

Bulletin of the American Physical Society

APS March Meeting 2024

Monday–Friday, March 4–8, 2024; Minneapolis & Virtual

Session BB03: V: Quantum Error Correction, Error Mitigation, and Machine Learning

11:30 AM–1:18 PM, Monday, March 4, 2024

Room: Virtual Room 03

Sponsoring Units: DQI GDS

Chair: Amin Hosseinkhani, IQM Quantum Computers; Benjamin Lienhard, Princeton University

Abstract: BB03.00009 : Revolutionizing Computations: Quantum Circuit Analogues with Nonlinear Acoustic Waves*

1:06 PM–1:18 PM

← Abstract

Presenter:

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Quantum computing utilizes superposition and entanglement to surpass classical computer capabilities. Central to this are qubits and their use to realize parallel quantum algorithms through circuits of simple one or two qubit gates. Controlling and measuring quantum systems is challenging. Here, we introduce a paradigm utilizing logical phi-bits, classical analogues of qubits using nonlinear acoustic waves, supported by an externally driven acoustic metastructure. These phi-bits bridge a low-dimensional linearly scaling physical space to a high-dimensional exponentially scaling Hilbert space in which parallel processing of information can be realized in the form of unitary operations. Here, we show the implementation of a nontrivial three-phi-bit unitary operation analogous to a quantum circuit but achieved via a single action on the metastructure, whereby the qubit-based equivalent requires sequences of qubit gates. A phi-bit-based approach might offer advantages over quantum systems, especially in tasks requiring large complex unitary operations. This breakthrough hints at a fascinating intersection of classical and quantum worlds, potentially redefining computational paradigms by harnessing nonlinear classical mechanical systems in quantum-analogous manners, blending the best of both domains.

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