

Dr Paul Knott

Research Fellow, University of Nottingham

CONTACT

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Nationality British

Date of birth 11th April 1986

ACADEMIC CAREER

12/2017 – Present **RESEARCH FELLOW, UNIVERSITY OF NOTTINGHAM**

Holder of a Research Fellowship from the Royal Commission for the Exhibition of 1851, which I received without the need of an interview, due to the strength of my application. My research project utilises techniques from AI and machine learning to automate the engineering of useful quantum states, enabling the design of novel experiments to bring forward the development of new technologies such as quantum computing, communications and metrology.

3/2017 – 11/2017 **POSTDOCTORAL RESEARCH FELLOW, UNIVERSITY OF NOTTINGHAM**

Postdoctoral Research Fellow on a project funded by the Foundational Questions Institute (FQXi) entitled 'Sentient observers in the quantum regime and the emergence of an objective reality', with supervisors Professor Gerardo Adesso, Dr Marco Piani, and Dr Tommaso Tufarelli. This project involved using quantum information theory to investigate foundational questions concerning the role of the observer in physical theories.

3/2015 – 2/2017 **POSTDOCTORAL RESEARCH FELLOW, UNIVERSITY OF SUSSEX**

Postdoctoral Research Fellow in Quantum Sensing Networks, as part of the UK Quantum Technology Hub: Networked Quantum Information Technology, with supervisor Professor Jacob Dunningham. My research included quantum metrology, quantum state engineering, quantum sensing networks, and optical interferometry.

ACADEMIC VISITS

4/2019 – 5/2019 **VISITING SCHOLAR, CENTRE FOR HUMAN COMPATIBLE AI, UC BERKELEY**

I spent one month as a visiting scholar with the primary goal of developing and commencing collaborative projects with researchers at the Centre for Human Compatible AI (CHAI). During this research visit I began working with CHAI on a project on robustness in collaborative deep reinforcement learning, which has lead to a paper on which I am first author. The visit was also invaluable for the exposure to a world-leading artificial intelligence research group, and in helping to build my knowledge and skills in AI safety and deep reinforcement learning.

EDUCATION

April 2015 **PhD in Physics, University of Leeds**
Thesis title: 'Robust Quantum Metrology'.

July 2010 **PGCE, University of Manchester**
Postgraduate Certificate in Education in secondary school physics teaching.

July 2009 **MPhys & BSc, University of Leeds**
Grade: First class with honours.

PAPERS UNDER REVIEW

- P A Knott, M Carroll (UC Berkeley), S Devlin (Microsoft), K Ciosek (Microsoft), K Hofmann (Microsoft), A Dragan (UC Berkeley), R Shah (UC Berkeley), *Evaluating and Improving the Robustness of Collaborative*

