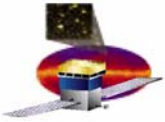**Gamma-ray Large Area Space Telescope**
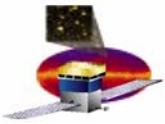
GLAST Large Area Telescope:

LAT System Engineering
LAT Quality Assurance

Pat Hascall
Joe Cullinan

Topics

- **NCR Metrics**
- **Significant NCRs**
- **NCR List**
- **LAT Level Verification Status**

LAT NCR Metrics 3/02/06

Subsystem	Open NCRs	Closed NCRs last 30 days	NCRs Open 30 days or more	NCRs open 90 days or more	NCRs ready to close (disposition complete; need final QA/MRB review to close)
DAQ	31	23	26	15	15
Tracker	8	2	7	7	7
Mechanical	7	1	5	5	5
CAL	0	0	0	0	0
ACD*	0*	0	0	0	0
I&T	61	3	48	25	21

* All NCRs related to ACD are now
categorized as I&T NCRs
(including 5 open ACD PRs and
PFRs from GSFC)
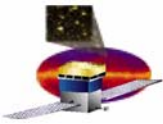
Open I&T NCR Metrics 3/02/06

| Open I&T NCRs	December	January
	50	61
New NCRs created	9	14
NCRs closed	14	3
NCRs Ready to Close (analysis complete, need final QA/MRB review to close)	16	21
NCRs with Analysis in Progress	30	36
NCRs to remain open to monitor trend or performance	4	4
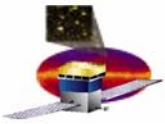
NCR 458

- **Anomaly Description**
  - **TEM reported TKR GTCC and GTRC phasing errors during a single test in two tower test configuration.**
  - **Reopened when TEM reported TKR GTCC and GTRC phasing errors during six tests in full LAT configuration at an apparent higher rate than expected**
- **Root Cause**
  - **Appears to result from a known bug in the VHDL for GTIU FPGA.**
  - **Bug causes the FPGA to issue a TKR readout token for event "N+1" instead of "N" under known, rare conditions.**
- **Resolution**
  - **Recent test data in fact shows no significant change from previous tests**
 - **Will study potential for impacts in orbit**
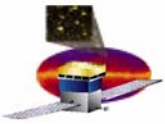
NCR 684

- **Anomaly Description**
  - **Tracker modules have occasional out-of-spec noise occupancy in isolated layers ("noise flares").**
- **Investigation**
  - **Analysis showed similar noise at INFN.**
  - **Occupancy still within spec.**
  - **Noise flares have been observed from 4 layers (out of 576 layers) during 21 hours of 16-tower muon data monitoring. Two of the layers are in flare states for 10-20% of time while the others are in flare states for 1-2% of time.**
  - **TKR meets data occupancy and trigger occupancy requirements even during flares.**
  - **No noise flares have been observed in review of 100 hours of online Tracker FM 8 data taking, a more detailed review of offline data is in process.**
- **Resolution Plan**
  - **Continue extended testing on Tracker module 8 to further characterize.**
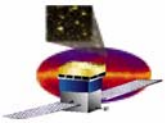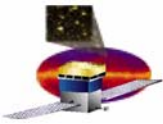
Open I&T NCR List

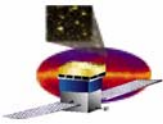| NCR	Date Opened	Affected Hardware	Problem Description	Status
458	5/10/05	TEM/TPS	Observed GTCC and GTRC phasing errors within the TEM	Final MRB required
477	5/23/05	TEM/TPS	TEM FIFO errors observed during FMA and FMB	Final MRB required
487	5/23/05	TEM/TPS	Failed CAL script register test	QA to close
529	6/16/05	TKR	TEM register test on PDU1 and GASU redundant failed, Twr 3	Monitor
532	6/16/05	TEM/TPS	TEM register test (Trigger Interface Controller) failed.	Final MRB required
535	6/20/05	TKR	Monitor trend data for TKR 4 thru LAT testing (spin-off NCR)	Monitor
549	6/27/05	TKR	Temperature alarm and setpoints, Bay 1	Final MRB required
604	8/11/05	TKR	Bay 4 TkrReadingConfigurationTest failure on x0, FE0	QA to close
607	8/12/05	CAL	LAT CPT- CAL section, data acquisition TEM errors	QA to Close
608	8/12/05	CAL	LAT CPT - CAL, intermittent range discriminator scan failure.	QA to Close
618	8/17/05	ACD	HldCal output for GARC5 is faulty; counter resets during run	Disposition required
624	8/27/05	ACD	Fluctuations in temperature reading (originally an ACD PR)	Disposition required
625	8/27/05	ACD	AcdVetoHitmapPha failed (originally an ACD PR)	Disposition required
626	8/27/05	ACD	ACDMonitor script high counts during T/V (originally ACD PR)	Monitor
648	9/13/05	ACD	I&T ACD Receiving Test - AcdGafeNoise failure	Disposition Required
652	9/13/05	ACD	ACD Triggered Ops event numbers skipped by large gaps	Disposition required
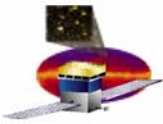
Open I&T NCR List

