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Quantum computation using many-body localization SOONWON CHOI, SARANG GOPALAKRISHNAN, Harvard Univ, NORMAN YAO, University of California Berkeley, MIKHAIL LUKIN, Harvard Univ — Conventional wisdom holds that a stable quantum bit — the building block for a quantum computer — requires an isolated degree of freedom. Here, we explore a new approach to quantum information processing using disordered, strongly interacting systems in the many-body localized (MBL) phase. Our approach makes use of a number of unique features of an MBL phase: a lack of thermalization, a locally gapped spectrum, and slow dephasing. We illustrate our main idea using a spin-1 model, demonstrating the ability to encode, decode and perform a universal set of gates. We extend this approach to generic MBL systems and discuss both limitations and possible experimental realizations.

Soonwon Choi
Harvard Univ

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