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Hawking radiation in a laboratory

Einstein's theory of gravity opened Pandora's box of warped spacetime in 1915, and out popped the black hole, confusing and delighting (or maddening) physicists ever since. In the early 1970's it was discovered that black holes have entropy and temperature, and decay by Hawking radiation like radioactive whirlpools in the spacetime river. Two persistent puzzles have resulted from this discovery: the information paradox and the transPlanckian problem. To bring some of this down to earth, Unruh in 1980 conceived of a black hole analog, formed by a quantum fluid, which might one day be studied in a laboratory.

That day has now come: In the last few years, Jeff Steinhauer has carried out a number of experiments on Bose-Einstein condensates of rubidium atoms, configured to emulate a black hole, and reported on the observation of thermal phononic Hawking radiation and its quantum entanglement with phonons inside the sonic black hole. In this colloquium I will discuss these ideas, the experiments, and simulations, and the extent to which such analog black holes are (or are not) relevant to the puzzles of spacetime black holes.