David Layden

Curriculum Vitae

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Summary

Goal: *I aim to develop theoretical and computational tools to help realize near-term quantum technologies.*

Highlights

- 9 publications before my second year of doctoral work (6 as first author), cited 73 times
- Extensive Master's/undergraduate research experience in both theory and experiment (circuit QED)
- Ranked in the top 10 STEM graduate students nationally in the Vanier Canada competition
- Sole student speaker at *GRC Quantum Control of Light & Matter 2015* (of 50-75 applicants)

Education

Massachusetts Institute of Technology, Cambridge, MA — 2016–Present
PhD Nuclear Science and Engineering – Quantum Engineering Group

- *Research* – Publications: [1]
  - Thesis: "Quantum Error Correction for Near-Term Devices"
  - Advisor: Paola Cappellaro
- *Coursework* – GPA: 4.9/5. Selected courses:
  - Quantum Computation (in progress)
  - Atomic and Optical Physics
  - Theory of Solids
  - Numerical Methods

University of Waterloo, Waterloo, Canada — 2014–2016
MMath Applied Mathematics – Quantum Information

- *Research* – Publications: [2, 3, 5]
  - Thesis: *"Indirect Quantum Control: An Implementation-Independent Scheme"*
  - Committee: Raymond Laflamme, Achim Kempf, Eduardo Martín-Martínez
  - Advisor: Achim Kempf
- *Coursework* – GPA: 95/100. Courses:
  - Implementations of Quantum Info. Processing
  - Theory of Quantum Optics
  - Numerical Analysis
  - Applied Functional Analysis

University of Waterloo, Waterloo, Canada — 2010–2014
BSc Mathematical Physics (Honors, Co-operative)

- *Research* – Publications: [4, 6–9]
  - Selected placements: CERN, Perimeter Institute, Institute for Quantum Computing
  - Thesis: *"Universal Uncertainty Relations"*
  - Advisor: Robert Spekkens
- *Coursework* – GPA: 96/100. Selected courses:
  - Quantum Information Processing
  - Quantum Theory (Graduate Level)
  - Computational Mathematics
  - Physics of Information

Research

Doctoral

Massachusetts Institute of Technology, Cambridge, MA — 2016–Present
Quantum Engineering Group, Advisor: Paola Cappellaro

- Developing application-specific quantum error correction schemes for near-term quantum devices [1]

Master's

Institute for Quantum Computing, Waterloo, Canada 2014–2016
Physics of Information Group, Advisor: Achim Kempf

- Developed a method to control open quantum systems that scales well with system complexity, making a class of previously intractable quantum control problems solvable [3]
- Characterized a particular family of open quantum dynamics [2, 5], which lead to the general scheme in [3]

Undergraduate Full-time research for co-op (roughly: paid internship) credit, unless otherwise indicated.

Perimeter Institute for Theoretical Physics, Waterloo, Canada Fall 2013
Quantum Foundations Group, Advisor: Robert Spekkens

- Benchmarked and refined a novel method for comparing quantum measurement statistics
- Visitor, part-time basis, not for co-op credit. Work led to undergraduate thesis

CERN, Geneva, Switzerland Summer 2013
ATLAS Experiment, Supervisor: Brigitte Vachon

- One of five students chosen to represent Canada in CERN's international summer student program
- Computational project [9] continued from McGill (see below)

McGill University, Montreal, Canada Summer 2013
ATLAS Group, Supervisor: Brigitte Vachon

- Developed high-performance computing tools to characterize ATLAS photon detection efficiency [9]

Institute for Quantum Computing, Waterloo, Canada Fall 2012
Superconducting Quantum Devices, Supervisor: Adrian Lupaşcu

- Designed and conducted experiments quantifying environmental noise with superconducting qubits [4]

University Health Network, Toronto, Canada Winter 2012
Biophotonics Group (University of Toronto), Supervisor: Alex Vitkin

- Theoretically developed a protocol to minimize noise in photonic devices [7,8], now in active experimental use [6]

University of Waterloo, Waterloo, Canada Fall 2011
Astrophysics Group, Supervisor: Michael Balogh

- Created a program to automatically identify and describe structures of interest in astronomical data

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Publications

Submitted Papers

[1] **D. Layden**, P. Cappellaro, *Error-corrected quantum sensing with parallel signal and noise*, arXiv:1708.06729. Submitted to Phys. Rev. Lett.

