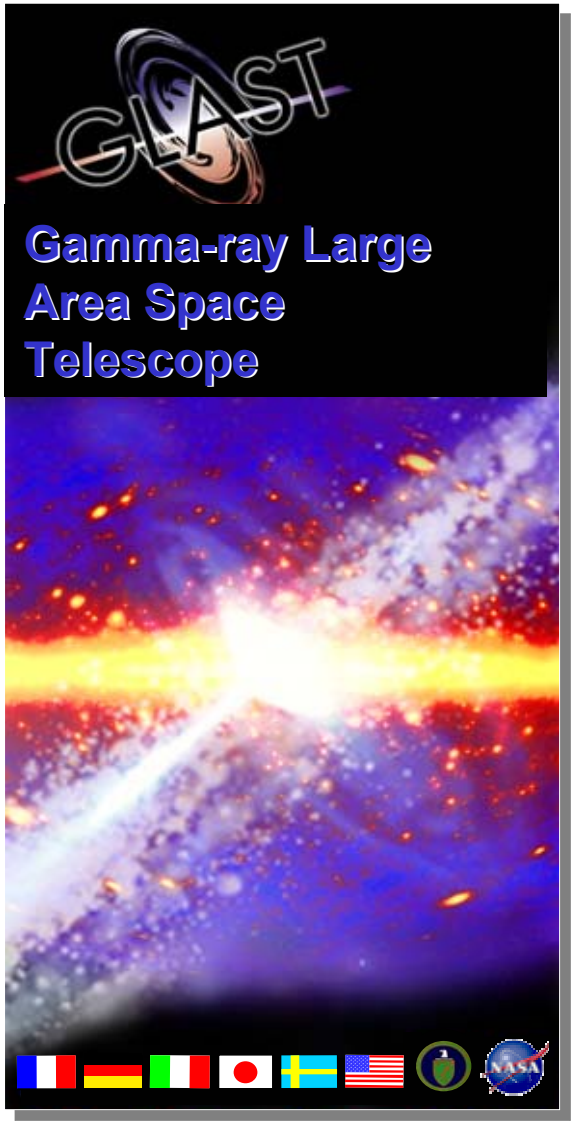

GLAST Large Area Telescope:

AntiCoincidence Detector (ACD)
Overview of the Design
WBS 4.1.6

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Level III Key Requirements Summary

Reference: LAT-SS-00016

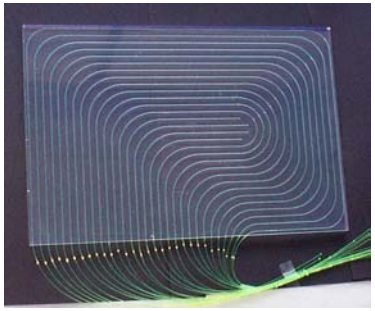
Parameter	Requirement	Expected Performance	Verification Method
Detection of Charged Particles	**≥ 0.9997 average detection efficiency over entire area of ACD (less for bottom row of tiles)**	**≥0.9997** **≥0.99 (bottom tiles)**	**Test and Analysis**
Fast VETO signal	Logic signal 50-700 nsec after passage of charged particle	50-700 nsec	Test
PHA signal	For each phototube, pulse height measurement for each Trigger Acknowledge (TACK) Below 10 MIP, precision of <0.02 MIP or 5% (whichever larger) Above 10 MIP, precision of < 1 MIP or 2% (whichever larger)	 < 0.02 MIP or 5% < 1 MIP or 2%	Test and Analysis
False VETO rate - backsplash	**< 20% false VETO's due to calorimeter backsplash at 300 GeV**	**< 20%**	**Analysis**
False VETO rate - noise	< 1% gamma-ray rejection from false VETO's due to electrical noise	< 1%	Analysis
High Threshold (Heavy Nuclei) Detection	Detection of highly-ionized particles (C-N-O or heavier) for calorimeter calibration.	Yes	Test and Analysis
Size	Outside: 1796 x1796 x 1015 mm Inside Grid: 1574 x 1574 x 204.7 mm Inside TKR: 1515.5 x 1515.5 x 650 mm	1796 x1796 x 1015 1574 x 1574 x 204.7 1515.5 x 1515.5 x 650	Test
Mass	≤ 235 kg (228 + 7 allocated)	228	Test
Power	< 31 Watts (conditioned)	14	Test
Instrument Lifetime	Minimum 5 yrs	> 5 yr.	Analysis

