Signaling by Phytochrome, a Knotted Bacterial Photoreceptor

Phytochrome is a multidomain red-light photoreceptor that allows cells to respond to the quality and intensity of incoming light. Bacterial phytochromes adopt a deep figure-of-eight knotted polypeptide and bind the linear tetrapyrrole biliverdin. Photon absorption causes a rotation about a double bond in this chromophore, leading to signaling to a modular output domain. To advance our research goals of understanding the structure/function relationships of bacterial phytochromes, we are studying the biochemistry and structural biology of the signal transduction pathway of the bacterial phytochromes of *Deinococcus radiodurans* and *Rambibacter tatouinensis*. Each contains a histidine kinase domain, and each is predicted to be a light-regulated enzyme that phosphorylates across a homodimeric interface and subsequently transfers phosphate to a response regulator protein. We have shown that *R. tatouinensis* bacterial phytochrome interacts specifically with at least one cognate single domain response regulator (Brr). As seen in x-ray crystal structures, this Brr forms a previously uncharacterized homodimeric interaction. We are engaged in determining the functional consequences of the knotted phytochrome topology and the oligomeric response regulator. We imagine both could limit motions of phytochrome domains upon illumination to steer signal transduction along a productive trajectory.