



## Report from the EPS Plasma Physics Division Board, Summer 2018

### Board meetings

The Board met twice in 2017, on 25<sup>th</sup> June in Belfast (UK) and on 8<sup>th</sup> 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/>.

### Belfast EPS Plasma Physics Conference 2017 (<https://www.qub.ac.uk/sites/eps2017/>)

The successful 44<sup>th</sup> EPS Plasma Physics Conference took place in Belfast (UK) from 26<sup>th</sup> to 30<sup>th</sup> June 2017, hosted by Queen's University Belfast. The Local Organising Committee was ably chaired by Brendan Dromey, and similarly the Programme Committee by Marta Fajardo (PT). The Programme Committee comprised:

- MCF: E. Westerhof (NL – sub-chair), C. Challis (UK), A. Hakola (FI), P. Hennequin (FR), M. Hirsch (DE), R. Lorenzini (IT), M.-L. Mayoral (UK), B. van Milligen (SP), T. Puetterich (DE) and V. Pustovitov (RU)
- BPIF: C. Riconda (FR – sub-chair), A. Marocchino (IT), F. Negoita (RO), J. Nedjl (CZ), G. Sarri (UK), U. Schramm (DE), P. Velarde (SP) and J. Vieira (PT),
- BSAP: A. Bret (SP – sub-chair), J. Büchner (DE), R. Keppens (BE), J. Petri (FR), A. Robinson (UK) and N Vlahakis (GR)
- LTDP: A. Melzer (DE – sub-chair), N. Bordel (SP), W. Miloch (NO), I. Pilch (SE) and S. Starikovskaya (FR).

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 2017. The scientific programme included joint activities with other EPS Divisions: Solar Physics, and Quantum Electronics and Optics. There were 673 registered participants, of whom 213 were postgraduate students – believed to be a record number, and an extremely healthy indicator for our field. 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/EPS2017PAP/html/> and constitute volume 41F of the Europhysics Conference Abstracts series. A very high proportion of the invited talks, totalling 48, led to refereed journal articles published in the January 2018 issue of *Plasma Physics and Controlled Fusion*, available online at <http://iopscience.iop.org/issue/0741-3335/60/1>. A successful satellite meeting on high field laser-plasma interactions took place in Belfast on the day after the conference, leading to a further eleven refereed papers that will appear together in *PPCF*.

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

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

- 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. Rasio (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)

Five satellite meetings will take 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. For further information see <https://eps2018.eli-beams.eu/en/scientific-program/satellite-meetings/>.

## Milan EPS Plasma Physics Conference 2019 (<https://www.ifp.cnr.it/top-stories/eps-conference-2019-in-milan>)

The 46th EPS Plasma Physics Conference will take 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)
- BPIF: A. Brantov (RU), A. Casner (FR), G. Cristoforetti (IT), K. Lancaster (UK), T. Toncian (DE), L. Volpe (ES), M. Vranic (PT)
- BSAP: L. Gremillet (FR), D. Burgess (UK), R. Smets (FR), H. Yan (DE), C. Fendt (DE)
- LTDP: J. van Dijk (NL), P. Brault (FR), K. Kutasi (HU), S. Milosevic (HR)

In addition to the 46<sup>th</sup> annual Divisional conference in 2019, the EPS-PPD supports the 3<sup>rd</sup> European Conference on Plasma Diagnostics which will be held in Lisbon 10<sup>th</sup> to 15<sup>th</sup> May 2019: <https://www.ipfn.tecnico.ulisboa.pt/ECPD2019/index.html>

### 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 **2018 EPS Hannes Alfvén Prize** is awarded to **Tony Bell** of Oxford University, UK, who has opened up new research fields in both astrophysical and laboratory plasma physics. His seminal contributions cover cosmic ray acceleration by shocks, magnetic field amplification by cosmic rays, flux-limited electron transport, the generation of magnetic field by laser-produced energetic electrons, the collimation of electron beams for inertial fusion, and the prolific production of electron-positron pairs.

During his career as a theoretical plasma physicist, Tony Bell has opened up new research fields in both astrophysical and laboratory plasmas. His foremost achievement is the leading role he played in the development of what is now the standard model of astrophysical particle acceleration and cosmic ray origins. He is the sole author of two particularly seminal papers: in 1978 he proposed the theory of diffusive shock acceleration; and in 2004 he showed how streaming cosmic rays can excite a new plasma instability and amplify magnetic fields, as required for cosmic ray acceleration to PeV energies in supernova remnants, and to explain the strong magnetic fields observed at shocks. The process of diffusive shock acceleration was independently proposed by Bell and by three other research groups. The theory of magnetic field amplification was proposed by Bell alone. Shock-accelerated relativistic electrons are responsible for the synchrotron and inverse Compton radiation, from radio to gamma-ray wavelengths, that contributes a substantial part of our knowledge of the universe.

In the field of laboratory plasma physics, Tony Bell has been one of the main contributors over three decades in developing the understanding of electron transport in laser-produced plasmas. A long-term aim is the development of laser-driven thermonuclear fusion as a commercially viable source of electricity. In the medium term, laser-plasma interactions at high laser intensity are increasingly seen as a short-pulse source of energetic photons, protons, electrons and positrons with a variety of applications. His main achievements in laboratory plasma physics are:

- (i) Explanation of 'flux-limited' inhibition of thermal conduction in inertial confinement fusion (ICF) capsules. This initiated the development of the non-local theory of electron transport that has become one of the building blocks of the understanding of laser-produced plasmas.
- (ii) The theory of energetic electron transport that shows how self-generated magnetic fields can focus beams of energetic electrons into the dense thermonuclear fuel, as required for high gain ICF by 'fast ignition'.
- (iii) The theoretical demonstration that quantum Electrodynamics (QED) will play an important role in experiments that exploit the next generation of high power lasers, leading to prolific gamma-ray and electron-positron pair generation.

