

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.**
 - **Implemented rate-limited yaw maneuver (so avoid sun avoidance maneuver in survey mode)**
 - **Battery management - Tested 45 deg survey profile, reverted back to 50 deg**
 - **Collision avoidance**
 - **Conjunction assessment report, review of thruster control parameters**
 - **Reaction wheels**
 - **Adjusting survey profile to reduce peak wheel speed**
 - **Reduced Earth Avoidance angle from 20 to 5 deg.**
- **Updated LAT GRB trigger parameters**
- **Beth Pumphrey is now Fermi Mission Director!**
- **GI Cycle 3 underway, preparing for Cycle 4 (Suzaku, 2-year regular proposals)**
- **Data analysis and science/proposer workshops**

Observations summary

- **Almost exclusively in nominal data taking in survey mode**
 - 50 deg rocking angle from Sept 2, 2009 - April 29, May 27 onwards
 - 45 deg rocking angle from April 29 - May 27
- **ARRs (approx 1/month)**
 - 5 hour pointed mode observations in response to bright GBM detected bursts.
- **1 ToO**
 - 360 ks observation of Crab
- **LAT Calibrations**
 - ~6 hours
 - Implemented changes in FSW that will greatly reduce the time needed to take calibration data.
- **Anomalies/engineering**
 - none

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**
 - **Plans for updated instrument response functions (improved description of PSF and effective area)**
 - **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.**

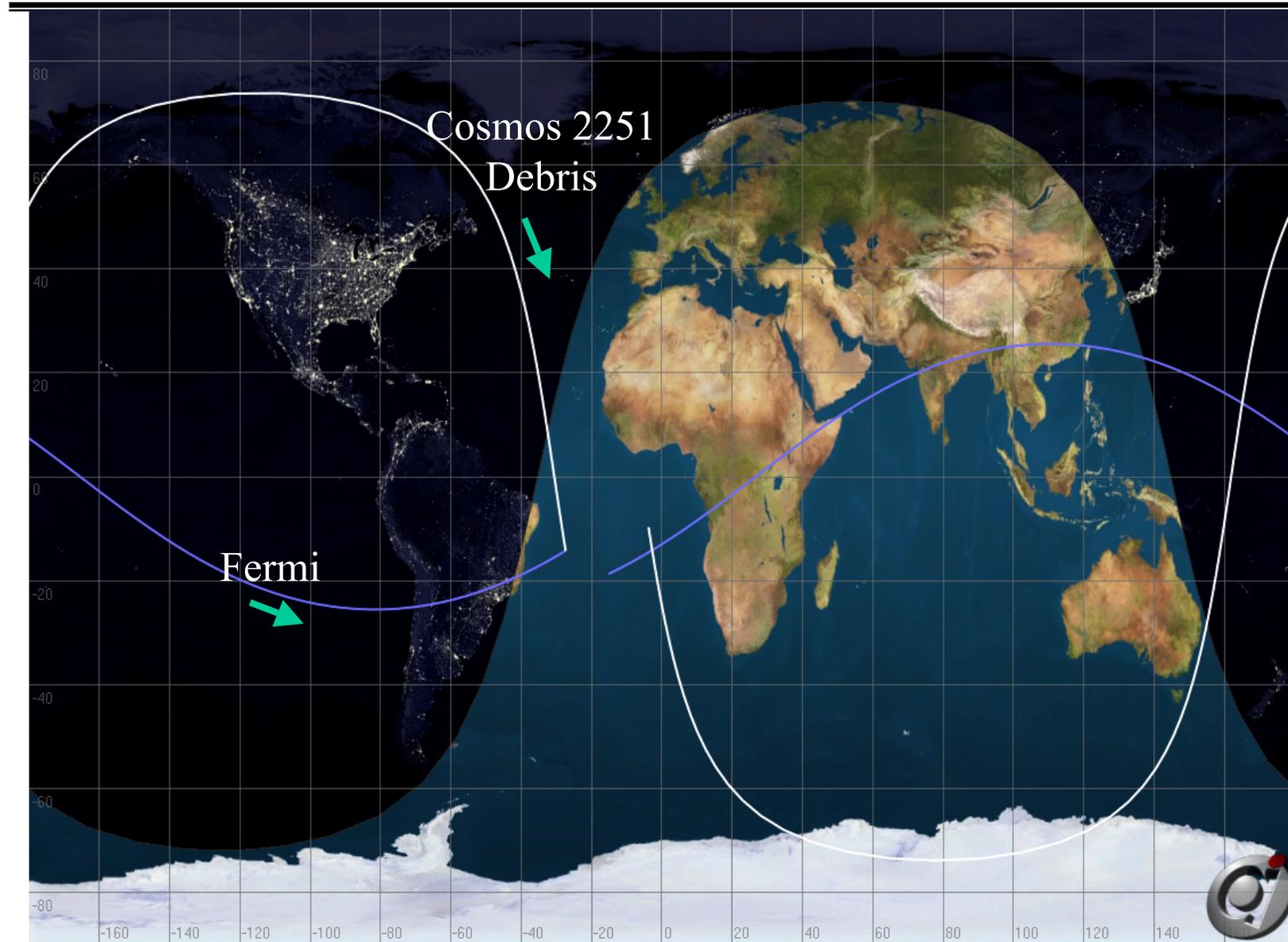
LAT “burst mode” data

- **LAT team is currently developing GRB analysis methods that use loose event selections.**
 - 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) available to the user community.**

Upcoming Activities

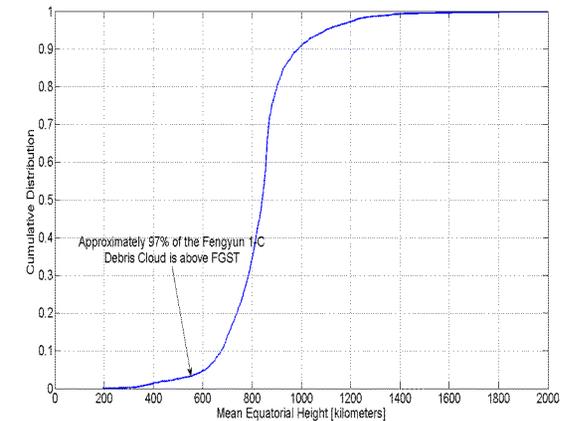
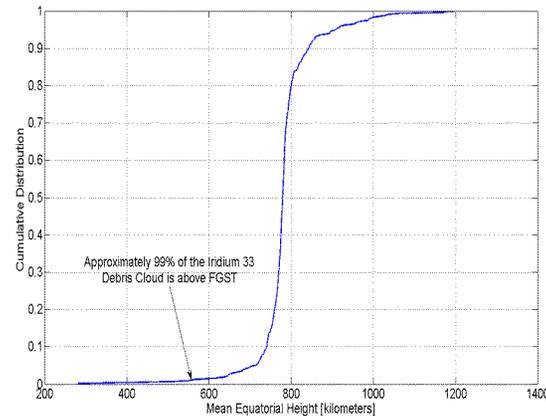
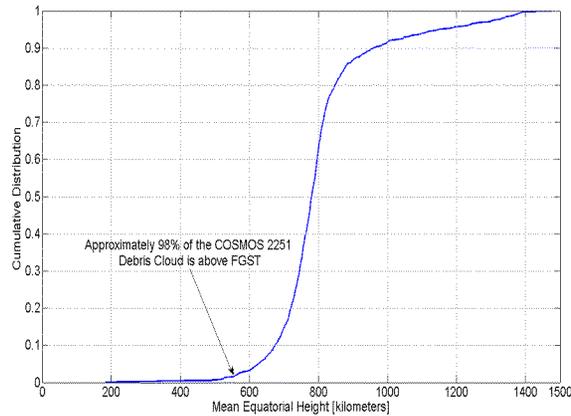
- **Observatory**
 - **Reduce ARR duration to from 5 to 2.5 hours.**
 - **Better match to the GeV afterglow durations observed by LAT**
 - **Fewer missed data contacts = reduced latency to get science data containing the burst = faster dissemination of LAT burst locations.**

