

# **IOP** | Institute of Physics **Plasma Physics Group**

## **UK Plasma Physics News – Summer 2016**

*Welcome to the UK IOP Plasma Physics Group (PPG) e-newsletter. If you have items for inclusion in future newsletters, please send these to [p.browning@manchester.ac.uk](mailto:p.browning@manchester.ac.uk) – meeting announcements, research achievements, new appointments, facilities, projects, buildings etc.*

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### **COMMITTEE NEWS**

We are very grateful to retiring Committee members - Adrian Cross, Stuart Mangles and John Simons - for all their hard work on behalf of the Plasma Physics Group. We now welcome 3 new members to the Committee who were elected at the AGM in Skye:

*Bengt Eliason, Strathclyde.* Bengt joined the Atoms Beams and Plasmas group at Strathclyde University about 3 years ago, having worked at Ruhr-University Bochum in Germany for about 10 years. His research interests are in Vlasov simulations and code development, kinetic theory (electron and ion holes), ionospheric physics, quantum plasmas, dusty (complex) plasmas, laser-plasma interactions, etc.

*Felipe Iza, Loughborough* Felipe joined the School of Electronic, Electrical and Systems Engineering at Loughborough University in 2007, where he is a Senior Lecturer in Bioelectrics and Health Care, having previously worked at Pohang University of Science and Technology (Korea), His research interest is focused on experimental and computational low-temperature plasma physics and engineering, with special attention to microplasmas and atmospheric discharges for biomedical and environmental applications.

*Andrew Thornton, CCFE.* Andrew is a scientist at Culham Centre for Fusion Energy and his research is focussed on the measurement of target power loads during steady state and transient events.

### **RECENT MEETINGS**

#### **43<sup>rd</sup> IOP Plasma Physics Conference**

The 43<sup>rd</sup> IOP Plasma Physics conference was held at Sabhal Mhor Ostaig in the Isle of Skye, from 23<sup>rd</sup> – 26<sup>th</sup> May 2016. The meeting was attended by 91 delegates, who enjoyed a week of glorious sunshine in a beautiful venue. Everybody appreciated the hospitality of the College, as well as the opportunities to engage in discussions with colleagues in a self-contained venue. 11 invited speakers, including representatives of the UK community as well as leading international researchers, gave excellent talks on a range of topics across plasma physics, and there was also a wide range of interesting contributed talks and posters. A novel feature of this meeting was the “breakout and recap” sessions, allowing delegates to discuss the day’s talks, deciding on highlights and the future challenges for our discipline.

Some comments from delegates: “Fantastic location, schedule, food and physics.” “great venue, very well organised”... participants were able to discuss and network outside of the formal

conference sessions because everyone remained centred around the conference venue". "The flash poster presentation and recap sessions were very good new concepts". Congratulations to Declan Diver (Glasgow) and Jon Roe (IOP) for organising this successful meeting!

Student poster prizes were sponsored by IOP Publishing and awarded to Hannah Willet, York, and Rachel Irwin, Belfast. For the first time, prizes were also awarded for the best Flash Poster presentations, sponsored by Nature Physics – these were won by John Colvin, Warwick and Bill Graham, Belfast. We are very grateful to the publishers for this sponsorship and for exhibiting. We are also very grateful to conference sponsors AWE, STFC, CCFE and Hiden Analytic – without this generous support, the meeting would not be viable.



## FORTHCOMING MEETINGS

### **BOUT++ workshop 2016, 19-21st September 2016, York**

<http://boutproject.github.io/workshop2016.html>

This workshop is intended for new and existing users of BOUT++, and for researchers interested in plasma physics relevant to the edge of tokamak plasmas. The workshop consists of hands-on instruction in using BOUT++, presentation of recent results and ongoing work, and discussion of issues and future directions for development and collaborations. Some funding to support travel and accommodation is available, depending on circumstances.

If you are interested in attending please contact Ben Dudson ([benjamin.dudson@york.ac.uk](mailto:benjamin.dudson@york.ac.uk), 01904 322229) before August 31st.

### **14<sup>th</sup> Technological Plasma Workshop: October 12<sup>th</sup> -13<sup>th</sup> 2016**

The 14<sup>th</sup> Technological Plasma Workshop (TPW) will be held at the Ricoh Arena in Coventry on 12<sup>th</sup> and 13<sup>th</sup> October 2016. TPW ([www.tpw-uk.org](http://www.tpw-uk.org)) is principally a UK-based forum in the science and technology of plasmas and gas discharges. In recent years international delegates have participated in this workshop and are most welcome. Since the EPSRC Technological Plasma Initiative in 1997, technological plasmas have found new applications in diverse fields ranging from nano-science, through biomedicine and environment, to space exploration. Collaboration between academic and industrial communities is now the norm and there are new and exciting career prospects for younger scientists and engineers. To support a full realisation of these opportunities, TPW aims to foster academic-industry collaboration and to engage young plasma scientists with a scientific programme anchored by leading plasma scientists.

The workshop will comprise invited talks, contributed presentations and a poster session. TPW will be co-located with the Vacuum Symposium at the Vacuum Expo (<http://www.vacuum-expo.com>) and the programme will allow time for delegates to network with others and to visit the exhibition.

