Quantum signatures of a mass-superposed black hole

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In this talk, I present a new operational framework for studying "superpositions of spacetimes", which are of fundamental interest in the development of a theory of quantum gravity [1]. The approach that my collaborators and I develop capitalises on nonlocal correlations in curved spacetime quantum field theory, allowing us to formulate a metric for spacetime superpositions as well as characterizing the coupling of particle detectors to a quantum field. We apply our approach to analyze the dynamics of a particle detector in a spacetime generated by a (2+1)-dimensional Banados-Teitelboim-Zanelli (BTZ) black hole in a superposition of masses. We find that the detector exhibits signatures of quantum-gravitational effects corroborating and extending Bekenstein's seminal conjecture concerning the quantized mass spectrum of black holes in quantum gravity. Crucially, this result follows directly from the approach, without any additional assumptions about the black hole mass properties.

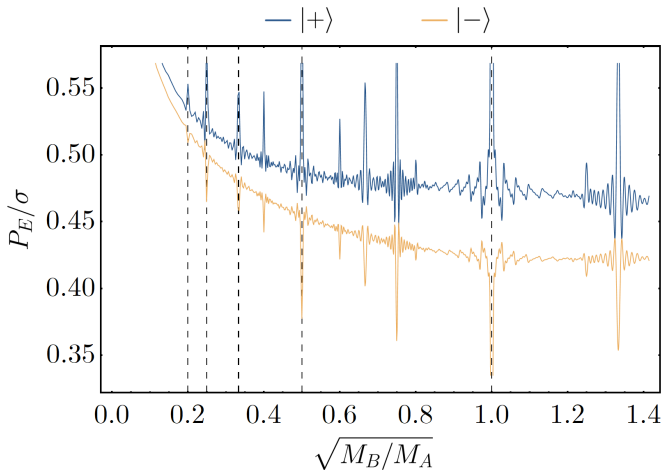

Figure 1: Response of a detector situated outside the mass-superposed black hole as a function of the mass ratio.

[1] Joshua Foo, Cemile Senem, Magdalena Zych, and Robert B. Mann, arXiv:2111.13315 (2021).