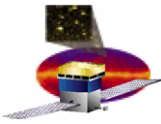


Fermi Large Area Telescope Instrument Science Operations Center

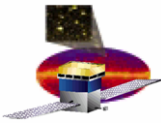
LAT and ISOC Operations Status

Robert Cameron
ISOC Manager
rac@slac.stanford.edu



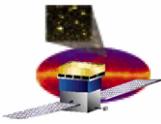
Outline

- ❑ LAT Operations Highlights
 - SLAC Power Outage
- ❑ LAT Instrument Performance
- ❑ ISOC Operations Status
 - FSW Updates
- ❑ The Future: LAT Performance Updates



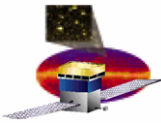
LAT Uptime for Physics = 99.1%

- Since the last IFC meeting: LAT Uptime > 99.99%
 - About 3 minutes not spent in routine data-taking
 - 3 interruptions for restarting the LAT to use new register configuration files
 - Each restart of the LAT takes about a minute, involving 3 real time commands sent from the MOC
- LAT outages from routine data-taking total 132.15 hours since the start of the sky survey
- LAT operations are very stable
 - FSW Build 2-2-0, started on 29 Oct 2009, fixed final concerns with LAT reboots
 - Longest running FSW Build since launch



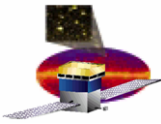
LAT data collection since Launch

Build	Events	Percentage	Activation Date	Days
Pre-activation				13
B1-0-8	4978114560	4.740	24-Jun-08	37
B1-1-0	9787216696	9.320	31-Jul-08	61
B1-1-3	20154913225	19.193	30-Sep-08	120
B2-0-0	15254567639	14.526	28-Jan-09	94
B2-0-1	4465013138	4.252	2-May-09	27
B2-0-2	18861007646	17.961	29-May-09	111
B2-1-0	2297478230	2.188	17-Sep-09	14
B2-0-2'	1323628181	1.260	1-Oct-09	7
B2-1-2	3607700760	3.435	8-Oct-09	21
B2-2-0	24283170549	23.124	29-Oct-09	141
Total	105012810624	100.000	19-Mar-10	646



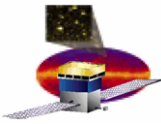
LAT Operations Highlights since Oct 2009

- ❑ 2009/10/8 – LAT FSW B2-1-2 activated
- ❑ 2009/10/15 – Updated configuration
 - 4 TKR strips & 1 CAL LAC disabled
 - Started compressed TEM diagnostics (for ghost track identification)
- ❑ 2009/10/15 – Update to RTS40 to include LAT register resets
 - Fixes SEFI occurring during SAA transits
- ❑ 2010/10/29 – LAT FSW B2-2-0 activated – final fix for reboots
- ❑ 2010/1/19 – Power outage at SLAC
 - 2010/1/20 – End of power outage
 - 2010/1/22 – Return to normal ops in ISOC after SLAC outage
- ❑ 2010/1/21 – Updated configuration – 2 TKR strips disabled
- ❑ 2010/2/16 – Updated configuration – 2 TKR strips disabled
- ❑ 2010/2/18 – LAT passed 100 billion triggers
- ❑ 2010/2/28 – FSW B2-2-0 became longest running FSW Build on the LAT
- ❑ 2010/3/11 – Updated configuration – 3 TKR strips disabled



LAT Operations during SLAC outage

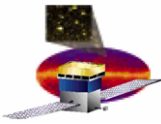
- ❑ SLAC power outage, with associated ISOC outage, from 0515 PST on 19 Jan 2010 to 1830 PST on 20 Jan 2010
 - Also partial power outage on Stanford campus, on 19 Jan
 - Core Backup ISOC systems at Stanford transitioned to emergency power, with 11 second transition sustained by UPS
- ❑ ISOC staff stayed off SLAC campus for 2 days
 - Communication sustained through non-SLAC email used with Stanford-based Collaboration mailing lists
- ❑ Coordination with Fermi Mission through telecons during the outage
- ❑ The MOC transitioned to delivering LAT Level0 files to the Backup ISOC at 1100 PST on 19 Jan.
 - Realtime engineering telemetry are always relayed to Backup ISOC from the MOC. Normal ISOC displays are available on workstations.
 - Backup ISOC provides monitoring and limit checking of telemetry, and limited “FastMon” processing of LAT science data.
- ❑ MOC resumed delivery of L0 products to SLAC at 0440 PST on 21 Jan
 - Catch-up delivery of ~2 days of L0 products to SLAC done in 10 hrs
- ❑ L1 science processing at SLAC was throttled during catch-up
 - L1 processing was up to date on 22 Jan; catch-up rate = 2.3x



SLAC Power Outage: Lessons Learned (1/2)

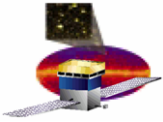
- ❑ Put essential and useful Operations and Collaboration information in secure areas in the Internet “Cloud”:
 - Google Groups created for non-SLAC web pages and mailing lists for the ISOC and LAT Collaboration
 - Private: “Fermi LAT” web site and “LAT Alert” mailing list for operations and contact information.
 - Semi-public: “Fermi LAT News” web site for sharing LAT, ISOC and Collaboration status information.

The image displays three screenshots of Google Groups pages. The first screenshot shows the 'Fermi LAT' group page, which is a Restricted-Access group. It includes a 'Home' section with a description, a 'Members' section with 17 members, and a 'Pages' section with links to 'ISOC Call Tree', 'ISOC Call Tree - New', 'Backup ISOC Functional Checkout', 'Backup ISOC Support Guide', and 'Backup ISOC User Guide'. The second screenshot shows the 'LAT Alert' group page, a private mailing list. It features a 'Home' section, a 'Discussions' section with one message, and a 'Members' section with 26 members. The third screenshot shows the 'Fermi LAT News' group page, an announcement-only group. It includes a 'Home' section, a 'Discussions' section with two messages, a 'Members' section with 11 members, and a 'Files' section with one file. All three screenshots show the standard Google Groups interface with search bars, navigation links, and group information.

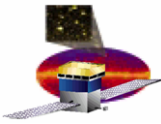


SLAC Power Outage: Lessons Learned (2/2)

- ❑ Create and remote host Collaboration mailing lists using non-SLAC email addresses
- ❑ Added broader set of contact information to the ISOC Call Tree
 - SLAC, PPA, and KIPAC management contacts
 - SLAC Computing Division contacts
- ❑ Add data-gap checking and reporting as an extra requirement on the Backup ISOC
 - LAT datagram checking at the ISOC augments the MOC's packet-level checking per downlink
- ❑ Add Nagios monitoring of Backup ISOC systems and processes, to alert for failures
- ❑ Update “FastMon” processing on Backup ISOC
- ❑ Ensure timely status information is passed from SLAC Management to LAT and Fermi Mission management during outages, to keep the science community informed of LAT data availability issues
- ❑ Better coordination of SLAC and Fermi resuming normal operations

