Testing the photon and foundations of electromagnetism

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The Standard-Model Extension (SME) induces a mass to a photon [1,2], the only SM free massless particle. Observations of Fast Radio Bursts [3-5] and solar wind plasma [6,7] allowed estimates and limits listed in the Particle Data Group reviews. SME, classic (de Broglie-Proca and others) massive and non-linear electromagnetism theories (Born-Infeld, Heisenberg-Euler and others) determine a frequency shift of the photon in presence of a background, with which it exchanges energy [8]. This shift, added to expansion red shift, determines new cosmological scenarios, e.g., without recurring to the accelerated expansion to explain Supernovae data [9-11]. The upper limit of this shift would be 7.7×10^{-27} Delta f/f per metre which implies 2.9×10^{-18} in Delta f/f for an interferometer simulating the Earth-Moon distance. Finally, we apply the Heisenberg principle in the energy-time form to cosmological scales and read the Hubble constant as quantum measurement [12,13].

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