2023 CAP LECTURE TOUR

The Canadian Association of Physicists
and the
Department of Physics & Astronomy
at Trent University
present

Neuromorphic hardware and its role in quantum technologies

by

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Date: Wednesday, February 15, 2023
Time: 11:00-11:50am
Room: ENW 115

ABSTRACT

Rapid developments in quantum computing algorithms during the last few years have uncovered the great potential of overcoming conventional von-Neumann computing architectures. Theoretical studies suggest promising applications of quantum computation and quantum simulation hardware in everyday life and in the discovery of new physical phenomena. Driven by these forecasts, experimental realizations of quantum computers are advancing swiftly, albeit state-of-the-art hardware is still limited to noisy implementations of quantum states on small numbers of qubits. The power of artificial neural networks (ANNs) in promoting the overcoming of these limitations has recently been demonstrated at various stages. In this context, ANNs are commonly used as systematically tunable wavefunction ansatz to represent quantum states in numerical simulations. At the same time, constant progress in the development of biologically inspired neuromorphic hardware enables accelerated implementations of ANNs on small and energy-efficient analog devices. In this talk, I will introduce the principles and ideas of neuromorphic chips and discuss their role in quantum technologies. I will consider the tomographic reconstruction of quantum states as an example to introduce the focus of my research team on how specific hardware can advance the broad field of quantum computation.