

Entanglement in Unruh and Hawking radiation from a quantum optical perspective

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Free quantum field theory in flat space-time is often believed to be well established, holding no surprises. However, in recent work we show that a uniformly accelerated atom in Minkowski space-time emits entangled photon pairs into a squeezed state which mimics entanglement between Minkowski modes which are dominantly in opposite causal wedges of the space-time. Similar emission of photon pairs occurs if an atom is held above the black hole event horizon. Namely, a ground-state atom becomes excited by emitting a “negative”-energy photon under the horizon and then spontaneously decaying back to the ground state by emitting a positive-energy photon outside the horizon, which propagates away from the black hole.

[1] M. Scully, A. Svidzinsky, and W. Unruh, *Phys. Rev. Res.* 4 (2022) 033010.