Shared-control shuttling link between distant germanium spin-qubit registers

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Significant progress has been made in the operation of spin qubits in semiconductor platforms, with high-fidelity control of small qubit registers demonstrated across various systems [1,2]. A key challenge is now to interconnect such qubit registers, as it may open up scalable modular quantum computing [3]. Conveyor-mode shuttling, which consists in displacing a spin in a moving potential well defined using interdigitated gate electrodes, offers a promising approach to make scalable quantum links between distant qubit registers [4].

In this work, we investigate conveyor-mode shuttling in germanium. We demonstrate the coherent transfer of a single hole spin between two quantum dot arrays spaced by 1.2 µm. Combining resonant control with spin shuttling, we characterize the rotations induced by the spin-orbit interaction during the shuttling and estimate the corresponding transfer fidelity. Our work shows that on-chip shared control can be used to establish quantum links between qubit registers and could enable the construction of modular quantum processors with semiconductor technology.

References

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Figures

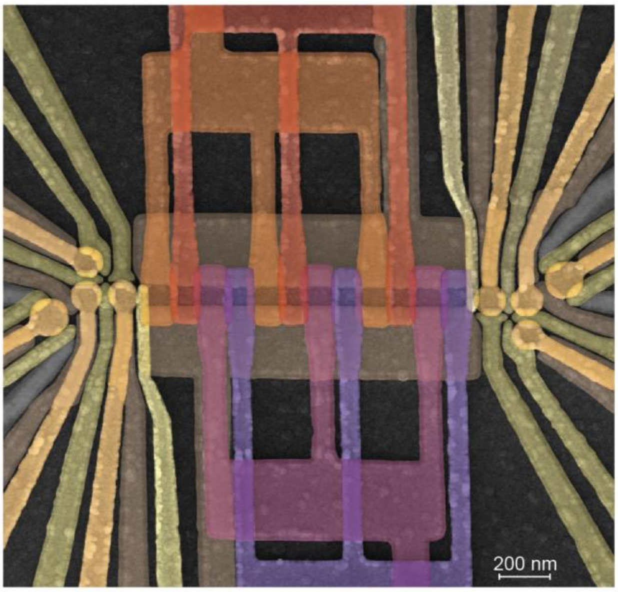

Figure 1: Conveyor-mode shuttling device in germanium. False-coloured scanning electron micrograph of a conveyor-mode shuttling device similar to the one studied. The device is composed of two arrays of three quantum dots which host spin qubits and are connected via a shuttling lane. The potential in the shuttling lane is controlled by four sets of interdigitated gate electrodes. They enable to generate a moving potential well used to displace coherently spins from one register to another.