What's Next?
From Milagro to HAWC

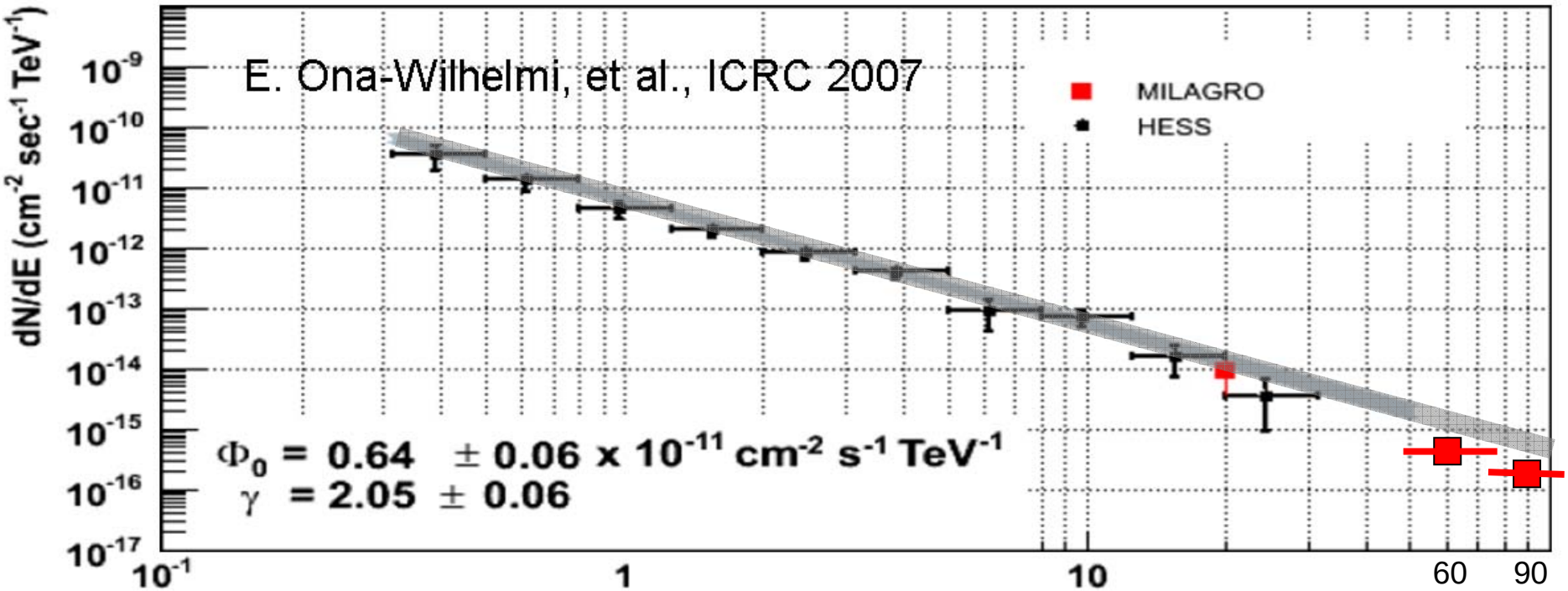
Petra Hüntemeyer

Why are High Energies Important?

- Do spectra continue or break at high energies?
  - Hard to accelerate electrons beyond 50-100 TeV

More on 1908+06 - *Preliminary*

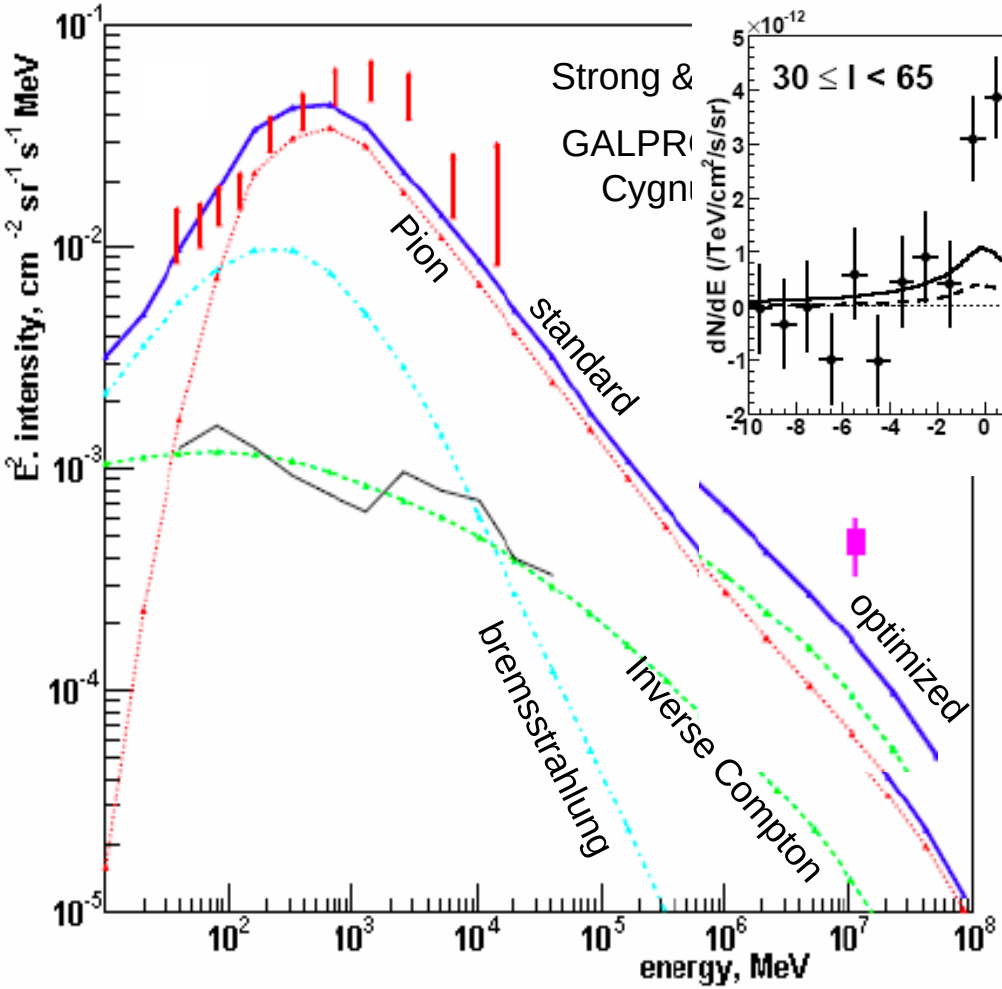
Median energy for this angle and α=-2.0 is 50 TeV
Cut on A4> 4 & 9 gives median E of 60 and 90 TeV

