THE HIGH ALTITUDE WATER CHERENKOV OBSERVATORY

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University Park

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HAWC
High Altitude Water Cherenkov Gamma-ray Observatory

Image courtesy of Philip Suárez Mauro

Outline

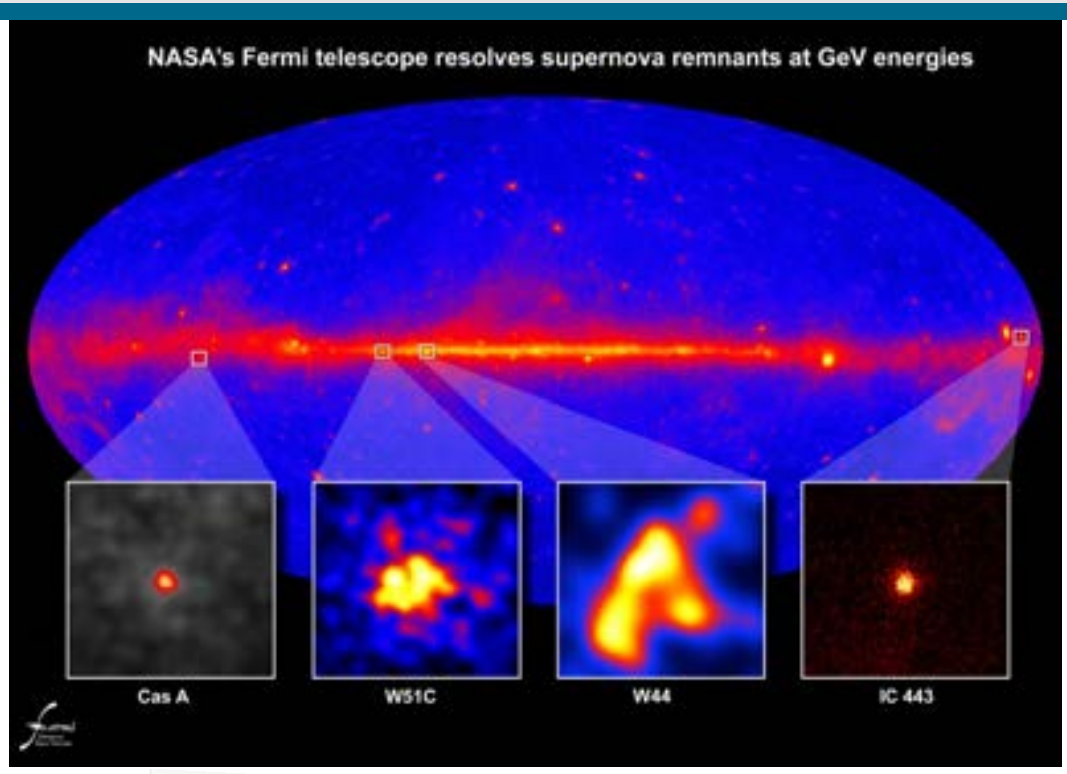
Introduction & Motivation

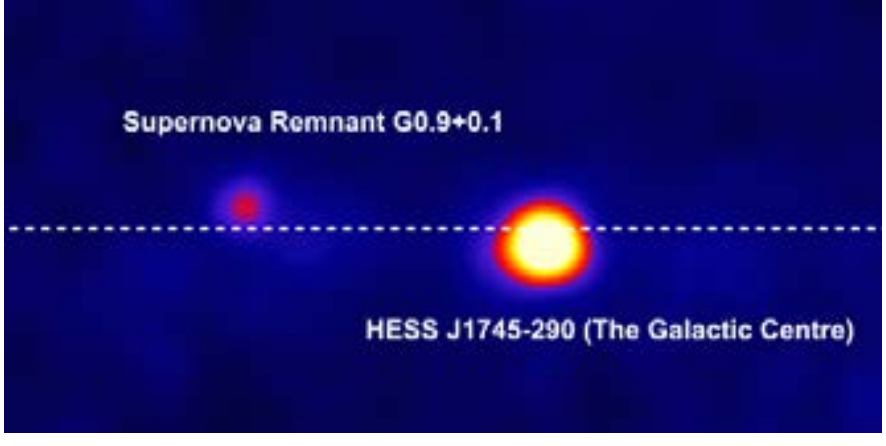
Description of the HAWC observatory

Latest (interesting) results

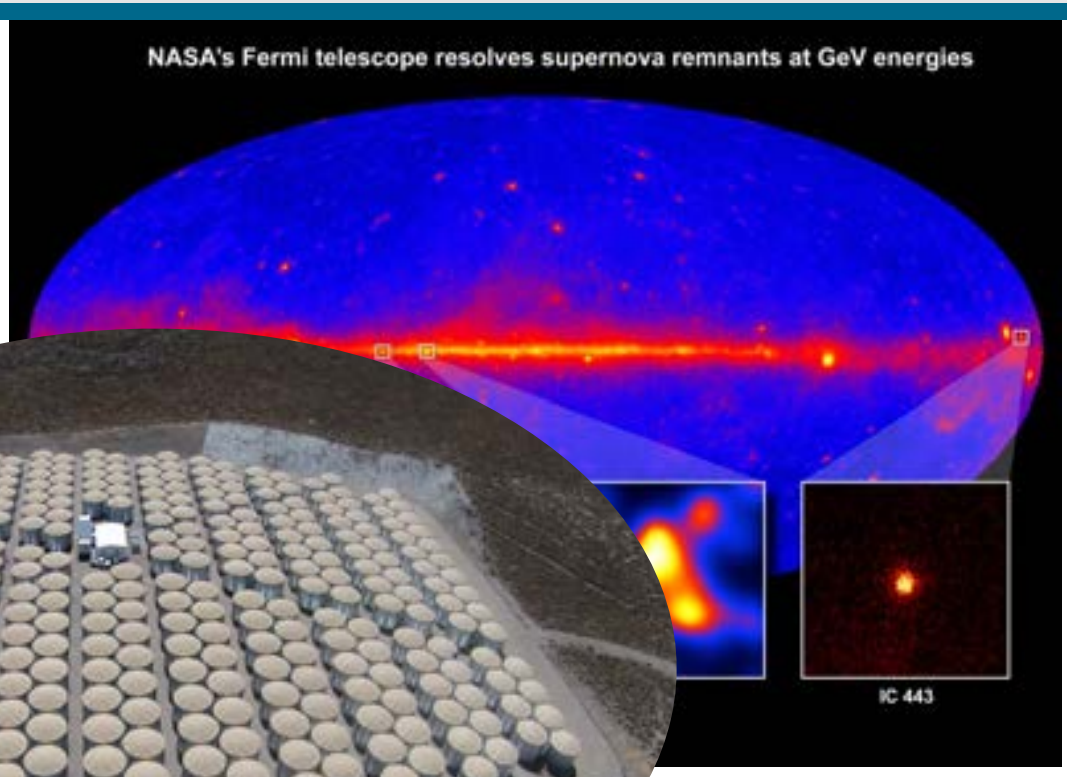
Outlook & Conclusions

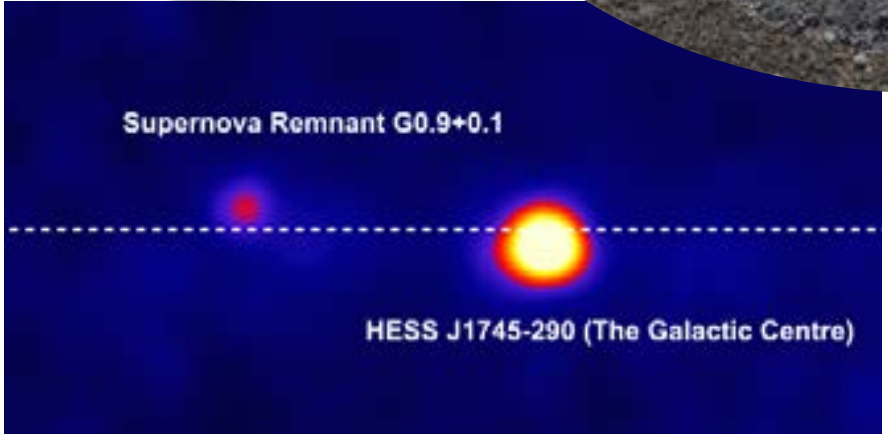
VHE γ-RAYS





GROUND ARRAYS





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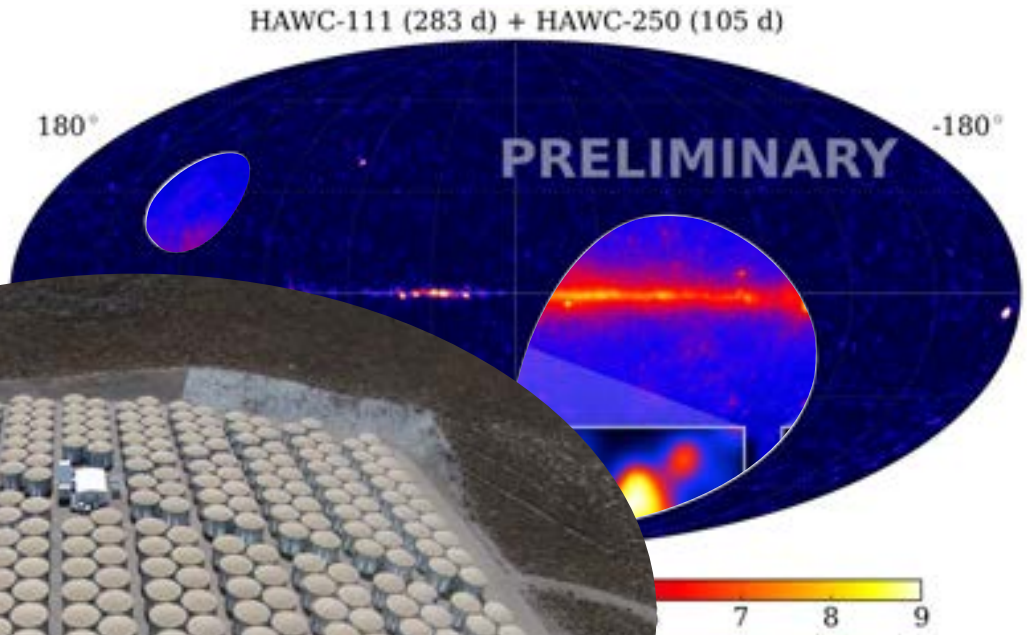
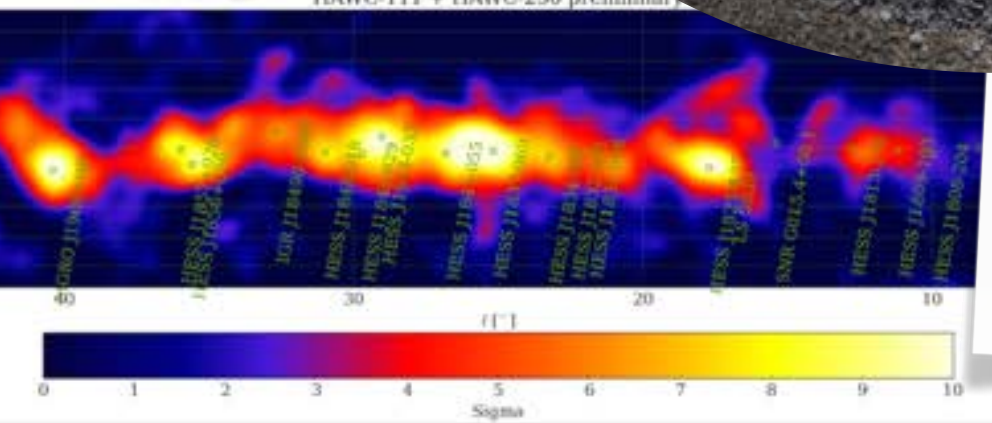
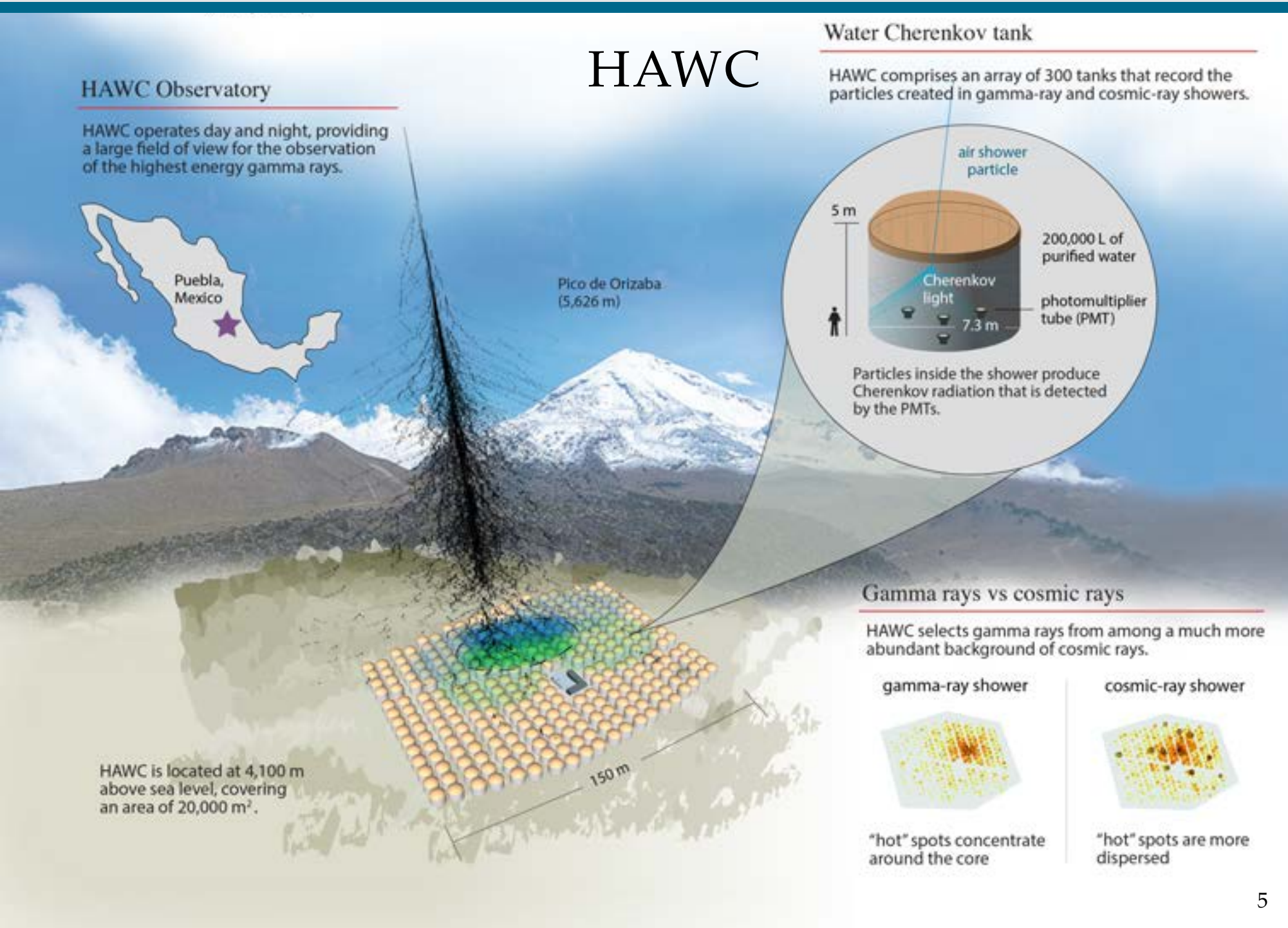




