HEDS

Monday, 19 April

[HEDS-Opening] 9:00-9:10
Opening Remarks
Chair: Ryosuke Kodama
Osaka University

[HEDS-1] 9:10-10:25
Acceleration/Diagnostics I
Chair: Yasuhiro Kuramitsu
Osaka University

HEDS-1-01 9:10 *Invited*

Controlled injection of relativistic protons in wake-field by using dual-laser pulses

Shogo Isayama[1], Shih Hung Chen[2], Han Wei Chen[2], Yao Li Liu[2], Yasuhiro Kuramitsu[3], Yuji Fukuda[4]
[1]Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, [2]Department of Physics, National Central University, [3]Graduate School of Engineering, Osaka University, [4]KPSI, QST

We propose an efficient hybrid acceleration scheme to generate relativistic protons using dual pulses and solid density and near critical density foils in tandem. The acceleration mechanism is the two stage acceleration process of radiation pressure acceleration and laser wakefield acceleration where the injection of relativistic ions into the wakefield is controlled by the parameters of the dual pulses.

HEDS-1-02 9:35 *Invited*

Wakefield Excitation and Associated Particle Acceleration in Relativistic Collisionless Shocks

Masanori Iwamoto[1], Takanobu Amano[2], Yosuke Matsumoto[3], Shuichi Matsukiyo[1], Masahiro Hoshino[2]
[1]Kyushu University, [2]University of Tokyo, [3]Chiba University

Relativistic collisionless shocks are ubiquitous in the universe, in which synchrotron maser instability produces intense electromagnetic waves and then induces wakefield in the upstream. Our 2D PIC simulation indeed confirms the wakefield excitation and demonstrates the particle acceleration in the upstream. In this talk, we discuss the mechanism of this particle acceleration in details.

HEDS-1-03 10:00 *Invited*

High energy density plasmas produced by the interaction between high intensity laser and structured medium ~A new platform studying magnetic confined plasmas using laser~

Yasuaki Kishimoto, Kenji Imadera, Ryutaro Matsui
Kyoto University

We studied high energy density plasmas by the interaction between high intensity laser and structure medium with sub-micron meter and found a new confinement state exceeding inertia time dominated by coherent magnetic structure.

[HEDS-2] 10:45-11:50
Acceleration/Diagnostics II
Chair: Yasuhiro Kuramitsu
Osaka University

HEDS-2-01 10:45 *Invited*

Investigating kinetic-scale current filamentation dynamics and associated magnetic fields in interpenetrating plasmas

George Swadling[1], Colin Bruulsema[2], Frederico Fiuza[3], Drew Higginson[1], Channing Huntington[1], Hye-Sook Park[1], Brad Pollock[1], Wojciech Rozmus[2], Hans Rinderknecht[4], Joe Katz[4], Andrew Birkel[5], James Ross[1]
[1]LLNL, [2]University of Alberta, [3]SLAC National Accelerator, [4]Laboratory for Laser Energetics, [5]Plasma Science and Fusion Center, MIT

Ion-stream filamentation and magnetic field generation was observed in interpenetrating plasmas, driven by the ion-Weibel instability. The interactions of counter propagating, collisionless plasma flows were probed using Thomson scattering, revealing anticorrelated modulations in the density of the two streams at the ion skin depth scale, and a correlated modulation in the plasma current consistent with a magnetic field amplitude ~ 30±6 T, ~ 1% of the flow KE.

HEDS-2-02 11:10 *Invited*

Applications of Solid State Nuclear Track Detectors for Measurements of Laser-Accelerated Ions

Masato Kanasaki
Kobe University

The characteristics and the methods of using solid state nuclear track detectors as an ion detector are introduced with the results from the recent studies measuring laser-accelerated ions.

HEDS-2-03 11:35

X-ray spectroscopy of relativistic plasma with controlled preplasma formation at J-KAREN-P experiments

Tatiana Pikuz[1,2], Maria A Alkhimova[2], Sergey N Ryazantsev[2], Igor Yu Skobelev[2,3], Sergey Pikuz[2,3], Artem S Martynenko[2], Maxim V Sedov[2], Alexey N Shatokhin[4,5], Eugene A Vishnyakov[4], Akito Sagisaka[6], Koichi Ogura[6], Bruno Gonzalez Izquierdo[6], Kotaro Kondo[6], Yasuhiro Miyasaka[6], Akira Kon[6], Masahiko Ishino[6], Masaharu Nishikino[6], Timur Zh Esirkepov[6], James K Koga[6], Masaki Kando[6], Hiromitsu Kiriyama[6], Kinimori Kondo[6], Ryosuke Kodama[7,8], Tetsuya Kawachi[6], Yuji Fukuda[6], Alexander S Pirozhkov[6], Youichi Sakawa[7]
[1]OTRI, Osaka University, [2]JIHT, RAS, [3]National Research Nuclear University MEPhI, [4]P.N. Lebedev Physical Institute, RAS, [5]Moscow Institute of Physics and Technology, [6]KPSI, QST, [7]ILE, Osaka University, [8]Graduate School of Engineering, Osaka University,

We will report on the new experiments performed at PW-class J-KAREN-P laser with the tailored plasma density profile created by specially incorporated prepulse both from the front and rear side of the solid target. The detailed analysis of plasma parameters provided by means of high-resolution x-ray spectroscopic methods, based on emission characteristics of plasma in the spectral range of Ne-like Fe and H-like Cl ionization states will be presented.

[HEDS-3] 13:00-15:00
Diagnostics/Reconnection
Chair: Tatiana Pikuz
Osaka University

HEDS-3-01 13:00 *Invited*

Cosmic Ray Muon Imaging of Khufu's Pyramid with Nuclear Emulsions

Kunihiro Morishima
Nagoya University

We are developing the nuclear emulsion technologies for observation of cosmic rays and its analysis for cosmic ray muon imaging.

