Performance of the AntiCoincidence Detector on the GLAST Large Area Telescope

(NASA Goddard Space Flight Center), for the GLAST/LAT Collaboration
* now at University of Denver

ACD Performance Requirements

0.9997 detection efficiency for singly charged relativistic particles (averaged over entire area).
For 300 GeV photons, the probability of false veto due to calorimeter backscatter must be less than 20%.
No more than 6% of incident γ-rays can interact in the ACD.

ACD contribution to the required total LAT level charged particle background rejection ratio of -10^5.
Provide good photon detection efficiency for photons of 300 GeV and higher.
Maintain high LAT photon detection efficiency at all energies.

Trade-Off: Efficiency vs. Backsplash

ACD and LAT Status
- August 4, 2005 - Completion of ACD environmental and performance tests
- August 13 – ACD arrival at SLAC
- August 23 – Formal acceptance of ACD by LAT
- December – ACD integration into LAT

Early 2006 – Functional tests of LAT complete. Ship to NRL for environmental tests,
Middle of 2006 – LAT shipment to SpectrumAstro for integration with the spacecraft
Spring of 2007 – Shipment of GLAST spacecraft to Kennedy Space Center for launch preparation
September 2007 - Launch

ACD Final Performance
- Total efficiency can’t be directly measured on the ground: no isotropic source of charged particles available.
- Now we have measured performance for all individual flight detectors, as well as their position measurements on the structure, and sample efficiency measurements at various locations on the array.
- All this was put into ACD simulations to determine the detection efficiency for singly-charged relativistic particles, as well as the final backscatter probability. The backscatter simulations used the results from CERN beam exposures of tile and calorimeter emulators (Moiseev et al. 2004, Astroparticle Physics 22, 275).
- ACD meets its scientific requirements with moderate margin on detection efficiency and substantial margin on backscatter.

ACD assembled, showing the scintillator tile layout

Design Approach
- To suppress self-veto caused by backscatter, we segment the ACD, then ignore ACD hits that are far from the reconstructed point of entry. Optimal segmentation was determined by simulations.
- To reduce signal fluctuations (origin of inefficiency), we need as much light yield as possible from the tiles. Testing showed that 1 cm thickness of plastic scintillator is enough if the spacing of wavelength-shifting fibers is 5 mm.
- Also must minimize the gaps between segments (while allowing for very significant thermal expansion/contraction). Scintillator tiles overlap in one dimension; in the other direction, the gaps are covered by ribbons of scintillating fibers (fabricated at Washington University, St. Louis).

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