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(G*) Signatures of Rotating Black Holes in Quantum Superposition

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A new approach for operationally studying the effects of spacetime in quantum superpositions of semiclassical states has recently been proposed by some of the authors. This approach was applied to the case of a (2+1)-dimensional Bañados-Teitelboim-Zanelli (BTZ) black hole in a superposition of masses, where it was shown that a two-level system interacting with a quantum field residing in the spacetime exhibits resonant peaks in its response at certain values of the superposed masses. Here, we extend this analysis to a mass-superposed *rotating* BTZ black hole, considering the case where the two-level system co-rotates with the black hole in a superposition of trajectories. We find similar resonances in the detector response function at rational ratios of the superposed outer horizon radii, specifically in the case where the ratio of the inner and outer horizons is fixed. This suggests a connection with Bekenstein's seminal conjecture concerning the discrete horizon spectra of black holes in quantum gravity, generalized to the case of rotating black holes. Our results suggest that deeper insights into quantum-gravitational phenomena may be accessible via tools in relativistic quantum information and curved spacetime quantum field theory.

Keyword-1

Quantum Gravity

Keyword-2

Quantum Field Theory

Keyword-3

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