Coherence activity in neuronal cultures from noise focusing

July 22 2013

A research led by researchers from the University of Barcelona (UB) and published on *Nature Physics* enables to establish a basic mechanism of collective of self-organization of cultured neuronal networks. Authors have been able to determine the physical origin of neurons' collective dynamics, which takes place spontaneously.

This phenomenon may explain the mechanisms which produce and characterise spontaneous electrical activity of neuronal tissues, a really relevant aspect in neuroscience. Moreover, the research points out that this behaviour can be applied to other similar systems in really different subject areas, for instance, in rumour spreading on social networks.

The research, highlighted on the article "Neuronal networks: Focus amidst the noise" signed by J. M. Beggs in the section *News and Views*, has been carried out by a group of Catalan researchers from the University of Barcelona, led by doctors Jaume Casademunt and Jordi Soriano, together with researchers Javier G. Orlandi and Sara Teller. Dr Enric Álvarez Lacalle, from the Universitat Politècnica de Catalunya Barcelona TECH, collaborated too.

Cultured neuronal networks: a non-directed orchestra

Neuronal cultures in vitro are a relatively simple but interesting system to study neurons' collective dynamics. Cultures are prepared from neurons at early stages of development. In a few days, neurons

spontaneously create a connection network which has a rich electrical activity.

This activity begins randomly and in a non-coordinated way (so-called 'noise') and evolves into a state of coherent activity in which all neurons are simultaneously activated following a pattern that Jaume Casedemunt, professor from the Department of Structure and Constituents of Matter of the UB describes as "surprisingly harmonic". "It happens in a completely spontaneous way; thousands of neurons behave as if they were members of a non-directed orchestra, in other words, there is not any coordinating element which plays the role of leader", adds the researcher.

According to Jordi Soriano, Ramón y Cajal researcher from the same UB Department and pioneer in experimenting on neuronal cultures in Catalonia, "this phenomenon may happen in all neuronal tissues at early stages of development. It might be a key to establish spontaneous activity patterns of different neuronal tissues, an aspect of paramount importance in neuroscience".

The analysis of these behaviour patterns enables to understand how neurons are programmed in order to be the basic elements of the nervous system, and which primary forces run behaviour. Forces define the basis on which the different biological agents that control the development of the nervous system in organisms act.

Noise focusing

The phenomenon is explained by what Catalan researchers named 'noise focusing effect', a strong spatio-temporal localization of the noise dynamics, originating in the complex structure of avalanches of spontaneous activity.

The physical origin of the phenomenon, produced by the combination of neurons' excitation dynamics and connection networks' statistics, suggests that this behaviour can be also applied to the study of similar collective phenomena, for instance, rumour generation and spreading on social networks.

More information: *Nature Physics*, AOP 21 July 2013. DOI: 10.1038/nphys2686
Nature Physics, News and Views, 21 July 2013. DOI:10.1038/nphys2707