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Entanglement control of superconducting qubits

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Entanglement is a key resource for novel quantum technologies, especially quantum computing. Each physical system has its own merits and challenges, which need to be considered when creating and manipulating entanglement. Superconducting qubits can be easily connected to cavities in the form of planar waveguides and to each other via the cavity modes. On the other hand, one of their most notorious challenges is their dense spectrum ('spectral crowding'), which makes fast quantum control challenging. In this talk, theoretical work addressing this challenge will be presented: we have developed a technique for fast entangling gates by Speeding up Waveforms by Inducing Phases to Harmful Transitions (SWIPHT gates), which we have used to design universal gates for quantum computing. Our results include high-fidelity two-qubit and three-qubit entangling gates that are fast and based on smooth, experimentally friendly pulse shapes.