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PhD
THESIS DEFENSE

WEAK HOPF ALGEBRAS, MATRIX PRODUCT OPERATORS AND THE CLASSIFICATION OF QUANTUM PHASES OF MATTER

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ABSTRACT: Understanding the entanglement structure of quantum many-body systems is one of the driving forces in theoretical physics in recent decades. In particular, this has led to the use of tensor networks, the central objects of this thesis, which are models described in terms of local tensors contracted along an underlying graph structure. Here, we first establish how representations of well-known algebraic structures, such as weak Hopf algebras, give rise to one-dimensional tensor networks exhibiting exotic properties. In addition, we provide a dictionary between the algebraic properties and those of the corresponding tensors, which allows very interesting results to be transferred between these two configurations. As applications, we classify a wide variety of representative quantum mixed states via shallow circuits of quantum channels. Also, we demonstrate the power of our framework by constructing a large class of topological states and by providing promising tools for the study of topological phases.

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