Relation between entanglement measures and Bell inequalities for three qubits C. Emary and C. W. J. Beenakker

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Abstract

For two qubits in a pure state there exists a one-to-one relation between the entanglement measure (the concurrence $C$) and the maximal violation $M$ of a Bell inequality. No such relation exists for the three-qubit analogue of $C$ (the tangle $\tau$), but we have found that numerical data is consistent with a simple set of upper and lower bounds for $\tau$ given $M$. The bounds on $\tau$ become tighter with increasing $M$, so they are of practical use. The Svetlichny form of the Bell inequality gives tighter bounds than the Mermin form. We show that the bounds can be tightened further if the tangle is replaced by an entanglement monotone that can identify both the W state and the Greenberger-Horne-Zeilinger state.