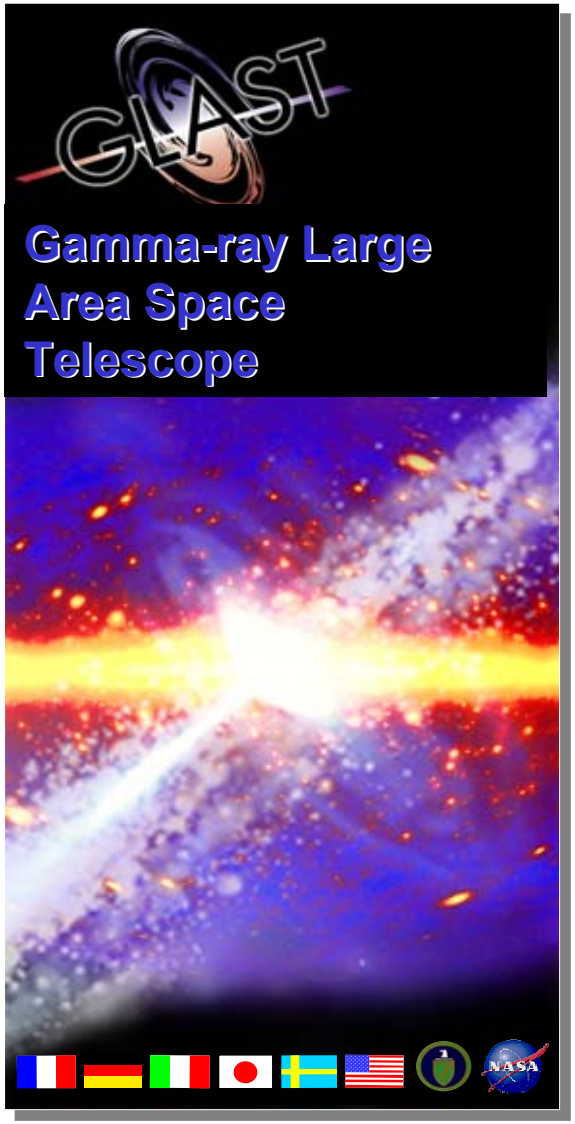

GLAST Mission
Large Area Telescope Project

Rebaseline Review

July 31, 2003

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Overview

- **Motivation for reviewing cost and schedule**
  - **CNES in France deciding to not fund LAT work**
  - **Completion of CDR/CD-3 Review**
    - **Design is mature**
    - **Construction of flight hardware beginning**
- **Proposal**
  - **LAT Funding increased by $17.2 million**
    - **Fabrication Phase (LAT construction project) increased by $11.7 million**
    - **Commissioning Phase increased by $5.5 million**

Proposed additions to budgets

By element in the LAT project	FY03	FY04	FY05	FY06	Total
Fabricate CDEs using US funds	$1.6	$2.6			$4.2
Tracker	$0.5	$1.0			$1.5
ACD		$0.9			$0.9
Electronics Manufacturing costs		$0.8			$0.8
Mechanical Design / Fab		$2.0			$2.0
Schedule Delay		$1.0	$1.7	$2.7	$5.4
Increase to Contingency		$0.7	$1.7		$2.4
Total	**$2.1**	**$9.0**	**$3.4**	**$2.7**	**$17.2**

All values in millions of dollars

Increases by system

- **Calorimeter $4.2 million**
  - CNES (French) funding for GLAST was terminated in May. This required adding the cost of the CDE manufacturing and some of the mechanical parts to the US costs.
- **Schedule $5.4 million**
  - The LAT schedule was delayed by the startup time required for CDE manufacturing. The other subsystems were reprogrammed to reduce risk. Delivery of the LAT moved from September 22, 2005 to December 1, 2005.
- **Tracker $1.5 million**
  - MCM circuit boards (fabrication and assembly), flex-circuit cables, bias circuits and ASICs cost more to complete the development than planned.
- **ACD $0.9 million**
  - BEA mechanical structure complexity increased over PDR
  - Both ASICs testing and ASICs qualification and screening efforts require significant additional investment

Increases by system

- **Electronics $0.8 million**
  - **Power supply bids came in high, so chose to develop in-house.**
  - **Reduced risk through modification of Event Processor Unit by adding a Storage Interface Board.**
  - **Support of additional ASICs rounds (design as well as $100K procurement each time).**
- **Mechanical $2.0 million**
  - **Lockheed/Martin Phase II contract higher cost than planned (increased scope includes X-LAT final design work and more extensive testing of radiators and heat pipe).**
- **Additional Contingency $2.4 million**
  - **Additional funds to keep the available contingency at the same percentage of costs at risk.**

Sources of Funding

- **The LAT project is funded by:**
  - **A DOE Capital Equipment Project (MIE)**
    - **Funded through the Stanford Linear Accelerator Center (SLAC)**
  - **DOE Operating funds**
    - **Funded through SLAC**
  - **NASA GLAST Mission funds**
    - **Through a contract with Stanford University**
  - **Foreign Contributions**
    - **INFN Italy, Tracker Towers, Silicon Detectors**
    - **KTH Sweden, Cesium Iodide "logs"**
    - **JGC Japan, Silicon Detectors**
    - **IN2P3 France, Calorimeter support structure**
  - **Participation of the LAT Collaborating institutions**

Fabrication Phase

- The Fabrication Phase of the LAT project is defined as all work on the LAT during the DOE Capital Equipment Project.
- The end of the DOE Capital Equipment Project occurs at the successful completion of the Critical Decision 4 review.
  - The proposed criterion for CD-4 is the successful completion of the Pre-Environmental Test Review.
- Work in the Fabrication Phase is funded by:
  - The DOE Capital Equipment Project (MIE)
  - DOE Commissioning and Operating funds
  - NASA GLAST Mission funds
  - Foreign Contributions
  - Participation of the LAT Collaborating institutions

Commissioning Phase

- The LAT project enters the Commissioning Phase after the completion of the Fabrication Phase

- The work for the LAT project in this phase is:
  - Responsibility for the LAT environmental test
  - Pre-Shipment Review
    - After successful completion of this review the responsibility for the LAT instrument is accepted by the NASA GLAST Project Manger
  - Support of Observatory Integration
  - Support through launch and initial calibration on-orbit

- Funding for this phase comes from:
  - DOE Operating funds
  - NASA GLAST Mission funds
  - Participation by the LAT Collaborating institutions

Evolution of the IOC

- The Instrument Operations Center (IOC) is a deliverable of the LAT project.
- The original plan for LAT had the IOC implemented by the Hansen Experimental Physics Laboratory (HEPL) at Stanford, funded by NASA funds.
- During the detailed planning of the LAT the implementation of the IOC was transferred to the LAT project office, funded out of Fabrication Phase funds.
- As part of this rebaseline review the costs of implementing the IOC were moved to DOE commissioning/operating funds.
  - The IOC manager remains funded from the Fabrication Phase to assure coordination with the rest of the project and to assure that the requirements of the deliverable are met

