# Quantum control for quantum technologies: Tools, achievements, limitations

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Quantum control is an important prerequisite for quantum devices. A major obstacle is the fact that a quantum system can never completely be isolated from its environment, and the interaction with the environment causes decoherence. Optimal control theory is a tool that can be used to identify control strategies in the presence of decoherence. I will show how to adapt optimal control theory to quantum information tasks for open quantum systems [1] and present examples for superconducting qubits [2,3].

The perspective on decoherence only as the adversary of quantum control is nevertheless too narrow. There exist a number of control tasks, such as cooling and measurement, that can only be achieved by an interplay of control and dissipation. I will show how to utilize optimal control theory to derive efficient cooling strategies when the timescales of coherent dynamics and dissipation are very different [1]. Our approach can be generalized to quantum reservoir engineering, opening up new avenues for control.

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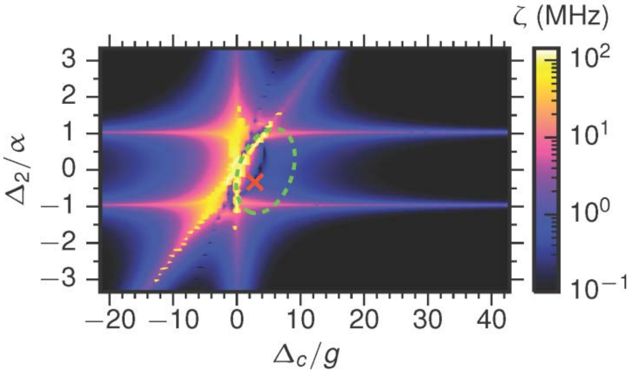

Figure 1: For superconducting transmon qubits, we identify the optimal region of design parameters – the quasi-dispersive straddling qutrits (QuaDisQ) regime [2]. It is outside of the usually considered strongly dispersive regime and is characterized by interference of multiple sources of entanglement. The QuaDisQ regime allows for the fastest universal set of gates, with errors approaching the limit of intrinsic coherence.