M2 Internship Offer

Quantum Optics with Exciton-Polariton Neural Networks

*We are seeking a highly motivated M2 student interested in **experimental quantum optics**.*

Team : **Quantum Fluids of Light**, Laboratoire Kastler Brossel
Supervisor : **Alberto Bramati**
Location : Sorbonne Université - Campus Pierre-et-Marie-Curie (Jussieu)
Duration : 4-6 months, **possibility to continue with PhD thesis**
Website : https://www.lkb.fr/quantumfluids/
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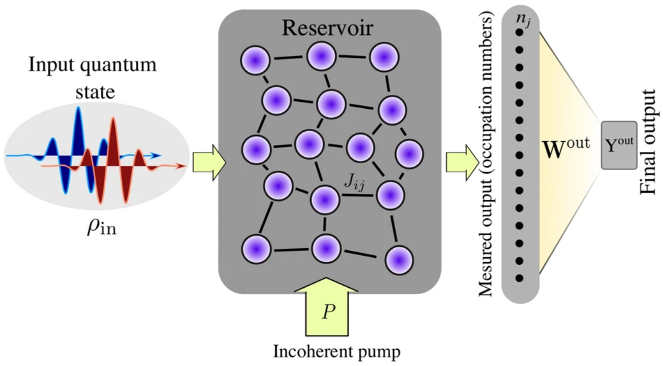
To fully characterize a quantum state of light, repeated measurements involving a phase reference, eg. homodyne detection, are required. The Quantum Fluids of Light team has recently begun an ambitious project (see https://www.qone-project.eu/news) to realize a quantum reservoir processor capable of fully characterizing quantum states of light from intensity measurements only, eliminating the need for a phase reference.

To achieve this goal, we have begun implementing a neural network of (exciton-)polaritons - strongly interacting quasiparticles which are part-light, part-matter. The central idea of physical reservoir computing [1] is that rather than “impose” digital computation on intrinsically analog systems, we should instead try to exploit the underlying physical nature of the system, such as its complex dynamics or quantum properties. In this regard, polaritons are an ideal physical substrate for quantum state recognition, as not only do they exhibit rich dynamics governed by the Gross-Pitaevski equation (a phase transition, bistability, and famously, superfluidity [2]), they are themselves quantum objects.

The intern will work in close collaboration with a post-doctoral researcher to study the response of the polariton network to excitation by different optical states, while simultaneously beginning to implement a squeezed source resonant with the polaritons [3], with the prospective to join the team as a PhD student in Fall of 2025. As the work will take place within the context of a European project, the student will have the opportunity to work in a fast-moving, exciting, and international collaboration, whose stated goal is to realize a disruptive quantum technology.



Schematic representation of a quantum reservoir processor, from Ref. [1].

References

1. Ghosh, S., Opala, A., Matuszewski, M. *et al.* Quantum reservoir processing. *npj Quantum Inf* **5**, 35 (2019). https://doi.org/10.1038/s41534-019-0149-8
2. Amo, A. *et al.* Superfluidity of polaritons in semiconductor microcavities. *Nature Phys* **5**, 805–810 (2009). https://www.nature.com/articles/nphys1364
3. Burks, S. *et al.* Vacuum squeezed light for atomic memories at the D_2 cesium line. *Opt. Express, OE* **17**, 3777–3781 (2009). https://doi.org/10.1364/OE.17.003777