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

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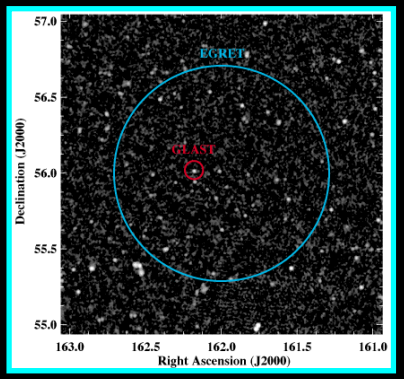
for the GLAST Collaboration

Outline

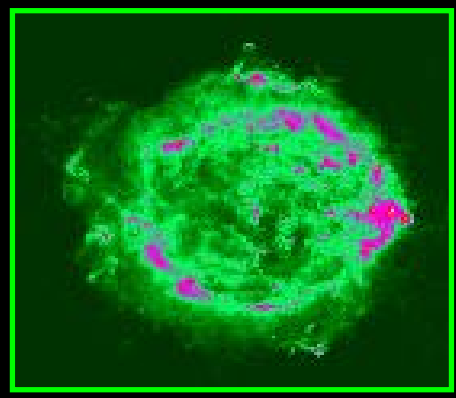
- The GLAST mission
- The GLAST detector
  - the Large Area Telescope (LAT)
  - the LAT silicon tracker (TKR)
- TKR construction and testing
  - efficiency of the SSD planes
- Integration of the LAT
- Cosmic ray data analysis
  - study of the ToT distributions
  - dependence of the ToT on track parameters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

