

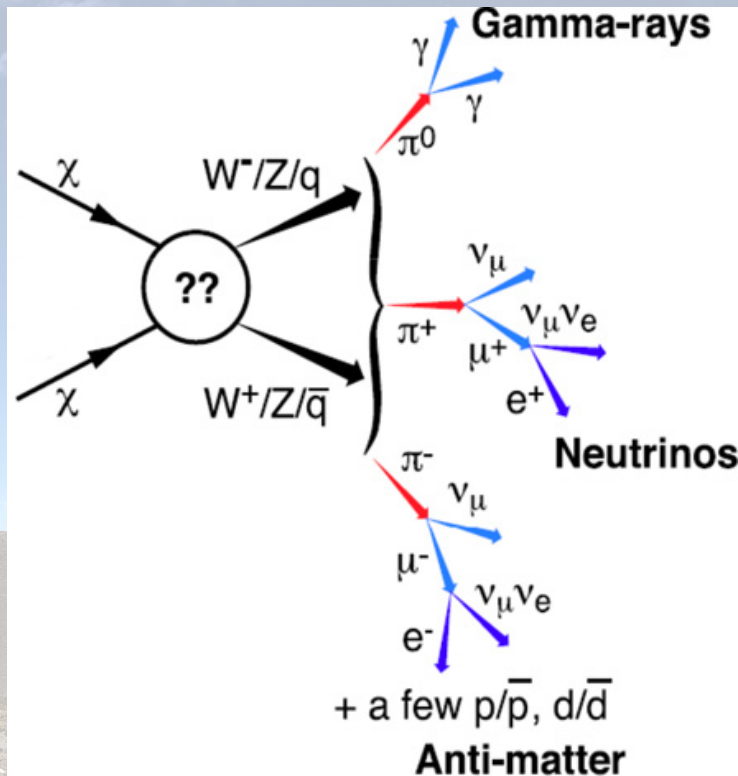
# Limits on Diffuse Dark Matter with HAWC



Mora Durocher  
ICRC July 2021



# Diffuse Gamma-Ray Background



The Diffuse Gamma-Ray Background (DGRB) is expected to be mainly produced by isotropic gamma rays, emitted by the interaction of high-energy cosmic rays with matter and radiation in our Galaxy. At TeV energies, dark matter annihilations or decays from an extended galactic halo may also contribute to the DGRB.

We use 535 days of data from the High Altitude Water Cherenkov (HAWC) gamma-ray observatory to explore the more conventional channels for dark matter annihilation and decay interactions, which are the  $b\bar{b}$  and  $\tau^+\tau^-$  channels.

**HAWC Observatory**  
High Altitude Water Cherenkov Gamma-Ray Observatory

Mapping the Northern Sky in High-Energy Gamma Rays

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 m<sup>2</sup>.

**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

7.3 m

photomultiplier tube (PMT)

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.

