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# Testing fundamental principles with high-energy cosmic rays

It is not yet clear whether the observed flux suppression for ultra-high energy cosmic rays (UHECR) at energies above 4.10E19 eV (AUGER, HiRes) is a signature of the Greisen-Zatsepin-Kuzmin (GZK) cutoff or corresponds to the maximum energies available at the relevant sources. Both phenomena can be sensitive to violations of standard special relativity modifying cosmic-ray propagation or acceleration at very high energy, and would allow to set bounds of Lorentz symmetry violation (LSV) parameters in models incorporating a privileged local reference frame (the "vacuum rest frame", VRF). These effective parameters are expected to be directly linked to Planck-scale physics, or even to physics beyond Planck scale, as well as to the dynamics relating LSV patterns for nucleons, quarks, leptons and the photon. Other possible violations of fundamental principles and conventional basic hypotheses (quantum mechanics, energy and momentum conservation, vacuum homogeneity and "static" properties, effective space dimensions...) can also be considered and tested in high-energy cosmic-ray phenomena. We present an updated discussion of the theoretical and phenomenological situation, including new ideas and prospects for earth-based and space experiments.

**Auteur principal:** Dr GONZALEZ-MESTRES, Luis (LAPP)

**Orateur:** Dr GONZALEZ-MESTRES, Luis (LAPP)

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