



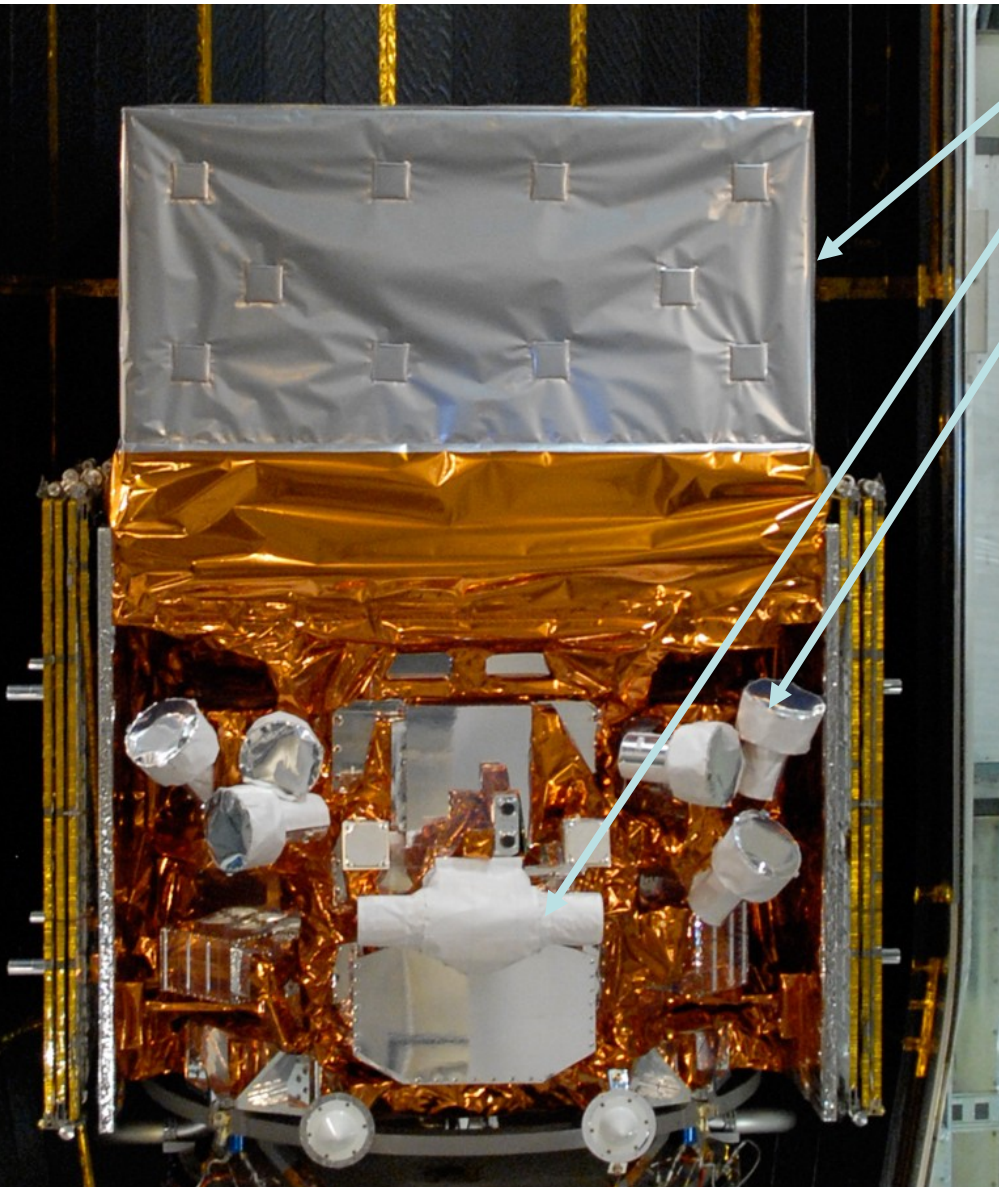
Fermi

Gamma-ray Space Telescope

Gamma-ray transients with Fermi

Rolf Bühler for the LAT
collaboration

AMON workshop 11th December
2014 at DESY Zeuthen



Large Area Telescope (LAT)
20 MeV - >300 GeV

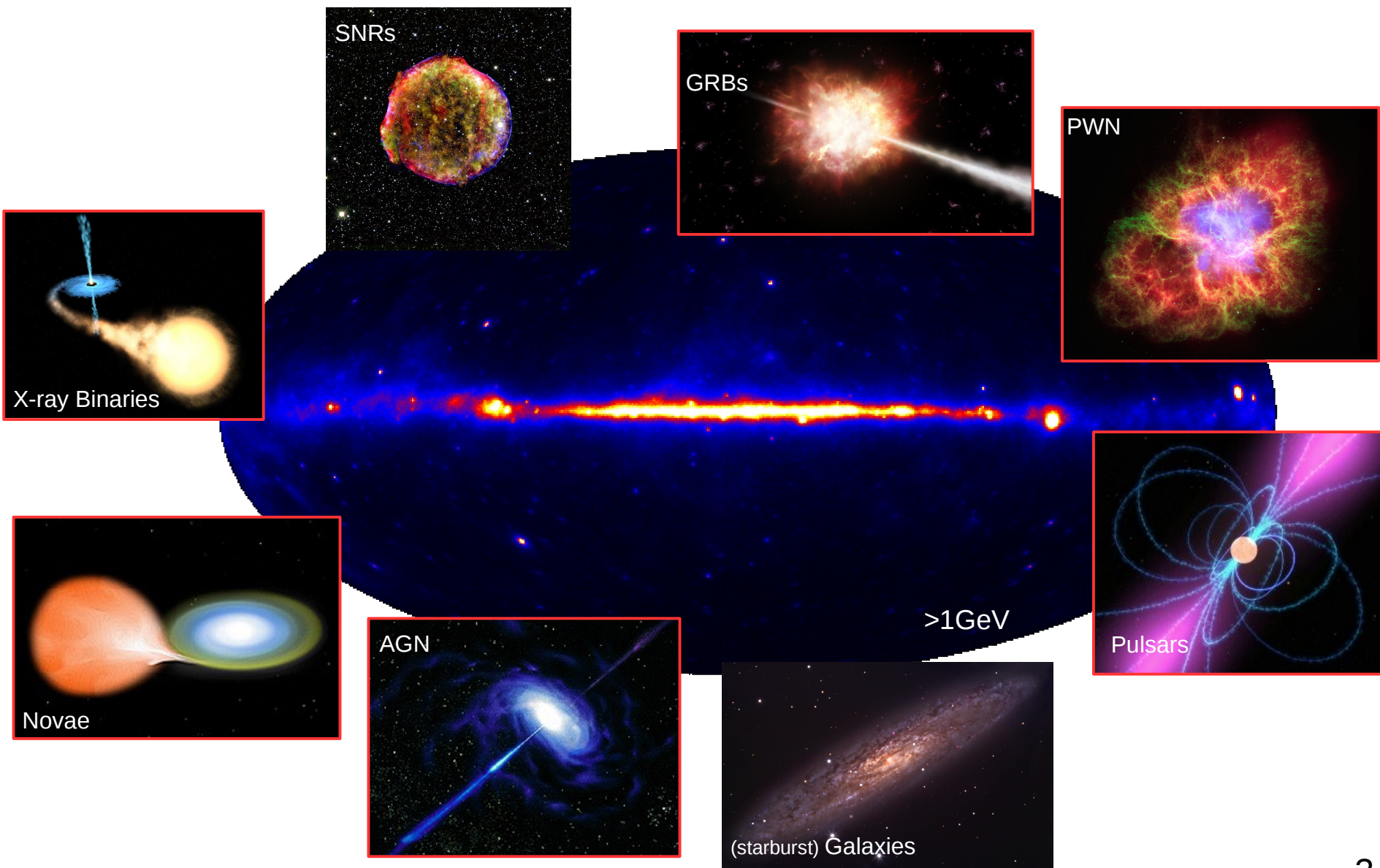
Gamma-ray Burst Monitor (GBM)
NaI and BGO Detectors
8 keV - 40 MeV

