GLAST
is now
Fermi
Gamma-ray Space Telescope

First Light Introduction

Dave Thompson
NASA GSFC on behalf of the Fermi Mission Team

see *http://www.nasa.gov/fermi* and links therein

About that Name

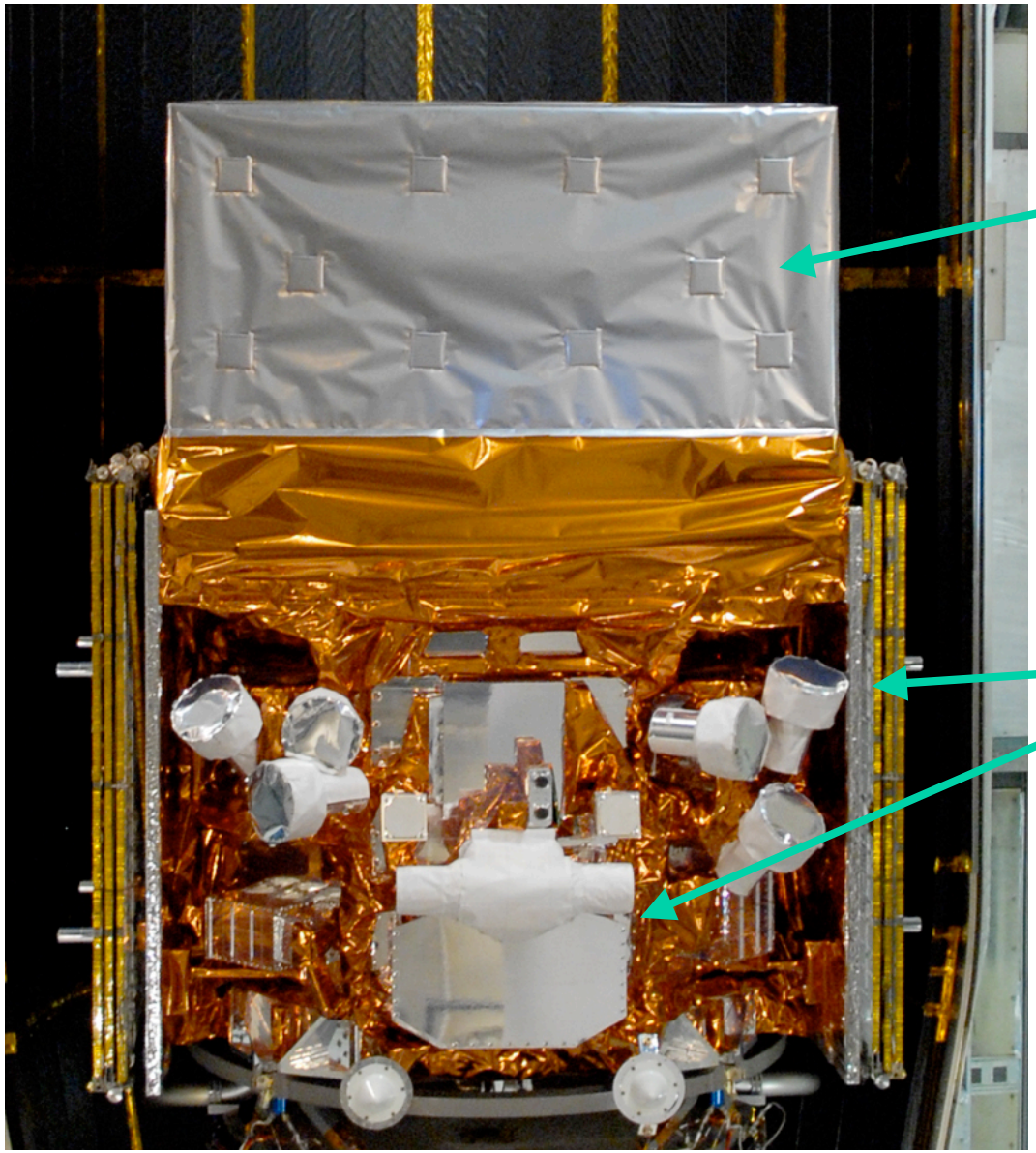
Enrico Fermi was an Italian physicist who immigrated to the United States before World War II. He was the first to suggest a viable way to produce high-energy particles in cosmic sources. Since gamma-rays are produced by interactions of such energetic particles, his work is the foundation for many of the studies being done with the **Fermi Gamma-ray Space Telescope**, formerly GLAST.

U. S. Postal Service

Launch!

