# The Fermi Gamma-ray Space Telescope Bright Source List


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**On behalf of the**
**Fermi Large Area Telescope (LAT) Collaboration**


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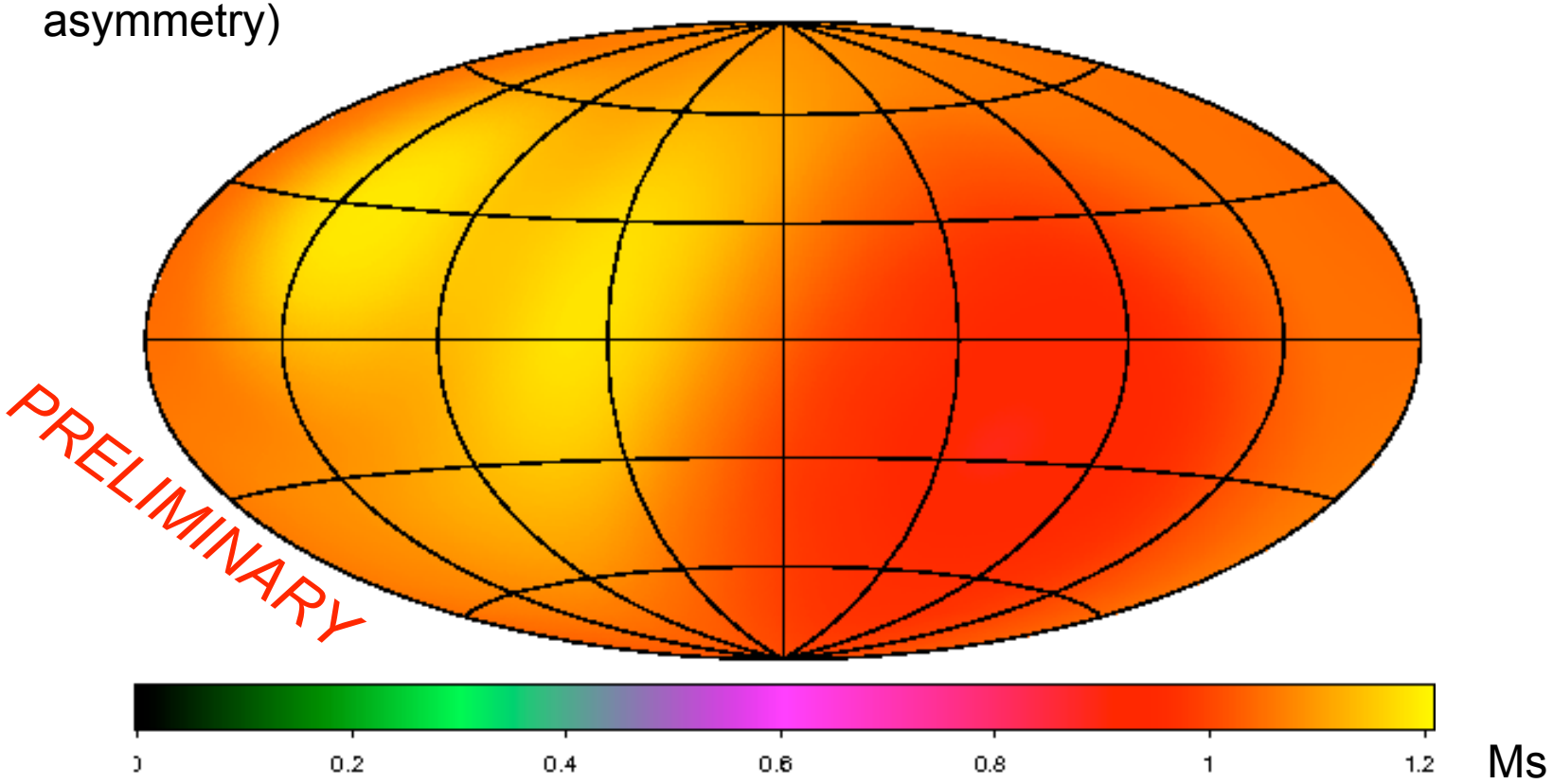
# The LAT Bright Source List