Delta Costs and Funding

Commissioning / Operating	FY03	FY04	FY05	FY06	Total
Costs added to Commissioning / Operating					
LAT environmental test			$1.0	$2.7	$3.7
Instrument Operations Center	$0.2	$1.0	$0.6		$1.8
Total	**$0.2**	**$1.0**	**$1.6**	**$2.7**	**$5.5**
Funding added to Commissiong / Operating					
NASA GLAST Mission Funds			$0.5	$1.4	$1.9
DOE Operating Funds	$0.2	$1.0	$1.1	$1.4	$3.6
Total	**$0.2**	**$1.0**	**$1.6**	**$2.7**	**$5.5**
Fabrication Phase					
Net costs added to Fabrication Phase					
Total Costs Added to Fabrication Phase	$2.1	$9.0	$3.4	$2.7	$17.2
Costs identified as Operating/Comm.	$0.2	$1.0	$1.6	$2.7	$5.5
Difference	**$1.9**	**$8.0**	**$1.8**	**$0.0**	**$11.7**
Funding added to Fabriaction Phase					
NASA Glast Mission Funds	$1.8	$3.0	$1.9		$6.7
DOE Capital Equipment Project (MIE)	$0.1	$0.0	$4.9		$5.0
Stanford University bridge loan		$5.0	-$5.0		$0.0
Total	**$1.9**	**$8.0**	**$1.8**	**$0.0**	**$11.7**
Total					
Source of funds					
NASA	$1.8	$3.0	$2.4	$1.4	$8.6
DOE	$0.3	$1.0	$6.0	$1.4	$8.6
Stanford University bridge loan		$5.0	-$5.0		$0.0
Total	**$2.1**	**$9.0**	**$3.4**	**$2.7**	**$17.2**

Total Fabrication Phase Cost and Funding

	Previous	FY03	FY04	FY05	Total
Baseline Fab Phase Cost	$35.4	$35.1	$24.6	$12.8	**$107.9**
Baseline Fab Phase Funding	$37.6	$33.5	$31.0	$19.6	**$121.7**
Baseline Fab Contingency		$0.6	$6.4	$6.8	**$13.8**
Contingency as % of this years cost			26.0%	53.1%	
New Fab Phase Cost	$35.4	$37.0	$31.9	$12.9	**$117.2**
New Fab Phase Funding	$37.6	$35.4	$39.0	$21.4	**$133.4**
New Fab Contingency		$0.6	$7.1	$8.5	**$16.2**
Contingency as % of this years cost			22.3%	66.0%	

Baseline cost at risk*	$54.3
Contingency as percent fo cost at risk	25%
with funded schedule float**	33%
New cost at risk*	$63.7
Contingency as percent fo cost at risk	25%
with funded schedule float**	32%

*Cost at Risk = Estimated cost to compete minus EPO costs

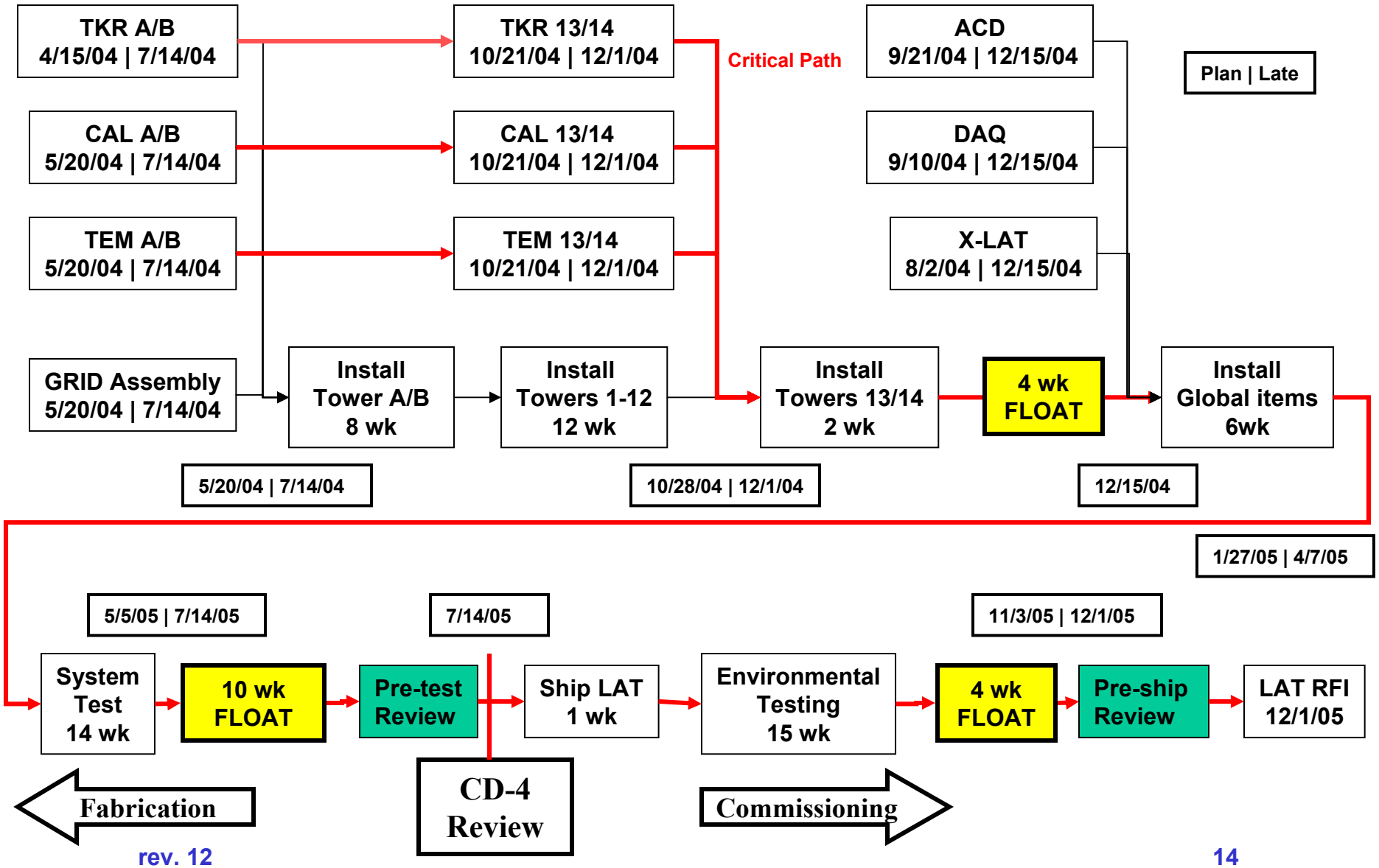
** The schedule has 14 weeks of schedule contingency funded at $3.9 million total when included the contingency becomes $17.7 million and $20.1 million respectively

Funding by Source

Current Baseline	Previous	FY03	FY04	FY05	FY06
DOE	$16.8	$8.8	$7.9	$3.5	$6.2
NASA	$20.8	$24.7	$22.1	$15.7	$8.0
Japan			$1.0	$0.4	
Total	**$37.6**	**$33.5**	**$31.0**	**$19.6**	**$14.2**
Proposed Baseline					
DOE	$16.8	$9.1	$8.9	$9.5	$7.6
NASA	$20.8	$26.5	$25.1	$18.1	$9.4
Japan			$1.0	$0.4	
Bridge loan			$5.0	-$5.0	
Total	**$37.6**	**$35.6**	**$35.0**	**$28.0**	**$17.0**

