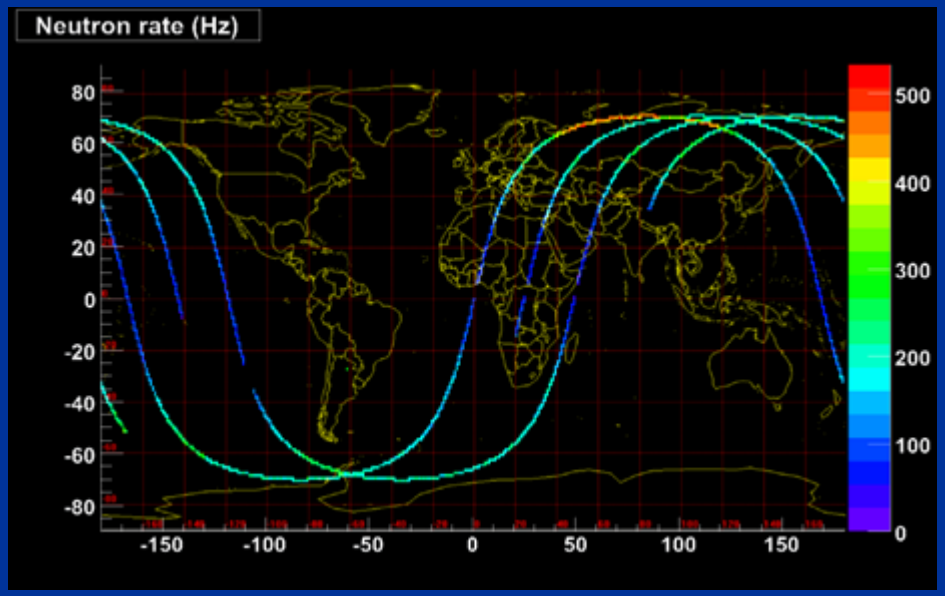


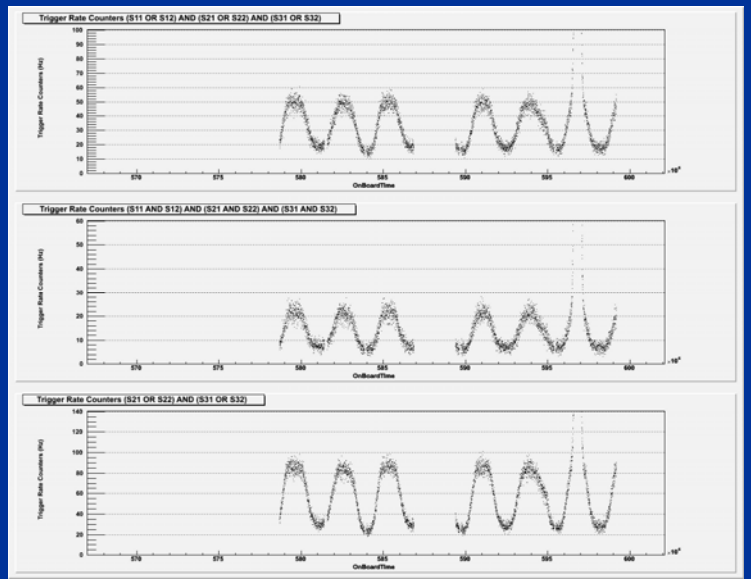




27.01.2012. QUICKLOOK Data







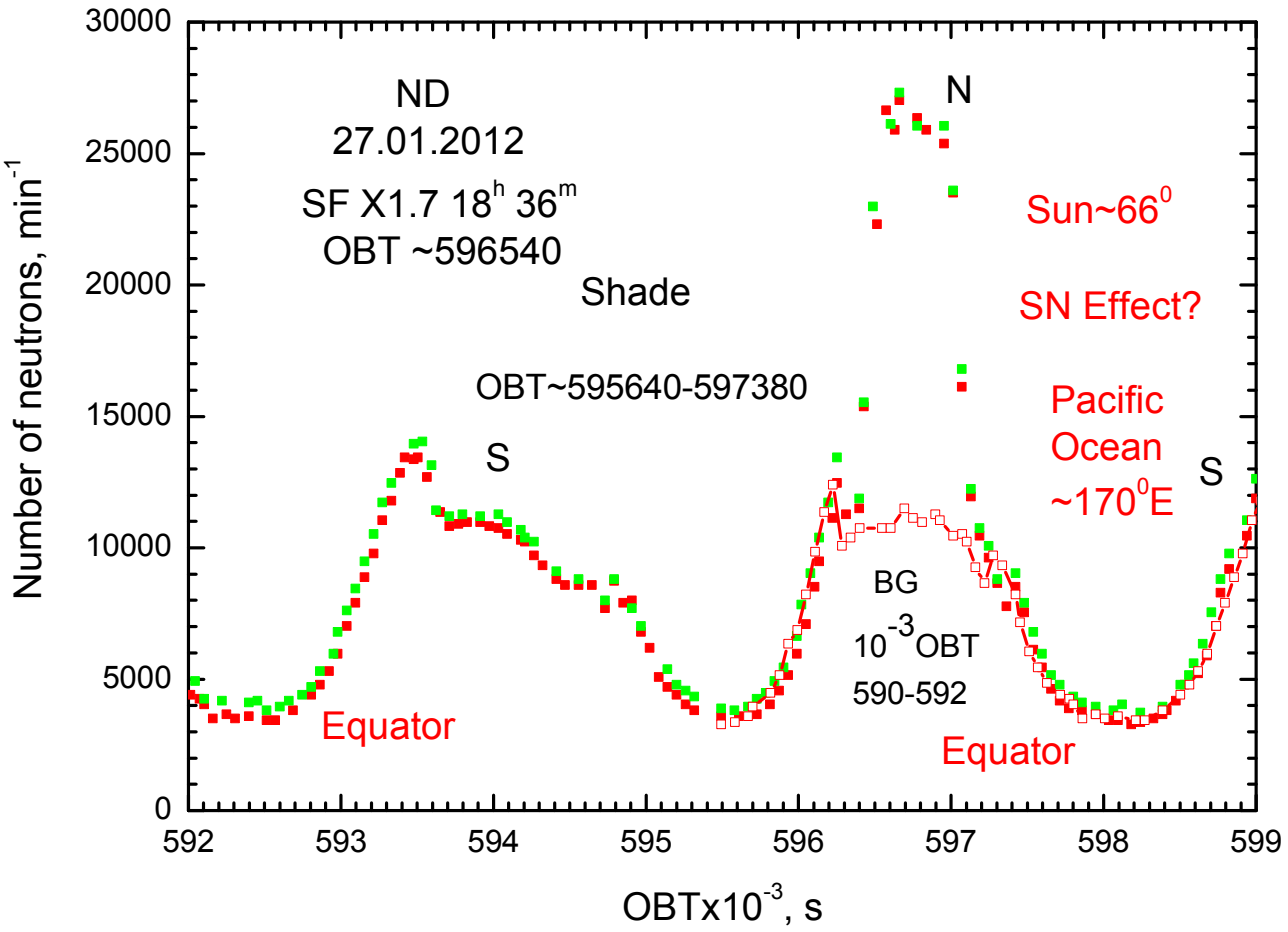
NO

Pre-pulse

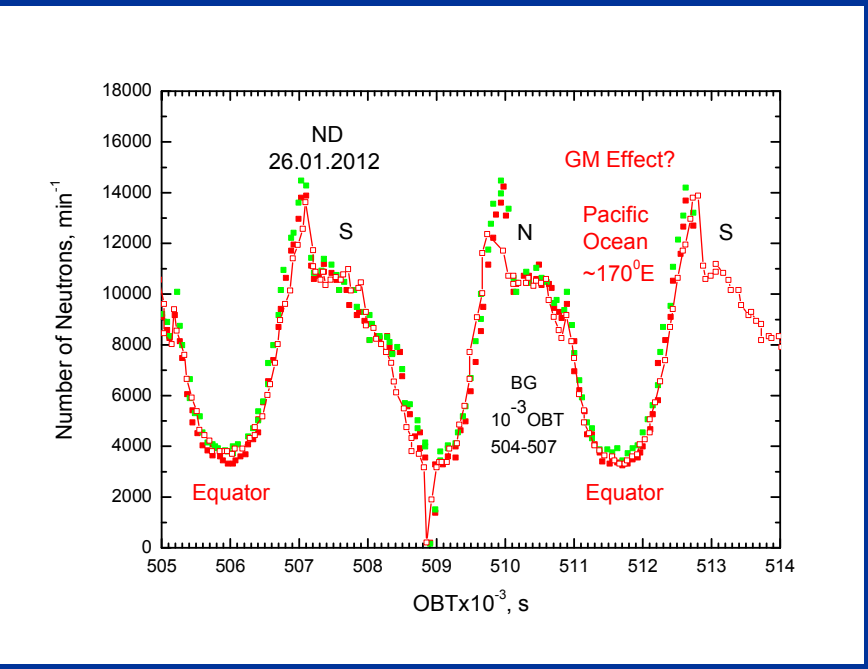
near North

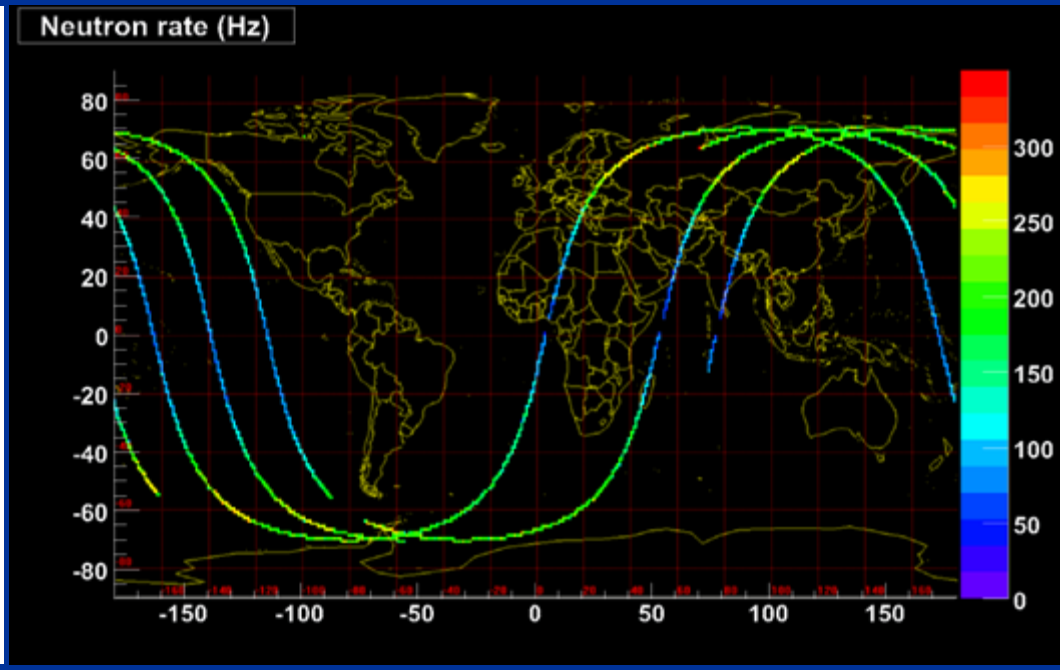
in S1-S3

27.01.2012. QUICKLOOK Data Digitization



26.01.2012. QUICKLOOK Data Digitization





SN: 27.01.2012 OBT~597870-598470 ND: 74876-77519= - 2643±390, **- 3.41±0.50%**

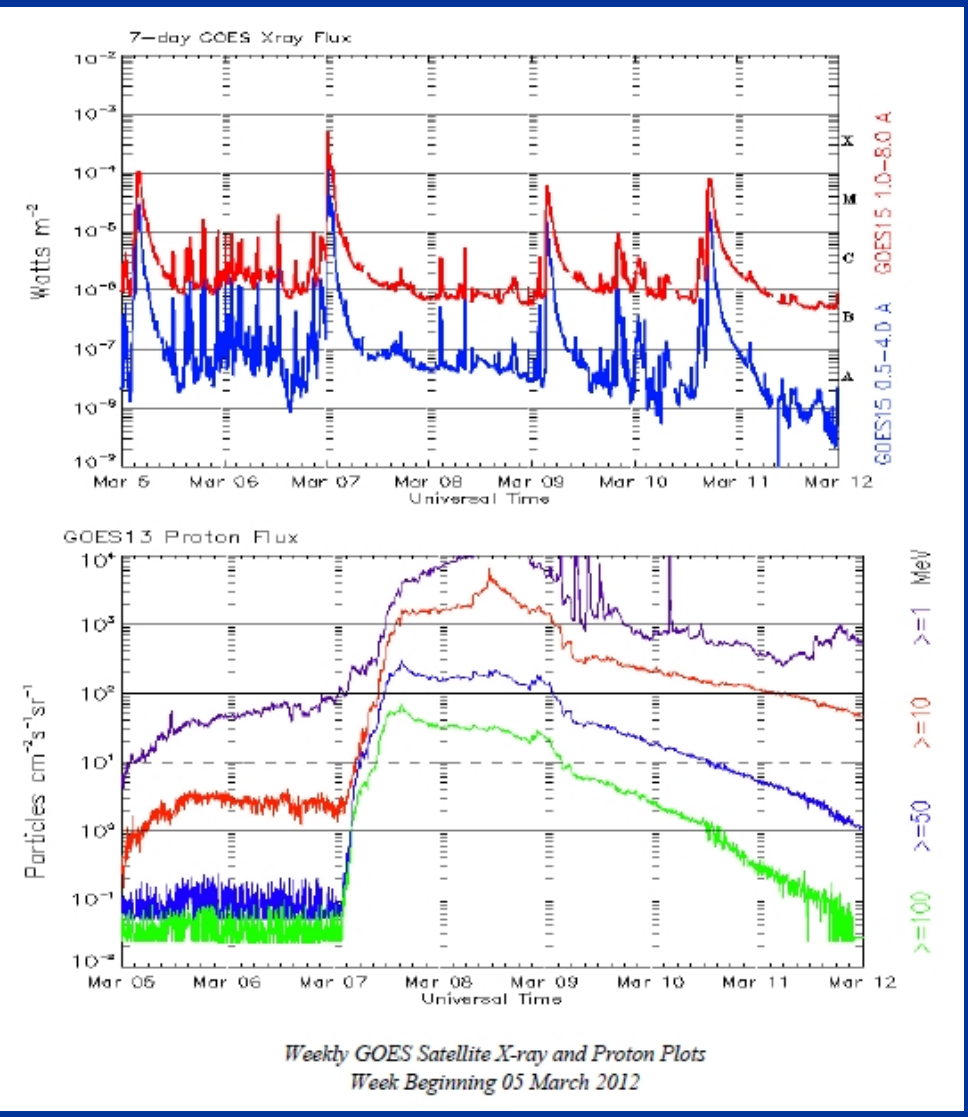
GM: 26.01.2012 OBT~511390-511990 ND: 72437-75113= - 1543±279, **-3.56±0.51%**

(GM Cut-off shift ~15.5-15.0 GV)

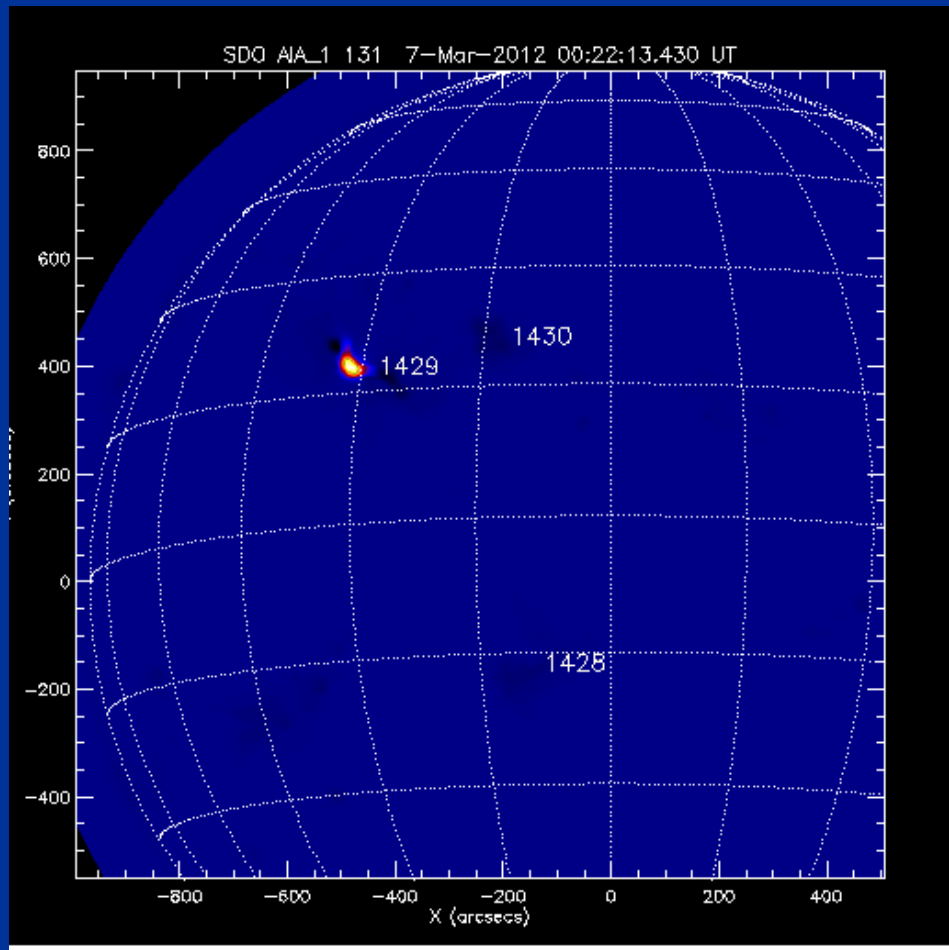
Total Effect SN-GM:+0.15±0.72% for ~42-52 min after SF, E_n~23-38 MeV

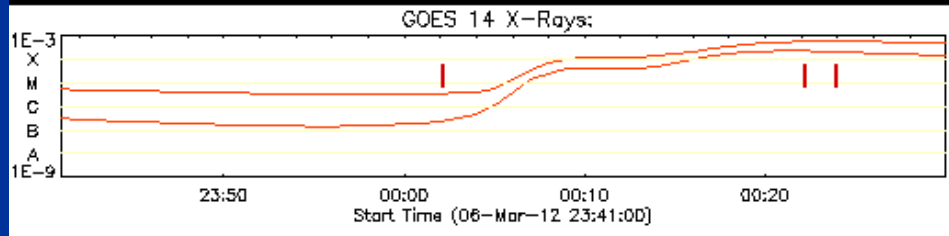
NO SOLAR NEUTRONS? Only upper limit I_n(23-38 MeV) ~ 310 n/m^{2}s?

07 March 2012. SF X5.4 00:24 UT
Area 1430, N14E27

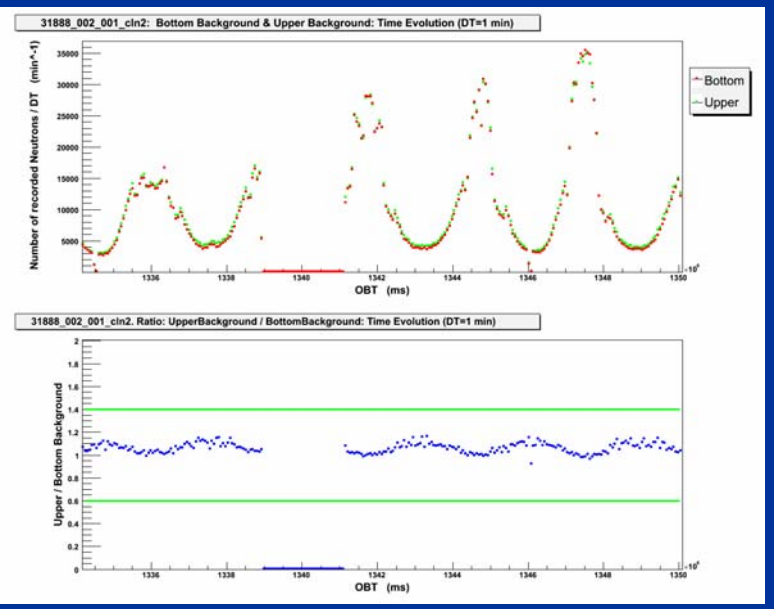


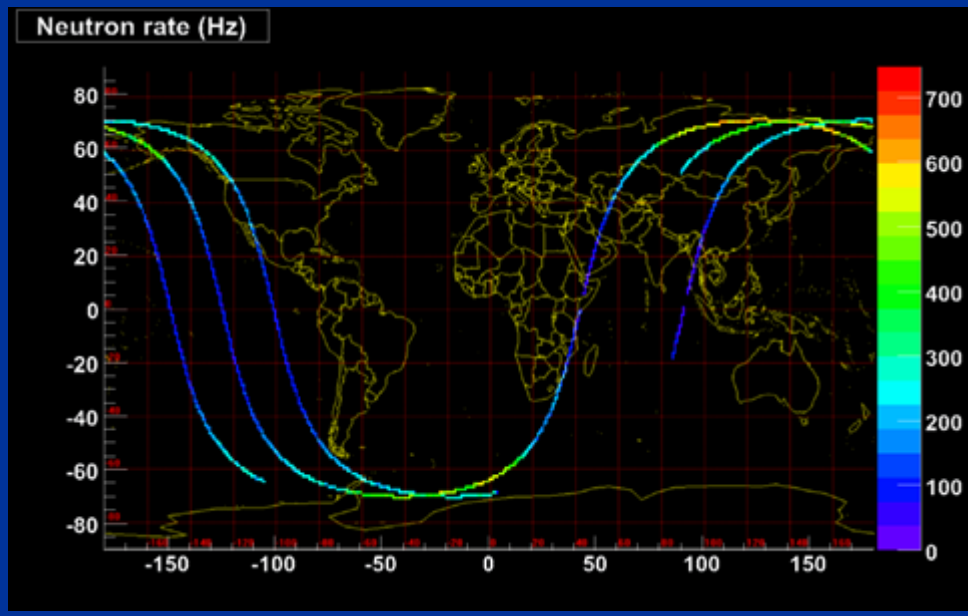
Weekly GOES Satellite X-ray and Proton Plots
Week Beginning 05 March 2012

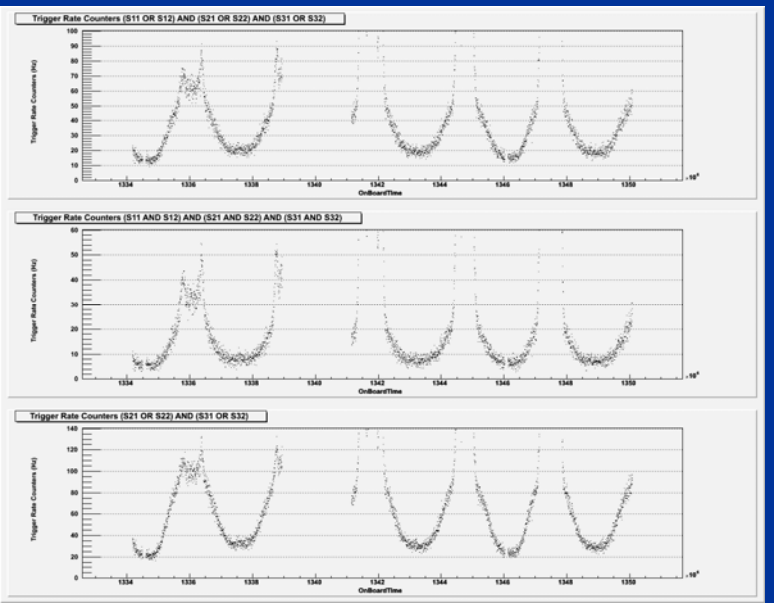




07.03.2012. QUICKLOOK Data





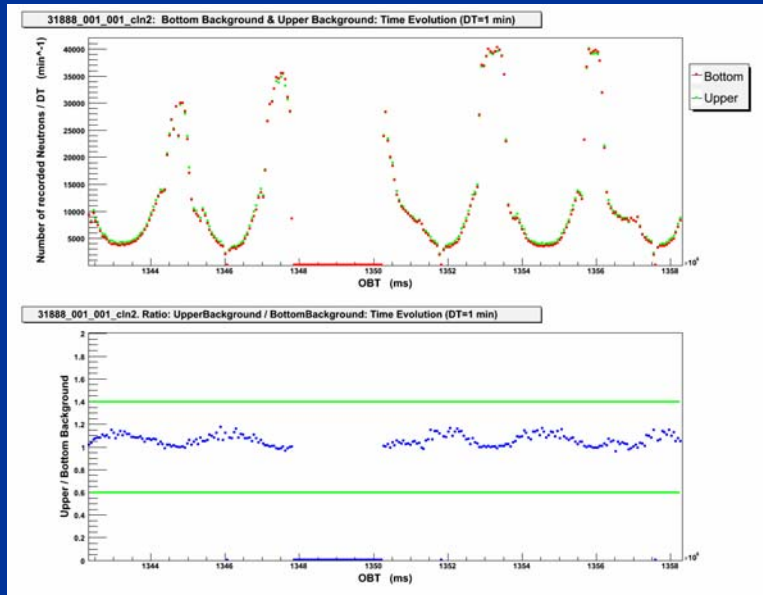


n>p+e+…?