- 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 multiwavelength studies of these sources;
  2. Facilitate proposals for the second cycle of Fermi Guest Investigator proposals, due on March 6.
- 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 North-South asymmetry)




Equivalent on-axis observing time, Galactic coordinates

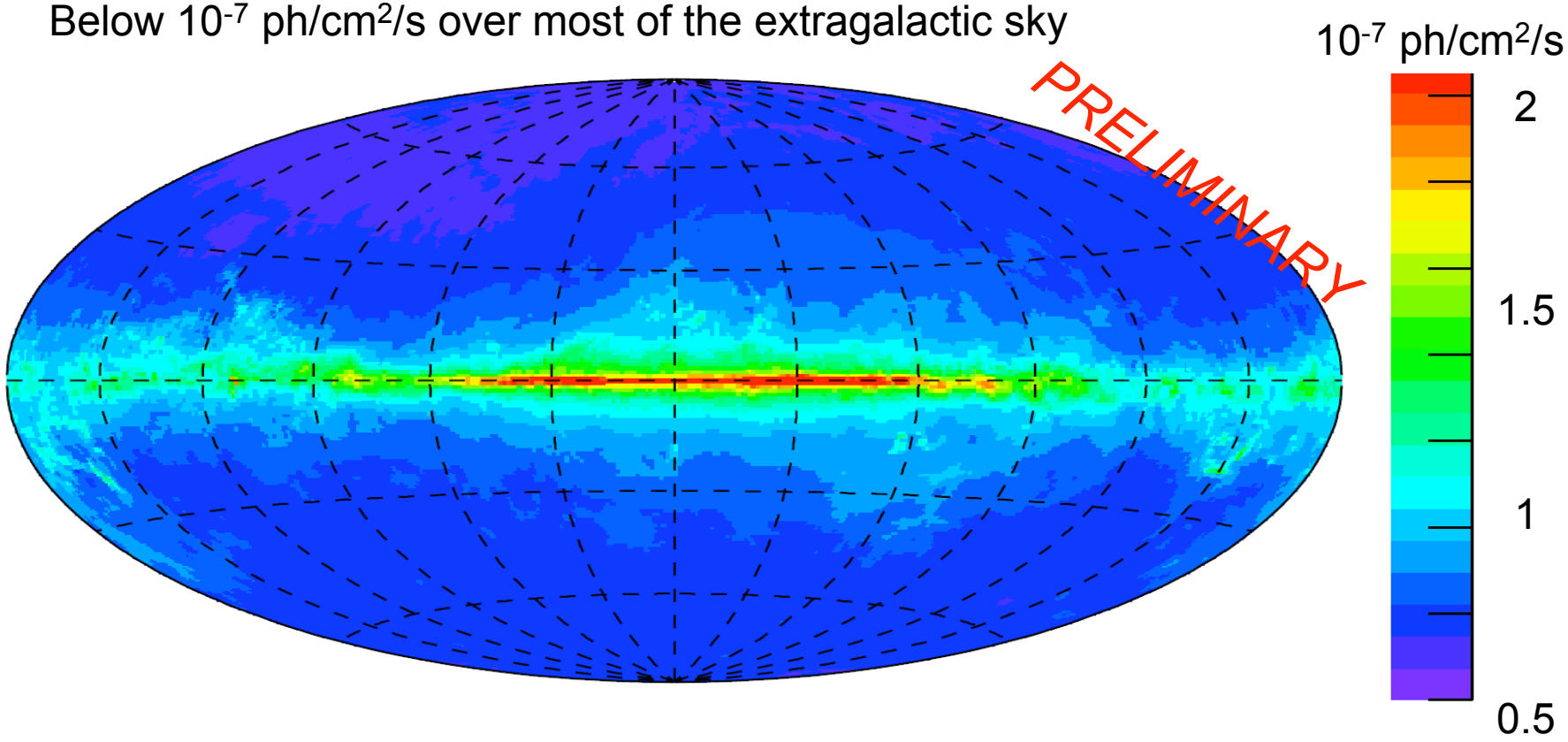
# Constructing the LAT Bright Source List

- 2.8 M events above 100 MeV with current cuts
- Maximum likelihood analysis was used to determine source significance, fluxes in two energy bands, locations, 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.

