Measurement-Prepared Quantum Phases and Phase Transitions: From Ising Model to Gauge Theory, And Beyond

by
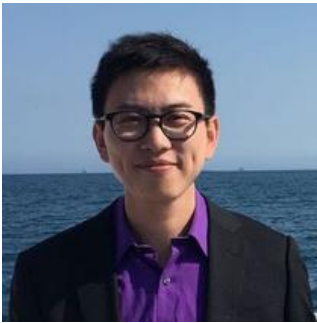
Professor Zhen BI (畢震教授)
Department of Physics
Penn State University, USA

Date: December 2, 2022 (Friday)
Time: 4:00 - 5:00 p.m.
Place: L2, Science Centre, CUHK

ALL INTERESTED ARE WELCOME
****

Abstract

In condensed matter physics, we usually think about quantum phases and phase transitions in the context of equilibrium many-body system. In this talk, we consider a slightly different setup. We consider preparing quantum phases and phase transitions with shallow quantum circuit and measurements in the so-called quantum simulators. First, I will talk about ways one can prepare interesting quantum states, including topological order, symmetry breaking state, etc., by measuring a so-called resource state. Then I will show that with post-selection one can tune a phase transition between certain quantum states by changing a continuous parameter in the measurements. This measurement-prepared quantum critical state corresponds to the so-called conformal quantum critical points where the equal-time correlators exhibit spatial conformal invariance. This establishes an exact correspondence between the measurement-prepared critical states and conformal field theories of a range of critical spin models, including familiar Ising models and gauge theories. Finally, without post-selection, we can show the correspondence between the ensemble of quantum states prepared by measurements and the ensemble of the random bond Ising model along the special path called Nishimori line. Our findings suggest a novel mechanism in which a quantum critical wavefunction emerges, providing new practical ways to study quantum phases and conformal quantum critical points.

Enquiries: 3943 6303