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First Lorentz Invariance Violation constraint from a cooperation of Imaging Atmospheric Cherenkov Telescopes

Lorentz invariance violation (LIV) arises from modifications to the dispersion relation of massless particles in effective models attempting to coherently merge quantum field theories and general relativity. One way of detecting or constraining LIV effects is by measuring time delays in the arrival of high-energy photons from astrophysical sources. Suitable targets are variable, distant and highly energetic objects such as pulsars, gamma-ray bursts (GRBs), and active galactic nuclei (AGN) flares. However, a major challenge arises from intrinsic time lags due to source-specific emission processes. To improve the precision of these measurements and distinguish potential LIV-induced delays from intrinsic effects, a collaborative effort has been established among major Imaging Atmospheric Cherenkov Telescopes (IACTs): H.E.S.S., MAGIC, VERITAS, and the first Large-Sized Telescope (LST-1) of CTAO. The Gamma-ray LIV Working Group (γ LIV WG) aims to combine observational data from multiple sources, enhancing the sensitivity and robustness of LIV searches. We present the first set of limits on the LIV energy scale derived from a combination of real data from IACT experiments.

Collaboration(s)

CTAO, H.E.S.S., MAGIC, VERITAS

Authors: BOLMONT, Julien (LPNHE Paris); CAMPOY, Anna (IEEC); CAROFF, Sami (Univ. Savoie Mont Blanc, CNRS, Laboratoire d'Annecy de Physique des Particules - IN2P3, 74000 Annecy, France); KERSZBERG, Daniel (LPNHE); PENSEC, Ugo (LPNHE); PLARD, Cyann; STRIŠKOVIĆ, Jelena (Josip Juraj Strossmayer University of Osijek, Department of Physics, Osijek, Croatia); TERZIĆ, Tomislav (University of Rijeka); WONG, Samantha

Presenter: PLARD, Cyann

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