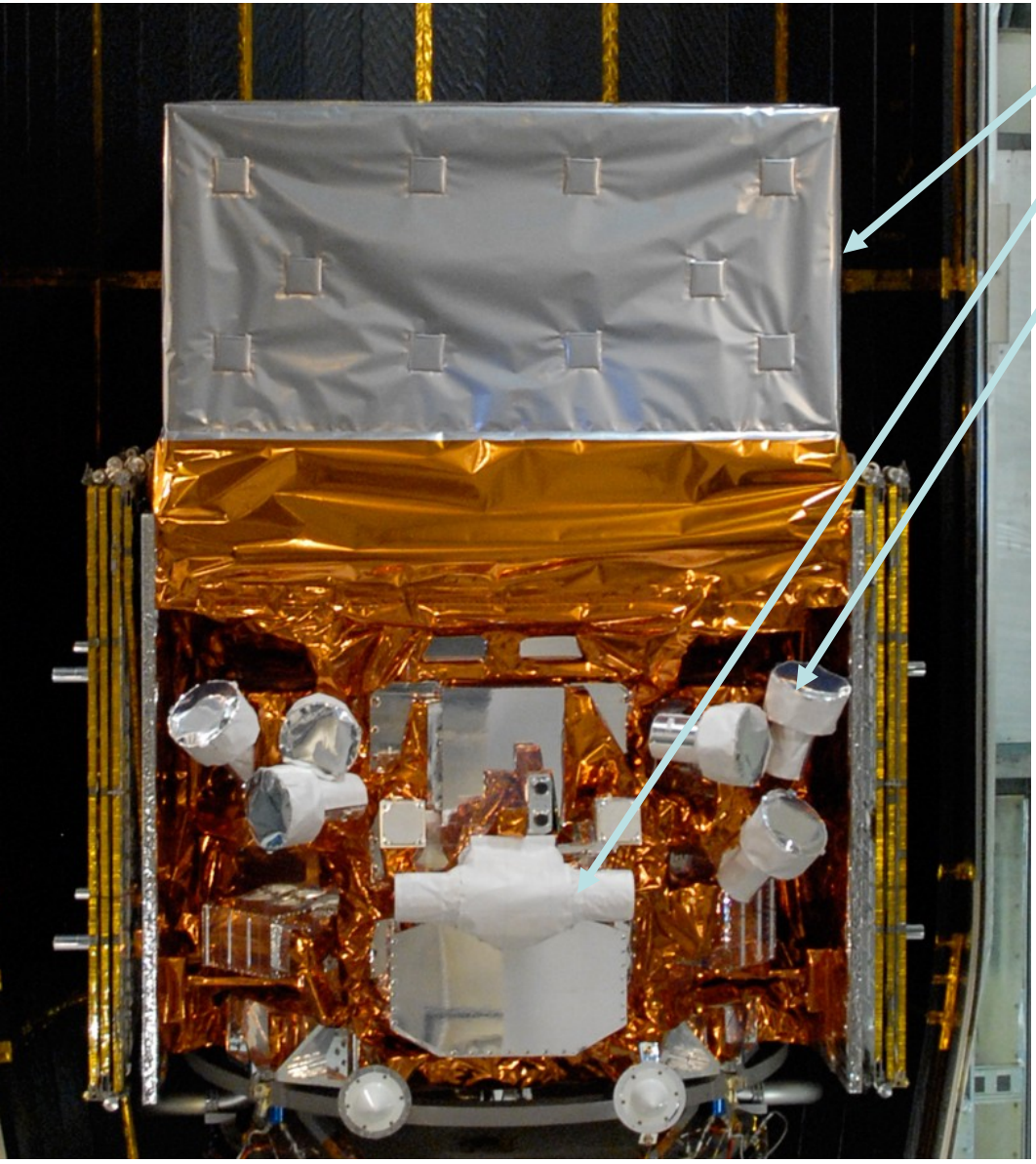
Gamma-ray transients with Fermi

Rolf Bühler for the LAT collaboration

AMON workshop 11th December 2014 at DESY Zeuthen

The Fermi Satellite



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

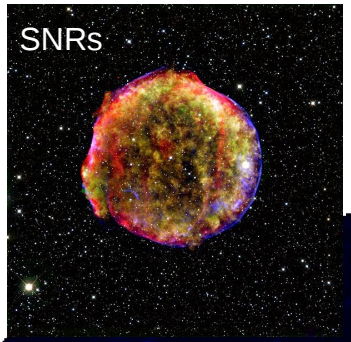
Gamma-ray Burst Monitor (GBM)
NaI and BGO Detectors
8 keV - 40 MeV

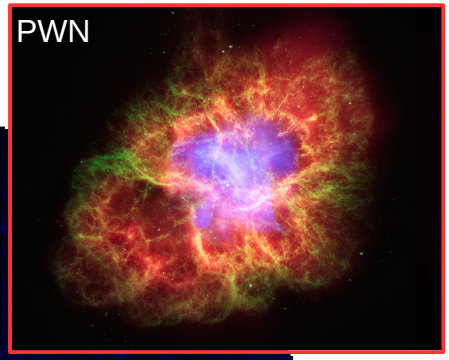
KEY FEATURES

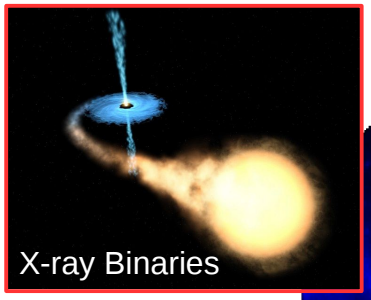
- **Huge field of view**
  - **LAT: 2.4 sr; 20% of the sky at any instant;**
  - **GBM: whole unocculted sky at any time (~8 sr).**
- **Broad energy range.**
  - **Total of >7 energy decades!**
- **Every photon can be time-tagged.**
  - **1 microsecond accuracy**

