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Instrumentation for the Scintillator Upgrade of IceTop

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IceCube is a cubic-kilometer neutrino detector installed in the ice at the geographic South Pole. It comprises a deep-ice detector (installed between 1450 and 2450 m under the ice surface) and a surface array called IceTop, featuring 162 tanks with frozen water. More than five thousand photomultipliers detect the Cherenkov light emitted by charged particles; these detections are used to reconstruct energy and direction of those particles and their progenitors which have cosmic origins.
Over the past twelve years, snow accumulation on top of the IceTop tanks has reached depths that affect the sensitivity to low energy cosmic-ray showers. The IceCube Collaboration plans to install a few hundred homogeneously spaced scintillator detectors as a new calibration instrument for the IceTop tanks. Each detector features extruded plastic scintillator bars and wavelength shifting fibers, which collect the scintillation light produced by minimum ionizing particles and guide it to a silicon photomultiplier. Custom readout electronics allows for the precise measurement of light pulses from a single photo-electron to tens of thousands and features nanosecond time resolution, with the ability to resolve time development of complex light pulses of order one hundred nanoseconds in duration.
Prototypes of such detectors have been installed over the last austral summer. The project will also serve as a platform to develop instrumentation, electronics and an infrastructure system that could be scaled to a future large array, spanning up to 20 thousand sensors distributed over 75 km^2.

Primary author: TOSI, Delia (WIPAC / University of Wisconsin Madison)

Presenter: TOSI, Delia (WIPAC / University of Wisconsin Madison)

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