Contribution ID: **41** Type: **Poster**

Oddities in the Entanglement Scaling of the Quantum Six-Vertex Model

We investigate the entanglement properties of the Quantum Six-Vertex Model on a cylinder, focusing on the Shannon-Renyi entropy in the limit of Renyi order $n = \infty$.
This entropy, calculated from the ground state amplitudes of the equivalent XXZ spin-1/2 chain, allows us to determine the Renyi entanglement entropy of the corresponding Rokhsar-Kivelson wavefunctions, which describe the ground states of certain conformal quantum critical points.
Our analysis reveals a novel logarithmic correction to the expected entanglement scaling when the system size is odd.
This anomaly arises from the geometric frustration of spin configurations imposed by periodic boundary conditions on odd-sized chains.
We demonstrate that the scaling prefactor of this logarithmic term is directly related to the compactification radius of the low-energy bosonic field theory description, or equivalently, the Luttinger parameter.
Thus, this correction directly probes the underlying Conformal Field Theory (CFT) describing the critical point.
Our findings highlight the crucial role of system size parity in determining this model's entanglement properties and offer insights into the interplay between geometry, frustration, and criticality.

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Session Classification: Poster