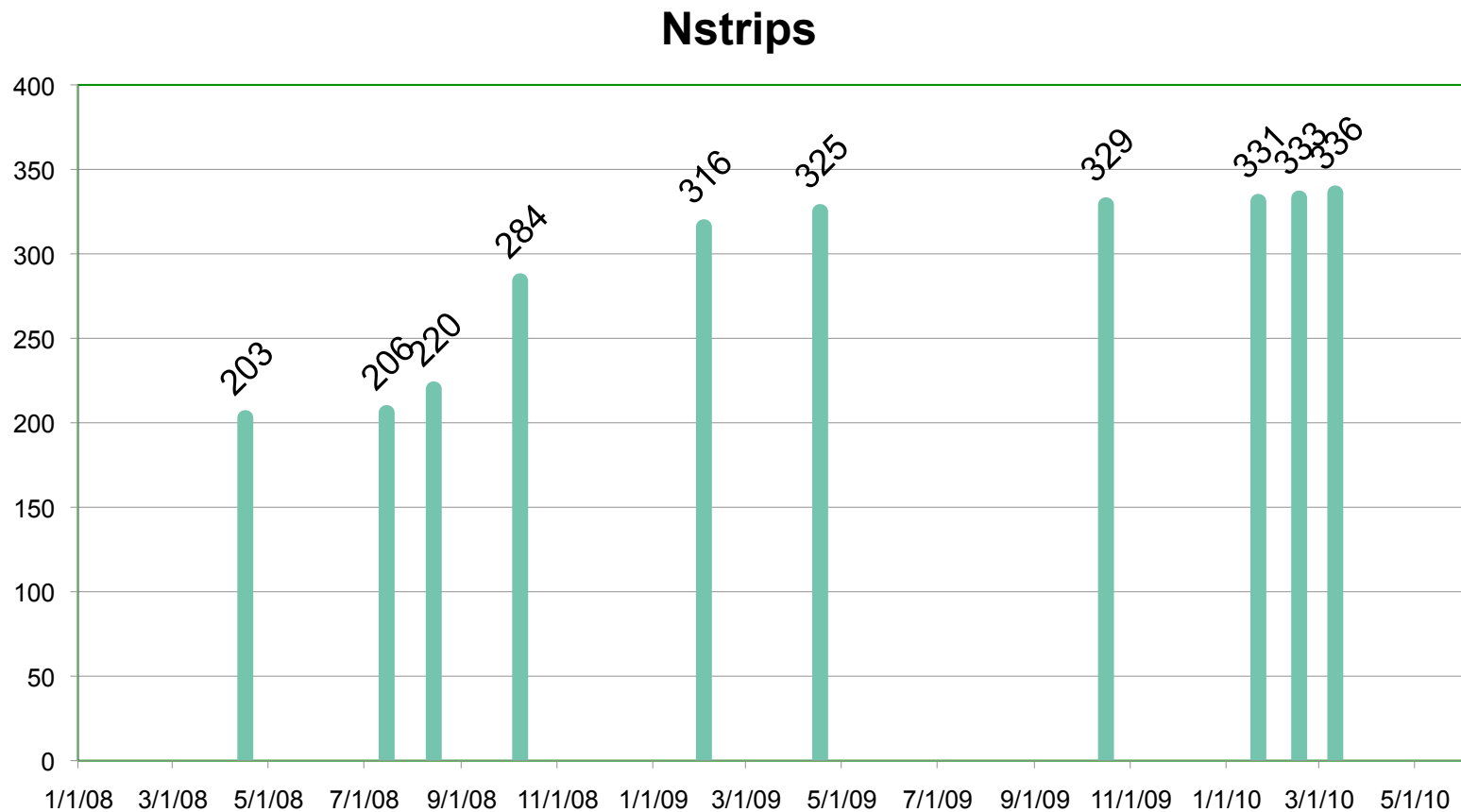


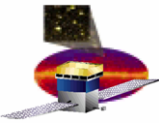
Instrument Performance and Trending



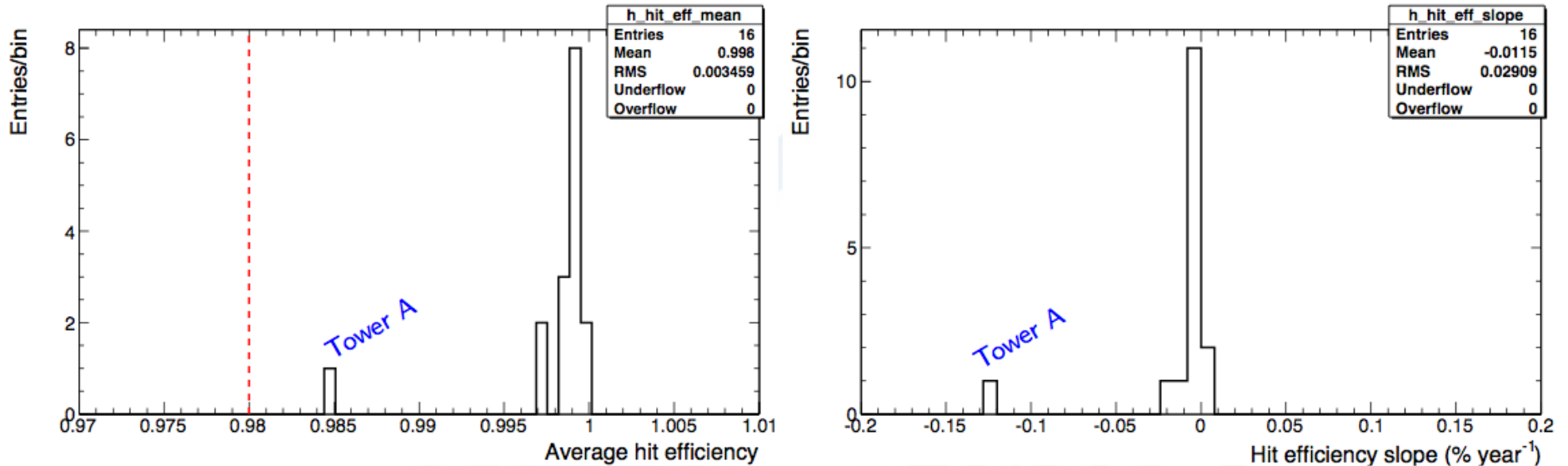
LAT TRACKER Si Strip Masking

- ❑ 133 strips masked since launch
 - ❑ 93 of these are on Tower A (the 1st tower); none after the first year
- ❑ Total number of masked strips = 336 of 884, 736 = 0.038%

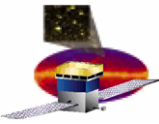




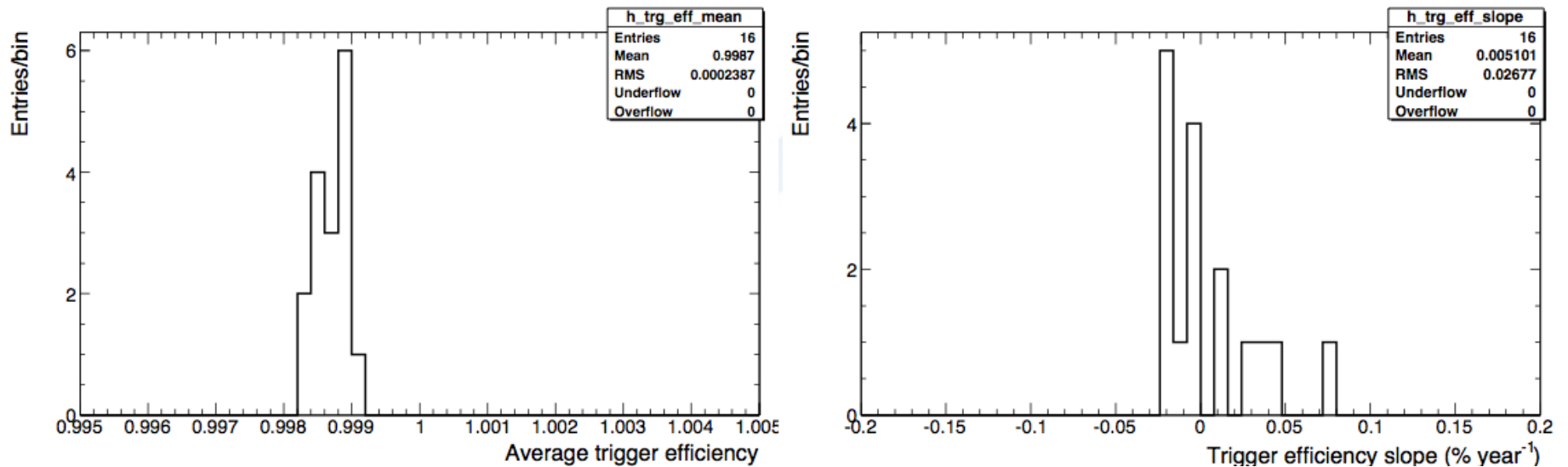
Tracker Tower Hit Efficiency



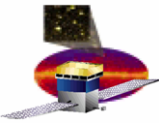
- 15 of 16 towers have hit efficiency $> 99.5\%$, with no obvious trend of change with time
- Outlier: Tower A (the first manufactured tower)
 - Tower A trend is driven by changes in 2008; consistent with 0 since mid-2009



