Cryptophyte algae have evolved a unique light harvesting antenna comprised of phycobiliproteins (PBP) that are basic in comparison to their distant relatives (the red alga), who create a highly ordered megacomplex called the phycobilisome [1,2]. Cryptophytes have reduced and adapted their antenna from phycobilisome components, requiring only two protein components and linear tetrapyrrole chromophores. The protein chains include a single conserved beta subunit (plastid encoded) and an adapted scaffolding protein [3] called the alpha chain (which has had gene duplications, are nuclear encoded and co-expressed). Together, two alpha and two beta subunits bind chromophores and combine to produce a small tetrameric complex to do their light harvesting work. Our research is focused on understanding how such a simple complex can carry out a similar role to that of the dominating and complicated phycobilisome. We present three new structures of cryptophyte PBPs that reveal how a mix and match strategy (whereby different alpha subunits and chromophores) can be used to achieve a range of spectral absorption properties with seemingly simple components.

Our structures show the single highly conserved cryptophyte beta subunit has a largely unchanged structure across species, however the α subunits control the structural and spectral properties of the mature cryptophyte PBP by controlling quaternary structure and by altering the structural properties of the chromophores. We previously discovered that a single amino acid insertion within the alpha chain can have a fundamental effect on the quaternary structure of these complexes-causing a switch from a closed to open state [4]. Our new data suggests that the alpha chain also dictates both the conformational differences resulting in the rotation of individual pyrrole rings within the chromophores and the chromophore environment. These alterations result in the variation of relative peak heights within the absorption spectra of the PBP with otherwise identical chromophores.

References: