

RELATIVISTISCHE LASER-PLASMA-PHYSIK (SYLP)

gemeinsam veranstaltet von den Fachverbänden
Plasmaphysik (P) und
Quantenoptik und Photonik (Q)

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The symposium will cover all experimental and theoretical aspects of high-intensity laser physics and relativistic laser plasma physics. Session SYLP 1 focusses on the acceleration of electrons, in particular highlighting the recent results on the generation of monoenergetic electron beams with lasers. SYLP 2 addresses the basic mechanisms of proton and ion acceleration in laser-matter interaction as well as applications of these beams in plasma diagnostics and accelerator physics. SYLP 3 complements the oral presentations with posters on technical aspects of the topic and includes the post dead-line applications.

ÜBERSICHT DER HAUPTVORTRÄGE UND FACHSITZUNGEN
(Hörsaal HU Senatssaal)

Hauptvorträge

- SYLP 1.1 Sa 10:00 (HU Senatssaal) **Recent progress in laser plasma accelerators**, [Victor Malka](#), Jérôme Faure, Yannick Glinec, Alexander Pukhov
SYLP 2.1 Sa 14:00 (HU Senatssaal) **Laser Acceleration of Protons**, [Claes-Göran Wahlström](#), Filip Lindau, Olle Lundh, Anders Persson, Paul McKenna

Fachsitzungen

- | | | | | |
|--------|---|----------------|---------------|--------------|
| SYLP 1 | Relativistische Laser-Plasma-Physik 1 | Sa 10:00–12:00 | HU Senatssaal | SYLP 1.1–1.5 |
| SYLP 2 | Relativistische Laser-Plasma-Physik 2 | Sa 14:00–17:00 | HU Senatssaal | SYLP 2.1–2.7 |
| SYLP 3 | Poster zum Symposium Relativistische Laser-Plasma-Physik | Sa 10:00–17:00 | HU Senatssaal | SYLP 3.1–3.9 |

Fachsitzungen

– Haupt-, Kurzvorträge und Posterbeiträge –

SYLP 1 Relativistische Laser-Plasma-Physik 1

Zeit: Samstag 10:00–12:00

Raum: HU Senatssaal

Hauptvortrag

SYLP 1.1 Sa 10:00 HU Senatssaal

Recent progress in laser plasma accelerators — ●VICTOR MALKA¹, JÉRÔME FAURE¹, YANNICK GLINEC¹, and ALEXANDER PUKHOV² — ¹Laboratoire d'Optique Appliquée, ENSTA, CNRS UMR 7639, Ecole Polytechnique, 91761 Palaiseau, France — ²Institut für Theoretische Physik,1, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf, Germany

Plasmas are attractive media for the next generation of compact particle accelerators because they can sustain electric fields larger than those in conventional accelerators by more than three orders of magnitude. Recently we demonstrated the production of high quality and high energy electron beams from laser-plasma interaction: within a distance of 3 mm, a very collimated and quasi-monoenergetic electron beam is emitted with a 1 nanocoulomb charge at 170 MeV +/-20 MeV. This dramatic increase in performance occurs when the laser pulse is able to drive a plasma bubble. The plasma bubble is an ideal structure for trapping electrons and accelerating them to a single energy. In this talk, we will review the different regimes of electron acceleration and we will show how enhanced performances can be reached with state-of-the-art ultrashort laser systems.

SYLP 1.2 Sa 10:40 HU Senatssaal

Laser Electron Acceleration in the Bubble Regime — ●MICHAEL GEISSLER, JÖRG SCHREIBER, and JÜRGEN MEYER-TER-VEHN — Hans-Kopfermann-Str. 1, D 85748 Garching

Laser-Plasma interaction with ultra-short ultra-high Power laser pulses leads to a new and very efficient electron regime of wakefield acceleration. In this so called bubble regime highly collimated electron beams with a narrow energy spread are generated. This multi-MeV beams will serve for a number of applications ranging from x-ray generation to multi stage accelerator chains. Based on 3D-PIC simulations a systematic study will be presented for the necessary pulse and plasma condition to reach the bubble regime. Recent experiments in this field will be analyzed and an outlook for experiments with the upcoming Laser systems in Garching will be given.