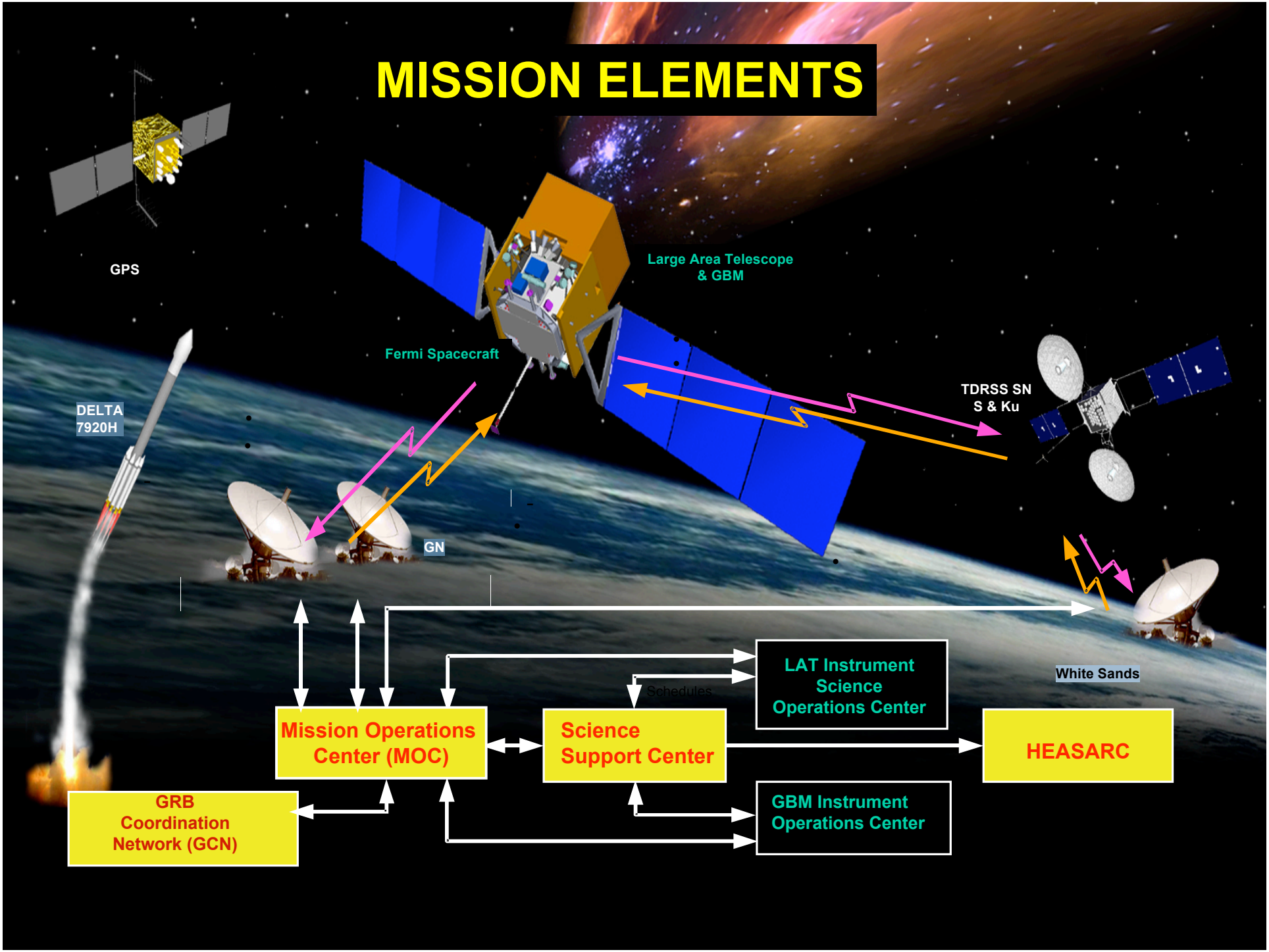
- Launch from Cape Canaveral Air Station 11 June 2008 at 12:05PM EDT
- Circular orbit, 565 km altitude (96 min period), 25.6 deg inclination.
- Communications:
  - Science data link via TDRSS Ku-band, average data rate 1.2 Mbps.
  - S-band via TDRSS and ground stations

The Observatory

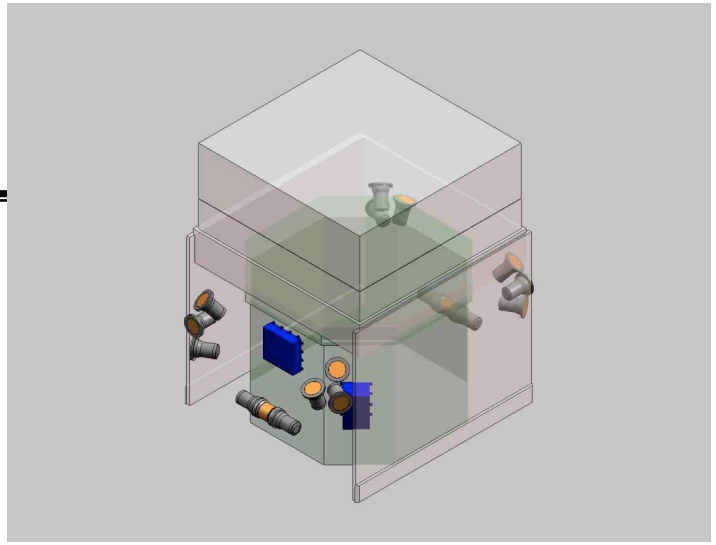


Large Area Telescope - LAT
The Anticoincidence Detector, the outermost part of the LAT, was built here at Goddard

Gamma-ray Burst Monitor - GBM


MISSION ELEMENTS
GPS
Large Area Telescope
& GBM
Fermi Spacecraft
TDRSS SN
S & Ku
DELTA
7920H
GN
White Sands
LAT Instrument
Science
Operations Center
Schedules
Mission Operations
Center (MOC)
Science
Support Center
HEASARC
GRB
Coordination
Network (GCN)
GBM Instrument
Operations Center

GBM Collaboration



National Space Science & Technology Center

University of Alabama in Huntsville

NASA Marshall Space Flight Center

Max-Planck-Institut für extraterrestrische Physik

Los Alamos NATIONAL LABORATORY

Charles Meegan (PI)
Jochen Greiner (Co-PI)

LAT Collaboration

- **France**
  - CNRS/IN2P3, CEA/Saclay
- **Italy**
  - INFN, ASI, INAF
- **Japan**
  - Hiroshima University
  - ISAS/JAXA
  - RIKEN
  - Tokyo Institute of Technology
- **Sweden**
  - Royal Institute of Technology (KTH)
  - Stockholm University
- **United States**
  - Stanford University (SLAC and HEPL/Physics)
  - University of California at Santa Cruz - Santa Cruz Institute for Particle Physics
  - Goddard Space Flight Center
  - Naval Research Laboratory
  - Sonoma State University
  - Ohio State University
  - University of Washington

Principal Investigator:
Peter Michelson (Stanford University)

