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Cherenkov Radiation from Quantum Vacuum in Pulsars

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This work investigates Cherenkov radiation originating from the quantum vacuum in pulsars. These compact astronomical objects, characterized by extreme magnetic fields, emit radiation as they rotate. By analyzing the vacuum polarization near the pulsar's surface, we explore the contribution of Cherenkov radiation to the pulsar's electromagnetic spectrum. Preliminary results, based on the literature, involve using the Euler-Heisenberg Lagrangian. This Lagrangian accounts for vacuum polarization in the weak-field limit and provides the dispersion relation for a photon in a background magnetic field region. Notably, the vacuum in the presence of an extreme magnetic field exhibits an effective permittivity constant that depends on the field' s intensity. Analogous to Maxwell's theory in material media, the electromagnetic spectrum of Cherenkov radiation is derived from the Euler-Heisenberg Lagrangian. Our study sheds light on the intriguing nonlinearity of electrodynamics in these astrophysical sources and plays a crucial role in understanding the emission processes of pulsars.

Primary author: Mr AUGUSTO OLIVEIRA GOMES, Tales (UFES)

Co-author: GOULART COELHO, Jaziel (Universidade Federal do Espírito Santo (UFES))

Presenter: GOULART COELHO, Jaziel (Universidade Federal do Espírito Santo (UFES))

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