Anisotropy of Positron and Electron Fluxes Measured with the Alpha Magnetic Spectrometer on the ISS

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Executive Summary

The latest measurements of AMS-02 on the positron and electron fluxes have shown unexpected features that cannot be explained with the current understanding of the acceleration and propagation mechanisms. On the one hand, the positron flux shows a significant excess above ∼25 GeV followed by a sharp drop-off above ∼ 284 GeV. The excess is consistent with the existence of a source term of high-energy positrons with a characteristic energy cutoff of ∼ 810 GeV. On the other hand, 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 positrons one; the electron flux does not show an energy cutoff below 1.9 TeV.

The origin of these features remains unclear, and many models have been proposed. In the case of positrons, the additional contribution cannot be explained by a pure secondary component and the inclusion of nearby primary sources is necessary: whether of astrophysical (pulsars) or a more exotic (dark matter) origin. In particular, the presence of a nearby source may imprint some degree of anisotropy on the fluxes that could be measured by AMS-02.

Therefore, the measurement of the anisotropy of the positron and electron fluxes provides an additional characterization to the energy dependence of the fluxes that may help to the understand the observations.

This work presents the measurement of the dipole anisotropy in the arrival directions of cosmic ray electrons and positrons in galactic coordinates with AMS-02. Results are presented for 9 years of data taking. No deviations from isotropy have been found and upper limits to the dipole amplitude are established. In particular, in the lowest energy range $E_{min} = 16$ GeV the limits are $\delta = 0.36\%$ and $\delta = 1.65\%$ for electrons and positrons respectively.

AMS will continue taking data until the end of the ISS operation, currently 2028. By that time AMS measurement will be sensitive to the positron anisotropy level predicted by pulsar models.