Science Requirements

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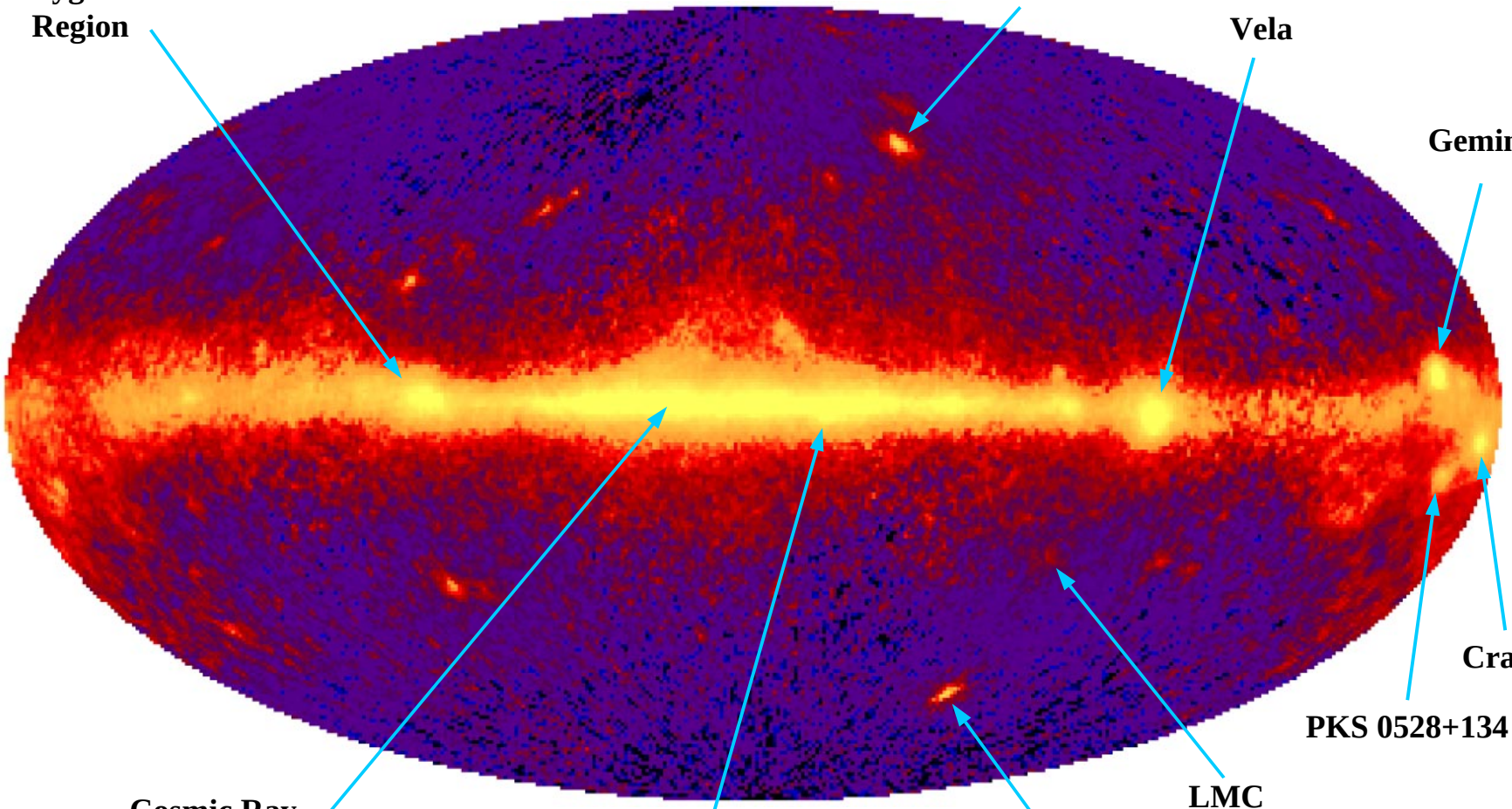
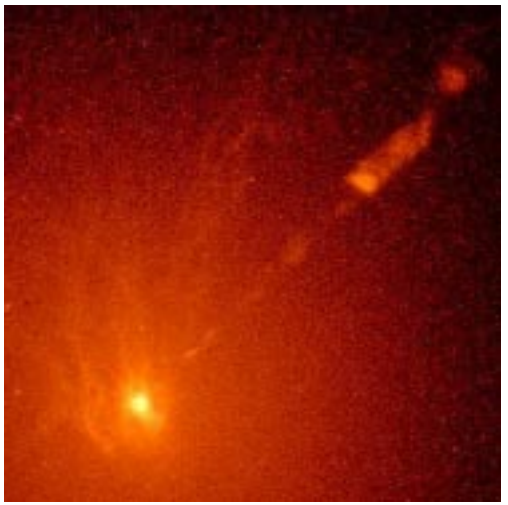
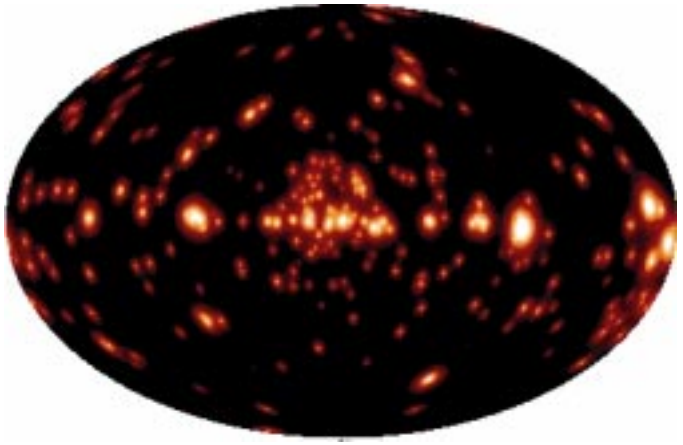
EGRET All Sky Map (>100 MeV)



Science Topics

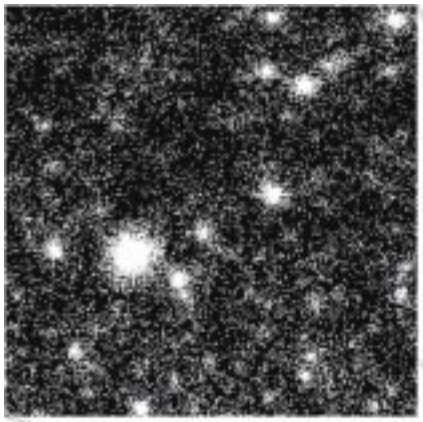
- **Active Galactic Nuclei**
- **Isotropic Diffuse Background Radiation**
- **Cosmic Ray Production:**
  - Molecular Clouds
  - Supernova Remnants
  - Normal Galaxies
- **Endpoints of Stellar Evolution**
  - Neutron Stars/Pulsars
  - Black Holes
- **Unidentified Gamma-ray Sources**
- **Dark Matter**
- **Solar Physics**
- **Gamma-Ray Bursts**



