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Finite Difference Time-Domain Methods for Askaryan Propagation Modeling in IceCube-Gen2 [Time: 8+0]

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The radio array design of IceCube-Gen2 relies on an understanding of the propagation of Askaryan radiation from UHE neutrino signals through the South Pole firn. Classical ray-tracing techniques are implemented in our standard Monte Carlo package, NuRadioMC, to solve the problem of arrival angle and location of surface signals that have curved paths through a changing index of refraction. The classical solution is based on the connection between density and RF index of refraction, and may be derived analytically while introducing just two free parameters. The model does not account for observed horizontal propagation, and it does not account for wavelength-dependent effects. MEEP is a fast, parallel computational implementation of Maxwell's equations with a time-tested suite of electromagnetic field calculation tools in media with complex dielectric constants. Based on the FDTD approach, MEEP can be used to model RF antenna response, to predict electric field strength in complex propagation problems, including analytic Askaryan RF emission model radiation propagation through firn. Finally, note that the radio array of IceCube-Gen2 includes phased arrays of identical RF elements in an environment with potentially varying index of refraction. Tools like FDTD will have to be deployed to understand the effect of the varying index on phased array properties.

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