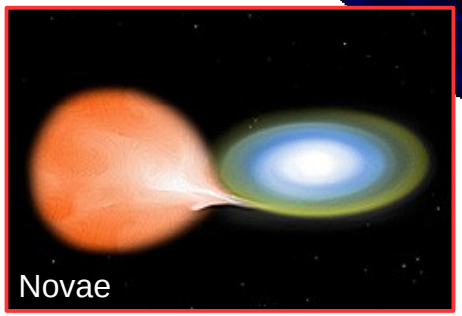
Launched June 11, 2008

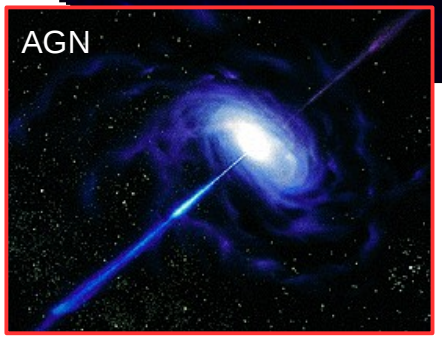
The gamma-ray sky



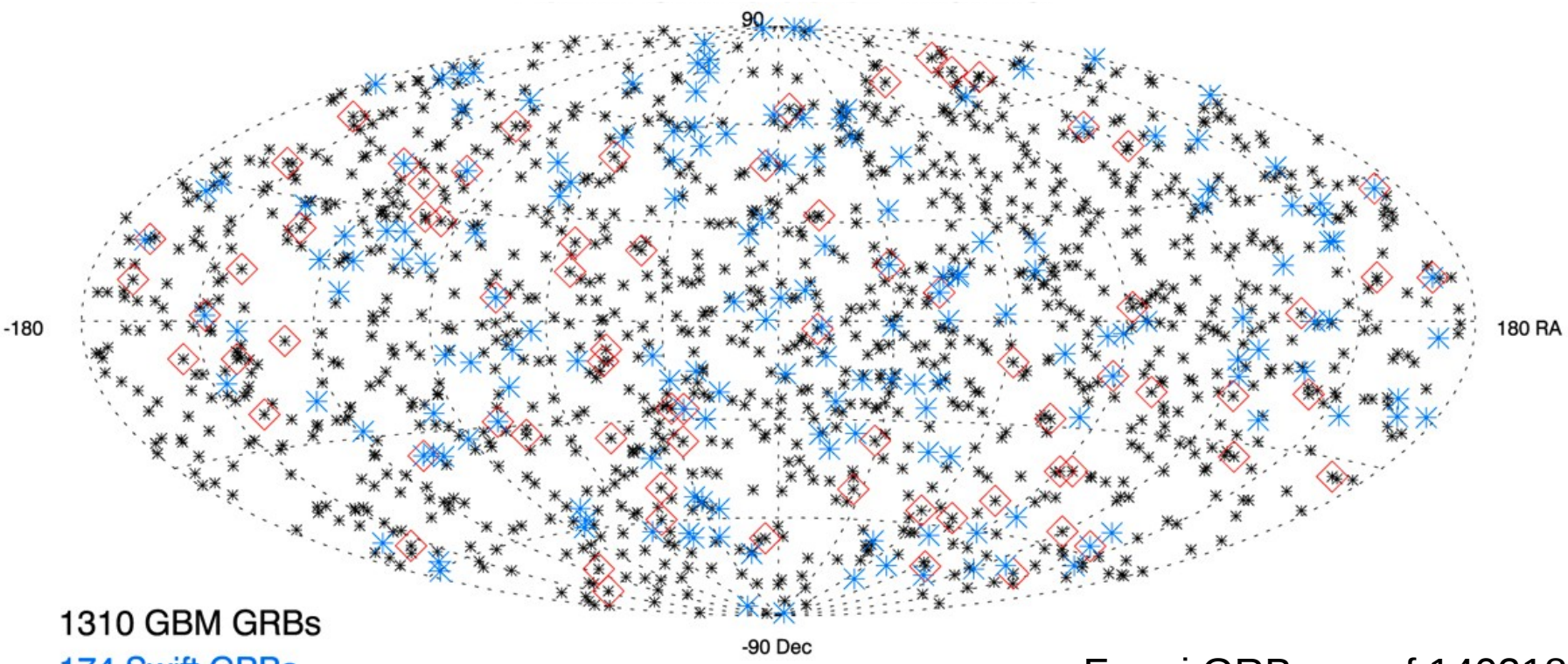








The Gamma-ray Burst Monitor



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°

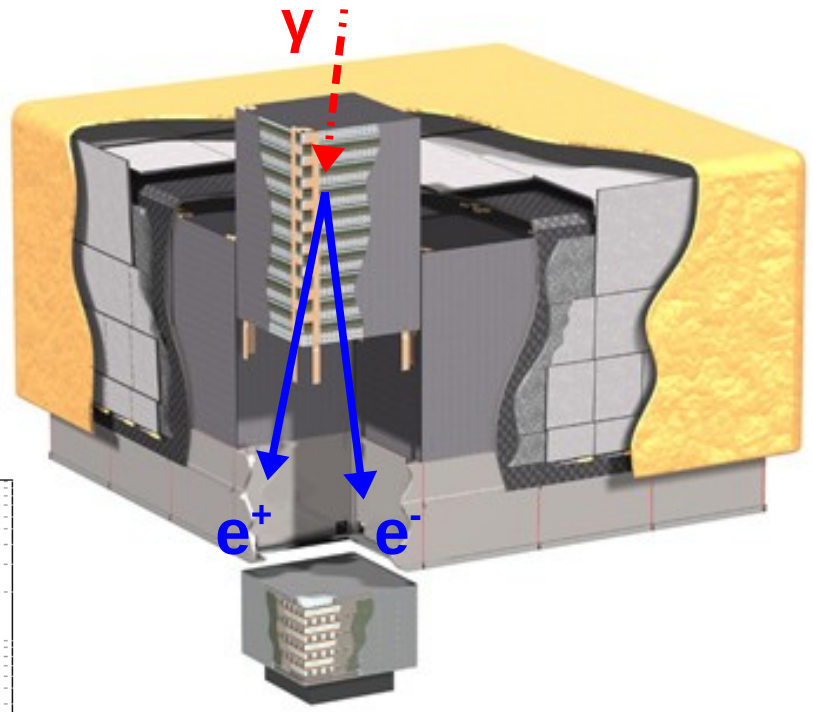
The Large Area Telescope

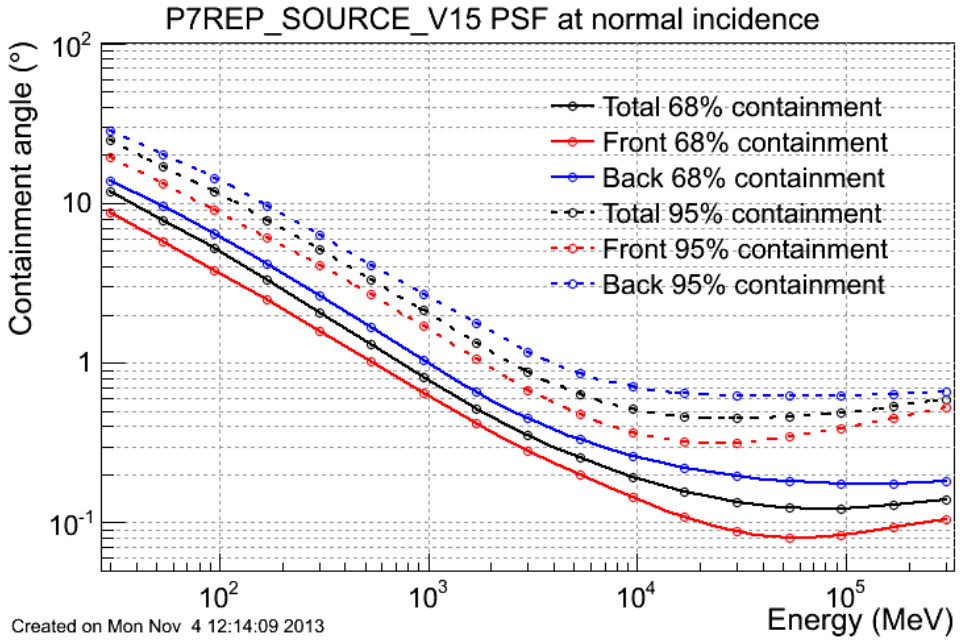
Automated Science Processing constantly checks for flares

