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Chiral conformal field theory for topological states and the anyon eigenbasis on the torus.

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Summary: Model wave functions constructed from (1+1)D conformal field theory (CFT) have played a vital role in studying chiral topologically ordered systems. There usually exist multiple degenerate ground states when such states are placed on the torus. The common practice for dealing with this degeneracy within the CFT framework is to take a full correlator on the torus, which includes both holomorphic and antiholomorphic sectors, and decompose it into several conformal blocks. In this paper, we propose a pure chiral approach for the torus wave function construction. By utilizing the operator formalism, the wave functions are written as chiral correlators of holomorphic fields restricted to each individual topological sector. This method is not only conceptually much simpler, but also automatically provides us the anyon eigenbasis of the degenerate ground states (also known as the “minimally entangled states”). As concrete examples, we construct the full set of degenerate ground states for $SO(n)_1$ and $SU(n)_1$; chiral spin liquids on the torus, the former of which provide a complete wave function realization of Kitaev’s sixteenfold way of anyon theories. We further characterize their topological orders by analytically computing the associated modular $S$ and $T$ matrices.

MSC:

81T45  Topological field theories in quantum mechanics
81P16  Quantum state spaces, operational and probabilistic concepts
03C64  Model theory of ordered structures; o-minimality
14M25  Toric varieties, Newton polyhedra, Okounkov bodies
47A10  Spectrum, resolvent
14D06  Fibrations, degenerations in algebraic geometry
62H20  Measures of association (correlation, canonical correlation, etc.)
30G12  Finely holomorphic functions and topological function theory
81V27  Anyons
57R15  Specialized structures on manifolds (spin manifolds, framed manifolds, etc.)

Full Text: DOI arXiv

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