



Constraining the TeV Gamma-Ray Sky with HAWC

IceCube Particle Astrophysics Symposium

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Los Alamos National Laboratory
9 May 2017

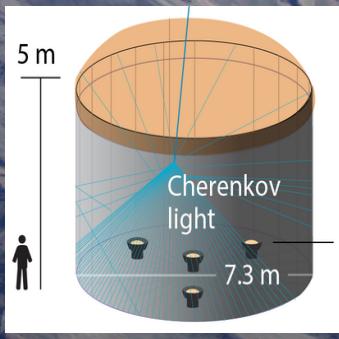


The High Altitude Water Cherenkov Observatory



Citlaltepetl
Pico de Orizaba
5160m a.s.l.

- **22,000 m² air shower array**
- **300 Water Cherenkov detectors (WCD)**
- **200,000 liters of purified water per WCD**
- **4 sensors (photo-multiplier tubes) per WCD**
- **Completed March 2015**



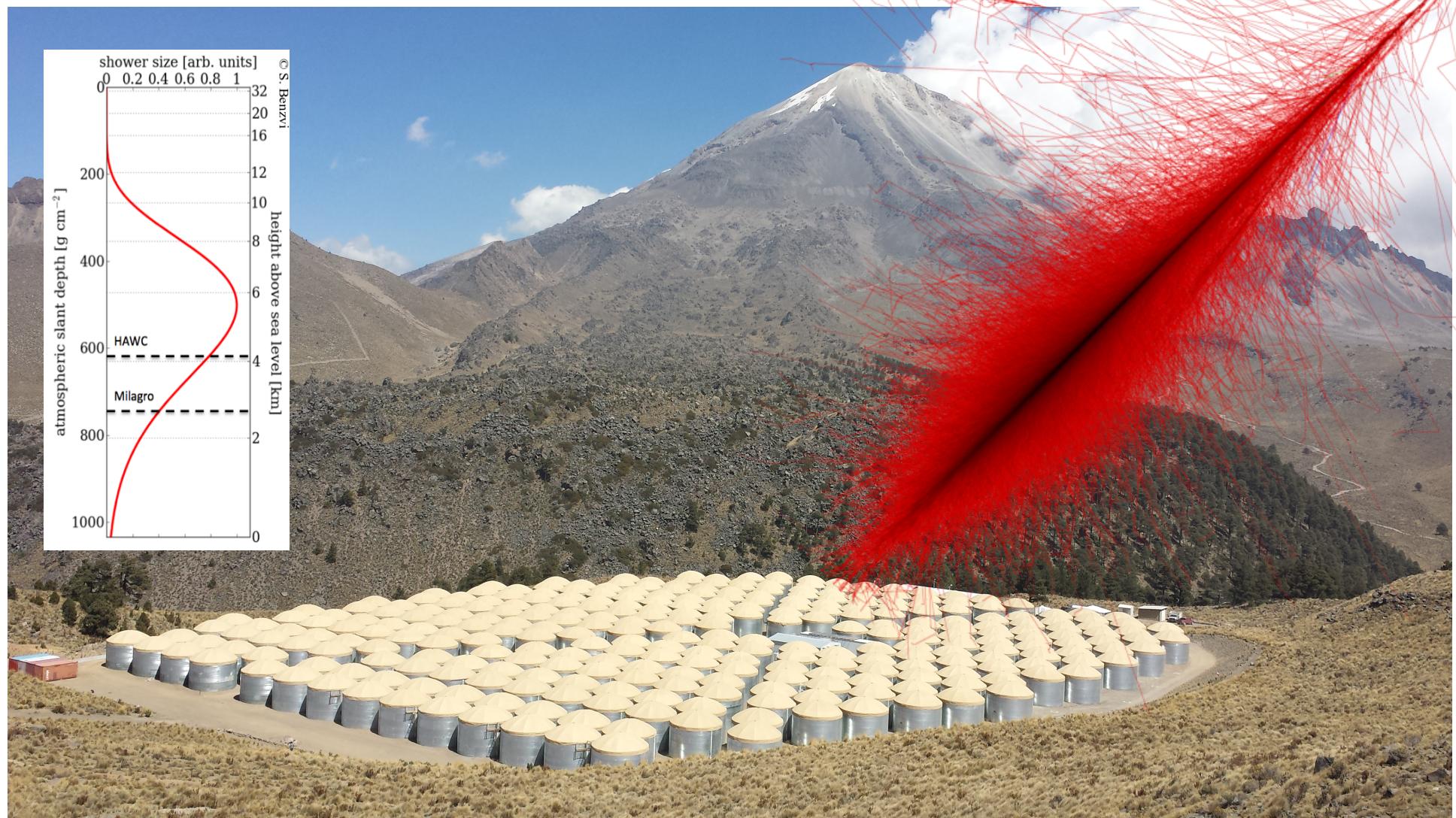
HAWC
4100 m a.s.l.

Large
Millimeter
Telescope

Tlaltepetl
Sierra Negra
4582m a.s.l.



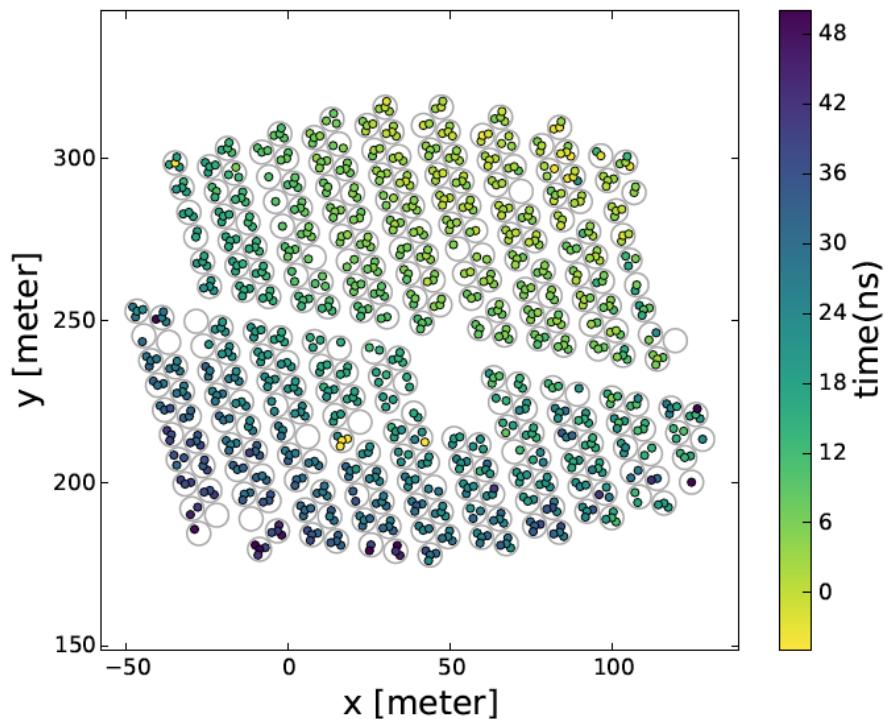
Extensive Air Shower Arrays



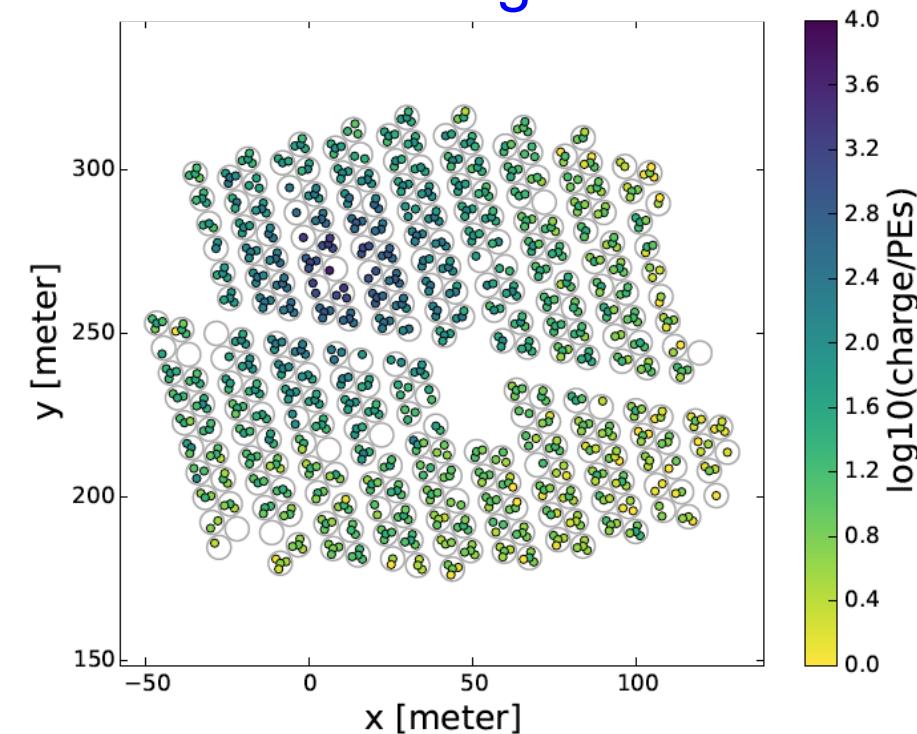
Shower Reconstruction

- Measure: time and light level in each of our detectors
- Estimate: direction, location, energy, and background rejection

