



Dr Patrick M. Ledingham, PhD

Experimental Quantum Physicist

- New Zealander; 4th April 1986
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Profile

I am an experimental quantum physicist conducting research toward the implementation of scalable quantum technology with single photons. My work has focused on light-matter interactions using various material systems – including rare earth ion doped media, defects in diamond, and alkali vapours – to store and recall quantum optical states on-demand – a quantum optical memory. I am currently a Lecturer in Quantum Light and Matter Group in the School of Physics and Astronomy at Southampton, where I lead the Hybrid Quantum Networks Laboratory. I specialise in broadband (>GHz) quantum memory protocols in atomic ensembles across room temperature and cryogenic platforms, for interfacing with heralded and deterministic single photon sources.

Links

- Twitter: @quantumBoss
- Linkedin: [patrick-ledingham](#)
- ORCID iD: [0000-0002-9804-6132](#)
- ArXiv: arxiv.org/a/ledingham_p_1
- Google Scholar: <https://goo.gl/gJsJGu>
- Publons: AAC-8831-2019

Education

- 03/2008-06/2011 Ph.D. in Physics U. of Otago, NZ
Department of Physics, The University of Otago, New Zealand
Completed: 11/2011
Date conferred: 17/12/2011
- 03/2004-10/2007 Bachelor of Science in Physics (First Class Honours) U. of Otago, NZ
Department of Physics, The University of Otago, New Zealand
Date completed: 11/2007
Date conferred: 03/05/2008

Positions

- 07/2020-Now Lecturer in Quantum, Light and Matter Hybrid Quantum Networks Lab U. of Southampton, UK
- 11/2018-06/2020 Senior Researcher: Q. Memories Team Leader Ultrafast Quantum Optics Group - I. A. Walmsley U. of Oxford, UK
- 11/2016-10/2018 Marie Skłodowska-Curie Fellow Ultrafast Quantum Optics Group - I. A. Walmsley U. of Oxford, UK
- 12/2014-10/2016 Postdoctoral Research Assistant Ultrafast Quantum Optics Group - I. A. Walmsley U. of Oxford, UK
- 02/2012-10/2014 Postdoctoral Researcher Quantum Photonics with Solids and Atoms Group - H. de Reidmatten ICFO, Spain
- 07/2011-01/2012 Research Engineer Quantum Photonics with Solids and Atoms Group - H. de Reidmatten ICFO, Spain
- 10/2008 Visiting Scientist Solid-State Spectroscopy Group - M. J. Sellars ANU, Australia
- 03/2008-06/2011 PhD Candidate Otago Quantum Optics Group - J. J. Longdell U. of Otago, NZ
- 10/2007-02/2008 Research Assistant Summer Studentship Otago Quantum Optics Group - J. J. Longdell U. of Otago, NZ

Fellowships and Awards

- 2016-2018 Marie Skłodowska-Curie Individual Fellowship. Grant Agreement No. 705278. European Commission H2020. Award total: EUR 183,454.80
- 2008-2011 The University of Otago Ph.D. Scholarship (Pacific Islands)
- 2007 The University of Otago Pacific Islands Bursary Award
- 2006-2007 The University of Otago Beverly Bursary Award

Co-supervision of Graduate Students

- From 08/2018 O. G. Lazo Arjona (Oxford PhD), T. Hird (UCL CDT PhD)

Mentoring/Training of Graduate Students

Current Students

[T. Hird](#) (UCL CDT PhD from 07/2017), [O. G. Lazo Arjona](#) (Oxford PhD from 10/2016), [M. Nicolle](#) (Bristol CDT PhD from 10/2016)

Former Students

[D. Main](#) (Summer Student at Oxford from 07/2019), [Dr S. Thomas](#) (Imperial CDT PhD; 05/2015-04/2019), [Dr J. Klatzow](#) (Oxford PhD from 05/2016-02/2019), [Dr C. Weinzetl](#) (Oxford PhD; 05/2016-02/2019), [Dr J. H. D. Munns](#) (Imperial CDT PhD; 12/2014-10/2018), [S. Gao](#) (Oxford PhD; 10/2016-10/2018), [J. Smith](#) (DST CDT MSc; 04/2017-07/2017), [J. Friel](#) (DST CDT MSc; 04/2017-07/2017), [E. Oguz](#) (Oxford MPhys; 10/2016-05/2017), [Dr C. Qui](#) (visiting Oxford PhD; 12/2014-10/2015), [Dr T. F. M. Champion](#) (Oxford PhD; 12/2014-05/2015), [Dr N. Maring](#) (ICFO PhD; 10/2013-10/2014), [Dr K. Kutluer](#) (ICFO PhD; 10/1012-10/2014), [Dr D. Rieländer](#) (ICFO PhD; 04/2012-10/2014), [Dr M. Gündoğan](#) (ICFO PhD; 07/2011-10/2014).

Highlights

High-speed Noise-free Optical Quantum Memory

PHYSICAL REVIEW A 97, 042316 (2018)

High-speed noise-free optical quantum memory

K. T. Kaczmarek,^{1,2} P. M. Ledingham,¹ B. Brecht,¹ S. E. Thomas,^{1,2} G. S. Thekkadath,^{1,2} O. Lazo-Arjona,¹ J. H. D. Munn,^{1,2} E. Poem,¹ A. Fitzgour,¹ D. J. Saunders,¹ J. Nunn,¹ and I. A. Walmsley¹
¹Clarendon Laboratory, University of Oxford, Parks Road, Oxford OX1 3PU, United Kingdom
²QOLS, Blackett Laboratory, Imperial College London, London SW7 2BZ, United Kingdom
³University of Ottawa, 25 Templeton Street, Ottawa, Canada K1N 6N5

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⁵Centre for Photonics and Photonic Materials, Department of Physics, University of Bath, Claverton Down, Bath BA2 7AY, United Kingdom

(Received 9 November 2017; published 10 April 2018)

PRA 97, 042316 (2018)

Heralded single photons are stored and recalled on-demand using the off-resonant cascaded absorption protocol. We show for the first time that a quantum memory does not alter the quantum properties of the input state.