Schedule

LAT Working Schedule



Level 1 and 2 Milestones

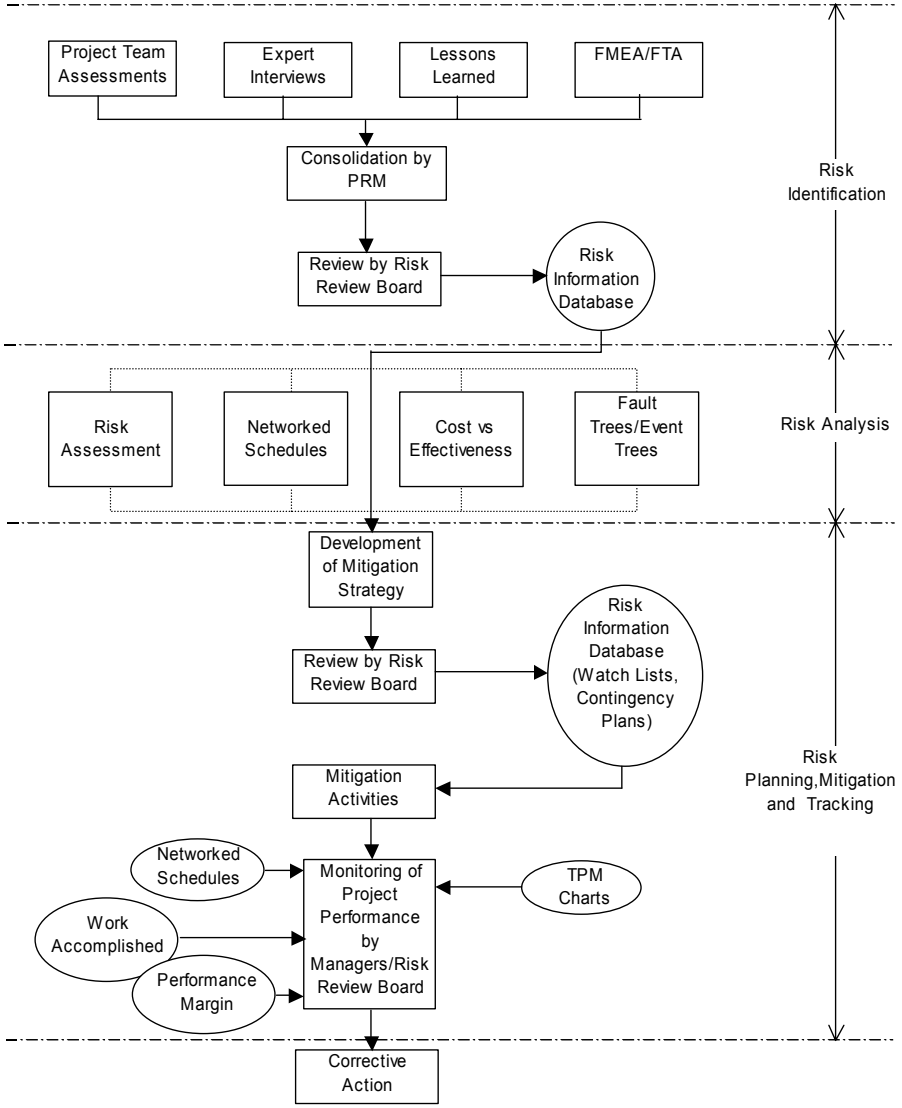
	Existing	Proposed	
Level 1 Milestones -- DOE/NASA Joint Oversight Group			
DOE Critical Decision (CD) 0 Approval	June 25, 2001	June 25, 2001	Actual
CD-1 Approval	July 1, 2002	July 23, 2002	Actual
CD-2 Approval	December 13, 2002	November 8, 2002	Actual
CD-3 Approval	July 15, 2003	August 31, 2003	
Flight Grid Complete	September 15, 2004	September 15, 2004	
CD-4 Approval	March 15, 2006	March 15, 2006	
Level 2 Milestones -- Federal Project Managers			
Launch Balloon Flight	August 1, 2001	August 1, 2001	Actual
Instrument Preliminary Design Review	January 8, 2002	January 8, 2002	Actual
Instrument Critical Design Review	April 30, 2003	May 16, 2003	Actual
TKR, CAL FMA,B Available for Calibration Unit	February 17, 2004	**See note:**	
Start LAT Integration	June 15, 2004	**August 24, 2004**	
Pre Enviornmental Review	February 15, 2005	**July 14, 2005**	
Instrument Pre-Ship Review (PSR)	July 7, 2005	**December 1, 2005**	

Note: The calibration test has been moved until after LAT integraion. Units FM A and B of the Tracker and Calorimeter will be installed in the

Proposed changes in Blue

RISK

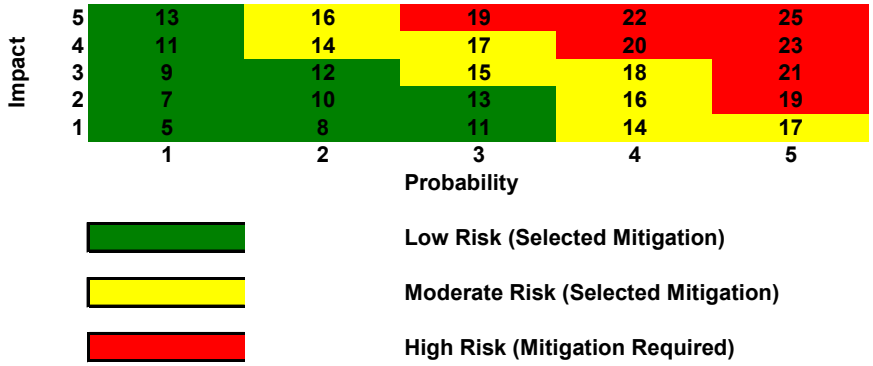
LAT Risk Management System



LAT Risk Management Defined By LAT-MD-00067-03

- Parallel Process To GSFC ….
- Continuous Process Across LAT
- Risk Ranked By Probability and Impact to Technical, Cost & Schedule

Risk Ranking



Top risks to cost

ID #	Risk Rank	Risk Description	Risk Mitigation	Status
SE--0007	Moderate	Critical component failure post LAT integration requiring de-integration impacting cost & schedule	•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	• Completed evaluation for improving access (9/02) • Qual & acceptance planning in-place •I&T developing contingency plans
Proj Mgt - 005	Moderate	Parts and vendor orders have not been completed therefore flight production cost may exceed projection	•Manufacturing engineer added to expedite minimum cost closure •Clarification and purchase package review to ensure accurate bids	• Processes in place •Remaining vendor selections by 11/03
Proj Mgt - 006	Moderate	Critical skilled positions (senior personnel) required to execute project remain open, potential impact to cost and schedule if not closed in short term	•Management team has identified critical skill needs • Identify skilled personnel within Collaboration environment	• Added SLAC Site Rep in Italy • Added Scientist to Tracker Team •Software candidates interviews ongoing •Mechanical candidates interviews ongoing •ECD 10/03

