Performances of the Fermi-LAT silicon strip tracker after 14 years of operation

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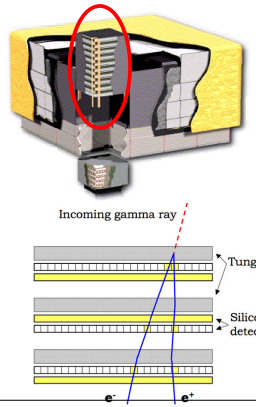
The Fermi-LAT Tracker

The Large Area Telescope (LAT) is a pair-conversion γ -ray detector able to measure γ-ray photons from 30 MeV to more than 300 GeV.



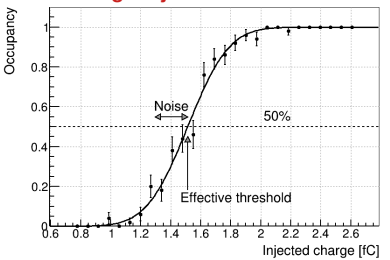
LAT Tracker

- 18 x-y detection planes of single sided silicon strip detector (SDD)
- Interleaved with tungsten foils to increase conversion probability (12 foils 0.03 X_0 thick, 4 foils 0.18 X_0 thick)
- 4 parallel ladders, each ladder built by connecting the strips of 4 SSD
- 400μm thickness, pitch of 228 μm, 15536 strips per layer
- data stream: hit strips coordinates (digital readout) + layer OR Time over threshold (ToT)
- Self triggering (3 bi-layers hit in the same tower)

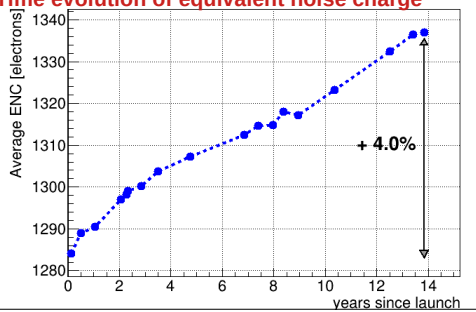
Noise performances

Noise is monitored by means of charge injection runs. For each Si strip the average occupancy as a function of the injected charge is fitted with an error function. The slope gives an estimation of the width of the underlying noise distribution.

Charge injection scan



Time evolution of equivalent noise charge

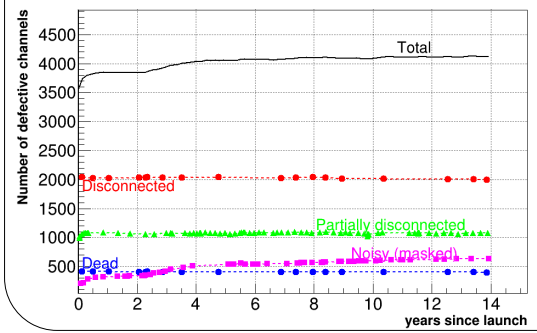


~4% increase of equivalent noise charge (ENC)

related to increased leakage current due to radiation damage

Defective channels

Time evolution of bad strips

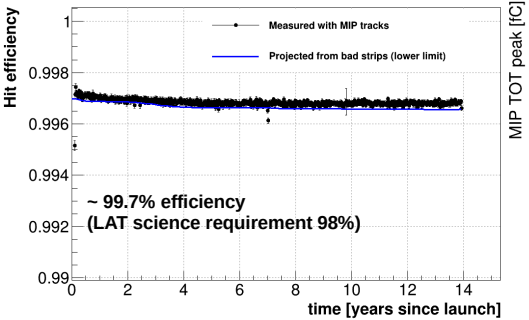


Different types of bad channels:

- Dead preamplifier.
- Disconnected: silicon strip is not physically connected to the preamplifier input. Low (~ 250 electrons) ENC.
- Noisy: noise occupancy > 1%,
- Partially disconnected: one or more of the wire bonds along the ladder is defective. Intermediate noise levels.

- **3661 defective strips at launch (0.31%)**
- **4120 defective strips at present (0.46%))**

Strip hit efficiency



Mip charge monitoring