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Breakdown of the Equivalence Principle for a composite quantum body. ANDREI LEBED, Univ of Arizona — We investigate behavior of a quantum body with internal degrees of freedom in an external gravitational field. We show that all quantum states of such a body can be subdivided into two types: traditional states and exotic ones. For traditional quantum states, gravitational masses are shown to be equal to their inertial masses and, thus, the Equivalence Principle survives. On the other hand, for exotic quantum states – coherent macroscopic ensembles of the superpositions of stationary quantum states – gravitational masses are not anymore related to energies by the Einstein's equation, $E = mc^2$. We discuss possibilities to create such exotic states, which break the Equivalence Principle, by lasers in the Earth's laboratories.

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