HEDS-3-02 13:25 *Invited*

A Scintillator-based detector system to measure GeV class ions

Atsushi Tokiyasu[1], Yasuhiro Kuramitsu[2], Takumi Minami[2], Kou Iwasaki[2], Hideki Kohri[3], Yuki Abe[4], Yuji Fukuda[5], Satoshi Kodaira[6], Takafumi Asai[7], Masato Kanasaki[7]
[1]Research Center for Electron Photon science, Tohoku Univeristy, [2]Graduate School of Engineering, Osaka University, [3]RCNP, Osaka University, [4]ILE, Osaka University, [5]KPSI, QST, [6]NIRS, QST, [7]Graduate School of Maritime Sciences, Kobe University

It is essential to measure the energy of the accelerated ions in a real time manner to reveal the mechanism of laser ion acceleration. For this purpose, we proposed a detector system composed of scintillators and PMTs. In this talk, the detection principle and design concepts are reviewed. Test experimental results using HIMAC facility is reported. Future prospect to use the system for laser ion acceleration experiments with J-KAREN laser facility is also discussed.

HEDS-3-03 13:50

A New Measurement Method for Laser-accelerated Sub-GeV Protons utilizing Multiple Coulomb Scattering in an Emulsion Cloud Chamber

Takafumi Asai[1,2], Masato Kanasaki[1], Satoshi Jinno[3], Nobuko Kitagawa[4], Nobumichi Shutoh[5], Satoshi Kodaira[6], Tomoya Yamauchi[1], Keiji Oda[1], Kunihiro Morishima[4], Yuji Fukuda[2]
[1]Kobe University, [2]QST-KPSI, [3]The University of Tokyo, [4]Nagoya University, [5]Kindai University, [6]QST-NIRS

We have developed a new measurement method for laser-accelerated sub-GeV-class protons utilizing a multiple Coulomb scattering method in an Emulsion Cloud Chamber, which is a stack of nuclear emulsion films and scatterer plates.

HEDS-3-04 14:05 *Invited*

Generation of Megatesla Magnetic Fields by Microtube Implosion

Masakatsu Murakami[1], Javier Honrubia[2], Katheleen Weichman[3], Alex Arefiev[3], Sergei Bulanov[4]
[1]Osaka University, [2]Universidad Politécnica de Madrid, [3]UCSD, [4]ELI-Beamline

We have recently proposed a novel mechanism called a "microtube implosion," and demonstrated the generation of megatesla (MT) order magnetic fields via particle simulations. This is three orders of magnitude higher than what has ever been achieved in a laboratory. Such high magnetic fields are expected only in celestial bodies like neutron stars and black holes.

HEDS-3-05 14:30

Experimental investigation of magnetic reconnection in laser-driven self-generated magnetic field

Taichi Morita[1], Suzuto Matsuo[2], Takuto Kojima[2], Kento Aihara[3], Yasunobu Arikawa[4], Shunsuke Egashira[4], Shogo Isayama[1], Otono Kuramoto[4], Shuichi Matsukiyo[1], Yushiro Matsumoto[4], Kentaro Sakai[5], Kei Sugiyama[3], Taichi Takezaki[6], Ryo Yamazaki[3], Youichi Sakawa[4]
[1]Faculty of Engineering Sciences, Kyushu University, [2]Interdisciplinary, Graduate School of Engineering Sciences, Kyushu University, [3]Department of Physics and Mathematics, Aoyama Gakuin University, [4]ILE, Osaka University, [5]Graduate School of Engineering, Osaka University, [6]Faculty of Engineering, University of Toyama

We report the magnetic reconnection experiments with Gekko-XII laser beams. Magnetic reconnection was driven between adjacent two plasma plumes, and some plasma parameters and magnetic field structures around the diffusion region were measured and analysed.

HEDS-3-06 14:45

Tin Droplet CO2-laser Ablation Plasma Dynamics and EUV Emission

Sergey V. Zakharov[2,4], Vassily S. Zakharov[1,2,3], Xinbing Wang[3]
[1]Keldysh Institute of Applied Mathematics RAS, [2]NRC 'Kurchatov Institute', [3]Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, [4]EATS

Laser-produced plasma (LPP) induced during irradiation of a liquid tin droplet by CO2-laser pulse with various pulse durations and energies is considered. The radiative magnetohydrodynamic (RMHD) plasma code Zstar is used to simulate the emission and plasma dynamics.

[HEDS-4] 15:30-17:50
Collisionless Shock/Acceleration
Chair: Yuji Fukuda
QST

HEDS-4-01 15:30 *Invited*

Fast Particle Acceleration Mechanisms in Astroplasma and Laboratory Astrophysics

Masahiro Hoshino[1], Y. Matsumoto[2], M. Iwamoto[3], T. Amano[1]
[1]The University of Tokyo, [2]Chiba University, [3]Kyushu University

In the Universe, cosmic rays with energies up to $10^{15.5}$ eV are widely recognized to be accelerated by supernova shocks, and the more energetic cosmic rays with energies up to 10^{20} eV are believed to be generated by extragalactic relativistic shocks. The plasma mechanisms of those particle acceleration are still major unresolved problem, and we discuss our perspective of the astrophysical shock dynamics based on various plasma instabilities.

Program

HEDS

Monday, 19 April

HEDS-4-02 15:55 *Invited*

Microstructures at near-Sun solar wind perpendicular interplanetary shocks: Predictions for Parker Solar Probe and Solar Orbiter

Zhongwei Yang[1], Shuichi Matsukiyo[2]
[1]State Key Laboratory of Space Weather, National Space Science Center, [2]Faculty of Engineering Sciences, Kyushu University

Based on the plasma parameters estimated from PSP at 10R_s, microinstabilities and waves excited at perpendicular interplanetary shocks in the near-Sun solar wind are investigated by PIC simulations. Key findings: different types of ES waves are observed. The 1st one is ECH waves excited by ECDI, and the 2nd one around the upper hybrid frequency is excited by the accelerated ring-like electrons and the incident core. X mode emission is also observed.

