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Hamiltonian tomography for quantum many-body systems with arbitrary couplings[1] SHENG-TAO WANG, Univ of Michigan - Ann Arbor, DONG-LING DENG, Condensed Matter Theory Center and Joint Quantum Institute, University of Maryland, College Park, LUMING DUAN, Univ of Michigan - Ann Arbor — Characterization of qubit couplings in many-body quantum systems is essential for benchmarking quantum computation and simulation. We propose a tomographic measurement scheme to determine all the coupling terms in a general many-body Hamiltonian with arbitrary long-range interactions, provided the energy density of the Hamiltonian remains finite. Different from quantum process tomography, our scheme is fully scalable with the number of qubits as the required rounds of measurements increase only linearly with the number of coupling terms in the Hamiltonian. The scheme makes use of synchronized dynamical decoupling pulses to simplify the many-body dynamics so that the unknown parameters in the Hamiltonian can be retrieved one by one. We simulate the performance of the scheme under the influence of various pulse errors and show that it is robust to typical noise and experimental imperfections.

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Shengtao Wang
Univ of Michigan - Ann Arbor

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