Miami Physics Conference 2025

Date: Dec 12-18, 2025

Location: Lago Mar Resort

Affiliation: Chapman University

Roman Buniy

Degrees of Entanglement of Dicke States of Qubits

Abstract

We have calculated the bounds $\mu_{n,m}$ of the expected values of the Mermin operators for Dicke states $v_{n,m}$. These are symmetric states of n qubits among which m qubits are in one possible state and $n-m$ qubits are in the other possible state. We show that $\lambda_{n,\floor{\gamma_{n,m}}}\le\mu_{n,m}<\lambda_{n,\floor{\gamma_{n,m}}+1}$, where $\lambda_{n,m}$ is the expected value of the Mermin operator for the GHZ state $u_{n,m}$ of n qubits in which m qubits are entangled. The number $\gamma_{n,m}=\frac{2\ln{\mu_{n,m}}}{\ln{2}}-n+2$ is a degree of entanglement of the state $v_{n,m}$ relative to the state $u_{n,m}$. This puts the entanglement properties of $v_{n,m}$ between the entanglement properties of the GHZ states of n qubits with $\floor{\gamma_{n,m}}$ entangled qubits and those with $\floor{\gamma_{n,m}}+1$ entangled qubits. For a fixed n, the degree $\gamma_{n,m}$ increases with m and reaches its maximum for either $m=\floor{\frac{1}{2}n}$ or $m=\floor{\frac{1}{2}(n+1)}$, for which it satisfies $\gamma_{n,m}<n$.