

The Photon Self-Energy and its Implications for Dark Matter Searches

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In many environments, such as the early universe or stars, finite temperature effects modify the properties of particles, including their dispersion relations. In particular, the Standard Model photon acquires an effective mass. Furthermore, collective plasma excitations give rise to a longitudinal mode which is absent in vacuum. The key object to compute the effective in-medium mass of both the transverse and longitudinal photons is the photon self-energy. Beautiful analytic approximations have previously been computed for on-shell photons, through a series of approximations. However, these expressions are not valid for off-shell photons. These can be important for dark matter phenomenology in astrophysical and cosmological environments, for example. In this work, I will present new analytic expressions for the photon self-energy, valid for off-shell photons. I will relate them to the on-shell self-energy. I will discuss applications in dark matter phenomenology.

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