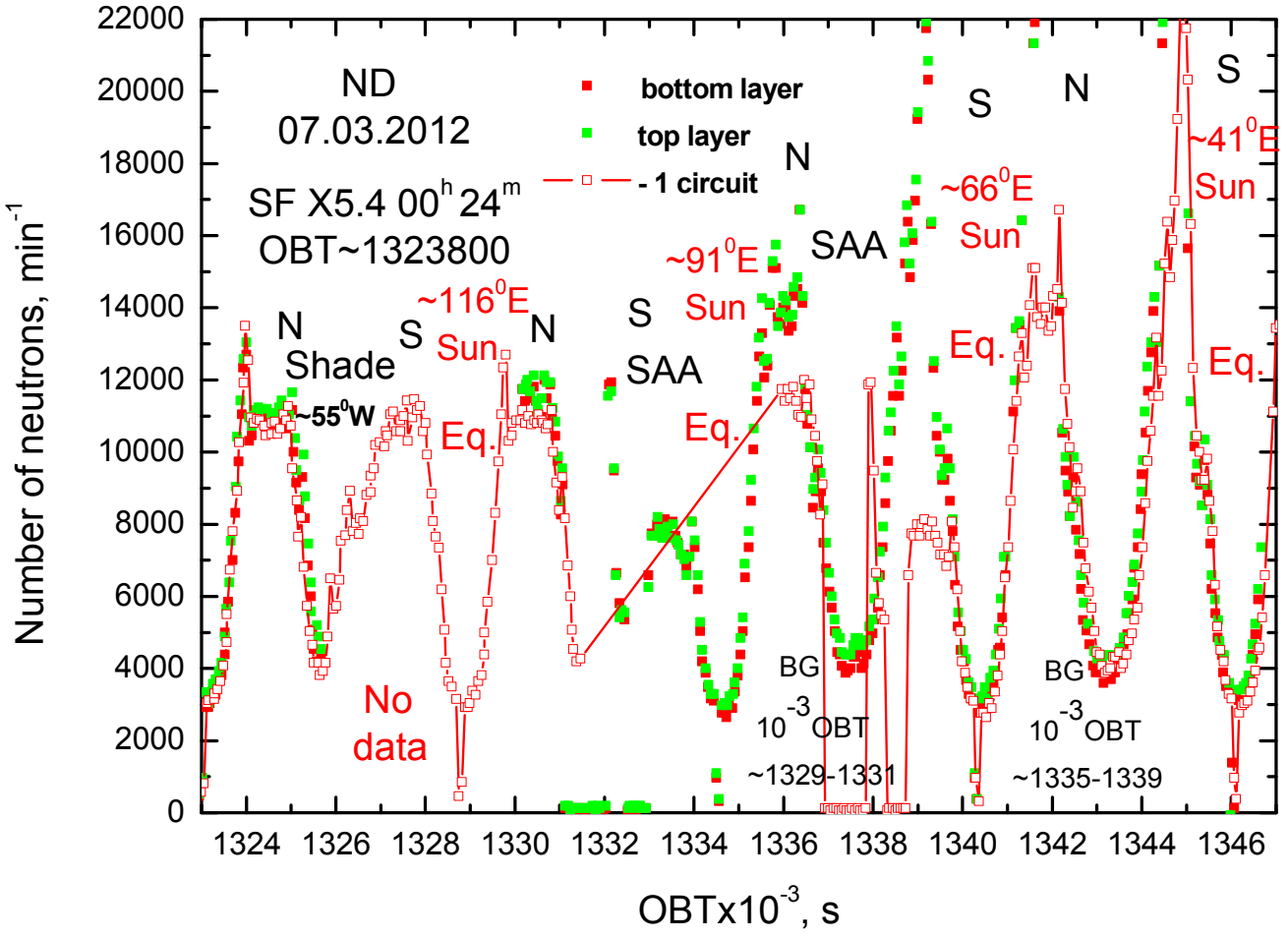
Pre-pulse

near South

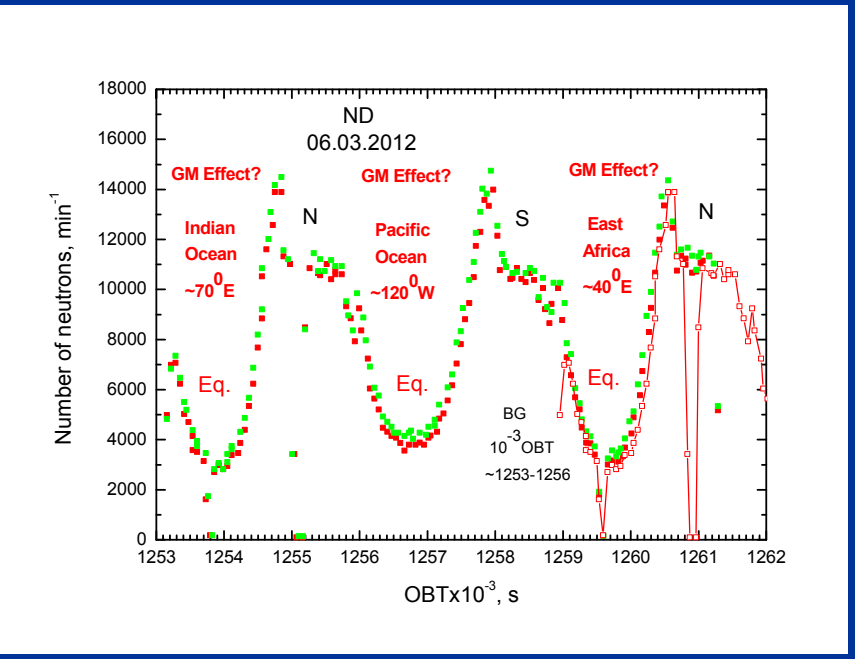
in S1-S3

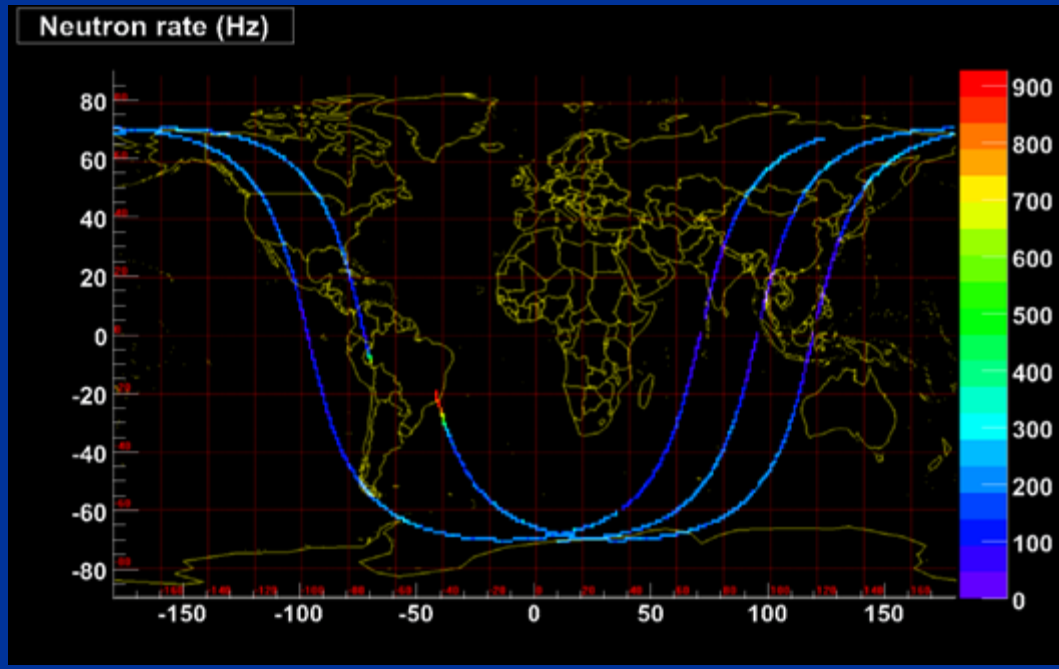


07.03.2012. QUICKLOOK Data Digitization



06.03.2012. QUICKLOOK Data Digitization





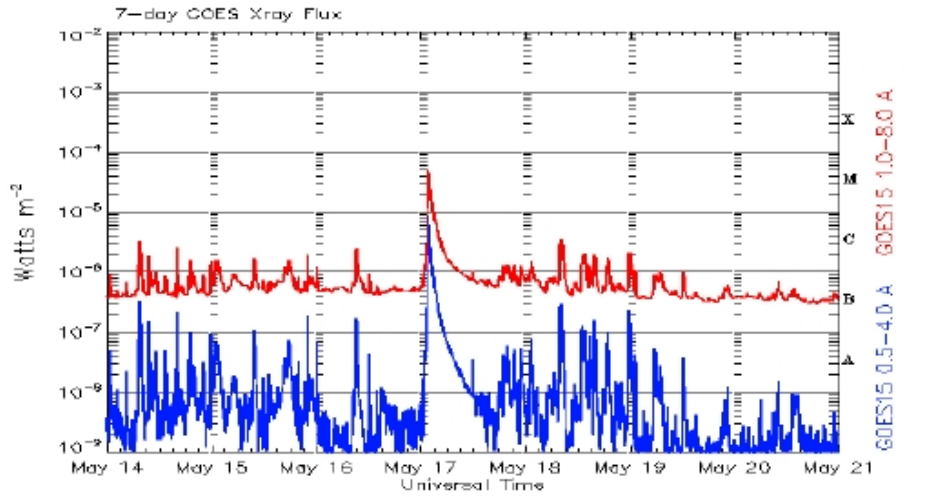
SF 07.03.2012 X5.4 00:24 UT, Common Data: Fermi LAT found E_γ=0.1-4.0GeV !!!,

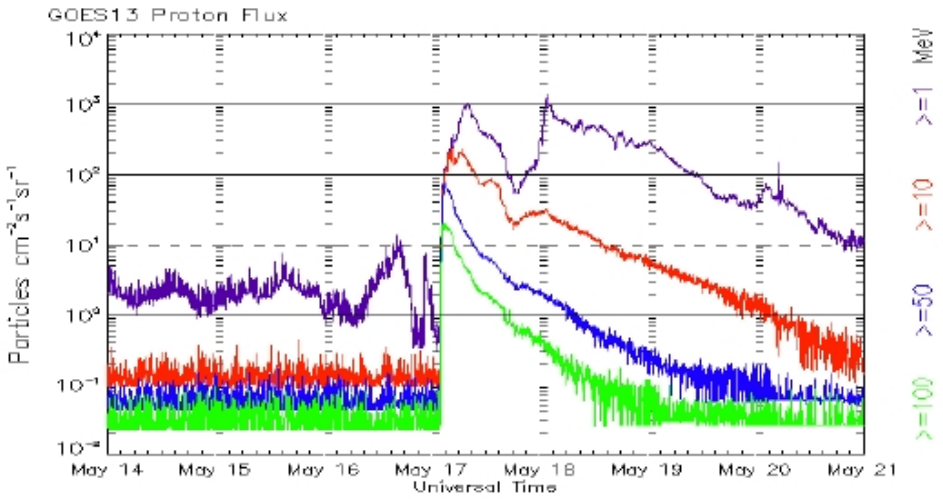
PAMELA: the first SCR went in ~04:03 !!!

NB. No QUICKLOOK data near 00:55-02:41 UT (OBT~1325670-1332000 s)

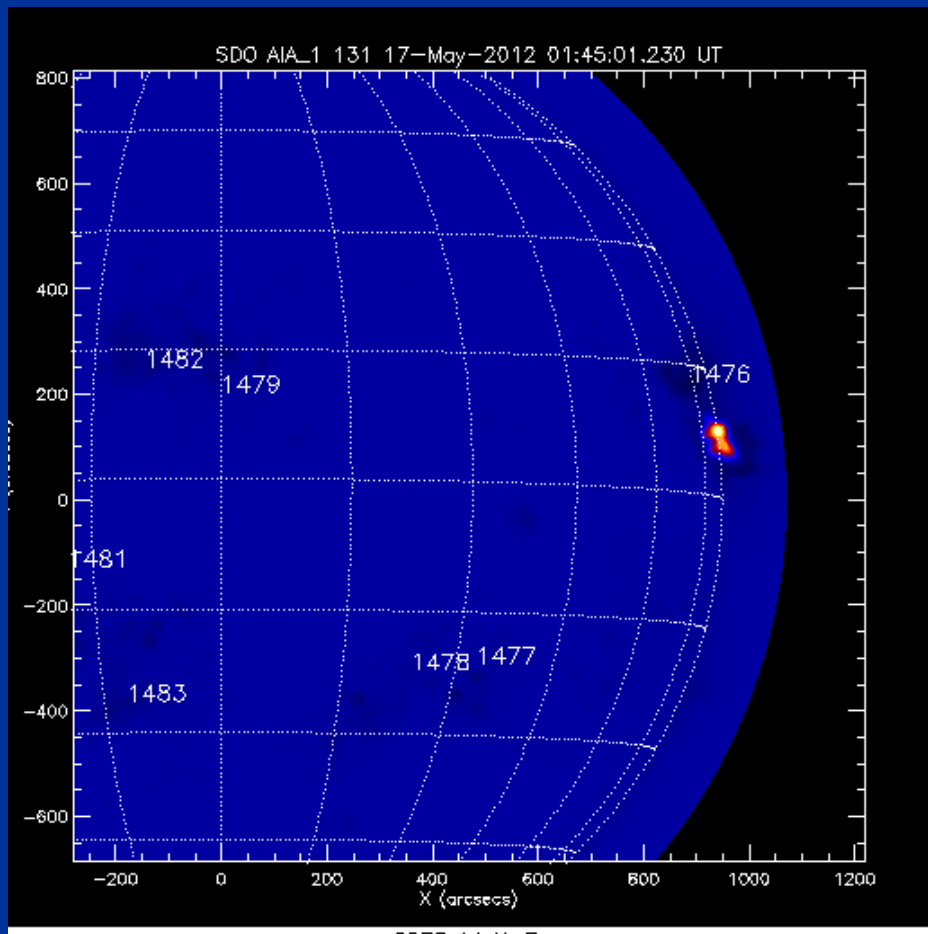
NO SOLAR NEUTRONS.

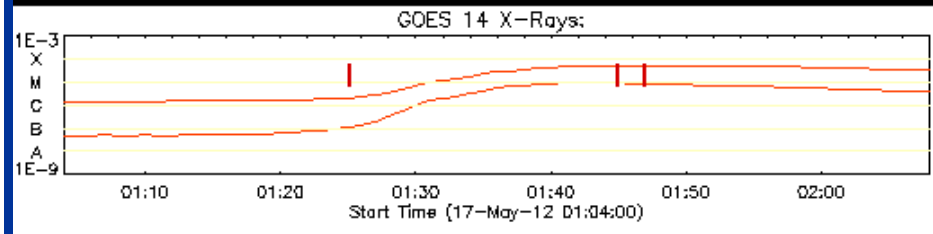
17 May 2012. SF M5.1 01:47 UT
Area 1476, N11W76



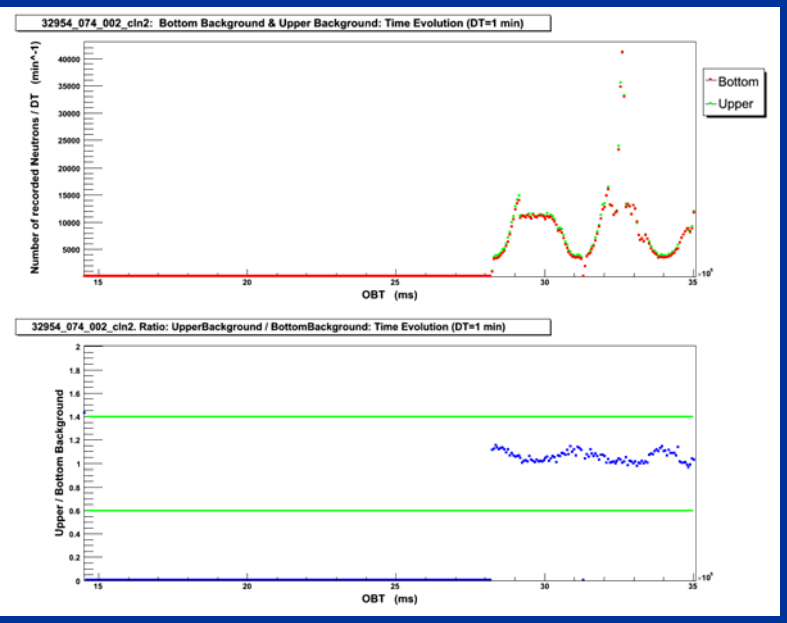


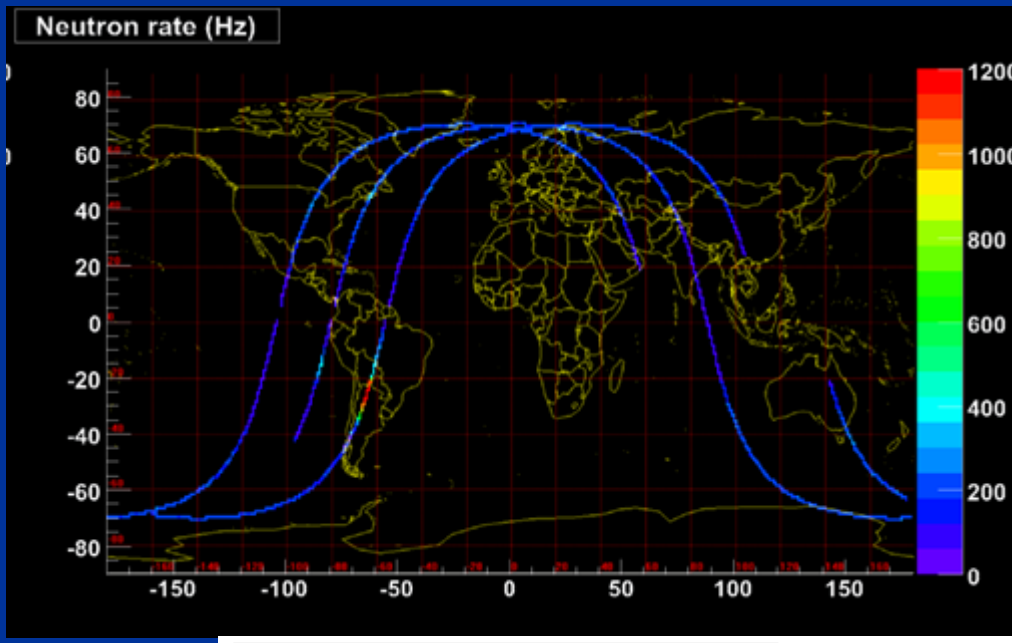
Weekly GOES Satellite X-ray and Proton Plots
Week Beginning 14 May 2012

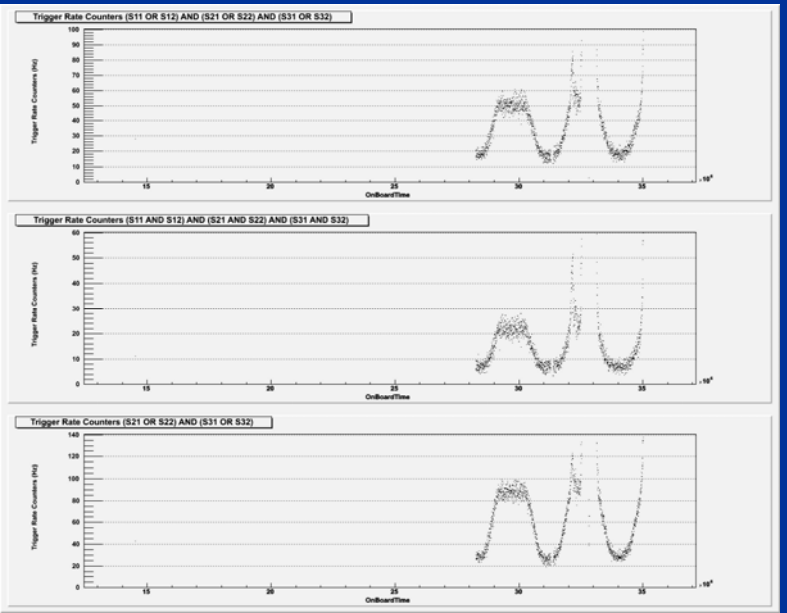




17.05.2012. QUICKLOOK Data





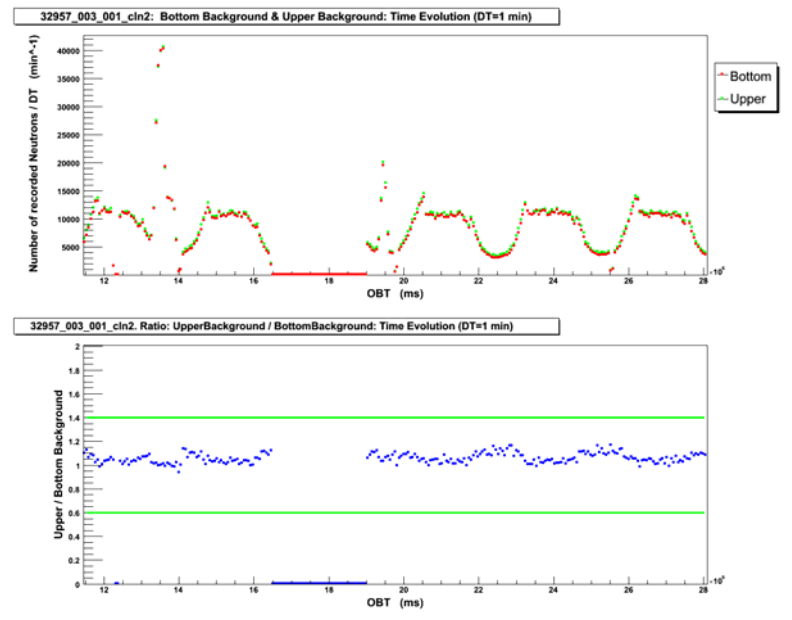


n>p+e+…?

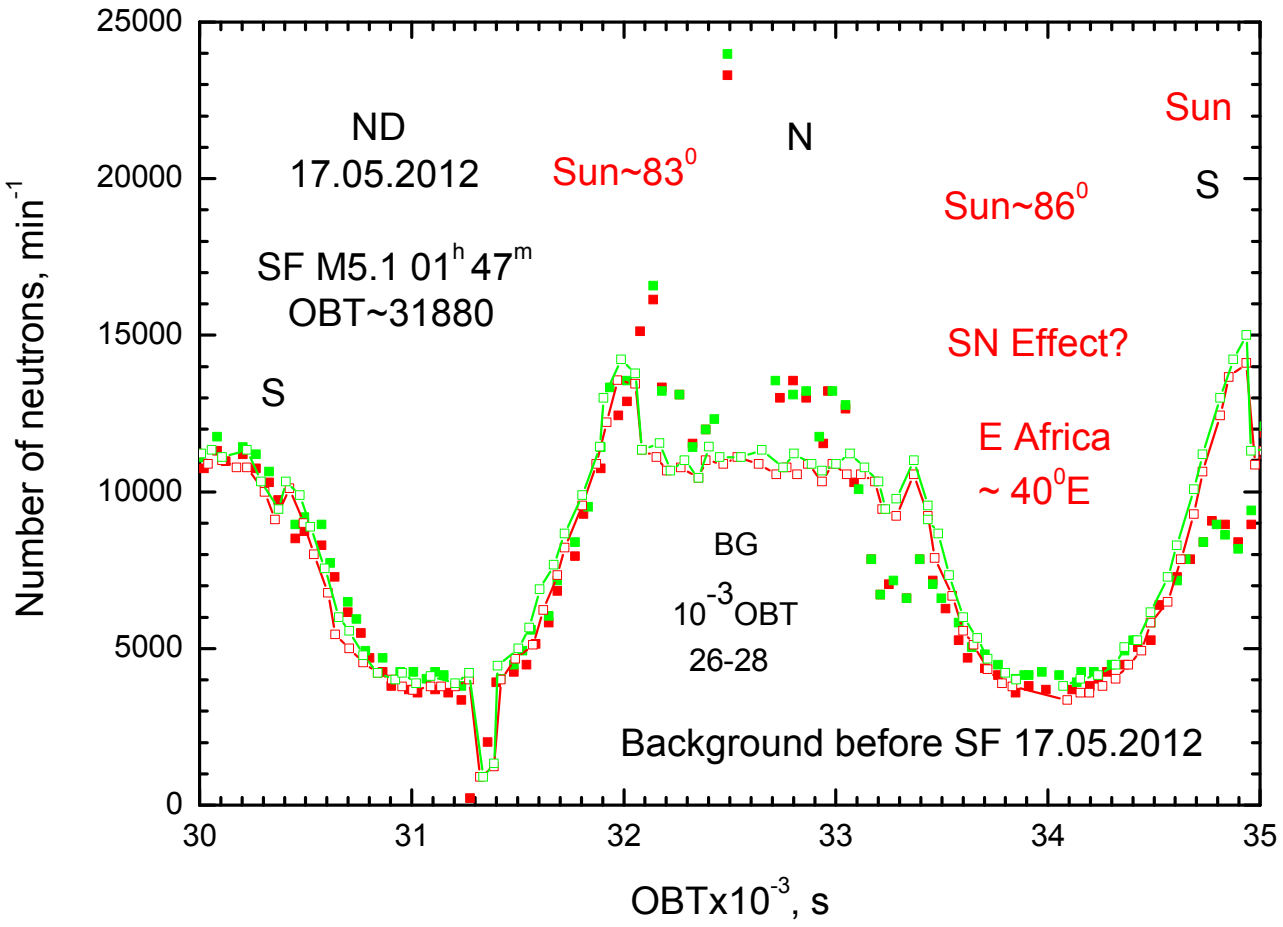
Pre-pulse

Near North

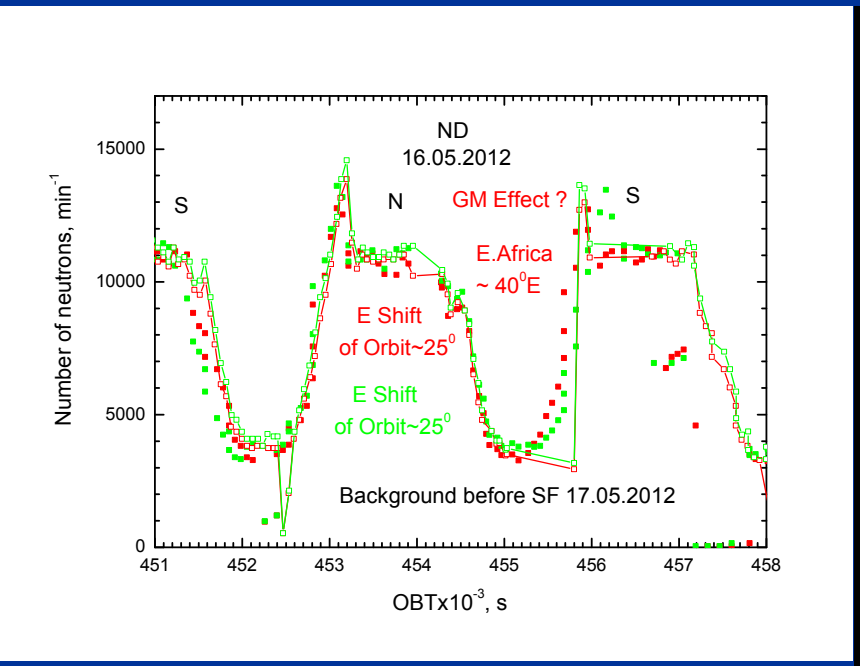
in S1-S3

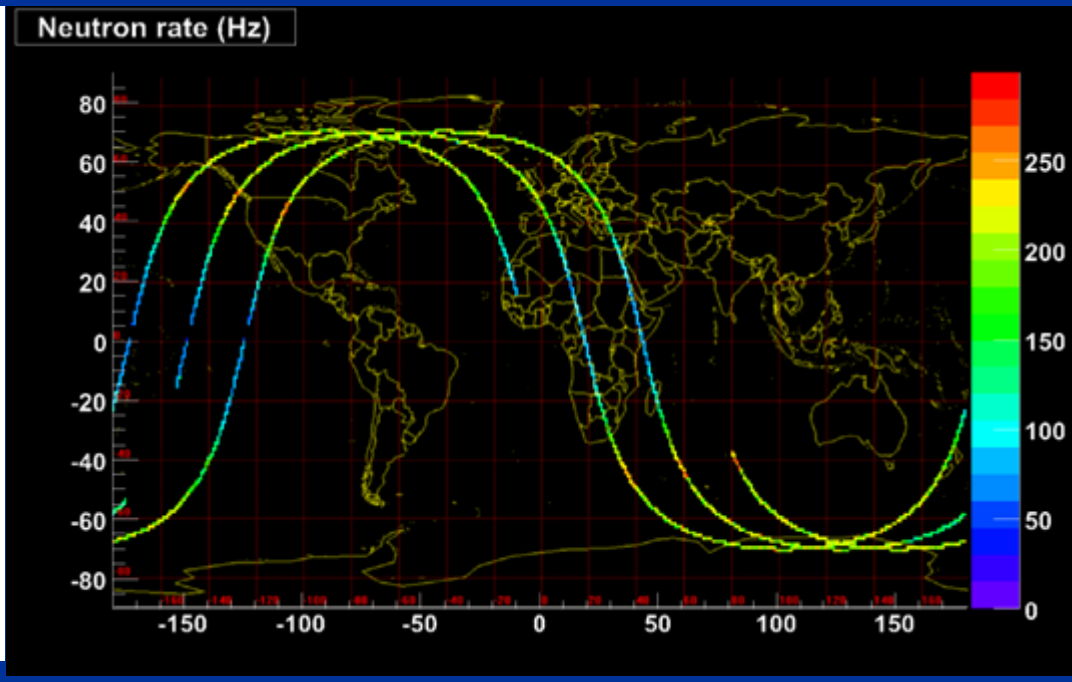


17.05.2012. QUICKLOOK Data Digitization



16.05.2012. QUICKLOOK Data Digitization





SN: 17.05.2012 OBT~33580-33880 ND(b&t): 45838-47507=1669±306, -**3.51±0.64%**

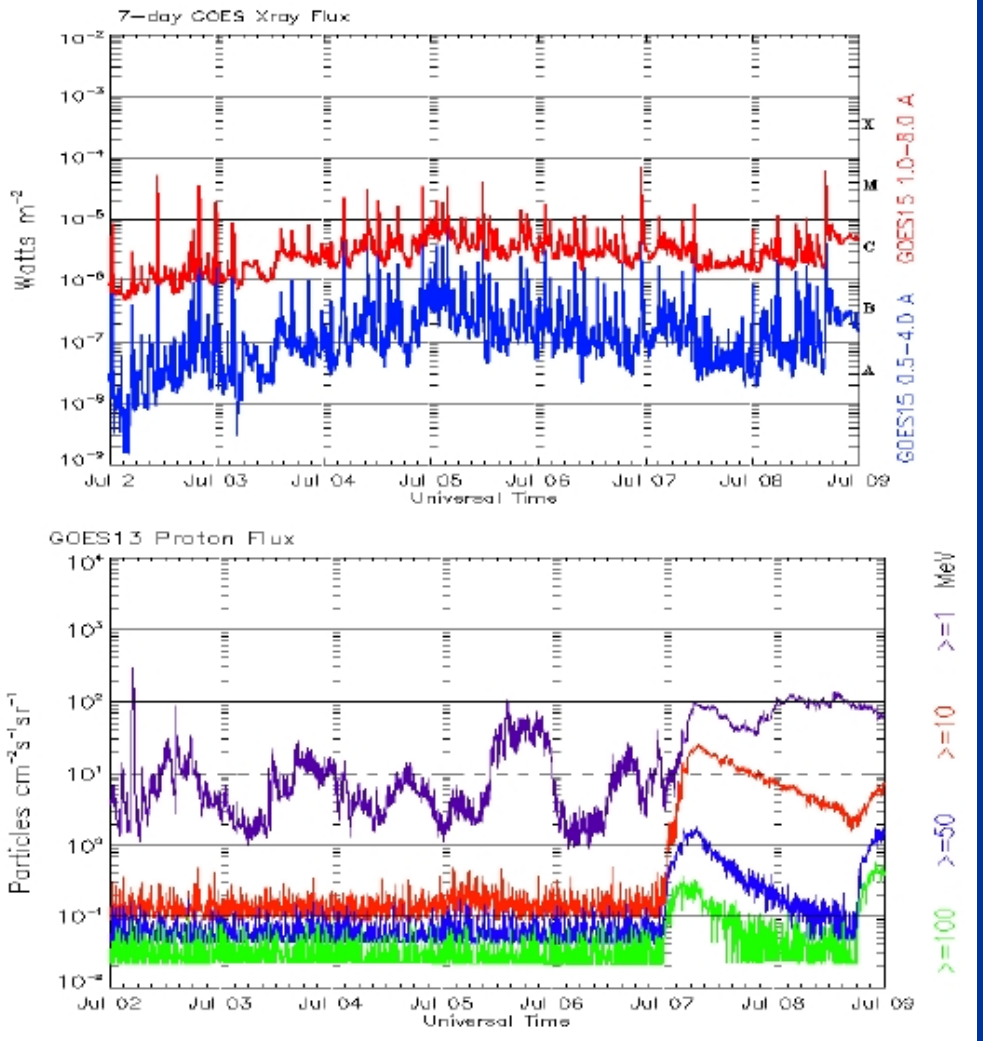
GM: 16.05.2012 OBT~454720-455020 ND(b&t):41659-44021= 2362±293, -5.37**±0.67%**

