Job Description and Selection Criteria

<table>
<thead>
<tr>
<th>Job title</th>
<th>Two Postdoctoral Research Assistants in Mathematical Modelling of Batteries</th>
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<tbody>
<tr>
<td>Division</td>
<td>Mathematical, Physical and Life Sciences</td>
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<tr>
<td>Department</td>
<td>Mathematical Institute</td>
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<tr>
<td>Location</td>
<td>Andrew Wiles Building, Radcliffe Observatory Quarter, Woodstock Road, Oxford, OX2 6GG</td>
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<tr>
<td>Grade and salary</td>
<td>Grade 7: salary £31,604 - £38,833 p.a.</td>
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<tr>
<td>Hours</td>
<td>Full time</td>
</tr>
<tr>
<td>Contract type</td>
<td>Fixed term until 28 Feb 2021</td>
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<tr>
<td>Reporting to</td>
<td>Professors S. Jon Chapman and Colin P. Please</td>
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<tr>
<td>Vacancy reference</td>
<td>133459</td>
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<tr>
<td>Additional information</td>
<td>These are full-time positions that cannot be held concurrently with any other substantive post without the explicit permission of the Head of Department.</td>
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<td></td>
<td>These positions are subject to a 9 month probationary period.</td>
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<td></td>
<td>These positions are funded by the Faraday Institution.</td>
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<td></td>
<td>(PLEASE NOTE: Applicants are responsible for contacting their referees and making sure that their letters are received by the closing date)</td>
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</tbody>
</table>

The Role

We invite applications for two Postdoctoral Research Assistants to undertake research in battery modeling within the Multi-Scale Mathematical Modeling Fast Start Project of the Faraday Institution to work with Professors S.J. Chapman and C.P. Please at the Mathematical Institute, University of Oxford. These positions are fixed-term until the end of the project (28 February 2021).
The two postholders will work on specific aspects of the project undertaking fundamental research in asymptotics, homogenisation and numerics to develop, analyse and solve models of the coupled electrochemistry, mechanics and heat flow that determine the behaviour of batteries. Preference will be given to candidates with a strong mathematical background in asymptotics, partial differential equations, and experience of modelling physical systems. The postholders will report directly to Professors Jon Chapman and Colin Please and be based in the Mathematical Institute. The Oxford based postholders will be members of the combined team between mathematics and engineering with responsibility for carrying out research across the project.

The Fast Start Project is expected to be funded for a total of three years by the Faraday Institution and involves researchers at Imperial, UCL, Southampton, Warwick, Bath, Lancaster and Oxford Universities and industrial interaction with AGM Batteries, Arcola Energy, BBOXX, BMW, Caterpillar, Continental, Ford, Jaguar Land Rover, Johnson Matthey, Nexeon, nVIDIA, Potentza, Ricardo, Rolls Royce, Shell, Siemens, Williams, and CoSeC. The project spans theoretical approaches to examine behaviour in batteries on lengthscales from the atomistic to the battery module. There are three components of this project (XP1, XP4 and XP5 described below) which will be the main focus of the research undertaken in the Oxford Mathematical Institute, but postholders may also contribute to the other parts of the project.

XP1 will identify the processes that are ultimately limiting low temperature intercalation rates and develop rational strategies to overcome these. The initial focus will be the negative electrode where the risk of Li plating makes the implications of sluggish intercalation more serious. A multi-scale approach will quantify the energetics/dynamics of Li desolvation and intercalation into graphite. A continuum model of Li desolvation/intercalation, using phase fields, will be developed and parameterised from the atomistic data.

XP4 will use systematic methods to develop reduced order models of battery behaviour. An electrochemical cell-level battery model can include many coupled complex mathematical relations associated with degradation, and thermal/mechanical stress. These models are computationally costly and difficult to parameterise, and hence have not been adopted widely in battery management systems (BMS). At present, industry best practice employs over simplified steady state look-up tables or simple equivalent circuit models (ECM), which are only loosely related to underlying physics, require extensive parameterisation, and cannot predict remaining useful life. In XP4 we will develop reduced order modelling techniques to identify physically coherent low-dimensional models that can be solved rapidly by efficient computational tools that are suitable for real-time implementation. We will exploit a structured approach: first to exploit scales within the models (e.g. using asymptotics), second to choose appropriate basis functions and project onto a low dimensional subspace, third to solve the resulting ODEs and evaluate the accuracy of the approaches.

