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RESEARCH ARTICLE

Noether versus Killing symmetry of conformally flat Friedmann metric

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Abstract In a recent study Noether symmetries of some static spacetime metrics in comparison with Killing vectors of corresponding spacetimes were studied. It was shown that Noether symmetries provide additional conservation laws that are not given by Killing vectors. In an attempt to understand how Noether symmetries compare with conformal Killing vectors, we find the Noether symmetries of the flat Friedmann cosmological model. We show that the conformally transformed flat Friedman model admits additional conservation laws not given by the Killing or conformal Killing vectors. Inter alia, these additional conserved quantities provide a mechanism to twice reduce the geodesic equations via the associated Noether symmetries.

Keywords Noether symmetry · Killing vector · Conformal Killing vector

1 Introduction

The Einstein field equations that govern the general theory of Relativity are highly nonlinear coupled partial differential equations [1]. Because of this nonlinearity, it is quite difficult to find their exact solutions. Thus, all physically interesting solutions that exist in the literature are sought under the assumption that they possess some symmetry. This symmetry is expressed in terms of Killing vectors (kvs). A kv is the one along

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