HARVARD UNIVERSITY 17 Oxford Street Cambridge, MA 02138



Tuesday, October 13, 2020, at 10:00 (Boston) 15:00 (UK/Eire) 16:00 (C.Europe) 22:00 (China) Mathematical Picture Language Seminar

Zoom at: https://harvard.zoom.us/j/779283357?pwd=MitXVm1pYUIJVzZqT3lwV2pCT1ZUQT09

Fractionalization, Exactly Solvable Models, and Quantum Circuits Xun Gao, Harvard University

Abstract: I shall report on a new approach to study some classes of exactly solvable models and quantum circuits. Concretely, using "knots" gives a topological way to characterize the solvability of 2D Ising model. We find a new class of exactly-solvable, statistical-mechanics models, and they lead to a topological extension of Kramers-Wannier duality. The method relies on the abstraction of sparse encoding of Majorana zero modes (also known as the Z_2 Quon language). This point of view may also help us find new types of exactly solvable models.

Our method lets us partially open the blackbox of each small tensor in the tensor network representation (of, e.g., quantum circuits and partition function of many-body systems). As a bonus, we find a unified framework to characterize two famous classes of classically-simulable quantum circuits, namely, Clifford and matchgate. Besides, we also find a new class of classically simulable quantum circuits by combining them in a topological way. We could evaluate these circuits by untying the "knots". Our method is also suitable for programming, which may help us design quantum circuit compiler for simplifying quantum circuits.

