Study of the performance of the GLAST LAT as a ground based cosmic ray observatory

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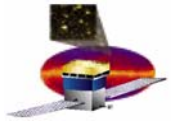
for the GLAST Collaboration

Outline



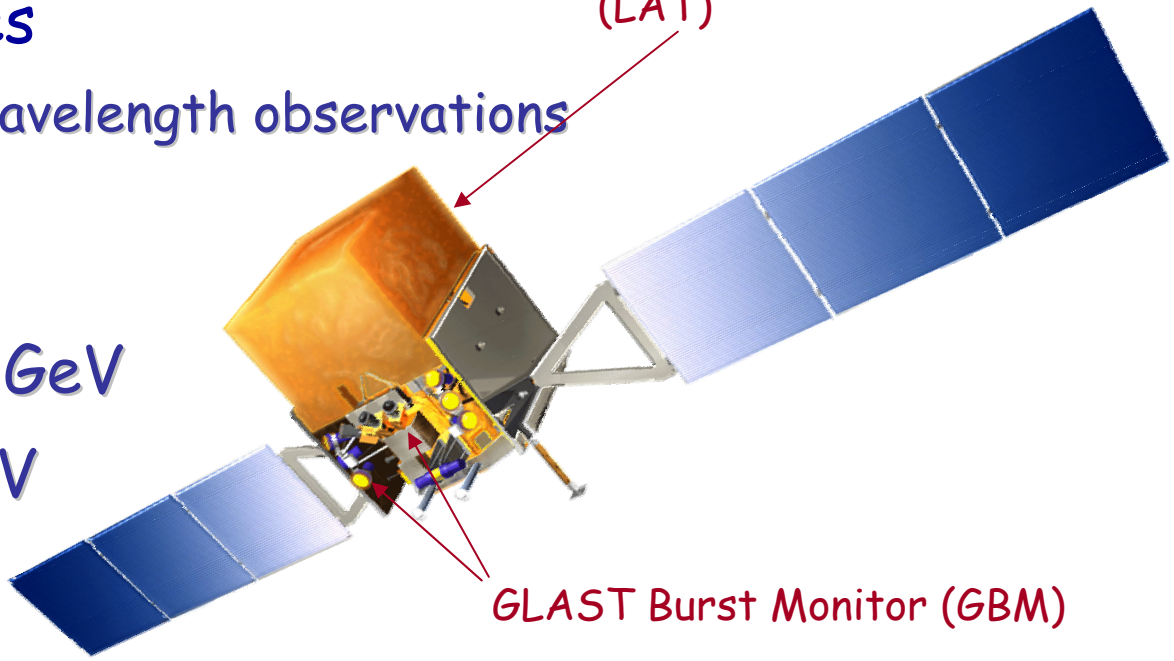
- GLAST - LAT instrument description
- LAT Status
- Cosmic ray tests as part of the calibration strategy of the LAT
- Instrument Science Operations Center activity
- Conclusions

The GLAST Mission

- GLAST: An International Science Mission
  - Large Area Telescope (LAT)
  - GLAST Burst Monitor (GBM)
- The strategy
  - Survey mode ⇒ entire sky every three hours
- Science opportunities
  - The need for multi-wavelength observations

LAT: 20 MeV – >300 GeV

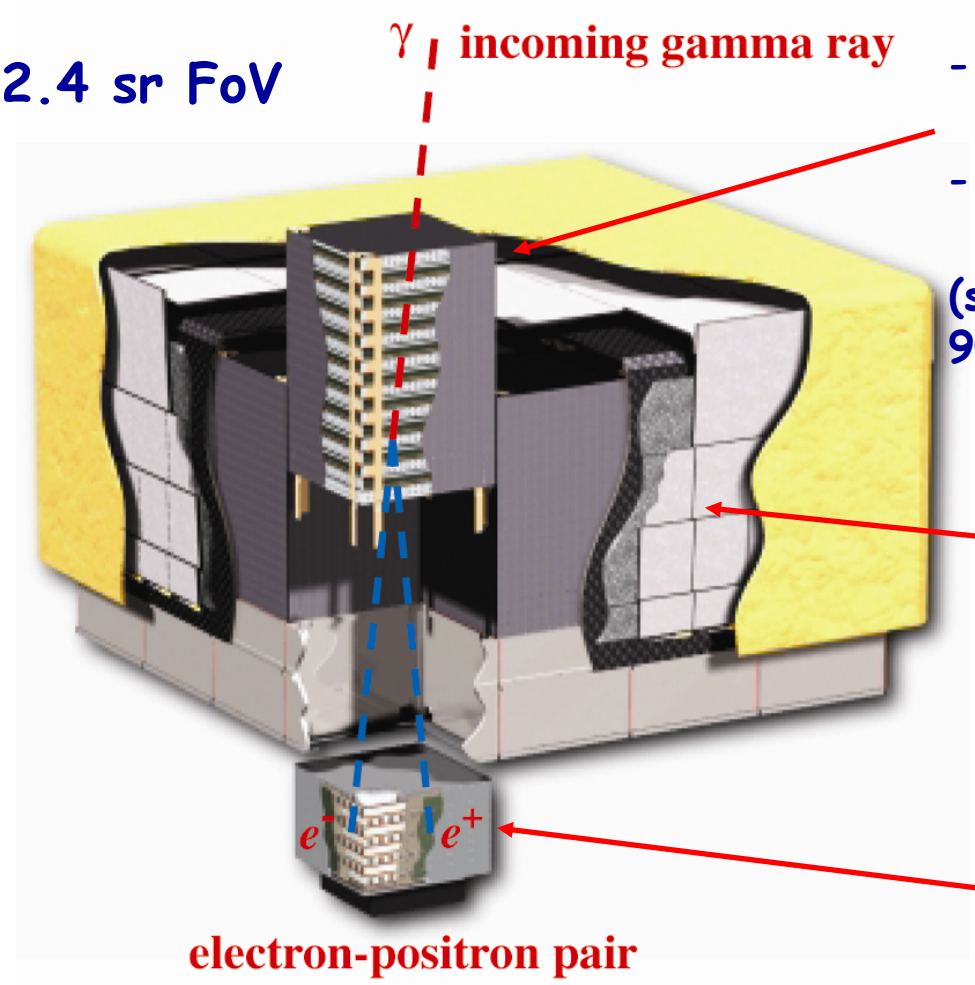
GBM: 10 keV – 25 MeV



Overview of the Large Area Telescope

~20 MeV < E < ~300 GeV

2.4 sr FoV



Tracker (16 towers):
- Pair conversion telescope
  → W conversion foils
- Measures e^-/e^+ track
  → 18 layers of Si strips detectors
(single sided, each layer is rotated by 90° with respect to the previous one).
  → 87 m^2 of Si

