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Searching for cosmic antihelium nuclei with the GAPS experiment

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At low-energies, cosmic antideuterons and antihelium provide an ultra-low background signature of dark matter annihilation, decay, and other beyond the Standard Model theories. The General Antiparticle Spectrometer (GAPS) is an Antarctic balloon experiment designed to search for low-energy (0.1-0.3 GeV/n) antinuclei and is planned to launch in the austral summer of 2022. While optimized for an antideuteron search, GAPS has unprecedented capabilities for the detection of low-energy antihelium nuclei as well, utilizing a novel detection technique based on the formation, decay, and annihilation of exotic atoms. The AMS-02 collaboration has recently reported several antihelium nuclei candidate events, which sets GAPS in the unique position to set constraints on the cosmic antihelium flux in an energy region which is essentially free of astrophysical background. In this talk, we will illustrate the capabilities of GAPS to search for cosmic antihelium-3 utilizing complete instrument simulations, event reconstruction, and the inclusion of atmospheric effects. We will show that GAPS is capable of setting unprecedented limits on the cosmic antihelium flux and thus opening a new window on exotic cosmic physics.

Keywords

dark matter;antinuclei;anti helium;cosmic ray;exotic atom;x-ray;low background;exotic physics;Antarctica;balloon;LDB;

Collaboration

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Experimental Methods & Instrumentation

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