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Anisotropy of Cosmic Rays Arrival Directions with AMS-02 on the International Space Station

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Abstract

AMS-02 is a particle physics detector installed onboard the International Space Station, which provides precise measurements of the different cosmic ray species. The AMS results have revealed unpredicted features on their spectra, which cannot be accounted within the current understanding of the production and propagation of galactic cosmic rays.

On the one hand, the positron flux shows an excess above ~10 GeV [1] which cannot be explained by a pure secondary origin. For most of the explanations the inclusion of primary sources is required; typically, being classified in two scenarios: dark matter and astrophysical sources.

On the other hand, the proton [2] and nuclei [3] spectra deviate from a single power law and the spectral index progressively hardens above ~ 100 GV. The origin of these effects may also reveal the existence of local sources or a change in their propagation mechanisms.

In all cases, the contribution of nearby sources may induce some degree of anisotropy in the arrival directions of the different cosmic ray species. Thus, its measurement would help to support or disfavor some of the aforementioned scenarios.

The directionality can be studied by comparing the data sample to a reference map, which represents the expectation for an isotropic flux; any deviation will be regarded as a signal. The large scale anisotropy can be described at first order by a dipole which is determined by its projection onto three orthonormal axes.

Results on the dipole anisotropy in galactic coordinates for different charged cosmic rays from the first 7.5 years of data taking with AMS-02 will be presented. The expected upper limits on the dipole amplitude are 1.9% for positrons above 16 GeV, whereas for protons, helium, carbon and oxygen is 0.38%, 0.36%, 1,9% and 1.7% respectively, for rigidities above 200 GV.

[1] M. Aguilar et al. (AMS Collaboration), PRL 122, 041102
[2] M. Aguilar et al. (AMS Collaboration), PRL 114, 171103
[3] M. Aguilar et al. (AMS Collaboration), PRL 119, 251101

[2] AMS Collaboration, Phys. Rev. Lett. 114, 171103
[3] AMS Collaboration Phys. Rev. Lett. 119, 251101

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