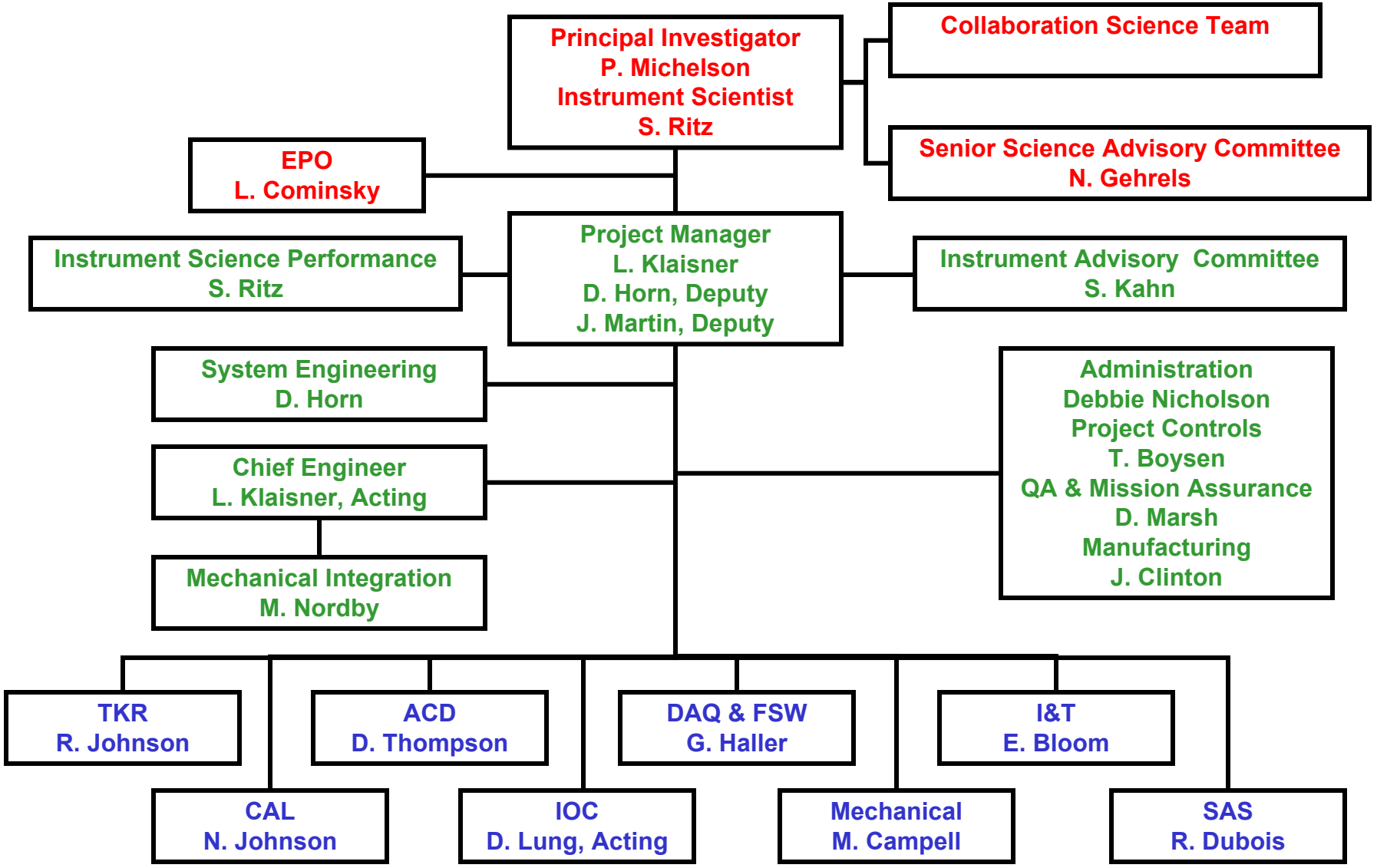
Top risks to schedule

ID #	Risk Rank	Risk Description	Risk Mitigation	Status
Proj Mgt - 003	Moderate	Completion of Tracker subsystem qualification program delayed due to EM closure or MCM electronics	• Manufacturing Eng assigned to close MCM issues • Increased team integration with Italian partners • GSFC audit/support to Tracker EM closure	• Teledyne contracted as MCM vendor • SLAC Site rep added to Italian team
Proj Mgt - 002	Moderate	ASIC's fail to meet requirements; results in schedule impact	•Focused review & test. Margin for re-runs protected where possible •Individual risks Identified by subsystem	• Tracker/DAQ ASIC's flight ready • Cal/ACD ASIC's expected 9/03
Proj Mgt - 004	Moderate	TEM Power supply final design is delayed, final implementation may exceed current schedule	•Key focus item identified for DAQ • Design peer review planned for 9/03 • Basing approach on flight proven designs where possible	• Design closure 9/03
SE-- 0007	Moderate	Critical component failure post LAT integration requiring de-integration impacting cost & schedule	•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	• Completed evaluation for improving access (9/02) • Qual & acceptance planning in-place •I&T developing contingency plans

Actions to manage cost & schedule

- New Project Manager and revised management organization
  - See organization chart
- Filled critical positions
  - Identified additional critical areas
- Improved communications
  - Focused interactions

LAT Organization Chart



Added key personnel

- Mike Menning, Mechanical Engineering consultant focusing on the Cross LAT plate to electronics interface and the CAL-GRID interface.
- Nanda Menon, Providing an interface between the project and the effort in Italy. Helping the INFN personnel with test planning and execution.
- Hiroyasu Tajima, Physicist added full time to the Tracker group to assist with managing the start up of manufacturing.
- Eric Siskind, Experienced consultant working on DAQ system and detail designs.

Improved communications

- Putting in place milestones for each subsystem for the next 3 months
  - Review at weekly subsystem managers teleconference
- Daily 7:30 am management meeting with Klaisner, Horn, Martin and Ritz to review priorities and assign action items
  - Focus on high priority issues and the path to closure
- Strong support by the GLAST Mission Office
  - Thermal and mechanical support
  - Monthly reviews with subsystem managers
    - Identifies areas that can use additional support
- Monthly face to face meetings of Subsystem Managers to discuss issues – particularly where one subsystem needs support from another subsystem

Contingency

Contingency Analysis

(Escalated K$) WBS Item	Project Estimate					
	To Date Cost*	To Go Cost	Total Cost	Contingency %	Contingency $	Total Cost Plus Cont.
4.1.1 Instrument Management	$ 8,197	$ 7,049	$ 15,246	13%	$ 911	$ 16,157
4.1.2 Systems Engineering	$ 3,599	$ 2,993	$ 6,592	12%	$ 366	$ 6,958
4.1.4 Tracker	$ 8,381	$ 4,091	$ 12,472	37%	$ 1,514	$ 13,986
4.1.5 Calorimeter	$ 8,965	$ 13,593	$ 22,558	22%	$ 3,019	$ 25,576
4.1.6 ACD	$ 7,090	$ 6,104	$ 13,194	30%	$ 1,806	$ 15,000
4.1.7 Electronics	$ 5,967	$ 11,932	$ 17,899	33%	$ 3,938	$ 21,837
4.1.8 Mechanical Systems	$ 4,961	$ 7,495	$ 12,456	30%	$ 2,249	$ 14,705
4.1.9 Instrument Integration & Test	$ 1,972	$ 4,836	$ 6,808	34%	$ 1,663	$ 8,471
4.1.A Performance & Safety Assurance	$ 1,149	$ 437	$ 1,586	18%	$ 77	$ 1,664
4.1.B Instrument Operations Center	$ 549	$ 485	$ 1,034	10%	$ 48	$ 1,082
4.1.C Education & Public Outreach	$ 934	$ 1,656	$ 2,590	0%	$ -	$ 2,590
4.1.D Science Analysis Software	$ 1,478	$ 2,009	$ 3,487	22%	$ 451	$ 3,938
4.1.E Suborbital Flight Test**	$ 1,321	$ 0	$ 1,321	0%	$ -	$ 1,321
Subtotal***	$ 54,563	$ 62,681	$ 117,243	26%	$ 16,041	$ 133,284
Unallocated Contingency					$ 116	$ 116
Total Project Estimate	$ 54,563	$ 62,681	$ 117,243	26%	$ 16,157	$ 133,400

*"To date cost" refers to cost through June 30, 2003. "To go cost" refers to cost after June 30, 2003.

**4.1.E Suborbital Flight Test is completed.

***Total contingency for project calculated against remaining costs at risk. Costs not at risk are costs to date and E/PO.

