

# GLAST Large Area Telescope:

## Data Challenge Overview

December 2003

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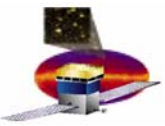
[ritz@milkyway.gsfc.nasa.gov](mailto:ritz@milkyway.gsfc.nasa.gov)



# Outline

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- **Data challenge purposes and scope**
- **What's been done**
  - **the signal**
  - **backgrounds**
- **The Warts**
- **Ready for analysis!**
  - **minimum success for DC1**
  - **going beyond minimum**
- **Organization**
- **Overview of meeting**
- **Summary**



## But first...

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- THANKS TO THE LOCAL ORGANIZERS!!!!
- Thanks to everyone who worked very hard to get us to this point!



# Purposes of the Data Challenges

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- **“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.**

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**Support readiness by launch time to do all first-year science.**



# Data Challenge Planning Approach

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- **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

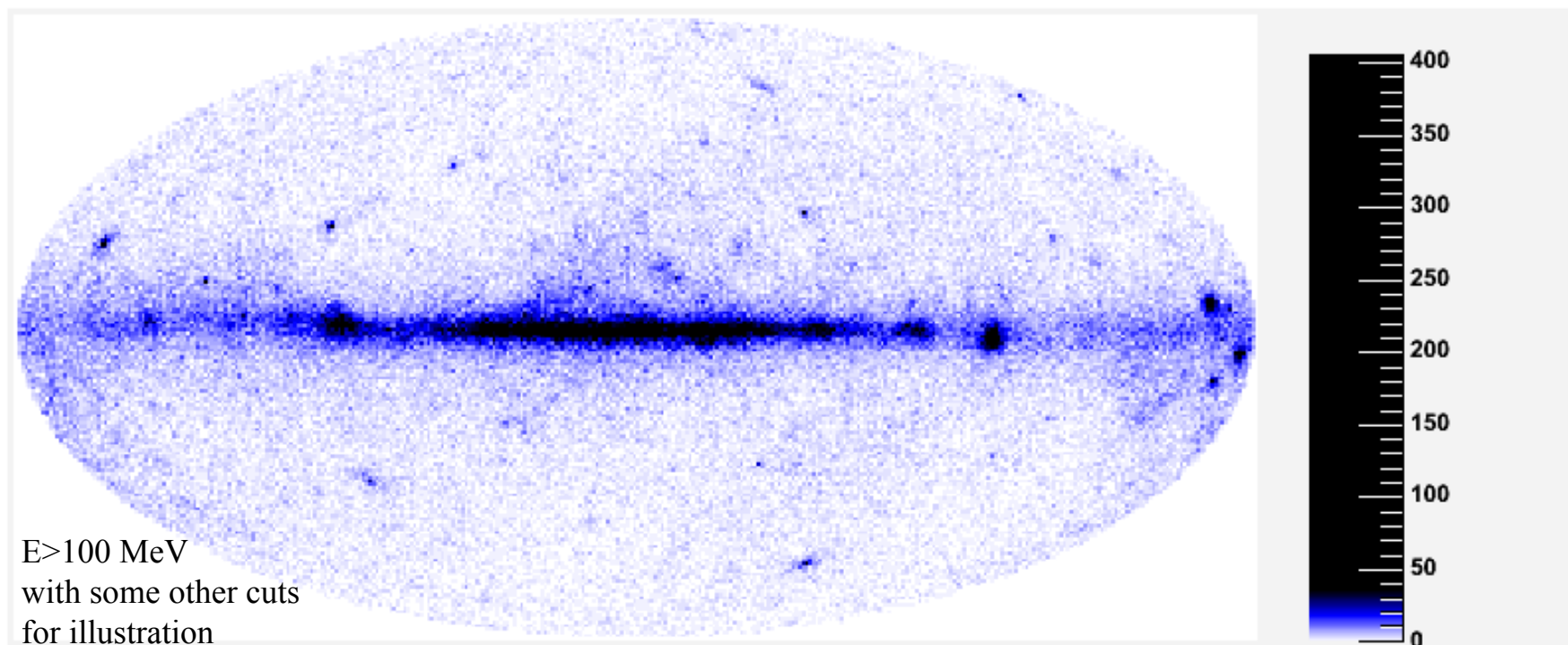
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- **Very large effort during the past ~9 months by many people.**
- **Instrument analysis:**
  - done previously with earlier tools for AO, PDR, etc., demonstrating LAT meets requirements.
  - Now done again with new tools (See Atwood talk). More to 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.



