Localization of trions by imperfections in quantum wells.

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We present a theoretical study of lateral localization of positively charged and neutral excitons in quantum wells due to the well width fluctuations or in the presence of remote charged centers in the barrier.

The ground state energies for trions and excitons are obtained using the variational technique in which the wave functions are expanded in terms of products of correlated Gaussian functions with respect to the in-plane coordinates and exact solutions for the one-particle quantum well potential in the direction perpendicular to the quantum well plane. The minimization of ground state energies was performed by optimizing the basis functions parameters using the simulated annealing technique.

We first considered an ideal quantum well without defects. Taking into account the polaron correction for charged excitons we have obtained binding energies which are in good agreement with experimental results. Then we also considered non-ideal quantum wells, with a localization potential, which is modeled by a Gaussian profile in the plane of the quantum well. In particular we have analyzed the dependence of the trion binding energy on the localization potential width and depth. Finally, having obtained the expression of the trion ground state wave function, we also compare the absorption coefficient corresponding to the formation of a trion, in an ideal quantum well and in the presence of localization potential.

We compare numerical results obtained for the quantum well system CdZnTe/CdMgZnTe with recently published experimental data.