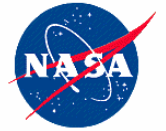




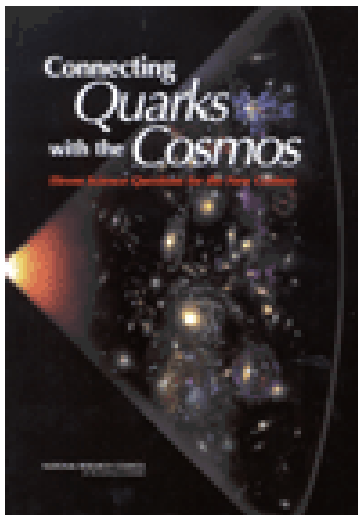
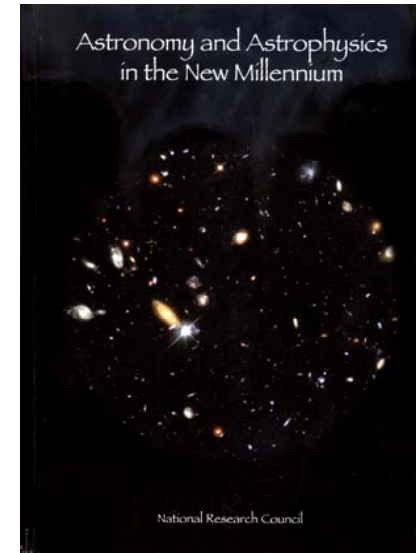
Science Impacts of LAT Descope

Peter Michelson
LAT Principal Investigator
Steven Ritz
GLAST Project Scientist

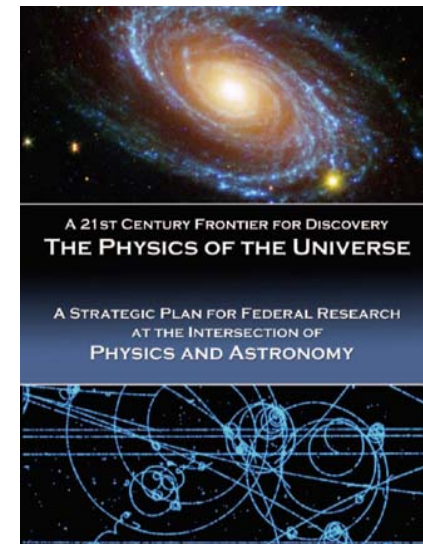


GLAST: Exploring the High-Energy Universe

- ▶ *a direct view into Nature’s largest accelerators*
- ▶ *gamma rays probe cosmological distances in a largely unexplored energy range*
- ▶ *great potential for Discovery*
 - *GLAST top-ranked mission in its category by the National Academy of Sciences 2000 Decadal Survey (Taylor-McKee);*
 - *featured in NAS “Connecting Quarks with the Cosmos” and the Physics of the Universe 2004 Strategic Plan*



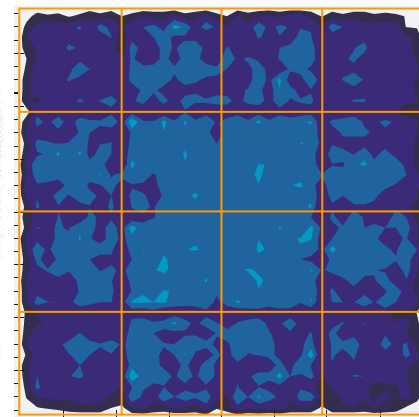
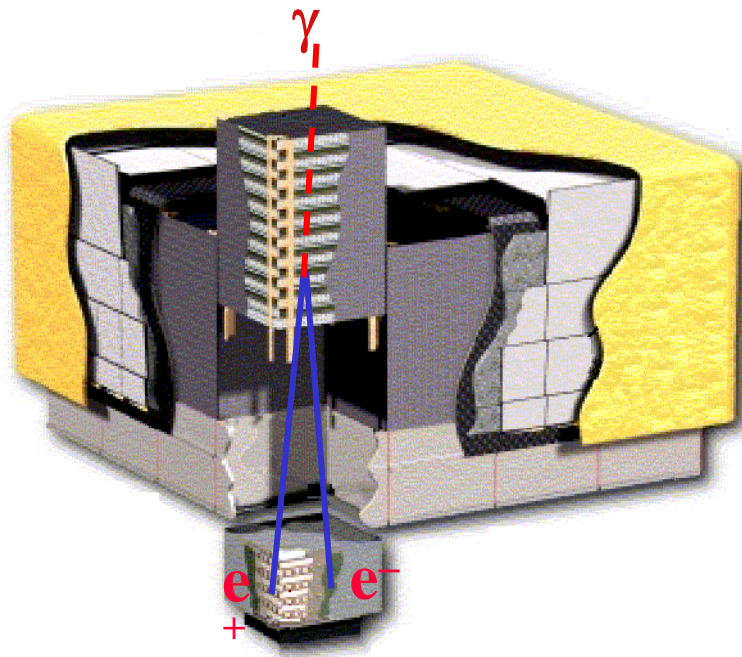
“...GLAST will focus on the most energetic objects and phenomena in the universe...it will also search for Dark Matter candidate particles.”



