Environmental test activity on the flight modules of the GLAST LAT Tracker


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GLAST, the Gamma-Ray Large Area Space Telescope, scheduled for launch in September 2007, is composed by two main instruments: the Large Area Telescope (LAT) and the Gamma Ray Burst Monitor (GBM). The LAT is a gamma-ray telescope consisting of a silicon micro-strip Tracker (TKR) followed by a segmented CsI calorimeter, to reconstruct γ-ray direction and energy. The tracker and the calorimeter are covered by a segmented scintillator anticoincidence system to reject charged particle background.

The Tracker of the Large Area Telescope is based on the conversion of gamma-rays into electron-positron pairs and is arranged in a 4x4 modular array of towers. Each tower corresponds to a stack of 19 carbon fiber trays supporting the silicon detectors and the electronics.

All the 16 flight towers have been built, subjected to environmental testing and delivered to SLAC where the Tracker is being assembled. The Tracker assembly status at the 15th October 2005 is shown in the picture on the right: 14 out of 16 towers have been assembled in the flight grid structure.

The INFIN-Bari group is responsible for the performance of the environmental testing of the LAT Tracker towers. The dynamic and thermal vacuum tests have been performed in the Alenia-Alcatel Assembly Integration and Test facility in Rome. The environmental testing of the flight TKR towers has been completed in October 2005. The test sequence performed is the following:

- Low Level Signature Sweep in the 5-2000 Hz frequency range studies the tower normal modes and compares the pre and post test results.
- Vibration Test Sequence (Z, X, Y axis):
  - Pre Test Low Level Signature Sweep 5 - 2000 Hz
  - Sine Test at low frequency 5 - 50 Hz
  - Low Level Signature Sweep 5 - 2000 Hz
  - Random Vibration 20 - 2000 Hz
  - Post Test Low Level Signature Sweep 5 - 2000 Hz

- Thermal Vacuum Tests
  - The main scope of functional tests is to check the detector’s performance before, during and after environmental tests. Comprehensive Performance Tests (CPT) include the verification of the front-end electronics and registers, the monitoring of noise and gain of Si strip detectors, the measurement of the number of disconnected channels for each layer, cosmic rays data acquisition. Some results of functional tests performed during TV cycles are shown.
  - Average temperature, gain and noise measured for each functional test performed during the TV cycles of a TKR tower as a function of time.
  - Average gain as a function of temperature (left) and gain distribution measured at 45°C (right).
  - Summary table of the number of disconnected channels of the layers monitored throughout a TV test. Only the layers having a number of disconnected channels greater than zero are shown.
  - Average noise as a function of temperature (left) and noise distribution measured at 45°C (right).

Summary plot of the vibration test results of all flight TKR towers: the pre and post normal modes frequencies and Q values are shown.

Low Level Signature Sweep in the 5-2000 Hz frequency range studies the tower normal modes and compares the pre and post test results.

Summary of the number of disconnected channels of the layers monitored throughout a TV test. Only the layers having a number of disconnected channels greater than zero are shown.