ICTS | International Centre for Theoretical Sciences

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

ICTS LECTURE SERIES

Quantum dynamics in the pre-fault tolerant era

As quantum devices move from the NISQ to the pre-fault tolerant era, understanding the nature of quantum dynamics requires the combination of unitary evolution, mid-circuit measurements, and conditional feedback, which are the required ingredients for quantum error correction. At the same time, novel phenomena have been uncovered because of the competition of entangling unitary evolution and disentangling local measurements, which drives a measurement induced phase transition in the structure of the entanglement. Upon the incorporation of feedback from the measurement outcomes, it's possible to steer the dynamics to a predetermined quantum state. This is only possible after overcoming the inherent chaotic evolution of generic quantum dynamics that defines a control induced phase transition that can be observed in correlation functions. Recent advances in adaptive quantum circuits have allowed for the direct experimental realization of these measurement and control induced phase transitions on superconducting qubit and trapped ion hardware.

This five-part lecture series will cover our modern understanding of quantum dynamics in isolated and monitored quantum many-body systems. We will present four technical lectures that cover classical and quantum chaos, the current analog and digital quantum platforms, monitored quantum dynamics, and adaptive quantum circuits. In the final lecture we will present a tutorial on how to use our open-source quantum dynamic simulation software.

Lecture 1: Classical chaos and quantum chaos/thermalization in isolated quantum systems.
Lecture 2: Analog and digital quantum simulators from unitary dynamics to midcircuit measurements.
Lecture 3: Monitored quantum dynamics in random quantum circuits.
Lecture 4: Adaptive quantum circuits and control induced phase transition.
Lecture 5: Open quantum dynamics software tutorial.

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Jedediah Pixley is a theoretical condensed matter physicist whose research focuses on critical phenomena in quantum systems, both in and out of equilibrium. He earned dual degrees in Physics and Pure Mathematics from the University of California, Santa Cruz, and received his PhD from Rice University under the supervision of Qimiao Si. Following a postdoctoral fellowship at the University of Maryland with Sankar Das Sarma, he joined Rutgers University in 2017, where he is now Associate Professor and Director of the Center for Materials Theory. He is also a long-term visiting scientist at the Flatiron Institute, serves on the Board of General Members at the Aspen Center for Physics, and is a Faculty Associate of the International Center for Theoretical Sciences in Bangalore India. His work spans condensed matter theory, statistical physics, AMO physics, computational physics, and quantum information science.

03, 05, 08, 09, 11 June 2026
Chern Lecture Hall
ICTS, Bengaluru

Zoom link: https://shorturl.at/qgK2M
Meeting ID: 968 8879 9183
Passcode: 583327