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On the robustness of oscillations in a mixed mechanism phosphorylation system against perturbations in the total amount of the processive enzyme

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Many biochemical oscillators exist, and this work aims to analyse substrate cycles able to oscillate, shown by a periodical in- and decrease in the concentrations of the individual components. Such biochemical oscillators are one of the mechanisms involved in the timekeeping of organisms and the maintenance of the circadian rhythm. Mechanisms sustaining the circadian rhythm ought to be robust against perturbations, because if changes in concentrations of one or more components were to significantly change the properties of the oscillation, the circadian rhythm and hence the timekeeping of the organism would be impaired. Mixed systems consist of a processive and a distributive enzyme. Suwanmajo and Krishnan described a system that consists of a processive phosphorylation and a distributive dephosphorylation [1].

Conradi et al. have already proven that this system can exhibit oscillations, and that these oscillations are robust against variations in the total amount of kinase, the processive enzyme [2]. A similar system consists of a distributive phosphorylation and processive dephosphorylation. We study oscillations and their robustness against perturbations in the total amount of phosphatase, the processive enzyme.

References

[1] T. Suwanmajo, J. Krishnan, Mixed mechanisms of multi-site phosphorylation, *Journal of the Royal Society Interface*, 12:20141405, 2015.

[2] C. Conradi, M. Mincheva, A. Shiu, Emergence of Oscillations in a Mixed-Mechanism Phosphorylation System, *Bulletin of Mathematical Biology*, 81:1829–1852, 2019.