FULL PUBLICATION LIST

1. J Rubio, P A Knott, T Proctor, J A Dunningham. *Quantum sensing networks for the estimation of linear functions*, Journal of Physics A: Mathematical and Theoretical (2020).
2. R Nichols, L Mineh, J Rubio, J C Matthews, P A Knott. *Designing quantum experiments with a genetic algorithm*, Quantum Science and Technology 4.4 (2019): 045012.
3. L O'Driscoll, R Nichols, and P A Knott. *A hybrid machine-learning algorithm for designing quantum experiments*, Quantum Machine Intelligence, 1, 5 (2019).
4. P A Knott, T Tufarelli, M Piani, and G Adesso, *Generic emergence of objectivity of observables in infinite dimensions*, Physical Review Letters, 121, 160401 (2018). **Featured on the front cover of Physical Review Letters.**
5. R Nichols, P Liuzzo-Scorpo, P A Knott, G Adesso, *Multiparameter gaussian quantum metrology*, Physical Review A, 98, 012114 (2018).
6. T J Proctor*, P A Knott*, and J A Dunningham, *Multiparameter estimation in networked quantum sensors*, Physical Review Letters, 120, 080501 (2018). *These authors equally contributed to this paper.
7. J Rubio, P A Knott, and J A Dunningham, *Non-asymptotic analysis of quantum metrology protocols beyond the Cramér–Rao bound*. Journal of Physics Communications, 2(1), 015027 (2018).
8. S Pallister, S Coop, V Formichella, N Gampierakis, V Notaro, P A Knott et. al., *A blueprint for a simultaneous test of quantum mechanics and general relativity in a space-based quantum optics experiment*. EPJ Quantum Technology 4, 2 (2017).
9. P A Knott*, T J Proctor*, A J Hayes, J F Ralph, P Kok, and J A Dunningham, *Local versus global strategies in multiparameter estimation*, Physical Review A, 94(6), 062312, (2016). *These authors equally contributed to this paper.
10. P A Knott, *A search algorithm for quantum state engineering and metrology*, New Journal of Physics 18, 073033 (2016). **A New Journal of Physics highlighted paper of 2016.**
11. P A Knott, W J Munro, and J A Dunningham, *Correspondence: Enhancing a phase measurement by sequentially probing a solid state system*, Nature Communications 7, (2016).
12. P A Knott, T J Proctor, A Hayes, J P Cooling, and J A Dunningham, *Practical quantum metrology with large precision gains in the low photon number regime*, Physical Review A 93, 033859 (2016).
13. T Tanaka*, P A Knott*, Y Matsuzaki*, S Dooley, H Yamaguchi, W J Munro, S Saito, *Robust entanglement-based magnetic field sensor beyond the standard quantum limit*, Physical Review Letters 115, 170801 (2015). *These authors equally contributed to this paper.
14. P A Knott, *Robust Quantum Metrology*, PhD Thesis, University of Leeds (2015).
15. P P Rohde, K R Motes, P A Knott, J Fitzsimons, W J Munro, and J P Dowling, *Evidence for the conjecture that sampling generalized cat states with linear optics is hard*, Physical Review A 91, 012342 (2015).
16. P A Knott, T J Proctor, K Nemoto, J A Dunningham, W J Munro, *Effect of multimode entanglement on lossy optical quantum metrology*, Physical Review A 90 (3), 033846 (2014).
17. P A Knott, W J Munro, J A Dunningham, *Attaining subclassical metrology in lossy systems with entangled coherent states*, Physical Review A 89 (5), 053812 (2014).
18. P A Knott, J A Dunningham, *Precise Phase Measurements using an Entangled Coherent State*, Conference proceedings for Photopics 2014.
19. P A Knott, J Sindt, J A Dunningham, *Detecting measurement-induced relative-position localization*, Journal of Physics B 46 (9), 095501 (2013).
20. G Leung, P A Knott, J Bailey, V Kendon, *Coined quantum walks on percolation graphs*, New Journal of Physics 12 (12), 123018 (2010).

INVITED CONFERENCE TALK

- *The role of quantum correlations in optical quantum metrology*, Bristol Quantum Information Technologies conference, 6-8 April 2016. This included sitting on a panel to discuss the future technological potential of quantum metrology

SELECTED CONTRIBUTED CONFERENCE TALKS

- *An evolutionary algorithm for quantum state engineering and metrology*, Quantum Machine Learning and Biomimetic Quantum Technologies, 19-23 March 2018, Bilbao, Spain.
- *Networked quantum sensing*, Italian Quantum Information Science, 11-15 September 2017, Florence, Italy.

- *Decoherence, quantum Darwinism, and the generic emergence of our objective classical reality*, What is Consciousness and Why Observers Matter in Quantum Theory?, 8 September 2017, Cambridge, UK.
- *Networked quantum sensing*, Networked Quantum Information Technologies Theory Meeting, 10 January 2017, Oxford, UK.
- *The role of quantum correlations in optical quantum metrology*, Networked Quantum Information Technologies Theory Meeting, 18 March 2016, Oxford, UK.
- *Squeezed-entangled states in optical quantum metrology*, Quantum Information Processing and Communication (QIPC), 13-18 September 2015, Leeds, UK.
- *Presenting a project on "Quantum Physics in Space" to a European Space Agency panel*, Summer School Alpbach, 13-24 July 2015, Alpbach, Austria.
- *Squeezed-entangled states in optical quantum metrology*, Central European Workshop on Quantum Optics, 6-10 July 2015, Warsaw, Poland.
- *Attaining sub-classical metrology in lossy systems with entangled coherent states*, Photon 14, 1-4 September 2014, London, UK.
- *Attaining sub-classical metrology in lossy systems with entangled coherent states*, Central European Workshop on Quantum Optics, 23-27 June 2014, Brussels, Belgium.
- *Relative position localisation of particles due to entanglement*, Exploring the limits of the quantum superposition principle, 12-17 May 2013, Bad Honnef, Germany.

