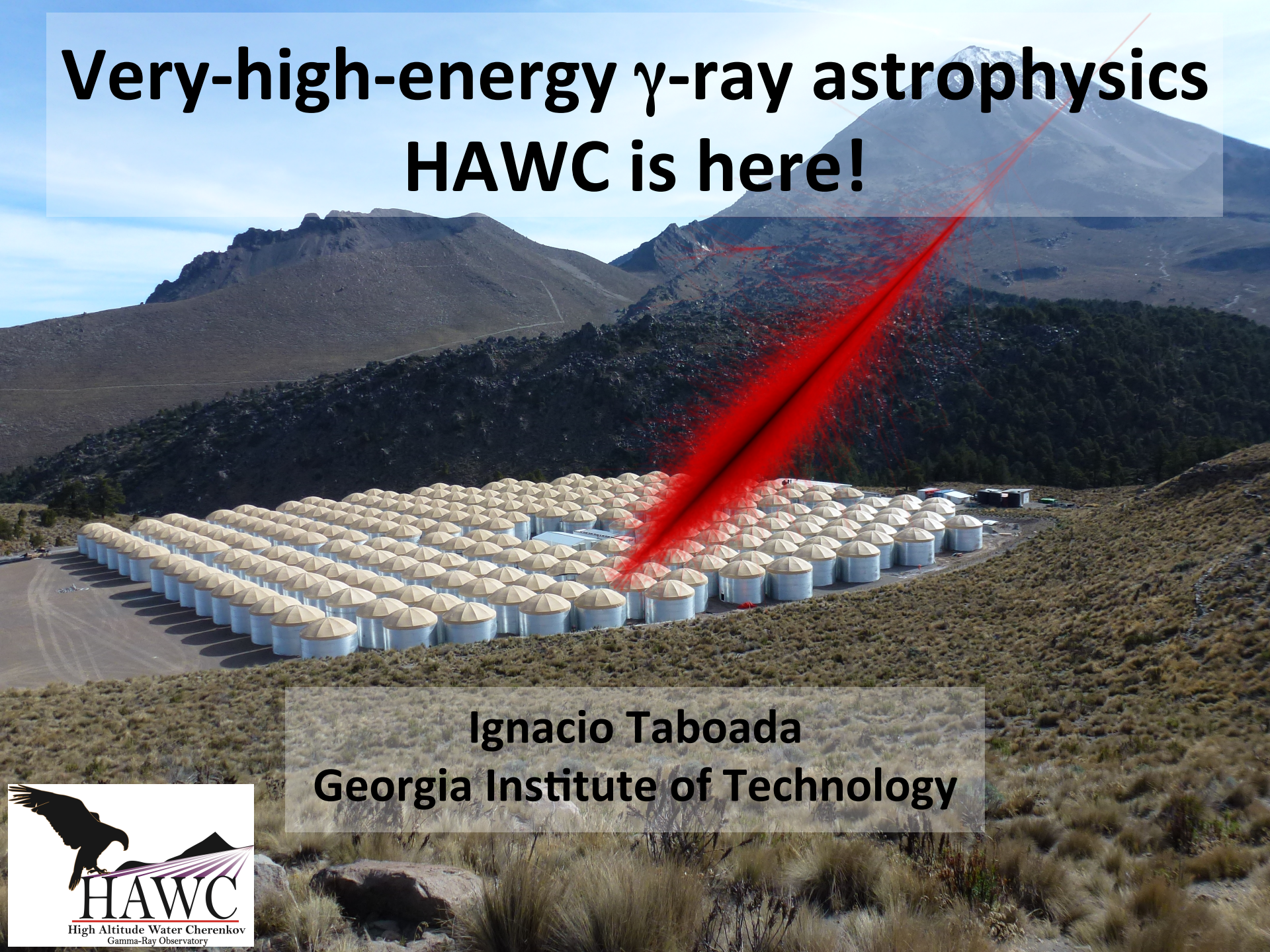
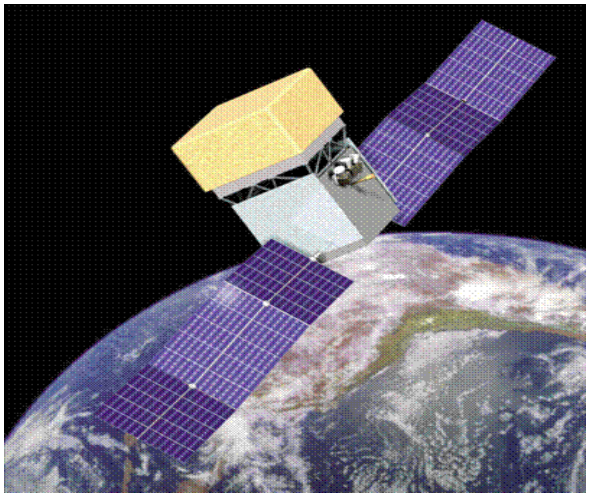
Very-high-energy γ-ray astrophysics
HAWC is here!



Ignacio Taboada
Georgia Institute of Technology

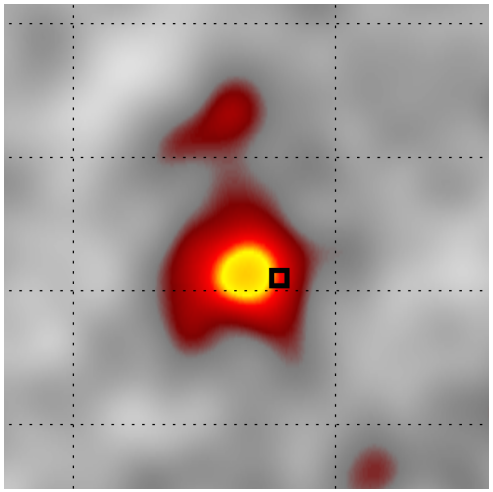
HAWC
High Altitude Water Cherenkov
Gamma-Ray Observatory

Very-high-energy γ-ray instruments

Satellites Fermi	Air Cherenkov Telescopes Hess, Magic, VERITAS, CTA	Air shower arrays Milagro, Argo, Tibet, HAWC
		
Space-based (Small Size) **"Background Free"** **Large Duty Cycle/Large Aperture**	**Large Effective Area** **Excellent Background Rejection** **Low Duty Cycle/Small Aperture**	**Moderate Area** **Good Background Rejection** **Large Duty Cycle/Large Aperture**
Sky Survey (< 300 GeV) **AGN Physics** **Transients (GRBs) < 30 GeV**	**High Resolution Energy Spectra** **Studies of known sources** **Surveys of limited regions of sky**	**Unbiased Sky Survey (> 1 TeV)** **Extended sources** **Transients**

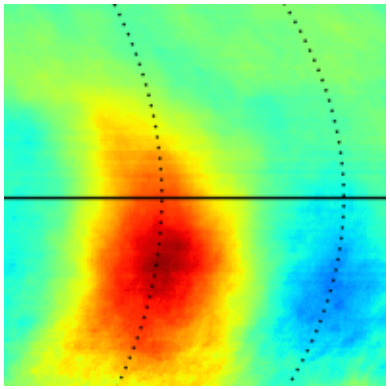
HAWC targets

AGNs:
Unbiased monitoring

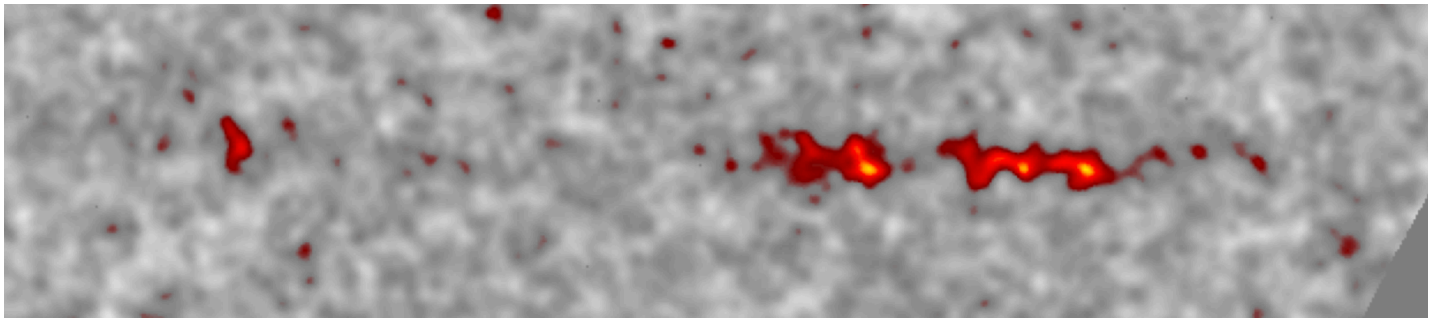


GRBs:
VHE prompt

Cosmic Ray
Anisotropy



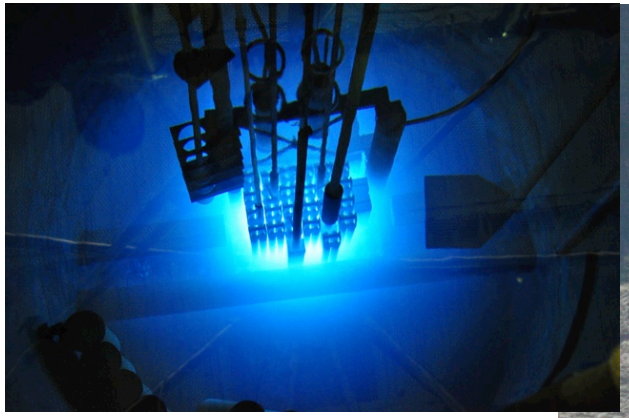
Sky survey, extended sources, diffuse VHE flux