Conjunction Assessment



Conjunction Assessment

- Local Debris Environment Characterization



- ~20% of our current events are from 3 new debris clouds, >97% of the debris still lies above us and will move to lower altitudes in the next few years
- Make an estimate of the evolution of 3 large debris clouds: Fengyun 1-C, Iridium 33 and COSMOS 2251.
- Use this to come up with an estimate of the likelihood of needing to do a maneuver over the Fermi mission lifetime

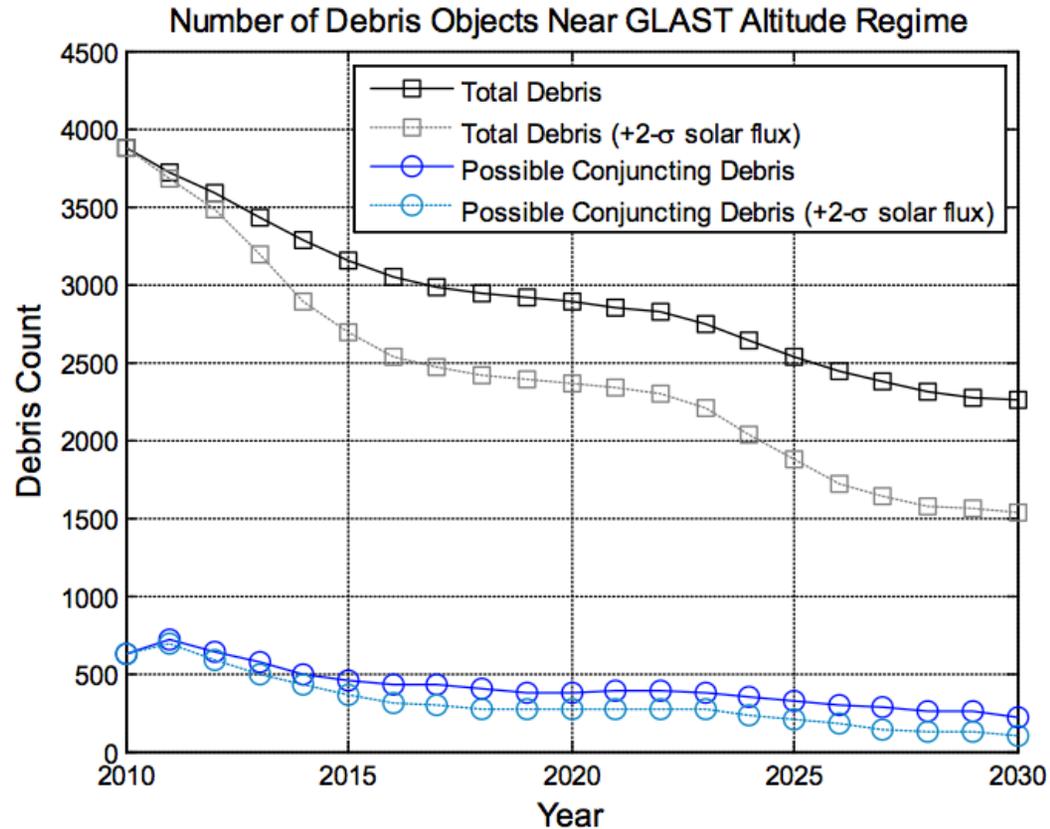
Modeling propagation of debris fields

- **High fidelity force modeling that includes the Earth geopotential, luni-solar gravity, and atmospheric drag**

| Parameter | Modeling |
|--------------------------------|--------------------------------------|
| Earth Geopotential model | 4x4 Joint Gravity Model (JGM)-2 |
| Non-Central Bodies | Sun, Moon (JPL DE200 Ephemeris File) |
| Atmospheric Density Model | Iacchia Roberts |
| Solar Radiation Pressure model | Thin plate model |

- **Output is the evolution of orbit inclination and altitude (apogee and perigee) of >3800 components of the 3 debris fields.**

The bottom line



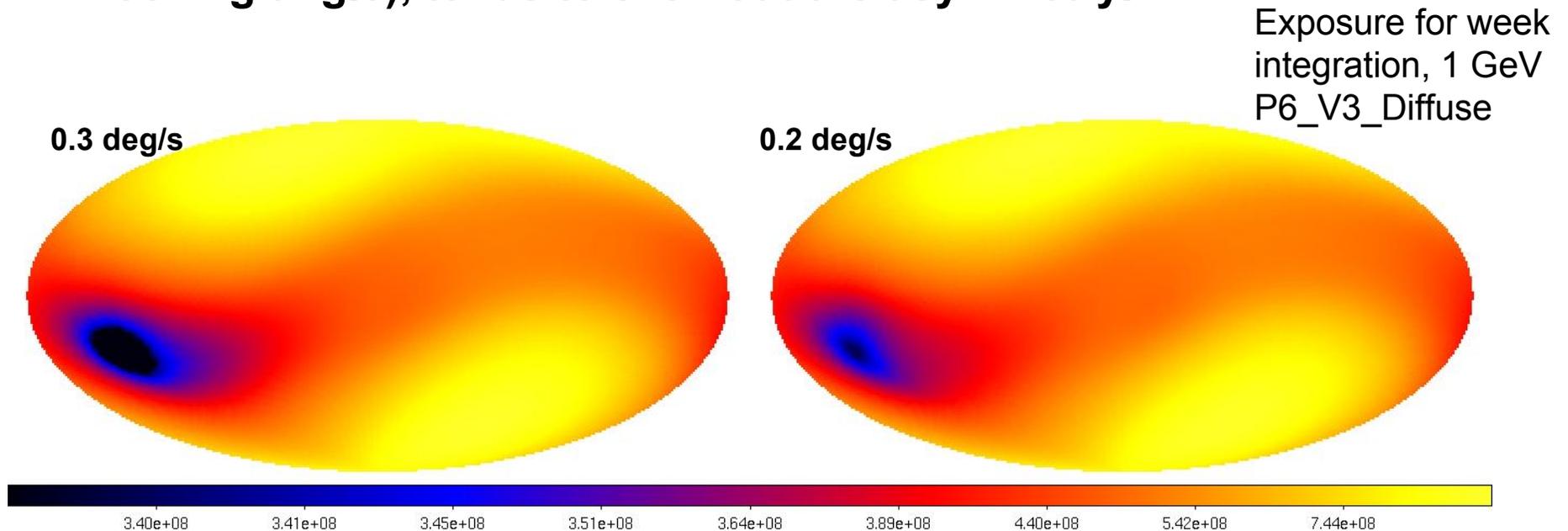
- The rate of close approaches is predicted to be stable/mild decrease through the mission life.
 - Likelihood of a collision avoidance maneuver will not increase.

Reaction Wheels

- **Continuing to monitor RWA performance closely.**
 - **Received a report from the manufacturer listing the risk factors associated with the onboard failures experienced by several missions.**
 - **Failure of RWA on DAWN has spurred renewed studies.**
 - **The main factor that we can control is peak wheel speed.**
 - **Sun avoidance/Yaw maneuvers**
 - **Rocking during survey mode**
 - **Looking at small modification to shape of survey profile to reduce the peak wheel speeds during initial acceleration.**
 - » **Reduced acceleration during onset of slew**
 - » **Reduced peak slew speed during rocking maneuver from 0.3 to 0.2 deg/s**