The GLAST mission: scientific goals

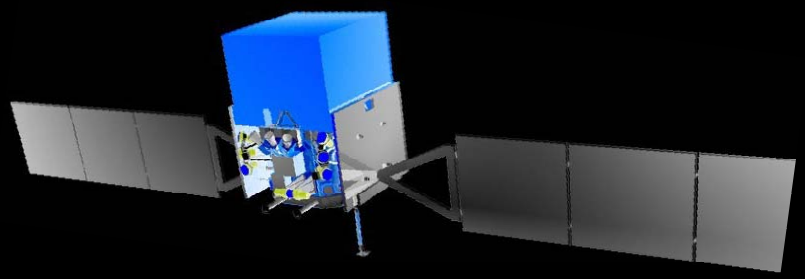


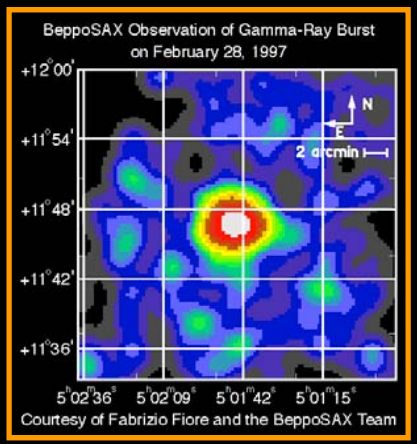
Unidentified sources

Active Galactic Nuclei

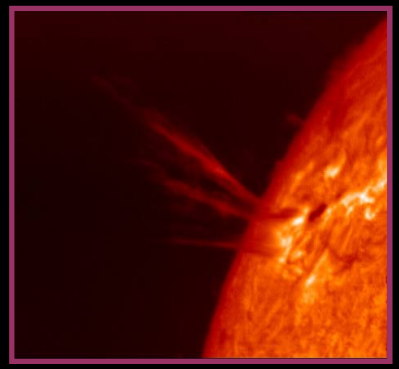


SuperNova Remnants



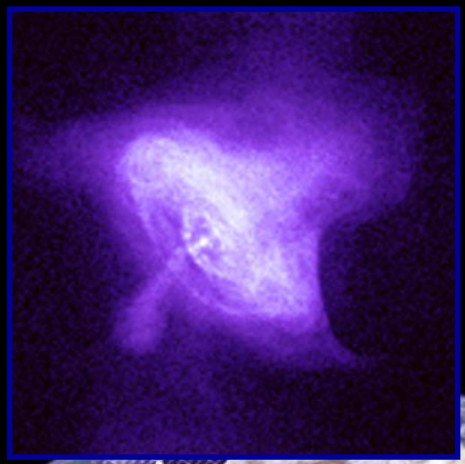


Gamma Ray Bursts



Solar Flares

Dark Matter

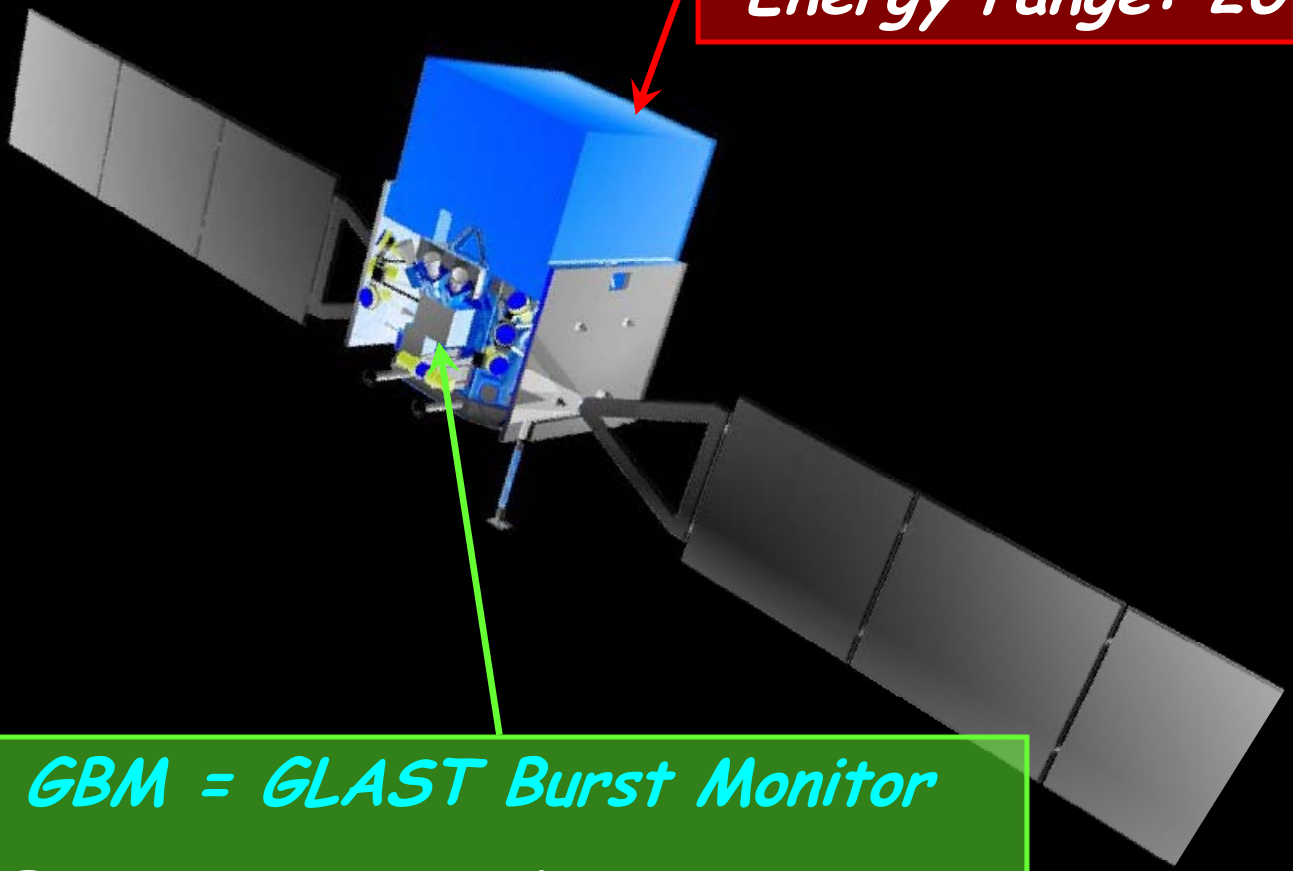


Pulsars

The GLAST detector

LAT = Large Area Telescope

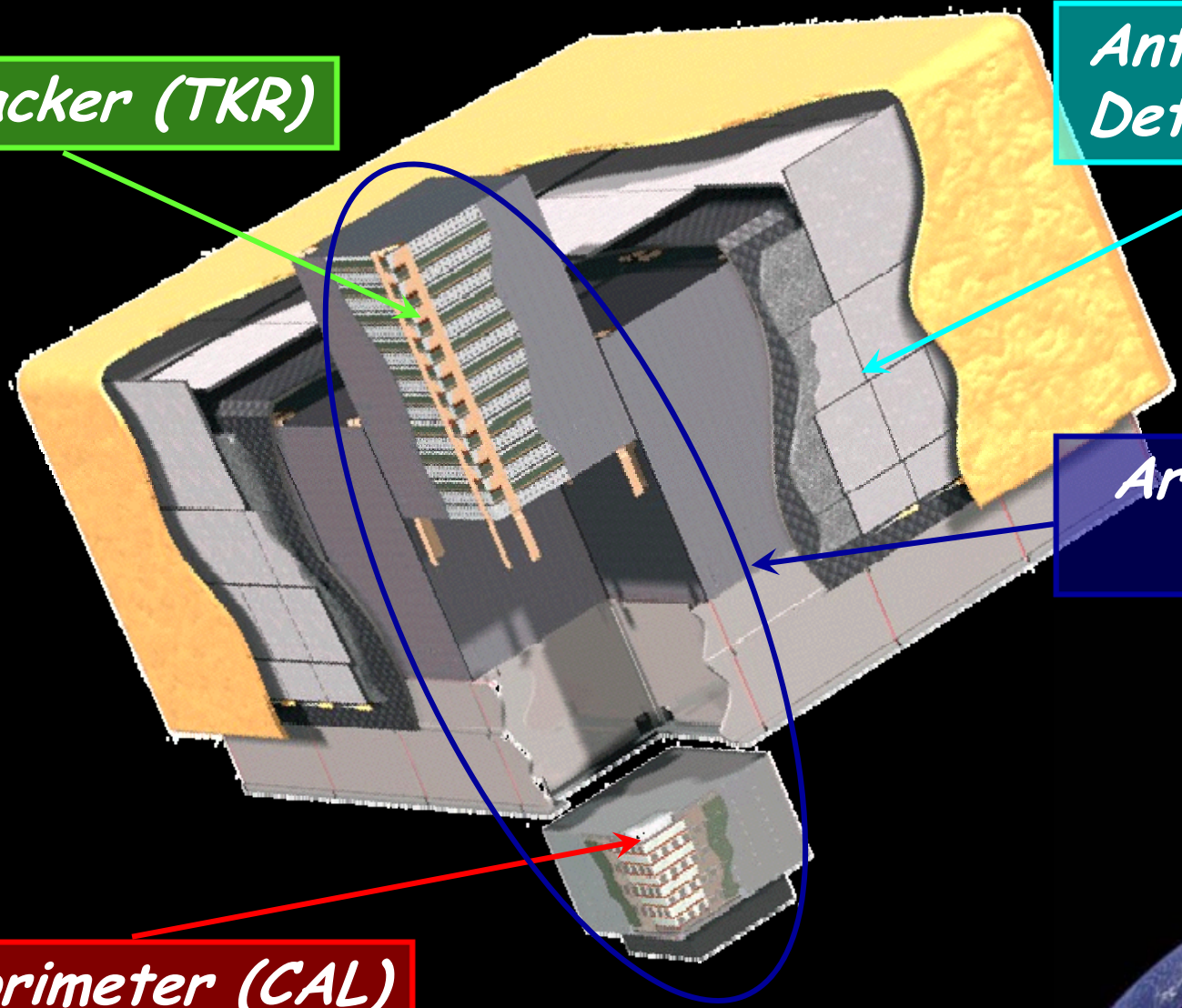
Energy range: 20 MeV-300 GeV



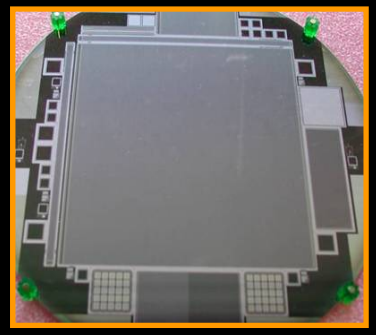
GBM = GLAST Burst Monitor

Energy range: 1 keV - 30 MeV

The GLAST LAT



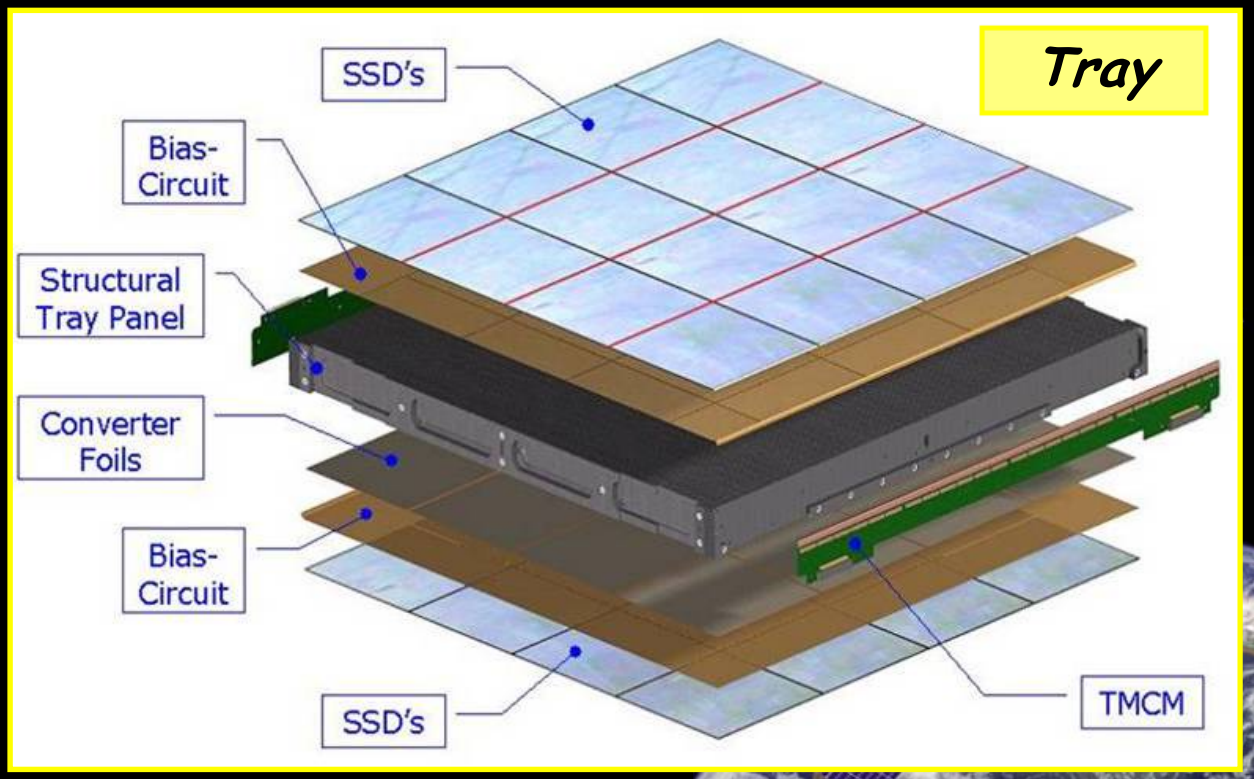
The LAT tracker (TKR)



Wafer

Ladder

The GLAST SSDs	
Cross section	8.95 x 8.95 cm^2
Thickness	400 μm
Strips	384
Pitch	228 μm



