

MAS17-2017-000023

Abstract for an Invited Paper
for the MAS17 Meeting of
the American Physical Society

Magnesium regulates the circadian oscillator in cyanobacteria.¹

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The circadian clock is a 24-hour biological rhythm in our body, which controls many of our time related activities, such as sleep and awake. The cyanobacterial circadian clock is the simplest clock and its oscillator is composed of KaiA, KaiB, and KaiC proteins, which generate the self-sustained circadian oscillation of phosphorylation and dephosphorylation on KaiC. KaiA activates the phosphorylation of KaiC by binding A-loop in KaiC while KaiB attenuates it by sequestering KaiA from A-loop. The structural analysis revealed that the magnesium regulates the phosphorylation and dephosphorylation of KaiC by association or dissociation on the catalytic Glu, which activates the phosphorylation. High magnesium concentration made KaiC dephosphorylate though low magnesium concentration made KaiC phosphorylate without KaiA. The magnesium concentration was altered by light in cyanobacteria and KaiC alone behaved as an hourglass type oscillator by altering magnesium concentration. Our findings suggested that the circadian oscillator has evolved from an hourglass to a self-sustained oscillator.

¹This research is supported by the NJIT start-up.