Resolution of outstanding technical issues

CAL to Grid Interface

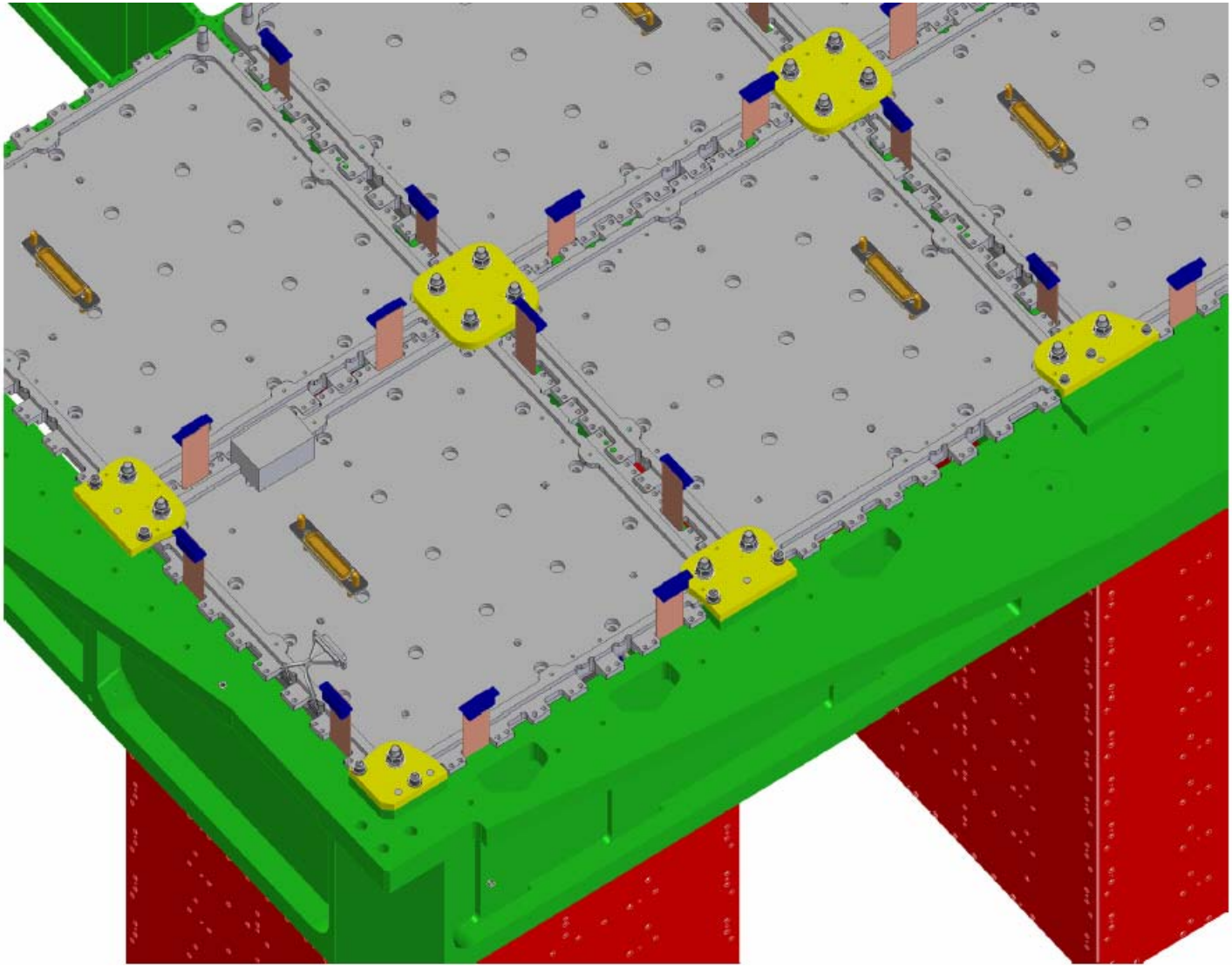
X-LAT Plate to Electronics Interface

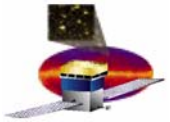
Tracker Bottom Tray Design

CAL to GRID Interface

- **Design modifications to provide an adequate shear load path which is independent of friction at the interface have been identified. Plates have been added at the corners of the Calorimeter base plates to carry the shear loads.**
- **Details of the modifications to the grid, calorimeter base plates, and cable trays have been defined and evaluated.**
- **Development testing and structures analysis of the design modifications have been successfully completed for worst-on-worst conditions.**
- **Actions to formally implement the design change have been initiated.**
- **The associated CDR action item will be closed out with GSFC by a tiger team peer review.**

CAL to GRID Interface





X-LAT Plate to Electronics Interface

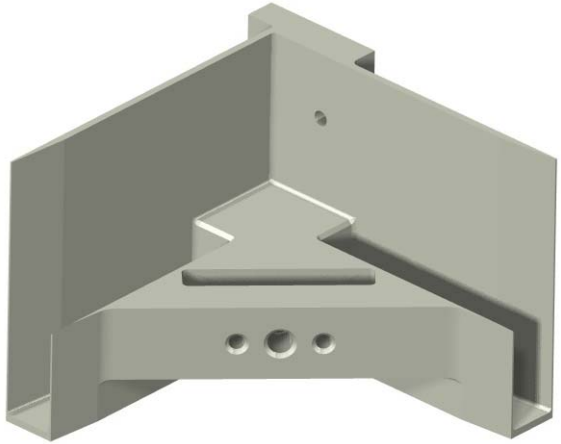
- **Two solutions have been identified to resolve the issue of conducting heat from the electronics boxes to the X-Lat plate, copper straps and rigid attachment.**
  - **The flexible copper strap solution is workable but it has many parts, is heavy, and introduces additional integration effort.**
  - **The rigid connection is a workable solution but the stresses involved need to be evaluated.**
    - **Ascent loads and on-orbit thermal distortions are not design drivers.**
    - **Initial strains in the X-Lat heat pipes due to assembly tolerances are being evaluated.**
- **Component tests to validate the analytically derived thermal performance of the interface are in progress.**
- **A selection of the final design is expected by 8/8/03.**

Tracker Bottom Tray Design

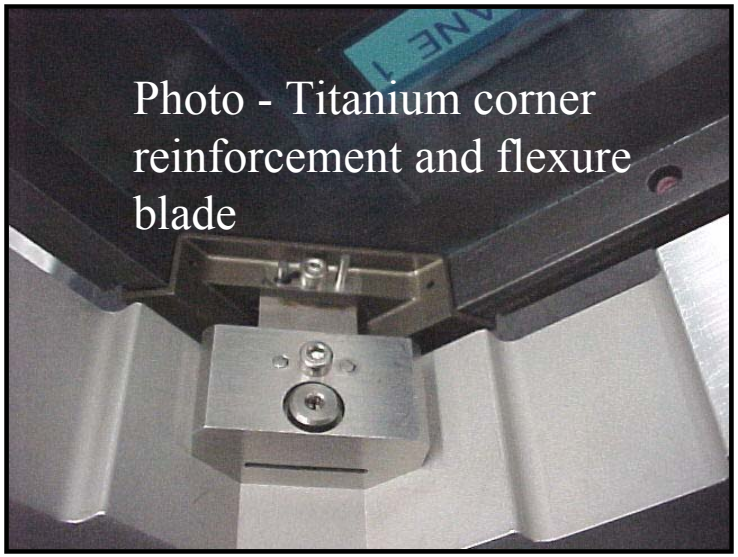
- Redesign and analysis of the bottom tray are complete. Verification is in progress
  - Titanium corner brackets fitted to carbon fiber closeouts
  - Other changes: insert positions, closeout dimensions, material changed to stronger hybrid, and thicker face sheets and honeycomb core
  - Analysis included current LAT environmental values
- Two prototype bottom trays were fabricated
  - With bias circuits, non-functional SSDs, and MCMs
- Initial static tests were performed successfully
  - Static equivalent of qualification vibration levels
    - 3x RMS random vibe load
  - Completion expected by end August
- Vibration test of full Engineering Model is planned for September