- The resulting bright source list is not a full 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.
  - No detailed energy spectral information.

# Sensitivity map

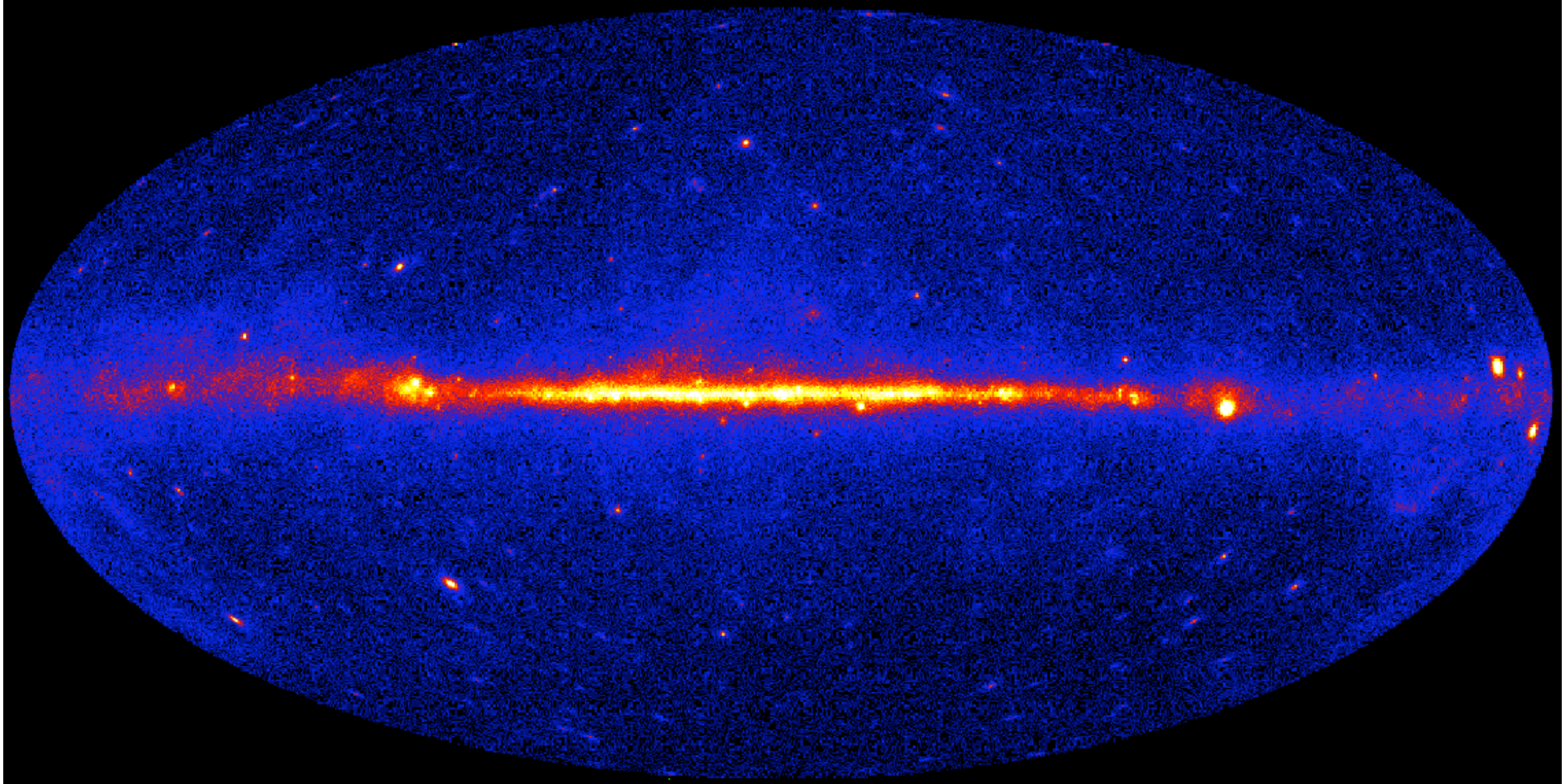
- Structure is mostly that of the interstellar medium
- Below $10^{-7}$ ph/cm$^2$/s over most of the extragalactic sky




