Monthly Cost/Schedule Status

GLAST LAT Calorimeter August 27, 2003

W. N. Johnson

Naval Research Lab

Outline

Technical Status:

- Last Month's Accomplishments
  - Summary of issues & concerns
  - Status/Closure of action items
- Open Design/Engineering model/manufacturing issues and closure plan for them
- Status of Subsystem's Parts List & qualification program
- Near-term Milestones & Status towards them for next 3 months

Cost & Schedule Status – July PMCS Status:

- Significant cost and schedule variances (for July and cumulative)
- Identify threats to maintaining schedule and cost

Significant Accomplishments August 2003

- **CDEs**
  - CsI Crystals
    - To date Kalmar has received 450 CsI xtals (including 48 proto-flight) from Amcrys H. Of these, 208 have been fully tested and shipped to NRL. Another 100 crystals will be shipped to NRL before the end of August.
    - Minor quality issues are being worked. 12 xtals have been rejected in Kalmar, mainly for light taper. 10 xtals have exceeded maximum chamfer-to-chamfer distance (by a tiny amount) and have been trimmed at Kalmar.
    - Samples from 8 more boules have passed the radiation hardness test. These boules will enter flight production line in September.
  - PDA Manufacturing
    - Prototype tooling has been manufactured and tested. Results good, minor improvements needed for efficiency.
    - PDA manufacturing process spec completed and used to select vendor for manufacture.
    - PDAs for CDE Qual units are being manufactured at NRL.
  - Approx. 25 CDEs have been bonded at Swales for training and tooling tests.
    - Optical tests at NRL have been completed on 4 CDEs from practice work with EM tooling – good quality, meet specs.
    - Bond shear strength tests have been completed on 2 CDE – exceed specs by > x2.

Significant Accomplishments August 2003 (2)

- **CDEs (cont.)**
  - 12 copies of flight CDE bonding tooling have been manufactured.
    - 4 CDEs (pre-Qual units) have been fab'ed w/ flight tooling. All bonds good, no problems.
    - MRR for Qual CDE (12) will occur 29 Aug.. Qual bonding begins early Sept.
  - Remaining Flight CDE manufacturing tooling (38 copies) has been released for manufacture.
- **Mechanical Structure**
  - Revised, reviewed and released flight machined part drawings – all except base plate which requires review and approval by IPO.
  - Manufactured Structural Model 1 (SM1) carbon composite structure using flight-like tooling and autoclave at LLR.
    - Results were excellent. Some minor modifications to tooling for placement of inserts will be made before making SM2 in Sept.
    - Strength testing of SM1 will occur in Sept.

Significant Accomplishments August 2003 (3)

- **AFEE Electronics**
  - ADC, DAC and ASIC radiation test boards have been completed.
  - ASIC burn-in procedure and burn-in board design have been completed.
  - ASIC verification plans have been completed and are in review.
  - Revisions to EM AFEE schematic have been completed, new layout is in progress. Prototype board expected mid Sept.
- **EM CAL was delivered to SLAC.**
  - EM Data package was completed and delivered to SLAC.
  - Post-ship functional testing showed no change in CAL performance.
  - CAL team worked with I&T on the transfer of CAL test software to the I&T LATTE environment.
  - Test insertion of the EM CAL into the 1x4 GRID was performed.
    - Insertion was successful.
    - Minor issues of MGSE interference need to be addressed.

Issues / Concerns

- **PIN Diode Assembly (PDA = diode + wires + staking + connector) preparation may delay the start of CDE manufacture.**
  - Prototype tooling in hand. Units made at NRL are good but improvements in tooling are needed.
  - Vendor for PDA manufacture has been selected but need to train and provide sufficient tooling.

