Q 53: Ultrashort laser pulses III

Time: Thursday 16:30–18:30 Location: DO26 207

Q 53.1 Thu 16:30 DO26 207

Carrier-envelope phase stability of differentially-pumped hollow-fibres used for few-cycle pulse generation — William Okell[1], Davide Fabris[1], Dane Austin[1], Maiman Bocoum[2], Aurelien Ricci[2], Aurelie Jullien[2], Daniel Walke[1], Jon P. Marangos[1], Rodrigo Lopez-Martens[2], •Tobias Witting[1], and John W.G. Tisch[1] — [1]Blackett Laboratory, Imperial College London SW7 2AZ, UK — [2]Laboratoire d'Optique Appliquée, Ecole Nationale Supérieure de Techniques Avancées-ParisTech, Ecole Polytechnique-CNRS, 91761 Palaiseau Cedex, France

We have examined the energy scaling of a hollow-fibre pulse compression system using a 260μm inner-diameter, 1m long hollow fiber filled with neon. Three common configurations have been investigated: static-fill with linear polarisation (SFLP), differentially-pumped with linear polarisation (DPLP), and static-fill with circular polarisation (SFCP). Using either DPLP or SFCP boosts the maximum output energy from 0.6mJ to 0.8mJ. Ionisation decreases the CEP stability, but this effect is saturated at 1.25mJ by ionisation-induced energy losses inside the fibre. For our experimental parameters, DPLP has similar CEP stability to SFLP. We have generated 0.4mJ, 3.5fs pulses with a CEP stability of 200mrad over >2h using a differentially pumped fibre. Our experimental findings are backed up by a coupled-mode, split-step model, incorporating modal dispersion and loss, the Kerr effect including self-steepening, and ionization.

Q 53.2 Thu 16:45 DO26 207

Determining the optical response of a nanostructure using carrier-envelope-phase-dependent photoemission — •Michael Krüger[1,2], Dominik Hoff[3], Georg Wachter[4], Lothar Maisenbacher[1,2], Michael Förster[1,2], Sebastian Thomas[1,2], Christoph Lemell[4], Joachim Burgdörfer[4], A. Max Sayler[3], Gerhard G. Paulus[3], and Peter Hommelhoff[1,2] — [1]University Erlangen-Nuremberg, D-91058 Erlangen — [2]Max Planck Institute of Quantum Optics, D-85748 Garching bei München — [3]Institute for Optics and Quantum Elektronics and Helmholtz Institute Jena, D-07743 Jena — [4]Vienna University of Technology, A-1040 Vienna, Austria

The carrier-envelope phase (CEP) dependence of strong-field photoemission is a powerful tool to understand electron dynamics on ångström and attosecond scales. Photoemission from metal nanotips has also been shown to be highly sensitive to the CEP [1]. The solid-state material response leads to a strongly enhanced optical near-field that is phase-shifted with respect to the incident field. Here we present a direct comparison of the CEP dependence of photoemission from atomic xenon and a metal nanotip employing a phase-tagging scheme [2]. We are able to measure the phase shift and hence the full dielectric response of different nanotips, which is of high interest in the field of nano-optics and plasmonics.

[1] M. Krüger, M. Schenk, P. Hommelhoff, *Nature* **475**, 78 (2011).
[2] N. G. Johnson et al., *Phys. Rev. A* **83**, 013412 (2011).

Q 53.3 Thu 17:00 DO26 207

Laserpuls- und Elektronenbunchprofilmessungen am S-DALINAC — •Markus Wagner, Joachim Enders, Martin Espig, Yuliya Fritzsche und Andreas Kaiser — Institut für Kernphysik, TU-Darmstadt

An der Quelle polarisierter Elektronen am supraleitenden Darmstädter Elektronen-Linearbeschleuniger S-DALINAC ist es möglich, ähnlich zu einer Streak-Kamera Profile von Laserpulsen durch Messung der Elektronenbunche aufzunehmen. Dazu wird in einem GaAs-Halbleiter zunächst der optische Puls in einen Elektronenbunch umgewandelt und dieser anschließend mittels Hochfrequenzfelder über eine Blende abgelenkt. Wir zeigen in diesen Experimenten die derzeit erreichte Auflösung dieser Pulslängenmessung und geben Auskunft über zeitliche spininduzierte Prozesse, welche innerhalb des Halbleiters während dieser Zeit stattfinden.

Gefördert durch die DFG im Rahmen des SFB 634 durch das Land Hessen im LOEWE-Zentrum HIC for FAIR.

Q 53.4 Thu 17:15 DO26 207

Michelson-type all-reflective interferometric autocorrelation in the VUV regime — •Thomas Gebert, Dimitrios Rompotis, Fawad Karimi, Armin Azima, Marek Wieland, and Markus Drescher — Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, D-22761 Hamburg, Germany

We demonstrate second-order interferometric autocorrelation of a pulse in the vacuum-ultraviolet (VUV) spectral range using an optical arrangement equivalent to a Michelson interferometer. In an all-reflective design, wavefront splitting is realized with two moveable interdigitated reflective gratings. This arrangement is used to demonstrate interferometric autocorrelation in krypton with femtosecond VUV pulses at 160 nm wavelength. In addition to the pulse duration, which is already accessible with non-collinear intensity autocorrelation, the full interferometric contrast of the presented approach enables us to extract also information on temporal phases.

