

National Aeronautics and Space Administration



Fermi

Gamma-ray Space Telescope

www.nasa.gov/fermi

Fermi

Gamma-ray Space Telescope

Mission Status

LAT IFC Meeting

Hiroshima

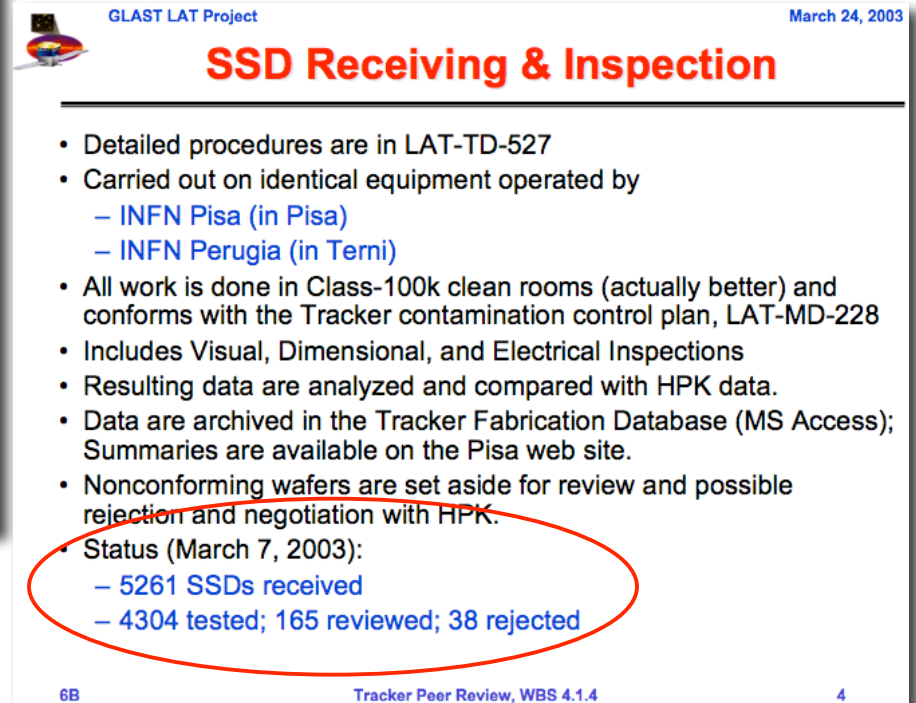
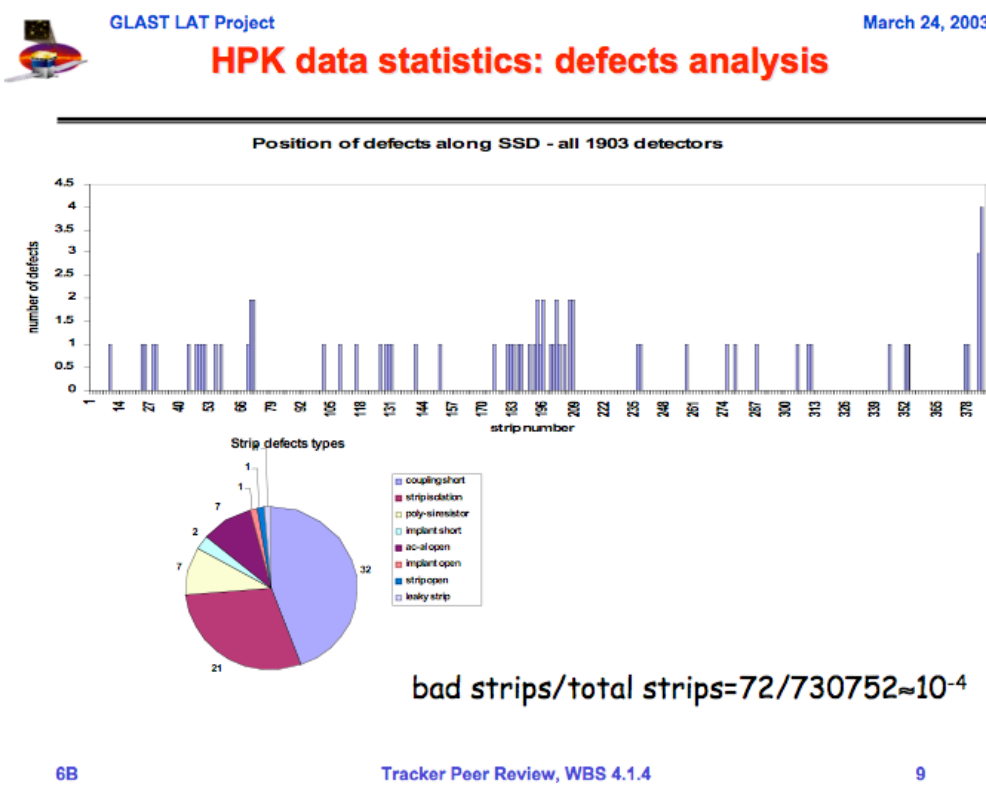
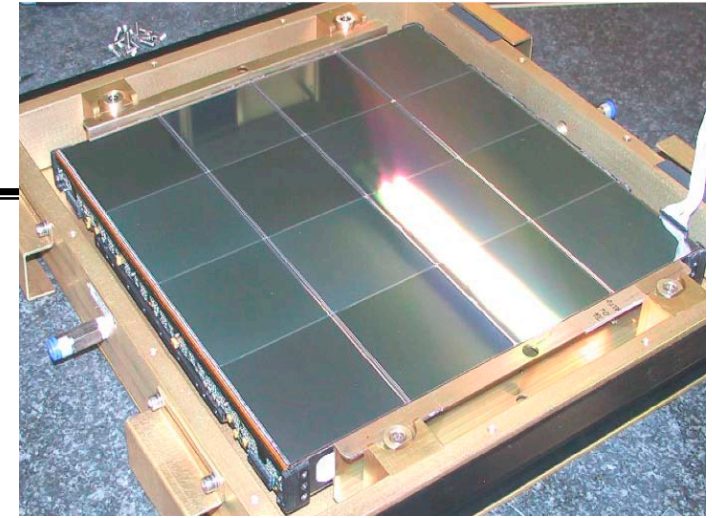
27 February 2009

