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The Optimization of Magnetic Ordering in Quantum Dots[1]
JAMES PIENTKA, RAFAL OSZWALDOWSKI, IGOR ZUTIC, JONG HAN, SUNY at Buffalo, ANDRE PETUKHOV, South Dakota School of Mines and Technology — Lately, there have been several theoretical studies that demonstrate how carrier-mediated magnetic ordering is influenced by multiple occupancies in quantum dots (QD) [1,2]. Experimentally, multiple-occupancy can be reached by high photo-excitation intensity. It was observed in type-II QDs that magnetic polaron (MP) formation persists at large temperatures [3]. We show that varying QD occupancy has important consequences, including thermally enhanced magnetic ordering in QDs [4]. We extend our method to take into account the formation of magnetic bipolarons (MBP) [1,2]. We show that a standard mean-field treatment of MBP leads to unphysical phase transitions, removed when fluctuations are taken into account. Finally, we demonstrate that for a single MP, the shrinking of the carrier wave function due to the exchange with magnetic impurities is a small effect. [1] R. Oszwaldowski, I. Zutic, and A. G. Petukhov, Phys. Rev. Lett. 106, 177201 (2011). [2] R. Oszwaldowski, P. Stano, A. G. Petukhov, and I. Zutic, accepted to Phys. Rev. B. (Rapid Communications), arxiv:1210.6422. [3] I. R. Sellers, R. Oszwaldowski, et al., Phys. Rev. B 82, 195320 (2010). [4] J. M. Pientka, R. Oszwaldowski, A. G. Petukhov, J. E. Han, and I. Zutic, Phys. Rev. B. 86, 161403(R) (2012).

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