International Low Temperature Plasma Community

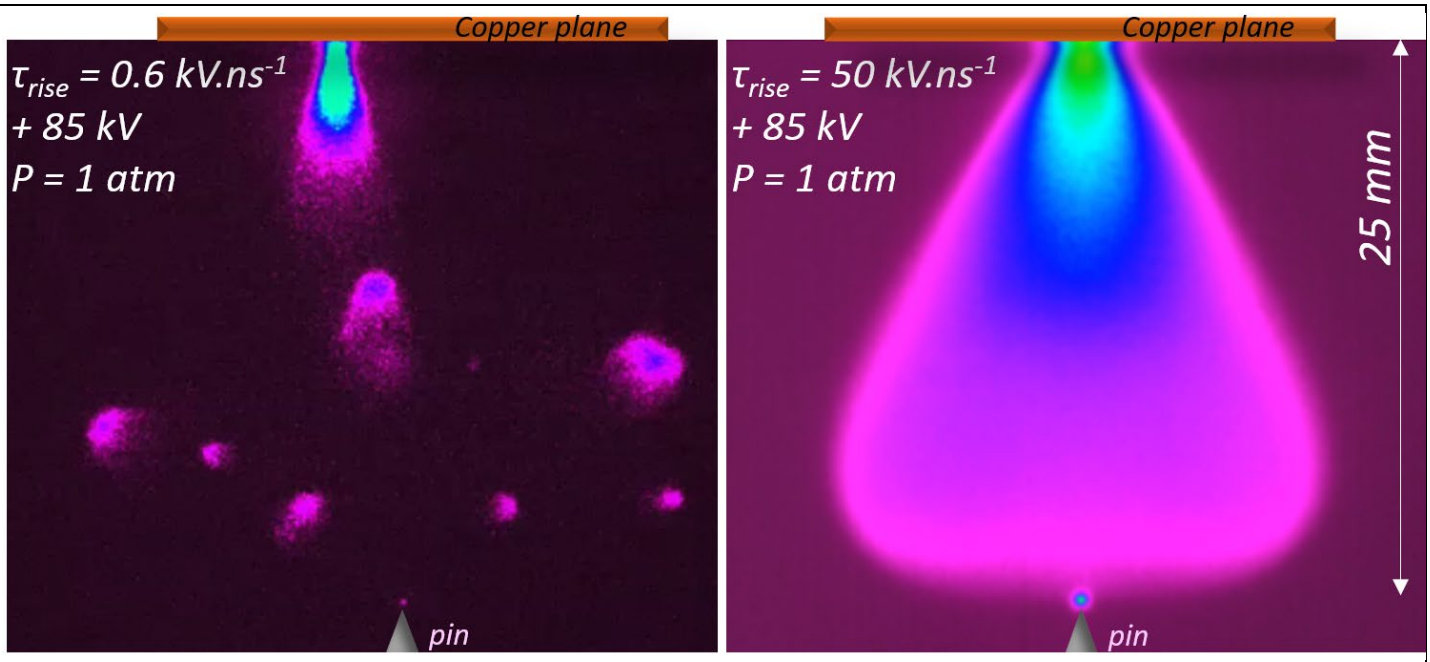
https://mipse.umich.edu/iltpc.php, iltpc-central@umich.edu

Newsletter 33

7 July 2023

Images to Excite and Inspire!

Please send your images (with a short description) to iltpc-central@umich.edu. The recommended image format is TIF, JPG, or PNG. The minimum file width is 800 px.



