

Modeling the mammalian circadian pacemaker as coupled phase oscillators: Self-organization and entrainment

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The suprachiasmatic nucleus (SCN) is considered to be the seat of the mammalian circadian clock. It has been modeled as a collection of ≈ 1000 globally coupled pacers (phase oscillators) each with a constant angular velocity and two alternating states: active and inactive. The current model is based on the model described in Beersma et al 2008 (Journal of Biological Rhythms). Each pacer responds to a stimulus at the end of the active state by an instantaneous phase delay and near the end of the inactive state by an instantaneous phase advance whose amounts are proportional to the strength of the stimulus. Entrainment of a pacer to a periodic stimulus is characterized by the stimulus parameters and four pacer parameters: its period, the duration of its active state, and the proportionality constants related to phase delay and phase advance. Numerical results and their biological relevance will be discussed.