**THE UNIVERSITY OF MANCHESTER**

**PARTICULARS OF APPOINTMENT**

**FACULTY OF SCIENCE & ENGINEERING**

**SCHOOL OF ENGINEERING**

**DEPARTMENT OF COMPUTER SCIENCE**

# RESEARCH ASSOCIATE IN EXPERIMENTAL SKYRMIONICS FOR NEUROMORPHIC COMPUTING

**VACANCY REF: SAE-029214**

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| **Salary:** | £37,174 - £45,413 per annum depending on experience |
| **Hours:** | Full time (1 FTE) |
| **Duration:** | Fixed term for 18 months |
| **Location:** | Oxford Road, Manchester |

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**Enquiries about the vacancy, shortlisting and interviews:**
Name: Christoforos Moutafis
Email: Christoforos.Moutafis@manchester.ac.uk

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## The University of Manchester

The University of Manchester is the largest single-site university in the UK and has a history of world leading research being undertaken across its three faculties, with 25 Nobel prize winners among its current and former staff and students. The Faculty of Science and Engineering has nine academic Departments with over 500 academic staff, along with a similar number of researchers, engaged in a diverse range of research activities.

## Nano Engineering and Storage Technology Research Group

The Nano Engineering & Spintronic Technologies (NEST) research group has research interests in spintronics, nanomagnetism, Skyrmions, nano-fabrication for data storage and advanced sensors applications. The NEST group is housed in an integrated suite of staff offices, specialised laboratory space for thin film deposition and magnetic/electrical/high frequency characterisation and a class 1000 cleanroom area. The group are active members of the National Graphene Institute (for nanofabrication) and the Royce Institute (for X-Ray characterisation).

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Our research encompasses many aspects and can be broadly divided into the following areas:

- Static and dynamic nanoscale magnetism
- Skyrmions: fundamentals and theory
- Skyrmions for Nanocomputing and Neuromorphic Computing
- High frequency dynamics in novel magnetic thin films (GHz and THz)
- Micromagnetic modelling
- Spintronics for data processing and storage
- Magnetic recording and materials
- Sensors, actuators, and instrumentation

**Background**

The University seeks to appoint a research associate with expertise on experimental techniques in the Department of Computer Science to work on an interdisciplinary project on Skyrmionics for Neuromorphic Computing. The candidate will conduct research related to emerging magnetic nanotechnologies in order to enable computing hardware for brain-inspired computing. In particular, the candidate will work towards the development of skyrmionics-based neuromorphic components, such as nanosynaptic devices, taking into consideration realistic operating conditions. Details for the post are found in the link below for the Further Particulars document which contains the person specification criteria. The candidate will be part of the Skyrmionics team and will be hosted by the Nano Engineering and Spintronic Technologies (NEST) group. The NEST group is a vibrant community of interdisciplinary researchers working on a variety of topics including spintronics, magnetic data storage, nano-technology applications, numerical modelling and simulation. The group are active members of the National Graphene Institute (NGI), the Royce institute for advanced materials. More information can be found at:

http://nest.cs.manchester.ac.uk/

https://skyrmionics.org/

The University of Manchester values a diverse workforce and welcomes applications from all sections of the community.

**Overall Purpose of the Job**

The principal aim of the project is to build skyrmionics-based neuromorphic components, such as nanosynaptic devices, taking into consideration realistic operating conditions. This can lead to building next-generation magnetoelectronic hardware by exploring the potential of non-volatile devices that manifest synaptic and neuronal functionality, based on the manipulation of skyrmionic textures as information carriers, for energy-efficient brain-inspired operations (neuromorphic computing). The PDRA will be tasked to work in Manchester and in collaboration with our collaborators and partners to develop next-generation interconnected synapse-to-neuron magnetic devices in analogy with biological synapses, wherein multiple information carriers may emulate neurotransmitters and facilitate complex computations at the synapse level. The PDRA will explore the potential of non-volatile devices, based on nanoscale magnets, including our own recent proposals from Manchester for a multilayer skyrmionic synapses and the skyrmionic interconnect, aimed at enhancing energy-efficient, brain-inspired

computational processes (neuromorphic computing). There is a recognised need for ultra-low power and always-on sensory data processing and neuromorphic hardware is one of the most promising routes for applications. The project goal is to demonstrate that interconnected nanoscale skyrmionic-based systems (that use nanoscale whirling vortex-like magnetic states called skyrmions as information carriers) are a viable candidate for energy-efficient smart edge-computing devices.

