PHYSICS

CONDENSED MATTER PHYSICS SEMINAR SERIES

4:00 pm - Rm 184 NSH

Thursday, April 16

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Wiring the Brain: An Intersection of Genetics and Physics

An important challenge of modern neuroscience is to unveil the mechanisms shaping the wiring of the connectome, answering the difficult question of how the brain wires itself. Neuronal systems display a high degree of wiring reproducibility, so that multiple circuits and architectural features appear to be identical within a species, invariants that current models are unable to explain. It is increasingly established that encoding the connectome requires both transcriptionally encoded neuronal identity and genetically driven mechanisms that encode the formation of specific synapses and gap junctions. I will show that such genetically encoded mechanisms can be described by unique mathematical operators, and the resulting intuition can be summarized as B = XOXT, where Xi denotes the vector that describes the full genetic expression pattern of neuron i, B is the resulting wiring diagram, and O represents the sum of all biological operators Oj acting in the specific brain. This theory has been validated in C. elegans, and has implications for (1) unveiling the genetic circuits underlying brain wiring, and (2) providing a biologically-validated model for studying the encoding of innate behaviors through neural networks, both of which will be discussed.

https://www.cell.com/neuron/fulltext/S0896-6273(19)30926-2?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS0896627319309262%3Fshowall%3Dtrue