Peer-Reviewed Papers

[2] D. Grimmer, **D. Layden**, E. Martín-Martínez, R. B. Mann, *Open dynamics under rapid repeated interaction*, Phys. Rev. A **94**, 032126 (2016).

[3] **D. Layden**, E. Martín-Martínez, A. Kempf, *Universal scheme for indirect quantum control*, Phys. Rev. A **93**, 040301(R) (2016).

[4] J.-L. Orgiazzi, C. Deng, **D. Layden**, R. Marchildon, F. Kitapli, F. Shen, M. Bal, F. R. Ong, A. Lupaşcu, *Flux qubits in a planar circuit quantum electrodynamics architecture: quantum control and decoherence*, Phys. Rev. B **93**, 104518 (2016).

[5] **D. Layden**, E. Martín-Martínez, A. Kempf, *Perfect Zeno-like effect through imperfect measurements at a finite frequency*, Phys. Rev. A **91**, 022106 (2015).

[6] A. Gribble, **D. Layden**, and I. A. Vitkin, *Experimental validation of the optimum input polarization states for Mueller matrix determination with a dual photoelastic modulator polarimeter*, Opt. Lett. **38**, 5272 (2013).

[7] **D. Layden**, M. F. G. Wood, and I. A. Vitkin, *Optimum selection of input polarization states in determining the sample Mueller matrix: a dual photoelastic polarimeter approach*, Opt. Express **20**, 20466 (2012).

Book Chapters

[8] **D. Layden**, N. Ghosh, and I. A. Vitkin, "Quantitative Polarimetry for Tissue Characterization and Diagnosis," in *Advanced Biophotonics: Tissue Optical Sectioning*, V. V. Tuchin and R. K. Wang, eds. (Taylor & Francis 2013), pp. 73–108.

Published Reports

[9] **D. Layden**, *Measuring 2012 ATLAS Photon Trigger Efficiency*, CERN-STUDENTS-Note-2013-074.

Google Scholar Citation Report Total Citations: 73 (as of September 27, 2017)

Presentations

◦ conference expenses paid by organizers

Contributed Talks (Speaker)

- APS March Meeting 2016 (Baltimore, MD) *"A universal scheme for indirect quantum control"*
- ◦ GRC Quantum Control of Light & Matter 2015 (South Hadley, MA) *"Emergent unitarity in open quantum systems"*
  - Only student talk out of 50-75 applicants
- APS March Meeting 2015 (San Antonio, TX) *"Perfect Zeno effect through imperfect measurements at a finite frequency"*
- Canadian Undergraduate Physics Conference 2013 (Hamilton, Canada)
- CERN Student Sessions 2013 (Geneva, Switzerland; Video: 12:30 – 26:30)
- ATLAS Canada Summer Student Meeting (International Videoconference; August 14, 2013)

Contributed Talks (Co-Author)

- CAP Congress 2016 (Ottawa, Canada) *"Repeated interaction with ensemble of ancillas."* Author 2 of 3.
- APS March Meeting 2014 (Denver, CO) *"Decoherence of superconducting flux qubits in coplanar waveguide resonators."* Author 3 of 7.
- APS March Meeting 2013 (Baltimore, MD) *"Experimental results on decoherence and readout of coupled superconducting flux qubits in a circuit-QED setup."* Author 2 of 7.

