GLAST Large Area Telescope:
Science Analysis Software Overview
WBS: 4.1.D

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Outline

• Overview

• Level III Requirements Summary

• WBS Interfaces

• Cost
Science Analysis Software Overview

• Data Pipeline
  – Prompt processing of Level 0 data through to Level 1 event quantities
  – Providing near real time monitoring information to the IOC
  – Monitoring and updating instrument calibrations
  – Reprocessing of instrument data
• Performing bulk production of Monte Carlo simulations
• Higher Level Analysis
  – Creating high level science products from Level 1 for the PI team
    • Transient sources
    • Point source catalogue
  – Providing access to event and photon data for higher level data analysis
• Interfacing with other sites (sharing data and analysis tool development)
  – mirror PI team site(s)
  – SSC
• Supporting Engineering Model and Calibration tests
• Supporting the collaboration for the use of the tools
Data Flow

Data recon + MC on disk. Abstract full-recon output into L1 DB for analysis

Fully automated server, with RDB for data catalogue + processing state. Uses SLAC batch CPU and disk farms.

Parts of L2 processing also automated
Level 1 Chain

Source Fluxes → Particle Transport → "Raw" Data → Recon → Background Rejection - Particle ID

3 GeV γ
Processing Pipeline

Level 0
IOC
Batch system
Level 0
HSM
Level 1, diagnostics
Automated Tape Archive

50-100 CPUs; ~50 TB disk by 2010
# Level III Requirements Summary

<table>
<thead>
<tr>
<th>Function</th>
<th>Requirement</th>
<th>Expected Performance (if applicable)</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight Ground Processing</td>
<td>perform prompt processing from Level 0 through Level 1</td>
<td>keep pace with up to 10 GB Level 0 per day and deliver to SSC within 24 hrs</td>
<td>demonstration</td>
</tr>
<tr>
<td></td>
<td>provide near-real time monitoring to IOC</td>
<td>within 6 hrs</td>
<td>demonstration</td>
</tr>
<tr>
<td></td>
<td>maintain state and performance tracking</td>
<td></td>
<td>demonstration</td>
</tr>
<tr>
<td></td>
<td>facilitate monitoring and updating of instrument calibrations</td>
<td></td>
<td>demonstration</td>
</tr>
<tr>
<td></td>
<td>archive all data passing through</td>
<td>&gt; 50 TB on disk and tape backup</td>
<td>demonstration</td>
</tr>
<tr>
<td>Instrument Design Support</td>
<td>Create simulation tool, based on instrument geometry, that reproduces the interactions of photons and background</td>
<td>system test - comparison to balloon flight and existing data</td>
<td>system test</td>
</tr>
<tr>
<td></td>
<td>Create physics model of expected photons and backgrounds incident upon the instrument</td>
<td>system test - comparison to balloon flight and existing data</td>
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<tr>
<td></td>
<td>Create algorithms to interpret the data from the instrument to identify the interaction and estimate photon direction and energy</td>
<td>system test - comparison to balloon flight and engineering model tests</td>
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<td></td>
<td>Create algorithms to generate calibration constants for the subsystem components</td>
<td>system test - in conjunction with engineering model tests</td>
<td></td>
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<tr>
<td>High Level Tools</td>
<td>Interface with the SSC and PI mirror sites, sharing selected data and algorithms</td>
<td></td>
<td>demonstration</td>
</tr>
<tr>
<td></td>
<td>Create High-Level Science products. Development of analysis tools</td>
<td></td>
<td>demonstration</td>
</tr>
<tr>
<td>Mission Support</td>
<td>Support the Software system for the life of the mission</td>
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<td>demonstration</td>
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</tbody>
</table>
Science Analysis Software Status

- Ported existing simulation/reconstruction code to new environment: architecture, I/O, code management
  - Will need another iteration to optimize use of the new tools
- Ported ’99 Beam Test version of Recon to be mainstream – used for PDR Instrument Performance and BFEM
  - Gained experience leading to redesign (in progress)
- Supported BFEM data handling and analysis
- Supported PDR Instrument Performance
  - Bulk production of simulations on SLAC linux farm
  - Tuned up Sources and recon algorithms
- Preparing to bring GEANT4 simulation package online
- On target for Spring and Fall Major Sim/Recon code releases
- Started work defining Level 1 database requirements and technology with SSC
- Negotiating with SSC on responsibilities and scope of shared Science Tools efforts
- Joint planning workshop with SSC in early Spring ‘02
Responses to Pre-Baseline Recommendations