Peculiarities of discharges induced by strong over-voltages: An atmospheric pressure discharge ignited by a voltage pulse of moderate amplitude and rise rate develops as a streamer, or a branching of streamers (left), each leaving a quasi-neutral plasma trail behind. The electric field distribution in this filament is highly transient. High fields are very localised in the streamer (the ionisation front) and are screened in 10-100 ps by electrons. Seeking to maintain high electric fields in space and time, voltage pulses with both high amplitude and high rise rates have been investigated. A fast ionization wave is obtained that extends up to cm scales. Even though some processes are common with streamers and glow or spark-like discharges, the inception mechanisms and some post-discharge kinetics remain unclear. Focusing on the electric field distribution, measurements suggest an enhancement of the electron impact ionization mechanisms compared to more standard conditions. Also, ahead of the ionization front, the electric field spreads much further, which could reveal the existence of a long-distance pre-ionization mechanism. More surprisingly, shortly after breakdown (gap crossing), a fast (ns) electric field enhancement (several hundreds of Td) was observed in the vicinity of the pin, which is unexplained by attachment processes or gas expansion. Aside from these elementary questions, the discharge produces reactive species with remarkable efficiency and could be of special interest for a large range of applications. **Dr. Alexandra Brisset,** Université Paris-Saclay (alexandra.brisset@centralesupelec.fr); **Dr. Pierre Tardiveau,** Université Paris-Saclay (pierre.tardiveau@universite-paris-saclay.fr); and **Prof. Ana Sobota**, Eindhoven University of Technology (a.sobota@tue.nl).

In this issue:	
• Images • Call for Contributions • LTP Perspectives • Leaders of the LTP Community • General Interest Announcements	• Meetings and Online Seminars • Community Initiatives, Special Issues • Research Highlights, Breakthroughs • New Resources • Career Opportunities • Collaborative Opportunities

Call for Contributions

Please submit content for the next issue of the Newsletter. Please send your contributions to iltpc-central@umich.edu by **August 11, 2023.** Please send contributions as MS-Word files if possible – and **avoid sending contributions as PDF files**.

In particular, please send **Research Highlights and Breakthroughs** using this ***template:*** https://mipse.umich.edu/iltpc/highlight_template_v05.docx. The highlight consists of an image and up to 200 words of text; please also send your image as a separate file (the recommended image format is JPG or PNG; the minimum file width is 800 px). The topic can be anything you want - a recently published work, a new unpublished result, a proposed new area of research, company successes, anything LTP-related. Please see the *Research Highlights and Breakthroughs* for examples.

My Thoughts on Fundamental Research

One of the previous "perspectives", *Choose Your Research Problems Carefully*, discusses issues related to basic research. I often discuss this matter with friends and colleagues. I enjoy seeing that new models come out which have true predictive capabilities for certain plasma processes and that new industrial innovations originated from basic research. In addition, I draw tremendous satisfaction when we have identified key physical processes which can explain phenomena observed in experiments.

That said, there are many temptations that lure students away from performing fundamental research. This observation comes from a relatively small database, i.e., the students I am familiar with. There are a variety of fundamental research topics which are both important and interesting. Plasma surface interaction is one of them, as discussed by both Shahid Rauf and Ursel Fantz. These temptations likely result from students wanting to solve the world's problems during the first days of their graduate studies without realizing that these solutions are based on, or should be based on, fundamental principles.

To obtain significant results on fundamental topics, one needs to have a strong physics and mathematics background, to overcome many hurdles and to make consistent effort for a long time. The story told in their PhD thesis has to be both convincing and important. If these students publish papers on these fundamental topics, it is difficult to predict that they will get many citations, regardless the quality of the work. The connection between their fundamental work and solving the world's problems is not clear to them. Therefore, many students prefer to work on projects which have nearer term applications (and citations). Research problems involving difficult diagnostics and complicated analysis and modeling are seemingly not the most popular candidates for a PhD thesis research topic.

For experienced researchers, we have other concerns. A reliable research outcome often comes from a combined effort in both modeling and experimental verification. For experimentalists, many diagnostic equipment are costly to purchase and sometimes difficult to operate. Once you get some data, it may be hard to interpret the results properly. One needs to eliminate any possible artifacts encountered in the experiments. For theoretical work, one may have to deal with issues involving the lack of fundamental data or problems related to numerical computation. In this aspect, we may need to invent new principles which could provide a simpler approach to deal with the complicated chemical processes both in the gas phase and on surfaces. On the other hand, I will not be surprised to see new breakthroughs in basic research will occur in the near future due to the application of AI algorithms.

