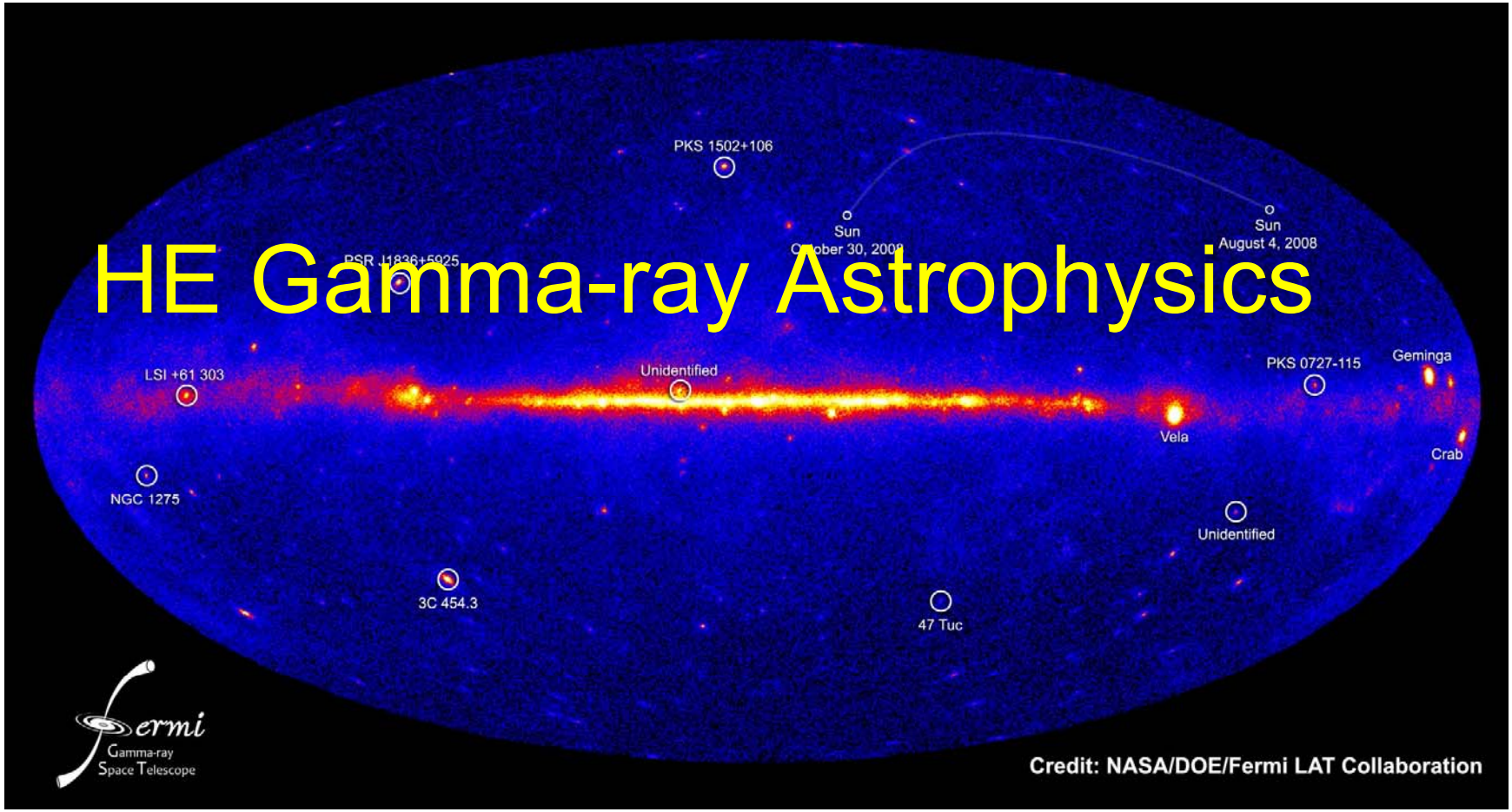
HE Gamma-ray Astrophysics



Francesco Longo

Department of Physics, University of Trieste and INFNTrieste

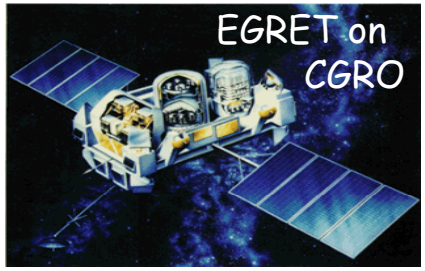
credits to the AGILE and Fermi LAT collaborations

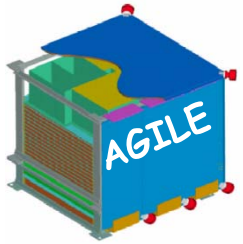
Summary

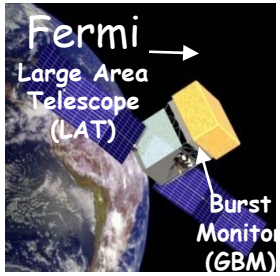
- Brief Introduction to Gamma-ray Astrophysics
  - The Main Questions
- HE Gamma-ray astrophysics
  - From EGRET to AGILE and Fermi
- (Brief) Introduction to AGILE data analysis
- Introduction to Fermi LAT data analysis
  - Source simulation and detection
  - Documentation

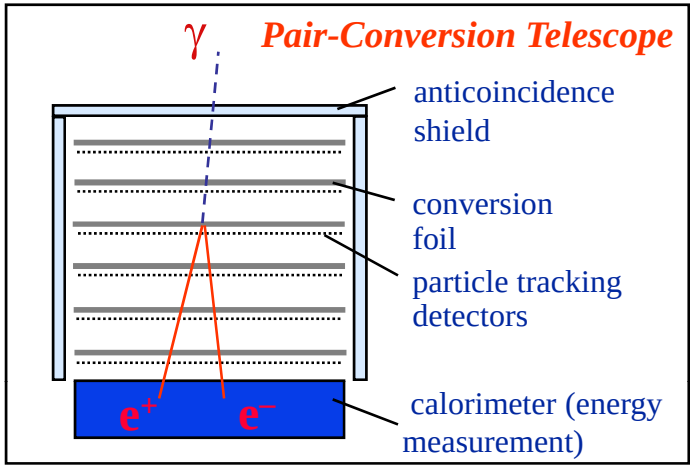
Gamma-ray Experiment Techniques

- Space-based:
  - use pair-conversion technique







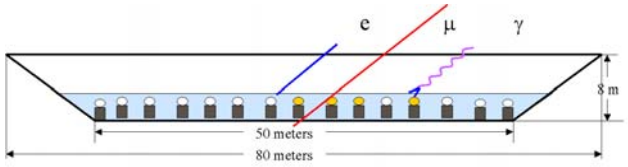


- Ground-based (VHE shower info reaches gnd):
  - Airshower Cerenkov Telescopes (ACTs)

    image the Cerenkov light from showers induced in the atmosphere. Examples: Whipple, STACEE, CELESTE, VERITAS, MAGIC, HESS

Directly detect particles from the showers induced in the atmosphere. Examples: MILAGRO, ARGO,

  - Extensive Air Shower Arrays (EAS)

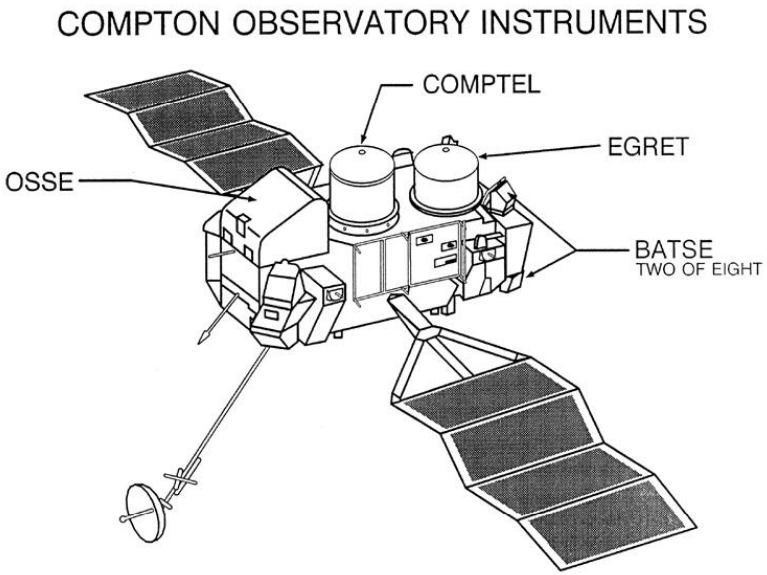


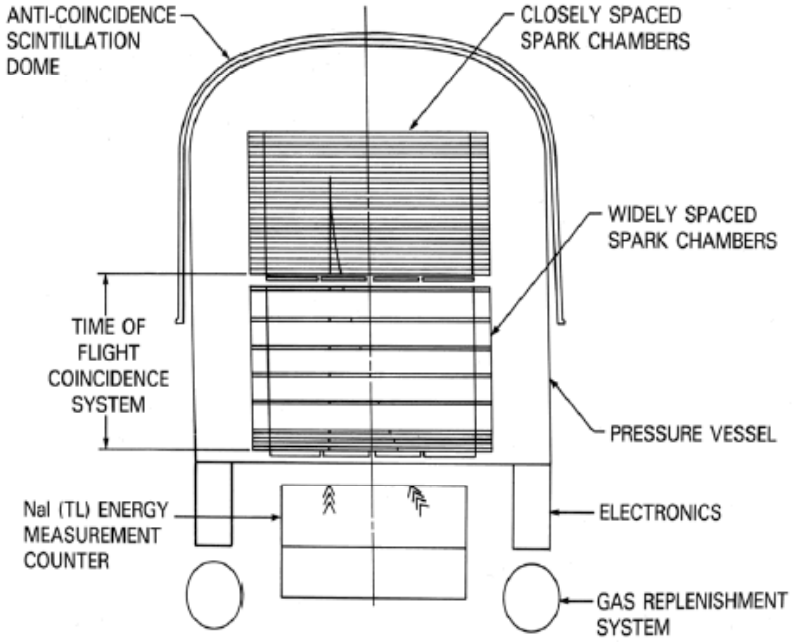
Some key questions for Gamma-Astrophysics

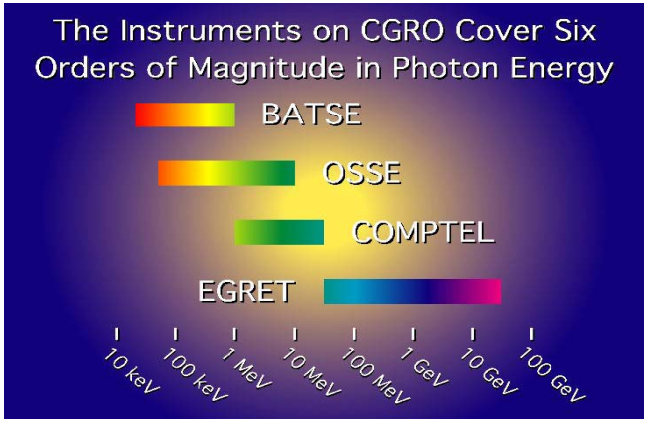
- Black Holes
  - Supermassive BH – AGN
  - Stellar BH – Galactic Gamma-ray binaries
  - Stellar BH – Gamma Ray Bursts
- Compact objects
  - Electromagnetic fields in strong Gravitational fields
- The origin of cosmic-rays
  - Particle acceleration – the Fermi mechanism
- The Nature of Dark Matter
- Photon propagation over cosmological distances

The EGRET Legacy

EGRET



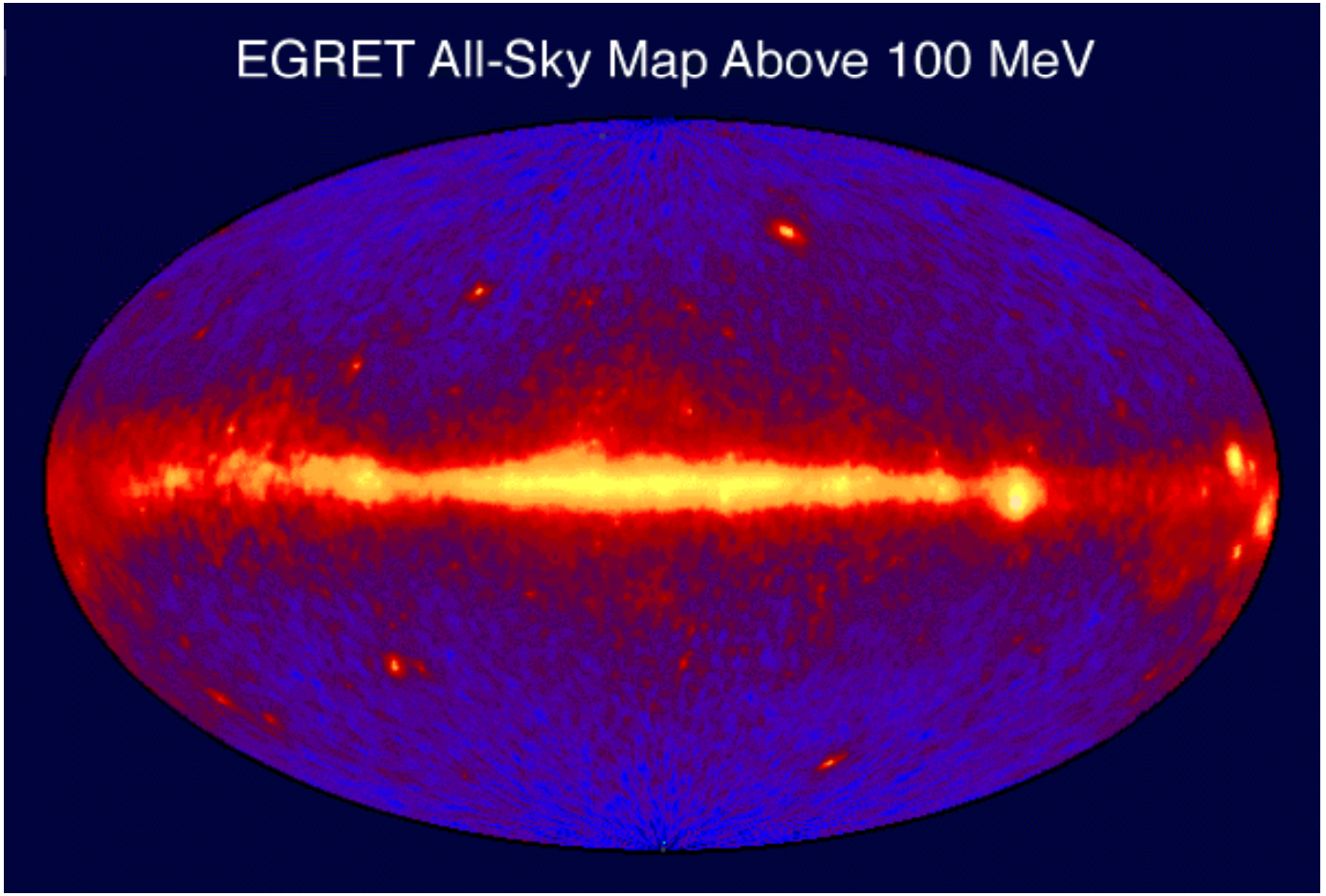




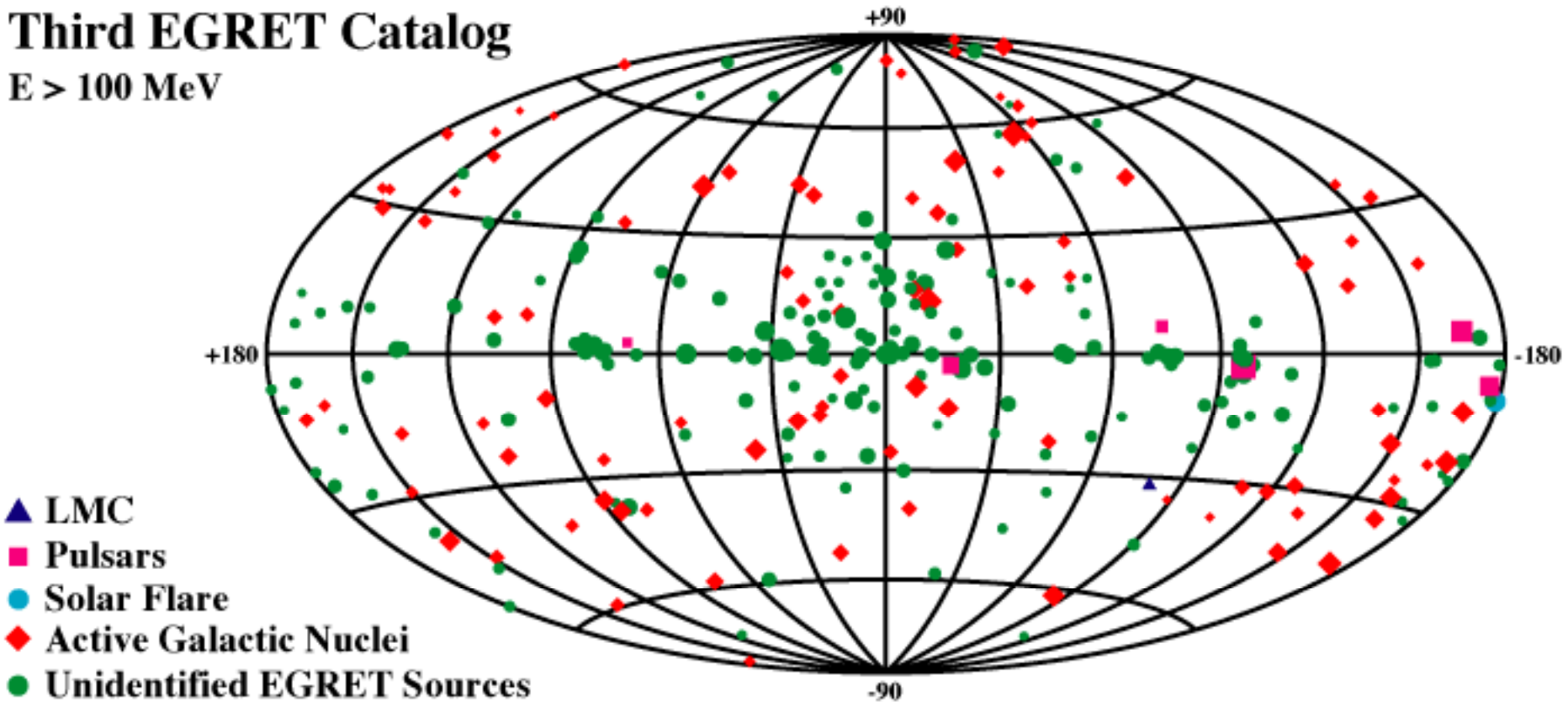
EGRET

- 1991-2000
- 30 MeV - 30 GeV
- AGN, GRB, Unidentified Sources, Diffuse Bkg

The Legacy from EGRET

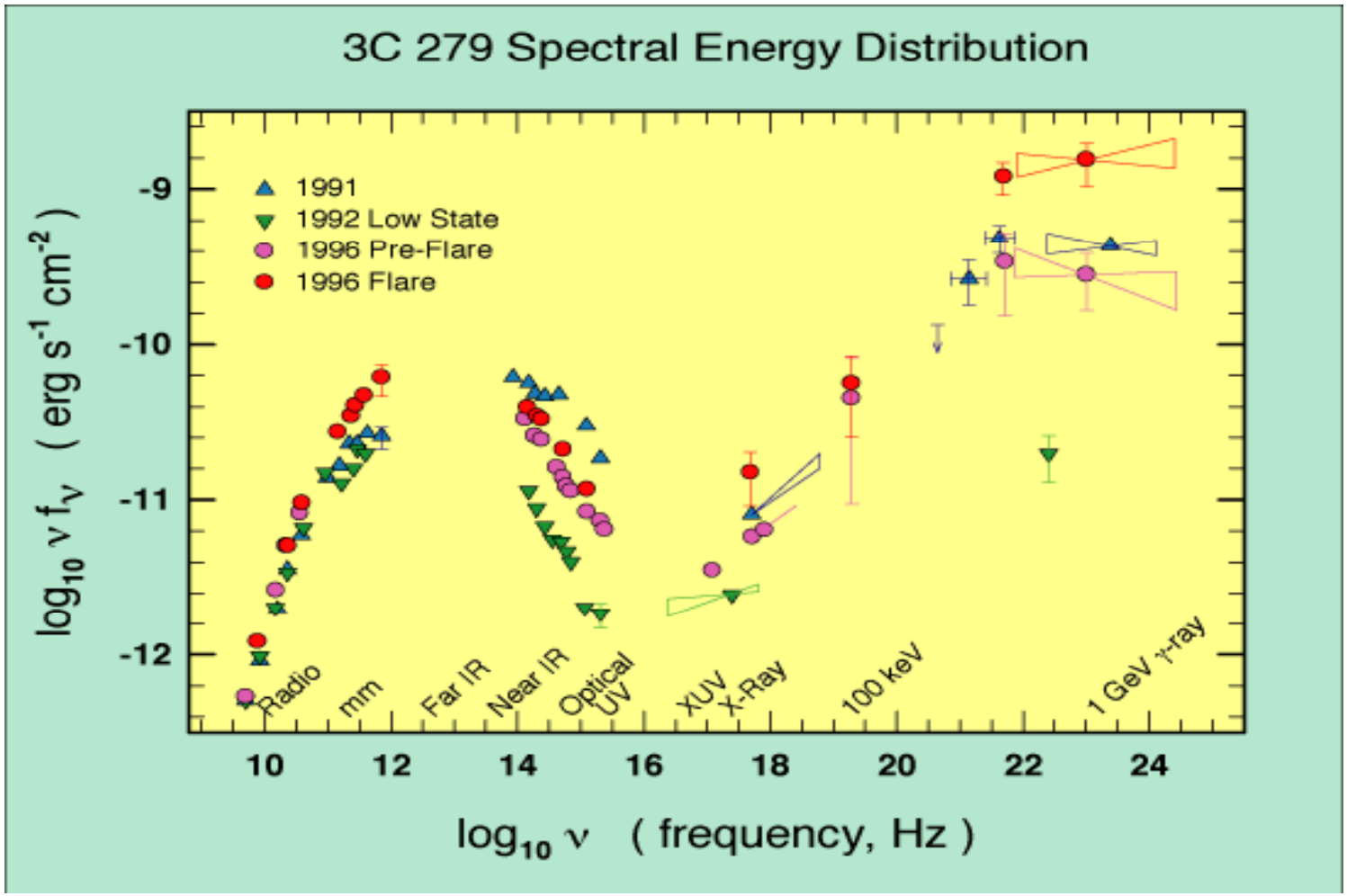


EGRET Gamma-ray Sources

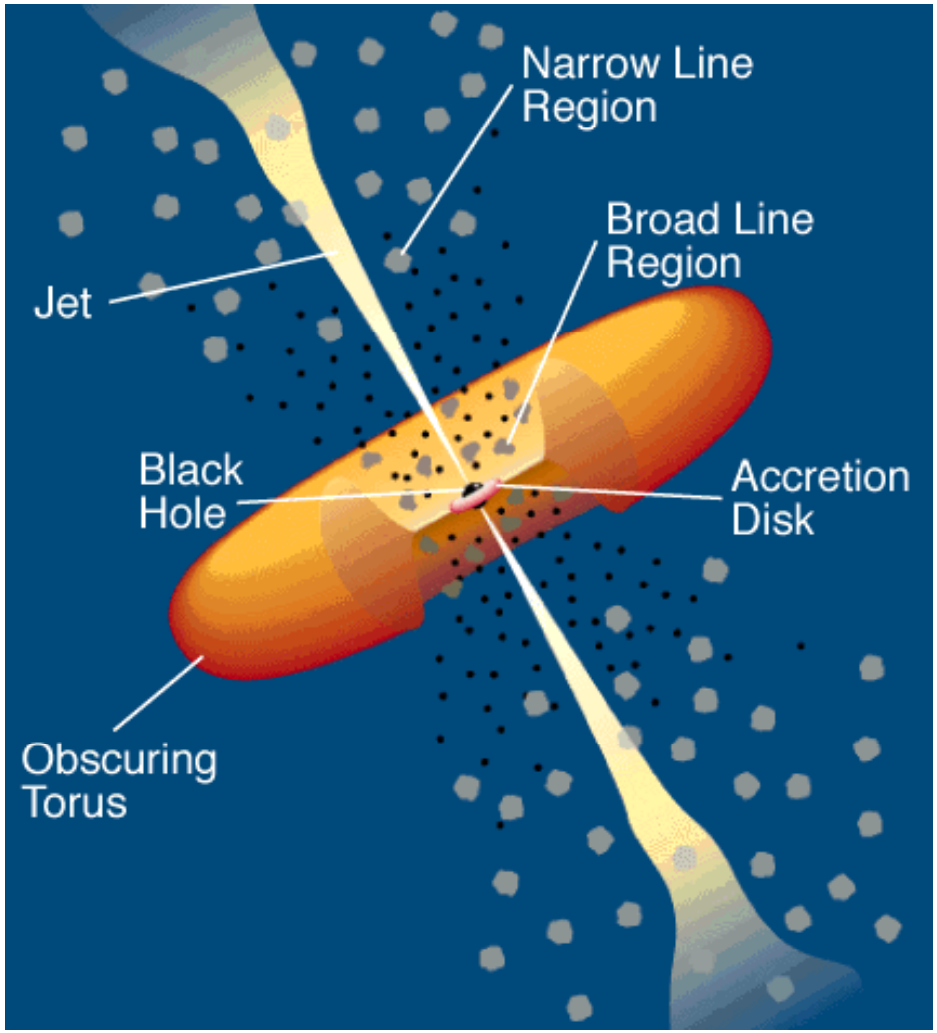


Challenge # 1

- Need simultaneous multiwavelength data to study variability and emission processes

