

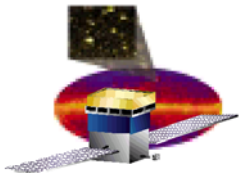




GLAST's Use of ROOT

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Outline

- Quick Introduction to GLAST
- Data Challenge I
- New GLAST Gaudi Root Persistency Service
- GRB Modeling and ROOT
- AstroRoot for Windows
- Root2IDL update
- Comments, Requests

GLAST Large Area Telescope (LAT)

~200 collaborators

Si Tracker Tower

pitch = 228 μm

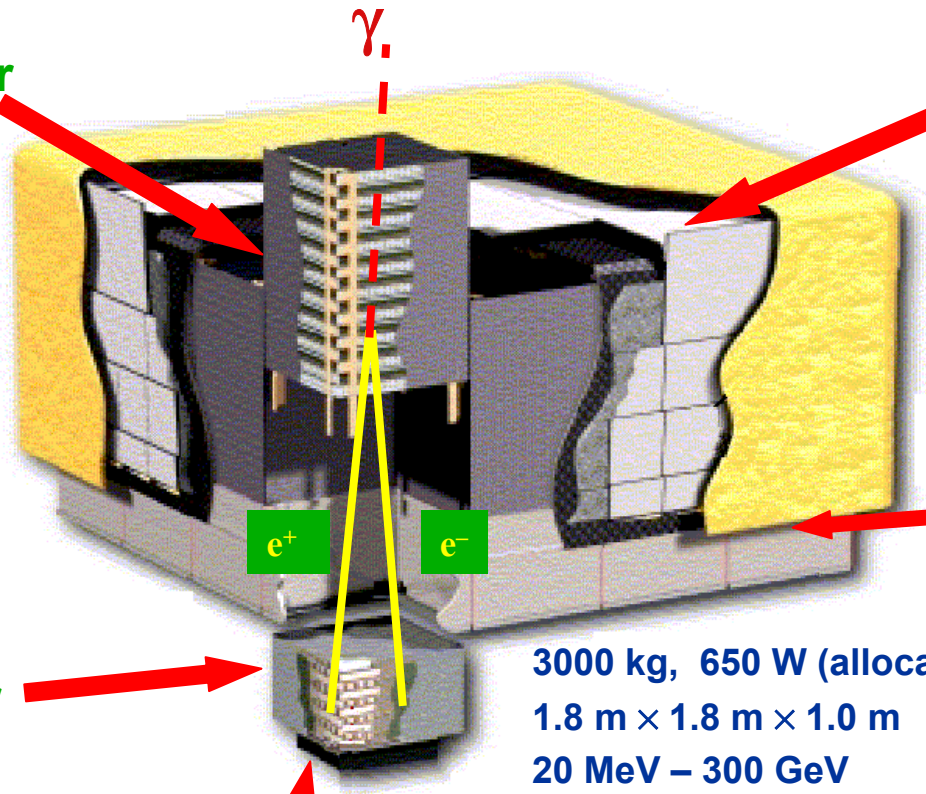
5.52 10^4 channels

12 layers × 3% X_0

+ 4 layers × 18% X_0

+ 2 layers





ACD



Segmented scintillator tiles

0.9997 efficiency

⇒ minimize self-veto

Grid (& Thermal Radiators)



3000 kg, 650 W (allocation)