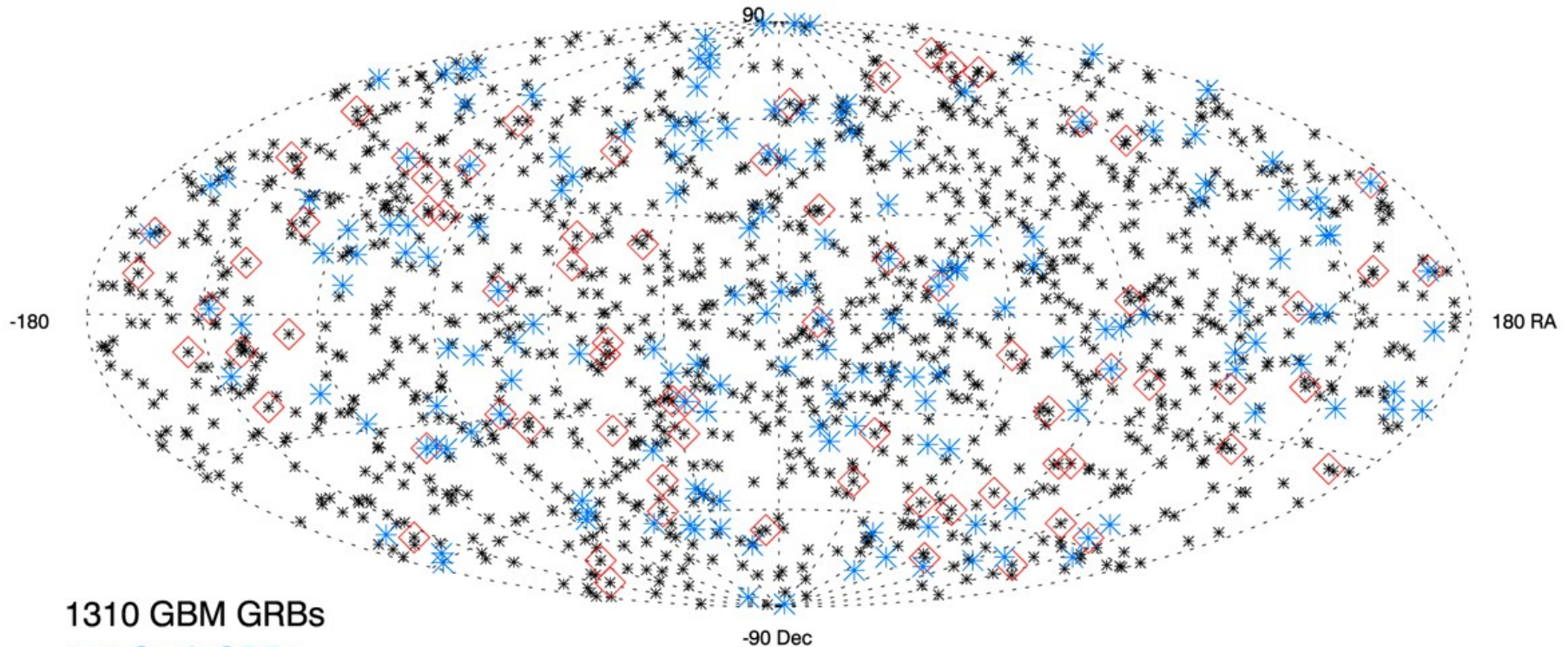
KEY FEATURES

- **Huge field of view**
 - LAT: 2.4 sr; 20% of the sky at any instant;
 - GBM: whole unocculted sky at any time (~8 sr).
- **Broad energy range.**
 - Total of >7 energy decades!
- **Every photon can be time-tagged.**
 - 1 microsecond accuracy

Launched June 11, 2008

The gamma-ray sky





1310 GBM GRBs

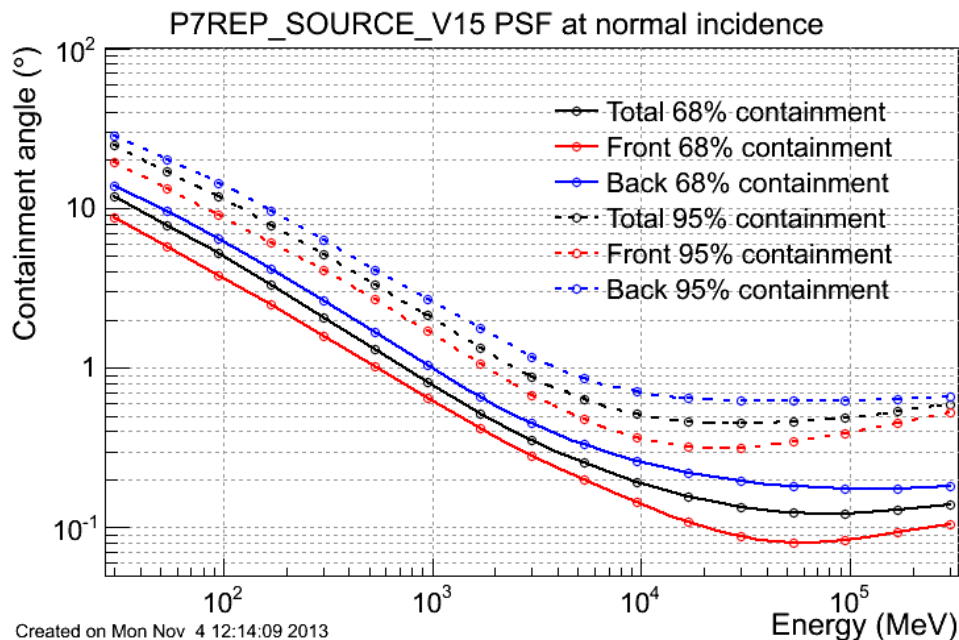
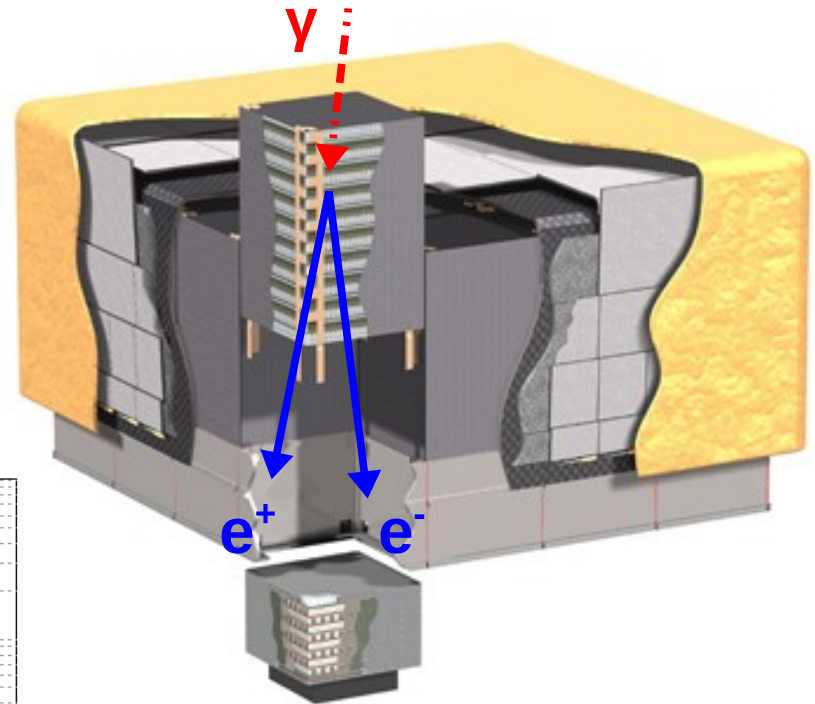
174 Swift GRBs

