B·DEBATE International Center for Scientific Debate BARCELONA

IDIBAPS Institut D'Investigacions Biomèdiques August Pi i Sunyer

GUSTAVO DECO

CV

PARTICIPANT AT:

A DIALOGUE WITH THE CEREBRAL CORTEX: CORTICAL FUNCTION AND INTERFACING

April, 29th-30th, 2015, Barcelona

Gustavo Deco, ICREA Research Professor and Full Professor at the **Universitat Pompeu Fabra**, Barcelona, Spain

Gustavo Deco is ICREA Research Professor and Full Professor at the Universitat Pompeu Fabra, where he heads the Computational Neuroscience Group and directs the Center for Brain and Cognition. He studied Physics at the National University of Rosario. In 1987, he received his Ph.D. in Physics for his thesis on Relativistic Atomic Collisions. In 1997, he obtained his habilitation (maximal academical degree in Germany) in Computer Science at the Technical University of Munich for his thesis on Neural Learning. In 2001, he received his Ph.D. in Psychology at the Ludwig-Maximilian-University of Munich for his thesis on Visual Attention. His research interests include computational neuroscience, neuropsychology, psycholinguistics, biological networks, statistical formulation of neural networks, and chaos theory. He has actively contributed to the modelling and integration of experimental measurements through theoretical frameworks, and collaborates with many experimentalists to confront theory and experiments. Recognised as a world leader in computational neuroscience, he has led pioneering work in dynamical modelling of human brain activity. He is an ERC Advanced grantee and member of the Human Brain Project.

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ABSTRACT

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The Dynamics of Resting Fluctuations in the Brain

The grand average functional connectivity (FC) of a resting brain captures properly the well- structured spatial correlations between different brain areas. Whole-brain models explicitly linking spontaneous local neuronal dynamics with the tractography based anatomical structure of the brain are able to explain the emergence of those spatial resting correlations. Nevertheless, resting activity is not only spatially structured but also shows a very stereotypical temporal structure which is characterized by rapid transitions switching between a few discrete FC states across time. In this talk, we introduce a powerful theoretical framework, which allows us to demonstrate that resting functional connectivity FC dynamics (FCD) constrains more strongly the dynamical working point of whole-brain models. Further more, using a very general neural mass model based on the normal form of a Hopf bifurcation we are able to demonstrate that the temporal dynamics of resting state fluctuations emerges at the edge of the transition between asynchronous to oscillatory behavior. Even more importantly, at that particular working point the global metastability of the whole brain is maximized. By optimizing the spectral characteristics of each local brain node, we discover the dynamical core of the brain, i.e. the set of nodes, which drives by oscillations the rest of the whole brain. This dynamical core can be interpreted as the "memory" core of nodes sustaining consciousness.

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