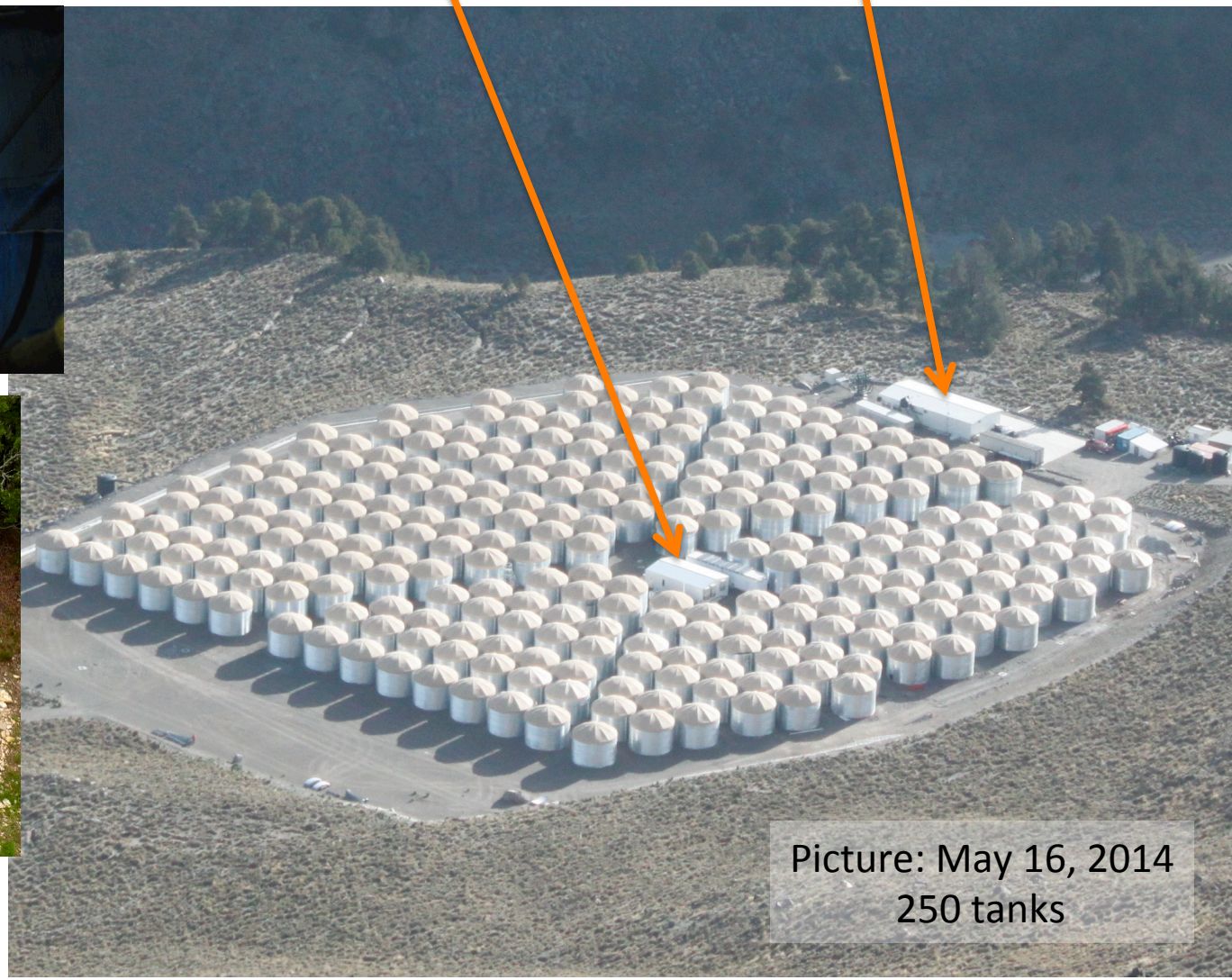


Also: Solar physics, dark matter, TeV binaries, etc.

HAWC

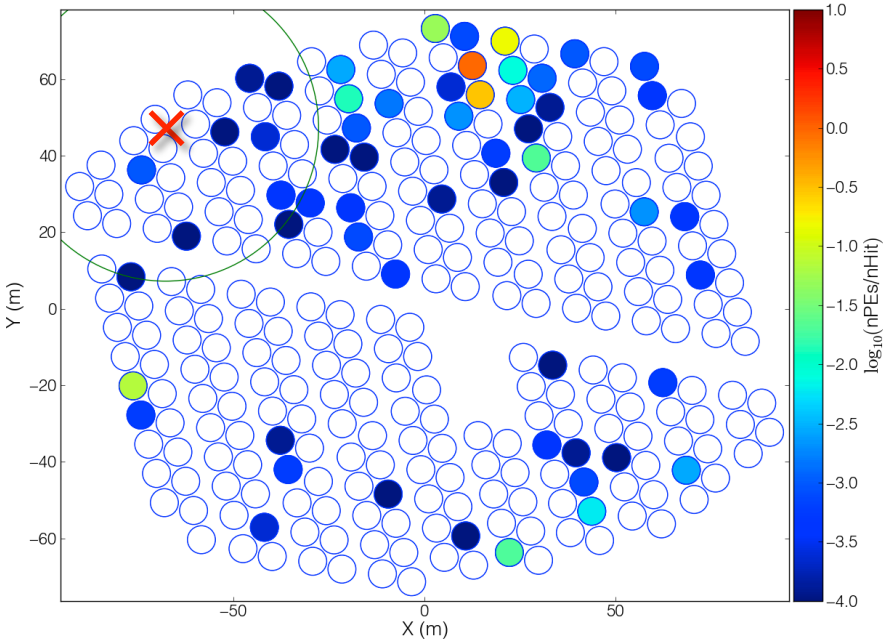
300 Water Tanks. 7.3 m (diam), 4.5 m deep. 20,000 m^2