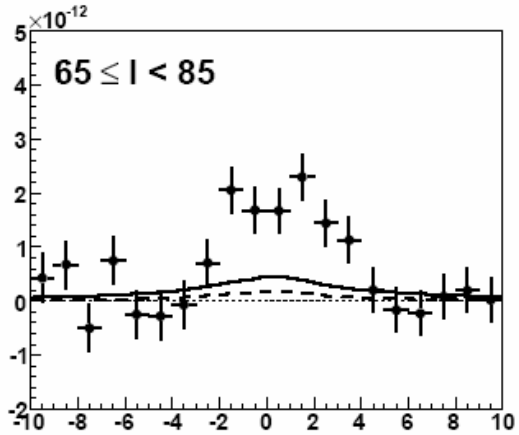


Why are High Energies Important?

- Do spectra continue or break at high energies?
  - Hard to accelerate electrons beyond 50-100 TeV
- Photons from hadronic interactions probe the knee region (~10x higher E)
- Need a high energy picture of the Galaxy, for example diffuse emission:

Why are High Energies Important?





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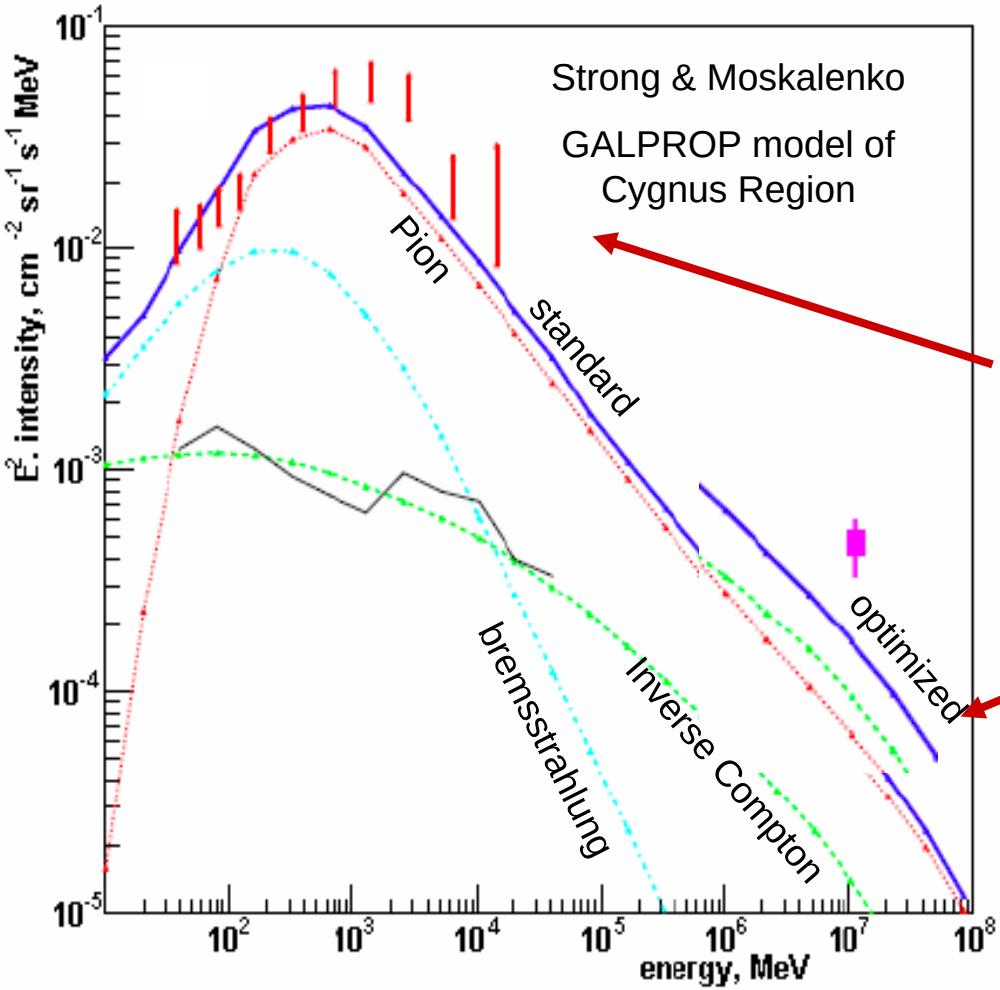
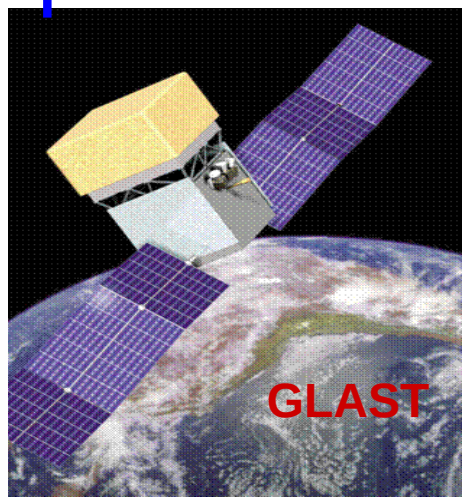




