First *Fermi*-LAT Solar flare catalog Appendix

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ABSTRACT

We present the appendix of the first *Fermi*-Large Area Telescope (LAT) Solar flare catalog covering the 24th Solar cycle. The catalog (published in ApJS) contains 45 *Fermi*-LAT Solar flares (FLSFs) with emission in the γ-ray energy band (30 MeV - 10 GeV) detected with a significance $\geq 5\sigma$ over the years 2010-2018. A subsample containing 37 of these flares exhibit delayed emission beyond the prompt-impulsive hard X-ray phase with 21 flares showing delayed emission lasting more than two hours. No prompt-impulsive emission is detected in four of these flares. We also report the first

time observations of GeV emission from 3 flares originating from Active Regions located behind the limb (BTL) of the visible Solar disk. We report the light curves, spectra, best proton index and localization (when possible) for all the FLSFs and correlations with Solar multi-wavelength phenomena. The γ-ray spectra is consistent with the decay of pions produced by >300 MeV protons. The work presented in the First *Fermi* Solar Flare Catalog contains the largest sample of high-energy gamma-ray flares ever reported and provides the unique opportunity to perform population/correlation studies on the different phases of the flare and thus allowing to open a new window in solar physics.

1. INTRODUCTION

In this appendix we list the temporal and spectral characteristics of the γ-ray emission observed with *Fermi*-LAT whether detected with the LLE, `SunMonitor` approach or both, as well as potentially associated multiwavelength phenomena when available for all of the 45 FLSFs in the catalog. For each FLSF with emission detected in LLE we provide, in addition to the standard maximum likelihood analysis results, the LLE-SED in the 30 MeV to 10 GeV range and lightcurves in three energy ranges (<30 MeV, 30-100 MeV and 100-5000 MeV). For the cases where the localization 68% containment error is $\leq 365''$, we also include the localization results overlaid on the SDO-AIA 171Å image of the Sun at the time of the localization of the FLSF. For a small subset of the FLSFs, the GOES HEPAD recorded a significant flux of protons with energy >500 MeV and for these cases the time profiles of the SEPs are also included. For each FLSF we include tables listing the maximum likelihood analysis results, SED values in each energy bin, localization results (position in helioprojective coordinates, 68% and 95% containment radii) as well as multiwavelength associations (GOES X-ray, CME, HXR, SEP). All the analysis details and cross correlation results are presented in detail in the the First *Fermi*-LAT Solar Flare Catalog (published in ApJS).

1.1. *FLSF 2010-06-12*

Gamma-ray flare detected only in LLE. Emission started on 2010-06-12 00:55:49 (UTC) and ended on 2010-06-12 00:56:20 (UTC) with a total duration of 30 seconds. The flare is classified as LLE-Prompt. Most likely associated to a M2.0 GOES flare which started on 2010-06-12 00:30 and to a CME with speed 486 km s^{-1} with first LASCO C2 appearance on 2010-06-12 01:31:39 UTC.
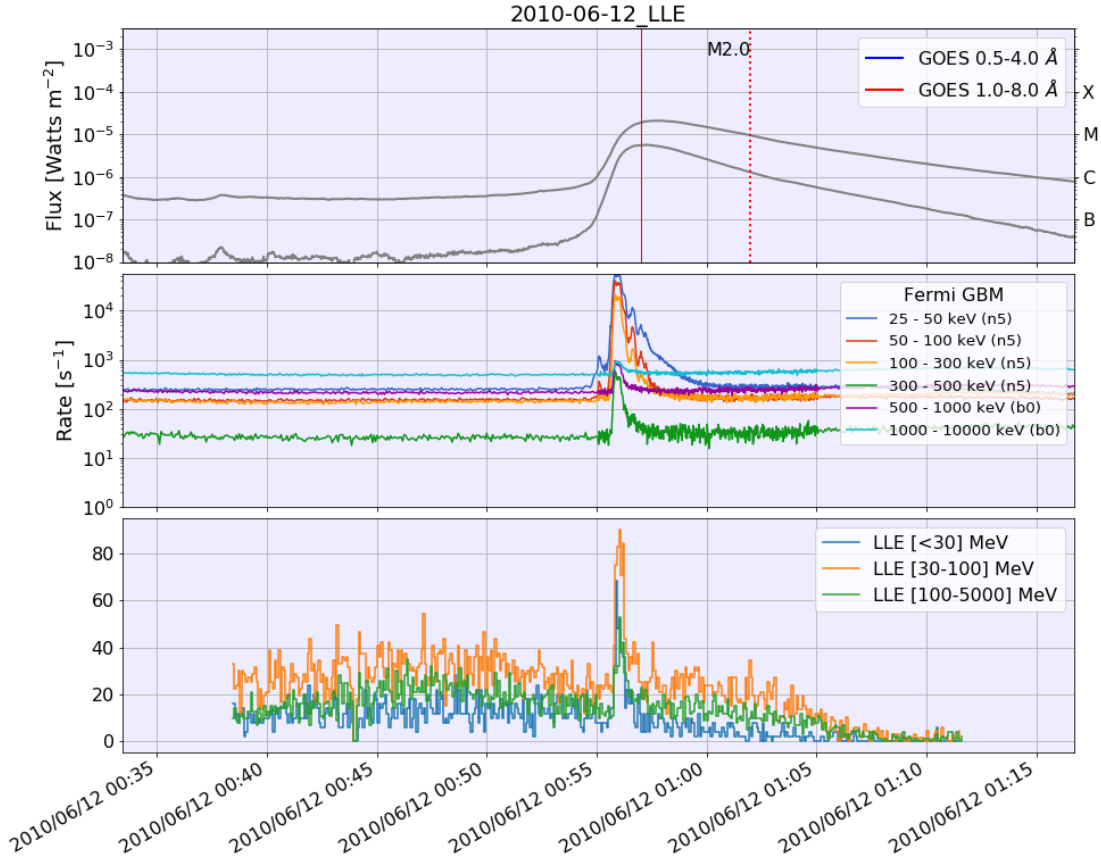

Figure 1. Light curve for FLSF 2010-06-12 using the LLE approach. From top to bottom: GOES X-rays, *Fermi*-GBM, *Fermi*-LLE.
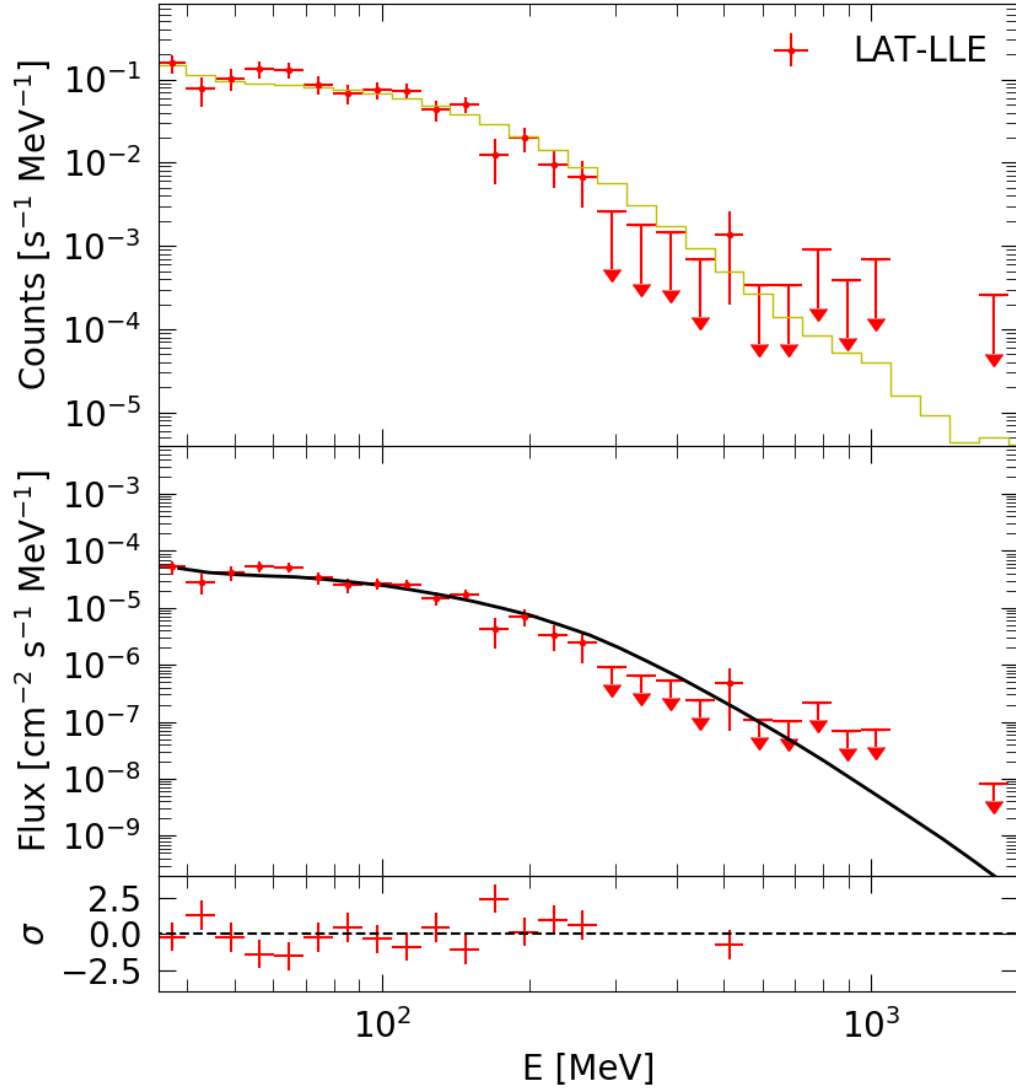
Figure 2. SED for FLSF 2010-06-12 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 1.

Start Time	Duration	Flux	Flux	TS cutoff	TS pion
(UTC)	(sec)	(30 MeV − 10 GeV)	(100 MeV − 10 GeV)		
2010-06-12 00:55:49	30.1	446 ± 35	191 ± 12	119	215

Table 1. LLE Spectral results for FLSF 2010-06-12. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
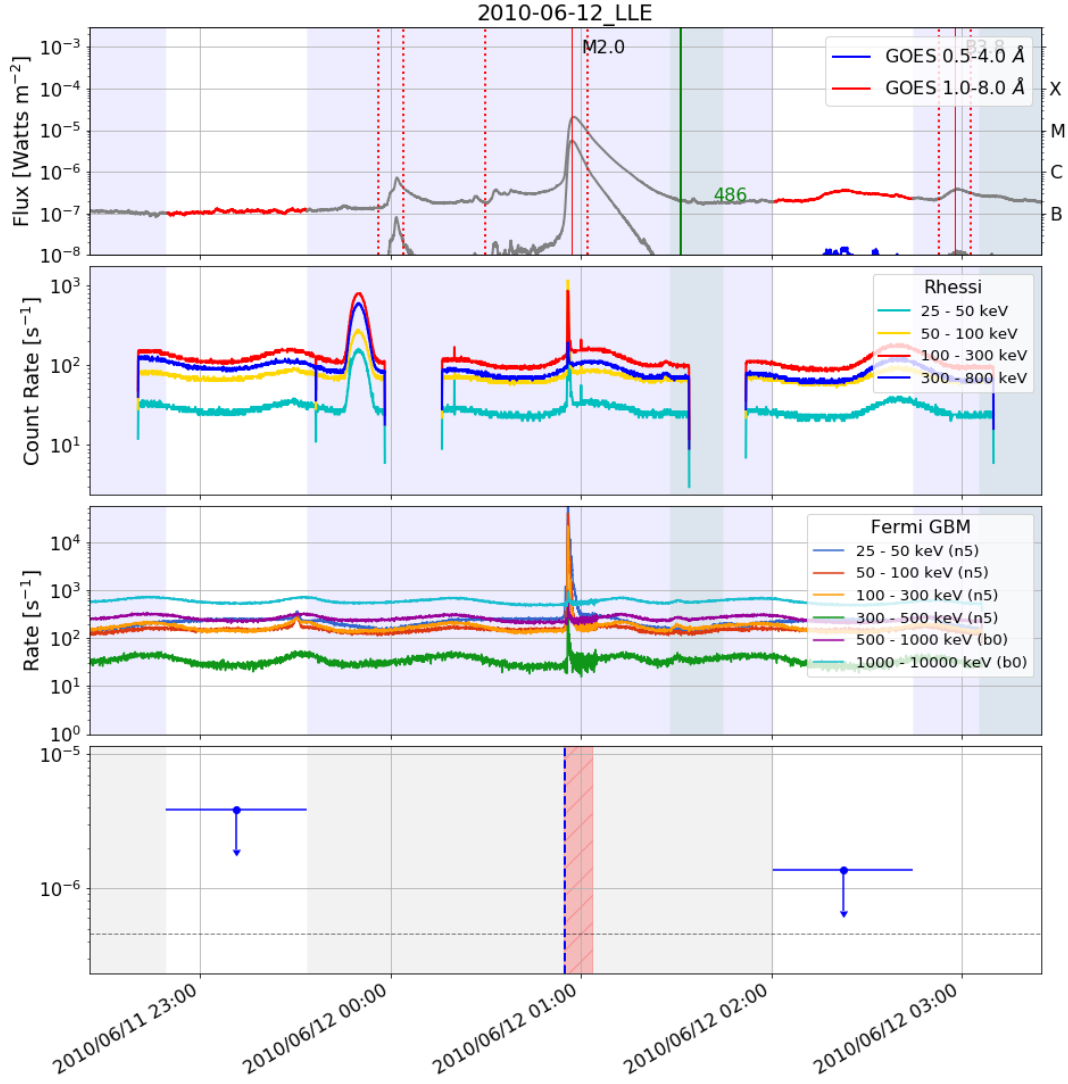
Figure 3. Light curve for FLSF 2010-06-12. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M2.0	2010-06-12 00:30	2010-06-12 00:57	2010-06-12 01:02	1000	BGO

Table 2. Properties of the GOES X-ray flare associated with FLSF 2010-06-12 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
486	2010-06-12 01:31	10	GOES

Table 3. Properties of the CME potentially associated with FLSF 2010-06-12 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.2. *FLSF 2011-03-07*

The Sun was in the field of view of the LAT from 2011-03-07 20:10 to 2011-03-08 09:39 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 15.8 hours. The flare is classified as Delayed. Most likely associated to a M3.7 GOES flare which started on 2011-03-07 19:43 and to a CME with speed 2125 km s^{-1} with first LASCO C2 appearance on 2011-03-07 20:00:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2011-03-07 20:10	29	2.06 ± 0.19	317	27	Exp	-0.76 ± 0.45	172 ± 55	4.3 ± 0.4
2011-03-07 23:21	44	3.04 ± 0.20	710	70	Exp	-0.31 ± 0.36	138 ± 27	4.13 ± 0.26
2011-03-08 02:33	43	3.23 ± 0.22	621	66	Exp	-0.15 ± 0.41	110 ± 22	4.70 ± 0.32
2011-03-08 05:44	44	1.40 ± 0.15	219	32	Exp	0.67 ± 0.99	63 ± 22	>6
2011-03-08 09:13	26	0.48 ± 0.11	46	-0.1	PL	-2.55 ± 0.25	-	-

Table 4. Maximum likelihood results for FLSF 2011-03-07. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
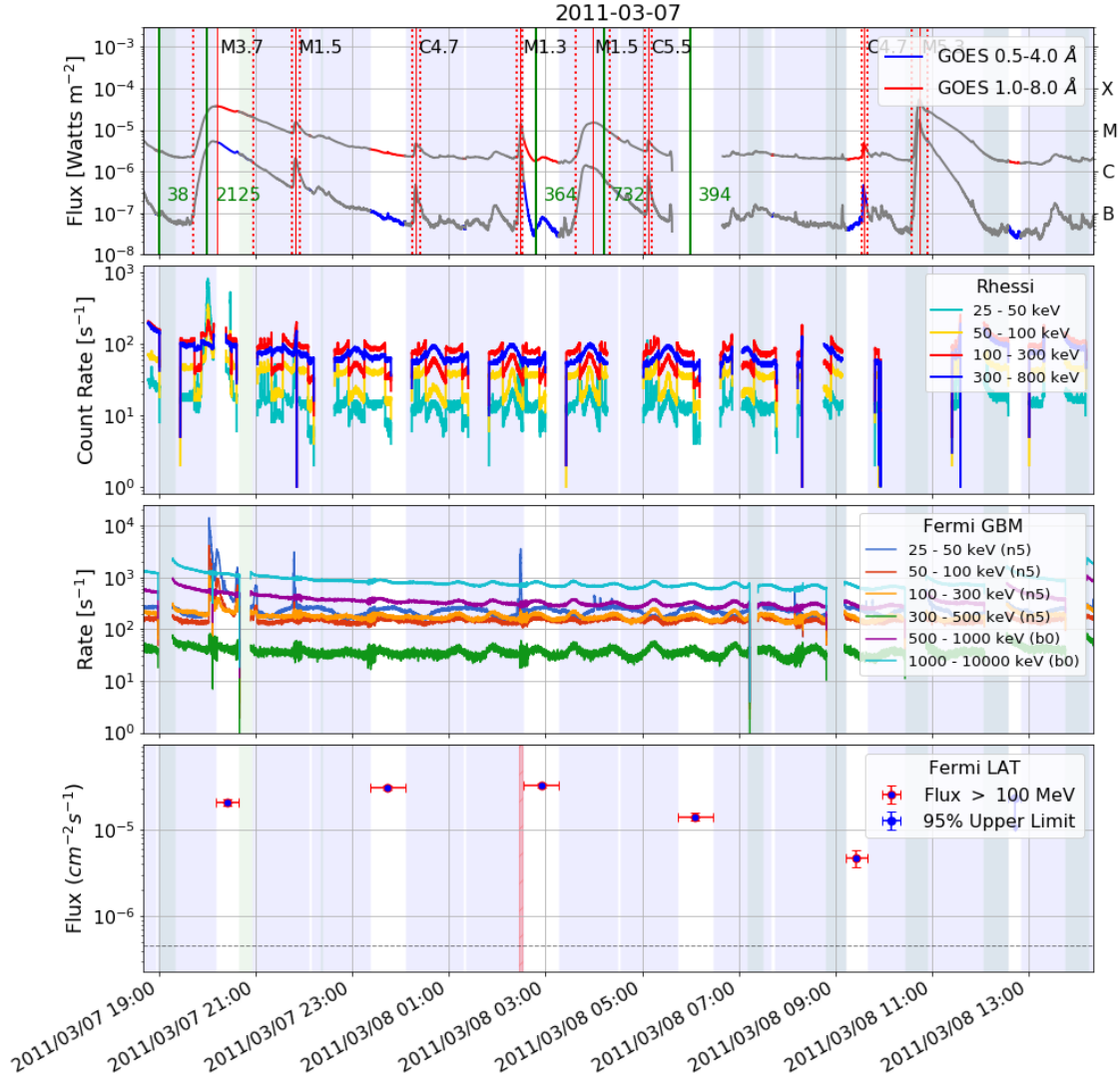
Figure 4. Light curve for FLSF 2011-03-07. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

| Time interval | | | | Energy bin (MeV) | | | | | | |
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
20:10:40 - 20:39:35	$(2.6 \pm 0.6) \times 10^2$	159 ± 25	55 ± 10	15.6 ± 3.5	2.8 ± 1.1	<1.2	<0.3	<0.2	<0.1	<0.1
23:21:49 - 00:05:38	$(3.5 \pm 0.6) \times 10^2$	187 ± 25	96 ± 11	28 ± 4	3.9 ± 1.1	<1.2	<0.2	<0.1	<0.1	<0.1
02:33:05 - 03:16:33	$(3.8 \pm 0.7) \times 10^2$	246 ± 29	102 ± 12	22 ± 4	2.7 ± 0.9	<1.3	<0.2	<0.2	<0.1	<0.1
05:44:01 - 06:27:59	$(2.3 \pm 0.6) \times 10^2$	102 ± 20	45 ± 8	8.3 ± 2.3	<1.6	<0.5	<0.2	<0.2	<0.1	<0.1
08:47:42 - 09:39:05	$(1.0 \pm 0.5) \times 10^2$	46 ± 17	15 ± 6	3.2 ± 1.9	<2.1	<0.9	<0.4	<0.4	<0.1	<0.1

Table 5. SED values for the time resolved intervals of FLSF 2011-03-07. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M3.7	2011-03-07 19:43	2011-03-07 20:12	2011-03-07 20:58	100	BGO

Table 6. Properties of the GOES X-ray flare associated with FLSF 2011-03-07 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
2125	2011-03-07 20:00	50	GOES

Table 7. Properties of the CME potentially associated with FLSF 2011-03-07 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.3. *FLSF 2011-06-07*

The Sun was in the field of view of the LAT from 2011-06-07 07:47 to 2011-06-07 11:34 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 6.0 hours. The flare is classified as Delayed. Most likely associated to a M2.5 GOES flare which started on 2011-06-07 06:16 and to a CME with speed 1255 km s^{-1} with first LASCO C2 appearance on 2011-06-07 06:49:12 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2011-06-07 07:47	36	3.18 ± 0.20	740	76	Exp	-0.13 ± 0.37	104 ± 19	4.97 ± 0.33
2011-06-07 11:16	19	0.32 ± 0.10	19	5	PL	-2.70 ± 0.35	-	-

Table 8. Maximum likelihood results for FLSF 2011-06-07. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
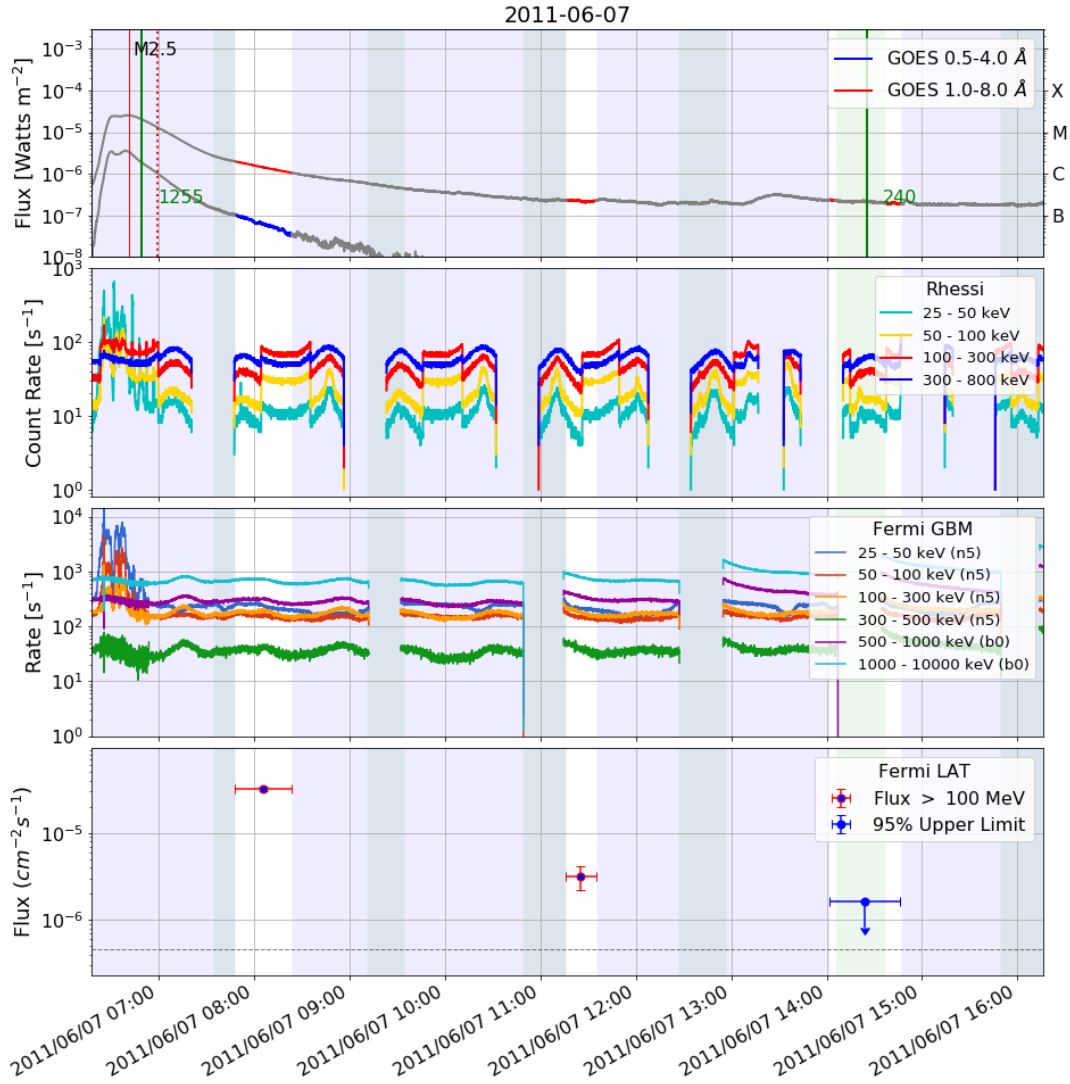
Figure 5. Light curve for FLSF 2011-06-07. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

| Time interval | Energy bin (MeV) | | | | | | | | | |
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
07:33:50 - 08:32:09	$(4.1 \pm 0.6) \times 10^2$	250 ± 27	92 ± 10	24 ± 4	2.8 ± 0.9	<0.5	<0.2	<0.2	<0.1	<0.0
10:48:42 - 11:43:33	<156.5	36 ± 17	17 ± 7	<4.7	<2.4	<0.9	<0.5	<0.3	<0.2	<0.1

Table 9. SED values for the time resolved intervals of FLSF 2011-06-07. Units are 10^{-8} cm^{-2} s^{-1} MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M2.5	2011-06-07 06:16	2011-06-07 06:41	2011-06-07 06:59	100	NaI5

Table 10. Properties of the GOES X-ray flare associated with FLSF 2011-06-07 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1255	2011-06-07 06:49	100	GOES

Table 11. Properties of the CME potentially associated with FLSF 2011-06-07 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.4. *FLSF 2011-08-04*

The Sun was in the field of view of the LAT from 2011-08-04 04:55 to 2011-08-04 05:37 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 2.3 hours. The flare is classified as Delayed. Most likely associated to a M9.3 GOES flare which started on 2011-08-04 03:41 and to a CME with speed 1315 km s^{-1} with first LASCO C2 appearance on 2011-08-04 04:12:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2011-08-04 04:55	42	2.30 ± 0.18	413	49	Exp	-0.09 ± 0.50	95 ± 21	5.4 ± 0.4

Table 12. Maximum likelihood results for FLSF 2011-08-04. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
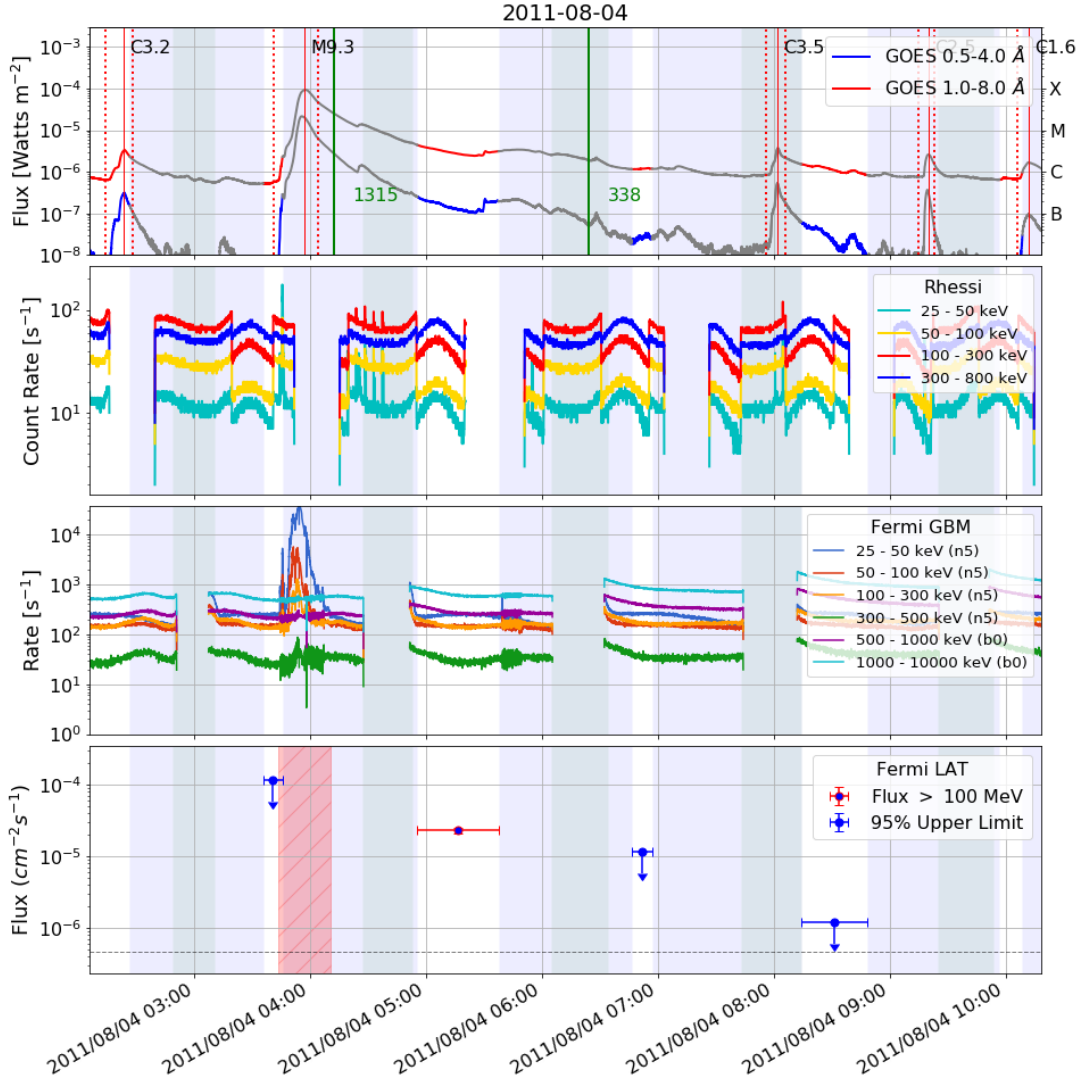
Figure 6. Light curve for FLSF 2011-08-04. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
04:55:28 - 05:37:28	$(4.1 \pm 0.7) \times 10^2$	156 ± 23	69 ± 10	16.7 ± 3.2	<2.2	<0.5	<0.3	<0.2	<0.1	<0.1

Table 13. SED values for the time resolved intervals of FLSF 2011-08-04. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M9.3	2011-08-04 03:41	2011-08-04 03:57	2011-08-04 04:04	300	NaI5

Table 14. Properties of the GOES X-ray flare associated with FLSF 2011-08-04 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1315	2011-08-04 04:12	100	GOES

Table 15. Properties of the CME potentially associated with FLSF 2011-08-04 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.5. *FLSF 2011-08-09*

The Sun was in the field of view of the LAT from 2011-08-09 07:37 to 2011-08-09 08:09 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 52 minutes. The flare is classified as Prompt Short-Delayed. Most likely associated to a X6.9 GOES flare which started on 2011-08-09 07:48 and to a CME with speed 1610 km s^{-1} with first LASCO C2 appearance on 2011-08-09 08:12:06 UTC. Gamma-ray emission >30 MeV also detected with the LLE approach. The LLE emission started on 2011-08-09 08:01:51 (UTC) and ended on 2011-08-09 08:06:01 (UTC) with a total duration of 250 seconds.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\mathrm{cm}^{-2}\mathrm{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2011-08-09 07:37	32	2.29 ± 0.23 *	186	26	Exp	-0.04 ± 0.87	91 ± 37	5.4 ± 0.6

Table 16. Maximum likelihood results for FLSF 2011-08-09. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the S15 event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.

Start Time (UTC)	Duration (sec)	Flux (30 MeV − 10 GeV)	Flux (100 MeV − 10 GeV)	TS cutoff	TS pion
2011-08-09 08:01:51	250.0	31.20 ± 0.24	13.02 ± 0.22	10	124

Table 17. LLE Spectral results for FLSF 2011-08-09. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
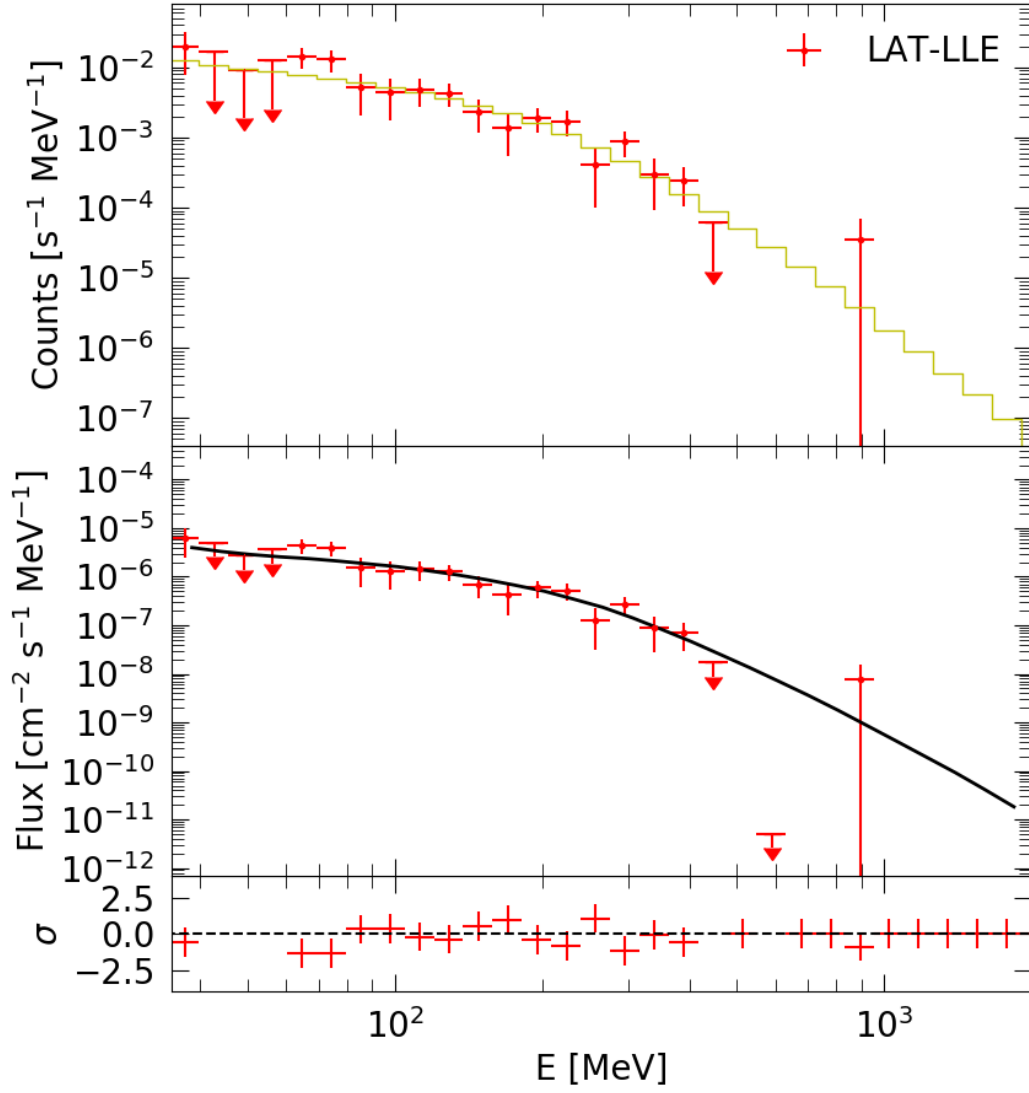
Figure 7. SED of FLSF 2011-08-09 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 17.
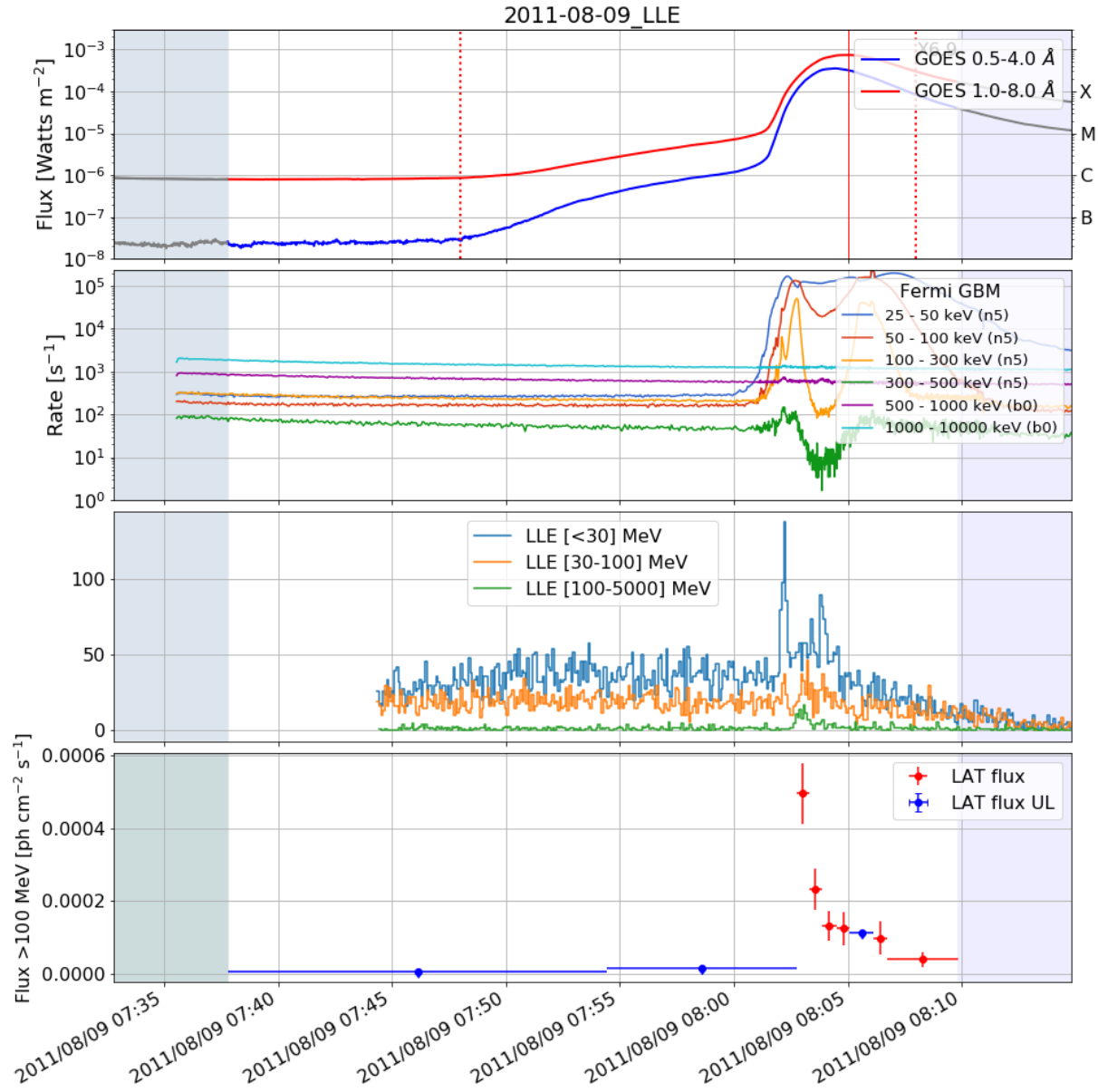
Figure 8. Fine time binning light curve for FLSF 2011-08-09. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate, *Fermi*-LLE, *Fermi*-LAT maximum likelihood results with fine time binning.
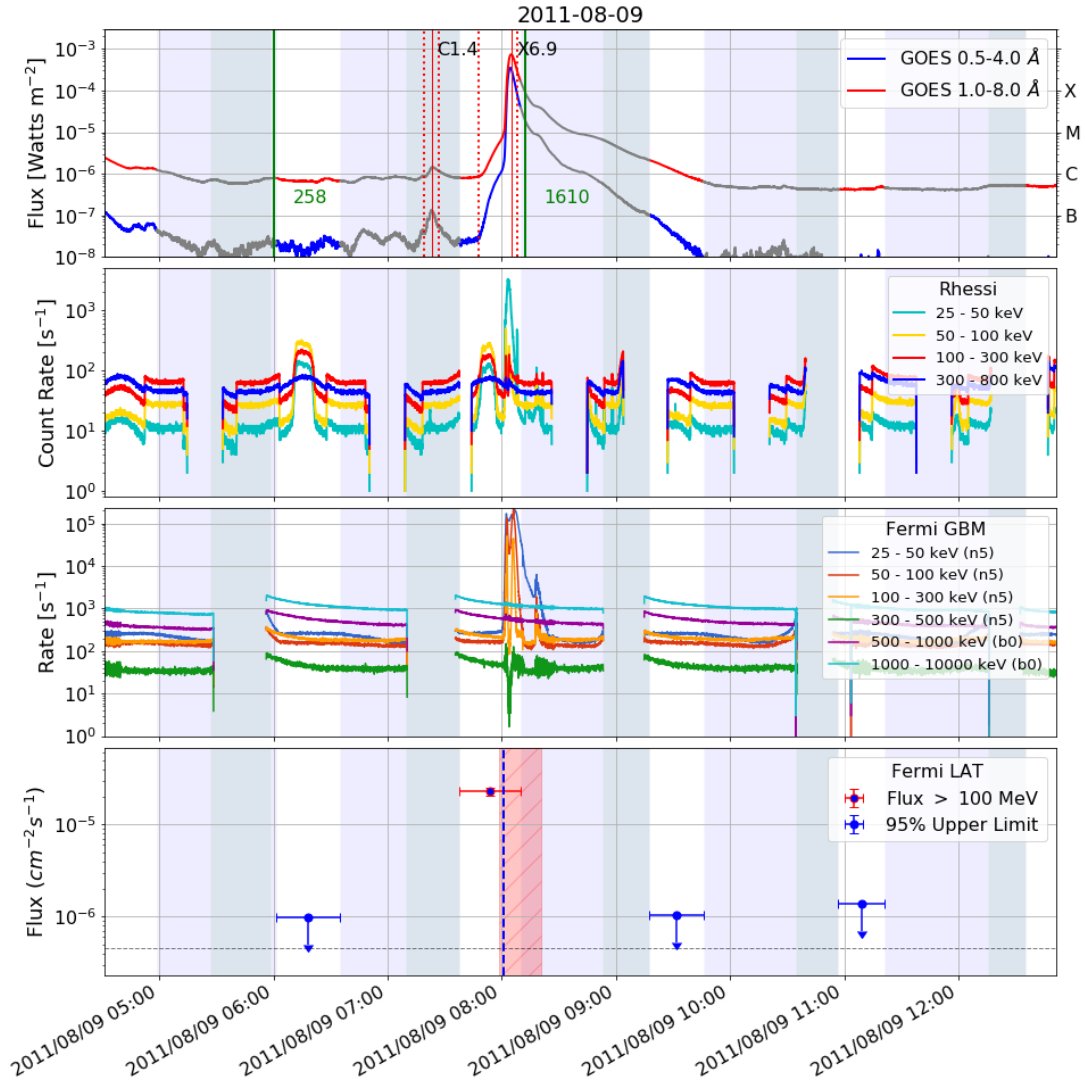
Figure 9. Light curve for FLSF 2011-08-09. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval		Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3390	3390–6000	6000–10000
07:09:35 - 08:09:48	$(2.3 \pm 0.8) \times 10^2$	192 ± 32	74 ± 13	15 ± 4	<3.7	<1.4	<0.5	<0.3	<0.2	<0.1

Table 18. SED values for the time resolved intervals of FLSF 2011-08-09. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X6.9	2011-08-09 07:48	2011-08-09 08:05	2011-08-09 08:08	300	NaI5

Table 19. Properties of the GOES X-ray flare associated with FLSF 2011-08-09 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1610	2011-08-09 08:12	100	GOES

Table 20. Properties of the CME potentially associated with FLSF 2011-08-09 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.6. *FLSF 2011-09-06*

The Sun was in the field of view of the LAT from 2011-09-06 22:11 to 2011-09-06 22:47 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 2.0 hours. The flare is classified as LLE-Prompt Short-Delayed. Most likely associated to a X2.1 GOES flare which started on 2011-09-06 22:12 and to a CME with speed 575 km s^{-1} with first LASCO C2 appearance on 2011-09-06 23:05:57 UTC. Gamma-ray emission >30 MeV also detected with the LLE approach. The LLE emission started on 2011-09-06 22:18:07 (UTC) and ended on 2011-09-06 22:19:47 (UTC) with a total duration of 100 seconds.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2011-09-06 22:11	36	22.8 $\pm$ 0.4 *	8197	437	Exp	-0.89 $\pm$ 0.09	161 $\pm$ 11	4.89 $\pm$ 0.11

Table 21. Maximum likelihood results for FLSF 2011-09-06. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the S15 event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.

