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Simulating a transmon implementation of the surface code, Part II[1] THOMAS O'BRIEN, Lorentz Institute, Leiden University, BRIAN TARASINSKI, QuTech and Kavli Institute of Nanoscience, Delft University of Technology, and Lorentz Institute, Leiden University, The Netherlands, ADRIAAN ROL, NIELS BULTINK, XIANG FU, QuTech and the Kavli Institute of Nanoscience, Delft University of Technology, Delft, The Netherlands, BEN CRIGER, QuTech and the Kavli Institute of Nanoscience, Delft University of Technology, Delft, The Netherlands, and RWTH Aachen, Aachen, Germany, LEONARDO DICARLO, QuTech and the Kavli Institute of Nanoscience, Delft University of Technology, Delft, The Netherlands — The majority of quantum error correcting circuit simulations use Pauli error channels, as they can be efficiently calculated. This raises two questions: what is the effect of more complicated physical errors on the logical qubit error rate, and how much more efficient can decoders become when accounting for realistic noise? To answer these questions, we design a minimal weight perfect matching decoder parametrized by a physically motivated noise model and test it on the full density matrix simulation of Surface-17, a distance-3 surface code. We compare performance against other decoders, for a range of physical parameters. Particular attention is paid to realistic sources of error for transmon qubits in a circuit QED architecture, and the requirements for real-time decoding via an FPGA

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