

Validating quantum devices

Prof. Dr. Matthias Troyer

Institute for Theoretical Physics, ETH Zürich

About a century after the development of quantum mechanics we have now reached an exciting time where non-trivial devices that make use of quantum effects can be built. While a universal quantum computer of non-trivial size is still out of reach there are a number of commercial and experimental devices: quantum random number generators, quantum encryption systems, and analog quantum simulators. In this colloquium I will present some of these devices and validation tests we performed on them. Quantum random number generators use the inherent randomness in quantum measurements to produce true random numbers, unlike classical pseudorandom number generators which are inherently deterministic. Optical lattice emulators use ultracold atomic gases in optical lattices to mimic typical models of condensed matter physics. I will then discuss the devices built by Canadian company D-Wave systems, which are special purpose quantum simulators for solving hard classical optimization problems and provide an outlook towards future universal quantum computers.