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Observation of Bogoliubov excitations in exciton-polariton condensates

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Particle-particle interaction and peculiar excitation spectra are keys for understanding BEC and superfluidity physics. A quantum field-theoretical formulation for a weakly interacting Bose condensed system was developed by Bogoliubov in 1947, which predicted the phonon-like excitation spectrum in the low- momentum regime. Exciton-polaritons in a semiconductor microcavity, which are elementary excitations created by strong coupling between quantum-well excitons and microcavity photons, were proposed as a new BEC candidate in solid-state systems. Recent experiments with exciton-polaritons have demonstrated several interesting signatures from the viewpoint of polariton condensation, such as quantum degeneracy at non-equilibrium conditions, the polariton-bunching effect at the condensation threshold, long spatial coherence and quantum degeneracy at equilibrium conditions. The particle-particle interaction and the Bogoliubov excitation spectrum are at the heart of BEC and superfluidity physics, but have only been studied theoretically for exciton-polaritons. In this talk, we report the first observation of interaction effects on the exciton-polariton condensate and the excitation spectra, which are in quantitative agreement with the Bogoliubov theory.