Q 14: Ultrakurze Laserpulse: Erzeugung 1

Time: Monday 14:30–16:00 Location: SCH 251

Q 14.1 Mon 14:30 SCH 251

Ultrakurze 120 μJ Laserpulse durch kohärentes Kombinieren zweier Faserverstärker — •Sven Breitkopf[1], Enrico Seise[1,3], Arno Klenke[1], Marco Plötner[2], Jens Limpert[1,2,3] und Andreas Tünnermann[1,2,3] — [1]Institut für Angewandte Physik, Friedrich Schiller Universität Jena, Albert-Einstein-Str. 15, 07745 Jena — [2]Fraunhofer Institut für Angewandte Optik und Feinmechanik, Albert-Einstein-Str. 7, 07745 Jena — [3]Helmholtz-Institut Jena, Max-Wien-Platz 1, 07743 Jena

Das Konzept des kohärenten Kombinierens ultrakurzer Laserpulse eröffnet neue Möglichkeiten der Leistungsskalierung von Lasersystemen, über die Grenzen des verwendeten Verstärkerkonzepts hinaus. Dabei wird ein Strahl zunächst in N Kanäle aufgeteilt, um diese nach anschließender Verstärkung wieder kohärent zu kombinieren. Das Prinzip ist universell und völlig unabhängig vom verwendeten Verstärkertyp nutzbar.

In einem Experiment mit zwei Kanälen wurde das Konzept umgesetzt. Die Strahlaufspaltung in dem aktiv stabilisierten Mach-Zehnder-Interferometer, wurde durch polarisationsabhängige Strahlteiler umgesetzt. Nach der Verstärkung in Yb-dotierten Fasern erfolgte die Rekombination. So wurden 120 μJ-Pulse mit einer Pulsdauer von 800 fs erzeugt, wohingegen die Kanäle einzeln komprimiert lediglich 66 μJ Pulsenergie lieferten. Die Kombinationseffizienz betrug somit 91 %.

Es werden die grundlegende Theorie, sowie experimentelle Herausforderungen und Messergebnisse des kohärenten Kombinierens ultrakurzer Pulse präsentiert.

Q 14.2 Mon 14:45 SCH 251

Development of a laser-based XUV source on the μJ level — •Wolfram Helml[1], Gilad Marcus[1], Laszlo Veisz[1], Reinhard Kienberger[2], and Ferenc Krausz[1,3] — [1]Max-Planck-Institut f. Quantenoptik, Hans-Kopfermann-Str. 1, 85748 Garching, Deutschland — [2]TU München, James-Franck-Str. 1, 85748 Garching, Deutschland — [3]Ludwig-Maximilians-Universität München, 85748 Garching, Deutschland

High-harmonic generation has over the last decade been established as the method of choice to produce coherent XUV radiation with sub-femtosecond duration. One of the main issues that hinders the applicability of this technique to a large number of experiments, including for instance highly anticipated XUV pump - XUV probe measurements, is the relatively low efficiency of the process and subsequent low flux of the generated XUV photons.

We have built up an HHG beamline, based on a high-energy (100 mJ), ultrashort ($\sim$ 8 fs) OPCPA system and a very long focal-length geometry, that allows us to fully exploit the power of the IR laser. We measured the resulting XUV intensity with a Zr-coated photo diode and demonstrate a flux of 10^{10} photons at an energy of 100 eV, corresponding to $\sim 2.24 \times 10^{-4}$ mJ per pulse. First tests with a multiple-nozzle quasi-phase-matching scheme to further enhance the yield have been conducted and show very promising results to increase the XUV intensity above the μJ level.

Q 14.3 Mon 15:00 SCH 251

High-Harmonic Generation source for seeding FLASH — •M. Mittenzwey[1], A. Azima[1], J. Boedewadt[1], F. Curbis[1], H. Delsim-Hashemi[1], M. Drescher[1], U. Hipp[1], T. Maltezopoulos[1], V. Miltchev[1], M. Rehders[1], J. Roensch-Schulenburg[1], J. Rossbach[1], R. Tarkeshian[1], M. Wieland[1], S. Bajt[2], S. Duesterer[2], J. Feldhaus[2], T. Laarmann[2], H. Schlarb[2], S. Khan[3], and R. Ischebeck[4] — [1]University of Hamburg — [2]DESY, Hamburg — [3]DELTA, Dortmund — [4]PSI, Villigen, Switzerland