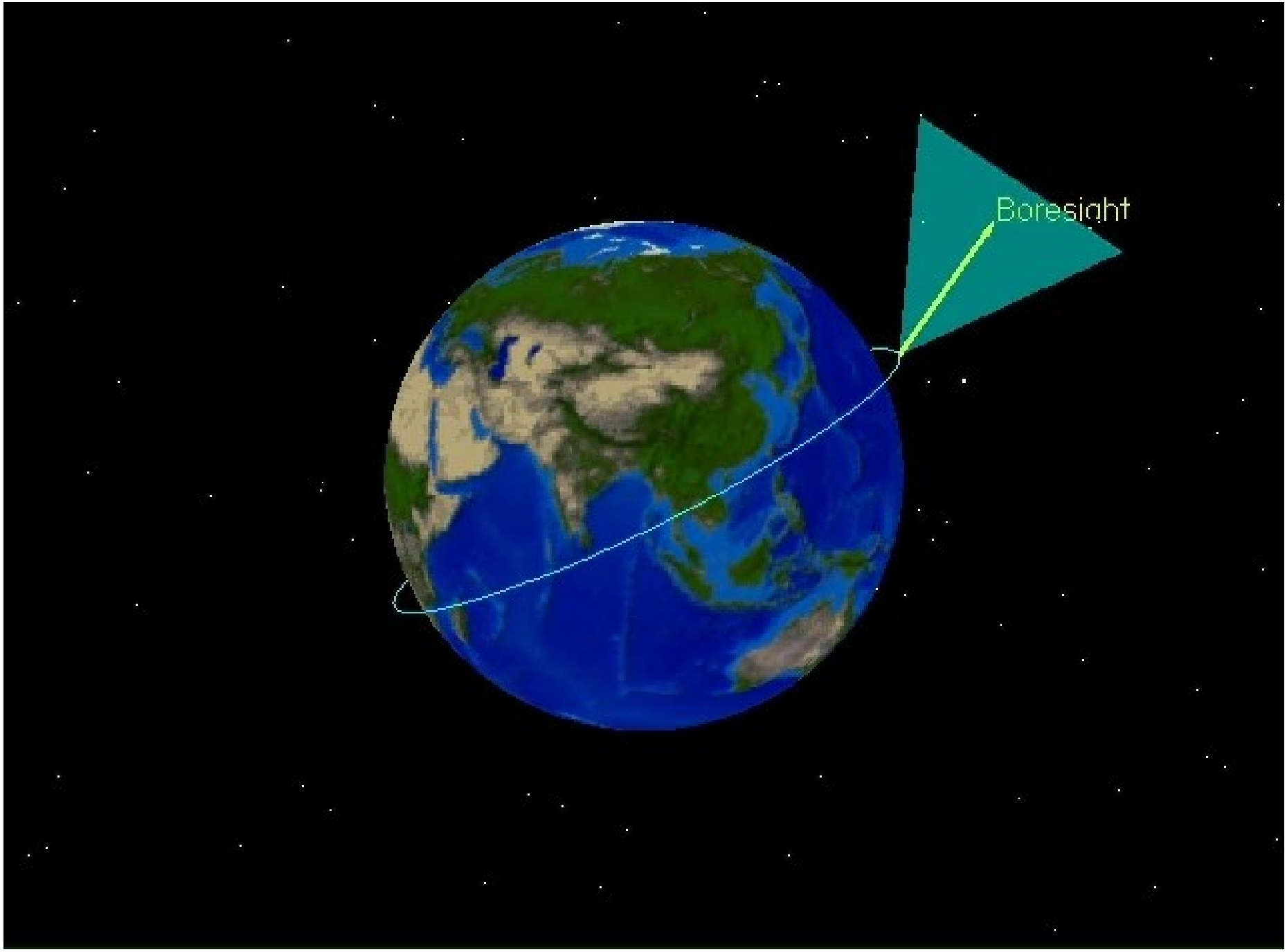
Down link, event reconstruction and analysis takes ~12 h

