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Stability Criteria in f(R) Gravity from Thermodynamics Analogy

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In this work we analyze the stability criteria in $f(R)$ theories of gravity in the metric formalism under the approach of a thermodynamics analogy proposed in [C.D. Peralta and S.E. Jorás JCAP06(2020)053] for ϕ^4 and double well inflationary potentials. We starting from the mentioned potentials in the Einstein frame, and obtain a parametric form of $f(R)$ in the corresponding Jordan frame. Such approach yields plenty of new pieces of information, namely a self-terminating inflationary solution with a linear Lagrangian, a robust criterion for stability of such theories, and a dynamical effective potential for the Ricci scalar R.

The addition of an *ad-hoc* Cosmological Constant in the Einstein frame leads to a Thermodynamical interpretation of this physical system described by a Van der Waals like behavior, which allows whole thermodynamics picture then follows: a equation of state, binodal and spinodal curves, phase transition, critical quantities (pressure, volume and temperature), entropy jumps, specific-heat divergence (and the corresponding critical exponent).

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