1.8 m × 1.8 m × 1.0 m

20 MeV – 300 GeV

CsI Calorimeter

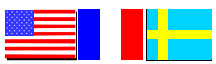
Hodoscopic array

8.4 X_0 8 × 12 bars

2.0 × 2.7 × 33.6 cm

⇒ cosmic-ray rejection

⇒ shower leakage correction

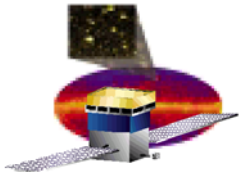


Data acquisition



Launch May 2007

LAT Home Page:
http://www-glast.stanford.edu



Some of our Favorite Things

RH 9 / gcc 3.2

VC 7.0/7.1

Gaudi: our framework

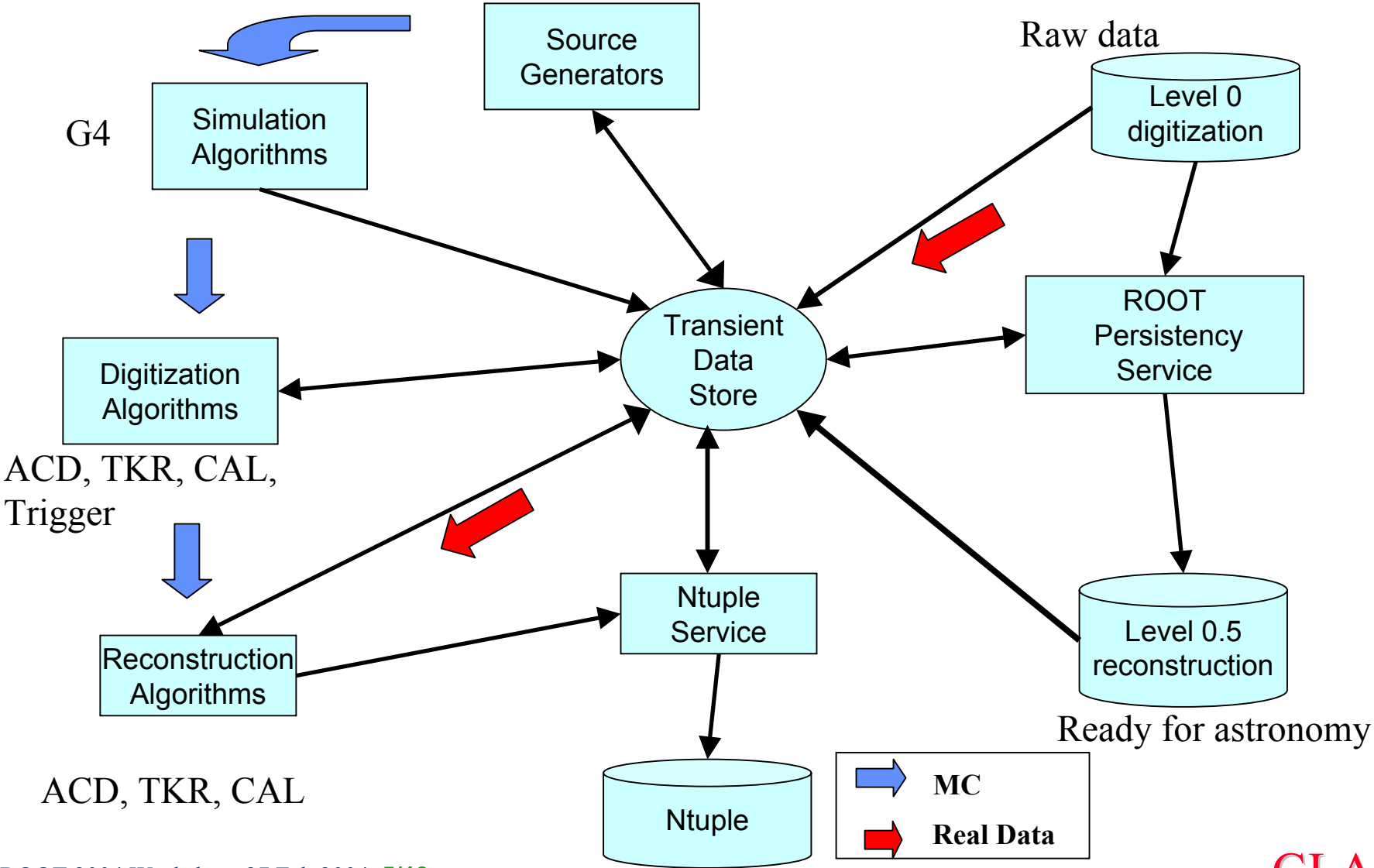


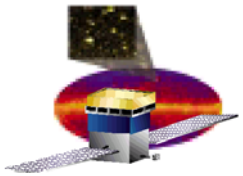
ROOT