Tracker – Bottom Tray
Corner Reinforcement Bracket + Stronger Closeouts

Structural Closeout Wall

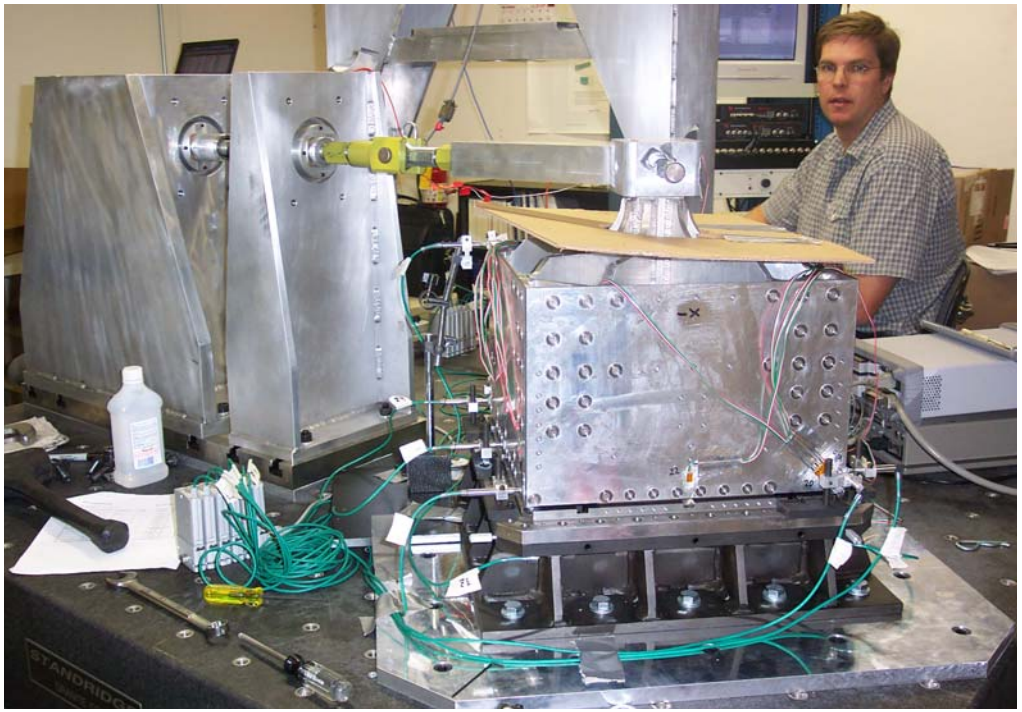


Inside View of Corner Reinforcement Bracket



Lateral XY (45° Axis) Static Proof Test

- Test Load: 9550 N (27 g's)
- Test performed to 100% of 3σ Static Equivalent Random Vibration Loads
- Both directions were tested (positive & negative)
- Corner Flexure buckling critical load case



- Max Predicted Flexure Loads
  - Corner Flexure
    - Axial = ±6224N
    - Shear = ±1473N
  - Side Flexure
    - Axial = ±1347N
    - Shear = ±2440N
- Results: *NO Evidence of Damage – Test Successful*

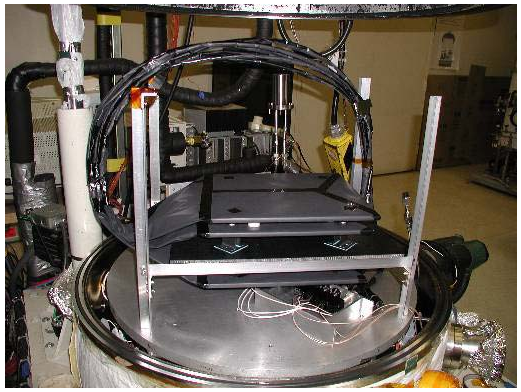
HYTEC INCORPORATED

Status of the Subsystems

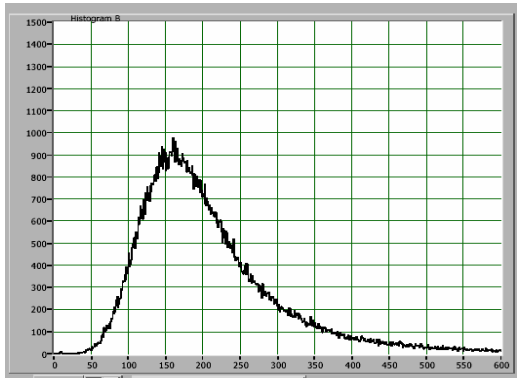
Anticoincidence Detector – ACD
Tracker – TKR
Calorimeter – CAL
Electronics and Flight Software
Mechanical and Thermal

ACD – EM-level Test Program

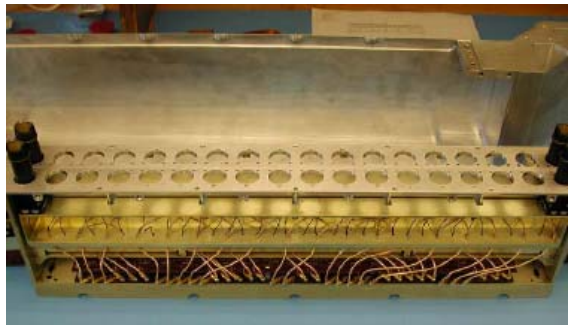
- **Designs of following have been finalized and tested at EM-level**
  - **Tile Shell Assembly**
  - **Phototubes (PMT) and housings**
  - **Tile Detector Assemblies (TDA)**
- **End-to-end electronics system test using flight-like TDAs, phototubes, High Voltage Bias Supply, and FRont End Electronics (FREE) card with current ASICs has shown good performance**
- **Very few items remaining**
  - **High Voltage Bias Supply EM testing August 2003**
  - **Flight ASIC versions due in October 2003**
  - **Electronic chassis EM begun; testing to start October 2003**



Thermal vac test of EM shell panel, TDAs, PMTs



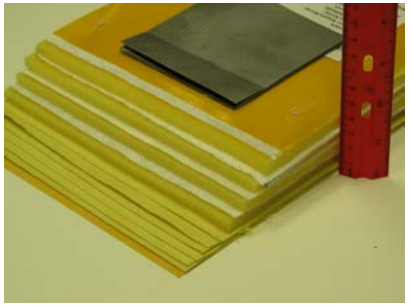
Pulse height spectrum from end-to-end test



Electronics chassis mechanical structure

ACD – Flight Production

- All flight PMTs received and testing/screening complete
  - Excellent yields
- Other Flight Part procurements begun
  - PMT housings - July
  - Resistor Network PCBs - July
  - Tile Detector Assemblies – now in fabrication at Fermilab
  - Composite structure (shell) – panels in fabrication
  - Flight electronic parts – all ordered
  - Digital and analog ASICs – in fabrication
  - Clear fiber fabrication – materials received
  - Micrometeoroid shield/thermal blanket materials
- PMT assembly facility ready (He-controlled environment)
- Base Electronics Assembly – start fabrication August 2003
- High Voltage Bias Supply assembly – start Oct 2003
- Front-end electronics assembly – start Nov 2003
- ASIC qual, screen and test plan in review



On schedule for October 2004 delivery

Tracker – Engineering Models

- **Outstanding issue of bottom tray redesign nearly closed**
  - **Verification testing is underway**

- **Engineering Models**
  - **Structural EM**
    - **Full tower fit-up check underway this week**
    - **Vibration/Thermal tests planned for September/October**
  - **Mini-Tower (Electrical/functional)**
    - **1st round of testing completed in June**
    - **2nd round underway – presently debugging electronics and software**
    - **Delivery to SLAC by Aug 22 for I&T, DAQ teams**

Tracker – Flight Production

- First Flight Tower forecast for 19 April 2004
- Ladder production has begun
  - Tooling performs well – excellent alignment results
  - ~600 manufactured so far
  - ~450 tested, excellent yield so far
- Tray panel fabrication to start in September
- Bonding of ladders to panels to start in October
- MCMs
  - Preproduction of 50 flight MCMs to start in August
- ASICs
  - Flight run complete
  - 75% tested so far – yield is well above 90%, enough for spares
  - Dicing imminent
- Reviewing plans to assure that a minimum number of silicon detectors are put at risk by a failure of other components (particularly latent design defects)

Calorimeter – Engineering Model

- Calorimeter-GRID interface resolved (Led by Mechanical Systems)
  - Final drawings/analyses
- Vibration and Thermal-Vac completed with excellent results
- Minimal variance from Flight Production design/processes
- EMI/EMC testing of CAL identified configuration issues
  - Test configuration Of CAL/TEM/PS without flight-like LAT external shielding is a problem
  - Lessons learned will be used to improve test configuration and procedures for flight EMI/EMC testing.
  - LAT working group identified to develop system-wide approach to EMI/EMC testing for subsystems.
- "mini-EM" planned for extended use by I&T, Electronics, and FSW
  - Not for environmental test
  - Somewhat limited in form factor, orientation, etc.
  - Delivery to SLAC by end October

