

Time-resolved X-ray solution scattering observations of light induced structural changes in sensory rhodopsin II

Daniel Sarabi*, Robert Bosman*, Lucija Ostojić*, Swagatha Ghosh*, Giorgia Ortolani*, Matteo Levantino**, Martin Nors Pedersen**, Mathias Sander**, Petra Båth*, Greger Hammarin*, Robert Dods*, Per Börjesson*, Cecilia Safari*, Michael Wulff**, Gisela Brändén*, Richard Neutze*

*Department of Chemistry and Molecular Biology, University of Gothenburg, Sweden, **European Synchrotron Radiation Facility, 38043 Grenoble Cedex 9, France

Light sensing in archaea is an important factor in their survival and navigation within their natural environments. Sensory rhodopsin II (SRII) is a heptahelical light-sensitive protein (1), which in the complex with its transducer protein (HtrII) plays a crucial role in initiating a negative phototaxis response through the two-component signaling pathway (2). We used time-resolved X-ray solution scattering (TR-XSS) to trace the light induced conformational changes in SRII alone and in complex with HtrII. Time-dependent changes in X-ray scattering of SRII are similar to those observed for bacteriorhodopsin (3). The presence of HtrII influences the X-ray scattering differences once the SRII:HtrII complex forms. Structural fitting using targeted molecular dynamics simulations indicates that these observations can be modelled as conformational changes, notably an outward movement of helices E and F, alongside smaller changes in helices C and the extracellular segments of helices D and E. The movement of helices E and F is somewhat diminished in the presence of HtrII, possibly due to interactions between SRII and TM2 of the HtrII. This study provides further insights into the mechanism of signal propagation in haloarchaea.

References:

1. Sasaki, J. & Spudich, J. L. Signal Transfer in Haloarchaeal Sensory Rhodopsin–Transducer Complexes†. *Photochemistry and Photobiology* 84, 863–868 (2008).
2. Stock, A. M., Robinson, V. L. & Goudreau, P. N. Two-Component Signal Transduction. *Annual Review of Biochemistry* 69, 183–215 (2000).
3. Sarabi, D. et al. Modeling difference x-ray scattering observations from an integral membrane protein within a detergent micelle. *Struct Dyn* 9, 054102 (2022).