The TKR front-end electronics

strips

↓

Preamplifier + shaper

↓

Discriminators

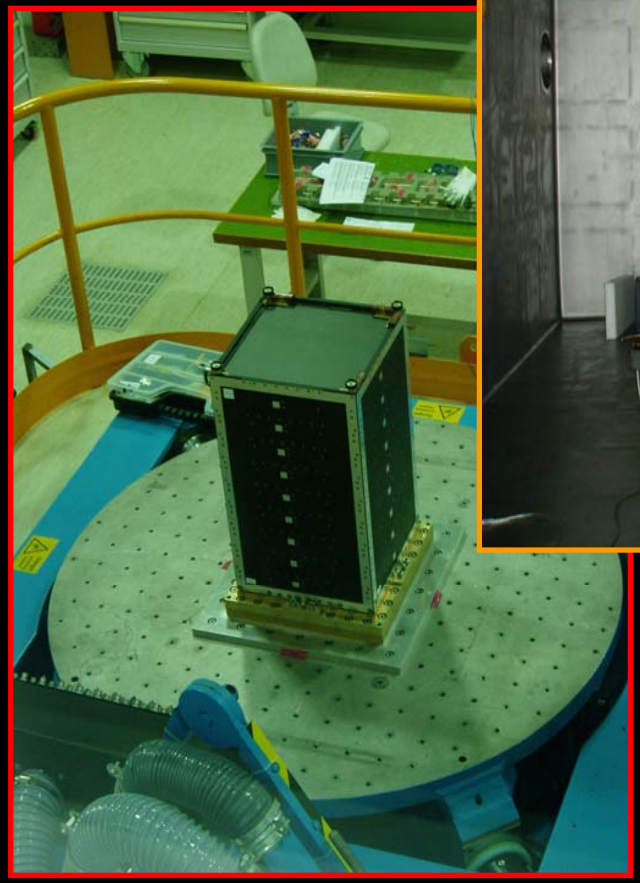
↓

- "Hit" strips
- Time over Threshold (ToT)

TKR towers: construction & environmental tests

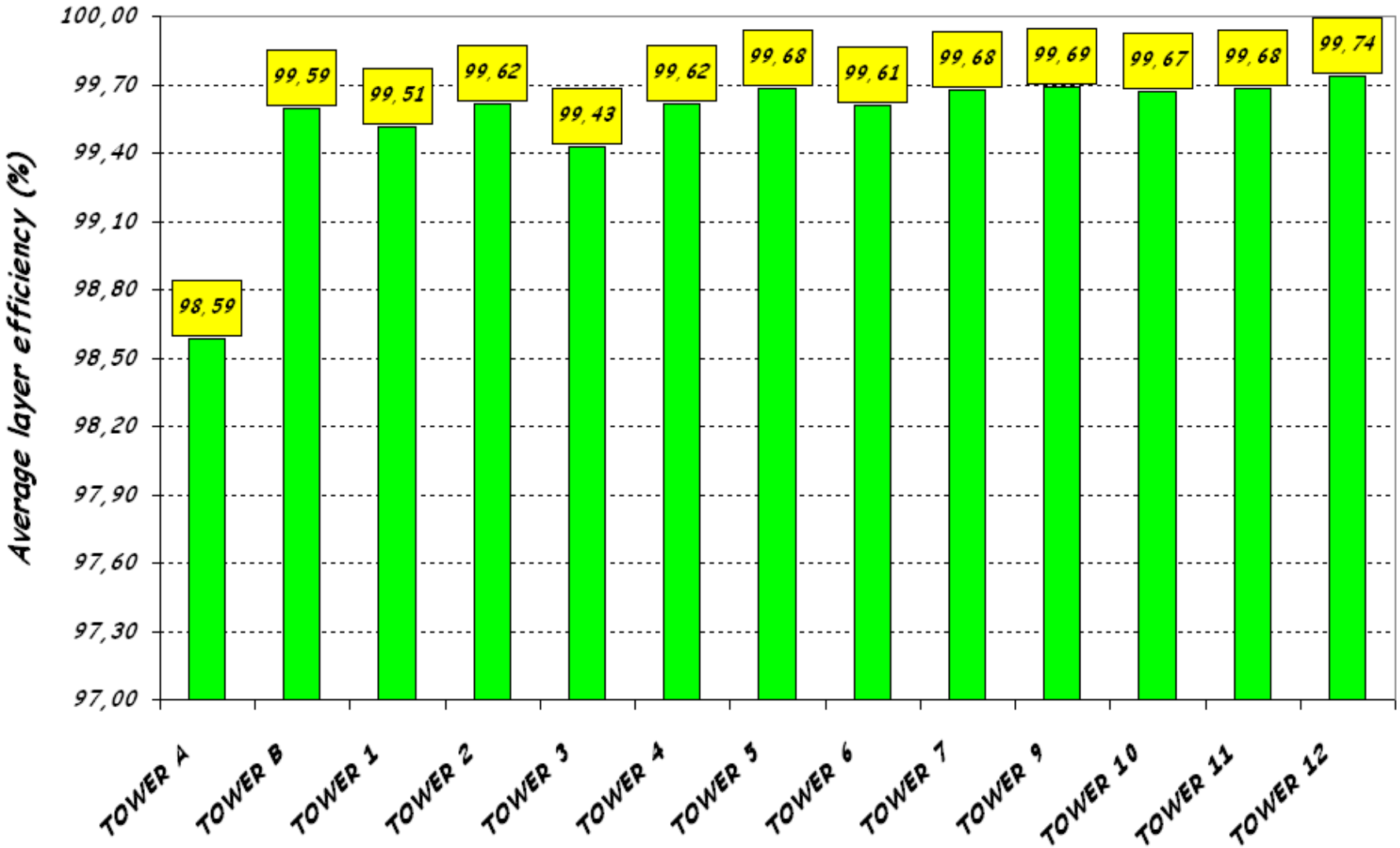
Assembly (INFN Pisa)

Vib tests (Alenia, Roma)

