

Nengkun Yu: Quantum Max-Flow Min-Cut theorem

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The max-flow min-cut theorem is a cornerstone result in combinatorial optimization. Calegari et al. (arXiv:0802.3208) initialized the study of quantum max-flow min-cut conjecture, which connects the rank of a tensor network and the min-cut. Cui et al. (arXiv:1508.04644) showed that this conjecture is generally false. This paper establishes a quantum max-flow min-cut theorem for a new definition of quantum maximum flow. In particular, we show that for any quantum tensor network, there are infinitely many n , such that quantum max-flow equals quantum min-cut, after attaching a dimension maximally entangled state to each edge as ancilla. Our result implies that the ratio of the quantum max-flow to the quantum min-cut converges to 1 as the dimension n tends to infinity. As a direct application, we prove the validity of the asymptotical version of the open problem about the quantum max-flow and the min-cut, proposed in Cui et al. (arXiv:1508.04644). The link to this paper is arXiv:2110.00905.