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Probing Lorentz Invariance Violations with the MAGIC telescopes

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Abstract: Lorentz Invariance Violation (LIV), as predicted by several quantum gravity models, can manifest in very tiny energy-dependent gradients of light speed in vacuum, dispersing time of flight (ToF) along the path from source to observer for photons of different energy. Despite being suppressed by the Planck energy, LIV effects in the ToF of photons can be amplified by huge cosmological distances. Gamma-Ray Bursts (GRBs) are therefore perfect candidates for detecting LIV. On January 14, 2019, the most energetic photons ever observed from a gamma-ray burst were recorded by the Major Atmospheric Gamma Imaging Cherenkov (MAGIC) telescopes. GRB190114C was used to probe LIV effects in the ToF of gamma rays. From a set of conservative assumptions on the possible intrinsic spectral and temporal evolution, competitive lower limits on the quadratic leading order modification of the speed of light were obtained. The first LIV test ever performed on a gamma-ray burst signal at TeV energies has been performed, which will serve as a stepping stone to future studies.

Primary author: D'AMICO, Giacomo (University of Bergen)

Co-authors: KERSZBERG, Daniel; MARTINEZ, Manel; PERENNES, Cédric; RICO, Javier

Presenter: D'AMICO, Giacomo (University of Bergen)

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