

National Aeronautics and Space Administration



Fermi

Gamma-ray Space Telescope

www.nasa.gov/fermi

Fermi

Gamma-ray Space Telescope

**Users Group Meeting
5 Nov 2010**

Mission Status Update

J. McEnery, E. Hays



Status Highlights

- **Observatory is operating smoothly, FOT continues to look for ways to improve operations.**
 - **Closely monitor reaction wheels - no issues or concerns.**
 - **Reaction wheel life test ends in August.**
 - **Updated FSW to handle reduced wheel observation modes - code complete, testing is underway.**
 - **Battery management - performance is stable**
 - **CSS noise dropouts**
 - **Solar eclipse on Jan 4**
 - **Thermal sensor (RTD/TIB) management**
 - **Adjusted the Earth Avoidance Angle from 20 deg. to 5 deg. (2010-259)**
- **GI Cycle 4**
- **Level 1 requirements review on May 19 - Passed!**
- **Press and outreach coordination and planning, tied to major science results releases.**



Observations summary (since last meeting)

- **Almost exclusively in nominal data taking in survey mode**
 - 50 deg rocking angle from May 27 2009 onwards
 - Adjusted the slew rate to slow the transition and lower peak wheel speeds (2010-259)
 - Changed phase (to perform rocking maneuver when Earth is cooler to minimize battery heating).
- **ARRs (1-2 per month)**
 - Duration of ARR reduced to 2.5 hours (from 5 hours)
- **2 TOO**
 - Cygnus X-3, Crab
 - Being more proactive about notifying community
- **1 modified survey mode observation**
 - Two orbits south, 1 orbit north to enhance coverage during PSR B1259 periastron.
- **LAT Calibrations**
 - ~6 hours

Nadir pointed observation

- **Accepted cycle 4 GI proposal to point at the Earth**
 - **50 Orbits**
 - **Nominally 2 orbits/day, 1 day per week for 25 weeks (i.e. 3 hours per week)**
 - **Starting in the Autumn**
 - **Planning a test observation in July**
 - **Some planning/preparation required as we may need to adjust configuration of the observatory (LAT, GBM and spacecraft)**

Observations planning

- **The Science Policy Document (linked from the main Fermi users group page) describes the current policy for balance of observation modes**
 - **>70% sky survey + ARR**
 - **ARR rate is lower than originally planned, duration now shortened**
 - **<= 20% pointed mode, planned TOO**
 - **None in cycles 1,2,3;**
 - **<= 10% Mission discretionary time - MDT (unplanned TOO, time critical science observations between GI cycles, calibrations)**
 - **3C454.3, Crab and Cyg-X3 TOOs; PSR B1259 modified survey mode**
 - **Small amount of calibrations/engineering <1 day/year**
 - **Reported to FUG**
- **Unused pointed mode and MDT allocation is assigned to sky survey.**
- **It was anticipated that we may want to increase the allocation of pointed mode later in the mission - do we?**

Data, software and all that

- **Formed a steering group between project, LAT team and FSSC to coordinate releases of LAT data and software updates.**
 - **Low background data selection available in November LAT data update - DONE**
 - **Plans for updated instrument response functions (improved description of PSF and effective area) - DONE**
 - **Updates on diffuse models, catalog, data processing**
 - **Discussions on release of additional software - python scripts, pointlike etc**
 - **Future enhanced data releases - LAT burst mode data etc**
- **LAT, GBM, FSSC group to exercise and validate GRB (LAT +GBM) analysis methods.**

LAT “burst mode” data

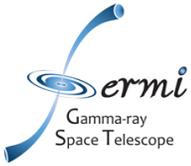
- **LAT team has developed GRB analysis methods that use loose event selections (sometimes known as LLE - LAT Low Energy).**
 - Provides additional effective area (i.e. more counts) especially at low energies.
 - Very high background contamination.
- **Details of final event selection and reconstruction parameters is not yet finalized, but it is clear that this type of event selection is useful for GRB studies with LAT.**
 - Data volume is very high (factor of 10-30 greater than current LAT data)
 - Analysis requires instrument responses calculated with a dedicated montecarlo simulation of the GRB location.
- **Investigating ways to make this data (and associated high level products needed for its analysis) produced more routinely for each GBM trigger.**
 - Goal is to make these data publicly available by the end of the year

Solar Flares And The LAT

- **Solar flares cause increased hit rate in the ACD:**
 - **Pile-up effect:**
 - **Most pronounced in the largest tile on the side towards the Sun.**
 - **Does not affect the ACD Veto which is used onboard in the trigger and event filters.**
 - **Does not cause any loss of events onboard.**
- **Photon identification algorithm:**
 - **Uses the total energy in the ACD.**
 - **Increased ACD activity causes the classification algorithm to reject the event.**
 - **This causes an offline photon (identification) loss:**
 - **We have the events but they are not identified as photons!**
- **Data Quality Flag:**
 - **Periods with significant photon rate loss are flagged as BAD in the FT2 file.**

