Quantum interferometric visibility as a witness of general relativistic proper time

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http://www.nature.com/ncomms/journal/v2/n10/full/ncomms1498.html [2]

Current attempts to probe general relativistic effects in quantum mechanics focus on precision measurements of phase shifts in matterwave interferometry. Yet, phase shifts can always be explained as arising because of an AharonovBohm effect, where a particle in a flat spacetime is subject to an effective potential. Here we propose a quantum effect that cannot be explained without the general relativistic notion of proper time. We consider interference of a 'clock'a particle with evolving internal degrees of freedomthat will not only display a phase shift, but also reduce the visibility of the interference pattern. According to general relativity, proper time flows at different rates in different regions of spacetime. Therefore, because of quantum complementarity, the visibility will drop to the extent to which the path information becomes available from reading out the proper time from the 'clock'. Such a gravitationally induced decoherence would provide the first test of the genuine general relativistic notion of proper time in quantum mechanics.

- QIPC [3]
- Q-ESSENCE [4]
- Highlight [5]
- Result [6]

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