HEDS-4-03 16:20 *Invited*

Kinetic Modeling of Electron Pre-acceleration at Low Mach Number Shocks in Merging Galaxy Clusters

Jacek Niemiec[1], Oleh Kobzar[2], Takanobu Amano[3], Masahiro Hoshino[3], Shuichi Matsukiyo[4], Yosuke Matsumoto[5], Martin Pohl[6,7], Karol Fułat[8]
[1]Institute of Nuclear Physics Polish Academy of Sciences, [2]Astronomical Observatory, Jagiellonian University, [3]University of Tokyo, [4]Kyushu University, [5]Chiba University, [6]Institute of Physics and Astronomy, University of Potsdam, [7]DESY-Zeuthen, [8]Faculty of Physics and Applied Computer Science, AGH University of Science and Technology

We report on recent large-scale 2D PIC studies of electron pre-acceleration in low-Mach-number shocks in high beta plasmas. We investigate the effects of shock front rippling and multi-scale turbulence in the shock transition on electron energization. We show that electron injection to DSA can be provided through the process of stochastic shock-drift acceleration.

HEDS-4-04 16:45 *Invited*

Energy spectra measured by New Horizon Mission around an interplanetary shock near Pluto: PIC simulations versus in situ experimental results

Bertrand Lembege[1], Zhongwei Yang[1,2]
[1]LATMOS-UVSQ-CNRS, [2]National Space Science Center -CAS

While traveling though the interplanetary medium, New Horizon's space mission has succeeded to measure very detailed energy spectra of solar wind and pickup ions (PUIs) in the upstream region of an interplanetary shock in Pluto environment at a distance of 34 A.U.[1]. Recent 1D PIC simulations of a shock have been performed including different solar wind ion (SWIs) and pick up ion (PUIs) populations and are compared with experimental data [2].

HEDS-4-05 17:10 *Invited*

Electron heating and ion acceleration in ultrarelativistic laser-solid interactions

Nicholas P Dover[1,2], Hironao Sakaki[2], Akira Kon[2], Kotaro Kondo[2], Hazel F Lowe[2], Oliver C Ettlinger[1], Mariya A Alkhimova[3], Emma Jane Ditter[1], Anatoly Ya. Faenov[4,3], Masahara Hata[4], George S Hicks[1], Natsumi Iwata[4], Hiromitsu Kiriyama[2], James K Koga[2], Takumi Miyahara[5,2], Tatsuhiko Miyatake[5,2], Tatiana A Pikuz[4,3], Alexander S Pirozhkov[2], Akito Sagisaka[2], Ulrich Schramm[6], Yasuhiko Sentoku[4], Kenichi Shiokawa[5,2], Yukinobu Watanabe[5], Tim Ziegler[6], Karl Zeil[6], Masaki Kando[2], Kiminori Kondo[2], Zulfikar Najmudin[1], Mamiko Nishiuchi[2]
[1]Imperial College London, [2]KPSI, [3]RAS, [4]Osaka University, [5]Kyushu University, [6]HZDR

We investigated the acceleration of energetic electrons and ions generated during ultra-high intensity laser-solid interactions, measuring the beam scaling with laser intensity. This leads to a stable proton source exceeding 30 MeV at 0.1 Hz.

HEDS-4-06 17:35

X-ray spectroscopy evidence of solid-density ultra-relativistic laser plasma in renewable micron-scale cryogenic clusters targets.

Sergey N. Ryazantsev[1,2], T. A. Pikuz[1,3], S. A. Pikuz[1,2], T. Kaji[4], H. Tanabe[4], T. Nakagawa[4], T. Asai[4,5], M. Kanasaki[4], T. Yamauchi[4], S. Jinno[6], T. Taguchi[7], K. Himeno[7], K. Iwasaki[7], K. Sakai[7], T. Minami[8], Y. Abe[8], A. Tokiyasu[9], H. Kohri[10], Y. Kuramitsu[7], Y. Sakawa[8], Y. Miyasaka[5], Ko. Kondo[5], A. Kon[5], A. S. Pirozhkov[5], M. Kando[5], K. Kondo[5], T. Kawachi[5], H. Kiriyama[5], Y. Fukuda[5]
[1]JIHT, RAS, [2]National Research Nuclear University MEPhI, [3]OTRI, Osaka University, [4]Graduate School of Maritime Sciences, [5]KPSI, QST, [6]Nuclear Professional School, The University of Tokyo, [7]Graduate School of Engineering Osaka University, [8]ILE, Osaka University, [9]ELPH, Tohoku University, [10]RCNP, Osaka University

Features of plasma X-ray spectracorresponding to a case of a high-intensity laser pulse interaction with a microns-scale cluster are discussed. The spectra were measured during irradiation of cryogenic (T = 140 K – 220 K) Ar flows by ultra-intensive (I = 10^{22} W/cm^2) femtosecond laser pulses generated by the J-KAREN-P laser.

Tuesday, 20 April

[HEDS-5] 9:00-10:15
Radiation I
Chair: Shuta Tanaka
Aoyama Gakuin University

HEDS-5-01 9:00 *Invited*

The electromagnetic cascade in neutron star and black hole magnetospheres

Shota Kisaka
Hiroshima University

The plasma injection mechanism to a relativistic outflow from neutron stars and black holes is long standing problem. The electromagnetic cascade in the magnetospheres is likely the source of plasma. As a result of pair cascade, the momentum distribution of flows consists of two component, a beam and a quasi-thermal component. We discuss the radiation mechanisms and the plasma processes in the neutron star and black hole magnetospheres based on PIC simulation results.

HEDS-5-02 9:25 *Invited*

Direct cosmic-ray measurements with CALET on the International Space Station

Yosui Akaike
Waseda University

The CALorimetric Electron Telescope (CALET), launched on August 2015, is a high-energy astroparticle physics experiment on the International Space Station to precisely measure the cosmic-ray electrons, gamma-rays and nuclei. The detector features the thickness of 30 radiation lengths and fine imaging capability, providing high energy resolution and particle identification. The detail of the on-orbit performance and the latest results will be presented.

