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The GLAST LAT tracker construction and test

F. Belli[a,*], L. Andreanelli[a], F. Angelini[b], R. Bagagli[b], M. Bagni[c], L. Baldini[b], G. Barbiellini[d], F. Bellardi[b], R. Bellazzini[b], A. Brez[b], M. Brigida[e], G. Busetto[f], A. Caliandro[e], M. Ceccanti[b], C. Cecchi[g], A. De Angelis[h], C. Favuzzi[e], M. Fazzi[b], G. Foglia[c], M. Frailis[h], P. Fusco[e], F. Gargano[e], D. Gasparrini[g], S. Germani[g], R. Giannitrapani[h], N. Giglietto[e], F. Giordano[e], M. Kuss[b], L. Latronico[b], F. Longo[d], F. Loparco[e], P. Lubrano[g], B. Marangelli[e], M. Marchetti[a], M.M. Massai[b], G. Mazzenga[a], M.N. Mazziotta[e], N. Menon[c], M. Minori[a], M. Minuti[b], N. Mirizzi[e], M. Mongelli[e], A. Morselli[a], N. Omodei[b], M. Pepe[g], M. Perchiazzi[e], M. Pesce-Rollins[b], P. Picozza[a], S. Raino'[e], R. Rando[f], E. Rapposelli[c], M. Razzano[b], A. Sacchetti[e], N. Saggini[c], G. Scolieri[g], C. Sgro'[b], G. Spandre[b], P. Spinelli[e], A. Tenze[b], A. Troianiello[c]

[a]*INFN-Tor Vergata and University of Roma Tor Vergata, Via della Ricerca Scientifica 1, 00133 Roma, Italy*
[b]*INFN-Pisa and University of Pisa, Via Buonarroti 2, 56100 Pisa, Italy*
[c]*Stellar Solutions Inc. and INFN-Pisa*
[d]*INFN-Trieste and University of Trieste, Via Valerio 2, 34127 Trieste, Italy*
[e]*INFN-Bari, Via E. Orabona 4, 70126 Bari, Italy*
[f]*INFN-Padova and University of Padova, Via Marzolo 8, 35131 Padova, Italy*
[g]*INFN-Perugia, Via A. Pascoli, 06154 Perugia, Italy*
[h]*INFN-Trieste and University of Udine, Via delle Scienze 208, 33100 Udine, Italy*

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Abstract

GLAST is a next generation high-energy gamma-ray observatory designed for making observations of celestial gamma-ray sources in the energy band extending from 10 KeV to more than 300 GeV. Respect to the previous instrument EGRET, GLAST will have a higher effective area (six times more), higher field of view, energy range and resolution, providing an unprecedented advance in sensitivity (a factor 30 or more). The main scientific goals are the study of all gamma-ray sources such as blazars, gamma-ray bursts, supernova remnants, pulsars, diffuse radiation, and unidentified high-energy sources. The construction and test of the Large Area Telescope (LAT) tracker, has been a great effort during the past years, involving tens of people from many Italian INFN sections and industrial partners. Environmental and performance tests of the hardware, detectors and reading electronics, have been carried on during all the steps of the LAT construction. The resulting LAT performance are better than the ones required by the original science proposal, demonstrating the quality of the italian group effort. In this article we summarize the LAT construction and test workflow, presenting its main results.

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Keywords: Gamma-ray; Satellite; Silicon detectors; Tracker

1. The GLAST scientific program

GLAST (Gamma-Ray Large Area Telescope) [1] is a next generation experiment for the observation of cosmic-gamma rays in the energy range from 10 KeV to more than

*Corresponding author.
E-mail address: Francesco.Belli@roma2.infn.it (F. Belli).

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300 GeV. This will permit the study of gamma-ray sources such as blazars, gamma-ray bursts, supernova remnants, pulsars, diffuse radiation and unidentified sources in an uncovered energy range with respect to previous experiments, such as EGRET [2] and with an overlap at higher energies with ground experiments (Fig. 1). Furthermore, in comparison with EGRET, GLAST will have better performance in terms of effective area, angular resolution, field of view and dead time (Fig. 2), providing an improvement factor of 30 or more in sensitivity, and better capability to study transient phenomena [3].