S. Ritz

Project Scientist

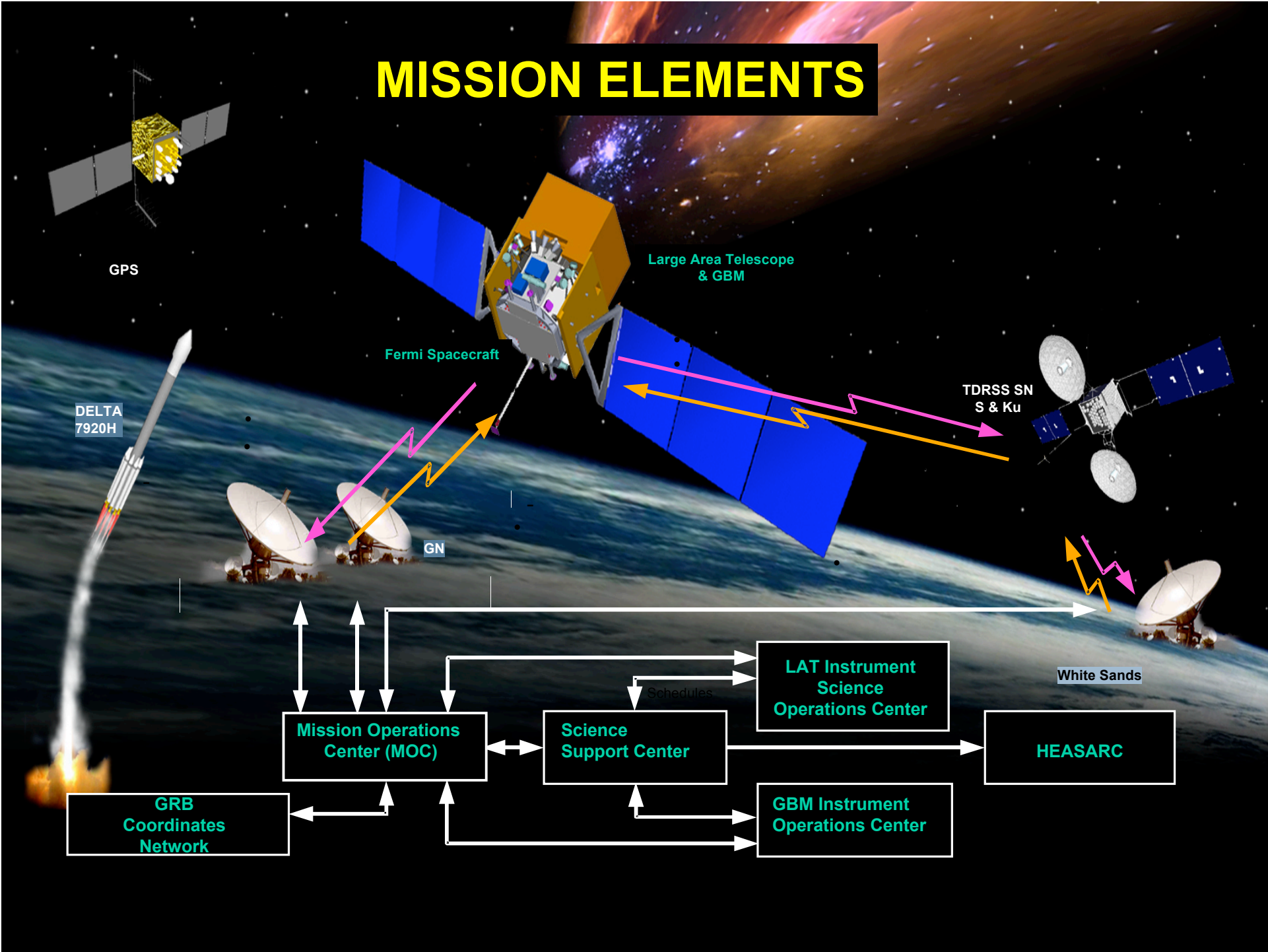
NASA GSFC

Historical Interlude

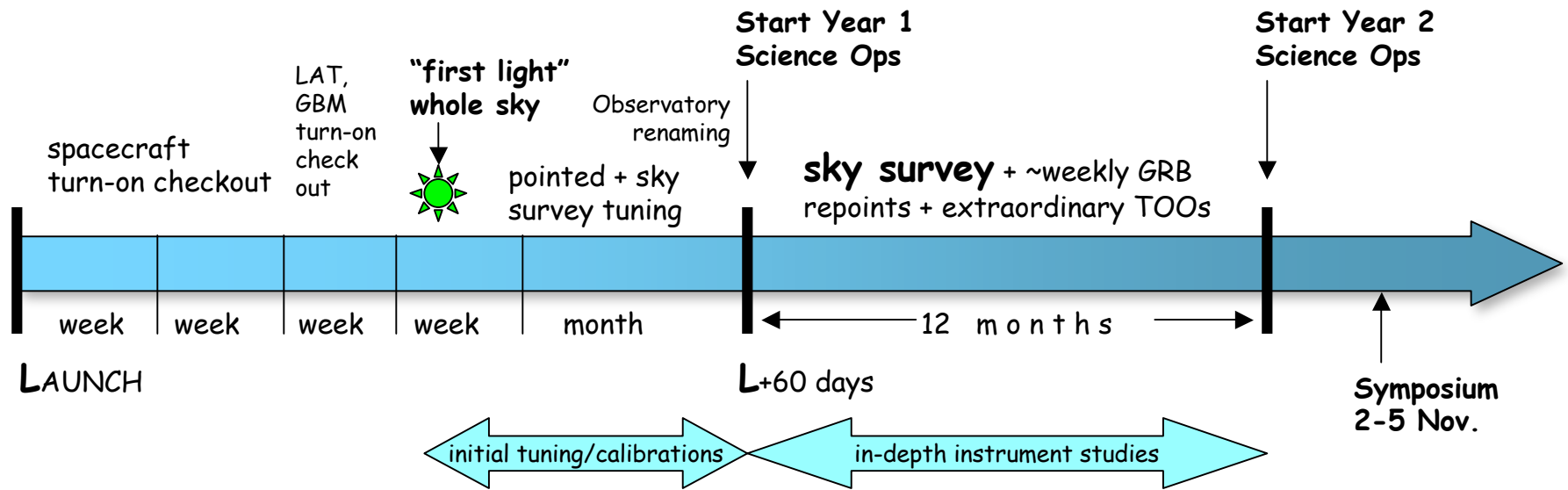


- The silicon strip detectors made here in Japan are at the heart of Fermi, and they are spectacular!