Start Time (UTC)	Duration (sec)	Flux (30 MeV – 10 GeV)	Flux (100 MeV – 10 GeV)	TS cutoff	TS pion
2011-09-06 22:18:07	100.0	54.0 $\pm$ 1.4	16.6 $\pm$ 1.1	257	125

Table 22. LLE Spectral results for FLSF 2011-09-06. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
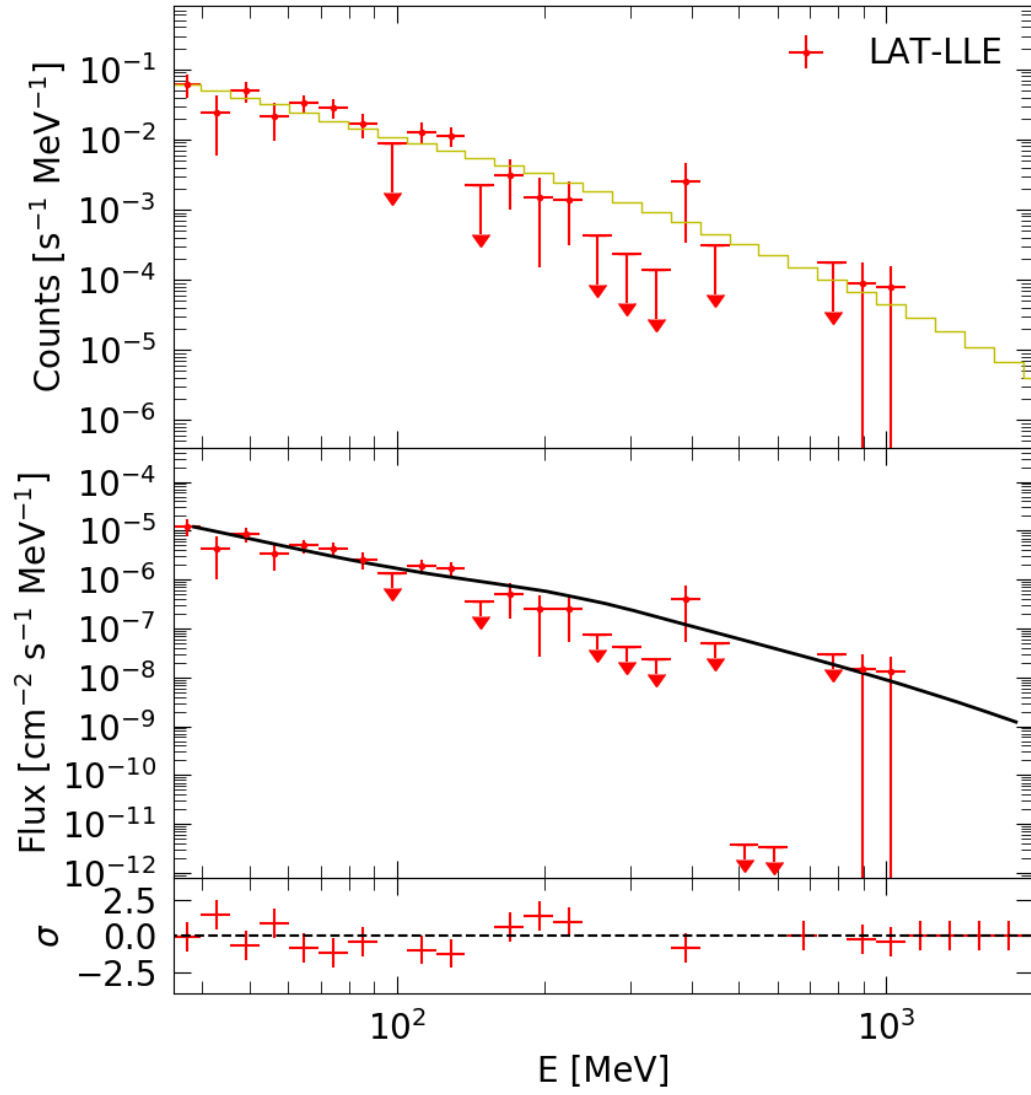
Figure 10. SED of FLSF 2011-09-06 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 22.
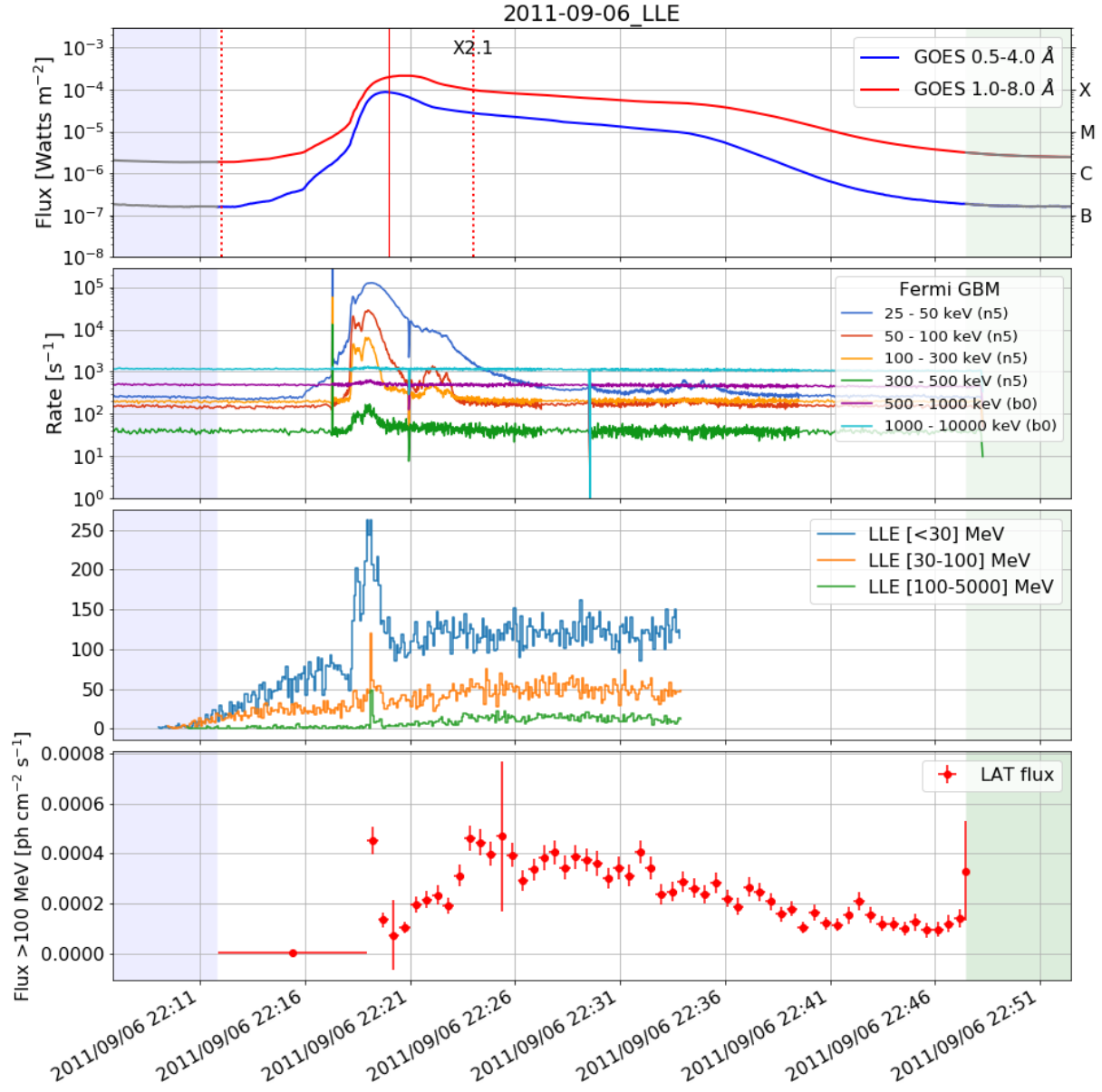
Figure 11. Fine time binning light curve for FLSF 2011-09-06. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate, *Fermi*-LLE, *Fermi*-LAT maximum likelihood results with fine time binning.
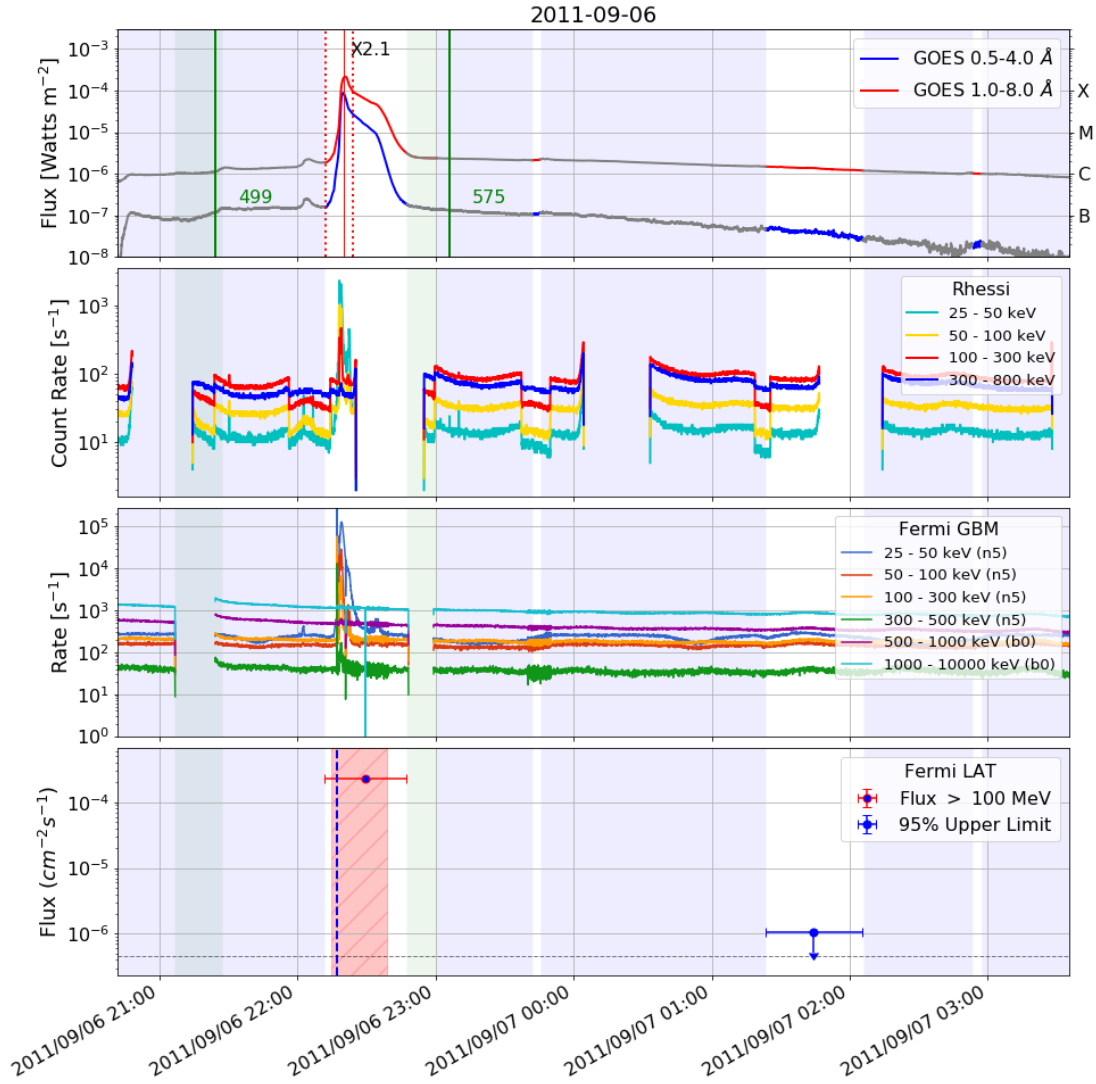
Figure 12. Light curve for FLSF 2011-09-06. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Date and Time	Helio X	Helio Y	ERR 68	ERR 95
2011-09-06 22:11 - 22:47	219	533	139	220

Table 23. Localization results for FLSF 2011-09-06. The GOES X-ray flare associated with the FLSF originated from AR 11283 whose position at the time of the GOES flare was N14W18. All values are in arcseconds.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
22:11:50 - 22:47:28	$(3.52 \pm 0.13) \times 10^3$	$(1.69 \pm 0.06) \times 10^3$	624 ± 23	148 ± 8	21.9 ± 2.4	3.1 ± 0.7	<0.4	<0.3	<0.1	<0.1

Table 24. SED values for the time resolved intervals of FLSF 2011-09-06. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X2.1	2011-09-06 22:12	2011-09-06 22:20	2011-09-06 22:24	1000	BGO

Table 25. Properties of the GOES X-ray flare associated with FLSF 2011-09-06 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
575	2011-09-06 23:05	100	GOES

Table 26. Properties of the CME potentially associated with FLSF 2011-09-06 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.7. *FLSF 2011-09-07*

The Sun was in the field of view of the LAT from 2011-09-07 23:35 to 2011-09-08 00:23 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 2.0 hours. The flare is classified as Delayed. Most likely associated to a X1.8 GOES flare which started on 2011-09-07 22:32 and to a CME with speed 792 km s^{-1} with first LASCO C2 appearance on 2011-09-07 23:05:58 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2011-09-07 23:35	48	0.77 ± 0.08	270	30	Exp	-0.10 ± 0.69	114 ± 40	4.4 ± 0.5

Table 27. Maximum likelihood results for FLSF 2011-09-07. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
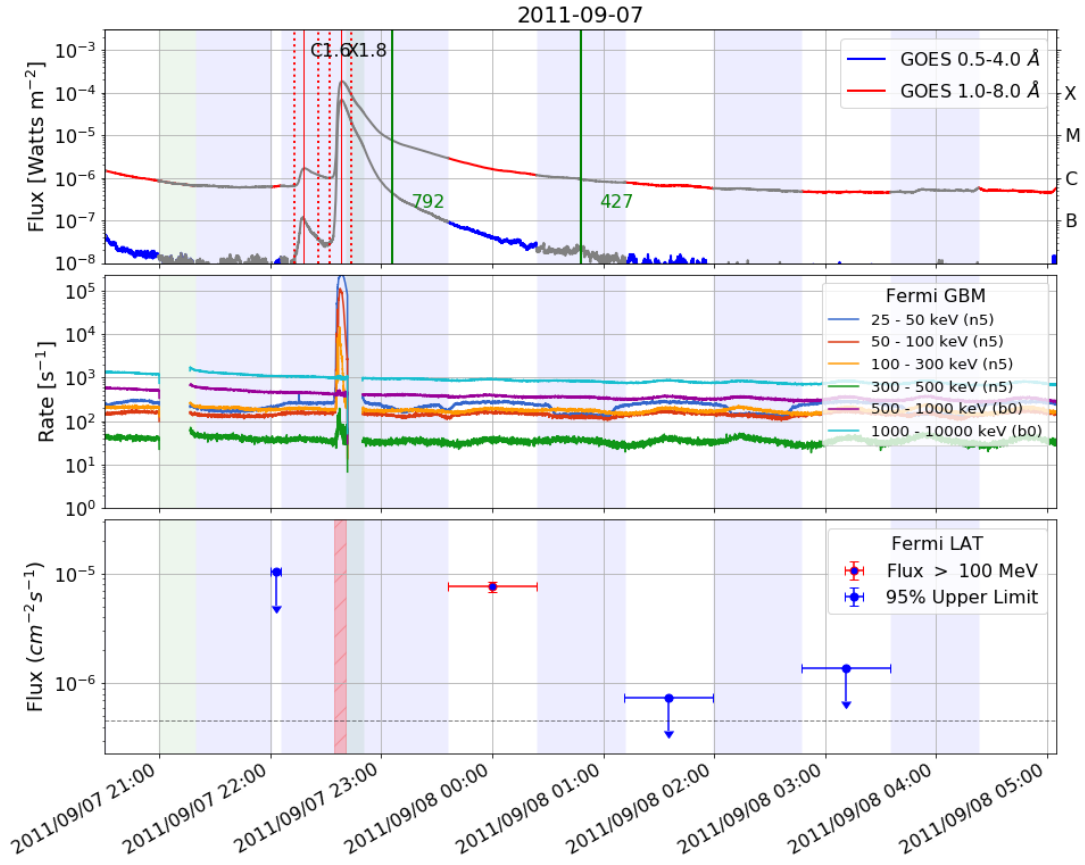
Figure 13. Light curve for FLSF 2011-09-07. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
23:35:04 - 00:40:30	93 ± 24	42 ± 9	29 ± 5	5.9 ± 1.5	0.8 ± 0.4	<0.5	<0.2	<0.1	<0.1	<0.0

Table 28. SED values for the time resolved intervals of FLSF 2011-09-07. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.8	2011-09-07 22:32	2011-09-07 22:38	2011-09-07 22:44	500	BGO

Table 29. Properties of the GOES X-ray flare associated with FLSF 2011-09-07 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
792	2011-09-07 23:05	NaN	NaN

Table 30. Properties of the CME potentially associated with FLSF 2011-09-07 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.8. *FLSF 2011-09-24*

The Sun was in the field of view of the LAT from 2011-09-24 09:18 to 2011-09-24 09:47 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 72 minutes. The flare is classified as LLE-Prompt Short-Delayed. Most likely associated to a X1.9 GOES flare which started on 2011-09-24 09:21 and to a CME with speed 1936 km s^{-1} with first LASCO C2 appearance on 2011-09-24 09:48:06 UTC. Gamma-ray emission >30 MeV also detected with the LLE approach. The LLE emission started on 2011-09-24 09:35:53 (UTC) and ended on 2011-09-24 09:37:33 (UTC) with a total duration of 100 seconds.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2011-09-24 09:18	30	0.50 ± 0.10 *	50	5	PL	-2.51 ± 0.22	-	-

Table 31. Maximum likelihood results for FLSF 2011-09-24. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the S15 event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.

Start Time (UTC)	Duration (sec)	Flux (30 MeV – 10 GeV)	Flux (100 MeV – 10 GeV)	TS cutoff	TS pion
2011-09-24 09:35:53	100.0	65.2 ± 1.7	0.43 ± 0.07	130	7

Table 32. LLE Spectral results for FLSF 2011-09-24. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
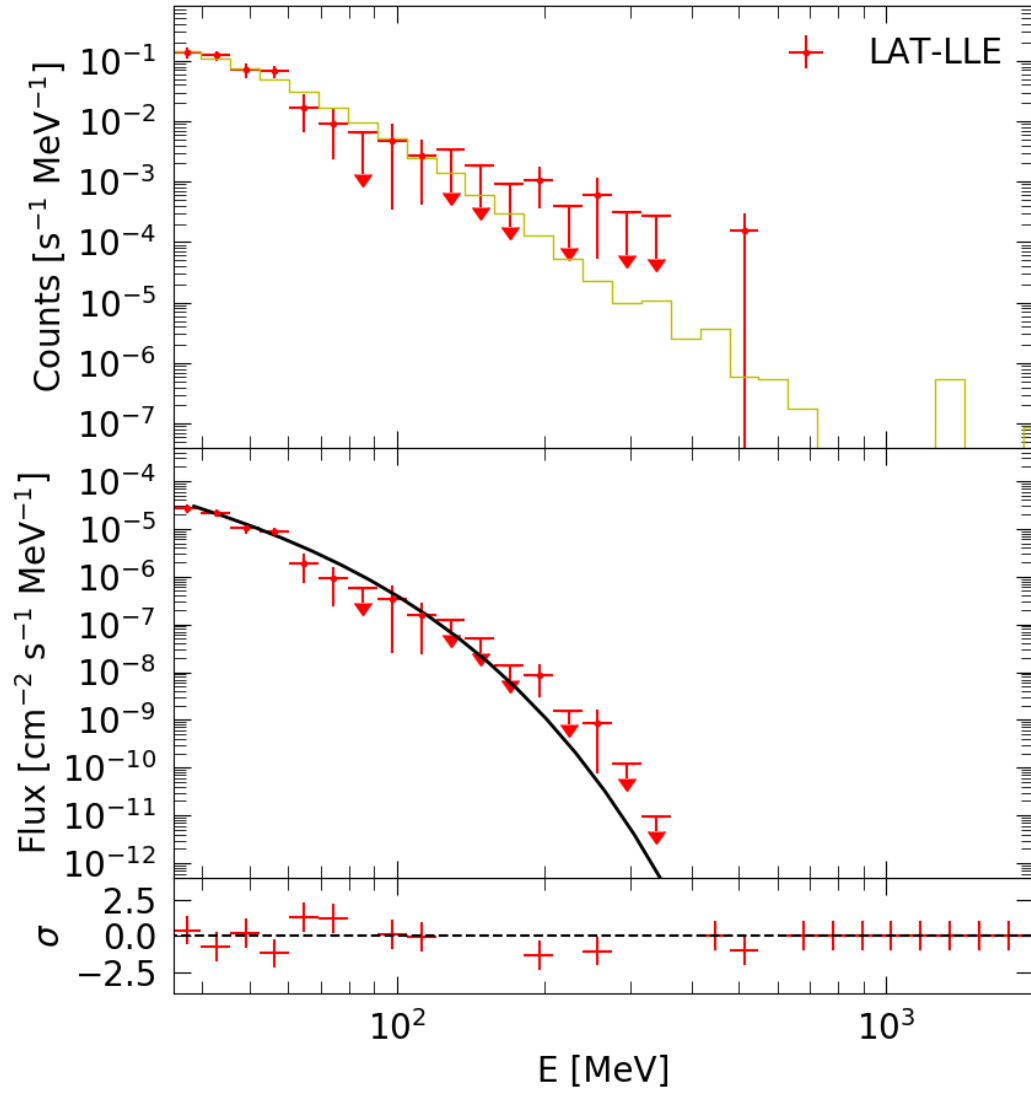
Figure 14. SED of FLSF 2011-09-24 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 32.
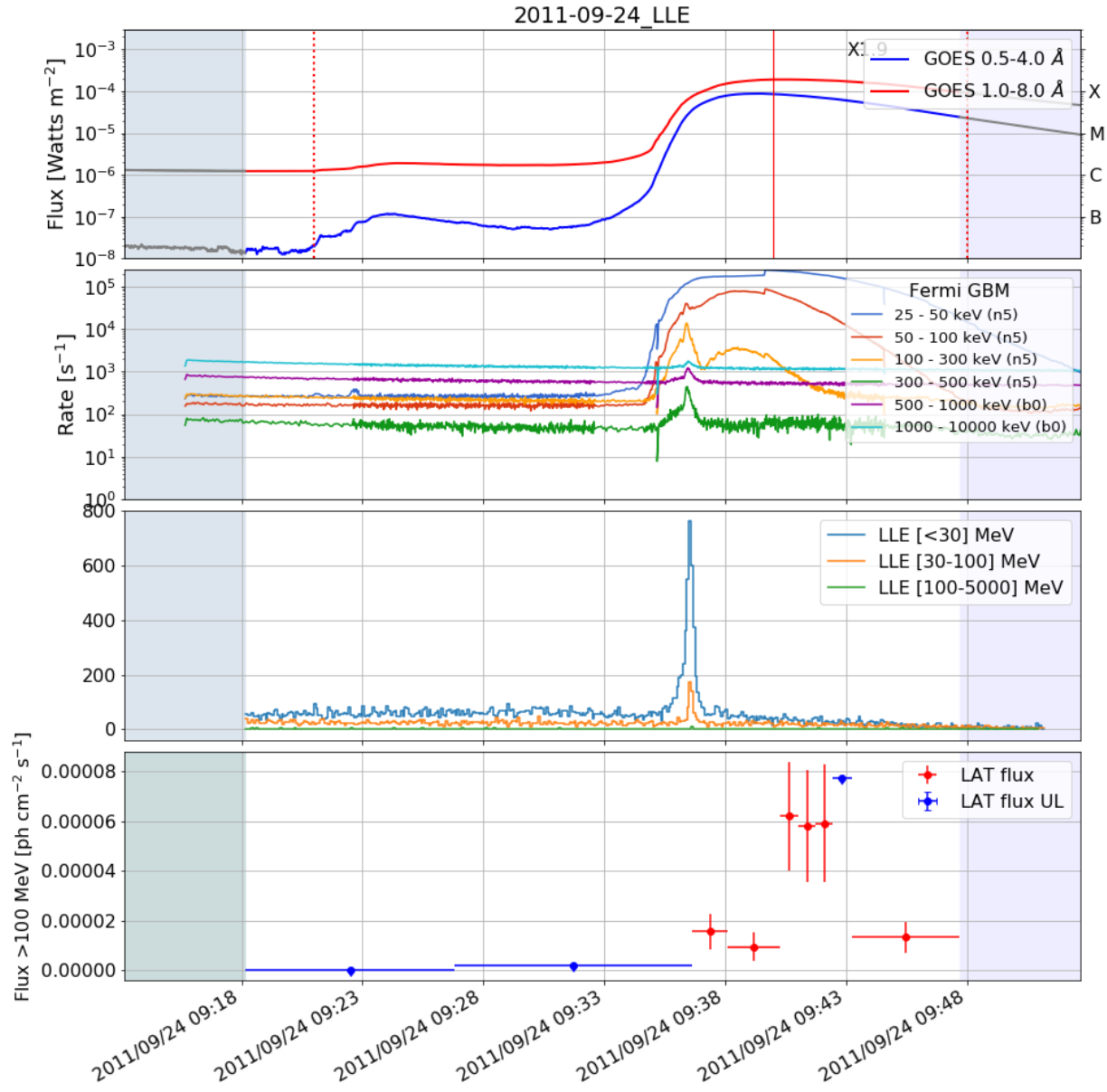
Figure 15. Fine time binning light curve for FLSF 2011-09-24. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate, *Fermi*-LLE, *Fermi*-LAT maximum likelihood results with fine time binning.
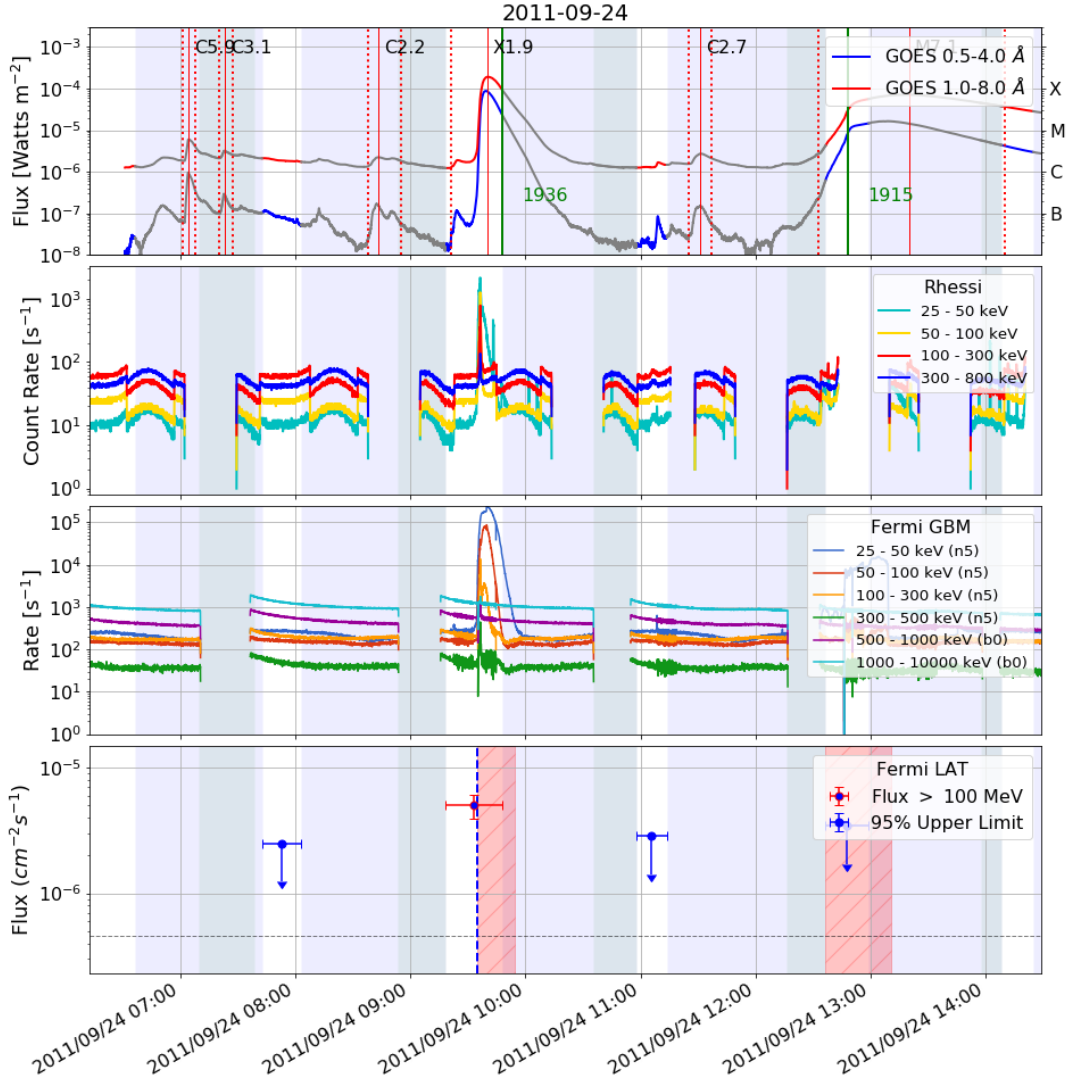
Figure 16. Light curve for FLSF 2011-09-24. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
08:53:12 - 09:47:40	$(8 \pm 4) \times 10^1$	49 ± 16	14 ± 5	5.5 ± 2.2	<2.0	<1.0	<0.4	<0.2	<0.2	<0.1

Table 33. SED values for the time resolved intervals of FLSF 2011-09-24. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.9	2011-09-24 09:21	2011-09-24 09:40	2011-09-24 09:48	1000	BGO

Table 34. Properties of the GOES X-ray flare associated with FLSF 2011-09-24 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1936	2011-09-24 09:48	NaN	NaN

Table 35. Properties of the CME potentially associated with FLSF 2011-09-24 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.9. *FLSF 2012-01-23*

The Sun was in the field of view of the LAT from 2012-01-23 04:06 to 2012-01-23 09:26 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 5.9 hours. The flare is classified as Delayed. Most likely associated to a M8.7 GOES flare which started on 2012-01-23 03:38 and to a CME with speed 2175 km s^{-1} with first LASCO C2 appearance on 2012-01-23 04:00:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-01-23 04:06	40	1.12 ± 0.11	258	26	Exp	0.12 ± 1.09	81 ± 40	5.5 ± 0.6
2012-01-23 05:33	48	1.99 ± 0.12	796	92	Exp	0.25 ± 0.41	80 ± 13	5.6 ± 0.4
2012-01-23 07:20	27	1.97 ± 0.31	93	12	Exp	-0.25 ± 1.05	100 ± 49	5.5 ± 0.9
2012-01-23 08:58	28	1.63 ± 0.23	116	27	Exp	1.81 ± 1.41	51 ± 18	5.6 ± 0.8

Table 36. Maximum likelihood results for FLSF 2012-01-23. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
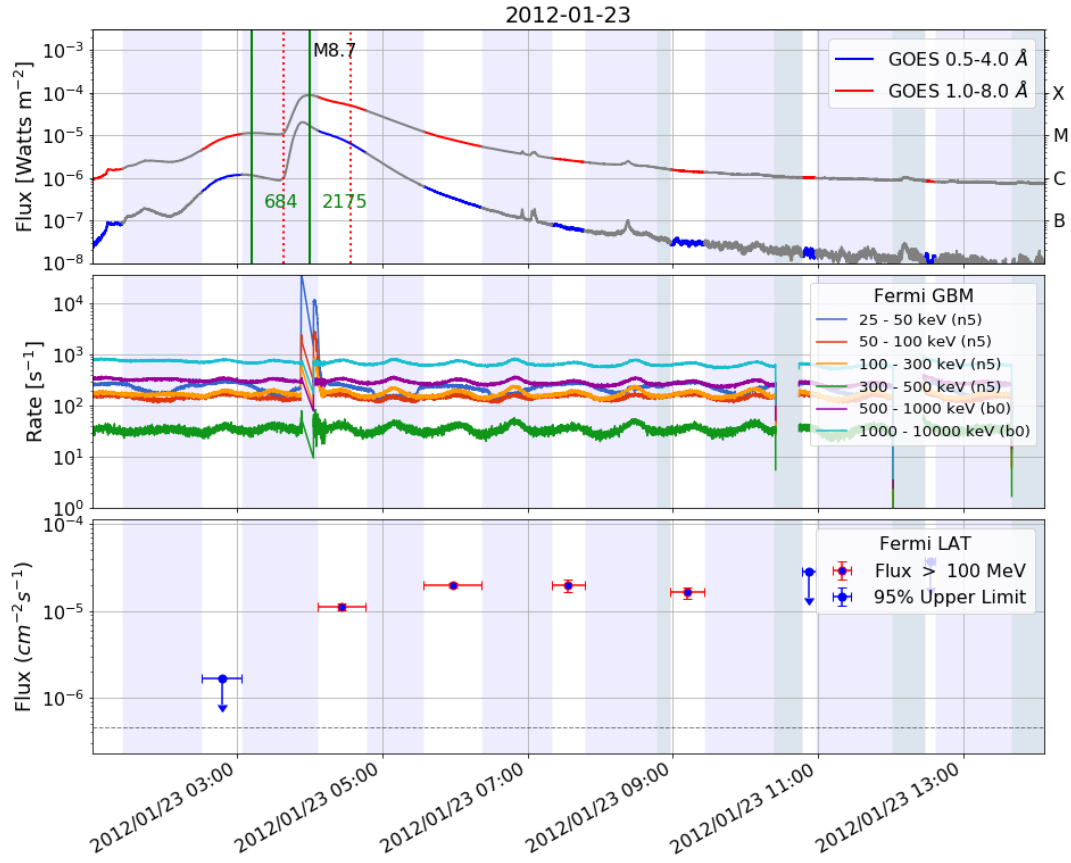
Figure 17. Light curve for FLSF 2012-01-23. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
04:06:19 - 04:59:11	154 ± 34	91 ± 15	36 ± 6	5.7 ± 1.7	<1.6	<0.8	<0.2	<0.1	<0.1	<0.0
05:23:11 - 06:34:36	$(2.6 \pm 0.4) \times 10^2$	180 ± 18	51 ± 6	15.3 ± 2.4	<1.5	<0.3	<0.2	<0.1	<0.1	<0.0
07:20:05 - 07:47:05	$(2.1 \pm 1.1) \times 10^2$	$(1.9 \pm 0.5) \times 10^2$	57 ± 15	8 ± 4	<6.4	<1.2	<0.6	<0.4	<0.2	<0.1
08:46:54 - 09:26:09	$(1.7 \pm 0.8) \times 10^2$	113 ± 31	60 ± 13	13 ± 4	<1.7	<0.9	<0.5	<0.3	<0.2	<0.1

Table 37. SED values for the time resolved intervals of FLSF 2012-01-23. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M8.7	2012-01-23 03:38	2012-01-23 03:59	2012-01-23 04:34	100	NaI5

Table 38. Properties of the GOES X-ray flare associated with FLSF 2012-01-23 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
2175	2012-01-23 04:00	100	GOES

Table 39. Properties of the CME potentially associated with FLSF 2012-01-23 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.10. *FLSF 2012-01-27*

The Sun was in the field of view of the LAT from 2012-01-27 19:37 to 2012-01-28 00:55 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 6.8 hours. The flare is classified as Delayed. Most likely associated to a X1.7 GOES flare which started on 2012-01-27 17:37 and to a CME with speed 2508 km s^{-1} with first LASCO C2 appearance on 2012-01-27 18:27:52 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\mathrm{cm}^{-2}\mathrm{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-01-27 19:37	18	3.3 ± 0.5	102	14	Exp	0.31 ± 1.43	65 ± 33	>6
2012-01-27 21:08	28	0.72 ± 0.14	66	8	PL	-2.53 ± 0.20	-	-
2012-01-28 00:19	36	0.25 ± 0.09	19	1	PL	-2.60 ± 0.39	-	-

Table 40. Maximum likelihood results for FLSF 2012-01-27. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
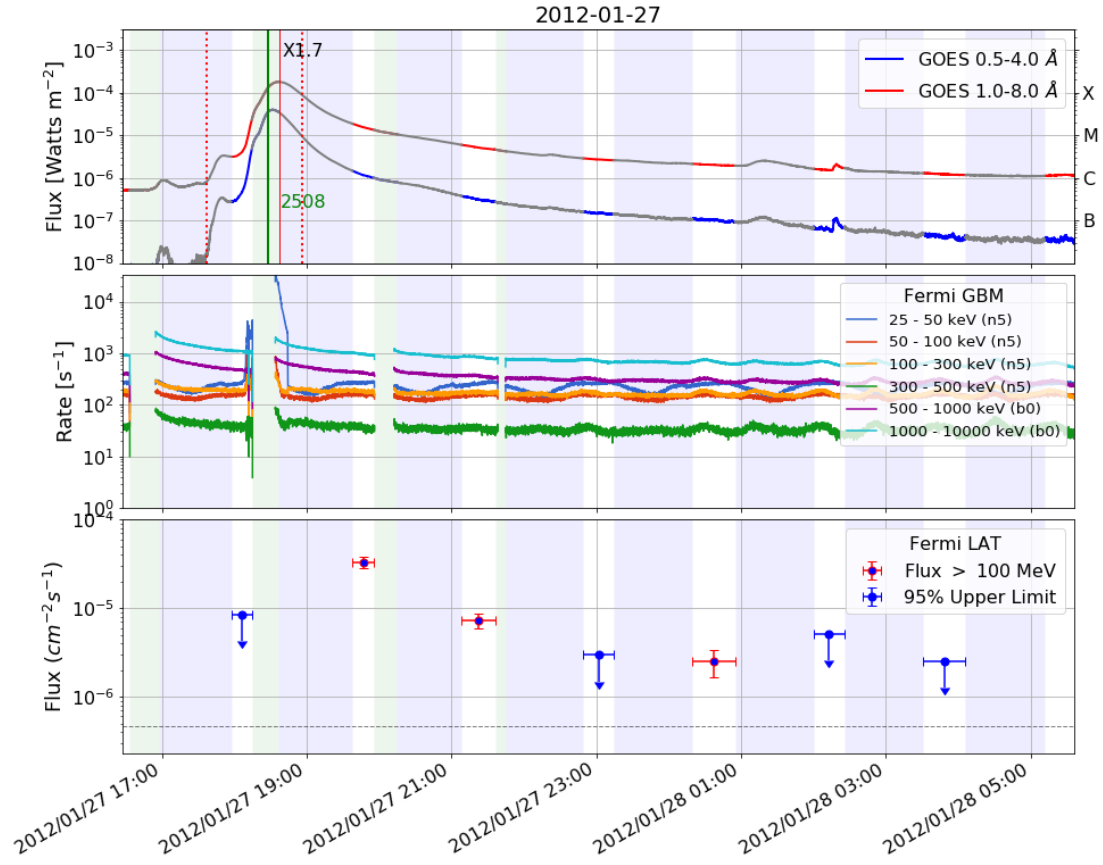
Figure 18. Light curve for FLSF 2012-01-27. From top to bottom: GOES X-rays, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.
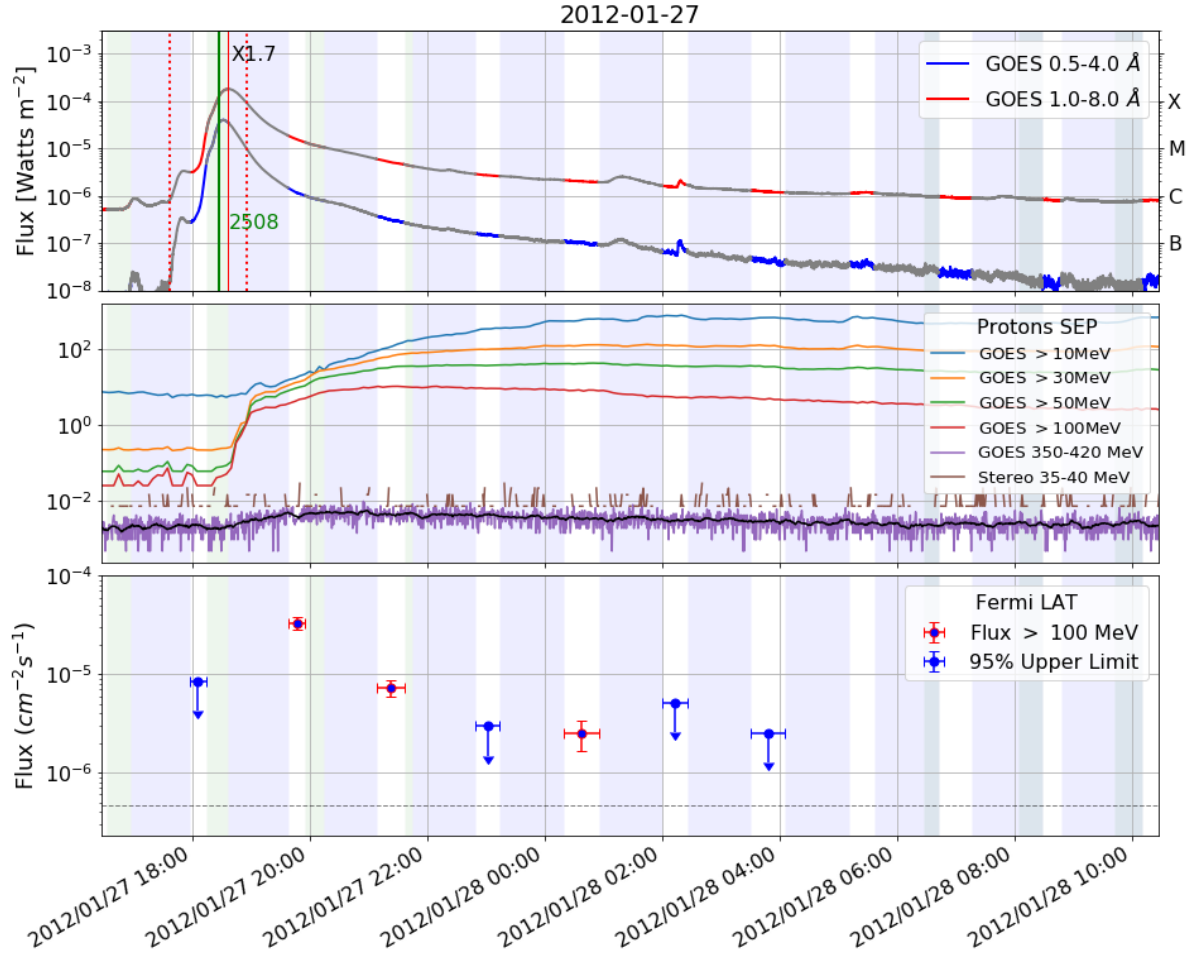
Figure 19. Composite light curve for FLSF 2012-01-27. Top panel shows the GOES X-rays, middle panel shows the GOES SEP count rate (ACE and Stereo data when avaliable), bottom panel shows the *Fermi*-LAT >100 MeV flux.

Time interval					Energy bin (MeV)						
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
19:37:57 - 19:55:41	$(5.6 \pm 2.1) \times 10^2$	$(2.8 \pm 0.7) \times 10^2$	93 ± 23	19 ± 7	<5.4	<1.7	<0.9	<0.6	<0.3	<0.2
21:08:26 - 21:36:42	$(1.0 \pm 0.5) \times 10^2$	79 ± 23	24 ± 8	5.0 ± 2.5	1.7 ± 1.0	<0.8	<0.4	<0.2	<0.1	<0.1
00:19:42 - 00:55:12	<207.0	<39.4	<12.8	<6.6	<3.4	<0.9	<0.4	<0.2	<0.1	<0.1

Table 41. SED values for the time resolved intervals of FLSF 2012-01-27. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.7	2012-01-27 17:37	2012-01-27 18:37	2012-01-27 18:56	100	NaI5

Table 42. Properties of the GOES X-ray flare associated with FLSF 2012-01-27 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
2508	2012-01-27 18:27	605	GOES

Table 43. Properties of the CME potentially associated with FLSF 2012-01-27 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.11. *FLSF 2012-03-05*

The Sun was in the field of view of the LAT from 2012-03-05 04:07 to 2012-03-05 07:54 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 4.4 hours. The flare is classified as Delayed. Most likely associated to a X1.1 GOES flare which started on 2012-03-05 02:30 and to a CME with speed 1531 km s^{-1} with first LASCO C2 appearance on 2012-03-05 04:00:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\mathrm{cm}^{-2}\mathrm{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-03-05 04:07	42	0.58 ± 0.09	100	11	Exp	0.34 ± 1.33	63 ± 31	>6
2012-03-05 05:36	48	0.63 ± 0.07	175	16	Exp	-0.20 ± 0.85	79 ± 31	>6
2012-03-05 07:18	36	0.55 ± 0.11	53	6	PL	-2.52 ± 0.21	-	-

Table 44. Maximum likelihood results for FLSF 2012-03-05. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
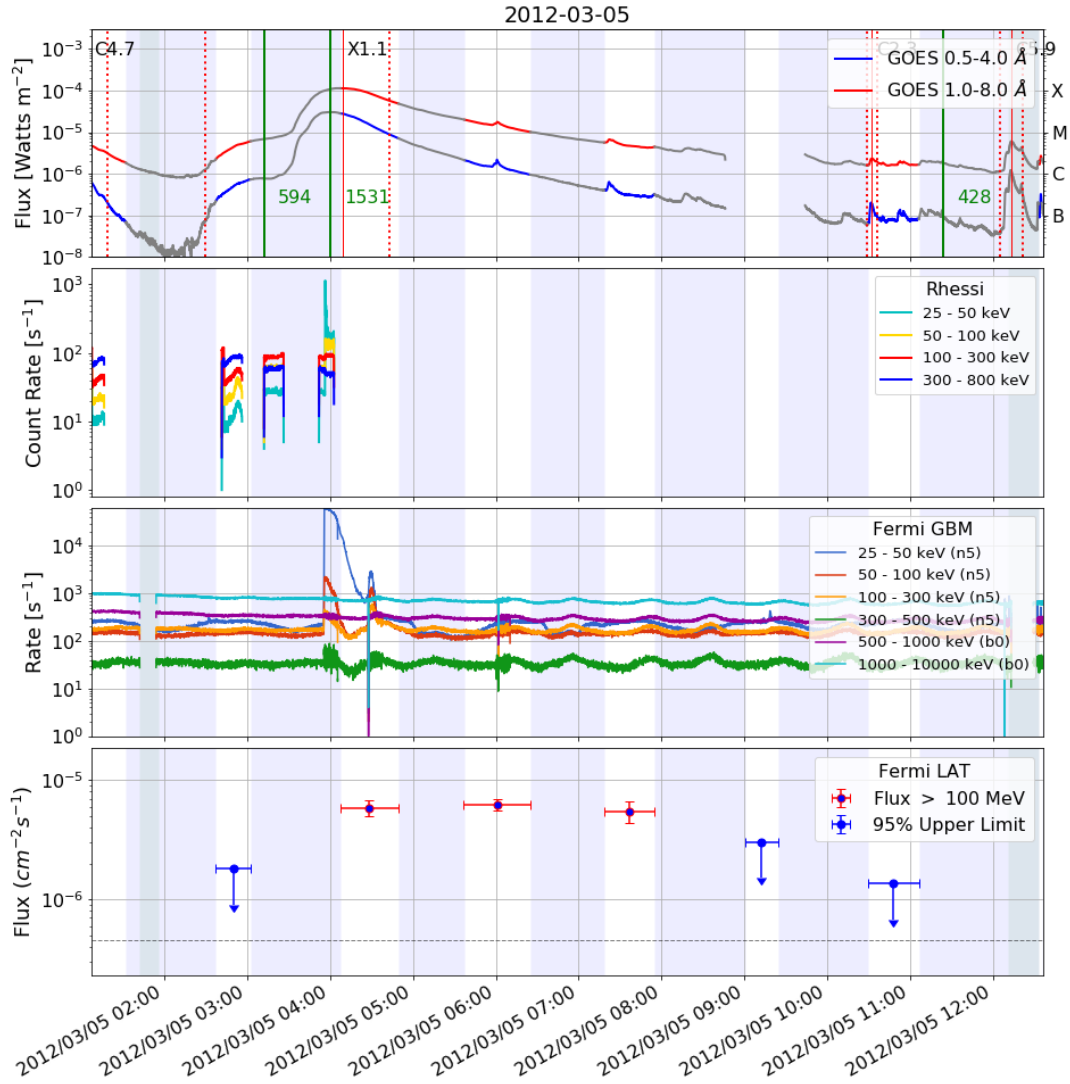
Figure 20. Light curve for FLSF 2012-03-05. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval					Energy bin (MeV)							
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
04:07:30 - 05:02:02	94 ± 33	61 ± 13	16 ± 4	<3.8	<1.2	<0.6	<0.2	<0.1	<0.1	<0.0
05:23:55 - 06:37:55	120 ± 25	50 ± 9	19 ± 4	2.0 ± 0.9	<1.2	<0.3	<0.1	<0.1	<0.1	<0.0
07:18:27 - 07:54:57	$(1.1 \pm 0.5) \times 10^2$	44 ± 16	19 ± 6	5.2 ± 2.2	<2.4	<1.0	<0.3	<0.2	<0.1	<0.1

Table 45. SED values for the time resolved intervals of FLSF 2012-03-05. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.1	2012-03-05 02:30	2012-03-05 04:09	2012-03-05 04:43	100	NaI5

Table 46. Properties of the GOES X-ray flare associated with FLSF 2012-03-05 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1531	2012-03-05 04:00	NaN	NaN

Table 47. Properties of the CME potentially associated with FLSF 2012-03-05 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.12. *FLSF 2012-03-07*

The Sun was in the field of view of the LAT from 2012-03-07 00:40 to 2012-03-07 20:15 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 20.3 hours. The flare is classified as Delayed. Most likely associated to a X5.4 GOES flare which started on 2012-03-07 00:02 and to a CME with speed 2684 km s^{-1} with first LASCO C2 appearance on 2012-03-07 00:24:06 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-03-07 00:40	40	233 ± 8 *	75611	-254574	Exp	-0.65 ± 0.03	182 ± 4	3.875 ± 0.025
2012-03-07 02:26	18	75.1 ± 2.6	2377	117	Exp	-1.45 ± 0.13	355 ± 47	3.77 ± 0.10
2012-03-07 03:51	40	95.1 ± 1.2	21100	1459	Exp	-0.84 ± 0.05	199 ± 8	4.01 ± 0.05
2012-03-07 05:38	18	97.3 ± 3.2	2675	249	Exp	-0.59 ± 0.17	147 ± 14	4.51 ± 0.13
2012-03-07 07:02	40	62.8 ± 1.0	12829	1210	Exp	-0.30 ± 0.08	120 ± 5	4.71 ± 0.07
2012-03-07 08:49	17	49.8 ± 2.5	1181	123	Exp	-0.17 ± 0.32	102 ± 14	5.17 ± 0.24
2012-03-07 10:14	25	26.8 ± 0.9	2803	344	Exp	0.27 ± 0.21	84 ± 7	5.28 ± 0.17
2012-03-07 13:24	13	8.6 ± 0.9	258	31	Exp	0.30 ± 0.75	78 ± 22	5.7 ± 0.6
2012-03-07 16:35	13	1.54 ± 0.32	49	10	Exp	1.41 ± 1.91	46 ± 23	>6
2012-03-07 18:23	9	2.2 ± 0.7	25	8	PL	-2.91 ± 0.41	-	-
2012-03-07 19:46	29	0.26 ± 0.08	22	3	PL	-2.37 ± 0.30	-	-

