

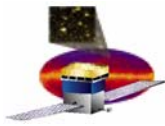
# **GLAST Large Area Telescope:**

## **I&T Overview**

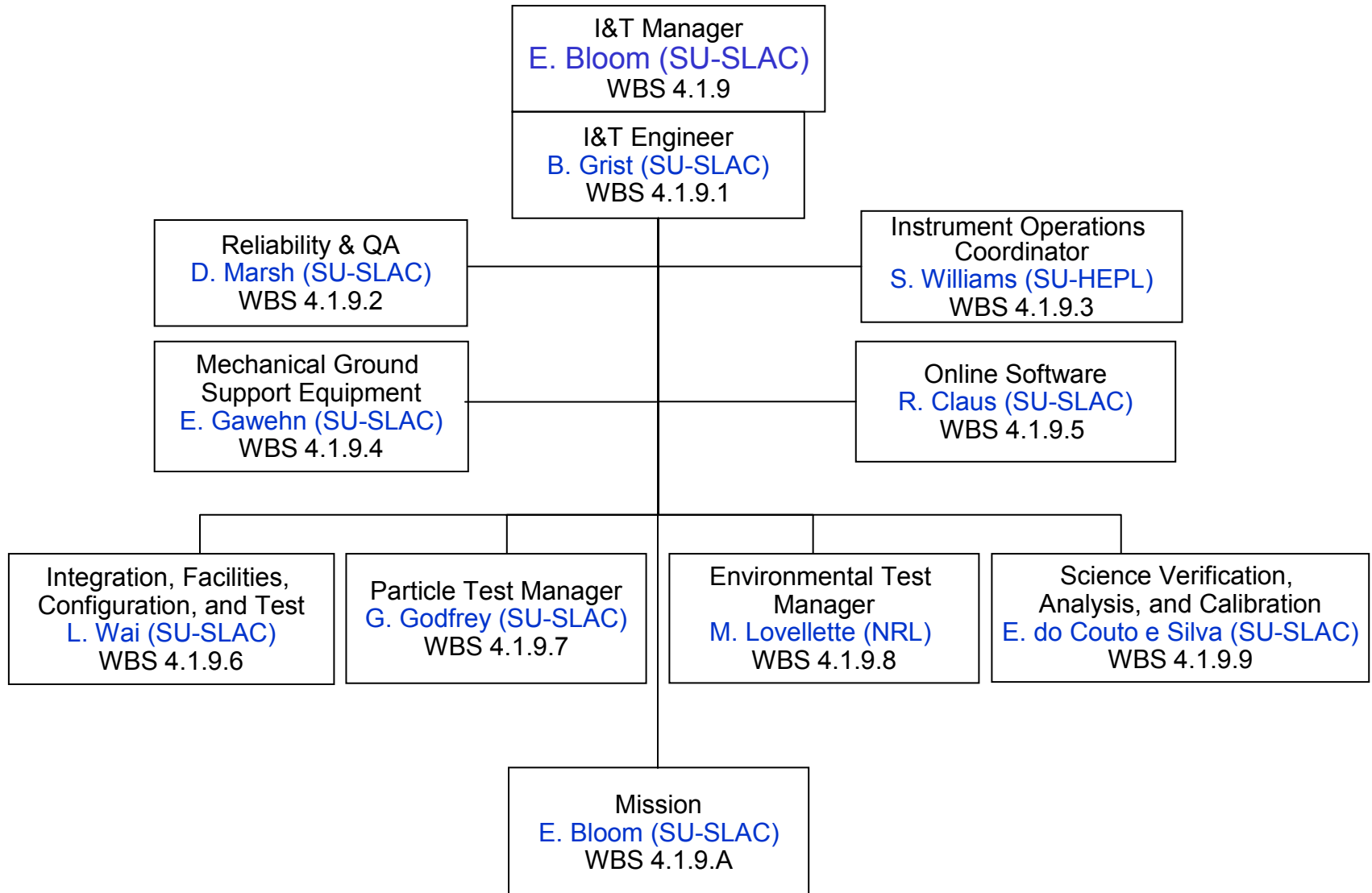
### **WBS: 4.1.9**

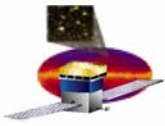
**Elliott D. Bloom**  
**Stanford Linear Accelerator Center**  
**I&T Subsystem Manager**

