GLAST
Gamma-ray Large Area Space Telescope

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for the GLAST LAT Collaboration

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GLAST Key Features

- **Huge field of view**
  - LAT: 20% of the sky at any instant; in sky survey mode, expose all parts of sky for ~30 minutes every 3 hours. GBM: whole unocculted sky at any time.

- **Huge energy range, including band 10 GeV - 100 GeV**

- **Will transform the HE gamma-ray catalog:**
  - by > order of magnitude in # point sources
  - spatially extended sources
  - sub-arcmin localizations (source-dependent)

**Two GLAST instruments:**
LAT: 20 MeV – >300 GeV
GBM: 10 keV – 25 MeV
Launch: Dec 2007. 565 km, circular orbit
5-year mission (10-year goal)
GLAST Operating Modes

- Primary observing mode is Sky Survey
  - Full sky every 2 orbits (3 hours)
  - Uniform exposure, with each region viewed for ~30 minutes every 2 orbits
  - Best serves majority of science, facilitates multiwavelength observation planning
  - Exposure intervals commensurate with typical instrument integration times for sources
  - EGRET sensitivity reached in ~days

- Pointed observations when appropriate with automatic earth avoidance selectable. Target of Opportunity pointing.

- Autonomous repoints for onboard GRB detections in any mode.
Overview of LAT

- **Precision Si-strip Tracker (TKR)**
  18 XY tracking planes. Single-sided silicon strip detectors (228 µm pitch)
  Measure the photon direction; gamma ID.

- **Hodoscopic CsI Calorimeter (CAL)**
  Array of 1536 CsI(Tl) crystals in 8 layers.
  Measure the photon energy; image the shower.

- **Segmented Anticoincidence Detector (ACD)**
  89 plastic scintillator tiles.
  Reject background of charged cosmic rays; segmentation removes self-veto effects at high energy.

- **Electronics System**
  Includes flexible, robust hardware trigger and software filters.

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

United States
- University of California at Santa Cruz - Santa Cruz Institute of Particle Physics
- Goddard Space Flight Center – Laboratory for High Energy Astrophysics
- Naval Research Laboratory
- Ohio State University
- Sonoma State University
- Stanford Linear Accelerator Center
- Stanford University (KIPAC, HEPL, Physics Dept.)
- University of Washington
- Washington University, St. Louis

France
- IN2P3, CEA/Saclay

Italy
- INFN, ASI, INAF

Japanese GLAST Collaboration
- Hiroshima University
- ISAS, RIKEN

Swedish GLAST Collaboration
- Royal Institute of Technology (KTH)
- Stockholm University

~230 Members (including ~84 Affiliated Scientists, plus 24 Postdocs, and 36 Graduate Students)

Cooperation between NASA and DOE, with key international contributions from France, Italy, Japan and Sweden.

Managed at Stanford Linear Accelerator Center (SLAC).
GLAST LAT Sponsors

United States
   Department of Energy
   National Aeronautics and Space Administration

France
   Commissariat á l’Energie Atomique (CEA)
   Centre National de la Recherche Scientifique / Institut National de
   Physique Nucléaire et de Physique des Particules (IN2P3)

Italy
   Agenzia Spaziale Italiana (ASI)
   Istituto Nazionale di Fisica Nucleare (INFN)

Japan
   Ministry of Education, Culture, Sports, Science and Technology
   High Energy Accelerator Research Organization (KEK)

Sweden
   Royal Institute of Technology (KTH)
   Swedish Space Board
   K. A. Wallenberg Foundation

all the LAT sponsors are represented on the GLAST LAT International Finance Committee
LAT Status

- After integration at SLAC and environmental testing at NRL, shipped to General Dynamics/Spectrum Astro in September. Now integrated with the spacecraft.

- Beam tests of Calibration Unit (flight spare components) completed at CERN and at GSI.

