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Emulation of cosmic-ray antideuteron fluxes from dark matter annihilation

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Cosmic-ray antimatter, particularly low-energy antideuterons, constitute a sensitive probe of dark matter annihilating in our Galaxy. We study this smoking-gun signature and explore its complementary to indirect search via cosmic-ray antiprotons. We revisit the Monte Carlo simulation of antideuteron coalescence and cosmic-ray propagation, allowing us to assess uncertainties from both processes. In particular, we incorporate uncertainties in the Λ_b production rate and the coalescence momentum and consider two distinctly different propagation models. To this end, we further the development of the neutral emulator DarkRayNet enabling a fast prediction of propagated antideuteron energy spectra for a wide range of annihilation channels and any admixtures thereof. We find that our network can predict the various spectra with excellent accuracy, offering a significant speed-up over the full simulation. Employing the network's output, we then test the detectability of antideuterons from dark matter annihilation with AMS-02 and the upcoming GAPS experiment for a wide range of dark matter masses.

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