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Characterizing multipartite entanglement with moments of random correlations

Abstract: The trustworthy detection of multipartite entanglement usually requires a number of judiciously chosen local quantum measurements which are aligned with respect to a previously shared common reference frame. If such a reference frame is not available, one has to develop alternative detection strategies which do not rely on a specific choice of the local measurement bases. One possibility in this direction is to perform a number of local measurements with settings distributed uniformly at random and by resorting to statistical tools draw conclusions about the entanglement of the underlying states. In this work we follow such a treatment and show that an improved detection of multipartite entanglement is possible by combining moments of different order. To do so, we make use of unitary designs which link entanglement criteria based on moments to ordinary reference-frame independent ones involving a number of fixed measurement settings. The strengths of our methods are illustrated in various cases starting with two qubits and followed by more involved multipartite scenarios. In particular, we also discuss the possibility to discriminate different classes of multipartite entangled states.

Reference:

Andreas Ketterer, Nikolai Wyderka, Otfried Gühne, [arXiv:1808.06558](https://arxiv.org/abs/1808.06558)