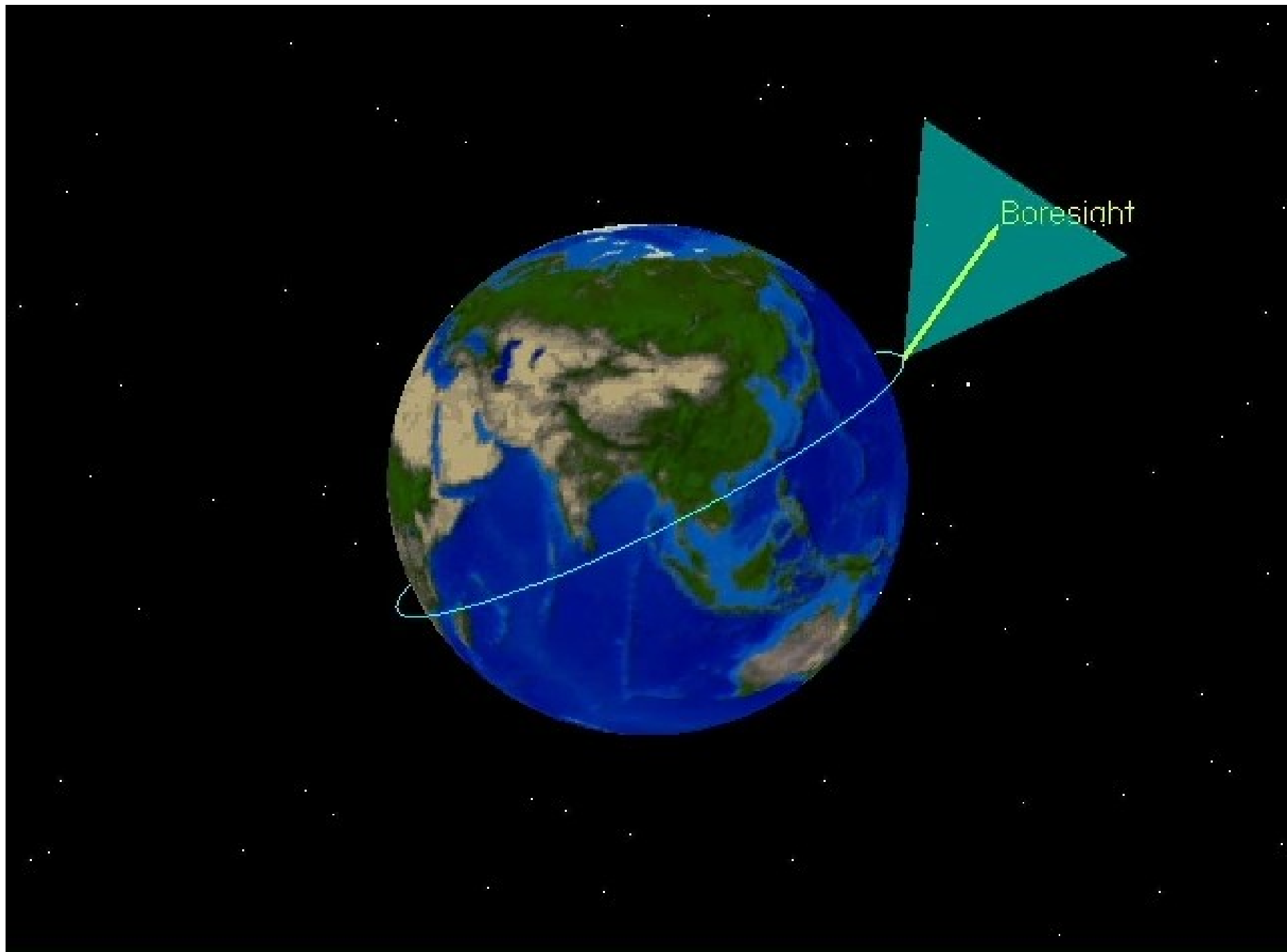
73 LAT GRBs

Fermi GRBs as of 140218

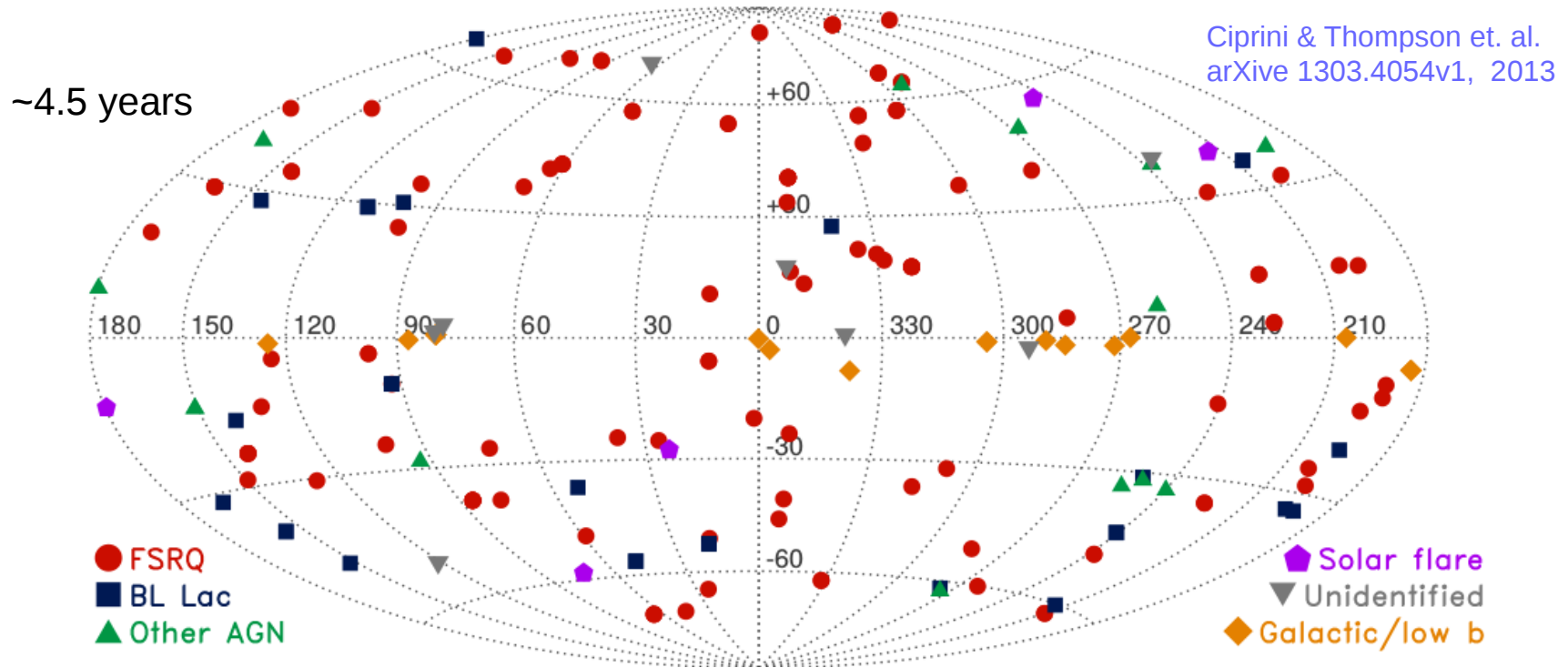
GBM detects ~240 GRBs per year (~10% LAT detected). On-board trigger starts autonomous re-point recommendation (ARR). Time for trigger to reach ground ~5s, GCN notice send out. Position uncertainty 5-15°

