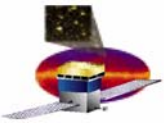


GLAST Large Area Telescope: LAT System Engineering

Pat Hascall
SLAC
System Engineering



Topics

- **Action Item Status**
- **Technical Baseline Management**
- **Issues**
- **Interface Control Documentation**
- **RFA Closure**
- **Key Metrics**
- **Risk Management**



Monthly Action Item Status

Action Item ID	Actionee	Description	Status
7-30-03-008	B. Estey	Define and maintain the production readiness/execution plan to include vendor selection and associated schedule to ensure unit availability dates are met	OPEN: Draft production plan completed & provided to GSFC. Refinement required as vendors are selected. Update provided early December, 2003. Next update and process for update: TBD. Schedules for TEM/TPS provided to B.Graf, action to be closed when similar schedules are provided for the rest of the boxes. SIU/EPU expected Jan 19->28, Heater Control Box expected Jan 26->Feb 9. Meeting scheduled with Bernie, Brigitte and Pat for Mar 2



Technical Baseline: Flight Drawing Release

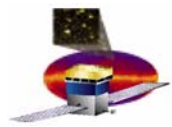
- **Status details (DAQ reported separately)**
 - **Tracker**
 - **141 of 141 completed (total is 15 over original plan)**
 - **ACD**
 - **Last assembly drawing in signoff**
 - **Mech**
 - **Completed 61 of 81 (total is 22 part over original plan)**
 - **16 MLI drawings will be reduced based on successful meeting with Spectrum to simplify blanket design and interface**
 - **Remaining 4 drawings (shims and spacers) are needed in July**
 - **Design Integration**
 - **Major drawings: 2 of 6 signed off**



Technical Baseline: DAQ Flight Drawing Release

Group	Total	In Config Control	To Go	In Sign off	Notes
TEM/TPS	48	48	0		
PDU	34	34	0		
GASU	69	56	13		13 to close with FPGA docs*
EPU/SIU	59	56	3	3	3 FPGA documents have started signoff process*
Harness	35	35	0		
Brackets/hardware	35	33	2		2 brackets coupled to MLI resolution, need date is post tower integration
Heater Control Box	21	1	20		

* FPGA document release held to allow more checkout time before FPGA program burn in



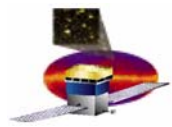
Issues

No.	Description	Status	Due Date	Actionee
3	Technical baseline: Flight Drawing release	-All drawings to be under CM prior to flight build -Flight drawing release plan generated and statused weekly	Weekly Review	P. Hascall
22	ASIC radiation testing status	Radiation testing scheduled for completion. GLTC TID in March	30 April ->June- >Jan 05 >March 05	Sadrozinski
24	No plans to conduct Tracker Subsystem EMI/EMC	Looking at an EMI/EMC test to be performed after Tracker delivery but before integration. Tracker B AT complete, Tracker 1 qual test end of March	30 Sept>March	Himel



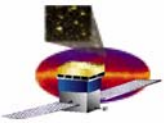
Issues (continued)

No.	Description	Status	Due Date	Actionee
31	Tracker flex cable coupon failures	Process change implemented. Coupons from flight panels failed. Steve Kahn assigned to work with Parlex on quality and schedule.	10/15/04- >11/5> 1/31	Rich
32	Tracker wire bond breaks (heavy trays) pitch adapter to ladder	Evaluating root cause. Potentially delete encapsulation. Tower A and B to proceed with encapsulation. Tower 1 and following will not have encapsulation		R. Johnson
35	Reliability assessments not completed	FMEAs done, reviews with Subsystems started. Held TKR and Mech reviews with SLAC, ELX review potentially on Friday	12/31/04	DiVenti
36	SIIS capability to support I&T	SLAC will build EGSE to support I&T	Closed	Haller/ Bloom
37	SIB EEPROM DPA Failure	PCB approved enough parts for flight build, still working parts for spares and qual		Haller

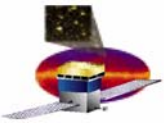


Issues (continued)

