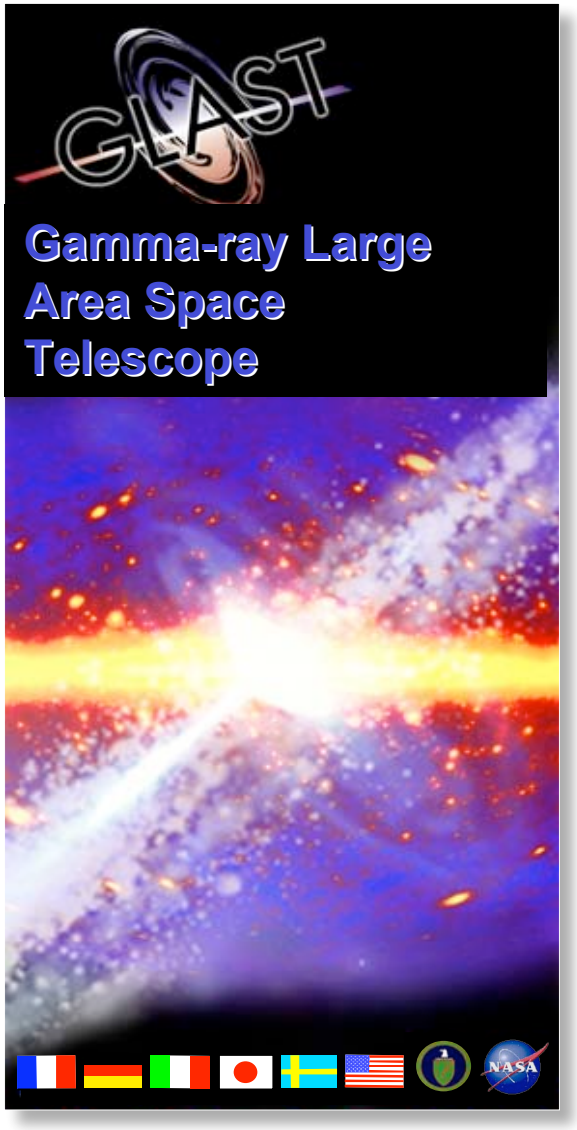


GLAST Large Area Telescope

Next Steps, First Ops, and Summary

Bill Atwood

Next Steps

Presentation 6 of 6

Analysis Iteration Prior to Launch

Context:

- For DC2 four iterations on the Event Analysis were made, each showing improvement of its predecessor
  - Final DC2 results showed that Irreducible backgrounds dominated the residuals
  - Presence of irreducible backgrounds corrupts the development of a background rejection analysis from making "cuts" to training Classification Trees
  - All previous background rejection passes binned the events in energy - this leaves artifacts in the resulting acceptances.

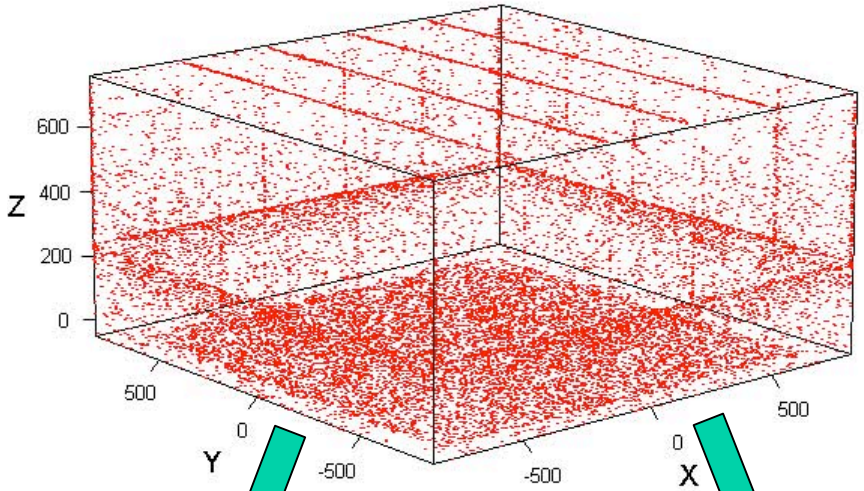
Pass 5 Underway:

- Identify and remove the irreducible component from background flux.
- Divide analysis up along general event features
- **C**harged **P**articles within the **F**ield-of-View (**CPF**s)
- Initial Shower Topology, Full Shower Topology
- Re-assess Event Classification according the Science Topics
  - GRB, Galactic plane Sources, High-latitude Sources, Diffuse

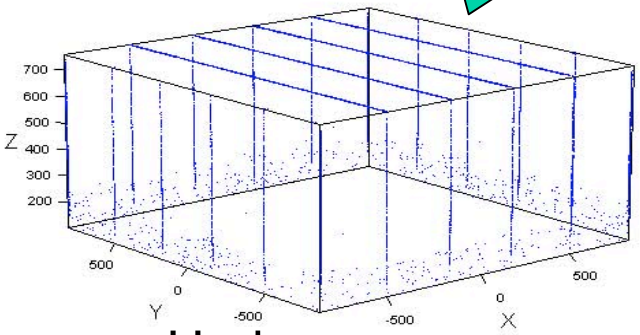
A First Step: CPF Analysis

Goal: Hermitically Seal the LAT from Charged Particles entering the Front
(This is essentially an ACD analysis - with minimal usage of Tracker Information)

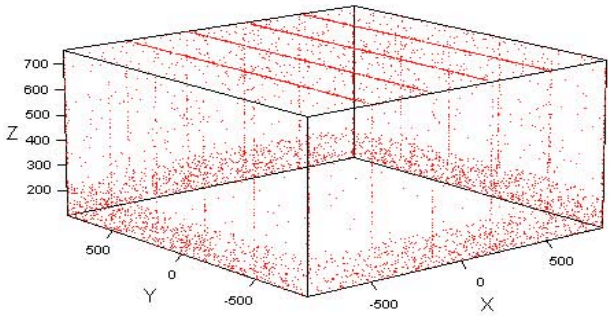
Full Sample
Entry Points
for Down-Linked Data
(Hardware Trigger & OBF applied)



CPFs Only:



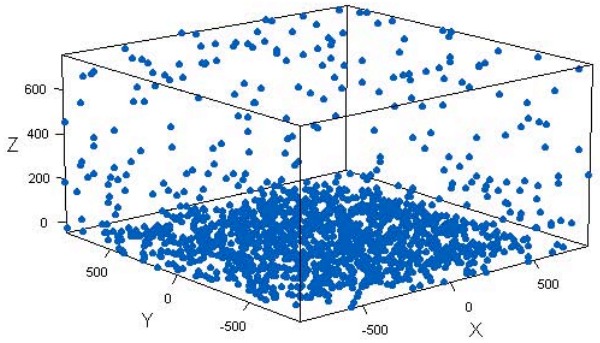
Hadrons (McId > 100)

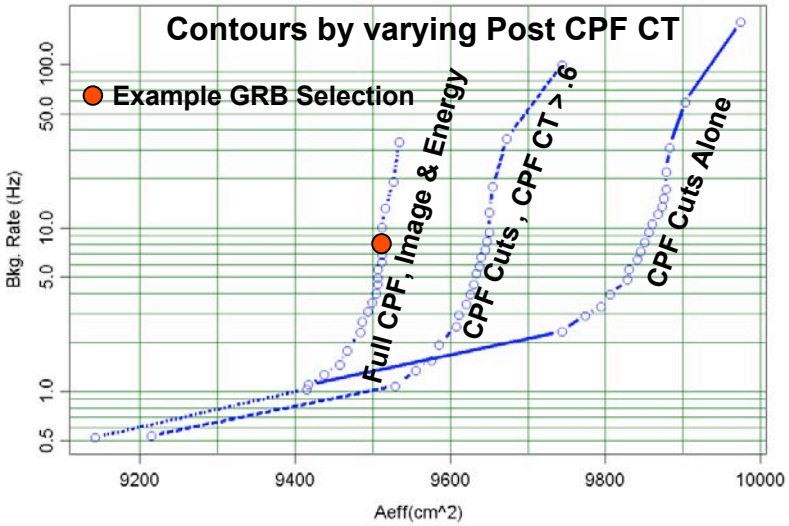


e+e- (McId < 100)