Table 48. Maximum likelihood results for FLSF 2012-03-07. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the `S15` event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
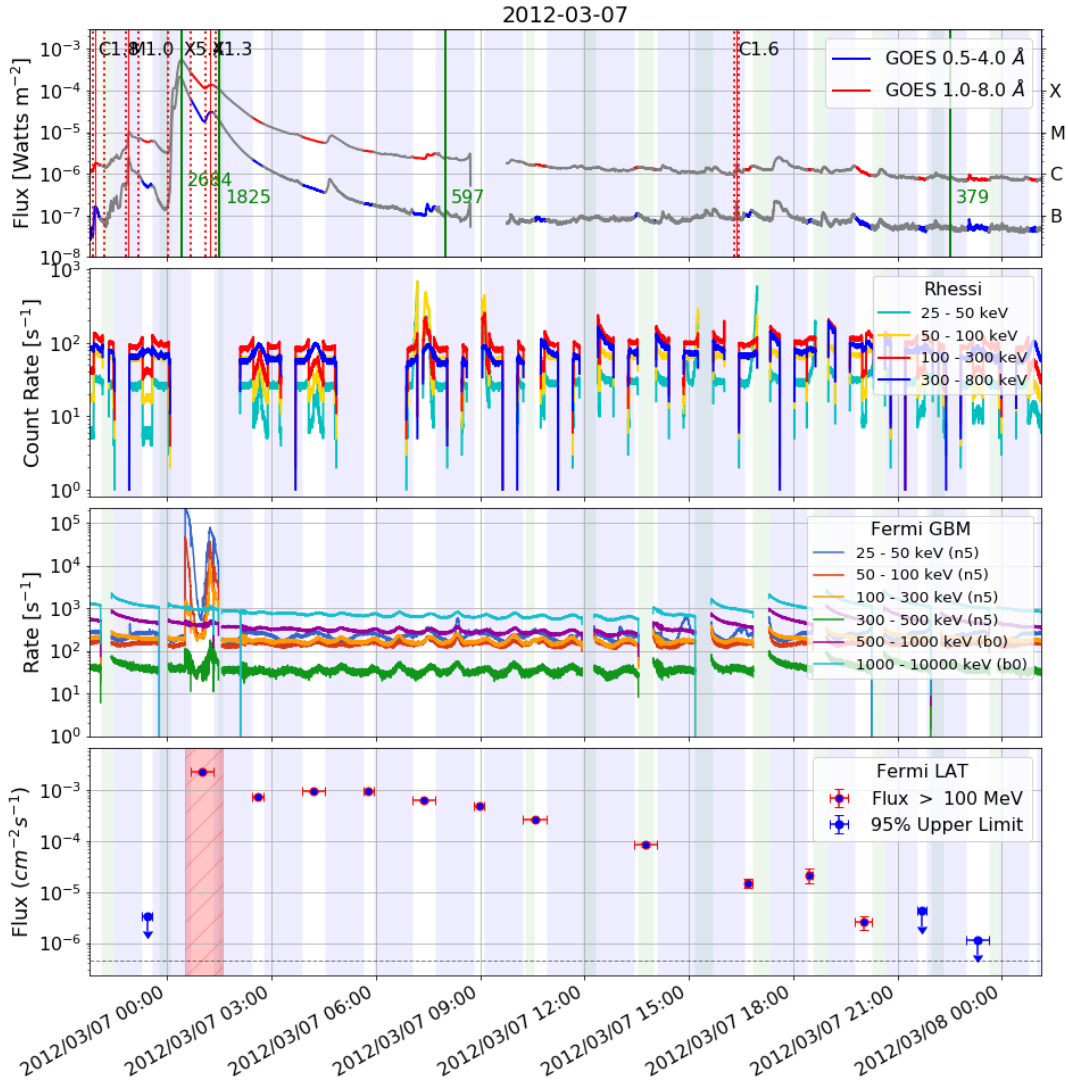
Figure 21. Light curve for FLSF 2012-03-07. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.
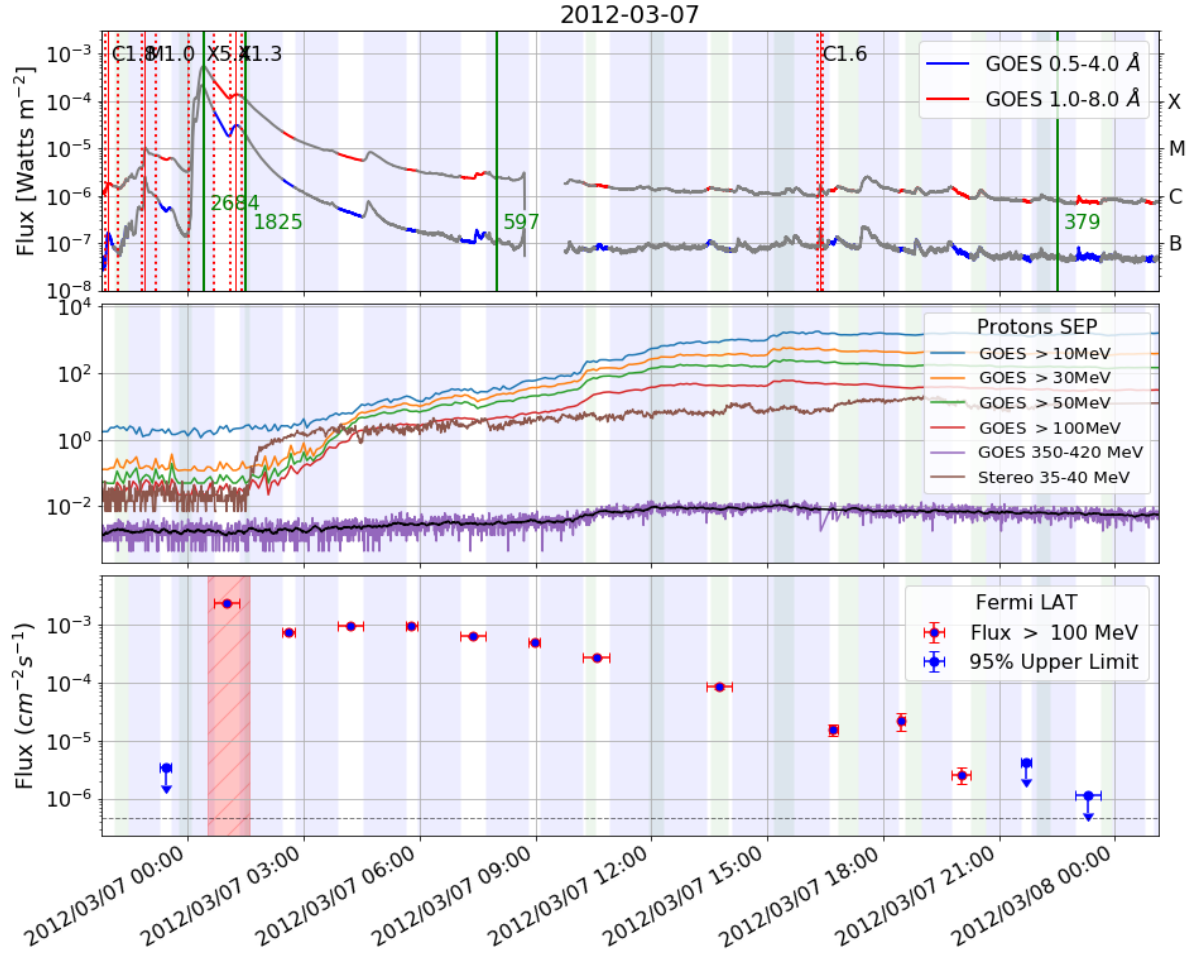
Figure 22. Composite light curve for FLSF 2012-03-07. Top panel shows the GOES X-rays, middle panel shows the GOES SEP count rate (ACE and Stereo data when avaliable), bottom panel shows the *Fermi*-LAT >100 MeV flux.
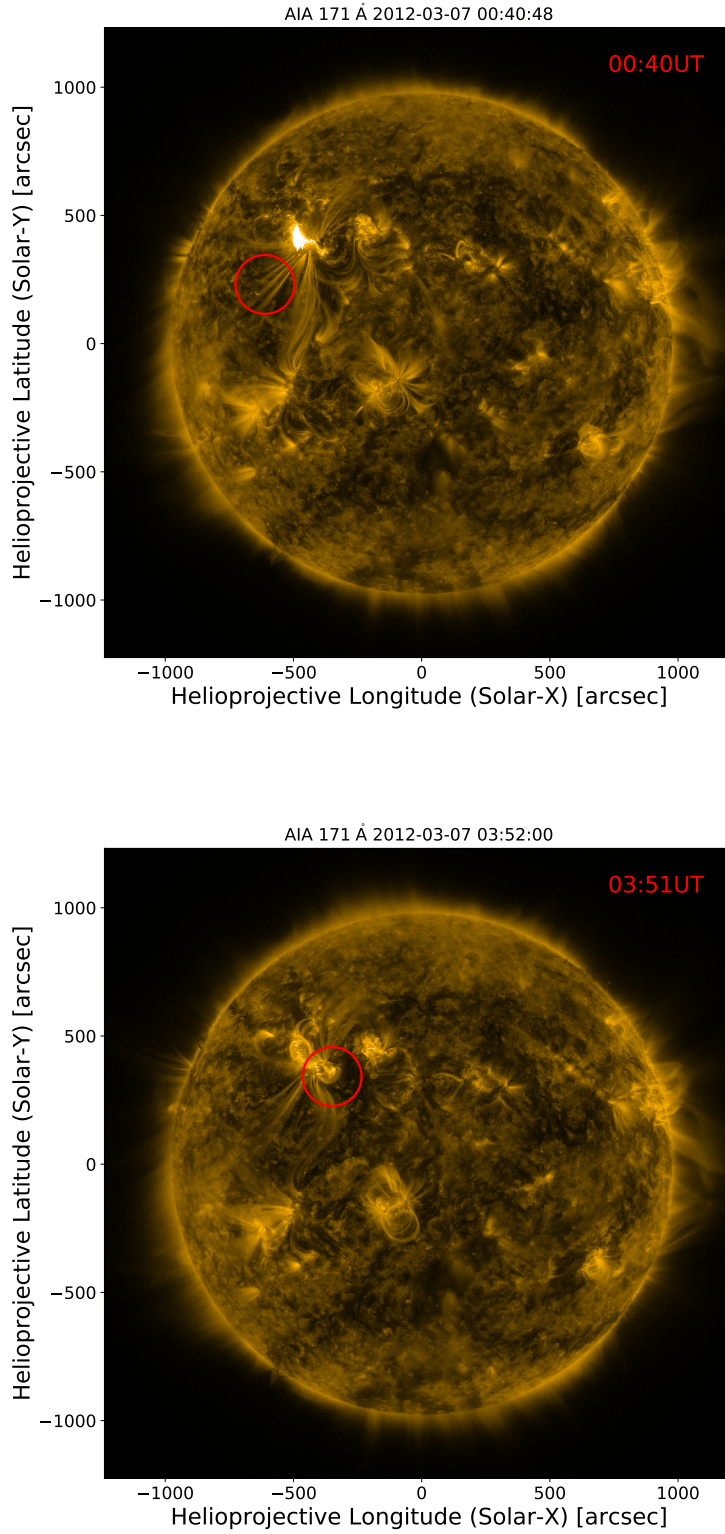
Figure 23. Time resolved localization of the >100 MeV emission from FLSF 2012-03-07. The mean time of the intergated time is annotated in the upper right hand corner of each panel. The radius of the emission centroid is the 68 percent containment. More information on the localization results can be found in Table 49.
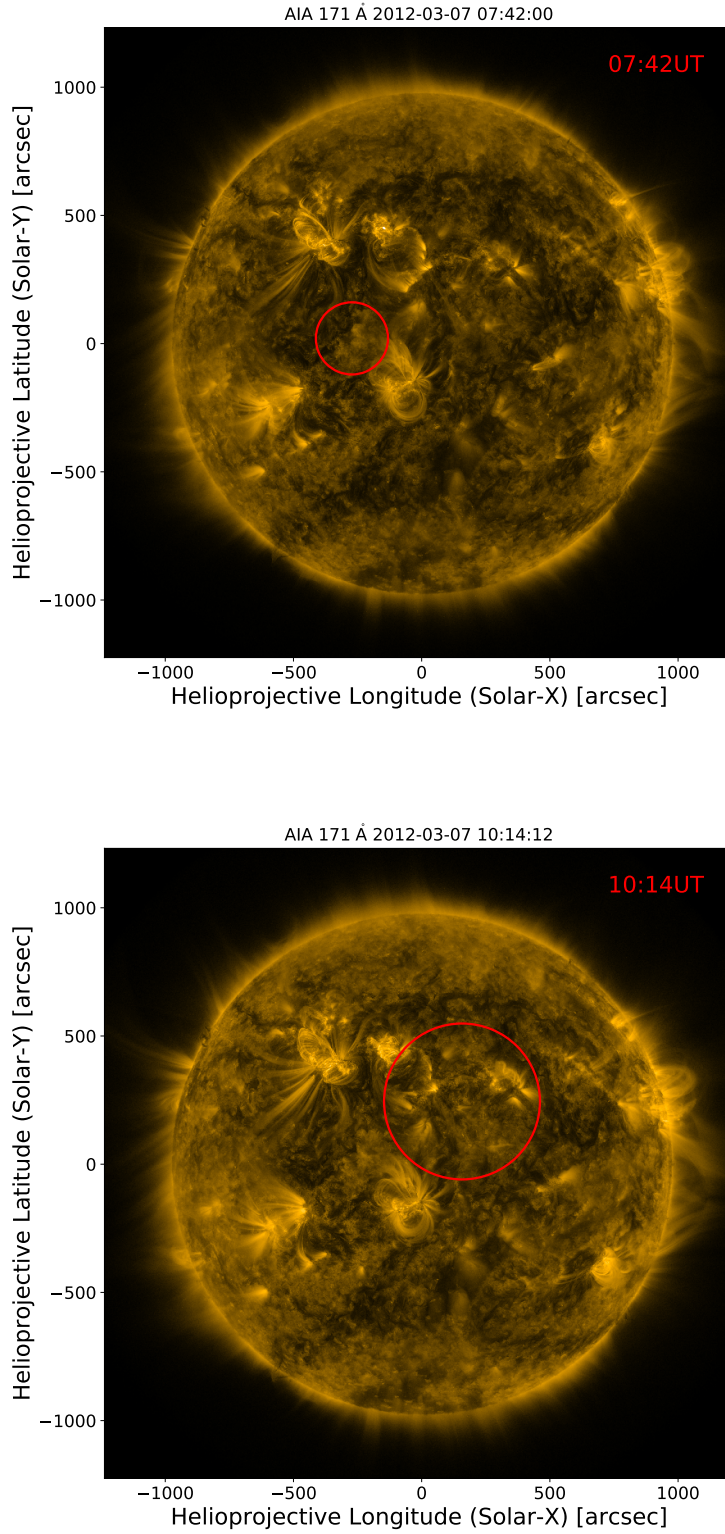
Figure 24. Time resolved localization of the >100 MeV emission from FLSF 2012-03-07. The mean time of the intergated time is annotated in the upper right hand corner of each panel. The radius of the emission centroid is the 68 percent containment. More information on the localization results can be found in Table 49.

Date and Time	Helio X	Helio Y	ERR 68	ERR 95
2012-03-07 00:40 - 01:20	-562	231	56	84
2012-03-07 03:51 - 04:31	-300	342	84	144
2012-03-07 07:02 - 07:42	-320	20	126	203
2012-03-07 10:14 - 10:54	207	245	291	462

Table 49. Localization results for FLSF 2012-03-07. The GOES X-ray flare associated with the FLSF originated from AR 11429 whose position at the time of the GOES flare was N17E15. All values are in arcseconds.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
00:40:41 - 01:20:11	$(2.90 \pm 0.05) \times 10^4$	$(1.871 \pm 0.022) \times 10^4$	$(8.06 \pm 0.10) \times 10^3$	$(2.38 \pm 0.04) \times 10^3$	426 ± 12	57.1 ± 3.2	6.1 ± 0.8	0.38 ± 0.16	<0.1	<0.1
02:26:54 - 02:45:24	$(1.08 \pm 0.13) \times 10^4$	$(5.0 \pm 0.4) \times 10^3$	$(2.16 \pm 0.13) \times 10^3$	$(6.0 \pm 0.4) \times 10^2$	120 ± 13	23 ± 4	2.8 ± 1.1	0.48 ± 0.34	<0.5	<0.3
03:51:53 - 04:31:23	$(1.16 \pm 0.04) \times 10^4$	$(6.53 \pm 0.15) \times 10^3$	$(2.74 \pm 0.06) \times 10^3$	785 ± 23	151 ± 7	17.4 ± 1.7	1.6 ± 0.4	<0.3	<0.1	<0.1
05:38:18 - 05:55:48	$(1.23 \pm 0.15) \times 10^4$	$(6.7 \pm 0.5) \times 10^3$	$(2.96 \pm 0.16) \times 10^3$	$(7.4 \pm 0.5) \times 10^2$	107 ± 13	11.6 ± 3.1	<1.3	<0.8	<0.5	<0.3
07:02:43 - 07:42:43	$(7.92 \pm 0.32) \times 10^3$	$(4.76 \pm 0.13) \times 10^3$	$(1.84 \pm 0.05) \times 10^3$	482 ± 18	58 ± 4	3.8 ± 0.8	<0.4	<0.2	<0.2	<0.1
08:49:38 - 09:06:38	$(5.5 \pm 1.0) \times 10^3$	$(4.6 \pm 0.4) \times 10^3$	$(1.27 \pm 0.11) \times 10^3$	$(3.6 \pm 0.4) \times 10^2$	37 ± 8	<2.6	<2.2	<0.8	<0.5	<0.3
10:14:03 - 10:54:01	$(3.37 \pm 0.29) \times 10^3$	$(2.16 \pm 0.12) \times 10^3$	$(8.2 \pm 0.5) \times 10^2$	176 ± 15	17.5 ± 3.3	<0.9	<0.5	<0.3	<0.2	<0.1
13:24:48 - 14:04:51	$(1.3 \pm 0.4) \times 10^3$	$(7.1 \pm 1.3) \times 10^2$	$(2.6 \pm 0.5) \times 10^2$	46 ± 13	3.7 ± 2.7	<2.9	<1.4	<0.8	<0.5	<0.3
16:35:54 - 16:48:48	<425.0	$(2.1 \pm 0.6) \times 10^2$	29 ± 14	8 ± 5	<3.4	<1.7	<1.0	<0.6	<0.3	<0.2
18:23:45 - 18:32:52	<1027.5	$(3.6 \pm 1.6) \times 10^2$	$(9 \pm 4) \times 10^1$	<32.1	<9.5	<4.8	<2.6	<1.9	<1.0	<0.6
19:46:53 - 20:15:28	<138.5	<33.2	8 ± 4	3.5 ± 1.8	<2.2	<1.0	<0.3	<0.2	<0.1	<0.1

Table 50. SED values for the time resolved intervals of FLSF 2012-03-07. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X5.4	2012-03-07 00:02	2012-03-07 00:24	2012-03-07 00:40	1000	BGO

Table 51. Properties of the GOES X-ray flare associated with FLSF 2012-03-07 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
2684	2012-03-07 00:24	605	GOES

Table 52. Properties of the CME potentially associated with FLSF 2012-03-07 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.13. *FLSF 2012-03-09*

The Sun was in the field of view of the LAT from 2012-03-09 05:12 to 2012-03-09 10:41 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 7.2 hours. The flare is classified as No-Prompt Delayed. Most likely associated to a M6.3 GOES flare which started on 2012-03-09 03:22 and to a CME with speed 950 km s^{-1} with first LASCO C2 appearance on 2012-03-09 04:26:09 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-03-09 05:12	43	0.27 ± 0.08	32	-0.2	PL	-2.24 ± 0.25	-	-
2012-03-09 06:47	43	0.96 ± 0.12	139	20	Exp	0.09 ± 0.92	87 ± 34	5.5 ± 0.7
2012-03-09 08:22	43	0.89 ± 0.12	140	28	Exp	1.78 ± 1.21	50 ± 15	5.6 ± 0.8
2012-03-09 09:58	22	0.43 ± 0.13	25	0.3	PL	-2.51 ± 0.32	-	-

Table 53. Maximum likelihood results for FLSF 2012-03-09. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
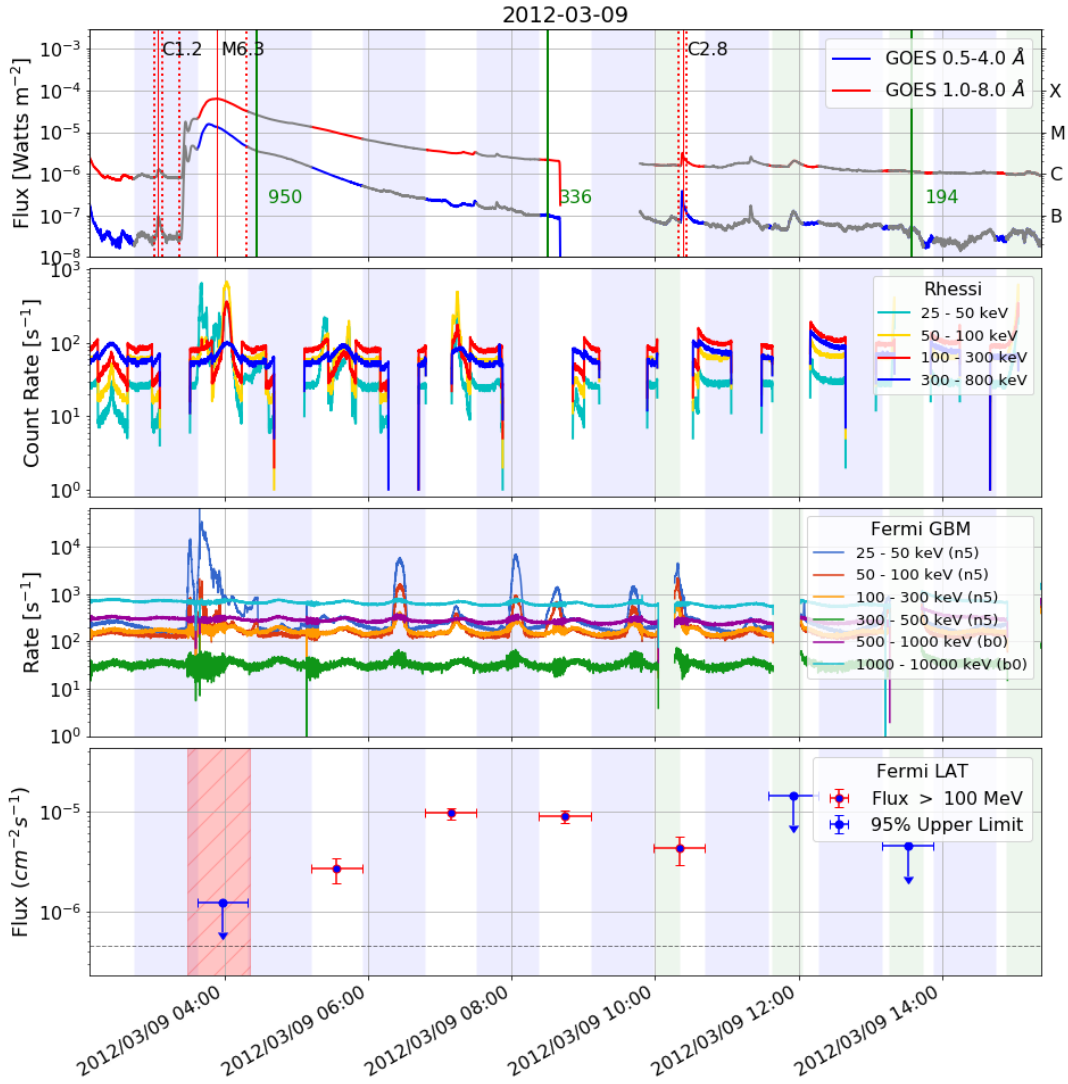
Figure 25. Light curve for FLSF 2012-03-09. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
05:12:07 - 05:55:07	<62.5	38 ± 13	6.9 ± 3.4	<5.6	<1.1	<1.1	<0.3	<0.1	<0.0	<0.1
06:47:32 - 07:30:32	$(1.9 \pm 0.5) \times 10^2$	60 ± 16	25 ± 6	8.2 ± 2.3	<1.6	<0.5	<0.3	<0.1	<0.1	<0.1
08:22:57 - 09:05:57	74 ± 34	80 ± 18	33 ± 7	4.0 ± 1.6	<1.3	<0.5	<0.4	<0.1	<0.1	<0.1
09:58:51 - 10:41:52	<181.0	46 ± 21	21 ± 8	<6.6	<1.9	<1.0	<0.9	<0.3	<0.2	<0.1

Table 54. SED values for the time resolved intervals of FLSF 2012-03-09. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M6.3	2012-03-09 03:22	2012-03-09 03:53	2012-03-09 04:18	100	NaI5

Table 55. Properties of the GOES X-ray flare associated with FLSF 2012-03-09 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
950	2012-03-09 04:26	NaN	NaN

Table 56. Properties of the CME potentially associated with FLSF 2012-03-09 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.14. *FLSF 2012-03-10*

The Sun was in the field of view of the LAT from 2012-03-10 21:00 to 2012-03-10 23:15 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 6.0 hours. The flare is classified as Delayed. Most likely associated to a M8.4 GOES flare which started on 2012-03-10 17:15 and to a CME with speed 1296 km s^{-1} with first LASCO C2 appearance on 2012-03-10 18:00:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-03-10 21:00	34	0.23 ± 0.06	25	2	PL	-2.50 ± 0.30	-	-
2012-03-10 22:35	40	0.19 ± 0.06	18	3	PL	-3.04 ± 0.40	-	-

Table 57. Maximum likelihood results for FLSF 2012-03-10. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
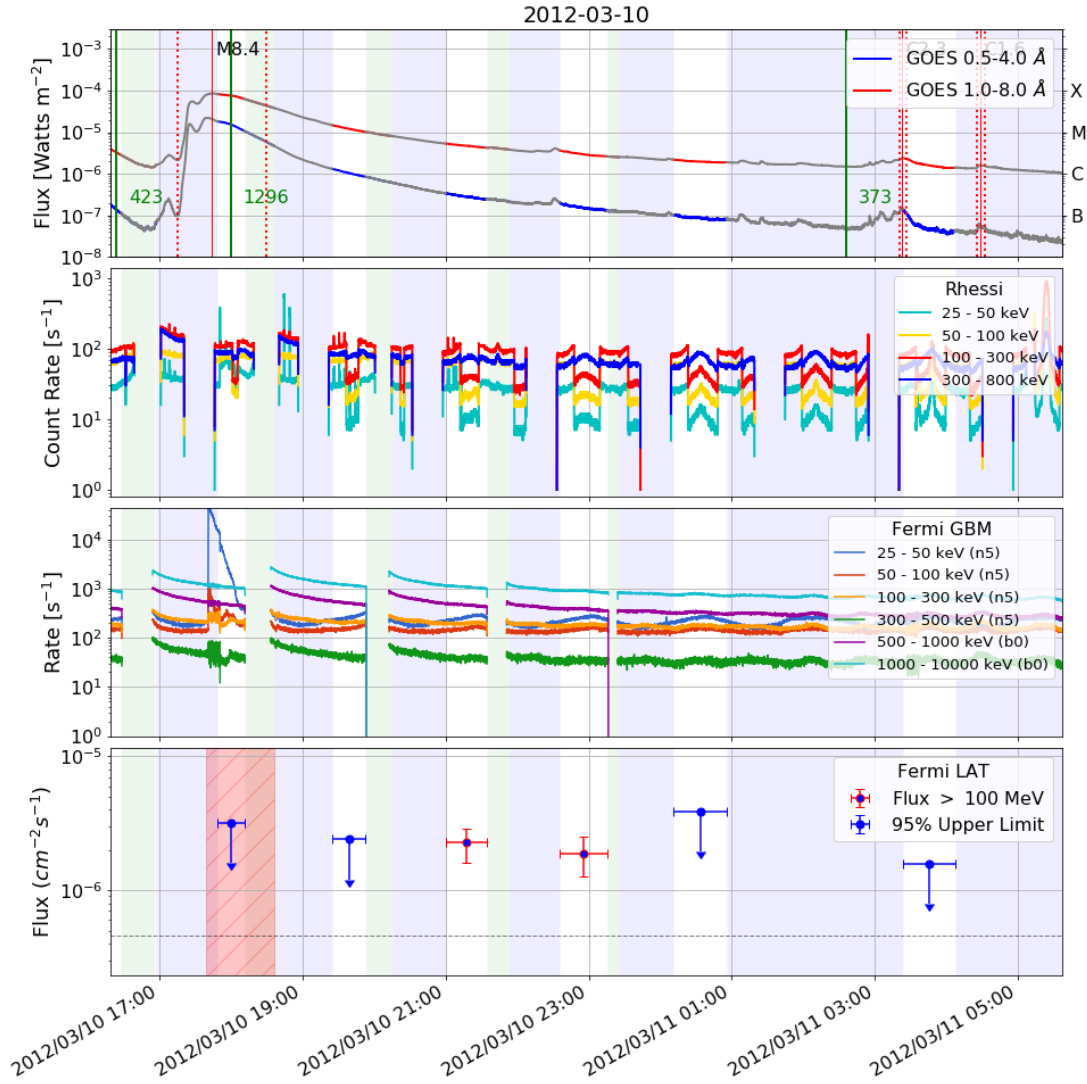
Figure 26. Light curve for FLSF 2012-03-10. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

| Time interval | Energy bin (MeV) | | | | | | | | | |
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
21:00:07 - 21:34:12	63 ± 30	<38.3	<11.6	<5.4	<2.3	<0.5	<0.3	<0.2	<0.1	<0.1
22:35:26 - 23:15:15	<101.2	<40.0	10 ± 4	<4.2	<0.8	<0.4	<0.2	<0.1	<0.1	<0.1

Table 58. SED values for the time resolved intervals of FLSF 2012-03-10. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M8.4	2012-03-10 17:15	2012-03-10 17:44	2012-03-10 18:30	50	NaI5

Table 59. Properties of the GOES X-ray flare associated with FLSF 2012-03-10 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1296	2012-03-10 18:00	NaN	NaN

Table 60. Properties of the CME potentially associated with FLSF 2012-03-10 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.15. *FLSF 2012-05-17*

The Sun was in the field of view of the LAT from 2012-05-17 02:12 to 2012-05-17 04:18 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 2.6 hours. The flare is classified as Delayed. Most likely associated to a M5.1 GOES flare which started on 2012-05-17 01:25 and to a CME with speed 1582 km s^{-1} with first LASCO C2 appearance on 2012-05-17 01:48:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-05-17 02:12	32	1.19 ± 0.19	100	10	Exp	-0.72 ± 0.77	207 ± 117	3.7 ± 0.5
2012-05-17 03:49	30	0.44 ± 0.13	29	7	PL	-2.30 ± 0.28	-	-

Table 61. Maximum likelihood results for FLSF 2012-05-17. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
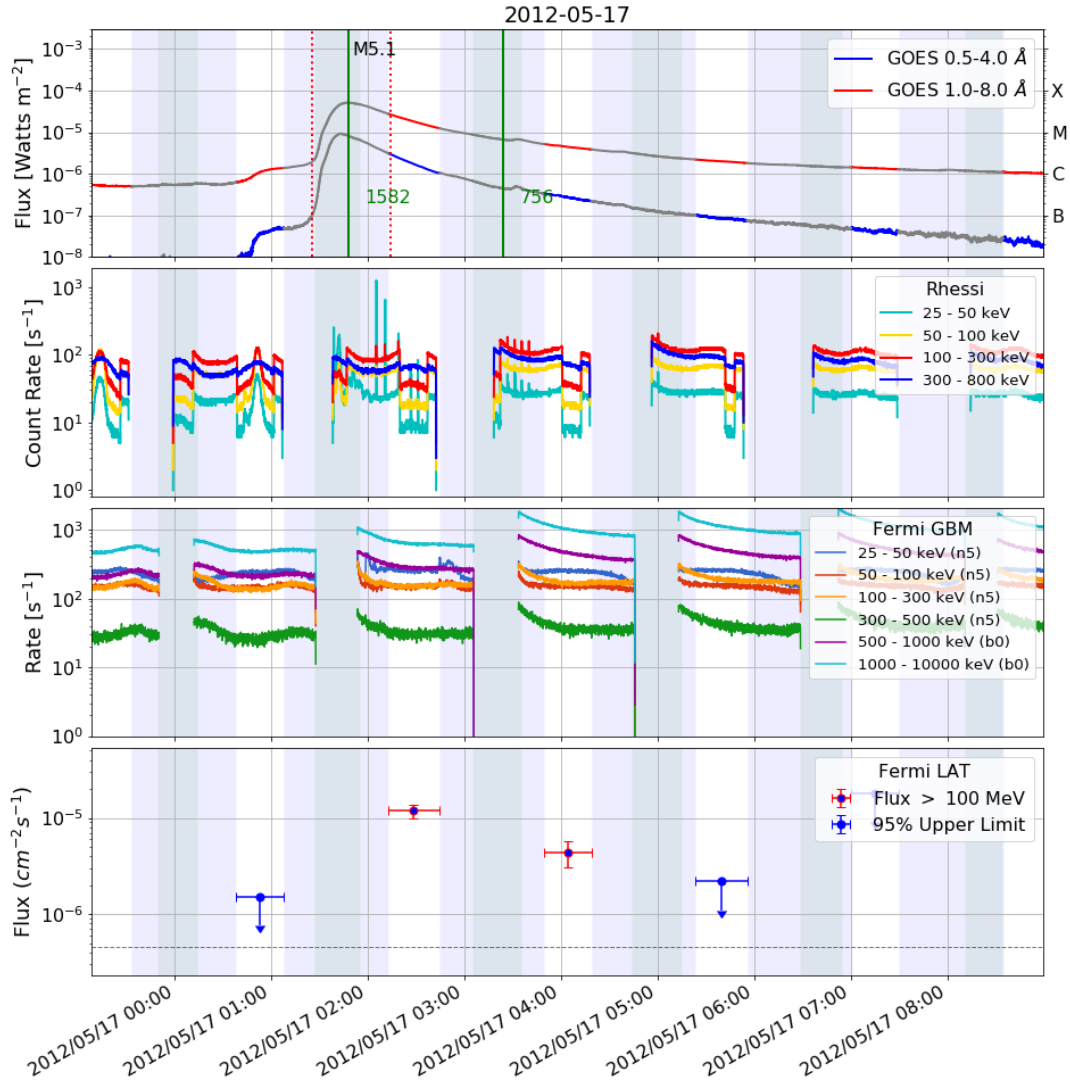
Figure 27. Light curve for FLSF 2012-05-17. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.
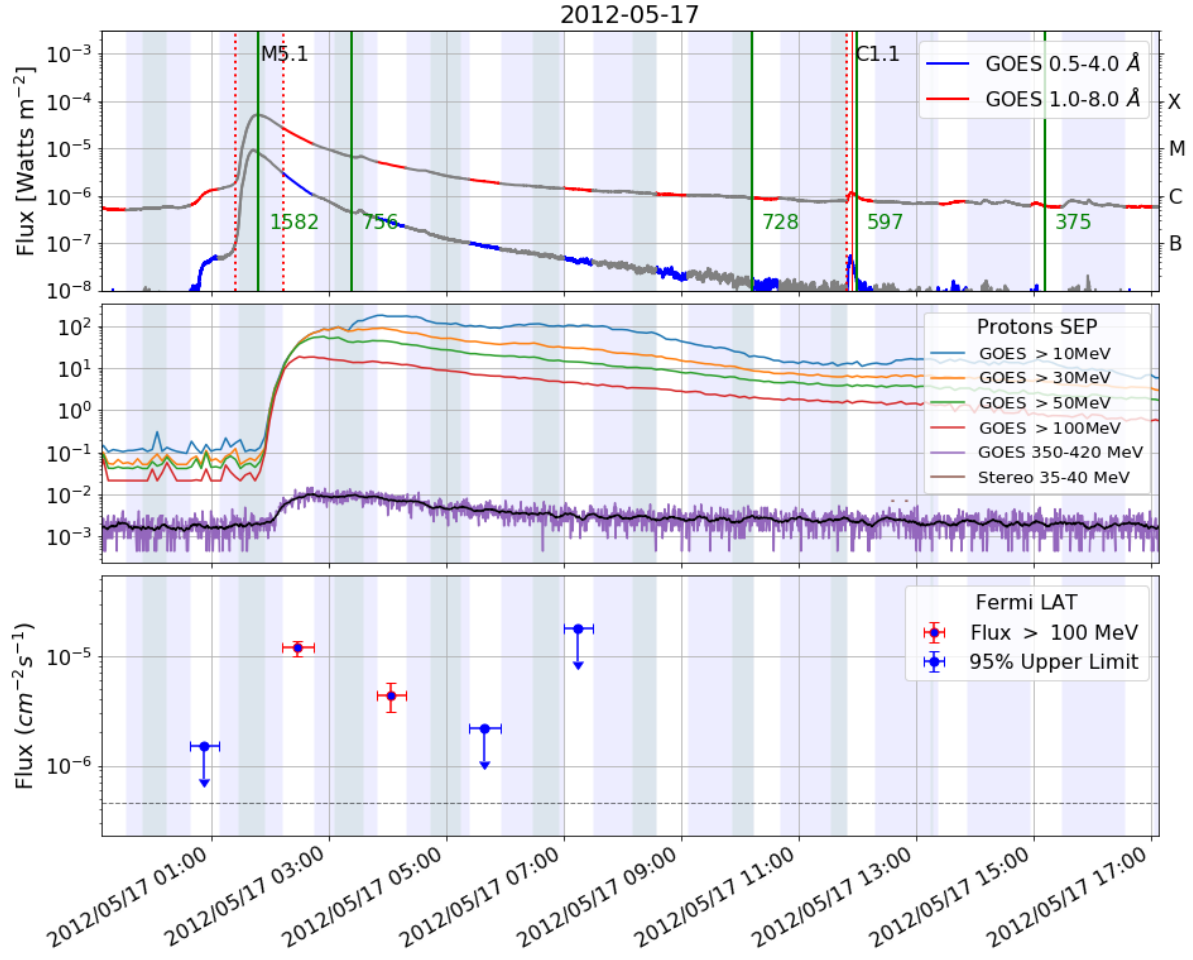
Figure 28. Composite light curve for FLSF 2012-05-17. Top panel shows the GOES X-rays, middle panel shows the GOES SEP count rate (ACE and Stereo data when avaliable), bottom panel shows the *Fermi*-LAT >100 MeV flux.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
02:12:24 - 02:44:24	$(1.4 \pm 0.7) \times 10^2$	63 ± 23	40 ± 10	9.4 ± 3.5	2.0 ± 1.1	<2.0	<0.4	<0.2	<0.2	<0.1
03:49:18 - 04:18:48	<197.5	<81.9	<21.5	5.6 ± 2.8	2.1 ± 1.2	<0.9	<0.5	<0.3	<0.2	<0.1

Table 62. SED values for the time resolved intervals of FLSF 2012-05-17. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M5.1	2012-05-17 01:25	2012-05-17 01:47	2012-05-17 02:14	100	Rhessi

Table 63. Properties of the GOES X-ray flare associated with FLSF 2012-05-17 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1582	2012-05-17 01:48	605	GOES

Table 64. Properties of the CME potentially associated with FLSF 2012-05-17 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.16. *FLSF 2012-06-03*

The Sun was in the field of view of the LAT from 2012-06-03 17:38 to 2012-06-03 18:02 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 1.9 hours. The flare is classified as LLE-Prompt Short-Delayed. Most likely associated to a M3.3 GOES flare which started on 2012-06-03 17:48 and to a CME with speed 605 km s^{-1} with first LASCO C2 appearance on 2012-06-03 18:12:05 UTC. Gamma-ray emission >30 MeV also detected with the LLE approach. The LLE emission started on 2012-06-03 17:53:20 (UTC) and ended on 2012-06-03 17:53:40 (UTC) with a total duration of 20 seconds.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-06-03 17:38	24	3.06 ± 0.25	395	39	Exp	-0.19 ± 0.63	104 ± 34	5.0 ± 0.4

Table 65. Maximum likelihood results for FLSF 2012-06-03. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.

Start Time (UTC)	Duration (sec)	Flux (30 MeV − 10 GeV)	Flux (100 MeV − 10 GeV)	TS cutoff	TS pion
2012-06-03 17:53:20	20.1	111 ± 5	50 ± 5	0	119

Table 66. LLE Spectral results for FLSF 2012-06-03. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
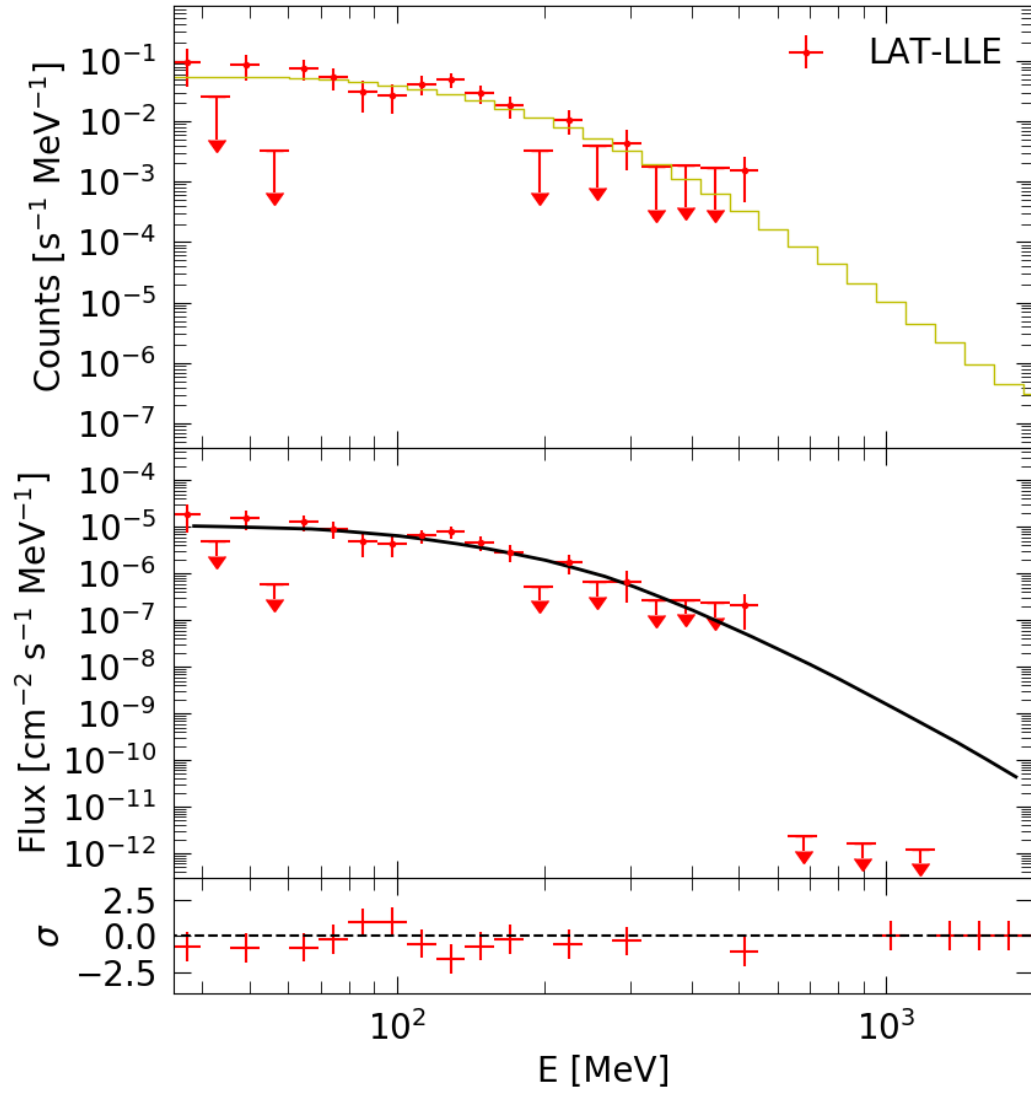
Figure 29. SED of FLSF 2012-06-03 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 66.
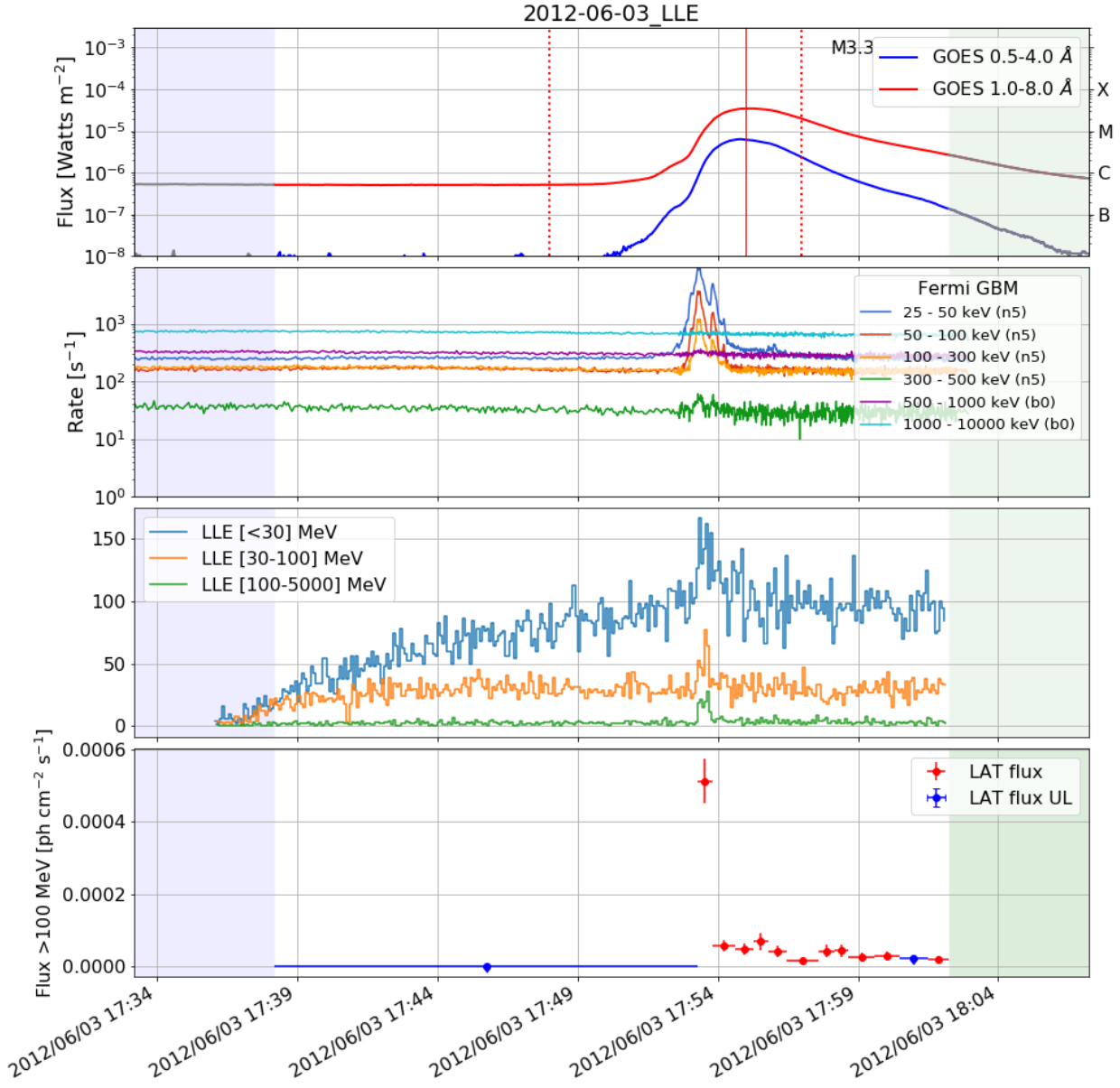
Figure 30. Fine time binning light curve for FLSF 2012-06-03. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate, *Fermi*-LLE, *Fermi*-LAT maximum likelihood results with fine time binning.
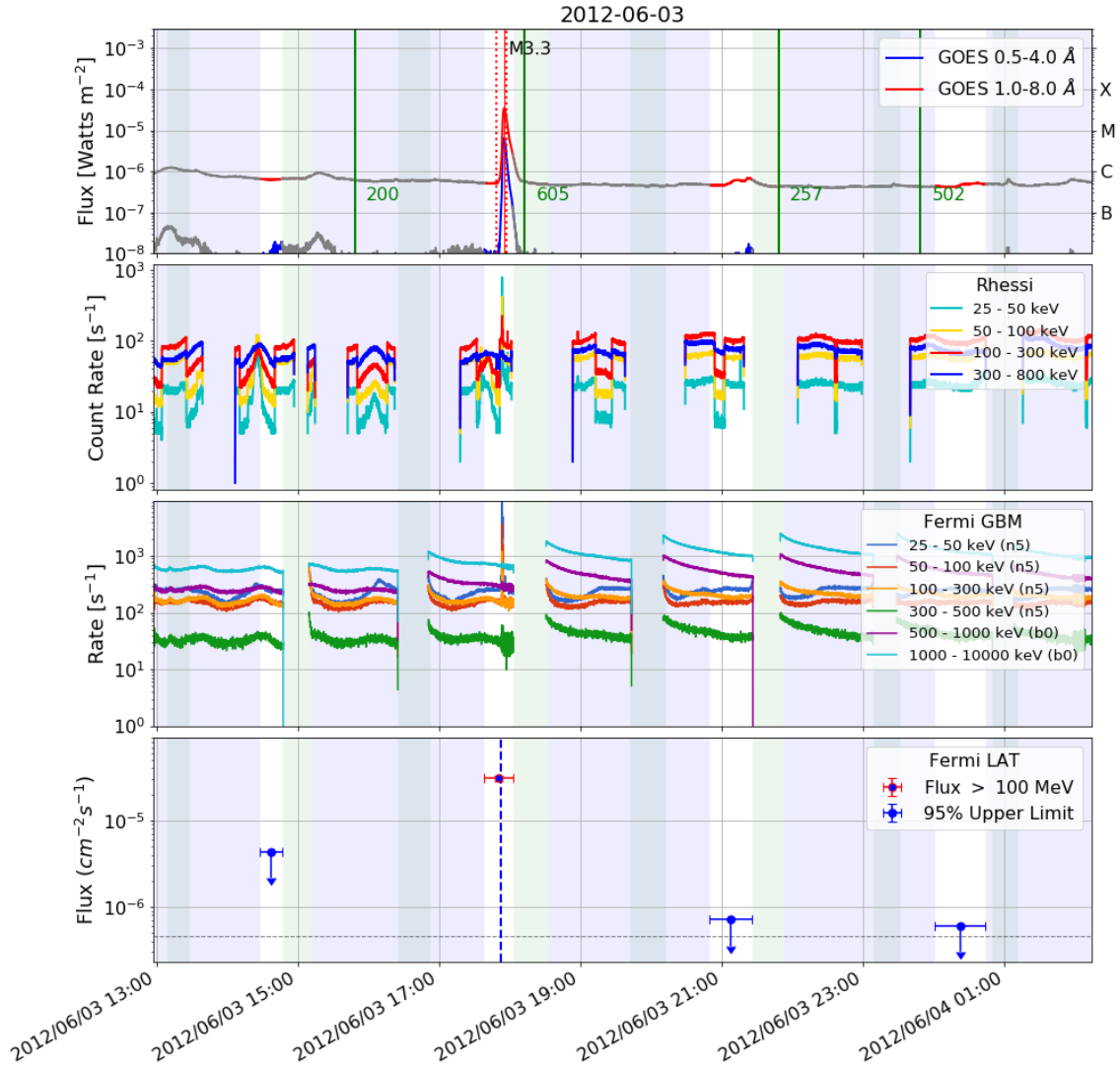
Figure 31. Light curve for FLSF 2012-06-03. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
17:38:11 - 18:02:14	$(3.4 \pm 0.8) \times 10^2$	$(2.9 \pm 0.4) \times 10^2$	83 ± 13	19 ± 4	2.5 ± 1.1	<1.4	<0.4	<0.2	<0.2	<0.1

Table 67. SED values for the time resolved intervals of FLSF 2012-06-03. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M3.3	2012-06-03 17:48	2012-06-03 17:55	2012-06-03 17:57	100	Rhessi

Table 68. Properties of the GOES X-ray flare associated with FLSF 2012-06-03 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
605	2012-06-03 18:12	NaN	NaN

Table 69. Properties of the CME potentially associated with FLSF 2012-06-03 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.17. *FLSF 2012-07-06*

The Sun was in the field of view of the LAT from 2012-07-06 23:20 to 2012-07-07 00:08 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 76 minutes. The flare is classified as Delayed. Most likely associated to a X1.1 GOES flare which started on 2012-07-06 23:01 and to a CME with speed 1828 km s^{-1} with first LASCO C2 appearance on 2012-07-06 23:24:06 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-07-06 23:20	48	3.06 ± 0.15	1173	143	Exp	0.40 ± 0.35	74 ± 10	5.75 ± 0.29

Table 70. Maximum likelihood results for FLSF 2012-07-06. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
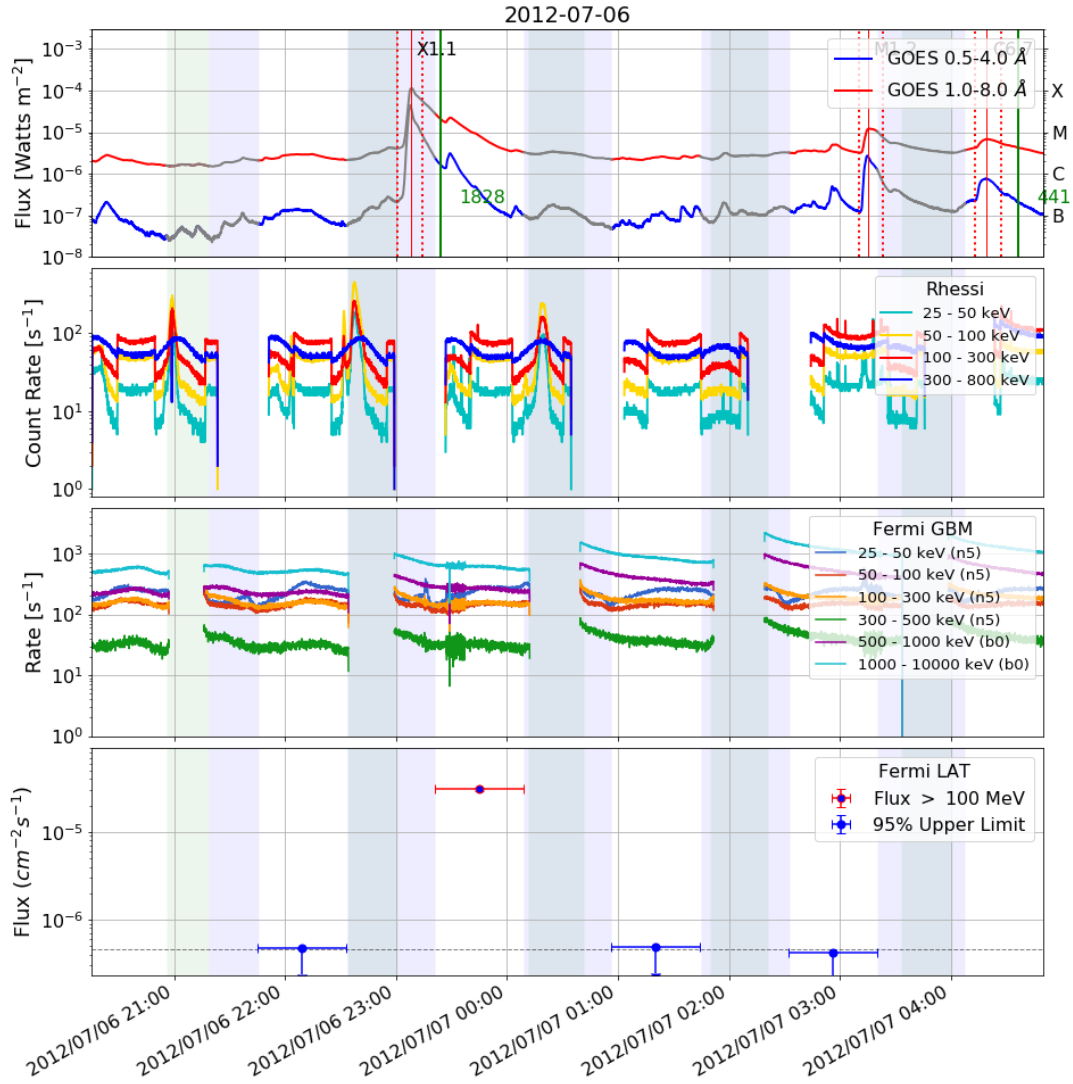
Figure 32. Light curve for FLSF 2012-07-06. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Date and Time	Helio X	Helio Y	ERR 68	ERR 95
2012-07-06 23:20 - 00:08	530	-432	362	586

