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A new symmetry for the imperfect fluid in relativistic astrophysics

We will address the existence of a new symmetry for an imperfect
fluid by introducing local four-velocity gauge-like transformations for the case when there is vorticityˆ1. A similar tetrad formulation as to the Einstein-Maxwell spacetimes formalism presented in previous manuscriptsˆ2,3 will be developed in this manuscript for the imperfect fluids. The four-velocity curl and the metric tensor will be invariant under these kinds of four-velocity gauge-like local transformations. While the Einstein-Maxwell stress-energy tensor is locally gauge invariant under electromagnetic gauge transformations, the perfect fluid stress-energy tensor will not be invariant under four-velocity gauge-like local transformations. We will dedicate our analysis to the imperfect fluid stress-energy tensor that will be invariant under local four-velocity gauge-like transformations when additional transformations are introduced for several variables included in the stress-energy tensor itself. We will also pay special attention to the construction of a vorticity stress-energy tensor invariant under local four-velocity gauge-like transformations. An application on neutron stars will be developed in order to show the simplifications brought about by these new tetradsˆ4,5,6

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Author: GARAT, Alcides (Former Professor at Universidad de la República)

Presenter: GARAT, Alcides (Former Professor at Universidad de la República)