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Scrutinizing the evidence for dark matter in cosmic-ray antiprotons

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During the last decade, the space-based experiment AMS-02 has drastically reduced the measurement uncertainty of primary and secondary cosmic-ray fluxes. Therefore, global fits of these fluxes provide great potential to study cosmic-ray propagation models and search for exotic sources of antimatter such as annihilating dark matter. Previous studies of AMS-02 antiprotons revealed a possible hint for a dark matter signal which, intriguingly, would be in agreement with the dark matter interpretation of the gamma-ray excess at the Galactic center. On the other hand, systematic uncertainties in the theoretical description of cosmic rays become gradually more relevant as the data uncertainties are reduced. I will discuss two important sources of uncertainties in order to test the robustness of the putative dark matter signal: the antiproton production cross-sections needed to calculate the source spectra of secondary antiprotons and potential correlations in the experimental data, so far not provided by the AMS-02 collaboration. In particular, to investigate the impact of cross-section uncertainties I will present the results of two different methods. In the first method, the uncertainties are taken into account by including a covariance matrix determined from nuclear cross-section measurements. The alternative approach is to perform a joint fit, simultaneously to cosmic-ray and cross-section data. I will show that the cross-section uncertainties have a small effect on the cosmic-ray fits. The inclusion of potential correlations in the data could have a much larger impact. I will discuss a method to determine and include possible benchmark models for the correlations in a data-driven approach.

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