The Eötvös Experiment, GTR, Differing Gravitational and Inertial Masses: Proposition for a Crucial Test of Metric Theory

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Abstract. The Eötvös experiment has been taken as basis for metric theories of gravity and particularly for the general theory of relativity (GTR), which assumes that gravitational mass (mG) and inertial mass (mI) are identical. We highlight the fact that, unlike the long lasting and reigning belief, the setup by Eötvös Experiment and its follow-ups on this subject, serve to demonstrate no more than a mere linear proportionality mG =KmI between said masses, and not ineludibly their exclusive equality, the proportionality constant K thusly assuming the value of unity, strictly. So much so that, as one distinct framework, Yarman-Arik-Kholmetskii (YARK) gravitation theory, where a purely metric approach is not aimed, makes the identity between inertial and gravitational masses no longer imperative while still remaining in full conformance with the result of the Eötvös experiment, as well as that of free fall experiments. It is further shown that Eötyös experiment deprives us of any knowledge concerning the determination of the proportionality coefficient K, coming into play. Henceforward, the Eötvös Experiment and its follow-ups cannot be taken as a rigorous foundation for GTR. In this respect, we suggest a crucial test of the equality of gravitational and inertial masses via the comparison of the oscillation periods of two pendulums with different arm lengths, where the deviation of the predictions by GTR and by YARK theory represents a measurable value under modern development in experimental techniques.