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Studies of intrinsic resolution of low energy electron and muon neutrino events with neutrino telescopes

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Existing large-volume neutrino telescopes such as ANTARES and IceCube, as well as the future KM3NeT/ARCA, investigate neutrinos at characteristic particle energies of 10TeV, whereas KM3NeT/ORCA and PINGU will operate around 10GeV to determine the neutrino mass hierarchy using atmospheric neutrinos propagated through the Earth. In this energy regime, intrinsic fluctuations in particle interactions become important.

These intrinsic fluctuations have been investigated to answer two basic questions. Firstly: How do intrinsic fluctuations limit the reconstruction accuracy of an ideal detector, i.e. if every single photon is detected? While this requires making some basic assumptions about the methods used in the reconstruction, the answer to this question will indicate the optimum that could be achieved by any detector. Secondly: Given that only a finite number of photons will be detected, what is the best possible reconstruction accuracy in the case of a perfect use of the information carried by these photons? For this study the characteristics of the KM3NeT/ORCA detector have been used. This investigation separately considers muons, electromagnetic and hadronic showers. Taking the kinematics of the neutrino interactions into account, limits on the best possible reconstruction accuracy in energy and direction for the initial neutrinos achievable with an ORCA-type detector are derived. The poster will summarise the analysis methods and results.

Collaboration

KM3NeT

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