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Non-commuting two-local Hamiltonians for quantum error suppression ELEANOR RIEFFEL, NASA Ames Research Center, ZHANG JIANG, Stinger Ghaffarian Technologies Inc., NASA Ames Research Center, QUAIL TEAM — Physical constraints make it challenging to implement and control multi-body interactions. Designing quantum information processes with Hamiltonians consisting of only one- and two-local terms is a worthwhile challenge. A common approach to robust storage of quantum information is to encode in the ground subspace of a Hamiltonian. Even allowing particles with high Hilbert-space dimension, it is not possible to protect quantum information from single-site errors by encoding in the ground subspace of any Hamiltonian containing only commuting two-local terms [1]. We demonstrate how to get around this no-go result by encoding in the ground subspace of a Hamiltonian consisting of non-commuting two-local terms arising from the gauge operators of a subsystem code. Specifically, we show how to protect stored quantum information against single-qubit errors using a Hamiltonian consisting of sums of the gauge generators from Bacon-Shor codes [2] and generalized-Bacon-Shor code [3]. Thus, non-commuting two-local Hamiltonians have more error-suppressing power than commuting two-local Hamiltonians. Finally, we comment briefly on the robustness of the whole scheme. [1] I. Marvian and D. A. Lidar, PRL 113, 260504 (2014) [2] D. Bacon, PRA 73, 012340 (2006) [3] S. Bravyi, PRA 83, 012320 (2011)

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