Coherent shuttling of spins between silicon-based quantum dots

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Coherent communication between quantum registers separated by ~ 10 μm distances is one of the requirements for scalability of architectures based on gated quantum dots [1]. Moving a spin qubit across this distance, e.g. along a chain of tunnel-coupled dots [2], is one of possible solutions. I will discuss our recent theoretical work [3,4] on such a dot-to-dot adiabatic charge transfer in presence of realistic amount of charge noise and electron-phonon coupling in Si/SiGe QDs, which are currently the best candidates for a scalable semiconductor qubit architecture. I will discuss the close relationship between non-adiabatic (and thus non-deterministic) character of charge transfer, and spin dephasing caused by dot- and state-specific g-factors. Finally, I will describe an alternative qubit shuttling scheme in which gates are used to create a moving quantum dot [5,6]. I will argue that this scheme is more robust to electrostatic disorder compared to the one based on pre-existing tunnel coupled quantum dots, and I will discuss how the valley-orbit coupling in presence of interface roughness will be the main source of spin qubit dephasing in this scheme [6].

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