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Astrophysical Probes of New Physics: From Neutron Stars to High-Energy Neutrinos

Wednesday, 25 June 2025 13:30 (1 hour)

Axion-like particles (ALPs) appear in many beyond-the-Standard-Model theories, either as candidatesfor dark matter or as partners of the axion that explains the apparent conservation of charge-parity symmetry, known as the strong CP problem. In the first part of the talk, I will present a novel method for probing ALPs using eclipsing binary systems which can serve as an astrophysical realization of light-shining-through-walls experiments. Such systems are composed of a neutron star that is bright in X-rays and a larger companion star, through which ALPs produced via conversion in the neutron star's magnetosphere can pass during the eclipse. The ALPs then partially reconvert into photons in the interstellar medium on their way to Earth, and the resulting X-rays are detectable by space observatories such as XMM-Newton.

In the second part of the talk, I will focus on the recently reported KM3-230213A neutrino event reported by the KM3NeT collaboration, which is nearly an order of magnitude more energetic than the highest-energy neutrino in IceCube's catalog. Despite its larger effective area and longer data-taking period, IceCube has not observed events of similar energies, which implies a 2-3σ tension, depending on the type of neutrino source. The 220 PeV neutrino, detected at KM3NeT, traversed approximately 150 km through rock and sea, whereas neutrinos from the same location in the sky would cross only about
10 km of ice to reach IceCube. I will show how this difference in propagation distance helps to resolve this tension in the framework of a model containing a light sterile neutrino.

Please choose your topic

Compact Objects & Particles

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