In the meantime, I have found out that the students who worked on basic research, once they graduate, are very much in demand in research institutes, universities, and companies. Apparently, the training they received during their PhD program has helped them to perform well in their new work places. Perhaps, the challenges encountered in doing basic research provide an opportunity to enhance their problem solving abilities. Mastery of the fundamentals that comes from basic research accelerates the development of technologies that address the world's problems. It is our responsibility to make students aware of how important this transition is. Therefore, if we do this, I think that the number of students who are interested in basic research will increase in the future. It is very likely these students will play an essential role in solving a variety of technological problems we face today in the world.

Prof. Yi-Kang Pu
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Leaders of the LTP Community: Career Profiles

Xinpei Lu – An Innovator in Plasma Biomedical Research

Professor Xinpei Lu, based at the School of Electrical and Electronic Engineering at Huazhong University of Science and Technology, serves not only as a teacher but also the director of the Institute of Low-Temperature Plasma Applications. His expedition into the realm of low-temperature plasma research, encompassing both theoretical and practical aspects, commenced in the late 20th century. This has established him as a pioneering figure in the field of plasma biomedical research. The collaborative endeavors of the research community have seen this field evolve and branch out into areas such as cancer therapy, chronic wound management, dental healthcare, and the aerosol sterilization of harmful microbes.

Professor Lu's research scope includes several critical aspects of low-temperature plasmas, for example, the atmospheric pressure non-equilibrium plasma jet mechanism, active particle diagnosis, and jet sources. He has spearheaded significant initiatives, like crafting the world's inaugural dry battery-powered air plasma jet tool and a device for generating plasma within dental root canals. In the realm of plasma biomedical research, his notable contributions span across areas including plasma's antimicrobial/antiviral attributes, plasma-induced apoptosis in cancerous cells, the stimulation of stem cell growth and differentiation, the intrusion mechanics into biological tissue, and the consequences of plasma's physical energy on such tissues.

With a fervent enthusiasm for expanding plasma biomedical applications, Professor Lu Xinpei has acted as both the coordinator and editor for special editions emphasizing *Plasma Physics and Medical Applications* across a variety of publications in the spheres of plasma, applied physics, and biomedicine. He has penned numerous monographs, such as *Nonequilibrium Atmospheric Pressure Plasma Jets: Fundamentals, Diagnostics, and Medical Applications* and *Low-Temperature Plasma Technology: Methods and Applications*.

Known for his speaking prowess, Professor Lu has been invited to deliver talks at all principal plasma conferences. He is esteemed within the community as an erudite, discerning, and gracious figure, and a bona fide leader in the field. His conversations have consistently been a source of inspiration, and many peers have experienced his warm hospitality during their trips to Wuhan, China. Owing to his scientific acumen and congenial nature, Huazhong University of Science and Technology is recognized as a hub for plasma biomedical research. His mentees have gone on to work at various universities and set up their plasma laboratories.

Apart from his research and publication pursuits, Professor Lu has played a crucial role in instituting an international seminar on plasma biomedicine. As an IEEE Senior Member and recipient of the Early Career Award in Plasma Medicine, among other honors, he persistently promotes the advancement of the low-temperature plasma discipline.

Prof. Liu Dawei
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General Interest Announcements

Please send you General Interest Announcements to iltpc-central@umich.edu.

Meetings and Online Seminars

- **The Online Low-Temperature Plasma (OLTP) Seminar Series – 3 Year Anniversary**

  The schedule for OLTP seminars and more information on the program, including links to past seminars, can be found at the OLTP website:

  https://theory.pppl.gov/news/seminars.php?scid=17&n=oltp-seminar-series

  The seminars are held on Tuesdays at 10:00 am EDT or EST via Zoom and are free to access.

  Co-Chairs:

  Dr. Mikhail Shneider, Princeton University, USA, shneyder@princeton.edu
  Prof. Dr. Vasco Guerra, University of Lisboa, Portugal, vguerra@tecnico.ulisboa.pt

