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KM3NeT: from deep-sea technology to high-energy neutrino discoveries

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KM3NeT is a cutting-edge neutrino observatory under construction in the Mediterranean Sea, aimed at exploring fundamental questions in neutrino physics and high-energy astrophysics. The project features two deep-sea Cherenkov detectors: ARCA, located off the coast of Sicily and optimized for detecting cosmic neutrinos in the TeV–PeV range, and ORCA, situated near the French coast, which focuses on precise measurements of atmospheric neutrinos and oscillation parameters in the GeV energy range.

Although still under construction, both detectors are already operational and producing competitive scientific results. A landmark achievement is the recent detection by KM3NeT/ARCA of an ultra-high energy neutrino event, referred to as KM3-230213A, with a reconstructed energy of 220 PeV. This observation, representing the highest-energy neutrino ever recorded, marks a significant milestone for the experiment, opening new avenues for studying extreme astrophysical environments and the origin of cosmic neutrinos. In addition to its core scientific program, KM3NeT actively participates in the realm of multi-messenger astronomy, contributing real-time neutrino alerts to global networks and enabling prompt follow-up observations in electromagnetic and gravitational waves.

This presentation will provide an update on the status of the KM3NeT infrastructure and its deployment, highlight the latest scientific findings —particularly the implications of the recent high-energy neutrino detection —and outline the potential for future discoveries with the full-scale detector arrays.

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