
Variations of a grand gravitational theme: Dynamics, Equivalence Principle, Universality of Free Fall and the Principle of Relativity

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Abstract

This paper is a discussion of connected themes in gravity and dynamics with implications to the analysis and interpretation of experiments that rely on testing the Universality of Free Fall (UFF) to test the equivalence principle and the theories of gravity. I will start with a careful analysis of the relation and difference between the UFF and the Equivalence Principle (EP). Then, their relation to dynamics – the laws of motion – will be discussed. A deep relation between all these and the principle of relativity and the usual Lorentz invariance will be brought out. The main results to be discussed are, (1) Law of dynamics, Principle of Relativity, the Equivalence Principle and the Universality of Free Fall will all be shown to have the same gravitational origin, leading to a significant shift in the scope of interpretation of experiments, (2) A case of composition dependent long range coupling obeying the UFF will be demonstrated and discussed, (3) new ways of testing the equivalence principle, without testing for UFF, will be discussed based on the relation between dynamics and EP, and finally (4) a coherent scenario for the physics of UFF and EP consistent with cosmological evidence will be presented.

References:

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