No.	Description	Status	Due Date	Actionee
38	RAD750 heat sink and Omnirel alert	Heat sinks reworked and Omnirel regulators to be replaced.		Haller
39	LAT Stay-Clear Violations	Successful series of meetings, change paper underway	31 Jan	Bielawski
40	LAT-DAQ FPGA development and qualification	SLAC to respond to AIs' from FPGA reviews – AI's in review		Haller
41	Qualification of ERNI connectors	BAE to respond to GSFC solder joint analysis Trial runs for LAT ERNI connectors at Aeroflex		Haller
42	Pitch Adapter to GTFE bond breaks	Will use screened parts through tower 3. Validation process underway for improved encapsulation. Covers as a backup		Johnson



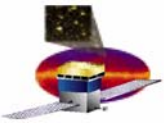
Interface Management



Interface Document Status

- **SC-LAT ICD ICN Status**
 - **LAT signed this month**
 - **None**
 - **Currently under signature review**
 - **None**
 - **Currently in draft or revision**
 - **None**

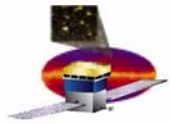
- **Internal LAT ICD's**
 - **Signed Off**
 - **None**
 - **Currently in signature review**
 - **None**
 - **Currently in update**
 - **Electronics-LAT ICD (Comments being incorporated as they are received)**
 - **CAL-LAT ICD**



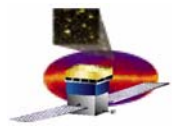
Deliverables/Receivables

- **LAT Deliverables**
 - **Feb: None Scheduled**
 - **Mar: ISIS Training?? Spectrum unable to provide firm date.**
 - **Apr: None Scheduled**
 - **May: None Scheduled**

- **LAT Receivables**
 - **Feb: None**
 - **Mar: SIIS**
 - **Apr: None Scheduled**
 - **May: None Scheduled**



Key Design Metrics



Mass and Power Status Summary

- **Mass**
 - Have measured values for Calorimeters, two Trackers, and one TEM/TPS
 - No significant issues (within a few percent of predicts)
 - Will update the mass report when the grid is measured
- **Power**
 - Updated survival power budget
 - Supports higher Survival Cold temperatures to minimize Tracker cold exposure
 - Also corrected typo, so the net result was an improvement in margin
 - Measured data for Tower A indicates a potential increase in LAT power estimates of around 20 watts



LAT Mass Status

LAT Mass Status Report

LAT-TD-00564-10

LAT Mass Status

Martin Nordby

Effective Date: 15-Sep-04

Print Date: 15-Sep-04

Sep-04

Mass (kg)	Estimate	Alloc.
TKR	514.0	510.0
CAL	1374.3	1440.0
ACD	286.2	295.0
Mech	366.6	386.6
Elec	230.4	240.0
Systems	7.0	8.0
LAT Total	2778.5	2879.6
Rsrv/Margin	221.5	
Rsrv/Margin*	8.0%	
Allocation		3000.0

* AIAA G-020 recommended min reserve = 5.2%
 Allocations per latest mass CCB on 18 June 2004

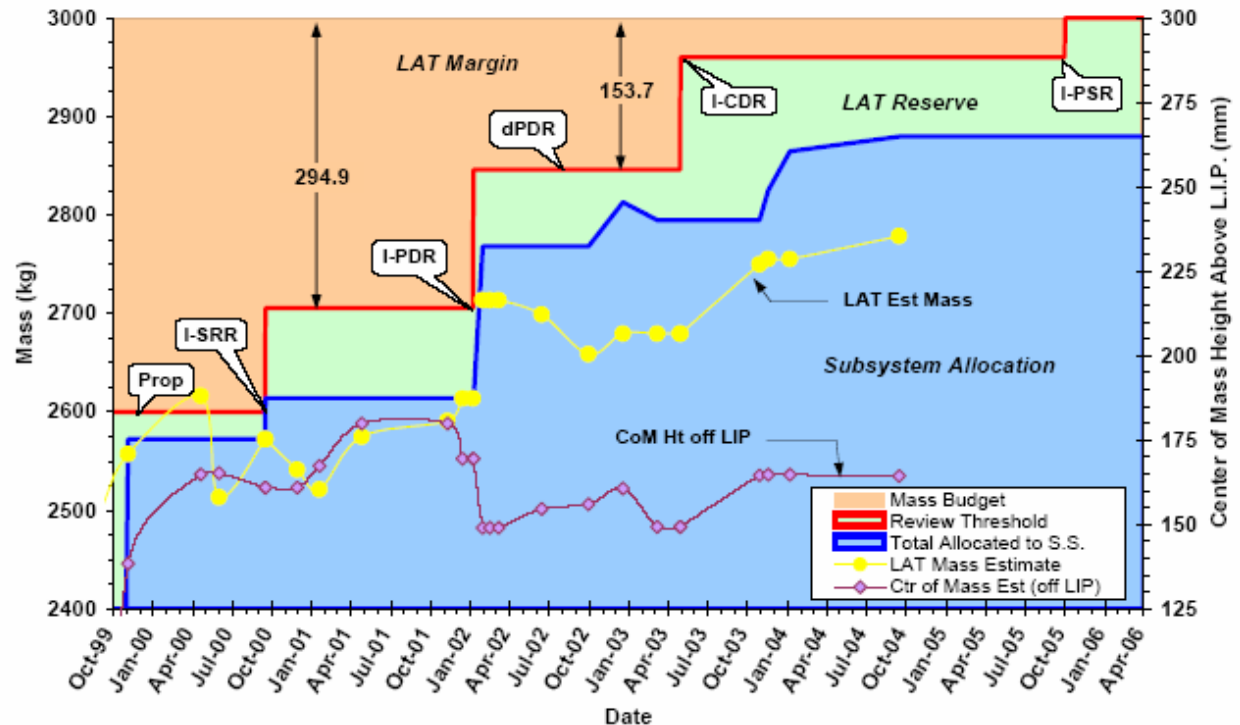
Center of Mass (mm)

