Breakdown of the Equivalence between Gravitational Mass and Energy for a Quantum Body in Metric Theories of Gravity[1] ANDREI LEBED, Department of Physics, University of Arizona — We define passive gravitational mass operator of a hydrogen atom in the post-Newtonian approximation of metric theories of gravity, including general relativity [1,2], and show that it does not commute with energy operator, taken in the absence of gravitational field. Nevertheless, the equivalence between the expectation values of passive gravitational mass and energy is shown to survive for stationary quantum states. Inequivalence between passive gravitational mass and energy at a macroscopic level results in time dependent oscillations of the expectation values of passive gravitational mass for superpositions of stationary quantum states, where the equivalence restores after averaging over time. Inequivalence between gravitational mass and energy at a microscopic level reveals itself as unusual electromagnetic radiation, emitted by the atoms, supported and moved in the Earth gravitational field with constant velocity using spacecraft or satellite, which can be experimentally measured.

[1] A.G. Lebed, arXiv:1111.5365v1 [gr-qc]; arXiv:1205.3134v1 [gr-qc].
[2] A.G. Lebed, to be published in proceedings of MG-13 Meeting (arXiv:1208.5756v1 [gr-qc]).

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