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QE

Quantum Efficiency Seminar und Colloquium

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Nonlinear modes in PT-symmetric metamaterials

Synthetic systems with matched gain and loss may form parity-time (PT)-symmetric metamaterials described through non-hermitian Hamiltonians and showing a phase transition in between an exact and a broken phase as a function of the gain/loss power [1]. The PT-symmetry breaking has been experimentally observed in optical lattices [2]. We introduce a PT-symmetric metamaterial consisted of split-ring resonator (SRR) dimers, one with loss and the other with equal amount of gain, coupled magnetically while nonlinearity and gain are introduced through tunnel Esaki diodes. Within the framework of the equivalent circuit model [3], extended for the PT- dimer chain, we investigate the dynamics of charge accumulated in the n-th SRR governed by a coupled set on nonlinear ODE's.

In the absense of nonlinearity, for fixed inter-SRR coupling the propagation bandwidths as a function of the gain/loss parameter show the onset of the PT-phase transition and a resulting band modification. The presence of nonlinearity may induce intrinsic localized modes in the form of discrete breathers with the largest part of the total energy concentrated into two neighboring sites belonging to the same gain/loss dimer [3]. The PT- symmetric nonlinear metamaterial may be used for dynamic tuning in the range of the modified band and switching to the broken phase.

References

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