THEORY LECTURE SERIES: "Random Quantum Circuits: Theory and Applications"

MICHAEL GULLANS

September 17, 2024 to September 27, 2024
10:00 to 12:00
Blue Lecture Room

Abstract:
Random quantum circuits have emerged as a powerful tool in modern research in quantum information science and quantum many-body physics. In the first lecture, I will give an overview of the random matrix theory limit of the problem. I will then develop the formalism needed to describe local random circuits using mappings to classical and quantum statistical mechanics models. In the second lecture, I will discuss the emergence of phase transitions in these systems tuned by the addition of non-unitary operations such as measurement or noise. Throughout these two lectures I will describe various applications of random circuits to tomography and benchmarking of quantum systems. In the third lecture, I will present a theoretical computer science perspective on random quantum circuits. I will then discuss the status of tests of quantum computational advantage in random sampling experiments, focusing on the effects of noise. In the final lecture, I will introduce a family of random quantum circuits that naturally arise in fault-tolerant quantum computation, exploring aspects relevant to recent experiments in neutral atom arrays.

Prof Michael Gullans' Biography:

Michael Gullans is a Fellow of the Joint Center for Quantum Information and Computer Science (QuICS) at NIST, where he is a research physicist, and University of Maryland, College Park, where he is an adjunct assistant professor in the Department of Physics and the Department of Computer Science. He received his Ph.D. from Harvard University in 2013. He did postdoctoral work at NIST and Princeton University prior to joining QuICS in 2020. His research interests center on quantum information science, many-body physics, and quantum optics. A common theme in his research is understanding the role of randomness, noise and disorder in many-body quantum systems using methods from statistical physics.
September 17, 19, 26, 27, 2024 from 10:00 to 12:00
Participation is open to all ICFOnians.

If you are unable to attend the lecture in person, here is the link to follow it online. However,

we strongly encourage you to attend in person.

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