



UNIVERSITY OF LEEDS

CANDIDATE BRIEF

**Research Fellow in Data-driven Dynamical Models of Earth's Core,
School of Earth and Environment**



Salary: Grade 7 (£39,355 – £46,735 p.a. depending on experience)

Reference: ENVEE1816

Fixed term for 36 months - to complete specific time limited work

Location: University of Leeds (with a scope of hybrid working)

We are open to discussing flexible working arrangements

Research Fellow in Data-driven Dynamical Models of Earth's Core, Faculty of Environment

Overview of the role

Are you an ambitious researcher looking for your next challenge? Do you have a background in machine learning or fluid dynamics and an interest in applying your skills to understand the dynamics of Earth's fluid core and space-weather hazard? Do you want to further your career in one of the UK's leading research intensive Universities?

We are seeking a Research Fellow to fulfil a key role in our project to 1) produce new data-driven models of the magnetohydrodynamics of Earth's core and 2) better understand and predict the south Atlantic Anomaly (SAA), a region of weak magnetic field intensity in the south Atlantic in which spacecraft are exposed to high energy radiation. The SAA is the primary focus of the recent Macau satellite mission *MSS-1* whose observations will be integral to the project. You will be based in the [deep Earth research group](#) within the [School of Earth and Environment](#) at the University of Leeds and work closely with Professors [Phil Livermore](#) and [Chris Davies](#) (SEE), collaborating with Drs [William Brown](#) and [Ciaran Beggan](#) at the British Geological Survey (BGS). You will also work with a variety of external project partners: Macau Institute of Space Technology and Application, British Antarctic Survey, and the Technical University of Denmark; and a project stakeholder group including the Met office, the European Space Agency, RiskAware and RAL Space. There will be travel opportunities to work in-person with this network of collaborators, as well as for presenting the research at national and international conferences. This work is part of the NERC-funded project "A new paradigm for the geodynamo: data-driven models of core dynamics that explain and predict Earth's magnetic shield" between the University of Leeds and BGS.

You will begin by mapping the SAA using both geomagnetic and high-energy particle data as measured by the *MSS-1* mission. You will also (if required) learn how to use physics-informed neural networks (PINNs) and how they can be applied to the fluid dynamics of Earth's core where the global magnetic field is generated. Using a numerical geodynamo simulation as a benchmark, you will undertake a thorough investigation of both local and global PINN reconstructions of the modelled core using



sparse synthetic magnetic field observations. Next, you will develop a suite of PINN models, simultaneously constrained by the equations of magnetohydrodynamics and global magnetic satellite data from 1999-present including data from MSS-1. You will use these models to infer dynamics and structures hidden from observation, such as the internal flow, magnetic field, temperature, and stratification profile. Finally, you will use these models to investigate the underlying dynamics of the SAA and predict its future and associated space-weather hazard over the next 20 years. Throughout the project, you will help coordinate 6-monthly meetings with the project partners and stakeholders, ensuring two-way communication about project findings but also areas to focus on to maximise impact.

You will have a PhD (or close to completion) in geophysics, physics, applied mathematics or similar highly numerical discipline with a strong background in computational modelling or scientific machine learning. You will also have the ability to conduct independent research and a developing track record of publications in international journals. In addition, you will have excellent communication, planning, and team working skills.

Main duties and responsibilities

- Designing, planning and undertaking a program of research in collaboration with Professors Phil Livermore and Chris Davies (Leeds), and Drs William Brown and Ciaran Beggan (BGS);
- Developing and applying physics-informed neural networks to the magnetohydrodynamics of Earth's liquid core, constrained by sparse magnetic observations;
- Generating and pursuing original research ideas in the appropriate subject area;
- Communicating or presenting research results through publication, workshops and conference presentations;
- Preparing papers for publication in leading international journals and writing reports;
- Working both independently and also as part of a larger team of researchers, engaging in knowledge-transfer activities where appropriate and feasible;
- Maintaining your own continuing professional development and acting as a mentor to less experienced colleagues as appropriate;
- Contributing to the research culture of the School, where appropriate;



- Contributing to the training of both undergraduate and postgraduate students, where appropriate, including assisting with the supervision of projects in areas relevant to the project.

These duties provide a framework for the role and should not be regarded as a definitive list. Other reasonable duties may be required consistent with the grade of the post.

Qualifications and skills

Essential

- A degree and PhD (or close to completion) in geophysics, physics, applied mathematics, or a similar highly numerical discipline;
- A strong background in either computational fluid dynamics or scientific machine learning;
- A proven ability to work well both individually and in a team;
- Good time management and planning skills, with the ability to meet deadlines, manage competing demands and work effectively under pressure and without close support;
- Excellent written and verbal communication skills;
- A developing track record of peer reviewed publications in international journals;
- A strong commitment to your own continuous professional development.

Desirable

- Experience of scientific machine learning methods such as physics-informed neural networks;
- Experience in modelling the properties, dynamics and magnetic field generated within Earth's liquid core;
- Experience of modelling space weather and associated spacecraft hazard;
- Evidence of wider scientific engagement outside of your immediate research area, for example, in interdisciplinary discussion groups or outreach;
- Experience of pursuing external funding to support research;
- Evidence of software development to enable reproducible research.



Additional information

Please note: If you are not a British or Irish citizen, from 1 January 2021 you will require permission to work in the UK. This will normally be in the form of a visa but, if you are an EEA/Swiss citizen and resident in the UK before 31 December 2020, this may be your passport or status under the EU Settlement Scheme.

Please note that this post may be suitable for sponsorship under the Skilled Worker visa route but first-time applicants might need to qualify for salary concessions. For more information please visit: www.gov.uk/skilled-worker-visa.

For research and academic posts, we will consider eligibility under the Global Talent visa. For more information please visit: <https://www.gov.uk/global-talent>.

Find out more about the [Faculty of Environment](#)

Find out more about the [School of Earth and Environment](#)

Find out more about our [Research and Associated Facilities](#)

Find out more about [Equality in the Faculty](#)

Working at Leeds

We are a campus-based community and regular interaction with campus is an expectation of all roles in line with academic and service needs and the requirements of the role. We are also open to discussing flexible working arrangements. To find out more about the benefits of working at the University and what it is like to live and work in the Leeds area visit our [Working at Leeds](#) information page.

Our University

As an international research-intensive university, we welcome students and staff from all walks of life and from across the world. We foster an inclusive environment where all can flourish and prosper, and we are proud of our strong commitment to student education. Within the Faculty of Environment, we are dedicated to diversifying our community and we welcome the unique contributions that individuals can bring, and particularly encourage applications from, but not limited to Black, Asian, people who



belong to a minority ethnic community; people who identify as LGBT+; and disabled people. Candidates will always be selected based on merit and ability.

The Faculty of Environment has received a prestigious Athena SWAN silver award from [Advance HE](#), the national body that promotes equality in the higher education sector. This award represents the combined efforts of all schools in the Faculty and shows the positive actions we have taken to ensure that our policies, processes and ethos all promote an equal and inclusive environment for work and study.

Candidates with disabilities

Information for candidates with disabilities, impairments or health conditions, including requesting alternative formats, can be found on our [Accessibility](#) information page or by getting in touch with us at disclosure@leeds.ac.uk.

Criminal record information

Rehabilitation of Offenders Act 1974

A criminal record check is not required for this position; however, all applicants will be required to declare if they have any 'unspent' criminal offences, including those pending.

Any offer of appointment will be, in accordance with our Criminal Records policy. You can find out more about required checks and declarations in our [Criminal Records](#) information.