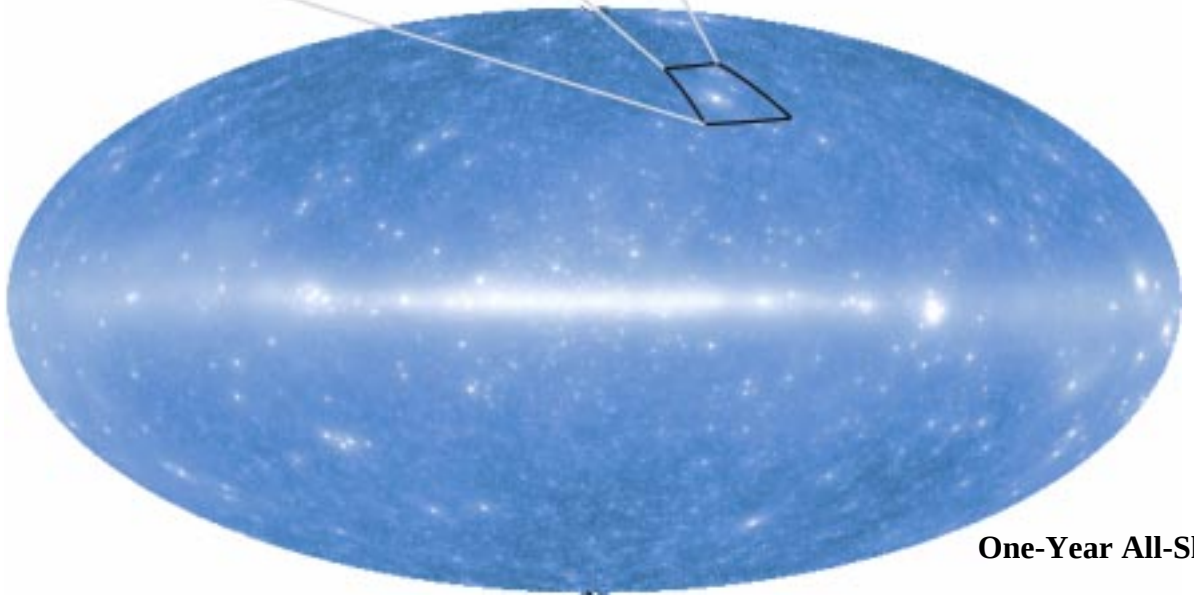


GLAST Simulated All Sky Map

Virgo Region (E > 1 GeV)



- **Map the gamma-ray sky with sensitivity > 30 times that of EGRET without becoming source confusion limited.**

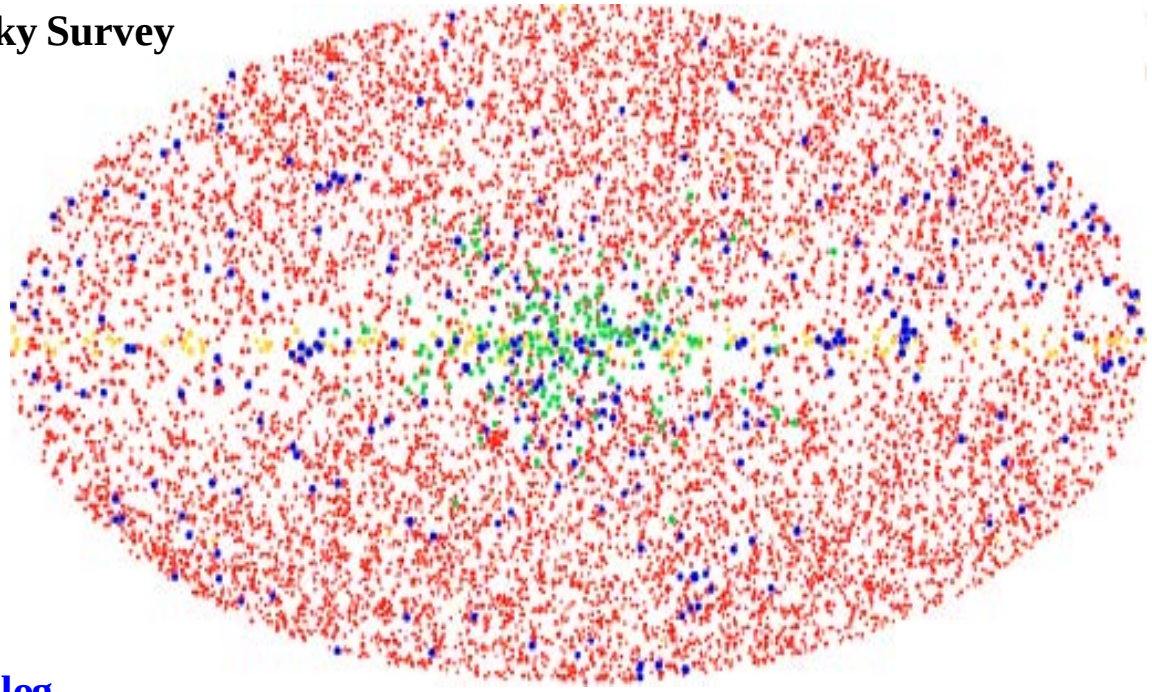


One-Year All-Sky Map (E > 100 MeV)

