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University of Miami, Physics Department Colloquium

Date: Wednesday, Feb 28, 2024
Time: 4:00 pm – 5:00 pm
Location: Wilder Auditorium – Rm 112, Knight Physics Building

Fantastic Quantum Error-Correcting Codes and Where to Find Them

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Abstract

Quantum computers have the potential to make significant contributions to a range of outstanding problems in science and technology, including simulating complex condensed matter systems, and aiding in solving the electronic structure problem in quantum chemistry. However, to ensure that quantum computations are trustworthy -- i.e., robust to noise from the environment and faulty operations -- we need to be able to detect and correct errors before they corrupt information. We need, in particular, a quantum error-correcting code -- a redundant encoding of the quantum information along with a strategy for detecting and correcting errors. Ideally, this code should account for limitations of the underlying hardware and come at a minimal cost in additional resources.

In this talk, I will begin with a pedagogical introduction to quantum error-correcting codes and emphasize their deep connection to quantum phases of matter. I will then describe recent work in which we constructed promising new quantum error-correcting codes, inspired by the classification of topological phases of matter in two spatial dimensions. I will further comment on new directions in the study of quantum matter motivated by quantum error correction and our ongoing search for novel quantum error-correcting codes, aimed at reducing computational overheads and moving us closer to reliable quantum computation.

Biography

Tyler Ellison graduated from Washington University in St. Louis in 2015 and received a Master's degree from SUNY Stony Brook in 2017. In 2021, he completed his doctoral studies at the University of Washington and is currently a Prize Postdoctoral Fellow in the condensed-matter theory group at Yale University. Tyler is generally interested in problems related to quantum computing, quantum phases of matter, and quantum information. Outside of physics, Tyler enjoys pick-up sports, savory ice cream flavors, and learning new board games.