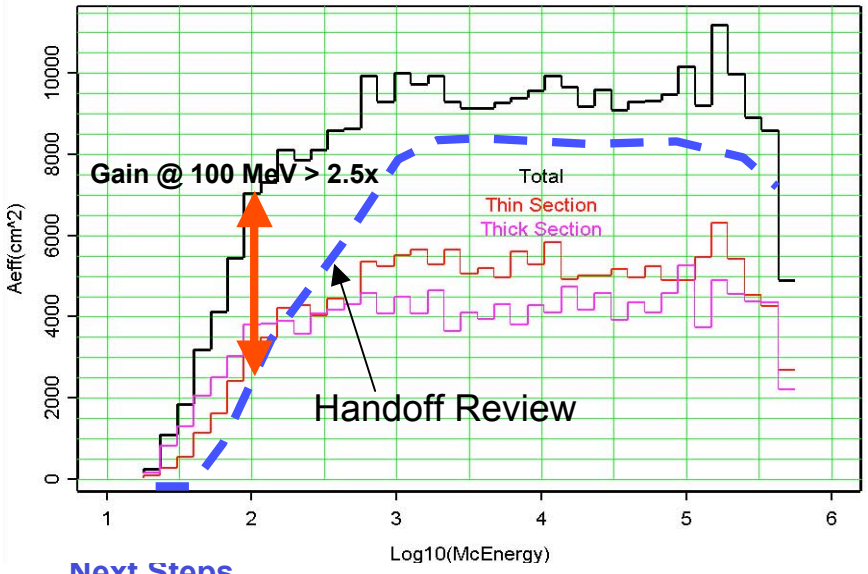
Example GRB Selection

Minimal Imaging, Minimal Energy Res.,
Moderate CPF Rejection, Moderate Post CPF
Classification Tree Rejection

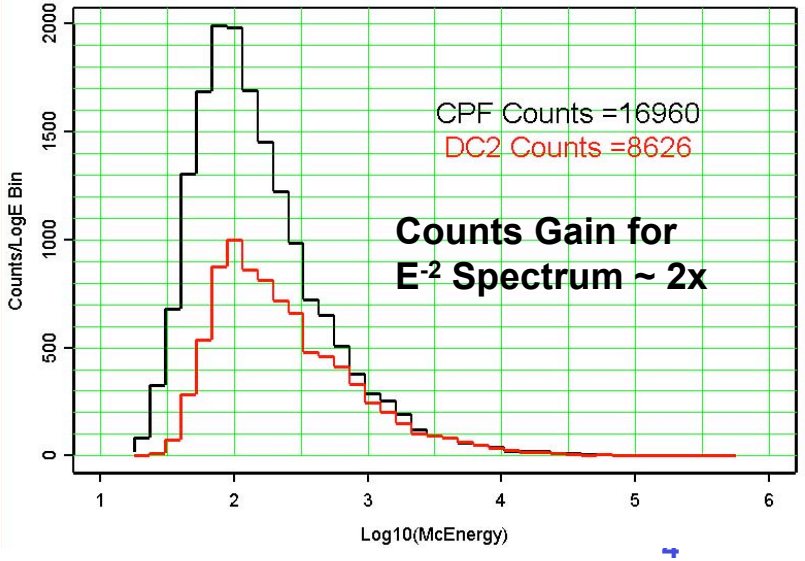




Effective Area vs Log10(McEnergy)



GRB Counts vs Log10(McEnergy)



Next Steps

Presentation 6 of 6

Getting Ready for Data: Operations & Science Prep.

Operations: **I**nstrument **S**cience **O**perations **C**enter (ISOC)
located at SLAC - Manger Rob Cameron (SLAC)
Oversees the day-to-day operation of the LAT
- Control & Command of the LAT Instrument
- Processing of down-linked data
- Monitoring of Instrument Performance
- Participation from across the collaboration