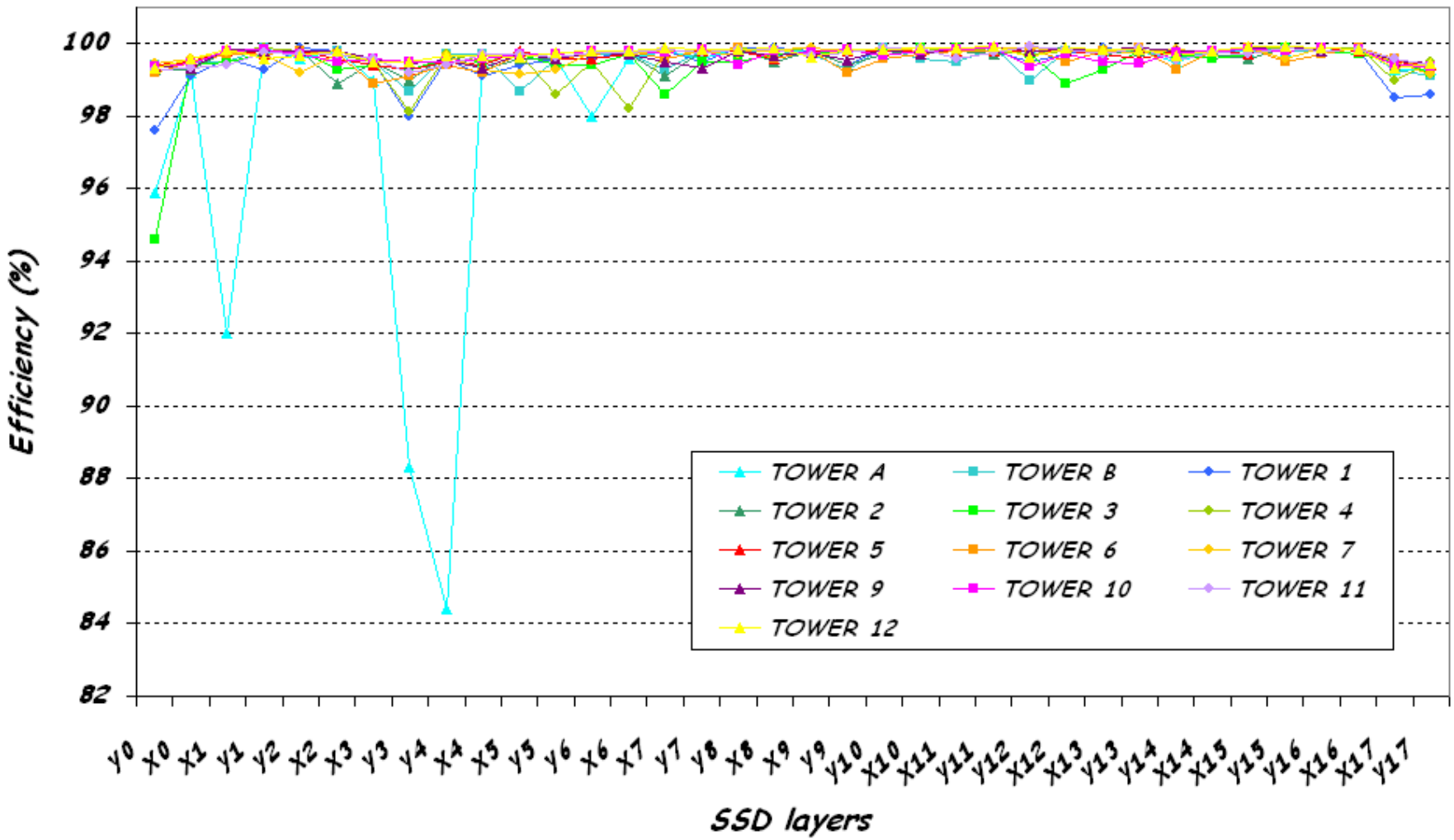


TV tests (Alenia, Roma)

