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Session Z40: Towards Fault Tolerance and Realization of Quantum Error Correction

11:30 AM–2:06 PM, Friday, March 18, 2022

Room: McCormick Place W-196B

Sponsoring Unit: DQI

Chair: Kevin Satzinger, Google

Abstract: Z40.00002 : High threshold fault-tolerant measurement-based quantum computing with biased noise qubits

11:42 AM–11:54 AM

← Abstract →

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Measurement-based quantum computing (MBQC) is an alternative model of quantum computation that is equivalent to the standard gate-based model and is the preferred approach for several optical quantum computing architectures. In MBQC, a quantum computation is executed by preparing an entangled cluster state and then selectively measuring qubits. MBQC can be made fault-tolerant by creating an MBQC computation that executes the standard surface code, an approach known as "foliation."

Recent results on gate-based quantum computing have demonstrated that in the presence of biased noise, a modified version of the surface code known as the XZZX code has much higher thresholds than the standard surface code. However, naively foliating the XZZX code does not result in a high-threshold fault-tolerant MBQC, because the foliation procedure does not preserve the noise bias of the physical qubits. To create a high-threshold fault-tolerant MBQC, we introduce a modified cluster state that preserves the bias, and use our modified cluster state to construct an MBQC computation that executes the XZZX code. Using full circuit-level noise simulations, we show that the threshold of our modified MBQC is higher than either the standard fault-tolerant MBQC or the naïve foliated XZZX code in the presence of biased noise, demonstrating the advantage of our approach.