Physikalisches Institut

Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg

IRTG-Seminar

IRTG CoCo

Dr. Jürgen Hauer

University of Vienna

"Vibrational-Electronic Coherence in Light Harvesting"

Since 2007, so-called quantum coherences were discussed as the source behind the surprising efficiency of natural light harvesters.[1] Long-lived oscillations in time-resolved signals with picosecond dephasing times at 77 K were interpreted as electronic wavepackets between large organic chromophores. This hypothesis was central to a field of research called quantum biology. In this talk, I will summarize how the field evolved from discussing long-lived purely electronic coherences to the now commonly accepted role of vibrational-electronic (vibronic) coupling. The fruitful interplay between electronic and vibrational degrees of freedom leads to enhanced excitation energy transport and long-lasting superpositions. After outlining the experimental basics of two-dimensional electronic spectroscopy, I will report on vibronic coupling as the origin of long-lived coherences in an artificial light harvester.[2] For a natural light harvesting antenna complex (LH2), I will show how vibronic coupling doesn't only explain long-lived oscillations in time-resolved signals, I will also discuss how vibronic coupling enhances the efficiency of transfer within the complex.[3]

[1] G.S. Engel, T.R. Calhoun, E.L. Read, T.-K. Ahn, T. Mancal, Y.-C. Cheng, R.E. Blankenship, G.R. Fleming, Evidence for wavelike energy transfer through quantum coherence in photosynthetic systems, Nature, 446 (2007) 782-786.
[2] J. Lim, D. Palecek, F. Caycedo-Soler, C.N. Lincoln, J. Prior, H. von Berlepsch, S.F. Huelga, M.B. Plenio, D. Zigmantas, J. Hauer, Vibronic origin of long-lived coherence in an artificial molecular light harvester, Nat Commun, 6 (2015) 10.1038/ncomms8755.
[3] V. Perlík, J. Seibt, L.J. Cranston, R.J. Cogdell, C.N. Lincoln, J. Savolainen, F. Šanda, T. Mančal, J. Hauer, Vibronic coupling explains the ultrafast carotenoid-to-bacteriochlorophyll energy transfer in natural and artificial light harvesters, The Journal of Chemical Physics, 142 (2015) 212434

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Physics High Rise, Hermann-Herder-Str. 3