# POLARITON CONDENSATES IN PHOTONIC CIRCUITS

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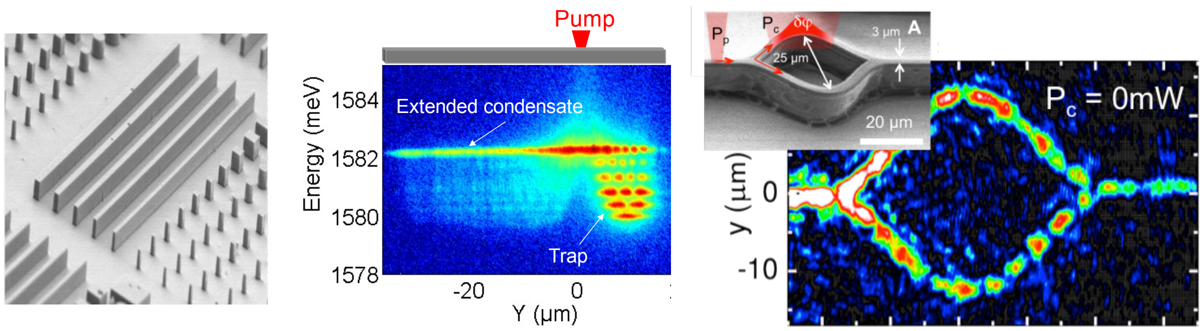
At the frontier between non-linear optics and the physics of Bose Einstein condensation, semiconductor microcavities opened a new research field, both for fundamental studies of bosonic quantum fluids, and for the development of new devices for all optical information processing.
Optical properties of semiconductor microcavities are indeed governed by bosonic quasi-particles named cavity polaritons, which are light-matter mixed states. Cavity polaritons propagate like photons, but interact strongly with their environment via their matter component.

Our group at Laboratoire de Photonique and Nanostructures has developed these last years, thanks to the technological facilities available in the LPN clean room, state of the art microcavities and photonic circuits.

After a general introduction on cavity polaritons, I will review recent experimental works performed on these photonic circuits. I will show how we can generate polariton flows which propagate over macroscopic distances (mm) while preserving their spatial and temporal coherence. These polaritons can be optically manipulated, trapped and re-amplified along their propagation. I will illustrate the crucial role of polariton interactions by presenting evidence for self-localization for polariton condensates in a periodic potential. These properties are the basic ingredients for future development of polaritonic devices. I will describe recently implemented polariton devices: a polariton interferometer and a non-linear resonant tunneling polariton diode.

I will conclude with some perspectives opened by these new polariton devices.




*Figures : (left) Scanning electron microscopy image showing an array of photonic wires and micropillars; (centre) Emission of a 1D cavity showing an extended polarton condensate and optically trapped polaritons ; (right) Scanning electron microscopy image of a polariton interferometer; Spatially resolved emission measured on the polariton interferometer.*

## References

**[1]** *Spontaneous formation and optical manipulation of extended polariton condensates* , E. Wertz, et al., Nat. Phys. 6, 860 (2010); **[2]** *Interactions in Confined Polariton Condensates* , L. Ferrier, et al., Phys. Rev. Lett. 106, 126401 (2011); **[3]** *Backscattering suppression in supersonic 1D polariton condensates* , D. Tanese, et al., Phys. Rev. Lett. 108, 036405 (2012); **[4]** *Polariton condensation in photonic molecules*, M. Galbiati, et al., Phys. Rev. Lett. 108, 126403 (2012); **[5]** *Propagation and Amplification Dynamics of 1D Polariton Condensates*, E. Wertz et al., Phys. Rev. Lett. 109, 216404 (2012) **[6]** Realization of a Double-Barrier Resonant Tunneling Diode for Cavity Polaritons, H. S. Nguyen et al., Phys. Rev. Lett. 110, 236601 (2013) **[7]** *Giant phase modulation in a Mach-Zehnder exciton-polariton interferometer*, C. Sturm et al., arXiv:1303.1649.