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## Curriculum Vitae

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### Personal Data

Name: Earl Terence Campbell  
E-mail: earlrcampbell@gmail.com  
Homepage: <http://earlrcampbell.com/>  
Date of birth: November 26, 1981  
Nationality: Welsh British

### Employment History

**EPSRC Research Fellow and proleptic lecturer** April 2015-  
University of Sheffield, PI on 5 year EPSRC grant EP/M024261/1. At the end of the fellowship in 2020, I will automatically transfer onto a lectureship.

**Research associate** March 2014-March 2015  
University of Sheffield. Working with Dr. P. Kok and Sir Prof. K. Burnett.

**Postdoctoral researcher** Sept. 2010-March 2014  
Freie Universität Berlin, and University of Potsdam, Germany. Working with Prof J. Eisert.

**Royal Commission of 1851 Research Fellow** Sept. 2008-Sept. 2010  
University College London, UK. Primary investigator.

### Education

**Ph.D. in quantum information** Sept. 2005 - Sept. 2008  
Oxford University, UK. Supervisors: Dr. S. Benjamin and Dr. P. Kok.  
Thesis title: *Distributing entanglement for quantum computing*  
Viva defense on 26<sup>th</sup> Sept. 2008.

**M.Sci. in physics & philosophy** Sept. 2001 - July 2005  
University of Bristol, UK. 1<sup>st</sup> class MSci joint honours degree in physics/philosophy.

### Teaching Experience

**Academic tutor for PHY101, Sheffield** 2016-  
I tutor ~15 students on 1<sup>st</sup> year core physics: optics, waves, electromagnetism, thermal physics and quantum physics.

**Project supervisor for 3<sup>rd</sup> and 4<sup>th</sup> year project** 2016-  
Two student projects supervised to date.

**Teaching assistant for advanced quantum mechanics** 2014-2015  
Supplied cover for Masters course on advanced quantum mechanics at Sheffield University.

**Teaching assistant for 2<sup>nd</sup> year quantum mechanics** 2013-2014  
I tutored 2<sup>nd</sup> year quantum mechanics at the Freie Universität, and with other tutors developed problem sheets and the final examination paper.

**Teaching assistant for advanced statistical mechanics** 2012  
I lectured part of the Masters course on advanced statistical mechanics at the Freie universität, and developed problem sheets.

**Mathematics tutor at Oxford University, UK.** 2006-2008  
I tutored the 1<sup>st</sup> and 2<sup>nd</sup> year courses on mathematics for material scientists.

## Supervision & Management Experience

<b>James Seddon</b> Current CDT PhD student at University College London under remote supervision.	2017-
<b>Luke Heyfron</b> Current PhD student at Sheffield.	2016-
<b>Mark Howard</b> Post-doctoral research associate on my EPSRC research grant.	2015-
<b>Michael Herold</b> Physics Master's project at Freie Universität Berlin resulting in publication in <i>npj: Quantum Information</i> .	2013-2014
<b>Stephan Wäldchen</b> Physics Master's project at Freie Universität Berlin resulting in paper in <i>Phys. Rev. Lett.</i>	2013-2014
<b>Joris Dolderer</b> Physics Bachelor's project at Freie Universität Berlin (awarded highest grade).	2013
<b>Alexander Kegeles</b> Physics Master's project at Freie Universität Berlin.	2011-2012
<b>Dr Hussain Anwar</b> PhD at University College London. Assisted Dr Dan Browne with supervision.	2009-2013
<b>Dr Matty Hoban</b> PhD at University College London. Assisted Dr Dan Browne with supervision.	2008-2011