???

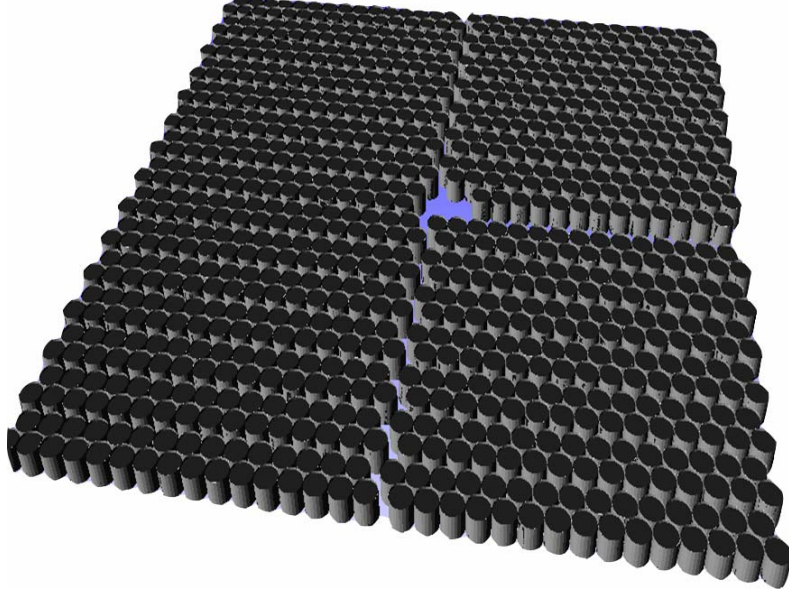

HAWC - A Wide-Field Gamma-Ray Telescope

- Build detector at extreme altitude
  - Sierra Negra, Mexico 4100m
- Incorporate new design
  - PMTs in isolated tanks
  - Larger PMT spacing
  - Single PMT layer (4m deep)

