Report from the EPS Plasma Physics Division Board, Summer 2019

Board meetings

The Board met twice in 2018, on 1st July in Prague (CZ) and on 13th December at Culham (UK).

Operation of the Division

Richard Dendy (Culham Centre for Fusion Energy and Warwick University, UK) continues as Chair 2016-2020 of the Division, and Kristel Crombé (ERM/KMS and Ghent University, Belgium) continues as Secretary. The Board members leading the arrangements for the competitions for the 2018 EPS-PPD Prizes were: Alfvén, John Kirk (Max Planck Institute for Nuclear Physics, Germany); Innovation, Holger Kersten (Kiel University, Germany) and Eva Kovačević (Orléans University, France); PhD Research Award, Carlos Silva (Instituto Superior Técnico, Portugal). Further information is available at http://plasma.ciemat.es/eps/board/.

Prague EPS Plasma Physics Conference 2018 (https://eps2018.eli-beams.eu/en/)

The successful 45th annual EPS Plasma Physics Conference took place at the Žofín Palace in Prague from 2nd to 6th July 2018, hosted by a consortium of Czech plasma research organisations. The Local Organising Committee was ably chaired by Stefan Weber (ELI-Beamlines), who is also an EPS-PPD Board member. The Programme Committee was ably chaired by Stefano Coda (CH) and comprised:

•MCF: M. Mantsinen (ES – sub-chair), T. Eich (DE), G. Ericsson (SE), L. Frassinetti (SE), G. Huijsmans (ITER), R. König (DE), J. Mailloux (UK), P. Piovesan (IT), R. Zagorski (PL)

•BPIF: C. Michaut (FR – sub-chair), O. Klimo (CZ), M. Nakatsutsumi (XFEL), A. Ravasio (FR), S. Kar (UK), R. Scott (UK)

•BSAP: G. Lapenta (BE – sub-chair), M.E. Dieckmann (SE), E. Falize (FR), T. Grismayer (PT), G. Rodriguez-Prieto (SP), M. Romè (IT), M Koepke (USA)

•LTDP: J. Berndt (FR – sub-chair), U. Cvelbar (SI), V. Guerra (PT), J.-S. Yoon (KR)

Suggestions from the plasma research community for invited and plenary speakers were welcomed through the Open Forum, and from the American Physical Society and the Association of Asia Pacific Physical Societies, which kindly contributed participants to Programme Committee and EPS-PPD Board meetings during 2018. The scientific programme included joint activities with other EPS Divisions: Solar Physics, and Statistical and Nonlinear Physics. There were 850 registered participants, of whom a quarter were postgraduate students. This represents a 35% increase with respect to the steady level of registered participants, typically 650 in recent years, and indeed 850 is believed to be a record number. It is an extremely healthy indicator for the field of plasma physics in Europe and beyond, and the Local Organising Committee rose superbly to the opportunities and challenges which this presented. The financial outturn was positive, thereby contributing also to the financial health of EPS-PPD. The conference benefited from highly effective work by Boudewijn van Milligen in support of the online system, including the publication of the 4-page papers associated with contributed orals and posters; these are available online at http://ocs.ciemat.es/EPS2018PAP/html/ and constitute volume 42A of the Europhysics Conference Abstracts series. Many of the invited talks, totalling 39, led to refereed journal articles published in the January 2019 issue of *Plasma Physics and Controlled Fusion*, available online at http://iopscience.iop.org/issue/0741-3335/61/1. Five satellite meetings took place immediately before and after the Conference, on: high field laser-plasma interactions; non-local radiation hydrodynamics for ICF; runaway electrons in MCF; electric fields, self-organisation and turbulence in magnetised plasmas; and warm dense matter. Some of these have led to further refereed papers that will appear in *PPCF*. For further information see https://eps2018.eli-beams.eu/en/scientific-program/satellite-meetings/.

Milan EPS Plasma Physics Conference 2019 (https://www.epsplasma2019.eu/)

The 46th annual EPS Plasma Physics Conference takes place at Milano-Bicocca University (UniMiB) in Milan (IT) from 8th to 12th July 2019, co-hosted by CNR and the University. The Local Organising Committee is chaired by Daniela Farina (CNR), who is also an EPS-PPD Board member, with Giuseppe Gorini (UniMiB) as co-chair.

