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Intrinsic Resolution Limits in Low-Energy Neutrino Event Reconstruction with IceCube

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The IceCube Observatory is a cubic-kilometer neutrino telescope built into the deep glacial ice at the South Pole. Low energy extensions to the detector include the existing DeepCore subarray and the upcoming IceCube Upgrade. These focus on neutrino oscillation physics using atmospheric neutrinos and are characterized by a denser instrumentation. These elusive particles are indirectly detected by collecting Cherenkov photons emitted by secondary charged particles produced as a result of neutrino-nucleon interactions inside the detector. The reconstruction of event information, in particular direction and energy of an incoming neutrino, is a crucial ingredient to the oscillation analyses. The accuracy of reconstruction is therefore affected by statistical fluctuations in the particle shower development as well as by photon propagation and detection efficiencies of sensors. My current research is focussed towards identifying the theoretically achievable resolution in the absence of modeling inaccuracies and computational limitations. The study aims to analyze the factors that limit reconstruction performance, which include algorithmic deficiencies such as minimizer performance and the available information contained in the events.

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