FITS The Astronomical Image and Table Format
Flexible Image Transport System

IDL

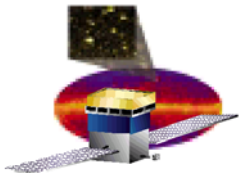
Data flow in the Gaudi framework





GLAST LAT Data Files

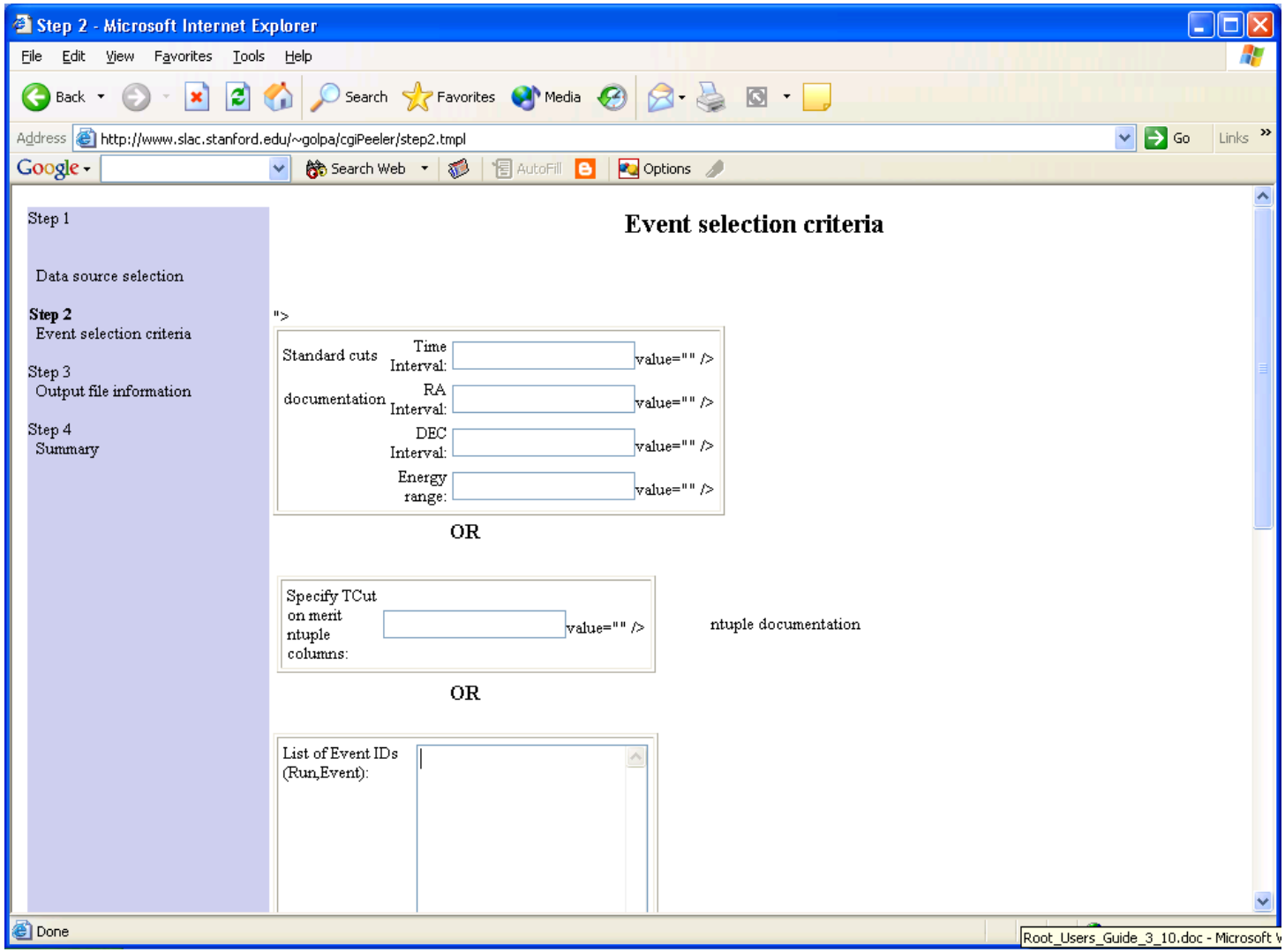
- Summary ntuple
  - 236 branches of Double_t
- Monte Carlo record: either full or truncated
- Detector Digitization Data
  - TKR strips, CAL logs, ACD PHAs
- Full Reconstruction Data
  - Tracks, CAL log energies, ..
- Currently 4 parallel files
  - Need to make use of TTree friends