**[elliott@slac.stanford.edu](mailto:elliott@slac.stanford.edu)**



# I&T Organization Chart

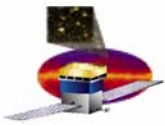




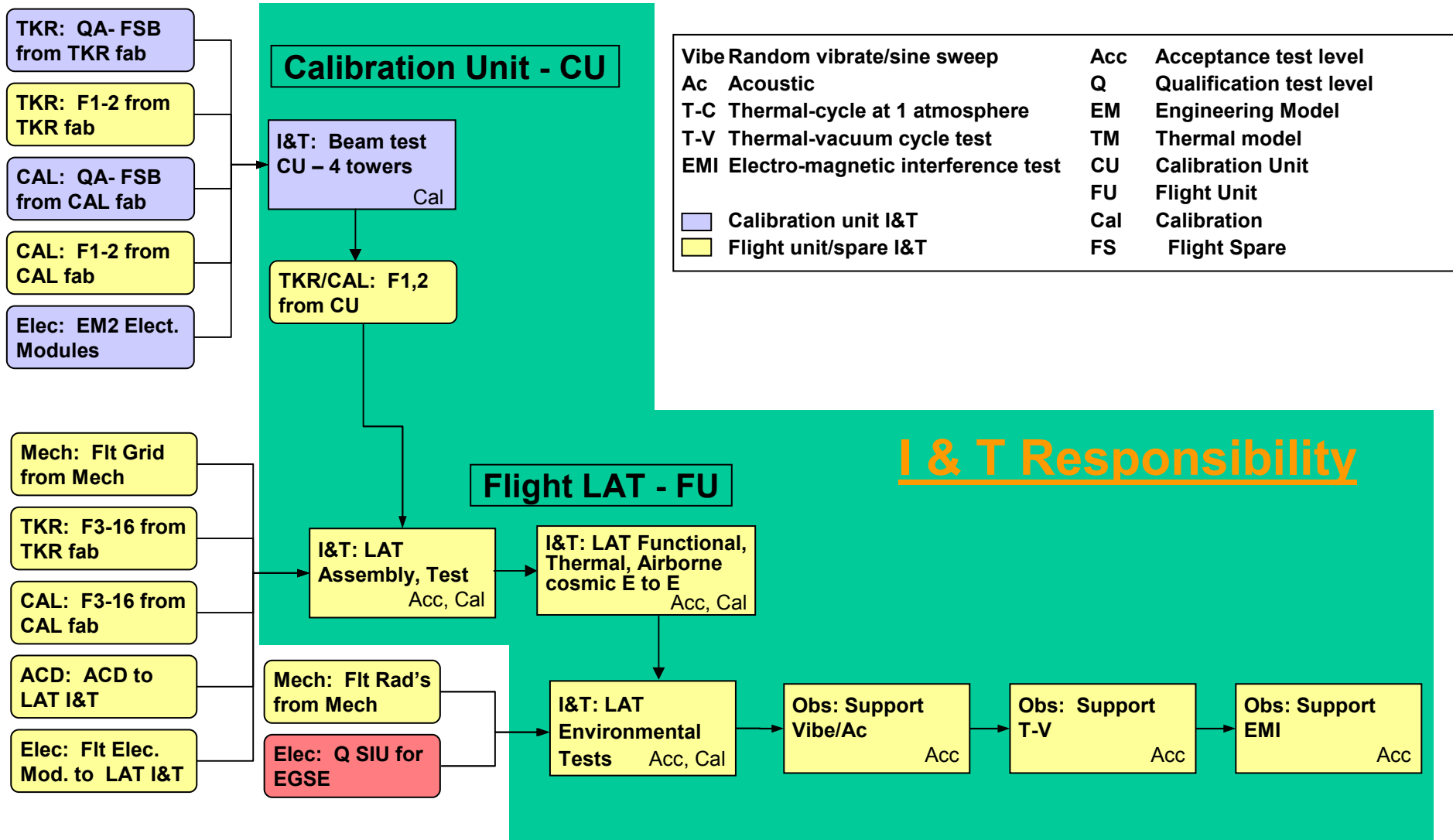
# Integration and Test Activities

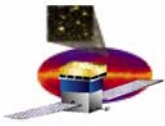
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- **I & T “subsystem” is focal point of LAT integration activities.**
  - **I & T team plans and manages activities.**
  - **TKR, CAL, and ACD subsystem teams and other Collaboration members provide support for Integration & Test & Calibration.**
- **Total I & T effort involves activities in I&T and other subsystems.**
  - **I & T Subsystem activities.**
    - **LAT integration planning and management.**
    - **Mechanical integration and MGSE and EGSE development.**
    - **Plan environmental tests and execute.**
    - **Plan particle tests and execute.**
    - **Particle beam and test equipment development.**
    - **Ground verification and calibration of LAT.**
    - **Ground science verification of LAT.**
    - **Phase A commissioning of LAT in orbit -- deliver a working instrument to IOC.**



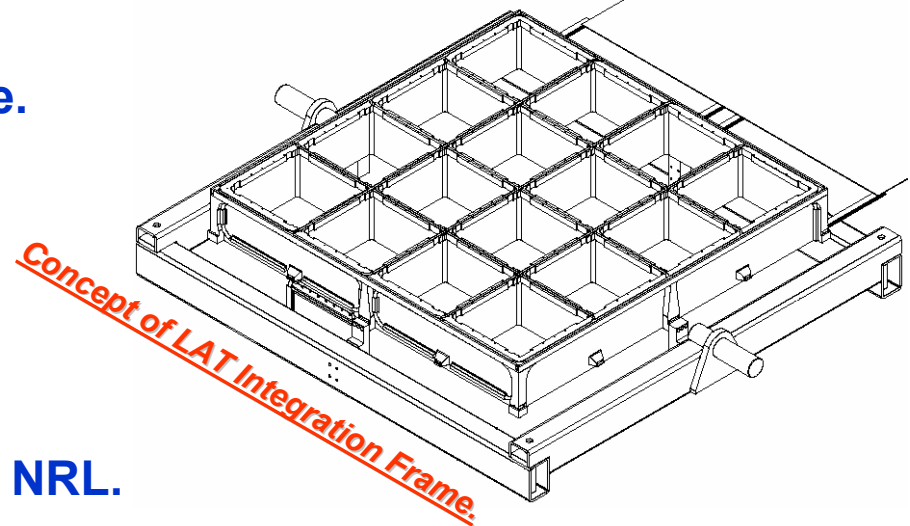
# LAT I&T, Verification, and Calibration Flow