~270 Members
(~90 Affiliated Scientists, 37 Postdocs, and 48 Graduate Students)

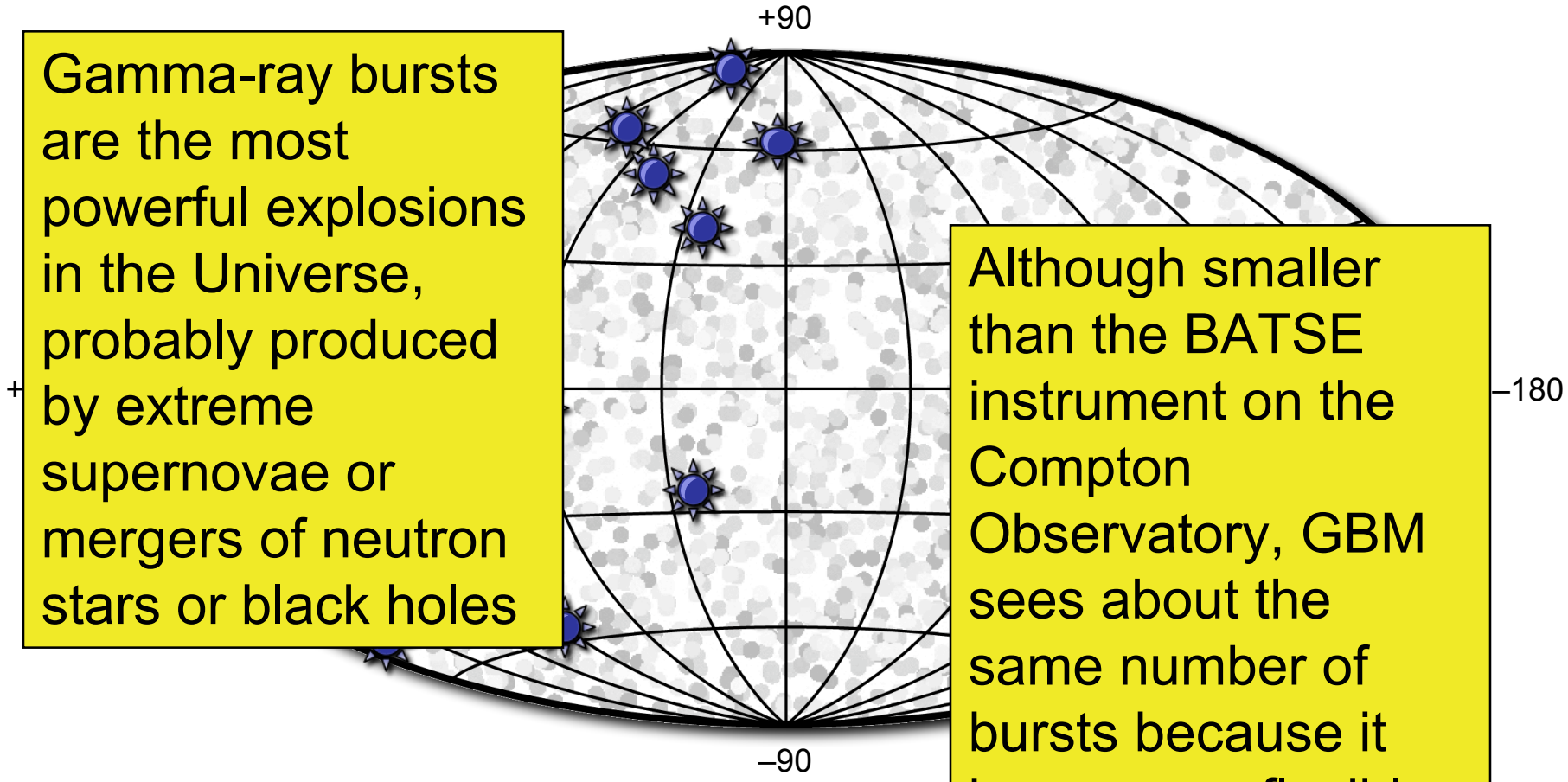
construction managed by
Stanford Linear Accelerator Center (SLAC), Stanford University

What Makes Fermi Special?

1. **Fermi studies gamma rays.** Gamma rays are the most powerful form of light. They tell us about extreme conditions, powerful processes, and exotic phenomena.
2. **Fermi surveys the whole sky every three hours.** Taking advantage of the huge fields of view of the GBM and the LAT, Fermi is operated in a scanning mode that monitors the sky regularly. The reason this survey mode is important is that the gamma-ray sky is dynamic, showing changes on time scales ranging from milliseconds to years.