HEDS-5-03 9:50 *Invited*

An Experimental Challenge with Accelerator and Plasma to Astrophysical Fast Radio Bursts

Yoske Sumitomo[1], Tomohiko Asai[1], Shota Kisaka[2], Yasushi Hayakawa[1], Shigeru Inagaki[3], Norita Kawanaka[4], Daichi Kobayashi[1], Haruhisa Koguchi[5], Shiomi Kumagai[1], Takeshi Sakai[1], Norihiro Sei[5], Taichi Seki[1]
[1]Nihon University, [2]Hiroshima University, [3]Kyushu University, [4]Kyoto University, [5]AIST

The Fast Radio Bursts are one of mysterious and highly bright astrophysical events whose mechanism is not yet understood. Now, we are initializing a research project mimicking the Fast Radio Bursts at our accelerator laboratory with our plasma technology. Here we illustrate two ongoing experiments focusing on the non-linear enhancement mechanisms of radiations from relativistic electrons.

[HEDS-6] 10:35-11:35
Radiation II
Chair: Shuta Tanaka
Aoyama Gakuin University

HEDS-6-01 10:35

Formation of a Supercritical Collisionless Shock in a Magnetized Uniform Plasma at Rest

Ryo Yamazaki[1], S. J. Tanaka[1], S. Matsukiyo[3], T. Morita[3], T. Takezaki[8], T. Umeda[5], Y. Ohira[6], K. Tomita[9], Y. Kuramitsu[2], Y, Sakawa[2], N. Ohnishi[4], A. Ishii[7]
[1]Aoyama Gakuin University, [2]Osaka University, [3]Kyushu University, [4]Tohoku University, [5]Nagoya University, [6]The University of Tokyo, [7]Max Planck Institute for Gravitational Physics, [8]University of Toyama, [9]Hokkaido University

We present our recent attempt to excite a collisionless shock propagating into magnetized plasma at rest using kilo-Jule-class high-power lasers. With a help of laser Thomson scattering and plasma self emission measurements, we see a possible signature of the collisionless shock with Alfven Mach number larger of around 15.

HEDS-6-02 10:50

Collective Thomson scattering as a diagnostics for non-equilibrium plasmas

Kentaro Sakai[1], Shogo Isayama[2], Taichi Morita[3], Shuichi Matsukiyo[2], Yasuhiro Kuramitsu[1]
[1]Graduate School of Engineering, Osaka University, [2]Department of Advanced Environmental Science and Engineering, Kyushu University, [3]Department of Advanced Energy Engineering Science, Kyushu University

We investigated collective Thomson scattering (CTS) in analytical and numerical manners to establish the analysis of non-equilibrium plasmas. Since the CTS spectrum in high energy density plasmas showing non-equilibrium distribution function is not well-understood, we theoretically calculate and numerically simulate the CTS spectrum. Our results makes it possible to directly measure two-stream instability via CTS.

HEDS-6-03 11:05

Multiple diagnostics in laser-plasma experiment at ~10^{22} W/cm^2

Alexander Pirozhkov[1], A. Sagisaka[1], K. Ogura[1], T.Zh. Esirkepov[1], B. Gonzalez Izquierdo[1], A.N. Shatokhin[2,3], E.A. Vishnyakov[2], C. Armstrong[4], T.A. Pikuz[5,6], M.A. Alkhimova[6], S.A. Pikuz[6], W. Yan[7], T.M. Jeong[7], S. Singh[8], P. Hadjisolomou[7], O. Finke[7], G. Grittani[7], M. Nevrkla[7], C. Lazzarini[7], A. Velyhan[7], T. Hayakawa[9], Y. Fukuda[1], J.K. Koga[1], M. Ishino[1], Ko. Kondo[1], Y. Miyasaka[1], A. Kon[1], M. Nishikino[1], A.O. Kolesnikov[2,3], et. al.[10,11]
[1]KPSI, QST, [2]LPI RAS, [3]MIPT, [4]CLF RAL, [5]OTRI, Osaka University, [6]JIHT RAS, [7]ELI-Beamlines, [8]IPP ASCR, [9]TARRI, QST, [10]KIAM RAS, [11]Dep. Phys., University of Strathclyde

We present multi-diagnostic results from laser-plasma experiment at ~10^{22} W/cm^2, including optical and high harmonics, soft x-rays, keV x-rays, and sub-MeV x-rays. We discuss methods to find at-focus target position and compare intensity dependences.

HEDS

Tuesday, 20 April

HEDS-6-04 11:20

Experimental Observation of Induced Compton Scattered Radiation with J-KAREN P Laser

Shuta Tanaka[1], Yasuhiro Kuramitsu[2], Yuji Fukuda[3], Ryo Yamazaki[1,2], Youichi Sakawa[2]
[1]Aoyama Gakuin University, [2]Osaka University, [3]KPSI

We report some experimental results of induced Compton scattering in order to observe the characteristic spectral signatures of induced Compton scattered light predicted by our previous study.

[HEDS-7] 15:30-17:55
Collisionless Shock/Radiation
Chair: Shuichi Matsukiyo
Kyushu University

HEDS-7-01 15:30 ***Invited***

MAVEN observations of the Martian bow shock and foreshock

Christian X. Mazelle
IRAP CNRS - The University of Toulouse - CNES

Without global magnetic field the bow shock of Mars has a size comparable to kinetic scales and is observed well inside the neutral exosphere. We discuss recent results by MAVEN on the microphysics of the shock and the electron foreshock.

