

Theory and experiments with quantum fluids of polaritons: from superfluid hydrodynamics to quantum Hall liquids of light

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A few years after the first observation of Bose-Einstein condensation, quantum gases of dressed photons in semiconductor microcavities (the so-called exciton-polaritons) are a powerful workbench for the study of phase transitions and many-body effects in a novel non-equilibrium context [1].

In this talk, I will first briefly review remarkable experiments investigating superfluid hydrodynamics effects in photon fluids hitting localized defects: depending on the flow speed, a wide range of behaviors have been observed, from superfluid flow, to the super-sonic Mach cone, to the nucleation of topological excitations such as solitons and vortices.

I will then illustrate recent theoretical studies in the direction of generating strongly correlated photon gases, from Tonks-Girardeau gases of impenetrable photons in one-dimension, to quantum Hall liquids in the presence of artificial magnetic fields.

Advantages and disadvantages of the different material platforms in view of generating and detecting strongly correlated gases will be reviewed, in particular laterally patterned microcavity and micropillar devices in the optical range, and circuit-QED devices in the microwave domain.

References

- [1] I. Carusotto and C. Ciuti, *Rev. Mod. Phys.* **85**, 299 (2013)