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Tunable lattices and potential landscapes for polariton condensates

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Abstract: Microcavity exciton-polaritons (MPs) are bosonic quasi-particles resulting from the strong coupling between photons in a microcavity (MC) and excitons confined in a quantum well (QW) embedded in it. The hybrid matter/light character yields polaritons a low effective mass and, therefore, long de Broglie wavelengths reaching several µm. In addition, polaritons undergo a transition to a Bose-Einstein-like state (a condensate) with extended temporal and spatial coherence at temperatures of a few K.[1] The long spatial and temporal coherence enables the control of MPs and the formation of MP lattices using µm-sized potentials. In this talk, I address polariton lattices generated in (Al,Ga)As MCs via the modulation by surface acoustic vibrations (Fig. 1a).[2] The lattices have tunable amplitude and move with a velocity proportional to the SAW phase velocity. Micrometer-sized polariton condensates can be confined at each lattice site (cf. Fig. 1(d)[3]) while the interaction with neighbors can be controlled by the SAW amplitude. Tunable lattices with arbitrary shapes can be realized by combining SAWs with static polariton traps. Tunable polariton lattices are solid-state analogues to optical lattices of cold atoms.[2,4] They can hold MP phases of different symmetries and solitonic behavior,[4] thus providing a test-bed for the investigation of many-body interactions in non-equilibrium many-body phases.

Figure 1: (a) Acoustic square lattice created by interfering surface acoustic waves (SAWs) on an (Al,Ga)As microcavity and (b) stroboscopicphotoluminescence image of a lattice of polariton condensates.

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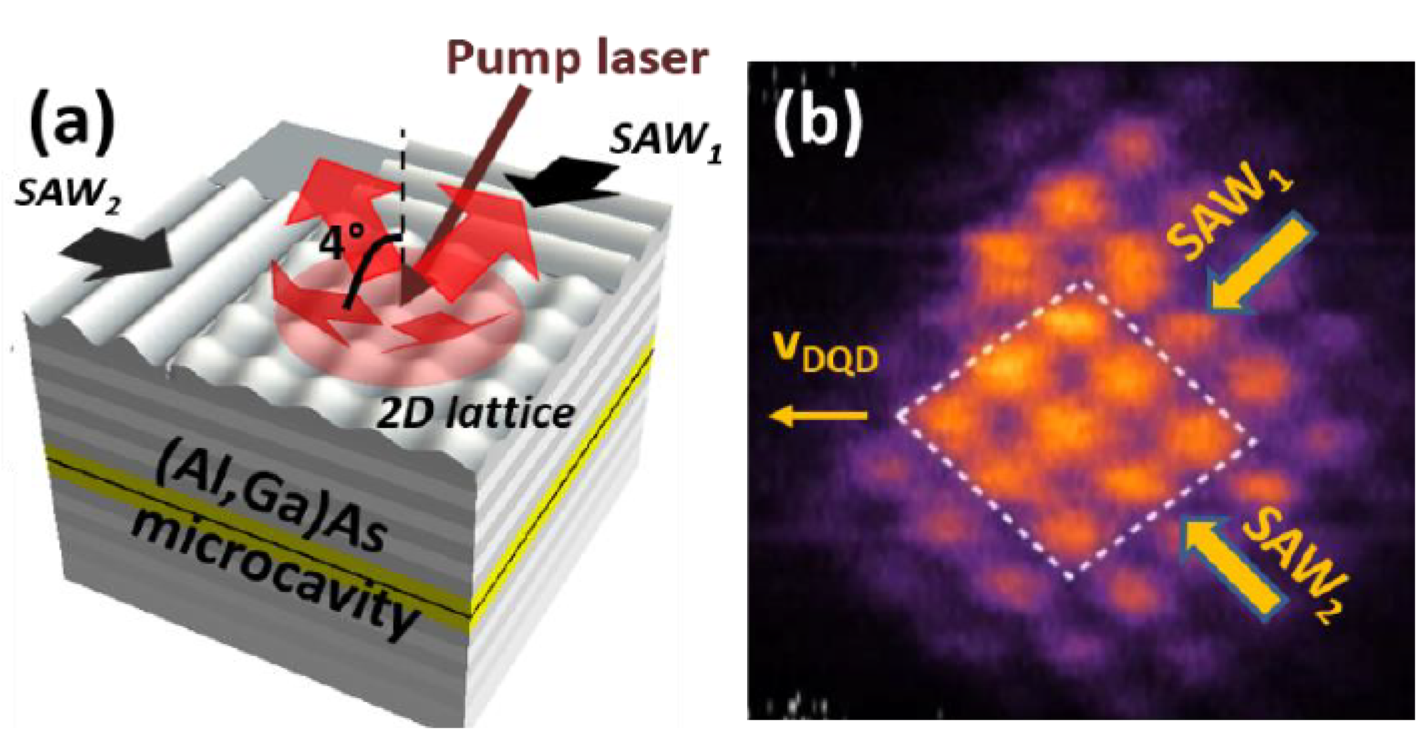

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