

Probing Materials Properties using Spin Qubits

Master Thesis Project

Project Description

The large-scale integration of semiconductor spin qubits into functional quantum processors requires the ability to reliably characterize thousands of devices. This is technically challenging due to the current limitations on integrating only a few quantum dots in modern array-type architectures. **QARPET** (Qubit-Array Research Platform for Engineering and Testing) is a novel crossbar-based architecture that enables scalable characterisation of dense arrays of quantum dots.

In this project, you will contribute to the measurement and analysis of germanium spin qubits [1], with the dual purpose of improving methods for large-scale characterisation and investigating the quantum coherence properties of the host material

Project Goals

- Study the behaviour of hole spin qubits hosted in QARPET extracting coherence metrics and analysing variability across the array.
- Explore methods for automating and accelerating measurements for qubit characterisation.

Student Learning Outcomes

- Hands-on experience with cryogenic measurement setups (dilution refrigerator).
- Practical understanding of semiconductor spin qubits and quantum-dot device physics.
- Skills in data acquisition and statistical analysis.

[1] QARPET: A crossbar chip for benchmarking semiconductor spin qubits A Tosato, A Elsayed, F Poggiali - arXiv preprint arXiv:2504.05460, 2025

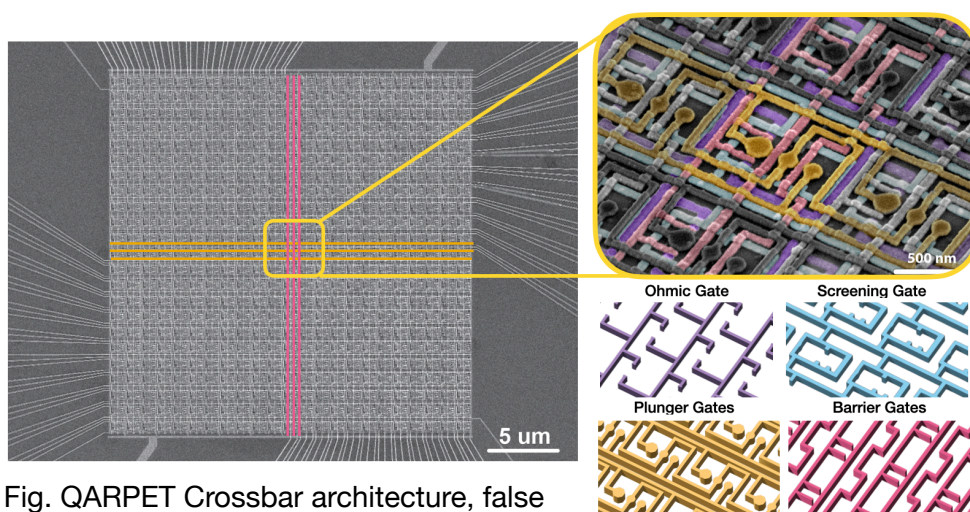


Fig. QARPET Crossbar architecture, false colored SEM image is taken from [1]