SYPA 1: Sympsium Plasma-based Particle Accelerators 1

Zeit: Mittwoch 14:00–16:00 Raum: Plenarsaal

Hauptvortrag SYPA 1.1 Mi 14:00 Plenarsaal
Laser-driven ion acceleration in plasmas — •Jörg Schreiber — Ludwig-Maximilians-Universität München, Garching b. München

We investigate acceleration of ion bunches during relativistically intense laser pulse interactions with plasmas. Relying on coherent acceleration, such sources feature distinct ion bunch characteristics, including (ultra)short bunch duration, high bunch density, low emittance and synchronism with other parallel laser-driven sources. I review the main acceleration concepts based on our recent studies with various target (plasma) types; including ultrathin foils and levitated micro targets. For applications in fields of radiation physics, chemistry, biology and medicine, we have established the Centre for Advanced Laser Applications (CALA). CALA will feature the ATLAS3000 chirped pulse amplification system that delivers driving laser pulses with peak power of 3 petawatts. Advancing towards an integrated laser-driven ion accelerator system (ILDIAS) represents a remarkable technological challenge. In this talk, I present our experiences in target technology, ion beam guidance and instrumentation. Among the numerous potential applications of laser-driven particle acceleration [1], ion-bunch induced ultrasound waves in water is highlighted as a fascinating example at the interface of tailored detection methodology and physics at high local and instantaneous energy density.

[1] Bolton, P.R., K. Parodi, and J. Schreiber, Applications of Laser-driven Particle Acceleration. 2018: CRC Press, Taylor & Francis Group.

Hauptvortrag SYPA 1.2 Mi 14:30 Plenarsaal
Laser-driven electron acceleration in plasmas — •Jeroen van Tilborg — BELLA Center, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720

Laser plasma accelerators (LPAs) rely on the interaction of ultra-intense laser pulses ($> 10^{18}$ W/cm^2) and underdense plasma targets (density $\sim 10^{16} - 10^{19}$ cm^{-3}). The short-lived displacement of plasma electrons by the laser pulse results in a plasma wakefield co-propagating with the laser pulse, able to sustain acceleration gradients of order 100 GV/m in cm-scale plasma structures. Various injection schemes have been demonstrated to load background electrons into the wakefield, accelerating them to relativistic energies in well-directed beams.

In recent years, electron beams of several GeV have been demonstrated. The quality of the electron beams is being investigated with ever-advancing methods, targeting the beam emittance, charge, energy distribution, and bunch duration. Beams of sub-micron emittance, few-fs duration, with 10-100s of pC charge at GeV-level energies, all intrinsically locked to the femtosecond laser driver, are key LPA features. The availability of such beams has stimulated funding towards compact light source applications, advanced transport concepts, and high-field science experiments. I will present a general overview of LPAs, as well as highlight the compact light source efforts at the BELLA Center at LBNL.

Supported by: DOE Contract No. DE-AC02- 05CH11231 and the Gordon and Betty Moore Foundation Grant ID GBMF4898.

Hauptvortrag SYPA 1.3 Mi 15:00 Plenarsaal
Beam-driven electron acceleration in plasmas — •Richard D'Arcy — DESY, Notkestr. 85, 22607 Hamburg, Germany

Electric fields in plasma waves, driven by relativistic particle beams, can accelerate particles to tens of GeV energies over metre-scale distances. These accelerating gradients, orders of magnitude higher than those achievable in conventional radio-frequency cavities, have the potential to drastically reduce the footprint of future photon-science and high-energy-physics facilities if a number of technical challenges can be met. Through addressing these challenges, recent conceptual and experimental breakthroughs in the field have ushered in a world-wide effort that may be transformative for accelerators and their applications. To this end, beam-driven plasma-wakefield acceleration (PWFA) holds many potential advantages over other techniques, such as mitigated dephasing and defocussing, the opportunity for depletion studies, and the potential for immediate high-average-power plasma research. PWFA science, therefore, clearly warrants detailed investigation. The advent of experimental PWFA research in the 2000s was ushered in by the FACET and ATF facilities at SLAC and BNL, respectively. Thanks to the milestones reached by these groundbreaking experiments, additional facilities, such as the recently commissioned FLASHForward experiment at DESY – a precision PWFA facility with FEL-quality beams and MHz rep. rate capability – and the upcoming FACET-II – the ultra-high peak-current successor to FACET – will strive to make transformative leaps in the field in order to assess whether plasma-wakefield acceleration truly represents the wave of the future.

Hauptvortrag SYPA 1.4 Mi 15:30 Plenarsaal
Solar energetic electron events: Trying to understand the role of the shock — •Nina Dresing[1], Max Bruedern[1], Raúl Gómez-Herrero[2], Bernd Heber[1], Andreas Klassen[1], Manuela Temmer[3], Solveig Theesen[1], and Astrid Veronig[3] — [1]University of Kiel, Geramy — [2]SRG, University of Alcalá, Alcalá de Henares, Spain — [3]University of Graz, Austria

Solar energetic particles (SEPs) are believed to be accelerated either within strong magnetic re-connection areas at the Sun, so-called solar flares, or at shock fronts which may be driven by fast coronal mass ejections (CMEs). A specific class of events are the so-called widespread SEP events, where the energetic particles can be observed up to all around the Sun by multiple spacecraft at the same time. For these events an extended shock front is often favored to explain the extraordinarily wide particle distributions. However, in-situ observations of shocks at Earth's orbit reveal nearly no efficiency in accelerating electrons to energies of about 100 keV and more, typical for SEP events. We will show multi-spacecraft observations of the two STEREO and close-to-Earth observatories combining remote-sensing and in-situ measurements. We especially use energetic particle anisotropy observations to disentangle injection and transport effects to shed some light on the role of CME-driven shocks for the electron acceleration and their wide longitudinal distribution in the inner heliopshere.