SYLP 1.3 Sa 11:00 HU Senatssaal

A photon-collider at relativistic intensities — ●BEN LIESFELD, KAY-UWE AMTHOR, JENS BERNHARDT, HEINRICH SCHWOERER, and ROLAND SAUERBREY — Institut fuer Optik und Quantenelektronik, Friedrich-Schiller-Universitaet Jena

We present an experimental setup in which two high-intensity ultrashort laser pulses counter-propagate through a common focus positioned in a He gas-jet. The setup is located in a vacuum chamber and fully computer controlled and allows for precise focusing and spacial and temporal overlap of the two foci. A single-shot autocorrelation of an ultra-short

laser pulse at relativistic intensity (3×10^{18} W/cm²) was carried out. Non-linear Thomson scattering from plasma electrons in the He gas-jet was used as second-order autocorrelation signal. Beyond this first pulse duration measurements at relativistic intensities the presented setup offers the means for the generation of counter-propagating particle beams, for Thomson scattering of a laser beam with a counter-propagating laser-accelerated electron beam or for the generation of particle-anti-particle pairs.

SYLP 1.4 Sa 11:20 HU Senatssaal

Pair production in a laser driven electron-electron collider *

— ●U. SCHRAMM¹, D. HABS¹, R. SAUERBREY², and H. SCHWÖRER² — ¹LMU München, Department für Physik — ²IOQ, Universität Jena

At the IOQ Jena 10 TW laser, two parabolic focusing mirrors can provide counterpropagating laser pulses focused into the same (gas) target area to intensities above 10^{18} W/cm², so that the precise head-on collision of laser accelerated electron beams become possible. In the electron-electron collisions, e^+e^- pairs are predicted to be formed at a rate of the order of 1/s, emitted predominantly in forward and backward direction at an energy around 200 ± 100 keV. Thus the reaction products are planned to be guided out of the target area by magnetic fields for detection. As the cross-section and the angular distribution of this reaction is well understood, the measurement will provide the luminosity of the colliding electron beams, an important input parameter for the anticipated future production of short-lived exotic particles. One step further, colliding backscattered photon beams could increase the reaction rate by orders of magnitude.

* funded by DFG Transregio TR18.

SYLP 1.5 Sa 11:40 HU Senatssaal

Laser Wakefield und monoenergetic Elektrons: the dawn of compact accelerators — ●ALEXANDER PUKHOV, SERGEI GORDIENKO, and SERGEI KISELEV — HHUD, Institut fuer Theoretische Physik 1, Duesseldorf

Plasma-based accelerators have been proposed for the next generation of compact accelerators because of the huge electric fields they can support. However, it has been difficult to use them efficiently for applications because they produce poor quality particle beams with large energy spreads. We demonstrate a dramatic enhancement in the quality of electron beams produced in laser-plasma interaction: an ultrashort laser pulse drives a plasma bubble which traps and accelerates plasma electrons to a single energy. This bubble is scalable to high electron energies. The first experiment [J.Faure et al., Nature 2004) demonstrates an extremely collimated and quasi-monoenergetic electron beam with a high charge of 0.5 nanocoulomb at energy 170 +/- 20 MeV. The experiment is compared with 3D PIC simulations.

SYLP 2 Relativistische Laser-Plasma-Physik 2

Zeit: Samstag 14:00–17:00

Raum: HU Senatssaal

Hauptvortrag

SYLP 2.1 Sa 14:00 HU Senatssaal

Laser Acceleration of Protons — ●CLAES-GÖRAN WAHLSTRÖM¹, FILIP LINDAU¹, OLLE LUNDH¹, ANDERS PERSSON¹, and PAUL MCKENNA² — ¹Department of Physics, Lund Institute of Technology, Lund, Sweden — ²Department of Physics, University of Strathclyde, Glasgow, UK

Laser acceleration of ions during the interaction of intense femtosecond lasers with thin solid target foils will be discussed. In particular, a systematic experimental study of the spatial distribution of the proton beams as function various laser parameters will be described. In this study, which is performed with the target foil irradiated under oblique

angle of incidence, it is found that under certain laser and target conditions, the proton beams are directed away from the target normal. This deviation is towards the laser forward direction, with an angle that depends on the level and duration of the ASE pedestal before the main laser pulse. In addition, for a given laser pulse, this beam deviation increases with proton energy.