50 deg survey profile

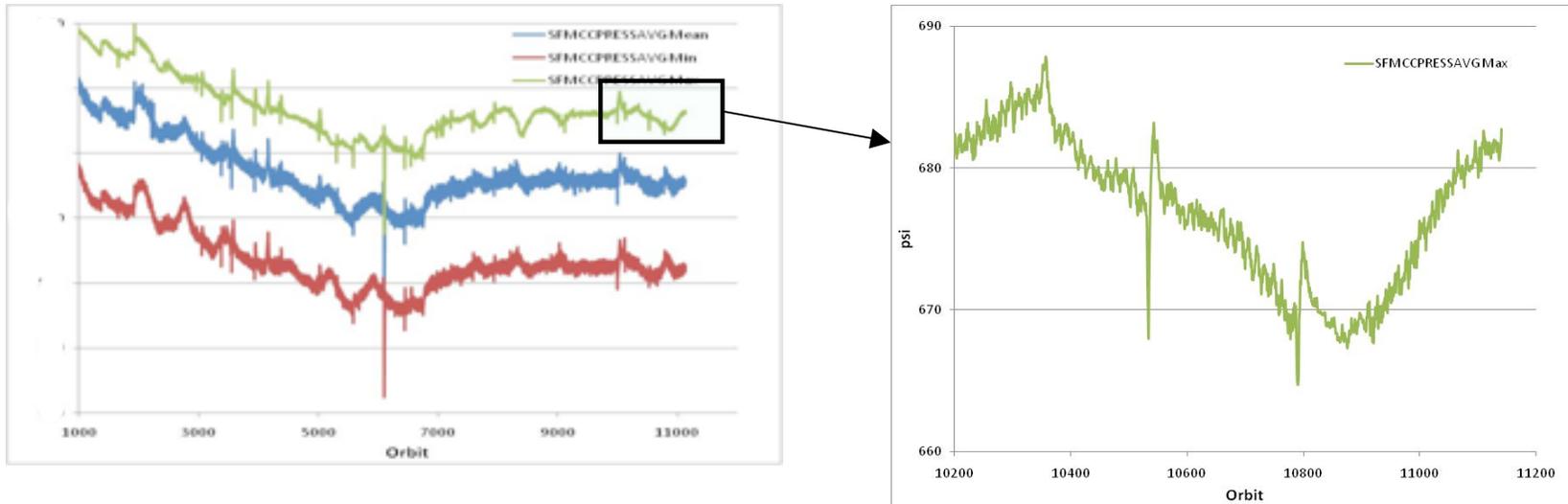
- Exposure asymmetry is dominated by the over exposure of the orbit poles.
- Reducing the slew speed (and thus spending less time at 50 deg rocking angle), tends to even out the asymmetry.



Exposure uniformity for 50 deg survey profile is slightly better for the 0.2 deg/s case. **So even though our motivation for the change was to reduce peak wheel speeds, it is also a better science profile.**

Battery Status

Pressure



- **Transitioned to 45 deg rocking profile on April 29 to explore stability at a slightly more scientifically beneficial survey profile.**
- **Transitioned back to 50 deg on May 27.**
- **The battery performance is optimal at 50 deg rocking angle.**

High Energy Activity from the Crab

AGILE detection of enhanced gamma-ray emission from the Crab Nebula region

ATel #2855; [M. Tavani \(INAF/IASF Roma\)](#), [E. Striani \(Univ. Tor Vergata\)](#), [A. Bulgarelli \(INAF/IASF Bologna\)](#), [F. Gianotti, M. Trifoglio \(INAF/IASF Bologna\)](#), [C. Pittori, F. Verrecchia \(ASDC\)](#), [A. Argan, A. Trois, G. De Paris, V. Vittorini, F. D'Ammando, S. Sabatini, G. Piano, E. Costa, I. Donnarumma, M. Feroci, L. Pacciani, E. Del Monte, F. Lazzarotto, P. Soffitta, Y. Evangelista, I. Lapshov \(INAF-IASF-Rm\)](#), [A. Chen, A. Giuliani \(INAF-IASF-Milano\)](#), [M. Marisaldi, G. Di Cocco, C. Labanti, F. Fuschino, M. Galli \(INAF/IASF Bologna\)](#), [P. Caraveo, S. Mereghetti, F. Perotti \(INAF/IASF Milano\)](#), [G. Pucella, M. Rapisarda \(ENEA-Roma\)](#), [S. Vercellone \(IASF-Pa\)](#), [A. Pellizzoni, M. Pilia \(INAF/OA-Cagliari\)](#), [G. Barbiellini, F. Longo \(INFN Trieste\)](#), [P. Picozza, A. Morselli \(INFN and Univ. Tor Vergata\)](#), [M. Prest \(Universita' dell'Insubria\)](#), [P. Lipari, D. Zanello \(INFN Roma-1\)](#), [P.W. Cattaneo, A. Rappoldi \(INFN Pavia\)](#), [P. Giommi, P. Santolamazza, F. Lucarelli, S. Colafrancesco \(ASDC\)](#), [L. Salotti \(ASI\)](#)

on 22 Sep 2010; 14:45 UT

Distributed as an Instant Email Notice (Transients)

Password Certification: Marco Tavani (tavani@iasf-roma.inaf.it)

Subjects: Pulsars

Referred to by ATel #: [2856](#), [2858](#), [2861](#), [2866](#), [2867](#), [2868](#), [2872](#)

AGILE is detecting an increased gamma-ray flux from a source positionally consistent with the Crab Nebula.

Integrating during the period 2010-09-19 00:10 UT to 2010-09-21 00:10 UT the AGILE-GRID detected enhanced gamma-ray emission above 100 MeV from a source at Galactic coordinates (l,b) = (184.6, -6.0) +/- 0.4 (stat.) +/- 0.1 (syst.) deg, and flux $F > 500$ e-8 ph/cm²/sec above 100 MeV, corresponding to an excess with significance above 4.4 sigma with respect to the average flux from the Crab nebula ($F = (220 +/- 15)e-8$ ph/cm²/sec, Pittori et al., 2009, A&A, 506, 1563).

We strongly encourage multifrequency observations of the Crab Nebula region.

INTEGRAL (Atel # 2856), Swift (Atel # 2858, 2866), or RXTE (Atel # 2872) or NIR (Atel #2867). No evidence for active AGN near Crab (Swift, Atel # 2868).

Fermi LAT confirmation of enhanced gamma-ray emission from the Crab Nebula region

ATel #2861; [R. Buehler \(SLAC/KIPAC\)](#), [F. D'Ammando \(INAF-IASF Palermo\)](#), [E. Hays \(NASA/GSFC\) on behalf of the Fermi Large Area Telescope Collaboration](#)

on 23 Sep 2010; 17:34 UT

Distributed as an Instant Email Notice (Transients)

Password Certification: Rolf Buehler (buehler@slac.stanford.edu)

Subjects: >GeV, Pulsars

Referred to by ATel #: [2866](#), [2867](#), [2868](#), [2872](#)

Following the detection by AGILE of increasing gamma-ray activity from a source positionally consistent with the Crab Nebula occurred from September 19 to 21 (ATel #[2855](#)), we report on the analysis of the >100 MeV emission from this region with the Large Area Telescope (LAT), one of the two instruments on the Fermi Gamma-ray Space Telescope.

Preliminary LAT analysis indicates that the gamma-ray emission ($E > 100$ MeV) observed during this time period at the location of the Crab Nebula is $(606 +/- 43) \times 10^{-8}$ ph/cm²/sec, corresponding to an excess with significance >9 sigma with respect to the average flux from the Crab nebula of $(286 +/- 2) \times 10^{-8}$ ph/cm²/sec, estimated over all the Fermi operation period (only statistical errors are given). Ongoing Fermi observations indicate that the flare is continuing.

