

Abstract Submitted
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Universal decoherence due to gravitational time dilation IGOR PIKOVSKI, ITAMP / Harvard University, MAGDALENA ZYCH, FABIO COSTA, University of Queensland, CASLAV BRUKNER, IQOQI / University of Vienna — The absence of quantum behavior on macroscopic scales is usually attributed to decoherence — the suppression of quantum superpositions due to interaction with an environment. Here we show that time dilation provides a universal decoherence mechanism for any complex system (1). The effect takes place even for isolated particles that do not interact with any external environment and causes decoherence of position and momentum of the center of mass of the system. While time dilation is very weak on earth, it is already sufficient to decohere gram-scale objects and complex molecules. The results show that novel phenomena arise at the interplay between quantum theory and general relativity even in the low energy limit. Possible experimental verifications of the effect are briefly discussed.

(1) I. Pikovski, M. Zych, F. Costa, and Č. Brukner, *Nature Physics* **11**, 668-672 (2015).

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