XP5 will develop models to describe battery degradation, failure, and estimations of lifetime. The aim is to develop a comprehensive, predictive approach to modelling how batteries evolve during long-term use. This work will be closely aligned with another Faraday Institution project creating experimental data of degradation. The main contribution of the Oxford based research will be continuum modeling focused on developing new model frameworks that can account fully for the multiphase, multicomponent nature of electrode materials and electrolytes, and include a wider array of coupled physical phenomena that contribute to degradation, such as thermal and mechanical effects. Coupled mass, charge, heat, and momentum transport is controlled by mechanisms at the micron scale, so homogenization techniques will be deployed to create a practical cell scale model that goes well beyond the conventional porous electrode theory.
Applicants should have skills in modelling, relevant to some aspect of the problem, as well as skills for solving PDE problems either with analytical or numerical methods. The two postholders will be based in the Mathematical Institute. There will be a large amount of interaction between the many parts of the Multi-Scale Mathematical Modelling project and the successful candidates will be central to driving these interactions. This may require some traveling to other institutions for discussions. There will also be regular meetings with industrial collaborators and the Faraday Institution where results will be discussed and presented. The postholders will also provide guidance to junior members of the research group including doctoral students.

Responsibilities

The successful candidate will be expected to:

- Manage their own academic research and administrative activities as well as coordinate research activities with other parts of the Multi-scale modelling project. This involves small scale project management, to co-ordinate multiple aspects of work to meet deadlines
- Adapt existing and develop new research methodologies
- Prepare working theories and analyse qualitative and/or quantitative data from a variety of sources, reviewing and refining theories as appropriate
- Contribute ideas for new research projects
- Collaborate in the preparation of research publications
- Present papers at conferences or public meetings
- Act as a source of information and advice to other members of the group on methodologies or procedures
- Represent the research group at external meetings/seminars, particularly those related to Faraday Institute activities either with other members of the group or alone
- Carry out collaborative projects with colleagues in partner institutions, and research groups, particularly those within the multi-scale modelling project
- Develop ideas for generating research income, and present detailed research proposals to senior researchers

It is the policy of the Mathematical Institute to give all PDRAs the opportunity to teach, where the conditions of the grant allow this, and to require teaching if there is a departmental need. Such teaching, if undertaken, will not exceed 3 hours per week for 24 weeks of the year and additional remuneration will be paid. It will normally be delivered as classes, but it might also involve giving lectures or college tutorials.

Selection criteria

Applicants will be expected to
• have, or be close to completing, a PhD in mathematics or a related discipline;
• have expertise in modelling practical problems using analytical or numerical approaches for solving PDEs;
• possess sufficient specialist knowledge in the discipline to work within established research programmes;
• have the ability to manage their own academic research and associated activities;
• have a good track record (for the stage of their career) of publications in leading international journals;
• have the ability to contribute ideas for new research projects;
• have excellent communication skills, including the ability to write for publication, present research proposals and results, and represent the research group at meetings.

Desirable selection criteria
• Experience of modelling problems related to electrochemistry, mechanics or diffusion
• Experience of independently managing a discrete area of a research project

About the University of Oxford

Welcome to the University of Oxford. We aim to lead the world in research and education for the benefit of society both in the UK and globally. Oxford’s researchers engage with academic, commercial and cultural partners across the world to stimulate high-quality research and enable innovation through a broad range of social, policy and economic impacts.

We believe our strengths lie both in empowering individuals and teams to address fundamental questions of global significance, while providing all our staff with a welcoming and inclusive workplace that enables everyone to develop and do their best work. Recognising that diversity is our strength, vital for innovation and creativity, we aspire to build a truly diverse community which values and respects every individual’s unique contribution.

While we have long traditions of scholarship, we are also forward-looking, creative and cutting-edge. Oxford is one of Europe's most entrepreneurial universities. Income from external research contracts in 2014/15 exceeded £522.9m and we rank first in the UK for university spin-outs, with more than 130 companies created to date. We are also recognised as leaders in support for social enterprise.

Join us and you will find a unique, democratic and international community, a great range of staff benefits and access to a vibrant array of cultural activities in the beautiful city of Oxford.

For more information please visit www.ox.ac.uk/about/organisation
The Mathematical Institute

The Mathematical Institute, as Oxford’s Department of Mathematics is known, is one of the leading mathematics departments in the world. Our mathematical research, impact and environment were all ranked first in the UK in the 2014 Research Excellence Framework exercise, a government review of research in all UK universities. The Mathematical Institute is the focus of research into both fundamental mathematics and its applications, and our inclusive nature and overall size are key factors in the provision of an outstanding research environment for our members. The large number of faculty, postdocs and students in the Mathematical Institute, all supported by excellent facilities, allows us to maintain a critical mass in research groups encompassing a wide spectrum of mathematics, while our integrated nature fosters collaboration between fields. We also host a large number of academic visitors. Our web pages (www.maths.ox.ac.uk) provide comprehensive information about all of our activities.

