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A model independent approach to the study of f(R) cosmologies with expansion histories close to ΛCDM

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We propose a new framework for studying the cosmology of f(R) gravity which completely avoids using the reconstruction programme. This allows us to easily obtain a qualitative feel of how much the ΛCDM model differs from other f(R) theories of gravity at the level of linear perturbation theory for theories that share the same background dynamics. This is achieved by using the standard model independent cosmographic parameters to develop a new dynamical system formulation of f(R) gravity which is free from the limitation of having to first specify the functional form of f(R). By considering a set of representative trajectories, which are indistinguishable from ΛCDM, we use purely qualitative arguments to determine the extent to which these models deviate from the standard model by including an analysis of the linear growth rate of density fluctuations and also whether or not they suffer from the Dolgov-Kawasaki instability. We find that if one demands that a late time f(R) cosmology is observationally close to the ΛCDM model, there is a higher risk that it suffers from a Dolgov-Kawasaki instability. Conversely, the more one tries to construct a physically viable late time f(R) cosmology, the more likely it is observationally different from the ΛCDM model.

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