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How to create a horizon in the lab and the route to measure entanglement in experiments

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Quantum field theory in curved spacetimes (QFTCS) predicts the amplification of field excitations and the occurrence of classical and quantum correlations, as in the Hawking effect for example. This raises the interest for experiments in which the curvature of spacetime can be controlled and correlations measured. Such analogue simulations are typically done with fluids accelerating from sub- to supersonic speeds: acoustic excitations are dragged by the supersonic flow, effectively trapped inside an acoustic horizon. Quantum fluctuations of the acoustic field are predicted to yield entangled emission across the horizon, as in black holes.

In this talk, I will introduce a new QFTCS simulator in a one-dimensional polaritonic fluid of light. I will explain how we can engineer smooth and steep horizons, which respectively have quasi-thermal, but weak, and strong Hawking radiation. I will then show new measurements of the spectrum on either side of the horizon and evidence the excitation of negative energy waves.

Interestingly, I will show that, beyond phononic excitations as in other systems, our simulator also supports excitations with a tunable massive, relativistic dispersion. This benchmarks and thereby establishes a QFTCS simulator of a new class.
In conclusions I will explain how quantum optics techniques offer the possibility to measure entanglement, giving insight in this outstanding prediction of QFTCS.

Primary author: JACQUET, Maxime (Sorbonne Université)

Presenter: JACQUET, Maxime (Sorbonne Université)