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Renormalization of Optical Transition Strengths in Semiconductor Quantum Dots due to Band Mixing KIRILL VELIZHANIN, Los Alamos National Laboratory — Strength of electronphoton coupling determines such important quantum dot (QD) characteristics as the radiative lifetime and absorption cross section. This strength is often assumed to be fully encoded by the so called Kane momentum matrix element. This parameter, however, pertains to a bulk semiconductor material and, as such, is not sensitive to the quantum confinement effects in a QD. In this work we demonstrate that the quantum confinement, via the so called band mixing, can result in a significant suppression of the strength of electron interaction with electromagnetic field. Within the envelope function formalism, we show how this suppression can be described by introducing an effective energy-dependent Kane momentum. Then, the effect of band mixing on the efficiencies of various photoinduced processes can be fully captured by the conventional formulae (e.g., spontaneous emission rate), once the conventional Kane momentum is substituted with the renormalized energy-dependent Kane momentum introduced here. As an example, we evaluate the energy-dependent Kane momentum for PbSe and PbS QDs and show that neglecting band mixing in these systems can result in the overestimation of absorption cross sections and emission rates by a factor of 2.

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