

# Exploring the Universe's Transparency through Lorentz Invariance Violation and Doubly Special Relativity in Astrophysical Phenomena

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**Abstract:** In this talk, I will present phenomenological approaches to quantum gravity that introduce modifications to the standard energy–momentum relation of Special Relativity or alter the composition of momenta in interaction processes. Such effects, particularly relevant for high-energy particles like gamma rays, may provide an observational window into quantum-gravitational phenomena. I will focus on two main frameworks: Lorentz Invariance Violation (LIV), where Lorentz symmetry is broken, and Doubly Special Relativity (DSR), where it is deformed. The implications of these scenarios for the propagation of high-energy gamma rays will be discussed, with particular emphasis on their impact on the transparency of the Universe. Finally, I will outline how the sensitivity of the future Southern Wide-field Gamma-ray Observatory can be assessed by combining extrapolated intrinsic source spectra from the literature with attenuation effects induced by LIV, consistent with current constraints from experiments such as LHAASO and H.E.S.S.