One Year Point Source Catalog

5 σ sources from
Simulated All Sky Survey

AGN



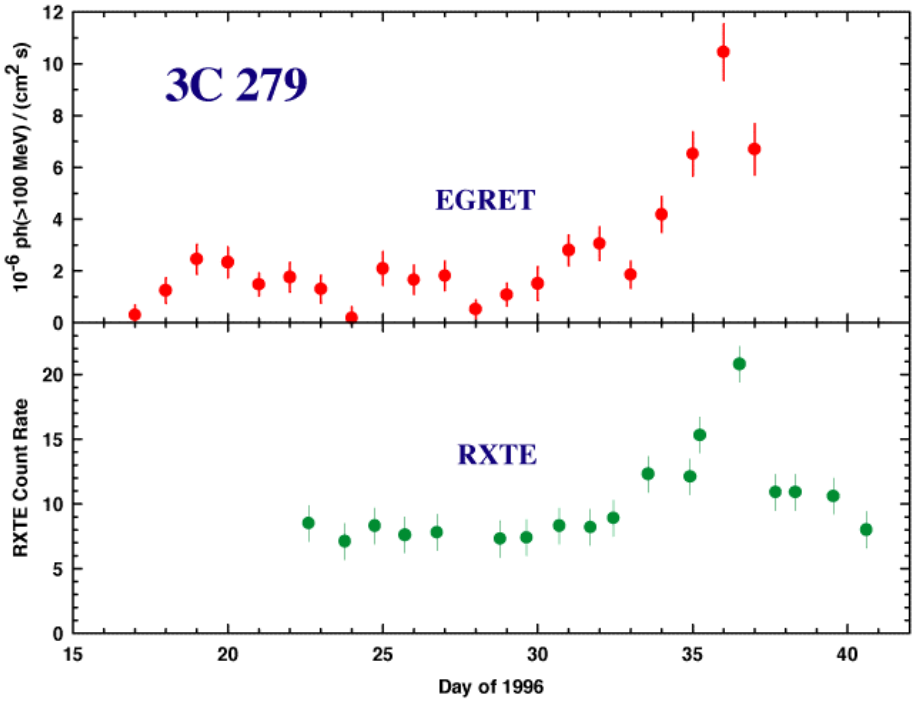
Galactic plane

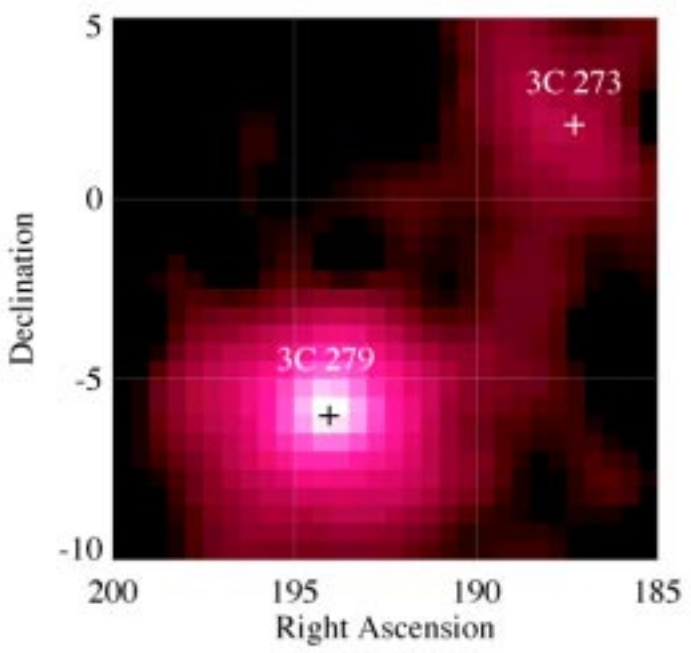
3EG catalog

Galactic halo

Active Galactic Nuclei

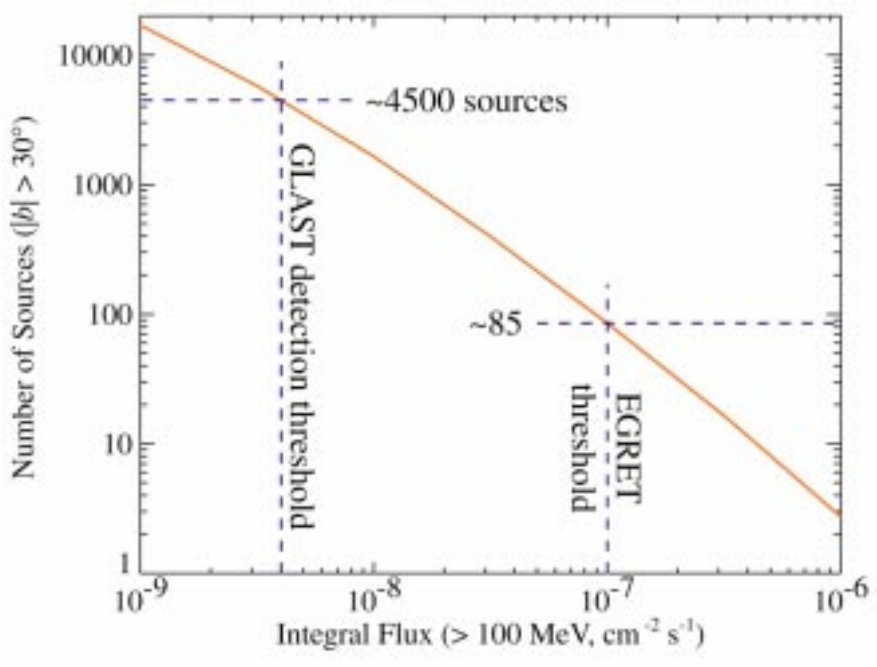
- **EGRET discovered gamma-ray beams from blazars. Blazars are super massive black hole driven Active Galactic Nuclei (AGN) whose beams point towards Earth.**





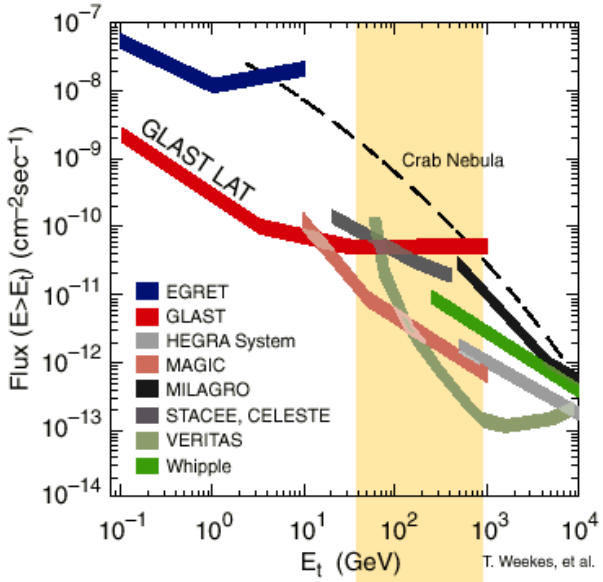
Active Galactic Nuclei: Time Variability

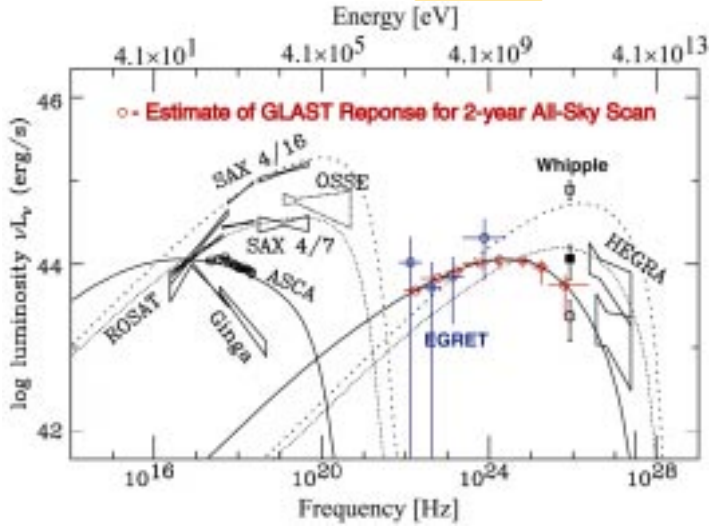
- **Study variability of bright sources down to the sub-day timescales**
- **Obtain significant sky coverage to monitor time variability of large numbers of AGN**
- **Constrain the AGN logN-logS function to a factor of > 25 fainter than EGRET**
- **Assure clean separation of sources on the sky (minimize source confusion)**



Active Galactic Nuclei: Spectra

- **Measure the spectra above 100 MeV from AGN (based on blazar logN-logS extrapolations)**
- **Explore low-energy spectrum where many AGN have peak emission**
- **Measure high-energy cutoffs**
- **Overlap with ground-based gamma-ray observations**

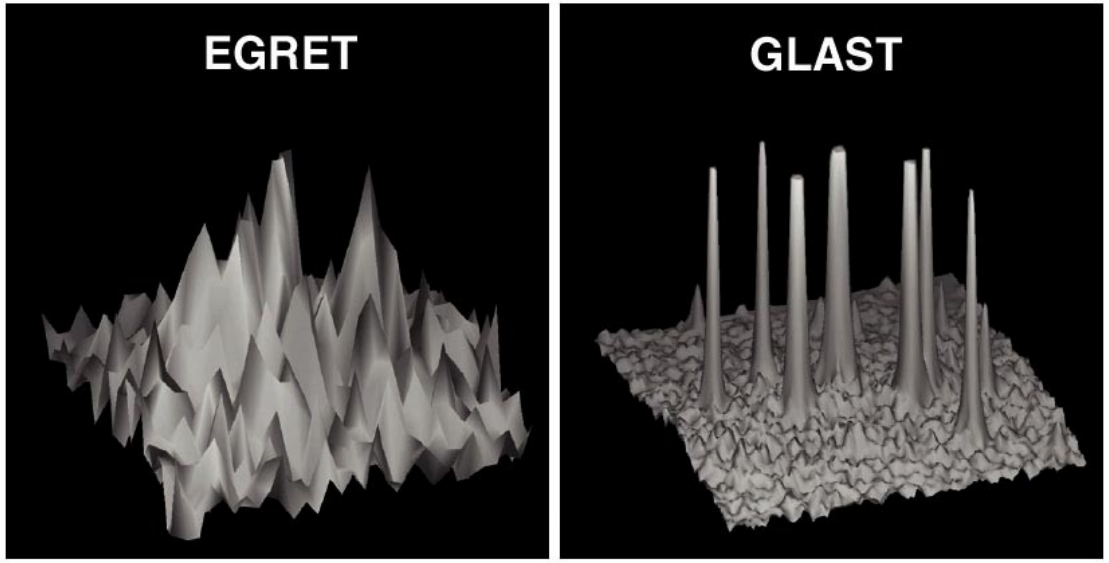




Active Galactic Nuclei: Requirements

- Energy response: 20 MeV to > 300 GeV
- Spectral resolution of 10% or better (E > 100 MeV)
- Effective area of > 8000 cm^2 (~ 5 times EGRET)
- Flux sensitivity < 6 x 10^{-9} cm^{-2} s^{-1} (1 year of scanning data)
- Point source localization of < 2 arcmin
- FOV of > 2 sr (~ 4 times EGRET)