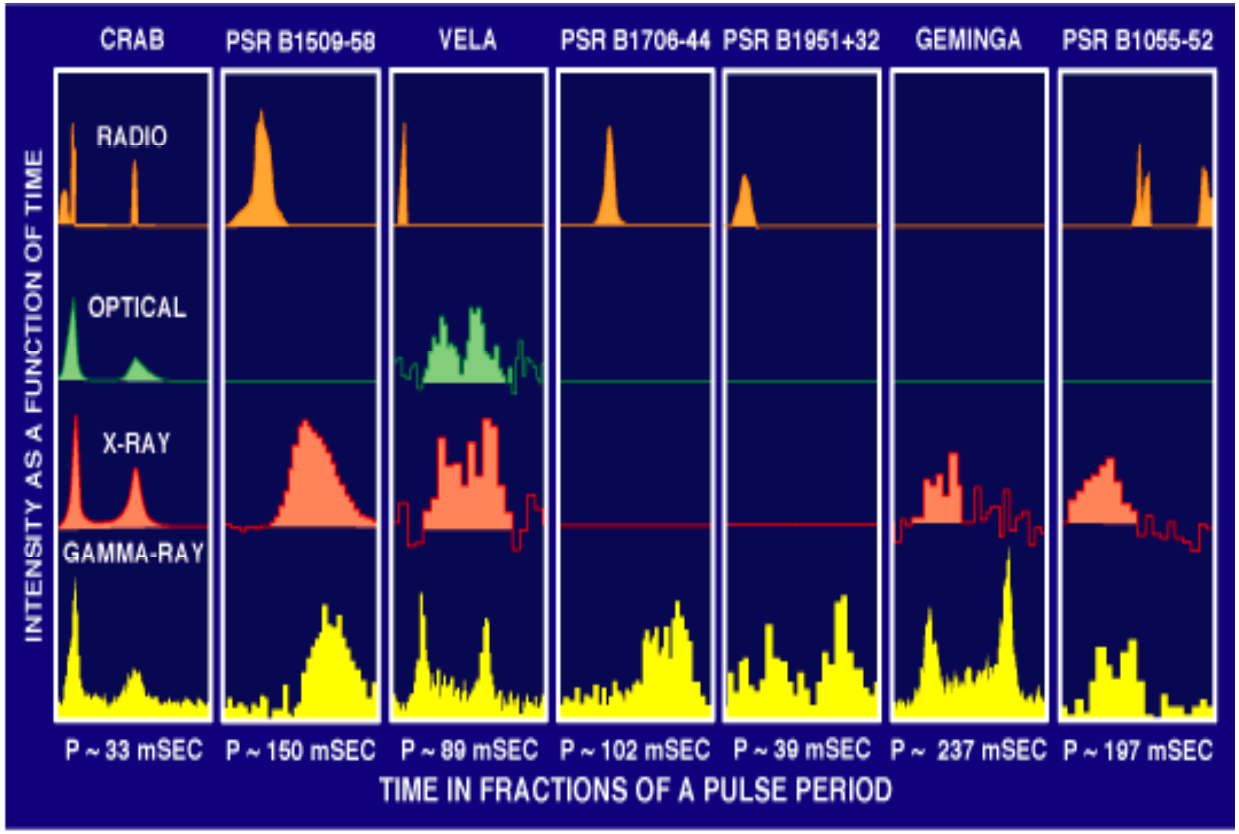


Active Galactic Nuclei

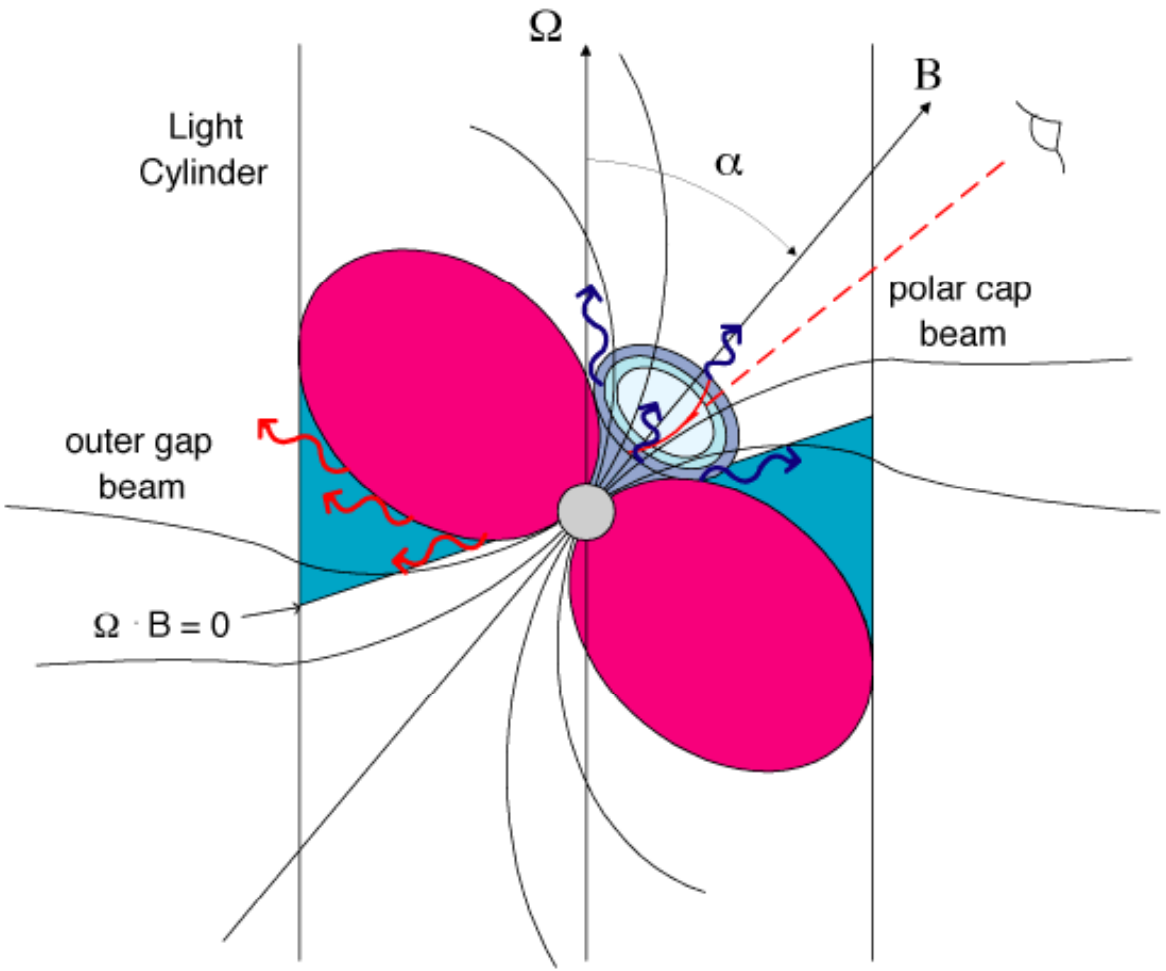


Challenge # 2

- Need more exposure and optimal timing (and radio monitoring) to discover more gamma-ray PSRs.



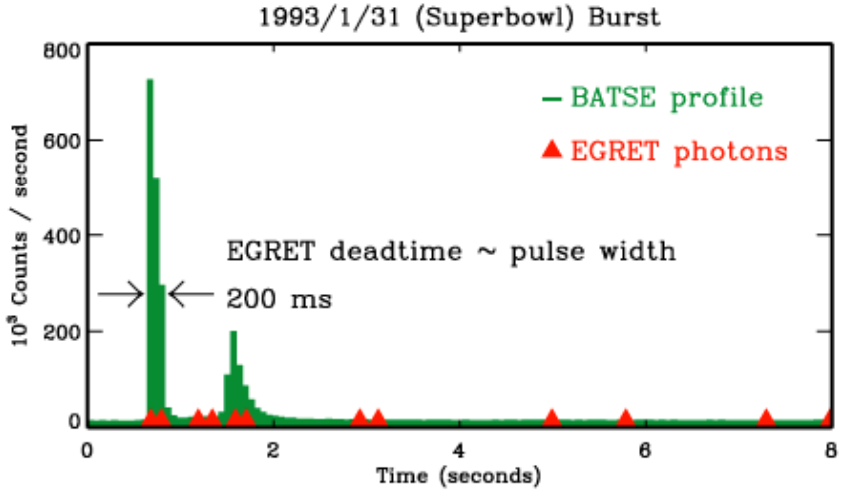
Pulsars



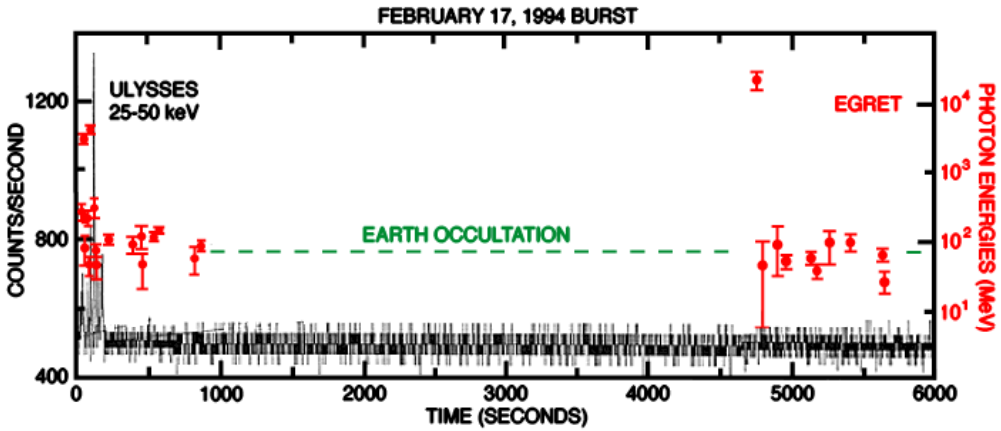
Challenge # 3

- Need fast timing for gamma-ray detection (improving EGRET deadtime, 100 msec → 100 microsec or less).

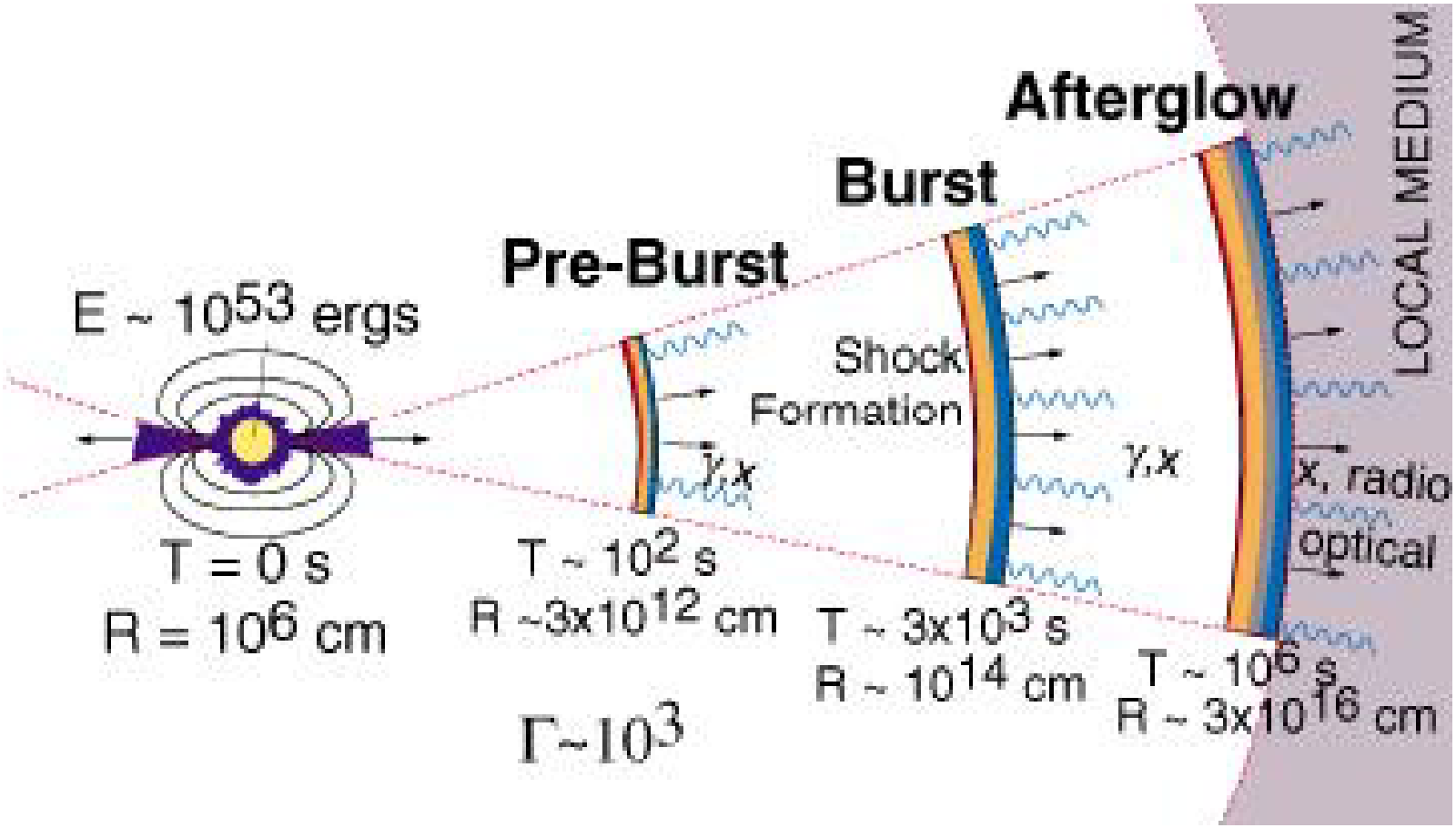
Prompt Emission (GRB 930131)



Delayed Emission (GRB 940217)

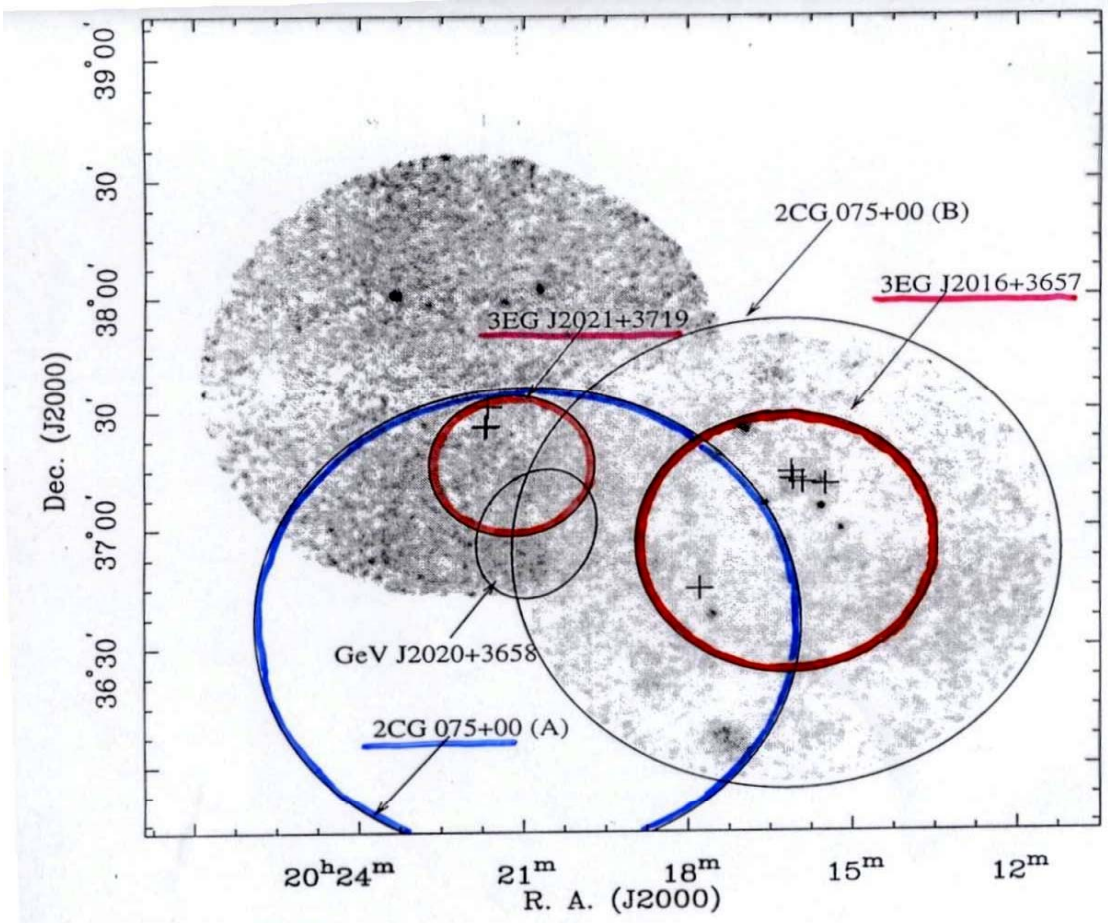


GRB

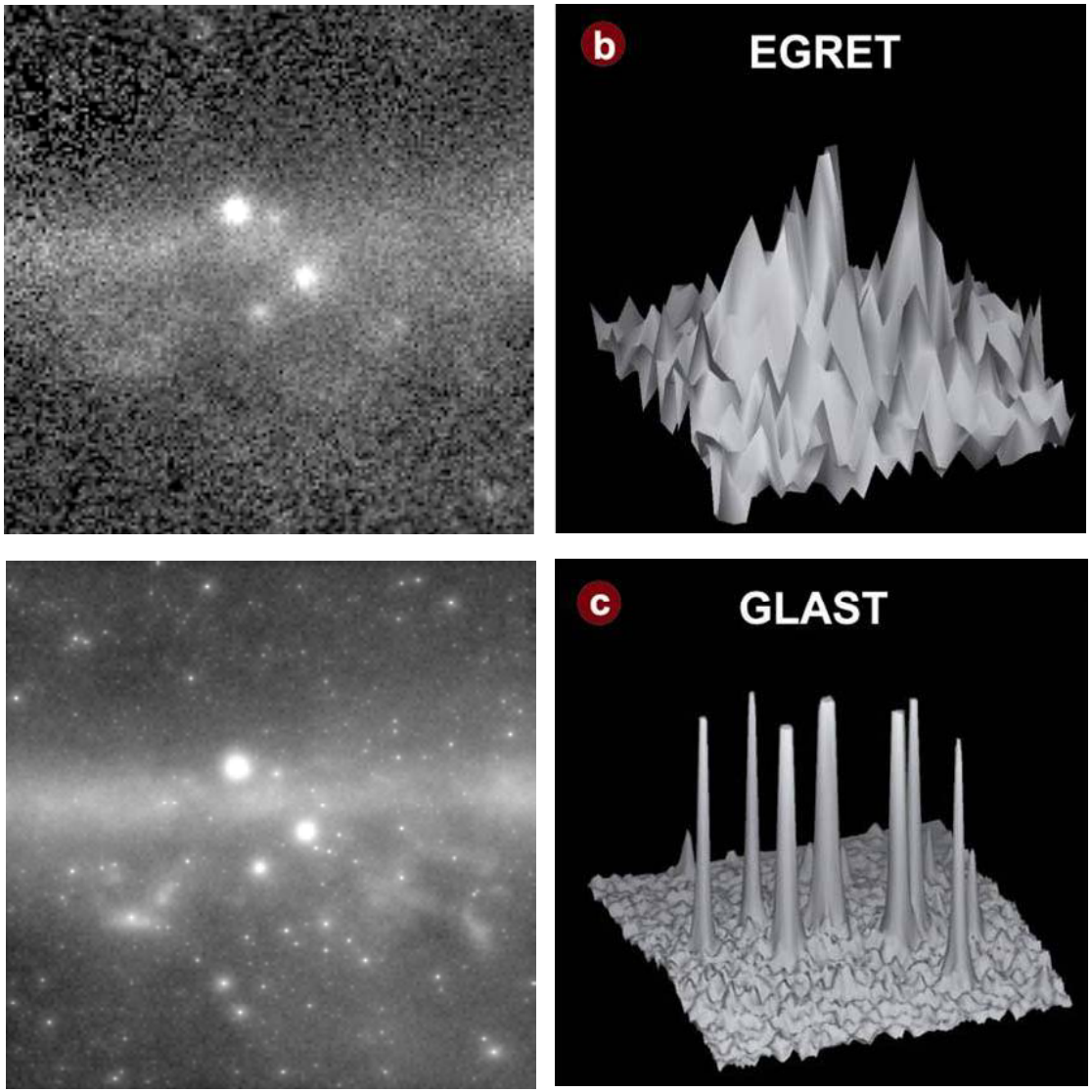

Afterglow
Burst
Pre-Burst
LOCAL MEDIUM
E ~ 10^53 ergs
Shock
Formation
γ,x
x, radio
optical
T = 0 s
R = 10^6 cm
T ~ 10^2 s
R ~3x10^12 cm
T ~ 3x10^3 s
R ~ 10^14 cm
T ~ 10^6 s
R ~ 3x10^16 cm
Γ~10^3

Challenge # 4

- Need arcminute positioning of gamma-ray sources (improving EGRET error box radii by a factor of 2-10).