The specific tasks will involve the growth and optimisation of ultrathin magnetic films and multilayers, that are tailored to enable the hosting of skyrmionics spin textures, like the magnetic skyrmion or the skyrmionium and the advanced characterisation of films, interface quality and magnetic properties. A further set of tasks will involve advanced lithography for nanofabricating devices. The PDRA will then use a combination of imaging and electrical characterisation (transport measurements) to investigate the operation of the devices, with multiple techniques. The PDRA will be expected to optimise skyrmionics materials and nanofabrication of devices in view of optimal devices operation, according to the project needs.

The successful candidate will be part of the NeuroΣky team and the NEST research group and will be expected to work closely with the PI of the project and the other members of the group. As this project has both an experimental and simulation activity, the PDRA will be a key part of the team and it will be essential for the success of the project that the post holder works directly with the PDRA and PhD students on interfacing the experimental part with the computational work and simulations that will inform the devices design. Part of the work will be relevant to the SkyANN Horizon Europe consortium. The consortium (https://www.skyann.eu) comprises the University of Manchester, CNRS, Thales, Aristotle University of Thessaloniki (AUTh) and Eurida. The PDRA will be expected to collaborate and coordinate with the SkyANN consortium researchers in terms of samples, devices, measurements, simulations, to help achieve milestones and deliverables of the work packages of this project. The successful candidate will be integral in developing and preparing, with the PI, the other skyrmionics team members and the other partners, the deliverables pertaining to the skyrmionics for neuromorphic computing projects. The candidate will be expected to communicate the results of the research to a wider cross-disciplinary academic and industrial community through high quality publications and at international conferences and workshops.

**Key Responsibilities, Accountabilities or Duties**

The main responsibilities of the role include:

- Sputtering of multilayer thin-films, including developing processes for fine-tuning film properties;
- Magnetic and structural characterisation of fabricated thin-films using a variety of experimental techniques and analysis of the results;
- Creating devices from thin films using nanolithography;
- Electrical and imaging measurements od devices;
- Analyse/interpretation of experimental data and draw appropriate conclusions from results;
- Assist in the planning of the experimental programme;

- Planning and undertaking experiments at central facilities e.g. STXM
- Assist in the supervision of graduate students (PhD, MSc) and undergraduate project students, working within the research group;
- Assist in the running of the research group by working with other researchers, organising group activities and maintaining basic laboratory infrastructure;
- Assist in the running of the research group by contributing to knowledge management, project management and team communication tools;
- Assist in preparing deliverables for project's work packages;
- Keep up to date with scientific literature, performing regular surveys of published work to inform the direction of the project and communicate to the team;
- Write scientific reports and articles for publication, as and when required, with a focus of publishing in international, leading, high-impact journals. Typically, this would involve a minimum of 2 journal papers per year;
- Present results at national and international meetings and conferences, as well as presenting to colleagues and co-workers;
- Work with the SkyANN project partners, help organise and host meetings, attend project meetings and visiting partner sites for research and discussions;
- Engage with the general public in your research by participating in public engagements activities organised by the University or others (ScienceX, Bluedot festival etc);
- Undertake any additional duties appropriate to the role.

**Person Specification**

**Essential**

The person appointed will need to demonstrate the following:

- is in possession or close to submitting a PhD degree or equivalent in a relevant discipline (e.g. physics, materials science, computer science, electrical & electronic engineering);
- has hands-on experience of research in magnetic materials/spintronics and/or devices including film deposition and characterisation;
- has experience with electrical measurements;
- has hands-on experience in nanofabrication of devices;
- has a strong interest and expertise in experimental applied physics;
- exhibits data analysis skills and familiarity with standard scientific programs (e.g. Matlab, Origin, Mathematica or similar);
- is able to demonstrate the ability to carry out research at a high level;
- has a high standard of communication skills, both written and oral;
- is able to demonstrate the ability to work both independently and as part of a team;
- has a willingness to travel both within the UK and internationally;

- has a willingness to undergo training where needs are identified and engage in continuous professional development;
- has an ability to write papers and publish in high-quality scientific journals;
- has evidence of presenting their work at high-standing, international conferences;
- has a willingness to contribute to the team's knowledge base by contributing to the wiki, GitHub repositories, and documentation, including protocols and experimental note

**Desirable**

Knowledge and experience of one or more of the following is desirable:

- experience sputtering thin magnetic films;
- has a willingness to develop micromagnetics simulations skills;
- knowledge of magnetometry measurement techniques (e.g. VSM, SQUID, Kerr);
- experience of materials charaterisation techniques (e.g. XRD, XRR);
- experience undertaking central facilities experiments (e.g. X-Ray/Neutron);
- ability to conduct electrical measurements on nano/meso-scale devices;
- have a desire to pass on skills, expertise and knowledge to young researchers, such as PhD, MSc and undergraduate project students.