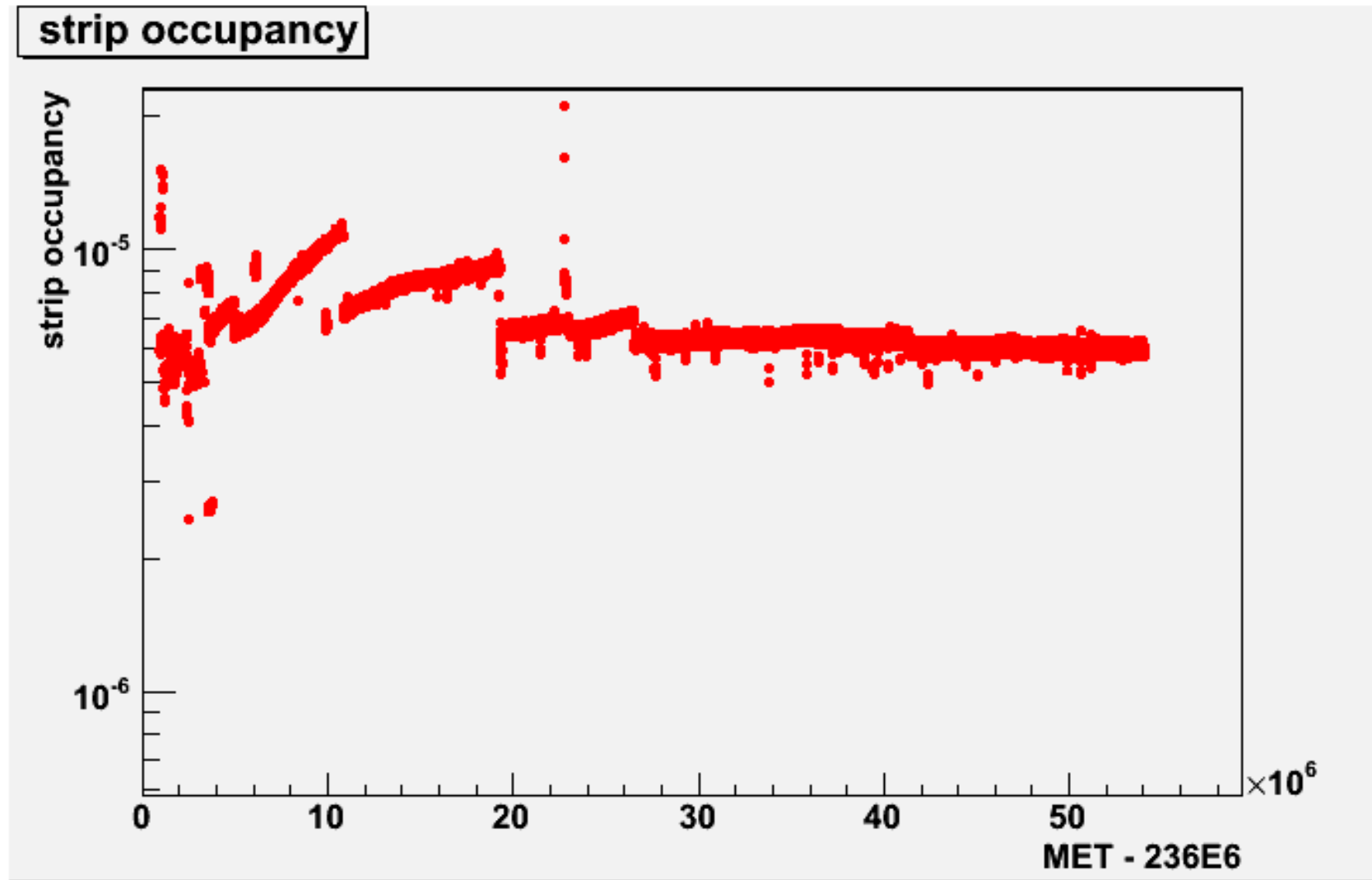
Tracker Tower Trigger Efficiency

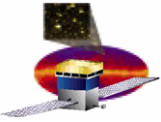


- ❑ Mean trigger efficiency > 99.8% for all towers
- ❑ No significant trends

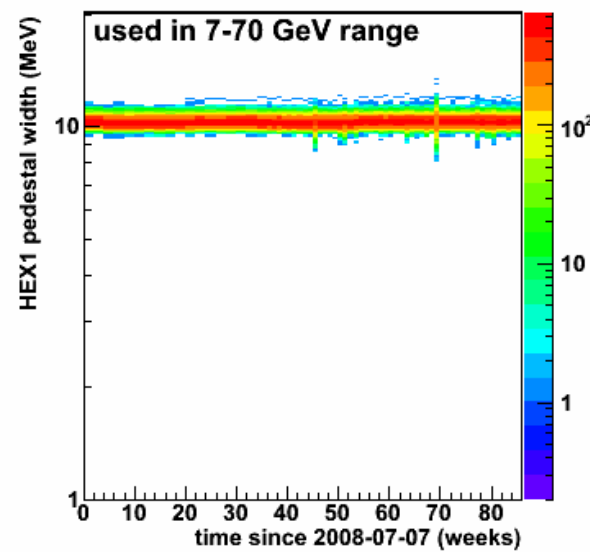
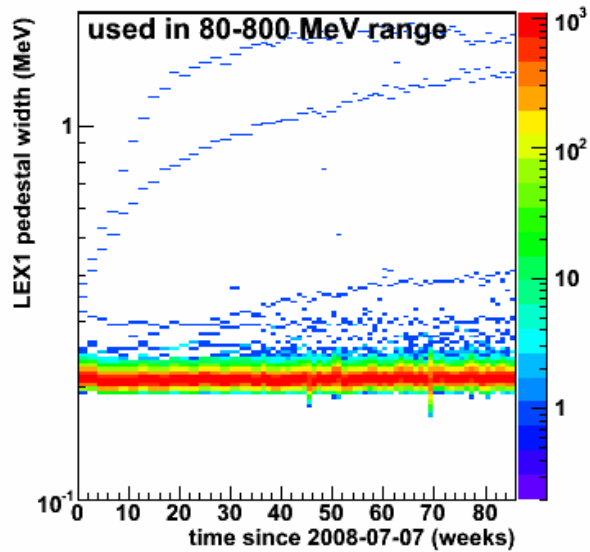
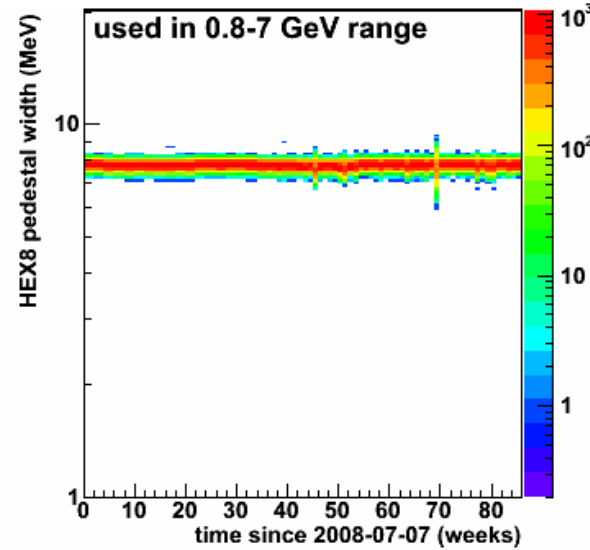
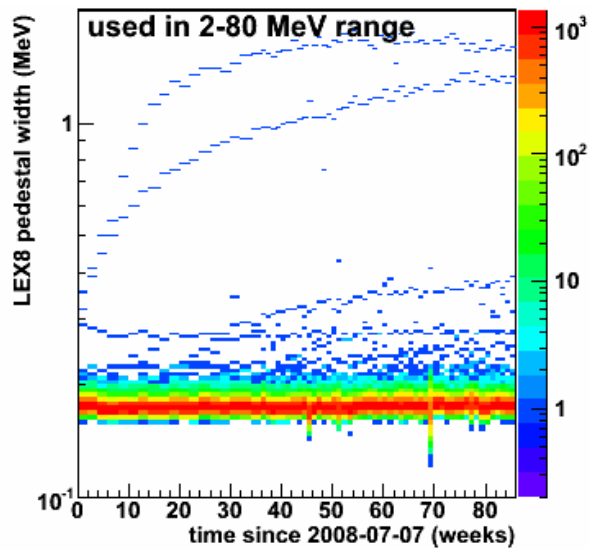


