Performance of the integrated tracker towers of the GLAST Large Area Telescope (LAT)

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Outline

- The GLAST mission
- The GLAST detector
  - the Large Area Telescope (LAT)
  - the LAT silicon tracker (TKR)
- TKR construction and testing
  - efficiency of the SSD planes
- Integration of the LAT
- Cosmic ray data analysis
  - study of the ToT distributions
  - dependence of the ToT on track parameters
  - evaluation of the hit capture efficiency
- Conclusions
The GLAST mission: scientific goals

- Gamma Ray Bursts
- Solar Flares
- Dark Matter
- Pulsars
- SuperNova Remnants
- Active Galactic Nuclei
- Unidentified sources

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The GLAST detector

LAT = Large Area Telescope
Energy range: 20 MeV - 300 GeV

GBM = GLAST Burst Monitor
Energy range: 1 keV - 30 MeV
The LAT tracker (TKR)

The GLAST SSDs

Cross section: 8.95 x 8.95 cm²
Thickness: 400 μm
Strips: 384
Pitch: 228 μm
The TKR front-end electronics

- strips
- Preamplifier + shaper
- Discriminators
- “Hit” strips
- Time over Threshold (ToT)
TKR towers: construction & environmental tests

- **Assembly** (INFN Pisa)
- **Vib tests** *(Alenia, Roma)*
- **TV tests** *(Alenia, Roma)*
Study of the TKR efficiency

Average layer efficiency (%)


TOWER A  TOWER B  TOWER 1  TOWER 2  TOWER 3  TOWER 4  TOWER 5  TOWER 6  TOWER 7  TOWER 9  TOWER 10  TOWER 11  TOWER 12
Efficiency of the TKR layers
Integration of the TKR towers
Some cosmic ray muon events
An analysis of Cosmic Ray data

Event Selection:
- TKR trigger from 3x+3y in a row layers
- Single tower events
- Single muon tracks in the TKR

Study of the ToT in track layers:
- Investigation of the ToT distribution
- Dependence of the ToT on the track parameters

Study of the ToT in triggering layers:
- Evaluation of the hit capture efficiency
CR Muon angular distributions

![Graphs showing angular distributions of CR muons.](image-url)
ToT distribution

The ToT distribution is well fitted by the Landau function:

- peak value $\approx 5.8 \mu s \rightarrow q_{mp} \approx 4 fC$
The ToT is minimum for vertical tracks and increases with $1/\cos\theta$ (track length).
ToT vs azimuth angle

ToT exhibits a periodic dependence on $\varphi$:

- $X$-view layers: maxima at $90^\circ$ and $270^\circ$
- $Y$-view layers: maxima at $0^\circ$ and $180^\circ$
The ToT is proportional to maximum strip pulse amplitude.

Pulse amplitudes on strips are proportional to the fraction of track length belonging to their sensitive volume.

The ToT depends on the track length projected along the strip view.
The ToT depends linearly on the ratio $l/l'$ (track length/projected track length).
Evaluation of the hit capture efficiency

To generate a trigger, a coincidence among 6 planes in a row is requested.

The probability of a noisy plane being involved in the trigger is negligible.

The study of hit distributions in triggering layers allows to get an estimate of the hit capture efficiency.
**Conclusions**

- The construction and testing of the LAT TKR towers has been completed.
- The average efficiency of the TKR towers is greater than 99%.
- The first 14 TKR towers have been integrated and are taking data.
- A study of the TKR performance is actually in progress.
- The behaviour of the LAT TKR is consistent with expectations.