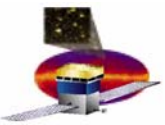
thanks to Julie!

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

# 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 ( $A_{\text{eff}}$ ).
  - Used these cuts on the photon sample for DC1. Provides a good description of impacts of background rejection.
    - at normal incidence,  $A_{\text{eff}}$  asymptotes to 10,000 cm<sup>2</sup>. At 100 MeV, ~4,500 cm<sup>2</sup>
    - 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

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- **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!

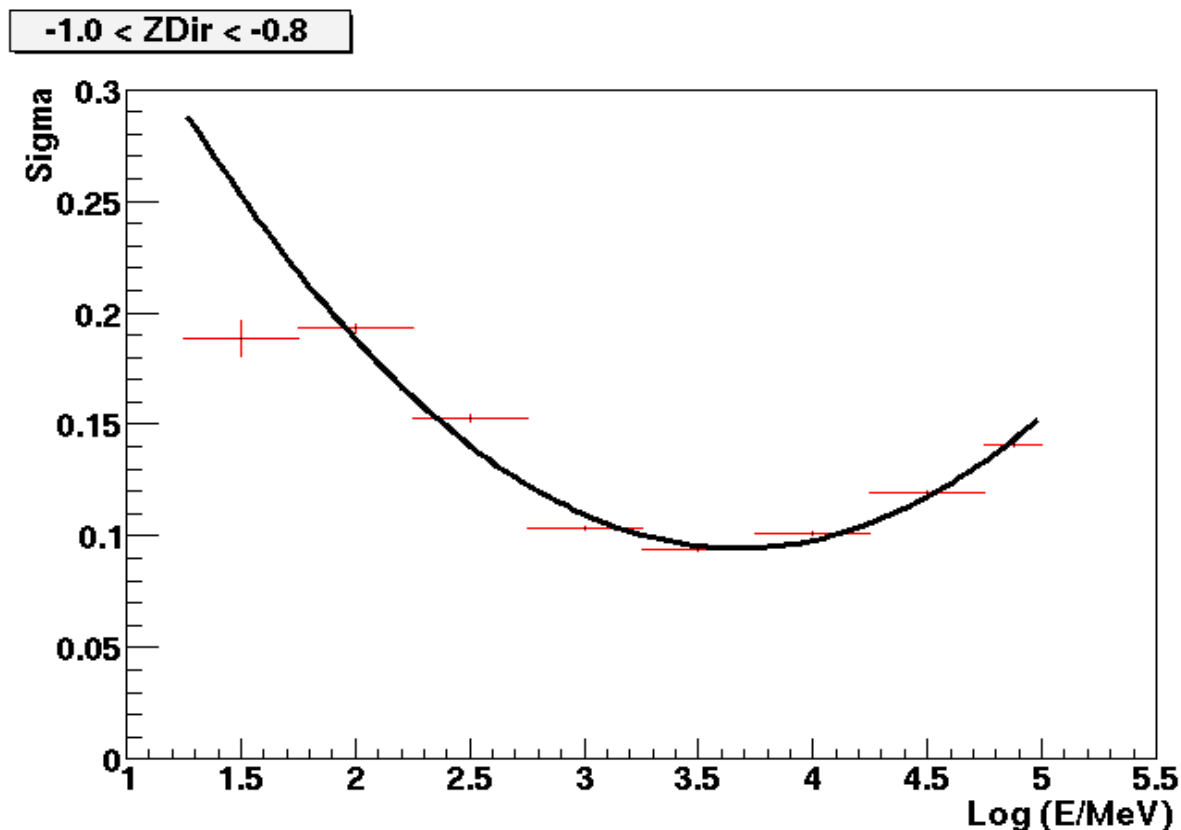
**Remember: this is DC1, 3 years before launch.**