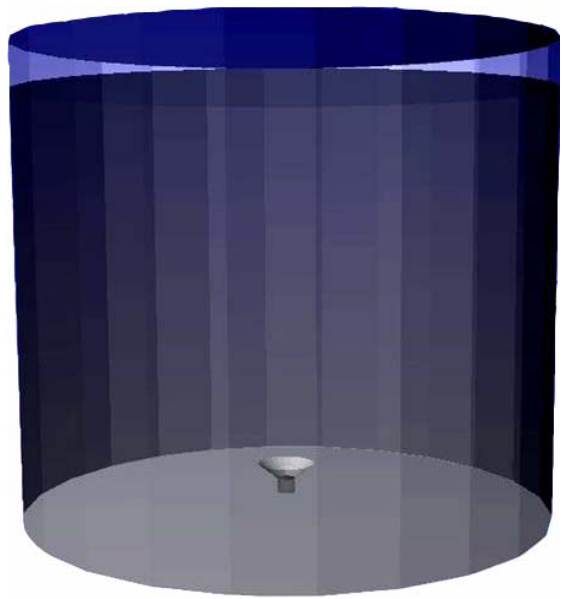
HAWC: High Altitude Water Cherenkov

~$6M for complete detector

From Milagro to HAWC

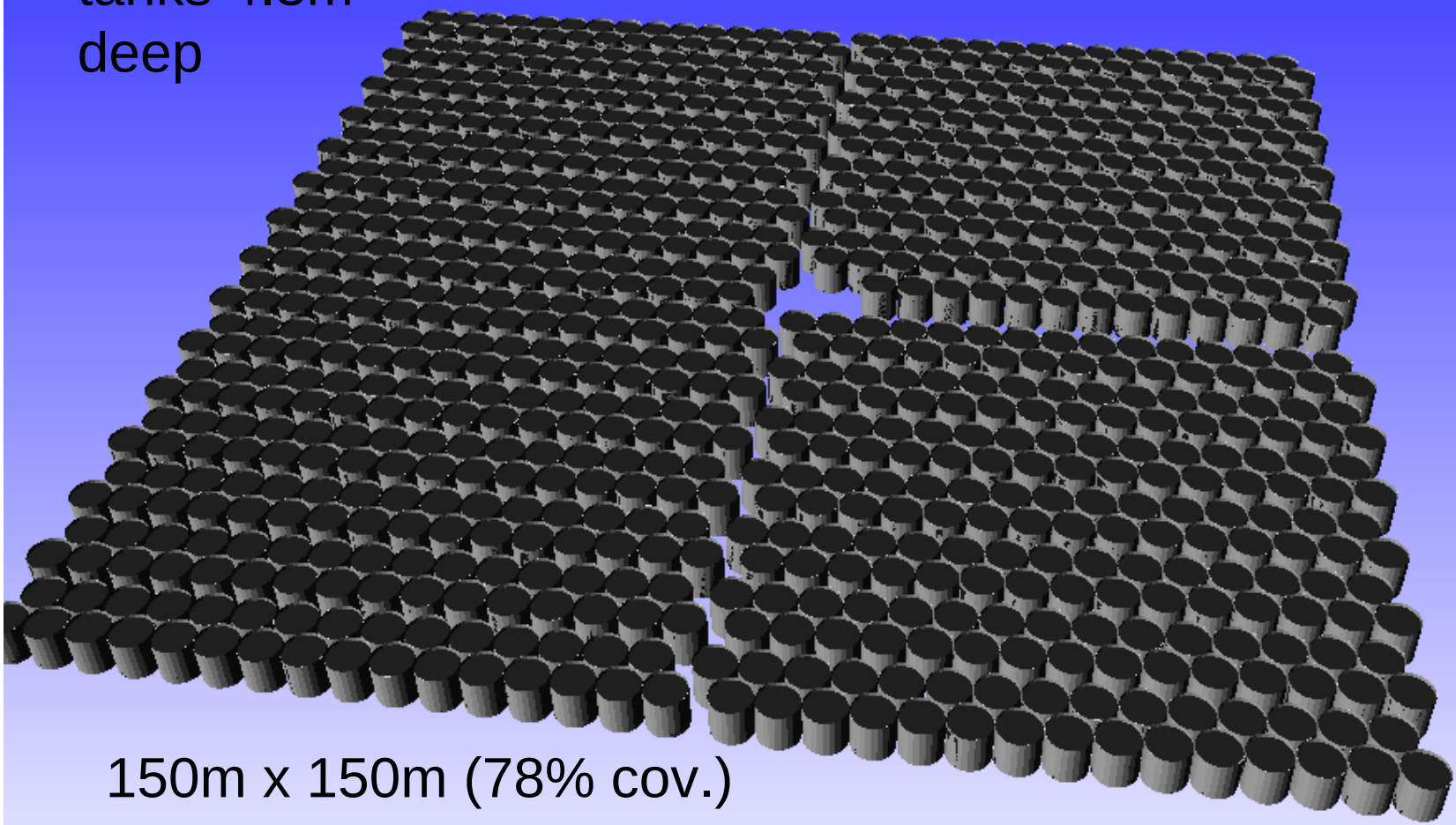


- Increase Altitude to 4100 m from 2650 m
- Increase Area to 22,000 m^2 from 4,000 m^2 (2,200m^2)
- Reuse Milagro PMTs and front end electronics - upgrade later?
- HAWC ~10x-15x Sensitivity of Milagro:
- Better Sensitivity at Low Energy
  - ~100m^2 at 100-200 GeV



