# Three-way junction device with six Ge hole spin qubits

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Quantum dot (QD) devices with 2D qubit connectivity would be highly advantageous to reduce the overheads of quantum algorithms and error correction. However, this remains a challenge in most platforms, where QDs are connected in a linear chain or lack individual readouts.

We report our progress towards a 3-way junction device with six hole spin qubits in Ge/SiGe. Using the three sensors, we can form seven quantum dots simultaneously in the single-hole configuration, including the middle junction dot that connects the three qubits pairs on the three device arms (Fig. A).

Qubit pairs are initialized in the $T_- = |\downarrow\downarrow\rangle$ state by separating a (2,0)S adiabatically. This requires a deterministic control of the $S/T_-$ crossing gap, which we study as a function of the applied in-plane magnetic field angle. We find that the gap opens and closes with specific directions, which can inhibit this initialization. We can also drive Rabi oscillations on each of the six qubits, which we use to measure the angular dependence of the six g-factors.

Finally, we realize in a different device a dressed singlet-triplet (ST) qubit which leverages the advantage of high resonant exchange Rabi frequencies (Fig. B). We perform 2-qubit CZ and resonant-SWAP gates where we report on the calibration of the drives and phases required to do full 2Q benchmarking.

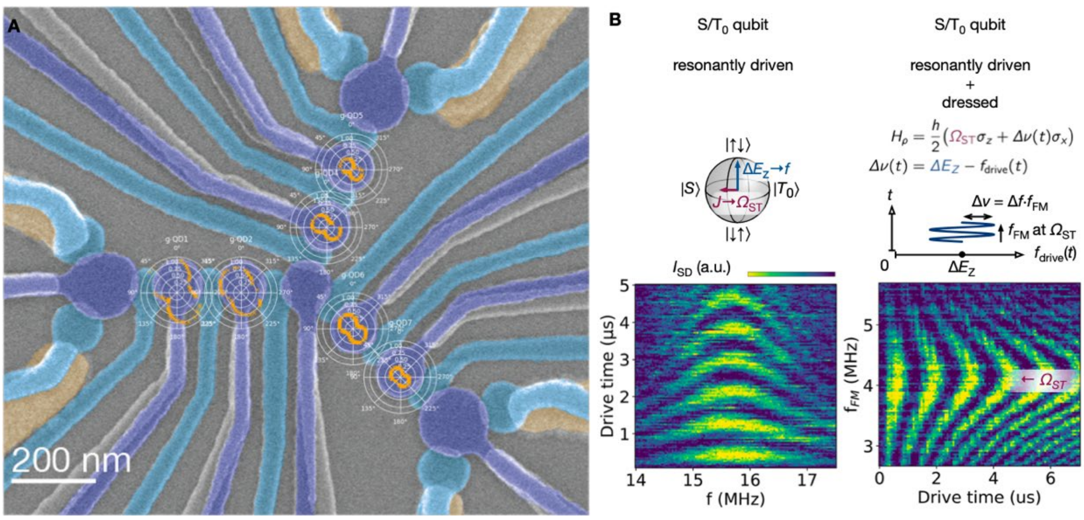


***Figure A.*** *Junction device with 7 dots and 3 sensors in the single hole charge occupation. Over each dot location, we show the in-plane g-factor angular dependence of 6 qubits.* ***Figure B.*** *Resonantly driven $S/T_0$ qubit and dressed $S/T_0$ qubit. Taking advantage of the large Rabi frequency and frequency modulation (FM) capabilities of the drive, we realize a dressed qubit that is Rabi-driven with FM.*