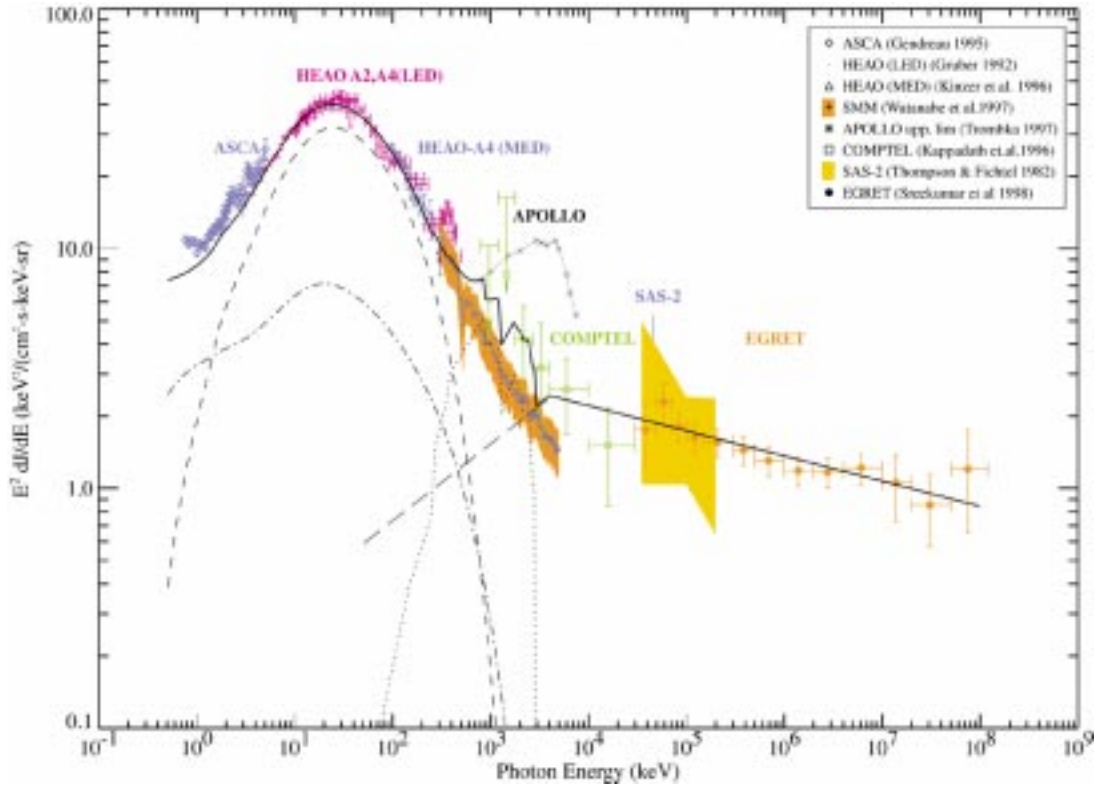
Cygnus Region 15 x 15 deg



Isotropic Diffuse Background

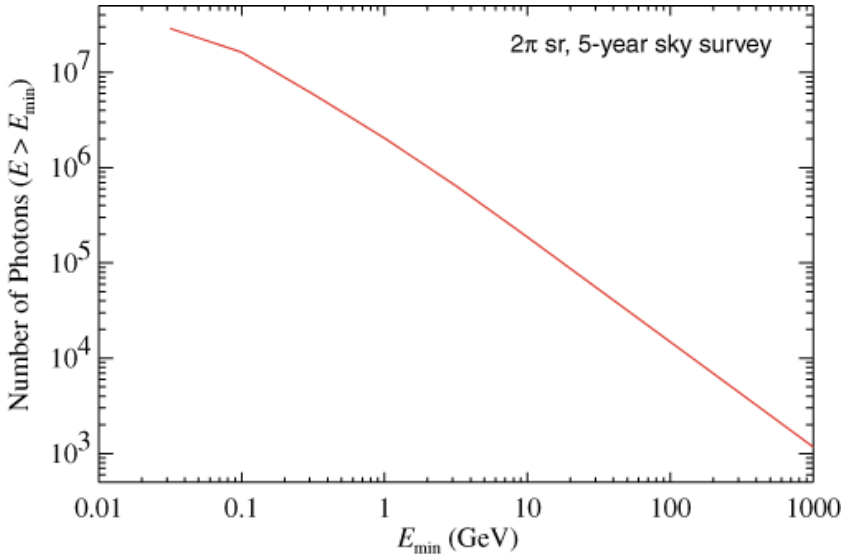
- **Find point source contribution (AGN + ??)**
- **Background rate < 10% of the isotropic diffuse component**
- **Extend coverage of diffuse spectral measurements**

Cosmic Diffuse Background



Isotropic Diffuse Background: Requirements

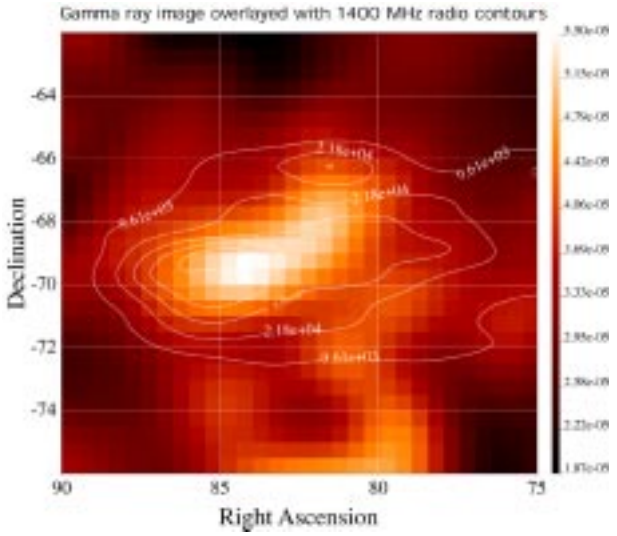
- Background < 10% of high latitude diffuse flux (Shreekumar et al.) with goal of 1%
- Energy range:
  20 MeV - 300 GeV
- Point source flux sensitivity: (1 year survey)
  < 6 x 10^{-9} cm^{-2} s^{-1}

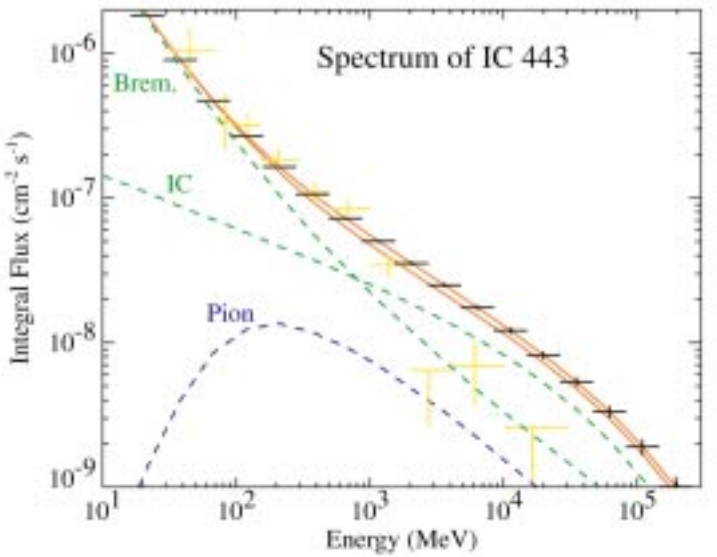


Cosmic Ray Production

- **Identify and map supernova remnants and other diffuse features**
- **Make spatially resolved precise spectral measurements and explore the pion bump**

