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Singular deformations of nearly $R^2$ inflation potentials. (English) Zbl 1329.83162
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Summary: We investigate in which cases a singular evolution with a singularity of type IV can be consistently incorporated into deformations of the $R^2$ inflationary potential. After demonstrating the difficulties that the single scalar field description is confronted with, we use a general two scalar fields model without other matter fluids, to describe the type IV singular evolution, with one of the two scalar fields being canonical. By appropriately choosing the noncanonical scalar field, we show that the canonical scalar field corresponds to a potential that is nearly the $R^2$ inflation potential. If the type IV singularity occurs at the end of inflation, the Universe’s dynamical evolution near inflation is determined effectively by the canonical scalar field and at late-time the evolution is effectively determined by the noncanonical scalar. We also discuss the evolution of the Universe in terms of the effective equation of state and we show that the type IV singularity that occurs at late time, this might affect the inflationary era. We also investigate which Jordan frame pure $F(R)$ gravity corresponds to the nearly $R^2$ inflation scalar potentials we found. The stability of the solutions in the two scalar fields case is also studied, and we investigate how type IV singularities can be incorporated in certain limiting cases of $R + R^2$ gravity in the Einstein frame. Finally, we briefly discuss a physical appealing scenario triggered by instabilities in the dynamical system that describes the evolution of the scalar fields.

MSC:
83D05 Relativistic gravitational theories other than Einstein’s, including asymmetric field theories
83F05 Relativistic cosmology
83C15 Exact solutions to problems in general relativity and gravitational theory
83C75 Space-time singularities, cosmic censorship, etc.

Keywords:
singular deformations; inflation

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