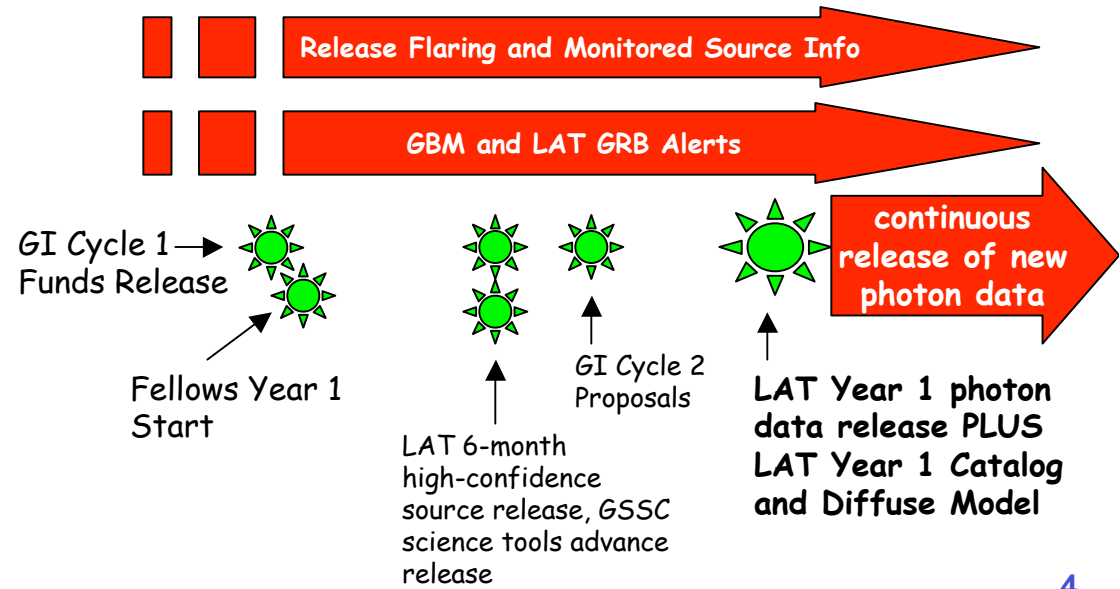
MISSION ELEMENTS



Year 1 Science Operations Timeline Plan



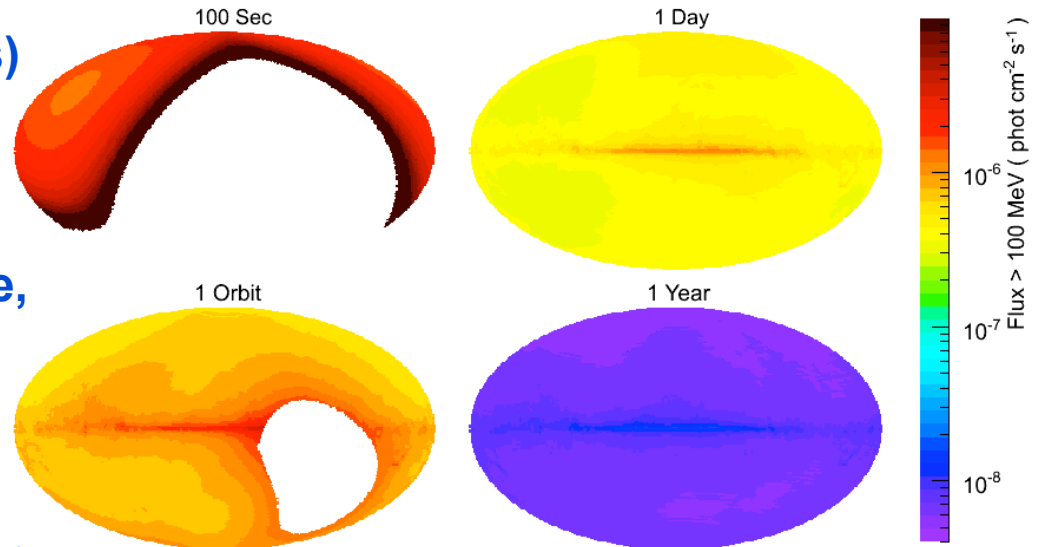
Thus far:
~20 Atels on flaring sources
>100 GRB alerts (GCN)



Operating modes

- **Primary observing mode is Sky Survey**

- Full sky every 2 orbits (3 hours)
- Uniform exposure, with each region viewed for ~30 minutes every 2 orbits
- Best serves majority of science, facilitates multiwavelength observation planning
- Exposure intervals commensurate with typical instrument integration times for sources
- EGRET sensitivity reached in days



- Pointed observations when appropriate (selected by peer review in later years) with automatic earth avoidance selectable. Target of Opportunity pointing.
- Autonomous repoints for onboard GRB detections in any mode.

Status Highlights

- **Operations continue to be very smooth, thanks to an outstanding Flight Ops Team and great cooperation across the mission.**
- **Weekly operations planning meeting and status/trending meeting (also quarterly trending meetings).**
- **Transition to sustaining engineering level has been smooth. Proactively working issues to maintain smooth operations, including:**
 - **battery management**
 - **FSW updates (LAT, GBM, spacecraft) for minor bug fixes, operations and science processing improvements**
 - **collision avoidance**
 - **continuously looking at robustness of fault management and opportunities for improvements**
 - **careful monitoring of all subsystems (including the reaction wheels)**
- **Preparation for GI cycle 2**
- **Press and outreach coordination and planning, tied to major science results releases. Many papers coming out!**
 - **activities coordinated by Frank Reddy, working with list of international partner agency and institutional contacts, Lynn Cominsky, LAT & GBM PIs, Mission. Involving LAT science groups directly.**
 - **Periodic “lookahead” strategy sessions for upcoming results and major international conference talks.**

Example: Fermi Results at AAS

- **Galactic Sources**
 - Vela (345.02), CTA 1 (345.03), J2021 (345.04), J1028 (345.06)
 - radio-quiet (blind) pulsar searches (612.02)
 - millisecond pulsars (345.05)
 - xrbs (468.11), transients (612.04)
- **AGN**
 - Early blazar detections (355.01, 468.08) and monitoring (468.09)
 - Initial look at populations (355.03) and variability studies (468.10) (326.03) (446.07)
 - PKS 2155, TeV connection, (355.02)
- **Diffuse Emissions**
 - first look (355.06)
 - modeling galactic diffuse (355.07)
 - Unidentified sources contributions (355.04)
 - Orion and Monoceros (468.12)
- **Solar system sources (355.05)**
- **GRB (345.08, 345.09)**
- **The Bright Source List (345.01)**
- **Instrument/Observatory Performance/FSSC (468.02 to 468.07)**
- **Also a press conference on pulsar results (Cominsky, Romani, Harding)**

Most recent press release very successful

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News results: Standard Version | Text Version | Image Version Results 1 - 10 of about 105 from Feb 17, 2009 to today for Fermi gamma burst. (0.34 seconds)

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
Fermi telescope sees giant gamma-ray burst
MarketWatch (press release) - Feb 23, 2009
WASHINGTON, Feb 23, 2009 (UPI via COMTEX) -- The first gamma-ray burst to be seen in high resolution from the US space agency's Fermi Gamma-ray Space ...
Most Powerful Cosmic Explosion Brightens Student's First Day On Job Space Daily
Most extreme gamma-ray blast ever, seen by Fermi gamma-ray space ... Innovations report
Huge gamma-ray blast spotted 12.2 billion light-years from earth Times of Malta
[all 9 news articles >](#)




Most Powerful Gamma-Ray Burst May Point to New Physics
Sky & Telescope, FL - Feb 20, 2009
Observations from NASA's Fermi Gamma-ray Space Telescope hint that all forms of light may not travel through space at the same speed. Very-high-energy gamma ...
New window on the high-energy universe Science News
NASA 'scope captures ferocious gamma ray burst Register
Fermi Records Extreme Gamma-Ray Burst It's one for the record books Softpedia
BBC News - LiveScience.com
[all 100 news articles >](#)

Gamma Rays in High Resolution; Saturn Transit
AccuWeather.com - Feb 20, 2009
Meanwhile, the Fermi telescope has observed the most extreme Gamma-Ray burst yet! Another solar wind stream is headed our way, and is expected to affect ...

