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Spontaneous Hawking radiation in a Bose-Einstein condensate and analogue cosmological particle creation in a fluid of light

Friday, 1 September 2023 11:50 (1 hour)

We confirm that Hawking radiation from an analogue black hole in a Bose-Einstein condensate is spontaneous, thermal, and stationary. Furthermore, we follow the time evolution of the Hawking radiation, and compare and contrast it with the predictions for real black holes. We observe the ramp up of the Hawking radiation, similar to a real black hole. The end of the spontaneous Hawking radiation is marked by the formation of an inner horizon. The Maryland group predicted that particles emanating from the inner horizon can cause stimulated Hawking radiation. We find that these stimulated Hawking pairs are directly observable. We also present our observation of analogue cosmological particle creation in a 3-dimensional quantum fluid of light. The process is seen to be spontaneous, and in close quantitative agreement with the quantum-field theoretical prediction. We find that the long-wavelength particles provide a window to early times. This latter work introduces a new quantum fluid, as cold as an atomic Bose-Einstein condensate.

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