Qubit Operations and Statistics in a Dense 10-qubit Array

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Résumé

In recent years, planar germanium qubits in Ge/SiGe heterostructures have emerged as a compelling platform for quantum computation (1). Their favourable properties have enabled the demonstration of a four-qubit quantum processor (2), high-fidelity two-qubit gates (3) and the implementation of extensible control strategies (4). However, to prove a quantum advantage with semiconductor qubits, larger quantum dot architectures need to be developed meeting the stringent requirements in device quality and operations fidelities.
In this work, we investigate an extended 10-quantum dot array operated in the few hole regime under an external magnetic field of a few tens of mT. We operate the array with dense occupation and achieve single-qubit gate fidelities above 99% for all qubits. We then assess the driving efficiency and the g-factor variability of all 10 qubits as a function of all the 22 gates in the array, extracting valuable statistics to evaluate driving locality, directionality and crosstalk in a dense qubit array. These experiments are then repeated from single hole to three-hole to five-hole occupations per dot to identify the optimal operation regime in a dense spin qubit array.

This work was supported by the Dutch Research Council (NWO) through an ENW grant, the European Union through ERC Starting Grant QUIST 850641, and through the IGNITE project of European Union's Horizon Europe Framework Programme under grant 101069515.

References

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