Measured Time



Measured Light Level

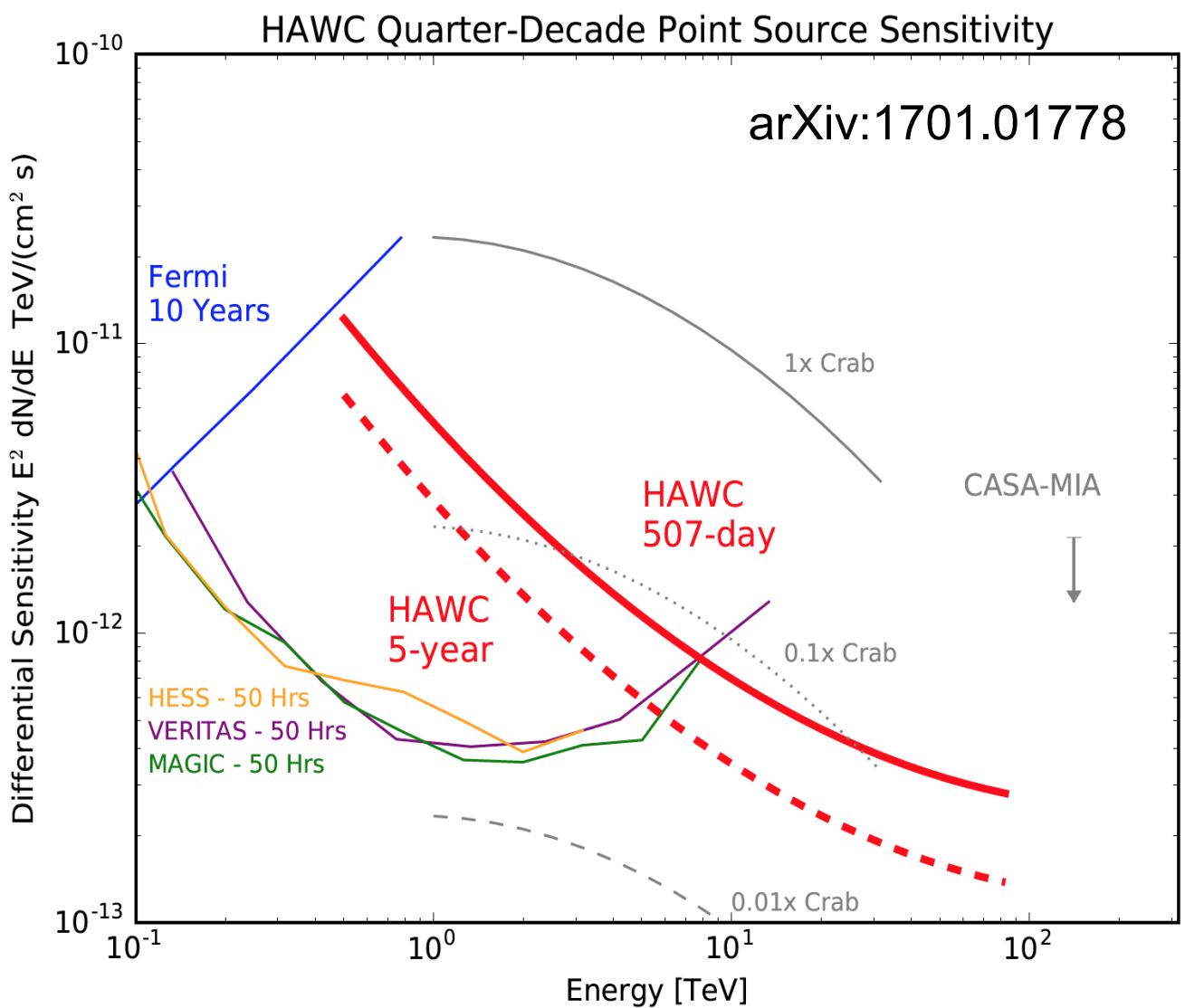




HAWC is the most sensitive observatory to the highest energy gamma rays



- HAWC has ~ 2 sr field of view and observes $\sim 2/3$ of the sky each day
- Long integration times give sensitivity to the highest energy gamma rays
- Angular resolution and field of view are similar to Fermi LAT