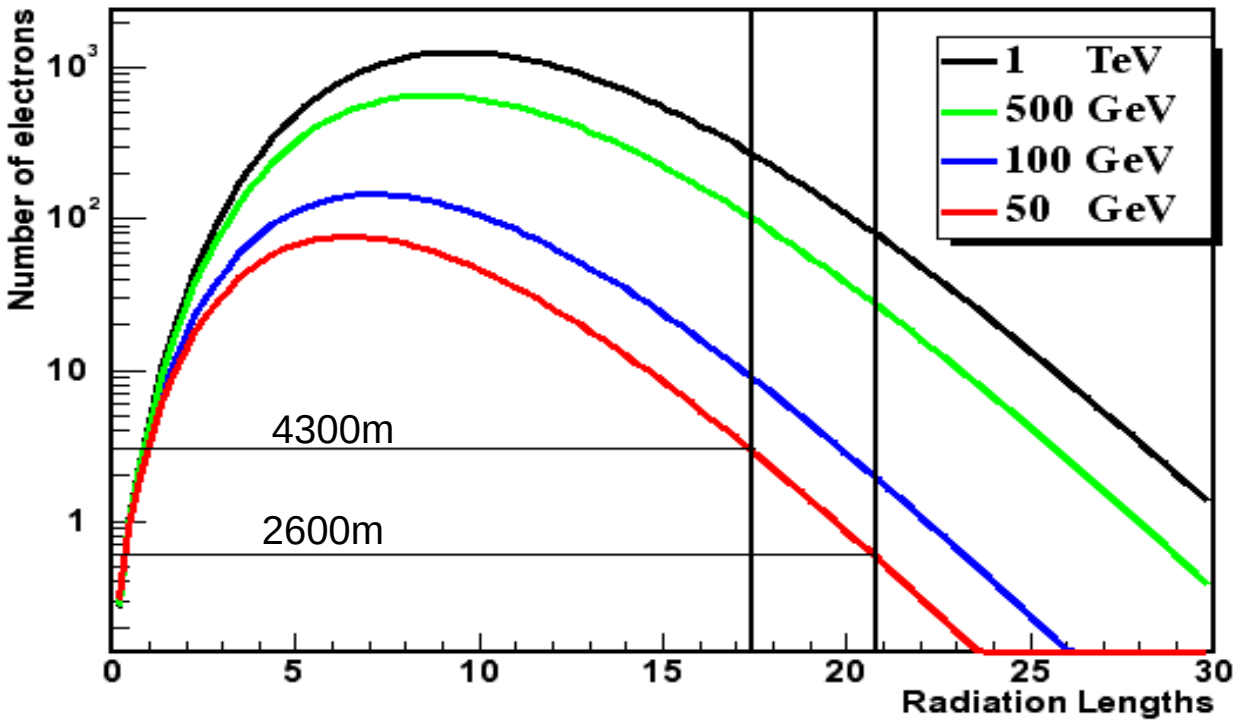
900 5m dia. tanks 4.3m deep

Reuse Milagro PMTs & FE elec.



150m x 150m (78% cov.)

Higher Altitude is Closer to Shower Max.



Difference between 2600m (Milagro) and 4300m (HAWC):