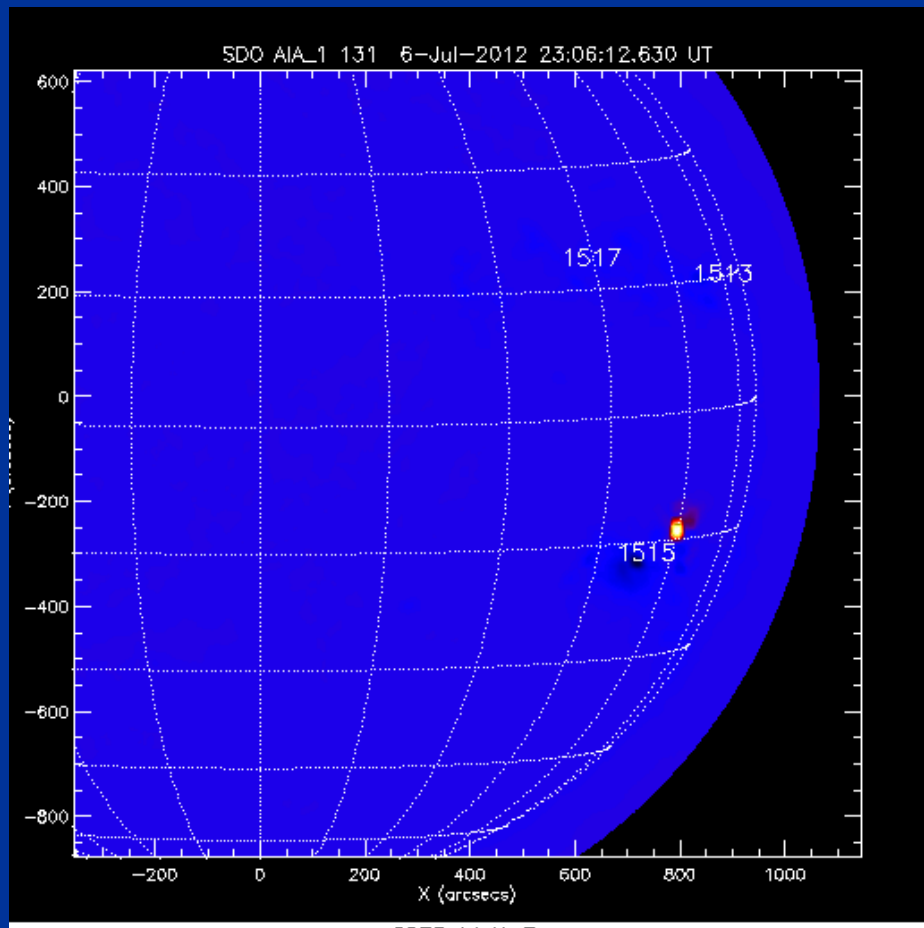
(GM: Cut-off shift ~ 15.9-16.8GV). **NB.** Quality of QL data for 16.05.2012 is so so…

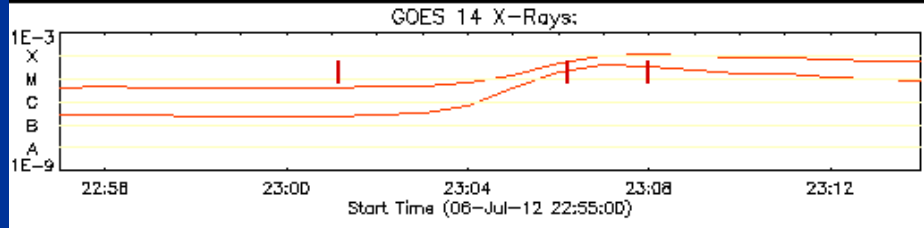
Total Effect SN-GM: +1.85±0.93% for 36-41 min after SF, E_n ~22-27 MeV

PROBABLY SOLAR NEUTRONS… Near the Earth I_n(22-27 MeV)~810 n/m^{2}s…

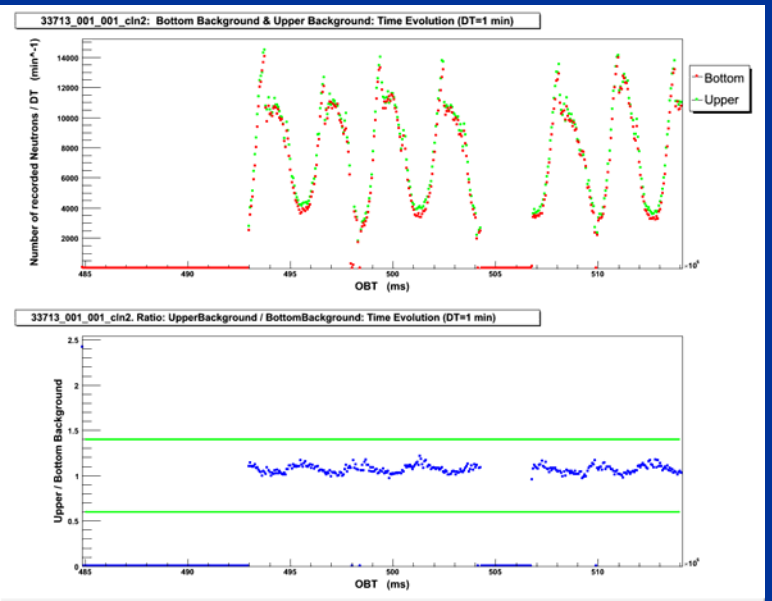
06 July 2012. SF X1.1 23:08 UT
Area 1514, S13W59

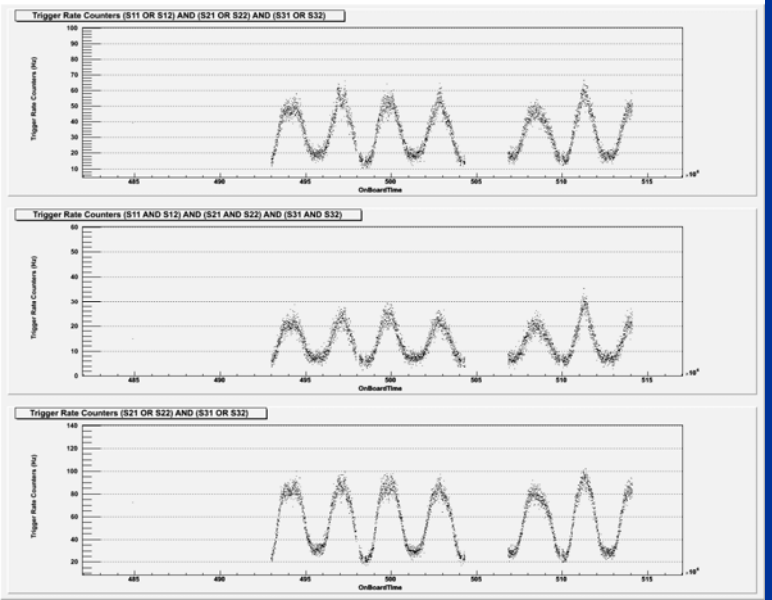


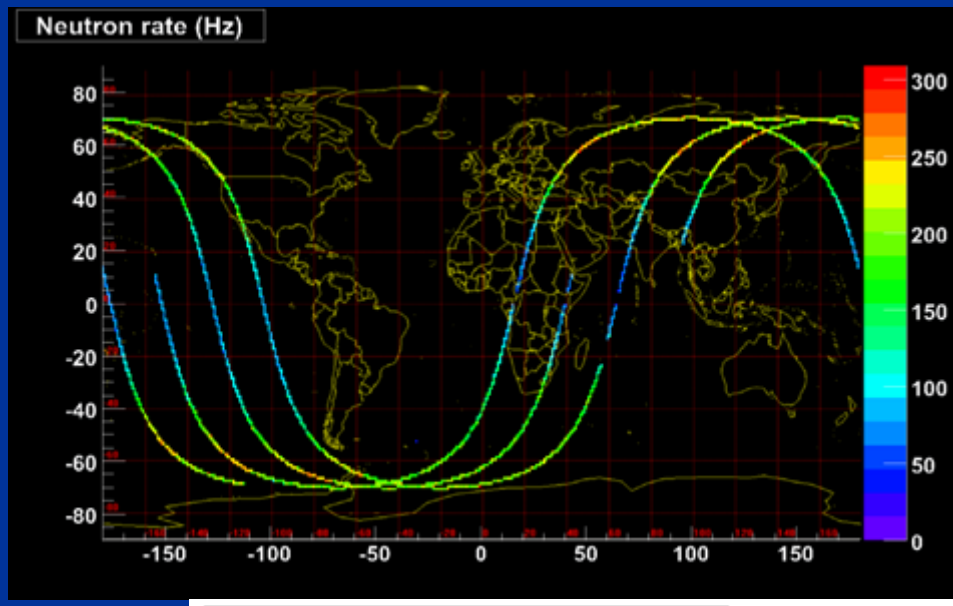




06.07.2012. QUICKLOOK Data





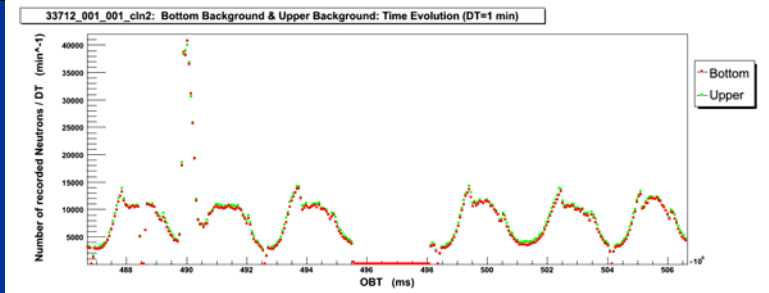


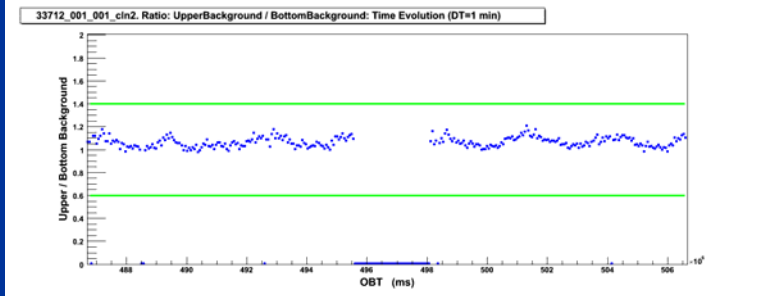
No

Pre-pulse

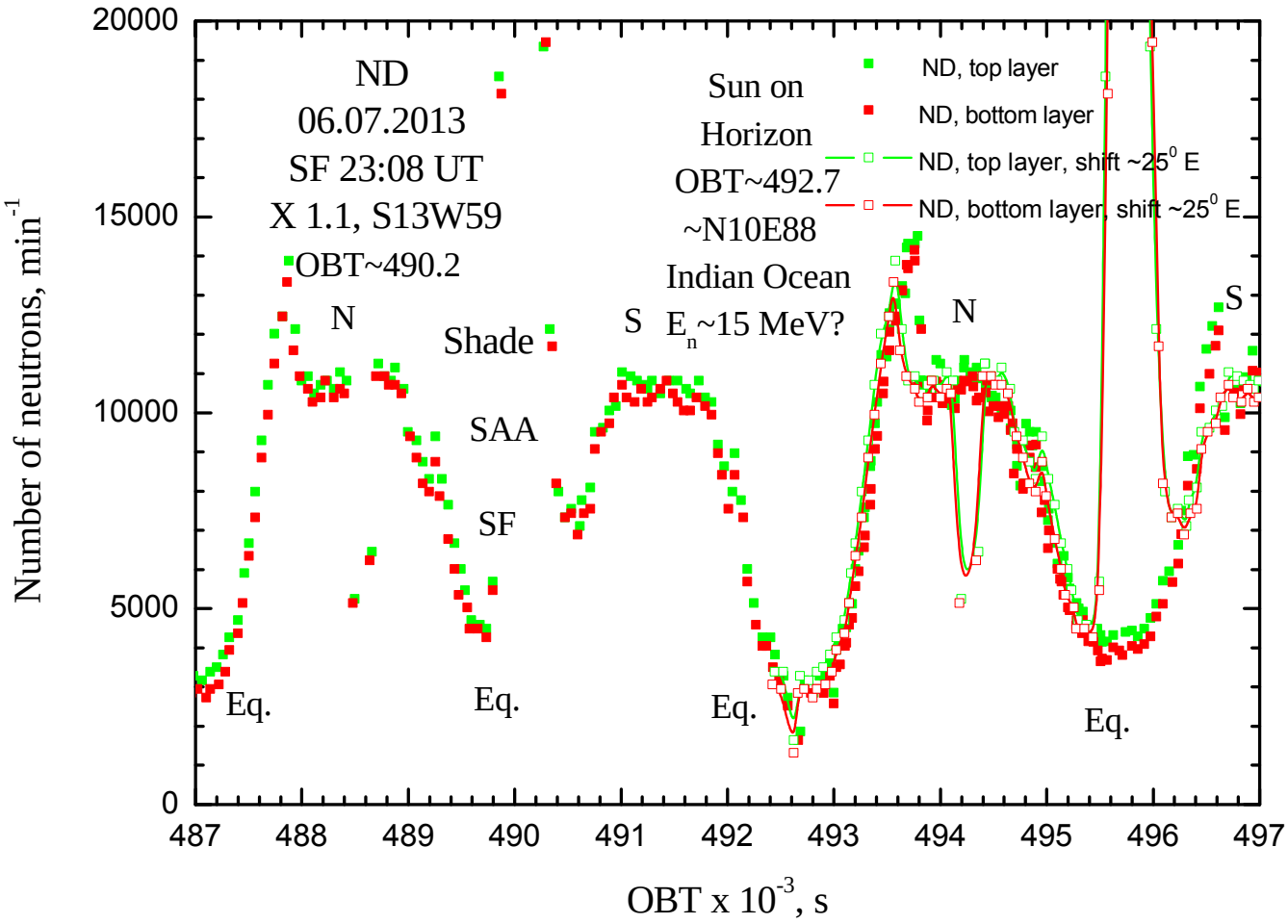
Near South

in S1-S3

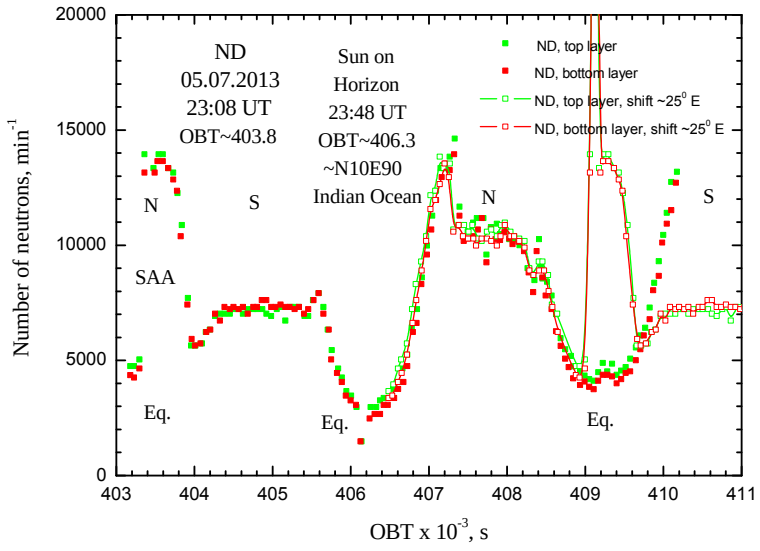


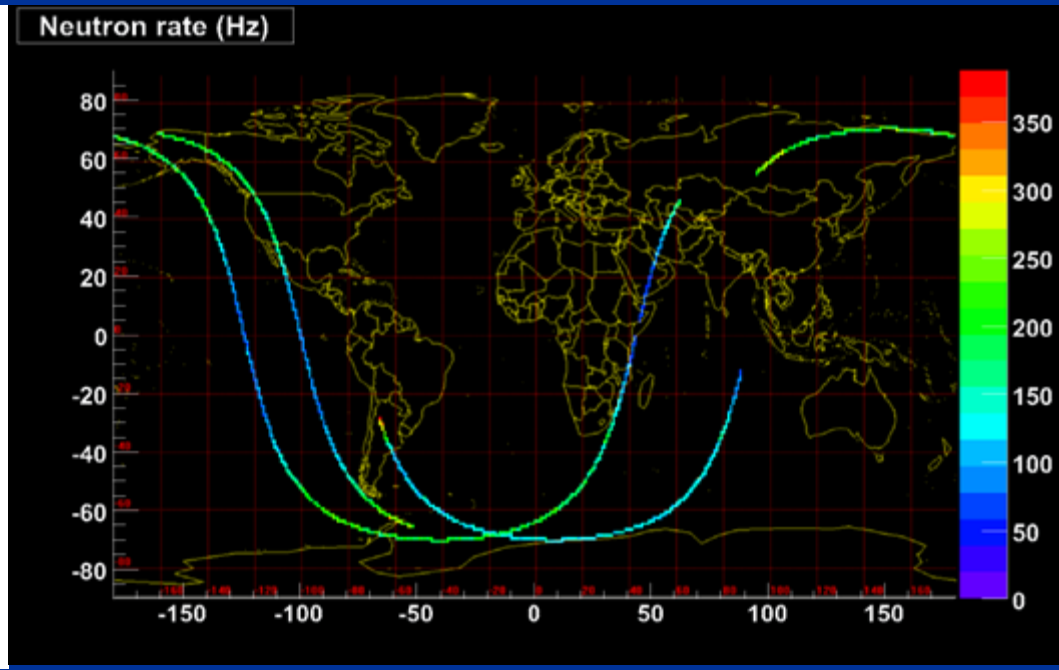


06.07.2012. QUICKLOOK Data Digitization



05.07.2012. QUICKLOOK Data Digitization





SN: 06.07.2012 OBT~492500-492920 ND(b&t): 42077-44482=2504±294, -**5.41±0.66%**

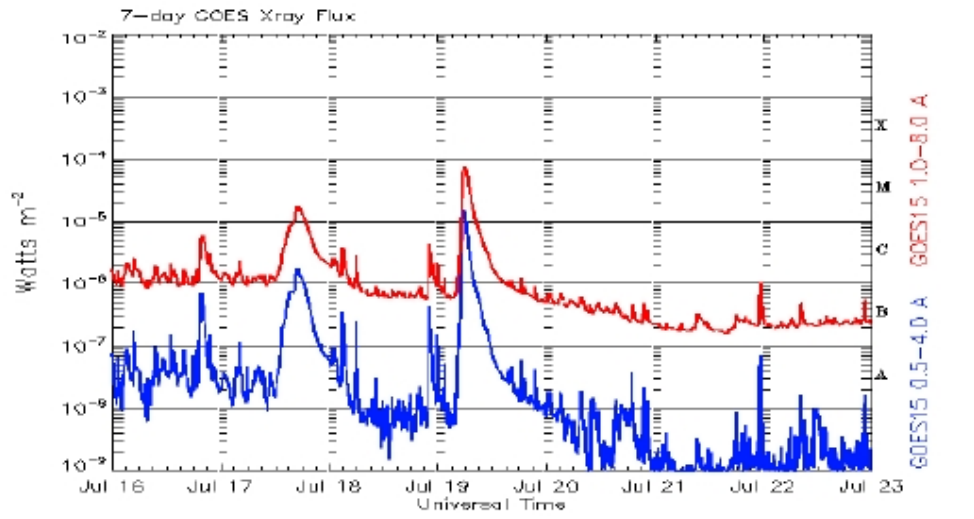
GM: 05.07.2012 OBT~406600-406720 ND(b&t):12853-14435=-1582±165,-10.96**±1.14%**

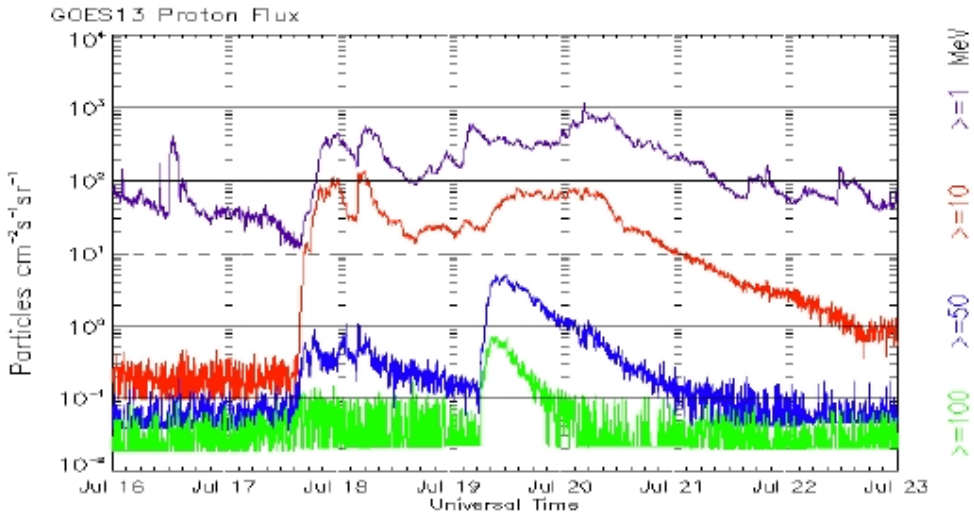
(GM: Cut-off shift ~ 15.9-16.8GV). **NB.** Quality of QL data for 16.05.2012 is so so…

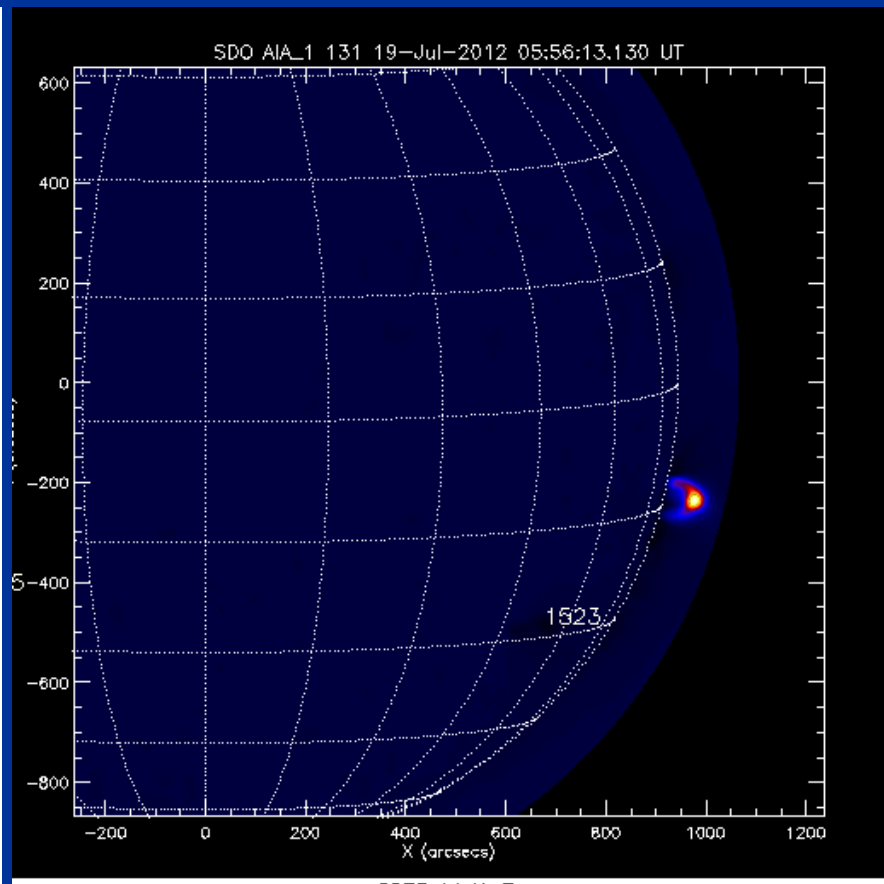
Total Effect SN-GM: +5.55±1.32% for 49-56 min after SF, E_n ~11-15 MeV

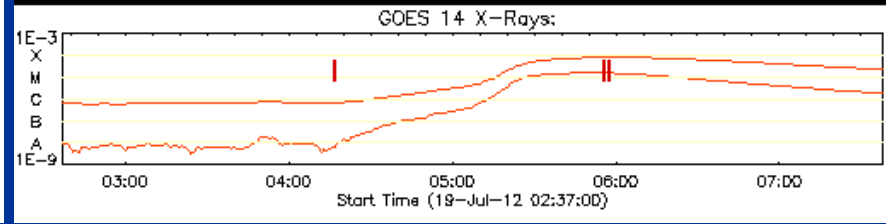
PROBABLY SOLAR NEUTRONS… Near the Earth I_n(~11-15 MeV)~1600 n/m²s…

19 July 2012. SF M7.7 05:58 UT
Area 1520, S13W88

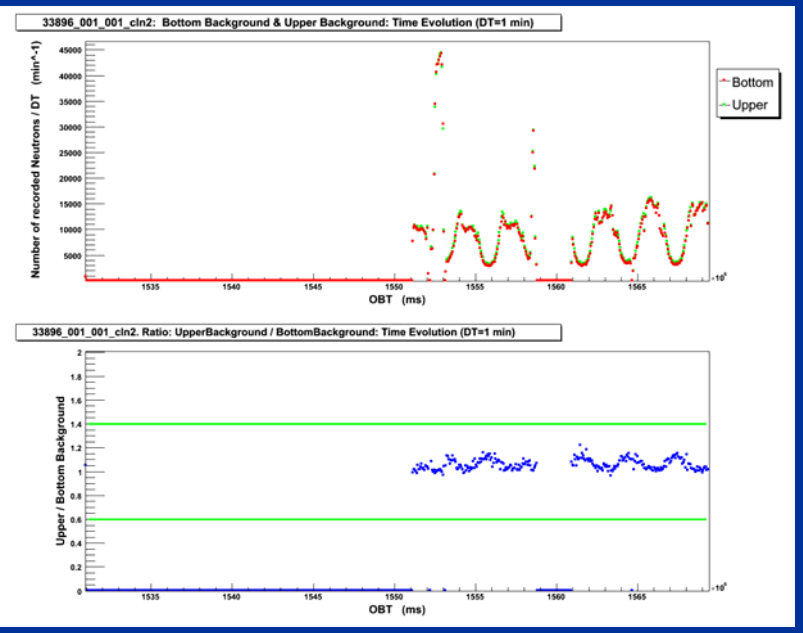


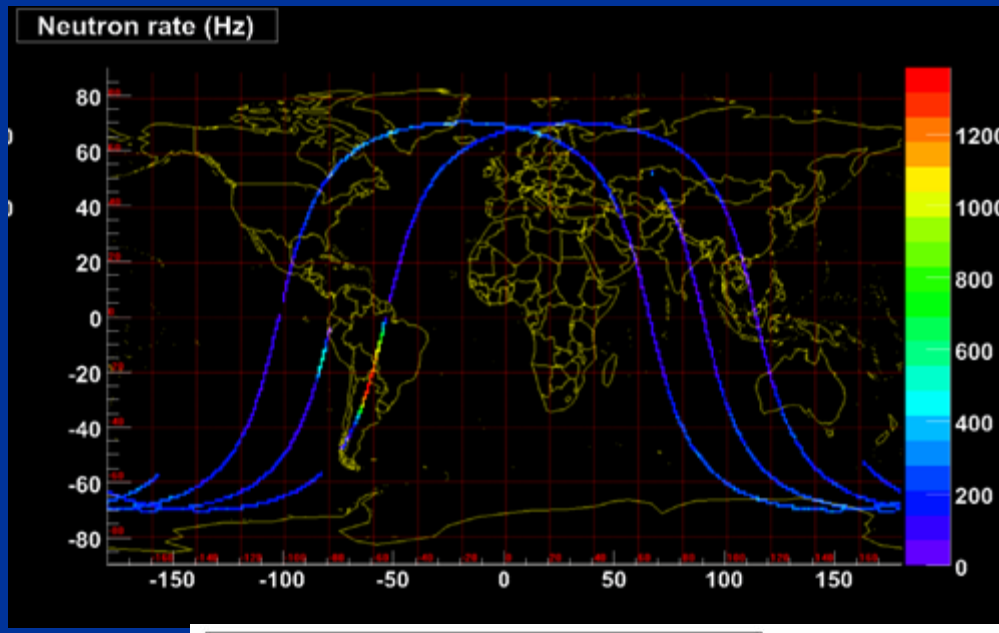


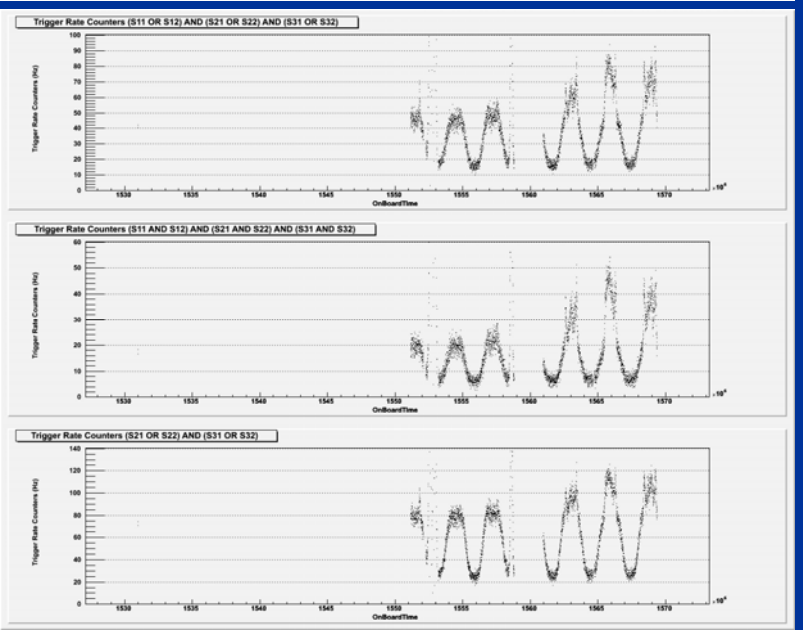




19.07.2012. QUICKLOOK Data





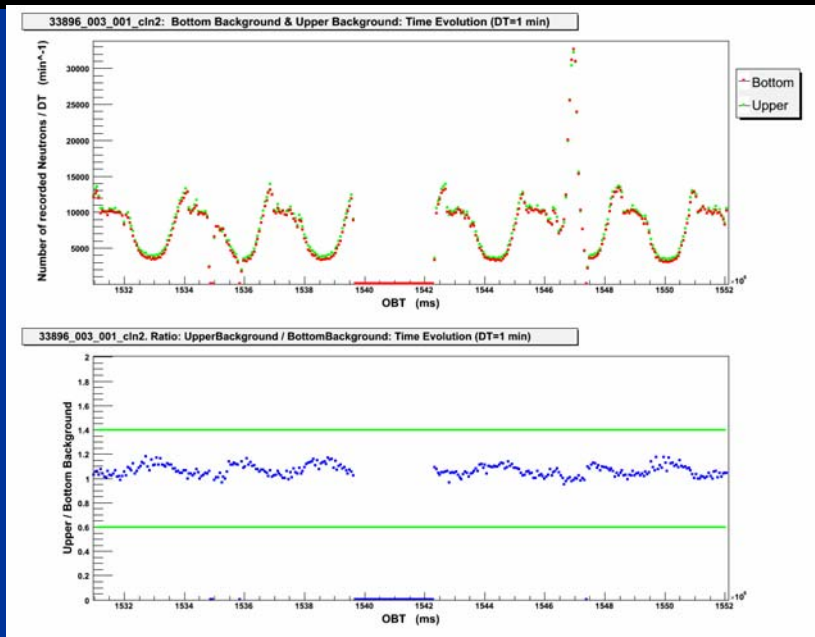


n>p+e+…?