SYLP 2.2 Sa 14:40 HU Senatssaal

Laser accelerated ions and electron transport in ultra-intense laser matter interaction — ●MARKUS ROTH¹, ERIK BRAMBRINK^{1,2}, PATRICK AUDEBERT², ABEL BLAZEVIC¹, ROBERT CLARKE³, JIM COBBLE⁴, JULIEN FUCHS², MATTHIAS GEISSEL⁵, DIETER HABS⁶, MANUEL HEGELICH⁴, STEFAN KARSCH³, KENNETH LEDINGHAM⁷, DAVID NEELY³, JÖRG SCHREIBER⁶, and JUAN FERNANDEZ⁴ — ¹University of Technology Darmstadt, Germany — ²Laboratoire pour l'Utilisation des Lasers Intense, France — ³Rutherford Appleton Laboratory, Great Britain — ⁴Los Alamos National Laboratory, USA — ⁵Sandia National Laboratory, Albuquerque, USA — ⁶Ludwigs Maximilian Universität, München, Germany — ⁷University of Strathclyde, Glasgow, Great Britain

Laser accelerated ion beams have been the subject of great interest. The ion beam peak power and beam emittance has been found to be unmatched by any conventionally accelerated ion beam. Comparing ion acceleration experiments at laser systems with different beam parameters and using targets of varying thickness, material and temperature, insight on the underlying physics can be obtained. In the talk, we will present experimental results obtained at different laser systems, a first beam quality measurement on laser accelerated heavy ions and ion beam source size measurements at different laser parameters. We will compare information obtained from micro patterned ion beams about the accelerating electron sheath and the influence of magnetic fields on the electron transport inside conducting targets.

SYLP 2.3 Sa 15:00 HU Senatssaal

Sudden acceleration of ions with intense femtosecond laser-pulses — ●MATTHIAS SCHNÜRER^{1,2}, SARGIS TER-AVETISYAN^{1,2}, STEFAN BUSCH^{1,2}, PETER NICKLES^{1,2}, and WOLFGANG SANDNER^{1,2} — ¹Max-Born-Institut, Max-Born-Str. 2a, 12489 Berlin — ²Transregio TR18 collaboration

If intense femtosecond Ti:Sa-laser pulses (intensity $> 10^{18} \text{W/cm}^2$, pulse duration $< 50 \text{fs}$) irradiate matter (thickness $\sim 10 \mu\text{m}$) an energetic electron population is immediately created which builds up an acceleration field for ions. In succession ions are abruptly accelerated from the plasma-vacuum interface. As shorter the laser pulse as steeper the electron distribution is formed which results in specific start conditions for the ion burst. Detailed studies of ion spectra from isolated water droplet targets as well as from plane foil targets are introduced and the acceleration behaviour, leading to deep modulations in the ion energy spectra [1], is discussed in the frame of a multi-electron temperature plasma. A creation of narrow band (monoenergetic) ion/proton spectra seems to be possible, which could give new application options in the accelerator and proton imaging technology. [1] S. Ter-Avetisyan e.a. Phys.Rev.Let. 93, 155006 (2004)

SYLP 2.4 Sa 15:40 HU Senatssaal

Electric field measurements in dense plasmas using proton imaging — ●TOMA TONCIAN¹, P. ANTICI², P. AUDEBERT², M. BORGHESI³, C. A. CECCHETTI³, J. FUCHS², G. PRETZLER¹, L. ROMAGNANI³, and O. WILLI¹ — ¹Heinrich-Heine-Universität Düsseldorf, Universitätsstr. 1 40225 Düsseldorf, Germany — ²Laboratoire pour l'Utilisation des Lasers Intenses (LULI), Ecole Polytechnique, Palaiseau cedex, France — ³Queens University, Belfast, United Kingdom

Proton imaging is a powerful technique to investigate electric fields in dense laser produced plasmas. During the interaction of an intense laser pulse 10^{19}W/cm^2 with thin metal foil targets a multi MeV proton beam is generated. This diagnostic has been applied to study the rear side proton acceleration process of laser irradiated targets. The experimental results have been compared to the theoretical model of plasma expansion in vacuum. Good agreement has been found.

