

The Surface Array planned for IceCube-Gen2 – *Executive Summary*

Frank G. Schröder for the IceCube-Gen2 Collaboration

The IceCube-Gen2 Surface array will extend the design of the IceTop enhancement consisting of hybrid stations with scintillators and radio antennas at the surface to the full area of the Gen2 optical array. This increases the surface-only aperture by a factor of 8-10, and the aperture for coincidences with the deep in-ice detector by more than a factor of 30. This unique combination of a surface with a deep detector at the South Pole enables a rich science case supporting the mission of IceCube-Gen2.

Veto for the IceCube-Gen2 Optical Array

- Increased sensitivity for downgoing neutrinos for a large range of zenith angles
- Check high-energy neutrino candidates identified by the real-time alert system
- Test applicability of surface antennas as veto for $> 10\text{PeV}$ inclined neutrino candidates

Hadronic Interactions in Air Showers

- Investigate transition from conventional to prompt muon fluxes around $0.5 - 1\text{PeV}$
- Scrutinize interaction models by muon spectroscopy (GeV at surface, TeV in ice)
- Extend muon measurements at surface to 0.5EeV for overlap with AMIGA at Auger

Most energetic Galactic Cosmic Rays (and transition to extragalactic CRs)

- Unprecedented accuracy for primary mass by combination of surface and deep detectors
- Extend energy range of large-scale dipole anisotropy at high statistical significance
- Increase IceCube's exposure for PeV photon searches by an order of magnitude

Cross-check Calibration of in-ice Detectors (optical and radio arrays)

- In-situ measurement of cosmic-ray flux and muon tagging for in-ice optical array
- Provide energy estimate of vertical showers for calibration of in-ice radio array
- Cross-calibrate absolute energy scale for cosmic-ray air showers by radio antennas