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Hidden neutrino interactions with dark energy: Effects on oscillation probabilities and tests with high-energy neutrinos

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If dark energy is some kind of scalar field rather than a cosmological constant and can interact with the neutrino sector, it might cause CPT/Lorentz violating effects and also modifies the neutrino oscillation phenomenology. The effects will be insignificantly small compared to the ordinary oscillation effect at low energies, but might become visible in very high energies, since the terms in the transition probability induced by interactions with dark energy do not depend on the energy, while the ordinary component decreases with $1/E$. If such dark energy effects were found, it would be a strong indication that the nature of dark energy is different from a cosmological constant. We investigate the effect of such a dark energy interaction in the three-neutrino scheme and use IceCube data to put constraints on the new oscillation parameters that emerge from this interaction.

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