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Peer Review

Review of: "Why Is Gravitational Mass Equal to Inertial Mass?"

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The subject matter of the paper is both relevant and intellectually stimulating. However, I encountered some difficulty in following the author's reasoning at certain points. Specifically, the statement that in Newton's laws of motion, "acceleration is exogenously determined while force and mass are endogenously determined," raises some conceptual concerns.

Consider the case where the same force FFF is applied to two objects of different masses, m_1 and m_2. According to Newton's second law, the resulting accelerations a_1 and a_2 will satisfy the relation:

$$m_1/m_2=a_2/a_1.$$

Given that mass is a dimensional quantity, one may define m_1 as a unit of mass. This allows for the measurement of the mass of any other object in terms of m_1, independently of the applied force. Once mass and acceleration are determined, the force can be subsequently calculated.

Furthermore, consider two objects with inertial and gravitational masses m_{i1} and m_{g1} and m_{i2} and m_{g2} respectively, placed at a distance r from a massive gravitating body of gravitational mass M. According to Newton's law of universal gravitation, the equations of motion for these objects are:

$$m_{i1}\,a_1 = \frac{G\,m_{g1}\,M}{r^2}$$

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$$m_{i2} a_2 = \frac{G m_{g2} M}{r^2}$$

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The question then arises: whether $a_1 = a_2$ or not ? As argued by the author, in the first equation, it is possible to define the gravitational constant G such that $m_{i1} = m_{g1}$. However, this choice does not logically necessitate that $m_{i2} = m_{g2}$. Newton assumed the equivalence of inertial and gravitational mass, and Einstein later adopted this assumption as a foundational element of his equivalence principle. Nevertheless, Einstein's formulation extends beyond mere equivalence, encompassing broader conceptual and empirical implications.

Declarations

Potential competing interests: No potential competing interests to declare.