Table 71. Localization results for FLSF 2012-07-06. The GOES X-ray flare associated with the FLSF originated from AR 11515 whose position at the time of the GOES flare was S18W64. All values are in arcseconds.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
23:17:02 - 00:11:01	$(4.3 \pm 0.5) \times 10^2$	254 ± 21	93 ± 8	17.7 ± 2.6	1.6 ± 0.6	<0.3	<0.2	<0.1	<0.1	<0.0

Table 72. SED values for the time resolved intervals of FLSF 2012-07-06. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.1	2012-07-06 23:01	2012-07-06 23:08	2012-07-06 23:14	0	

Table 73. Properties of the GOES X-ray flare associated with FLSF 2012-07-06 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1828	2012-07-06 23:24	100	GOES

Table 74. Properties of the CME potentially associated with FLSF 2012-07-06 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.18. *FLSF 2012-08-06*

Gamma-ray flare detected only in LLE. Emission started on 2012-08-06 04:36:01 (UTC) and ended on 2012-08-06 04:36:31 (UTC) with a total duration of 30 seconds. The flare is classified as LLE-Prompt. Most likely associated to a M1.6 GOES flare which started on 2012-08-06 04:33 and to a CME with speed 198 km s^{-1} with first LASCO C2 appearance on 2012-08-06 05:12:06 UTC.
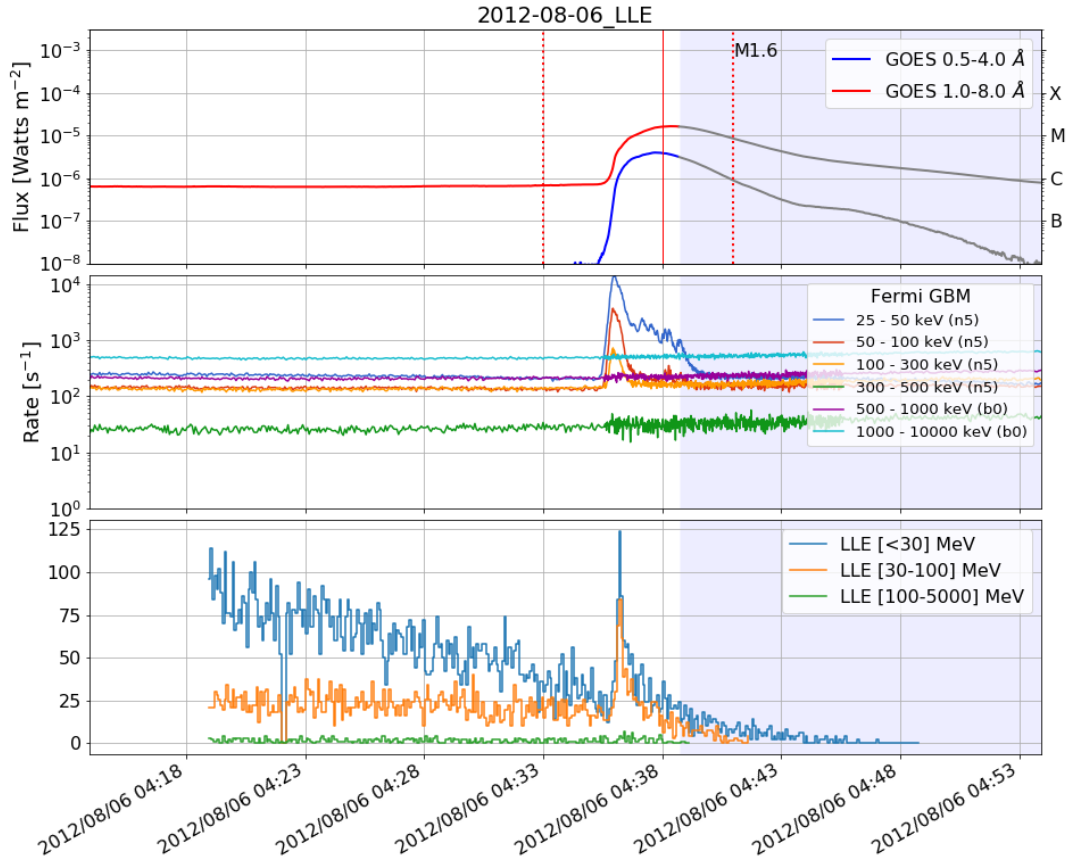
Figure 33. Light curve for FLSF 2012-08-06 using the LLE approach. From top to bottom: GOES X-rays, *Fermi*-GBM, *Fermi*-LLE.
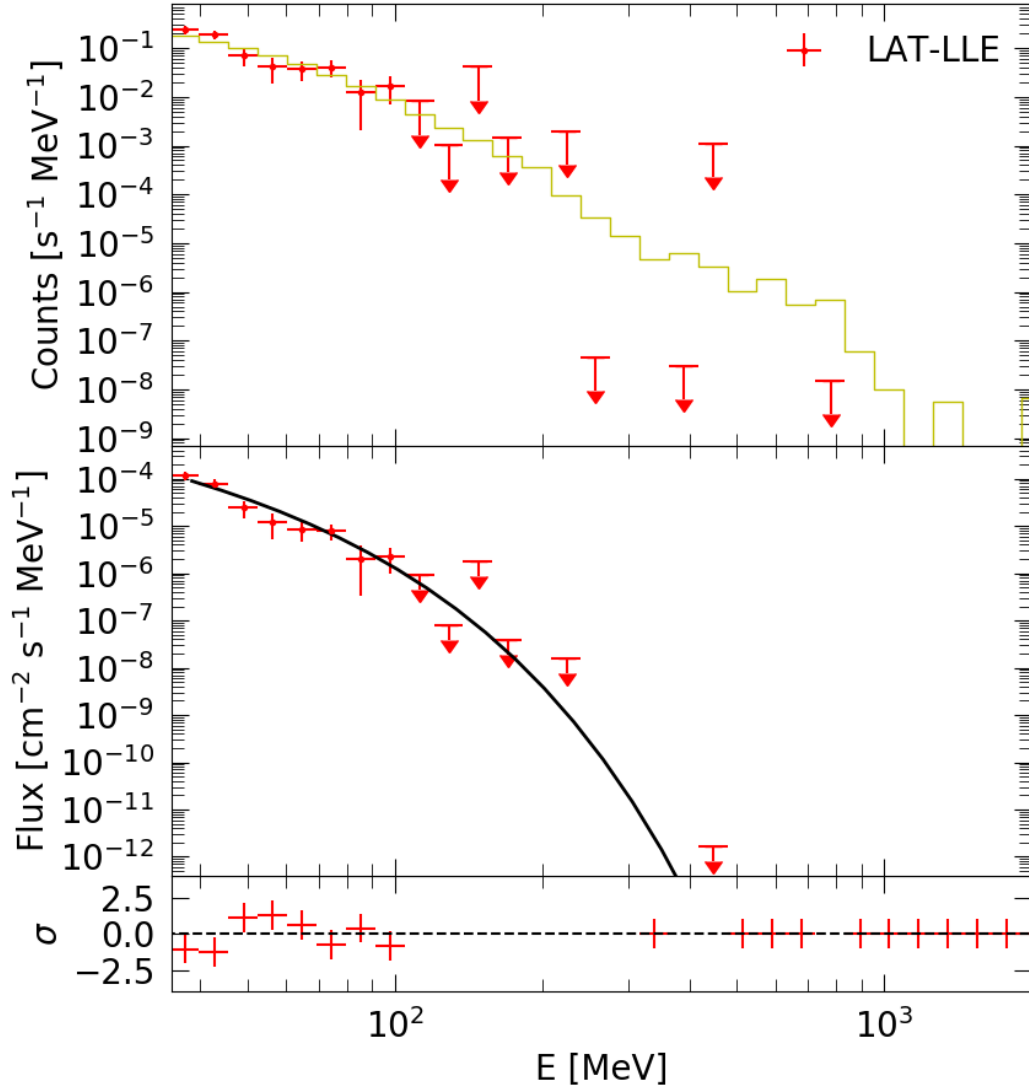
Figure 34. SED for FLSF 2012-08-06 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 75.

Start Time	Duration	Flux	Flux	TS cutoff	TS pion
(UTC)	(sec)	(30 MeV − 10 GeV)	(100 MeV − 10 GeV)		
2012-08-06 04:36:01	30.2	205 ± 5	1.79 ± 0.12	86	0

Table 75. LLE Spectral results for FLSF 2012-08-06. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
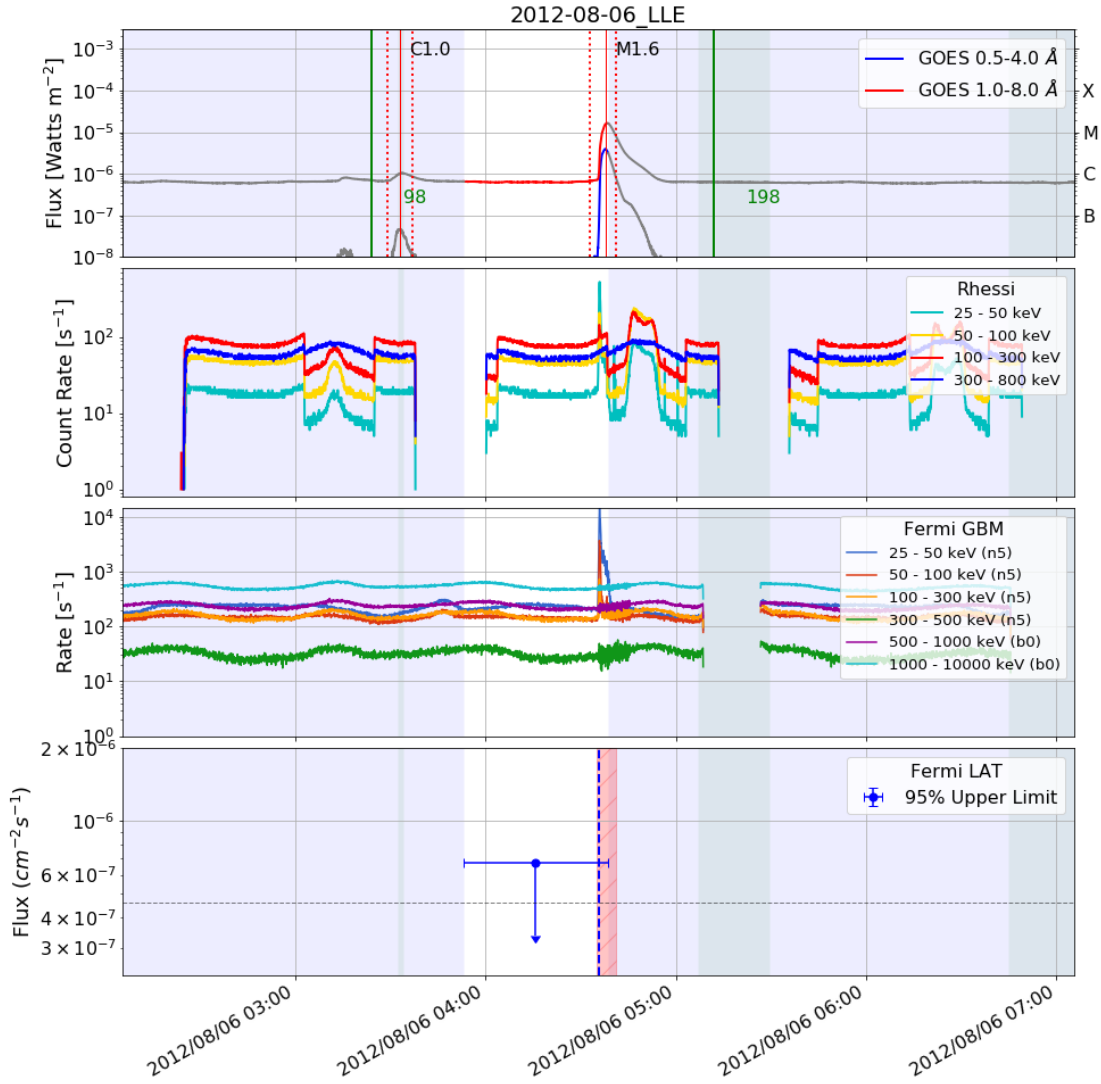
Figure 35. Light curve for FLSF 2012-08-06. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M1.6	2012-08-06 04:33	2012-08-06 04:38	2012-08-06 04:41	100	NaI5

Table 76. Properties of the GOES X-ray flare associated with FLSF 2012-08-06 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
198	2012-08-06 05:12	NaN	NaN

Table 77. Properties of the CME potentially associated with FLSF 2012-08-06 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.19. *FLSF 2012-10-23*

The Sun was in the field of view of the LAT from 2012-10-23 04:13 to 2012-10-23 04:43 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 1.9 hours. The flare is classified as LLE-Prompt Delayed. Most likely associated to a X1.8 GOES flare which started on 2012-10-23 03:13 and no CME associated with this flare. Gamma-ray emission >30 MeV also detected with the LLE approach. The LLE emission started on 2012-10-23 03:15:33 (UTC) and ended on 2012-10-23 03:15:53 (UTC) with a total duration of 20 seconds.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\mathrm{cm}^{-2}\mathrm{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-10-23 04:13	30	0.73 ± 0.18	39	9	PL	-2.73 ± 0.27	-	-

Table 78. Maximum likelihood results for FLSF 2012-10-23. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.

Start Time (UTC)	Duration (sec)	Flux (30 MeV – 10 GeV)	Flux (100 MeV – 10 GeV)	TS cutoff	TS pion
2012-10-23 03:15:33	20.0	$(3.08 \pm 0.27) \times 10^3$	105 ± 20	77	3

Table 79. LLE Spectral results for FLSF 2012-10-23. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
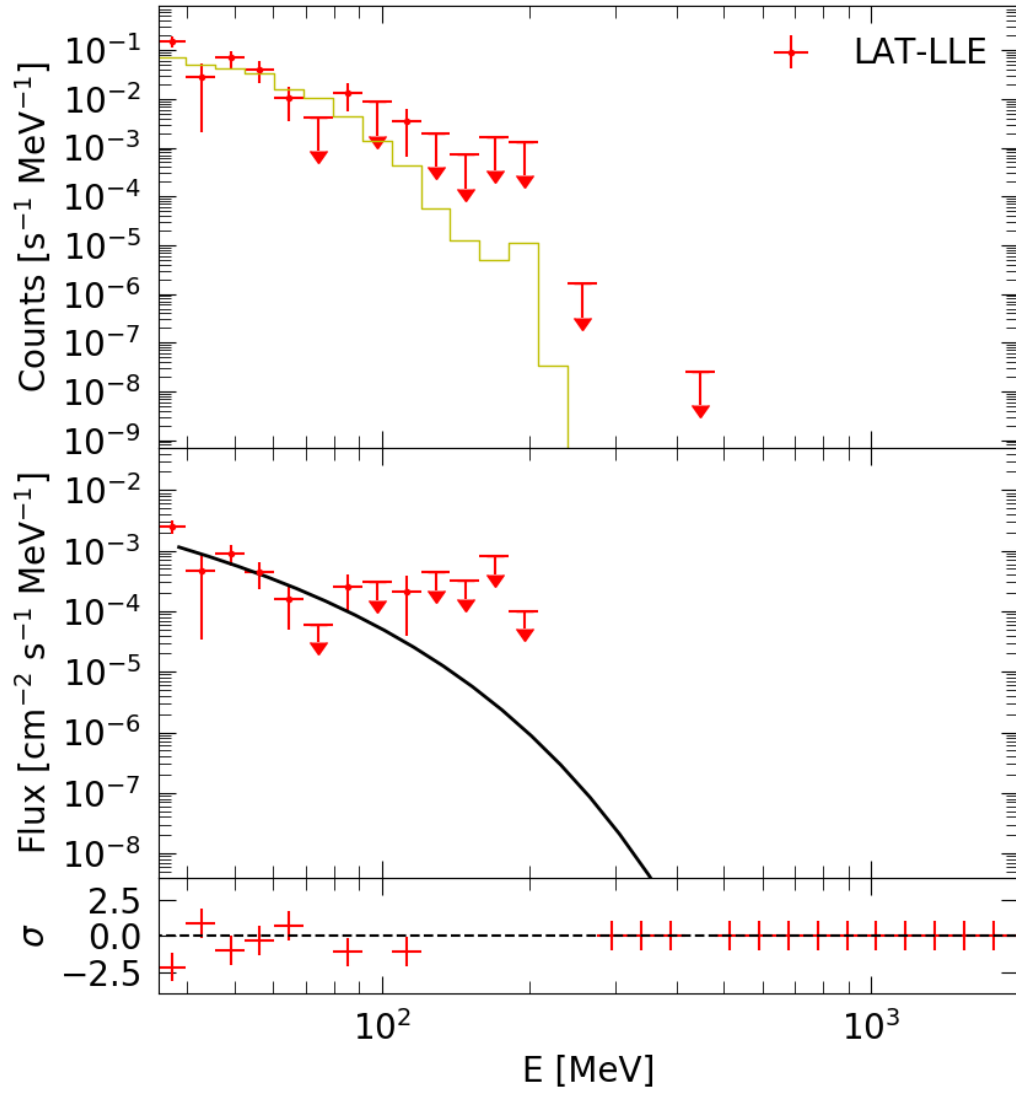
Figure 36. SED of FLSF 2012-10-23 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 79.
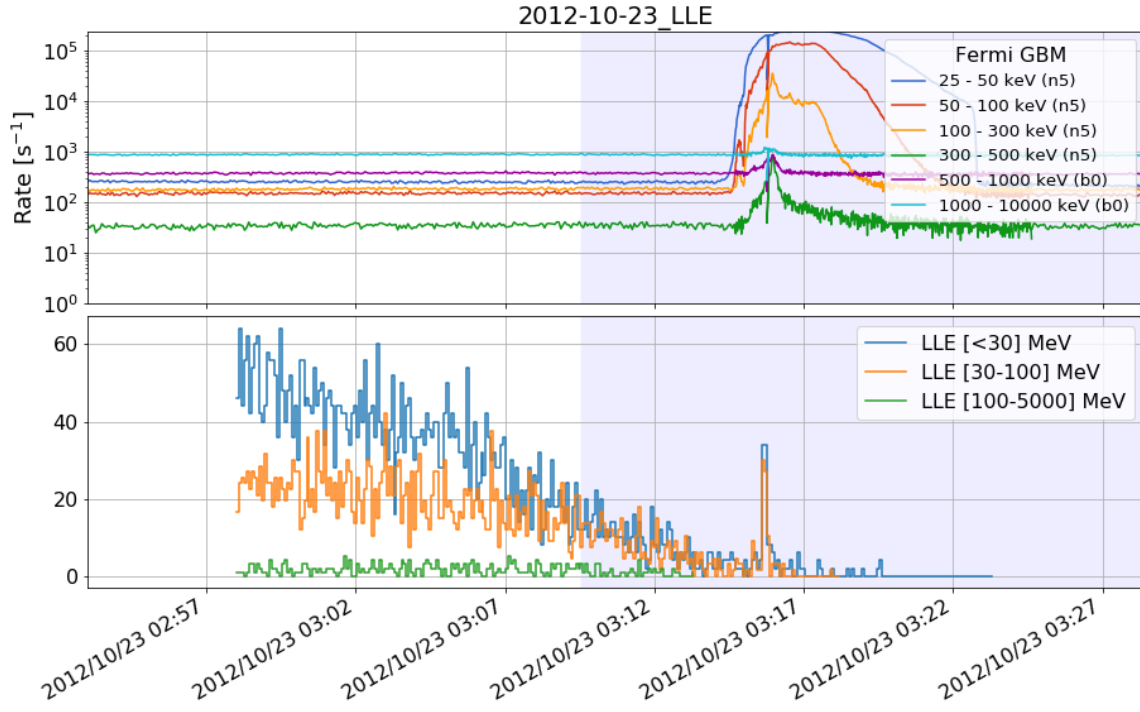
Figure 37. Light curve for FLSF 2012-10-23 with the LLE approach. Top panel: GOES X-rays, middle panel: Fermi-GBM X-rays and bottom panel: Fermi-LAT.
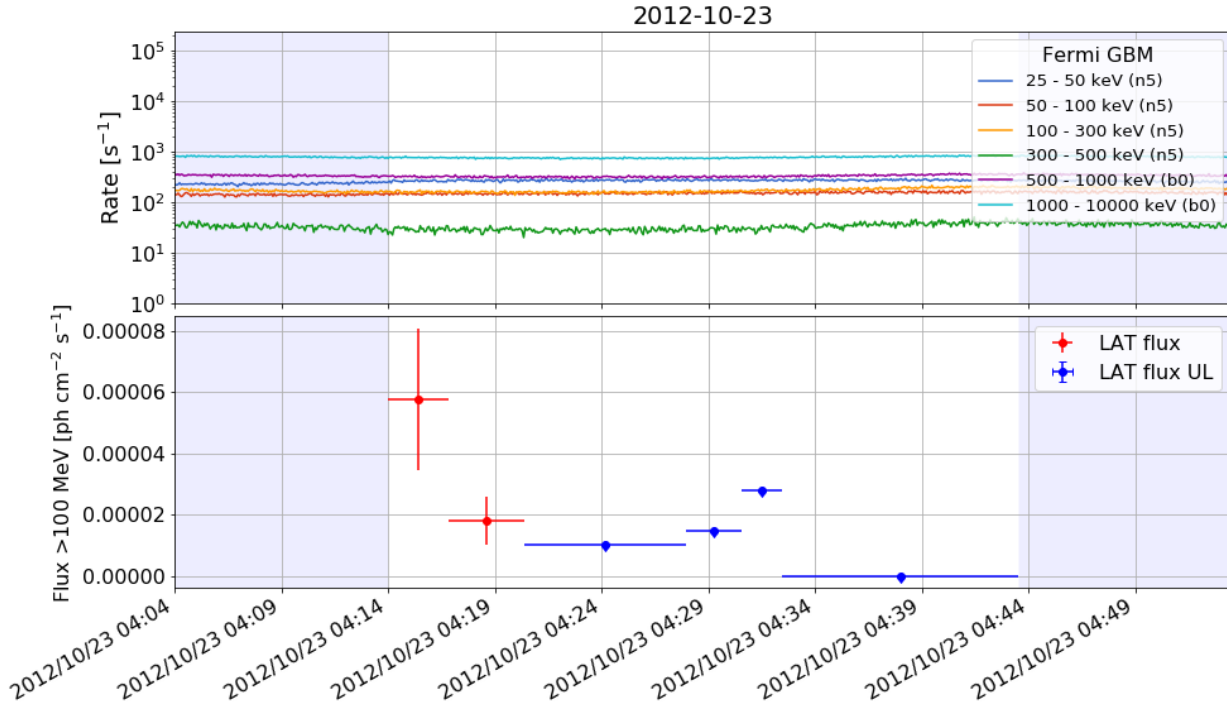
Figure 38. Fine time binning light curve for FLSF 2012-10-23. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate, *Fermi*-LAT maximum likelihood results with fine time binning.
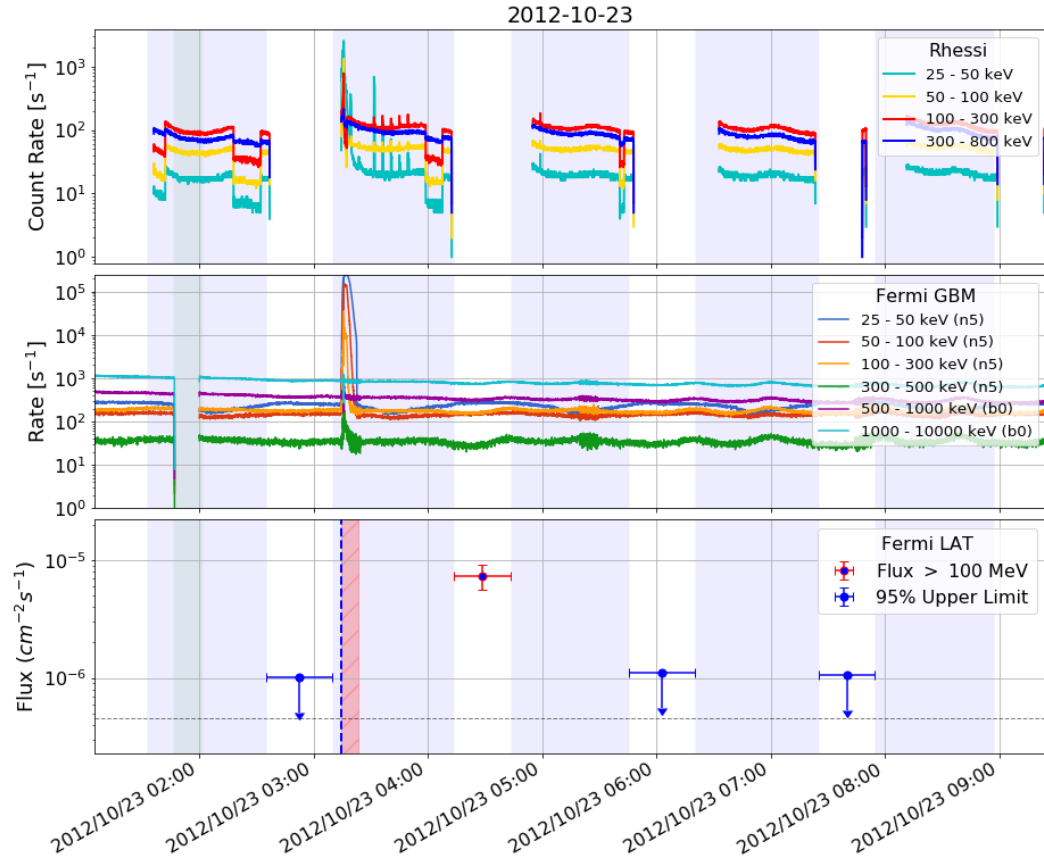
Figure 39. Light curve for FLSF 2012-10-23. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
04:13:59 - 04:43:29	<270.0	91 ± 30	32 ± 11	4.1 ± 2.6	<2.3	<1.0	<0.5	<0.3	<0.2	<0.1

Table 80. SED values for the time resolved intervals of FLSF 2012-10-23. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.8	2012-10-23 03:13	2012-10-23 03:17	2012-10-23 03:21	1000	BGO

Table 81. Properties of the GOES X-ray flare associated with FLSF 2012-10-23 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
-	None	NaN	NaN

Table 82. Properties of the CME potentially associated with FLSF 2012-10-23 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.20. *FLSF 2012-11-13*

The Sun was in the field of view of the LAT from 2012-11-13 01:34 to 2012-11-13 02:14 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 75 minutes. The flare is classified as Prompt. Most likely associated to a M6.0 GOES flare which started on 2012-11-13 01:58 and to a CME with speed 851 km s^{-1} with first LASCO C2 appearance on 2012-11-13 02:24:06 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-11-13 01:34	40	0.46 ± 0.09 *	60	7	PL	-2.61 ± 0.21	-	-

Table 83. Maximum likelihood results for FLSF 2012-11-13. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the S15 event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
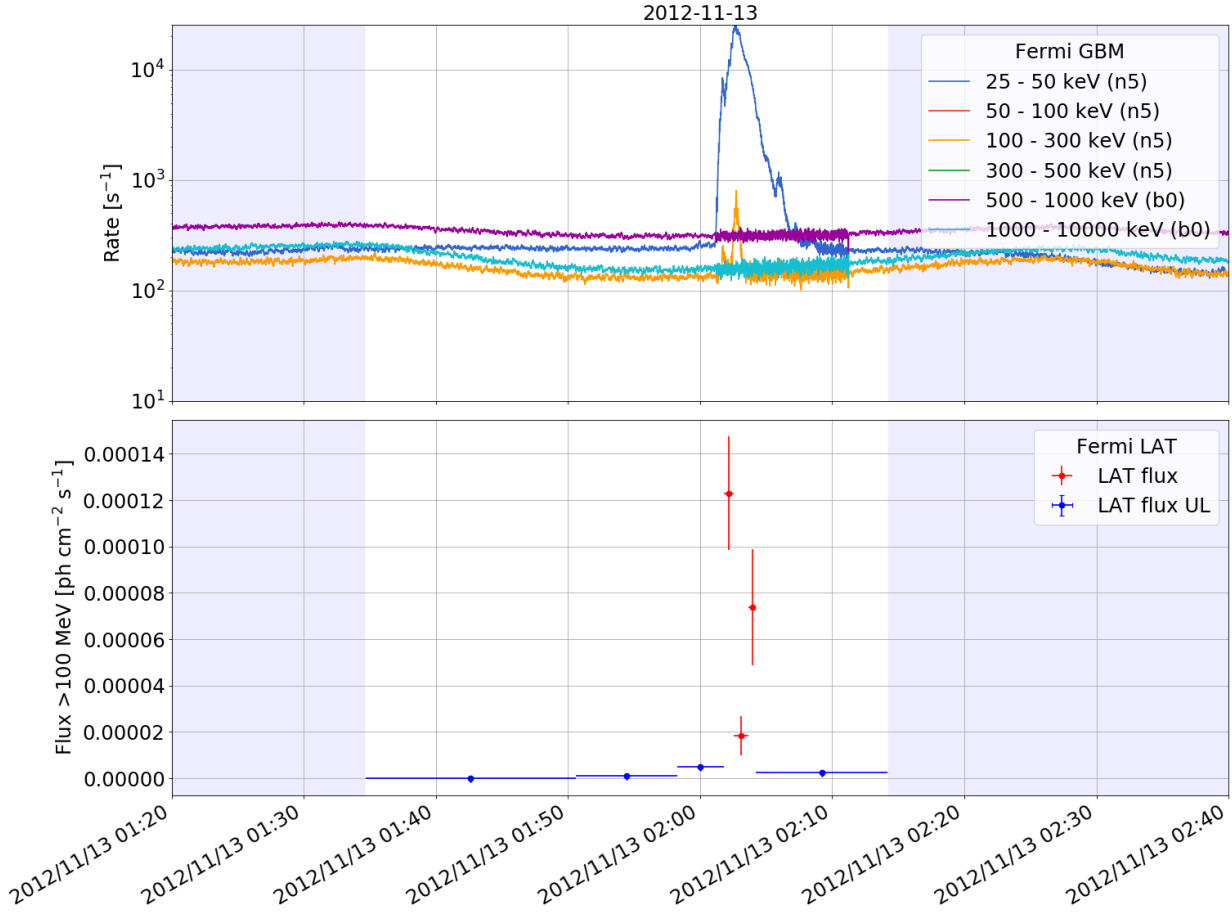
Figure 40. Fine time binning light curve for FLSF 2012-11-13. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate and the *Fermi*-LAT maximum likelihood results with fine time binning.
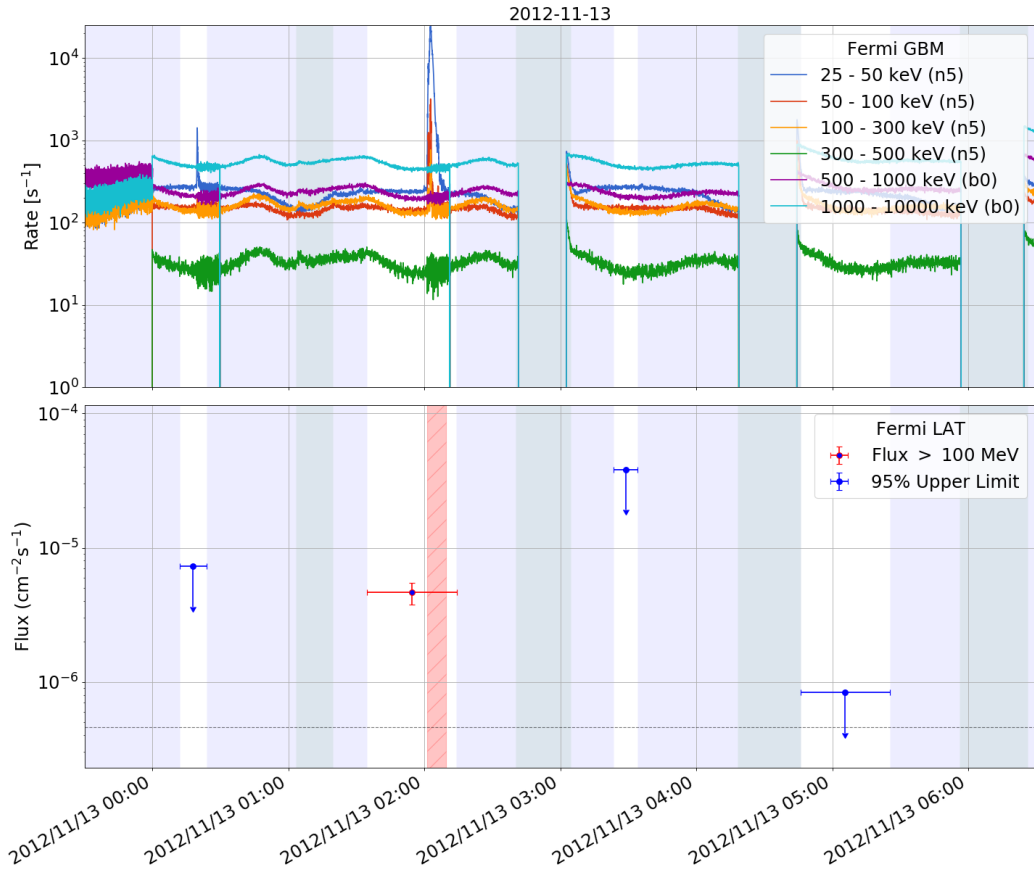
Figure 41. Light curve for FLSF 2012-11-13. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
01:34:40 - 02:14:10	110 ± 35	45 ± 12	11 ± 4	4.7 ± 1.7	<1.7	<0.6	<0.3	<0.2	<0.1	<0.1

Table 84. SED values for the time resolved intervals of FLSF 2012-11-13. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M6.0	2012-11-13 01:58	2012-11-13 02:04	2012-11-13 02:04	100	NaI5

Table 85. Properties of the GOES X-ray flare associated with FLSF 2012-11-13 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
851	2012-11-13 02:24	NaN	NaN

Table 86. Properties of the CME potentially associated with FLSF 2012-11-13 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.21. *FLSF 2012-11-27*

The Sun was in the field of view of the LAT from 2012-11-27 15:48 to 2012-11-27 16:34 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 10 minutes. The flare is classified as Prompt Short-Delayed. Most likely associated to a M1.6 GOES flare which started on 2012-11-27 15:52 and no CME associated with this flare.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\mathrm{cm}^{-2}\mathrm{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2012-11-27 15:48	46	0.27 ± 0.07	44	2	PL	-2.22 ± 0.21	-	-

Table 87. Maximum likelihood results for FLSF 2012-11-27. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
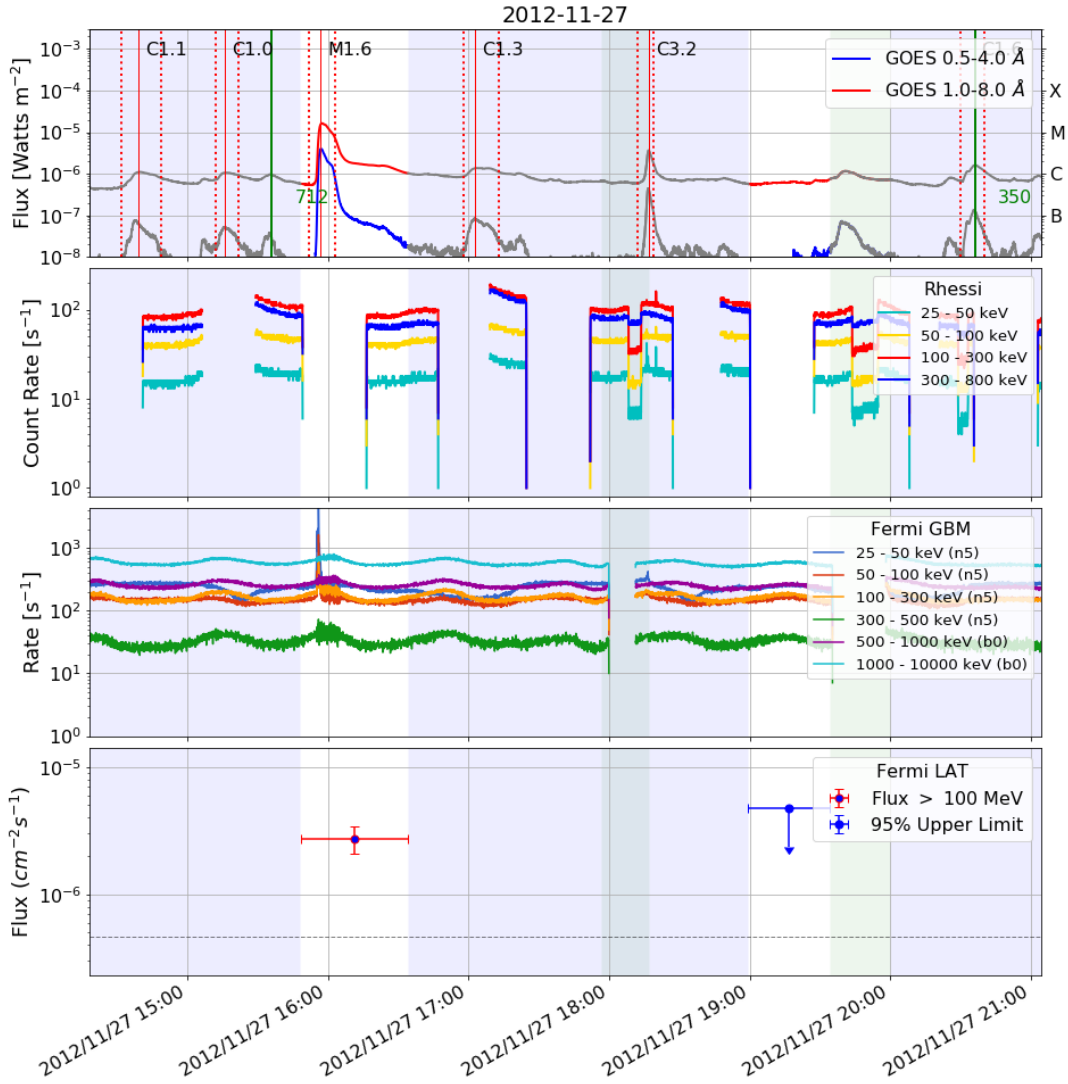
Figure 42. Light curve for FLSF 2012-11-27. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)										
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
15:48:20 - 16:40:20	<85.0	23 ± 9	7.3 ± 3.2	<5.2	<1.9	<0.6	<0.4	<0.1	<0.1	<0.0

Table 88. SED values for the time resolved intervals of FLSF 2012-11-27. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M1.6	2012-11-27 15:52	2012-11-27 15:57	2012-11-27 16:03	500	BGO

Table 89. Properties of the GOES X-ray flare associated with FLSF 2012-11-27 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
-	None	NaN	NaN

Table 90. Properties of the CME potentially associated with FLSF 2012-11-27 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.22. *FLSF 2013-04-11*

The Sun was in the field of view of the LAT from 2013-04-11 07:00 to 2013-04-11 07:39 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 23 minutes. The flare is classified as No-Prompt Short-Delayed. Most likely associated to a M6.5 GOES flare which started on 2013-04-11 06:55 and to a CME with speed 861 km s^{-1} with first LASCO C2 appearance on 2013-04-11 07:24:06 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2013-04-11 07:00	39	5.71 ± 0.24 *	1422	120	Exp	-0.43 ± 0.27	105 ± 15	5.67 ± 0.27

Table 91. Maximum likelihood results for FLSF 2013-04-11. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the `S15` event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
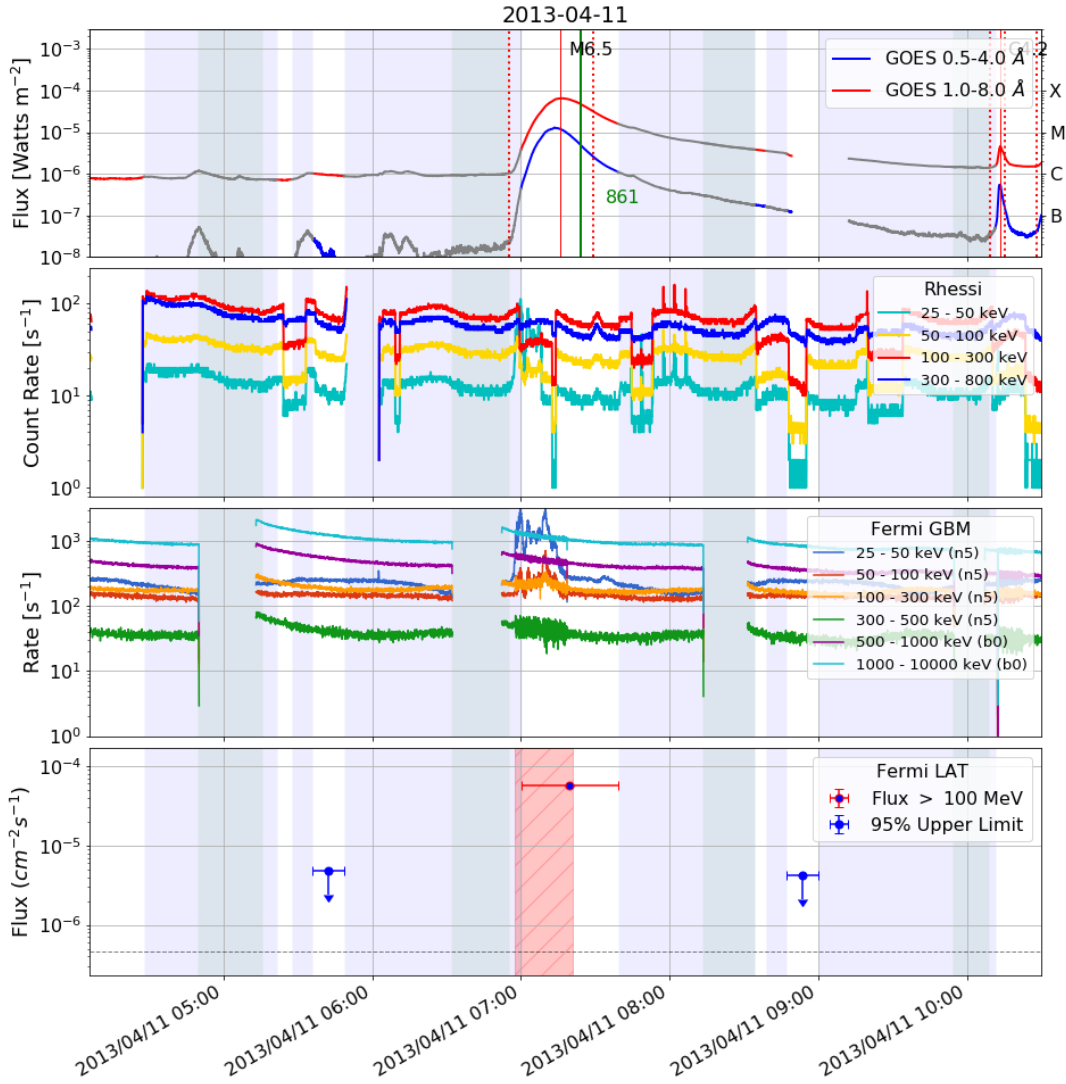
Figure 43. Light curve for FLSF 2013-04-11. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
07:00:01 - 07:39:01	$(9.2 \pm 0.8) \times 10^2$	463 ± 33	166 ± 13	33 ± 4	2.6 ± 0.9	<1.0	<0.3	<0.2	<0.1	<0.1

Table 92. SED values for the time resolved intervals of FLSF 2013-04-11. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M6.5	2013-04-11 06:55	2013-04-11 07:16	2013-04-11 07:29	100	NaI5

Table 93. Properties of the GOES X-ray flare associated with FLSF 2013-04-11 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
861	2013-04-11 07:24	100	GOES

Table 94. Properties of the CME potentially associated with FLSF 2013-04-11 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.23. *FLSF 2013-05-13a*

The Sun was in the field of view of the LAT from 2013-05-13 04:31 to 2013-05-13 05:14 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 4.0 hours. The flare is classified as Delayed. Most likely associated to a X1.7 GOES flare which started on 2013-05-13 01:53 and to a CME with speed 1270 km s^{-1} with first LASCO C2 appearance on 2013-05-13 02:00:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5} \text{cm}^{-2} \text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2013-05-13 04:31	43	0.96 ± 0.11	188	36	Exp	3.00 ± 0.14	31 ± 2	>6

Table 95. Maximum likelihood results for FLSF 2013-05-13a. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
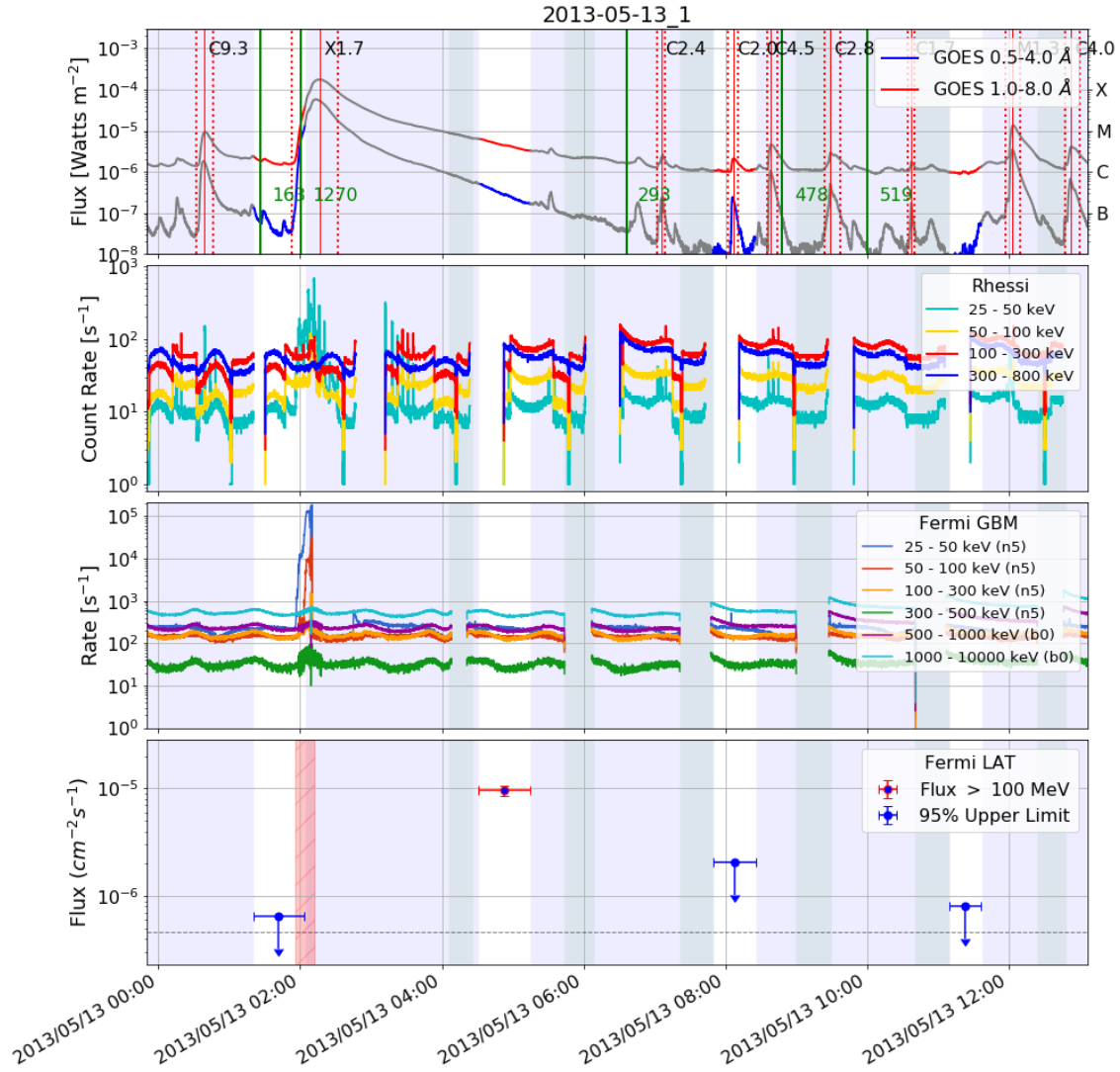
Figure 44. Light curve for FLSF 2013-05-13a. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

| Time interval | Energy bin (MeV) | | | | | | | | | |
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
04:31:16 - 05:15:46	121 ± 35	111 ± 18	25 ± 6	2.4 ± 1.3	<1.3	<0.6	<0.2	<0.1	<0.1	<0.0

Table 96. SED values for the time resolved intervals of FLSF 2013-05-13_1. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.7	2013-05-13 01:53	2013-05-13 02:17	2013-05-13 02:32	300	NaI5

Table 97. Properties of the GOES X-ray flare associated with FLSF 2013-05-13a and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1270	2013-05-13 02:00	60	STEREO

Table 98. Properties of the CME potentially associated with FLSF 2013-05-13a and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.24. *FLSF 2013-05-13b*

The Sun was in the field of view of the LAT from 2013-05-13 17:15 to 2013-05-13 21:09 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 6.1 hours. The flare is classified as Delayed. Most likely associated to a X2.8 GOES flare which started on 2013-05-13 15:48 and to a CME with speed 1850 km s^{-1} with first LASCO C2 appearance on 2013-05-13 16:07:55 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2013-05-13 17:15	30	2.41 ± 0.21	371	43	Exp	-0.24 ± 0.48	142 ± 38	3.91 ± 0.31
2013-05-13 20:26	43	1.72 ± 0.14	371	43	Exp	0.21 ± 0.73	80 ± 25	5.5 ± 0.5