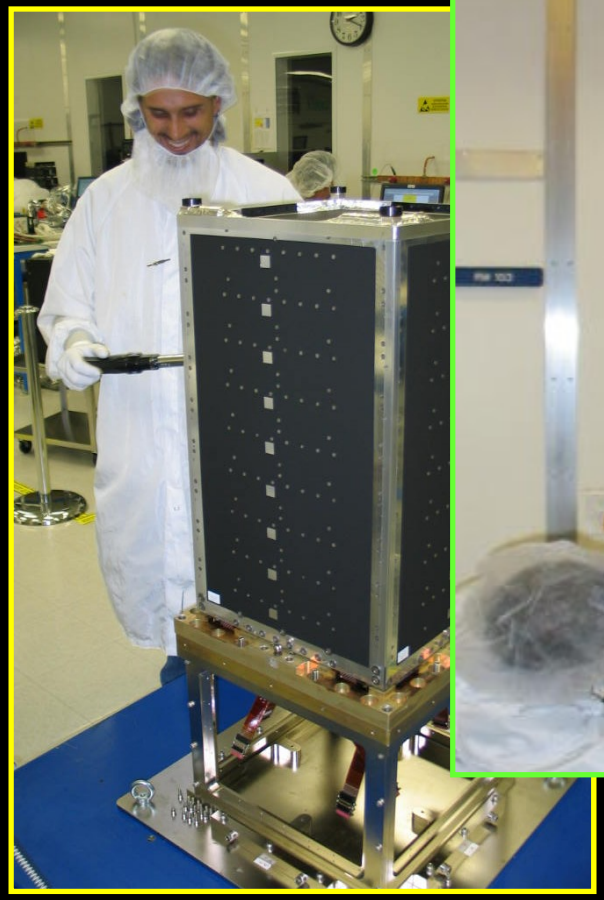
Study of the TKR efficiency

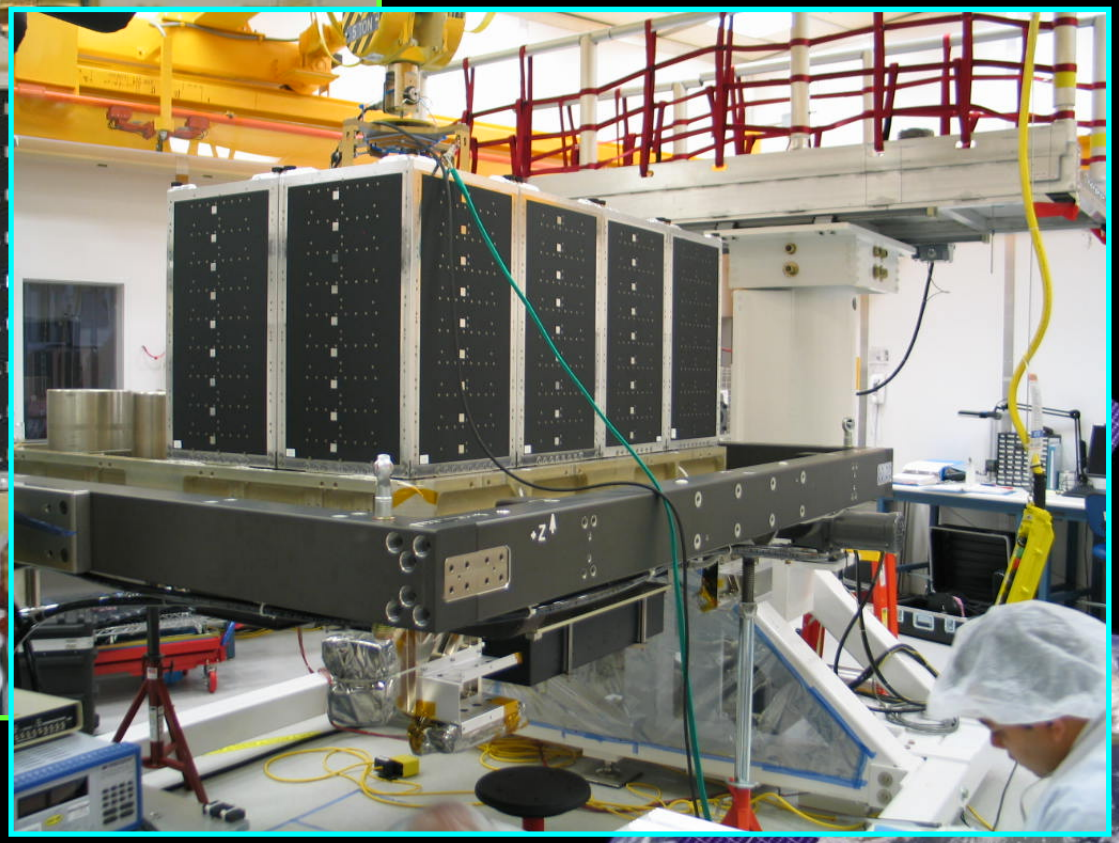


Efficiency of the TKR layers

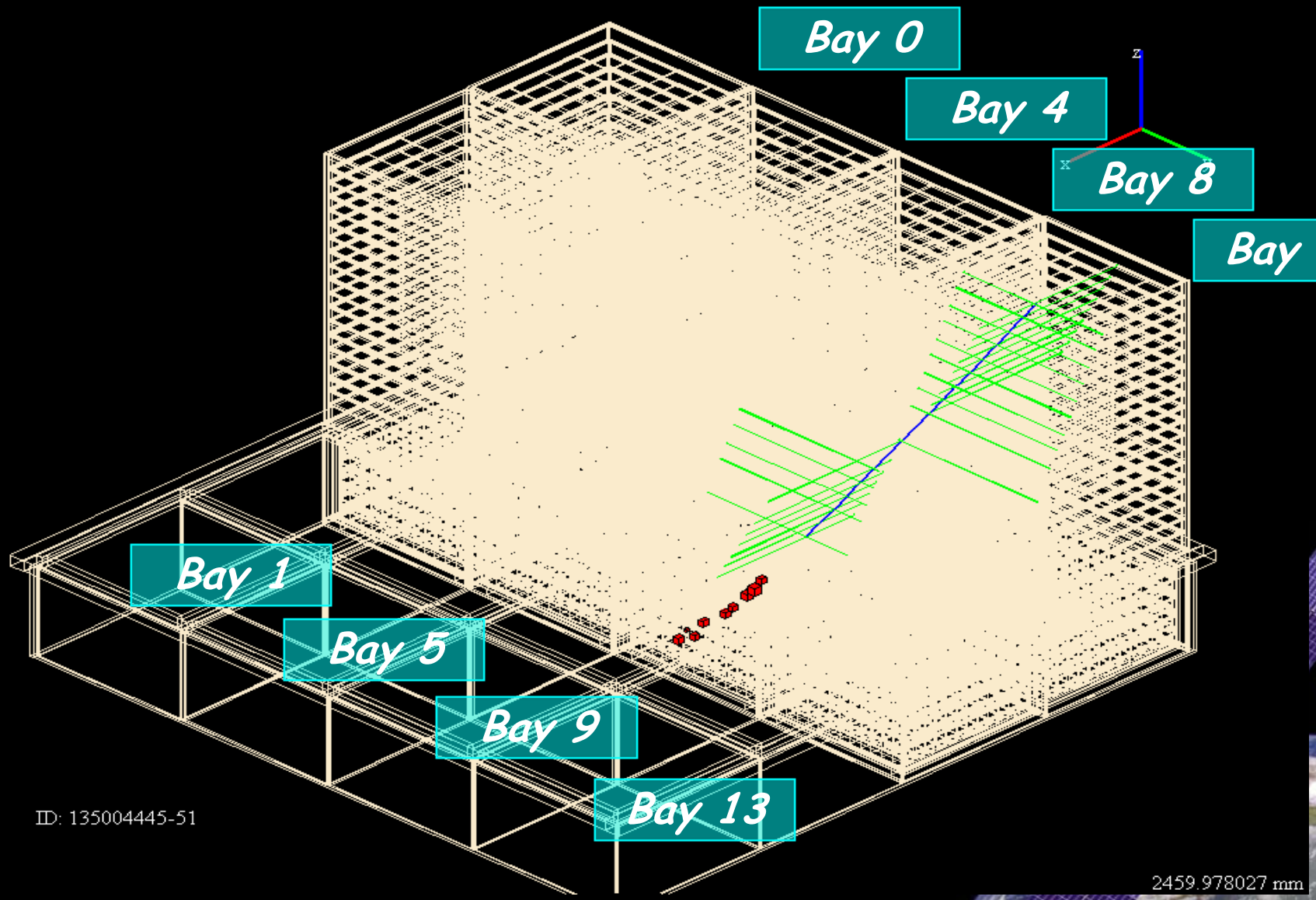


Integration of the TKR towers





Some cosmic ray muon events



An analysis of Cosmic Ray data

Event Selection:

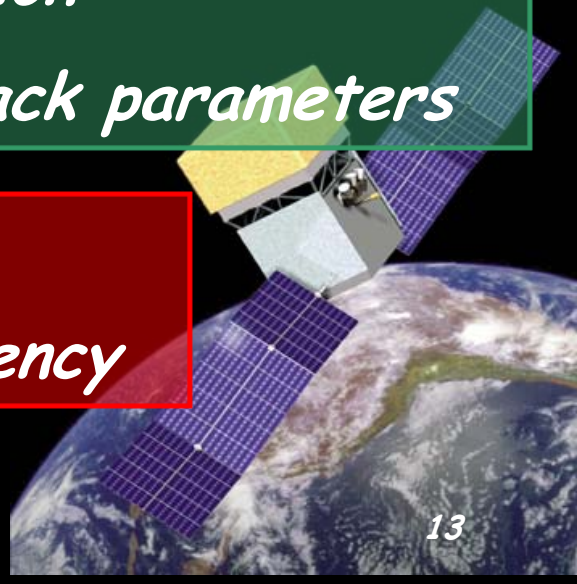
- TKR trigger from 3x+3y in a row layers
- Single tower events
- Single muon tracks in the TKR

Study of the ToT in track layers:

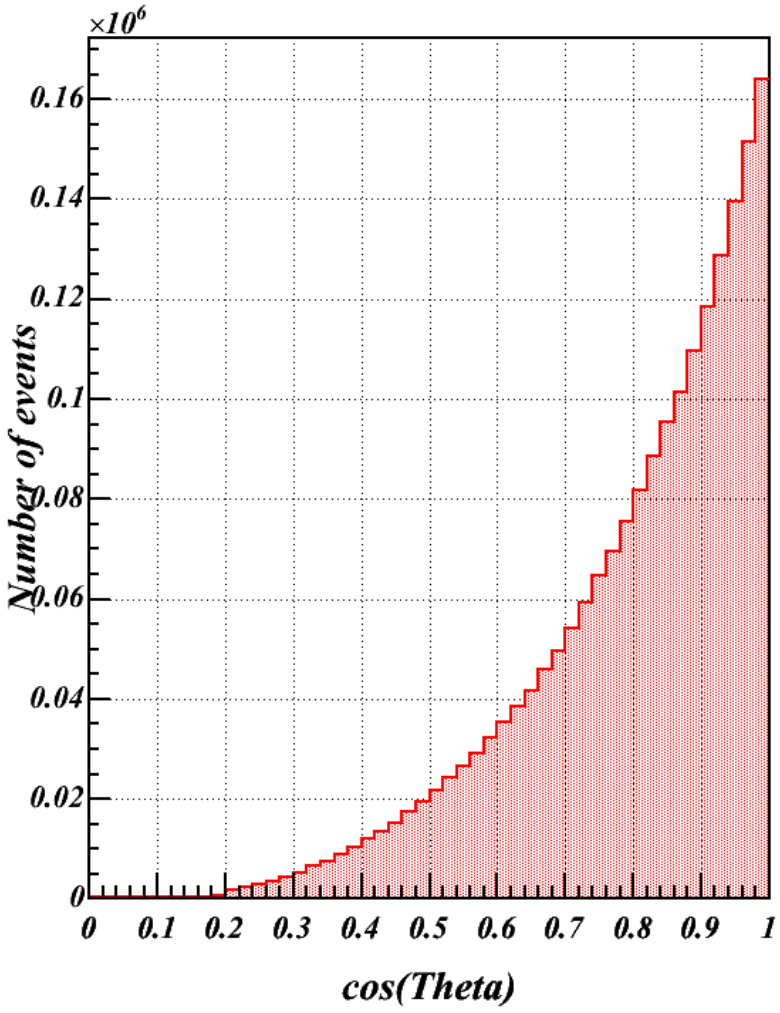
- Investigation of the ToT distribution
- Dependence of the ToT on the track parameters

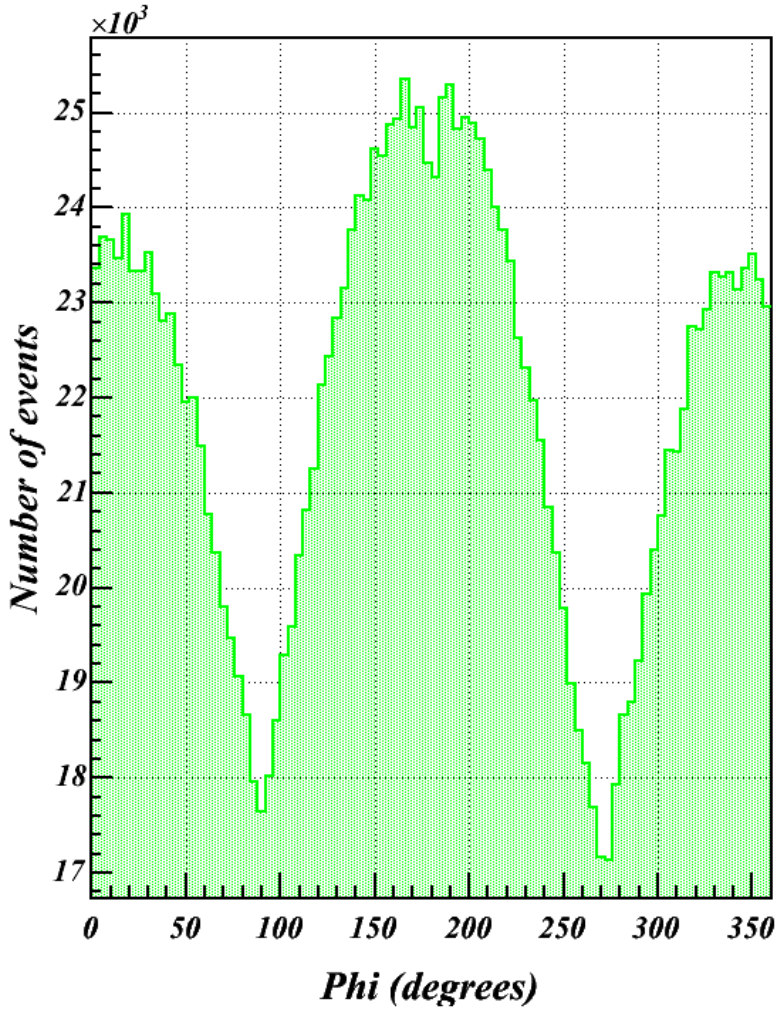
Study of the ToT in triggering layers:

- Evaluation of the hit capture efficiency

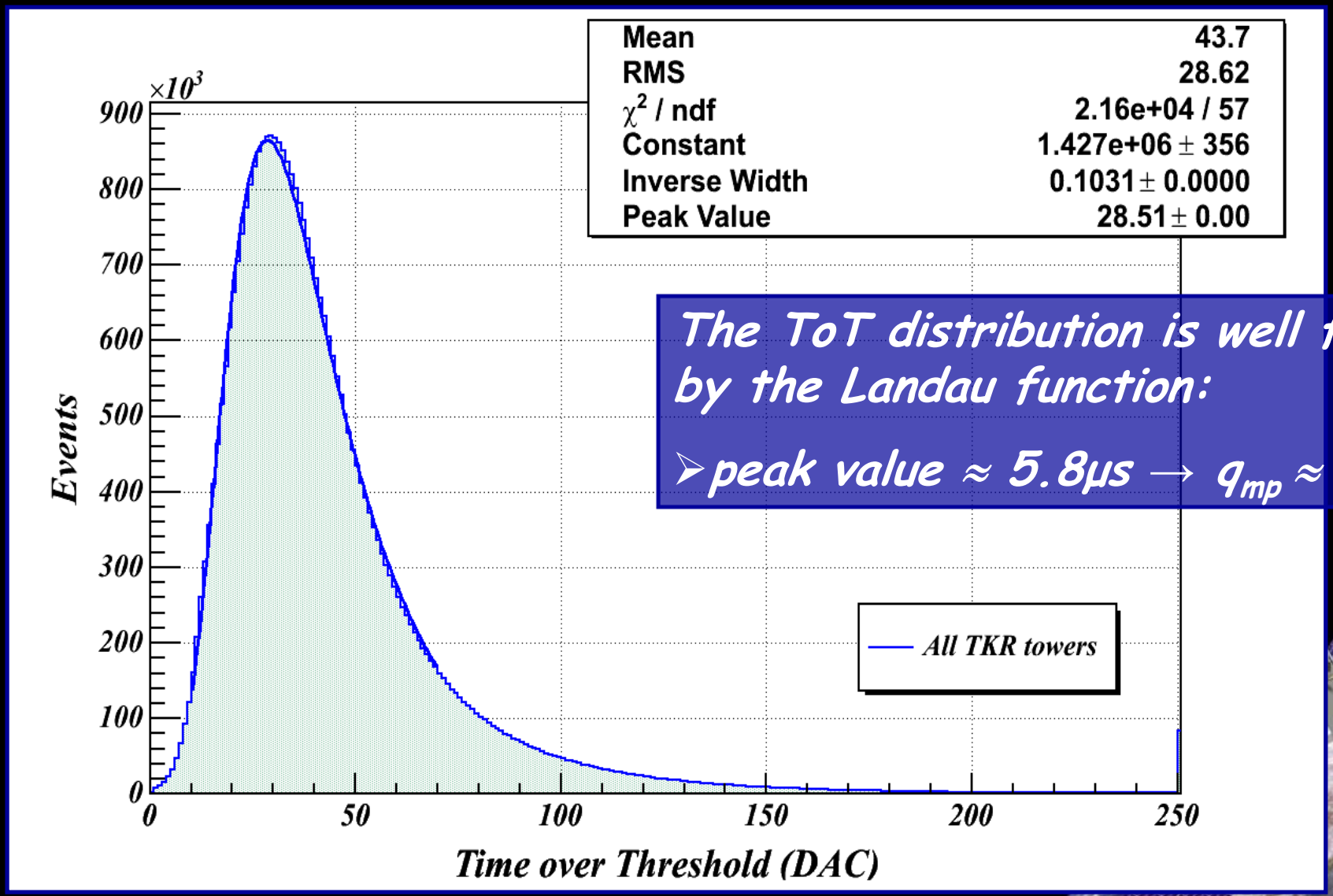


CR Muon angular distributions





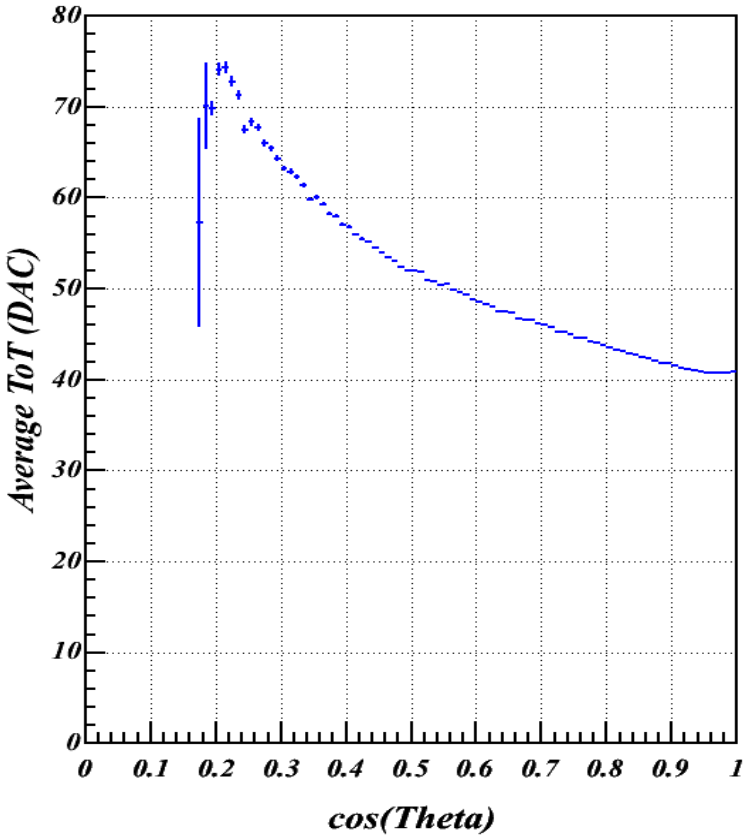
ToT distribution

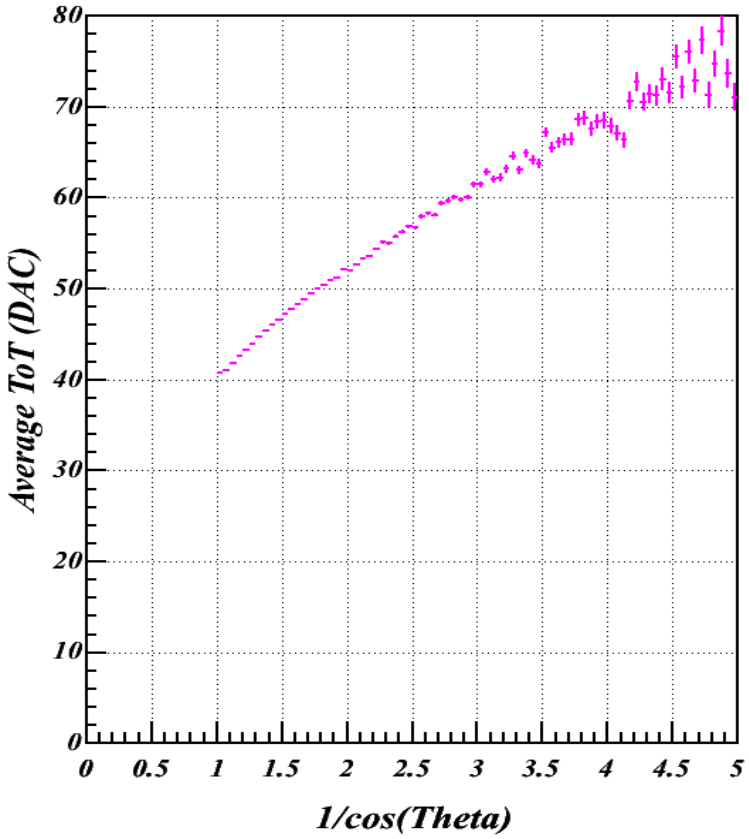


The ToT distribution is well fitted by the Landau function:

