3rd European Advanced Accelerator Concepts Workshop

Contributions book

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Contribution ID : 1

ultrashort PW lasers pulse interaction with target and ion acceleration

Monday 25 Sep 2017 at 16:25 (00h25')

Content :

The unique exploratory mission of laser driven ion acceleration research is to build the scientific foundation needed to develop high energy laser-particle accelerators. This presentation will discuss the ion acceleration obtained on 1.5 PW laser. The newly found scenario of ion acceleration offers more favorable proton energy scaling with laser intensity than it is known for “ordinary” so-called Target-Normal-Sheath-Acceleration. For the first time the ion energy scaling law for acceleration process in the ultra-short regime was extend beyond 1020 W/cm2.
However, at ultrahigh contrast of the laser pule on the electron density profile at the target surface a regular structure is generated during the interaction which acts as a grating and some of the diffraction maxima is under back reflection angle [1]. This back reflection of the order of 1% of laser energy, measured in the experiments, can lead to a serious constraints on both the laser operation (cause damage) and the conditions of interaction.
These investigations are closely related to recent development or imminently anticipated development of laser technology to bring the existing laser systems to a multi-PW level.

[1] S. Ter-Avetisyan et al., Optics Express, 24, 28104 (2016)

Primary authors : Prof. TER-AVETISYAN, Sargis (ELI-ALPS)

Co-authors :

Presenter : Prof. TER-AVETISYAN, Sargis (ELI-ALPS)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 2

Energy efficiency studies for dual-grating dielectric laser-driven accelerators

Thursday 28 Sep 2017 at 17:00 (00h15')

Content :

Dielectric laser-driven accelerators (DLAs) utilizing large electric field from commercial laser system to accelerate particles with high gradients in the range of GV/m have the potential to realize a first particle accelerator 'on a chip'. Dual-grating structures are one of the candidates for DLAs. They can be mass-produced using available nanofabrication techniques due to their simpler structural geometry compared to other types of DLAs. So far the dual-grating structures have been reported to improve the electron energy efficiency through geometry optimizations. Apart from optimizations, this talk proposes two new schemes to improve the electron energy efficiency for dual-grating structures. One is to introduce a Bragg reflector that can boost accelerating field in the channel, thereby generating a 70% higher energy gain compared to bared dual-grating structures. A pulse-front-tilt operation for a laser beam is proposed as a second scheme to extend the interaction length, thereby resulting in a greater energy gain by (133±32)% for a dual-grating DLA. The detailed analytical calculations and particle-in-cell simulations for both schemes will be presented in this talk. In addition, some fabrication studies for dual-gratings are also included in this talk.

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Presenter : Mr. WEI, Yelong (University of Liverpool/Cockcroft Institute)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 3

Isochoric heating of solid gold targets with the PW-laser-driven ion beams

Monday 25 Sep 2017 at 18:20 (00h20')

Content :

We present first results on ion acceleration with the BELLA PW laser as well as end-to-end simulation for isochoric heating of solid gold targets using PW-laser generated ion beams: (i) 2D Particle-In-Cell (PIC) simulations are applied to study the ion source characteristics of the PW laser-target interaction at the long focal length (f/65) beamline at laser intensities of ~5×10^19 Wcm-2 at spot size of 0=53 m on a CH target. (ii) In order to transport the ion beams to an EMP-free environment, an active plasma lens will be used. This was modeled [1] by calculating the Twiss parameters of the ion beam from the appropriate transport matrixes taking the source parameters obtained from the PIC simulation. (iii) Hydrodynamic simulations indicate that these ion beams can isochorically heat a 1 mm3 gold target to the Warm Dense Matter state.

Reference:
J. van Tilborg et al, Phys. Rev. Lett. 115, 184802 (2015).

This work was supported by Laboratory Directed Research and Development (LDRD) funding from Lawrence Berkeley National Laboratory, provided by the Director, Office of Science, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

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Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 4

Indirect Measurement of the Self-Modulation Instability in the AWAKE experiment at CERN

Wednesday 27 Sep 2017 at 16:00 (00h18')

Content :

The AWAKE experiment at CERN aims to create GV/m plasma wakefields over a length of 10 m by using a self-modulated 400 GeV/c proton drive beam from the CERN SPS. The first AWAKE run taking place in 2016 and 2017 is dedicated to study the physics and development of the Self-Modulation Instability within the first few meters of plasma. The two screen measurement aims to measure the radial proton beam distribution 2 m and 10 m downstream the end of the plasma to show that protons get defocused in the order of 1 mrad. Measuring maximum defocusing angles in this order requires GV/m radial plasma wakefields, which can only be present if the Self-Modulation Instability developed successfully. We present the first analysis results of the indirect SMI two-screen measurement and we give estimates on the strength of the created plasma-wakefields.

Primary authors : Mrs. TURNER, Marlene (CERN/TU Graz)

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Presenter : Mrs. TURNER, Marlene (CERN/TU Graz)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 5

150 years of Maxwell's (other) equations and application to plasma wakefield acceleration

Tuesday 26 Sep 2017 at 16:00 (00h20')

Content :

In 1867, just two years after laying the foundations of electromagnetism, J. Clerk Maxwell presented a fundamental paper on gas dynamics, in which he described the evolution of the gas in terms of certain "moments" of its velocity distribution function. This inspired Ludwig Boltzmann to formulate his famous kinetic equation, from which followed the H-theorem and the connection with entropy. The present talk celebrates the 150th anniversary of the publication of Maxwell's formalism, and discusses how its generality and adaptability enable it to play a key role in efficient modeling of electron beams in plasma wakefield acceleration.

Primary authors : Prof. ROBSON, Robert (James Cook University)

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Presenter : Dr. MEHRLING, Timon (Deutsches Elektronen-Synchrotron DESY)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 6

Phase-space reconstruction of low-emittance electron beams through betatron radiation in a laser-plasma accelerator at FLAME facility

Monday 25 Sep 2017 at 16:30 (00h20')

Content :

A new methodology able to model and reconstruct the transverse phase space of low-emittance electron
beams accelerated in the bubble regime of laser-plasma interaction is presented. The single-shot
measurement of both the electron energy spectrum and the betatron radiation spectrum is shown to
allow a complete measurement of the transverse emittance, including the correlation term. A novel
technique to directly measure the betatron oscillation amplitude distribution is described and tested at the SPARC-LAB test facility through the interaction of the ultrashort ultraintense Ti:Sa laser FLAME with a He gas-jet target. Via the exposed technique the beam transverse profile is also retrieved. From the study of the electron transverse dynamics inside the plasma bubble, the nonlinear correlation between the betatron amplitude and the divergence, i.e. the angle with respect the acceleration axis, is found. The angular distribution of the electron beam inside the bubble is retrieved. The knowledge of the phase-space density allows a more accurate measurement of the transverse emittance with respect to previous paradigms.

Primary authors : CURCIO, Alessandro (LNF)

Co-authors : ANANIA, Maria Pia (LNF) ; BISESTO, Fabrizio Giuseppe (LNF) ; CHIADRONI, Enrica (LNF) ; CIANCHI, Alessandro (ROMA2) ; FERRARIO, Massimo (LNF) ; FILIPPI, Francesco (LNF) ; GIULIETTI, Danilo (PI) ; MAROCCHINO, Alberto (LNF) ; PETRARCA, Massimo (ROMA1) ; SHPAKOV, Vladimir (LNF) ; Mr. ZIGLER, Arie (Racah Institute of Physics, Hebrew University, Jerusalem 91904, Israel) ; MIRA, Francesco (R)

Presenter : CURCIO, Alessandro (LNF)

Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 7

Multiple beam acceleration based on proton-driven wakefield in a hollow plasma channel

Tuesday 26 Sep 2017 at 17:00 (00h15')

Content :

Proton-driven plasma wakefield acceleration has recently been proposed to accelerate a bunch of electrons to more than 600 GeV in a single stage of acceleration. This may pave the way to realising the energy frontier colliders based on this scheme in the future. However, the resulting beam quality and luminosity are not good enough for the direct applications. In this paper, we propose a new scheme of multiple beam acceleration from the proton-driven wakefield in a hollow plasma channel. The simulation results show that multiple electron or positron bunches can be accelerated simultaneously in the proton-driven wakefield at hollow plasma channel. The resultant beam quality is well preserved after long distance propagation in plasma. In addition, this multiple beam acceleration scheme enhances the collider luminosity significantly.

Primary authors : Ms. LI, Yangmei (University of Manchester) ; Mr. WILLIAMSON, Barney (University of Manchester and Cockcroft Institute) ; Dr. XIA, Guoxing (Cockcroft Institute and the University of Manchester)

Co-authors :

Presenter : Ms. LI, Yangmei (University of Manchester, Cockcroft Institute)

Session classification : WG8_Parallel

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 8

Experimental investigation of high transformer ratio PWFA using photocathode laser based bunch shaping

Monday 25 Sep 2017 at 16:54 (00h18')

Content :

Since the first considerations on beam driven plasma wakefield acceleration (PWFA) the energy transfer efficiency from drive to witness bunch has been the subject of detailed investigations. The energy transfer efficiency is mainly defined by the ratio of the accelerating fields in the witness to the decelerating fields in the driver bunch, the so called transformer ratio, as well as by the correlated homogeneity of deceleration in the driver. Several methods to maximise the transformer ratio have been introduced theoretically, where the most promising are based on long, shaped drive bunches. The difficulty of such methods is the creation and transport of such bunches. As they are longer than the plasma wavelength, they can be subject to several plasma instabilities preventing controlled acceleration. After the first successful experimental demonstration of high transformer ratio PWFA at the Photoinjector test facility, DESY Zeuthen site (PITZ), which employed such long, shaped drive bunches, our efforts focus on the investigation of different driver bunch shapes, as well as advanced bunch shaping techniques. Simulations and experimental results on these investigations will be presented.

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Presenter : LOISCH, Gregor (DESY Zeuthen)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 9

On the spontaneous emission in quantum free-electron lasers

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

In this work, we investigate the spontaneous emission process and its detrimental effects on coherent free-electron laser (FEL) emission. In our model, the electron dynamics are described by a discrete Wigner distribution coupled to Maxwell equations. For an FEL operating in the quantum regime of single photon recoil, insights on the variation of momentum distribution, bunching factor, and radiation power are presented. We also derive a simple differential equation that describes the evolution of the radiated power in the linear regime. It is shown that the essential results of this work agree with those predicted by a density matrix approach.

Primary authors : FARES, Hesham ()

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Presenter : FARES, Hesham ()

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 10

Experimental measurement of transverse wakefields in hollow plasma channels

Monday 25 Sep 2017 at 16:00 (00h18')

Content :

Plasma wakefield acceleration (PWFA) is a promising technology for a compact TeV-scale electron-positron collider. While great progress has been made on PWFA for electrons, the same is not true for positrons. Hollow channel plasma wakefield acceleration (HC-PWFA) is a promising alternative approach for accelerating positrons, where energy is transferred from a drive bunch to a trailing bunch in a hollow tube of plasma via a strong longitudinal wakefield. However, an offset drive beam also excites a transverse wakefield, whereby the drive and trailing beams are strongly deflected away from the axis. This sets stringent limits on alignment tolerances; one of the main challenges for a HC-PWFA-based collider. We present experimental measurements of the longitudinal profile of this transverse wakefield, based on data from the FACET 2016 positron run, and compare these to theoretical predictions.

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Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 11

Plasma lens experiments at the CLEAR Test Facility, CERN

Tuesday 26 Sep 2017 at 18:20 (00h20')

Content :

Future plasma-based accelerators will need strong and compact focusing elements to complement the high gradient acceleration, in particular for beam transport between plasma stages. Using discharge capillary (active) plasma lenses is a promising technology, providing axially symmetric (focusing only) large magnetic field gradients at cm-scale. This is achieved by passing a strong discharge current through a long, thin capillary to set up a focusing magnetic field. The newly commissioned CLEAR Test Facility at CERN (previously the CALIFES injector at CTF3) provides an ideal beam to characterize such a discharge capillary plasma lens. We present early experimental results from the 2017 run.

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Co-authors : Mr. FARABOLINI, Wilfrid (CEA/IRFU and CERN) ; GAMBA, Davide (CERN; John Adams Institute (JAI)) ; CORSINI, Roberto (CERN) ; Prof. HOOKER, Simon (University of Oxford) ; Dr. DYSON, Anthony (Oxford University) ; Dr. OSTERHOFF, Jens (Deutsches Elektronen-Synchrotron DESY) ; Mr. ROECKEMANN, Jan-Hendrik (DESY) ; Dr. ADLI, Erik (University of Oslo, Norway) ; Dr. SCHAPER, Lucas (University Hamburg / DESY)

Presenter : Mr. LINDSTRØM, Carl Andreas (University of Oslo)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 12

Simulations of an energy dechirper based on dielectric lined waveguides

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

THz wakefields can be excited by ultra-short relativistic electron bunches travelling through the dielectric lined waveguide (DLW) structures. These wakefields can either accelerate a witness bunch with gradient two or three orders of magnitude larger than that in the conventional RF linear accelerators, or introduce energy modulation within the driving bunch itself. In this paper, we study a dechirper based on the DLW to compensate the correlated energy spread of the bunches accelerated by the laser plasma wakefield accelerator (LWFA). A rectangular waveguide structure is employed taking advantage of its continuously tunable gap during operation. The assumed 200 MeV driving bunch has a Gaussian distribution with a bunch length of 3.0 μm, a relative correlated energy spread of 1%, and a total charge of 10 pC. Both of the CST Wakefield Solver and PIC Solver are used to simulate and optimize such a dechirper. The effects of the time-dependent self-wake on the driving bunch will be analyzed in terms of the energy modulation and the transverse phase space.

Primary authors : Dr. NIE, Yuancun (CERN)

Co-authors : Dr. XIA, Guoxing (Cockcroft Institute and the University of Manchester) ; Mr. PACEY, Thomas (University of Manchester and the Cockcroft Institute)

Presenter : Dr. XIA, Guoxing (Cockcroft Institute and the University of Manchester)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 13

LIGHT: Generation of highest peak intensities of ultrashort MeV proton bunches and going towards applications

Wednesday 27 Sep 2017 at 18:00 (00h20')

Content :

Laser-driven ion acceleration became a promising field in the past 20 years. The Laser Ion Generation, Handling and Transport (LIGHT) collaboration makes in this field a significant impact. This collaboration was founded to combine laser-driven ion acceleration with conventional accelerator technology. It consists of several university groups (Technische Universität Darmstadt, Technische Universität Dresden, Johann Wolfgang Goethe-Universität Frankfurt) and research centers (GSI Helmholtzzentrum für Schwerionenforschung, Helmholtzzentrum Dresden-Rossendorf, Helmholtzinstitut Jena). In the last few years, a 6 m long test beamline was set up at GSI and sub-nanosecond, intense MeV proton bunches were generated through phase focussing. In the next experiments, the beam homogeneity has been improved to enable the time-resolved imaging capability. Moreover, first energy loss pre-experiments are planned based on specially developed ultrafast diamond detectors.

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Presenter : JAHN, Diana (Technische Universität Darmstadt)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 14

Evolution of electrical fields generated during interaction of high intensity laser with structured targets

Wednesday 27 Sep 2017 at 09:50 (00h40')

Content :

Interaction of high-intensity laser pulses with solid targets results in generation of large quantities of energetic electrons that are the origin of various effects such as intense x-ray emission, ion acceleration,etc
Our, recent measurements related to the field enhancement conducted on FLAME laser will be presented. We realized a spatially - resolved Electro Optical Sampling by using a crystal and a laser-probe. Such solution allows monitoring temporal profile (with resolution < 100 fsec) in a single-shot way. We retrieved the bunch Coulomb electric field, allowing retrieving the temporal profile and the quantity of the escaped electrons and demonstrated the field enhancement process by structured targets. In the case of the planar foil target, the signal shows the presence of a first emitted bunch with charge ~1. 2 nC Laser interaction with the tip target produced a much larger number of released electrons.We report, for the first time, a novel femtosecond-resolved experimental study of the fields generated by the interaction. Our results reveal the temporal evolution of large fields, up to 0.6 TV/m, that generated close to the target.. Such a picture represents a new step toward the understanding of the interaction mechanism.

Primary authors : Prof. ZIGLER, Arie (Hebrew University of Jerusalem)

Co-authors : Dr. POMPILI, Riccardo (LNF) ; BISESTO, Fabrizio Giuseppe (LNF) ; FERRARIO, Massimo (LNF) ; ANANIA, Maria Pia (LNF) ; Dr. CURCIO, Alessandro (INFN,Pisa) ; Prof. BUTTON, Mordehai (Hebrew University of Jeruasalem) ; Dr. HENIS, Zohar (Hebrew University of Jerusalem) ; Mr. SCHLEIFER, elad (Hebrew University of Jerusalem)

Presenter : Prof. ZIGLER, Arie (Hebrew University of Jerusalem)

Session classification : Plenary 5

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 15

First experimental evidence for self-modulation of an electron bunch in a plasma

Tuesday 26 Sep 2017 at 11:00 (00h30')

Content :

The self-modulation instability is fundamental for the plasma wakefield acceleration experiment of the AWAKE collaboration at CERN where this effect is used to generate proton bunches short enough for producing high acceleration fields. Utilizing the availability of flexible electron beam shaping together with excellent diagnostics including an RF deflector, a supporting experiment was set up at the electron accelerator PITZ (Photo Injector Test facility at DESY, Zeuthen site). This gives valuable results since the underlying physics is the same for electron and proton beams. The goals are to demonstrate and investigate in detail the self-modulation of long electron beams.
In 2016 experiments were conducted with an improved setup compared to the preceding year. An upgraded plasma cell with improved layout was used together with an ArF excimer laser for plasma generation. Here we present first measurements showing clear evidence of self-modulation: the longitudinal profile of the self-modulated electron bunch was measured with an RF deflector. Additionally the longitudinal phase space was measured showing characteristic energy modulations.

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Presenter : Dr. GROSS, Matthias (DESY)

Session classification : Plenary 4

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 16

LIGHT: Improving the proton beam homogeneity and first imaging results

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The Laser Ion Generation, Handling and Transport (LIGHT) collaboration makes a significant impact in the field of laser-driven ion acceleration. Within this collaboration, laser-driven ion acceleration is combined with conventional accelerator technology (see talk). One research topic within the LIGHT project is the improvement of the beam homogeneity and demonstrate the proton imaging capability. First results will be presented on the poster.

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Presenter : JAHN, Diana (Technische Universität Darmstadt)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG2 - Ion Beams from Plasmas

Type : poster

Contribution ID : 18

Demonstration of a beam loaded nanocoulomb-class laser wakefield accelerator

Monday 25 Sep 2017 at 18:36 (00h18')

Content :

Laser-plasma wakefield acceleration is capable of producing quasi-monoenergetic electron beams reaching into the GeV range with few-femtoseconds bunch duration. Scaling the charge to the nanocoulomb range would yield hundreds of kiloamperes peak-current and stimulate the next generation of radiation sources covering high-field THz, high-brightness X-ray and γ-ray sources, compact FELs and laboratory-size beam-driven plasma accelerators. Laser-plasma accelerators generating such high currents operate in the beam loading regime where the accelerating field is strongly modified by the self-fields of the injected bunch, improving the final beam quality if appropriately controlled. Here we experimentally investigate the effects of beam loading at the theoretically predicted limit by loading unprecedented charges of about 0.5 nC within a mono-energetic peak into the first plasma cavity. As the energy balance is reached, the final energy spread is minimized. We show that the beam quality is maintained up to an estimated peak-current of 50 kA, an order of magnitude larger than in state-of-the-art conventional and laser-plasma accelerators.

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Presenter : Mr. COUPERUS, Jurjen (Helmholtz-Zentrum Dresden - Rossendorf)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 19

EuPRAXIA@SPARC_LAB: design study towards a new compact FEL facility at LNF

Wednesday 27 Sep 2017 at 18:00 (00h15')

Content :

On the wake of the results obtained so far at the SPARC_LAB test-facility at LNF, we are currently investigating the possibility to design and build a new multi-disciplinary user-facility, equipped with a soft X-ray Free Electron Laser (FEL) driven by a ~1 GeV high brightness linac based on plasma accelerator modules. It is in fact widely accepted by the international accelerator scientific community that a fundamental milestone towards the realization of a plasma driven future Linear Collider (LC) will be the integration of the new high gradient accelerating plasma modules in a FEL user facility (see the H2020 approved Design Study EuPRAXIA). This fundamental goal will be integrated in the LNF facility by using a high gradient X-band RF linac and the high power laser FLAME to drive Plasma Oscillations in the accelerator module. This design study is performed in synergy with the EuPRAXIA design study and is aiming also to candidate the LNF site as a possible hosting laboratory of the future EuPRAXIA project. In this talk we report about the recent progresses in the on going design study of the new facility.

Primary authors : FERRARIO, Massimo (LNF)

Co-authors :

Presenter : FERRARIO, Massimo (LNF)

Session classification : WG1-WG8 Joint Session

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 20

Energy spread of the beam induced by betatron radiation in PWFA

Tuesday 26 Sep 2017 at 16:30 (00h15')

Content :

Energy spread caused by the longitudinal size of the beam is well known in PWFA. Usually this issue can be resolved with beam loading effect that allows to keep accelerating field constant, or close to constant, along all the duration of the beam. In this work however, we would like to address another source of energy spread, that arises at higher energies - betatron radiation.

Primary authors : SHPAKOV, Vladimir (LNF)

Co-authors : FERRARIO, Massimo (LNF) ; Dr. ROSSI, Andrea Renato (MI) ; MAROCCHINO, Alberto (LNF)

Presenter : SHPAKOV, Vladimir (LNF)

Session classification : WG8_Parallel

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 22

Simulations of the possible AWAKE Run-2 experiment at CERN

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The AWAKE Run-2 is a possible extension of the current AWAKE experiment on the proton driven plasma wakefield acceleration using the 400 GeV beam from the CERN SPS accelerator. The current AWAKE experiment is aimed at the proof-of-principle demonstration of electron acceleration driven by a self-modulating proton beam in plasma, while the focus of the proposed AWAKE Run-2 experiment will be on application of this technology for acceleration of electron bunch with a reasonably high quality and intensity. A better quality of accelerated electron beam can be achieved by injecting the short and intense electron bunch after the stabilization of self-modulating proton beam over the first 7-10 m of plasma. 2D and 3D quasi-static PIC simulations of the proposed experiment will be presented.

Primary authors : Dr. PETRENKO, Alexey (CERN)

Co-authors : Prof. LOTOV, Konstantin (Novosibirsk State University) ; Mr. MINAKOV, Vladimir (Novosibirsk State University) ; Prof. PUKHOV, Alexander (uni duesseldorf) ; SOSEDKIN, Alexander (Novosibirsk State University)

Presenter : Dr. PETRENKO, Alexey (CERN)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 23

Spectral and spatial shaping of a laser-accelerated proton beam for radiation biology applications

Monday 25 Sep 2017 at 19:00 (00h15')

Content :

Laser accelerated proton beams have an extremely high peak current and a total charge per shot in the order of nC. However, their wide divergence and continuous spectra make their application to target irradiation difficult. On the SAPHIR laser (LOA) we used a set of permanent magnet quadrupoles to focus the proton beam to a wide irradiation area for in vitro irradiation studies. Absolutely calibrated online dosimetry provides control on the stability of irradiation conditions. Our study represents a step forward in the practical use of laser-accelerated ion beams, and opens the way to the exploration of radiation biology at dose rates exceeding 10^8 Gy/s.

Primary authors : Dr. FLACCO, Alessandro (LOA/ENSTA)

Co-authors : Mr. POMMAREL, Loann (Laboratoire d'Optique Appliquée, ENSTA-Paris Tech / École Polytechnique / CNRS) ; SCHILLACI, Francesco (LNS) ; ROMANO, Francesco (LNS) ; Dr. SCUDERI, Valentina (LNS) ; CIRRONE, Giuseppe (LNS) ; Prof. DEUTSCH, Eric (INSERM U1030, Gustave Roussy–Cancer Campus–Grand Paris) ; Prof. MALKA, Victor (LOA) ; Dr. VAUZOUR, Benjamin (CEA, DAM, DIF, F-91297 Arpajon, France) ; Dr. MÉGNIN-CHANET, Frédérique (INSERM U1030, Gustave Roussy–Cancer Campus–Grand Paris) ; Dr. BAYART, Émilie (LOA/École Polytechnique) ; Dr. DELMAS, Olivier (LOA/École Polytechnique) ; Dr. GOUDJIL, Farid (Institut Curie—Centre de Protonthérapie d'Orsay) ; Dr. NAURAYE, Catérine (Institut Curie—Centre de Protonthérapie d'Orsay) ; Dr. LETELLIER, Virgile (Institut Curie—Centre de Protonthérapie d'Orsay) ; Dr. POUZOULET, Fréderic (Institut Curie, Translational Research Department)

Presenter : Dr. FLACCO, Alessandro (LOA/ENSTA)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 24

Dielectric wakefield R programme at Daresbury Laboratory

Monday 25 Sep 2017 at 16:30 (00h20')

Content :

Construction of CLARA Phase I at Daresbury Laboratory is now completed and the machine is being currently commissioned. Combined with already existing VELA beamline and recently upgraded experimental beam area, this new facility is now capable of conducting a variety of experiments including advanced accelerator concepts R The beam area is further enhanced by the availability of high power TW femtosecond laser. In its current state, the facility is capable of generating sub-ps electron bunches with up to 250pC bunch charge, ~50MeV beam energy and at a rep-rate of 10Hz (with further upgrade to 400Hz).
As part of the overall exploitation programme, the dielectric wakefield R will be conducted at CLARA/VELA facility. First steps include generation of tunable THz radiation and preliminary studies of dielectric dechirper for CLARA FEL.
In this presentation, a brief overview of CLARA/VELA facility is given, summary of electron beam characterisation and first results with planar variable gap dielectric wakefield structure is also presented.

Primary authors : Dr. SAVELIEV, Yuri (STFC, Daresbury Lab., ASTeC)

Co-authors : Dr. XIA, Guoxing (Cockcroft Institute and the University of Manchester) ; Ms. HEALY, Alisa (Cockcroft Institute, Lancaster Uni.) ; Mr. PACEY, Thomas (Cockcroft Institute, Manchester Uni.) ; Mr. SURMAN, mark (STFC, Daresbury Lab., ASTeC) ; Mr. WALSH, David (STFC, Daresbury Lab., ASTeC)

Presenter : Dr. SAVELIEV, Yuri (STFC, Daresbury Lab., ASTeC)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 25

Measurement of Transformer Ratio from Ramped Beams in the Blowout Regime

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

We present the plans for, and initial results from, a UCLA-Argonne collaborative plasma wakefield acceleration (PWFA) experiment aimed at demonstrating the dependence of transformer ratio – the relation between maximum acceleration observed in a plasma wake to the maximum deceleration of the driving beam – on beam shape. Utilizing the unique capabilities of the emittance exchange (EEX) beamline, we may obtain transformer ratios in excess of six in a ~120 MeV/m PWFA. These experiments are a crucial step in enabling applications ranging from compact X-ray free electron laser (FEL) light sources to TeV-class linear colliders for high energy physics.

Primary authors : Mr. ROUSSEL, Ryan (University of California Los Angeles)

Co-authors : Prof. ROSENZWEIG, James (UCLA) ; Dr. ANDONIAN, Gerard (UCLA) ; POWER, John (Argonne National Laboratory)

Presenter : Mr. ROUSSEL, Ryan (University of California Los Angeles)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 26

Cascaded acceleration of highly energetic carbon ions by single femtosecond laser pulses and nanotargets

Wednesday 27 Sep 2017 at 16:00 (00h20')

Content :

It is demonstrated in experiments and simulations that radiation pressure acceleration (RPA) and sheath acceleration of ions can be automatically cascaded in sequence when a single n ultraintense femtosecond laser pulse is focused on a double-layer target composed of well controlled, slightly underdense plasma and ultrathin foil. We reveal that such cascaded acceleration is especially suited for heavy ion acceleration with femtosecond lasers by combining the merits of RPA and sheath acceleration. At optimal condition, carbon ions with energy per nucleon up to 48 MeV/u were generated with pulse energy of 9.2 J on targets. With the spreading of petawatt laser systems all over the world, laser-based heavy ion sources employing this scheme may trigger significant advances in nuclear physics, high energy density physics, and medical physics.

Primary authors : Prof. MA, wenjun (Peking university)

Co-authors : Dr. KIM, I Jong (Center for Relativistic Laser Science, Institute for Basic Science, Gwangju 61005, Korea) ; Dr. YU, jinqing (Peking university) ; Prof. SCHREIBER, Jörg (LMU Munich) ; Prof. ZEPF, Matt (Department of Physics and Astronomy, Centre for Plasma Physics, Queens University, Belfast BT7 1NN, United Kingdom) ; Prof. YAN, xueqing (Peking University) ; Prof. NAM, Chang Hee (Center for Relativistic Laser Science, Institute for Basic Science, Gwangju 61005, Korea)

Presenter : Prof. MA, wenjun (Peking university)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 28

New concept of light ion acceleration from low-density target

Wednesday 27 Sep 2017 at 17:15 (00h15')

Content :

In this talk we discuss further development of the recently proposed concept of proton synchronized acceleration by slow light (SASL) from low-density targets by powerful laser pulses [Brantov et.al, Phys.Rev.Lett. 116, 085004 (2016)]. The key point of SASL is the capability for the laser pulse first to slow and then to increase its group velocity monotonically inside a target. Ions are accelerated by laser ponderomotive electric sheath, which propagates in the plasma with the same group velocity as a laser pulse. The monotonic increase of the pulse group velocity makes ions achieve a synchronized acceleration in this sheath. Based on 3D PIC simulations we compare the features of ion acceleration by linearly and circularly polarized laser pulses from thin foils and low-density targets to show advantage of SASL mechanism. The discussion of advances of circularly polarized laser pulses for ion acceleration is addressed in details.
This work was supported by the Russian Science Foundation (Grant # 17-12-01283).

Primary authors : Dr. BRANTOV, Andrey (P.N. Lebedev Physical Institute of the Russian Academy of Sciences)

Co-authors : Prof. BYCHENKOV, Valery (P.N. Lebedev Physical Institute of the Russian Academy of Sciences)

Presenter : Dr. BRANTOV, Andrey (P.N. Lebedev Physical Institute of the Russian Academy of Sciences)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 29

Laser-plasma acceleration inducing nuclear fusion reactions

Wednesday 27 Sep 2017 at 19:00 (00h15')

Content :

After the development of very high intensity, ultra-short pulse laser systems, laser-plasma acceleration has become a concrete reality. This new acceleration technique is an interesting alternative to the gigantism of conventional accelerators and is, however, paving the way for innovative applications in a number of fields, especially the medical one. What was difficult to predict is that such acceleration techniques could also be useful in the field of the studies on nuclear fusion processes. In fact, considering the energy values of protons and ions accelerated by laser-plasma techniques (some MeV/uma), it is possible to induce nuclear fusion processes by addressing these protons/ions on suitable targets. Essentially, instead of bringing the fusion plasma to several dozen or hundreds of keVs, the partners of the fusion process are collided, giving them a kinetic energy in the mass center of the same order or higher. This report will present recent results obtained in collaboration with the INER group of the ENEA Research Center in Frascati at the CELIA laboratory in Bordeaux, regarding the nuclear fusion processes D+D and p+11B.

Primary authors : Prof. GIULIETTI, danilo (Pisa University)

Co-authors :

Presenter : Prof. GIULIETTI, danilo (Pisa University)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 30

New Measurement Techniques Using a Novel X-band Transverse Deflecting Structure with Variable Polarization

Monday 25 Sep 2017 at 17:00 (00h15')

Content :

A transverse deflecting structure is a well-known device for the characterization of the longitudinal properties of an electron bunch in a linear accelerator. The standard use of such a cavity involves streaking the bunch along a transverse axis and analysing the image on a subsequent screen to find the bunch length and the slice properties along the other transverse axis. A novel X-band deflecting structure, which will allow the polarization of the deflecting field to be adjusted, is currently being designed as part of a collaboration between CERN, DESY and PSI. Using this cavity, the beam distribution can be characterized in all transverse directions. By collecting measurements of bunches streaked at different angles and combining them using tomographic techniques, 3D distributions of the charge density can be reconstructed. In addition, the device can be combined with quadrupole and dipole magnets for transverse and longitudinal phase space measurements. In this paper, possible measurements using this novel device are discussed and simulations are presented to show how these techniques could be applied, for example, at SINBAD, an upcoming research & development facility at DESY.

Primary authors : Mr. MARX, Daniel (DESY)

Co-authors : Dr. ASSMANN, Ralph (DESY) ; Mr. DORDA, Ulrich (DESY) ; MARCHETTI, Barbara (DESY) ; Dr. CRAIEVICH, Paolo (PSI) ; GRUDIEV, Alexej (CERN)

Presenter : Mr. MARX, Daniel (DESY)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 31

Controlled and combined injection schemes for laser wakefield accelerators

Thursday 28 Sep 2017 at 16:00 (00h18')

Content :

The electron injection process is crucial to the performance of a laser wakefield accelerator as a whole. Here we present recent results and scalings for several controlled injection schemes, i.e. ionization-induced injection, shock-front injection and colliding pulse injection. We demonstrate that the combination of ionization-induced injection and shock-front injection permits the reliable generation of quasi-monoenergetic electron beams. Furthermore, shock-front injection and colliding pulse injection can be used simultaneously, leading to tunable, dual-energy electron beams.

Primary authors : Dr. DÖPP, Andreas (LMU / MPQ)

Co-authors : Prof. KARSCH, Stefan (LMU Munich) ; Mr. GILLJOHANN, Max (Ludwig-Maximilians-Universität München) ; SCHINDLER, Sabine (LMU München) ; DING, Hao (LMU München) ; Mr. WENZ, Johannes (Ludwig-Maximilians-Universität München) ; Mr. KHRENNIKOV, Konstantin (Ludwig-Maximilians-University Munich (LMU), Max-Planck-Institute for Quantum Optics(MPQ)) ; Mr. GÖTZFRIED, Johannes (LMU Munich)

Presenter : Dr. DÖPP, Andreas (LMU / MPQ)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 32

Generation handling and transport of laser-accelerated heavy ion beams within LIGHT

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

High intensity laser driven ion sources are of great interest to researchers in the fields of tumor therapy, isochoric heating or energy loss measurements. The extremely low emittance, high luminosity, short pulse lengths and high field gradients, which allow for very short ion beamlines, make laser driven ion generation the ideal ion source for these applications.
In the context of the Laser Ion Generation, Handling and Transport (LIGHT) collaboration we explore laser driven ion acceleration and beam shaping at “GSI Helmholtzzentrum für Schwerionenforschung”. We therefore combine a target normal sheath acceleration (TNSA) ion source with conventional accelerator technology.
A pulsed solenoid serves as beam collimator and energy selector by means of chromatic focusing. The temporally diverging ion beam can then be compressed with a radiofrequency cavity. In previous experimental campaigns intense multi-MeV sub-nanosecond proton bunches could be generated using the LIGHT beamline.
After the successful demonstration of the transport and bunching of laser-generated fluorine ion beams in 2016, experiments in spring and autumn 2017 aim at laser-generated intense carbon ion beams. I will present first promising results of this novel accelerator concept.

Primary authors : Mr. DING, Johannes (Technical University Darmstadt)

Co-authors : Dr. BAGNOUD, Vincent (GSI Helmholtz Centre) ; Dr. BLAZEVIC, Abel (GSI Helmholtz Centre) ; Dr. SCHUMACHER, Dennis (GSI Helmholtz Centre) ; Dr. BRABETZ, Christian (GSI Helmholtz Centre) ; JAHN, Diana (Technische Universität Darmstadt) ; BRACK, Florian-Emmanuel (Helmholtz Centre Dresden-Rossendorf) ; KROLL, Florian (Helmholtz Centre Dresden-Rossendorf) ; Prof. COWAN, Thomas (Helmholtz Centre Dresden-Rossendorf) ; Prof. SCHRAMM, Ulrich (Helmholtz Centre Dresden-Rossendorf) ; Prof. ROTH, Markus (Technische Universität Darmstadt)

Presenter : Mr. DING, Johannes (Technical University Darmstadt)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG2 - Ion Beams from Plasmas

Type : poster

Contribution ID : 33

Long-range attraction of an ultrarelativistic electron beam by a column of neutral plasma

Thursday 28 Sep 2017 at 18:18 (00h18')

Content :

We report on the experimental observation of the attraction of a beam of ultrarelativistic electrons towards a column of neutral plasma. In experiments performed at the FACET test facility at SLAC we observe that an electron beam moving parallel to a neutral plasma column, at an initial distance of many plasma column radii, is attracted into the column. Once the beam enters the plasma it drives a plasma wake similar to that of an electron beam entering the plasma column head-on. A simple analytical model is developed in order to capture the essential physics of the attractive force. The attraction is further studied by 3D particle-in-cell numerical simulations.

Primary authors : Dr. ADLI, Erik (University of Oslo, Norway)

Co-authors : Mr. LINDSTRØM, Carl Andreas (University of Oslo) ; Dr. AN, Weiming (University of California Los Angeles) ; Dr. CLAYTON, Christopher (UCLA) ; Mr. MARSH, Kenneth (UCLA) ; Prof. MORI, Warren (UCLA) ; Prof. JOSHI, Chandrashekhar (UCLA) ; Dr. VAFAEI-NAJAFABADI, Navid (UCLA) ; Mr. CORDE, Sebastien CORDE (Laboratoire d'Optique Appliquée) ; Prof. LU, Wei (Tsinghua University of Beijing, China) ; Mr. ALLEN, James (SLAC) ; GESSNER, Spencer (CERN) ; Dr. FREDERICO, Joel (SLAC) ; Dr. GREEN, Selina (SLAC) ; HOGAN, Mark (SLAC National Accelerator Laboratory) ; Dr. LITOS, Michael Dennis (Univ. of Colorado, Boulder) ; Dr. O'SHEA, Brendan (SLAC National Accelerator Laboratory) ; Dr. YAKIMENKO, Vitaly (SLAC)

Presenter : Dr. ADLI, Erik (University of Oslo, Norway)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 34

Preliminary RF design of an X-Band LINAC for the EuPRAXIA@SPARC_LAB project

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

In the framework of the upgrade of the SPARC_LAB facility at INFN-LNF, named EuPRAXIA@SPARC_LAB, a high gradient LINAC has been foreseen. One of the most suitable options is to realize it in X-Band. A preliminary design study of the accelerating structures and power distribution system has been performed. It is based on 0.5 m long travelling wave (TW) accelerating structures operating on the $2\pi/3$ mode and fed by klystrons and pulse compressor systems. The main parameters of the structures and LINAC are presented with the basic RF LINAC layout.

Primary authors : Mr. DIOMEDE, Marco (Sapienza University of Rome)

Co-authors : ALESINI, David (LNF) ; BELLAVEGLIA, Marco (LNF) ; BUONOMO, Bruno (LNF) ; CARDELLI, Fabio (ROMA1) ; CATALAN LASHERAS, Nuria (CERN) ; CHIADRONI, Enrica (LNF) ; DI PIRRO, Giampiero (LNF) ; FERRARIO, Massimo (LNF) ; GALLO, Alessandro (LNF) ; GHIGO, Andrea (LNF) ; GIRIBONO, Anna (ROMA1) ; GRUDIEV, Alexej (CERN) ; PIERSANTI, Luca (LNF) ; SPATARO, Bruno (LNF) ; VACCAREZZA, Cristina (LNF) ; WUENSCH, Walter (CERN)

Presenter : Mr. DIOMEDE, Marco (Sapienza University of Rome)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 35

Status of the Electron source and transfer lines for the AWAKE Experiment at CERN

Wednesday 27 Sep 2017 at 16:54 (00h18')

Content :

The AWAKE collaboration prepares a proton driven plasma wakefield acceleration experiment using the SPS beam at CERN. A long proton bunch extracted from the SPS interacts with a high power laser and a 10 m long rubidium vapour plasma cell to create strong wakefields allowing sustained electron acceleration. The electron beam to probe these wakefields is created by an electron accelerator consisting of an RF-gun and a booster structure. This electron source should provide beams with intensities between 0.1 to 1 nC, bunch lengths between 0.3 and 3 ps and an emittance of the order of 2 mm mrad. The booster structure should accelerates the electron beam to 16 MeV. The electron line includes a series of diagnostics (pepper pot, BPMs, spectrometer, faraday cup and BTVs) and an optical transfer line merge the electron beam with the proton beam on the same axis. The installation of the electron line started in early 2017 and the commissioning will take place at the end 2017. The layout of the electron accelerator and transfer line, the diagnostics, the installations status and the planning for the commissioning will be presented.