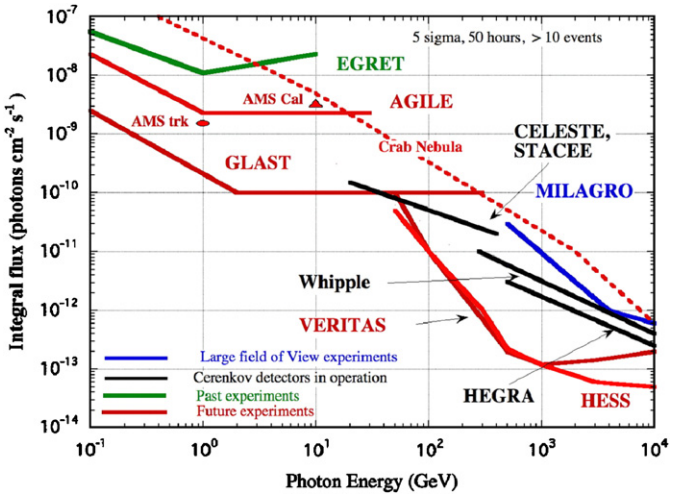

Fig. 1. GLAST energy range.

The GLAST construction has involved many worldwide partners from United States, Italy, Japan, France and Sweden, both from research institutions and from industries. The construction of the Large Area Telescope (LAT) Tracker modules [4] performed in Italy and finished last September, after years of efforts with excellent results, demonstrating a great coordination work between researchers and industrial partners.

2. The LAT tracker construction and test workflow

Modularity is the main concept in the tracker design. This allows the necessary redundancy to guarantee a safe operability in space environment and reproducibility in the construction workflow. Furthermore, severe acceptance, functional, mechanical and environmental tests are indispensable during all the instrument construction steps.

The LAT (Fig. 3) is a 4×4 array of 16 towers, each one composed by a tracker, in which the photon conversion takes place, followed by a calorimeter; the whole is surrounded by a segmented anticoincidence shield to allow the charged particle signal rejection.

The tracker (composed by 16 towers, for a total detecting surface of 83 m^2), has been built with almost 10,000 single sided, 8.95×8.95 cm microstrip silicon sensors, 228 μm pitch, bonded in groups of four to form a ladder; four ladders constitute a tracker tower plane. These planes are stacked with their strips alternatively oriented at 90° to form an *xy* coordinates grid: a tower is composed by 19 panels for a total of 18 of such *xy* planes.

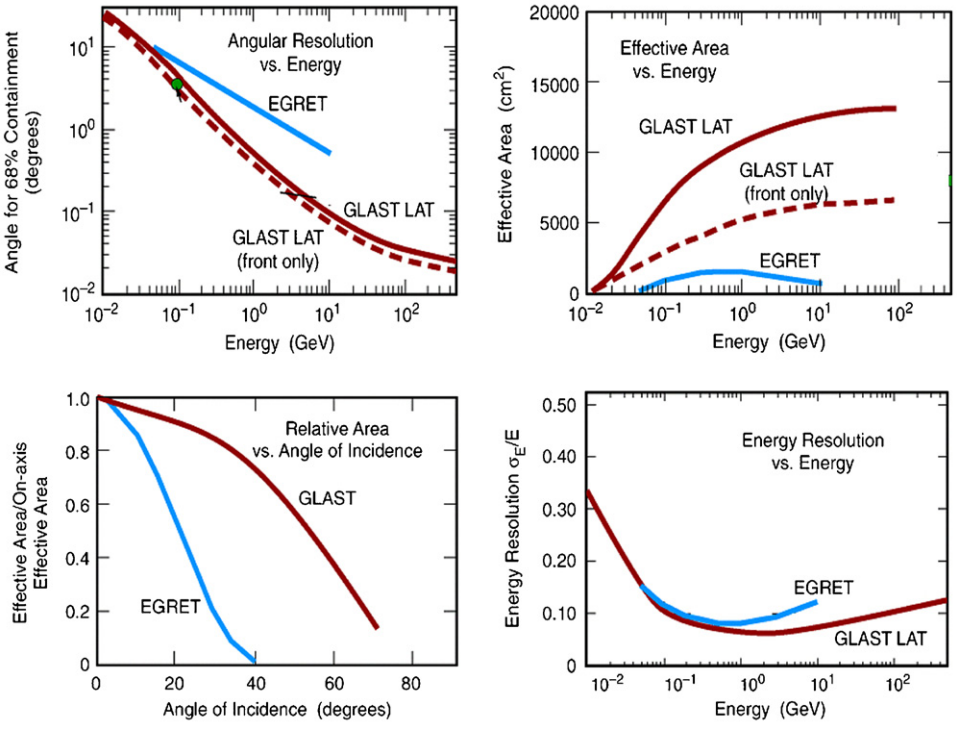

Fig. 2. GLAST LAT performance compared to Egret.