

Facilitating Multiwavelength Observations With GLAST

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Outline

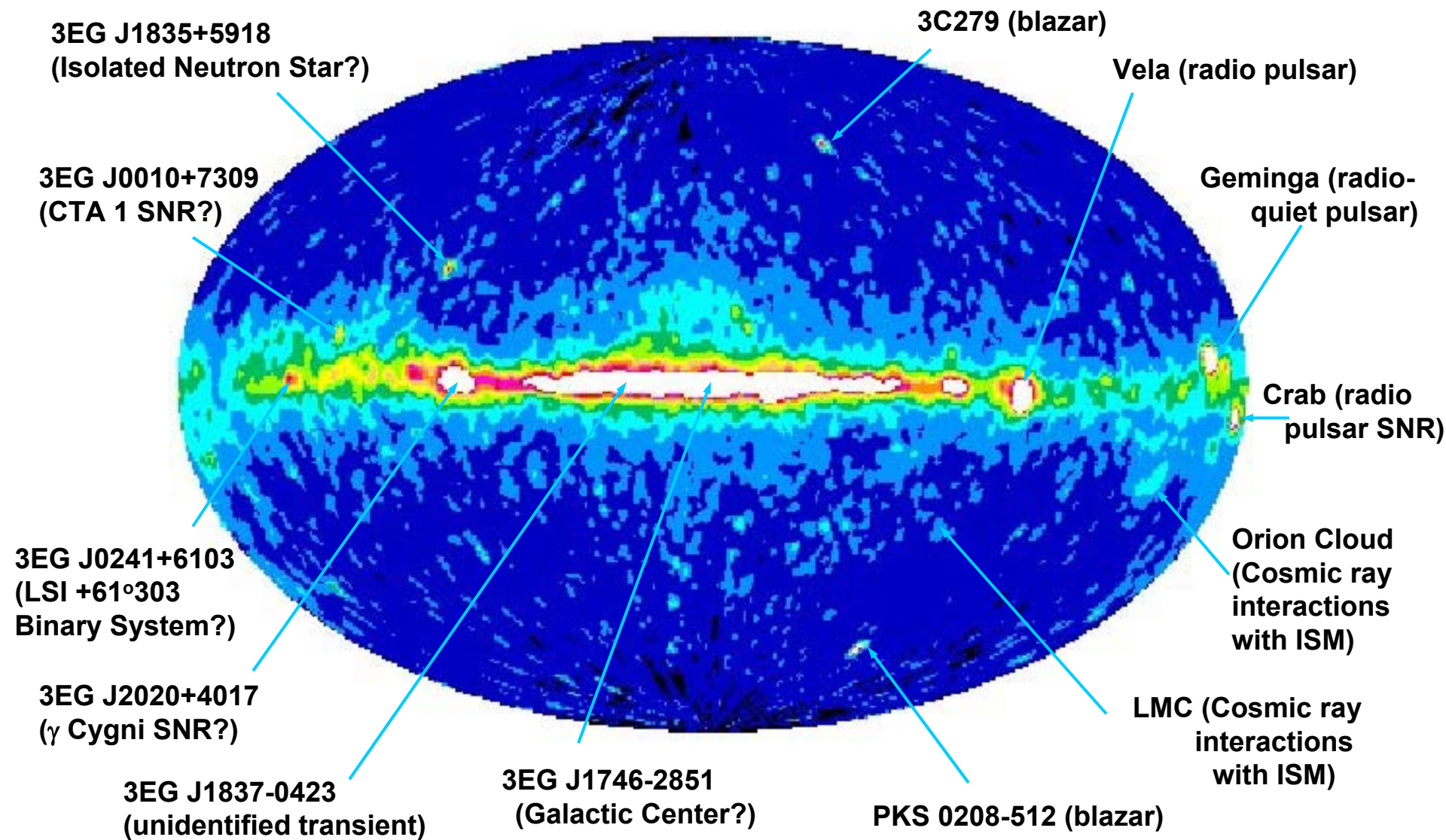
- **Reminder of the interest in multiwavelength studies of astrophysical sources**
- **Past experience and challenges for multiwavelength studies**
- **Some specific activities and suggestions**

