1139-81-307 **Chris Chubb** and **Steven Flammia***, steven.flammia@sydney.edu.au. *Stat mech models for any stabilizer code and Pauli channel.* Preliminary report.

We give a broad generalization of the mapping, originally due to Dennis, Kitaev, Landahl and Preskill, between certain statistical mechanical models and quantum error correcting codes. We show how the mapping can be applied to arbitrary stabilizer or subsystem codes and for arbitrarily correlated Pauli noise models, including models of fault tolerance. When the code is topological and the noise correlations are local in space-time, the critical point in the stat mech model coincides with the threshold. Therefore any existing method (e.g. Monte Carlo) for finding phase transitions in stat mech models can be applied to find the threshold of any such code without having to compute the optimal decoding. Simultaneously, we show that this mapping also gives a general recipe for speeding up the optimal decoder by generalizing the tensor network approach of Bravyi, Suchara and Vargo. For $N = L^D$ qubits and T rounds of syndrome measurement, the optimal decoding can be computed in time $\exp\big[O(NT/X)\big]$, where $X = \max\{L, T\}$. Moreover, any efficient strategy for contracting tensor networks leads to an approximation of the optimal decoder that runs in polynomial time. (Received February 14, 2018)