**Registration deadline:** 2<sup>nd</sup> September

**Abstract deadline:** 31<sup>st</sup> September

### **Solar-Tokamak Workshop II**

A second Workshop promoting interactions between tokamak and solar plasma physics is proposed to be held at the University or Warwick in 2017. Details will be circulated in due course.

### **44<sup>th</sup> IOP Plasma Physics Conference, Oxford, April 3<sup>rd</sup> -6<sup>th</sup> 2017**

The 2017 IOP Plasma Physics Group Conference will be held at Worcester College, Oxford 3<sup>rd</sup> to 6<sup>th</sup> April 2017. Worcester is a beautiful college with 26 acres of grounds including a lake. It boasts medieval and neoclassical architecture and a chapel partly designed by Hawksmoor. It is also located very near to Oxford railway station. The College is building a new conference facility, the Nazrin Shah building, and the conference will be one of the first events held in the building.

The conference will cover the usual topics from high temperature fusion plasmas to laser plasma interactions and from solar and astrophysical plasmas to low temperature plasmas. The community will be invited to make nominations for invited speakers in due course (likely for September 2016). The deadline for contributed abstracts will be early January 2017.

The **MAST-U research forum** will be held straight after the Conference at the same venue, more details on this to follow.

Picture: Worcester College, Main Quad



*The PPG Committee is always keen to receive offers from members to organise one day meetings, especially on topics which bring together different areas of research. Joint meetings with other IOP Groups are especially welcome. We have a small amount of funding available to support such meetings, and can assist with publicity, finding speakers etc.*

## **PRIZES AND AWARDS**

### **Rutherford Plasma Physics Communication Prize**

The Rutherford Plasma Physics Communication prize, generously sponsored by STFC, is awarded for an excellent achievement in outreach – this could be a podcast, video, lecture, public talk, website, essay, blog, article etc.

We are very pleased to announce that this year's winner was Kate Lancaster, from the University of York – congratulations to Kate.

### **Culham Thesis Prize**

We are pleased to announce that the 2015 Culham Thesis Prize has been awarded to Thomas White, University of Oxford, for his thesis on “Resolving ion acoustic waves in warm dense matter”. Thomas presented an excellent invited talk on his work at the Skye conference, and was awarded the prize by CCFE Chief Executive Steve Cowley. We are very grateful to CCFE for sponsoring this prize.

## **COMMUNITY NEWS**

### **News from CCFE – MAST Upgrade assembly update**

The past months have seen significant progress in the assembly of MAST Upgrade with the installation of three of the five major vessel components as the project heads towards completion. Back in March, the tokamak's completed bottom plate, with its precision-engineered coils, support structures and embedded set of diagnostics, was moved into place. It was the first part of the new device to go into the machine area and therefore a big moment for the project team.

“The installation of the bottom plate is the culmination of all the design, procurement and assembly of the 45,000 components that make up this critical part of the machine,” said Project Leader Joe Milnes.

Then on 25 May, an even more significant moment – the 41-tonne outer cylinder, the largest part of the vacuum vessel, was lifted into the area. Since early 2014, the outer cylinder had been in an assembly tent where it was stripped down, cleaned and refitted with thousands of parts. Now it is back in its concrete-lined blockhouse, the process of installing the remaining machine parts can begin, on the road to pump down, commissioning and the all-important ‘first plasma’ in 2017.

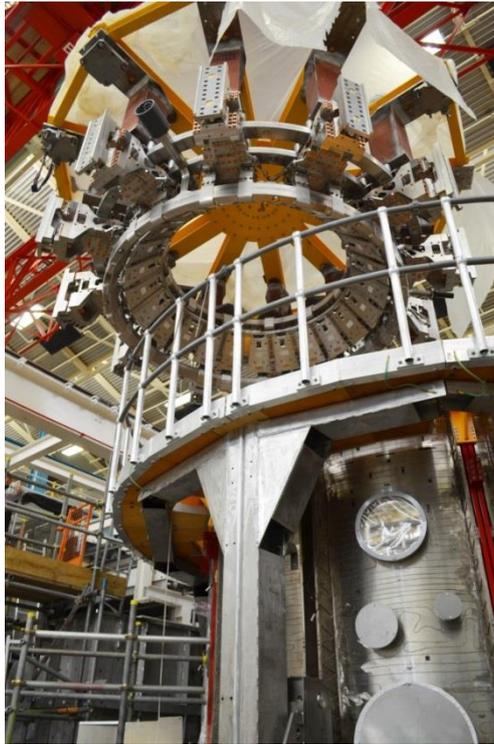


*Image showing the installation of the outer cylinder on to the bottom plate. The super-X divertor tiles can be seen installed on the bottom plate.*

The first part to be attached to the rehoused cylinder was the upper divertor coil cassette, comprising four of the poloidal field coils for one of MAST-U’s new Super-X divertors. The centre tube will be installed next, followed by the upper plate to complete the MAST-U vessel.

