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Cyanobacterial Photoreceptors: Crystal Structure and Spectral Properties of AnPixJ_GAF2

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Cyanobacteria are unique phototrophic prokaryotes that perform oxygenic photosynthesis like plants. Recent genome projects have revealed that a number of putative photoreceptors that may be involved in various acclimation processes in the phototrophic life. We have been studying phytochrome-like photoreceptors named “cyanobacteriochromes” that bind a linear tetrapyrrole to form photoreversible chromoproteins but are distinct in spectral and phylogenetic features from the classic phytochrome superfamily. One of the well-studied responses is phototactic motility of cyanobacterial cells, which is driven by type IV-like pili. We have revealed that SyPixJ1 is a blue light receptor, which is essential for positive phototaxis in a unicellular cyanobacterium *Synechocystis* sp. PCC 6803. It binds phycoviolobilin and shows reversible photoconversion between blue light absorbing form and green light absorbing form. The phylogenetic analysis suggests that filamentous heterocyst-forming cyanobacteria harbor homologous but distinct photoreceptor genes. Among them, AnPixJ of *Anabaena* sp. PCC 7120 consists of four cyanobacteriochrome-type GAF domains (GAF1~FAF4) and MCP (methyl-accepting chemotaxis protein)-type domains. Of these, only the second GAF domain shows a reversible photoconversion between 648 nm-absorbing Pr form and 543 nm-absorbing Pg form. Spectral analyses showed that Pr binds C15-Z-phycocyanobilin and Pg binds C15-E-phycocyanobilin as a chromophore. We crystallized the Pr form in the presence of potassium iodide. X ray diffraction at 1.8 A was analyzed by SAD method. The structural model, thus obtained, will be discussed with regard to the common and unique features compared with the phytochromes.