Sun position in FT2 file

- **During periods when the sun is very bright, it is essential to exclude times when the sun lies close to your ROI**
 - **FSSC provided a script to add sun location to the FT2 files, users can use gtmktime to define time periods to exclude from the analysis (described in a note to fermi-news, and as a news item on webpage)**
 - **LAT team is planning to update the FT2 file definition so that the Sun position is always written to the FT2 files (so that users will no longer need to run the script).**



GI Program Review

- **Part of a general evaluation of the NASA R&A program (including APRA, ATP, ADP).**
- **Chandra, Spitzer, Hubble and Fermi were asked to present to the panel**
- **Fermi presentation was at the AAS meeting in Seattle**
- **The following slides are from that presentation...**

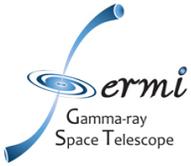


Program Description

- **Unique nature of Fermi defines GI Program**
 - **Proposals are typically requests for grant support rather than data rights, spacecraft orbits or *ksec***
 - **NOAO, NRAO & Suzaku^(new) joint programs**
 - **Pointed observations (ToO &/or Scheduled)**
- **Open to international community**
 - **No grants issued outside the US**
- **Proposal Categories**
 - **Data analysis, coordinated observations, & theory**
- **Proposal sizes**
 - **Regular: 1 or 2^(new) year, ~<\$80k/year**
 - **Large: up to 3 years, ~<\$200k/year**
 - **Accommodate investigations that require significant resources, or a long duration (e.g. MW monitoring campaign)**
- **GI program developed in partnership with the Fermi Users Group**
- **\$8M total budget**

Assessing program success

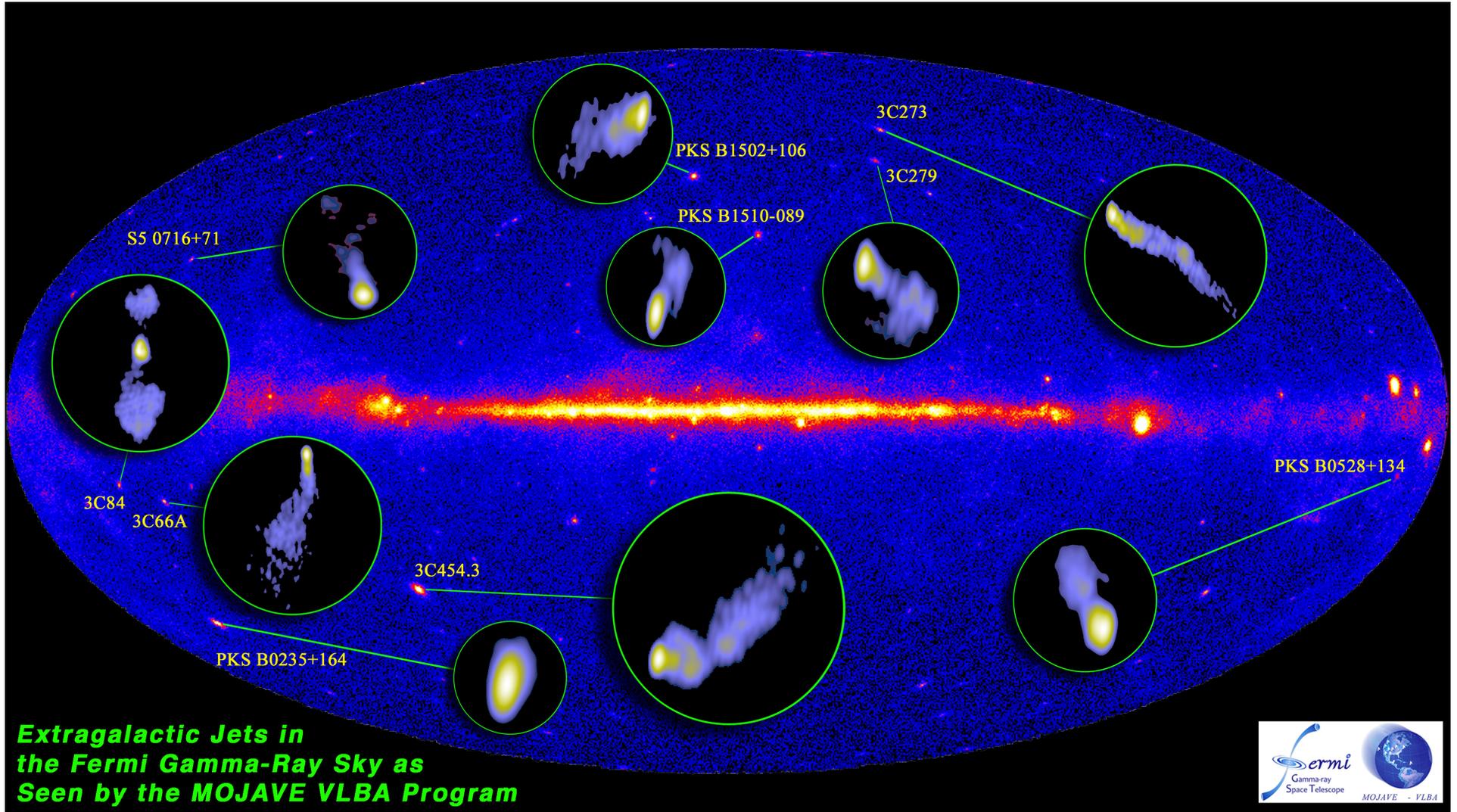
- **Large proposals**
 - **Progress report due each year, reviewed by GI review panels.**
 - **Strong encouragement to provide community resource**
 - **software, models, MW data**
- **Regular proposals**
 - **For two year awards, we will ask for a progress report at the time that the second year of funding is requested.**