Biggest bang yet seen in universe
Sydney Morning Herald, Australia - Feb 20, 2009
... the universe "like a laser beam" until it reached the Earth, where it was detected by NASA's Fermi satellite as a powerful burst of gamma-ray radiation. ...




Hihetetlen energiájú gammavillanás
Index, Hungary - 18 hours ago
A GRB 080916C katalógusjellet ellátott kitérés (GRB, Gamma-Ray Burst) a déli Carina (Hajógerinc) csillagképben következett be, és az eseményt a Fermi ...



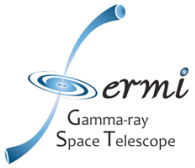
Un sursaut gamma pulvérise le record des explosions cosmiques
Futura Sciences, France - Feb 23, 2009
... Max Planck de l'ESO à La Silla au Chili ne tardèrent pas à prendre le relais des détecteurs Gamma-ray Burst Monitor et Large Area Telescope de Fermi. ...
Espace : Le télescope Fermi révèle une explosion géante Innovation le journal
L'explosion la plus violente depuis le Big Bang Le Vif L'Express
[all 3 news articles >](#)

Violentissima esplosione fotografata dal satellite Fermi
Tornoscienza.it, Italy - Feb 23, 2009
Si tratta di un lampo gamma di altissima energia (Gamma Ray Burst, GRB) prodotto da una catastrofe cosmica. La scoperta è stata pubblicata dalla rivista ...



Rekord-Gamma-ray Burst begeistert Astronomen
AstroNews, Germany - Feb 20, 2009
von Stefan Deiters Der erste plötzliche Ausbruch im Gammastrahlenbereich, ein sogenannter Gamma-ray Burst, den das Weltraumteleskop Fermi detailliert ...
Fermi beobachtet stärksten Gammastrahlenausbruch Raumfahrer.net
[all 5 news articles >](#)

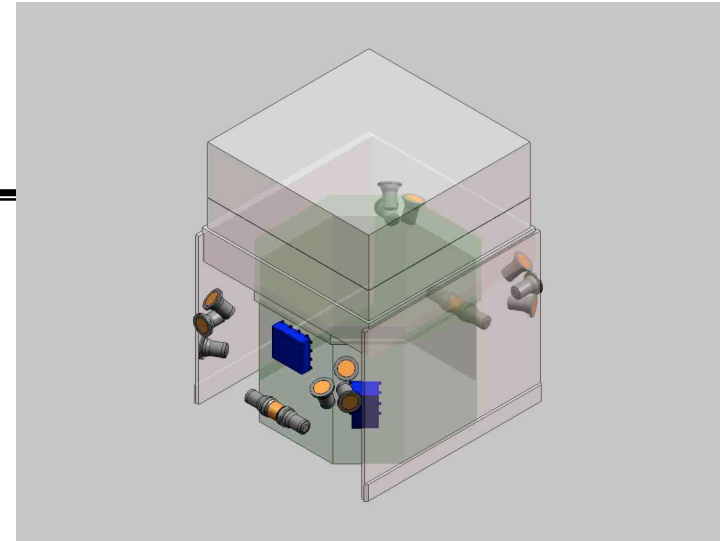
Fermi-Teleskop zeigt eine Super-Explosion von Gammastrahlen im Weltall
Hamburger Abendblatt, Germany - Feb 22, 2009
Juni 2008 gestartete Satellitenobservatorium Fermi misst mit seinen beiden Detektoren, dem Gamma-ray Burst Monitor GBM und dem Large Area Telescope LAT, ...