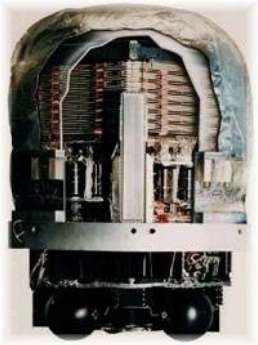


Technology impact -- PSF



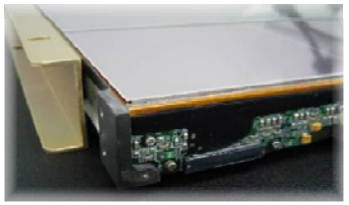
Cygnus region (15^0 x 15^0), $E\gamma > 1$ GeV

EGRET
(1991-2000)
Phases 1-5



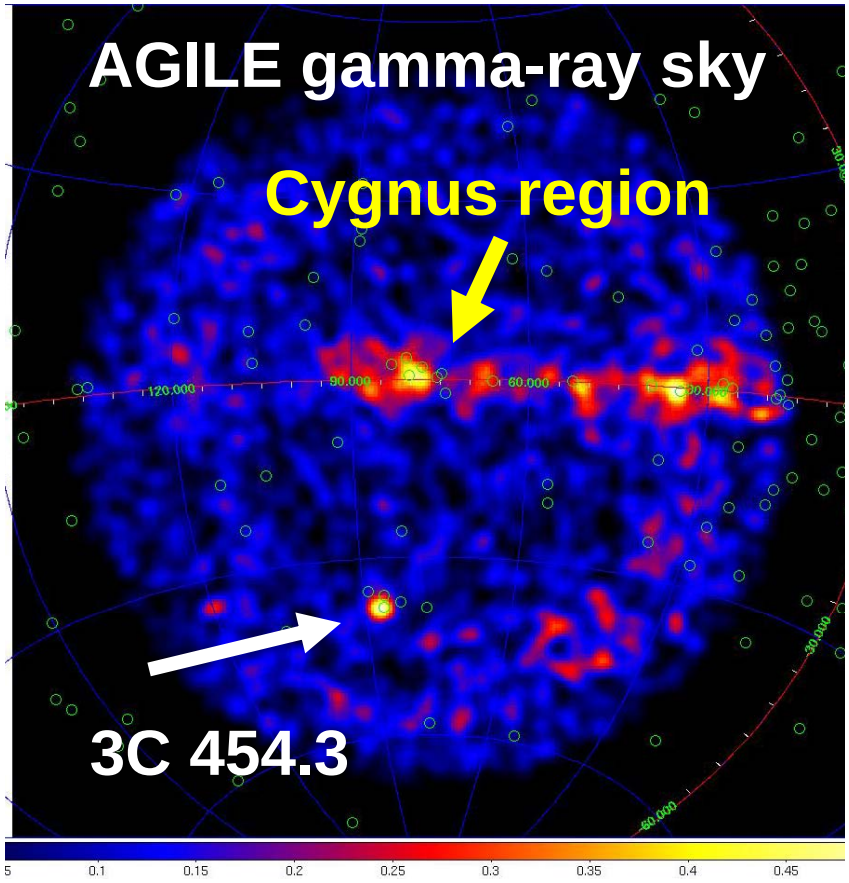
Spark chamber
- **sense electrode spacing ~mm**
- **sensitive layer depth ~cm**
  - ***up to 28 hit over >1m***

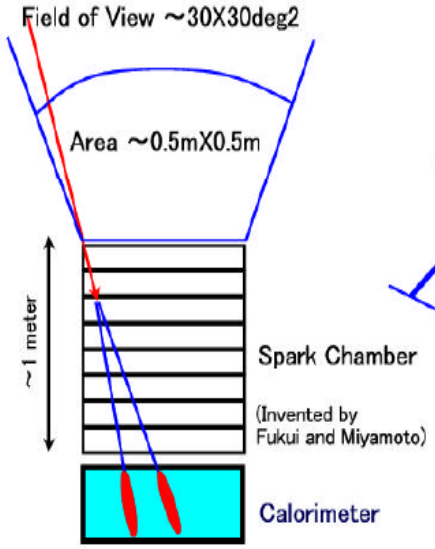
LAT
(2008- >2013)
1-yr simulation



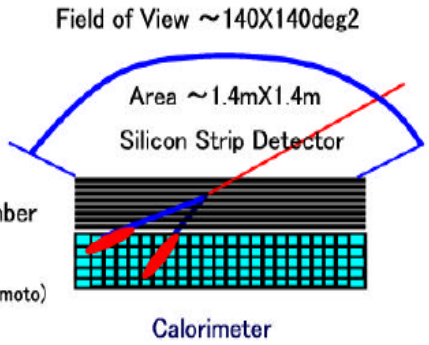
Si-strip detectors
- **sense electrode spacing ~0.2mm**
  - ***better single hit resolution***
- **sensitive layer depth ~0.4mm**
  - ***up to 36 hit over 0.8m***
  - ***converter proximity to minimize MCS***