LMC Detection

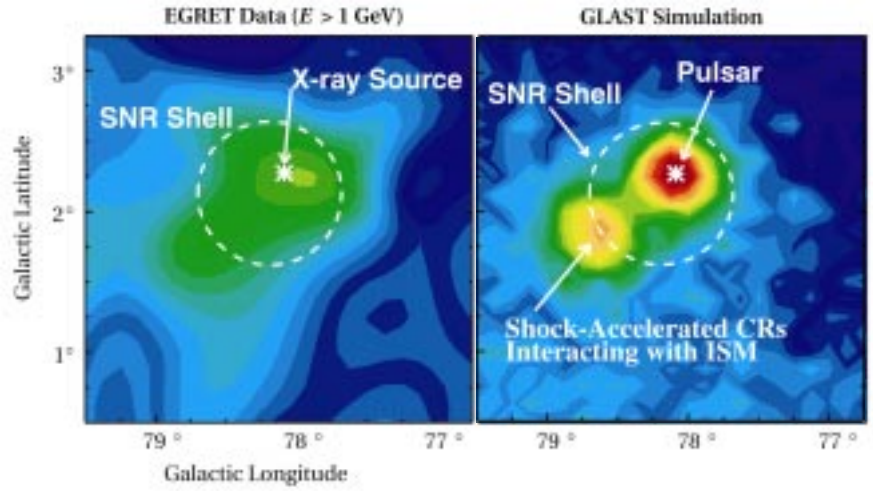


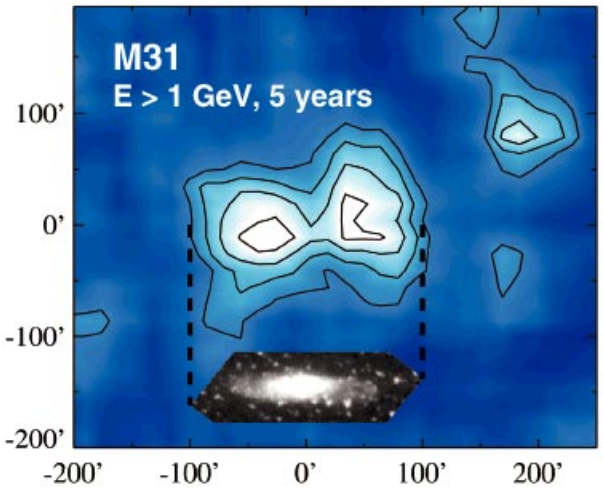


Cosmic Ray Production: Requirements

- Single photon angular resolution goal of < 0.5 at 1° GeV
- Point source localization of < 2 arcmin
- Spectral resolution of < 30% at low energies

SNR g-Cygni

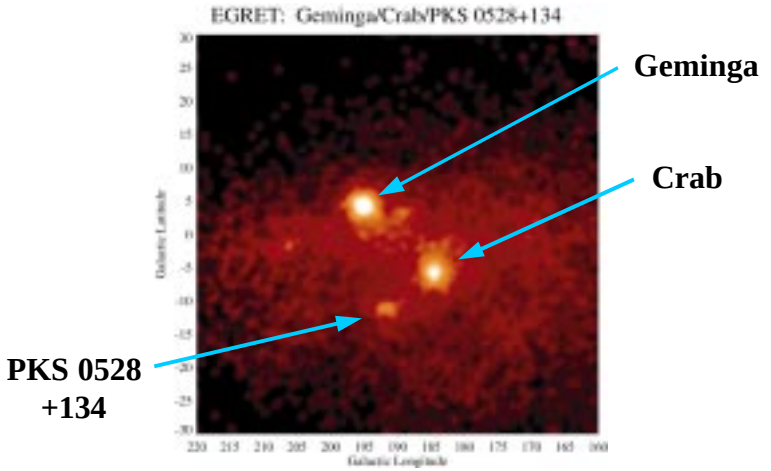


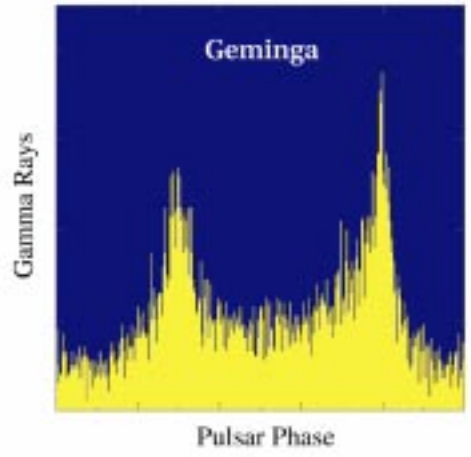


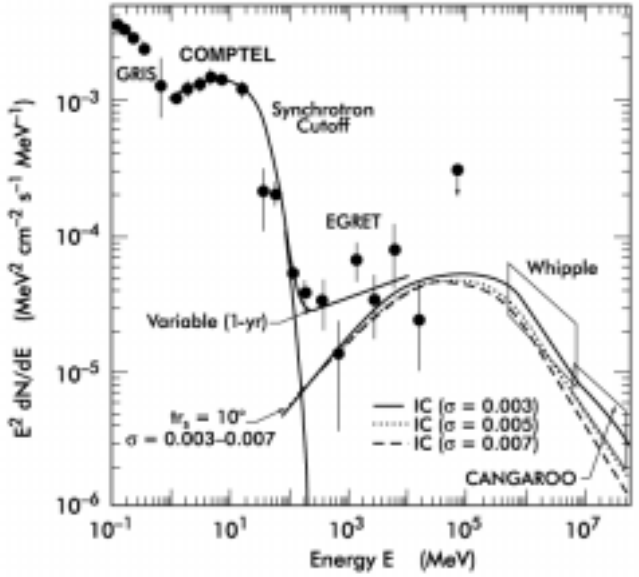
Endpoints of Stellar Evolution

- **Facilitate searches for pulsations from millisecond pulsars**
- **Characterize pulse profiles of detected pulsars**
  - Requires spectral resolution of ~10%, especially above 1 GeV where pulsar spectral breaks occur
  - Requires absolute timing to 10 μsec