HEDS-7-02 15:55 ***Invited***

Laboratory evidence for proton energization by collisionless shock surfing

Weipeng Yao[1,2], A. Fazzini[1], S. N. Chen[3], K. Burdonov[1,2], P. Antici[4], J. Béard[5], S. Bolaños[1], A. Ciardi[2], R. Diab[1], E. D. Filippov[6,7], S. Kisyov[3], V. Lelasseux[1], M. Miceli[8], Q. Moreno[9,10], V. Nastasa[3], S. Orlando[8], S. Pikuz[6,11], D. C. Popescu[3], G. Revet[1], X. Ribeyre[9], E. d'Humières[9], J. Fuchs[1]
[1]LULI - CNRS, CEA, UPMC Univ Paris 06 : Sorbonne Université, Ecole Polytechnique, Institut Polytechnique de Paris -, [2]Sorbonne Université, Observatoire de Paris, Université PSL, CNRS, LERMA, [3]ELI-NP, IFIN-HH, [4]INRS-EMT, [5]LNCMI, UPR 3228, CNRS-UGA-UPS-INSA, [6]JIHT, RAS, [7]IAP, RAS, [8]INAF–Osservatorio Astronomico di Palermo, [9]University of Bordeaux, Centre Lasers Intenses et Applications, CNRS, CEA, UMR, [10]ELI-Beamlines, Institute of Physics, Czech Academy of Sciences, [11]NRNU MEPhI

Collisionless shocks are held responsible for the production of non-thermal particles. Coupling high-powerful lasers with high-strength magnetic fields, we have investigated the generation of magnetized collisionless shock and the associated particle energization [1]. We have characterized the plasma density, temperature, as well as the EM fields and particle energization in the experiments and modeled the shock formation with both MHD and PIC simulation.

HEDS-7-03 16:20

Relativistic beam formation and magnetisation driven by the propagation of a gamma-ray beam in a pair plasma

Bertrand Martinez, Thomas Grismayer, Luís Oliveira Silva
GoLP, Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, Universidade de Lisboa

Compton scattering of gamma rays in a pair plasma can drive the formation of a relativistic electron positron beam. This process is scrutinised theoretically and numerically via particle-in-cell simulations. The beam can prompt a beam-plasma instability and convert its kinetic energy into magnetic energy. We argue that this fundamental problem is relevant to study the energy dissipation of gamma-rays at the photosphere radius of a Gamma-Ray Burst.

HEDS-7-04 16:35 ***Invited***

High-field QED experiments with high-power lasers: current status and next steps

Gianluca Sarri Sarri
The Queen's University of Belfast

An overview of the current efforts in high-field QED experiments will be given [1,2], together with an outlook for the next few years [3,4]. [1] K. Poder et al., Phys. Rev. X (2018) [2] J. Cole et al., Phys. Rev. X (2018) [3] E-320 experiment at FACET-II (SLAC) [4] arXiv:1909.00860 (2019)

HEDS-7-05 17:00 ***Invited***

Theoretical studies on a radiating electron in high-intensity laser pulse

Keita Seto
ELI-NP/IFIN-HH

A theoretical model is discussed of polarization-dependent nonlinear Compton scattering with locally constant field approximation. The information of a polarization mode of an emitted photon provides a finer resolution of the collision process. Then we will discuss the conceptual design of its experiment at the ELI-NP laser facility.

HEDS-7-06 17:25

Generation of plasmas in the extreme photoionization-dominated regime using the VULCAN laser

Raj Laxmi Singh[1], Francis Keenan[1], Matthew Charlwood[1], Cormac Hyland[1], David Bailie[1], Steven White[1], Gianluca Sarri[1], Steven Rose[1], EDWARD Hill[2], David Riley[1]
[1]Queen's University Belfast, [2]Imperial College London

We conducted an experiment on VULCAN laser to produce Ar photoionised plasma (photoionisation parameter > 50 ergcms^{-1}). We recorded spatially- and spectrally-resolved data of the photoionised Ar plasma X-ray emission. We will present the results obtained from this experiment.

HEDS-7-07 17:40

Magnetised Transport in a Laser Generated Plasma Driven by Heat Flow

Adam Devlin Dearling[1], Christopher Arran[1], Philip Bradford[1], George Hicks[2], S Al-Atabi[2], Luca Antonelli[1], Ollie Ettlinger[2], Matthew Khan[1], Kevin Glize[3], Margaret Notley[3], Chris Walsh[2], Robert Kingham[2], Zulfikar Najmudin[2], Christopher Ridgers[1], Nigel Woolsey[1]
[1]University of York, [2]Imperial College London, [3]STFC Central Laser Facility

A recent experiment studied hot magnetised plasma on the nanosecond timescale. Transitioning from a fluid to a kinetic-like plasma regime, we are able to assess extended magneto-hydrodynamic (MHD) models. Data suggests that extended MHD models that include the Nernst effect are necessary to describe the plasmas evolution, with kinetic modelling required for more accurate results to be obtained.

Wednesday, 21 April

[HEDS-8] 9:00-10:15
Reconnection/Turbulence
Chair: Taichi Morita
Kyushu University

HEDS-8-01 9:00 ***Invited***

Nonthermal Electron and Ion Acceleration in Laser-Driven Magnetic Reconnection

Samuel Richard Totorica[1,2,3,4], Masahiro Hoshino[5], Tom Abel[6,7,2], Frederico Fiuza[1]
[1]SLAC National Accelerator Laboratory, [2]Kavli Institute for Particle Astrophysics and Cosmology, Stanford University, [3]Department of Astrophysical Sciences, Princeton University, [4]International Research Collaboration Center, National Institute of Natural Sciences, [5]Department of Earth and Planetary Science, University of Tokyo, [6]Department of Physics, Stanford University, [7]SLAC National Accelerator Laboratory

We present kinetic particle-in-cell simulations of laser-driven magnetic reconnection experiments at large system sizes. We analyze the nonthermal acceleration of electrons and ions and discuss the implications for space physics and atrophysics.

HEDS-8-02 9:25 ***Invited***

Particle dynamics in collisionless magnetic reconnection

Seiji Zenitani[1], Tsugunobu Nagai[2], Iku Shinohara[2], Hiroshi Hasegawa[2]
[1]Kobe University, [2]ISAS/JAXA

Magnetic reconnection plays a key role in many plasma systems. In a collisionless plasma, the physics of magnetic reconnection is controlled by complex particle motions inside its magnetic geometry. In this talk, we will overview our recent progress in particle dynamics near the X-line of magnetic reconnection, based on two-dimensional particle-in-cell (PIC) simulations.

HEDS-8-03 9:50 ***Invited***

Forming a long current sheet magnetic reconnection with intense lasers

Jiayong Zhong
Department of Astronomy, Beijing Normal University

We report here a group of long current magnetic reconnection experiments with a millimeter plasma device.

