# OBSERVATION OF NON-SIMULTANEOUS ROTATION OF EXCITON-POALRITON SUPERFLUID

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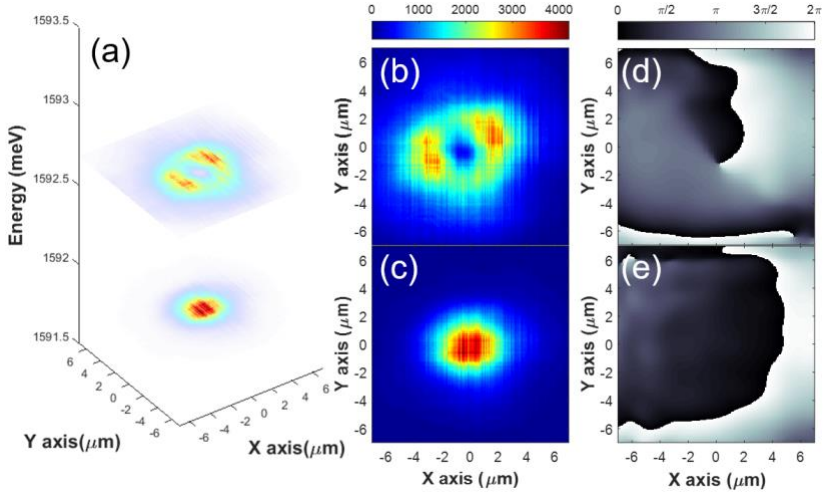
Exciton-polaritons (polaritons) in a semiconductor based 2D microcavity are bosonic quasiparticles, which are formed as a result of strong coupling between quantum well excitons and cavity photons. Polaritons condense to macroscopic coherent states, called polariton condensates due to their bosonic characteristics. A quantum vortex state, which has quantized angular moment in a superfluid, can be created by non-resonant Laguerre-Gaussian excitation in GaAs based planar microcavity.[1] Traditional superfluids have been described as a single wave function with all particles have the same angular momentum. However, we show that total angular momentum of polariton superfluid need not be quantized in the same way. We observed the photoluminescence of two distinguished polariton states in energy spectrum as shown in Fig. 1(a). Figs. 1(b) and 1(d) show that the higher energy state has a ring shaped intensity distribution and a 2π phase winding around the core of polariton distribution, indicating the presence of a quantized vortex. Figs. 1(c) and 1(e), however, show that the lower energy state has Gaussian distribution and zero angular momentum. So, the polariton superfluid has both the rotational and irrotational parts simultaneously. This phenomenon most likely resulted from non-equilibrium dynamics of polariton condensates and relaxation process of condensation. This result will be helpful for understanding superfluidity of polariton condensates and non-equilibrium superfluid in general.




**References**

[1] Min-Sik Kwon, Byoung Yong Oh, Su-Hyun Gong, Je-Hyung Kim, Hang Kyu Kang, Sooseok Kang, Jin Dong Song, Hyoungsoon Choi, and Yong-Hoon Cho, *Physical Review Letters*, 2019, **122**, 045302