Technology impact - FoV





EGRET on Compton GRO

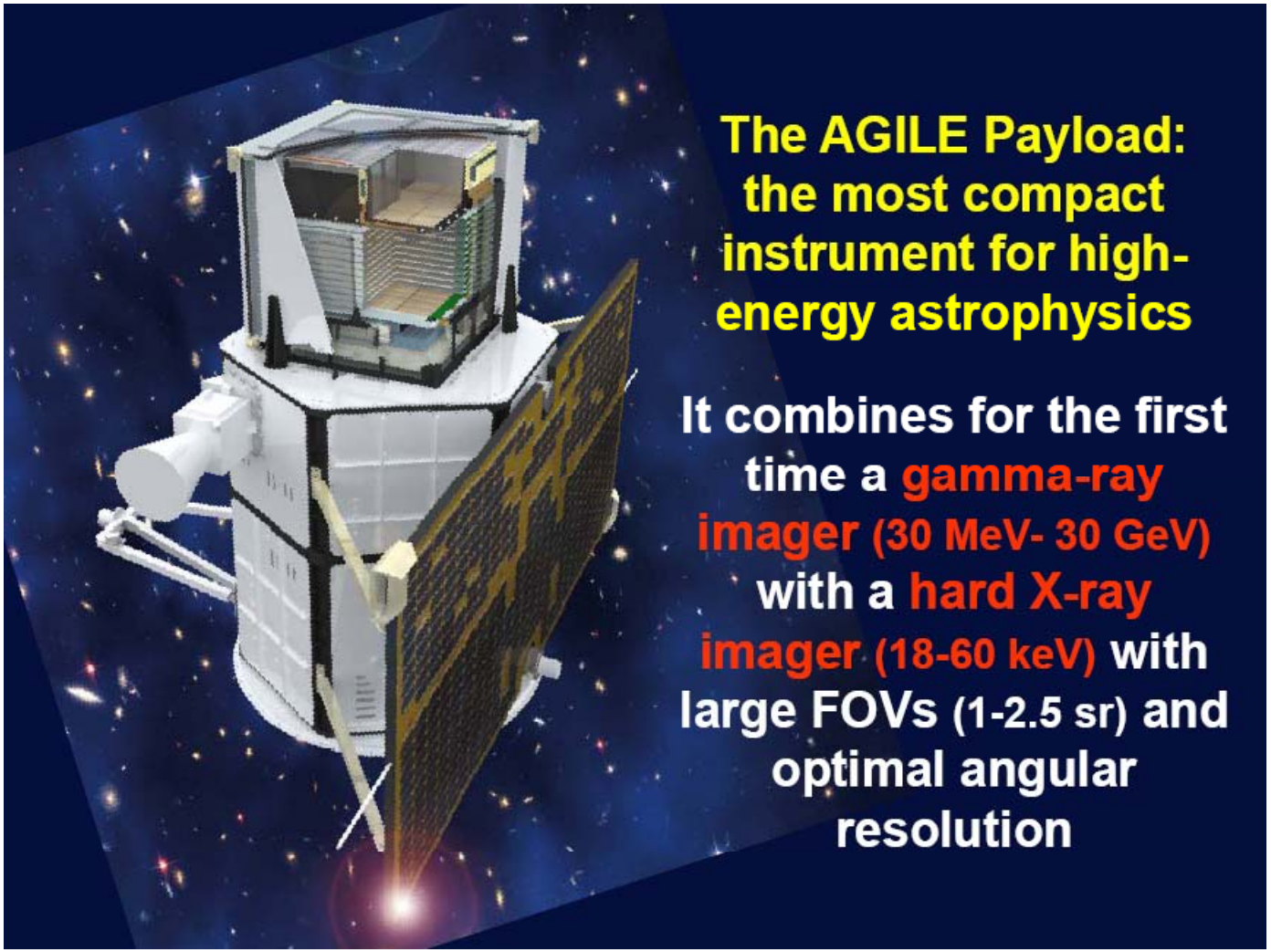


GLAST Large Area Telescope

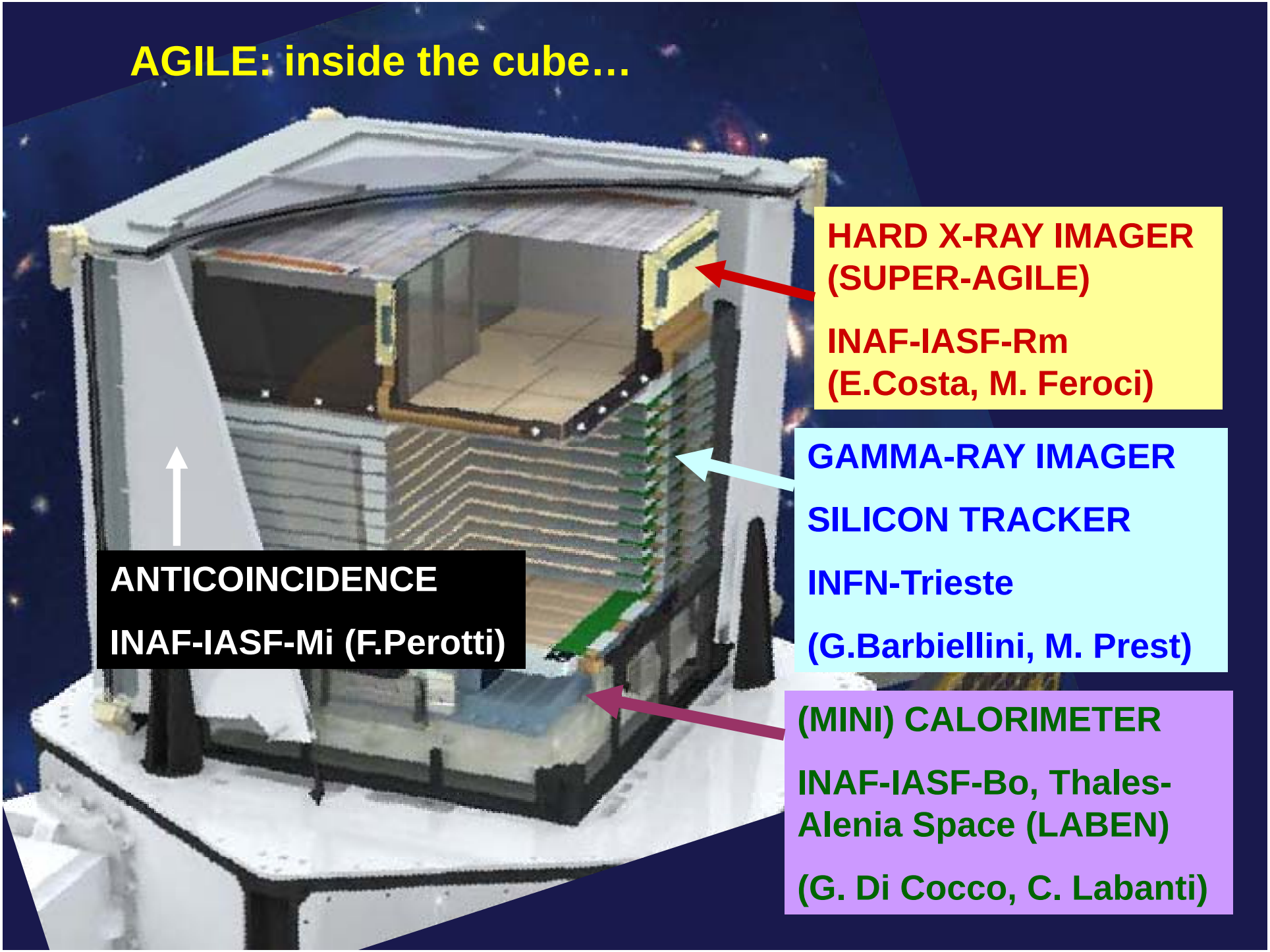
AGILE

AGILE

AGILE instrument



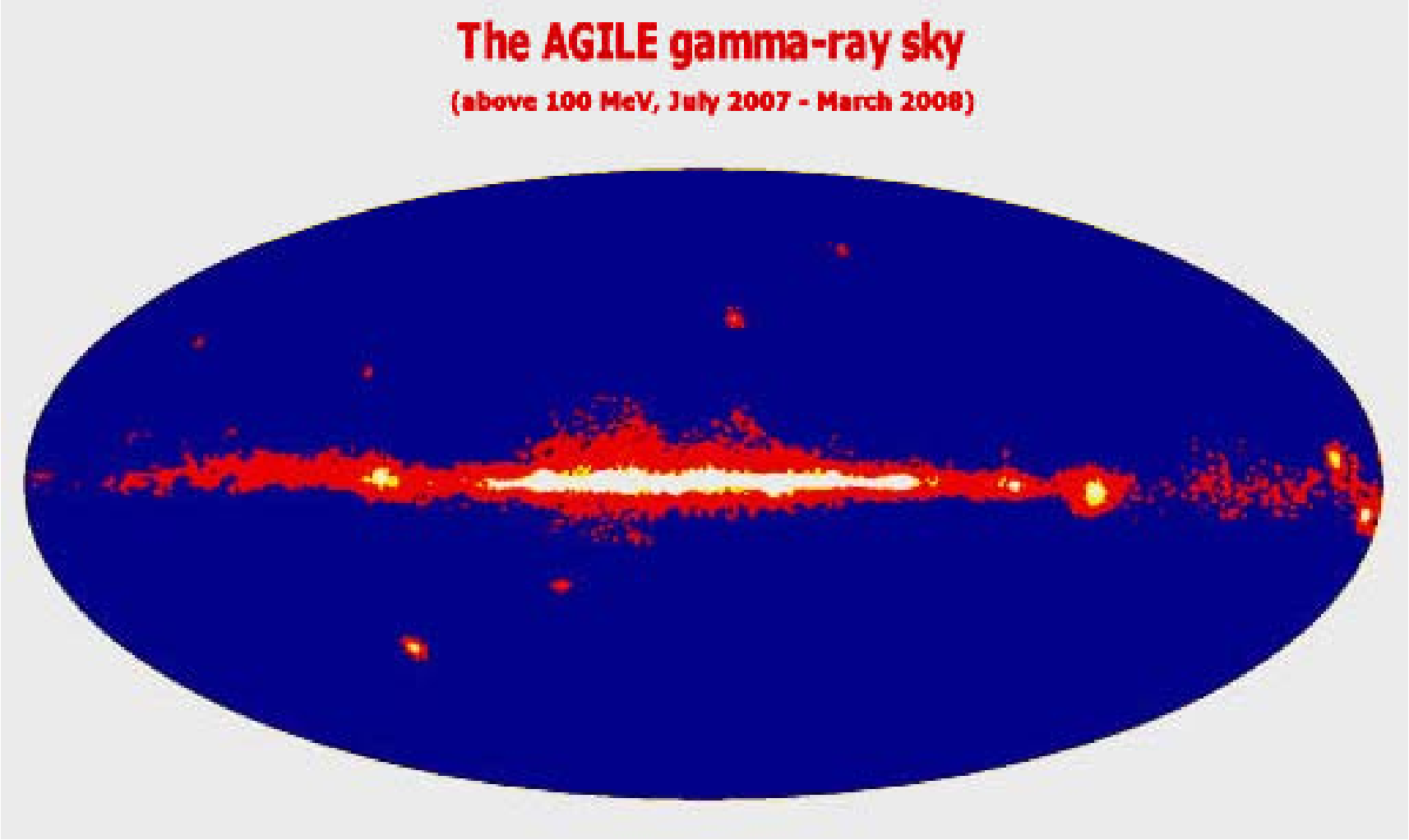
AGILE: inside the cube…



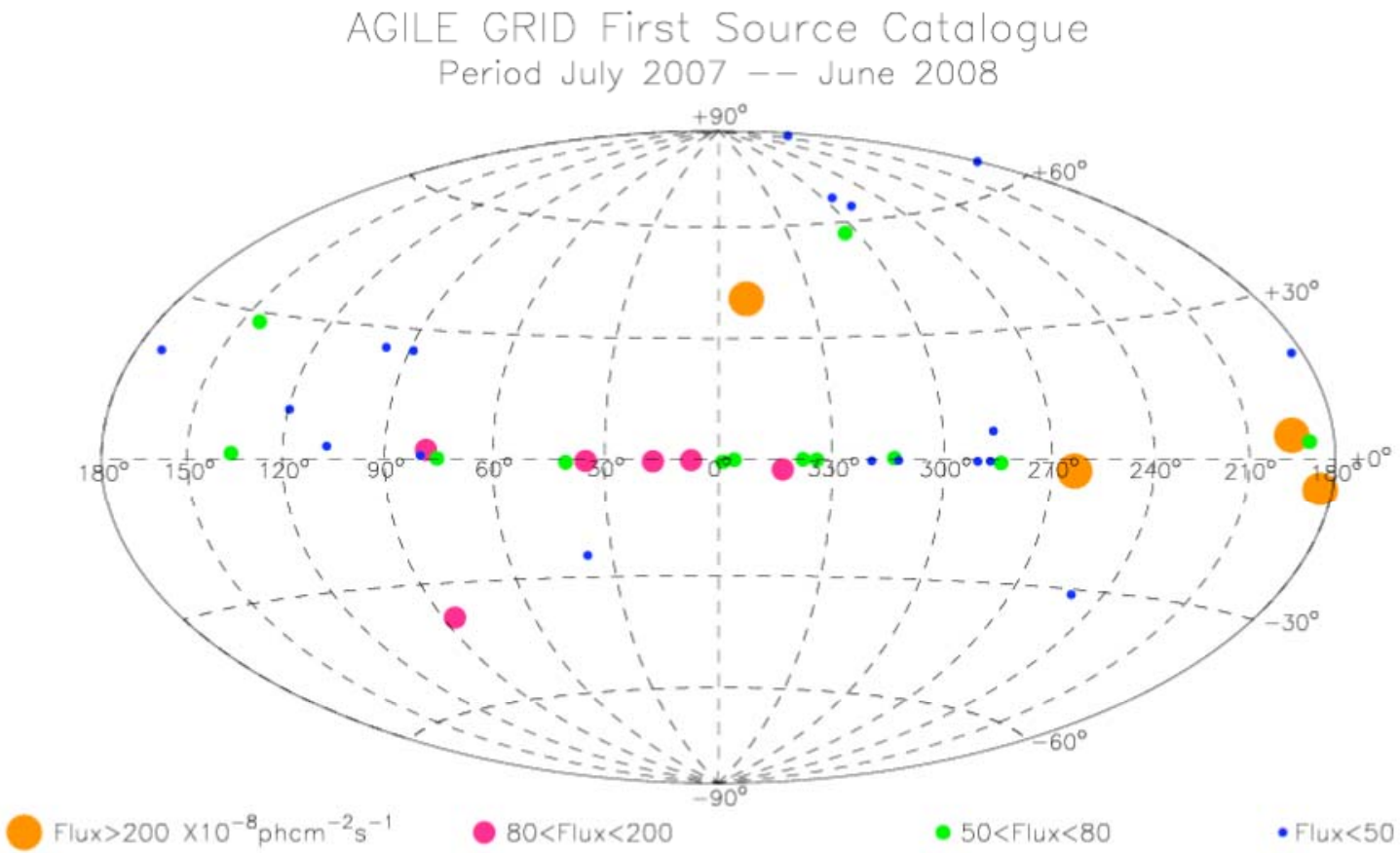
The AGILE tracker

AGILE launch

The AGILE sky



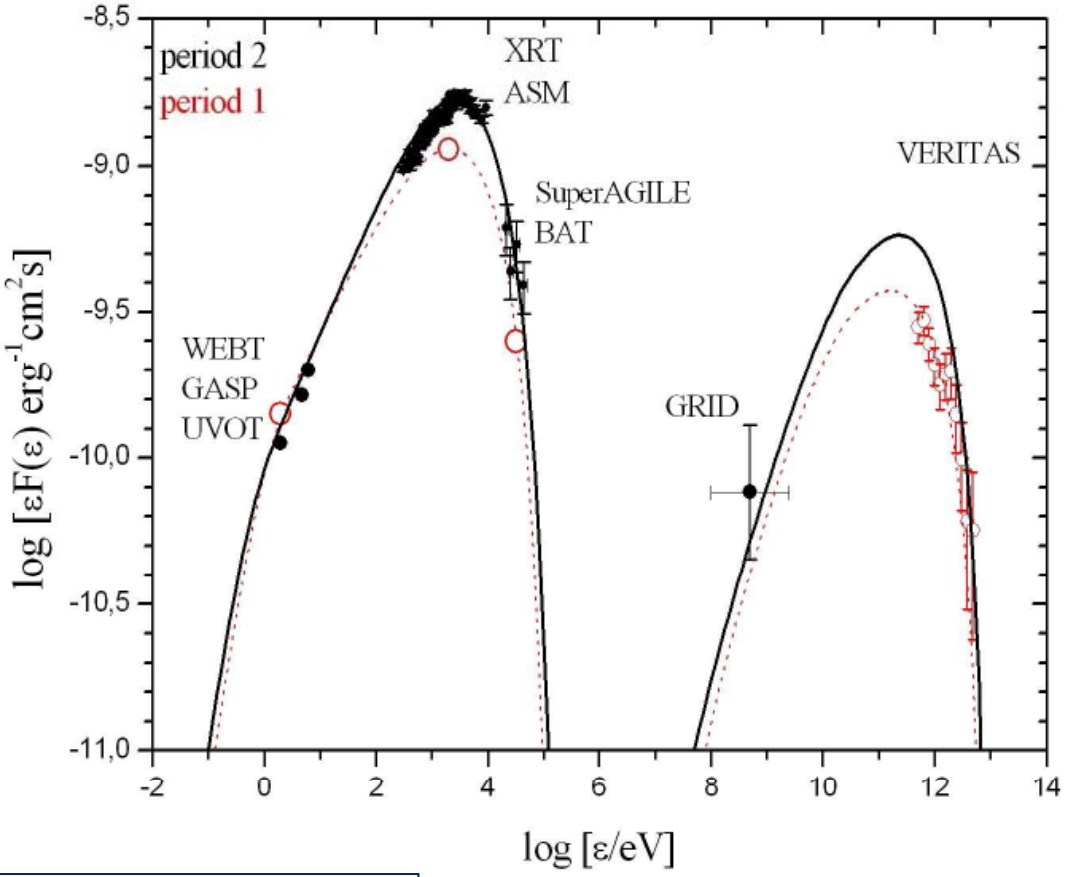
AGILE sources



Pittori et al. 2009

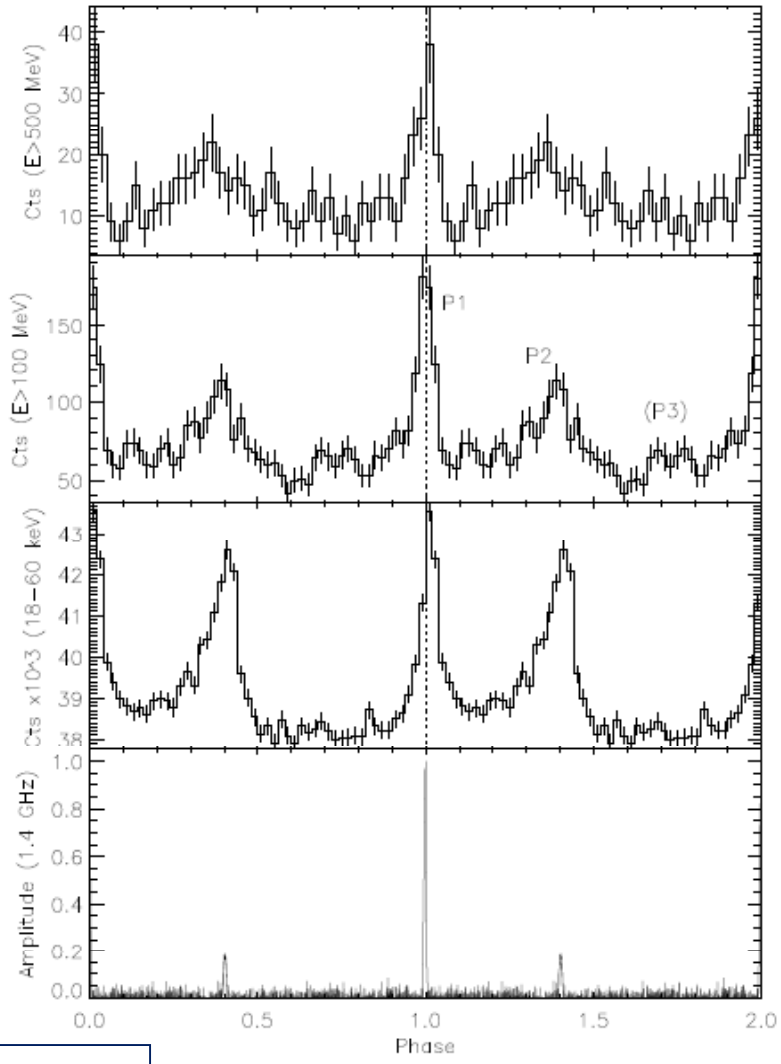
Challenge # 1 – AGN

joint campaign with MAGIC and VERITAS on Mkn 421



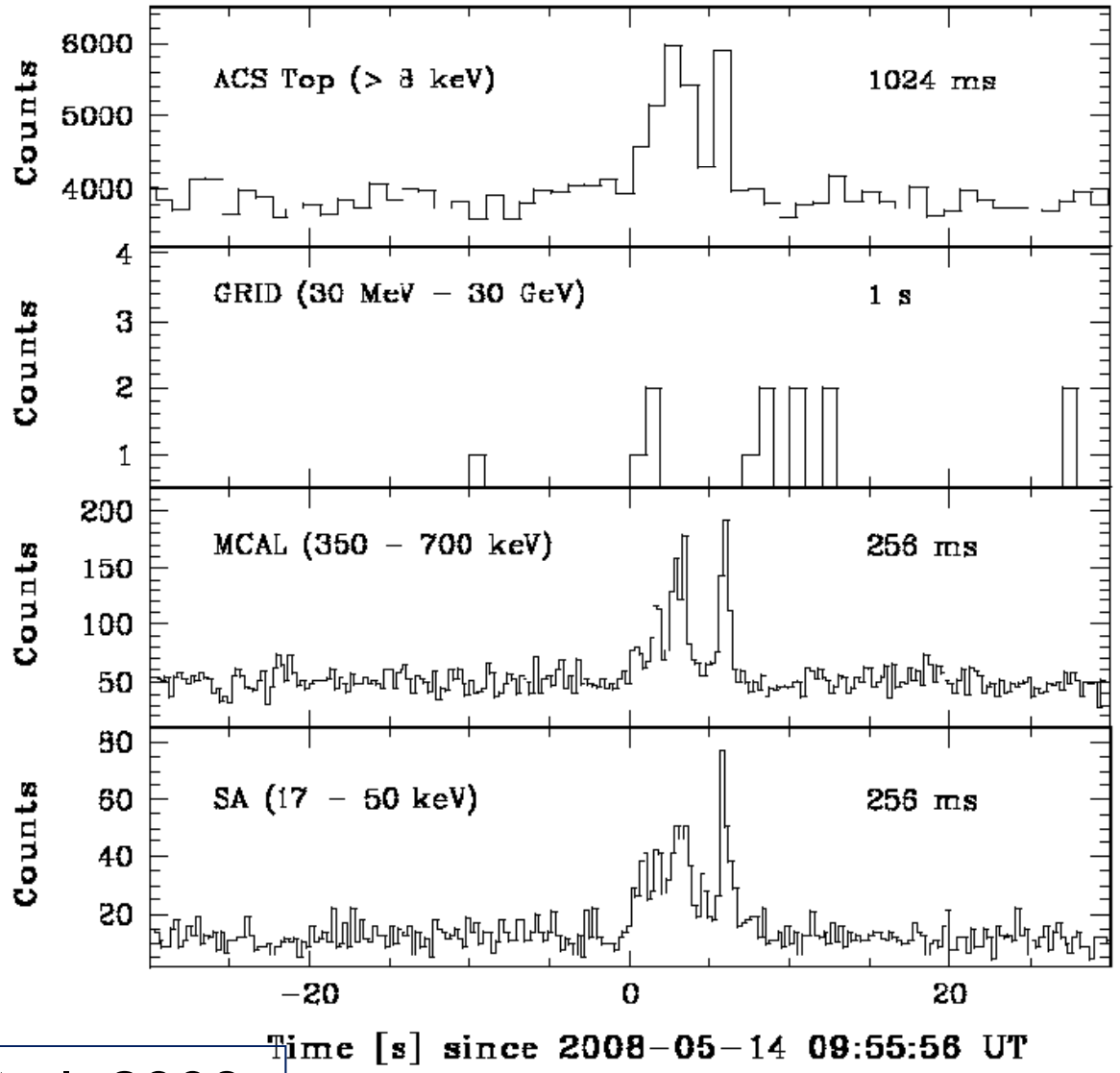
Donnarumma et al. 2009

Challenge # 2 – Pulsar
High Precision Timing (eg. Crab)



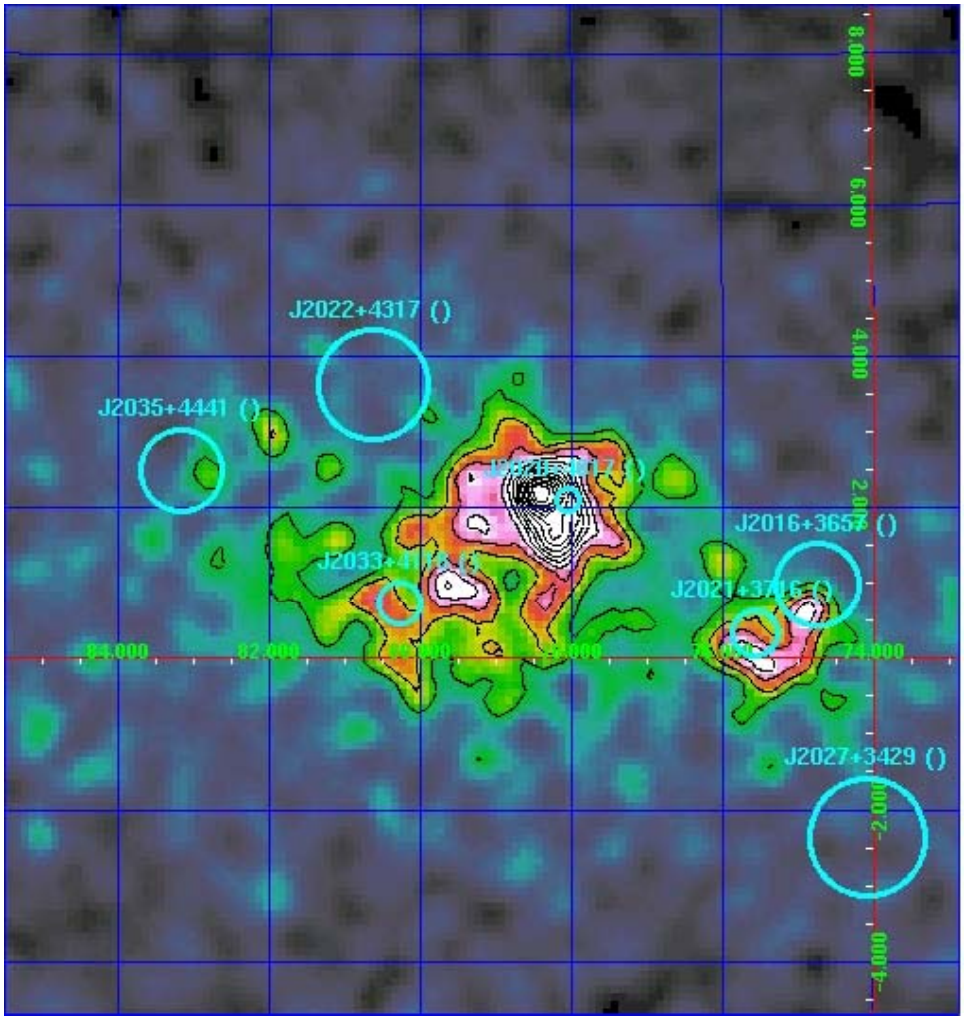
Pellizzoni et al. 2009

Challenge # 3 – GRB



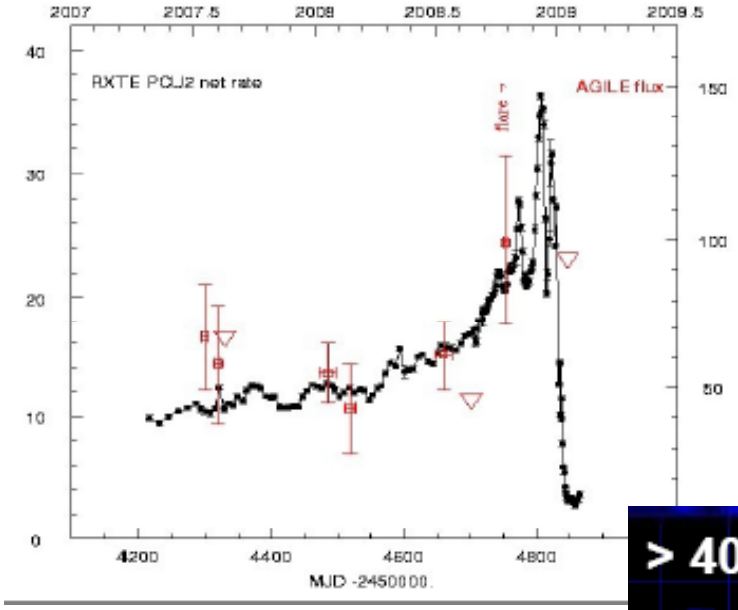
Giuliani et al. 2008

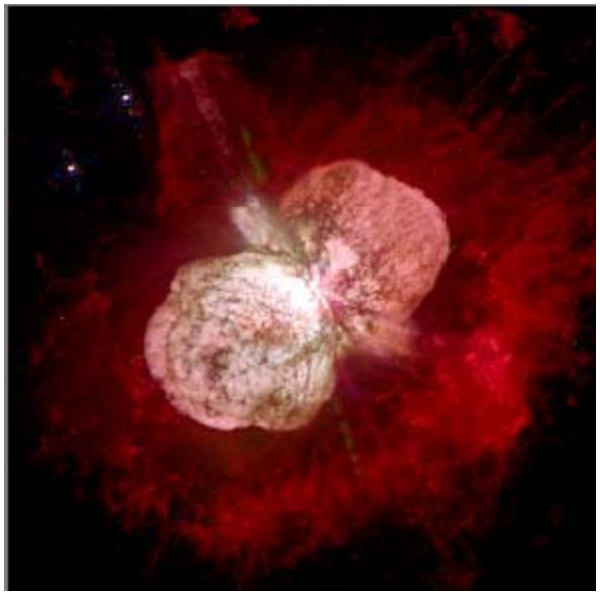
Challenge # 4 – Unidentified

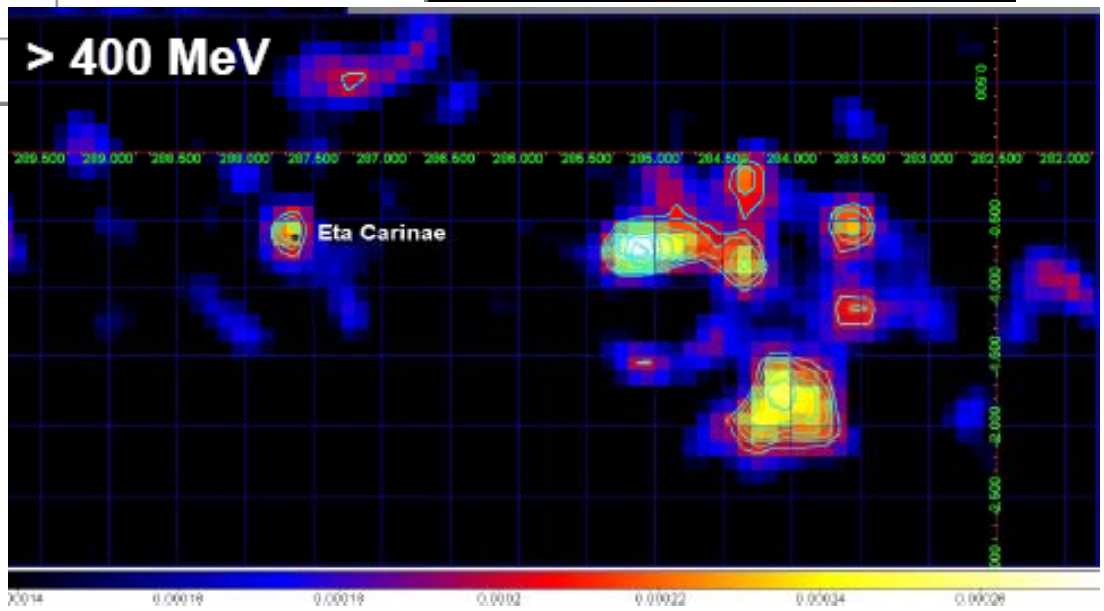


Chen et al. in prep.

The Carina field



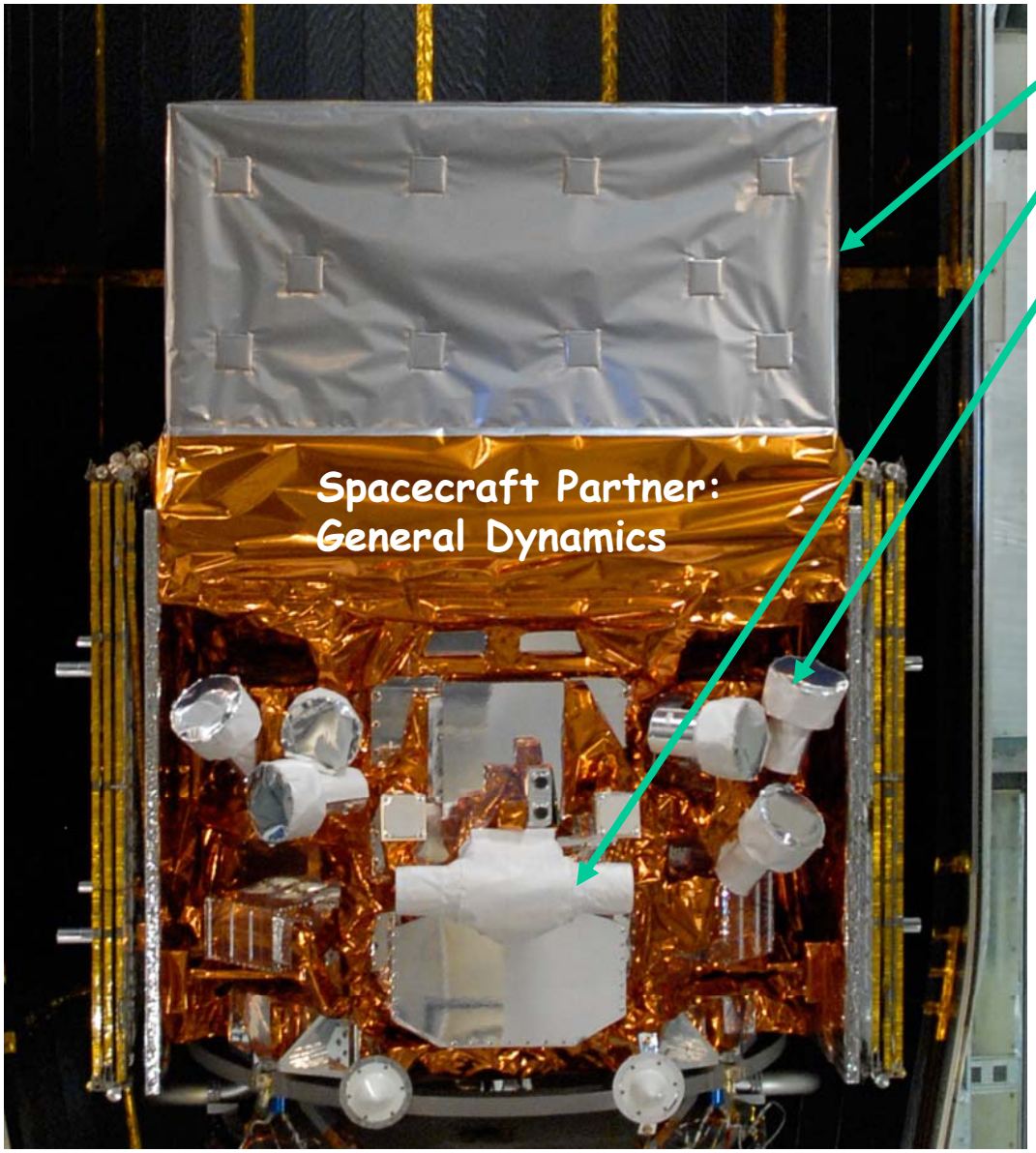




Tavani et al. 2009

Fermi LAT

The Gamma-ray Observatory



Large AreaTelescope (LAT)
20 MeV - >300 GeV

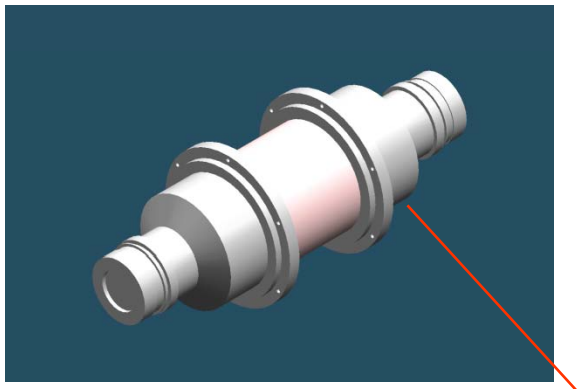
Gamma-ray Burst Monitor (GBM)
NaI and BGO Detectors
8 keV - 40 MeV

KEY FEATURES

- **Huge field of view**
  - **LAT: 20% of the sky at any instant; in sky survey mode, expose all parts of sky for ~30 minutes every 3 hours**
  - **GBM: whole unocculted sky at any time.**
- **Huge energy range, >7 decades!**
  - **including largely unexplored band 10-100 GeV**
- **Very small deadtime, <1us absolute timing accuracy**
- **Large leap in all key capabilities**
- **Great discovery potential**

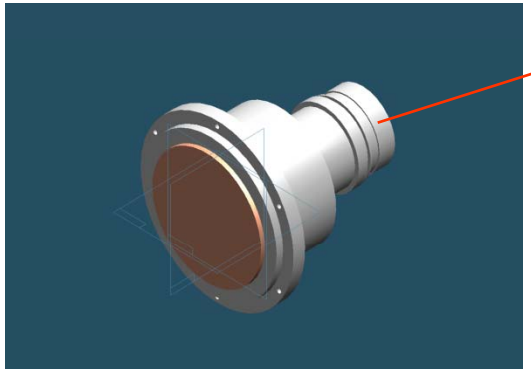
Gamma-ray Burst Monitor (GBM)

Bismuth Germanate (BGO) Scintillation Detector

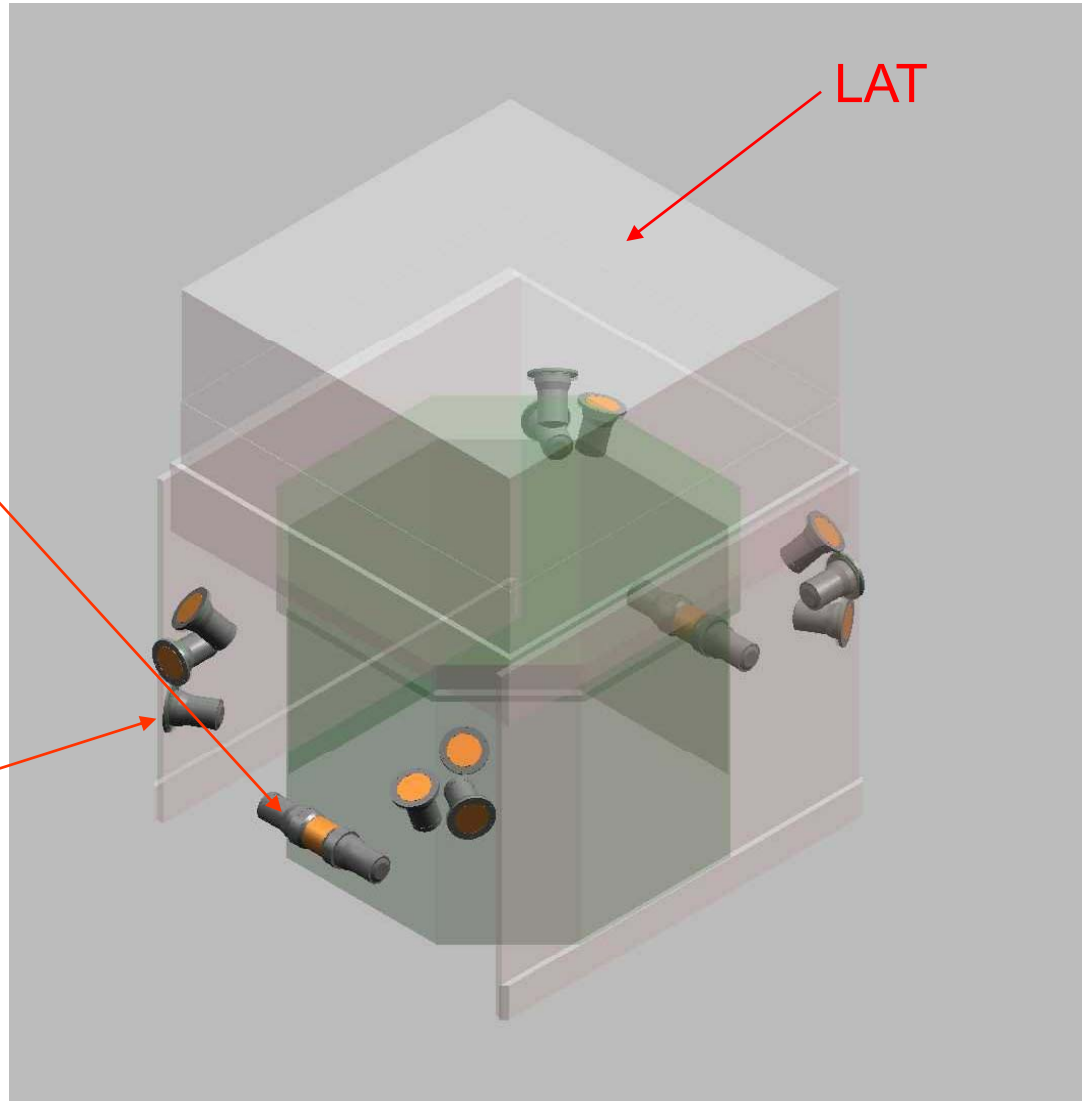


– spectral coverage: 150 keV – 40 MeV

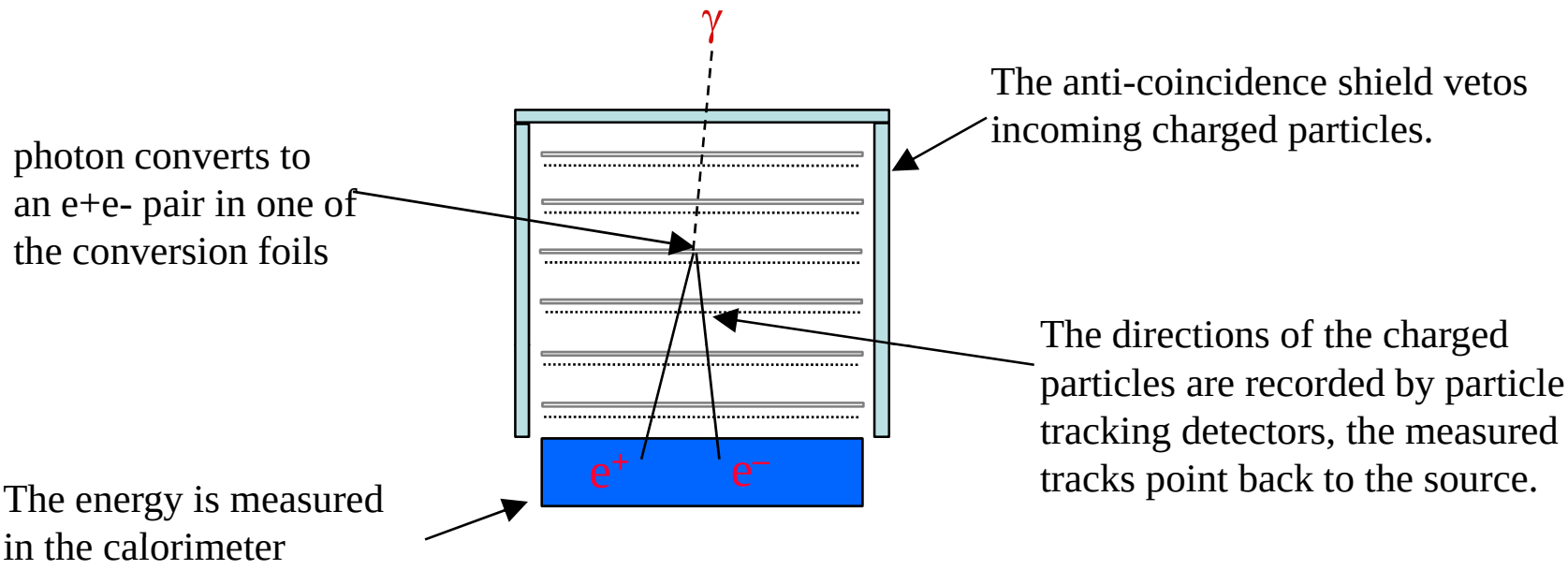
(12) Sodium Iodide (NaI) Scintillation Detectors