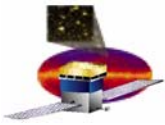




# Integration Planning Activities

- LAT integration planning.
  - Planning for subsystem integration has been included in development of interfaces and LAT design integration.
  - Developing concepts for integration EGSE and MGSE.
- LAT integration facilities.
  - New clean room facilities have been built and commissioned at SLAC for GLAST.
  - Facilities include I&T infrastructure.
    - Clean room with high bay.
    - Storage for flight hardware.
- Environmental Tests.
  - LAT thermal test at SLAC.
  - We are prepared to execute a full suite of environmental tests at NRL.
- Observatory integration support.
  - I&T team has been involved with mission in investigating options for observatory integration.
  - LAT and observatory require combined EGSE, MGSE plans, and coordinated environmental test plans.



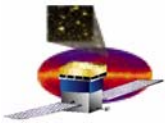


# Level III Requirements Summary

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- **Science Requirements**
  - Defined by Instrument Performance Spec 433-SRD-0001
  - Verification will be performed by a combination of particle tests
    - Cosmic Ray
    - Van de Graff
    - End Station A Beam Test
- **Design Requirements**
  - LAT Instrument Performance Verification Plan, LAT- MD-00408 -- SE with input from I&T.
  - Subsystem ICDs -- I&T to all relevant subsystems, e.g., LAT-SS-00570-01 (I&T ↔ SAS), LAT-TD-00623-01 (I&T ↔ ACD).
  - Test methodology defined by 433-MAR-0001
  - Instrument Verification will be performed by
    - Electrical Performance Tests
    - Structural and Mechanical Tests
    - EMC/EMI Tests
    - Thermal Verification Tests
    - Visual Inspection
    - Instrument Monitoring
    - End-to-end test (at ~ 35,000 ft in a jet airplane during transport to NRL for environmental tests)

