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Blueprint for an analog quantum code fabric[1]

ELIOT KAPIT, The Graduate Center, City University of New York

A physical realization of self correcting quantum code would be profoundly useful for constructing a quantum computer. In this theoretical talk, we provide a partial solution to major challenges preventing self correcting quantum code from being engineered in realistic devices. We consider a variant of Kitaev's toric code coupled to propagating bosons, which induce a long-ranged interaction between anyonic defects. By coupling the primary quantum system to an engineered dissipation source through resonant energy transfer, we demonstrate a "rate barrier" which leads to a potentially enormous increase in the system's quantum state lifetime through purely passive quantum error correction, even when coupled to an infinite temperature bath. While our mechanism is not scalable to infinitely large systems, the maximum effective size can be very large, and it is fully compatible with active error correction schemes. Our model uses only on-site and nearest-neighbor interactions, and could be implemented in superconducting qubits.

[1]With John T. Chalker and Steven H. Simon of the University of Oxford