HAWC

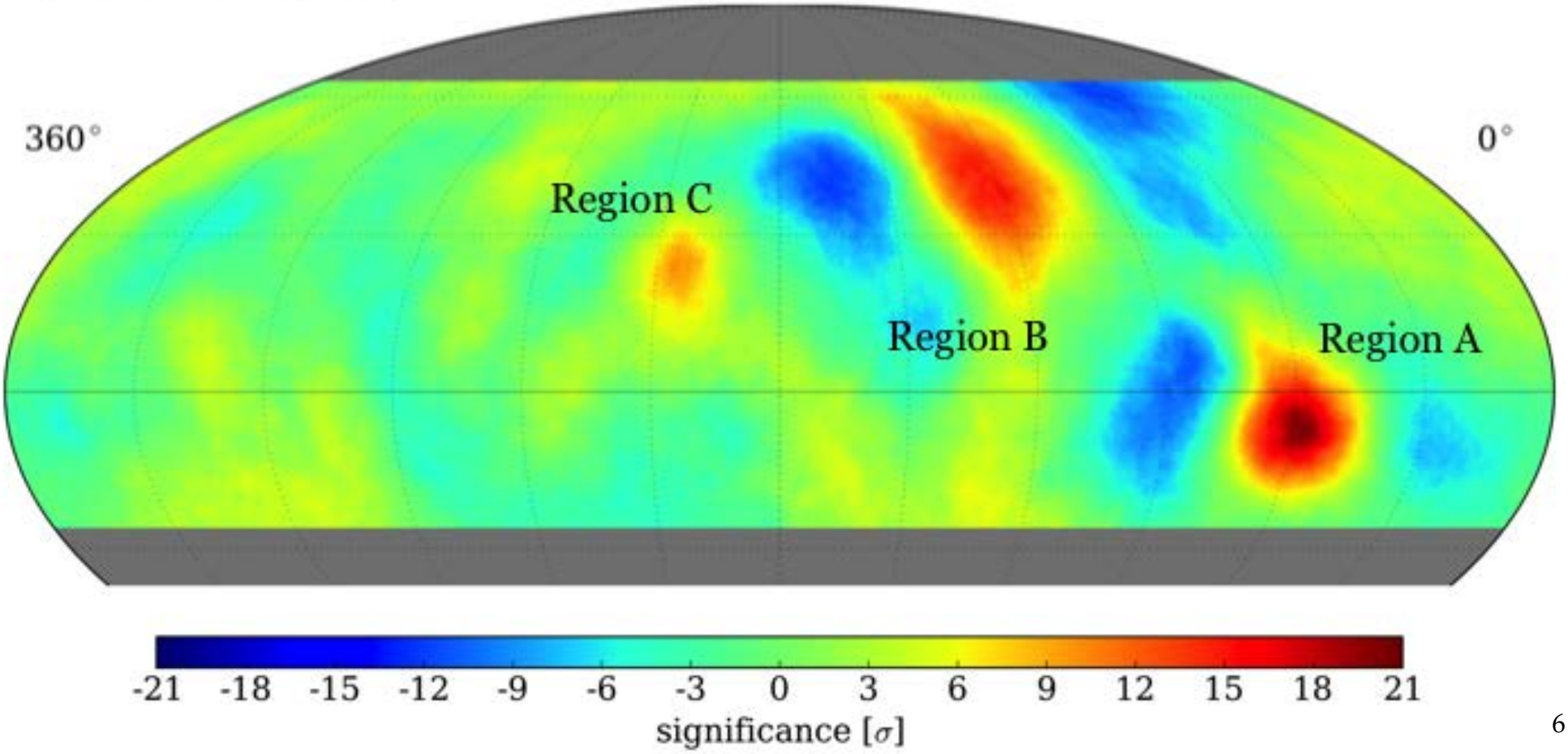

HAWC Observatory
HAWC operates day and night, providing a large field of view for the observation of the highest energy gamma rays.
Puebla, Mexico
Pico de Orizaba (5,626 m)
HAWC is located at 4,100 m above sea level, covering an area of 20,000 m².
150 m
Water Cherenkov tank
HAWC comprises an array of 300 tanks that record the particles created in gamma-ray and cosmic-ray showers.
air shower particle
5 m
200,000 L of purified water
Cherenkov light
photomultiplier tube (PMT)
7.3 m
Particles inside the shower produce Cherenkov radiation that is detected by the PMTs.
Gamma rays vs cosmic rays
HAWC selects gamma rays from among a much more abundant background of cosmic rays.
gamma-ray shower
cosmic-ray shower
"hot" spots concentrate around the core
"hot" spots are more dispersed

SMALL-SCALE COSMIC RAY ANISOTROPY

Small-scale (< 60°)
Large-scale removed (dipole,quadrupole,+octupole)
10° smoothing applied
86 billion events over 181 days

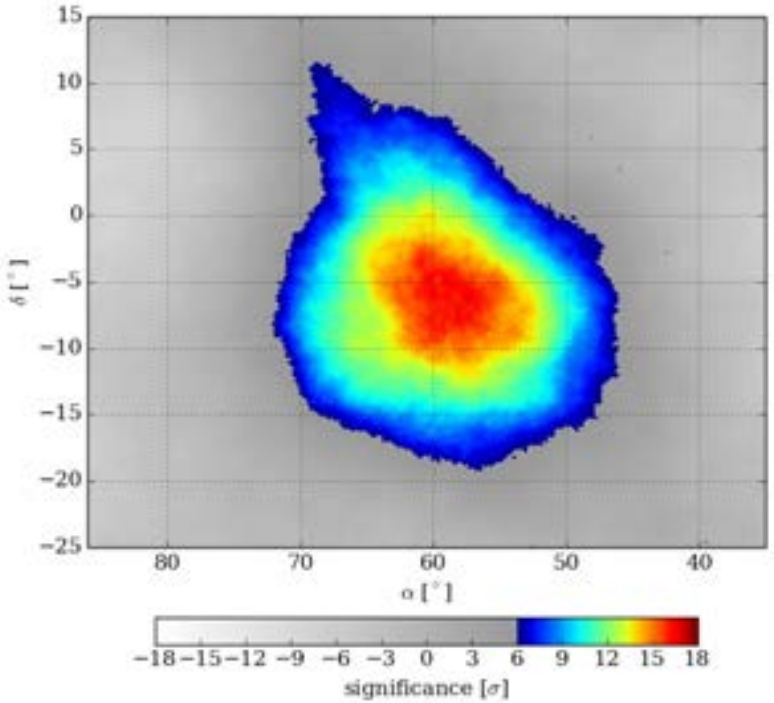
In press with Astrophys. J. (arXiv 1408.4805 [astro-ph.HE])

3 significant excesses
- A – strongest, harder spectrum than bkg, at ~10 TeV consistent with Milagro
- B – most extended
- C – confirms Argo-YBJ observation

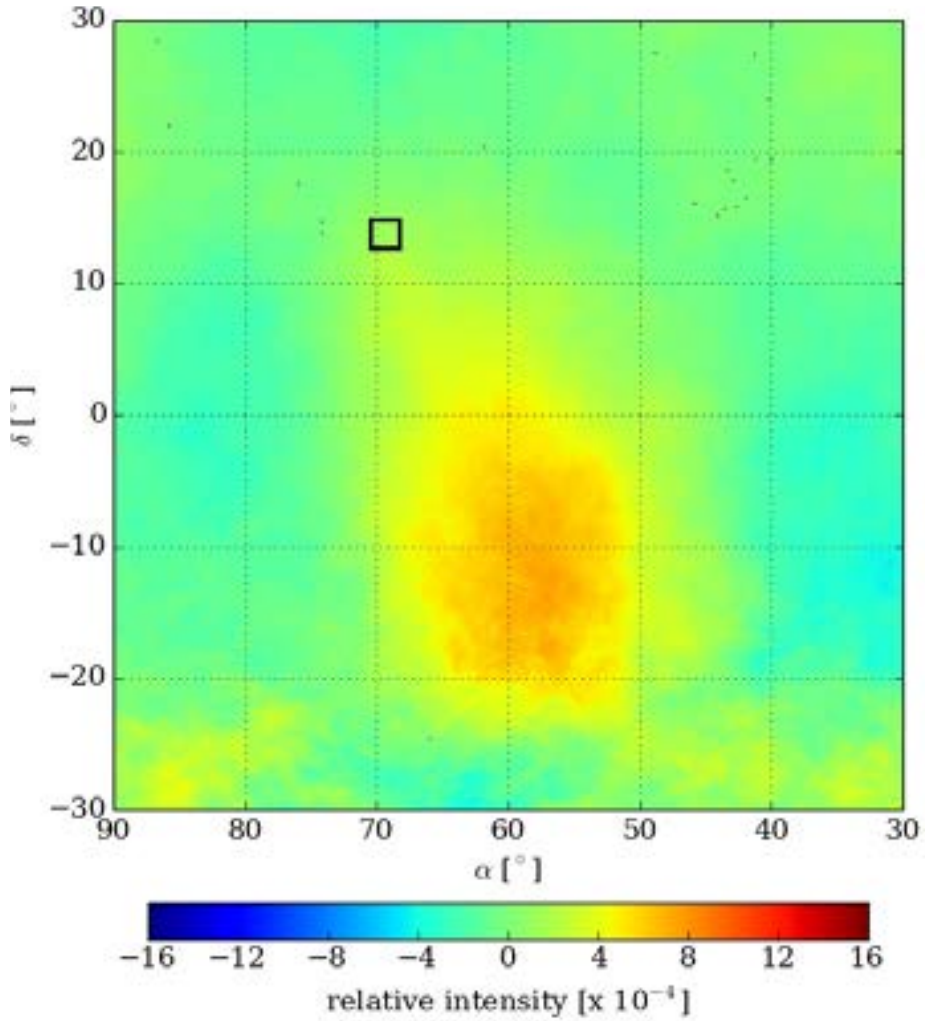


REGION A

- Preliminary spectral analysis



inclusive



bin 0 (lowest energy)

REGION A

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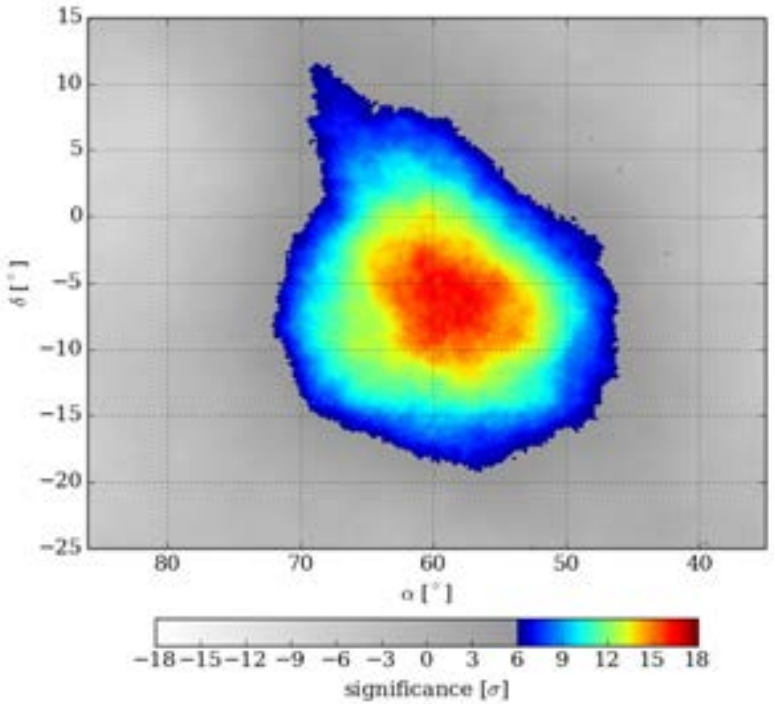

