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Document Title **GLAST LAT ACD As-Built Area Density of the ACD MMS/MLI**		

Gamma-ray Large Area Space Telescope

(GLAST)

Large Area Telescope (LAT)

Anticoincidence Detector (ACD)

GLAST LAT ACD As-Built Area Density of the ACD MMS/MLI

ACD-RPT-000394
Rev A

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As-Built Area Density of the ACD MMS/MLI

1. Introduction

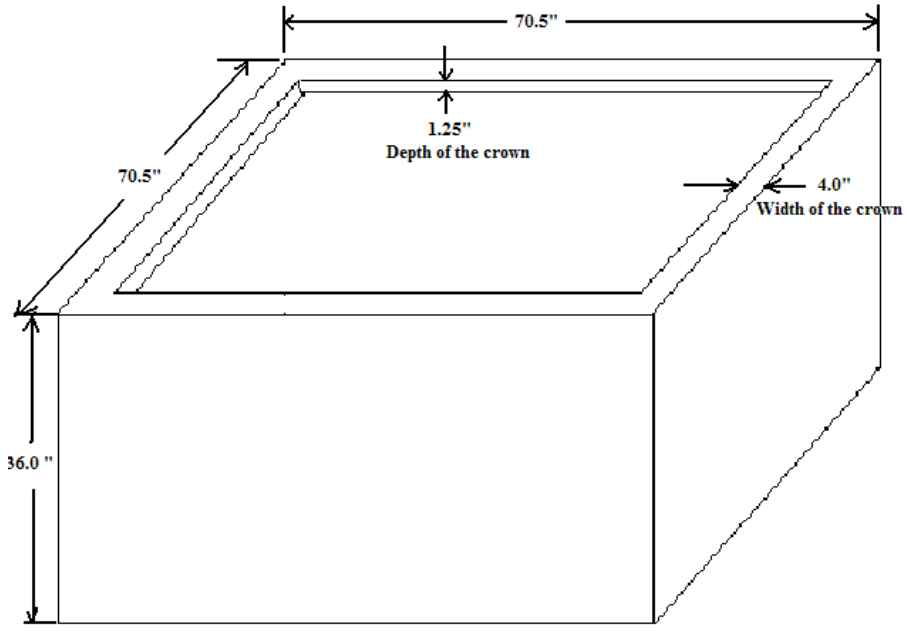
The measured area density for the ACD Micrometeoroid Shield/Multi-Layer Insulation (MMS/MLI) turned out to be 0.39 g/cm2, about 22% larger than the original estimated value of 0.32 g/cm2, which is a requirement in our Level IV Requirements Document. This report is a review of the materials and fabrication of the MMS/MLI to account for that change. Information comes from the materials log accumulated by Diane Schuster. **This revision incorporates the final mass measurements on the outer blankets, which were slightly heavier than estimated in the September, 2005, report.**

2. The measurement of the area density.

The measured mass of the ACD MMS/MLI is 39.455 kg.

The dimensions of the MMS without the MLI are shown in the figure below.

GLAST ACD MMS Surface Area
Outside dimensions of MMS (No MLI)
Measurements +/- 0.15"



Add 0.15” for the MLI (soft material, so this is an approximation).

The outside surface area is in three sections:

Sides (179.8 cm x 91.8 cm) x 4	66022 cm2
Top (179.8 cm x 179.8 cm)	32328
Inside of crown (158.0 cm x 3.2 cm) x 4	2022
Total	100372 cm2

The average area density seen by incident micrometeoroids is the total mass divided by the total outer area, or 0.39 g/cm2.

3. Kevlar Layers

Based on the Johnson Space Center group analysis of the revised space debris flux, it was necessary to add two additional layers of Kevlar to the sides of the ACD, but not the top.

Material properties: 0.0228 g/cm2
0.03 cm thickness/layer Density 0.76 g/cm2
56 cm radiation length (found two references online consistent with this number. Long number because Kevlar is low density woven material.)

6 layers – 0.137 g/cm2
8 layers – 0.182

These are the layers that contain the largest mass. They are closest to the scintillators.

4. Nextel Layers

The four Nextel layers are separated by Solimide foam.

Material properties 0.0298 g/cm2
0.043 cm thickness/layer Note: implies density of 0.69 g/cm3

42 cm radiation length (Al_2O_3 62.5%, SiO_2 24.5%, B_2O_3 13%) or 29 g/cm2

Radiation length is just the weighted average of the radiation lengths for the three materials, given in CERN/NUFACT Note 023, using the radiation lengths in g/cm2, <u>not</u> converting to cm with the nominal densities of these materials, which is large.

4 layers – 0.119 g/cm2

5. Solimide Foam

Purpose is to separate the Nextel layers.

Material properties 0.0036 g/cm2
0.65 cm thickness/layer (density 0.0055 g/cm3)

Composition similar to that of Kapton. Equivalent thickness of Kapton determined by scaling by the density = 0.010 cm
Radiation length of Kapton 28.2 cm

6. MLI and Handling Layers – Combination of Kapton, Mylar

Includes correction for overlaps, scrim, glue, tape, lifting spools – all similar materials. Most of this material is in the outer layers with the MLI. The MLI itself has more layers than originally planned (14 vs 12), in order to meet the thermal requirements. The handling layers are Kapton with Kevlar scrim and were added for protection of the MMS during handling. The outer layer is Germanium on Kapton.

Equivalent density 1.4 g/cm3

Thickness 0.07 cm total of all materials
Area density 0.098 g/cm2
Radiation length 28.2 cm

7. Summary

Sides (8 layers Kevlar) – 0.182 + 0.119 + 0.015 + 0.098 = 0.41 g/cm2

Top (6 layers Kevlar) – 0.137 + 0.119 + 0.015 + 0.098 = 0.36 g/cm2

Sides 0.41 g/cm2 x 66022 cm2 = 27069 g

Top 0.36 g/cm2 x 34350 cm2 = 12366

Total 39435 g

Compare to actual mass of 39455 g. The 20 g difference is well within the approximations made in the calculations.

The larger area density comes from five sources:

1. The addition of two more layers of Kevlar to the sides for debris protection.
2. The addition of more layers to the MLI to meet thermal requirements.
3. The addition of reinforced handling layers for protection.
4. The additional material such as glue and tape needed to build the MMS.

5. The Germanium/Kapton outer layer was heavier than originally estimated.

Note that the additional Kevlar accounts for most of the added mass (0.046 g/cm2).