# Some problems with energy resolution

Plot from Luis

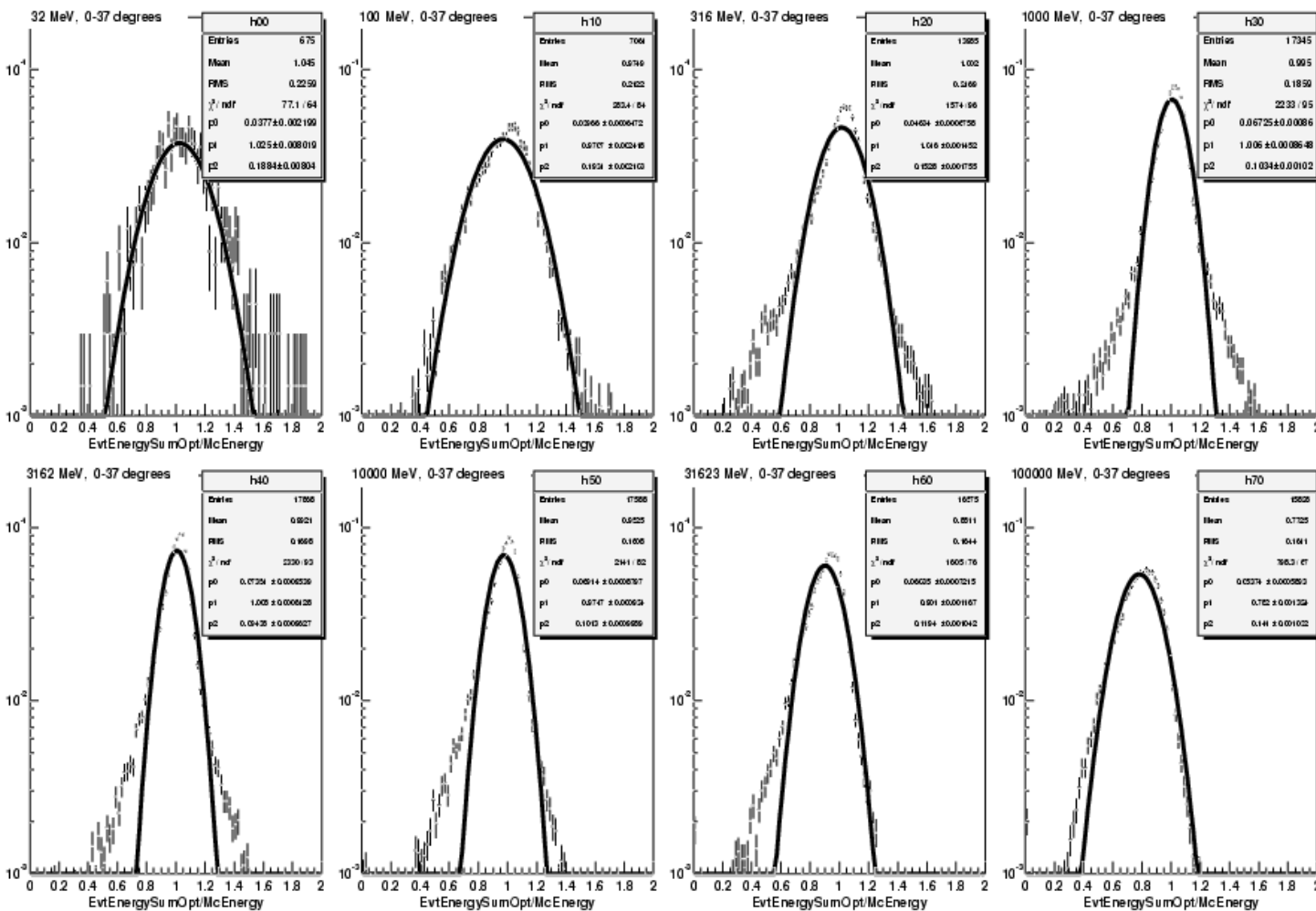
Something funny  
going on here.  
Resolution is  
significantly  
worse than  
before.

Stay tuned.



Response is certainly adequate for DC1!

# Some problems with energy resolution





# DC1 Minimum Results

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- 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

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- **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

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- **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

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- **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

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- **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

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- **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.**