Time sees one point 15-40 mins

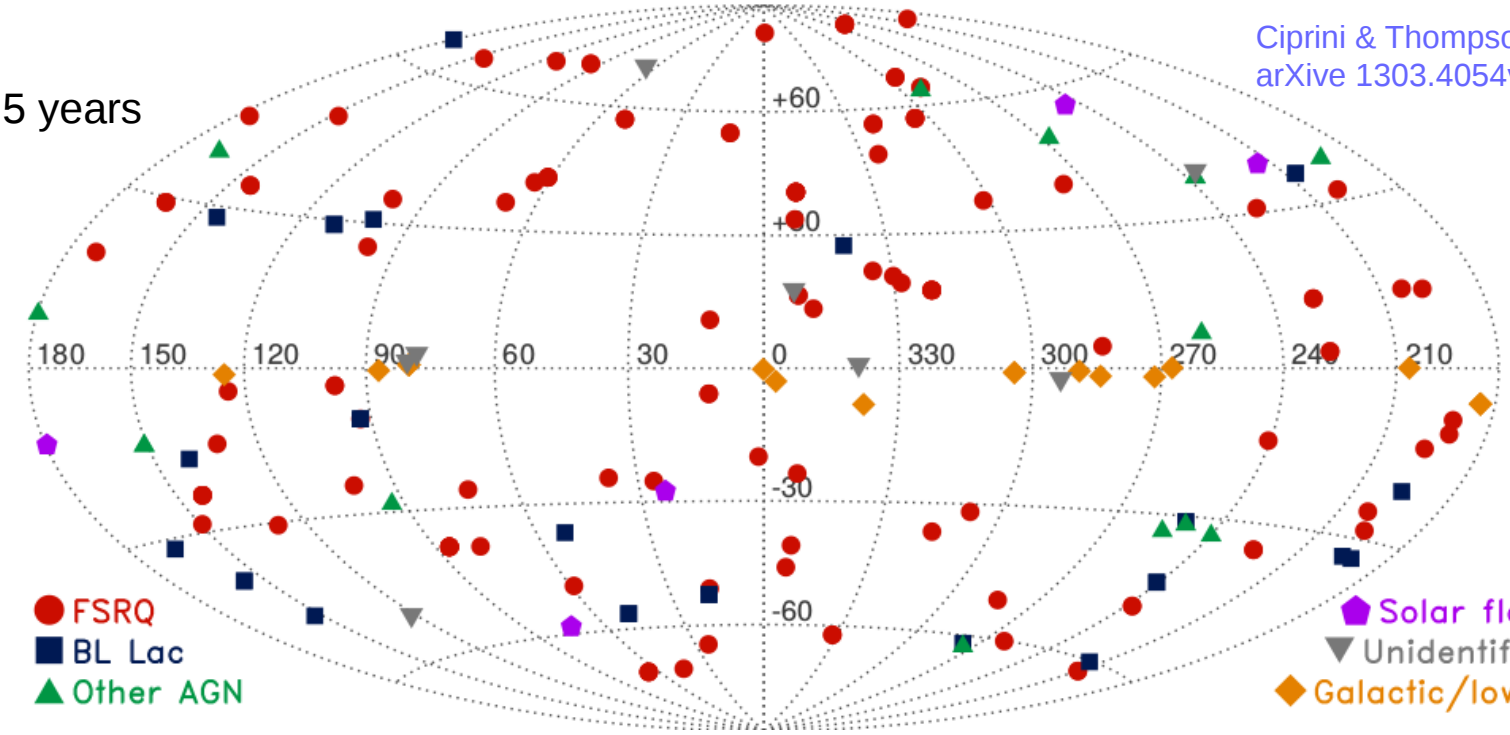
Scans the sky every ~3 hours





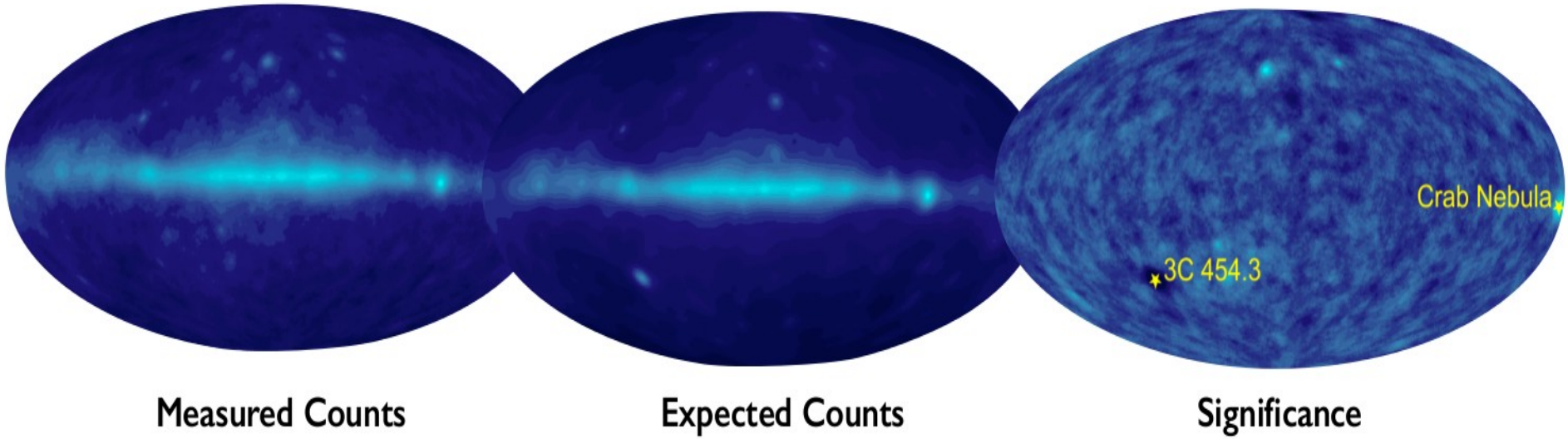

Boresight

Flare Advocates



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

Fermi All-sky Variability Analysis

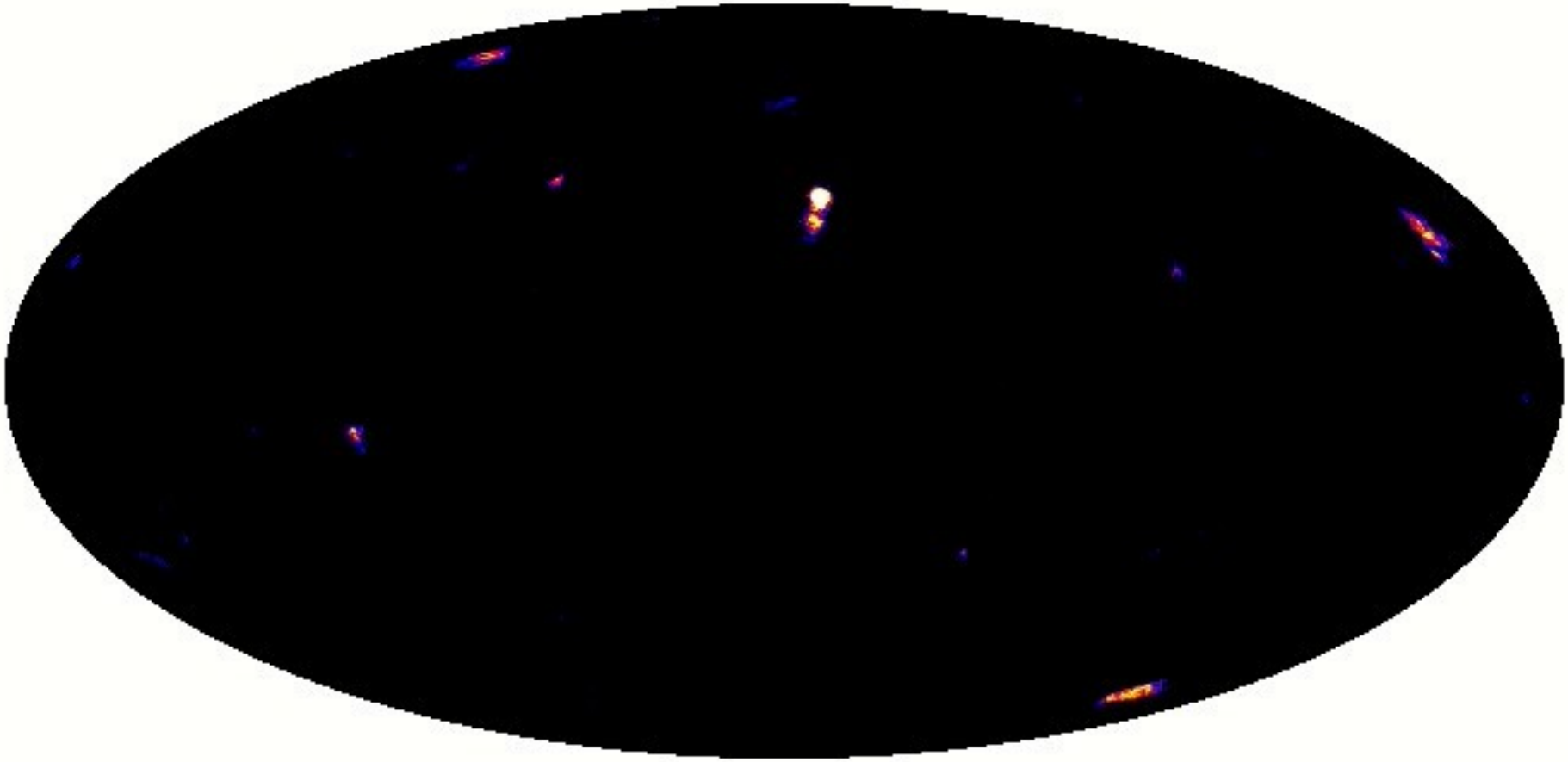


Flare search in real time in weekly bins >100 MeV and >800 MeV

Catalog of flaring sources in first 40 months published

Ackermann et al., ApJ 771 1, 2013

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



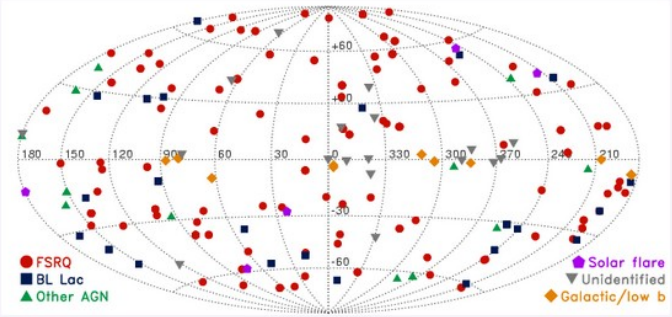
Astronomer's Telegrams

www.asdc.asi.it/feratel/

List of Sources in Fermi LAT ATels

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

Help
Show/hide columns
Advanced filtering
Print current view of table
Print complete table
Reset all filters



asdc ASI Science Data Center VO Tools

VO mode: off (turn on) Help

Cone Search
Source Name
Resolve name and search
RA, Dec L,B Clean
radius 5 arcmin Search
Reset filter