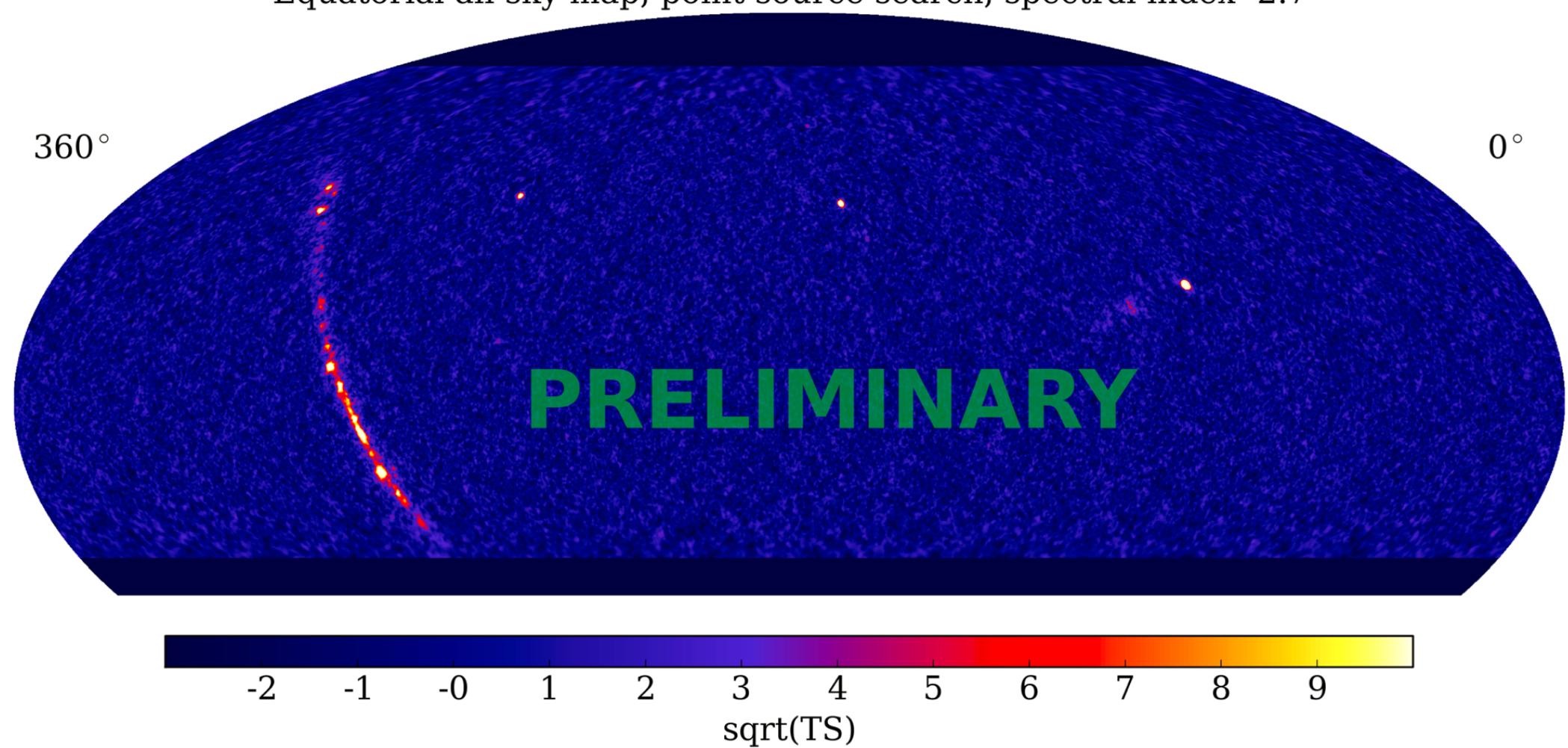




HAWC observes 2/3 of the sky every day



Equatorial all sky map, point source search, spectral index -2.7

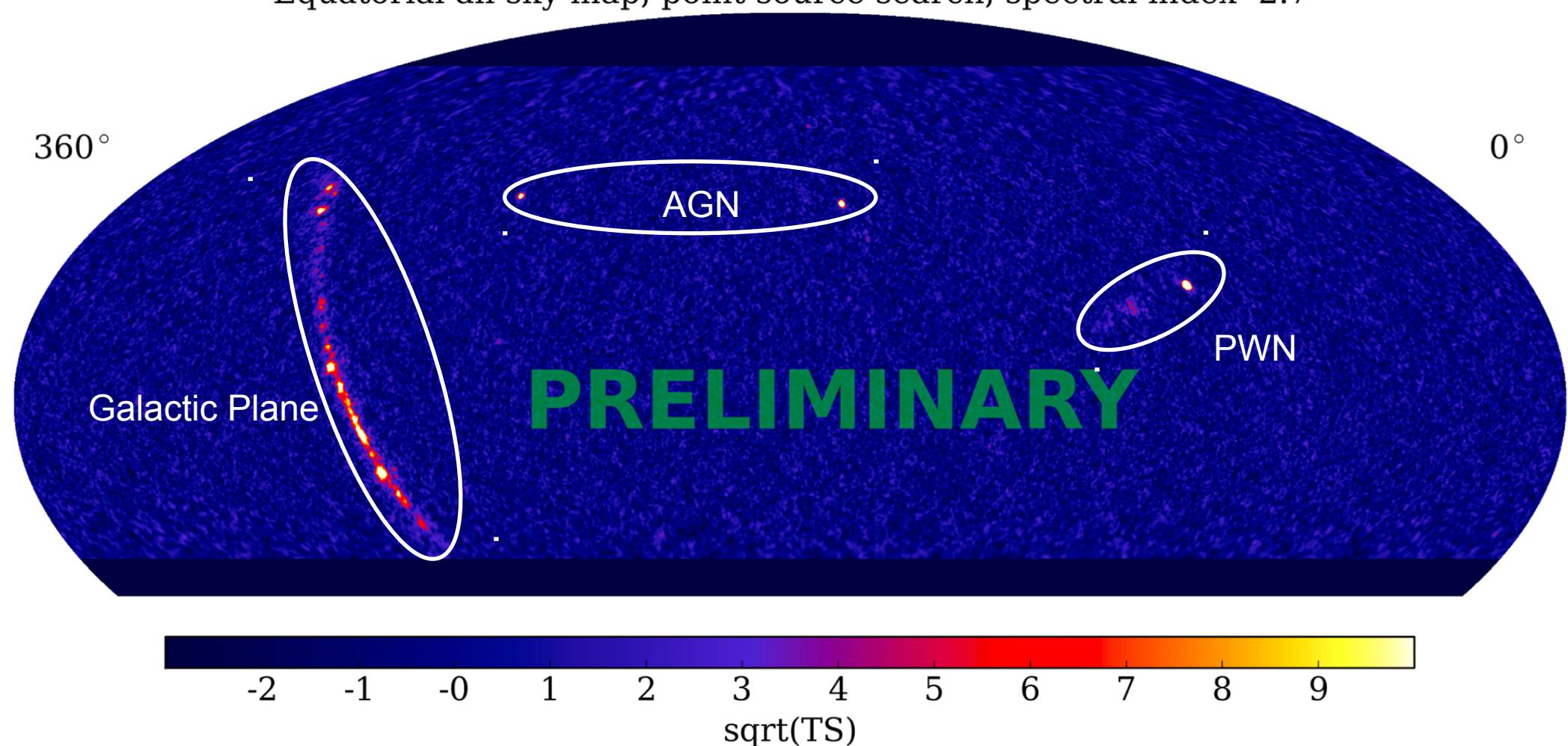




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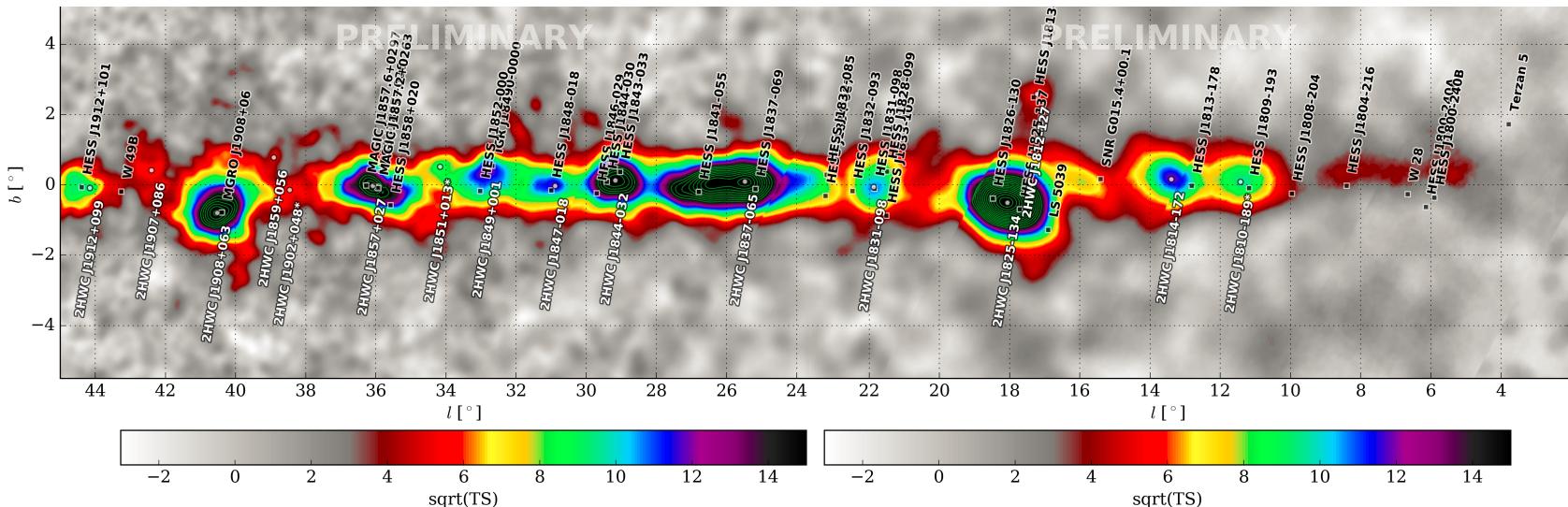
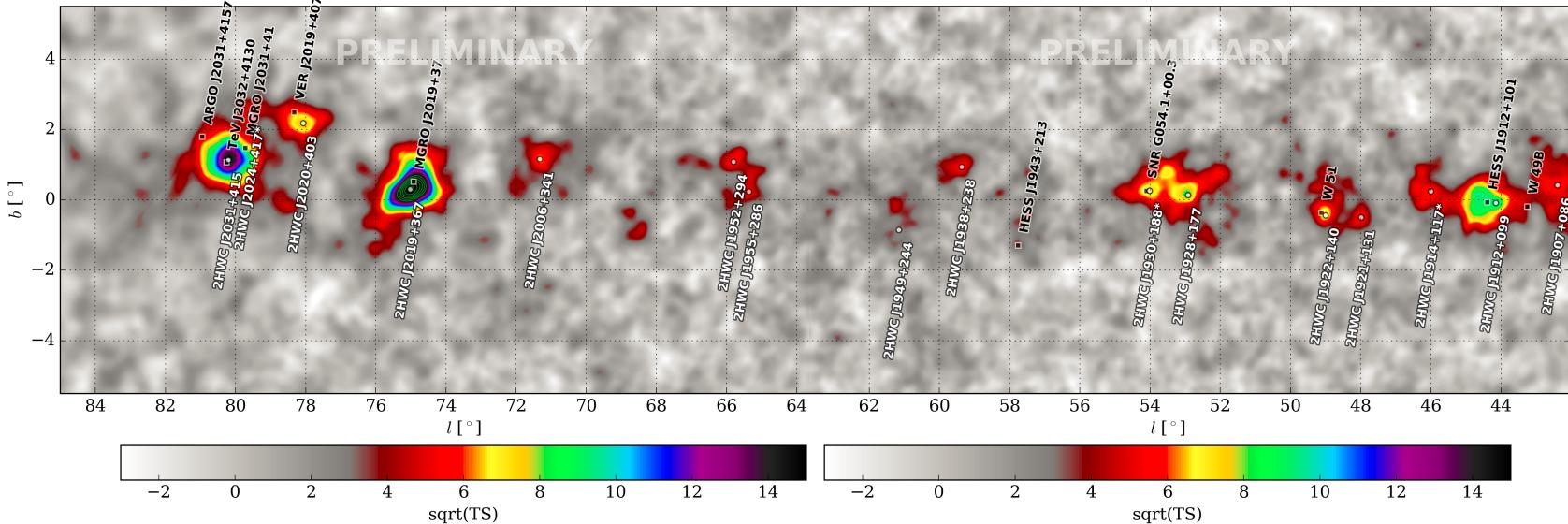
Equatorial all sky map, point source search, spectral index -2.7





