Quantum computation from dynamic automorphism codes

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1. Abstract

In my talk, I will introduce a model of quantum computation comprised of low-weight measurement sequences that simultaneously encode logical information, enable error correction, and apply logical gates. These measurement sequences constitute a new class of quantum error-correcting codes generalizing Floquet codes, which we call dynamic automorphism (DA) codes. The measurement sequences generating these codes can be chosen such that they also implement sequences of logical gates while collecting error syndromes at the same time.
In our work, we construct an explicit example, the DA color code, that can realize all 72 automorphisms of the 2D color code. On a stack of N (bilayer) triangular patches, N logical qubits are encoded and the full logical Clifford group can be implemented by a sequence of two- and, more rarely, three-qubit Pauli measurements.
We make the first step towards universality. For this, we construct a 3D DA color code and show that a non-Clifford logical gate can be implemented by adaptive two-qubit measurements.

The talk is based on a joint work with Nathanan Tantivasadakarn, Shankar Balasubramanian, and David Aasen [arXiv:2307.10353 (2023)].