Vibrational Landscape of Excitons in Photosynthetic Proteins

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In the last two decades, the observation oscillations at ultrafast timescales in photosynthetic complexes has given rise to a number of fascinating hypotheses about the origin of the extremely high quantum efficiency of the primary steps of the photosynthetic process. These hypotheses generally put forward the importance of the vibrational modes coupled with the involved electronic transitions leading to the transduction of light energy. An essential question us thus to characterize the vibrational landscape of the excited states involved. However, in most photosynthetic proteins, excitonic coupling between closely located chlorophylls leads to the formation of molecular excitons, *i.e.* electronic excited states where the wavefunction is shared by two or more molecules.

We have performed careful analyses of the vibrationial modes coupled with the electronic transitions of such states in a number of light-harvesting systems, and compared them with the mode observed for the corresponding isolated pigments. Our study yields to i) the determination of the extent of these molecular excitons, and the structure of the molecules involved, and ii) the characterization of vibrational modes only observed when pigments are bound to photosynthetic proteins. Presence of these additional modes likely opens new channels for excitation energy transfers, by vibration-assisted mixing of the excited states.