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End-to-end optimization of in-ice radio neutrino detectors using differentiable programming

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In-ice radio detection of neutrinos is a rapidly growing field and a promising technique for discovering the predicted but yet unobserved ultra-high-energy astrophysical neutrino flux. With the ongoing construction of the Radio Neutrino Observatory in Greenland (RNO-G) and the planned radio extension of IceCube-Gen2, we have a unique opportunity to improve the detector design now and accelerate the experimental outcome in the field for the coming decades. To achieve this goal, we have developed a fully differentiable end-to-end simulation, detection, and reconstruction pipeline that allows for efficient optimization of detector parameters with respect to a science outcome. In this presentation, I will discuss the prospects of measuring the ultra-high-energy neutrino flux with in-ice radio detectors, how we can optimize physics detectors with differentiable and GPU programming, and relate it to other applications in neutrino physics theory and analyses.

Primary author: RAVN, Martin

Co-authors: GLASER, Christian (Uppsala University); PILAR, Philipp (Uppsala University)

Presenter: RAVN, Martin

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