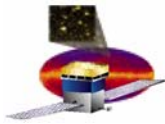
**Produce a Working  
Instrument**



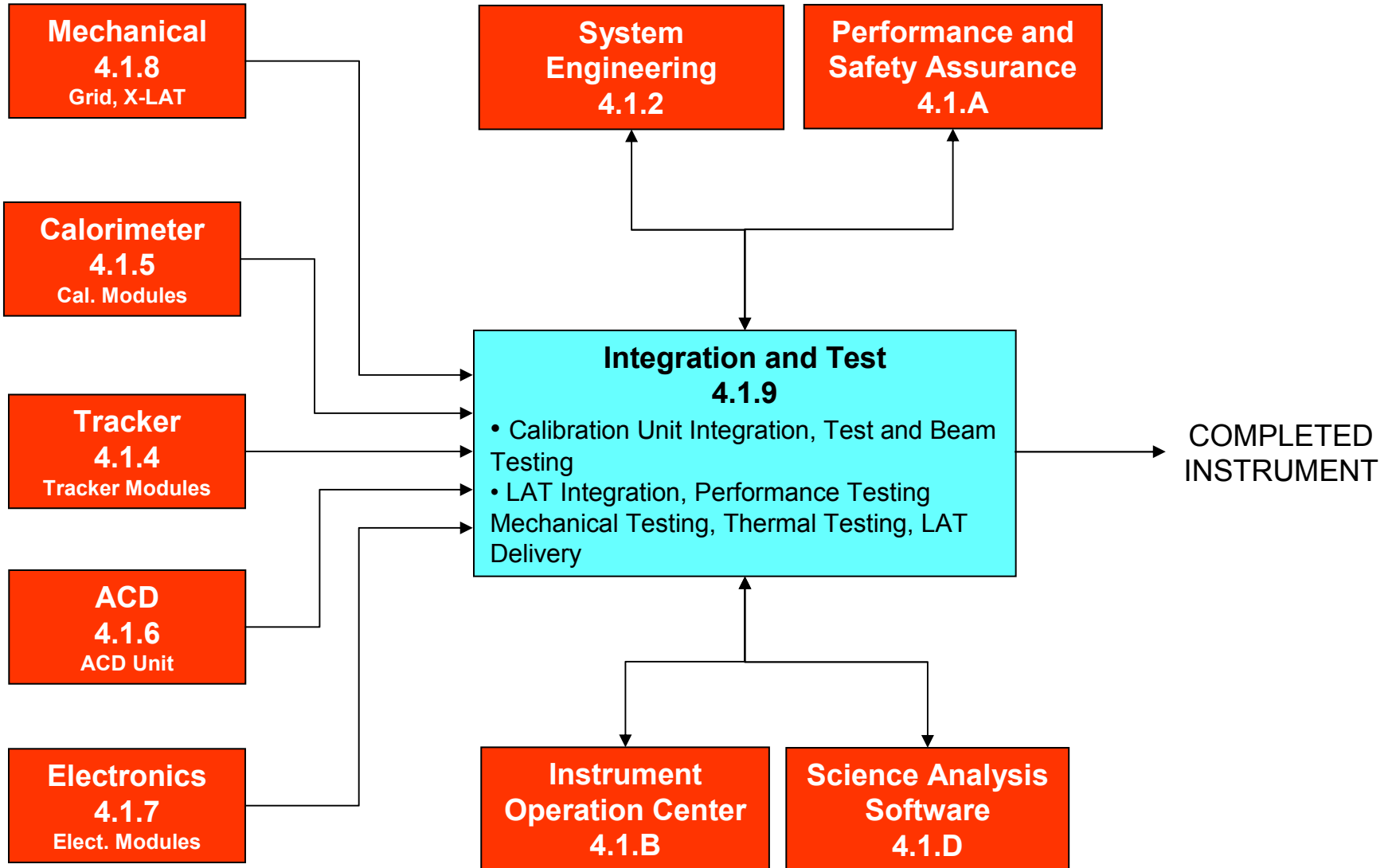
# I&T Status

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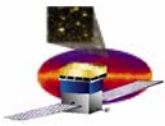
- **PDR Presentations Complete.**
- **PDR Report Complete.**
- **Design Products Defined.**
- **The I&T Management Staff Buildup Begun in Late August is Complete.**
- **EGSE Level III Requirements Complete.**
- **EM1 EGSE R1 Delivery Milestones are Complete.**
- **I&T Contamination Control Implementation Plan Complete (TBR).**
- **Calibration Plan Complete (TBR).**
- **Particle Test Plan Complete (TBR).**
- **Airplane Cosmic Ray End-to-End Test Plan Complete (TBR).**
- **RFI for Commercial Air Transport of LAT to NRL complete.**
- **RFI for Environmental Tests of LAT complete.**
- **Integration and Electronics Integration Plan Complete (TBR).**
- **Revision 0 Assembly Traveler Available (TBR).**
- **New WBS, Cost Estimate, BoE, P3 Schedule with Risk Assessment, Complete**



# Subsystem WBS Interfaces

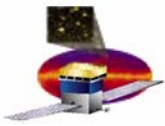






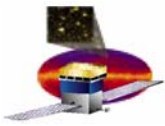
# Key Level III Milestones

<b>Description</b>	<b>Early Finish</b>
EGSE Workstation / Software #1 (I&T to CAL)	29MAR02 *
EGSE Workstation / Software #1 (I&T to TKR)	29MAR02 *
EGSE Workstation / Software #1 (I&T to ELX)	29MAR02 *
MGSE Requirements for ACD (from I&T to ACD)	01APR02 *
ICD for EM finalized I&T/SVAC-SAS	19APR02 *
1st Major Release of Sim/Recon (SAS to I & T)	31MAY02 *
EGSE Workstation / Software #2 (I&T to ACD)	01JUL02 *
Delivery of EM (2X2) Grid to I&T/MSGSE	01AUG02 *
ICD for CU I&T/SVAC to SAS	03SEP02 *
EM1 EGSE WS-S/W R2 I&T to ACD/CAL/ELX/IOC/TKR	13SEP02 *
EM MC Runs from SAS to I&T/SVAC	01OCT02 *
SIS description-ELX to I&T	25NOV02 *
Delv of TKR EM to SLAC I&T/MGSE	02DEC02 *
EGSE EM2 Release-Elec to I&T	15JAN03 *
EM from CAL to I&T	21JAN03 *
Online EM2 release #1 to FSW	31JAN03 *



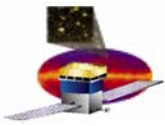
# Key Level III Milestones

EGSE Workstation / Software #3 (I&T to ACD)	03MAR03 *
All EM recon files ready SAS to I&T	28MAR03 *
EM CAL Returned to NRL (arrives on dock)	28MAR03 *
CU EGSE H/W Release for I&T	16MAY03 *
CU SIS - ELX to I&T Online*	22MAY03 *
ICD for LAT I&T/SVAC to SAS	13JUN03 *
CU Monte Carlo sim from SAS to I&T/SVAC	13JUN03 *
Tracker Modules A & B RFI ( for Calibration)	15AUG03 *
Calorimeter Modules A & B RFI ( for Calibration)	15AUG03 *
EM2 TEM Assy A,B-Elec to I&T	15AUG03 *
EM2 TEM PS Assy A,B-Elec to I&T	15AUG03 *
FU SIS - ELX to I&T/Online*	14OCT03 *
Tracker Modules 1 & 2 RFI ( for Calibration)	03NOV03 *
Calorimeter Modules 1 & 2 RFI (for Calibration)	03NOV03 *
ACD Calibration Test Unit at SLAC, Tested & RFI	03NOV03 *
Flight TEM PS Assy 1,2-Elec to I&T	03NOV03 *
EGSE Flight Unit Release-Elec to I&T	05NOV03 *



