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IceCube-Gen2 Radio Array Surface Calibration: Opportunities from Unique Transmitter and Receiver Systems [Time: 8+4]

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Calibration of the IceCube-Gen2 radio array requires calibrations of the RF channels of stations, and constraining effects from the ice surrounding the channels. Regarding RF channel calibration, experience with ARA and ARIANNA has demonstrated the utility of fixed heartbeat calibration pulse units that probe RF channel response from a fixed location over time. Heartbeat units are operated by station electronics and are installed beneath the surface at locations horizontally separated from RF channels. There are advantages, however, to adding calibration measurements for constraining ice effects from temporary, above-surface fixed transmitters not connected to a station. In a recent publication, the ARIANNA collaboration presented a suite of measurements collected in Moore's Bay and at the South Pole by the RICE collaboration. These measurements revealed horizontal RF propagation over kilometer distances despite expectations given the index of refraction profile of the firn. The mathematics of ray-tracing suggests that horizontal propagation is forbidden in the absence of perturbations in the index of refraction profile. Similar measurements in Greenland also reveal this effect. Repeating such measurements for IceCube-Gen2 would add value by constraining horizontal propagation and attenuation in the actual ice in which the detector is deployed. Another technique that would add value beyond heartbeat units would make use of drone borne transmitters and receivers. Heartbeat units provide single-point azimuth and zenith measurements over time, but cannot probe angular parameter space. Proposed hybrid station designs will require calibration of the radiation pattern and polarization of deployed RF channels built from both dipole and LPDA antennas at different depths and orientations. Finally, drone borne transmitters and receivers would provide a unique opportunity to constrain horizontal variations in the RF attenuation length and birefringence over kilometer distances.

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