Assessing Program Success

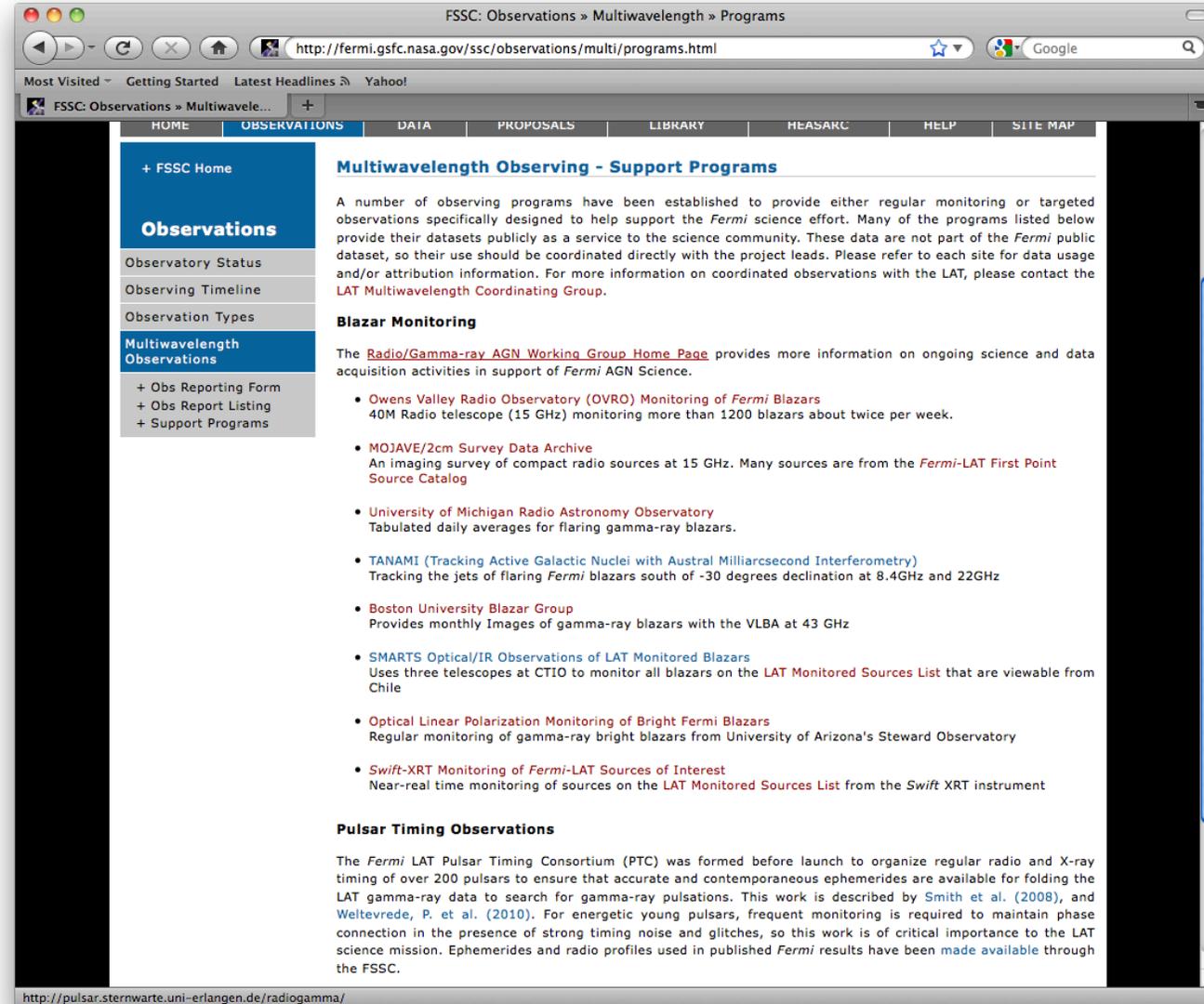
- **Fermi Users Group**
 - **Reviews plans for each GI cycle (including review process, program changes etc)**
 - **Reviews results**
- **FSSC and Fermi project organize regional GI workshops.**
 - **Los Angeles, Santa Cruz, Berkeley, Palo Alto, Chicago, Boston, New York, Ann Arbor**
 - **Solicit feedback and suggestions from prospective and past GIs**

