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The GAPS Instrument: A Large Area Time of Flight and High Resolution Exotic Atom Spectrometer for Cosmic Antinuclei

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Low-energy cosmic ray antideuterons (< 0.25 GeV/n) are a compelling, mostly uncharted channel of many viable dark matter models, and they benefit from a highly sup-pressed astrophysical background. The General Antiparticle Spectrometer (GAPS) is a first-of-its-kind Antarctic balloon-borne experiment specialized for the detection of low energy antiprotons, antideuterons, and antihelium with a targeted launch in 2022.

The results of our novel technology development and a summary of our current construction status are the focus of this contribution. GAPS exploits an antiparticle identification technique based on exotic atom formation and decay, allowing more active target material for a larger overall acceptance since no magnet is required. The GAPS instrument consists of a large-area ($\sim$ 50 m^2) scintillator time-of-flight, ten planes of custom silicon detectors with dedicated ASIC readout, and a novel oscillating heat pipe cooling approach.

This contribution will briefly introduce the exotic atom detection technique and expected flux sensitivities. Following this, the instrument design will be discussed, and a detailed description of experimental hardware and expected performance will be presented, followed by a summary of the progress on construction and testing while also highlighting developments of a scaled, integrated prototype.

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Collaboration

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Subcategory

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