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Applications of the EoS formalism to f(R) models

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We present an application of the equation of state approach to dark sector perturbations as a comprehensive phenomenological framework to understand the evolution of perturbations in dark energy and modified gravity models. The
approach is based on the observation that any modified gravity theory can be recast into an effective dark energy fluid. By eliminating the internal degree of freedom of the given theory, the gauge invariant entropy perturbation and
anisotropic stress can be expressed in terms of the fluid variables. They represent the equations of state at the perturbed level and describe how matter and dark energy perturbations evolve. In this work we specialise to $f(\mathcal{R})$ gravity theories. By incorporating the equations of motion in a suitably modified version of the Boltzmann code CLASS, we follow the evolution of background and perturbed quantity. By parametrizing this class of models via the parameter B_0, we present the impact of $f(\mathcal{R})$ models on several observables, such as the CMB and matter power spectrum and the lensing potential. With the help of the analytic expressions for the perturbed equations of state, we explain the different evolution and features appearing in the fluid variables and in the observables considered. We show that our approach is numerically stable and fast to be used in parameter constraints studies and we provide approximated expressions for the entropy perturbation and anisotropic stress which capture the
physics involved.

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