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Renormalized ρ_{vac} without m^4 terms

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The cosmological constant (CC) term, Λ, in Einstein's equations has been for some three decades a fundamental building block of the concordance or standard ΛCDM model of cosmology. Even though the model is not free of fundamental problems, they have not been circumvented by any alternative dark energy proposal either.

However, an interesting alternative is that the vacuum energy is a "running quantity" in quantum field theory in curved spacetime. Several works have shown that this is option can compete with the ΛCDM with a rigid Λ term. The so-called, "running vacuum models" (RVM) are characterized by a vacuum energy density, ρ_{vac}, which is evolving with time as a series of even powers of the Hubble parameter and its time derivatives. This form has been motivated by renormalization group arguments in previous works.

In this talk we show how to compute the renormalized energy-momentum tensor with the help of adiabatic regularization procedure as it has been done in arXiv/2005.03164 (Eur. Phys. J. C (2020) 80 : 692). The final result is a RVM-like form of the vacuum energy, with $\rho_{vac}(H)$ being a constant term plus others $\sim H^2$ and $\sim H^4$. Besides, it does not carry dangerous terms proportional to m^4, the quartic powers of the masses of the fields, which are a well-known source of exceedingly large contributions.

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