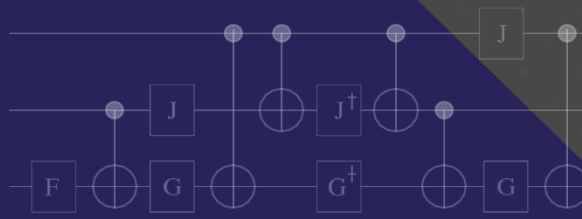
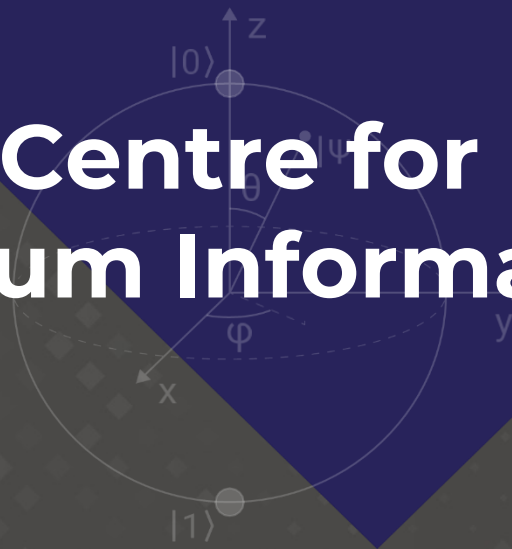
Quantum Informatics CDT





Introduction to the EPSRC Centre for Doctoral Training in Quantum Informatics

Prof Chris Heunen

THE UNIVERSITY of EDINBURGH

HERIOT WATT UNIVERSITY

UCL

UNIVERSITY OF OXFORD

University of Strathclyde Glasgow

UKRI Engineering and Physical Sciences Research Council

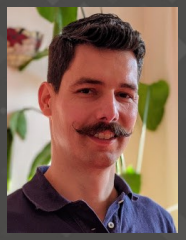
Overview

- 75+ PhD studentships over 5 intakes
- Fully funded 4-year programme
- Year 1 at the University of Edinburgh
- Years 2-4 at five leading Universities
- 70+ Academic experts
- 30+ Industry partners
- 10+ International universities

Vision

- End-to-end solutions take years to develop and require skills outside traditional quantum engineering and physics.
- Make quantum technology interoperable and impactful.
- Interaction of quantum hardware, software, and applications.
- Social and ethical implications of innovation in quantum informatics.
- Unique collaboration of academia, industry, and government.

Team

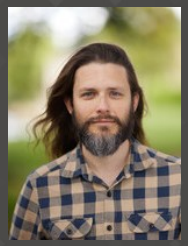


Prof. Chris Heunen
Director
Edinburgh Informatics

Prof. Ben Leimkuhler
Co-Director
Edinburgh Maths

Prof. Viv Kendon
Cohort Director
Strathclyde Physics

Prof. Erika Andersson
Director of Training
Heriot-Watt Physics



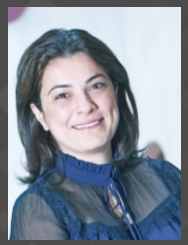
Dr. Aleks Kissinger
Director of Comms
Oxford CS

Prof. Mark Parsons
Director of Industry
Edinburgh EPCC

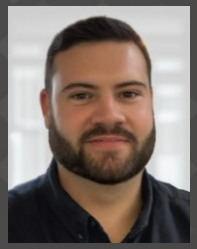
Prof. Andrew Green
Recruitment Coord
UCL Physics

Prof. Luigi del Debbio
Recruitment Coord
Edinburgh Physics

Prof. Majid Safari
Director of EDI
Edinburgh Engineering



Prof. Elham Kashefi
NQCC Liaison
Edinburgh Informatics



Jared de Bruin
Centre Manager
Edinburgh Informatics

Craig Skeldon
Business Development
Edinburgh Informatics

UK-Wide Centre

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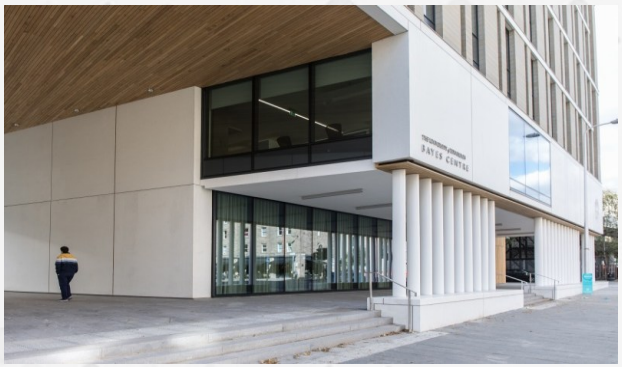