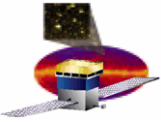
TKR Strip Occupancy



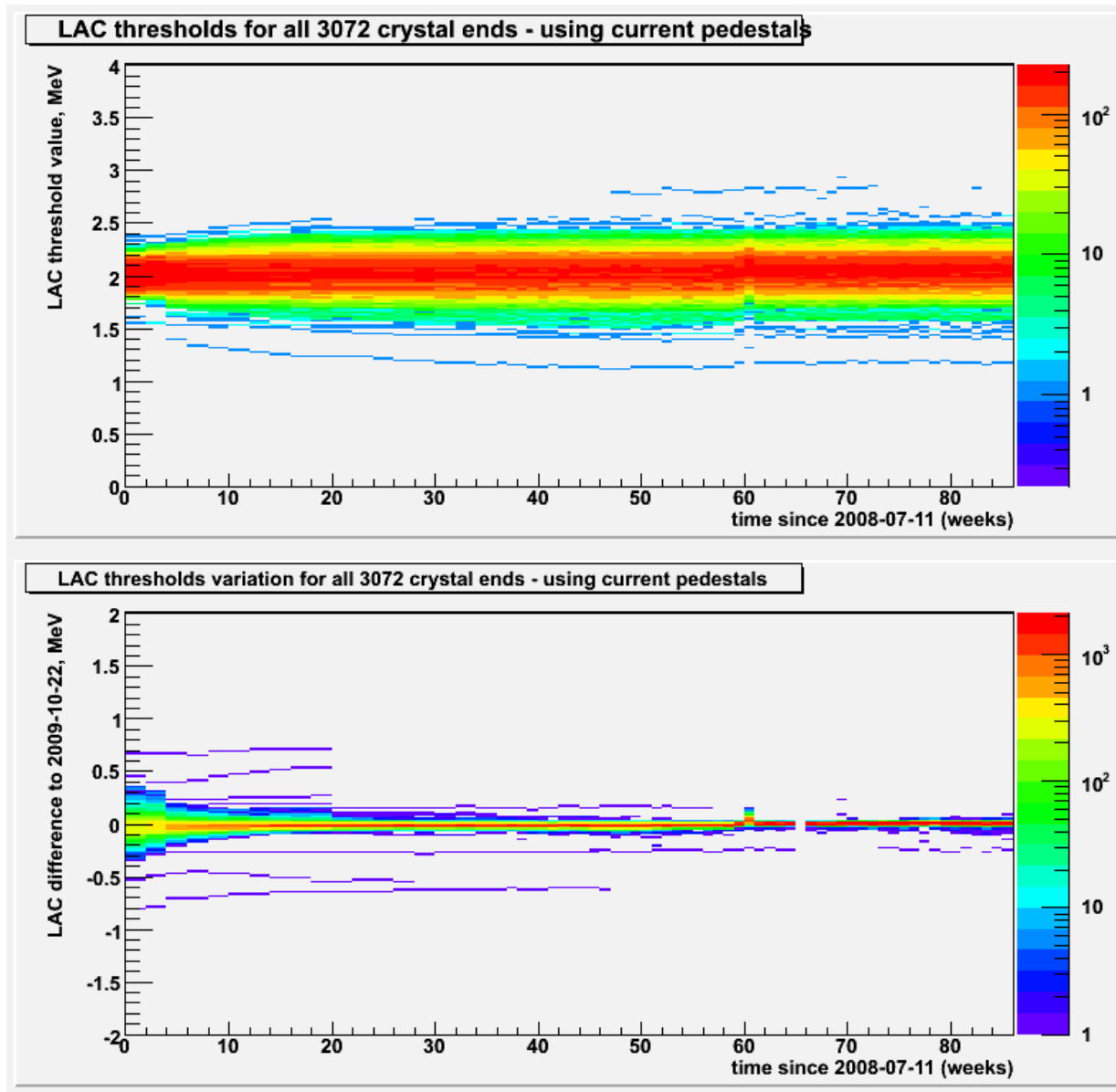


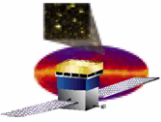
CAL Pedestal Widths





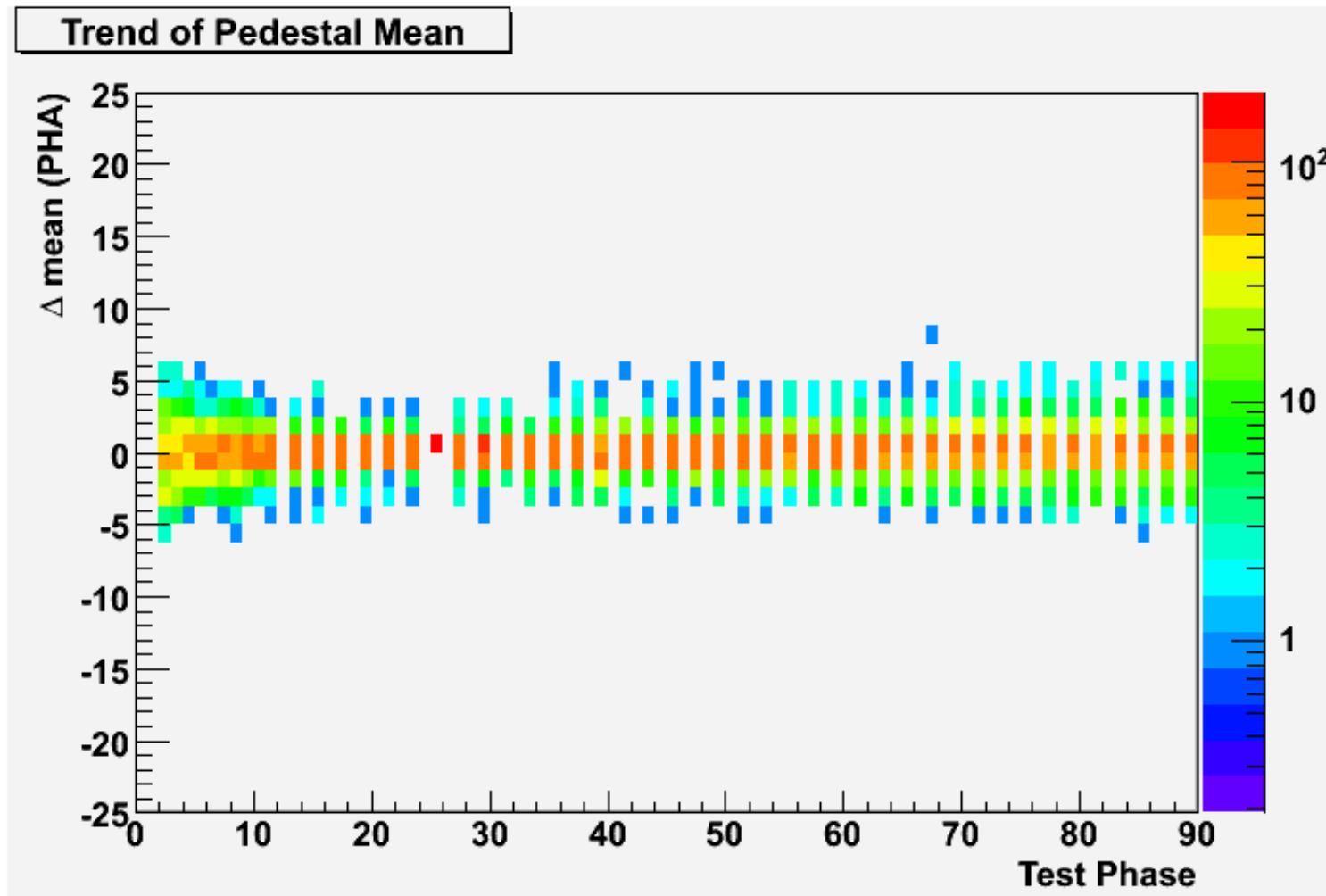
CAL LAC Thresholds

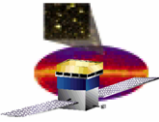




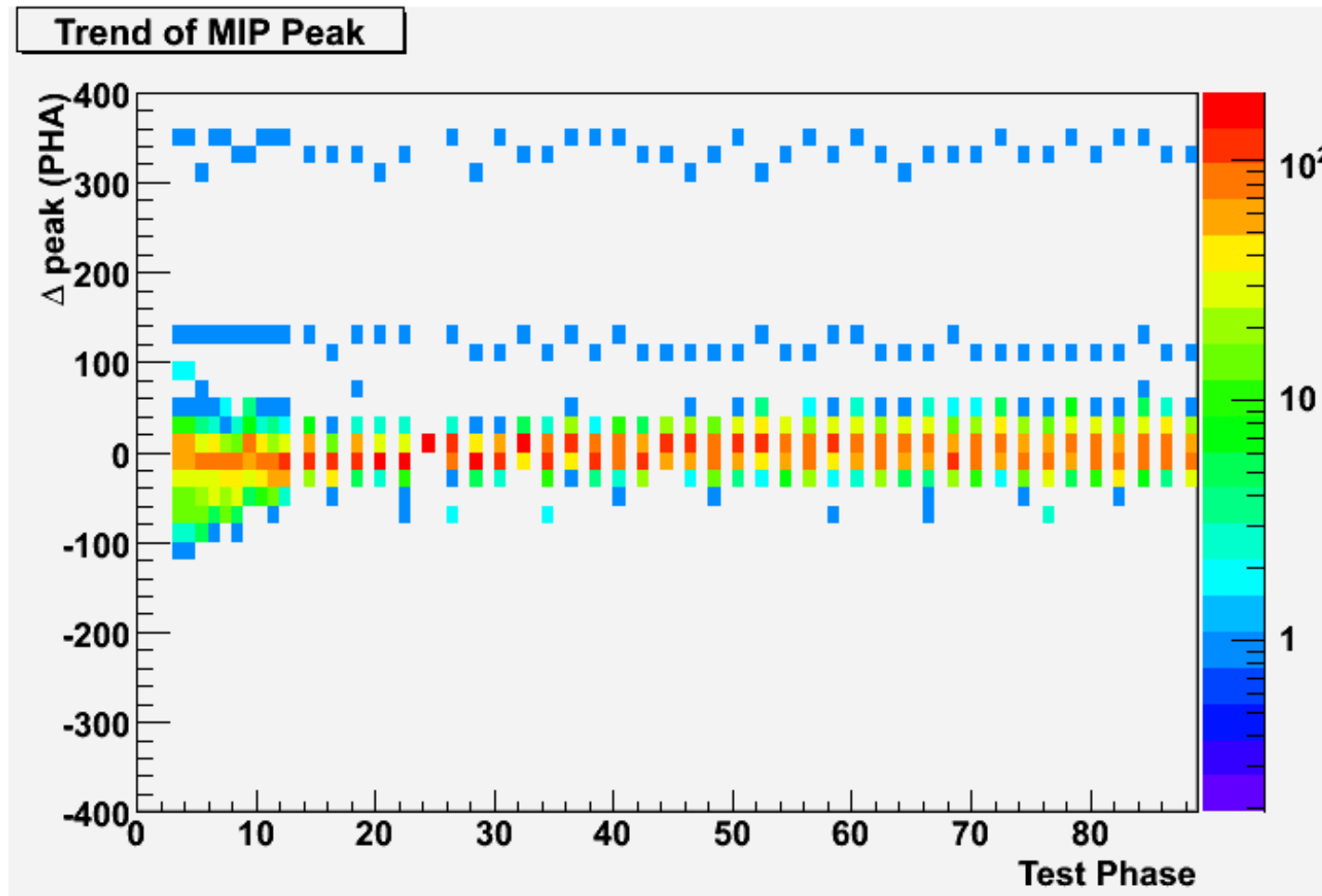
ACD: Pedestal Stability

- Reference Calibration is over 1 year old