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

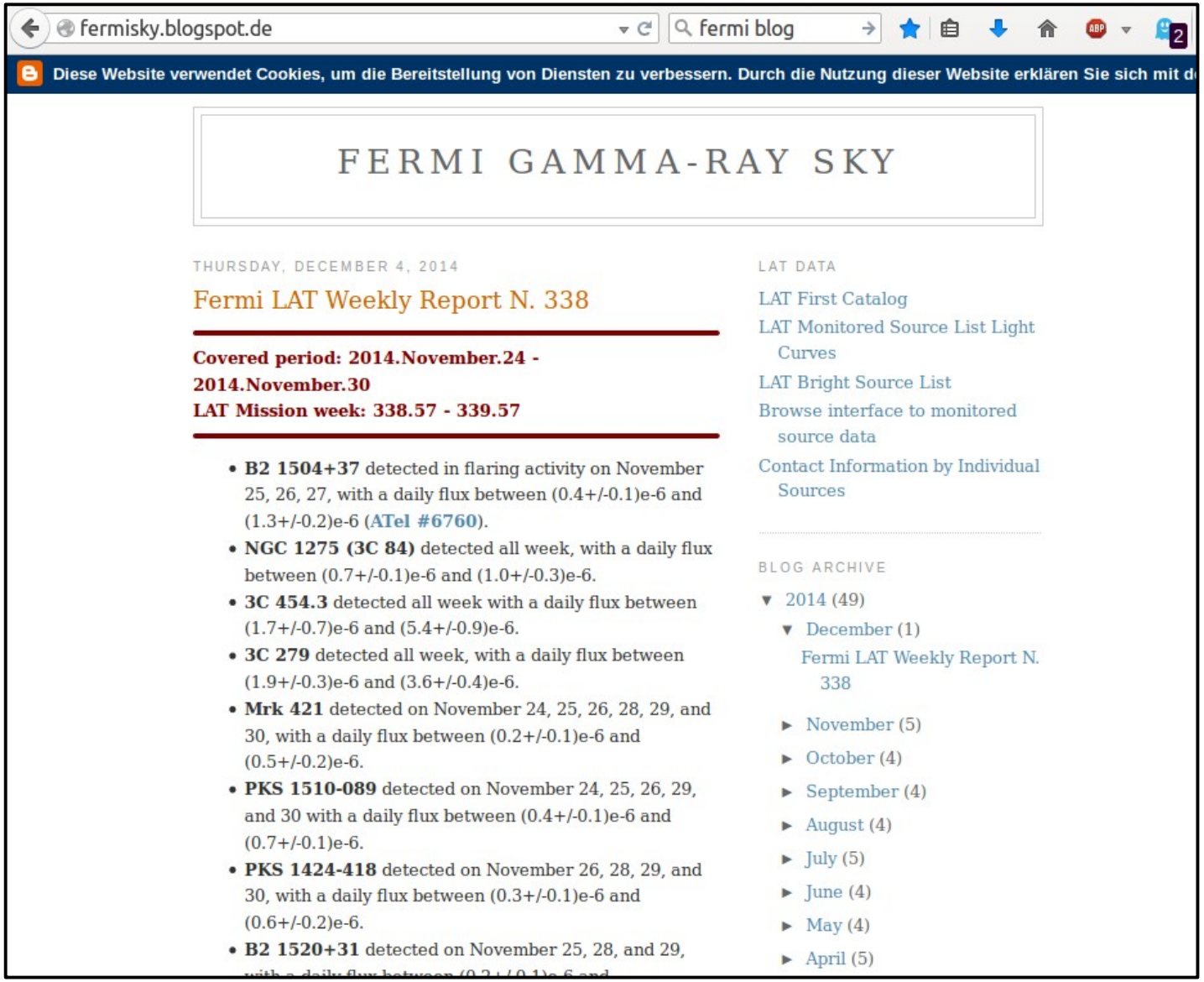
LAT Astronomer's Telegrams
Fermi Gamma-ray Sky Blog
Astronomer's Telegrams website

Export Current view of Table in: Latex format | FITS format | Raw text format | CSV text format

Previous Page Next Page Page Size (# of lines) 200 Refresh page Reset all filters Show all entries

Entry number (Selection mode: Include / All)		Archive	Source name	2FGL name	RA (J2000.0) hh mm ss.d	Dec (J2000.0) dd mm ss.d	Fermi-LAT ATel Number	Date of Flare	redshift	Flux 1-100 GeV 2FGL (ph/cm²/s)	Flux ATel (1e-8ph/cm²/s)	Spectral index	Other Gamma ATel First
1 Select	ASDC Data Explorer	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 Select	ASDC Data Explorer	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	-

Fermi Blog


fermisky.blogspot.de
fermi blog
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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+/-0.1)e-6 and (1.3+/-0.2)e-6 (ATel #6760).
• NGC 1275 (3C 84) detected all week, with a daily flux between (0.7+/-0.1)e-6 and (1.0+/-0.3)e-6.
• 3C 454.3 detected all week with a daily flux between (1.7+/-0.7)e-6 and (5.4+/-0.9)e-6.
• 3C 279 detected all week, with a daily flux between (1.9+/-0.3)e-6 and (3.6+/-0.4)e-6.
• Mrk 421 detected on November 24, 25, 26, 28, 29, and 30, with a daily flux between (0.2+/-0.1)e-6 and (0.5+/-0.2)e-6.
• PKS 1510-089 detected on November 24, 25, 26, 29, and 30 with a daily flux between (0.4+/-0.1)e-6 and (0.7+/-0.1)e-6.
• PKS 1424-418 detected on November 26, 28, 29, and 30, with a daily flux between (0.3+/-0.1)e-6 and (0.6+/-0.2)e-6.
• B2 1520+31 detected on November 25, 28, and 29,
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)

Monitored source list

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

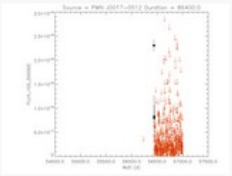
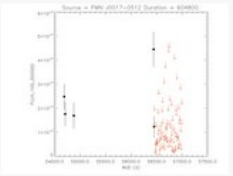
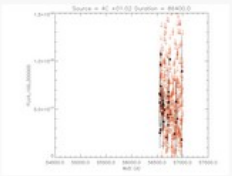
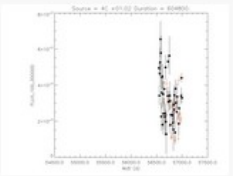
The LAT team monitors flux values for a number of bright sources and transient sources that have shown flares during the mission. (See up-to-date weekly reports on flaring sources at the Fermi-LAT Flare Advocate Blog.) As sources cross the monitoring flux threshold of 1×10^{-6} cm^{-2} s^{-1}, they are added to the monitored source list. (The initial flux threshold was 2×10^{-6} cm^{-2} 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.

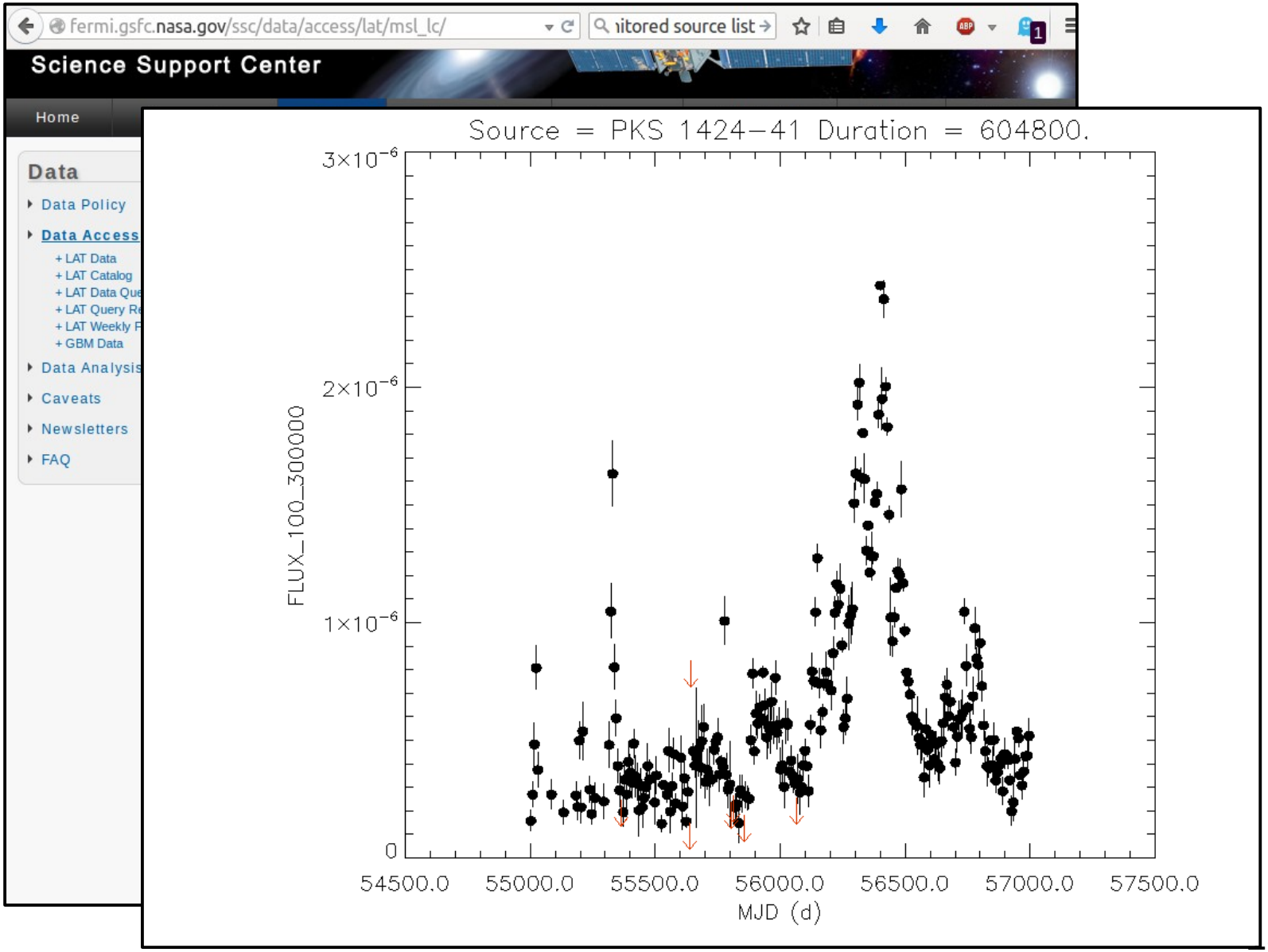
Note: Due to a software error, flux upper limits are not available for dates between approximately 2010-09-14 to 2011-02-21.

