Paper ID: 24194
oral
student

21st IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

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THE AFIS DETECTOR: MEASURING ANTIMATTER FLUXES ON NANOSATELLITES

Abstract

The Antiproton Flux in Space (AFIS) mission aims to measure the flux of antiprotons trapped in Earth's magnetic field at very low energies. A novel particle detector featuring cutting-edge silicon-based sensor technology and fast real-time electronics is being developed specifically for this purpose at Technische Universität München (TUM). Its innovative yet relatively simple design results in a sensitivity range for the particle energy of 20 to 100 MeV per nucleon, a value which is considerably lower than achieved in previous missions. In addition to detecting antiprotons, the detector can identify incoming charged particles and ions in that energy range.

The AFIS detector is intended for the application on nanosatellites and is therefore designed according to the CubeSat standard. Getting spaceborne for the first time aboard the triple-unit CubeSat MOVE 2, it is going to operate while flying through the South Atlantic Anomaly, directly linking to the measurement of the trapped antiproton flux at energies above 80 MeV published by the PAMELA collaboration in 2011.

In order to prove the working principle of the detector, a prototype with lower resolution has been successfully tested at a stationary particle beam in late 2013. The first full-scale version of the device is going to be deployed aboard an stratospheric research balloon as part of the REXUS/BEXUS program of the German Aerospace Center (DLR) and the Swedish National Space Board (SNSB) in October 2014. This precursor mission addresses open physics questions as well as engineering challenges involved in a space-based particle physics experiment, including meeting space, power and safety requirements of the CubeSat standard. Besides acting as a technology demonstrator, the balloon mission is going to measure the flux of ions of the cosmic ray spectrum in the 20 to 100 MeV per nucleon energy range.

AFIS is a student-only project at TUM, supported by senior researchers of the Physics Department and the Institute of Astronautics. Funding for the balloon mission is provided by DLR as part of the REXUS/BEXUS program.