Table 99. Maximum likelihood results for FLSF 2013-05-13b. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
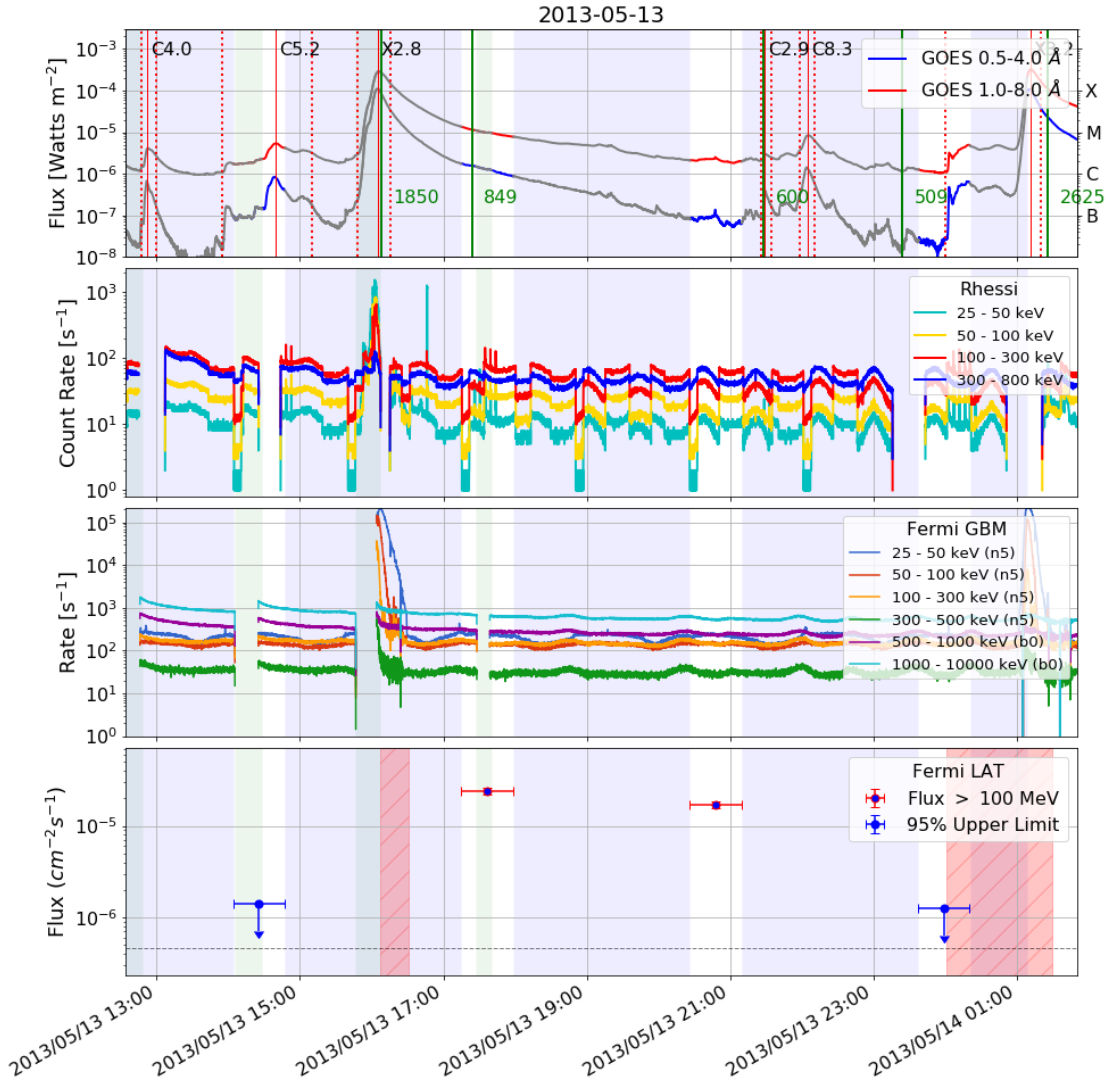
Figure 45. Light curve for FLSF 2013-05-13b. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

| Time interval | Energy bin (MeV) | | | | | | | | | | |
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
17:15:05 - 17:59:13	$(2.6 \pm 0.7) \times 10^2$	162 ± 28	65 ± 11	25 ± 5	3.5 ± 1.2	<1.5	<0.3	<0.2	<0.1	<0.1
20:26:23 - 21:09:44	$(2.4 \pm 0.5) \times 10^2$	147 ± 21	55 ± 8	7.0 ± 2.0	<2.1	<0.8	<0.2	<0.2	<0.1	<0.0

Table 100. SED values for the time resolved intervals of FLSF 2013-05-13. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X2.8	2013-05-13 15:48	2013-05-13 16:05	2013-05-13 16:16	800	Rhessi

Table 101. Properties of the GOES X-ray flare associated with FLSF 2013-05-13b and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1850	2013-05-13 16:07	60	STEREO

Table 102. Properties of the CME potentially associated with FLSF 2013-05-13b and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.25. *FLSF 2013-05-14*

The Sun was in the field of view of the LAT from 2013-05-14 01:08 to 2013-05-14 06:42 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 5.9 hours. The flare is classified as No-Prompt Delayed. Most likely associated to a X3.2 GOES flare which started on 2013-05-14 00:00 and to a CME with speed 2625 km s^{-1} with first LASCO C2 appearance on 2013-05-14 01:25:51 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2013-05-14 01:08	47	1.02 ± 0.09 *	292	46	Exp	0.55 ± 0.67	65 ± 15	>6
2013-05-14 02:43	47	3.30 ± 0.15	1518	193	Exp	0.62 ± 0.32	77 ± 9	4.95 ± 0.24
2013-05-14 04:19	47	2.32 ± 0.16	546	87	Exp	1.26 ± 0.61	54 ± 9	5.9 ± 0.4
2013-05-14 05:59	42	0.59 ± 0.09	105	19	Exp	1.05 ± 1.43	54 ± 24	>6

Table 103. Maximum likelihood results for FLSF 2013-05-14. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the `S15` event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
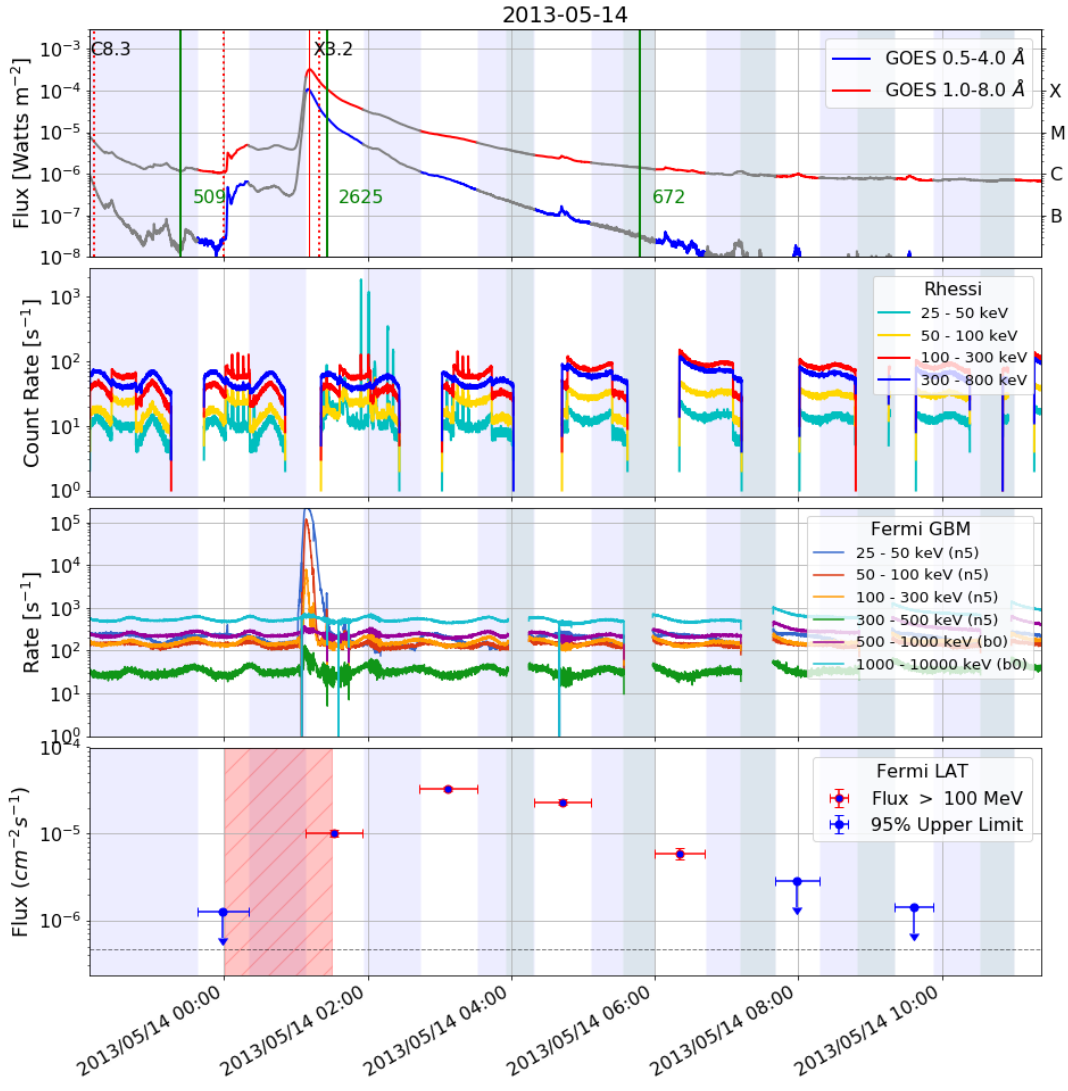
Figure 46. Light curve for FLSF 2013-05-14. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Date and Time	Helio X	Helio Y	ERR 68	ERR 95
2013-05-14 02:43 - 03:31	-1137	333	314	504

Table 104. Localization results for FLSF 2013-05-14. The GOES X-ray flare associated with the FLSF originated from AR 11748 whose position at the time of the GOES flare was N12E67. All values are in arcseconds.

Time interval	Energy bin (MeV)										
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
01:07:57 - 02:13:13	168 ± 29	76 ± 11	35 ± 5	5.9 ± 1.6	<0.6	<0.3	<0.2	<0.1	<0.1	<0.0
02:30:13 - 03:48:38	$(3.7 \pm 0.4) \times 10^2$	253 ± 20	110 ± 9	24.8 ± 2.9	1.8 ± 0.6	<0.3	<0.2	<0.1	<0.1	<0.0
04:19:21 - 05:06:51	$(2.8 \pm 0.5) \times 10^2$	213 ± 24	75 ± 9	11.6 ± 2.5	<1.4	<0.6	<0.2	<0.1	<0.1	<0.0
05:33:33 - 06:42:25	72 ± 29	63 ± 14	17 ± 5	<5.3	<1.3	<0.4	<0.2	<0.1	<0.1	<0.0

Table 105. SED values for the time resolved intervals of FLSF 2013-05-14. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X3.2	2013-05-14 00:00	2013-05-14 01:11	2013-05-14 01:20	500	BGO

Table 106. Properties of the GOES X-ray flare associated with FLSF 2013-05-14 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
2625	2013-05-14 01:25	60	STEREO

Table 107. Properties of the CME potentially associated with FLSF 2013-05-14 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.26. *FLSF 2013-05-15*

The Sun was in the field of view of the LAT from 2013-05-15 04:12 to 2013-05-15 04:58 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 3.5 hours. The flare is classified as No-Prompt Delayed. Most likely associated to a X1.2 GOES flare which started on 2013-05-15 01:25 and to a CME with speed 1366 km s^{-1} with first LASCO C2 appearance on 2013-05-15 01:48:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2013-05-15 04:12	46	0.36 ± 0.07	51	9	PL	-2.62 ± 0.22	-	-

Table 108. Maximum likelihood results for FLSF 2013-05-15. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
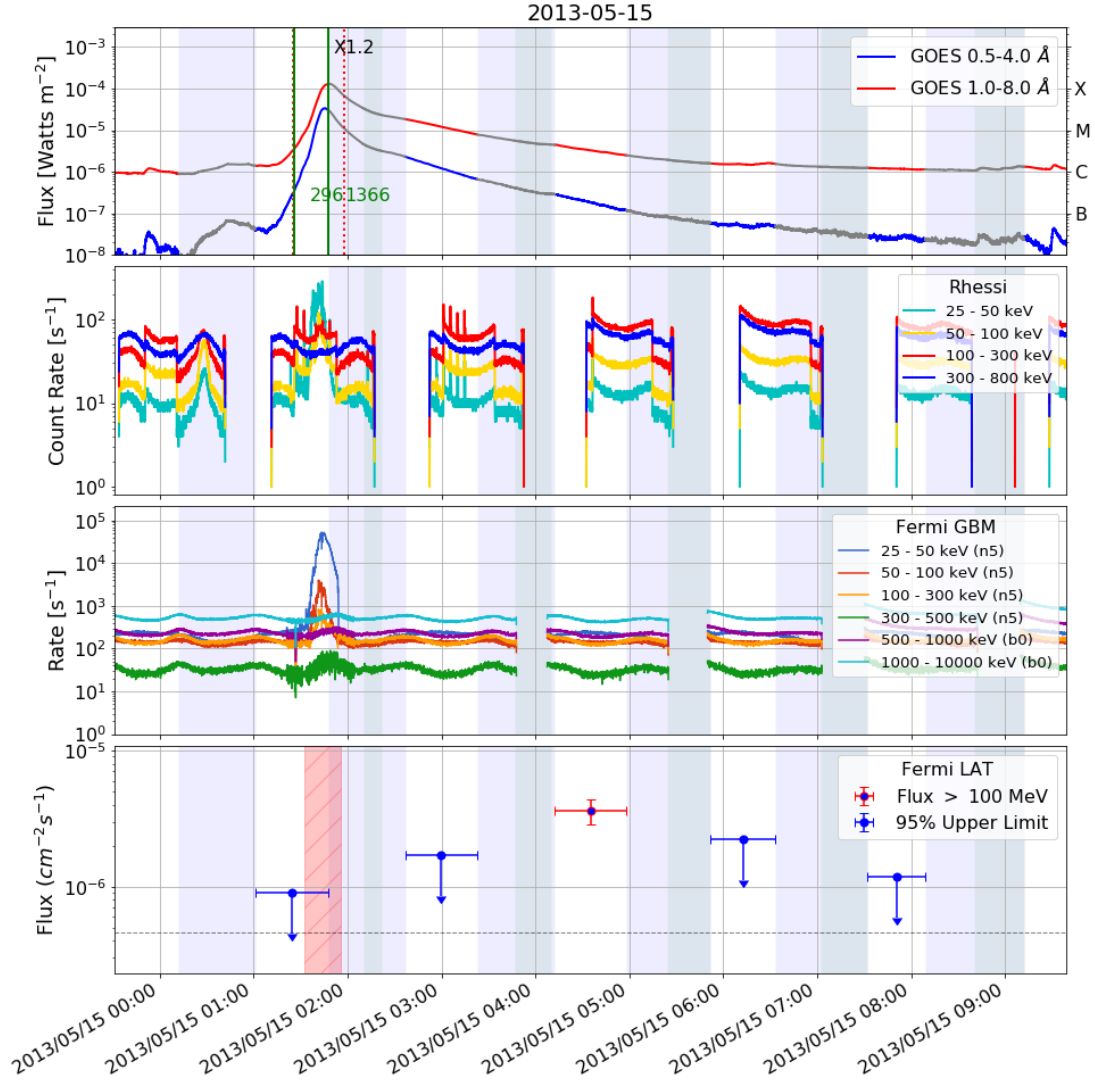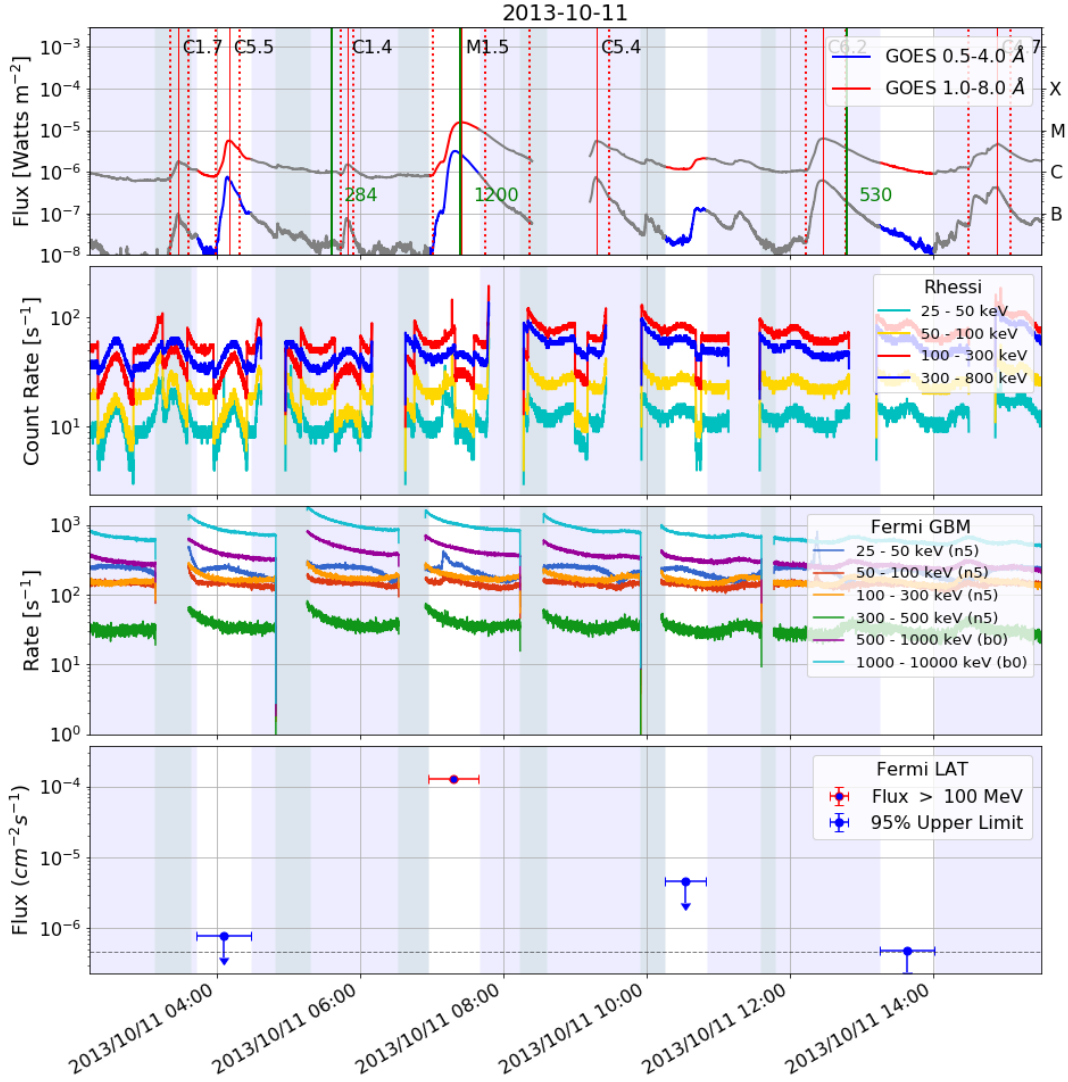
Figure 47. Light curve for FLSF 2013-05-15. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
04:12:16 - 04:58:16	72 ± 32	46 ± 13	10 ± 4	<4.5	<1.7	<0.4	<0.3	<0.1	<0.1	<0.0

Table 109. SED values for the time resolved intervals of FLSF 2013-05-15. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.2	2013-05-15 01:25	2013-05-15 01:48	2013-05-15 01:58	100	NaI5

Table 110. Properties of the GOES X-ray flare associated with FLSF 2013-05-15 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1366	2013-05-15 01:48	50	GOES

Table 111. Properties of the CME potentially associated with FLSF 2013-05-15 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.27. *FLSF 2013-10-11*

The Sun was in the field of view of the LAT from 2013-10-11 06:56 to 2013-10-11 07:39 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 23 minutes. The flare is classified as BTL Short-Delayed. Most likely associated to a M4.9* GOES flare which started on 2013-10-11 07:01 and to a CME with speed 1200 km s^{-1} with first LASCO C2 appearance on 2013-10-11 07:24:10 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\mathrm{cm}^{-2}\mathrm{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2013-10-11 06:56	42	12.5 ± 0.4	3949	317	Exp	-0.34 ± 0.16	131 ± 12	4.33 ± 0.12

Table 112. Maximum likelihood results for FLSF 2013-10-11. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.

Figure 48. Light curve for FLSF 2013-10-11. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Date and Time	Helio X	Helio Y	ERR 68	ERR 95
2013-10-11 06:56 - 07:39	-930	311	151	263

Table 113. Localization results for FLSF 2013-10-11. The GOES X-ray flare associated with the FLSF originated from AR whose position at the time of the GOES flare was N21E103. All values are in arcseconds.

Time interval	Energy bin (MeV)										
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
06:31:39 - 07:39:57	$(1.47 \pm 0.11) \times 10^3$	$(9.3 \pm 0.5) \times 10^2$	366 ± 19	104 ± 7	13.9 ± 1.9	0.73 ± 0.32	<0.6	0.08 ± 0.06	<0.1	<0.0

Table 114. SED values for the time resolved intervals of FLSF 2013-10-11. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M4.9*	2013-10-11 07:01	2013-10-11 07:25	2013-10-11 07:45	10	NaI5

Table 115. Properties of the GOES X-ray flare associated with FLSF 2013-10-11 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1200	2013-10-11 07:24	60	STEREO

Table 116. Properties of the CME potentially associated with FLSF 2013-10-11 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.28. *FLSF 2013-10-25a*

The Sun was in the field of view of the LAT from 2013-10-25 08:15 to 2013-10-25 08:57 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 81 minutes. The flare is classified as Delayed. Most likely associated to a X1.7 GOES flare which started on 2013-10-25 07:53 and to a CME with speed 587 km s^{-1} with first LASCO C2 appearance on 2013-10-25 08:12:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2013-10-25 08:15	42	1.15 ± 0.12 *	211	21	Exp	0.07 ± 0.88	79 ± 30	6 ± 4

Table 117. Maximum likelihood results for FLSF 2013-10-25a. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the S15 event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
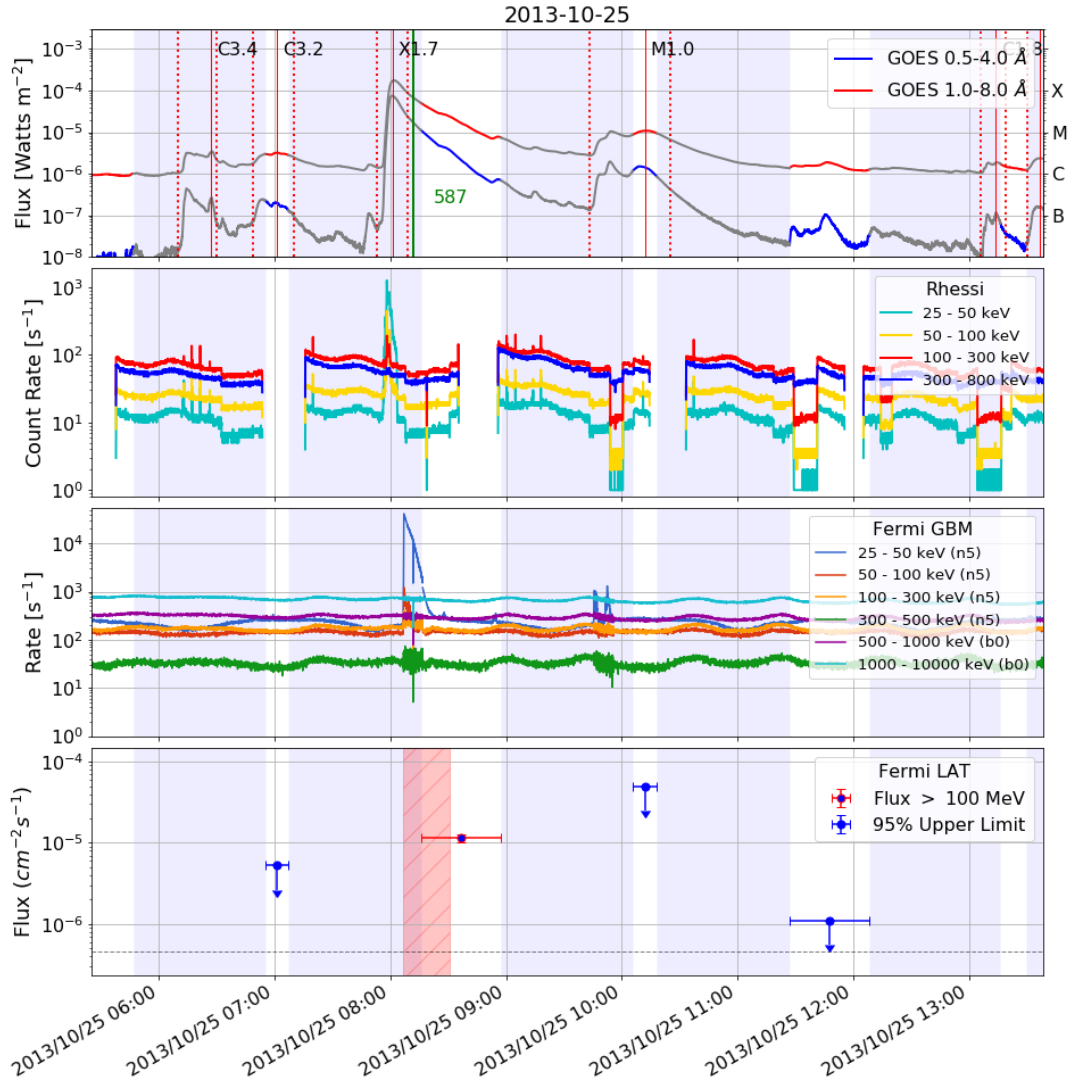
Figure 49. Light curve for FLSF 2013-10-25a. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
08:15:52 - 08:57:22	$(1.7 \pm 0.4) \times 10^2$	100 ± 17	33 ± 6	6.7 ± 2.0	<1.6	<0.7	<0.4	<0.2	<0.1	<0.1

Table 118. SED values for the time resolved intervals of FLSF 2013-10-25. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.7	2013-10-25 07:53	2013-10-25 08:01	2013-10-25 08:09	300	Rhessi

Table 119. Properties of the GOES X-ray flare associated with FLSF 2013-10-25a and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
587	2013-10-25 08:12	60	STEREO

Table 120. Properties of the CME potentially associated with FLSF 2013-10-25a and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.29. *FLSF 2013-10-25b*

Gamma-ray flare detected only in LLE. Emission started on 2013-10-25 20:56:52 (UTC) and ended on 2013-10-25 20:57:02 (UTC) with a total duration of 10 seconds. The flare is classified as LLE-Prompt. Most likely associated to a M1.9 GOES flare which started on 2013-10-25 20:54 and no CME associated with this flare.
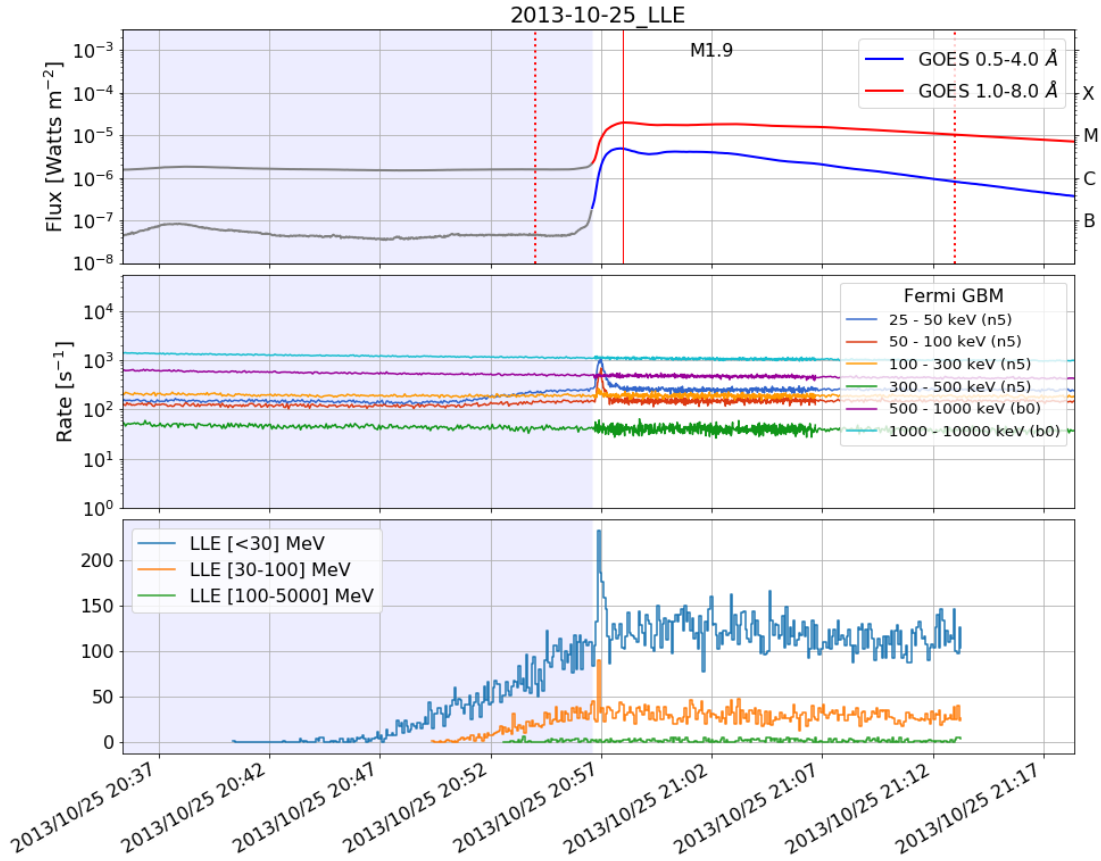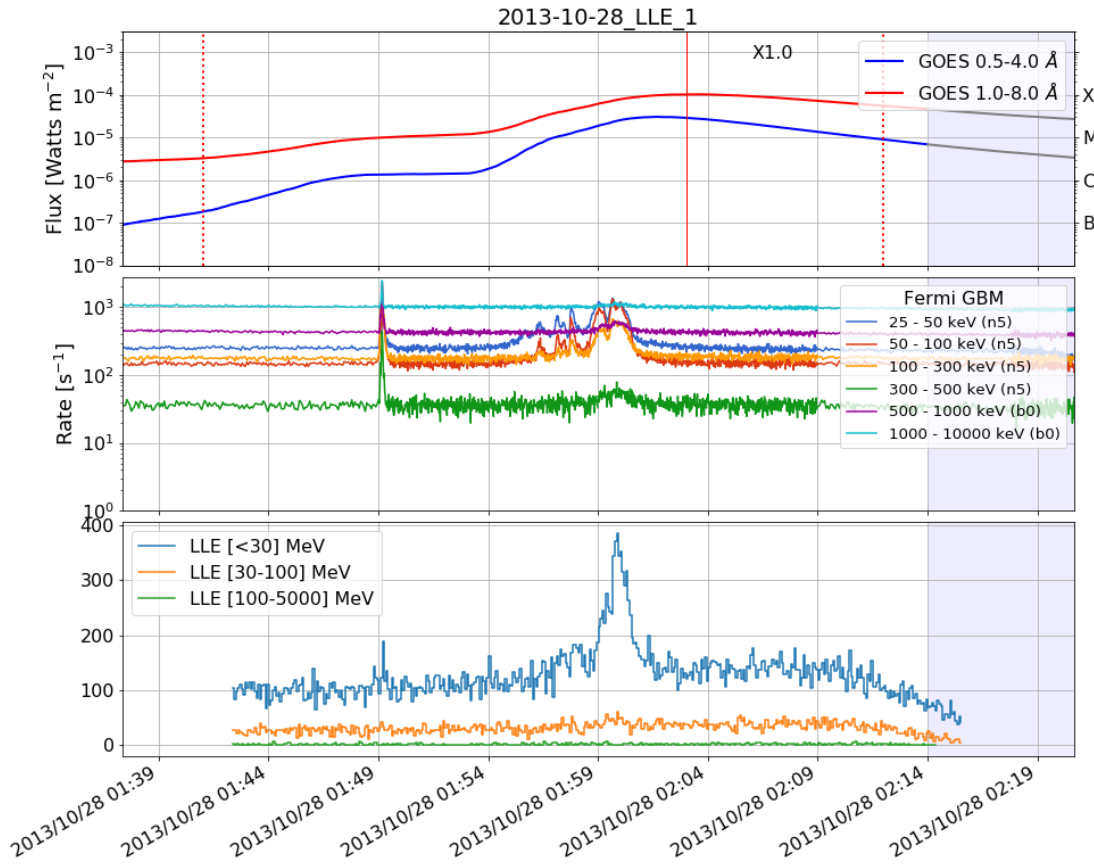

Figure 50. Light curve for FLSF 2013-10-25b using the LLE approach. From top to bottom: GOES X-rays, *Fermi*-GBM, *Fermi*-LLE.
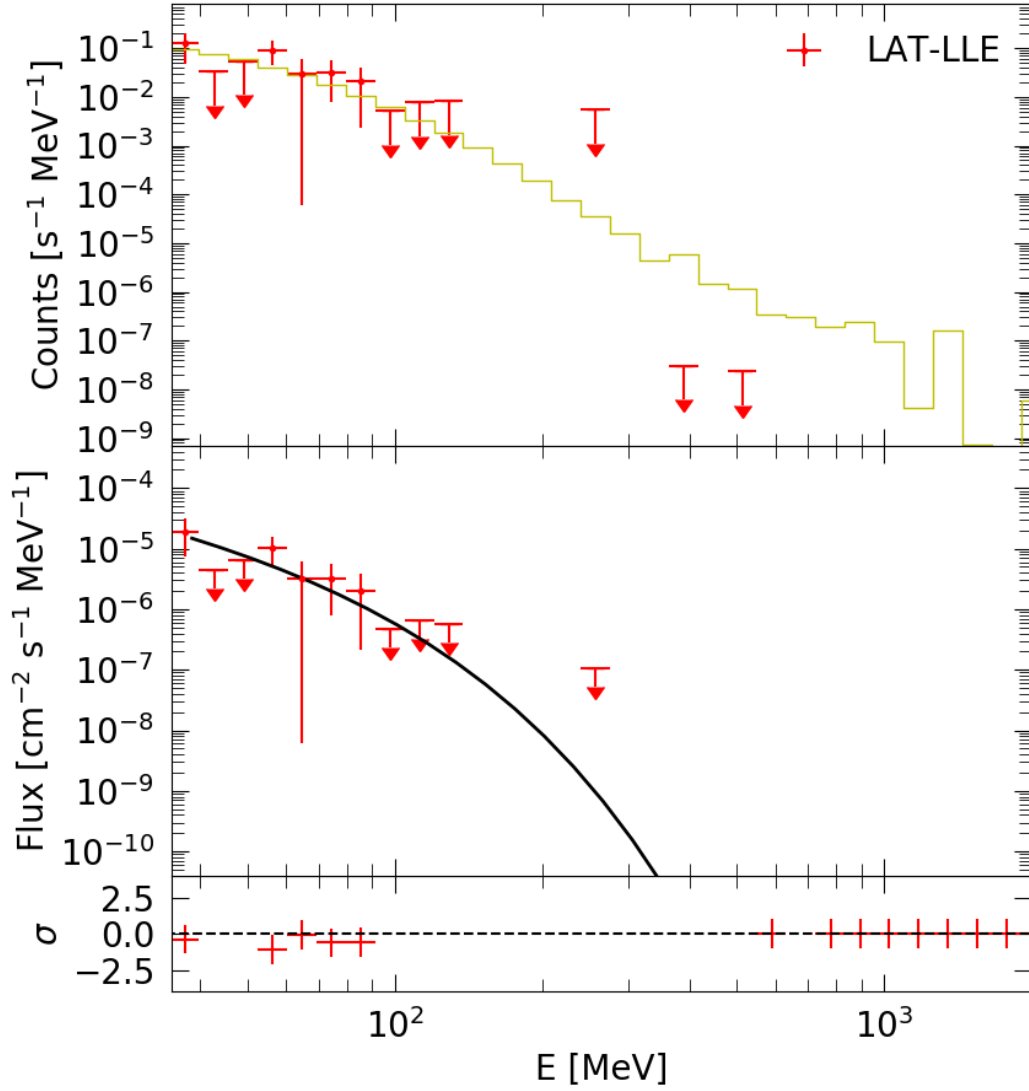
Figure 51. SED for FLSF 2013-10-25b from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 121.

Start Time	Duration	Flux	Flux	TS cutoff	TS pion
(UTC)	(sec)	(30 MeV − 10 GeV)	(100 MeV − 10 GeV)		
2013-10-25 20:56:52	10.0	38.9 ± 1.0	1.13 ± 0.09	17	0

Table 121. LLE Spectral results for FLSF 2013-10-25b. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
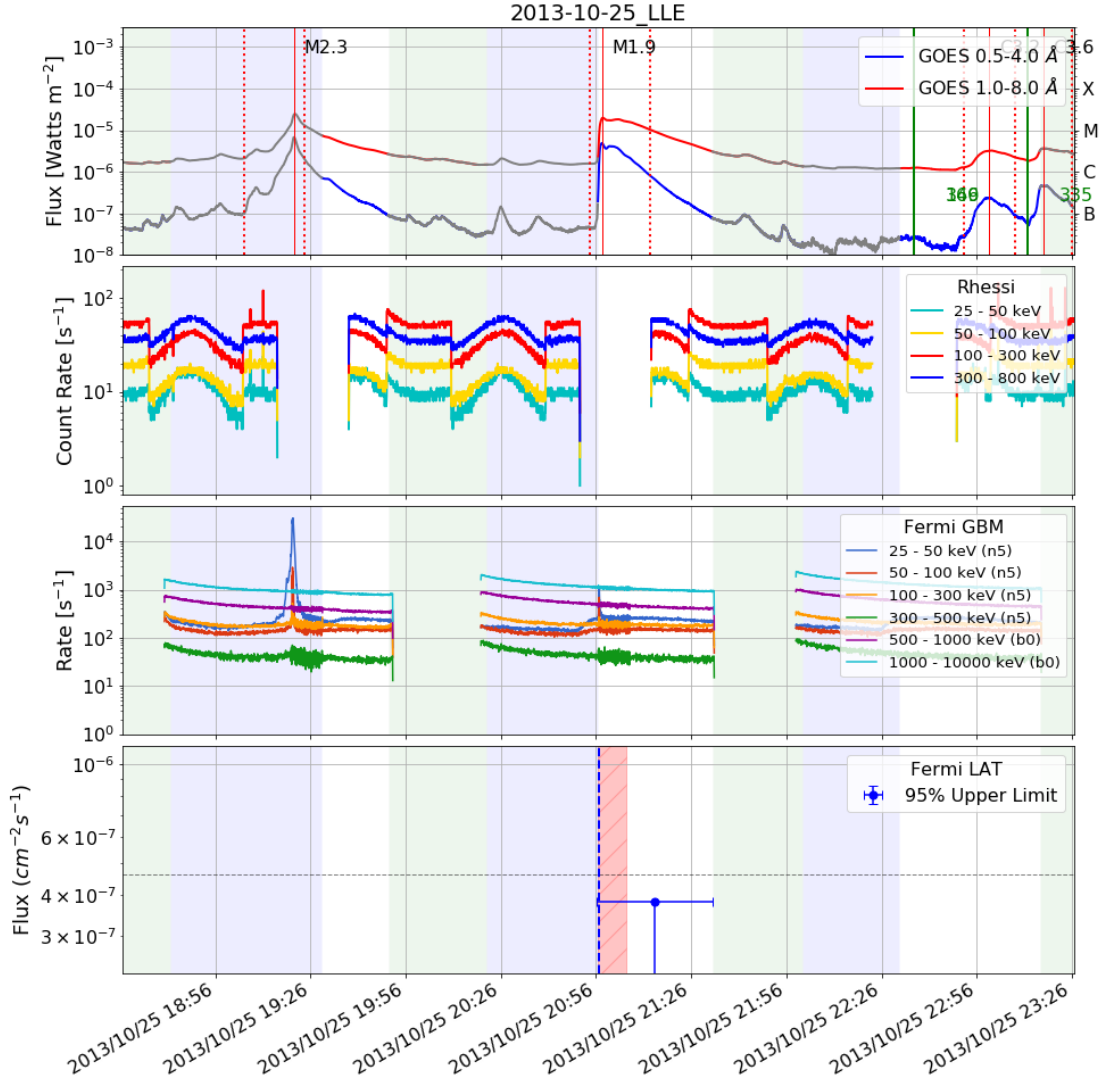
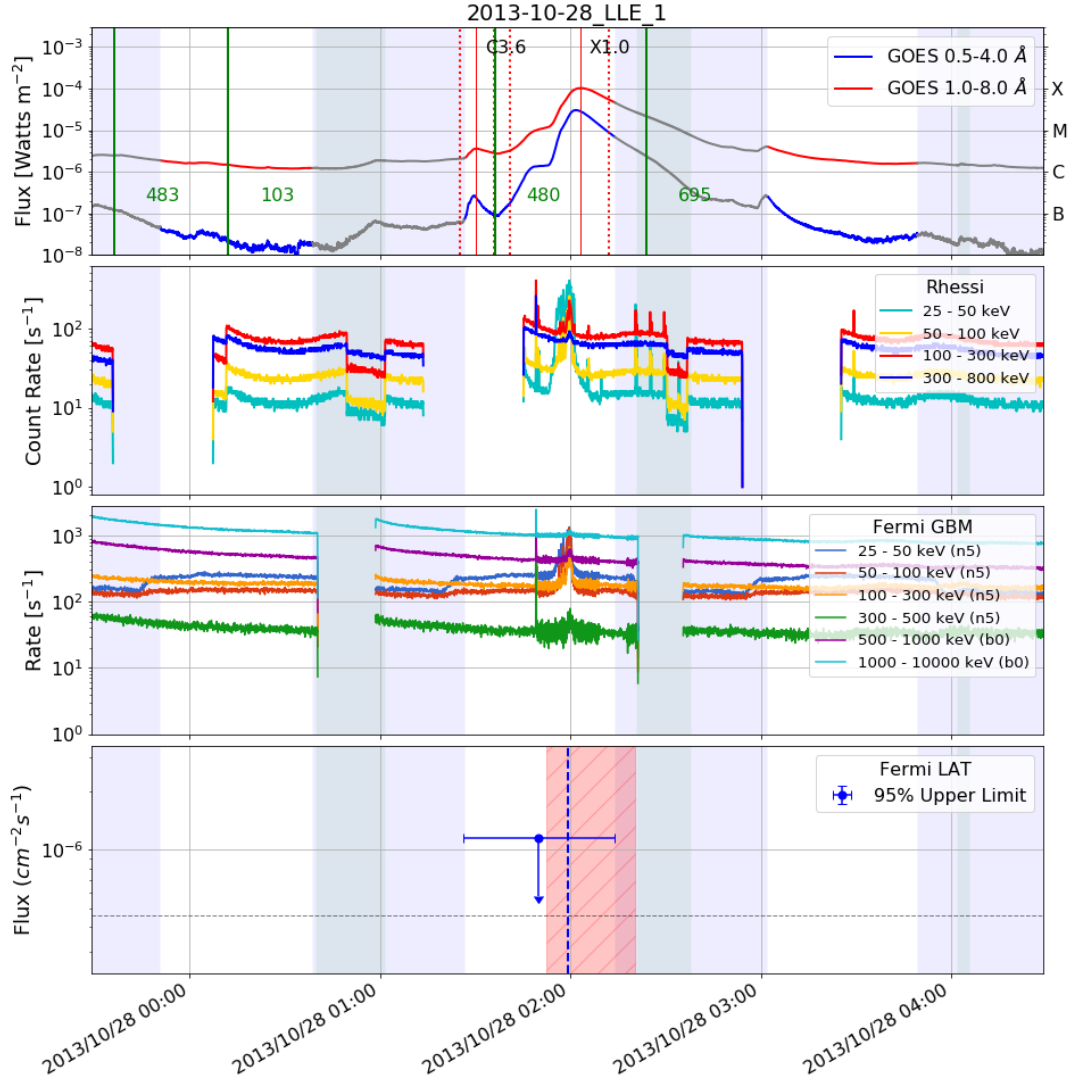**Figure 52.** Light curve for FLSF 2013-10-25b. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M1.9	2013-10-25 20:54	2013-10-25 20:58	2013-10-25 21:13	100	NaI5

Table 122. Properties of the GOES X-ray flare associated with FLSF 2013-10-25b and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
-	None	NaN	NaN

Table 123. Properties of the CME potentially associated with FLSF 2013-10-25b and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.30. *FLSF 2013-10-28a*

Gamma-ray flare detected only in LLE. Emission started on 2013-10-28 01:59:15 (UTC) and ended on 2013-10-28 02:00:26 (UTC) with a total duration of 70 seconds. The flare is classified as LLE-Prompt. Most likely associated to a X1.0 GOES flare which started on 2013-10-28 01:41 and to a CME with speed 695 km s^{-1} with first LASCO C2 appearance on 2013-10-28 02:24:05 UTC.

Figure 53. Light curve for FLSF 2013-10-28a using the LLE approach. From top to bottom: GOES X-rays, *Fermi*-GBM, *Fermi*-LLE.
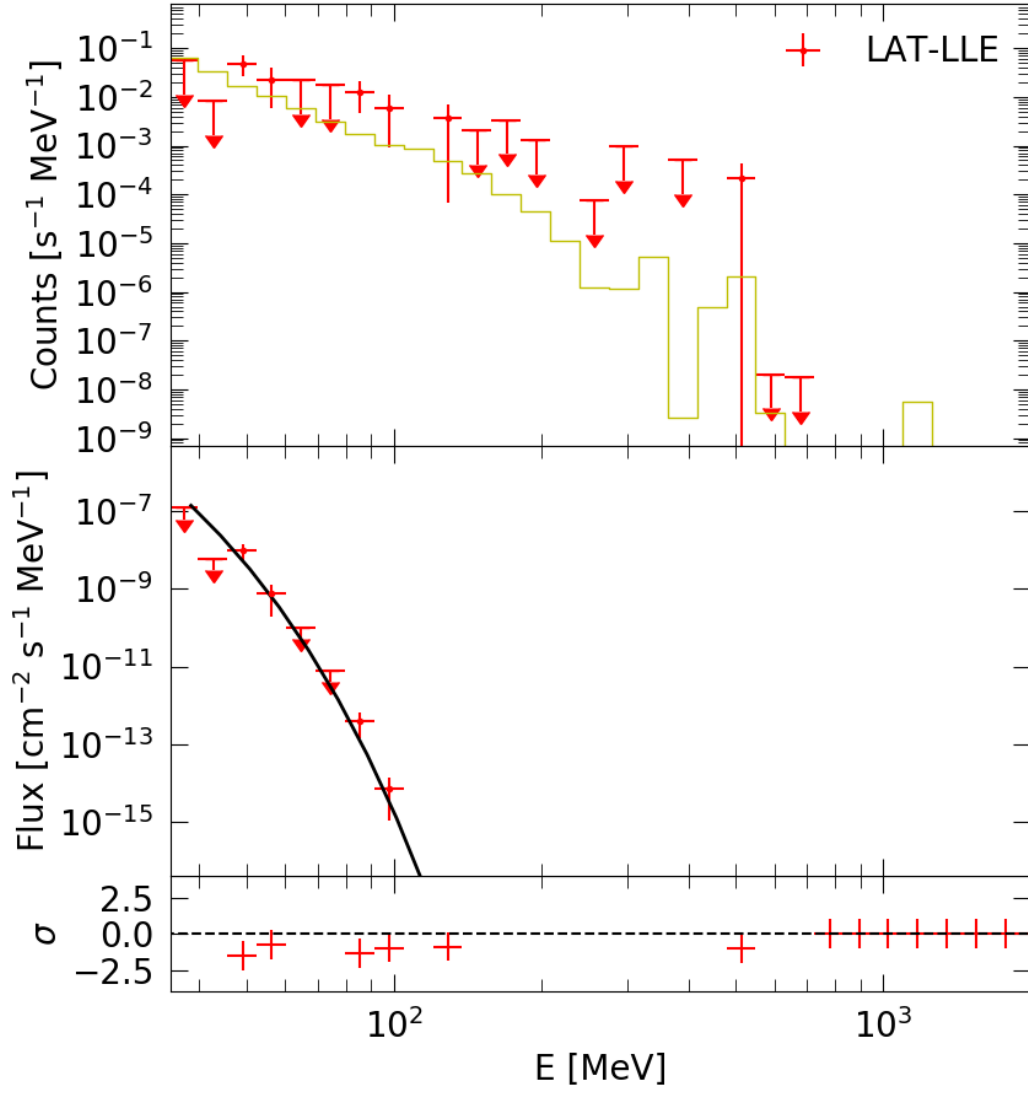
Figure 54. SED for FLSF 2013-10-28a from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 124.

Start Time (UTC)	Duration (sec)	Flux (30 MeV – 10 GeV)	Flux (100 MeV – 10 GeV)	TS cutoff	TS pion
2013-10-28 01:59:15	70.3	0.450 ± 0.035	$(6.1 \pm 2.4) \times 10^{-10}$	110	4

Table 124. LLE Spectral results for FLSF 2013-10-28a. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.