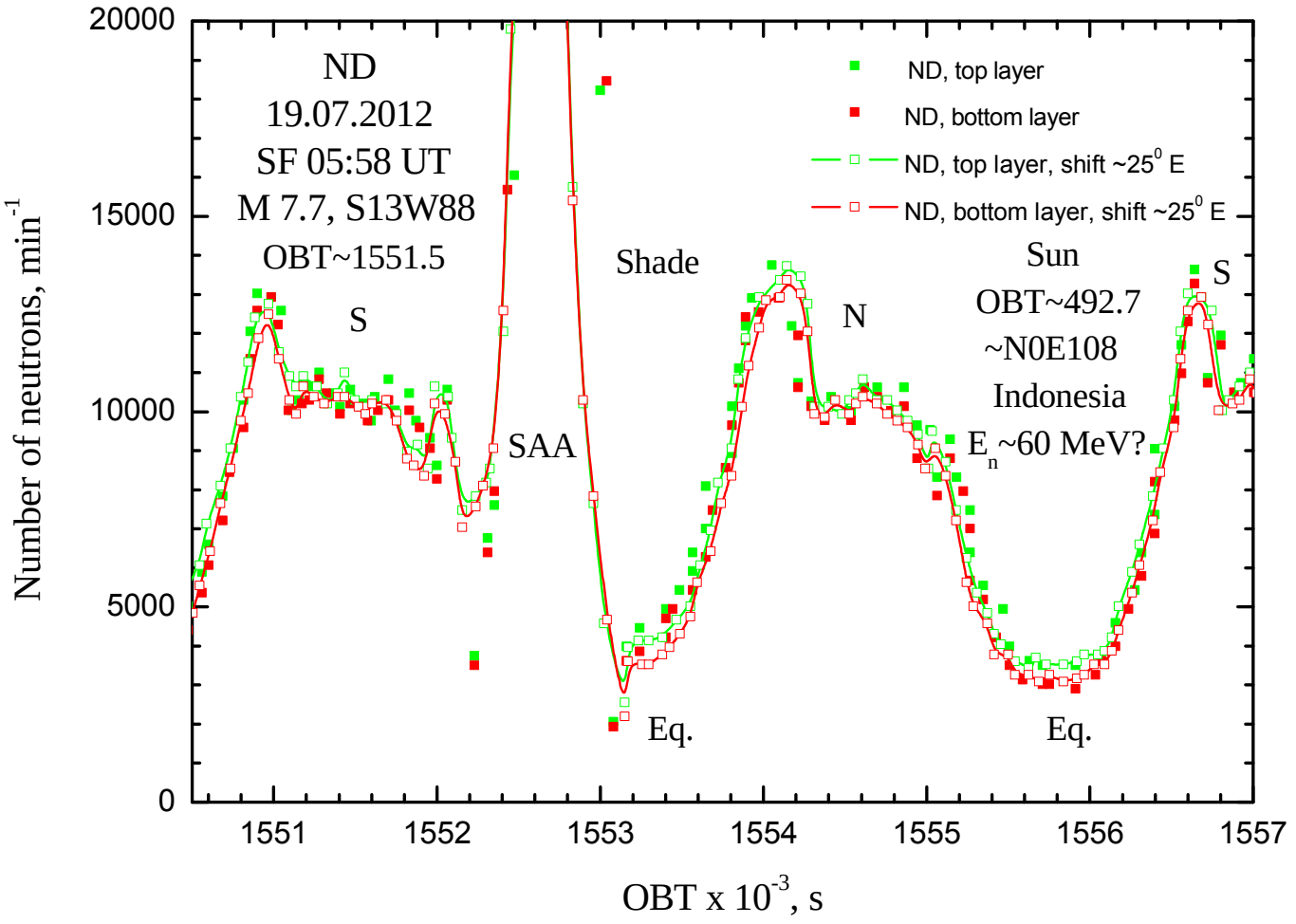
Pre-pulse

Near South

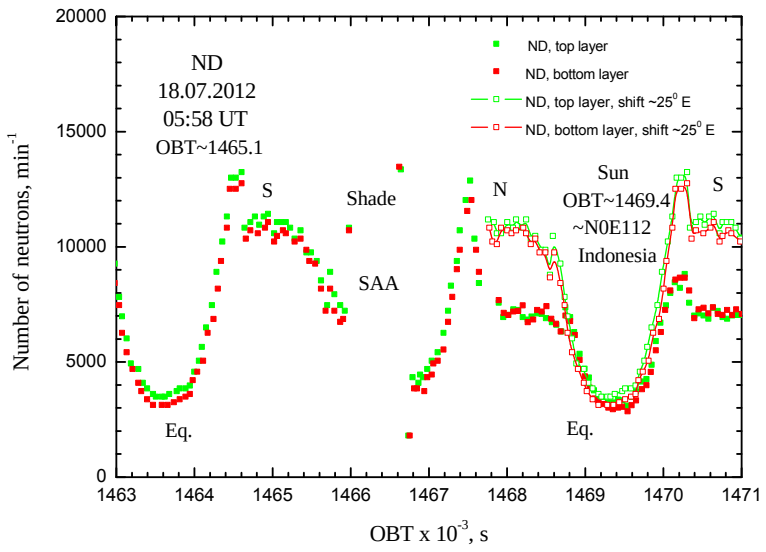
in S1-S3

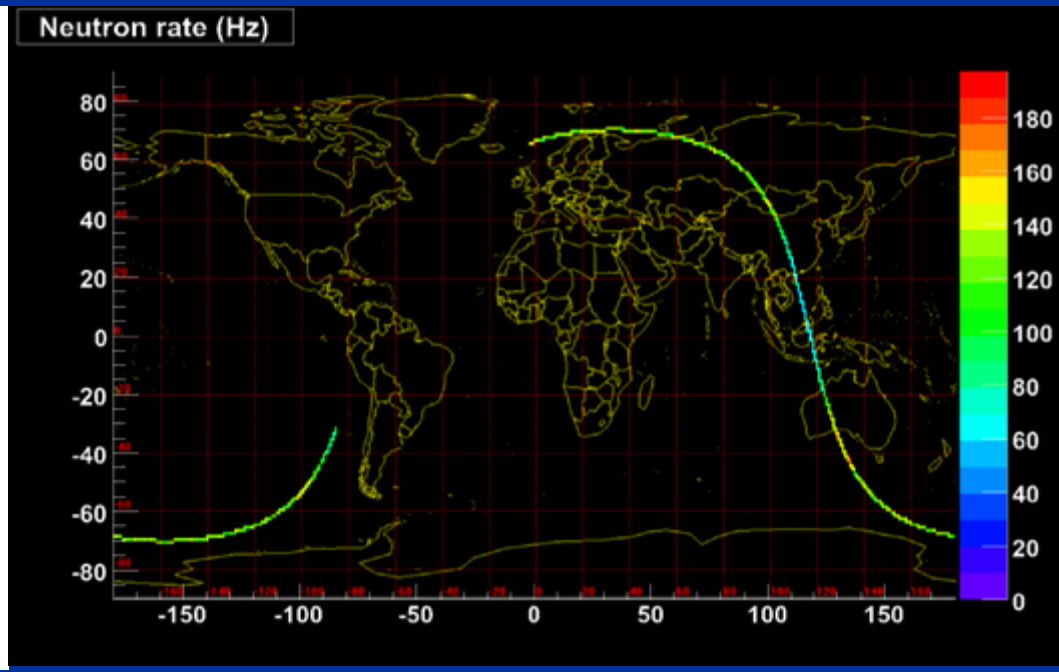


19.07.2012. QUICKLOOK Data Digitization



18.07.2012. QUICKLOOK Data Digitization





SN:19.07.2012 OBT~1555510-1555810 ND(b&t):33539-33607=68±259, -**0.20±0.77%**

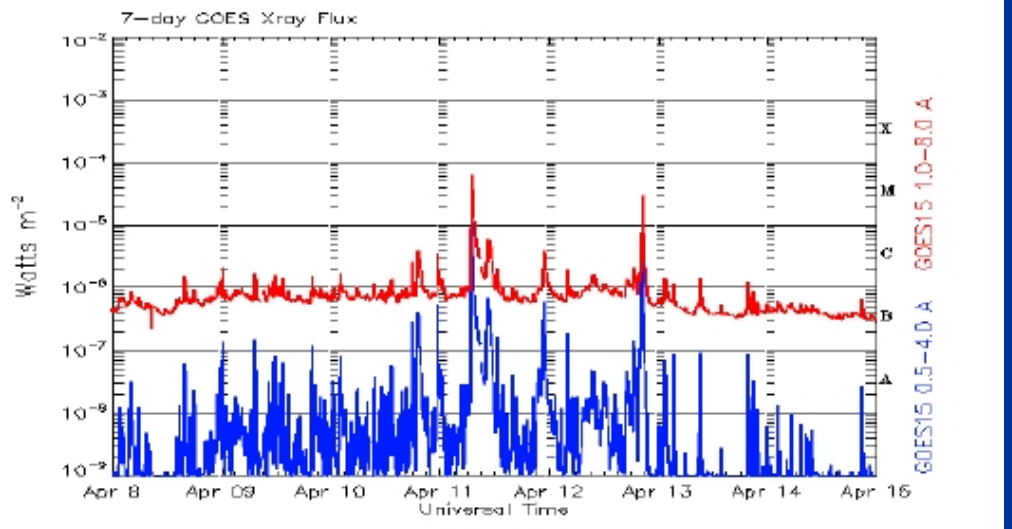
GM:18.07.2012 OBT1469170-1469470 ND(b&t):32175-33690=-1515±257,-4.50**±0.76%**

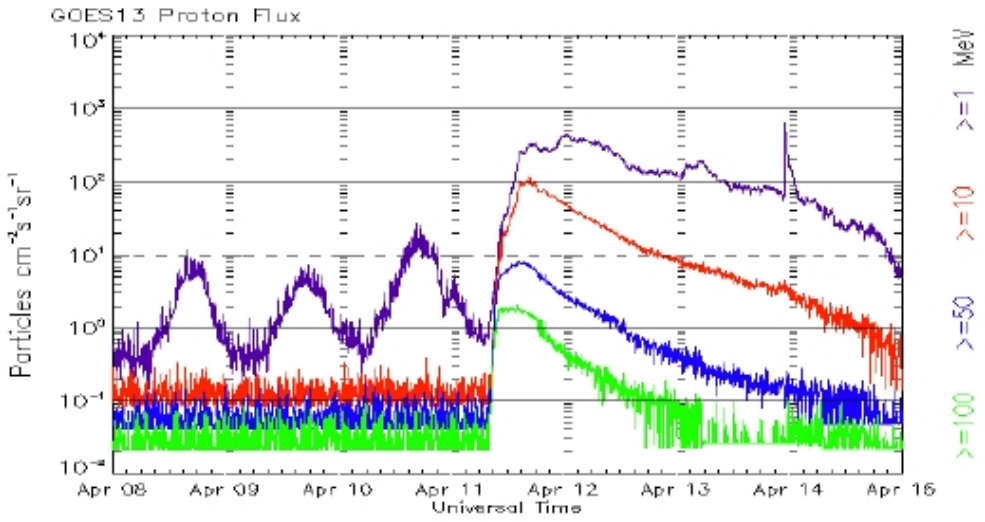
(GM: Cut-off shift ~ 15.9-16.8GV).

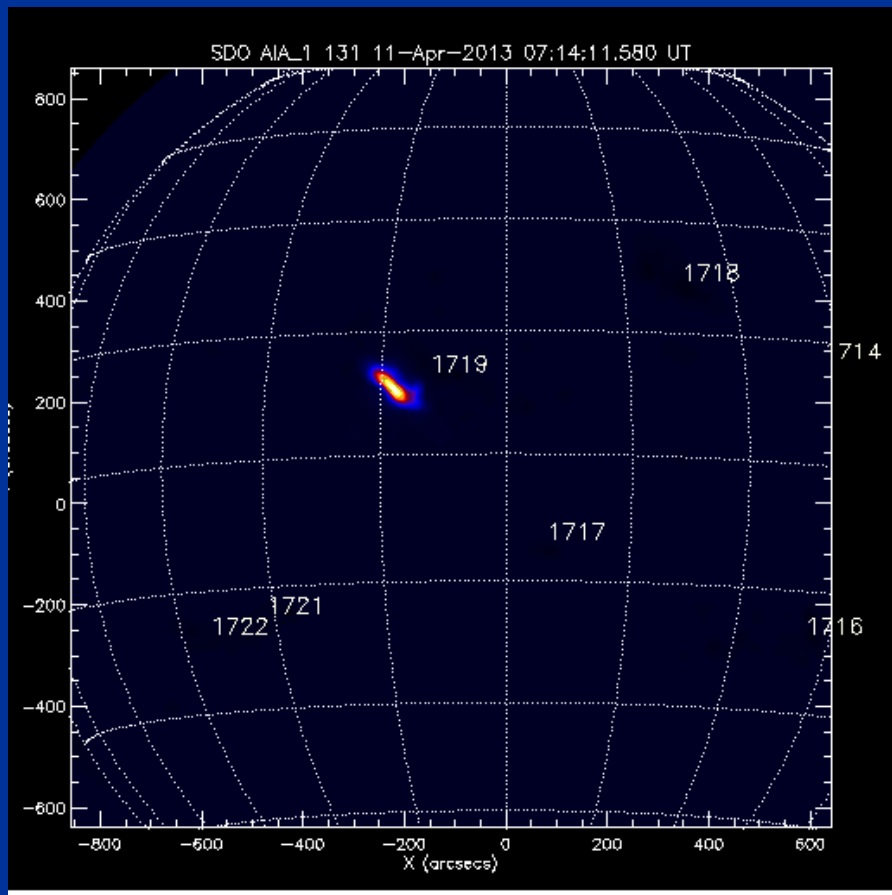
Total Effect SN-GM: +4.30±1.08% for 75-80 min after SF, E_n ~5.2-5.9 MeV

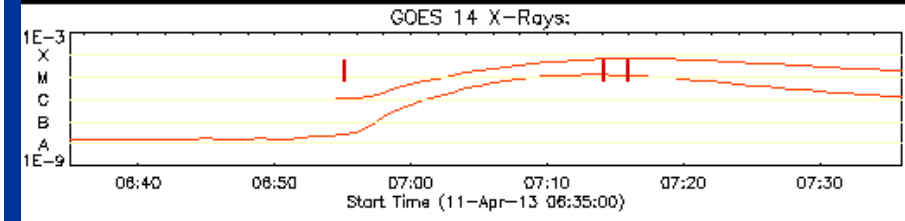
PROBABLY SOLAR NEUTRONS… Near the Earth I_n(~6 MeV)~1300 n/m^{2}s…