Anti-Coincidence Detector (ACD):
- Segmented (89 tiles)
- Rejection of CR background
- 0.9997 detection efficiency

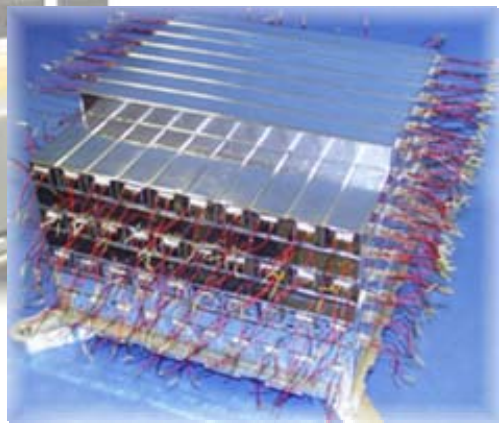
Calorimeter:
- Measures photon energy
  → 1536 CsI crystals
- 8.5 radiation lengths

The LAT

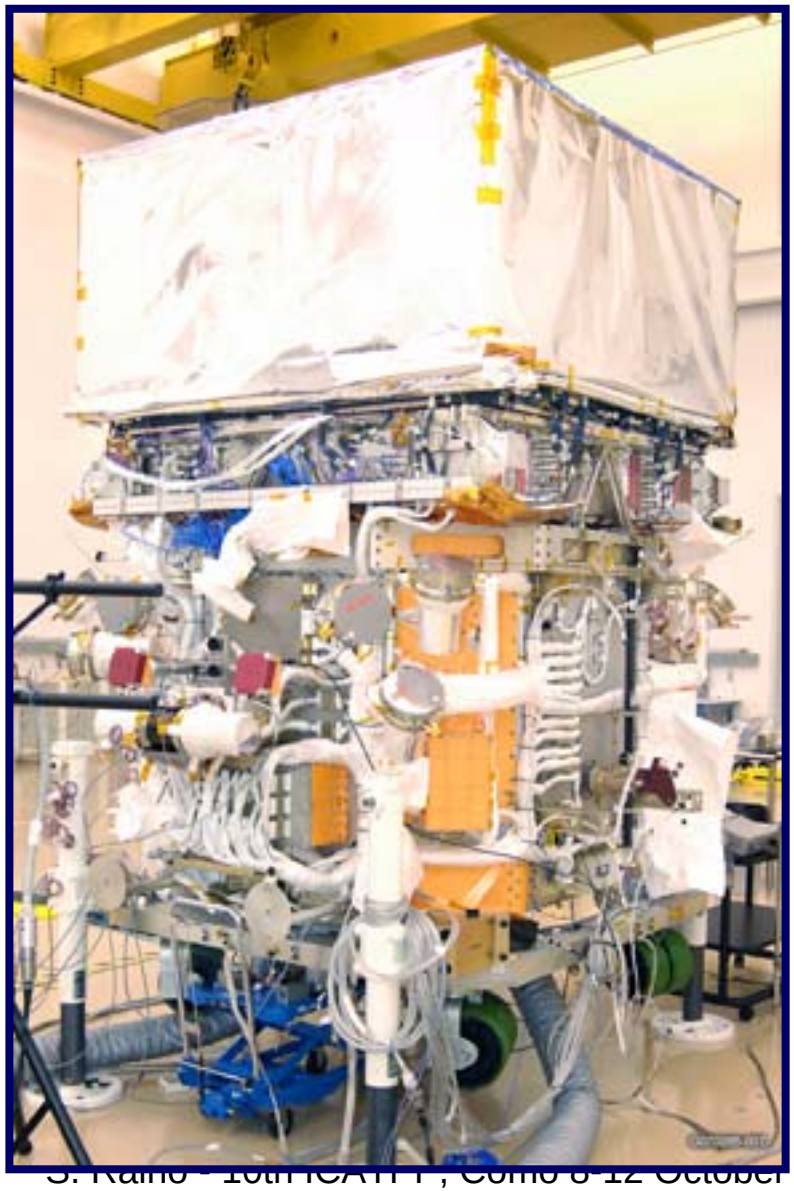
TKR Tower

ACD

CAL module



GLAST Observatory Status

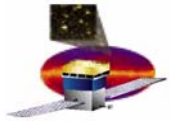


GLAST Observatory after the integration of the

Large Area Telescope

at General Dynamics in Phoenix Arizona

Observatory Cosmic ray test



