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Overview and future of Lorentz and CPT invariance searches in the neutrino sector

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The violation of Lorentz invariance is predicted by most of the theories beyond the Standard Model as string theories or quantum loop gravities. It arises as a consequence of merging the Standard Model with gravity, whose effects appear at the Planck mass scale. Therefore, the observation of the violation of Lorentz invariance (and CPT invariance) is searched as a very strong hint of physics beyond the Standard Model and the first sign of physics at the Planck mass scale.

In this talk, we will give an overview of the most recent searches of these effects in the neutrino sector. Indeed, through interferences between the neutrino mass states, neutrino oscillations are one of the most sensitive probe to this effect. However, the potential for discovery in this sector is limited by the impossibility to provide a joint fit of these different results, due to fundamental inconsistencies in the way the different experiments present their limit on the model parameters. We will propose one possible way to solve this issue in the future, through the example of the T2K search for Lorentz invariance violation. We will finally conclude on the exciting potential of the coming generation of neutrino oscillation experiments.

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