The research activities of the Institute as a whole can be gauged from the web pages of the research groups and centres within the Institute (www.maths.ox.ac.uk/research). The range of our research interests is well reflected by the profile of our faculty as listed at www.maths.ox.ac.uk/people. Many members of the Institute have received prestigious prizes and other special recognition for their work; some recent examples can be found at www.maths.ox.ac.uk/news/awards-and-prizes.

The Mathematical Institute moved into the purpose-built Andrew Wiles Building in the University’s Radcliffe Observatory Quarter in September 2013. As well as providing offices for all staff and graduate students, it houses a range of other facilities available to members of the department, including the Whitehead Library, a large range of meeting rooms, teaching spaces, lecture rooms, and social spaces, and a small facility for carrying out table-top experiments. For more information, see www.maths.ox.ac.uk/about-us.

Teaching is central to the life of the Mathematical Institute and we have an annual intake of approximately 300 undergraduates, some on courses jointly with other departments. We admit 100 students each year across five taught master’s degree courses and have over 230 doctoral students in residence at any one time. Our doctoral programme always attracts the best research students from across the world, and we have a broad mentoring and training programme. Our provision expanded in 2014 following the award of two EPSRC-funded Centres for Doctoral Training.

The Mathematical Institute strives to ensure that all staff and students are given the opportunities and support they need to achieve their potential. We are committed to equality of opportunities and to advancing women’s careers. We support staff returning from long-term absence and provide flexible arrangements for staff with parental responsibilities. Further information about family support can be found in the Standard Terms and Conditions. Our Good Practice Committee contributes to many aspects of our work, see www.maths.ox.ac.uk/members/good-practice.

As part of the department’s commitment to openness, inclusivity and transparency, we strongly encourage applications from all who consider they meet the requirements of the post, and particularly from women and ethnic minorities.

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1 The Mathematical Institute was a founding supporter of the London Mathematical Society’s Good Practice Scheme (www.lms.ac.uk/women/good-practice-scheme) and have recently been awarded an Athena SWAN silver award.
MPLS Division

The university’s Division of Mathematical Physical and Life sciences contains departments that span the full spectrum of the mathematical, computational, physical, engineering and life sciences. Between them, they undertake a huge range of fundamental research and develop application that respond to the great societal and technological challenges of our time. Research across the Division is increasingly interdisciplinary in nature.

MPLS’s scientists collaborate closely with colleagues in other Divisions across Oxford, with other universities, research organisations and industrial partners across the globe.

Our senior researchers have been awarded some of the most significant scientific honours (including Nobel prizes and prestigious titles such as FRS and FREng). The Division is equally proud of its tradition of attracting and nurturing the very best early career researchers, many of whom regularly secure prestigious fellowships.

The Division holds six Athena Swan Awards (four silver and two bronze) illustrating its commitment to encouraging women in science research and careers.

For more information visit http://www.mpls.ox.ac.uk/about/about-mpls-division

How to apply

Before submitting an application, you may find it helpful to read the ‘Tips on applying for a job at the University of Oxford’ document, at https://www.ox.ac.uk/about/jobs/research/

If you would like to apply, click on the Apply Now button on the ‘Job Details’ page and follow the on-screen instructions to register as a new user or log-in if you have applied previously. You will also be required to upload a curriculum vitae, list of publications, a statement of research interests and supporting statement. The supporting statement should describe how you meet the selection criteria outlined in the job description.

Please also provide details of two referees, one should include the applicant’s current or most recent employer, whenever possible and indicate whether we can contact them now.

Please upload all documents as PDF files with your name and the document type in the filename.

Applicants should ask their referees to send their letters of reference DIRECTLY to

The Administrative Assistant (Vacancies)
The Mathematical Institute, Andrew Wiles Building, Radcliffe Observatory Quarter, Woodstock Road, Oxford, OX2 6GG. Tel: 01865 273525: Email: vacancies@maths.ox.ac.uk

by the closing date (a letter by email is sufficient) quoting the vacancy reference 133459

Referees should preferably not be from the same institution and whenever possible one should be the applicant’s current, or most recent, supervisor. NOTE: reference letters must be received from your referees by the closing date for your application to be complete.