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) • 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) • 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 occurance rates for the Fermi-LAT Monitor triggers broken down by type is:

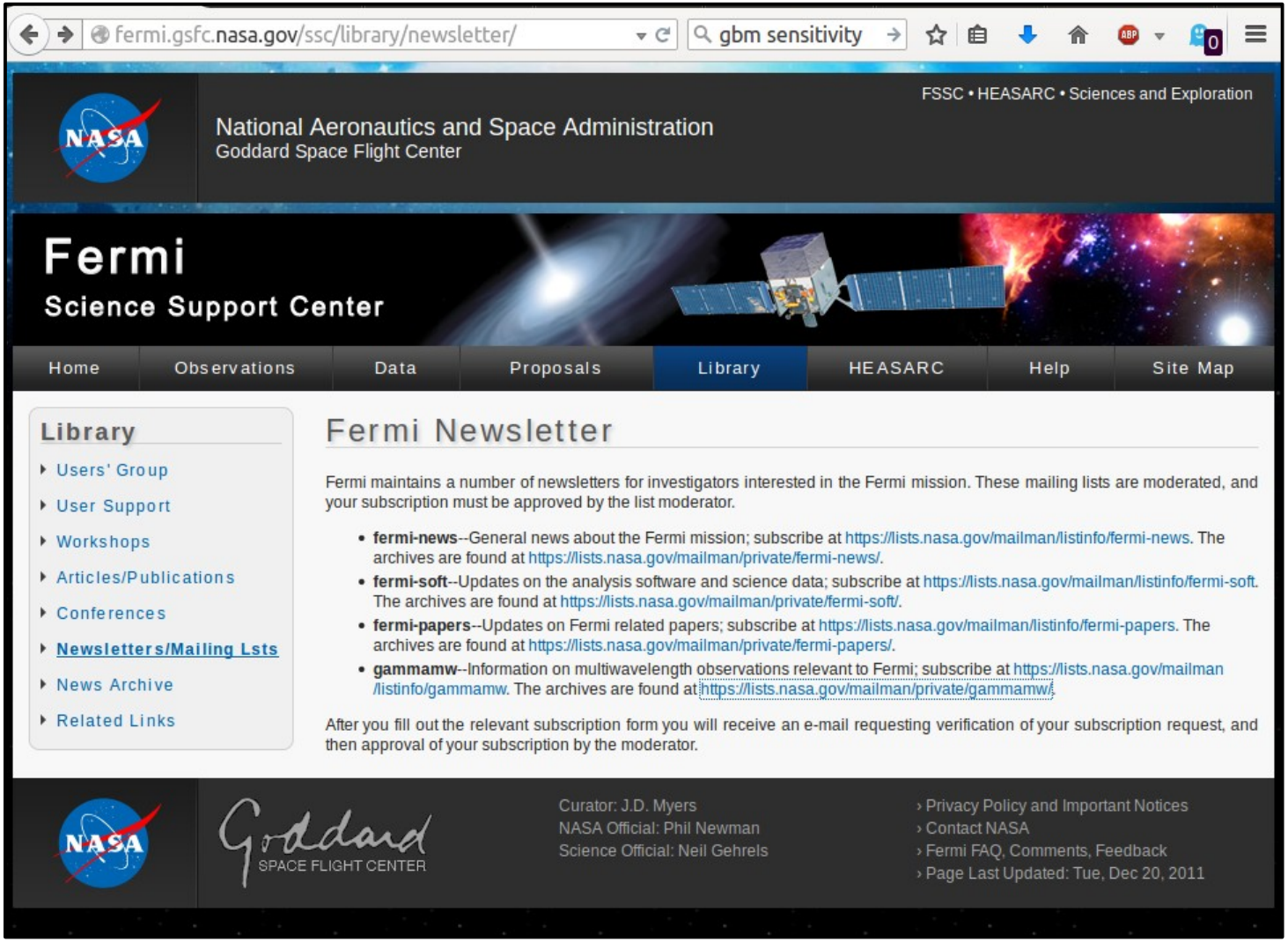
YEAR	MONITOR	TRANSIENT	COMMENT
2012	6	0	
2011	5	0	Only Aug26 thru Dec31, transitioned to normal ops (eff=100%)
2011	5	2	Only Apr25 thru Aug25, during testing phase, ops efficiency <100%

Fermi-LAT EVENTS

EVENT			OBSERVATION					
RefNum	Date	Time UT	MesgType Mon Trans	RA (J2000) [deg]	Dec (J2000) [deg]	Error [arcmin]	Inten [ph/cm2/s]	Comments / Monitor_LC_URL
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