SYLP 2.5 Sa 16:00 HU Senatssaal

Charge distributions of ions accelerated from thin foils irradiated by high-intensity laser pulses — ●JÖRG SCHREIBER^{1,2}, FLORIAN GRÜNER¹, ULRICH SCHRAMM¹, MICHAEL GEISLER², MANUEL HEGELICH³, JIM COBBLE³, ERIK BRAMBRINK⁴, JULIEN FUCHS^{5,6}, PATRICK AUDEBERT⁵, DIETER HABS¹, and KLAUS WITTE² — ¹LMU München, Garching, Germany — ²MPI für Quantenoptik, Garching, Germany — ³Los Alamos Natl. Lab, Los Alamos, USA — ⁴TU Darmstadt, Darmstadt, Germany — ⁵LULI, CNRS-CEA-École Polytechnique-Univ. Paris VI, Palaiseau, France — ⁶University of Nevada, Reno, USA

We report on measurements of spectra and charge state distributions of ions accelerated from thin foils irradiated by ultrashort (300fs) high-intensity ($6 \times 10^{19} \text{W/cm}^2$) laser pulses. The foils were resistively heated to remove the light surface contaminants. Sandwich targets consisting of a 25- μm thick tungsten layer, a 2-nm thin beryllium layer, and again a tungsten layer whose thickness was varied were used. Among the spectra of beryllium ions, peaked energy spectra of oxygen and argon ions corresponding to the equilibrium distribution after propagation through matter were observed [1]. For the found agreement we suggest an explanation in terms of starting positions of the detected ions underneath the rear-surface. Among the sandwich target geometry, a variety of different target materials was investigated to crosscheck spectra and charge state distributions of different elements in terms of the proposed explanation. Partially funded by DFG TR18.

[1] J. Schreiber *et al.*, Appl. Phys. B, (2004)

SYLP 2.6 Sa 16:20 HU Senatssaal

Investigation of high-intensity laser interaction with gaseous targets and the consequent plasma evolution — ●RALPH JUNG¹, JENS OSTERHOLZ¹, OSWALD WILLI¹, MARCO BORGHESI², SATYABRATA KAR², LORENZO ROMAGNANI², MARCO GALIMBERTI³, ROBERT HEATHCOTE⁴, CARLO ALBERTO CECCHETTI², and JULIEN FUCHS⁵ — ¹Heinrich-Heine-Universität Düsseldorf — ²Queens University Belfast — ³IPCF, Consiglio Nazionale delle Ricerche, Pisa — ⁴CLF, Rutherford Appleton Laboratory, UK — ⁵École Polytechnique, France

In a recent 100 TW-experiment at the Rutherford Appleton Laboratory (UK) the laser interaction with gaseous targets has been investigated using the proton imaging technique and infrared emission observations. The experiment used the VULCAN pulse (700 fs, 1.05 μm) at focussed intensities of 2-3- 10^{19}W/cm^2 . The proton images show evidence of channelled propagation and filamentation of the laser beam, revealed by the associated electric fields.

SYLP 2.7 Sa 16:40 HU Senatssaal

Plasma of extreme energy density by intense VUV-beams — ●ANNIKA KRENZ and JÜRGEN MEYER-TER-VEHN — Max-Planck-Institut für Quantenoptik Hans-Kopfermann-Str.1, Garching

We report on new possibilities to generate solid-density plasma at extreme energy density by intense VUV-beams becoming available at DESY in 2005. The VUV-FEL TESLA Test Facility TTF2 will provide pulses of 10^{13} photons with 20-200eV photon energy and 100fs pulse duration reaching intensities up to 10^{17}W/cm^2 by focussing up to $1 \mu\text{m}^2$. Photons in this energy range show maximum absorption and energy deposition in solids and therefore producing uniform plasma layers at solid density with temperatures up to 500eV. In this context we discuss the absorption mechanism of VUV light in solid targets. In addition scattered photons will provide detailed information on the structure of the generated plasma. This offers new possibilities to study equations of state and opacities over a wide range of the phase diagram also in the regime relevant for Inertial Confinement Fusion. Besides, fundamental studies of the warm dense matter regime (0,1-10eV) are of particular interest in first experiments. Here the liquid-gas phase transitions are located and therefore the information about the critical points which are unknown for many materials.

