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Production and propagation of secondary antinuclei in the Galaxy

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The AMS-02 experiment, a multipurpose cosmic ray detector on board the International Space Station since 2011, has reported having detected 7 candidates for antideuterons, 6 antihelium-3, and 3 antihelium-4 during nearly 12 years of operation [1]. Their origin is an open question, on one side their production in cosmic ray interactions (secondary production) is predicted to follow a hierarchy from lighter to heavier antinuclei that measurements seem to avoid. On the other hand, theories beyond the Standard Model predict antinuclei production at low energies (<1GeV/n), orders of magnitude above secondary production [2]. Studying the effects of production and absorption cross-sections for antinuclei and their uncertainties in the Galaxy is fundamental to understand the origin of these observations.
This work reviews the current state of the antinuclei production cross-sections in cosmic ray interactions and its uncertainties, considering the coalescence model and recent measurements in accelerator experiments. These cross-sections have been included in a simulation of antinuclei propagation in the Galaxy using GALPROP v57 [3], where an updated diffusive reacceleration model was taken into account. Estimations of the expected antinuclei fluxes at Earth are presented.

[1]Samuel Ting, CERN Colloquium 2023 (2018). URL https://indico.cern.ch/event/1275785/.
[2] von Doetinchem, P. et al. Cosmic-ray antinuclei as messengers of new physics: status and outlook for the new decade. Journal of Cosmology and Astroparticle Physics 2020, 035 (2020).
[3] Porter, T. A., Jóhannesson, G., and Moskalenko, I. V., "The GALPROP Cosmic-ray Propagation and Non-thermal Emissions Framework: Release v57", The Astrophysical Journal Supplement Series, vol. 262, no. 1, IOP, 2022. doi:10.3847/1538-4365/ac80f6.

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