GLAST Large Area Telescope:

Data Challenge Overview

December 2003

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Outline

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• What’s been done
  – the signal
  – backgrounds
• The Warts
• Ready for analysis!
  – minimum success for DC1
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But first…

• THANKS TO THE LOCAL ORGANIZERS!!!!

• Thanks to everyone who worked very hard to get us to this point!
Purposes of the Data Challenges

• “End-to-end” testing of analysis software.
• Familiarize team with data content, formats, tools and realistic details of analysis issues (both instrumental and astrophysical).
• If needed, develop additional methods for analyzing LAT data, encouraging alternatives that fit within the existing framework.
• Provide feedback to the SAS group on what works and what is missing from the data formats and tools.
• Uncover systematic effects in reconstruction and analysis.

Support readiness by launch time to do all first-year science.
Data Challenge Planning Approach

• Walk before running: design a progression of studies.
• DC1. Modest goals. Contains most essential features of a data challenge. Original plan:
  • 1 simulated day all-sky survey simulation, including backgrounds
  • find flaring AGN, a GRB
  • recognize simple hardware problem(s)
  • a few physics surprises
  • exercise:
    – exposure, orbit/attitude handling, data processing pipeline components, analysis tools

• DC2, start end of CY04. More ambitious goals. Encourage further development, based on lessons from DC1. One simulated month.
• DC3. Support for flight science production.
What’s been done: preparatory work

- Very large effort during the past ~9 months by many people.
- Instrument analysis:
  - done previously with earlier tools for AO, PDR, etc., demonstrating LAT meets requirements.
  - Now done again with new tools (See Atwood talk). More to do, but more than adequate for DC1.
- Fluxes
- Data formats, processing
- Science tools

Already a great success!
The DC1 Sky

One day all-sky survey. Generated E>20 MeV.

Lots to analyze!
A few surprises to find...

thanks to Julie!
Backgrounds

- **DC1** is an approximate modeling of one day of LAT data.
  - at face value, this means 400M background triggers (4kHz). [This is not the number generated, which is larger, since many miss the instrument.]
  - using an updated version of Bill Atwood’s background rejection analysis shown in Rome, residual contamination of photon sample would be about ~6%.

- **One-day science is generally NOT background limited.** Several purposes to generating background for DC1:
  - exercise the machine, find the problems (already done!)
  - generate amounts of background needed anyway to complete the analysis.

- **We therefore decided to unhook the background generation for DC1**
  - Rejection analysis already at a sufficient level to estimate instrument performance for gammas (Aeff).
  - Used these cuts on the photon sample for DC1. Provides a good description of impacts of background rejection.
    - at normal incidence, Aeff asymptotes to 10,000 cm². At 100 MeV, ~4,500 cm²
    - small fall-off in area for E>10 GeV, will be improved soon. Not a background rejection issue.
  - Already at a sufficient level to make background a non-issue for DC1 science analyses.
  - This allows the background rejection analysis to proceed at its own pace.

- **At end of DC1, both background rejection and signal analyses will be completed to the levels planned.**
The Warts

• Lots of hard work by many people on the machinery up until the last minute.
  – some things might not work as expected.
  – some compromises in the data flow.
  – instrument response not yet in CALDB (but is hooked up to science tools)

• Sky model is fairly rich and accurate. Some details could be better
  – could have some remaining bugs and “features”
  – no flaring sources implemented (though some variable sources might have
day-long fluxes different from your expectation…)
  – some bursts missing

• No (intentional) hardware problems implemented.
  – decided to postpone to DC2, when ISOC is up and running

• No onboard filter in data path yet
  – similar to background rejection situation. The incremental loss of area (after
other cuts) is now expected to be very small. Lots of progress here. More
details at February closeout meeting.

• Instrument response functions are not really mature.
  – some problems still. certainly good enough for DC1 science goals, however!

Remember: this is DC1, 3 years before launch.
Some problems with energy resolution

Plot from Luis
Something funny going on here. Resolution is significantly worse than before.

Stay tuned.

Response is certainly adequate for DC1!
Some problems with energy resolution
DC1 Minimum Results

• The existence of the data sets and the volume of data generated for background analyses already meets one of the success criteria.

• A minimum set of plots and tables that we must collectively produce:
  – TABLE 1: found sources, ranked by flux (E>100 MeV). Table has the following columns
    – reconstructed location and error circle
    – flux (E>100 MeV) and error
    – significance
    – 3EG identification (yes or no) [note: DON'T assume DC1 sky is the 3EG catalog!]
    – extra credit:
      » include flux below 100 MeV
      » spectral indices of brightest sources
      » comparison of 3EG position and flux characteristics with GLAST analysis
  – FIGURE 1: LogN-logs plot of TABLE1

  – TABLE 2: list of transients detected. Columns are
    • location and error circle
    • flux (E>100 MeV) and error
    • significance
    • duration
  – FIGURE 2: light curve
    • Extra credit: FIGURE 2a: spectra.

  – PLUS: reports of any physics surprises found.
Beyond the minimum

Here are a few suggestions:

- we may generate and release more days of data
  - better exercise tools and infrastructure
  - more transients
- spectral analyses
- localization studies
  - one-day localization of Vela is particularly interesting
- analysis improvements

But don’t let this list limit you. The sky is the limit!
Organization

• An organizing committee has been working to help facilitate DC1:
  – Toby Burnett, Seth Digel, Richard Dubois, Berrie Giebels, Francesco Longo, SR, Tracy Usher
  – Large amount of work, particularly by local members, to make this meeting possible

• Let the organizing committee help you get your work done. Please communicate:
  – what you are working on
  – your status
  – what problems you are encountering

• The organizing committee will help ensure there are no holes in the analysis so that we can meet our minimal success criteria.
Meetings & Communication

• CLOSEOUT MEETING 12-13 February at SLAC. Show your final results there.

• Interim get-togethers in VRVS as needed.

• We’ll set up a limited-time email distribution list. Sign up here. Tell your colleagues who want to participate but could not attend this meeting.
This Meeting

- Monday morning: overview talks, orientation
  - analysis, instrument response functions, data path and data available, tools, basic how-to’s

- Monday afternoon: tutorials

- Tuesday morning: divide up the work.
  - Time to hook up with others interested in similar analyses. You may choose to work together….or not.
  - Let others know what you plan to do so we can assess if there will be holes

- Tuesday morning and afternoon: start work! Help desk available.
Summary

• DC1 is already a great success, due to the hard work of many people working together. We have learned many lessons already.

• Now the fun part: analyzing the sky!

• There will be some frustrating days, but it will be worthwhile.

• Looking forward to all the great results at the February 12-13 meeting at SLAC.