To learn and cancel quantum noise: Probabilistic error cancellation with sparse Pauli-Lindblad models on noisy quantum processors

Zlatko Minev

IBM Quantum Research, USA

zlatko.minev@aya.yale.edu

Error-mitigation techniques can enable access to accurate estimates of physical observables that are otherwise biased by noise in pre-fault-tolerant quantum computers. One particularly general error-mitigation technique is probabilistic error cancellation (PEC), which effectively inverts a well-characterized noise channel to produce noise-free estimates of observables. Experimental realizations of this technique, however, have been impeded by the challenge of learning correlated noise in large quantum circuits. In this work, we present a practical protocol for learning a sparse noise model that scales to large quantum devices and is efficient to learn and invert. These advances enable us to demonstrate PEC on a superconducting quantum processor with crosstalk errors, thereby revealing a path to error-mitigated quantum computation with noise-free observables at larger circuit volumes.