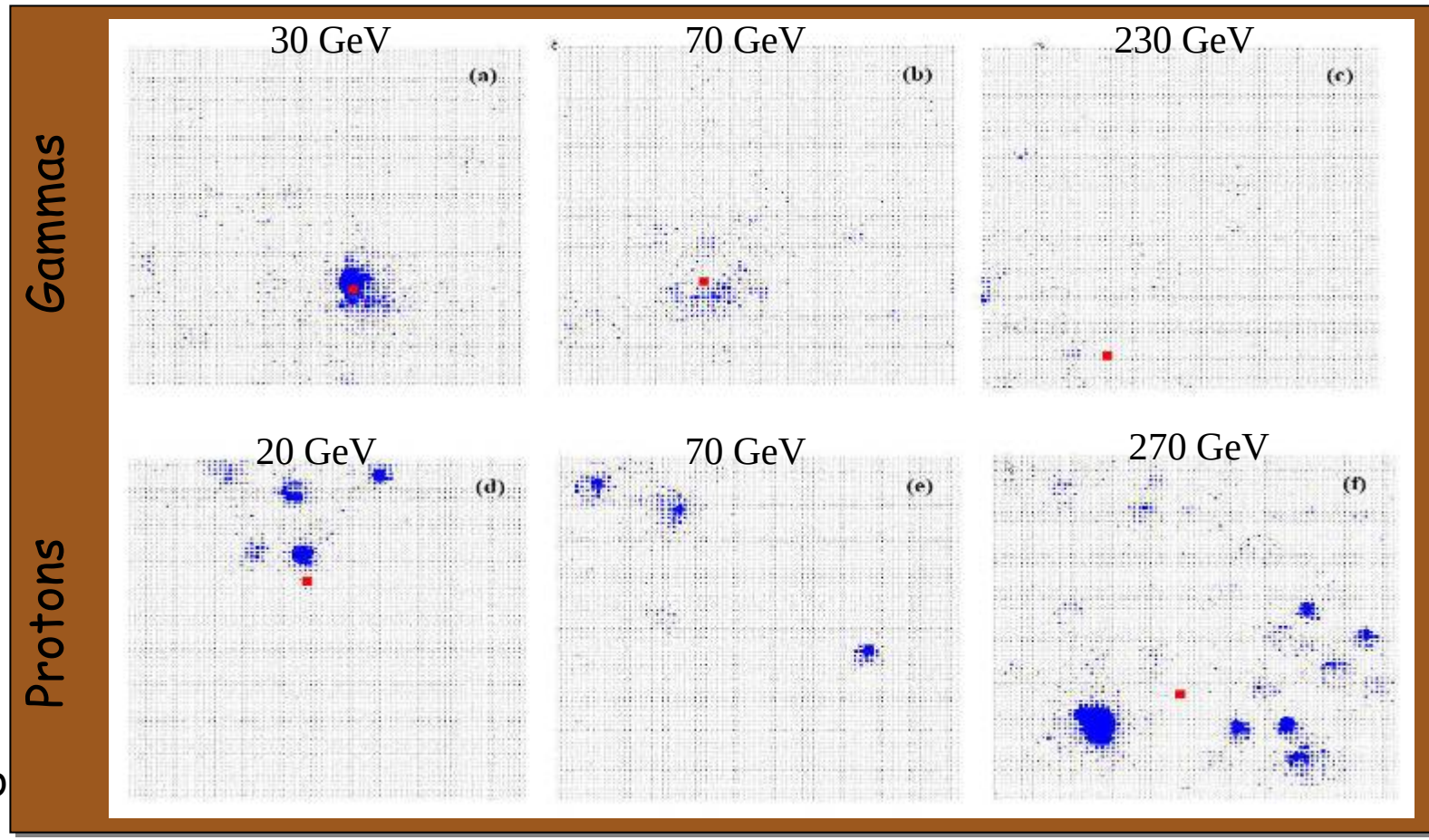
~ 6x number of particles

HAWC's median trigger energy ~ 1 TeV vs Milagro's ~ 4 TeV

Gamma/Hadron Separation

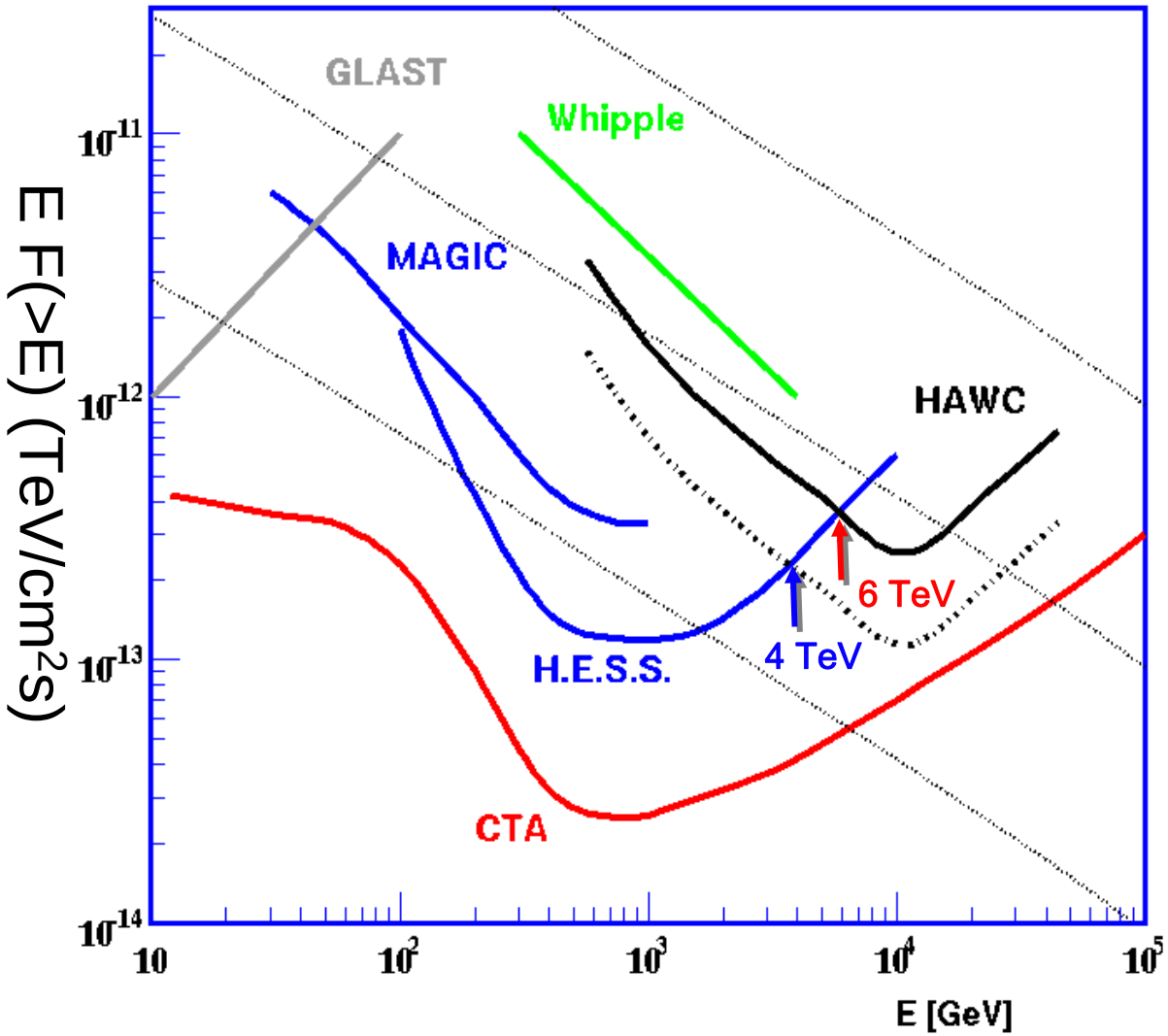
Size of HAWC

Size of Milagro deep layer



Energy Distribution at ground level

Gamma-Ray Sensitivity to Crab-like Point Source

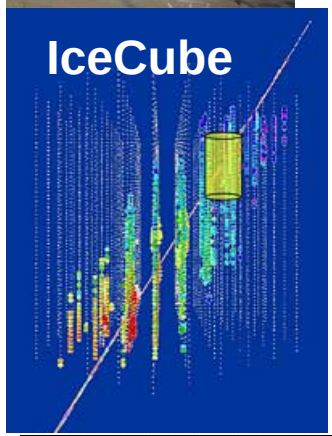


- **HESS/VERITAS, MAGIC, Whipple, CTA** sensitivity in 50 hours, (~0.2 sr/year)
- **GLAST** sensitivity in 1 year (4π sr)
- **HAWC, Milagro**, sensitivity in 1(5) year 2π sr
- HAWC will do better for hard & diffuse sources

