LORENTZ SYMMETRY VIOLATION AND UHECR EXPERIMENTS

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Lorentz symmetry violation (LSV) at Planck scale can be tested through ultra-high energy cosmic rays (UHECR). We discuss deformed Lorentz symmetry (DLS) and energy non-conservation (ENC) patterns where the effective LSV parameter varies like the square of the momentum scale (e.g. quadratically deformed relativistic kinematics, QDRK). In such patterns, a $\approx 10^{-6}$ LSV at Planck scale would be enough to produce observable effects on the properties of cosmic rays at the $\approx 10^{20}\ eV$ scale: absence of GZK cutoff, stability of unstable particles, lower interaction rates, kinematical failure of any parton model and of standard formulae for Lorentz contraction and time dilation... Its phenomenological implications are compatible with existing data. Precise signatures are discussed in several patterns. If the effective LSV or ENC parameter is taken to vary linearly with the momentum scale (e.g. linearly deformed relativistic kinematics, LDRK), contradictions seem to arise with UHECR data. Consequences are important for UHECR and high-energy gamma-ray experiments, as well as for high-energy cosmic rays and gravitational waves.