- Develop resource-loaded cost and schedule
  - Done
- Develop clear, formal agreements with all off-project software providers
  - Agreements in place with Italy, France and Japan
  - Not ‘formal’, but is in budget/schedule/work-packages
  - Expected to expand as Science Tools effort crystallizes
- Plan for calibration software development in conjunction with the detector subsystems.
  - Done, with I&T
- Plan for a sufficient level of infrastructure staffing to track changes and development in all the software tools planned for use.
  - Devoting new SLAC hire to librarian, code dist, etc tasks
  - Targeted new GSFC hire to user support
    - Delayed 1 yr by budget cut
- Define parts of software that are mission critical and determine a reasonable contingency for those parts.
  - done
SAS Organization

Instrument Project Office

R.Dubois
Manager
4.1.D
SLAC

T.Burnett
Sim/Recon
4.1.D.1
UW

H.Kelly
ACD
4.1.D.1.5
GSFC

E.Grove, A.Djannatti-Atai
CAL
4.1.D.1.6
NRL, France

T.Usher
TKR
4.1.D.1.7
SLAC, UCSC, Italy

Y.Fukazawa
Sources
4.1.D.1.1
Hiroshima, Stanford

A.de Angelis
GEANT4
4.1.D.1.4
Italy

E.do Couto e Silva
Calibrations
4.1.D.6
SLAC

S.Digel
Science Tools
4.1.D.4
GSFC

H.Kelly
Analysis Tools
4.1.D.2
GSFC

Performance Tune & Mon
4.1.D.2.8

K.Young
Release MAnagement
4.1.D.2.9
SLAC

Performance Metrics
in conjunction with
S.Ritz GSFC

Trigger Simulation
4.1.D.1.8

Background Rejection
4.1.D.1.9

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Section 7.8 SAS Overview 11
## SAS Interface Milestones (Level 3)

<table>
<thead>
<tr>
<th>Milestone Description</th>
<th>Date</th>
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<tbody>
<tr>
<td>Science Analysis Software Requirements Review</td>
<td>04/20/01</td>
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<tr>
<td>Science Analysis Software PDR</td>
<td>08/17/01</td>
</tr>
<tr>
<td>AV: Calibration Prototype Coding for I &amp; T</td>
<td>05/15/02</td>
</tr>
<tr>
<td>AV: ACD Pulse Height Histograms for I &amp; T</td>
<td>06/21/02</td>
</tr>
<tr>
<td>AV: Tracker Dead/Noisy Strips for I &amp; T</td>
<td>06/21/02</td>
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<tr>
<td>Science Analysis Software CDR</td>
<td>09/04/02</td>
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<tr>
<td>AV: Tracker Tower &amp; Tray Alignment</td>
<td>01/22/03</td>
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## Key SAS Milestones (Level 4)

<table>
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<tr>
<th>Milestone</th>
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<tr>
<td>Prototype Release Manager in Place</td>
<td>03/11/02</td>
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<tr>
<td>AV: 1st Major Release of Simulation &amp; Reconstr'n</td>
<td>04/09/02</td>
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<tr>
<td>Second Major Code Release</td>
<td>10/25/02</td>
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<td>Annual Evaluation &amp; Tracking of LAT Performance</td>
<td>12/23/02</td>
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<td>Photon Database Technology Implemented</td>
<td>01/14/03</td>
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<td>Completed Instrument Response function</td>
<td>05/29/03</td>
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<td>Annual Evaluation &amp; Tracking of LAT Performance</td>
<td>08/29/03</td>
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<tr>
<td>Production Version of Data Processing Facility</td>
<td>01/08/04</td>
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<td>Annual Evaluation &amp; Tracking of LAT Performance</td>
<td>08/31/04</td>
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<tr>
<td>Annual Evaluation &amp; Tracking of LAT Performance</td>
<td>08/31/05</td>
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<tr>
<td>Science Tools in Place</td>
<td>11/21/05</td>
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<tr>
<td>Final End-to-End test</td>
<td>01/04/06</td>
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<td>Data Processing Facility Completed</td>
<td>01/04/06</td>
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Science Analysis Software Cost & Commitments

4.1.D Science Analysis Software Costs and Commitments

FY00 FY01 FY02 FY03 FY04 FY05 FY06

$M, Then Year Dollars

AGWP Actual Commit BCWS BCWS + Planned Commit
Science Analysis Software Cost Profile

4.1.D Science Analysis Software Cost Type

<table>
<thead>
<tr>
<th>Year</th>
<th>Labor</th>
<th>M &amp; S (no Travel)</th>
<th>Travel</th>
<th>Taxes (GSFC)</th>
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$M, Then Year Dollars