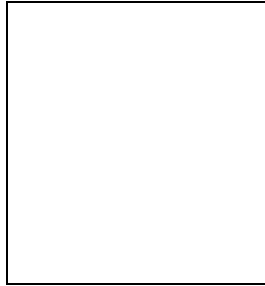


GeV Gamma-Ray Astronomy with GLAST

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GLAST is NASA's next major mission to observe the gamma ray sky with unprecedented sensitivity in the energy range between 20 MeV and 300 GeV. The collaboration consisting of institutions in the US, France, Italy, Sweden and Japan is now building the engineering model to demonstrate validity of the flight model design. We will proceed to the flight model construction in the fall of 2002 which will be launched in March 2006. The instrument and science of GLAST Large Area Telescope will be described briefly here.

1 Introduction

The Gamma-Ray Large Area Space Telescope (GLAST) is NASA's next major mission dedicated to observations of high energy gamma rays. GLAST will provide unprecedented sensitivity to gamma rays in the energy range of about 20 MeV to about 300 GeV. The GLAST observatory will consist of the two instruments, the Large Area Telescope (LAT) and the GLAST Burst Monitor (GBM), as well as the spacecraft housing. The Large Area Telescope (LAT) will be built by an international collaboration of scientists and engineers. Its Instrument Project Office is located at Stanford Linear Accelerator Center. The GLAST Burst Monitor (GBM) will be built by another international collaboration. Goddard Space Flight Center (GSFC) manages the GLAST mission. The present paper primarily deals with the instrument and science potential of the Large Area Telescope.

Currently, the LAT team is carrying out the Formulation Phase, addressing key design issues, and bringing together a coherent design in time for a NASA Preliminary Design Review (PDR) and a DOE Baseline Review ("Lehman Review") scheduled jointly by the two agents for October 2001. We have built a prototype model (one tower of the 16 towers required for the final instrument) in 1999 for a beam test. The prototype has been modified to become the Balloon Flight Engineering Model (BFEM) and will be flown from Palestine Texas in July 2001.

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We will advance to build the engineering model, demonstrate validity of the flight model design, and proceed to the flight model construction in the fall of 2002. The GLAST observatory is scheduled for launch in March 2006.

2 The GLAST LAT Instrument

The key features of the design are summarized in Fig.1 and itemized below.

- A pair-production high-energy (20 MeV - 300GeV) gamma-ray telescope, consisting of a plastic scintillator anti-coincidence system, a tracker made of Si strip detectors and thin tungsten converters, a CsI hodoscopic calorimeter, and a triggering and data acquisition electronic system.
- The instrument has a large effective area (typically 11000 cm²) and a large field of view (2.5sr) while maintaining good point spread function.
- The instrument will be primarily operated in the all-sky survey mode, scanning almost the entire sky every orbit (approx. 90minutes).
- The discovery reach of one-day data will be nearly equal to that of the lifetime data of EGRET. The instrument will allow us to keep hourly monitor of high energy universe, discovering 100 of GRBs, 10k of cosmological AGNs, tens of radio-quiet pulsars, and cosmic-rays in clusters of galaxies in the first year.

3 Science with GLAST LAT

The science goal of GLAST LAT is study of physics in the extreme environments of the early universe, in particular in the era of galaxy formation. Topics we will address include

- Observation of ≥ 5000 AGNs at cosmological distances: understanding of AGN evolution, acceleration mechanisms producing high-energy jets, and environment surrounding AGNs.
- Measurement on star formation in the early universe through absorption of AGN gamma rays by external background light.
- Discovery of acceleration sites of the highest energy cosmic rays: acceleration in galactic scale shocks.
- Measurement of the cosmic-ray density in nearby galaxies and clusters of galaxies (Fig.2).
- Determination of baryonic mass distribution in the Galaxy (Fig.3) which will lead to mapping of C/H.
- Understanding of physics processes underlying the gamma-ray burst.
- Discovery, if exists, of dark matter particles.
- Mapping of Galactic diffuse emission and its association with SNRs, pulsars, and giant molecular clouds.

GLAST-LAT will also be unique in its monitoring capability. It has an unprecedented wide field of view, covering 2.5sr or 20(Fig.4). Daily sensitivity will be almost equal to that of lifetime EGRET. We will discover long term variability which may lead to discovery of new phenomena. AGNs will be characterized by variability, and, precession and glitches in pulsars will be monitored.

Instrument

Consists of 6 flowlers to help
Height/width is 0.41 giving field of view

Tracker

Sistrip detectors: 236 mm pitch, to help
8.8 x 10 ch.

Calorimeter

Made of hodoscopic CsI crystal array to
facilitate cosmic ray rejection and shower
leakage correction

$X(Tkr + Cal)10 RL$

shower max is contained < 100 GeV

Anticoincidence Shield

Made of segmented plastic scintillator to
minimize self veto
>0.9997 efficiency & redundant readout

