Towards Understanding the Origin of Cosmic-Ray Electrons

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The Alpha Magnetic Spectrometer (AMS) is a precision particle physics detector on the International Space Station conducting a unique, long-duration mission of fundamental physics research in space. In this report, the precision measurement of the electron flux based on 28.1 million electron events collected by AMS is presented. These results have improved accuracy and extended energy range beyond 1 TeV in comparison with other recent measurements.

AMS data on cosmic-ray electrons and positrons are crucial for providing insights into their origins. In the entire energy range, the electron flux is well described by the sum of two power-law components. The electron flux exhibits a significant excess starting from 42 GeV compared to the lower energy trends, but the nature of this excess is different from the positron flux excess above 25 GeV. Contrary to the positron flux, which has an exponential energy cutoff of 810 GeV, at the 5σ level the electron flux does not have an energy cutoff below 1.9 TeV.

Comparison of the AMS results with the GALPROP prediction shows that the contribution of the collision of cosmic rays to the electron spectrum is negligible in the entire energy range. It suggests an extra source for primary cosmic ray electrons such as supernova remnant, pulsars, or Dark matter annihilation. The primary source as the dark matter should produce both high-energy electrons and positrons. AMS electron flux is consistent both with or without a charge symmetrical source, obtained from the analysis of positron flux.

Distinctly different magnitudes and energy dependences of the cosmic-ray electrons and positrons measured by AMS is clear evidence that most high-energy electrons originate from different sources than high-energy positrons. Future AMS measurements with improved accuracy and energy reach will reveal detailed features in the electron spectrum.