Q 53.5 Thu 17:30 DO26 207

Finite-Elemente-Simulation laserinduzierter periodischer Oberflächenstrukturen in Silizium — •Madlen Klötzer, Karsten König und Martin Straub — Universität des Saarlandes, Lehrstuhl für Biophotonik und Lasertechnologie, Fakultät für Physik und Mechatronik, Campus Am Markt, Zeile 5, D-66125 Saarbrücken

Laserinduzierte periodische Oberflächenstrukturen konnten in den vergangenen Jahren in einer großen Anzahl an Dielektrika beobachtet werden. Auf Si(100)-Oberflächen wurden Strukturen mit einer Periodizität von 130 nm mittels sub-15 fs Lasermikroskop erzeugt [1,2]. Die Entstehung dieser Ripple-Strukturen kann durch die Anregung eines Elektron-Loch-Plasmas über die kritische Ladungsträgerkonzentration erklärt werden, welches zur Anregung von Oberflächenplasmonen führt [1]. Es wurden dazu Simulationsrechnungen in Silizium mit der Finite-Elemente-Methode durchgeführt, bei denen sowohl Ein- und Zwei-Photonenabsorption, Absorption freier Ladungsträger sowie Ladungsträgerdiffusions- und Rekombinationsprozesse berücksichtigt wurden. Dabei konnten nicht nur laserinduzierte periodische Oberflächenstrukturen mit einer Periode in Übereinstimmung mit den Experimenten beobachtet werden, sondern auch Selbstfokussierungseffekte im Material, welche durch eine hohe ortsabhängige Ladungsträgergeneration und somit ortsabhängige Veränderung des Brechungsindexes im Material verursacht werden.

[1] M. Straub et al., Opt. Lett. 37, 190-192 (2012) und J. Appl. Phys. 111, 124315 (2012) [2] K. König et al., J. Laser Appl. 24, 042009 (2012). Gefördert durch Schwerpunktprogramm 1327 der DFG.

Q 53.6 Thu 17:45 DO26 207

Second order QED tree-level processes in pulsed plane wave fields — •Felix Mackenroth and Antonino Di Piazza — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

Second order tree-level processes in dressed state QED can occur with either an off-shell ($p^2 \neq m^2$) or on-shell particle connecting the two vertices. We show for the study of an intermediate electron propagator that by dropping the usual assumption of a monochromatic scattering laser field, the laser dressed propagator naturally splits up into an on- and off-shell part and is finite without the need for ad-hoc regularization [1]. We relate this study of two-photon emission to a recently proposed quantum picture of radiation reaction in the so-called ultra-relativistic, moderately quantum regime interpreting it as the incoherent emission of several photons [2]. We corroborate this latter picture by identifying quantum radiation patterns typical of radiation reaction. Finally we comment on the possibility of treating processes involving a photon instead of an electron propagator.

[1] D. Seipt, B. Kämpfer, Phys. Rev. D **85**, 101701 (2012), F. Mackenroth, A. Di Piazza, Phys. Rev. Lett. **110**, 070402 (2013).
[2] A. Di Piazza, K. Z. Hatsagortsyan and C. H. Keitel, Phys. Rev. Lett. **105**, 220403 (2010).

Q 53.7 Thu 18:00 DO26 207

On-line arrival time monitor/measurement for pump-probe experiments at FLASH — •Sven Stephan[1,2], Marie-Kristin Czwalinna[1], Stefan Düsterer[1], Leonie Flückinger[3], Rosen Ivanov[1], Bruno Langbehn[3], Jan-Philippe Müller[3], Maria Müller[3], Harald Redlin[1], Daniela Rupp[3], Mario Sauppe[3], Sebastian Schulz[1], Anatoli Ulmers[3], Thomas Möller[3], Ulrich Teubner[2,4], and Sven Toleikis[1] — [1]Deutsches Elektronen-

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A limiting factor of ultrafast studies employing pump-probe techniques at free-electron lasers is the inherent jitter between optical laser and FEL pulses. Therefore, the determination of the arrival time between the two laser pulses (optical and FEL) is of utmost importance for improving the time resolution in a pump-probe experiment. We present an online diagnostic tool which allows to determine the arrival time between the two laser pulses for each shot, hereby measuring the jitter after acquiring a sufficient number of shots. This tool is based on time-resolved optical probing of the transient transmission change in a transparent, non-metal solid due to the absorption of the FEL photons.

Q 53.8 Thu 18:15 DO26 207

Transverse mode conversion of ultrashort pulses in optical fibers using optically induced long-period gratings — •Martin Schnack, Tim Hellwig, and Carsten Fallnich — Institute of Applied Physics, Westfälische Wilhelms-Universität Münster, Corrensstr. 2, 48149 Münster

We present our latest advances in numerical studies and experimental results on transverse mode conversion of femtosecond laser pulses in optical fibers using optically induced long-period fiber gratings.

The gratings are transiently generated by a high-power write beam, that excites a combination of transverse modes. By exploiting the Kerr-effect the spatial intensity pattern emerging from multi-mode interference is translated into a spatial refractive index modulation. A co-propagating, cross-polarized probe beam is converted from one to another transverse mode, if the grating period is suitable. We show first experimental results in a step-index fiber and discuss the limitations of distinguishing probe and write beam by polarization.

Furthermore, numerical studies employing graded-index fibers are presented. They allow utilizing write and probe pulses at different wavelengths and overcome current bandwidth limitations, making broadband mode conversion possible. In our numerical studies we demonstrate the optical switching capabilities based on this technique, providing a high modulation between the on and off state.