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Neutrino-induced showers in the ANTARES Deep-Sea Telescope

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The ANTARES neutrino telescope operating in the Mediterranean Sea aims to measure the cosmic neutrino flux and locate point sources in the multi-TeV energy range. Primarily this is achieved by detecting up-going muon tracks caused by charged-current interactions of neutrinos having passed through the Earth. Neutrino-induced showers, initiated by neutral-current interactions, extend the sensitivity of the detector to all neutrino flavors. A major challenge in reconstructing showers is their identification within an overwhelming background of down-going atmospheric muons. We have developed a strategy to select up-going showers with high efficiency and purity. Atmospheric muons are suppressed largely by estimating the shower direction from the direction of light emission and rejecting down-going events. In addition, events are selected with a large amount of collected charge. We estimate the mean space-time position of the shower vertex, assuming that the shower light is emitted from a bright point, and refine the estimate by an M-estimator fit. By combining the quality cuts on observables describing the shower structure, we are able to reconstruct showers with high purity and a selection efficiency of about 22%. The parameters of the selection strategy are tuned on Monte-Carlo simulations producing the proper amount of background and atmospheric neutrino-induced showers. The method has been applied to ANTARES experimental data and the performance results will be discussed.

Summary

Neutrino-induced showers, initiated by neutral-current interactions, extend the sensitivity of the ANTARES neutrino detector to all neutrino flavors. We have developed a method to largely suppress the huge background and reconstruct showers with high purity and decent selection efficiency by combining quality cuts on observables describing the shower structure. Performance results, tuned on Monte Carlo events and applied to ANTARES experimental data will be presented.

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