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INTERACTION ENERGY OF A CHARGED MEDIUM AND ITS EM FIELD IN A CURVED SPACETIME

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Abstract. In the electrodynamics of special relativity (SR) or general relativity (GR), the energy tensors of the charged medium and its EM field add to give the total energy tensor that obeys the dynamical equation without external force. In the investigated scalar theory of gravitation (SET), this assumption leads to charge non-conservation, hence an additional, "interaction" energy tensor $\boldsymbol{T}_{\rm inter}$ has to be postulated. The present work aims at constraining this tensor. First we study the independent equations of electrodynamics and their number, beginning with SR and GR. As in SR and GR, the system of electrodynamics of SET is closed in the absence of $\boldsymbol{T}_{\rm inter}$. Hence, with $\boldsymbol{T}_{\rm inter}$, at least one additional equation must be provided. This is done by assuming that $\boldsymbol{T}_{\rm inter}$ is Lorentz-invariant in the situation of SR. We derive equations allowing one in principle to compute $\boldsymbol{T}_{\rm inter}$ in a given gravitational plus EM field. $\boldsymbol{T}_{\rm inter}$ may contribute to the dark matter.

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1. Introduction

The main motivation for the work summarized in this paper is to develop a consistent electrodynamics in an alternative theory of gravity with a preferred reference frame: "the scalar ether theory", or in short SET [4, 5]. In turn the motivations for SET, which have been exposed in detail elsewhere [7], are essentially as follows. i) Special relativity (SR) can be interpreted within classical concepts of space and time, thus keeping a "preferred" simultaneity. This is the Lorentz-Poincaré version