Gamma-ray Sources: Inherently Multiwavelength

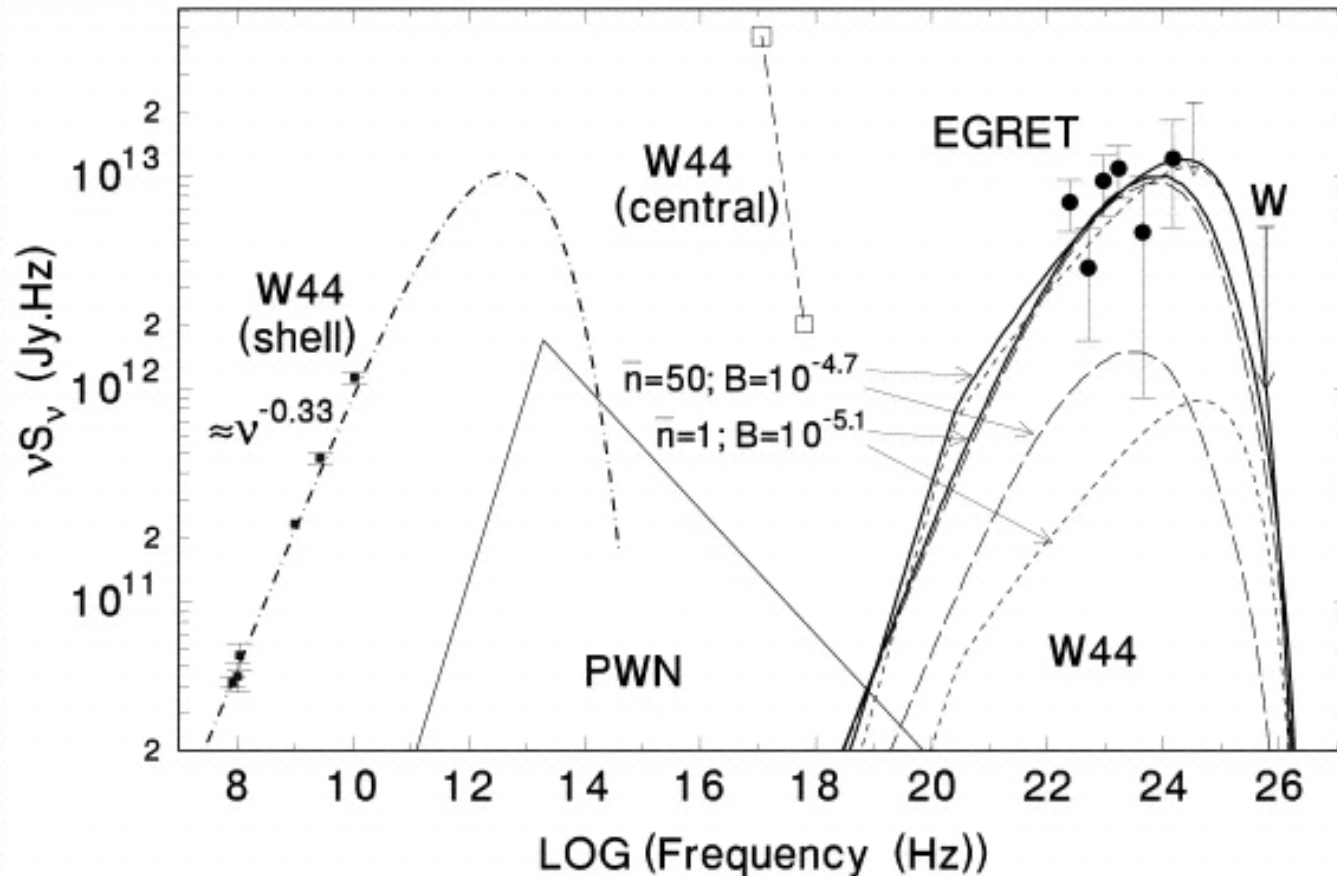
**In the MeV range and above, sources are non-thermal
⇒ produced by interactions of energetic particles**

- **Nature rarely produces monoenergetic particle beams. Broad range of particle energies leads to a broad range of photon energies.**
 - **Example: π^0 production**
- **Charged particles rarely interact by only one process. Different processes radiate in different energy bands.**
 - **Example: synchrotron-Compton processes**
- **High-energy particles, as they lose energy, can radiate in lower-energy bands.**
 - **Contrast: nonthermal X-ray source can have high-energy cutoff**

EGRET All Sky Map (>1 GeV)



Supernova Remnants – Multi-component Sources



Multi-component model of SNR W44 by De Jager and Mastichiadis (1997). Components include synchrotron, thermal X-ray, pulsar wind nebula, relativistic bremsstrahlung, and inverse Compton.

