



# Gamma-ray Large Area Space Telescope (GLAST) Project Status

## GLAST User's Committee Meeting

### October 22, 2003

**Kevin Grady**
**GLAST Project Manager**


# Outline

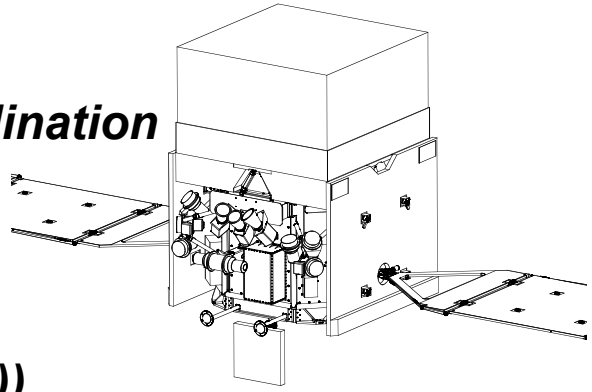

- ***Overview***
- ***GLAST Project Organization/Implementation***
- ***Status***
- ***System Margins***
- ***Schedule***
- ***Issues***
- ***Upcoming***

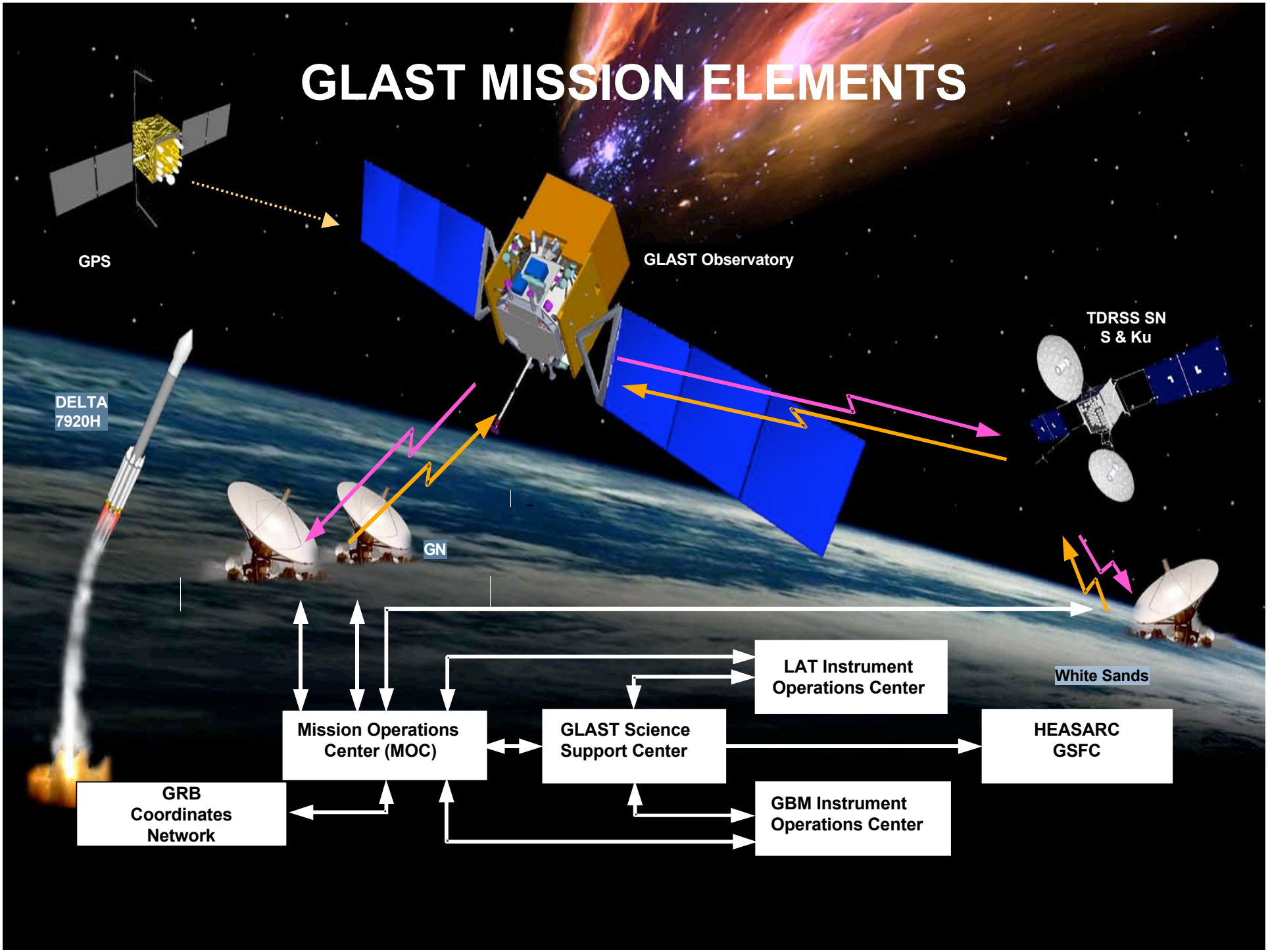
# GLAST MISSION SUMMARY

- ***GLAST:*** ***Gamma-Ray Large Area Space Telescope***
- ***Objective:*** ***Larger field of view (FOV), higher sensitivity, and broader energy detection range than any previously flown gamma-ray mission. Affords scientists the unprecedented opportunity to sample the history of the universe, a variety of high energy astrophysical phenomena, and many of the little understood features of the sky***

- ***Mission Duration:*** ***5 yrs (10 yr ops budget)***
- ***Orbit:*** ***565 km Circular, 28.5° Inclination***
- ***Launch Date:*** ***February 2007***
- ***Launch Vehicle:*** ***Delta 2920H-10***
- ***Launch Site:*** ***CCAS (Eastern Range (ER))***
- ***TDRSS (SN):*** ***S-Band Single Access or Multiple Access***