AWARDS, COMPETITIONS, AND MISCELLANEOUS

STEM for Britain poster competition, Houses of Parliament

I was selected to display a poster of my work at the Houses of Parliament, to share my research with MPs and other interested parties. Following this event, I arranged for my local MP, Chris Leslie, to visit the Mathematical Sciences Department at my university.

AWARD

Whiddington Prize for Physics, University of Leeds, 2009.

European Space Agency Summer School

I worked in an interdisciplinary group to design a complete space mission to test fundamental physics in space. I lead the science team in our group, where one of my roles was to justify, to a panel of European Space Agency senior members, the importance and feasibility of our proposed mission.

Conference organisation

I was part of the organising team and scientific committee for the Workshop on the Quantum to Classical transition, University of Strathclyde, 2018; and for Quantum Roundabout, University of Nottingham, 2018.

Professional membership

I have been granted membership of the Foundational Questions Institute (FQXi).

RESEARCH FUNDING

- **2020:** Following a successful initial proposal, I was invited by FQXi to lead a Large Grant application on "Consciousness in the Physical World" (currently under review).
- **2019:** I am joint principle investigator, with Prof. Gerardo Adesso and Dr Ludovico Lami, on a Large Grant from FQXi on "Intelligence and the Physical World".
- **2018:** Myself and Dr Tommaso Tufarelli received an FQXi mini-grant to fund the production of an illustrated book on quantum mechanics.
- **2017:** I currently hold a Research Fellowship from the Royal Commission for the Exhibition of 1851, which I received without the need of an interview, due to the strength of my application.
- **2017:** I received a Research Travel Prize from the University of Nottingham to attend the Italian Quantum Information Science Conference 2017 (IQIS2017) and young IQIS2017.
- **2017:** With two others I received a Small Grant from the University of Nottingham to hold a one-day outreach event about particle physics for local schools.

RESEARCH OUTPUTS

BOOK: *Our Quantum Reality*, a short illustrated book on quantum mechanics. Written by P A Knott, Illustrated by J Namara Hollis. Freely available online: <https://illustratedquantum.wordpress.com/>. (Included in my University's REF.)

CODE: 1) Collaborated on codebase: https://github.com/HumanCompatibleAI/human_ai_coord; 2) An

algorithm for designing quantum optics experiments (Matlab). Open source: <https://github.com/paulk444/AdaQuantum>

PATENT: *Magnetic field detection scheme*, Tanaka, T., Knott, P. A., Matsuzaki, Y., Munro W. J. et al. NNT reference: NTTH265174.

SUPERVISION

- *Lana Mineh, PhD student, Bristol.* I submitted an application to supervise a 10 week project student as part of Bristol's Centre for Doctoral Training. Lana selected my project and has produced outstanding work under my supervision.
- *Jesús Rubio, PhD student, Sussex.* I took part in the selection and interview process for Jesús's PhD position, and I co-supervised Jesús through most of his PhD.
- Throughout my PhD and Postdocs I have supervised over 10 Masters and summer students, including supervising two summer students on an AI-safety-related project, and co-supervising a computer science student.

JOURNAL REFEREEING

- I have refereed for Scientific Reports, European Physics Journal, Optics Express, Physica Scripta, and New Journal of Physics.

COMPUTING

- Python, Matlab, LaTeX and Linux.

NON-ACADEMIC WORK EXPERIENCE

Jan-Sep 2011: The Polesworth School, Staffordshire.

Physics secondary school teacher. Responsible for the planning and teaching of a range of science classes, including a large proportion of A level Physics teaching.