



Future Multiwavelength Studies with the Fermi Large Area Telescope

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on behalf of the Fermi Large Area Telescope Collaboration

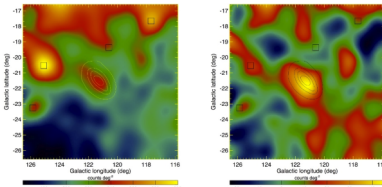


Summary: Future Fermi LAT multiwavelength studies will be able to take advantage of deeper exposures, higher energies with better resolution, faster response for flares, and longer time series.

Abstract

With two and a half years of experience, Fermi Large Area Telescope contributions to multiwavelength studies have become an integral part of many astrophysical research projects. Future efforts will benefit from (1) Deeper LAT exposures, resulting in more sources; (2) More high-energy, high-angular resolution photons, giving better source locations and imaging; (3) Faster analysis of variability and announcements to the community; and (4) Longer time series for studies of variable source properties in comparison to other wavelengths.

Deeper Exposures

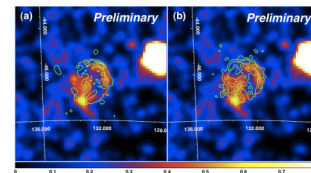


Abdo et al. A&A 523, L2 (2010)

Gaussian kernel ($\sigma = 0.5^\circ$) smoothed counts maps of the region near M31 in a local projection before (left) and after subtraction of the background model (right) for the energy range 200 MeV-20 GeV and for a pixel size of $0.05^\circ \times 0.05^\circ$. Overlaid are IRIS 100 μm contours of M31 convolved with the LAT point spread function to indicate the extent and shape of the galaxy. The boxes show the locations of the 4 point sources that have been included in the background model.

- Nearly 2 years of data were needed to detect the nearby normal galaxy M31.
- Except in the Galactic ridge, the LAT is not confusion-limited. More exposure will continue to reveal new features.
- These deeper exposures are particularly important for sources predicted by multiwavelength analysis, but not yet seen by the LAT. Examples are clusters of galaxies and dwarf galaxies.

Higher Energies – Better Spatial Resolution



Tanaka et al. 2011

Fermi LAT counts map of the region that contains SNR RX J0852.0-4622 (Vela Jr.). Events with energies above 10 GeV are selected. Left: The green contours are the X-ray image in 1.3-2.4 keV by ROSAT. The bright source located to the right of the SNR is the Vela pulsar. Right: The same counts map as the left panel but with the H.E.S.S. image (Aharonian et al. 2007) overlaid as contours.

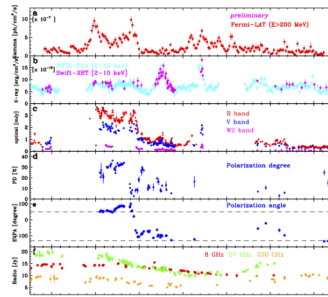
- For steady sources like supernova remnants, accumulating exposure allows the use of photons with higher energies. The LAT Point Spread Function improves with higher energies, giving better spatial resolution.
- The counts map above 10 GeV is compared with ROSAT and H.E.S.S. contours. Takaaki Tanaka will describe details of these results in a Wednesday parallel session.
- Better spatial resolution facilitates multiwavelength comparisons.

Faster Response for Multiwavelength Follow-up

- The Fermi-LAT Flare Advocates continue to improve turnaround on quicklook analysis of results.
- A recent addition is a flag for bright sources that have known TeV counterparts, facilitating quicker messages to our TeV colleagues.
- The LAT team is working with the GCN group at Goddard to implement GCN notices for LAT flares, with typical latency of a day. Automated analysis of the monitored sources would be one input; the Flare Advocate reports would be the other.
- A sample Fermi-LAT GCN notice for a blazar flare is shown below.

```
NOTICE_TYPE: Known
NOTICE_DATE: 09/08/10
NOTICE_TIME: 19:00:00
SOURCE_NAME: PKS 2326-502
SOURCE_RA: 352.3370000
SOURCE_DEC: -49.9279667
SOURCE_ERROR:
CURRENT_FLUX: 1.1e-06 +- 0.3e-06 photons/cm^2/s
BASELINE_FLUX: 8.0e-08 +- 1.1e-08 photons/cm^2/s
SIGNIFICANCE: 8.2 sigma
ENERGY_BAND: 0.1 - 300 GeV
TIMESCALE: 1day
EVENT_DATE: 07/08/10
EVENT_TIME: 12:00:00
SOURCE_LC_URL:
COMMENTS: The source is identified as 1FGL J2329.2-4954 in the first Fermi-LAT catalog (Abdo et al. 2010, ApJS, 188, 405). The Fermi LAT contact person for PKS 2326-502 is Filippo D'Ammando (dammando@frc.inaf.it).
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Longer Time Series Studies



Hayashida et al. 2011

Multiwavelength light curves of blazar 3C279 from the beginning of the Fermi mission.

- Optical, Radio, and X-ray coverage can span years. Now the Fermi-LAT coverage begins to match that sort of range, allowing detailed multiwavelength comparisons.
- As can be seen in the 3C279 light curve above, short time slices could produce completely incorrect conclusions. See the poster by Masaaki Hayashida et al. at this session for details.

The Fermi-LAT team welcomes cooperative multiwavelength and multimessenger efforts of all kinds. Please see <https://confluence.slac.stanford.edu/display/GLAMCOG> or contact David.J.Thompson@nasa.gov for information about working with the LAT team.