GBM Spots Gamma Ray Bursts Daily

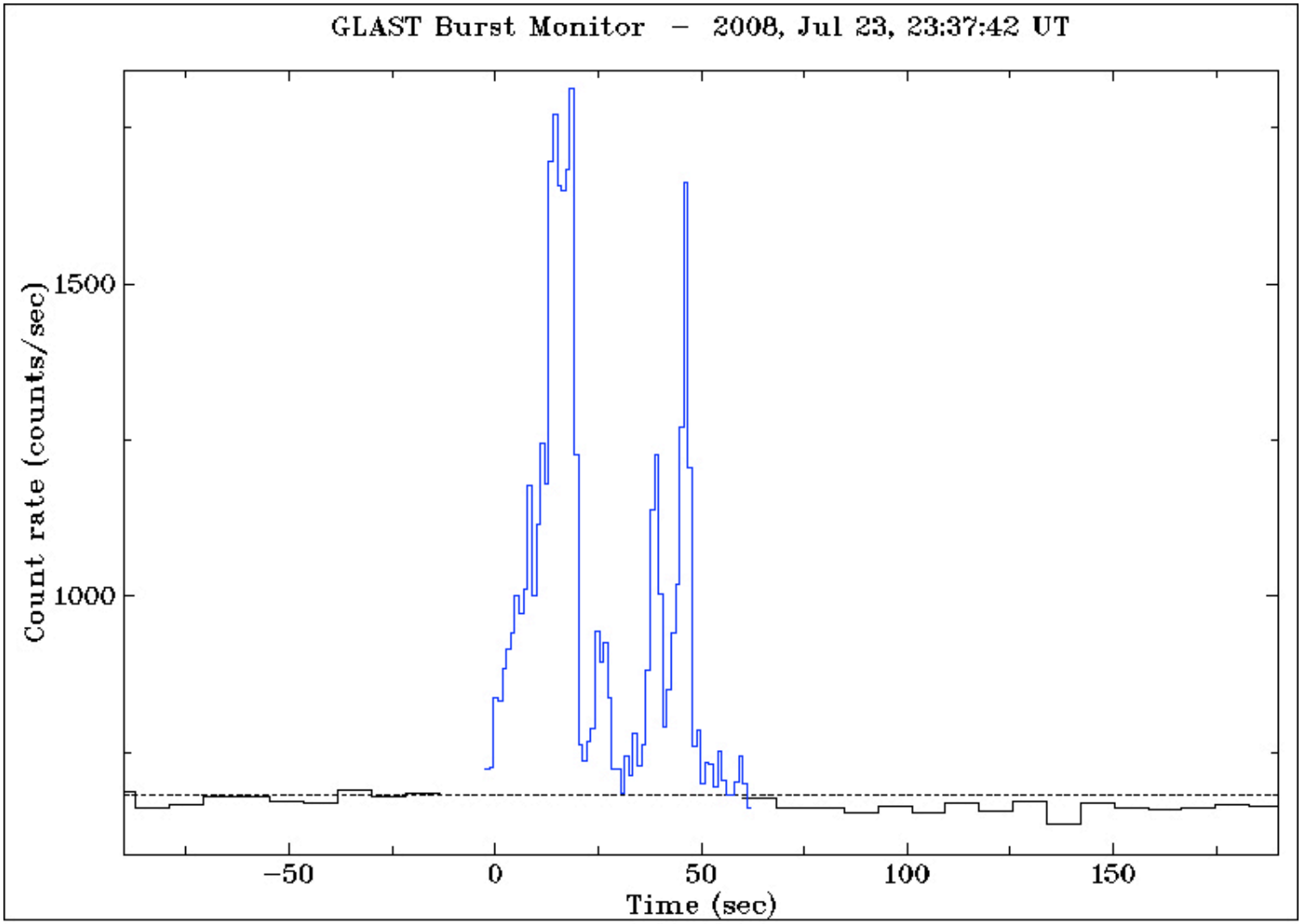
Gamma-ray bursts are the most powerful explosions in the Universe, probably produced by extreme supernovae or mergers of neutron stars or black holes



Although smaller than the BATSE instrument on the Compton Observatory, GBM sees about the same number of bursts because it has a more flexible detector trigger.

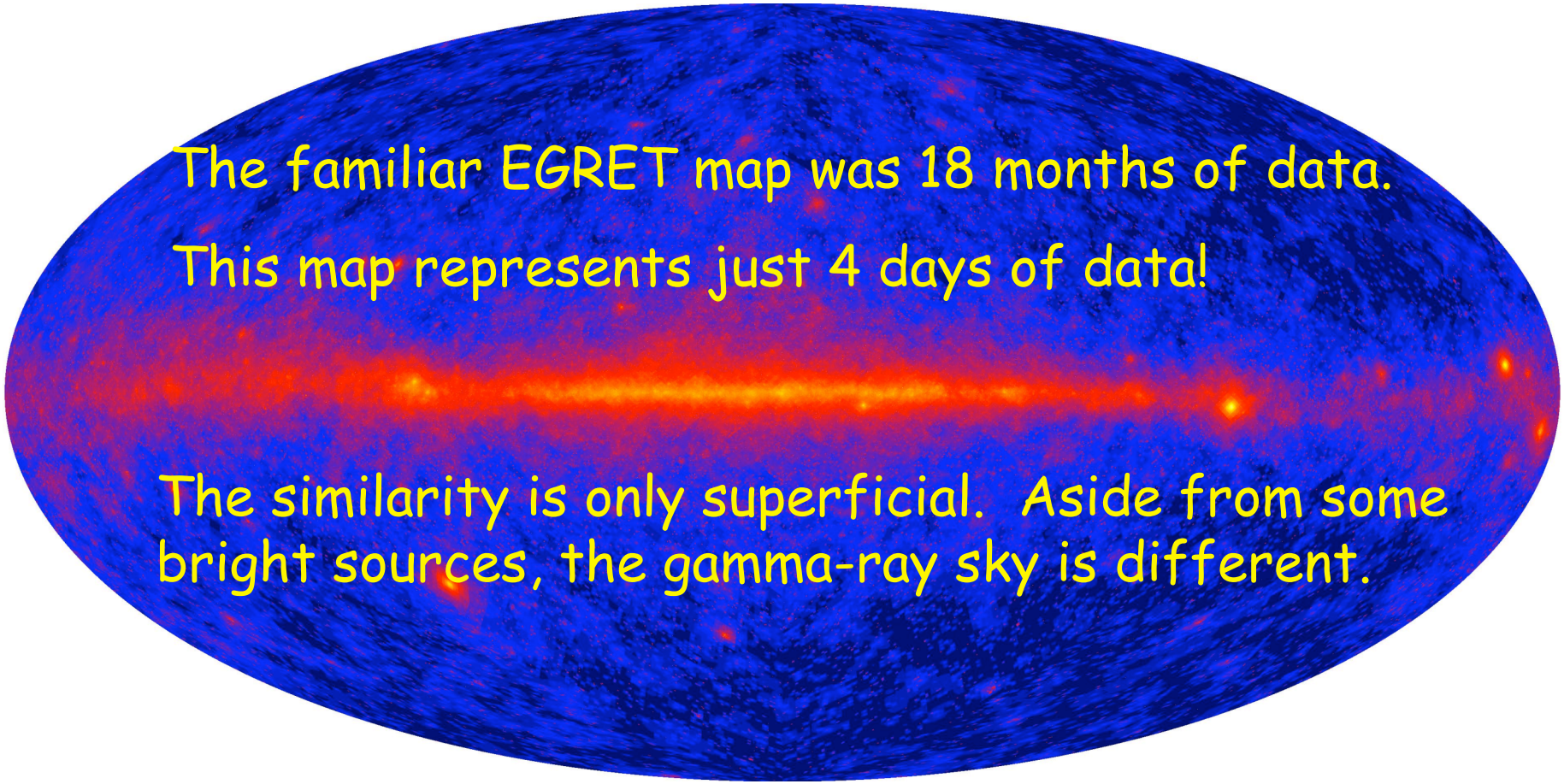
- 31 GRBs seen in first month of operations
- Activation phase complete; all working well
- Sensitivity as predicted
- GRB locations within a few degrees of Swift's