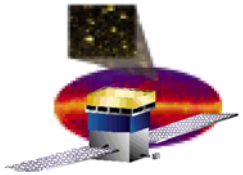
Data Challenge I

- Just completed our first Data Challenge where we simulated 6 days worth of data.
  - 63 GB MC, 8 GB Digi, 86 GB Recon
  - Over 6 million triggered events
- A prototype LAT data server was created to serve ROOT files to DC1 participants.
  - Provided the facility to search data using arbitrary TCuts on the columns in our summary ntuple

Event Selection



GLAST

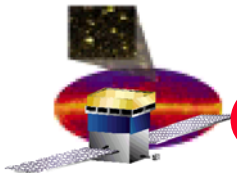




Gaudi and ROOT



- We use both Gaudi and ROOT
  - Would like them to co-exist nicely
- Easy to write ntuples
  - Gaudi's RootCnvSvc.
- Gaudi supports TBlobs for ROOT
  - Just a bit stream.. Structure lost
- "Cheated" with ROOT I/O algorithms for our full ROOT trees for MC, Digi, Recon data.
- Should be using Gaudi Persistency Service.



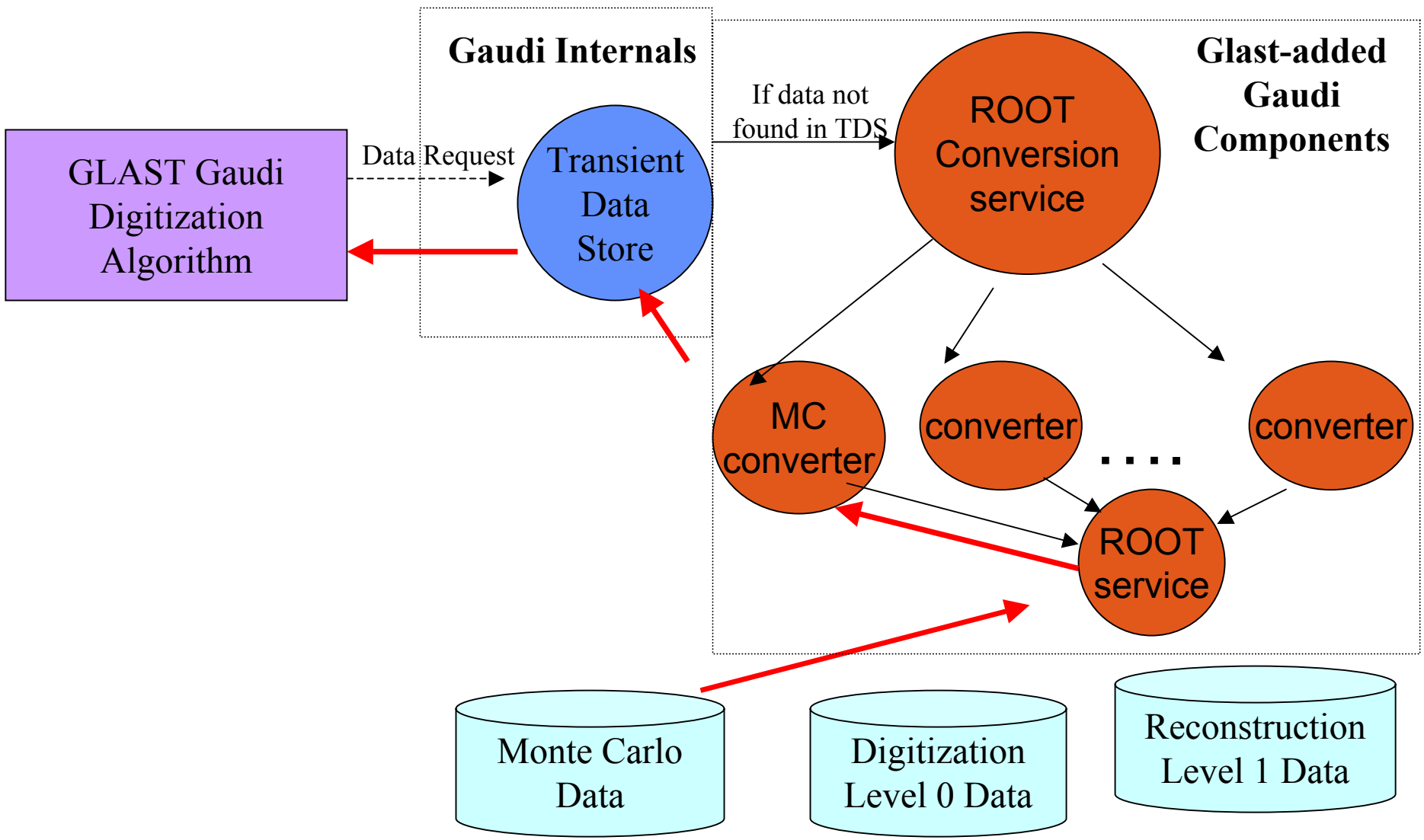
GLAST Gaudi Root Persistency Service

- Written by Ursula Berthon (IN2P3)
- Converters now exist for all of our objects.

  Each data object has its own hand-crafted converter
- Currently in the Testing Phase.
- Soon we will replace our outdated algorithms that currently handle all Root I/O
- Why?