Some Lessons Learned from CGRO

No Real Surprises Here

- Observers at other wavelengths seem very helpful with “service observations”, as long as the observing time needed is relatively small.
- Organizing a true multiwavelength campaign, especially for extended observations, is VERY difficult.
- Relying on a few “friends” to carry out coordinated observations is risky (ground conditions vary).
- We were most successful in just announcing a target of interest to a large group and then seeing who was able to collect data.
- AGN flares seemed to be more easily seen first in gamma rays; these could prove to be a useful trigger for a coordinated campaign.
- Unidentified gamma-ray sources are far less interesting than known objects to observers at other wavelengths (largely due to position uncertainties).

Challenges for Multiwavelength Observations (1)

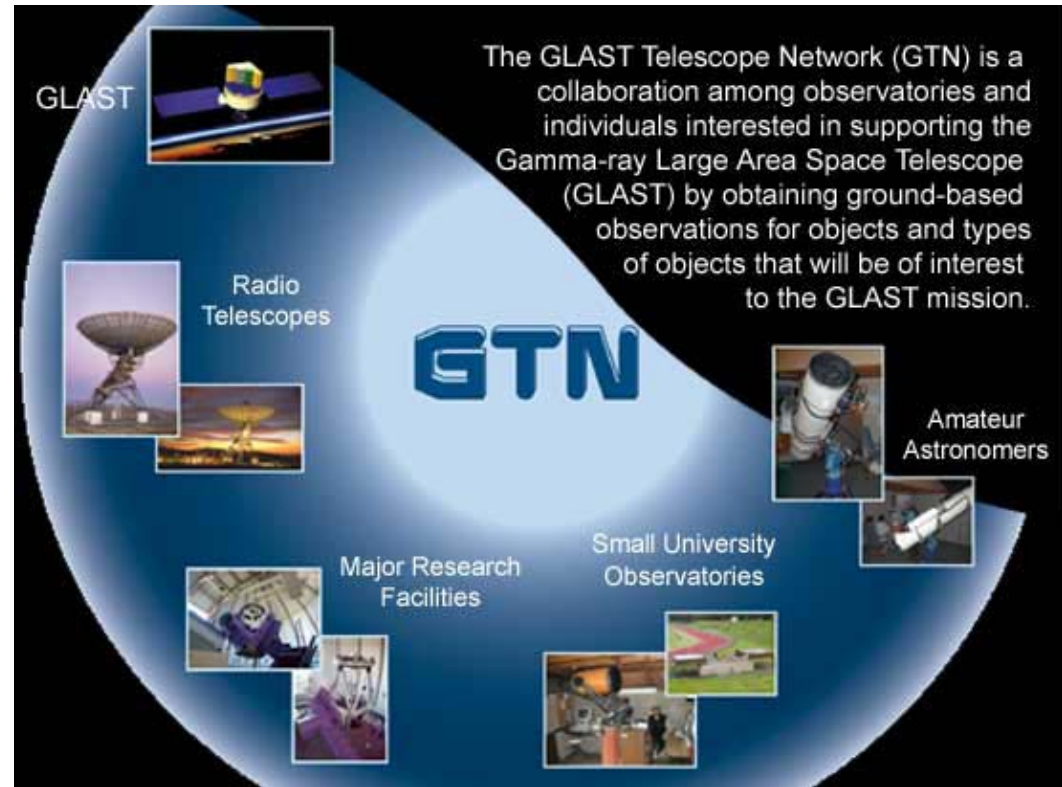
- GLAST can monitor the sky for variable sources.