Calorimeter EM Test Program complete – now preparing to ship to SLAC

Calorimeter – Flight Production

- 350 CsI crystals delivered to Kalmar for acceptance testing
  - Excellent yield; 117 have been shipped to NRL
  - Total of 1920 required and will be delivered in 2003
- CDE flight production preparations progressing well
  - 12 copies of flight tooling in manufacture
  - Bonding testing with reprocessed EM crystals underway
    - 16 CDE have been manufactured and are being tested at NRL
  - CDE process qualification units start Sept 1st (bonding)
  - Flight Unit A planned to start early October
- Mechanical Structure
  - Calorimeter-GRID interface resolved
  - Finalizing drawings of base plate
  - Completed tooling/materials prep for composite structure
  - 1st Flight unit to be fabricated and tested in August
- Electronics
  - ASIC designs adequate for flight
  - Front end / Readout electronics board fabrication to start mid-October

Electronics –Status

- ASICS
  - Final versions of ACD, CAL, and DAQ - delivery mid-September
  - Successful radiation tests of DAQ ASIC's
- Power Supplies
  - Alternative power supply design being simulated
  - Successful radiation tests of key components (DC/DC converters)
  - Power Distribution Unit board back from fabrication, loaded – EM in use by 1 Oct
- Global Trigger, ACD, DAQ and Signal Distribution Unit (GASU)
  - First breadboard complete
- Tower Electronics Module (TEM) – a prototype of the final design in use by 1 Oct
  - Engineering Models are in use at INFN, NRL, GSFC, UCSC, and SLAC
- LAT Communication Board (LCB) EM in use by 15 Sept
- Storage Interface Board EM in use by 15 Sept
- Crate back-plane – ready to test by 15 Sept
- EGSE TEM with ASICs – test-stands ready with EM1 Flight Software by 1 Oct

- Plan to complete requisitions for all flight-parts by mid-October

Flight Software (FSW) - Status

- Excellent progress on filter (output data compression)
- First boot code committed to SUROM on RAD750 and tested
- Communication software packages begun
- EM1 (all SW to support TEM-based test-stand including monitoring, filtering) by 1 Oct
- Mini-tower test support through October
- Spectrum Astro Inc. spacecraft interface simulator received

Mechanical - Status

- GRID
  - 1X4 version for EM delivered to SLAC in August
    - Ready for I&T in September
  - Cal-GRID – detailed design being finalized now
  - X-LAT to Electronics boxes – downselect design early August – detailed design completed by early September
  - 4X4 on schedule for delivery to I&T in April 2004
    - RFP sent late June; two compliant bids received
    - Detailed stress analysis to complete in August 2003
    - Design Review planning underway – will complete by the end August
    - MRR scheduled for early September
    - Billet delivery late August – machining to start mid-September

Thermal - Status

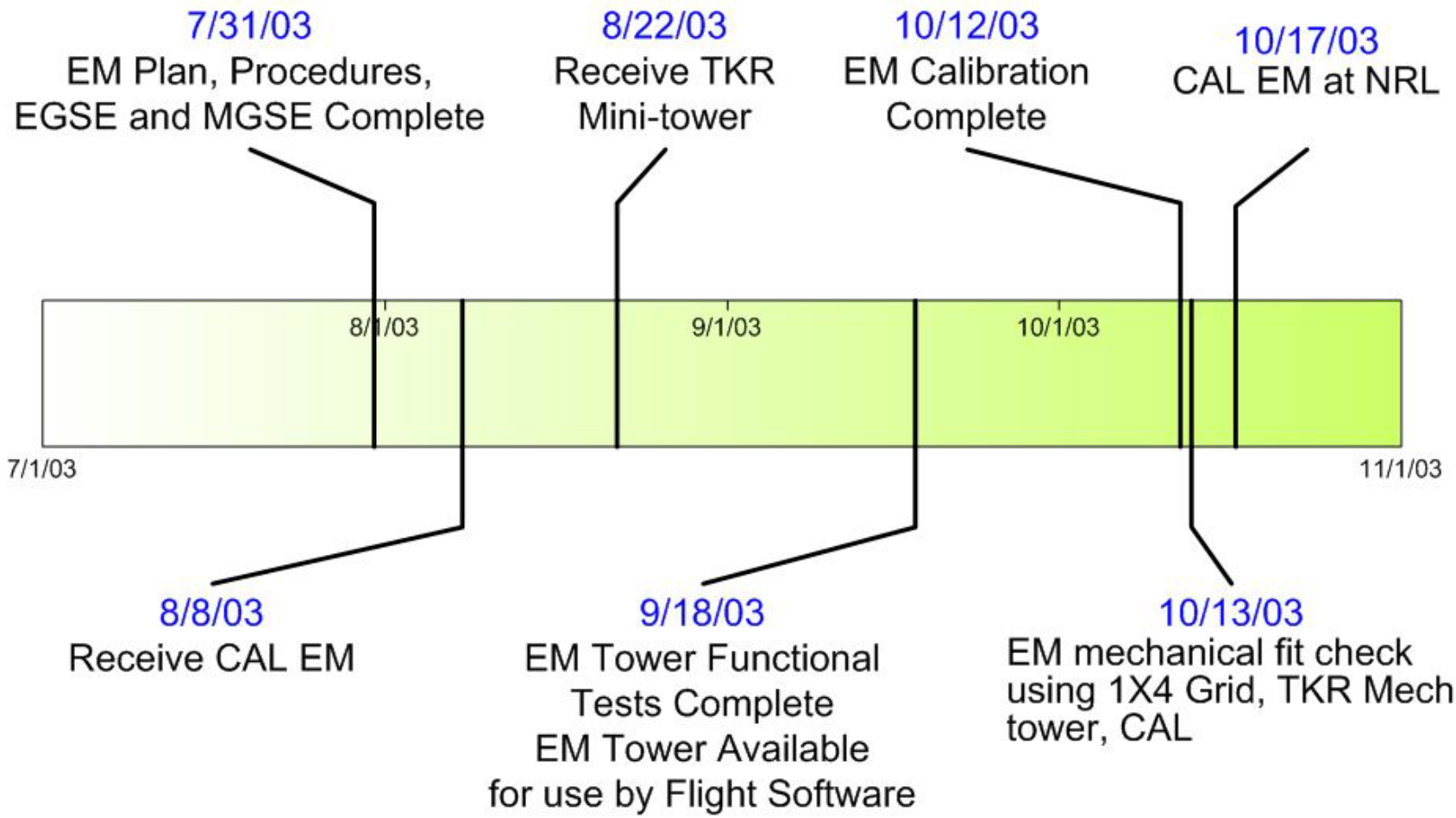
- X-LAT
  - Detailed design by mid-September
  - Delivery to SLAC scheduled for Feb 2004, but must be reviewed
- Constant Conductance Heat Pipes
  - Manufacturing Readiness Review held on July 28, 2003
- Radiators and Variable Conductance Heat Pipes
  - EM efforts near completion
    - Heat Pipe bend development tests
    - Radiator insert strength tests
  - Thermal analysis near completion
  - Manufacturing Readiness Review planned for mid September
  - Radiator detailed design by end of August
- Thermal Control System
  - Design underway – completion end of November
  - On schedule for delivery to Lockheed/Martin for thermal balance tests in June 2004