- peak value ≈ 5.8μs → q_{mp} ≈ 4 fC

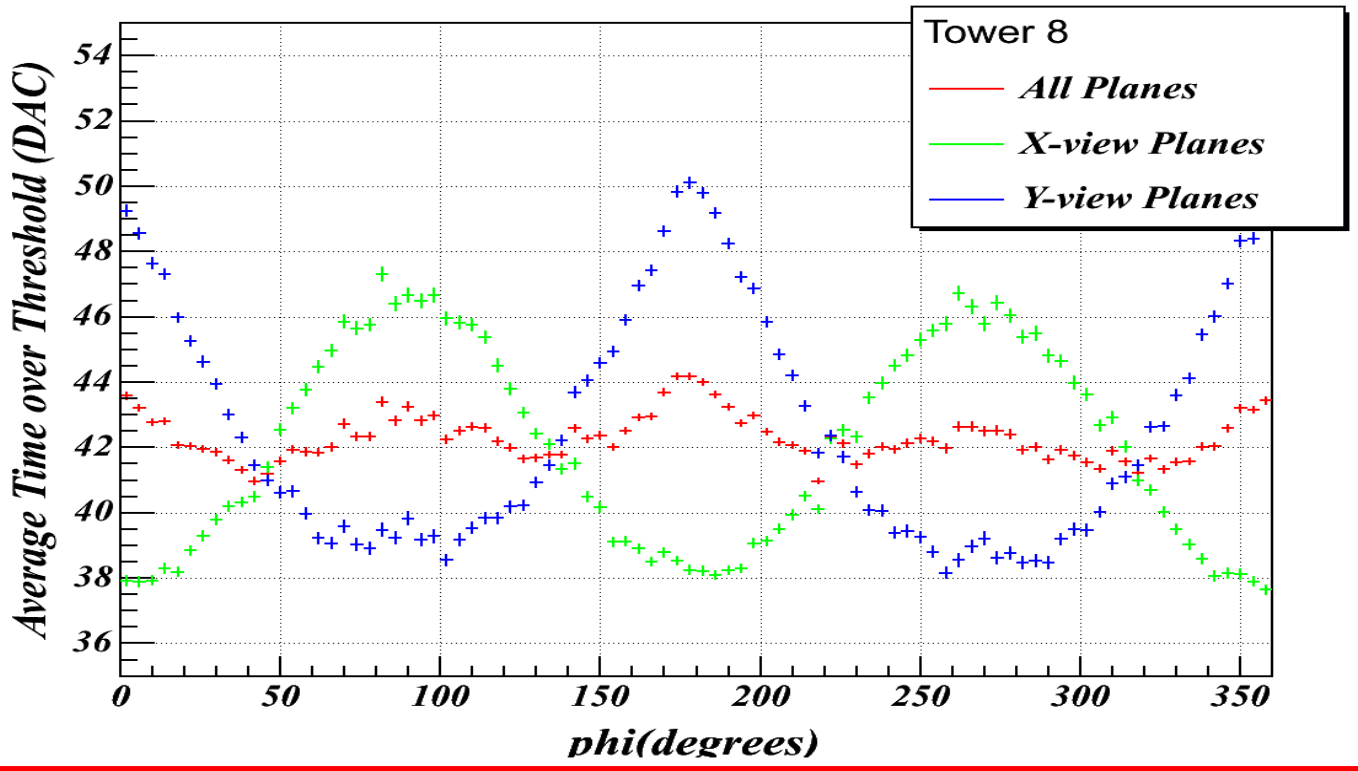
ToT vs zenith angle





The ToT is minimum for vertical tracks and increases with 1/cosθ (track length)

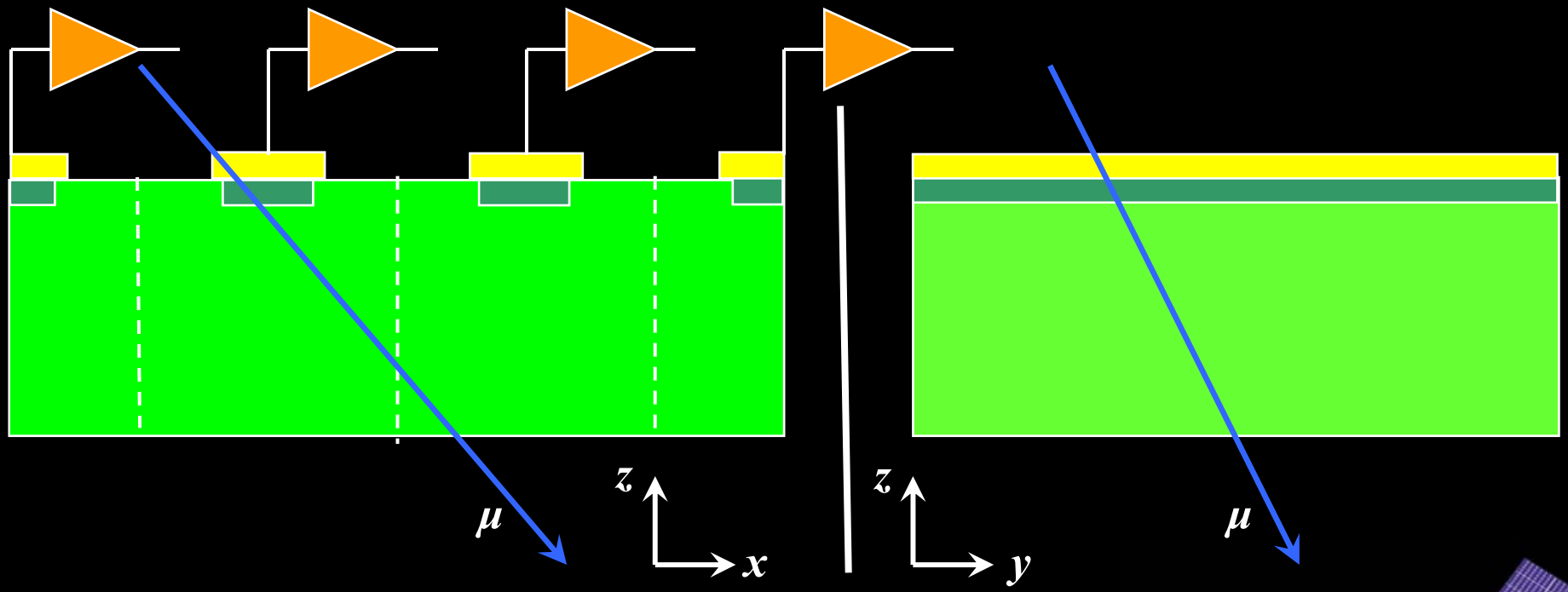
ToT vs azimuth angle



ToT exhibits a periodic dependence on φ:

