<u>Wednesday, September 26, 2018</u>
2:30-3:00 p.m.

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Harnessing bilin-based optogenetic actuators

Bilins are heme-derived linear tetrapyrroles found widely in nature. Inherently flexible molecules, bilins exhibit little fluorescence or stable photochemistry in solution. However, bilins have been harnessed by at least two unrelated protein families: phycobiliproteins use them for efficient light capture for photosynthesis in cyanobacteria and algae, and phytochromes and cyanobacteriochromes (CBCRs) use them for regulation of short-term behavior and longer term adaptive responses to light. Oxygenic photosynthetic organisms all possess the heme oxygenases and ferredoxin-dependent bilin reductases required for bilin synthesis, so expression of a phytochrome or CBCR apoprotein is sufficient to produce functional light sensors in any transformable cyanobacterial, plant or algal species. Phytochromes and CBCRs are modular proteins with conserved bilin-binding photosensory input regions that regulate protein kinase/phosphatase, nucleotidyl cyclase, chemotaxis-related, DNA-binding and other associated output domains. I will discuss insights from biochemical, spectroscopic, mutagenesis, and structural studies of these sensors as applied to design of novel optogenetic reagents for synthetic biology applications. By exploiting natural diversity, we envisage a bright future of these sensors for regulation of novel synthetic pathways in photosynthetic species by changing the quality and/or quantity of light.