Automated Science Processing
constantly checks for flares
Down link, event reconstruction
and analysis takes ~12 h
Time sees one point 15-40 mins
Scans the sky every ~3 hours

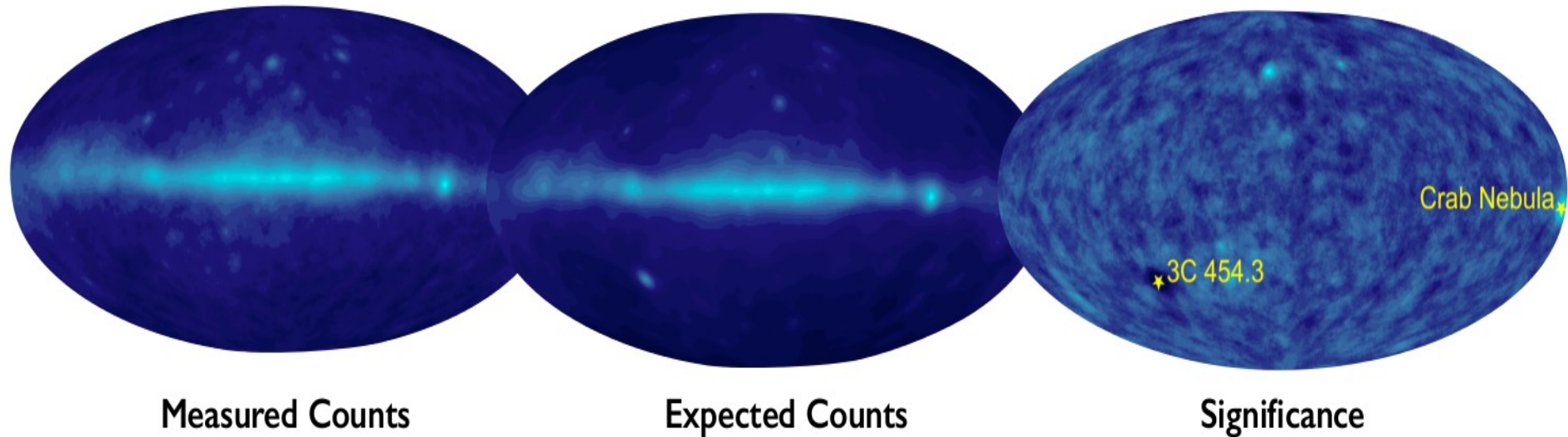




Boresight



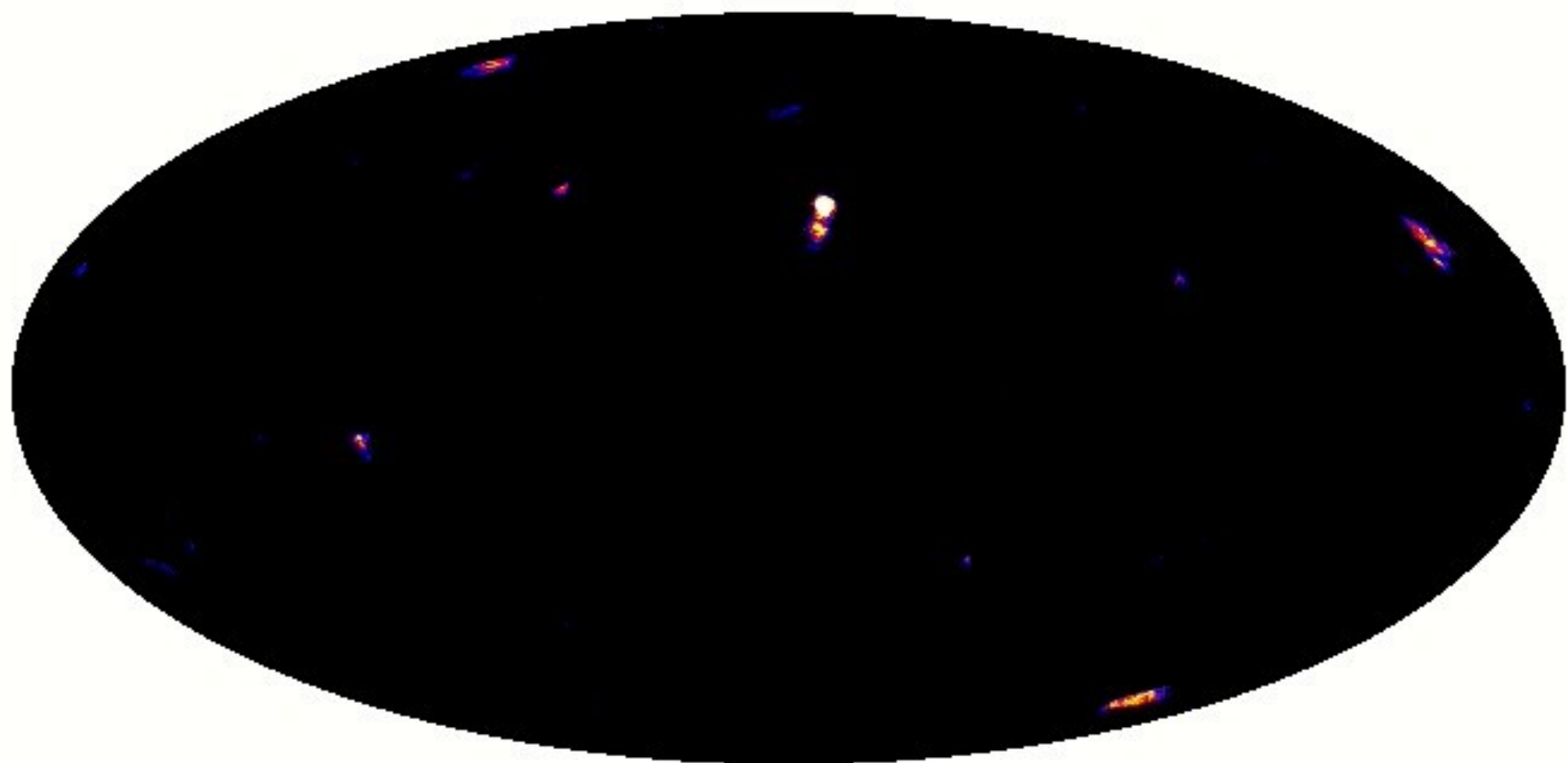
Shifters scan the sky for flares in 6h, 24h and weekly time bins. If source flux above 100 MeV greater 10^{-6} ph cm⁻² s⁻¹ send out ATel within ~day



Flare search in real time in weekly bins >100 MeV and >800 MeV
Catalog of flaring sources in first 40 months published

Ackermann et al., ApJ 771 1, 2013

<http://www.asdc.asi.it/fava/>



www.asdc.asi.it/feratel/ ascd astronomers telegram

List of Sources in Fermi LAT ATels

at ASCD v3.6 (last update 25 August 2014)

Help

Show/hide columns

Advanced filtering

Print current view of table

Print complete table

Reset all filters

● FSRQ ● Solar flare
 ■ BL Lac ▼ Unidentified
 ▲ Other AGN ◆ Galactic/low b

VO mode: off (turn on) Help

Cone Search

Source Name

Resolve name and search

RA, Dec LB

(e.g. 00 02 34.6 -93 01 10.2 or 0.64417, -53.01951)

radius arcmin

This is an interactive list of gamma-ray sources subject of Fermi LAT ATels.

