Monthly Progress Report
(Month Ending March 2004)

GLAST Large Area Telescope (LAT)

LAT-MR-03687-01
May 5, 2004
1.0 Introduction

This monthly progress report is submitted to the GLAST Project Office at the Goddard Space Flight Center and the Department of Energy SLAC Site Office. The report summarizes LAT project status as of the end of March, 2004.

2.0 Recent Progress and Status

A review was conducted by DOE and NASA March 31-April 1 to assess the technical, cost, and schedule status.

4.1.4 Tracker
Multichip module (MCM) preproduction was completed. All MCM flight production issues were resolved, and flight production commenced. A new engineer was hired at SLAC to oversee the MCM production. MCM/ASIC qualification tests began, and the engineering-model thermal-vacuum test was completed. Flight tray panel production proceeded, with closeouts and core-facesheet sandwiches assembled for the first several trays. Production of bias circuits was completed for one tower, and production of the remaining bias circuits began. Production of titanium parts and bottom-tray closeouts began. Drawings were completed for Tracker-Grid interface hardware, and orders were placed for engineering-evaluation parts. Flex-circuit cable mechanical layouts were completed, and two electrical layouts are nearly ready for production. Sidewall prepreg procurement began. Special tooling to install MCMs onto trays is being machined. Dummy trays for testing the process were built. Procedure documents were completed for enhanced speckle-pattern interferometry and vibration tray-panel testing. Procedures were drafted for assembly of ladders onto trays, for MCM incoming inspection, and for MCM pitch-adapter screening. Progress was made on quality assurance procedures throughout the Italian collaboration. Work began on preparing the static-test fixture for operation in Italy. Designers were assigned to start work on grid simulators for static and vibration testing for the new interface design.

4.1.5 Calorimeter
Flight production is well underway. Over 50% of the PIN diode assemblies have been manufactured. Over 25% of the Crystal Detector Elements (CDE) have been manufactured. Three carbon composite structures have been manufactured and tested. Two of these have been delivered to NRL. Functional testing and screening has been performed on all flight ASICs (11,000 front-end ASICs version 9A, and 950 readout controller ASICs version 5). The first half of the ASICs are in burn-in. Assembly of the first Pre-Electronics Module has begun.

4.1.6 Anticoincidence Detector
Assembly of the flight front-end electronics cards continued, including installation of the analog ASICs as they are screened. Screening of the digital ASICs continues and the first parts will be ready for assembly in early April. Analysis of the photomultiplier tube anomaly was completed and reviewed; qualification of the new mounting design commenced. The flight composite shell that supports the detectors was completed, as was
the flight base frame assembly. Flight detector testing is underway, and performance is good. Assembly of the high-voltage bias supplies is partially completed; a capacitor replacement for a failed part was received and the screening process begun.

4.1.7 Electronics, Data Acquisition, and Flight Software
The tower electronics modules (TEMs), tower power supplies, and LAT Communication Boards for electrical ground support equipment stations were assembled and tested. The new version of the test-bed power distribution module was received. The schematic of the qualification unit version of the GASU was finalized, and board layout commenced. Seven tower electronics modules and tower power supplies were assembled on the test bed.

The file upload library has been integrated into the primary boot code and the file upload state machine has been finished and unit tested. Bitfield support for the command and telemetry database has been implemented and work on the housekeeping code has been restarted. Configuration file handling and packet creation/handling functionality has been implemented. Work on the thermal control software continued with the basic algorithm working on simulated data. The RAD750 can now be rebooted in a flight crate in ethernet mode, as well as serial mode. An official Windows build of flight software and all scripts and packages are available. The flight software requirements document was updated.

4.1.8 Mechanical Systems
Finish machining operations on the first grid are approximately 50% complete. The second grid has been rough-machined and heat treatment has been completed. The configuration control board has approved revisions to the Grid to accommodate the Tracker interface and Tracker cable chaseway modifications, the revised spacecraft interface, modifications to the grid wing to improve radiator installation and several minor producibility improvements. These changes have been implemented in the solid models, and check prints of the drawings have been created.

4.1.9 Integration & Test (I&T)
The Integration & Test training mockup has been completed and is ready for implementation. An integration kick-off meeting was held. Six of ten open positions have been filled. Version 3.0 of the LAT Test Executive (LATTE) was released; this is the initial online software for integration.
3.0 Schedule Status

There are two equal critical paths for the project, driven by the Tracker MCM production and the delay in the Calorimeter front-end ASIC delivery. The delay in front-end ASIC delivery to Calorimeter also determines the critical path to the integration of the first flight module. There is four weeks’ variance to the baseline float of five weeks to the “ready for CD-4 review” milestone. Workaround plans to mitigate this delay are currently being assessed.

The status of significant milestones is summarized in Attachments 1 and 2. Attachment 1 presents the status of the Level 1 and Level 2 milestones. Attachment 2 shows the status of the Level 3 milestones planned to occur during the six months preceding and following the current month. Unfavorable variance projections greater than one week to the future milestones are discussed below.