  Increased flexibility and easier maintenance

Reading Monte Carlo Data



GRB modeling with ROOT

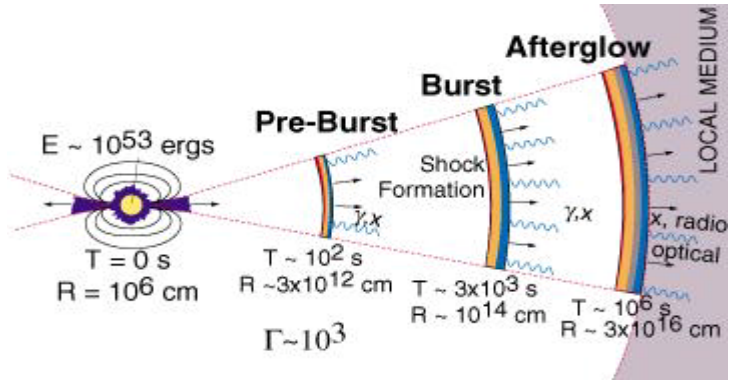
GRB Physical Model

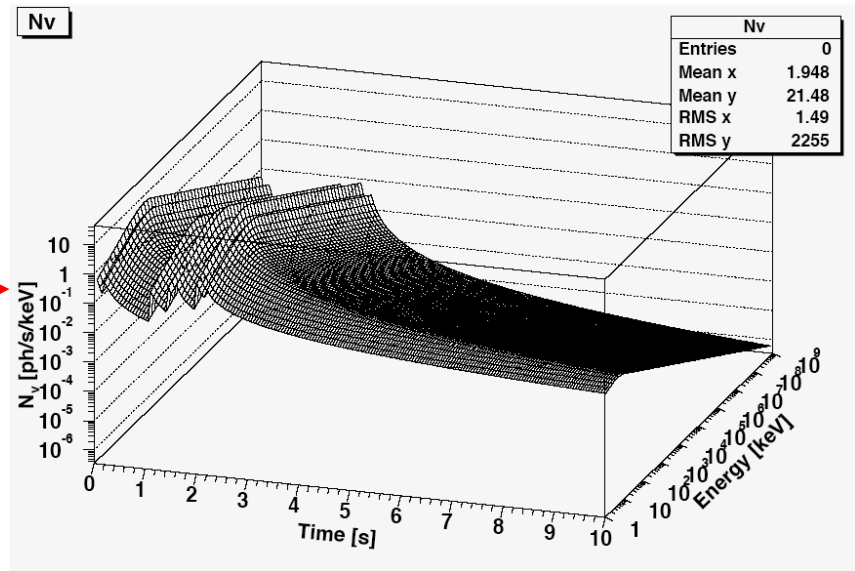
Compute the initial distribution of the shells, Lorentz Factors are randomly chosen

The shells evolve with the time

When a shock occurs, the parameter needed to compute the emission are computed (Synchrotron + Inverse Compton)

A TH2D represents the flux(time, energy)



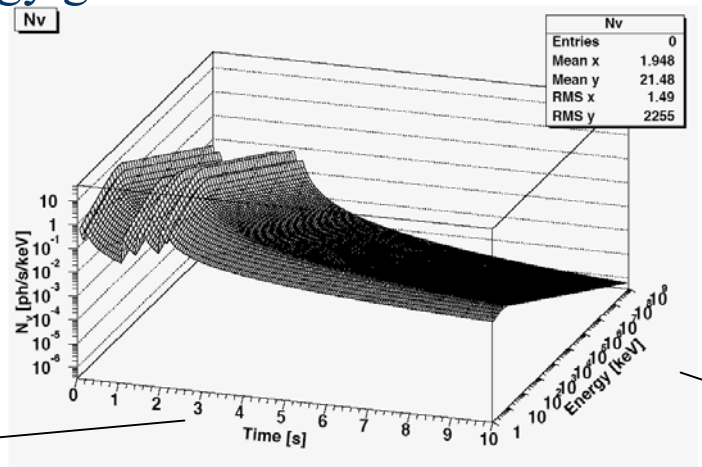


GRB Slides courtesy of
Nicola Omedei (INFN, Pisa)

