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P-ONE: The Pacific Ocean Neutrino Experiment A Next-Generation Deep-Sea Neutrino Detector for Fundamental Physics

The Pacific Ocean Neutrino Experiment (P-ONE) is a next-generation neutrino observatory planned for deployment in the deep Pacific Ocean off the coast of Canada. By detecting high-energy (up to the PeV scale) and ultra-high-energy (above the PeV scale) cosmic neutrinos with unprecedented sensitivity and resolution, P-ONE will probe extreme cosmic environments—such as those powered by black holes—where particle physics and gravity converge. P-ONE capitalizes on Ocean Networks Canada’s (ONC) world-class infrastructure to establish a stable, long-term, deep-sea platform for neutrino detection. Its innovative architecture, in which each detection line functions as a fully integrated unit, enables precise event reconstruction, continuous calibration, and seamless multi-messenger synergy with observatories such as IceCube, KM3NeT, Baikal-GVD, and gravitational-wave detectors. In addition to advancing fundamental physics, P-ONE integrates oceanographic instrumentation to monitor environmental parameters over long time baselines, supporting marine and climate sciences. With strong international collaboration, European and Canadian institutional leadership, and a phased deployment strategy, P-ONE is poised to become a key pillar in the future of high-energy neutrino astro-particle physics. Its inclusion in the European Particle Physics Strategy Update would consolidate Europe’s leadership in neutrino and cosmic messengers research, ensure P-ONE’s pivotal role in addressing fundamental questions about our Universe, and enhance the resilience of neutrino studies against present and future geopolitical challenges.

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