Seminarankündigung

Dienstag, 03. April 2012
17:15 Uhr

WSI, Seminarraum S 101

"Efficiency of multi-exciton generation in colloidal nanostructures"

There are two models that explain the high efficiency of multiexciton generation (MEG) observed in nanocrystals (NCs): the coherent superposition model, based on the strong quasi-resonant coupling between exciton and multi-exciton states in a NC and non-coherent models that are based on the important observation that the density of biexciton states is significantly larger than the density of exciton states at the same energy. We unify both approaches and consider a single-photon excitation coherently coupled with many multi-exciton-states in a NC within a full quantum-state evolution approach. Our quantum simulations that include hundreds of thousands of exciton and multi-exciton states show how the complex time-dependent dynamics of these states in a closed electronic system yields a saturated MEG effect on a picosecond timescale. The initial single-photon excitation becomes lost in the dense maze of multi-exciton states of the NC and a single exciton does not appreciably revive. Including phonon relaxation confirms that efficient MEG requires the exciton--biexciton coupling time to be faster than exciton relaxation time. Enhancement of the exciton-biexciton coupling is one way to increase the efficiency of MEG. Such enhancement could be realized in thin nanorods (NRs) and nanowires (NWs), because the carriers in such structures interact predominantly through the surrounding media with a small dielectric constant. Due to this enhancement the binding energy of excitons in PbSe NRs and NWs could be as large as 400 meV. Indeed, resent preliminary measurements of PbSe NRs have shown the MEG efficiency, which is higher than the one measured in spherical PbSe NC of the same size.

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