– spectral coverage: 8 keV – 1 MeV



Pair Conversion Technique



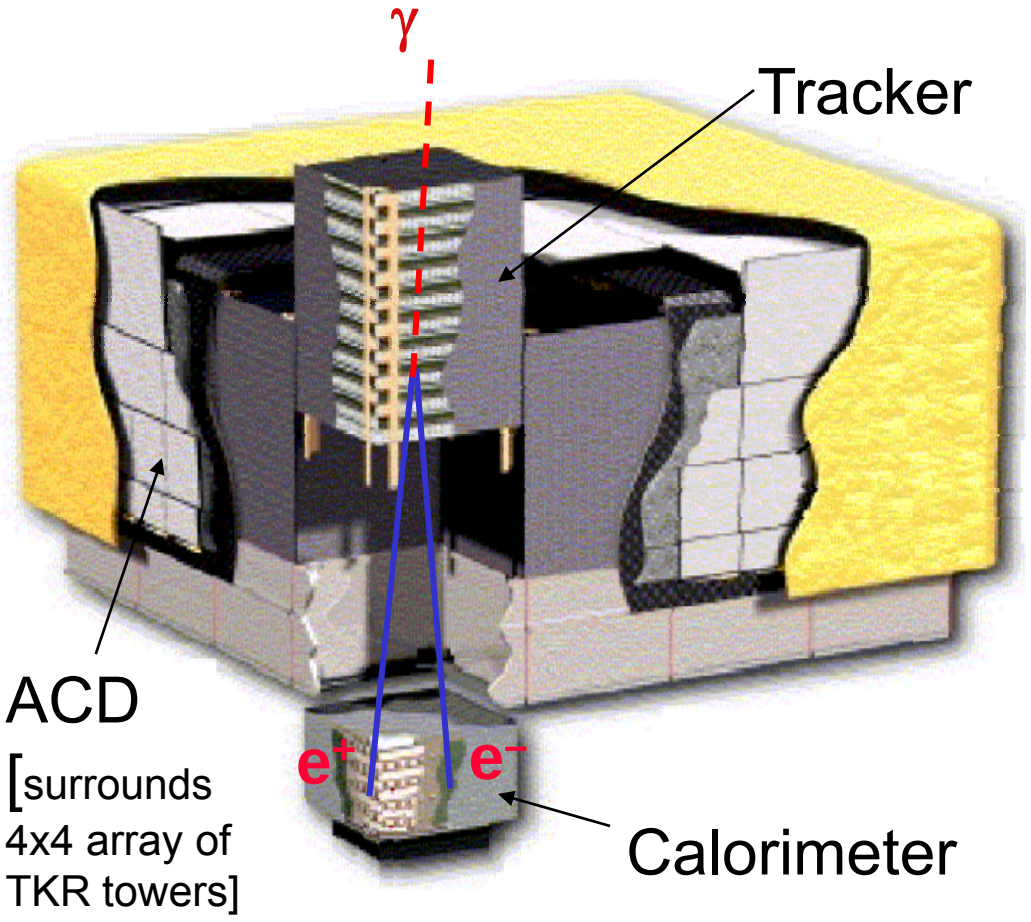
Tracker: angular resolution is determined by:
multiple scattering (at low energies) => Many thin layers
position resolution (at high energies) => fine pitch detectors

Calorimeter:
Enough X_0 to contain shower, shower leakage correction.

Anti-coincidence detector:
Must have high efficiency for rejecting charged particles, but not veto gamma-rays

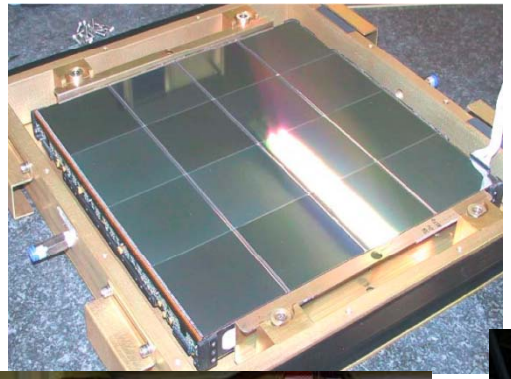
Overview of LAT

- Precision Si-strip Tracker (TKR) 18 XY tracking planes. Single-sided silicon strip detectors (228 μm pitch) Measure the photon direction; gamma ID.
- Hodoscopic CsI Calorimeter(CAL) Array of 1536 CsI(Tl) crystals in 8 layers. Measure the photon energy; image the shower.
- Segmented Anticoincidence Detector (ACD) 89 plastic scintillator tiles. Reject background of charged cosmic rays; segmentation removes self-veto effects at high energy.
- Electronics System Includes flexible, robust hardware trigger and software filters.

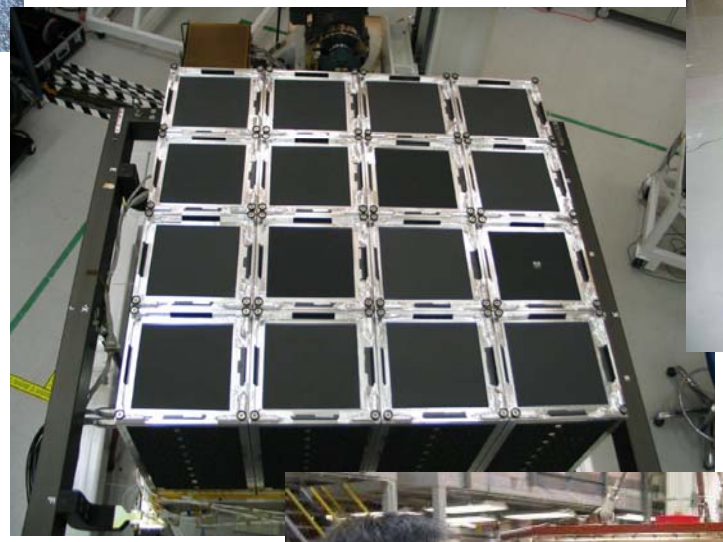


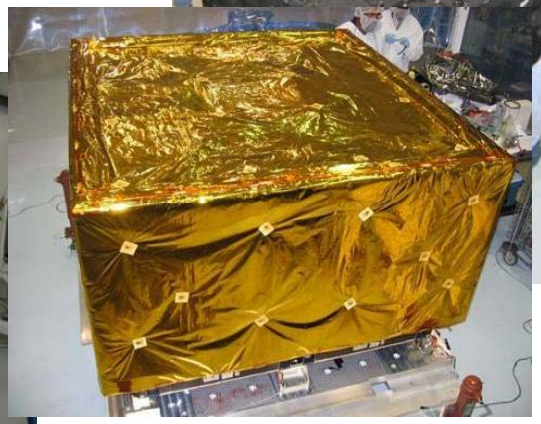
Systems work together to identify and measure the flux of cosmic gamma rays with energy 20 MeV - >300 GeV.

LAT Construction: An International Effort



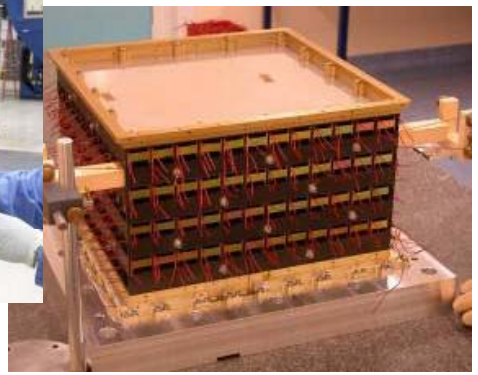
Integration &
Data System: US





ACD: US

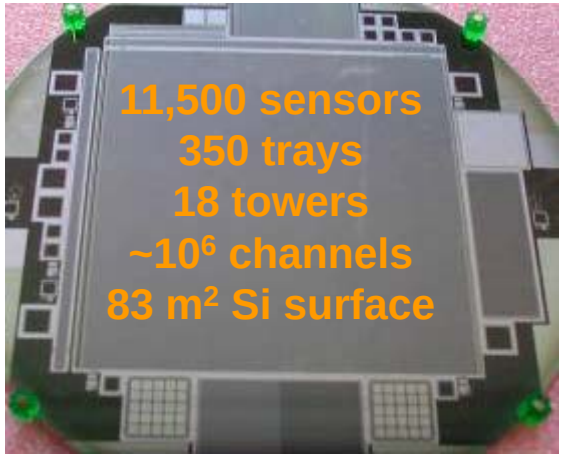
Tracker: US, Italy, Japan

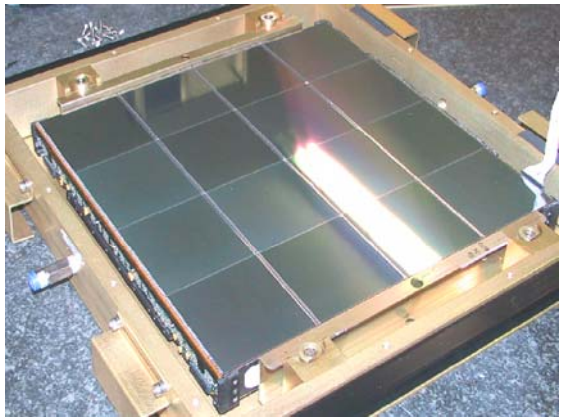


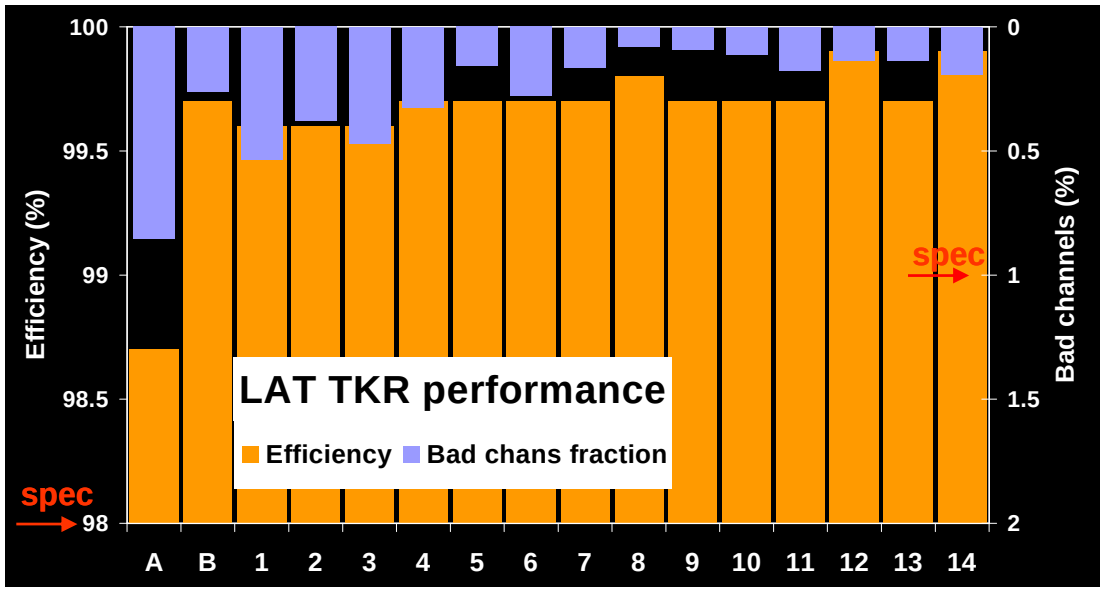
Calorimeter: US, France, Sweden

LAT Silicon Tracker

team effort involving physicists and engineers from Italy (INFN & ASI), Japan*, and the United States*







Fermi 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.

Fermi Gamma-ray Space Telescope

GLAST renamed *Fermi* by NASA on August 26, 2008

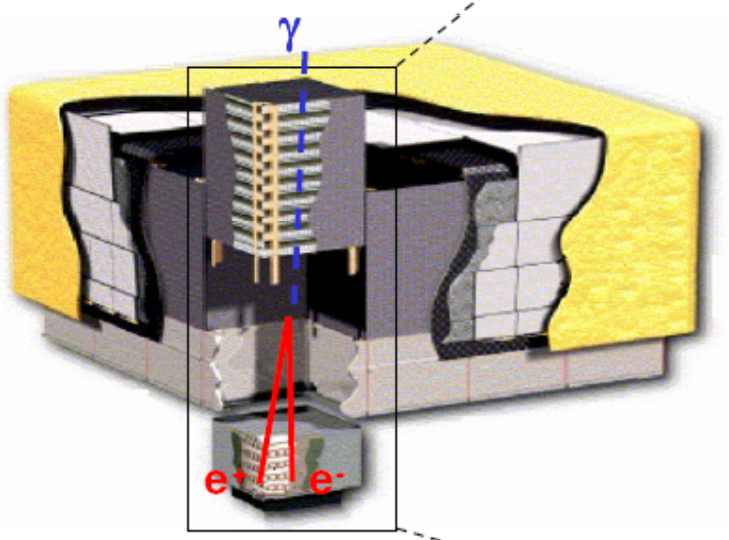
http://fermi.gsfc.nasa.gov/

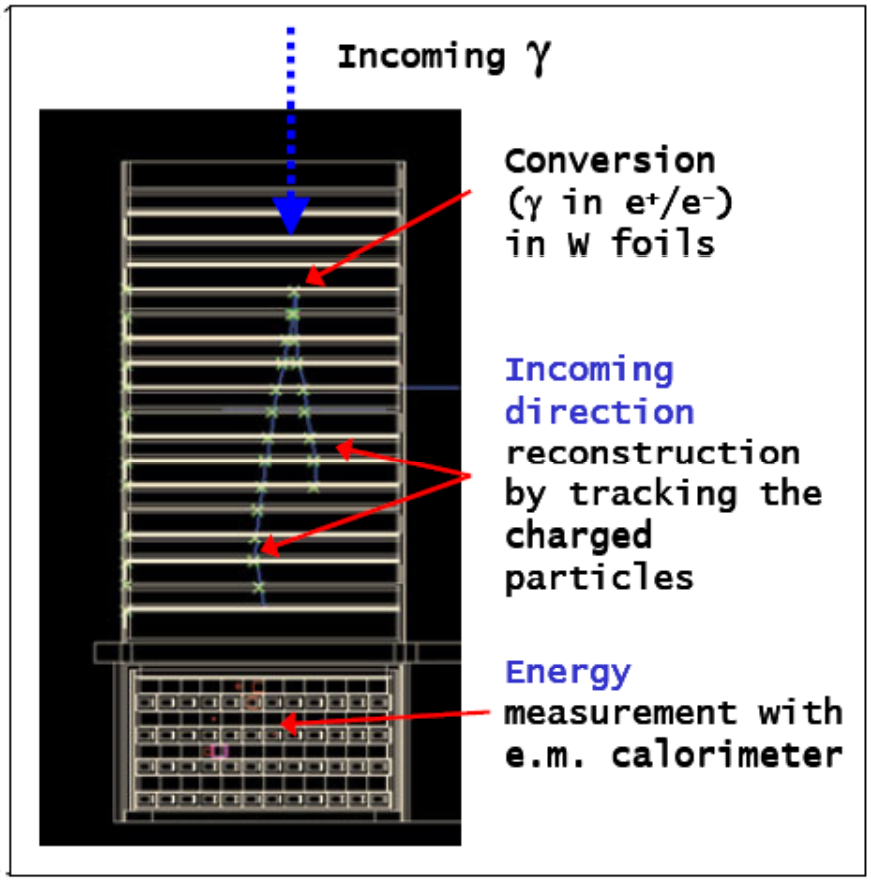
“ Enrico Fermi (1901-1954) was an Italian physicist who immigrated to the United States. He was the first to suggest a viable mechanism for astrophysical particle acceleration. This work is the foundation for our understanding of many types of sources to be studied by NASA’s Fermi Gamma-ray Space Telescope, formerly known as GLAST. ”

LAT as Gamma-ray detector

4 x 4 array of identical towers with:

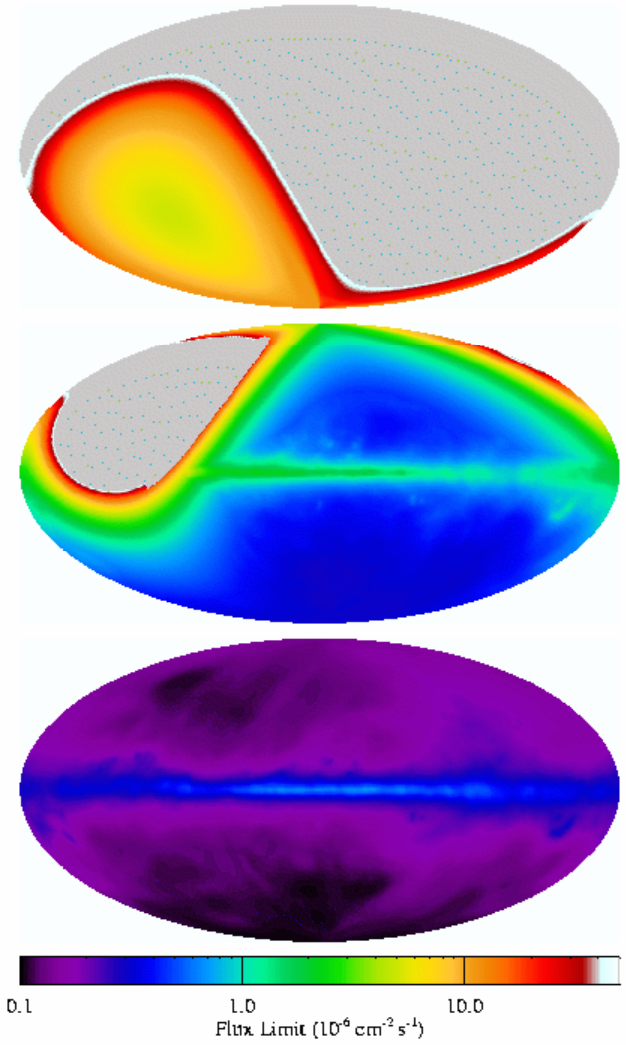
- Precision Si-strip tracker (TKR)
  - With W converter foils
- Hodoscopic CsI calorimeter (CAL)
- DAQ and Power supply box





An anticoincidence detector around the telescope distinguishes gamma-rays from charged particles

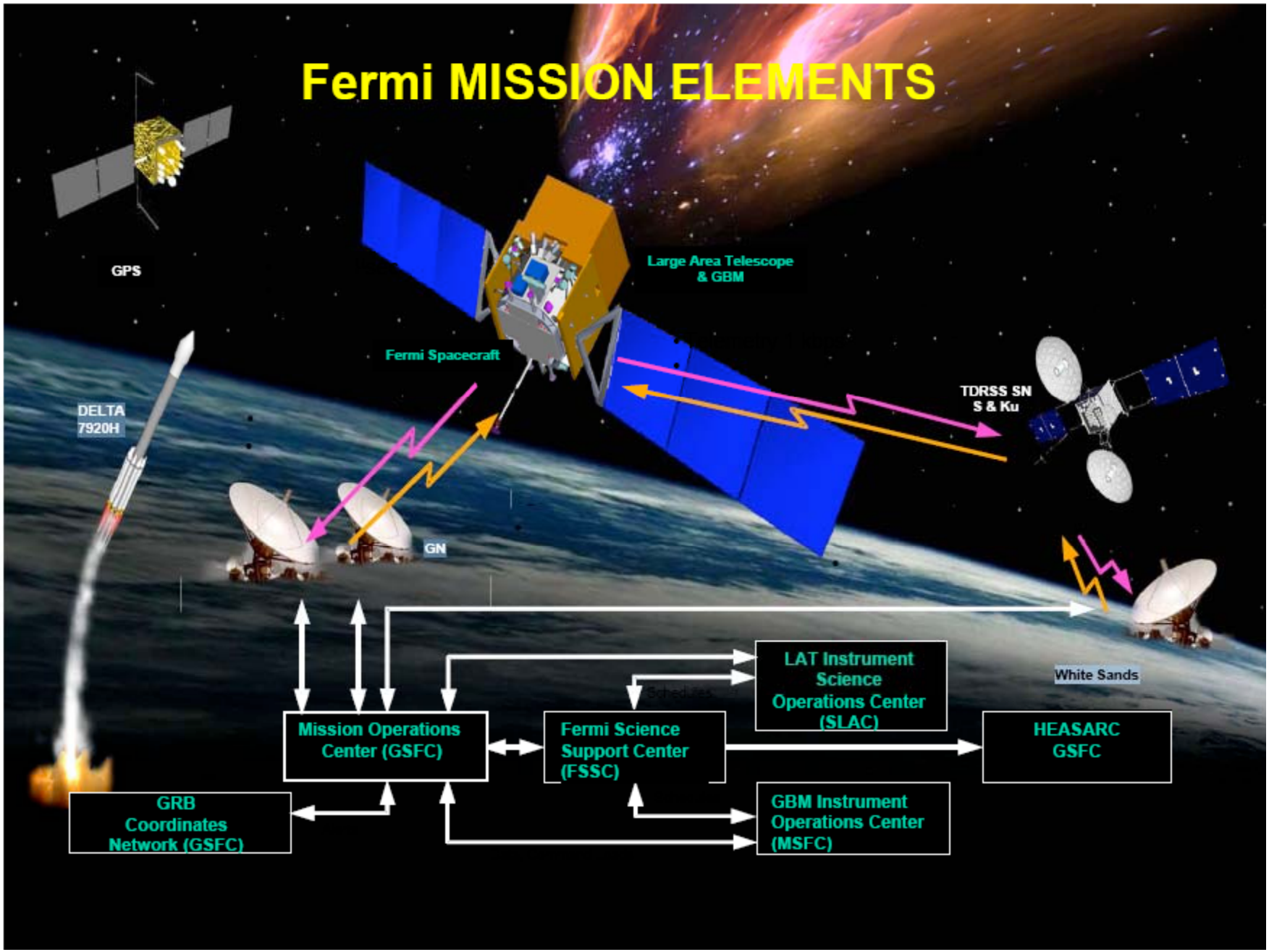
Observation Mode



The field of view of the LAT is huge > 20% of the sky.

