Mean-field approximation for non-Hermitian and PT-symmetric many-boson systems

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Abstract:

The mean-field description of many-boson systems can be formulated as the effective dynamics resulting from a constraint to fully condensed states. For Hermitian systems of weakly interacting particles this yields the Gross-Pitaevskii equation for the dynamics of the effective single-particle wave function. It has recently been shown that this approximation is modified in the presence of non-Hermitian terms in the many-particle Hamiltonian, for the example of a Bose-Hubbard dimer with complex on-site energies.

Here we review the generalised mean-field approximation for non-Hermitian systems, and compare the resulting dynamics to those arising from a Gross-Pitaevskii equation with complex on-site energies. Further we consider the case of an additional complex particle interaction term, modelling particle losses due to interaction. The latter leads to a complex nonlinear term in the mean-field approximation in contrast to the linear term arising from complex on-site energies. The interplay between non-linearity and non-Hermiticity modifies the self-trapping transition and leads to new bifurcation scenarios that are analysed in detail.

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