DAMOP15-2015-000014

Abstract for an Invited Paper
for the DAMOP15 Meeting of
the American Physical Society

Beyond Moore's law: towards competitive quantum devices

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A century after the invention of quantum theory and fifty years after Bell's inequality we see the first quantum devices emerge as products that aim to be competitive with the best classical computing devices. While a universal quantum computer of non-trivial size is still out of reach there exist a number commercial and experimental devices: quantum random number generators, quantum simulators and quantum annealers. 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. In my talk I will focus especially on the devices built by Canadian company D-Wave systems, which are special purpose quantum simulators for solving hard classical optimization problems. I will review the controversy around the quantum nature of these devices and will compare them to state of the art classical algorithms. I will end with an outlook towards universal quantum computing and end with the question: which important problems that are intractable even for post-exa-scale classical computers could we expect to solve once we have a universal quantum computer?