Physikalisches Institut
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Albert-Ludwigs-Universität Freiburg

QE

Quantum Efficiency Seminar und Colloquium

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On the relation of kinetic rates, vibrational coherences and quantum efficiency in ultrafast photo-isomerization reactions

Photo-isomerization reactions occur on sub-nanosecond time scales and are at the basis of a large variety of optoelectronic switching schemes, light-assisted chemical reactions, and biophysical assays. They form also the primary step in key biological processes such as bacterial photosynthesis, photo-taxis and vision. Indeed, the visual receptor protein rhodopsin, and its photosensitive chromophore retinal, display one of the fastest and most efficient photo-isomerization processes known in Nature. Reproducing the < 200 fs reaction time and >60% reaction yield is a formidable challenge for material scientists, theoretical chemists and physicists alike, as it requires a deep understanding of the ultrafast photophysics of these systems.

We will present in this talk our most recent results obtained on biomimetic molecular switches [1-3], and on a new form of retinal proteins, the Anabaena Sensory Rhodopsin. Both systems question the still wide-spread belief, based on the Landau-Zener relation, that higher kinetic rates necessarily imply an increased quantum yield.

1. "*Mechanistic Origin of the Vibrational Coherence Accompanying the Photoreaction of Biomimetic Molecular Switches*", J. Léonard, I. Schapiro, J. Briand, S. Fusi, R. Rossi Paccani, M. Olivucci, and S. Haacke, Chemistry – A European Journal, **48**, 15296–15304, (2012)
2. "*Coherent ultrafast torsional motion and isomerisation of a biomimetic dipolar photo-switch*", J. Briand, J. Réhault, O. Bräm, J. Léonard, J. Helbing, A. Cannizzo, V. Zanirato, M. Chergui, M. Olivucci and S. Haacke*, Phys. Chem. Chem. Phys.* **12,** 3178-3187 (2010).
3. ***"****An artificial molecular switch that mimics the visual pigment and completes its photocycle in picoseconds",* A. Sinicropi et al., Proc. Nat. Acad. Sci. USA**, 105,** *17642-17647 (2008)*

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