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(G*) Quantum detectors freely falling into black holes

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In the 1970s, it was discovered that a uniformly accelerated detector, interacting with the vacuum state of a quantum scalar field in flat spacetime, has a thermal response with a temperature proportional to its proper acceleration. This phenomenon, known as the Unruh effect, is considered a signpost in the search for a quantum theory of gravity. Since the discovery of the effect, efforts have been dedicated to the study of quantum detectors in curved spacetime because their response encodes information about fluctuations of the vacuum state of the field and hence of the underlying spacetime. However, despite more than four decades of dedicated research, little is known about the response of quantum detectors as they freely fall into black holes. I present results detailing the response of a detector interacting with the Hartle-Hawking vacuum state of a massless scalar field in a Bañados-Teitelboim-Zanelli (BTZ) black hole as the detector freely falls toward and across the event horizon. I also discuss how this response changes for the geon counterpart of a BTZ black hole, an object identical to the BTZ black hole outside its horizon but having a different topology inside. Our results suggest that the detector can potentially serve as an 'early warning system'that indicates the presence of the event horizon and discerns the interior topology of the black hole.

Keyword-1

quantum detectors

Keyword-2

black holes

Keyword-3

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