First results from GLAST-LAT integrated towers cosmic ray data taking and MonteCarlo comparison

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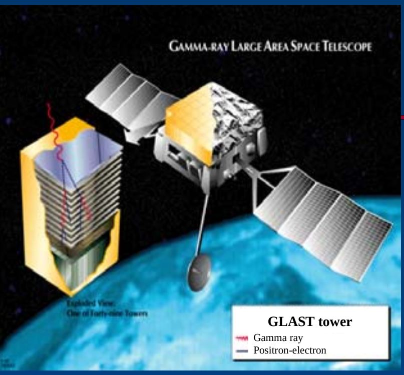


Fig1. GLAST artistic view

The GLAST-LAT and MonteCarlo simulation

The instruments on the GLAST mission are the Large Area Telescope (LAT) and the GLAST Burst Monitor (GBM). The LAT will consist of three sub-systems: a solid state detector (SSD) tracker (TKR), a CsI calorimeter, calorimeter (CAL) and a plastic scintillator anticoincidence (ACD) system. The energy coverage is from a few keV to 300 GeV. The LAT has a modular structure, consisting of a 4x4 array of identical towers. Each tower is composed by a tracker, a calorimeter and data acquisition module. The tracking detector consists of layers of SSDs and tungsten converter foils

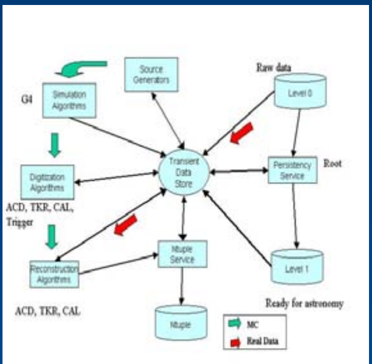


Fig.2 GLAST simulation data flow

The GLAST LAT simulation software implemented by the Collaboration is an Object-Oriented C++ framework called Gleam (GLAST LAT Event Analysis Machine): the generation and interaction of generated particles with the detector is based on the Geant4 MonteCarlo toolkit. Fig. 2 shows the Gleam data flow. The output from the simulation is in the same format as the real data: the hits generated by the MC simulation are converted in digital output signal, as read by the electronics. Finally, the digitized events can be processed by the reconstruction package.

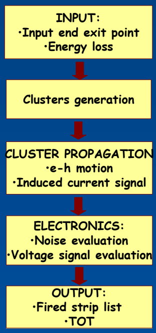


Fig. 3 Block diagram of SSD simulation code

To implement the Tracker digital output, a full simulation code has been developed. The TKR Digit algorithm describe the physical processes that take place in a SSD, when crossed by an ionizing particle. The input parameters (*hits*) are provided by the Geant4 LAT simulation. Then, the currents signals induced on each strip are evaluated and converted in voltage signals: the detector noise as well as the electronic noise are taken into account. Finally, the fired strips and the associated Time over Threshold (ToT) are evaluated. Fig.3 shows the bloc diagram of SSDs simulation code.

Fig4. First eight towers integrated in the grid

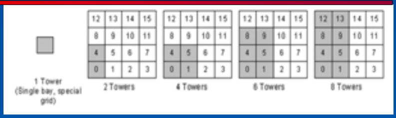


Fig5. Towers integration in the grid

The GLAST-LAT integrated towers

Eight towers have been tested and assembled at Stanford Linear Accelerator Center (SLAC) (see Fig. 4). Data taking with cosmic rays and Van de Graaff photons has been performed. At present data taking with 1, 2, 4, 6, 8 Modules (FMs) installed in the LAT grid are available (Fig 5).
Fig.6 shows the event display for a muon event from cosmic ray data taking, with eight towers hardware configuration

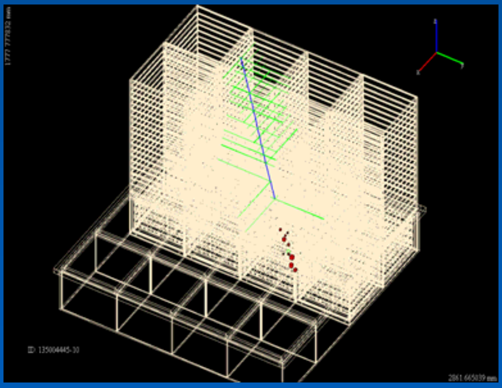


Fig6. Event display for a muon event from cosic ray data taking

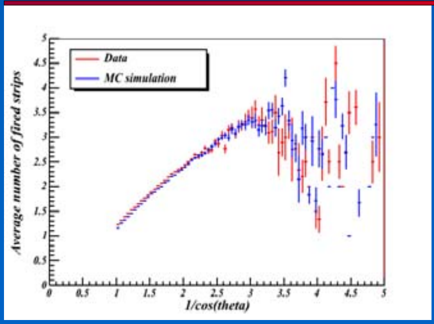


Fig. 7. Average number of fired strips vs 1/cosθ and MC comparison

The muon data analysis ...

We used the data from cosmic ray data taking for eight towers configuration. The event selection :

- events triggered by the TKR;
- only a single muon tracks;
- events fully contained in a tower;
- minimum ionizing particles;

We studied the dependence of the hit strip multiplicity by the zenith angle θ. As shown in Fig.7, the hit multiplicity increases linearly with 1/cosθ, proportional to the track length in the SSDs.

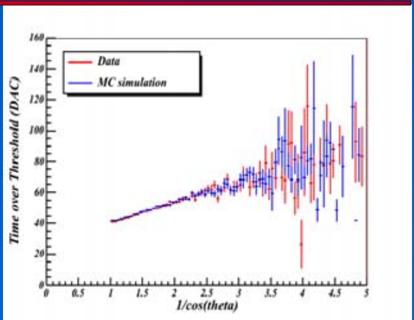
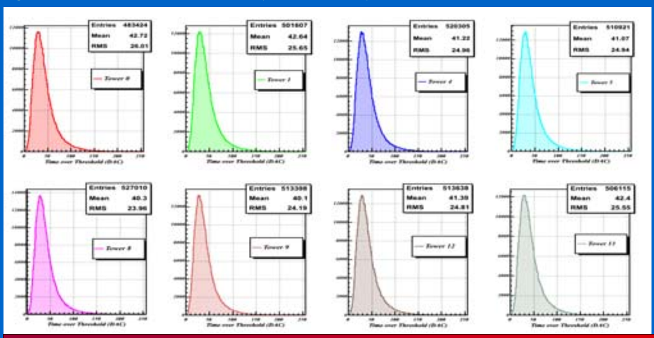


Fig. 9. ToTs vs 1/cosθ and MC comparison

Fig. 8. ToTs distribution for each track layers and MC comparison



... and MonteCarlo comparison

In order to validate the MC digital output simulation we examined the ToTs distributions. Fig.8 shows the distribution of ToTs in each track layers: the real data are well reproduced by the MC the mean ToT value is consistent with expected charge deposition in 400μm thick silicon layers. Finally, the dependence of the ToT in the track layers on the geometrical parameters (φ and cosθ) has been taken also in account. As the hit strip multiplicity, the ToTs in the track layers increases linearly with the 1/cosθ (proportional to the track length in the SSDs) as expected by the MC simulation (Fig.9).