T 121: Cosmic Ray VI

Time: Thursday 15:50–17:20 Location: POT/0351

T 121.1 Thu 15:50 POT/0351

Detector Design Update for the AFIS Sattelite Mission — •Liesa Eckert[1], Peter Hinderberger[1], Martin J. Losekamm[1], Stephan Paul[1], Thomas Pöschl[1], and Sebastian Rückerl[2] — [1]Technical University of Munich, Department of Physics, Garching, Germany — [2]Technical University of Munich, Department of Aerospace and Geodesy, Garching, Germany

Radiation in space consists of charged particles, photons, and neutrons. We aim to measure the charged nuclear component of the radiation environment with CubeSat-sized detectors composed of scintillating-plastic fibers read out by silicon photomultipliers (SiPMs). With different detector versions, we study the radiation's composition for dosimetry with the RadMap Telescope and aim to measure the flux of antiprotons trapped in the Earth's magnetic field with the upcoming AFIS mission.

For the latter, we are currently improving the detector design and plan to verify the updated version as part of the In-Orbit Verification Experiment 1 (IOV-1) on the International Space Station.

In this talk, I will present the current detector design as used in the RadMap Telescope, as well as the opportunities for improvement we identified during production and calibration. Furthermore, I will show which changes we plan to apply to the current design to achieve a better performance and simplify production for future missions.

Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

T 121.2 Thu 16:05 POT/0351

Onboard Data Processing for the AFIS Satellite Mission — •Peter Hinderberger[1], Martin J. Losekamm[1], Stephan Paul[1], Thomas Pöschl[1], and Sebastian Rückerl[2] — [1]Technical University of Munich, Department of Physics, Garching, Germany — [2]Technical University of Munich, Department of Aerospace and Geodesy, Garching, Germany

The Antiproton Flux in Space (AFIS) satellite mission aims to measure the flux of antiprotons trapped in Earth's Van Allen radiation belts at energies of 20 to 100 MeV. The mission's central instrument is a charged-particle detector comprised of scintillating-plastic fibers and silicon photomultipliers. We are testing a range of processing approaches and hardware options to filter and analyze the recorded data in real time in order to reduce the amount of data that needs to be sent to ground. In this contribution, we present the technical motivation of these approaches, as well as early test implementations and simulations. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

T 121.3 Thu 16:20 POT/0351

The RadMap Telescope — Ready for Flight — •Martin J. Losekamm[1], Liesa Eckert[1], Peter Hinderberger[1], Stephan Paul[1], Thomas Pöschl[1], and Sebastian Rückerl[2] — [1]Technical University of Munich, Department of Physics, Garching, Germany — [2]Technical University of Munich, Department of Aerospace and Geodesy, Garching, Germany

The RadMap Telescope will demonstrate new technologies for the characterization of the nuclear component of cosmic rays by measuring the radiation environment aboard the International Space Station (ISS). At the heart of the instrument is a tracking calorimeter made from scintillating-plastic fibers and silicon photomultipliers capable of recording particle-dependent energy spectra; several silicon-based dosimeters provide additional dosimetry information. RadMap will be deployed to the ISS in March 2023, with operations expected to begin a few weeks later. In this contribution, we present the instrument design, its capabilities, and our plans for on-orbit operations that shall lead to a full validation of the central detector and its read-out electronics. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

T 121.4 Thu 16:35 POT/0351

Resolution limits in low-energy neutrino event reconstruction with IceCube — •Kaustav Dutta, Sebastian Böser, Martin Rongen, and Elisa Lohfink — Johannes Gutenberg Universität Mainz, Germany

The IceCube Observatory is a cubic-kilometer neutrino telescope built into the deep glacial ice at the South Pole. Low energy extensions to the detector include the existing DeepCore subarray and the upcoming IceCube Upgrade. These focus on neutrino oscillation physics using atmospheric neutrinos and are characterized by a denser instrumentation. These elusive particles are indirectly detected by collecting Cherenkov photons emitted by secondary charged particles produced as a result of neutrino-nucleon interactions inside the detector. The reconstruction of event information, in particular direction and energy of an incoming neutrino, is a crucial ingredient to the oscillation analyses. The accuracy of reconstruction is therefore affected by statistical fluctuations in the particle shower development as well as by photon propagation and detection efficiencies of sensors. Here we present first steps to identify the theoretically achievable resolution in the absence of modeling inaccuracies and computational limitations.

T 121.5 Thu 16:50 POT/0351

SkyLLH: A tool for using the public 10-year IceCube point-source data — •Martin Wolf and Chiara Bellenghi — TU-Munich, James-Franck-Straße 1, 85748 Garching, Germany

The IceCube collaboration has released 10 years of recorded data suitable for point-like neutrino source searches. In addition, the instrument response function is provided as well, making this data set usable for neutrino source searches by the public. In this contribution we highlight the tool "SkyLLH", a software framework for performing log-likelihood-ratio-based analyses on celestial data, and its interface to the public 10-year IceCube point-source data. Within the accuracy of the released binned instrument response function, the public data interface of SkyLLH allows to reproduce IceCube's results published in Phys. Rev. Lett. 124, 051103 (2020).

T 121.6 Thu 17:05 POT/0351

Reconstruction of proton showers using H.E.S.S. — •Benedetta Bruno, Jonas Glombitza, and Stefan Funk for the H.E.S.S.-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen Centre for Astroparticle Physics, Nikolaus-Fiebiger-Str. 2, 91058 Erlangen, Germany

Imaging Atmospheric Cherenkov Telescopes (IACTs) - like the High Energy Stereoscopic System (H.E.S.S.) - observe extensive air showers initiated by gamma rays and cosmic rays (CRs) when interacting with the Earth's atmosphere. IACTs image the distribution of Cherenkov light emitted by air shower particles as they propagate toward the Earth's surface. The traditional reconstructions of the properties of the gamma rays rely on the Hillas parameterization, which reduces the measurement to a few characteristics using elliptical modelling of the image.

For the analysis of cosmic rays, which are usually considered background in gamma-ray astronomy, the reconstruction is more challenging. Since the development of hadronic-induced shower is subject to larger fluctuations, the detected IACT images feature deviations from the typical elliptical shape, making modifications necessary.

In this contribution, we utilize H.E.S.S. simulations to investigate the reconstruction of protons using the Hillas parametrization. In addition, we discuss the potential to use deep-learning-based reconstruction techniques to overcome the limits of the Hillas approach and outline the potential of H.E.S.S. data to measure the CR spectrum.