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GW from inflaton decay and photon bremsstrahlung

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Effective field theory (EFT) concept provides a necessary tool for obtaining general predictions of low energy theory valid below its unitarity breaking scale (cutoff scale). Early Universe inflation and subsequent reheating could be a unique setup for testing potentially observable effects coming from the derivative expansion of the corresponding EFT around the flat space vacuum. In this work, we consider an EFT describing perturbative reheating dominated by the decay of inflaton to photons caused by the dimension-5 operator $\phi F_{\mu\nu}F^{\mu\nu}$. We compute the graviton production during reheating and high frequency gravitational wave signal due to the bremsstrahlung effect in the presence of $R_{\mu\nu\lambda\rho}F^{\mu\nu}F^{\lambda\rho}$ operator. It may lead to the dominant contribution at high momenta if the EFT cutoff is lower than the Planck mass. Assuming the general consequences of the unitarity and causality constraints, which imply that all EFT operators should be present, and be suppressed by the scales following from the dimension analysis, we obtain the observational constraints (CMB bound for the dark radiation) on mass of the inflaton and UV cutoff of gravity. We found that for the typical parameters of large field inflation models the gravitational cutoff scale cannot be lower than 10^{15} GeV.

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