## Selected Oral Presentations

<b>QIP conference, Delft.</b> Due to present talk entitled "Shorter gate sequences for quantum computing by mixing unitaries". Highly competitive conference with success rate $57/296 = 19\%$	February 2018
<b>ThinkQ conference, IBM Watson Research Center, New York</b> Invited talk entitled "Classical simulation of quantum computers with few nonClifford gates"	November 2017
<b>Quantum Error Correction (QEC), Maryland.</b> Invited talk entitled "Small angle rotations: exotic magic states vs gate synthesis".	September 2017
<b>QIP conference, Seattle.</b> Presented talk entitled "Unifying gate-synthesis and magic state distillation" and co-author on talk entitled "Application of a resource theory for magic states to fault-tolerant quantum computing", presented by Mark Howard. Highly competitive conference with success rate $58/247 = 23\%$	January 2017
<b>19<sup>th</sup> Symposium on Topological Quantum Information, Leeds.</b> Invited talk entitled "Cellular automata decoders on the toric code".	April 2016
<b>SIQS consortium annual conference, Venice.</b> Invited talk entitled "Fault tolerant dynamical decoders for topological quantum memories".	March 2016
<b>TQC conference, Brussels.</b> Presented talk entitled "Thermalisation and decoherence in open Majorana systems". Co-author on two other talks presented at the conference.	May 2015
<b>Symposium on Topological Quantum Information, MPQ Garching.</b> Talk entitled "Thermalisation and decoherence in open Majorana systems".	April 2015
<b>Quantum Error Correction (QEC), Zurich.</b>	December 2014

Invited talk "The advantages of qudit fault tolerance" and co-author on one other paper.

**ESF workshop, Azores.** **Sept 2011**

Invited talk on "Non-locality, a Generalized Mermin Paradox and Measurement-based Quantum Computing".

**GDR - IQFA colloquium, Nice.** **March 2011**

Invited talk on "Hybrid matter-optical proposals for MBQC."

**QIP conference, Singapore.** **Jan. 2011**

Featured talk on "Catalysis and activation of magic states in fault tolerant architectures Highly competitive with success rate below 25%."

**Symposium on Topological Quantum Information, Leeds.** **April 2010**

Invited talk entitled "Correlated noise in magic states".

**TQC conference, Waterloo.** **May 2009**

Talk entitled "Neither Magical nor Classical".

**St. Anne's College subject family lecture, Oxford.** **Nov. 2006**

Popular audience talk on non-locality and quantum entanglement.

### **Local seminars**

I have given numerous group seminars, including at: Maryland, Aachen, Cambridge, Leeds, Bristol, Durham, Oxford, University College London, Imperial, Singapore, Waterloo, Hanover.

## **Honours, awards and grants**

**Industrial collaboration award** **August. 2017 - August. 2018**

Project "Developing simulation software for quantum computers" in collaboration with IBM New York and Oxford NQIT hub. Joint funded by Sheffield IiKE funding and NQIT partnership fund. Full economic cost £102,135.

**EPSRC fellowship award** **April. 2015 - April. 2020**

Grant EP/M024261/1 on project "Towards fault-tolerant quantum computing with minimal resources", Full economic cost £824,914.

**Royal commission of 1851 fellowship award** **Sept. 2008 - Sept. 2010**

Awarded fully funded 2 year independent fellowship.

**Una Goodwin scholarship** **Sept. 2007 - Sept. 2008**

Scholarship awarded by St. Anne's college for academic excellence, including a prize of £2000.

## **Conference organisation**

**FTQT workshop, Benasque, Spain.** **August 2016**

Two week international workshop on Fault Tolerant Quantum Computing hosted at the Centro de Ciencias de Benasque Pedro Pascual. Co-organised with Dan Browne and Michael Kastoryano. Approx 40 participants and €8,000 external sponsorship.

**QuTe workshop, Sheffield.** **March 2015**

Lead organiser for one-day workshop on quantum technologies. Approx 50 participants and £2,600 external funding.

**COST conference, Potsdam-Berlin.** **Jan. 2014**

Local organiser for workshop on quantum thermodynamics.

**Seminar organiser, UCL** **2008-2010**

Arranged weekly quantum information seminars at University College London.

**QuCoCo, workshop, Oxford.****November 2009**

Organised a 2-day workshop on “*Quantum Computation and Correlations*”, that took place on 9<sup>th</sup>-10<sup>th</sup> November 2009. Co-organised with Klearchos Loukopoulos.