Rocking mode provides an efficient way of observing the entire sky with reasonably uniform exposure on timescales of hours.

more exposure → greater sensitivity
more coverage → excellent for monitoring the sky on timescales from hours to years


Fermi MISSION ELEMENTS
GPS
Large Area Telescope
& GBM
Fermi Spacecraft
DELTA
7920H
TDRSS SN
S & Ku
GN
White Sands
LAT Instrument
Science
Operations Center
(SLAC)
Mission Operations
Center (GSFC)
Fermi Science
Support Center
(FSSC)
HEASARC
GSFC
GRB
Coordinates
Network (GSFC)
GBM Instrument
Operations Center
(MSFC)

Fermi LAT science

20 MeV - > 300 GeV

> several x 10^3 AGNs
blazars and radiogal = f(θ,z)
evolution z < 5
Sag A*

10-20 GRB/year
GeV afterglow
spectra to high energy

γ-ray binaries
pulsar winds
μ-quasar jets

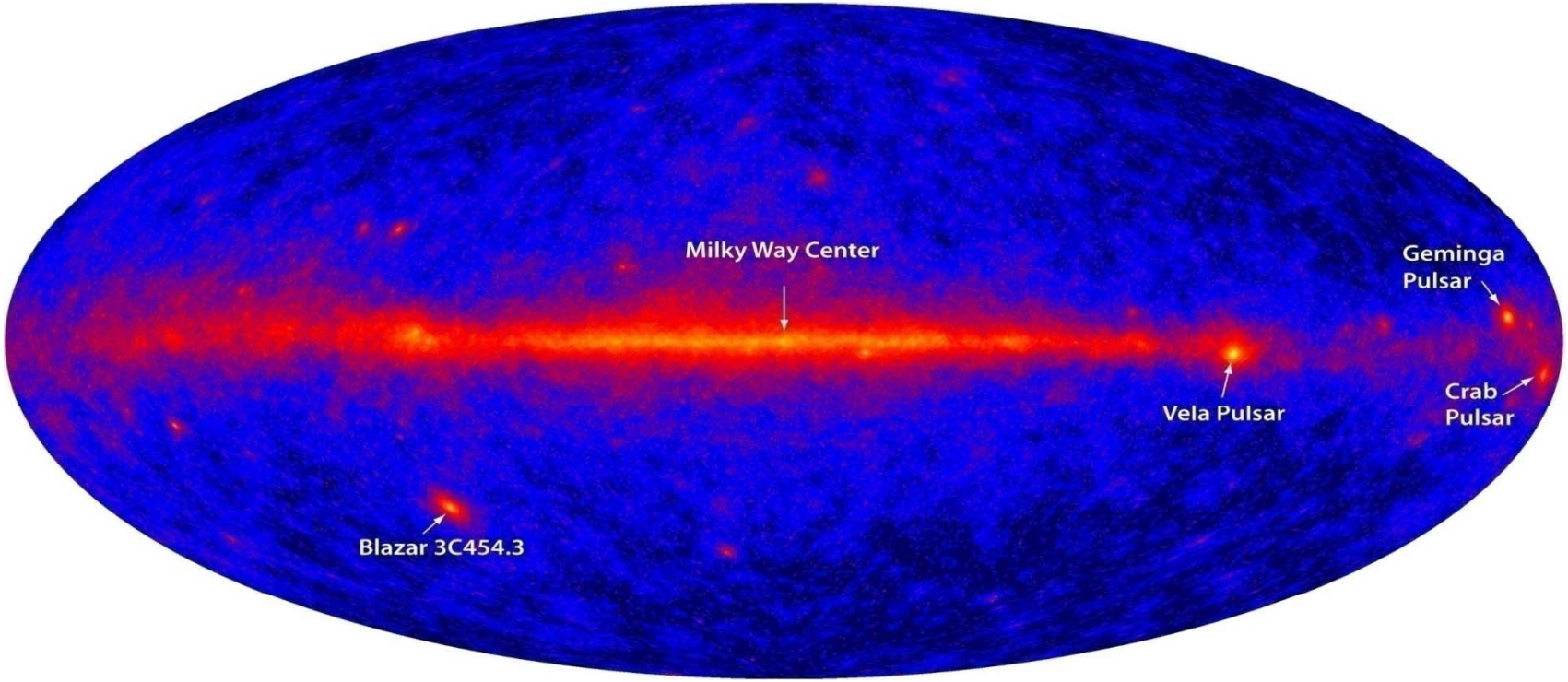
Possibilities
starburst galaxies
galaxy clusters
measure EBL
unIDs

Dark Matter
neutralino lines
sub-halo clumps; e^+ + e^- spectrum

Cosmic rays and clouds
acceleration in Supernova remnants
OB associations
propagation (Milky Way, M31, LMC, SMC)
Interstellar mass tracers in galaxies

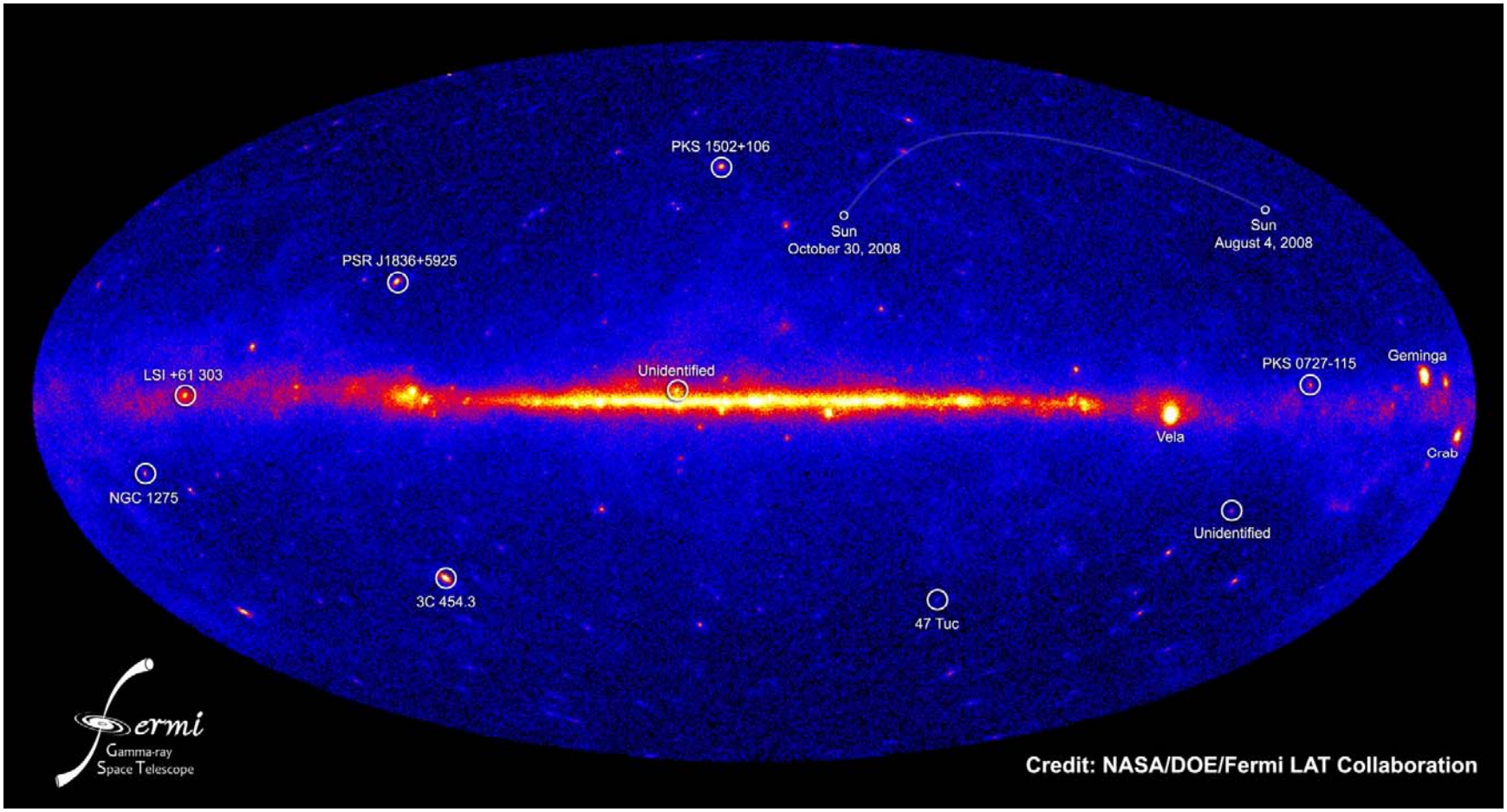
Pulsars
emission from radio and X-ray pulsars
blind searches for new Gemingas
magnetospheric physics
pulsar wind nebulae

Fermi LAT First Light

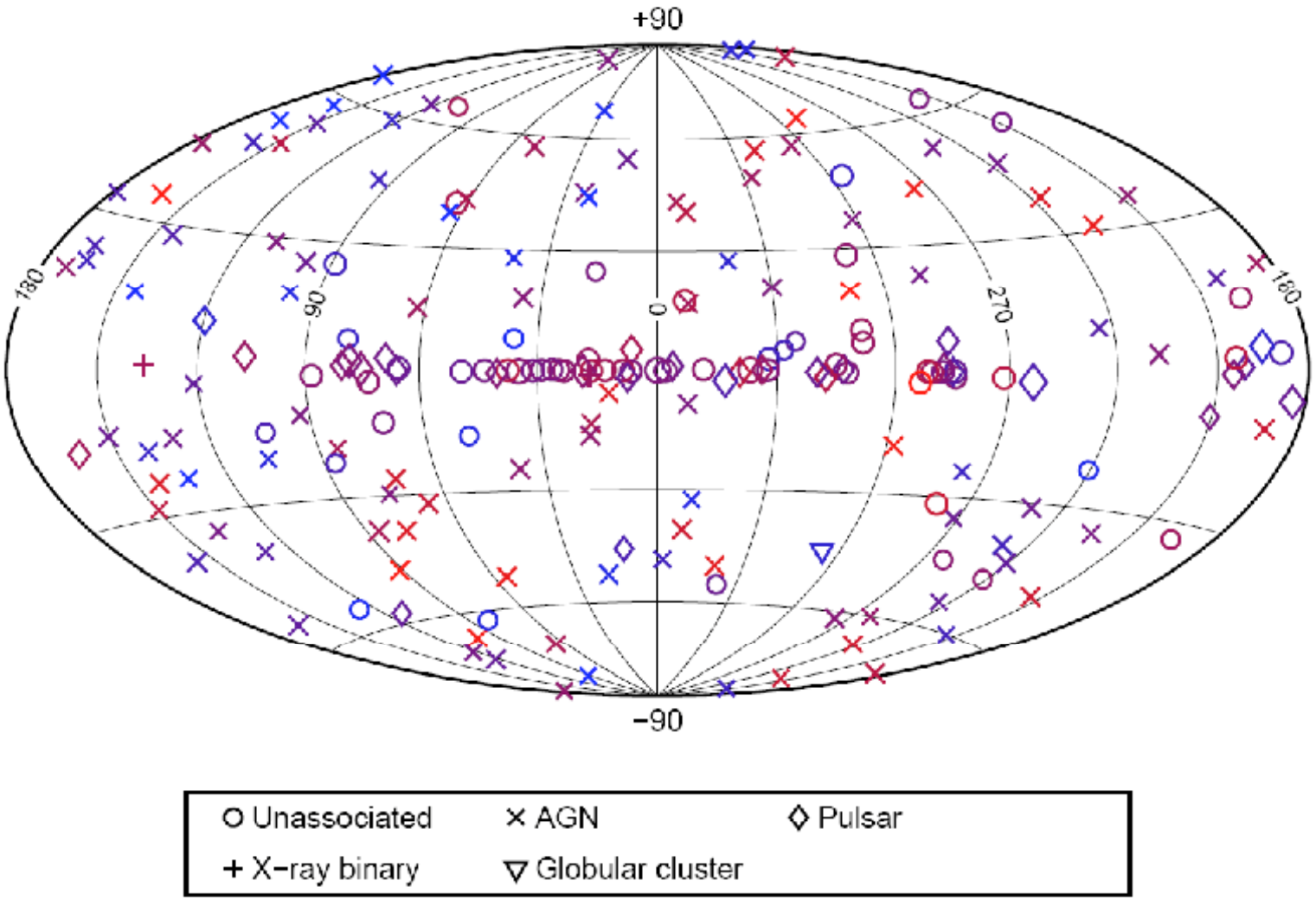


Four days of all-sky survey engineering data.