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

# 205 LAT Bright Sources

Map above 300 MeV

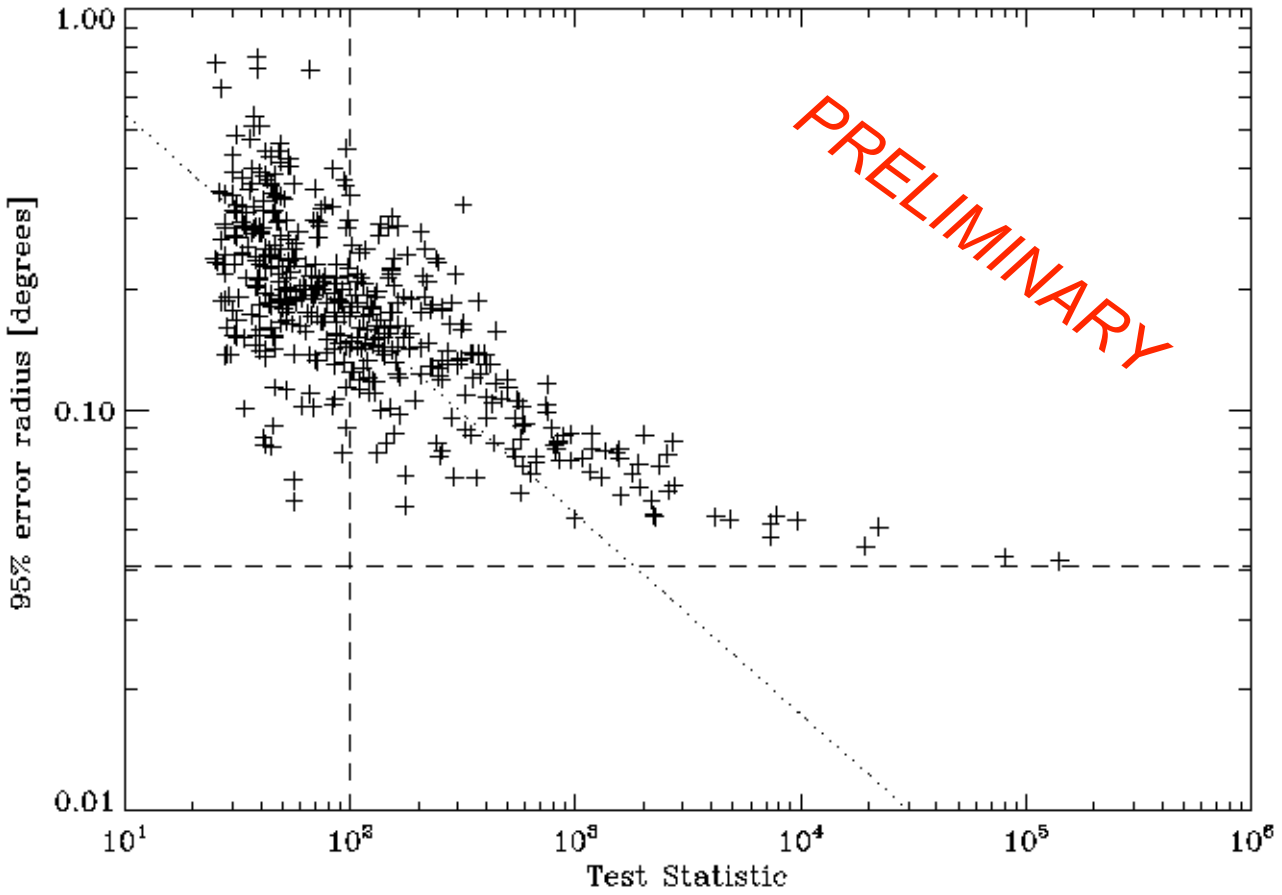


http://fermi.gsfc.nasa.gov/ssc/data/access/lat/bright_src_list/

