MP 6: Quantum Computing and Quantum Dynamics

Time: Tuesday 9:30–10:30 Location: HL 001

Invited Talk MP 6.1 Tue 9:30 HL 001

The mathematical physics of near-term quantum computing — •Jens Eisert — Freie Universität Berlin — Helmholtz Center Berlin — Heinrich-Hertz-Institute Berlin

Quantum computers promise the efficient solution of some computational problems that are classically intractable. For many years, they have been primarily objects of theoretical study, as only in recent years, protagonists have set out to actually build intermediate-scale quantum computers. This creates an interesting state of affairs, but also begs for an answer to the question what such devices are possibly good for. In this talk, we discuss such questions from the perspective of mathematical physics. While we cannot provide a comprehensive answer, this talk will be dedicated to a number of results offering substantial progress along these lines. We will discuss rigorous quantum advantages in paradigmatic problems [1,2], and will explore the use of quantum computers in machine learning [3,4,5] and optimization [6]. We will also discuss limitations, by providing efficient classical algorithms for instances of quantum algorithms, hence "de-quantizing" them, and by identifying limitations to quantum error mitigation [9]. The talk will end with an invitation to view such near-term problems from the perspective of mathematical physics.

[1] Rev. Mod. Phys. 95, 035001 (2023). [2] arXiv:2307.14424 (2023). [3] Quantum 5, 417 (2021). [4] arXiv:2303.03428, Nature Comm. (2024). [5] arXiv:2306.13461, Nature Comm. (2024). [6] arXiv:2212.08678 (2022). [7] arXiv:2309.11647 (2023). [8] Phys. Rev. Lett. 131, 100803 (2023). [9] arXiv:2210.11505 (2022).

Invited Talk MP 6.2 Tue 10:00 HL 001

Quantum chaos, integrability, and the complexity of time evolution — •Vijay Balasubramanian — University of Pennsylvanian, Philadelphia, PA 19004, USA

I will discuss recent work characterizing chaos and integrability in quantum systems in terms of the complexity of time evolution seen as a quantum computation, and in terms of the dynamical spread of the wavefunction over the Hilbert space.