Fermi LAT 3 months image



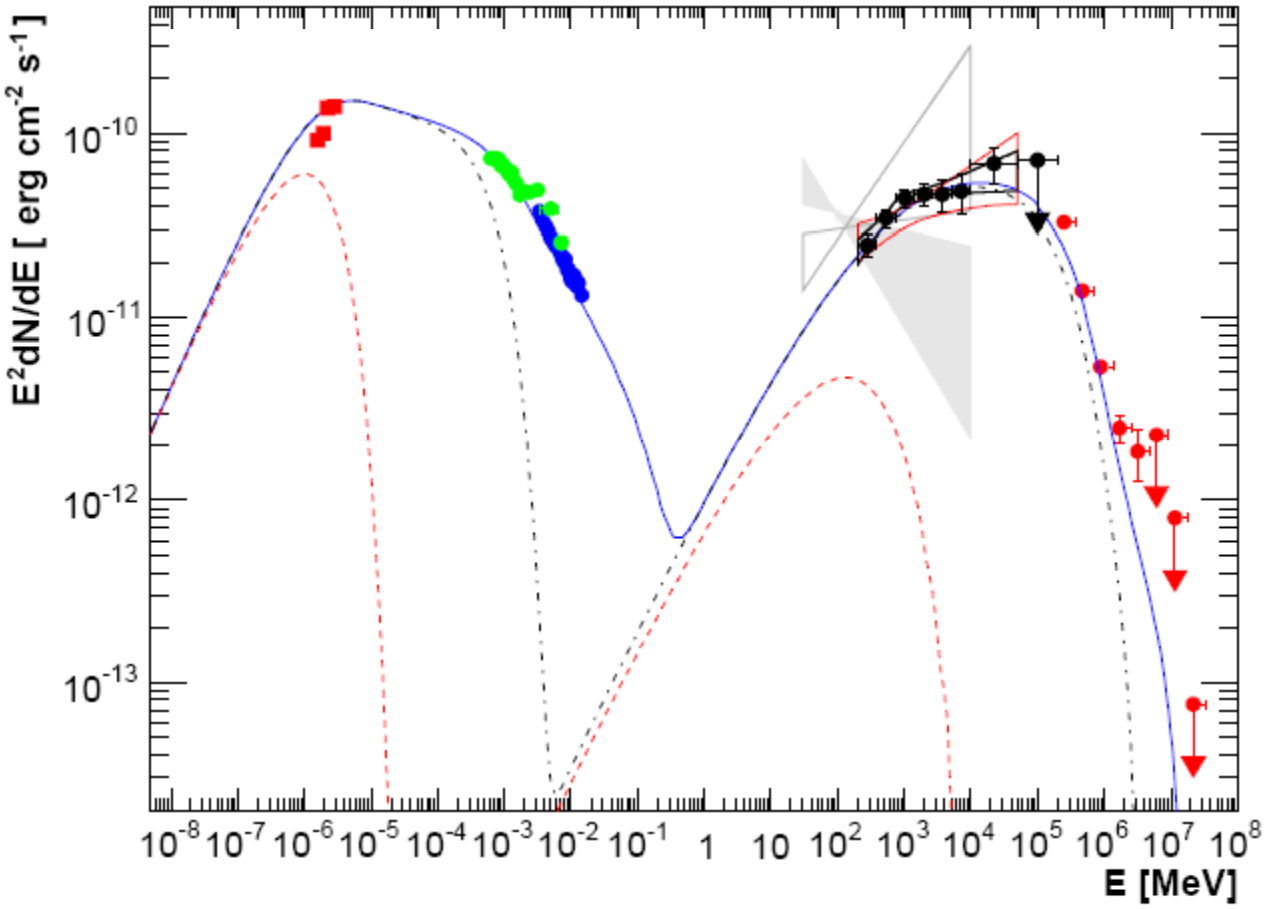
LAT bright source list



Abdo et al. 2009

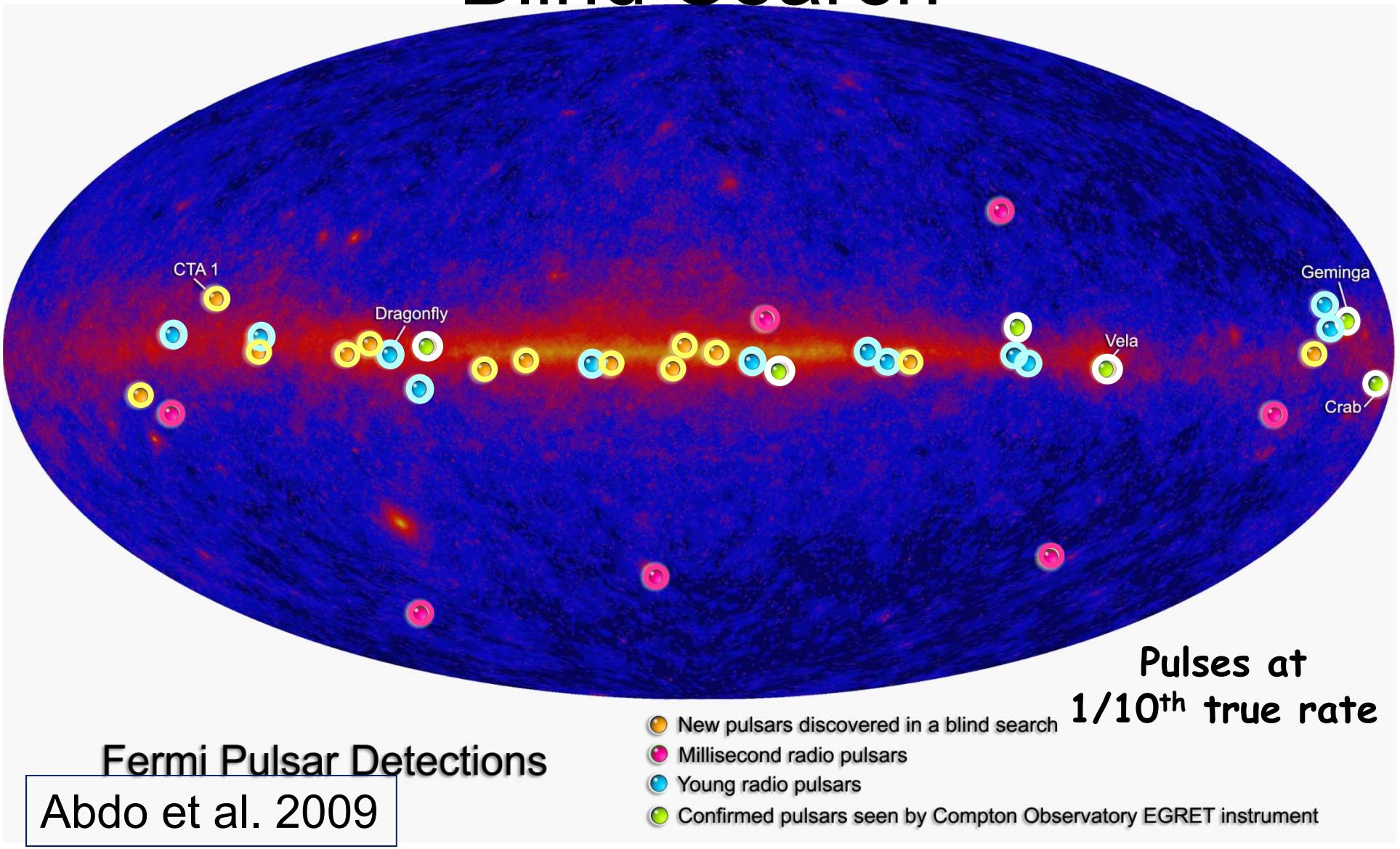
Challenge # 1 – AGN

Joint campaign on PKS 2155 with HESS



Aharonian et al. 2009

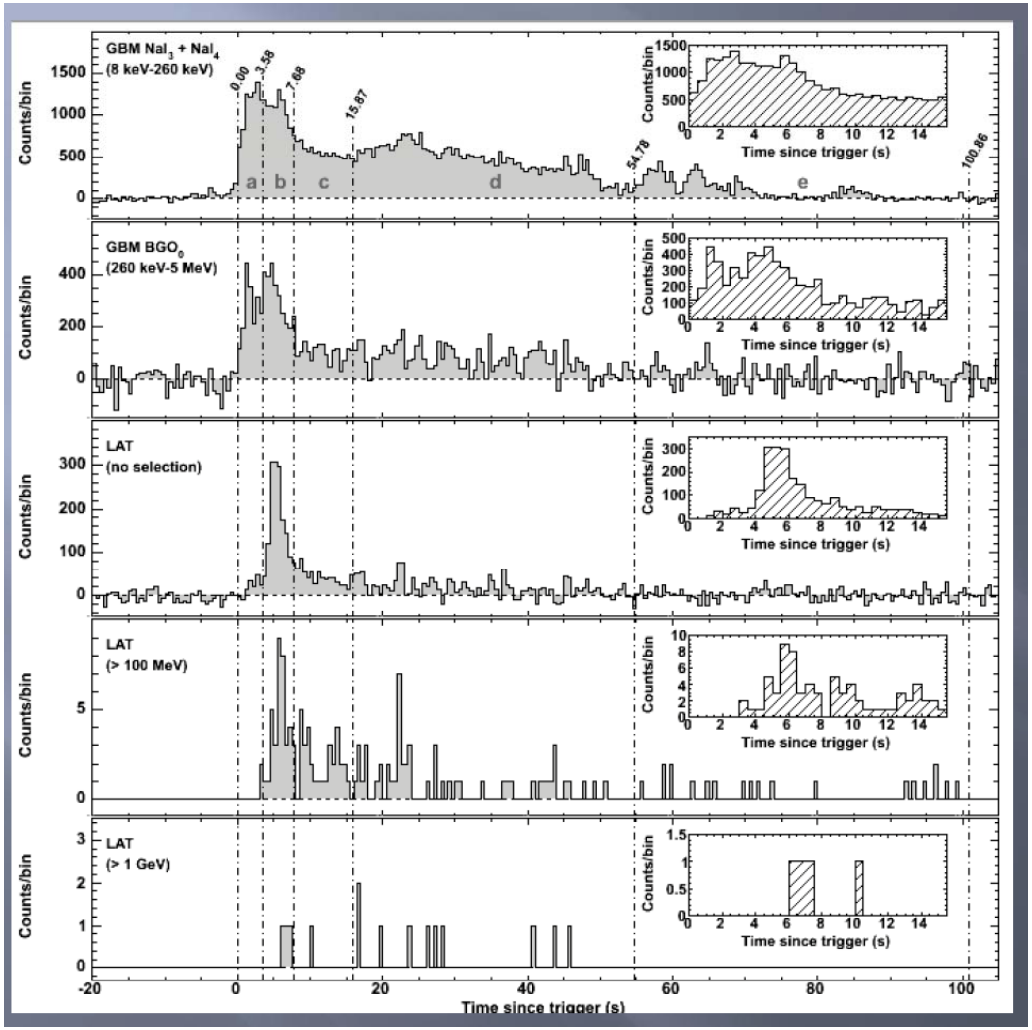
Challenge # 2 – Pulsars Blind Search



Fermi Pulsar Detections

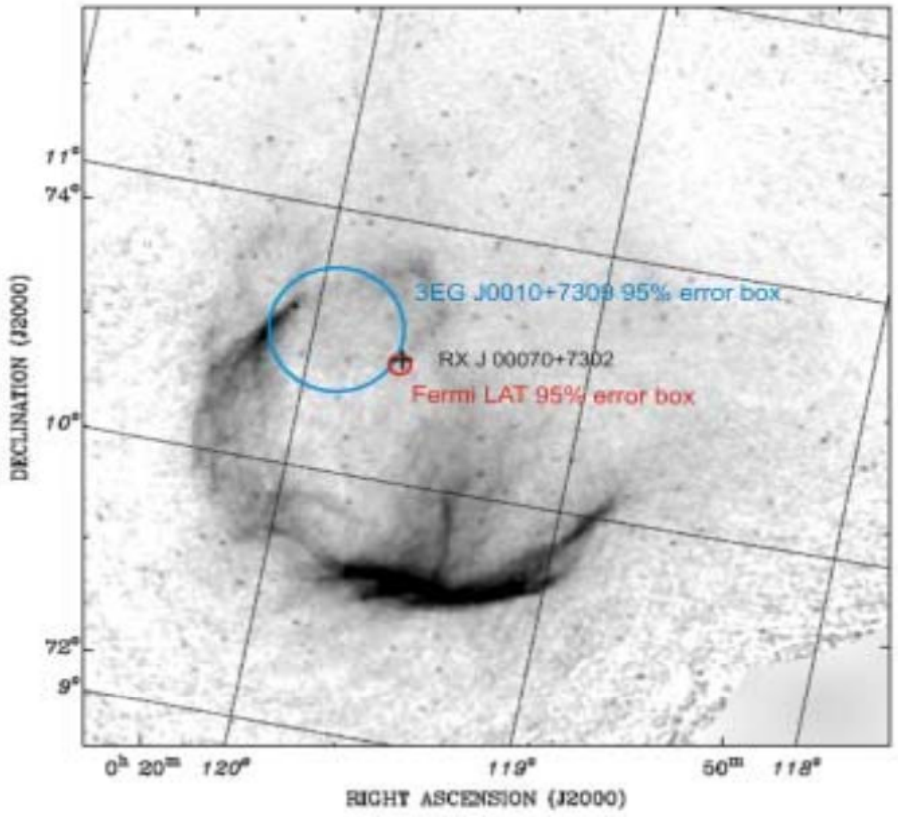
Abdo et al. 2009

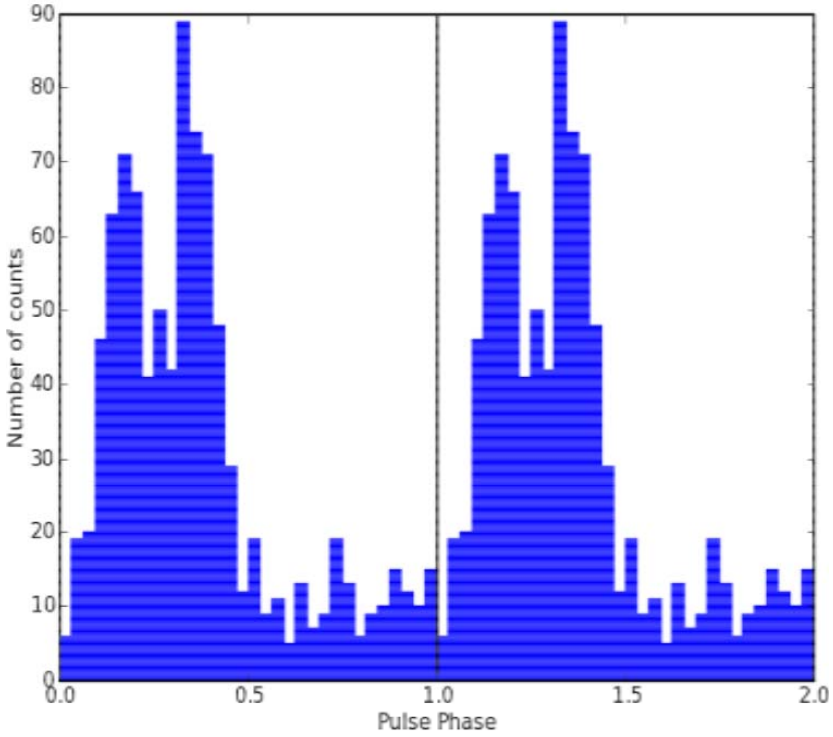
Challenge # 3 – GRB



Abdo et al. 2009

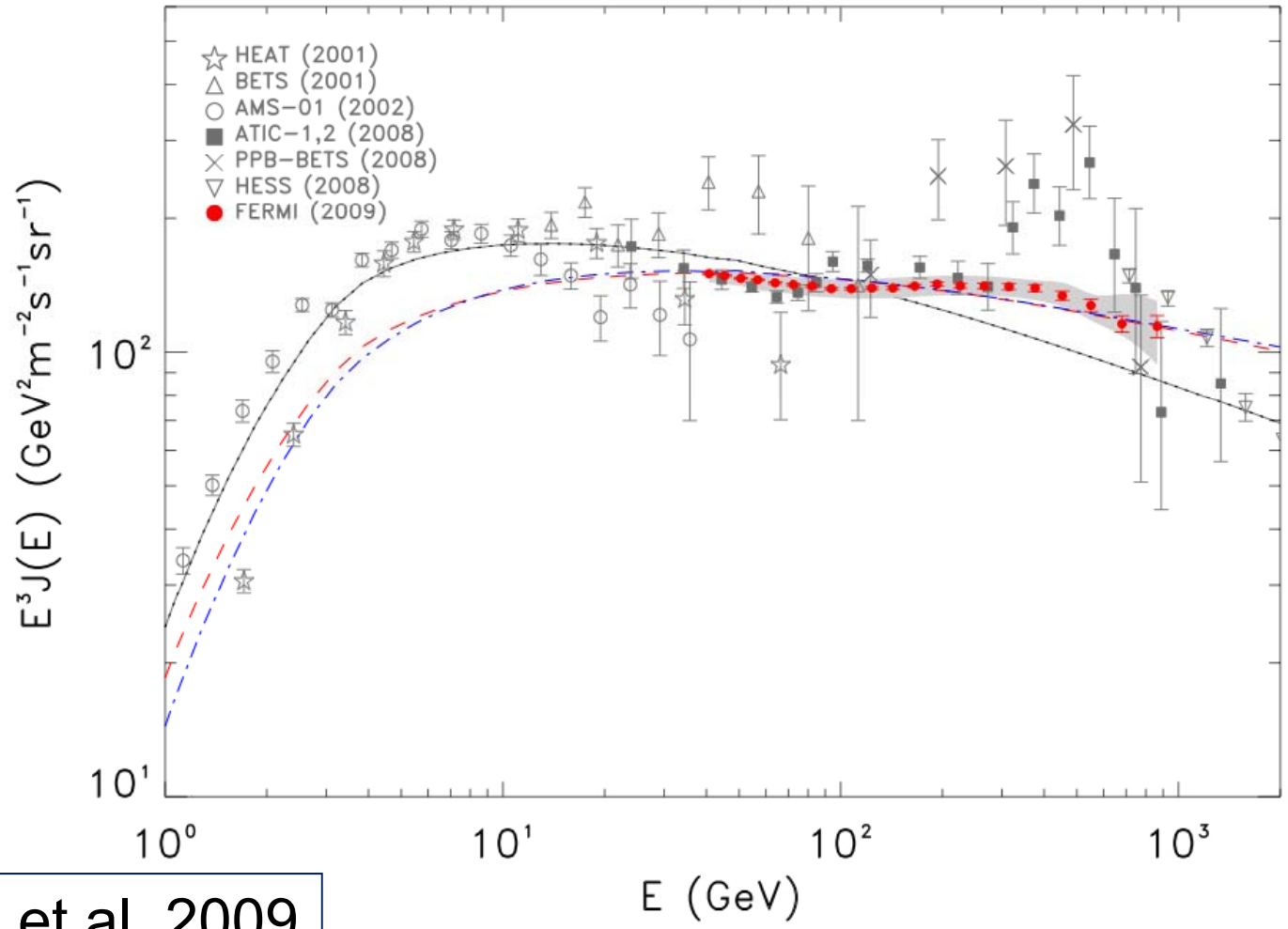
Challenge # 4 – Unidentified CTA 1 Discovery





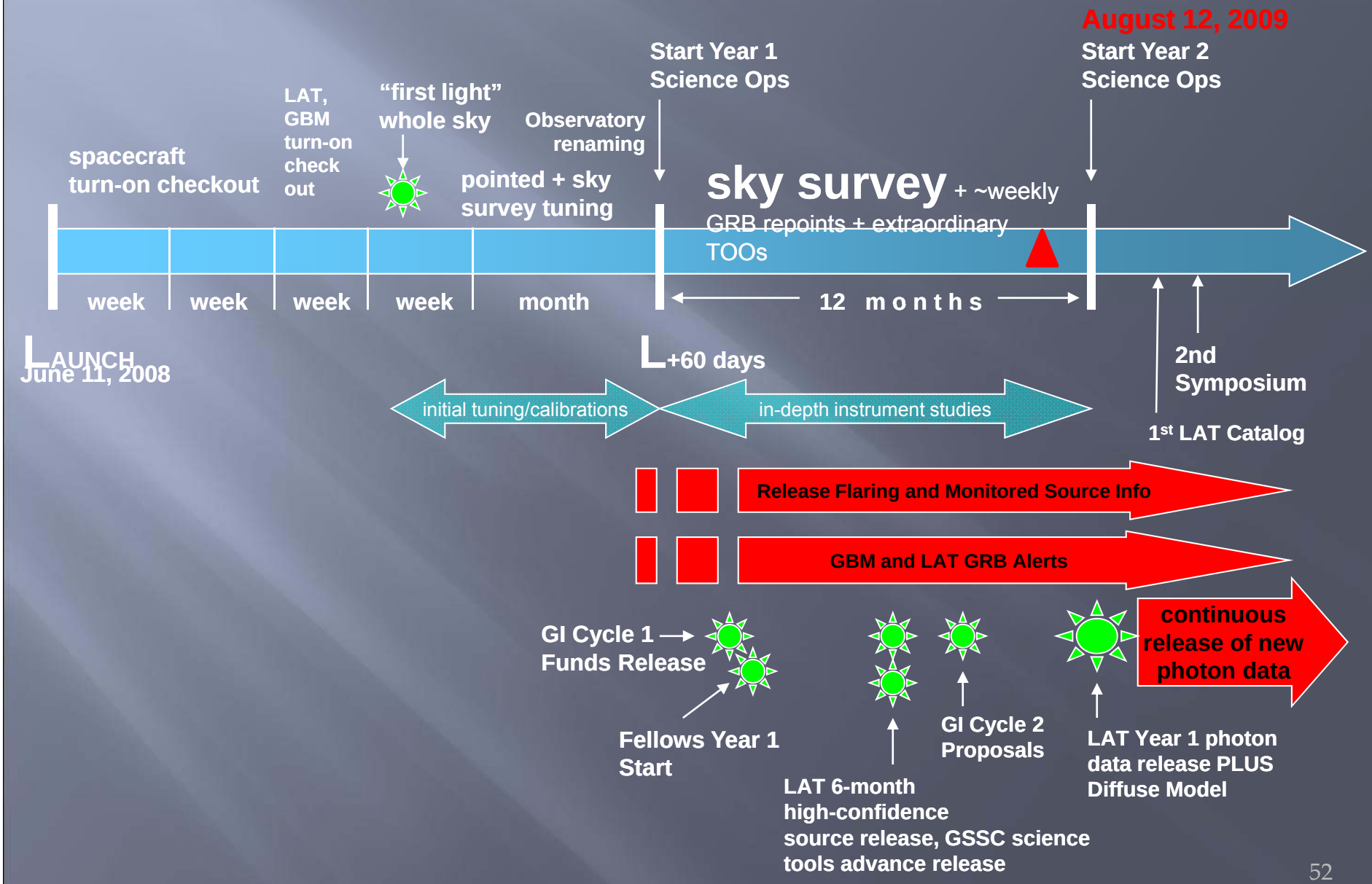
Abdo et al. 2008

The e^+e^- spectrum



Abdo et al. 2009

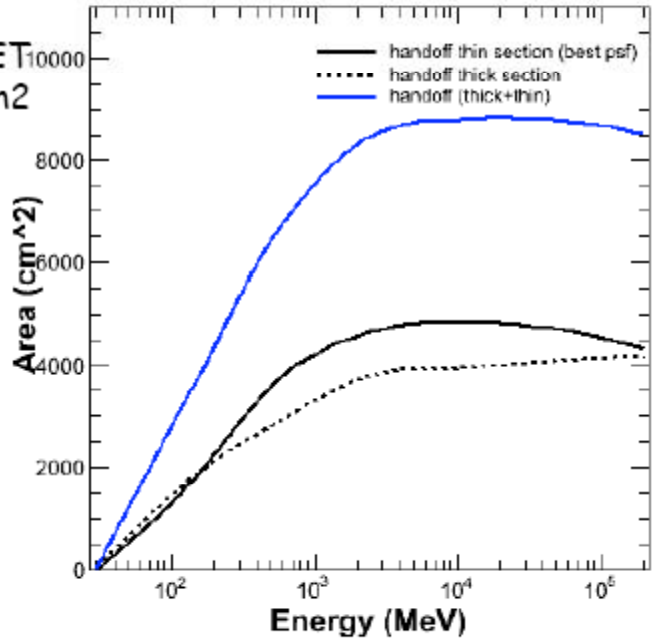
Year 1 Science Operations Timeline Overview

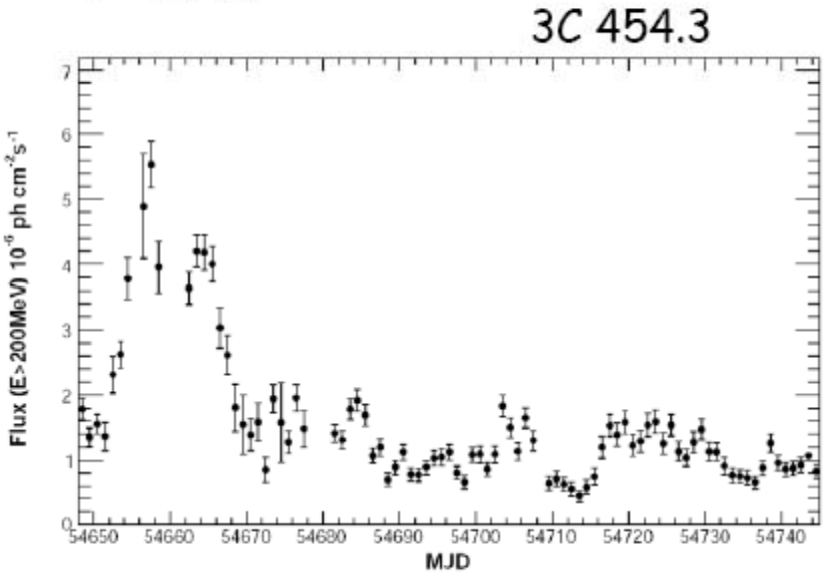


LAT performance - effective area

http://www-glast.slac.stanford.edu/software/IS/glast_lat_performance.htm

c.f. EGRET ~1500 cm2

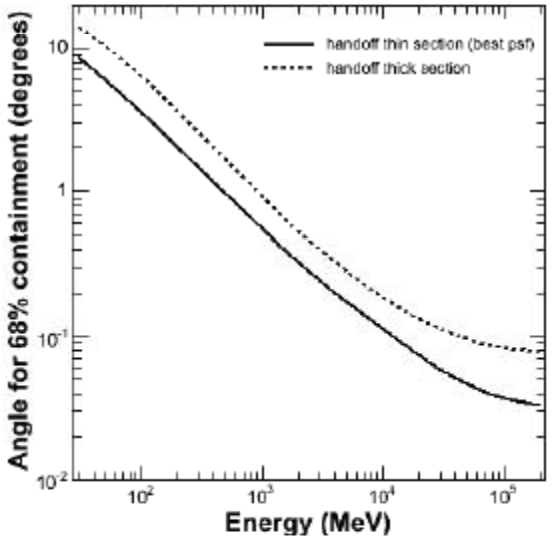


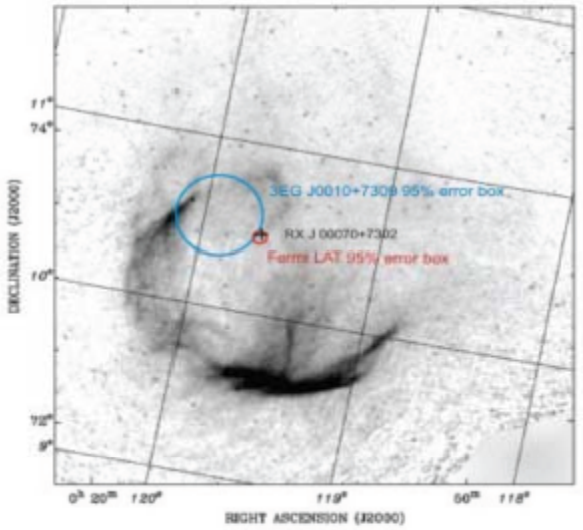


- Large effective area means that more gamma-rays are detected in GLAST for a given source brightness.
- Effective area remains flat out to a few hundred GeV -> broad spectral coverage
- Improves sensitivity; observations of rapid variability/transients (typical minimum integration for bright sources is 1 day, but can go smaller for brightest sources)

LAT Performance - Angular resolution

http://www-glast.slac.stanford.edu/software/IS/glast_lat_performance.htm



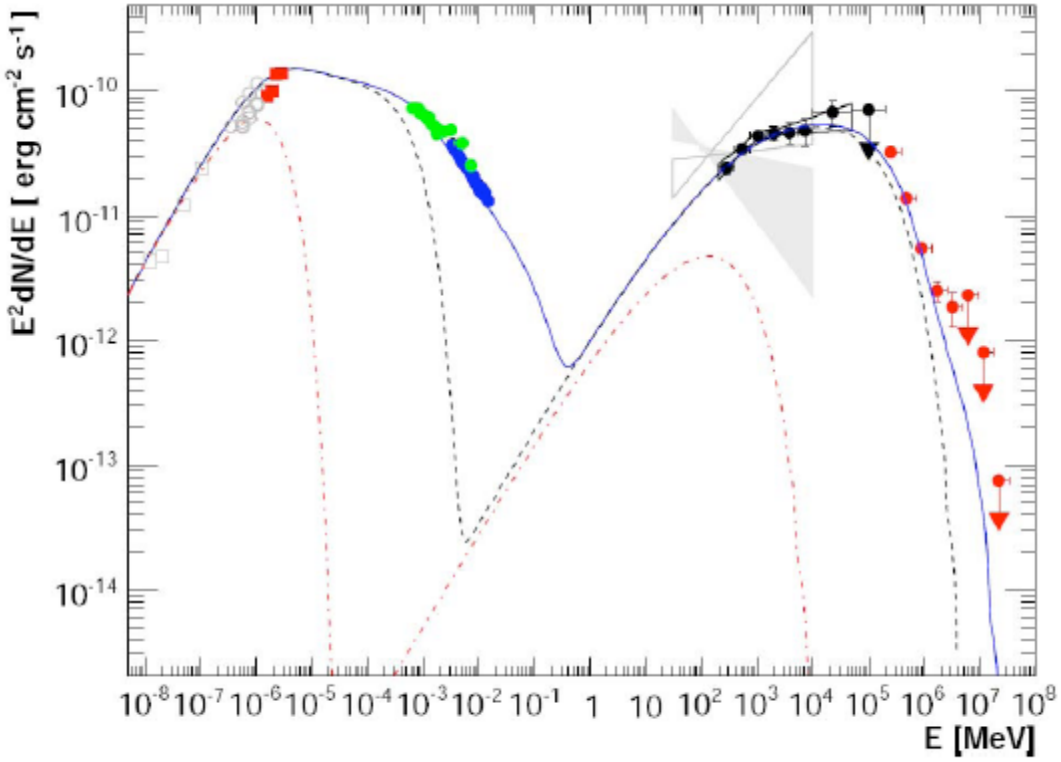


- **Angular resolution rapidly improves with increasing energy.**
- **Improved sensitivity (less background); greatly improved source locations, reduced source confusion - particularly for hard spectrum sources.**
- **Source localizations 5-10's arcmin typically - can follow up with MW observations.**
  - **Everything is better when we know where to look!**

LAT Performance - Energy range

LAT energy range is very broad (20 MeV - 300 GeV), includes the largely unexplored range between 10 and 100 GeV

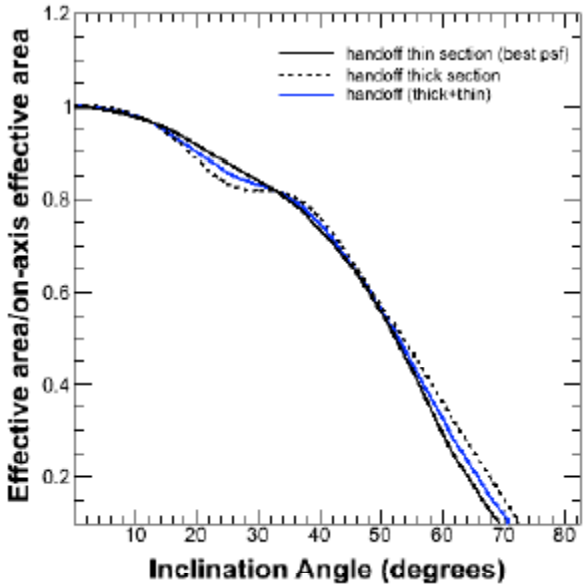
Allows ground-based TeV data to be combined with the space-based GeV data

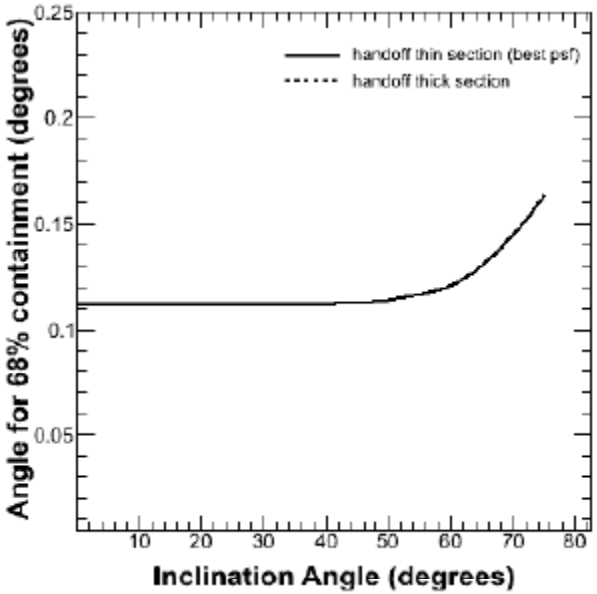


SED for PKS 2155-304

LAT Performance - Field of View

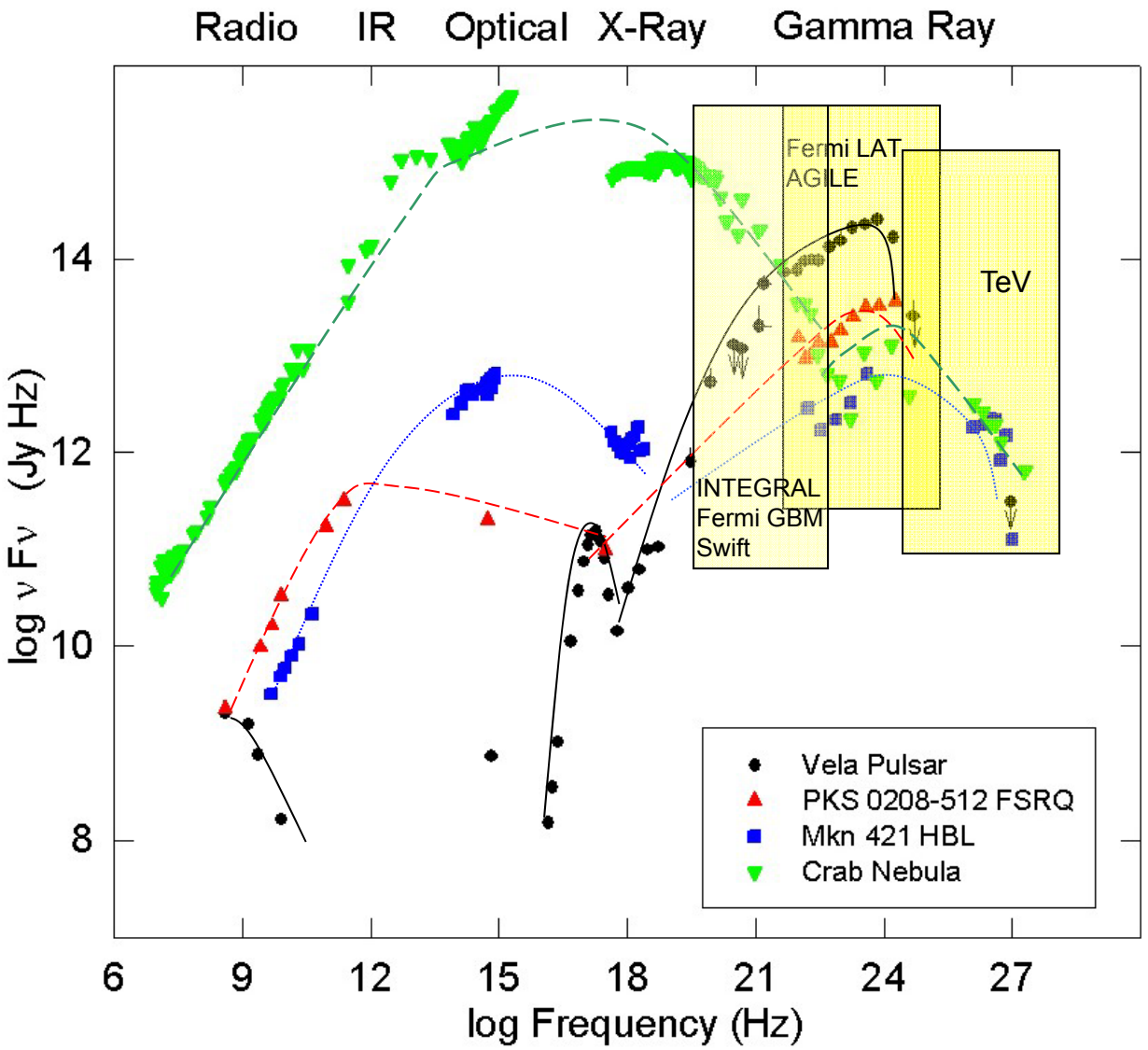
http://www-glast.slac.stanford.edu/software/IS/glast_lat_performance.htm





- **Field of view is HUGE! (>55 deg half angle, >2.2 sr)**
  - **Increases total exposure time (and thus sensitivity)**
  - **Superb at "catching" transients/GRB.**

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 objects, seen across much of the spectrum.

