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 Malka[1], Jérôme Faure[1], Yannick Glinec[1], and Alexander Pukhov[2] — [1]Laboratoire d'Optique Appliquée, ENSTA, CNRS UMR 7639, Ecole Polytechnique, 91761 Palaiseau, France — [2]Institut 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 ($3 \times 10^{18}\,\mathrm{W/cm^2}$) 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. Schramm[1], D. Habs[1], R. Sauerbrey[2], and H. Schwörer[2] — [1]LMU München, Department für Physik — [2]IOQ, 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 $10^{18}\,\mathrm{W/cm^2}$, 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 planed 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 orderds of magnitude.

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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.