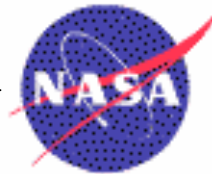
GBM Collaboration



National Space Science & Technology Center



University of Alabama
in Huntsville



NASA
Marshall Space Flight Center

Marshall
Space
Flight
Center

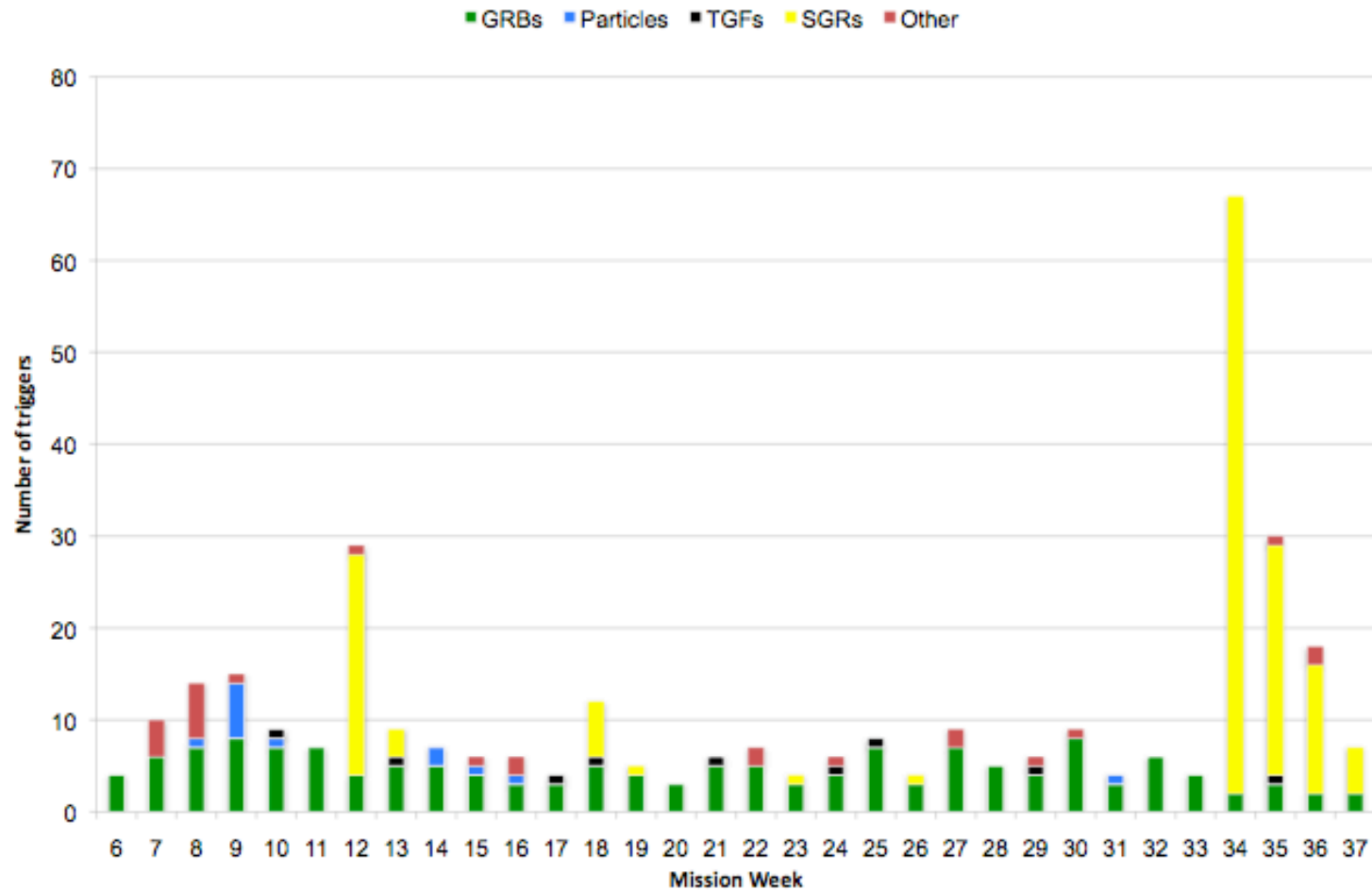


Max-Planck-Institut für
extraterrestrische Physik



Bill Paciesas (PI)
Jochen Greiner (Co-PI)

GBM Trigger Rate (weekly)



Now have >140 GBM-detected GRBs, two SGRs (SGR 0501+4516, SGR 1806-20), one AXP (AXP 1E1547.0-5408), over 5 TGFs

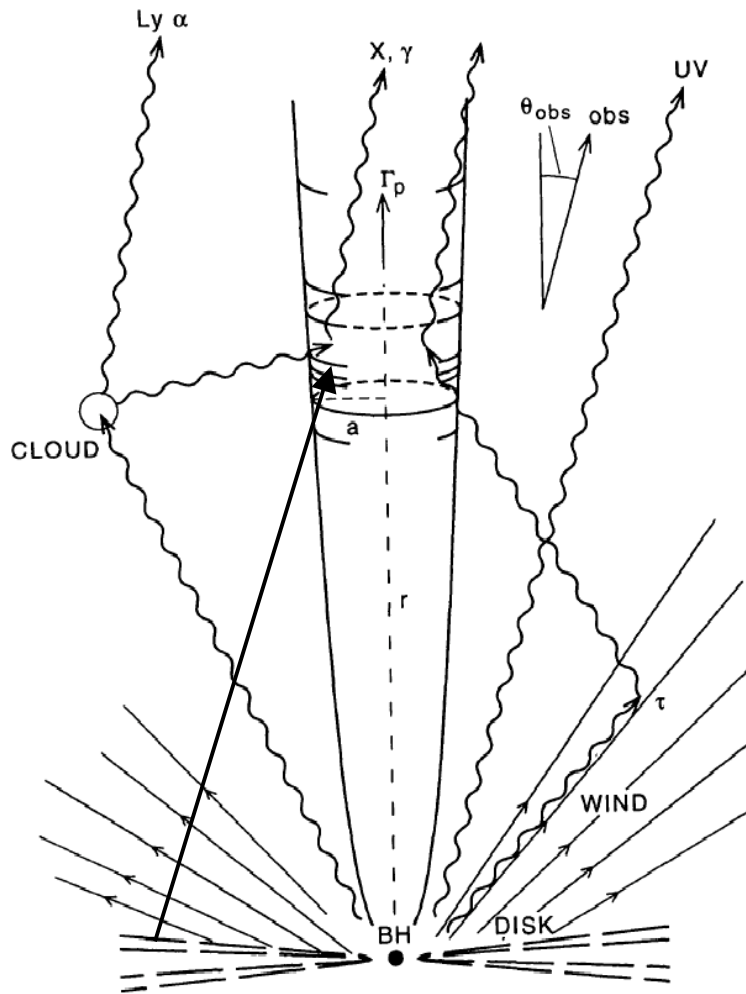
Big Questions From EGRET Era

- **How and where do pulsars emit gamma rays? How common are radio-quiet pulsars?**
 - **necessary clue to magnetic field configurations and dynamics**
- **What are the EGRET Unidentified Sources?**
 - **most of the EGRET source identifications are a mystery**
- **What are the energy budgets of gamma-ray bursts? What are the temporal characteristics of the high-energy emission?**
 - **not well characterized yet, key tests of models.**
- **What are the origins of the diffuse emissions?**
 - **galactic: cosmic-ray and matter distributions; sources**
 - **extragalactic: populations**
 - **new sources (Dark Matter annihilations, clusters, ...)**
- **How do the supermassive black hole systems of AGN work? Why do the jets shine so brightly in gamma rays?**
 - **temporal and spectral variability over different timescales**
- **What remains to be discovered with great new capabilities??**
 - **EGRET showed us the tip of the iceberg. New sources and probes for new physics.**