The Free electron LASer in Hamburg (FLASH) is currently operated in the self-amplified spontaneous emission mode (SASE), producing photons in the XUV range. Due to the statistical nature of SASE the radiation shows intensity and spectral pulse-to-pulse fluctuations. Moreover, the electron acceleration process introduces arrival time fluctuations of the electron bunch at the undulator entrance, which leads to a temporal jitter of the XUV pulses. In order to reduce these fluctuations a seeding scheme for the electron bunch can be used. To this end, XUV seed pulses from a High-Harmonic Generation (HHG) source will be overlapped in space and time with the electron bunches. In this case the amplification process takes place within the seed pulse length leading to a radiation without temporal jitter, lower intensity- and spectral fluctuations, and full control over the pulse length. In this contribution the general design and first results of the seeding experiment at FLASH will be presented. In particular the HHG source will be explained in detail. This work is supported by the Federal Ministry of Education and Research under contract 05 ES7GU1.

Q 14.4 Mon 15:15 SCH 251

Prepulse suppression in a Multi-10-TW diode-pumped Yb:Glass laser — •Sebastian Keppler[1], Ragnar Bödefeld[1,2], Marco Hornung[1,2], Alexander Sävert[1], Joachim Hein[1], and Malte Christoph Kaluza[1,2] — [1]Institute of Optics and Quantum Electronics, FSU Jena — [2]Helmholtz-Institut Jena

High energy short-pulse laser systems often consist of an oscillator and a certain number of regenerative amplifiers. The repetition rate of such laser systems is some orders of magnitude lower than the repetition rate of the oscillator. Pulse picking systems employing the technique of polarization gating are widely used for this purpose.

Due to the limited extinction ratio of the polarizers and the remaining birefringence of the PC, the polarization contrast of a pulse picker could practically not be increased beyond a certain value. A small part of the pulse train ($\sim 10^{-3}$) will leak into the subsequent regenerative amplifier cavity.

By synchronizing the round trip times, this prepulse could be shifted in time underneath the intensity pedestal of the main pulse. At the time the postpulse arrives at the injection TFP of the second amplifier, the main pulse is also there. Hence, the latter could be hidden in the pedestal of the main pulse.

Q 14.5 Mon 15:30 SCH 251

Compact 7.4 W femtosecond oscillator for white-light generation and nonlinear microscopy — •Andy Steinmann, Bernd Metzger, Robin Hegenbarth, and Harald Giessen — 4th Physics Institute and Research Center SCOPE, University of Stuttgart

Compact femtosecond laser oscillators with high average powers and MHz repetition rates are essential laser sources for a lot of applications in science. In this contribution we present a passively mode-locked two-crystal Yb:KGW oscillator delivering 7.4 W average power at a repetition rate of 41.7 MHz and 425 fs pulse duration.

With this simple, reliable, and cost efficient laser source we demonstrate nonlinear experiments such as the generation of high-power white-light pulses in tapered fibers or pumping of an optical parametric oscillator, which generates a signal power up to 2 W with femtosecond pulses tunable in a wavelength range from 1.45 to 1.88 μm.

Q 14.6 Mon 15:45 SCH 251

Non-collinear Optical Parametric Chirped-Pulse Amplification of ultrashort pulses at 20 k-Hz — •Wataru Kobayashi[1], Jiaan Zheng[1], Thomas Haman[1], Markus Lührmann[2], Johannes A. L'huilier[2], Richard Wallenstein[2], and Helmut Zacharias[1] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str.10, 48149 Münster, Germany — [2]TU Kaiserslautern, Fachbereich Physik, Erwin-Schrödinger-Str.46, 67663 Kaiserslautern, Germany

We present a non-collinear optical parametric chirped-pulse amplification (NOPCPA) system generating sub-20 fs, 150 μJ optical pulses at a repetition rate of 20 kHz. A Kerr-lens mode-locked Ti:sapphire oscillator generates 7fs, 2 nJ seed pulses at a repetition rate of 80 MHz. A frequency-doubled mode-locked Nd:YVO_4 amplifier is employed as a pump source [1]. The pump laser is synchronized with the seed oscillator and generates 250 ps, 1.25 mJ pulses at the wavelength of 532 nm operating at 20 kHz repetition rate. A grism pair induces negative 2nd-and 3rd-order dispersion and stretches the seed pulse to about 100 ps. An acousto-optic programmable dispersive filter (AOPDF) follows the stretcher to compensate for the higher order dispersion. A three-stage optical parametric amplification (OPA) based on type I phase matching in BBO amplifies the seed up to 150 μJ. The seed pulses are compressed to sub-20 fs by use of Brewster-angle-cut SF57 glass blocks and a fused silica glass block.

[1] M. Lührmann, C. Theobald, R. Wallenstein, J. A. L'huillier, Opt. Exp. 17, 22761 (2009)