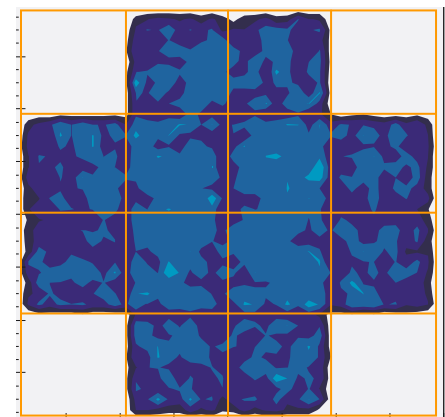


LAT Descope Configuration

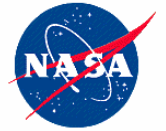
- ▶ **At this stage of project, the tracker is only instrument subsystem for descope**
 - *TKR is the critical path in the schedule;*
 - *all CAL module deliveries well off critical path; deletion of calorimeter modules requires insertion of mechanically equivalent replacement*
- ▶ **descope configuration = 12 TKR + 16 CAL modules**



16 tower LAT



descope LAT



Impacts of Descope on Performance

| Performance Parameter | EGRET | LAT (16 towers) | LAT (12 towers) |
|---|-----------------|------------------|--|
| Peak Effective Area (cm ²) | 1,200 | 9,000 | 6,300 |
| Background Contamination (relative to EGRET extragalactic diffuse flux) | <10% (E>100MeV) | <10% (E>100 MeV) | <50%* (100 MeV<E<1GeV) <10% (E>1 GeV) |

* current best estimate of background rejection based on Monte Carlo simulations

- ▶ ***descoped LAT violates GLAST Level 1 requirements***
- ▶ ***loss of peak A_{eff} larger than 4/16 due to tighter charged-particle background rejection cuts, required to maintain <10% contamination for E>1 GeV***
- ▶ ***for E<1 GeV, charged-particle bkgd rejection worse than EGRET***



Overview of Impacts on Breakthrough Science



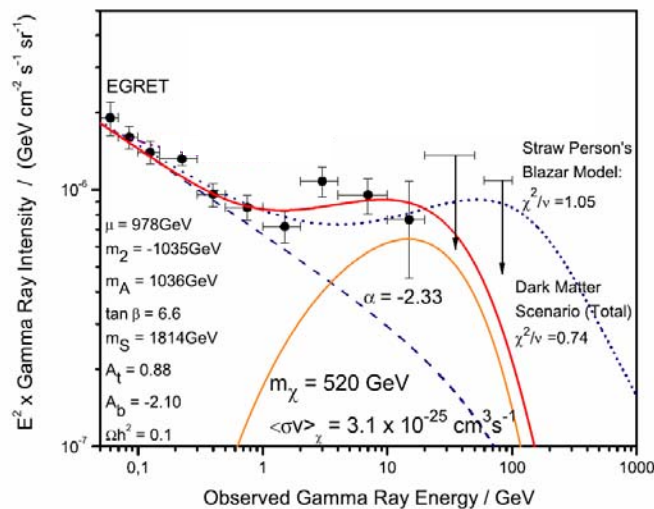
- ▶ *Loss of capability to measure extragalactic diffuse gamma-ray radiation, whose origin is unknown, below ~ 1 GeV due to larger charged-particle background (worse than EGRET; see following slides).*
- ▶ *high-energy spectra lost for $\sim 1/2$ the sources at cosmological distances, risking loss of unique measurement of optical-UV extragalactic background light (see following slides)*
- ▶ *in general:*
 - *15% poorer sensitivity for discovery of new, faint source classes, e.g.,*
 - *faint radio galaxies (other than blazars)*
 - *ultra-luminous infrared galaxies*
 - *outer radius of dark gas clouds in the Milky Way*
 - *presently undetected subpopulations hardest hit*
 - *survey point source sensitivity reduced*
 - *40% fewer AGN & 30% fewer pulsars and galactic sources detected*
 - *30% fewer photons for time-limited observations*
 - *pulsar blind searches (new Gemingas)*
 - *short-term variability (e.g. blazars, microquasars)*



