Many-body perturbative calculations for multi-excitons in perovskite nanocrystals

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Perovskite nanocrystals (NCs) are among the most fashionable names nowadays in the field of colloidal synthesis owing to their superior photoluminescence quantum yield and blinking-free properties, which make them promising materials for both classical [1,2] and quantum light sources [3,4]. Their brightness and sub-nanosecond radiative decay originates from the inherent correlation effects [5,6]. The many-body Coulomb interaction has generally been studied for semiconductor quantum dots [7,8]. Perovskites, as a consequence of the unique properties of their dielectric functions, possess enhanced Coulomb interaction between the charge carriers [9]. This leads to large binding energies of multi-exciton systems such as trion and biexciton in these NCs or the sizable splitting in the fine structure of single exciton states. Considering each NC as an artificial atom under the envelope function approximation, this problem of correlation effects can be approached at first by using second-order many-body techniques as outlined in Ref. [10]. This offers an elegant and efficient method that provides qualitative results for the trion and biexciton binding energies [11]. In going beyond the second-order description, configuration interaction can be employed to include the correlation energies between the various charge carriers in a more holistic manner.

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