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Electronic Structure of PbSe Nanorods ADAM BARTNIK, Cornell University, ALEXANDER L. EFROS, Naval Research Laboratory, WEON-KYU KOH, University of Pennsylvania, JUN YANG, Cornell University, CHRISTOPHER MURRAY, University of Pennsylvania, FRANK WISE, Cornell University — In spherical lead-salt (PbS and PbSe) nanocrystals, their large dielectric constant and mirror-like band structure significantly weaken the Coulomb interaction, while their large exciton Bohr radii place them at the limit of strong confinement. But in a 1-dimensional structure, the Coulomb interaction can act primarily through the medium, greatly reducing screening. Thus, by controlling their length, the lead-salts can uniquely switch from strong confinement to strong Coulomb binding. To investigate this, we develop a 4-band k-p model of the electronic structure of lead-salt nanorods (NRs), which includes the Coulomb interaction through an effective 1D potential along the NR axis. Perpendicular to the cylindrical axis, confinement dominates and is the major determinant of the location of peaks in the optical spectra. Along the rod axis, the effective Coulomb potential dominates, highly correlating the electron and hole in this direction and enhancing multiparticle interactions, with the observable effect of producing isolated peaks in optical spectra. Predictions of the locations of these enhanced transitions are shown to have good agreement with measured optical spectra of recently synthesized colloidal PbSe NRs.

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