Crosses mark source locations, in Galactic coordinates

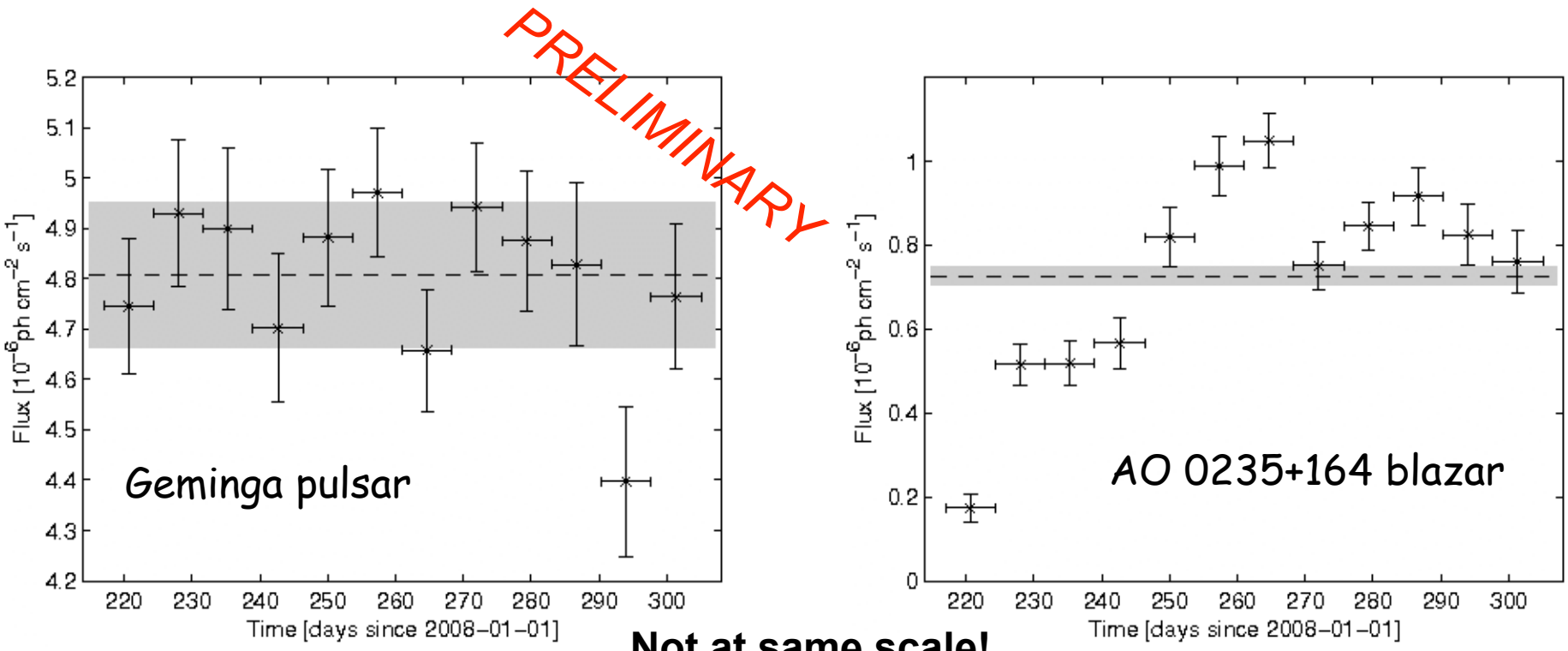
# Source localization

- Conservative error radii adjusted on known associations
- Conservative 0.04° absolute limit based on bright pulsars