11 April 2013. SF M6.5 07:16 UT
Area 1719, N07E13

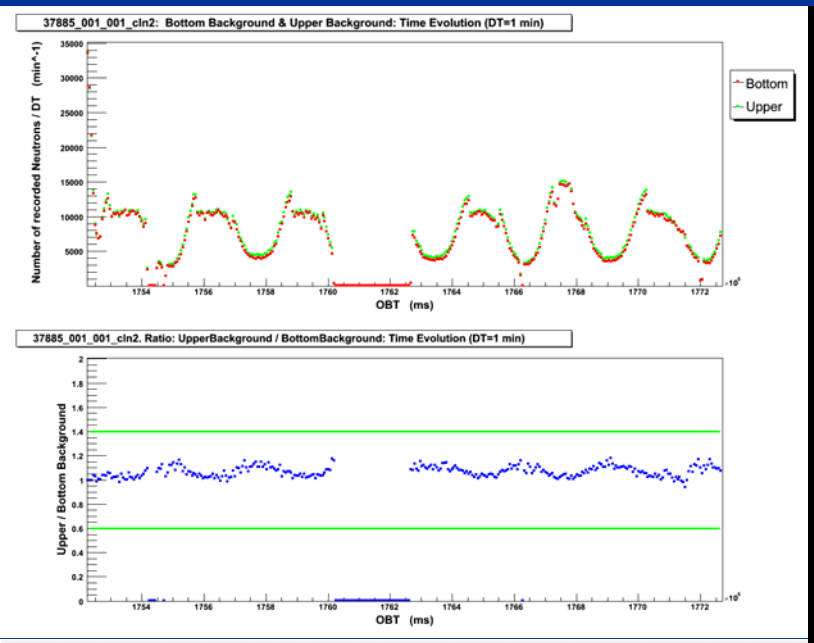


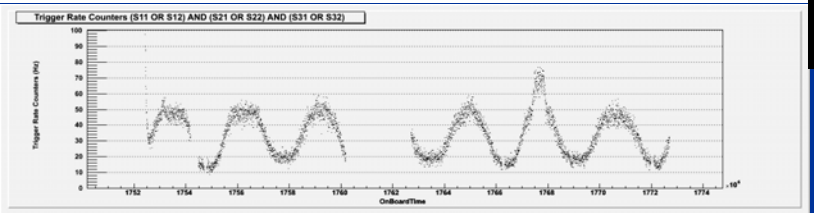


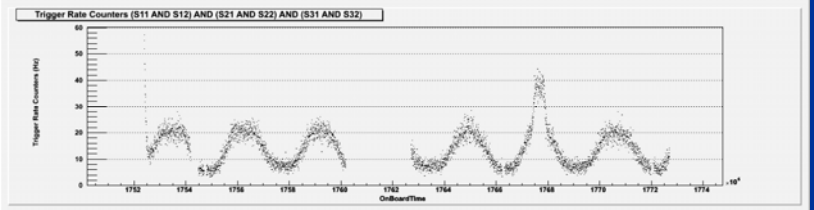


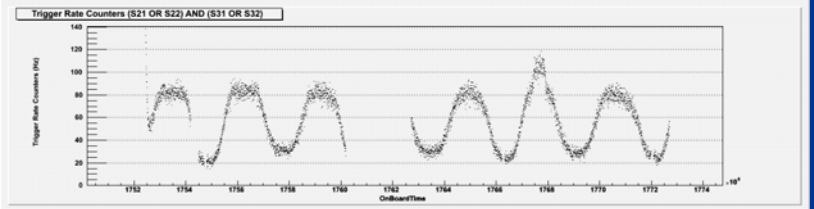


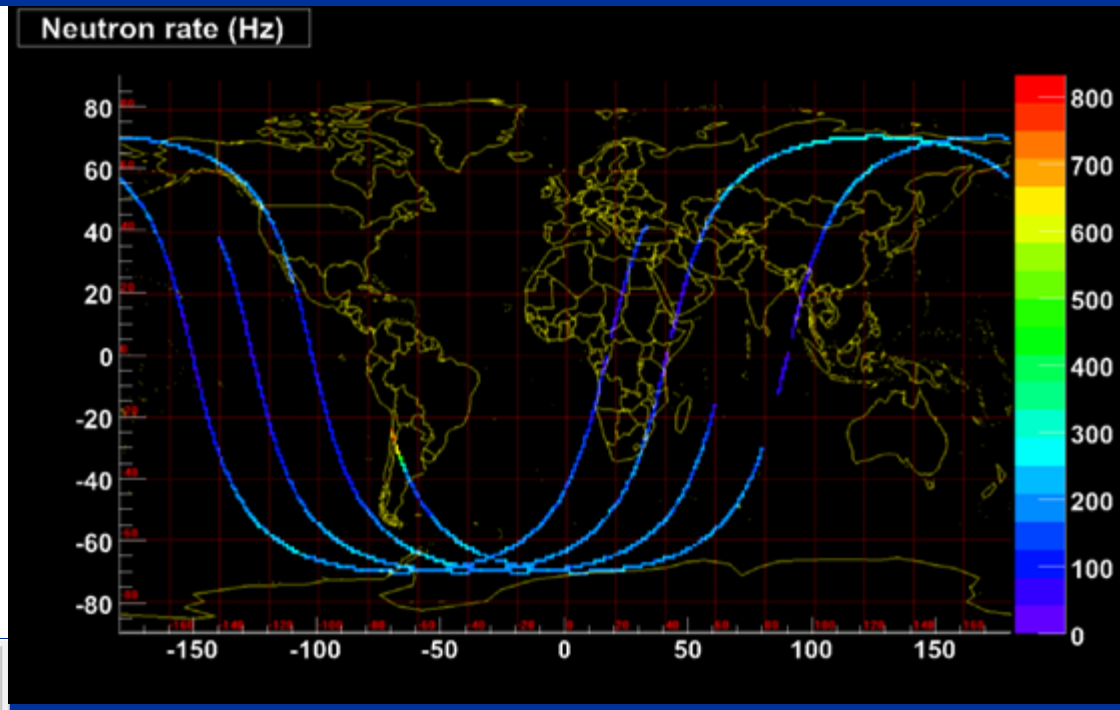
11.04.2013. QUICKLOOK Data











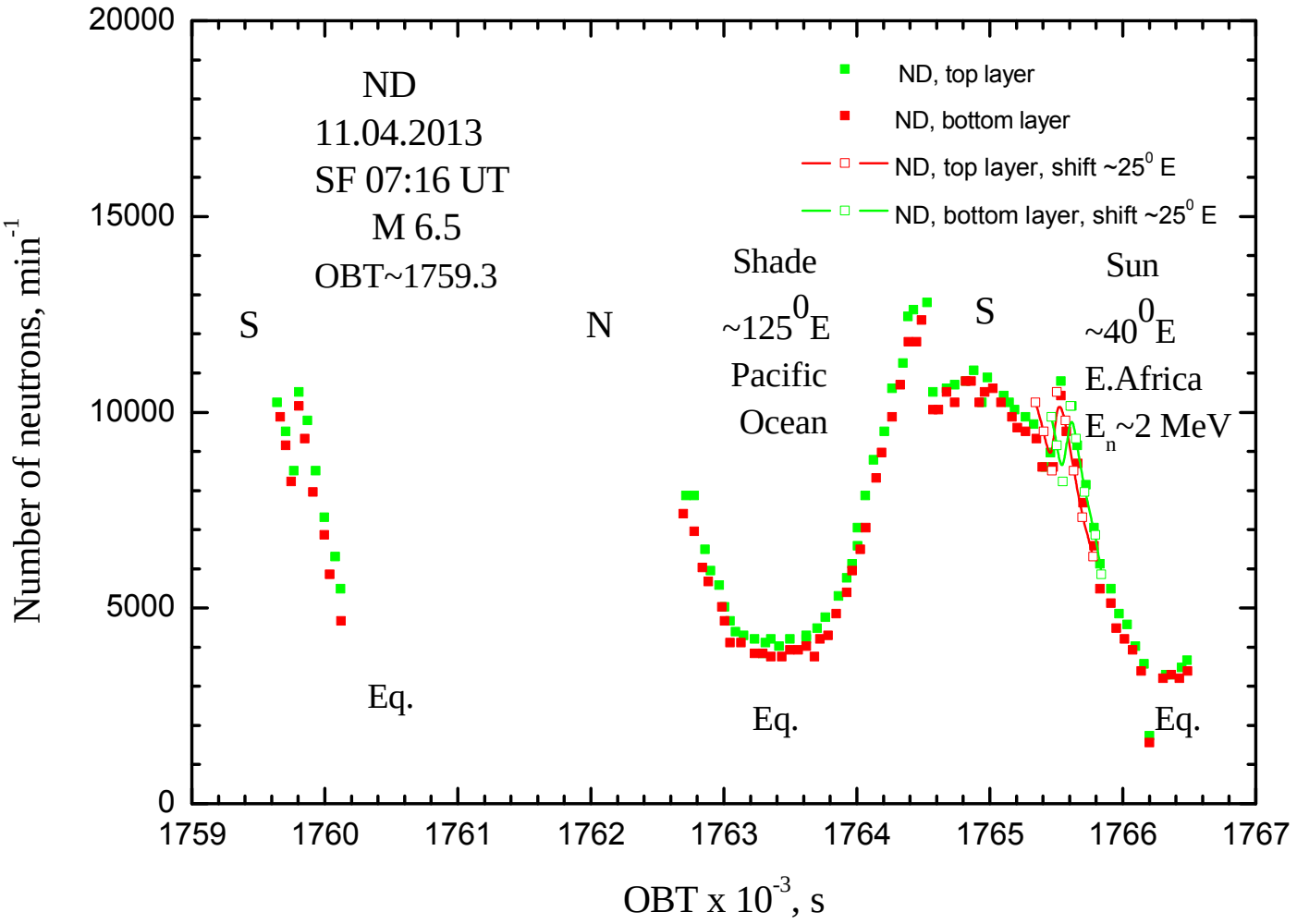
No

Pre-pulse

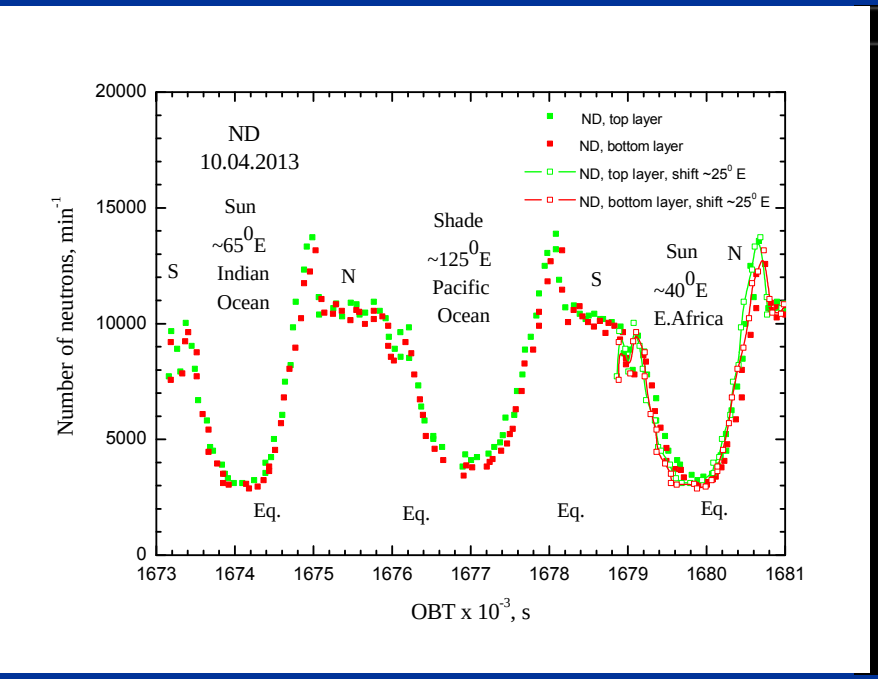
Near North

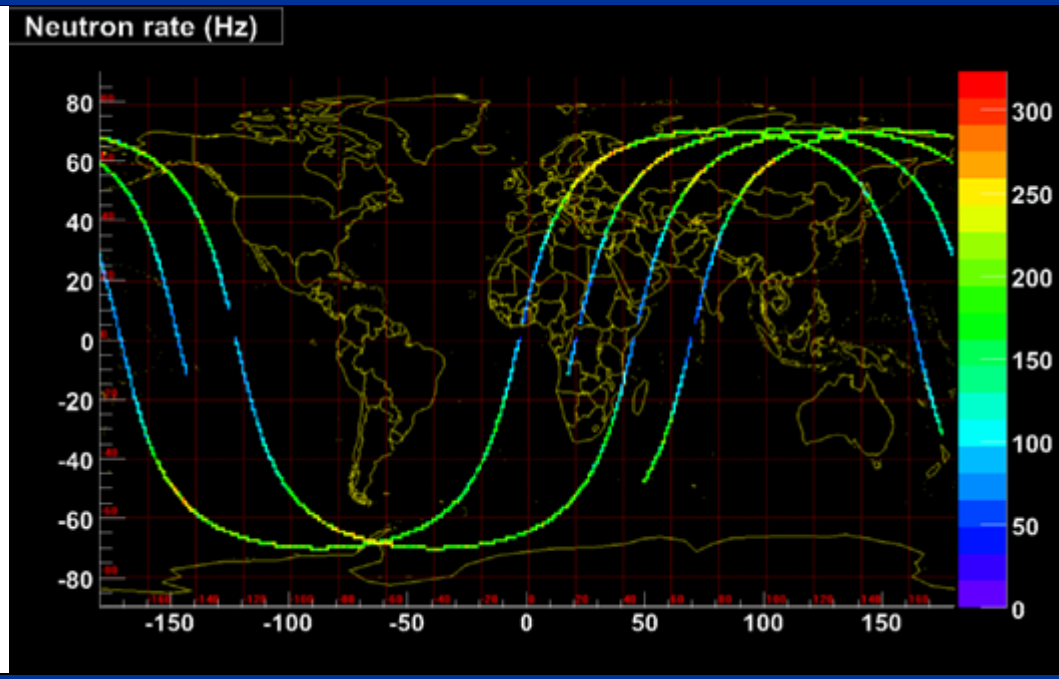
in S1-S3

11.04.2013. QUICKLOOK Data Digitization



10.04.2013. QUICKLOOK Data Digitization

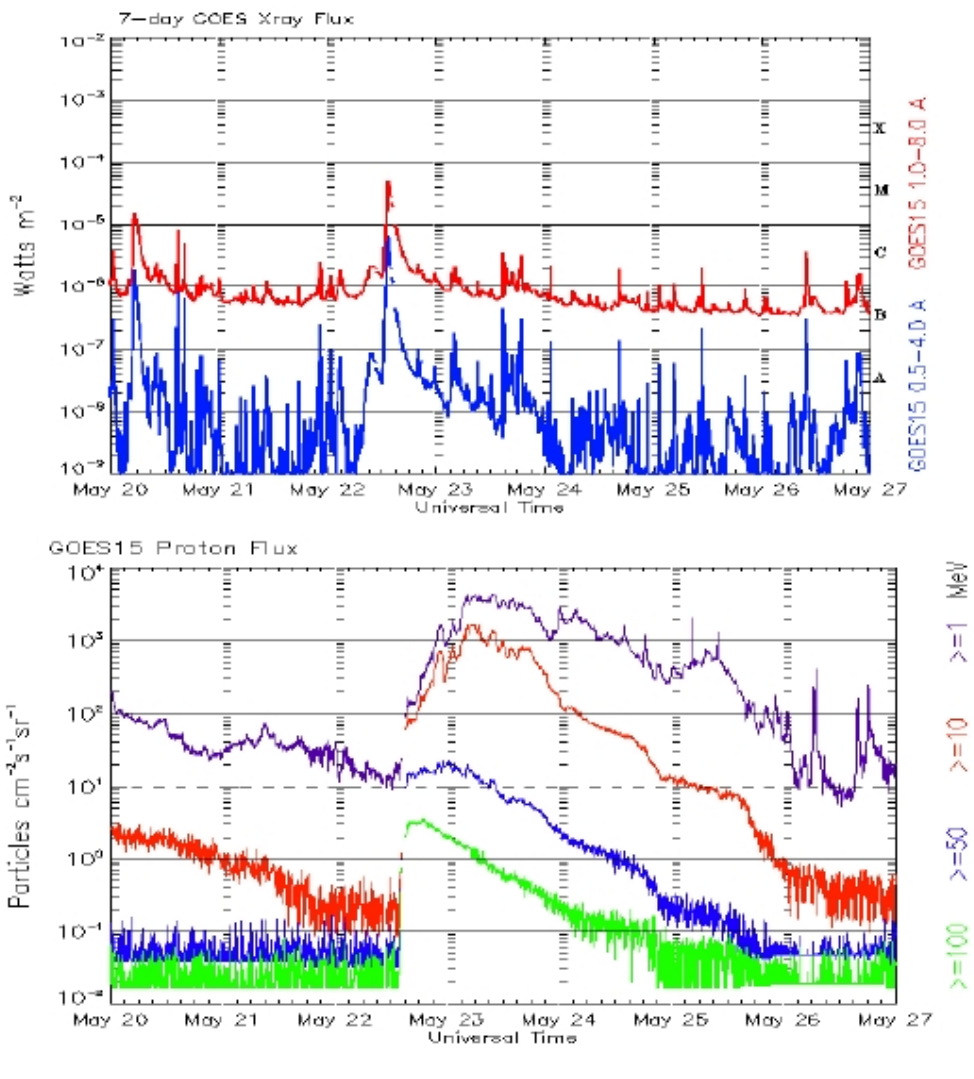


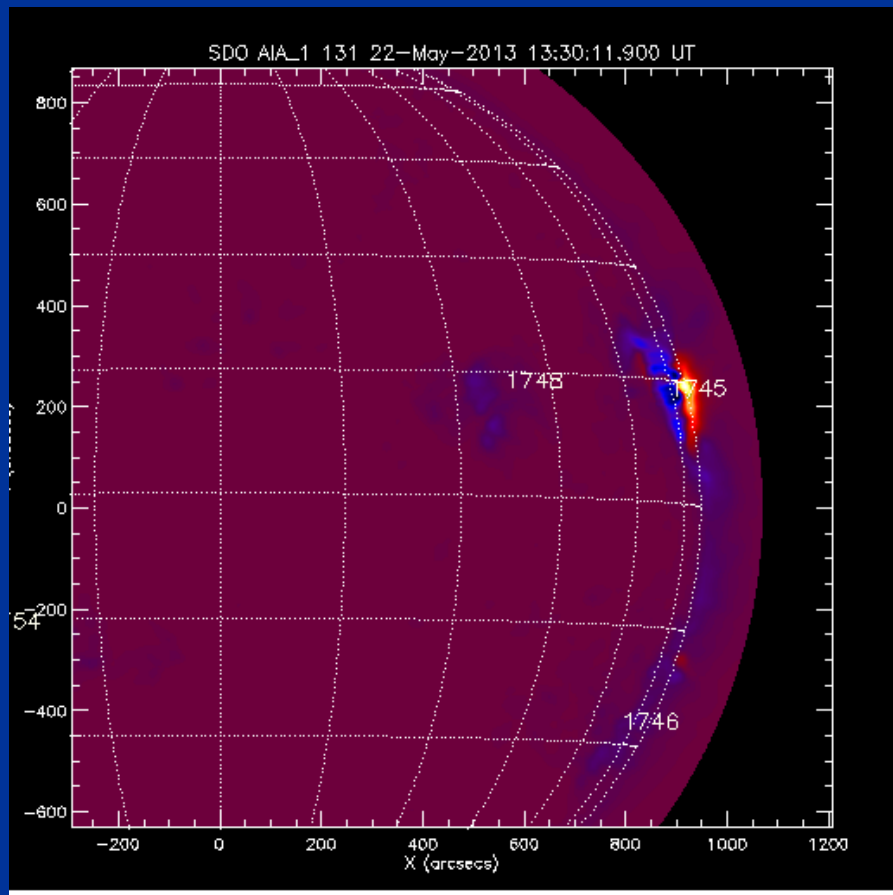


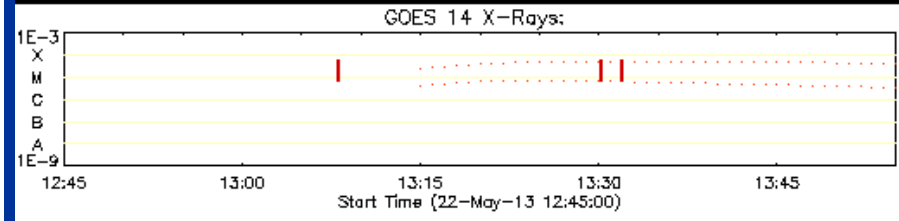
SN:11.04.2013 07:31-08:13 UT (OBT~1760200-1762700s) – **NO QUICKLOOK DATA**

NO SOLAR NEUTRONS ?… No QUICKLOOK Data or Shade…

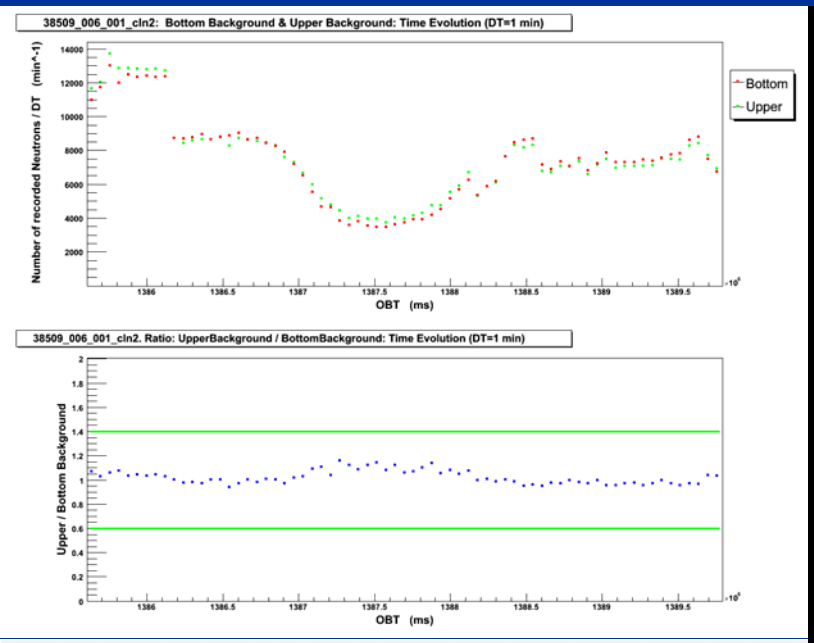
22 May 2013. SF M5.0 13:32 UT
Area 1745, N14W87

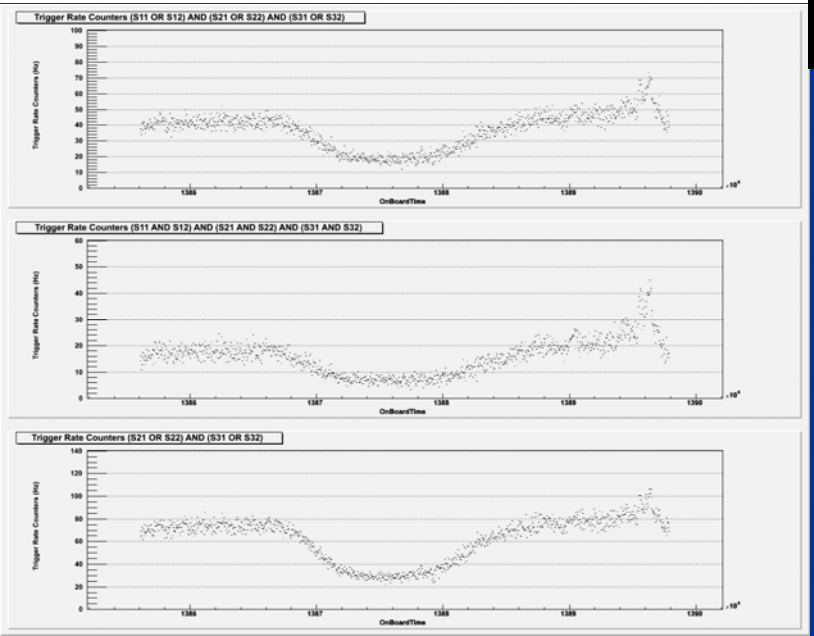


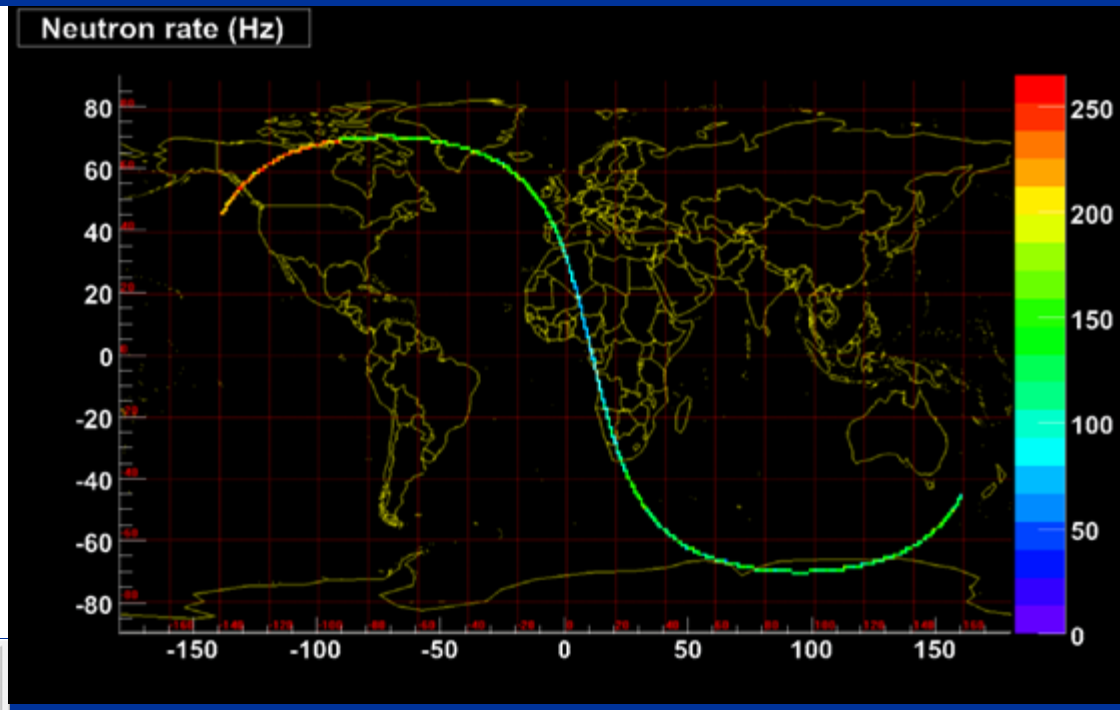




22.05.2013. QUICKLOOK Data





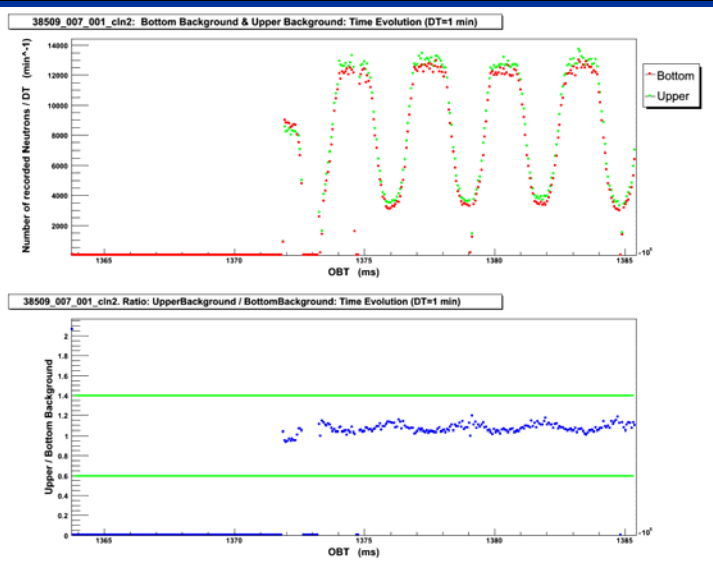


n>p+e+…?

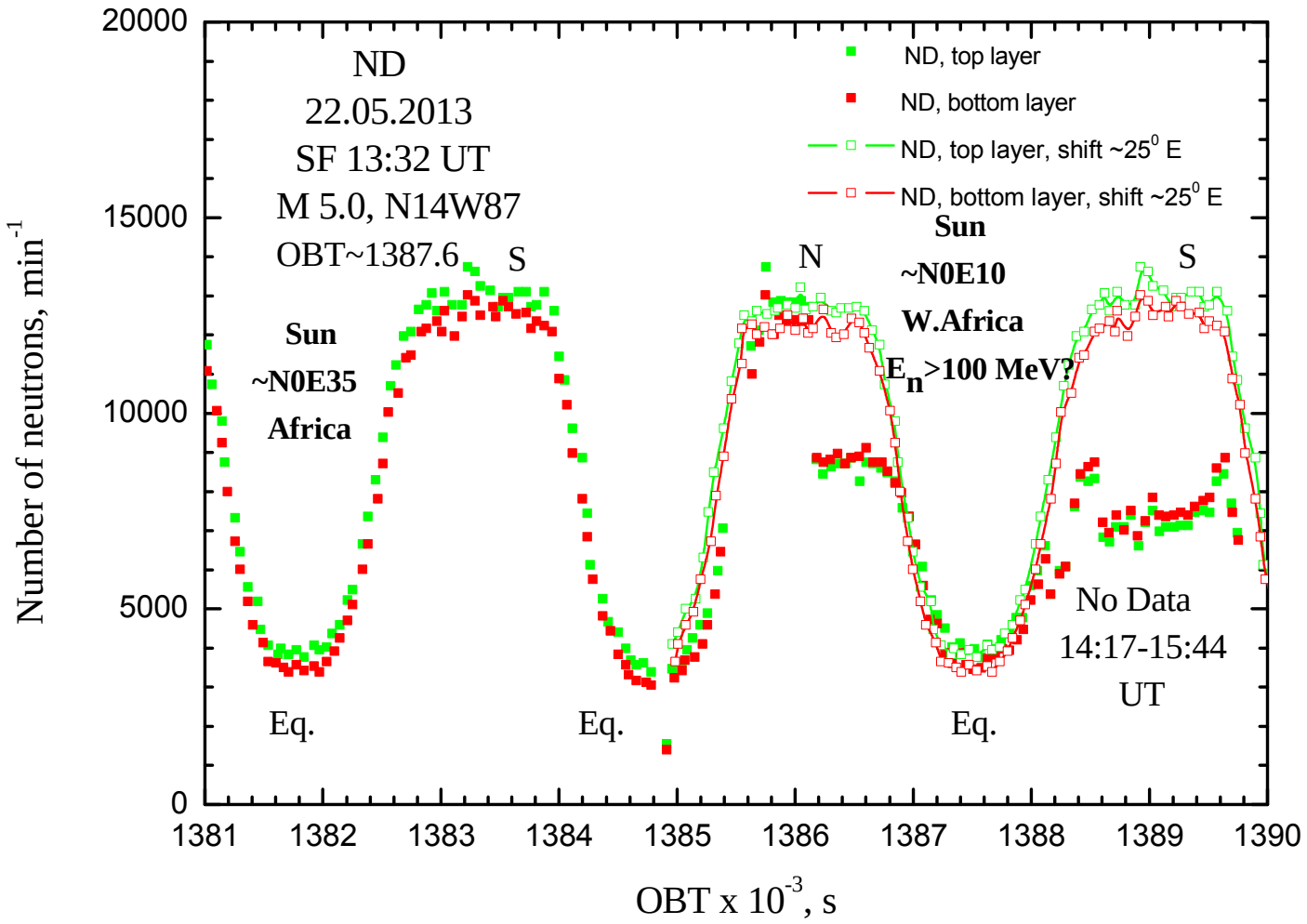
Pre-pulse

Near South

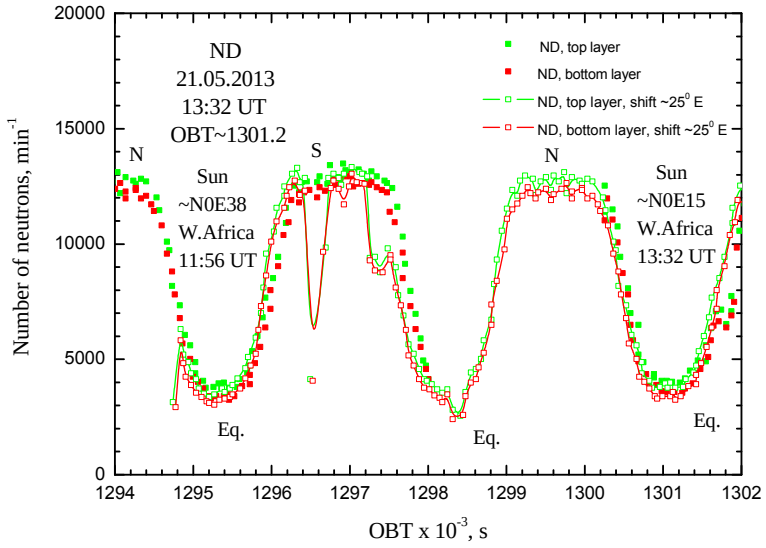
in S1-S3

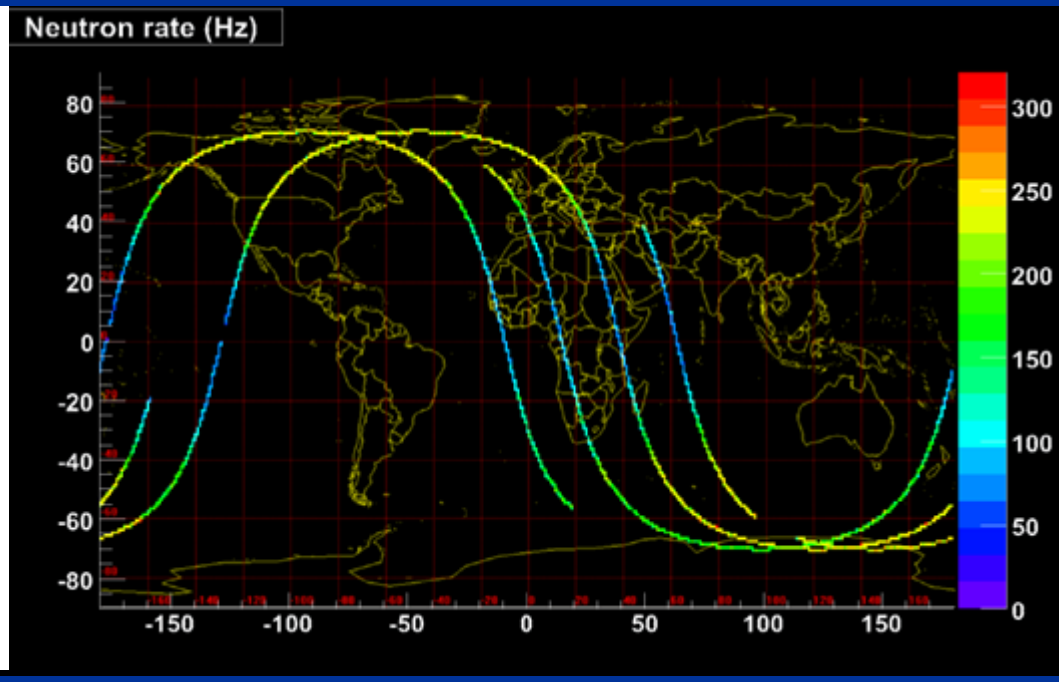


22.05.2013. QUICKLOOK Data Digitization



21.05.2013. QUICKLOOK Data Digitization





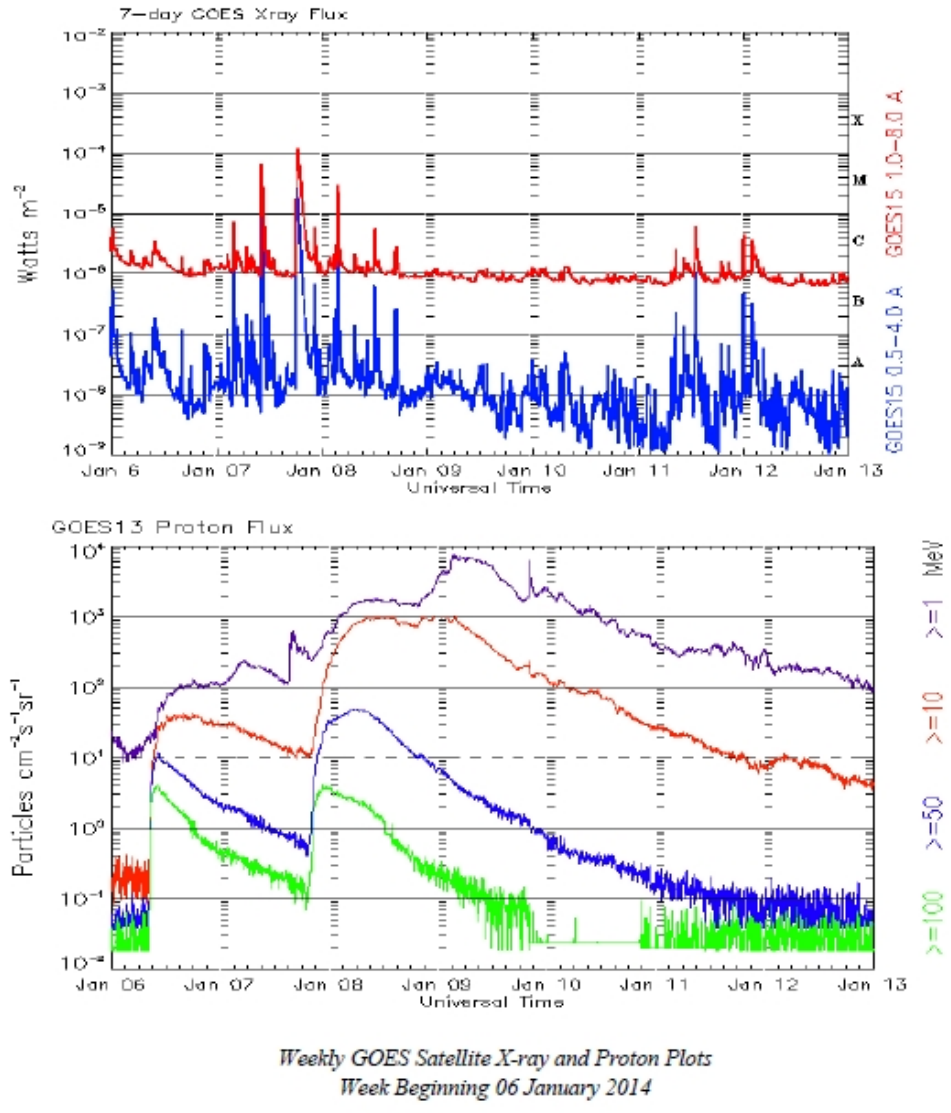
SN:22.05.2013 OBT1387600-1388200 ND(b&t):92820-94113=-1273±432, -**1.35±0.46%**
GM:21.05.2013OBT1301200-1301800 ND(b&t):99963-105890=-5927±454,-5.60**±0.43%**

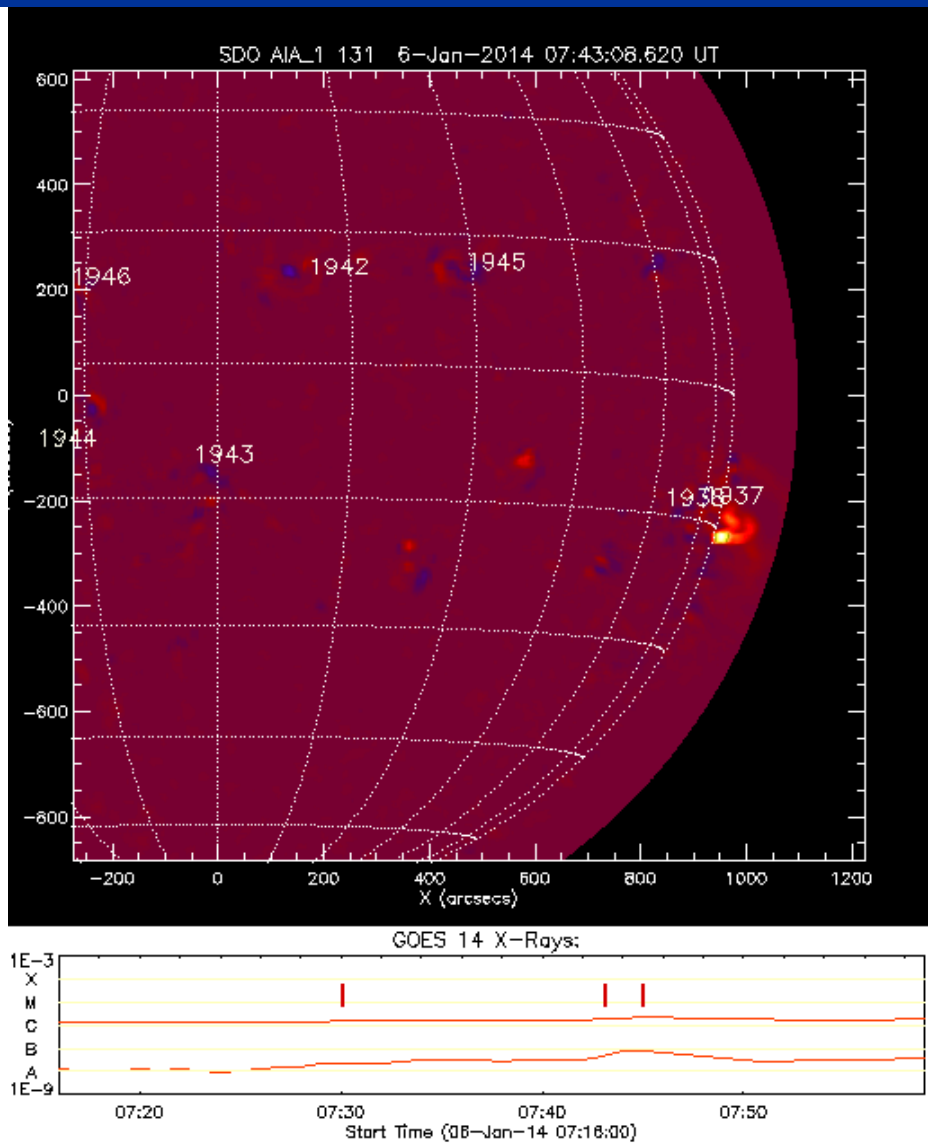
(GM: Cut-off shift ~ 11.5-12.0GV).

Total Effect SN-GM: +4.25±0.63% for 8-18 min after SF, E_n ~> 100 MeV

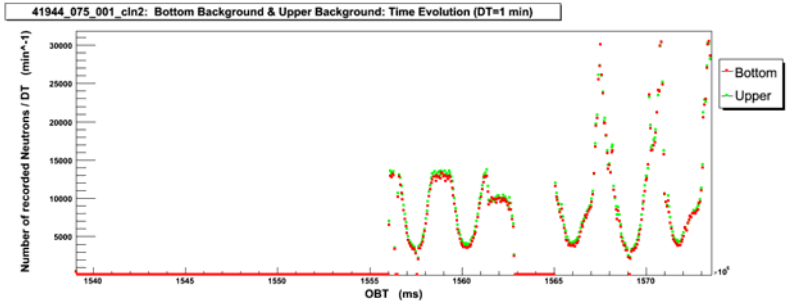
PROBABLY SOLAR NEUTRONS… Near the Earth I_n(>100 MeV)~1800 n/m^{2}s…

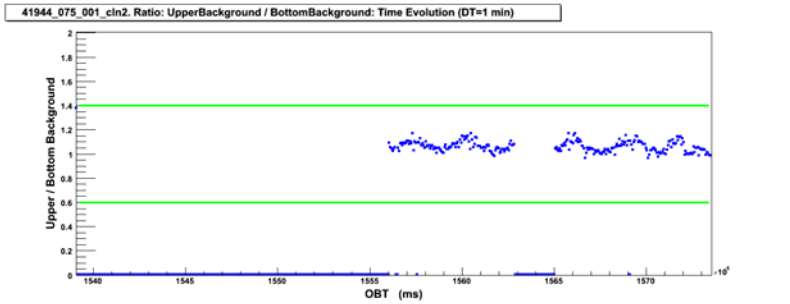
06 January 2014. SF C2.1 07:45 UT
Area 1936, S15W89

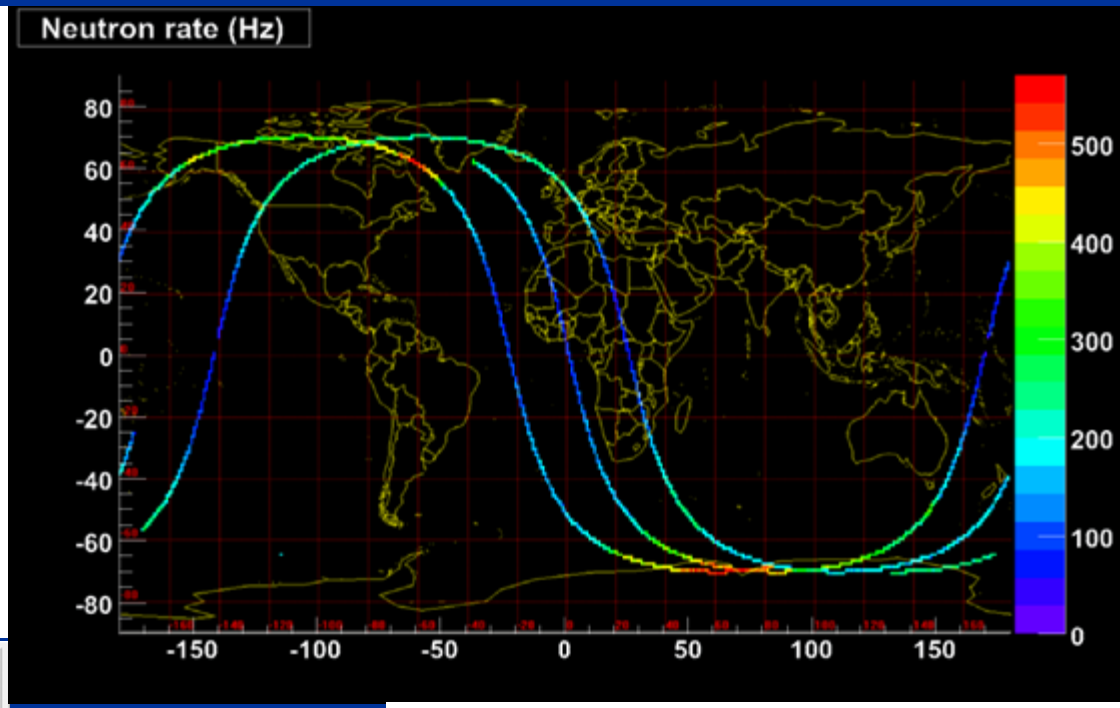


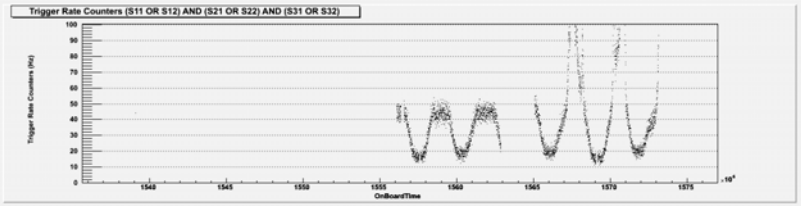


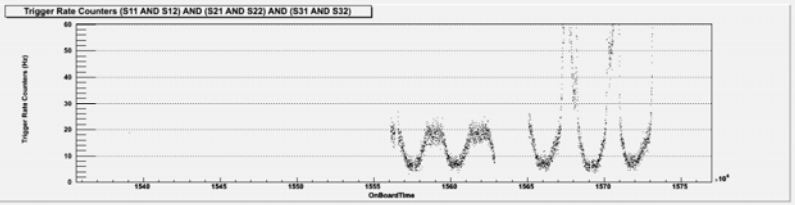
06.01.2014. QUICKLOOK Data

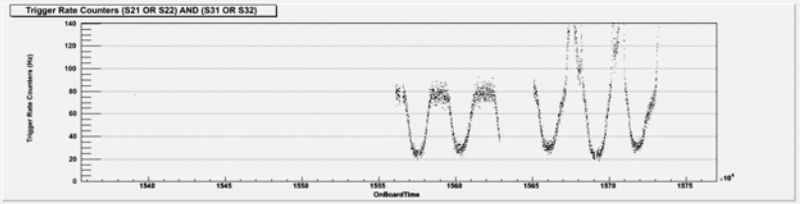










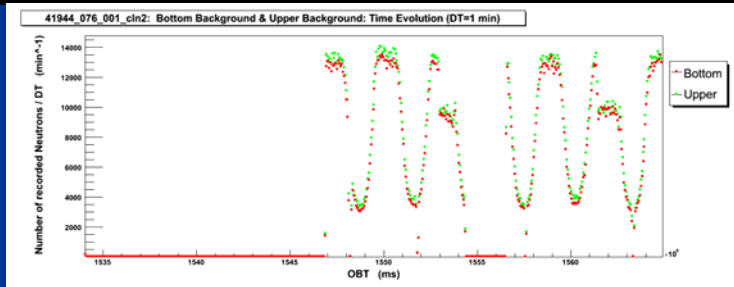


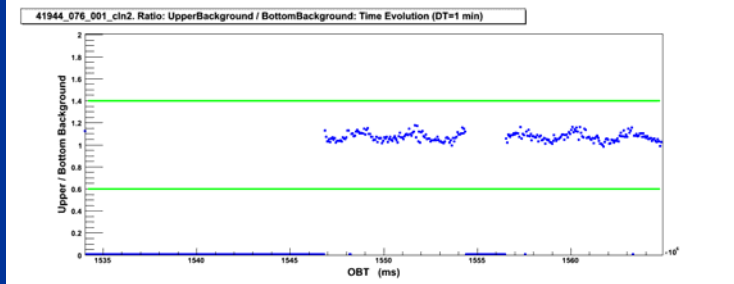
No

Pre-pulse

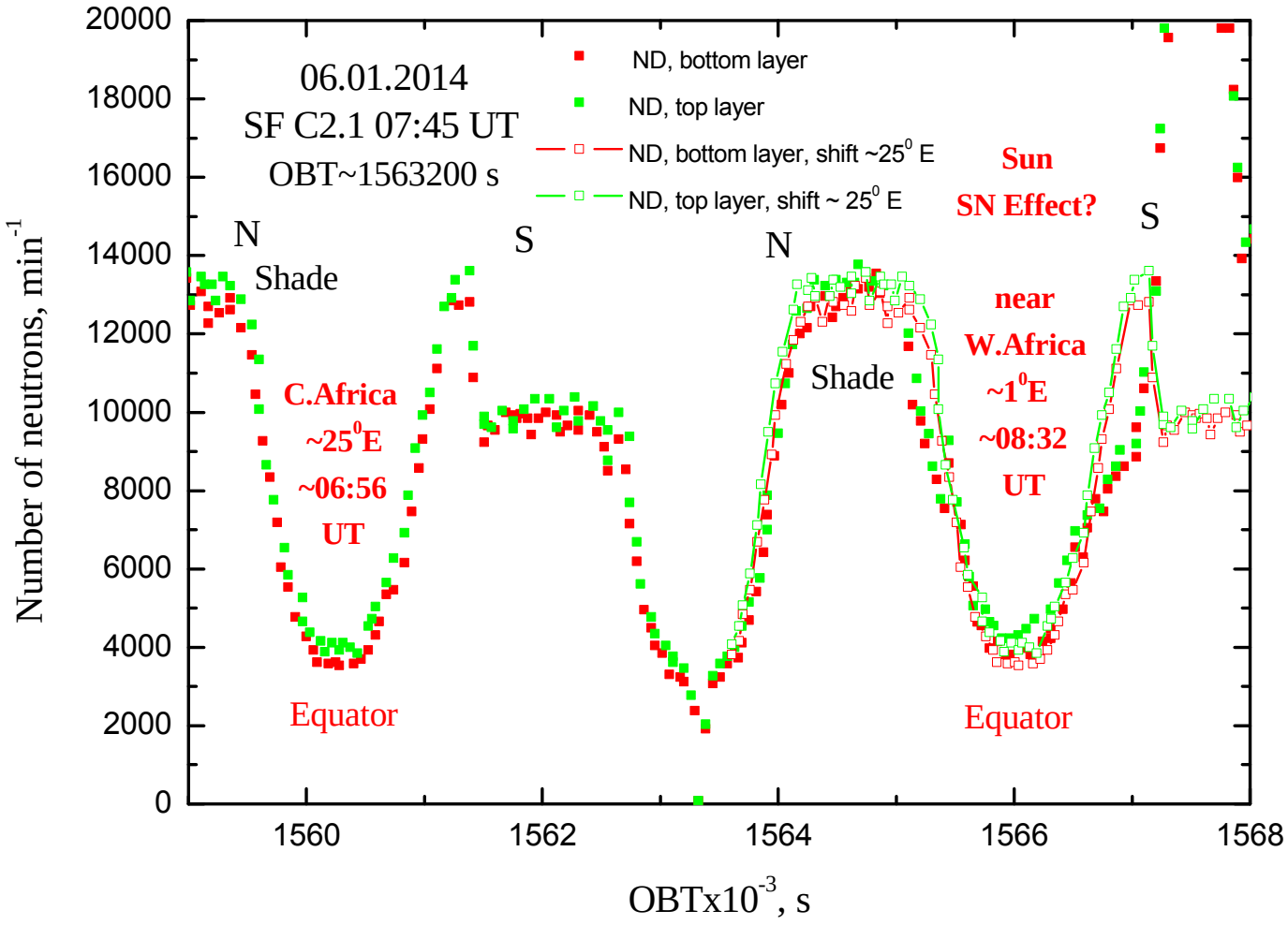
Near South

in S1-S3

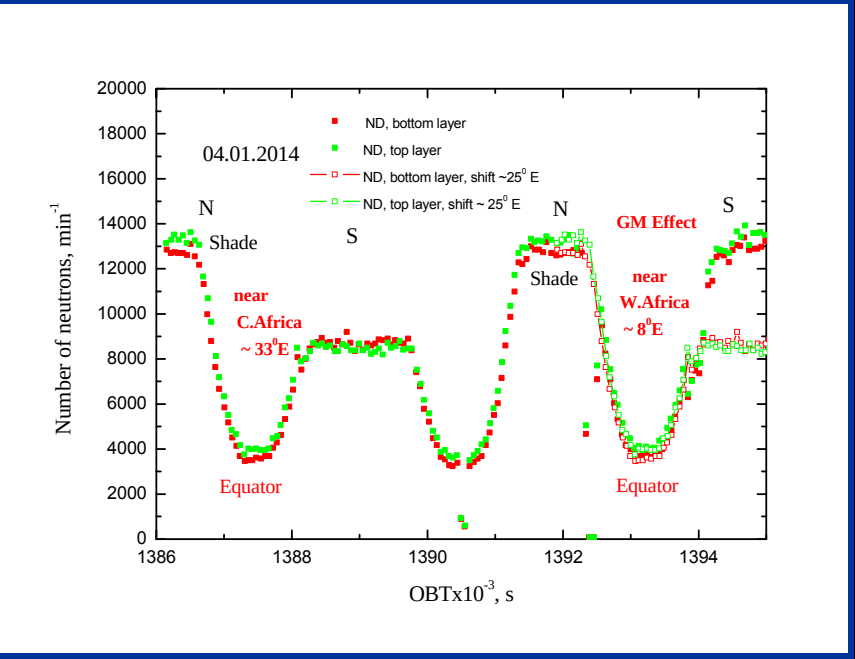


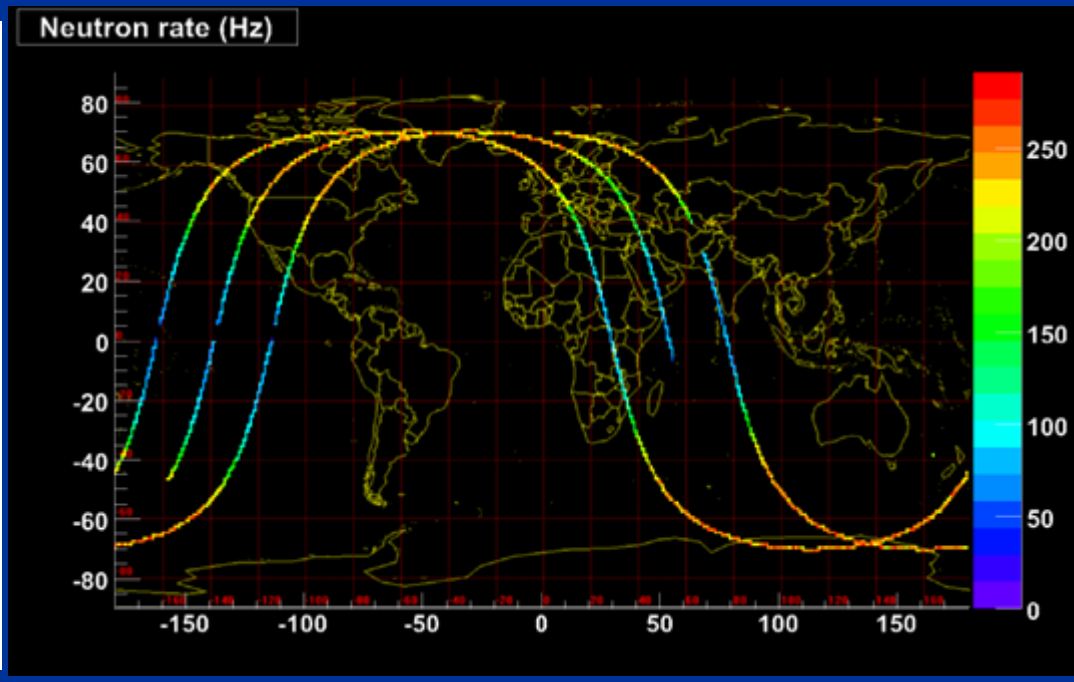


06.01.2014. QUICKLOOK Data Digitization



04.01.2014. QUICKLOOK Data Digitization





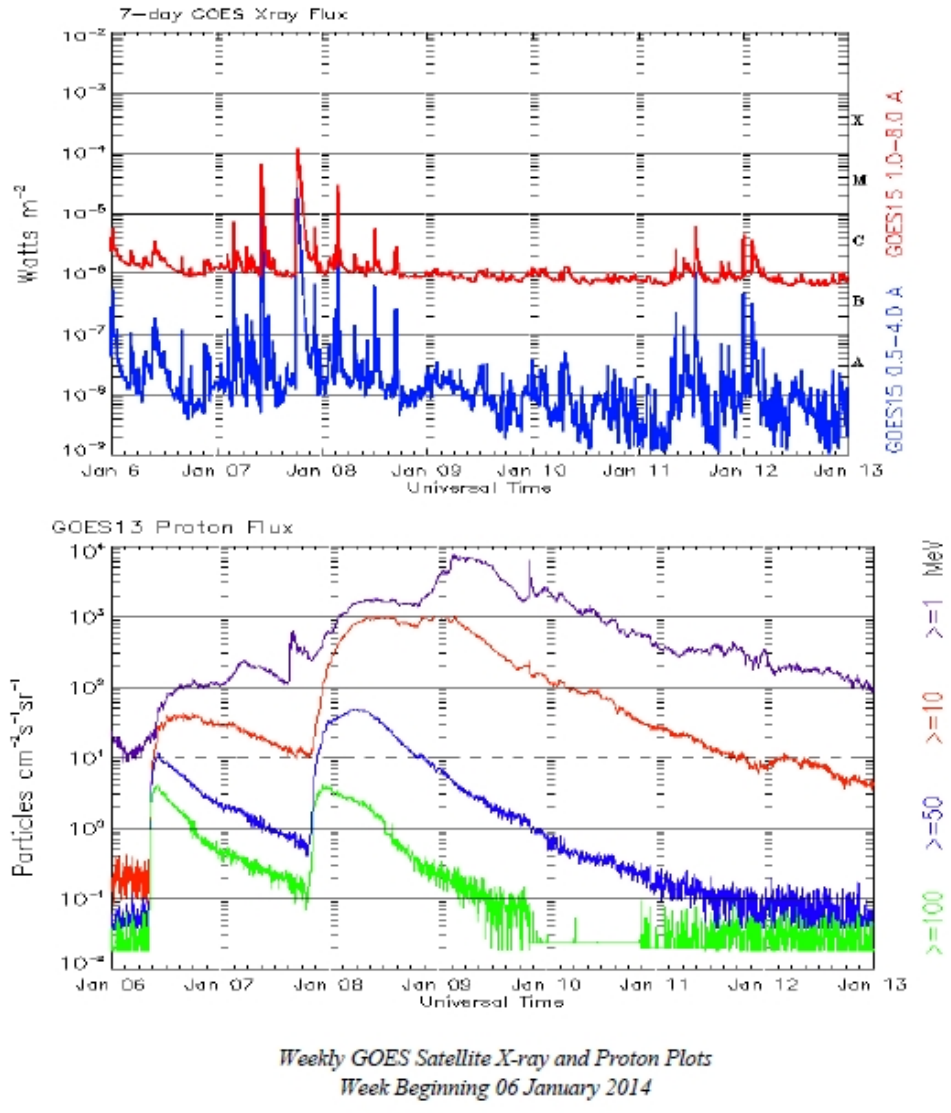
SN:06.01.2014 OBT1565800-1566300 ND(b&t):68039-61885=+6154±360,+9.94±0.58%
GM:04.01.2014OBT1393000-1393400 ND(b&t):63436-60679=+2857±352,+4.72**±0.58%**

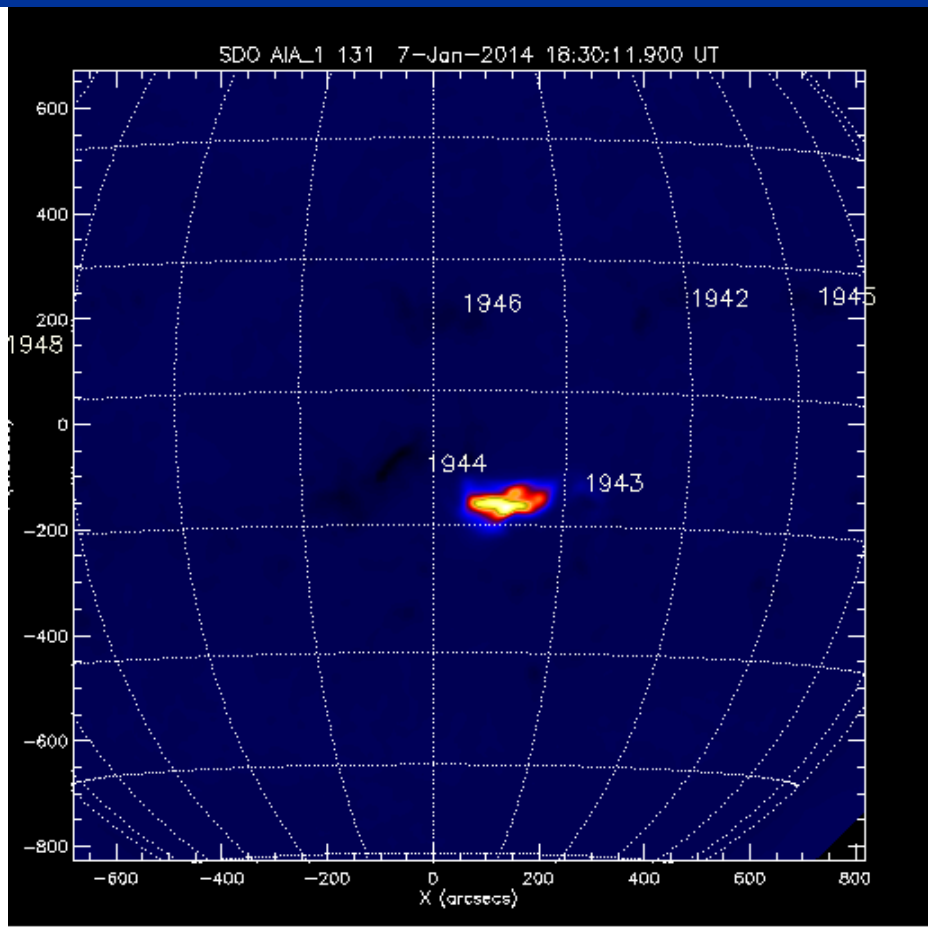
(GM: Cut-off shift ~ 13.3-13.7GV).

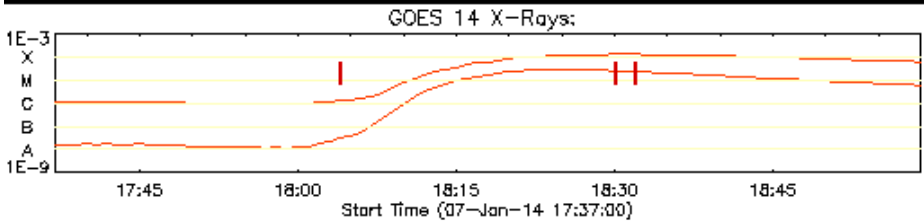
Total Effect SN-GM: +5.23±0.82% for 43-51 min after SF, E_n ~9.3-13.6 MeV

PROBABLY SOLAR NEUTRONS… Near the Earth I_n(9-14 MeV)~1500 n/m^{2}s…

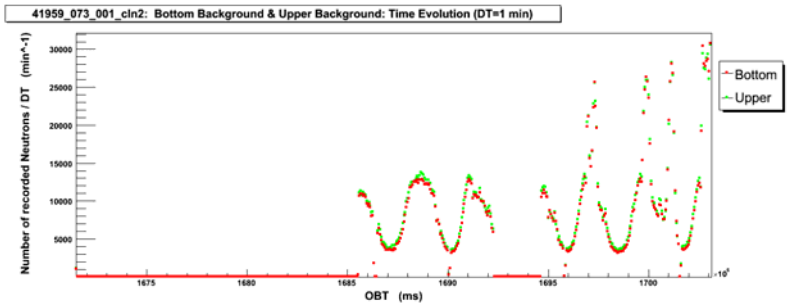
07 January 2014. SF X1.2 18:32 UT
Area 1944, S12W08

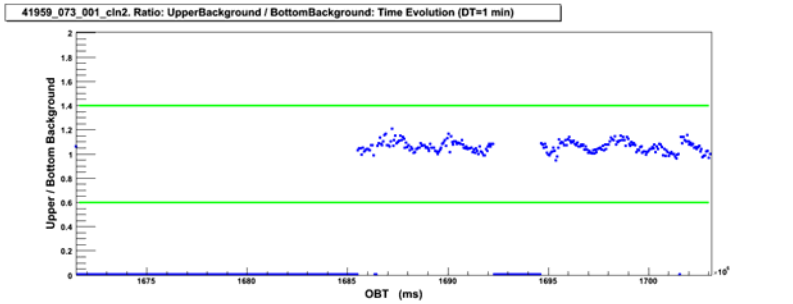


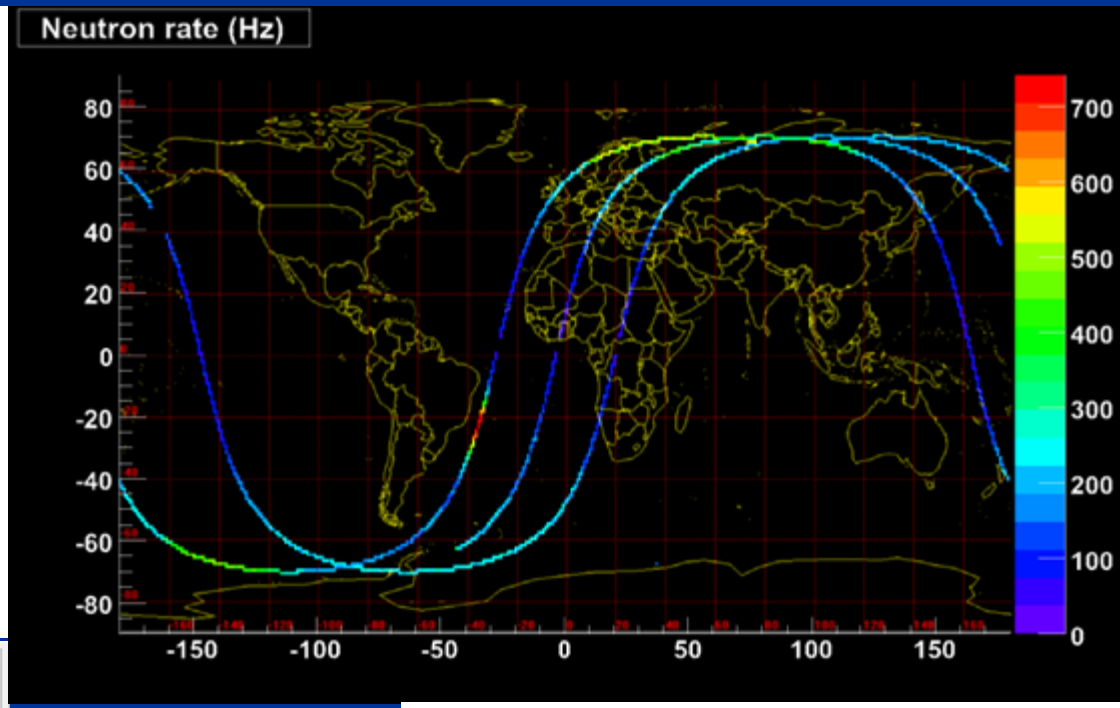


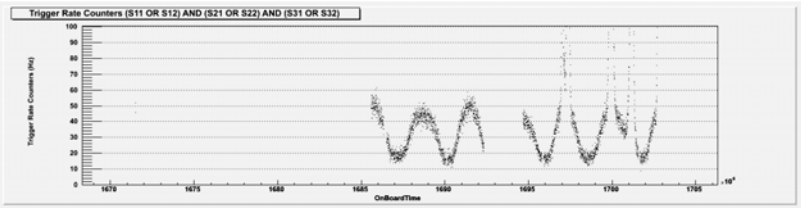


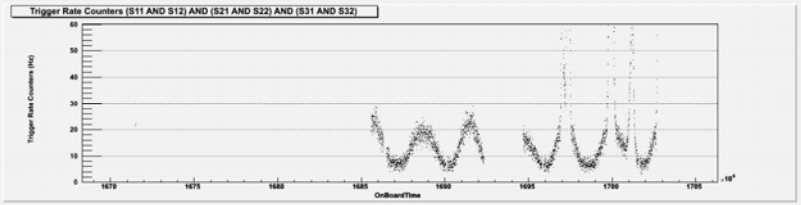
07.01.2014. QUICKLOOK Data

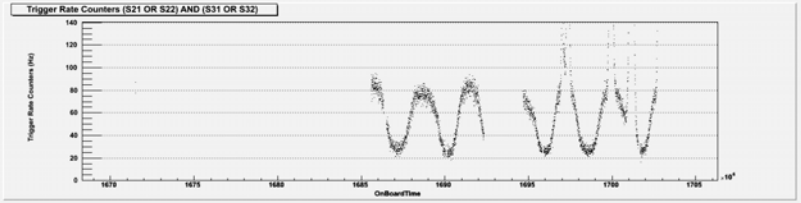










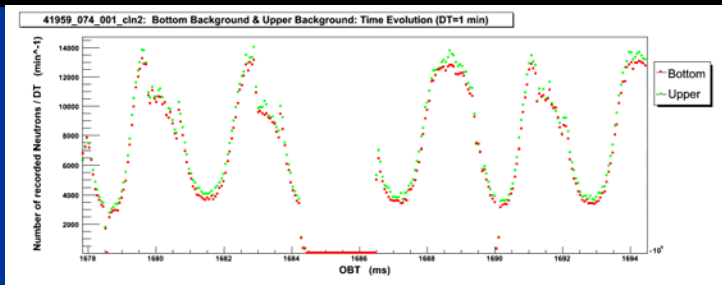


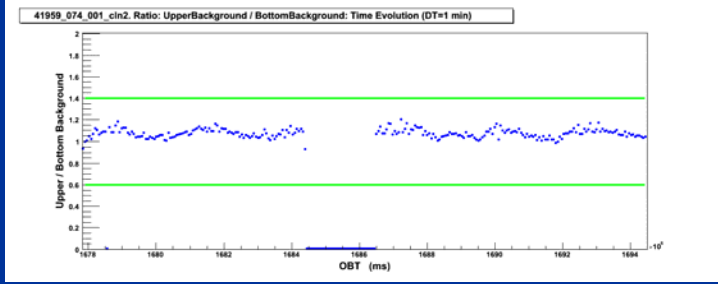
n>p+e+…?

