The Gamma Ray Imaging Detector of the AGILE satellite: a novel application of silicon trackers for detection of astrophysics high energy photons

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(on behalf of the AGILE collaboration)

**AGILE** is a project of Italian Space Agency (ASI) dedicated to

X-ray (18 – 60 keV) and γ-ray (30 MeV – 50 GeV) astrophysics

The instrument is operating on all-satellite, and was designed to satisfy many requirements:

- good angular resolution
- good time resolution
- large Field Of View (FOV)
- limited power consumption
- lightness and compactness
- long life
- resistance in space environment

These goals can be achieved using silicon detectors

The instrument consists of:

- X-ray coded-mask detector (**Super-Agile**)
- Gamma Ray Imaging Detector (GRID)

- Silicon tracker (ST)
- CsI bars calorimeter (MCAL)
- Plastic scintillators anticoincidence (AC)

The ray detection (30 MeV – 50 GeV) is in GRID

based on e+ e- pair production inside the silicon telescope and reconstruction of their trajectories.

This allows to determine the direction and the energy of the incident photon

Each plane of the telescope is composed of 16 silicon detector units, 410 mm thick and 9.5 x 9.5 cm² sized.

Active strips are interleaved with floating strips, resulting in a 764 strips readout with 242 µm pitch.

Active strips are on a specially designed mechanical support (MGSE), suitable for setting any position and direction of the instrument with respect of the tagged photon beam

On-ground calibration of the silicon tracker

A tagged photon beam was implemented at Frascati INFN laboratory (LNF), using the 450 MeV electron beam of Beam Test Facility (BTF)

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The first reconstructed tagged photon

The angular resolution of **AGILE** GRID

The Point Spread Function (PSF) is used, defined as the angular aperture that contains the 68 % of the reconstructed tracks, around the “true” direction. It depends on the pointing direction (θ, φ)

Evaluation of PSF as a function of photon energy

The measured PSF ranges from ~ 3° (0°, 0°) to ~ 7° (0°, 55°)

The found values are in good agreement with the Monocular predictions (also shown)

Comparison of the PSF measured on the real data (BTF) and the one calculated or simulated beam (MC). The green lines represent the ideal case of simulated bremsstrahlung and calculated photons, with a very large statistics.

First **AGILE** results

The **AGILE** satellite orbit is equatorial (altitude ~ 540 km; inclination = 25°)

The best orbit ever obtained for γ-ray astrophysics (very low particle background)

The **AGILE** GRID calibration at BTF

The e+ e- pair is well visible on most of the silicon tracker planes

Reconstruction of the BTF photon beam for different energy ranges

The effective FOV of **AGILE** GRID determined on natural γ-ray background

Effective FOV of **AGILE** GRID determined on natural γ-ray background

**AGILE** in operation

The satellite was launched on April 23, 2007 from the Indian Space Research Organisation base of Sriharikota (Chennai-Madras)

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