Primary authors : Dr. PEPITONE, Kevin (CERN)

Co-authors : Mr. BAUCHE, Jeremie (CERN) ; Dr. FEDOSSEEV, Valentin (CERN) ; Mr. JENSEN, Lars (CERN) ; Mr. MAZZONI, Stefano (CERN) ; Dr. METE, Oznur (The University of Manchester) ; Dr. SCHMIDT, Janet (CERN) ; Mr. VERZILOV, Victor (TRIUMF) ; Dr. BRACCO, Chiara (CERN) ; Prof. BURT, Graeme (Cockcroft) ; Mr. CHAUCHET, Alan (CERN) ; Dr. DOEBERT, Steffen (CERN) ; Mr. CHEVALLAY, Eric (CERN) ; Mr. CHRITIN, Nicolas (CERN) ; Mr. CURT, Stephane (CERN) ; Mr. DELORY, Cedric (CERN)

Presenter : Dr. PEPITONE, Kevin (CERN)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 36

Design of a 5 GeV laser plasma accelerating module in the quasi-linear regime

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Multi-GeV-class laser-plasma accelerating modules are key-components of laser-plasma accelerators, being used either as a booster of an upstream plasma or conventional injector or as modular acceleration sections of a multi-staged high energy plasma linac. Such a plasma module, operating in the quasi-linear regime, has been especially designed for the 5 GeV acceleration stage of the EuPRAXIA project. The design was based on analytical expressions valid in this regime and simulations with the PIC code WARP were implemented to evaluate its performance. At low bunch charge, the 5 GeV energy gain was achieved with a 30 cm long plasma channel and a quasi-matched laser power around 140 TW, in good agreement with analytical expressions. At practical bunch charge (30 pC), the beam loading and accelerating field curvature effects were partially compensated to minimize the energy spread for Gaussian and triangular bunch shapes. Optimal energy spreads smaller than 4% and 1%, respectively, were obtained while the transverse emittances were preserved. In addition, preliminary studies on the matching of the beam at the entrance and exit of the plasma channel, and on the robustness of the plasma module against various errors have been carried out.

Primary authors : Dr. LI, Xiangkun (CEA/IRFU)

Co-authors : Dr. MOSNIER, Alban (Commissariat à l'Energie Atomique (CEA/IRFU))

Presenter : Dr. LI, Xiangkun (CEA/IRFU)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 37

Studies of an ultra-short bunch injector for AWAKE RUN2

Wednesday 27 Sep 2017 at 17:12 (00h18')

Content :

The proton driven plasma wake-field experiment AWAKE at CERN aims to demonstrate electron acceleration with a long electron bunch in a first series of experiments. After the long shutdown of LHC a second phase for AWAKE is planned starting 2021 called RUN2. In this phase the aim is to demonstrate the acceleration of high quality electron beams therefore a bunch length of the order of 100 fs rms is required corresponding to a fraction of the plasma wavelength. The AWAKE collaboration is studying the design of such an injector either based on classical RF-gun injectors or on laser wake-field acceleration. The focus for the RF accelerator is on a hybrid design using an S-band RF-gun and x-band bunching and acceleration cavities. The status of these studies will be presented.

Primary authors : Dr. DOEBERT, Steffen (CERN)

Co-authors : Mr. WILLIAMSON, Barney (University of Manchester / CERN)

Presenter : Dr. DOEBERT, Steffen (CERN) ; Mr. WILLIAMSON, Barney (University of Manchester / CERN)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 38

High-performance laser proton acceleration using cryogenic hydrogen jet targets with cylindrical and planar geometry

Monday 25 Sep 2017 at 18:00 (00h20')

Content :

We report on recent experimental results deploying a continuous cryogenic hydrogen jet as a debris-free, renewable laser-driven source of pure proton beams generated at the 150 TW ultrashort pulse laser Draco. Efficient proton acceleration reaching cut-off energies of up to 20 MeV with particle numbers exceeding 10^9 particles per MeV per steradian is demonstrated, showing for the first time that the acceleration performance is comparable to solid foil targets with thicknesses in the micrometer range. Two different target geometries are presented and their proton beam deliverance characterized: cylindrical (diameter = 5 µm) and planar (20 µm x 2 µm).

In both cases typical Target Normal Sheath Acceleration emission patterns with exponential proton energy spectra are detected.

Significantly higher proton numbers in laser-forward direction are observed when deploying the planar jet as compared to the cylindrical jet case. This is confirmed by two-dimensional Particle in Cell (2D3V PIC) simulations, which demonstrate that the planar jet proves favorable as its geometry leads to more optimized acceleration conditions.

Primary authors : Mrs. OBST, Lieselotte (Helmholtz-Zentrum Dresden-Rossendorf)

Co-authors : Dr. ZEIL, Karl (Helmholtz-Zentrum Dresden-Rossendorf) ; Mr. REHWALD, Martin (Helmholtz-Zentrum Dresden-Rossendorf) ; Dr. SCHLENVOIGT, Hans-Peter (Helmholtz-Zentrum Dresden - Rossendorf) ; Mr. BRACK, Florian-Emanuel (Helmholtz-Zentrum Dresden-Rossendorf) ; Dr. METZKES, Josefine (Helmholtz-Zentrum Dresden-Rossendorf) ; Mr. HUEBL, Axel (Helmholtz-Zentrum Dresden-Rossendorf) ; Dr. KLUGE, Thomas (Helmholtz-Zentrum Dresden-Rossendorf) ; Mr. BRANCO, João (Helmholtz-Zentrum Dresden-Rossendorf) ; Dr. KRAFT, Stephan (Helmholtz-Zentrum Dresden-Rossendorf) ; Mr. LOESER, Markus (Helmholtz-Zentrum Dresden-Rossendorf) ; Mr. ZIEGLER, Tim (Helmholtz-Zentrum Dresden-Rossendorf) ; Prof. SCHRAMM, Ulrich (Helmholtz-Zentrum Dresden-Rossendorf) ; Prof. COWAN, Thomas (Forschungszentrum Dresden-Rossendorf) ; Dr. GÖDE, Sebastian (European XFEL) ; Mr. KAZAK, Lev (University of Rostock, Germany) ; Mr. WOLTER, Steffen (University of Rostock, Germany) ; Dr. GAUTHIER, Maxence (SLAC National Accelerator Laboratory) ; Mrs. CURRY, Chandra (SLAC National Accelerator Laboratory) ; Dr. RÖDEL, Christian (Friedrich-Schiller-University Jena, Germany) ; Dr. GLENZER, Siegfried (SLAC National Accelerator Laboratory)

Presenter : Mrs. OBST, Lieselotte (Helmholtz-Zentrum Dresden-Rossendorf)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 40

High frequency laminated metallic structures for particles radiation and acceleration

Monday 25 Sep 2017 at 19:10 (00h20')

Content :

The results of theoretical, numerical and experimental studies of two-layer metallic structures electro-dynamical properties are presented. For the low conductivity inner layer the longitudinal impedance has a narrow band resonance at high frequency when the inner layer thickness is smaller than the skin depth. The resonant frequency is determined by the tube radius and the inner layer thickness. The resonance is conditioned by the synchronous TM01 fundamental mode, which forms the particle radiation and can support the particle acceleration. The spectrum measurements for the copper-germanium flat structure is presented and compared with theoretical predictions.

Primary authors : Prof. TSAKANOV, Vasili (CANDLE Synchrotron Research Institute)

Co-authors :

Presenter : Prof. TSAKANOV, Vasili (CANDLE Synchrotron Research Institute)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 41

Proton acceleration studies with ultrashort PW pulses at DRACO

Monday 25 Sep 2017 at 19:15 (00h15')

Content :

With the recent upgrade, the DRACO Ti:Sa laser at Helmholtz-Zentrum Dresden – Rossendorf (HZDR), became a multi-beam, multi-target-area laser facility, delivering pulses of 30 fs pulse duration with energies of up to currently 30 J. The implementation of a "plug-in" plasma mirror allows to study the scaling of ion acceleration performance with laser pulse energy, temporal pulse contrast and target thickness while all further, typically facility-dependent conditions remain fixed. For the studies, a suite of single-shot, online diagnostics to monitor pre-interaction laser pulse parameters, laser-plasma interaction and ion beam characteristics was employed. In addition, a proton beamline based on pulsed solenoids was characterized in order to deliver proton pulses into a 5×5×5 mm^3 target volume with homogenized lateral and depth dose profiles and average dose rates relevant for experimental cancer therapy studies.

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Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 42

Multi-proton bunch driven hollow plasma wakefield acceleration in the nonlinear regime

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Proton-driven plasma wakefield acceleration has been demonstrated in simulations to be capable of accelerating particles to the energy frontier in a single stage. However, its potential is hindered by the fact that currently available proton bunches are orders of magnitude longer than the plasma wavelength. Self-modulation instability enables the micro-bunching of long proton bunches and allows driving plasma waves resonantly, however, it causes a significant loss of protons and requires the interaction regime to be linear. In this paper, we propose to use a hollow plasma channel for the multiple proton bunch driven plasma wakefield acceleration and demonstrate that it enables the electron acceleration in the nonlinear regime with much stronger plasma waves excited. The simulations show that over 90% protons can be kept after 150 m propagation in the hollow plasma and the region where the protons can stay is expanded significantly. Most importantly, the witness bunch is accelerated to the energy frontier with well-preserved beam quality.

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Presenter : Ms. LI, Yangmei (University of Manchester, Cockcroft Institute)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : poster

Contribution ID : 43

Study of Transverse Instabilities in Proton Driven Hollow Plasma Wakefield Acceleration

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Hollow plasma has been introduced into the proton-driven plasma wakefield accelerator to overcome the issue of beam quality degradation caused by the nonlinear transverse wakefields varying in radius and in time in uniform plasma. It has been demonstrated that the electrons can be accelerated to energy frontier with well-preserved beam quality in a long hollow plasma channel. However, this scheme imposes tight requirements on the driving beam to be on axis of the hollow channel, otherwise the transverse instabilities are deduced. For long-term relativistic beam-plasma interaction, the driving instabilities are of big concern as they could develop excessively and distort the driving bunch dramatically in a long time scale. This would successively trigger a series of nontrivial issues such as reduction of the energy transfer efficiency, nonuniformities of the wakefields and degradation of the beam quality etc. In this contribution, we examine these detrimental effects from theoretical and numerical aspects and discuss the effect of the transverse wakefields on the beam and the resultant beam breakup instability in terms of the beam and plasma parameters.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 44

Probing active plasma lenses

Tuesday 26 Sep 2017 at 18:00 (00h20')

Content :

Active plasma lenses are a key component for advanced accelerator concepts due to their high, tunable gradients (short focal length), radial symmetry (focusing in both planes) and compact design. A detailed characterization of their properties is inevitable in order to fully decipher and control the relevant plasma processes and bring active plasma lenses up to current accelerator standards in terms of stability, repeatability and quality.

Here experimental results from a recent measurement campaign at the Mainz Microtron addressing these questions are presented. Plasma lenses of 1mm diamter and 7mm to 15mm length with directly measured gradients of up to 900T/m, have been used. Results on their influence on electron bunch emittance and their measured magnetic field linearity will be shown, which are linked and constitute crucial studies to determine the achievable lens quality.

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Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 45

Relativistic magnetic reconnection driven by a laser interacting with a micro-plasma-slab

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Magnetic reconnection (MR) in the relativistic regime is generally thought to be responsible for powering rapid bursts of non-thermal radiation in astrophysical events such as pulsar winds and flares of blazars. Due to the difficulty in making direct measurements in astrophysical systems or achieving such extreme energy density conditions that are necessary to observe relativistic MR in laboratory environments, the particle acceleration process is usually studied by fully kinetic particle-in-cell (PIC) simulations. Here we present a numerical study using 3D PIC simulations of a readily available (TW-mJ-class) laser interacting with a micro-scale plasma slab. The simulations show that when the electron beams that are excited on both sides of the slab approach the end of the plasma structure, ultrafast relativistic MR occurs. As the field topology changes, the explosive release of magnetic energy results in emission of relativistic electron jets with cut-off energy ~12 MeV. A hard power-law electron energy distribution with index p~1.8 is observed. We propose a novel scenario that can be straightforwardly implemented in experiments, and might significantly improve the understanding of fundamental questions such as reconnection rate, field dissipation and particle acceleration in relativistic MR.

Primary authors : LONGQING, Yi ()

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Presenter : LONGQING, Yi ()

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 46

Simulation Study of a LWFA-Based Electron Injector for AWAKE Run II

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The AWAKE experiment [1] is a proof-of-principle proton driven plasma accelerator at CERN. Using a 400 GeV SPS proton beam GV/m wakefields are excited in a 10 m plasma to accelerate an injected electron bunch, derived from an adjacent S-band RF electron gun and booster. Future experiments will demonstrate electron acceleration while preserving the beam quality. This places new requirements on the electron injector that are challenging to meet with the current S-band RF system. A laser wakefield accelerator [2] (LWFA) has therefore been proposed to produce fs duration electron bunches and provide sufficient beam current required to load the proton-driven wakefields [3] from a compact design. We present 2D/3D PIC simulations to evaluate potential LWFA schemes that satisfy the required electron beam parameters with minimal shot-to-shot fluctuations. In addition, challenges to its implementation, particularly in beam transport needed to optimize bunch parameters prior to injection, are discussed.

Please see the comments section for details of the references

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Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 47

Spectroscopic characterisation of plasma targets with absolute calibration

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

One of the key issues for the generation of stable and reproducible beams in plasma particle accelerators is control of the initial plasma density distribution. Not only the longitudinal but also the transverse density profile, the species distribution, as well as fragmentation and ionisation dynamics can have significant impact on the generated beams. In particular in increasingly complex scenarios, e.g. controlled electron injection and laser beam transport mechanisms, precise knowledge of these parameters is vital. Currently established methods such as interferometry or gas density diagnostics using scattering processes only allow for gas targets to be characterised at densities well above 10^17 cm-3 and lack versatility.
Here, electron density measurements based on stark broadening are presented. For a wide parameter range laser and discharge generated plasmas have been investigated regarding longitudinal and transverse electron density distributions, plasma lifetime, and electron temperature. In addition, an absolute density calibration has been performed for the parameter range investigated. This is necessary since literature values prove to be of insufficient accuracy in the transient situations in targets required for plasma acceleration.

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Presenter : Mr. GOLDBERG, Lars (Deutsches Elektronen-Synchrotron DESY)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 48

Laser driven plasma acceleration at PEARL laser system: progress and prospects.

Wednesday 27 Sep 2017 at 17:00 (00h15')

Content :

The work presents the experimental investigation of interaction between femtosecond sub-PW laser pulse with plasmas conducted at PEARL laser facility. The conditions of effective laser energy deposition into the solid target leading to TNSA proton beams with up to 43 MeV energy cut-off are experimentally realized. The characterization of the target conditions is achieved by combining X-ray spectrometry and proton spectra measurement. The ways to improve the maximal energy of the laser driven protons which are based on laser pulse contrast enhancement techniques are considered as well as application perspectives.

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Co-authors :

Presenter : Dr. SOLOVIEV, Alexander (Institute of Applied Physics of RAS)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 49

Overview of recent electron acceleration and X-ray generation results from Garching

Tuesday 26 Sep 2017 at 11:30 (00h30')

Content :

The LMU ATLAS laser has recently been upgraded to 200 TW peak power and a new electron acceleration beamline was built. We will report on the first campaign with the new system in 2016. Various injection schemes yield up to nC beam charge and tunable energy (0.1-1.5 GeV). Combining shock-front and colliding pulse injection yields two independently tunable, quasi-monochromatic electron bunches suitable for driver-witness-type experiments. We studied the wakefields and beam currents using few-cycle shadowgraphy/faraday rotation probe pulses down to the low 1018 cm-3 density regime. In addition to the first observation of a fully broken bubble in the LWFA process, this diagnostic also proved the excitation of a wake by the primary LWFA electron bunch in a secondary plasma target as a first step towards true hybrid acceleration schemes.
In the field of X-ray generation, we continued our successful previous work towards applications of betatron radiation in medical imaging. Furthermore, we performed measurements and imaging using both single-pulse and dual-pulse Thomson scattering. Finally, we will give a brief status update of the ongoing 3-PW upgrade of ATLAS in the new CALA laboratory.

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Presenter : Prof. KARSCH, Stefan (LMU Munich)

Session classification : Plenary 4

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 50

Ultra-brilliance isolated attosecond gamma-ray light source from nonlinear Compton scattering

Tuesday 26 Sep 2017 at 16:00 (00h15')

Content :

In this work, we propose a novel method to generate high charge (~1nC) attosecond (<200 attosecond) electron bunch by the near-threshold self-injection mechanism in wakefield acceleration with current-generation laser, and demonstrate the ability to generate an ultra-brilliance (> 2 ×1024 photons s-1 mm-2 mrad-2 0.1%BW) attosecond (<200 attosecond) gamma-ray (Emax > 3 MeV) pulse via nonlinear Compton scattering. To the best of our knowledge, this is the first method to generate attosecond gamma-ray photon source using current-generation laser. This gamma-ray source is the shortest gamma-ray photon source even compared with the results (>800 attosecond) generated with next-generation laser, and the highest brilliance (orders higher than the results, reported) photon source in MeV range. This method can be widely applicated for experimental generation of 100 keV to several MeV high brilliance attosecond gamma-ray sources with certain ~100 TW laser facilities, will benefit ultra-high resolutions radiography application and some basic science.

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Presenter : Dr. YU, Jinqing (Peking University)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 52

Radial Equilibrium of ultrarelativistic particle beams in plasma wakefield accelerators

Wednesday 27 Sep 2017 at 16:00 (00h20')

Content :

AWAKE experiment on proton driven plasma wakefield acceleration in CERN presents a real challenge for numerical simulations. Parameters of the experiment fall far beyond the area for which most codes were originally developed and tuned. Proton beams are very long, a few hundred plasma wavelengths. The excited wakefield is a result of an instability and depends on small amplitude seed perturbations. At the same time, the design of the experiment relies mainly on simulation results rather than on other experiments. Therefore, it is important to provide a thorough validation of available codes with test problems that contain the main physical effects involved. In this report, we describe several AWAKE-related tests used for crosschecking computer codes and discuss which aspects are particularly important for quantitatively correct simulations of AWAKE physics.

Primary authors : Prof. LOTOV, Konstantin (Novosibirsk State University)

Co-authors :

Presenter : Prof. LOTOV, Konstantin (Novosibirsk State University)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 53

Measuring of ultra-short electron bunch durations from LWFA by using of a broadband, single-shot spectrometer for Coherent Transition Radiation

Monday 25 Sep 2017 at 16:00 (00h20')

Content :

Laser-wakefield accelerators (LWFA) feature electron bunch durations about a few fs. Precise knowledge of the longitudinal profile of such ultra-short electron bunches is essential for the design of future table-top Xray light-sources and remains a big challenge due to the resolution limit of existing diagnostic techniques and also limited reproducibility of electron bunches.

Measurement of broadband transition radiation produced when LWFA electron bunches pass a metal foil is a promising way to analyze longitudinal characteristics of these bunches.

Our ultra-broadband, single-shot spectrometer combines the TR spectrum in UV/VIS (200-1000nm), NIR (0.9-1.7μm) and mid-IR (1.6-12μm). A complete characterization and calibration of the spectrometer has been done with regard to wavelengths, relative spectral sensitivities and absolute photometric sensitivity.

Our spectrometer is able to characterize electron bunches with charges as low as 1 pC and resolve time-scales from 0.7 to 40 fs.

We present results from our recent measurement campaign by analyzing transition radiation spectra produced by nC class LWFA electron bunches from ionization-injection regime as well as study of transvers bunch profile by simultaneous imaging of the CTR at far- and near-field.

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Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 54

Transverse electron beam dynamics in a nanocoloumb-class laser wakefield accelerator

Thursday 28 Sep 2017 at 18:30 (00h15')

Content :

Laser-plasma wakefield accelerators have shown generation of quasi-monoenergetic (QME) electron bunches with reaching to multiple GeVs range. Scaling the accelerated charge within the QME bunch from pC to nC is one of the important issues for many applications. This high charge naturally brings laser wakefield in the so-called beam loading regime, which can deteriorate the beam quality if not properly controlled.
In our recent experiments carried out with the Draco Ti:Sapphire laser we explore the influence of beam loading on the transverse electron beam dynamics. Utilizing 2D x-ray spectroscopy technique we deduced the electron beam size close the plasma exit by analyzing the x-ray spectrum emitted as relativistic electrons perform betatron oscillation during acceleration. Simultaneously electron spectra and divergence were recorded at a charge calibrated point-to-point imaging electron spectrometer. We show that as the electron beam size increases with charge, the beam divergence reaches a minimum value at the optimum loading condition where, at the same time, the energy spread reaches a minimum. We anticipate that this result will open a new path for beam optimization in high charge laser wakefield accelerators.

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Presenter : Mr. KOEHLER, Alexander (Helmholtz-Zentrum Dresden - Rossendorf)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 55

Study of the electron transport in the COXINEL FEL beamline using a laser plasma accelerated electron beam

Wednesday 27 Sep 2017 at 16:00 (00h15')

Content :

The ERC Advanced Grant COXINEL aims at demonstrating free electron laser (FEL) amplification based on laser plasma accelerator (LPA) source. Due to the large energy spread and high divergence, in comparison to conventional accelerators, a 10 m long transport line was designed to preserve and improve the beam qualities. A triplet of permanent magnet variable gradient quadrupoles (QUAPEVA) handles the large divergence. The slice energy spread is reduced by a magnetic chicane. A set of electromagnetic quadrupoles provides a chromatic focusing in a 2 m long undulator. A reference model was established and sensibility to parameters studies were carried out.

Electrons were transported through the line for the LPA with ionization assisted self-injection (broad energy spectra up to ~220 MeV, few milliradians divergence), and with shock-injection, where energy spread is much smaller (few percent). Beam position and dispersion are controlled precisely thanks to specific beam based alignment method using displacement of the QUAPEVA magnetic center. The transported energy range was also controlled using a slit inserted in the chicane. Experimental results and numerical simulations are in a good agreement.

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Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 56

A tunable electron beam source using density down-ramp trapping

Thursday 28 Sep 2017 at 17:12 (00h18')

Content :

One challenge in the development of laser wakefield accelerators is to demonstrate sufficient control and reproducibility of the beam parameters. Many schemes of controlled trapping of electrons have been proposed and implemented, aiming to improve control and reproducibility. Here we report on a numerical study of trapping in density down-ramps, as a continuation of our previous experimental study in which remarkable stability, using this trapping mechanism, was observed.

We demonstrate that trapping using density down-ramps allows for tuning of several electron bunch parameters by varying the properties of the density down-ramp. We show that the electron bunch length is determined by the difference in density before and after the ramp. The transverse emittance of the bunch is controlled by the steepness of the ramp. Finally, the amount of trapped charge depends both on the density difference and on the steepness of the ramp. We emphasize that both parameters of the density ramp are feasible to vary experimentally. This tunable electron accelerator makes it suitable for a wide range of applications, from those requiring short pulse length and low emittance, such as the FELs, to those requiring high-charge, large-emittance bunches to maximize betatron x-ray generation.

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Presenter : Mr. EKERFELT, Henrik (Lund University)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 57

n-machining, surface analysis and characterization measurements of a copper photocathode at SPARC_LAB

Wednesday 27 Sep 2017 at 16:50 (00h20')

Content :

An R activity on Cu photocathodes is under development at the SPARC_LAB test facility in order to fully know and characterize each stage of the photocathode life and to have a complete overview of the photoemission properties of the cathodes for high brightness electron beam photoinjectors. The n-machining process presented here consists in diamond milling, afterwards blown with clean air. This procedure shows a sensitive reduction of the roughness of the cathode surface and avoids surface contamination caused by other procedures, for example the polishing with diamond paste or the machining with oil. Both high roughness and surface contamination cause an increase of thermal emittance and consequently a reduction of the overall electron beam brightness.

We present Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS) and Atomic Force Microscopy (AFM) techniques used to analyze the cathode surface, roughness, morphology and its chemical composition. The analysis of Cu photocathode, polished by diamond paste procedure, shows the degradation of the photoemission properties caused by breakdowns in the RF gun and the Silicon contamination due to the polishing procedure. The same cathode is analyzed after n-machining and results show a cathode surface with roughness of the order of few nm (rms) and the absence of silicon contaminants.

We also present the intrinsic emittance and quantum efficiency measurements before and after n-machining in order to know the n-machining effects.

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Presenter : SCIFO, Jessica (LNF)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 58

Generation of Controllable Plasma Wakefield Noise in Particle-in-Cell Simulations

Wednesday 27 Sep 2017 at 17:15 (00h15')

Content :

Numerical simulations of beam-plasma instabilities may produce quantitatively incorrect results because of unrealistically high initial noise from which the instabilities develop. Of particular importance is the wakefield noise, the potential perturbations that have a phase velocity which is equal to the beam velocity. Controlling the noise level in simulations may offer the possibility of extrapolating simulation results to the more realistic low-noise case.
We propose a novel method for generating wakefield noise with a controllable amplitude by randomly located charged rods propagating ahead of the beam. The generation of this noise is not accompanied by parasitic Cherenkov radiation waves. We also illustrate the method with particle-in-cell simulations. The noise level and spectrum obtained in particle-in-cell simulations of randomly distributed thin rods with a smooth longitudinal charge distribution agrees with analytically calculated values. Consequently, the rod-based noise generator can be used in future numerical studies of beam-plasma instabilities.

Primary authors : Mr. SPITSYN, Roman (Budker Institute of Nuclear Physics)

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Presenter : Mr. SPITSYN, Roman (Budker Institute of Nuclear Physics)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 59

Transfer matrix and transfer function analysis for grating-type dielectric laser accelerators

Thursday 28 Sep 2017 at 17:15 (00h15')

Content :

The question of suitability of transfer matrix description of electrons traversing grating-type dielectric laser acceleration (DLA) structures is addressed. It is shown that although matrix considerations lead to interesting insights, the basic transfer properties of DLA cells cannot be described by a matrix. A more general notion of a transfer function is shown to be a simple and useful tool for formulating problems of particle dynamics in DLA. As an example, a focusing structure is proposed which works simultaneously for all electron phases.

Primary authors : Dr. SZCZEPKOWICZ, Andrzej (University of Wroclaw, Institute of Experimental Physics)

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Presenter : Dr. SZCZEPKOWICZ, Andrzej (University of Wroclaw, Institute of Experimental Physics)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 60

Features within sheath accelerated proton beams and their implications for electron transport

Monday 25 Sep 2017 at 17:10 (00h20')

Content :

In the interaction of high intensity lasers with solid targets, electron heating and transport play a crucial role in the transfer of energy from the laser to an energetic ion beam. When hot electrons traverse the target bulk, measurements have shown that they are subject to filamentation and can be strongly influenced by fields formed at the target rear surface resulting in a non-laminar beam, or in recirculation of the electrons back into the bulk of the target. Recirculation has been inferred from increased target heating in thin targets and an enlarge proton emission region. Here, we present studies of features, including annular rings, within the spatial profile of proton beams generated by the interaction of a high intensity laser (55 J, 0.6 ps) with micron scale metal foils. Particle tracking and fluid simulations are considered to explain the observed structures and to illustrate the importance of control of electron transport for the generation of high quality laminar proton beams for applications.

Primary authors : Dr. PALMER, Charlotte (Lancaster University/Cockcroft Institute)

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Presenter : Dr. PALMER, Charlotte (Lancaster University/Cockcroft Institute)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 61

Plasma-based diagnostic for the SMI in AWAKE

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

AWAKE develops a new plasma wakefield accelerator using the CERN SPS proton bunch as a driver. The proton bunch propagates through a 10m long rubidium plasma, induced by an ionizing laser pulse that also seeds the wakefields for the self-modulation instability (SMI). Current diagnostics for the occurrence of the SMI focus on the proton bunch.
The SMI transforms the bunch in a train with hundreds of bunchlets driving hundreds of plasma wave periods. We therefore investigate the possibility of measuring frequency modulation of a CW laser propagating perpendicularly to the wakefields to determine some of the wakefields characteristics. Wakefields period information will appear in the position of satellites in the laser beam spectrum, whereas wakefields amplitude information will be in the satellites intensity. Satellites at the harmonics of the plasma period would indicate nonlinear modulation of the plasma density and wakefields amplitude. Measuring the wakefields amplitude at two points of the plasma cell, near the plasma entrance and near the exit, would provide proof of the growth of the SMI.

Primary authors : Ms. BACHMANN, Anna-Maria (CERN)

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Presenter : Ms. BACHMANN, Anna-Maria (CERN)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 62

Laser wakefield acceleration in a heterogeneous plasma

Thursday 28 Sep 2017 at 16:18 (00h18')

Content :

Intense laser pulses (I0^18 W/cm^2) are routinely used to generate electron beams in plasmas using laser wakefield accelerators (LWFAs). It additionally provides a useful source of radiation which is suitable for many imaging applications. Significant research in LWFAs is aimed towards investigating new injection mechanisms which improve the stability of these electron beams/radiation sources to increase their applicability to industry.

A heterogenous plasma consists of monomers and clustered gas which provide a testbed for a new injection mechanism involving clusters. Clusters are a collection of atoms ranging from a few 100's to 1e7 atoms which are held together by the Van-der-Waals force. They act as a large source of electrons which can be injected and trapped by plasma wave . Clusters are know to have an additional self-focusing effect on the laser pulse and thus provide a mechanism to extend the guiding of laser pulses. Experiments performed on the Gemini laser (TA2/TA3) are presented and the properties of such a source, such as electron beam charge, stability and energy are compared to more common injection mechanisms such as self-injection and ionisation injection.

Primary authors : PATTATHIL, Rajeev (Central Laser Facility,) ; GERSTMAYR, Elias (Imperial College London) ; NAJMUDIN, Zulfikar (Imperial College London) ; Mr. SAVIO, Rozario (Imperial College London) ; Dr. WOOD, Jonathan (Imperial College London) ; Dr. COLE, Jason (Imperial College London) ; Dr. PODER, Kristjan (DESY)

Co-authors :

Presenter : Mr. SAVIO, Rozario (Imperial College London)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 63

Cryogenic Undulator Development and First Observed Radiation on COXINEL

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

COXINEL project aims at demonstrating compact Free Electron Laser (FEL), using a Cryogenic Permanent Magnet Undulator (CMPU), and a laser plasma acceleration source. CPMU takes advantage of the magnet's enhanced performance at low temperature and attains a higher magnetic field, thus enabling to shorten the period and making it applicable for compact FEL applications. The undulator that is currently installed is a CPMU of period 18 mm (U18) operating at room temperature, due to infrastructure reasons, at a resonance wavelength of 200 nm. Different measurements and optimizations have been done to improve the undulator quality in terms of phase error to enhance the radiation emitted, and field integrals to prevent any beam distortion along the undulator axis. The construction of U18 undulator and the magnetic measurements needed for optimization, alongside its operation as in observation of the emitted radiation, are presented. A particular method is also introduced, using SRWE code, to compute the spectra of the large energy spread beam (few percent) taking into account the variation of the Twiss parameters for each energy slice.

Primary authors : Mr. GHAITH, Amin (SOLEIL)

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Presenter : Mr. GHAITH, Amin (SOLEIL)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 64

Tunable High Gradient Quadrupoles For A Laser Plasma Acceleration Based FEL

Wednesday 27 Sep 2017 at 16:15 (00h15')

Content :

Laser Plasma Acceleration (LPA) is capable of producing a GeV beam within a centimetre accelerating distance, but with a rather high initial divergence and large energy spread. COXINEL aims to demonstrate a compact Free Electron Laser using such a source, where a specific transport line with adequate elements is used, such as tunable high gradient quadrupoles for handling the divergence. An innovative permanent magnet based quadrupole (QUAPEVA) made of two quadrupoles superimposed capable of generating a gradient of 210 T/m is presented. The first quadrupole consists of magnets shaped as a ring and attaining a constant gradient of 160T/m, and the second one made of four cylindrical magnets surrounding the ring and capable of rotating around their axis to achieve a gradient tunability of +/-50 T/m. Each tuning magnet is connected to a motor and is controlled independently, enabling the gradient to be tuned with a rather good magnetic center stability (+/-20 µm) and without any field asymmetry. The measurements and field optimization of seven quadrupoles with different magnetic lengths are reported. A set of QUAPEVA triplet, installed at COXINEL, achieved good focusing and enabled beam based alignment.

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Presenter : Mr. GHAITH, Amin (SOLEIL)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 65

Effects of the nitrogen concentration in direct laser acceleration of electrons in a laser wakefield accelerator

Thursday 28 Sep 2017 at 16:54 (00h18')

Content :

A parametric experimental study of ionization-induced trapping in láser wakefield acceleration is presented. Pulses from the multi-terawatt laser at Lund University are focused in a gas cell containing a variable mixture of hydrogen and nitrogen. Electron beams with continuos energy distribution up to 200 MeV are generated. When changing the composition of the gas target, a significant change in the electron beam is observed. It is found that, at high densities or high concentrations of nitrogen, the boosted electrons are emitted at a small angle with respect to the central optical axis, leading to an overall increase of the beam divergence in the laser polarization direction. It is concluded that the electromagnetic fields of the laser pulse can significantly influence the electrons trapped in the first plasma wave period. This is supported by 3D particle-in-cell simulations, showing that, if the betatron oscillation of the electrons are in resonance with the laser field, the electrons gain a significant transverse momentum from the laser fields, which can be transferred to longitudinal momentum via the magnetic part of the Lorentz force. This process is also known as direct laser acceleration.

Primary authors : GALLARDO GONZALEZ, Isabel (Lund University)

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Presenter : GALLARDO GONZALEZ, Isabel (Lund University)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 66

Bright betatron X-rays for imaging applications

Tuesday 26 Sep 2017 at 16:45 (00h15')

Content :

We present recent results on betatron X-ray production and application in laser wakefield accelerators. After upgrading the Atlas Laser to 300TW, we have managed to produce electron beams of increased charge and energy, which accordingly leads to bright betatron X-rays. We detected up to 10^9 photons per shot with an average energy of 20 keV, which is sufficient to penetrate macroscopic samples for single-shot X-ray imaging. Based on our previous work on X-ray tomography of thin biological specimen [1], we successfully extended the technique to medically relevant applications by imaging a human bone sample.

References
[1] J. Wenz et al. Quantitative X-ray phase-contrast microtomography from a compact laser-driven betatron source. Nat.Comms. (2015)

Primary authors : GOETZFRIED, Johannes (Ludwig Maximilian University of Munich)

Co-authors : Dr. DÖPP, Andreas (LMU / MPQ) ; DING, Hao (LMU München) ; Mr. GILLJOHANN, Max (Ludwig-Maximilians-Universität München) ; SCHINDLER, Sabine (LMU München) ; Mr. WENZ, Johannes (Ludwig-Maximilians-Universität München) ; Prof. KARSCH, Stefan (LMU Munich)

Presenter : GOETZFRIED, Johannes (Ludwig Maximilian University of Munich)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 67

Characterization of beam driven ionization injection in the blowout regime of Plasma Acceleration

Tuesday 26 Sep 2017 at 18:20 (00h20')

Content :

The scope of this work is to characterize the novel and promising strategy for ionization-induced trapping of electrons in a beam driven plasma accelerator, originally proposed by A. Martinez de la Ossa et al. [Phys Rev Lett (2013)].The beam driven ionization injection scheme is based on the field ionization of a dopant gas confined in a small region within a hydrogen plasma background. The ionized electrons are captured by the non-linear plasma wave at the accelerating and focusing wake phase, leading to high-brightness trailing bunches. The quality of the ionization-injected trailing bunches strongly and non-linearly depends on the properties of the dopant gas (density, initial ionization state).We used the full 3D PIC code ALaDyn to take into account the kinetic, three dimensional nature of the phenomenon. By mean of a systematic approach we have investigated the emittance and energy spread formation and evolution for different dopant gases and configurations. For a selected case we studied the ionization-injected bunch acceleration and transport over long distance (a few cm).

Primary authors : MIRA, Francesco (ROMA1)

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Presenter : MIRA, Francesco (ROMA1)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 68

High-brilliance betatron gamma-ray source powered by laser-accelerated electrons

Tuesday 26 Sep 2017 at 16:36 (00h18')

Content :

Thanks to the recent progress in laser-driven plasma acceleration of electrons, the ultra-short, compact and spatially coherent X-ray betatron sources based on this technique have been successfully applied to high-resolution imaging in the last few years. However, due to a difficulty to both optimize the electron energy and wiggling, the scope of the betatron sources is limited by a low energy efficiency and a photon energy in the 10's of keV range. Here, based on three-dimensional particle-in-cell simulations, we propose an original hybrid scheme that combines a low-density laser-driven plasma accelerator with a high-density beam-driven plasma radiator. We show that this scheme greatly improves the energy efficiency, with about 1% of the laser energy transferred to the radiation, and that the gamma-ray photon energy exceeds the MeV range when using a 15 J laser pulse. This high-brilliance hybrid betatron source opens the way to a wide range of applications requiring MeV photons, such as the production of medical isotopes with photo-nuclear reactions, radiography of dense objects in the defense or industrial domains and imaging in nuclear physics.

Primary authors : Dr. FERRI, Julien (Chalmers University of Technology)

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Presenter : Dr. FERRI, Julien (Chalmers University of Technology)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 69

A Paultrap-system for isolated targets at high-power laser systems

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

We present a target positioning system based on an electrodynamic trap specifically designed for high-power laser plasma interactions. By applying an electro-optical damping technique, micron-precise positioning of isolated targets of arbitrary material and shape is enabled, ensuring reliable overlap with the laser focus.
Results from a beamtime at the TPW [1] and two beamtimes at the PHELIX-PW [2] show expected acceleration mechanisms and reproducible acceleration of protons and ions using plastic, copper and tantalum spheres.
Current developments include the automatization of the trapping process for faster (sub-minute) target replacement, to satisfy requirements for the high repetition-rate PW laser at the new 'Center for advanced laser applications' (CALA) in Garching. Within the same update-phase trapping of planar nano-platelets made of Gold or Graphene will be pursued. We present our strategies for automatization as well as for trapping, positioning and alignment of such free-floating platelet. The repetition-rate will allow for applications using radiation being generated in the laser-plasma interaction [e.g. 1,2]. The novel platelet target may facilitate experimental tests of intriguing yet experimentally inaccessible ideas that have thus far only been studied via simulation [e.g. 3,4,5].

Primary authors : Mr. GEBHARD, Johannes (LMU Munich)

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Presenter : Mr. GEBHARD, Johannes (LMU Munich)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG2 - Ion Beams from Plasmas

Type : poster

Contribution ID : 70

Research Towards Hybrid Accelerators

Thursday 28 Sep 2017 at 18:54 (00h18')

Content :

Beam-driven wakefield accelerators have various advantages over laser-driven wakefield accelerators, but the requirements on the particle driver are challenging and met by only a few large-scale accelerators worldwide. However, electron beams from a laser-plasma accelerator are usually inherently well suitable as a driver, which potentially allows studying the physics of beam-driven wakefield acceleration in small-scale laser facilities.

In this talk we present the first direct observation of laser-accelerated electron bunches driving their own wakefields in an independent gas target, which is a first step towards a table-top plasma wakefield accelerator. Furthermore, we show measurements of a controlled injection technique that can be used to generate stable driver and witness bunches, for which simulations indicate the possibility of actual beam-driven wakefield acceleration of the witness bunch in our upcoming experiments.

