Quantum fluids in semiconductor microcavities

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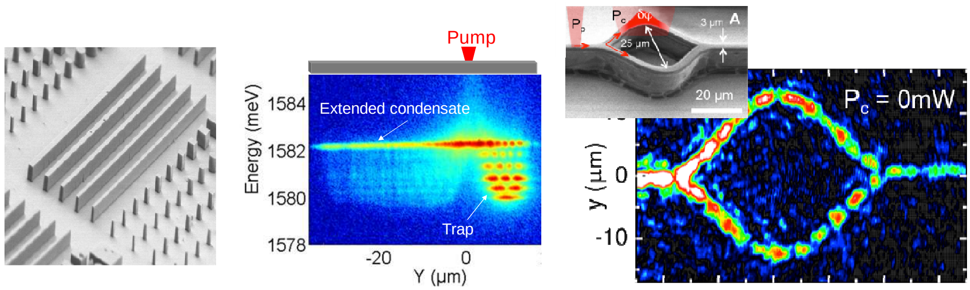
Semiconductor microcavities operating in the light-matter strong coupling regime provide a new system for fundamental studies of bosonic quantum fluids, and for the development of new devices for all optical information processing. Optical properties of semiconductor microcavities are governed by bosonic quasi-particles named cavity polaritons, which are exciton-photon 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, state of the art microcavities and photonic circuits, where polariton condensates can be generated in fully engineered potential landscape.

After a general introduction on cavity polaritons, I will review recent experimental works illustrating the potential of this system. 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. 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. Finally I will illustrate the crucial role of polariton interactions by presenting self-trapping experiments in coupled cavities.

I will conclude with perspectives opened by these 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

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