[LAT Astronomer's Telegrams](#)
[Fermi Gamma-ray Sky Blog](#)
[Astronomer's Telegrams website](#)

Export Current view of Table in:

Page Size (# of lines)

Entry number	Archive	Source name	2FGL name	RA (J2000.0)	Dec (J2000.0)	Fermi-LAT ATel Number	Date of Flare	redshift	Flux 1-100 GeV 2FGL (ph/cm ² /s)	Flux ATel (1e-8ph/cm ² /s)	Spectral index	Other Gamma ATel
Selection mode:		hh mm ss.d	hh mm ss.d	hh mm ss.d	dd mm ss.d				(ph/cm ² /s)	(1e-8ph/cm ² /s)		First
1 <input checked="" type="checkbox"/> <input type="button" value="Select"/>	<input type="button" value="ASDC Data Explorer"/> <input type="button" value="Data Access"/>	3C 454.3	2FGL J2253.9+1609	22 53 57.7	+16 08 53.5	ATel#1628	10-21 July 2008	0.859	9.6500003e-8	-	2.2263935	-
2 <input checked="" type="checkbox"/> <input type="button" value="Select"/>	<input type="button" value="ASDC Data Explorer"/> <input type="button" value="Data Access"/>	PKS 1502+106	2FGL J1504.3+1029	15 04 24.9	+10 29 39.1	ATel#1650	4-6 August 2008	1.83	4.0100002e-8	200*	2.147137	-

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FERMI GAMMA-RAY SKY

THURSDAY, DECEMBER 4, 2014

Fermi LAT Weekly Report N. 338

Covered period: 2014.November.24 - 2014.November.30
LAT Mission week: 338.57 - 339.57

- **B2 1504+37** detected in flaring activity on November 25, 26, 27, with a daily flux between $(0.4 \pm 0.1) \times 10^{-6}$ and $(1.3 \pm 0.2) \times 10^{-6}$ (**ATel #6760**).
- **NGC 1275 (3C 84)** detected all week, with a daily flux between $(0.7 \pm 0.1) \times 10^{-6}$ and $(1.0 \pm 0.3) \times 10^{-6}$.
- **3C 454.3** detected all week with a daily flux between $(1.7 \pm 0.7) \times 10^{-6}$ and $(5.4 \pm 0.9) \times 10^{-6}$.
- **3C 279** detected all week, with a daily flux between $(1.9 \pm 0.3) \times 10^{-6}$ and $(3.6 \pm 0.4) \times 10^{-6}$.
- **Mrk 421** detected on November 24, 25, 26, 28, 29, and 30, with a daily flux between $(0.2 \pm 0.1) \times 10^{-6}$ and $(0.5 \pm 0.2) \times 10^{-6}$.
- **PKS 1510-089** detected on November 24, 25, 26, 29, and 30 with a daily flux between $(0.4 \pm 0.1) \times 10^{-6}$ and $(0.7 \pm 0.1) \times 10^{-6}$.
- **PKS 1424-418** detected on November 26, 28, 29, and 30, with a daily flux between $(0.3 \pm 0.1) \times 10^{-6}$ and $(0.6 \pm 0.2) \times 10^{-6}$.
- **B2 1520+31** detected on November 25, 28, and 29, with a daily flux between $(0.2 \pm 0.1) \times 10^{-6}$ and

LAT DATA

- [LAT First Catalog](#)
- [LAT Monitored Source List Light Curves](#)
- [LAT Bright Source List](#)
- [Browse interface to monitored source data](#)
- [Contact Information by Individual Sources](#)

BLOG ARCHIVE

- ▼ 2014 (49)
 - ▼ December (1)
 - [Fermi LAT Weekly Report N. 338](#)
 - ▶ November (5)
 - ▶ October (4)
 - ▶ September (4)
 - ▶ August (4)
 - ▶ July (5)
 - ▶ June (4)
 - ▶ May (4)
 - ▶ April (5)

fermi.gsfc.nasa.gov/ssc/data/access/lat/mssl_lc/

Science Support Center

Home Observations **Data** Proposals Library HEASARC Help Site Map

Data

- Data Policy
- Data Access
 - + LAT Data
 - + LAT Catalog
 - + LAT Data Queries
 - + LAT Query Results
 - + LAT Weekly Files
 - + GBM Data
- Data Analysis
- Caveats
- Newsletters
- FAQ

Monitored Source List Light Curves

The LAT team monitors flux values for a number of bright sources and transient sources that have shown flares during the mission. (See up-to-date weekly reports on flaring sources at the [Fermi-LAT Flare Advocate Blog](#).) As sources cross the monitoring flux threshold of $1 \times 10^{-6} \text{ cm}^{-2} \text{ s}^{-1}$, they are added to the monitored source list. (The initial flux threshold was $2 \times 10^{-6} \text{ cm}^{-2} \text{ s}^{-1}$, but this value was lowered in June 2009.) In addition to the light curves below, the [flux values in several bands](#) are available via Browse. This list will continue to grow as the mission progresses.

PLEASE NOTE: The tabulated fluxes are derived at the LAT Instrument Science Operations center in an automated analysis to produce results quickly to facilitate follow-up multiwavelength observations of flaring sources. The table of released fluxes will be updated as analysis and calibrations improve.

These early flux estimates **do not include systematic uncertainties and do not have an absolute flux calibration**. Use of these data as absolute flux measurements for constraining models or for comparison to other data is strongly discouraged at this time. In addition to overall normalization uncertainties, source fluxes may have variations of up to 10% due to currently-uncorrected dependencies of the gamma-ray detection efficiency on variations of the particle background in orbit. Please note that these results are produced using preliminary instrument response functions and calibrations. The quality and stability of these results will improve when updated calibrations become available over the coming months.

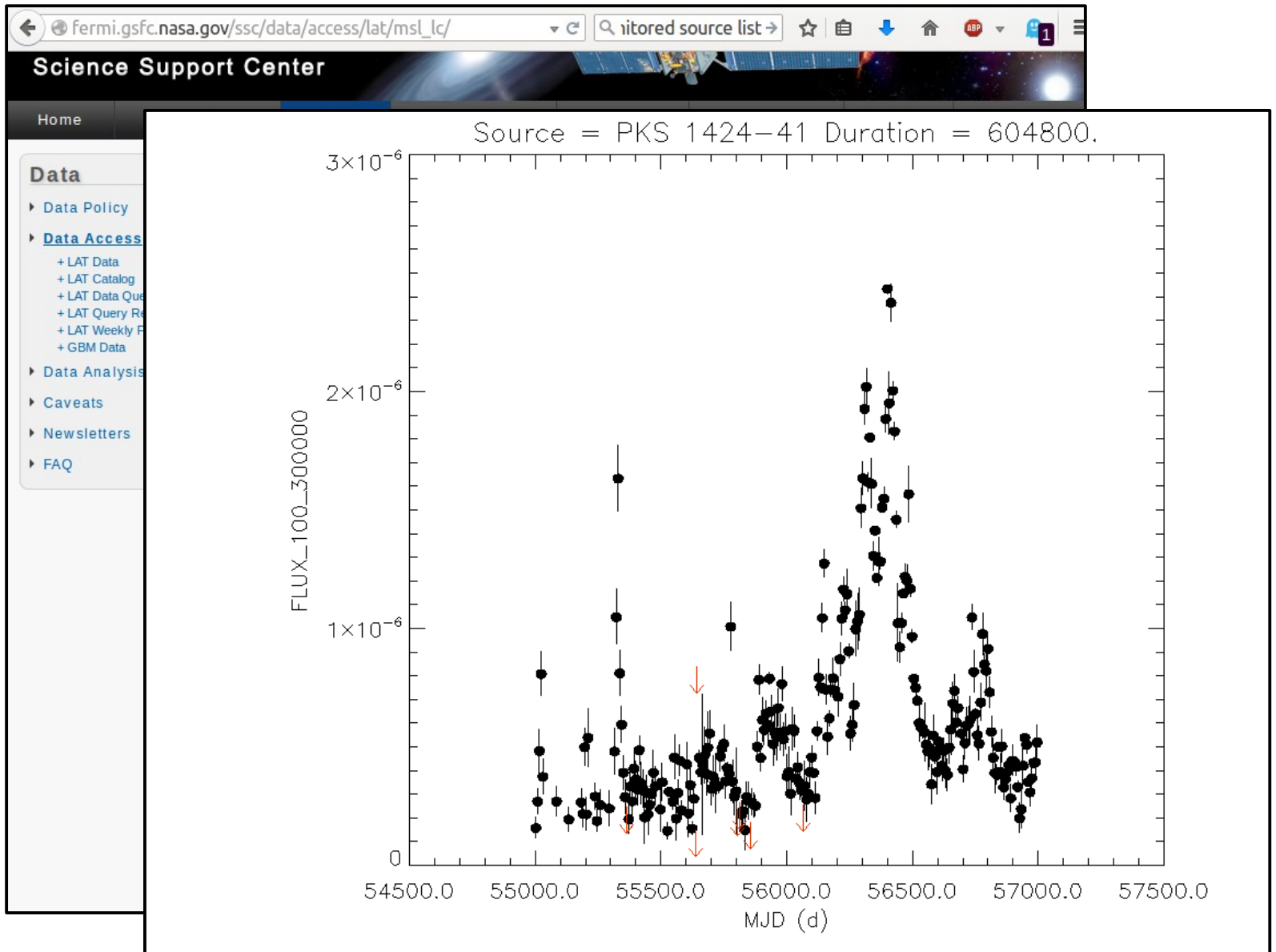
Note: Due to a software error, flux upper limits are not available for dates between approximately 2010-09-14 to 2011-02-21.