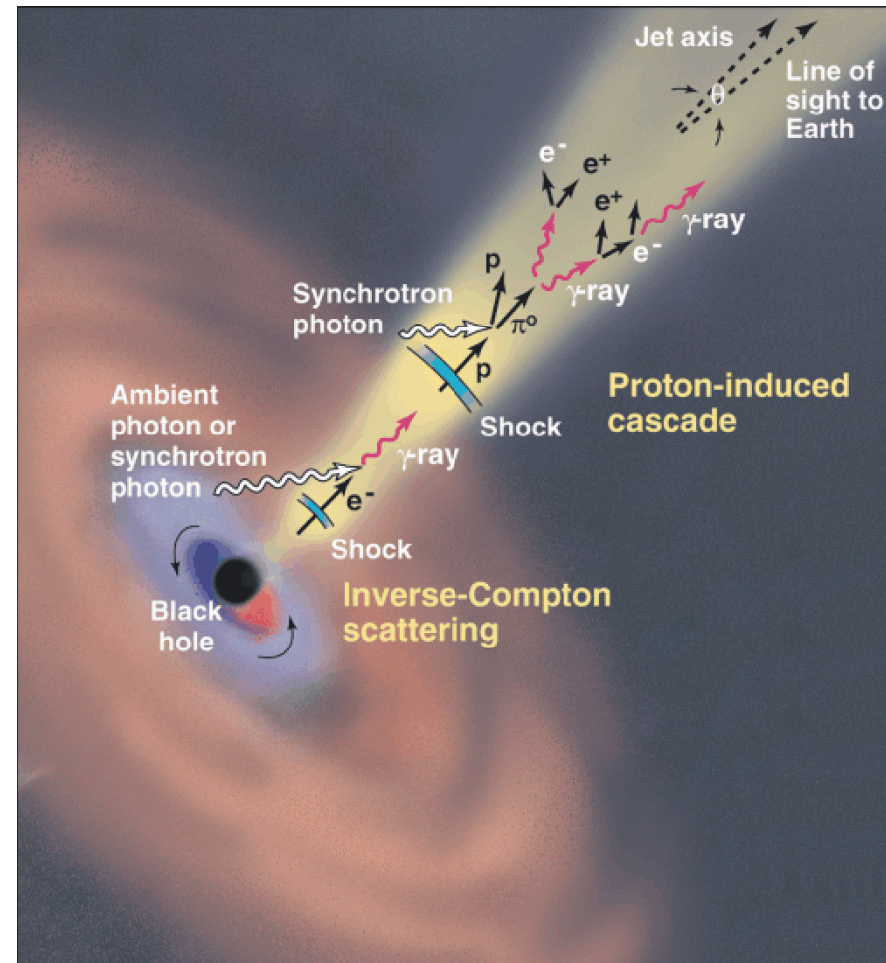
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Models of AGN Gamma-ray Production

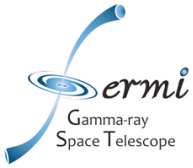


(from Sikora, Begelman, and Rees (1994))



(credit: J. Buckley)

=> multiwavelength observations are essential for the science



LAT First Year Source Monitoring List

http://fermi.gsfc.nasa.gov/ssc/data/policy/LAT_Monitored_Sources.html

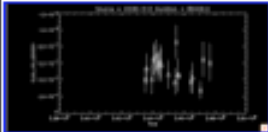
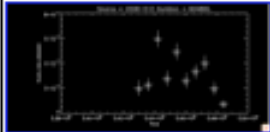
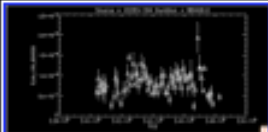
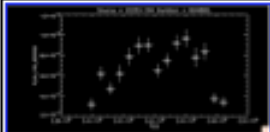
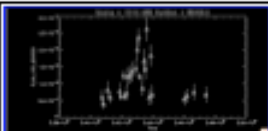
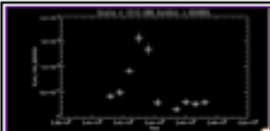
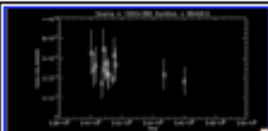
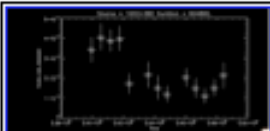
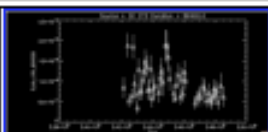
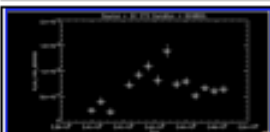
Light curves (daily and weekly integrations) in energy bands.

PLUS, same for any source flaring above $2e-6$ ph/cm²/s (lowering this now) until the average flux drops below $2e-7$ ph/cm²/s (two additional sources thus far: PKS 1454 and PKS 1502)

A "quicklook" analysis to get the results out as soon as possible. Tables may be updated as analysis and calibrations improve.

Source Type	Source Name	EGRET Name	Average or Min. Flux (10^{-8} γ cm ⁻² s ⁻¹)	Galactic Latitude	Redshift	TeV Source
Blazar	0208-512	3EGJ0210-5055	85.5 ± 4.5	-61.9	1.003	
	0235+164	3EGJ0237+1635	65.1 ± 8.8	-39.1	0.94	
	PKS 0528+134	3EGJ0530+1323	93.5 ± 3.6	-11.1	2.060	
	PKS 0716+714	3EGJ0721+7120	17.8 ± 2.0	28	0.3	
	0827+243	3EGJ0829+2413	24.9 ± 3.9	31.7	0.939	
	OJ 287	3EGJ0853+1941	10.6 ± 3.0	35.8	0.306	
	Mrk 421	3EGJ1104+3809	13.9 ± 1.8	65.0	0.031	Yes
	W Com 1219+285	3EGJ1222+2841	11.5 ± 1.8	83.5	0.102	
	3C 273	3EGJ1229+0210	15.4 ± 1.8	64.5	0.158	
	3C 279	3EGJ1255-0549	74.2 ± 2.8	57.0	0.538	
	1406-076	3EGJ1409-0745	27.4 ± 2.8	50.3	1.494	
	H 1426+428	NA		64.9	0.129	Yes
	1510-089	3EGJ1512-0849	18.0 ± 3.8	40.1	0.36	
	PKS 1622-297	3EGJ1625-2955	47.4 ± 3.7	13.4	0.815	
	1633+383	3EGJ1635+3813	58.4 ± 5.2	42.3	1.814	
	Mrk 501	NA		38.9	0.033	Yes
	1730-130 NRAO 530	3EGJ1733-1313	36.1 ± 3.4	10.6	0.902	
	1ES 1959+650	NA		17.7	0.048	Yes
	PKS 2155-304	3EG2158-3023	13.2 ± 3.2	-52.2	0.116	Yes
	BL Lacertae (2200+420)	3EGJ2202+4217	39.9 ± 11.6	-10.4	0.069	Yes
3C 454.3	3EGJ2254+1601	53.7 ± 4.0	-38.3	0.859		
1ES 2344+514	NA		-9.9	0.044	Yes	
HMXB	LSI+61 303 2CG135+01	3EGJ0241+6103	69.3 ± 6.1	1.0		Yes

Released Monitored Source Lightcurves

Source	RA	Dec	Daily	Weekly
0208-512	32.6930	-51.0170	 (lc)	 (lc)
0235+164	39.6620	16.6160	 (lc)	 (lc)
1510-089	228.170	-8.83000	 (lc)	 (lc)
1633+382	248.815	38.1350	 (lc)	 (lc)
3C 273	187.278	2.05200	 (lc)	 (lc)

