21 de MAYO de 2024

11:30 h
Aula del edificio I+D+i

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From the microbiome to the electrome: implications on the gut-brain axis

Dr. Herrera-Rincon

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While it is clear that bacteria in the gut and neurons in brain communicate (the micorbiota-gut-brain axis), many of the fundamental questions in this field are wide-open. Crucially, the scientific community focuses almost exclusively on molecular mechanisms and not – as we are doing – on top-down, information-based approaches, which are needed to fully understand the high-level meaning behind the mechanisms. Our hypotheses are that (1) there is a universal ancestral communication code, which would allow effective information transfer to take place across biological kingdoms and that (2) a computational analysis of cross- talk between bacteria and neural cells will reveal uniquely important aspects of how Information processing underlies emergence of complex systems at multiple levels of organization. To test these hypotheses, we are developing the first integrated electrical-optical Brain-Bacteria Interface (BBI), a multi-site stimulation and recording platform specifically suited to extract information in real-time across highly diverse biological entities. Here, we show real-time information transfer in co-culture of neurons and bacteria, both optically, through fluorescent genetically-encoded ion reporters, and electrically, through customized micro-electrode-array on microfluidic chambers. The extraction of information content from signaling between neurons and pathogens, and the establishment of a novel interface between synthetic biology, biophysics, information science, and molecular physiology will produce new knowledge of both basic and applied impact, bridge a capabilities gap that establishes a new direction for the field, and serve as an enabling technology which will allow others to research scientific questions that are fundamental relevance to practical current barriers in biomedicine, evolution, physiology, psychiatry, and unconventional computation.

Dr. Herrera-Rincon is a neuroscientist, mainly interested in fundamental topics like information processing and the nature of the mind: matter relation. Celia received her Ph.D. in Neuroscience, from the Complutense University of Madrid (Madrid, Spain) in 2014. In 2015, she moved to the USA and started her post-doctoral research at Tufts and Harvard Universities (Boston, MA) under the supervision of Prof. Michael Levin. During her postdoc studies, she began to uncover the bioelectric language by which cells coordinate their activity. After two years working as a postdoc, Dr. Herrera-Rincon became an Independent Researcher at Tufts in December 2017 after awarding a grant from the Templeton World Charity Foundation Inc., which funds 2-3 high risk/high-reward projects each year from promising researchers at early stages of the career across the globe. She was awarded a Ramón y Cajal Fellowship in 2020 and she joined the Complutense University of Madrid, where she is leading an international team to understand the deepest aspects of the brain-bacteria communication, using a unique methodology: the Brain-Bacteria Interface (BBI). BBI is the first integrated platform optimized to extract Information during live communication between bacteria and neurons. Currently, her interdisciplinary team (combining neuroscience, microbiology, computation, and mathematical modelling) is focused on the interactions between gut bacteria and neurons, with the ultimate goal to discover nutritional approaches targeting gut microbiota for mental well-being.

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