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Measuring neutrino oscillations in the deep sea

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KM3NeT/ORCA is a large-volume water-Cherenkov neutrino telescope, currently under construction at the bottom of the Mediterranean Sea at a depth of 2450 meters. The main goal of this experiment is to determine the neutrino mass ordering as well as measuring atmospheric neutrino oscillation parameters. Beyond these goals, the detector also exhibits sensitivity to diverse phenomena such as non-standard neutrino interactions, sterile neutrinos, and neutrino decay. This contribution describes the state of the art of measuring neutrino oscillations with KM3NeT as well as the use of a machine learning framework for building Deep Neural Networks (DNN) for energy regression to boost the experiment's sensitivity. By combining data from six detection units, the optimization of these models attempts to improve the oscillation analysis by using a sizable data sample of 433 kton-years from KM3NeT/ORCA. The performance of the DNN is assessed by determining the sensitivity to oscillation parameters in comparison with the conventional energy reconstruction methods of maximizing a likelihood function. The results demonstrate the DNN's ability to provide an improved energy estimate, exhibiting less bias within the context of oscillation analyses. This research not only contributes to the refinement of neutrino detection methodologies but also serves as an example on how the use of machine learning techniques may improve the precision of data analyses in the realm of neutrino physics.

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