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Optical manipulation of electron spin in quantum dot systems[1]
JOSE VILLAS-BOAS, SERGIO ULLOA, ALEXANDER GOVOROV, Ohio University — Self-assembled quantum dots (QDs) are of particular interest for fundamental physics because of their similarity with atoms. Coupling two of such dots and addressing them with polarized laser light pulses is perhaps even more interesting. In this paper we use a multi-exciton density matrix formalism to model the spin dynamics of a system with single or double layers of QDs. Our model includes the anisotropic electron-hole exchange in the dots, the presence of wetting layer states, and interdot tunneling [1]. Our results show that it is possible to *switch* the spin polarization of a single self-assembled quantum dot under elliptically polarized light by increasing the laser intensity. In the nonlinear mechanism described here, intense elliptically polarized light creates an effective exchange channel between the exciton spin states through biexciton states, as we demonstrate by numerical and analytical methods. We further show that the effect persists in realistic ensembles of dots, and we propose alternative ways to detect it. We also extend our study to a double layer of quantum dots, where we find a competition between Rabi frequency and tunneling oscillations. [1] J. M. Villas-Boas, S. E. Ulloa, and A. O. Govorov, Phys. Rev. Lett. 94, 057404 (2005); Phys. Rev. B 69, 125342 (2004).

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