CMx	-1.22	-20 < CMx < 20
CMy	-0.89	-20 < CMy < 20
CMz	-72.55	CMz < -51.2
Ht off LIP	163.65	Ht < 185

Second Moment of Inertia (kg-m²)

Ixx	1084.5	1500.0
Iyy	1032.1	1500.0
Izz	1410.8	2000.0

Mass Estimate Breakdown		
	(kg)	%
Parametric	139.9	5.0%
Calculated	1062.6	38.2%
Measured	1575.9	56.7%
Total	2778.5	100%





LAT Power Status

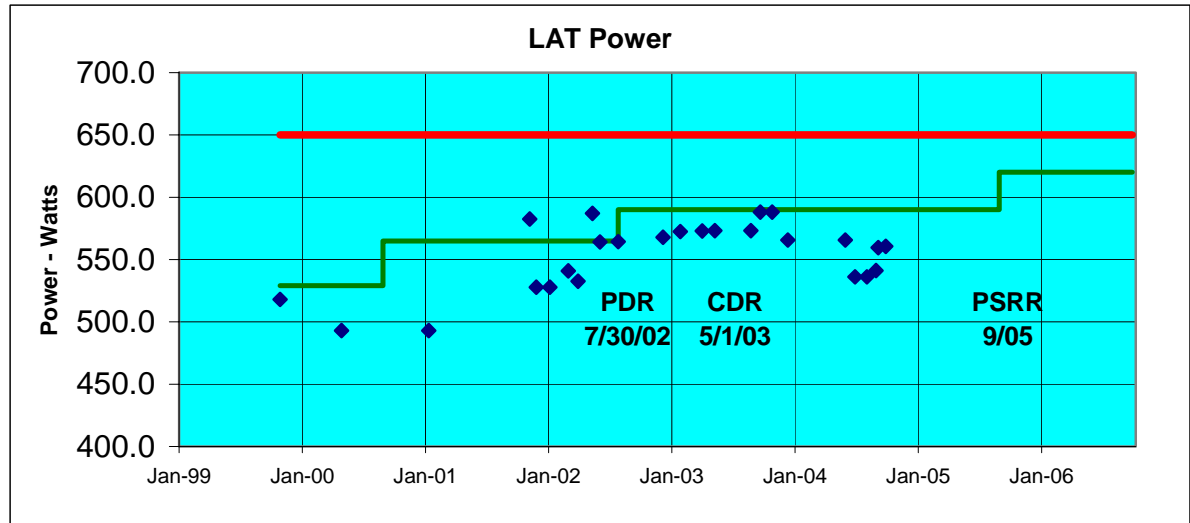
Calorimeter CR approved to change allocation to 71W

