Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **539** Type: **Invited Speaker / Conférencier(ère) invité(e)**

(I) Disordered array superconducting loop-based synaptic networks and neurons for neuromorphic computing

Monday 7 June 2021 15:45 (10 minutes)

High-temperature superconductor YBa2Cu3O7 (YBCO) can be systematically disordered by irradiating with a He-ion beams to induce a metal-insulator transition (MIT). Therefore, tunnel junctions demonstrating Josephson tunneling properties can be constructed in planar YBCO films using a He-ion microscope. We have used superconducting loops with disordered YBCO junctions to develop devices that together form fully recurrent neural networks.
Arrays of disordered loops with junctions in planar YBCO thin films with can demonstrate both neuron-like and synapse-like properties. A different architectural approach has been taken by replacing individual synaptic connections with a disordered array of superconducting loops with Josephson junctions. The disordered array can be connected to neurons at its incoming and outgoing nodes to form a fully connected and recurrent neural network and this demonstrates properties of a synaptic memory. The advantage of this approach is that the available memory increases exponentially with increasing size of the array while still fully connecting all the neurons in the network. A neuron-like device is designed with disordered YBCO Josephson junctions that demonstrate leaky integrate-and-fire properties with spiking output and dynamically varying threshold. I will discuss the designs and demonstrate them using equivalent circuit simulations and propose a collective synaptic network architecture that can also work with various other materials that are of interest.

Author: DYNES, Robert (University of California San Diego)

Presenter: DYNES, Robert (University of California San Diego)

Session Classification: M3-7 Jules Carbotte Memorial (DCMMP) / En mémoire de Jules Carbotte (DPMCM)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)