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# Theoretical prototype of a Hodgkin-Huxley neuron with 2D nanofluidic memristors

*mardi 16 mars 2021 14:30 (20 minutes)*

New energy-efficient computer architectures inspired by the mammalian brain have been growing as an alternative to traditional von Neumann computing. Yet, existing hardware implementations use electrons as charge carriers, while neurons rely on transport of ions for both computation and the building of memory. In my presentation, I will show how a two-dimensional electrolyte confined between atomically smooth surfaces – a recently demonstrated nanofluidic device – can exhibit neuromorphic behaviour. I will show that ions in the 2D monolayer form tightly bound Bjerrum pairs, that assemble into micelle-like clusters upon application of an electric field. The long-timescale dynamics of these ionic assemblies are at the source of memory effects in the system's conductivity – a behavior known as "memristor effect". Guided by analytical predictions, I will also present molecular simulations of nanofluidic circuitry incorporating memristor building blocks. The resulting system is capable of spontaneously emitting voltage spike trains, replicating the Hodgkin-Huxley neuron model (Nobel Prize 1962). Theses findings reveal a minimal, experimentally-accessible biomimetic neuron architecture based on nanofluidic channels, paving the way for the development of ion-based computing and prototype ionic machines.

Reference :
Paul Robin, Nikita Kavokine and Lydéric Bocquet, Hodgkin-Huxley iontronics with two-dimensional nanofluidic memristors, under review (2021).

## Language

English

## Field

Nanoscale physics, nanofluidics, interface with neuroscience.

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