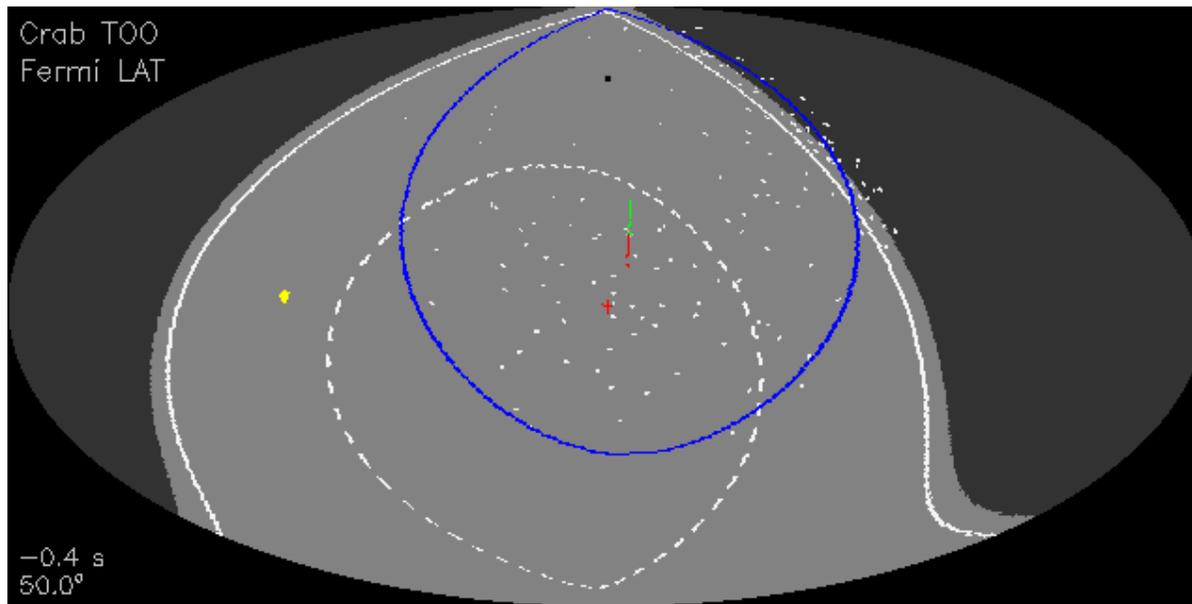
The flaring component has a spectral index of $2.49 +/- 0.14$. Its position, Ra: 83.59 Dec: 22.05 with a 68% error radius of 0.06 deg, is coincident with the Crab Nebula.

Fermi will interrupt its all-sky scanning mode between 2010-09-23 15:49:00 UT and 2010-09-30 15:49:00 UT to observe the Crab Nebula. Afterwards regular gamma-ray monitoring of this source will continue. We strongly encourage further multifrequency observations of that region.

For this source the Fermi LAT contact person is Rolf Buehler (buehler@stanford.edu).

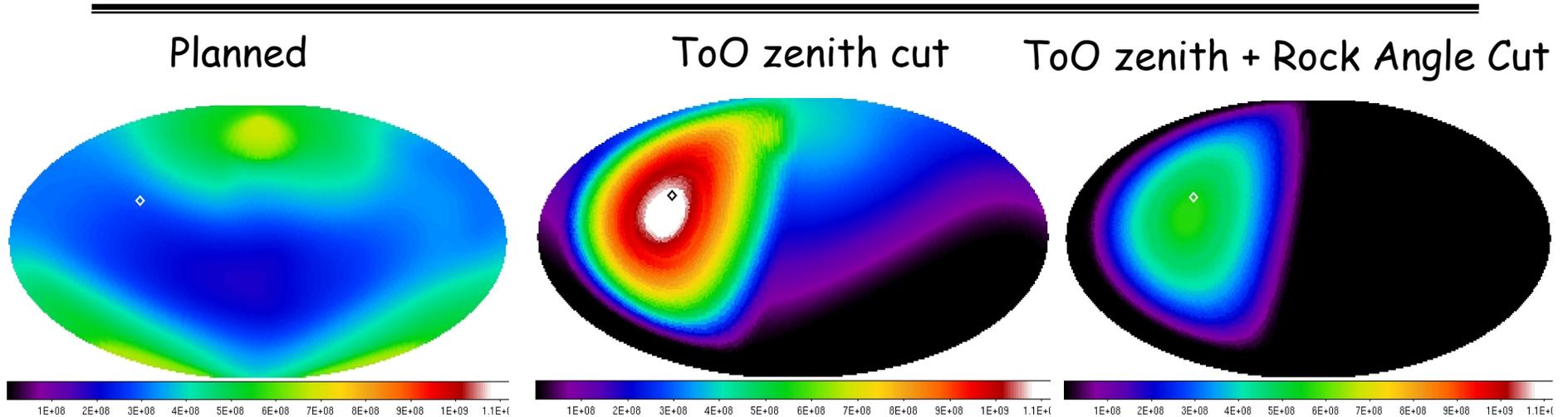
The Fermi LAT is a pair conversion telescope designed to cover the energy band from 20 MeV to greater than 300 GeV. It is the product of an international collaboration between NASA and DOE in the U.S. and many scientific institutions across France, Italy, Japan and Sweden.

Crab ToO Begins



Transient class photons shown. Note LAT field of view (blue) and Earth Avoidance Angle (solid white). Occulted sky is dark grey. Frames are 15 sec.

