SFB/TRR 21 - Colloquium

19. Juni 2015, Tübingen

Sebastian Diehl

(TU Dresden)

Universal phenomena in driven open quantum system

Quantum optics and many-body physics increasingly merge together in ultracold atomic gases and certain classes of solid state systems. This gives rise to new non-equilibrium scenarios in stationary state, where coherent and dissipative dynamics appear on an equal footing. Here we focus on universal aspects of such systems, which unambiguously reveal their microscopic driven nature on a macroscopic scale. In particular, we will report on a driven analogue of quantum dynamical criticality, with a possible realization in microcavity arrays. We establish a new interacting critical fixed point and determine its universality class within a functional renormalization group approach. Specifically, we argue that the critical point both exhibits coherence and retains its intrinsic non-equilibrium character even at the largest distances. This is in stark contrast to classical driven criticality, where decoherence and asymtptoptic thermalization were observed. Furthermore, we address ordering phenomena in two dimensions. We show that driven Bose systems cannot exhibit algebraic quasi-long range order, unless being strongly anisotropic. While the correlations thus generically do not show signatures of order, we demonstrate that the superfluid response, surprisingly, is finite. These results hint at a genuine phase transition visible in the responses but not the correlations, without counterpart in equilibrium.

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Universität Tübingen, Raum D4 A19
Auf der Morgenstelle 14, 72076 Tübingen

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