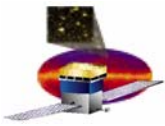
# Key Level III Milestones

CU MC Runs Ready SAS to I&T	24NOV03 *
Flight Grid RFI-Mech to I&T	02JAN04 *
Flight Tracker Tower 3, 4 RFI	02JAN04 *
Flight Calorimeter Tower 3, 4 RFI	02JAN04 *
LAT Assembly Readiness Review	02JAN04 *
Flight TEM Assy 1,2-Elec to I&T	14JAN04 *
Flight Tracker Tower 5, 6 RFI	15JAN04 *
Flight Calorimeter Tower 5, 6 RFI	15JAN04 *
Flight TEM Assy 3,4-Elec to I&T	16JAN04 *
Flight TEM PS Assy 3,4-Elec to I&T	16JAN04 *
Flight Tracker Tower 7, 8 RFI	29JAN04 *
Flight Calorimeter Tower 7, 8 RFI	29JAN04 *
Flight TEM Assy 5,6-Elec to I&T	02FEB04 *
Flight TEM PS Assy 5,6-Elec to I&T	02FEB04 *
Flight Tracker Tower 9, 10 RFI	12FEB04 *
Flight Calorimeter Tower 9, 10 RFI	12FEB04 *
Flight TEM Assy 7,8-Elec to I&T	17FEB04 *
Flight TEM PS Assy 7,8-Elec to I&T	17FEB04 *
Flight Tracker Tower 11, 12 RFI	26FEB04 *
Flight Calorimeter Tower 11, 12 RFI	26FEB04 *
Flight TEM Assy 9,10-Elec to I&T	02MAR04 *
Flight TEM PS Assy 9, 10-Elec to I&T	02MAR04 *



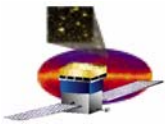
# Key Level III Milestones

Flight Tracker Tower 13, 14 RFI	10MAR04 *
Flight Calorimeter Tower 13, 14 RFI	10MAR04 *
Flight TEM Assy 11, 12-Elec to I&T	12MAR04 *
Flight TEM PS Assy 11, 12-Elec to I&T	12MAR04 *
Flight Tracker Tower 15, 16 RFI	24MAR04 *
Flight Calorimeter Tower 15, 16 RFI	24MAR04 *
Flight TEM Assy 13, 14-Elec to I&T	26MAR04 *
Flight TEM PS Assy 13,14-Elec to I&T	26MAR04 *
Flight TEM Assy 15, 16-Elec to I&T	01APR04 *
Flight TEM PS Assy 15,16-Elec to I&T	01APR04 *
Flight Tracker Tower 1, 2 RFI	26APR04 *
Flight Calorimeter Tower 1,2 RFI from I&T to I&T	26APR04 *
ACD Flight Unit at SLAC, Tested/Inspected & RFI	26APR04 *
Flight ICM/GLT-Elec to I&T	26APR04 *
Flight SIU-Elec to I&T	26APR04 *
Flight Event Processor Units-Elec to I&T	26APR04 *
Flight ACD Module-Elec to I&T	26APR04 *
Flight Harness-Elec to I&T	26APR04 *
X-LAT Thermal Plate RFI from Mech to I&T	26APR04 *
LAT Monte Carlo simulation by SAS to I&T SVAC	07MAY04 *
LAT MC Runs Ready	07JUN04 *



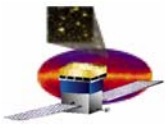
## Key Level III Milestones

LAT operations Rev by Sys Eng-I&T to System	30JUN04 *
Pre-NRL-Environ Readiness Rev/Safety-I&T to Sys	16AUG04 *
Ready to ship for Environmental I&T to NRL	16AUG04 *
Radiators ready for Mission I&T from Mech to I&T	16AUG04 *
LAT Data files avail for analysis-SAS to I&T*	20AUG04 *
LAT EMI/EMC Test from I&T to IOC	23SEP04 *
Integrate LAT on Vibe Mount-I&T to Mech	08OCT04 *
LAT Vib/Acoustic Test from I&T to IOC	18OCT04 *
LAT Thermal Test from I&T to IOC	25OCT04 *
Integrate LAT on Thermal-Vac Mount-I&T to Mech	25OCT04 *
LAT Final Functional Test @ NRL from I&T to IOC	29NOV04 *
Pre-Ship Review to SCO & Safety-I&T to Syst	20DEC04 *
LAT Hand off to IOC	31MAR06 *



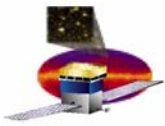
# Key Level IV Milestones

Description	Dates
Ready for I-PDR	03-Dec-01
MGSE Mechanical Eng on Site	01-Mar-02
EM MGSE geometry inform IFCT to Part Tst	29-Mar-02
EM1 Test Stand Done for I&T-Online to IFCT	22-Apr-02
Def of EM FITS File Format-Online from SVAC	14-May-02
Def EM Calib Scripts from SVAC to Online	14-May-02
EM MGSE geometry inform IFCT to Part Tst	12-Jun-02
LAT Transport Box Designed MGSE to IFCT	24-Jun-02
On Line Documentation Complete	24-Jul-02
EM Data Taking Begins	13-Sep-02
Ready for I-CDR	01-Oct-02
VDG Installation Complete	03-Dec-02
EM data taking begins	29-Jan-03
EM Data Taking Complete-Par Tst to SVAC	28-Mar-03
LAT Universal Handling Fixt-to IFCT from MGSE	29-Apr-03
Def of CU FITS file format-Online from SVAC	09-May-03



