Abstract

Dispersion and Localization of Excitations in Disordered Polar Matter

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It is well known that the coupling between photons and phonons in polar matters, for instance, ionic crystals or polar semiconductors, is strong near optical-phonon-photon resonance and gives rise to new quasiparticles — polaritons (M. Born and K. Huang, Dynamical theory of crystal lattices, 1954 J. J. Hopfield, Phys. Rev. 112, 1555 (1958)). In the present work we have investigated polariton excitations in inhomogeneous (disordered) polar matters. A simple model of isotropic disordered polar matter is formulated. To describe transverse optical excitations the displacement and the vector-potential are entered. Intermixing ions and electromagnetic excitations may be depicted by coupled mechanical and electromagnetic equations. In a homogeneous system as a consequence of the matters coupling the dispersion may be found from a forth order algebraic equation while in an inhomogeneous polar matter with random parameters eigen frequencies have to be found from the nonlinear eigenvalue problem. We have shown that in the space of doubled dimension the problem of polariton propagating may be reformulated as the Anderson localization problem with a nonsymmetric random matrix. By using an effective numerical approach we investigate the density of states and the level distribution. The eigenvalues near the polaritonic gap are tested for localization by a calculation of the participation rate.

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