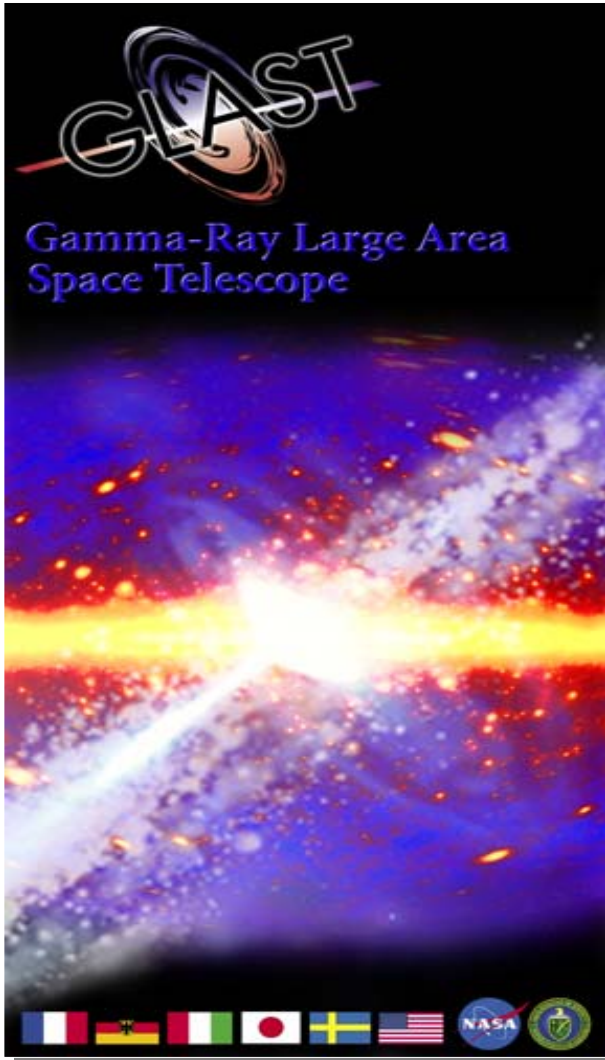


# Tracker Thermal Testing

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## Test Temperatures for Tracker Testing

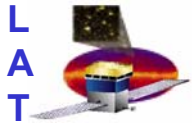
<12 Oct 2004>

J Goodman>

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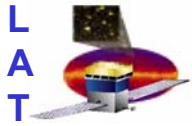
GLAST Project



# Tracker Thermal Testing - Background

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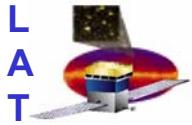
- According to 433-MAR-0001, **GLAST Mission Assurance Requirements**, the test program will demonstrate that *“the instrument performs within specification in a simulated space vacuum environment while instrument components are exposed to margined minimum and maximum temperature extremes. Required temperature margins will be 10°C above and below design hot and cold flight predictions ...”*
- This requirement was flowed down to LAT-SS-00778, LAT Environmental Specification, as *“During LAT thermal-vacuum testing, sink temperatures will be adjusted until at least one subsystem temperature reaches 10 degrees C beyond its operating limit, with the goal of most subsystems reaching this limit.”*
  - This means that the LAT instrument will be tested in a thermal vacuum chamber wherein the tracker can be exposed to hot temperatures of 40°C (30°C predicted + 10°C) and cold temperatures of -25°C (-15°C predicted - 10°C).
- Prudent robust design practice requires that the lower the level of (sub)assembly, the broader should be the test temperature extremes.



# Tracker Thermal Testing

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- The tracker tower, a first level subassembly below the LAT Instrument, will be thermally cycled in a vacuum between +50°C and -30°C. These temperature extremes are in line with the MAR and LAT Environmental Specification requirements and also prudent robust design practices.
- The completed tracker tray assembly including MCMs and silicon ladders, the second lower level subassembly, is scheduled to be thermally cycled at atmospheric pressure at temperature extremes of +50°C and -30°C. An atmospheric pressure environment has been chosen for this test because it was felt a vacuum would not provide additional stress on the tray components at that level of assembly.
- The tray panel with the kapton and tungsten bonded to the tray core, the third lower level of subassembly, is currently scheduled to be thermally cycled in vacuum between +60°C and -30°C.

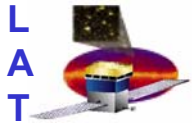


# Tracker Thermal Testing

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- A summary of test temperatures shows a level spot in the sequence of what should be increasing maximum temperatures; i.e., the Completed Tray maximum temperature should be between 50°C and 60°C. The sequence of minimum temperatures is okay even though it doesn't decrease below the tower level of assembly because the tracker base (Grid) is thermostatically controlled to -20°C in survival mode.

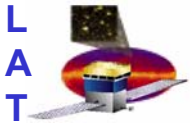
Test Description	Min. Temp (C)	Max Temp (C)
LAT Instrument	-25	+40
Tracker Tower	-30	+50
Completed Tray	-30	+50
Tray Panel	-30	+60 (Proposed)



# Tracker Thermal Testing

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- The aerospace community has seen various instances wherein on-orbit temperatures were 10°C (and more) higher than predicted. In such cases, a robust hardware design (and test plan) will assure no mechanical failure, even if instrument/hardware performance is degraded. Stanford University's own Gravity Probe – B program (Relatively Experiment) is an example of such a case; the instrument is functioning normally, but cryogen lifetime has been impacted.
- A robust design wherein subassemblies can tolerate wider temperature extremes than the level above will also assure against failure in case the hardware was inadvertently over tested at the next higher level of assembly.



# Tracker Thermal Testing

- The chart below shows proposed hot temperature test extremes. A wider separation of test temperatures for assemblies below the LAT level would be better, 10°C rather than 5°C, given the practical tolerance band of test temperatures. For these test values, a tolerance band of -0°C/+5°C is recommended. The sequence below should be considered minimum test temperatures necessary to achieve a robust design.

Test Description	Min. Temp (C)	Max Temp (C)
LAT Instrument	-25	+40
Tracker Tower	-30	+50
Completed Tray	-30	+55 (proposed)
Tray Panel	-30	+60 (Proposed)