The Programme Committee is chaired by Caterina Riconda (FR) and comprises:

•MCF: H.-S. Bosch (DE), S. Brezinsek (joint sub-chair, DE), R. Coelho (PT), G. Granucci (IT), C. Maggi (UK), K. McCarthy (joint sub-chair, ES), R. Panek (CZ), G. Pautasso (DE), Y. Sarazin (FR), M. Xu (PRC)

•BPIF: A. Brantov (RU), A. Casner (FR), G. Cristoforetti (IT), K. Lancaster (sub-chair, UK), T. Toncian (DE), L. Volpe (ES), M. Vranic (PT)

•BSAP: D. Burgess (sub-chair, UK),), C. Fendt (DE), L. Gremillet (FR), M. Koepke (USA), R. Smets (FR), H. Yan (DE)

•LTDP: P. Brault (sub-chair, FR), K. Kutasi (HU), S. Milosevic (HR), J. van Dijk (NL)

In addition to the 46th annual Divisional conference in 2019, the EPS-PPD supported the 3rd European Conference on Plasma Diagnostics which was held in Lisbon 6th to 9th May 2019: https://www.ipfn.tecnico.ulisboa.pt/ECPD2019/index.html

Sitges EPS Plasma Physics Conference 2020 (https://epsplasma2020.eu/)

The 47th annual EPS Plasma Physics Conference will take place in Sitges, Spain, from 22nd to 26th June 2020, hosted by the Barcelona Supercomputer Centre. The Local Organising Committee is chaired by Mervi Mantsinen (BSC). The programme Committee is chaired by Gerardo Giruzzi (FR) and comprises:

•MCF: D. Borba (UK – sub-chair), I. Garkusha (UA), T. Goerler (DE), C. Hidalgo (ES), J. Hillesheim (UK), T. Hoang (FR), A. Merle (CH), J. Mlynar (CZ), K. Nagasaki (JP), L. Piron (IT), E. Viezzer (ES)

•BPIF: R. Nuter (FR – sub-chair), A. Di Piazza (DE), A. Gopal (DE), M. Harmand (FR), P. Loiseau (FR), P. McKenna (UK), E. Oliva (ES), S. Pikuz (RU)

•BSAP: S. Lebedev (UK – sub-chair), M. Aloy Toras (ES), K. Issautier (FR), A. Marcowith (FR)

•LTDP: C. Arnas (FR – sub-chair), W. Miloch (NO), T. Mussenbrock (DE), I. Tannaro (ES)

Prizes

At this Annual Conference, the EPS Plasma Physics Division recognises researchers who have achieved outstanding scientific or technological results, reflecting and reinforcing excellence in plasma physics.

The **2019 EPS Hannes Alfvén Prize** for outstanding contributions to plasma physics is awarded jointly to:

Victor Malka (LOA, France, and Weizmann Institute of Science, Israel) for his major contributions to the development of compact laser-plasma accelerators, and to their innovative applications to science and society, which span ultra-fast phenomena, accelerator physics, medicine, radiobiology, chemistry and material science; and
Toshiki Tajima (University of California, Irvine, USA) for his seminal, broad, and novel contributions to plasma physics and plasma-based accelerator physics, including the concept of laser wakefield acceleration.

Victor Malka is an international research leader in the field of laser-driven plasma accelerators. He was one of the first researchers to realize the potential of laser-driven particle and radiation sources, and has dedicated much of his research career to developing this subject. Professor Malka's most significant contributions to the field include: the production of the first relativistic electron beams in the wave breaking regime; leading one of the first experiments to demonstrate monoenergetic electron beam acceleration in a laser-plasma wakefield; the introduction of colliding laser pulse techniques for controlling electron injection and acceleration; and pioneering measurements on laser-plasma accelerators as a driver of high energy synchrotron radiation. His most recent work includes the first use of wide-band spectral coherent transition radiation to temporally characterise electron acceleration, leading to the identification of a 1.5 femtosecond electron bunch. In addition, he has made important contributions to laser-driven ion acceleration, and is a pioneer of the application of laser-plasma accelerators to address societal challenges. For example, he collaborates with clinicians and industry to pursue medical applications in imaging and cancer therapy. Professor Malka has initiated and coordinated many joint European projects, and shown leadership in shaping European strategy in this research field. He is also passionate about training the next generation of researchers in laser-plasma physics; many of the sixteen PhD students whom he has supervised have received awards for their research achievements. Professor Malka has contributed to many summer schools, and has been very active in promoting plasma physics to the general public, in the popular press and in interviews.

