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Classical Correlations in Quantum Networks AMANDA GATTO LAMAS, School of Physics and Astronomy, University of Minnesota Twin Cities, ERIC CHITAMBAR, Department of Electrical and Computer Engineering, University of Illinois Urbana Champaign — Quantum networks consist of nodes that are linked by exchanging quantum bits ("qubits") or receiving them from a common source. Quantum networks can outperform classical networks for information processing by exploiting quantum resources such as entanglement and nonlocality. However, not all quantum networks manifest nonlocality, and those that do not can be simulated classically. Therefore, characterizing which quantum networks demonstrate nonlocality is fundamental to understanding which networks have distinctively quantum features that can be harnessed. In this work, we identify a classical model that simulates a quantum bipartite 4-party cycle network, in which the parties share the Bell state $|\beta\rangle = 1/\sqrt{2}\ (|00\rangle + |11\rangle)$ and make projective measurements in the Bell basis. Our results thus place necessary conditions on the structure of quantum networks if they are able to surpass classical approaches.

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