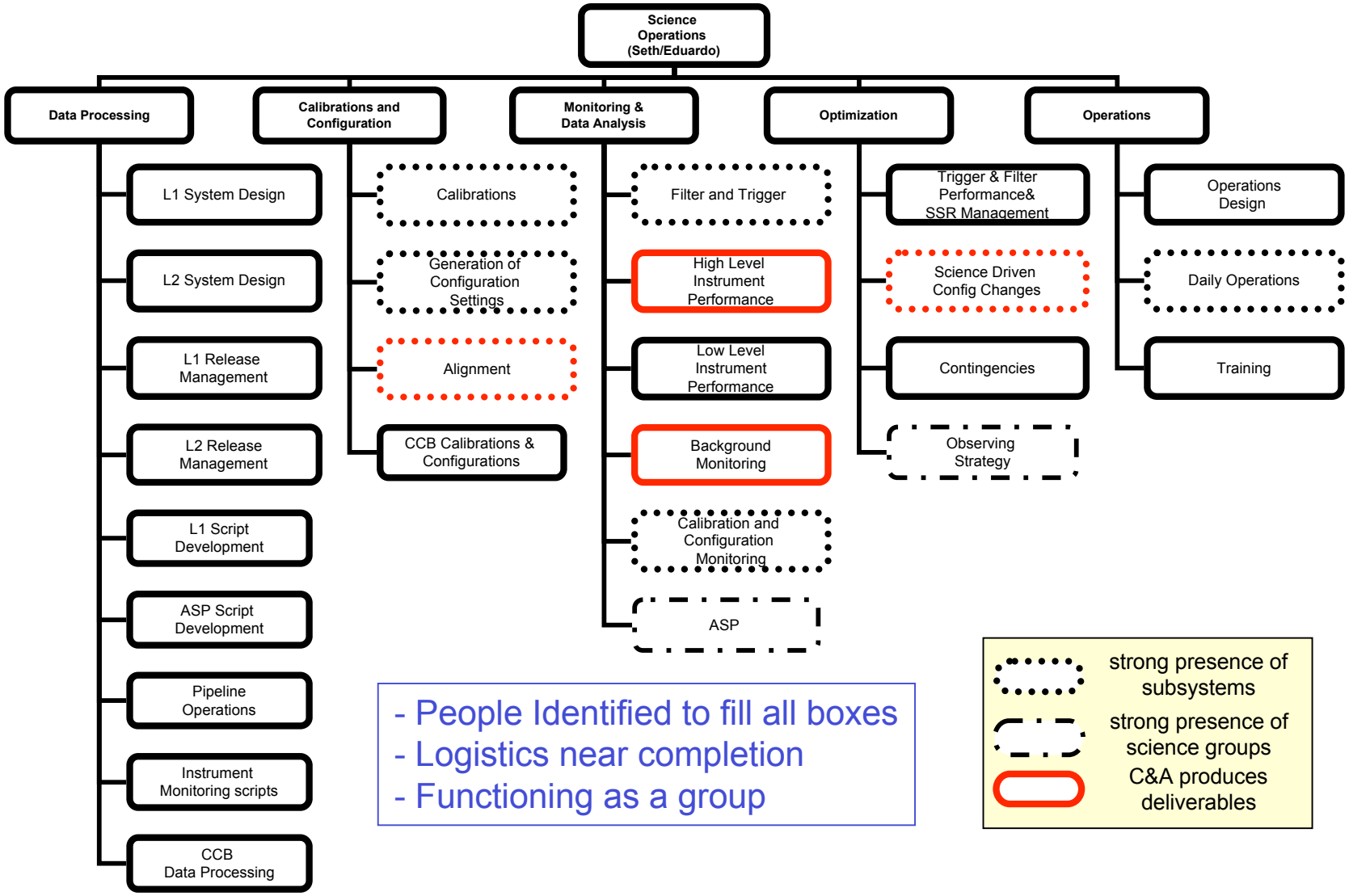
Science Prep.: LAT Science Groups

Overall analysis co-ordinator - Julie McEnery (GSFC)

9 Groups
- Blazars & Other AGNs
- Calibration & Analysis Methods
- Catalogs
- Dark Matter & New Physics
- Diffuse & Molecular Clouds
- Gamma Ray Bursts
- Pulsars, SNRs, & Perions
- Sources in the Solar System
- Unidentified Sources, Pop. Studies, & Other Galaxies