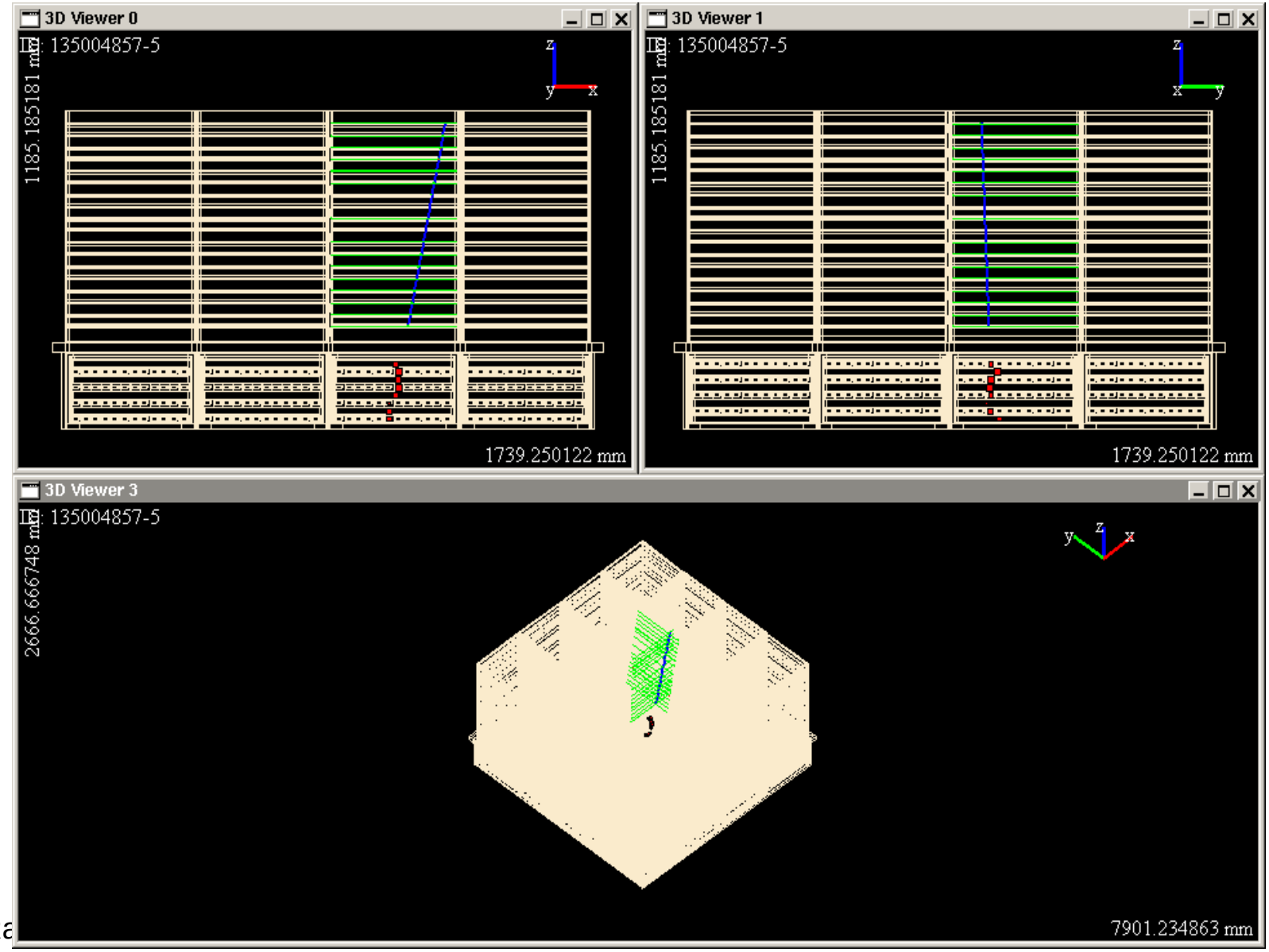
Cosmic ray data have been collected at ground after the integration of the LAT in the GLAST Observatory

The analysis of the data collected at ground (muons at sea level!) give a good opportunity:

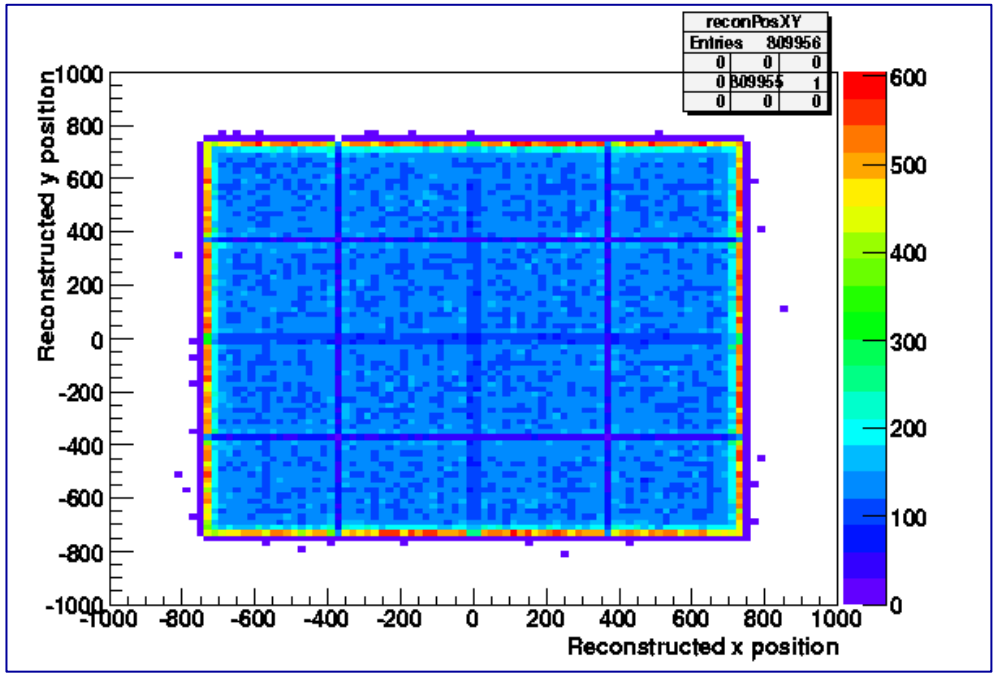
- to test the instrument response and complete the verification on the Science Requirements for the LAT
- to validate the Monte Carlo simulation of the instrument response together with the analysis of data from beam test campaign

(see M.Brigida talk tomorrow and C.Monte poster)

