Guest Lecture

A neural code for sleep need

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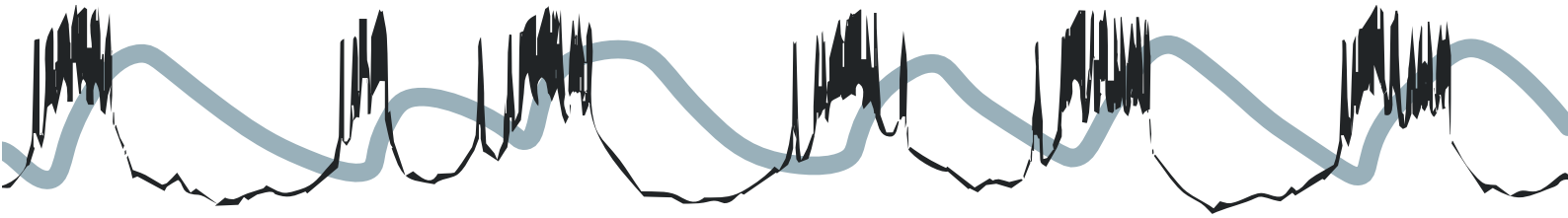
Seminar room SR 35 (MC2.J.01.040), MED Campus



Abstract

When confronted with the same problem, different organisms often arrive at remarkably similar solutions. Nervous systems of evolutionarily distant species differ in the overall anatomical makeup, used neurotransmitters and receptor types, but may share computational principles that are dissociable from species-specific implementational details. I will illustrate this using the example of *Drosophila melanogaster*, where neurons projecting to the dorsal fan-shaped body (dFBNs) have a central role in sleep homeostasis.

The *in vivo* ensemble activity of these cells is rhythmic, peaking at 0.2-1 Hz. The amplitude of these slow oscillations increases with sleep drive, and their optogenetic replay in dFBNs promotes sleep. While these findings motivate analogies to mammalian slow-wave sleep, our experiments also reveal important distinctions: dFBNs possess mutually-inhibitory connections with arousing dopamine neurons (reminiscent of circuit motifs in the sleep-wake control of mammals), but their oscillations persist during wakefulness. Slow-wave activity in the dFBNs ensemble originates from only a small subset of dFBNs, which are anticorrelated between hemispheres and form mutually inhibitory connections. This interpretation was confirmed by our optogenetic stimulation and loss-of-function experiments, was reproduced by a parsimonious computational model, and was further supported by anatomical evidence from an electron-microscopic connectome. The implications of behavioural and anatomical constraints on how (and potentially why) animals use slow-waves to encode sleep will be discussed.

Paper

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