

Post-doctoral position – Theory of hybrid quantum systems

A postdoctoral position is open at Laboratoire Kastler Brossel (LKB) in the Multimode Quantum Optics group to work on the theory of hybrid quantum systems that mix finite and infinite dimensional degrees of freedom.

The Multimode Quantum Optics group at LKB has carried out leading research in the experimental generation of squeezed and continuous-variable entangled states for the implementation of quantum information protocols. The activities in this area range from the generation of large entangled networks multiplexed both in time and frequency [1,2], to the implementation and verification of non-Gaussian operations in all-optical setups [3].

While, the generation of large-scale non-Gaussian states is a prerequisite for continuous-variable quantum computing, typical heralding-based methods such as photon subtraction are hard to implement at such scale. In other platforms with bosonic degrees of freedom, such as trapped ions [4] or superconducting microwave resonators [5], non-Gaussian states are generated by making the bosonic modes interact with a finite-dimensional systems (e.g. a qubit). In optics, a similar route is followed when making light interact with Rydberg atoms [6]. From a theory point of view, these are all hybrid approach that intertwine discrete and continuous degrees of freedom. Within this postdoctoral project, we aim to develop a general mathematical formalism to describe these systems in an intuitive way.

Phase space representations [7] form a natural starting point for this project. While these techniques were initially developed to describe continuous-variable systems, they have later also been translated to finite-dimensional systems. A particularly useful feature of such representations is that they can capture practically useful resources such as magic as negativity in the phase space representation [8]. Using the unifying language of group theory [9], we aim to develop a phase space description of hybrid systems, aiming to make their computational power apparent as a form of phase space negativity. The final goal of this project is to find an effective description to identify new methods for engineering resourceful quantum states, and to understand the computational potential of hybrid systems.

This project is part of the National Acceleration Strategies PEPR OQULUS and NISQ2LSQ:

<https://www.pepr-quantique.fr/en/projet/oqulus/>

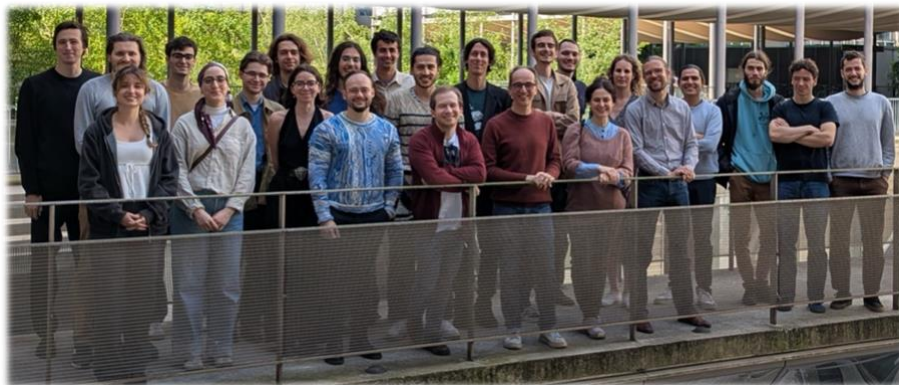
<https://www.pepr-quantique.fr/projet/nisq2lsq/>

- [1] Y. Cai, *et al.* [Nature communications 8 \(1\), 15645 \(2017\)](#)
- [2] V. Roman-Rodriguez, *et al.* [Physical Review Research 6 \(4\), 043113 \(2024\)](#)
- [3] YS Ra, *et al.* [Nature Physics 16 \(2\), 144-147 \(2020\)](#)
- [4] S. Saner, *et al.* [Phys. Rev. X 16, 021049 \(2026\)](#)
- [5] M. Kudra, *et al.* [PRX Quantum 3, 030301 \(2022\)](#)
- [6] V. Magro, *et al.* [Nat. Photon. 17, 688–693 \(2023\)](#).
- [7] M. Frigerio *et al.* [Quantum 10, 2155 \(2026\)](#)
- [8] D. Gross [J. Math. Phys. 47, 122107 \(2006\)](#)
- [9] C Brif and A Mann [J. Phys. A: Math. Gen. 31 L9 \(1998\)](#)

Environment

This project is conceived as an intense collaboration between the LKB and LIP6 at Sorbonne Université, and the QAT team at ENS. The successful candidate will be hosted primarily by the multimode quantum optics group at LKB to also reinforce a connection with experiments.

As a whole, the multimode quantum optics group has a tradition of working together with a diverse range of people from varied backgrounds. This diversity often leads to fruitful scientific input from different points of view, and it allows the group to explore new avenues. Furthermore, the moderate size of our group gives PhD students and postdocs the opportunity to discuss with PIs on a daily basis. This gives rise to a dynamical atmosphere with a lot of space for discussion.



Laboratoire Kastler Brossel is one of the worldwide leaders in the field of fundamental physics of quantum systems, covering a number of subjects spanning from fundamental tests of quantum theory to applications. It has an internationally recognized expertise throughout its 65 years history, including three Nobel Prize winners. Based in Sorbonne Université in the Pierre and Marie Curie Campus in the center of Paris, it is part of the Quantum Information Center (QICS) in Sorbonne, bringing together quantum physicists and computer scientists. It is also part of the Paris Centre for Quantum Technologies (PCQT), a research, training and innovation network involving 22 research laboratories in Paris Region, 35 start-ups and larger industry groups.

Practical information

- *Candidates* must hold an internationally recognized PhD in a field related to theoretical quantum physics. A good background and past research track record in quantum information theory, quantum correlations, or phase space techniques is a strength.
- *Application procedure*: Inquiries and applications (incl. a detailed CV and two names of potential references) should be sent by email to Mattia Walschaers (mattia.walschaers@lkb.upmc.fr) – please include “[Application postdoc hybrid]” in the subject line
- *Salary*: Monthly **net** salary (after-tax) between 2300€ and 3000€, depending on experience
- *Application deadline*: Preferentially apply before November 15th 2026
- *Starting date*: flexible
- *Duration*: up to 2 years