The delivery of the full Tracker EM (milestone 1M1001430) has been delayed by the issues discovered with the interface during the EM vibration test. A workaround plan is underway, enabling integration planning to continue by supplying other hardware and drawings in the interim. Thermal vacuum testing was completed in March, and vibration testing will be repeated.

Variances to the following milestones are due to delayed receipt of Calorimeter ASICs and other flight EEE parts. This is the critical path for the project. Much of the schedule will be recovered by using parts before completion of screening and qualification. However, continuing problems with the delivery of tantalum capacitors are impacting the schedule. A sufficient number of alternate capacitors have been found to proceed with the first Calorimeter module electronic cards.
• Calorimeter Modules A through 6 RFI (1M1000210, 1M1500, 1M1000230, 1M1510, 1M1000400, 1M1520, 1M1000390 and 1M1530)
• EM2 TEM/PS for FM9 through FM16 (return FMA through FM6) from I&T to Calorimeter (1M1001790 through 1M1001860)

Variances to the following milestones are due to delays in drawing release driving procurement placement. The drawing release process has been improved, and additional staff has been hired.

• Flight TEM Power Supply Assemblies to I&T (1M79002010 through 1M79002180)
• Flight TEM Assemblies A through 9 to I&T (1M79001010 through 1M79001110)
• Flight Cable Assemblies to I&T (1M79003010 through 1M79003180)

Variances to the following electronics ground support equipment (EGSE) milestones are due to delayed receipt and quality problems with connectors. Effort has been diverted to the installation of Tower Electronics Modules (TEMs) on the Test Bed.

• Updated EGSE Systems (#1-10) to Tracker (1M74000010 through 1M740000100)
• EGSE TEM/TEM PS/CTS w/ FE Electronics #1-3 to I&T (1M7941130, 1M7941150, and 1M7941160)
• G3 Test Stands to ACD (1M76000020 and 1M76000030) – (Note that the first of these was delivered in April.)
• Test Stations (5) for AFEE to Calorimeter (1M1001900)
• EGSE TEM/TEM PS/CTS/GASU FE Electronics to I&T (1M7941170)
• EGSE Development H/W/FSW 1st Delivery to I&T (1M7941180)
• EGSE TEM/TEM PS/CTS #1-2 for Bldg. 33 to I&T (1M7941190 and 1M7941420)
• EGSE TEM/TEM PS/CTS w/ GASU for Bldg. 33 to I&T (1M7941430)
• 5 EM2 TEM/PS for AFEE board assy & test: Elec to Cal (1M1001870)

Variances to the following milestones are due to a delay in completion of the Tracker/Calorimeter tower electronics module (TEM) ASIC qualification and screening plan. This is not considered critical path at this time.

• EM2 TEM/PS/CTS for Flight Models A-8 to Calorimeter (1M1001220, 1M1001600, 1M1001660, 1M1001680, 1M1001720, 1M1001760, 1M1001770, 1M1001780)

The schedule for the ACD Test Scripts (1M1001000) will be restored in the next reporting period.

The ISOC CDR date (1M005480) was delayed from March to August. This was a recommendation of the ISOC Peer Review held this month, and aligns the review date with the documentation availability. This has been coordinated with the GLAST project office at Goddard to minimize the impact on LAT ground system readiness.
4.0 Financial Status

Attachment 3 depicts the costs, commitments, and performance through the end of the current reporting period.

Attachments 4 and 5 summarize the actual costs through the current period, by WBS level 3 and institution, respectively. The hours worked/FTE lines include only DOE/NASA-funded labor.

5.0 Performance Status (Comparison to Project Baseline)

Attachment 6 is a Cost Performance Report (CPR) for the end of the current reporting period, by WBS level 3. The CPR shows the time-phased budget to date (BCWS), the earned value (BCWP), and the actual costs through the end of the month (ACWP). Attachment 7 shows the same information for each participating DOE- and/or NASA-funded institution. The schedule variance is equal to the difference between the budget-to-date and the earned value and represents a measure of the ahead (positive) or behind (negative) schedule position. The cost variance is equal to the difference between the earned value and the actual costs.

Attachment 8 shows performance analysis (by WBS level 3), including trends in the schedule and cost variances from the previous period. Cumulative cost variances exceeding 10% of the BCWP and cumulative schedule variances exceeding 10% of BCWS (favorable and unfavorable) are discussed below.

4.1.A Performance & Safety Assurance
The favorable cost variance is due to delayed subcontractor invoice payments, and is not a concern at this time.

4.1.C Education & Public Outreach
The favorable cost variance is due to delayed subcontractor invoice payments, and is not a concern at this time.
### 6.0 Change Control and Contingency Analysis

A summary of change requests approved during this period (Level 3 and above), including the impacts on LAT fabrication phase contingencies, is below.

