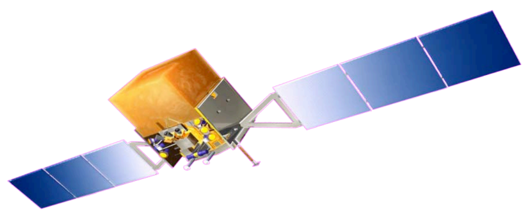
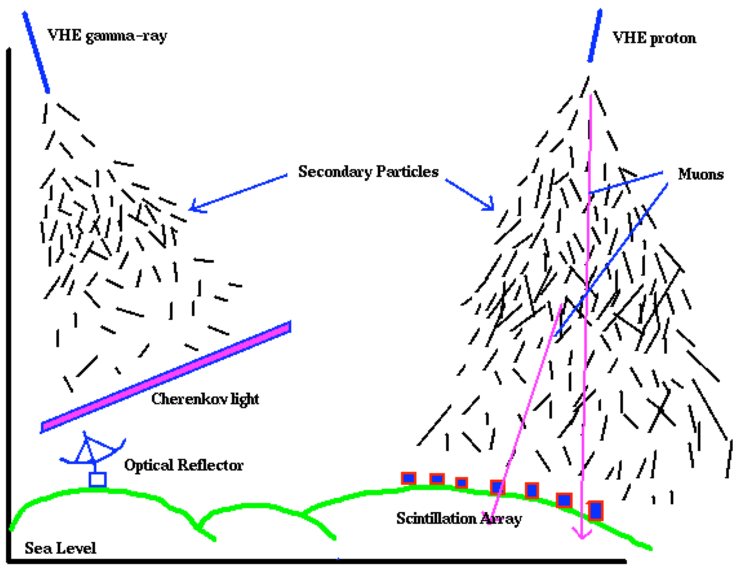
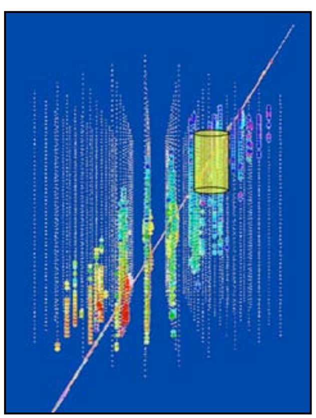


GLAST and TeV γ-ray/ν Connections

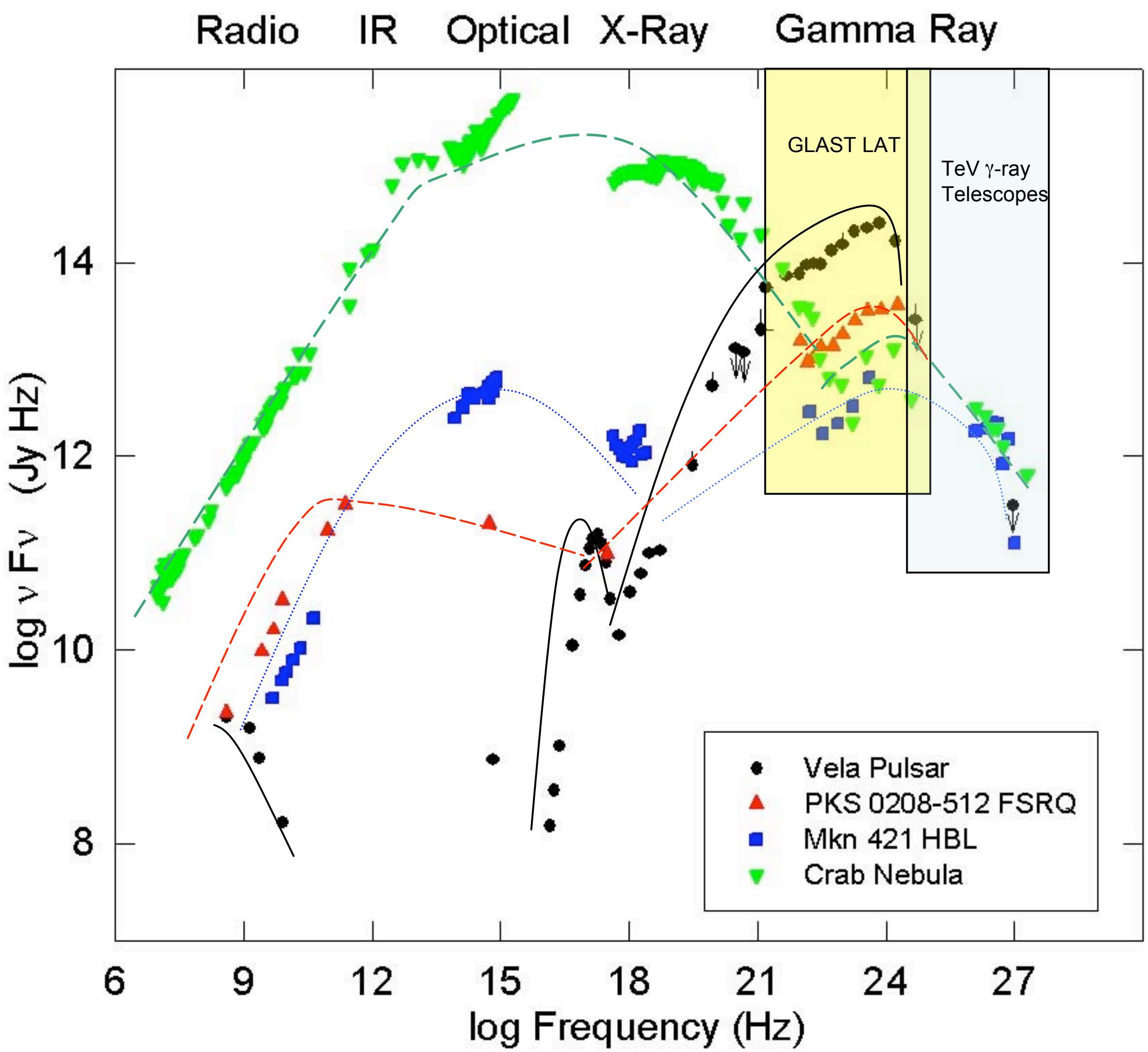
Andrew Smith -UMCP





Outline:

