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The General Antiparticle Spectrometer (GAPS) -Hunt for dark matter using low energy antideuterons

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The GAPS experiment is foreseen to carry out a dark matter search using low energy cosmic ray antideuterons (< 0.3GeV/n) using a novel detection approach. The theoretically predicted antideuteron flux resulting from secondary interactions of primary cosmic rays, e.g. protons, with the interstellar medium is very low. So far not a single cosmic antideuteron has been detected by any experiment but well-motivated theories beyond the standard model of particle physics, e.g. supersymmetry or universal extra dimensions, contain viable dark matter candidates which could led to a significant enhancement of the antideuteron flux due to self-annihilation of the dark matter particles. This flux contribution is believed to be especially large at small energies which leads to a high discovery potential for GAPS.

In comparison to other experiments, GAPS will be able to measure antideuterons at lower energies than the upcoming AMS-02 experiment and will partly cover complementary parameter space regions of dark matter scenarios studied by direct dark matter underground searches.

GAPS is designed to achieve its goals via a series of ultra-long duration balloon flights (bGAPS) at high altitude in Antarctica, starting in 2014. The detector itself will consist of 13 planes of Si(Li) solid state detectors and a time-of-flight system. The antideuterons 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 star. This unique event structure will deliver a nearly background free detection possibility.

To prove the performance of the different detector components at stratospheric altitudes a prototype flight (pGAPS) will be conducted in 2011 from Taiki, Japan. This flight will also be important to understand the particle and x-ray backgrounds which might influence the final bGAPS design.

This presentation will report on the general bGAPS concept and on the status of the pGAPS instrument and flight preparations.

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