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Quantum imprints of gravitational shockwaves

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Gravitational shockwaves are simple exact solutions of Einstein equations representing the fields of ultrarelativistic sources and idealized gravitational waves (shocks). Historically, much work has focused on shockwaves in the context of possible black hole formation in high energy particle collisions, yet they remain at the forefront of research even today. Representing hard modes in the bulk, shocks give rise to the gravitational memory effect at the classical level and implant supertranslation (BMS) hair onto a classical spacetime at the quantum level. The aim of this paper is to further our understanding of the 'information content' of such supertranslations. Namely, we show that, contrary to the several claims in the literature, a gravitational shockwave *does leave* a quantum imprint on the *vacuum state* of a test quantum field and that this imprint is accessible to local observers carrying Unruh–DeWitt (UDW) detectors in this spacetime.

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