

THE UNIVERSITY OF MANCHESTER
PARTICULARS OF APPOINTMENT
FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY
READER/PROFESSOR IN HYDROGEN/ TRITIUM SCIENCE AND TECHNOLOGY
VACANCY REF: SAE-016660

Salary:	Professorial Scale
Hours:	Full Time
Duration:	Permanent
Location:	Oxford Road, Manchester

Enquiries about vacancy shortlisting and interviews:

Name: Francis Livens

Email: francis.livens@manchester.ac.uk

BACKGROUND

Fusion energy has been explicitly identified in Government's Ten Point Plan for a Green Industrial Revolution, and in the December 2020 Energy White Paper. UKAEA leads the UK fusion energy programme and is running a Grand Challenge class programme to deliver power to the grid in the 2040's. In collaboration with UKAEA, The University of Manchester is establishing a research group focused on the behaviour, processing and applications in energy technologies of gases, particularly hydrogen and its isotopes. Research relevant to nuclear fusion technology will be a major, but not exclusive, focus of the group. Applications are invited for three appointments at levels from Research Fellow to Professor, as appropriate. While there are particular interests in Isotope Separation; Tritium Production and Processing, and Hydrogen in Materials, these are not exclusive and other relevant areas of expertise are also of interest.

Isotope Separation Tritium readily exchanges with other hydrogen isotopes so that separation of small masses of tritium from much larger masses of the stable isotopes is a very common problem. This is important to enable recovery and reuse of scarce and expensive tritium. The recovery of helium-3, the decay product of tritium, which has some specialist applications, would also be beneficial. However, isotope separations are typically laborious and energy-intensive so new approaches need to be explored. Beyond proof-of-principle, other challenges lie in the practical application, both scaling up to a usable process, and the applicability of any separation to a gas stream where the tritium:hydrogen atom ratio may easily be in the range 10⁻⁸ to 10⁻⁹.

Tritium Production and Processing The short (12.3 year) half life of tritium and its consumption in fusion reactors necessitates continuous supply of kg quantities of tritium. This can be 'bred' by

neutron irradiation of lithium materials, with two candidates being solid (e.g. lithium ceramics) or liquid (e.g. molten Pb/Li) target materials. The targets will be irradiated with neutrons from the fusion reactor and processed to recover the tritium. Research questions include the development and validation of: target materials; neutron irradiation procedures for the targets; methods for target processing and tritium recovery.

Hydrogen in Materials Hydrogen is very readily taken up by both metallic and non-metallic materials and tritium uptake creates several challenges for fusion technology. Allowing the tritium inventory of a fusion power station to increase continually is both a safety issue and a waste of valuable tritium. Hydrogenation of plasma facing materials, pipework and other components may alter mechanical properties leading, for example, to embrittlement and potential failure. The mechanisms by which uptake occurs, and the potential to reduce or eliminate it in reactor components through manufacturing processes or coating technologies, are major research challenges. The tritium content of wastes renders them difficult to manage so the ability to process wastes and recover the tritium (detritiation) would also be valuable.

Tritium Facilities Since tritium is a radioactive gas, it has to be handled using specialist facilities and experimental work with tritium will be carried out in very close collaboration with UKAEA through joint supervision of PhD students and other research projects, using facilities in both organisations. The University already has facilities for handling tritium and tritiated materials up to 1 GBq in activity, which will be relocated to the Henry Royce Hub Building during 2021. UKAEA hosts H3AT (Hydrogen-3 Advanced Technology <https://ccfe.ukaea.uk/technology/h3at/>), where multi-gram quantities (PBq) of tritium can be handled, and which will be used for scale-up to fusion-relevant quantities.

The University of Manchester already has presences at the Harwell Campus which is convenient for Culham and can be used as a base for work at UKAEA, and at the Dalton Cumbrian Facility where it hosts a dual beam ion accelerator facility.

The successful candidates will have the opportunity to establish and shape an exciting new research initiative, closely aligned with long term national priorities. They will be expected to develop their own research programmes and to collaborate with other researchers within their host Departments and further afield in The University. They will also be expected to contribute fully to teaching.

These posts may be held in any appropriate Department within the Faculty of Science and Engineering (FSE), which is subdivided into the School of Natural Sciences (comprising the Departments of Mathematics, Chemistry, Physics & Astronomy, Materials, Earth & Environmental Sciences) and the School of Engineering (comprising the Departments of Chemical Engineering & Analytical Science (CEAS), Electrical & Electronic Engineering (EEE), Mechanical, Aerospace and Civil Engineering (MACE), Computer Science). During 2021, the £ 450 M Manchester Engineering Campus Development will open, allowing colocation of the Departments of Materials, CEAS, EEE and MACE.