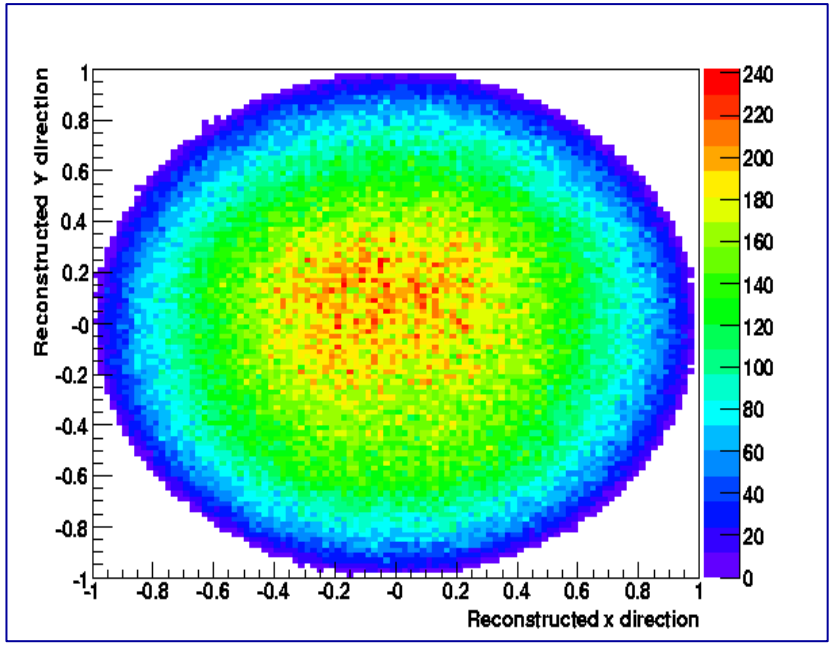
A Cosmic Ray muon event display



Monitoring -Tkr Reconstruction

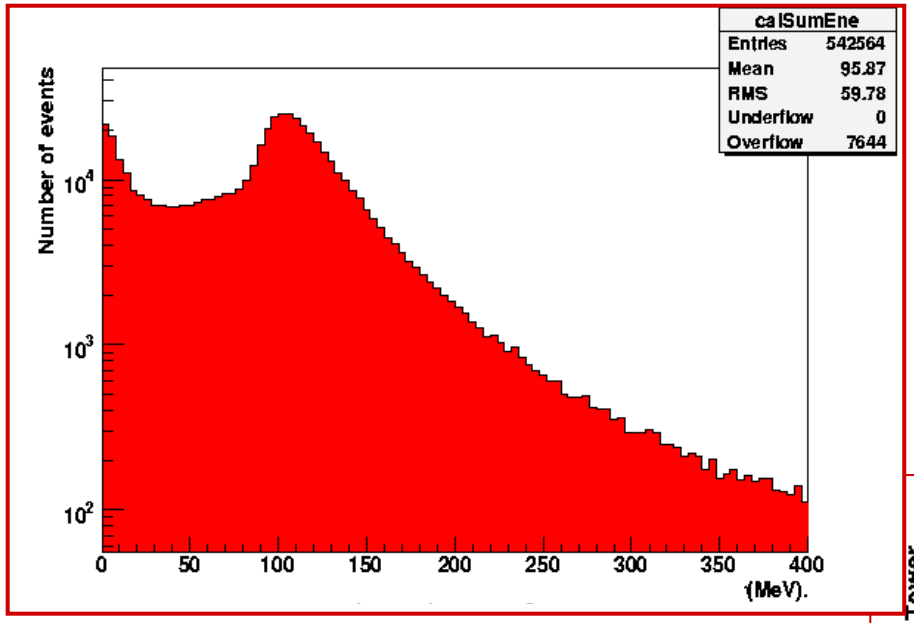


Reconstructed event position along the X and the Y axis.



Reconstructed event direction along the X and the Y axis

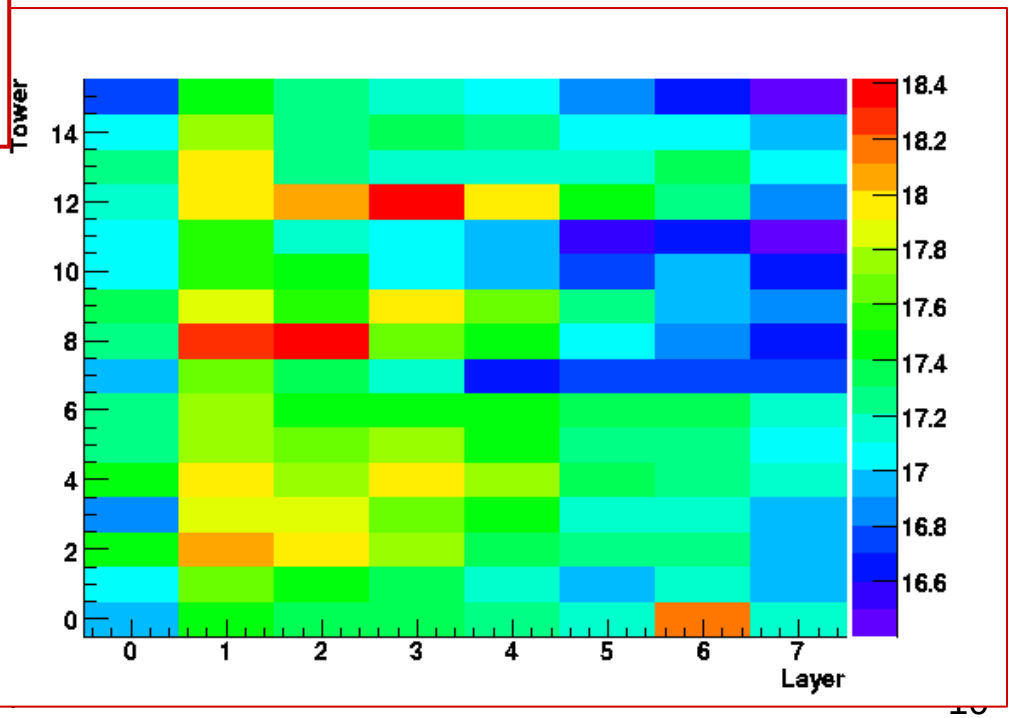
Monitoring - Cal reconstruction



CAL crystals energy distribution

(integrated over all events and all directions)

