Driven-dissipative Bose-Einstein condensates in periodic potentials

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In recent years, exciton-polariton condensates created in semiconductor microcavities have emerged as an attractive alternative to the atomic systems, owing to the relatively high condensation temperatures, direct momentum and real-space imaging via the cavity photoluminescence, and possibility to manipulate condensates using both optical pump and structure of the microcavity. Compared to atomic condensates, the distinct driven-dissipative nature of polariton condensates leads to unusual response to applied potentials and excitations, which needs to be understood in order to control and manipulate these macroscopic coherent states. In this talk we will discuss the behaviour of driven-dissipative condensates in periodic potentials that are either fabricated in the microcavity or induced by a structured optical pump. By analysing the flow of the polariton superfluid out of the excitation region we will show that the effective potentials produced by the polariton flows can substantially affect dynamics and localization properties of the condensate. We will describe striking consequences of this effect for transport and spatial structure of the open-dissipative condensate in spatially periodic systems, where the condensate can be spatially localized both in bands and gaps of the single-particle energy spectrum. The predicted features of the real-space localization of a dissipative polariton condensate are expected to have strong consequences for any proposed polariton-based devices incorporating spatially modulated potentials, as well as for continuously driven (pumped) condensates of ultracold atomic gases in various trapping geometries.