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# Signal amplification and transduction in phytochrome photosensors disclosed by time-resolved X-ray scattering

Sensory proteins must relay structural signals from the sensory site over large distances to regulatory output domains. Phytochromes are a major family of red-light-sensing kinases that control diverse cellular functions in plants, bacteria and fungi.

I will discuss our recent findings on the structural dynamics of signal transduction in bacterial phytochromes. Our crystal and solution structures show an open and closed form of the dimeric protein for the activated and resting states, respectively. This nanometer-scale rearrangement is controlled by refolding of an evolutionarily conserved ‘arm’, which is in contact with the chromophore [1].

We arrive at these conclusions by combining protein crystallography, time-resolved X-ray solution scattering and molecular dynamics simulations. I will discuss this new approach to protein structural dynamics. It opens up for studying the structural dynamics of protein complexes in real time and in solution.

Our findings demonstrate an unusual mechanism in which atomic-scale conformational changes around the chromophore are first amplified into an Ångstrom-scale distance change in the arm, and further grow into a nanometer-scale conformational signal. Unpublished solution scattering data on other phytochrome constructs support this mechanism.

[1] Takala H, Björling A, Berntsson O, Lehtivuori H, Niebling S, Hoernke M, Kosheleva I, Henning R, Menzel A, Ihalainen JA, Westenhoff S. (2014) Signal amplification and transduction in phytochrome photosensors. Nature 509(7499):245-8. doi: 10.1038/nature13310