- **IOPS Online Seminars**

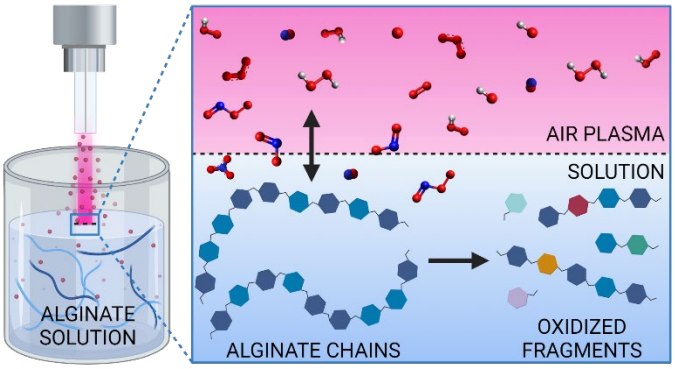
  The *International Online Plasma Seminar (IOPS)* is continuing to provide the international community with regular opportunities to hear from leading researchers in the field. The program of the IOPS (and links to past seminars) can be found at: http://www.apsgec.org/main/iops.php.

  Chair:
  Prof. Quan-Zhi Zhang, Dalian University of Technology, China, qzzhang@dlut.edu.cn

Community Initiatives and Special Issues

Please submit your notices for Community Initiatives and Special Issues to iltpc-central@umich.edu.

Does Non-thermal Plasma Modify Biopolymers in Solution?



According to recent studies, solutions of biopolymers with the ability to generate hydrogels, when treated with plasma, can enhance the generation of reactive species and influence their stability, resulting thus in the ideal media for indirect treatments of biological targets. The direct effects of the plasma treatment on the structure of biopolymers in water solution, as well as the chemical mechanisms responsible for the enhanced generation of RONS, are not yet fully understood.

In this study, we investigate, on the one hand, the nature and extent of the modifications induced by plasma treatment in alginate solution. On the other hand, we use this information to explain the mechanisms responsible for the enhanced generation of reactive species as a consequence of the treatment.

The approach we use in this research is twofold: i) investigating the effects of plasma treatment on alginate solution, and ii) study of a molecular model (glucuronate) sharing its chemical structure.

The results point out the active role of the biopolymer chemistry during direct plasma treatment. Short-lived reactive species, can modify the polymer structure, affecting its functional groups and causing partial fragmentation. Some of these modifications, are likely responsible for the secondary generation of long-lived reactive species. This is relevant in view of using biocompatible hydrogels as vehicle for storage and delivery reactive species for targeted therapies.

Contacts:
Dr. Francesco Tampieri and Dr. Cristina Canal
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francesco.tampieri@upc.edu, cristina.canal@upc.edu

Source:
Biomater. Sci., 2023.
https://doi.org/10.1039/D3BM00212H

Defects in Mitochondrial Functions Affect the Survival of Yeast Cells Treated with Non-thermal Plasma

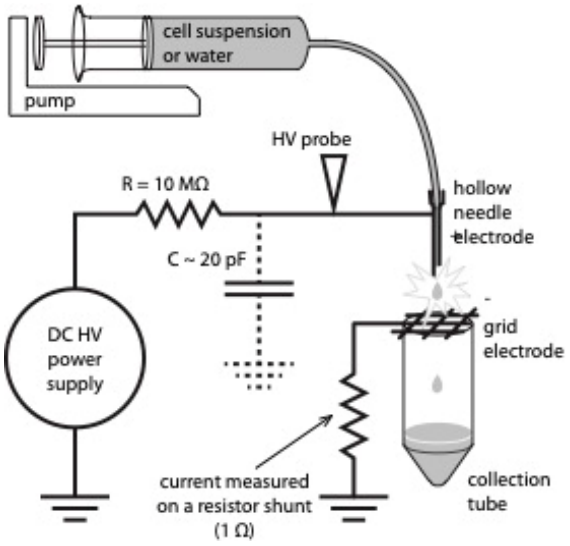

Figure 1. Experimental setup for plasma treatment of water. The transient spark discharge was operated between the tip of the needle electrode and a grid electrode. Treated deionized water was pumped through the needle electrode and electrosprayed through the plasma discharge.

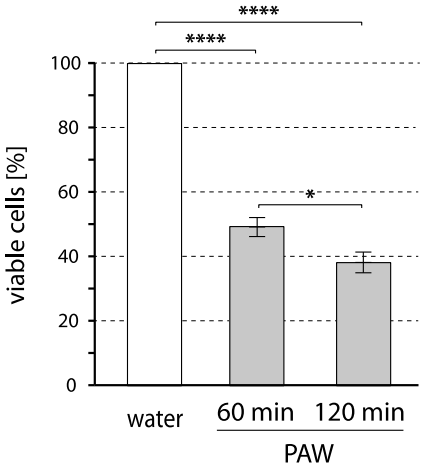

Figure 2. Effect of PAW on the viability of wild-type (BY4742) yeast strain. Cells were incubated with PAW or untreated water (control). After the indicated time of incubation (60 or 120 min) aliquots were spread onto Petri dishes with complete growth medium (YPD). Plotted values represent the number of colonies formed by treated cells relative to the untreated control, with control normalized to 100%.

Exposure of living cells to non-thermal plasma produced in various electrical discharges affects cell physiology and often results in cell death. Even though plasma-based techniques have started finding practical applications in biotechnology and medicine, the molecular mechanisms of interaction of cells with plasma remain poorly understood. In this study, the involvement of selected cellular components or pathways in plasma-induced cell killing was studied employing yeast deletion mutants. The changes in yeast sensitivity to plasma-activated water were observed in mutants with the defect in mitochondrial functions, including transport across the outer mitochondrial membrane, cardiolipin biosynthesis, respiration, and assumed signaling to the nucleus. Together these results indicate that mitochondria play an important role in plasma-activated water cell killing, both as the target of the damage and the participant in the damage signaling, which may lead to the induction of cell protection. On the other hand, our results show that neither mitochondria-ER contact sites, UPR, autophagy, nor proteasome play a major role in the protection of yeast cells from plasma-induced damage.

Contact:
Prof. Zdenko Machala
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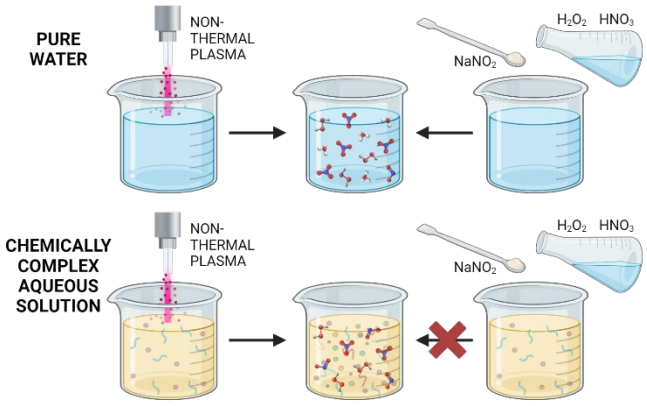
Source:
Int. J. Mol. Sci. **24**, 9391 (2023).
https://doi.org/10.3390/ijms24119391

Plasma-treated Liquids in Medicine: Let's Get Chemical



Fundamental and applied research on plasma-treated liquids for biomedical applications was boosted in the last few years, dictated by their advantages with respect to direct treatments. However, often, the lack of consistent analysis at a molecular level of these liquids, and of the processes used to produce them, have raised doubts of their usefulness in the clinic. The aim of this article is to critically discuss some basic aspects related to the use of plasma-treated liquids in medicine, with a focus on their chemical composition. We analyze the main liquids used in the field, how they are affected by non-thermal plasmas, and the possibility to replicate them without plasma treatment.

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Source:
Plasma Process. Polym., 2023.
https://doi.org/10.1002/ppap.202300077

New Resources

Please submit your notices for New Resources to iltpc-central@umich.edu.

Career Opportunities (for other career opportunities, see: https://mipse.umich.edu/jobs.php)

- **Assistant Professor in Electric Discharges for the Environment, Eindhoven University of Technology, The Netherlands**

We are looking for a tenure track or more senior candidate with an experimental, theoretical or numerical background to join the faculty of the Eindhoven University of Technology to work on one or more of the following topics:

- Lightning and upper atmospheric discharges.
- Space weather and its effects on earth.
- Discharges for environmental applications.
- Discharges for circular energy.

