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KM3NeT - ORCA: Measuring neutrino oscillations and the mass hierarchy in the Mediterranean

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The atmospheric flux of neutrinos has traditionally been seen as a background to the detection of an astrophysical neutrino signal. In recent years however, it has been realised that in the few-GeV range, this flux holds the key to resolving a fundamental question of particle physics: that of the neutrino mass hierarchy, i.e. whether the mass eigenstate ν_3 is heavier (normal hierarchy) or lighter (inverted hierarchy) than the ν_2 and ν_1 states.

The influence of the mass hierarchy on neutrino oscillations in matter leaves its imprint on the atmospheric neutrino flux via the characteristic appearance/disappearance patterns of different neutrino types as a function of energy and path through the Earth. ORCA - Oscillations Research with Cosmics in the Abyss - will be a dense configuration of KM3NeT detection units, optimised for studying the interactions of neutrinos in seawater at low energies. To be deployed at the French KM3NeT site, ORCA's multi-PMT optical modules will take advantage of the excellent optical properties of deep seawater to accurately reconstruct both cascade and track events with a few GeV of energy. This contribution reviews these methods and technology, and compares ORCA's power for not only determining the neutrino mass hierarchy, but placing new constraints on other key parameters such as θ_{23}, with other current and near-future experiments.

Collaboration

KM3NeT

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