

Decoding Quantum LDPC Codes

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Quantum low-density parity-check (LDPC) codes are stabilizer codes in which each stabilizer generator acts on $O(1)$ qubits and each qubit participates in $O(1)$ generators. Some famous classes of codes such as the toric code are quantum LDPC codes. There are several reasons that explain why this subclass of stabilizer codes is particularly interesting. For instance, last year it was shown by Gottesman that such codes would in principle allow fault-tolerant quantum computing with constant overhead. However, for this application we need quantum LDPC codes that are able to encode a linear fraction of qubits with good minimum distance properties and that are equipped with an efficient decoding algorithm. The fact that their classical counterpart enjoys all these nice properties could lead to think that it will be easy to obtain the same result in the quantum setting. However it has turned out that decoding quantum LDPC codes is a much more involved issue than decoding classical LDPC codes. The latter class of codes is decoded successfully by low complexity iterative decoding algorithms. In principle, such algorithms could also be used to decode quantum LDPC codes. However, this approach fails for quantum LDPC codes due to the fact that such codes are inherently highly degenerate. I will survey and discuss in this talk alternative approaches that have been successful for some subclasses of quantum LDPC codes.