

The Question of Quantum Advantage in Quantum Simulation

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Over the past years there has been rapid development in hardware for quantum computing across a range of platforms. In parallel to these developments, highly controlled quantum systems ranging from ultra cold atoms to superconducting qubits are being applied as "analogue quantum simulators" to study problems of interest in many-body physics. However, the big question is when and how they might answer to questions that we cannot address with simulation on classical computers.

I will give an introduction to the overarching question of what is difficult to compute regarding many-body systems, and how we might approach these questions using digital quantum computers, or analogue quantum simulators. I will discuss under which conditions can the answers we get out of each platform are quantitatively reliable, and where we might expect to obtain a practical quantum advantage for simulation of quantum systems in the early fault-tolerant era of quantum computing.