 - Will be updated in May





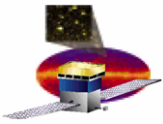
ACD MIP Peak



Gaussian fit to MIP peak

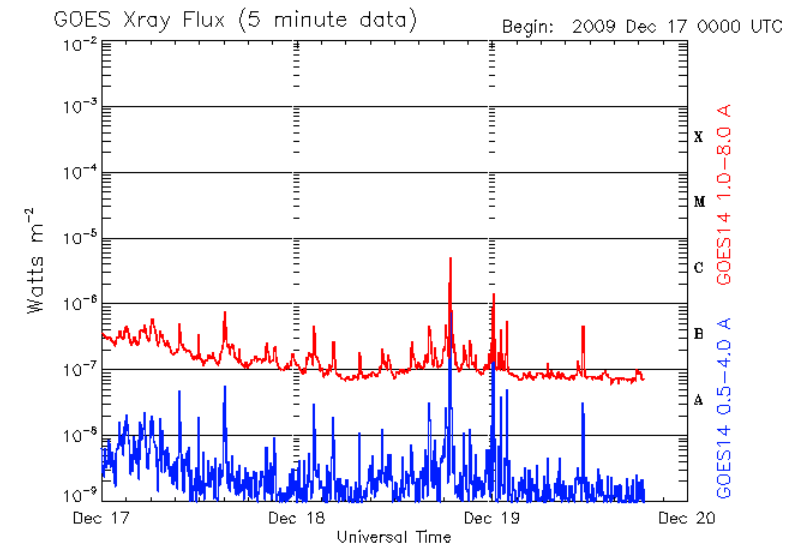
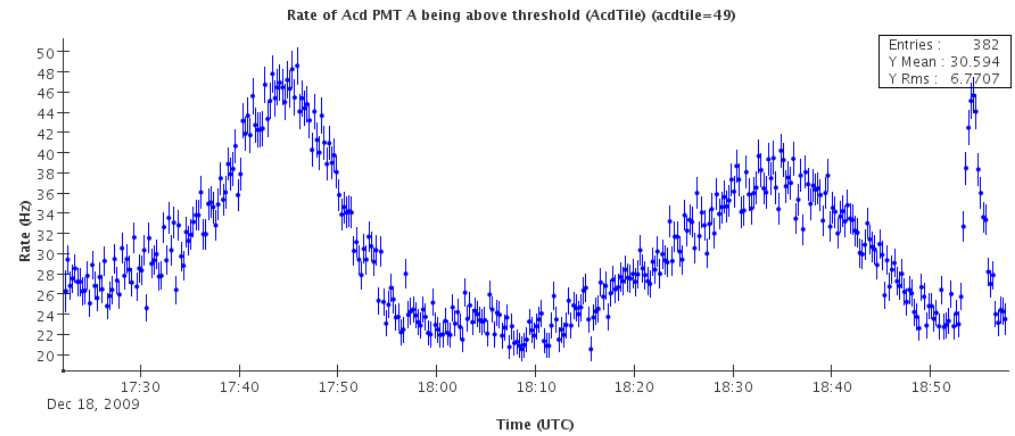
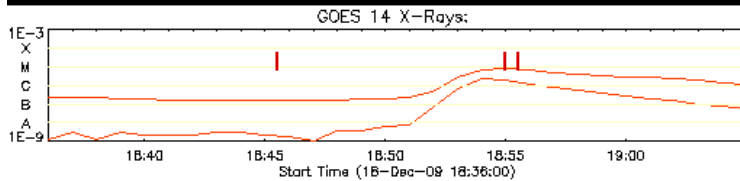
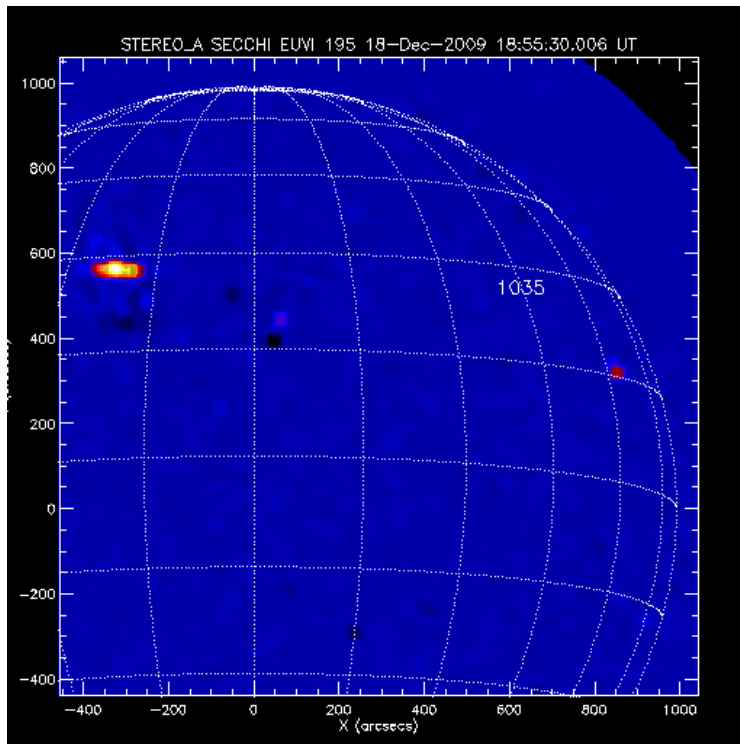
New fitting algorithm used since December 2008 calibration ("Test Phase" = 23)

