The GLAST LAT Instrument Science Operations Center

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for the GLAST LAT Instrument Science Operations Center

Abstract

Operations support and science data processing for the Large Area Telescope (LAT) instrument on the Gamma-ray Large Area Space Telescope (GLAST) will be provided by the LAT Instrument Science Operations Center (ISOC) at the Stanford Linear Accelerator Center (SLAC). The ISOC supports GLAST mission operations in cooperation with other GLAST mission ground system elements and supports the science activities of the LAT collaboration.

The ISOC will be responsible for monitoring the health and safety of the LAT, preparing command loads for the LAT, maintaining and updating embedded flight software which controls the LAT detector and data acquisition flight hardware, maintaining the LAT configuration and calibration, and applying event reconstruction processing to down-linked LAT data to recover information about detected gamma-ray photons. The SLAC computer farm will be used to process the large volume of LAT event data and generate science products to be made available to the LAT collaboration through the ISOC and the broader scientific community through the GLAST Science Support Center at GSFC. Science operations in the ISOC will optimize the performance of the LAT and oversee automated science processing of LAT data to detect and monitor transient gamma-ray sources. We describe the use of collaboration-wide data challenges to test and exercise LAT data processing before launch.

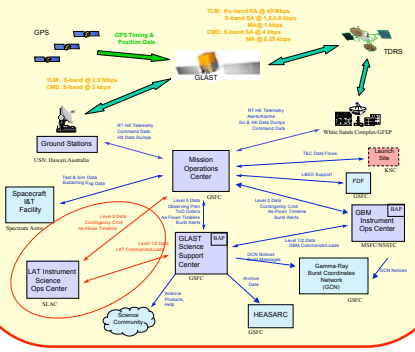
ISOC Functions

The LAT ISOC is organized to:
- Support operation of the Large Area Telescope (LAT)
- Produce and deliver LAT Level 1 data and selected Level 2 science data to the LAT Collaboration, and the scientific community via the NASA GLAST Science Support Center

Main Functions:
- LAT command planning and construction
- LAT Instrument health and safety monitoring
- Maintain and modify LAT flight software and the LAT Testbed
- LAT performance verification and optimization
- Receive and archive Level 0 data
- Process and archive LAT Level 1 and Level 2 data
- Maintain and optimize the software that produces LAT science data products

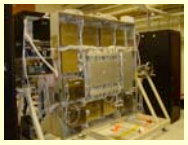
The ISOC and GLAST Operations

- The main ISOC operational interfaces are to the GLAST Mission Operations Center (MOC) and the GLAST Science Support Center (GSSC)
- Routine LAT observations are planned weekly
- LAT data down-linked from GLAST and delivered to the ISOC several times per day. ISOC supports automated data receipt and ingest for "lights-out" data processing.



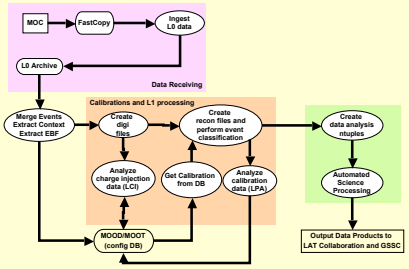
LAT Configuration and Maintenance

- The ISOC maintains a dataflow lab containing a flight-like testbed for the LAT on-board data acquisition and processing electronics
- Detector front-end simulators allow for flight-like event data and rates
- The LAT testbed is used for development, test and validation of LAT data collection configurations
- Development and test of LAT flight software
- Verification and validation of LAT commanding



LAT Data Processing

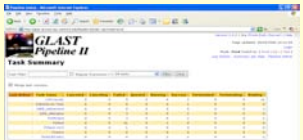
- Pipelined processing infrastructure used for processing LAT event data
- Implemented on SLAC computer farm, benefiting from existing large-scale computing infrastructure for particle physics experiments
- Expect to apply 400 CPUs to LAT processing
- Data volume for processing full down-linked LAT science dataset is shown below
- Approximately 1% of events in LAT science data are celestial photons. Possible to apply coarse filtering of background data in early processing to reduce disk needs. All Level 0 data are archived.

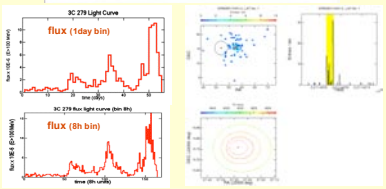


	Recon CPU	Merit tuple size	MonteCarlo size	Digi size	Recon size
Per event	0.06 sec	0.5 kB	28 kB	1.5 kB	8.6 kB
Per day	650 hrs	19 GB	1100 GB	58 GB	333 GB
Per year		7 TB	252 TB	21 TB	121 TB

Automated Science Processing

- Automated Level 2 processing on reconstructed LAT event (Level 1) photon data, to search for, detect and characterize transient events in the gamma-ray sky
  - Detection of gamma-ray bursts
  - Refined measurements (positions, light curves, spectra) for previously detected gamma-ray bursts
  - Detection, characterizing and monitoring of flaring blazars and other sources
- See J. Chiang presentation for more details on ASP





ASP examples: multi-timescale AGN light curves from DC2 data (G. Tosti), and GRB position refinement (J. Chiang)

Data Challenges

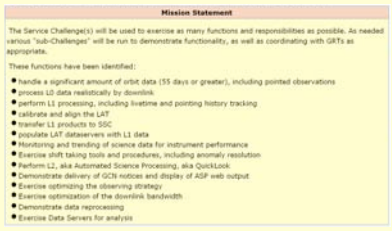
Data Challenges used by LAT Collaboration and ISOC to develop, test and demonstrate Level 1 and 2 processing
- Full LAT collaboration participates in data analysis
  - Exercise of GLAST science analysis toolkit
- DC1 (2004) simulated 1 day of LAT data
- DC2 (2006) simulated 55 days of LAT data
  - Delivered L1 event data to GSSC
  - Generated LAT pointing history and livetime
  - Generated initial LAT source catalog
  - Populated data servers at GSSC and ISOC
  - Joint data production/simulation/analysis with GLAST Burst Monitor (GBM)
  - ~200,000 CPU-hours on SLAC compute farm to generate background and sky data
- DC2 datasets used for test/development of ISOC science ops
  - Develop diagnostics, trending, reports etc.

DC2 results at **http://www-glast.slac.stanford.edu/software/DataChallenges/DC2/JuneCloseout/default.html**

Sky map of gamma-rays detected by the LAT in the DC2 simulation

Service Challenges

Service Challenges are successor and extension to successful Data Challenge model
- Broader set of objectives
  - Continue to provide simulation datasets to LAT collaboration for analysis development
  - Also provides rehearsal ISOC science operations activities with realistic datasets and data delivery
  - Detailed preparation and rehearsal of initial on-orbit instrument commissioning
  - Exercise ~10 analysis and operations threads



Acknowledgements

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