VLBA Monitoring of Fermi AGN with MOJAVE



- M. Lister et al, Large, Correlative

Leveraging GI program to provide MW resources



FSSC: Observations » Multiwavelength » Programs

http://fermi.gsfc.nasa.gov/ssc/observations/multi/programs.html

HOME OBSERVATIONS DATA PROPOSALS LIBRARY HEASARC HELP SITE MAP

+ FSSC Home

Observations

Observatory Status

Observing Timeline

Observation Types

Multiwavelength Observations

+ Obs Reporting Form

+ Obs Report Listing

+ Support Programs

Multiwavelength Observing - Support Programs

A number of observing programs have been established to provide either regular monitoring or targeted observations specifically designed to help support the *Fermi* science effort. Many of the programs listed below provide their datasets publicly as a service to the science community. These data are not part of the *Fermi* public dataset, so their use should be coordinated directly with the project leads. Please refer to each site for data usage and/or attribution information. For more information on coordinated observations with the LAT, please contact the [LAT Multiwavelength Coordinating Group](#).

Blazar Monitoring

The [Radio/Gamma-ray AGN Working Group Home Page](#) provides more information on ongoing science and data acquisition activities in support of *Fermi* AGN Science.

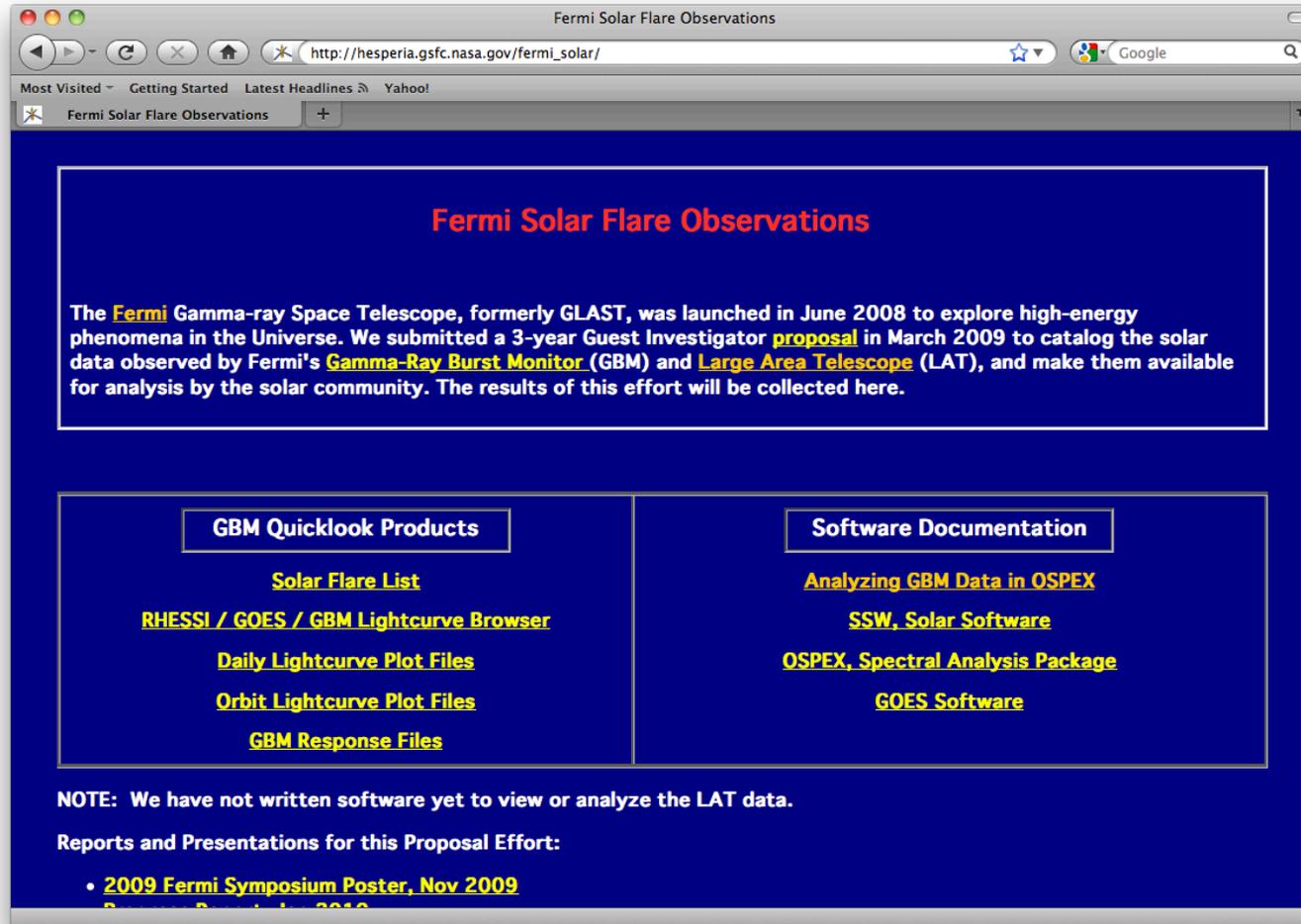
- **Owens Valley Radio Observatory (OVRO) Monitoring of *Fermi* Blazars**
40M Radio telescope (15 GHz) monitoring more than 1200 blazars about twice per week.
- **MOJAVE/2cm Survey Data Archive**
An imaging survey of compact radio sources at 15 GHz. Many sources are from the *Fermi*-LAT [First Point Source Catalog](#)
- **University of Michigan Radio Astronomy Observatory**
Tabulated daily averages for flaring gamma-ray blazars.
- **TANAMI (Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry)**
Tracking the jets of flaring *Fermi* blazars south of -30 degrees declination at 8.4GHz and 22GHz
- **Boston University Blazar Group**
Provides monthly Images of gamma-ray blazars with the VLBA at 43 GHz
- **SMARTS Optical/IR Observations of LAT Monitored Blazars**
Uses three telescopes at CTIO to monitor all blazars on the [LAT Monitored Sources List](#) that are viewable from Chile
- **Optical Linear Polarization Monitoring of Bright *Fermi* Blazars**
Regular monitoring of gamma-ray bright blazars from University of Arizona's Steward Observatory
- **Swift-XRT Monitoring of *Fermi*-LAT Sources of Interest**
Near-real time monitoring of sources on the [LAT Monitored Sources List](#) from the *Swift* XRT instrument

