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KAIC PHOSPHORYATION CYCLE AS THE PACEMAKER OF CYANOBACTERIAL CIRCADIAN CLOCK

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Circadian rhythms arefound in most organisms, allowing the organisms to coordinate their lives with the day/night alterations of their environments. In most model organisms, transcription/translation oscillatory processes based on negative feedback regulation of clock genes are proposed as the core mechanism to generate self-sustaining circadian oscillations. Cyanobacteria are the simplest organisms that exhibit circadian rhythms. In the cyanobacterium, *Synechococcus elongatus* PCC 7942, three genes (*kaiA*, *kaiB* and *kaiC*) were identified as essential components of the circadian clock and negative feedback regulation of *kaiBC* expression by Kai proteins was confirmed and proposed as a core loop of prokaryotic circadian oscillator.

However, under continuous dark conditions, we found robust circadian cyclingof KaiC phosphorylation even without *kaiBC* mRNA accumulation. This rhythm persisted in the presence of a translation or transcription inhibitor, and its period length was temperature compensated. Thus, we recently attempted to reconstitute the oscillation of KaiC phosphorylation *in vitro*. By incubating KaiC with KaiA, KaiB and ATP, we found the self-sustainable circadian oscillation of KaiC phosphorylation. The *in vitro* oscillation of KaiC phosphorylation persisted for at least three cycles and the period was compensated against temperature change. Furthermore, changes in circadian rhythm period length observed *in vivo* in various KaiC mutant strains were consistent with those measured *in vitro* when the incubations were carried out with the respective mutant KaiC proteins. These results demonstrate that the oscillation of KaiC phosphorylation is the primary pacemaker of the cyanobacterial circadian clock.