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Two-body and three-body interactions in phonon-assisted exciton energy transfer between quantum dots KAIJIE XU, CARLO PIERMAROCCHI, Department of Physics and Astronomy, Michigan State University — We theoretically study the dynamics of exciton energy transfer between semiconductor quantum dots. Phonons play a critical role in the exciton energy transfer process when the energy of the dots involved in the process is different. We find that the phonon-assisted energy transfer cannot be correctly described by two-body exciton-photon and exciton-phonon interactions if each dot is modeled as a single-level exciton system. Higher excited levels of the exciton state have to be included to properly describe the phonon-assisted process. However, excited states can be traced out by introducing a single-level exciton model with an effective three-body exciton-photon-phonon coupling term. The three-body term describes a change in the exciton-photon dipolar coupling due to phonon-induced deformations of the ground exciton wavefunction. The multi-level exciton model with two-body interactions and the single-level exciton model with three-body interaction reproduce the same exciton transfer rates to the leading order contributions of perturbation theory.

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