GRB models as MonteCarlo sources

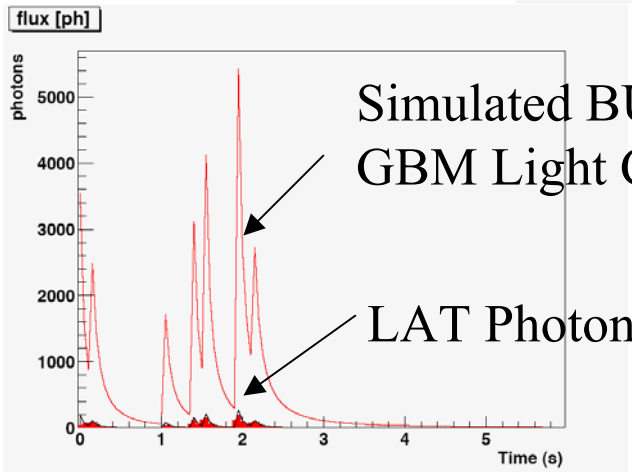
The time resolved spectrum is computed

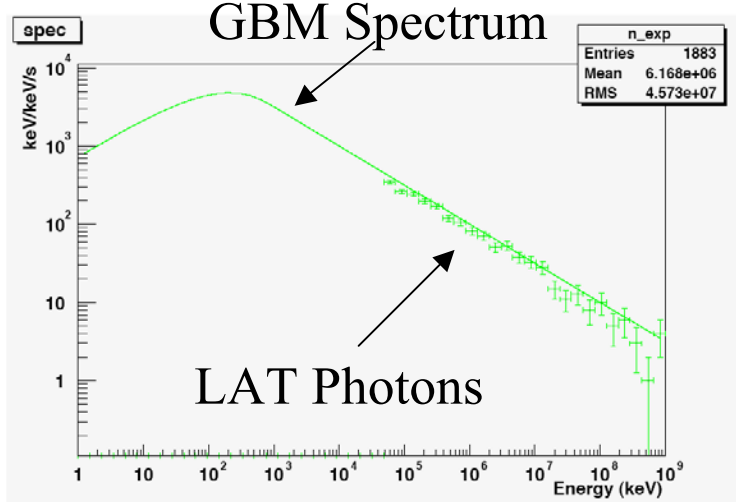
Photons with energy greater then a fixed minimum energy are extracted (LAT photons).



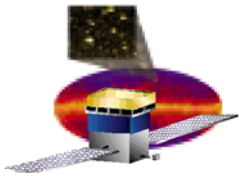
Spectrum as a function of time

The TH2D histogram contains all the information needed to compute the "photon list" for feeding the MonteCarlo





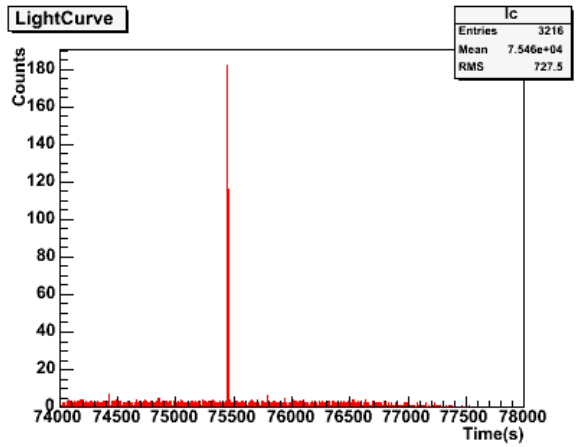
Time integrated spectrum

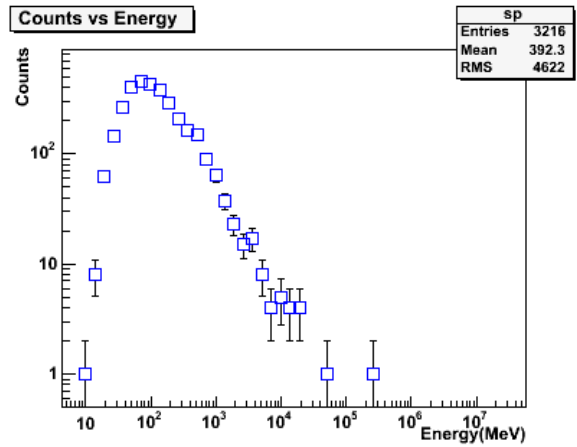


