University of Victoria

PHYSICS AND ASTRONOMY COLLOQUIUM (Online)

Dr. Zdenka Kuncic

University of Sydney

"Phase transitions, criticality and brain-inspired learning in physical neural networks"

Abstract

"Biological neural networks, unlike artificial neural networks, exhibit collective dynamics that emerge from the many-body interactions between neurons. If we could strip away the biological processes, new clues might be revealed pointing to the physical mechanisms underpinning the brain's efficient information processing capabilities and these mechanisms could then be exploited to develop next-generation intelligent computing systems. In this talk, I will present efforts towards demonstrating this principle using inorganic nanowires that self-assemble into a complex network structure, similar to the brain's neural network circuitry. Under electrical stimulation, nanowire cross-point junctions exhibit hysteresis and synapse-like responses that, collectively, are strikingly similar to the nonlinear dynamics observed in the brain. We found evidence of first-order dynamical phase transitions as well as critical dynamics. By harnessing the diverse dynamics in the readouts from the nanowire physical neural network, we also found optimal performance could be achieved in a machine learning task when the network was in a critical-like state, as has also been proposed for the brain's neural network. Overall, these results demonstrate the importance of emergent dynamics in brain-inspired physical learning, as opposed to data-driven statistical learning, with implications for machine intelligence beyond AI."

Wednesday, October 12, 2022

3:30 p.m. PDT

Zoom link available on Uvic Event Calendar