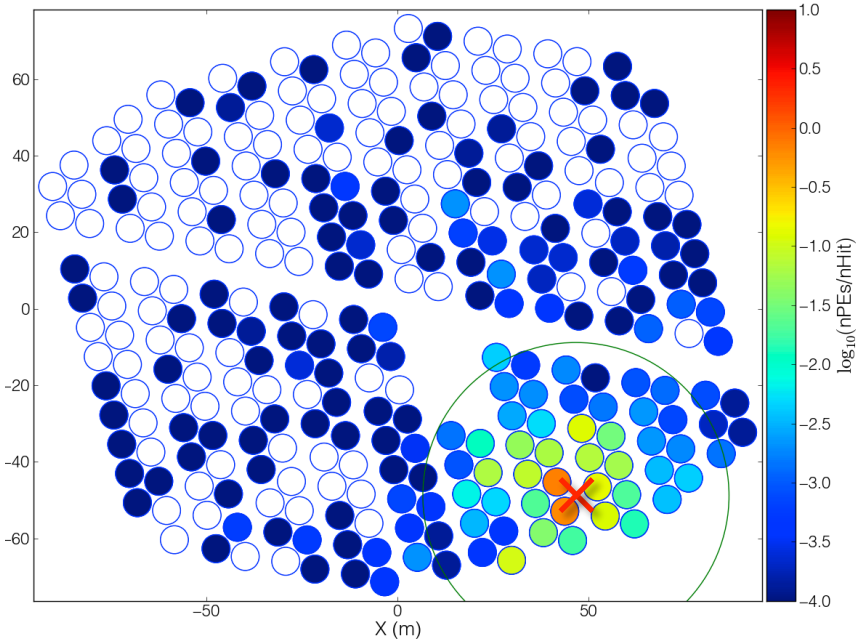


Cosmic ray and gamma ray signatures

Proton. 681 GeV



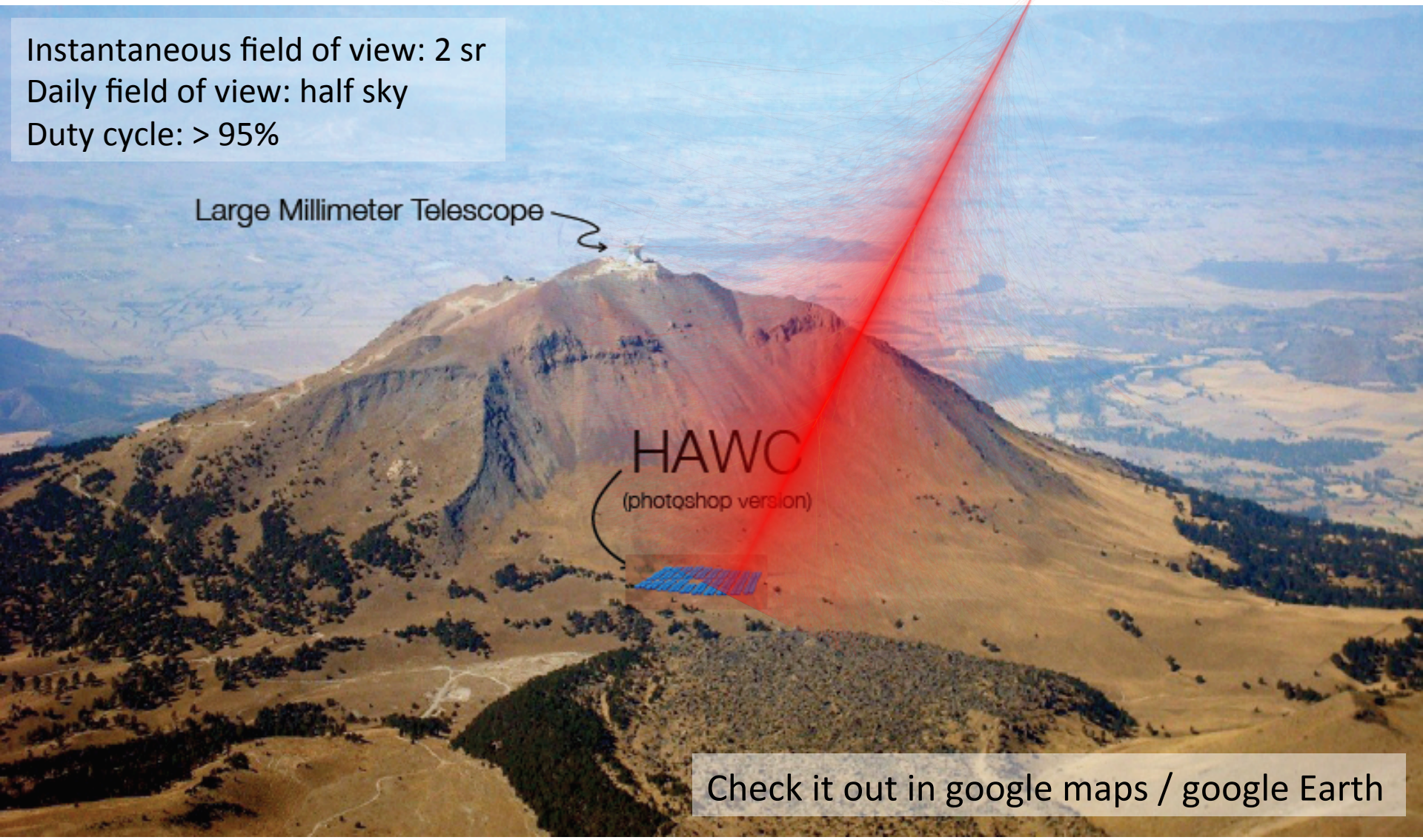
γ-ray. 2187 GeV



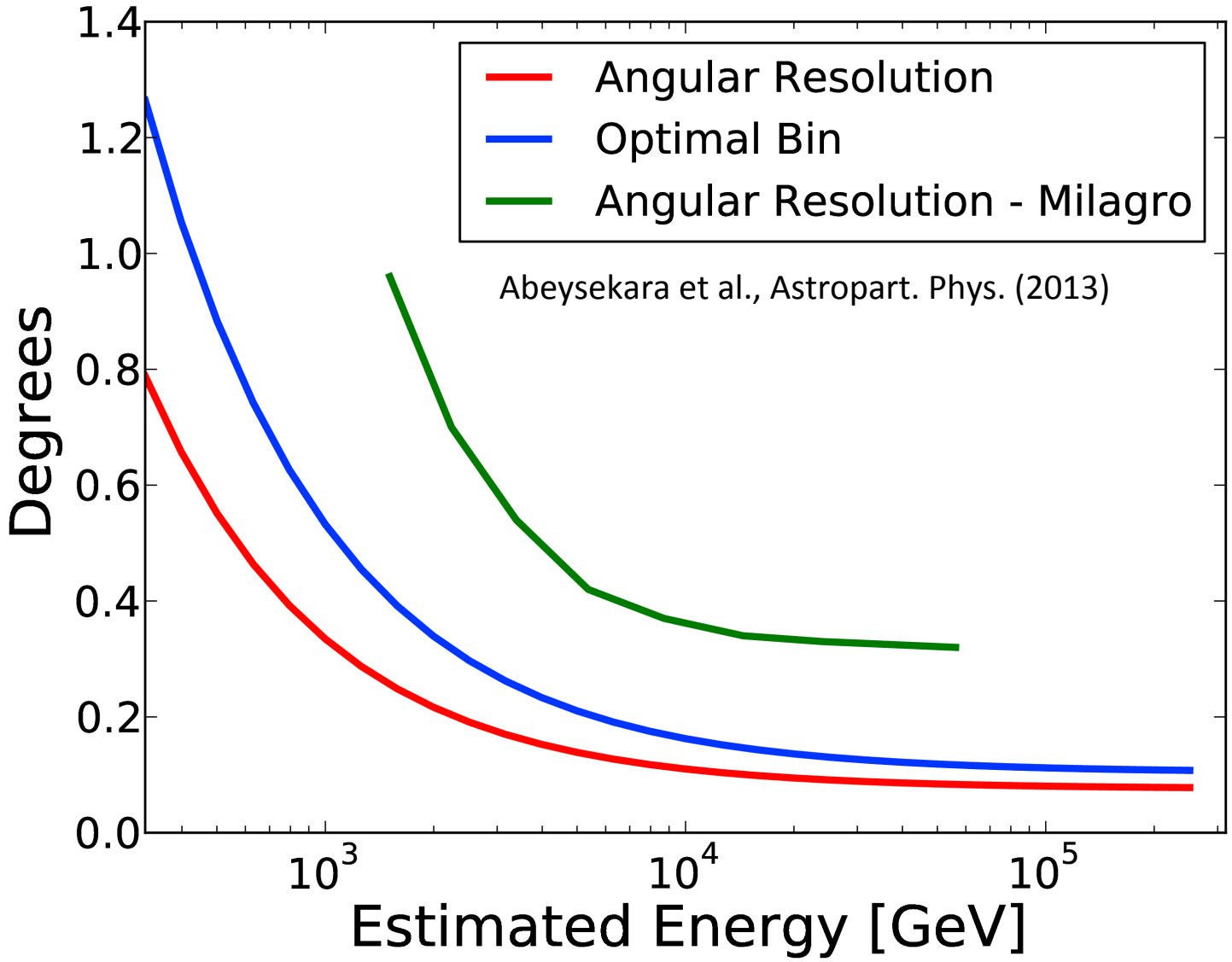
HAWC

Between Orizaba (5636 m), and Sierra Negra (4640 m)

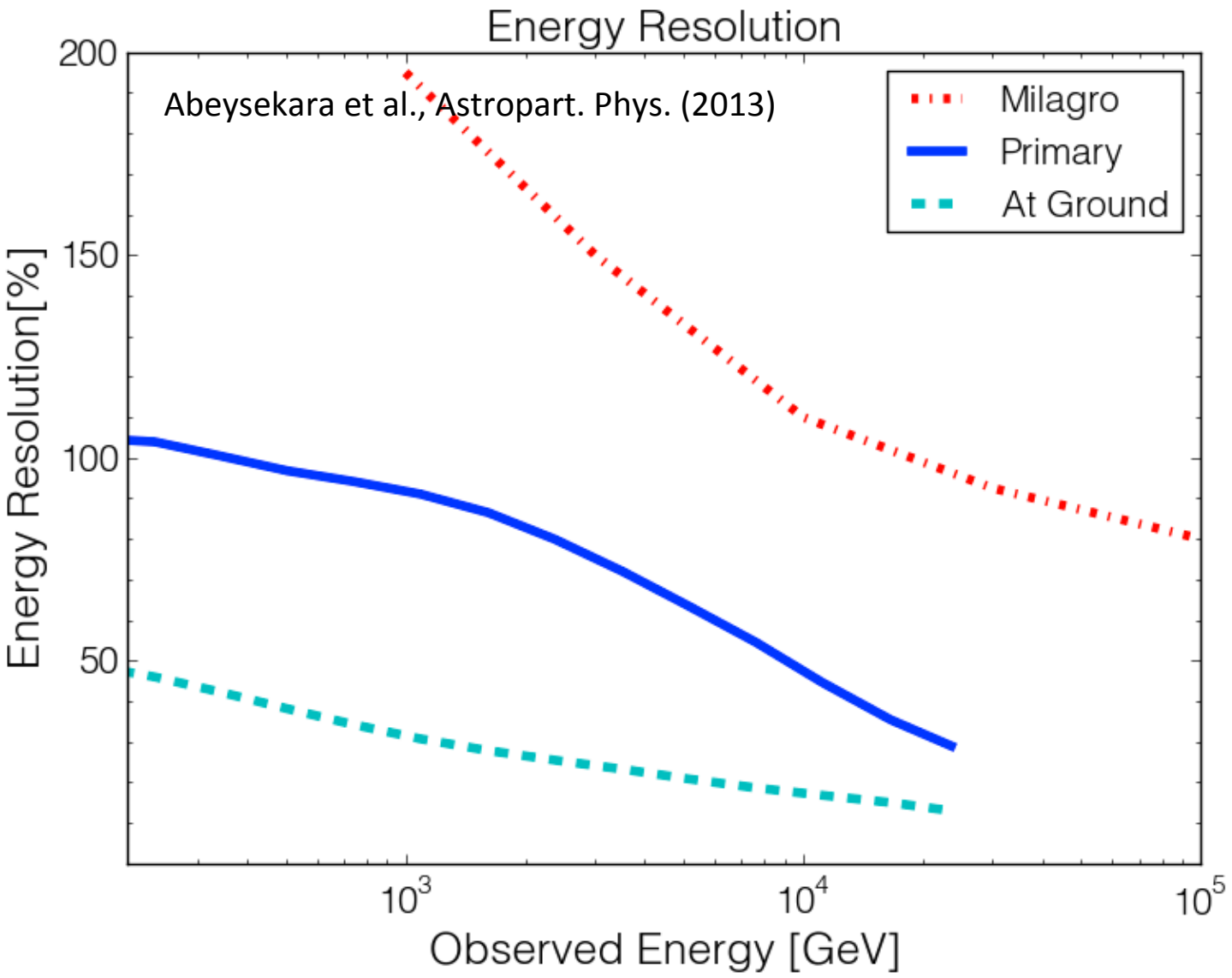
Site: 4100m, 18°58'N 97°16'W. Central Mexico