A detailed description of the data included in these files can be found [here](#).

Source	Daily LC	Weekly LC
PMN J0017-0512 (RA = 4.39900, Dec = -5.21200) <ul style="list-style-type: none"> Daily Light Curve Daily Light Curve Fits File Weekly Light Curve Weekly Light Curve Fits File 		
4C +01.02 (RA = 17.1620, Dec = 1.58300) <ul style="list-style-type: none"> Daily Light Curve Daily Light Curve Fits File Weekly Light Curve Weekly Light Curve Fits File 		
4C 31.03		

~100 sources

Monitored source list



Monitored source list

gcn.gsfc.nasa.gov/fermi_lat_mon_trans.html

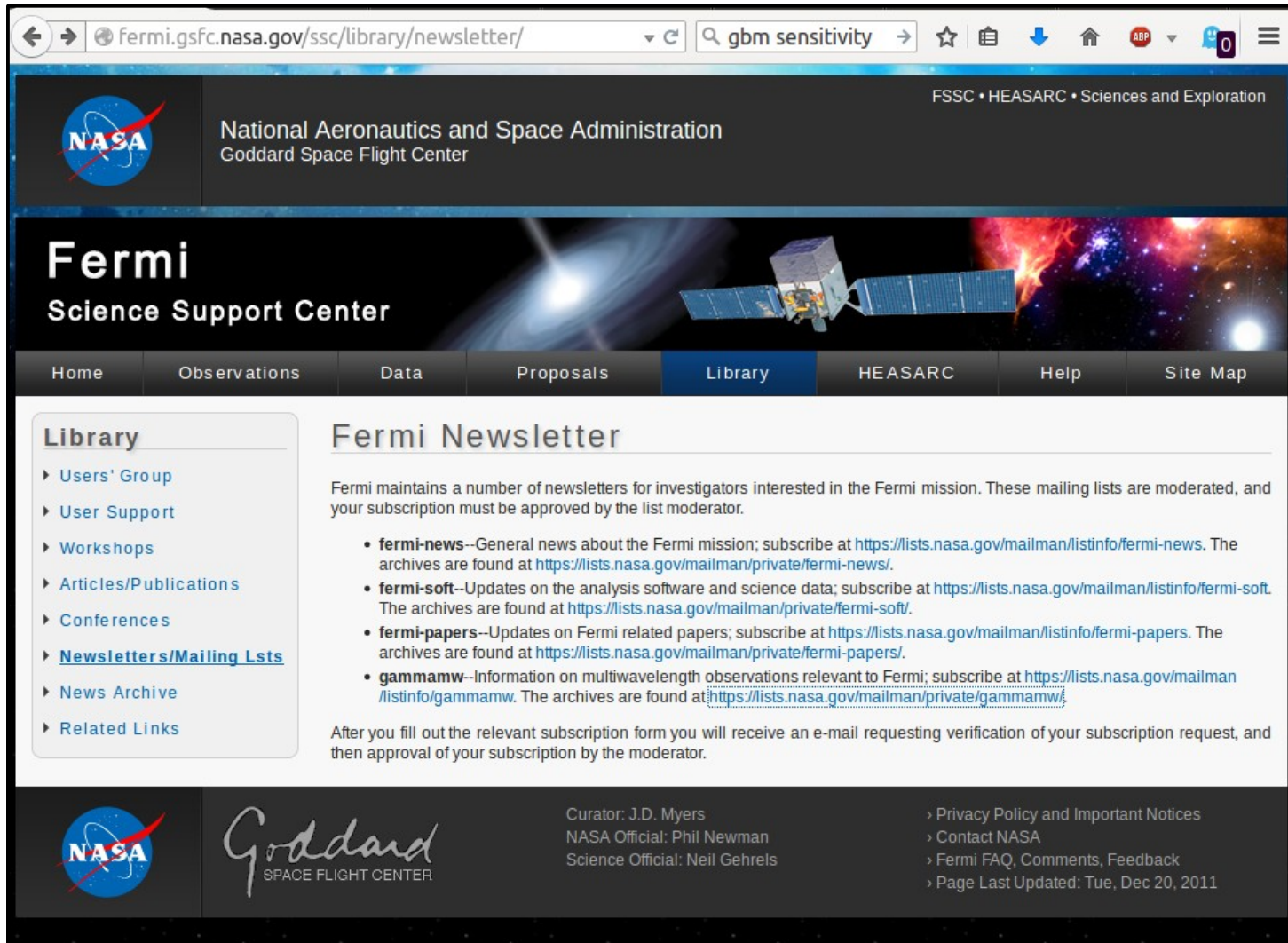
TRIGGER TYPE SUMMARY:
The annual occurrence rates for the Fermi-LAT Monitor triggers broken down by type is:

YEAR	MONITOR	TRANSIENT	COMMENT
2012	6	0	
2011	5	0	Only Aug26 thru Dec31, transitioned to normal ops (eff=100%)
2011	5	2	Only Apr25 thru Aug25, during testing phase, ops efficiency <100%

