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Using a quantum dot spin bus to implement CNOT gates between remote qubits[1] JIANJIA FEI, DONG ZHOU, MARK FRIESEN, Department of Physics, University of Wisconsin-Madison — A spin bus is a chain of individual spins with strong, always-on, static interactions (e.g., a linear array of single-electron quantum dots). Here, we consider a spin bus coupled to multiple external qubits via the Heisenberg exchange interaction. Using both theoretical and numerical methods, we show that a continuous range of two-qubit gates can be constructed. In particular, we show that SWAP and square-root-SWAP gates can be achieved with high accuracy, when the couplings between the qubits and the bus are weak. In combination with single-qubit operations, we can then realize controlled-NOT gates between remote qubits, as mediated by the bus. The spin bus therefore shows considerable potential for implementing universal quantum gates.

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Jianjia Fei
Department of Physics, University of Wisconsin-Madison

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