**MBQC workshop, Oxford.****March 2007**

Assistant organiser for workshop on measurement based quantum computing.

**Professional Activities****Editorial board member****2018-**

Due to join editorial board for Royal Society journal *Proceedings of the Royal Society A: Mathematical, Physical & Engineering Sciences*

**Committee member for QQQ group IoP****2016-**

QQQ is the quantum subject group of the Institute of Physics.

**Active member of EPSRC Peer Review College****2015-**

EPSRC is the largest UK funding body for my field. I provide referee reports on proposals submitted to EPSRC. At time of writing, I have reviewed 6 proposals.

**Journal review****2007-**

Referee for journals inc. *Physical Review Letters*, *Nature Communications* and *New Journal of Physics*.

**PhD examiner.****2015-**

External examiner for Dr. Nikolas Breuckmann (Aachen, Germany 2017).

External examiner for Dr. James Auger (University College London, UK 2017).

Internal examiner for Dr. Mark Pearce (Sheffield, UK 2005).

**St Anne's college MCR committee****2006-2008**

As a PhD student I held various College MCR committee positions: including president and social secretary.

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## Publications

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Publications where I was lead author are marked with an asterisk\*.

### Journal Papers: Refereed

#### **Hyperbolic and Semi-Hyperbolic Surface Codes for Quantum Storage**

Nikolas P. Breuckmann, Christophe Vuillot, Earl Campbell, Anirudh Krishna, Barbara M. Terhal.  
*Quantum Sci. Technol*, **2**, 035007, (2017)

#### **\*The Steep Road Towards Robust and Universal Quantum Computation**

E. T. Campbell, B. M. Terhal and C. Vuillot.  
*Nature*, **549**, 172, (2017)

#### **Optimal Quantum Metrology of Distant Black Bodies**

M. E. Pearce, E. T. Campbell and Pieter Kok.  
*Quantum*, **1**, 21, (2017)

#### **\*Shorter gate sequences for quantum computing by mixing unitaries**

E. T. Campbell.  
*Phys. Rev. A.*, **95**, 042306, (2017)

#### **Quantum computation with realistic magic state factories**

J. O’Gorman and E. T. Campbell.  
*Phys. Rev. A.*, **95**, 032338, (2017)

#### **Cellular automaton decoders of topological quantum memories in the fault tolerant setting**

M. Herold, M. J. Kastoryano, E. T. Campbell and J. Eisert.  
*New Journal of Physics*, **19**, 063012, (2017)

#### **Application of a resource theory for magic states to fault-tolerant quantum computing**

M. Howard and E. T. Campbell.  
*Phys. Rev. Lett.*, **118**, 090501, (2017)

#### **\*Unifying gate-synthesis and magic state distillation**

E. T. Campbell and M. Howard.  
*Phys. Rev. Lett.*, **118**, 060501, (2017)

#### **\*A unified framework for magic state distillation and multi-qubit gate-synthesis with reduced resource cost**

E. T. Campbell and M. Howard.  
*Phys. Rev. A*, **95**, 022316, (2017)

#### **\*An efficient magic state approach to small angle rotations**

E. T. Campbell and J. O’Gorman.  
*Quantum Science and Technology*, **1**, 015007, (2016)

#### **Renormalising entanglement distillation**

S. Waeldchen, J. Gertis, E. T. Campbell and J. Eisert.  
*Phys. Rev. Lett.*, **116**, 020502, (2016)

**Cellular-automaton decoders for topological quantum memories**

M. Herold, E. T. Campbell, J. Eisert and M. J. Kastoryano.  
*nature partner journal: Quantum Information*, **1**, 15010, (2015)

**Qudit Colour Codes and Gauge Colour Codes in All Spatial Dimensions**

F. H. E. Watson, E. T. Campbell, H. Anwar and D. E. Browne.  
*Phys. Rev. A*, **92**, 022312, (2015)

**\*Decoherence in open Majorana systems**

E.T. Campbell.  
*LIPICs conference proceeding for TQC2015*, **44**, 111, (2015)