  ***Ku-Band Single Access***

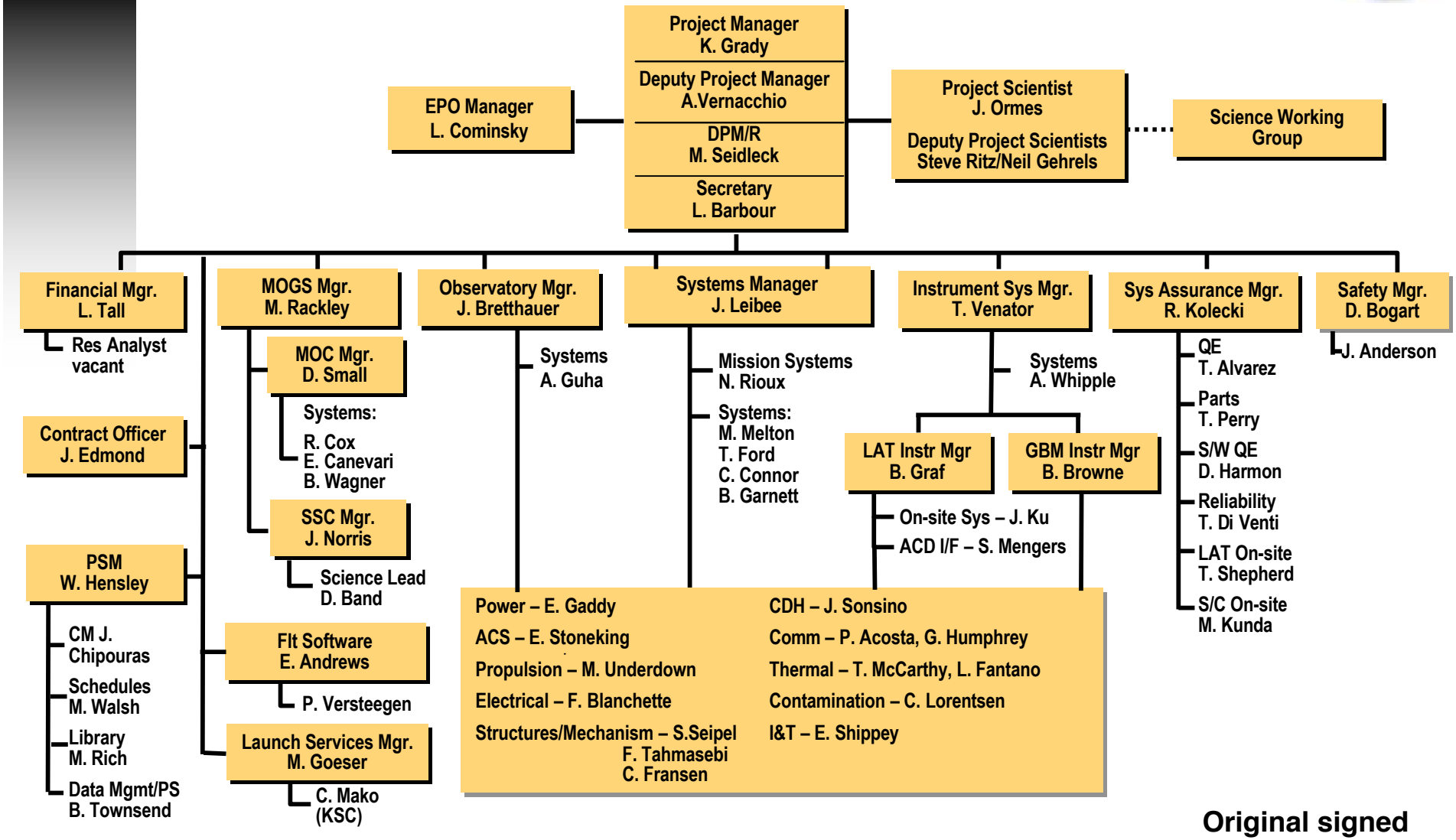



GLAST MISSION ELEMENTS
GPS
GLAST Observatory
TDRSS SN
S & Ku
DELTA
7920H
GN
White Sands
LAT Instrument
Operations Center
Mission Operations
Center (MOC)
GLAST Science
Support Center
HEASARC
GSFC
GRB
Coordinates
Network
GBM Instrument
Operations Center


# Implementation Approach


| Element | Acquisition Method | Developer |
|---|---|---|
| Large Area Telescope and LAT Operations Center<br>PI: Peter Michelson | Stanford University PI with host laboratory SLAC selected through NASA AO. Joint NASA/DOE funding with foreign participation. | Responsibility of SU/SLAC with international collaboration. SU/SLAC contracts and all except 1 MOU in place. NASA/DOE IA in place. |
| GLAST Burst Monitor and GBM Operations Center | MSFC PI selected through NASA AO. PI: Chip Meegan | MSFC responsibility with German participation. German LOA signed. |
| Spacecraft | Rapid Spacecraft Development Office firm, fixed price procurement. | Spectrum Astro, Inc. |
| Science Support Center | HQ selection. | GSFC In-house development. |
| Interdisciplinary Scientist | HQ selection via AO. | Dr. Charles D. Dermer - Analyzing and Modeling GLAST Science.<br>Prof. Brenda Dingus - GLAST: The First GeV All-Sky Monitor.<br>Dr. Martin Pohl - Modelling the Diffuse Galactic Gamma-ray Emission.<br>Prof. Stephen E. Thorsett - Pulsar Observations in Support of GLAST |
| Guest Observers | HQ selection via NASA Solicitation. | HQ selection. |
| Mission Operations Center | GSFC Sole Source (8A) | 8A (ANC) contract to be awarded December 03. |
| Data Routing | TDRSS Space Network. | Existing NASA services |
| Launch Vehicle | KSC NLS Contract | KSC/Boeing |

