# Spontaneous polariton currents in periodic lateral chains

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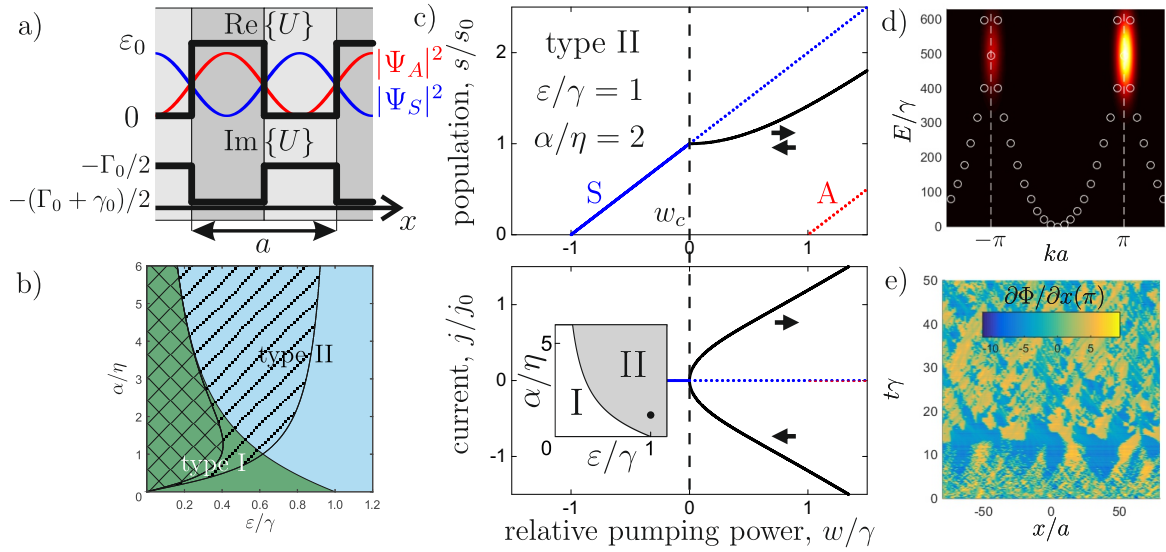
Figure 1: a) Complex periodic potential for polaritons and the two states at the edges of the lowest minigap A and S. b) Phase diagram showing the two transition types with color. Undashed, dashed and double dashed regions correspond to stable, stable in a certain range of pumping powers and unstable solutions in the short wavelength limit, respectively, depending on the potential $\alpha/\eta$ and nonlinearity $\varepsilon/\gamma$ parameters. c) Typical condensate population and current depending on the pumping power. d) Result of a numerical simulation in the stable case: a symmetry-breaking polariton current is evident from the condensate energy dispersion. e) Numerical simulation of the unstable case: a chaotic current domain structure is formed in space and time.

We predict theoretically the spontaneos generation of superfluid polariton currents in systems with one-dimensional periodic variation of both potential and decay rate. A spontaneous breaking of spatial inversion symmetry occurs at a critical pumping, and the current direction is stochastically chosen. Type-I and type-II transitions to the spontaneous current phase can be realised depending on the structure parameters. Above the bifurcation point the condensate is unstable towards long wavelength fluctuations. A peculiar spatial current domain structure emerges, where the current direction is switched at the domain walls. The characteristic domain size and lifetime decrease with further pumping increase. In finite size polariton rings the domain size may exceed the ring length in a range of pumping powers and the circular current solution is stable.