SYLP 3 Poster zum Symposium Relativistische Laser-Plasma-Physik

Zeit: Samstag 10:00–17:00

Raum: HU Senatssaal

SYLP 3.1 Sa 10:00 HU Senatssaal

Guiding at relativistic intensities in a plasma channel of capillary discharge — ●KAROL JANULEWICZ¹, GERD PRIEBE¹, JOHANNES TUEMMLER¹, PETER-VIKTOR NICKLES¹, BORIS GREENBERG², MICHAEL LEVIN², ANATOLY PUKHOV², and ARIE ZIGLER² — ¹Max-Born-Institut, Max-Born-Str. 2A, D-12489 Berlin, Germany — ²Racah Institute of Physics, Hebrew University of Jerusalem, Israel

A plasma channel created by a slow electric discharge in a boron nitride capillary was used as a pipe for radiation at relativistic intensities (10^{18} W/cm²). The beam of a 20 TW titan-sapphire laser was focused with an off-axis paraboloid to the focus diameter (matched beam radius) corresponding well to the channel radius. Guiding over the lengths between 10 and 30 mm has been demonstrated. The temporally resolved channel transmission, image of the transmitted beam, spectroscopy of the transmitted beam and XUV-spectroscopy were applied as diagnostic tools. Blue- and the red-shift in the spectrum of the transmitted beam were analysed in detail and used as a source of information about the processes accompanying propagation.

SYLP 3.2 Sa 10:00 HU Senatssaal

Intensitätsabhängigkeit charakteristischer Röntgenstrahlung aus relativistischen laserinduzierten Plasmen — ●SABINE VOLKMER, HEINRICH SCHWOERER, FRIEDRIKE EWALD, CHRISTIAN REICH und ROLAND SAUERBREY — Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena

Durch die Fokussierung kurzer Laserpulse (100 fs) auf dünne Metallfolien (Ti, Cu, Ag) wurde charakteristische K-Strahlung erzeugt und hinsichtlich der Abhängigkeit ihrer Ausbeute von der Laserintensität untersucht. Dabei wurde die Intensität im Bereich von 10^{16} W/cm² bis $3 \cdot 10^{19}$ W/cm² variiert, indem das Target in Laserrichtung durch den Fokus gefahren wurde. Die Anzahl der Röntgenquanten als Funktion vom Abstand zum Fokus weist typischerweise zwei oder drei Maxima auf. Zum Vergleich wurde der Zusammenhang zwischen Laserintensität und Strahlungsausbeute unter Verwendung von ein- bzw. dreidimensionalen relativistischen Elektronenenergieverteilungen und des relativistischen Wirkungsquerschnitts für K-Schalen-Ionisation simuliert. An Titanfolien wurden umfangreiche Versuche zum Einfluß der Laserpulsenergie durchgeführt. Es stellte sich heraus, daß oberhalb einer optimalen Pulsenergie die Strahlungsausbeute wieder sinkt. Dieser Effekt ist vermutlich auf ASE bzw. Vorpulse zurückzuführen.

SYLP 3.3 Sa 10:00 HU Senatssaal

Spectroscopy of few-cycle-laser accelerated electrons *

— ●U. SCHRAMM¹, D. HABS¹, F. KRAUSZ^{1,2}, K. SCHMID^{1,2}, G. TSAKIRIS², L. VEISZ², and K. WITTE² — ¹LMU München, Department für Physik — ²MPI für Quantenoptik, München

The recent exploration of a novel regime in the laser plasma wakefield acceleration of electrons, referred to as bubble acceleration [1], enables the efficient generation of near mono-energetic collimated electron pulses of up to 200 MeV energy [2]. The short acceleration lengths (few 100 μ m) and the good beam quality makes these beams interesting candidates for further applications like photon backscattering or spontaneous X-ray emission.