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Presenter : Mr. GILLJOHANN, Max (Ludwig-Maximilians-Universität München)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 71

Concept of the long wakefield accelerator based on the tunnel gas ionization by the electric field from a dense electron bunch

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The train of charged particle bunches is an effective driver for a plasma-based accelerator, but the amplitude of the excited wakefield strongly depends on the uniformity of plasma, in other words, the type of plasma source. For the train with N bunches relative uniformity must be better than 1/N, thus, the more bunches are in a beam, the higher are the requirements on plasma. One of the prospective ways to obtain the high uniformity of plasma is the full ionization of the initially uniform gas using powerful laser pulse. For example, this method forms the basis of the AWAKE experiment at CERN.

On the other hand, the laser pulse starts diverging after a long distance, it influences the radius of plasma column as well as the ionization degree and limits the possible length of the accelerator. This work considers charged particle bunches as the alternative to the laser pulse. Being charged, the bunch is able to be focused either by the external quadrupole magnets or the plasma itself and allows to increase the possible length of the accelerator significantly.

Primary authors : GORN, Aleksandr (Budker Institute of Nuclear Physics, Novosibirsk, Russia)

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Presenter : GORN, Aleksandr (Budker Institute of Nuclear Physics, Novosibirsk, Russia)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : poster

Contribution ID : 72

HDR spatio-temporal intensity mapping by single-shot optical probing

Monday 25 Sep 2017 at 16:50 (00h20')

Content :

Today's Petawatt (PW) laser systems are able to focus high power pulses to a few μm spot, achieving intensities up to 10^22 W/cm^2. Precise knowledge of the spatial and temporal intensity profile becomes increasingly important for describing the physics under these extreme conditions.
We present a new concept for acquiring high dynamic range (HDR) information of the 2D spatial and temporal intensity distribution of a high power laser in focus. In contrast to established methods that are restricted to significantly reduced laser energy (i.e. focal imaging and 3rd order HDR autocorrelation), our method is able to perform on target at full laser energy. It relies on optical probing of the dynamically generated plasma at a nm-thin foil. By using a temporally chirped probe pulse in combination with image multiplexing, movies with currently around 200 fs temporal and 25 μm spatial resolution can be obtained in a single shot.

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Presenter : Mr. SPEICHER, Martin (LMU Munich)

Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 73

Trojan Horse injection into a dielectric wakefield accelerator

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Trojan Horse (TH) Injection in a beam-driven plasma wakefield accelerator(PWFA)[1], which is predicted to generate sub 0.1 μm-emittance electron bunches. The scheme decouples the excitation of the accelerating field by the driving electron bunch from the injection of the witness bunch, triggered by a tightly focused co-propagating laser pulse. This allows for a precise release of electrons at the right phase of the wake by alignment and timing of the laser. To trap the electrons, which are released at rest by the laser, strong accelerating fields are required. So far, such fields have only been established in a plasma wakefield accelerator. It has been shown that phase velocity retardation in TH-PWFA does not need to increase the emittance so that trapping can be facilitated [2].
Recently GeV/m accelerating fields have been demonstrated in dielectric wake fields [3]. With such strong fields, Trojan Horse Injection into wakefields in a dielectric structure is possible.
Implications of TH injection into dielectric wakefield accelerators and simulation results are presented.
[1]B. Hidding et al., PRL, 2012
[2]A. Knetsch et al., submitted 2017
[3]B. O'Shea, Ph.D. thesis UCLA, 2014

Primary authors : Mr. KNETSCH, Alexander (Deutsches Elektronen-Synchrotron, DESY)

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Presenter : Mr. KNETSCH, Alexander (Deutsches Elektronen-Synchrotron, DESY)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 74

Viable Laser-driven Ion Source for Applications at CALA

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

One of the most intriguing features of laser-driven ion sources is their potentially short bunch duration and micrometer small source size (low longitudinal and transverse emittance), which are a direct consequence of the highly intense laser pulses at play. The transition from mostly single shot experiments performed during the last decade towards systems capable of repetition rates up to one Hz requires technological development.

My talk will allude the basic principle of laser ion acceleration, supported by recent examples demonstrating it's potential for applications. I will highlight recent progress regarding targetry and ion detection, pushing the performance towards higher repetition rates.

Using the unique features of laser-based accelerated ions for application may require guidance of the ion bunch. A set of permanent quadrupole magnets has been used to transport and refocus the beam on distances up to 1,5 m behind the interaction enabling a dose of multiple Gray within one bunch.

Those developments will facilitate a solid basis for our research targeted in the Centre for Advanced Laser Applications (CALA) at the research campus in Garching near Munich, which amongst other intriguing equipment, will host a 3 PW-laser system operated at 1Hz repetition rate.

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Presenter : HAFFA, Daniel (LMU Muenchen)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG2 - Ion Beams from Plasmas

Type : poster

Contribution ID : 75

Status and Objectives of the Dedicated Accelerator R Facility "SINBAD" at DESY

Monday 25 Sep 2017 at 16:50 (00h20')

Content :

We present an status update on the dedicated R facility SINBAD which is currently under construction at DESY. The facility will host multiple independent experiments on the acceleration of ultra-short electron bunches and novel, high gradient acceleration methods. The first experiment is the ARES-experiment with a normal conducting 100MeV S-band linac at its core. We present the objectives of this experiment ranging from the study of compression techniques to sub-fs level to its application as injector for various advanced acceleration schemes e.g. the plans to use ARES as a test-site for DLA experiments in the context of the ACHIP collaboration. The timeline including the planned extension with laser driven plasma-wakefield acceleration is presented. The second initial experiment is AXSIS which aims to accelerate fs-electron bunches to 15 MeV in a THz driven dielectric structure and subsequently create X-rays by inverse Compton scattering.

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Presenter : Mr. DORDA, Ulrich (DESY)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 76

FLASHForward X-1: High-brightness electron beams from a plasma cathode

Monday 25 Sep 2017 at 18:00 (00h18')

Content :

The beam-driven FLASHForward experiment 1 (X-1) aims at the generation of high-brightness electron bunches for photon science applications in several centimeters of plasma, with the plasma acting both as a cathode and accelerator.
The 1 GeV electron-bunch with a peak current of 2.5 kA and a synchronized TW-laser system makes FLASHForward a unique facility[1] to study controlled electron-injection into plasma wakes.
With density downramp injection, witness bunches of ~1 kA peak current at emittances well below 1 µm are achievable[2]. The sharp plasma density gradients are produced by means of controlled gas flow[3] or by localized laser ionization transverse to the electron-beam orbit[4].
Precise laser-to-electron-beam synchronization enables controlled injection as e.g. the Trojan Horse scheme[5], which is predicted to support sub-0.1-µm-emittance witness bunches.
experimental installation status, planning, and prospects of the FLASHForward X-1 experiments are presented.
[1]A. Aschikhin et al. NIM A,2016
[2]A. Martinez de la Ossa et al., submitted, 2017
[3]L. Schaper et al. NIM A, 2014
[4]G. Wittig et al. PRSTAB, 2015
[5]B. Hidding et al. PRL, 2012

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Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 77

Betatron radiation emission from laser-wakefields driven by pulses with OAM

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Betatron radiation from laser-wakefield accelerators (LWFA) has shown great potential as a source of high brightness ultra-short radiation. In typical experimental and simulation LWFA setups, the driver is a single laser pulse with a Gaussian profile. However, the recent advances in the field of structured light, in particular in the study and production of light pulses with orbital angular momentum, for example Laguerre-Gaussian modes, has opened new prospects for laser-wakefield acceleration. In this work, we explore LWFA driven by structured pulses comprised of Laguerre-Gaussian modes. We show that by using pairs of Laguerre-Gaussian modes, multiple wakefields can be driven with non-trivial dynamics. We investigate the possibility of driving pairs of wakefields rotating around the propagation axis though three-dimensional particle-in-cell simulations. Using a post-processing radiation diagnostic and the trajectories of bunch electrons taken from simulations, we examine the properties of the emitted radiation taking into account coherence effects.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 78

A spatial laser chirp compensates the energy spread of the elctron beam in Compton and Thomson sources

Wednesday 27 Sep 2017 at 16:30 (00h15')

Content :

Compact laser accelerator generate high energy electron beams with high electron charge and low emittance,but a rather large energy spread. When used in Compton back-scattering,the large energy spread impedes all applications requiring small bandwidths. An interaction scheme that allows to compensate the effect of the energy spread by introducing a transverse chirp in the alser pulse id here presented. Such a chirp together with a properly disperded electron beam can greatly reduce the broadening of the Compton radiation bandwidth due to the energy spread.

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Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 79

Wake fields effects in dielectric capillary

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

For plasma wake-field acceleration experiments (PWFA) that are foreseen at the SPARC_LAB test facility, we are going to use a gas-filled capillary plasma source composed of a dielectric capillary where the electron beam has to pass through it in order to achieve higher acceleration energies up to GeV level. In this acceleration scheme, wake fields produced by passing electron beams through dielectric structures can determine a strong beam instability that represents an important hurdle towards the capability to focus the high-current electron beam in the transverse plane. For this reasons, the estimation of the transverse wake-field amplitudes assumes a fundamental role in the implementation of the plasma wake-field acceleration. In this work, it will be presented a study to investigate which parameters affect the wake-field formation inside a cylindrical dielectric structure, both the capillary dimensions and the beam parameters, and it will be produced a quantitative evaluation of the longitudinal and transverse electric fields.

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Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 80

Modeling Multiple Coherent and Incoherent Photon Scattering in Solid-Density Plasmas with Particle-In-Cell Simulations

Wednesday 27 Sep 2017 at 17:00 (00h15')

Content :

Laser-driven solid density plasmas can be used to generate highly energetic electrons and ions. Diagnosing properties within those plasmas at nm length scales and down to fs time scales is crucial in understanding the involved processes. This has recently become feasible through the advent of X-Ray Free Electron Lasers (XFELs). For instance, XFELs allow to image the electron density distribution within plasmas via Small Angle X-Ray Scattering (SAXS). We present a scalable GPU-based software framework for simulating photon scattering processes of X-ray beams in matter using Monte-Carlo methods. These simulations enable us to produce synthetic SAXS signals from the interaction of a modeled X-ray pulse with an arbitrarily complex, 3D electron density distribution obtained e.g. from detailed particle-in-cell simulations. Additionally we present radiation transport methods in our 3D3V fully-relativistic PIC code PIConGPU. These methods enhance modeling of self-imaging of solid-density plasmas and lay the foundation for in-situ simulations of pump-probe experiments. Our new framework allows for single and multiple scattering and is extendable to include complex physics processes like ionization, atomic excitation and de-excitation along the photon path to further enhance its predictive capability.

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Presenter : Mr. GARTEN, Marco (HZDR, TU Dresden)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 81

Two-stage multi-beam linear accelerator EVT

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

A concept of an electron two-stage multi-beam linear accelerator is presented. The accelerator, short-named EVT (Electron Voltage Transformer) belongs to the class of two–beam accelerators. Drive beam-lets and accelerated beam generating in a common multi-beam electron gun, are modulated in RF modulators and then bunches pass into accelerating structure, comprising uncoupled with each other and inductive tuned cavities. The ensemble of the drive beam-lets is consisting of two groups. At the first stage the first group of drive beam-lets transfers their energy to the second group of beam-lets. At the second stage the second group of drive beam-lets transfers their energy to the accelerated beam. Such configuration allows increase transformation ratio and energy of the accelerated beam considerably. Preliminary results of numerical simulations of two-stage EVT operating in S-band with a 60 kV gun and generating a 1 A, 3.5 MeV beam at its output, having efficiency of 30% is presented.

Primary authors : Dr. TERYAEV, Vladimir E. (Omega-P, R, Inc.)

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Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 82

Shedding light on LWFA plasma dynamics - in-situ radiation diagnostics in PIConGPU

Wednesday 27 Sep 2017 at 19:10 (00h20')

Content :

We present recent results from the in-situ radiation diagnostics available in the particle-in-cell code PIConGPU and illustrate its power to provide insight into LWFA experiments when linked to experimental measurements.

PIConGPU is currently one of the fastest 3D3V PIC codes. Its speed allows including an in-situ radiation diagnostic based on Liénard-Wiechert potentials. This synthetic diagnostic is capable of computing the spectrally resolved far field radiation of billions of macro-particles for numerous observation directions. It allows resolving the intensity and polarization of the emitted radiation both temporally and spatially for frequencies extending from infrared to x-rays. Its use of form-factors and its capability of phase tracking each individual macro-particle enable quantitative predictions in both the coherent and incoherent regime. Applications for this synthetic radiation diagnostics have already been demonstrated in astrophysical simulations to identify and quantify the Kelvin-Helmholtz instability.

After a brief introduction of the techniques for computing the radiation in-situ, we focus on the characteristic radiation of LWFA, which allows identifying the various stages of the laser-plasma dynamics. We demonstrate the correlation between emitted radiation and particle dynamics and discuss application of these signatures in laboratory experiments

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Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 83

Laser-driven neutron sources and their applications

Wednesday 27 Sep 2017 at 18:40 (00h20')

Content :

The neutron sources produced by employing intense laser-driven ion beams have recently received a great deal of attention. Intense lasers can produce 10s of MeV protons in a small divergence cone by, for instance, Target Normal Sheath Acceleration (TNSA) mechanism, which is highly efficient in producing fast neutrons via fusion reaction with low mass atomic nuclei. Employing a neutron converter in close proximity to the laser driven ion source, a beamed neutron flux can be obtained which is highly suitable for applications and further transport. While fast neutrons are useful in many applications, such as fast neutron therapy [2], material testing in fission and fusion reactor research [3], a laser driven short bursts of moderate energy (~MeV) neutrons can be efficiently moderated to thermal and epithermal region for a wide range of applications, such as imaging [4], nuclear resonance spectroscopy [5], Boron neutron capture therapy [6] etc. Characterisation of the fast and moderated neutrons produced in an experiment at Rutherford Appleton laboratory employing 100 TW Vulcan laser will be presented. In addition, proof-of-principle study on neutron imaging of static objects will be discussed based on experimental data and simulations.

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Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 84

Laser beam circulator for high brightness Inverse Compton Scattering Sources

Monday 25 Sep 2017 at 19:00 (00h15')

Content :

The present paper will present the EuroGammas consortium development on the optics and laser of interaction point of the inverse Compton scattering source (ICS) of the ELI-Nuclear Physics project. The interaction point optical system of the ICS is based on a non resonant laser beam cavity allowing the circulation of one or two laser pulses to be focalized 32 times on a electron bunch train to produce X-ray to Gamma ray beam with high spectral brightness.
The laser beam circulator optical system and interaction point laser tests prior to the installation on site will be reported . Applications of a laser beam circulator in the context of compact high brightness power sources will be discussed.

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Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 86

Light Sail Acceleration of Ultra-Thin Foils

Wednesday 27 Sep 2017 at 16:20 (00h20')

Content :

The talk will present results of recent experiments using the GEMINI laser at the Rutherford Appleton Laboratory investigating the acceleration of ions from ultrathin carbon foils (2-100nm). The laser delivered ~8J (after two plasma mirrors) on target in a 30fs (λ= 800nm) pulse providing an intensity of approximately 6x10^20Wcm^-2.

In this interaction regime, it is known that laser polarization can play an important role in determining the dynamics of the laser-target coupling and of the ion acceleration process. In particular, the use of circular polarization (controlled by a quarter-wave plate) can significantly reduce electron heating, helping to preserve the opacity of the foils during the irradiation. This is key to accessing acceleration regimes where the laser radiation pressure is the dominant mechanism, such as the so-called Light Sail process.

Our results highlight a strong dependence of the maximum ion energies on laser polarization, with circular polarisation leading to the highest values (>25MeV/nucleon) for carbon and contaminant protons. For targets thinner than 20nm, circular polarisation produced energies over double that of linear polarisation. This is consistent with the onset of Light Sail acceleration, also indicated by Particle in Cell simulations.

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Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 88

Laser-Assisted Discharge Ignition for Plasma Waveguides

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

In the process of laser wakefield acceleration electrons can be accelerated by the huge longitudinal electric fields (>100GV/m) of a plasma wave structure, reaching GeV-energies on a centimeter-scale. To efficiently use these longitudinal fields of the plasma wave, the wave has to survive over the whole acceleration length meaning the laser intensity has to remain sufficiently high throughout the whole length. This can be achieved by guiding the laser pulse in a preformed plasma channel generated by a high-voltage discharge in a hydrogen filled capillary.
We present the results of a stabilization analysis of a high voltage discharge in a hydrogen filled capillary. In the experiment, the influence of preionization of the gas with an intensive femtosecond laser pulse on the discharge as well as the guiding properties of the plasma waveguide are investigated.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 89

Simulation studies for dielectric wakefield programme on CLARA facility

Wednesday 27 Sep 2017 at 18:50 (00h20')

Content :

The dielectric wakefield acceleration R programme has been initiated on a recently constructed CLARA (Phase I) facility at Daresbury Laboratory. The machine is capable of generating sub-ps electron bunches with up to 250pC bunch charges and ~50MeV beam energy. We present simulation results for upcoming experiments that will utilise a planar variable gap dielectric lined waveguide as a source of tunable THz radiation and a prototype for CLARA FEL energy dechirper. The emphasis is on investigation of wakefield longitudinal and transverse effects on drive bunches generated by CLARA. THz spectra and expected tunability range are also evaluated.

Primary authors : Dr. XIA, Guoxing (Cockcroft Institute and the University of Manchester) ; Dr. SAVELIEV, Yuri (STFC, Daresbury Lab., ASTeC) ; Mr. PACEY, Thomas (Cockcroft Institute/University of Manchester)

Co-authors :

Presenter : Mr. PACEY, Thomas (Cockcroft Institute/University of Manchester)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 91

Demonstration of the Excitation and Control of Plasma Wakefields by Multiple Laser Pulses

Monday 25 Sep 2017 at 18:54 (00h18')

Content :

We reconsider the idea of exciting plasma wakefields by a train of low energy laser pulses, rather than by a single, high-energy pulse. This “multi-pulse laser wakefield acceleration” (MP-LWFA) approach is related to the plasma beat-wave accelerator, but has significant advantages since, in principle, the properties of each pulse in the train can be tailored to optimize wake excitation. In particular, the pulse spacing can vary within the train, which avoids saturation by relativistic detuning.

We describe a proof-of-principle demonstration of the MP-LWFA concept. In this work, wakefields were driven by trains of up to seven laser pulses generated from a Ti:sapphire laser. Frequency-domain holography measurements of the wakefields show resonant excitation when the laser pulse spacing is a multiple of the plasma period. We also show that a suitably delayed laser pulse can damp the plasma wave driven by an earlier pulse, which is a first step towards an energy recovery plasma accelerator.

Our results are important since they are the first experimental demonstration of wakefield excitation by a laser pulse structure that is long compared to the plasma period, and that also has sufficient control to overcome relativistic saturation.

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Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 92

Research and Development of Tabletop Ion Accelerator

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

We have been developing a tabletop ion accelerator system which can be introduced and operated at the laboratory level for radiobiological experiments. In recent years, a heavy ion radiation therapy which is one of a highly effective radiotherapy for malignant tumors is becoming widespread in the general public. There is, however, not enough statistical data evaluating the influence of ion beam on DNA and so on so that, for example, the associated risk of radiation exposure against the low-speed ion beam cannot be evaluated accurately. Therefore, in our research, the tabletop ion accelerator system is being developed to advance the radiation biology rapidly, which will be used as a compact radiotherapy system in future. In order to accomplish a compact ion accelerator system, we have been developing and demonstrating a dielectric wall accelerator (DWA). DWA system consists of blumlein circuits and photoconductive semiconductor switch (PCSS) and high gradient insulators (HGI). In this workshop, we report the latest results of the performance tests of PCSS and high voltage generation and so on.

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Presenter : Mr. IKEDA, Naoki (The University of Tokyo)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG2 - Ion Beams from Plasmas

Type : poster

Contribution ID : 93

FEL performances of plasma accelerated electron beams

Wednesday 27 Sep 2017 at 18:45 (00h15')

Content :

The FEL performances of electron beams accelerated by laser or particle driven plasma waves are studied.
Start to end simulations from the photocathode to the undulator will be presented, showing the characteristics of the radiation.
The results will be compared with those of a conventional FEL based on linac accelerated beams.

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Presenter : Dr. PETRILLO, Vittoria (Università degli Studi di Milano)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 94

LCODE 3D: a free quasistatic plasma wakefield acceleration code

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

LCODE, a freely-distributed parallel quasistatic 2D3V code, has helped pushing plasma wakefield acceleration forward for decades. It empowers researchers with a numerically efficient simulation tool excelling at long-term propagation of ultrarelativistic particle beams in plasmas. While its performance-focused principles, techniques and tricks make it possible to simulate frontier plasma wakefield acceleration experiments in just days or hours of CPU time and megabytes of RAM, there is a number of 3D-specific effects like side-injection, filamentation or hosing instability that cannot be properly taken into account with a 2D simulation window.

A three-dimensional rewrite of LCODE is in the works, catering to the emergent need of proton-driven plasma wakefield acceleration to conduct 3D simulations. Building up on previous LCODE expertise, it aims to employ the same resource-frugal approach and techniques to marry simple and straightforward underlying models and algorithms with high numerical stability while striving to minimize the decrease of performance resulting from transitioning to 3D.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 95

A laser-to-beam-driven plasma wakefield accelerator

Thursday 28 Sep 2017 at 18:36 (00h18')

Content :

Plasma wakefield accelerators can be driven by either an intense laser pulse (LWFA) or a high-current particle beam (PWFA). A plasma accelerator combining both schemes consists of a LWFA providing an electron beam which subsequently drives a PWFA in the highly nonlinear regime. This scenario explicitly makes use of the advantages unique to each method, particularly exploiting the capabilities of PWFA schemes to provide energy-boosted high-brightness beams, while the LWFA stage inherently fulfils the demand for compact high-current electron bunches required as PWFA drivers. Effectively, the subsequent PWFA stage operates as a beam brightness and energy booster of the initial LWFA output, aiming to match the demanding beam quality requirements of accelerator based light sources. We present a design study based on theoretical considerations and full-detailed particle-in-cell simulations, aiming to address the feasibility and the capabilities of this promising strategy. Besides, we report on dedicated studies towards the implementation of a proof-of-principle experiment at the DRACO laser facility at Helmholtz-Zentrum Dresden-Rossendorf (HZDR).

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Presenter : Dr. MARTINEZ DE LA OSSA, Alberto (DESY)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 96

Laser-Ion-Acceleration using Water Droplets and Optical Probing

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

In order to gain more insights into laser driven ion acceleration experiments it is advisable to probe the laser target interaction, for example with an optical probe. Water droplets are ideal targets for this purpose, because the laser illuminated and the rear surface can be imaged simultaneously. However, strong light emission from the plasma typically outshines the probe.
To overcome this we used in our experiment the frequency doubled main pulse of the JETI 40 laser system at 400 nm while using a broadband optical probe centered around 750 nm. This gave us the opportunity to select a spectral region in which the plasma emission was weakest. Using this method, we could observe the hydrodynamic expansion of a water droplet hit by the laser pulse on a picosecond timescale. Although this is not directly related to ion acceleration, which takes place on a femtosecond timescale, the geometrical form of the expansion could be related to the maximum proton energy. Additional measurements of the proton beams' spatial profile have been performed which show strong density modulations likely connected to modulated electric or magnetic fields at the target's rear side, which will be investigated with the help of simulations.

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Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG2 - Ion Beams from Plasmas

Type : poster

Contribution ID : 97

Simulation of electron trapping with quasistatic code

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Laser plasma wakefield acceleration is a hot topic of research in new acceleration methods. A lot of laboratories with suitable lasers investigate the laser-plasma interaction in many configurations. Nevertheless, numerical simulation is still a necessary tool to study processes occurring in the interaction region. Full PIC codes are the most powerful instruments, but they are computationally demanding. Quasistatic codes use non-trivial assumptions to speedup simulation by several orders of magnitude, but this model doesn't take electron trapping into account.
Each time step only a small part of plasma electrons is trapped and doesn't impact plasma fields much. However, the trapped charge accumulates and influences the wave structure. To simulate this effect, we move these plasma particles with the general equation of motion. If they stay in the simulation window, we continue simulating evolution of these particles with the beam particles model. We choose only plasma particles with velocity close to the speed of light to prevent non-physical wave breaking or extra beam-loading. The solution is compared with full-3D PIC code. The new numerical instrument allows to perform wide and detailed parametric scanning with a fast code and use heavy codes only for benchmarking.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 98

Calibration of Charge Diagnostics using Electrons from a Laser Plasma Accelerator

Tuesday 26 Sep 2017 at 17:00 (00h15')

Content :

The results of calibrating three independent charge measurement diagnostics with electron bunches from a laser wakefield accelerator are presented. The detectors used are phosphor screens (type DRZ), an integrated current transformer (ICT/Toroid), and a cavity-based dark current monitor (DaMon). The simultaneous use of all three measurement techniques allowed the cross-calibration of the DRZ, ICT, and DaMon for other applications, e.g. future implementation in beam driven plasma wakefield acceleration experiments at FLASHForward. Results show that the use of the DaMon permits non-destructive detection of ultrashort electron bunches with an improved dynamic range when compared to conventional diagnostics such as phosphor screens and ICTs. This originates from the insensitivity of the DaMon to the electromagnetically noisy plasma environment and its strong response to electric charge passing through its cavity. Therefore, the DaMon enables the detection of low bunch charges down to the ~10 fC regime opening up new possibilities of precise charge measurements for plasma-based acceleration.

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Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 99

Propagation of trains of laser pulses in pre-formed plasma channels

Tuesday 26 Sep 2017 at 18:40 (00h20')

Content :

It has now been shown experimentally that electrons can be accelerated to 4-GeV energies in a plasma wakefield driven by a single high-intensity laser pulse. However, such laser systems have limited repetition rates and low wall-plug efficiency. An alternative method is to resonantly excite plasma oscillations using a train of laser pulses of lower intensity spaced by the plasma period to drive multi-pulse laser wakefield accelerators (MP-LWFAs). Fibre and thin-disc laser technologies offer the possibility to drive MP-LWFAs efficiently and at high repetition rate (tens of kHz), opening a new domain for applications including compact X-ray sources with high mean brightness.

MP-LWFA based accelerators would require propagation of trains of laser pulses over tens of centimetres in plasma channels. An attractive possibility is a plasma channel based on hydrodynamic expansion of plasma column formed by optical field ionization. Transverse plasma density gradients as well as a combination of pump photon deceleration and group velocity dispersion need to be taken into account designing MP-LWFA accelerators. We will present outcomes of our studies using the two-dimensional EPOCH PIC code.

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Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 100

Analytic model for electromagnetic fields in the bubble regime in non-uniform plasma

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

We consider a model of a strongly nonlinear plasma wakefield (a bubble) excited by an intense laser pulse or a relativistic electron bunch propagating in plasma with transverse inhomogeneity. Assuming an arbitrary shape of the electron sheath on the border of the bubble, we obtain a second-order ODE for the boundary of the bubble. We find two approximations when this equation is significantly simplified. Assuming small thickness of the electron sheath, we develop the lowest-order perturbation theory for the components of electromagnetic fields inside and outside the bubble. Unlike previous models, we derive simple explicit expressions for the components of electromagnetic fields not only in the vicinity of the center of the bubble, but in the whole volume of the bubble (including areas of driving or accelerated bunches) as well as outside it. Moreover, we apply the results to the case of radially non-uniform plasma. The obtained results are verified with 3D particle-in-cell simulations which show good correspondence to our model.

Primary authors : Mr. GOLOVANOV, Anton (Institute of Applied Physics RAS)

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 101

Time resolved diagnostics in AWAKE

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The AWAKE experiment relies on the self modulation instability (SMI) of a long (ns) proton bunch in a plasma. The self modulation of the bunch is responsible for resonant driving of the plasma wakefields and the proton bunch develops sub structures with a scale on the order of the plasma wavelength (~1.2 mm in AWAKE) and the square root of the plasma density.
Optical Transition Radiation as prompt lightsource and a streak camera are used to image a thin slice of the beam.
The resulting time resolved image contains information about the frequency of the self modulation. The remaing spatial dimension contains information about the SMI growth. The diagnostics aims at showing the relation between the SMI frequency and is able to show the complete modulation of the bunch.
Experimental results from the first AWAKE runs will be presented.

Primary authors : Mr. RIEGER, Karl (Max Planck Institute for Physics Munich)

Co-authors : Prof. MUGGLI, Patric (Max-Planck-Institut für Physik) ; AWAKE COLLABORATION, AWAKE (awake)

Presenter : Dr. MARTYANOV, Mikhail (Max Planck Institut fur Physik, Munich)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 102

Theoretical and experimental studies of plasma generation for beam-driven plasma wakefield accelerators

Monday 25 Sep 2017 at 16:36 (00h18')

Content :

Plasma targets required for wakefield acceleration rely on establishing specific electron density distributions in longitudinal and sometimes transverse direction to allow for control over the quality of accelerated electron bunches. The complex fragmentation dynamics of molecular gases in strong electric fields can have a crucial impact on target as well as injection properties in plasma wakefield acceleration. The importance of dissociative fragmentation during ionisation will be discussed in this contribution on the example of hydrogen. Especially in complex scenarios, in which multiple gas-species can be involved, the strength of the plasma generating source may be adjusted to accommodate for the species-specific ionisation thresholds to e.g. generate strong gradient down ramps. To predict the theoretical electron density distribution across the target, we compute the ionisation behaviour based on rate equations and ADK theory in strong electric fields. Here, the fragmentation dynamics governed by various dissociation and ionisation pathways play a crucial role in generating specific profiles. Results from these methods are benchmarked experimentally employing a multi-TW short-pulse laser. The developed understanding of the underlying processes of plasma generation allows for tailoring the electron density distribution by manipulating the focusing geometry and thus spatial laser-intensity evolution.

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Presenter : Mrs. TAUSCHER, Gabriele (DESY)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 103

The role of direct laser acceleration of electrons in a laser wakefield accelerator with ionization injection

Thursday 28 Sep 2017 at 16:36 (00h18')

Content :

We show through experiments and supporting simulations the role of direct laser acceleration (DLA) of electrons in a laser wakefield accelerator when ionization injection of electrons is employed. The laser pulse is intense enough to create a nonlinear wakefield and long enough to overlap the electrons trapped in the first accelerating potential well (bucket) of the wakefield. The betatron oscillations of the trapped electrons in the plane of the laser polarization in the presence of an ion column lead to an energy transfer from the laser pulse to the electrons through DLA. We show that the produced electron beams exhibit characteristic features that are indicative of DLA as an additional acceleration mechanism when the laser pulse overlaps the trapped electrons.

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Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 104

Ultrahigh 6D brightness electron beams from a single plasma acceleration stage

Thursday 28 Sep 2017 at 18:00 (00h15')

Content :

Plasma photocathode wakefield acceleration ("Trojan Horse") paves a way to deliver electron beams with ultralow emittance, multi-kA peak current, and GeV-class beam energy within a single plasma stage. This consequently leads to ultrahigh 5D-brightness orders of magnitude beyond of the state-of-the-art. However, an intrinsic by-product of the ultrahigh accelerating field gradients inherent to plasma accelerators is substantial correlated energy spread (energy chirp). This significant energy chirp raises serious challenges, i.e. for beam extraction from the plasma stage, witness beam transport and particularly for key applications such as free-electron-lasers. Here we present a novel single-stage plasma-based energy chirp compensation method which potentially allows to minimize the relative energy spread to the <0.1% level while preserving the 5D-brightness. In conclusion, the combination of ultrahigh 5D-brightness and minimized energy spread opens a path towards witness beams with unprecedented ultrahigh 6D-brightness [1]. Such high class electron beams may have a transformative impact for compact light sources of the next generation.

[1] Manahan, G.G. and Habib, A.F. et al. Nat. Commun.8, 15705 doi:10.1038/ncomms15705 (2017)

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Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 105

Commissioning Results From The LUX Beamline For Plasma-Driven Undulator Radiation

Wednesday 27 Sep 2017 at 18:00 (00h15')

Content :

We discuss the commissioning and present first experimental results from the LUX Beamline for plasma-driven undulator radiation. This beamline is built within a close collaboration of the University of Hamburg and DESY, combining university research with the tools and expertise of a large accelerator facility as a sound basis for robust performance for applications. In this talk we will give an overview of the design concept of the beamline, discuss the integration of the laser and the beamline into the accelerator controls system and report on lessons learned from daily operation. We will further present results from the commissioning of the plasma target at high rep-rates, and review results from electron beam transport and diagnostics, as well as the commissioning of our miniature undulator for generation of synchrotron-like undulator radiation.

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Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 106

Numerical studies on capillary discharges as focusing elements for electron beams

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The azimuthal magnetic field generated by the discharge current induced by applying a voltage to the extremities of a gas-filled capillary can be used to focus an electron beam passing through the device. The generated magnetic field gradient can reach values higher than those achieved in electromagnet and even permanent magnet quadrupoles.
In principle, optimal focusing condition is reached when the current density is perfectly parallel to the capillary axis and transversely uniform, as in this case the magnetic field intensity has a linear dependence on the distance from the axis. In a number of experimental situations, this is often not the case; thus, the aim of the present work is to numerically investigate capillary discharges in order to study the causes of the transverse non-linearity of the magnetic field and to allow future studies on mitigation strategies. In fact, the non satisfactory degree of uniformity of the current density distribution could be due to a number of reasons, including but not limited to: the dependence of the plasma resistivity on the local temperature, the shape of the electrodes and the capillary geometry.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 107

Undulator Upgrade for the LUX Beamline

Wednesday 27 Sep 2017 at 18:30 (00h15')

Content :

The LUX Experiment is a dedicated beamline for the generation of laser-plasma driven undulator radiation and built in a close collaboration of the University of Hamburg and DESY. After the first electron beams from LUX in 2016, we upgraded the beamline with a new beam transport and additional diagnostics, a miniature undulator and an x-ray spectrometer. Commissioning of the upgrade started in spring 2017. Here, we will report on the commissioning and lessons learned and present first experimental data from the beamline operation.

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Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 108

Ten Meter Laser Propagation with Resonance Enhanced Ionization of Rubidium for Plasma Generation at AWAKE

Monday 25 Sep 2017 at 19:15 (00h15')

Content :

The AWAKE project has a uniform rubidium vapor source with baseline density of 7e14 cm^-3 that must be completely ionized radially to 1 mm over its entire 10 meter length. Furthermore, the ionization must be substantially faster than a single plasma period to seed the self-modulation instability. We use a 4.5 TW fiber / titanium:sapphire chirped pulse amplification laser system to ionize. Because two of the transitions to ionization lie within the full width at half maximum of the laser spectrum, significant anomalous dispersion occurs within the laser pulse if there are large valence electron populations in the ground (5S) or first excited state (5P). This dispersion along with diffraction can cause the laser to stretch longitudinally and expand transversely, decreasing the ionization probability. If the laser pulse energy is too low as it propagates through the extended vapor source, depletion until critical intensity occurs and the beam crashes, causing rapid expansion and stretching.

We show that the pulse crashing problem can be overcome by using laser pulses with sufficient energy and intensity to propagate the full length of the vapor source. The strengths and limitations of using a resonance enhanced scheme are also discussed.

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Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 109

Time resolved X-ray absorption measurements of high energy density matter using broadband X-rays from an electron beam

Tuesday 26 Sep 2017 at 16:15 (00h15')

Content :

Measuring accurate and detailed information from energetic and dense plasmas, like those present in the core of large planets or inertial confinement fusion targets for example, presents a significant challenge. Within the laboratory frame, many of the key processes that govern these states occur over rapid time scales (femtoseconds or less), and due to the dense nature of such samples, many common diagnostics that rely on optical probing are inadequate. Here we present a new experimental technique that should provide a wealth of information about dense plasmas, on a truly ultrafast timescale. The X-rays generated by the betatron oscillations of a laser wakefield driven electron beam form a perfect probe beam. Not only does the pulse duration (10's of femtoseconds) provide a snapshot of the conditions present and that the brightness and photon energy (Ecritical = 25 keV) available can penetrate relatively large samples, but the smooth broadband spectral nature of these pulses make them ideal for performing single-shot X-ray absorption measurements near resonance edges, and ionisation states. This can provide direct information on the electron temperature and density, local structure, ionisation rate, and other more involved mechanisms such as ionisation potential depression.

Primary authors : Dr. KETTLE, Brendan (Imperial College London)

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Presenter : Dr. KETTLE, Brendan (Imperial College London)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 110

Considerations for Energy Scaling of Dielectric Laser Accelerators

Tuesday 26 Sep 2017 at 18:00 (00h20')

Content :

Dielectric Laser-driven Acceleration (DLA) refers to the acceleration of particles inside a vacuum channel within a dielectric structure powered by near infrared lasers. Recent demontrations of accelerating gradients approaching 1 GeV/m, improvements in energy gain, numerically optimized structure designs, and development of a variety of auxilliary laser-driven concepts for focusing, steering, and beam position monitoring, have set the stage for developing integrated laser-driven accelerator systems. However, the shift from microwave to optical wavelengths results in narrow beam apertures and tight tolerances on phase control, which pose unique challenges for scaling the approach to MeV, GeV, and higher energies of interest for first applications. We discuss some of these challenges as well as possible solutions and mitigations, review recent progress in this area, and present plans for future experiments.

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Presenter : Dr. ENGLAND, Joel (SLAC)

Session classification : WG8_Parallel

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 113

High Gradients in Dielectric Wakefield Accelerators

Monday 25 Sep 2017 at 18:00 (00h30')

Content :

Significant advancements in Dielectric Wakefield Accelerators (DWA) have been made since the first experiments 30 years ago. For example, the accelerating gradients observed have improved beyond the GV/m level at frequencies in the terahertz regime. Such strong fields generate a change in the dielectric field, similar to a metallization, that have implications for the operation of DWA as high-gradient accelerating structures. In addition to increases in gradient, the techniques used to fabricate DWA have improved leading to evolutions in the geometries of DWA, e.g. photonic confinement structures. This talk covers the details of this metallization-like process in dielectrics, its effects on running DWA at high gradients and how DWA based on exotic geometries impact the role of DWA as future accelerators.

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Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 115

Group and phase velocity matching in THz IFEL interaction

Thursday 28 Sep 2017 at 18:30 (00h20')

Content :

We review results from the recent guided-THz IFEL experiment at the UCLA PEGASUS facility. Using a parallel plate waveguide, the group velocity of a near-single cycle THz pulse was reduced to match electron beam propagation in an undulator, resulting in a ponderomotive interaction sustained for 30 cm. With a 1 uJ THz pulse obtained by optical rectification in a LN source, the projected beam energy distribution increased from a full peak width of 30 keV to more than 100 keV. When using a long (multi-ps) electron beam, longitudinal phase space measurements reveal the snake-like energy modulation from the ps-scale THz pulse. Using a short beam configuration, we also measure bunch compression, limited by the available drift length to a factor of two. Finally, we explore the application of this technique to amplification of the THz seed using the 1-D multi-frequency simulation code we have developed for this novel zero-slippage interaction scheme.

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Presenter : CURRY, Emma (UCLA)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 116

Observation of ultrafast solid-density plasma dynamics using femtosecond X-ray pulses from a free-electron laser

Monday 25 Sep 2017 at 16:00 (00h25')

Content :

The combination of ultra-intense lasers with x-ray free-electron lasers (XFELs) opens up a variety of applications in plasma and shock physics.
Many phenomena during the laser-target interaction happen on short time scales in the range from femto- to picoseconds and length scales of tens of nanometers to a few micrometers. Unlike the ultra-short, highly coherent x-ray pulse, optical methods or conventional continuous x-ray sources cannot probe the dynamics of the bulk material with sufficient temporal and spatial resolution. With this talk we will show the potential of Small angle X-Ray Scattering (SAXS) in combination with short-pulse laser experiments.
With this method it is possible to draw conclusions about the electron density distribution in the target by analyzing the XFEL diffraction pattern in the vicinity of the direct beam. A setup to perform such SAXS experiments was developed and optimized during a beamtime at the Matter in Extreme Conditions instrument (MEC) at the Linear Coherent Light Source (LCLS) in Stanford. We will discuss the setup and present a preliminary analysis of the data obtained during this experiment, especially the length scales of the target front side expansion.

