SFB 1078

Protonation Dynamics in Protein Function

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Freie Universität Berlin

via WebEx

Colloquium

Prof. Emina Stojkovic

Northeastern Illinois University, Chicago, USA

Structural Basis for Light Control of Cell Development: New Insights from Bacterial Phytochrome Proteins

Phytochromes (PHYs) are photoreceptor proteins first discovered in plants, where they control a variety of photomorphogenesis events. PHYs as photochromic enzymes that usually contain c-terminal kinase domain can reversibly switch between a red light absorbing (Pr) and a far-red light absorbing (Pfr) state. The unexpected discovery of bacteriophytochromes (BphPs) in non-photosynthetic bacteria has opened new frontiers in our understanding of the mechanisms by which these natural photoswitches can control single cell development. BphPs from the non-photosynthetic myxobacterium *Stigmatella aurantiaca* are of special interest. Myxobacteria are distinguished among prokaryotes by a multicellular stage in their life cycle known as fruiting bodies, which in *Stigmatella aurantiaca* is controlled by light. We recently determined the crystal structures of the two BphPs from *S. aurantiaca,* denoted *Sa*BphP1 and *Sa*BphP2. They have distinct photochemistry, although they bind the same bilin chromophore and share a large sequence identity. Unlike classical BphPs, wild-type SaBphP1 lacks a conserved histidine (His289) that stabilizes the covalently-bound bilin chromophore and undergoes limited Pr/Pfr photoconversion that can be restored by a single Thr289His mutation. Furthermore, the crystal structures of SaBphP1 wild-type and Thr289His mutant in comparison to classical SaBphP2 wild-type protein differ in the conformation of the essential bilin chromophore as well as important protein dimer interface in the dark-adapted Pr state. Our structural and sequence analyses of *S. aurantiaca's* BphPs highlight critical amino acid interactions with the chromophore and suggest the function for BphPs in the fruiting myxobacteria

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