Figure 55. Light curve for FLSF 2013-10-28a. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.0	2013-10-28 01:41	2013-10-28 02:03	2013-10-28 02:12	1000	BGO

Table 125. Properties of the GOES X-ray flare associated with FLSF 2013-10-28a and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
695	2013-10-28 02:24	NaN	NaN

Table 126. Properties of the CME potentially associated with FLSF 2013-10-28a and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.31. *FLSF 2013-10-28b*

Gamma-ray flare detected only in LLE. Emission started on 2013-10-28 04:37:48 (UTC) and ended on 2013-10-28 04:38:38 (UTC) with a total duration of 50 seconds. The flare is classified as LLE-Prompt. Most likely associated to a M5.1 GOES flare which started on 2013-10-28 04:32 and to a CME with speed 1201 km s^{-1} with first LASCO C2 appearance on 2013-10-28 04:48:05 UTC.
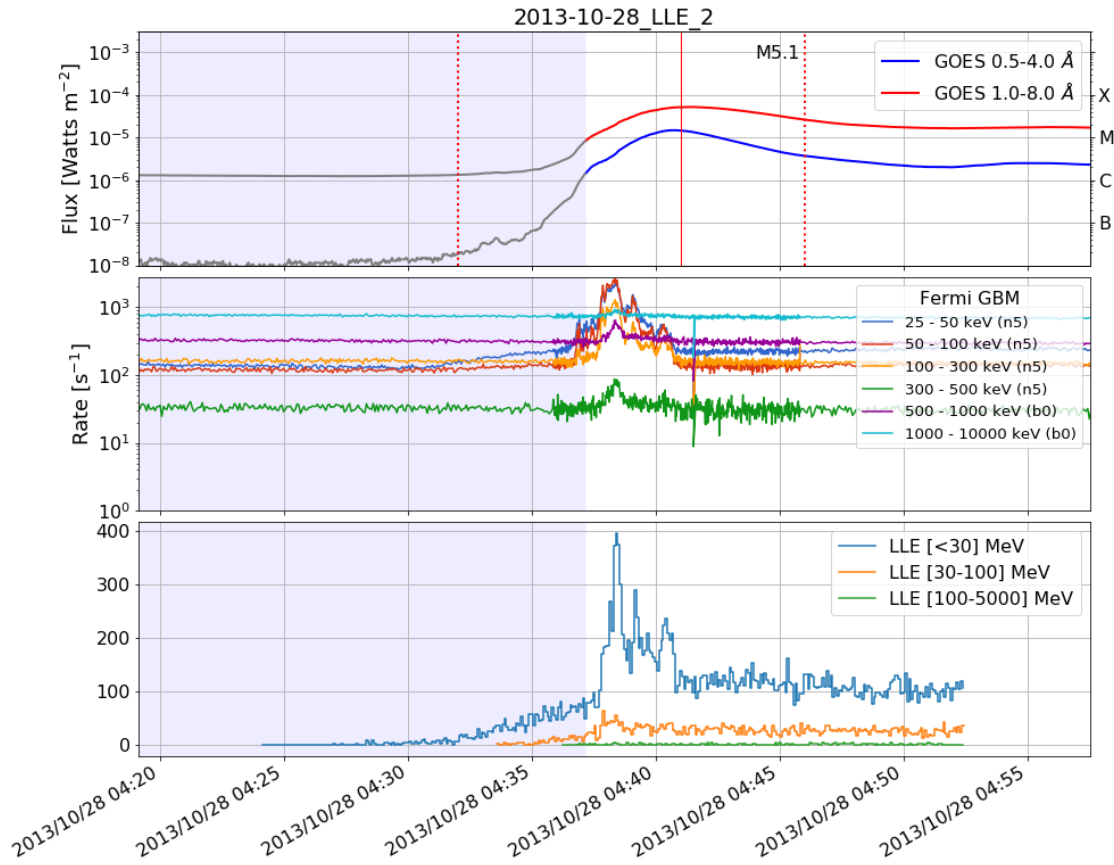
Figure 56. Light curve for FLSF 2013-10-28b using the LLE approach. From top to bottom: GOES X-rays, *Fermi*-GBM, *Fermi*-LLE.
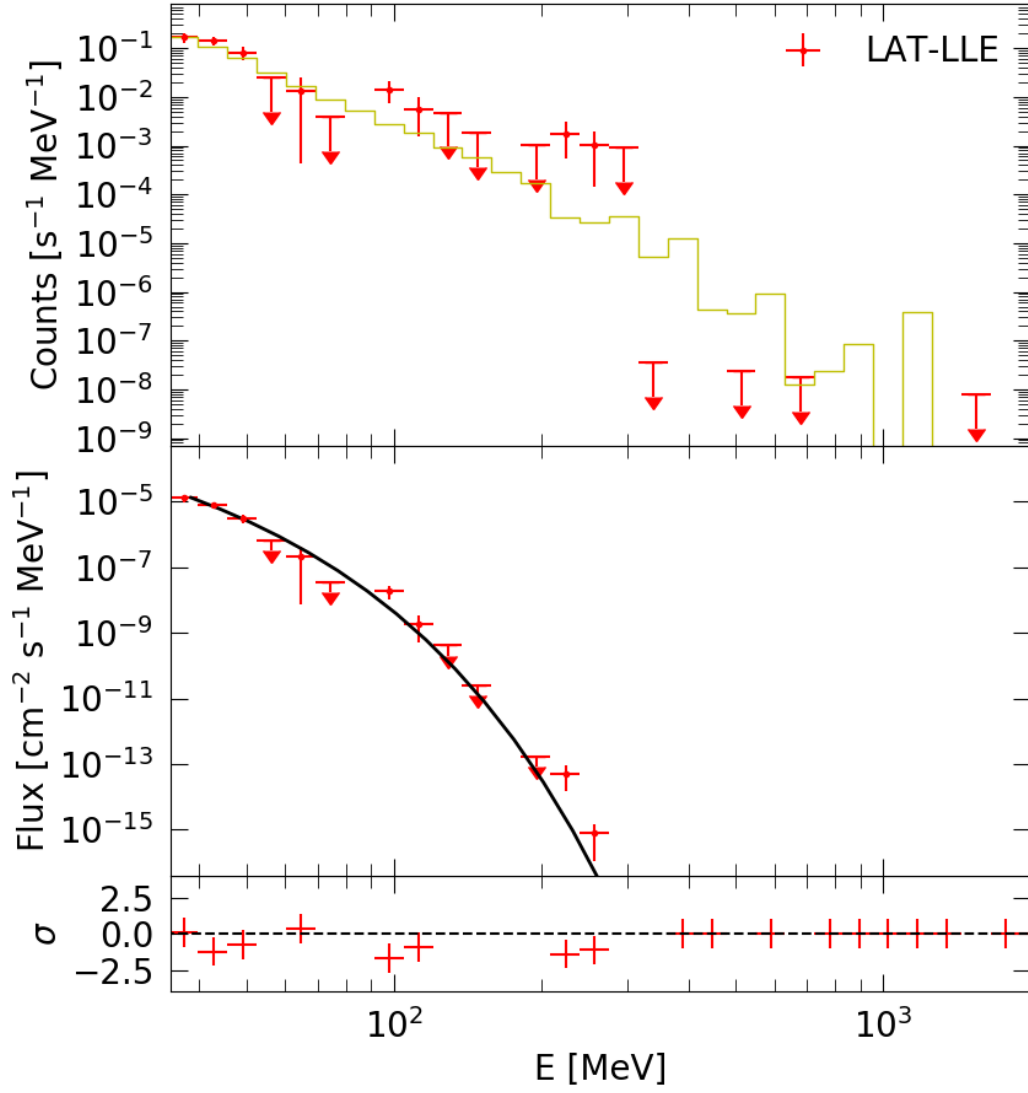
Figure 57. SED for FLSF 2013-10-28b from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 127.

Start Time	Duration	Flux	Flux	TS cutoff	TS pion
(UTC)	(sec)	(30 MeV − 10 GeV)	(100 MeV − 10 GeV)		
2013-10-28 04:37:48	50.1	25.9 ± 1.3	0.0029 ± 0.0016	110	2

Table 127. LLE Spectral results for FLSF 2013-10-28b. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
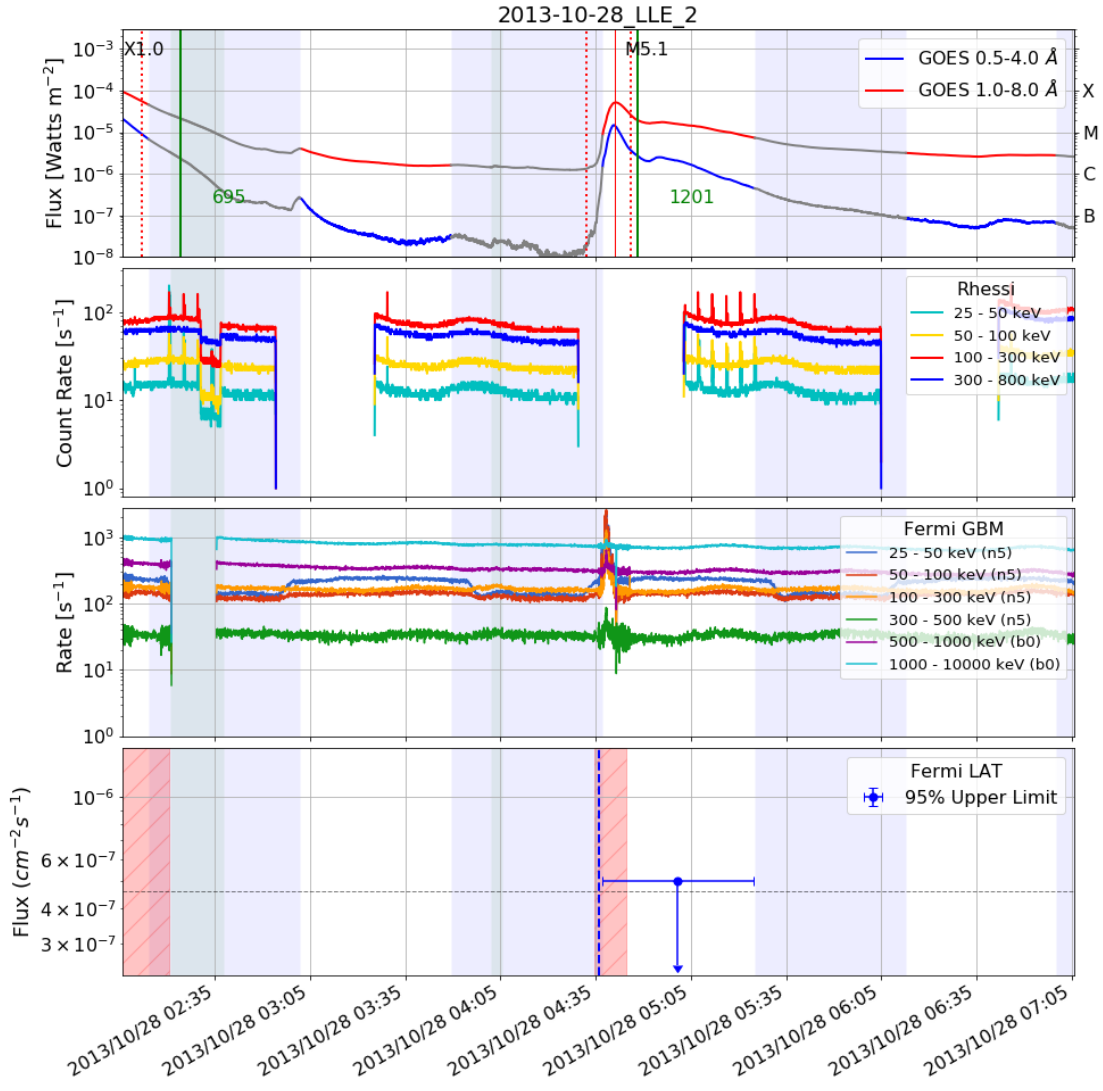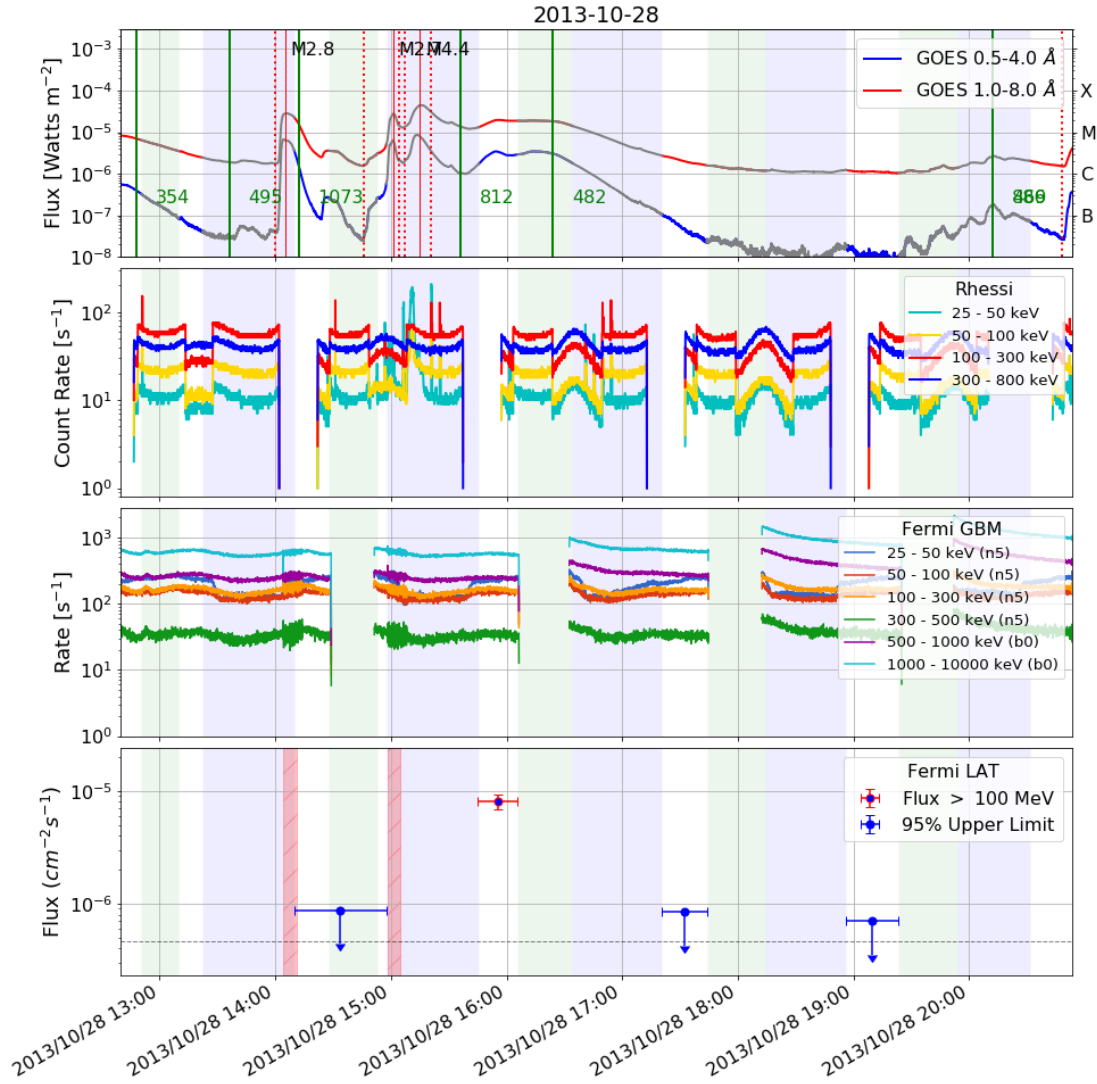
Figure 58. Light curve for FLSF 2013-10-28b. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M5.1	2013-10-28 04:32	2013-10-28 04:41	2013-10-28 04:46	1000	BGO

Table 128. Properties of the GOES X-ray flare associated with FLSF 2013-10-28b and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1201	2013-10-28 04:48	NaN	NaN

Table 129. Properties of the CME potentially associated with FLSF 2013-10-28b and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.32. *FLSF 2013-10-28c*

The Sun was in the field of view of the LAT from 2013-10-28 15:45 to 2013-10-28 16:05 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 1.6 hours. The flare is classified as Delayed. Most likely associated to a M2.7 GOES flare which started on 2013-10-28 14:46 and to a CME with speed 812 km s^{-1} with first LASCO C2 appearance on 2013-10-28 15:36:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2013-10-28 15:45	21	0.81 ± 0.12	120	8	PL	-2.32 ± 0.15	-	-

Table 130. Maximum likelihood results for FLSF 2013-10-28c. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.

Figure 59. Light curve for FLSF 2013-10-28c. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)										
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
15:32:31 - 16:46:08	$(1.3 \pm 0.5) \times 10^2$	55 ± 16	25 ± 7	7.3 ± 2.5	2.2 ± 1.0	<1.0	<0.5	<0.2	<0.1	<0.1

Table 131. SED values for the time resolved intervals of FLSF 2013-10-28. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M2.7	2013-10-28 14:46	2013-10-28 15:01	2013-10-28 15:04	50	Rhessi

Table 132. Properties of the GOES X-ray flare associated with FLSF 2013-10-28c and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
812	2013-10-28 15:36	60	STEREO

Table 133. Properties of the CME potentially associated with FLSF 2013-10-28c and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.33. *FLSF 2013-10-28d*

Gamma-ray flare detected only in LLE. Emission started on 2013-10-28 20:54:47 (UTC) and ended on 2013-10-28 20:55:37 (UTC) with a total duration of 50 seconds. The flare is classified as LLE-Prompt. Most likely associated to a M1.5 GOES flare which started on 2013-10-28 20:48 and to a CME with speed 771 km s^{-1} with first LASCO C2 appearance on 2013-10-28 21:25:11 UTC.
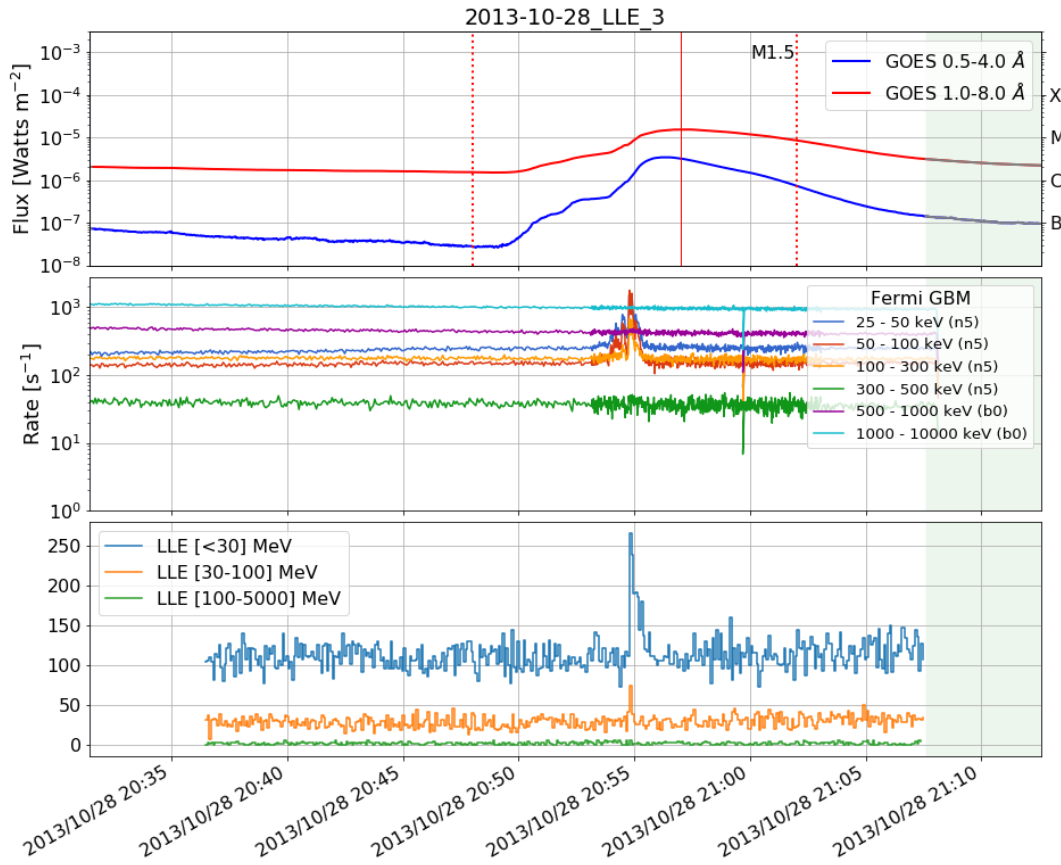

Figure 60. Light curve for FLSF 2013-10-28d using the LLE approach. From top to bottom: GOES X-rays, *Fermi*-GBM, *Fermi*-LLE.
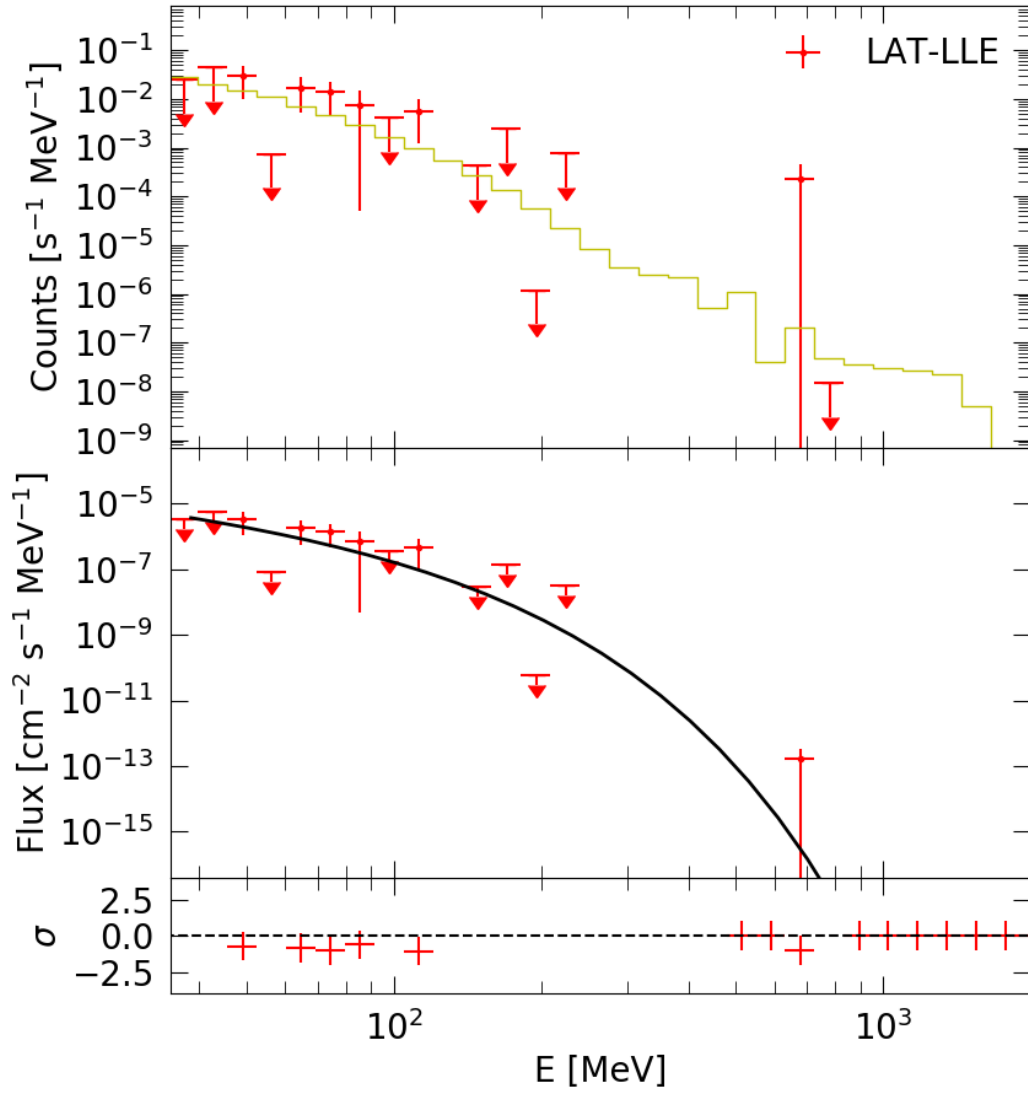
Figure 61. SED for FLSF 2013-10-28d from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 134.

Start Time	Duration	Flux	Flux	TS cutoff	TS pion
(UTC)	(sec)	(30 MeV − 10 GeV)	(100 MeV − 10 GeV)		
2013-10-28 20:54:47	50.0	9.8 ± 0.6	0.33 ± 0.05	5	6

Table 134. LLE Spectral results for FLSF 2013-10-28d. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
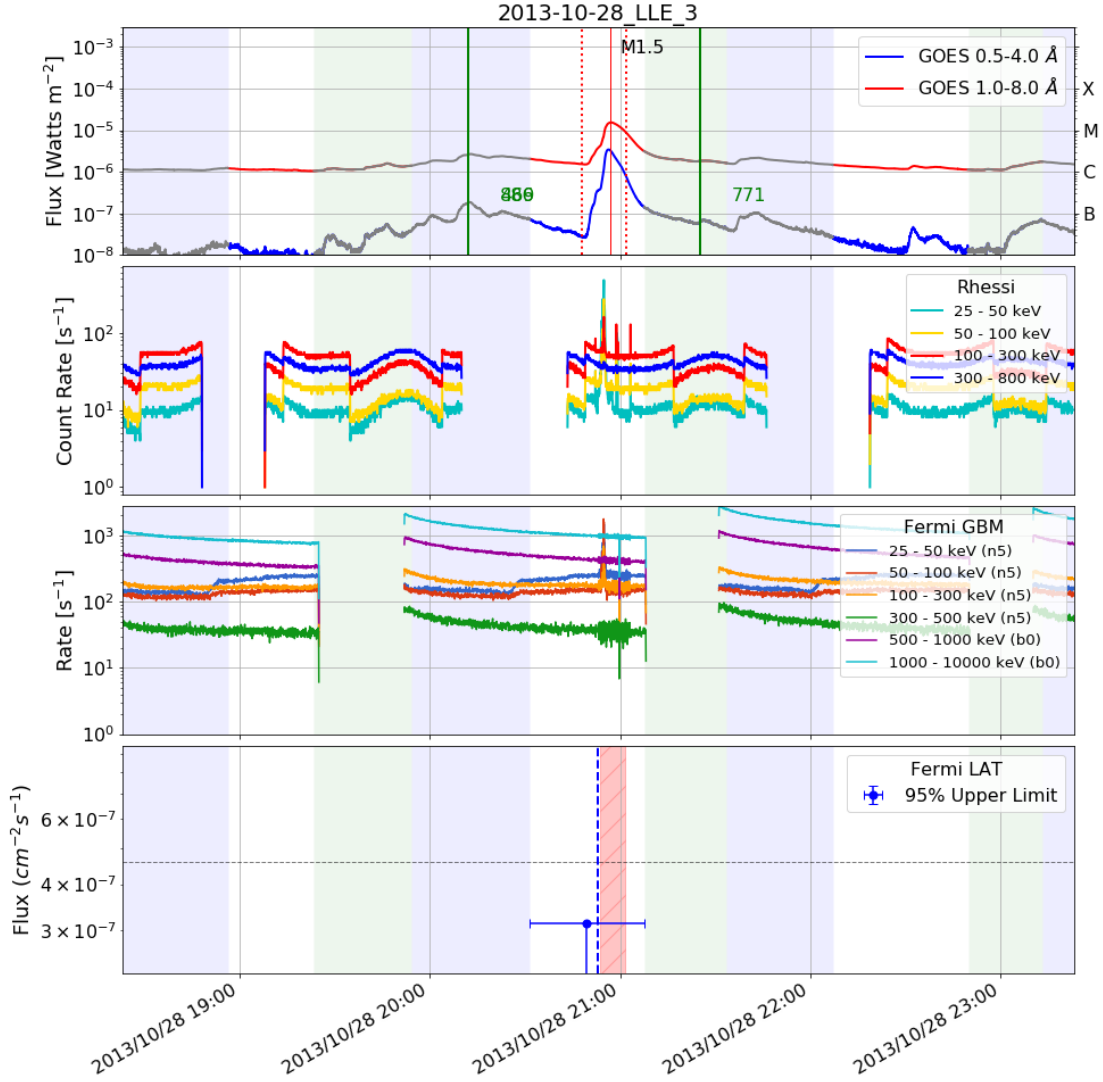
Figure 62. Light curve for FLSF 2013-10-28d. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M1.5	2013-10-28 20:48	2013-10-28 20:57	2013-10-28 21:02	100	NaI5

Table 135. Properties of the GOES X-ray flare associated with FLSF 2013-10-28d and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
771	2013-10-28 21:25	NaN	NaN

Table 136. Properties of the CME potentially associated with FLSF 2013-10-28d and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.34. *FLSF 2014-01-06*

The Sun was in the field of view of the LAT from 2014-01-06 07:55 to 2014-01-06 08:30 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 16 minutes. The flare is classified as BTL Short-Delayed. Most likely associated to a X3.5* GOES flare which started on 2014-01-06 07:40 and to a CME with speed 1402 km s^{-1} with first LASCO C2 appearance on 2014-01-06 08:00:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2014-01-06 07:55	34	0.42 ± 0.09	52	13	Exp	1.84 ± 2.16	49 ± 26	5.8 ± 1.9

Table 137. Maximum likelihood results for FLSF 2014-01-06. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
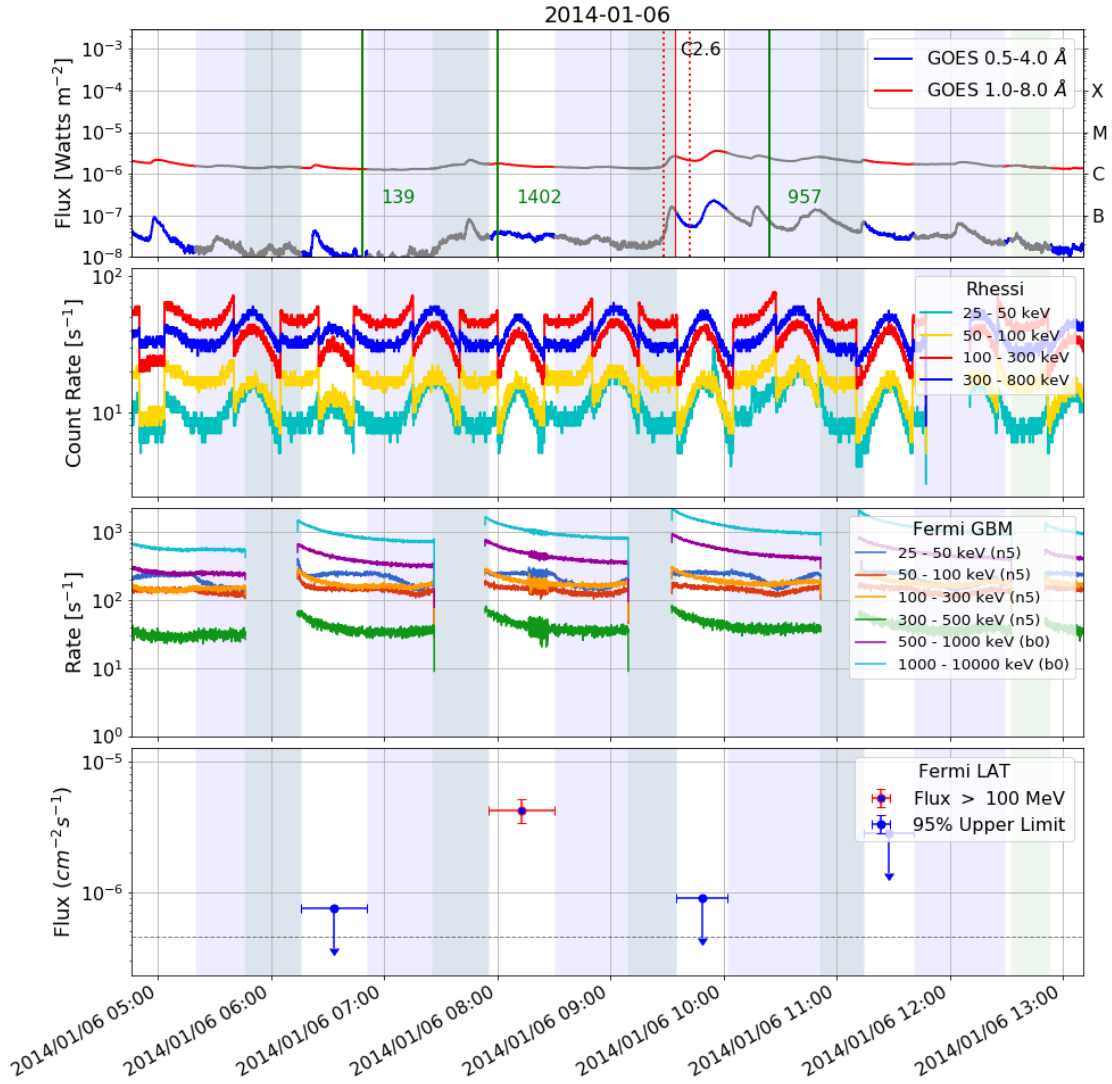
Figure 63. Light curve for FLSF 2014-01-06. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.
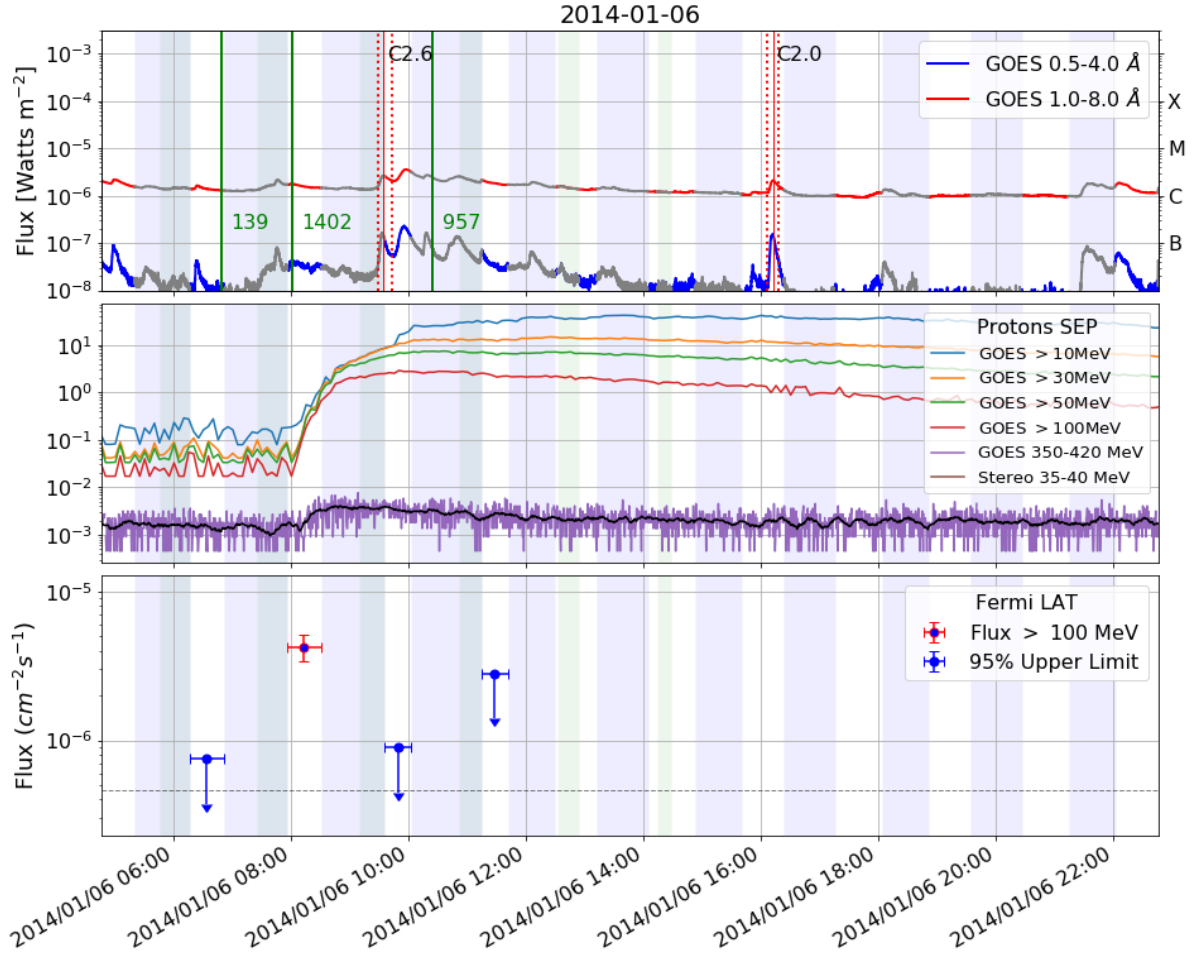
Figure 64. Composite light curve for FLSF 2014-01-06. Top panel shows the GOES X-rays, middle panel shows the GOES SEP count rate (ACE and Stereo data when avaliable), bottom panel shows the *Fermi*-LAT >100 MeV flux.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
07:24:55 - 08:32:31	<136.5	28 ± 11	17 ± 5	<5.2	<1.0	<0.5	<0.2	<0.1	<0.1	<0.1

Table 138. SED values for the time resolved intervals of FLSF 2014-01-06. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X3.5*	2014-01-06 07:40	2014-01-06 07:50	2014-01-06 08:08	6	Rhessi

Table 139. Properties of the GOES X-ray flare associated with FLSF 2014-01-06 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1402	2014-01-06 08:00	605	GOES

Table 140. Properties of the CME potentially associated with FLSF 2014-01-06 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.35. *FLSF 2014-01-07*

The Sun was in the field of view of the LAT from 2014-01-07 18:41 to 2014-01-07 19:29 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 63 minutes. The flare is classified as Delayed. Most likely associated to a X1.2 GOES flare which started on 2014-01-07 18:04 and to a CME with speed 1830 km s^{-1} with first LASCO C2 appearance on 2014-01-07 18:24:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2014-01-07 18:41	48	0.29 ± 0.07	32	5	PL	-2.68 ± 0.27	-	-

Table 141. Maximum likelihood results for FLSF 2014-01-07. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
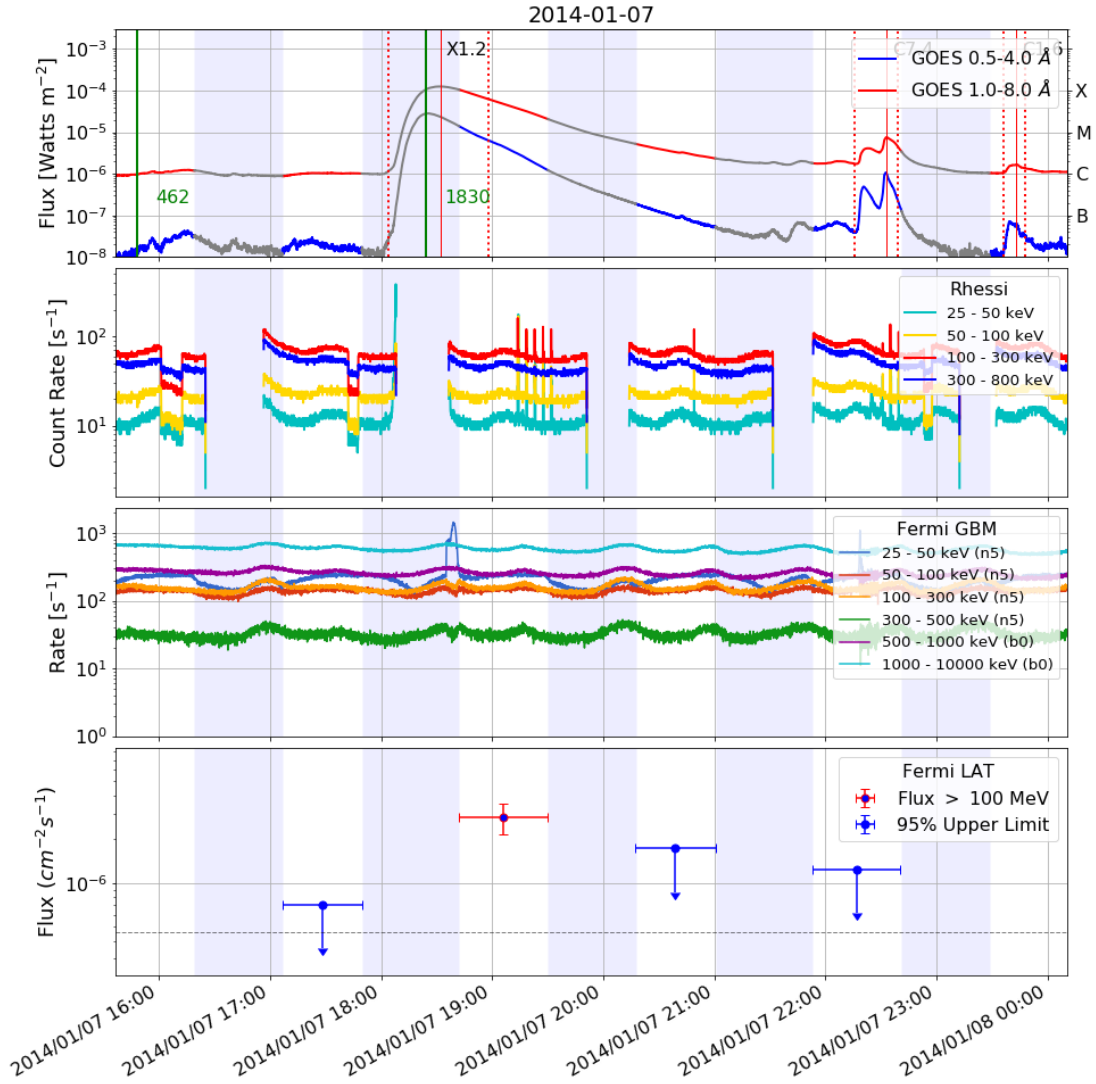
Figure 65. Light curve for FLSF 2014-01-07. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
18:41:01 - 19:32:31	<143.5	21 ± 9	9.5 ± 3.5	2.5 ± 1.3	<1.5	<0.3	<0.2	<0.2	<0.1	<0.0

Table 142. SED values for the time resolved intervals of FLSF 2014-01-07. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.2	2014-01-07 18:04	2014-01-07 18:32	2014-01-07 18:58	20	NaI5

Table 143. Properties of the GOES X-ray flare associated with FLSF 2014-01-07 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1830	2014-01-07 18:24	100	GOES

Table 144. Properties of the CME potentially associated with FLSF 2014-01-07 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.36. *FLSF 2014-02-25*

The Sun was in the field of view of the LAT from 2014-02-25 01:09 to 2014-02-25 07:51 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 8.4 hours. The flare is classified as LLE-Prompt Delayed. Most likely associated to a X4.9 GOES flare which started on 2014-02-25 00:39 and to a CME with speed 2147 km s^{-1} with first LASCO C2 appearance on 2014-02-25 01:25:50 UTC. Gamma-ray emission >30 MeV also detected with the LLE approach. The LLE emission started on 2014-02-25 00:44:47 (UTC) and ended on 2014-02-25 00:51:27 (UTC) with a total duration of 400 seconds.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2014-02-25 01:09	20	169.6 ± 2.0 *	24030	2121	Exp	-0.33 ± 0.06	154 ± 5	3.78 ± 0.04
2014-02-25 04:20	20	28.3 ± 0.9	2707	370	Exp	1.17 ± 0.28	47 ± 4	>6
2014-02-25 07:30	21	0.87 ± 0.17	74	11	Exp	2.39 ± 2.53	29 ± 14	>6

Table 145. Maximum likelihood results for FLSF 2014-02-25. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the `S15` event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.

Start Time (UTC)	Duration (sec)	Flux (30 MeV − 10 GeV)	Flux (100 MeV − 10 GeV)	TS cutoff	TS pion
2014-02-25 00:44:47	400.0	1407 ± 25	631 ± 26	3445	2651

