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GAPS - Dark matter search with low-energy cosmic ray antideuterons and antiprotons

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The GAPS experiment is foreseen to carry out a dark matter search by measuring low-energy cosmic ray antideuterons and antiprotons with a novel detection approach. It will provide a new avenue to access a wide range of different dark matter models and masses from about 10GeV to 1TeV.

The theoretically predicted antideuteron flux resulting from secondary interactions of primary cosmic rays is very low. Well-motivated theories beyond the Standard Model contain viable dark matter candidates, which could lead to a significant enhancement of the antideuteron flux due to annihilation or decay of dark matter particles. This flux contribution is believed to be especially large at low energies, which leads to a high discovery potential for GAPS. The GAPS low-energy antiproton search will provide some of the most stringent constraints on ˜10GeV dark matter, will provide the best limits on primordial black hole evaporation on galactic length scales, and explore new discovery space in cosmic ray physics.

GAPS is designed to achieve its goals via long duration balloon flights at high altitude in Antarctica. The detector itself will consist of 10 planes of Si(Li) solid state detectors and a surrounding time-of-flight system. Antideuterons and antiprotons will be slowed down in the Si(Li) material, replace a shell electron and form an excited exotic atom. The atom will be deexcited by characteristic X-ray transitions and will end its life by the formation of an annihilation pion/proton star. This unique event structure will deliver a nearly background free detection possibility. In June 2012, a successful prototype balloon flight from the balloon base in Taiki, Japan was carried out.

The presentation will motivate low-energy cosmic ray antideuteron and antiproton searches as well as specifically discuss the current status of the GAPS experiment and the design of the payload.

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