At MPQ, we presently setup a high resolution electron spectrometer for a range of 10-400 MeV that will allow for systematic studies of the acceleration mechanism at the high repetition rates of the MPQ Light-wave-synthesizers. We report on the status of the experiment concerning spectrometer, target area, and possible first measurements.

* funded by DFG Transregio TR18.

[1] M. Geissler et al. *contribution to this session*.

[2] S.P.D. Mangles et al. Nature 431, 535 (2004), C.G.R. Geddes et al., *ibid*, 538 and J. Faure et al., *ibid*. 541.

SYLP 3.4 Sa 10:00 HU Senatssaal

Acceleration of electrons and protons from thin foils — ●K.U. AMTHOR¹, B. LIESFELD¹, F. EWALD¹, H. SCHWOERER¹, R. SAUERBREY¹, F. HANNACHI², J.F. CHEMIN², T. ZAGAR³, J. MAGILL³, and K.W.D. LEDINGHAM⁴ — ¹IOQ, Jena — ²CENBG, Bordeaux — ³ITU, Karlsruhe — ⁴Strathclyde, Glasgow

Electron and proton beams were investigated using the Jena Multi-TW-Laser of 80 fs pulse duration with intensities up to about 2×10^{19}

W/cm² irradiating thin foil targets.

The electrons interacted with a scintillating screen and were found to be directed along target normal and also along the direction of the laser beam. It would appear that at these intensities there is evidence that both resonant absorption and ponderomotive accelerating mechanisms are present. As the laser intensity increased the number of electrons in the normal component remained relatively unchanged whereas the number of electrons in the laser direction increased. It was found that the angle between the two beams was largely independent of laser intensity and lay close to the laser beam direction.

The proton beam behind the target was directed along target normal with an opening half angle of about 8° for protons > 3.2 MeV and 15° for protons > 2.5 MeV. The maximum energy of the protons was < 5 MeV characteristic of a laser interaction at this intensity and pulse width with thin targets. To determine the proton energy as well as their emission angle a spectrometer has been developed consisting of a multi layered filter in combination with nuclear track detectors.

SYLP 3.5 Sa 10:00 HU Senatssaal

Plasma mirror using high intensity few-cycle laser pulses

— ●LASZLO VEISZ¹, YUTAKA NOMURA¹, KARL SCHMID¹, FERENC KRAUSZ¹, and TIBOR WITTMANN² — ¹Max-Planck-Inst. of Quantum Optics, Hans-Kopfermann-Str. 1, D-85748 Garching, Germany — ²LULI, Ecole Polytechnique, F-91128 Palaiseau, France

Ultrahigh intensity lasers have undesirable prepulses and pedestal (long background pulse). The contrast (ratio between the intensities of the prepulses or pedestal and the main pulse) becomes very important at relativistic laser-plasma interactions. The prepulses/pedestal already generate preplasma and the main pulse does not interact with a steep plasma. Plasma mirror is a good alternative to improve the contrast of these lasers. We generated, characterized and optimized a plasma mirror for high intensity few-cycle laser pulses. The typical characteristics as reflectivity of the mirror, focusability, contrast improvement and temporal structure of the reflected beam will be presented. Some applications will be discussed.

SYLP 3.6 Sa 10:00 HU Senatssaal

Ultra-high dynamic third order autocorrelator — ●KARL SCHMID, LASZLO VEISZ, YUTAKA NOMURA, and FERENC KRAUSZ — Max-Planck-Inst. of Quantum Optics, Hans-Kopfermann-Str. 1, D-85748 Garching, Germany

The temporal structure of ultrahigh intensity lasers is a major concern in various laser-plasma experiments as ion acceleration or surface harmonic generation. Prepulses or a pedestal (long background pulse) can significantly alter the interaction. The characterization of the contrast of these prepulses/pedestal requires a specially designed autocorrelator capable to measure We prepared a fully automatized, ultrahigh dynamic range (8-10 orders of magnitude), third order autocorrelator. The device is based on cascaded third harmonic generation and can be operated with a small portion of the laser light (50 μ J). Application of the correlator for characterization of pulse cleaning will also be presented.