1. VHE γ-ray detectors
2. Why is GLAST important
3. Repeat for VHE ν detectors



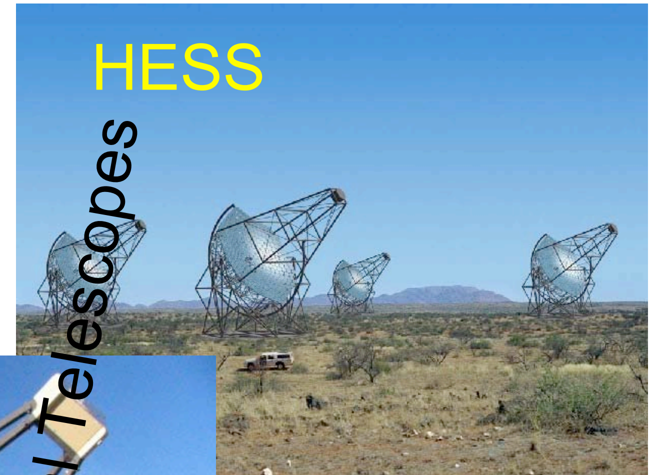
At launch of EGRET there was one TeV γ-ray source

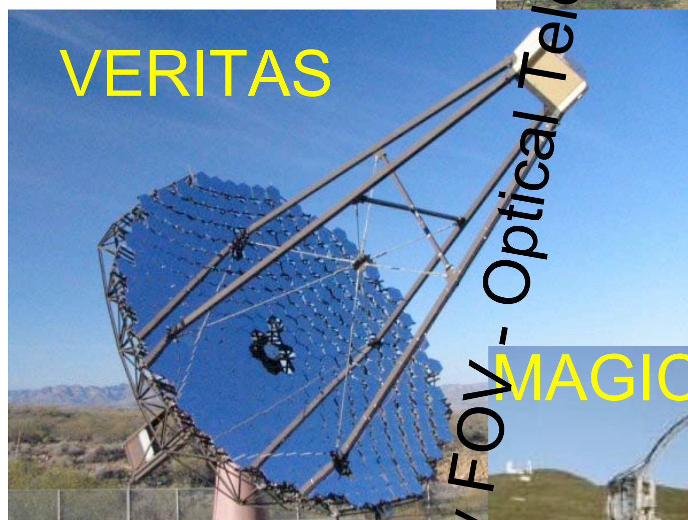
Today >30 TeV sources

No known ν sources

TeV γ-ray Instruments

Wide FOV - Continuously Operating



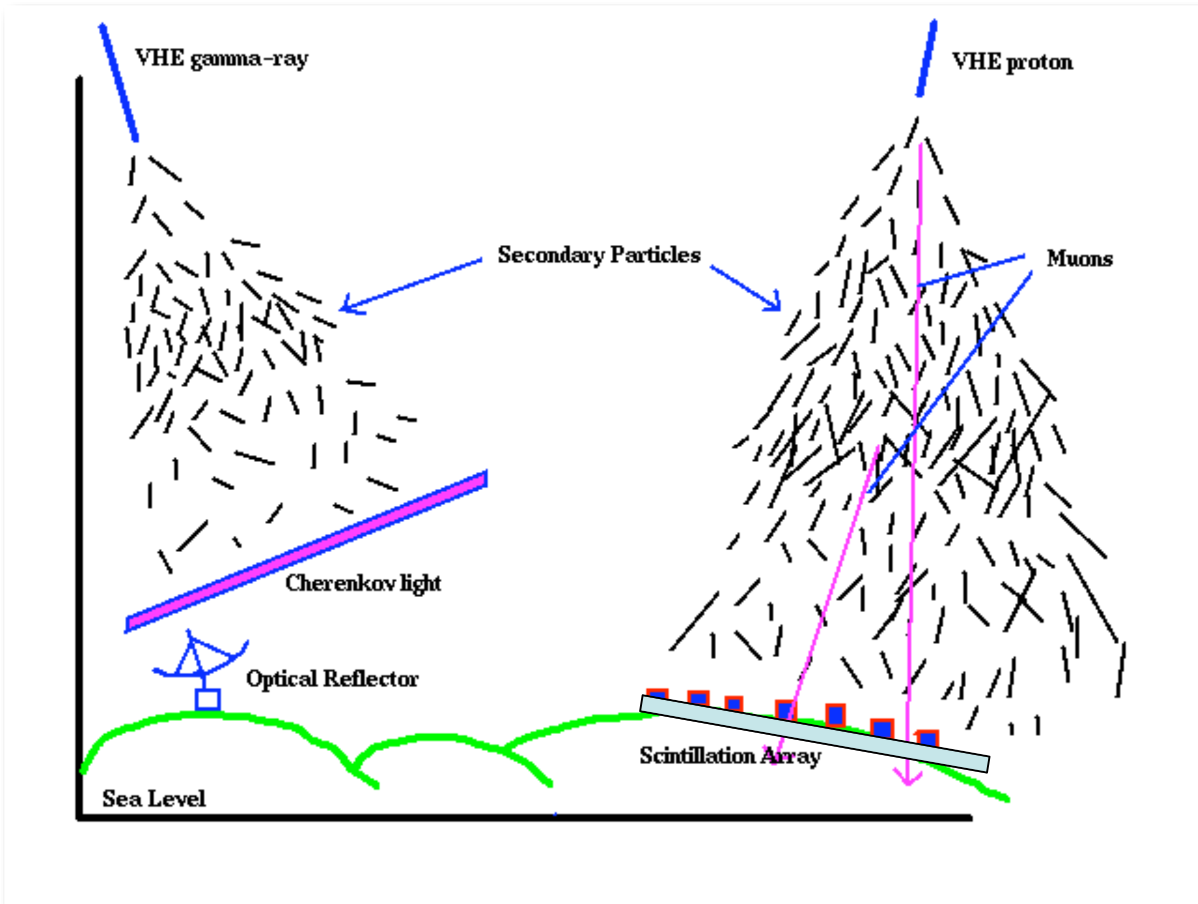


Narrow FOV - Optical Telescopes

TeV γ-ray Detection Techniques

Air Cherenkov Telescopes:
Low energy threshold
Small field of view
Low duty cycle
Good for sensitive studies of known sources.