All applications must be received by 12:00 noon UK time on Wednesday 2nd May 2018.

Information for priority candidates

133459 Further Particulars final
A priority candidate is a University employee who is seeking redeployment because they have been advised that they are at risk of redundancy, or on grounds of ill-health/disability. Priority candidates are issued with a redeployment letter by their employing departments.

If you are a priority candidate, please ensure that you attach your redeployment letter to your application (or email it to the contact address on the advert if the application form used for the vacancy does not allow attachments).

You should experience any difficulties using the online application system, please email recruitment.support@admin.ox.ac.uk. Further help and support is available from www.ox.ac.uk/about_the_university/jobs/support/. To return to the online application at any stage, please go to: www.recruit.ox.ac.uk.

Please note that you will be notified of the progress of your application by automatic emails from our e-recruitment system. Please check your spam/junk mail regularly to ensure that you receive all emails.

**Important information for candidates**

**Pre-employment screening**

Please note that the appointment of the successful candidate will be subject to standard pre-employment screening, as applicable to the post. This will include right-to-work, proof of identity and references. We advise all applicants to read the candidate notes on the University’s pre-employment screening procedures, found at: www.ox.ac.uk/about/jobs/preemploymentscreening/.

**The University's policy on retirement**

The University operates an Employer Justified Retirement Age (EJRA) for all academic posts and some academic-related posts. From 1 October 2017, the University has adopted an EJRA of 30 September before the 69th birthday for all academic and academic-related staff in posts at **grade 8 and above**. The justification for this is explained at: www.admin.ox.ac.uk/personnel/end/retirement/acrefire8+/.

For **existing** employees, any employment beyond the retirement age is subject to approval through the procedures: www.admin.ox.ac.uk/personnel/end/retirement/acrefire8+/.

From 1 October 2017, there is no normal or fixed age at which staff in posts at **grades 1–7** have to retire. Staff at these grades may elect to retire in accordance with the rules of the applicable pension scheme, as may be amended from time to time.

**Equality of Opportunity**

Entry into employment with the University and progression within employment will be determined only by personal merit and the application of criteria which are related to the duties of each particular post and the relevant salary structure. In all cases, ability to perform the job will be the primary consideration. No applicant or member of staff shall be discriminated against because of age, disability, gender reassignment, marriage or civil partnership, pregnancy or maternity, race, religion or belief, sex, or sexual orientation.

133459 Further Particulars final
Benefits of working at the University

University Club and sports facilities
The University Club provides social, sporting and hospitality facilities. It incorporates a bar, café and sporting facilities, including a gym. Staff can also use the University Sports Centre on Iffley Road at discounted rates, including a fitness centre, powerlifting room, and swimming pool.
See: www.club.ox.ac.uk and www.sport.ox.ac.uk/oxford-university-sports-facilities.

Information for international staff (or those relocating from another part of the UK)
If you are relocating to Oxfordshire from overseas, or elsewhere in the UK, the University's International Staff website includes practical information related to moving to and settling in Oxford such as advice on immigration, relocation, accommodation, or registering with a doctor.
See: www.internationalstaffwelcome.admin.ox.ac.uk/

The University of Oxford Newcomers’ Club
The University of Oxford Newcomers' Club is an organisation run by volunteers that aims to assist the partners of new staff to settle into Oxford and to provide them with an opportunity to meet people in the area. See www.newcomers.ox.ac.uk/

Childcare
The University has excellent childcare services with five University nurseries, as well as University-supported places at many other private nurseries.
For full details including how to apply and the costs, see www.admin.ox.ac.uk/childcare.

Family-friendly benefits
The University subscribes to My Family Care (www.admin.ox.ac.uk/personnel/staffinfo/benefits/family/mfc/) and staff are eligible to register for emergency back-up childcare and adultcare services, a 'speak to an expert' phone line and a wide range of guides and webinars through a website called the Work + Family space.

Disabled staff
We are committed to supporting members of staff with disabilities or long-term health conditions. Please visit www.admin.ox.ac.uk/eop/disab/staff for further details including information about how to make contact, in confidence, with the University’s Staff Disability Advisor.

Staff networks
The University has a number of staff networks including the Oxford Research Staff Society, BME staff network, LGBT+ staff network and a disabled staff network. You can find more information at www.admin.ox.ac.uk/eop/inpractice/networks/

Other benefits
Staff can enjoy a range of other benefits such as free visitor access to the University’s colleges and the Botanic Gardens as well as a range of discounts.
See www.admin.ox.ac.uk/personnel/staffinfo/benefits