Quantum fluids of light and strongly correlated photons

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In the first part of this presentation, I will review theory predictions and experimental demonstrations showing how light propagating in a nonlinear optical system can behave like a superfluid [1]. A nonlinear medium of choice is a semiconductor in which photons hybridize with excitons. The hybrid quanta, polaritons, behave like particles forming a superfluid. It has a rich phenomenology, which includes hydrodynamical formation of vortices and dark solitons, and emission of "supersonic Cherenkov radiation" when hitting an obstacle. In the second part, I will discuss systems allowing for strong correlation between photons (such as superconducting quantum circuits), unconventional and efficient photon blockade effects with photonic dimers as well as new theory predictions for strongly correlated quantum phases in driven arrays of coupled cavities[2].

[1] I. Carusotto, C. Ciuti, Rev. Mod. Phys. 85, 299–366 (2013) and references therein.
[2] A. Le Boité, G. Orso, C. Ciuti, Phys. Rev. Lett. 110, 233601 (2013).