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Friedmann cosmology with hyperfluids

In metric-affine gravity, both the gravitational and matter actions depend not just on the metric, but also on the independent affine connection. Thus, matter can be modeled as a hyperfluid, characterized by both the energy-momentum and hypermomentum tensors. The latter is defined as the variation of the matter action with respect to the connection, and it encodes extra (micro)properties of particles. For a homogeneous and isotropic universe, it was recently shown that the generic cosmological hypermomentum possesses five degrees of freedom: one in dilation, two in shear, and two in spin part. In this presentation, we discuss the implications of this perfect hyperfluid on the universe with the Friedmann-Lemaître-Robertson-Walker metric. We adopt a simple model with non-Riemannian Einstein-Hilbert gravitational action plus arbitrary hyperfluid matter, and solve analytically the cosmological equations for single and multiple component hypermomentum contributions using different assumptions about the equation of state. It is remarkable, that in a number of cases the forms of the time evolution of the Hubble function and energy density still coincide with their general relativity counterparts, only the respective indexes w_{eff} and w_ρ start to differ due to the hypermomentum corrections. The results and insights we obtained are very general and can assist in constructing interesting models to resolve the issues in standard cosmology.

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