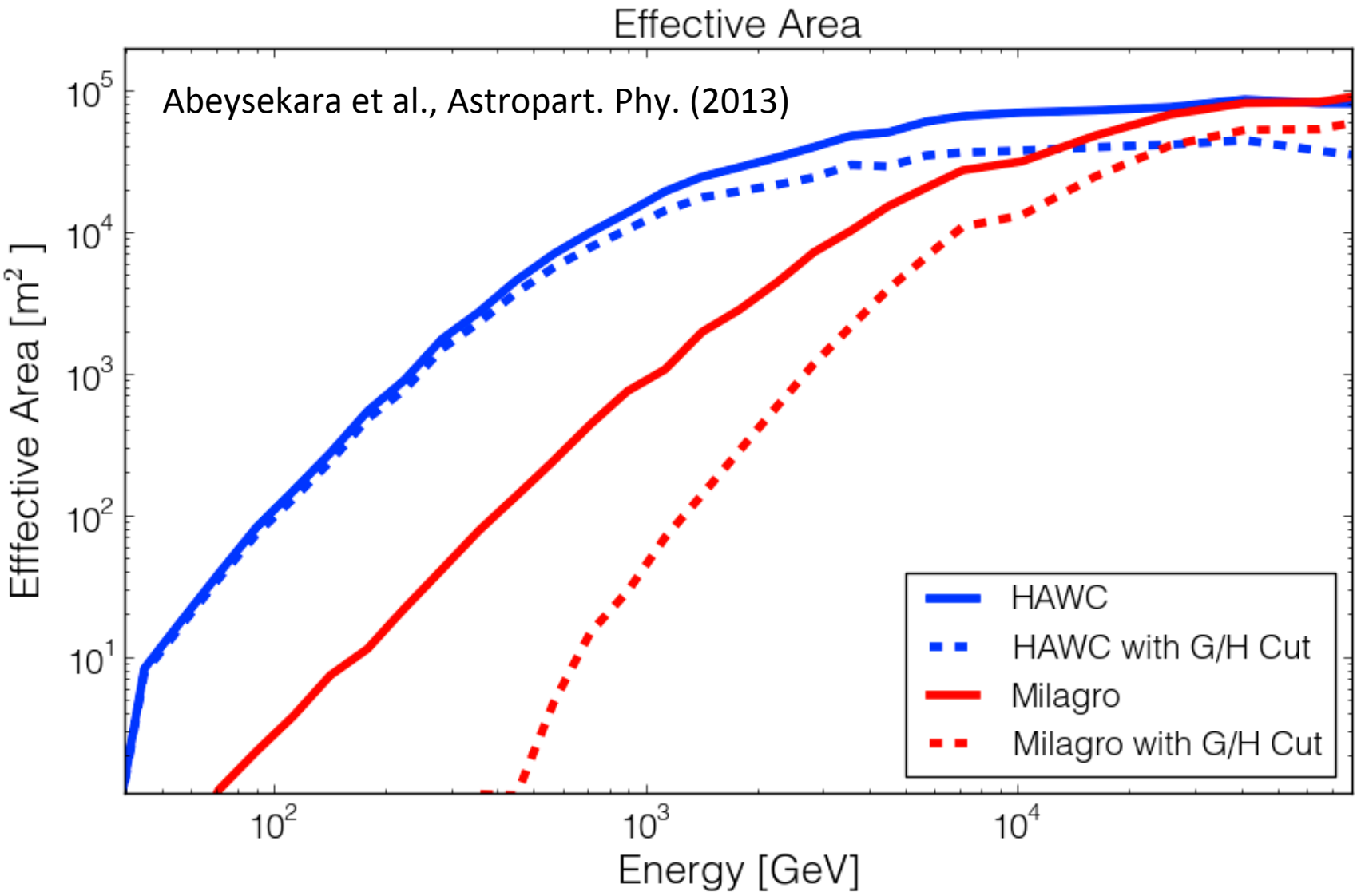
Performance



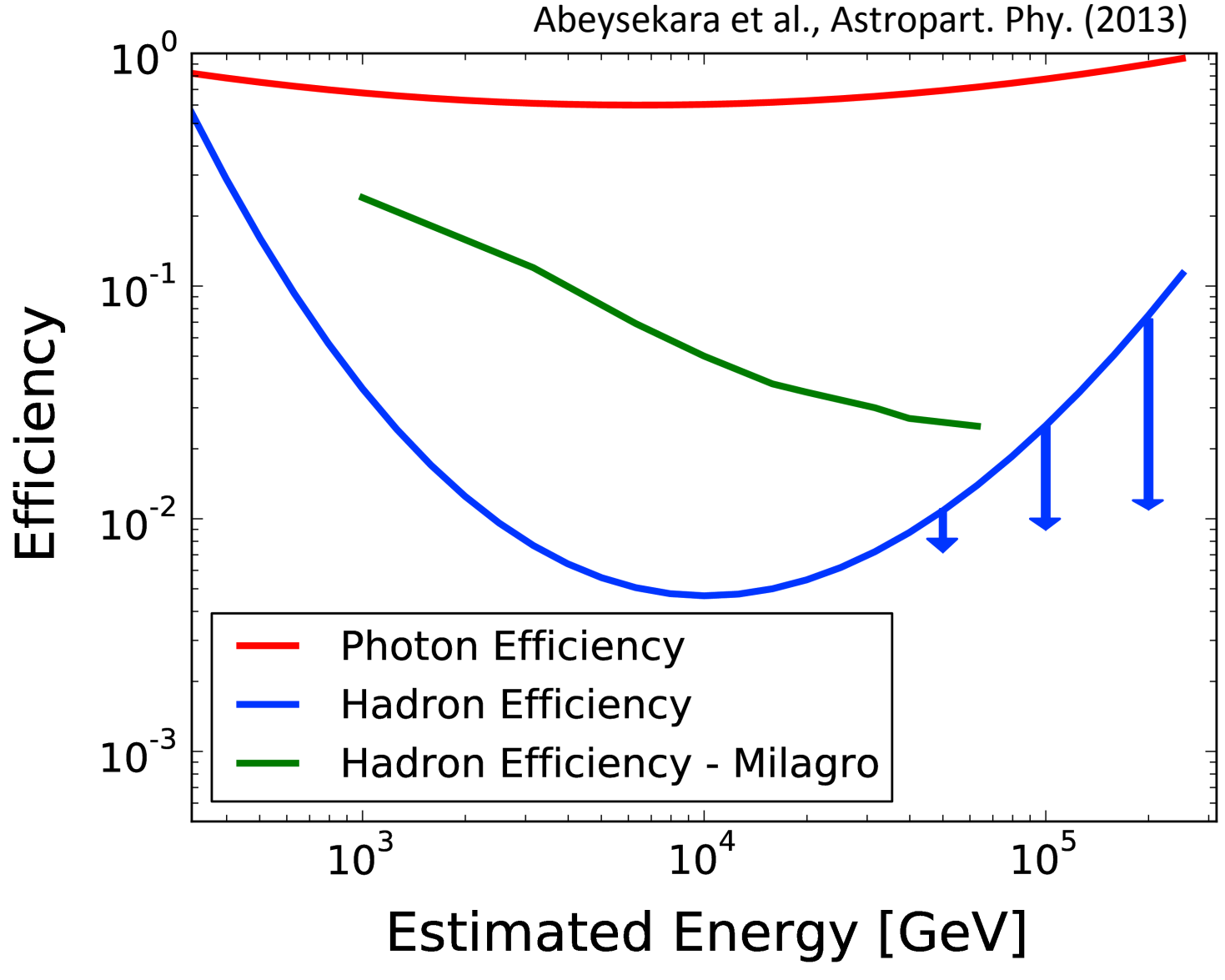
Performance



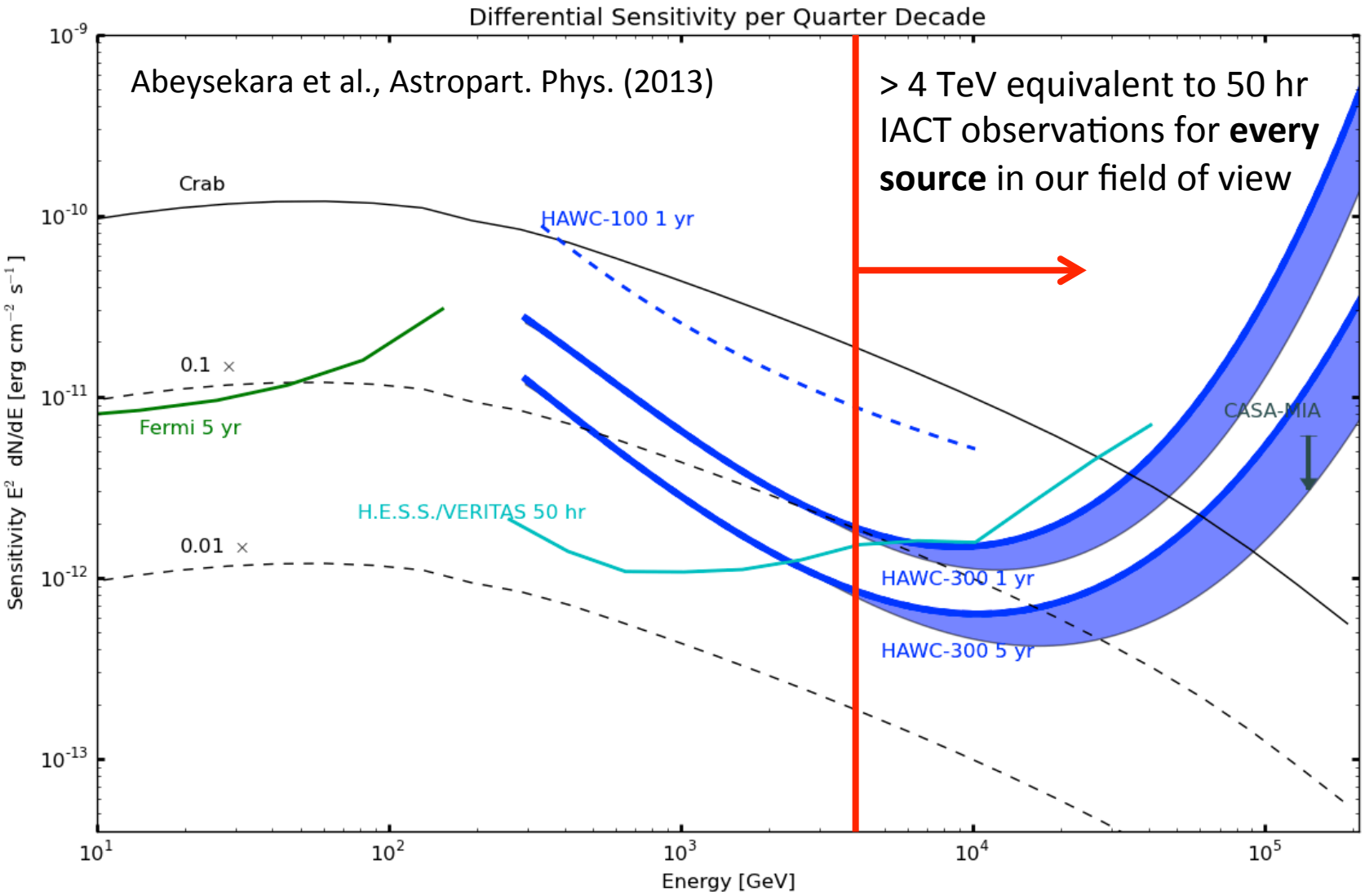
Performance



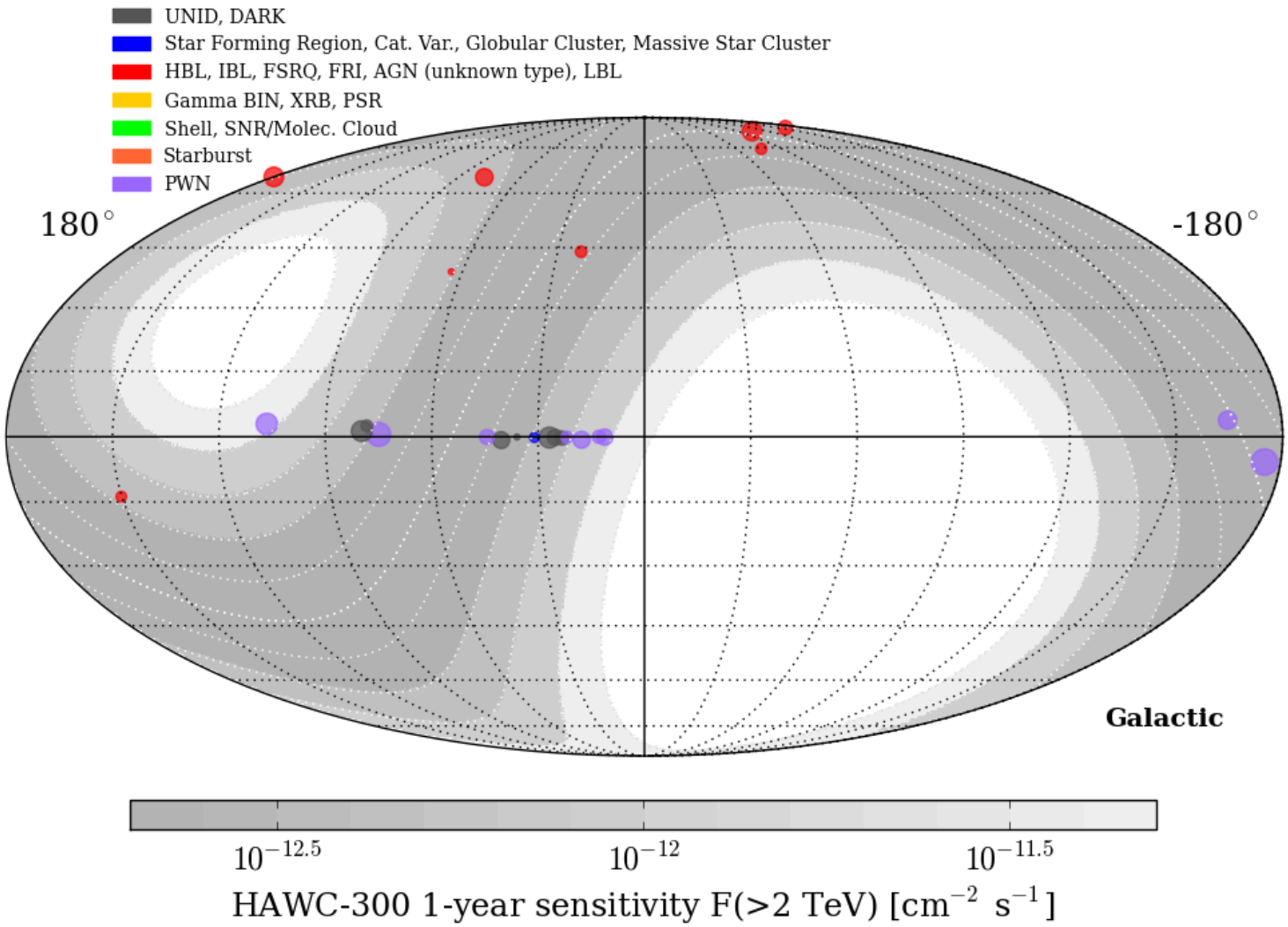
Performance



Performance

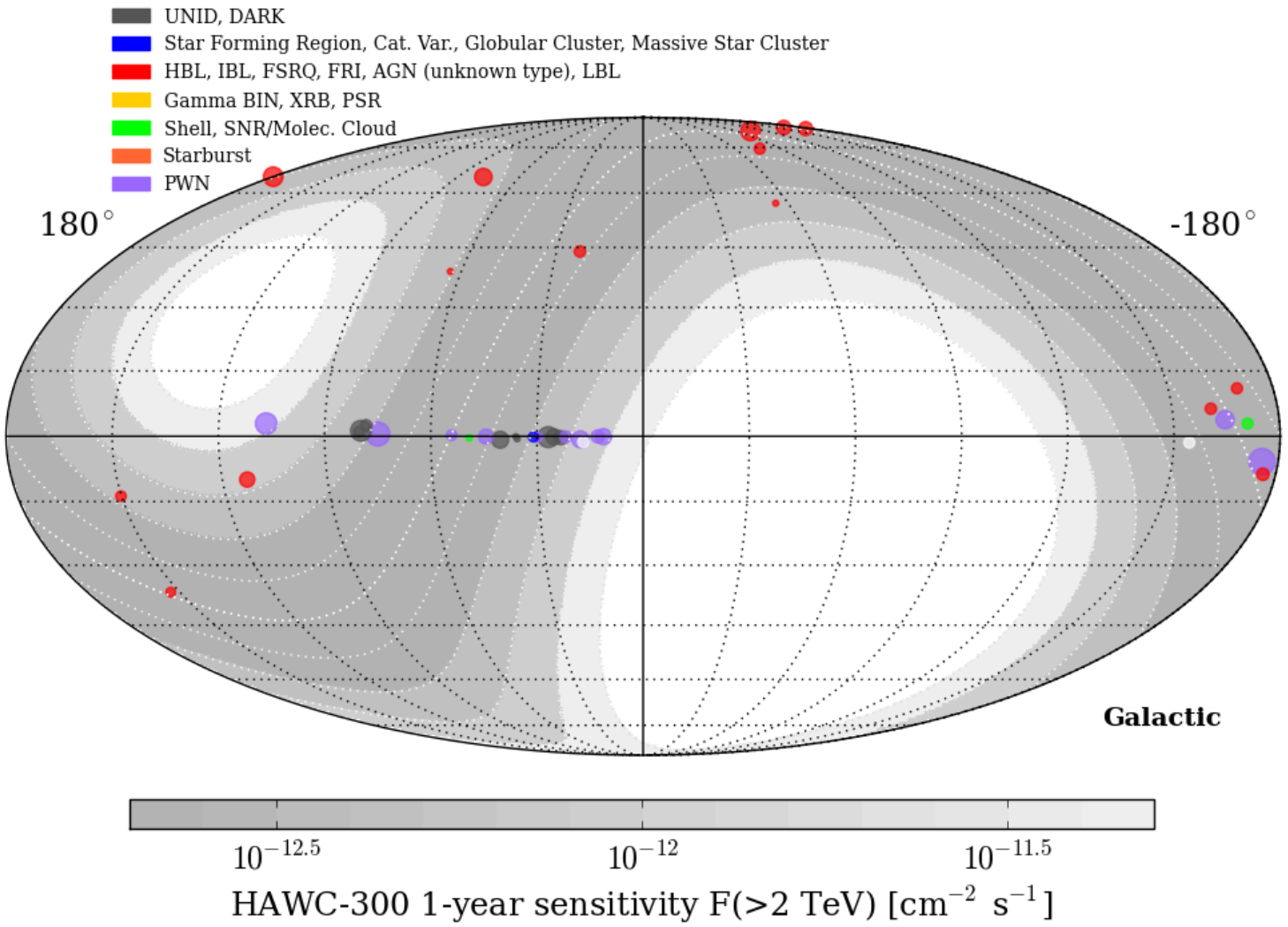