GeV

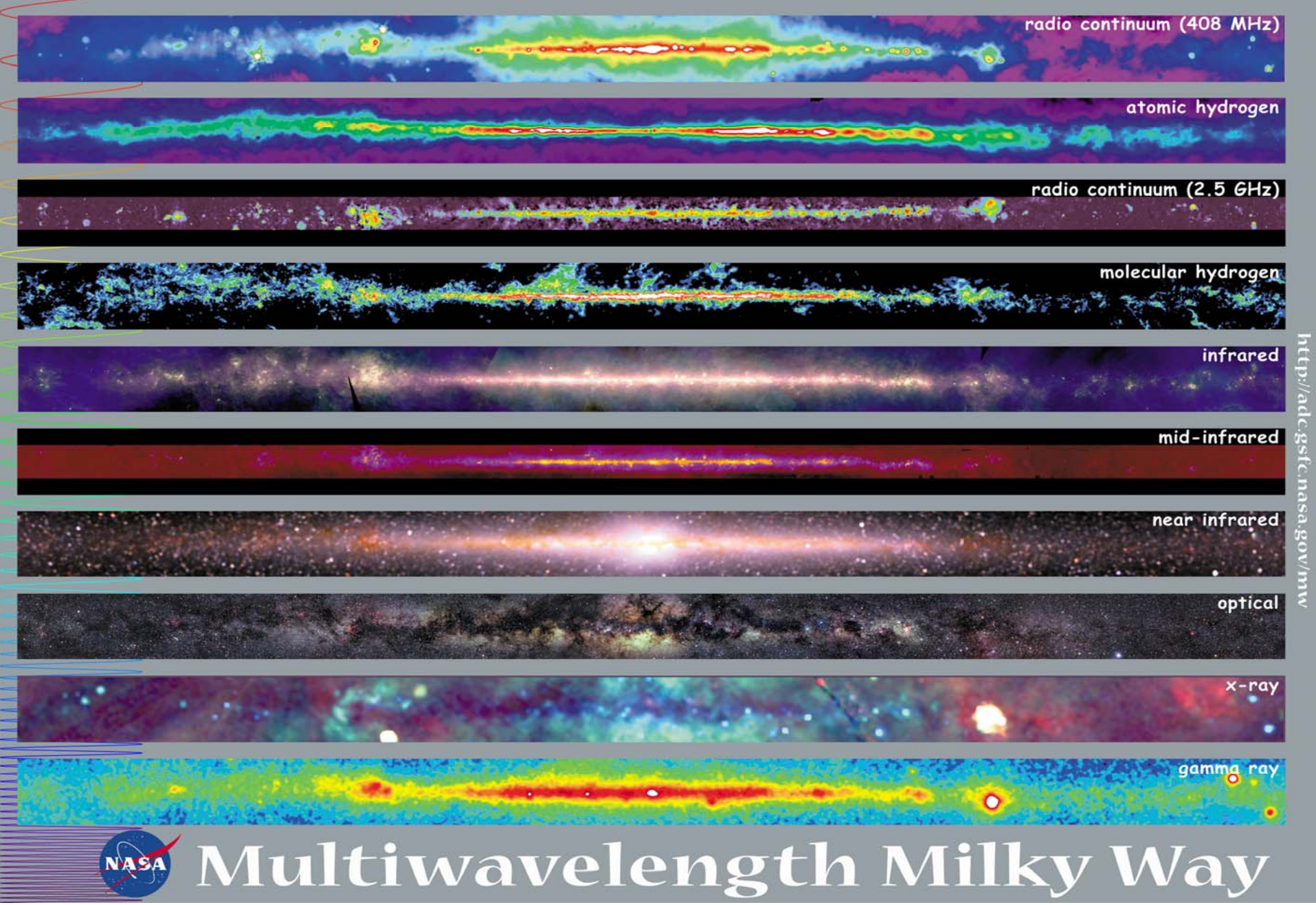
HAWC Complementary Science

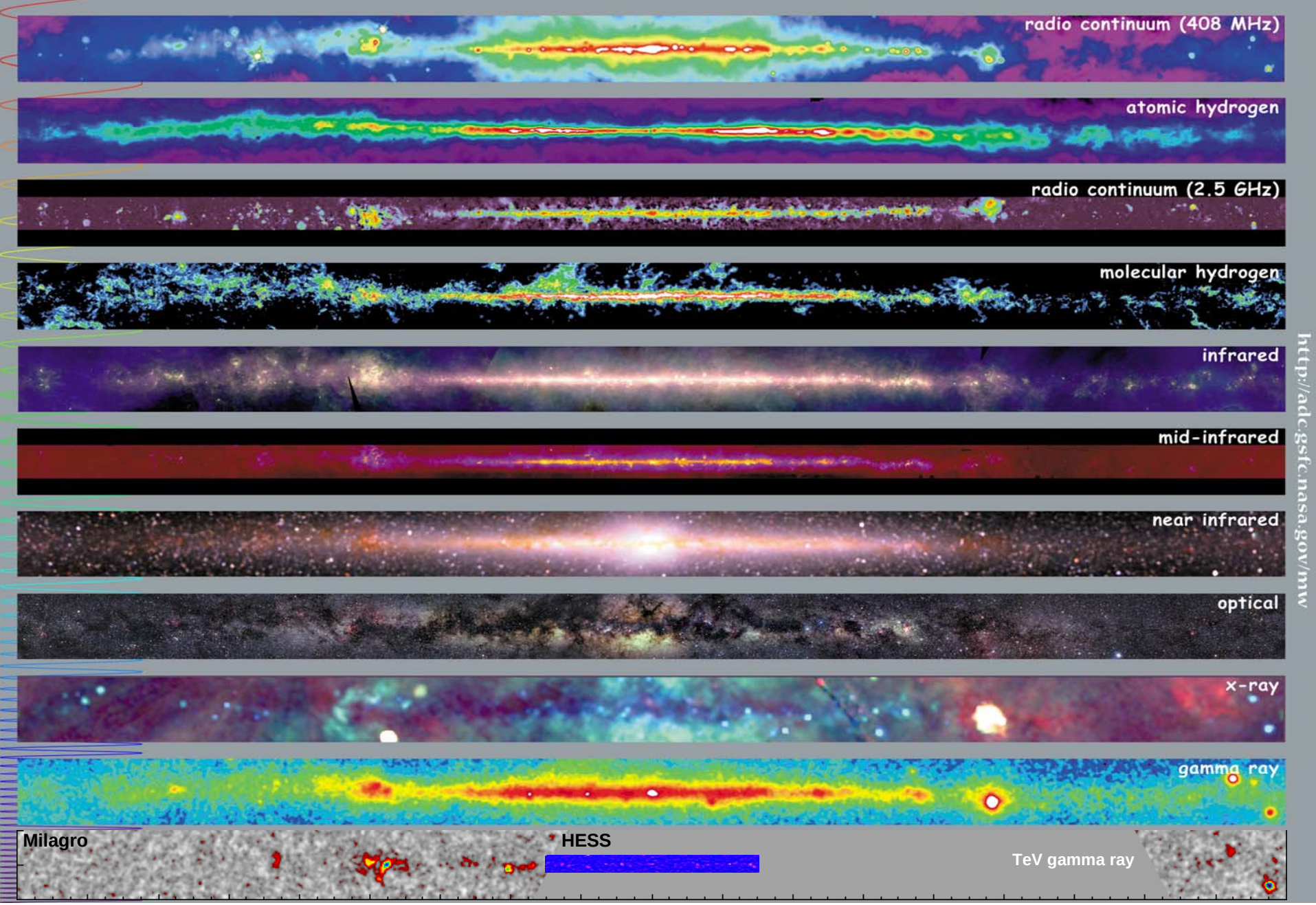
- Complements TeV atmospheric Cherenkov telescopes
  - Identifies new and flaring sources for follow up observation of morphology and sub TeV spectra
  - Extends TeV spectra to higher energies
- Complements TeV neutrino observations
  - Identifies new and flaring TeV sources to improve the sensitivity and interpretation of blind searches
- Complements GeV All Sky Survey
  - Determines which of GLAST's 1000s of sources extend to high energies



Conclusion

- Milagro has demonstrated the power of the water Cherenkov technique
  - Detection of Crab Nebula and Mrk 421, known TeV sources
  - Discovery of 7 new TeV sources
  - 1st detection of TeV diffuse emission from the Galactic plane
- Future: HAWC
  - Building on expertise with Milagro
  - Design improvements in Size, Altitude, Water tanks
  - 15x Milagro sensitivity
- Milagro /HAWC complementary to other particle astrophysics observatories


radio continuum (408 MHz)
atomic hydrogen
radio continuum (2.5 GHz)
molecular hydrogen
infrared
mid-infrared
near infrared
optical
x-ray
gamma ray
http://adc.gsfc.nasa.gov/mw
NASA
Multiwavelength Milky Way



TeV γ-rays: A New Window on the Sky

Petra Hüntemeyer
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