Encoding information beyond the circadian timescale in the multi-oscillator circadian clock

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The suprachiasmatic nucleus (SCN) is a collection of about 10,000 neurons, each of which functions as a circadian clock with different periods and phases, that work in concert to form and maintain the master circadian clock for the organism. The diversity among neurons confers on the SCN the ability to robustly encode both the 24-hour light pattern as well as the seasonal time. Synchronization brings the different neurons into line and reduces the large population to essentially two oscillators, coordinated by a macroscopic network motif of asymmetric repulsive-attractive coupling. We recount the steps leading to this simplification and rigorously examine the two-oscillator case by seeking an analytical solution. Through these steps, we identify physiologically relevant parameters that shape the behavior of the SCN network and define its encoding capacity of temporal light patterns beyond the circadian timescale.