Patrick J. Coles

Scientist 3, Theoretical Division, Los Alamos National Laboratory
Phone: 505-667-5656 E-Mail: pcoles@lanl.gov Citizenship: United States

Research Directions

Quantum computing, quantum machine learning, quantum neural networks, quantum error mitigation, quantum information theory, quantum cryptography, quantum foundations.

Academic Positions and Education

Los Alamos National Laboratory **2017 – Present**

Staff Scientist, Level 3, Theoretical Division

University of Waterloo **2014 – 2017**

Institute for Quantum Computing, Department of Physics
Postdoctoral Researcher

National University of Singapore **2012 – 2014**

Centre for Quantum Technologies
Postdoctoral Researcher

Carnegie Mellon University **2008 – 2012**

Department of Physics
Postdoctoral Researcher

University of California, Berkeley **2002 – 2008**

Department of Chemical Engineering
Ph.D., *NSF Fellow*

University of Cambridge **2001 – 2002**

Department of Biochemistry
M.Phil., *Churchill Fellow*
(only 11 Churchill Scholarships awarded annually)

Case Western Reserve University **1997 – 2001**

B.S., Chemical Engineering
GPA: 4.0 (maximum possible GPA: 4.0)

Grant Awards

Proposal: "Machine Learning of Quantum Computing Algorithms"
Early Career Research Award (Individual Grant)
Awarded by: LANL Laboratory Directed Research and Development
Funding Period: Oct. 1, 2018 – Sep. 30, 2020

Proposal: "Machine Learning for Next-Generation Quantum Hardware"
Directed Research Award (Grant for team of 10 LANL Scientists)
Awarded by: LANL Laboratory Directed Research and Development
Funding Period: Oct. 1, 2020 – Sep. 30, 2023

Proposal: "Taming Defects in Quantum Computers"
Directed Research Award (Grant for team of 9 LANL Scientists)
Awarded by: LANL Laboratory Directed Research and Development
Funding Period: Oct. 1, 2018 – Sep. 30, 2021

Proposal: "Optimization, Verification, and Engineered Reliability of Quantum Computers (OVER-QC)"
Quantum Computing Applications Team (QCAT) Award from ASCR, DOE
(Grant for team of 12 Scientists from Sandia, LANL, and Dartmouth)
Funding Period: Oct. 1, 2018 – Sep. 30, 2022

Proposal: "Advancing Integrated Development Environments for Quantum Computing (AIDE-QC)"
Accelerated Research in Quantum Computing (ARQC) Award from ASCR, DOE
(Multi-institutional Grant for team of LBNL, Sandia, ORNL, ANL, LANL, Chicago, Berkeley)
Funding Period: Oct. 1, 2019 – Sep. 30, 2024

Proposal: "Quantum Science Center"
National Quantum Initiative (NQI) Award from DOE
(Multi-institutional Grant for team of ORNL, LANL, FNL, Purdue, Microsoft, and others)
Personally leading the Error Mitigation project of this grant
Funding Period: Oct. 1, 2020 – Sep. 30, 2025

Proposal: "Topological phases of quantum matter and decoherence"
(Grant for team of 6 Scientists from LANL)
Awarded by: Basic Energy Sciences (BES), DOE
Funding Period: Oct. 1, 2018 – Sep. 30, 2021

Proposal: "Disentangling quantum entanglement"
(Grant for team of 5 Scientists from LANL and UC Davis)
Awarded by: High Energy Physics (HEP), DOE
Funding Period: Oct. 1, 2018 – Sep. 30, 2020

Proposal: "Quantum Principal Component Analysis on IBM's Quantum Computer"
Quantum Computing Education, Rapid Response (Individual Grant)
Awarded by: LANL Information Science and Technology Institute
Funding Period: Sep. 2017 – Dec. 2017

School Organizer: LANL Quantum Computing Summer School (2017 – Present)

Responsible for inviting speakers, organizing lectures, mentoring students.
School Format: Twenty students. Two weeks of lectures followed by eight weeks of research.
Students given access to and trained on commercial quantum computers from D-Wave, IBM, Rigetti.
School website: http://quantumcomputing.lanl.gov