[HEDS-9] 10:35-11:55
Reconnection/Turbulence II
Chair: Taichi Morita
Kyushu University

HEDS-9-01 10:35 ***Invited***

Study of particle energy energization from laser-driven magnetic reconnection experiment

King Fai Farley Law[1], Jinyuan Dun[2], Yuki Abe[2], Alessio Morace[2], Yasunobu Arikawa[2], Mao Takemura[2], Shuwang Guo[2], Tetsuo Ozaki[3], Baojun Zhu[2], Phillipp Korneev[4], Joao Jorge Santos[5], Shinsuke Fujioka[2], Yutaka Ohira[1], Masahiro Hoshino[1]
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In this work, the particle acceleration via magnetic reconnection is studied by laser-produced magnetized plasma. The energization of electrons and ions are investigated in the reconnection experiment and will be reported in details.

Program

HEDS

Wednesday, 21 April

HEDS-9-02 11:00 *Invited*

Exploring the late evolution of a Rayleigh-Taylor unstable system – an experimental insight on turbulence –

Gabriel Rigon[1,2], Bruno Albertazzi[2], Tatiana Pikuz[3,4], Paul Mabey[2], Victorien Bouffetier[5], Norimasa Ozaki[6,7], Tommaso Vinci[2], Emeric Fallize[8], Yuichi Inubushi[9,10], Nobuki Kamimura[6], Kento Katagiri[6], Sergey Makarov[4,11], Mario Manuel[12], Kohei Miyanishi[10], Sergey Pikuz[4,13], Olivier Poujade[8], Keiichi Sueda[10], Tadashi Togashi[10,9], Yuhei Umeda[6], Makina Yabashi[9,10], Toshinori Yabuuchi[9,10], Gianluca Gregori[14], Ryo Kodama[6], Alexis Casner[5], Michel Koenig[2,6]
[1]Graduate School of Science, Nagoya University, [2]LULI, CNRS, CEA, Institut Polytechnique de Paris, [3]OTRI, Osaka University, [4]JIHT RAS, [5]Université de Bordeaux, CNRS, CEA, CELIA, [6]Graduate School of Engineering, Osaka University, [7]ILE, Osaka, [8]CEA-DAM, DIF, [9]Japan Synchrotron Radiation Research Institute, [10]RIKKEN Spring8-Center, [11]Departement of Physics of accelerators and radiation medicine, [12]General Atomics, Inertial Fusion Technologies, [13]National Research Nuclear University MEPhI, [14]Departement of Physics, University of Oxford

In this talk we will present the results of a HED experiment performed on SACLA (Japanese X-FEL). This experiment is tailored to enable the growth of the Rayleigh-Taylor instability, until its turblent phase. Thank to the newly developed LiF based radiography, we manage to characterize this flow down to the micron scale, thus reveling unexpected features of the turbulence spectrum.

HEDS-9-03 11:25

B-field Generation by the Ion-Weibel Instability in Interpenetrating Plasmas of CH, Al, and Cu

Mario J-E Manuel[1], Swarvanu Ghosh[2], Marissa Adams[3], Raghuram Jonnalagadda[2], Channing Huntington[4], Bruce Remington[4], James Ross[4], Dimitri Ryutov[4], Youichi Sakawa[5], Hong Sio[4], George Swadling[4], Petros Tzeferacos[3], Scott Wilks[4], Farhat Beg[2], Hye-Sook Park[4]
[1]General Atomics, [2]University of California San Diego, [3]University of Rochester, [4]LLNL, [5]Osaka University

The ion-Weibel instability is a leading candidate mechanism for the formation of collisionless shocks observed in many astrophysical systems. Interpenetrating plasma flows drive the ion-Weibel instabilty and create B-fields that can mediate shock formation. Experimental results will be discussed that focused on studying the ion-Weibel instability under various plasma conditions through utilization of different ion species and experimental geometries.

HEDS-9-04 11:40

Magnetic field amplification by turbulent dynamo in relativistic collisionless shocks

Sara Tomita[1], Yutaka Ohira[2]
[1]Tohoku University, [2]The University of Tokyo

Recent magnetohydrodynamics simulations of relativistic shocks propagating into inhomogeneous media show that the ambient magnetic field is amplified by turbulent dynamo in the downstream region. We perform particle-in-cell simulations of relativistic collisionless shocks propagating into pair plasma with a density clump. We found that the magnetic field amplification does not work if the amplitude of the ambient density fluctuation is below a critical value.

[HEDS-10] 13:00-15:20
Turbulence
Chair: Takayoshi Sano
Osaka University

HEDS-10-01 13:00 *Invited*

Explosive phenomena on the Sun and protostars

Shinsuke Takasao
Osaka University

Solar flares are a typical example of explosions driven by magnetic reconnection. Newly-born stars or protostars are also known to produce explosions similar to solar flares, but protostellar flares are much more energetic than solar flares. In this talk, we will discuss how solar and protostellar flares occur based on observations and numerical simulations.

HEDS-10-02 13:25 *Invited*

Ion versus Electron Heating in Compressively Driven Astrophysical Gyrokinetic Turbulence

Yohei Kawazura[1], Alexander A. Schekochihin[2], Michael Barnes[2], Jason M. TenBarge[3], Yuguang Tong[4], Kristopher G. Klein[5], William Dorland[6]
[1]Tohoku University, [2]University of Oxford, [3]Princeton University, [4]University of California, Berkeley, [5]University of Arizona, [6]University of Maryland

We developed a gyrokinetic code in which turbulence is driven by a mixture of Alfvénic and compressive fluctuations. We found that the ion-to-electron heating ratio is an increasing function of the compressive-to-Alfvénic injection ratio. We also found that all the compressive injection goes to ion heating, and the partition of heating is decided at the injection scales.

HEDS-10-03 13:50 *Invited*

Direct numerical simulations of MHD turbulence in the solar wind

Munehito Shoda
National Astronomical Observatory of Japan

Recent results of direct numerical simulations of the solar wind turbulence are reported. It is found that compressional MHD turbulence plays a central role in heating and accelerating the fast solar wind. A direct comparison between simulation and PSP observation is also performed, which shows a nice similarity between the two data.