Geminga Radio-Quiet Pulsars

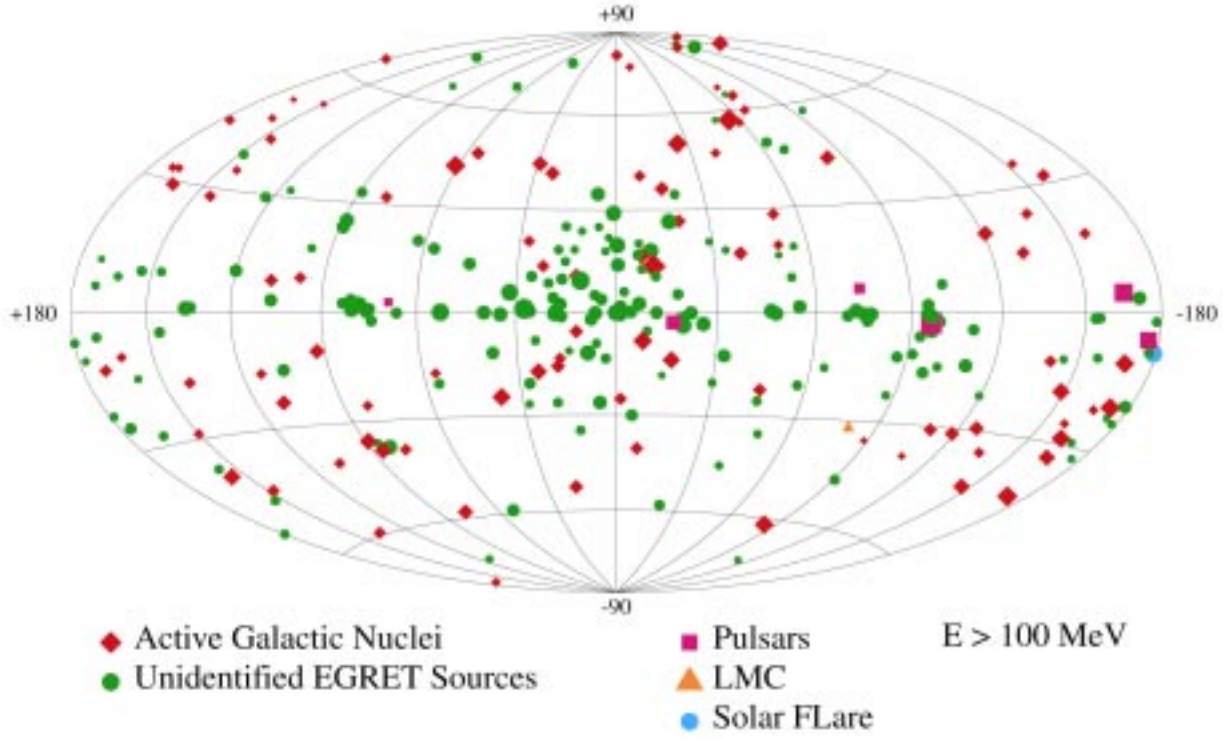






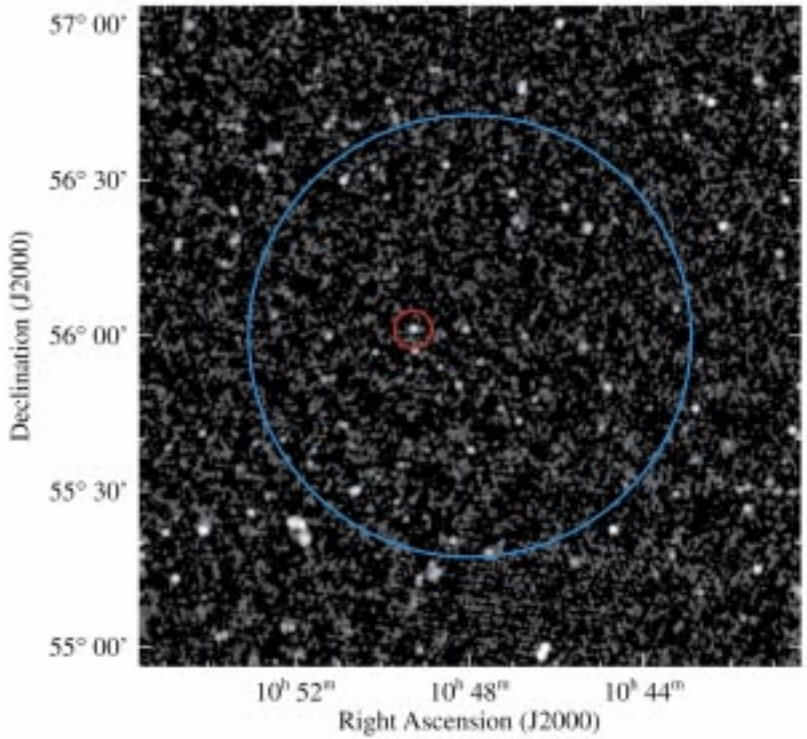
Unidentified Gamma-ray Sources

- **172/271 sources in 3rd EGRET catalog are unidentified**
  - Reduce source location error boxes to a few arcminutes
  - Monitor unidentified sources for time variability with high-duty-cycle
  - Facilitate counterpart searches at X-ray and lower energies and in TeV regimes



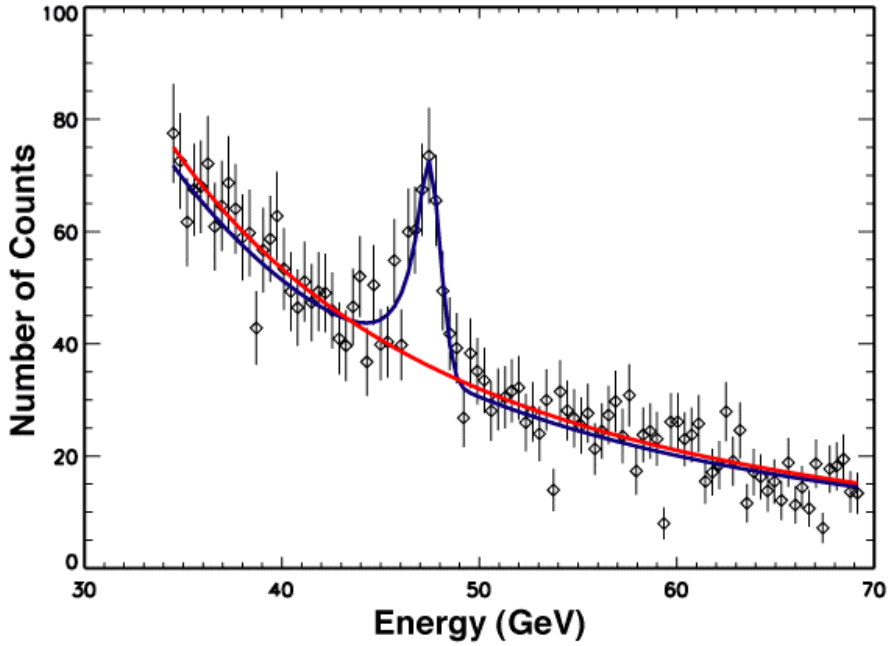
Unidentified Gamma-ray Sources: Requirements

- Source localization:
  < 5 arc minutes for source of strength 10^{-8} ph cm^{-2} s^{-1}
- Sensitivity above 1 GeV and large FOV