- Especially in scanning mode, but even if pointed, GLAST will see a large fraction of the sky with good sensitivity every day. GLAST can serve as a trigger for observations at other wavelengths. Flaring sources probably require some processing on the ground and will require a day or more (depending on intensity) for quicklook recognition. How the GLAST instrument teams communicate this information is under discussion. Proposals include a Web site showing bright sources, updated regularly.
- Bursts will give an on-board trigger that can be sent immediately to the ground. The current plan is to use the GCN.

Challenges for Multiwavelength Observations (2)

- Selecting the sources for multiwavelength study will rely largely on other wavelengths.

- Availability of telescope time, coordinated plans, and observational constraints will limit the number and choice of sources. The GLAST science teams want to cooperate in multiwavelength programs with the broadest coverage. The LAT team is encouraging small optical observatories and even amateurs to help monitor sufficiently bright sources. Resources probably limit campaigns to one a week, excluding bursts.



The GLAST Telescope Network

<http://www-glast.sonoma.edu/gtn/index.html>

The Whole Earth Blazar Telescope

<http://www.to.astro.it/blazars/webt/homepage.html>

The Whole Year Blazar Telescope

Challenges for Multiwavelength Observations (3)

• We need multiwavelength observation programs even for sources that are not flaring

- The broad-band shape of the spectrum is often critical in determining the nature of an unidentified source.
- The fluctuation (power density) spectrum is an important part of understanding flares.
- Determining blazar radio properties and redshifts is important, since GLAST expects to detect many blazars that are not yet identified as such. The proposed VLBA VIPS program could be extremely valuable.

Maximizing the science will require cooperation among many instruments at all wavelengths.

What Do We Do? Some Suggestions

- **Make a commitment to early sharing of data with the broad multiwavelength community. This approach produces the best science, and it is in the best interest of the instrument teams to assure cooperation after the all-sky survey.**
- **Help develop and promote tools to maximize multiwavelength productivity. Some examples:**
 - **All the Science Support Center analysis facilities**
 - **GTN and other EPO activities**
 - **Personal contacts and presentations at meetings**
 - **Visits by multiwavelength partners (we have a little money)**
 - **More SWG and instrument team members for a multiwavelength working group within the SWG. Volunteers?**
 - **Multiwavelength planning software – like VOLT (next slide)**
 - **Web-based information about multiwavelength GLAST activities**
 - **Multiwavelength mailing list with Web archive**

VOLT

visual
observation
layout
tool



VOLT is an application that was developed to facilitate the specification of coordinated observations over multiple observatories. VOLT will enable coordinated observations to be done more frequently, which will accelerate scientific discovery. Since VOLT is now offered via the Web, it provides users all over the world with a thin client for access via a standard Web browser.

Enter Web VOLT



<http://bahia.sesda.com/volt/Welcome.jsp>

Multiwavelength Observations

- [Gamma-ray Multiwavelength Mailing List Archive](#)

Please contact [Dave Thompson](#) or [J.D. Myers](#) to be added to the mailing list.

- [Science Requirements Document](#)
- [Large Area Telescope \(LAT\) Properties](#)
- [GLAST Burst Monitor \(GBM\) Properties](#)
- [Planning, Operations, and Data Policies \(from the NASA Announcement of Opportunity\)](#)
- [Operations Concept Document](#)
- Project Data Management Plan (in preparation)
- [GLAST Science Support Center](#)
- [GLAST Telescope Network](#)

Multiwavelength Contacts: [Dave Thompson](#), [Steve Thorsett \(Pulsars\)](#)

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

Gamma-Ray Multiwavelength Mailing List

Mail Explorer for communication of information about multiwavelength topics.

gammamw@olegacy.gsfc.nasa.gov Currently has about 80 names

Web-based archive is available at

http://heasarc.gsfc.nasa.gov/mail_archive/gammamw/

Mail Index

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Multiwavelength mailing list

From: Dave Thompson <David.J.Thompson@nasa.gov>

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Summary

- **Multiwavelength studies are important for GLAST.**
- **The limiting factor in multiwavelength observations is likely to be availability of observing time at other wavelengths and the difficulties of coordinating these observations.**
- **Encouraging the astrophysical community to include GLAST in their future multiwavelength plans seems like a good idea.**
- **The SWG should encourage development of tools to facilitate multiwavelength studies.**