

# Elucidating the Structures of Blue-Light Photoreceptor Proteins and Their Light-Induced Intermediate States

Kendra Njo, Szabolcs Bódizs, Taru Larkiala, Sebastian Westenhoff

Department of Chemistry for Life Sciences, Uppsala University, Uppsala, Sweden

Phototropins are essential blue-light photoreceptors in plants and algae<sup>1</sup>. They play a key role in mediating many light-driven functions like chloroplast movement, phototaxis, and phototropism<sup>2-4</sup>. In the two well-studied organisms, *Arabidopsis thaliana* and *Chlamydomonas reinhardtii*, two photosensory LOV (Light, Oxygen, Voltage-sensing) domains are associated with the chromophore FMN (flavin mononucleotide) and regulate a kinase domain<sup>5,6</sup>. Upon illumination, a covalent bond is formed between the FMN and a conserved cysteine residue, ultimately activating the phototropin kinase domain and translating the light signal into a chemical one.

Despite their important biological roles, no high-resolution structure of full-length phototropins is currently available. To address this, we aim to utilise single-particle cryo-EM to reconstruct the structures of *A. thaliana* and *C. reinhardtii* phototropins. Furthermore, we plan to implement time-resolved single-particle cryo-EM to resolve the distinct intermediate states involved in their photocycle.

1. Christie, J. M. Phototropin blue-light receptors. *Annu Rev Plant Biol* 58, 21–45 (2007).
2. Kagawa, T. et al. *Arabidopsis* NPL1: a phototropin homolog controlling the chloroplast high-light avoidance response. *Science* 291, 2138–2141 (2001).
3. Esmon, C. A. et al. A gradient of auxin and auxin-dependent transcription precedes tropic growth responses. *Proc Natl Acad Sci U S A* 103, 236–241 (2006).
4. Huang, K. & Beck, C. F. Phototropin is the blue-light receptor that controls multiple steps in the sexual life cycle of the green alga *Chlamydomonas reinhardtii*. *Proc Natl Acad Sci U S A* 100, 6269–6274 (2003).
5. Harper, S. M., Neil, L. C. & Gardner, K. H. Structural basis of a phototropin light switch. *Science* 301, 1541–1544 (2003).
6. Matsuoka, D. & Tokutomi, S. Blue light-regulated molecular switch of Ser/Thr kinase in phototropin. *Proc Natl Acad Sci U S A* 102, 13337–13342 (2005).