



INSTITUTIONEN FÖR KEMI OCH MOLEKYLÄRBIOLOGI

Signal Transduction in Photoreceptor Proteins Insights From Time-Resolved X-ray Solution Scattering

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Abstract

The ability to sense and react to different light conditions is of great importance for many organisms on the face of the earth. Specialized proteins known as photoreceptor proteins provide bacteria, plants and animals with this ability. To be able to sense the light the photoreceptor proteins have small molecules, known as chromophores, embedded within the protein matrix. Absorbed light triggers photochemical changes in the chromophore. These changes are relayed to the protein as structural changes and the biochemical activity of the protein is modified, thereby passing the signal on.

In this thesis, time-resolved X-ray solution scattering has been used together with molecular dynamics simulations to probe the conformational dynamics of photoreceptor proteins. The investigations reveal both the sequence and nature of light-induced structural transitions. Diverse mechanisms of signal transduction on different length- and timescales were found, from the nanometer scale light-induced separation of domains in phytochromes, to the Ångström scale opening of the light-oxygen-voltage dimer and subsequent supercoiling of the linker region, to the sub Ångström changes in the radius of gyration of cryptochromes. The results provide a structural link between the early photochemical events and the interaction and regulation of downstream processes and proteins.

Keywords: Signal transduction, Photoreceptor, Time-resolved X-ray solution scattering, Protein dynamics, Phytochrome, Light-oxygen-voltage, Cryptochrome