CEA - Saclay 91191 Gif-sur-yvette Cedex

Service de Physique de l'Etat Condensé

SÉMINAIRE

Mercredi 18 Juin 2014 à 11h15

Orme des Merisiers SPEC, Salle Itzykson, Bât.774

Feedback control and parity measurements with superconducting qubits

Diego Risté

Kavli Institute of Nanoscience

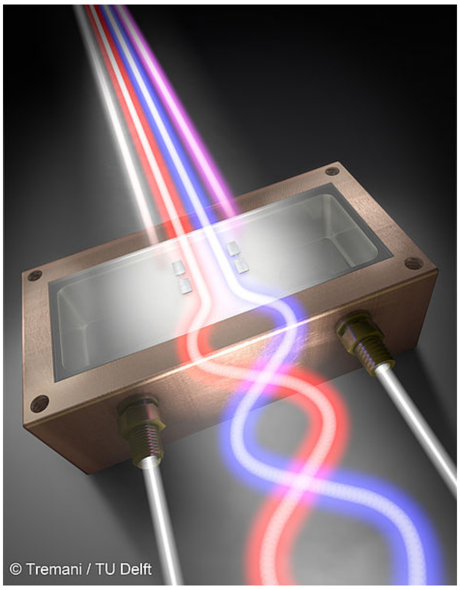

Image: Artist's impression of two superconducting qubits inside a microwave-frequency cavity, also illustrating the creation of their entanglement by a parity measurement. The starting state of the qubits, a superposition of the states 00, 01, 10, and 11, is represented by four colored beams impinging on the cavity. Only two of the beams cross the cavity and become intertwined, symbolizing the generation of entanglement in the form of a 01 and 10 superposition. The entanglement is created by the measurement, here represented by the white beam traversing the cavity through two connectors.

Performing quantum computing robustly requires closing the loop between measurement and qubit rotations to correct for errors in real time. Here, I present our development of feedback control of superconducting qubits and its first applications. Building on a nondemolition qubit readout with 99% single-shot fidelity, we implement a digital feedback loop to initialize a qubit fast and on demand. Moving to the multi-qubit setting, we transform the cavity into a qubit parity meter. Applying a parity measurement on a two-qubit superposition state, we first create entanglement probabilistically by postselection on either parity result, then deterministically using feedback to target the same Bell state every time. The entanglement fidelity is limited by measurement backaction, in the form of stochastic qubit phase kickbacks. Turning to an equivalent single-qubit scenario, we counteract such kickbacks using analog feedback. Finally, we report progress towards the implementation of the bit-flip error-correction code in a 5-qubit planar architecture.

A coffee break will be served at 11h00. The seminar will be given in English.