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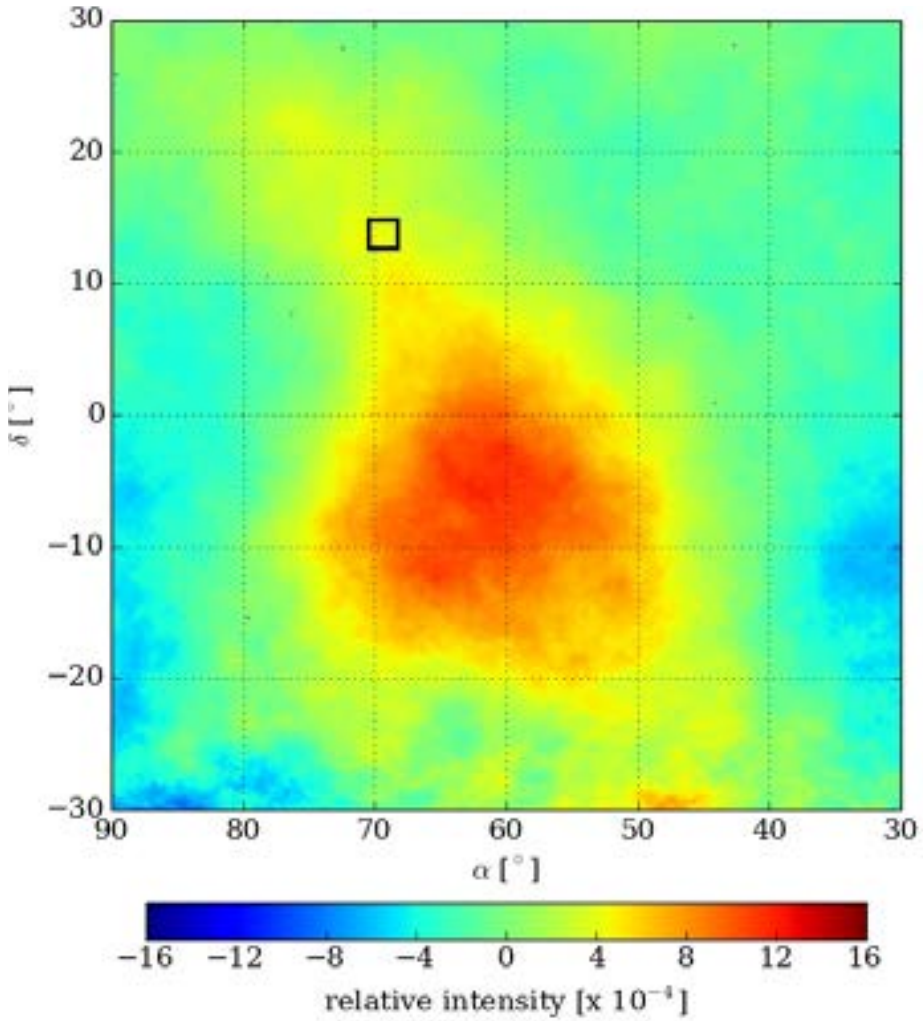

bin 1 ($\sim$ 3.2 TeV)

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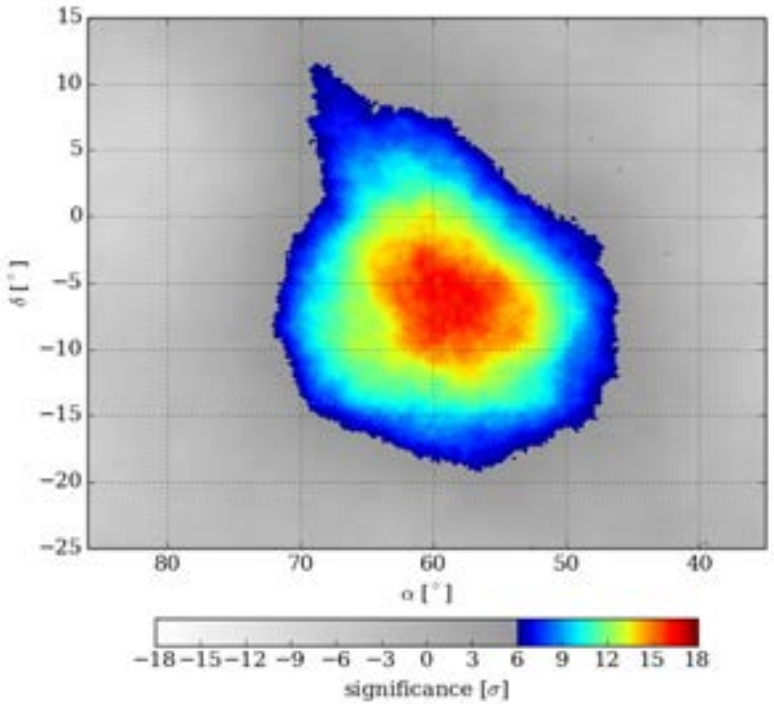

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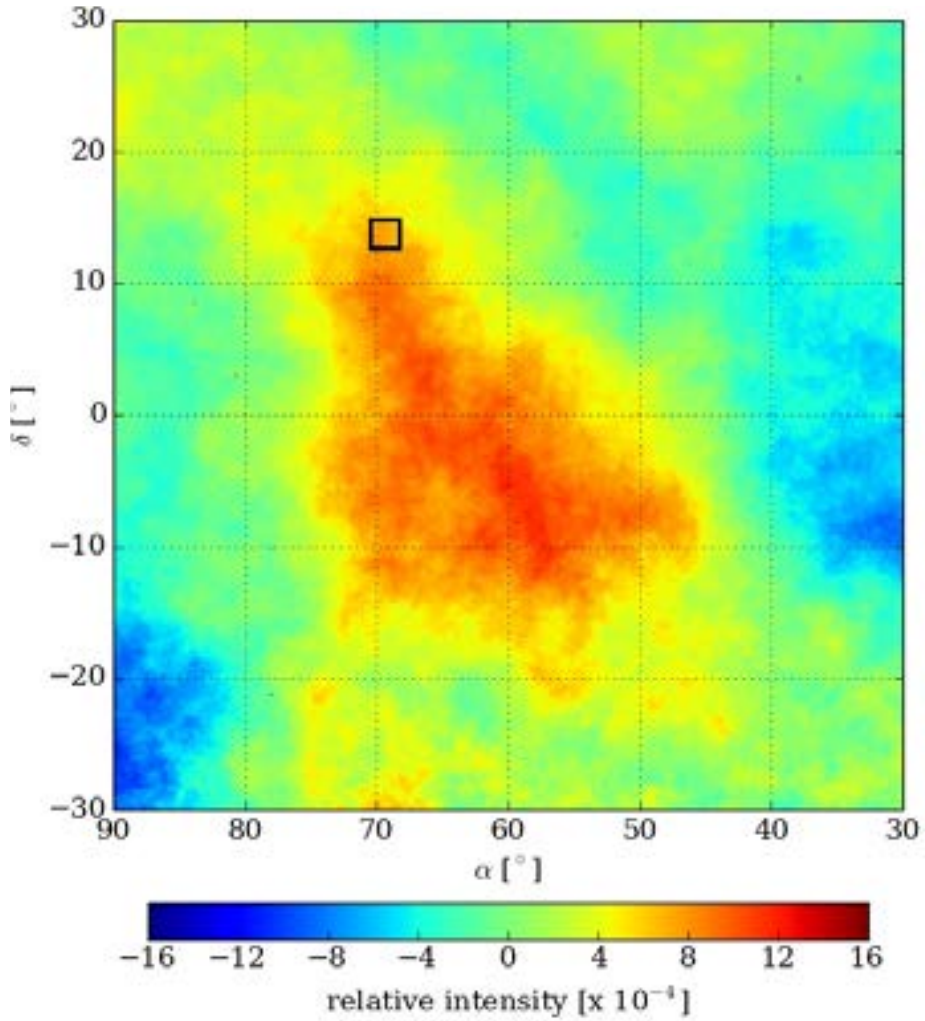

bin 2 ($\sim$ 6 TeV)

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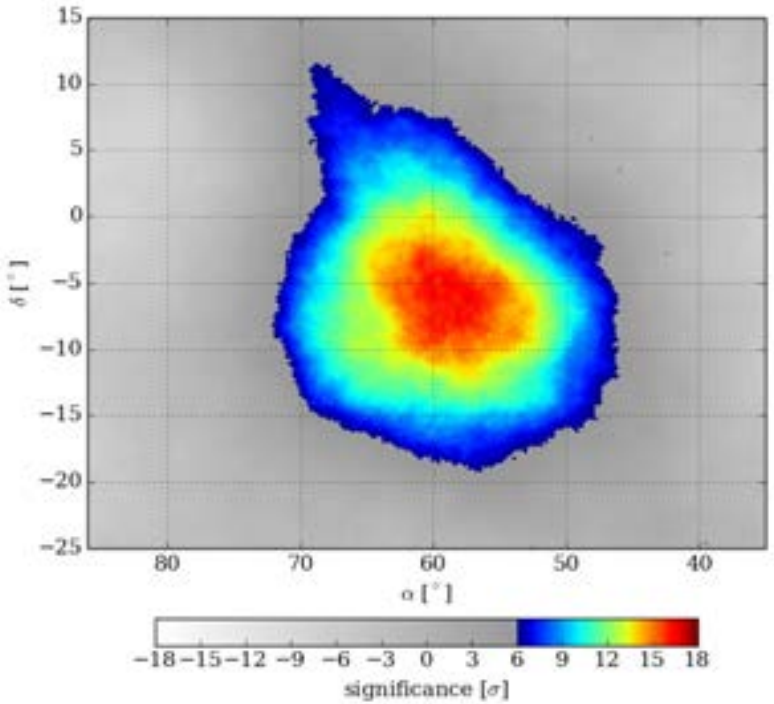

