CSU PHYSICS COLLOQUIUM

"Unsupervised Machine Learning of Quantum Phase Transitions"

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120 Engineering (Hammond Auditorium)

Abstract

Experimental quantum simulators have become large and complex enough that discovering new physics from the huge amount of measurement data can be quite challenging, especially when little theoretical understanding of the simulated model is available. Unsupervised machine learning methods are particularly promising in overcoming this challenge. I will review typical unsupervised learning methods and show that they generally only work for learning simple symmetry-breaking quantum phase transitions. I will then show that a more advanced method known as diffusion map, which performs nonlinear dimensionality reduction and spectral clustering of the measurement data, has much better potential for unsupervised learning of complex phase transitions, such as topological phase transitions and many-body localization. This method is readily applicable to many experimental quantum simulators as it only requires measuring each particle in a single and local basis.

Biography

Zhexuan Gong obtained his PhD in physics from University of Michigan in 2013. He then performed four years of postdoctoral research at the Joint Quantum Institute before joining Mines as an assistant professor of physics in 2018 with a joint position at NIST. He is interested in designing faster architectures for quantum computing, understanding novel quantum many-body physics via quantum simulation, and applying machine learning to facilitate new discoveries in quantum experiments. He has won multiple awards from NSF and the W. M. Keck Foundation in recent years to support his research.