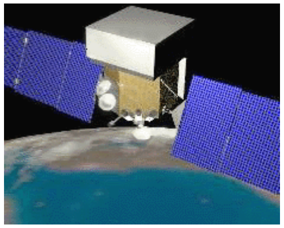
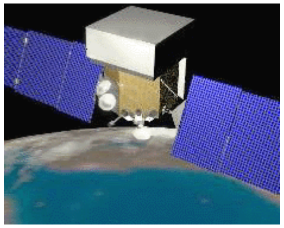


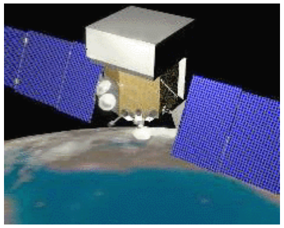
Discussion of Balloon Flight Objectives Document

Dave Thompson
with contributions by
T. Kamae, J. Ormes
and others



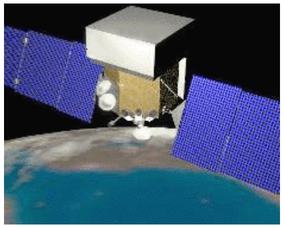
Talk Outline

- Rationale for a balloon flight
- Limitations of a balloon flight
- Definition of "success"
- Balloon flight objectives
- Outline of proposed approach



Requirement from the NASA AO

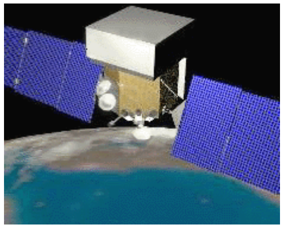
"The LAT proposer must also demonstrate by a balloon flight of a representative model of the flight instrument or by some other effective means the ability of the proposed instrument to reject adequately the harsh background of a realistic space environment. … A software simulation is not deemed adequate for this purpose."



"… the harsh background of a realistic space environment"

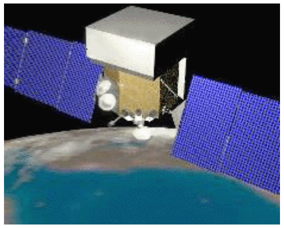
- A mixture of incident species - protons, heavier nuclei, electrons, photons
- A flux of unwanted background particles orders of magnitude greater than the flux of gamma rays
- Background incident on all parts of the instrument from all directions
- A background rate comparable to the rate in a 28° inclination, low earth orbit

A balloon flight provides this environment in a straightforward way.



Limitations of a Balloon Flight

- For realistic balloon altitudes, the secondary gamma-ray flux overwhelms any cosmic gamma-ray signal.
  - Example: for the Crab or Geminga (the brightest Northern hemisphere sources), a GLAST tower would see about 4 photons (>100 MeV)/hour, but within the corresponding PSF solid angle about 50 photons/hour would be seen from the atmosphere.
- One natural gamma-ray source, the horizon, can be detected by a GLAST tower, but the horizon is also bright in particles.
  - Seeing the horizon does not verify background rejection.



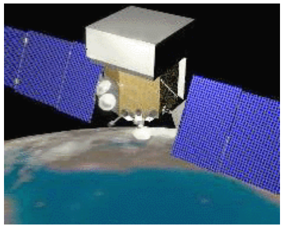
Option - An Artificial Source

• Concept: Put a block of material (such as graphite) ~2 m above the GLAST tower. Cosmic rays hitting the material will produce gamma rays, which can then be detected as a source.

• Problem 1: downward-moving protons hitting the target generate secondary charged particles that will produce self-veto.

• Problem 2: the source must still be seen against the atmospheric secondary gamma radiation.

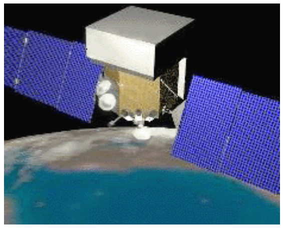
• Prof. Kamae is continuing this study.



Defining "Success"

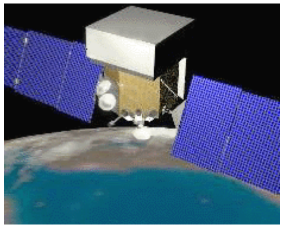
What <u>will</u> a GLAST tower see in a balloon flight?

- **Charged particles - rate ~1-3 kHz (>10^7 in a 6 hr. flight)**
- **Gamma rays - rate ~40-60 Hz (energies up to 100 GeV)**
- **Variation of flux with depth in the atmosphere**
- **Variation of flux with zenith angle (horizon ~10 times brighter than zenith)**
- **Gamma-ray flux, spectrum, and spatial distribution that can be compared with models and previous measurements (e.g. Thompson, 1974; Morris, 1986)**



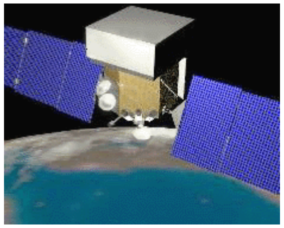
Suggested Measures of Success

- Can the DAQ reduce the trigger rate by a factor similar to what is needed in orbit (taking into consideration the higher gamma-ray rate)?
- Can the ground data system eliminate the residual background to a level that is consistent with expected atmospheric gamma-ray fluxes within uncertainties?
- Are the derived gamma-ray flux and energy spectrum consistent with previous measurements and models?
- Does a review of events indicate patterns that are not consistent with being gamma-ray pair production events?



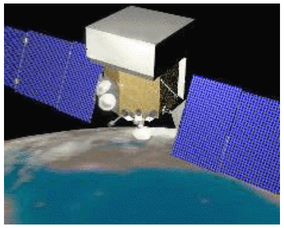
Possible List of Balloon Flight Objectives

- Demonstrate the ability of all GLAST subsystems to handle in-flight rates of background.
- Demonstrate the GLAST data analysis system capability to separate gamma-ray events from background.
- Demonstrate the ability of a GLAST tower to reproduce previous atmospheric gamma-ray results.



Issues

- These objectives are rather qualitative. How do we best quantify them?
- Are there other objectives?
- What requirements do these objectives put on the GLAST tower, the supporting hardware/electronics, and the balloon flight itself?



Outline of Proposed Approach

- The GLAST balloon flight tower will be a minimal redesign of the one used for the recent beam test.
- The tower will be enclosed in an existing pressure vessel to avoid thermal and high voltage breakdown problems.
- The tower will be carried on the existing GRIS gondola, which includes a pointing system.
- The balloon flight will be a minimal flight, typical duration 6-8 hours at float, from either Ft. Sumner, NM, or Palestine, TX, depending on the time of year.
- The flight will include a scan from zenith to horizon, possibly with an artificial source mounted above the tower.