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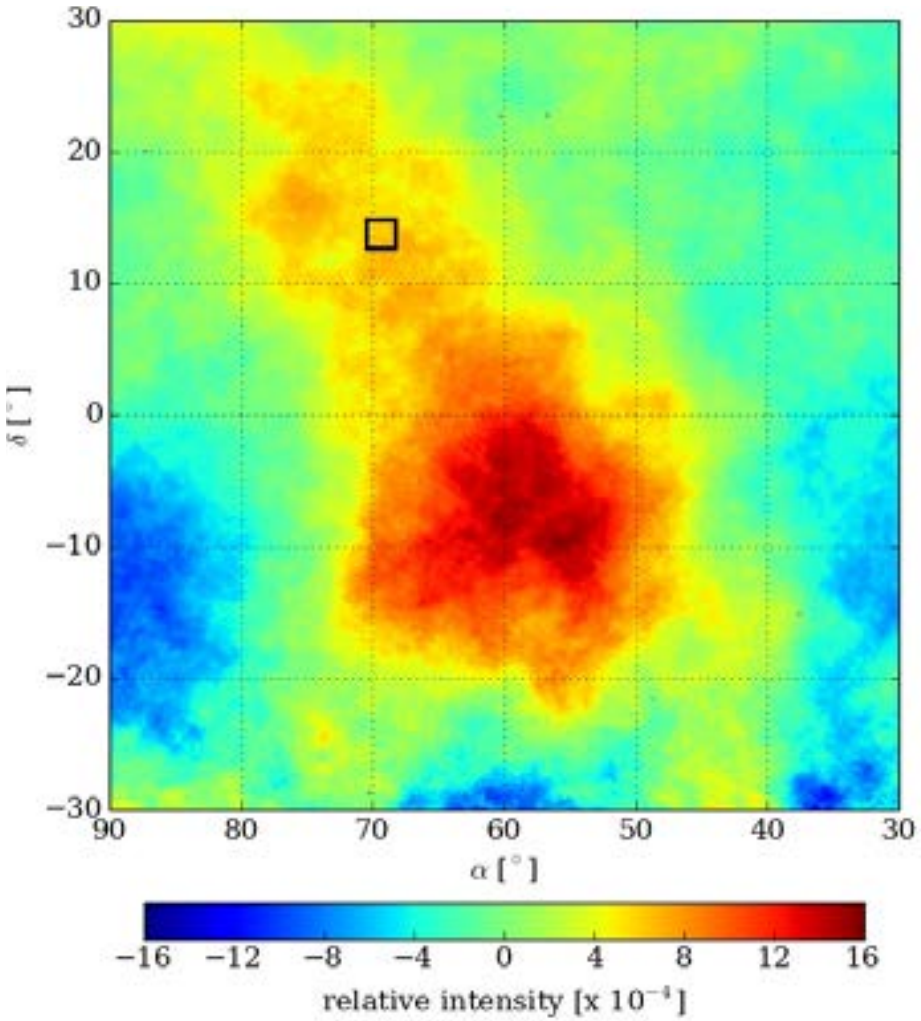
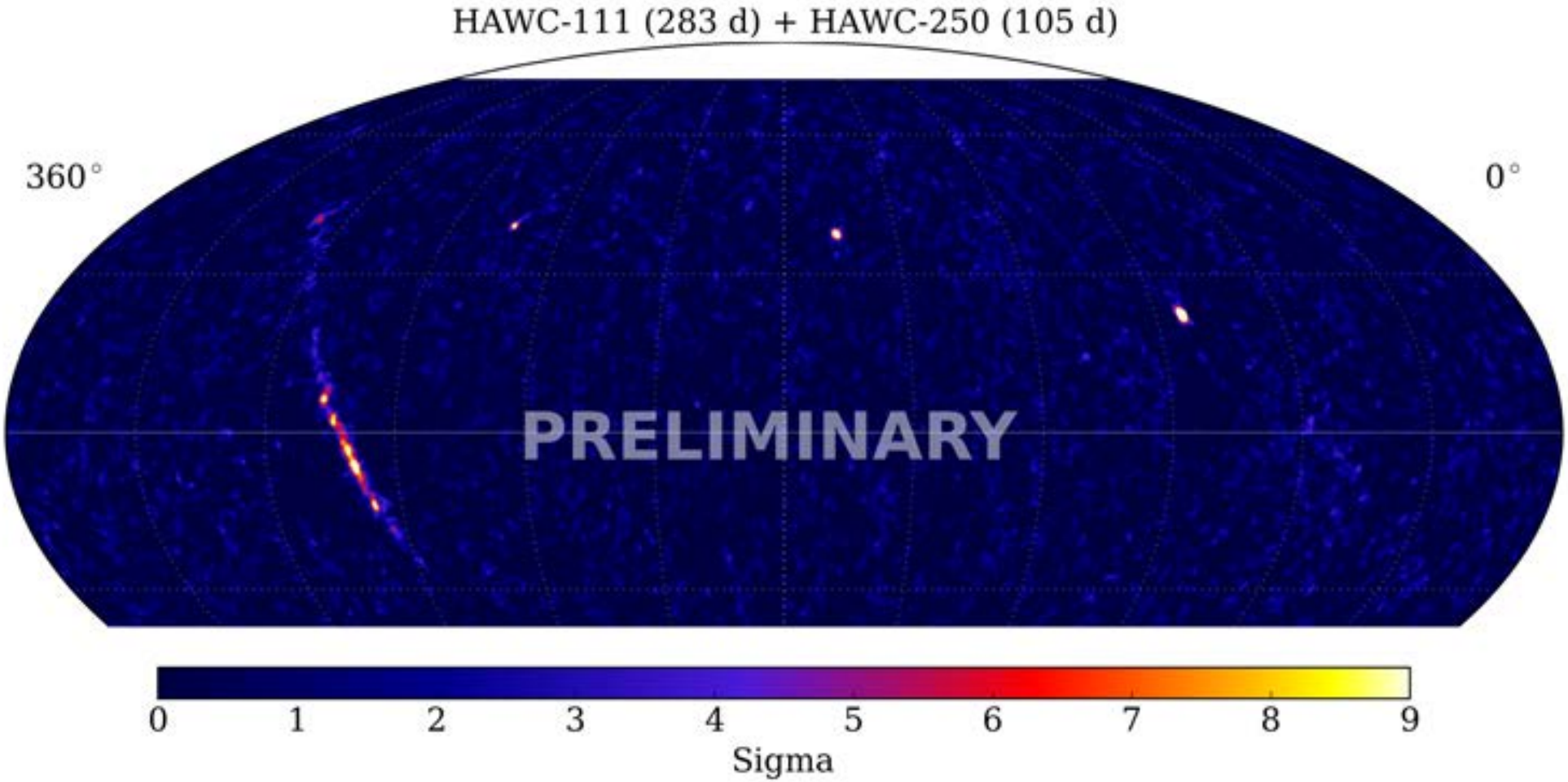


bin 3-6 ($\sim$ 14 TeV)

