Recent theoretical developments of trions, biexcitons, and exciton condenstation

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Abstract

Theoretical studies of the electronic structures and optical properties of trions, biexcitons, and exciton condenstation in semiconductors and quantum wells are presented. Recent theoretical developments for solving the Schrödinger equations of trions and biexcitons based on exciton basis (plus free carrier for trions) are reported. The main advantage of this basis is to eliminate the exciton contribution from the complex and aim at the binding part directly. The interacting electron-exciton or exciton-exciton system is treated using the recently developed composite boson many-body formalism[1] which allows an exact handling of electron exchange. We numerically solve the resulting biexciton Schrödinger equation with the exciton levels restricted to the ground state and we derive the biexciton ground state as well as the bound and unbound excited states as functions of hole-to-electron mass ratio.[2,3] Using the wave functions obtained numerically, we then calculate the optical absorption spectrum in the presence of hot carriers or excitons for a semiconductor quantum well. The recent development of finite T formalism for N excitons [4] will also be presented. Finally, we describe the effect of Pauli-scattering the critical behavior of exciton condenstation, and propose a pump-and-probe experiment which can be used to probe the momentum distribution of the exciton condensate.

References:

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