Universal phenomena in low dimensional driven open quantum systems

Sebastian Diehl
Institute for Theoretical Physics, University of Cologne, Germany

Quantum optics and many-body physics increasingly merge together in ultracold atomic gases and solid state, such as exciton-polariton systems. This gives rise to new non-equilibrium scenarios in stationary state, where coherent and dissipative dynamics appear on an equal footing.
We will report on universal crossovers in one and two dimensions. At long wavelength, the non-equilibrium character reveals itself via a mapping of such systems to a compact variant of the Kardar-Parisi-Zhang equation. This allows for defects without counterpart in the original non-compact equation. This is made manifest by a duality transformation to an open non-linear electrodynamics. We analyze the interplay of non-equilibrium KPZ physics and the proliferation of these defects. They always unbind asymptotically even at low effective temperature. While in two dimensions, the vortex proliferation scale preempts the onset of KPZ scaling, the situation is reversed in one dimension. This suggests one-dimensional exciton-polariton systems as a laboratory to study these universal crossovers.

.