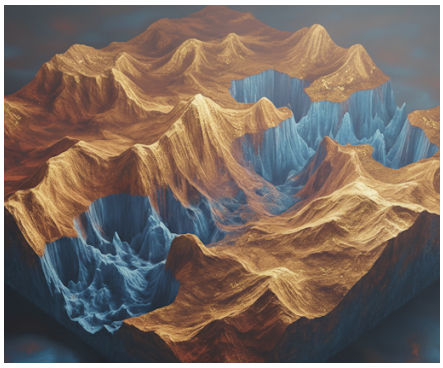
institute for pure & applied mathematics

The Quantum Monte Carlo Sign Problem: Structure, Complexity, and New Directions



January 25-29, 2027

Scientific Overview

The Monte Carlo sign problem remains a central obstruction to scalable simulation of interacting quantum many-body systems. By undermining reliable importance sampling in quantum Monte Carlo—the primary practical framework for large-scale quantum simulation—it renders wide classes of physically relevant models computationally intractable. Despite significant conceptual advances and model-specific breakthroughs, no general resolution is known, and the boundary between tractable and intractable regimes remains poorly understood.

This workshop will bring together researchers from physics, applied mathematics, quantum information, and theoretical computer science to critically examine the current landscape of sign-problem mitigation. The goal is not merely to survey existing approaches, but to clarify structural principles underlying sign-free formulations, identify new algorithmic and complexity-theoretic perspectives, and foster cross-disciplinary collaborations. Through lectures, tutorials, focused discussions, and problem-driven sessions, the workshop aims both to accelerate conceptual progress and to train early-career researchers entering this rapidly evolving field.

This workshop will include a poster session; a request for posters will be sent to registered participants in advance of the workshop.

Organizers

Bryan Clark (University of Illinois Urbana-Champaign), Itay Hen (University of Southern California), Emilie Huffman (Wake Forest University), Jianfeng Lu (Duke University), Nikolay Prokofiev (UMass Amherst)

Speakers

TBA

Participation

Additional information about this workshop including links to register and to apply for funding, can be found on the webpage listed below. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission, and we welcome their applications.

NSF UCLA

For more information, visit the program webpage:

www.ipam.ucla.edu/QMS2027