The equivalence principle and inertial-gravitational decoherence

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Since the earliest paper on the topic by Matvei Bronstein [1] it was clear that the equivalence principle is incompatible with the usual separation between a "quantum system" and a "classical detector", namely the fact that the charge/mass ratio is "small". A modern treatment, based on open quantum systems and path integrals, can however directly address this issue, and systematically calculate corrections both in the case of a light recoiling detector and in the case of a heavy gravitating one. We illustrate this for an interferometric setup of the type of [2,3] and show that for all parameters a "semiclassical limit", where one can measure a phase shift due to gravitational attraction between quantum objects, is unlikely.

[1] M. Bronstein, Gen. Rel. Grav. 44 (2012) 267-283, Original: Matvei Bronstein, Quantentheorie schwacher Gravitationsfelder, Physikalische Zeitschrift der Sowjetunion, Band 9, Heft 2–3, pp. 140–157 (1936).

[2] S. Bose et. al., arXiv:1707.06050 (PRL).

[3] C. Marletto, V. Vedral, arXiv:1707.06036 (PRL).