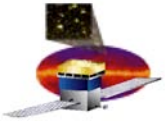


# **GLAST Large Area Telescope Multiwavelength Opportunities**

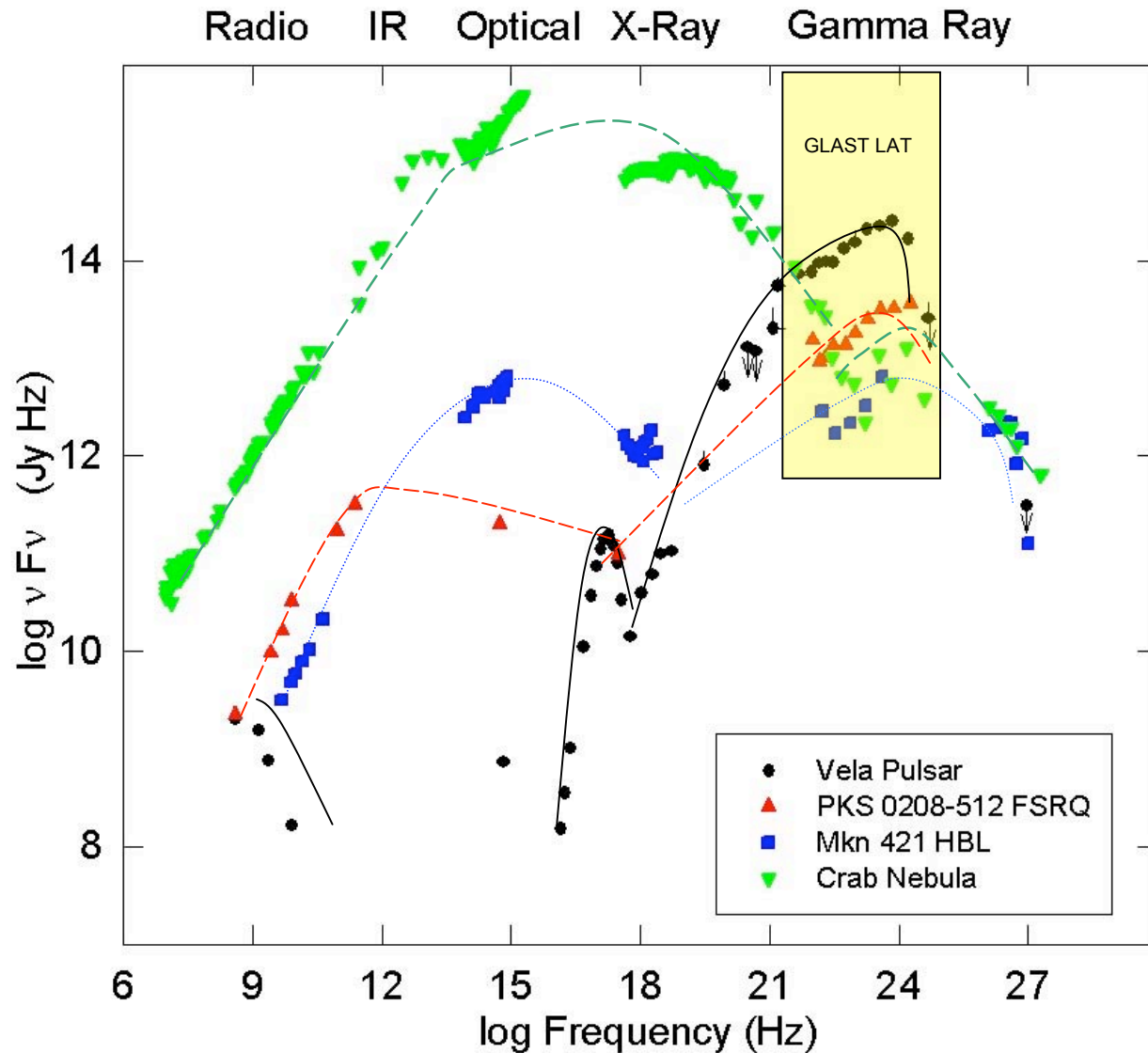
**Dave Thompson**

**GLAST Large Area Telescope  
Multiwavelength Coordinator**

- 1. Multiwavelength (MW) Value – a Reminder**
- 2. LAT Team MW Programs**
- 3. MW Opportunities for Everyone**

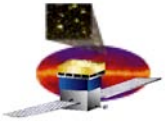


# Known Gamma-ray Sources Are Multiwavelength



Gamma-ray sources are nonthermal, typically produced by interactions of high-energy particles.

Known classes of gamma-ray sources are multiwavelength emitters, seen across much of the spectrum.