A Gamma-ray burst - gone in a minute



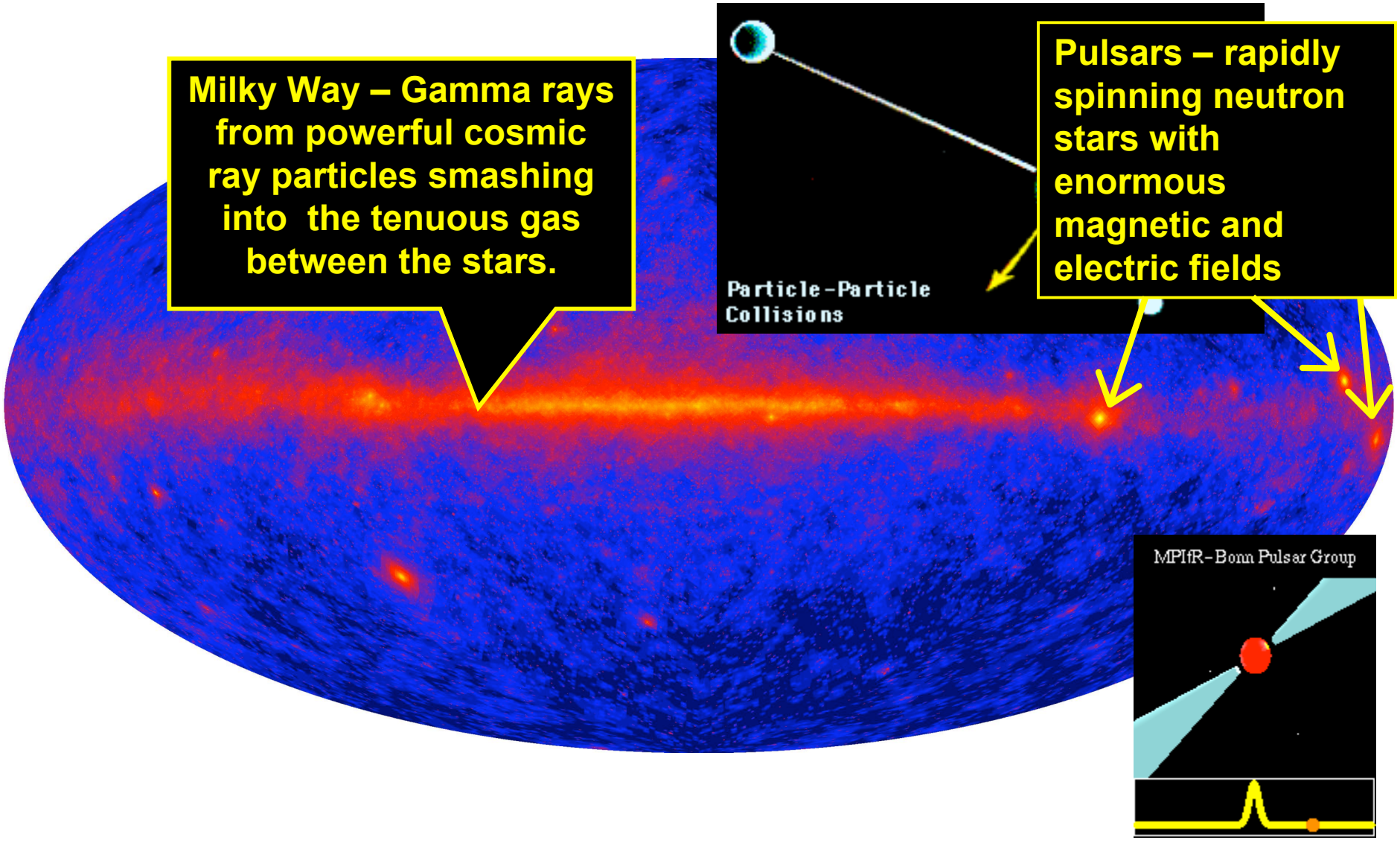
Large Area Telescope First Light!