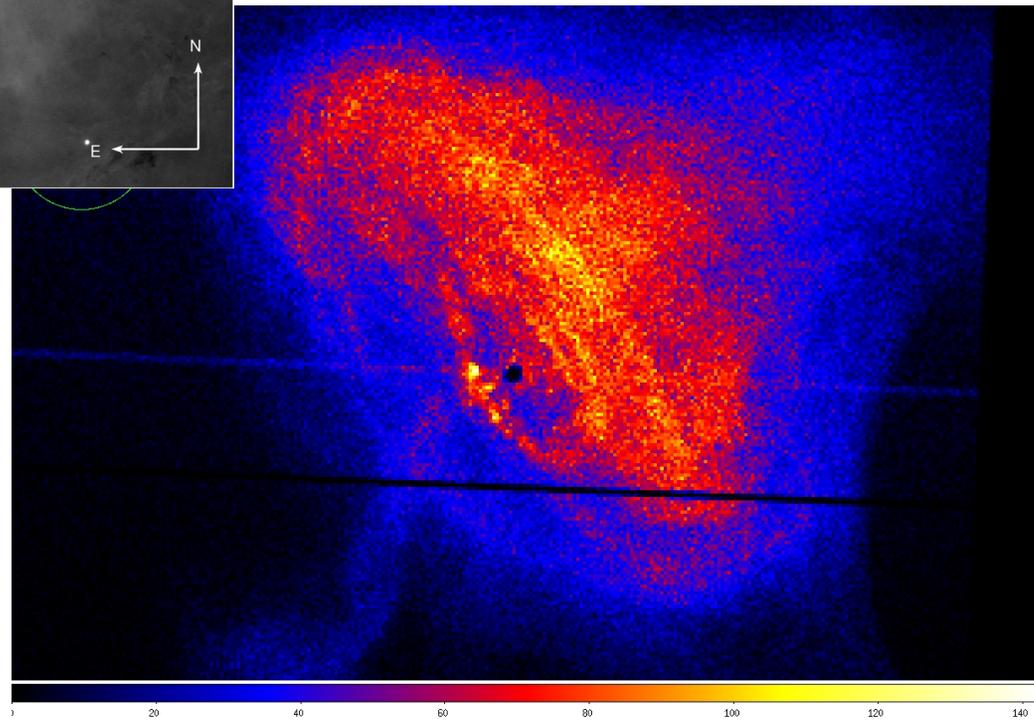
Crab ToO Exposure



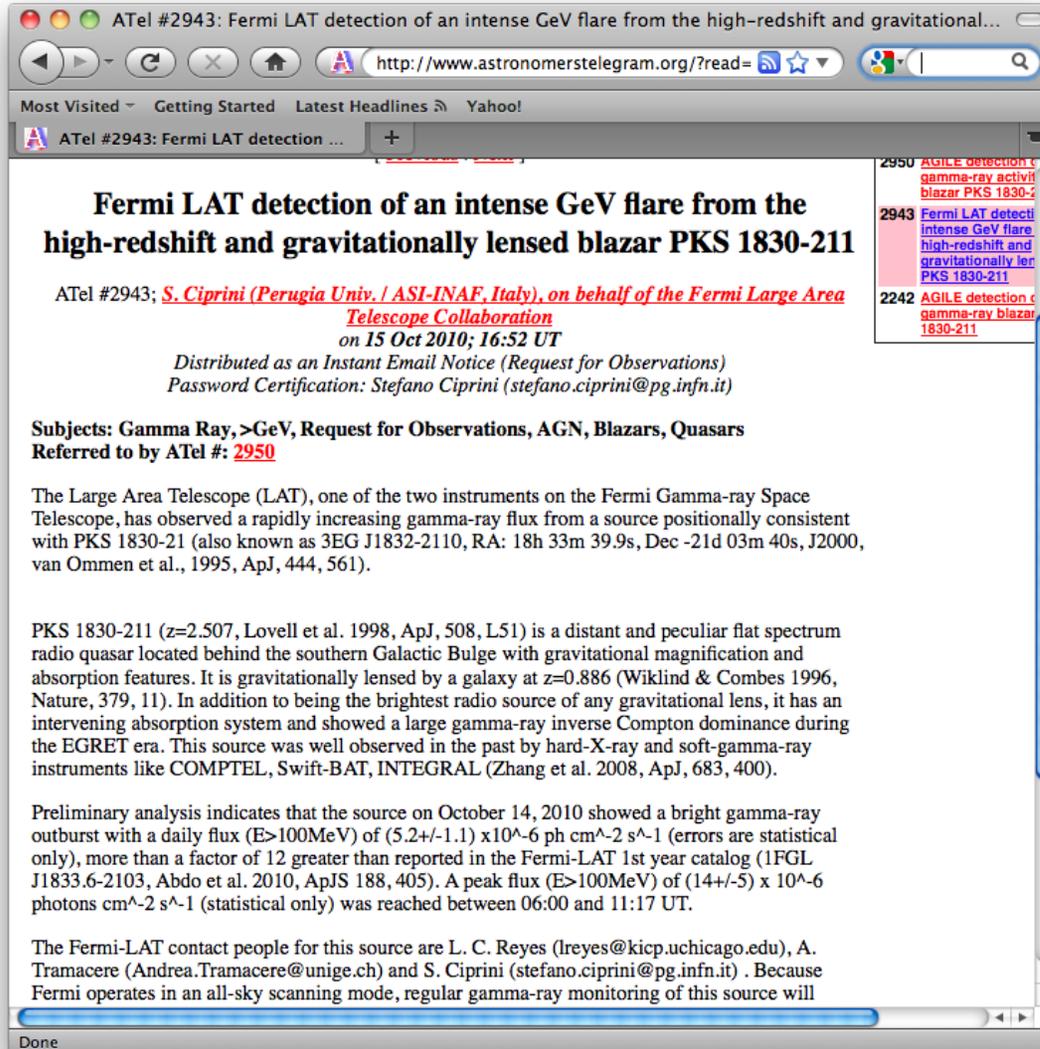
Exposure ($\text{cm}^2 \text{ s}$) in celestial coordinates for the planned timeline and the timeline as executed for the 360 ks ToO

- Target location offset 10 deg. towards the orbit equator
- Planned exposure did not favor direction of Crab
- ToO provided estimated 3.9x exposure for regional zenith exclusion (2.2x if rocking angle cut of 52 deg is also applied)
- A substantial fraction of the sky received no exposure during the ToO
- Ended early
 - Operational complications
 - Crab nebula stopped flaring in gamma-rays

Multiwavelength Observations



PKS 1830-21 Flare!



ATel #2943: Fermi LAT detection of an intense GeV flare from the high-redshift and gravitationally lensed blazar PKS 1830-211

ATel #2943; [S. Ciprini \(Perugia Univ. / ASI-INAF, Italy\)](#), on behalf of the [Fermi Large Area Telescope Collaboration](#)
on 15 Oct 2010; 16:52 UT
Distributed as an Instant Email Notice (Request for Observations)
Password Certification: Stefano Ciprini (stefano.ciprini@pg.infn.it)

Subjects: Gamma Ray, >GeV, Request for Observations, AGN, Blazars, Quasars
Referred to by ATel #: [2950](#)

The Large Area Telescope (LAT), one of the two instruments on the Fermi Gamma-ray Space Telescope, has observed a rapidly increasing gamma-ray flux from a source positionally consistent with PKS 1830-21 (also known as 3EG J1832-2110, RA: 18h 33m 39.9s, Dec -21d 03m 40s, J2000, van Ommen et al., 1995, ApJ, 444, 561).

PKS 1830-211 ($z=2.507$, Lovell et al. 1998, ApJ, 508, L51) is a distant and peculiar flat spectrum radio quasar located behind the southern Galactic Bulge with gravitational magnification and absorption features. It is gravitationally lensed by a galaxy at $z=0.886$ (Wiklind & Combes 1996, Nature, 379, 11). In addition to being the brightest radio source of any gravitational lens, it has an intervening absorption system and showed a large gamma-ray inverse Compton dominance during the EGRET era. This source was well observed in the past by hard-X-ray and soft-gamma-ray instruments like COMPTEL, Swift-BAT, INTEGRAL (Zhang et al. 2008, ApJ, 683, 400).

Preliminary analysis indicates that the source on October 14, 2010 showed a bright gamma-ray outburst with a daily flux ($E>100\text{MeV}$) of $(5.2\pm 1.1) \times 10^{-6} \text{ ph cm}^{-2} \text{ s}^{-1}$ (errors are statistical only), more than a factor of 12 greater than reported in the Fermi-LAT 1st year catalog (1FGL J1833.6-2103, Abdo et al. 2010, ApJS 188, 405). A peak flux ($E>100\text{MeV}$) of $(14\pm 5) \times 10^{-6} \text{ photons cm}^{-2} \text{ s}^{-1}$ (statistical only) was reached between 06:00 and 11:17 UT.

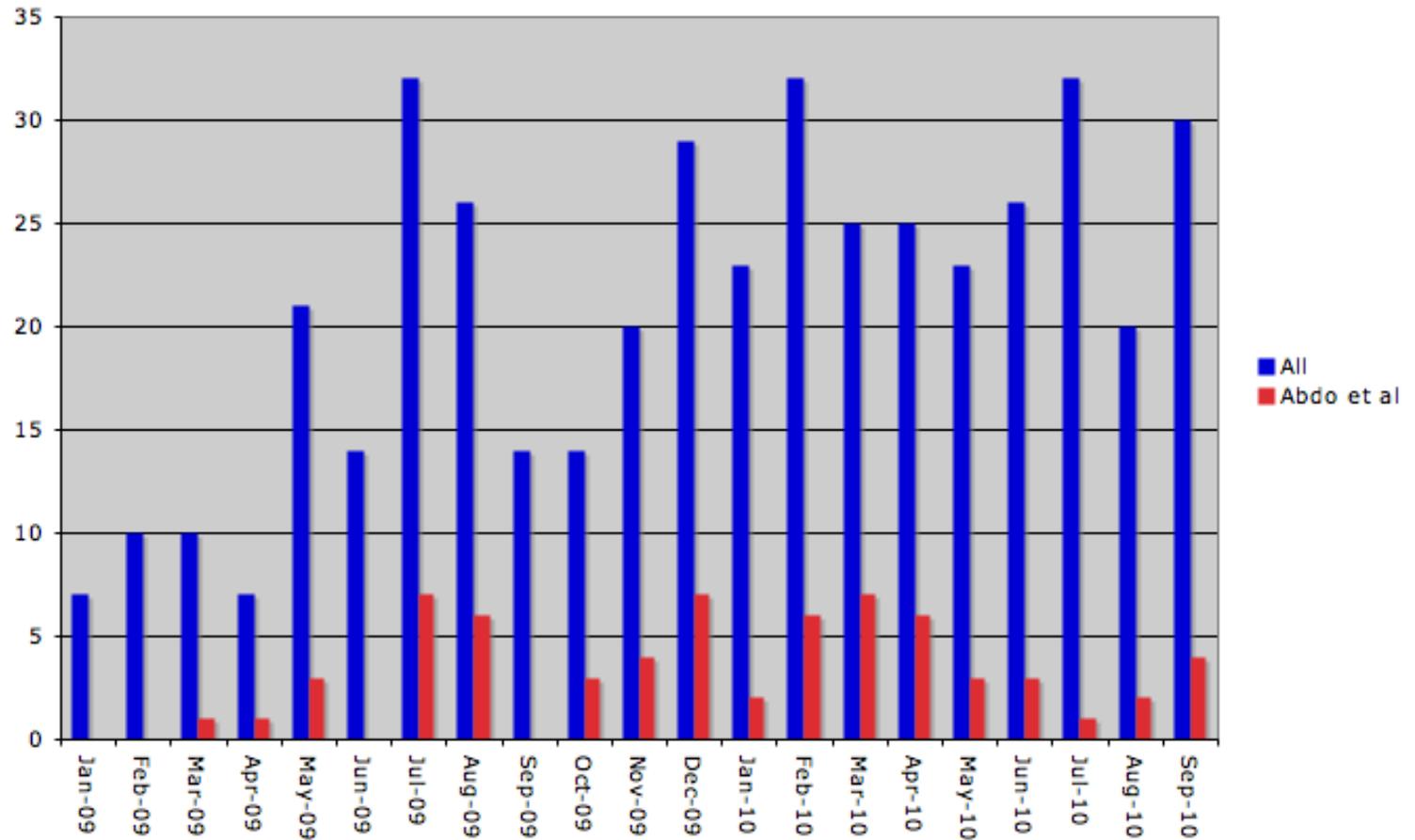
The Fermi-LAT contact people for this source are L. C. Reyes (lreyes@kicp.uchicago.edu), A. Tramacere (Andrea.Tramacere@unige.ch) and S. Ciprini (stefano.ciprini@pg.infn.it). Because Fermi operates in an all-sky scanning mode, regular gamma-ray monitoring of this source will

