

MO 22: Femtosecond Spectroscopy IV

Time: Thursday 14:30–15:45

Location: TOE 317

MO 22.1 Thu 14:30 TOE 317

Vibrational relaxation and decoherence of Rb₂ attached to helium nanodroplets — •BARBARA GRÜNER¹, MARTIN SCHLESINGER², WALTER T. STRUNZ², FRANK STIENKEMEIER¹, and MARCEL MUDRICH¹ — ¹Physikalisches Institut, Universität Freiburg, 79104 Freiburg, Germany — ²Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

We study the vibrational dynamics of rubidium dimers in triplet states, which are attached to superfluid helium nanodroplets. The oscillatory dynamics can be followed with high time resolution using femtosecond pump-probe spectroscopy. The slow decrease of signal contrast can be explained by decoherence due to weak coupling to the cold helium nanodroplet. Comparison with theoretical simulations reveals that the decoherence is mainly induced by energy dissipation. The molecules lose energy towards the cold bath and thereby relax stepwise down the vibrational ladder. The relaxation rate is found to be almost constant for excitation at low vibrational levels and to rise sharply when excited to higher levels. This may be related to fast heating of the helium droplet and subsequent loss of superfluidity.

MO 22.2 Thu 14:45 TOE 317

A phenomenological model for dissipation in dimers attached to helium nanodroplets — •MARTIN SCHLESINGER¹, WALTER T. STRUNZ¹, BARBARA GRÜNER², MARCEL MUDRICH², and FRANK STIENKEMEIER² — ¹Institut für Theoretische Physik, TU Dresden, 01062 Dresden — ²Physikalisches Institut, Universität Freiburg, 79104 Freiburg

Femtosecond pump-probe spectroscopy has been used to study vibrational wave packet dynamics in dimers attached to helium nanodroplets [1]. For the simulation of the dynamics, we use a well-known master equation to describe damping of vibrational wave packets [2]. This approach allows to reproduce the loss of signal contrast on the measurement timescale and to relate it to decoherence of vibrational wave packets. We find that decoherence occurs faster than dissipation. An analytical solution of the master equation allows to explain an oscillatory decay of coherences of the vibrational density matrix. Moreover, the decoherence rate can be quantified.

[1] M. Mudrich et. al., Phys. Rev. A **80**, 042512 (2009)

[2] B. Grüner et. al., arXiv:1011.0924v1

MO 22.3 Thu 15:00 TOE 317

Pump-Dump CARS: Realization of Laser Driven Molecular Logic Gates — •MEHDI MOHAMMAD KAZEMI, MAHESH NAMEBOODIRI, and ARNULF MATERNY — Center of Functional Materials and Nanomolecular Science, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany

Optically driven molecular switches are of great interest. Multi-photon interactions have been used in order to realize a logic gate. The order of the nonlinear process decides about the complexity of the component, and the pulse duration as well as molecular dynamics parameters about its response time. The possibility to use a stimulated Raman excitation (two laser pulses) with subsequent coherent anti-Stokes Ra-

man scattering (CARS, four-photon process) for the implementation of a three-bit gate (“Toffoli gate”) is discussed. There, vibrational modes of the molecules are switched on and off by the different laser pulses. By a proper combination, all possible gates (AND, OR, etc.) can be constructed. With the help of femtosecond laser pulses, an interplay of CARS probing and initial pump excitation and dump de-excitation is possible on suited molecular systems.

MO 22.4 Thu 15:15 TOE 317

Oriental dynamics of new Tröger bases with ESIPT investigated by ultrafast optically-heterodyne-detected optical Kerr effect — GUILHERME C VEBBER¹, RICARDO R.B. CORREIA², FABIANO RODEMBUSCH³, VALTER STEFANI³, MARCUS MOTZKUS¹, and •TIAGO BUCKUP¹ — ¹Physikalisch-Chemisches Institut, Ruprecht-Karls-Universität Heidelberg, D-69120 Heidelberg, Germany. — ²Instituto de Física, UFRGS, 91501-970, Brazil. — ³Instituto de Química, UFRGS, 91501-970, Brazil.

Tröger bases (TB) are well known molecules with broad application as artificial receptor systems. Due to its intrinsic chirality, several derivatives have been used as chiral solvent agents, particularly as specific receptors of DNA and amino acids. In spite of its potential in a wide range of applications, little is known about the intermolecular interactions of TB in solution. In this regard, we investigate the ultrafast orientation dynamics of a new TB derivative [1] capable of excited-state intramolecular proton transfer (ESIPT), which is very sensitive with the interaction with the environment. Optically-heterodyne-detected optical Kerr effect (OHD-OKE) with sub-40fs resolution is applied to Tröger bases composed of 2-(4-amino-2-hydroxyphenyl)benzazoles dissolved in chloroform. Particularly, the dependence of orientation diffusion and specific molecular interactions on the concentration of the TB is investigated for two derivatives. [1] Abella, C.A.M. et. al. Tetrahedron Letters 45 (2004) 5601.

MO 22.5 Thu 15:30 TOE 317

Dynamics of Organic Molecules on Inorganic Interfaces — •KHADGA JUNG KARKI, DANILO ROCCATANO, and ARNULF MATERNY — Center of Functional Materials and Nanomolecular Science, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany

Interfaces are important in various chemical and physical processes. Understanding the interactions on the surfaces is very important in the anticipated use of the hybrid materials. Apart from the static properties of the interfaces, the investigation of the dynamics of the organic molecules on the inorganic surfaces gives information about how the dynamics are affected by the interfaces. Results from such studies can be used to optimize the geometry/organization of the systems for better performance. In our work, we employ calculations, mainly molecular dynamics (MD) simulations, and time-resolved spectroscopy to investigate the hybrid systems. The organization of organic molecules like Chlorophylls and Carotenoids on silica surfaces, and their interaction energies are calculated from the MD simulations. The ultrafast dynamics of the molecules on the inorganic interfaces are investigated using femtosecond time-resolved spectroscopy. The results from experiments and calculations are presented.