You will be working as an independent PI within the group Elementary Processes in Gas Discharges (EPG, https://www.tue.nl/en/research/research-groups/elementary-processes-in-gas-discharges/). This group works on a variety of plasma related topics, ranging from the ones mentioned above, to more high-tech industrial oriented applications and plasma medicine. Experimental work is done using state-of-the art laser diagnostics, while our numerical efforts are mostly focused around our own Plasimo plasma simulation framework. The vacancy is open for an assistant professor, either tenure track or tenured, depending on the experience of the candidate. Female candidates are explicitly invited to apply.

- You will be responsible for setting up and driving your own independent research program, by generating funding, and supervising/coaching students at the bachelor/master/PhD level.
- You will be teaching at the Applied Physics bachelor and master level.
- You will contribute to the success of the research group, department, and associated institutes by initiating new internal and external collaborations and proactive participation.

You should be a motivated researcher, with a PhD in (applied) physics, chemistry, chemical or electrical engineering, or similar and preferably at least 2 years of experience as researcher. You should have an ability to conduct high quality academic research, reflected in demonstratable outputs while being motivated to teach, contribute to teaching processes, and to develop excellent teaching skills. You should have strong cooperation skills and ability to work in an interdisciplinary team. Effective communication and leadership skills, including coaching and mentoring of students and staff, leading a project or chairing a group are needed. Experience in acquiring external research funding from (inter)national funding bodies, or industry is an asset. Excellent (written and verbal) proficiency in English is needed.

We offer a meaningful job in a dynamic and ambitious university, in an interdisciplinary setting and within an international network. You will work on a beautiful, green campus within walking distance of the central train station. In addition, we offer a Tenure Track of five years with the prospect of becoming an Associate Professor. If you have a more senior profile, a tailor-made career proposal will be considered.

For more information, please visit the vacancy online at https://jobs.tue.nl/nl/vacature/assistant-professor-in-electric-discharges-for-the-environment-998385.html. Questions regarding the scientific content can be directed to the contacts.

Contacts:
Prof.dr.ir. Gerrit Kroesen, g.m.w.kroesen@tue.nl
Er.ir. Sander Nijdam, Associate Professor, s.nijdam@tue.nl
Josje van Oudenaarden, Senior Recruiter, j.e.v.oudenaarden@tue.nl or +31 643559575
Eindhoven University of Technology, The Netherlands

- **Post-doctoral Position in Plasma Surface Interaction (Data and Tools) Coupled Modelling (PSI.COM), Instituto Superior Técnico, Lisbon, Portugal**

Project PSI.COM addresses the coupled modelling of the plasma-surface chemistry in N_2-H_2 mixtures, comprising several exciting endeavours: bridging the gap between volume and surface reactivity in plasma simulations; exploring the full potential of high-quality controlled measurements in an interplay with self-consistent time-dependent kinetic simulations; embracing screening/reduction of chemistry schemes as key-component of modelling; and publishing validated data in web-based platforms.

We will leverage complementary expertise in modelling and diagnostics of low-temperature plasmas (LTP) from group N-PRiME (N-Plasmas Reactive: Modelling and Engineering, Instituto de Plasmas e Fusão Nuclear – IPFN, Instituto Superior Técnico – IST, Lisbon Portugal) and from LPP (Laboratoire de Physique des Plasmas, Ecole Polytechnique, Palaiseau, France).

Project tasks involve:

(i) The study of N_2-H_2 plasmas and the catalytic production of ammonia, using an interplay between modelling and diagnostics to understand the volume + surface kinetic paths, and to validate and reduce the kinetic scheme.

(ii) The development and the consolidation of the LoKI tool suite, aiming at full time-dependent description, extended to surface reactions and including the gas/plasma thermal balance, and including ML tools for sensitivity analysis.

(iii) The formulation and implementation of solutions for data storage and parsing in LTPs modelling, aiming at developing a high-performance open-access data-storage library for LoKI, in association with the LXCat stakeholders.

PSI.COM is currently inviting expressions of interest (EoI) for:

- **A three-year postdoctoral position at IPFN/IST, mainly to develop tasks (i) and (ii), starting in the fall of 2023** (here, we prefer candidates with previous experience in the modelling of low-temperature plasmas) - **OPEN CALL UNTIL AUGUST 2023.**
- **A two-year contract with an institution affiliated to IST, mainly to develop tasks (ii) and (iii), starting early 2024** (here, we prefer candidates with technical skills in the development of scientific software and of platforms for data storage, analysis, and visualization.