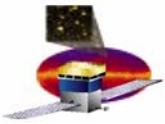| NCR	Date Opened	Affected Hardware	Problem Description	Status
654	9/13/05	ACD	ACD Triggered Ops shows tiles with large pha diferrences	Disposition required
684	10/3/05	TKR	Noise Occupancy failures due to intermittent hot strips.	Disposition Required
685	10/3/05	ACD	HldCal runs had excessive counts for GARC11, GAFE13	Disposition required
690	10/6/05	PDU	NCR to trend LPT failures observed in box level NCR #00631.	Disposition Required
706	10/18/05	ACD	Excess ACD veto retriggers during NCR #618 evaluation	Disposition required
718	10/27/05	ACD	VETO threshold for channel 1123 can't be set below minimum value of 0.45pC (originally an ACD PR)	Monitor
732	11/3/05	Integration	Spider surface should be flush surface of the TPS.	QA to Close
741	11/11/05	Integration	HIB Cables to short or wrong orientation.	QA to Close
743	11/13/05	Integration	EMI shield mechanical tolerances not met.	QA to Close
744	11/13/05	Integration	X-LAT plate mechanical hole tolerances not met.	Disposition required
765	12/5/05	Integration	X-LAT Heat pipe shims bonding fixture cannot be removed.	MRB Required
768	12/6/05	Integration	Cannot mate ACD cable assy to RF shield.	Disposition Required
774	12/8/05	Integration	Cannot mate harness LAT-DS-02092-53.	Disposition Required
777	12/13/05	Integration	DAQ-ACD Internal RF shield to GASU cable rework.	Disposition Required
783	12/15/05	ACD	ACD data taking sweep evetn errors	QA to close
785	12/20/05	GASU	GASU register test, GEM cr_statistics intermittent failure.	Disposition Required

Open I&T NCR List

| NCR	Date Opened	Affected Hardware	Problem Description	Status
787	12/20/05	ACD	ACD CPT crashes run control	Disposition Required
788	12/21/05	GASU	GASU AEM temperature alarm	Disposition Required
789	12/21/05	TKR	TKR test software isn't reading in bad channel lists	Disposition Required
790	12/21/05	Integration	Cannot mate LAT-DS-02094 harness to +X Doghouse holes.	QA to Close
791	12/22/05	ACD	ACD CPT script turns off/on all TEMs simultaneously	Disposition Required
793	12/28/05	ACD	GARC digital 3.3V current is slightly below allowed range	Disposition Required
795	12/30/05	ACD	ACD TciRegRange test gives bad linearity fits	Disposition Required
796	12/30/05	ACD	ACD TciHighRange test GARC 0 GAFE 11 Upper Gain slightly below limit.	Disposition Required
797	12/30/05	ACD	ACD long functional run 135005091 had test failures in AcdMaxPha, AcdPhaEnDis, AcdHldCal.	QA to Close
799	1/5/06	DAQ	TKR Analog voltage overshoot during power on sequence	QA to Close
800	1/5/06	ACD	ACD trigger test does not report all error events	QA to Close
804	1/16/06	Trigger	Trigger jitter from CAL-LO TREQ twice as broad as earlier tests on initial towers	QA to Close
805	1/16/06	Mechanical	Mapping problem wit hgrid temperature points 2,3 vs. 4,5	Disposition required
806	1/17/06	Trigger	CAL is retriggering during SVAC run	Disposition required
808	1/17/06	Integration	Harness connector backshell is loose (not properly torqued)	QA to Close
811	1/23/06	Integration	1553 cables rejected for workmanship	MRB Required