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Presenter : ROEDEL, Melanie ()

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 117

Laser wakefield electron acceleration with high power, few-cycle mid-IR lasers

Tuesday 26 Sep 2017 at 17:12 (00h18')

Content :

The study of laser wakefield electron acceleration (LWFA) using mid-IR laser drivers is a promising path for future laser driven electron accelerators, when compared to traditional near-IR laser drivers operating at 0.8 - 1 μm central wavelength (λ_laser), as the necessary vector potential (a_0) for electron injection can be achieved with smaller laser powers due to the linear dependence on λ_laser. In this work, we perform 2D PIC simulations on LWFA using few-cycle, high power (>10 TW) laser systems with λ_laser ranging from 0.8 - 3.2 μm. Such few-cycle systems are currently under development, aiming at Gas High Harmonics Generation applications, where the favourable (λ_laser)^2 scaling extends the range of the XUV photon energies. We keep a_0 and n_e/n_cr (n_e being the plasma density and n_cr the critical density for each λ_laser) as common denominators in our simulations, allowing for comparisons between drivers with different λ_laser, with respect to the accelerated electron beam energy, charge and conversion efficiency. While the electron energies are mainly dominated by the plasma dynamics, the laser to electron beam energy conversion efficiency shows significant enhancement with longer wavelength laser drivers.

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Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 118

Design of high brightness Plasma Wakefield Acceleration experiment at SPARC LAB test facility with the 3D particle-in-cell ALaDyn

Tuesday 26 Sep 2017 at 18:00 (00h20')

Content :

We present a numerical investigation of a Plasma Wakefield Acceleration scenario in the weakly non-linear regime relevant to the campaign at the SPARC LAB test facility. The investigation considers a two bunches configuration: a charged driver that induces the wakefield, followed by a less charged bunch (trailing bunch) that is accelerated; bunches are generated and pre-accelerated up to 100 MeV by a high brightness photo-injector. Our numerical investigation focuses on specific parameters that are of interest for the beam-driven experiments ongoing at SPARC LAB. The numerical simulations are conducted with the state-of-the-art 3D particle-in-cell code ALaDyn. For the specific case of PWFA experiments at SPARC LAB, we have identified a setup in the weakly non-linear regime capable to preserve witness quality over the propagated distance. Starting from this case scenario we modify a few parameters in order to evaluate the working point robustness: identify and measure the possible causes of witness quality degradation.

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Presenter : MAROCCHINO, Alberto (LNF)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 119

Plasma-based spatiotemporal synchronization and alignment of electron and laser beams

Tuesday 26 Sep 2017 at 16:40 (00h20')

Content :

Advanced particle accelerators and their applications rely on exact synchronization and alignment of laser pulses with respect to charged particle beams. Prominent examples are pump-probe experiments with free electron lasers and plasma photocathode accelerators..
The presentation discusses a novel technique which harnesses enhanced plasma recombination glow from impact ionization from laser-triggered plasma sparks. Spatial as well as temporal transitions triggered by this interaction allow for synchronization and alignment of ultrashort electron beams and laser pulses with few or even sub-fs accuracy and μm-level spatial sensitivity. This system was developed as integral diagnostics for the E210 campaign at FACET via a simple and robust layout, which may find application in a wide range of conventional as well as plasma-based accelerator setups.

[1] A. Knetsch,T. Heinemann, P. Scherkl et al., to be submitted

Primary authors : Mr. KNETSCH, Alexander (Deutsches Elektronen-Synchrotron DESY) ; Mr. SCHERKL, Paul (SUPA, University of Strathclyde, and the Cockcroft Institute) ; Mr. HEINEMANN, Thomas (Uni Strathclyde / DESY)

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Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 120

TNSA proton maximum energy laws for 2D and 3D PIC simulations

Tuesday 26 Sep 2017 at 19:15 (00h15')

Content :

TNSA numerical simulations have many uncertainties, due to the large arbitrariness in input parameters, besides huge computational costs for 3D. The energy spectrum of the accelerated particles is exponential with a cut-off and is correctly reproduced, but the maximum energy obtained depends on many user-chosen parameters, for example the simulation end time. The growth in time of the maximum energy follows different laws in 2D and 3D, the former following a logarithmic growth while the latter converging to an asymptotic value: the determination of an ultimate value is often arbitrary. In a recent paper, we proposed two laws for these rise in time of the cut-off energies: we have considered both a 2D model in which the surface charge is located on a strip with infinite length and a 3D model in which the surface charge is located on a disc. Fitting simulation results with the appropriate law, one can obtain the a more robust numerical cut-off energy. Our method can give a more insightful meaning to 2D simulations and also allows to stop 3D simulations quickly, using our law to obtain the maximum energy asymptotic value without reaching it.

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Presenter : SINIGARDI, Stefano (BO)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 121

Emittance of the accelerated electron bunch in two-stage AWAKE scenario

Thursday 28 Sep 2017 at 19:12 (00h18')

Content :

AWAKE is a proton-driven plasma wakefield experiment at CERN. Its future goal is to demonstrate a good quality of the accelerated electron beam. One of possible options under consideration for this experiment is a two-stage scenario, in which the electron beam is injected between two plasma cells. In the first plasma cell, the proton beam self-modulates, and the second cell is dedicated for acceleration. Possible energies and emittances of test electron microbunches in this scenario are numerically studied. Effect of strong emittance blow-up is demonstrated and described. The dependence of this effect on the length of the vacuum gap is also studied with simulations.

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Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 123

Simulations of low-density plasma channels capable of high repetition rate operation

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The next generation of Laser Wakefield Acceleration experiments require guiding laser drivers with longer and lower density plasma structures. We present theory and simulations describing an entirely optical mechanism of creating plasma channels 10s of centimetre long and with on axis plasma densities below 10^17 cm^-3. These channels would be suitable for guiding 10 GeV scale LWFA stages and could potentially operate at kHz repetition rates without damage.

Building on over two decades of successful work using Bessel beams to form plasma waveguides [1-3], we study using axicon focussing to produce long columns of hot plasma, the expansion of which can create guiding structures. Unlike collisional heating, using optical field ionization from elliptically polarised light allows the electrons in the plasma column to be heated independently of the density, enabling the formation of a plasma channel at unprecedented low densities. We present results of simulations on the development of the channels, using several different codes to encounter a range of interesting physics.

1. C. G. Durfee III and H. M. Milchberg, PRL 71, (1993)
2. H. Sheng et al, PRE 72, (2005)
3. A. J. Goers et al, APL 104, (2014)

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 124

Laser wakefield accelerators as x-ray sources for biomedical imaging applications

Tuesday 26 Sep 2017 at 16:30 (00h15')

Content :

Laser wakefield acceleration has been established in recent years as a proven method for the generation of electron beams up to the GeV scale in a compact laboratory setting. The oscillation of the electrons inside the plasma accelerator causes the emission of hard x-ray beams with short duration and high photon number. The effective x-ray source size is very small, typically near 1 micron, beneficial for x-ray imaging in two ways - the spatial resolution of point-projection radiography with this source is high, and the x-ray wavefront is spatially coherent over macroscopic distances, facilitating phase-contrast radiography. We have evaluated the suitability of laser-wakefield driven x-ray sources in the context of biomedical and pre-clinical imaging applications. We observe phase-contrast enhancement of small features in human soft-tissue samples, for example micro-calcifications in breast tissue which can be an early indication of cancer. Our source is of sufficient stability that we were also able to perform micro-computed tomography of embryonic murine samples, obtaining excellent resolution and signal-to-noise ratio throughout the 3D reconstruction.

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Presenter : Dr. COLE, Jason (Imperial College London)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 125

LWFA: Electron Cyclotron Resonance Imaging

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The multitude of imaging techniques for ultrafast laser-plasma interactions points to the wealth of knowledge that can be gained by having quantitative information about the interaction. Analysis and results on tracking the evolution of magnetic fields in the LWFA structure will be presented. To this end, few-cycle shadowgraphy has been combined with polarization and spectral filtering to understand the interplay of the Faraday , Cotton-Mouton and birefringence effects as they imprint information about the LWFA structure onto the probe beam. Experiments were performed at the JETI 40 laser system in Jena, Germany using a few-cycle VIS-NIR probe beam temporally synchronized to the driver laser. 3D PIC and plasma fluid simulations have also been implemented to help understand the complex interactions taking place during electron injection and acceleration. The goal of this work is to further develop diagnostics for investigating the various magnetic fields found within the LWFA process, be they from the driving laser, the accelerated electron bunch, the streaming walls of the electron cavity, or otherwise. With this knowledge, a better understanding of the highly dynamic and nonlinear process of plasma-based particle acceleration can be gained and improvements to simulation codes can be tested.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 126

Intrinsic elimination of the numerical Cherenkov instability in Lorentz-boosted frame simulations of plasma accelerators

Wednesday 27 Sep 2017 at 16:20 (00h20')

Content :

We present a novel Particle-in-Cell algorithm that is intrinsically free of the numerical Cherenkov instability for relativistic plasmas flowing at a uniform velocity. The new method is independent of the geometry and - unlike previous suppression strategies - we completely avoid artificial modifications of the electromagnetic fields. Application is shown at the example of Lorentz-boosted frame simulations of plasma accelerators, achieving excellent accuracy and high speed-ups using our spectral, quasi-3D GPU code FBPIC.

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Presenter : KIRCHEN, Manuel (University of Hamburg)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 127

Experimental observation of radiation reaction due to hard photon emission in the collision of a high-intensity laser with a laser-wakefield accelerated electron beam

Tuesday 26 Sep 2017 at 18:15 (00h15')

Content :

The dynamics of energetic particles in strong electromagnetic fields can be strongly influenced by radiation reaction, and today's lasers are sufficiently intense to explore the transition between the classical and quantum radiation reaction regimes. Here, we report on the observation of radiation reaction in the collision of an ultra-relativistic electron beam generated by laser wakefield acceleration (E > 500 MeV) with an intense laser pulse (a0 > 10). We measure an energy loss in the post-collision electron spectrum that is correlated with the detected signal of hard photons (gamma-rays), consistent with a quantum (stochastic) description of radiation reaction. The generated gamma-rays have the highest energies yet reported from an all-optical inverse Compton scattering scheme, with characteristic energy > 30 MeV.

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Presenter : Dr. COLE, Jason (Imperial College London)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 128

Laser-Accelerated Proton Beams as Diagnostics for Cultural Heritage

Thursday 28 Sep 2017 at 16:15 (00h15')

Content :

This work introduces the first use of laser-generated proton beams as diagnostic for materials of interest in the domain of Cultural Heritage. Using laser-accelerated protons, as generated by interaction of a high-power short-pulse laser with a solid target, we can produce proton-induced X-ray emission spectroscopies (PIXE). By irradiating a material sample with a high proton flux, we are able to perform the PIXE in a single shot without provoking more damage to the sample than conventional methodologies.

We report about experimental results where PIXE emission from materials of Cultural Heritage interest, irradiated with the laser-accelerated proton beam, has been measured. The morphological and chemical analysis of the sample before and after irradiation are compared in order to assess the damage provoked to the artifact. Numerical simulations confirm that the temperature in the sample stays safely below the melting point.

Compared to conventional diagnostic methodologies, laser-driven PIXE has the advantage of being potentially quicker and more efficient.

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Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 129

Numerical study of the focusing and propagation of complex laser pulses in under-dense plasmas

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

We report on some recent work for the inclusion of more realistic and complex laser pulses in the simulations of the Quasi-static PIC code WAKE and the PIC code CALDER-CIRC. Optical aberration in the driving laser pulse can deteriorate the quality of the accelerated electron bunch and limit the acceleration length. In the present work we study the influence of some perturbations in the phase of intense laser pulses on the propagation in under-dense plasmas. We also present simulation results on the focusing of laser pulses with axicon-type mirrors aimed at creating a guiding plasma channel prior to the main pulse.

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Presenter : Dr. CAIZERGUES, Clément (LOA)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 130

Fully optically controlled 90 degree Trojan Horse injection

Monday 25 Sep 2017 at 16:18 (00h18')

Content :

Fully optically controlled underdense photocathode plasma accelerators (“Trojan Horse”) has the potential to produce electron bunches with outstanding beam parameters. High charge, ultra low emittance electron beams are generated in a highly tunable nature due to the purely optical injection process. This injection method has been demonstrated at the SLAC national Accelerator Laboratory during in the E210 experiment. 3D PIC simulations and experimental results of Trojan Horse injection in 90 degree geometry from this campaign are presented.

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Presenter : Mr. ULLMANN, Daniel (University of Strathclyde)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 131

Traveling-Wave Electron Acceleration - Beyond the dephasing and depletion limits of laser-wakefield acceleration

Tuesday 26 Sep 2017 at 16:54 (00h18')

Content :

We show how to simultaneously solve several long standing limitations of laser-wakefield acceleration that have thus far prevented laser-plasma electron accelerators (LWFA) to extend into the energy realm beyond 10 GeV. Most prominently, our novel Traveling-Wave Electron Acceleration (TWEAC) approach eliminates both the dephasing and depletion constraints. The wakefield driver is a region of overlap of two obliquely incident, ultrashort laser pulses with tilted pulse-fronts in the line foci of two cylindrical mirrors, aligned to coincide with the trajectory of subsequently accelerated electrons.

TWEAC leads to quasi-static acceleration conditions, which do not suffer from laser self-phase modulation, parasitic self-injection or other plasma instabilities. Particularly, and in contrast to LWFA and PWFA, a single TWEAC-stage can arbitrarily be extended in length to higher electron energies without changing the underlying acceleration mechanism. Additionally, the TWEAC geometry greatly facilitates reducing beam transport distances between the laser-plasma accelerator and subsequent insertion devices, such as undulators, plasma lenses or colliding laser pulses, to below millimeters.

We introduce the new acceleration scheme, show results from 3D particle-in-cell simulations using PIConGPU, discuss energy scalability for both laser and electrons and elaborate on experimental realization requirements.

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Presenter : Dr. DEBUS, Alexander (Helmholtz-Zentrum Dresden-Rossendorf)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 132

Development of a non-numerical model for emittance calculation in external injection scenarios

Tuesday 26 Sep 2017 at 16:40 (00h20')

Content :

Witness beam quality preservation (in particular energy spread and emittance) for external injection scenarios in plasma-based accelerators is a crucial requirement for downstream applications such as Free Electron Lasers. Due to the complexity of the beam-plasma interaction, extensive studies of possible mechanisms to preserve beam quality are usually done using particle-in-cell (PIC) simulations.
The sheer number of possible properties and simulation settings involved result in time-consuming iterations over the corresponding parameter space. Analytical descriptions of the witness beam evolution could allow for quick optimizations and provide useful limits for further investigations. However, these models are often limited to strong assumptions and not capable of rendering higher order details of the beam evolution along the whole acceleration procedure.
The study of instabilities arising from the introduction of beams with non-symmetric distributions can be efficiently tackled by means of an analytic model for the evolution of the statistical moments of the beam distributions, introduced by Mehrling et al. We report on results from the application of this model to the evolution of transverse beam properties of a witness beam in a plasma wakefield, including benchmarks with existing PIC codes such as HiPACE and the SANA model.

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Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 133

Performance of the prototype THz-driven electron gun for the AXSIS project.

Wednesday 27 Sep 2017 at 18:00 (00h30')

Content :

The AXSIS project (Attosecond X-ray Science: Imaging and Spectroscopy) is aiming to develop a THz driven compact X-ray source for applications e.g. in chemistry and biology by using the ultrafast coherent diffraction imaging and spectroscopy. The key components of AXSIS are the THz driven electron gun and THz-driven dielectric loaded linear accelerator as well as an inverse Compton scattering scheme for the X-rays production. This paper is focused on the prototype of the THz driven electron gun which is capable to accelerate electrons up to tens of keV. Such a gun was manufactured and tested at the test-stand at the CFEL at DESY. Due to variations in gun fabrication and generation of THz-fields the gun is not exactly operated at design parameters. Extended simulations have been performed to understand the experimentally observed performance of the gun. A detailed comparison between simulations and experimental measurements is presented in this paper.

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Presenter : Dr. VASHCHENKO, Grygorii (DESY)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 134

Energy Measurements by Means of Transition Radiation in novel LINACs

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Advanced linear accelerator design may use Optical Transition Radiation (OTR) screens to measure beam spot size; for instance, such screens are foreseen in plasma based accelerators (EuPRAXIA@SPARC_LAB) or Compton machines (Gamma Beam Source@ELI-NP). OTR angular distribution strongly depends on beam energy. Since OTR screens are typically placed in several positions along the LINAC to monitor beam envelope, one may perform a distributed energy measurement along the machine. Furthermore, a single shot energy measurement can be useful in plasma accelerators to measure shot to shot energy variations after the plasma interaction. Preliminary measurements of OTR angular distribution of about 100 MeV electrons have been already performed at the SPARC_LAB facility. In this paper, we discuss the sensitivity of this measurement to beam divergence and others parameters, as well as the resolution required and the needed upgrades of conventional OTR diagnostics, using as an example the data collected at SPARC_LAB

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Presenter : MARONGIU, Marco (ROMA1)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 135

Laser pulses for Traveling-Wave Electron Acceleration and Thomson Scattering

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Generating and controlling ultrashort, pulse-front tilted laser pulses is essential for Traveling-Wave Electron Acceleration (TWEAC), Traveling-Wave Thomson Scattering (TWTS) and Traveling-Wave Optical FELs (TWTS-OFELs). All these applications require controlling angular and group-delay dispersion, while keeping experimental setups as compact as possible. However, the varying requirements with respect to laser power, extent of focal region, incident angles and laser mode quality lead to differing strategies in designing experimental setups.

This overview poster provides answers to the question: What experimental efforts in terms of laser system and optics are necessary in current labs for first proof-of-principle realizations of the different applications of "Traveling-Wave" laser pulses -- ranging from low-bandwidth and yield-enhanced Thomson sources (TWTS), laser-based electron accelerators beyond the LWFA depletion and dephasing limits (TWEAC) and ultimately an optical free-electron laser (TWTS-OFEL)?

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 136

On application of wobbling in experiments with cylindrical targets

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

For the experiments with cylindrical targets irradiated by high energy intense ion beams which are actual in some fundamental and applied researches (laboratory astrophysics, medicine, etc) it is necessary to shape the irradiating beam with hollow geometry. Among the various methods of hollow beam formation the wobbling is of interest. The deflecting plates or RF-cavities with phase shift of electromagnetic fields create the fast beam rotation. In the case of the suitable relation between the velocity of the rotation and the characteristic velocity of the processes inside the target substance arising from the irradiation (for instance, the velocity of the front motion of the shock wave caused by the target implosion) the beam may be considered as hollow one. In this report the benefits and the problems of the method are discussed, the calculation results are presented.

Primary authors : Dr. BARMINOVA, Helen (NRNU MEPhI)

Co-authors :

Presenter : Dr. BARMINOVA, Helen (NRNU MEPhI)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 137

PyCAMFT code for the multi-component ion bunch dynamics simulation with parallel computing

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The ion beams extracted from the laser ion source are characterized by complicated charge state distribution of the ions. As a rule, for the aims of the specific experiment only one of the charge states is needed, so the charge state separation is a part of the beam formation. To predict the behavior of intense ion bunch with various distributions of the charge states in magnetic field of the separator both dipole and quadrupole type the PyCAMFT code is developed with one of the goals to be included into the experiment automation system. The 3D-code is realized in Python and allows to treat the various particle density distributions, the various geometry of the bunch (ellipsoidal, sheet, axial-symmetric), arbitrary initial phase volumes. To provide the high accuracy and high calculation rate the parallel computing is implemented based on CUDA technology. Different tools of the result visualization are in-built.The user-friendly interface is developed.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 138

Phase portrait dynamics of emittance-dominated beams in solenoids

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Solenoid serves as a single magnetic lens and is used at the different stages of the beam formation with the effectiveness depending from the beam energy. It may change the shape of the initial phase volume of the beam, that may be especially important in some cases of laser-based acceleration because of more specific emittance formation in comparison with the phase volumes of the beams from conventional accelerators. In this report the analytic approach is applied to study the peculiarities of the beam phase volume transformation and manipulation in solenoidal magnetic field for the case of the emittance-dominated long-pulse beam. The modified KV-model used allows to obtain the beam envelope equations. The model is based on the specific kinetic distribution function which depends on the particle motion integrals and represents an accurate solution of the Vlasov equation. The transfer of rms emittances caused by the coupling of the particle oscillations is investigated for the case of elliptical beam cross-section and with approximation of uniform space charge distribution. The factors affecting the transfer are studied. The possibility of the beam emittance manipulation is discussed.

Primary authors : Dr. BARMINOVA, Helen (NRNU MEPhI)

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Presenter : Dr. BARMINOVA, Helen (NRNU MEPhI)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : poster

Contribution ID : 139

Results from a New Technique for Fast and Sensitive Measurement of Plasma Wakefields

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Frequency Domain Holography (FDH) has proved an effective way of measuring plasma wakefields driven by short laser pulses. With this technique, chirped probe and reference pulses are positioned temporally before and after a driving laser pulse, and co-propagate with it through the plasma. Information about the plasma wave is encoded in the transmitted probe pulse, and may be retrieved by spectral interferometry.

Reconstruction of the plasma wakefield requires that both the temporal and spectral amplitude and phase of the transmitted probe pulse are determined, which requires additional information about the incident probe and reference pulses. Temporally-encoded Spectral Shifting (TESS) allows the amplitude and frequency of the wakefield to be determined from a single Fourier transform of the interferogram.

We present results from a experiments with the Astra Laser at the Rutherford Appleton Laboratory in which TESS was used to characterize the plasma wakefield. We demonstrate the effectiveness of TESS both for fast on-shot measurement as well as for analysis of large data sets. We compare FDH and TESS analyses and show that the latter could measure the plasma frequency and the relative wake amplitude with sub-percent statistical error.

Primary authors : Mr. ARRAN, Christopher (University of Oxford)

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Presenter : Mr. ARRAN, Christopher (University of Oxford)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 140

High brightness, plasma boosted beams for driving a Free Electron Laser

Tuesday 26 Sep 2017 at 18:18 (00h18')

Content :

In this contribution we show start-to-end simulations assessing the feasibility of driving Free Electron Laser (FEL) sources with wavelength below 1 nm by plasma boosted, externally injected electron beams of different energies, in the framework of the EuPRAXIA project.
A 30-40 pC, sub micron normalized emittance, electron bunch is extracted from a photo-cathode, accelerated up to 500 MeV and longitudinally compressed down to few tens of fs by innovative techniques, mixing velocity bunching and ballistic bunching, in order to be injected in a laser driven plasma wave. There, its energy is brought to 1 GeV (and up) by preserving, as much as possible, its good quality and high peak current. Insertion and matching into plasma is accomplished by either standard, high performances, beam optics or by plasma sensing effects. At plasma exit, a similar strategy is employed as well as for matching into an undulator.
We present details of simulations, focusing on laser plasma stage, and experimental setups employing different plasma target, assess working point stability and show FEL performances for a few selected cases.

Primary authors : Dr. ROSSI, Andrea Renato (MI)

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Presenter : Dr. ROSSI, Andrea Renato (MI)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 141

Generation of hollow driver bunches followed by ultra-high brightness witness for plasma wakefield acceleration

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Plasma-based devices like accelerator modules and lenses for beam optics are of great interest in view of future compact accelerators.
Here we present a detailed study about their implementation at the SPARC_LAB facility in Frascati. In particular, we shape the driver bunch to have a donut-like shape, allowing to preserve the ultra-high brightness of the witness bunch that will be accelerated by the plasma. For this purpose we foresee to use plasma lenses to match the beam into the plasma and to extract it after plasma acceleration.
The aim is to obtain high-brightness plasma-accelerated beams ready to be injected in a Free-Electron Laser.

Primary authors : Dr. POMPILI, Riccardo (LNF)

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Presenter : Dr. POMPILI, Riccardo (LNF)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 142

Observation of annular point spread function of optical transition radiation from low-emittance e-beams emerging from a laser-plasma accelerator

Tuesday 26 Sep 2017 at 16:20 (00h20')

Content :

Because of their tiny accelerating cavities, laser-plasma accelerators (LPAs) can produce extremely low-emittance e-beams, but to date the smallest transverse LPA e-beam sizes have been characterized only indirectly inside the LPA by betatron x-ray spectroscopy. Here we report observations of visible optical transition radiation (OTR) imaged from a foil placed immediately (<1mm) outside a ~300 MeV, 300 pC bubble-regime LPA. We use a double foil: the first reflects the drive laser pulse; the front edge of the second foil (0.5-1mm downstream) rejects emission from the first foil, while its back surface emits OTR from transmitted LPA e-bunches. We observe radially polarized annular distributions with a strong central minimum, approximating the ideal point spread function expected from a point electron beam. The size and radial distribution of the OTR images, which we observe in conjunction with OTR and electron spectra, vary significantly and reproducibly as we translate the double foil over a ~1mm range along the e-beam propagation axis. We observe the smallest OTR images with the first foil several hundred microns from the LPA exit. We will present OTR data in conjunction with an e-beam propagation model.

Primary authors : Mr. LABERGE, Maxwell (HZDR/University of Texas at Austin) ; Dr. RAFAL, Zgadzaj (HZDR/University of Texas at Austin) ; Mr. ZARINI, Omid (HZDR)

Co-authors : Dr. IRMAN, Arie (HZDR) ; Dr. ALEXANDER, Debus (HZDR) ; Prof. ULRICH, Schramm (HZDR) ; Prof. DOWNER, Michael (HZDR/University of Texas at Austin) ; Dr. LUMPKIN, Alexander (Fermi National Accelerator Laboratory)

Presenter : Mr. LABERGE, Maxwell (HZDR/University of Texas at Austin)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 144

Experimental design for generating low-density plasma channels by optical field ionization

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The development of plasma channels with densities below 1x10^18cm-3 is of significant interest to plasma accelerators driven by particle bunches or laser pulses. For the latter it is also important to maintain a low matched spot size Wm over a long interaction region. For several potential applications of plasma accelerators, such as driving light sources, it would also be desirable to operate at multi-kilohertz pulse repetition rates. These requirements are challenging for existing guiding methods owing to difficulties in maintaining small Wm at low densities, or avoiding optical or thermal damage at high repetition rates.

We have proposed forming low-density plasma channels by hydrodynamic expansion of plasma columns formed by optical field ionization (OFI) with elliptically polarized laser pulses. Unlike earlier work on hydrodynamic channels, which utilized collisional heating, OFI-heating is independent of density so can drive channel formation in low density gases.

We will present the design considerations for an experiment to generate OFI plasma channels up to 50mm in length in hydrogen with an axicon lens using femtosecond duration laser pulses. Our investigation deals with some of the key aspects of the experimental design including the interferometric diagnostic, data analysis, and target design.

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Presenter : Mr. JONNERBY, Jakob (University of Oxford)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 146

Inverse Thomson Scattered x-rays from a Laser-Plasma Accelerator and Plasma Mirror

Tuesday 26 Sep 2017 at 16:00 (00h18')

Content :

We convert a GeV laser-plasma accelerator (LPA) driven by the Texas Petawatt Laser into a compact, femtosecond-pulsed, tunable gamma-ray source by inserting a 12 to 100μm-thick transparent low Z (glass or plastic) foil ~3 cm after the accelerator exit. The foil acts as a plasma mirror (PM) that retro-reflects spent drive laser pulses (1.17 eV) with field strength a0 ~ 0.3 back onto trailing electrons (peak Lorentz factor tunable from 1000 to 4400). The spectrum of the retro-reflected pulse differs only slightly from the incident spectrum, since the LPA operates well below the pump-depletion limit. Compton backscatter generated approximately 1e8 gamma-ray photons with sub-mrad divergence, and estimated peak brilliance 1e21 photons/s/mm2/mrad2/0.1% bandwidth. Scaling of the generated signal with PM position, thickness and material indicates that bremsstrahlung generated by GeV electrons within the PM is negligible. Gamma-ray photon energy, inferred from the measured electron energy distribution on each shot, peaked from 5 to 85 MeV, spanning a range otherwise available with comparable brilliance only from large-scale GeV-linac-based high-intensity gamma-ray sources that support nuclear photonic research and applications.

Primary authors : Mr. SHAW, Joseph M. (University of Texas at Austin) ; Dr. BERNSTEIN, Aaron (University of Texas at Austin) ; Dr. ZGADZAJ, Rafal (University of Texas at Austin) ; Prof. DOWNER, Michael (University of Texas at Austin)

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Presenter : Ms. HANNASCH, Andrea (University of Texas at Austin)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 147

Control and propagation effects of the wavefront quality for a high-power laser system

Monday 25 Sep 2017 at 18:45 (00h15')

Content :

Laser-Plasma Wakefield Accelerators showed promising results in the past few years, generating high-energy electron beam over cm-distances. Nevertheless, the quality and shot-to-shot stability of such beams have not yet reached the level of conventional accelerators. One of the crucial factors is the driver laser beam quality, which needs to be focused close to the diffraction limit. To achieve the highest electron beam quality, the laser wavefront has to be controlled via a closed loop including a deformable mirror and a wavefront sensor. The LUX beamline, built in collaboration between ELI-Beamlines, the University of Hamburg and DESY, aims to generate and study plasma-driven undulator radiation. It is driven by the 200 TW ANGUS laser system which includes such adaptive optics. I will present results on the wavefront control of the high power laser beam, including effects of the wavefront propagation through the 35 meters long transport beamline and wavefront-based alignment of the focusing parabolic mirror. The quality of the focal spot and the propagation through the focus are investigated as the final figure of merit.

Primary authors : Mr. LEROUX, Vincent (ELI Beamlines)

Co-authors : Mr. SCHNEPP, Matthias (University of Hamburg) ; JOLLY, Spencer (Center for Free-Electron Laser Science & Department of Physics, Hamburg University, Hamburg, Germany) ; MAIER, Andreas (CFEL/UHH)

Presenter : Mr. LEROUX, Vincent (ELI Beamlines)

Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 148

Electron-THz interaction in dielectric-lined waveguide deflecting structures

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Terahertz-driven dielectric-lined waveguides (DLWs) have uses in electron manipulation; in particular deflection, acceleration, and focussing. A rectangular DLW has been optimised for deflection of 100 keV electrons using a THz pulse with a centre frequency 0.5 THz. A narrowband THz pulse is generated using a lithium niobate crystal and chirped pulse beating. Electron-THz interaction and the effect of electron bunch injection timing on maximising deflection is presented, with a focus on beam dynamics. Structure design, including coupling from free-space into the DLW, has been completed and the practical aspects of operation are discussed. Finally DLWs and corrugated waveguides are compared to discuss relative advantages and disadvantages.

Primary authors : Ms. HEALY, Alisa (The Cockcroft Institute)

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Presenter : Ms. HEALY, Alisa (The Cockcroft Institute)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 149

Towards a single-shot diagnostics of ultra-short lasers for THz pulse shaping in optical rectification experiments

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

THz radiation is nowadays of great interest for a variety of applications e.g. to study the non-linear response of new materials, medical purposes, particle acceleration etc.. Regarding THz-based particle acceleration, the schemes explored to date make use of a direct interaction: THz-electrons. The THz radiation is generated through the optical rectification process induced in non-linear crystals by a pump laser. The optical rectification is a second-order process able to convert an infrared pump laser to the THz domain (0.5-10THz). The temporal shape of the pump laser and in general its characteristics are important aspects to be known in order to produce THz radiation via optical rectification in a controlled way, especially for single shot experiments. Here we present a technique that can be used to retrieve the pump laser temporal profile characteristics (envelope and phase), starting from the detection of the THz waveform/spectrum and the knowledge of the physical/optical properties of the crystal used to produce it. We show experimental examples of THz production via optical rectification and we show how we can reconstruct the pump temporal profile. Furthermore we highlight the pros and cons of this technique.

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Co-authors : PETRARCA, Massimo (ROMA1) ; LUPI, Stefano (ROMA1) ; CURCIO, Alessandro (LNF)

Presenter : DOLCI, Valerio (ROMA1) ; PETRARCA, Massimo (ROMA1) ; CURCIO, Alessandro (LNF)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 150

Ultrafast pulsed proton radiolysis in water: Delayed solvation time of electron

Thursday 28 Sep 2017 at 17:00 (00h15')

Content :

Bursts of laser driven protons have recently been shown to provide the basis for the study of ultrafast ion-matter interactions in both solid [1] and liquid [2] states. This is allowing the first real time study of the evolution of a key species in of water chemistry - the solvated electron. Formed when polar water molecules re-orientate to shield the charge of free ionised electrons, the solvation process leads to the formation of this long lived highly reactive species that can seed the formation of potent radicals. Here we show that the interaction of protons in water leads to a delay in the growth of the photoabsorption band of the solvated electron in comparison to that generated by fast electrons/X-rays. For our conditions we show that this time extends to 100's of picoseconds (ps, 10^-12s) under proton irradiation. Our initial interpretation is that proton stopping in water leads nanocavitation in the Bragg region which in turns leads to increased thermal motion of the surround water molecules, thus inhibiting the solvation process.
[1]Dromey et al., Nat.Comms.,4, 1763 (2013)
[2]Senje et al., App. Phys. Letts., 110, 104102 (2017);

Primary authors : Dr. DROMEY, Brendan (Queen's University Belfast)

Co-authors :

Presenter : Dr. DROMEY, Brendan (Queen's University Belfast)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 151

Innovative single shot diagnostics for electrons from laser-plasma interaction at SPARC_LAB

Monday 25 Sep 2017 at 17:15 (00h15')

Content :

Plasma wakefield acceleration is the most promising acceleration technique known nowadays, able to provide very high accelerating fields (> 100 GV/m), enabling acceleration of electrons to GeV energy in few centimeters. Due to the instabilities occurring during the process, single shot diagnostics are essential to properly characterize it.
In this work, an overview of the single shot diagnostics for electrons from laser-plasma interaction developped at SPARC_LAB will be given: Electro Optic Sampling (EOS) for temporal measurement on fast elctrons and Optical Transition Radiation (OTR) for an innovative one shot emittance measurements.

Primary authors : BISESTO, Fabrizio Giuseppe (LNF)

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Presenter : BISESTO, Fabrizio Giuseppe (LNF)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 152

Progress of the Development of the ELI-NP GBS High Level Applications

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The Gamma Beam system (GBS) is a high brightness LINAC to be installed in Magurele (Bucharest) at the ELI-NP (Extreme Light Infrastructure - Nuclear Physics) newly build laboratory. The accelerated electrons, with energies ranging from 280 to 720 MeV, will be made to collide with a high power laser to produce tunable high energy photons (0.2 MeV-20MeV) with high intensity (1013 photons/s), high brilliance and spectral purity (0.1 %BW), through the Compton backscattering process. This light source facility will be open to users for nuclear photonics and nuclear physics advanced experiments. Tested high level applications will play a key role in commissioning an operation. In this paper we report the progress made and the status of the development of the dedicated high level applications. We also report on the measurements to test on the FERMI LINAC of the beam-based alignment method for correcting residual dispersion, which would spoil machine performance.

Primary authors : Ms. CAMPOGIANI, Giovanna (INFN-Roma1)

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Presenter : Ms. CAMPOGIANI, Giovanna (INFN-Roma1)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 153

Stress testing of materials using Laser-accelerated protons

Thursday 28 Sep 2017 at 17:15 (00h15')

Content :

Laser-driven proton acceleration, obtained by irradiation of a solid by an ultra-intense (I>10e18 W/cm2) short pulse (duration<1 ps) laser, is a growing field of interest, in particular for its manifold potential applications in different fields. In this letter, we provide first experimental evidence that laser-generated protons can be used for stress testing materials and are particularly suited for stress-testing material in harsh condition. We show that laser-generated protons can produce, in a few single ns shots, a similar mechanical and thermal stress than what obtained during several months of full operation for typical fusion or reactor facilities. We confirm this by analyzing changes in mechanical, optical, electrical, and morphological properties of five materials of interest to be used in harsh conditions.

Primary authors : ANTICI, Patrizio (LNF)

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Presenter : ANTICI, Patrizio (LNF)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 155

AWAKE: operational safety in a proton driven plasma wakefield facility

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

AWAKE is installed in the underground former CERN neutrino to Gran Sasso facility. Transforming the area to be compatible with the operation of a proton driven plasma wakefield experiment is challenging. The high energy of the drive beam (400GeV/c) causes radiation safety issues, but also fire safety, evacuation routes and integration of emergency equipment needed reassessment. Specifics of AWAKE cause additional safety issues, including the underground use of oil and Rubidium, and the running of electron source and laser during general installation periods. This presentation shows how chemical, electrical, fire, evacuation and radiation safety issues were addressed during the design phase and how their solutions were implemented, leading to a successful start-up of AWAKE's protons-plus-laser operation in December 2016 and the preparation towards for operating AWAKE safely with protons, laser and electrons from 2018 on.

Primary authors : PARDONS, Ans (CERN)

Co-authors :

Presenter : PARDONS, Ans (CERN)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 156

FLASHForward X-2: Beam quality preservation in a plasma booster

Tuesday 26 Sep 2017 at 18:36 (00h18')

Content :

Staging of plasma-wakefield accelerators is essential to utilise them in particle physics or other applications requiring high energy beams.
Quality preservation in external beam injection is one of the key missing milestones towards this goal.
This and other topics related to the plasma booster will be studied at FLASHForward, a unique beam-driven plasma wakefield acceleration facility currently under construction at DESY (Hamburg, Germany),
in the frame of the FLASHForward X-2 experiment.
High-quality 1 GeV-class electron beams with μm-emittances from the free-electron laser FLASH will be utilised to generate driver-witness pairs
by using a mask in a dispersive section.
Alternatively, it is possible to generate two independent bunches directly in the photocathode electron-gun by using a double-pulse laser.

In this contribution, the physics case and the current status of the FLASHForward X-2 experiment will be reviewed.
The experimental installation will be described, with a focus on the electron beam line.
Electron beam dynamics and Particle-in-Cell simulations will be presented.

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Presenter : Dr. LIBOV, Vladyslav (DESY)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 157

Experimental demonstration of a low-density plasma channel capable of high repetition rate operation

Tuesday 26 Sep 2017 at 19:00 (00h15')

Content :

Design parameters for the next generation of laser plasma accelerators show the need for low density (~1e17cm-3) plasma channels of the order of hundreds of millimetres long with the capability to operate at repetition rates up to 1kHz.

Although gas-filled capillary discharge waveguides have been operated at repetition rates of 1kHz, it is not yet clear if they could guide high-energy laser pulses at high repetition rates for extended periods without damage to the waveguide structure. We propose a new approach capable of meeting these challenging requirements based on the hydrodynamic expansion of plasma columns formed by optical field ionization (OFI). Unlike collisional heating, which much of the previous work on laser-produced plasma waveguides was based, OFI heating is independent of the plasma density and hence it is possible to drive a radial shock and form channels at low initial gas densities. Since the channels are laser-generated, and not contained within a physical structure, they could operate at high repetition rates for extended periods.

We present experimental results showing the formation of plasma channels by this mechanism with on-axis densities as low as 2e17cm-3, and matched spot sizes of approximately 30-40μm.

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Presenter : Mr. SHALLOO, Robert (JAI, University of Oxford)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 158

Plasma acceleration based space radiation reproduction and hardness assurance

Tuesday 26 Sep 2017 at 18:00 (00h15')

Content :

Space radiation is a major obstacle for space exploration and makes radiation hardness assurance (RHA) an essential part of any space mission. The broadband nature of the radiations energy profile is a particularly challenging characteristic to recreate in the laboratory environment. Current testing relies on monoenergetic sources and so is unable to recreate all relevant conditions for RHA. Plasma acceleration provides the solution to this issue, the inherently broadband energy profile can be tuned to match a diverse range of radiation profiles creating an excellent tool for RHA .

