Contribution ID: **83** Type: **Poster**

No graph states can be prepared in quantum networks with bipartite sources

In research concerning quantum networks, it is often assumed that the parties can classically communicate with each other. However, classical communication might introduce substantial delay to the network, especially if it is large. As the latency of a network is one of its most important characteristics, it is interesting to consider quantum networks in which parties cannot communicate classically and ask what limitations this assumption imposes on the possibility of preparing multipartite states in such networks. We show that graph states of arbitrary prime local dimension known for their numerous applications in quantum information cannot be generated in a quantum network in which parties are connected via sources of bipartite quantum states and the classical communication is replaced by some pre-shared classical correlations. We then generalise our result to arbitrary quantum states that are sufficiently close to graph states.

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