epcc

Quantum Software Lab

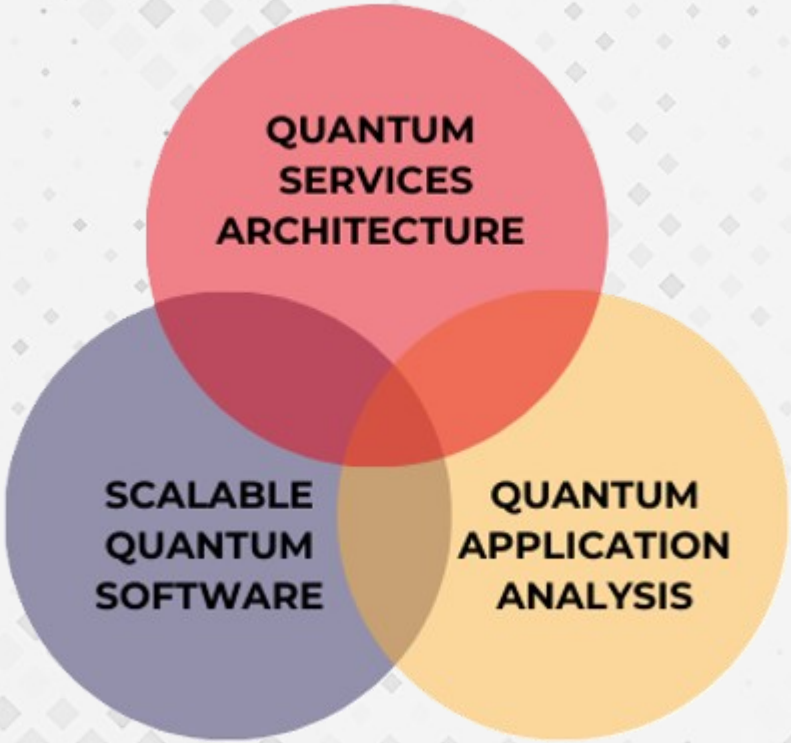
UKRI National Quantum Computing Centre

NPL National Physical Laboratory

UKRI Science and Technology Facilities Council

Hartree Centre

Interdisciplinary



- Interface high-performance computing with quantum computers
- Simulate quantum problems on classical computers
  Distributed and parallel computation for quantum problems
- New multi-party quantum communication protocols

- Compile application specification into hardware instructions
- Run larger computations on the same hardware
- Verify that quantum protocol does what it should
- New quantum algorithms

- Acquisition, storage, transmission, processing quantum information
- Quantify errors in quantum information
- Tolerate faulty or noisy quantum information
- Redesign algorithms to circumvent noise
- Relation to probabilistic algorithms, machine learning
- Relate quantum information flow and space-time entanglement

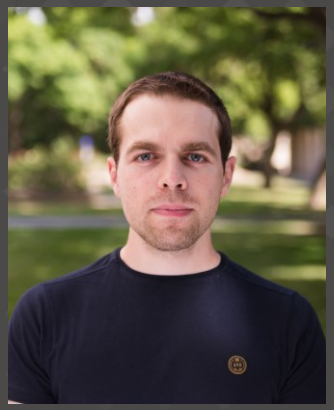
Cohort 1

Careers

Nuiok Dicaire, PhD 2023

The theory of localisable monads
Techniques to isolate 'where' parts of a quantum computation 'act'

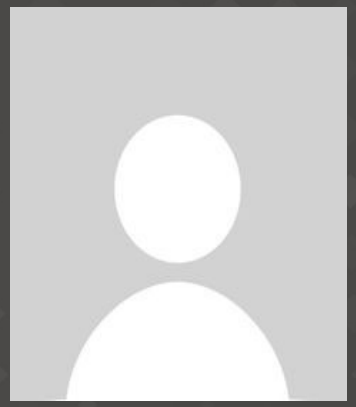
Q-Ctrl Sydney



Andru Gheorghiu, PhD 2018

Robust verification of quantum computation
Techniques to verify correctness of quantum computation on noisy hardware classically

Caltech, ETH, Chalmers, IBM



Theo Kapourniotis, PhD 2016

Efficient verification of universal and inter
quantum computing
Techniques to decrease complexity of cryptographic methods

Warwick, NQCC

Quantum PhD Project Examples (1 of 3)

María Gragera Garcés

Second Year PhD Student

PhD Title: Towards Scalable Heterogeneous Distributed Quantum Computing

Partnering with VeriQloud, my project focuses on efficiently allocating resources and distributing workloads across diverse quantum clusters. By exploring hybrid execution strategies at multiple levels including problem, algorithm, subroutine, and model, it enables scalable, parallel quantum computing inspired by High-Performance Computing principles. A key part of the research is designing mechanisms to coordinate and synchronise distributed quantum workloads, including early exploration of distributed quantum error correction. By developing techniques for flexible, secure, and efficient orchestration of quantum resources, this work contributes to shaping the next generation of quantum cloud architectures.

