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Novel Non-equilibrium Phenomena in Quantum Fluids of Light

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Driven-dissipative quantum fluids of light, experimentally realised in for example semiconductor microcavities, circuit or cavity QED systems, provide a unique testbed to explore new non-equilibrium quantum phenomena. I will review recent progress in this field. In particular, we show that polariton quantum fluid can exhibit a non-equilibrium order, where superfluidity is accompanied by stretched exponential decay of correlations [1]. This celebrated Kardar-Parisi-Zhang (KPZ) phase has not been achieved before in any system in 2D, and even 1D realisations have not been conclusive. I will then discuss how these systems can undergo other unconventional phase transitions and orders [2,3], and display flow properties connected but distinct from conventional superfluidity. Finally, when placed in strained honeycomb lattice potentials, polariton fluids can condense into a rotating state, the lowest Landau level, forming a vortex array and spontaneously breaking time reversal symmetry [4].

[1] A. Zamora et al, PRX 7, 041006 (2017); PRL 125, 265701 (2020); A. Ferrier et al, PRB 105, 205301 (2022)
[2] G. Dagvadorj et al, arXiv:2208.04167, PRL to appear (2023)
[3] G. Dagvadorj et al, PRB 104, 165301 (2021)
[4] C. Lledo et al, SciPost 12, 068 (2022)

Affiliation de l'auteur principal

Department of Physics and Astronomy, University College London, Gower Street, London, WC1E 6BT, UK

Orateur: SZYMANSKA, Marzena (University College London)

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