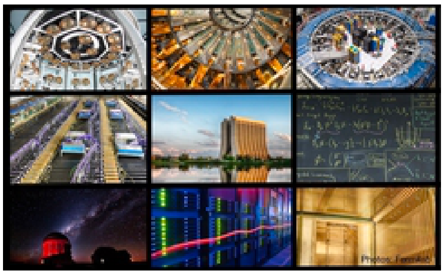

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The Cosmic-Ray Positron Excess and the Constraints on Milky Way Pulsars

Wednesday, 22 June 2022 11:00 (15 minutes)

Pulsars - spinning neutron stars that are magnetized – are likely the leading source which could explain the large excess in the observed positron flux present in data measurements from the AMS-01, HEAT, and PAMELA collaborations. While first thought to be from a source of annihilating dark matter, there have since been more compelling observations - via experiments such as HAWC - of TeV halos associated with pulsars that are especially young and within a few kiloparsecs of Earth. These halos indicate that such pulsars inject significant fluxes of very high-energy electron-positrons pairs into the interstellar medium (ISM), thereby likely providing the dominant contribution to the cosmic-ray positron flux. This talk highlights the important updates on the constraints of local pulsar populations which further support the pulsar explanation to resolving the positron excess, through building upon previous work done by Hooper, Linden, and collaborators. Using the cosmic-ray positron fraction as measured by the AMS-02 Collaboration and applying reasonable model parameters, a good agreement can be obtained with the measured positron fraction up to energies of roughly ~ 300 GeV. At higher energies, the positron fraction is dominated by a small number of pulsars, making it difficult to reliably predict the shape of the expected positron fraction. The low-energy positron spectrum supports the conclusion that pulsars typically transfer approximately ~ 5 – 20% of their total spindown power in efficiency into the production of very high-energy electron-positron pairs, producing a spectrum of such particles with a hard spectral index of ~ 1.5 – 1.7. Such pulsars typically spindown on a timescale on the order of 104 years. The best fits were obtained for models in which the radio and gamma-ray beams from pulsars are detectable to 28% and 62% of surrounding observers, respectively.

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