What Do Gamma-ray Measurements Offer?

- Huge energy range – 9+ orders of magnitude
- All-sky coverage, from both ground and space (Fermi sees the entire sky every three hours)
- Excellent sensitivity compared to previous instruments (Fermi LAT is about 30 times more sensitive than EGRET on the Compton Gamma Ray Observatory)
- Good source locations – 1 arcmin in many cases, especially for TeV sources.
- High time resolution for individual photons and flux variations
- Imaging for some extended sources

Gamma-ray Source Identification Demands MW Efforts

With the exception of gamma-ray pulsars, no source is likely to be conclusively identified using gamma-ray data alone. Spatial morphology is a strong indicator, but is often open to interpretation.

Almost by definition, identification means finding a counterpart at a longer wavelength.

Identification is a critical step in moving from source detection to scientific analysis.

Some Other Needs for Scientific Analysis

- **Distance – redshift, Dispersion Measure, parallax, proper motion, column density**
- **Composition – spectroscopy**
- **Precise source locations and imaging**
- **Velocities**
- **Polarization**
- **Magnetic fields**
- **Theories to connect the observations to physical models**

These are all multiwavelength studies.

Multiwavelength Approaches Being Used by the Fermi LAT Collaboration

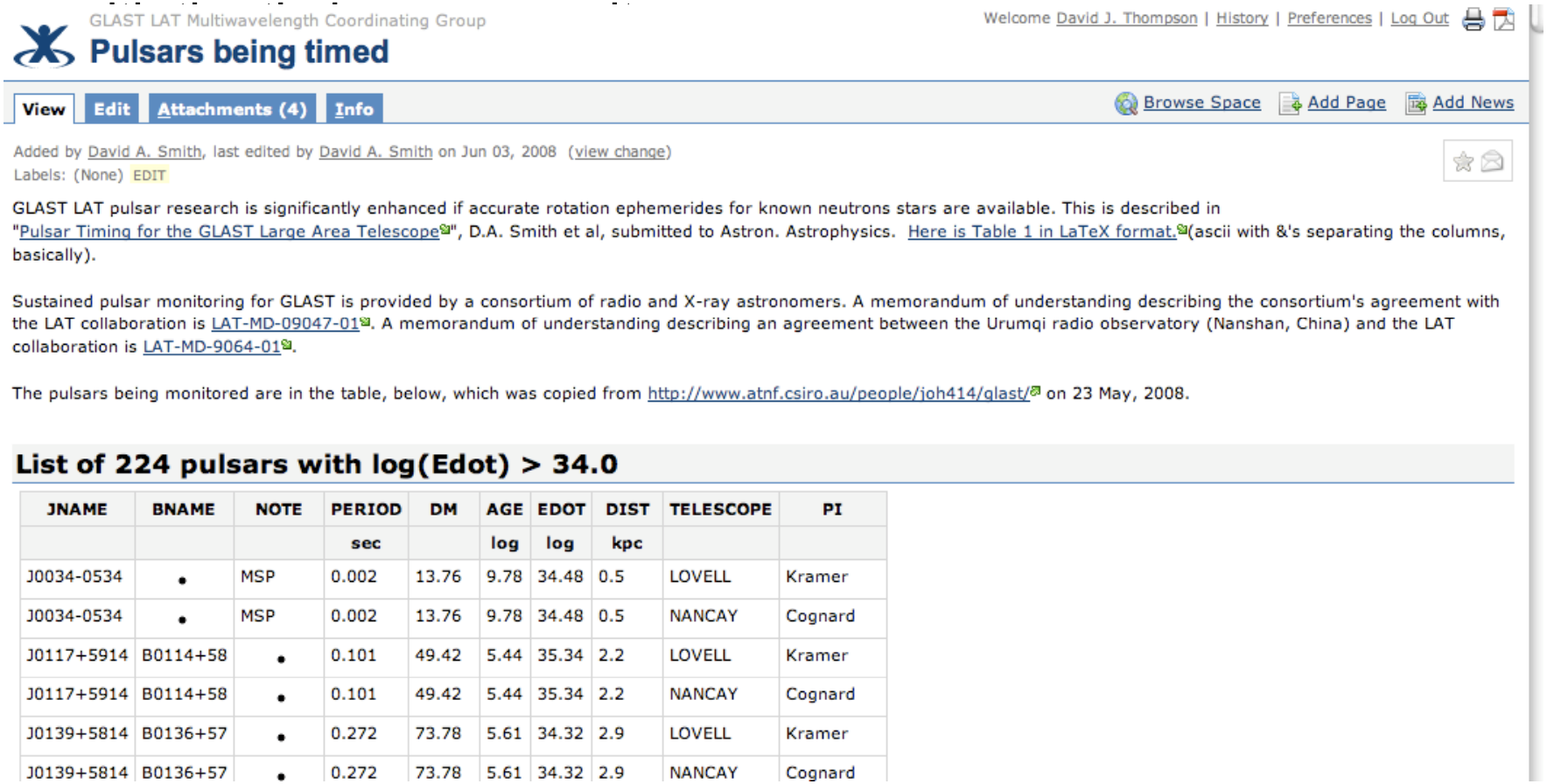
Three Methods:

1. **Monitoring - ongoing in radio, optical, X-ray**
2. **Planned Intensive Campaigns (PIC) - choose a time based on availability of MW resources**
3. **Target of Opportunity (TOO) - react to something seen in LAT or at other wavelengths.**

Much of the information about what the LAT team is planning is public.

Radio Monitoring

Pulsar timing (https://confluence.slac.stanford.edu/display/GLAMCOG/Pulsars+being+timed) - signed agreements



GLAST LAT Multiwavelength Coordinating Group

Pulsars being timed

Welcome David J. Thompson | History | Preferences | Log Out

View | Edit | Attachments (4) | Info | Browse Space | Add Page | Add News

Added by David A. Smith, last edited by David A. Smith on Jun 03, 2008 (view change)
Labels: (None) EDIT

GLAST LAT pulsar research is significantly enhanced if accurate rotation ephemerides for known neutrons stars are available. This is described in "Pulsar Timing for the GLAST Large Area Telescope", D.A. Smith et al, submitted to Astron. Astrophysics. Here is Table 1 in LaTeX format.(ascii with &'s separating the columns, basically).

Sustained pulsar monitoring for GLAST is provided by a consortium of radio and X-ray astronomers. A memorandum of understanding describing the consortium's agreement with the LAT collaboration is LAT-MD-09047-01. A memorandum of understanding describing an agreement between the Urumqi radio observatory (Nanshan, China) and the LAT collaboration is LAT-MD-9064-01.

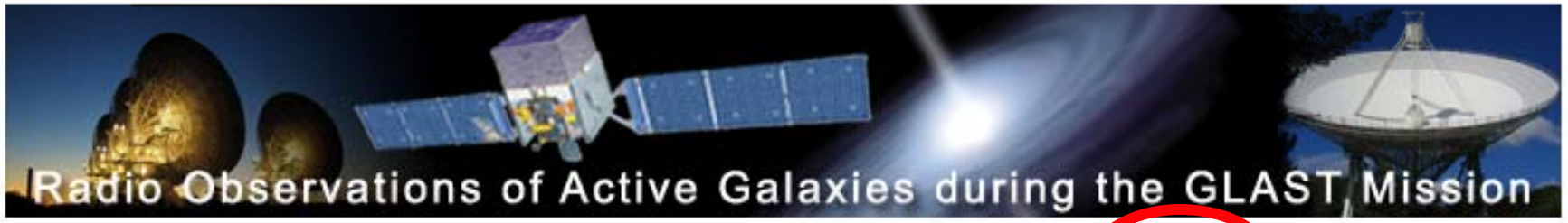
The pulsars being monitored are in the table, below, which was copied from http://www.atnf.csiro.au/people/joh414/glast/ on 23 May, 2008.

List of 224 pulsars with log(Edot) > 34.0

JNAME	BNAME	NOTE	PERIOD	DM	AGE	EDOT	DIST	TELESCOPE	PI
			sec		log	log	kpc		
J0034-0534	•	MSP	0.002	13.76	9.78	34.48	0.5	LOVELL	Kramer
J0034-0534	•	MSP	0.002	13.76	9.78	34.48	0.5	NANCAY	Cognard
J0117+5914	B0114+58	•	0.101	49.42	5.44	35.34	2.2	LOVELL	Kramer
J0117+5914	B0114+58	•	0.101	49.42	5.44	35.34	2.2	NANCAY	Cognard
J0139+5814	B0136+57	•	0.272	73.78	5.61	34.32	2.9	LOVELL	Kramer
J0139+5814	B0136+57	•	0.272	73.78	5.61	34.32	2.9	NANCAY	Cognard

Radio Monitoring

AGN studies (http://pulsar.sternwarte.uni-erlangen.de/radiogamma/)



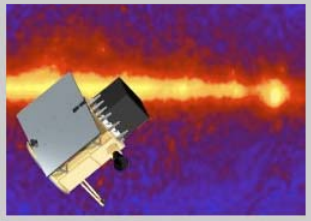
Activities of the GLAST/LAT AGN Science Working Group and Public Ressources:

Radio Samples | Ongoing VLBI Programs | VLBI Programs of the Past | Radio Flux Density Monitoring | Proposal Opportunities | LAT Team Contacts

GLAST, NASAs new gamma-ray observatory, has been launched on June 11, 2008. With a survey sensitivity approximately 30 times better than EGRET, GLAST is expected to detect thousands of AGNs. The GLAST mission, with its great increase in sensitivity and all-sky monitoring, will provide us with a tremendous opportunity to examine the central engines of AGN. The all-sky character of GLAST and the broadband emission characteristsics of its primary science targets has resulted in a significant increase in multiwavelength efforts and collaborations. Radio observations play a particularly important role in this framework since comparitive studies with VLBI and radio monitoring programs will yield insights as to where the gamma-rays are produced, and how jets are launched and collimated.

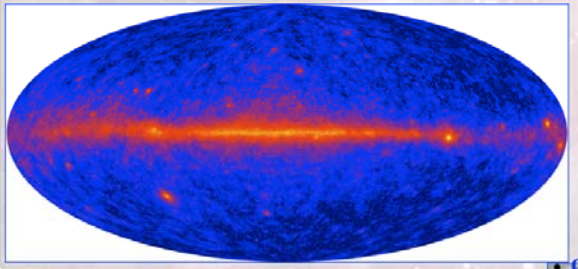
Here we provide a clearinghouse of information about ongoing activities in the radio, especially those that are conducted in collaboration with the GLAST/LAT Science Working Group on Blazars and Other AGN and useful public ressources.

The GLAST-AGILE Support Program (GASP)



The GLAST-AGILE Support Program (GASP) was organized within the Whole Earth Blazar Telescope to provide optical-to-radio long-term continuous monitoring of a list of selected gamma-ray-loud blazars during the operation of the AGILE and GLAST satellites.

Ground-based Observational Support of the Fermi Gamma-ray Space Telescope at the University of Arizona



The Palomar-Quest Sky Survey

Blazars From The Palomar-Quest Survey

Archival light curves, derived using a combination of exposures taken in the drift scan and point-a
supplemented by a few early observations from the JPL NEAT team, and brought to an empiricall
point using nearby stars, and roughly zero-pointed using USNO-B catalog. No color terms have be

PKS 1502+106

RA = 15h 04m 25.0s, Dec = +10d 29m 39s (J2000)
z = 1.839

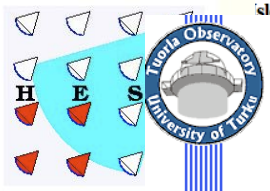
SMARTS Optical/IR Observations of LAT Monitored Blazars

NOTE: This website is currently under construction.
Please check back for more information shortly.
Thank you for your patience.

sler, C. Bailyn, M.Buxton, P.Coppi, A.Kaptur, M. Urry (Yale University).

ATOM

Automatic Telescope for Optical Monitoring for H.E.S.S.



Project description

This activity is one part of the participation of the LSW at the H.E.S.S.-project. See this page for a detailed descriptio activities concerning H.E.S.S..

Home | VISPA | Contact | Staff | Research | Telescopes | Seminars | History
News | Meetings | Teaching | Links | Publications | Theses | Visitors | OJ 287

Tuorla Observatory actively involved in obtaining similtaneous observations in the optical and gamma ray regions

Also REM, Global Telescope Network, PanSTARRS, Skymapper

High-Energy Monitoring

http://heasarc.gsfc.nasa.gov/W3Browse/fermi/fermilasp.html

Browse this table...

FERMILASP - Fermi LAT Monitored Source List

HEASARC Archive

Overview

The Fermi LAT table of monitored sources provides daily and weekly fluxes for sources of interest as described in http://fermi.gsfc.nasa.gov/ssc/data/policy/LAT_Monitored_Sources.html. In addition, similar information will be released for any source which flares above $2x10^{-6}$ photons cm^{-2} s^{-1} until the flux drops below $2x10^{-7}$ photons cm^{-2} s^{-1}. Fermi is currently in survey mode and observes the entire sky every day. However if a source does not exceed the detection threshold, no entry will appear in the catalog.

Swift watches the 23 LAT monitored sources.

INTEGRAL key proposals monitor a number of blazars.

Planned Intensive Campaigns -- PICs

Pre-set, major campaigns covering the electromagnetic spectrum for sources expected to be of special interest. Schedule set by availability of other telescopes.

Most complete example - Mkn 501 pre-launch campaign, led by David Paneque. See

https://confluence.slac.stanford.edu/display/GLAMCOG/Campaign+on+Mrk+501+%282008%2C+March-May%29

These campaigns are generally advertised in advance, with an invitation for any observers to join.

Targets of Opportunity -- ToOs

Similar to Planned Intensive Campaigns, but started ad hoc by a transient event. All Gamma-ray Bursts fall into this category.

An example - 3C454.3 “snapshot” campaign, led by Lars Fuhrmann. See

https://confluence.slac.stanford.edu/pages/viewpage.action?pageId=22743403

Other recent non-GRB examples - flares of PKS 1454-354, 3C273, PKS 1502+106.

These campaigns are generally announced by ATel or e-mail distribution lists, with a contact person noted.

Sample ATels

www.astronomerstelegram.org

[Previous | Next]

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.

[Previous | Next]

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.

LAT ATels include the name of a contact person who is a “friend of the source.”

Proposal Resources

https://confluence.slac.stanford.edu/display/GLAMCOG/Multiwavelength+Proposal+Opportunities

GLAST LAT Multiwavelength Coordinating Group

Multiwavelength Proposal Opportunities

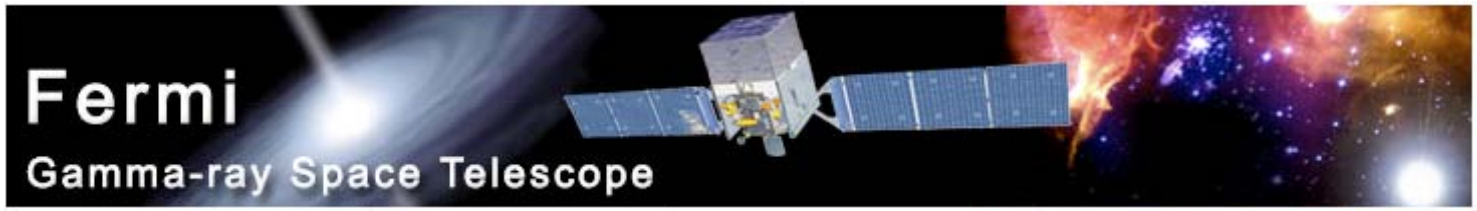
Added by David J. Thompson, last edited by David J. Thompson on Sep 23, 2008 (view change)
Labels: (None) EDIT

Some Known Proposal Opportunities

Facility and Cycle	Proposal Deadline	When Observations Scheduled	Notes
Swift Cycle 5	15 October, 2008	April, 2009 - April, 2010	Non-GRB pointing proposals allowed. Announcement.
NRAO Large Proposals	1 October, 2008		VLA, VLBA, GBT - Includes VIPS and MOJAVE blazar studies
XMM AO-8	10 Oct., 2008	May 2009 - April 2010	Announcement due Aug. 26
GALEX - Cycle 4	22 June, 2007 - PASSED	Dec. 2007 - Dec. 2008	no proposals submitted
INTEGRAL AO7	January 2009	16 Aug 2009 - 15 Aug 2010	
Suzaku Cycle 4	5 December, 2008	April, 2009 - April, 2010	Information HERE
RXTE Cycle 13	30 October, 2008	January - September, 2009	Proposal Information
Spitzer Cycle 6	10 October 2008	June, 2009 - ??	Large (Exploration Science) proposals Information
Herschel	26 Oct. 2007 - PASSED	~2008	http://www.ipac.caltech.edu/Herschel/propinfo.shtml
Chandra Cycle 11	~March 20, 2009	Dec. 2010 - Dec. 2011	http://cxc.harvard.edu/proposer/
GLAST Cycle 1	7 September 2007 - PASSED	Jan. 2008 - Jan. 2009 (tentative)	GLAST Science Support Center Proposal Information HERE
AGILE AO1	31 Oct. - PASSED	Dec. 2007 - Nov. 2008	http://agile.asdc.asi.it/ao.html
NRAO Regular Programs	1 Feb., 1 June, 1 Oct.	Trimester after proposal cycle ends	Aim for radio timing proposal for 1 Feb 2007
NOAO Regular Programs	30 Sept., 31 March	Feb.-July, Aug.-Jan.	
NOAO Survey Programs	15 March		
Effelsberg radio telescope	3 October 2006	Within year after acceptance	Radio timing proposal (Michael Kramer, PI)
Nançay radio telescope	~15 April, ~15 Oct	For 6 mos, begin 1 July, 1 Dec	Renew current proposal bi-annually
ESO	30 Sept., 31 March	Starts 6 months after proposal due	Announcement

Q. Where is there information about Fermi's Multiwavelength Program?

A. http://fermi.gsfc.nasa.gov/science/multi/ is a good starting point.



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Science

- Overview
- Instruments
- Science Support Center
- Science Working Group
- Multiwavelength Observations
- GRB/SF Science Team
- Resources

Multiwavelength Observations

- Gamma-ray Multiwavelength Mailing List - please visit the list page or contact Dave Thompson or J.D. Myers to be added to the mailing list.
- Gamma-ray Multiwavelength Mailing List Archive (Must be a member of the list)
- Old Gamma-ray Multiwavelength Mailing List Archive
- Multiwavelength Observations Reporting Form
- GLAST Guest Investigator Program Cycle 1 Announcement
- Data Released by the LAT Team During the First Year
  - LAT Monitored Sources
  - Data Access
- LAT Multiwavelength Coordinating Group
- Science Requirements Document
- Large Area Telescope (LAT) Properties
- GLAST Burst Monitor (GBM) Properties
- Project Data Management Plan
- Science Support Center
- Global Telescope Network
- Multiwavelength Contact: Dave Thompson

Links to information about the Fermi instruments, the Fermi Science Support Center, the gamma-ray multiwavelength mailing list, and public data.

Q. Any other good resources?

A. confluence.slac.stanford.edu/display/GLAMCOG is the public Web site used by the LAT team for MW,

GLAST LAT Multiwavelength Coordinating Group

Fermi LAT Multiwavelength Coordinating Group

Log In

View | Attachments (4) | Info

Browse Space

Added by Matt Langston, last edited by Elizabeth C Ferrara on Oct 01, 2008 (view change)
Labels: (None)

Purpose

Provide information about resources and points of contact for multiwavelength observations involving the Fermi Gamma-ray Space Telescope Large Area Telescope (LAT). Coordinate multiwavelength observations needed by the science groups. Maximize use of supporting observations and minimize duplication of effort.

N.B. This area can be viewed (but not edited) by the PUBLIC, although some links require a password.

Multiwavelength Planning

Multiwavelength campaign on 1es1959 (end September - Beginning November) - Follow this link for information

Planned Intensive Campaign on BL Lac - August 20 - September 10 2008 - Follow this link for more information

"Snapshot" MW campaign on 3C 454.3 during August 2008 - Follow this link for more information

Q. There is a gamma-ray multiwavelength mailing list. What is it and how do I get on it?

A. HEASARC at Goddard maintains this list as a service to the gamma-ray community. It is an e-mail exploder aimed at sending general announcements to anyone interested in multiwavelength gamma-ray studies. Sending an e-mail to gammamw@lists.gsfc.nasa.gov distributes that mail to the list and puts a copy in the archive at https://lists.nasa.gov/mailman/private/gammamw/

September 2008 Archives by date

- **Messages sorted by:** [thread] [subject] [author]
- More info on this list...

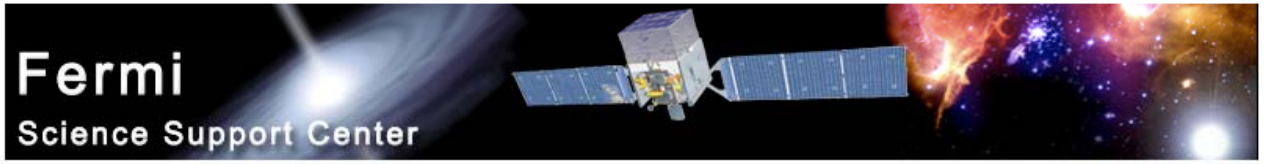
Starting: *Fri Sep 5 20:00:23 EDT 2008*
Ending: *Fri Sep 26 12:20:36 EDT 2008*
Messages: 5

- [gammamw] Possible new blazar flare *David Thompson*
- [gammamw] Fermi LAT Campaign on PKS 0528+134 *David Thompson*
- [gammamw] MW campaign on the blazar 1es1959+650 *David Paneque*
- [gammamw] Gamma-ray ATELs *David J. Thompson*
- [gammamw] Gamma-ray ATELs *George Djorgovski*

Last message date: *Fri Sep 26 12:20:36 EDT 2008*

Q. Can I avoid losing LAT data during my campaign?
A. Use the FSSC form to tell the Fermi Project your plans:

http://fermi.gsfc.nasa.gov/ssc/resources/multi/reporting/list.php



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Resources

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Multiwavelength Observations Report Listing

Click column heading to sort by that column.

ID	Object	Observation Dates	Wavelength Band
1	PKS 2155-304	2008-08-25 to 2008-09-04	radio/optical/X-ray/HE gamma/VHE gamma
2	3C454.3	2008-08-15 to 2008-08-15	infrared
3	3C454.3	2008-08-19 to 2008-08-19	infrared
5	3C279	2008-08-17 to 2008-08-17	infrared
6	3C279	2008-08-16 to 2008-08-16	infrared
7	PKS 0208-512	2008-08-18 to 2008-08-25	X-/hard X-ray (INTEGRAL)
8	BL LAC	2008-08-20 to 2008-09-09	X, optical, Gamma
9	All available LAT-monitored blazars + Fermi ToOs	2008-10-03 to 2008-10-09	Optical
10	All available LAT-monitored blazars + Fermi ToOs	2008-10-28 to 2008-11-03	Optical
11	All available LAT-monitored blazars + Fermi ToOs	2008-11-24 to 2008-12-05	Optical
12	All available LAT-monitored blazars + Fermi ToOs	2008-12-26 to 2009-01-01	Optical

This report informs the Fermi Project so that calibrations or other activities such as TOOs might be avoided if in conflict with MW observations.

HE astrophysics

- The “golden age”?
- Extragalactic sky
  - Population studies
  - High redshift GRB
  - Multiwavelenght studies
- Galactic sky
  - Pulsars
  - Identifications of source classes
- Search for DM in progress