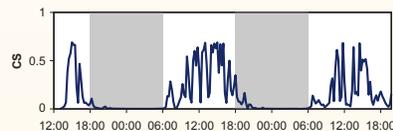# A Model of the Human Circadian Timing Mechanism

The biological clock in the suprachiasmatic nuclei (SCN) is modeled as a *limit cycle oscillator* that becomes synchronized to our local time zone on Earth by the 24-hour light-dark cycle processed by the retina.

The Daysimeter is a device that continuously measures circadian light stimulus (CS) over an extended number of days. The Daysimeter provides information about the light-dark input to the limit cycle oscillator model of the SCN. The limit cycle oscillator model computes circadian clock phase that can be tracked in a variety of ways. Minimum core body temperature (CBT_{min}) is one classic marker for tracking circadian phase that usually occurs about two to three hours before waking in the morning. Without light input on the retina, the SCN will run with a period of about 24.2 hours.
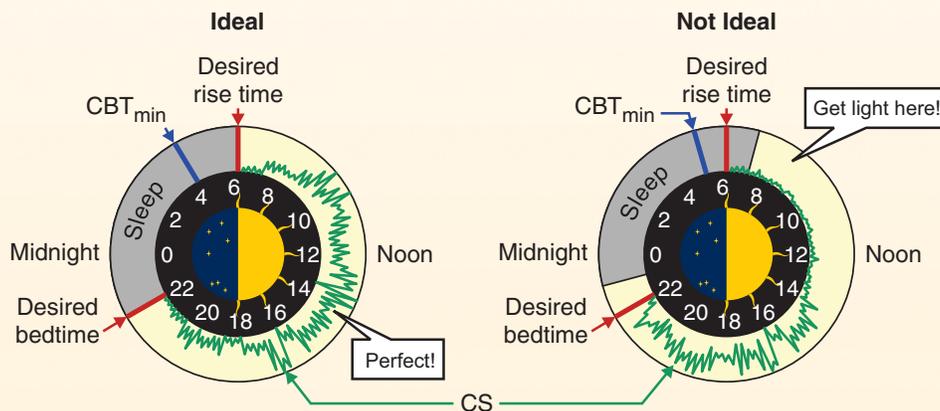
The Daysimeter

Daysimeter data

In complete darkness, the SCN will run on its own and become asynchronous with the external sunrise and sunset. With a regular 24-hour light-dark cycle on the retina, however, the SCN orchestrates the timing of nearly every biological function in the body so that, for example, we sleep at night and are active during the day.

With Daysimeter data and the model of the limit cycle oscillator, the LRC is now able to "write a prescription" so that a person can receive a light-dark pattern that matches his/her desired rise time and sleep time. The LRC envisions a biological watch that tracks a person's circadian time and can provide him/her with a recommendation for when to get more light and when to avoid light. In collaboration with colleagues at the Swedish Energy Agency and with the U.S. Department of Defense under a Small Business Innovation Research grant with Intelligent Automation, Inc., the LRC will be testing the effectiveness of the system in real life applications.

Rensselaer

Lighting Research Center