FT1Viewer

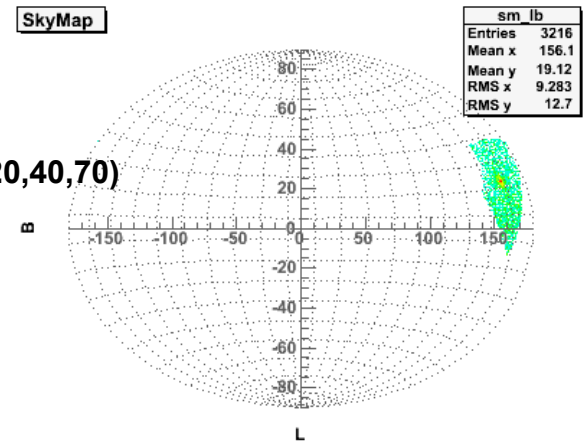
Thanks to its C++ interpreter, ROOT is extensively used for developing prototypes of GUIs.
FT1Viewer has been developed for viewing the "FT1 tree" which contains the results of the MonteCarlo simulations with the format of the real data.

```
root [1] .x compile.C
root [2] FT1Viewer a("DataSelection.root")
922782 Merit entries
 Time selection: 30.0276 , 86429.9
 Energy selection: 4.29641 , 5.85475e+07
 Galactic Region: Ra :0 , 360
                  Dec :-90 , 90
root [2] a.Replot()
```

