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Critical parameters of a noise model that affect fault tolerant quantum computation on a single qubit PAVITHRAN IYER, Univ of Sherbrooke, MARCUS P DA SILVA, Raytheon BBN Technologies, DAVID POULIN, Univ of Sherbrooke — In this work, we aim to determine the parameters of a single qubit channel that can tightly bound the logical error rate of the Steane code. We do not assume any a priori structure for the quantum channel, except that it is a CPTP map and we use a concatenated Steane code to encode a single qubit. Unlike the standard Monte Carlo technique that requires many iterations to estimate the logical error rate with sufficient accuracy, we use techniques to compute the complete effect of a physical CPTP map, at the logical level. Using this, we have studied the predictive power of several physical noise metrics on the logical error rate, and show, through numerical simulations with random quantum channels, that, on their own, none of the natural physical metrics lead to accurate predictions about the logical error rate. We then show how machine learning techniques help us to explore which features of a random quantum channel are important in predicting its logical error rate.

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