Open I&T NCR List

| NCR	Date Opened	Affected Hardware	Problem Description	Status
819	2/2/06	DAQ	Dimpled protrusions and oversized thru holes on HCB base	QA to Close
822	2/6/06	ACD	GAFE channel 17 pedestals shifted on all GARCs	Disposition Required
823	2/6/06	ACD	FREE Board 0 failed to initialize during PowerOn using FSW	QA to Close
824	2/6/06	Integration	VSC required reboot by resetting SBC	Disposition required
827	2/9/06	Mechanical	Insufficient screw thread engagement	Disposition Required
828	2/9/06	DAQ	FSW load on SIU-11 failed checksum on lower bank	QA to Close
829	2/10/06	ACD	ACD coherent noise at 1000 system clock ticks after each event collected in flight config.	Disposition Required
830	2/10/06	Integration	EPU J5, J8 connectors interfere with HIB connectors J5, J6 in Bays 00 and 12	Disposition Required
832	2/16/06	TKR	Calibration DAC correction factor did not work as expected on TkrThresholdCal.py	MRB Required
833	2/17/06	DAQ	SIU/EPU crates to be removed from LAT for RAD750 EEPROM bonding inspection	MRB Required
834	2/23/06	Mechanical	Accel mount bracket interferes with EPU screws	Disposition Required
835	2/23/06	DAQ	EPU 0 primary boot telemetry not observed after power on	MRB Required
836	2/27/06	Mechanical	MLI bar bracket does not mount flush, has insufficient thread engagement	Disposition Required
838	2/28/06	DAQ	Spare HCB had moisture condensation occur after T/V chamber was opened	Disposition Required

LAT Level Verification Status

Category	Verification Method					Requirements		
	Test	**Demonstration**	**Analysis**	**Inspection**	**Children**			
	# Complete	# Complete	# Complete	# Complete	# Complete	# Comp	Total	% Comp
Requirement Identified	-	-	-	-	-	457	457	100.0%
Flow Down Complete	-	-	-	-	-	454	457	99.3%
Draft Verification Plan	129	73	182	36	33	453	457	99.1%
Final Verification Plan	44	21	88	4	33	190	457	41.6%
Verification Plan Executed	0	0	2	0	33	35	457	7.7%
Requirement Sold	0	0	2	0	33	35	457	7.7%

- **Progress this month**
  - **Review of all 457 VPs in progress, many VPs updated**
    - **331 Level 2a/2b VPs and 124 Level 3 VPs**
    - **143 more VPs now final, remaining VPs in review by requirement owners**
  - **Input of NASA VP comments collected by Mark Melton complete**
  - **Science requirements VPs updated per inputs from Steve Ritz**
  - **Pass/Fail criteria addition for each reqt to VCRM ~ 30% complete**
  - **Verification Plan/Requirement owner assignment 100% complete**
- **Status**
  - **VCRM version 14 released**
 - **Updated version of the -00010 in review**
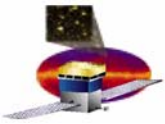
LAT Baseline Test Scope

- **The LAT Verification Cross Reference Matrix (VCRM), LAT-MD-07658, allocates requirements to LAT Level Test Cases**
  - **The VCRM documents 321 requirement Verification Plans to be sold by LAT Level Test in 36 separate test cases**
  - **211 requirements allocated to the Baseline Test**
- **Baseline Test documented by the Performance and Operations Test Plan, LAT-MD-02730-03**
  - **The plan identifies 31 of the test cases are to be run during the Baseline Test, which include:**
    - **13 test cases for the LAT CPT, 12 SVAC/ETE test cases, 3 LAT calibration test cases, 2 LAT Level test cases, and 1 one-time hardware verification test**
  - **Both requirements to be sold and functions to be validated by each test case are identified by the 2730**
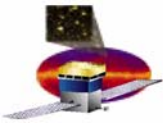 - **The plan was reviewed by NASA Systems and approved by LAT Systems, ACD, CAL, ELX, FSW, I&T, MECH, Thermal, & TKR**
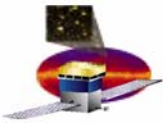
Baseline Test Case Summary (1 of 2)

Item	Test Case ID	Test Case Name(s)	Configurations						I&T Script Name	Reqts Allocated	Notes
			1	2	3	4	5	6			
1	LAT00x	LAT Power On	X	X	X	X	X	X	LatPowerOn	19	
2	LAT01x	LAT Power Off	X	X	X	X	X	X	LatPowerOff	0	
3	LAT02x	LAT Reinitialization	X	X	P	P		P	LatReInit	8	Also verifies cross-strapped interfaces.
4	LAT03x	LAT Electical Power Subsys Performance	X	X						9	Script may not be reqd (could use LatPowerOn).
5	LAT04x	Establish Science Operations Config	X	X					LatBaseSciOps	2	Also used to upload files & images
6	LAT05x	LAT Register Test	X	X						0	LAT Health test.
7	LAT06x	SIU/EPU Hardware Functional	X	X						1	LAT Health test, may combine with LAT02x.
8	LAT071	LAT Energy Measurement Calibration	X							0	Calibration, no requirement sell-off.
9	LAT08x	LAT Safe Modes	X	X						6	LAT Level test, may delete config 2 test.
10	LAT12x	LAT Science Modes	X	X						9	LAT Level test, may delete config 2 test.
11	LAT13x	LAT/Spacecraft I/F Functional	X	X	X	X	X			21	Tests all SC to LAT X-strap combinations.
12	LAT15x	LAT Ambient TCS Test	X	X						8	Test performed on hardware present
13	LAT16x	LAT Ambient Survival Htr Test	X	X						9	Specific script may not be required.
14	LAT17x	LAT Conducted & Radiated Emissions	X	P						3	EMI Test, not part of Baseline.
15	LAT18x	LAT Conducted & Radiated Susceptibility	X							4	EMI Test, not part of Baseline.
16	LAT20x	LAT Science Perf Diagnostics	X	X						2	LAT Level test, may delete config 2 test.
17	LAT21x	LAT Timing Measure & Adjust	X	X						13	
18	LAT22x	LAT Science Ops Demo	X	X	P	P	P	P	IntSeApp	8	Demonstrates ETE Science Ops
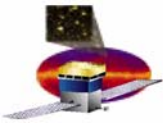
Baseline Test Case Summary (2 of 2)

