ENERGY STATES OF RYDBERG EXCITONS IN CUPROUS OXIDE QUANTUM WELLS: FROM WEAK TO STRONG CONFINEMENT

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Due to confinement along one direction, excitons in quantum wells (QWs) behave rather differently than in bulk materials. We investigate the dependence of energies of Rydberg excitons on the strength of confinement in cuprous oxide QWs [1]. The energy spectrum of hydrogen-like excitons in Cu_2O-based rectangular QWs is obtained numerically from the solution of the three-dimensional Schrödinger equation. The parametric dependence of the Rydberg energy levels on the QW width is observed. The evolution of the energy levels in a QW-like structure in the crossover region from weak to strong confinement is analyzed for different quantum numbers. Various crossings and avoided crossings of the Rydberg energy levels are categorized based on the symmetry properties of the exciton wave function. Particular attention is paid to the two limiting cases of narrow and wide QWs attributed to strong and weak confinement, respectively. The energies obtained with the pure Coulomb interaction are additionally compared with the results originating from the Rytova-Keldysh potential, i.e. by taking into account the dielectric contrast in the QW and in the barrier.

References

[1] P. A. Belov, F. Morawetz, S. O. Krüger, N. Scheuler, P. Rommel, J. Main, H. Giessen, S. Scheel, Energy states of Rydberg excitons in finite crystals: From weak to strong confinement, arXiv:2310.19746

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