Dark Matter, Gamma Rays, and You

Why pulsars are essential to the dark matter search.

By Andy Flinders

The quest to understand the nature of Dark Matter is one of the most compelling in modern astrophysics. While this substance makes up ~75% of the matter in the universe and is responsible for the existence of galaxies and stars, we know almost nothing about it. Particle detection experiments such as AMS-02 have clearly shown an excess of high energy positrons incident on our planet. Are these positrons the result of dark matter annihilation? While many scientists are inclined to answer yes, there are known sources of positrons which may be contributing to, or entirely responsible for, the positron excess.

Gamma rays are the highest energy form of electromagnetic radiation. They are produced in the most violent regions of the universe such as supernova remnants, pulsars, and pulsar wind nebulae. The emission mechanisms of gamma rays are not completely understood. Detailed observations of gamma ray sources will help us to understand these mechanisms. VERITAS is an array of four imaging air Cherenkov telescopes capable of detecting gamma rays with energies between ~100GeV and ~30TeV. These telescopes work by observing the Cherenkov light emitted by the gamma ray induced air showers in our atmosphere. I will discuss how these showers are detected and parameterized in order to determine the energy and incident direction of the gamma rays. Understanding the mechanisms by which these gamma rays are produced helps us to constrain possible dark matter annihilation signatures.