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The GAPS Experiment: Probing Unique Dark Matter Parameter Space With Low Energy Cosmic Ray Antinuclei

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Despite numerous recent efforts at colliders and multi-ton scale experiments, there has not been an unambiguous detection of particle dark matter. While progress has been made excluding large regions of parameter space, there remain many viable candidates, some of which can evade collider and direct detection sensitivities. Sub-GeV (50-250 MeV/n) cosmic ray antideuterons ($\overline{\mathrm{D}}$) are a compelling, mostly unmapped window into such models, and benefit from extremely low astrophysical background contamination. The General AntiParticle Spectrometer (GAPS) is a first generation Antarctic balloon-borne experiment tailored to $\overline{\mathrm{D}}$ detection. GAPS is also sensitive to antihelium and will detect many antiprotons at low kinetic energies (70-200 MeV).

Unlike traditional spectrometers, GAPS does not utilize a magnet, but instead relies on exotic atom formation and decay, permitting the use of more active target material for a larger overall acceptance. The design is based on a tandem Si(Li) tracker and large area (~ 53 m^2) scintillator based time of flight system.

In this contribution, I will outline the dark matter models GAPS can probe and review the cosmic ray indirect detection approach. Following this, I'll describe the exotic atom technique and detail the detector design. I will conclude with construction progress leading up to the Antarctic launch in late 2021, along with current detector performance.

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