HEDS-10-04 14:15 *Invited*

On non-equilibrium Alfvenic fluctuations in the solar wind

Yasuhiro Nariyuki
University of Toyama

In this talk, a stochastic phenomenological model to describe the non-equilibrium Alfvenic state is presented. It is shown that the relative speeds in the "friction" terms are necessary to incorporate the information of the parallel bulk speeds of each ion species into the model. Dependence of energy dissipation on wave-number spectra will also be discussed.

HEDS-10-05 14:40 *Invited*

Magnetic-geometry-induced activation of zonal flows in magnetically confined plasma turbulence

Motoki Nakata[1,2], Seikichi Matsuoka[1,2], Masanori Nunami[1,2], NGS team[1]
[1]NIFS, [2]The Graduate University for Advanced Studies

Spontaneous emergence of zonal flows in fusion plasmas is recognized as a key mechanism for improved plasma confinement. Here, we present the recent progress in theoretical and numerical studies on the magnetic-geometry-induced activation of the zonal flows. Utilizing mathematical optimization techniques with an extended turbulence model, numerical explorations of 3-D magnetic geometry found a plasma in which the transport is reduced by enhanced zonal flows.

HEDS-10-06 15:05

Interactions between non-isotropic electroconvection turbulence and mean flows

Takaki Ohguri[1], Kenichi Nagaoka[1,2], Motoki Nakata[2,3], Shinji Yoshimura[1,2], Yoshiki Hidaka[4], Kenichiro Terasaka[4], Yohei Masada[5]
[1]Nagoya University, [2]NIFS, [3]SOKENDAI, [4]Kyushu University, [5]Aichi University of Education

We generated mean flows in crystal liquid and investigated interactions between the flow and electroconvection turbulence. It is found that convective turbulence might enlarges the effective viscosity on the mean flows.

[HEDS-11] 15:50-17:30
Asian-Core
Chair: Youichi Sakawa
Osaka University

HEDS-11-01 15:50 *Invited*

Laboratory astrophysics using large-scale laser systems-Formation of Weibel-instability mediated collisionless shock

Youichi Sakawa
Osaka University

We investigated Weibel-instability mediated collisionless shock (Weibel shock) in a self-generated turbulent magnetic field theoretically/computationally and experimentally using large-scale laser systems, Omega laser and the National Ignition Facility (NIF).

HEDS-11-02 16:15 *Invited*

Extreme terahertz bursts generated from relativistic laser-foil interactions

Guoqian Liao, Yutong Li, Jie Zhang
Institute of Physics, CAS

We report on the highly efficient generation of THz bursts from relativistic laser interactions with a metal foil. The THz spectra can be manipulated effectively by tuning the laser or target parameters. Furthermore, the THz radiation can serve as a unique laser-plasma diagnostic.

HEDS-11-03 16:40 *Invited*

Tunable relativistic single-cycle infrared pulses generated from laser plasma interactions

Chih-Hao Rick Pai[1], Zan Nie[2], Jie Zhang[3], Xiaonan Ning[3], Jianfei Hua[3], Chaojie Zhang[2], Yunxiao He[3], Yipeng Wu[2], Qianqian Su[2], Shuang Liu[3], Yue Ma[3], Zhi Cheng[3], Wei Lu[3], Hsu-Hsin Chu[1], Jyhpyng Wang[1,4], Warren B. Mori[2], Chan Joshi[2]
[1]Department of Physics, National Central University, [2]University of California Los Angeles, [3]Department of Engineering Physics, Tsinghua University, [4]Institute of Atomic and Molecular Sciences, Academia Sinica

We have demonstrated that a photon decelerator based on a precisely controlled laser-wakefield configuration can generate single cycle, tunable and broadband, infrared pulses in the mid-IR (5-14 μm) spectral region with relativistic intensities. Such a versatile tunable IR source may be scaled up and meet the demands of many cutting-edge applications in strong-field physics.

HEDS-11-04 17:05 *Invited*

Relativistic plasma at a hundredth of relativistic intensity

Krishnamurthy Manchikanti
TIFR, Mumbai and Hyderabad

Relativistic temperature plasmas are typically with 10^{18}wcm^{-2} intensity. Do mJ lasers at 10^{16}wcm^{-2} generate a MeV electron temperature plasma? Using dynamic structures of the critical density of a liquid drop, we show imaging quality electron beams with energy upto 7 MeV. Single-shot electron radiographs with the source size <15 microns is demonstrated. Two plasmon decay instability is shown to be a key feature behind such a scheme.

[HEDS-Closing] 17:30-17:40
Closing Remarks
Chair: Youichi Sakawa
Osaka University

HEDS

Poster

[HEDS-P]
Poster Session

HEDS-P-01

Self Focusing and Gouy Phase Shift of Quadruple Gaussian Laser Beams in Thermal Quantum Plasma with Axial Density Ramp

Naveen Gupta Gupta[1], Sanjeev Kumar[2], S. B. Bhardwaj[3]
[1]Lovely Professional University, [2]Government college for women Karnal, [3]Pt. C. L. S College Karnal

This paper presents theoretical study on self-action effects of intense laser beams in-teracting with fusion plasmas. Particularly the phenomena associated with the nonlinear refraction of the laser beam have been investigated in detail.

HEDS-P-02

Screening Effect in the Magnetized Plasma and Its Impact on Weak Interactions

Yudong Luo[1,2], Michael A. Famiano[3], Toshitaka Kajino[2,4], Motohiko Kusakabe[4], A. Baha Balantekin[5]
[1]The University of Tokyo, [2]National Astronomical Observatory of Japan, [3]Western Michigan University, [4]Beihang University, [5]University of Wisconsin, Madison

Coulomb screening and its impact on weak interactions in magnetized plasma are investigated, we apply such impact in nucleosynthesis of different astrophysics site, point out screening could provide an observational signal in nucleosynthesis.

HEDS-P-04

Plasma heating via the interaction of whistler waves

Takayoshi Sano, Yusuke Tatsumi, Masayasu Hata, Yasuhiko Sentoku
Osaka University

We investigate what kind of plasma heating mechanism can work in a solar wind plasma, i.e., when whistler waves with different frequencies collide, using one-dimensional PIC simulations.