Prepare for Data with Data Service Challenges

ISOC Organization



Next Steps

Presentation 6 of 6

Overview of ISOC Tests and/or Workshops

- The Science Operations Team of the ISOC will participate in a series of tests with real data and Monte Carlo simulations to ensure readiness prior to launch
- End to End Tests (1 to 6)
  - interface tests between the observatory and the GLAST Ground System which is composed of all elements that are needed to support the Observatory from the ground during its mission lifetime
    - real data from LAT will be used to address data processing, implement and test operations tools and procedures used in the control room at SLAC
    - First test scheduled for mid-February
- Service Challenges (1 to N)
  - interface between science working groups, science analysis software groups and the ISOC.
    - simulated data from LAT will be used to address monitoring, data processing and data analysis related functions
    - First test November 2006
- ISOC Ops tests (1 and 2)
  - Simulate complete operations between Science and Flight Operations
    - detailed scope yet to be defined but will combine elements of End-to-end tests and Service Challenges
    - First test scheduled for summer 2007

Service Challenges

- Sequence of simulations, of varying degrees of fidelity to flight data to exercise our capabilities.
- Now that we have met the requirements, how are we to maximize the science return?
- What is coming:
  - Series of 1 year Quick Simulation (1st one in Nov. 2006)
    - Astrophysical source updates: GRB models, pulsars (noise, phase dependent spectra, more sophisticated GRBs, etc)
    - Quantify how different astrophysics models interact (e.g. blazar luminosity function on EBL studies or Galactic diffuse model on SNR studies)
    - Develop analysis requiring long datasets
    - Exercise catalog pipeline
  - 55 day full detector simulation
    - Updated sky model
    - Improved treatment of residual background in high level analysis
    - Exercise and test ASP* and Catalog pipelines, flow resulting data to the GSSC.
    - Some detector/observatory imperfections - exercise ISOC monitoring and explore the effects of these on the science results (and test communication between SO and the science groups).

*Automated Science Processing

Service Challenge

- **What is coming (cont)**
  - **Series of downlink (3hr) sized full detector sims in a variety of detector and observation configuration. Simulations produced in very low-level raw format.**
    - **Fully exercise level 1 pipeline**
    - **Exercise and develop all operations monitoring software (I.e. find and characterize instrument configurations and problems)**
    - **Practice ISOC science ops (duty scientist shifts etc)**
  - **One year full detector simulation (June 2007)**
    - **This will provide the most realistic simulation dataset to practice and develop science analysis.**
    - **Final iterations of instrument performance and IRFs.**
    - **Develop analyses that require long integration times (extragalactic and Galactic diffuse, dark matter searches etc)**
  - **In parallel with these large organized simulations, the science groups are also generating smaller sets of simulated data for specific studies**
    - **Populations of GRB, grids of point sources with systematically changing properties etc.**

First ~60 days On-Orbit

TASK*

- initial background flux assessments
- onboard filter tuning
- tuning and monitoring onboard science algorithms
- searches for subtle instrument problems and hardware system performance trending
- initial mechanical alignment calibration between LAT and spacecraft (see GLAST Calibration Plan document)
- initial science performance checks
- first-light science

*See outlined in SVAC plan, LAT-MD-00446

Summary Timeline

	Task	Duration	Comment
Initial LAT Operations	Power-on, boot, configuration, command/communication checks	5 days	Done in contact with the ground to maximum extent possible.
	Optional STRs*	2 days	Additional ground contacts possibly needed.
	Charge injection runs	2 days	Additional ground contacts needed for data dumps.
	Initial trigger and rate tests	5 days	Monitor trigger rates in near realtime as frequently as possible. Three or more orbits with filter in pass-through mode (see text); otherwise, nominal data downlinks. Observatory pointing optimized for ground contacts.
	Optional STRs	2 days	Additional ground contacts possibly needed.
Initial Science Observations	Sensor checks and coarse internal alignment; first-light pointed observations.	14 days plus 7 days of optional scheduled STRs interspersed.	Day 1 and day 7 inertially pointed; the rest is pointed with limb avoidance or two-target mode (TBD). The same data can be used for all these analysis purposes.
	Early sky survey tuning	14 days, including STRs	Nominal operations.