# GLAST Project Organization

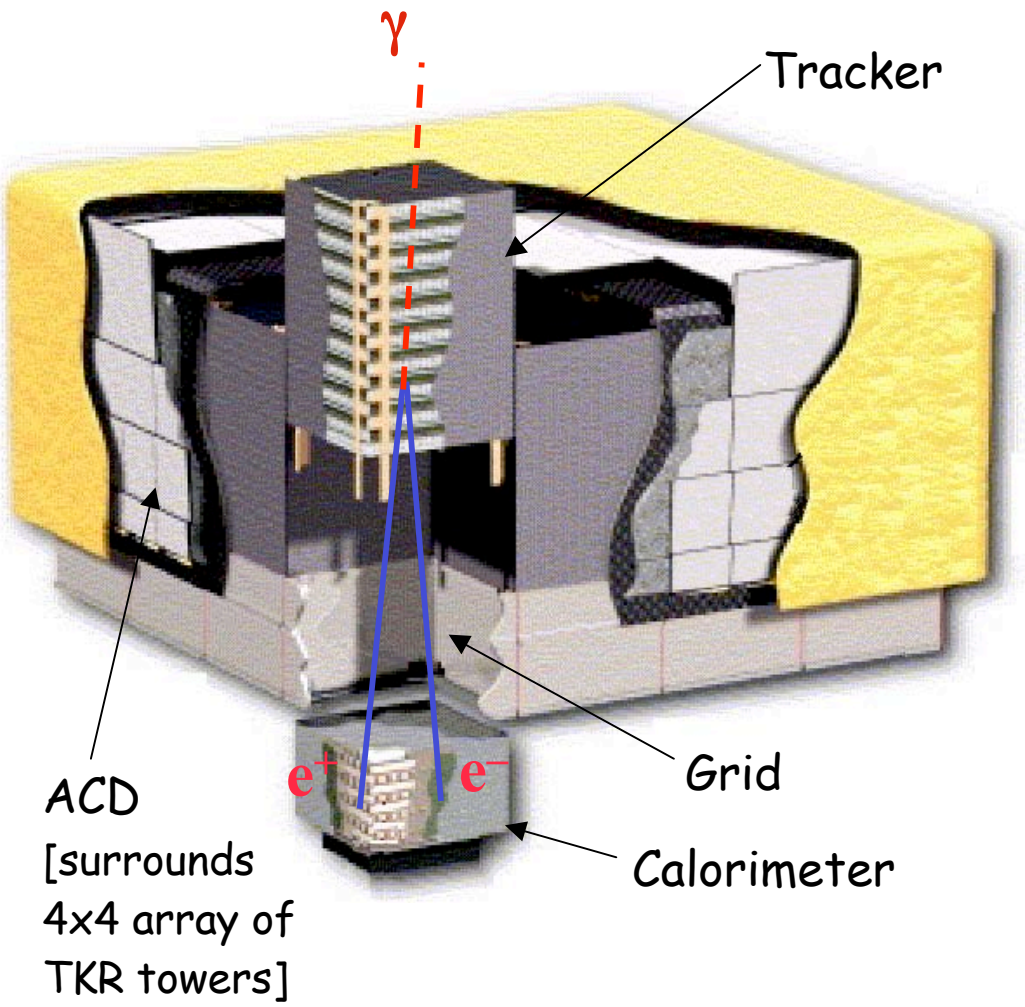



**Original signed**

Kevin Grady
**GLAST Project Manager**
September 9, 2003

# LAT Design Overview

- ***Precision Si-strip Tracker (TKR)*** *18 XY tracking planes. Single-sided silicon strip detectors (228 μm pitch) Measure the photon direction; gamma ID.* ***Italy/Japan/SLAC/UCSC***
- ***Hodoscopic CsI Calorimeter(CAL)*** *Array of 1536 CsI(Tl) crystals in 8 layers. Measure the photon energy; image the shower.* ***NRL/Sweden/France***
- ***Segmented Anticoincidence Detector (ACD)*** *89 plastic scintillator tiles. Reject background of charged cosmic rays; segmentation removes self-veto effects at high energy.* ***GSFC***
- ***Electronics System*** *Includes flexible, robust hardware trigger and software filters.* ***SLAC/NRL***
- ***Mechanical System*** *includes LAT Grid, thermal management (radiators, x-LAT plate with heat pipes, and ancillaries)* ***SLAC/LM***



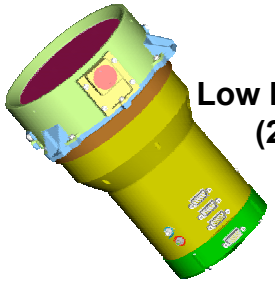

