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Testing Lorentz invariance in β decay

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In theories aiming to unify the Standard Model with gravity, Lorentz invariance may be broken. Although Lorentz symmetry appears to hold well, few experiments have been performed that consider its violation in the weak interaction. We have started a theoretical and experimental research program to this effect. We consider a Lorentz violating correction of the W-boson propagator, characterized by a tensor. With this extension of the Standard Model the β-decay rate will depend, on how the spin of the parent nucleus and the emission direction of the β and ν particles are oriented in absolute space. We explore the consequence for allowed Fermi and Gamow-Teller transitions and the spin degrees of freedom in the latter.

Experimentally we exploit the Gamow-Teller transition of polarized ^{20}Na, where we can test the dependence of the β-decay rate on the spin orientation of ^{20}Na. The polarization is measured using the β asymmetry, while the decay rate is measured by the γ yield. A change in the γ rate, when reversing the spin, implies Lorentz invariance violation. The decay rate should depend on sidereal time and the polarization direction relative to the rotation axis of the earth. The method of the measurement will be presented, together with the first results.