

Noether Symmetry in Newtonian Dynamics and Cosmology

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Abstract

A new symmetry for Newtonian Dynamics is analyzed, this corresponds to going to an accelerated frame, which introduces a constant gravitational field into the system and subsequently we consider the addition of a linear contribution to the gravitational potential ϕ which can be used to cancel the gravitational field induced by going to the accelerated frame, the combination of these two operations produces then a symmetry. This symmetry leads then to a Noether current which is conserved. The Conserved charges are analyzed in special cases. The charges may not be conserved if the Noether current produces flux at infinity, but such flux can be eliminated by going to the CM system in the case of an isolated system. In the CM frame the Noether charge vanishes, Then we study connection between the Cosmological Principle and the Newtonian Dynamics which was formulated via a symmetry [1] of this type, but without an action formulation. Homogeneous behavior for the coordinate system relevant to cosmology leads to a zero Noether current and the requirement of the Newtonian potential to be invariant under the symmetry in this case yields the Friedmann equations, which appear as a consistency condition for the symmetry.