A dual role of phycobilisomes in cyanobacteria:
Lessons learned from nitrogen-deprivation experiments
R. Kaňa et al.

ABSTRACT: Phycobilisomes (PBS) are the major light-harvesting antenna complexes of cyanobacteria. These several-megadalton supercomplexes are present in high abundance in most cyanobacterial strains. They are attached to the cytoplasmic surface of thylakoid membranes and, together with membrane-embedded chlorophyll-binding photosystems, drive the photochemical reactions that supply ATP and NADPH for the Calvin cycle and overall cellular metabolism. Consequently, PBS are traditionally viewed solely as light-harvesting proteins. However, our nitrogen-deprivation experiments with *Synechocystis sp. PCC 6803*, and previous observations from nitrogen-fixing cyanobacteria (e.g., *Crocosphaera*, *Trichodesmium*, *Oscilatoria*), suggest an additional role: PBS may function as a dynamic nitrogen reservoir—either as a nitrogen sink in diazotrophs or as a temporary nitrogen source during nitrogen starvation in *Synechocystis*.

This lecture will summarize recent results on short-term nitrogen deprivation in *Synechocystis PCC 6803.* Despite a strong reduction in PBS abundance, the cells kept maximal efficiency of PSI and PSII and maintained active electron transport. Confocal microscopy, biophysical measurements, biochemical analysis, and mass spectrometry together revealed a progression of PBS deactivation: starting with PBS decoupling, rod detachment, followed by stepwise degradation from rods to cores over ~24 hours. This process was absent in the PBS-rod mutant (Δcpc), which showed no response to nitrogen deprivation. Taken together, these findings highlight (i) a substantial excess capacity of PBS in light harvesting and (ii) a potential physiological function of PBS as a buffer of cellular nitrogen.