universität innsbruck

Department of
Theoretical Physics

Theory Colloquium

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"Complexity beyond entanglement - magic of many-body systems"

Abstract

Driven by groundbreaking experimental advances, quantum matter is currently entering the era of quantum error correction - where basic forms of computation can be demonstrated in a fault-tolerant manner. From a many-body theory viewpoint, these developments motivate the question: what are states that are challenging to realize in the presence of error correction? Entanglement alone is not informative about state complexity, and in fact, it is a free resource in such situations.

In this talk, I will tackle quantum state complexity of many-body systems under the lens of non-stabilizerness - also known as magic. Magic quantifies the difficulty of realizing states in most error corrected codes, and is thus of fundamental practical importance. However, very little is known about its significance to many-body phenomena. I will present method(s) to measure magic in tensor network simulations, and illustrate a series of applications to many body systems, including its relevance in critical matter and gauge theories, and its relations to entanglement.

Finally, I will discuss the broader impact of these findings on state complexity - indicating that realizing generic state quantum dynamics may require a very large amount of resources in error correcting quantum computers, but at the same time, providing interesting perspectives on new classes of variational states more powerful than traditional tensor networks.

Wednesday | 05.03.2025 | 5:00pm

SR 1 | ICT building