For more information, see https://nprime.tecnico.ulisboa.pt/psi.com/, and/or send your CV with subject "PSI.COM" to the contact.

Contact:
Prof. Luís L. Alves
Instituto Superior Tecnico, Lisbon, Portugal
llalves@tecnico.ulisboa.pt

- **PhD Project: Iodine-Fueled Neutralizers for Electric Propulsion Systems, University of South Wales, Australia**

The School of Engineering and Information Technology at the University of New South Wales (UNSW) Canberra has an open PhD position in the field of plasma physics and electric propulsion.

Estimates suggest that between 17,000-50,000 satellites could be launched over the next 10 years, the vast majority of which will require onboard propulsion systems. Electric propulsion is particularly attractive because of its high fuel efficiency, and some of the most successful technologies employed to date include gridded ion and Hall thrusters. Such systems have historically used xenon as a propellant; however, xenon is very rare and global production is both limited and susceptible to strong market fluctuations. An emerging alternative propellant is iodine which was first tested in space in 2020. Iodine is almost 100x cheaper than xenon, and in addition, can be stored unpressurized as a solid. While iodine has been successfully demonstrated as a propellant, several challenges remain in developing all-iodine electric propulsion systems, particularly with regards to neutralizers – electron emitting devices needed for the operation and/or neutralization of ion beams. Aside from challenges associated with iodine-compatible materials, the strong electron affinity and unique plasma chemistry of iodine can lead to the formation of large quantities of negative ions that affect the electron extraction capability of some neutralizers.

This is a theoretical/computational PhD project that will explore iodine-fuelled neutralizers for electric propulsion systems by taking advantage of recently calculated collision cross-sections to develop theoretical/numerical plasma models. This modelling will help to better understand fundamental iodine plasma discharge physics and aid in the development or proposal of future neutralizer technologies.

The project will be performed in collaboration with the Laboratoire de Physique des Plasmas (LPP) at Ecole Polytechnique situated just south of Paris, France. There is potential for the candidate to travel to France during their PhD to perform iodine experiments at LPP.

UNSW Canberra values diversity and equal opportunity, and this project is open to all candidates with a background in physics and/or engineering. The ideal candidate will have strong mathematical, programming, and communication skills. PhD scholarships worth AUD35,000 per year are available from the university for high-achieving candidates.

Express your interest in this project by emailing the contact. Include a copy of your CV and a motivation letter that highlights your research experience.

More information:

https://www.unsw.edu.au/research/hdr/our-projects/iodine-fuelled-neutralizers-for-electric-propulsion-systems

https://www.unsw.adfa.edu.au/study/scholarships/postgraduate-research-scholarships

Contact:

Dr. Trevor Lafleur
University of New South Wales, Australia
t.lafleur@adfa.edu.au

- **Scientific Programmer FORTRAN and C++, Plasma Modeling, Quantemol Ltd, United Kingdom**

Quantemol (www.quantemol.com) is hiring a full-time scientific programmer FORTRAN and C++. You will work on an exciting scientific R&D project, delivering new products and services for our plasma modelling software line. We are a London-based company, and the role will be predominantly work-from-home based within the UK. Some in-person meetings and office-based coworking are to be expected (up to 1-2 times a week). Furthermore, some national and international travel is to be expected.

Specifically, you will be working on writing a 3D plasma modelling code with unstructured mesh and participating in conferences and webinars relevant to your role. Part of your work will also include customer support, test automation, and potentially conducting calculations using our software.

Knowledge, skills, and experience:

Essential:

- Proven ability to code software in FORTRAN or C++ demonstrating good coding practices
- A PhD in plasma physics

Highly desirable:

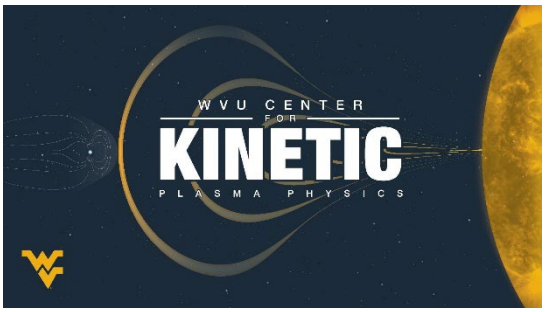
- Experience in working with meshes and unstructured meshes in particular
- Knowledge of low-pressure plasma physics

Quantemol is a scientific software and consultancy company with an international customer base and a small friendly team of experts based in the UK. We are providing plasma modelling solutions to the semiconductor industry and others. Our products are complicated but the results of your work have a real impact. We are facilitating innovation which can change the world. Join us on this journey!