News letter


fermi.gsfc.nasa.gov/ssc/library/newsletter/
gbm sensitivity
FSSC • HEASARC • Sciences and Exploration
National Aeronautics and Space Administration
Goddard Space Flight Center
Fermi
Science Support Center
Home
Observations
Data
Proposals
Library
HEASARC
Help
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Library
Users' Group
User Support
Workshops
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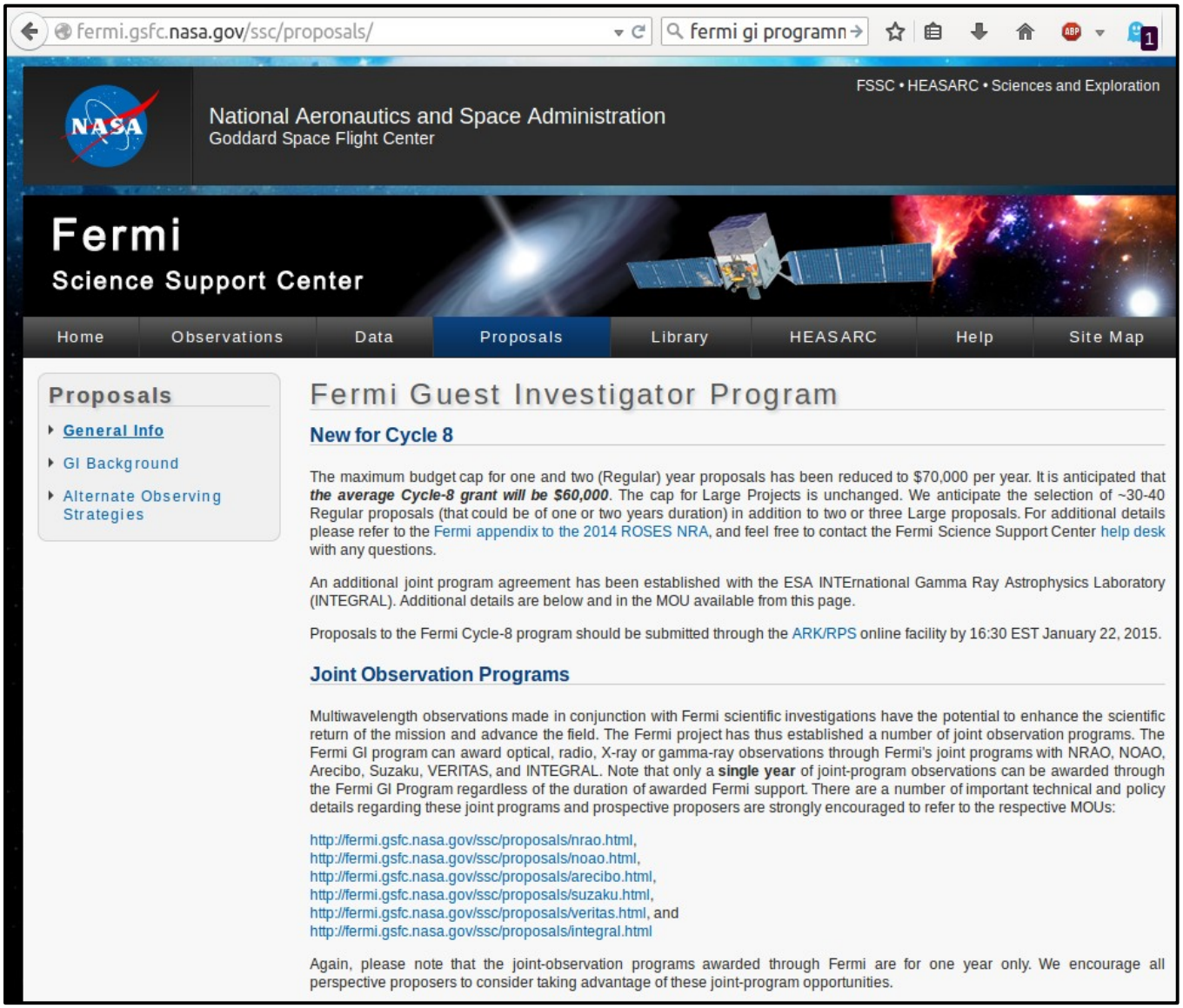
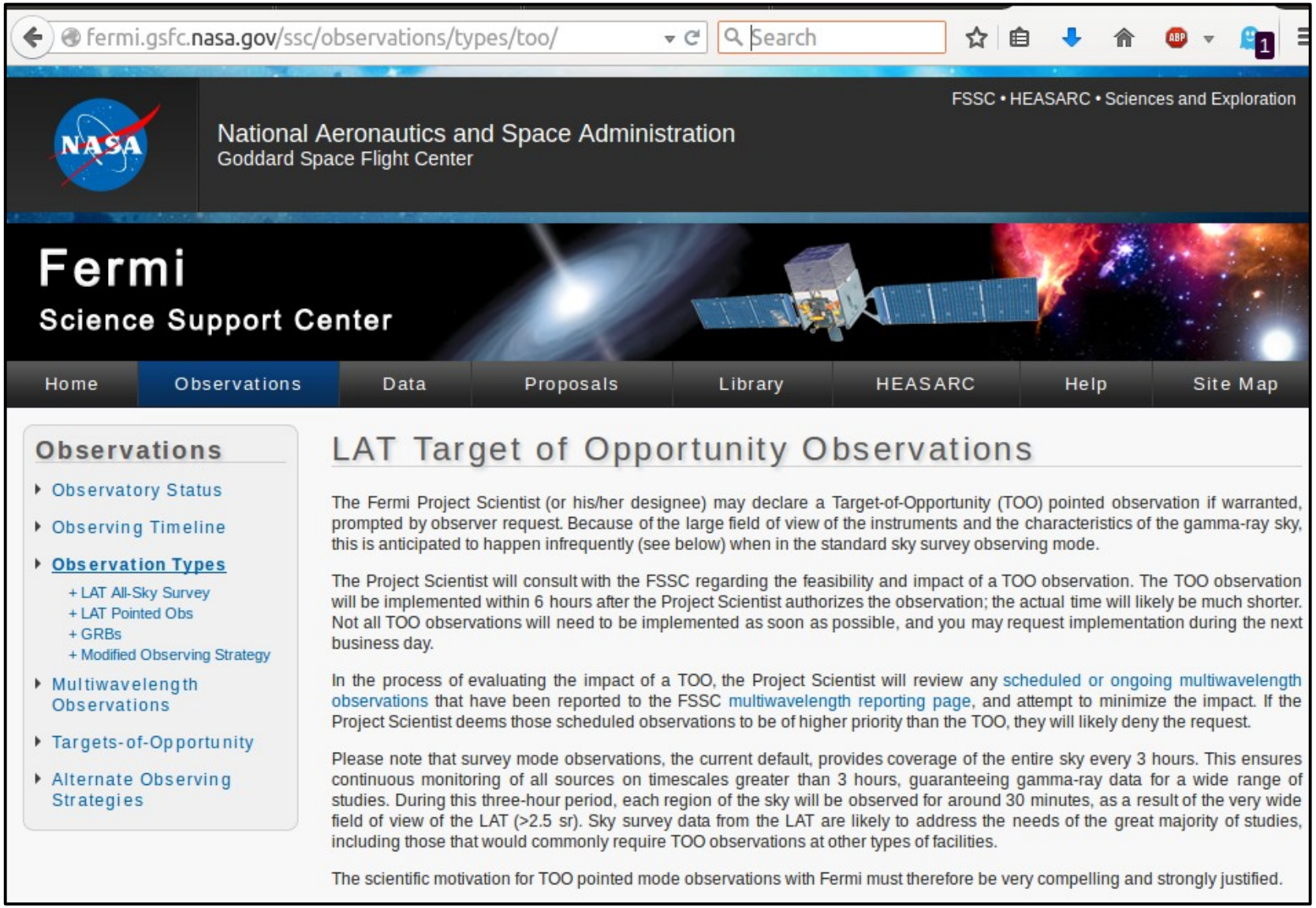
Fermi maintains a number of newsletters for investigators interested in the Fermi mission. These mailing lists are moderated, and your subscription must be approved by the list moderator.
fermi-news--General news about the Fermi mission; subscribe at https://lists.nasa.gov/mailman/listinfo/fermi-news. 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/.
After you fill out the relevant subscription form you will receive an e-mail requesting verification of your subscription request, and then approval of your subscription by the moderator.
Goddard
SPACE FLIGHT CENTER
Curator: J.D. Myers
NASA Official: Phil Newman
Science Official: Neil Gehrels
› Privacy Policy and Important Notices
› Contact NASA
› Fermi FAQ, Comments, Feedback
› Page Last Updated: Tue, Dec 20, 2011

The Guest Investigator program



Target of Opportunity



Conclusions

Fermi scanning the sky constantly from 8keV to 500 GeV.

