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Hypothetical Lorentz invariance violation and the muon content of extensive air showers

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Extensive air showers (EAS), produced by cosmic rays in the atmosphere, serve as probes of particle interactions, providing access to energies and kinematical regimes beyond the reach of laboratory experiments. Measurements from multiple cosmic-ray detectors indicate a significant, yet unexplained, discrepancy between the observed muon content in EAS and that predicted by state-of-the-art interaction models, suggesting a need for refinements in our understanding of fundamental physics. Here we show that a tiny, experimentally allowed, violation of the Lorentz invariance may result in the suppression of the number of electrons in EAS, leaving the muon number intact and explaining both the “muon excess” and its energy dependence. Future experimental tests of this scenario are outlined.

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