THE UNIVERSITY OF MANCHESTER

PARTICULARS OF APPOINTMENT

FACULTY OF BIOLOGY, MEDICINE & HEALTH

SCHOOL OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE

RESEARCH ASSOCIATE IN COMPUTATIONAL SKYRMIONICS FOR NEUROMORPHIC COMPUTING

VACANCY REF: SAE-029215

Salary:	Grade 6 £37,174 to £45,413 per annum, depending on relevant experience
Hours:	Full Time (1 FTE)
Duration:	Fixed Term For 18 Months
Location:	Oxford Road, Manchester

Enquiries about the vacancy, shortlisting and interviews:
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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 Spintronic Technologies Research Group
The Nano Engineering & Spintronic Technologies (NEST) research group has research interests in spintronics, nanomagnetism, Skyrmions, numerical modelling and simulation, nano-fabrication for data storage and advanced sensors applications, nanocomputing and neuromorphic computing.

The NEST group is housed in an integrated suite of staff offices, access to computing CPU and GPU clusters (local and at the University of Manchester Computational Shared Facility), 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) and have a wide range of collaborators in the UK and Europe.

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 computational techniques in the Department of Computer Science to work on Skyrmionics for Neuromorphic Computing, including an interdisciplinary project between Manchester, CNRS, Thales, AUTh and Eurida.

The post is relevant to candidates with computational skills, such as micromagnetic and atomistic simulations, with a strong interest on circuit-level and neural network-level simulations. 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 NeuroΣky 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.

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Overall Purpose of the Job:
The principal overall goal of the project is to design and 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).

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 such 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 development of computational models of fundamental device components for skyrmion-based neuromorphic electronics, defining device operational windows and interfacing with experimental work to guide fabrication, using micromagnetics or other approaches. A further set of tasks will involve running advanced neural network simulations, developing corresponding compact circuit models, and performing circuit simulations to study how spintronic devices interface with CMOS circuitry.

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 other members of the group. Since the overall project encompasses both experimental and simulation activities, the PDRA will play a central role within the broader team.

Successful outcomes depend critically on the post holder closely collaborating with the other PDRA and PhD students, ensuring seamless integration of computational simulations, used to inform device design, with the experimental work.

The work will be part of to the SkyANN Horizon Europe consortium (https://www.skyann.eu). The consortium 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 NeuroΣky 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

- Systematic micromagnetic simulations
- Numerical investigation and optimisation of multilayer stacks and characterisation of thermal stability for the generation and transport of multiple skyrmionic quasiparticles
- Numerically develop optimal skyrmionic nanodevices concepts to guide the nanofabrication
- Analyse/interpretate numerical and experimental data and draw appropriate conclusions from results
- Advanced circuit-level and ANN-level simulations
- Investigate biological learning rules suitable for the skyrmionics devices
- Investigate physical models and circuit models of the skyrmionic devices for used in learning simulations and benchmarking
- Neural network simulations
- Assist in the planning of the computational and experimental programme
- Assist in planning of experiments with laboratory techniques or at central facilities e.g. STXM by guiding the experimental work with feedback from simulations
- 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 groups by working with other researchers, organising group activities and maintaining basic computing 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
- 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

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PERSON SPECIFICATION

Essential:
The person appointed will need to demonstrate the following:

- Possession of or close to submitting a PhD degree in a relevant discipline (e.g. physics, computer science, electrical & electronic engineering)
- Has expertise and a strong interest in computational applied physics
- Has a strong interest in neuromorphic computing and Artificial Neural Networks (ANNs)
- Exhibits computational physics skills and familiarity with micromagnetics programs (e.g. mumax3, OOMMF or similar)
- Has experience of research in spintronics, magnetic materials and/or devices
- Exhibits data analysis skills and familiarity with standard scientific programs (e.g. Matlab, Origin, Mathematica or similar)
- Can demonstrate the ability to carry out research at a high level
- Has a high standard of communication skills, both written and oral
- Can 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 notes

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

- Experience with neuromorphic spintronics or neuromorphic engineering
- Experience with atomistic simulation of magnetic materials (e.g. Spirit, Fidimag, Vampire)
- Experience with circuit-level simulations (e.g. SPICE)
- Experience with coding and developing/maintaining scientific code
- Experience with spiking neural networks and neuromorphic simulations
- Experience of working with large computing clusters
- Experience with machine learning techniques (Deep Learning Neural Networks)
- Ability to analyse data from electrical and imaging 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