Item	Test Case ID	Test Case Name(s)	Configurations 1	2	3	4	5	6	I&T Script Name	Reqts Allocated	Notes
19	LAT23x	LAT GRB Handling	X	X	P	P				17	
20	LAT30x	LAT ACD CPT	X	X						11	ACD internally redundant, may delete config 2 test.
21	LAT31x	LAT ACD LPT	X	X						0	LAT Health test.
22	LAT40x	LAT CAL CPT	X	X						11	CAL internally redundant, may delete config 2 test.
23	LAT41x	LAT CAL LPT	X	X						0	LAT Health test.
24	LAT50x	LAT TKR CPT	X	X						11	TKR internally redundant, may delete config 2 test.
25	LAT51x	LAT TKR LPT	X	X						0	LAT Health test.
26	LAT521	LAT Config 1 Light Tight Test	X							1	One time verification.
27	LAT650	T&DF False Triggers	X							0	Test recommended by ETE Committee
28	LAT660	T&DF Data Transport Errors	X							0	Test recommended by ETE Committee
29	LAT70x	LAT SVAC Flight Config on Gnd	X	X						38	Requirements allocated to SVAC
30	LAT711	LAT Config 1 SVAC Muon Calibration	X							a	
31	LAT801	LAT Config 1 SVAC Condition Scan (27 V)	X							a	Test recommended by ETE Committee
32	LAT811	LAT Config 1 SVAC Condition Scan (29 V)	X							a	Test recommended by ETE Committee
33	LAT821	LAT Config 1 SVAC Nominal Rate CR	X							a	Test recommended by ETE Committee
34	LAT831	LAT SVAC Nominal Rate CR Data Volume	X							a	Test recommended by ETE Committee
35	LAT841	LAT SVAC Nominal Rate Condition Scan CR	X							a	Test recommended by ETE Committee
36	LAT85x	LATSVAC Nominal Rate Condition Scan CR	X	X						a	Test recommended by ETE Committee
Notes:										211	
a)		38 requirements sold across all SVAC tests cases.									

Baseline Test Case Priority

Tier	Tier Test Cases		Tier Reasoning
	Test Case ID	**Test Case Name**	
1	LAT00x LAT01x LAT04x LAT22x	LAT Power On LAT Power Off Establish Science Operations Config Science Operations Demo	The LAT must be power on, off, and put in a state where science data can be taken before anything else. Performed in config 1, possibly config 2.
2	LAT30x LAT40x LAT50x	ACD CPT CAL CPT TKR CPT	Detector hardware performance verification is of the next highest priority.
3	LAT07x LAT21x	LAT Energy Measurement Calibration LAT Timing Measure & Adjust	Understanding the timing and interaction of the entire Instrument is a high priority.
4	LAT03x LAT13x	Electrical Power Subsystem Performance LAT/Spacecraft Interface Test	External interface hardware verification tests.
5	LAT02x LAT06x	LAT Reinitialization SIU/EPU Hardware Functional	Demonstrate the ability of EPU/SIU hardware/software to perform basics such as boot, memory dump, manage files, and reprogram.
6	LAT15x LAT16x LAT521 Tier 1-6 X-Strap	LAT Ambient TCS Test LAT Survival Heater Test LAT Light Tight Test Tier 1-6 tests in Configs 2-6	Remaining hardware verifications.
7	LAT70x LAT711 LAT8xx	LAT SVAC Flight Config on Ground LAT SVAC Muon Calibration End-To-End Committee Recommended	SVAC/ETE tests.
8	LAT08x LAT12x	LAT Safe Modes LAT Science Modes	Hardware/Software interface tests.
9	LAT20x LAT23x	LAT Science Performance Diagnostics LAT GRB Handling	LAT Level demonstrations. Mostly software, GRB interface.
10	LAT30x LAT40x LAT50x	ACD LPT CAL LPT TKR LPT	LPTs not required until NRL.