Black Holes Decohere Quantum Superpositions

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We show that if a massive (or charged) body is put in a quantum superposition of spatially separated states in the exterior of a black hole, the mere presence of the black hole will eventually destroy the coherence of the superposition. This occurs because, in effect, the long-range fields sourced by the body radiate soft gravitons/photons through the horizon, allowing the black hole to harvest "which path" information about the superposition. The electromagnetic decoherence arises only when the superposed particle carries electric charge. However, since all matter sources gravity, the quantum gravitational decoherence applies to all superpositions. We provide estimates of the decoherence time for such quantum superpositions.

Based on [1], [2], [3], and work to appear.

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