JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Institutsskolloquium Psychologisches Institut

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„Brain rhythms – how synchronization of neuronal populations routes information through the brain“

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Abstract:

“Brain rhythms – how synchronization of neuronal populations routes information through the brain”

While knowledge on signal processing by individual nerve cells in the brain (neurons) is growing rapidly, our understanding of how networks of neurons process information under normal as well as pathological conditions is still very limited. One particular challenge in understanding these networks derives from their extremely dense connectivity: each neuron connects to and receives information from thousands of other neurons. At each point in time, any particular neuron receives information from most of its connections, but not all of it will be relevant. This raises the question of how the limited number of meaningful signals can be processed without becoming compromised by the overwhelming number of other, unrelated signals.

I will discuss how rhythmic synchronization of neurons can aid the process of routing the behaviorally important (e.g. the attended) information through the brain. First, research has shown that groups of neurons have the tendency to send their information in a synchronized and rhythmical manner. It is thought that sending information rhythmically makes the message “louder”, similar to an audience clapping synchronously. Second, “sender” neuronal groups which send different information engage in slightly different rhythms. A “receiver” neuronal group can then lock its rhythm with the sending group providing the attended information. In other words, a neuronal group processing incoming information is capable of “listening” solely to the attended input stream. This short, reversible locking of neurons provides the brain with a powerful dynamic mechanism to select and process only the relevant, while suppressing irrelevant signals. It shows that the brain is capable of flexibly reconfiguring its circuitry without changing the hard-wired anatomical connections between the neurons. These findings create a basis to understand and further explore how our amazing attentional capabilities are implemented in the brain.