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"Carotenoids and Light-Harvesting Proteins: Ultrafast Spectroscopic Studies"

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Αίθουσα σεμιναρίων στο ισόγειο του ΕΙΕ

Abstract

Carotenoids and Light-Harvesting Proteins: Ultrafast Spectroscopic Studies

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Carotenoids are used by photosynthetic organisms for light harvesting, photoprotection and structure stabilization, functions which are largely determined by their polyene backbone (typical π-conjugation lengths: 7-13). The molecular mechanisms behind these functions are still not fully understood, especially since the theoretical understanding of carotenoid electronic structure is poor; their profoundly complex excited state dynamics, resulting from a manifold congested by "dark" states, necessitates the development of experimental tools capable of dissecting coexisting and interacting excited species.

Transient absorption (pump-probe) experiments have been successful in painting the general picture of carotenoid excited state dynamics both in solution and in light-harvesting proteins. However, even when performed with broad-band detection, interpreting the observed dynamics is often non-trivial, due to the temporal and spectral overlap of signals originating from coexisting excited states. We have expanded transient absorption by developing "multi-pulse" schemes, where by adding a third pulse, tuned and timed to selectively interact with a specific excited state population achieving its "*in*coherent control", by either promoting it to a higher state or deexciting it to the ground state. In this manner, we can drive the ensuing reactions instead of merely observe them; in a series of experiments we have demonstrated how such techniques can be applied to characterize excited state manifolds, dissect coexisting species and uncover vibrationally excited ground states.

The next step is to capitalize on our understanding of photosynthetic light-harvesting proteins and networks and develop confocal multi-excitation fluorescence microspectroscopy that will bring ultrafast temporal resolution to nano/sub-micrometer lengthscales (*i.e.* individual proteins or networks). By making use of various molecular mechanisms already characterized on bulk measurements we study the connectivity among network components, aiming to link structure to function with ultimate goal the characterization of bio-inspired molecular photonic devices (*e.g.* 4^{th} generation photovoltaics).

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