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Network properties of the mammalian circadian clock

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The biological clock regulates daily and seasonal rhythms in mammals. This clock is located in the suprachiasmatic nuclei (SCN), which are two small nuclei each consisting of 10,000 neurons. The neurons of the SCN endogenously generate a rhythm of approximately 24 hours. Under the influence of the light-dark cycle, the SCN produce a coordinated output that is subjected to daily environmental changes. The adaptation to the light-dark cycle is a property of the neuronal network of the SCN. This neuronal network also explains the adjustment to long summer days and short winter days, and to shifts in the light-dark cycle caused by transatlantic flights or shift work.

In this thesis the neuronal network of the SCN is investigated using computational techniques. The computer simulations were directed by experimental results, while, vice versa, new experiments were guided by results from the simulations. These coordinated efforts of computational science and life sciences show how properties emerge at the neuronal network level, that are not present in individual cells.

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