GLAST Large Area Telescope: EM Status Report

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EM Program @ SLAC

- **Mechanical Integration**
  - Develop I&T procedures for flight integration

- **Functional Tests**
  - Develop I&T EGSE framework for flight integration
  - Develop test suite for I&T flight integration
  - Test functionality of individual hardware
  - Test functionality of integrated hardware

- **Flight Software Development**
  - Preliminary discussions indicate that any FSW use depends on successful characterization of integrated system during functional tests

- **Particle Data Taking**
  - Measure position resolution in CAL using TKR tracks
  - Reconstruct Photons with TKR trigger
  - Measure VDG spectrum in EM CAL with CAL trigger
EM Test Flow

Stand-alone TKR Mini-Tower tests
- Receive TKR mini-tower at SLAC
- TKR Mini-tower Post Ship Test
- Install mini-tower on EM single bay
  - AUG 11 – AUG 27
  - CAL script migration

Stand-alone CAL tests
- Receive CAL Module at SLAC from NRL
- CAL Module Post-Ship Test (in shipping container)
- Install CAL Module in EM Single Bay
- Single Bay Electrical Performance Tests
  - AUG 27

Stand-alone TKR Mechanical Model tests
- Receive EM TKR Mechanical Tower
- Mechanical TKR Inspection/Test
  - COS 17 - OCT 1
  - Cosmic ray data taking
  - SEP 19 - OCT 9
  - Flight Software Development
  - OCT 2 - 6
  - Van de Graaff data taking

Stand-alone EM Grid tests
- Receive EM Grid
- EM Grid Inspection/Test
- Install Mech. TKR into EM Grid
- Fit Check w/ Mech TKR, CAL, and EM GRID
- EM CAL Shipped to NRL and on dock
  - OCT 14
  - OCT 17

E. do Couto e Silva
## Mechanical Integration

<table>
<thead>
<tr>
<th>DATE</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 7</td>
<td>CAL Arrival @ SLAC</td>
<td>On time delivery !</td>
</tr>
<tr>
<td>Aug 22</td>
<td>TKR Arrival @ SLAC</td>
<td>On time delivery !</td>
</tr>
<tr>
<td>Aug 27</td>
<td>Install TKR in single bay</td>
<td>Cable problems delayed integration</td>
</tr>
<tr>
<td>Aug 28</td>
<td>Install CAL in single bay</td>
<td>TKR and CAL integrated in 1 day (Sep 2)</td>
</tr>
<tr>
<td>Sep 16</td>
<td>Cosmic Ray Set Up Ready</td>
<td></td>
</tr>
<tr>
<td>Oct 1</td>
<td>VDG Set Up Ready</td>
<td></td>
</tr>
<tr>
<td>Oct 13</td>
<td>Install Mech. TKR in 1x4 Grid</td>
<td>Postponed to Mid November</td>
</tr>
<tr>
<td>Oct 17</td>
<td>CAL back at NRL dock</td>
<td></td>
</tr>
</tbody>
</table>

Thanks to everyone’s effort we are on schedule!
TKR installation
Thanks for the new features Xin!
CAL Instalation
CAL reports and Plots

Shame on you Eduardo for not being able to show the nice plots and reports provided with the CAL functional test !!!
# Functional Tests

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Aug 7-8</td>
<td>Test CAL using TEM/PS and CAL EGSE</td>
<td>Good preliminary documentation from CAL including tests, plots and reports</td>
</tr>
<tr>
<td>Aug 11-27</td>
<td>CAL script migration to I&amp;T EGSE system</td>
<td>First release to CAL by Sep 5. We are at a stage that the CAL LATTE scripts allow us</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to support the integrated system</td>
</tr>
<tr>
<td>Aug 25-26</td>
<td>Test TKR using another TEM/PS and I&amp;T EGSE</td>
<td>We have developed a concise set of Limited Functional Tests. Problems found prior to delivery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>at SLAC are being investigated.</td>
</tr>
<tr>
<td>Aug 28-29</td>
<td>Test TKR/CAL integrated system</td>
<td>Done by Sep 2 thanks to the incredible effort of the EM crew</td>
</tr>
<tr>
<td>Sep 1-12</td>
<td>CAL script migration (if necessary) and script development for integrated</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td>system</td>
<td>system</td>
</tr>
<tr>
<td>Sep 15-16</td>
<td>Test TKR/CAL integrated system (set baseline for particle data taking)</td>
<td></td>
</tr>
</tbody>
</table>

Thanks to everyone’s effort we are on schedule!
TKR Cosmics – efficiency ("online")

Detection efficiency for layerX3

- About 1.3 MIPs

Preliminary data

Thanks Luca!
## Data Taking

<table>
<thead>
<tr>
<th>DATE</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
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</thead>
<tbody>
<tr>
<td>Sep 17-26</td>
<td>Cosmic rays with TKR trigger vertical position</td>
<td></td>
</tr>
<tr>
<td>Sep 29</td>
<td>Cosmic rays with TKR trigger vertical position (Threshold scan)</td>
<td></td>
</tr>
<tr>
<td>Sep 30</td>
<td>Cosmic rays with TKR trigger vertical position (Bias scan)</td>
<td></td>
</tr>
<tr>
<td>Oct 1</td>
<td>Cosmic rays with TKR trigger horizontal position</td>
<td></td>
</tr>
<tr>
<td>Oct 2-3</td>
<td>VDG Data Taking TKR trigger</td>
<td></td>
</tr>
<tr>
<td>Oct 6</td>
<td>VDG Data Taking CAL trigger</td>
<td></td>
</tr>
</tbody>
</table>

We believe we can maintain schedule but we need help from Collaborators to “fully” characterize the system prior to data taking.

