To all members of the
Faculty of Physics

Vienna, 25 July 2016

Invitation to the public defense of the doctoral thesis

A Tensor Network Study of Topological Quantum Phases of Matter

by

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Josef-Stefan lecture hall, 3rd floor, Boltzmanngasse 5, 1090 Vienna

Abstract

Understanding the structure of the phases of matter has long been a big challenge in physics. In the past decade, this problem has been shown to be closely related to quantum information and computation, which gives concrete applications to the fundamental properties of the physical systems.

In this thesis, motivated by this problem, we explore a general tensor network framework combining topological quantum field theories and hamiltonian many-body physics to gain a systematic understanding of the phases of quantum matter. We characterize topological order via simple axioms in the language of tensor networks by introducing new concepts, which we call tensor network operator injectivity and deformable tensor network operators.

Finally, we apply this framework for models in 1+1, 2+1, and 3+1 space-time dimensions, e.g., Dijkgraaf-Witten, Kitaev quantum double, Levin-Wen and Walker-Wang models.

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