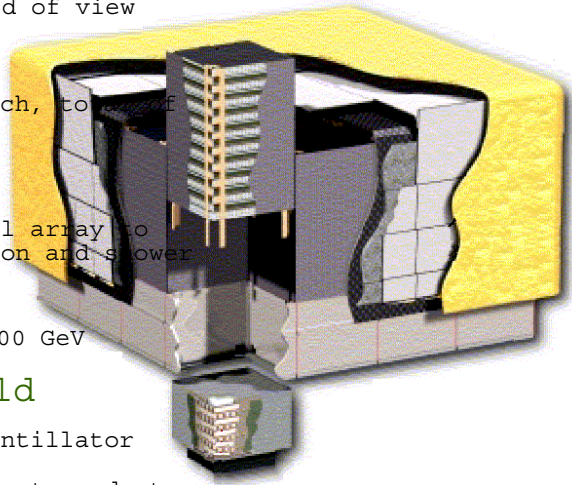


Figure 1: GLAST Large Area Telescope

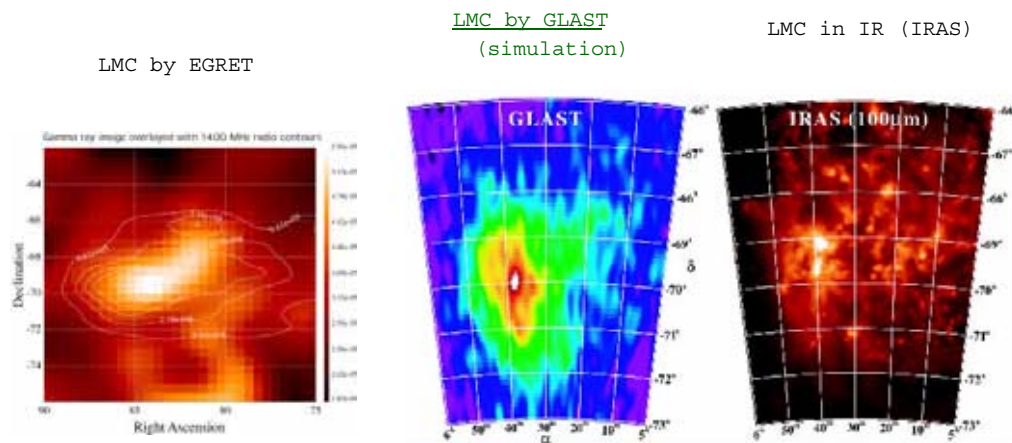


Figure 2: Image of LMC with EGRET, GLAST LAT (simulation), and IRAS

Pizero flux
measurement
by GLAST will
determine the
total mass in
the GMCs and
their C/H ratio.

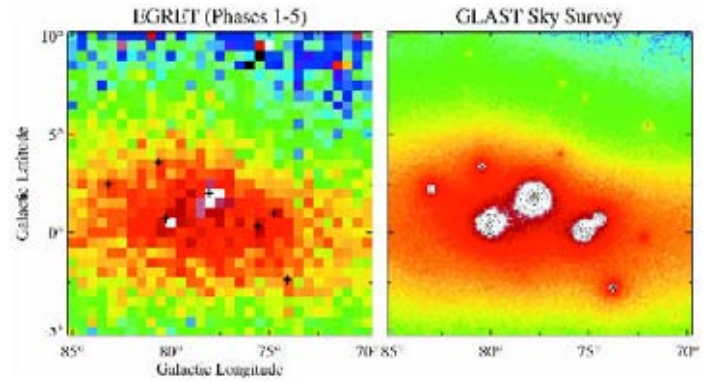


Figure 3: Image of Giant Molecular Clouds with EGRET and GLAST LAT (simulation)

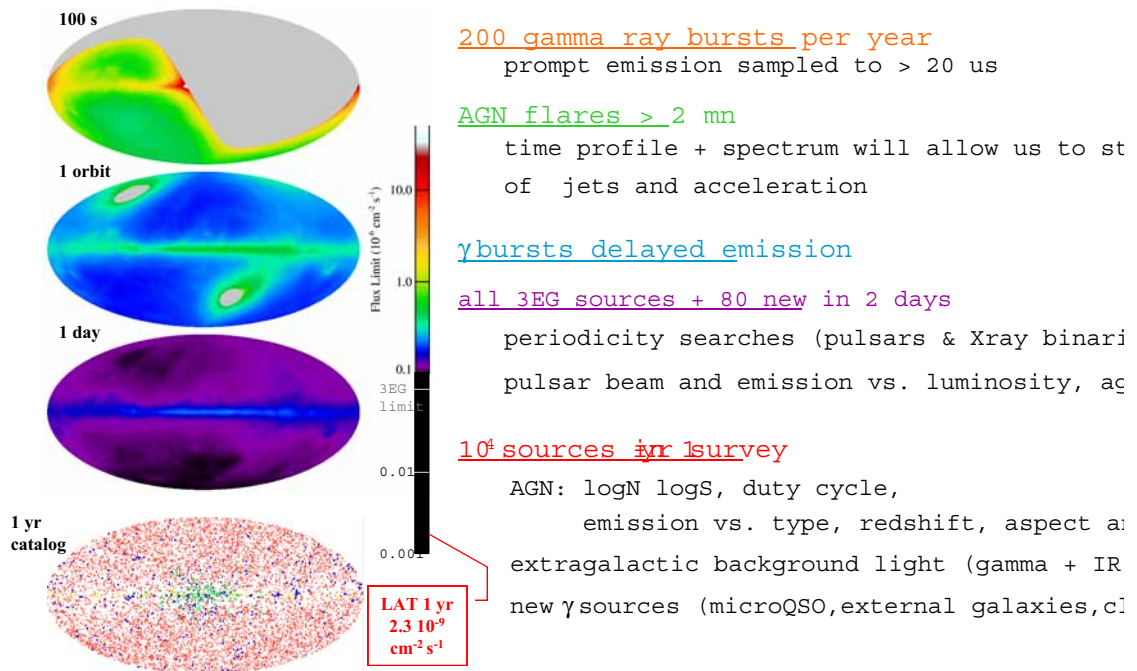


Figure 4: Science capability of GLAST LAT in all sky survey mode