Sensitivity to known objects



25 known sources to be detected in 1 year (quiescent state)

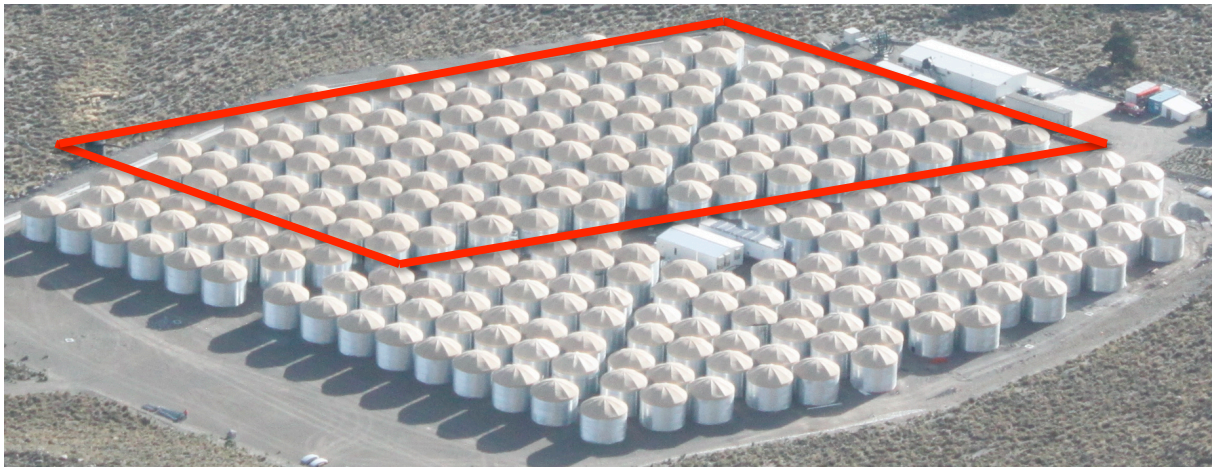
Sensitivity to known objects

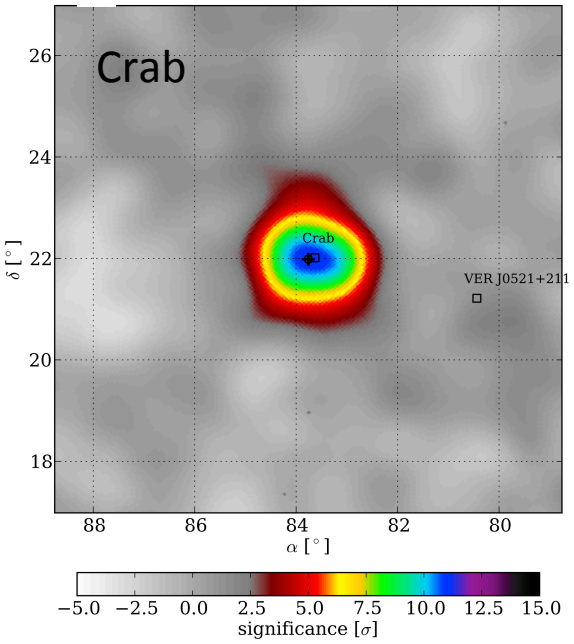


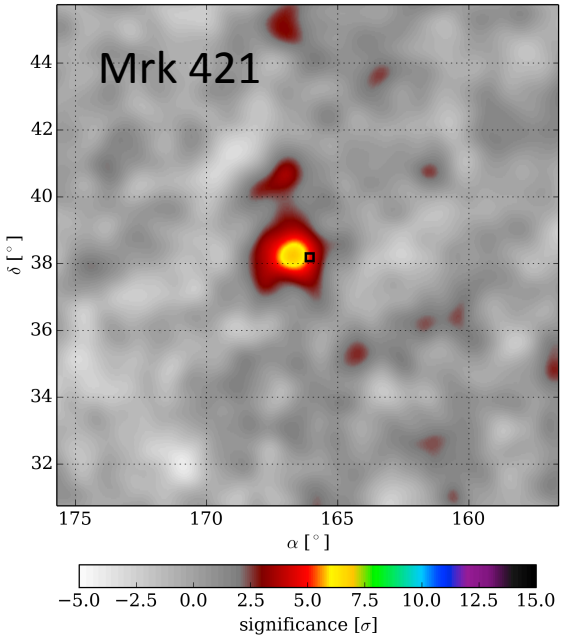
40 known sources to be detected in 5 years (quiescent state)

