A minimal model of phototrophic growth: understanding resource allocation in cyanobacteria

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Cellular metabolism must continuously adapt to a multitude of changing environmental conditions to ensure best possible growth. Recent studies on cellular growth rate and metabolism focus on the relationship to proteome resource allocation. Understanding the mechanisms behind proteome resource allocation is essential to get insights into the impact of metabolic processes on changing growth rates. Current mathematical descriptions of bacterial growth show that those relationships can be derived from simple kinetic coarse-grained models (see for instance [1]). The need for continuous adaptation is in particular true for phototrophic organisms that rely on harvesting the sun's energy for cellular growth. Phototrophic metabolism is presumed to be carefully orchestrated to meet cellular demands for energy requirement and to provide sufficient storage compounds for periods of darkness [2]. Here, we develop a dynamic coarse-grained model of phototrophic metabolism to describe optimal growth over a full diurnal period. The aim of this project is to investigate the ratio of proteome resources under different environmental conditions and to understand which mechanisms are responsible for it. The knowledge about adjustment of proteome resources in order to increase growth rate in phototrophic organisms like cyanobacteria could help for example to get a higher level of biofuel productivity.

References

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[2] Rügen M, Bockmayr A, Steuer R (2015) Elucidating temporal resource allocation and diurnal dynamics in phototrophic metabolism using conditional FBA. *Sci Rep* 5: 15247.