Toshiki Tajima has exceptional scientific accomplishments. He is recognized, with the late John Dawson, as one of two inventors of the concept of laser wakefield acceleration (LWA). Their seminal scientific contribution on LWA was published in Physical Review Letters in 1979, and has been cited over four thousand times; his total citations exceed twenty-four thousand. These statistics eloquently express his work's extensive impact on physics, together with its wider applications. LWA has been a transformational concept: both in the physics of high-intensity laser-plasma interactions, and in particle acceleration technology. Driven by a laser at optical wavelengths, LWA has the potential to shrink the size of future accelerators by a factor of at least a

thousand. It is seen as the preeminent solution to the limitations of conventional accelerator technology that the accelerator community is seeking. Professor Tajima's formidable impact is evidenced by the fact that several thousand researchers and engineers are now involved in LWA work, in 150 laboratories worldwide. The field remains one of the most exciting topics in laser physics. The continuing high level of financial investment is estimated at five billion dollars over the next five years. Within Europe, four large scale facilities are being built: Apollon in France, and the three Extreme Light Infrastructure (ELI) facilities in central and eastern Europe.

The **2019 EPS Plasma Physics Innovation Prize** for technological, industrial or societal applications of research in plasma physics is awarded jointly to Professors **Hana Barankova** and **Ladislav Bardos**, both of the Ångström Laboratory, Uppsala University, Sweden.

Hana Barankova and **Ladislav Bardos** have contributed significantly to the fundamental understanding, and to novel designs, of hollow cathodes and new processes leading to enhanced performance of functional thin films. Linear Arc Discharge (LAD) and Magnets in Motion (M-M) technologies have been patented, licensed, and adopted by industry. They have contributed significant novel work on environmental protection by the conversion of hazardous gases, and on the reduction of energy consumption in industrial processes by means of plasma technology. Among the several non-conventional high-density plasma sources which they invented or developed, the radiofrequency hollow cathode plasma jet (RHCPJ) deserves special mention. Their use of graphite cathodes has opened up new hybrid processes which combine plasma vapour deposition (PVD) and plasma-enhanced chemical vapour deposition (PE CVD). These have led to extremely high deposition rates, up to 2.5 microns per minute, of amorphous carbon coatings that have good adhesion to insulators, without an interlayer.

They have recently developed a new magnetron with a magnetised hollow cathode enhanced target, which can enhance the TiN deposition by 50% compared to the deposition rate of Ti. The resulting stoichiometric coatings exhibit very high micro-hardness (up to 31.4 GPa) and a dense structure comparable with that of HIPIMS films. These findings are of a significant interest for upgrading conventional magnetrons. They have made significant contributions both in reduced pressure and atmospheric plasma hollow cathodes. They invented the fused hollow cathode (FHC) cold atmospheric plasma source, which has an integrated open structure with flowing gas. Combination of the hollow cathode plasma with the microwave antenna was used in a new hybrid hollow electrode activated discharge source (H-HEADS). International patents have been granted on gas and surface treatment by FHC and on H-HEADS. Both sources have been exploited in many applications, from the surface treatment of heat sensitive substrates to the sintering of powders. Their work on gas conversion for environment cleaning is noteworthy. Results in NOx + air confirmed that plasma can act as a 100% oxidation catalyst, without any additives and without any further heterogeneous catalyst. The conversion of CO2 to glassy deposits was achieved, thus suggesting a path for CO2 fixation. They performed field experiments at Vattenfall AB Värme and verified the results in the real environment.

Hana Barankova and Ladislav Bardos are also currently working on the use of plasma for hydrogen production in liquids. Results from their novel plasma source design confirm the highly efficient production of a hydrogen rich (65%) synthesis gas, from ethanol-water mixtures. The energy corresponds to 7 kWH per 1 kg of hydrogen. They continue this applied research, in cooperation with industry, for the development of a hydrogen-on-demand concept using renewable electric energy. The system can be also used for production of high value chemicals from low value feeds.

The **2019 EPS Plasma Physics Division PhD Research Awards** were judged by a small external committee of referees, comprising Enzo Lazzaro, Michel Chatelier, Arutiun Ehiasarian and Alexander Andreev, who examined all the submitted theses in a process co-ordinated by Carlos Silva representing the EPS-PPD Board. This year's awards go to (in alphabetical order of surname): **Giada Cantono** (Université Paris-Saclay, France, and Università di Pisa, Italy) for her thesis on "Relativistic plasmonics for ultra-short radiation sources", nominated by Marco Borghesi; **Michael Faitsch** (Ludwig-Maximilians-Universität München, Germany) for his thesis on "Divertor Power Load Studies at ASDEX Upgrade and TCV", nominated by Hartmut Zohm; **Francisco Javier Artola Such** (Université Aix-Marseille, France) for his thesis on "Free-boundary simulations of MHD plasma instabilities in tokamaks", nominated by Guido Huijsmans; and **Eleanor Tubman** (York University, UK) for her thesis on "High energy density magnetic reconnection experiments in colliding carbon plasma flows", nominated by Nigel Woolsey. For further information, please see http://www.epsnews.eu/2019/03/2019-phd-research-award-of-the-eps-plasma-physics-division/.

