Astronomy and Astrophysics from Antarctica

September 8-10, 2021 Virtual Meeting

Contribution ID: **29**

Type: **not specified**

The IceCube Surface Array Enhancement - A comprehensive overview of the planned cosmic-ray surface detector at the South Pole

Thursday, 9 September 2021 11:45 (15 minutes)

The IceCube Neutrino Observatory is a Cherenkov light detector located deep in the Antarctic ice. A cosmic-ray detector at the surface, named IceTop, composed of Ice-Cherenkov tanks complements the in-ice detector. A Surface Array Enhancement for the IceCube Neutrino Observatory is planned to be deployed in the near future at the South Pole. It will consist of 32 hybrid stations positioned within the current IceTop footprint. Each station of the surface enhancement has one central hybrid DAQ connecting 8 scintillator panels and 3 radio antennas, all elevated to avoid snow coverage. The surface enhancement will considerably increase the detection sensitivity to air showers in the ~100 TeV to EeV primary energy range, mitigate the effects of snow accumulation on the existing IceTop tanks, and be the first step of a future large-scale surface array of IceCube-Gen2 using the same technology. The DAQ and its related components are designed to be easily integrated into the already existing computing, timing, and communication infrastructure of IceCube. In January 2020, a complete prototype station comprising 8 scintillator panels and 3 antennas was deployed and is continuously operating. In this talk, we will try to give a comprehensive view of the development, deployment, and maintenance of a remotely accessible detector and will present some results of the first cosmic-ray induced air-showers detected by the prototype station. We will conclude with an outlook on the scientific prospects of the IceCube-Gen2 surface array whose design builds on the successful experience with the prototype station and extends the planned surface enhancement of IceTop.

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Session Classification: Science