Pulsar Timing Observations

The *Fermi* LAT Pulsar Timing Consortium (PTC) was formed before launch to organize regular radio and X-ray timing of over 200 pulsars to ensure that accurate and contemporaneous ephemerides are available for folding the LAT gamma-ray data to search for gamma-ray pulsations. This work is described by [Smith et al. \(2008\)](#), and [Weltevrede, P. et al. \(2010\)](#). For energetic young pulsars, frequent monitoring is required to maintain phase connection in the presence of strong timing noise and glitches, so this work is of critical importance to the LAT science mission. Ephemerides and radio profiles used in published *Fermi* results have been [made available](#) through the FSSC.

<http://pulsar.sternwarte.uni-erlangen.de/radiogamma/>

Solar Physics with Fermi



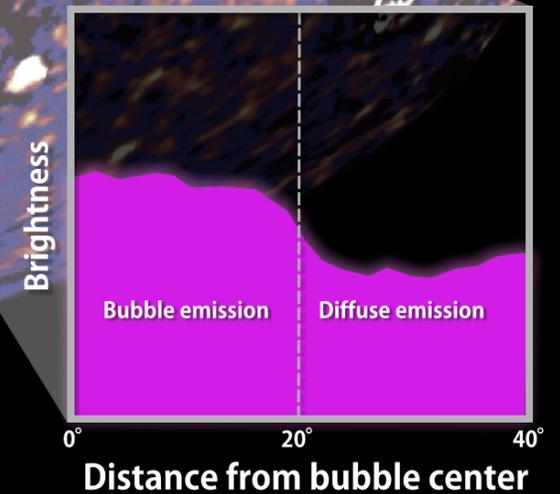
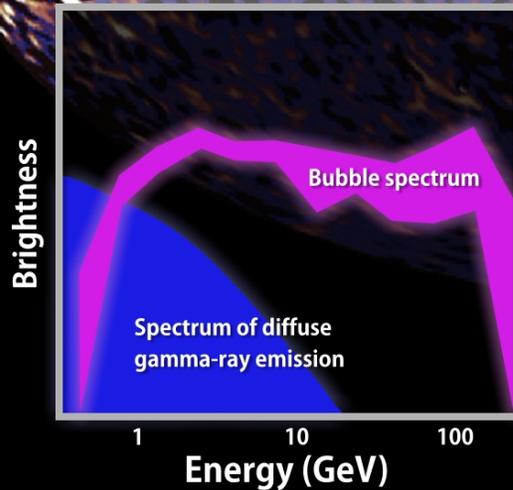
The screenshot shows a web browser window titled "Fermi Solar Flare Observations" with the URL http://hesperia.gsfc.nasa.gov/fermi_solar/. The page has a dark blue background with white and yellow text. The main heading is "Fermi Solar Flare Observations" in red. Below it, a paragraph explains the mission: "The **Fermi** Gamma-ray Space Telescope, formerly GLAST, was launched in June 2008 to explore high-energy phenomena in the Universe. We submitted a 3-year Guest Investigator **proposal** in March 2009 to catalog the solar data observed by Fermi's **Gamma-Ray Burst Monitor (GBM)** and **Large Area Telescope (LAT)**, and make them available for analysis by the solar community. The results of this effort will be collected here." The page is divided into two columns of links. The left column, under "GBM Quicklook Products", includes: [Solar Flare List](#), [RHESSI / GOES / GBM Lightcurve Browser](#), [Daily Lightcurve Plot Files](#), [Orbit Lightcurve Plot Files](#), and [GBM Response Files](#). The right column, under "Software Documentation", includes: [Analyzing GBM Data in OSPEX](#), [SSW, Solar Software](#), [OSPEX, Spectral Analysis Package](#), and [GOES Software](#). At the bottom, a note states: "NOTE: We have not written software yet to view or analyze the LAT data." Below that, it says "Reports and Presentations for this Proposal Effort:" followed by a bullet point: "• [2009 Fermi Symposium Poster, Nov 2009](#)".

