

# Cosmic-Ray Studies with the Surface Instrumentation of IceCube

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IceCube is a cubic-kilometer Cherenkov detector installed in deep ice at the geographic South Pole. IceCube's surface array, IceTop, measures the electromagnetic signal and mainly low-energy muons from extensive air showers above several 100 TeV primary energy, with shower bundles and high-energy muons detected by the in-ice detectors. In combination, IceCube and IceTop provide unique opportunities to study cosmic rays in detail with large statistics. This contribution summarizes recent results from these studies. In addition, the IceCube-Upgrade will include a considerable enhancement of the surface detector through the installation of scintillation detectors and radio antennas and possibly small air-Cherenkov telescopes. We will discuss the results of the prototype detectors installed at the South Pole and the prospects of this enhancement as well as the surface array planned for IceCube-Gen2.

## Keywords

Cosmic Rays, Energy Spectrum, Composition, Hadronic Interaction Model, Transition Region

## Collaboration

IceCube

## other Collaboration

## Subcategory

Experimental Results

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