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Two-qubit parity meters in 3D and 2D circuit QED[1]

LEONARDO DICARLO, Kavli Institute of Nanoscience, Delft University of Technology

Non-demolition measurements of multi-qubit observables and feedback control conditioned on their outcomes are essential for quantum error correction. We present two implementations of two-qubit parity meters in circuit QED. In 3D, we match the dispersive coupling of two qubits to a common cavity to encode parity in the transmission of an applied microwave pulse. In 2D, we first encode the parity of two data qubits in the computational state of an ancillary qubit using resonant interactions, and subsequently project the ancilla using a dedicated, dispersively-coupled resonator. A key advantage of this second scheme is the protection of data qubits from dephasing by measurement photons. First applications of these parity meters include probabilistic entanglement by measurement, and deterministic entanglement using digital feedback control. Current efforts target the implementation of measurement-based bit-flip error correction.

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