- Making Fermi solar data available in formats compatible with standard solar analysis software.
- B. Dennis et al, Large proposal, data analysis

Fermi Lobes

The bubbles display a harder (more energetic) spectrum than the diffuse emission.

The bubbles display sharp edges (less than 2°), which suggests a sudden, impulsive event.



Pulsar Timing

- **Pulsar timing**
 - **Gamma-rays**
 - Timing models of gamma-ray pulsars (P. Ray, Regular, data analysis)
 - **Radio**
 - Timing models of young radio pulsars (F. Camilo, regular, correlative)
 - Search for ms pulsars at location of Fermi sources (S. Ransom, regular, correlative)

Pulsar timing models are essential for many Fermi studies (not just pulsars!), LAT team collects timing solutions, FSSC makes these available to the community.

GI program provides funding for the analysis, and observations (from NRAO program)

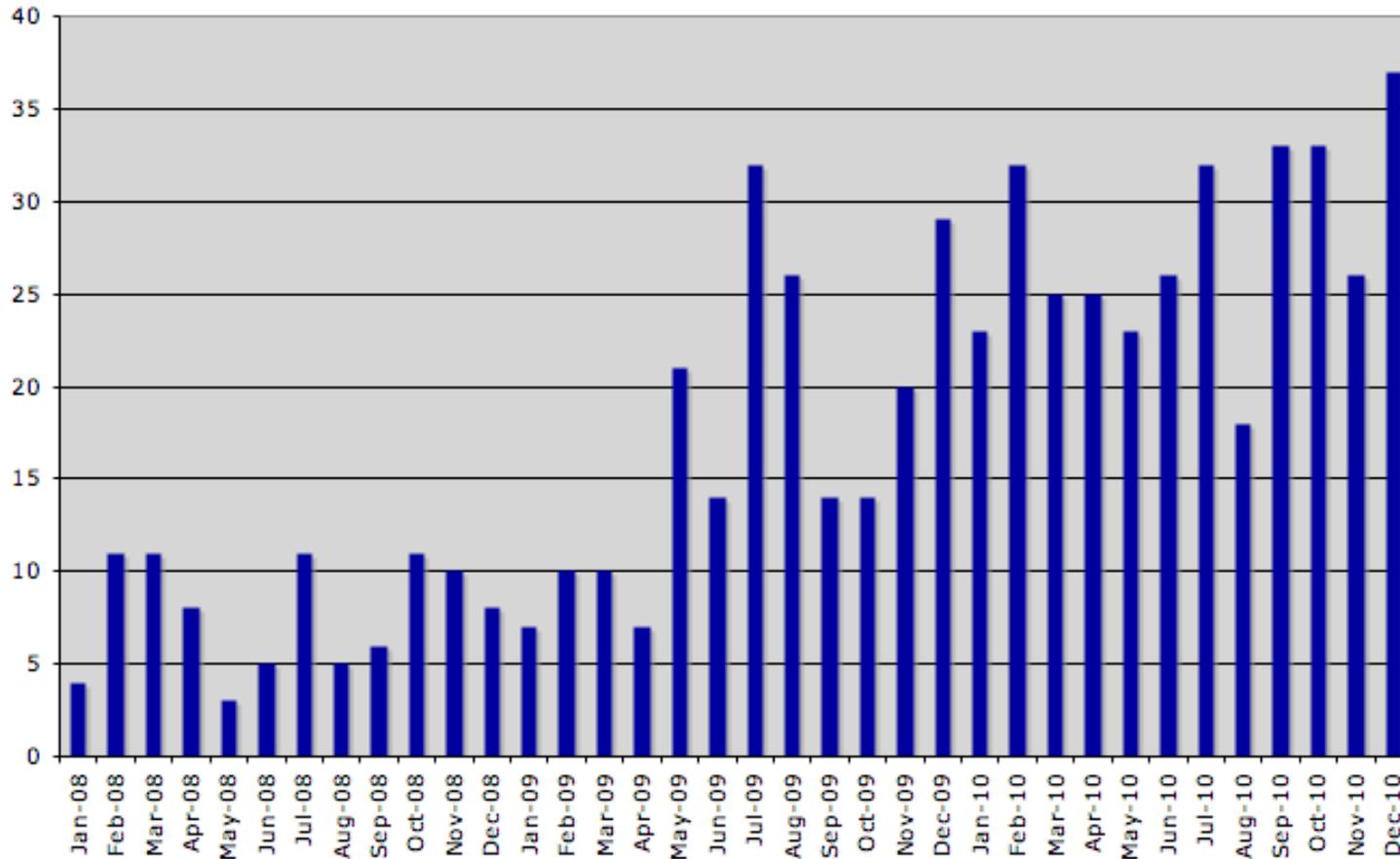
GI Program Review Summary

- **Primary role of the GI program is to provide financial support for Fermi studies**
 - **GI program has supported many significant science results**
 - **GI program enables GI's to obtain and distribute resources that are of use to the Fermi science community**
- **The Fermi GI program was developed with the input and guidance of the Fermi Users Group.**
 - **All changes are reviewed by (and often suggested by) the FUG**
- **The FSSC and the Fermi proactively seek feedback and input from the GI community.**
 - **Workshops, booths at major meetings etc**
- **Suggestions on how to improve the Fermi GI program are always welcome.**

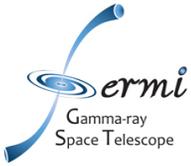
The Fermi GI Program is extremely important to the scientific success of the Fermi Mission

Published Refereed Papers

Fermi Publications



Also collecting lists of PhD students using Fermi data.



