P 14 Schwerionen- und lasererzeugte Plasmen 1

Zeit: Dienstag 14:45–16:30 Raum: 1004

P 14.1 Di 14:45 1004

Thomson scattering in VUV-FEL plasma experiments — •Robert Thiele, Carsten Fortmann, Arne Höll, Ronald Redmer, Heidi Reinholz, and Gerd Röpke — Universität Rostock, Institut für Physik, Universitätsplatz 3, 18055 Rostock

Photon scattering off charged plasma constituents provides an important insight into fundamental plasma properties. Thomson scattering has been established as a diagnostic tool to probe electronic density fluctuations in the plasma. High energetic photons in the 40 eV region with high brilliance as provided by a VUV–FEL, e.g. at DESY Hamburg, allow to investigate matter close to solid state densities. Our theoretical considerations will contribute to the development of future Thomson scattering experiments [1]. We describe the electronic density fluctuations by the dielectric function which is calculated in different approximations and related to the Thomson scattering cross section. It is shown that electron-ion collisions can yield significant corrections to the RPA scattering cross section at certain temperatures and densities [2]. Furthermore, a careful description of Bremsstrahlung as thermal background radiation is needed to discriminate it from the Thomson scattering signal.

[1] A. Höll, R. Redmer, G. Röpke and H. Reinholz, Eur. Phys. J. D **29**, 159-162 (2004)
[2] H. Reinholz, R. Redmer, G. Röpke, A. Wierling, Phys. Rev. E **62**, 5648 (2000)

P 14.2 Di 15:00 1004

Generation of Quasi-monoenergetic Electron Bunches with 80-fs Laser Pulses — •Bernhard Hidding[1], Kay-Uwe Amthor[2], Ben Liesfeld[2], Heinrich Schwoerer[2], Stefan Karsch[3], Michael Geissler[3], Laszlo Veisz[3], Karl Schmid[3,4], Georg Pretzler[1], and Roland Sauerbrey[2] — [1]Institut für Laser- und Plasmaphysik, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf, Germany — [2]Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena, 07743 Jena, Germany — [3]Max-Planck-Institut für Quantenoptik, 85748 Garching, Germany — [4]Department für Physik, Ludwig-Maximilians-Universität München, 85748 Garching, Germany

Highly collimated, quasi-monoenergetic multi-MeV electron bunches were generated by the interaction of tightly focused, 80-fs laser pulses with a high-pressure gas jet. These monoenergetic bunches are characteristic of wakefield acceleration in the highly nonlinear broken wave regime, which was previously thought to be accessible only by much shorter laser pulses in thinner plasmas. In our experiment, the initially long laser pulse was modified in under-dense plasma to match the necessary conditions. This picture is confirmed by semi-analytical scaling laws and 3D particle-in-cell (PIC) simulations. Our results show that laser-plasma-interaction can drive itself towards this type of laser wakefield acceleration even if the initial laser and plasma parameters are outside the required regime.

P 14.3 Di 15:15 1004

Studies of Skind Layer Accelerated Plasma Blocks — •Jan Badziak[1], Heinrich Hora[2], and Jie Zhang[3] — [1]Inst. Plasma Phys. and Laser Microfusion, Warsaw — [2]Theor. Physics, Univ. NSW, Sydney, Australia — [3]Inst.Physics, Chinese Academ. Sci., Beijing

The ignition of deuterium-tritium fuel at densities at or above the solid state for very high energy gain controlled reactions is one of the options to be explored with the new PW-ps laser techniques of fast ignition (FI). Based on ion emission from solids with TW-ps laser pulses, the skin layer acceleration (SLA) by the nonlinear (ponderomotive) force was discovered \1\ under the conditions that very clean laser pulses with a suppression of prepulses by a factor 108 (contrast ratio) were applied. This resulted in ion current densities in the space charge neutral blocks exceeding 10ˆ11 Amps/cmˆ2. Similar observations from x-ray emission \2\ could be explained in the same way that the clean pulses avoided the otherwise usual relativistic self-focusing while TW-ps laser pulses from the Schaefer method automatically demonstrated the SLA mechanism with relativistic self focusing \3\] as seen from the nonlinear force acceleration of the generated plasma. Latest results on these developments are presented. \1\ H. Hora, J. Badziak et al Opt. Comm. 207, 333 (2002); J. Badziak, H. Hora et al, Phys. Letters, A315, 452 (2003); \2\ P. Zhang et al, E57, 3746 (1998); \3\ R. Sauerbrey, Phys. Plasma 3, 4712 (1996)

P 14.4 Di 15:30 1004

Lasergeheizte Hohlräume: Strahlungskonverter für die Erzeugung homogener Plasmen — •Gabriel Schaumann[1], Thomas Hessling[1], Abel Blazevic[1], Alexander Pelka[1], Olga Rosmej[2] und Markus Roth[1] — [1]TU-Darmstadt — [2]GSI

An der Gesellschaft für Schwerionenforschung werden Experimente zur Wechselwirkung von schweren Ionen mit lasererzeugten Plasmen hoher Dichte und Temperatur durchgeführt. Eine Möglichkeit räumlich homogene Plasmen hoher Dichte zu erzeugen, ist die Verwendung eines Hohlraums um die Laserstrahlung in thermische Strahlung zu konvertieren und damit das Target zu heizen. Erste Experimente zur Charakterisierung der Hohlraumstrahlung wurden mit dem Lasersystem nhelix durchgeführt. Mit zeitaufgelöster Röntgenspektroskopie konnte eine Temperatur der Röntgenstrahlungsquelle bestimmt werden. Die Arbeit wird durch hydrodynamische Simulationen für verschiedene Konvertergeometrien durch unsere Kollaborationspartner in Sarov (Russland) unterstützt.

P 14.5 Di 15:45 1004

Spectroscopic investigations of the heavy ion charge state dynamics in solid and gaseous targets — •Korostiy Svitlana[1], Rosmej Olga[1], Blazevic Abel[2], Fertman Alexander[3], Turtikov Vladimir[3], Pikuz Sergey[4], Mutin Timofey[3], Efremov Vladimir[4], Shevelko Viatcheslav[5], and Hoffmann Dieter[1,2] — [1]Gesellschaft für Scherionenforschung, GSI, Department of Plasma Physics, Darmstadt, Germany — [2]Technical University, Darmstadt, Germany — [3]Institute of Experimental and Theoretical Physics, Moscow, Russia — [4]Institute for High Energy Density, Russian Academy of Sciences, Moscow, Russia — [5]Lebedev Institute, Russian Academy of Sciences, Moskow, Russia

The study of heavy ion stopping dynamics using the X-ray spectroscopy of K-shell projectile radiation is at the focus of our researches. 5.9 and 11.4 MeV/u Ca ions were slowed down in silica aerogels and 1.9 Bar Ne gas. The characteristic emission of ions in photon range of 3-4 MeV/u was registered by means focusing spectrometers with spatial resolution. To determine the ion velocity dynamics along the ion beam trajectory inside the interaction volume the Doppler Effect was used. Silica aerogels with low densities of 0.01-0.15 g/cc allowed stretching the ion stopping range and resolved dynamics of stopping inside solid target. The charge state distribution measured in gaseous target has shown the difference in comparison with solids. The theoretical calculations were done to prove the evidance of gas-solid effect.

P 14.6 Di 16:00 1004

Characteristics of high temperature plasmas with low flux lasers — •Gonzalo Rodríguez Prieto[1], Gabriel Schaumann[1,2], Thomas Hessling[1,2], Abel Blazevic[1,2], Marius Schollmeier[1], Svitlana Korostiy[1,2], and Dieter H. H. Hoffmann[1,2] — [1]GSI, Plankstrasse 1 64291 DA — [2]TU Darmstadt, Institut für Kernphysik

Experimental studies with the nhelix laser facility in GSI generating a Magnesium plasma were performed. At these experiments X-ray and UV spectrometers together with visible streak and X-ray pinhole cameras heve been used to characterize the plasma. Even with low laser fluxes ($10^{11} W/cm^2$) high temperature plasmas could be obtained due to special focus geometry. The plasma was created with an annular flux with the focus at a plane in front of the target surface. The plasma emission follows a gaussian emision law with two well defined plasma regions: a bigger and colder region close to the target, and the small high temperature region in the best focus. The influence of the intensity focal distribution and the focus position with respect to the target on the plasma characteristics was also studied. The plasma emission cone could be converted from a gaussian shape to a cilinder, if the focus is located not directly on the target but some hundred micrometers in front of it. In this configuration the plasma expands to bigger volumes but with lower temperatures.

P 14.7 Di 16:15 1004

Beam Emittance Measurement and Plasma Channel Properties for Channel-based Ion Beam Transport — •Renate Knobloch-Maas[1], Stephan Neff[1], Andreas Tauschwitz[2], and D.H.H. Hoffmann[1,2] — [1]TU Darmstadt, FB Physik, Schloßgartenstr. 9, 64289 Darmstadt — [2]GSI, Planckstr. 1, 64291 Darmstadt

Plasma-channel-based beam transport for heavy-ion-beam-driven inertial fusion is a promising final transport concept. Measurements of channel properties and ion beam emittance after transport were conducted at GSI.

The properties of ion-beam-induced plasma channels in several gases were studied for a wide range of pressure and voltage for a channel length of 106 cm. A comparison of different background gases shows that high-Z noble gases are more suitable to create channels for beam transport than low-Z noble gases or nitrogen. Laser-induced plasma channels were also analyzed.

The results of measurements of the beam emittance behind the channel during beam transport demonstrate the feasibility of measuring beam emittance after a transport channel in a single shot. The data indicate no changes in the emittance within statistical errors.