Quantum PhD Project Examples (2 of 3)

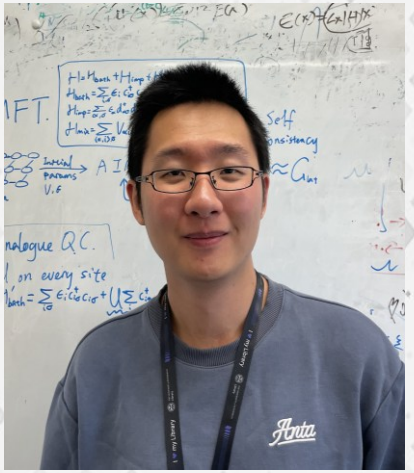
Mario Herrero González

Second Year PhD Student

PhD Title: Opportunities and Obstacles in Quantum Machine g

My research explores how quantum computers can transform the way we generate and analyse data. Unlike traditional methods that predict outcomes, quantum generative models aim to replicate complex patterns and distributions, opening up new possibilities for data synthesis. Early experiments suggest that quantum devices can tackle certain tasks far faster than classical computers, offering a potential real-world advantage. By tapping into uniquely quantum phenomena like entanglement and contextuality, my work seeks to turn this potential into practical tools for data generation. Ultimately, my research aims to unlock real-world applications of quantum computing, demonstrating how quantum advantage can deliver faster, smarter, and more powerful ways to generate and understand data.

Quantum PhD Project Examples (3 of 3)