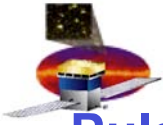


# Gamma-ray Source Identification Demands MW Efforts

**With the exception of bright pulsars (which might be detected by finding a period and period derivative), no source is likely to be identified using gamma-ray data alone.**

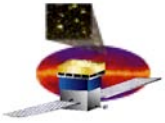
**Finding counterparts at other wavelengths provides the critical identification information:**

- **Precision source location**
- **Distance**
- **Mass and composition**
- **Overall energetics**
- **Short-term time variability (distance scale)**



# LAT Team MW Planning - **Known source classes**

- **Pulsars (Thorsett, Ransom, Johnston talks this morning)**
  - Timing programs in radio and X-ray
- **Blazars (Benoit Lott's poster)**
  - Finding new blazars - examples
    - CGraBS (Healey and Romani poster) – radio/optical
    - VIPS – radio polarization/optical followup
  - Multiwavelength monitoring – examples
    - MOJAVE (Lister poster), RATAN-600 and U. Michigan – radio
    - Global Telescope Network (GTN), Perugia, Pan-STARRS - optical
  - Multiwavelength campaigns (Fuhrmann, Kadler, Tosti – parallel session 5)
    - Target of Opportunity (TOO) - flaring sources (e.g. Foschini poster)
    - Planned Intensive Campaign (PIC) – mobilize maximum resources
- **Gamma-ray Bursts (Neil Gehrels' talk tomorrow)**
  - Swift, GCN, Interplanetary Network



# LAT Team Multiwavelength Planning for Gamma-Ray Source Identification

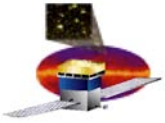
The GLAST LAT team is developing Figure of Merit approaches for statistical association of sources with possible new classes, involving many catalogs at various wavelengths, plus parameters such as spectra or variability (see poster by Lonjou and Knödlseider).

We will need some specific examples to confirm such associations and move beyond identification toward understanding the sources. Some possibilities (see also Caraveo and Reimer, parallel session 7).

**“Top-Down” approach: look for an X-ray or TeV counterpart with better source localization, then work down in energy for identification.**

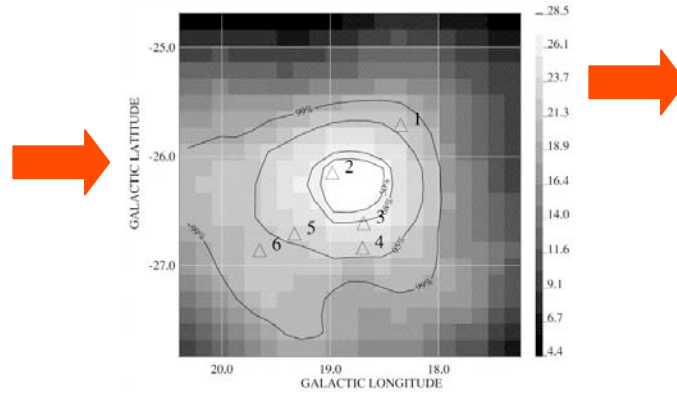
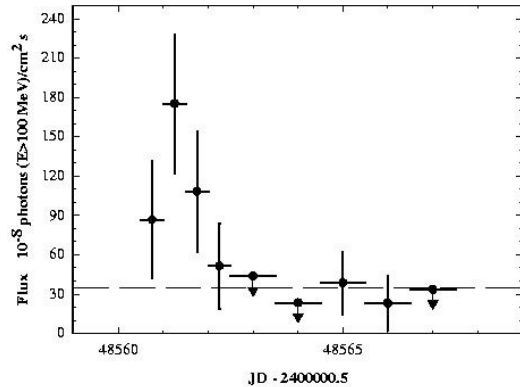
**“Bottom-Up” approach: look for a flat-spectrum radio counterpart that might be a blazar.**

**“Correlated Variability/Spectral Modeling” approach: look for consistency across the spectrum (Diego Torres’ talk yesterday).**

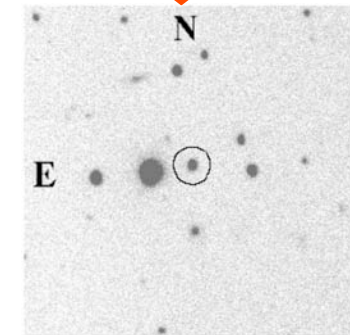


# MW Source Identification: 3EG J2006-2321

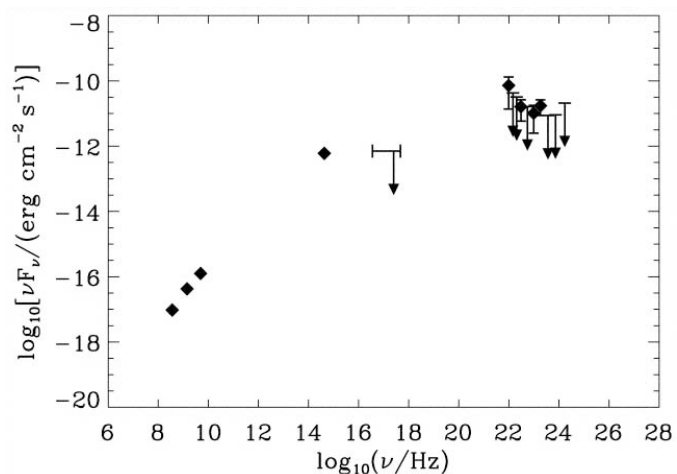
First Clue: Gamma-ray variability    Radio sources in the error box