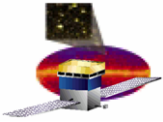
- Fit starting point based on results of previous fit; outliers are due to poor fits



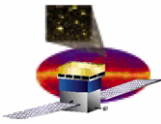
Here Comes the Sun

- Hard X-rays from solar flares detected in ACD monitoring
 - 100 keV ~ 0.08 MIP; close to threshold; most likely only seen in 1 of 2 PMTs



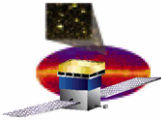


ISOC Operations Status and Plans



FSW Updates on the LAT

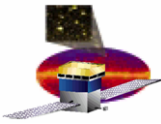
- ❑ Most recent build activation: B2-2-0, 15 Oct 2009
 - Completed implementation of work around for SIU spontaneous reboots
 - Implemented miscellaneous debugging and error recovery tools
 - Implemented numerous internal, “clean-living” changes
- ❑ Next change: April 2010
 - Restart of LAT with new configuration-control code: LCFG/RIM
 - Already installed on the LAT as part of B2-2-0
 - Has been waiting for update of ground software config-building tools
 - LCFG/RIM provides readiness for future LAT hardware failures
 - Allows for communication of configuration info among CPUS; needed for compression of data taken in non-standard configurations
- ❑ B2-3-0: mid-2010
 - LCI (Charge Injection Calibration) rework
 - Provides significant speed-up of TKR and CAL on-orbit calibrations (which currently take hours)
 - In conjunction with FSW update, we will also schedule “before” and “after” calibrations of LAT, to verify correctness of new calibration data



Science Operations: Level1 Processing

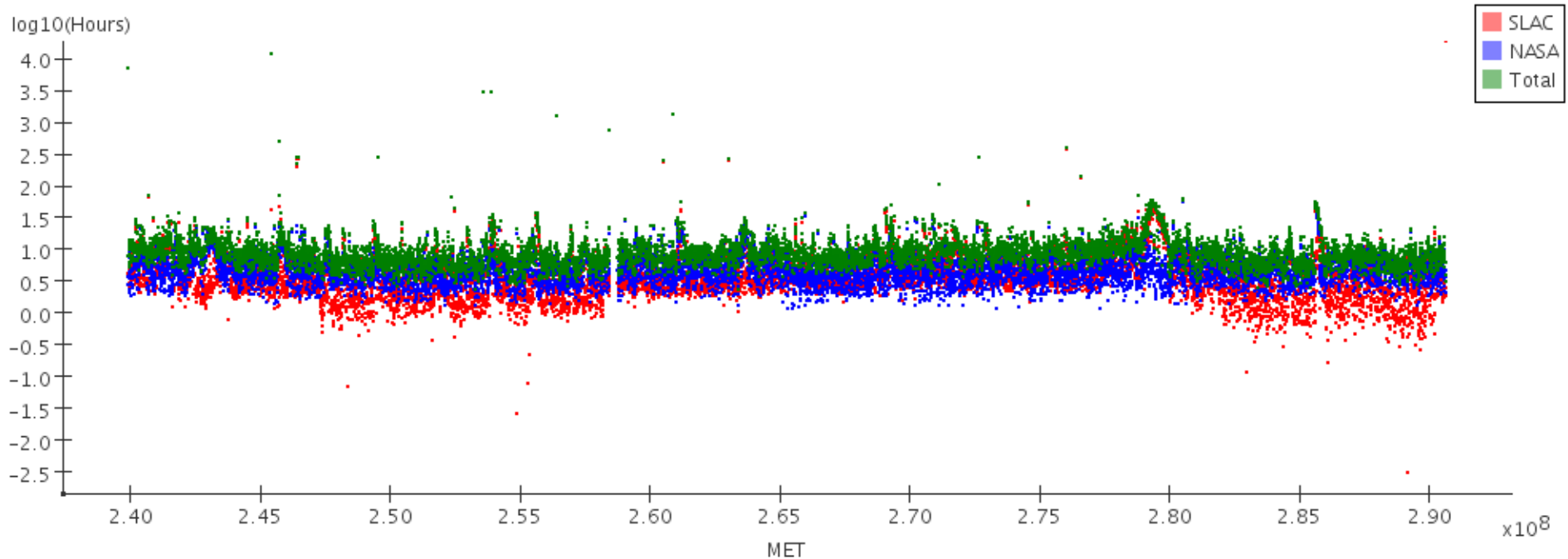
- ❑ Incremental improvements to improve reliability and throughput
 - E.g. throttle on job submission to prevent overloads on backlogs

- ❑ SLAC Farm has transitioned to RHEL5 and 64 bits
 - New cores show a speed-up of processing at SLAC, after initial troubleshooting



Science Ops: Level1 Data Processing

Data processing elapsed time per run vs MET

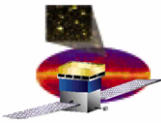


Time from end of run onboard Fermi to delivery of photon list to FSSC.

- SLAC data processing latency is typically about 3 hours.
- Typical overall turnaround is less than 10 hours.

