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THE HAMBURG CENTRE FOR ULTRAFAST IMAGING

NEWSLETTER

CUI – Graduate School

No.5, April 2014

Main topics

Editorial

The New Year for the Graduate School of CUI started with new events held for the first time: the Graduate Days of CUI and the science slam. They turned out to be a great success in terms of organization, participation, and quality of the lectures.
The summer term 2014 offers once again a rich course programme and within our CUI colloquium we are going to have very high-profile speakers, in particular, the 1997 Nobel Prize winner Prof. William D. Phillips.
We are very proud of the fact that several CUI members received prestigious awards and that there were a substantial number of publications with major scientific results in very high-profile journals.

Antonio Negretti and Peter Schmelcher

The Graduate Days

From March 10 to March 12, 2014, our first Graduate Days (GDs) took place, an event devoted to the education and training of Master and PhD students as well as post-docs. The goal of the GDs is to provide courses that broaden the physics, chemistry, and biology knowledge of the students and that teach specialized techniques as well. In this way a common scientific language among the research groups of CUI can be formed, which is particularly relevant for the CUI PhD students.

At the GDs, 73 applicants registered via the online application form, half of them being not CUI members.

The course programme has been split into three parallel sessions. In the morning we had three courses, one for each CUI research area, on the following topics:

- Superconductivity in mesoscopic systems (Dr. Dolcini, Politecnico di Torino);
- Molecular spectroscopy (Prof. Merkt, ETH Zurich);
- Nanoparticles: From nucleation and growth to application and materials and life of science (Prof. Weller, UHH).

In the afternoon session the following courses took place:

- Ultracold physics in low dimensions (Dr. Mark, Universität Innsbruck);
- Gas phase molecules and FELs (Dr. Rolles, DESY);
- Modern methods in X-ray physics (Dr. Sprung and Dr. Müller, DESY).

In addition to these lectures, Prof. Lyons (Oxford, UK) held a course on *Practical statistics*. Besides, two soft skill courses have been proposed: *Presentation skills*, and *Scientific writing and writing for funds*.

In the evening of Monday March 10, Mr. Behling of the Philips Medical Systems of Hamburg gave a presentation about the company. Besides, he illustrated the job opportunities within the company and the difference between the academic and the industrial way of doing research.

Finally, on Tuesday March 11, after the special colloquium of Prof. Miller, the first ever science slam of CUI took place. Three teams per research area had been previously formed. The leaders of the teams were: Prof. Kärtner (area A), Dr. Perbandt (area B), and Prof. Röhlsberger (area C). The groups had to answer to questions formulated during Miller's talk and randomly selected by the vice-dean of the MIN faculty Prof. Meier, who chaired the evening. The teams demonstrated their capability and creativity in responding to different questions. It turned out to be an entertaining event for all participants.

Course programme

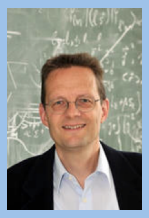
The summer term has just started and consequently the course programme has been prepared. As usual, seminars and lectures have been selected on the bases of the interdisciplinary research carried

Personalia

The CUI postdoc Dr. Xiaojun Wu within the group of Prof. Kärtner has received the Alexander von Humboldt fellowship. She is working on high-field THz generation and its application in electron acceleration and in the development of compact X-ray sources.
Prof. Andreas Hemmerich (Institut für Laserphysik) and Prof. Peter Schmelcher (Zentrum für Optische Quantentechnologien) have been appointed as "outstanding referee" by the American Physical Society (APS). APS honours only the best experts, who excel through the quality of their assessment, their objectivity, and their rapid handling.
We congratulate all of them on such outstanding awards!


Xiaojun Wu


Andreas Hemmerich


Peter Schmelcher

out within our cluster.
The main lecture of this term is *Light-Matter interactions: Atoms, molecules and (non) linear optics*, given by Prof. Bressler and Prof. Wurth.
The detailed programme can be downloaded at the CUI webpage.

Colloquia

During the summer term we are going to host again very high-profile speakers for our CUI colloquium. In particular, we will have the 1997 Nobel Prize winner Prof. Phillips.
The invited speakers are:

- Prof. Wiseman (McGill University, Canada)
  Thursday April 10, 2014.
  New frontiers in fluorescence fluctuation image analysis on cells and neurons
- Prof. Phillips (University of Maryland, USA)
  Thursday May 8, 2014.
  At the crossroads of atomic and solid-state physics: ultracold atoms as a new condensed matter system
- Prof. Tokmakoff (University of Chicago, USA)
  Thursday June 19, 2014.
  2D IR spectroscopy of tautomerism in DNA with applications to an anti-HIV drug

Further information concerning hosts, time, and location can be found at the CUI webpage.

Research highlights

The CUI PhD student P. Mishra in collaboration with the CUI researchers Dr. Vendrell and Prof. Santra has made a theoretical proposal to boil water in a time shorter than 1 ps with sub-picosecond high-intensity THz pulses.
The idea behind the scheme is to change the interaction strength between the molecules of water with a THz pulse. In this way a violent vibration of the molecules is induced such that many of them participate at the desired chemical process at the same time.
The scientists have calculated the interaction of the THz-flash with bulk water. The simulations have been carried out at the Supercomputer Center Jülich and used a total of $2 \cdot 10^5$ hours of processor time by massive parallel computing.
The novel approach opens interesting new paths for experiments dealing with heated samples of chemical or biological relevance.

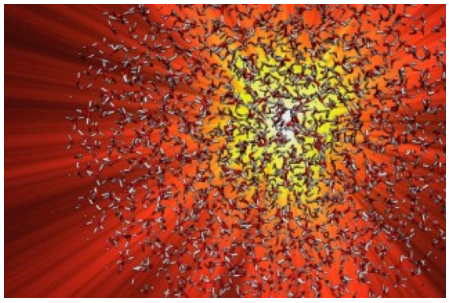


Fig. 1: A single THz-flash can heat up water to 600 degrees Celsius.

Ref: Angew. Chem. Int. Ed. 52, 13685 (2013).

A team of researchers of the Centre for Optical Quantum Technologies of UHH, L. Cao and P. Schmelcher, and of the Nanjing University, has discovered a way to create the analogue of an optical frequency comb (FC) for vibrations in solid matter including crystals.
The mechanism, which provides phononic FCs, uses non-linear resonances as a key ingredient. Frequency combs normally refer to the generation of a series of equidistant spectral lines via cascade excitations of the eigenmodes of the system. In the generating process of the new type of FCs, however, only 2-3 eigenmodes can be excited. Comparing to traditional FCs, this new FC can be viewed as a hyperfine comb structure around certain selected eigenmodes.
This method can rise to new applications in high-accuracy frequency measurements and entanglement production.
Ref: PRL 112, 075505 (2014).

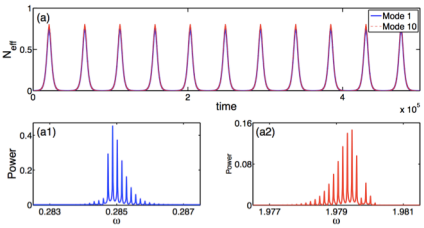


Fig. 2: The hyperfine phononic frequency comb, with the spatial and the temporal fingerprint shown in the panels (a) and (a1)-(a2), respectively.

New professor at CUI

We warmly welcome Dr. A. Pearson of the University of Leeds (UK), who accepted the CUI professorship at the UHH in biophysics. She will officially begin with her research activity next May.
We wish her a very good start and successful work at CUI.

Important dates in 2014

We remind you that in November 12-14 the next CUI international workshop in conjunction with the Hamburg Prize for Theoretical Physics will take place. Please, mark the date in your agenda!