# Key Level IV Milestones

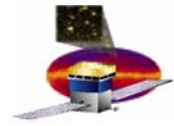
CU Calibr Scripts def from SVAC to Online	09-Jun-03
Def LAT Calibr Scripts from SVAC to Online	10-Jul-03
SLAC ESA Avail for installations	01-Aug-03
SLAC A-line & ESA Beamline work complete	29-Aug-03
CU S/W, Initial Rel from Online to IOC	04-Sep-03
Online CU S/W, Initial Rel	04-Sep-03
Int.Clean Room Ready for LAT Integration	05-Sep-03
CU beam geometry provided by Particle Tests	17-Sep-03
CU beam info for elec log	17-Sep-03
CU beam geometry Particle Tests to SVAC	01-Oct-03
CU-CR & VG data taking begins SVAC to Par Tst	13-Oct-03
Def LAT-Env Calibr Scripts-SVAC to Online	17-Oct-03
Review of CU Ops concept	30-Oct-03
CU-CR & VG Data Taking Begins IOC to Part Tst	31-Oct-03
CU Func/Accept Tst done from IFCT to Par Tst	16-Dec-03



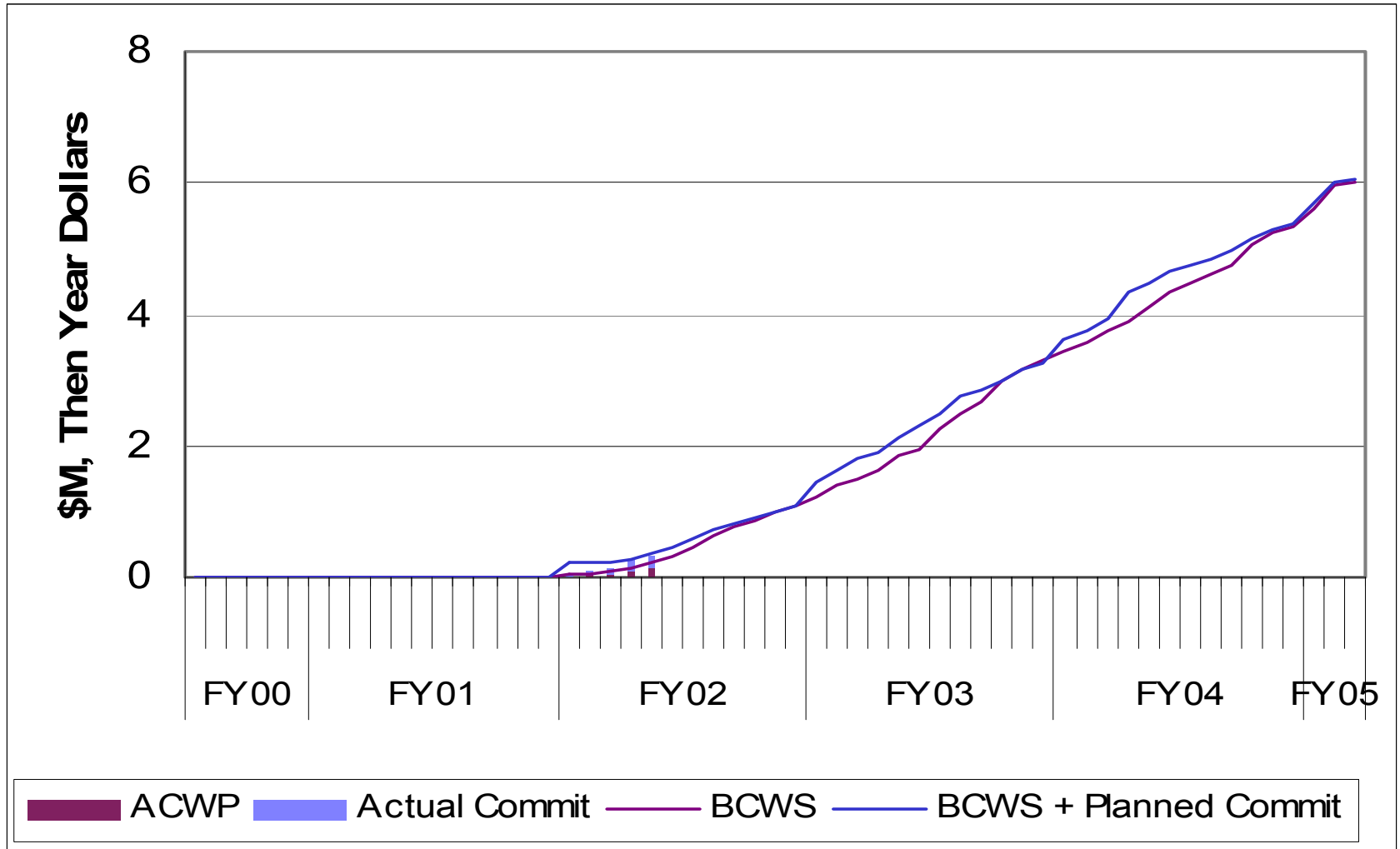
# Key Level IV Milestones

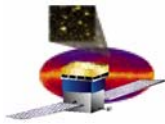
CU-CR & VG data taking -From Par tst to SVAC	06-Jan-04
Positron Data Taking Begins Par Tst to SVAC	06-Jan-04
Photon Data Taking Begins Par Tst to SVAC	21-Jan-04
Hadron Data Taking Begins Par Tst to SVAC	04-Feb-04
Online FU EGSE Suppt IOC CDR	19-Feb-04
CU Beam test data taking Par Tst to SVAC	04-Mar-04
LAT-CR & VG data taking begins ParTst to SVAC	21-May-04
NRL Thermal Test Support @ SLAC EVT to IFCT*	12-Aug-04
Eval SVAC Fit Test Calibr Tools for Inst Ops	17-Aug-04
LAT Airplane data taking complete	17-Aug-04
LAT On Dock @ NRL for Env Test	19-Aug-04
LAT Cosmic Data Taking @ NRL begins	19-Nov-04
LAT Cosmic Data Taking @ NRL Complete	07-Dec-04