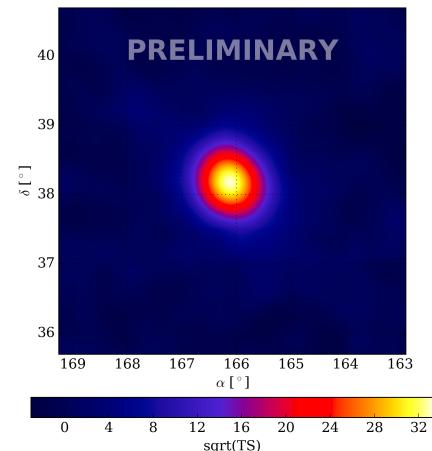
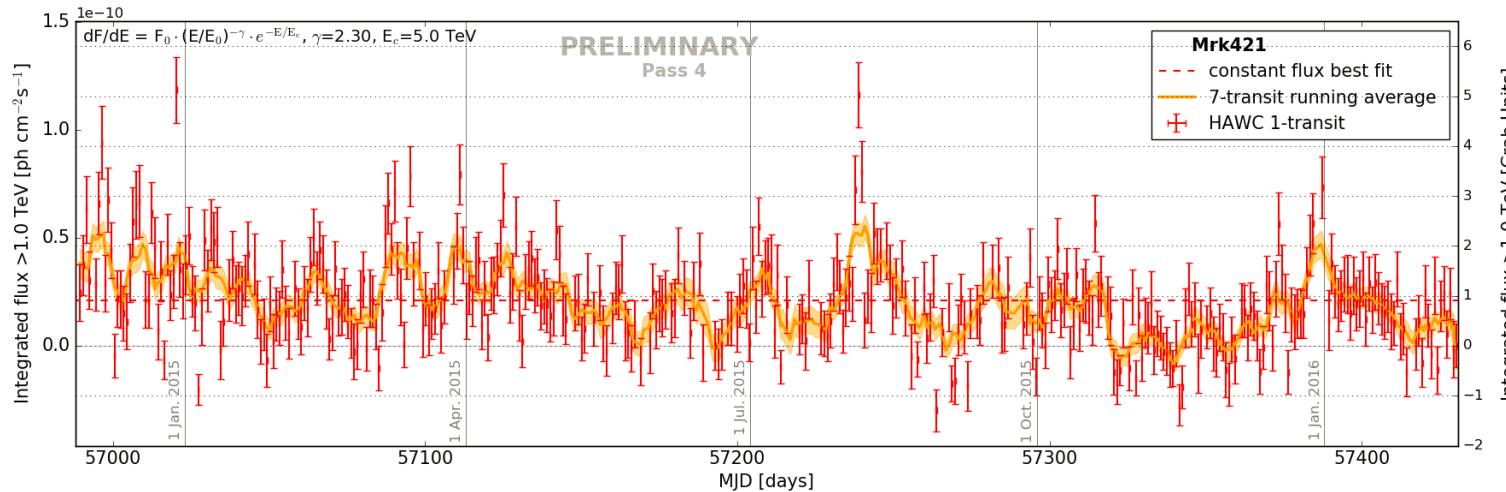
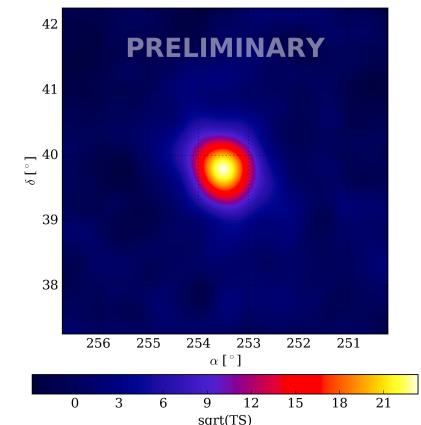
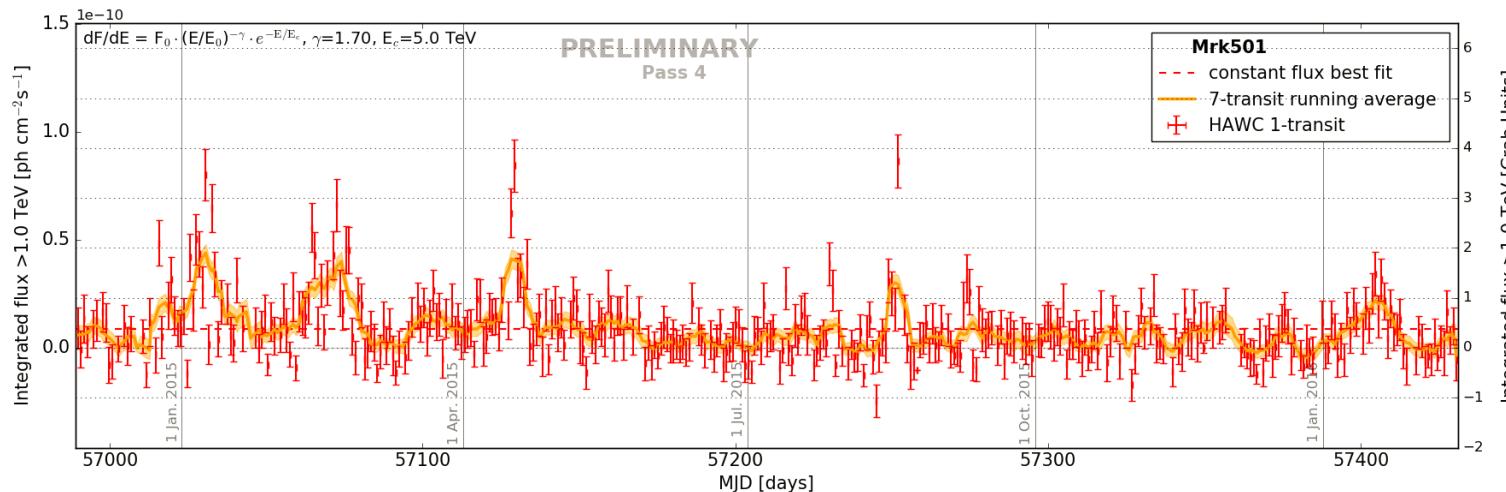
The HAWC Galactic Plane Survey

