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Aspects of antiproton modulation in the heliosphere

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Unlike cosmic ray protons, the antiproton local interstellar spectrum (LIS) was not observed by the Voyager missions when crossing the heliopause into the interstellar medium. As a result, the shape and values of the antiproton LIS at lower energies (rigidities) are still unknown. The recent AMS-02 observations, averaged over a Bartel rotation (27 days), confirmed earlier model predictions that cosmic ray antiprotons are relatively less sensitive to solar cycle related changes in the transport parameters at lower rigidities, which is in sharp contrast to protons. In this study, the previously established set of proton modulation parameters that reproduced PAMELA and AMS-02 proton observations between 2006 and 2022 is applied in our physics-based 3D-drift numerical model to simulate modulated antiproton spectra over the same period. This way the only differences between galactic protons and antiprotons simulations remain their LISs and the sign of their charges. This study will illustrate and discuss peculiar aspects of antiproton modulation. It will highlight how the shape of its LIS at lower rigidities intriguingly resembles the shape of modulated spectra deep inside the heliosphere as influenced by adiabatic energy losses.

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