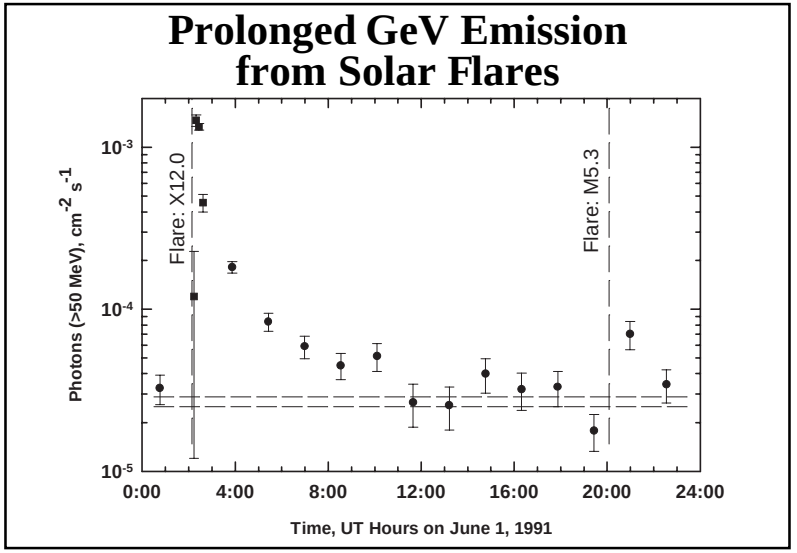
Dark Matter

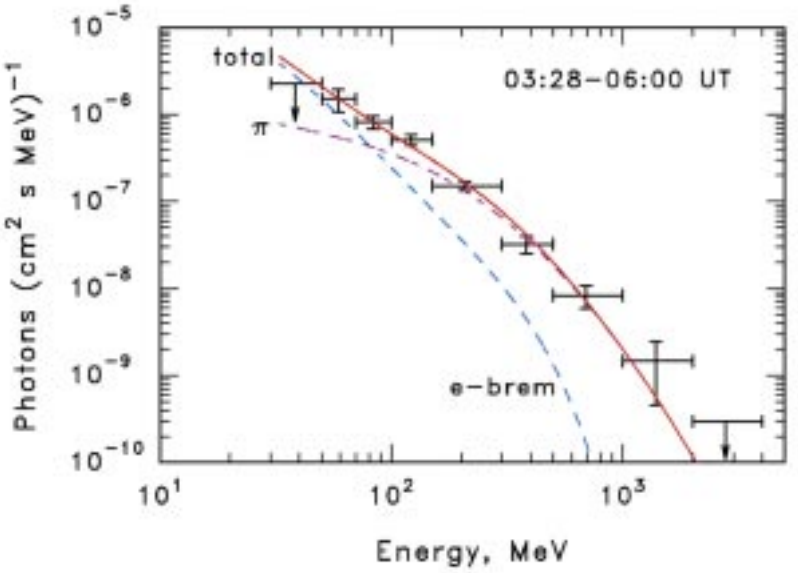
- **Constrain cold dark matter candidates**
- **Identify relatively narrow spectral lines**
  - Requires energy range with response to at least 300 GeV
  - Requires spectral resolution:
    5% at energies above 10 GeV (goal of 3%)



Solar Physics

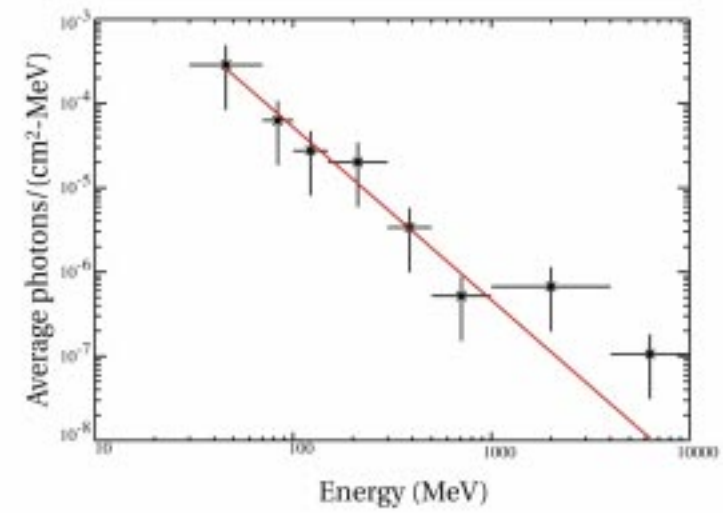
- **Determine the upper limit of accelerated particle energy in a solar flare**
- **Study the variability from flare to flare of the time profile of emission**
- **Investigate relation between the relative contribution of electron bremsstrahlung and pion gamma-ray emission to solar flare geometry**
  - Requires operation through the solar cycle 24 and solar maximum 2010
  - Cover energy band > 20 MeV and to > 1 GeV with high sensitivity

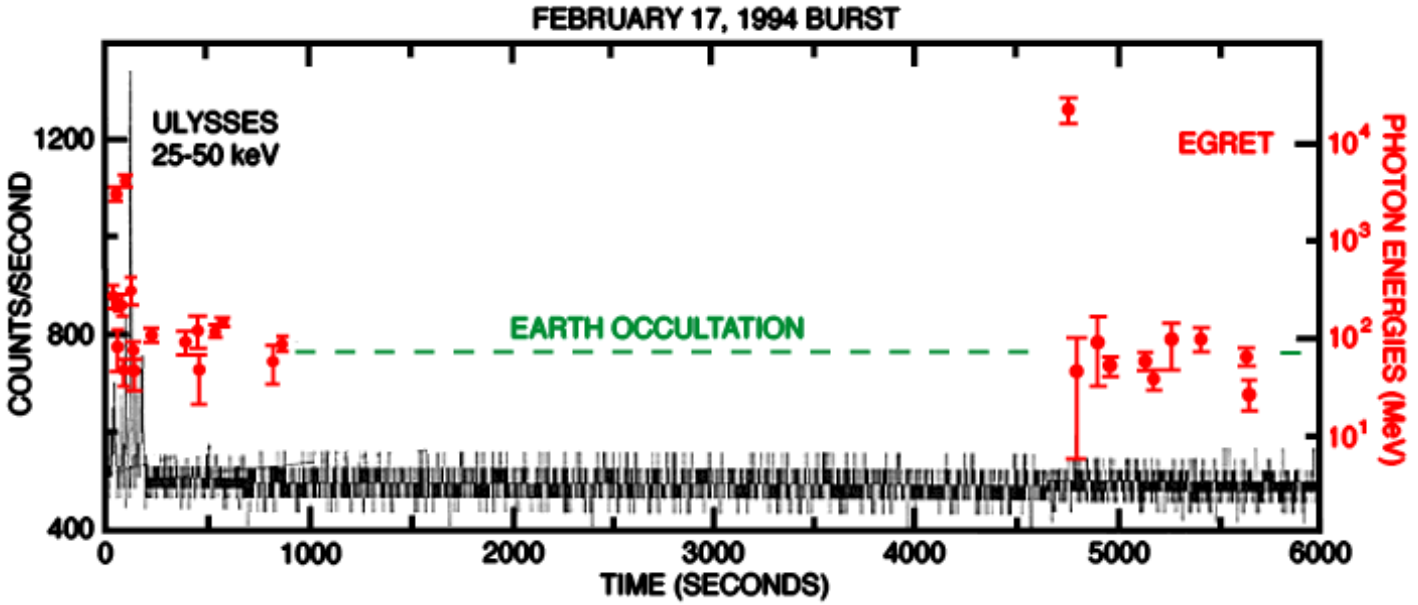




Gamma-Ray Bursts at > 20 MeV

- **EGRET discovered high energy GRB afterglow**
  - only one burst
  - dead time limited observations





