Observation of a Supersolid Phase in a Spin-orbit Coupled Exciton-polariton Bose-Einstein Condensate at Room Temperature

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Abstract— We report the fabrication of a liquid crystal microcavity with tunable birefringence. It allows achieving Rashba-Dresselhaus spin-orbit coupling with equal strength. An embedded polymer provides strong light-matter coupling and room-temperature polariton condensation in the two minima of the dispersion. The interference of the two corresponding wave vectors leads to the modulation of the condensate density and to the formation of the supersolid phase. With single-shot experiments, we demonstrate the gauge freedom of the supersolid phase. The suppression of disorder-induced pinning with the increase of the condensate density allows us to claim the superfluid property of the supersolid.

The supersolid phase, combining the superfluidity of quantum liquids with the spatially periodic nature of solids, has been long sought for, but reported only recently in condensates of ultracold atoms [1]. The formation of density stripes has been reported in photonic systems as well at cryogenic temperatures [2].

Here, we report the formation of a supersolid polariton condensate thanks to Rashba-Dresselhaus spin-orbit coupling in a liquid crystal microcavity at room temperature [3]. Single-shot experiments demonstrating the freedom of the phase of the stripes from disorder allow claiming superfluidity.

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