Manipulating polariton condensates on a chip

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Recent advances in the growth of high finesse microcavities capable of supporting increased photon lifetimes, have made condensation of solid state polariton quasiparticles, built from mixing semiconductor excitons with microcavity photons possible. In a condensed phase, polariton gas has been shown to exhibit superfluid behaviour favouring the establishment of long range order and opening new prospects of quantum manipulation of extended polariton condensates. Recent experiments on manipulation of such quantum fluids have relied on statically imprinted potentials exploiting photonic confinement in micropillar and wire structures. Here, we explore the possibility of manipulation of two-dimensional polariton condensates on a semiconductor microcavity chip using optically imprinted external potentials as shown in Figure 1. The control is achieved on the fly by optically injecting polaritons onto the chip with specific spatial profile to create potential energy landscape in which condensate propagates. We present, tomography technique which can be used to directly visualise formation of such spontaneously created quantum fluid. Beyond the very rich physical phenomena of quantum fluids the ability of their manipulation reveals their great potential for integrated semiconductor-based interferometric devices.

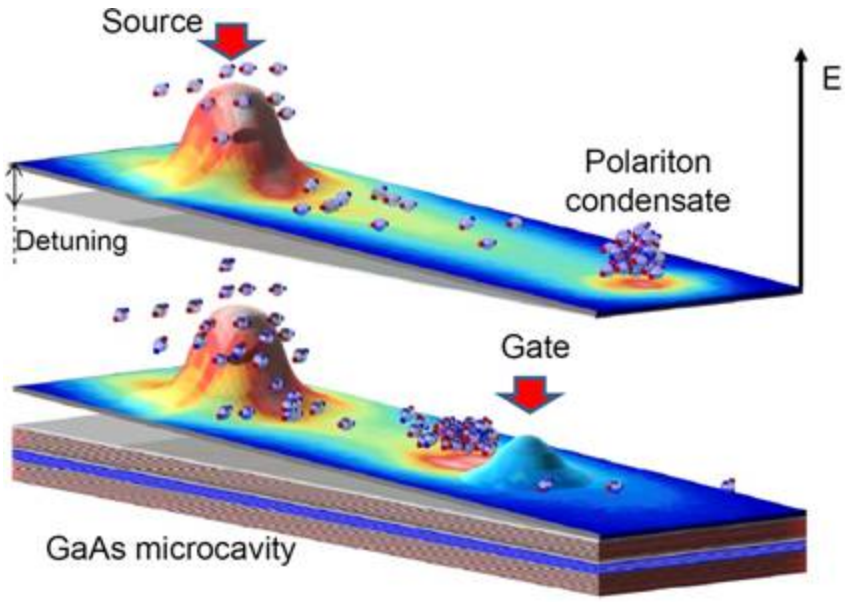

Figure 1. On chip gating of the polariton condensate flow.