Joe Milnes commented: “The recent progress embodies the huge amount of work that’s been done to get MAST Upgrade to this stage. We undoubtedly still have some final technical challenges to overcome this year, but reinstallation of such large items really lifts the spirits and gives us all a push to get this fantastic machine completed.”

MAST-U is targeting pump down towards the end of 2016, with commissioning and restart taking place in early 2017. The first MAST-U research forum will be held at Worcester College, Oxford on the 6 and 7<sup>th</sup> of April, following the IOP Plasma Physics Conference. We welcome your participation in the experimental programme and look forward to your ideas and contributions to the MAST-U experiment.



*Installation of the upper divertor coil cassette into the outer cylinder which contains 5 poloidal field coils for plasma and divertor shaping*

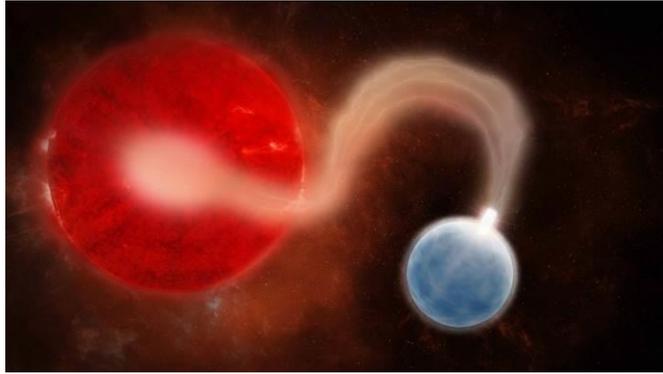
#### **News from AWE: Orion's first academic access campaigns published in Nature journals**

Two eminent international teams of academics who worked on the world-leading Orion laser have published papers about their respective experiments in Nature Communications and Scientific Reports, both of which are highly acclaimed scientific publications.

The experiments led by Professor Gianluca Gregori (University of Oxford) and Dr Andy Higginbotham (previously at Oxford and now at the University of York), were undertaken as part of the Orion collaborative academic access programme. In addition to AWE scientists and facility staff, participants from many other institutions supported the experiments, including the UK's STFC Rutherford Appleton Laboratory, French groups from the LULI Laboratory (CNRS), the CEA and the Observatoire de Paris (CNRS), and US researchers from the University of Michigan and Lawrence Livermore National Laboratory.

Supported by the MOD, the peer-reviewed academic access programme allows UK-led teams to work on Orion – a unique centre of excellence based at AWE – using the wider capabilities of the facility to pursue their collaborative academic research programmes. The application process is highly competitive and has been significantly oversubscribed since the first call for proposals in 2013. A high energy density physics experimental facility, Orion allows scientists to study matter compressed to many times denser than solid and heated to millions of degrees without resorting to underground nuclear testing. This capability also allows Orion to recreate the extreme conditions found at, for example, the cores of the Earth and the Sun and within the atmospheres of stars. Experiments to understand the basic physics of these otherwise distant and inaccessible environments support the complex computer codes and models used in the deterrent programme, as well as expanding our understanding of the wider universe.

Concerning his experiment studying fundamental properties of silicon, Andy said: "The data quality we obtained at Orion is unprecedented. This has allowed us to gain deep insight into the response of silicon to rapid compression – a topic which has puzzled the scientific community for around two decades. We are very grateful to the Orion staff, whose tireless hard work in fielding this experiment was invaluable."



*Image pictured above: Artist's impression of a magnetic cataclysmic variable. In these systems a 'white dwarf', an extremely dense star, transfers mass from a low-mass companion star (a main sequence or red star) to the white dwarf due to its gravitational pull. This accreted material produces a high-energy burst of radiation when it reaches the surface of the white dwarf at its magnetic pole. (Copyright Animea/F Durillon, CEA)*

Speaking about his experiment to investigate the physics of an unusual class of binary star, Gianluca said: "The Orion campaign has provided a vital piece of the jigsaw in the understanding of how strong shock waves behave. There are always three key ingredients that need to be considered each time a shock occurs. First, the shock compresses the ambient medium and its density increases. Second, the temperature rises. Third, some of the stored energy is radiated away.

"We were able to reproduce all of these elements in the experiment, making it a good replica of what is believed to occur when gas extracted from a main sequence star impacts the surface of a magnetised white dwarf – a phenomenon characteristic of an elusive binary system known as a cataclysmic variable."

Commenting on the performance of Orion, he added: "The quality of the data was impressive and well above what was previously possible, giving us access to quantities otherwise inaccessible in astronomical observations. I believe this work could stand as the ideal platform where astrophysics and laboratory communities meet to solve the enigmatic behaviour of cataclysmic variables."

The results are expected to attract significant interest from the international community, which is vital to both future research and inspiring the next generation of scientists. It is also expected to encourage future collaborative applications to Orion as part of AWE's successful academic access programme.

Link to the Nature Communications paper <http://dx.doi.org/10.1038/ncomms11899>

Link to Scientific Reports paper <http://dx.doi.org/10.1038/srep24211>

Link to AWE Orion web page <http://www.awe.co.uk/what-we-do/science-engineering-technology/orion-laser-facility>