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**Stereoelectronic Determinants of Color Vision: Engineering Protein Mimics of Pigmented Rhodopsins and Designing New Protein Fusion Tags**

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The field of protein engineering has undergone phenomenal growth from its inception approximately 20 years ago. A wide variety of topics have been addressed, including the construction of new protein folds, the introduction of metal binding sites that are both structural and catalytic, the development of novel enzymatic activity and the creation and optimization of new ligand binding sites. However, left behind has been the issue of protein/chromophore interactions. Protein-chromophore interactions are a central component of a wide variety of critical biological processes such as color vision and photosynthesis. To understand the fundamental elements that contribute to spectral tuning of a chromophore inside the protein cavity, we redesigned small cyctosolic human proteins to fully encapsulate all-trans-retinal and form a covalent bond as a protonated Schiff base. These systems, using rational mutagenesis, have led to restructuring of the electrostatic environment within the binding pocket of the host protein, enabling the regulation of the absorption maximum of the pigment over 200 nm. So far our work has shown that the manipulation of the electrostatic potential projected by the protein onto the chromophore has a powerful effect on the absorption properties of the ligand. We have parlayed these results towards developing new protein fusion tags and pH responsive protein dyes.