P 10: Laser Plasmas II

Zeit: Dienstag 14:00–15:30 Raum: HS 20

Hauptvortrag P 10.1 Di 14:00 HS 20

HiBEF: New vistas into high-field and laser-plasma science — •Toma Toncian — Helmholtz-Zentrum Dresden-Rossendorf, Schenefeld, Germany

Helmholtz International Beamlines for Extreme Fields is an international user consortium of over 80 groups from more than 60 institutes across 16 countries serving a wide scientific community. HiBEF will establish high-repetition-rate ultra-high intensity (200 TW at 10 Hz) and high energy lasers (100 J at 10 Hz), as well as pulsed high-field magnets (up to 60 T in 1 ms, single shot) and diamond anvil cells, and integrate these into the HED instrument at the European XFEL. These will allow researchers to drive plasmas, matter and materials to extremes of pressure, temperature, magnetic and electric fields, and compression at high strain- rate. This will open new vistas in high energy density and plasma physics, strong-field physics, magnetic materials and correlated electron systems, high-pressure physics, planetary science, and material dynamics. A status of the ongoing commissioning and exemplary science cases will be given.

P 10.2 Di 14:30 HS 20

Hot electron dynamics in ultra intense laser plasma experiments revealed from detection of bremsstrahlung spectra — •Maria Molodtsova[1,2], Anna Ferrari[1], Alejandro Laso Garcia[1], Josefine Metzkes-Ng[1], Stephan Kraft[1], Benjamin Lutz[1], Irene Prencipe[1], Manfred Sobiella[1], Daniel Stach[1], David Weinberger[1], Tim Ziegler[1,2], Ulrich Schramm[1,2], and Thomas Cowan[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]Technische Universität Dresden

Using high-intensity short-pulse lasers (I $\sim 10^{21}$W/cm^2), plasma generation, extreme states of matter and new accelerator concepts are explored, enabling technological breakthrough in material science and medicine. A critical component is the characterization of relativistic electrons that are accelerated and transported in the ionized material of the target, generating ultra-intense bremsstrahlung. Measuring this bremsstrahlung spectrum is therefore a crucial aspect of plasma diagnostics. In this work it is shown how photon spectra can be reconstructed using calorimetric techniques, making possible to study the hot electron dynamics in the laser-generated plasma. Calorimeters with different readouts are under development at HZDR for this purpose. Absorption properties of different targets were studied in a measurement campaign at the in-house Terawatt laser DRACO. A large data set was taken both with passive and active calorimeter prototypes to find correlations between target material and thickness and the resulting electron and ion spectra. Results from this campaign together with the detector concepts are presented here.

P 10.3 Di 14:45 HS 20

Energy enhancement of the target surface electron by using a 200 TW sub-picosecond laser — •Jingyi Mao[1], Olga Rosmej[2], Liming Chen[3], and Thomas Kuehl[2] — [1]Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences, Chongqing 400714, China — [2]GSI Helmholtzzentrum, Darmstadt 64291, Germany — [3]Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China

Compared to the traditional initial confinement fusion (ICF) mechanism, fast ignition greatly lowers the demands of its experimental conditions. Ignition by target surface electrons (TSE) has many advantages[1]; for example, it can be driven by laser pulses, and the beam is of high charge, collimation and mono-energetic property. In our recent work[2], one order of magnitude energy enhancement of the target surface electron beams with central energy at 11.5 MeV is achieved by using a 200 TW, 500 fs laser at an incident angle of 72° with a prepulse intensity ratio of 5x10E(-6). The experimental results demonstrate the scalability of the acceleration process to high electron energy with a longer (sub-picosecond) laser pulse duration and a higher laser energy (120 J). The total charge of the beam is around 400 pC (E>2.7 MeV). Such a high orientation and mono-energetic electron jet would be a good method to solve the problem of the large beam divergence in fast ignition schemes and to increase the laser energy deposition on the target core. [1]J. Y. Mao et al., Phys. Rev. E. 85, 025401 (R) (2012); J. Y. Mao et al., Appl. Phys. Lett. 106, 1311058 (2015). [2]J. Y. Mao et al., Opt. Lett. 43, 3909 (2018).

P 10.4 Di 15:00 HS 20

Absorption of Ultra-short Laser Pulses on Aluminum over a Wide Range of Intensities — •Julian Wegner, Julia Kunzelmann, and Georg Pretzler — Institut für Laser- und Plasmaphysik, Heinrich Heine Universität Düsseldorf, Germany

The absorption of intense laser pulses at solid surfaces is described by various different mechanisms which act under specific conditions, respectively. In this talk we present measurements characterizing the absorption of sub 10 fs Ti:Sa-laser pulses and a maximum pulse energy of 0.5 mJ in a 4-orders-of-magnitude-range of intensities between 10^{14} W/cm^2 and 10^{18} W/cm^2. This huge range was made possible by using a novel fully reflective variable pulse energy attenuator which keeps all other spatial and spectral pulse parameters constant. Our results show significant variations of the relative absorption, which are discussed and explained in the talk.

P 10.5 Di 15:15 HS 20

Spectroscopy of Ions Emitted by an Ultra-Short Pulse Laser Plasma — •Jan Riedlinger, Bastian Hagmeister, and Georg Pretzler — Institut für Laser- und Plasmaphysik, Heinrich-Heine-Universität Düsseldorf

The interaction of ultrashort high-intensity laser pulses with solids generates high temperature plasmas with extremely transient behaviour, of which many aspects are still not fully understood. An important example is the achieved ionization state which is difficult to predict due to the variety of possible processes on ultra-small temporal and spatial scales. We present here experiments aiming at the determination of the various ion species in a plasma created by focusing ultra-short laser pulses with a peak intensity close to 10^{18} W/cm^2 on a solid target. Particles emitted by this plasma propagate into the whole solid angle and reach kinetic energies of several hundred electron volts. We developed a compact and versatile Thomson parabola spectrometer for this purpose which is also presented here.