# Source variability

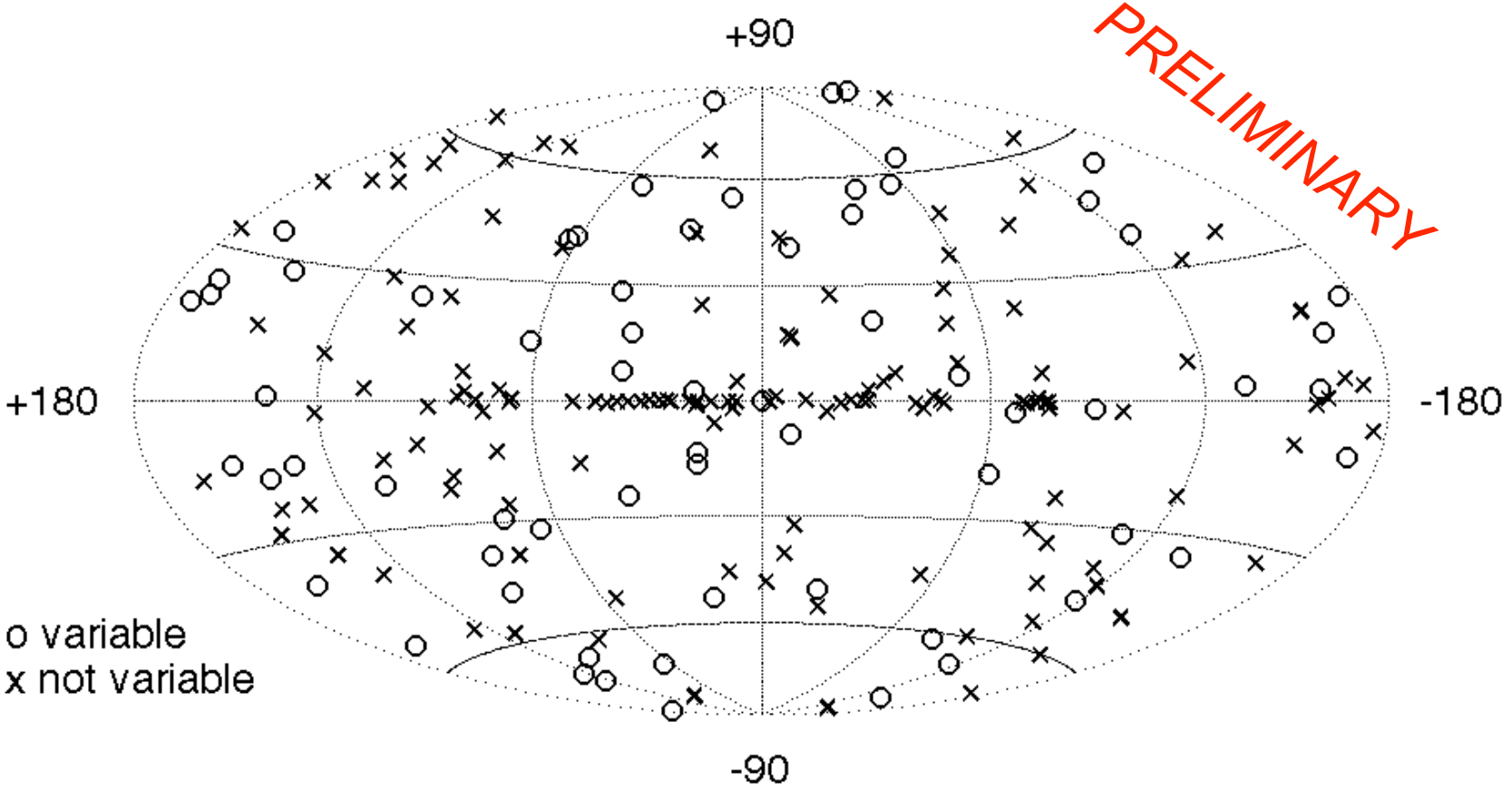
- Build light curves of all sources on one-week time scale
- Pulsars are stable within 3%
- Bright blazars are very clearly variable




**Not at same scale!**

# Source variability 2

- Many blazars are too faint (even at TS > 100) to be detected as variable even if they were
- Many fewer variable sources in the plane



# 205 LAT Bright Sources

## Census of Associations (not Identifications)

| Class | Number |
|---|---|
| Radio/X-ray pulsar | 15 |
| LAT pulsar | 14 |
| Globular cluster (pulsars?) | 1 |
| HMXB | 2 |
| LMC | 1 |
| Flat Spectrum Radio Quasars | 62 |
| Bl Lac Objects | 46 |
| Blazar, uncertain type | 11 |
| Radio galaxies | 2 |
| Special cases (under study) | 14 |
| Unassociated | 37 |

Note:

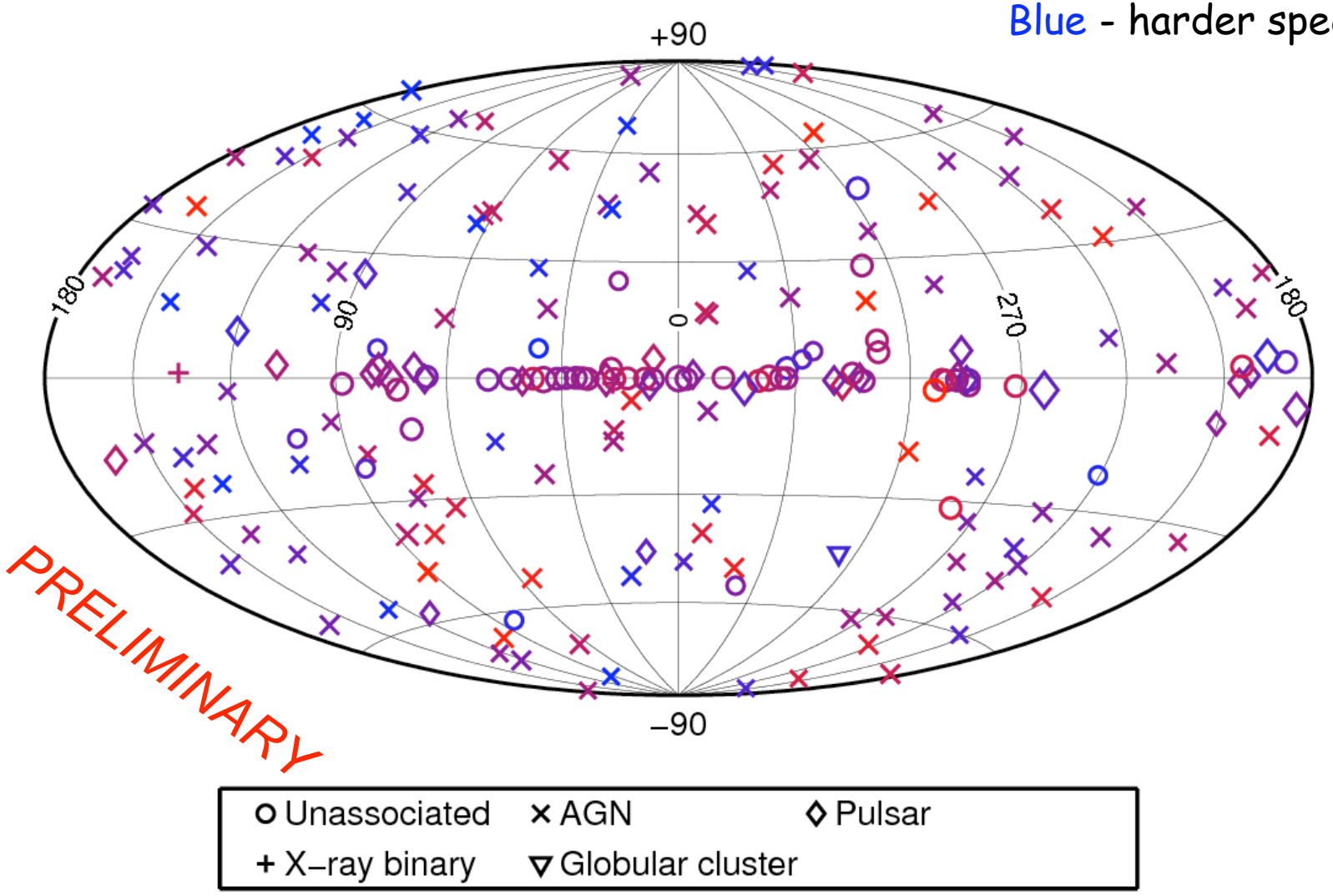
No obvious LMXB, Seyfert galaxy, starburst galaxy, or prominent cluster of galaxies associations in the Bright Source List.