 Los Alamos
NATIONAL LABORATORY
EST. 1943



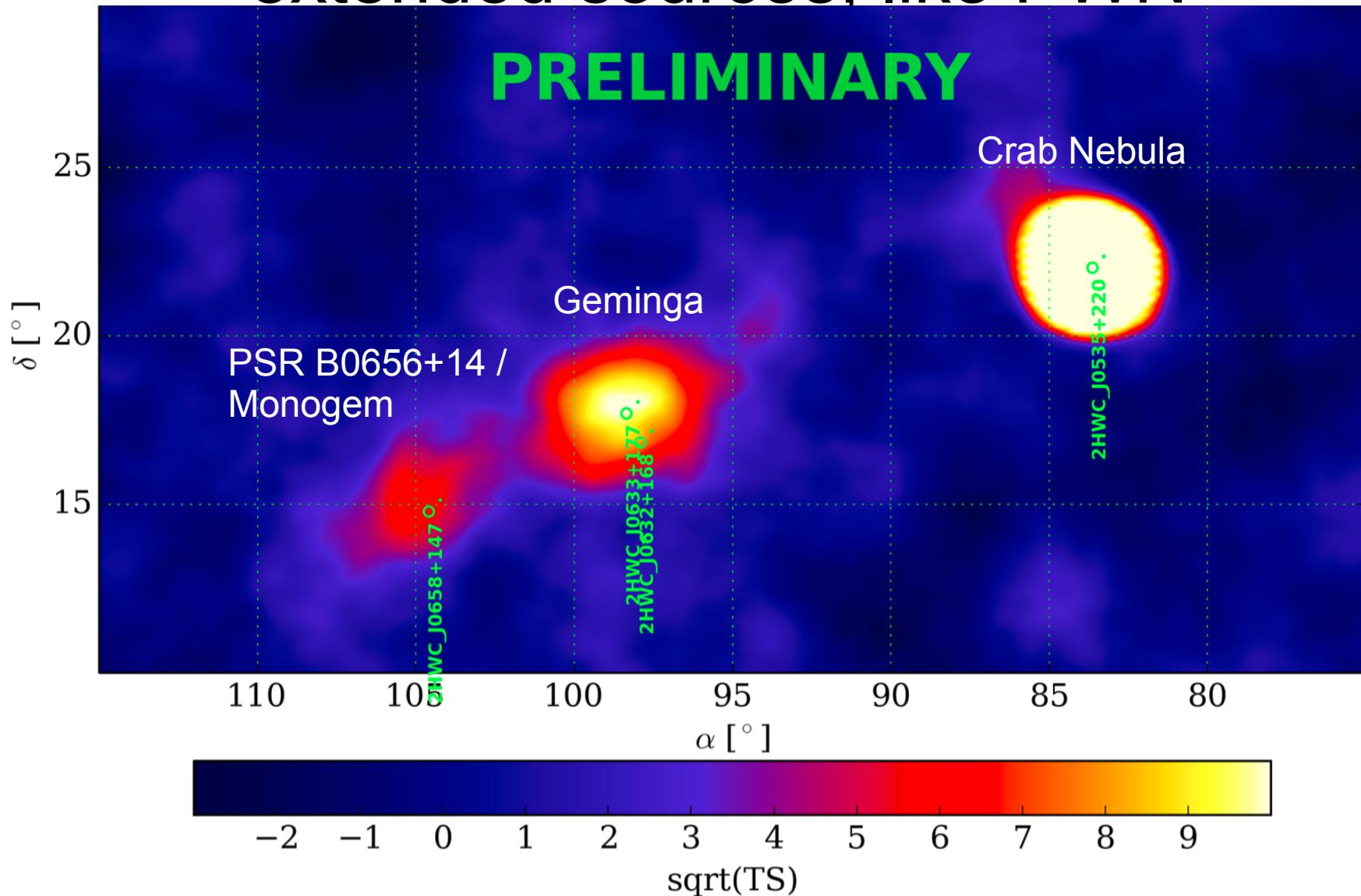


HAWC's >95% uptime enables unbiased monitoring of variable sources

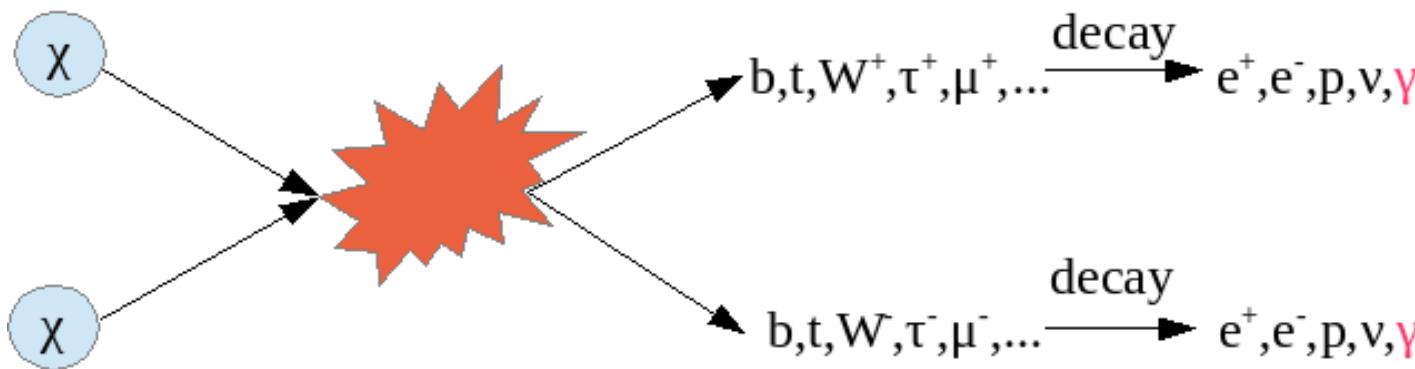




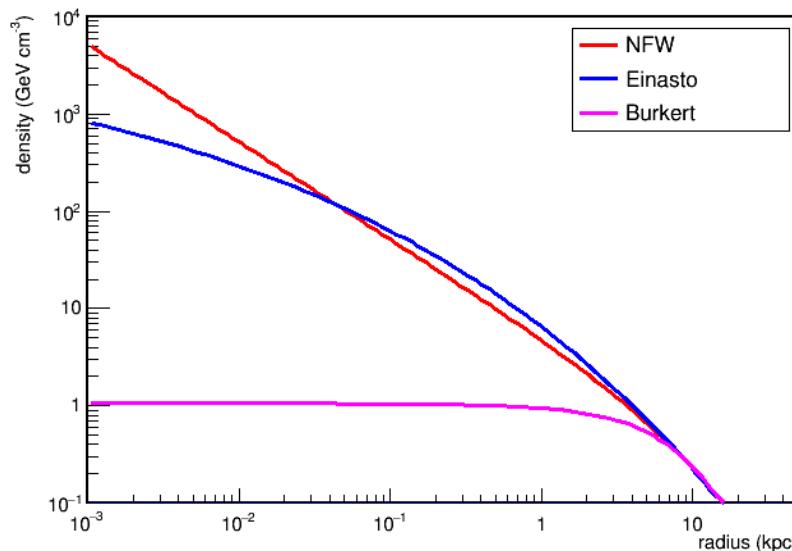
HAWC's wide field-of-view enables observations extended sources, like PWN



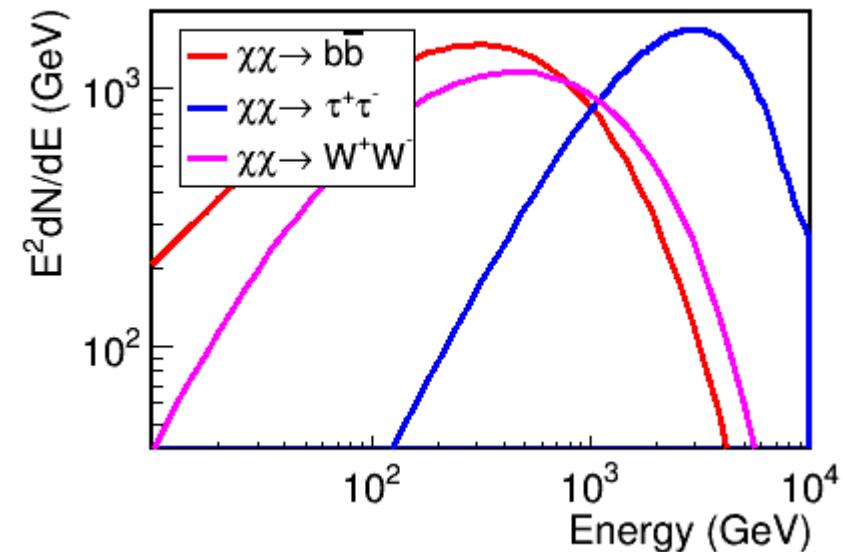
Dark Matter Annihilation and Decay



$$Flux_{ann} \propto \frac{\langle \sigma v \rangle}{M_\chi^2} \frac{dN_\gamma}{dE} \int_{l.o.s.} dx \rho^2(r)$$

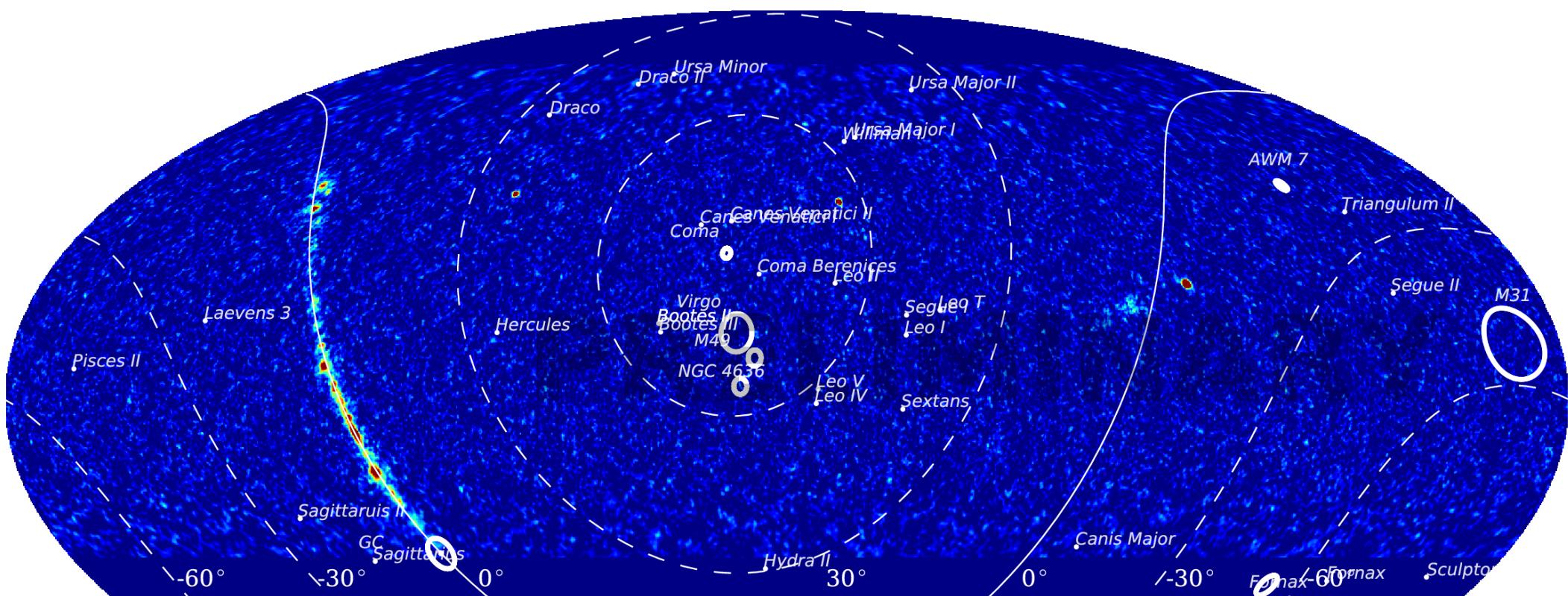


$$Flux_{decay} \propto \frac{1}{\tau} \frac{1}{M_\chi} \frac{dN_\gamma}{dE} \int_{l.o.s.} dx \rho(r)$$