The novel application of these accelerators to the field of space radiation testing will be presented with both experimental and 3D PIC simulations presented. The various methods of plasma acceleration , underdense and overdense , provide a platform for the first accurate recreation of the space radiation profile on earth

[1]B. Hidding et al. Laser-plasma-based Space Radiation Reproduction in the Laboratory, Scientific Reports (2017)

Primary authors : Prof. HIDDING, Bernhard (University of Strathclyde / Hamburg) ; Mr. KARGER, Oliver (University of Hamburg, Institute for Experimental Physics)

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Presenter : Mr. BEATON, Andrew (University of Strathclyde)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 159

Seeded Self-Modulation along the Proton Bunch at AWAKE

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The AWAKE experiment uses the seeded self-modulation (SSM) to drive large amplitude wakefields in a plasma. The seed for the wakefields is a sharp ionizing front located near the middle of the proton bunch. It is created by an intense laser pulse ionizing Rubidium (Rb). For electron acceleration, the electron bunch must be injected into the accelerating and focusing phase of the wakefields, approximately 100 plasma periods behind the seed
laser position. Here, we show that by using a replica of the intense laser pulse we can determine precisely the position (timing) of the proton micro-bunches with respect to the ionizing laser pulse. Since the relative phase of the wakefields is tied to the proton micro-bunches, this method can be used to determine experimentally the delay between the ionizing laser pulse and the electron bunch so that the electrons can be injected into the accelerating and focusing phase of the wakefields. The results presented also
show that the timing of the micro-bunches is stable against variations of the proton input parameters. They show as well the difference between seeded and unseeded self-modulation.

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Presenter : Mr. BATSCH, Fabian (CERN)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 160

High quality plasma wakefield acceleration experiment in linear regime at SPARC_LAB

Tuesday 26 Sep 2017 at 18:00 (00h18')

Content :

The possibility to design an high quality beam driven plasma based accelerator in linear regime will be investigated. The high quality requirements for a driving bunch in order to create a plasma wakefield in blow-out regime will be stated. Starting from the very well estabilished cold fluid plasma model a set of equations will be presented in order to describe the fields generated by a low quality driver. Those equations will be used to fix the trailing bunch requirements for an high quality acceleration. High brightness trailing bunch will result to suffer a lower degradation while accelerated in a linear regime plasma wakefield. The beam loading effect results to be not negligible for this kind of trailing bunches in realistic situations. It will be showed how in this case, assuming energy spread compensation, the transverse matching of the trailing bunch doesn't depend on driving bunch parameters. The design of a scheme involving low quality driving bunch and high quality trailing bunch will result to be compatible with high quality acceleration. The requirements of the working point will be compared to the simulation results for the SPARC_LAB injector, obtained via the hollow beam velocity bunching scheme.

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Presenter : ROMEO, Stefano (LNF)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 161

Heterodyne measurement of CTR from self-modulation instability (SMI) in AWAKE

Wednesday 27 Sep 2017 at 16:36 (00h18')

Content :

We present the measurement setup and first results of a waveguide-integrated heterodyne measurement of coherent transition radiation (CTR) in the AWAKE experiment. As a result of the self-modulation instability, a pulse of strong CTR is expected from the modulated proton bunch passing through a CTR-screen. This radiation pulse, which has the length of the modulated part of the bunch and a frequency at the plasma frequency, is transported by overmoded waveguides over 15m to a heterodyne detector setup. With the two waveguide-integrated receivers, covering the frequency-bandwidths 90-140 GHz and 255-270 GHz, a significant fraction of the available plasma frequencies can be measured. The two mixers convert the CTR into a signal in the range of 5-20GHz that is measured on a fast oscilloscope, with a high spectral resolution of 1-3 GHz dominated by the pulse length. The first results measured with this setup on AWAKE, with the goal of precisely measuring the plasma frequency, will be presented.

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Presenter : Mr. BRAUNMUELLER, Falk (Max-Planck Institute for Physics)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 163

Particle acceleration in twisted plasma waves with orbital angular momentum

Tuesday 26 Sep 2017 at 18:54 (00h18')

Content :

Plasma accelerators have the potential to drastically reduce the cost and size of conventional devices. An unique property of plasma wakefields is that they can be shaped nearly arbitrarily. Because the wakefield results from the collective motion of electrons, we can access this topological freedom of the plasma by controlling the individual trajectories of plasma electrons.

With theoretical modelling and massively parallel particle-in-cell (PIC) simulations using the PIC code Osiris, we will investigate the properties of structured plasma waves that contain orbital angular momentum. Twisted plasma waves can generate helical particle bunches, where individual bunch particles execute spiralling trajectories, similarly to an helical undulator. Twisted plasma waves can be driven by light spring laser drivers, which are characterised by spiralling intensity profiles. We show that the phase velocity of twisted plasma waves driven by the light spring drivers can be regulated in parabolic plasma channels, and that this property might be attractive to extend the acceleration distances.

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Presenter : Dr. VIEIRA, Jorge (Instituto Superior Tecnico)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 164

Beam dynamics and tolerance studies of the THz-driven electron linac for the AXSIS experiment

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

A dielectric-loaded linac powered by THz-pulses is one of the key parts of the "Attosecond X-ray Science: Imaging and Spectroscopy" (AXSIS) experiment at DESY, Hamburg. Like in conventional accelerators the AXSIS linac is designed to have the phase velocity equal to the speed of light and in this case it is realized by tuning of the dielectric layer width and the radius of the vacuum channel. Therefore, structure fabrication errors will lead to a change in the beam dynamics and beam quality. Additionally, errors in the bunch injection will also affect the acceleration process and can cause a beam loss on the linac wall. This paper numerically investigates the process of the electron beam acceleration in the AXSIS linac taking into account the aforementioned errors. Particle tracking simulations were done using the ECHO code which uses low-dispersive algorithm for field calculation and was especially adopted for the dielectric-loaded accelerating structures.

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Presenter : Dr. GALAYDYCH, Kostyantyn (DESY)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 165

Theoretical studies on laser triggered density down-ramp injection for FLASHForward

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The realisation of high quality (high brightness and low energy spread) electron beams from plasma Wakefield accelerators is crucial for the advancement of fields such as photon science and future high-energy physics colliders.
The FLASHForward facility is a pioneering dedicated beam-driven wakefield experiment combining the 1 GeV, 2.5 kA, FLASH electron beam and a 25 TW, 25 fs pulsed laser [1].
The Experiment 1 (X-1) branch of the project aims to produce and study such high-quality, high- brightness beams from a centimetre scale plasma cell.
In preparation for the experimental runs in FLASHForward X-1, exploratory numerical studies are run using the OSIRIS particle in cell (PIC) code to study injection from a density down-ramp (DDR) [2] triggered and produced by a transverse ionisation laser [3]. Additional investigations are made into the effects arising from the intrinsic properties of the plasma channel, including the the wake structure resulting from a narrow plasma channel.
[1] A. Aschikhin et al. NIM A, 2016
[2] A. Martinez de la Ossa et al., submitted, 2017
[3] G. Wittig et. al. Phys. Rev. ST Accel. Beams

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Presenter : Mrs. SHEERAN, Bridget (DESY)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 166

External Injection into a Laser-Driven Plasma Accelerator with Sub-Femtosecond Timing Jitter

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

With the experimental achievement of multi-GeV energies, the The use of external injection in plasma acceleration is attractive due to the high control over the electron beam parameters, which can be tailored to meet the plasma requirements and therefore preserve its quality during acceleration. However, using this technique requires an extremely fine synchronization between the driver and witness beams. In this paper, we present a new scheme for external injection in a laser-driven plasma accelerator that would allow, for the first time, sub-femtosecond timing jitter between laser pulse and electron beam.

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Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 167

Acceleration of electrons in THz driven structures: first steps towards AXSIS

Monday 25 Sep 2017 at 11:00 (00h30')

Content :

We present recent results in keV level acceleration of electrons using microJoule, single-cycle THz pulses. THz-driven structures represent a promising emerging technology for development of compact acceleration of sub-femtosecond electron bunches. The millimeter scale of the driving field offers a favorable compromise between conventional accelerators which are proven & reliable but large & costly, and other advanced accelerators like plasma-based or laser-driven devices where the small accelerator structures make device control difficult and limit the charge payload. THz-driven devices benefit over plasma devices in that they are built from static, macroscopic structures that can be fabricated by conventional means but can support field gradients that are significantly higher than in conventional accelerators, promising capabilities to produce sub-femtosecond electron bunches. In addition, the strong fields in THz based devices offer unexpected versatility in the compact manipulation and diagnosis of electron bunches. Our results pave the way for development of a THz-based light source for sub-femtosecond investigation of material structure.

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Presenter : Dr. MATLIS, Nicholas (DESY (Deutches Elektronen Synchrotron))

Session classification : Plenary 2

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 168

Investigation of the self-modulation seeding by a short electron bunch within a long proton bunch

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The AWAKE Experiment at CERN is world's first proton-driven plasma wakefield accelerator aiming for acceleration of externally injected electrons in gradients up to the GeV/m scale.
The 12 cm long proton bunch from CERN's Super Proton Synchotron propagates through a 10-m long laser induced plasma channel and is split into a train of microbunches on the order of the plasma wavelength by its electromagnetic interaction with the plasma by the self-modulation instability (SMI), a transverse plasma instability. According to simulations, this instability does not significantly grow over a meter scale and is therefore seeded by having an ionizing laser pulse co-propagating at the centre of the proton bunch.
We present calculations and simulations for a different concept of SMI by electron injection. The timing between laser and protons is shifted, so that the whole protons bunch propagates through a preformed plasma. The proton beam current is modulated by the external injection of a short electron bunch in the centre of the proton beam. The resulting sharp rise of the total current in the electron bunch drives large wakefields that seed the growth of the SMI. This seeding technique will also be tested experimentally.

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Presenter : Mr. HÜTHER, Mathias (Max-Planck-Institut für Physik)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 169

Simulations of an hybrid and compact attosecond X-ray source based on RF and THz technologies

Wednesday 27 Sep 2017 at 18:30 (00h20')

Content :

In this paper, we present beam dynamics simulations for a proposal of hybrid and compact attosecond X-ray source based on Inverse Compton Scattering (ICS). The layout consists of an S-band gun as electron source and a dielectric-loaded waveguide driven by a multicycle THz pulse to accelerate and longitudinally compress the bunch, which will then be used to produce attosecond X-ray pulses through ICS with an infrared laser pulse. The purpose of this hybrid scheme is to generate ultrashort electron bunches (shorter or equal to 1 fs rms), at moderate energies (15 to 20 MeV), with a charge of at least 1 pC and focused to a transverse size below 10 um rms while keeping a compact beamline (shorter than 2 m), which has never been achieved using only conventional RF technologies. Simulations from the photocathode up to the ICS point are presented, looking at the influence of various parameters of the accelerating and transverse focusing devices.

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Presenter : Dr. VINATIER, thomas (DESY)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 170

Exploring Energy Absorption in Ultra-Thin Targets

Wednesday 27 Sep 2017 at 16:40 (00h20')

Content :

Ion acceleration in thin targets can occur through several different mechanisms such as relativistic transparency and radiation pressure acceleration. The acceleration regimes are distinguishable through the structure of the ion beams produced as well as the level of laser energy absorption.
We present data from a recent experiment conducted using ultra-thin targets on the Astra-Gemini laser. Energy absorption into these thin foils was investigated as well as the spatial profile of the transmitted light. Targets of thickness $2 - 100$nm showed variation in the reflected and transmitted light, allowing for the level of energy absorption and the consequential effect on ion energies and flux to be studied. Structure in the spatial profiles of the thin targets also show signatures of the relativistic transparency regime.

Primary authors : Ms. DITTER, Emma-Jane (Imperial College London)

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Presenter : Ms. DITTER, Emma-Jane (Imperial College London)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 171

Enhanced Betatron Radiation from a Laser Wakefield Accelerator in a Long Focal Length Geometry

Tuesday 26 Sep 2017 at 16:18 (00h18')

Content :

A self-guided, self-injecting laser wakefield accelerator driven by a 120 TW laser pulse was implemented in a long focal length (f/40) geometry. Electrons were accelerated beyond 1.9 GeV in a 10 mm long plasma while maintaining a betatron source size below 0.5 micrometers. When the plasma length was extended beyond 10 mm a second electron bunch was injected with a high charge per unit bandwidth, which increased the number of betatron x-ray photons by a factor of five at moderate photon energies (16 keV critical energy). Simulations suggest this second injection resulted from a dynamic evolution of the bubble size. By further increasing the laser power to 240 TW the peak brightness of the betatron beam was increased above 1.0 x 10^24 photons/s/mm^2/mrad^2/0.1%BW at 18 keV, with the whole beam containing 3 x 10^10 photons above 1 keV. This has led to a significant advancement in the capabilities of the betatron source, demonstrated by a dramatic improvement in the signal to noise ratio of betatron imaging.

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Presenter : Dr. WOOD, Jonathan (Imperial College London)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 172

Possible experiments using dielectric-loaded waveguides on the ARES linac

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The ARES S-band linac, intended to be started at the beginning of 2018, will be the central part of the SINBAD (Short and INnovative Bunches At Desy) platform at DESY and aims to be a test bench for various types of novel acceleration schemes (plasma, THz, optical, etc.). In this paper, we present experiments using dielectric-loaded waveguides (DLWs) which are intended to be performed on the ARES linac. These experiments first aim at gaining experience for the AXSIS project, by testing the transmission of a low energy (lower than 5 MeV) electron bunch with a few pC of charge through a DLW and by proving the possibility of a significant energy gain (higher than 1 MeV) in a DLW driven by a multicycle THz pulse. The experiments also aim at using the DLWs as diagnostics devices for fs bunch lengths measurements (passive streaking by bunch-induced transverse wakefields, tomographic reconstruction using bunch energy spectra, etc.).

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Presenter : Dr. VINATIER, thomas (DESY)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 173

Numerical Studies for Bunch Length and Bunch Arrival Time Jitter Minimization in Preparation of a LaserPlasma Wakefield Acceleration Experiment with External Injection at the SPARC_LAB Facility

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Experimental research on plasma acceleration techniques is one of the most important activities presently ongoing at SPARC_LAB, the multidisciplinary facility of INFN Frascati Laboratories, bunches with energies up to 170 MeV feeding four experimental beamlines. The facility is based on the combination of high power laser pulses (300TW), from the FLAME facility, with high brightness beams (≈10^15 A m^−2 rad^−2) from the SPARC photo-injector. The recent activity has been mainly focused on the study of particle driven plasma waves, while a run dedicated to the study of laser driven plasma wave is in preparation. External injection in a laser driven plasma can potentially provide very high accelerating fields and good beam quality, but it requires both bunch lengths and a relative arrival time jitter (ATJ) between the injected beam and the laser pulse generating the plasma in the 10 fs range. Thus, since the bunch has to be shortened, it tends to follow the RF phase of the compressor and to lose its time relation to the photocathode laser. The paper presents numerical studies to optimize the photoinjector working point in order to meet the bunch length and synchronization requirements by investigating and exploiting the difference between the intra-bunch energy chirp, which depends also on space charge, and the multi-shot time-energy distribution of bunch centroids.

Primary authors : MARTINELLI, Valentina (LNF)

Co-authors : GALLO, Alessandro (LNF) ; PIERSANTI, Luca (LNF) ; BELLAVEGLIA, Marco (LNF) ; CHIADRONI, Enrica (LNF) ; Dr. POMPILI, Riccardo (LNF) ; FERRARIO, Massimo (LNF) ; Dr. ROSSI, Andrea Renato (MI)

Presenter : MARTINELLI, Valentina (LNF)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 174

First results of CTR measurement of modulated proton bunch in AWAKE

Wednesday 27 Sep 2017 at 16:18 (00h18')

Content :

We present a first measurements of microwave coherent transition radiation (CTR) emitted by a SPS proton bunch in AWAKE experiment at CERN. Detailed simulation predicts a significant and experimentally detectable amount of CTR power. Strong signal has been detected in all non-frequency-resolved detectors when proton bunch interacted with a Rubidium plasma. We used three Schottky diodes integrated into different wave-guides designed to measure a signal in 90-140, 140-220, 220-320 GHz bands. Preliminary results show a presence of harmonics of plasma frequency in CTR signals as is predicted by our CTR simulations. Also we used a quasi-optical Schottky diode, placed behind a set of 7 cut-off wave-guides mounted onto a remotely controlled wheel. This setup was used to find (roughly) a CTR carrier frequency in between of two cut-offs. We attempted a novel heterodyne detection of a CTR microwave burst based on specially designed photo-sensitive Schottky diode that mixes a microwave CTR signal with the intensity beat of two tunable CW lasers as a local frequency input, aiming at measuring the bunch modulation frequency that is expected to be equal to the plasma electron frequency.

Primary authors : Dr. MARTYANOV, Mikhail (Max Planck Institut fur Physik, Munich)

Co-authors : Prof. MUGGLI, Patric (Max-Planck-Institut für Physik) ; Mr. BRAUNMUELLER, Falk (Max-Planck Institute for Physics) ; Prof. CALDWELL, Allen (Max Planck Institute for Physics)

Presenter : Dr. MARTYANOV, Mikhail (Max Planck Institut fur Physik, Munich)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 175

electron-gamma compact colliders for muon based applications

Tuesday 26 Sep 2017 at 18:30 (00h15')

Content :

The conceptual design of a compact source of GeV-class muons is presented, based on a plasma based electron-gamma collider. Evaluations of muon flux, spectra and brilliance are presented, carried out with ad-hoc montecarlo simulations of the electron-gamma collisions. These are analyzed in the context of a large spread of the invariant mass in the e-gamma interaction, due to the typical characteristics of plasma self-injected GeV electron beams, carrying large bunch charges with huge energy spread. The availability of a compact point-like muon source, triggerable at nsec level, may open a completely new scenario in the muon radiography application field.

Primary authors : SERAFINI, Luca (MI)

Co-authors :

Presenter : SERAFINI, Luca (MI)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 176

Chirp Mitigation of Plasma-Accelerated Beams by a Modulated Plasma Density

Monday 25 Sep 2017 at 18:40 (00h20')

Content :

Plasma-based accelerators offer the possibility to drive future compact light sources and high-energy physics applications. Achieving good beam quality, especially a small beam energy spread, is still one of the major challenges. Here, we propose to use a periodically modulated plasma density to actively shape the longitudinal fields acting on an electron bunch in the linear wakefield regime. We show, that we can generate an on-average flat accelerating field that suppresses the energy chirp evolution and thus maintains a small beam energy spread. The general concept of a modulated plasma density offers further advantages that we will discuss.

Primary authors : MAIER, Andreas (CFEL/UHH)

Co-authors : Dr. BRINKMANN, Reinhard (DESY) ; Mr. JALAS, Soeren (Center for Free-Electron Laser Science and Department of Physics, University of Hamburg) ; Dr. MEHRLING, Timon (Deutsches Elektronen-Synchrotron DESY) ; Dr. MARTINEZ DE LA OSSA, Alberto (DESY) ; Dr. OSTERHOFF, Jens (Deutsches Elektronen-Synchrotron DESY) ; Dr. SCHMIDT, Bernhard (DESY) ; Ms. WACKER, Violetta (DESY) ; Mr. DELBOS, Niels (University of Hamburg / Center for Free Electron Laser Science) ; Mr. KIRCHEN, Manuel (University of Hamburg) ; Ms. DORNMAIR, Irene (University of Hamburg) ; Dr. ASSMANN, Ralph (DESY) ; Dr. BEHRENS, Christopher (DESY) ; Dr. FLOETTMANN, Klaus (DESY) ; Dr. GREBENYUK, Julia (DESY) ; Dr. GROSS, Matthias (DESY)

Presenter : Mr. KIRCHEN, Manuel (University of Hamburg)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 177

X-ray absorption spectroscopy of warm dense matter with betatron x-ray radiation

Friday 29 Sep 2017 at 12:30 (00h30')

Content :

Betatron x-ray radiation, driven by electrons from laser-wakefield acceleration, has unique properties to probe high energy density (HED) plasmas and warm dense matter. This source is produced when relativistic electrons oscillate in the plasma wake of a laser pulse. Its properties are similar to that of a synchrotron, with a 1000-fold shorter pulse. This presentation will focus on the experimental challenges and results related to the development of betatron radiation for applications at large scale HED science laser facilities. We will present recent experiments performed at the Linac Coherent Light Source (LCLS) at SLAC, where we have recently commissioned the betatron x-ray source, driven by the Matter under Extreme Conditions (MEC) short pulse laser (1 J, 40 fs). The source is used as a probe by investigating the X-ray absorption near edge structure (XANES) spectrum at the K- or L-edge of several materials (iron, silicon oxide) driven to a warm dense matter state (temperature of a few eV, solid densities). The driver is either LCLS itself or optical lasers. With these experiments we are able to study, with sub-picosecond resolution, the electron-ion equilibration mechanisms in warm dense matter.

Primary authors : Dr. ALBERT, Felicie (Lawrence Livermore National Laboratory)

Co-authors :

Presenter : Dr. ALBERT, Felicie (Lawrence Livermore National Laboratory)

Session classification : Plenary 10

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 178

Construction and characterization of a short-period undulator for a laser-plasma driven light source

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Laser-plasma accelerators provide high accelerating gradients and are therefore promising candidates as drivers for next generation brilliant light sources. The LUX Beamline, developed and operated in a close collaboration of the University of Hamburg and DESY aims at producing spontaneous undulator radiation from laser-plasma generated electron beams. The BEAST II undulator is based on permanent magnets and is designed and built for in-vacuum operation in the LUX beamline. It features a short period length of 5 mm, a gap of 2 mm and consists of 100 periods. Already for an electron beam with a kinetic energy of 400 MeV, the produced X-ray radiation is expected to reach the water window with a wavelength of 4 nm. The contribution will cover the design, construction and commissioning of the BEAST II undulator.

Primary authors : TRUNK, Maximilian (University of Hamburg)

Co-authors : MAIER, Andreas (CFEL/UHH) ; Mr. WERLE, Christian (University of Hamburg) ; DORNMAIR, Irene (University of Hamburg)

Presenter : TRUNK, Maximilian (University of Hamburg)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 179

Plasma targets for the laser-plasma driven undulator x-ray source LUX

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Laser-plasma accelerator are promising candidates to provide ultra-relativistic electron beams for compact light sources. However, the generation of stable, high quality electron beams which are necessary to drive such a compact light source is challenging. The main determining factors are thereby the plasma properties which are given by the structure of the cm-scaled plasma target itself. Here, wepresent the design process of the LUX plasma targets. Based on computational fluid dynamic simulations, targets were produced allowing to control the plasma properties and to set stable, repeatable conditions. Raman spectroscopy measurements of the gas density in the target confirm these simulations. Furthermore, results from target machining in sapphire crystals using a femtosecond laser system with KHZ repetition rate are presented and compared to the machining with state of the art milling machines.

Primary authors : Mr. MESSNER, Philipp (University of Hamburg)

Co-authors : Mr. DELBOS, Niels (University of Hamburg / Center for Free Electron Laser Science) ; MAIER, Andreas (CFEL/UHH)

Presenter : Mr. MESSNER, Philipp (University of Hamburg)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 180

Effects of pulse shape and plasma density on laser propagation in laser-driven wakefield accelerators

Monday 25 Sep 2017 at 17:10 (00h20')

Content :

The driving laser pulse in a plasma wakefield accelerator experiences changes in the longitudinal energy distribution due to refraction, depletion, photon (de)acceleration and group delay dispersion. These processes are highly dependent on the plasma wave structure, which in turn depends on the laser energy distribution. Here, we present models to describe the evolution of the temporal laser profile and experimental measurements of depletion and pulse compression. This process is shown to be highly dependent on the initial pulse shape, which therefore has a dramatic effect on the electron beams produced by the accelerator.

Primary authors : Dr. STREETER, Matthew (The Cockcroft Institute)

Co-authors :

Presenter : Dr. STREETER, Matthew (The Cockcroft Institute)

Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 181

Photon beamline for a soft x-ray FEL driven by high gradient acceleration at EuPRAXIA@SPARC_LAB

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

We are proposing a facility based on high gradient acceleration via x-band RF structures and plasma acceleration. We plan to reach an electron energy of the order of 1 GeV, enough to drive a Free Electron Laser in the so called “water window” (2-4 nm). At the end of the beamline we will have a user end station where we plan to do coherent imaging, laser ablation and pump-probe experiments. We present the design of the photon beamline, from the expected photon beam coming from the undulators to the user experimental chamber, mainly focusing on diagnostic, manipulation and transport of the photon beam.

Primary authors : VILLA, Fabio (LNF)

Co-authors : MARCELLI, Augusto (LNF) ; STELLATO, Francesco (ROMA2) ; CORENO, Marcello (LNF) ; DABAGOV, Sultan (LNF) ; GIANNESSI, Luca (ENEA & ST) ; LUPI, Stefano (ROMA1) ; Dr. MASCIOVECCHIO, Claudio (Elettra-Sincrotrone Trieste) ; MINICOZZI, Velia (R) ; MORANTE, Silvia (ROMA2)

Presenter : VILLA, Fabio (LNF)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 183

High Energy Narrowband Terahertz Generation with Broadband Chirped Pulse Trains in Periodically Poled Lithium Niobate

Wednesday 27 Sep 2017 at 19:10 (00h20')

Content :

We generate narrowband terahertz (THz) radiation in periodically poled lithium niobate (PPLN) crystals using chirped-and-delayed driver pulse trains from a broadband high-energy Ti:Sapphire laser. We achieve higher conversion efficiencies via cryogenic cooling, and produce multicycle THz pulses with record energies of 40 μJ at 0.544 THz and above 100 μJ at 0.361 THz using crystals with different length, aperture, and poling period. Limitations based on the effect of higher order phase and the pump pulse format are discussed for different potential driver lasers, along with scaling and compensation towards even higher pulse energies. These high energy narrowband THz pulses are useful for high-gradient particle acceleration within miniaturised acceleration structures, and also for pump-probe studies with modern ultrafast light sources.

Primary authors : JOLLY, Spencer (Center for Free-Electron Laser Science & Department of Physics, Hamburg University, Hamburg, Germany)

Co-authors : MAIER, Andreas (CFEL/UHH) ; Dr. MATLIS, Nicholas (DESY (Deutches Elektronen Synchrotron)) ; Prof. KAERTNER, Franz (DESY, Center for Free-Electron Laser Science) ; AHR, Frederike (DESY) ; RAVI, Koustuban (Center for Free Electron Laser Science) ; ISHIZUKI, Hideki (Institute for Molecular Science) ; TAIRA, Takunori (Institute for Molecular Science)

Presenter : JOLLY, Spencer (Center for Free-Electron Laser Science & Department of Physics, Hamburg University, Hamburg, Germany)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 185

High Repetition Rate Laser Wakefield Acceleration

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Today, many LWFA experiments rely on targets, which operate with short bursts of gas to reduce gas load within the vacuum system to a minimum. However, even in burst mode it requires considerable time to reduce the pressure in the vacuum system to a level low enough for the next laser shot, which is one of the most limiting factors in electron repetition rate. Here, we show a design, which is implemented at the LUX beamline for plasma-driven undulator radiation. It allows for continuous flow operation of a capillary-type target. The system enables electron repetition rates, which are only limited by the repetition rate of the driver laser. Continuous flow operation minimizes pressure fluctuations inside the target and eliminates timing jitter issues between laser pulse and target gas bursts. Our concept features a differential pumping setup, specially designed for laser applications, and allows for direct online pressure measurement at the target inlets, which yields absolutely calibrated values.

Primary authors : Mr. DELBOS, Niels (University of Hamburg / Center for Free Electron Laser Science)

Co-authors : Mr. MESSNER, Philipp (University Hamburg) ; MAIER, Andreas (CFEL/UHH) ; Mr. WERLE, Christian (University of Hamburg) ; Mr. JALAS, Soeren (Center for Free-Electron Laser Science and Department of Physics, University of Hamburg) ; JOLLY, Spencer (Center for Free-Electron Laser Science & Department of Physics, Hamburg University, Hamburg, Germany) ; Mr. KIRCHEN, Manuel (University of Hamburg) ; Mr. LEROUX, Vincent (University of Hamburg) ; Mr. SCHNEPP, Matthias (University of Hamburg) ; TRUNK, Maximilian (University of Hamburg) ; Mr. WINKLER, Paul (DESY)

Presenter : Mr. DELBOS, Niels (University of Hamburg / Center for Free Electron Laser Science)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 186

Proof-of-principle experiment for a sub-femtosecond electron bunch length diagnostic

Monday 25 Sep 2017 at 16:40 (00h20')

Content :

With electron beam durations down to femtoseconds and sub-femtoseconds achievable in current state-of-the-art accelerators, longitudinal bunch length diagnostics with resolution at the attosecond level are required. In this paper, we present such a novel measurement device which combines a high power laser modulator with an RF deflecting cavity in the orthogonal direction. While the laser applies a strong correlated angular modulation to a beam, the RF deflector ensures the full resolution of this streaking effect across the bunch hence recovering the temporal beam profile with sub-femtosecond resolution. A first proof-of-principle experiment of this concept was conducted at the Accelerator Test Facility (ATF) at Brookhaven National Laboratory (BNL) recently, the results of which are presented and discussed here. Moreover, a possible application of the technique for novel accelerator schemes, such as plasma-accelerated electron beams, is examined based on simulations with the particle-tracking code ELEGANT and our beam profile reconstruction tool. Effects limiting the device resolution, in particular the bunch energy spread and initial divergence, are considered in detail in this context.

Primary authors : Ms. WEIKUM, Maria Katharina (DESY / University of Strathclyde)

Co-authors : Dr. ANDONIAN, Gerard (UCLA) ; Dr. ASSMANN, Ralph (DESY) ; Mr. SUDAR, Nicholas (University of California, Los Angeles Department of Physics and Astronomy) ; Dr. FEDURIN, Mikhail (Brookhaven National Laboratory Accelerator Test Facility) ; Dr. POLYANSKIY, Mikhail (Brookhaven National Laboratory) ; Dr. SWINSON, Christina (Brookhaven National Laboratory) ; Dr. OVODENKO, Andrey (RadiaBeam Technologies) ; Dr. O'SHEA, Finn (RadiaBeam Technologies) ; HARRISON, Mark (RadiaBeam Technologies) ; Prof. SHENG, Zheng-Ming (University of Strathclyde)

Presenter : Ms. WEIKUM, Maria Katharina (DESY / University of Strathclyde)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 187

Prospects for Plasma Wakefield Acceleration at the MAX IV Laboratory

Wednesday 27 Sep 2017 at 18:15 (00h15')

Content :

MAX IV Laboratory is a Swedish national laboratory providing scientists with brilliant X-rays. The Linear Accelerator is used both for top-up injection into two storage rings, and as a high brightness source for the Short Pulse Facility (SPF). Using a photo-cathode injector, and two double achromats for compression, it can produce bunches of accelerated electrons with energy above 3 GeV, emittance below 1 mm.mrad, charge above 100 pC, and duration well below 100 fs (down to 10 fs are obtained in simulations).

We explore the possibility to adapt the existing infrastructure for beam-driven plasma wakefield acceleration (PWFA) at the SPF. Beam dynamics simulations in ELEGANT show that it is possible to transport two electron bunches within one RF period from the photo-cathode, through the entire length of the accelerator. The effects of coherent synchrotron radiation and cavity wakefields can be controlled and limited. After compression, the bunches are separated by a controllable delay of a few hundred femtoseconds. Plasma simulations in CALDER-Circ show that at an optimized density, the first bunch can drive a non-linear plasma wake, in which the second bunch experiences a substantial energy gain equivalent of several GeV/m.

Primary authors : Dr. LUNDH, Olle (Lund University) ; Mr. BJÖRKLUND SVENSSON, Jonas (Lund University) ; Dr. THORIN, Sara (MAX IV Laboratory) ; Prof. WERIN, Sverker (MAX IV Laboratory) ; Mr. EKERFELT, Henrik (Lund University) ; Mr. ANDERSSON, Joel (MAX IV Laboratory) ; Dr. CURBIS, Francesca (MAX IV Laboratory) ; Ms. GALLARDO GONZALEZ, Isabel (Lund University) ; Mr. HANSSON, Martin (Lund University) ; Dr. KOTUR, Marija (MAX IV Laboratory) ; Dr. LINDAU, Filip (MAX IV Laboratory) ; Dr. MANSTEN, Erik (MAX IV Laboratory)

Co-authors :

Presenter : Dr. LUNDH, Olle (Lund University)

Session classification : WG1-WG8 Joint Session

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 188

Conceptual design of electron beam diagnostics for high brightness plasma accelerator

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

A design study of the diagnostics of a high brightness linac, based on X-band structures, and a plasma accelerator stage, has been delivered in the framework of the EuSparc project. In this paper, we present a conceptual design of the proposed diagnostics, using state of the art systems and new and under development devices.

Primary authors : CIANCHI, Alessandro (ROMA2)

Co-authors : CHIADRONI, Enrica (LNF) ; Dr. POMPILI, Riccardo (LNF) ; BISESTO, Fabrizio Giuseppe (LNF) ; SHPAKOV, Vladimir (LNF) ; ALESINI, David (LNF) ; CASTELLANO, Michele (LNF) ; FERRARIO, Massimo (LNF) ; Prof. MOSTACCI, Andrea (Sapienza)

Presenter : CIANCHI, Alessandro (ROMA2)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 189

Layout considerations for a future electron plasma research accelerator facility EuPRAXIA

Wednesday 27 Sep 2017 at 19:00 (00h15')

Content :

The Horizon 2020 Project EuPRAXIA (“European Plasma Research Accelerator with eXcellence In Applications”) is preparing a conceptual design for a highly compact and cost-effective European facility with multi-GeV electron beams using plasma as the acceleration medium. The design includes two user areas: one for FEL science and one for HEP detector development and other pilot applications. The accelerator facility will be based on a laser and/or a beam driven plasma acceleration approach. This contribution discusses facility space considerations for future plasma accelerator facilities in the context of EuPRAXIA. It compares conventional and novel plasma accelerator facility requirements and presents potential layouts for the future site.

Together with performance analysis, cost effectiveness, and targeted user cases of the individual configurations, such layout studies will later enable a ranking of potential configurations. Based on this information the optimal combination of technologies will be defined for the 2019 conceptual design report of the EuPRAXIA facility.

Primary authors : Dr. WALKER, Paul Andreas (UHH/CFEL)

Co-authors : Dr. ASSMANN, Ralph (DESY) ; Dr. BRINKMANN, Reinhard (DESY) ; Mr. DORDA, Ulrich (DESY) ; MARCHETTI, Barbara (DESY) ; Mr. KOCON, Dariusz (ELI-Beamlines) ; Dr. PRIBYL, Lukas (ELI Beamlines, IOP ASCR) ; CHIADRONI, Enrica (LNF) ; FERRARIO, Massimo (LNF) ; Prof. WALCZAK, Roman (University of Oxford) ; Dr. SPECKA, Arnd (LLR - Ecole Polytechnique - CNRS/IN2P3)

Presenter : Dr. WALKER, Paul Andreas (UHH/CFEL)

Session classification : WG1-WG8 Joint Session

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 190

X/Gamma-ray emission from self-modulated wakefield accelerators

Thursday 28 Sep 2017 at 18:45 (00h15')

Content :

An application of compact, high-gradient laser-wakefield accelerators is the development of novel light sources. They have potential for many applications, including high energy density sciences, where they can be used as probes to explore the physics of dense plasmas and warm dense matter. Our recent experimental and theoretical work shows that we can use three mechanisms to produce high energy x-rays and gamma-rays from a Self-Modulated Laser Wakefield Accelerator: Betatron motion of electrons, Bremsstrahlung and inverse Compton scattering. A series of experiments at the Lawrence Livermore National Laboratory, using the 1 ps 150 J Titan laser, have demonstrated low divergence electron beams with energies up to 300 MeV and 6 nCs of charge, and betatron x-rays with critical energies up to 20 keV. Additional experiments have also demonstrated that using Inverse Compton scattering and Bremsstrahlung we were able to generate gamma-rays with energies larger than 1MeV. Our results suggest that we will be able to develop SMLWFA-based light sources at large scale facilities for applications. This work was performed under the auspices of the U.S. Department of Energy by LLNL under Contract DE-AC52-07NA27344.

Primary authors : Mr. CANDEIAS LEMOS, Nuno (Lawrence Livermore National Laboratory)

Co-authors : Dr. ALBERT, Felicie (Lawrence Livermore National Laboratory) ; Dr. SHAW, Jessica (Laboratory for Laser Energetics) ; Mr. KING, Paul (UT Austin) ; Mr. MILDER, Avi (Laboratory for Laser Energetics) ; Mr. MARSH, Ken (UCLA) ; Mr. PAK, Arthur (Lawrence Livermore National Lab) ; Prof. JOSHI, Chandrashekhar (UCLA)

Presenter : Mr. CANDEIAS LEMOS, Nuno (Lawrence Livermore National Laboratory)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 191

Plasma ramps generation by outflow in gas-filled capillaries

Tuesday 26 Sep 2017 at 19:15 (00h15')

Content :

Plasma confinement inside capillaries has been developed in the past years for plasma-based acceleration to ensure a stable and repeatable plasma density distribution during the interaction with either particles or laser beams. In particular, in gas-filled capillaries, the neutral gas is ionized by a discharge current and confined to let it evolves leading to a stable and almost predictable distribution during the interaction with particles. However, the plasma ejected through the electrodes interacts with the beam outside the capillary, affecting the quality of the beam. We have studied the evolution of the plasma flown at the two ends of the capillary, in particular the longitudinal density distribution and the expansion velocity of the plasma. The study of these properties provides a deeper knowledge of the processes involved in the discharge and allows a better understanding of the beam-plasma interaction for future plasma based experiments.

Primary authors : FILIPPI, Francesco (LNF)

Co-authors : BIAGIONI, Angelo (LNF) ; MAROCCHINO, Alberto (LNF) ; FERRARIO, Massimo (LNF) ; CHIADRONI, Enrica (LNF) ; ANANIA, Maria Pia (LNF) ; ZIGLER, Arie (LNF) ; BRENTEGANI, Emanuele (LNF)

Presenter : FILIPPI, Francesco (LNF)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 192

extreme high brightness electron beam generation in a space charge regime

Wednesday 27 Sep 2017 at 17:10 (00h20')

Content :

The generation of ultra-short, low emittance and low energy spread electron bunches is nowadays a critical requirement for accelerators in plasma wave or for femtosecond light sources. These are applications were the scientific community is strongly investing in terms of study, and money, with projects and test facility around the word. This paper describes a new longitudinal compression scheme, were a balanced using of Velocity Bunching and Ballistic Bunching current techniques with the space charge permits to enter in a peculiar regime, Hybrid Laminar Velocity Bunching. It is a regime where the bunch is longitudinal compressed to the disadvantage of the transversal size, and were the over-bunching is forbidden by the laminarity; going to the minimal longitudinal dimension the bunch is adiabatically frozen and transversally refocused. This gym, as well as giving extremely high brightness, heats the uncorrelated energy spread resulting in electron distributions that, in case of bending paths, does not required Laser Heater devices.

Primary authors : BACCI, Alberto Luigi (MI)

Co-authors :

Presenter : SERAFINI, Luca (MI)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 193

Next-Generation Simulations for XFEL-Plasma Interactions with Solid Density Targets with PIConGPU - Solutions for Predictive 3D Modeling

Wednesday 27 Sep 2017 at 18:50 (00h20')

Content :

PIConGPU reportedly is the fastest particle-in-cell code in the world with respect to sustained Flop/s. Written in performance-portable, single-source C++ we constantly push the envelope towards Exascale laser-plasma modeling. However, solving previously week-long simulation tasks in a few hours with a speedy framework is only the beginning.

This talk will present the architecture and recent additions driving PIConGPU. As we speak, we run on the fastest machines and the community approaches a new generation of TOP10 clusters. Within those, many-core computing architectures and severe limitations in available I/O bandwidth demand fundamental rethinking of established modeling workflows towards in situ-processing.