# Source association

- Mostly AGN outside the Galactic plane
- Not that many unassociated outside the plane

Red - steeper spectra

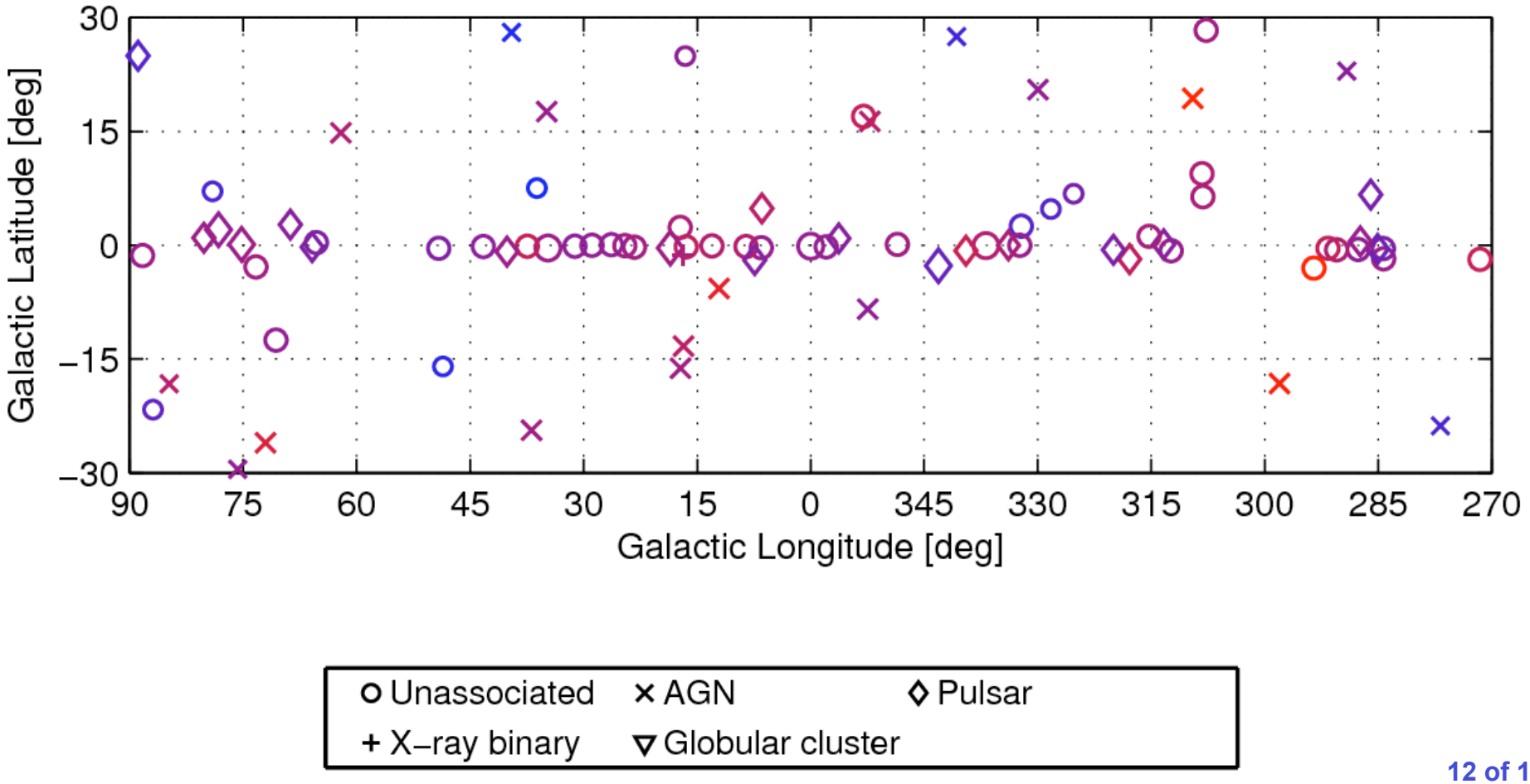
Blue - harder spectra



# Source association 2

PRELIMINARY

- Most associated sources in the Galaxy are pulsars
- Many unassociated sources in the inner regions of the Galaxy



# 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 in the list 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.
- 37 sources have no obvious associations with known gamma-ray emitting types of astrophysical objects.