**Systems work together to identify and measure the flux of cosmic gamma rays with energy 20 MeV - >300 GeV.**

# GLAST BURST MONITOR

| | |
|---|---|
| **Mass:** | **97 kg** |
| **Instrument Size:** | **See diagrams (at right)** |
| **Science FOV:** | **Targets 0-120° from +Z; >25° apart; FOV must be covered by ≥ 3 NaI sensors within 80°, with Ps >95%; one BGO sensor visible with Ps >95%.** |
| **Mounting:** | **S/C supported.** |

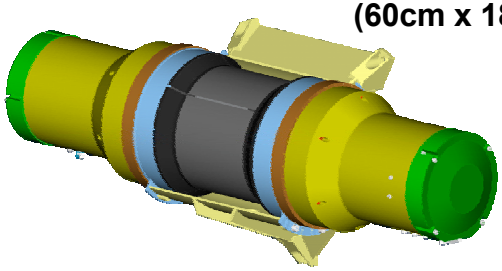
**Key GBM Accommodation Requirements:**

- **12 Sodium Iodide (NaI) and 2 Bismuth Germanate (BGO) detectors distributed around spacecraft bus. Germany/DLR/MPE/DJO**
- **Data Processing Unit located on +X spacecraft panel. MSFC/SwRI**
- **GBM Power Supply mounted on spacecraft. Germany/DLR/MPE/DJO**

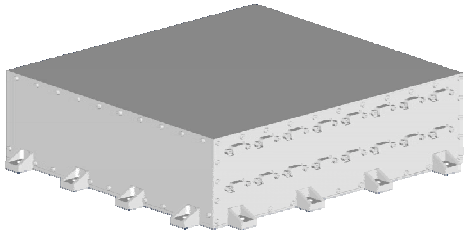


**12 NaI**
**Low Energy Detectors**
**(26cm x 18cm)**

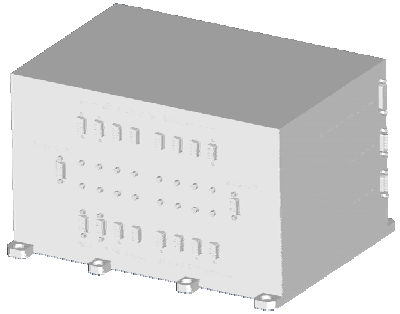
**2 BGO**
**High Energy Detectors**
**(60cm x 18cm)**



