QSUN Quantum Research Group of Stellenbosch University

SA QuTI South African Quantum Technology Initiative

NITheCS National Institute for Theoretical and Computational Sciences

Stellenbosch University iYunivesithi Universiteit

SEMINAR

Decoherence Limiting the Cost to Simulate an Anharmonic Oscillator

Dr Tzula Benjamin Propp (Delft University of Technology)

Friday, 15 March 2024 @ 14h00-15h00 SAST
Venue: Physics Seminar Room, Stellenbosch University, and online

ABSTRACT

Decoherence increases the efficiency with which we simulate the quantum dynamics of an anharmonic oscillator governed by the Kerr effect. As decoherence washes out the fine-grained subPlanck structure associated with phase-space quantum interference in the closed quantum system, open quantum dynamics can be more efficiently simulated using a coarse-grained finite-difference numerical integration. We tie this to the way in which decoherence recovers the semiclassical truncated Wigner approximation (TWA), which strongly differs from the exact closed-system dynamics at times when quantum interference leads to cat states and more general superpositions of coherent states. The regression in quadrature measurement statistics to semiclassical dynamics becomes more pronounced as the initial amplitude of the oscillator grows. Furthermore, this regression to classical dynamics does not have the form of a convex noise model, such as for a depolarizing noise channel, which we derive measurement statistic signatures for. Instead, closed quantum system effects interact with the open system effects, giving rise to distinct open system behavior. Both the interaction between closed and open quantum system effects leading to non-convexity and the regression to classicality increasing with macroscopicity have implications for the quantum advantage achievable on near-term NISQ devices.

BIOGRAPHY

Originally hailing from San Diego, California in the US, Tzula Benjamin Propp [they/them] studied Physics and Philosophy for their bachelors degree at the College of Wooster, Ohio, and then did a PhD in Physics at the University of Oregon where their dissertation examined theoretical limits to single-photon detection. They then joined University of New Mexico's Center for Quantum Information and Control as a National Science Foundation postdoctoral fellow to study decoherence and open quantum systems, where they completed the research they will present in this talk.

As of August 2023, Tzula has joined QuTech as a postdoc in the Wehner group, researching novel quantum computation and communication applications of the quantum internet with an eye towards positive social benefit, and supporting the development of photonic clients—quantum communication devices to interface with quantum servers—with quantum optical modeling. In addition to research activities, Tzula is actively working to promote resiliency and retention of marginalized researchers in quantum through outreach programs and community organizing and mentorship, recently resulting in their co-founding of the global organization Diversity in Quantum [DiviQ.org] in 2023.

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