

Phasecraft-funded PhD project: Error-mitigated near-term quantum algorithms

This is an exciting opportunity to join Phasecraft, a quantum algorithms start-up based in London and Bristol whose main goal is to deliver quantum computing solutions to real world problems in the near-term. The successful candidate will join a team of scientists and engineers based in the company's Bristol office, whilst also being part of the dynamic cohort of the School of Mathematics' PhD researchers at the University of Bristol. The School of Mathematics has been ranked 4th in the UK for Mathematical Sciences Research ([REF 2021](#)) and is based in the historic [Fry Building](#), which has recently undergone a £35 million refurbishment.

This fully-funded 4 year studentship covers:

- tuition fees at UK rate
- tax-free stipend in line with [UKRI stipend rates](#) for living expenses
- Stipend enhancement of £4K/year and
- equipment and travel allowance to support research related activities.

This opportunity is open to UK, EU, and international applicants.

1. Company information

Phasecraft is the quantum algorithms company – our main goal is to accelerate the practical application of quantum computing. Our team brings together many of the world's leading quantum scientists, including founders Toby Cubitt, Ashley Montanaro, and John Morton, as well as a growing international network of renowned experts including Andrew Childs and Maris Ozols. Through our network of partnerships we have an unprecedented level of access to the world's best quantum hardware, which is accessible to all our staff and sponsored students.

2. About the Project

The project will design and build quantum algorithms and error-mitigation techniques for near-term quantum computers.

Since Feynman's seminal work in the early 1980s, there has been a widespread expectation that quantum computers would be able to outperform classical computers, especially in the modelling and simulation of quantum systems, through their ability to natively simulate quantum effects. For decades, the expectation has been that such potential would only be unlocked when full-scale, fault-tolerant quantum computers became available. In recent years, work by the Phasecraft team has changed this paradigm, showing that despite their limitations in terms of size and accuracy, near-term quantum computers can indeed outperform classical methods in certain cases.

However, this near-term hardware will be small-scale and noisy, and it is therefore critical that the quantum algorithms being developed are highly efficient and are combined with techniques for error mitigation. This project will aim to deliver such techniques.

The project will build on recent results by the Phasecraft team, including efficient quantum algorithms for Hamiltonian simulation ([Nat Commun 12, 4989 \(2021\)](#)), materials modelling ([arXiv:2205.15256](#)) and finding low-energy states of quantum systems ([Phys Rev B 102, 235122 \(2020\)](#)), and error mitigation schemes ([arXiv:2102.02120](#)). The project will include both the theoretical development of novel algorithms and error-mitigation schemes, and their implementation on real quantum hardware via the cloud.

The successful candidate will have:

- A background in theoretical aspects of computer science, mathematics, or physics, ideally with some exposure to quantum information theory / quantum computing.
- A strong academic record at undergraduate and/or Masters level.
- An aptitude for independent research.
- Proficiency in English (both oral and written) as per the [University's English Language Requirements Policy \(Profile E\)](#).
- Ability to undertake quantum technologies research under the National Security and Investment Act. This project will be subject to confidentiality and publication arrangements under the Studentship agreement to which the successful applicant must comply.

3. Project Supervisors

Academic supervisor: **Prof Ashley Montanaro, Professor of Quantum Computation (University of Bristol)** and **Co-Founder and CEO (Phasecraft Ltd)**. Prof Montanaro has over 18 years of experience in the field of quantum algorithms and quantum computation research, and has >50 publications in peer-reviewed journals and conferences. Over his career he has supervised 5 PhD students to completion who went on to excellent careers in academia and industry, and is currently supervising 3 more.

Industrial supervisor: **Dr Cat Mora, Director of Research Operations (Phasecraft Ltd)**. Dr Mora has over 10 years experience in research and project management, having worked for leading UK universities and funding agencies before joining Phasecraft. With a PhD in quantum information and computation from the University of Innsbruck, over the years she has supported the career development of early career academics from a wide range of disciplines.

4. Contact

Please email either Prof. Montanaro or Dr. Mora for more details about the project or an informal chat: ashley.montanaro@bristol.ac.uk , cat@phasecraft.io

5. Application Deadline

Application deadline is **31 January 2024**. Please quote 'Phasecraft' in the funding section of the application form and in your Personal Statement to ensure your application is reviewed correctly.

Please apply by the deadline to the PhD Mathematics programme using the [online application system](#).