Average energies (MeV)
measured in each CAL layer

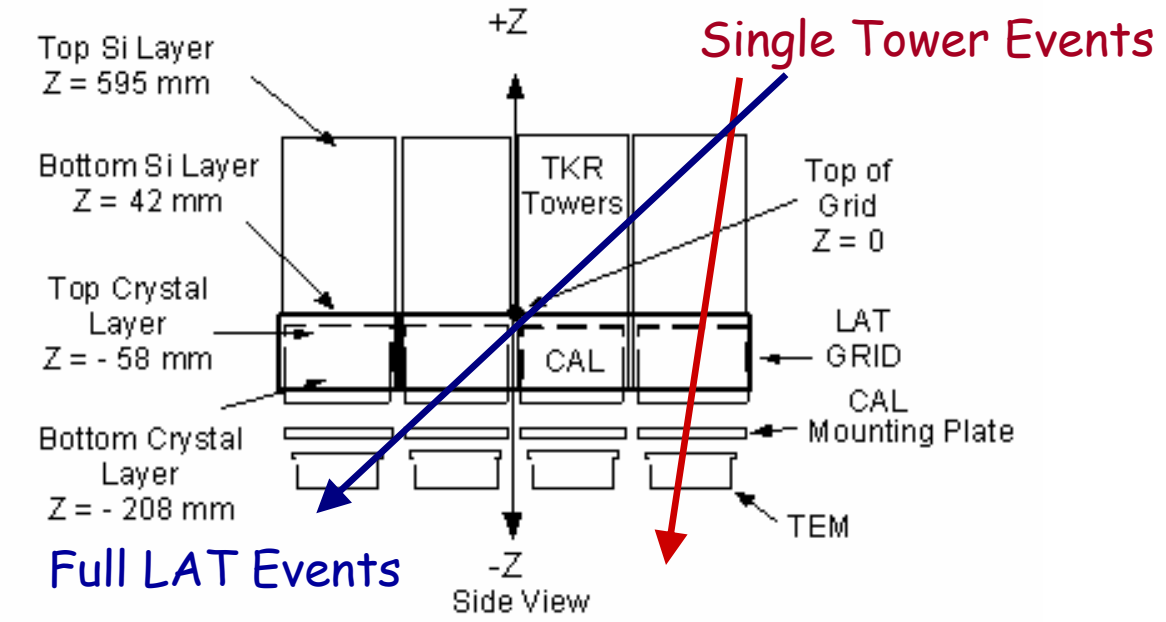


Data analysis

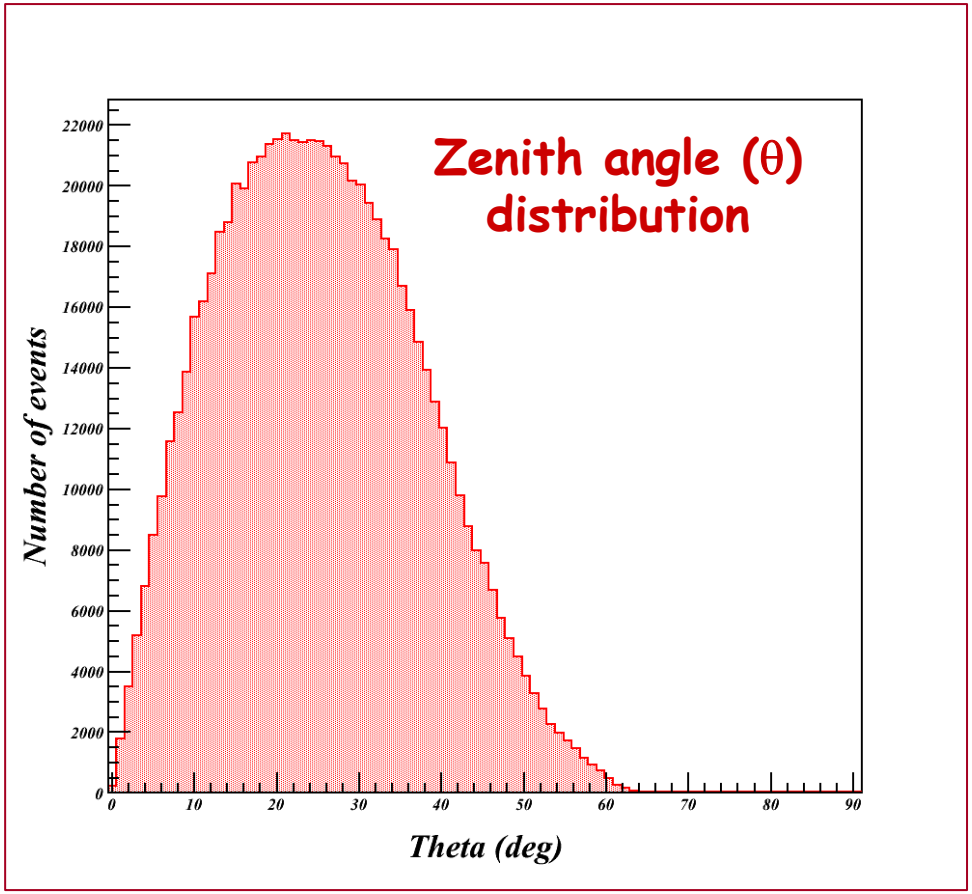
Event Selection:

- single muon tracks
- events triggered by both the TKR and the ACD
- events releasing signals in both the TKR and the CAL
- events fully contained in the LAT (blue arrow) or events fully contained in one tower (red arrow);

