MPIDS Colloquium

MAX-PLANCK-GESELLSCHAFT

Spontaneous symmetry breaking out of equilibrium: Kibble-Zurek-Mechanism in colloidal monolayers

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The Kibble-Zurek mechanism describes the evolution of defects and domains when a system is forced through a phase transition with spontaneously broken symmetry. It is used to describe transitions on such different scales like the Higgs field in the early universe shortly after the Big Bang [1] or in condensed matter systems like quenched quantum fluids [2]. Cooling at a finite rate, a domain structure naturally arises for a system with continuous phase transition. Since diverging correlation lengths are accompanied with critical slowing down, the system has to fall out of equilibrium for any non-zero rate in the vicinity of the transition. At this so called fall out time, a fingerprint of critical fluctuations is taken before the symmetry can switch globally. Within this picture, we investigate the non-equilibrium dynamics in a soft-matter analogue, a two-dimensional ensemble of colloidal particles which in equilibrium obeys the Kosterlitz-Thouless-Halperin-Nelson-Young melting scenario. The ensemble is exposed to finite cooling rates at very different rates, from the isotropic fluid deep into the symmetry broken phase. We analyse the defect configurations and the evolution of orientationally ordered domains quantitatively via video microscopy and validate the Kibble-Zurek scaling when adopted for the Kosterlitz-Thouless universality [3].

[1] T.W.B. Kibble, J. Phys. A: Math. Gen. **9**, 1387 (1976); Phys. Rep. **67**, 183 (1980).
[2] W.H. Zurek, Nature **317**,505 (1985); Acta. Phys. Pol. B **24**, 1301 (1993).
[3] S. Deutschländer, P. Dillmann, G. Maret, and P. Keim, Proc. Natl. Acad. Sci. **112**, 6925 (2015).

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MPIDS, video conference at www.zoom.us
Meeting ID: 959 2774 3389
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