Table 146. LLE Spectral results for FLSF 2014-02-25. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
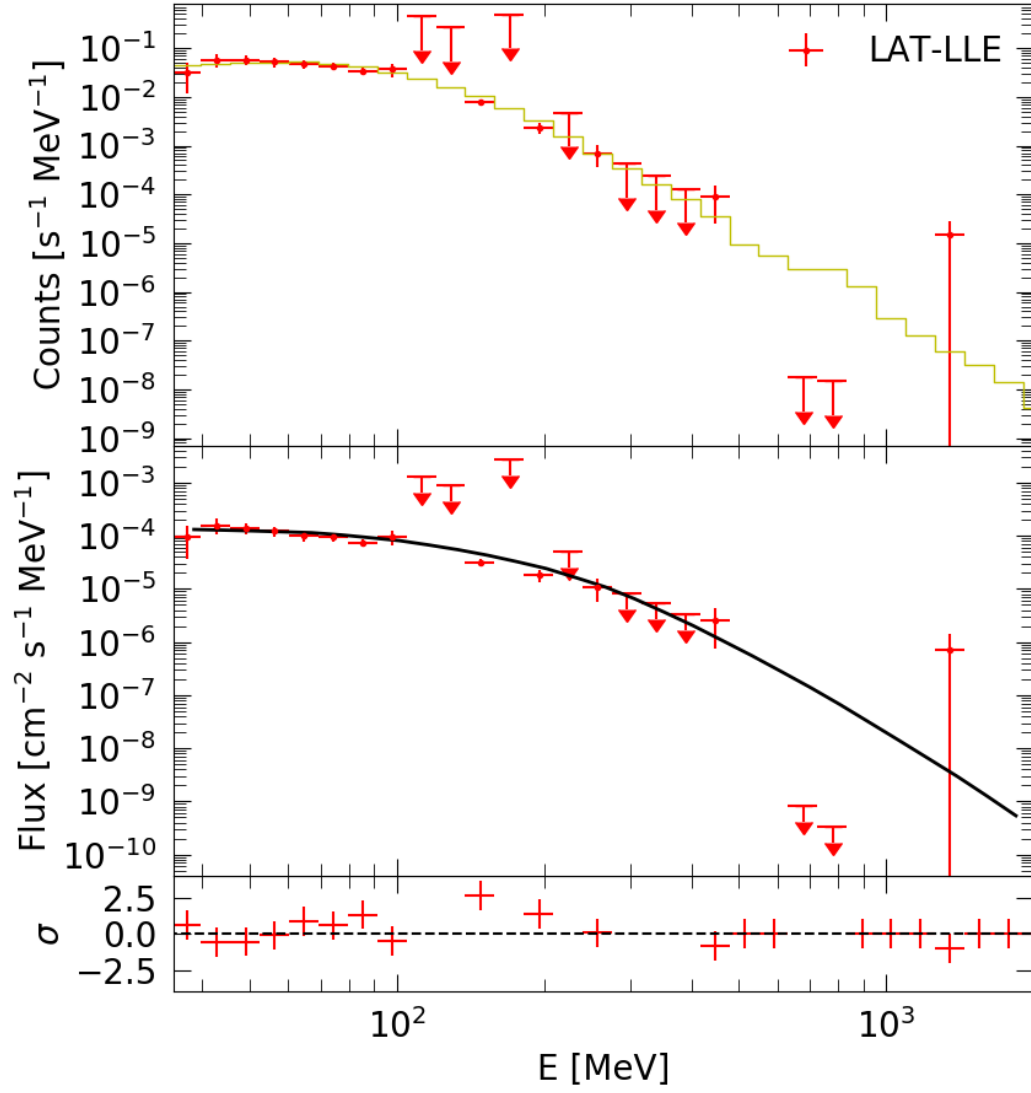
Figure 66. SED of FLSF 2014-02-25 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 146.
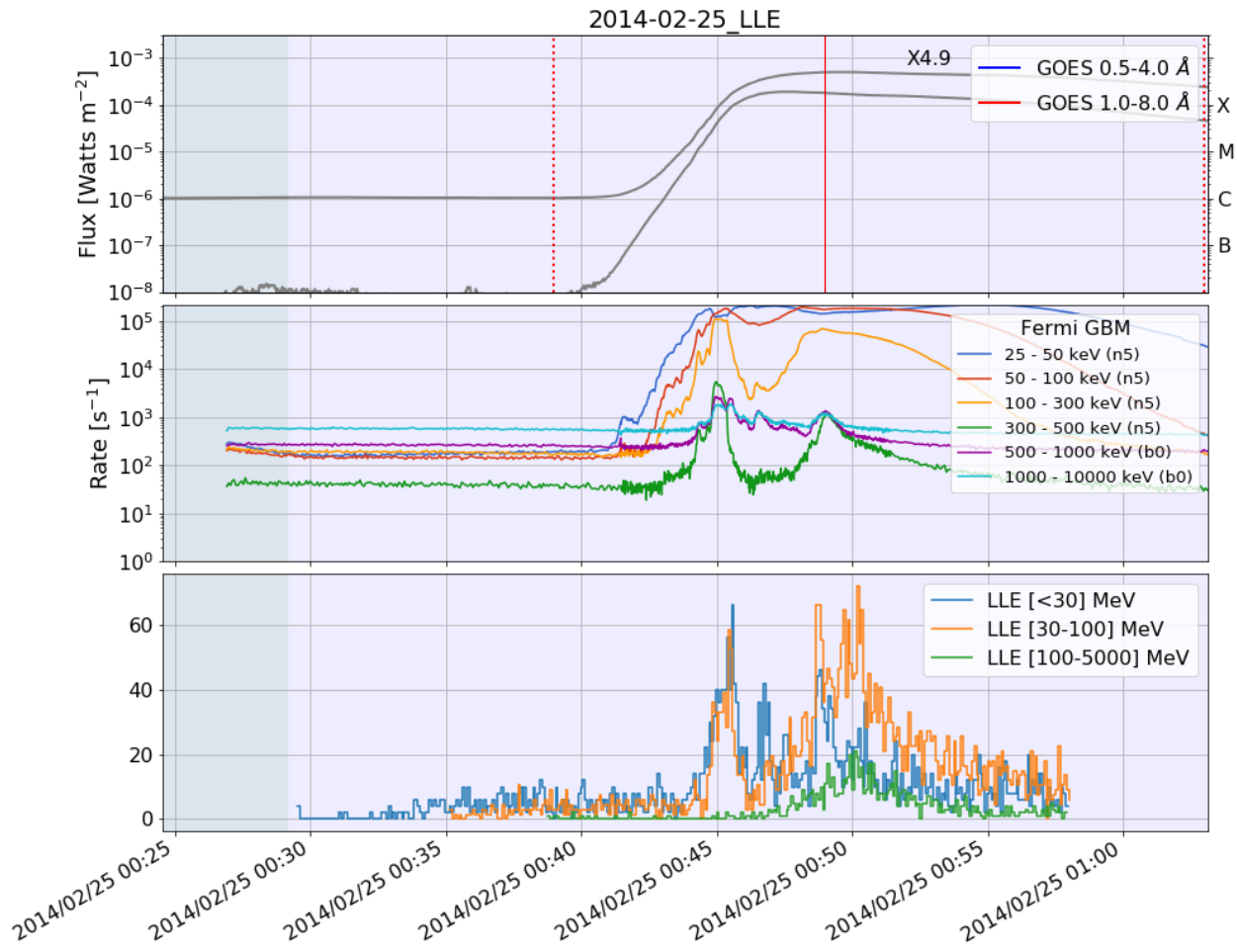
Figure 67. Light curve for FLSF 2014-02-25 with the LLE approach. Top panel: GOES X-rays, middle panel: Fermi-GBM X-rays and bottom panel: Fermi-LAT.
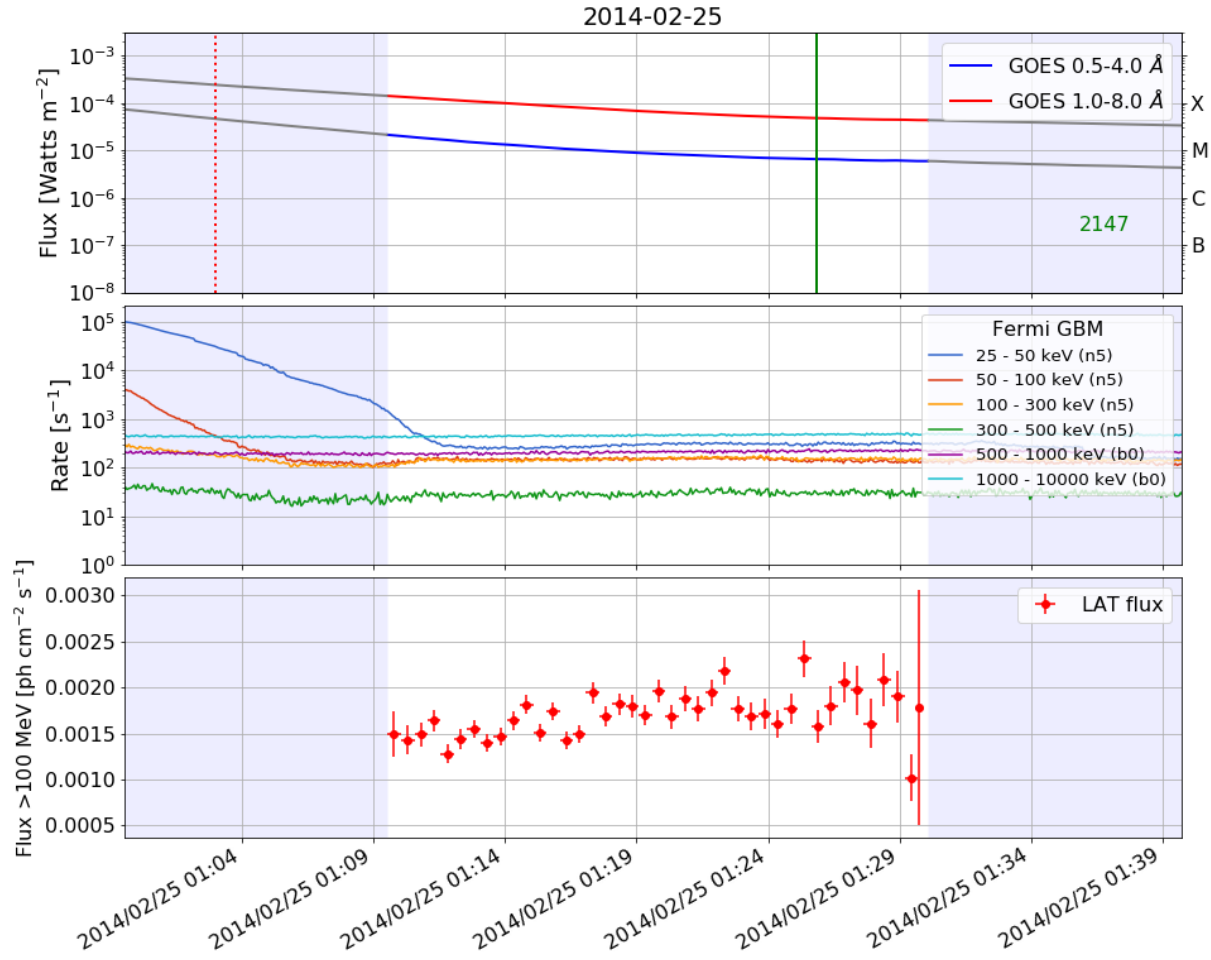
Figure 68. Fine time binning light curve for FLSF 2014-02-25. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate, *Fermi*-LAT maximum likelihood results with fine time binning.
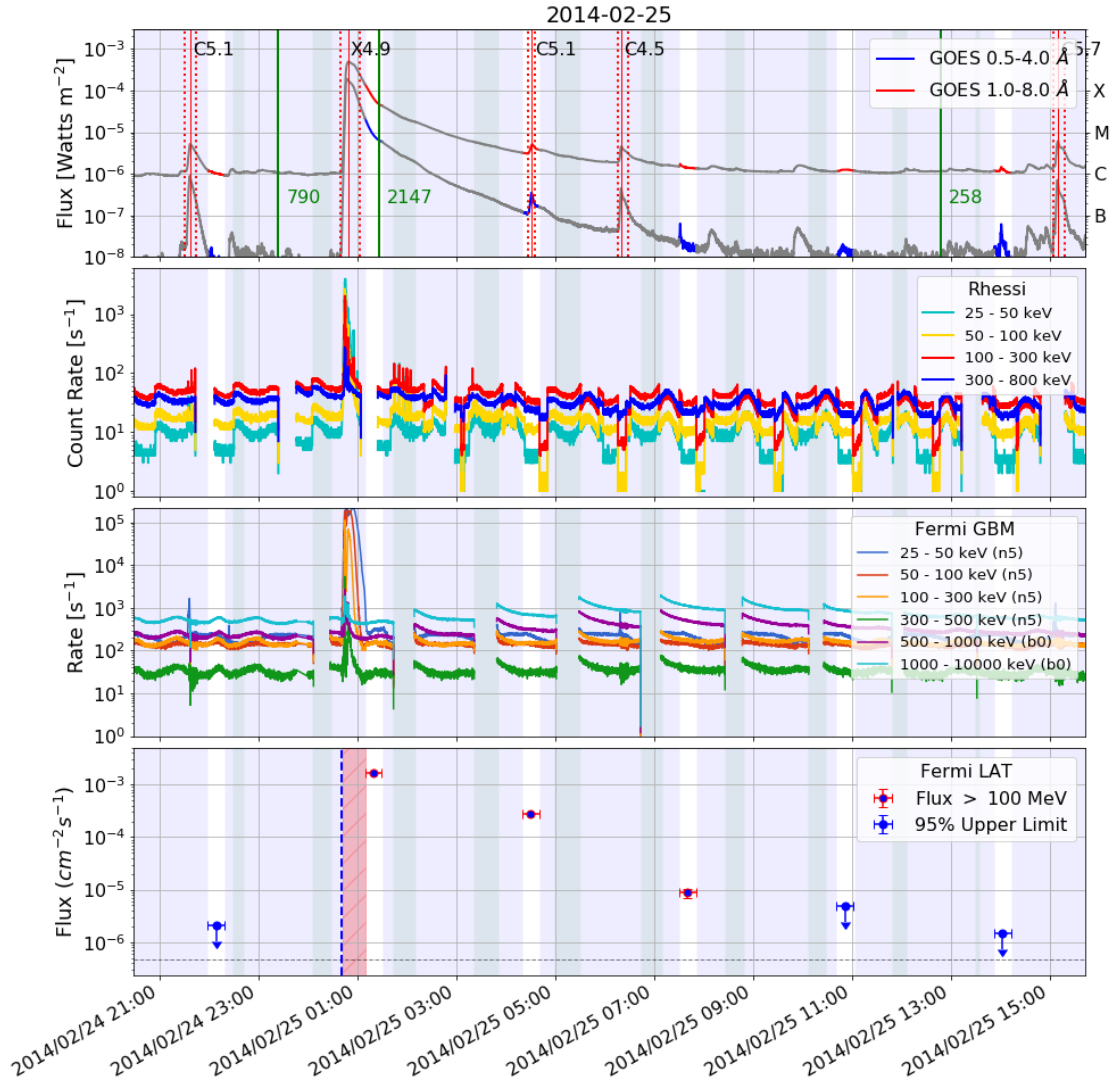
Figure 69. Light curve for FLSF 2014-02-25. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.
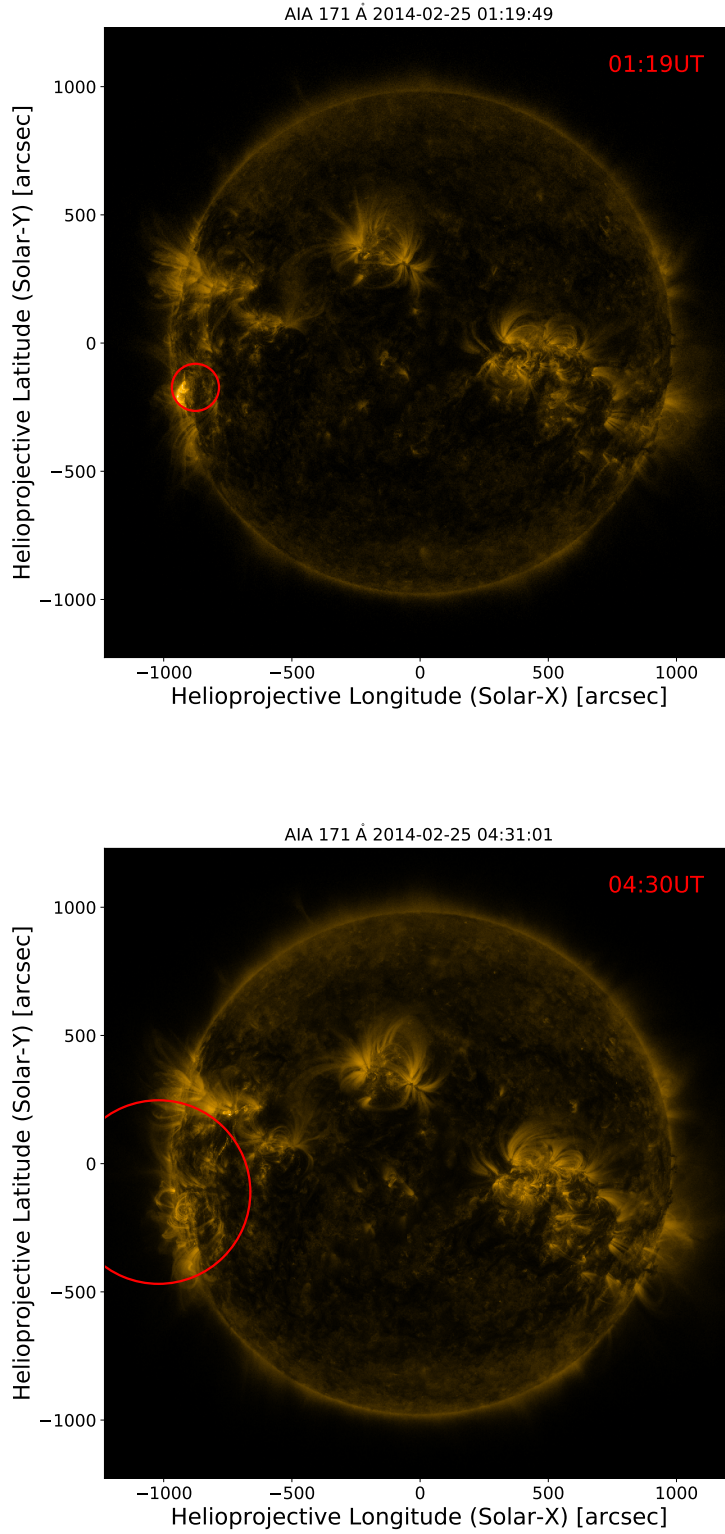
Figure 70. Time resolved localization of the >100 MeV emission from FLSF 2014-02-25. The mean time of the intergated time is annotated in the upper right hand corner of each panel. The radius of the emission centroid is the 68 percent containment. More information on the localization results can be found in Table 147.

Figure 71. Time resolved localization of the >100 MeV emission from FLSF 2014-02-25. The mean time of the intergated time is annotated in the upper right hand corner of each panel. The radius of the emission centroid is the 68 percent containment. More information on the localization results can be found in Table 147.

Date and Time	Helio X	Helio Y	ERR 68	ERR 95
2014-02-25 01:09 - 01:29	-933	-347	92	147
2014-02-25 04:20 - 04:40	-982	-213	358	574

Table 147. Localization results for FLSF 2014-02-25. The GOES X-ray flare associated with the FLSF originated from AR 11990 whose position at the time of the GOES flare was S15E65. All values are in arcseconds.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
01:09:31 - 01:30:05	$(1.68 \pm 0.05) \times 10^4$	$(1.084 \pm 0.024) \times 10^4$	$(5.31 \pm 0.11) \times 10^3$	$(1.61 \pm 0.04) \times 10^3$	288 ± 14	29.0 ± 3.3	2.8 ± 0.8	0.25 ± 0.19	<0.3	<0.2
04:20:31 - 04:41:05	$(5.00 \pm 0.34) \times 10^3$	$(2.69 \pm 0.14) \times 10^3$	$(8.4 \pm 0.5) \times 10^2$	81 ± 10	<2.9	<1.0	<0.8	<0.3	<0.2	<0.1
07:30:31 - 07:52:05	$(1.7 \pm 0.7) \times 10^2$	106 ± 28	20 ± 8	<5.0	<1.8	<1.1	<0.5	<0.3	<0.2	<0.1

Table 148. SED values for the time resolved intervals of FLSF 2014-02-25. Units are 10^{-8} cm^{-2} s^{-1} MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X4.9	2014-02-25 00:39	2014-02-25 00:49	2014-02-25 01:03	7000	BGO

Table 149. Properties of the GOES X-ray flare associated with FLSF 2014-02-25 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
2147	2014-02-25 01:25	100	GOES

Table 150. Properties of the CME potentially associated with FLSF 2014-02-25 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.37. *FLSF 2014-06-10*

The Sun was in the field of view of the LAT from 2014-06-10 14:00 to 2014-06-10 14:26 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 1.9 hours. The flare is classified as LLE-Prompt Delayed. Most likely associated to a X1.5 GOES flare which started on 2014-06-10 12:36 and to a CME with speed 1469 km s^{-1} with first LASCO C2 appearance on 2014-06-10 13:30:23 UTC. Gamma-ray emission >30 MeV also detected with the LLE approach. The LLE emission started on 2014-06-10 12:47:18 (UTC) and ended on 2014-06-10 12:47:43 (UTC) with a total duration of 25 seconds.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2014-06-10 14:00	25	1.17 ± 0.26	49	5	PL	-2.47 ± 0.22	-	-

Table 151. Maximum likelihood results for FLSF 2014-06-10. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.

Start Time (UTC)	Duration (sec)	Flux (30 MeV – 10 GeV)	Flux (100 MeV – 10 GeV)	TS cutoff	TS pion
2014-06-10 12:47:18	25.0	6.7 ± 1.3	2.9 ± 1.1	16	17

Table 152. LLE Spectral results for FLSF 2014-06-10. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
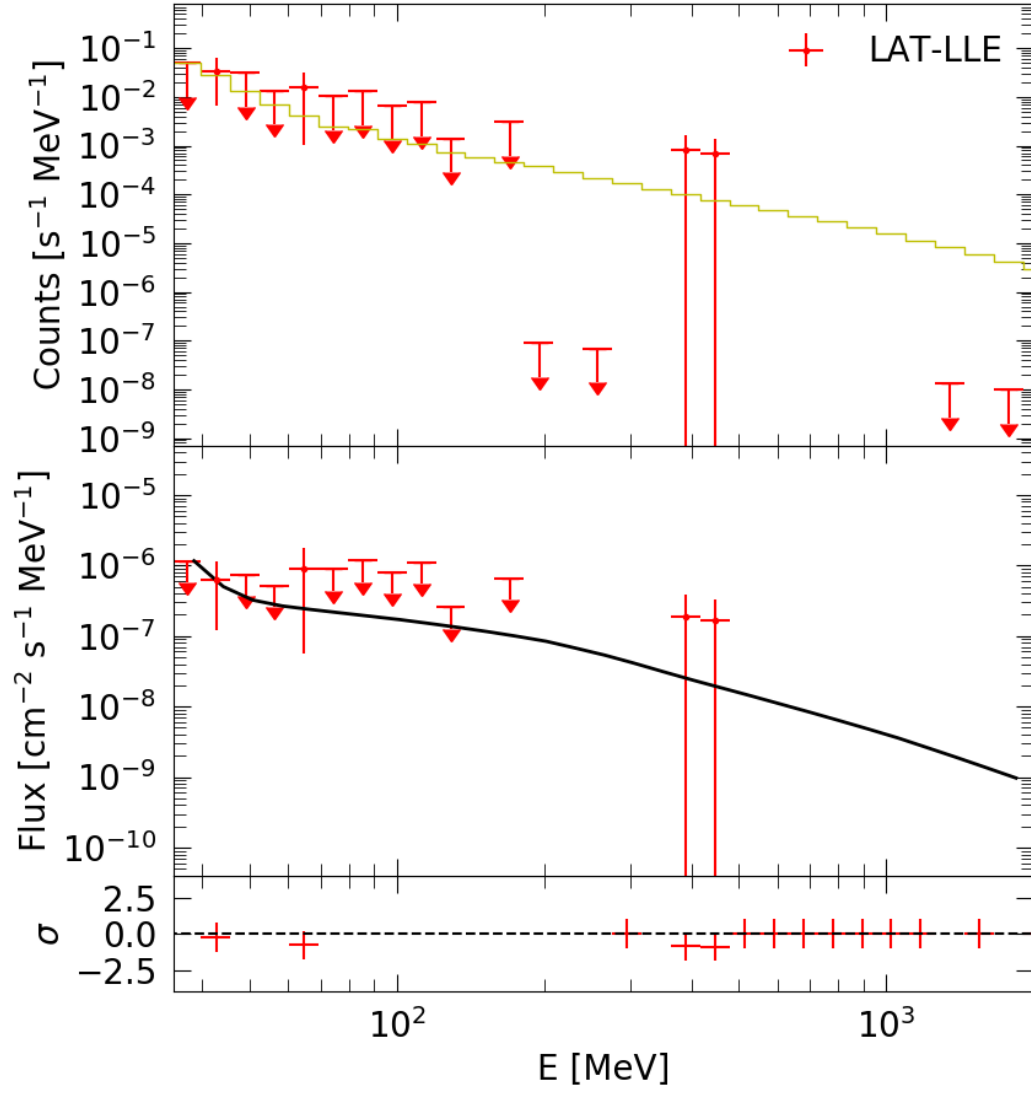
Figure 72. SED of FLSF 2014-06-10 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 152.
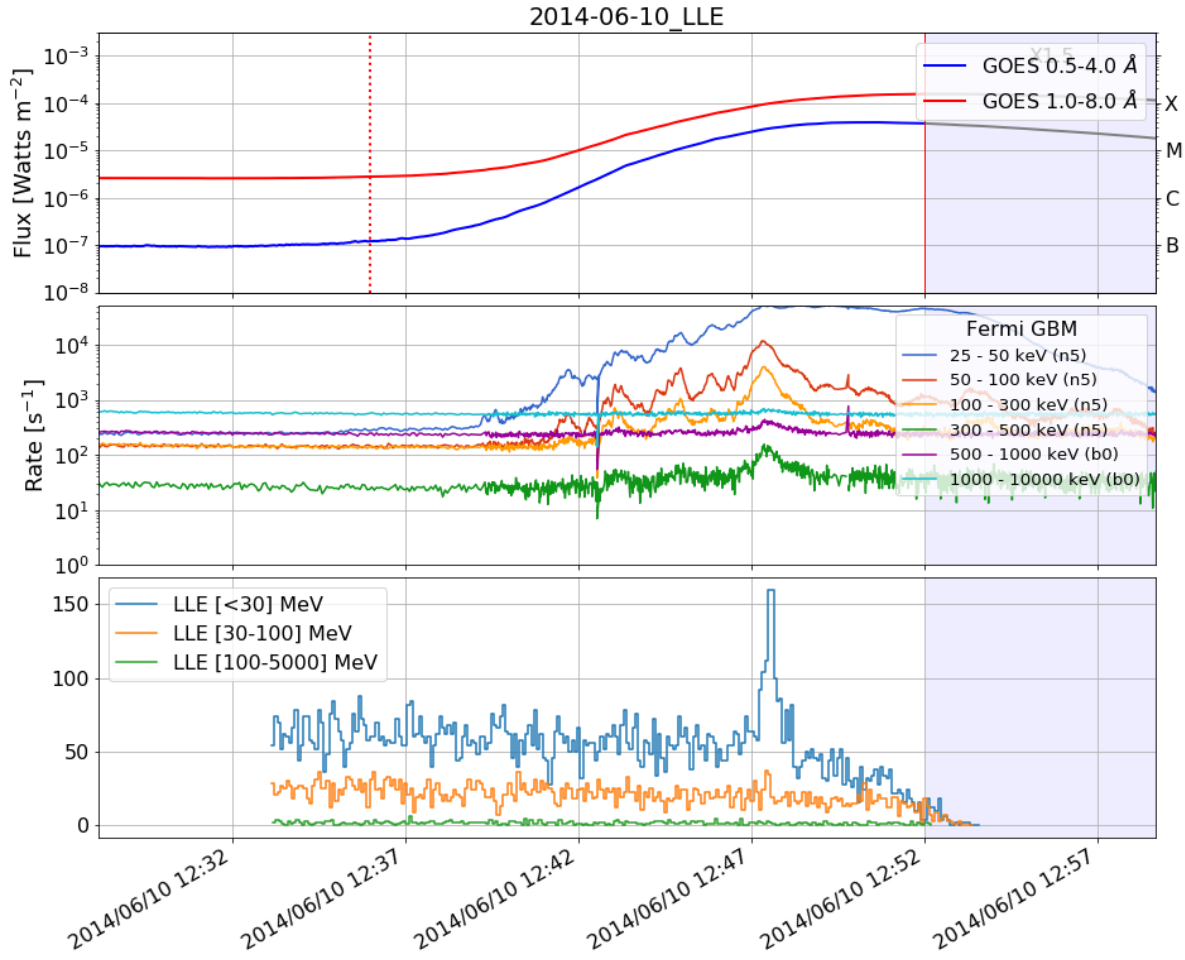
Figure 73. Light curve for FLSF 2014-06-10 with the LLE approach. Top panel: GOES X-rays, middle panel: Fermi-GBM X-rays and bottom panel: Fermi-LAT.
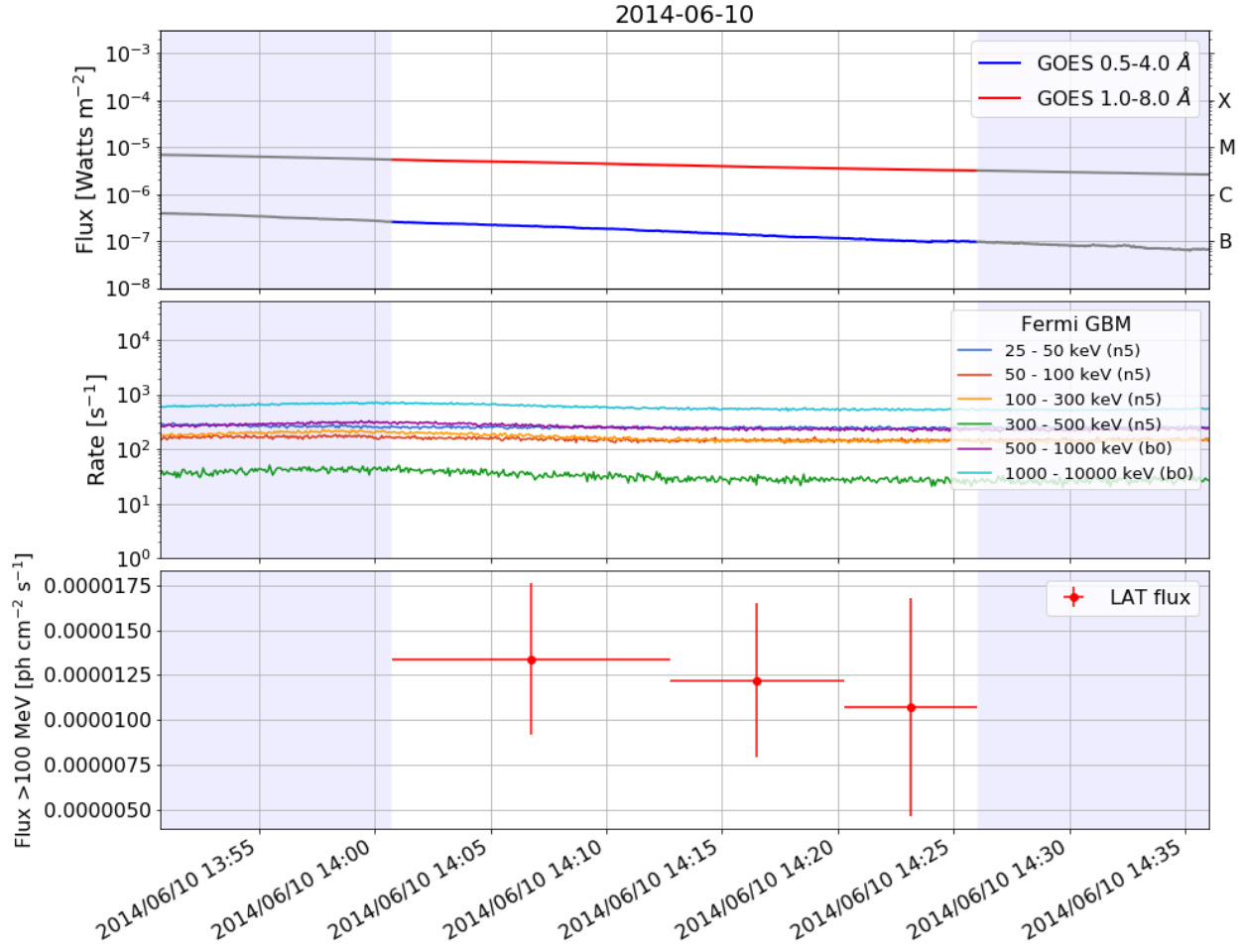
Figure 74. Fine time binning light curve for FLSF 2014-06-10. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate, *Fermi*-LAT maximum likelihood results with fine time binning.
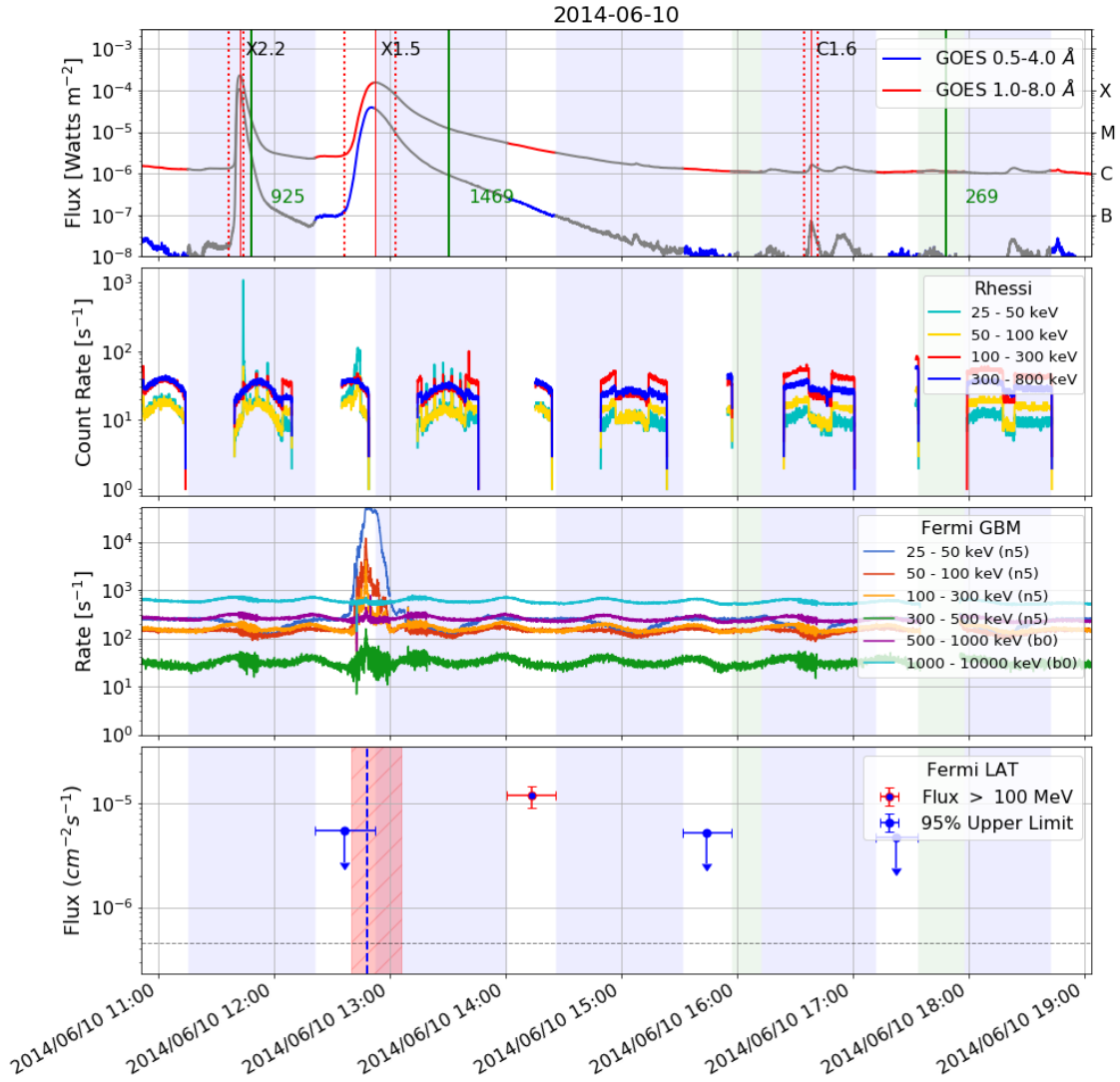
Figure 75. Light curve for FLSF 2014-06-10. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
14:00:43 - 14:26:01	$(2.6 \pm 1.4) \times 10^2$	<128.6	38 ± 14	16 ± 6	<4.8	<1.9	<0.7	<0.4	<0.2	<0.1

Table 153. SED values for the time resolved intervals of FLSF 2014-06-10. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.5	2014-06-10 12:36	2014-06-10 12:52	2014-06-10 13:03	1000	BGO

Table 154. Properties of the GOES X-ray flare associated with FLSF 2014-06-10 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1469	2014-06-10 13:30	60	STEREO

Table 155. Properties of the CME potentially associated with FLSF 2014-06-10 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.38. *FLSF 2014-06-11*

The Sun was in the field of view of the LAT from 2014-06-11 09:06 to 2014-06-11 09:30 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 14 minutes. The flare is classified as Short-Delayed. Most likely associated to a X1.0 GOES flare which started on 2014-06-11 08:59 and to a CME with speed 829 km s^{-1} with first LASCO C2 appearance on 2014-06-11 09:24:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux $(10^{-5}\text{cm}^{-2}\text{s}^{-1})$	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2014-06-11 09:06	24	0.99 ± 0.26 *	30	3	PL	-2.77 ± 0.30	-	-

Table 156. Maximum likelihood results for FLSF 2014-06-11. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the `S15` event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
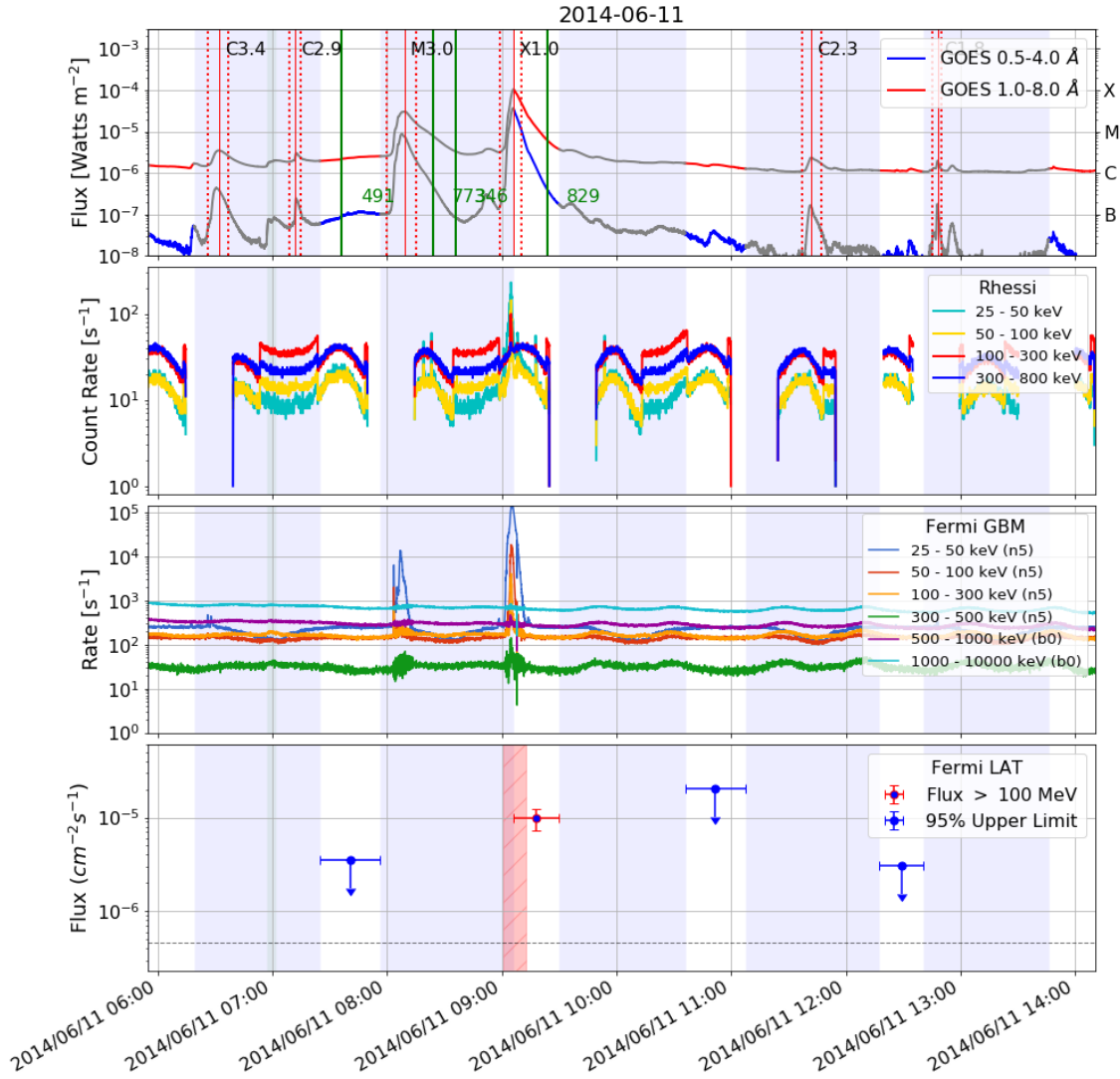
Figure 76. Light curve for FLSF 2014-06-11. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
09:06:21 - 09:30:01	$(3.5 \pm 1.5) \times 10^2$	<128.7	32 ± 14	9 ± 5	<4.4	<1.7	<0.9	<0.6	<0.4	<0.2

Table 157. SED values for the time resolved intervals of FLSF 2014-06-11. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.0	2014-06-11 08:59	2014-06-11 09:06	2014-06-11 09:10	1000	BGO

Table 158. Properties of the GOES X-ray flare associated with FLSF 2014-06-11 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
829	2014-06-11 09:24	NaN	NaN

Table 159. Properties of the CME potentially associated with FLSF 2014-06-11 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.39. *FLSF 2014-09-01*

The Sun was in the field of view of the LAT from 2014-09-01 11:02 to 2014-09-01 12:57 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 2.5 hours. The flare is classified as BTL Delayed. Most likely associated to a X2.4* GOES flare which started on 2014-09-01 10:58 and to a CME with speed 1901 km s^{-1} with first LASCO C2 appearance on 2014-09-01 11:12:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2014-09-01 11:02	16	379 ± 7	41620	-5590	Exp	-1.03 ± 0.09	177 ± 10	4.70 ± 0.07
2014-09-01 12:25	32	2.98 ± 0.22	545	31	Exp	-1.16 ± 0.29	290 ± 82	3.72 ± 0.24

Table 160. Maximum likelihood results for FLSF 2014-09-01. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
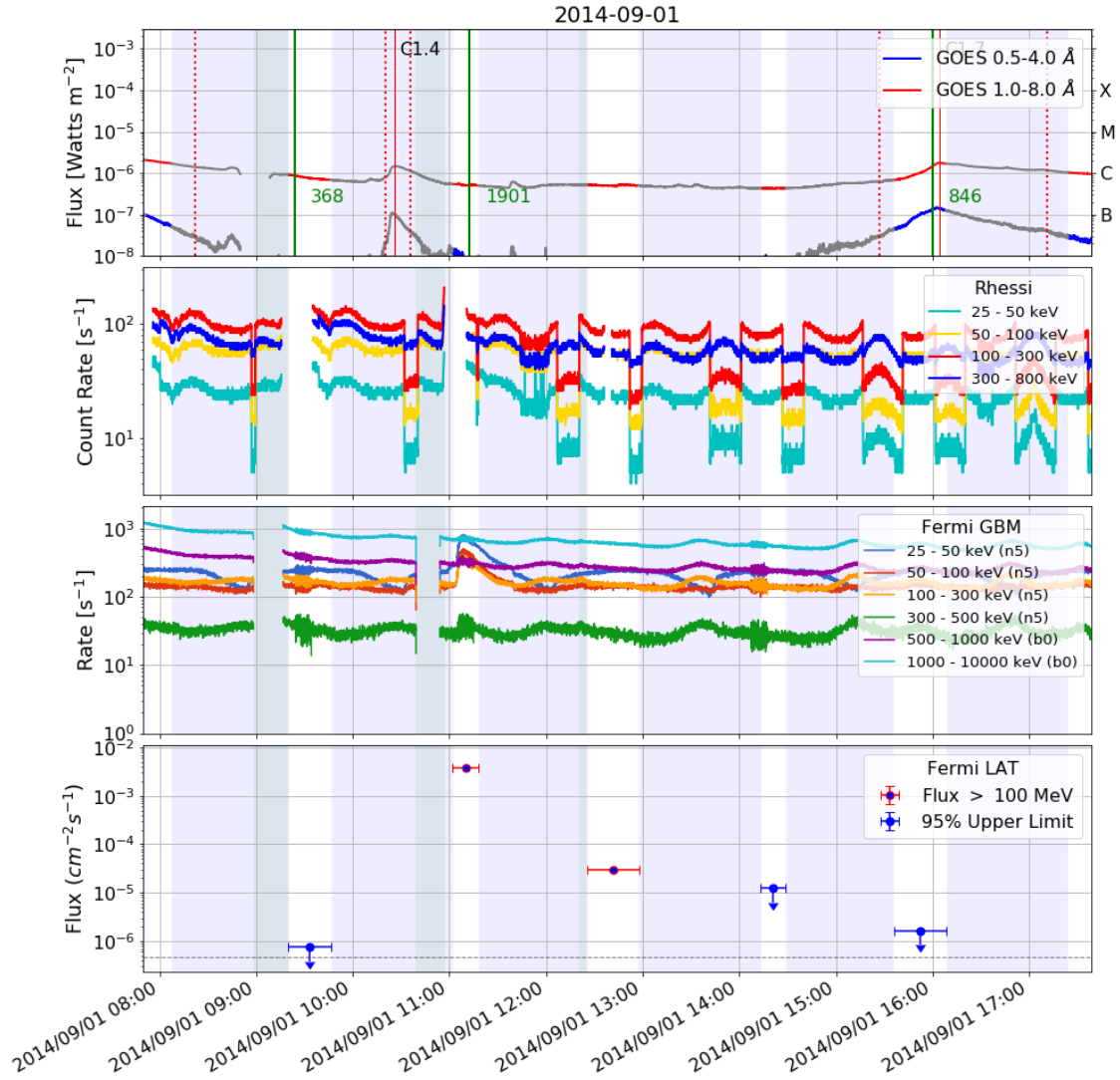
Figure 77. Light curve for FLSF 2014-09-01. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
11:02:03 - 11:18:03	$(6.33 \pm 0.35) \times 10^4$	$(3.08 \pm 0.11) \times 10^4$	$(1.203 \pm 0.034) \times 10^4$	$(2.87 \pm 0.10) \times 10^3$	390 ± 26	43 ± 6	4.3 ± 1.5	0.6 ± 0.4	<0.6	<0.3
12:25:25 - 12:57:31	$(3.3 \pm 0.7) \times 10^2$	226 ± 30	79 ± 11	24 ± 4	4.4 ± 1.3	1.3 ± 0.5	<0.6	<0.2	<0.1	<0.1

Table 161. SED values for the time resolved intervals of FLSF 2014-09-01. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X2.4*	2014-09-01 10:58	2014-09-01 11:12	2014-09-01 11:40	100	NaI5

Table 162. Properties of the GOES X-ray flare associated with FLSF 2014-09-01 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1901	2014-09-01 11:12	100	GOES

Table 163. Properties of the CME potentially associated with FLSF 2014-09-01 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.40. *FLSF 2014-09-10*

The Sun was in the field of view of the LAT from 2014-09-10 17:35 to 2014-09-10 17:53 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 18 minutes. The flare is classified as Short-Delayed. Most likely associated to a X1.6 GOES flare which started on 2014-09-10 17:21 and to a CME with speed 1071 km s^{-1} with first LASCO C2 appearance on 2014-09-10 17:24:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2014-09-10 17:35	18	7.4 ± 0.5 *	559	66	Exp	0.35 ± 0.54	86 ± 20	4.66 ± 0.34

Table 164. Maximum likelihood results for FLSF 2014-09-10. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the S15 event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
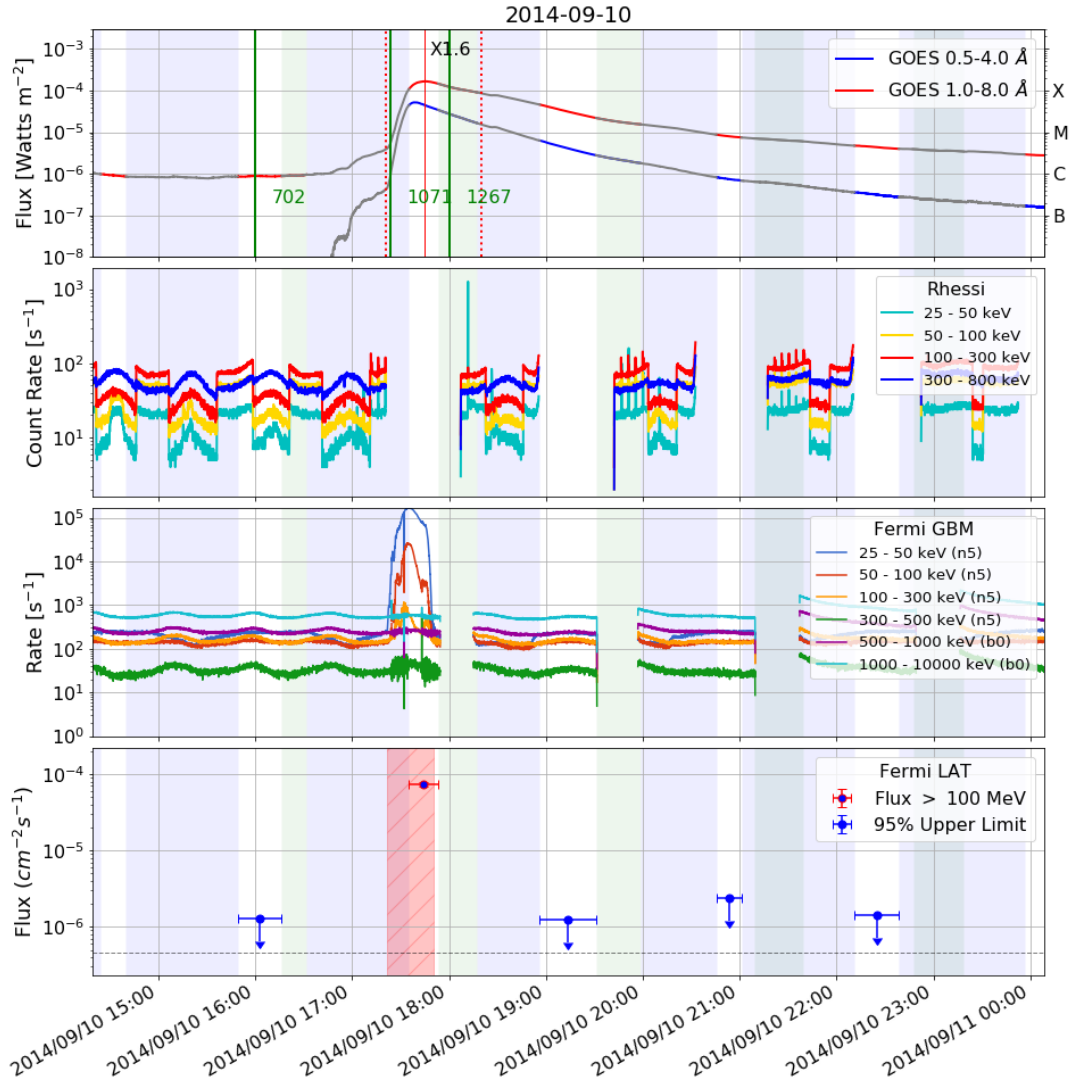
Figure 78. Light curve for FLSF 2014-09-10. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval					Energy bin (MeV)						
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
17:35:17 - 18:22:11	$(8.8 \pm 1.5) \times 10^2$	$(4.9 \pm 0.6) \times 10^2$	293 ± 31	41 ± 8	5.6 ± 2.4	<3.1	<0.9	<0.5	<0.5	<0.2

Table 165. SED values for the time resolved intervals of FLSF 2014-09-10. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X1.6	2014-09-10 17:21	2014-09-10 17:45	2014-09-10 18:20	100	NaI5

Table 166. Properties of the GOES X-ray flare associated with FLSF 2014-09-10 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1071	2014-09-10 17:24	100	GOES

Table 167. Properties of the CME potentially associated with FLSF 2014-09-10 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.41. *FLSF 2015-06-21*

The Sun was in the field of view of the LAT from 2015-06-21 02:09 to 2015-06-21 12:14 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 11.5 hours. The flare is classified as Prompt Delayed. Most likely associated to a M2.7 GOES flare which started on 2015-06-21 02:04 and to a CME with speed 1366 km s^{-1} with first LASCO C2 appearance on 2015-06-21 02:36:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2015-06-21 02:09	33	0.25 ± 0.08	23	5	PL	-3.05 ± 0.39	-	-
2015-06-21 05:19	33	1.26 ± 0.15	162	16	Exp	-0.18 ± 0.74	118 ± 44	4.3 ± 0.6
2015-06-21 08:30	33	0.81 ± 0.13	101	12	Exp	0.03 ± 1.14	110 ± 57	4.2 ± 0.7
2015-06-21 11:40	33	0.38 ± 0.10	31	10	Exp	2.05 ± 2.61	49 ± 29	>6

Table 168. Maximum likelihood results for FLSF 2015-06-21. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
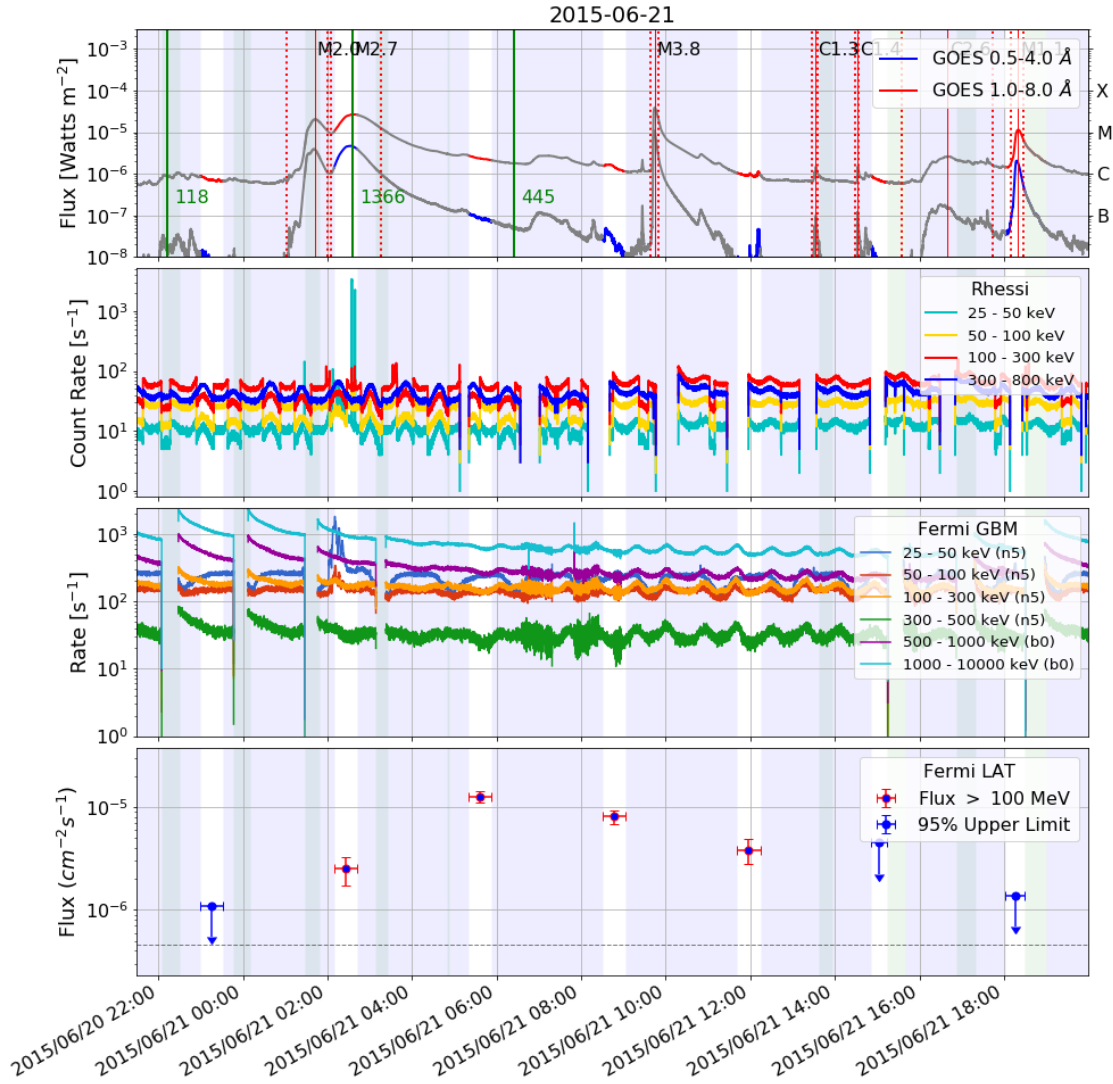
Figure 79. Light curve for FLSF 2015-06-21. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)										
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
02:09:20 - 02:42:01	$(9 \pm 4) \times 10^1$	38 ± 15	<18.8	<3.9	<1.2	<0.5	<0.3	<0.2	<0.1	<0.1
05:19:46 - 05:53:01	$(1.6 \pm 0.5) \times 10^2$	75 ± 19	46 ± 9	8.8 ± 2.6	1.6 ± 0.8	<0.6	<0.3	<0.3	<0.1	<0.1
08:30:18 - 09:03:01	$(9 \pm 4) \times 10^1$	59 ± 16	24 ± 7	6.4 ± 2.3	<3.0	<0.8	<0.4	<0.2	<0.1	<0.1
11:40:44 - 12:14:01	<103.0	36 ± 14	12 ± 5	<9.0	<1.2	<0.5	<0.4	<0.2	<0.1	<0.1