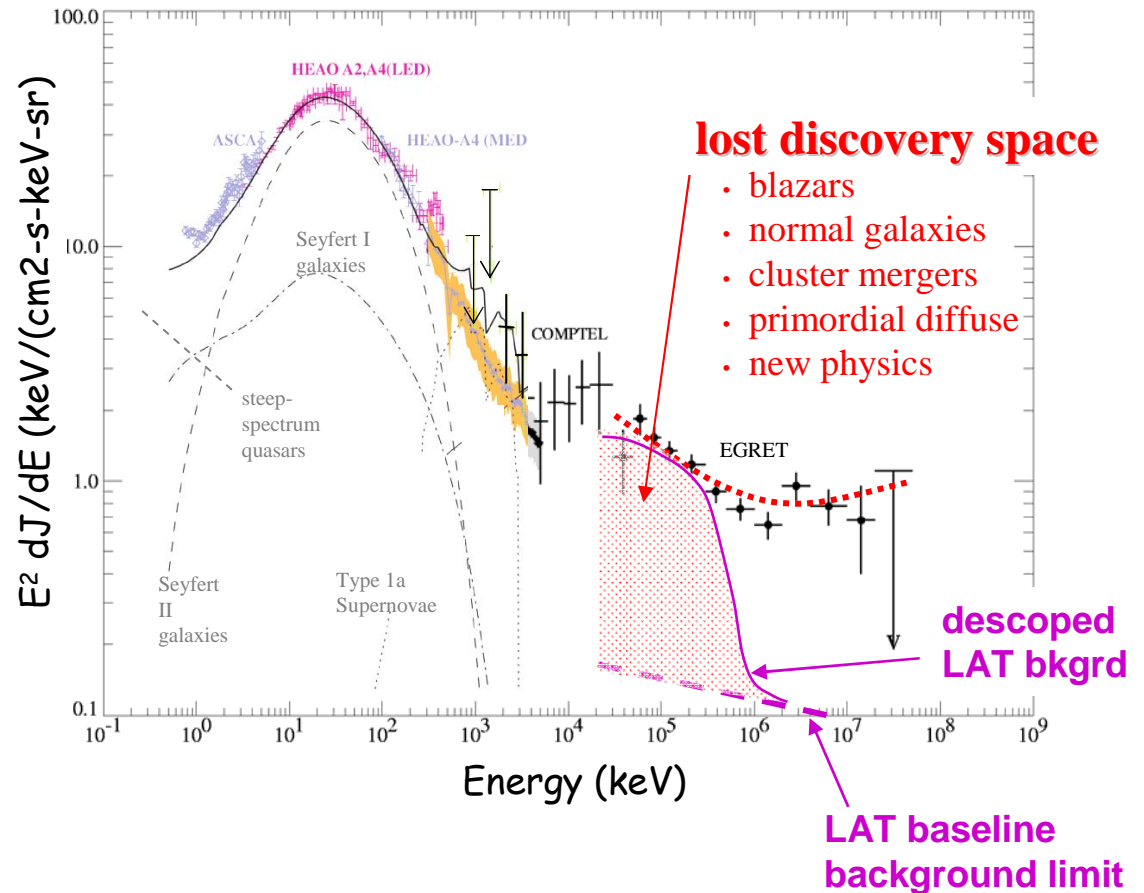
Cosmology: Origin of Extragalactic Diffuse Radiation

- ▶ **origin is a mystery; either sources there for GLAST to resolve (and study!) OR there is a truly diffuse flux from the early Universe**

