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Interaction Energy between a Charged Medium and its Electromagnetic Field as a Dark Matter Candidate

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In special relativity (SR) and in general relativity, the energy tensors of a charged medium and its electromagnetic field, $\mathbf{T}_{\text{chg}}$ and $\mathbf{T}_{\text{field}}$, add to give the total energy tensor $\mathbf{T}$ obeying $T^{\mu\nu}_{;\nu} = 0$: one has
$\mathbf{T} = \mathbf{T}_{\text{chg}} + \mathbf{T}_{\text{field}}$. (1)
In the "scalar ether theory of gravitation" (SET), assuming (1) leads to charge non-conservation [1]. In SET we must abandon (1), which means to introduce an "interaction energy tensor" $\mathbf{T}_{\text{inter}}$ such that
$\mathbf{T} = \mathbf{T}_{\text{chg}} + \mathbf{T}_{\text{field}} + \mathbf{T}_{\text{inter}}$. (2)
Imposing on $\mathbf{T}_{\text{inter}}$ that, in SR, it should be Lorentz-invariant, leads to the form $T^{\mu}_{\text{inter}\ \nu} = p\delta^{\mu}_{\nu}$, with p a scalar field [2]: one more equation is needed, which can be imposed to be charge conservation. Being gravitationally active and present virtually everywhere according to that theory, and having an exotic character, the interaction energy $E_{\text{inter}} = T^{00}_{\text{inter}}$ could contribute to the dark matter.

To check if the distribution of E_{inter} resembles a "dark halo", one needs to describe the interstellar radiation field in a galaxy (ISRF) as a solution of the Maxwell equations. Axisymmetry may be assumed, and for the ISRF the source-free Maxwell equations are appropriate [3]. In the axisymmetric case, we proved that any time-harmonic source-free Maxwell field has an explicit decomposition based on a pair of scalar fields. Using this result, a model giving the ISRF as an exact Maxwell field has been proposed [3]. Its application to predict the variation of the spectral energy density in our Galaxy is being tested [4].

[1] Arminjon M., Open Physics 14 (2016) 395–409.

[2] Arminjon M., Open Physics 16 (2018), 488–498.

[3] Arminjon M., Open Physics 19 (2021), 77–90.

[4] Arminjon M., submitted for publication. HAL preprint hal-03160323 (2021).

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