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Testing Cosmic-Ray Propagation Scenarios with AMS-02 and Voyager Data

Based on AMS-02 and Voyager cosmic-ray (CR) measurements, we have tested and revised various CR propagation scenarios under standard assumptions: pure diffusion, diffusion with convection, diffusion with reacceleration, and diffusion with reacceleration and convection. We report on the performance of these scenarios against CR measurements, aiming to minimize the number of model parameters as much as possible. For each scenario, we find parameters that can reproduce the Voyager and AMS-02 data across the entire energy range for all the CR species tested. Above several GV, we observe a similar injection spectral index for He and C, with He being harder than H. Some previously disfavored scenarios are now reconsidered. For example, contrary to common assumptions, we find that the pure diffusion scenario does not require an upturn in the diffusion coefficient at low energy, while it does require the same number of low-energy breaks in the injection spectrum as diffusive-reacceleration scenarios. We show that the scenarios differ in their modeled spectra of secondaries by one order of magnitude for positrons at ~ 1 GeV and by a factor of 2 for antiprotons at several GV. The force-field approximation describes well the AMS-02 and Voyager spectra analyzed, except for antiprotons. We confirm the ~ 10 GeV excess in the antiproton spectrum for all scenarios. Additionally, for all scenarios, the resulting modulation is expected to be stronger for positrons than for nuclei, with reacceleration models requiring much larger modulation.

Collaboration(s)

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