P 8: Dichte Plasmen, Schwerionen- und Laserplasmen

Time: Tuesday 10:30–12:30 Location: V57.02

Invited Talk P 8.1 Tue 10:30 V57.02

Simulations of FEL-excited matter — •Nikita Medvedev[1], Beata Ziaja[1], Christoph Bostedt[2], Henry Chapman[1], Tim Laarmann[3], Thomas Moeller[4], Robin Santra[1], Fenglin Wang[1], and Edgar Weckert[4] — [1]Center for Free-Electron Laser Science at DESY, Notkestr. 85, 22607 Hamburg, Germany — [2]LCLS, SLAC, Stanford, USA — [3]HASYLAB, DESY, Hamburg, Germany — [4]TU Berlin, Berlin, Germany

We apply continuum approach to follow the dynamics of irradiated complex samples. First we discuss its advantages and limitations when compared to other modelling methods. We then apply this approach to describe data on irradiated clusters and laser-created plasmas that were recorded at the free-electron-laser (FEL) FLASH facility at DESY Hamburg. We show a good agreement between experimental results and our theoretical estimations. Finally we give an outlook on applying the continuum approach to describe ultrafast transitions within FEL-excited solids.

Invited Talk P 8.2 Tue 11:00 V57.02

Magnetic Fields and Strong Correlations in One-Component Plasmas — •Torben Ott — Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität Kiel

The One-Component Plasma (OCP) is a paradigmatic model for a diverse number of plasmas, ranging from the interior of white dwarfs and neutron star crusts to laboratory dusty plasmas. The thermodynamic state of the OCP is fully characterized by a single parameter, the coupling parameter $\Gamma \propto 1/T$. For $1 < \Gamma < 175$, the OCP is in a strongly correlated liquid state in which strong particle interactions modify the behaviour of the plasma and lead, e.g., to the existence of transverse (shear) waves.

The transport properties [1] and the wave spectra [2,3] of a strongly correlated liquid OCP in the presence of a strong magnetic field (i.e., $\omega_c/\omega_p \approx 1$) are relevant to both laboratory and astrophysical plasmas and reveal a number of surprising features. This talk gives a unifying overview of recent theoretical and simulational results for such magnetized OCPs.

[1] T. Ott and M. Bonitz, Phys. Rev. Lett. **107**, 135003 (2011)
[2] M. Bonitz *et al.*, Phys. Rev. Lett. **105**, 055002 (2010)
[3] T. Ott *et al.*, Phys. Rev. E **83**, 046403 (2011)

P 8.3 Tue 11:30 V57.02

Simulation der Fokusierung eines laserbeschleunigten Protonenstrahls in einem Solenoiden — •Peter Schmidt[1,2], Oliver Boine-Frankenheim[1,2], Vladimir Kornilov[1] und Peter Spädtke[1] — [1]GSI, Beschleunigerphysik, Darmstadt, Deutschland — [2]TU Darmstadt, Darmstadt, Deutschland

Im Rahmen des LIGHT Projekts bei GSI werden laserbeschleunigte Protonenstrahlen durch einen Solenoidmagneten für den nachfolgenden Transport kollimiert. In diesem Beitrag werden die Magnetfeldeigenschaften des gepulsten (Pulslänge $\approx 0.7ms$) Solenoiden unter Berücksichtigung von Wirbelstromverlusten, Skin-Effekt, Störfeldern und Phasenverschiebungen in Anbauteilen durch eine Simulation mit der Software CST EM Studio analysiert. Die optischen Eigenschaften des Aufbaus werden durch particle tracking bestimmt und mit der Approximation durch dünne Linsen verglichen. Insondere werden dabei die Einflüsse von Anbauteilen und elektrischen Zuleitungen auf die optischen Eigenschaften herausgearbeitet. Nachfolgend wird die Dynamik eines ladungs- und stromneutralisierten Protonenstrahls in dem Solenoid anaysiert. Hierzu werden Particle-In-Cell (PIC) Simulationen mit CST Particle Studio durchgeführt. Als Emissionsmodell für den Strahl wird u.a. das Plasmaexpansionsmodell nach P. Mora verwendet.

