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Simpler, faster, better: robust randomized benchmarking tests for non-unitality and non-Markovianity in quantum devices JOEL WALLMAN, Univ of Waterloo, STEVE FLAMMIA, University of Sydney, MARIE BARNHILL, JOSEPH EMERSON, Univ of Waterloo — Characterizing and suppressing noise in quantum systems is the major obstacle to developing a universal quantum computer. It is impossible to completely characterize the noise acting on n qubits efficiently, since a complete characterization would require an exponential number of parameters. However, we can efficiently obtain parameters of interest, such as the average gate fidelity (which gives the average error rate introduced by using a noisy gate instead of an ideal gate) using protocols such as randomized benchmarking, which will be reliable under certain strong assumptions (such as time-independent and gate-independent noise). In this talk, we will present recent results that allow randomized benchmarking to be used in a wider array of scenarios (in particular, to characterize time-dependent noise), with simpler operations (e.g., using only single-qubit operators, which makes the assumption of gate-independent noise more reasonable) and to obtain additional information about the noisy processes (e.g., whether they are unital and/or Markovian). These results allow a more efficient and complete characterization of noisy quantum systems.

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