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Anisotropic Spin Exchange in Coupled Quantum Dots KERWIN FOSTER, Dillard University, LAYLA HORMOZI, DIMITRIJE STEPANENKO, NICHOLAS BONESTEEL, Dept. of Physics and NHMFL, Florida State University — We study the effect of spin-orbit coupling on the exchange interaction between spins in coupled quantum dots in III-V semiconductors. Our motivatation is recent work showing that spin-orbit induced anisotropic corrections to the isotropic Heisenberg exchange are potentially useful for quantum computation.[1] We show that ferromagnetic direct exchange *enhances* the anisotropy of the interaction by reducing the size of the isotropic term — an important effect if these terms are going to used for quantum computation. If only one orbital is kept per dot (Hund-Mulliken approximation) the effect of ferromagnetic direct exchange is overestimated for large dots.[2] This can be seen, for example, by noting that the calculated isotropic exchange coupling becomes *negative* in zero magnetic field for some interdot distances, in violation of the Lieb-Mattis theorem. To reliably estimate the enhancement of the anisotropy, we therefore work within an approximation in which more than one orbital is kept per dot, and show that this new approximation is applicable to a wider range of dot parameters. Apart from the improved reliability of the approximation, adding more orbitals gives new insight into the symmetry of the resulting interaction.

[1]D. Stepanenko and N.E. Bonesteel, PRL **93**, 140501 (2004).
[2]G. Burkard, D. Loss, and D.P. DiVincenzo, PRB **59**, 2070 (1999).

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