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Calibrated State Tomography in Singlet-Triplet Qubits[1] OLIVER DIAL, MICHAEL SHULMAN, SHANNON HARVEY, HENDRIK BLUHM[2], Harvard University, VLADIMIR UMANSKY, Weizmann Institute of Science, AMIR YACOBY, Harvard University — Quantitative and accurate state tomography is becoming increasingly necessary in spin qubits to establish gate fidelities, entanglement measures, and optimize the increasingly complex gate sequences needed to perform experiments. In spin-qubits, to perform state tomography single-qubit rotations are used to map different axes of the Bloch sphere to the singlet-triplet axis, followed by projective measurement onto the singlet-triplet axis. Two orthogonal rotations are provided by two physically distinct mechanisms: magnetic field gradients and exchange rotations. The complex interplay between these mechanisms, noise sources, and pulse distortions make it difficult to accurately predict the angle and axis of rotations from first principles, leading to a circular problem: how can one calibrate tomographic rotations without any calibrated tomographic rotations? We describe and demonstrate a method which, using minimal assumptions, makes it possible to detect and correct for both axis errors in tomography and losses during the rotations associated with state tomography. This allows state tomography with unprecedented precision in these systems.

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