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Running vacuum interacting with dark matter or with running gravitational coupling. Phenomenological implications

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The cosmological constant is usually associated with the notion of vacuum energy density in quantum field theory (QFT). Whether Λ is a rigid quantity or a dynamical variable has been a matter of debate for many years, especially after the introduction of the general notion of dark energy (DE). In an expanding universe one may expect that Λ, and the corresponding vacuum energy density, $\rho_{\rm vac}$, evolve slowly with the cosmological expansion. In this talk I will consider the class of running vacuum models (RVMs), which can describe inflation followed by essentially the standard evolution. For these models, the vacuum energy density takes the form of a constant plus a series of (even) powers of the Hubble rate. Solid theoretical reasons will be given supporting this structure. In addition, the RVM's predict that the dark energy is mildly dynamical and appears effectively as quintessence. Running vacuum models can be of different types, in the two basic ones the vacuum can exchange energy with dark matter (type I) or just evolve with matter conservation but at the expense of a mildly evolving gravitational coupling (type II). The RVM's prove very competitive against the standard ΛCDM model and give a handle for solving the σ_8 tension and alleviating the H_0 one.

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