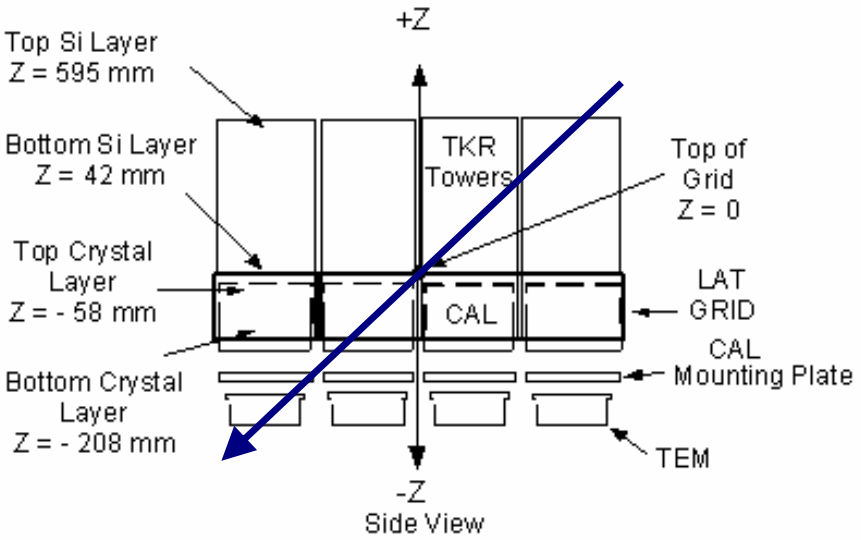
LAT Front view



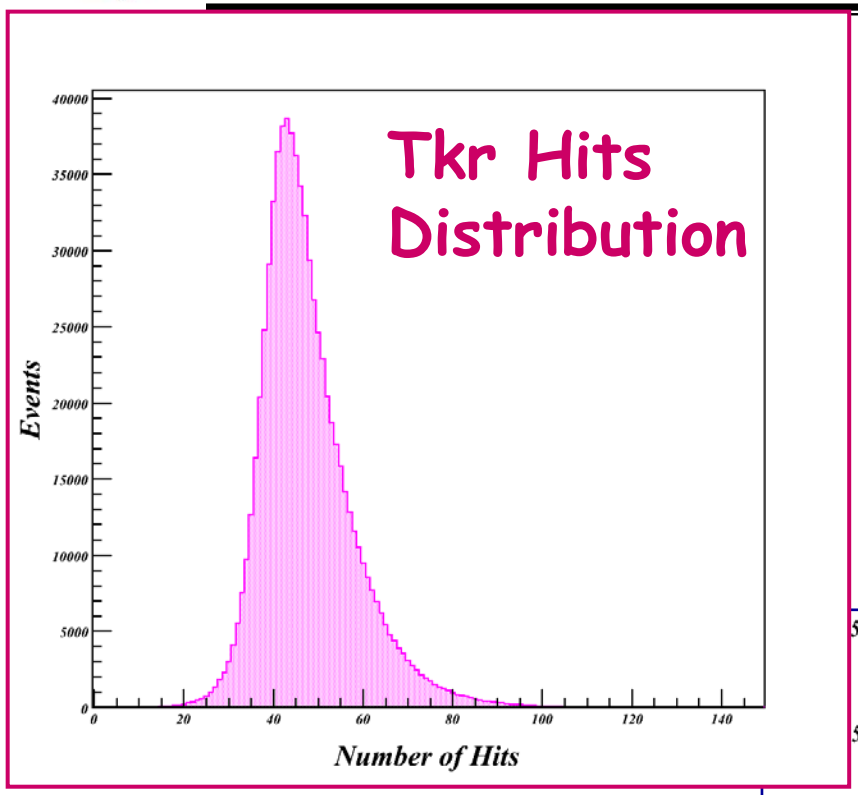
Cosmic Ray angular distributions



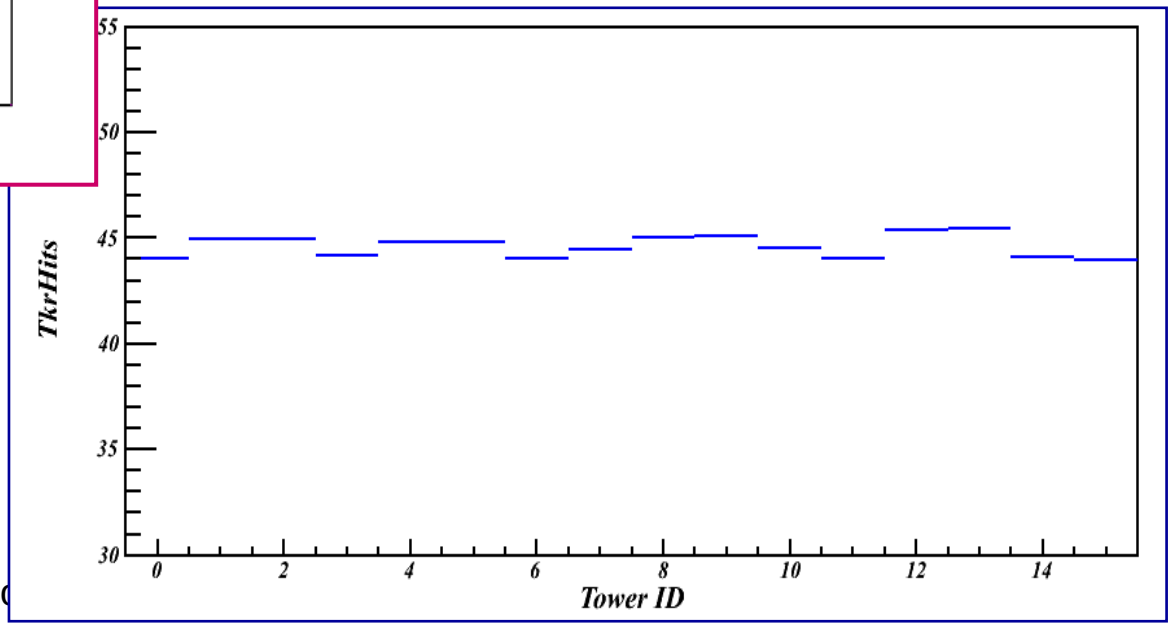
Full LAT events



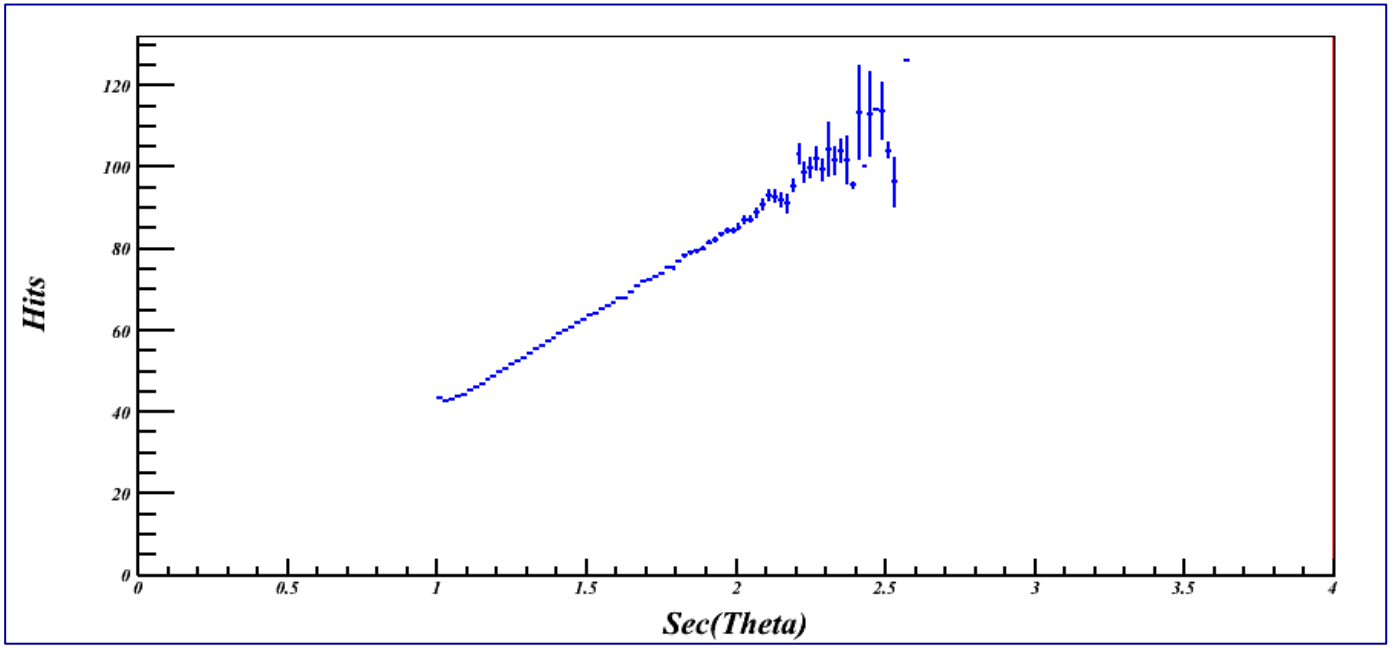
Average Tkr Hits Vs Tower



It reproduces the number of strips fired by a track crossing the whole LAT

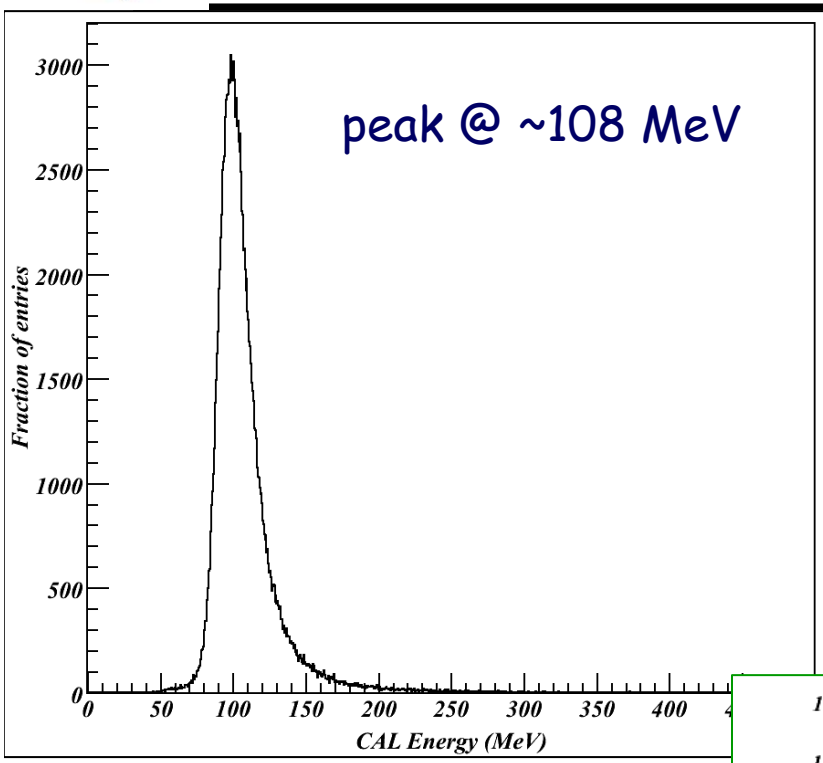


Tkr Hits Vs Zenith Angle

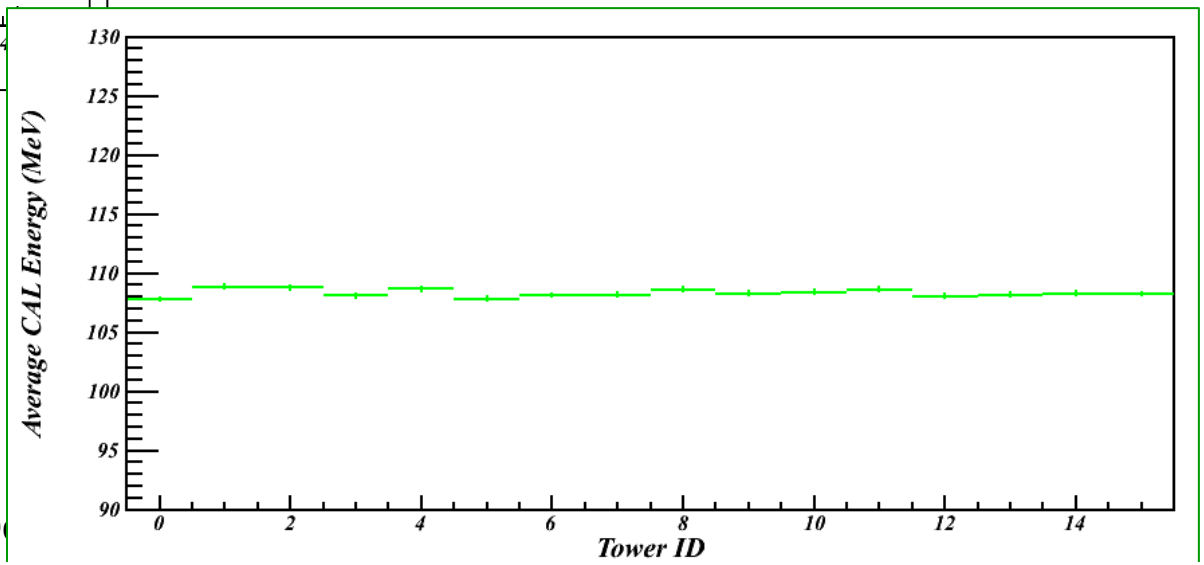


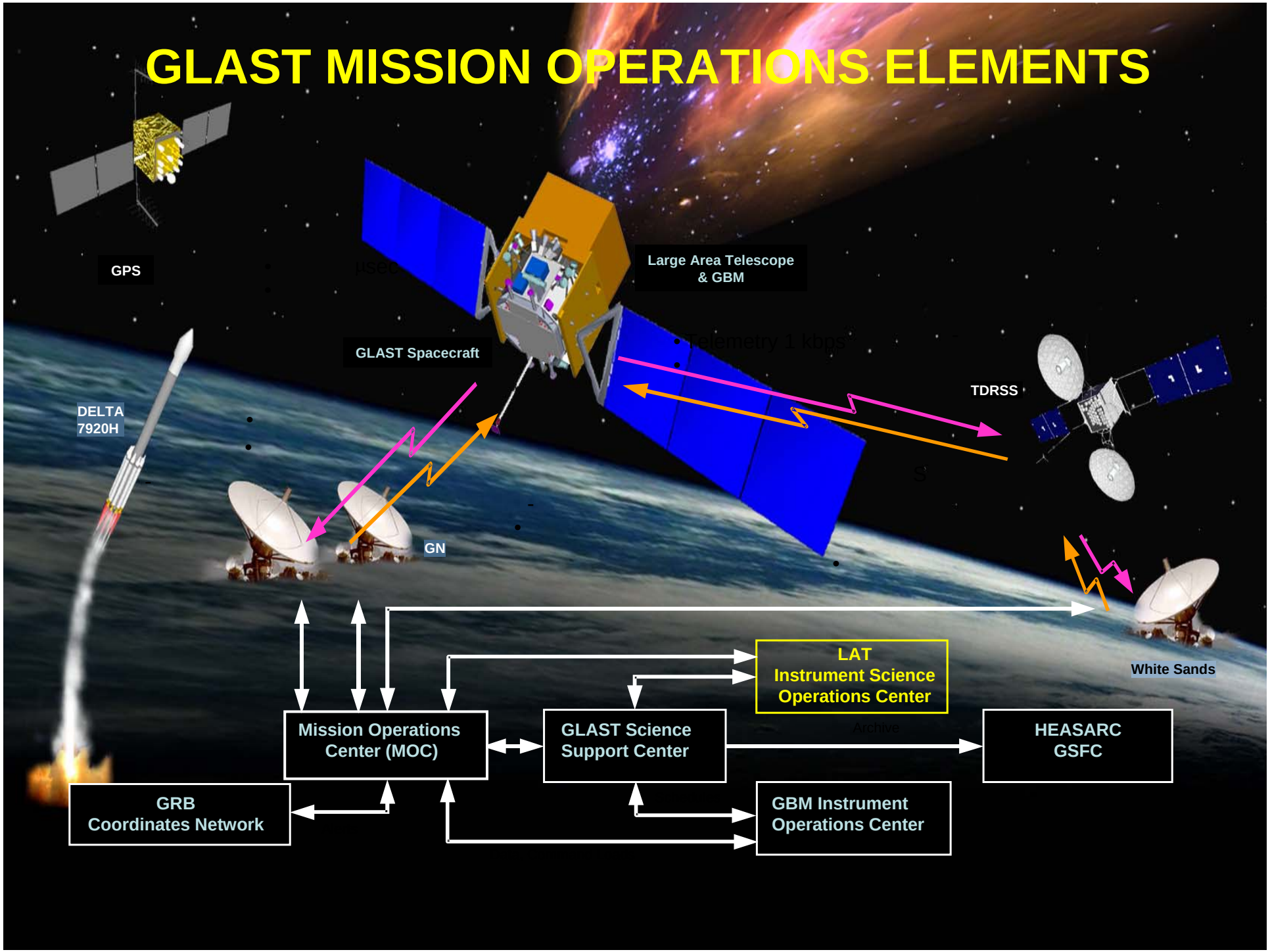
The dependence of TKR hits number on the zenith angle θ reproduces the dependence on the track length for different inclinations of the tracks

CAL Energy

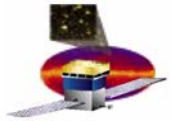


CAL Energy distribution for single tower events, i.e. for almost straight tracks




GLAST MISSION OPERATIONS ELEMENTS
GPS
Large Area Telescope
& GBM
GLAST Spacecraft
TDRSS
DELTA
7920H
GN
White Sands
LAT
Instrument Science
Operations Center
Mission Operations
Center (MOC)
GLAST Science
Support Center
HEASARC
GSFC