The postgraduate student winners of the **2019 EPS/PPCF/IUPAP Poster Prizes** https://iopscience.iop.org/journal/0741-3335/page/2019_PPCF_EPS_IUPAP_PhD_Poster_Prizes and the **2019 Kyushu University Itoh Project Prize**, sponsored by Kyushu University (Japan) and supported by IOP Publishing, https://www.epsplasma2019.eu/prizes-awards/ will be determined during the conference, and will be announced during the closing session. Last-minute applications up to lunchtime on Monday 8th July can be accommodated: to enter your poster for either of these prizes, simply send an e-mail to ppcf@ioppublishing.org. with

"PPCF/EPS/IUPAP PhD Poster Prize" or “Kyushu University Itoh Project Prize” in the subject line. Please include your name, your poster number; the day and time you are presenting your poster, plus the abstract.

International collaborations of EPS-PPD beyond Europe

International links between EPS-PPD and North America through APS-PPD are longstanding. A flagship joint project is the biannual Landau-Spitzer Prize http://plasma.ciemat.es/eps/awards/landau-spitzer-award/. For the 2018 Prize, Emilia Solano represented the EPS-PPD Board as vice-chair of the EPS-APS judging panel, alongside Eva Kovačević, Vladimir Tikhonchuk and three APS-DPP colleagues. The fourth biannual Landau-Spitzer Prize 2018 was awarded jointly to **Yevgen Kazakov** and **Jozef Ongena** (both of the Laboratory for Plasma Physics of the Royal Military Academy, Belgium), and **John Wright** and **Stephen Wukitch** (both of MIT Plasma Science and Fusion Center, USA). The award recognises their experimental verification, through collaborative experiments, of a novel and highly efficient ion cyclotron resonance heating scenario for plasma heating and generation of energetic ions in magnetic fusion devices.

International links with Asia/Pacific are also a priority, and EPS-PPD welcomes the increasing engagement with AAPPS-PPD at working level. Negotiations over several years with AAPPS-PPD to establish a counterpart to the Landau-Spitzer Prize did not bear fruit; fortunately, Institute of Physics Publishing stepped up to sponsor a prize for collaborations in plasma physics between European and Asia-Pacific researchers. The second annual award, for 2019, is to **Michel Koenig** (Laboratoire LULI – CNRS, France), **Norimasa Ozaki** (Osaka University, Japan), and **Yasuhiro Kuramitsu** (National Central University, Taiwan and Osaka University, Japan). They demonstrated how high power pulsed lasers can contribute actively to scientific challenges in inertial confinement fusion and astrophysics, by their interdisciplinary studies. The collaboration actively influenced the plasma physics community both by their innovative experimental techniques, and by direct applications to planetary science, material science, and laboratory astrophysics. For details, see https://iopscience.iop.org/journal/0741-3335/page/PPCF-Dendy-Europe-Asia-Pacific-Award-for-Outstanding-Research-Collaboration-in-Plasma-Physics.

Development of the Division

A central objective of the EPS-PPD Board is to establish a multi-year pipeline of future venues for our conference. This is essential if we are to continue to host the conference in appropriate and affordable facilities, and at the optimum time of year for our community. Such facilities are primarily located in major population centres; and the competition for them, from the many professional groupings with greater financial resources than ours, can only be met by careful long-term planning. We are therefore extremely grateful to the management of host institutions which are willing to set up a Local Organising Committee, and to underwrite our conference more generally. In the near term, these are the CNR Institute for Plasma Physics and the Milano-Bicocca University, Milan (2019 conference), and the Barcelona Supercomputer Centre (2020 conference). Looking further ahead, EPS-PPD Board is in advanced discussions with the Hellenic Fusion Association for 2021, and the Dutch Institute for Fundamental Energy Research for 2022.

Elections for a fresh tranche of Board members, approximately half the total Board membership, will be initiated in the first half of 2020. Please consider whether you are willing to stand for election to this role, which involves attending two Board meetings each year and contributing throughout the year to the work outlined in this Report. The term is four years, renewable once, and the electorate comprises all Individual Members of EPS who are affiliated to EPS-PPD. The following opportunity to stand, or vote, will arise in 2024.

Richard Dendy, Chair
on behalf of the EPS Plasma Physics Division Board
30th May 2019