  Mitigation: vendor personnel will work w/ NRL in building test units, transferring knowledge.
- **CAL assembly and test plan relies on a large number of prototype TEM/PS (>10)**

  (Carry over from last month, no new info)
  - Needs are not compatible w/ flight TEM/PS deliveries, EM units of high fidelity are required.
  - Must be capable of supporting CAL environmental protoflight/acceptance test conditions.
- **ASIC grinding, dicing and packaging schedule.**
  - Difficulties in execution of the T31D wafer dicing and (soon) packaging do not bode well for flight ASIC processing, as scheduled. This is critical path to delivery of first CAL flight units.
- **Parts approval vs use**
  - The only hope for CAL to meet a 20 May '04 delivery of FMA/B is to start installing flight parts on PCBs before the approval process is complete. Some qual tests would be incomplete and data review and approval would not have occurred.
- **EMI/EMC**
  - Currently organized EMI/EMC spec's and testing are untestable (IMHO).
- **Production pipeline has considerable overlap of module assembly. Potential for assembly problem cascading into all subsequent deliveries is significant.**
  - The usual, yada, yada

Action Items

- None

Open Design/EM/Manufacturing Issues

- **AFEE – TEM Cable**
  - EM version of cable is too stiff – caused by several layers of kapton tape and copper tape for EMI protection.
  - Use with and without connector savers on the TEM will be challenging if not impossible.
    - Wire bending at the Nanonics connector poses risk to connections.
    - Violation of CAL stay clear would be essentially impossible to avoid in use w/ connector saver.
  - Adequacy of EMI protection in current design is in question.

  Closure:
  - Investigate alternate shielding concepts
  - Build more support and EMI protection into current cable support bracket on base plate.
  - Don't use connector savers during module test.
- **EMI/EMC performance**
  - Is self-EMI a significant concern?
  - CAL cannot meet EMI spec without additional shielding – LAT outer EMI shield.

Parts List and Qualification Plan

- **All flight parts orders are in place except for AFEE-TEM cable.**
- **All CAL EEE parts have been approved except for the plastic encapsulated microcircuits – ADCs, DACs and ASICs.**
  - Flight lot ADCs and DACs have begun qualification and screening – No problems to date. Unexpected additional SEL test at TAMU is a recent addition.
  - Flight lot ASICs are in production.
- **Flight lot connectors need to be screened.**
- **Flight lot LM185 voltage reference needs radiation testing.**
- **Qualification and Screening Flow for ADCs, DACs and ASICs have been approved by LAT parts control board and GSFC.**
- **Radiation test plans for AFEE parts have been approved by LAT parts control board and GSFC.**
- **Critical path for completion of flight parts qualification and screening is thru the ASICs.**
- **This is also the critical path for the delivery of the 1st CAL flight modules.**

Parts Requiring Approval

Part	Purch Qty	Flt Qty (18 CAL)	Specification	Status / Comments
Maxim MAX145 ADC For all of LAT	10,000	3,456 CAL	LAT –DS-01131 (procure) LAT-SS-01878 (qual/scrn)	Qual/Screening by Code 562, in process. Est. completion 9/08/03
Maxim MAX5121 DAC For all of LAT	1,000	288 CAL	LAT –DS-01130 (procure) LAT-SS-01878 (qual/scrn)	Qual/Screening by Code 562, in process Est. completion 9/23/03
GCFE ASIC (custom design) Version 9A	11,000	3,456	LAT-DS-02227 (packaging) LAT-SS-01879 (qual/scrn) LAT-PS-02392 (burn-in)	Flight parts in fab at Mosis, avail 9/17/03. Backup parts in packaging (GCFE9)
GCRC ASIC (custom design) Version 5	850	288	LAT-DS-02226 (packaging) LAT-SS-01879 (qual/scrn) LAT-PS-02393 (burn-in)	Flight parts in packaging. 2nd fab available 9/17/03
Hamamatsu S8576-01 Dual PIN Photodiode	4,800	1,728	LAT-DS-00209 (procure)	Qual of pre-flight lot by Code 562, in process. Flt lot deliveries have begun.

Plans for September

- Rebaseline the cost and schedule of CAL.
- Establish contract for manufacture of flight PDAs and build 100 PDAs.
- Manufacture and test 12 CDE qualification units.
- Hold MRR for flight CDE manufacturing.
- Release CAL base plate drawings and begin manufacture of aluminum parts.
- Test Structural Model 1 for strength.
- Manufacture prototype of flight AFEE boards.
- Continue support of I&T for EM activities at SLAC.