- X-view layers: maxima at 90° and 270°
- Y-view layers: maxima at 0° and 180°

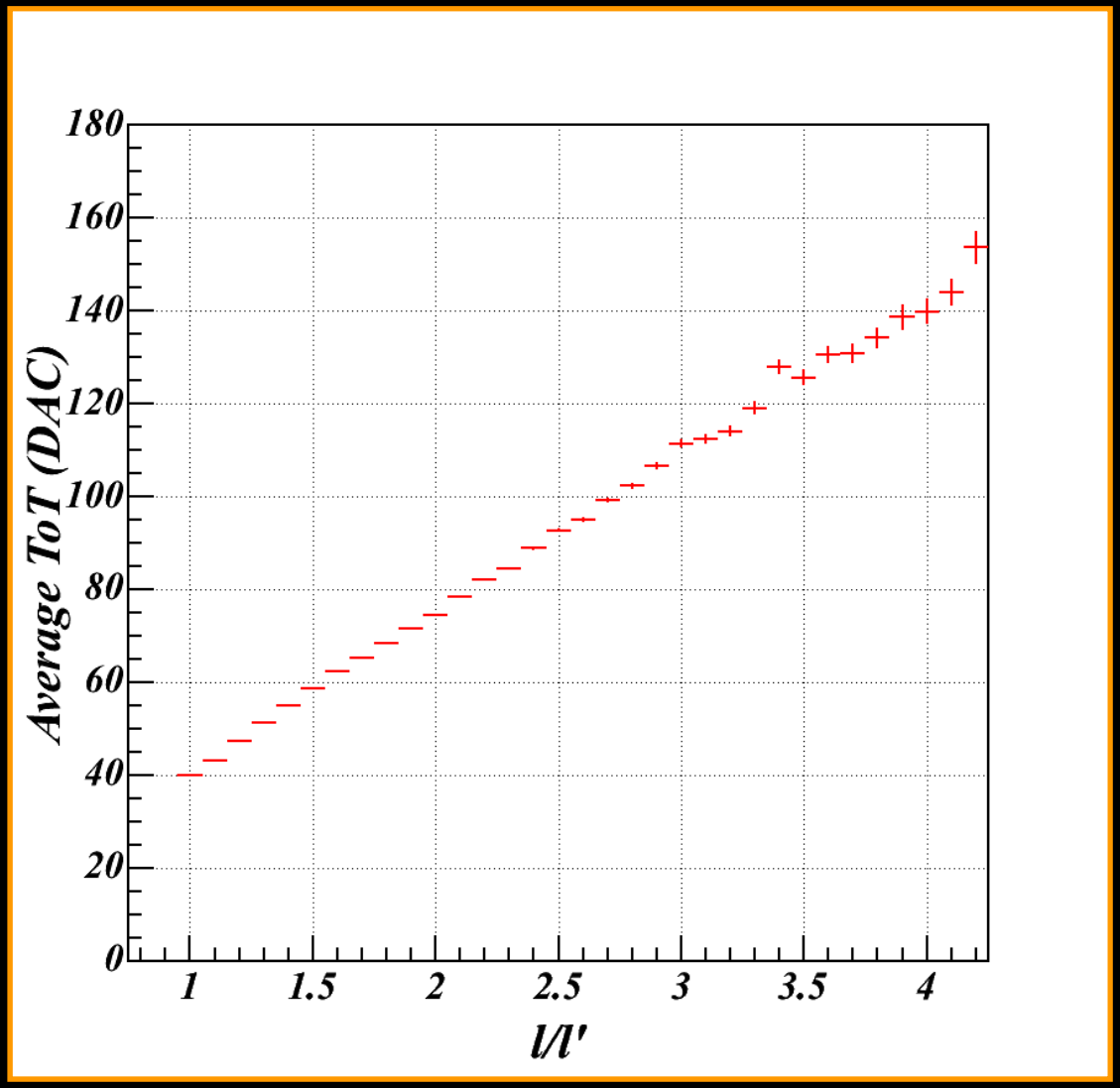
ToT and projected track length



- *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*

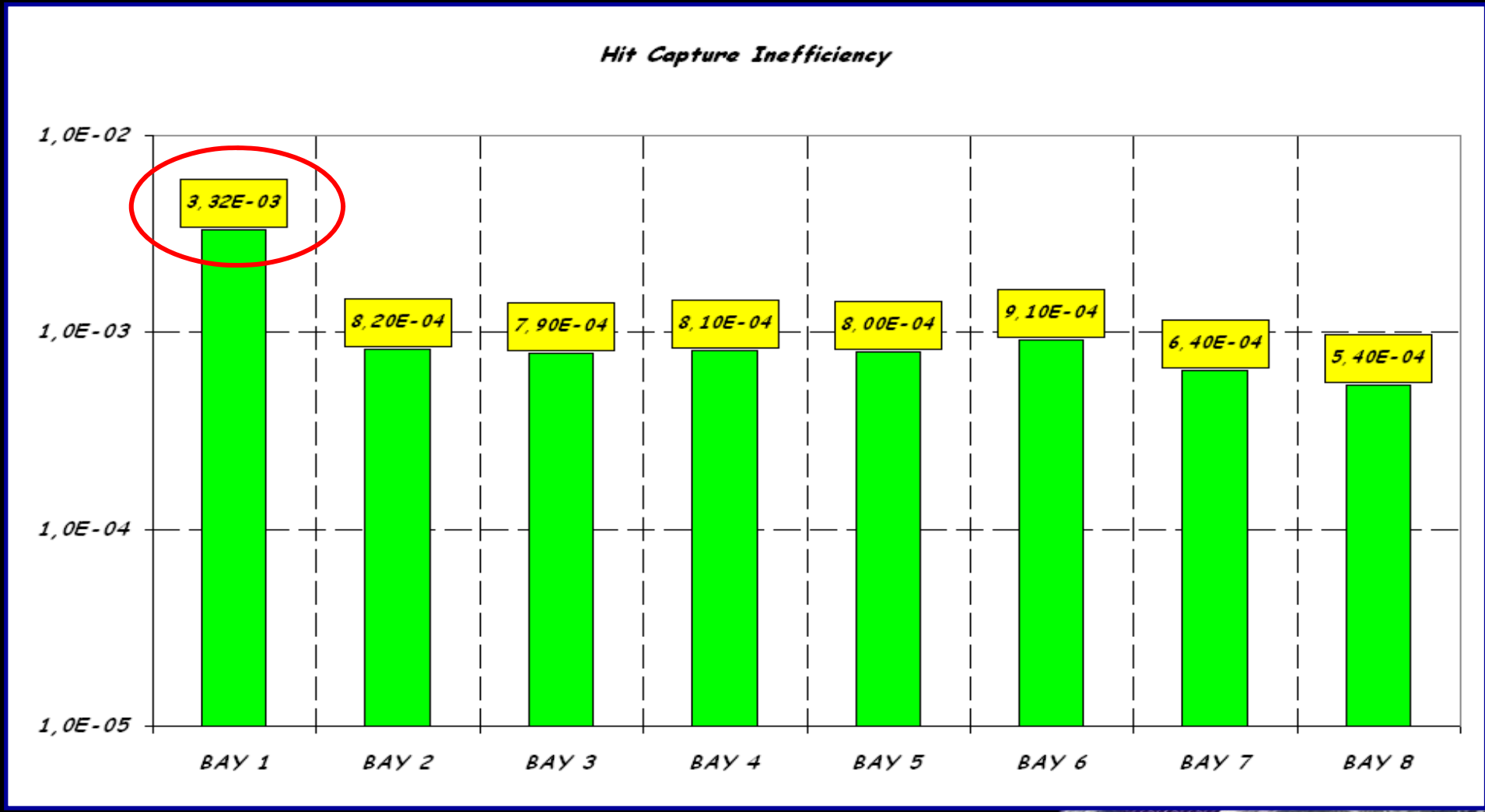
The ToT depends on the track length projected along the strip view

ToT vs track length/projected track length



The ToT depends linearly on the ratio l/l' (track length/projected track length)

Evaluation 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