The full gamma-ray sky projected onto a surface



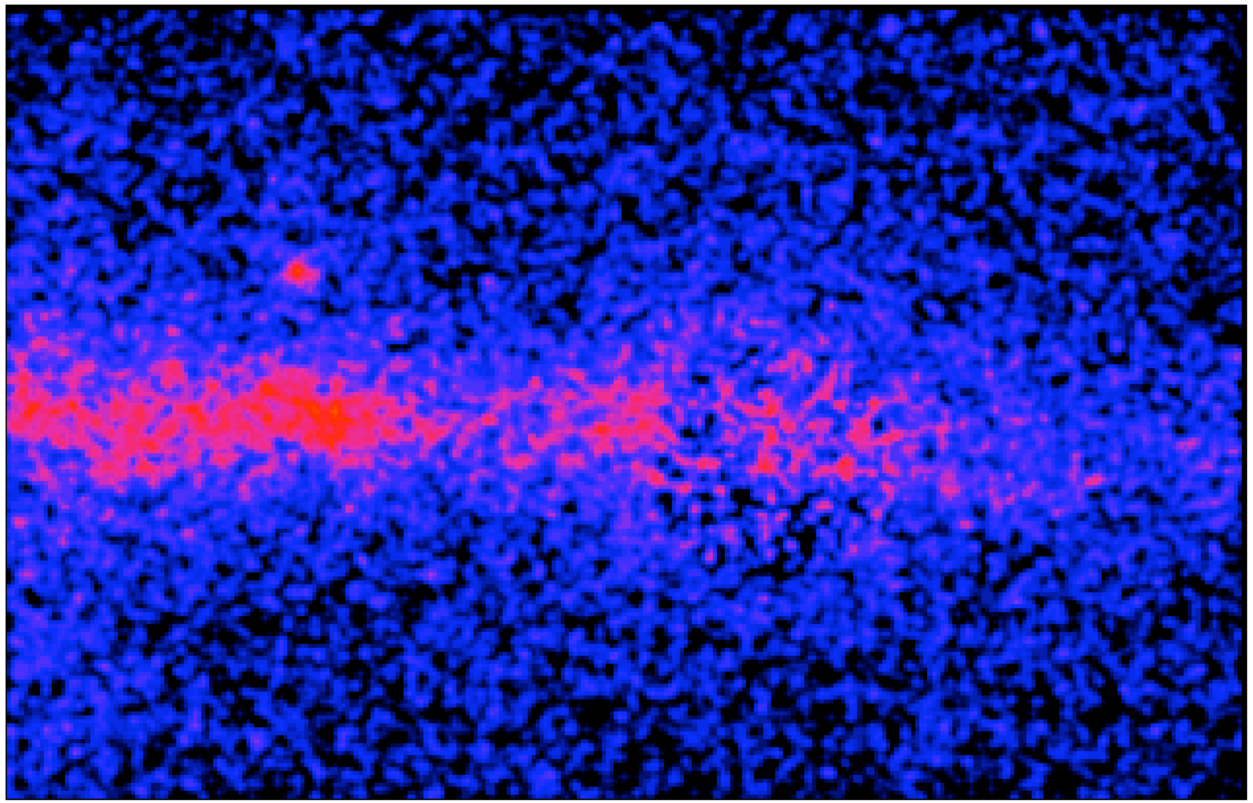
But it looks like the EGRET map. What's new?

What is going on in the gamma-ray sky?



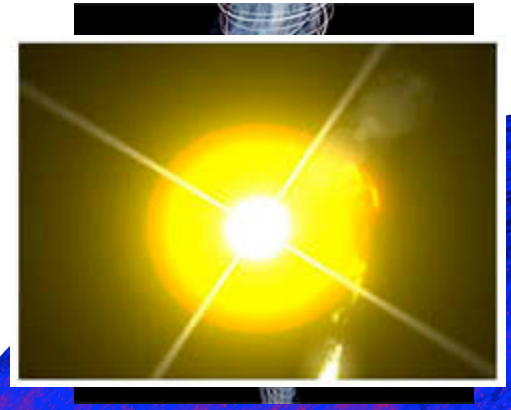
The Vela Pulsar in Action

The entire neutron star rotates in less than 1/10 of a second



Some gamma-ray pulsars took years for EGRET to see. The LAT confirmed all the EGRET pulsars in a matter of days and is now looking for more.

What is new in the gamma-ray sky?



PKS 1502+106 - a blazar 10 billion light years away, never detected by EGRET, flared up overnight to become one of the brightest things in the gamma-ray sky.

3C454.3 - LAT saw it flare up 5 times brighter than EGRET ever measured.

Blaz
sup
blac
hug
particles and radiation pointed right at Earth.

Two Atels - Astronomer's Telegrams

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GLAST-LAT detection of extraordinary gamma-ray activity in 3C 454.3

ATel #1628; *G. Tosti (Univ/INFN-Perugia) , J. Chiang (SLAC), B. Lott (CENBG/Bordeaux), E. do Couto e Silva (SLAC), J. E. Grove (NRL/Washington), J. G. Thayer (SLAC) on behalf of the GLAST Large Area Telescope Collaboration*
*on **24 Jul 2008; 14:25 UT***
Password Certification: Gino Tosti (tosti@pg.infn.it)

Subjects: Gamma Ray, >GeV, AGN, Quasars

The Large Area Telescope (LAT), one of two instruments on the Gamma-ray Large Area Space Telescope (GLAST) (launched June 11, 2008), which is still in its post-launch commissioning and checkout phase has been monitoring extraordinarily high flux from the gamma-ray blazar 3C 454.3 since June 28, 2008. This confirms the bright state of the source reported by AGILE (see ATel #1592) and by the optical-to-radio observers of the GASP-WEBT Project (ATel #1625).

3C 454.3 has been detected on time scales of hours with high significance (> 5 sigma) by the LAT Automatic Science Processing (ASP) pipeline and the daily light curve (E>100 MeV) indicates that the source flux has increased from the initial measurements on June 28. Although in-flight calibration is still ongoing, preliminary analysis indicates that in the period July 10-21, 2008 the source has been in a very high state with a flux (E>100MeV) that is well above all previously published values reported by both EGRET (Hartman et al. 1999, ApJS, 123,79) and AGILE (see e.g. ATel #1592 and Vercellone et al. 2008, ApJ,676,L13).

