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CUI THE HAMBURG CENTRE FOR ULTRAFAST IMAGING

NEWSLETTER

CUI – Graduate School

No.16, December 2017

Main topics

Editorial

One year is left to the end of the CUI adventure and we very much look forward to continue with the newly proposed excellence cluster AIM. Indeed, the review panel has very well received our pre-proposal and with the full one we aim to further demonstrate the strength of our cluster concept. We can be very proud to contribute to Hamburg's excellence research environment, as proven by the success obtained by the four invited cluster proposals from our university.

We wish you a Merry Christmas and a Happy New Year!

Antonio Negretti and Peter Schmelcher

The Hamburg Prize for Theoretical Physics 2017

On November 9 the Joachim Herz Foundation jointly with CUI awarded Prof. Andrew Millis (Columbia University, New York, USA) the Hamburg Prize for Theoretical Physics.

Prof. Millis made outstanding contributions to the field of condensed matter physics, particularly on the theory of strongly correlated electrons in solids and nanostructures. His interests include quantum critical phenomena, superconductivity, non-equilibrium dynamics of interacting electrons, and the theory of oxide superlattices and optical conductivity. All this shows how strongly his research interests are connected to the CUI activities. Hence, we very much look forward to his extensive visits in Hamburg, as his expertise will be extremely valuable for several CUI research groups ranging from quantum material design to ultracold matter.

Graduate Days

The next Graduate Days (GDs) of CUI will take place on March 19-22, 2018.

The scientific programme offers a very rich selection of topics: Optimal control of molecular processes, topological quantum matter, functional biomaterials, antimicrobial peptides, water, and assembled nanoparticles. Additionally, two practical and three soft-skills workshops will be organized.

As usual there will be two talks in the later afternoons: The colloquium by Prof. Hendrik Dietz (Technische Universität München, Germany), who will discuss how to engineer molecular systems with DNA, and the industry event by Dr. Alina Chanaewa (Skytree, Amsterdam, Holland), who is a former PhD student of Prof. Horst Weller and will describe her working experience in a spinoff of the European Space Agency, which develops CO_2 capture technologies for everyday life.

For further information on the GDs, please visit the CUI website.

Winter school

The fifth winter school organized by our PhD students will take place from February 26 to March 2, 2018, in the Karpacz, namely in the polish mountains. There will be three general and introductory courses, one for each research area of CUI, by invited speakers from different places in Europe. Specifically, there will be a course on multi-photon interferences and high-order photo correlations, a course on the physical chemistry of mesoscopic crystalline assemblies of colloidal nanocrystals, and a course on approaches to data analysis of X-yay scattering processes as well as modelling of biological structures. In addition to these lectures, all participating PhD students will give a short presentation on their own research project. Moreover, two discussion meetings are scheduled with the aim of stimulating the information exchange and to figure out new scientific paths and bridges between the different backgrounds within CUI. Finally, a social science talk is also planned, where the highly timely topic on the connection between natural science and armament and warfare will be discussed.

Personalia

Dr. Kai Bagschik, Dr. Bernhard Ruff, and Dr. Johannes Schurer have recently received the doctoral degree in Physics. Dr. Bagschik conducted a thesis on coherent soft X-ray magnetic scattering and spatial coherence determination, where he investigated on the one hand magnetic maze domain patterns of a wedge-shaped Co/Pd multilayer film and on the other hand the spatial coherence properties of synchrotron radiation using a newly developed method. Dr. Ruff has studied the interactions of ultrashort laser pulses with ultracold atomic clouds of rubidium, where he observed suppression of strong field effects in photoionization as well as atomic momentum transfer as a consequence of the optical dipole force exerted by the light pulses. Finally, Dr. Schurer investigated static as well as dynamical properties of an ion impurity immersed in an ensemble of ultracold bosonic atoms by means of ab-initio numerical many-body simulations, where, for instance, he elucidated the many-body nature of collinear mesoscopic molecular ions.

