Source Localization and Pointing Knowledge

- LAT science requirement for source location is < 30 arcsec
  - High latitude source of 10^{-7} cm^{-2} s^{-1} flux at >100 MeV with a photon spectral index of -2.0 above a flat background and assuming no spectral cut-off. 1 sigma radius. 1-year survey.
- Pointing knowledge (<10 arcsec) vs. pointing accuracy (<2°)
- The uncertainty in the measured direction of a single photon by LAT is determined by:
  - single photon PSF
  - end-to-end pointing knowledge
    - GN&C uncertainties
    - mechanical/thermal uncertainties
    - alignment calibration uncertainties
- LAT will measure many photons from a point source. The point source localization is determined by a combination of several factors:
  - Aeff, FOV, single photon direction errors, source characteristics (brightness, emission spectrum, sky region), and exposure

The requirements explicitly specify all of these.

Sequence of On-Orbit Calibrations

- Internal LAT alignment using cosmic rays (straight trajectories)
  - LAT SVAC Plan (LAT-MD-00446).
  - Standard technique for particle trackers
    - No external measurements or references needed
    - Technique verified on ground: muons from cosmic ray airshowers; on-orbit: cosmic ray protons
- Then, first two-week observations to perform initial LAT-SC calibration to better than 15 arcsec (more than sufficient for most year-one science topics).
  - Optimization of initial observing strategy (source selection, optimal orientation, etc.) under investigation.
- Then, proceed with sky survey and use known sources to reduce the error over year 1 to the required level.
  - 4 arcsec calibration residual statistically achievable
  - Mechanical/thermal stability details under study by feeding the results of the observatory thermal-mechanical analyses into the full LAT detector simulation.

Calibration Residual

- For science, there is no need to align LAT-SC physically to very high precision prior to launch (or to maintain that mechanical alignment during launch). Requirement: 0.5 deg
  - well-established, bright gamma-ray point sources whose positions on the sky are known (pulsars, AGN) provide a calibration reference
  - the pointing knowledge requirement is mainly a stability requirement on orbit.
- Since the system is used to calibrate itself, all the other pointing knowledge components can affect the calibration.
  - necessary to take into account residual in the decomposition
  - analysis of expected residual size requires a detailed understanding of the mechanical/thermal stability of the system over the timescales needed to accumulate sufficient photon statistics.
- Calibration continuously refined as data accumulate.

Simulations of the Tracker Alignment Calibration

- Detailed LAT instrument simulation has the capability of including effects of misalignments.
- Can simulate a full year of all-sky survey observations of a source. By introducing misalignments, and passing the simulated data through the full reconstruction and science analysis chain, we can
  - simulate the calibration observations and verify the statistical precision obtained with time;
  - quantify the impacts of thermal-mechanical distortions

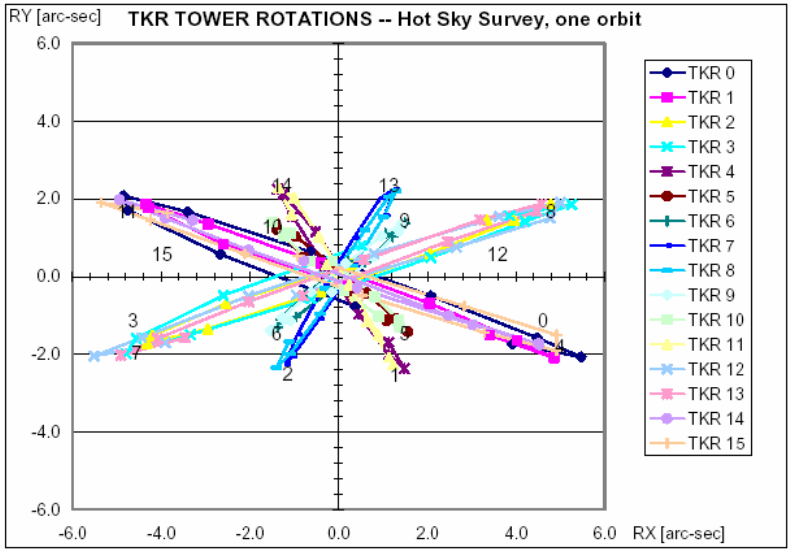
- Now that the results from the thermal-mechanical analyses are available, this work is proceeding. Results will be ready for mission CDR.

PRELIMINARY!

GLAST LAT Project

Sky Survey Tower Rotations w.r.t. Orbit Average

- These are not official results yet.
- start here: put these (small!) rotations into the simulation, and observe Vela (and other sources). Julie is working on this, with help from Leon.
- distortion relative to uniform room-temperature case is much larger (still <~30 arcsec), but what matters here is on-orbit stability.
- transient analysis (repoint) not done yet.
- longer-term variations also must be taken into account.



TKR Positions

12	13	14	15
8	9	10	11
4	5	6	7
0	1	2	3

Analysis by Mike Opie