Because GLAST will continue with calibration activities, regular monitoring of this source cannot be pursued. Monitoring by the LAT is expected to resume in early August. In consideration of the ongoing activity of this source we strongly encourage multiwavelength observations of 3C 454.3.

The GLAST LAT is a pair conversion telescope designed to cover the energy band from 20 MeV to greater than 300 GeV. It is the product of an international collaboration between NASA and DOE in the U.S. and many scientific institutions across France, Italy, Japan and Sweden.

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GLAST LAT detection of a possible new gamma-ray flaring blazar: PKS 1502+106

ATel #1650; *S. Ciprini (Univ./INFN Perugia) on behalf of the GLAST Large Area Telescope Collaboration*
*on **8 Aug 2008; 0:02 UT***
Password Certification: Stefano Ciprini (stefano.ciprini@pg.infn.it)

Subjects: Gamma Ray, >GeV, AGN, Quasars
Referred to by ATel #: 1661

The Large Area Telescope (LAT), one of two instruments on the Gamma-ray Large Area Space Telescope (GLAST) (launched June 11, 2008), which is still in its post-launch commissioning and checkout phase, has been monitoring high flux from a source positionally consistent with the blazar PKS 1502+106 (R.A.:15h04m24.9797s; Dec.:+10d29m39.198s, also known as OR 103 and S3 1502+10) since August 6, 2008.

Preliminary analysis indicates that the source is in a high state with a gamma-ray flux (E>100MeV) well above pre-defined LAT flaring source reporting threshold of 2x10^-6 photons cm^-2 s^-1.

This is a well-known radio source classified as a Flat Spectrum Radio Quasar (FSRQ), observed by several X-ray instruments. This is the first time that it has been reported to have gamma-ray emission.

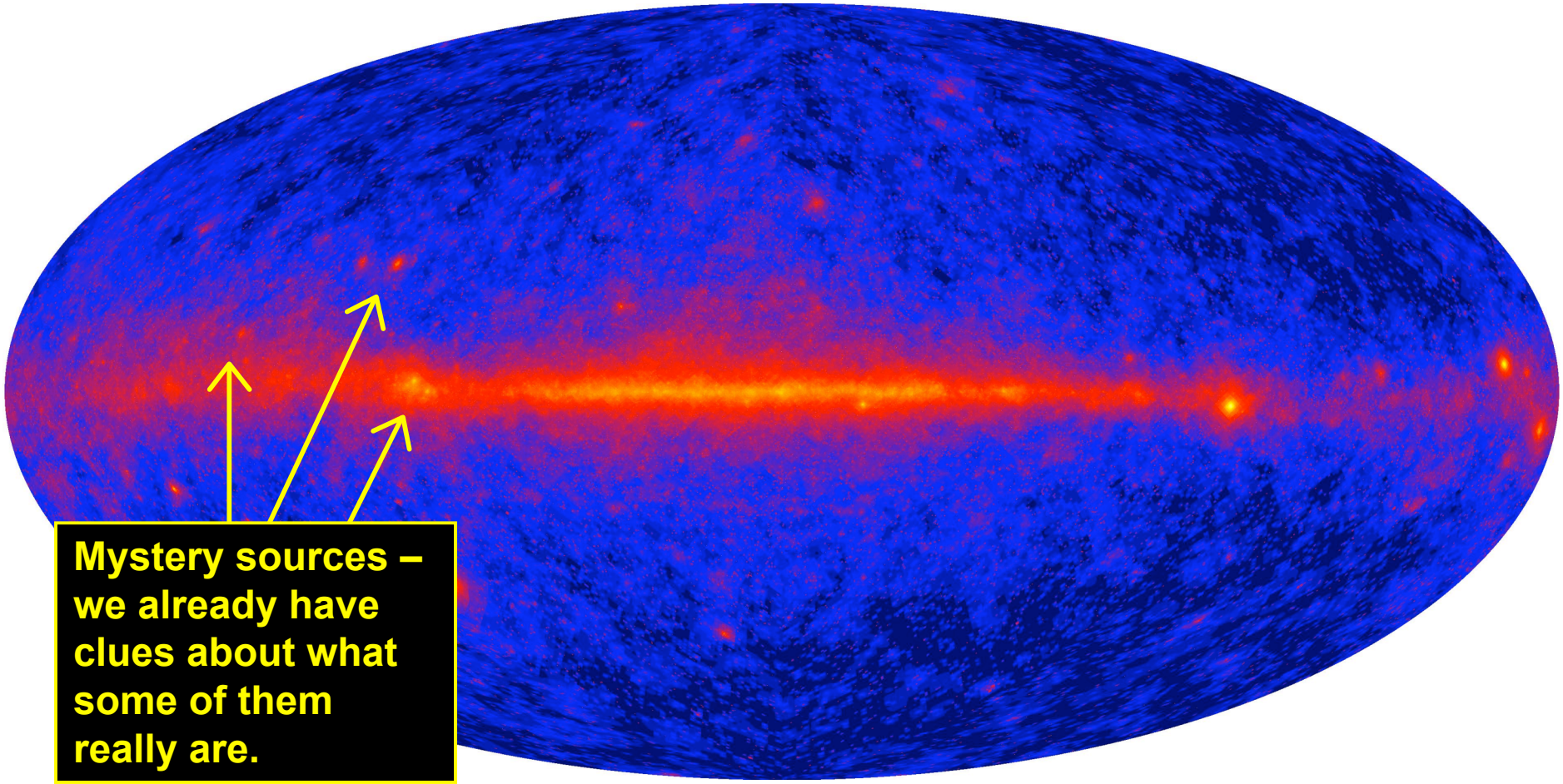
Please note that PKS 1502+106 has two possible redshifts listed in the literature: z=0.56 and 1.83; the former seems preferred (A.E. Wright et al. 1979 ApJ 229,73; B.J. Wilkes 1986, MNRAS, 218, 331).

