

Joschka Roffe

Physics Department, The University of Sheffield, Sheffield, UK

Contact: joschka@roffe.eu

Webpage: www.roffe.eu

Current Employment

- **Since Nov. 2018 | Research Associate, The University of Sheffield, UK**
Postdoctoral research in Earl Campbell's quantum computing group. This position is funded by the Quantum Code Design & Architectures project (qcda.eu).

Education

- **2015-2019 | PhD Quantum Computing, Durham University, UK**
Thesis: The coherent parity check framework for quantum error correction ([available online](#))
Supervisors: Viv Kendon, Nicholas Chancellor & Dominic Horsman
- **2011-2015 | MPhys Physics, University of Manchester, UK**
Grade: First class honours
Master's thesis: Modelling open quantum systems beyond the weak coupling regime
Supervisor: Ahsan Nazir
- **2013-2014 | Physics Exchange, University of California at Santa Barbara, USA**
Undergraduate exchange programme
GPA: 3.8/4.0
- **2010 - 2011 | Shell Oil Research, Year in Industry**
Prior to starting my undergraduate degree I spent a year working for Shell Oil Research as part of the UK Year in Industry programme. My project focused on developing automation routines to improve throughput in the analytical technology group.

Publications

1. **Single-shot error correction of three-dimensional homological product codes**
Armanda O. Quintavalle, Michael Vasmer, Joschka Roffe, Earl T. Campbell
September 2020, [arXiv:2009.11790](https://arxiv.org/abs/2009.11790)
2. **Decoding across the quantum LDPC code landscape**
Joschka Roffe, David R. White, Simon Burton, Earl T. Campbell
May 2020, [arXiv:2005.07016](https://arxiv.org/abs/2005.07016), *Submitted to PRX Quantum*
3. **Quantum codes from classical graphical models**
Joschka Roffe, Stefan Zohren, Dominic Horsman, Nicholas Chancellor
January 2020, IEEE Transactions on Information Theory, DOI: [10.1109/tit.2019.2938751](https://doi.org/10.1109/tit.2019.2938751)

4. **Quantum error correction: an introductory guide**
Joschka Roffe
October 2019, Contemporary Physics, DOI: [10.1080/00107514.2019.1667078](https://doi.org/10.1080/00107514.2019.1667078)
5. **Decoding quantum error correction with Ising model hardware**
[Joschka Roffe](#), Stefan Zohren, Dominic Horsman, Nicholas Chancellor
March 2018, [arXiv:1903.10254](https://arxiv.org/abs/1903.10254)
6. **Protecting quantum memories using coherent parity check codes**
[Joschka Roffe](#), David Headley, Nicholas Chancellor, Dominic Horsman, Viv Kendon
May 2018, Quantum Science and Technology, DOI: [10.1088/2058-9565/aac64e](https://doi.org/10.1088/2058-9565/aac64e)
7. **Graphical structures for design and verification of quantum error correction**
Nicholas Chancellor, Aleks Kissinger, [Joschka Roffe](#), Stefan Zohren, Dominic Horsman
June 2017, [arXiv:1611.08012v3](https://arxiv.org/abs/1611.08012v3)

Teaching Experience

- **Fall 2020 | PHY472 - Advanced Quantum Mechanics, Sheffield University**
I am currently teaching a lecture course on Advanced Quantum Mechanics to fourth-year undergraduates at Sheffield University.
- **Since April 2020 | MSc project supervision, The University of Sheffield**
I am currently supervising a quantum computing theory project for a student on the Sheffield MSc Mathematical and Theoretical Physics course.
- **2015-2018 | Teaching assistant, Durham University**
I have helped run problem solving classes for 2nd year Durham undergraduates studying courses in quantum mechanics, electromagnetism and computational physics.

Computing Skills and Experience

- **Open-source software:** I maintain the BP+OSD repository for simulating the decoding of sparse quantum codes. Available to download at: https://github.com/quantumgizmos/bp_osd
- **Programming languages:** I have extensive experience using Python for small-scale numerics, plotting and collaborative coding. I am also skilled in the use of C++ for computationally resource intensive numerics where speed is a priority. I use Mathematica for algebraic manipulation and solving equations analytically.
- **High-performance computing:** I have used HPC systems at Sheffield University and Durham University. I also attended a course on programming with GPUs whilst at Durham.
- **Quantum computing software:** The results of an experiment I programmed using IBM's *QISKit* and ran on a 5-qubit IBM quantum computer are published in [[Roffe et.al Quantum Sci. Technol. 2018](#)].
- **Graphics and plotting:** I create vector graphics using TIKZ or Inkscape as seen for example in [[Roffe, Contemporary Physics 2019](#)]. For presenting numerical results, I use *matplotlib* for static plots and Plotly.js for interactive plots that can be embedded on the web.

- **Presentation software:** I have recently started using the Reveal.js HTML framework for creating web-based slides with interactive elements and animations (see [here](#) for an example). I also have experience in creating slides using Beamer and PowerPoint.
- **Web development:** I am familiar with various tools for creating websites including HTML, CSS, Dokuwiki and WordPress. See roffe.eu and qcda.eu for examples of websites I maintain.

Recent Presentations

- **July 2020 | QCDA Virtual Seminar**
Title: Decoding across the LDPC code landscape (slides available [here](#))
- **Dec. 2019 | Huawei Quantum Computing Workshop, ETH Zurich**
Title: Quantum error correction with semi-topological codes
- **Dec. 2018 | 22nd Symposium on Quantum Information, Leeds**
Title: The coherent parity check framework for quantum error correction

Other Relevant Experience

- **Conference Organisation**
[Fault Tolerant Quantum Technologies](#), Hosted online, August 2020.
Third Northern Quantum Meeting, Durham University, June 2018.
- **Peer-review for academic journals:** I regularly referee papers for journals including Physical Review A, Physical Review X, Quantum Information and Computation and Advanced Quantum Technologies.
- **Website maintenance:** I help maintain websites for the QCDA network (qcda.eu) and the Sheffield Quantum Centre (quantum.shef.ac.uk).

Awards and Achievements

- **2019 | Winton Doctoral Prize, Durham University**
Prize awarded for the best PhD thesis in computational physics.
- **2015-2019 | Durham Doctoral Studentship, Durham University**
My PhD was funded by a Durham University Faculty of Science scholarship.
- **2013 | Physics Vacation Essay Prize, The University of Manchester**
Prize awarded for an essay written on the topic of quantum computers.
- **2013 | BP Achievement Awards 2013**
I was awarded a scholarship by the BP oil company after winning an essay writing competition on the applications of nuclear magnetic resonance technology in the petroleum industry.

- **2011 | The Year in Industry Contribution to Business Awards**

Best placement project in UK North-West region & national finalist. Prize awarded for work developing industrial automation routines whilst on placement at Shell Oil Research.