Preprint Series in Particles and Cosmos Physics

nº IPARCOS- UCM-23-006

INSTITUTO DE FÍSICA
DE PARTÍCULAS Y DEL COSMOS

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TDiff invariant field theories for cosmology

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January 2023

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Abstract

We study scalar field theories invariant under transverse diffeomorphisms in cosmological contexts.
We show that in the geometric optics approximation, the corresponding particles move along geodesics and contribute with the same active mass (energy) to the gravitational field as in Diff invariant theories.
However, for low-frequency modes, the contributions to the energy-momentum tensor differ from that of Diff invariant theories.
This opens up a wide range of possibilities for cosmological model building.
As an example, we show that the simplest TDiff invariant scalar field theory with only kinetic term could drive inflation and generate a red-tilted spectrum of density fluctuations.
We also present a detailed analysis of cosmological perturbations and show that the breaking of full Diff invariance generically induces new non-adiabatic pressure perturbations.
A simple scalar field dark matter model based on a purely kinetic term that exhibits the same clustering properties as standard cold dark matter is also presented.

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