Because GLAST has just started its scientific standard operations, regular gamma-ray monitoring of this source will be pursued. In consideration of the ongoing activity of this source we strongly encourage multiwavelength observations of PKS 1502+106.

The GLAST LAT is a pair conversion telescope designed to cover the energy band from 20 MeV to greater than 300 GeV. It is the product of an international collaboration between NASA and DOE in the U.S. and many scientific institutions across France, Italy, Japan and Sweden.

These announcements encourage cooperation from other telescopes, like Swift, to help understand how these powerful jet sources work.

What is new in the gamma-ray sky?

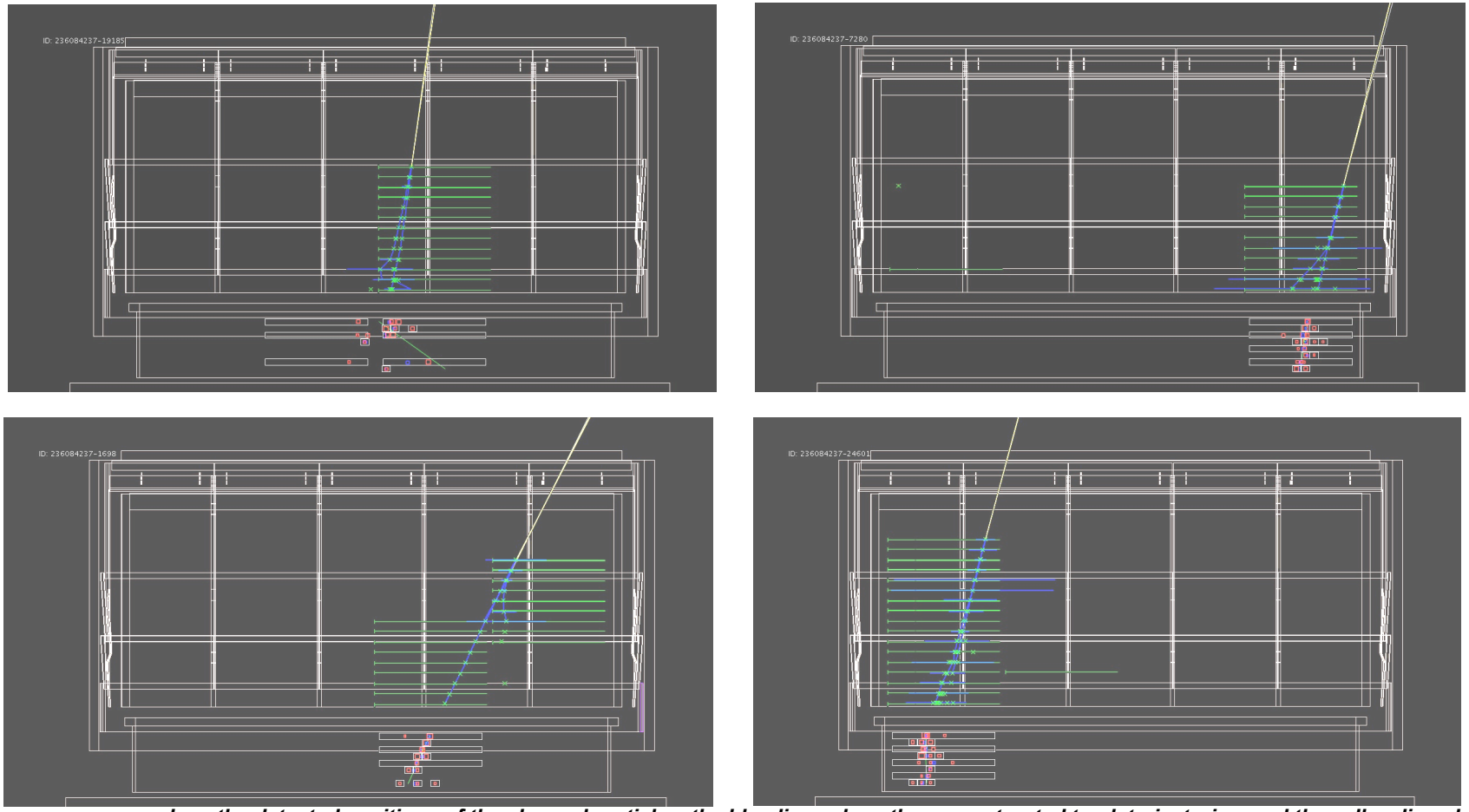


What Next for Fermi?

- **We have only scratched the surface of what the Fermi Gamma-ray Space Telescope can do.**
  - **The gamma-ray sky is changing every day, so there is always something new to learn about the extreme Universe.**
- **Some results from both the GBM and the LAT are starting to be made public through the Fermi Science Support Center (here at Goddard) this week.**
- **Fermi science teams are cooperating with many other missions and observatories to maximize the scientific return.**
- **Follow the latest news at the Project Scientist's blog, http://blogs.nasa.gov/cm/blog/GLAST**

Extra Slides

LAT Gamma Candidate Events



The green crosses show the detected positions of the charged particles, the blue lines show the reconstructed track trajectories, and the yellow line shows the candidate gamma-ray estimated direction. The red crosses show the detected energy depositions in the calorimeter.

A Word of Thanks

The scientists who are looking at the data pouring in from the Fermi instruments are wildly enthusiastic.

We recognize that any project like this is a team effort.

On behalf of the scientific community, I want to thank Goddard management, Kevin Grady, the Project Manager, and everyone who had anything to do with planning, building, testing, launching, and operating the Fermi Gamma-ray Space Telescope. We will do our best to provide you with some exciting scientific results.