

New test of the Lorentz invariance by observations of air shower maximum depths at ultra-high energies

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Abstract. Departures from exact Lorentz invariance suggested by Coleman and Glashow to undo the Greisen, Zatspin and Kuzmin cutoff may also be tested in extensive air shower experiments by observing shower maximum depths at energies above $5 \cdot 10^{19}$ eV. Lorentz-violating kinematics reveals new phenomena with confirm not only the cosmological origin of the most energetic cosmic ray particles suggested by Farrar and Bierman but predict also stable neutral pions change the longitudinal development of air shower

that may be detected. Comparison with the shower maximum depth of the highest energy event observed by the Fly's Eye air shower detector to constraint of maximum attainable velocity difference of photon and neutral pions as small as $c_\gamma - c_{\pi^0} < 10^{-20}$. If upper error bar is taken into account then even strongest constraint as small as 10^{-20} may be reached.

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