Preprint Series in Particles and Cosmos Physics

nº IPARCOS-UCM-24-044

Generalised Cherenkov radiation

by M. Artola, J. A. R. Cembranos, and P. Martín-Moruno

July 2024

Plaza de las Ciencias, 1 28040 Madrid, Spain

www.ucm.es/iparcos/

IPARCOS

INSTITUTO DE FÍSICA
DE PARTÍCULAS Y DEL COSMOS

UNIVERSIDAD COMPLUTENSE MADRID

IPARCOS
INSTITUTO DE FÍSICA
DE PARTÍCULAS Y DEL COSMOS

Abstract

It is believed that Lorentz invariance might not be an exact symmetry of nature at all energy scales, and this possibility has been primarily motivated from quantum gravity. In particular, modified dispersion relations are considered as encapsulating quantum gravity phenomenology. In the present work we propose a class of Lorentz invariance violating phenomenological dispersion relations, different for each particle species, to study the generalized vacuum Cherenkov radiation process. We start by identifying the kinematic regions where the process is allowed, and then compute the energy loss rate of electromagnetic and gravitational vacuum Cherenkov radiation. Afterwards, we obtain the constraints for the Lorentz invariance breaking parameters for protons and gravitons using ultra high energy cosmic ray detections via the existence or absence of vacuum gravitational Cherenkov radiation.

UNIVERSIDAD COMPLUTENSE MADRID