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Bipartite and tripartite entanglement in a Bose-Einstein acoustic black hole

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In this talk, we will present recent results concerning quantum entanglement of the Hawking radiation in an analogue black hole realized in the flow of a Bose-Einstein condensate. In particular, we will show that the system is described by a three-mode Gaussian state, giving rise to bipartite and tripartite entanglement. The latter is measured using a continuous version of the 3-tangle constructed from monogamy inequalities. We will also discuss how entanglement is affected by thermal effects and how it can be measured experimentally. These results are reported in [1].

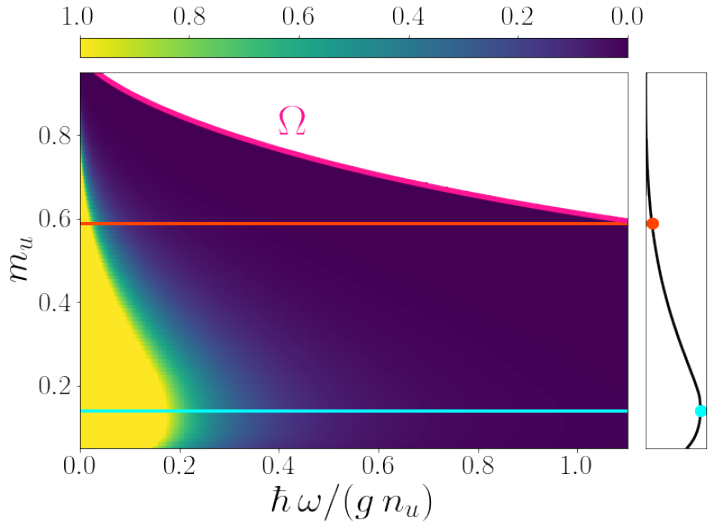

Figure : Tripartite entanglement (color code, from low/blue to high/yellow entanglement) as a function of dimensionless energy (x-axis) and of the upstream Mach number m_u (y-axis). The horizontal red line corresponds to the value m_u~0.59 of the experimental realization [2], the light blue line to the value of maximal tripartite entanglement. The right plot shows the integral of the left plot over horizontal lines.

[1] M. Isoard, N. Milazzo, N. Pavloff, and O. Giraud, arxiv.org/abs/2102.06175 (2021)
[2] J. R. M. de Nova, K. Golubkov, V. I. Kolobov, and J. Steinhauer, Nature **569**, 688 (2019)