Quantum Correlations between Single Telecom Photons and a Multimode On-Demand Solid-State Quantum Memory

Selected for a Viewpoint in
PHYSICAL REVIEW X 7, 021028 (2017)

Quantum Correlations between Single Telecom Photons and a Multimode On-Demand Solid-State Quantum Memory

Alessandro Seri,¹ Andreas Lenhard,¹ Daniel Rieländer,¹ Mustafa Gündoğan,^{1,2} Patrick M. Ledingham,^{1,3} Margherita Mazzera,^{1,4} and Hugues de Riedmatten^{1,2}
¹ICFO-Institut de Ciències Fotòniques, The Barcelona Institute of Science and Technology, Mediterranean Technology Park, 08850 Castelldefels (Barcelona), Spain
²ICREA-Institució Catalana de Recerca i Estudis Avançats, 08015 Barcelona, Spain
(Received 9 December 2016; revised manuscript received 30 March 2017; published 24 May 2017)

PRX 7, 021028 (2017)

A world's first demonstration of storing and recalling on-demand heralded single photons using the spin-wave Atomic Frequency Comb quantum memory. Furthermore, the stored photon is nonclassically correlated with a telecommunication wavelength photon.

Quantum Storage of a Photonic Polarization Qubit in a Solid

PRL 108, 190504 (2012) PHYSICAL REVIEW LETTERS week ending 11 MAY 2012

Quantum Storage of a Photonic Polarization Qubit in a Solid

Mustafa Gündoğan,^{1,2} Patrick M. Ledingham,^{1,3} Ataollah Almasi,^{1,4} Matteo Cristiani,¹ and Hugues de Riedmatten^{1,2}
¹ICFO-Institut de Ciències Fotòniques, Av. Carl Friedrich Gauss 3, 08860 Castelldefels (Barcelona), Spain
²ICREA-Institució Catalana de Recerca i Estudis Avançats, 08015 Barcelona, Spain
(Received 18 January 2012; published 10 May 2012)

PRL 108, 190504 (2012)

A first-time demonstration of storing weak-coherent-state encoded polarization qubits using the Atomic Frequency Comb quantum memory protocol in a rare-earth-ion doped solid.

Experimental Realization of Light with Time-Separated Correlations by Rephasing Amplified Spontaneous Emission

PRL 108, 190504 (2012) PHYSICAL REVIEW LETTERS week ending 11 MAY 2012

Quantum Storage of a Photonic Polarization Qubit in a Solid

Mustafa Gündoğan,^{1,2} Patrick M. Ledingham,^{1,3} Ataollah Almasi,^{1,4} Matteo Cristiani,¹ and Hugues de Riedmatten^{1,2}
¹ICFO-Institut de Ciències Fotòniques, Av. Carl Friedrich Gauss 3, 08860 Castelldefels (Barcelona), Spain
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(Received 18 January 2012; published 10 May 2012)

PRL 109, 093602 (2012)

Non-classically correlated time-separated photon pairs are generated from a rare-earth-ion doped solid for the first time using the RASE protocol.

Teaching Activities

- 06/2019 Graduate class U. of Oxford, UK
Engineering Quantum Devices: Photonic devices, Memories
- 03-05/2010 Lab and Tutorial Instructor U. of Otago, NZ
Experimental Physics II
- 2008-2010 Lab and Tutorial Instructor U. of Otago, NZ
Experimental Physics I

Outreach Activities

- 09/2010 Assistant U. of Otago, NZ
'Otago Feed your Mind' at the International Science Festival and Expo
- 09/2009 Assistant U. of Otago, NZ
Otago Science Open Day

Organisation of Scientific Meetings

- 11/2016 Co-organiser U. of Oxford, UK
'Ultrafast Away Day' workshop
- 11/2010 Co-organiser U. of Otago, NZ
3rd Annual Conference on Optics and Lasers Applications, KOALA.
- 01/2010 Co-organiser U. of Otago, NZ
Postgraduate student symposium as a part of the Dodd-Walls Symposium.

Publications/Conferences Summary

I have a total of 23 peer-reviewed publications with 998 citations, with an h-index of 15 (Google Scholar - July 2, 2020). I have contributed to 23 conferences and workshops, 17 that were peer reviewed, 6 that were non-peer reviewed. More details are included in my 'List of Publications' document.

Press Selected Articles

- 02/2019 Quantum effects boost engine performance
Physics World
- 04/2018 I'm building a machine that breaks the rules of reality
New Scientist
- 11/2017 The new thermodynamics: how quantum physics is bending the rules
Nature News feature
- 05/2012 Photon-polarization qubits stored in atomic combs
Physics World

Recent Invited Talks

- 10/2019 Seminar Presentation U. of Southampton, UK
Quantum Optical Memories with Vapours and Solids
- 05/2019 Seminar Presentation U. of Durham, UK
Atomic-ensemble-based Quantum Memories for Scalable Photonic Networking
- 05/2019 Seminar Presentation KTH, Sweden
Atomic-ensemble-based Quantum Memories for Scalable Photonic Networking
- 12/2018 Seminar Presentation Heriot-Watt, UK
Atomic-ensemble-based Quantum Optical Memories for Scalable Photonic Networking
- 11/2017 Seminar Presentation U. of Otago, NZ
Atomic-ensemble-based Optical Memories for Quantum Networking