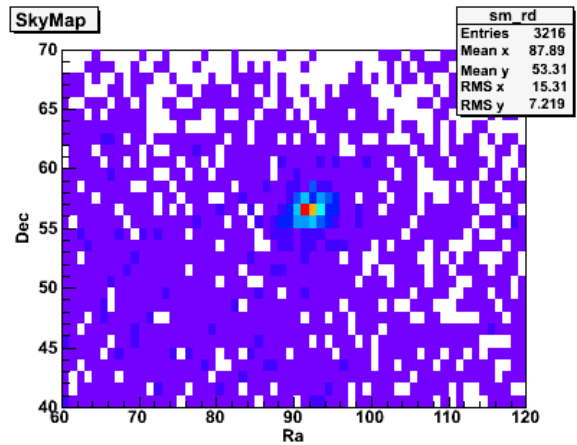




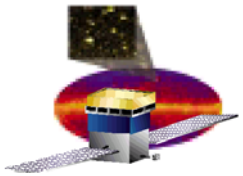

```
root [3] a.SelectTimeInterval(74000,78000)
 Time selection: 74000 , 78000
root [4] a.Replot()
```



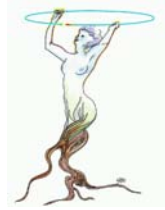

```
root [5] a.SelectGalacticRegion_RaDec(60,120,40,70)
 Galactic Region: Ra :60 , 120
                  Dec :40 , 70
root [6] a.Replot()
```



GLAST



AstroRoot

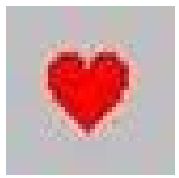


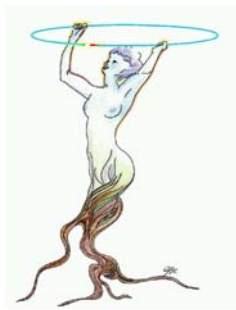
- Astronomical community loves FITS.
- FITS files will be a provided to the user community through the GLAST SSC.
- Windows port for version AstroRoot 3.0
  - Navid Golpayegani (GSFC)
- Main problems revolved around rootcint's construction of the dictionary files – long long
  - Minor problems with UNIX-only includes
  - Some remaining troubles with command line exes tfconvert
    - debugging points to TIter ctor.
- Will provide fixes to AstroRoot team to allow for general Windows support.

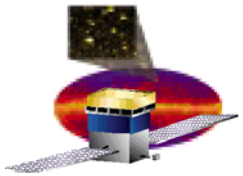
Root2IDL

- We still have some hard-core IDL users.
- We offer root2idl for ntuples
- Working on providing unlimited access to the full tree data – through the use of Matt Langston's RootQuery package.



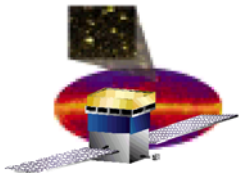






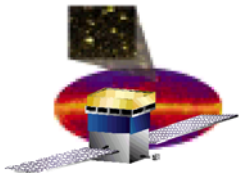
Our To Do List

- We have not exhausted ROOT's abilities
- Optimize our I/O
- Try PROOF and xrootd for our data server
- Continue to explore PyRoot



Some of our Not-So-Favorite Things

- Chaining processing time
  - Large number of files ~100
- Does long long support preclude the use of the pedantic flag in gcc > 3.2?
- More draw features a la xfig/Powerpoint
  - Toolbox for circles, lines, etc..
- TreeViewer
  - Display leaves of friend trees
  - Easier application of an existing TCut in Cut button
  - Save cuts and aliases



Some of our Favorite ROOT things

- The Win32GDK version of ROOT
- Prompt attention from Root Talk
- Support for large files > 2 GB in ROOT v4
- Improved STL container support in ROOT v4