

Course Information Sheet for entry in 2024-25: Fusion Power (DPhil)



Course facts

Mode of study	Full Time Only
Expected length	4 years

About the course

The Fusion Power cohort-based training programme is provided by a collaboration between five UK universities (Durham, Liverpool, Manchester, Oxford, and York), other research organisations including Culham Centre for Fusion Energy, and industry such as Tokamak Energy, First Light Fusion and OxfordSigma.

The Fusion Power cohort-based training programme provides training from world-leading experts in a range of fusion-relevant disciplines, focusing on the aspects of materials science, and plasma physics, required to make fusion power a reality.

You will be trained to PhD-level (a PhD is known as a DPhil at Oxford) in disciplines related to fusion power. A significant number of fully-funded four-year doctoral studentships are expected to be available each year. The programme expects to train at least 80 students over five intakes from 2024 to 2028.

The majority of projects are expected to collaborate with the wider fusion industry.

You will have access to a range of fusion materials facilities within Oxford and across the UK, and international links provide access to many other fusion devices around the world.

The combination of world-leading experts and world-class facilities creates an outstanding training environment for the next generation of fusion scientists - the generation who may exploit STEP, ITER, NIF and other international experiments to make fusion energy a reality.

Course outline

In Oxford, students will focus on materials for fusion power. You will train and study alongside students undertaking the DPhil in Materials, together forming an Oxford cohort of research students in materials.

The programme is normally carried out in four years of full-time study under the supervision of an experienced member of staff. The first year will be focussed on training.

You will spend the first eight months of the programme, attending a number of technical fusion modules designed to provide the best possible platform for your substantial research project. Please note that the modules offered may change to reflect the latest academic thinking and expertise of staff. Some examples of modules include:

- Introduction to Fusion Plasmas
- Introduction to Materials
- Plasma Facing Technologies
- Irradiation Damage and Degradation
- Leadership and Research skills
- Tritium and the Fusion Fuel Cycle
- Plasma Surface Interactions Lab
- Functional and Superconducting Technologies
- Data Management and Software Skills
- Analytical Tools for Fusion Materials
- Manufacturing and Design Codes
- Multi-scale Computational materials engineering

Many of these modules take place at the University of York, and all students will be based at the York Plasma Institute to begin with, following registration at the University of Oxford. There will also be a number of intensive one-week modules based at the other collaborating universities. Travel and subsistence funds are provided for attending the different week-long courses.

During your first year, you will also attend 'Frontiers of Fusion and Interfaces', an annual workshop which features fascinating talks by well-known and internationally-respected external speakers. Students from all cohorts (and their supervisors) will gather for a scientific meeting exploring a range of fusion issues and how they link to related fields, such as fission, advanced instrumentation, technological plasmas, and more.

The remaining three years of the programme will be spent conducting research. A wide range of exciting DPhil projects is available and they are listed on the Department of Materials website under *Fusion Power DPhil projects*.

Fusion materials research at the University of Oxford

Research interests in Oxford's Department of Materials extend over most branches of materials science, as well as some aspects of solid state physics and chemistry. These include the study of a wide range of materials of relevance in advanced technological applications, including metals and alloys, composites, semi- and super-conductors, polymers, biomaterials, ceramics and materials for quantum information processing.

Much of the research is carried out in close collaboration with industry. World-leading research takes place on:

- the characterisation of materials, where there is emphasis on electron microscopy and related techniques
- processing and manufacturing of materials
- modelling of materials, where there is attention to both structures and processes
- properties of materials
- energy materials, including those for batteries, nuclear fusion and photovoltaics
- quantum information processing, which includes groups working on experimental studies, theory and modelling.

The plasma-facing components and breeding blanket of any future fusion tokamak will be subjected to one of the most extreme engineering environments possible. Materials will experience temperatures of up to 1200C in steady state and 3300C in transient events, and irradiation with 14MeV neutrons, causing displacement damage, transmutation giving rise to compositional changes, and internal H and He generation, plasma facing surfaces also can have high erosion rates due to interactions with the fusion plasma. Ideally, the materials should not retain tritium or themselves transmute to long-lived radioactive isotopes. For fusion to be feasible as an economic power source, the materials must be able to survive these conditions, retaining usable thermal and mechanical properties, for five years or more.

Materials of current interest include special 'reduced activation' steels, tungsten alloys and composites, ceramic composites for neutron shielding, silicon carbide and high-temperature superconductors.

The University offers a range of projects, both experimental and modelling, on the processing, joining, microstructure, mechanical properties, and resistance to radiation damage of these materials.

Projects will use a range of specialised research techniques, usually in combination:

- advanced processing, coating and joining methods (mechanical alloying, rapid solidification, spray forming, additive manufacture, friction-stir welding)
- irradiation of materials by high-energy ion-beams, protons and neutrons.
- liquid metal corrosion
- characterisation of superconducting materials
- electron microscopy of microstructures, and radiation damage effects, including in-situ irradiations, and field-ion microscopy of radiation damage
- microanalysis by atom-probe tomography and electron-optical methods
- X-ray diffraction including use of the diamond light source mechanical testing, including micromechanics, over a wide temperature range
- computer modelling of radiation damage effects, deformation and microstructural development.

