Serving Data to the GLAST Users Community

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Abstract

The scientific community will access the public GLAST data through the website of the GLAST Science Support Center (GSSC). For most data products the GSSC website will link to the NASA High Energy Astrophysics Science Archive Research Center's (HEASARC) Browse interface, which will actually serve the data. For example, data from the GLAST Burst Monitor (GBM) from a given burst will be packaged together and accessible through Browse. However, the photon and event data produced by the Large Area Telescope (LAT), GLAST's primary instrument, will be distributed through a custom GSSC interface. These data will be collected over the LAT's large field-of-view, usually while the LAT is scanning the sky, and thus photons from a particular direction cannot be attributed to a single "observation" in the traditional sense. Users will request all photons detected from a region on the sky over a specified time and energy range. Through its website the GSSC will also provide long and short term science timelines, spacecraft position and attitude histories, exposure maps and other scientific data products. The different data products provided by the GSSC will be described.

LAT Data

Photon and event data will be served through the GSSC's LAT data server. The GSSC populates the photon database based on event data received from the LISOC.

Events are all triggers reconstructed by the LISOC and will include, e.g., electrons and protons in addition to photons. There are about 200 parameters associated with each event. Based on these parameters, a subset of events are classified as gamma-ray photons. We then use only the events classified as photons and extract about 20 of the 200 parameters for each photon that are most useful for scientific analysis to populate the photon database. Most users will only need the photon data, but the event data will be there for those who wish to rescreen the data themselves.

New data will be added to the sever as soon as they are received from the LISOC. This will occur within 72 hours of the data being taken but likely in much less time. A variety of source catalogs will be served through Browse. A burst catalog will be updated on a per event basis. Other catalogs will be updated infrequently. Also available will be an interstellar emission model and an instrument background model. These will be refined as the mission progresses and updated infrequently. The GSSC will also provide and various data on the exposure and live-time of the LAT instrument updated with each photon database update.

Data Properties and Data Serving

It is impossible to define an "observation" for the LAT in the traditional sense. Given the large field of view of the LAT and the continuously scanning operating mode, any given object is constantly moving into and out of the instrument's field of view and is typically observed for ~30 minutes every 3 hours of observing. Also, the low angular resolution at low energies results in photons from one source overlapping with photons from nearby sources and requires simultaneous fitting to disentangle closely spaced objects. Typically a user will need data from a part of the sky equal to a 20-30° diameter field of view to fully analyze an object at the center of that field. This corresponds to ~1-2% of the entire sky for a single analysis.

The LAT will trigger on a large number of events, only a small fraction of which will be actual photons. Filtering will reduce the ~2.5 kHz of triggers to ~30 Hz delivered to the GSSC from which ~2-5 Hz of photons will extracted. This corresponds to ~100 million photons and ~1 billion events a year. With the current data record specifications, this translates into ~10 GB of photon data and ~1 TB of event data a year with a typical photon query returning 100-200 Mbytes of data.

It is also expected that the LAT will detect thousands of sources. The large number of sources, combined with the moderately large data volume and high degree of source overlap make it unrealistic to prepackage the data on a source by source or even region by region basis. This would result in an unnecessary duplication of the same data multiple times in the data system.

All of these factors point toward the development of a dynamic data retrieval system that retrieves the data as needed according to the user's unique specifications instead of relying on static prepackaged files.

GLAST Data Policy and Access

All GBM data is public immediately from the beginning of the mission. During the first year of the mission, LAT event data are proprietary to the instrument team and the Interdisciplinary scientists, although lightcurves and spectra of detected transients and ~20 selected sources will be made public as soon as possible. A month after the end of the first year, the event data will become publicly available.

Starting the second year, all subsequent science data acquired by the spacecraft will be immediately in the public domain without a proprietary data period. Full details on the GLAST Data Policy can be found on the GSSC web site. Also see **Poster 19.1** for more information about the GLAST GI program and observation proposals.

All public data from the GLAST mission will be available through the GSSC's website. Much of the data will be served through the HEASARC Browse (an interface to all of NASA's high energy astrophysics data from both current and previous missions). The GSSC website will link to this interface. Those data not available through Browse will be served directly from the GSSC's website.

Data Properties and Data Analysis

The LAT will detect photons that can be used in data analysis up to ~66º off-axis. The effective area decreases off-axis, but the solid angle increases, and therefore a large fraction of the data will be taken off-axis. The GBM will detect bursts down to the Earth's limb. While GLAST can point at individual sources, there will rarely be any advantage because of the LAT's large FOV. Usually GLAST will rock ~35° above and below the orbital plane once per orbit for uniform sky coverage.

The LAT's PSF will be ~3.5º at 100 MeV, <0.15º at 10 GeV (68% containment radius) with significant tails that will decrease as a power law with radius. LAT sources will be observed against a bright spatially varying Galactic and isotropic Extragalactic diffuse background. The average LAT count rate from astrophysical sources (including the background) will be 2-3 counts/s.

Most persistent sources will be observed by the LAT at a variety of detector orientations; each count must be analyzed using the response function appropriate for the detector orientation when the count was detected. Counts from different sources, including the diffuse background, will often overlap.

LAT Data Server

The LAT Data Server will provide users with access to events, photons, and position and attitude history from the LAT. It will accessed by users through a customized web interface hosted by the GSSC.

The user enters the desired position with optional energy and time cuts and will then be served a page with the estimated query time and a link to a results page. When the data files (FITS format files) are ready, they will be made available for download on the results page.

The data server is implemented as a small cluster of Linux PCs which operate on event lists stored in FITS files. Based on the user's query, the photons matching the data cuts are extracted and presented to the user as a downloadable FITS file. The photon and event databases will be updated immediately when new data are received by the GSSC from the LAT instrument team.

GBM Data

Data products for the GBM will be similar to those of the BATSE instrument on the Compton Gamma Ray Observatory. For bursts, catalogs with derived parameters, which include preliminary lightcurves and spectral fits, will be provided through Browse. The catalog entries will link to data packages which will include accumulated counts (CTIME and CSPEC files), time tagged events, response functions, backgrounds, and other files necessary to analyze the data. New bursts will be added to the catalog as soon as the data is received from the GIOC. Although burst alert notices will go out immediately, the data will not enter the archive until the GIOC is finished processing the data. The entire day of data is processed by the GIOC to account for background variability before any data is sent to the GSSC.

Spacecraft and Other Data

In addition to the science data, various data products dealing with the spacecraft will be available via the GSSC website to help scientists and observers. These will include proposed and observed science timelines for coordinating simultaneous multi-wavelength observations, spacecraft alerts, pointing and livetime history, and various other spacecraft related data.

The GSSC website will also provide scientists with access to information on the status of Target of Opportunity (ToO) observations including when they were submitted, accepted and transmitted to the spacecraft. Data from the ToO observations will be available as part of the standard data sets.

GSSC Website:

http://glast.gsfc.nasa.gov/ssc

GLAST Data Products