Short duration variability

Air-Shower Arrays:
Higher energy threshold
Large field of view (~2sr)
High duty cycle (>90%)
Good for all sky survey/monitor and for investigation of transient sources.
Long duration variability

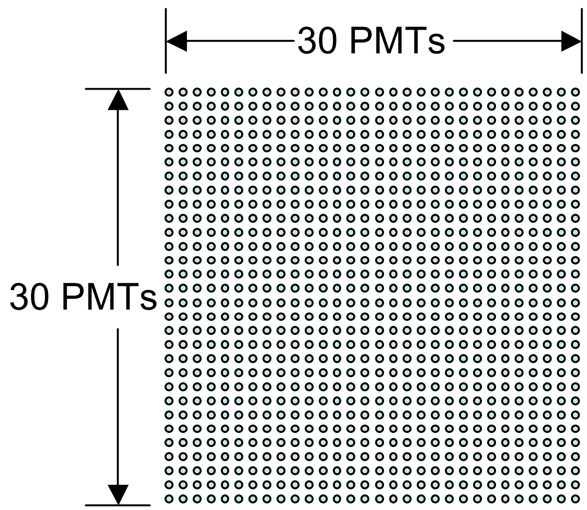


New Instruments - Under Construction

Add 28m dish to center of HESS Array

Lower energy threshold to ~30 GeV

New Instruments - Proposed

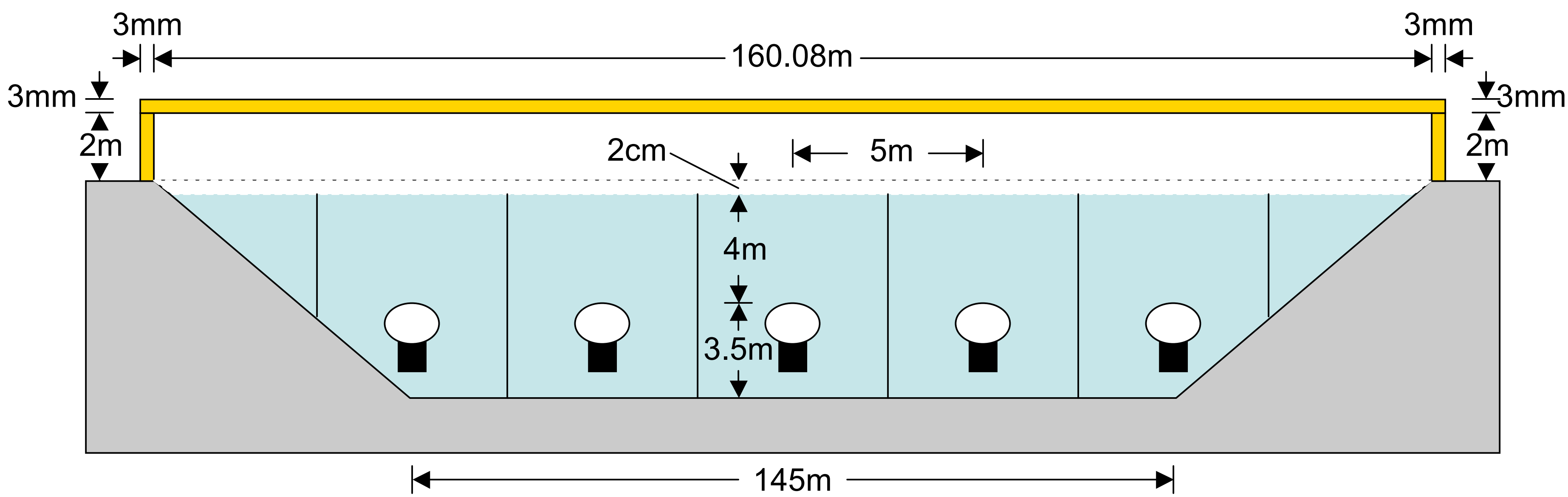


HAWC
High Altitude Water Cherenkov Observatory

Redeploy and optimize Milagro in a new High altitude Pond.