The University actively fosters a culture of inclusion and diversity and seeks to achieve true equality of opportunity for all members of its community. The Faculty welcomes applications from all sections of the community and are committed to having a representative workforce. Across the Schools we hold Bronze and Silver Athena SWAN Awards, which recognise our commitment to equality, diversity and inclusion and particularly the advancement of women's careers in STEM.

The University also holds a Bronze Race Charter Mark recognising our commitment to improving the representation, progression and success of minority ethnic staff and students within higher education. In addition, we are a Disability Confident Employer, guaranteeing an interview for any disabled applicant who meets the minimum requirements for a job.

The University of Manchester

The University of Manchester (www.manchester.ac.uk) enjoys a global reputation for its research and its innovative approach to learning, with an on-going £1 billion investment in facilities, staff and buildings. This builds on our tradition of success that stretches back over 180 years. The birth of the modern computer, the splitting of the atom, the founding principles of modern economics, the discovery of graphene, and the birthplace of chemical engineering – these and many more world changing innovations have their roots at our University. We are at the forefront of the search for solutions to some of the world's most pressing problems, boasting strong collaborative links with industry and public services. The University hosts the largest nuclear community in UK academia, coordinated by the Dalton Nuclear Institute, and has a wide collaborative network in nuclear research and training. University staff support Government, regulators and industry across the nuclear sector.

Overall Purpose of the Jobs:

Successful applicants will be expected to work together and in collaboration with others across the Faculty to develop high quality, relevant research programmes. Example areas of interest include the behaviour and effects of hydrogen in materials, isotope separation, the processing of hydrogen, management of tritiated materials (note that this is not an exhaustive list). They will also be expected to participate fully in relevant undergraduate and postgraduate teaching programmes including undergraduate and post-graduate project supervision. The senior appointee will be expected to lead the group, developing a coherent identity for it, and engendering a supportive culture for earlier career staff.

Key Responsibilities, Accountabilities or Duties:

Research

- Undertake and direct high quality research in a relevant research programmes. Example areas of interest include the behaviour and effects of hydrogen in materials, isotope separation, the processing of hydrogen, management of tritiated materials (note that this is not an exhaustive list)
- Publish research in high quality academic journals and through presentations at virtual and physical conferences and seminars
- Establish strong collaborations, including joint supervision of PhD students and other researchers, with UKAEA and other organisations in the nuclear fusion arena
- Identify and secure significant external research funding
- Attract and supervise postgraduate students and postdoctoral research associates; and
- Develop research impact through suitable collaborations and partnerships.
- Be a strong advocate of research integrity and embed social responsibility within all activities

Teaching

- Teach on relevant undergraduate and postgraduate programmes, covering both core material and specialist research topics
- Design and deliver high quality teaching and learning material and provide timely and effective support and feedback to students
- Set, mark and assess coursework and examinations
- Contribute to teaching-related administration, examination and curriculum design
- Supervise undergraduate and taught postgraduate student projects and tutorials
- Build an understanding of social responsibility relating to the field into projects and curriculum

Service and Leadership

- Contribute to the relevant department's organisation and administration
- Take an active role in supporting and driving collaboration with colleagues across the Faculty
- Help drive initiatives to build an inclusive and positive culture across the Faculty

Please note that the Faculty is rethinking the way nuclear topics are taught in the undergraduate curriculum so there is an opportunity to contribute to innovations in both content and delivery.

PERSON SPECIFICATION

Essential Knowledge, Skills and Experience:

The appointed person will be highly self-motivated with demonstrable expertise in his/her field and clear potential for development at the international level. They will have:

- A first degree and PhD (or equivalent) in a relevant discipline
- A clear commitment through previous actions to social responsibility and inclusivity
- Excellent interpersonal and communication skills
- An ability to work collaboratively as part of a team

A demonstrable research track record in a relevant area which includes:

- A successful record of relevant high quality publications
- Experience of presenting at national and international conferences
- Recognition within the relevant research community
- A commitment to developing and maintaining a programme of research and disseminating the results
- The ability, or potential, to obtain significant research funding and evidence of managing research projects

- Enthusiasm for teaching and evidence of teaching ability

Desirable Knowledge, Skills, Experience and Qualifications:

- Experience of a range of teaching methods
- Postdoctoral research or industrial experience
- Experience of planning and developing a range of teaching materials
- Experience of supervising postgraduate students/undergraduate project students
- Experience of working in or with industry