Please email your CV with a cover letter to recruitment@quantemol.com.

Contact:
Anna Nelson
Quantemol, Ltd, United Kingdom
a.nelson@quantemol.com

- **Post-doctoral Position in Plasma Physics, West Virginia University, USA**



The plasma physics group headed by **Professor Earl Scime** (escime@wvu.edu) at West Virginia University, Morgantown, USA, invites applications for at least one Postdoctoral Research Associate position within the Center for KINETIC Plasma Physics (https://kineticplasma.wvu.edu/). The primary responsibilities of the position involve the performance of experiments focused on magnetic reconnection and thermal anisotropy driven instabilities in the PHAse Space MApping (PHASMA) facility, ion acoustic solution excitation, and multi-photon fluorescence spectroscopy. A PhD in physics or other relevant field and a strong experimental background and/or experience with low temperature plasma sources, plasma diagnostics, vacuum systems, and spectroscopy are required. The salary and benefits are competitive and the successful applicant will have opportunities to develop new research ideas, participate in proposal development, lead collaborations with other research groups, and mentor graduate and undergraduate students. Morgantown is regularly listed among the top ten small cities on the east coast of the USA and is located approximately 70 miles south of Pittsburgh, PA and 200 miles east of Washington, DC. The university has an enrollment of 20,000 students and the Department of Physics and Astronomy has strong research programs in plasma physics, condensed matter physics, physics education research, and astronomy. For a complete job description and to apply for this position (a CV, cover letter, and three letters

of reference are required), please visit https://careers.wvu.edu/career-opportunities and click on the "View Open WVURC Positions" link to find Position #22060.

Contact:
Prof. Earl Scime
West Virginia University, USA
escime@wvu.edu

- **Post-doctoral Research Associate, Tokamak and Stellarator Operation and Liquid Lithium/Metals, High-Power Impulse Magnetron Sputtering, University of Illinois Urbana-Champaign, USA**

  The Center for Plasma Material Interactions (CPMI) at the University of Illinois Urbana-Champaign is looking to fill positions at the post-doctoral research associate level, who will work on research areas relevant to plasma material interactions for several applications. The Center for Plasma-Material Interactions currently has 4 faculty, 1 Post Doc, 22 graduate students, and over 25 undergraduate researchers. The primary emphasis is experimental and computational study of plasma relating to nuclear fusion (plasma material interactions, liquid metal technology, edge plasma, diagnostics) and manufacturing of semiconductor devices (plasma-based lithography, plasma etching, PVD sputtering, PECVD thin-films). In particular, we are looking for expertise in the field of **Tokamak and Stellarator Operation and Liquid Lithium/Metals as well as Chemistry and High-Power Impulse Magnetron Sputtering (HiPIMS).** The hired post-docs are expected to closely work with **Research Associate Prof. Daniel Andruczyk** and **Prof. David Ruzic** in managing research activities in the lab and conducting experiments while assisting students with research.

  To apply for this position please send a cover letter, CV/resume, and contact information for 3 references to the contact listed below. The Postdoctoral Research Associate is a full-time, benefits-eligible position appointed on a 12-month service basis. The start date is Fall 2023 or sooner if possible with expected duration of 1-2 years.

  More information:
  - Center for Plasma Material Interactions: http://cpmi.illinois.edu
  - Department of Nuclear, Plasma and Radiological Engineering: http://npre.illinois.edu
  - University of Illinois: http://illinois.edu

  Contact:
Prof. Daniel Andruczyk
University of Illinois, USA
andruczy@illinois.edu

Collaborative Opportunities

Please submit your notices for Collaborative Opportunities to iltpc-central@umich.edu.

Disclaimer

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and Engineering