**\*Enhanced fault-tolerant quantum computing in d-level systems**

E. T. Campbell.  
*Phys. Rev. Lett.*, **113**, 230501, (2014)

**Order 3 Symmetry in the Clifford Hierarchy**

I. Bengtsson, K. Blanchfield, E. T. Campbell and M. Howard.  
*J. Phys. A: Math. Theor. [IoP selected highlight of 2014]*, **47**, 455302, (2014)

**Fast Decoders for Qudit Topological Codes**

H. Anwar, B.J. Brown, E. T. Campbell and D.E. Browne.  
*New Jour. Phys.*, **16**, 063038, (2014)

**\*Majorana fermions and non-locality**

E. T. Campbell, M.J. Hoban and J. Eisert.  
*Quantum Inf. Comp.*, **14**, 0981, (2013)

**\*Continuous-variable entanglement distillation and non-commutative central limit theorems**

E. T. Campbell, M. G. Genoni and J. Eisert.  
*Phys. Rev. A*, **87**, 042330, (2013)

**\*Magic state distillation in all odd prime dimensions using quantum Reed-Muller codes**

E. T. Campbell, H. Anwar and D. E. Browne.  
*Phys. Rev. X*, **2**, 041021, (2012)

**\*Gaussification and entanglement distillation of continuous variable systems: a unifying picture**

E. T. Campbell and J. Eisert.  
*Phys. Rev. Lett.*, **108**, 020501, (2012)

**Qutrit Magic State Distillation**

H. Anwar, E. T. Campbell and D. E. Browne.  
*New Jour. Phys.*, **14**, 063006, (2012)

**Non-adaptive Measurement-based Quantum Computation and Multi-party Bell Inequalities.**

M.J. Hoban, E. T. Campbell, K. Loukopoulos, and D.E. Browne.

*New Jour. Phys*, **13**, 023014, (2011)

**\*Catalysis and activation of magic states in fault tolerant architectures.**

E. T. Campbell.

*Phys. Rev. A*, **83**, 032317, (2011)

**\*Optimal entangling capacity of dynamical processes**

E. T. Campbell.

*Phys. Rev. A*, **82**, 042314, (2010)

**\*On the structure of protocols for magic state distillation.**

E. T. Campbell, and Dan E. Browne.

*TQC postproceedings in L.N. Comp. Sci.*, **5906**, 20, (2009)

**\*Bound states for magic state distillation in fault-tolerant quantum computation**

E. T. Campbell and D.E. Browne.

*Phys. Rev. Lett.*, **104**, 030503, (2010)

**\*An introduction to one-way quantum computing in distributed architectures.**

E. T. Campbell, and J. Fitzsimons.

*Int. Jour. Quantum Inf.*, **8**, 219, (2010)

**\*How to exploit local information when distilling entanglement.**

E. T. Campbell.

*Int. Jour. Quant. Inf.*, **8**, 161, (2010)

**\*Measurement based entanglement under conditions of extreme photon loss.**

E. T. Campbell and S.C. Benjamin.

*Phys. Rev. Lett.*, **101**, 130502, (2008)

**\*Distributed quantum-information processing with minimal local resources**

E. T. Campbell.

*Phys. Rev. A Rapid Comm.*, **76**, 040302(R), (2007)

**\*Efficient growth of complex graph states via imperfect path erasure**

E. T. Campbell, J. Fitzsimons, S. C. Benjamin, and P Kok.

*New Jour. Phys.*, **9**, 196, (2007)

**\*Adaptive strategies for graph state growth in the presence of monitored errors**

E. T. Campbell, J. Fitzsimons, S. C. Benjamin, and P. Kok.

*Phys. Rev. A*, **75**, 042, (2007)

## Preprints

**Magic state parity-checker with pre-distilled components**

E. T. Campbell and M. Howard.

arXiv:1709.02214, (2017)