universität innsbruck

Department of
Theoretical Physics

Seminar Talk

Khadijeh Sona Najafi, IBM Quantum, Cambridge, MA

"Exploring the fabric of universe in IBM quantum processors"

Abstract

As the number of qubits in quantum processors continues to rise, we find ourselves on the cusp of the quantum utility era, poised to transcend classical limitations in quantum simulation. This presentation delves into the utilization of digital quantum processors for probing fundamental questions, ranging from conformal field theory to simulating strongly correlated systems in qudit frameworks.

The initial segment of the talk unveils experimental results showcasing the quantum simulation of quantum spin chains at critical points in three distinct models: the transverse field Ising chain with Z2 symmetry, the XXZ chain with U(1) symmetry, and the tricritical Ising model representing the universality class with supersymmetry. Leveraging advanced error mitigation techniques such as probabilistic error mitigation, we achieve a groundbreaking extraction of the central charge, a pivotal component of conformal field theory, with an accuracy exceeding 5%.

Transitioning to the latter part of the presentation, a novel approach to simulating the Fermi-Hubbard model in qudit systems is introduced. This approach offers valuable insights into the intricate nature of strongly correlated phenomena. By generalizing the fermionic mapping into qudit space, we streamline the encoding and simulation of quantum many-body systems, presenting a generic and hardware-agnostic methodology. The potency of this technique is exemplified through the application of fixed-frequency superconducting transmons and their native gates as qudits in our computational simulations. These results underscore the advantages of qudits in quantum simulations, opening new avenues for understanding the physics of strongly correlated systems and establishing a paradigm shift in the study of quantum many-body systems.

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Schrödinger hall | IQOQI