US M&S Group Report

John Krizmanic (for US M&S Group)
18-Jun-15

1. Action items from last TIM
2. Programmatic activities
3. Epics CALET simulation run summary
4. Summary of group’s analysis activities
5. Summary of presentations by the US M&S group
Action Items from last TIM

1. Get info on ISS solar panels
   a) Have sufficient information on solar cells.
   b) Need information on mechanical structures (from ISS office via NICER).

2. Calculate Soyuz Kaktus background at JEM-EF (completed, see following slides).
Calculation of Soyuz Kaktus Background at the JEM-EF

John Krizmanic & Steve Sturner (CRESST/NASA/GSFC)
18-Feb-15

Methodology:

• Using a mass model of the Soyuz spacecraft and MGEANT, the background flux from the Kaktus gamma-ray-altimeter was calculated for that passing through a disk of 5 m radius located at the center of the inboard side (relative to the Soyuz docking positions) of the JEM-EF.

• The rates are calculated based upon the nominal activity of the 137-Cs source in the Kaktus altimeter versus each of the three Soyuz docking positions.

• These could be used by an experiment on the JEM-EF, such as MAXI or CALET, since the fluxes are meant to represent that illuminating the JEM-EF. The assumption is that a mass model of the JEM-EF as well as the experiment exists to properly determine the background in the experiment on the outboard side of the JEM-EF.
Orange triangle shows the illumination in the Service Module from Kaktus due to the opening in the depleted uranium shield.
MAXI Location on ISS

With distances to Soyuz

<table>
<thead>
<tr>
<th></th>
<th>ISS Coordinates</th>
<th>Distance from MAXI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X(m)</td>
<td>Y(m)</td>
</tr>
<tr>
<td>MAXI</td>
<td>14</td>
<td>-14.7</td>
</tr>
<tr>
<td>POISK Kaktus</td>
<td>-23.659836</td>
<td>-0.01842</td>
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<tr>
<td>PIRS Kaktus</td>
<td>-23.6982</td>
<td>-0.0202</td>
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<tr>
<td>RASSVET Kaktus</td>
<td>-11.1701</td>
<td>-0.02549</td>
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MAXI at JEM EFU #1
X: 14.055m
Y: -14.665m
Z: 6.547m
Flux Calculation Point on JEM-EF

Flux calculated at inboard side (relative to Soyuz docking positions) at the center of the JEM-EF
Soyuz Kaktus Flux Results

Comments:

- Soyuz at POISK docking position is very well shielded by ISS truss and a portion of a radiator assembly.
- The POISK calculation DOES NOT include this shielding effect: POISK flux (top plot) should be significantly reduced in reality.
- Soyuz at the PIRS and RASSVET docking positions have a clear view of the JEM-EF: flux predictions should be valid.
Programmatics

1. The issue of Intel version dependence regarding ability to compile latest COSMOS/EPICS and CALET models has been. The dependence appears only to be for the 64-bit version of the Intel compiler, 32-bit version works but with a modest reduction in performance (x1.64 vs x1.95 using optimization). The results were sent to KK.

2. LSU group has developed software to convert CALET Epics data ➔ HDF5 format ➔ root format. Root conversion validated and being used by US group.


4. GSFC has successfully built the various versions of Akaike’s CALET Epics data ➔ unified root format converter.

5. CERN Test Beam support: Brian Rauch and John Mitchell supported the test beam run at CERN earlier in 2015.
LSU HPC CALET Run Summary

LSU group completed high-statistics CALET runs using remaining HPC allocation.

CALET Epics Configuration:
- Dpmjet3 hadronic interaction model.
- Events thrown over partial sphere up to 110° zenith angle.
- All thrown events recorded, no pre-selection. Allows for complete data set.
- Events generated in decades of energy, $E^{-1}$ spectra.

<table>
<thead>
<tr>
<th>Particle Type</th>
<th>Min. GeV</th>
<th>Max. GeV</th>
<th>Number of Events</th>
<th>Total Walltime (Hours)</th>
<th>Total SUs Spent</th>
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<tr>
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<tr>
<td>100 – 1000 GeV</td>
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<tr>
<td>1 – 10 TeV</td>
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<td>100 – 1000 TeV</td>
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Simulations with CALET CAD Model Rev 15

GSFC:
• Mono-energetic electrons, protons, 12C completed, analysis underway.
• Goal is to validate CALET response compared to previous versions, validate Rev 21 data format.

WashU:
• Mono-energetic: 10 GeV/nuc, 50 GeV/nuc, 100 GeV/nuc
  • He4, Cl17, C12, Ne20, Ne22, Cr24, Si28, P31, S32, K39, Ar40, Ca40, Sc45, Ti48, V51, Mn55, Fe56, Co59, Ni59, Cu64, Rh103
• Mono-energetic: 10 GeV, 100 GeV, 1000 GeV
  • electrons, protons
Analysis Activities

- e/p Separation:
  - Using selection cuts: old school (JFK: GSFC)
  - Using MVA: new school (Aaron Worley: Denver)
  - Planning to do head-to-head comparison
- Proton spectrum reconstruction (Alex Moiseev: GSFC)
- Gamma/e separation, gamma detection capability (Nick Cannady: LSU)
- UltraHeavy CR measurements: (Brian Rauch: WashU)
- On-orbit Calibration (Amir Javaid: LSU)
  - has implemented corrected version of CALET trigger, based on Y. Asaoka’s documentation.
  - getting similar orbit-averaged results to Japan on-orbit analysis.
  - some unresolved issues in comparison to Japan results in different latitude bins.
  - working on understanding the differences, will report once completely resolved.
CALET Presentations

ICRC Papers:
• *Gamma-Ray Observations with CALET: Exposure Map, Response Functions, and Simulated Results* (Nick Cannady: LSU)
• *Predicted CALET Measurements of Heavy and Ultra-Heavy Cosmic Ray Nuclei* (Brian Rauch: WashU)
• Amir Javaid’s ‘Kringing’ paper withdrawn due to time constraints.

APS April 2015 Meeting Presentations:
• CALET Overview (Brian Rauch: WashU)
• On-orbit instrument calibration of CALET (Amir Javaid: LSU)
• Proton - Electron discrimination capabilities with CALET (Aaron Worley: Denver)

Physics of the Cosmos Cosmic Ray SIG:
• Cosmic Ray Electron Measurement Overview (Brian Rauch: WashU)
Pisa TIM Presentations

Talks at this TIM from US M&S Group:

• Epics-based e/p separation study results (JFK)
• Gamma-ray/electron separation and expected gamma-ray signal from 1 year of CALET orbit (Nick Cannady: LSU)
• Predicted CALET Measurements of Heavy and UltraHeavy Cosmic Ray Nuclei (Brian Rauch: WashU)
• MVA tuning and analysis for e/p discrimination (video talk) (Aaron Worley: Denver)
• Update on the status of the US CDC (Doug Granger: LSU)
• Accessing the US CDC archives (Doug Granger: LSU)
• Introduction and status of the Data Handling Pipeline on the US CDC (Mike Stewart: LSU)
• Brief overview of the Level 1 HDF format (Mike Stewart: LSU)