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A Two-Qubit Geometric Phase Gate for Localized Electron Spin Qubits using Cavity Polariton Resonance SHRUTI PURI, NA YOUNG KIM, E. L. Ginzton Laboratory, Stanford University, California, USA, YOSHIHISA YAMAMOTO, E. L. Ginzton Laboratory, Stanford University, California, USA, National Institute of Informatics, Tokyo, Japan — We propose a two-qubit geometric phase gate, in which the interaction between a pair of localized electron spins, is mediated by quantum well microcavity exciton-polaritons. The entanglement between the electrons is a result of their spin dependent Coulomb exchange interaction with the exciton-polaritons. This optical coupling, resembling the electron-electron Ruderman-Kittel-Kasuya-Yosida (RKKY) interactions, offers high speed, high fidelity two-qubit gate operation with moderate cavity quality factor Q. The long ranged interaction by microcavity polaritons (order of micrometers) makes this gate suitable for fault tolerant operations. By the use of electrostatic quantum dots, the errors caused by unwanted excitations to charged excitons or trions are eliminated. The errors due to the finite lifetime of the polaritons can be minimized by optimizing the optical pulse parameters (duration and energy). The proposed design maximizes entanglement and ensures scalability.

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