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Circular Unruh effect using coupled annular Josephson junctions at finite ambient temperatures

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The Unruh effect, a fundamental prediction of quantum field theory, postulates that a uniformly accelerated observer perceives the vacuum as a thermal bath. Direct experimental verification remains a formidable challenge due to the minuscule magnitude of the effect under linear acceleration. We have previously proposed a tabletop experiment utilizing the circular motion of fluxon-antifluxon pairs in inductively coupled annular Josephson junctions to generate a measurable Unruh temperature, estimated to be on the order of 1K. In this study, we incorporate realistic laboratory temperatures into our analysis as the initial conditions of the thermal bath. This enables a more concrete feasibility assessment for observing the circular Unruh effect in practical settings. Specifically, we investigate the impact of ambient thermal noise on the detectability of the Unruh temperature. Furthermore, we evaluate the sensitivity of our proposed thermometer, demonstrating a temperature resolution on the order of 10mK. This analysis provides crucial insights into the experimental requirements and potential challenges for the observation of the circular Unruh effect in Josephson junction systems.

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