**Data Processing Unit**
**30 x 30 x 10 cm**

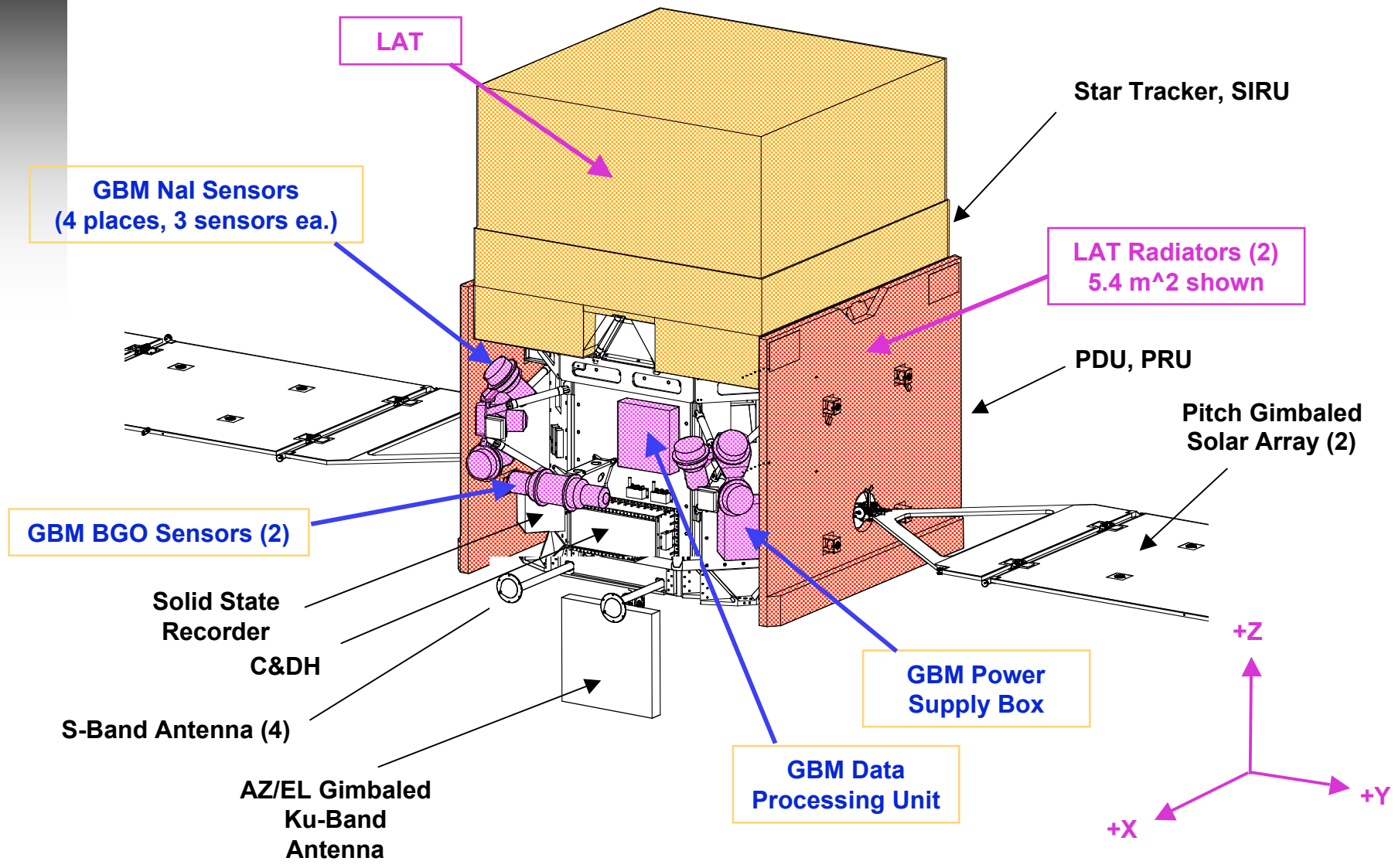


**Power Supply Box**
**30 x 22 x 19 cm**



***GBM provides spectra for bursts from 10 keV to 30 MeV, connecting LAT high-energy measurements with the more familiar energy domain. Wide sky coverage (8 sr) enables autonomous repointing requests for exceptionally bright bursts that occur outside LAT FOV for high-energy afterglow studies (an important question from EGRET). GBM also provides burst alerts to the ground.***