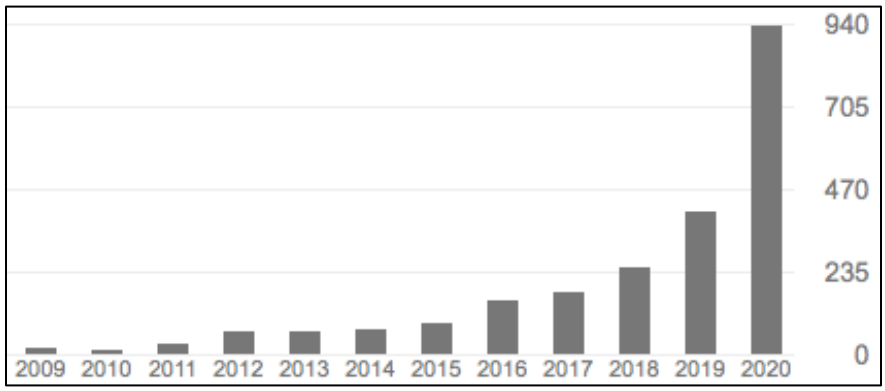
Software Development (2015 – 2016)

University of Waterloo
Led a team of students in developing the first software for calculating key rates of quantum key distribution (QKD) protocols. The software is a GUI based in Matlab. It is publicly available at this website: https://lutkenhausgroup.wordpress.com/qkd-software/

Publications

Citations

Total: 2498, h-index: 28
(from Google Scholar, accessed on Jan. 2, 2021)



Articles

64. Z. Holmes, K. Sharma, M. Cerezo, **P. J. Coles**
Connecting ansatz expressibility to gradient magnitudes and barren plateaus
arXiv:2101.02138 (2021)
https://arxiv.org/abs/2101.02138

63. M. Cerezo, A. Arrasmith, R. Babbush, S. C. Benjamin, S. Endo, K. Fujii, J. R. McClean, K. Mitarai, X. Yuan, L. Cincio, **P. J. Coles**
Variational quantum algorithms
arXiv:2012.09265 (2020)
https://arxiv.org/abs/2012.09265

62. A. Arrasmith, M. Cerezo, P. Czarnik, L. Cincio, **P. J. Coles**
Effect of barren plateaus on gradient-free optimization
arXiv:2011.12245 (2020)
https://arxiv.org/abs/2011.12245

61. E. Fontana, M. Cerezo, A. Arrasmith, I. Rungger, **P. J. Coles**
Optimizing parametrized quantum circuits via noise-induced breaking of symmetries
arXiv:2011.08763 (2020)
https://arxiv.org/abs/2011.08763

60. A. Pesah, M. Cerezo, S. Wang, T. Volkoff, A. T. Sornborger, **P. J. Coles**
Absence of Barren Plateaus in Quantum Convolutional Neural Networks
arXiv:2011.02966 (2020)
https://arxiv.org/abs/2011.02966

59. A. Lowe, M. Hunter Gordon, P. Czarnik, A. Arrasmith, **P. J. Coles**, L. Cincio
Unified approach to data-driven quantum error mitigation
arXiv:2011.01157 (2020)
https://arxiv.org/abs/2011.01157

58. J. L. Beckey, M. Cerezo, A. Sone, **P. J. Coles**
Variational Quantum Algorithm for Estimating the Quantum Fisher Information
arXiv:2010.10488 (2020)
https://arxiv.org/abs/2010.10488

57. A. Sone, M. Cerezo, J. Beckey, **P. J. Coles**
A Generalized Measure of Quantum Fisher Information
arXiv:2010.02904 (2020)
https://arxiv.org/abs/2010.02904

56. Z. Holmes, A. Arrasmith, B. Yan, **P. J. Coles,** A. Albrecht, A. Sornborger
Barren plateaus preclude learning scramblers
arXiv:2009.14808 (2020)
https://arxiv.org/abs/2009.14808