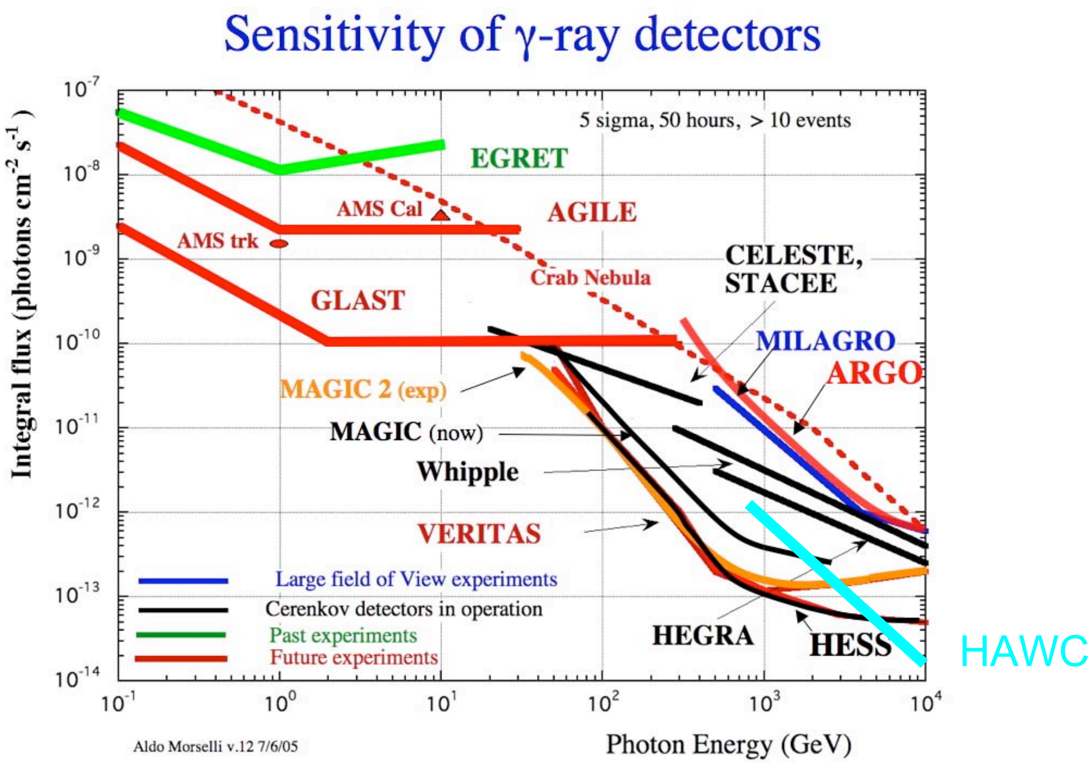
X 15 Sensitivity increase over Milagro

Cheap (~6M$), can build rapidly.



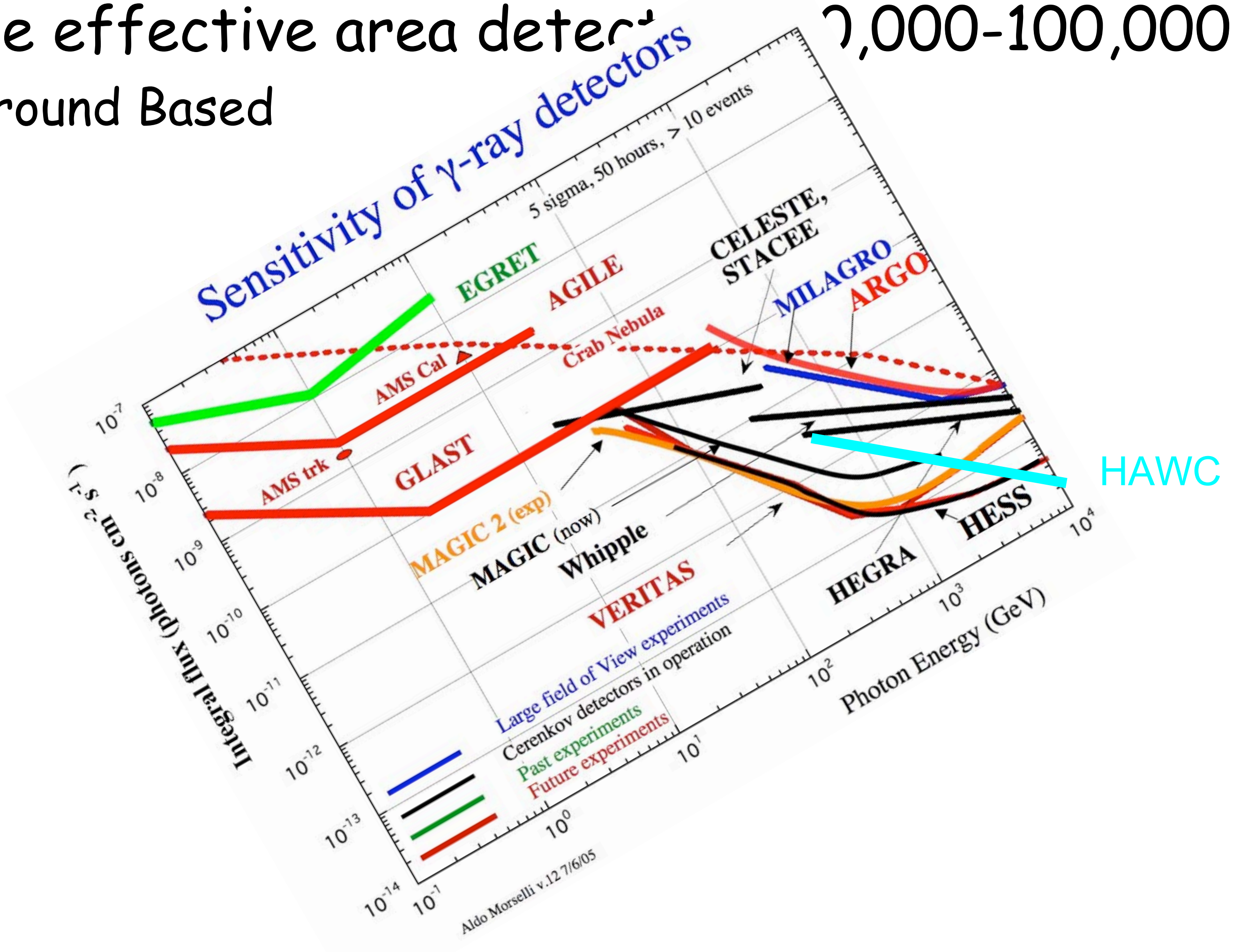
TeV Astronomy

- Small Flux: ≤ $10^{-7}/m^2/s$
- Large effective area detectors: 10,000-100,000 m
  - Ground Based



