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Secret neutrino interaction at rare meson decay and neutrino experiments

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Secret coupling of neutrinos to a new light vector boson, Z′, with a mass smaller than few hundred MeV is motivated within a several scenarios which are designed to explain various anomalies in particle physics and cosmology. Due to the longitudinal component of the massive vector boson, the rates of three-body decay of charged mesons (M) such as the pion, kaon and D mesons to the light lepton plus neutrino and Z' ($M \to l\nu Z'$) are enhanced by a factor of $(m_M/m_{Z'})^2$ and followed by the subsequent decay of Z' into the pair of neutrino and anti-neutrino. On the other hand, the standard two body decay $M \to l\nu$ is suppressed by a factor of $(m_l/m_M)2$ due to chirality.
Consequently, this new interaction can be examined through meson decay experiments, involving the detection of the charged lepton, and in neutrino experiments, which change the neutrino spectrum. The strongest current bound comes from kaon decay experiment the NA62 experiment. We investigate the potential of future neutrino experiments for identifying specifically ν_τ appearance in probing secret neutrino interactions.

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