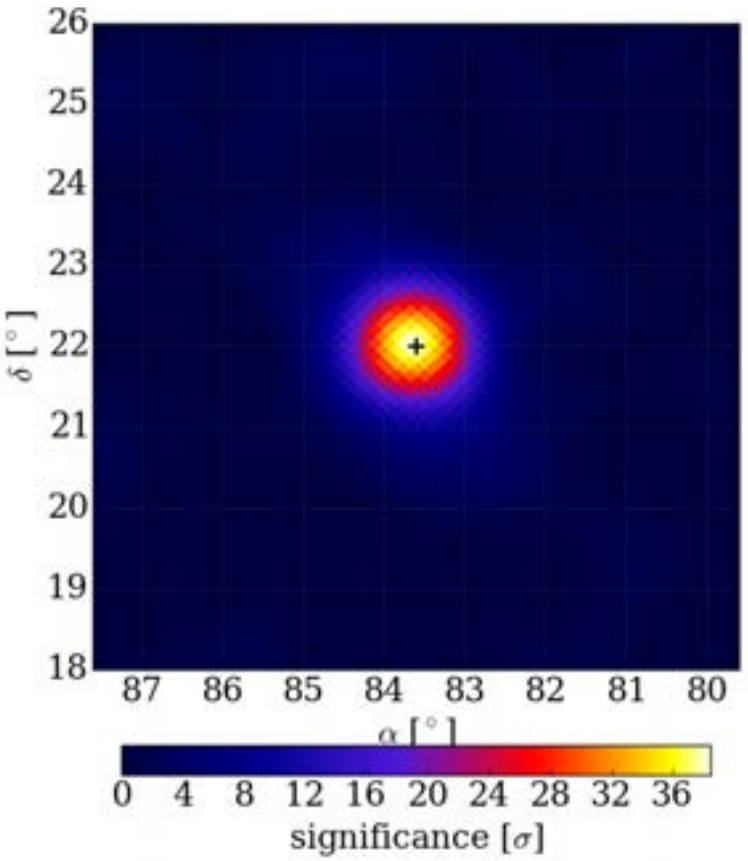
γ-RAYS

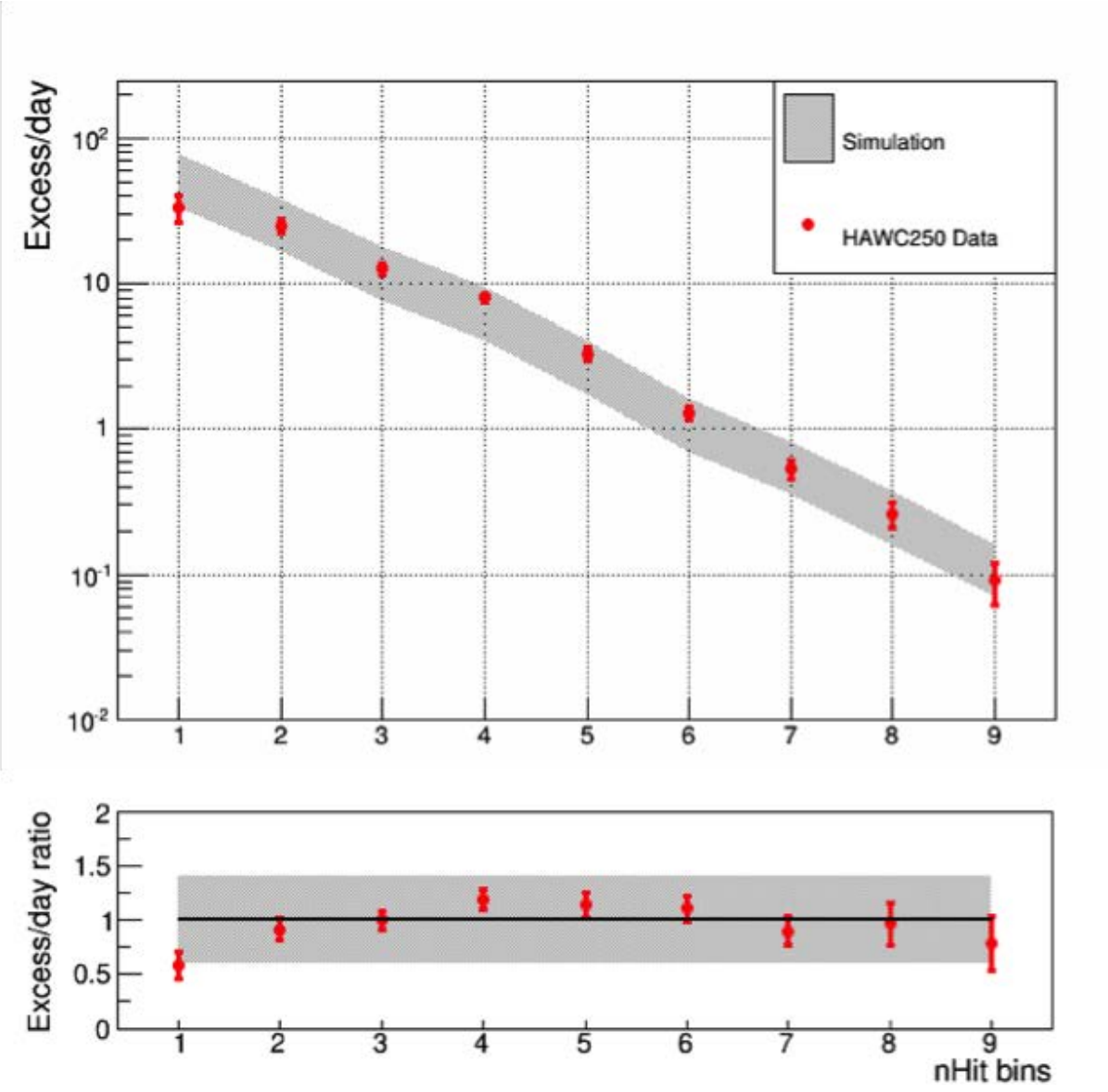
- Sky map



γ-RAYS

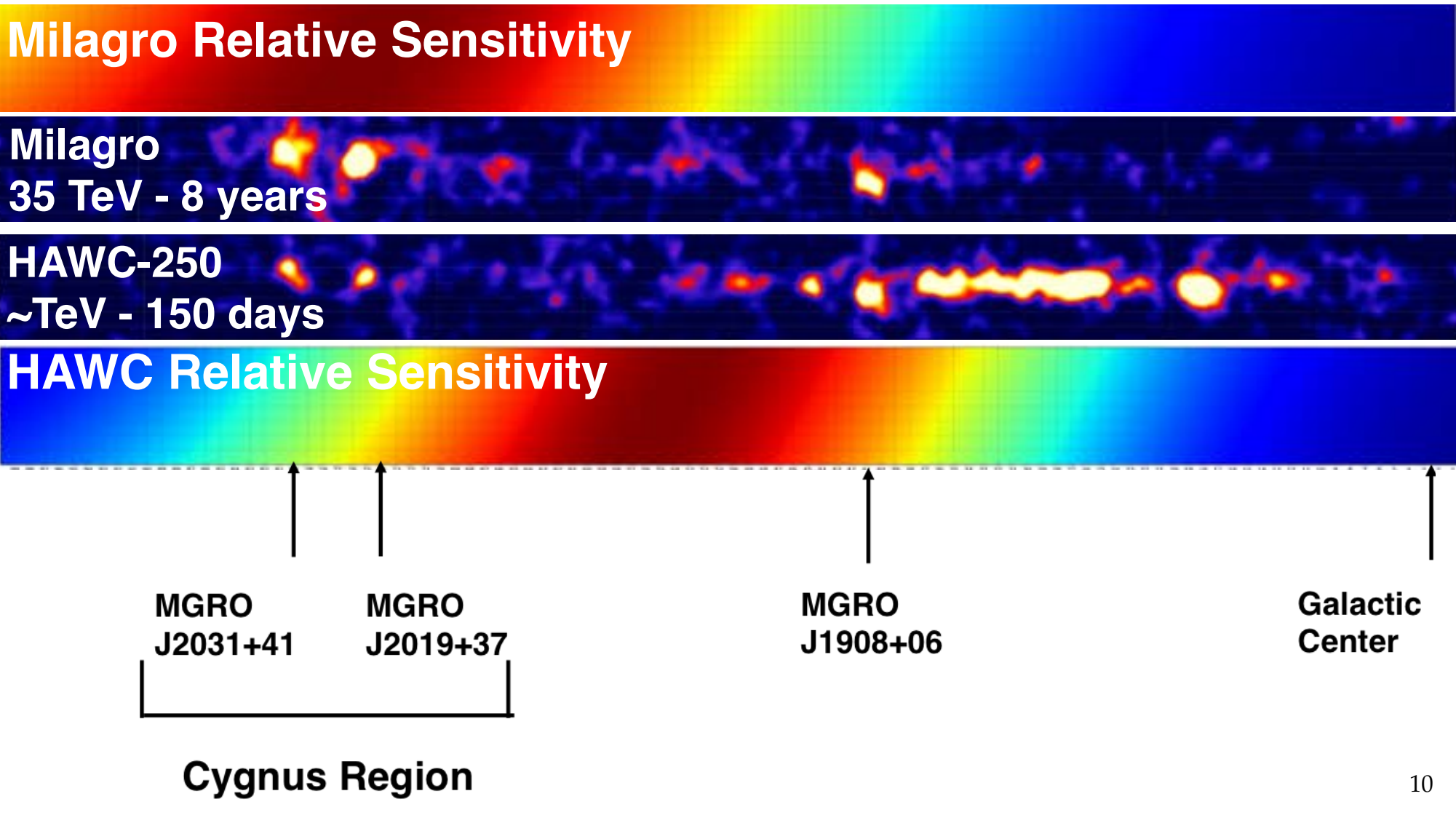
- The Crab





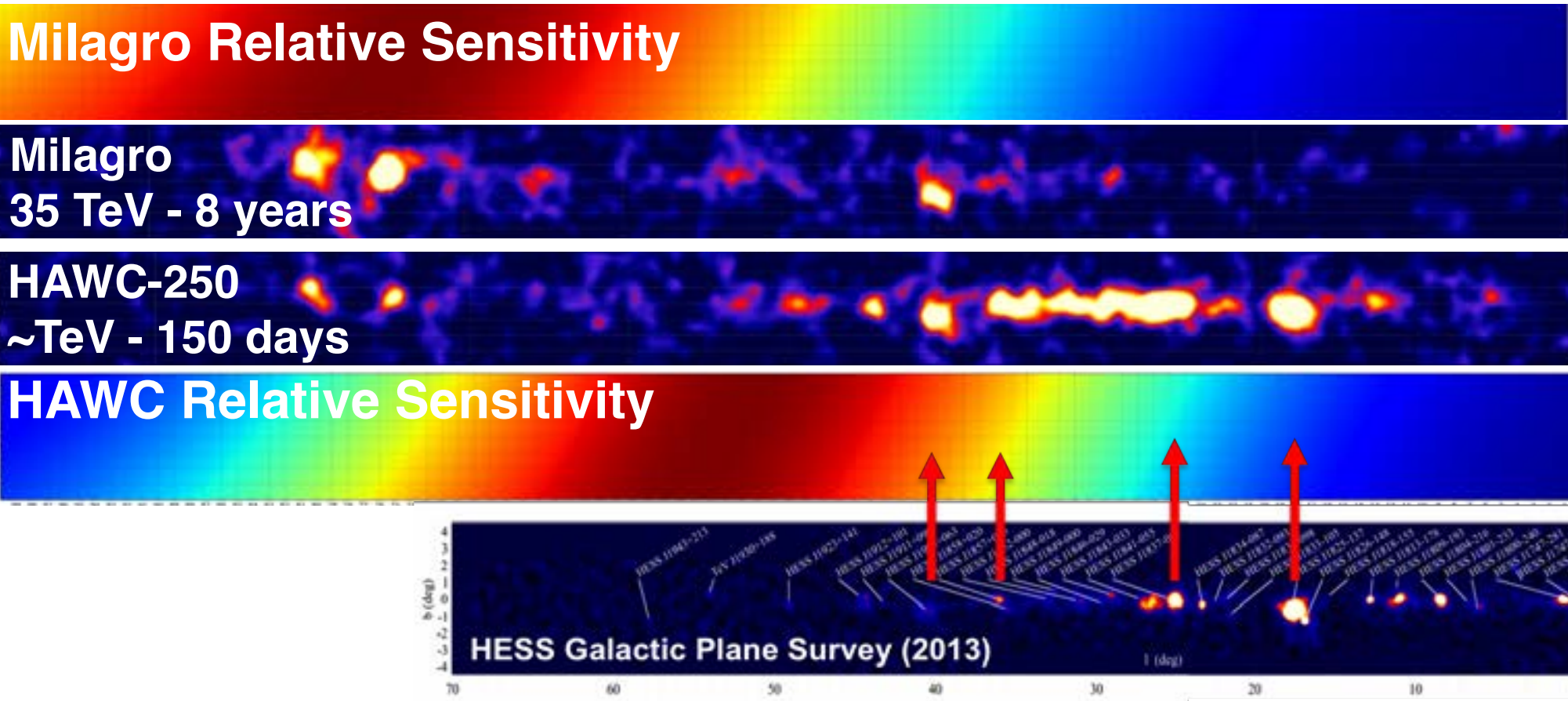
γ-RAYS

- Galactic plane



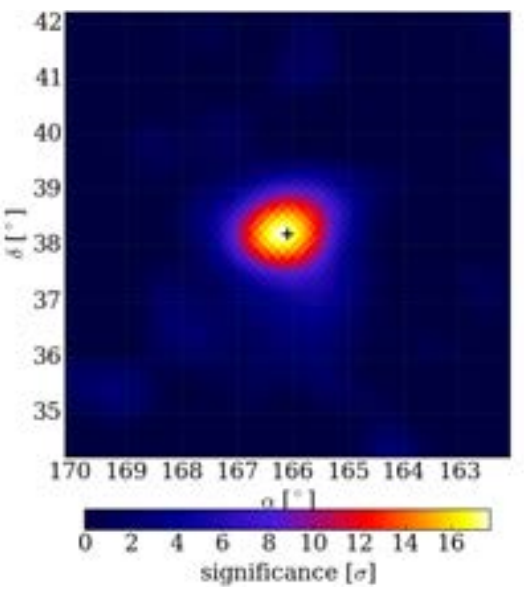