TeV Astronomy

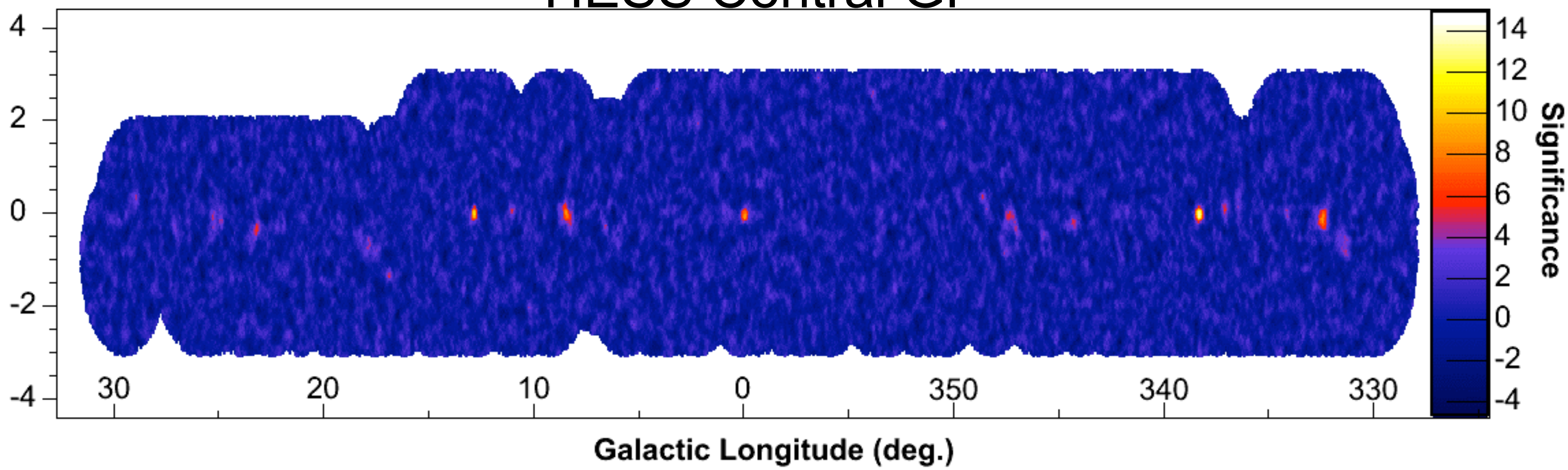
- Small Flux: ≤ $10^{-7}/m^2/s$
- Large effective area detec ... 0,000-100,000 m
  - Ground Based



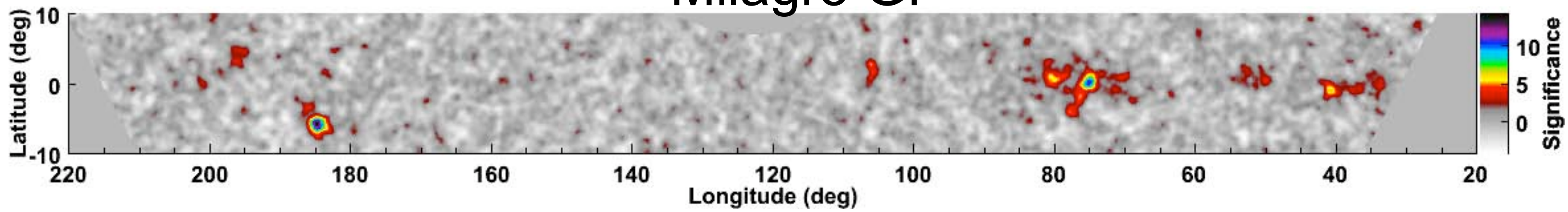
What TeV γ-ray astronomers want from GLAST

- Calibration
  - Cross-over in energy range with VHE ground based instruments. No VHE test beams.
- High resolution γ-ray map
  - Improved angular resolution in GLAST may matter much more than overall sensitivity increase.
- Coincident observations:
  - MW observations are critical to the understanding of the environment of the acceleration. Synchrotron? IC? Cutoffs?
- Transients:
  - Simultaneous observation of variable sources. AGN, GRBs, etc…

