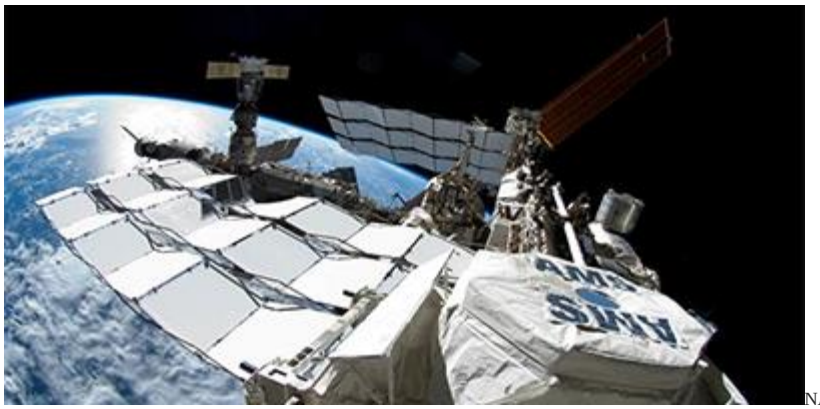
Synopsis: More Dark Matter Hints from Cosmic Rays?


NASA

Electron and Positron Fluxes in Primary Cosmic Rays Measured with the Alpha Magnetic Spectrometer on the International Space Station

M. Aguilar et al. (AMS Collaboration)

Phys. Rev. Lett. **113**, 121102 (2014)

Published September 18, 2014

Excitement still surrounds a possible hint of dark matter in an unexpected excess of cosmic-ray antielectrons (positrons) relative to electrons. A new set of data from the Alpha Magnetic Spectrometer (AMS) aboard the International Space Station confirms the positron excess and provides the most accurate measurement to date of the shape of both the electron and positron spectra. The analysis reveals that the positron flux is significantly different from the electron flux above 30 GeV in energy, which suggests that positrons and electrons have a different origin. Cosmic rays are predominantly protons and other nuclei, but electrons and positrons make up part of the mix. Standard astrophysical models of interstellar particle collisions predict that, in cosmic rays, the fraction of positrons relative to electrons should decrease with energy. However, recent observations from satellites (e.g., PAMELA and Fermi) and from AMS have shown that the positron fraction actually increases with energy.

The AMS experiment, which has a large permanent magnet that allows particle discrimination, has been collecting data since May 2011. Out of 41 billion detection events, the AMS collaboration has identified 580,000 positrons and 9.2 million electrons (50% more than in their previous data release, see 3 April 2013 Viewpoint). Thanks to the additional data, they were able to extend their measurements of the positron flux up to 500 GeV and, similarly, of the electron flux up to 700 GeV. The high-precision data reveal that both spectra change their slope at around 30 GeV but behave differently towards higher energies: the positron flux drops off much more slowly than the electron flux. One possible explanation for this spectral difference is that the positrons are being created in

annihilations of dark matter particles. The authors say data at higher energy will be needed to confirm a dark matter origin.

This research is published in Physical Review Letters.

–Michael Schirber