# GLAST Observatory




# STATUS/RECENT PROGRESS

- ***Conducted LAT CDR/CD-3 Review May 12-16.***
  - *Resolved 2 of the 3 open CDR mechanical issues and an alternate development approach for the CNES CDE withdrawal. Tracker EM environmental test is the remaining open CDR mechanical lien.*
- ***GBM instrument completed CDR for electronics and flight software.***
  - *CDR for German contributions planned for December 2003.*
  - *System CDR planned for early 2004. EM detectors and DPU being tested.*
- ***Spectrum Astro Inc. is developing GLAST spacecraft under Rapid Spacecraft Development contract.***
  - *Completed PDR and Flight Software PDR May 5-8. Completed series of flight software CDR peer reviews.*
  - *Construction of Spectrum Astro's new integration and test facility to be completed in December 2003. Certification in February 2004.*
- ***Ground System SRR completed for all GLAST ground elements in July 2003***
- ***Completed Ku-band science downlink trade study in response to the withdrawal of availability (X-band upgrades not funded) of the Italian Malindi ground station***
  - *Performance and LCC benefits for utilizing TDRSS Space Network Ku-band service. Ku-band is new baseline.*

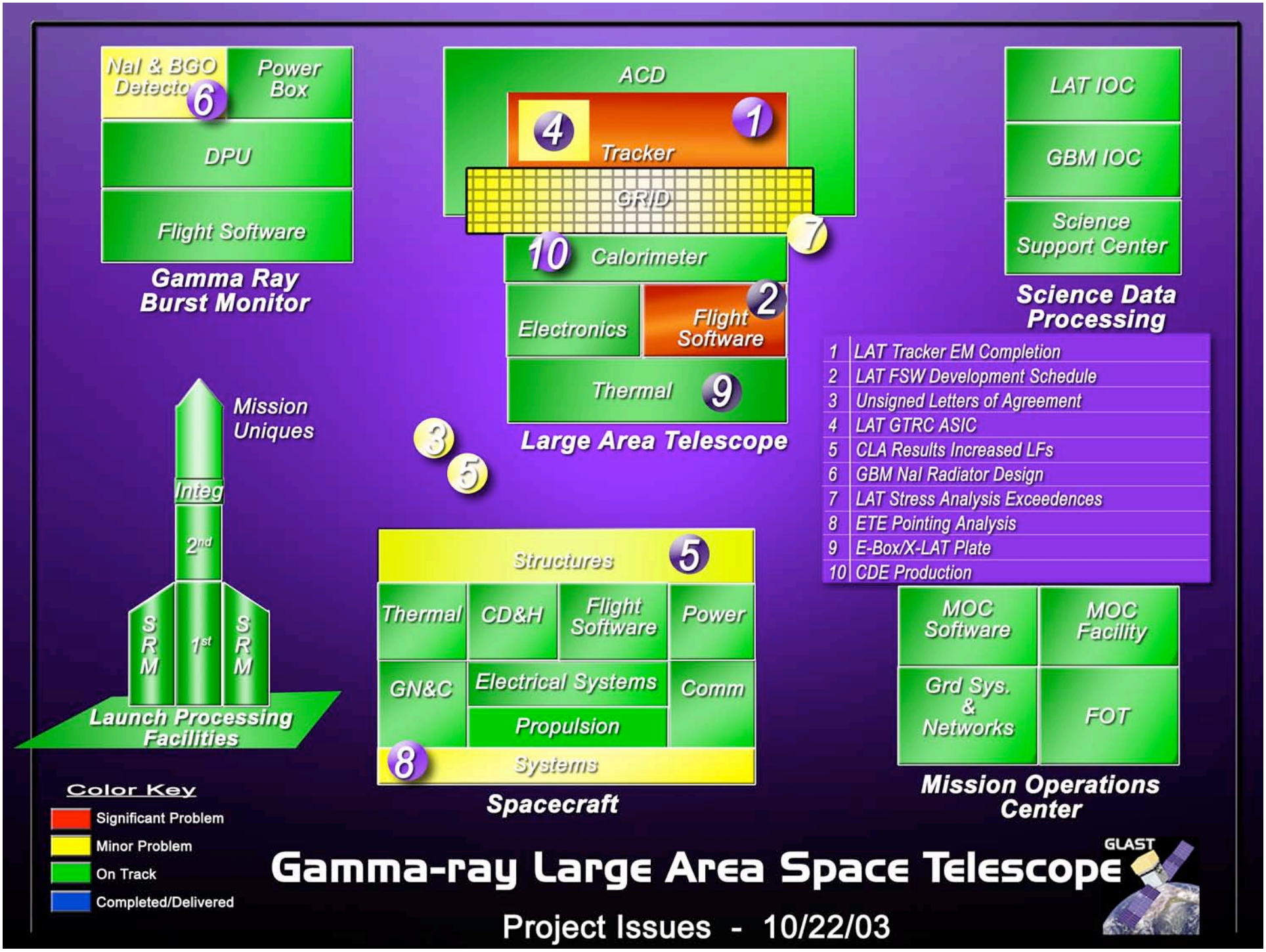

# STATUS/RECENT PROGRESS (cont.)


- ***GLAST launch services: will utilize NASA Launch Services (NLS) contract to procure Delta 2920H launch vehicle***
  - *MIWG held on October 21, 2003. GOWG on October 22-23, 2003*
- ***Completed GSFC and JSC orbital debris assessments***
  - *Results indicate that the GLAST debris casualty area is below the threshold for controlled re-entry with the implementation of 4 "design for demise" changes. Awaiting results from one JSC ORSAT analysis.*
- ***Signed IV&V agreement for LAT flight software and spacecraft assessment.***
- ***Conducted GLAST Mission Preliminary Design Review and Non-Advocate Review on June 3-5.***
  - *Simultaneous review by GSFC SRO and HQ IRT*
- ***Completed GLAST mission schedule and budget assessment and concurrence with Astronomy and Physics Division on September 11, 2003***
  - *Drivers: CNES CDE production withdrawal, Malindi unavailability, other LAT technical issues, overall mission schedule risk.*
- ***Completed Mission Confirmation Readiness Review on October 9, 2003***
  - *Findings presented by GSFC SRO and HQ IRT review teams.*