Fermi Science Support Center

HOME RESOURCES PROPOSALS DATA HEASARC HELP

+ FSSC Home

Data

Data Policy

Data Access

+ LAT Data

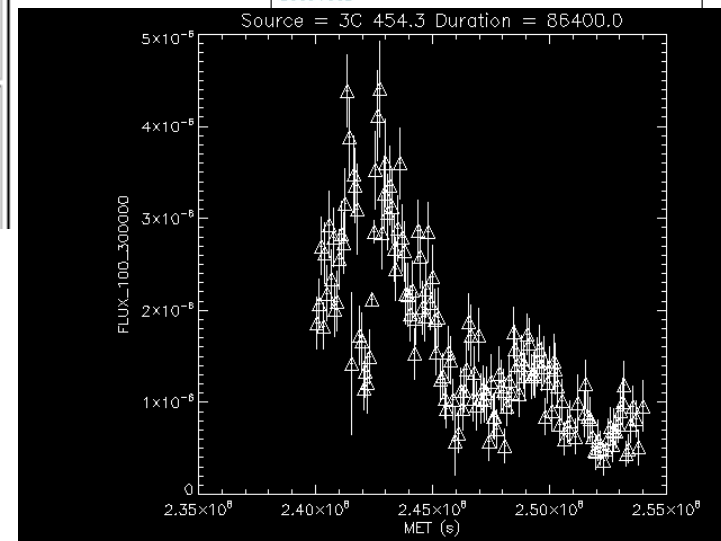
+ GBM Data

Data Analysis

Newsletter

Monitored Source List Light Curves

Source	RA	Dec
0208-512 <ul style="list-style-type: none"> > Daily Light Curve > Daily Light Curve Fits File > Weekly Light Curve > Weekly Light Curve Fits File 	32.6930	-51.0170
0235+164 <ul style="list-style-type: none"> > Daily Light Curve > Daily Light Curve Fits File > Weekly Light Curve > Weekly Light Curve Fits File 	39.6620	16.6160
1406-076 <ul style="list-style-type: none"> > Weekly Light Curve > Weekly Light Curve Fits File 	212.235	-7.87400
1510-089 <ul style="list-style-type: none"> > Daily Light Curve > Daily Light Curve Fits File > Weekly Light Curve > Weekly Light Curve Fits File 	228.170	-8.83000
1633+382	248.815	38.1350
	187.278	2.05200



Guest Investigator AGN Studies

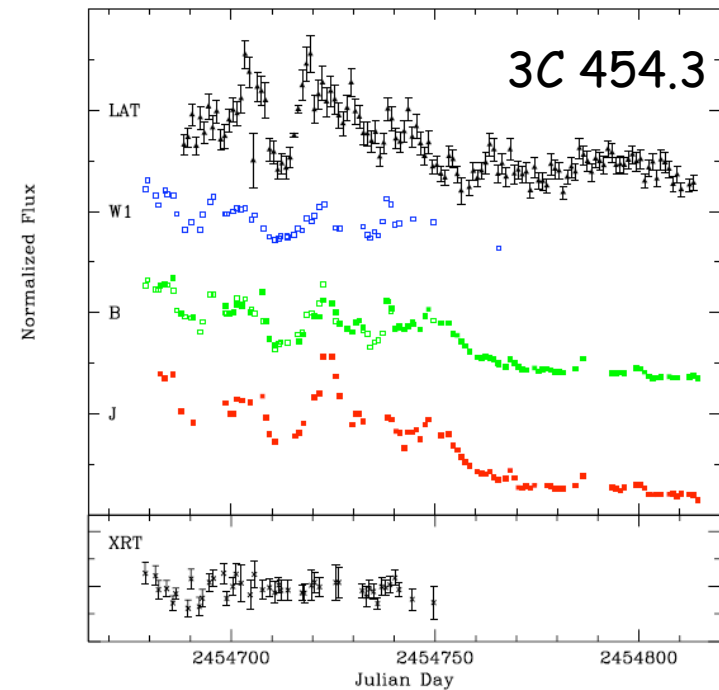
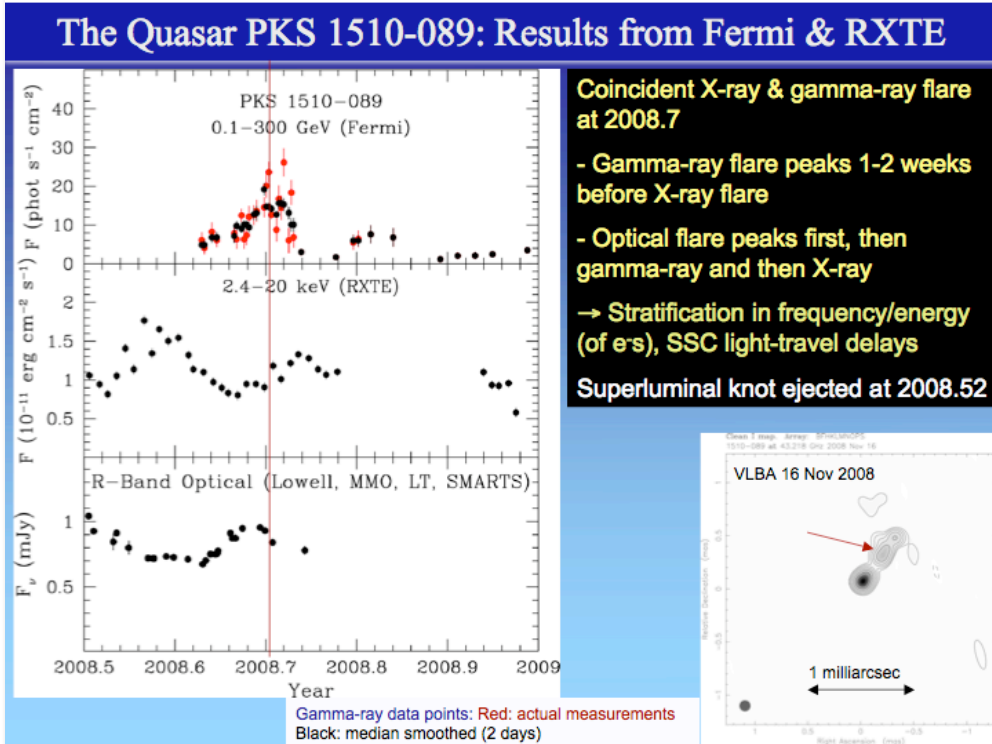


FIG. 1.— Multi-wavelength light curves of 3C 454.3 at (top panel) gamma-ray (0.1-300 GeV), UV (W1), optical (B), and IR (J) wavelengths from Fermi LAT, Swift UVOT, and SMARTS. Fluxes have been normalized to JD 2454700. Light curves are offset for clarity; minor tick spacing corresponds to 50% change. Fluxes at JD 2454700 are 2.83×10^{-6} cts s^{-1} at 0.1-300 GeV, 1.64×10^{-11} erg s^{-1} cm^{-2} in W1, 2.21×10^{-11} erg s^{-1} cm^{-2} in B, and 3.62×10^{-11} erg s^{-1} cm^{-2} in J. (Bottom panel) Swift XRT 2-10 keV light curve, normalized to flux at JD 2454700 (2.90×10^{-11} erg s^{-1} cm^{-2}). The IR/optical/UV variations are well correlated with the gamma-ray variations, with a lag of $\lesssim 1$ day, while the (minimal) X-ray variability is uncorrelated. The variability has much higher amplitude in the J-band than in B, which can be explained if there is a relatively constant blue component, as expected for an accretion disk. At $z=0.859$, Balmer continuum from an accretion disk, as well as Fe II and Mg II emission lines would be redshifted into the B and V bands; H α is shifted into the J band.

