Fritz-Haber-Institut der Max-Planck-Gesellschaft

Physikalische Chemie — Direktor: Prof. Dr. Martin Wolf

MAX-PLANCK-GESELLSCHAFT

Department Seminar:

Monday, January 14, 2019, at **11:00** a.m.;
— all are invited to meet at around 10:40 for a chat and coffee —

Prof. Dr. Donatas Zigmantas Chemical Physics,
Lund University, Sweden.

Two-dimensional electronic spectroscopy: revealing excitation and dissipation dynamics from photosynthetic to plexiton systems

PC Seminar Room G2.06, Building G, Faradayweg 4 R. Ernstorfer

Abstract:

Two-dimensional electronic spectroscopy (2DES) is a comprehensive optical femtosecond spectroscopy tool for revealing correlations and tracking dynamics of the excited states and charge carriers (1). It provides two-dimensional excitation/detection energy maps of the optical transitions in the system and allows for measuring full time-dependent complex permittivity function. By resolving the excitation evolution 2DES affords for example insights into the congested spectra of natural and artificial light-harvesting systems, as well as to the pathways and properties of exciton transport and trapping.

We have applied 2DES to study multiple isolated photosynthetic systems, which allowed us to characterize and understand the light-initiated workings of the intricate chromophore-protein structures, wherein energy transfer and electron transport efficiencies approach unity (2,3). The development of the scatter resistant 2DES (4) enabled us to investigate the intact photosynthetic machinery, and in the pilot study we were able to unravel all the energy transfer pathways and efficiencies in the intact photosynthetic unit from green sulfur bacteria cells (5).

We have also investigated composite materials consisting of plasmons strongly coupled to molecular excitons (so-called plexcitons), which have garnered increased attention in the recent years as a test-bed for quantum optics as well as for creating fast light emitters (6). Our main aim is to understand the basic photophysical properties of the plexitons and to unravel de-excitation pathways by studying contributions of the different dissipative mechanisms: molecular vibrational relaxation, metal electron-electron and electron-phonon scattering, as well as lattice phonons. Our research effort helps to delineate the limits of the material applications placed by the different dissipation and dephasing channels.

1. T. Brixner et al., *Nature*, **434**, 625 (2005).
2. E. Thyrhaug et al., *Nat. Chem*., **10**, 780 (2018).
3. M. Schröter et al., *J. Phys. Chem. Lett.* **9**, 1340 (2018).
4. R. Augulis and D. Zigmantas, *Opt. Express*, **19**, 13126 (2011).
5. J. Dostal, J. Psencik and D. Zigmantas, *Nat. Chem.,* **8**, 705 (2016).
6. S. Balci et al. *ACS Photonics*, **3**, 2010 (2016).