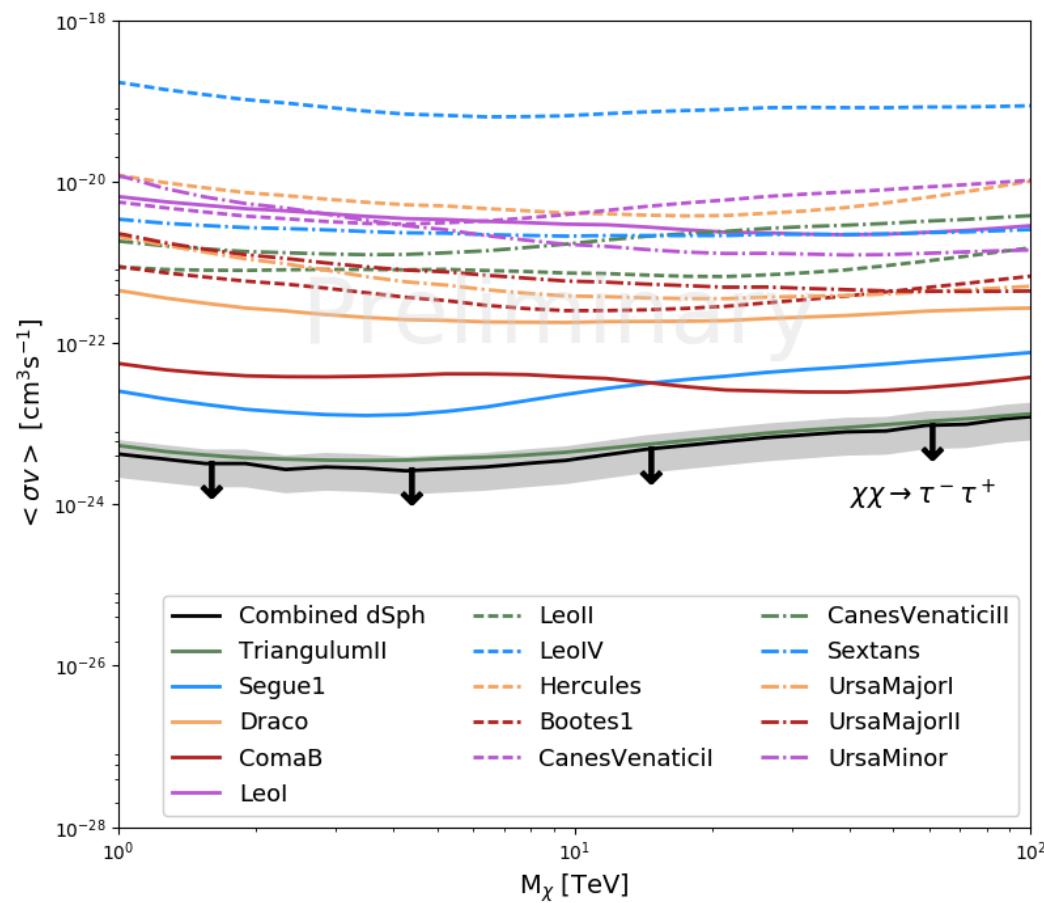
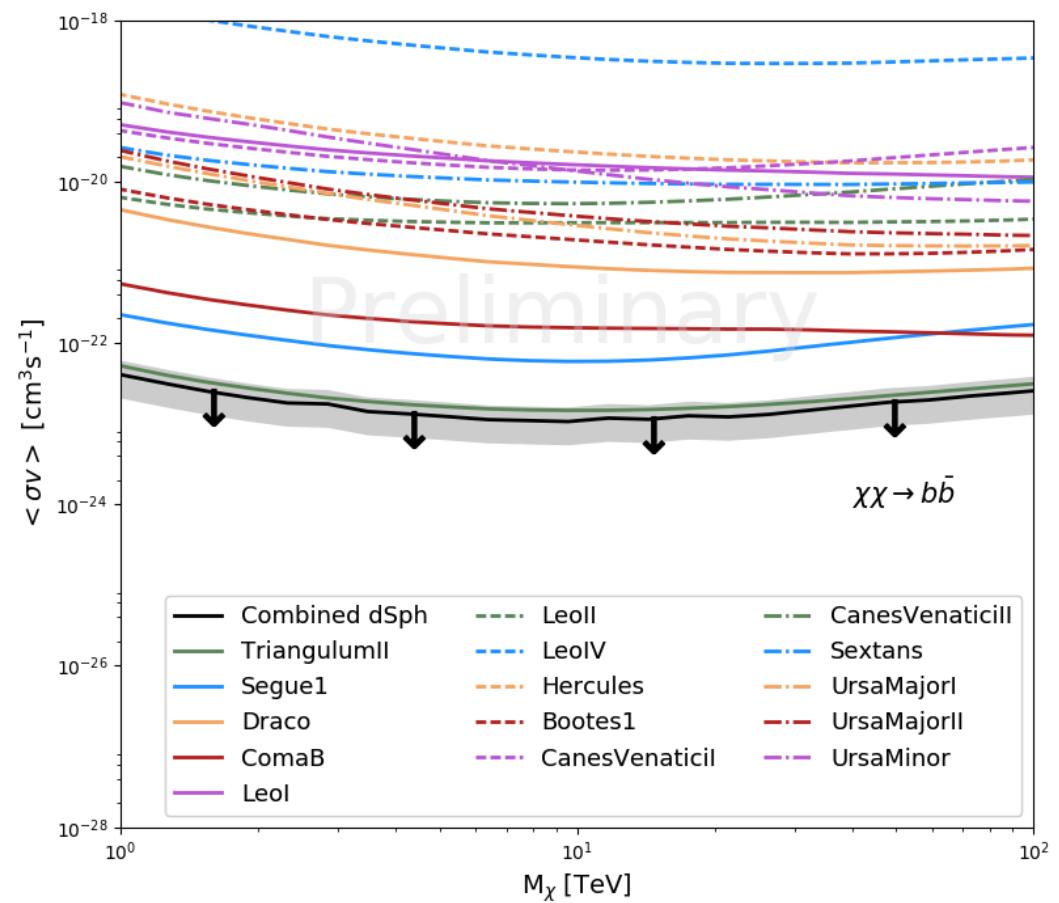




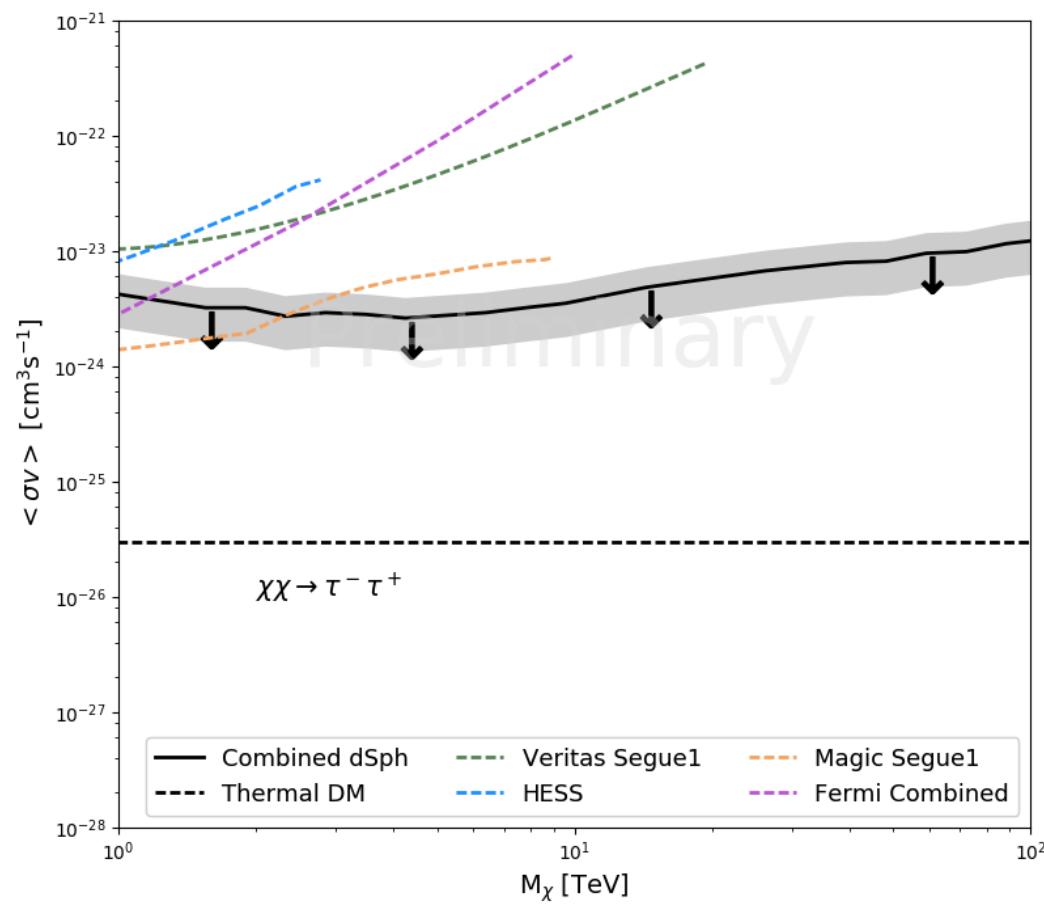
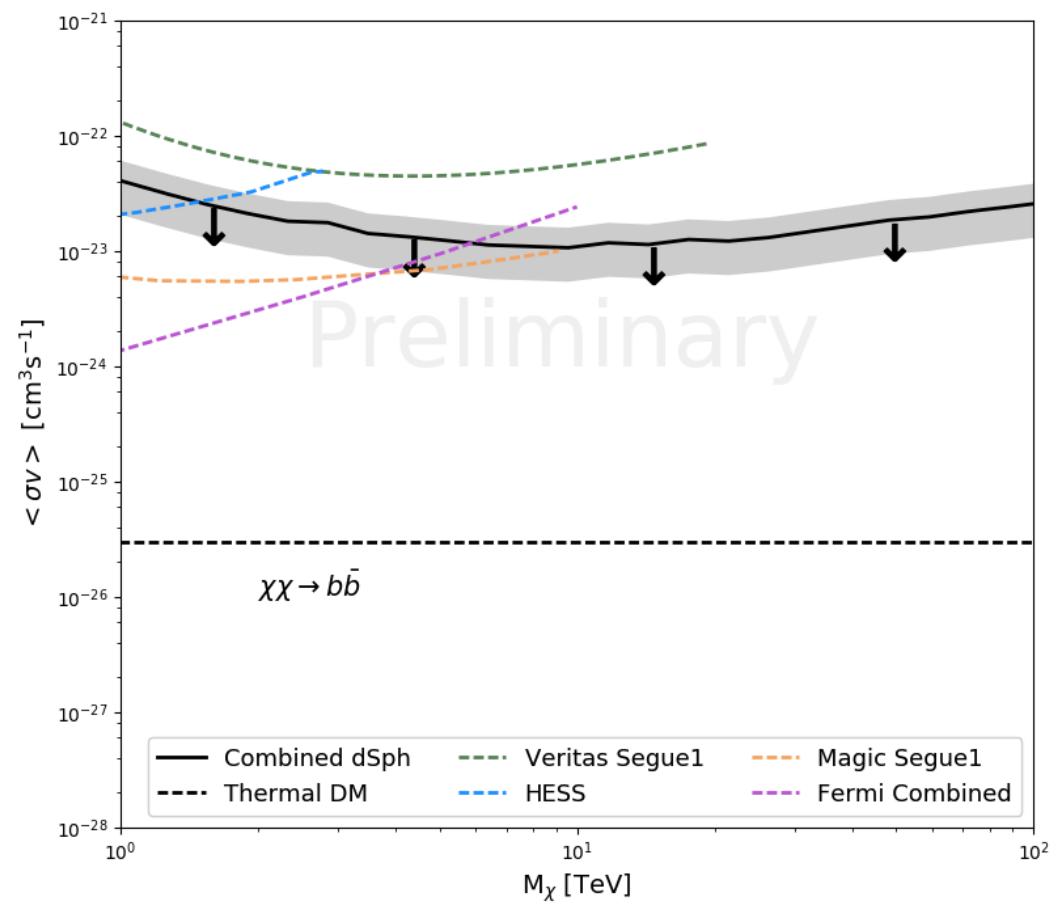
Where HAWC is Looking for WIMPs



