SFB 1078

Protonation Dynamics in Protein Function

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Freie Universität Berlin

via Webex

Colloquium

Prof. Janne Ihalainen

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Photoactivation studies of bacteriophytochromes – details from its early and late reactions

Phytochrome proteins control the growth, reproduction, and photosynthesis of plants, fungi, and bacteria. Light is detected by a bilin cofactor, which isomerizes. Related to this action, multiple structural changes in the protein environment take place which then controls the biochemical activity of the protein. To some extent, the activation process and the structural details related to that remain still elusive (1).
In this talk, I will concentrate on the photoactive reactions of bacteriophytochromes. I will introduce our findings from the early reactions of the biliverdin detected by Serial Femtosecond X-ray (SFX) technique and ultrafast laser spectroscopy (2). In the second part of the talk, the biochemical activity of bacteriophytochrome from *Deinococcus radiodurans* in its dark and light states will be discussed (3). Here, we concentrate on the interactions of the bacteriophytochrome to its response regulation and demonstrate that instead of histidine kinase function, the bacteriophytochromes can function as light-activated phosphatase as well.

References: (1) Heikki Takala et al.: Tips and turns of bacteriophytochrome photoactivation. *Photochemical and Photobiological Sciences* 2020. In Press. (2) Elin Claesson et al.: The primary structural photoresponse of phytochrome proteins captured by a femtosecond X-ray laser. *eLife 2020*, 53514.(3) Elina Multamäki et al.: Illuminating a Phytochrome Paradigm – a Light-Activated Phosphatase in Two-Component Signaling Uncovered. bioRxiv doi: https://doi.org/10.1101/2020.06.26.173310

Prof. Kevin Gardner

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Exploring biomolecular dynamics in ligand-regulated protein/protein interactions: Understanding how Nature's switches work

Environmental cues regulate many biological processes, coordinating cellular pathways to respond to changing conditions. Such regulation is often initiated by sensory protein domains which expand their chemical repertoire by using small molecule ligands to convert environmentally-triggered changes into altered protein/protein interactions. Several families of these domains have evolved with remarkable diversity in their inputs and outputs. Using a combination of biophysics, biochemistry and synthetic chemistry, we seek to gain insight into the mechanistic controls of such environmental sensing domains for both fundamental understanding and subsequent artificial control.
Here I will discuss examples of our work exploring how the Period-ARNT-Singleminded (PAS) and Light-Oxygen-Voltage (LOV) protein domains convert changes in biochemical stimuli into control of a wide range of output functions. Using solution NMR complemented by a range of other biophysical and biochemical approaches, these proteins have given us the mechanistic understanding needed to develop the artificial regulation of such systems, both *in vitro* and in living cells. A unifying theme among these systems is that dynamics – at the residue or molecular level – are essential for these systems to properly switch. Taken together, our work provides an integrated view of a fascinating class of natural switches and suggests routes by which these can be manipulated to achieve desired therapeutic and/or technological outcomes.

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