Fully machine learning-driven control and characterisation of quantum devices

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Scaling semiconductor qubit devices requires precise control over high-dimensional device parameters, a challenge that increasingly benefits from machine learning techniques [1]. In this talk, I will present our demonstration of fully autonomous spin qubit tuning (Fig.1), where machine learning systematically maps operational regimes and extracts qubit properties across a broad parameter range [2,3]. This approach enables real-time identification of Rabi frequencies spanning 50 to 150 MHz within a single charge transition [3].

Beyond tuning, machine learning is particularly useful for understanding and characterising device variability. I will show how physics-informed models reveal disorder potentials in quantum dot devices [4] and how these insights contribute to closing the gap between simulation and experiment [5,6]. Finally, I will discuss emerging directions in cross-platform device tuning [7-9], physics-aware quantum control, and digital twin frameworks.

References

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Figures

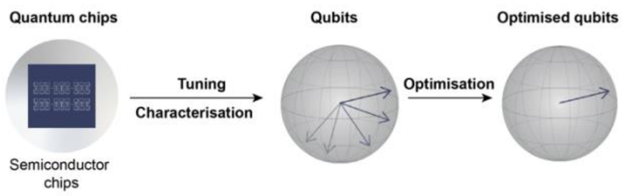

Figure 1: Semiconductor quantum devices require precise tuning and control protocols to function as qubits. Machine learning can automate and accelerate these processes, enabling high-throughput characterisation and optimisation of qubit metrics.