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Title: Entanglement duality in free supersymmetric systems

Abstract:
Supersymmetry (SUSY), originally proposed to address fundamental issues in high energy physics, has proven a useful method in various areas of quantum theory. This also includes quantum material design where, in the context of topological mechanics, e.g., bosonic materials inheriting topological properties from fermionic systems can be constructed via SUSY.
We show a general relation between the fermionic and bosonic entanglement in the ground state of such free (quadratic) SUSY Hamiltonians [1]. The relation arises from a canonical identification of bosonic and fermionic subsystems through the supercharge. Its derivation nicely showcases the strength of the Kähler structure approach to Gaussian states, as a unified framework for describing bosonic and fermionic Gaussian states in terms of complex linear structures. Time permitting, as a special application, we consider topological insulators and superconductors and their SUSY partners, discussing the recently derived classification of supercharges in this context [2].

[1] Jonsson, Robert H., Lucas Hackl, and Krishanu Roychowdhury. “Entanglement Dualities in Supersymmetry.” Physical Review Research 3, no. 2 (June 16, 2021): 023213.
[2] Gong, Zongping, Robert H. Jonsson, and Daniel

Malz. “Supersymmetric Free Fermions and Bosons: Locality, Symmetry, and Topology.” Physical Review B 105, no. 8 (February 24, 2022): 085423.