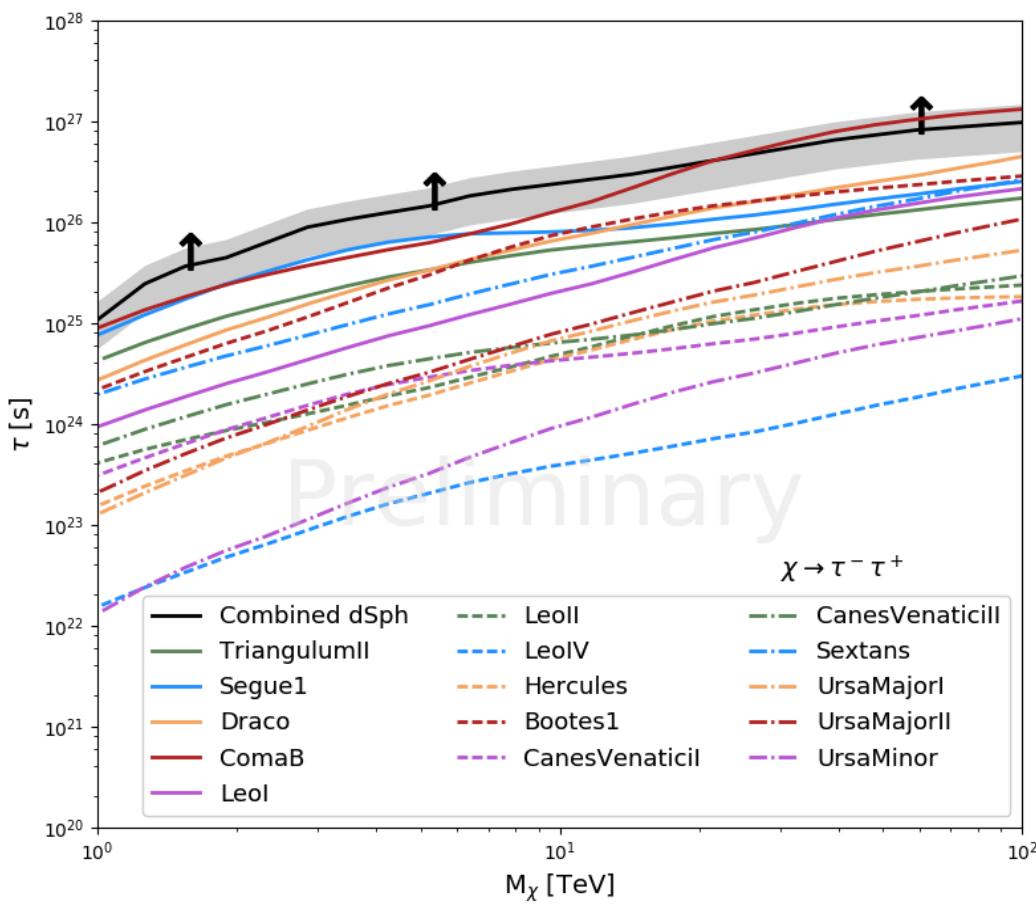
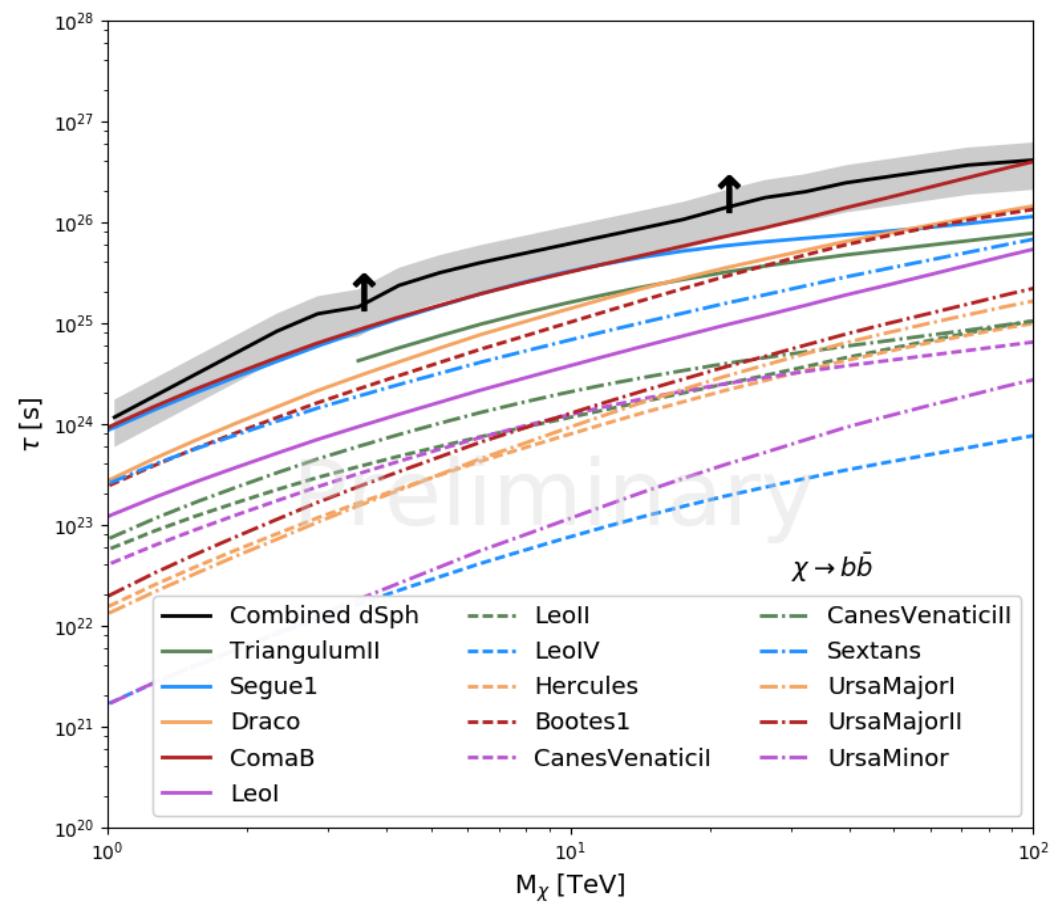
WIMP Annihilation Limits from Dwarf Galaxies



WIMP Annihilation Limits from Dwarf Galaxies

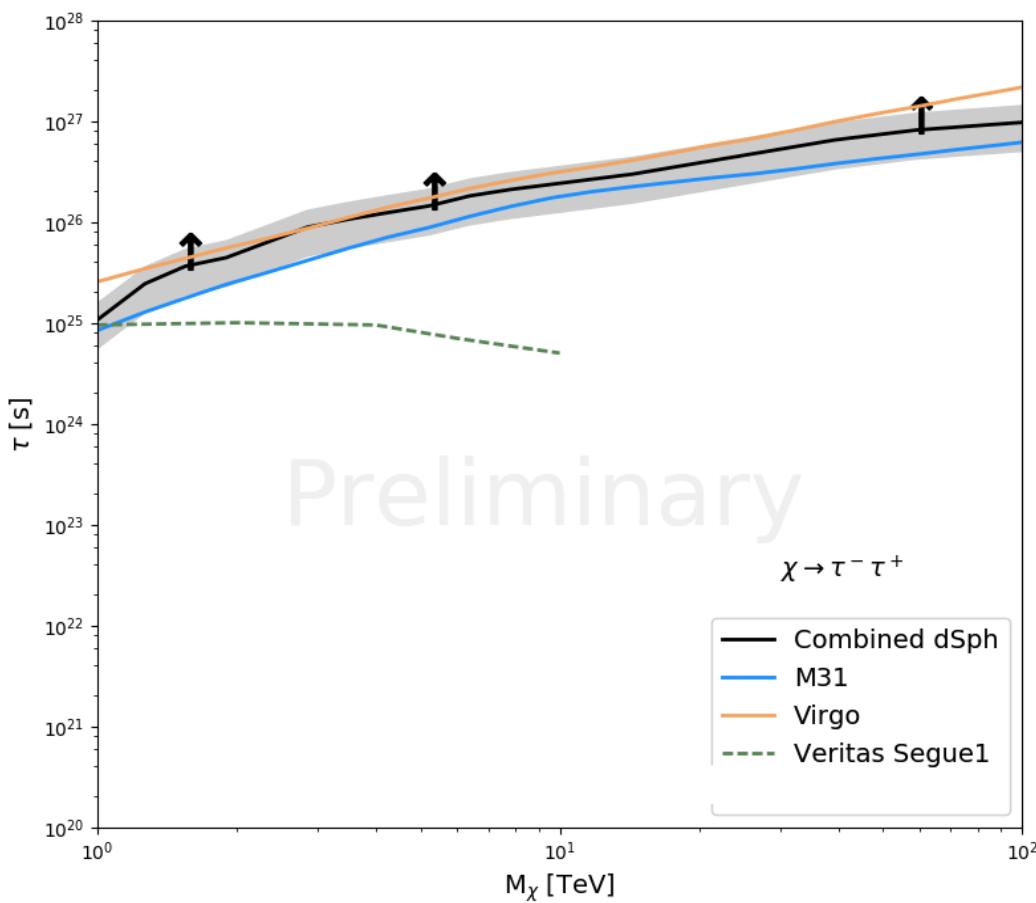
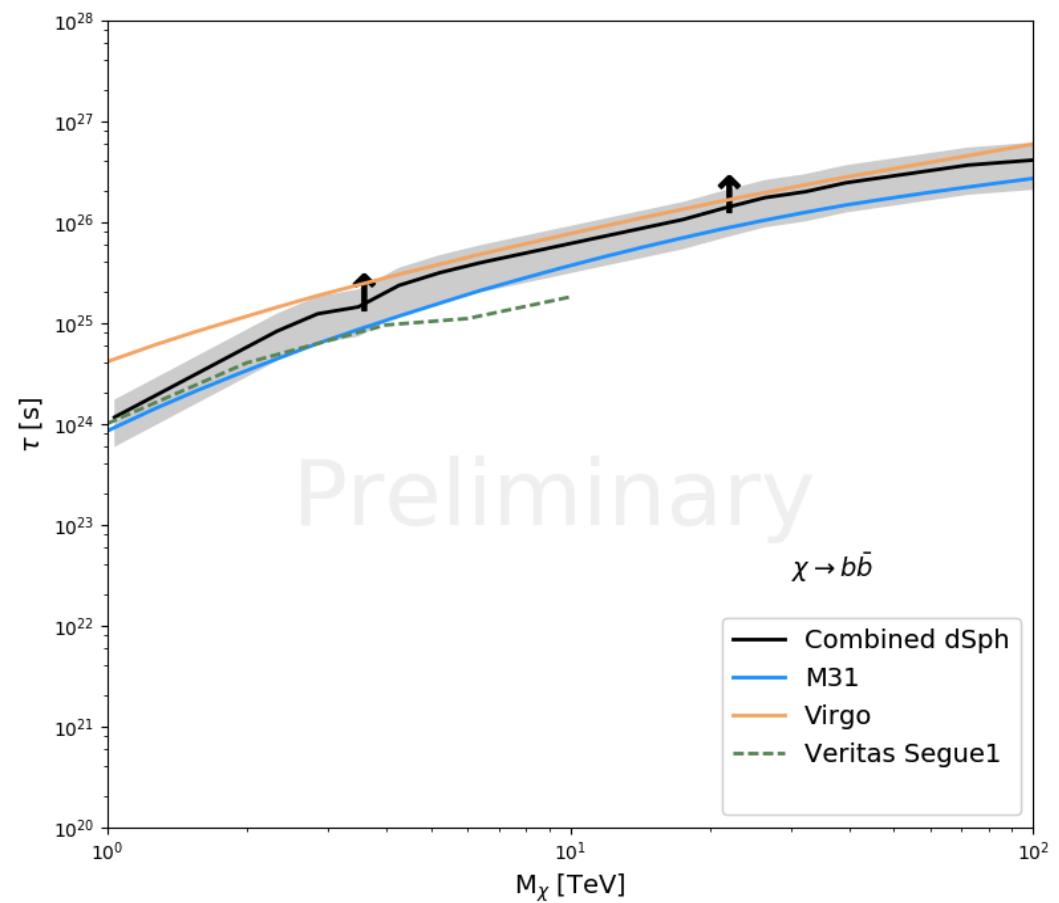