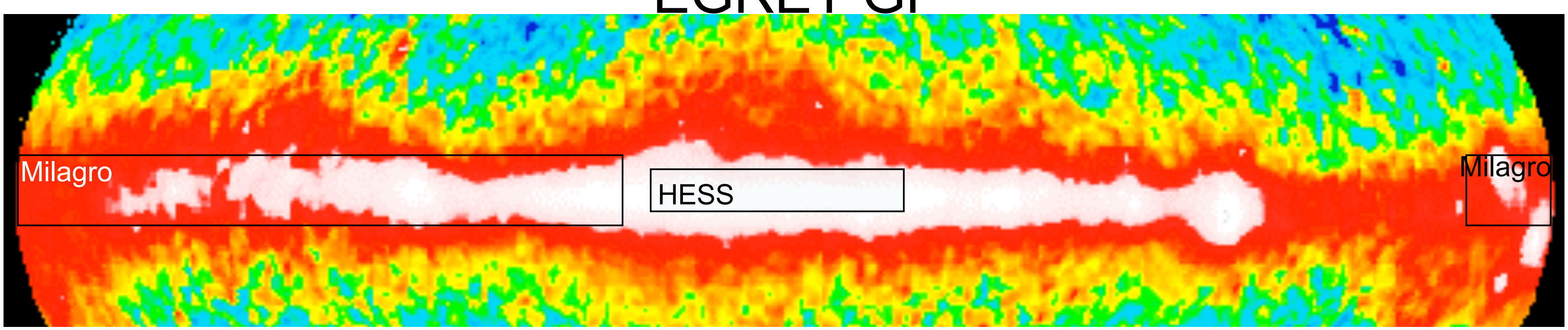
HESS Central GP



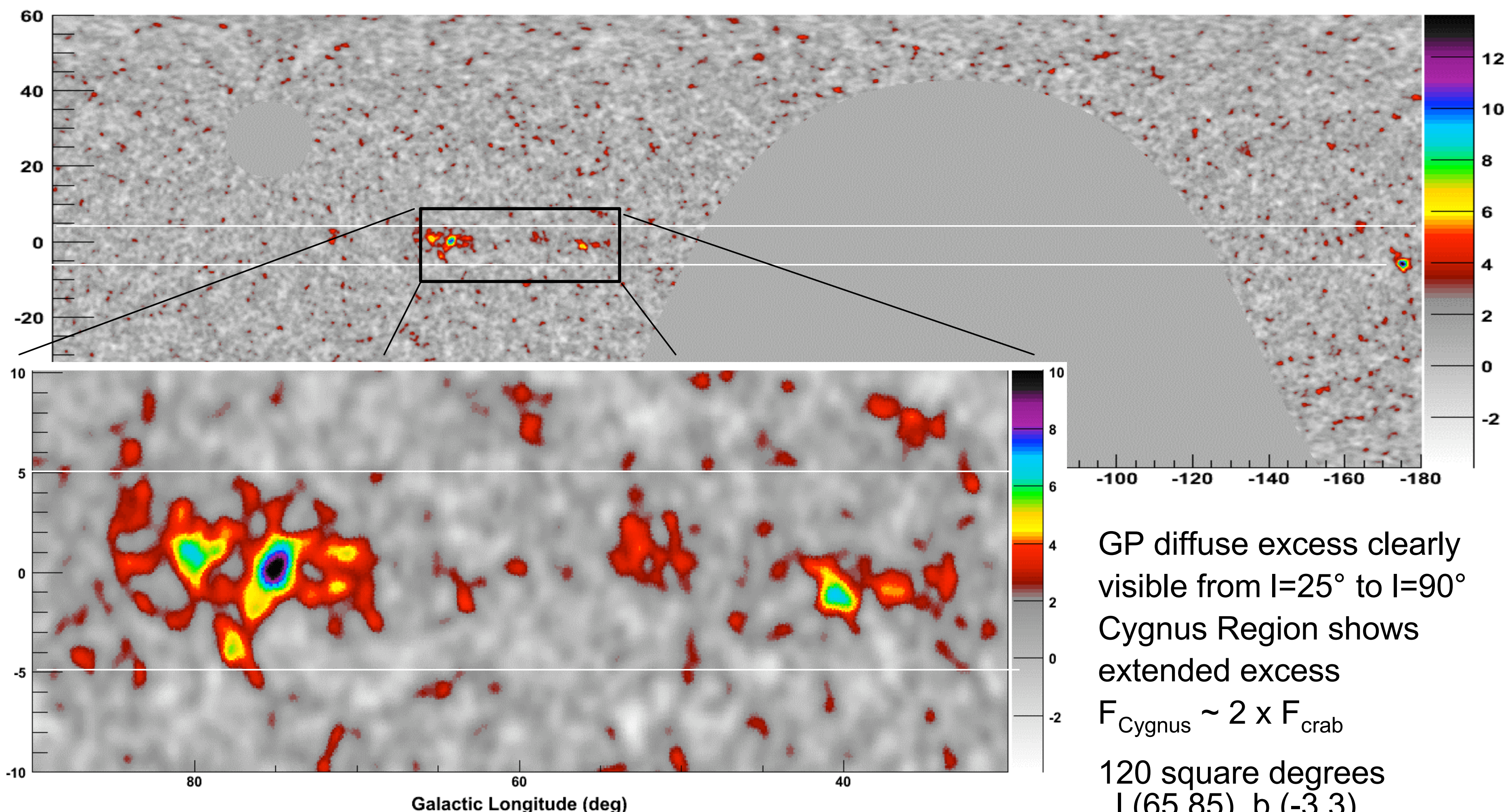
Milagro GP



EGRET GP



A Look at the Galactic Plane at 10 TeV



GP diffuse excess clearly visible from l=25° to l=90°

Cygnus Region shows extended excess

$F_{Cygnus} \sim 2 \times F_{crab}$

120 square degrees
l (65,85), b (-3,3)

