

Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Kastler Brossel	
CNRS identification code: UMR 8552	
Internship director's surname: Alberto Bramati	
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Internship location: Laboratoire Kastler Brossel, 4 place Jussieu, 75005 Paris	
Thesis possibility after internship:	YES
Funding: NO	If YES, which type of funding:

Quantum simulation of black hole effects with fluids of light

Analogue gravity is a type of analogue quantum simulation that enables the study of gravitational effects in the laboratory [1]: it is possible to create conditions in which waves in media propagate as though they were in the vicinity of a black hole [2] or on an expanding universe [3], for example.

In the Quantum Optics Group at Laboratoire Kastler Brossel, we study excitons-polaritons in semiconductor microcavities and make them behave as “fluids of light”. At present, we are interested in engineering the flow profile of the fluid of light to create event horizon (the point of no-return that bounds the interior of the black hole) for excitations of the fluid. We aim to observe the Hawking effect at the horizon, that is the spontaneous emission of entangled pairs of excitations of the fluid at the horizon [4]. Specifically, the internship is concerned with setting up and using homodyne detection to this end.

We have recently obtained promising theoretical results and are currently assembling a new experiment to create the horizon and observe the Hawking effect. The M2 internship would consist in using this new experimental platform to collect data and in analysing this data by comparing it with theoretical predictions.

The student would work with the Polariton team (2 PhD students and a postdoc) under the supervision of Prof Alberto Bramati, who has strong expertise in quantum optics techniques like

homodyne detection. This M2 internship could lead to a PhD project depending on funding availability. The research community at LKB is composed of people from all around the world and we strive to promote an inclusive environment. We encourage applications from female candidates and candidates from under-represented groups.

[1] W. G. Unruh, Physical Review Letters 46, 1351 (1981).

[2] L.-P. Euve, F. Michel, R. Parentani, T. Philbin, and G. Rousseaux, Physical Review Letters 117, 1079 (2016).

[3] S. Eckel, A. Kumar, T. Jacobson, I. B. Spielman, and G. K. Campbell, Physical Review X 8, 021021 (2018).

[4] M.J.Jacquet, T.Boulier, F.Claude, A.Maître, E.Cancellieri, C.Adrados, A.Amo, S.Pigeon, Q.Glorieux, A.Bramati, Philosophical Transactions of the Royal Society A 378, 20190225 (2020), arXiv: 2002.00043

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	NO
Quantum Physics:	YES	Theoretical Physics:	NO