Intense Laser-Matter Interaction and Pulse Propagation

Workshop & Seminar
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The aim of the seminar and workshop was to bring together the currently best experts and promising young scientists on the fields of interaction of intense ultrashort laser pulses with atoms, molecules and clusters and the propagation of high peak power pulses in optical media. Among the more than 100 participants from 23 countries there was a balance between established and young scientists, researchers from experiment and theory, physicists and chemists. A main focus was to give the graduate students and post docs an overview of the theoretical approaches, computational methods and experiments, which have been carried out and are under investigation, as well as of the challenges for the future.

During the seminar leading scientists gave an introduction to the basic phenomena and the current trends in series of lectures (two 90 min lectures, each morning from Monday to Friday). The focus of the first week was on theoretical and computational methods of photo induced dynamics in strong laser fields (F.H.M. Faisal, N. Moiseyev, U. Peskin) and the formation of laser filaments in optical media (J. Moloney). In the second week different aspects of the response of molecules to a strong field were introduced and discussed (W. Hill III, H. Kono, D. Tannor). The seminar was completed with a focus on the generation and application of attosecond pulses (P. Agostini) and an introduction to relativistic optics (R. Sauerbrey). Interaction between the graduate students and post docs with the experts were inspired by joint work on computer projects, a discussion on open problems (named by the lecturers), short talks by the participants as well as social activities in the afternoons and evenings.

The international workshop focused on the most last achievements, among them were

High harmonics and attosecond science and technology. The generation of intense radiation from high harmonics and its application to generate pulses in the sub-femtosecond regime is currently one of the most vividly discussed topic in the field. The measurement of a two-photon two-electron ionisation with high harmonics in the soft X-ray regime was presented. Different aspects of the observation of attosecond electron dynamics with and without attosecond laser pulses were discussed.

Molecules and clusters in intense fields. A wide spectrum of theoretical approaches, ranging from numerical simulation techniques to the combination of wave packet approaches with S-matrix methods, to investigate phenomena in complex targets, such as molecules and clusters, were discussed. These talks were complemented by the presentation of experimental observations of the ionisation and Coulomb explosion of small diatomic molecules, the dynamics of atoms in the rearrangement of molecular ions and the dissociation of large molecules and clusters.

Coherent Control. It was shown how experimental techniques to shape a laser pulse in intensity, phase and polarisation allow to coherently control the response of a molecule to an optical field. While the control mechanisms in the non-perturbative intensity regime are

still widely unknown, impressive theoretical progress in understanding the optimisation of processes at low intensities were presented.

Femtosecond interaction and propagation. Several reports showed the current joint efforts of experiment and theory towards an understanding and control of the formation of laser filaments. The importance of these studies became obvious from presentations on the perspectives how to use femtosecond plasma channels for atmospheric research.

Relativistic super-intense optics and applications. An overview of the generation of highest laser intensities and the possible applications for laser induced particle acceleration was given.

Young scientists presented their results in more than 70 posters during two poster sessions, which were times of vivid discussions among the participants of the workshop.

A special event of the workshop was a panel discussion on the filamentation of femtosecond laser pulses in optical media. During one afternoon the leading experts openly discussed the current understanding of the physics as well as the challenges and open problems towards an application of this interesting phenomenon. According to the reaction of the panel members it was one of the few opportunities where people did freely exchange their points of view on the same field of interest.

R. Sauerbrey gave a public evening lecture on *Die Kraft des Lichts. Physik mit Hochintensitätslaser*, which was well attended by approx. 150 guests. A vivid discussion between the guests and the speaker at the end of the lecture as well as over snacks and wine in the lobby concluded the evening.

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