Meeting the ACD Requirements

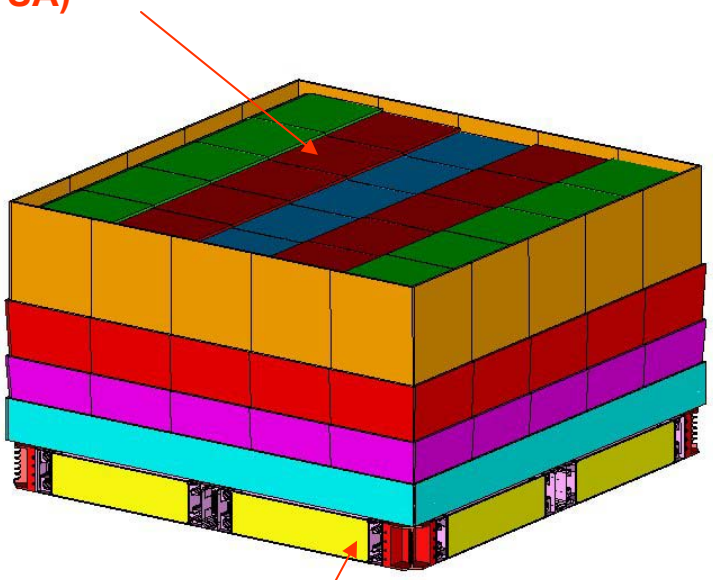
- REQUIREMENT – average particle detection efficiency 0.9997
- ACHIEVED BY HIGH DETECTION EFFICIENCY, NO GAPS
  - 1 cm thick plastic scintillator
  - light collection by waveshifting fibers (for uniformity)
  - light detection by phototubes (gain ~10^6)
  - overlapping tiles in one dimension on faces and at corners
  - covering gaps in other dimension with scintillating fiber ribbons
- REQUIREMENT - < 20% self-veto loss due to backsplash
- ACHIEVED BY SEGMENTATION OF SCINTILLATOR
  - 1000 cm^2 area scintillator tiles at top of instrument
  - smaller tiles on sides to maintain similar solid angle seen from calorimeter

Anticoincidence Detector Overview

Prototype ACD tile read out with Wavelength Shifting Fiber



Tile Shell Assembly (TSA)



Base Electronics Assembly (BEA)

- **TILE SHELL ASSEMBLY**
  - 89 Plastic scintillator tiles
  - Waveshifting fiber light collection (with clear fiber light guides for long runs)
  - Two sets of fibers for each tile
  - Tiles overlap in one dimension
  - 8 scintillating fiber ribbons cover gaps in other dimension (not shown)
  - Supported on self-standing composite shell
  - Covered by thermal blanket + micrometeoroid shield (not shown)
- **BASE ELECTRONICS ASSEMBLY**
  - 194 photomultiplier tube sensors (2/tile)
  - 12 electronics boards (two sets of 6), each handling up to 18 phototubes. High voltage power supply on each board.

ACD Technical Heritage

- **Plastic Scintillator** - used in all previous gamma-ray telescopes OSO-3, SAS-2, COS-B, CGRO (all 4 instruments), plus many cosmic ray experiments.
- **Waveshifting fibers** - used in GLAST LAT Balloon Flight Engineering Model (BFEM). Waveshifting bars used by HEXTE on RXTE (same material in a different geometry)
- **Photomultiplier tubes** - used in all previous gamma-ray telescopes. HEXTE/RXTE used a commercial version of the same tube we are using (Hamamatsu 4443), and GOLF on SOHO used the same tube as the ACD except for the cathode material (Hamamatsu 4444)
- **High Voltage Bias Supplies** - used in all previous gamma-ray telescopes, plus many cosmic ray experiments.
- **Electronics** - similar ASIC's (same designer) used on the BFEM. Discriminators, PHA and logic signals similar to many flight instruments.

SUMMARY

- The ACD design meets its requirements using space-flight-proven technologies: plastic scintillator with photomultiplier tube readout.