The Fermi Gamma-ray Space Telescope
Bright Source List

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On behalf of the
Fermi Large Area Telescope (LAT) Collaboration
The LAT Bright Source List (0FGL)

- During the early part of the Fermi mission, the Large Area Telescope (LAT) team is optimizing calibrations, analysis methods, and background subtraction techniques.
- The brightest sources seen by LAT are less influenced by these ongoing improvements than are weaker sources.
- Releasing information about the brightest sources early has two principal goals:
  1. Provide opportunities for multi-\(\lambda\) studies of these sources;
  2. Facilitate proposals for the second cycle of Fermi Guest Investigator proposals (US only), due on March 6.
- The release date for the bright source list is February 6 at http://fermi.gsfc.nasa.gov/ssc/
- This list is a first step toward the first LAT catalog, due in the Fall of this year.
Exposure map

- Data used are the first three months of all-sky scanning data, Aug. - Oct. 2008. Total live time is 7.53 Ms.
- Scanning scheme makes exposure map very uniform (SAA creates 25% North-South asymmetry).

Equivalent on-axis observing time, Galactic coordinates, Aitoff projection.
Constructing the LAT Bright Source List

- 2.8 M events above 100 MeV with current cuts
- Maximum likelihood analysis was used to determine locations, source significance, fluxes below and above 1 GeV, and variability information, all of which is included in the list.
- Only sources with confidence level greater than $10 \sigma$ over 3 months were retained for the bright source list.
- Associations with known sources are provided
- The resulting bright source list is not a catalog:
  - Not complete - many more sources at lower significance
  - Not flux limited - cut is on confidence level
  - Not uniform - sources near the Galactic plane must be brighter because of the strong diffuse background.
Sensitivity map

- Structure is mostly that of the interstellar medium
- Below $10^{-7}$ ph/cm$^2$/s outside the Galaxy ($|b| > 10^\circ$)

Flux $> 100$ MeV required to reach $10\sigma$ for average E$^{-2.2}$ spectrum

Galactic coordinates, Aitoff projection
205 LAT Bright Sources

Front > 200 MeV, Back > 400 MeV

Crosses mark source locations, in Galactic coordinates. 1/3 at |b| < 10°. Only 60 clearly associated with 3EG EGRET catalog. The sky changes!
Source localization

- Alignment slightly adjusted in flight
- Conservative error radii adjusted on known associations
- Conservative 0.04° absolute limit based on bright pulsars
The variable Fermi sky

1-day snapshots, > 100 MeV, viewed from the poles (orthographic proj). Red is significant. The Sun is clearly visible moving downwards right of the North pole.
Source variability

- Build light curves of all sources on one-week time scale
- Pulsars are stable within 3%
- Bright blazars are very clearly variable
- Variability index: $\chi^2$ criterion against constant hypothesis.

**Geminga pulsar**

**J0235+164 blazar**

Not at same scale!
Source variability 2

- Flag as variable for probability < 1%
- 1/3 sources flagged as variable
- Not very large fractional variability
Many blazars are too faint (even at > 10 \( \sigma \)) to be detected as variable even if they were.

Many fewer variable sources in the plane.
Source association

- 2/3 of the sources at $|b|>10^\circ$, mostly AGN (hear B. Lott on Wednesday)
- Not that many unassociated outside the plane
- Globular cluster 47 Tuc (plenty of ms pulsars)
Source association 2

• Most associated sources in the Galaxy are pulsars (hear F. Giordano’s talk today and D. Smith on Wednesday)
• Many unassociated sources in the inner regions of the Galaxy

Close-up on the Galactic ridge
205 Preliminary LAT Bright Sources

Conclusions

- EGRET on the Compton Observatory found only 31 sources above $10 \sigma$ in its lifetime.
- Typical 95% error radius is less than 10 arcmin. For the brightest sources, it is less than 3 arcmin. Improvements are expected.
- About 1/3 of the sources show definite evidence of variability.
- 29 pulsars are identified by gamma-ray pulsations.
- Over half the sources are associated positionally with blazars. Some of these are firmly identified as blazars by correlated multiwavelength variability.
- Over 40 sources have no obvious associations with known gamma-ray emitting types of astrophysical objects.
- Additional results on many of these sources at this meeting.
Fermi-LAT
3 months
Front > 200 MeV
Back > 400 MeV

Orthographic projection