- A gamma-ray flare from a gravitationally lensed AGN.
- If this flare is from the NE image, then we expect a second flare from the SW image to occur 24 ± 5 days later.
- Several requests/enquiries for TOO/enhanced observations.

Science Impact

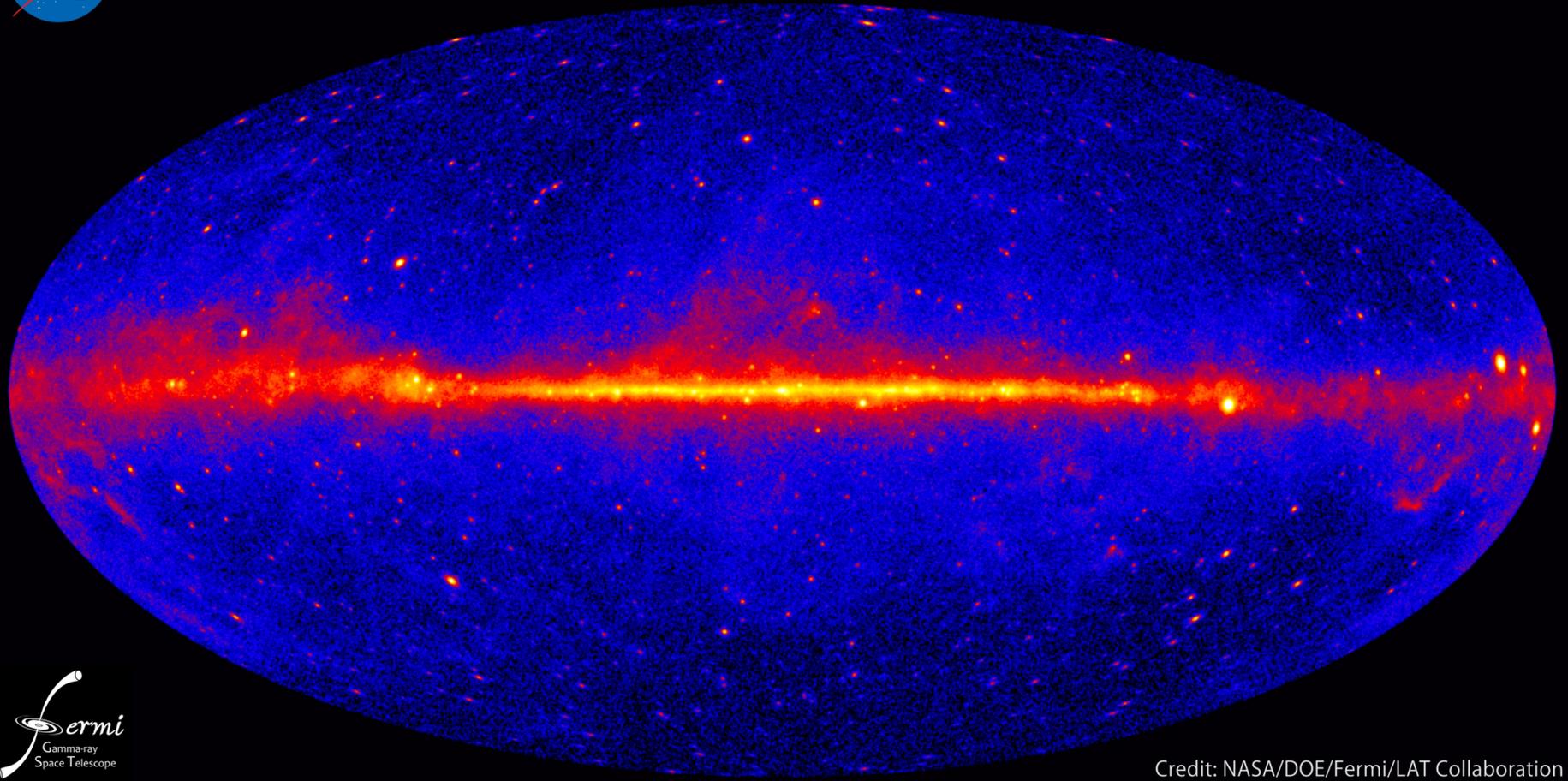
Papers
published in
refereed
journals