Pre-pulse

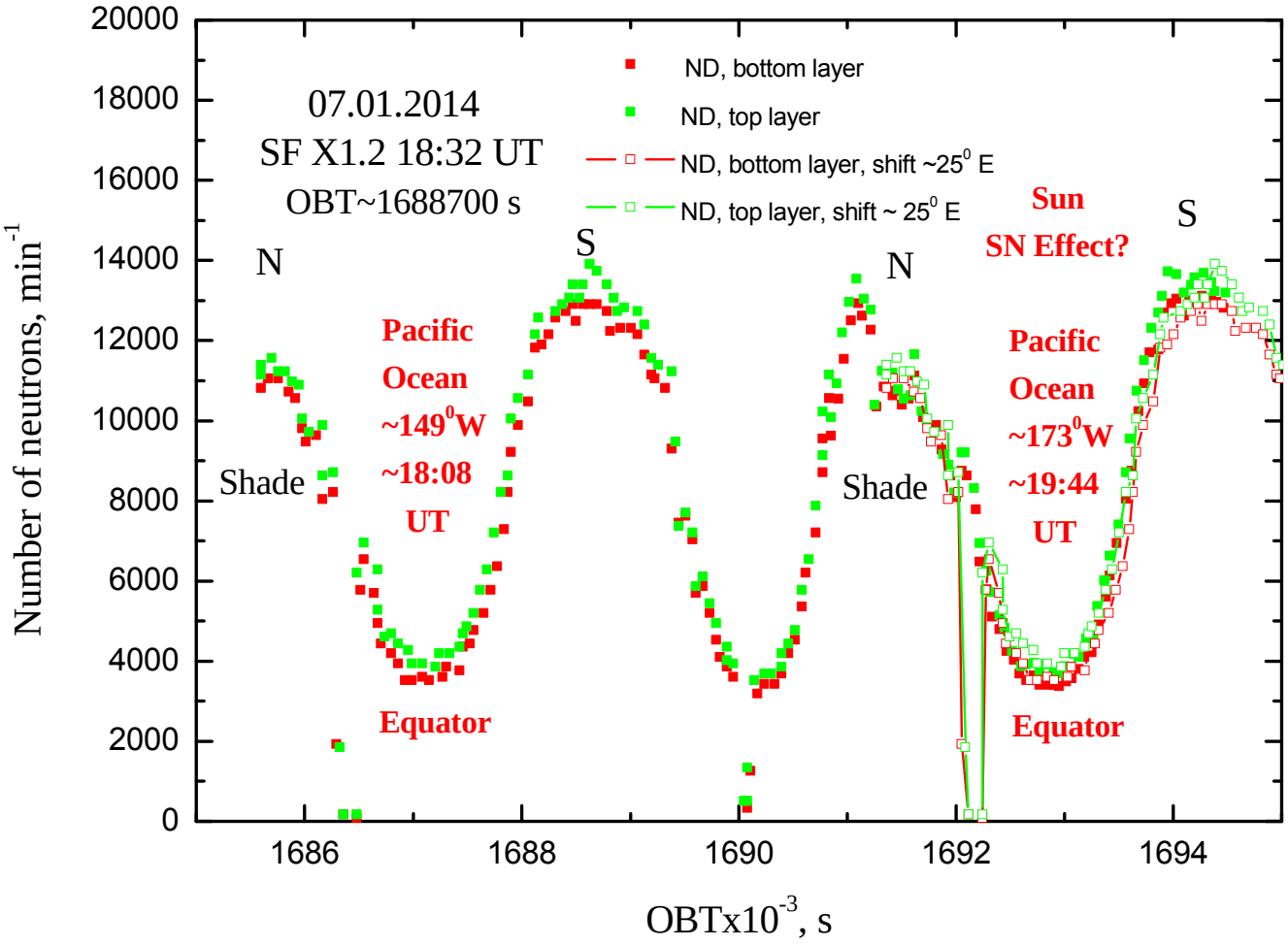
Near North

in S1-S3

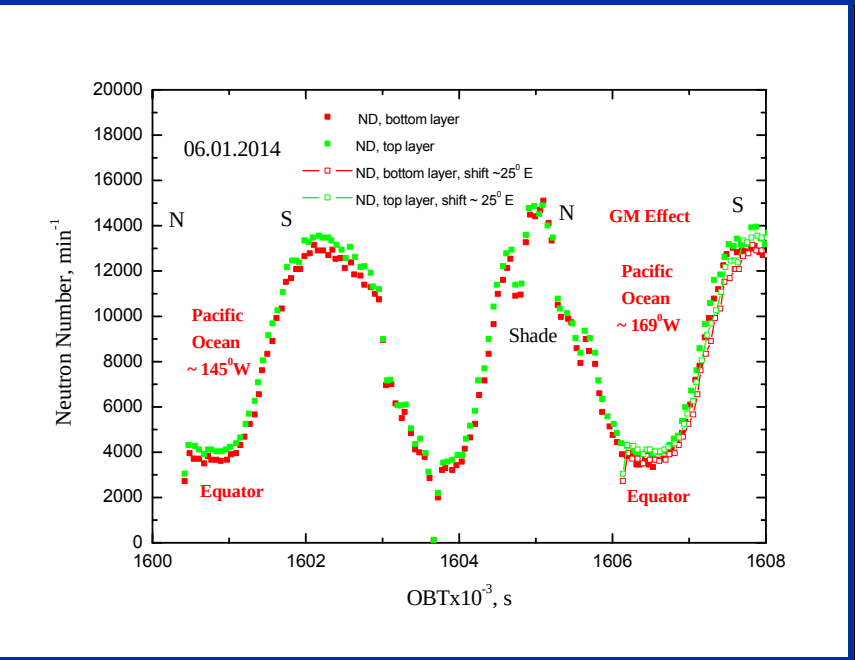


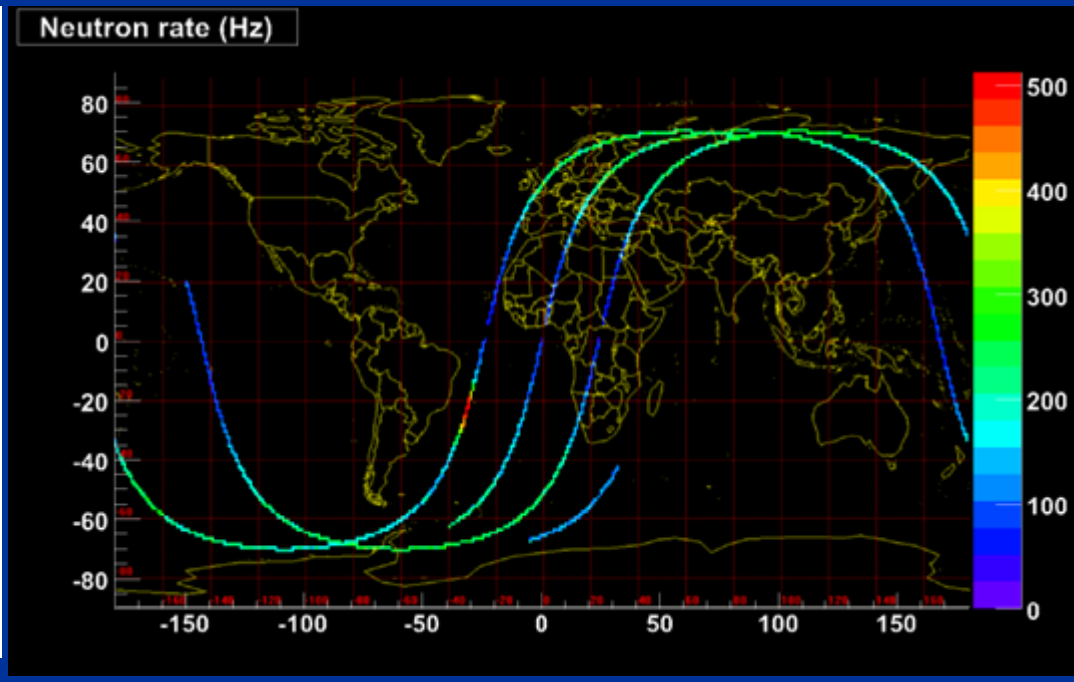


07.01.2014. QUICKLOOK Data Digitization



06.01.2014. QUICKLOOK Data Digitization





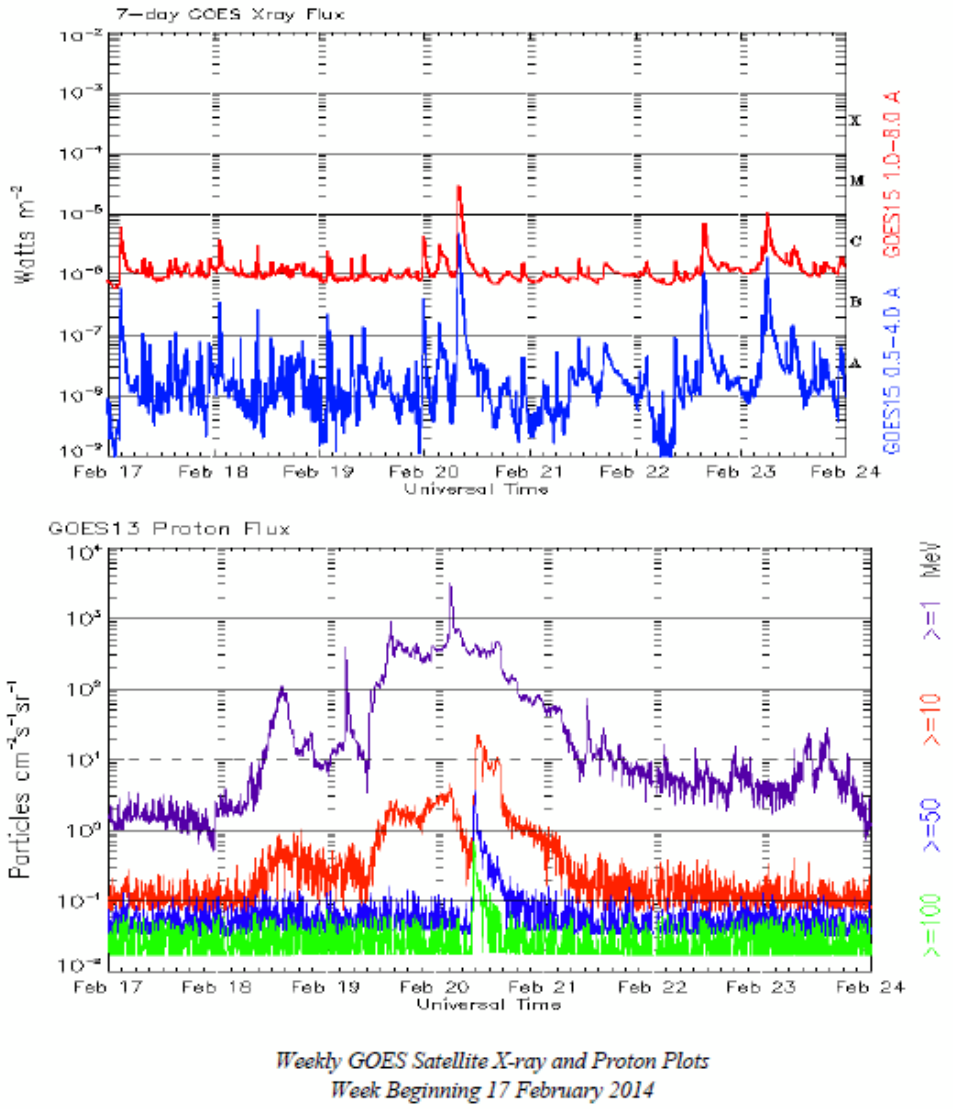
SN:07.01.2014 OBT1692650-1693050 ND(b&t):58494-62514=-4020±348,-6.43±0.56%
GM:06.01.2014OBT1606250-1606650 ND(b&t):60314-62023=-1709±350,-2.76**±0.56%**

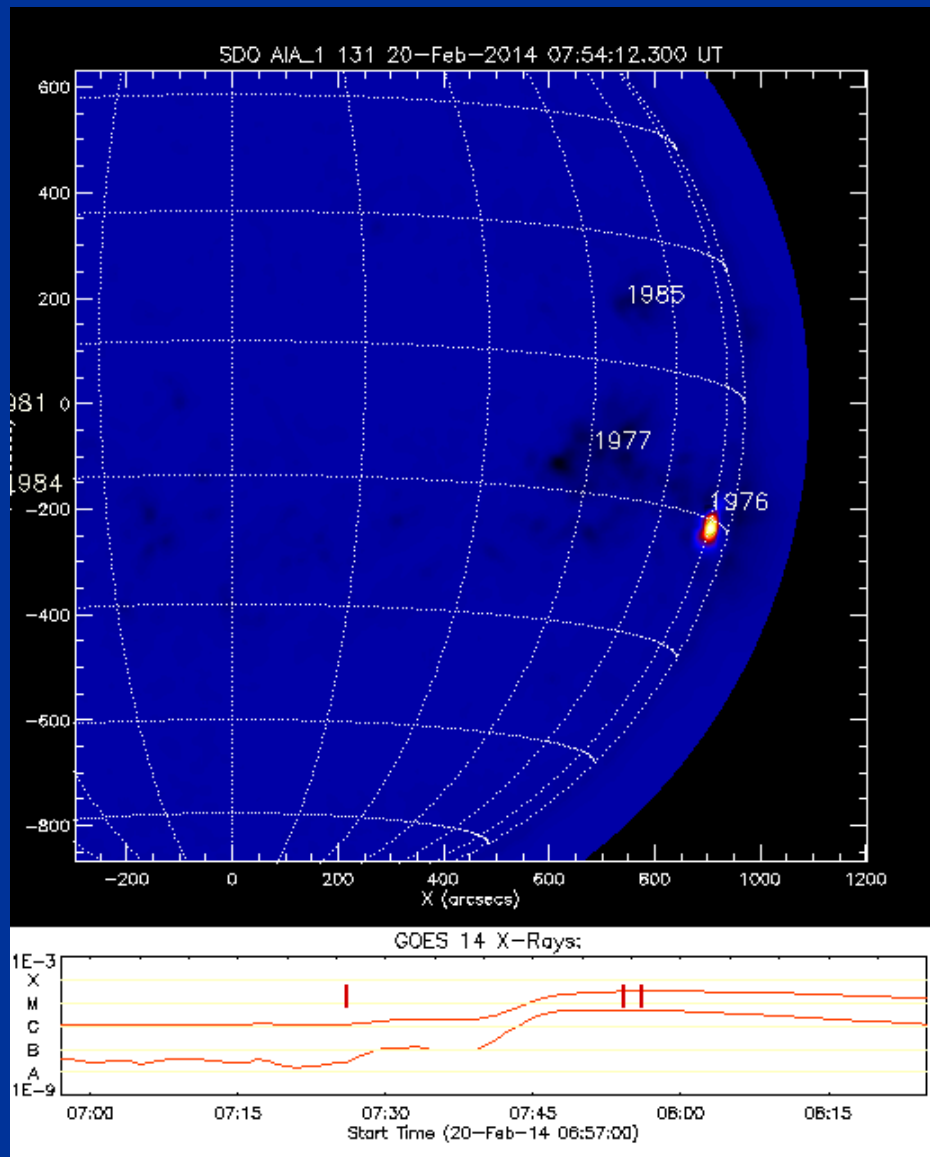
(GM: Cut-off shift ~ 13.1-12.6GV).

Total Effect SN-GM: -3.68±0.82% for 66-73 min after SF, E_n ~5.1-6.0 MeV

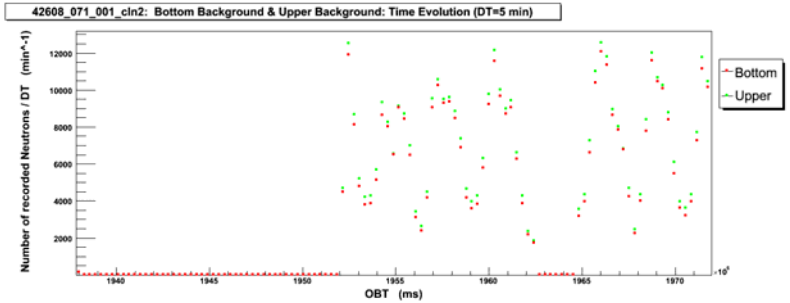
NO SOLAR NEUTRONS?… Effect of background after SF 06 January 2014?…

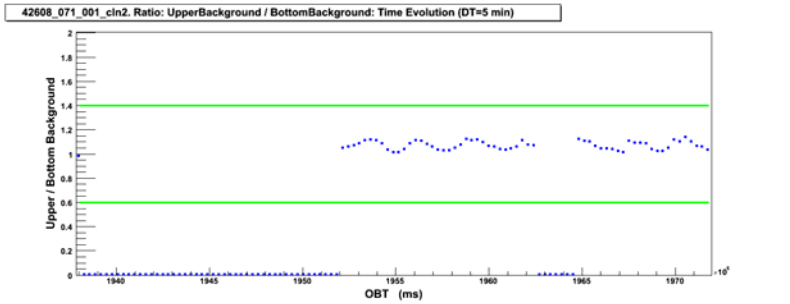
20 February 2014. SF M3.0 07:56 UT
Area 1976, S15W75

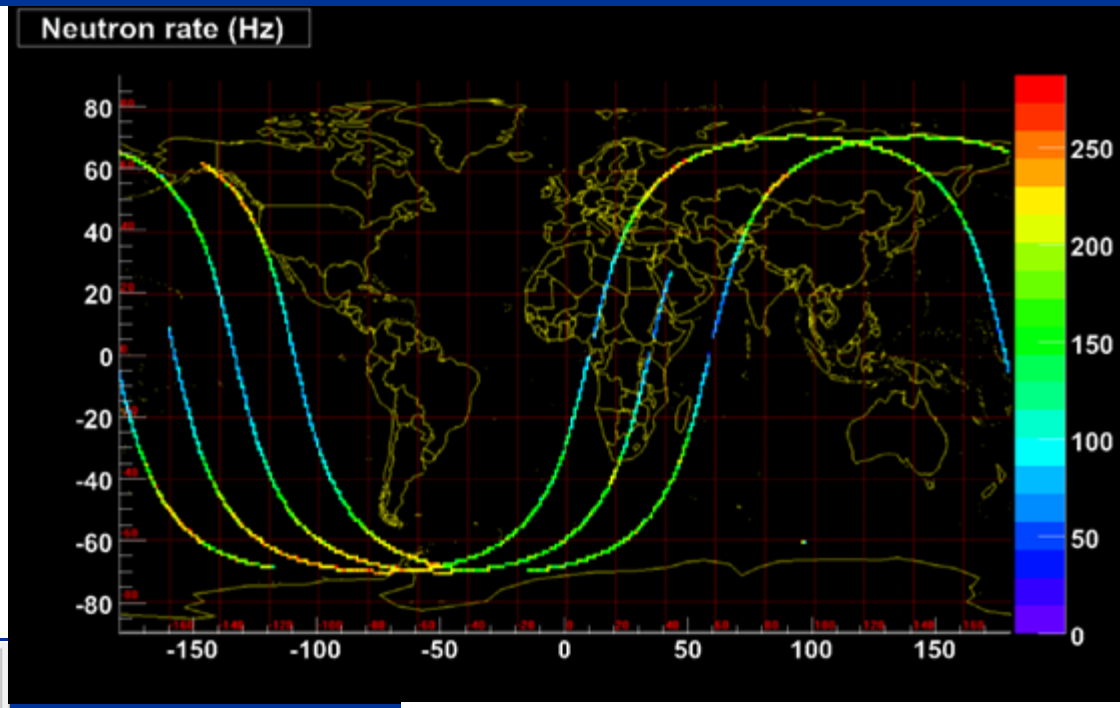


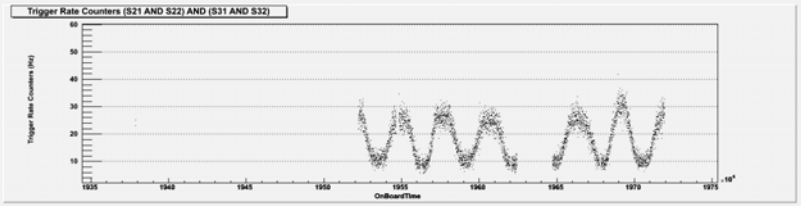


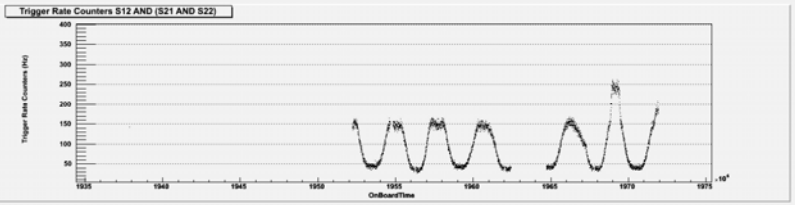
20.02.2014. QUICKLOOK Data

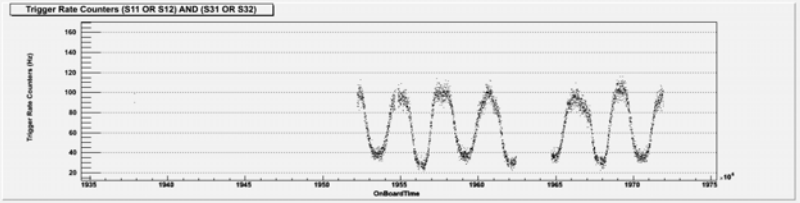










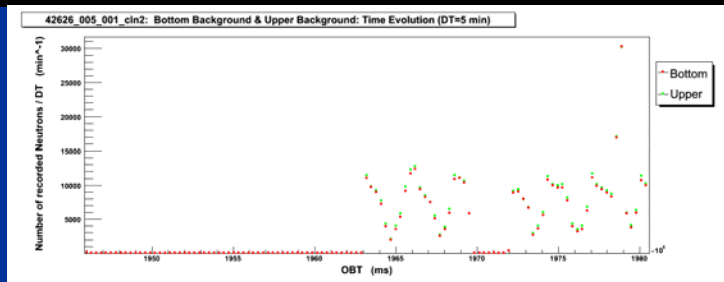


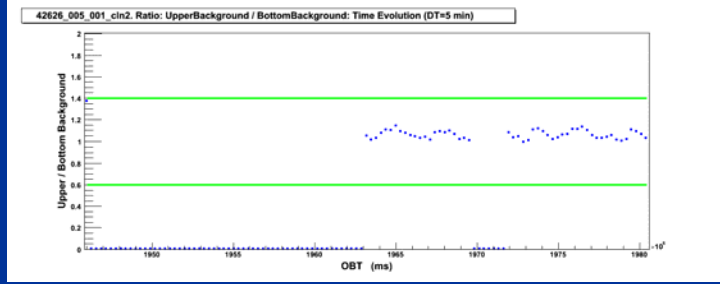
No

Pre-pulse

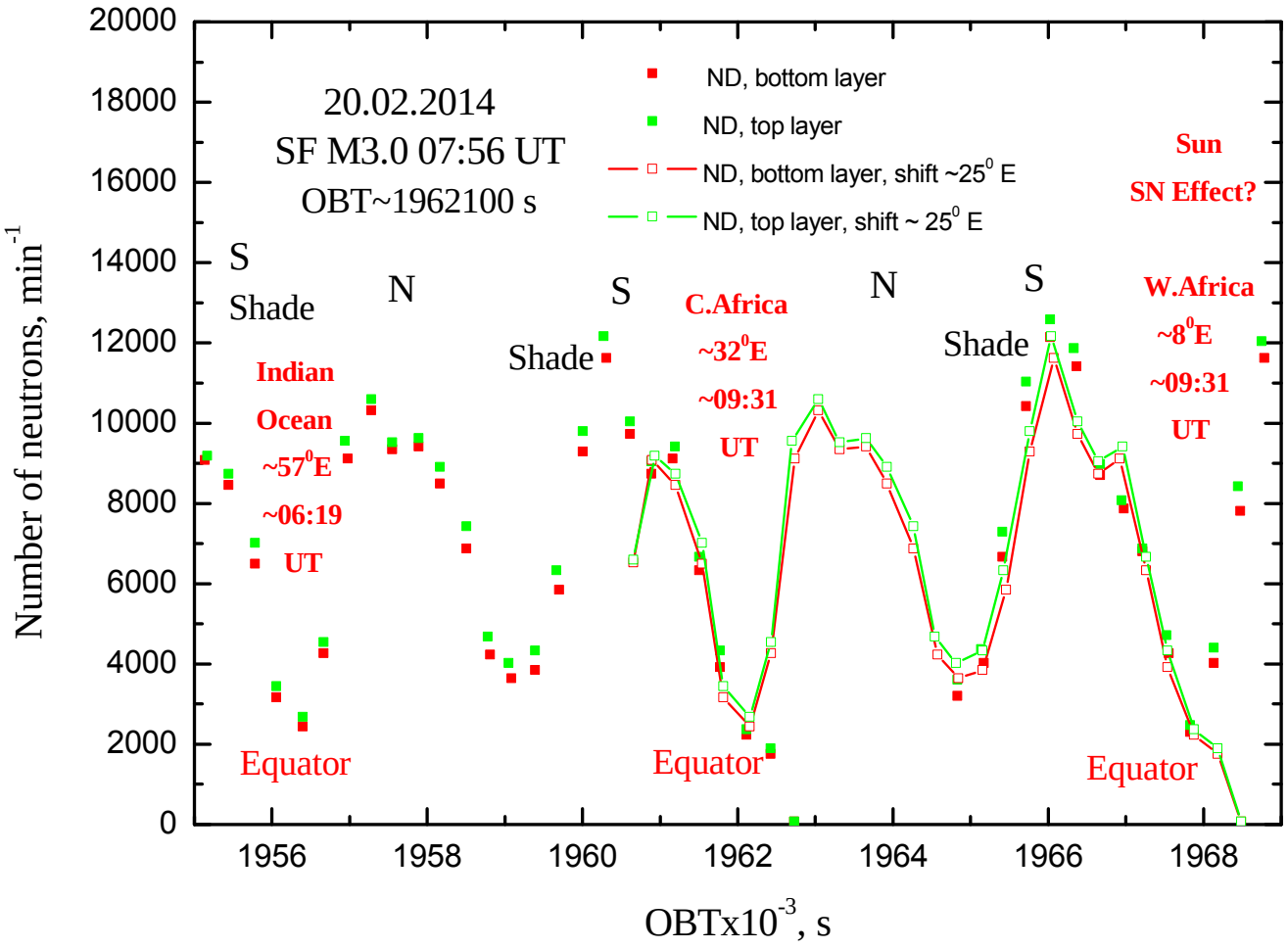
Near North

in S1-S3

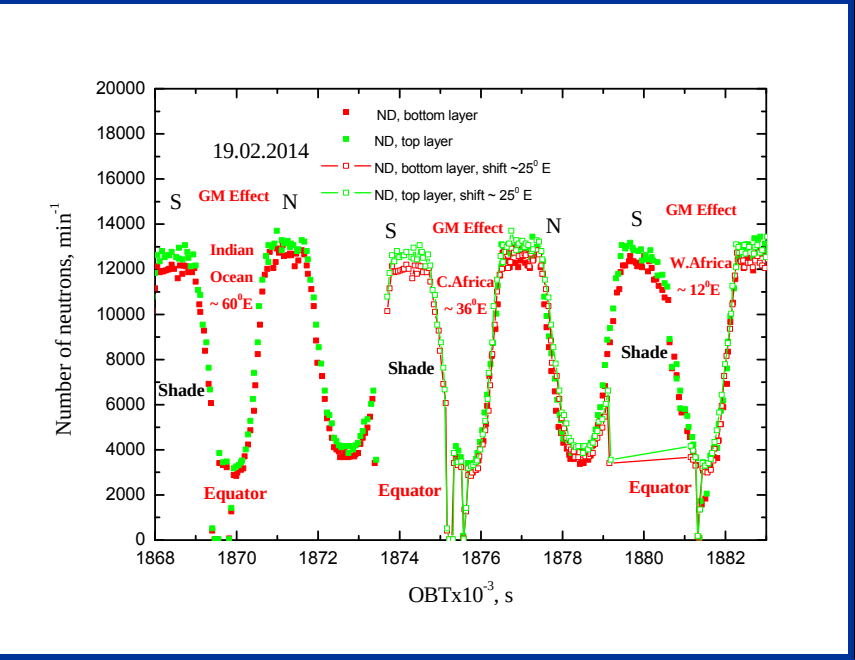


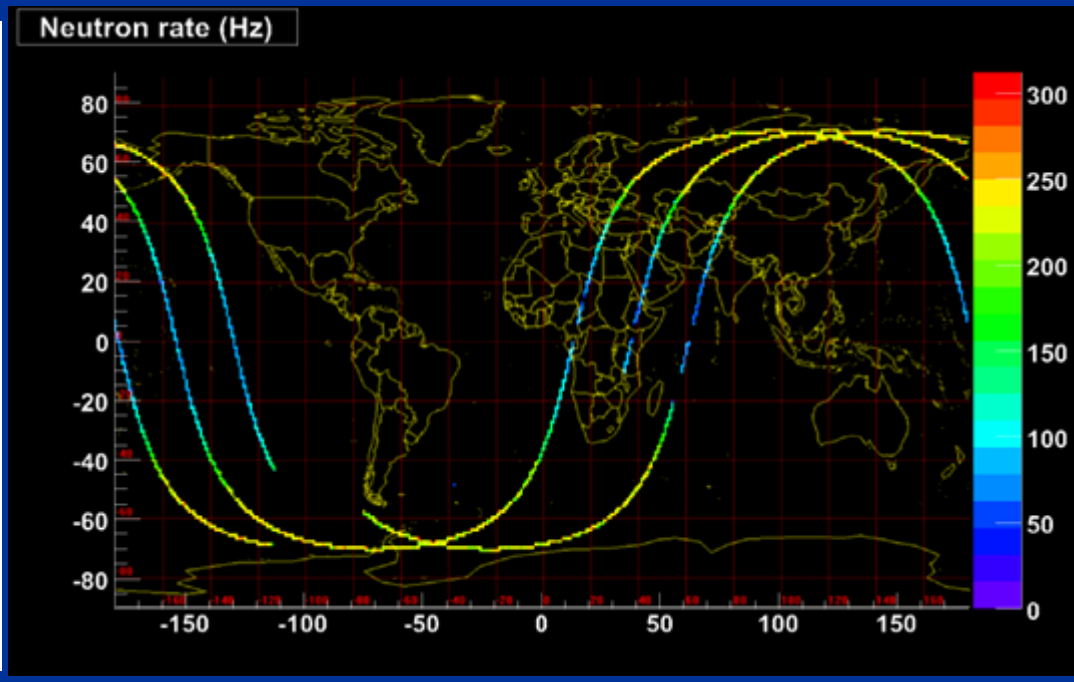


20.02.2014. QUICKLOOK Data Digitization



19.02.2014. QUICKLOOK Data Digitization





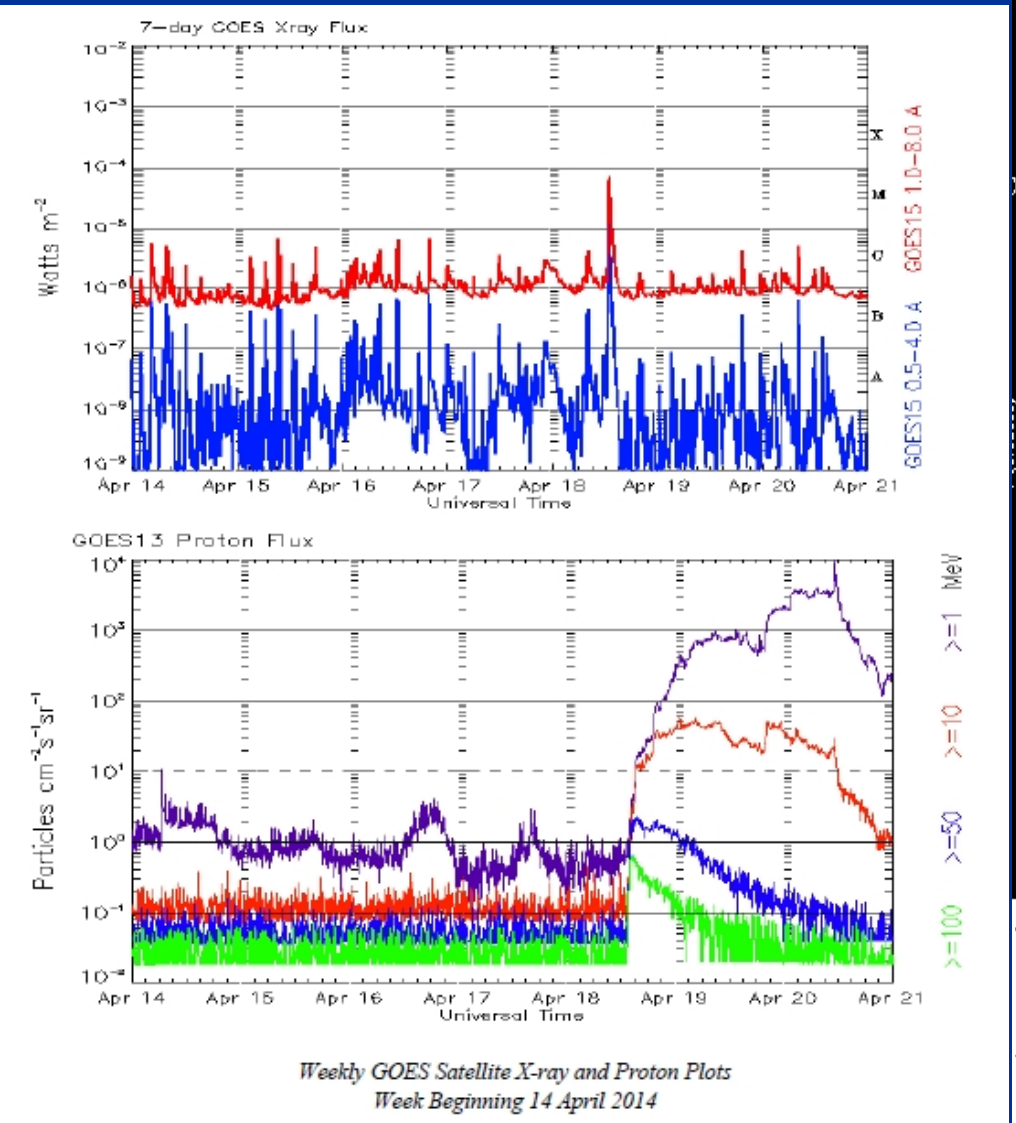
SN:20.02.2014 OBT1967550-1968150 ND(b&t):22177-21112=+1065±208,+5.05±0.99%
GM:19.02.2014OBT1881200-1881800 ND(b&t):50386-47876=+2510±313,+5.24±0.65%

(GM: Cut-off shift ~ 12.8-13.4GV).