55. N. Tkachenko, J. Sud, Y. Zhang, S. Tretiak, P. Anisimov, A. Arrasmith, **P. J. Coles,** L. Cincio, P. Dub
Correlation-Informed Permutation of Qubits for Reducing Ansatz Depth in VQE
arXiv:2009.04996 (2020)
https://arxiv.org/abs/2009.04996

54. B. Commeau, M. Cerezo, Z. Holmes, L. Cincio, **P. J. Coles,** A. Sornborger
Variational Hamiltonian Diagonalization for Dynamical Quantum Simulation
arXiv:2009.02559 (2020)
https://arxiv.org/abs/2009.02559

53. M. Cerezo, **P. J. Coles**
Impact of Barren Plateaus on the Hessian and Higher Order Derivatives
arXiv:2008.07454 (2020)
https://arxiv.org/abs/2008.07454

52. S. Wang, E. Fontana, M. Cerezo, K. Sharma, A. Sone, L. Cincio, **P. J. Coles**
Noise-Induced Barren Plateaus in Variational Quantum Algorithms
arXiv:2007.14384 (2020)
https://arxiv.org/abs/2007.14384

51. K. Sharma, M. Cerezo, Z. Holmes, L. Cincio, A. Sornborger, **P. J. Coles**

Reformulation of the No-Free-Lunch Theorem for Entangled Data Sets
arXiv:2007.04900 (2020)
https://arxiv.org/abs/2007.04900

50. L. Cincio, K. Rudinger, M. Sarovar, **P. J. Coles**
Machine learning of noise-resilient quantum circuits
arXiv:2007.01210 (2020)
https://arxiv.org/abs/2007.01210

49. K. Sharma, M. Cerezo, L. Cincio, **P. J. Coles**
Trainability of Dissipative Perceptron-Based Quantum Neural Networks
arXiv:2005.12458 (2020)
https://arxiv.org/abs/2005.12458

48. T. Volkoff, **P. J. Coles**
Large gradients via correlation in random parameterized quantum circuits
arXiv:2005.12200 (2020)(Accepted in Quantum Science and Technology)
https://arxiv.org/abs/2005.12200

47. P. Czarnik, A. Arrasmith, **P. J. Coles**, L. Cincio
Error mitigation with Clifford quantum-circuit data
arXiv:2005.10189 (2020)
https://arxiv.org/abs/2005.10189

46. A. Arrasmith, L. Cincio, R. Somma, **P. J. Coles**
Operator Sampling for Shot-frugal Optimization in Variational Algorithms
arXiv:2004.06252 (2020)
https://arxiv.org/abs/2004.06252

45. Y. Zhang, **P. J. Coles,** A. Winick, J. Lin, N. Lutkenhaus
Security proof of practical quantum key distribution with detection-efficiency mismatch
arXiv:2004.04383 (2020)(Accepted in Physical Review Research)
https://arxiv.org/abs/2004.04383

44. M. Cerezo, K. Sharma, A. Arrasmith, **P. J. Coles**
Variational Quantum State Eigensolver
arXiv:2004.01372 (2020)
https://arxiv.org/abs/2004.01372

43. M. Cerezo, A. Sone, T. Volkoff, L. Cincio, **P. J. Coles**
Cost-Function-Dependent Barren Plateaus in Shallow Quantum Neural Networks
arXiv:2001.00550 (2020)
https://arxiv.org/abs/2001.00550

42. C. Bravo-Prieto, R. Larose, M. Cerezo, Y. Subasi, L. Cincio, **P. J. Coles**
Variational Quantum Linear Solver
arXiv:1909.05820 (2019)
https://arxiv.org/abs/1909.05820

41. C. Cirstoiu, Z. Holmes, J. Iosue, L. Cincio, **P. J. Coles,** A. Sornborger
Variational Fast Forwarding for Quantum Simulation Beyond the Coherence Time

npj Quantum Information. 6, 82. (2020)
https://www.nature.com/articles/s41534-020-00302-0