P 8.4 Tue 11:45 V57.02

Simulation study for the LIGHT project: Characterization of TNSA from double-layer targets — •Zsolt Lecz[1], Vladimir Kornilov[2], and Oliver Boine-Frankenheim[1,2] — [1]TU Darmstadt, TEMF — [2]Darmstadt, GSI

This contribution to the LIGHT (Laser Ion Generation, Handling and Transport) project at GSI is devoted to the numerical investigation of the proton acceleration via the TNSA (Target Normal Sheath Acceleration) mechanism. The protons are accelerated from a thin hydrogen-rich contamination layer deposited on the rear surface of a thin metal foil (few μm) interacting with intense (10^{19} W/cm^2) and short (several 100 fs) laser pulse. The electric field induced by the large hot electron pressure is investigated by using 1D and 2D particle-in-cell (PIC) electro-magnetic simulations. Depending on the thickness of the layer the protons can be accelerated in three different ways: quasi-static acceleration for mono-layers, isothermal plasma expansion for thick layers and there is a combined regime for intermediate thickness wich is not well understood yet. The transverse acceleration (divergence) of the protons also depends on the layer thickness and is very different for the two extreme cases. A comparison of analytical models and PIC simulations will be presented.

P 8.5 Tue 12:00 V57.02

Interaction of ultrarelativistic electron and proton bunches with dense plasmas — •Saltanat P. Sadykova[1] and Anri A. Rukhadze[2] — [1]Humboldt-Universität zu Berlin, Germany, Newtonstr. 15, 12489 Berlin, Germany — [2]Prokhorov General Physics Institute, Russian Academy of Sciences 119991, Vavilov Str., 38., Moscow, Russia

Here we discuss the possibility of employment of ultrarelativistic electron (UREB) (A. A. Rukhadze, Zhurnal Tekhnicheskoj Fiziki. 31, Nr.10, (1961) 1236) and proton bunches (URPB) for generation of high plasma wakefields (WF) in dense plasmas due to the Cherenkov resonance plasma-bunch interaction. Recently, in the work of A. Caldwell, et al. Nature Phys. 2009 the possibility of generation of high power WFs of terra-watt amplitude using the URPB was introduced. In the present work this idea along with the employment of electron bunch is discussed at the qualitative level. Namely, we make an estimation of plasma parameters, maximum amplitude of the generated WF when the UREBs and URPBs are used and sysem length at which the maximum amplitude of the WF can be gained. On the basis of the conducted analysis, we can make the following conclusion: the wake amplitude growth produced by the bunches gets saturated with an increase of bunch energy at a quite high level. The amplitude of the electric WF produced in plasma at $n_p = 10^{17} cm^{-3}$ by the UREB is of order 30 G V/m, whereas that produced by the URPB bunch is not higher than 1.3 T V/m. These magnitudes are higher than those gained with the help of contemporary quite powerful pulse lasers (10^{21-22} W/cm^2).

P 8.6 Tue 12:15 V57.02

Sub-femtosecond extremely-intense laser pulse generation — •Matteo Tamburini[1], Christoph H. Keitel[1], Andrea Macchi[2,3], Francesco Pegoraro[3,2], Tatyana V. Liseykina[4], Naveen Kumar[1], Ashutosh Sharma[1], and Antonino Di Piazza[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg, Germany — [2]Istituto Nazionale di Ottica, CNR, Pisa, Italy — [3]Dipartimento di Fisica, Università di Pisa, Largo Bruno Pontecorvo 3, I-56127 Pisa, Italy — [4]Institut für Physik, Universität Rostock, Wismarsche Strasse 43-45, 18057 Rostock, Germany

At the ultrahigh optical laser intensities expected in the foreseen experiments ($I > 10^{23}$ W/cm^2), a solid-density thin plasma foil can be quickly accelerated up to relativistic energies by the radiation pressure of an impinging laser pulse [1,2]. The very high electron density of such relativistic foil allows to efficiently reflect a second, counter-propagating and intense laser pulse producing a sub-femtosecond extremely-intense laser pulse.

In this contribution, the Doppler intensity increase of a laser pulse with a counter-propagating relativistic foil is studied with particle-in-cell (PIC) simulations including the effect of the so called radiation reaction force [2].

[1] T. Esirkepov, M. Borghesi, S. V. Bulanov, G. Mourou, T. Tajima, Phys. Rev. Lett. **92**, 175003 (2004). [2] M. Tamburini, F. Pegoraro, A. Di Piazza, C. H. Keitel and A. Macchi, New J. Phys. **12**, 123005 (2010).