EGRET constrains blazars to be > 25% of diffuse;
 annihilation of cosmological neutralinos has, in principle, a distinctive spectral signature



from Elasser & Mannheim, astro-ph/0405235

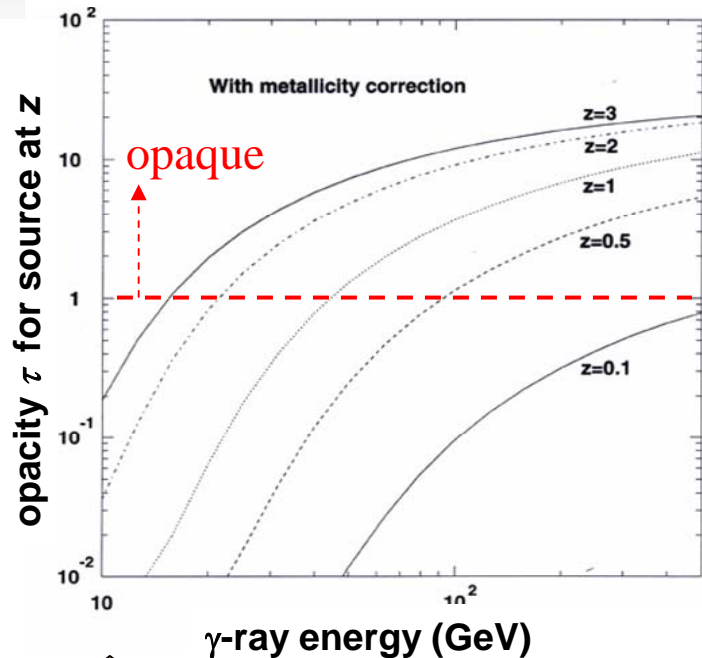


Unique science for GLAST

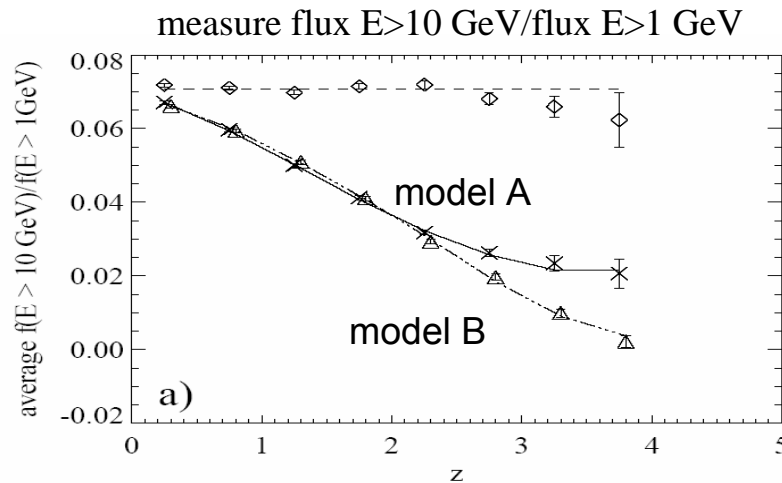


Cosmology: Probing Extragalactic Background Light

- ▶ **High-redshift ($z > 3$) blazar detections important for visible-UV EBL studies and blazar/galaxy evolution**
 - **Number of detections with spectral measurements above 10 GeV reduced by a factor of ~2**

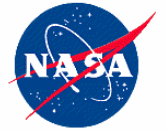


↑ No significant attenuation below 10 GeV



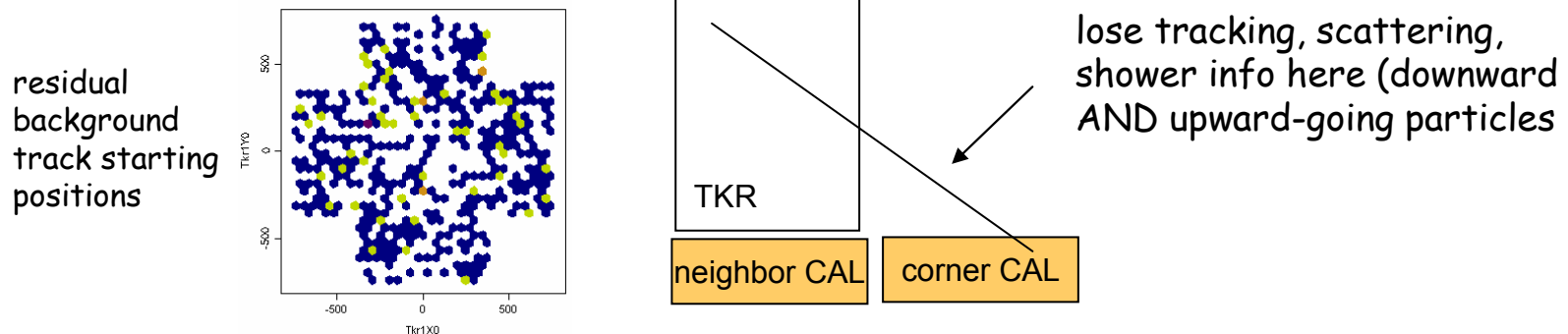
number of sources in bins of z
luminosity-function dependent (important science for GLAST!)