GRB reaction time is order 5s and positioning accuracy is 5-15°

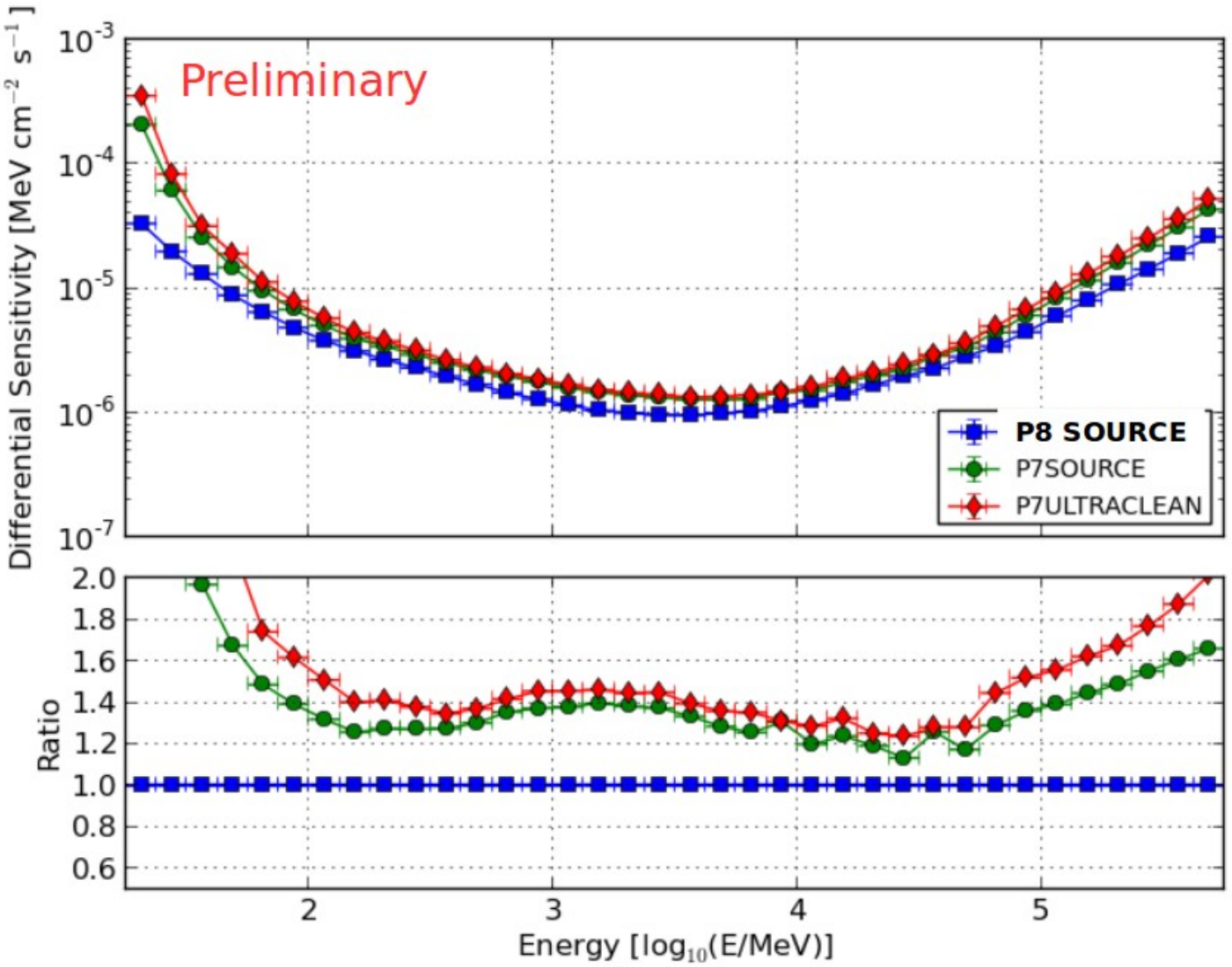
LAT reaction time is ~12 hours and positioning accuracy ~0.02-1°

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.

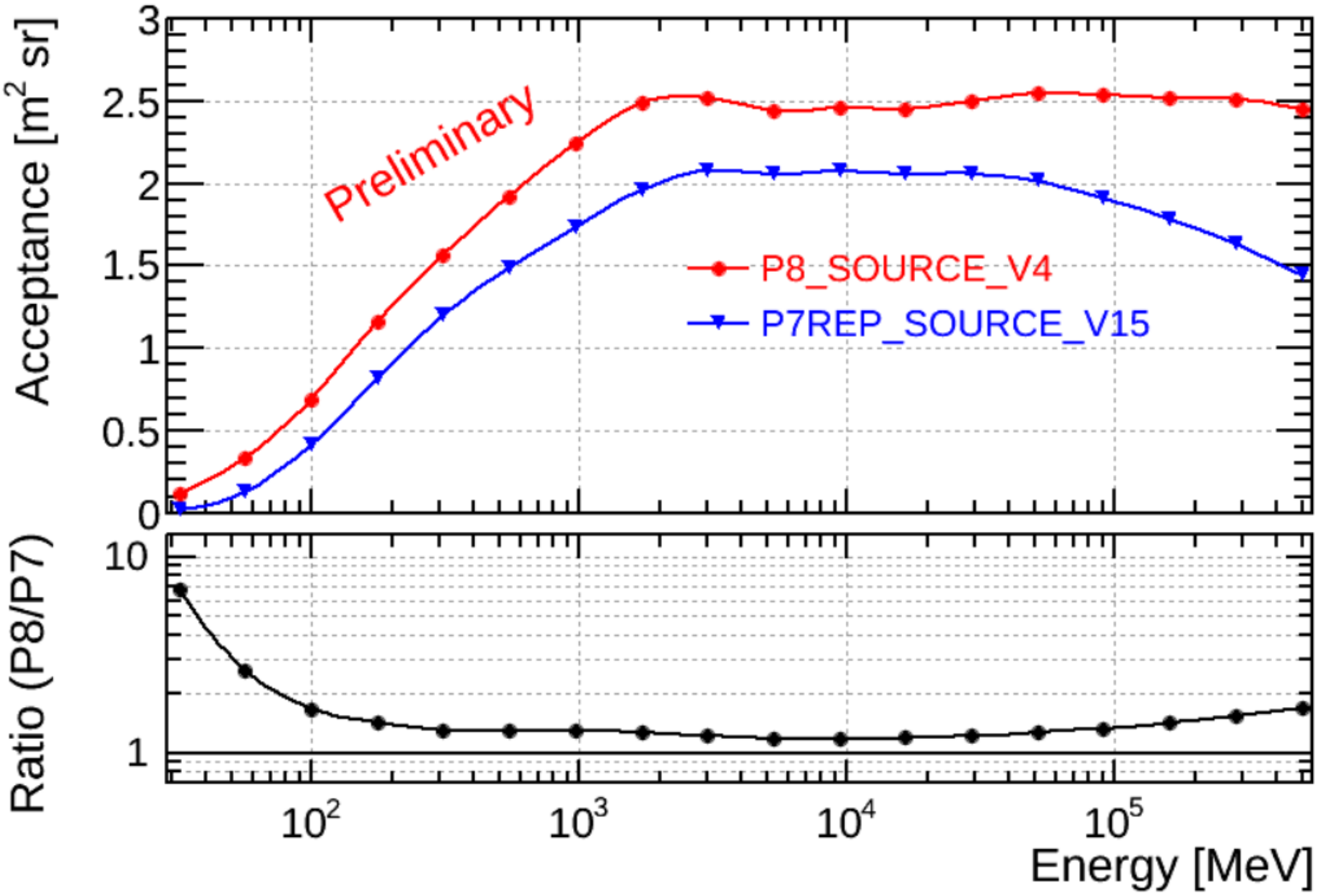
I did not talk about (many) multi-frequency campaigns, which are generally setup and coordinated by different responsible persons from the LAT side. Our MW coordinator is Dave Thompson.

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

Pass 8


Preliminary
Differential Sensitivity [MeV cm^{-2} s^{-1}]
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
P8 SOURCE
P7SOURCE
P7ULTRACLEAN
Ratio
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
2
3
4
5
Energy [$\log_{10}$(E/MeV)]

Pass 8


Acceptance [m^2 sr]
Preliminary
P8_SOURCE_V4
P7REP_SOURCE_V15
Ratio (P8/P7)
Energy [MeV]