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**Control of Anisotropic Spin Exchange in Quantum Dots** DIMITRIJE STEPANENKO, LAYLA HORMOZI, NICHOLAS BONESTEEL, Dept. of Physics, NHMFL and MARTECH, Florida State University, KERWIN FOSTER, Dillard University — To first order in spin-orbit coupling, the exchange interaction between spins in coupled quantum dots has the form $J(\mathbf{S}_1 \cdot \mathbf{S}_2 + \vec{\beta} \cdot (\mathbf{S}_1 \times \mathbf{S}_2))$. Recently we have shown that the ability to control the Dzyaloshinski-Moriya vector $\vec{\beta}$ is a potentially useful resource for quantum computation.[1] Here we study microscopically the degree of this control for coupled quantum dots in III-V semiconductors. At the level of the Hund-Mulliken (HM) approximation, in which one orbital is kept per dot, spin-orbit coupling enters as a small spin precession during interdot tunneling. $\vec{\beta}$ is proportional to this precession angle, and its dependence on dot parameters (e.g., interdot distance and dot size) can be strongly enhanced by ferromagnetic direct exchange. We determine the range of effective $\vec{\beta}$ values in quantum gates produced by pulsing the exchange interaction through numerical integration of the Schrödinger equation. Anisotropy in any particular gate is determined by the pulse duration, which is limited by decoherence for slow pulses and adiabaticity for fast pulses. The effects of going beyond the HM approximation, keeping more than one orbital per dot, are also discussed.

[1]D.Stepanenko, N.E.Bonesteel, PRL **93**, 140501 (2004).

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