*STR: **S**pecial **T**est **R**equest

First Light

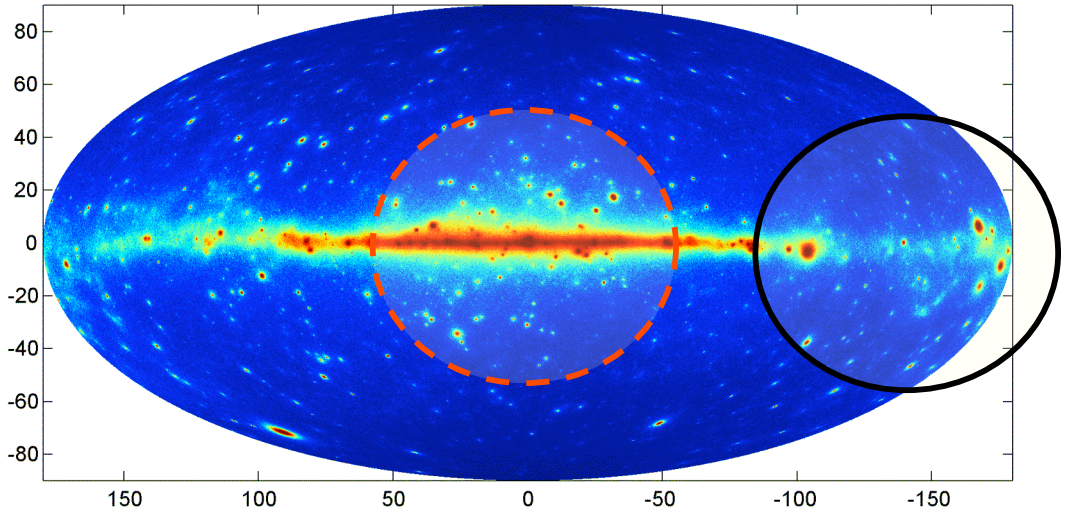
Use Bright Pulsars as in Flight Calibration Sources

- Ephemeris Identification (we can be certain what we are looking at!)
- Large Photon Stats: determine on-orbit instrument response
- Timing analysis: Calibrates Clocks, orbit location determination
- Provides alignment between the LAT and Star-tracker
- Gamma-ray pulsars have hard spectra with sharp, measurable cutoffs
  - verify that the location of the spectral feature is consistent with previous measurements
  - science bonus: produce the best determination of the location and shape of the spectra

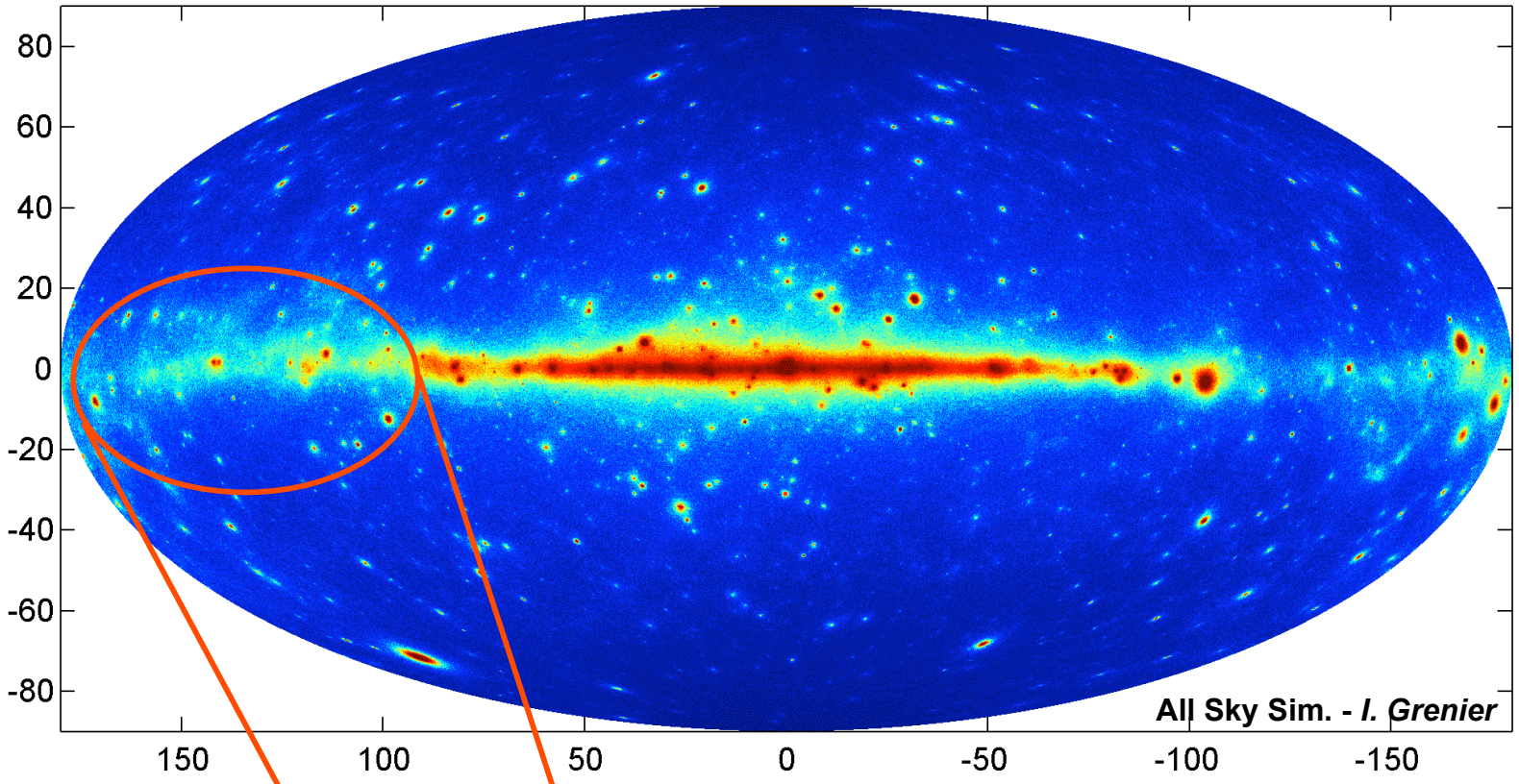
Slew to the secondary target when the primary target is occulted by the Earth