γ-RAYS

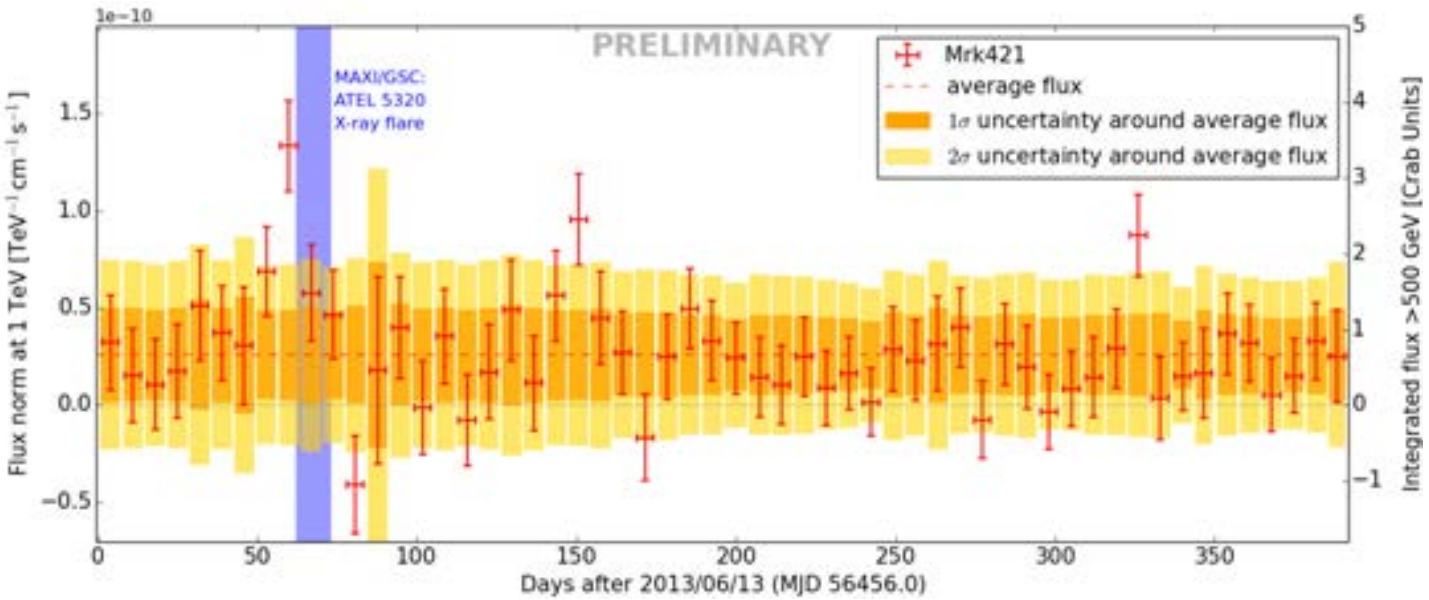
- Galactic plane



MONITORING TEV SOURCES

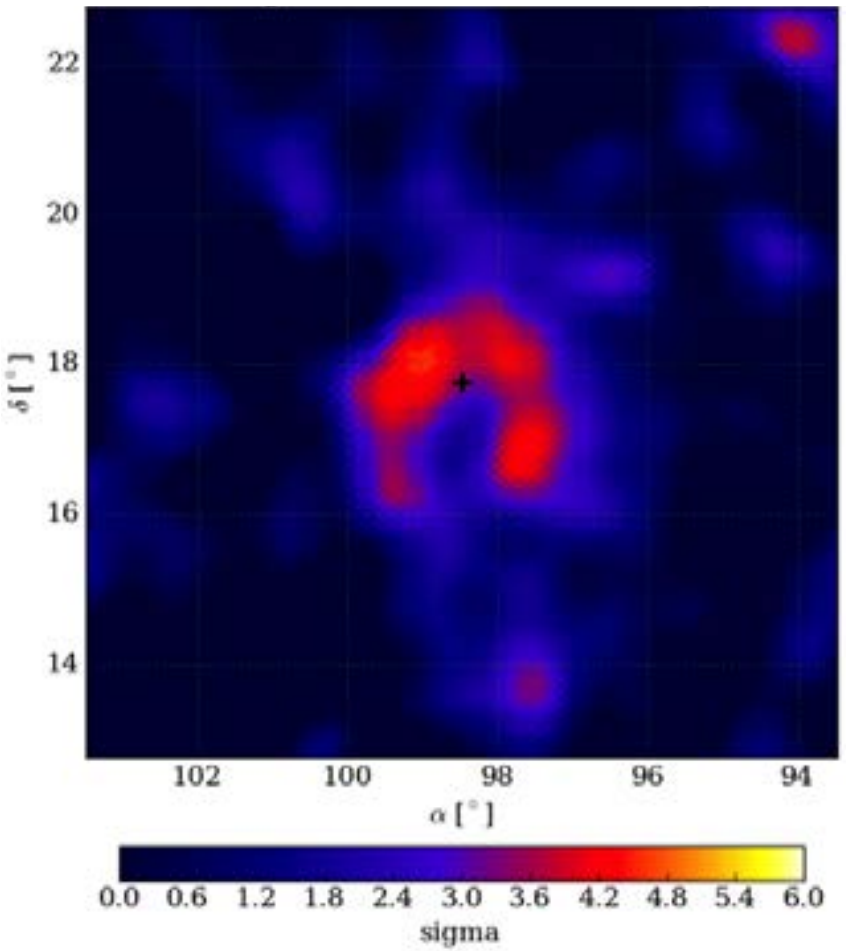
- Mrk 421

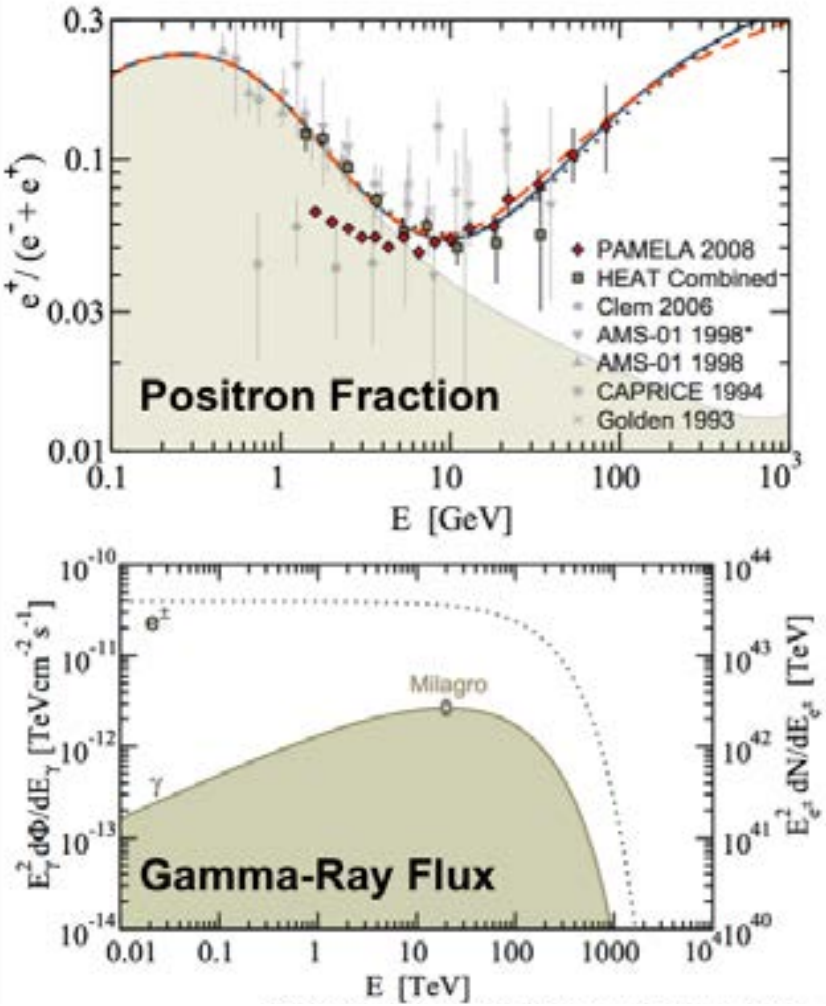




GEMINGA

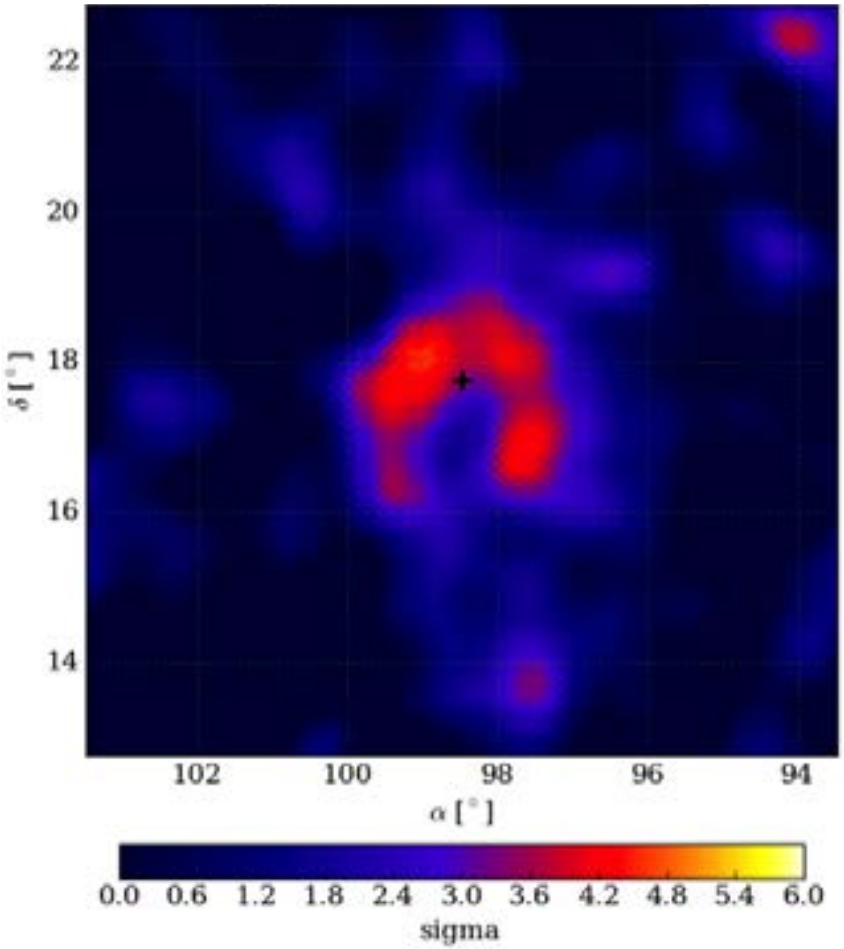
Contributor to the positron excess?



