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Quantum Fluids of Polariton Condensates

Polaritons are light-matter quasi-particles, which are formed in semiconductor microcavities under strong coupling between cavity photons and quantum well excitons. They have recently shown very surprising phenomena, typical of Bose-Einstein condensates (BEC) [1,2], despite their intrinsic dissipative nature. Some of these phenomena have paved the way for the study of new properties, which are unique of such non-equilibrium system. Indeed polaritons, compared to their atomic-BEC counterpart, due to their hybrid light-matter nature, offer strong advantages, amongst which extremely high condensation temperatures, the ability to be easily manipulated/observed and the possibility of straightforwardly integrate with present semiconductor technology.We will review some of the most striking physical phenomena associated with polariton condensates put in motion [3-6]. In particular we will show how it is possible to manipulate and control the polariton flow dynamics, with the formation of vortices, solitons, expanding shock waves and a resolution-limited, long-lived, backjet. Finally, by using controlled fluid dynamics experiment, we will demonstrate the first building block in the use of polariton fluids for the possible realisation of next generation all-optical devices [7].

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