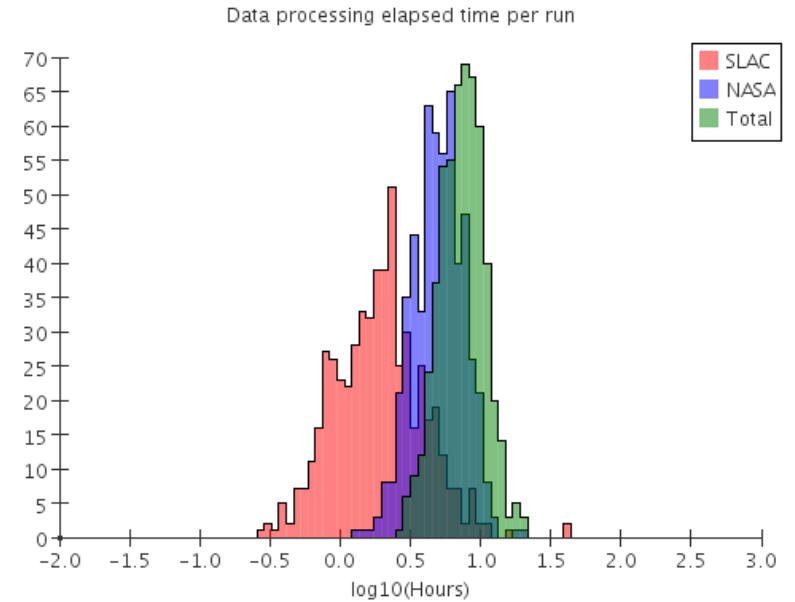
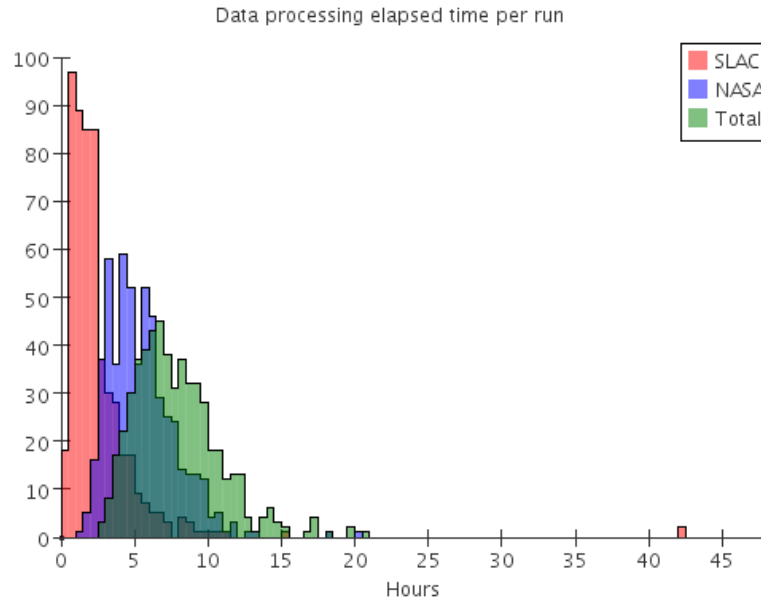
NASA = Hours elapsed between end of data taking for run and ALL data for that run arriving at SLAC.

SLAC = Hours elapsed between ALL data for that run arriving at SLAC and data being registered in data catalog.

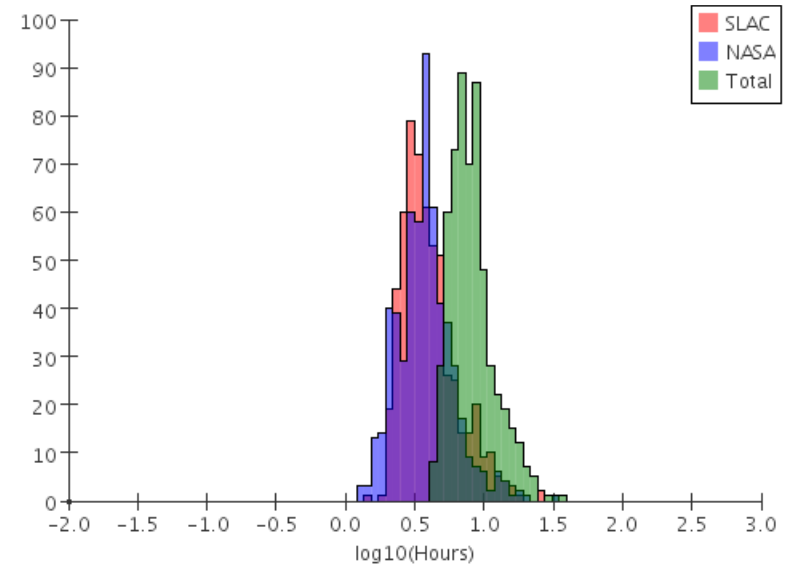
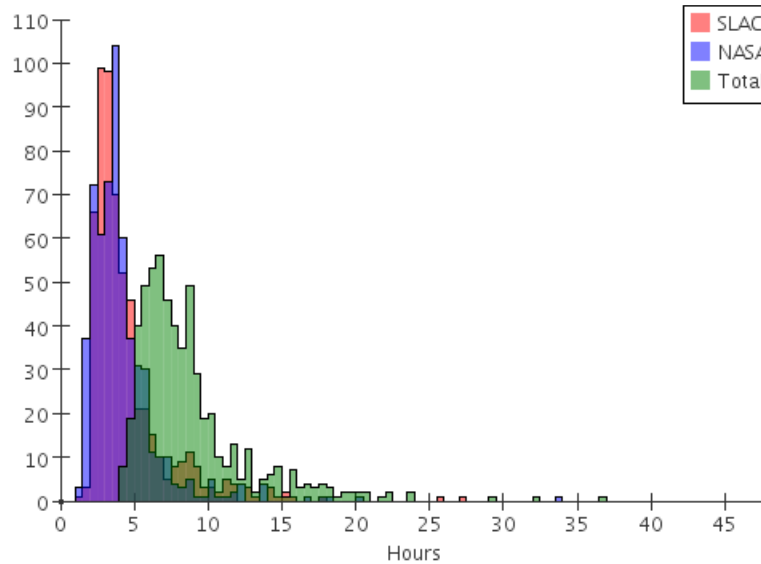


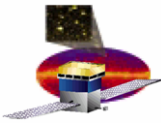
LAT Data Processing Latency Changes

Feb 2010



June 2009



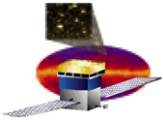


Science Operations: Data Monitoring

- ❑ Continued fine tuning of monitoring limits
 - About 120,000 variables are automatically monitored

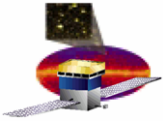
- ❑ Still adding monitoring capabilities
 - E.g. 2-D mapping of LAT rates during near-transits of SAA

- ❑ Always looking for additional Data Monitoring Scientists
 - Small cadre of regulars perform most monitoring

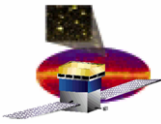


Automated Science Processing

- LAT Collaboration is now releasing monitoring data for 51 variable sources
 - Daily and Weekly fluxes are released, through the Fermi Science Support Center
 - Criteria for adding a source to the monitored list: source flux exceeds the 10^{-6} ph/cm²/s threshold and has an Astronomer's Telegram issued by the LAT Collaboration