LAT Engineering Model

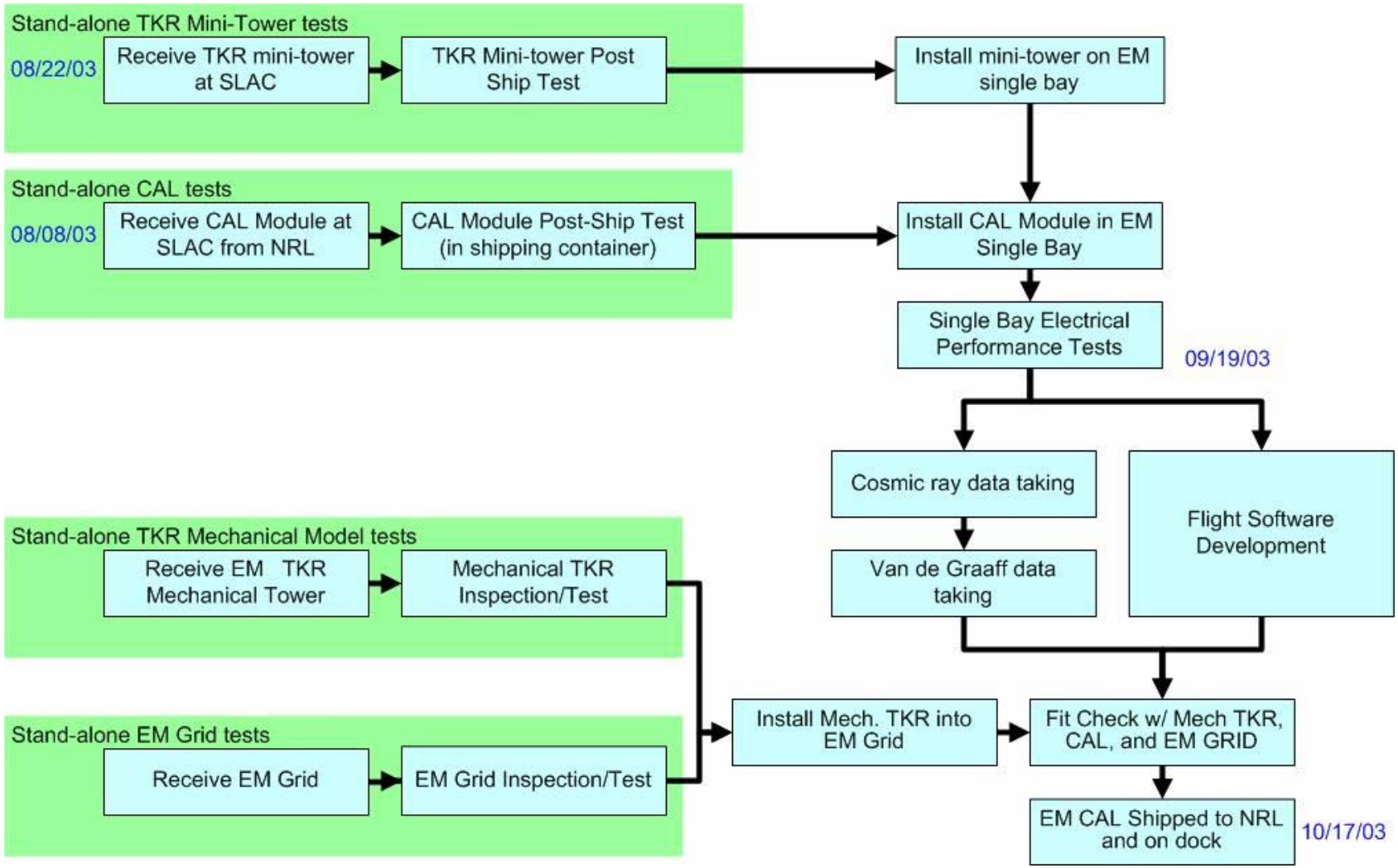
LAT Engineering Model

- Each subsystem has engineering models to reduce risk in the implementation of the flight hardware for that subsystem.
- The LAT Engineering Model consists of:
  - EM Grid
  - EM Calorimeter
  - Tracker mini-tower
  - EM TEM and TEM power supply
  - Flight software packages needed for cosmic ray readout and analysis
  - Associated Ground Support Equipment (GSE)
- The goals of LAT EM are:
  - Integrated system tests including measuring cosmic ray tracks through the Tracker and Calorimeter
  - Practice with assembly
  - Developing and testing flight and ground software

LAT Engineering Model Testing Timeline



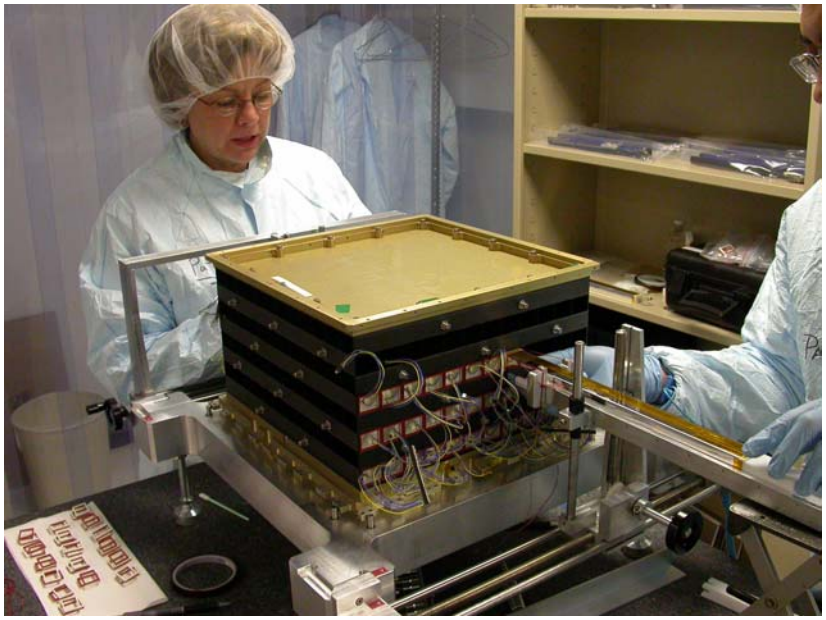
Engineering Model Test Flow



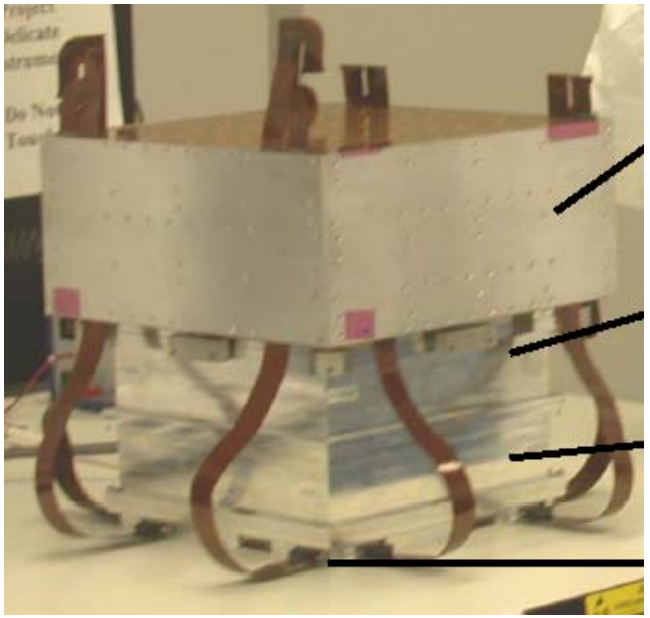
Engineering Models

1 X 4 Grid

Calorimeter EM



Tracker Minitower



Summary

- Project is starting fabrication of flight hardware
  - Completed the CD-3/CDR review
- The instrument design is mature
- A review of cost and schedule indicates that the project needs $17.2M increase in funding to have adequate cost contingency
- Also the project needs an additional 3 months of schedule to have adequate schedule contingency
- Define CD-4 as the successful completion of the pre-test review
  - The Fabrication Phase needs a $11.7M increase
  - CD-4 date is unchanged
- Some reorganization of the LAT to better address this next phase
- Strong support by the NASA, DOE and SLAC management to assure resources are available
- The approval of this proposal will provide the funds including contingency to complete the project successfully