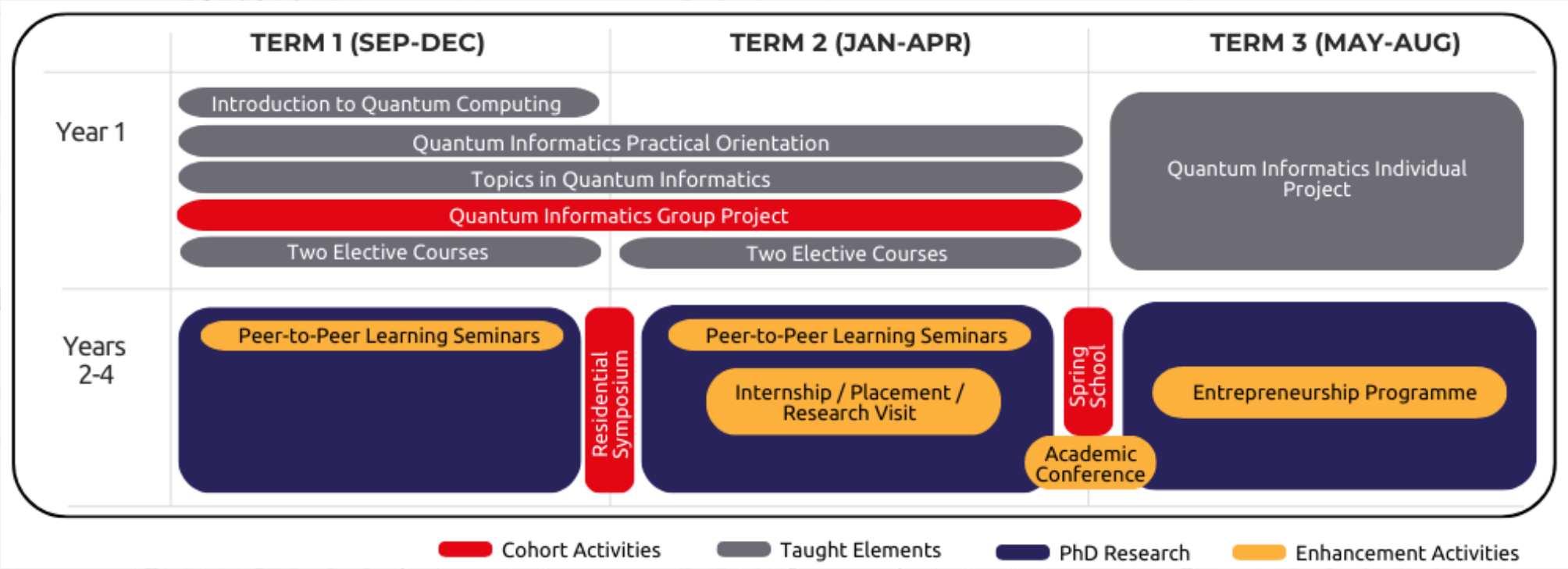
Weixi Zhang

Second Year PhD Student

PhD Title: Quantum Algorithms for Materials Simulations

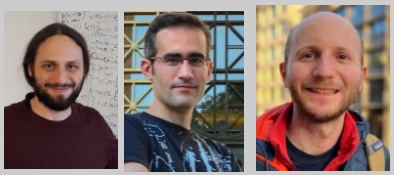
My PhD research focuses on developing more accurate and efficient algorithms for materials simulations, building on existing methods such as Dynamical Mean Field Theory (DMFT), a key tool for understanding strongly correlated materials with wide-ranging real-world applications. I explore hybrid quantum-classical algorithms as solvers within DMFT, including the use of quantum simulations on analogue quantum devices. The work also extends classical approaches through tensor networks and neural quantum states, aiming to push the boundaries of what is possible in computational materials science.

Programme Structure

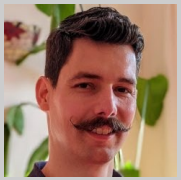


Core Courses

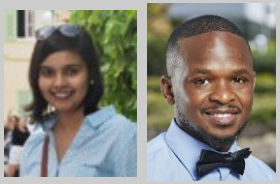
Introduction to Quantum Computing
Basics, standard algorithms, measurement-based computing, fundamentals of error correction, practical quantum programming.



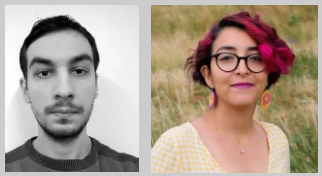
Practical Orientation
Research planning and management, writing and publishing, personal effectiveness, research ethics and integrity.



NQCC Residency (2 weeks)
Various quantum hardware platforms, software development kits. Responsible Research and Innovation, regulation.



Group Project
Small groups from different undergraduate backgrounds read and discuss research from various parts of the literature, leading to small research project.



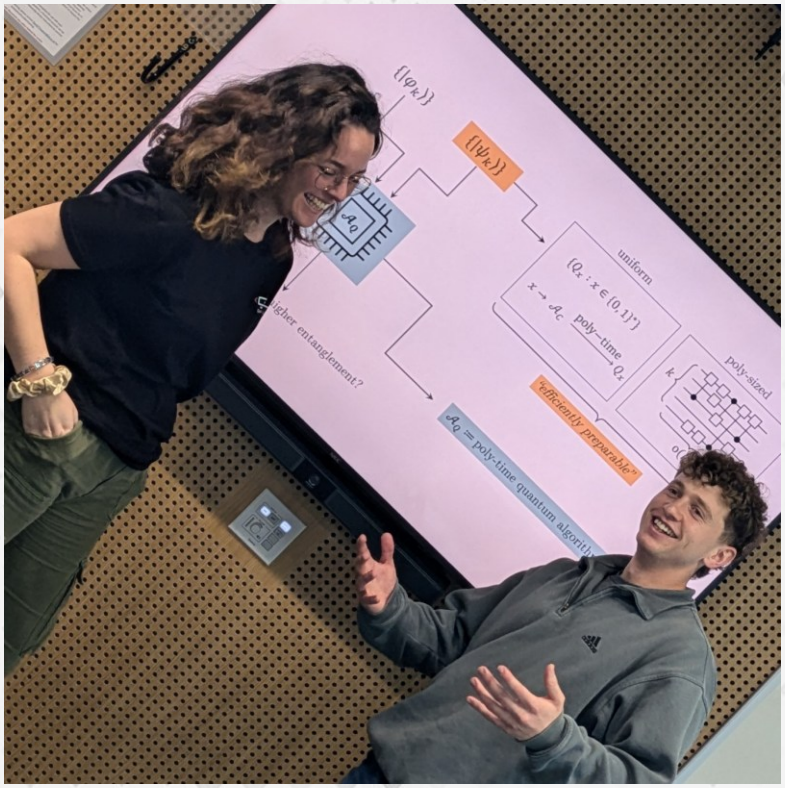
Topics in Quantum Informatics
Overview of research topics, introduced by the 70+ experts as seminars, to facilitate the PhD topic selection.

