Spatial pattern formation in nonequilibrium condensates

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Abstract:

Quasiparticles in semiconductors — such as microcavity polaritons — can form condensates in which the steady-state density profile is set by the balance of pumping and decay. We model trapped, pumped, decaying condensates by a complex Gross-Pitaevskii equation and analyse the density and currents in the steady state. If the pumping spot is larger than the Thomas-Fermi cloud radius, then rotationally symmetric solutions are replaced by solutions with spontaneous arrays of vortices. These vortex arrays arise without any rotation of the trap, spontaneously breaking rotational symmetry. By taking account of the polarization degree of freedom for such condensates, and considering the effects of an applied magnetic field, I will discuss the interplay between polarization dynamics, and the spatial structure of the pumped decaying condensate. Interactions between the spin components can influence the dynamics of vortices; produce stable complexes of vortices and rarefaction pulses with both co- and counter-rotating polarizations; and increase the range of possible limit cycles for the polarization dynamics, with different attractors displaying different spatial structures.