Quantum Technology Initiative Journal Club

Report of Contributions

https://indico.cern.ch/e/1486722

Contribution ID: **2** Type: **not specified**

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Thursday, 12 December 2024 16:00 (40 minutes)

TITLE: Order Parameter Discovery for Quantum Many-Body Systems
Link: https://arxiv.org/abs/2408.01400

ABSTRACT:
Quantum phase transitions reveal deep insights into the behavior of many-body quantum systems, but identifying these transitions without well-defined order parameters remains a significant challenge. In this work, we introduce a novel approach to constructing phase diagrams using the vector field of the reduced fidelity susceptibility (RFS). This method maps quantum phases and formulates an optimization problem to discover observables corresponding to order parameters. We demonstrate the effectiveness of our approach by applying it to well-established models, including the Axial Next Nearest Neighbour Interaction (ANNNI) model, a cluster state model, and a chain of Rydberg atoms. By analyzing observable decompositions into eigen-projectors and finite-size scaling, our method successfully identifies order parameters and characterizes quantum phase transitions with high precision. Our results provide a powerful tool for exploring quantum phases in systems where conventional order parameters are not readily available.

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Session Classification: CERN QTI Journal CLUB