We present our ready-to-use open-source solutions and address scientific repeatability, data-reduction in I/O, predictability and new atomic modeling for XFEL pump-probe experiments.

Primary authors : Mr. HUEBL, Axel (Helmholtz-Zentrum Dresden - Rossendorf)

Co-authors : Mr. WIDERA, René (Helmholtz-Zentrum Dresden - Rossendorf) ; Mr. PAUSCH, Richard (Helmholtz-Zentrum Dresden - Rossendorf) ; Mr. GARTEN, Marco (Helmholtz-Zentrum Dresden - Rossendorf) ; Mr. BURAU, Heiko (Helmholtz-Zentrum Dresden - Rossendorf) ; Mr. KOLLER, Fabian (Helmholtz-Zentrum Dresden - Rossendorf) ; Dr. KLUGE, Thomas (Helmholtz-Zentrum Dresden - Rossendorf) ; Dr. VORBERGER, Jan (Helmholtz-Zentrum Dresden - Rossendorf) ; Dr. DEBUS, Alexander (Helmholtz-Zentrum Dresden - Rossendorf) ; Prof. COWAN, Thomas (Helmholtz-Zentrum Dresden - Rossendorf) ; Prof. SCHRAMM, Ulrich (Helmholtz-Zentrum Dresden - Rossendorf) ; Dr. CHUNG, Hyun-Kyung (International Atomic Energy Agency) ; Dr. BUSSMANN, Michael (Helmholtz-Zentrum Dresden - Rossendorf)

Presenter : Mr. HUEBL, Axel (Helmholtz-Zentrum Dresden - Rossendorf)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 194

Warp-X: a new exascale computing platform for Beam-Plasma Simulations

Wednesday 27 Sep 2017 at 18:00 (00h25')

Content :

Turning the current experimental plasma accelerator state-of-the-art from a promising technology into mainstream scientific tools depends critically on high-performance, high-fidelity modeling of complex processes that develop over a wide range of space and time scales. As part of the U.S. Department of Energy's Exascale Computing Project, a team from Lawrence Berkeley National Laboratory, in collaboration with teams from SLAC National Accelerator Laboratory and Lawrence Livermore National Laboratory, is developing a new powerful plasma accelerator simulation tool. The new software will harness the power of future exascale supercomputers for the exploration of outstanding questions in the physics of acceleration and transport of particle beams in chains of plasma channels. This will benefit the ultimate goal of compact and affordable high-energy physics colliders, and many spinoff applications of plasma accelerators along the way. We will present the various components of the codes such as the new Particle-In-Cell Scalable Application Resource (PICSAR) and the redesigned adaptive mesh refinement library AMReX, which are combined with redesigned elements of the Warp codes, in the new WarpX software. The status, examples of applications and future developments will be discussed.

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Presenter : VAY, Jean-Luc (Berkeley Lab)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 195

Laser-Generated Proton Beams for High-Precision Ultra-Fast Crystal Synthesis

Thursday 28 Sep 2017 at 16:00 (00h15')

Content :

We present a method for the synthesis of micro-crystals and micro-structured surfaces using laser-accelerated protons. In this method, a solid surface material having a low melting temperature is irradiated with laser-generated protons for only a few tens of ps, provoking in the ablation process thermodynamic conditions that are between the boiling and the critical point. The intense and very quick proton energy deposition (sub-ns) induces an explosive boiling and produces microcrystals that aggregate in a plasma plume composed by ions and atoms detached from the laser-irradiated surface. The synthesized particles in the plasma plume then aggregate on a neighboring, non-irradiated, cold solid secondary target surface.
We experimentally verify the synthesizing methods by depositing low-melting-material microcrystals - such as gold - onto nearby silver surfaces and modeling the proton/matter interaction via a montecarlo code, confirming that we are in the above described thermodynamic conditions. Morphological and crystallinity measurements indicate the formation of gold octahedral crystals with dimensions of 1.2 μm (standard deviation < 5%), uniformly distributed on an entire silver surface (5 mm x 1 cm). This laser-accelerated particle based synthesis method paves the way for the development of new material synthesis.

Primary authors : ANTICI, Patrizio (LNF) ; Prof. BARBERIO, Marianna (INRS)

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Presenter : ANTICI, Patrizio (LNF)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 196

Peaked transverse ion spectra from picosecond pulses interacting with underdense targets

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

We will discuss OMEGA EP experiments of the interaction of a relativistic intensity, picosecond-duration laser pulse with an underdense plasma. A 1200 J, 2.5 ns pulse heated a plastic (or deuterated plastic) target to create an underdense plasma plume target. The ponderomotive force of the laser forms a channel through the plasma. Filamentation of the laser, and therefore filamentation of the created channel, have been observed both with proton and optical probing. High-energy electron beams have been measured along the laser axis, with energies exceeding 400 MeV. Peaked structures were observed in the transverse ion spectra. Two-dimensional particle-in-cell simulations are used to investigate the interaction. In particular, to look for evidence of the peaked ion spectra and the origin of the structures.

Primary authors : Dr. WILLINGALE, Louise (University of Michigan)

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Presenter : Dr. WILLINGALE, Louise (University of Michigan)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG2 - Ion Beams from Plasmas

Type : poster

Contribution ID : 197

ELECTRON BEAM TRANFER LINE DESIGN FOR PLASMA DRIVEN FREE ELECTRON LASER

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Plasma driven particle accelerators represent the future of compact accelerating machines and Free Electron Lasers are going to benefit from these new technologies. One of the main issue of this new approach to FEL machines is the design of the transfer line needed for the matching of the plasma beam with the magnetic undulators. Despite the reduction of the chromaticity of plasma beams is one of the main goals, the target of this line is to be effective even in cases of beams with a considerable value of chromaticity.

Primary authors : Mr. ROSSETTI CONTI, Marcello (INFN Milano)

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Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 198

The ANGUS 200TW laser at the LUX plasma accelerator and its online diagnostics system at the laser repetition rate

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Laser-plasma based acceleration has matured into a technique providing high-energy electron beams able to drive undulator-based x-ray light sources. The LUX beamline, currently built up in a collaboration between University of Hamburg, DESY and ELI-Beamlines, is designed to be such a light source. The plasma acceleration stage is driven by the 5 Hz 200 TW laser system ANGUS. Recently first accelerated electrons have been shown. In this presentation the ANGUS laser system and its transport beamline will be briefly introduced. The implementation of the online diagnostics with a data acquisition system at the laser repetition rate will be presented. Furthermore long term stability measurements will be discussed in view of accessibility, reliability and suitability of the laser as a driver for laser plasma wake field acceleration.

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Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : poster

Contribution ID : 199

Accurate modeling of plasma accelerators with arbitrary order pseudo-spectral solvers

Wednesday 27 Sep 2017 at 18:25 (00h25')

Content :

Numerical Cherenkov radiation (NCR) is a numerical artefact in PIC codes which results from inaccurate modeling of the electromagnetic dispersion relation. It can be a dominant source of spurious beam quality degradation in terms of emittance and energy spread. As a result of their high spectral precision pseudo-spectral solvers suppress NCR. However, due to the global nature of these solvers they are unsuited for parallelisation by domain decomposition. Arbitrary order pseudo-spectral solvers can provide the needed locality for parallelisation, but they can again suffer from NCR. Here we show at the example of the PIC code FBPIC, that even for problems of plasma accelerators with high beam charge, low grid resolution and long propagation distance already low orders of these solvers are sufficient to correctly model the physics of interest while also offering the locality needed for parallelisation.

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Presenter : Mr. JALAS, Soeren (Center for Free-Electron Laser Science and Department of Physics, University of Hamburg)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 200

Matched electron beams in multi stage laser wakefield acceleration.

Tuesday 26 Sep 2017 at 18:35 (00h15')

Content :

A perspective scheme of accelerators suitable for high energy physics experiments is a multi stage laser wakefield acceleration. Relativistic electron bunch accelerated in the laser wakefields undergoes betatron oscillations and emits synchrotron radiation that affects the dynamics of electron motion and polarization. A model for numerical simulation of the acceleration of polarized electrons has been developed in Ref. [1]. In this work, to describe the synchrotron radiation of particles the radiative reaction force in the Landau-Lifshitz form was used and quantum recoil effects were taken into account. In simulations, an electron bunch was accelerated in preformed plasma channel with the initial emittance matched to the averaged focusing forces. To preserve the beam emittance during transport between stages, the adiabatically decreasing plasma density and an increasing channel radius were used at the exit of accelerating stages [2]. The evolution of beam emittance during acceleration is studied and the final depolarization of accelerated electrons is estimated.

This work was supported by the Russian Science Foundation (Project No. 14-50-00124).

[1] D.V. Pugacheva, N.E. Andreev, Quantum Electronics 46 (2016) 88
[2] P. Tomassini, A. R. Rossi, Plasma Phys. Control. Fusion 58 (2016) 034001

Primary authors : Mrs. PUGACHEVA, Daria (JIHT RAS)

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Presenter : Mrs. PUGACHEVA, Daria (JIHT RAS)

Session classification : WG8_Parallel

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 201

Saturation of the beam-hosing instability in quasi-linear plasma-wakefield accelerators

Tuesday 26 Sep 2017 at 16:20 (00h20')

Content :

The beam-hosing instability is of key importance for the design of future plasma-wakefield accelerators. While previous work on this topic focused mainly on the blow-out wakefield regime, here we analyze theoretically the BBU for plasma-accelerators in the quasi-linear wakefield regime. Importantly, we show both analytically and numerically that, in this regime, the instability can saturate after a characteristic acceleration distance, due to head-to-tail variations in focusing forces. Thus the BBU in the quasi-linear regime may not as severe as standard scalings would suggest.

Primary authors : Dr. LEHE, Remi (Lawrence Berkeley National Laboratory)

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Presenter : Dr. LEHE, Remi (Lawrence Berkeley National Laboratory)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 202

Laser driven ion beam for multidisciplinary applications at ELIMAIA beamline

Monday 25 Sep 2017 at 18:40 (00h20')

Content :

Nowadays, high power laser-driven acceleration is one of the most interesting challenges in particle acceleration field, showing attractive characteristics for multidisciplinary and medical applications. Nevertheless, optically accelerated ion peculiarities make mandatory development of transport, selection, diagnostics and dosimetry system to deliver reproducible and controlled beams for multidisciplinary purposes. This is the main purpose of the user-oriented ELIMAIA (ELI Multidisciplinary Applications of laser-Ion Acceleration) beamline that will be installed at the ELI-Beamlines facility in Czech Republic within 2018, where high-energy laser driven ions, up to 60 MeV/n, will be available for users.
In this contribution an overview of the ELIMAIA beamline development, with a description of the adopted solutions for transport elements, diagnostics and dosimetry devices will be presented.
Preliminary results on time of flight measurements of high-energy proton beam accelerated by the PW Vulcan laser at the RAL facility (UK), performed using high temporal resolution diamond detectors, will be discussed. Moreover, some results on relative and absolute dose measurements performed with transmission ionization chamber and Faraday cup using the high repetition rate laser system at LOA laser laboratory (France) will be also presented.

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Presenter : Dr. SCUDERI, Valentina (ELI-Beamlines, IoP-ASCR, INFN-LNS)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 204

Multi-GeV electron acceleration from self-guided laser wakefield accelerators with extended focussing geometry

Monday 25 Sep 2017 at 18:18 (00h18')

Content :

Recent experimental electron acceleration results in the self-guiding, self-injecting regime from the 250 TW Gemini laser are presented. Employing an extended f/40 focussing geometry instead of an f/20 resulted in maximum single stage energy gains of up to 2.5 GeV, a more than twofold increase. The generated electron beams carry hundreds of millijoules of energy, with more than 50 % of the total beam energy in electrons with energies beyond 1 GeV. Three-dimensional particle-in-cell simulations revealed the differing dynamics of self-focussing in the extended focal geometry. Smoother transverse self-focussing provides stable self-injection into the wake in a phase with extremely high accelerating fields, resulting in enhanced acceleration in a quasi-stable ion cavity.

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Presenter : Dr. PODER, Kristjan (DESY)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 205

Experimental demonstration of Ballistic Bunching with Dielectric Lined Waveguides at PITZ

Monday 25 Sep 2017 at 18:30 (00h20')

Content :

We discuss a recent experiment at the PITZ facility in DESY, Zeuthen. Here an electron bunch was energy modulated from its self wake in a dielectric-lined waveguide at ~6 MeV. The relatively low energy of the beam resulted in ballistic bunching and formation of enhanced peak currents at the DLW frequency (300 GHz). We discuss the theory and experimental realization.

Primary authors : Dr. LEMERY, Francois (DESY)

Co-authors :

Presenter : Dr. LEMERY, Francois (DESY)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 206

Laser wakefield electron acceleration to multi-GeV energies

Tuesday 26 Sep 2017 at 18:20 (00h15')

Content :

The development of advanced acceleration methods with a large acceleration gradient, much larger than achieved in conventional radio frequency accelerators, is necessary to reach a TeV-energy range for future electron-positron colliders. One of the possible approaches is based on the multistage acceleration in the wakefields generated in plasma by relativistic-intense femtosecond laser pulses.
The laser wakefield acceleration of short electron bunches to multi-GeV energies with small emittance and energy spread is modelled and analyzed. Trapping and acceleration of short electron bunches externally injected into the wakefields generated by intense femtosecond laser pulse in plasma channel are optimized. The influence of the laser nonlinear dynamics and loading effect (self-action of the bunch charge) to the bunch final energy and energy spread of the accelerated electrons is investigated. The restrictions to the charge of accelerated electron bunch caused by the require of its small energy spread are determined [1].
The work was supported by the Russian Science Foundation (grant No. 14-50-00124).

[1] Andreev N.E., Baranov V.E., Matevosyan H.H., Journal of Physics Conf. Ser., 2017, in press.

Primary authors : Prof. ANDREEV, Nikolay E. (Joint Institute for High Temperatures of RAS)

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Session classification : WG8_Parallel

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 207

FLASHForward P-9: An X-band transverse deflection cavity for femtosecond-scale longitudinal phase space diagnostics

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The FLASHForward project at DESY is an innovative beam-driven plasma-wakefield acceleration experiment, aiming to accelerate electron beams to GeV energies over a few centimetres of ionised gas. These accelerated beams must be of sufficient quality to demonstrate exponential free-electron laser gain; achievable only through rigorous analysis of both the driver and witness beam's longitudinal phase space. The pulse duration of these witness beams is typically in the few-fs range and thus difficult to resolve with traditional diagnostic methods. In order to longitudinally resolve these very short bunch lengths it is necessary to utilise the properties of a transverse RF deflector operating in the X-band frequency regime. This X-band Transverse Deflection Cavity (XTDC) will be introduced to the FLASHForward beam line in order to perform fs- level single-shot longitudinal phase space measurements. The initial investigations into the implementation and operation of this device, as well as the international collaborative efforts required to realise it, are outlined.

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Presenter : Dr. D'ARCY, Richard (DESY)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 208

Particle-Driven Wakefield Dynamics in a Confined Plasma Channel

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Plasma wakefield accelerators driven by a beam of charged particles usually rely on a pre-formed plasma, such as a narrow channel of optically pre-ionized ambient gas utilizing a powerful laser system. While this method enables to provide plasma lengths and thus accelerating distances on the meter-scale, the width of the channel potentially, deliberately or inadvertently, varies significantly. When the channel's transverse extent is on the same order as the blowout radius, small variations in the plasma channel width strongly affect the blowout dynamics, particularly its size and strength. Investigating the influence of the channel dimensions on the wakefield provides important key insights for designing and realizing a particle driven plasma wakefield accelerator with stable acceleration conditions on meter scales. Furthermore, sophisticated optical plasma generation offers precise control over the plasma channel shape and thus enabling to deliberately tune the electromagnetic field configuration along the acceleration. We report on our insights gained during the E210 experimental campaign at FACET/SLAC accompanied by particle-in-cell simulations.

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Presenter : Mr. HEINEMANN, Thomas (Uni Strathclyde / DESY)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 209

EuPRAXIA@SPARC_LAB: the high-brightness RF photoinjector layout proposal

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

After the last decades of R activity, the crucial role of high-brightness RF photoinjectors in the fields of radiation generation and advanced acceleration schemes has been largely established, making them effective candidates to drive plasma-based accelerators as pilots for user facilities. Indeed, these photoinjectors are fundamental for the successful development of external injection plasma wakefield accelerators, since the ultimate beam brightness and its stability and reproducibility are strongly influenced by the RF-generated electron beam. At EuPRAXIA@SPARC_LAB, the unique combination of an advanced high-brightness RF linac and plasma-based accelerator technology will drive a facility for user applications. The main challenge for the photoinjector whereas external injection schemes are considered comes from the request of producing high quality electron beams. The beam dynamics in such high-brightness photoinjector has been explored by means of simulations, resulting in a working point able to provide high-brightness, ultra-short bunches with up to 3kA peak current at the advanced X-band linac booster. A proposal for the EuPRAXIA@SPARC_LAB high-brightness photoinjector is here reported together with performance optimisation and sensitivity studies aiming to actual check the robustness and reliability of the optimised working point.

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Presenter : GIRIBONO, Anna (ROMA1)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 210

LUX Electron Beam Optic

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

The LUX experiment, built and operated by the University of Hamburg in close cooperation with DESY, produces laser-plasma electron bunches with 5 Hz repetition and is currently upgraded towards the generation of undulator radiation. Here, we present a beam optic for electron energies of 100-400 MeV with a modified, compact electro quadrupole doublet. The magnets feature a gap size as small as 12 mm, resulting in field gradients of up to 150 T/m, which allows capturing the beam 10cm behind the target and focusing it into a 5mm period undulator or an electron spectrometer, respectively. Special care was taken in the beam pipe design to ensure clip-free laser transport to the post target diagnostics. Based on this beam optics we will present our concepts to longitudinal phase space diagnostics using transition radiation.

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Presenter : Mr. WINKLER, Paul (DESY and CFEL, Universität Hamburg)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 211

FLASHForward - A Future-Oriented Wakefield-Accelerator Research and Development Facility at FLASH

Wednesday 27 Sep 2017 at 18:45 (00h15')

Content :

The FLASHForward project at DESY, Germany, is an innovative plasma-wakefield acceleration (PWFA) experiment, aiming to accelerate electron beams to GeV energies over a few centimetres of ionised gas. Stable and high-quality electron beams from the SCRF FLASH linear accelerator will act as a driver. The experimental configuration will allow for investigation into both internal and external witness-beam injection techniques e.g. density-downramp and double bunch injection. Particle-in-cell (PIC) simulations are being used to assess the efficacy of these techniques, providing a range of experimental properties for the accelerated bunches. In order to confirm the predictions of PIC codes a wide range of diagnostic tools is required. Accompanying the more traditional PWFA techniques - such as electron spectrometry, projected emittance reconstruction, and X-ray diagnostics - the FLASHForward post-plasma beam line will include ~fs longitudinal phase space and transverse slice emittance measurements of both the drive- and witness-beams. The operation parameters of FLASHForward, as well as the physics case and current experimental status, will be reviewed. Concepts of the main components currently under design and implementation - the target area, plasma cell, post-plasma beam transport, and diagnostics - will be described.

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Presenter : Dr. OSTERHOFF, Jens (Deutsches Elektronen-Synchrotron DESY)

Session classification : WG1-WG8 Joint Session

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 212

Demonstration of cascaded pre-bunching for enhanced particle trapping in an Inverse Free Electron Laser accelerator

Thursday 28 Sep 2017 at 18:00 (00h30')

Content :

We present results of an experiment performed at Brookhaven National Lab's Accelerator Test Facility showing the first successful demonstration of a cascaded pre-bunching scheme. Two modulator-chicane pre-bunchers arranged in series and a high power CO_2 laser seed tailor the longitudinal phase space of a 52 MeV electron beam creating a series of dense micro-bunches. Injecting this bunched beam in the stable accelerating potential of a seeded, strongly tapered undulator interaction increases the trapping fraction from 25\% to 95\%, accelerating up to 80\% of the particles to the final design energy. These results represent an important step in the development of high efficiency tapered undulator interactions, both as advanced accelerators and as high peak and average power coherent radiation sources.

Primary authors : Mr. SUDAR, Nicholas (University of California, Los Angeles)

Co-authors : Prof. MUSUMECI, Pietro (UCLA) ; GADJEV, Ivan (UCLA PBPL) ; Dr. FEDURIN, Mikhail (Brookhaven National Laboratory Accelerator Test Facility) ; Dr. POGORELSKY, Igor (BNL) ; Dr. POLYANSKIY, Mikhail (Brookhaven National Lab) ; Dr. SWINSON, Christina (Brookhaven National Lab) ; Dr. SAKAI, Yusuke (University of California, Los Angeles)

Presenter : Mr. SUDAR, Nicholas (University of California, Los Angeles)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 213

Experimental investigation of sheath-driven proton acceleration in the ultra-short pulse, ultra-high intensity regime

Monday 25 Sep 2017 at 16:50 (00h20')

Content :

The behaviour of high power laser driven ion generation at the extreme intensities available at next-generation laser facilities is an important topic for realising potential applications. One of the simplest schemes for proton sources for applications is sheath acceleration, for which different models predict varying dependence on laser and target parameters, motivating experimental investigation.

We will present experimental data investigating sheath driven proton acceleration using the ultra-high intensity, high contrast J-KAREN-P laser. A ~10 J, 40 fs pulse was focused to an intensity ~5x1021 Wcm-2, generating protons up to 50 MeV from freestanding ~μm foils, and up to 40 MeV at 0.1 Hz from a 5 μm tape target, with conversion efficiencies >1% into protons above 10 MeV. Scaling with different methods of laser intensity variation will be discussed. Simultaneous measurement of the electron distribution and optical probing of plasma formation on the rear target surface provide insights into electron absorption. Target irradiation at 45° angle of incidence is shown to produce a systematic asymmetry in rear surface sheath formation and resultant proton distribution due to the non-thermal electron distribution, causing the highest energy protons to be steered partly towards the laser axis.

Primary authors : Dr. DOVER, Nicholas (National Institutes for Quantum and Radiological Science and Technology, Japan)

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Presenter : Dr. DOVER, Nicholas (National Institutes for Quantum and Radiological Science and Technology, Japan)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 214

SINGLE-STAGE LASER-DRIVEN PLASMA ACCELERATION WITH EXTERNAL INJECTION FOR EuPRAXIA

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The EuPRAXIA (European Plasma Research Accelerator with eXcellence In Applications) project aims at producing a conceptual design for the European plasma-based accelerator facility, capable of delivering high quality multi-GeV electron beams. This facility will be used for various user applications, including free-electron-lasers and high-energy physics detector tests. EuPRAXIA explores different approaches to plasma acceleration techniques. Laser-driven plasma wakefield acceleration with external injection of an RF-generated electron beam is one of the basic configurations explored. We present studies of electron beam acceleration to several GeV by a single-stage laser wakefield accelerator with external injection from an RF accelerator as a first step towards a 5 GeV electron beam. Electron beam injection, acceleration and extraction from the plasma are investigated using particle-in-cell simulations.

Primary authors : Dr. SVYSTUN, Elena (DESY)

Co-authors : Dr. ASSMANN, Ralph (DESY) ; Mr. DORDA, Ulrich (DESY) ; Mr. HEINEMANN, Thomas (Uni Strathclyde / DESY) ; MARCHETTI, Barbara (DESY) ; Mr. FERRAN POUSA, Ángel (DESY) ; Dr. WALKER, Paul Andreas (DESY) ; Ms. WEIKUM, Maria Katharina (DESY / University of Strathclyde) ; Mr. ZHU, Jun (MPY, DESY)

Presenter : Dr. SVYSTUN, Elena (DESY)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 215

BEAM QUALITY PRESERVATION IN A LASER-PLASMA ACCELERATOR WITH EXTERNAL INJECTION IN THE CONTEXT OF EuPRAXIA

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Over the past decades the production of multi-GeV electron beams from laser-plasma-based accelerators has been successfully demonstrated. However, the overall quality of electron beams produced in plasma accelerators is not yet good enough for the realization of applications such as compact X-ray sources for material processing or medical imaging. To satisfy the requirements of these user-applications, produced electron beams should have sufficient stability, reproducibility and quality. To avoid degradation of the relative energy spread during acceleration, the electron beam should be injected at the proper phase and its longitudinal size should be much shorter than the plasma wave length. Tailoring the longitudinal plasma density profile has been used to minimize emittance growth. We present studies on minimization of the beam quality degradation during acceleration to 1 GeV in a laser plasma accelerator with external injection from an RF linac, using simulations with the particle-in-cell code OSIRIS [1].

[1] R. Fonseca et al., Lect. Notes Comput. Sci. 2331, 342 (2002); R. Fonseca et al., Plasma Phys. Control. Fusion 50, 124034 (2008).

Primary authors : Dr. SVYSTUN, Elena (DESY)

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Presenter : Dr. SVYSTUN, Elena (DESY)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 216

Kinetic and finite ion mass effects on the transition to relativistic self-induced transparency in laser-driven ion acceleration

Wednesday 27 Sep 2017 at 18:20 (00h20')

Content :

We study kinetic effects responsible for the transition to relativistic self-induced transparency in the interaction of a circularly-polarized laser-pulse with an overdense plasma and their relation to hole-boring and ion acceleration. It is demonstrated using particle-in-cell simulations and an analysis of separatrices in single-electron phase-space, that ion motion can suppress fast electron escape to the vacuum, which would otherwise lead to transition to the relativistic transparency regime. A simple analytical estimate shows that for large laser pulse amplitude the time scale over which ion motion becomes important is much shorter than usually anticipated. As a result, the threshold density above which hole-boring occurs decreases with the charge-to-mass ratio. Moreover, the transition threshold is seen to depend on the laser temporal profile, due to the effect that the latter has on electron heating. Finally, we report a new regime in which a transition from relativistic transparency to hole-boring occurs dynamically during the course of the interaction. It is shown that, for a fixed laser intensity, this dynamic transition regime allows optimal ion acceleration in terms of both energy and energy spread.

Primary authors : Dr. SIMINOS, Evangelos (Chalmers University of Technology)

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Presenter : Dr. SIMINOS, Evangelos (Chalmers University of Technology)

Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 217

Resonnant excitation of surface plasma waves in the relativistic regime: electron bunches and high order harmonic generation

Thursday 28 Sep 2017 at 18:50 (00h20')

Content :

Exploiting the ultra-high contrast laser facility UHI100 in Saclay we observed the acceleration of an electron beam driven by surface plasma waves (SPW) and the generation of high order harmonic along the surface of opportunely structured targets. Our experimental results clearly show a strong enhancement of both the energy and the number of electrons emitted from such targets irradiated at an incidence angle close to the resonant value for SPW excitation when compared to flat targets. High current (almost 120 pC) electron emission is concentrated in a narrow cone close to the target surface, with energy spectra peaking at 5-8 MeV and reaching up to ~20 MeV that we succeeded to reproduce with massively parallel 2D and 3D numerical simulations. Standard target translation stages motion speed are high enough to renew the target surface and get repetition rates of some tens of Hz that making such electron bunches an interesting candidate for a broad-range of applications such as pulsed radiolysis experiments, electron microscopy, ultra-fast electron diffraction or medical applications. It should be pointed out that a grating-like structure can be also produced on the target surface using opportunely modulated transient plasma gradients.

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Presenter : Dr. CECCOTTI, Tiberio (CEA Saclay)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 218

Demonstration of increased interaction length in a high gradient dielectric laser accelerator

Thursday 28 Sep 2017 at 16:40 (00h20')

Content :

We will present recent observations in which a pulse front tilted laser is used to accelerate electrons along a 0.5mm dual-grating dielectric laser accelerator (DLA). The tilted pulse front provides group velocity matching of the laser to the electron beam, allowing us to take advantage of the high accelerating gradient provided by an ultrafast laser; while free space optics are used to manipulate the laser wavefront in order to maintain phase synchronicity over many hundreds of optical cycles. The extended electron-laser interaction lasts for a substantial fraction of a synchrotron oscillation, introducing the possibility to study electron dynamics in a DLA.

Primary authors : CESAR, David (UCLA-PBPL)

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Presenter : CESAR, David (UCLA-PBPL)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 219

Wakefield Acceleration and Phase Space Manipulation at the Argonne Wakefield Accelerator Facility (AWA)

Monday 25 Sep 2017 at 16:00 (00h30')

Content :

The AWA facility is dedicated to the study of beam physics and the development of technology for future accelerators. Two independent electron linacs are used to study wakefield acceleration: 70MeV high charge electron bunches of up to 100nC are used to drive wakefields, which can be probed by bunches originating from the same linac or from the 15MeV linac. Recent Two-Beam-Acceleration (TBA) experiments reached accelerating gradients of 150MV/m. The wakefields were generated by the passage of the 15 – 45nC drive bunches through iris-loaded metallic structures operating at 11.7GHz. No indication of witness beam quality degradation was observed, and bunch charge was preserved during the acceleration process. Another series of experiments was conducted using two TBA stages, demonstrating acceleration of the witness beam in these two subsequent stages by means of two independent drive bunch trains. Other TBA experiments used dielectric loaded structures operating at 26GHz. Another main thrust of the research program consists of exploring and developing techniques to manipulate the phase space of electron bunches, including bunch shaping and the exchange of emittances in the transverse and longitudinal phase spaces.Especially shaped bunches can achieve higher transformer ratios in collinear wakefield acceleration experiments.

Primary authors : Dr. CONDE, Manoel (Argonne National Laboratory)

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Presenter : Dr. CONDE, Manoel (Argonne National Laboratory)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 220

RF injector design studies for the witness beam for a plasma-based user facility

Monday 25 Sep 2017 at 17:10 (00h20')

Content :

The interest in plasma-based accelerators as pilot of user facilities is growing worldwide thanks to its compactness and reduced costs. The most demanding user application, as the operation of an X-ray FEL, requires ultra-high brightness electron beams in the GeV energy range. Intense beam dynamics studies have been performed to provide a reliable working point for the EuPRAXIA injector aiming to drive a witness bunch suitable for external injection schemes, both in particle beam and laser driven plasma wakefield acceleration. A case of interest foresees a 1 GeV witness beam energy with less than 1mm.mrad slice emittance and 30pC in 10 fs fwhm, which turns into 3kA peak current at the undulator entrance. The witness beam has been successfully compressed down to 10fs in a conventional SPARC-like photoinjector and boosted up to 500 MeV in an advanced high-gradient X-band linac reaching the plasma entrance with 3 kA peak current, 0.07% energy spread, 0.5 mm.mrad transverse normalised emittance and a focal spot down to 1 μm. RF injector studies are here reported with the aim to satisfy the EuPRAXIA requests for the Design Study of a plasma-based user facility.

Primary authors : GIRIBONO, Anna (ROMA1)

Co-authors : FERRARIO, Massimo (LNF) ; CHIADRONI, Enrica (LNF) ; VACCAREZZA, Cristina (LNF)

Presenter : GIRIBONO, Anna (ROMA1)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 221

Optically controlled laser-plasma electron accelerators for compact gamma-ray sources

Tuesday 26 Sep 2017 at 19:00 (00h15')

Content :

Optimizing nonlinear evolution of the drive pulse, through adequate photon engineering, is a vital element of the laser-plasma accelerator (LPA) design, offering new avenues to control electron beam phase space on a femtosecond time scale. Stacked pulse-driven LPA is a perfect tool to exercise this control, affording kHz-scale repetition rate at a manageable average power, favoring radiation physics applications dependent on dosage.

An incoherent stack of two sub-Joule, multi-TW pulses of different colors is almost immune to self-compression while driving an electron density bubble. Very slow etching of the stack leading edge suppresses continuous injection and delays electron dephasing, thereby nearly doubling electron energy gain against the predictions of standard scaling. This permits generation, in a mm-scale dense plasma (n ~ 10^19 cm^{-3}), of low-background, near-GeV, quasimonoenergetic electron bunches with 10^17 A/m^2 5D brightness. Trains of such bunches, with controlled energy spacing, may be also produced in a single shot. These unconventional beams, inaccessible with standard acceleration techniques, emit trains of highly collimated, quasimonochromatic, gigawatt gamma-ray pulses via inverse Thomson scattering process, each pulse corresponding to a distinct energy band, in the range 3 - 17 MeV.

Primary authors : Dr. KALMYKOV, Serge (University of Nebraska - Lincoln)

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Presenter : Dr. KALMYKOV, Serge (University of Nebraska - Lincoln)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 222

Parametric study of proton beams driven by 200TW laser system using a tape driven target system

Wednesday 27 Sep 2017 at 19:15 (00h15')

Content :

Ultra-short intense laser-plasma interaction comprises diverse physical processes resulting in particle acceleration and generation of radiations that are promising for future accelerator, material and medical fields. In order to generate high quality proton beam and use them as a diagnostic tool, it is important to investigate correlations between laser and the proton beam parameters. In this work, we investigate the scaling of proton beam parameters, for instance, maximum energy, flux and beam temperature to incident laser parameters (200 TW, fs laser system at Shanghai Jiao Tong University, China). For a systematic study, we used recently developed tape-driven target system, which can produce stable and reproducible proton beam. The results show fast scaling for variation of the laser energy, whereas, in case of the focal spot variation the maximum proton energy scales moderately with the laser intensity. The dependence of maximum proton energy on laser pulse duration, while keeping laser energy and focal spot size fixed, was also investigated. This information would be helpful for developing next generation accelerators and to predict properties of proton beams to be used for applications in radiography or radiotherapy.

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Session classification : WG2_Parallel

Track classification : WG2 - Ion Beams from Plasmas

Type : talk

Contribution ID : 223

Optimization of laser-wakefield acceleration using ionisation-induced injection

Tuesday 26 Sep 2017 at 18:40 (00h20')

Content :

Ionization-induced injection is a promising scheme to achieve stable laser-plasma injectors with low energy spread (~10%) electron beams. This scheme is easy to implement experimentally and offers an additional parameter of control on electron beam properties for compact injectors in the 100 to 200 MeV range. Simulations were performed with realistic laser-plasma parameters using the pic code Warp, to study the influence of N_2 concentration in the plasma on the generated electron beam properties. We will show that there is an optimum value of concentration for the considered laser-plasma parameters, allowing to maximize the accelerated charge, and minimize emittance and energy spread.

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Presenter : Mr. LEE, Patrick (Laboratoire de Physique des Gaz et des Plasmas)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 224

Plasma-based diagnostics of High-Brightness Electron Beams at the frontier of Temporal and Spatial Resolution

Tuesday 26 Sep 2017 at 16:00 (00h20')

Content :

We present a novel diagnostics to characterize high brightness electron beams. The technique, based on the tunnel ionization of a neutral gas by the intense (GV/m) self-field of the electron beam, can be used to measure the volumetric charge density of the beam; e. g. to reconstruct pulse durations shorter than few femtoseconds or to measure transverse beam sizes below the micron level. Results from analytical (Ammosov Delone Krainov (ADK) model) and particle-in- cell code simulations will be discussed up to beam durations that approach the through-the- barrier tunneling times, where deviations from the ADK model are expected. Experiments with sub femtosecond unipolar self-field of electron beam, could further deepen our understanding of quantum tunneling process. We finally present practical implementation of this new diagnostics at LCLS, in the XLEAP* experiment, and laser plasma accelerator BELLA.

Primary authors : Dr. TARKESHIAN, Roxana (Universität Bern)

Co-authors : Prof. FEURER, Thomas (University of Bern) ; Dr. KREJCIK, Patrick (SLAC) ; Dr. LEEMANS, Wim (Lawrence Berkeley National Laboratory) ; Dr. LEHE, Remi (Lawrence Berkeley National Laboratory) ; Dr. PRAT, Eduard (PSI) ; Dr. ISCHEBECK, Rasmus (PSI)

Presenter : Dr. TARKESHIAN, Roxana (Universität Bern)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 225

Design concept for THz-driven electron streaking with ultrahigh resolution

Monday 25 Sep 2017 at 16:20 (00h20')

Content :

We propose a new concept for a femto- to sub-femtosecond resolution electron streaking detector. It is based on a split ring resonator (SRR), which is loaded by a single cycle THz pulse. The methodology relies on a resonant THz sub-wavelength structure irradiated with an intense single cycle THz pulse. The deflecting electrodes and the RF streaking field of a standard streaking device are replaced by a SRR and the electric near-field in its gap, respectively. The electron bunch passing through the SRR's gap experiences a transverse momentum with sign and magnitude depending on the longitudinal bunch position. Thus, the longitudinal bunch density is mapped onto the transverse axis and can be easily measured with a spatially resolving electron detector. THz-driven streaking should be well adapted to measure ultrashort electron bunches, even on a single-shot basis. A first proof-of-principle experiment will be performed at the FLUTE accelerator test facility at KIT, Germany.

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Presenter : Ms. HAYATI, Mozhgan (University of Bern)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 226

THz-Driven Accelerator Components

Monday 25 Sep 2017 at 18:00 (00h20')

Content :

Plasmon- or phonon-polaritons excited at plane or structured interfaces or in in sub-wavelength resonators by strong THz pulses are interesting candidates for miniaturized accelerator components. Often these structures show either electric or magnetic near-field enhancement alleviating the need for a strong driving THz source. Today laser-driven THz sources can produce single-cycle pulses with field strengths between 10 to 100 MV/m (electric) and around several Tesla (magnetic); they can be easily synchronized to a gun laser or any other laser in the accelerator chain and the THz free-space wavelength or the plasmon wavelength are well matched to a typical transverse electron bunch size on the order of 100 microns.
Here, we will discuss deflecting structures for electron streaking diagnostics, accelerating structures, and also miniaturized undulator structures.

Primary authors : Prof. FEURER, Thomas (University of Bern)

Co-authors : Dr. TARKESHIAN, Roxana (Universität Bern) ; Ms. HAYATI, Mozhgan (University of Bern) ; Dr. OLLMANN, Zoltan (University of Bern)

Presenter : Prof. FEURER, Thomas (University of Bern)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 227

Characterization of self-injected electron beams from LWFA experiments at SPARC_LAB

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The plasma-based acceleration is an encouraging technique to overcome the limits in the conventional RF LINAC. A plasma accelerator is able to provide accelerating fields around hundreds of GeV/m, i.e. order of magnitude greater than RF structures, paving the way to accelerate particles to several MeV over a short distance (millimiter scale).
In this work, the characteristics of electron beams obtained through Laser WakeField Acceleration (LWFA) in the self-injection regime produced with the FLAME high-power laser at the SPARC_LAB test facility are shown.
In our setup, the high intensity laser power (10^19 W/cm^2) ionizes the gas coming out from a gas-jet, while the ponderomotive force creates a bubble inside the plasma where a strong electric field arises on the back of the bubble. Therefore, electrons are self-injected in this region and quickly accelerated. In detail, with a laser energy on focus of 1 J and a pulse temporal length (FWHM) of 40 fs, we obtained an electron plasma density of 10^19cm^-3, transversal dimensions in the range 5-15 mm (rms), energy up to 220 MeV and beam charge of the order of 10^2 pC.

Primary authors : Ms. COSTA, Gemma (LNF-INFN)

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Presenter : Ms. COSTA, Gemma (LNF-INFN)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 228

Lattice design and start-to-end simulations for the ARES linac

Wednesday 27 Sep 2017 at 18:30 (00h15')

Content :

The SINBAD (Short INnovative Bunches and Accelerators at DESY) project is a dedicated, long-term accelerator research and development (R) facility currently under construction at the DESY Hamburg campus, aiming to provide an infrastructure for developing several types of novel high-gradient accelerators. We present the design of the magnetic lattice as well as the modeling and simulations of ultra-short electron bunch generation at the ARES (Accelerator Research Experiment at SINBAD) linac, which is the core of the SINBAD facility. In order to meet the requirements of the high-gradient accelerators, the ARES linac was optimized to provide ~100 MeV, low charge (0.5 to 30 picocoulombs) and ultra-short electron bunches (sub-femtosecond to a few femtoseconds) with ultra-small spot sizes (less than a few micrometers) and excellent timing stability (rms bunch arrival-time jitter < 10 femtoseconds).

