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Interferometric Reconstruction and Analysis Methods for the Askaryan Radio Array

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Reconstruction of potential ultra-high-energy (UHE) neutrino events at the Askaryan Radio Array (ARA) is complicated by the variable index of refraction of South Pole ice, leading to curved radio signal paths from the interaction vertex. We solve this computational challenge by using a multi-step spline table framework that provides information about the “firn shadow” region along with both direct and reflected signal paths. We then use this framework to enable a GPU-accelerated interferometric reconstruction of the event vertex that can be used both for online event filtering and offline analysis. We present the sensitivity of an ARA UHE neutrino search using this framework, along with potential gains of using both direct and reflected signals in reconstruction.

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