Fermi-LAT EVENTS

EVENT			OBSERVATION					Comments / Monitor_LC_URL
RefNum	Date	Time UT	MesgType Mon Trans	RA (J2000) [deg]	Dec (J2000) [deg]	Error [arcmin]	Inten [ph/cm2/s]	
1415375482	14/11/06	12:00:00.00	Monitor	277.302	-58.232	n/a	3.70e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/PKS
1411051517	14/09/17	12:00:00.00	Monitor	228.170	-8.830	n/a	1.70e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/1510-089
1402843568	14/06/14	12:00:00.00	Monitor	343.491	+16.148	n/a	1.40e-05	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/3C
1402325101	14/06/08	12:00:00.00	Monitor	343.491	+16.148	n/a	7.60e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/3C
1398265181	14/04/22	12:00:00.00	Monitor	233.160	-13.350	n/a	1.30e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/TXS
1398264862	14/04/22	12:00:00.00	Monitor	263.261	-13.080	n/a	7.40e-07	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/1730-130
1386518403	13/12/07	12:00:00.00	Monitor	186.227	+21.380	n/a	1.80e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/PKS
1386344973	13/12/05	12:00:00.00	Monitor	194.047	-5.789	n/a	3.00e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/3C
1383493775	13/11/02	12:00:00.00	Monitor	352.337	-49.928	n/a	2.20e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/PKS
1382107677	13/10/17	12:00:00.00	Monitor	83.633	+22.014	n/a	9.80e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/Crab
1381157365	13/10/06	12:00:00.00	Monitor	246.445	-25.461	n/a	3.10e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/PKS
1380560775	13/09/29	12:00:00.00	Monitor	186.227	+21.380	n/a	2.30e-06	LAT Monitor flare alert. This Notice was ground-generated -- not flight-generated. http://fermi.gsfc.nasa.gov/FTP/glast/data/lat/catalogs/asp/current/lightcurves/PKS

GCN notices send out for flares of monitored sources



fermi.gsfc.nasa.gov/ssc/library/newsletter/

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Home Observations Data Proposals **Library** HEASARC Help Site Map

Library

- Users' Group
- User Support
- Workshops
- Articles/Publications
- Conferences
- Newsletters/Mailing Lsts**
- News Archive
- Related Links

Fermi Newsletter

Fermi maintains a number of newsletters for investigators interested in the Fermi mission. These mailing lists are moderated, and your subscription must be approved by the list moderator.

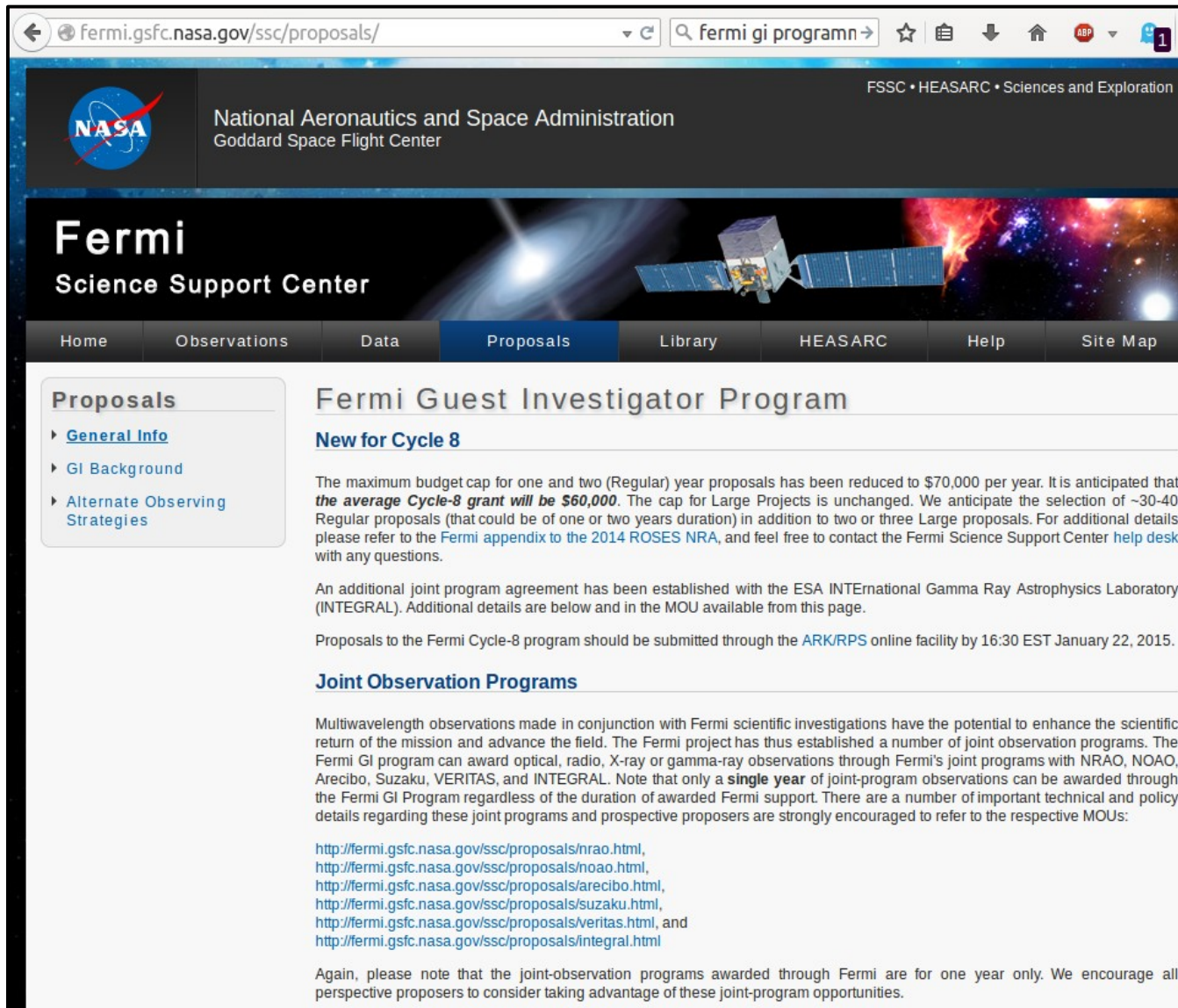
- fermi-news**--General news about the Fermi mission; subscribe at <https://lists.nasa.gov/mailman/listinfo/fermi-news>. The archives are found at <https://lists.nasa.gov/mailman/private/fermi-news/>.
- fermi-soft**--Updates on the analysis software and science data; subscribe at <https://lists.nasa.gov/mailman/listinfo/fermi-soft>. The archives are found at <https://lists.nasa.gov/mailman/private/fermi-soft/>.
- fermi-papers**--Updates on Fermi related papers; subscribe at <https://lists.nasa.gov/mailman/listinfo/fermi-papers>. The archives are found at <https://lists.nasa.gov/mailman/private/fermi-papers/>.
- gammamw**--Information on multiwavelength observations relevant to Fermi; subscribe at <https://lists.nasa.gov/mailman/listinfo/gammamw>. The archives are found at <https://lists.nasa.gov/mailman/private/gammamw/>.

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NASA Goddard SPACE FLIGHT CENTER

Curator: J.D. Myers
NASA Official: Phil Newman
Science Official: Neil Gehrels

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Home Observations Data **Proposals** Library HEASARC Help Site Map

Proposals

- General Info
- GI Background
- Alternate Observing Strategies

Fermi Guest Investigator Program

New for Cycle 8

The maximum budget cap for one and two (Regular) year proposals has been reduced to \$70,000 per year. It is anticipated that **the average Cycle-8 grant will be \$60,000**. The cap for Large Projects is unchanged. We anticipate the selection of ~30-40 Regular proposals (that could be of one or two years duration) in addition to two or three Large proposals. For additional details please refer to the [Fermi appendix to the 2014 ROSES NRA](#), and feel free to contact the Fermi Science Support Center [help desk](#) with any questions.

An additional joint program agreement has been established with the ESA International Gamma Ray Astrophysics Laboratory (INTEGRAL). Additional details are below and in the MOU available from this page.

