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High-threshold decoding algorithms for the gauge color code WILLIAM ZENG, Rigetti Computing, BENJAMIN BROWN, Niels Bohr Institute, University of Copenhagen — Gauge color codes are topological quantum error correcting codes on three dimensional lattices. They have garnered recent interest due to two important properties: (1) they admit a universal transversal gate set, and (2) their structure allows reliable error correction using syndrome data obtained from a measurement circuit of constant depth. Both of these properties make gauge color codes intriguing candidates for low overhead fault-tolerant quantum computation. Recent work by Brown et al. calculated a threshold of 0.31% for a particular gauge color code lattice using a simple clustering decoder and phenomenological noise. We show that we can achieve improved threshold error rates using the efficient Wootton and Loss Markov-chain Monte Carlo (MCMC) decoding. In the case of the surface code, the MCMC decoder produced a threshold close to that code's upper bound. While no upper bound is known for gauge color codes, the thresholds we present here may give a better estimate.

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