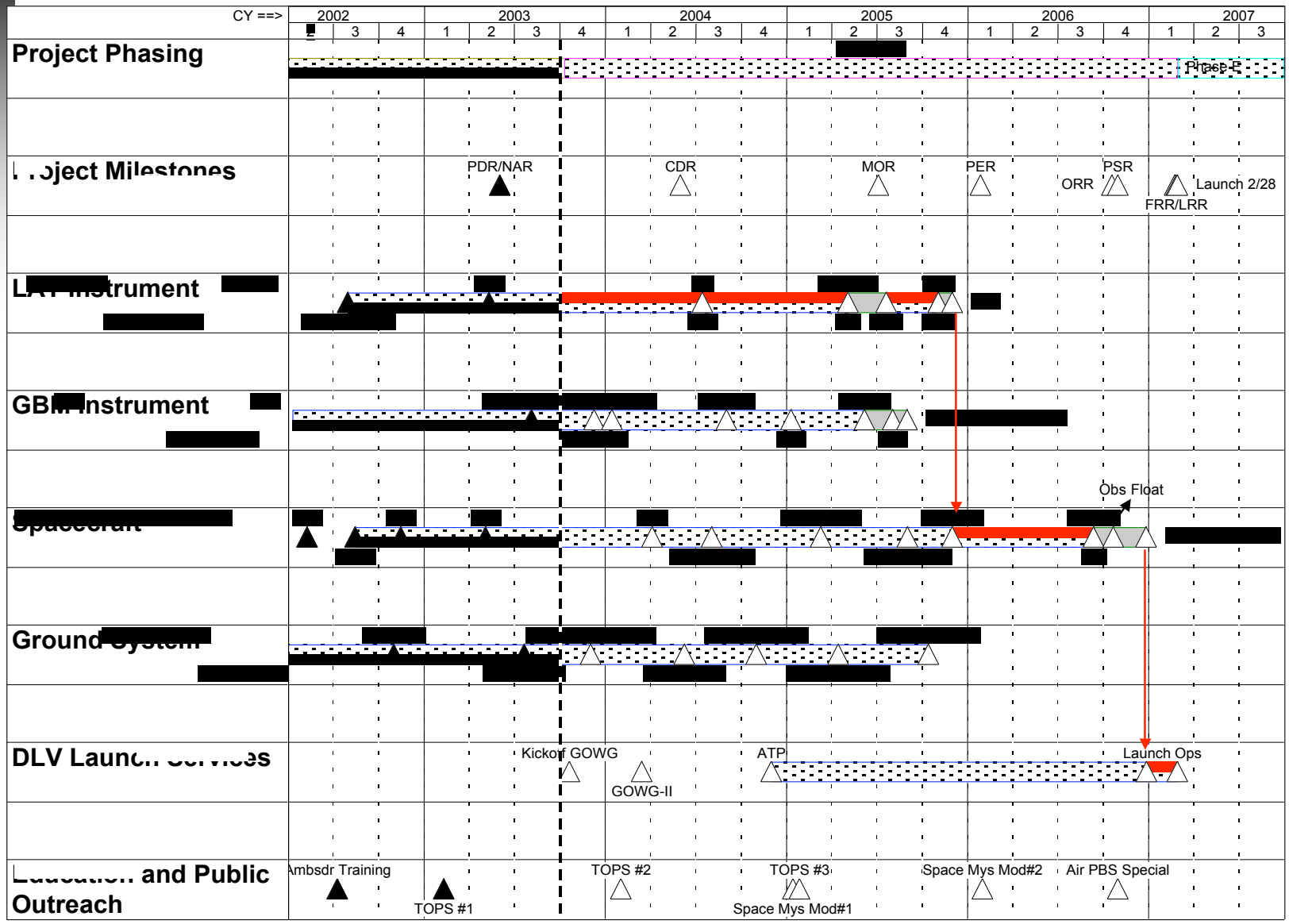

# Key System Margins

| Technical Performance Metric | Requirement | Estimate | Margin |
|---|---|---|---|
| Observatory Mass (kg) | 4627 | 4062 | 14% |
| Observatory Axial Center of Gravity (m) | 1.37 | 1.35 | 0.02 |
| Observatory (Pointed Observation Mode) Orbit Average Power (W) | 1700 | 1373 | 24% |
| Observatory Pointing Knowledge (arc sec) | 10.0 | 6.9 | 1.4 x |
| SC Attitude Determination Error for GBM (arcmin) | 5.0 | 2.17 | 2.3 x |
| Data Storage Capacity (Gbits) | 46.45 | 96 (BOL) | 107% |
| Observatory Lateral Frequency (Hz) | >12 | 15.5 | 29% |
| Ku-band D/L [40 Mbps] (dB) | 3 | 3.08 | 0.08 dB |
| S-band U/L [GN 2 kbps] (dB) | 0 | 39.0 | 39.0 dB |
| S-band D/L [GN 2.5 Mbps] (dB) | 0 | 10.5 | 10.5 dB |
| S-band Fwd [TDRSS 250 bps MA] (dB) | 0 | 2.2 | 2.2 dB |
| S-band Rtn [TDRSS 1 kbps MA] (dB) | 0 | 1.9 | 1.9 dB |
| S-band Fwd [TDRSS 4 kbps SA] (dB) | 0 | 4.7 | 4.7 dB |
| S-band Rtn [TDRSS 1 kbps SA] (dB) | 0 | 10.7 | 10.7 dB |

*NOTE: Performance Estimate values are expressed as CBE – Current Best Estimate*


NaI & BGO Detector
6
Power Box
DPU
Flight Software
Gamma Ray Burst Monitor
ACD
4
1
Tracker
GRID
7
10
Calorimeter
Electronics
Flight Software
2
Thermal
9