Marscher et al

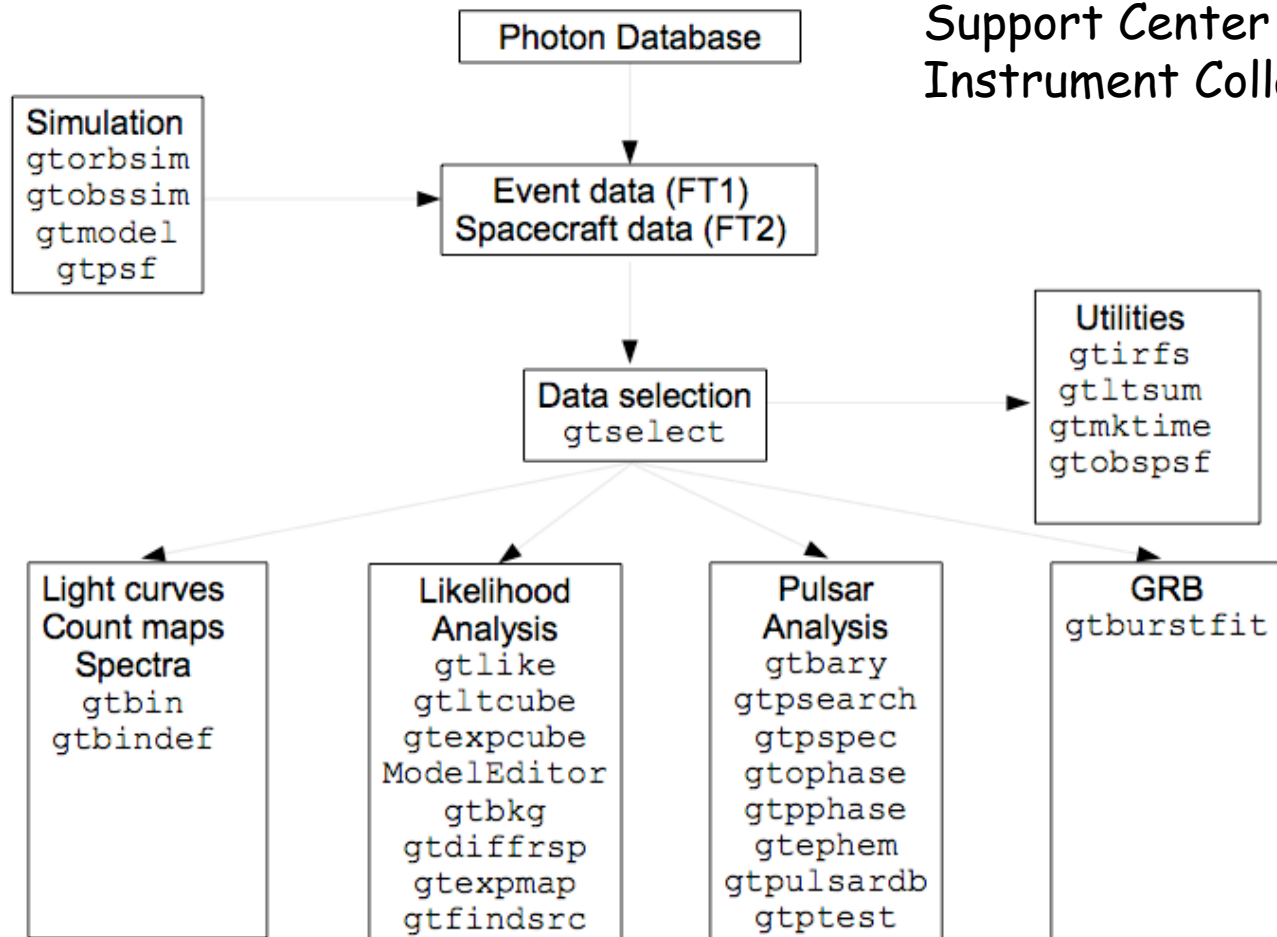
Demonstrates the value of multiwavelength observations with Fermi data

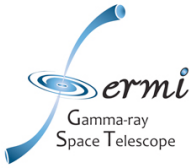
Bonning et al arXiv:0812.4582v1

For campaigners' information and coordination, see <http://fermi.gsfc.nasa.gov/science/multi>

Tools With the Photon Data

Developed jointly by Science Support Center and Instrument Collaborations





Guest Investigator Cycle 2

Guest Investigator **Cycle 2 proposals DUE March 6, 2009**

See <http://fermi.gsfc.nasa.gov/ssc/proposals/cycle2/>

- **expect to fund ~75 regular and up to 8 large projects:**
 - detailed analyses of LAT photon candidate events
 - analyses of monitored sources and summary data
 - **Fermi-related MW observations**
 - **In addition, NRAO and NOAO MOUs provide joint observing time through the regular Fermi GI program. See FSSC site.**
 - **Fermi-related theory**
 - **Fermi-relevant data analysis methodology**

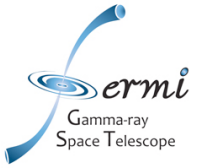
Summary



- **Fermi is off to a great start!**
 - The instruments are beautiful
 - The gamma-ray sky is keeping its promise, with just 5%-10% of the data. Great cooperation across the international team.
- **Already addressing many important questions from EGRET era**
 - new analysis techniques and approaches are essential -- new topics!
 - the challenge of great discovery potential
- **Guest Investigator **Cycle 2 proposals DUE March 6, 2009****
 - See <http://fermi.gsfc.nasa.gov/ssc/proposals/cycle2/>
- **2-5 November 2009 International Fermi Symposium in Washington, DC**
- **Personnel change effective 1 April !**

Sign up for newsletters:

<http://fermi.gsfc.nasa.gov/ssc/resources/newsletter/>



Questions?