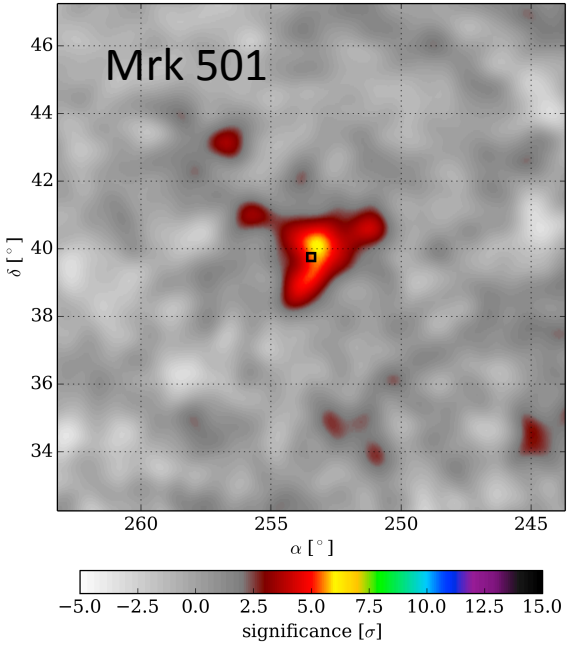
HAWC 95/111 observations

1/3 array operating
3 months of data

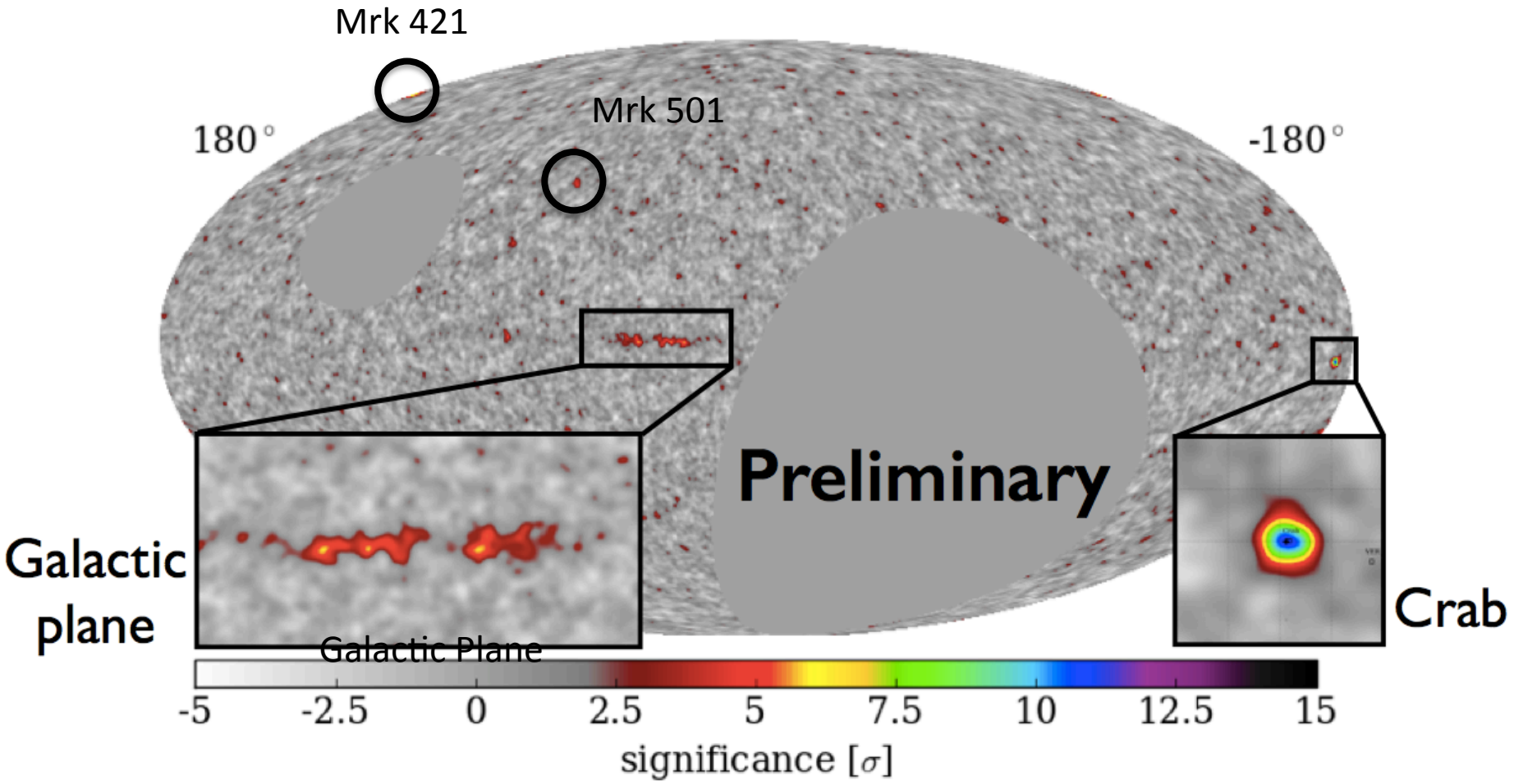




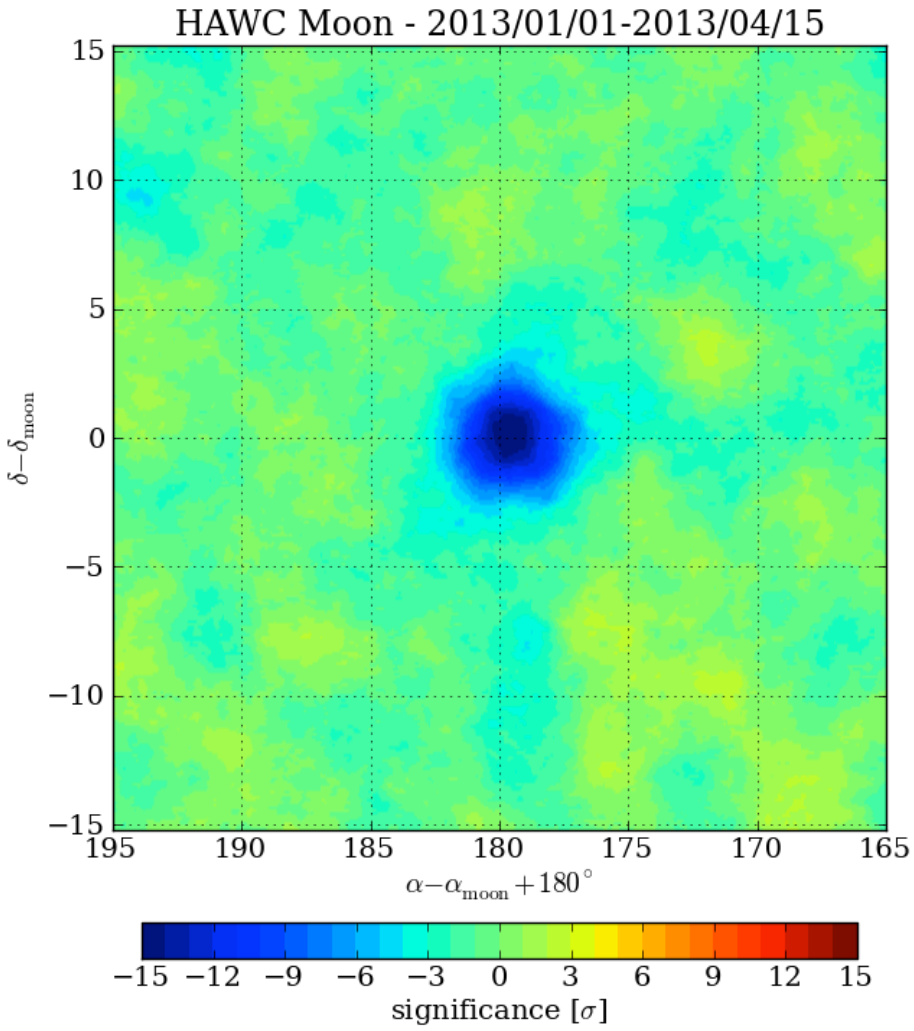


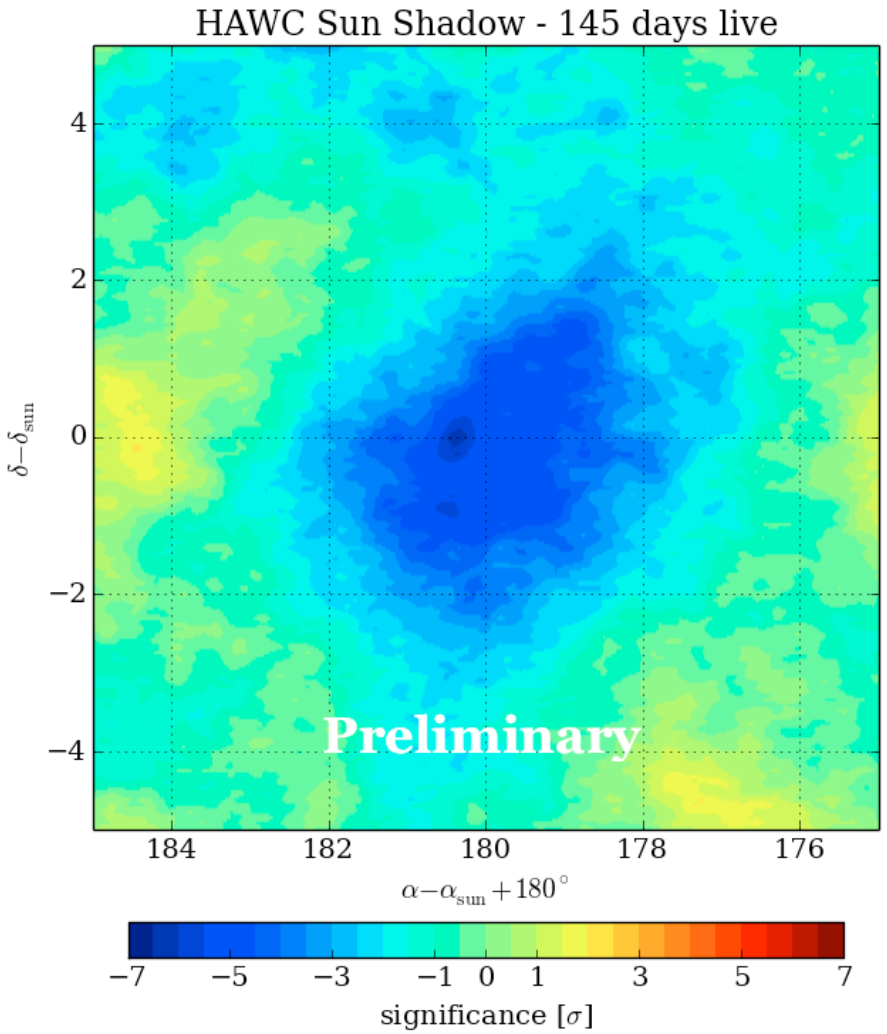


HAWC 95/111 observations

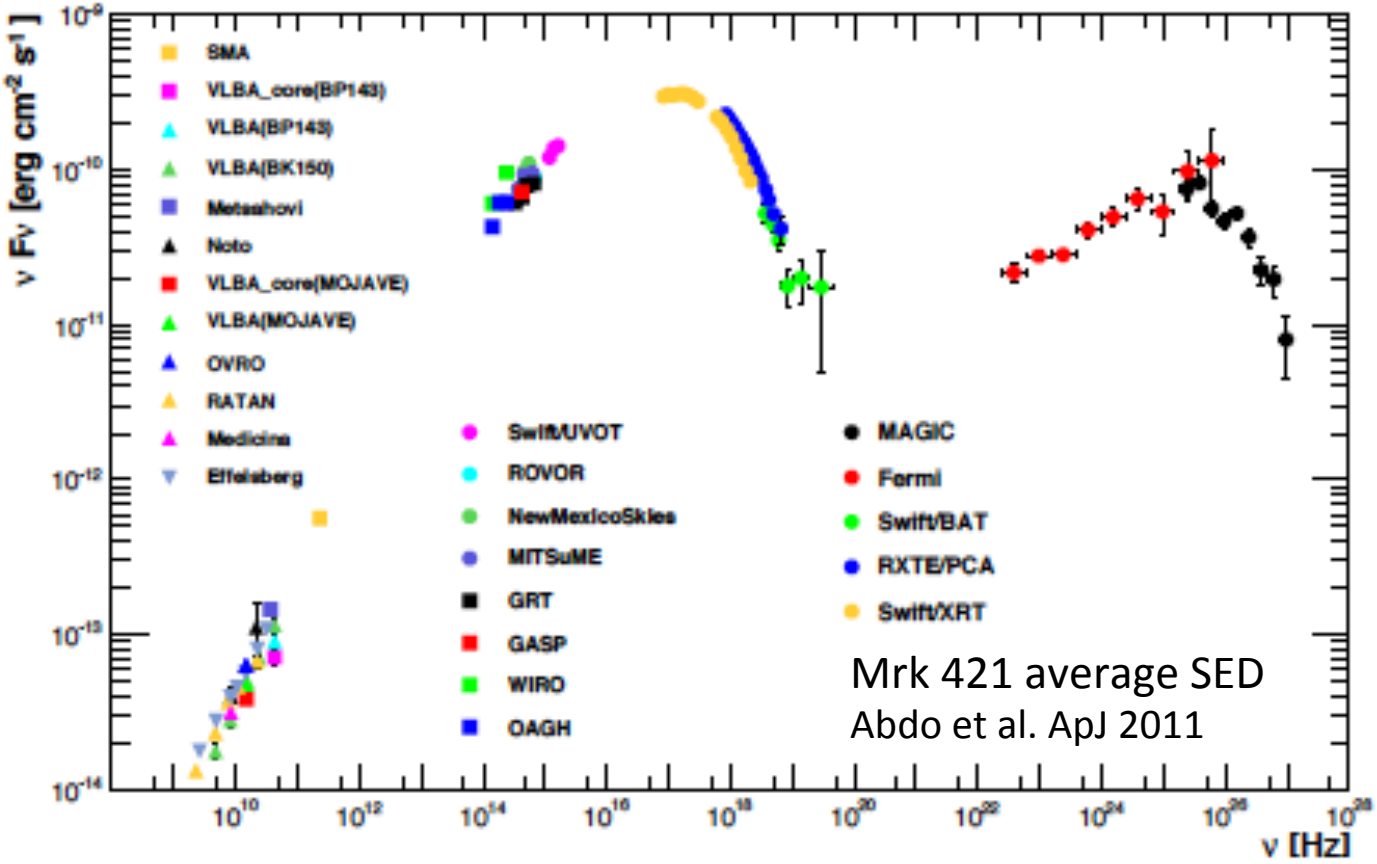


The Moon and Sun





More on targets: AGNs



Flares: 1 Crab in one transit. 5 Crab in 30 minutes

Fast alerts to community. Unbiased TeV lightcurves

EBL, intergalactic magnetic fields, orphan flares, etc.

More on targets: Gamma Ray Bursts

Sensitive to bright historical bursts if spectrum extends modestly:

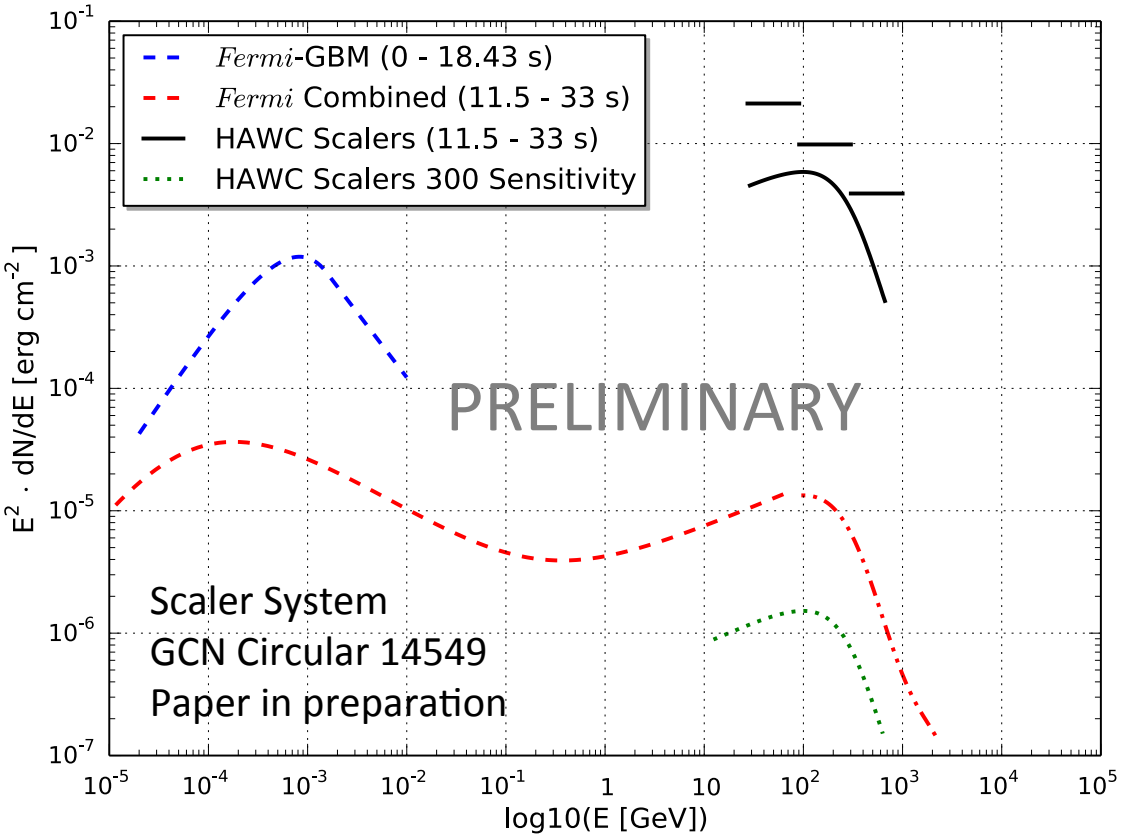
GRB 080916C, 090902B

Or without extension

GRB 090510, 130427A

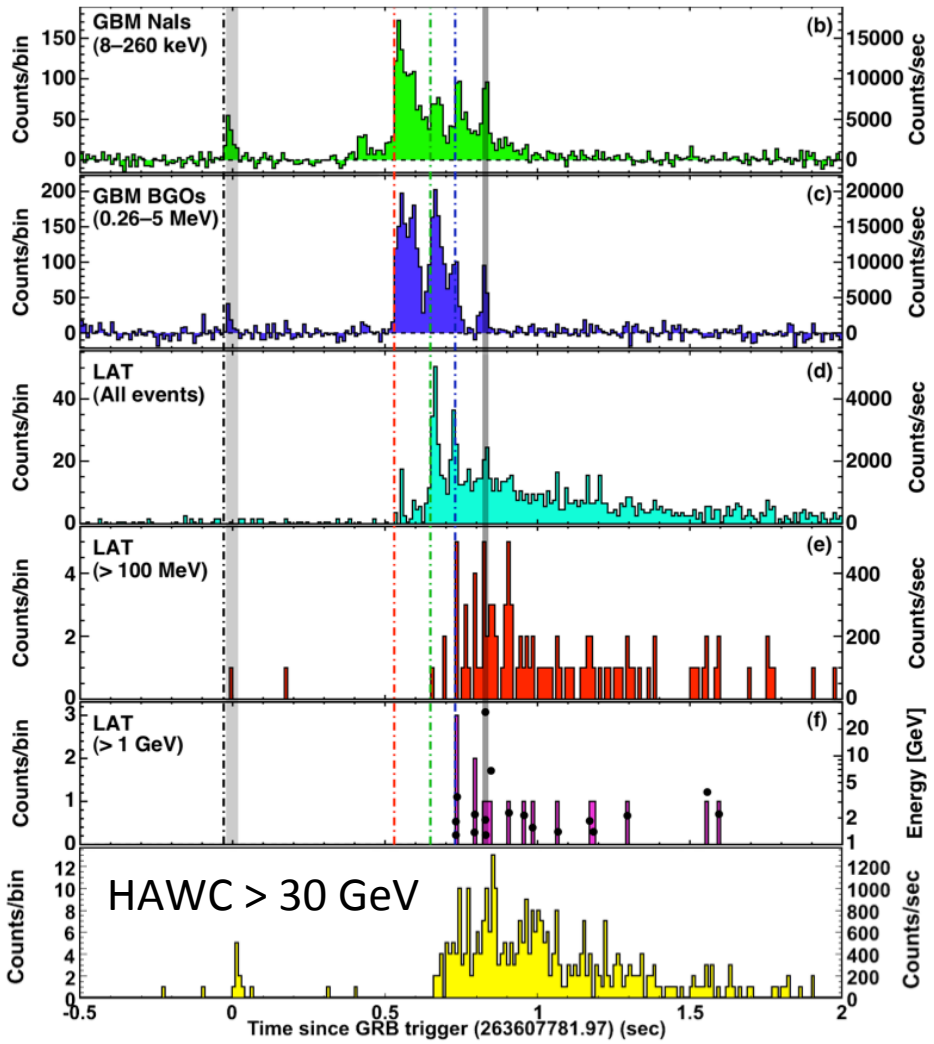
If spectrum is cutoff only by EBL, HAWC GRB rate is as high as ~1.6/year

Taboada & Gilmore 2013



See also: Abeysekara et al. Astropart. Phys. 2012

More on targets: Gamma Ray Bursts

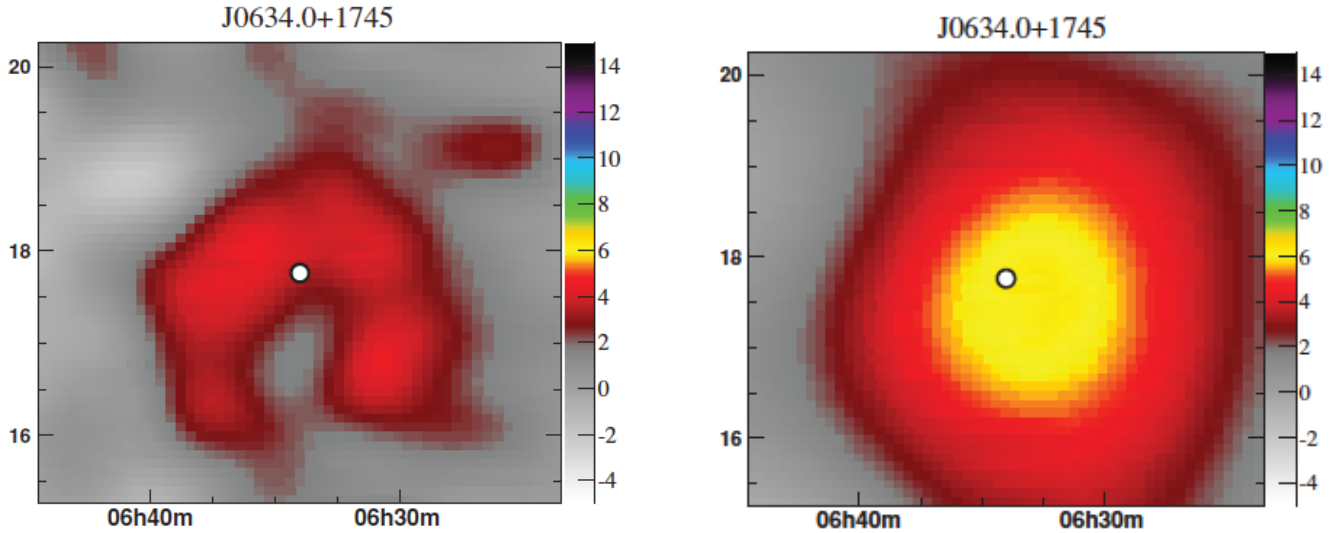


Test LIV, EBL, internal cutoffs, time delay for VHE, etc.

Example: If GRB 090510 spectrum extends to 125 GeV and taking into account EBL:
~200 photons above 30 GeV

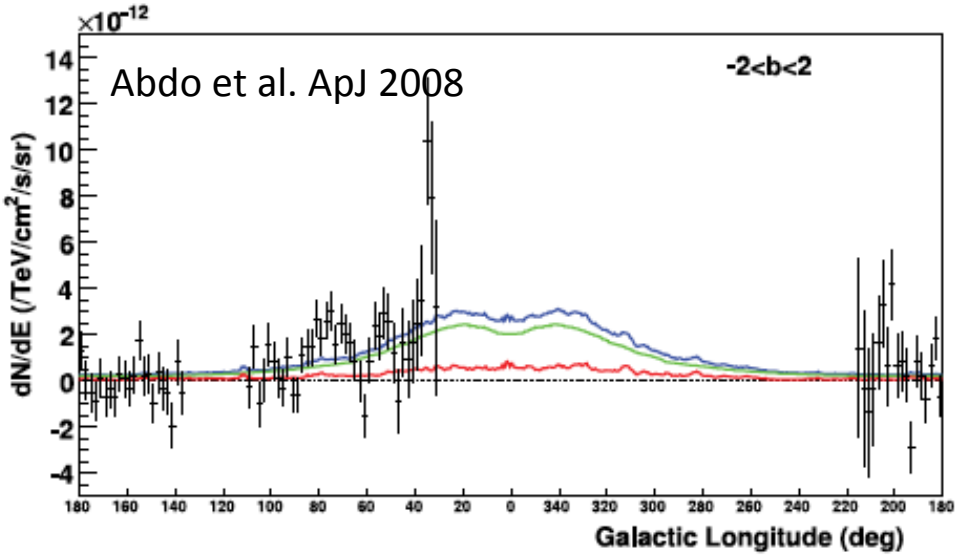
More on targets: our Galaxy

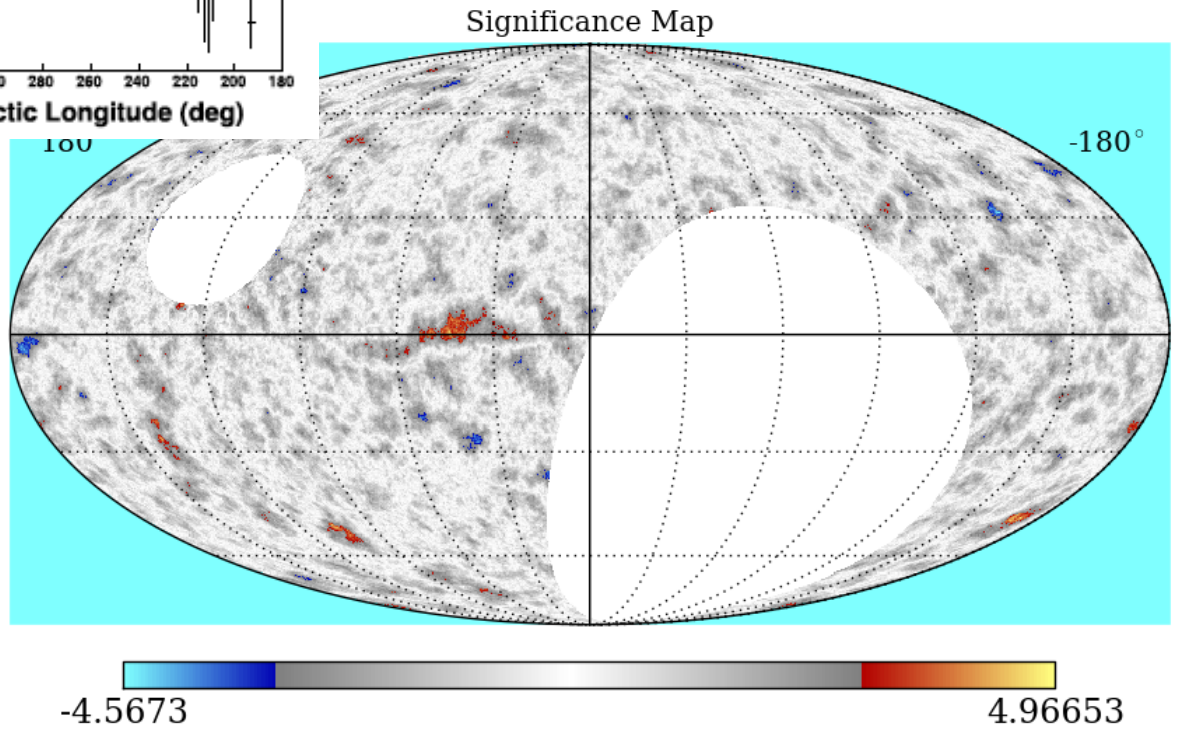
Abdo et al. ApJL 2009



Geminga: extended source candidate in Milagro

More on targets: Diffuse emission





1 year
Galprop simulation
4 deg smoothing

Outlook

We are just getting started!

HAWC: operations (1/3 finished) for over a year. Construction and full commissioning this year.

Wide field of view, very high uptime

Several galactic and extragalactic sources observed

See my other presentation for anisotropy results.

The HAWC Collaboration

HAWC Collaboration Meeting, February 25-27, 2014
Universidad Autónoma del Estado de Hidalgo
Pachuca, Hidalgo