Primary authors : Mr. ZHU, Jun (MPY, DESY)

Co-authors : MARCHETTI, Barbara (DESY) ; Dr. ASSMANN, Ralph (DESY) ; Mr. DORDA, Ulrich (DESY)

Presenter : Mr. ZHU, Jun (MPY, DESY)

Session classification : WG1-WG8 Joint Session

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 229

Silicon nano-structures for dielectric laser accelerators: fabrication, simulation and testing

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Dielectric laser accelerators (DLAs) have proven to be good candidates for miniaturized particle accelerators. Acceleration gradients in the range of GeV/m have already been shown. In this work we show the field distribution simulations and error tolerances for different DLA geometries when they are powered with short pulses of infrared laser beams. We also discuss the fabrication and testing of silicon nano-structures that have been constructed via the conventional techniques of e-beam lithography and reactive ion etching.

Primary authors : Mr. YOUSEFI, Peyman (Friedrich Alexander University of Erlangen Nürnberg)

Co-authors : Dr. MCNEUR, Joshua (Friedrich Alexander University) ; Dr. KOZÁK, Martin (Friedrich Alexander University) ; Dr. LOHSE, Olga (Max-Planck institute for the science of light) ; Dr. GANNOTT, Florentina (Max-Planck institute for the science of light) ; Dr. HARDER, Irina (Max-Planck institute for the science of light) ; Prof. HOMMELHOFF, Peter (University of Erlangen and Max Planck Institute for the science of light)

Presenter : Mr. YOUSEFI, Peyman (Friedrich Alexander University of Erlangen Nürnberg)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 230

Indirect imaging of optical near-fields in dielectric laser accelerators

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Dielectric Laser Accelerators (DLAs) have undergone extensive theoretical and experimental study recently. For all applications of DLAs, the laser-generated near field pattern strongly influences the potential quality of electron beams traversing the DLAs. Although these fields are well understood theoretically and numerically, they have not been observed experimentally. To do so, we use ultrafast electron microscopy to image the spatial dependent energy modulation of electrons propagating through DLA near-fields. This allows for an indirect measurement of the electromagnetic near fields at silicon nano structures. This is achieved in a laser triggered transmission electron microscope (TEM) that provides sub-ps time resolution combined with spectrally resolved imaging typically used for PINEM studies. We report on findings from this experimental study and their comparison to numerical simulations.

Primary authors : Mr. SCHÖNENBERGER, Norbert (Friedrich-Alexander-Universität Erlangen-Nürnberg)

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Presenter : Mr. SCHÖNENBERGER, Norbert (Friedrich-Alexander-Universität Erlangen-Nürnberg)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : poster

Contribution ID : 231

Staging, focusing and microbunching in dielectric laser accelerators

Thursday 28 Sep 2017 at 16:00 (00h20')

Content :

Dielectric laser accelerators (DLAs) form a class of novel accelerators that potentially enables a variety of exciting applications, ranging from MeV handheld electron sources to table-top coherent x-ray sources. Recently, DLAs have demonstrated acceleration gradients approaching 1 GeV/m with a variety of dielectric materials, laser wavelengths, and nanostructure geometries. Realizing the above applications, however, requires extending the interaction length between electrons and the laser induced fields. Furthermore, the restrictive longitudinal and transverse acceptance of the nanostructures necessitates microbunching and focusing the electron beam, preferably on a similarly-miniaturized scale. Here, we report on experimental demonstration of DLA-based staging and focusing and on efforts to realize a DLA-based microbunching scheme. Approaches for addressing these challenges are discussed.

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Presenter : Dr. MCNEUR, Joshua (Friedrich-Alexander-University of Erlangen Nürnberg)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 232

Two-Pulse Ionisation Injection with simultaneous space-time focused pulses

Thursday 28 Sep 2017 at 18:00 (00h18')

Content :

Controlling the injection of electrons into laser wakefields will be important for improving the quality of the accelerated bunches, and reducing their shot-to-shot jitter. This is particularly challenging for accelerators operating in the quasi-linear regime since the fields are weaker. We recently proposed the two-pulse ionization injection (2PII) scheme in which electrons ionized from a dopant species by a tightly focused trailing pulse are trapped in the quasi-linear wake driven by a leading pulse. Here we build on that work by considering simultaneous space-time focusing (SSTF) of the injection pulse; this provides tighter localization of the injection, leading to reduced energy spread and reduced emittance. We present PIC simulations of 2PII with SSTF pulses and explore the extent to which this approach can improve the electron bunch properties and control the spectrum and brilliance of betatron X-rays they generate.

Primary authors : Dr. HOLLOWAY, James (The University of Oxford)

Co-authors : Prof. HOOKER, Simon (University of Oxford) ; Prof. WALCZAK, Roman (University of Oxford)

Presenter : Dr. HOLLOWAY, James (The University of Oxford)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 233

Characterization of Field-Emission from Silicon Nano Cathodes

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Field emission cathodes are capable of providing electron beams with appealing brightness required for, e.g. the development of compact accelerator-based light sources to serve as injector for high-gradient accelerating structures (e.g. dielectric laser accelerators). A collaboration between Northern Illinois University and the Argonne Center for Nanoscale Materials, has recently developed field-emission cathodes consisting of arrays of nanocones. This paper discusses the recent results to test these cathodes using a DC gun. We will especially present the the measured I –V characteristic curves and transverse beam distributions of the emitted electron beams and compare our results with numerical simulations.

Primary authors : Mr. MOHSEN, Osama (Northern Illinios University)

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Presenter : Mr. MOHSEN, Osama (Northern Illinios University)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : poster

Contribution ID : 234

Adiabatic plasma lens experiments at SPARC

Tuesday 26 Sep 2017 at 16:45 (00h15')

Content :

Plasma lenses in the underdense regime have been shown to give extremely strong linear focusing, with strength proportional to the local plasma ion density. This technique has been proposed as the basis of an scheme for future linear colliders that mitigates the Oide effect through adiabatic focusing. In this scenario the plasma density in the lens is ramped slowly on the scale of betatron motion, to funnel the beam to its final focus while forgiving chromatic aberrations. We present to the physics design of an adiabatic plasma lens experiment to be performed at SPARC Lab. We illustrate the self-consistent plasma response and associated beam optics for both symmetric and asymmetric beams in plasma, simulated by QuickPIC using density profiles obtained from experiment. We discuss experimental plans including plasma source development and betatron-radiation-based beam diagnostics.

Primary authors : Prof. ROSENZWEIG, James (UCLA)

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Presenter : Prof. ROSENZWEIG, James (UCLA)

Session classification : WG8_Parallel

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 235

The ACHIP experimental chambers at PSI

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

ACHIP is an international collaboration, funded by the Gordon and Betty Moore Foundation, whose goal is to demonstrate that laser-driven accelerator on a chip can be integrated to fully build an accelerator based on dielectric structures.
PSI will provide access to the high brightness electron beam of SwissFEL to test structures, approaches and methods towards achieving the final goal of the project. In this contribution, we will describe the two interaction chambers installed at SwissFEL to perform proof-of-principle experiments. In particular, we will present the positioning system for the samples, the magnets needed to focus the beam to sub-micrometer dimensions and the diagnostics to measure beam properties at the interaction point.

Primary authors : Dr. FERRARI, Eugenio (Epfl)

Co-authors :

Presenter : Dr. FERRARI, Eugenio (Epfl)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 236

On the impact of short laser pulses on cold low-density plasmas

Tuesday 26 Sep 2017 at 19:12 (00h18')

Content :

Applying a recently developed plane hydrodynamical model to the impact of a very short and intense laser pulse normally onto a diluted plasma at rest, we determine the motion of the plasma electrons shortly after the beginning of the laser-plasma interaction. We thus analytically derive the main features of the induced wake-fi eld wave in the plasma, when and for which electrons the hydrodynamical description breaks, and strict lower bounds for the electron density n_e well inside the plasma (in particular, n_e>n_0/2 if the initial one n_0 was uniform). Since in reality the laser spot size R is fi nite, we suggest that a ion bubble can form uniquely at the vacuum plasma interface, it can propagate behind the pulse only if R,n_0 are sufficiently small, while for slightly larger R,n_0 the slingshot effect (i.e. the backward expulsion of hig-energy electrons from the plasma) may occur.
In our model we reduce the Lorentz-Maxwell and continuity PDEs to decoupled systems of nonautonomous 1-dim Hamilton equations adopting u=ct-z instead of time t as an independent variable in the Action, Lagrangian and Hamiltonian.

Primary authors : Prof. FIORE, Gaetano (Università Federico II, and INFN, Napoli)

Co-authors :

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Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 237

Ultra-High Brightness Electron Beams From Very-High Field Cryogenic Radiofrequency Photocathode Sources

Wednesday 27 Sep 2017 at 16:00 (00h30')

Content :

Recent investigations of RF copper structures operated at cryogenic temperatures performed by a SLAC-UCLA collaboration have shown a dramatic increase in the maximum surface electric field, to 500 MV/m. We examine use of these fields to enable very high field cryogenic photoinjectors that can attain over an order of magnitude increase in peak electron beam brightness. We present beam dynamics studies relevant to X-ray FEL injectors, using start-to-end simulations that show the high brightness and low emittance of this source enables operation of a compact FEL reaching a photon energy of 80 keV. The preservation of beam brightness in compression is discussed. Also, extreme low emittance scenarios obtained at low charge, appropriate for pushing performance limits of ultrafast electron microscopy experiments, are reviewed. While the gain in brightness at high field is due to increase of the emission current density, further increases in brightness due to lowering of the intrinsic cathode emittance in cryogenic operation are also enabled. The potential to probe fundamental brightness limits in these cold, dense beam systems is examined. Issues in experimental implementation, including: dark current suppression, cavity optimization for cryogenic thermal dissipation, external coupling, and cryo-cooler systems are discussed.

Primary authors : Prof. ROSENZWEIG, James (UCLA)

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Presenter : Prof. ROSENZWEIG, James (UCLA)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 238

Laser-driven Dielectric Wakefield Accelerator

Thursday 28 Sep 2017 at 16:20 (00h20')

Content :

A new concept in laser-driven high field acceleration is proposed in which a laser is used to excite, by optical rectification in a nonlinear medium, a series of resonant THz cavities. This second order process entails a mode conversion from optical-IR to THz radiation that is analogous to ponderomotive excitation of plasma waves in the laser wakefield accelerator. With a laser pulse train, it is foreseen to reach GV/m-class fields with this method. We present electromagnetic simulations including the optical rectification process that show the performance of an example system. Practical issues associated with experimental proof-of-principle are discussed.

Primary authors : Prof. ROSENZWEIG, James (UCLA)

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Presenter : Prof. ROSENZWEIG, James (UCLA)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 239

The ESCULAP project in Orsay

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The ESCULAP project aims at studying external injection of low energy (10 MeV) electrons in a plasma in the quasilinear regime. This facility will use the photo injector PHIL and the high power laser LASERIX. We will give a status report of the preliminary work on the facility and the status of the two machines. We will also present the results of simulations showing the expected performances of the facility.

Primary authors : Mr. WANG, Ke (LAL) ; Mr. DELERUE, Nicolas (LAL, CNRS and Université Paris-Sud 11)

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Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 240

Simulations and plans for possible DLA experiments at SINBAD

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

In this work we present the outlines of possible experiments for dielectric laser acceleration of ultra-short relativistic electron bunches produced by the ARES linac, currently under construction at the SINBAD facility (DESY Hamburg). The experiments are to be performed as part of the Accelerator on a Chip International Program (ACHIP), funded by the Gordon and Betty Moore Foundation. At SINBAD we plan to test the acceleration of already pre-accelerated relativistic electron bunches in laser-illuminated dielectric grating structures. We present outlines of both the acceleration of ultra-short single bunches, as well as the option to accelerate phase-synchonous microbunch trains. Here the electron bunch is conditioned prior to the injection by interaction with an external laser field in an undulator. This generates a sinusoidal energy modulation that is transformed into periodic microbunches in a subsequent chicane. The phase synchronization is achieved by driving both the modulation process and the DLA with the same laser pulse. In addition to the conceptual layouts and plans of the experiments we present start-to-end simulation results for different ARES working points.

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Presenter : Mr. MAYET, Frank (DESY, Hamburg, Germany & University of Hamburg, Germany)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 241

Using short drive laser pulses to achieve net focusing forces in tailored dual grating dielectric structures

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Laser-driven grating type DLA (Dielectric Laser Accelerator) structures have been shown to produce accelerating gradients on the order of GeV/m. In simple beta-matched grating structures - due to the nature of the laser induced steady-state in-channel fields - the per period forces on the particles are mostly in longitudinal direction. Even though strong transverse magnetic and electric fields are present, the net focusing effect over one period is negligible in the case of relativistic electrons. Stable acceleration of realistic electron beams in a DLA channel however requires the presence of significant net transverse forces. In this work we simulate and study the effect of using the transient temporal shape of short Gaussian drive laser pulses in order to achieve suitable field configurations for potentially stable acceleration of relativistic electrons in the horizontal plane. In order to achieve this, both the laser pulse and the grating geometry are optimized. Particle tracking simulations conducted with the Particle-In-Cell code VSim 7.2 are shown for both the transient and steady state/long pulse case.

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Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 242

Tapering of plasma density ramp profiles for adiabatic lens experiments

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

One of the key elements of the PWFA blowout regime is the strong, linear focusing provided by the ion density. One advantage of this focusing is its extraordinary strength whose gradient is proportional to the local background plasma density, permitting adiabatic focusing schemes in future compact linear colliders. Plasma density variations can be locally obtained in gas-filled capillaries by varying the capillary diameter in order to modify its local value. We present here a study of hydrogen discharges that explores the density profiles obtained for different tapering angles, and discuss their utility for adiabatic lens experiments.

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Presenter : FILIPPI, Francesco (LNF)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 243

EUPRAXIA at SPARC_LAB: Beam Dynamics studies for the X-band Linac

Wednesday 27 Sep 2017 at 16:45 (00h15')

Content :

In the framework of the Eupraxia Design Study an advanced accelerator facility EUPRAXIA at SPARC_LAB has been proposed to be realized at Frascati (Italy) Laboratories of INFN. Two advanced acceleration schemes will be applied, namely an ultimate high gradient 1 GeV X-band linac together with a plasma acceleration stage to provide accelerating gradients of the GeV/m order.
A FEL scheme is foreseen to produce X-ray beams within 3-10 nm range. A 500-TW Laser system is also foreseen for self-injection and ion production experiments and a Compton backscattering Interaction is planned together with extraction beamlines at intermediate electron beam energy for neutron beams and THz radiation production. The electron beam dynamics studies in the linac are here presented together with the preliminary machine layout.

Primary authors : VACCAREZZA, Cristina (LNF)

Co-authors :

Presenter : VACCAREZZA, Cristina (LNF)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 244

A MW field-emission electron beam sources

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

High-power electron beam could support a wide array of applications including high-flux accelerator-based radiation sources. We have recently investigated the production of high-power electron beam by coupling a field-emission source to a superconducting radiofrequency cavity. In this contribution we describe the concept and demonstrate its performances via numerical simulations. We also discuss the application of such an electron source to drive a THz radiation source.

Primary authors : Mr. MOHSEN, Osama (Northern Illinios University)

Co-authors : PIOT, Philippe (Northern Illinois University)

Presenter : Mr. MOHSEN, Osama (Northern Illinios University)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : poster

Contribution ID : 245

Geant4 simulation of the ELIMED transport and dosimetry beamline for high-energy laser-driven ion beam multidisciplinary applications

Thursday 28 Sep 2017 at 16:30 (00h15')

Content :

The ELIMED (ELI-Beamlines for MEDical and multidisciplinary application) beamline is being developed at LNS-INFN with the aim of focus, transport and select in energy proton and ion beams accelerated by laser-matter interaction at ELI-Beamlines (Prague, CZ). A Monte Carlo simulation has been developed to support the design of the beamline in terms of particle transport efficiency, optimize the beam parameters at the irradiation point in air and predict transport element parameters to deliver controlled dose distributions at the final irradiation point. The application has been developed with the Geant4 Monte Carlo toolkit and has been designed in a modular way in order to easily switch on/off geometrical components according to different experimental setups and User's requirements. Energy distributions, lateral beam profiles and longitudinal dose distributions in the in-air final section have been simulated selecting proton beams with energies ranging between 5 and 60 MeV and adopting laser-driven proton source generated by PIC (Particle In Cell) code able to simulate PW class laser system. Moreover, in order to produce longitudinal dose distributions of clinical relevance, preliminary simulations, for active-modulation of the beam energy varying the energy selector magnetic field, have been performed.

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Presenter : MILLUZZO, Giuliana Giuseppina (LNS)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 246

Gas cell density characterization for laser wakefield acceleration

Monday 25 Sep 2017 at 19:15 (00h15')

Content :

Laser plasma acceleration (LPA) is a promising scheme for compact high energy accelerators and the multi-staged scheme is actively investigated in relation with several large scale projects such as CILEX / Apollon and EuPRAXIA. However, several issues have to be addressed to optimize electron properties.
In particular, the target density average and its fluctuations are crucial parameters and need to be controlled. Indeed, the electron density influences the laser beam propagation and plays a crucial role in the injection of electrons in the plasma wave. Moreover, density fluctuations are suspected to have a major influence on electron beam pointing fluctuations which need to be reduced to allow reliable external injection in a second stage.
In the frame of CILEX / Apollon, several gas cells are being tested as prototypes of the future electron injector in the 50 – 200 MeV range. As optical density characterization is not possible over the entire geometry due to the presence of opaque walls, interferometry is used to estimate the electron density in experiments; these results are combined to fluid simulations to determine the absolute density profile in a wide range of experimental parameters; experimental and simulation results will be discussed.

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Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 247

Laser wakefield injector in the frame of EuPRAXIA

Thursday 28 Sep 2017 at 18:15 (00h15')

Content :

The EuPRAXIA project aims to study the design of a linear electron accelerator based on high-gradient plasma acceleration. Both RF and laser plasma injectors are considered to generate electron beams at the 200 MeV level. Generated electrons bunches would then be further accelerated up to 5 GeV in a plasma structure and distributed to two user areas.
In particular, this project includes the design of the laser system, of the plasma structures which have to be suitable for staging, of the electron beam magnetic transport lines and of the undulator for a free electron laser in the X-UV range.
A comparative study of the various laser plasma injector considered for this project was carried out based on the experimental results published by the community as well as on the physical mechanisms that make it possible to reach the required beam parameters for the applications. The results of this study will be presented and discussed.

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Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 248

The FLAME laser at SPARC_LAB

Monday 25 Sep 2017 at 18:30 (00h15')

Content :

Plasma wakefield acceleration is the most promising acceleration technique known nowadays, able to provide very high accelerating fields (10–100 GV/m), enabling acceleration of electrons to GeV energy in few centimetres. Here we present some of the plasma related activities currently underway at SPARC_LAB using the high power laser FLAME and the LINAC. In particular, we will give an overview of all the experiments performed with the FLAME system, passing from the electron acceleration by LWFA to TNSA. Eventually, we will discuss the external injection scheme, allowing the possibility to accelerate high brightness electron bunches accelerated by a LINAC with the high accelerating field generated by a high power laser in a plasma and in particular we will show the current status of the experiment at SPARC_LAB.

Primary authors : ANANIA, Maria Pia (LNF)

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Presenter : ANANIA, Maria Pia (LNF)

Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 250

Towards a realistic model for the ELI-NP GBS RF linac

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The ELI-NP Gamma Beam System is an advanced gamma ray source with unprecedented specifications of brilliance (> 10^21), monochromaticity (0.5 %) and energy tunability (0.2 - 19.5 MeV). Here the challenging source performances are provided by the head on collision of a recirculated high power laser pulse and a train of 32 high quality electron beams at 100 Hz repetition rate for the RF power system. The machine is currently in its delivery phase in Magurele (Romania) and so a preparatory phase of the commissioning of the overall facility is already ongoing. In view of the commissioning a model as much “realistic” as possible for the RF linac is needed. The paper focuses on the aspects that are mostly involved in the robustness, operational reliability and active and passive element constraint specifications as the multipolar contribution coming from the input couplers of the high-gradient RF gun and the insertion of measured field maps in tracking codes for high gradient - warm C-band accelerating sections (including RF couplers) and magnets as well.

Primary authors : GIRIBONO, Anna (ROMA1)

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Presenter : GIRIBONO, Anna (ROMA1)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 251

Toward a proof-of-principle experiment of Optical Stochastic Cooling

Thursday 28 Sep 2017 at 19:10 (00h20')

Content :

Owing to the superior bandwidth of amplifiers at optical wavelengths the Optical Stochastic Cooling (OSC) technique was first proposed more than 20 years ago as a radical improvement of the widely used Stochastic Cooling operating in the microwave regime. Fermilab is currently developing a proof-of-principle experiment of the OSC method using a 100-MeV electron beam circulating in the compact IOTA ring. The developed capabilities are generic and could have applications to optical manipulations of electron beams beyond OSC. This paper report on the development of an optical amplifier capable of amplifying undulator radiation along with simulations of the OSC insertion beamline.

Primary authors : Mr. ANDORF, Matthew (Northern Illinois University)

Co-authors : LEBEDEV, Valeri (Fermi National Accelerator Laboratory) ; Dr. PIOT, Philipppe (Northern Illinois University) ; Dr. RUAN, Jinhao (Fermi National Accelerator Laboratory)

Presenter : Mr. ANDORF, Matthew (Northern Illinois University)

Session classification : WG3_Parallel

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : talk

Contribution ID : 252

Modelling of laser-plasma acceleration of relativistic electrons in the frame of ESCULAP project

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Objective of ESCULAP project is the experimental study of laser-plasma acceleration of relativistic electron bunch. LAL photoinjector (PHIL) will be used to inject electron beam in plasma wakefield created by high power laser (LASERX) in the plasma cell. Control of the quality of the accelerated bunch is one of the main difficulties in laser-plasma acceleration. Extensive modelling of the ESCULAP experiment was performed in order to determine optimal parameters of the plasma cell density profile, focalization area, sensitivity to bunch quality etc. Plasma wakefield predicted by linear theory is compared with one obtained from kinetic modelling. We demonstrated that the large part of the initial electrons bunch can be accelerated up to hundreds of MeV in 9 cm length plasma cell where electric field reaches 100 MeV/cm.

Primary authors : Mr. KUBYTSKYI, Viacheslav (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France)

Co-authors : BAYNARD, Elsa (CLUPS, Univ. Paris-Sud, Université Paris-Saclay, Orsay, France) ; BRUNI, Christelle (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; CASSOU, Kevin (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; CHAUMAT, Vincent (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; DELERUE, Nicolas (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; DEMAILLY, Julien (LPGP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France) ; DOUILLET, Denis (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; EL KAMCHI, Noureddine (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; GARZELLA, David (LIDYL, CEA/DRF, Université Paris-Saclay, Saclay, France) ; GUILBAUD, Olivier (LPGP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France) ; JENZER, Stephane (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; KAZAMIAS, Sophie (LPGP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France) ; LEPERCQ, Pierre (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; LUCAS, Bruno (LPGP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France) ; MAYNARD, Gilles (LPGP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France) ; NEVEU, Olivier (LPGP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France) ; PITTMAN, Moana (CLUPS, Univ. Paris-Sud, Université Paris-Saclay, Orsay, France) ; PRAZERES, Rui (LCP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France) ; PURWAR, Harsh (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France) ; ROS, David (LPGP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France) ; WANG, Ke (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France)

Presenter : Mr. KUBYTSKYI, Viacheslav (LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 253

Full PIC simulation of first ACHIP experiment @ SINBAD

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

In laser illuminated dieelectric accelerators (DLA) high acceleration gradients can be achieved, due to high damage thresholds of the materials at optical frequencies. This is a necessity in developing more compact particle accelerator technologies. The Accelerator on a CHip International Program funded by the Gordon and Betty Moore Foundation is researching such devices. DESY Hamburgs ARD group under Ralph Aßmann is part of the collaboration. The dedicated accelerator research facility SINBAD under construction is particulary well suited for DLA experiments at relativistic electron energies, due to the high quality beams und short bunch lengths anticipated. In this study the results of the first conductable experiment at the facility are estimated via a combination of particle-in-cell (PIC) and tracking simulations. It will be an acceleration experiment with a bunch from the ARES linac. Astra is used to simulate an electron bunch at a suitable working point. The dielectric part of the setup will be simulated using the PIC code from CST Particle Studio incorporating the retrieved bunch from the ASTRA simulation. The energy spectra of the electron bunches are calculated as would be measured from a spectrometer dipole with and without the laser fields.

Primary authors : Mr. KUROPKA, Willi (DESY Hamburg, University of Hamburg)

Co-authors : Mr. MAYET, Frank (DESY, Hamburg, Germany & University of Hamburg, Germany) ; Mr. DORDA, Ulrich (DESY) ; Dr. ASSMANN, Ralph (DESY)

Presenter : Mr. KUROPKA, Willi (DESY Hamburg, University of Hamburg)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 254

Simulation of deflecting structures for dielectric laser driven accelerators

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

In laser illuminated dieelectric accelerators (DLA) high acceleration gradients can be achieved, due to high damage thresholds of the materials at optical frequencies. This is a necessity in developing more compact particle accelerator technologies. The Accelerator on a CHip International Program funded by the Gordon and Betty Moore Foundation is researching such devices. DESY Hamburgs ARD group under Ralph Aßmann is part of the collaboration.
Means to manipulate the beam, i.e. focusing and deflection, are needed for the proper operation of such devices. These means should rely on the same technologies for manufacturing and powering like the accelerating structures. In this study different concepts for dielectric laser driven deflecting structures are investigated via particle-in-cell (PIC) simulations and compared afterwards. The comparison is conducted with respect to the suitability for beam manipulation. Another interesting application will be investigated as a diagnostic device for ultra short electron bunches from conventional accelerators functioning alike a radio frequency transverse deflecting cavity (TDS).

Primary authors : Mr. KUROPKA, Willi (DESY Hamburg, University of Hamburg)

Co-authors : Dr. ASSMANN, Ralph (DESY) ; Mr. DORDA, Ulrich (DESY) ; Mr. MAYET, Frank (DESY, Hamburg, Germany & University of Hamburg, Germany)

Presenter : Mr. KUROPKA, Willi (DESY Hamburg, University of Hamburg)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 255

Gas-filled capillary discharge for tens-centimetre long plasma channel

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Novel plasma acceleration techniques are based on the use of on the excitation of large amplitude waves generated in well controlled plasma sources. The length of the plasma channel, as well as its homogeneity, is crucial for the development of compact accelerators. Gas filled capillary discharge have already proven their ability to confine plasma for long distances with relatively well controlled distribution. We aim to produce tens-centimeter-long capillaries in which we can ignite a discharge with relatively low potential and control its evolution along the interaction length. An investigation on the possible implementation of those sources will be presented.

Primary authors : FILIPPI, Francesco (LNF)

Co-authors : ANANIA, Maria Pia (LNF) ; BIAGIONI, Angelo (LNF) ; CHIADRONI, Enrica (LNF) ; FERRARIO, Massimo (LNF) ; ZIGLER, Arie (LNF)

Presenter : FILIPPI, Francesco (LNF)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 256

Timing measurement of laser-accelerated electron beams

Monday 25 Sep 2017 at 19:12 (00h18')

Content :

Laser accelerated electron beams are considered to be jitter-free with respect to a probe laser pulse that can be split from the driving laser pulse. Such feature is favorable to apply laser accelerated electron beams for pump-probe experiment. However, we have detected a large delay (~1 ps) of electron beams in a self-injected case when the plasma density is low. Increase of the plasma density the time delay was decreased as well as jitter. While electron beams using ionization injection do not show such time delays.

Our scheme utilized an electro-optical sampling technique with obliquely incident probe Ti:sapphire laser pulse. Electron beams were produced by focusing 400 mJ, 30 fs laser pulses irradiated onto helium or nitrogen gas target with a peak intensity of 1.8x10^18 W/cm^2. The timing was measured just after the gas-jet nozzle for 10-40 MeV electron beams with quasi-monoenergetic feature.

2D simulation results qualitatively reproduced our experimental results showing that injection mechanisms relate with the electron injection timing.

Primary authors : Dr. KANDO, Masaki (KPSI, QST)

Co-authors :

Presenter : Dr. KANDO, Masaki (KPSI, QST)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk

Contribution ID : 257

Development of a Novel Undulator with a Very Short Period Length

Wednesday 27 Sep 2017 at 18:15 (00h15')

Content :

We are exploring a novel method to fabricate undulator magnets having a very short period. Here, very short period means periods one order-of-magnitude shorter than the ordinary period of several cm.Two types of the magnet plates 100mm and 152mm long with 4-mm period length have been successfully fabricated.They produce an undulator field of approximately 4kG at a gap of 1.6mm. A connection method of these magnet plates has also been successfully developed to fabricate longer undulator magnets. Prototype undulators based on these technologies have been constructed.Field measurements and characterization show that the quality of the undulator field of these magnet plates is satisfactory for a very short period undulator, and a spectrum calculation shows that the fundamental radiation emitted from this field is quite satisfactory.Test experiments for light generation using the real electron beam based on two kinds of sources are being prepared. One is being planned at an S-band linac of Tohoku University in Japan, and the other is at an experimental site for a laser wake field acceleration in SPring-8/RIKEN under the ImPACT program.

Primary authors : Prof. YAMAMOTO, Shigeru (High Energy Accelerator Research Organization (KEK), Photon Factory)

Co-authors :

Presenter : Prof. YAMAMOTO, Shigeru (High Energy Accelerator Research Organization (KEK), Photon Factory)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 258

Conventional and advanced concepts in the designs of plasma-based colliders

Tuesday 26 Sep 2017 at 16:00 (00h30')

Content :

In this talk we will discuss the present concepts of plasma-based colliders, and in particular will discuss the sub-systems of the design, reviewing the assumptions and exploring if conventional sub-systems can be replaced, in some cases, by advanced designs.

Primary authors : Prof. SERYI, Andrei (John Adams Institute for Accelerator Science)

Co-authors :

Presenter : Prof. SERYI, Andrei (John Adams Institute for Accelerator Science)

Session classification : WG8_Parallel

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 259

Progress on Experiments towards LWFA Based FELs

Wednesday 27 Sep 2017 at 09:10 (00h40')

Content :

Free Electron Lasers are commonly regarded as the potential key appli- cation of laser wakefield accelerators. It was noticed that electron bunches exiting from state-of-the-art laser wakefield accelerators exhibit a normal- ized 6-dimensional beam brightness comparible to those in conventional linear accelerators. Effectively harnessing this beneficial beam property for an LWFA-based FELs is challenging due to the extreme initial condi- tions particularly in terms of beam divergence and energy spread. Several different approaches for capturing, reshaping and matching LWFA beams to suited undulators are currently being explored, for instance bunch de- compression or transverse-gradient undulator schemes. In this talk these and further concepts will be discussed with a focus on recent experimental achievements.

Primary authors : Dr. BERNHARD, Axel (Karlsruhe Institute of Technology (KIT))

Co-authors :

Presenter : Dr. BERNHARD, Axel (Karlsruhe Institute of Technology (KIT))

Session classification : Plenary 5

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 260

Foam-based, multi-layer targets for laser-driven ion acceleration

Wednesday 27 Sep 2017 at 11:00 (00h30')

Content :

Laser-plasma ion sources have been experimentally and theoretically investigated for a long time now. Major improvements in the acceleration process, i.e. increase of ion maximum energy and total charge, can be obtained using advanced targets, without raising laser requirements.
In our contribution we present recent experimental and numerical results of laser-driven ion acceleration with an advanced, robust targetry concept: foam-based multilayer targets. They consist in solid thin foils coated with a porous nanostructured Carbon layer at near-critical density for typical Ti:Sapphire laser systems. In this condition the foam density and the laser frequency match each other so that a complex interaction takes place, enhancing the acceleration process.
Experimental campaigns over wide ranges of laser and target parameters show that the foam may allow for a systematic increase of proton cutoff energy and number, allowing to obtain tens of MeVs protons with few Joules lasers.
Numerical simulations suggest that such improvement is a consequence of a higher conversion efficiency of laser energy into electron kinetic energy, with respect to bare targets. They also show that several features of the interaction physics, e.g. energy absorption, depend on the sub-micrometer structure of the target material.

Primary authors : Ms. FORMENTI, Arianna (Politecnico di Milano)

Co-authors :

Presenter : Ms. FORMENTI, Arianna (Politecnico di Milano)

Session classification : Plenary 6

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 261

Overview of Plasma Lens Experiments and Recent Results

Thursday 28 Sep 2017 at 08:30 (00h30')

Content :

Beam injection and extraction from a plasma module is still one of the crucial aspects to solve in order to produce high quality electron beams with a plasma accelerator. Proper matching conditions require to focus the incoming high brightness beam down to few microns size and to capture a high divergent beam at the exit without loss of beam quality.
Plasma-based lenses have proven to provide focusing gradients of the order of kT/m with radially symmetric focusing thus promising compact and affordable alternative to permanent magnets in the design of transport lines.
In this talk an overview of recent experiments and future perspectives of plasma lenses is reported.

Primary authors : CHIADRONI, Enrica (LNF)

Co-authors :

Presenter : CHIADRONI, Enrica (LNF)

Session classification : Plenary 7

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 262

Plasma sources for laser- and beam-driven plasma accelerators

Tuesday 26 Sep 2017 at 09:10 (00h40')

Content :

All plasma accelerators require a region of plasma in which the plasma waves are driven, yet this key component is often taken for granted. The plasma source will usually need to be well-defined in terms of its spatial extent, density, uniformity, and composition. Further, plasma does not exist at room temperature, and hence the ionization mechanism must be considered; the plasma may need to perform other functions, such as optical guiding; and the design of the plasma source may be constrained by its environment, for example by materials compatibility or vacuum requirements.

I will review the plasma sources used to date in plasma accelerators driven by particle beams and laser pulses, and will try to identify the main challenges for the next generation of plasma accelerators.

Primary authors : Prof. HOOKER, Simon (University of Oxford)

Co-authors :

Presenter : Prof. HOOKER, Simon (University of Oxford)

Session classification : Plenary 3

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 263

Time Resolved Imaging of Shock Compressed Matter Using X-Rays from a Laser Wakefield Electron Accelerator

Friday 29 Sep 2017 at 12:00 (00h30')

Content :

Betatron radiation from laser wakefield accelerators is an ultrashort pulsed source of hard, synchrotron-like x-ray radiation. It emanates from a centimetre scale plasma accelerator producing GeV level electron beams. In recent years betatron radiation has been developed as a source capable of taking high resolution x-ray images in compact geometries, however until now the short pulse nature of this light has not been exploited. This talk will detail experiments which utilised betatron radiation to probe a rapidly evolving phenomenon by imaging laser driven shock waves in solid density targets. The imaging resolution was improved to a point where it was comparable to that which has been achieved in similar experiments performed at conventional synchrotron light sources. This suggests that compact betatron imaging beamlines could impact positively on the imaging and diagnosis of high-energy-density physics experiments. Such measurements could be important for the validation of equation of state models and understanding the phases of matter inside planets.

Primary authors : Dr. WOOD, Jonathan (Imperial College London)

Co-authors :

Presenter : Dr. WOOD, Jonathan (Imperial College London)

Session classification : Plenary 10

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 265

10 m long laser-ionized uniform Rb plasma source for plasma wakefield accelerators

Monday 25 Sep 2017 at 19:00 (00h15')

Content :

The World's first proton driven plasma wakefield accelerator experiments AWAKE at CERN has started at the end of 2016. For the first stage of the experiments self-modulation-instability (SMI) is studied. SMI develops as the 12 cm long 400 GeV proton bunch traverses the plasma where it gets transversely modulated over 10 meters by the transverse forces in the plasma. In the second phase of the experiment electrons will be injected and accelerated into the large scale resonant wakefield (~GeV/m) created by the micro-bunches formed as a result of SMI. Plasma density variation as small as 0.2 % can disrupt the injection and acceleration process. Therefore a unique plasma source is built to meet this requirement. The plasma source is a Rb vapor confined in a 10 m heat exchanger tube, which is laser ionized to create a 2 mm diameter 10^14-10^15 cm^-3 density fully ionized plasma. Two reservoirs located at the ends continuously flow Rb vapor into the open 10 m tube. Precise temperature control of the reservoirs allows generating positive or negative density gradients. Here we present the details of the plasma source with measurements and simulations.

Primary authors : Dr. OZ, Erdem (Max Planck for Physics)

Co-authors : Dr. MOODY, Joshua (Max Planck Institute for Physics) ; Mr. BRAUNMUELLER, Falk (Max-Planck Institute for Physics) ; Prof. CALDWELL, Allen (Max Planck Institute for Physics) ; SAVARD, Nicolas (University of Victoria, TRIUMF) ; EASTON, Daniel (Wright Design Limited) ; PISANI, Justin (Wright Design Limited) ; UNCLES, Jim (Wright Design Limited) ; MARTYANOV, Mikhail (Max Planck Institute for Physics) ; BUSTAMANTE, Sebastien (CERN) ; KERSEVAN, Roberto (CERN) ; PLYUSHCHEV, Gennady (Ecole Polytechnique Federal de Lausanne) ; MUGGLI, Patric (Max Planck Institute for Physics) ; BATSCH, Fabian ()

Presenter : Dr. OZ, Erdem (Max Planck for Physics)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 268

Symplectic Particle-in-Mode Algorithms for Modeling Plasma Accelerators

Wednesday 27 Sep 2017 at 16:40 (00h20')

Content :

Conventional particle-in-cell methods for modeling plasma accelerators are prone to a variety of numerical instabilities and artifacts which can make them unreliable for long simulations. This is due to two issues: a lack of fidelity in the dispersion of the electromagnetic field update, and grid heating. We present a new class of algorithms, symplectic particle-in-mode (symPIM) algorithms, which are not subject to either of these artifacts. This makes symPIMs suitable for modeling long plasma stages with high fidelity.

Primary authors : WEBB, Stephen (RadiaSoft, LLC)

Co-authors :

Presenter : WEBB, Stephen (RadiaSoft, LLC)

Session classification : WG6_Parallel

Track classification : WG6 - Theory and Simulations

Type : talk

Contribution ID : 269

The open source PIC code SMILEI

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

SMILEI is an open-source, particle-in-cell code. It is designed for high performances on super-computers and applied to a wide range of physics-related studies: from relativistic laser-plasma interaction to astrophysical plasmas. It is co-developed by both physicists and HPC experts. This poster presents the main structure of the code, its features, parallel performances and provide several example of scientific production.

Primary authors : Dr. BECK, Arnaud (Laboratoire Leprince Ringuet)

Co-authors :

Presenter : Dr. BECK, Arnaud (Laboratoire Leprince Ringuet)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 270

Overview of State of the Art Diagnostics of Plasma Accelerators

Tuesday 26 Sep 2017 at 08:30 (00h40')

Content :

Enormous progress has been made in Plasma Acceleration since its inception over three decades ago. Multi-GeV energy gains have been demonstrated both in particle and laser driven accelerators, with many facilities now routinely generating high quality, GeV-class beams. Experimental characterization of the various aspects of the accelerating structures, and the accelerated charge, and emitted radiation, has been an equally long and ongoing, parallel research effort. The very transient, evolving, microscopic nature of the underlying accelerating plasma waves, their luminal propagation, as well as the unique properties of the accelerated charge and radiation, all have posed a great diagnostic challenge, requiring the development of a novel class of probing techniques. We will present a brief summary of the properties that have been the targets of experimental characterization, such as the plasma wave's density structure, electric and magnetic field structure, the temporal evolution of these structures, or the injected charge within the plasma wave and post-exit, and an overview of the specific methods of characterization developed by researchers around the world, with particular challenges that each method poses. Emphasis will be placed on an overview of the latest advances in the diagnostic techniques

Primary authors : Dr. ZGADZAJ, Rafal (University of Texas at Austin)

Co-authors :

Presenter : Dr. ZGADZAJ, Rafal (University of Texas at Austin)

Session classification : Plenary 3

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 271

Laser-driven charged particle beam structures in the relativistic transparency regime

Wednesday 27 Sep 2017 at 11:30 (00h30')

Content :

The ability to control the collective plasma behaviour during the interaction of intense laser light is fundamental to the development of relativistic optics as well as laser-driven particle and radiation sources. Here we show that for an ultra-thin (nanometre-scale) foil target interacting with an intense laser pulse, the resultant accelerated electron and proton beam structures can be changed by varying the polarisation of the incoming laser. We demonstrate, that due to a combination of plasma expansion and heating, a finite ‘relativistic plasma aperture’ can be formed within the previously overdense plasma, allowing the laser to propagate and diffract [1]. The produced near-field diffraction pattern at the rear of the target, defined by the laser polarisation, can induce transverse electron current structures which, through strong charge-separation-induced electrostatic fields, can be mapped into the resultant proton beam [2].

