Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Synchronized Cycles: An allosteric model of the cyanobacterial circadian oscillator DAVID LUBENSKY, University of Michigan, J.S. VAN ZON, Imperial College, P. ALTENA, P.R. TEN WOLDE, AMOLF (Amsterdam) — In a remarkable experiment, Nakajima et al. [Science, 2005] showed that the 3 cyanobacterial clock proteins KaiA, KaiB, and KaiC are sufficient to generate circadian phosphorylation of KaiC *in vitro*. This system is thus a rare example of a functioning biochemical circuit that can be reconstituted in the test tube. Theoretically, it presents the further challenge that the only reactions driven out of equilibrium are those associated with KaiC phosphorylation and dephosphorylation. Here, we present a model of the Kai system. At its heart is the assumption, motivated by classical models of allostery, that each KaiC hexamer to tends to be phosphorylated in a cyclic manner. For macroscopic oscillations to be possible, however, the cycles of the different hexamers must be synchronized. We propose a novel synchronisation mechanism that allows us to reproduce a wide range of published data, including temperature compensation of the oscillation period, and to make nontrivial predictions about the effects of varying the concentrations of the Kai proteins.

David Lubensky
University of Michigan

Date submitted: 20 Nov 2006 Electronic form version 1.4