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Self-consistent Theory of Magnetic Polarons in Semiconductor Quantum Dots.[1] DAN REDERTH, RAFAL OSZWALDOWSKI, SDSMT Physics, A. G. PETUKHOV, NASA Ames Research Center — Nanostructures based on dilute magnetic semiconductors indicate paths towards novel devices that could employ carrier spin [1-2]. Magnetic quantum dots (QDs) are an example of such structures. We use a robust numerical method, based on the Luttinger-Kohn Hamiltonian and suitable for realistic self-assembled QD geometries [3], to study electronic structure and magnetism of p-type II-VI quantum dots doped with Mn magnetic ions. Our method relies on self-consistent treatment of exchange coupling of holes and magnetic ions within the mean-field approximation [4]. It explicitly takes into account multi-band character of the hole kinetic energy operator. We demonstrate formation of the hole magnetic polarons, which manifests itself in self-induced splitting of the hole levels in absence of an external magnetic field [5]. Furthermore, we conduct detailed studies of the magnetically-ordered QD ground state. The structure of the ground state reveals highly anisotropic, as well as, position- and temperature-dependent self-induced magnetization. [1] Semiconductor spintronics and quantum computation, D.D. Awschalom, D. Loss, and N. Samarth eds., (Springer, Berlin, 2002). [2] J. Fabian, A. Matos-Abiague, C. Ertler, et al., Acta Phys. Slov 57, 565 (2007). [3] H. Kirmse, R. Schneider, M. Rabe, et al., Appl. Phys. Lett. 72, 1329 (1998). [4] R. Oszwaldowski, P. Stano, A. Petukhov, and I. Zutic, Phys. Rev. B 86, 201408 (2012). [5] Seufert, J., Bacher, G., Scheibner, et al., Phys. Rev. Letters 88, 27402 (2002).

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