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Physical running in quadratic gravity

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Running coupling were introduced in quantum field theory in order to preserve perturbativity in scattering amplitudes, despite the appearance of large logs of external momenta. It is commonly believed that these logarithms are directly related to UV divergencies in one-loop perturbation theory, however this is not completely true in higher derivative theories, where large logs can emerge also from UV finite loop integrals due to IR effects and, on the other hand, some UV divergent diagrams do not depend on external momenta. We define a new set of beta functions for quadratic gravity based on the explicit computation of large logs of momenta and discuss their features concerning the asymptotic UV behavior of the theory. In particular, we observe the existence of a unique trajectory of the perturbative RG leading to asymptotic freedom without presence of tachyons.

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