The common theme uniting these apparently disparate researches is the generation and transport of energetic particles, whether they are cosmic rays in astrophysics or energetic electrons and electron-positron pairs in laser-produced plasmas.

The **2018 EPS Plasma Physics Innovation Prize** is awarded to **Arutiun Ehasarian** of Sheffield Hallam University, UK, for the use of plasma physics in coating technology and engineering, through seminal contributions to the science and industrial applications of High Power Impulse Magnetron Sputtering for substrate pre-treatment and deposition of coatings and thin films.

High Power Impulse Magnetron Sputtering (HIPIMS) is the most significant development in plasma vapour deposition technology in the past decade. Its importance is at the same level as the invention of the magnetron. After more than a decade of dedication to the development of this technology, Arutiun Ehasarian is the undisputed leader. His many accomplishments include: deepened understanding of the fundamentals of the process; being the first to implement the technique using industrial scale equipment; patenting HIPIMS metal ion surface pre-treatment; and being the first to analyze the growth mechanisms of complex films. He is also a leader in organising scientific forums to accelerate the progress of HIPIMS.

Arutiun Ehasarian's central role in developing understanding of the physics of the HIPIMS discharge and applications to thin film technology is reflected by the award to him in 2003 of the first UK grant to study the fundamental physics of HIPIMS. His research provided the first direct evidence of the presence of large fractions of singly and doubly charged metal ions in HIPIMS. He discovered a new regime of plasma confinement and mechanism for discharge sustainment. He elucidated the origins of the ion and electron energy distribution functions, and found conditions for high levels of dissociation of reactive gas, leading to changes in crystallographic texture and extreme densification of the deposited films. In 2006 he discovered strong instabilities in the HIPIMS plasma which has led to a revision of the understanding of the working principle of the magnetron itself.

Arutiun Ehasarian is among the world leaders in the effort to make HIPIMS accessible and to develop its industrial applications. He was the first to accomplish the scale-up of the HIPIMS process: based on his design, Hüttinger manufactured the first industrially viable power supply to drive targets with an area of 2000 square centimetres. This instigated the industrialisation of HIPIMS technology worldwide. He supported the establishment of the largest production HIPIMS coating facility at Ionbond UK in 2014. Based on his work, Zimmer Biomet successfully implanted HIPIMS-coated artificial joints in a sheep test model. He patented the HIPIMS etching technology which has been licensed to major companies in Europe and the USA. In collaboration with the Rutherford Appleton Laboratory (UK), he developed HIPIMS technology for coatings for cryogenic coolers for space satellites, achieving spaceflight qualification.

Arutiun Ehasarian's work provides a rare example of exceptionally broad research across the whole spectrum from fundamental studies to large scale industrialisation.

The **2018 EPS Plasma Physics Division PhD Research Awards** were judged by a small external committee, comprising Stefano Atzeni and Hartmut Zohm, 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): **Matteo Falessi** (Roma Tre University, Italy) for his thesis on "Gyrokinetic theory for particle transport in fusion plasmas", supervised by Fulvio Zonca; **Jack Hare** (Imperial College London, UK) for his thesis on "High energy density magnetic reconnection experiments in colliding carbon plasma flows", supervised by Sergey Lebedev; **Adrien Leblanc** (University of Paris-Saclay, France) for his thesis on "Plasma mirrors and plasma gratings under ultra-intense laser illumination: high-order harmonic generation, and relativistic electron beams", supervised by François Amiranoff; and Wei Zhang (Ghent University, Belgium) for his thesis on "Plasma edge modeling with ICRF coupling", supervised by Jean-Marie Noterdaeme.

The postgraduate student winners of the **2018 EPS/PPCF/IUPAP Poster Prizes** [http://iopscience.iop.org/journal/0741-3335/page/2018\\_EPS\\_poster\\_prize](http://iopscience.iop.org/journal/0741-3335/page/2018_EPS_poster_prize) and the **2018 Kyushu University Itoh Project Prize**, sponsored by Kyushu University (Japan) and supported by IOP Publishing, <http://iopscience.iop.org/journal/0741-3335/page/Itoh-Project-Prize-2018> will be determined during the conference, and will be announced during the closing session. Last-minute applications up to lunchtime on 2<sup>nd</sup> July can be accommodated.

## Development of the Division

Two pressing objectives of the EPS-PPD Board are the establishment of a multi-year pipeline of future venues for our conference, and the steady expansion of EPS-PPD's international links. We are very grateful to the management of the CNR Institute for Plasma Physics and the Milano-Bicocca University, Milan (2019 conference); and the Barcelona Supercomputer Centre (2020 conference).

International links between EPS-PPD and North America through APS-PPD are longstanding. The 2018 application deadline for our joint biannual Landau-Spitzer Prize <http://plasma.ciemat.es/eps/awards/landau-spitzer-award/> has now passed; Emilia Solano represents the EPS-PPD Board as vice-chair of the judging panel.

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 new prize for collaborations in plasma physics between European and Asian/Pacific researchers. The first, 2018, award is to **H. Urano** (Japan), **C. Maggi** (UK), **O. Kwon** (Korea) and **S. Saarelma** (UK): for details see <http://iopscience.iop.org/journal/0741-3335/page/PPCF-Dendy-Europe-Asia-Pacific-Award-for-Outstanding-Research-Collaboration-in-Plasma-Physics>.

A handwritten signature in grey ink that reads "Richard Dendy". The signature is written in a cursive, flowing style.

*Richard Dendy, Chair  
on behalf of the EPS Plasma Physics Division Board  
June 2018*