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Electromagnetic Cascades as probes of the High and Ultra-High Energy Universe

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It is well known that our Universe is opaque to high-energy gamma-rays due to electromagnetic cascades over cosmological distances, resulting in a spectrum of secondary gamma-rays at lower energies. In this talk, we will summarize the physics and features of such cascades and discuss their importance in the context of multimessenger astrophysics up to ultra-high energies. In particular, we demonstrate how one can infer properties of the IceCube neutrino sources from their corresponding cascaded gamma-ray counterparts. We also show how muon pair production can play an important role in the cascade development at high-redshifts, leading to the production of ultra-high energy neutrinos.

Primary authors: Mr ESMAEILI, AmirFarzan (Pontificia Universidade Católica do Rio de Janeiro); CAPANEMA, Antonio (Pontificia Universidade Católica do Rio de Janeiro); ESMAILI, Arman (Pontificia Universidade Católica do Rio de Janeiro); SERPICO, Pasquale Dario (CNRS, Laboratoire d'Annecy-le-Vieux de Physique Théorique (LAPTh), France)

Presenter: CAPANEMA, Antonio (Pontificia Universidade Católica do Rio de Janeiro)

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