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Bounds on ultra-long-range flavored neutrino interactions with IceCube

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High-energy astrophysical neutrinos, with TeV–PeV energies, are acutely sensitive to the existence of potential new flavor-dependent interactions with the electrons around them. For the first time, we probe this possibility by looking for deviations in the flavor composition of the astrophysical neutrinos seen by IceCube. At these energies, the relative contribution of standard oscillations is weakened, compared to the contribution of the new interaction . We choose a physically motivated scenario where the interaction is mediated by a new neutral vector boson. We explore the possibility that it is ultra-light, with a mass of 10^{-10} eV or smaller, which makes the interaction range ultra-large, between 10^4 km and a few Gpc. Because the number of electrons contained within these distances is huge, they could signifcantly distort the flavor composition of astrophysical neutrinos, even if the new coupling is feeble. Based on IceCube results on flavor composition, we set tight bounds on the existence of ultra-light mediators, down to tiny masses of 10^{-35} eV.

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