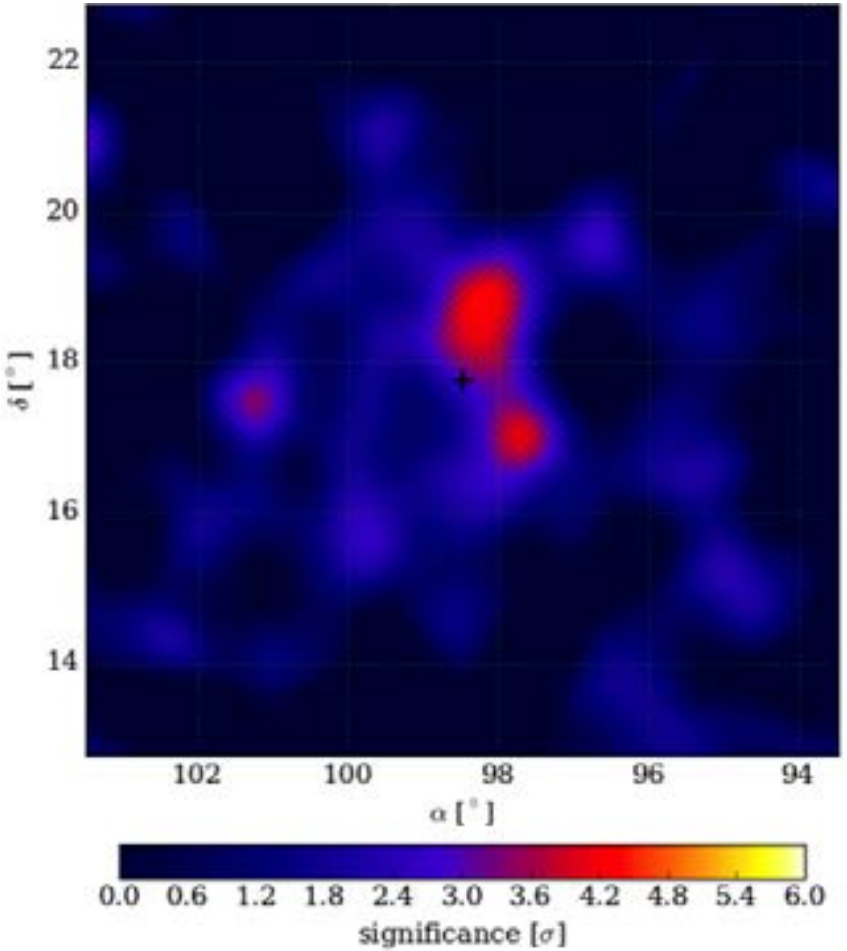


- Milagro data
- Yuksel, Kistler & Stanev, Phys. Rev. Lett. 103 (2009) 051101

GEMINGA

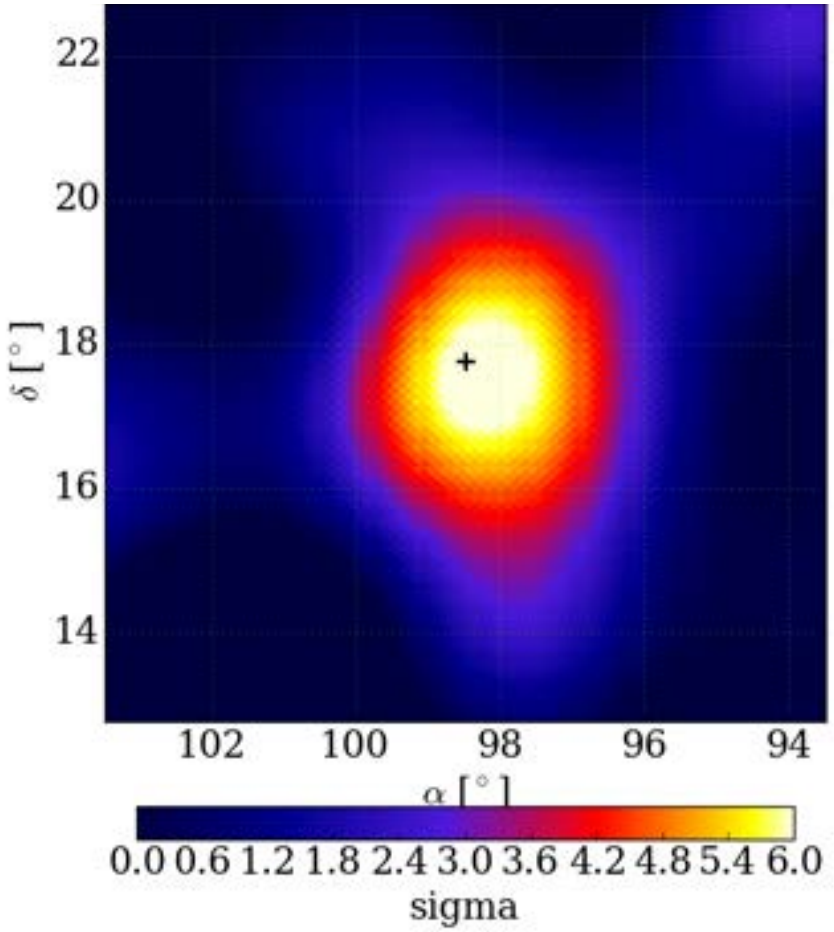


- Milagro data
  Point source analysis

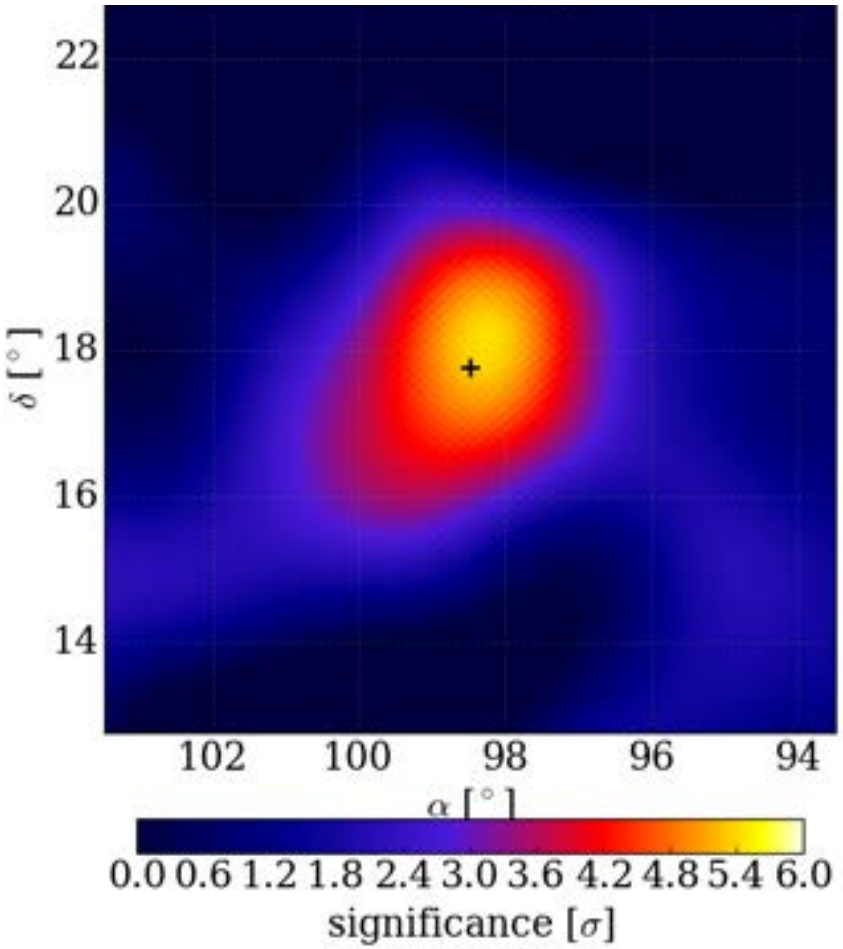


- HAWC data
  Point source analysis

GEMINGA



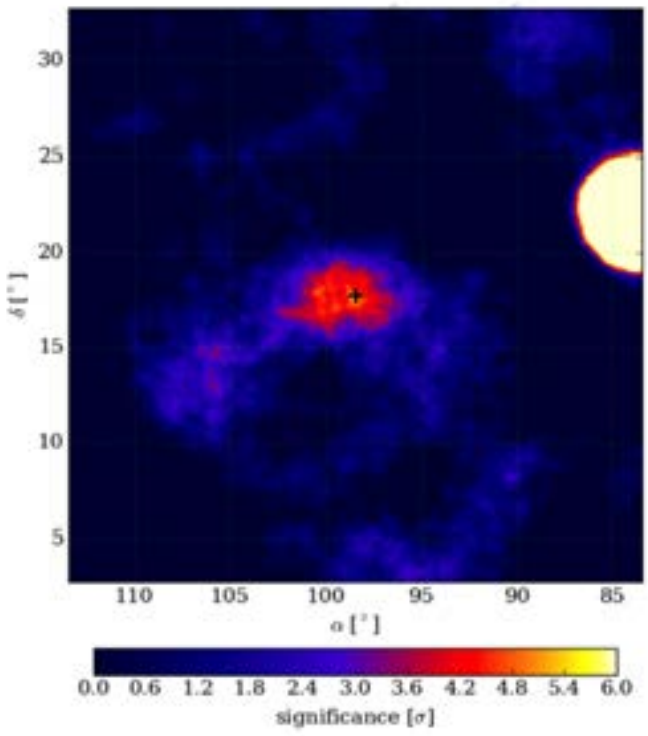
- Milagro data
  1 deg smearing

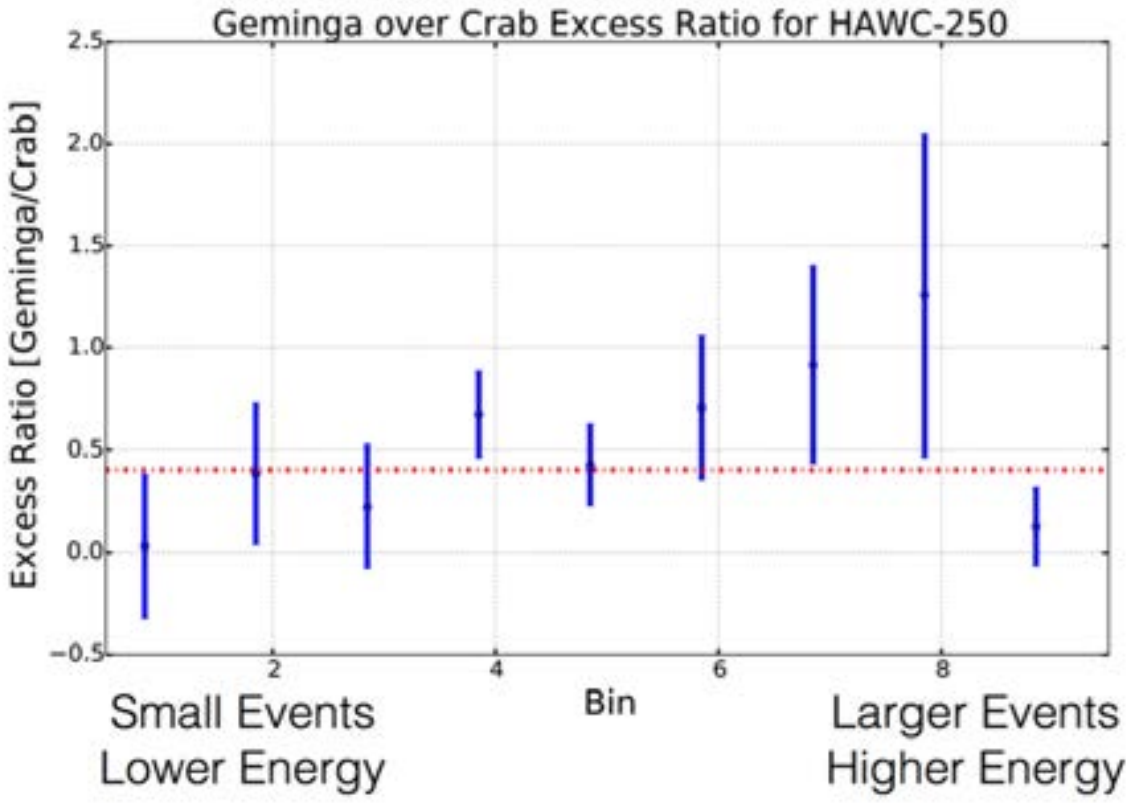


- HAWC data
  1 deg smearing

GEMINGA

VERY PRELIMINARY

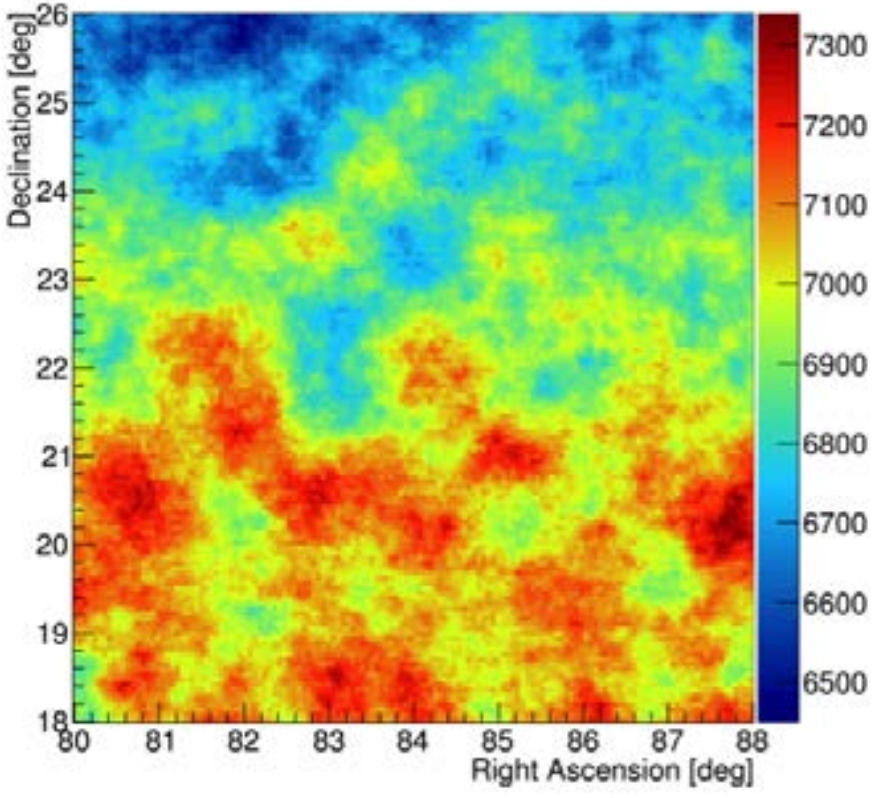




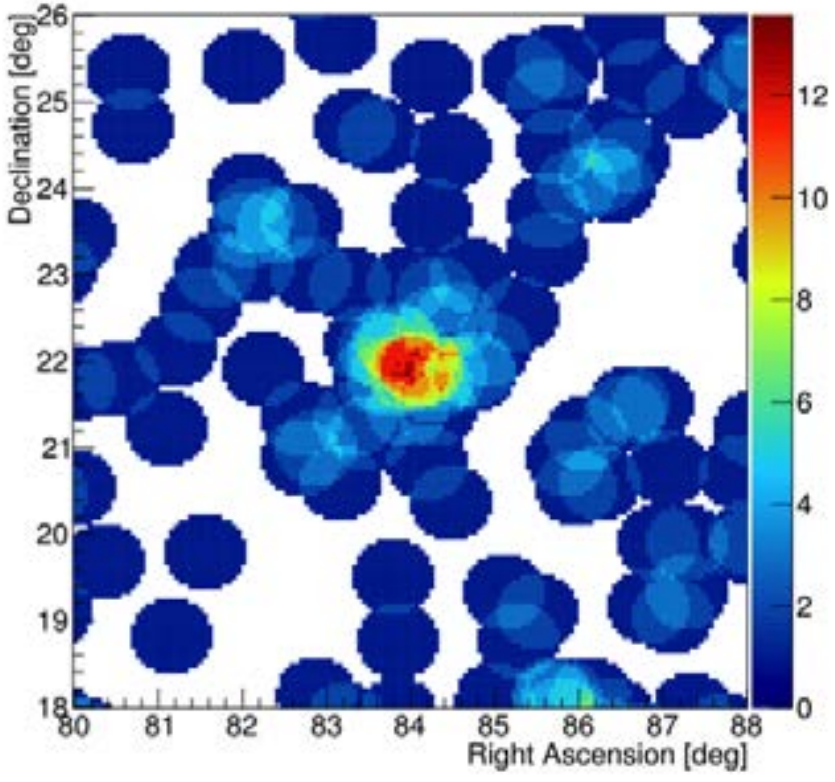
- Very extended
  3° top-hat smearing
- Harder than the Crab...

DIFFUSE EMISSION

- Photon-rich dataset above 10 TeV



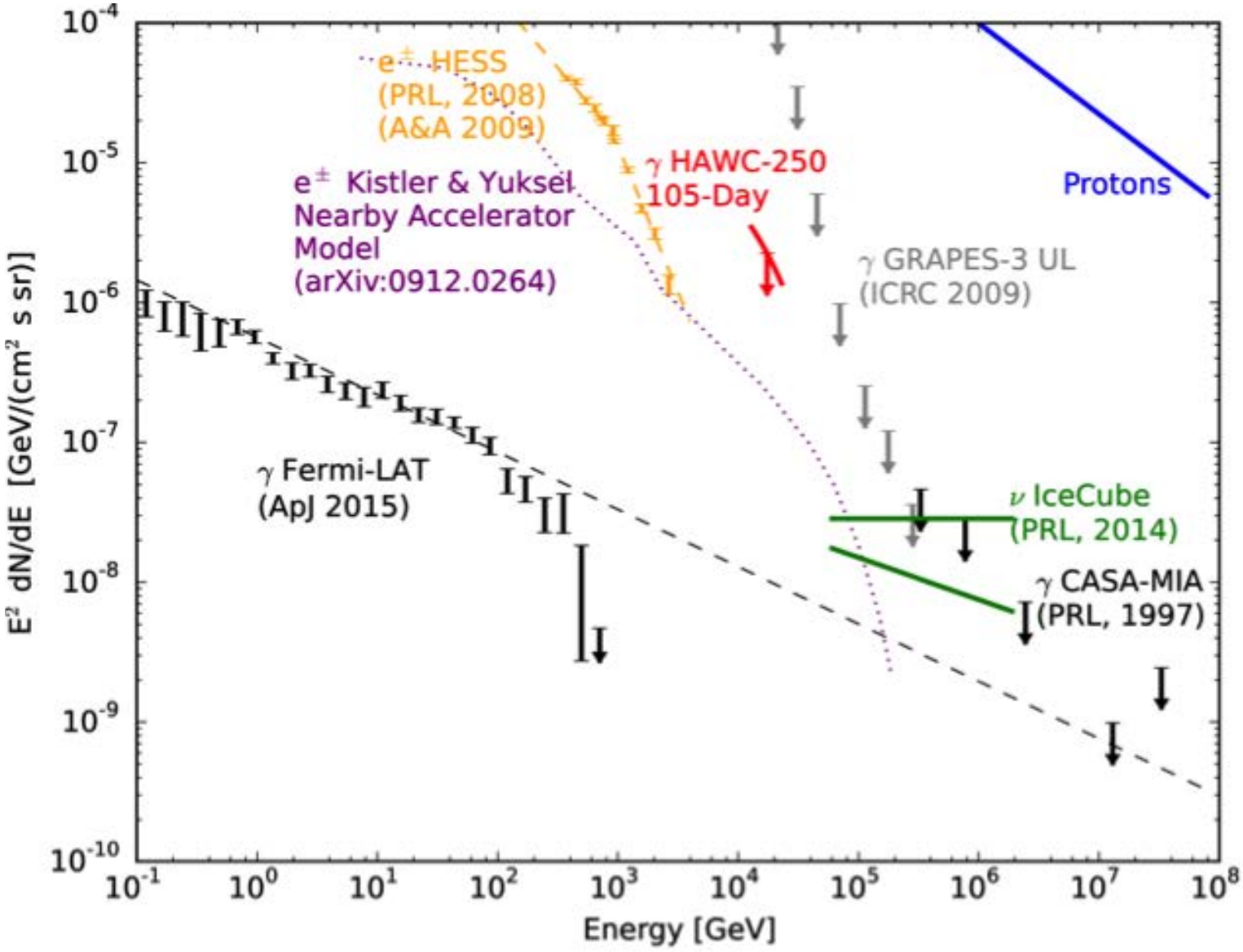
large events
$\Rightarrow >$ 85% of the array
median $E \sim 10$ TeV



strong photon-like requirements
$\Rightarrow$ 1 in every 10^4 events pass
25% efficiency for gammas