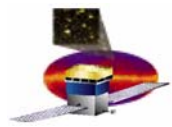
Item	1-Nov-04 Estimate (Watts)	PARA (Watts)	CALC (Watts)	MEAS (Watts)	ALLOC. (Watts)
ACD	11.5	2.4	3.9	5.2	10.5
Tracker	146.9	1.5	0.0	145.4	153.0
Calorimeter	66.8	0.0	0.0	66.8	65.0
Trigger & Data Flow	320.1	43.2	86.1	190.8	327.5
Grid/thermal	20.4	20.4	0.0	0.0	35.0
Instrument Total	565.6	67.5	90.0	408.2	591.0
Instrument Allocation	650.0				
% Reserve	14.9%				

PDR Reserve Was 15.2%
CDR Reserve Was 13.4%
Goal for PSRR Reserve > 5%

PARA - Best Estimate based on conceptual design parameters
CALC - Estimate based on Calculated power from detailed design documentation
MEAS - Actual power measurements of components

Goals estimated using guidelines given in ANSI/AIAA G-020-1992 "Estimating and Budgeting Weight and Power Contingencies for Space Craft Systems"



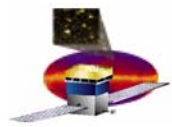


LAT Power Status (Continued)

- Survival Power

Component	Current Alloc.	Subsystem Power Estimates (W)				
		PARA	CALC	MEAS	Total	Margin
On-Orbit Average Power Total ¹	278.00	0.00	203.00	0.00	203.00	36.90%
Regulated VCHP Power Total	58.00	0.00	43.00	0.00	43.00	34.90%
Unregulated Passive Survival Power	220.00	0.00	160.00	0.00	160.00	37.50%

¹Power estimates reflect the LAT steady state orbit average. Numbers do not reflect transition into or out of survival mode, i.e. early orbit operations.



FSW Resource Usage Current Estimates

Resource	Total Available	Current Usage	Margin Factor
EPU Boot PROM	256 kB	128 kB	2
SIU Boot PROM	256 kB	128 kB	2
EPU EEPROM	6 MB	1.5 MB	4
SIU EEPROM	6 MB	1.5-2.5 MB	3
EPU CPU cycles	200% in 2 EPUs	30%	> 6
SIU CPU cycles	100% in 1 SIU	25%	4
EPU memory	128 MB	16-32 MB	4-8
SIU memory	128 MB	< 16 MB	8



Instrument Bandwidth Resources

- LAT communication, bandwidth (BW) in Mbyte/sec

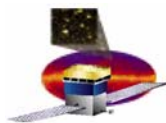
Resource	Max Total BW limited by Hardware	Max limited by SC-ground transmission	Ave current BW at 10 KHz max trigger rate*	Ave current BW at 2 KHz nominal trigger rate*	Margin Factor (for 10 KHz rate)
Detector to GASU-EBM	45	N/A	10	2	4.5
GASU-EBM to EPU-CPU	20	N/A	5	1	4
EPU-CPU to GASU-EBM	2.5	0.075	0.04*	0.02*	2
GASU-EBM to SIU-CPU	5	0.15	0.08*	0.015*	2
SIU-CPU to Spacecraft	5	0.15	0.08*	0.015*	2

* Present performance of event filter for EPU-CPU, still being optimized. Eventually the physics filter will be adjusted/loosened to take advantage of the max average bandwidth

EBM: Event-Builder Module

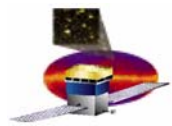
EPU: Event-Processing Unit

SIU: Spacecraft Interface Unit

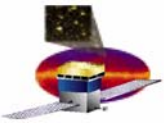


Key Science Performance Metrics

Parameter	SRD Value	Present Design Value
Peak Effective Area (in range 1-10 GeV)	>8000 cm ²	10,000 cm ² at 10 GeV
Energy Resolution 100 MeV on-axis	<10%	9%
Energy Resolution 10 GeV on-axis	<10%	8%
Energy Resolution 10-300 GeV on-axis	<20%	<15%
Energy Resolution 10-300 GeV off-axis (>60°)	<6%	<4.5%
PSF 68% 100 MeV on-axis	<3.5°	3.37° (front), 4.64° (total)
PSF 68% 10 GeV on-axis	<0.15°	0.086° (front), 0.115° (total)
PSF 95/68 ratio	<3	2.1 front, 2.6 back (100 MeV)
PSF 55°/normal ratio	<1.7	1.6
Field of View	>2sr	2.4 sr
Background rejection (E>100 MeV)	<10% diffuse	6% diffuse (adjustable)
Point Source Sensitivity(>100MeV)	<6x10 ⁻⁹ cm ⁻² s ⁻¹	3x10 ⁻⁹ cm ⁻² s ⁻¹
Source Location Determination	<0.5 arcmin	<0.4 arcmin (ignoring BACK info)
GRB localization	<10 arcmin	5 arcmin (ignoring BACK info)