HEDS-P-05

Time-evolution of the magnetic field structure in laser-driven magnetic reconnection measured by proton radiography

Suzuto Matsuo[1], Taichi Morita[1], Takuto Kojima[1], Shogo Isayama[1], Shuichi Matsukiyo[1], Taichi Takezaki[2], Yasunobu Arikawa[3], Youichi Sakawa[3], Shunsuke Egashira[3], Otono Kuramoto[3], Yushiro Matsumoto[3], Kentaro Sakai[3], Ryo Yamazaki[4], Kei Sugiyama[4], Kento Aihara[4]
[1]Kyushu University, [2]University of Toyama, [3]Osaka university, [4]Aoyama Gakuin University

Our research group investigated time-evolution of the magnetic field structure in laser-driven magnetic reconnection by using proton radiography. We discuss the reconnection rate from obtained images.

HEDS-P-06

Characterizing Weibel Instability in Counter-Propagating Plasma Flows

Swarvanu Ghosh[1], Mario Manuel[2], Farhat Beg[1], Raghuram Jonnalagadda[1], Channing Moore Huntington[3], Bruce Remington[3], Steven Ross[3], Dmitri Dmitriyevich Ryutov[3], George Forester Swadling[3], Scott C Wilks[3], Hye-Sook Park[3], Marissa Adams[4], Petros Tzeferacos[4,5], Youichi Sakawa[6], Hong Sio[7]
[1]University of California San Diego, [2]General Atomics, [3]LLNL, [4]University of Rochester, [5]Laboratory for Laser Energetics, University of Rochester, [6]Osaka University, [7]Massachusetts Institute of Technology

Collisionless shocks are very common in universe, occuring in astrophysical systems like supernova remnants, bow shocks. These shocks are mediated by Weibel instabilities in astrophysical environments instead of Coloumb collisions. High-power lasers have provided a unique platform to study the electromagnetic Weibel instabilities in laboratory. We have carried out laser experiments at Omega Laser Facility to generate the unmagnetized collisionless shocks.

HEDS-P-07

Study on magnetized collisionless shocks using PIC simulation and laser experiment

Shuichi Matsukiyo[1,5], R. Yamazaki[2,5], T. Morita[1], K. Tomita[3], Y. Kuramitsu[4], T. Sano[5], S. J. Tanaka[2], T. Takezaki[6,7], S. Isayama[1], M Iwamoto[1], T. Nagano[1], S. Furukawa[1], H. Luo[1], T. Higuchi[8], H. Murakami[8], T. Horie[8], N. Katsuki[8], R. Hatsuyama[8], M. Edamoto[8], H. Nishioka[8], M. Takagi[8], T. Kojima[8], S. Tomita[9,10], T. Oguchi[6], N. Ishizaka[2], S Kakuchi[2], S. Sei[2], K. Sugiyama[2], K. Aihara[2], S. Kambayashi[2]
[1]Faculty of Engineering Sciences, Kyushu University, [2]Department of Physics and Mathematics, Aoyama Gakuin University, [3]Division of Quantum Science and Engineering, Hokkaido University, [4]Graduate School of Engineering, Osaka University, [5]ILE, Osaka University, [6]Faculty of Engineering, University of Toyama, [7]Department of Creative Engineering, National Institute of Technology, Kitakyushu College, [8]Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, [9]Astronomical Institute, Tohoku University, [10]Frontier Research Institute for Interdisciplinary Sciences, Tohoku University

We develop the method of particle-in-cell (PIC) simulation of collisionless shock formation and development to mimic an experimental situation at the institute of laser engineering, Osaka Univ., and compare the results with the experiment conducted in 2019-2020.

HEDS-P-08

Turbulent Magnetic Field Amplification Relevant to Astrophysical Scenarios due to High-power LaserPlasma Interaction

Indraj Singh, R. Uma, R. P. Sharma
IIT Delhi

High-power lasers are being utilized for emulating many astrophysical scenarios in laboratory astrophysics. A theoretical model is proposed to study the turbulent magnetic field amplification, which ensues due to the high-power laser interaction with plasma.

HEDS-P-09

Simulation studies for turbulence generation and vortex formation in high beta plasma by nonlinear interaction of Extraordinary Laser and 3-D KAW

Himani Dewan, R Uma, R.P. Sharma
IIT Delhi

This investigation revolve around the nonlinear interplay between pump laser and 3D-Kinetic Alfvén wave. The equations are modelled accounting ponderomotive nonlinearity due to the pump wave and are crucial in investigating the astrophysical scenarios[1-3].

HEDS-P-10

Investigation on ion acceleration with graphene as a nanolayer target using ELI-NP laser

Takumi Minami[1], Yu-Tzu Liao[2], Takamasa Hihara[1], Kentaro Sakai[1], Takahiro Nishimoto[1], Masaki Takano[1], Hiromitsu Kiriyama[3], Yasunobu Arikawa[4], Youichi Sakawa[4], Alessio Morace[4], Shunsuke Egashira[4], Masato Ota[4], Tomohiro Izumi[4], Yoshiharu Nakagawa[4], Takafumi Asai[3,5], Kouki Nishimura[1], Yoshiaki Hayashi[1], Satoshi Jinno[6], Masato Kanasaki[5], Yuji Fukuda[3], Kazuo A Tanaka[1,7], Hideaki Habara[1], Wei-Yen Woon[2], Yasuhiro Kuramitsu[1]
[1]Guraduate school of engineering, Osaka University, [2]Department of Physics, National Central University, [3]KPSI, QST, [4]ILE, Osaka University, [5]Graduate School of Maritime Sciences, Kobe University, [6]Nuclear Professional School, School of Engineering, The University of Tokyo, [7]Extreme Light Infrastructure – Nuclear Physics

We are using large-area suspended graphene (LSG) targets in laser ion acceleration experiments. We show our numerical investigations with the experimental condition at ELI-NP using particle-in-cell (PIC) simulations.