Some of the I&T crew will be away during the month of September
Ric – Sep 3-23
Eduardo – Sep 12 -23
Selim - Sep 5 -29
At last the CAL goes first!

- **Highlights**
  - On time delivery with support from 3 CAL people
  - Preliminary documentation allowed I&T to evaluate the acceptance criteria
  - Although some of mechanical procedures were missing, they were developed in a timely fashion in conjunction with the I&T group
  - Since delivery, CAL and I&T have been holding weekly meetings to resolve issues and prepare for integrated system tests
TKR Mini Tower is back…

• Highlights
  – Italian Collaborators put a considerable effort to beef up the documentation and to understand the system prior to its delivery
  – On time delivery with support from 1 person (but he never stops to work so we can count him as 2 !)
  – Some problems identified prior to shipment continue to be investigated at SLAC, and TKR is taking the lead to solve them in conjunction with ELX and I&T (Bravo Luca !)
  – UCSC post docs have also come to SLAC to participate in the EM effort
I&T Coordination

• Highlights
  – The implementation of the I&T Plan has been essential to identify processes and issues, which need to be resolved for flight integration
  – The rapid development of tools and procedures and the commitment of the people involved have kept the EM on schedule
  – The EM effort has produced a positive effect on the communication across subsystems
ELX is guiding the tests

• Highlights
  – The electronics crew have put extra effort in guiding the EM crew throughout the debugging procedures to fully characterize the system.
  – They organized and EM dinner improve Team spirit (thanks Mike)
SAS is coming on board

• Highlights
  – SAS is already debugging test files for offline processing (thanks Joanne and Heather)
  – Their contribution is ramping up as we approach the data taking period
CAL/TKR Integration

CAL being lowered while the EM crew protect the TKR cables
CAL/TKR Integration

CAL being lowered using the alignment fixture
CAL/TKR Integration

These are the master minds behind the smooth mechanical integration.
Preliminary data

GLAST Online Single Event Display

Preliminary Cosmic Ray Data taken on Sep 3 !!!

Thanks Jim, Luca, and Selim!

CAL
• Pedestal subtracted
• Zero suppress off
• 4 range off
Integrated System - Preliminary Results

Preliminary data

- BINS for Xtal: 9
  - Pedestal subtracted
  - Hit Map (6, 7, 0)
  - TOT (6, 7, 0)

- pos vs neg end, Xtal: 9
  - Pedestal subtracted

E. do Couto e Silva
Mahalo !!

Thanks to Debbie, Diana and Chris for making life less stressful during the EM effort!

A little chubby for a hula dancer!
The people that make the difference!

Bloom, Elliott
Claus, Ric
Chen, Xin
do Couto e Silva, Eduardo
Gawehn, Eric
Godfrey, Gary
Grist, Brian
Kavelaars, Alicia
Kamae, Tune
Mizuno, Tsunefumi
Molini, Mark
Panetta, Jim
Rogers, Reggie
Tajima, Hiro
Tice, Jeff
Tuvi, Selim
Wai, Larry

Bui, Henry
Salgado, Lupe
Huffer, Mike
Nelson, Dave
Sapozhnikov, Leonid

Bogaert, Gilles
Giebels, Berrie
Sandora, Patty
Grove, Eric
Leas, Byron
Wolku, Kurt

Baldini, Luca
Bhatnagar, B.J.
Borden, Tom
Latronico, Luca
Williams, Roger
Zeigler, Marcus
Bogart, Joanne
Kelly, Heather
Chehtman, Alexander
Rochester, Leon
Usher, Tracy

As LAT Collaborators we feel there is no need for subsystem labels since we are all working as LAT Collaborators with a LAT EM Integrated Hardware

Thanks to everyone for their extra hours to get the work done (including weekends and holidays, 8 am and 4 pm meetings) and also for the heated but fruitful discussions. At last for keeping good humor when things appear to be going bad…
Summary

- We have successfully integrated CAL/ELX/TKR into a single bay and collected preliminary data.
- In the EM effort we have uncovered issues, which require further investigation (mostly interfaces) and begin improving the processes. These were not the subject of this talk since a full report will be provided at the end EM effort (stay tuned!)
- We are in the process of system characterization/debugging and infrastructure development for data taking.
- We are building the team spirit and we are confident we will get this “puppy” together.
- Can’t thank enough for everyone’s participation including the strong Project Management support!
Back up
TKR Noise occupancy

Preliminary data

Threshold = 30 DAC, range 0. ~ 100000 events, most of the strips never read out.

All strips enabled.

13 noisy strips masked, 10 minutes later.

Thanks Luca!
TKR Cosmics - hitmap

Preliminary data

Threshold = 30 DAC, range 0, 13 strips masked. ~ 15000 events collected.

Thanks Luca!

Y1 and Y2: “shadow” of Y3.

X2: “ladder 4” issue.

X3: 7 wire bonds removed.

Y3: 157 wire bonds missing (due to problems with pitch adapter).
**Mini-TKR to EM TEM Cable Transit**

With 0.642" [16.3 mm] High Cal Base Plate to TEM Stand Off