will also perform a continuous inertial pointed observation of the primary target, allowing the Earth to enter the FoV. Allows gamma-albedo in the front of the LAT and charged particles in the back to better determine the nature of the backgrounds

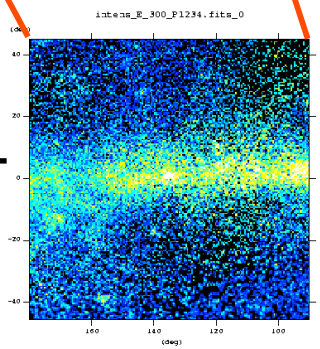
Present Candidate:
Vela, Crab, & Geminga
Secondary Target
PSR 1706 (Galactic center also in the FoV)

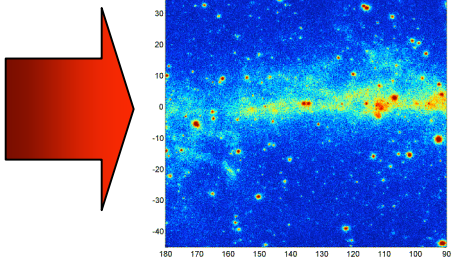


First Year Scan - All Sky Survey



EGRET





GLAST

Key Level 2 Science Performance Requirements Summary

Parameter	SRD Value	Current Best Estimate
Peak Effective Area (in range 1-10 GeV)	>8000 cm^2	~ 9000 cm^2
Energy Resolution 100 MeV on-axis	<10%	~ 10%
Energy Resolution 10 GeV on-axis	<10%	< 6%
Energy Resolution 10-300 GeV on-axis	<20%	< 8%
Energy Resolution 10-300 GeV off-axis (>60º)	<6%	~ 5%
PSF 68% 100 MeV on-axis	<3.5°	< 3.2º
PSF 68% 10 GeV on-axis	<0.15°	< .1º
PSF 95/68 ratio	<3	< 3
PSF 55º/normal ratio	<1.7	<1.5
Field of View	>2sr	>2sr
Background rejection (E>100 MeV)	<10% diffuse	See Discussion
Point Source Sensitivity(>100MeV)	<6x10^{-9} $cm^{-2}s^{-1}$	< 4 x 10^{-9}
Source Location Determination	<0.5 arcmin	< 0.5 arcmin
GRB localization	<10 arcmin	< 5 arcmin
Instrument Time Accuracy	<10 μsec	<<10 μsec (current 1σ = .7μs)
Dead Time	<100 μsec/evt	26.5 μsec/evt nominal
GRB notification time to spacecraft	<5 seconds	Design meets requirement