Sensitivity of the KM3NeT/ORCA detector to the neutrino mass ordering and beyond

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The KM3NeT collaboration is currently building a new generation of large-volume water-Cherenkov neutrino telescopes in the Mediterranean sea. Two detectors, ARCA and ORCA, are under construction. They feature different neutrino energy thresholds: TeV range for ARCA and GeV range for ORCA. The main research goal of ORCA is the measurement of the neutrino mass ordering and atmospheric neutrino oscillation parameters.

With three years of data taking with the full detector, KM3NeT will be able to determine the neutrino mass ordering at 4.4σ is the true order is normal and 2.3σ if inverted. This results accounts for systematic uncertainties on the oscillation parameters, neutrino flux, cross-section and detector response.

A similar analysis indicates that the precision to determine θ_{23} and Δm^2_{32} will be improved signigicantly with respect to the current status. The expected 90% confidence level interval on Δm^2_{32} and θ_{23} are $85 \cdot 10^{-6}\,\mathrm{eV}^2$ and $(^{+1.9}_{-3.1})^\circ$ for NO and, $75 \cdot 10^{-6}\,\mathrm{eV}^2$ and $(^{+2.0}_{-7.0})^\circ$ for IO. The data will also help in resolving the θ_{23} octant.

KM3NeT-ORCA will also benefit from an unprecedented large sample of $\overset{(-)}{\nu}_\tau$ which will allow to test the PMNS unitarity by measuring the $\overset{(-)}{\nu}_\tau$ normalisation. This normalisation can be constrained to $\pm 30\%$ at 3σ-level and to $\pm 10\%$ at 1σ-level after one year of data taking.

Finally ORCA can be used as far detector for a tagged long baseline neutrino experiment from U70 Protvino. The large size of the detector allows to operate at a modest beam power and thus to instrument the beam line with trackers. These trackers can be used to reconstruct kinematically the neutrino when they are produced. Such an experiment will allow to determine δ_{CP} with a precision which is stable over the whole span of δ_{CP} values and ranges between 6° and 8°.