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An electronically steered phased-array for the radio detection of high-energy neutrinos

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Radio detector arrays such as RICE, ANITA, ARA, and ARIANNA target the discovery of both cosmogenic neutrinos and the sources of the PeV-scale astrophysical neutrinos observed by IceCube. These radio arrays exploit the Askaryan effect and the radio transparency of glacial ice, which together enables the economical instrumentation of necessarily large volumes of ice. We describe here the electronics design of a digitally-phased radio array that would both lower the energy threshold of existing radio detectors and provide a more efficient coverage of the instrumented volume of ice.

A real-time trigger board digitizes 8 antennas each at 7-bit resolution and at a Nyquist sampling rate of 1.5 GHz.

The digital correlation between antennas in the array is performed in an on-board field-programmable gate array, which includes several gigabit serial-links to daisy chain trigger boards in order to phase larger arrays. The first implementation of this radio phased-array will be as a dynamic vertically-polarized trigger for the ARA detector at the South Pole. We will characterize the electronics in-situ and use the 16-antenna phased array as an impulsive triggering device in this initial installation planned for 2017.

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