Sonderseminar

Universität Konstanz

Dr. Xiao Mi
Google Research, Mountain View, CA, USA

Di 18. August 2022
15:15 Uhr
P1138

Simulating Many-body Phases of Matter with Superconducting Qubit Processors

A fertile ground of exploration for NISQ quantum computers is the study of quantum phases and their associated transitions into chaotic regimes. Sharp growths of quantum correlation and entanglement often accompany quantum phases near their critical points, providing opportunities for quantum computational advantage. Furthermore, the discovery of any robust quantum order in, for example, topological phases of matter may also enable new error-correction paradigms. I will present two recent experiments studying quantum phases of matter with superconducting qubits. In the first experiment, we implement periodic ("Floquet") dynamics on a 1D chain of 20 superconducting qubits. Engineered disorders in the two-qubit couplings allow many-body localization (MBL) to occur despite strong external drive, thereby stabilizing a non-equilibrium phase of matter termed a discrete time-crystal (DTC) [1, 2]. In a second experiment [3], we probe the Majorana edge modes (MEMs) in a chain of 47 superconducting qubits driven by a clean, disorder-free kicked Ising model. We find that the MEMs are remarkably resilient toward various perturbations and even low-frequency noise within the quantum processor, demonstrating lifetimes close to that of single-qubit T1. These results indicate the general usefulness of NISQ quantum computers in furthering our understanding of non-equilibrium quantum systems, critical phenomena and symmetry-protected topological phases.

[1] M. Ippoliti et al., PRX Quantum 2, 030346 (2021).

[2] X. Mi, et al., Nature 601, 531 (2022).

[3] X. Mi, et al., arXiv:2204.11372 (2022).