WIMP Decay Limits from Dwarf Galaxies



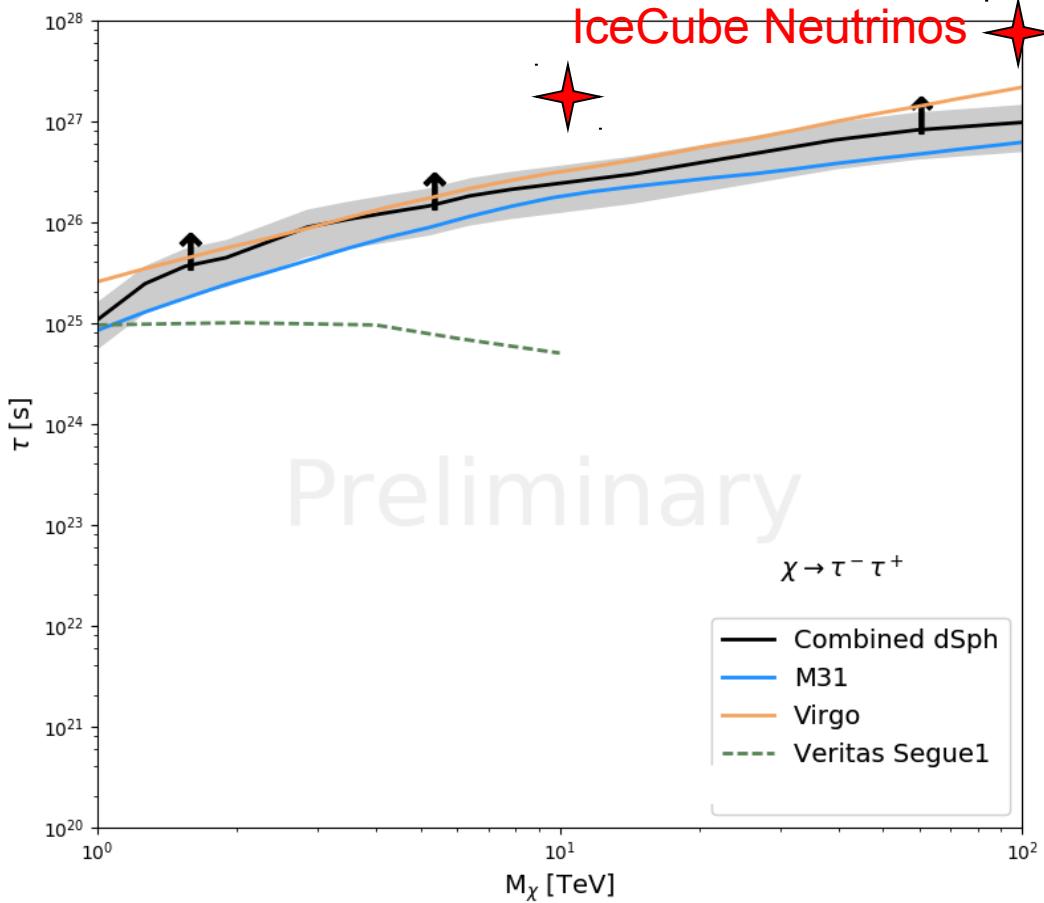
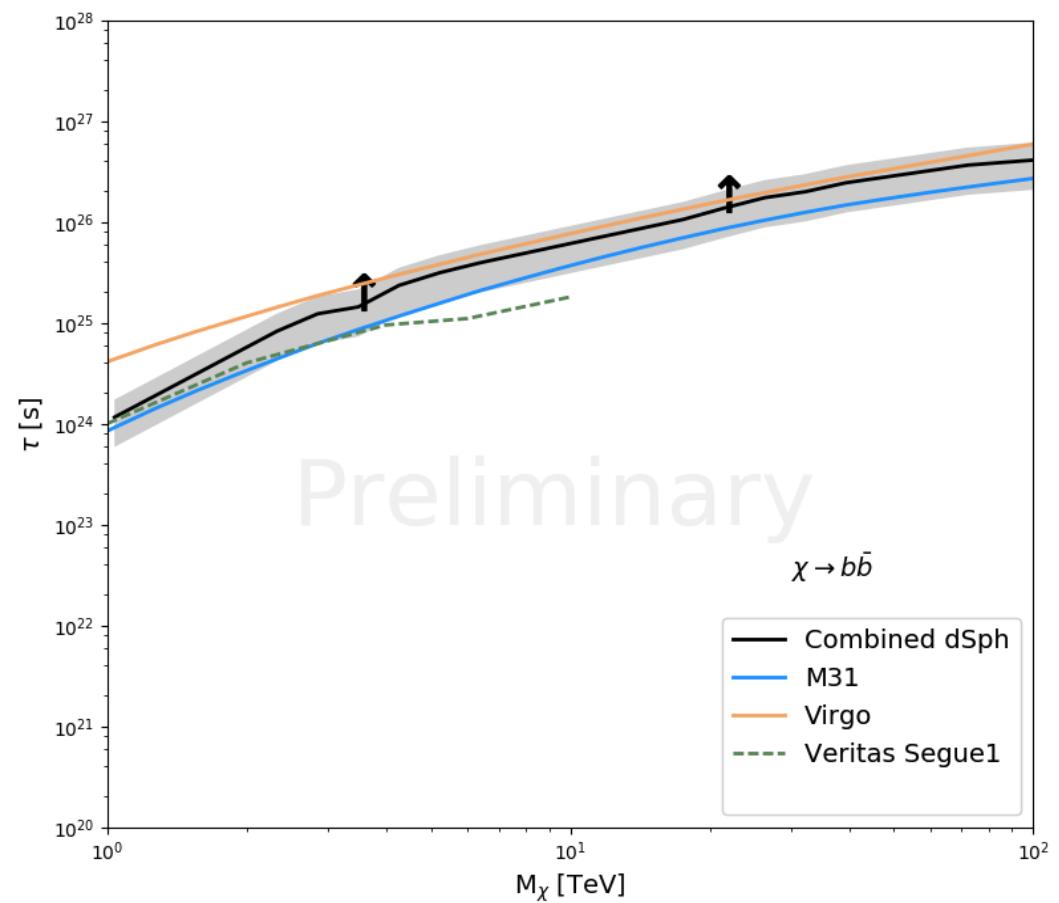


WIMP Decay Limits from M31 Galaxy and Galaxy Clusters





WIMP Decay Limits from M31 Galaxy and Galaxy Clusters





For more on HAWC, see Michelle Hui's plenary talk - Tomorrow at 11am

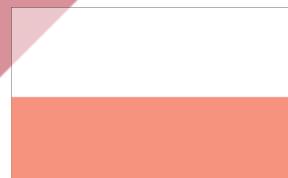


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