SYLP 3.7 Sa 10:00 HU Senatssaal

Monoenergetic electron bunches from a high-density laser-plasma accelerator — ●KAY-UWE AMTHOR¹, BERNHARD HIDDING², BEN LIESFELD¹, STEFAN KARSCH³, LASZLO VEISZ³, GEORG PRETZLER², HEINRICH SCHWOERER¹, and ROLAND SAUERBREY¹ — ¹Friedrich-Schiller-Universität Jena — ²Heinrich-Heine Universität Düsseldorf — ³Max-Planck-Institut für Quantenoptik, Garching

Narrow monoenergetic electron bunches have been observed from the interaction of a 15 TW, 80 fs Ti:Sapphire laser with a subsonic, high density (10^{20} e/cm³) gas jet. In contrast to previous experiments (see title of Nature 431, 2004), the strong peaks were observed with longer pulses (80 fs vs. 30-50 fs), shorter focusing ($f/2.2$), and higher density, which is completely unexpected by the explanations given in these papers. The pulse propagated in a channel created solely by relativistic self-focusing. The electrons were emitted in a very narrow (mrad) cone, and their spectrum shows a low-energy exponential tail and one or two intense, monoenergetic spikes. The mechanism leading to the formation of these monoenergetic features in a parameter regime previously ruled out by the current theories will be discussed.

SYLP 3.8 Sa 10:00 HU Senatssaal

Time resolved observation of THz emission by laser-accelerated electrons in a gas jet — ●STEFAN KARSCH¹, STEVEN JAMISON², KAY-UWE AMTHOR³, JORDAN GALLACHER², BEN LIESFELD³, CHRISTOPHER MURPHY⁴, BERNHARD HIDDING⁵, LASZLO VEISZ¹, FERENC KRAUSZ¹, ROLAND SAUERBREY³ und HEINRICH SCHWOERER³ — ¹Max-Planck-Institut für Quantenoptik, Garching — ²University of Strathclyde, Glasgow — ³Friedrich-Schiller-Universität Jena — ⁴Rutherford-Appleton Laboratory, Didcot — ⁵Heinrich-Heine-Universität Düsseldorf

A time-resolved measurement of the THz radiation emitted from a laser-driven electron bunch crossing the plasma-vacuum boundary of a gas jet was performed. We re-imaged the THz radiation from the gas jet into a ZnTe crystal, which exhibits a large Pockels effect. The time-dependent polarisation caused by the THz fields in the crystal rotates the polarisation state of a stretched, chirped probe laser pulse passing simultaneously through the same crystal, acting as a fast optical shutter. The probe pulse is subsequently analysed in a spectrometer or a cross-correlated with a second, short probe pulse to reconstruct the time structure of the THz pulse. We will discuss the results obtained from both methods and discuss mechanisms for the THz generation. This will also give allow to put an upper limit for the duration of the electron bunch.

SYLP 3.9 Sa 10:00 HU Senatssaal

Observation of laser-driven filamented electron beams by means of Cerenkov radiation — ●J. STEIN^{1,2}, E. FILL¹, J. MEYER-TER-VEHN¹, U. SCHRAMM², D. HABS², and K. WITTE¹ — ¹Max-Planck-Institut für Quantenoptik, Garching — ²Ludwig-Maximilians-Universität München

Cerenkov radiation [1] has been used to investigate electron beam filamentation in solids with high spatial resolution of $4\mu\text{m}$. The patterns show strongly filamented ring-like structures of $300\mu\text{m}$ diameter, observed at the rear side of thin foils irradiated with $10^{19}\text{W}/\text{cm}^2$ pulses. The Cerenkov medium ($50\mu\text{m}$) emitting visible light detected by means of a fast gated CCD. It is proportional to the thickness of the Cerenkov medium and to the number of electrons with energies of about 200 keV. We interpret the results as evidence for the decay of a cylindrical electron beam, when passing through dense plasma, due to return currents and Weibel instability [2, 3]. After passing several micrometers in matter the filaments have the tendency to coalesce with each other leading to strong anomalous stopping of the beam exceeding Coulomb stopping by orders of magnitude. [1] F. Brandl, et al., Europhys. Lett. 61, 632 (2003) [2] M. Honda, et al., Phys. Rev. Lett. 85, 2128 (2000) [3] Y. Sentoku, et al., Phys. Rev. Lett. 90, 155001 (2003)