Poster Sessions

- MIT-Harvard Center for Ultracold Atoms 2017 Retreat (Plymouth, NH) *"A universal scheme for indirect quantum control"*
- ◦ Coherent Control of Complex Quantum Systems 2016 (Okinawa, Japan) *"A universal scheme for indirect quantum control"*
- ◦ GRC Quantum Control of Light & Matter 2015 (South Hadley, MA) *"Emergent unitarity in open quantum systems"*
- McGill Undergraduate Research Poster Day 2013 (Montreal, Canada)
- CERN Summer Student Poster Session 2013 (Geneva, Switzerland)

Awards

Highlights

Vanier Canada Graduate Scholarship (2016, Declined) Value: $3 \times 50\,000$ C$

- Ranked 9th nationally out of 161 finalists across STEM fields
- Applied as a Master's student, although the award is primarily for PhD students

Clarendon Scholarship (2016, Declined) Value: 110 000 £

- For study at the University of Oxford, of greater value than the Rhodes scholarship

Other Selected Awards

Award	Value	Years
Meredith and Ray Rothrock Fund Fellowship	37 500 US$	2016
NSERC Canada Graduate Scholarship - Doctoral (CGS D, Declined)	$3 \times 35\,000$ C$	2016–2019
NSERC Canada Graduate Scholarship - Doctoral (PGS D)	$3 \times 21\,000$ C$	2016–2019
NSERC Canada Graduate Scholarship - Master's (CGS M)	17 500 C$	2014–2015
Ontario Graduate Scholarship	15 000 C$	2015–2016
Mensa Canada Scholarship - Woodhams Memorial Trust Award	10 100 C$	2016
President's Graduate Scholarship (×2)	$2 \times 10\,000$ C$	2014–2016
Mike Lazaridis Scholarship in Theoretical Physics (Declined)	7 500 C$	2013
Institute of Particle Physics Summer Fellowship	7 100 C$	2013
NSERC Undergraduate Student Research Award (×3)	$3 \times 4\,500$ C$	2011–2013
Rhodes Scholarship Finalist (Quebec, Canada)	-	2014

Teaching

Course Development

Theory of Quantum Optics (QIC 895), University of Waterloo — Spring 2015
- Designed and proposed a new graduate course in quantum optics, which was approved and offered
- Format: reading course with weekly student seminars and invited faculty (internal and external) lectures
- 6 students enrolled for credit, 7 others audited the course. Supervising Instructor: Achim Kempf

Teaching Assistantships

Quantum Theory 2 (AMath 673/473), University of Waterloo — Fall 2014
Multivariate Calculus (Math 207), University of Waterloo — Fall 2015

- Nominated for Outstanding TA Awards for both courses on the basis of my tutorials

Media & Service

Media Coverage

- The Economist: Letter to the editor regarding *Technology Quarterly: Quantum Devices*
- Phys.org: *Researchers find new way to control quantum systems*
- University of Waterloo News: *Waterloo researchers find new way to control quantum systems*
- Institute for Quantum Computing News: *Handle with quantum care*
- Institute for Quantum Computing Annual Report: *Quantum Control* (featured student profile, page 15)

Academic Service

- Peer reviewer for the Journal of the Optical Society of America A
- Invited panelist on international research for UWaterloo's International Education Week (2013)

Community

Let's Talk Science – Outreach Volunteer — 2015–2016
- Conducted classroom (K–12) and community visits to organize hands-on STEM activities

University of Waterloo Triathlon Club – President — 2015–2016
- Coordinated run, bike and swim practices. Club member 2010–2014, triathlete and marathon runner

Programming

Specialties: Optimization, Stochastic Modeling, Machine Learning, Data Analysis
Languages & Software: Python, Matlab, Mathematica, Maple, LabView, Git
Libraries: QuTiP, TensorFlow, NumPy, SciPy

Languages

- English (native proficiency)
- French (professional proficiency)

Prepared September 27, 2017.