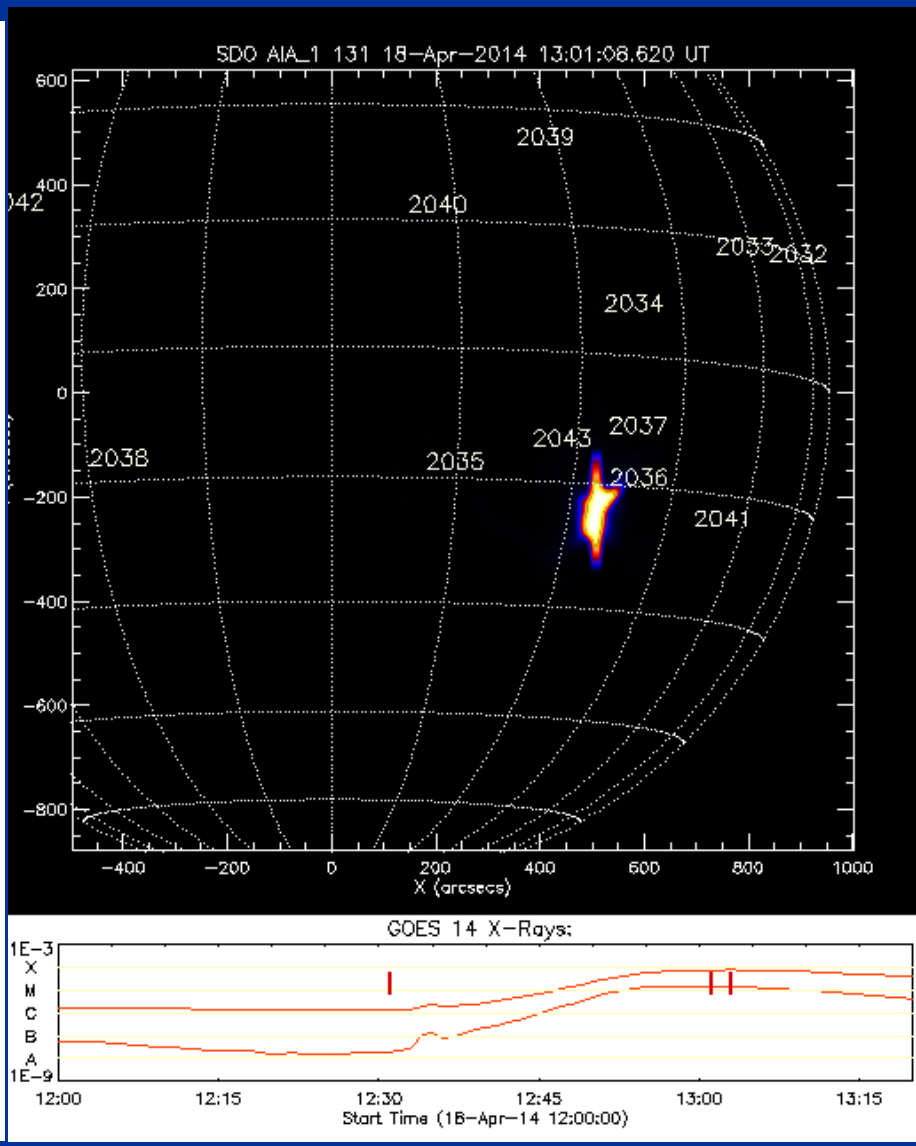
Total Effect SN-GM: -0.20±1.18% for 91-101 min after SF, E_n ~3.0-3.5 MeV

NO SOLAR NEUTRONS…

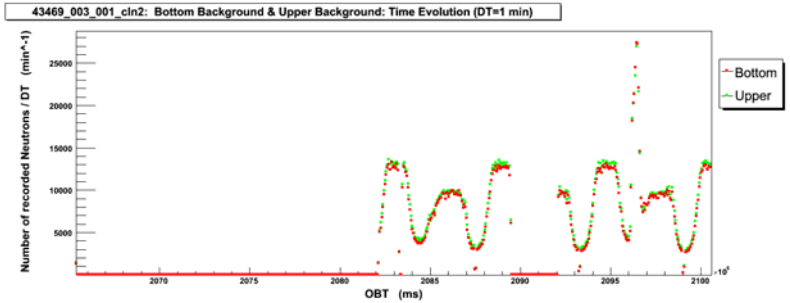
18 April 2014. SF M7.3 13:03 UT
Area 2056, S20W34

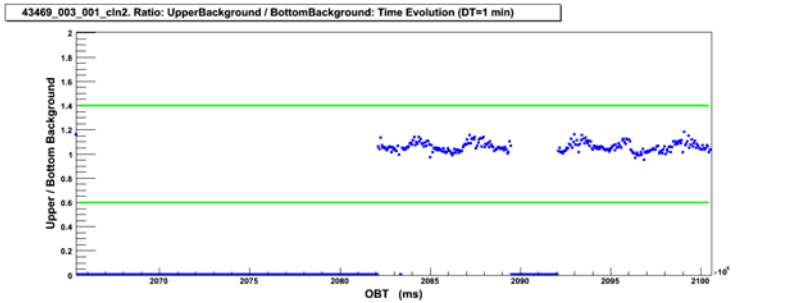


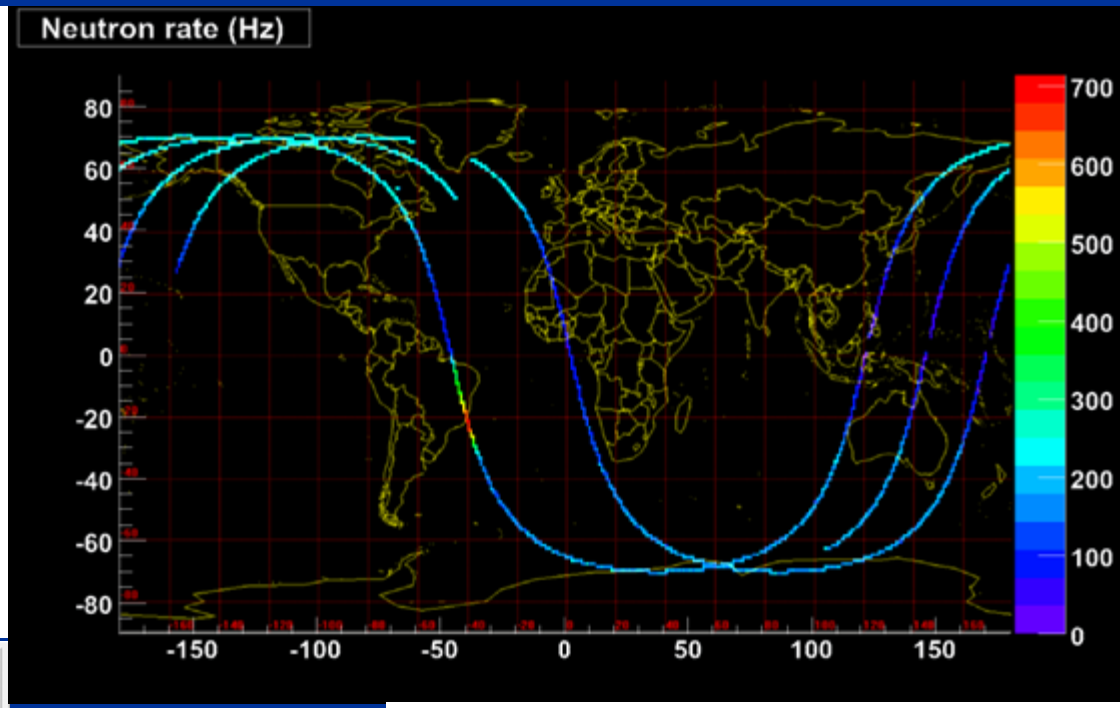
Weekly GOES Satellite X-ray and Proton Plots
Week Beginning 14 April 2014

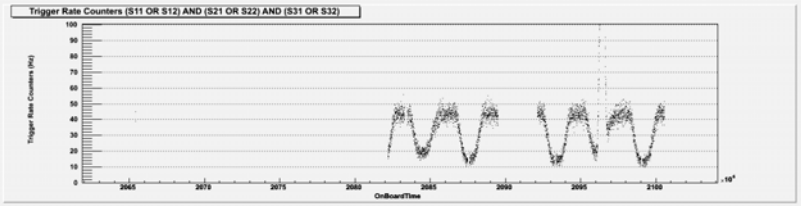


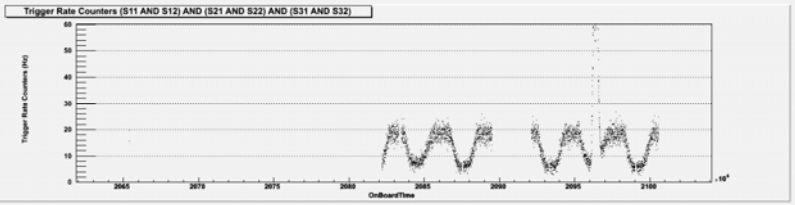
18.04.2014. QUICKLOOK Data

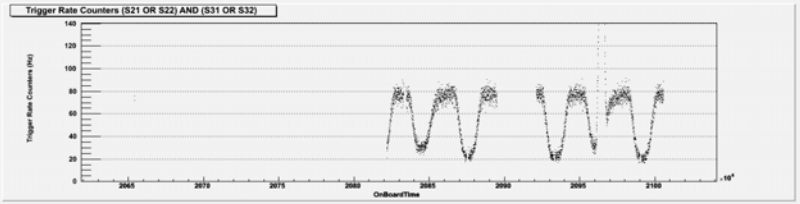










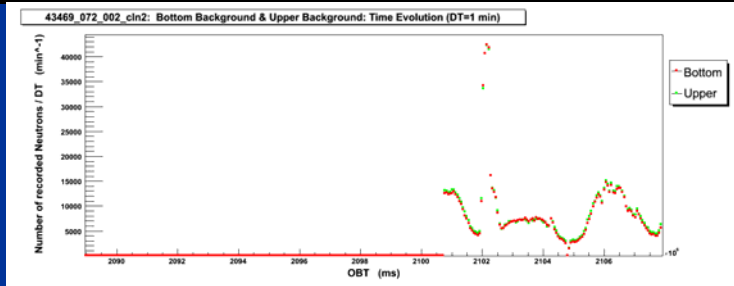


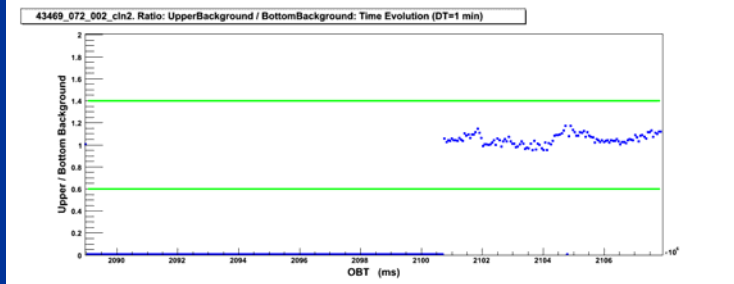
n>p+e+…?

Pre-pulse

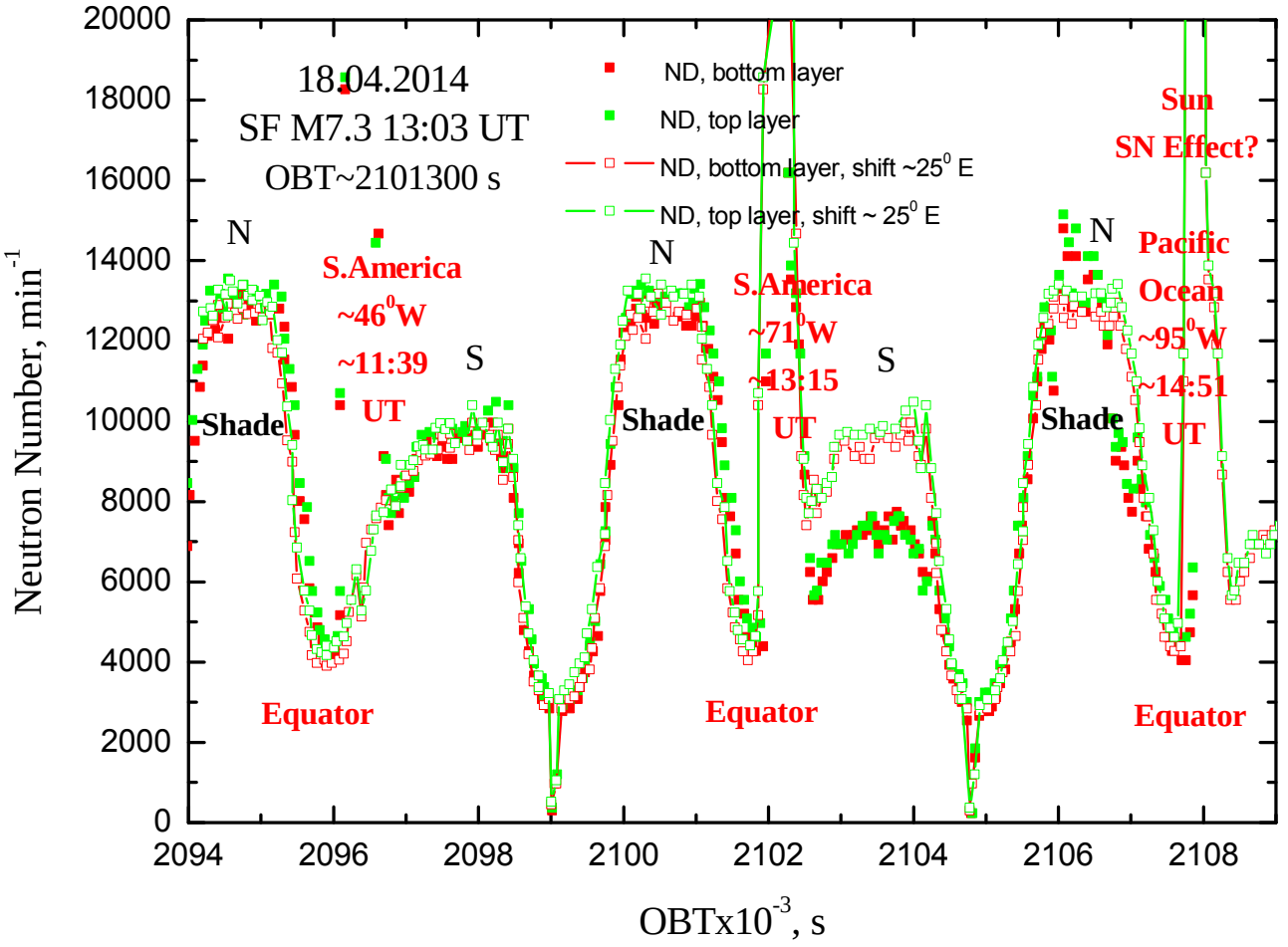
Near North

in S1-S3

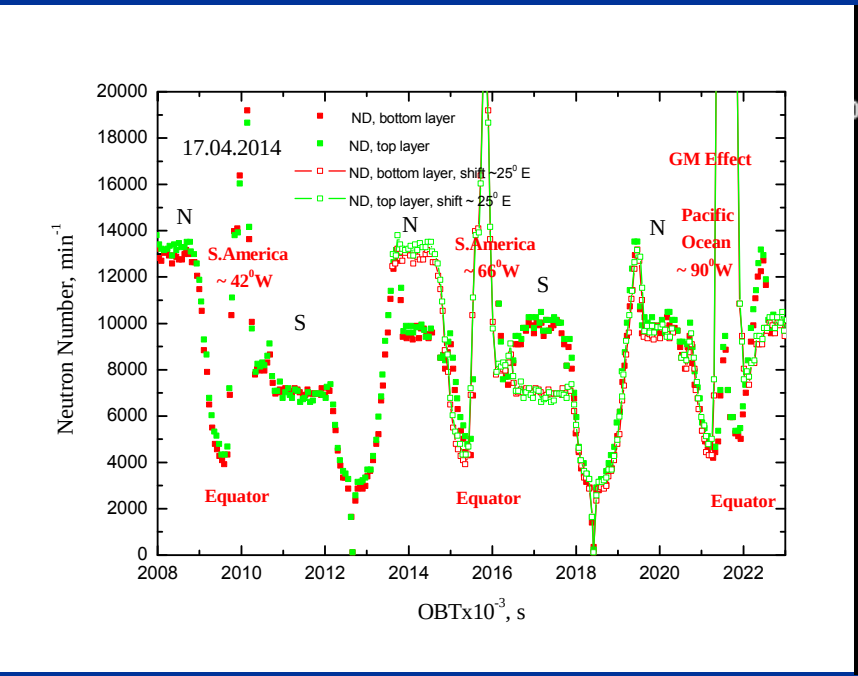


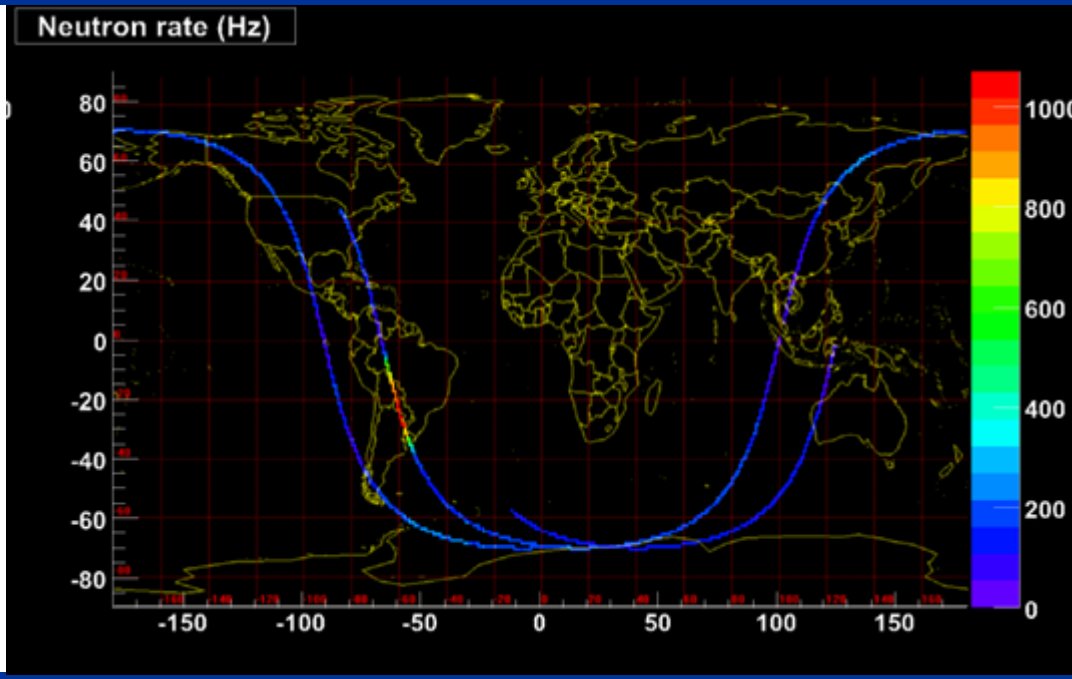


18.04.2014. QUICKLOOK Data Digitization



17.04.2014. QUICKLOOK Data Digitization





SN:18.04.2014 OBT2107550-2107750 ND(b&t):35491-37226=-1735±270,-4.66±0.73%
GM:17.04.2014OBT2021150-2021330 ND(b&t):36852-38601=-1749±275,-4.53±0.71%

(GM: Cut-off shift ~ 12.3-11.2GV).

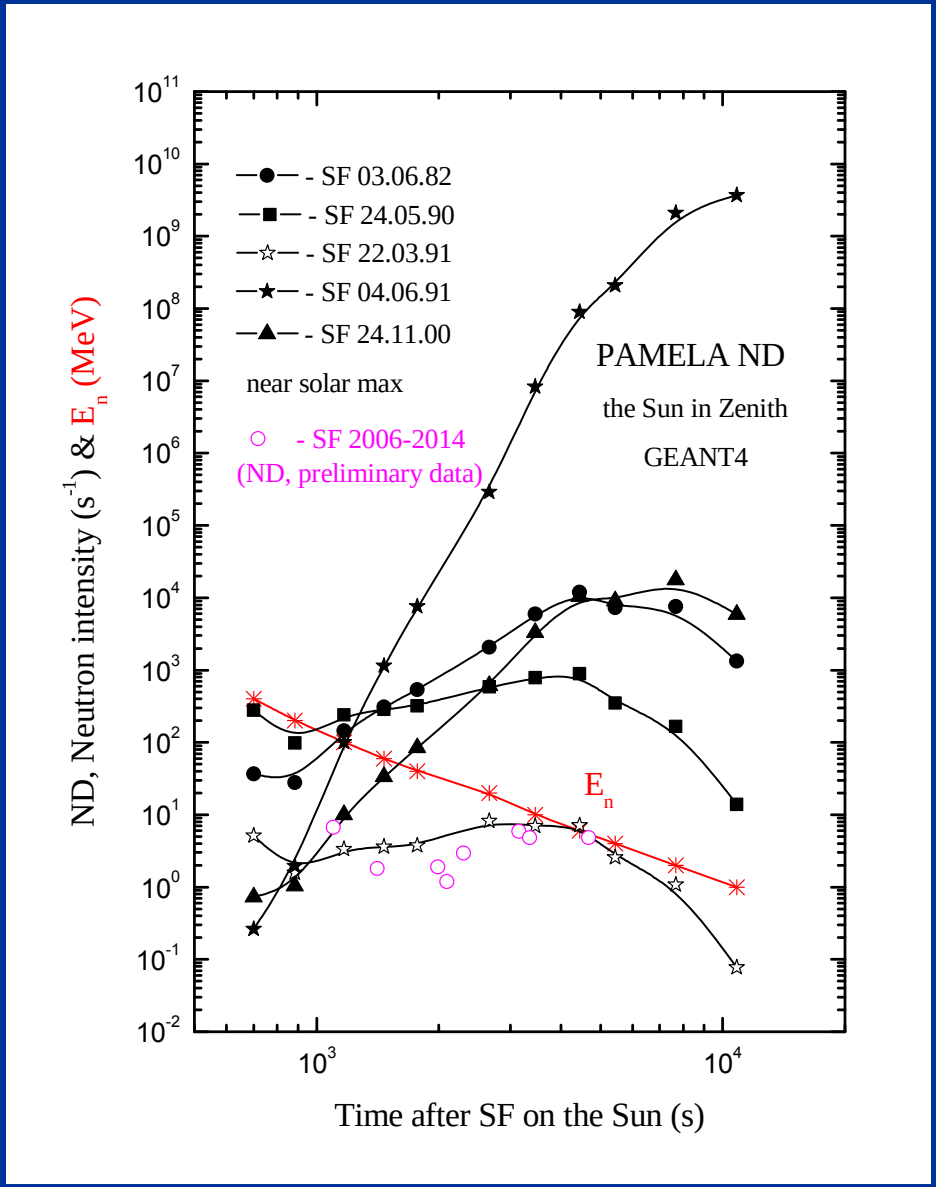
Total Effect SN-GM: -0.13±1.02% for 105-108 min after SF, E_n ~2.6-2.8 MeV

NO SOLAR NEUTRONS…

Предварительные итоги.

Solar Flare	Class	Area	Energy	Effect SN(GM)	
13 December 2006	X3.4	S06 W24	E_n ~38-96 MeV	+1.3±0.7%	**Yes?**
07 June 2011	M2.5	S22 W53	E_n ~27-40 MeV	-1.8±0.8%	**No**
23 January 2012	M8.7	N18 W21	E_n ~18-23 MeV	+1.5±0.8%	**Yes?**
27 January 2012	X1.7	N27 W71	E_n ~23-38 MeV	+0.2±0.7%	**No?**
07 March 2012	X5.4	N17 E27	E_n ~ ? MeV	No QL Data	**No?**
17 May 2012	M5.1	N11 W76	E_n ~22-27 MeV	+1.9±0.9%	**Yes?**
06 July 2012	X1.1	S13W59	E_n ~11-15 MeV	+5.6±1.3%	**Yes?**
19 July 2012	M7.7	S13W88	E_n ~ 5-6 MeV	+4.3±1.1%	**Yes?**
11 April 2013	M6.5	N07E13	E_n ~ ?	No QL Data	**No?**
22 May 2013	M5.0	N14W87	E_n ~ >100 MeV	+4.3± 0.7%	**Yes?**
06 January 2014	C2.1	S15W89	E_n ~ 9-14 MeV	+5.2±0.8%	**Yes?**
07 January 2014	X1.2	S12W08	E_n ~ 5-6 MeV	-3.7±0.8%	**No?**
20 February 2014	M3.0	S15W75	E_n ~ 3-4 MeV	-0.2±1.8%	**No**
18 April 2014	M7.3	S20W34	E_n ~ 2-3 MeV	-0.1±1.0%	**No**

НД. Ожидаемые спектры солнечных нейтронов.



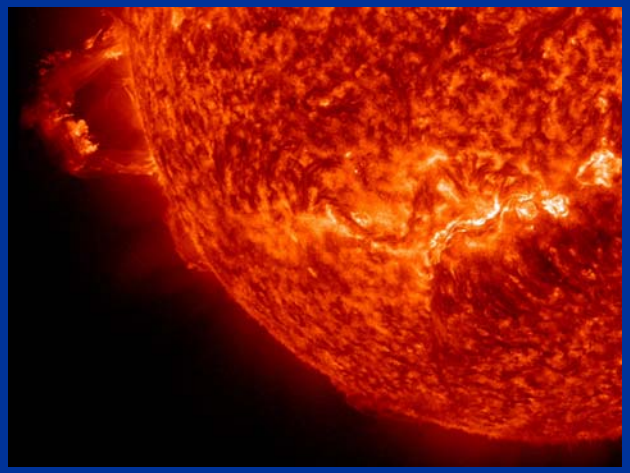
Заключение.

- Солнечные нейтроны должны генерироваться в большей или меньшей мере в каждой вспышке. Проблема в чувствительности прибора…
- Анализ PAMELA QL данных во время вспышек 2006-2014 показал, что солнечные нейтроны вероятно обнаружены в вспышках 13.12.2006, 23.01.2012, 17.05.2012, 06.07.2012, 19.07.2012, 22.05.2013 и 06.01.2014 на уровне 2-4 стандартных отклонений…

  Нижний предел регистрации в НД PAMELA потока солнечных нейтронов ~ 300 n/м^2 с.
- Более точные данные можно получить из анализа Level 2 data.

- P.S. Анализ полётной информации эксперимента PAMELA позволяет получить во время вспышек комплекс данных о динамике спектров СКЛ во времени, спектрах изотопов ^{1}H, ^{2}H, ^{3}H, ^{3}He, ^{4}He и солнечных нейтронах.…

Наилучшие пожелания из Санкт-Петербурга :~)



Благодарю.