[1] B. Gonzalez-Izquierdo, et al., Nat. Phys. 12, 505–512 (2016)
[2] B. Gonzalez-Izquierdo, et al., Nat. Comms. 7, 12891 (2016)

Primary authors : Dr. KING, Martin (University of Strathclyde)

Co-authors :

Presenter : Dr. KING, Martin (University of Strathclyde)

Session classification : Plenary 6

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 272

High-quality GeV-scale electron bunches with the Resonant Multi-Pulse Ionization Injection

Thursday 28 Sep 2017 at 09:30 (00h30')

Content :

Laser Wake Field accelerated electrons need to possess a good beam-quality to comply with FEL requirements, or to be post-accelerated in a further LWFA stage towards multi-GeV energies scale.
Controlling electron injection and laser pulse evolution are therefore two of the crucial tasks for high-quality e-bunch production. A new bunch self-injection scheme, the Resonant Multi Pulse Ionization Injection (RMPII), is able to generate electron bunches with extremely low normalized emittances (as low as 0.08 mm mrad) and very low energy spread (below 0.3% of slice rms energy spread), with peak current of about 1kA.
The new scheme employs a single Ti:Sa laser system whose main fraction is time shaped as a train of resonant pulses that drive a large-amplitude plasma wave. A minor fraction is frequency doubled and acts as an ionizing pulse that extracts electrons in a controlled way. Further, in order to achieve multi-GeV energies, a stable pulse(s) propagation should be achieved. A detailed comparison between the pulse evolution in standard single-pulse and multi-pulse setup will be given. Finally, FEL simulations with GeV-scale electron bunches generated via the RMPII scheme will be presented.

Primary authors : Dr. TOMASSINI, Paolo (INO-CNR)

Co-authors : LABATE, Luca Umberto (PI) ; LONDRILLO, Pasquale (BO) ; Dr. DE NICOLA, sergio (SPIN-CNR) ; Prof. FEDELE, Renato (Scuola Politecnica e delle Scienze di Base, Dipartimento di Fisica, Università di Napoli Federico II and INFN Sezione di Napoli, Napoli, Italy) ; GIZZI, Leonida Antonio (PI) ; TERZANI, Davide (INFN)

Presenter : Dr. TOMASSINI, Paolo (INO-CNR)

Session classification : Plenary 7

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 273

Time and space characterization of a laser pulse for a new multi-pulse LWFA design

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The use of laser pulse trains is one of the promising methods to achieve laser wakefield
acceleration because of the low-energy requirements and high repetition rate.
A new design for the generation of a suitable train of pulses from a single highenergy
fast pulse is presented, exploiting optical properties of the main pulse impacting, just before the last focusing mirror, on a “mask” sectioned in concentric zones with different thickness, in order to deliver multiple laser pulses. A hole in the middle of the mask lets part of the original pulse to pass through and provide electron injection.
In the poster we will show how spatial and temporal profile of the laser emerging from each section are related to their radius and thickness. In particular we use (i) a self-developed code based on diffraction theory to calculate the e.m. field at the focus plane of an off-axis parabolic mirror, (ii) Mirò simulations to evaluate
the effects on the pulse duration (iii) analytical solution for the time separation of
the pulses. From this characterization it is possible to perform plasma wakefield simulations and use the results as feedback for the choice of different mask’s parameters.

Primary authors : VANTAGGIATO, Gianluca (Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche)

Co-authors : GIZZI, Leonida Antonio (PI) ; Dr. TOMASSINI, Paolo (INO-CNR) ; LABATE, Luca Umberto (PI)

Presenter : VANTAGGIATO, Gianluca (Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 274

Convergence of the ponderomotive guiding center approximation in the LWFA

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Plasma accelerators arose as potential candidates for future accelerator technology in the last few decades because of its predicted compactness and low cost. One of the proposed designs for plasma accelerators is based on Laser Wakefield Acceleration (LWFA). However, simulations performed for such systems have to solve the laser wavelength which is orders of magnitude lower than the plasma wavelength. In this context, the Ponderomotive Guiding Center (PGC) algorithm for particle-in-cell (PIC) simulations is a potent tool. The laser is approximated by its envelope which leads to a speed-up of around 100 times because the laser wavelength is not solved. However, the convergence of the self-injected beam parameters, such as energy and charge, was not studied before and has vital importance for the use of the algorithm in predicting the beam parameters. Our goal is to do a thorough investigation of the stability and convergence of the algorithm in situations of experimental relevance for LWFA. To this end, we perform simulations using the PGC algorithm implemented in the PIC code OSIRIS. To verify the PGC predictions, we compare the results with full PIC simulations.

Primary authors : Dr. SILVA, Thales (GoLP/Instituto Superior Técnico (Lisbon))

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Presenter : Dr. SILVA, Thales (GoLP/Instituto Superior Técnico (Lisbon))

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG6 - Theory and Simulations

Type : poster

Contribution ID : 275

Low Energy Bunch Compression with Dogleg Chicane

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The ESCULAP project joins the photo injector PHIL with the High Power Laser LASERIX to perform a laser plasma wakefield acceleration (LPWA) experiment. A prerequisite is that the electron beam (10pC,10MeV) has to be compressed longitudinally before being injected into the plasma cell from 2000fs (FWHM) to less than 300fs (and later 100fs). To achieve such compression we present a solution based on a dogleg chicane. The design of this chicane uses the simulation codes ASTRA and ImpactT. Effects such as 3D space charge and coherent synchrotron radiation are taken into account. The simulation result states that space charge and CSR have little effect on transverse emittance, but lead to a phenomenal growth in bunch length. Then the electron bunch is focused with a solenoid and injected into plasma, a preliminary result shows that more than 50% particles can be trapped and accelerated.

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Presenter : Mr. WANG, Ke (LAL)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG3 - Electron Beams from Electromagnetic Structures, Including Dielectric and Laser-driven Structures

Type : poster

Contribution ID : 276

First experimental results of the AWAKE experiment

Tuesday 26 Sep 2017 at 09:50 (00h40')

Content :

We present the first experimental results on the self-modulation of a long, 400GeV proton bunch in a dense ((1-10)e14/cc), 10-m long plasma. These results include evidence for: seeding of self-modulation; appearance of a halo of defocused protons; formation of micro-bunches at the plasma period; modulation period corresponding to the rubidium density, with period measured both in the time domain (streak camera) and in the frequency domain (heterodyne measurements). We will also show occurrence of the hosing instability.

Primary authors : Prof. MUGGLI, Patric (Max-Planck-Institut für Physik)

Co-authors :

Presenter : Prof. MUGGLI, Patric (Max-Planck-Institut für Physik)

Session classification : Plenary 3

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 277

Light Ions Acceleration Line (L3IA): commissioning and test experiments

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The construction of a novel Laser driven Light Ions Acceleration Line (L3IA) is progressing rapidly towards the operation, following the recent >100 TW scale upgrade of the ILIL-PW laser facility. The Line was designed following the pilot experimental activity carried out earlier at the same facility to define design parameters and to identify main components including target control and diagnostic equipment, also in combination with the systematic numerical simulations for the optimization of laser and target parameters. A preliminary set of data was acquired following the successful commissioning of the laser system. Data include output from a range of different ion detectors and evaluation and a first set of target parameter scans carried out for qualification of the laser-target interaction. An overview of the results will be given along with a description of the L3IA set up and a summary of the relevant upgraded ILIL-PW facility and features.

Primary authors : GIZZI, Leonida Antonio (PI) ; GIOVE, Dario Augusto (MI)

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Presenter : GIZZI, Leonida Antonio (PI)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG2 - Ion Beams from Plasmas

Type : poster

Contribution ID : 278

High quality LWFA: design and implementation at ILIL-PW

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Demonstration of high quality laser-plasma acceleration is mandatory for future development of novel plasma-based radiation sources like the EuPRAXIA H2020 project. In this context we are developing a test electron beam-line based on laser-wakefield acceleration with the aim of driving a Free Electron Laser in the X-ray domain. Our developments include design of a novel injection and acceleration scheme named ReMPI to produce low energy spread, low emittance bunches, and the experimental proof-of-principle demonstration of such a scheme, including a short wavelength injection pulse and a resonant pulse train, all starting from a single Ti:Sa laser pulse. These developments take advantage of the recent upgrade of the ILIL-PW facility including the recent >100 TW scale laser upgrade and the commissioning of the new, PW scale interaction area. A preliminary set of data was already acquired following the successful commissioning of the laser system. Data include output from a range of diagnostics designed to characterize gas target, laser-gas interaction stability and electron bunch characterization. An overview of the preliminary results will be given along with a description of the full design and the relevant upgraded ILIL-PW facility and features.

Primary authors : GIZZI, Leonida Antonio (PI)

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Presenter : GIZZI, Leonida Antonio (PI)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 279

A compact Laser based Neutron source

Thursday 28 Sep 2017 at 16:45 (00h15')

Content :

Several experiments of neutron generation using high intensity laser sources, with a power exceeding 10^19W/cm^2 via TNSA (Target Normal Sheath Acceleration) or other similar methods, have been performed in the past years in different laboratories. However, so far there is no one running neutron source based on such a technology. In the framework of the Conceptual Report Design of a new accelerator in at LNF-Frascati we are studying the possibility to have a laser-based neutron source, not only by TNSA but also from selfinjection schemes.

Primary authors : CIANCHI, Alessandro (ROMA2)

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Presenter : CIANCHI, Alessandro (ROMA2)

Session classification : WG4_Parallel

Track classification : WG4 - Applications of Compact and High-Gradient Accelerators

Type : talk

Contribution ID : 280

Emittance preservation of a electron bunch in a loaded quasi-linear plasma wakefield

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

We investigate beam loading and emittance preservation for a high-charge electron beam being accelerated in quasi-linear plasma wakefield driven by a short proton beam. The structure of the wakefield is similar to that of a long, modulated proton beam. By selecting transverse and longitudinal electron beam parameters in order to appropriately load the wake, we show that the bulk of the electron beam can be accelerated without significant emittance growth.

Primary authors : BERGLYD OLSEN, Veronika K. (UiO Department of Physics) ; Prof. MUGGLI, Patric (Max-Planck-Institut für Physik) ; ADLI, Erik (CERN)

Co-authors :

Presenter : BERGLYD OLSEN, Veronika K. (UiO Department of Physics)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 281

Towards a proposal for an Advanced Linear Collider

Monday 25 Sep 2017 at 12:00 (00h30')

Content :

This report is presented on behalf of the workshop organising committee chaired by B. Cros and P. Muggli; workshop presentations are available at https://indico.cern.ch/event/569406/.

Advanced and novel accelerators have achieved electron energy gains in the multi-GeV range, relevant for high energy physics applications. Several remaining challenges have been identified and need to be tackled in order to deliver the design of an advanced linear collider by 2035. This goal requires larger projects and broader coordination than has been carried out to date.

A preliminary scientific roadmap towards the design of an advanced linear collider is proposed as the outcome of the ANAR2017 workshop, organised at CERN in April 2017, on the initiative of the Advanced and Novel Accelerator panel of the International Committee for Future Accelerators (http://www.lpgp.u-psud.fr/icfaana/front-page). A study group aimed at realising an advanced linear collider will be created to coordinate the international preparation of a technical design report. In the short term, the first objective of this study group will be to provide input towards the update of the European strategy for particle physics.

Primary authors : Dr. CROS, Brigitte (LPGP-CNRS-UP11)

Co-authors : Prof. MUGGLI, Patric (Max-Planck-Institut für Physik)

Presenter : Dr. CROS, Brigitte (LPGP-CNRS-UP11)

Session classification : Plenary 2

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 282

The CLEAR User Facility at CERN

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

The conversion of the CALIFES beam line of CTF3 into the "CERN Linear Electron Accelerator for Research" (CLEAR) facility was approved in December 2016.
The primary focus for CLEAR is general accelerator R and component studies for existing and possible future accelerator applications. This includes studies for high gradient acceleration methods, e.g. for CLIC and plasma technology, and prototyping and validation of accelerator components, e.g. for the HL-LHC upgrade. The facility also provides irradiation test capabilities for characterisation of electronic components and for medical applications.
A description of the facility with details on the achievable beam parameters and the scientific program for this year,together with the present status, will be presented.

Primary authors : GAMBA, Davide (CERN; John Adams Institute (JAI))

Co-authors :

Presenter : GAMBA, Davide (CERN; John Adams Institute (JAI))

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : poster

Contribution ID : 283

Acceleration of a positron beam in a hollow channel plasma

Wednesday 27 Sep 2017 at 19:30 (01h00')

Content :

Hollow plasma channels have been proposed as a technique for generating accelerating fields without deleterious transverse forces. In this experiment, we generate meter-scale hollow plasma channels using high-order Bessel profile lasers to ionize a Lithium vapor source. The experiment took place at FACET at SLAC National Accelerator Laboratory. FACET was the only facility in the world capable of providing positron beams for PWFA experiments. Using a higher-charge positron beam to excite a wake in the hollow plasma channel, we are able to demonstrate the acceleration of a lower-charge trailing beam traveling in the hollow channel wake.

Primary authors : GESSNER, Spencer (CERN)

Co-authors : Dr. ADLI, Erik (University of Oslo, Norway) ; JOSHI, C. (UCLA) ; Mr. LINDSTRØM, Carl Andreas (University of Oslo) ; LITOS, M. (University of Colorado and SLAC) ; MARSH, K. A. (UCLA) ; MORI, W. B. (UCLA) ; Dr. O'SHEA, Brendan (SLAC National Accelerator Laboratory) ; VAFAEI-NAJAFABADI, N. (Stony Brook University and SLAC) ; Dr. YAKIMENKO, Vitaly (SLAC) ; ALLEN, J. M. (SLAC) ; Dr. AN, Weiming (University of California Los Angeles) ; CLARKE, C. I. (SLAC) ; CLAYTON, C. E. (UCLA) ; Prof. CORDE, Sébastien (Ecole Polytechnique) ; Mr. DOCHE, Antoine (Laboratoire d'Optique Appliquée, Ecole Polytechnique-Ensta, France) ; GREEN, S. Z. (SLAC) ; HOGAN, Mark (SLAC National Accelerator Laboratory)

Presenter : GESSNER, Spencer (CERN)

Session classification : Wine and Poster Session 2 (WG4-WG5-WG6-WG7)

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : poster

Contribution ID : 284

Beam-based measurements of the plasma decay constant

Monday 25 Sep 2017 at 18:20 (00h20')

Content :

The evolution of plasmas on timescales much longer than the beam-plasma interaction time is of interest for potential high repetition rate applications. In the AWAKE experiment, a terawatt-class laser is used to ionize a ten meter-long Rb vapor during or before the transit of a 400 GeV proton beam. The proton beam is modulated by the plasma through a process called the Self-Modulation Instability (SMI). The modulation occurs at the plasma frequency, which is proportional to the square root of the plasma density. In this experiment, we scan the laser timing from zero (coincident with the beam) to tens of microseconds ahead of the beam. At each point, we measure the modulation frequency on the proton beam and deduce the plasma density, and from this information we are able to extract a decay constant from the plasma.

Primary authors : GESSNER, Spencer (CERN)

Co-authors :

Presenter : GESSNER, Spencer (CERN)

Session classification : WG5_Parallel

Track classification : WG5 - High-Gradient Plasma Structures/Advanced Beam Diagnostics

Type : talk

Contribution ID : 285

Review of laser-plasma acceleration scaling in quasi-linear and blowout regimes

Wednesday 27 Sep 2017 at 08:30 (00h40')

Content :

The majority of research on laser-plasma acceleration of electrons can be broadly categorized as belonging to either the quasi-linear regime, or the nonlinear blowout regime. The quasi-linear regime is characterized by nearly linear wakes, pre-formed channel guiding, and some auxiliary process to inject an initial population of electrons into the wake. The blowout regime is characterized by self-guiding, and usually self-injection. Most experimental success has been in the blowout regime, perhaps because of the relative simplicity of configuration. The scaling of accelerated beam parameters with laser and plasma parameters has been explored in the literature for both regimes. We will review these scalings in the context of both single and multi-stage accelerator concepts, considering issues of size, power consumption, energy, beam quality, and suitability for applications. Comparison of analytical, numerical, and experimental results will be discussed where possible.

Primary authors : GORDON, Daniel (Naval Research Laboratory, Plasma Physics Division, Washington D.C., USA)

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Presenter : GORDON, Daniel (Naval Research Laboratory, Plasma Physics Division, Washington D.C., USA)

Session classification : Plenary 5

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 287

MeV electron beams at 1 kHz

Thursday 28 Sep 2017 at 09:00 (00h30')

Content :

We show that using high density gas jet targets approaching critical density makes possible electron acceleration to relativistic energies with low laser pulse energies, enabling high repetition rate operation. The near-critical density is approached in two ways. For 30 fs, lambda= 800nm, <10 mJ pulses from a 1 kHz Ti:Sapphire laser, we used cryo-cooled, continuous flow high density H_2 and He jets, with $N_e/N_{cr} < 0.69$. And in the first laser wakefield experiments using ultrashort mid-infrared laser pulses (100fs, lambda= 3.9um, <20 mJ pulses from a mid-IR OPCPA system), the non-cryo-cooled target density reaches $N_e/N_{cr} < 2.2$. In both experiments, the high electron density enables onset of relativistic self-focusing and few MeV electron acceleration at millijoule-scale laser energies. In the case of the mid-IR laser driver, we image the onset and scaling of relativistic self-focusing from single filament collapse through the multifilamentation regime.

Primary authors : Prof. MILCHBERG, Howard (University of Maryland)

Co-authors :

Presenter : Prof. MILCHBERG, Howard (University of Maryland)

Session classification : Plenary 7

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 288

Multi-MeV, stable electron bunch using supersonic air jet target

Monday 25 Sep 2017 at 19:30 (01h00')

Content :

Relativistic interaction of short-pulse, high intensity lasers with underdense plasmas results in acceleration of electrons in relativistic regime. These relativistic electron beams have the ability to serve as a source of spatially coherent collimated, point-like and femtosecond X-ray radiation. Generation of a quasi-monoenergetic bunch of electrons is important for generation of stable betatron radiation and X-ray pulses from inverse Compton scattering.
The purpose this work was to optimize conditions necessary for building this type of electron and X-ray source in a small laboratory equipped with a common femtosecond few-terawatt laser. Various gas jet targets, such as helium, a mixture of helium and argon, helium with an admixture of synthetic air, and dry air were tested for this purpose using different backing pressures and the obtained results are compared. Additionally, a razor blade was used to create steep density gradient of the neutral gas in order to achieve shock injection and thus to increase the number of trapped electrons. Simulations and experimental results are presented.

Primary authors : Dr. CHAULAGAIN, Uddhab (ELI beamlines)

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Presenter : Dr. CHAULAGAIN, Uddhab (ELI beamlines)

Session classification : Wine and Poster Session 1(WG1-WG2-WG3-WG8)

Track classification : WG1 - Electron Beams from Plasmas

Type : poster

Contribution ID : 289

Recent results on compact FEL based on laser plasma accelerators

Tuesday 26 Sep 2017 at 12:00 (00h30')

Content :

The laser invention more than fifty years ago was a major scientific revolution. Among the different possible gain medium, the Free Electron Lasers (FEL) uses free electrons in an undulator field, covering wavelengths from far infrared to X-ray. Nowadays, the advent of tuneable intense (mJ level) short pulse FELs with record peak power (GW level) in the X-ray domain sets a major step in laser development, and these reliable light sources enable to study unexplored scientific areas, such as deciphering molecular reactions in real time, understanding functions of proteins. Besides, lasers have also been considered for driving plasma electron acceleration. A high-power femtosecond laser focused into a gas target resonantly drives a nonlinear plasma wave in which plasma electrons are trapped and accelerated. Nowadays, laser wakefield acceleration (LWFA) produces electron beams up to multi-GeV energies, hundreds pC charge, percent energy spread and milliradian divergence. It is relevant to consider a FEL application to quality these laser plasma produced electrons. The large energy spread and divergence of these beams should be mitigated, for handling chromatic effects. The different beam manipulation strategies are discussed. First results on the decompression chicane scheme, in particular from COXINEL experiment, are presented.

Primary authors : Dr. COUPRIE, Marie-Emmanuelle (Synchrotron SOLEIL)

Co-authors :

Presenter : Dr. COUPRIE, Marie-Emmanuelle (Synchrotron SOLEIL)

Session classification : Plenary 4

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 290

Mitigation of the hose instability in plasma-wakefield accelerators

Wednesday 27 Sep 2017 at 12:00 (00h30')

Content :

The hose instability is a long standing challenge for plasma-wakefield accelerators (PWFAs). It is seeded by initial transverse asymmetries of the beam or plasma spatial or momentum distributions.
According to current models, the beam centroid displacement is amplified exponentially during the beam propagation in the plasma, resulting in an unstable acceleration process or in beam-breakup. However, particle-in-cell (PIC) simulations indicate that these models overestimate the hosing growth rates as soon as the drive-beam energy change becomes significant. This intriguing result suggests that the blowout regime in PWFA can provide saturation mechanisms for the hose instability, which strongly damp the beam centroid oscillations during propagation.
In this contribution, we present a model which describes the saturation mechanisms in excellent agreement with PIC simulations, thereby demonstrating for the first time the possibility of stable beam acceleration in PWFAs over long distances [T. Mehrling et al., PRL 118 174801 (2017)]

Primary authors : Dr. MEHRLING, Timon (Deutsches Elektronen-Synchrotron DESY) ; Dr. VIEIRA, Jorge (Instituto Superior Tecnico)

Co-authors : Dr. MARTINEZ DE LA OSSA, Alberto (DESY) ; Prof. FONSECA, Ricardo (ISCTE - IUL) ; Dr. OSTERHOFF, Jens (Deutsches Elektronen-Synchrotron DESY)

Presenter : Dr. MEHRLING, Timon (Deutsches Elektronen-Synchrotron DESY)

Session classification : Plenary 6

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 291

Graphene and Quantum Dot Photocathodes: Lifetime and Performance Benefits

Monday 25 Sep 2017 at 11:30 (00h30')

Content :

Since their inception, photocathode materials have been generally fallen into one of three categories: a bulk metal (such as copper or magnesium); a bulk semiconductor, perhaps with a surface treatment (such as cesiated gallium arsenide); or a thin-film semiconductor (for example cesium telluride deposited upon a molybdenum substrate). In recent years, apart from process improvements, there has been a significant effort to both improve the performance of existing photocathodes, and to develop and study new photocathode materials. The ACERT effort at Los Alamos has pursued both of these paths. This talk will review our efforts both to develop graphene coatings for cathodes for lifetime improvement; and to develop quantum dot photocathodes, which appear to combine air stability with improved QE over copper. We present our findings to date, and intended path towards future studies.

Primary authors : ISTVAN, Robel (Los Alamos National Laboratory) ; LEWELLEN, John W. (Los Alamos National Laboratory) ; MOHITE, Aditya (Los Alamos National Laboratory) ; PAVLENKO, Vitaly (Los Alamos National Laboratory) ; MOODY, Nathan A. (Los Alamos National Laboratory) ; MAKAROV, Nikolay S. (Los Alamos National Laboratory) ; LIM, Jaehoon (Los Alamos National Laboratory) ; PIETRYGA, Jeffrey M. (Los Alamos National Laboratory) ; HOFFBAUER, Mark A. (Los Alamos National Laboratory) ; BATISTA, Enrique R. (Los Alamos National Laboratory) ; YAMAGUCHI, Hisato (Los Alamos National Laboratory) ; LIU, Fangze (Los Alamos National Laboratory) ; GUPTA, Gautam (Los Alamos National Laboratory)

Co-authors :

Presenter : ISTVAN, Robel (Los Alamos National Laboratory)

Session classification : Plenary 2

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 292

Warp-X: a new exascale computing platform for Beam-Plasma Simulations

Tuesday 26 Sep 2017 at 18:50 (00h15')

Content :

Turning the current experimental plasma accelerator state-of-the-art from a promising technology into mainstream scientific tools depends critically on high-performance, high-fidelity modeling of complex processes that develop over a wide range of space and time scales. As part of the U.S. Department of Energy's Exascale Computing Project, a team from Lawrence Berkeley National Laboratory, in collaboration with teams from SLAC National Accelerator Laboratory and Lawrence Livermore National Laboratory, is developing a new powerful plasma accelerator simulation tool. The new software will harness the power of future exascale supercomputers for the exploration of outstanding questions in the physics of acceleration and transport of particle beams in chains of plasma channels. This will benefit the ultimate goal of compact and affordable high-energy physics colliders, and many spinoff applications of plasma accelerators along the way. We will present the various components of the codes such as the new Particle-In-Cell Scalable Application Resource (PICSAR) and the redesigned adaptive mesh refinement library AMReX, which are combined with redesigned elements of the Warp codes, in the new WarpX software. The status, examples of applications and future developments will be discussed.

Primary authors : VAY, Jean-Luc (Berkeley Lab)

Co-authors :

Presenter : VAY, Jean-Luc (Berkeley Lab)

Session classification : WG8_Parallel

Track classification : WG8 - Advanced and novel accelerators for High Energy Physics

Type : talk

Contribution ID : 293

Status of ImPACT Program in Japan aiming for repeatable GeV-class LWFA

Thursday 28 Sep 2017 at 10:00 (00h30')

Content :

The ImPACT program in JAPAN is funding an effort on laser wakefield acceleration (LWFA) with the goal of very stable/repeatable beams that should be used for constructing a plasma-based FEL. Important results on stability, controllability, repeatability of electron beams and staging LWFA have been shown in the experiments at Osaka university and QST. These results will be presented and discussed. A future experimental site at SPRING-8/RIKEN is being prepared. The plans towards a test area on a plasma FEL at SPRING-8 will be presented.

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Session classification : Plenary 7

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 294

The Accelerator-on-a-Chip International Program

Monday 25 Sep 2017 at 10:00 (00h30')

Content :

The Accelerator-on-a-Chip International Program (ACHIP) has been initiated in 2015 to advance research on laser-based acceleration in dielectric microstructures. These microstructures can be built using the technologies of the semiconductor industries and integrated on the surface of a chip. Scientists from seven universities, three national laboratories, and industrial partners are working together to develop all necessary components for such a compact accelerator.
At the same time, we are working on the integration of these components into an accelerator-on-a-chip. This will include an electron source that emits suitable electron bunches into the dielectric structure, as well as the power source, coupling structures, and control of the electromagnetic fields. The experiments are supported by start-to-end simulations of the processes.
We summarize here the results of the first two years of the ACHIP collaboration. The experimental infrastructure has been set up in several laboratories, and first experiments have been performed at different beam energies. Numerical modeling is used to optimize the structures for coupling and acceleration.

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Co-authors :

Presenter : ISCHEBECK, Rasmus (Paul Scherrer Institut (PSI) - The ACHIP collaboration)

Session classification : Plenary 1

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 295

Feedback control of the spatio-temporal properties of high-intensity laser pulses to optimize x-ray and 100 MeV electron generation

Monday 25 Sep 2017 at 16:00 (00h30')

Content :

We describe how active feedback routines can be applied at limited repetition rate (5 Hz) to optimise high power laser interactions with clustered gases. X-ray generation and 100 MeV electron beams were produced and optimized using genetic algorithms approximately doubling the x-ray flux and increasing electron beam charge by a factor of 3. The complicated interaction dynamics of the cluster ionization and absorption processes and laser dispersion in plasma, all controlled through the feedback loop, lead to the evolution of the laser pulse into a slowly rising intensity profile or multiple pulses, which we believe optimises the few-picosecond expansion and subsequent laser energy coupling into the cluster medium and tailors the plasma wake acceleration process. Our work suggests that this technique can be more widely utilised for control of intense pulsed secondary radiation from petawatt-class laser systems. This demonstration represents an important step towards the improvement of these sources for their use in scientific and societal applications

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Presenter : SYMES, Dan (Central Laser Facility, STFC Rutherford Appleton Laboratory, Didcot, UK)

Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 296

High Gradient X-band RF accelerating structures

Friday 29 Sep 2017 at 09:00 (00h40')

Content :
An introduction and a short review of the state-of-the-art of high gradient X-band linac research and development in the frame work of linear collider study and beyond will be given. Possible applications of the high gradient linacs in the field of X-ray FELs, medical linacs, drive beam linacs and others will be discussed.

Primary authors : GRUDIEV, Alexej (CERN)

Co-authors :

Presenter : GRUDIEV, Alexej (CERN)

Session classification : Plenary 9

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 297

The potential socio-economic impact of a breakthrough in the technology of particle accelerators

Friday 29 Sep 2017 at 09:40 (00h40')

Content :

More than 30,000 particle accelerators are in use in the world. The market for medical and industrial accelerators represents the largest one (80% for radiotherapy and ion implementation, 9% for other industrial applications) and is growing more than 10% annually. The yearly market value of sales for industry only is estimated 2.2 billion (around 1100 systems). How a social cost-benefit analysis of the transition to new technologies should be designed? The main potential net socio-economic benefit is the difference between the cost trajectory of the current and future technologies. Other benefits may include incremental effects on human capital, technological spillovers, product and service innovations, cultural effects, as described in Florio and Sirtori (2016, in Technological Forecasting and Social Change). These concepts are captured quantitatively by the expected net present value (NPV) of such difference, over a suitable long-term intertemporal integration, given a social discount rate. Given the high uncertainty surrounding both the demand drivers, the cost savings, the additional benefits, several variables in a forecasting model should be treated as stochastic and the final result expressed as a conditional probability distribution of the NPV after a suitable Delphi assessment and Montecarlo.

Primary authors : Prof. FLORIO, Massimo (Università degli studi di Milano)

Co-authors :

Presenter : Prof. FLORIO, Massimo (Università degli studi di Milano)

Session classification : Plenary 9

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 298

Future Colliders for Particle Physics - Big and Small

Monday 25 Sep 2017 at 08:40 (00h40')

Content :

I will present a perspective of energy-frontier colliders in the 21st century. After a brief historical review, several proposed next-, next-next- and next-next-next-generation circular and linear e+e-, hadron and muon colliders and their underlying technologies are introduced. Looking beyond, possible routes for dramatic future performance improvements or transformational mitigation, novel technologies, additional breakthrough applications, and ultimate limitations are discussed. Finally, I will confront the audience with a couple of challenges.

Primary authors : ZIMMERMANN, FRANK (CERN)

Co-authors :

Presenter : ZIMMERMANN, FRANK (CERN)

Session classification : Plenary 1

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 299

Overview of laser-driven positron sources

Friday 29 Sep 2017 at 11:30 (00h30')

Content :

The generation of high-quality relativistic positron beams is a central area of research in experimental physics due to their potential relevance in a wide range of scientific and engineering areas, ranging from fundamental science to practical applications. There is now growing interest in developing hybrid machines that will combine plasma-based acceleration techniques with more conventional radio frequency accelerators, in order to minimise the size and cost of these machines.
Moreover, the physics of electron-positron plasmas is attracting renewed interest, due to the presence of this exotic state of matter in a wide range of extreme astrophysical scenarios.
Here we report on recent results obtained by our group in the generation of high-quality positron beams and neutral electron-positron beams [1-5]. After comparing our experimental results with alternative methods proposed in the literature, we will discuss the main physical principles at play and finally propose future experimental directions in this area.

Primary authors : Dr. SARRI, Gianluca (Queen's University Belfast)

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Presenter : Dr. SARRI, Gianluca (Queen's University Belfast)

Session classification : Plenary 10

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 301

Advances @ ELI Beamlines: Status of user facility development

Friday 29 Sep 2017 at 10:20 (00h40')

Content :

An overview on the development of the "ELI-Beamline facility" being built within the Extreme Light Infrastructure (ELI) project based on the European Strategy Forum on Research Infrastructures process.
ELI-Beamlines will be a high-energy, repetition-rate laser pillar of the ELI (Extreme Light Infrastructure) project. The main objective of the ELI-Beamlines Project is the delivery of ultra-intense high-energy pulses for high field experiments and the generation and applications of high-brightness X-ray sources and accelerated particles. The different laser systems will be delivering pulses with length ranging between 10 fs and 150 fs and will provide high-energy Petawatt and 10-PW peak powers. Two lasers will be available: 1. A 10 Hz, 1 PW (30fs) laser using as the active medium Ti:sapphire with a new gas cooled diode pumped Nd doped Glass pump laser and 2. A mixed Nd doped glass laser with 1.5 kJ in 150fs and an enhanced repetition rate. The lasers will be able to provide focused intensities attaining >1022-23 Wcm-2, while this value will might be increased in a later phase without the need to upgrade the building infrastructure using nonlinear compression schemes and relativistic plasma mirror investigation to go to the ultra-relativistic interaction regime above 1024 Wcm-2 and higher.

Primary authors : Dr. KORN, Georg (x)

Co-authors :

Presenter : Dr. KORN, Georg (x)

Session classification : Plenary 9

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 305

High efficiency, diode pumped Petawatt lasers for the next generation particle accelerators and secondary sources

Monday 25 Sep 2017 at 09:20 (00h40')

Content :

Large laser systems that deliver optical pulses with peak powers exceeding one Petawatt have been constructed at dozens of research facilities worldwide and have fostered research in High-Energy-Density Science, High-Field and nonlinear physics. The high intensities exceeding 1018W/cm2 allow for efficiently driving secondary sources, specifically laser plasma accelerators. The feasibility of numerous applications with transformational character has been demonstrated, while the applicability relies on the laser driver repetition rate and the associated secondary source brightness and luminosity. Extending from the recently demonstrated High repetition rate Advanced Petawatt Laser System (HAPLS) that can deliver Petawatt pulses with luminosity MJ/hour, LLNL has developed several scalable, diode-pumped solid-state laser concepts for single aperture, ultrahigh average power lasers that will enable future applications of secondary sources and laser-matter interaction for the scientific, industrial, and government communities. These new high average power systems are designed to produce up to 300kW average power and petawatt-class peak powers, and emphasize efficiency through direct diode pumping of the amplifier medium.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

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Presenter : Dr. HAEFNER, Constantin (Lawrence Livermore National Lab)

Session classification : Plenary 1

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 307

Laser technology for k-BELLA and beyond

Monday 25 Sep 2017 at 18:00 (00h30')

Primary authors : Dr. LEEMANS, Wim (Lawrence Berkeley National Laboratory)

Co-authors :

Presenter : Dr. LEEMANS, Wim (Lawrence Berkeley National Laboratory)

Session classification : WG7_Parallel

Track classification : WG7 - High Brightness Power Sources: from Laser Technology to Beam Drivers

Type : talk

Contribution ID : 308

A European Plasma Accelerator Project

Thursday 28 Sep 2017 at 11:00 (00h25')

Content :

The Horizon 2020 Project EuPRAXIA (“European Plasma Research Accelerator with eXcellence In Applications”) will produce a design report for a highly compact and cost-effective European facility with multi-GeV electron beams using plasma as the acceleration medium. The accelerator facility will be based on a laser and/or a beam driven plasma acceleration approach and will have user areas for FEL user experiments, high-energy physics detector tests, and other applications such as compact X-ray sources for medical imaging or material processing. EuPRAXIA started in November 2015 and will deliver the design report in October 2019

Primary authors : Dr. ASSMANN, Ralph (DESY)

Co-authors :

Presenter : Dr. ASSMANN, Ralph (DESY)

Session classification : Plenary 8

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 309

Eupraxia Laser design optimization and industry

Thursday 28 Sep 2017 at 11:25 (00h25')

Content :

The EuPRAXIA infrastructure design study is paving the way to the development of a compact European plasma-based accelerator comprising novel acceleration schemes to drive radiation sources and large-scale user areas for applications. The laser-driven plasma acceleration schemes foreseen in the project rely on a high average power, PW peak power laser system with unprecedented temporal and spatial quality and stability and perspective industrial strength. These very challenging needs are being examined in view of the current dramatic developments of high average power systems and optical components to guide the architecture and technology down-selection.
A summary of the laser specifications in view of the expected staged accelerator performances and foreseen applications will be given followed by a description of the basic laser design and main subsystems compatible with the project physics requirements, notably concerning pulse minimum duration and bandwidth. A special attention will be given to the description of applicable diode-pumping schemes and available prototypes, and their potential industrial developments. A discussion will follow on the main challenges identified for future project-driven dedicated developments and testing.

Primary authors : GIZZI, Leonida Antonio (PI)

Co-authors :

Presenter : GIZZI, Leonida Antonio (PI)

Session classification : Plenary 8

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 311

Simulations and Performance

Thursday 28 Sep 2017 at 11:50 (00h25')

Content :

Numerical simulations are critical in the development and design of plasma-based acceleration concepts. Particle-in-cell (PIC) approach with its recent advanced algorithms is a widely used tool for the investigation of both laser- and beam-driven plasma acceleration. However, the actual performance depends on the critial parameters of the plasma acceleration process together with their error range, for which a deviation from the design value could result in a significant impact on the beam quality. The most recent results of simulations performed in the framework of the EuPRAXIA project, including laser-driven and beam-driven plasma acceleration, internal and external injection, will be in particular presented.

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Session classification : Plenary 8

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 312

Progress on Petawatt level experiments at BELLA Center for electron and ion acceleration

Thursday 28 Sep 2017 at 12:15 (00h25')

Content :

In 2014, electron beams up to 4.3 GeV were obtained from 9 cm long capillary discharge based plasma waveguides, using 310 TW of peak power [1]. Higher beam energies were not obtained despite having more peak power available. To guide all the laser power required higher plasma density than optimal for higher beam energy. Results at full PW power will be shown from a new concept [2] on the BELLA beamline to deepen the channels (i.e., lower the on-axis density). Active plasma lenses [3] were tested on BELLA and successfully focused 1.4 GeV beams with a 6 cm long lens. This is a precursor for staging [4] at BELLA and an ionization based charge density monitor [5]. In a first ion acceleration campaign high charge, low divergence multi-MeV proton beams have been obtained. The 3 D temporal and spatial structure of the laser pulses has been measured at PW peak power level using both the INSIGHT and TERMITES techniques. The work was supported by the Office of Science, US DOE under Contract DE-AC02-05CH11231 and the NSF. [1] W. P. Leemans et al., Phys. Rev. Lett. 113, 245002 (2014). [2] N.A. Bobrova et al., Phys. Plasmas 20, 020703 (2013). [3] J. van Tilborg et al. Physical Review Letters 115, 184802 (2015). [4] S. Steinke et al., Nature 530, 190-193 (2016). [5] R. Tarkeshian et al., to be submitted.

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Session classification : Plenary 8

Track classification : Invited Plenary Talk

Type : talk

Contribution ID : 313

Recent results at SPARC_LAB

Monday 25 Sep 2017 at 17:12 (00h18')

Content :

Several recent results from the SPARC_LAB test-facility are presented in view of plasma-based experiments. We report about the current status of the plasma wakefield acceleration experiment and first results obtained with the active plasma lens. Regarding the laser-driven scenario, we discuss about some achievements related to the reduction of the relative timing-jitter between the laser pulse and electron beam, pushing it down to 19 fs.

Primary authors : Dr. POMPILI, Riccardo (LNF)

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Presenter : Dr. POMPILI, Riccardo (LNF)

Session classification : WG1_Parallel

Track classification : WG1 - Electron Beams from Plasmas

Type : talk