| # blazars w/ spectra $z > 3$ | LAT16 | LAT12 |
|------------------------------|-------|-------|
| $E > 1$ GeV | 62 | 32 |
| $E > 10$ GeV | 12 | 7 |



Background Rejection Risks

- ▶ **Baseline LAT excels over EGRET in all areas; comparable in background rejection**
 - design trade: much larger FOV and high-energy acceptance
 - background rejection capabilities similar to EGRET ($>10^5:1$), using different approaches
- ▶ **Preliminary results of MC simulation studies of descoped configuration:**
 - after standard event selections, see predominantly new population of residual background with rate a factor ~ 5 relative to requirements (other original components reduced, too, as expected), mainly at $E < 1$ GeV.
 - work ongoing to understand the effects in detail. Loss of tracking info in the gaps:



- note: residual is a tiny fraction of the triggered sample!



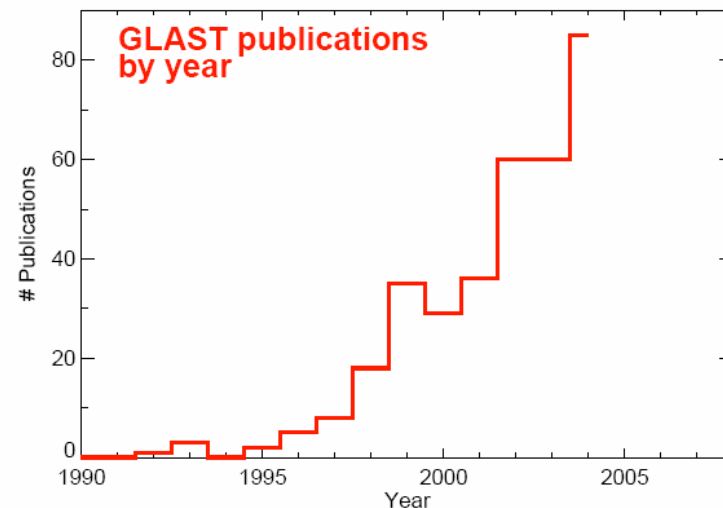
Science Community Involvement

- ▶ **At all mission levels: Science Working Group, User's Committee, Conferences, Workshops.**
- ▶ **Multiwavelength survey initiatives underway**
 - VLA monitoring for a large sample of flat-spectrum, compact sources (Ulvestad, et al.)
 - VLBA Imaging and Polarimetry Survey proposed to obtain a set of reference images for 1000 potential LAT sources in advance of GLAST launch (Taylor, Ulvestad, Readhead, Blandford, et al.).
 - Northern and Southern hemisphere radio pulsar timing campaigns in support of GLAST mission (Thorsett, et al. ; Manchester, et al.)
 - optical monitoring of LAT AGN

▶ **Broad and growing interest**

Publications & Conference Proceedings

| | | pre-launch | total |
|--------------|------------------|------------|-------------|
| COS-B | 1975-1982 | 11 | 481 |
| EGRET | 1991-2000 | 53 | 1212 |
| GLAST | 2007- | 342 | ??? |





Summary

- ▶ ***Descope would result in missed opportunities for exciting discoveries:***
 - *determine the origin(s) of the high-energy extragalactic diffuse background*
 - *measure extragalactic background light to $z > 3$*
 - *detect γ -ray emission from clusters of galaxies; CR acceleration on large scales*
 - *detect γ -rays from Ultra-Luminous Infrared Galaxies; cosmic ray acceleration efficiency and star formation rate*
 - *detect high-latitude Galactic Inverse-Compton emission and thereby measure TeV-scale CR electrons in the Galaxy*
 - *the unknown!*

- ▶ ***Very important to maintain the exploration and discovery reach of GLAST; it will be the last high-energy mission for a very long time***