An overview of the provision for research students in the Department of Materials can be found at the Summary of Provision for Materials Research Students webpage. Also available is Guidance on Supervision Arrangements.

Supervision

The allocation of graduate supervision for this course is the responsibility of the Department of Materials and it is not always possible to accommodate the preferences of incoming graduate students to work with a particular member of staff. Under exceptional circumstances a supervisor may be found outside the Department of Materials.

You will usually meet with your supervisor approximately every two to three weeks.

Assessment

All students will be initially admitted to the status of Probationer Research Student (PRS). Normally after six terms as a PRS student (and normally by the fourth term) you will be expected to apply for transfer of status from Probationer Research Student to DPhil status.

A successful transfer of status from PRS to DPhil status will require completion of the taught aspects of the Fusion course and a report on the first six months work on your DPhil project

If successful at transfer, you will also be expected to apply for and gain confirmation of DPhil status within nine terms of admission, to show that your work continues to be on track.

Both milestones normally involve an interview with two assessors (other than your supervisor) and therefore provide important experience for the final oral examination.

You will be expected to submit a substantial thesis after four years from the date of admission. To be successfully awarded a DPhil you will need to defend your thesis orally (*viva voce*) in front of two appointed examiners.

Changes to this course

The University will seek to deliver this course in accordance with the description set out above. However, there may be situations in which it is desirable or necessary for the University to make changes in course provision, either before or after you commence your course. These might include significant changes made necessary by any pandemic, epidemic or local health emergency. For further information, please see the University's Terms and Conditions (<http://www.graduate.ox.ac.uk/terms>) and our page on changes to courses (<http://www.graduate.ox.ac.uk/coursechanges>). We expect that the majority of applicants who are offered a place on this course will also be offered a fully-funded scholarship specific to this course, covering course fees for the duration of their course and a living stipend.

Costs

Annual fees for entry in 2024-25

Fee status	Annual Course fees
Home	£9,500
Overseas	£31,480

Information about course fees

Course fees are payable each year, for the duration of your fee liability (your fee liability is the length of time for which you are required to pay course fees). For courses lasting longer than one year, please be aware that fees will usually increase annually. Information about how much fees and other costs may increase is set out in the University's Terms and Conditions (<http://www.graduate.ox.ac.uk/terms>).

Course fees cover your teaching as well as other academic services and facilities provided to support your studies. Unless specified in the additional cost information (below), course fees do not cover your accommodation, residential costs or other living costs. They also don't cover any additional costs and charges that are outlined in the additional cost information.

Graduate students who have reached the end of their standard period of fee liability may be required to pay a termly University and/or a college continuation charge.

The University continuation charge, per term for entry in 2024-25 is £628, please be aware that this will increase annually. For part-time students, the termly charge will be half of the termly rate payable by full-time students.

If a college continuation charge applies (not applicable for non-matriculated courses) it is likely to be in the region of £100 to £600. Please contact your college for more details, including information about whether your college's continuation charge is applied at a different rate for part-time study.

Additional cost information

There are no compulsory elements of this course that entail additional costs beyond fees (or, after fee liability ends, continuation charges) and living costs. However, please note that, depending on your choice of research topic and the research required to complete it, you may incur additional expenses, such as travel expenses, research expenses, and field trips. You will need to meet these additional costs, although you may be able to apply for small grants from your department and/or college to help you cover some of these expenses.

Living costs

In addition to your course fees, you will need to ensure that you have adequate funds to support your living costs for the duration of your course.

The likely living costs for 2024-25 are published below. These costs are based on a single, full-time graduate student, with no dependants, living in Oxford. We provide the cost per month so you can multiply up by the number of months you expect to live in Oxford.

Likely living costs for one month

	Lower range	Upper range
Food	£315	£495
Accommodation	£745	£925
Personal items	£190	£320
Social activities	£40	£95
Study costs	£35	£85
Other	£20	£35
Total	£1,345	£1,955

Likely living costs for nine months

	Lower range	Upper range
Food	£2,835	£4,445
Accommodation	£6,705	£8,325
Personal items	£1,710	£2,880
Social activities	£360	£855
Study costs	£315	£765
Other	£180	£315
Total	£12,105	£17,595

Likely living costs for twelve months

	Lower range	Upper range
Food	£3,780	£5,940
Accommodation	£8,940	£11,100
Personal items	£2,280	£3,840
Social activities	£480	£1,140
Study costs	£420	£1,020
Other	£240	£420
Total	£16,140	£23,460

When planning your finances for any future years of study at Oxford beyond 2024-25, it is suggested that you allow for potential increases in living expenses of 5% or more each year – although this rate may vary depending on the national economic situation.

More information about how these figures have been calculated is available at www.graduate.ox.ac.uk/livingcosts.

Document accessibility

If you require an accessible version of this document please contact Graduate Admissions and Recruitment by email (graduate.admissions@admin.ox.ac.uk) or via the online form (<http://www.graduate.ox.ac.uk/ask>).