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Measurement of stimulated Hawking emission in an analogue system

Abstract:

There is a mathematical analogy between the propagation of fields in a general relativistic space-time and long (shallow water) surface waves on moving water. Hawking argued that black holes emit thermal radiation via a quantum spontaneous emission. Similar arguments predict the same effect near wave horizons in fluid flow. By placing a streamlined obstacle into an open channel flow we create a region of high velocity over the obstacle that can include wave horizons. Long waves propagating upstream towards this region are blocked and converted into short (deep water) waves. This is the analogue of the stimulated emission by a white hole (the time inverse of a black hole), and our measurements of the amplitudes of the converted waves demonstrate the thermal nature of the conversion process for this system. Given the close relationship between stimulated and spontaneous emission, our findings attest to the generality of the Hawking process.