Fermi-related Publications



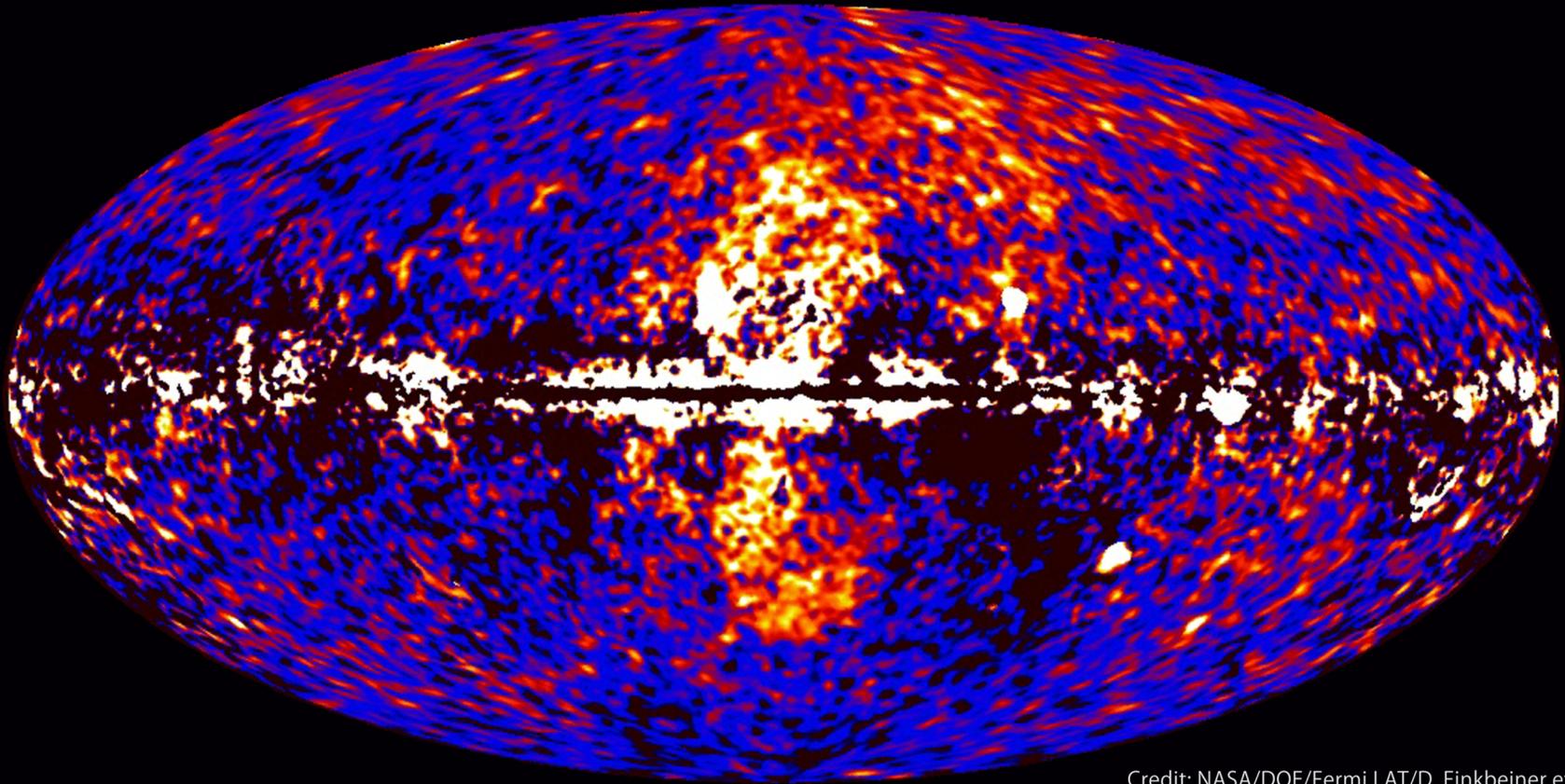


Fermi two-year all-sky map



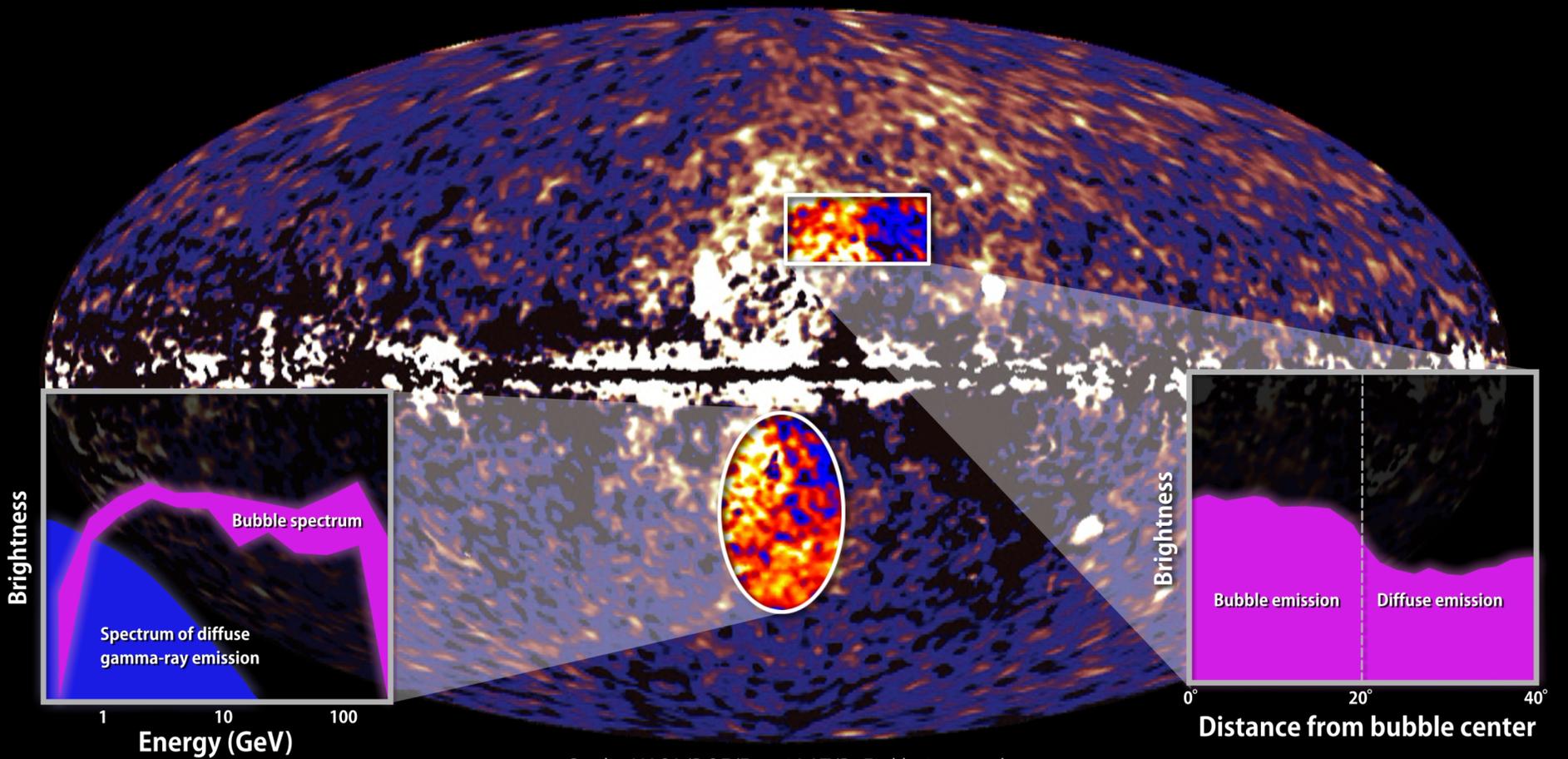
Fermi Bubbles

Fermi data reveals giant gamma-ray bubbles



Credit: NASA/DOE/Fermi LAT/D. Finkbeiner et al.

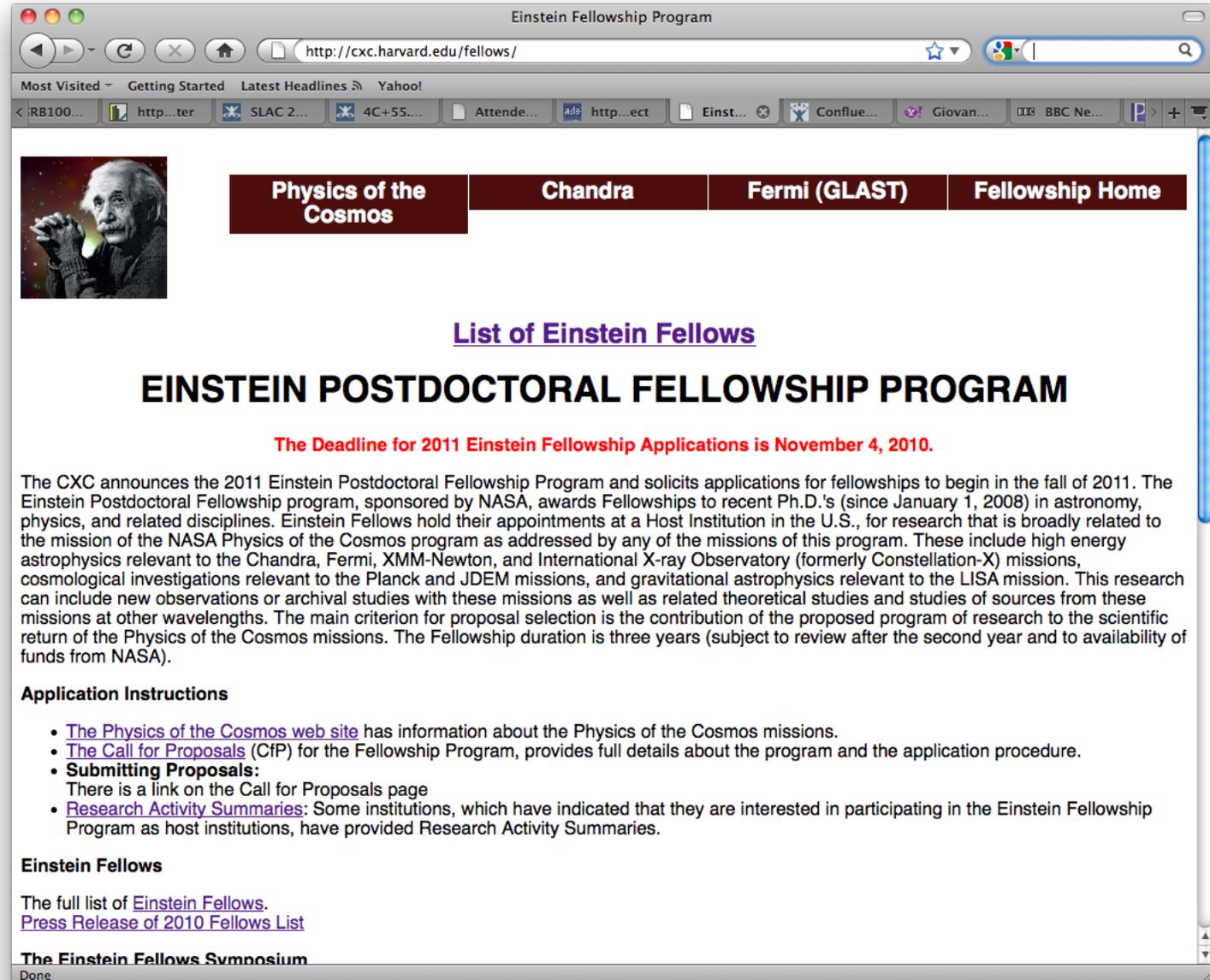
Bubbles show energetic spectrum and sharp edges