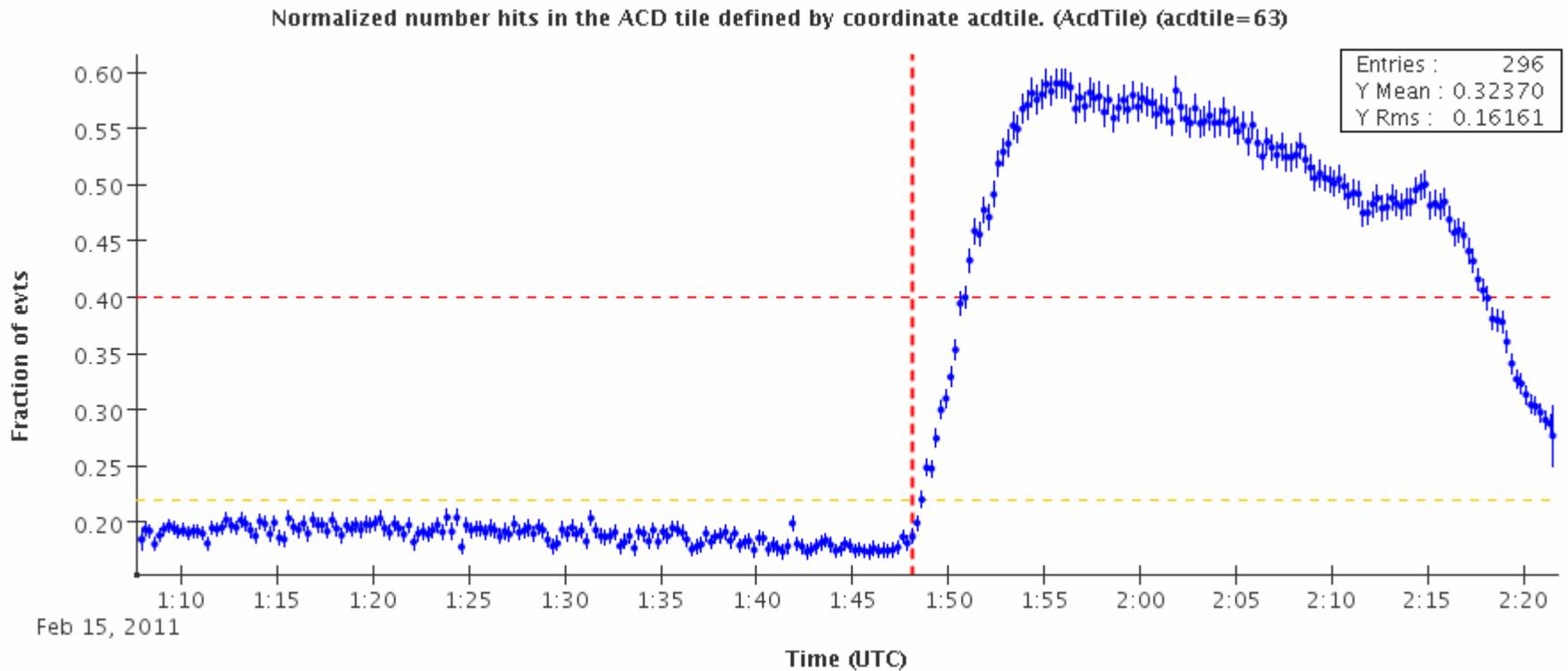
Fermi and Public Outreach

- Now make short video podcasts to accompany each press release
 - Post on nasa.gov, [youtube \(nasa channel\)](https://www.youtube.com/channel/UCv3p01101111111111111111), [Goddard](http://www.goddard.nasa.gov)
- Over 700,000 views on 3 videos produced since last November.
- **"NASA's Fermi Catches Thunderstorms Hurling Antimatter into space,"** AAS press briefing, Jan. 10. Story picked up by Time, USA Today, PC World, Ars Technica, IGN, Yahoo News
- **"NASA Satellites Find High-energy Surprises in 'Constant' Crab Nebula,"** AAS press briefing, issued Jan.12. Spent