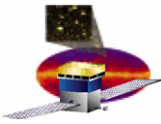
Future LAT Performance Updates



Improving LAT On-board Science Output

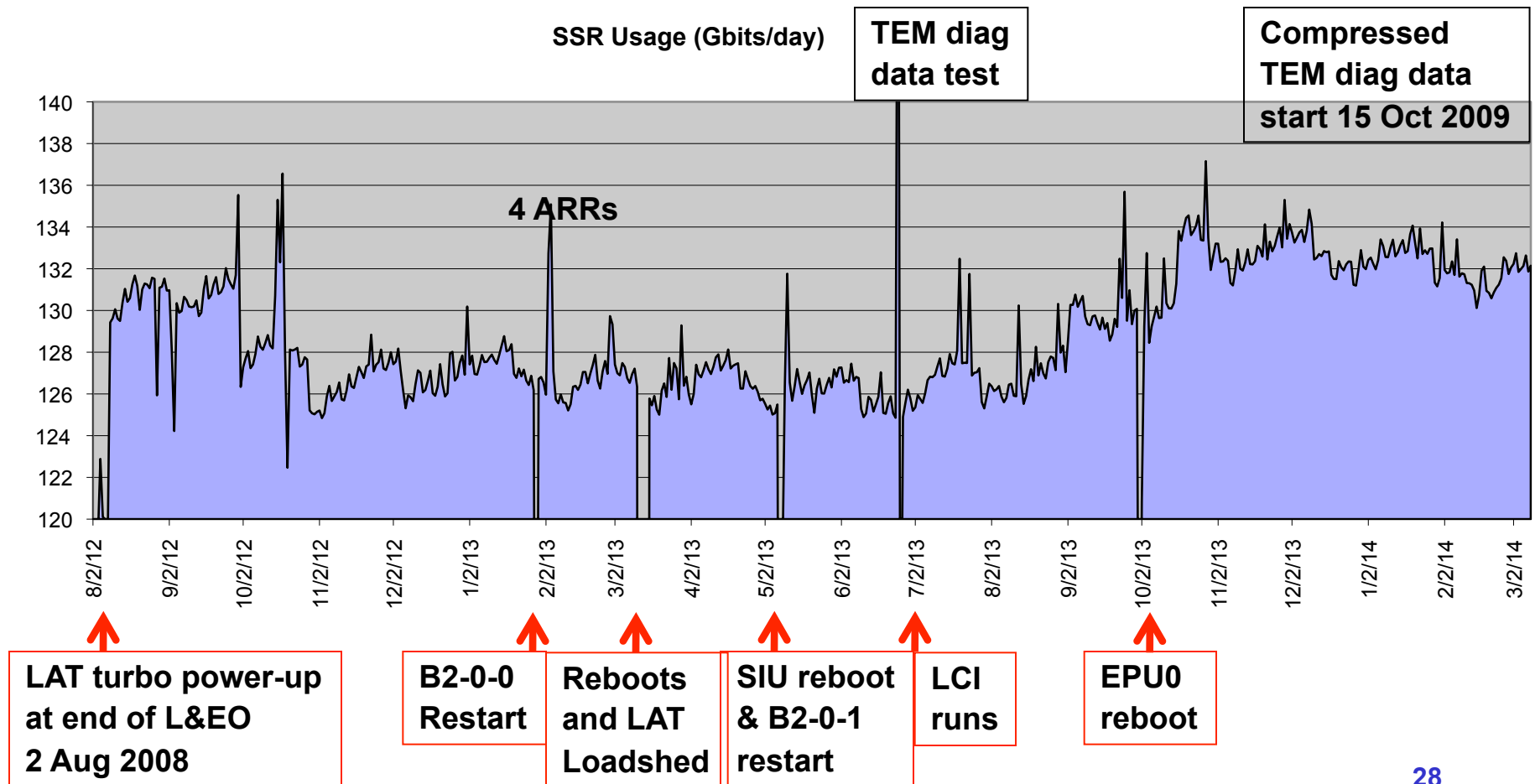
- ❑ Coming FSW parameter changes from study of the performance of on-board GRB algorithm
 - Update on the LAT: planning for April 2010

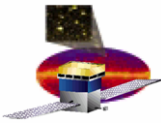
- ❑ Several meetings have occurred since late 2009 to gather inputs on other on-board science configuration updates, and other update ideas
 - Splinter session at recent LAT Collab meeting on this topic
 - Science drivers for updates
 - Offline studies and analysis improvements
 - Online/on-board changes
 - Suggested immediate change: lowering “pass-all-events” Energy threshold from launch value of 20 GeV
 - Makes use of available data downlink margin
 - Current downlink usage could allow up to 25% more LAT data
 - But do this without compromising LAT data completeness
 - 99.996% of packets recovered over mission
 - Since 2008/310: > 99.99999% packet data completeness; less than 1 second of data lost



LAT Data Rate to Solid State Recorder

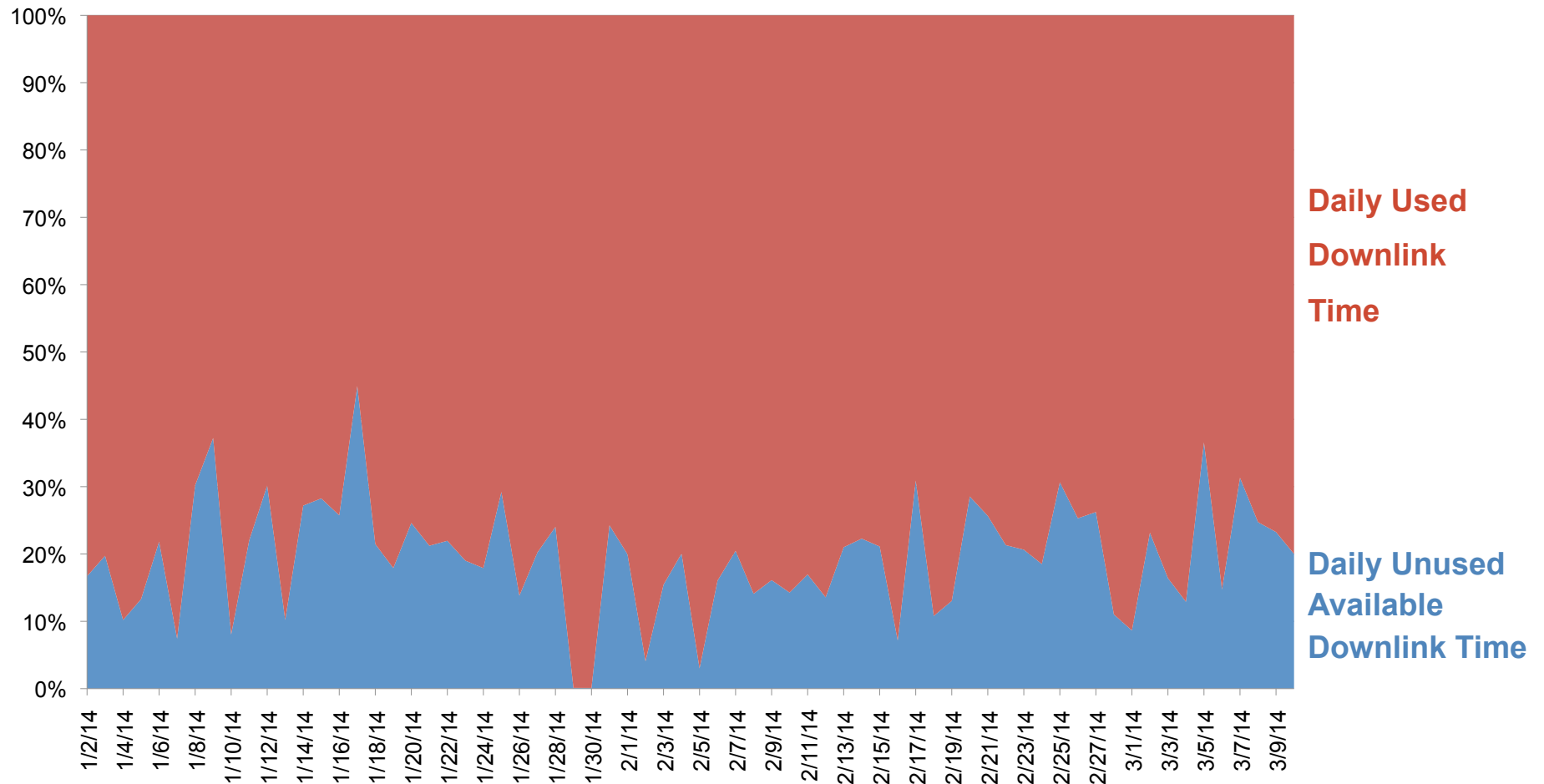
- Average LAT Science data rate for 2010:
 - 132.2 Gbits/day = 1.530 Mbits/second

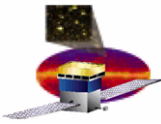




Ku Downlink Usage

- ❑ Increasing LAT data rate and used downlink time by 25% would saturate available Ku time





Executive Summary

- ❑ ISOC teams and systems are performing well
 - Incorporating lessons from outages etc to improve support

- ❑ LAT is performing very smoothly
 - Looking at ways to further increase science output in the future