Table 169. SED values for the time resolved intervals of FLSF 2015-06-21. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M2.7	2015-06-21 02:04	2015-06-21 02:34	2015-06-21 03:15	50	NaI5

Table 170. Properties of the GOES X-ray flare associated with FLSF 2015-06-21 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1366	2015-06-21 02:36	10	GOES

Table 171. Properties of the CME potentially associated with FLSF 2015-06-21 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.42. *FLSF 2015-06-25*

The Sun was in the field of view of the LAT from 2015-06-25 09:24 to 2015-06-25 10:09 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 2.4 hours. The flare is classified as Delayed. Most likely associated to a M7.9 GOES flare which started on 2015-06-25 08:02 and to a CME with speed 1627 km s^{-1} with first LASCO C2 appearance on 2015-06-25 08:36:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2015-06-25 09:24	45	0.40 ± 0.08	48	6	PL	-2.72 ± 0.22	-	-

Table 172. Maximum likelihood results for FLSF 2015-06-25. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model.
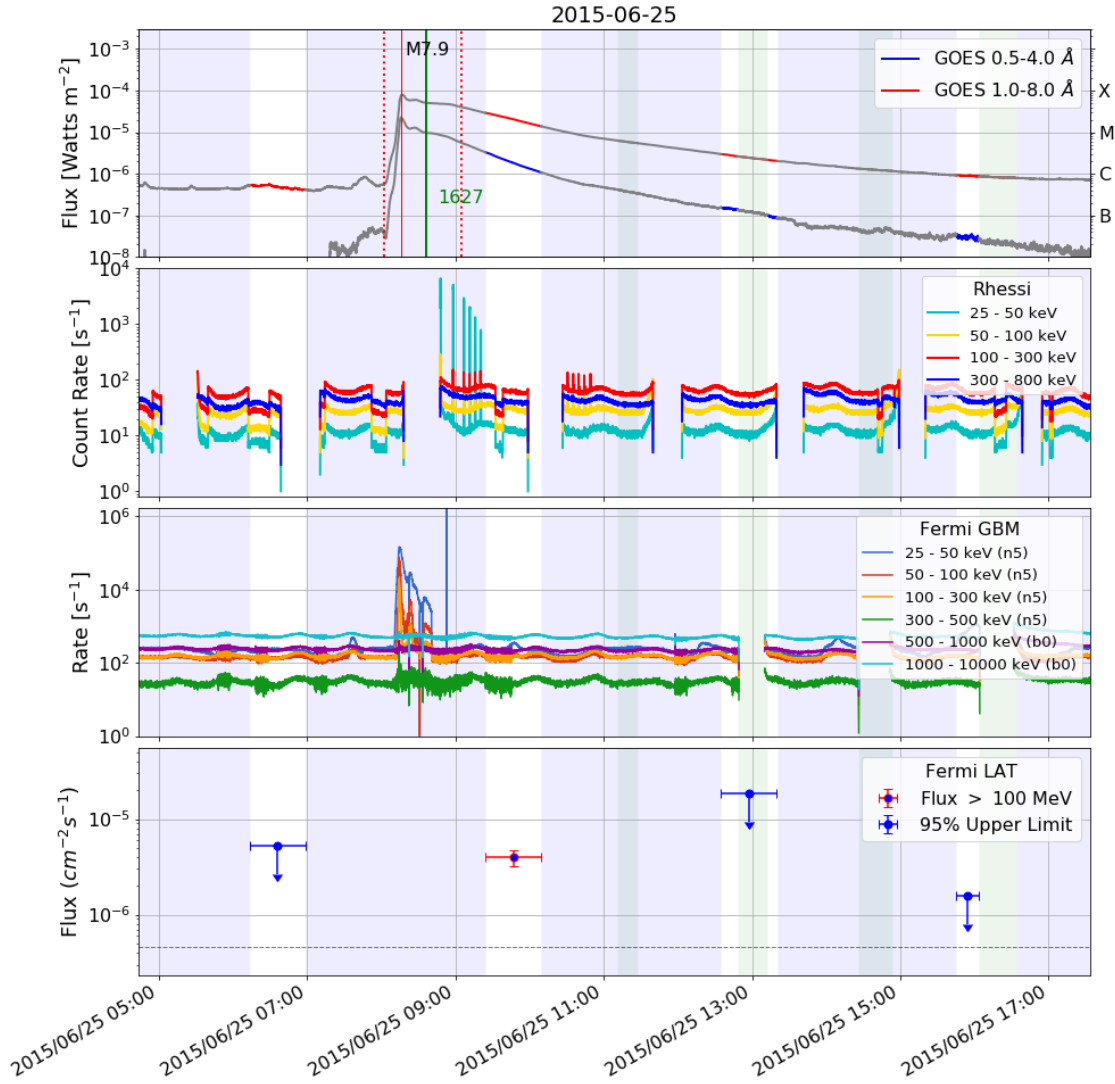
Figure 80. Light curve for FLSF 2015-06-25. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
09:24:19 - 10:12:19	$(1.1 \pm 0.4) \times 10^2$	34 ± 12	11 ± 4	5.0 ± 1.8	<1.3	<0.4	<0.2	<0.1	<0.1	<0.0

Table 173. SED values for the time resolved intervals of FLSF 2015-06-25. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
M7.9	2015-06-25 08:02	2015-06-25 08:16	2015-06-25 09:05	1000	BGO

Table 174. Properties of the GOES X-ray flare associated with FLSF 2015-06-25 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1627	2015-06-25 08:36	10	GOES

Table 175. Properties of the CME potentially associated with FLSF 2015-06-25 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.43. *FLSF 2017-09-06a*

The Sun was in the field of view of the LAT from 2017-09-06 08:51 to 2017-09-06 09:19 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 10 minutes. The flare is classified as Prompt. Most likely associated to a X2.2 GOES flare which started on 2017-09-06 08:57 and to a CME with speed 391 km s^{-1} with first LASCO C2 appearance on 2017-09-06 09:48:06 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2017-09-06 08:51	28	1.31 ± 0.16 *	130	21	Exp	0.59 ± 1.05	60 ± 22	>6

Table 176. Maximum likelihood results for FLSF 2017-09-06a. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the `S15` event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
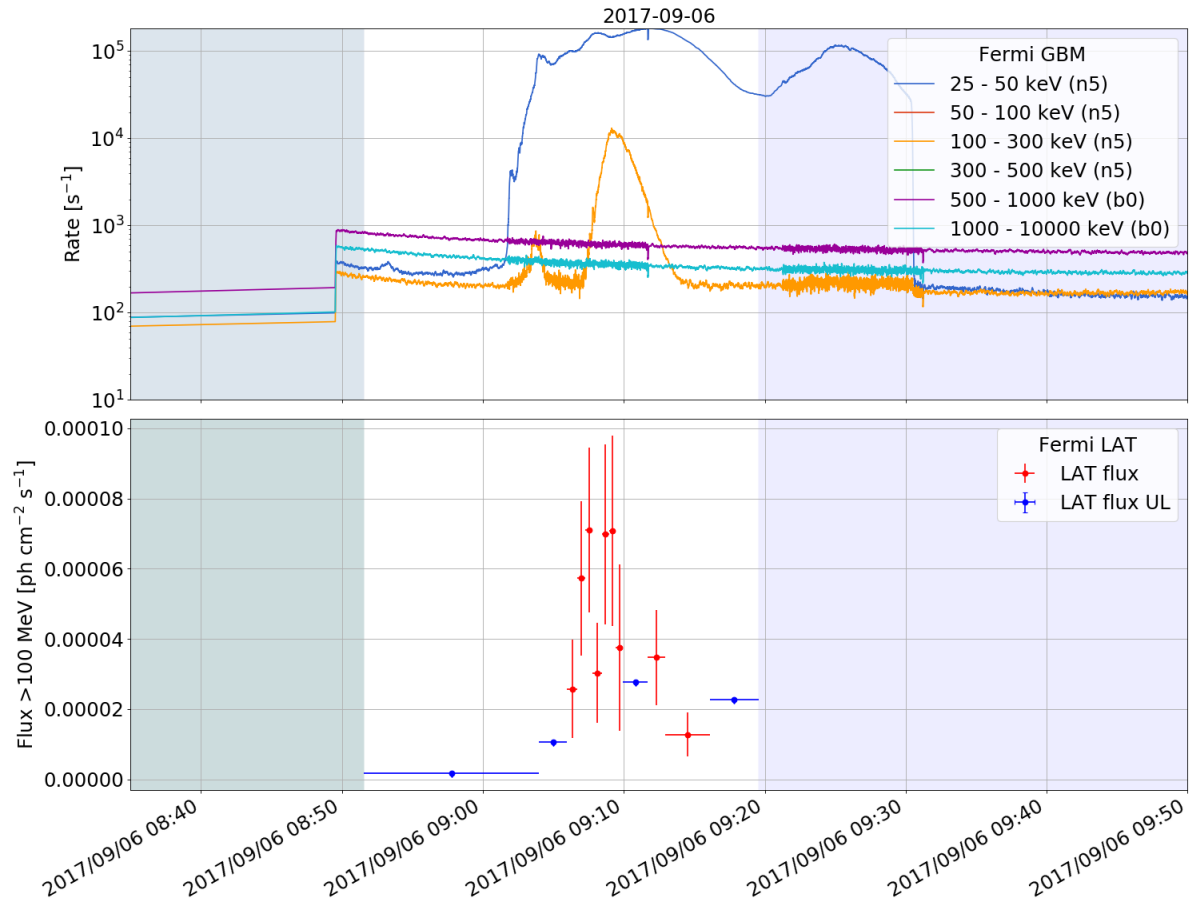
Figure 81. Fine time binning light curve for FLSF 2017-09-06a. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate and the *Fermi*-LAT maximum likelihood results with fine time binning.
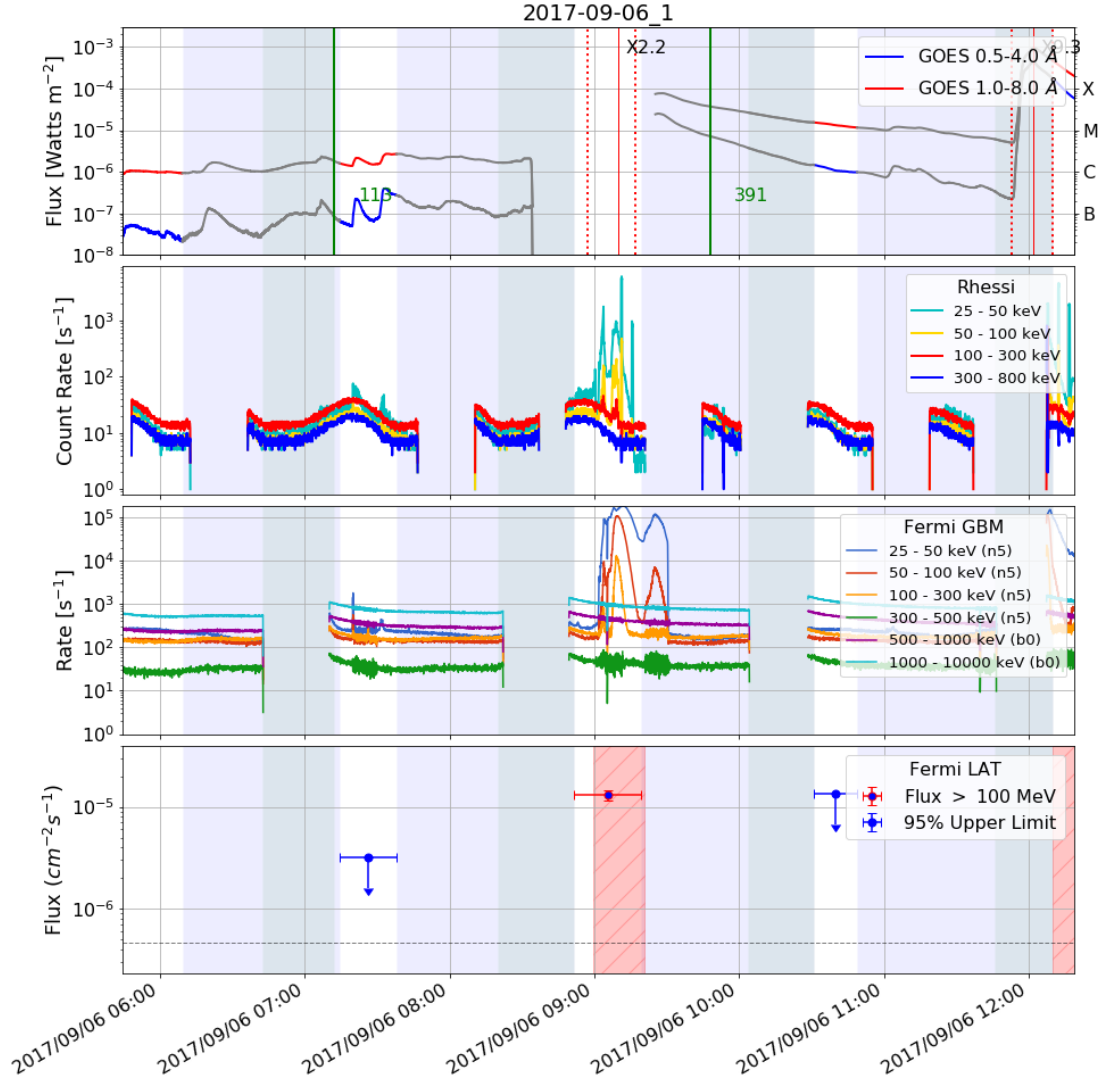
Figure 82. Light curve for FLSF 2017-09-06a. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval	Energy bin (MeV)									
(UTC)	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
08:20:08 - 09:19:32	$(2.2 \pm 0.6) \times 10^2$	124 ± 24	35 ± 8	4.9 ± 2.2	<2.1	<0.8	<0.5	<0.3	<0.2	<0.1

Table 177. SED values for the time resolved intervals of FLSF 2017-09-06_1. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X2.2	2017-09-06 08:57	2017-09-06 09:10	2017-09-06 09:17	300	NaI5

Table 178. Properties of the GOES X-ray flare associated with FLSF 2017-09-06a and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
391	2017-09-06 09:48	NaN	NaN

Table 179. Properties of the CME potentially associated with FLSF 2017-09-06a and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.44. *FLSF 2017-09-06b*

The Sun was in the field of view of the LAT from 2017-09-06 12:10 to 2017-09-07 01:11 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 13.3 hours. The flare is classified as Delayed. Most likely associated to a X9.3 GOES flare which started on 2017-09-06 11:53 and to a CME with speed 1571 km s^{-1} with first LASCO C2 appearance on 2017-09-06 12:24:05 UTC.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2017-09-06 12:10	25	0.96 ± 0.11 *	156	17	Exp	0.05 ± 1.06	58 ± 23	>6
2017-09-06 13:23	26	2.63 ± 0.17 *	604	66	Exp	0.39 ± 0.55	60 ± 12	>6
2017-09-06 15:03	18	2.9 ± 0.4	137	24	Exp	1.20 ± 1.29	59 ± 23	5.6 ± 0.8
2017-09-06 16:45	19	3.6 ± 0.5	130	24	Exp	1.24 ± 1.24	64 ± 22	5.2 ± 0.7
2017-09-06 18:14	36	2.73 ± 0.24	337	49	Exp	0.67 ± 0.68	71 ± 17	5.4 ± 0.5
2017-09-06 19:55	25	2.27 ± 0.35	96	17	Exp	0.74 ± 1.33	65 ± 27	>6
2017-09-06 21:25	35	2.56 ± 0.24	318	36	Exp	0.11 ± 0.67	84 ± 24	5.5 ± 0.5
2017-09-06 23:05	26	0.96 ± 0.22	43	4	PL	-3.06 ± 0.30	-	-
2017-09-07 00:36	35	0.62 ± 0.13	52	4	PL	-2.63 ± 0.22	-	-

Table 180. Maximum likelihood results for FLSF 2017-09-06b. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the `S15` event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
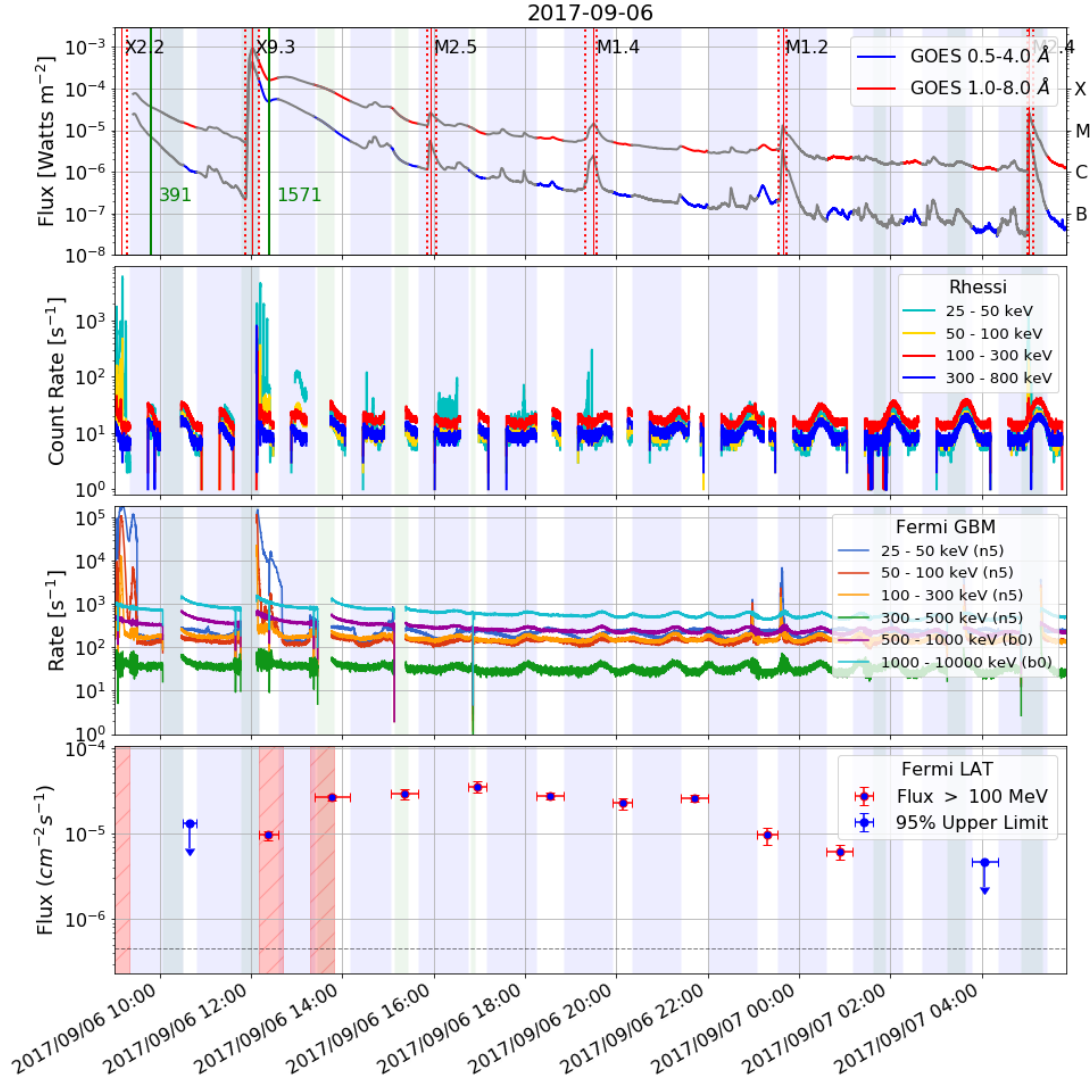
Figure 83. Light curve for FLSF 2017-09-06b. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
11:46:04 - 12:47:10	$(2.2 \pm 0.4) \times 10^2$	95 ± 16	20 ± 5	2.5 ± 1.3	<1.0	<0.6	<0.3	<0.2	<0.1	<0.1
13:10:10 - 14:22:14	$(4.6 \pm 0.6) \times 10^2$	260 ± 25	62 ± 8	9.8 ± 2.4	<1.8	<0.6	<0.3	<0.2	<0.1	<0.1
15:03:33 - 15:40:01	<480.0	$(2.3 \pm 0.6) \times 10^2$	125 ± 24	10 ± 5	<6.3	<1.5	<0.9	<0.5	<0.3	<0.2
16:45:01 - 17:09:59	$(3.6 \pm 1.9) \times 10^2$	$(2.3 \pm 0.7) \times 10^2$	112 ± 26	34 ± 9	<5.7	<1.7	<0.9	<0.6	<0.4	<0.2
18:14:29 - 18:50:38	$(3.5 \pm 0.8) \times 10^2$	207 ± 33	101 ± 14	13.9 ± 3.5	<3.1	<0.9	<0.3	<0.2	<0.1	<0.1
19:55:08 - 20:20:45	<435.0	$(2.6 \pm 0.6) \times 10^2$	50 ± 15	17 ± 6	<3.1	<1.3	<0.7	<0.4	<0.2	<0.1
21:25:15 - 22:00:51	$(3.8 \pm 0.9) \times 10^2$	187 ± 32	80 ± 12	18 ± 4	<2.7	<1.1	<0.4	<0.2	<0.1	<0.1
23:05:21 - 23:31:27	$(2.9 \pm 1.3) \times 10^2$	$(1.4 \pm 0.4) \times 10^2$	24 ± 10	<9.6	<3.5	<1.2	<0.6	<0.4	<0.2	<0.1
00:36:17 - 01:11:03	<255.0	46 ± 18	21 ± 7	5.8 ± 2.5	<2.2	<1.0	<0.4	<0.2	<0.1	<0.1

Table 181. SED values for the time resolved intervals of FLSF 2017-09-06. Units are $10^{-8} \ \mathrm{cm}^{-2} \ \mathrm{s}^{-1} \mathrm{MeV}^{-1}$.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X9.3	2017-09-06 11:53	2017-09-06 12:02	2017-09-06 12:10	300	Rhessi

Table 182. Properties of the GOES X-ray flare associated with FLSF 2017-09-06b and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
1571	2017-09-06 12:24	100	GOES

Table 183. Properties of the CME potentially associated with FLSF 2017-09-06b and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

1.45. *FLSF 2017-09-10*

The Sun was in the field of view of the LAT from 2017-09-10 15:52 to 2017-09-11 05:11 and the total estimated duration of the *Fermi*-LAT detected gamma-ray emission was 13.9 hours. The flare is classified as Prompt Delayed. Most likely associated to a X8.2 GOES flare which started on 2017-09-10 15:35 and to a CME with speed 3163 km s^{-1} with first LASCO C2 appearance on 2017-09-10 16:00:05 UTC. Gamma-ray emission >30 MeV also detected with the LLE approach. The LLE emission started on 2017-09-10 15:57:47 (UTC) and ended on 2017-09-10 16:03:12 (UTC) with a total duration of 325 seconds.

Detection Start (UTC)	Exposure (minutes)	Flux (10^{-5}cm^{-2}s^{-1})	TS	ΔTS	Model	Photon Index	Cutoff Energy (MeV)	Proton index
2017-09-10 15:52	35	291.0 ± 2.1 *	61725	4429	Exp	-0.67 ± 0.03	195 ± 4	3.737 ± 0.026
2017-09-10 17:33	24	76.4 ± 1.9	6112	469	Exp	-0.70 ± 0.30	248 ± 49	3.30 ± 0.06
2017-09-10 19:03	36	88.3 ± 1.3	16954	1819	Exp	-0.02 ± 0.07	140 ± 5	3.70 ± 0.05
2017-09-10 20:44	24	35.8 ± 1.3	2311	276	Exp	0.07 ± 0.22	117 ± 11	4.18 ± 0.14
2017-09-10 22:13	36	15.0 ± 0.5	2559	315	Exp	0.35 ± 0.22	91 ± 8	4.67 ± 0.16
2017-09-10 23:54	24	5.6 ± 0.5	310	68	Exp	2.03 ± 0.84	55 ± 11	4.9 ± 0.4
2017-09-11 01:23	36	2.38 ± 0.22	284	55	Exp	1.69 ± 0.83	48 ± 10	6.0 ± 0.5
2017-09-11 03:05	24	1.39 ± 0.28	59	12	Exp	1.00 ± 1.58	70 ± 34	5.0 ± 1.0
2017-09-11 04:34	37	0.49 ± 0.11	43	2	PL	-2.65 ± 0.24	-	-

Table 184. Maximum likelihood results for FLSF 2017-09-10. Flux values are integrated between 100 MeV and 10 GeV calculated for the best-fit model. The * indicates that the flux was calculated using the S15 event class because there was pile-up in the *Fermi*-LAT Anti-Coincidence Detector during the observation due to a high rate of X-rays.
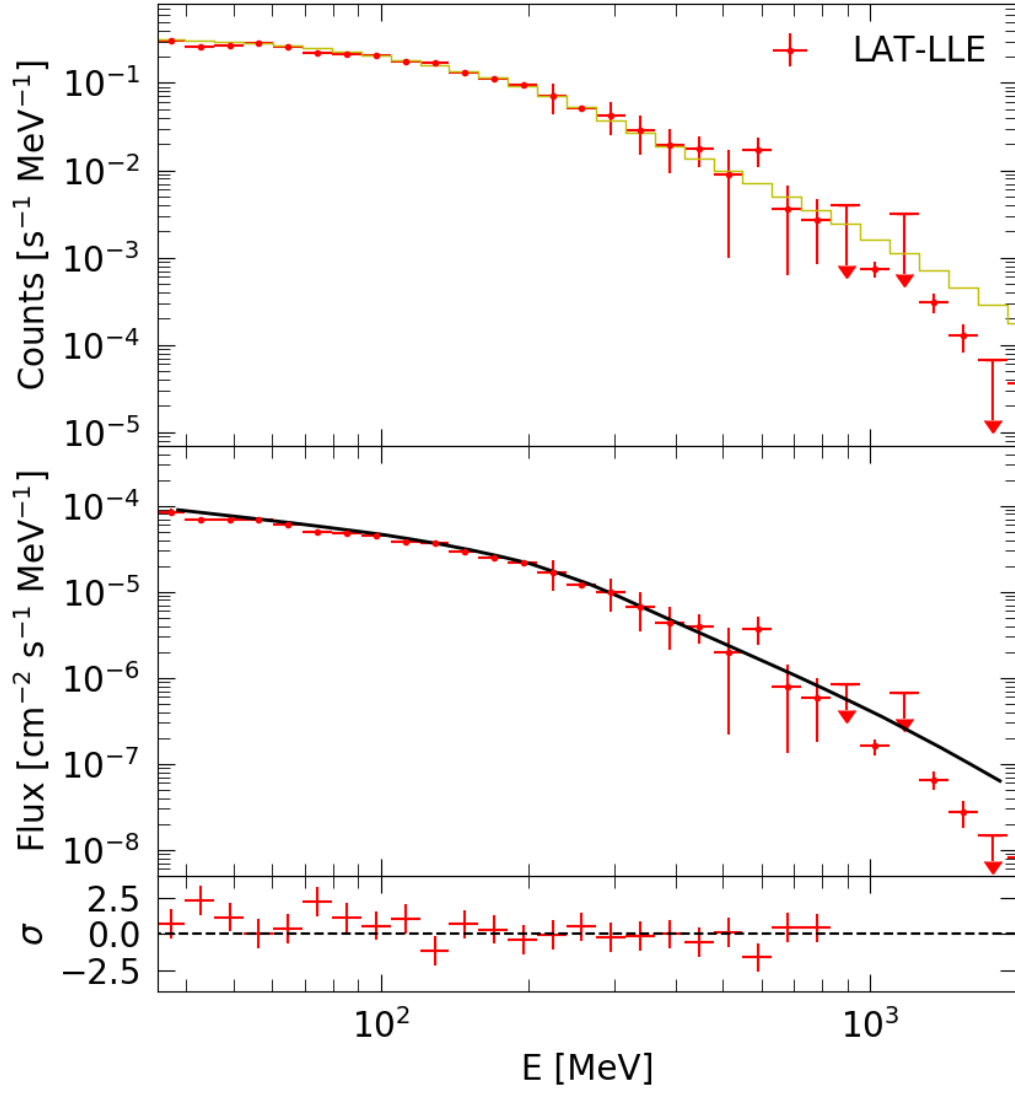
Figure 84. SED of FLSF 2017-09-10 from the LLE analysis approach. Solid black line represents the best fit model. The start time, duration and best fit model of the LLE flare are listed in Table 185.

Start Time	Duration	Flux	Flux	TS cutoff	TS pion
(UTC)	(sec)	(30 MeV − 10 GeV)	(100 MeV − 10 GeV)		
2017-09-10 15:57:47	325.0	1060 ± 9	601 ± 7	273	13338

Table 185. LLE Spectral results for FLSF 2017-09-10. The fluxes are in units of 10^{-5} photons s^{-1} cm^2.
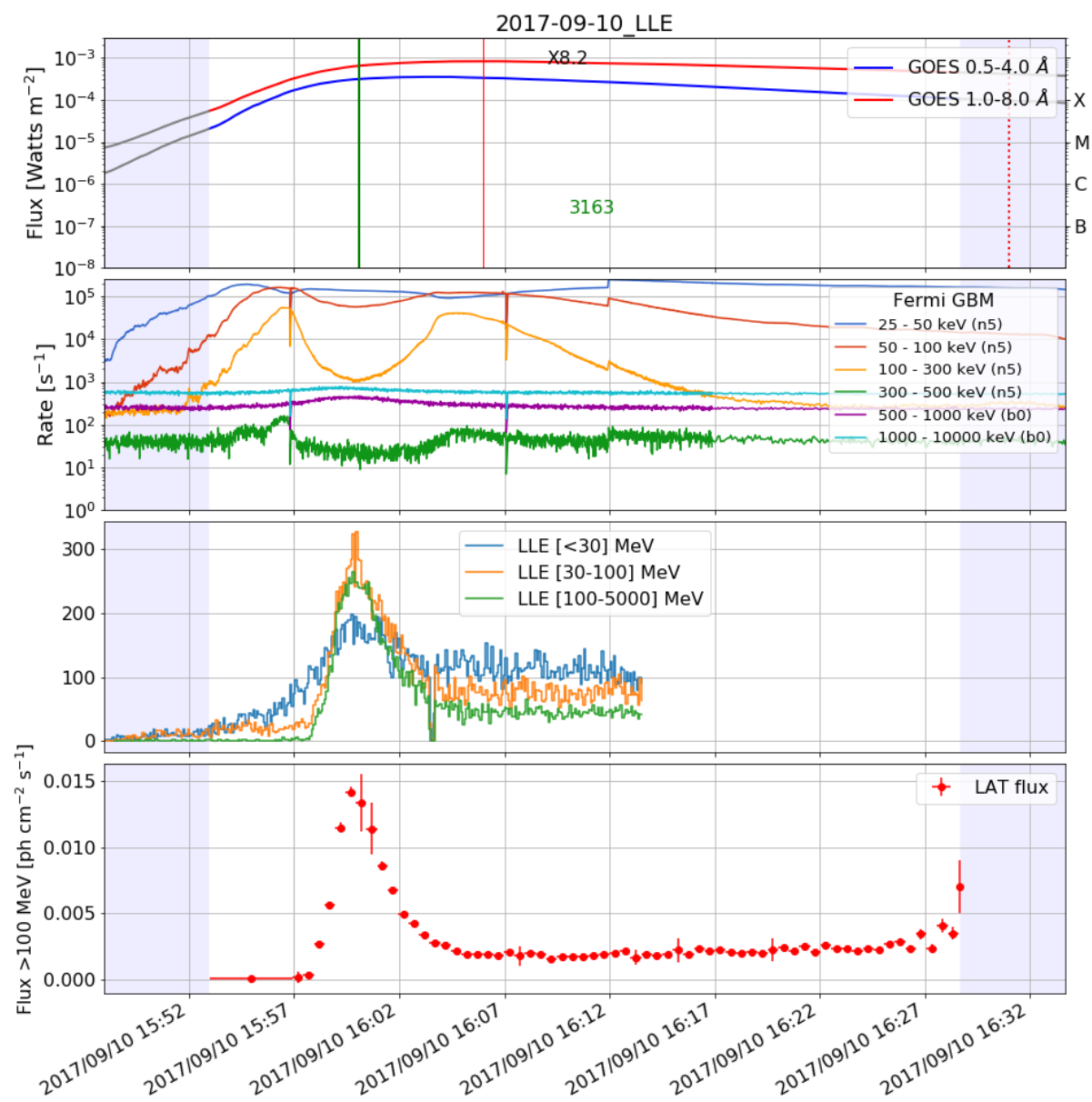
Figure 85. Fine time binning light curve for FLSF 2017-09-10. From top to bottom: GOES X-ray lightcurve, *Fermi*-GBM count rate, *Fermi*-LLE, *Fermi*-LAT maximum likelihood results with fine time binning.
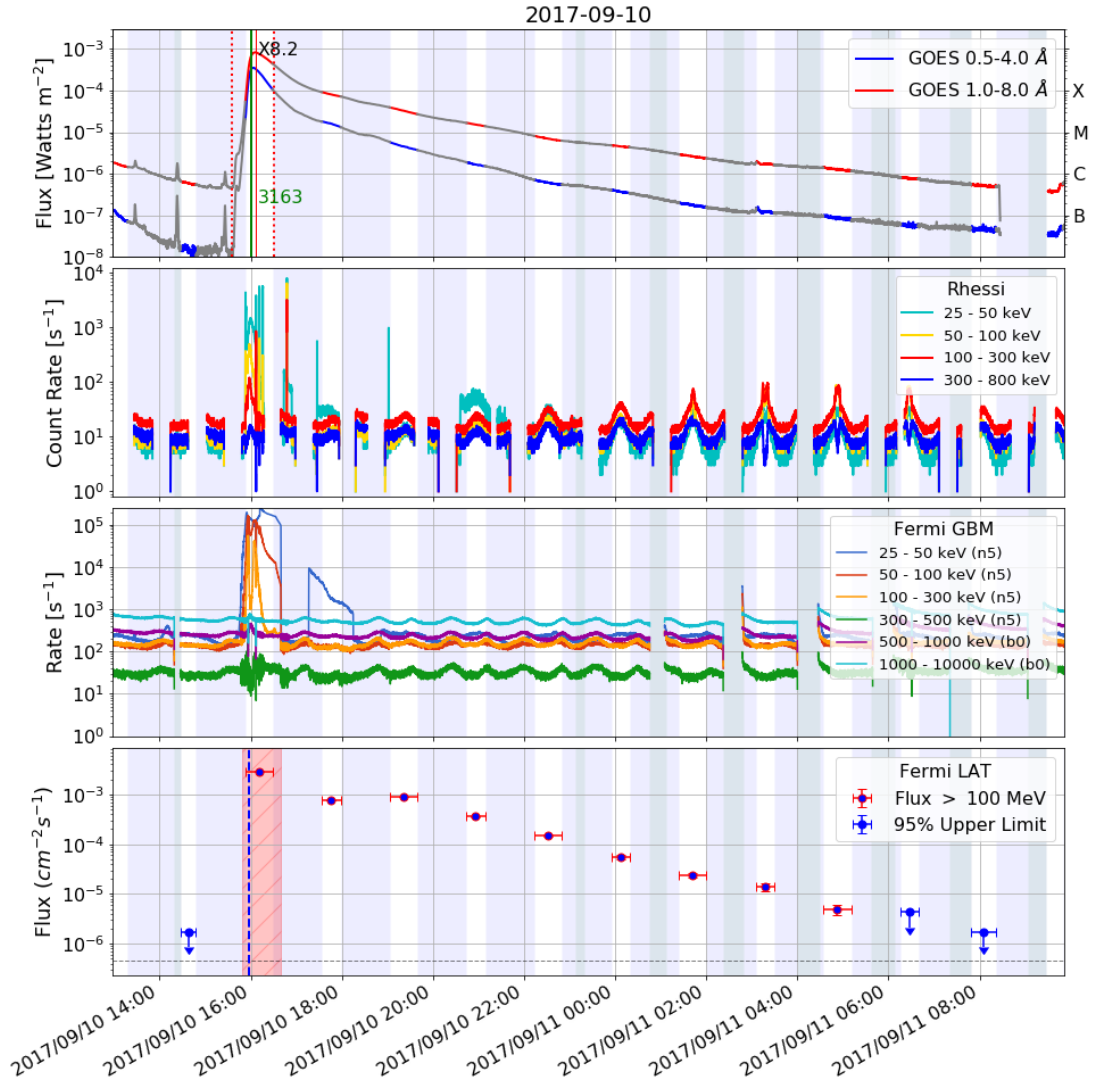
Figure 86. Light curve for FLSF 2017-09-10. From top to bottom: GOES X-rays, RHESSI uncorrected count rate, *Fermi*-GBM count rate, >100 MeV *Fermi*-LAT flux. Pink bands indicate BTI time windows.
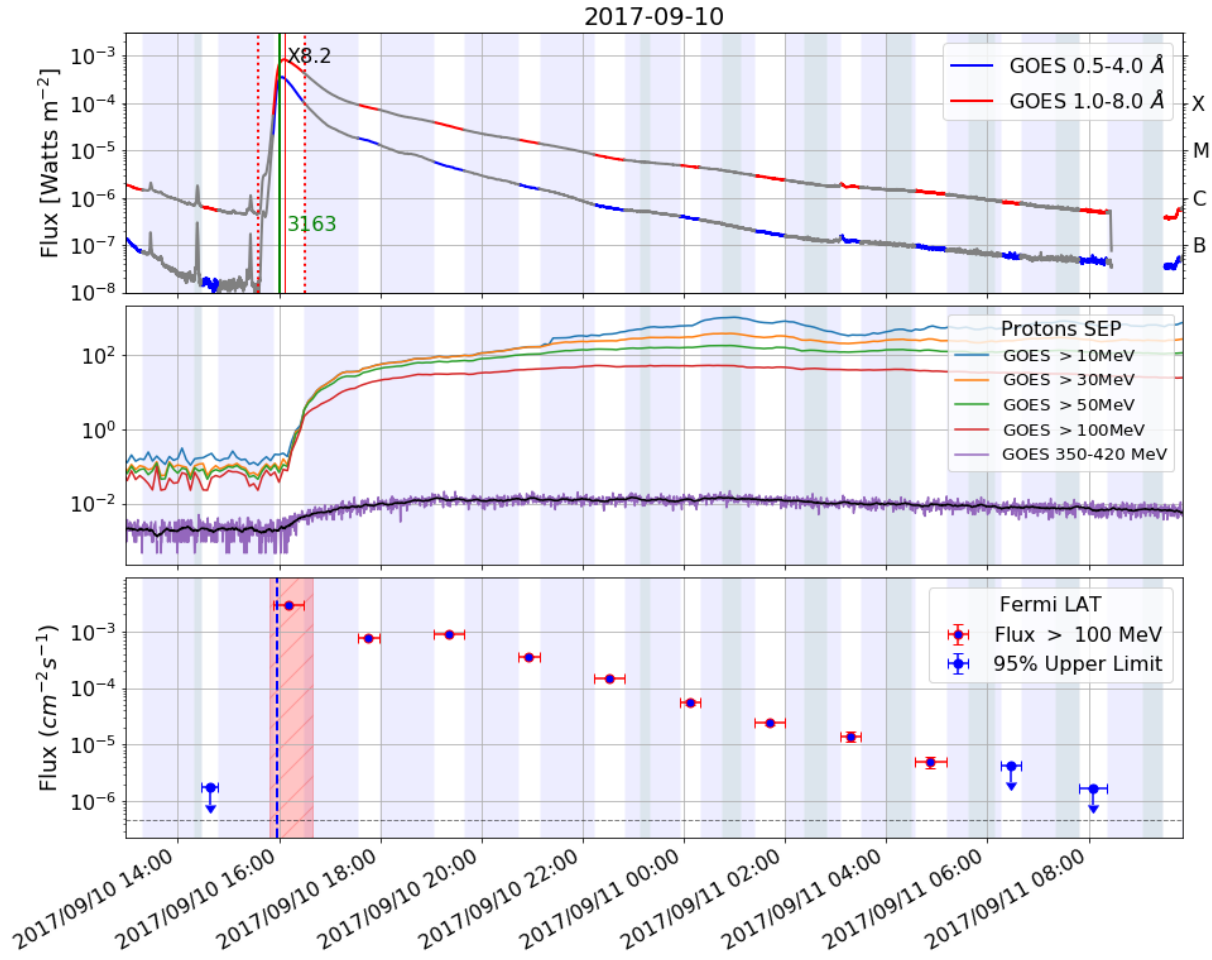
Figure 87. Composite light curve for FLSF 2017-09-10. Top panel shows the GOES X-rays, middle panel shows the GOES SEP count rate (ACE and Stereo data when avaliable), bottom panel shows the *Fermi*-LAT >100 MeV flux.
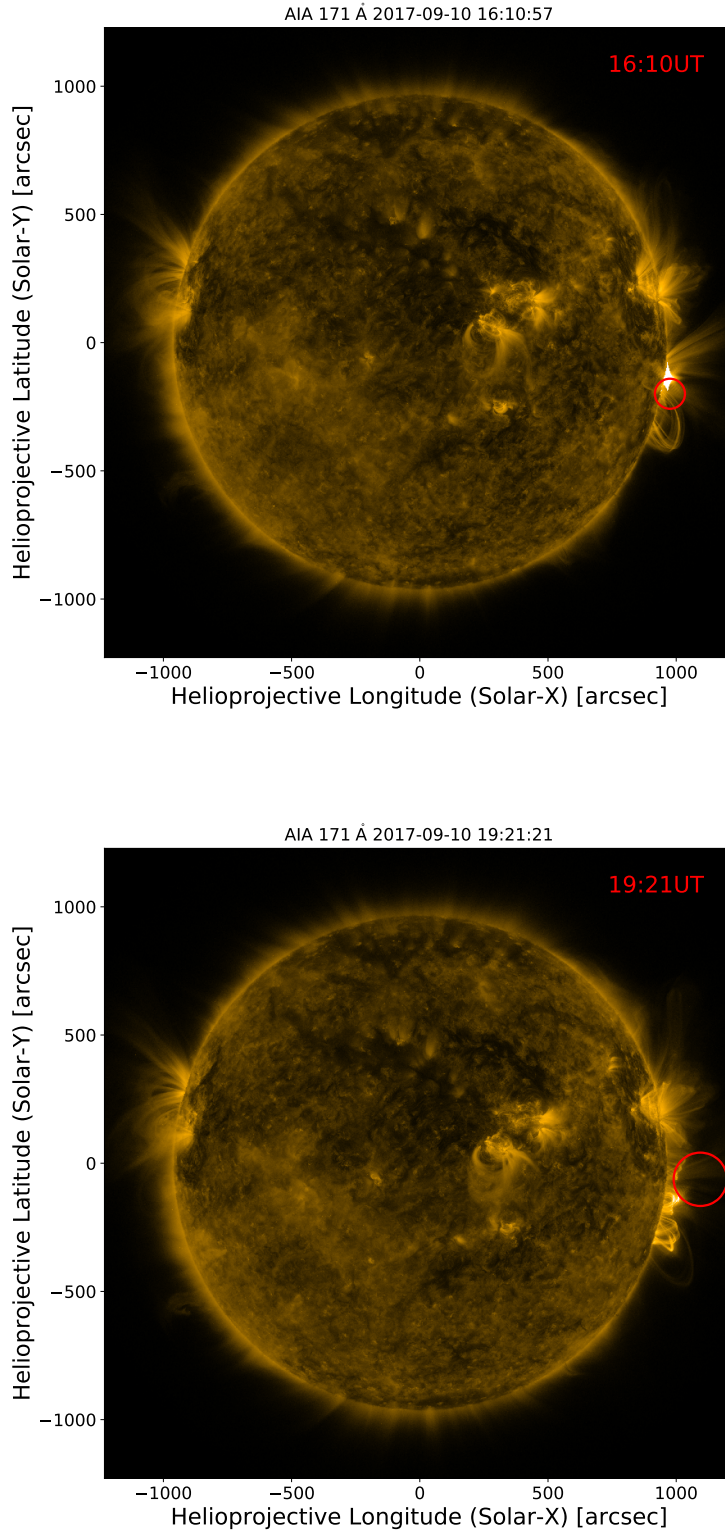
Figure 88. Time resolved localization of the >100 MeV emission from FLSF 2017-09-10. The mean time of the intergated time is annotated in the upper right hand corner of each panel. The radius of the emission centroid is the 68 percent containment. More information on the localization results can be found in Table 186.
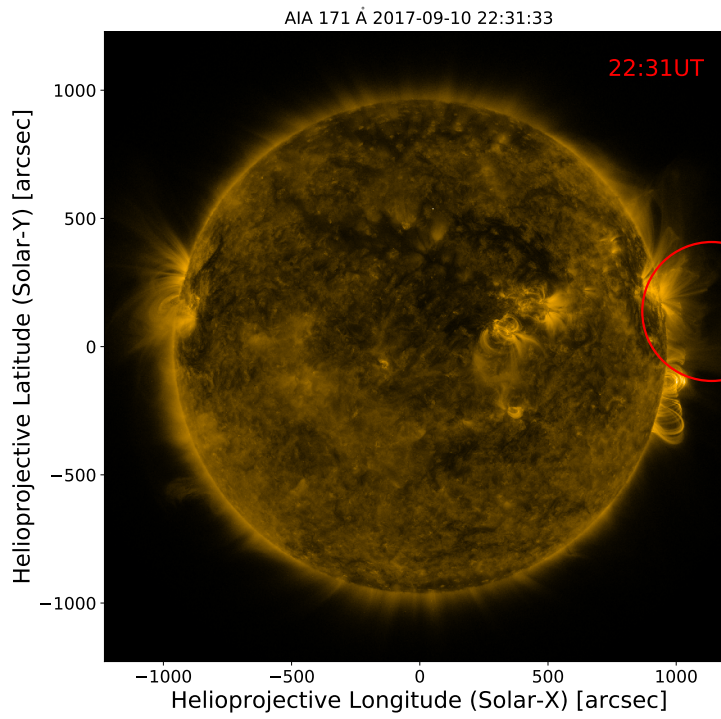
Figure 89. Time resolved localization of the >100 MeV emission from FLSF 2017-09-10. The mean time of the intergated time is annotated in the upper right hand corner of each panel. The radius of the emission centroid is the 68 percent containment. More information on the localization results can be found in Table 186.

Date and Time	Helio X	Helio Y	ERR 68	ERR 95
2017-09-10 15:52 - 16:28	847	-207	59	95
2017-09-10 19:03 - 19:39	1034	-131	104	166
2017-09-10 22:13 - 22:49	1139	137	271	443

Table 186. Localization results for FLSF 2017-09-10. The GOES X-ray flare associated with the FLSF originated from AR 12673 whose position at the time of the GOES flare was S08W88. All values are in arcseconds.

Time interval (UTC)	Energy bin (MeV)									
	60–100	100–167	167–278	278–464	464–771	771–1289	1289–2150	2150–3590	3590–6000	6000–10000
15:52:57 - 16:28:40	$(2.98 \pm 0.06) \times 10^4$	$(1.961 \pm 0.026) \times 10^4$	$(8.65 \pm 0.11) \times 10^3$	$(2.60 \pm 0.04) \times 10^3$	503 ± 14	76 ± 4	6.2 ± 0.9	0.84 ± 0.27	<0.3	<0.1
17:33:40 - 17:58:16	$(5.9 \pm 0.6) \times 10^3$	$(4.49 \pm 0.25) \times 10^3$	$(2.25 \pm 0.10) \times 10^3$	$(7.3 \pm 0.4) \times 10^2$	203 ± 13	33 ± 4	2.9 ± 0.8	<0.4	<0.3	<0.2
19:03:16 - 19:39:22	$(7.7 \pm 0.4) \times 10^3$	$(5.18 \pm 0.16) \times 10^3$	$(2.67 \pm 0.07) \times 10^3$	962 ± 28	180 ± 9	12.2 ± 1.6	<0.6	<0.2	<0.1	<0.1
20:44:22 - 21:08:29	$(3.6 \pm 0.5) \times 10^3$	$(2.25 \pm 0.18) \times 10^3$	$(1.10 \pm 0.07) \times 10^3$	337 ± 25	47 ± 7	3.2 ± 1.2	<1.2	<0.4	<0.3	<0.2
22:13:29 - 22:49:35	$(1.75 \pm 0.17) \times 10^3$	$(1.04 \pm 0.07) \times 10^3$	496 ± 29	123 ± 10	10.2 ± 2.0	<1.4	<0.5	<0.2	<0.1	<0.1
23:54:47 - 00:18:47	$(5.3 \pm 1.8) \times 10^2$	$(3.3 \pm 0.7) \times 10^2$	205 ± 30	47 ± 9	3.1 ± 1.7	<1.4	<0.7	<0.5	<0.3	<0.2
01:23:51 - 02:00:21	$(2.6 \pm 0.7) \times 10^2$	205 ± 31	78 ± 12	15 ± 4	<1.1	<0.9	<0.5	<0.2	<0.1	<0.1
03:05:44 - 03:29:14	$(2.3 \pm 1.2) \times 10^2$	73 ± 33	50 ± 15	10 ± 4	<3.9	<1.7	<0.7	<0.4	<0.3	<0.2
04:34:04 - 05:11:04	$(1.4 \pm 0.5) \times 10^2$	46 ± 17	<16.3	7.9 ± 2.7	<1.2	<0.6	<0.5	<0.2	<0.1	<0.1

Table 187. SED values for the time resolved intervals of FLSF 2017-09-10. Units are 10^{-8} cm^{-2} s^{-1}MeV^{-1}.

GOES Class	GOES Start	GOES Peak	GOES Stop	HXR Emax (keV)	HXR Instrument
X8.2	2017-09-10 15:35	2017-09-10 16:06	2017-09-10 16:31	3000	BGO

Table 188. Properties of the GOES X-ray flare associated with FLSF 2017-09-10 and the maximum energy in X-rays observed from the solar flare and the instruments that made the observation.

CME Speed (km s^{-1})	CME First C2 app.	SEP Emax (MeV)	SEP Instrument
3163	2017-09-10 16:00	605	GOES

Table 189. Properties of the CME potentially associated with FLSF 2017-09-10 and the maximum energy of the SEPs observed (when observed) at Earth. We also list the instruments that made the observation.

ACKNOWLEDGMENTS