Polariton black-hole horizons

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Photonic systems have appeared in the past few years as excellent candidates to study analogue gravity phenomena [1]. Microcavity polaritons are particularly well suited for this task. They combine long propagation distances with interparticle interactions that can largely exceed their linewidth, putting polaritons in the hydrodynamic regime with metrics in close analogy to that of space-time around the event horizon of a black hole [2].

Here we present the realization of an acoustic black hole using polaritons in a 1D semiconductor microcavity with an engineered obstacle [3]. At high excitation power, we show a transition at the position of the obstacle between regions of subsonic and supersonic flow, giving rise to an acoustic black hole horizon: sonic excitations of the fluid are unable to propagate back from the supersonic region to the horizon, analogous to what happens to light trying to escape from astrophysical black holes.

Our black hole presents interesting assets in views of observing Hawking radiation. The abruptness of the transition, results in a high analogue surface gravity, with an expected effective Hawking temperature on the order of a few Kelvin, much larger than the cavity lifetime, the relevant energy scale in our system [4].

We will discuss other configurations based on type-II Dirac points in engineered honeycomb lattices of polaritons, which present single particle dispersion relations mimicking those of light close to a black hole [5].

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