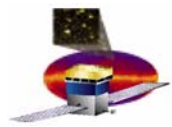


Risk Management



Risk Management Activity

- **No changes**



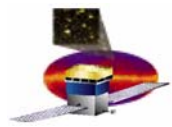
Top risks

ID #	Risk Rank	Risk Description	Risk Mitigation	Status
Proj Mgt - 002	Moderate	If ASICs fail to meet qualification requirements; then schedule impact will occur	<ul style="list-style-type: none">• Focused review & test. Margin for re-runs protected where possible• Individual risks Identified by subsystem• Extensive use of DAQ test bed to drive out system issues	<ul style="list-style-type: none">• Cal/ACD ASIC's continued testing• Test Bed operating• No new issues
Proj Mgt - 004	Moderate	If TEM Power supply fails qualification; then final implementation may exceed schedule impacting delivery to I&T	<ul style="list-style-type: none">• Key focus item identified for DAQ• TEM/PS extensive EM use as EGSE	<ul style="list-style-type: none">• Implementation plan in place and proceeding• Fuse audit completed• Functional tests complete, environmental tests to be completed in February



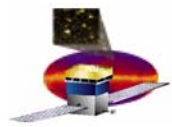
Top risks

ID #	Risk Rank	Risk Description	Risk Mitigation	Status
SE-007	Moderate	If a critical component fails post LAT integration; then de-integration will result in cost & schedule impact	<ul style="list-style-type: none"> •Extensive use of EM test bed to support flight H/W & S/W development •Thorough qualification and acceptance tests •Pre planned I&T actions for de-integration 	<ul style="list-style-type: none"> •Qual & acceptance planning in-place •I&T developing re-work contingency plans. •Integration plan baselined
Elec-004	Moderate	If target hardware, requirement development or manpower is delayed; Then Flight-Software development schedule will be impacted	<ul style="list-style-type: none"> •Detailed incremental development program •Ensure sufficient software test on target hardware during development to drive out any requirement disconnects. • Include adequate peer reviews before each spiral cycle prior to release •Include monthly Demos to verify functionality/measure progress 	<ul style="list-style-type: none"> •Adapting monthly demos •Tracking EGSE resource utilization •Updated detailed test plan released •Demo frequency increased from monthly to approximately weekly



Top risks

ID #	Risk Rank	Risk Description	Risk Mitigation	Status
Proj Mgt - 005	Moderate	If parts and vendor orders are delayed or bids exceed expectations; then flight production costs & delivery schedule will be impacted	<ul style="list-style-type: none">•Manufacturing engineer added to expedite minimum cost closure•Clarification and purchase package review to ensure accurate bids•Increase production management staff	<ul style="list-style-type: none">•Purchase order tracking/monitoring system in place to highlight roadblocks•Design documentation release plan prioritized by vendor selection and component fabrication need dates•Workarounds implemented for late parts•Hired additional head to manage production
IT - 006	Moderate	If logistic or facility integration issues are found during LAT environmental test program; then re-work will delay schedule	<ul style="list-style-type: none">•LAT I&T to plan a roadmap of activities from LAT building 33 to completion of environmental testing•LAT I&T to consider and develop opportunities to path find key activities required prior to LAT shipment to NRL	<ul style="list-style-type: none">•Follow up Environmental Planning TIM held on 1 October at SLAC, I&T driving AIs to conclusion•Continuing periodic TIMS



Top risks

ID #	Risk Rank	Risk Description	Risk Mitigation	Status
SE - 011	Low	If individual tracker towers do not meet performance requirements due to manufacturing issues (e.g. wire bond breaks) then the LAT may not meet science requirements	<p>Understand stability of performance to determine mitigation strategies</p> <p>Limit LAT temperature excursions to minimize possible propagation of some types of tracker issues</p> <p>Optimize placement of towers based on individual tower performance to minimize science effects and to minimize removal and replacement efforts should they become necessary</p>	<p>Temperature range reduced at the LAT level to allow a narrower range during Tracker and LAT tests</p> <p>Alternate plan for placement of Tracker A and B being implemented</p>