<table>
<thead>
<tr>
<th>Change Request No.</th>
<th>Description</th>
<th>Submitted By</th>
<th>Current Status</th>
<th>Contingency Impact</th>
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<td>LAT-XR-03019-01</td>
<td>ACD Phototube Helium Requirements</td>
<td>D. Thompson</td>
<td>Approved</td>
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<td>LAT-XR-03066-01</td>
<td>GSFC MPS Tax Budget Reduction</td>
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<td>LAT-XR-03191-01</td>
<td>Voltage Monitors</td>
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<td>LAT-XR-03192-01</td>
<td>Flight Temp Sensor Placement &amp; Distribution</td>
<td>R. Bielawski</td>
<td>Approved</td>
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<td>LAT-XR-03306-01</td>
<td>ACD Mechanical Materials &amp; Support</td>
<td>T. Johnson</td>
<td>Approved</td>
<td>N/A&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>LAT-XR-03307-01</td>
<td>ACD PMT Anomaly Resolution</td>
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The fabrication phase cost baseline is $124.1M. Funding applicable to that baseline is $136.6M; the resulting contingency is $12.4M.

### 7.0 Staffing

Attachments 9-10 demonstrate the staffing plan, and reports of actual manpower received. Note from Attachment 10 that not all participating organizations are providing manpower data.

The monthly planned FTEs reflect adjustments made so that the cumulative-to-date manpower plan corresponds to the approved changes in that month.

Goddard manpower was not reported in the months of October, November, and December. The January and February incremental FTE report includes the actual manpower for those months, so that the cumulative-to-date actual manpower is correct.

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<sup>1</sup> Budget reduction of $1,051K is directly offset by corresponding NASA funding decrease.
<sup>2</sup> Budget increase of $195K is directly offset by corresponding NASA funding increase.
<sup>3</sup> Budget increase of $299K is directly offset by corresponding NASA funding increase.
<sup>4</sup> Budget increase of $222K is directly offset by corresponding NASA funding increase.
<sup>5</sup> Budget increase of $94K is directly offset by corresponding NASA funding increase.
## Attachment 1
### Milestones, Levels 1-2

<table>
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<tr>
<th>Activity ID</th>
<th>Activity Description</th>
<th>Target Finish Date</th>
<th>Variance</th>
<th>Scheduled Finish Date</th>
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<td>DOE Critical Decision (CD) 0 Approval</td>
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### Instrument Project Office (Level 3)

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<td>1M1001520</td>
<td>EM CAL Returned to NRL (arrives on dock)</td>
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<td>1M1001380</td>
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<td>1M1001430</td>
<td>Delv of TKR EM to SLAC I&amp;T/MSGE</td>
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## Attachment 2
### Level 3 Milestones (One-Year View)

#### Activity ID

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<th>Variance</th>
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<td>1M1001650</td>
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<td>1M74000070</td>
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© Primavera Systems, Inc.
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## Instrument Project Office (Level 3)

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Attachment 3
Budget vs Actuals vs Performance
DOE + NASA Project Expenditures
4.1 LAT

[Graph showing budget vs actuals vs performance across different fiscal years (FY00 to FY05)]
### LAT Costs, through March 2004, by WBS

#### Monthly Contractor Financial Management Report

**To:**
Kevin Grady, GLAST Project Manager (NASA)  
Ev Valle, LAT Project Manager (DOE)

**From:**
Tanya Boysen, LAT Project Controls Manager

**Cost:**
$0

**Fund Limitation:**
$0

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Attachment 5
LAT Costs, through March 2004, by Organization and Cost Code

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## LAT Performance, through March 2004, by WBS

### Cost Performance Report - Work Breakdown Structure

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### LAT Performance, through March 2004, by Organization

#### Cost Performance Report - Work Breakdown Structure

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#### OBS[1]

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### LAT Performance Analysis, March 2004

#### LEGEND

- **BAC**: Budget At Complete
- **BCWS**: Budgeted Cost of Work Scheduled (to date)
- **BCWP**: Budgeted Cost of Work Performed (to date)
- **ACWP**: Actual Cost of Work Performed (to date)
- **SV $**: Schedule Variance = BCWP - BCWS
- **CV $**: Cost Variance = BCWP - ACWP
- **% BCWS**: Percent Scheduled = BCWS / BAC
- **% BCWP**: Percent Complete = BCWP / BAC
- **% ACWP**: Percent Spent = ACWP / BAC
- **SPI**: Schedule Performance Index = BCWP / BCWS
- **CPI**: Cost Performance Index = BCWP / ACWP
- **SPI Trend**: Better than 1.10
- **CPI Trend**: Better than 1.10
- **SPI and CPI Change Thresholds**
  - Worse than .85
  - Between .95 and 1.10
  - Between .85 and .95
  - Better than 1.10

#### LAT Performance Analysis, March 2004

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Note: Monthly planned manpower reflects adjustments so that the cumulative-to-date plan corresponds to the approved changes for that month.
### LAT Manpower Data, through March 2004, by Organization

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#### Cum-to-Date

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**Grand Totals:***

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**4.1 GLAST LAT***

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**Grand Totals:***

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