Prof. Henry Chapman has been named honorary doctor at the Faculty of Science and Technology at Uppsala University in Sweden for his innovative experiments, where the structure of complex biological molecules has been solved with ultrashort and extremely intensive X-ray pulses from the free-electron laser.
Prof. R. J. Dwayne Miller has received an honorary doctorate from the University of Waterloo in Canada for his achievements in developing a camera to observe atoms in motion during structural changes based on the novel concept of "ultrabright" electrons.
Prof. Andrea Cavalleri has been awarded the Frank Isakson Prize for optical effects in solids by the American Physical Society, particularly for pioneering contributions to the development and application of ultrafast optical spectroscopy to condensed-matter systems. Moreover, he has been elected member of the Academia Europaea, i.e. a non-governmental body promoting research and scholarship across Europe.

We congratulate all of the awardees!


Henry Chapman


Dwayne Miller


Andrea Cavalleri


Kai Bagschik


Bernhard Ruff


Johannes Schurer

Research highlights

Light can drive collective electron vibrations, i.e. plasmons, in gold nanoparticles. The plasmon dephasing generates a hot electron distribution in the gold nanoparticles. Those are considered to be useful in a broad spectrum of applications like catalysis, solar energy conversion or thermal cancer therapy. Recent theoretical works discussed the generation of the hot electron mechanism controversially.
The group of Prof. Holger Lange has addressed this topic and was able to contribute valuable experimental insight. Lange's group has a strong connection between chemistry and physics, which leads to short ways for in-group collaboration like in this work. The CUI PhD student Emanuele Minutella performed monochromatic pump white light probe transient absorption spectroscopy on gold nanoparticles synthesized by Dr. Florian Schulz. Due to the fact that light has a negligible momentum in comparison to electrons in a crystal, there are two possible sources, namely surface scattering or the plasmon itself to mediate an intra-band transition. The results support the solely plasmonic hot electron generation due to the absence of a size dependency. They also investigated the influence of the excitation wavelength, which is shown in Fig. 1, by performing experiments with different pump wavelengths covering the complete visible spectrum. The researchers observed two clear distinguishable regimes separated at 550 nm. Wavelengths shorter than this threshold lead to a 'hotter' electron distribution, which results in longer decay times. This is the first experimental proof that inter-band transitions more effectively generate hot electrons than the intra-band plasmon decay.
The work has been published in *J. Phys. Chem. Lett.* **8**, 4925 (2017).

You are welcome to: ... send us suggestions of topics, which you would like to be mentioned in the next newsletter (anegrett@physnet.uni-hamburg.de).

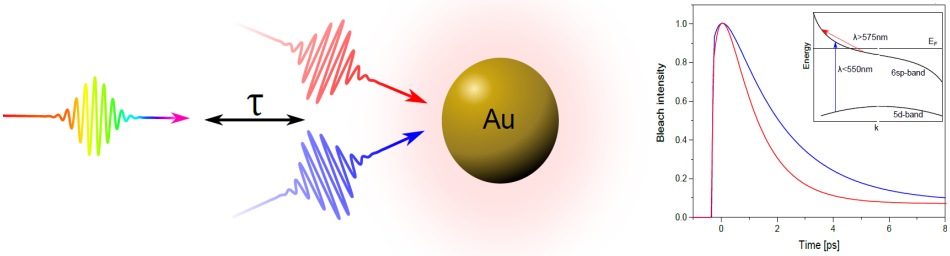

Fig. 1: On the left it is shown schematically the excitation process of a gold nanoparticle with different monochromatic light with a subsequent white light-probe. On the right the corresponding decay curves are shown. Pumping with light with wavelengths shorter than 550 nm (blue) leads to a slow decay because of the possibility of an inter-band transition (shown in the inset) and a resulting higher electronic temperature than pumping with longer wavelengths (red), where only intra-band transitions can occur.