A foundry-fabricated spin qubit unit-cell with in-situ dispersive readout

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Semiconductor quantum dots (QDs) offer a compelling platform for spin-based quantum computing, thanks to their exceptional gate fidelities [1] and compatibility with industrial processes [2]. However, the scalability of QD arrays is often constrained by the size and sensitivity of charge sensors.
In this work, we introduce a 300mm foundry-fabricated spin qubit unit cell that integrates both readout and coherent control mechanisms. We operate the cell in the isolated regime and leverage gate-based reflectometry [3] for dispersive spin state measurement, which removes the need for external charge sensors. The device it is implemented in is the same as the one described in [4].
Our unit cell achieves high-visibility single-shot readout of a singlet-triplet qubit and demonstrates two-axis coherent control. Furthermore, we show that this unit cell operates effectively at elevated temperatures up to 1 K.
The integration of readout in this qubit unit cell highlights its significant potential for developing scalable quantum computing architectures.

References

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[3] F. Vigneau, Appl. Phys. Rev, 10 (2023) 021305
[4] P. Hamonic, et al., arxiv:2412.16044 (2024)

Figures

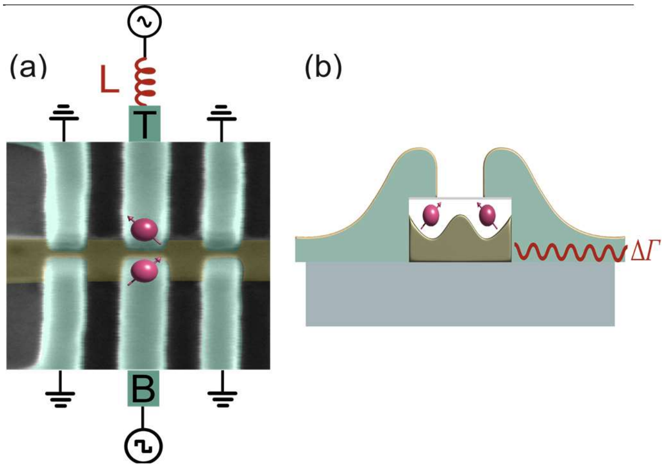

Figure 1: (a) Scanning electron microscopy (SEM) with false color showing the device where the qubit unit cell is implemented. (b) Artistic view of a cut of the T-B double dot perpendicular to the channel in (a).

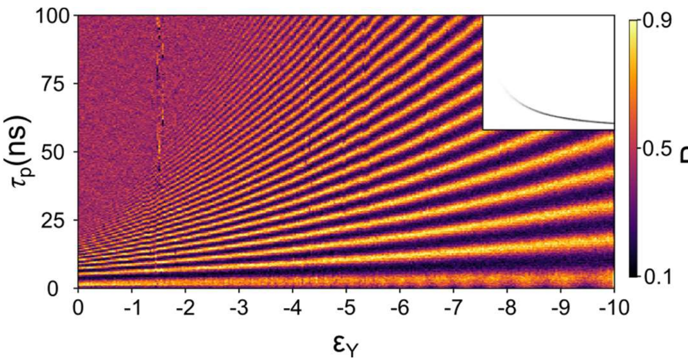

Figure 2: Exchange oscillations done at different detunings ε_Y showing the expected exponential frequency dependency