Milagro Data

TeV Galactic plane dominated by sources, not CR+matter interactions

GRBs

High GRB detection rate - 40kev-1MeV

200 GRBs/year from GBM

100 in LAT

1/6th coincident with EAS FOV

Only a few with >10 GeV photons

EAS arrays with large area

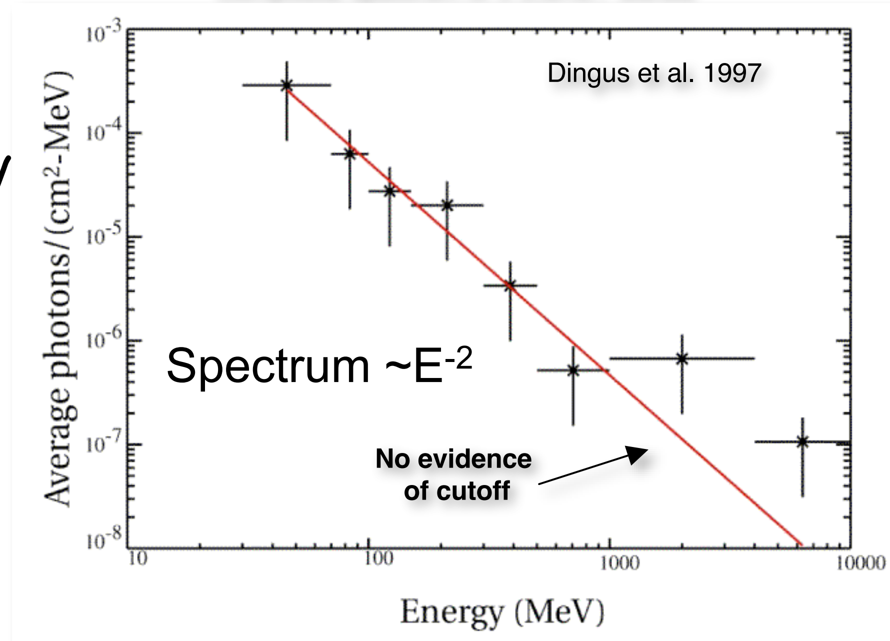
may be required if cutoff >100 GeV.

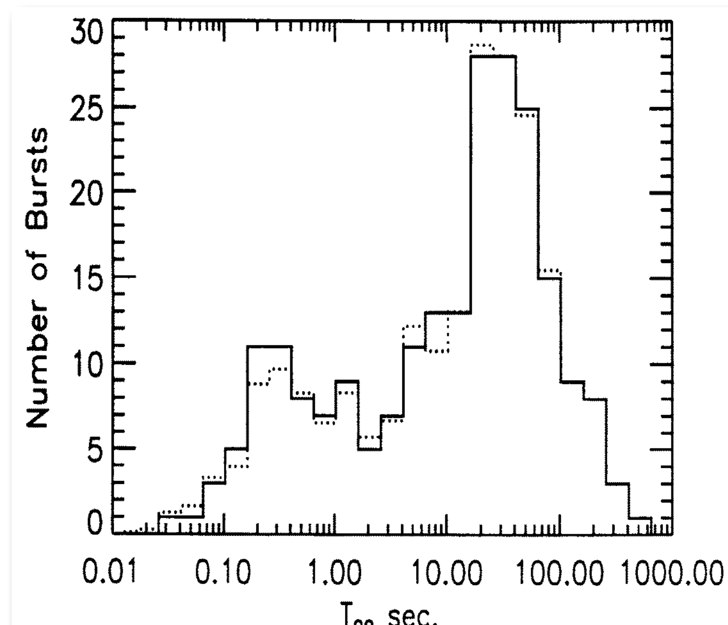
Only ~3-6/year in ACT sky

Need to slew to source

Seldom able to slew to active GRB

Composite spectrum of 5 EGRET Bursts



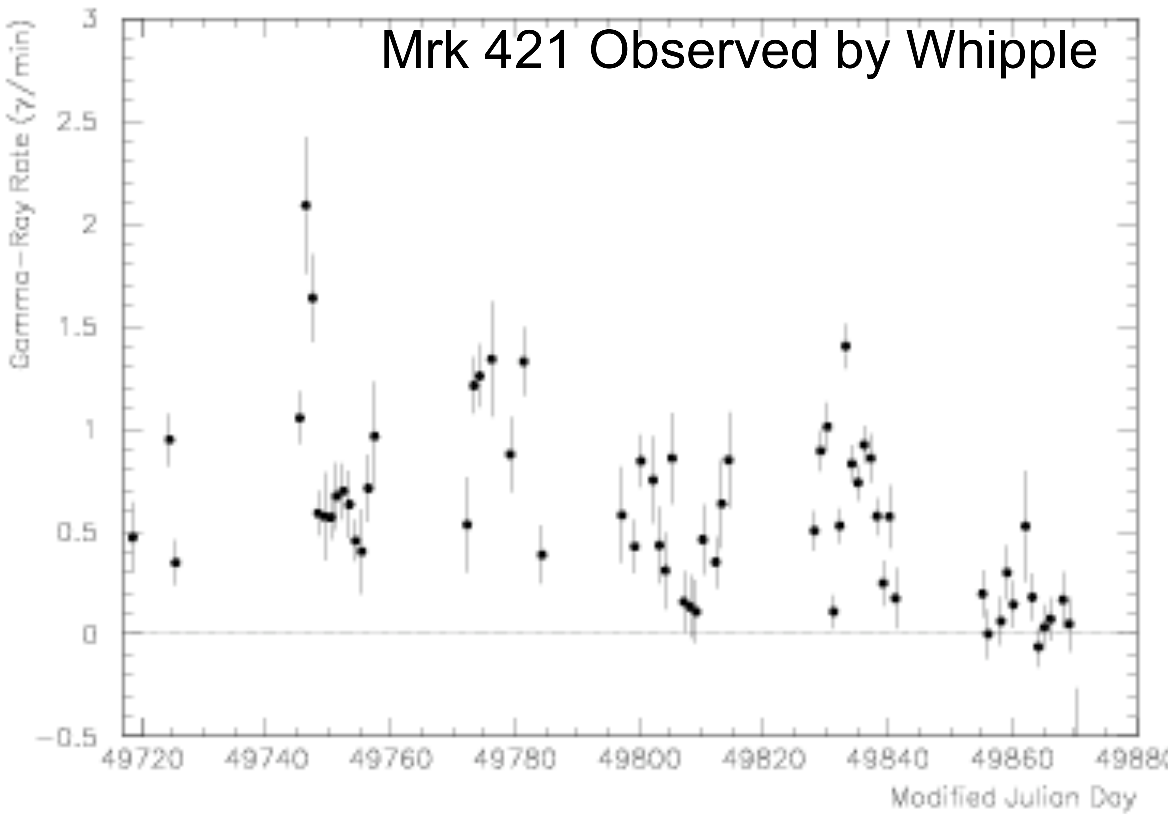


AGN - Variability

Nearby blazars are highly variable at >1 TeV, <~5min.

