Exciton-polarons in doped semiconductors

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The dynamics of a quasiparticle can be significantly modified by a quantum media surrounding it. This type of phenomenon can be viewed quite generally as a polaronic effect, using the concept invented by L. Landau and S. Pekar. The Bose-polaron problem involving the quantum bath of phonons or magnons has been important historically, stimulating the development of the path integral formulation of quantum mechanics and creative new numerical tools in quantum physics. Over the past decade, the Fermi-polaron problem involving a Fermi gas as the quantum media has become experimentally accessible in cold atom systems, and considerable progress has been achieved in understanding of its rich behaviour.

In my talk, I will argue that the Fermi-polaron physics govern the optical properties of moderately doped two-dimensional semiconductors. The interactions of photoexcited excitons with Fermi sea formed by excess charge carriers split them into attractive and repulsive exciton-polarons, that manifest as two separate peaks in the absorption. The doping dependence of resonant frequencies of two peaks and their amplitudes are in a very good agreement with recent experimental results as in conventional quantum well systems, as in transition metal dichalcogenides.

References

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