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Investigating the properties of the EAS simulated with LIV pair production cross-sections

One of the intriguing possibilities in the search for the new physics in ultra-high energy cosmic rays (UHECR) is the discovery of the Lorentz invariance violation (LIV). Several studies have investigated the consequences of the different LIV scenarios for cosmic ray physics and their influence on the measured properties of the extensive air showers (EAS). Yet, only recently, a new approach was considered: the suppression of the Bethe-Heitler e^+e^- pair production cross-sections for gammas of ultra-high energy. A deviation from the standard e/m physics adopted in the existing simulation codes can significantly affect the interpretation of the UHECR experimental data.

In this study, we investigate, how reducing the pair production cross-sections for very energetic gammas changes the measured EAS properties. The most essential of them are: the form of the cascade curve (CC), the shower maximum position ($X_{\max}$) and the number of particles recorded at the ground level (N_μ, N_e). A special attention is payed to the case of the inclined air-showers (with large zenith angle), as it is vital to consider the zenith-angle dynamics of the introduced changes in order to estimate the scale and validity of the proposed hypothesis.

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