One flat-spectrum radio source, 260 mJy at 5 GHz; one marginally-flat source, 49 mJy; other sources are much weaker



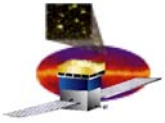
Optical observations:  
 The 49 mJy source is a normal galaxy;  
 The 260 mJy source has an optical counterpart with a redshift  $z=0.83$



Variable optical polarization is seen.  
 Only an X-ray upper limit found.

Spectral energy distribution is bimodal like other blazars  
**Conclusion: a flat spectrum radio quasar (FSRQ) – Wallace et al., 2002**

Dave Thompson



# Scientific Community Involvement

## REMINDERS:

Both GLAST instruments have huge fields of view.

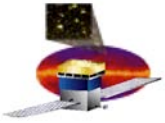
GLAST will be operated in scanning mode.

Both the GBM and the LAT will survey the entire sky about every three hours.

**Whatever your favorite source is, GLAST will observe it. Your involvement can be determined by the science, not the GLAST observing plan.**

**The burst data become public immediately.**

**The LAT data are not generally public during Phase 1, but there are exceptions (including bursts), and the LAT team is eager to cooperate with observers with correlative data.**



# Blazars with GLAST LAT - Suggestions

## Pre-Launch:

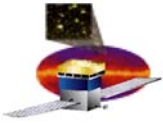
- Help identify new blazars. LAT will probably detect more blazars than are currently cataloged.
- Join the GTN or the Whole Earth Blazar Telescope (WEBT) to monitor blazars or participate in campaigns.
- Sign up for the Gamma-ray Multiwavelength e-mail list by contacting [David.J.Thompson@nasa.gov](mailto:David.J.Thompson@nasa.gov)

## During the First Year (Most LAT data not public):

- Use the public data from ~20 prominent sources (light curves and energy spectra to be posted to the Web) for observational or theoretical scientific analysis – most of these are blazars.
- Bright blazar flare data will be made public, along with the name of a LAT contact who will help coordinate MW analysis. Join us or use the data on your own. TOO proposals for other observatories can be based on these announcements.

**PROPOSE FOR GUEST INVESTIGATIONS (Band Poster, GSSC Booth)!**





# Source Identification with GLAST LAT - Suggestions

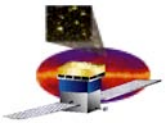
## Pre-Launch:

- Model candidate gamma-ray sources to predict which ones might be observable.
- Start learning about the LAT data system through the GLAST Science Support Center (Horner poster)
- Sign up for the Gamma-ray Multiwavelength e-mail list by contacting [David.J.Thompson@nasa.gov](mailto:David.J.Thompson@nasa.gov)

## During the First Year (most LAT data not public):

- Bright flare data from unidentified sources will be made public, along with the name of a LAT contact who will help coordinate MW analysis. Join us or use the data on your own.
- A preliminary list of high-confidence source detections will be released in the middle of the first year. Many are likely to be unidentified, and those can become targets for correlated observations and/or modeling.

**PROPOSE FOR GUEST INVESTIGATIONS (Band Poster, GSSC Booth)!**



# GLAST Multiwavelength – Other Resources

## Web site:

<http://glast.gsfc.nasa.gov/science/multi/>

## Some other LAT scientists active in MW studies:

### Blazars

Jennifer Carson

Jim Chiang

Stefano Ciprini

Werner Collmar

Luigi Foschini

Benoit Lott

Greg Madejski

Julie McEnery

David Paneque

Rita Sambruna

Gianpiero Tagliaferri

Gino Tosti

### Pulsars

Steve Thorsett

Roger Romani

### Unidentified/Diffuse

Patrizia Caraveo

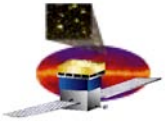
Seth Digel

Stefan Funk

Isabelle Grenier

Olaf Reimer

Kent Wood



# GLAST Multiwavelength – Summary

**You do not have to be a GLAST scientist to work with the LAT team, even during Phase 1. If your data include a source seen by the LAT, we are interested.**

**There are opportunities for theorists and observers from all wavelengths to help open up the discovery space that GLAST will provide. Join the fun!**