Magnetic Polarons in Semiconductor Quantum Dots

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Semiconductor quantum dots (QDs) doped with magnetic impurities have been a focus of continuous research for a couple of decades. A significant effort has been devoted to studies of magnetic polarons (MP) in these nanostructures [1]. These collective states arise through exchange interaction between a carrier confined in a QD and localized spins of the magnetic impurities (typically: Mn). We discuss our theoretical description of various MP properties in self-assembled QDs. First, we present a self-consistent, temperature-dependent approach to MPs formed by a valence band hole. We use the Luttinger-Kohn $\mathbf{k} \cdot \mathbf{p}$ Hamiltonian to account for the important effects of spin-orbit interaction [2]. Next, we propose that in the case of 2 holes, the spins align to form a magnetic "bipolaron" [3]. Finally, we report on a particular QD system, where experiments reveal a robust MP with a surprising temperature dependence [4].

References:

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