GLAST Calorimeter Quarterly Report
April – June 2000

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WBS 4.1.5. Calorimeter

Progress/Status

4.1.5.1 Management

Identification of the program management team at NRL is behind schedule. Candidates have been interviewed and selection is imminent.

Organization and management of the calorimeter efforts in France is also behind schedule. CEA/Saclay and IN2P3 institutions are working on a mutually agreeable management structure and allocation of responsibilities. Original program manager in France was drawn back into INTEGRAL mission support and must be replaced.

Draft of Calorimeter Electronics Specification has been created and circulated. The draft has been reviewed with GLAST systems engineering team. The requirements for the front end electronics have been discussed with ASIC design team and draft of the Calorimeter Analog ASIC specification has been initiated.

4.1.5.3 CsI Detector Module

Light yield testing at Ecole Polytechnique with various optical treatments of inner wall of carbon cells. Test with fully polished crystal achieves 2800 e-/MeV yield.

Investigations into alternate bonds of PIN photodiode onto CsI crystal have been performed. NRL assembled 10 CsI crystal test box for GSI testing in July using silicone elastomeric optical pads to attach PIN photodiodes to CsI crystals. CEA/Saclay has begun investigation into space qualified silicone elastomeric materials.

4.1.5.4 Analog Front End Electronics

Designed and built test printed circuit board for radiation susceptibility testing of COTS ADCs proposed for the calorimeter. The board provides control signals and readout of the ADCs, measures currents and detects/resets latch-up conditions in the ADC. It supports both proposed COTS ADCs for the calorimeter – Burr Brown ADS7816 and the Maxim 189. Initial probing with a 600 nm laser indicates latch up sensitivities for the BB part at a LET of 15 – 20 MeV cm^2/mg. The Maxim part is less sensitive, showing latch up at LET of 70. Both parts latch up in the digital sections. The GLAST IRD requirement is a SEU LET sensitivity greater than 8 MeV cm^2/mg.

4.1.5.5 Compression Cell

Significant progress has been made in the design and verification of the carbon cell calorimeter mechanical structure. A complete prototype of the 12 cell x 8 layer design (VM0) has been completed. VM0 is a full size prototype (proposal dimensions) and demonstrates concepts for cell closeout and electronics attachment. Interface of calorimeter to Grid structure is not addressed in VM0. A second prototype (VM1, also proposal dimensions) will be fabricated and loaded with dummy crystals for vibration testing in September.

4.1.5.9 Design and Verification

Reviewed calorimeter requirements in support of the calorimeter electronics specification. Particular areas of investigation were both the low energy and high energy response requirements for the calorimeter. The low energy response is largely affected by the signal to noise performance of the front end ASICs and the tracker material above the calorimeter. Investigations of low energy performance included studies of PIN diode size, simulations of the low energy performance, including triggered energy deposition in tracker vs calorimeter and the degradation caused by direct energy deposition in the PIN photodiodes. Direct deposition in the diodes is not significant at low energies. SuperGLAST tracker radiation length significantly affects the energy resolution below 100 MeV since most of the energy is lost in the tracker. Studies of the high energy performance of GLAST indicate that the high energy limit of measurement for a single CsI crystal could be reduced to 50 GeV (from the current 100 GeV requirement) without significant reduction in the performance or resolution of the GLAST measurements at 300 GeV.

Calibration and analysis of results from the BTEM testing at SLAC in Dec, '99 – Jan, '00 beam tests is on-going. Calibration files for the calorimeter have been generated and distributed. The major activity has been in event reconstruction and understanding of the event data streams.

Preparations for the hadronic beam tests at GSI were completed. The BTEM calorimeter and supporting test hardware have been shipped to Germany. The calorimeter handling dolly was adapted to a test stand to provide two axes of motion and two axes of rotation. BTEM DAQ environment was reconfigured to operate standalone without VxWorks license server. DAQ calorimeter software was investigated for improved event throughput. With SU support, event throughput was effectively doubled.

4.1.5.10 Sub-Orbital Flight

Refurbishment plans of the BTEM calorimeter for the sub-orbital flight are being developed. The major issue for the calorimeter is the thermal environment expected for the sub-orbital flight and its impact on the optical bonds of the PIN photodiodes to the CsI crystals. Measurements to date indicate no additional degradation in light yields for BTEM crystals from that experienced during shipment to SLAC prior to the Dec. '99 beam test.

Issues and Concerns:

There are no new significant issues and concerns. The management structures at NRL and in France are not complete but the current resources are sufficient to support GLAST IPO requests and to advance the design specifications for the calorimeter.

The major technical concern is the qualification of the COTS ADCs for flight. The radiation susceptibility aspects of this qualification are being pursued aggressively.

Schedule and Cost Status:

Calorimeter activities are generally on schedule with the exception of specification and initiation of the analog front end ASIC design. Organization and resource limitations in France have delayed the initiation of the ASIC design by a few months. Scheduled start was June; the work will likely not start until September. Mitigations for this late start are being actively pursued and include a dedicated run at the DMILL foundry for the first prototype ASIC run.

NASA actual costs are running behind planned costs principally due to the delay at NRL in bringing on the program management team. We will work hard at NRL to make sure we never let this happen again, we promise to spend all the money you send to us in a timely fashion.

Plans for the next quarter:

Beam test at GSI. The BTEM calorimeter will be exposed to beams of ^{12}C and ^{58}Ni at energies of ~700 MeV/nucleon. Objectives of the tests are to develop calibration strategies for in-flight calibration of the calorimeter using heavy cosmic rays, investigate the light saturation effects of heavies vs electromagnetic showers, and to develop tools and experience in identifying heavy fragmentation and the characteristics of the resulting energy depositions.

Assembly of VM1. A second mechanical model of the carbon cell structure will be manufactured and loaded with dummy crystals for mechanical testings.

Vibration Test of VM1. A key test of the carbon cell structure will be vibration to qualification levels in September.

Completion of Radiation testing on COTS ADCs. Initial testing with lasers will be followed by particle beam testing at Brookhaven National Laboratory.

Completion of preliminary design specifications for the calorimeter.

Preparation and Support for SRR.