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Universality in Driven-Dissipative Bose-Einstein Condensation

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Abstract:

Recent years have seen tremendous progress in the experimental realization of systems at the interface of quantum optics and condensed matter physics. A prominent example are exciton-polariton condensates: In these bosonic many-body systems continuous loss of particles has to be compensated by external laser pumping, and the system evolves into a stationary state that is characterized by the balance of loss and gain and is not thermodynamic equilibrium. We discuss universal aspects of Bose-Einstein condensation in such a non-equilibrium stationary state. In three spatial dimensions we characterize dynamical critical behavior by means of a functional renormalization group analysis. We find that the long-wavelength behavior is effectively thermal. The approach to this thermal behavior, however, is determined by a critical exponent that is absent in equilibrium. In two spatial dimensions we show that long-wavelength phase fluctuations which are governed by the KPZ equation destroy algebraic order that would be present in an equilibrium system. True algebraic order is possible only in spatially anisotropic systems.