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Improving the directional reconstruction of PeV hadronic cascades in IceCube

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Abstract content

Many neutrino interactions measured by the IceCube Neutrino Observatory produce only hadronic showers, which appear as almost point-like light emission due to the large detector spacing (˜125m). At PeV energies these showers often saturate the PMTs closest to the interaction vertex - thus the reconstruction has to rely on more diffused photons which requires precise understanding of the optical properties of the Antarctic ice. Muons produced in the hadronic showers carry information about the neutrino direction, and their Cherenkov light arrives earlier than the photons emitted by the electromagnetic component. A new reconstruction method has been developed which explicitly takes into account the muonic component of hadronic showers and is shown to be robust against systematic ice uncertainties. By applying the new reconstruction, the angular resolution of multi-PeV cascade events can be significantly improved. This will potentially enable follow-up studies of the highest-energy cascade events measured by IceCube.

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