

Newton's Open Problem: The Troubled Microphysics of Gravitation - Miguel Ohnesorge

Abstract:

Newton's Principia committed to reducing the forces acting on large bodies to the forces acting between their microscopic parts. Newton envisioned a new form of evidence for his laws of resistance and gravitational force, due to them not only being (i) robust across perturbations of idealized models, but also (ii) invariant down to the microscopic constituents of bodies. However, Book III of the Principia failed to demonstrate that the observed inverse-square gravitation of composite bodies empirically reduces to inverse-square attraction of their parts. Several serious theoreticians – from Huygens up to Lorentz – continued to endorse theories entailing that inverse-square gravitation is not a basic property of matter or may already fail at mesoscopic distances. Only by the early twentieth century did tests in physical geodesy and laboratory physics decisively settle this stalemate in favour of Newtonian gravitation. These tests, and their underlying logic, are essential to understanding why the models of Newtonian gravitation were so exceptionally stable and well supported, pre- and post-GR.