GLAST could notify/direct observations by narrow field ACTs.

HAWC has similar flare detection time scale to GLAST, hrs-days.



From F. Krenrich

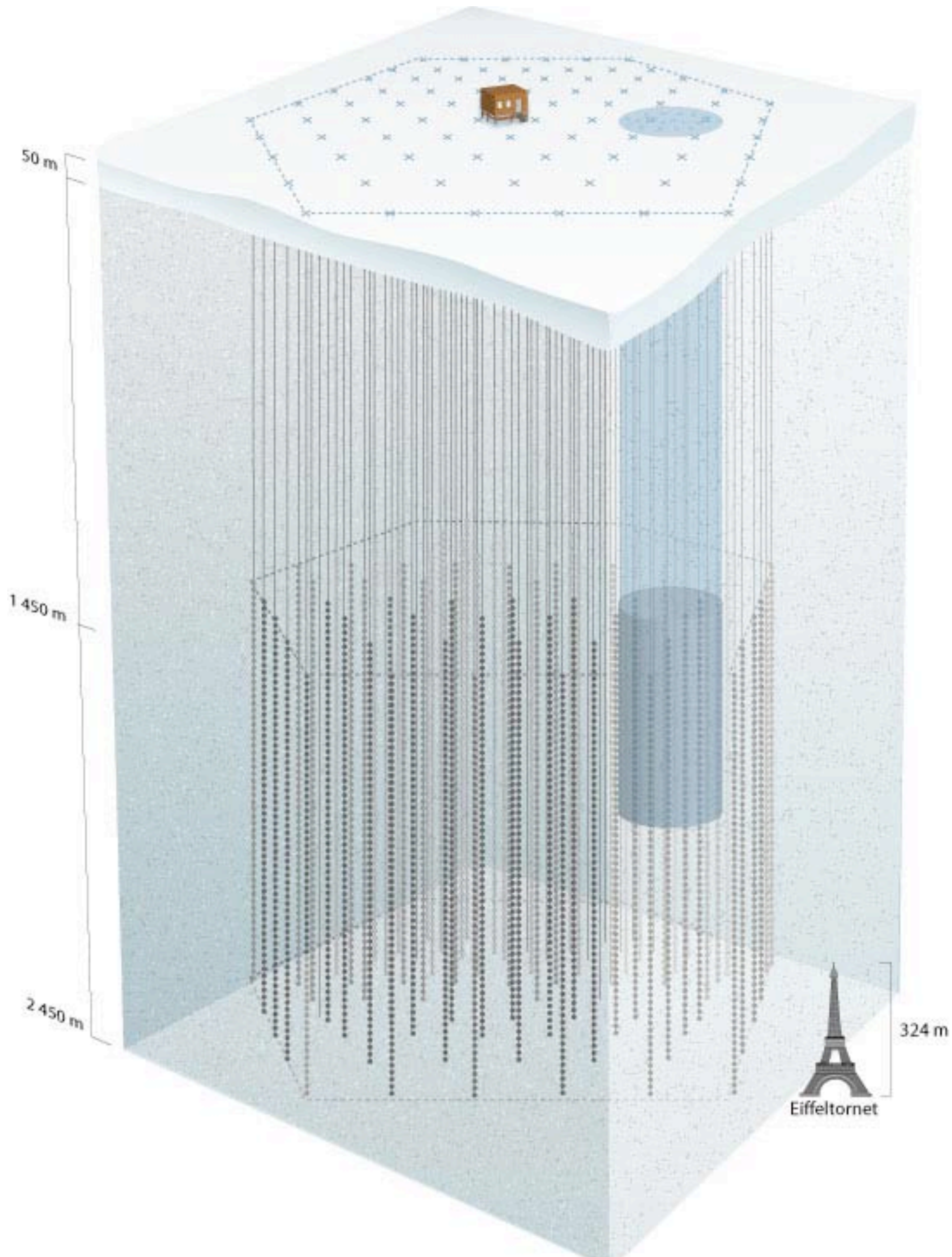
IceCube Neutrino Observatory

IceTop shower array

80 pairs of Cherenkov tanks

IceCube

4800 optical modules on 80 strings (18+ installed)



VHE Neutrino Astronomy

- Small flux and small area, but very small background.
- Background suppressed at high energies.
  - $\pi^{\pm}$ re-interaction
  - No IR absorption
- GRBs:
  - If GRBs are source of UHECR then ν signal possibly detectable.
  - VHE ν flux ~10^{-5} to 10^{-1} ν/GRB
  - Signal not detectable without external GRB identification
  - GLAST GBM gives large sample w/ precise locations
  - Exact localization (~3^{o}) and redshift not required
- AGN:
  - Possibly detectable in neutrinos.
  - Need catalog and activity monitor.

What Neutrino Astronomers want from GLAST

- HE transient (GRB) catalog
  - Wide-field GRB detector
  - Large sample
  - Good Localization

- AGN monitor
  - Monitor AGN for flaring
  - Distant AGN unobservable to VHE γ-ray telescopes.

- Conclusion
  - TeV γ/ν astronomy is data driven
  - Expect a great data injection from GLAST