Near Term CAL Milestones

Activity ID	Activity description	Total float	Early finish	Milestone Level
5C1132	AV: EM from Calorimeter to I&T	93	7-Aug-03	3
	Fab Struc Model (SM) carbon structure		8-Aug-03	4
	Release Flt drawings - new base plate		15-Aug-03	4
5C52000121	FMA CsI Crystals at NRL	87	29-Aug-03	4
5C52000141	FMB CsI Crystals at NRL	105	2-Sep-03	4
	Fab CDE Qual Units		7-Sep-03	4
	Strength Test SM structure		8-Sep-03	4
5C52000161	FM1 CsI Crystals at NRL	121	15-Sep-03	4
5C76000421	AV: GCRC V5 from manuf	88	18-Sep-03	4
5C52000181	FM2 CsI Crystals at NRL	122	26-Sep-03	4
5C54300020	FM A DPD ready for CDE	70	1-Oct-03	4
	FM A structure fab		8-Oct-03	4
5C54300050	FM B DPD ready for CDE	84	8-Oct-03	4
5C54300080	FM 1 DPD ready for CDE	104	15-Oct-03	4
5C91000010	ND: EM CAL Returned to NRL (arrives on dock)	173	17-Oct-03	3
5C54300110	FM 2 DPD ready for CDE	109	22-Oct-03	4
5C76000221	AV: GCFE V9A from manuf	11	27-Oct-03	4
5C61300590	AV: Flight Mech Dwgs	94	29-Oct-03	4
5C62300020	IN: FMA CDE	70	30-Oct-03	4
5C62300000	IN: Receive FMA Mechanical Struct	69	5-Nov-03	4

29-Aug ??

Schedule Variances

Cumulative SV = - $1,112K (- $335K for July)

SV major components

- **PEM Assembly: -$166K**
  - Baseline shows PEMs for A,B,1 complete; HA! HA! No flight CDEs or structure yet.
- **Flight AFEE boards: -$760K (critical path)**
  - Baseline has all flight parts delivered, tested and ready for ass'y. HA! HA!
    - Actually, deliveries have just begun (not critical).
    - Order for AFEE-TEM cable has not been placed (not critical).
    - Prototype Flt AFEE board is about to be submitted for assembly (not critical).
    - New ASIC fab will not be available until Oct - Nov. (critical path)
- **Prep for flight ass'y & test: -$188K (not critical path, disappears Oct '03)**
  - Held release of flight MGSE/EGSE and facilities until EM assembly complete.
  - We are now documenting changes and preparing for flight MGSE/EGSE build.

Cost Variances

Cumulative CV = –$61K (–$341K for July)

- **Mgmt + Sys Eng (CV = +250K): caused mainly by less travel than planned.**
- **4.1.5.5 CDE: (CV = -$470K, -$182K for July)**
  - -$328K, Baseline has someone else building CDEs
  - -$142K, Delivery of Dual PIN Photodiodes w/ tooling and masks. Budgeted in FY04.
- **4.1.5.6 PEM, EM and Assy Facilities & Support (CV +55K):**
  - -$82K, Overrun in EM PEM assembly – required more testing and repair of EM CDEs than planned
  - +$183K, Late start and non-uniform expenditures on facilities and staffing (LOE).
  - -$55K, Planning and procurement of Flt Machined parts – not a baseline task
- **4.1.5.7 AFEE (CV ~ -$383K) Unprogrammed SLAC contributions to ASICs and PCB.**
- **4.1.5.7.4 &.5 AFEE boards (CV -$189K) Higher than programmed costs for design, assy and test of AFEE boards.**
- **4.1.5.7.6 AFEE Flight Units (CV +$309K) Delay in contractor invoicing, lower than programmed labor costs and inaccuracies in description of work plan.**
- **4.1.5.9 Ass'y & Test (CV +$309K) Cost savings in completion of PEM Checkout electronics and accounting variations in parts procurements and level of effort activity**

Top 5 Threats to Cost / Schedule

- Availability of sufficient quantities of EM (/ Flight?) TEM/PS of appropriate pedigree to support the assembly and test (including environmental) of flight CAL modules.
- Inability to qualify the plastic encapsulated modules – ADC, DAC, ASICs.
- Inability to qualify the Dual PIN photodiode.
- Late transfer of flight CDE and PDA manufacturing to US. Problems or delays in getting this work going at the required production rate.
- Inability to sustain the flight module assembly and test schedule.