- Pending flight software updates scheduled (June 26) for bug fixes and to implement onboard science (GRB) algorithms.
Latest Picture of GLAST Observatory

General Dynamics, Gilbert, AZ
16 Towers with ACD
GLAST MISSION ELEMENTS

- DELTA 7920H
- GPS
- GN
- GLAST Spacecraft
- Large Area Telescope & GBM
- Telemetry 1 kbps
- White Sands
- TDRSS SN S & Ku
- LAT Instrument Science Operations Center
- GRB Alerts
- Data, Command Loads Schedules
- Mission Operations Center (MOC)
- GLAST Science Support Center
- LAT Instrument Science Operations Center
- GBM Instrument Operations Center
- HEASARC GSFC
GLAST has a very broad menu that includes:

- Systems with supermassive black holes (Active Galactic Nuclei)
- Gamma-ray bursts (GRBs)
- Pulsars
- Binary systems, microquasars
- Solar physics
- SNRs, Origin of Cosmic Rays, PWN
- Probing the era of galaxy formation, optical-UV background light
- Solving the mystery of the high-energy unidentified sources

Huge increment in capabilities.
LAT Collaboration Organization, Science Groups

- Group Coordinators report to Analysis Coordinator (J. McEnery)
- each group identifies MW needs and submits proposals and makes connections through LAT MW Coordinator (D.J. Thompson)

LAT Science Group Coordinators
- Catalog: Grenier, Digel, Ballet
- Diffuse: Porter, Grenier
- Pulsars/SNR: Harding, Romani
- AGN: Tosti, Lott
- UNID: Caraveo, Reimer
- GRB: Omodei, Connaughton
- Solar: Longo, Share
- DM and New Physics: R. Johnson, J. Conrad
- Calibration and Analysis Methods: P. Bruel, L. Latronico

see http://www-glast.stanford.edu/
and
http://www-glast.slac.stanford.edu/
Data Challenges

Data challenges provide excellent test beds for science analysis software.

Full observation, instrument, and data processing simulation. Team uses data and tools to find the science. “Truth” revealed at the end.

A progression of data challenges.

- **DC1 in 2004.** 1 simulated week all-sky survey simulation.
  - find the sources, including GRBs
  - a few physics surprises

- **DC2 in 2006.** 55 simulated days all-sky survey.
  - first catalog
  - add source variability (AGN flares, pulsars). lightcurves and spectral studies. correlations with other wavelengths. add GBM. study detection algorighths. benchmark data processing/volumes.
GLAST One-year Service Challenge Simulation

red: 0.1-0.4 GeV  
green: 0.4-1.6 GeV  
blue: >1.6 GeV
• ISOC facility build-out at SLAC completed in January

• Flight Operations
  – LAT flight software and development of operations narrative procedures for use in MOC
  – Support of GLAST mission testing: Ground Readiness Tests 6 and 7, End-to-End test 1, Mission Planning Exercise 1, Instrument Commissioning simulation in MOC
  – launch and early on-orbit preparations

• Science Operations
  – Many contributions from LAT collaboration support
    • E.g. IRF monitoring, instrument anomalies
  – Development of on-orbit tools
    • Instrument monitoring, LAT configuration, calibration trending

• Science Analysis Systems
  – Support for Collaboration analysis and ISOC operations through Service Challenges
  – Procurement of computer processors and disk for launch readiness
  – Improved processing pipeline in place
Launch Schedule

- Official Launch Readiness Date (LRD) remains 12/14/07.
- KSC has indicated significant delays in the completion of the Delta IIH 1st and 2nd stages. KSC has requested United Launch Alliance provide information supporting readiness for 12/14/07 LRD.
- General Dynamics has encountered several issues that have resulted in erosion of schedule reserve. Currently projecting a January 2008 launch date. NASA has requested a recovery plan from GD to address steps to be taken to improve schedule performance.
- The GLAST Mission and General Dynamics will continue to aggressively manage the schedule and actively mitigate potential threats
Forward Plan

- Complete observatory environmental test program.
  - Electromagnetic interference/compatibility (June)
  - Acoustics, vibration, shock (July/August)
  - Thermal/vacuum & thermal balance (August/Sept)
- Complete End-to-End test program.
- Conduct numerous launch simulations.
- Ship to launch site (mid-Oct).
- Conduct launch site campaign

• Launch in December 2007... Science Operations begin within 60 days ... the high-energy gamma-ray universe opened dramatically for exploration.