

Conditional Validity of $E = mc^2$ and the Repulsive Force in General Relativity

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Abstract. Currently, the formula $E = mc^2$ is often misinterpreted as the unconditional equivalence between inertial mass and each type of energy (i.e., $m = E/c^2$). However, according to Einstein's general relativity, such a claim is incorrect. Clearly, a necessary condition for any type of energy (or a combination of many types of energy) to be equivalent to mass is that the combined energy results in a tensor having a non-zero trace. For instance, the energy of photons include the energy of its gravitational wave component as demanded by $E = mc^2$. It is pointed out that the Reissner-Nordstrom metric illustrated that electromagnetic energy and mass are different in terms of gravity. The misinterpretation of $E = mc^2$ being unconditional is responsible to overlooking the repulsive charge-mass interaction. Such an interaction implies that the unification of electromagnetism and gravitation is necessary and correct. Moreover, this analysis shows that the interpretation of 't Hooft and Wilczek on $m = E/c^2$ being unconditionally true is incorrect.

Key words: Photons; $E = mc^2$; Charge-mass interaction, Euclidean-like Structure.