Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Analyzing quantum simulators efficiently: Scalable state tomography and quantifying entanglement with routine measurements MARCUS CRAMER, TILLMANN BAUMGRATZ, OLIVER MARTY, Ulm University, DAVID GROSS, Freiburg University, MARTIN PLENIO, Ulm University — Conventional full state tomography reaches its limit already for a few qubits and hence novel methods for the verification and benchmarking of quantum devices are called for. We show how the complete reconstruction of density matrices is possible even if one relies only on local information about the state. This results in an experimental effort that is linear in the number of qubits and efficient post-processing – in stark contrast to the exponential scaling of standard tomography. Whenever full tomography is not needed but instead less information required, one would expect that even fewer measurements suffice. Taking entanglement content of solid state samples and bosons in lattices as an example, we show how it may be quantified unconditionally using already routinely performed measurements only.
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Marcus Cramer
Ulm University

Date submitted: 07 Nov 2012 Electronic form version 1.4