Individual Project
Mentored by academic supervisor and possibly a industry supervisor. Develops a coherent research programme for years 2-4.

Elective Courses

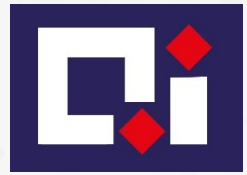
- Introduction to Quantum Programming and Semantics
- Quantum Cyber Security
- HPC architectures
- Design and Analysis of Parallel Algorithms
- Accelerated Systems: Principles and Practice
- Elements of Programming Languages
- Computer Architecture and Design
- Introduction to Modern Cryptography
- Computational Complexity
- Algorithms and Data Structures
- Randomised Algorithms
- Machine Learning
- Topics in Mathematical Physics
- Quantum Information
- Fundamentals of Optimization
- Category Theory
- Quantum Field Theory
- Quantum Theory
- Symmetries of Quantum Mechanics
- Advanced Coding Techniques
- Machine Learning in Signal Processing
- Digital Communication Fundamentals
- Probability, Estimation Theory and Random Signals
- Python Programming
- Scottish Mathematical Sciences Training Centre modules [https://smstc.ac.uk]

A Typical Week



- **Kickoff:** I start the week by mapping out tasks for my two core courses. Around that I slot in research, the talks I might want to attend this week, and plan for my quantum group project meeting.
- **Daily Routine:** My day usually begins with coffee in the office, which has a nice mix of quiet work areas and social spaces. I find the silent area ideal for focused work in the morning, while the chatting area is perfect for winding down toward the afternoon. I usually attend 2-3 research talks per week on quantum and other informatics research, which is a great way to learn about ongoing projects. Weekly group meetings keep me aligned on research goals and papers we're exploring.
- **Highlights**: The office setup is a good balance of concentration and connection. I go to the gym regularly since it's right next to the office, so it's super convenient. I also do yoga twice per week, as informatics and the chaplaincy next door have free sessions once per week, it's a perfect way to recharge and reset without leaving the area.
- **Social**: Starting out with a cohort has been really reassuring; it's great to have a built-in group, so it didn't feel like I was starting from scratch. It's also my first time in Edinburgh, which is a lovely, very social city. Our group often hangs out—watching movies, going to events like Puzzled Pints, or hiking Arthur's Seat. It's been a fun way to get to know the city and settle in.

Internships and Placements



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atom computing

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BT

cambridge consultants
Part of Capgemini Invent

Entropica Labs

Google AI Quantum

IBM

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INPUT | OUTPUT

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ORCA COMPUTING

Pasqal

PHASECRAFT

QBA

QUANDELA

QUANTINUUM

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seeqc

XANADU

Research Visits

BERKELEY LAB
Lawrence Berkeley National Laboratory
Berkeley
UNIVERSITY OF CALIFORNIA

東京大学
THE UNIVERSITY OF TOKYO

SYDNEY QUANTUM ACADEMY

IQC Institute for Quantum Computing
UNIVERSITY OF WATERLOO

JOINT CENTER FOR QUANTUM INFORMATION AND COMPUTER SCIENCE
UNIVERSITY OF MARYLAND

QuantumHub
UNIVERSITY OF COPENHAGEN

Quantum Delta NL
Universiteit Leiden

Quantum Information Center
ALLIANCE SORBONNE UNIVERSITÉ

QuSoft
UNIVERSITEIT VAN AMSTERDAM

Other Activities

- Residential Symposium
- Reading Groups
- Spring School
- Seminars

Entrepreneurship

Venture Builder
Incubator

Application Documents

- ***CV***: describe your background, in any form, 2 pages
- ***Statement of Intent***: describe previous experiences to demonstrate motivation and ability, 2 pages
- Two ***Letters of Reference***: letterhead, signed, dated, less than year old
- ***Certificates*** and ***Transcripts***: translated to English, interim ok
  (if you don't have English language certificate yet, will still consider)
- ***Demographics Survey***

Recruitment Timeline

- Applications live: Now!
- Application deadline: 8th Jan 2026
- Interviews: Mar/Apr 2026
- Outcomes: Apr 2026
- Start: Sep 2026

Further Information

Apologies if we do not get to your questions in time.

For more information:

- CDT website: *https://quantuminformatics-cdt.ac.uk*
- CDT information: *info@quantuminformatics-cdt.ac.uk*
- General information: *futurestudents@ed.ac.uk*
- LinkedIn: *https://linkedin.com/company/qi-cdt/*

Quantum Informatics CDT

Thank You

quantuminformatics-cdt.ac.uk

info@quantuminformatics-cdt.ac.uk

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