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On a gauge invariant variable for scalar perturbations during inflation

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We discuss cosmological perturbations of the scalar type in the spatially flat FRWL background during inflation. There are five independent scalar perturbations. Four of them are perturbations of the FRWL metric and the fifth one represents perturbations of a scalar field. As usual, a scalar field is used to describe dominant (perfect) cosmological fluid responsible for inflation [1].

These five scalar perturbations are not gauge invariant, i.e. their values strongly depend on coordinate system we use and are not physical. In order to obtain physical quantities, gauge invariant variables are introduced. Their values will not depend on a choice of coordinate system we use and will not change under general coordinate transformations.

Frequently used gauge invariant scalar perturbations in the literature are two Bardeen's potentials, the gauge invariant perturbations of a scalar field and the Mukhanov-Sasaki variable [2,3,4]. The main idea is to construct a general gauge invariant variable, that will contain all four mentioned gauge variables. It can be done by looking at a set of expressions defining explained in details in this work. At the end, we discuss about dynamical equation and its solution for a general gauge invariant variable.

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