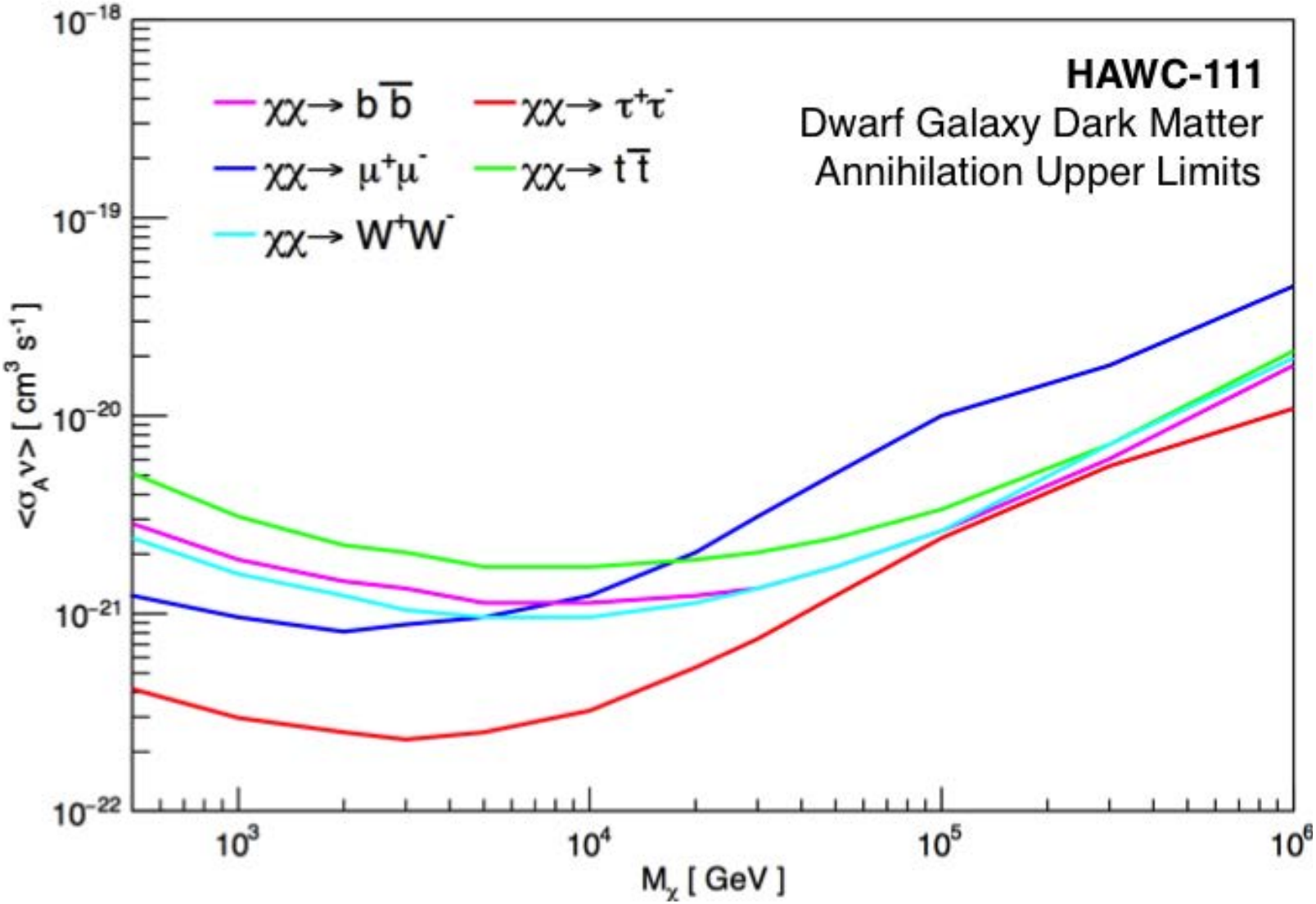
DIFFUSE EMISSION

- Preliminary limits

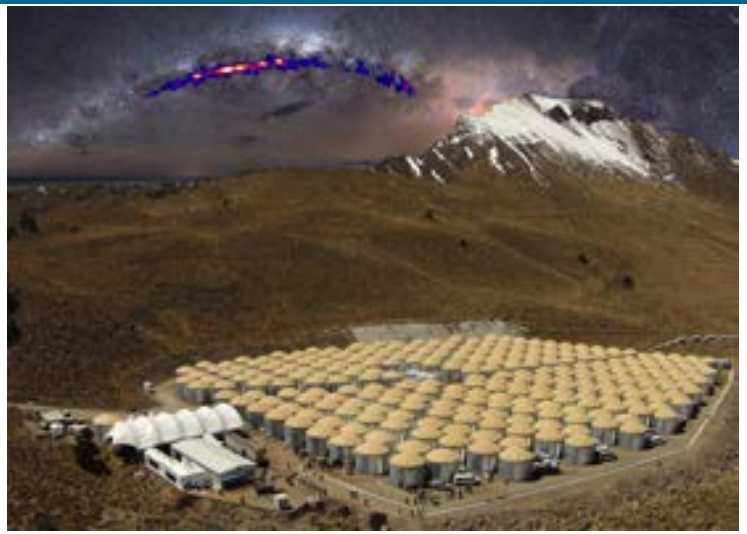


INDIRECT DETECTION OF DM

- Preliminary annihilation cross-section limits



CONCLUSION & OUTLOOK



- HAWC array completed
  Nearing design sensitivity

CONCLUSION & OUTLOOK

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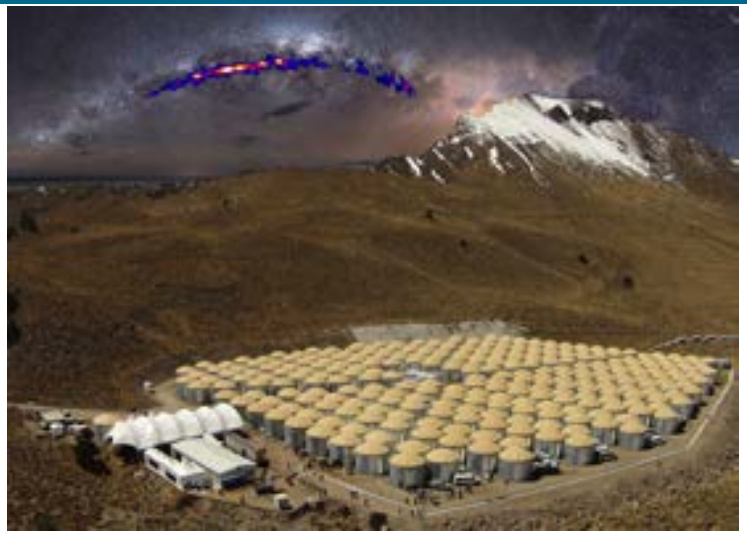
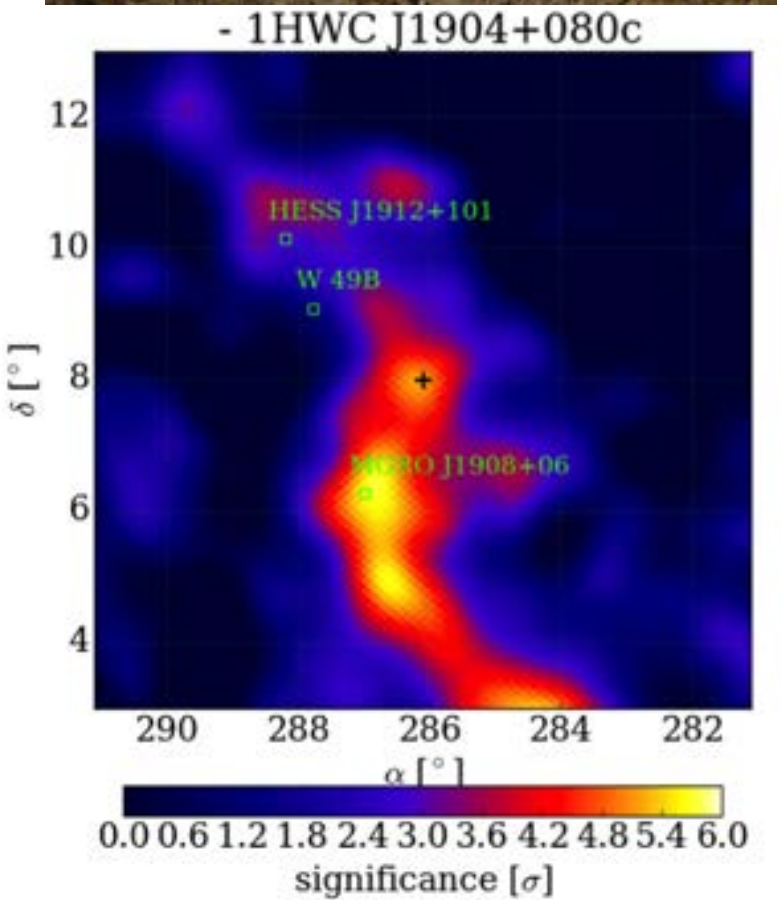
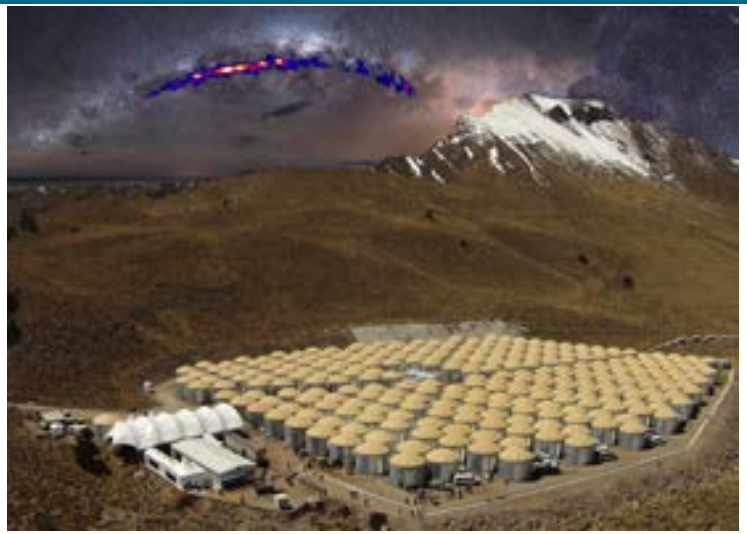
  Nearing design sensitivity

- Key science contributions
  γ-rays, CRs, solar physics,
  particle physics,
  multi-messenger studies, ...

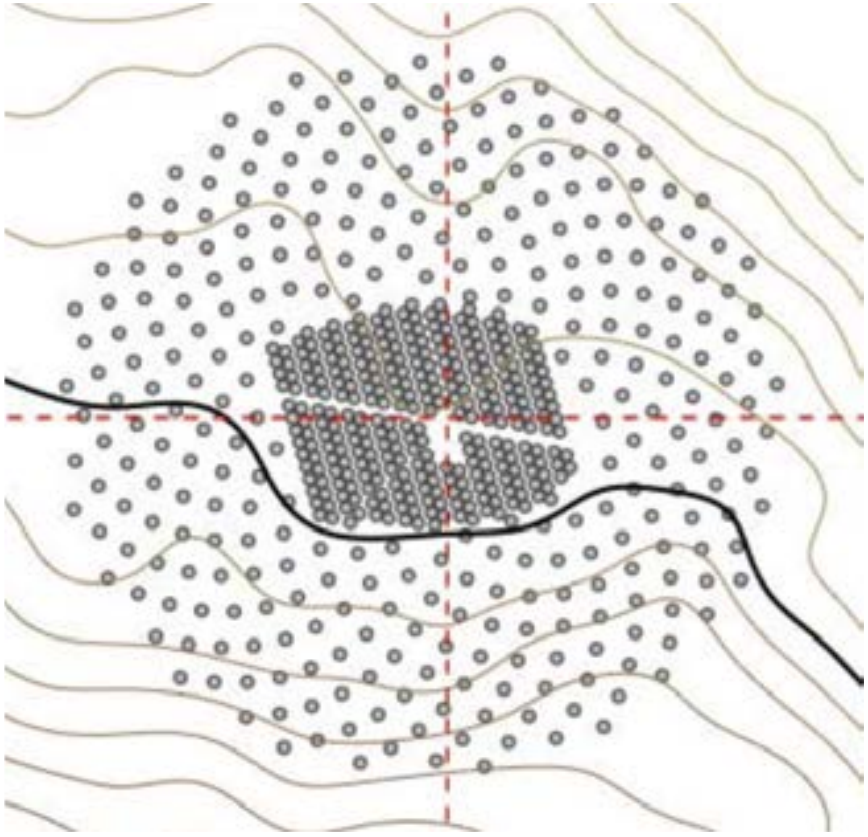


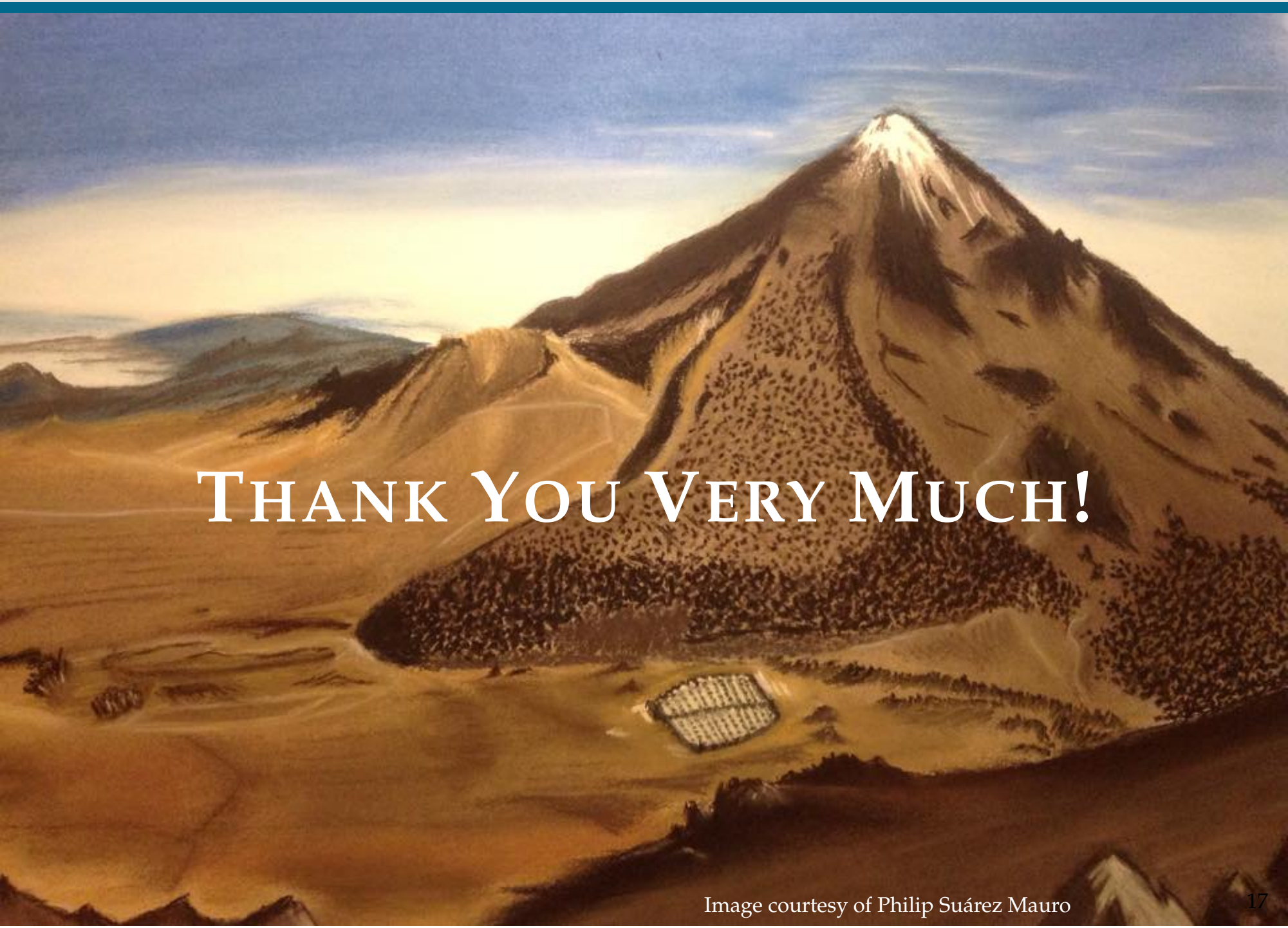


CONCLUSION & OUTLOOK



- HAWC array completed
  Nearing design sensitivity
- Key science contributions
  γ-rays, CRs, solar physics,
  particle physics,
  multi-messenger studies, ...
- Outrigger array funded
  Enhanced sensitivity above
  10 TeV





THANK YOU VERY MUCH!

Image courtesy of Philip Suárez Mauro