about two weeks as a NASA.gov most-viewed story. Picked up by New Scientist, MSNBC, Space Daily, Sify, Astronomy, SatNews, Physics World
- **"NASA's Fermi Finds Giant, Previously Unseen Structure In Our Galaxy"** and held media telecon (Nov. 9); resulted in stories in: New York Times, LA Times, USA Today, Nature, Science News, Discovery News, Space.com/MSNBC, AFP, UPI, BBC

Questions?

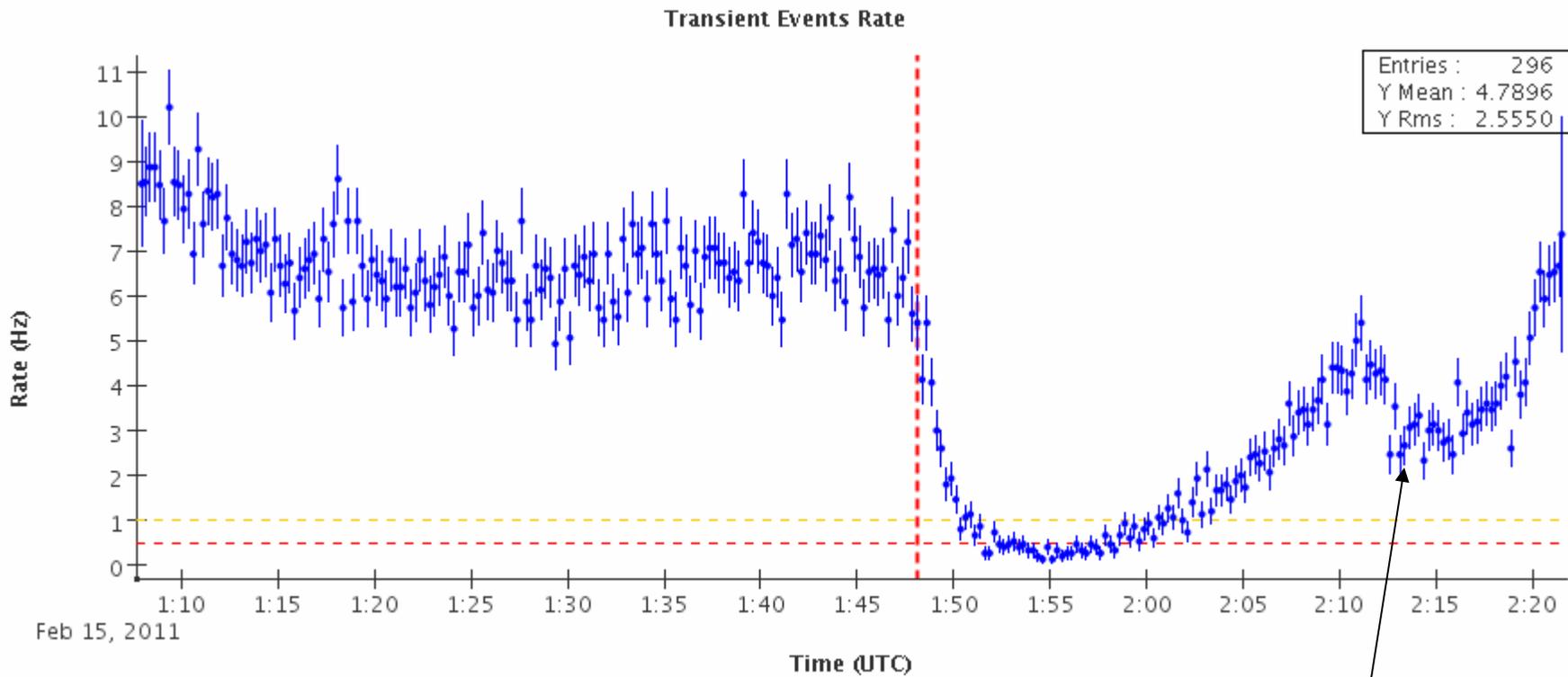
February 15, 2011 X-Class Solar Flare

Normalized rate of hits in the largest ACD tile on the Sun side



February 15, 2011 X-Class Solar Flare

Transient Photon rate



This drop is due to Rocking