Does rotation of the interacting masses limit experiments to test the Universality of Free Fall and the Weak Equivalence Principle?

Anna M. Nobili[1]

[1] *Dept. of Physics "E. Fermi", University of Pisa and INFN, Largo Bruno Pontecorvo 3, 56127 Pisa, Italy*

It has recently been claimed [1] that in the framework of General Relativity (GR) rotation of the interacting bodies may hamper experimental tests of the Universality of Free Fall (UFF) and the Weak Equivalence principle (WEP) from firmly assessing a non null (violation) result. Rotation and its effects in GR are not a new topic. Literature dates back to 1918 –just two years after publication by Einstein of "*The foundation of the general theory of relativity*"– when Lense and Thirring [2] investigated the effects of rotation of the central body on the motion of planets and satellites. In the early1950s Papapetrou and Corinaldesi [3, 4] derived the equations of motion of a spinning test particle in a gravitational field. A decade later, based on their work, Leonard Schiff [5–7] established the theoretical bases of the GP-B space experiment –devoted to measuring De Sitter and Lense-Thirring precession– by assessing the effects of Earth's rotation on the precession of high precision gyroscopes orbiting around it. In the 1970s Barker and O'Connel [8, 9], motivated by binary neutron stars and especially by the discovery in 1974 of the binary pulsar PSR1913+16, derived the equations of motion in the general case of two interacting bodies with arbitrary masses, spin and even quadrupole mass moments. Based on the work of these outstanding authors we investigate how Microscope, GG, the rotating torsion balance and Lunar Laser Ranging experiments devoted to testing UFF/WEP are affected by rotation of both the source body and the free falling masses. We find that the effects of rotation are smaller than the respective sought for violation signal by orders of magnitude, neither they are expected to become a limiting factor in the future.

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