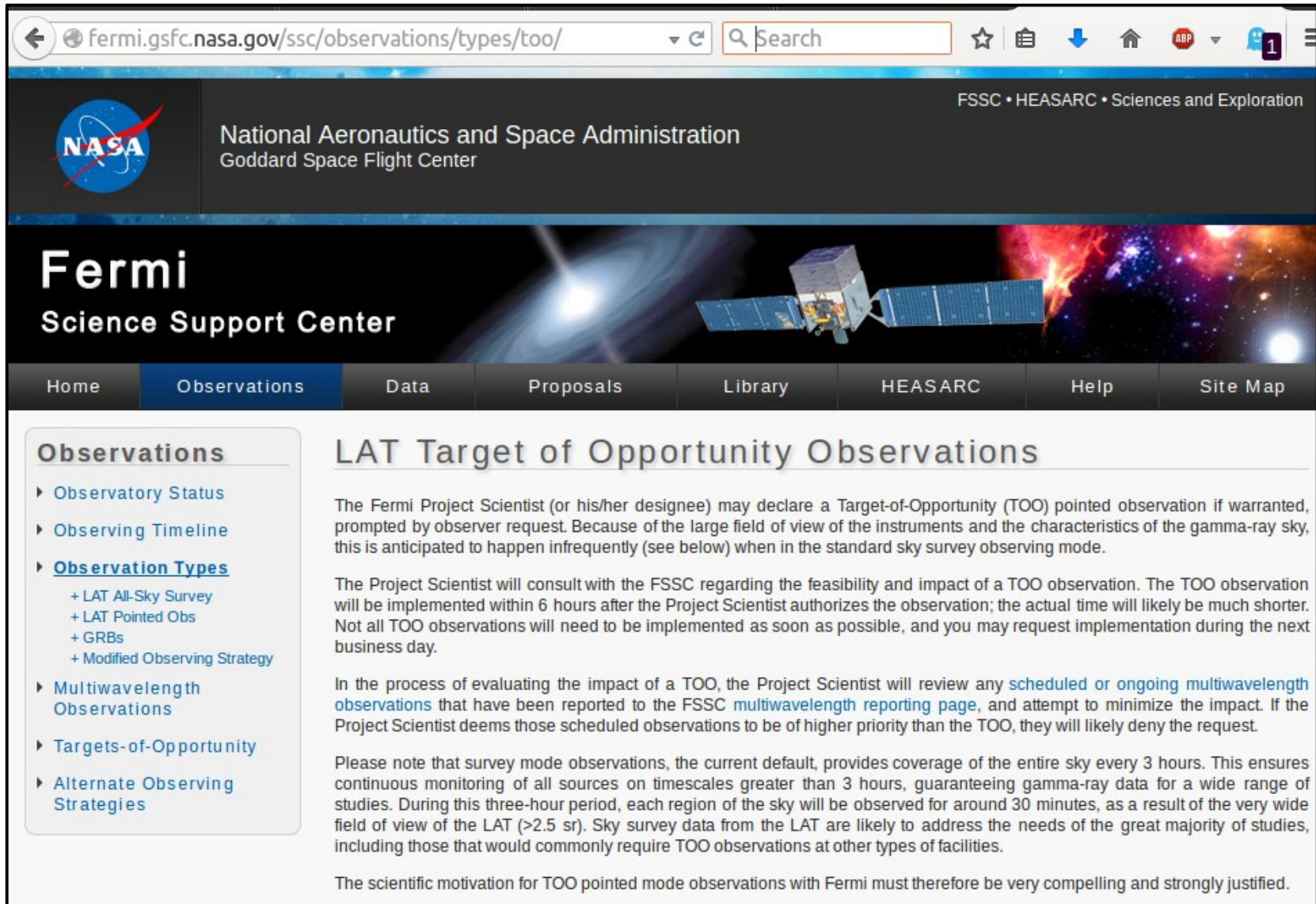
Proposals to the Fermi Cycle-8 program should be submitted through the [ARK/RPS](#) online facility by 16:30 EST January 22, 2015.

Joint Observation Programs

Multiwavelength observations made in conjunction with Fermi scientific investigations have the potential to enhance the scientific return of the mission and advance the field. The Fermi project has thus established a number of joint observation programs. The Fermi GI program can award optical, radio, X-ray or gamma-ray observations through Fermi's joint programs with NRAO, NOAO, Arecibo, Suzaku, VERITAS, and INTEGRAL. Note that only a **single year** of joint-program observations can be awarded through the Fermi GI Program regardless of the duration of awarded Fermi support. There are a number of important technical and policy details regarding these joint programs and prospective proposers are strongly encouraged to refer to the respective MOUs:

<http://fermi.gsfc.nasa.gov/ssc/proposals/nrao.html>,
<http://fermi.gsfc.nasa.gov/ssc/proposals/noao.html>,
<http://fermi.gsfc.nasa.gov/ssc/proposals/arecibo.html>,
<http://fermi.gsfc.nasa.gov/ssc/proposals/suzaku.html>,
<http://fermi.gsfc.nasa.gov/ssc/proposals/veritas.html>, and
<http://fermi.gsfc.nasa.gov/ssc/proposals/integral.html>

Again, please note that the joint-observation programs awarded through Fermi are for one year only. We encourage all perspective proposers to consider taking advantage of these joint-program opportunities.



fermi.gsfc.nasa.gov/ssc/observations/types/too/

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Home Observations Data Proposals Library HEASARC Help Site Map

Observations

- ▶ [Observatory Status](#)
- ▶ [Observing Timeline](#)
- ▶ [Observation Types](#)
 - + [LAT All-Sky Survey](#)
 - + [LAT Pointed Obs](#)
 - + [GRBs](#)
 - + [Modified Observing Strategy](#)
- ▶ [Multiwavelength Observations](#)
- ▶ [Targets-of-Opportunity](#)
- ▶ [Alternate Observing Strategies](#)

LAT Target of Opportunity Observations

The Fermi Project Scientist (or his/her designee) may declare a Target-of-Opportunity (TOO) pointed observation if warranted, prompted by observer request. Because of the large field of view of the instruments and the characteristics of the gamma-ray sky, this is anticipated to happen infrequently (see below) when in the standard sky survey observing mode.

The Project Scientist will consult with the FSSC regarding the feasibility and impact of a TOO observation. The TOO observation will be implemented within 6 hours after the Project Scientist authorizes the observation; the actual time will likely be much shorter. Not all TOO observations will need to be implemented as soon as possible, and you may request implementation during the next business day.

In the process of evaluating the impact of a TOO, the Project Scientist will review any [scheduled or ongoing multiwavelength observations](#) that have been reported to the FSSC [multiwavelength reporting page](#), and attempt to minimize the impact. If the Project Scientist deems those scheduled observations to be of higher priority than the TOO, they will likely deny the request.

Please note that survey mode observations, the current default, provides coverage of the entire sky every 3 hours. This ensures continuous monitoring of all sources on timescales greater than 3 hours, guaranteeing gamma-ray data for a wide range of studies. During this three-hour period, each region of the sky will be observed for around 30 minutes, as a result of the very wide field of view of the LAT (>2.5 sr). Sky survey data from the LAT are likely to address the needs of the great majority of studies, including those that would commonly require TOO observations at other types of facilities.

The scientific motivation for TOO pointed mode observations with Fermi must therefore be very compelling and strongly justified.

**Fermi scanning the sky constantly from 8keV to 500 GeV.
GRB reaction time is order 5s and positioning accuracy is 5-15°
LAT reaction time is ~12 hours and positioning accuracy ~0.02-1°**

Interesting events are announced as fast as possible with GCNs and ATels. Great effort is put into making results available quickly via web pages and newsletters.

I did not talk about (many) multi-frequency campaigns, which are generally setup and coordinated by different responsible persons from the LAT side. Our MW coordinator is Dave Thompson.

As data is public, external groups also have LAT flare monitors (e.g. VERITAS and MAGIC)

