Quantum optics in curved spacetime: Surprises and insights

Marlan Scully

Texas A&M University
Baylor University
Princeton University

An atom uniformly accelerated in Minkowski vacuum can become excited by emitting a photon. This is known as Unruh acceleration radiation. The energy required to emit the photon by the accelerated atom is gained from the atom's kinetic energy. Using a combination of quantum optics and general relativity, we showed that atoms freely falling into a black hole emit radiation. We call the emitted radiation Horizon Brightened Acceleration Radiation (HBAR) and note that it is very similar to Hawking radiation, as we discuss in [1,2].

[1] M. O. Scully, S. Fulling, D. M. Lee, D. N. Page, W. P. Schleich and A. A. Svidzinsky, *Quantum optics approach to radiation from atoms falling into a black hole*, PNAS 115 (2018) 8131.

[2] M. O. Scully, A. A. Svidzinsky and W. Unruh, *Quantum optics in curved spacetime: Surprises and insights*, Int. J. of Mod. Phys. D 34 (2025) 2543004.