Credit: NASA/DOE/Fermi LAT/D. Finkbeiner et al.

Einstein Fellowship Program

Deadline was
Nov 4



The screenshot shows a web browser window titled "Einstein Fellowship Program" with the URL "http://cxc.harvard.edu/fellows/". The browser's address bar and tabs are visible. The website content includes a navigation menu with "Physics of the Cosmos", "Chandra", "Fermi (GLAST)", and "Fellowship Home". A portrait of Albert Einstein is on the left. The main heading is "EINSTEIN POSTDOCTORAL FELLOWSHIP PROGRAM" with a red sub-heading: "The Deadline for 2011 Einstein Fellowship Applications is November 4, 2010." The text below describes the program's goals and application process. A list of application instructions follows, including links to the Physics of the Cosmos website, the Call for Proposals (CfP), and Research Activity Summaries. The page also lists "Einstein Fellows" and "The Einstein Fellows Symposium".

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Physics of the Cosmos Chandra Fermi (GLAST) Fellowship Home

[List of Einstein Fellows](#)

EINSTEIN POSTDOCTORAL FELLOWSHIP PROGRAM

The Deadline for 2011 Einstein Fellowship Applications is November 4, 2010.

The CXC announces the 2011 Einstein Postdoctoral Fellowship Program and solicits applications for fellowships to begin in the fall of 2011. The Einstein Postdoctoral Fellowship program, sponsored by NASA, awards Fellowships to recent Ph.D.'s (since January 1, 2008) in astronomy, physics, and related disciplines. Einstein Fellows hold their appointments at a Host Institution in the U.S., for research that is broadly related to the mission of the NASA Physics of the Cosmos program as addressed by any of the missions of this program. These include high energy astrophysics relevant to the Chandra, Fermi, XMM-Newton, and International X-ray Observatory (formerly Constellation-X) missions, cosmological investigations relevant to the Planck and JDEM missions, and gravitational astrophysics relevant to the LISA mission. This research can include new observations or archival studies with these missions as well as related theoretical studies and studies of sources from these missions at other wavelengths. The main criterion for proposal selection is the contribution of the proposed program of research to the scientific return of the Physics of the Cosmos missions. The Fellowship duration is three years (subject to review after the second year and to availability of funds from NASA).

Application Instructions

- [The Physics of the Cosmos web site](#) has information about the Physics of the Cosmos missions.
- [The Call for Proposals \(CfP\)](#) for the Fellowship Program, provides full details about the program and the application procedure.
- **Submitting Proposals:**
 - There is a link on the Call for Proposals page
- [Research Activity Summaries](#): Some institutions, which have indicated that they are interested in participating in the Einstein Fellowship Program as host institutions, have provided Research Activity Summaries.

Einstein Fellows

The full list of [Einstein Fellows](#).
[Press Release of 2010 Fellows List](#)

The Einstein Fellows Symposium

3rd Fermi Symposium



III Fermi Symposium

The 2011 Fermi Symposium is dedicated to results and prospects for scientific exploration of the Universe with the Fermi Gamma-ray Space Telescope and related studies.

Topics include: blazars and other active galactic nuclei, pulsars, gamma-ray bursts, supernova remnants, diffuse gamma radiation, unidentified gamma-ray sources, and searches for dark matter. Multi-wavelength/multi-messenger contributions to these topics are welcome.

Scientific Organizing Committee

- W. Atwood (UCSC)
- N. Bahcall (Princeton)
- R. Bellazzini (INFN, Pisa)
- L. Bergstrom (Stockholm)
- R. Blandford (Stanford/MPAG)
- E. Bloom (SLAC)
- P. Caraveo (INAF-IASF, Milano)
- V. Connaughton (UA Huntsville)
- C. Dermer (NRU)
- S. Egel (SLAC)
- R. Ekers (ATNF)
- D. Fraai (NRAO)
- N. Gehrels (GSFC)
- J. Greiner (MPE)
- P. Grismm (ASDC)
- I. Grenier (Laboratoire AIM, Saclay)
- E. Hays (GSFC)
- D. Horan (LDR)
- B. James (NSMG)
- S. Johnston (ATNF)
- N. Kanit (Osaka)
- P. Michelson (Stanford)
- A. Marscher (BU)
- J. McEnery (GSFC)
- J. Ornes (Denver)
- W. Paciesas (UA Huntsville)
- S. Rahmon (NASA)
- A. Readhead (Caltech)
- S. Ritz (UCSC)
- S. Shore (Pisa)
- P. Slane (CIA)
- G. Tosti (Perugia)
- D. Thompson (GSFC)
- S. Wagner (Heidelberg)
- A. Zensus (MPIFR)

Local Organizing Committee

- R. Bellazzini, INFN
- A. Capone, INFN & Univ. of Roma La Sapienza
- P. Caraveo, INAF
- F. Cerretani, ASI
- S. Ciprini, Univ. of Perugia
- S. Collini, ASSIC
- M. Ercoli, ASI
- D. Gasparini, ASDC
- L. Latronico, INFN
- A. Morsetti, INFN Roma Tor Vergata
- G. Spandre, INFN
- V. Vitale, INFN Roma Tor Vergata

The Symposium is being held at the Aula Magna, Università di Roma "La Sapienza" Piazzale Aldo Moro, Roma

ROMA
9-12 May, 2011

Contacts
E-mail: symposium2011@milkyway.gsfc.nasa.gov

<http://fermi.gsfc.nasa.gov/science/symposium/2011/>

May 9-12, 2011 in Rome, Italy.

Budgets and finances

- **Continuing resolution (so don't yet have all our FY2011 funding)**
 - **Not yet funded all cycle 3 grants**
- **No cost extensions**
 - **We automatically approve the first no cost extension, but generally decline the second one.**
- **Starting to look at how to adjust budgets for the extended phase of the mission.**



Questions?

Fermi Summer School

- **Long format: 2 weeks**
 - **May 31 - June 10, 2010**
- **Small scale: 25-30 students**
- **University of Delaware Conference Center in Lewes, Delaware**
 - **Housing, 2/3 meals, and meeting rooms onsite**
 - **Keep cost affordable for students**
- **Cover a range of Fermi-related topics**
 - **Support from FSSC, LAT, and GBM**
 - **Small core of instructors to lead projects in key science areas throughout the school**
 - **Additional speakers giving lectures on science and analysis**

