



Contribution ID: 313

Type: not specified

TeV Halos: A New Class of Gamma-Ray Sources Provide Insight into Galactic Diffusion

Monday, 11 September 2023 16:45 (15 minutes)

Observations by the HAWC and HESS telescopes have found extended TeV emission consistent with a handful of young and middle-aged pulsars. In this talk, I will show that these detections have significant implications for our understanding of both pulsar emission and TeV astrophysics. Most importantly, the high-luminosity and spatial extension of TeV halos indicate that cosmic-ray diffusion on 20-50 pc scales surrounding energetic sources is atypical of the standard interstellar medium. Four models have been proposed, including those where locally anisotropic diffusion creates an appearance of a concentrated source from certain viewing angles, models which invoke rectilinear transport to produce a compact spatial profile in an otherwise standard diffusion environment, models where some pulsars fortuitously pockets of low-diffusion, and finally models where the pulsar (or associated supernova remnant) actively inhibit diffusion on moderate spatial scales. I will review each model, and argue that current observations prefer models where energetic sources actively inhibit diffusion in their surrounding environment.

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Session Classification: GRA: Gamma Ray Astronomy

Track Classification: Gamma Ray Astronomy