GRB
Coordinates Network
GBM Instrument
Operations Center

ISOC



The GLAST mission is approaching the launch date and the need of extending existing pre-launch activities into on-orbit operations is covered by the

GLAST LAT

Instrument Science Operations Centre

The ISOC will support real time activities and instrument monitoring during GLAST to ground contacts mission operations and data processing. The main functions can be classified in

- LAT command planning and construction
- Instrument health and safety monitoring
- Maintain and modify LAT flight software
- LAT calibration, performance verification and optimization
- Process and archive LAT data
- Maintain and optimize the software that produces science data

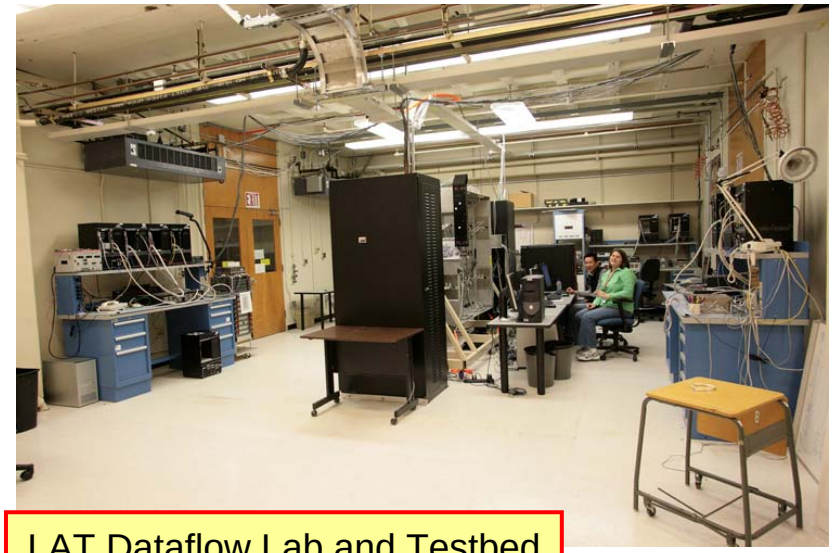
Operations Simulation Week @ SLAC

ISOC tools and software are tested with simulated sky data analysis

This week @ SLAC simulation of in-flight operations

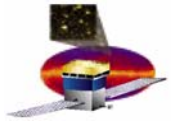
- Simulation of 16 MC orbits fed into pipeline in real time for monitoring
- Rehearsals of operation shifts and related activities
- On-line and off-line analysis
- Test tools and procedures
- Make short term analysis to address contingencies

ISOC Ops Support Area



LAT Dataflow Lab and Testbed

Conclusions



- Once the LAT has been integrated in the spacecraft acquisition of cosmic ray data have been done
  - o analysis of the CR data have been done as part of the calibration strategy of the LAT
  - o need to complete the validation of the Monte Carlo simulation (see M.Brigida talk and C. Monte poster)
  - o the analysis methods are carrying over for studies of the in-flight performance of the LAT in the ISOC
- The Instrument Science Operations Center is supporting the mission operations and data monitoring and it will be the contact point from GLAST satellite to ground.

Current Status:

The GLAST Observatory is undergoing the final environmental testing before launch date expected in February 2008.

RXTE launch on a DELTA II rocket.