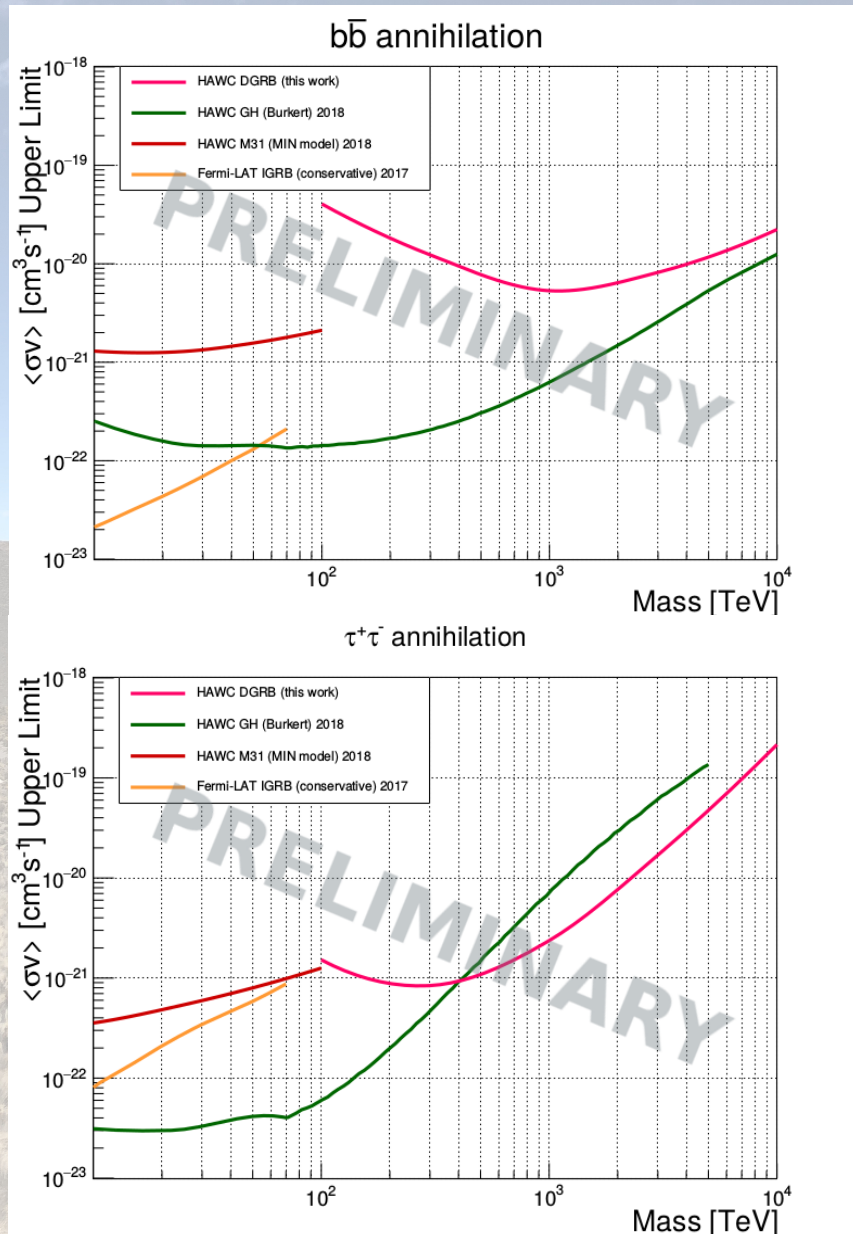
gamma-ray shower

cosmic-ray shower

"hot" spots concentrate around the core

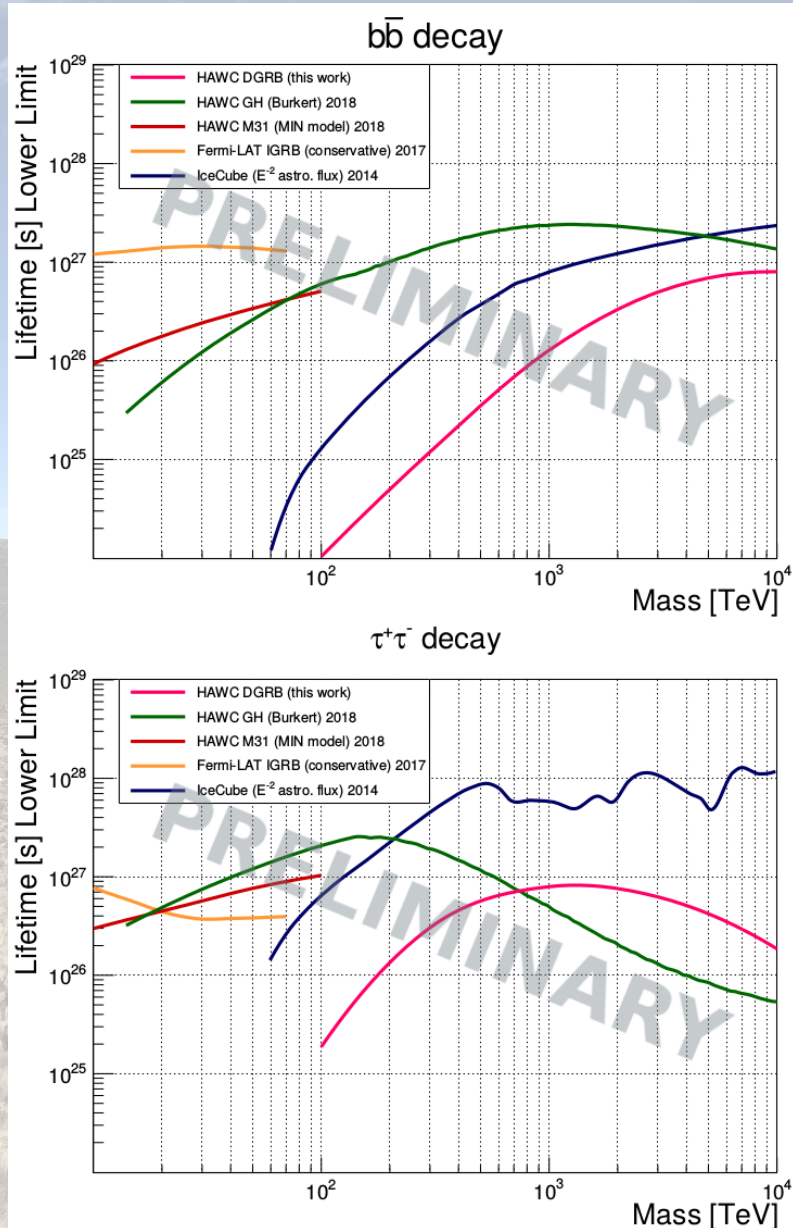
"hot" spots are more dispersed

# Cross-Section Upper-Limits



- Inject isotropic and spatial-model independent gamma-ray emissions from galactic dark matter annihilation interactions into bottom quarks and tau leptons.
- Perform maximum likelihood analysis on our DGRB data with respect to spectra of chosen dark matter masses.
- Calculate the 95% confidence level cross-section upper-limits.
- Compare to recent dark matter searches with HAWC and the Fermi-LAT Isotropic Gamma-Ray Background (IGRB).

# Lifetime Lower-Limits



- Perform the same procedure to obtain the 95% confidence level lifetime lower-limits of dark matter decay interactions into bottom quarks and tau leptons.
- Also compare to recent dark matter searches with HAWC and other experiments.
- Our limits push into an energy range higher than the Fermi-LAT IGRB and the HAWC Andromeda Galaxy constraints.
- Better limits for interactions involving tau leptons when compared to the HAWC Burkert Galactic Halo limits.