# Measurement-device independent quantum tomography

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Characterization of quantum states and devices is paramount to fundamental quantum science and many applications in quantum technology. The detailed characterization often requires many individual projection measurements, such as in the case of quantum state tomography. The constituent measurements have to be perfectly under control; unfortunately, this is not the case in an experimental setting. The resulting accuracy of the quantum state characterization is ultimately limited by a mismatch between actual and assumed constituent measurements. Particularly, the mismatch yields an artificial decrease in the purity of the measured quantum state. Such artifacts can be detected by injecting a few near-pure but otherwise unknown states into the measurement device, which is perfectly feasible, particularly in photonic experiments. We show how to use the reconstruction artifacts to correct the assumption about the constituent measurements and, ultimately, reach the accurate quantum state characterization. The calibrated measurement device can be utilized for full quantum state tomography or partial characterization schemes, such as fidelity estimation and compressed sensing. We experimentally demonstrate the self-calibrating method for polarization state tomography. Furthermore, we also discuss scenarios of rotating-waveplate polarimetry and photonic path-qubit tomography on optical chips. Finally, the approach is directly applicable to multi-qubit quantum systems and quantum devices while requiring the self-calibration step solely for constituent single-qubit measurements; i.e., the approach is fully scalable. The developed measurement-device independent quantum tomography opens the way for accurate quantum state and device characterization without adverse effects of measurement imperfections.