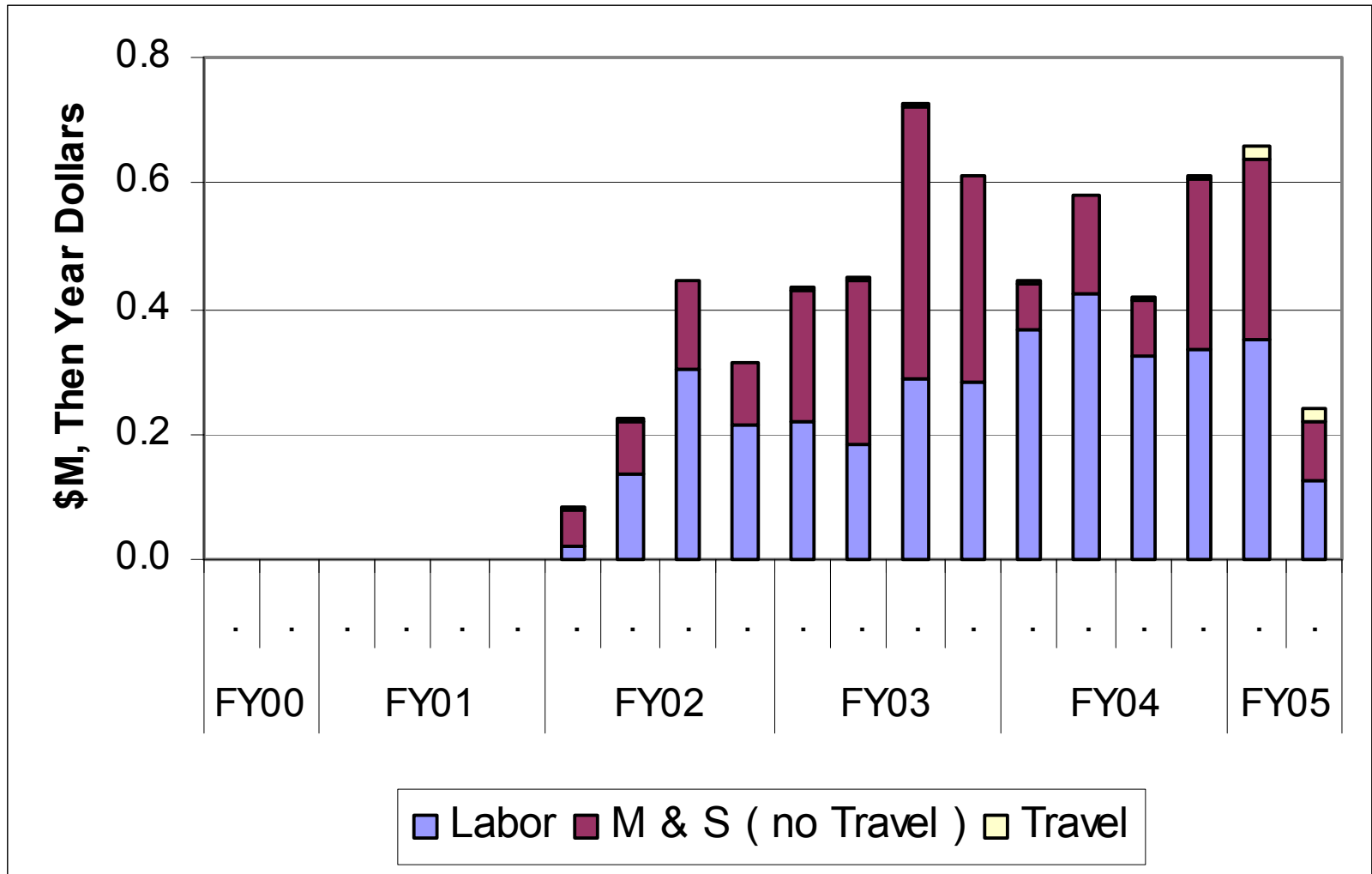


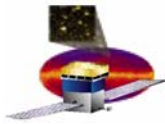
# I & T Cost & Commitments



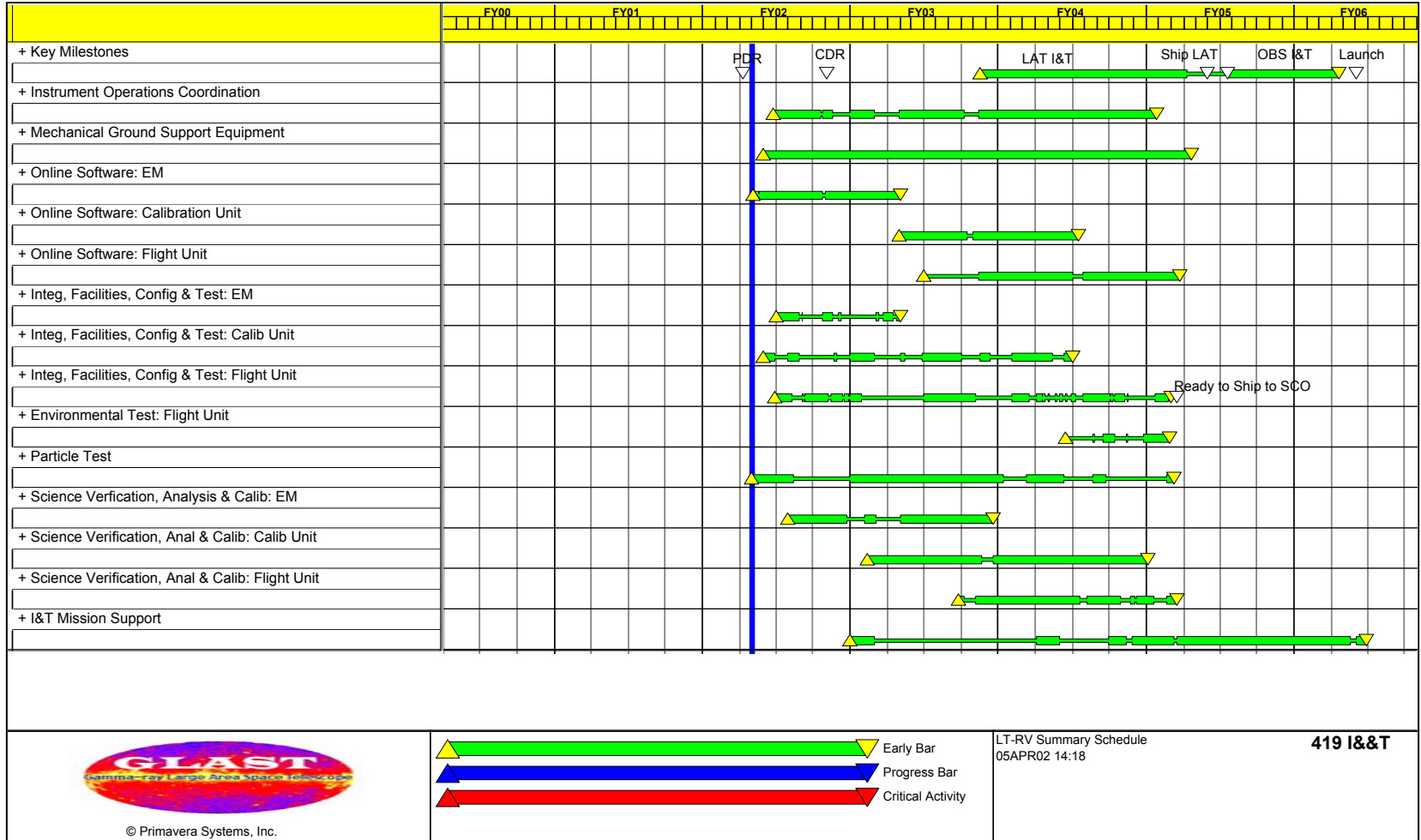


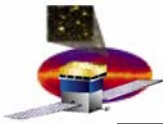
# I & T Cost Type





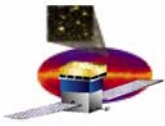
# Integrate and Test Summary Schedule





## I&T RISK ASSESSMENT

RISK	RECOVERY	Po	IMPACT	MITIGATION
<b>Integration</b>				
ACD Fit	Redesign, Modify	0.1	2-4 weeks	Transfer tooling & Early fit check
Electronics Fit	Redesign, Modify	0.05	3-6 weeks	Early fit check
TRK/CAL Fit	Redesign, Modify	0.02	3-6 months	Early fit check
S/S Availability	Adjust Schedule	0.2	3 months	Work arounds
<b>Facilities</b>				
Beam Test	Project Schedule Slip	0.25	< 10 Wks or 9 months	Preserve schedule --add money early
Clean Room Cert	Schedule Slip	0.1	2-4 weeks	Early certification
<b>Verification</b>				
Thermal/Dynamic Failure	Remove/Redesign	0.05	6 months	Early S/S testing
S/S Failure	Remove/Replace	0.1	4-8 weeks	Early testing thorough qual/accept & maintain spares
<b>Preparations</b>				
S/W Failure	Redesign	0.3	2-4 weeks	Early compatability testing
Sequence Accuracy	Redesign	0.1	1-2 weeks	Early compatability testing
GSE Thoroughness	Make New	0.05	4-8 weeks	Thorough handling analysis



## PDR/Lehman Recommendations

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1. Complete the reworked WBS with review and approval by project management by February 2002. **This is Done.**
2. Complete the reworked cost and milestones with review and approval by project management by March 2002. **This is Done.**
3. Perform a subsystem baseline review as soon as possible after the work on items 1 and 2 are complete. **This is scheduled for June.**
4. Write the integration and electronics integration plans and get them under configuration management by March 2002. **Integration and Electronics integration plan Draft 0 is done.**
5. Write a baseline level plan for the airborne test by March 2002 and ensure that any requirements on the subsystems levied by this test are flowed to subsystem managers. **This Plan is in Cyber Docs.**
6. Revision 0 assembly traveler should be written and under configuration control before Qualification Unit A arrives. **This work is in progress with demo available at this review.**