Large Area Telescope
3
5
LAT IOC
GBM IOC
Science Support Center
Science Data Processing
1 LAT Tracker EM Completion
2 LAT FSW Development Schedule
3 Unsigned Letters of Agreement
4 LAT GTRC ASIC
5 CLA Results Increased LFs
6 GBM NaI Radiator Design
7 LAT Stress Analysis Exceedences
8 ETE Pointing Analysis
9 E-Box/X-LAT Plate
10 CDE Production
Mission Uniques
Integ
2nd
SRM
1st
SRM
Launch Processing Facilities
Structures
5
Thermal
CD&H
Flight Software
Power
GN&C
Electrical Systems
Comm
Propulsion
8
Systems
Spacecraft
MOC Software
MOC Facility
Grd Sys. & Networks
FOT
Mission Operations Center
Color Key
Significant Problem
Minor Problem
On Track
Completed/Delivered
Gamma-ray Large Area Space Telescope
GLAST
Project Issues - 10/22/03

# GLAST MASTER SCHEDULE




# Upcoming Key GLAST Events


- *Complete series of confirmation reviews*
- *Conduct GBM Detector and Power Supply CDR in Germany*
- *Conduct ground system element CDR peer reviews*
- *Complete LAT engineering model environmental testing*
- *Conduct spacecraft subsystem CDR peer reviews*
- *Deliver first flight set of flight tower components*
- *Conduct spacecraft systems CDR*
- *Conduct systems CDR for GBM instrument*
- *Conduct mission CDR*
- *ATP for launch vehicle*