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On the Effect of Coherence of Noise in Quantum Error Correction
YASUNARI SUZUKI, KEISUKE FUJII, MASATO KOASHI, Univ of Tokyo — We evaluated how the coherence of noise affects the error threshold under a coherent noise model. As the simplest model, we choose the one-dimensional (1D) quantum repetition code with repetitive parity measurements. Quantum error correction (QEC) with the 1D repetition code is simple but still able to capture a necessary ingredient for fault-tolerant QEC, and hence was experimentally demonstrated as a building block for scalable fault-tolerant quantum computation. We construct an efficient classical algorithm to simulate the quantum circuits for the QEC process with the 1D repetition code under a coherent noise model. The key idea of our algorithm is mapping all noise process and parity measurements into non-unitary free-fermionic dynamics. By using this algorithm, we calculated the error threshold and found that the existence of coherence in the noises significantly decrease the error threshold.

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