# Everything you always wanted to know about carotenoids but were too afraid to ask

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In large organic molecules, ultrafast energy transfer between two electronic states is mediated by nuclear motions.[1] Carotenoids present a biologically important case of such vibronic energy relaxation; their optical properties are defined by π-conjugated electronic states, extended along their polyene backbone.[2]While this structural motif is simple, carotenoids perform a number of functions ranging from light-harvesting in the green-blue spectral region to photoprotection by quenching (bacterio-)chlorophyll triplet states or singlet oxygen. This multifunctionality is largely based on the ultrafast and convoluted energy deactivation network of carotenoids. This makes time-resolved spectroscopy with femtosecond ($10^{-15}$ s) resolution the method of choice to study carotenoids, both in solution and as part of photosynthetic light harvesting complexes.

In this talk, I will give a short overview of the multiple roles of carotenoids as light harvesting pigments, followed by a brief introduction to time-resolved spectroscopic techniques. I will show how a rigorous treatment of vibronic coupling in a fully quantum mechanical framework explains features of transient spectra, previously associated with additional and elusive electronic states.[3]

References

[1] M. Klessinger and J. Michl, Excited States and Photochemistry of Organic Molecules, VCH Publ., New York, 1995.
[2] T. Polívka and V. Sunström, Chem. Rev., 2004, 104, 2021–2071.
[3] V. Balevičius, D. Abramavicius, T. Polívka, A. Galestian Pour, and J. Hauer, "A Unified Picture of S* in Carotenoids" The Journal of Physical Chemistry Letters 7, 3347-3352 (2016).