

Allgemeines Physikalisches Kolloquium

Donnerstag, 14.01.2021 um 16 Uhr c.t.
Online-Kolloquium

Jun.-Prof. Dr. Marc Aßmann

TU Dortmund, Experimentelle Physik 2

An Unexpected Twist – Vortex Control in Optically Imprinted Polariton Landscapes

Exciton-polaritons are mixed light-matter quasiparticles arising due to the strong coupling of photons and excitons inside a semiconductor microcavity. As they are composite bosons of low mass, they may form a macroscopically coherent non-equilibrium condensate at elevated temperatures [1], which led to fascinating demonstrations of superfluidity [2] and quantized vortices [3] in the solid state. The photons leaking from the cavity are a part of the polariton wave function. Thus, the properties of the polariton condensate, including its energy, spin, momentum and phase may be investigated by spectroscopic means.

Under non-resonant excitation, polaritons form spontaneously from free carriers and form a condensate that interacts with them. As polaritons are several orders of magnitude lighter than these carriers, the latter effectively form a static repulsive potential for the condensed polaritons. Spatially shaping the excitation beam then enables us to investigate polariton condensates in optically imprinted potential landscapes. We show how to utilize them to control the momentum and direction of flowing polaritons. Further, we discuss the creation of quantized vortices that couple directly to the orbital angular momentum of the emitted light. Finally, we demonstrate how to robustly switch the flow direction of such a vortex using a time-dependent potential and monitor the switching dynamics using a dedicated orbital angular momentum spectroscopy technique with picosecond temporal resolution [4], which opens up new perspectives for polaritonics.

References:

1. J. Kasprzak et al., Nature **443**, 409 (2006).
2. A. Amo et al., Nat. Phys. **5**, 805 (2009).
3. K.G. Lagoudakis et al., Nat. Phys. **4**, 706 (2008).
4. X. Ma et al., Nat. Comm. **11**, 897 (2020).