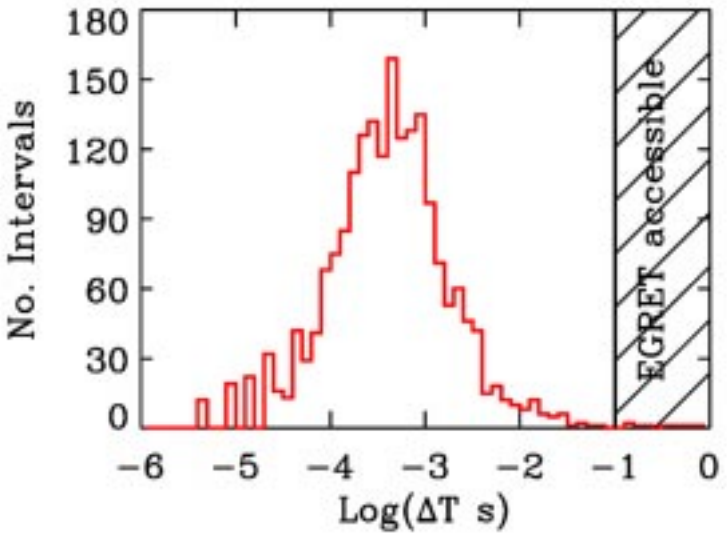
Gamma-Ray Bursts at > 20 MeV

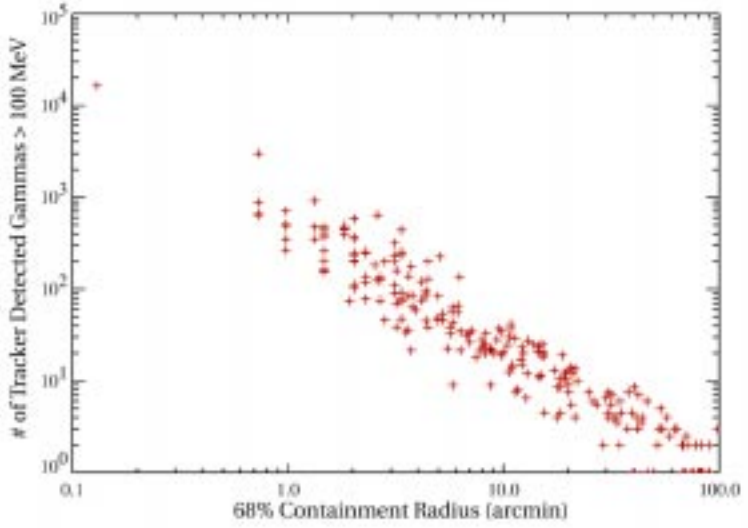
Spatial:

- **Monitor > 2 sr of the sky at all times**
- **Localize sources to with > 100 photons to < 10 arcmin**

Temporal:

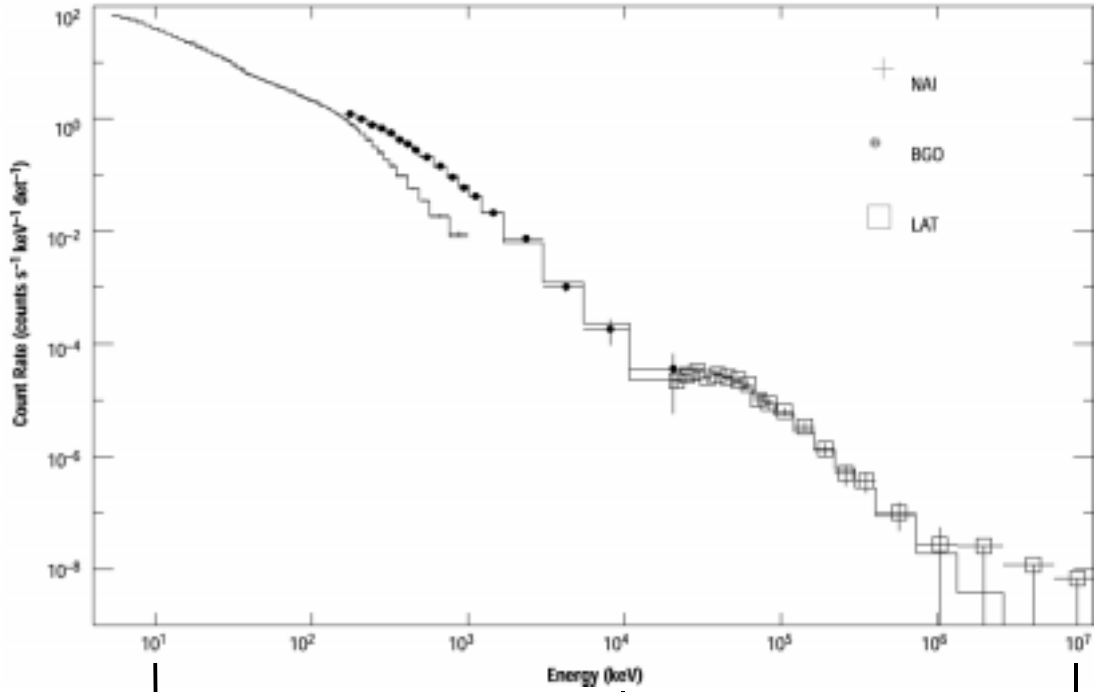
- **Perform broad band spectral studies and search for spectral structure**
- **Find correlation between 10 keV - 20 MeV and > 20 MeV photons**
- **Determine characteristics of > 20 MeV afterglow**





GLAST Burst Monitor (10 keV - 20 MeV)

- **Cover the classical gamma-ray band where most of the burst photons are emitted**
- **Monitor all of the sky that is visible from low-Earth orbit**
- **Identify when and where to re-point the spacecraft to optimize observations and notify other observers**



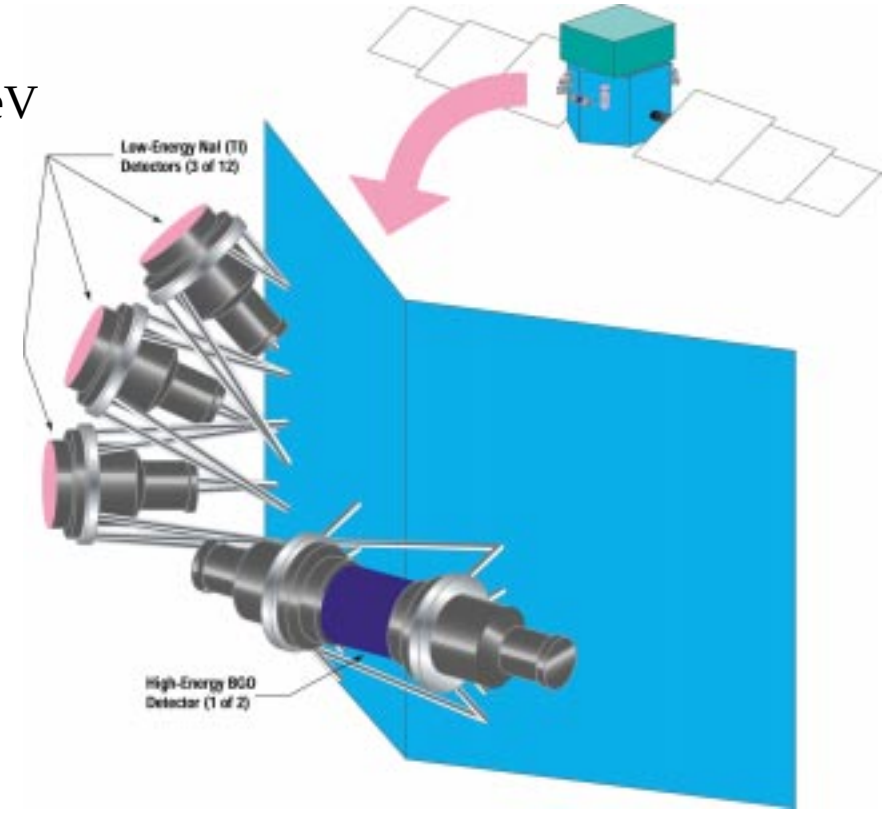
Gamma-ray Bursts: Requirements

LAT:

- Capture > 25% of GRBs in LAT FOV (2 sr or more)
- Deadtime of < 100 μsec per event
- Spectral resolution < 20%, especially at energies above 1 GeV

GBM:

- Monitor energy range: 10 keV - 20 MeV
- Monitor FOV of 8 sr (shall overlap that of the LAT)
- Notify observers world-wide:
  - Recognize bursts in realtime
  - Determine burst positions to few degree accuracy
  - Transmit (within seconds) GRB coordinates to the ground
  - Re-point the main instrument to GRB positions within 10 minutes



Discovery Potential

Have observational capability to be

SURPRISED!