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 Janulewicz[1], Gerd Priebe[1], Johannes Tuemmler[1], Peter-Viktor Nickles[1], Boris Greenberg[2], Michael Levin[2], Anatoly Pukhov[2], and Arie Zigler[2] — [1]Max-Born-Institut, Max-Born-Str. 2A, D-12489 Berlin, Germany — [2]Racah 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 (I 10^{18}W/cm^2). The beam of a 20 TW titan-sapphir 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, Friederike 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 cm^{-2} bis $3 \cdot 10^{19}$ W cm^{-2} 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. Schramm[1], D. Habs[1], F. Krausz[1,2], K. Schmid[1,2], G. Tsakiris[2], L. Veisz[2], and K. Witte[2] — [1]LMU München, Department für Physik — [2]MPI 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 μm) 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 Lightwave-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. Amthor[1], B. Liesfeld[1], F. Ewald[1], H. Schwoerer[1], R. Sauerbrey[1], F. Hannachi[2], J.F. Chemin[2], T. Zagar[3], J. Magill[3], and K.W.D. Ledingham[4] — [1]IOQ, Jena — [2]CENBG, Bordeaux — [3]ITU, Karlsruhe — [4]Strathclyde, 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/cm^2 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 Veisz[1], Yutaka Nomura[1], Karl Schmid[1], Ferenc Krausz[1], and Tibor Wittmann[2] — [1]Max-Planck-Inst. of Quantum Optics, Hans-Kopfermann-Str. 1, D-85748 Garching, Germany — [2]LULI, 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 presentred. 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 ulrahigh intensity lasers is a major concern in various laser-plasma experiments as ion acceleration or surface harmonic generation. Prepulses or a pedestal (long backgroung 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 μJ). 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 Amthor[1], Bernhard Hidding[2], Ben Liesfeld[1], Stefan Karsch[3], Laszlo Veisz[3], Georg Pretzler[2], Heinrich Schwoerer[1], and Roland Sauerbrey[1] — [1]Friedrich-Schiller-Universität Jena — [2]Heinrich-Heine Universität Düsseldorf — [3]Max-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/cm^3) 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 Karsch[1], Steven Jamison[2], Kay-Uwe Amthor[3], Jordan Gallacher[2], Ben Liesfeld[3], Christopher Murphy[4], Bernhard Hidding[5], Laszlo Veisz[1], Ferenc Krausz[1], Roland Sauerbrey[3] und Heinrich Schwoerer[3] — [1]Max-Planck-Institut für Quantenoptik, Garching — [2]University of Strathclyde, Glasgow — [3]Friedrich-Schiller-Universität Jena — [4]Rutherford-Appleton Laboratory, Didcot — [5]Heinrich-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. Fill[1], J. Meyer-ter-Vehn[1], U. Schramm[2], D. Habs[2], and K. Witte[1] — [1]Max-Planck-Institut für Quantenoptik, Garching — [2]Ludwig-Maximilians-Universität München

Cerenkov radiation [1] has been used to investigate electron beam filamentation in solids with high spatial resolution of $4\mu m$. The patterns show strongly filamented ring-like structures of $300\mu m$ diameter, observed at the rear side of thin foils irradiated with $10^{19} W/cm^2$ pulses. The Cerenkov medium ($50\mu m$) 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 filamentes 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)