40. J. Kubler, A. Arrasmith, L. Cinco, **P. J. Coles**
An Adaptive Optimizer for Measurement-Frugal Variational Algorithms
Quantum. 4: 263. (2020)
https://quantum-journal.org/papers/q-2020-05-11-263/

39. K. Sharma, M. Cerezo, S. Khatri, **P. J. Coles**
Noise Resilience of Variational Quantum Compiling
New Journal of Physics. 22, 043006 (2020)
https://iopscience.iop.org/article/10.1088/1367-2630/ab784c

38. M. Cerezo, A. Poremba, L. Cincio, **P. J. Coles**
Variational Quantum Fidelity Estimation
Quantum. 4: 248. (2020)
https://quantum-journal.org/papers/q-2020-03-26-248/

37. **P. J. Coles**, M. Cerezo, L. Cincio
Strong bound between trace distance and Hilbert-Schmidt distance for low-rank states
Physical Review A. 100, 022103 (2019)
https://journals.aps.org/pra/abstract/10.1103/PhysRevA.100.022103

36. A. Arrasmith, L. Cincio, A. Sornborger, W. Zurek, **P. J. Coles**
Variational consistent histories as a hybrid algorithm for quantum foundations
Nature Communications. 10 (1), 3438 (2019)
https://www.nature.com/articles/s41467-019-11417-0

35. R. LaRose, A. Tikku, E. O'Neel-Judy, L. Cincio, **P. J. Coles**
Variational quantum state diagonalization
npj Quantum Information. 5 (1), 8 (2019)
https://www.nature.com/articles/s41534-019-0167-6

34. S. Khatri, R. LaRose, A. Poremba, L. Cincio, A. T. Sornborger, **P. J. Coles**
Quantum-assisted quantum compiling
Quantum. 3, 140 (2019)
https://quantum-journal.org/papers/q-2019-05-13-140/

33. **P. J. Coles**, V. Katariya, S. Lloyd, I. Marvian, M. M. Wilde
Entropic energy-time uncertainty relation
Physical Review Letters. 122 (10), 100401 (2019)
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.122.100401

32. Y. Subasi, L. Cincio, **P. J. Coles**
Entanglement spectroscopy with a depth-two quantum circuit
Journal of Physics A: Mathematical and Theoretical. 52: 044001 (2019)
https://iopscience.iop.org/article/10.1088/1751-8121/aaf54d

31. L. Cincio, Y. Subasi, A. T. Sornborger, **P. J. Coles**
Learning the quantum algorithm for state overlap
New Journal of Physics. 20 (11), 113022 (2018)

https://arxiv.org/abs/1803.04114

30. **P. J. Coles,** et al. (31 co-authors)
Quantum algorithm implementations for beginners
arXiv:1804.03719. (2018)
https://arxiv.org/abs/1804.03719

29. A. Winick, N. Lutkenhaus, **P. J. Coles**
Reliable numerical key rates for quantum key distribution
Quantum. 2: 77. (2018)
https://quantum-journal.org/papers/q-2018-07-26-77/

28. **P. J. Coles**, M. Berta, M. Tomamichel, S. Wehner
Entropic uncertainty relations and their applications
Reviews of Modern Physics. 89: 015002. (2017).
https://journals.aps.org/rmp/abstract/10.1103/RevModPhys.89.015002

27. F. Rozpedek, J. Kaniewski, **P. J. Coles**, S. Wehner
Quantum preparation uncertainty and lack of information
New Journal of Physics. 19: 023038. (2017)
http://iopscience.iop.org/article/10.1088/1367-2630/aa5d64/meta;jsessionid=720C9852D43866FED1E2F373404D076F.ip-10-40-2-120

26. **P. J. Coles**, E. M. Metodiev, N. Lütkenhaus
Numerical approach for unstructured quantum key distribution
Nature Communications. 7: 11712. (2016)
http://www.nature.com/ncomms/2016/160520/ncomms11712/full/ncomms11712.html

25. **P. J. Coles**
Entropic framework for wave-particle duality in multi-path interferometers
Physical Review A. 93: 062111. (2016)
http://journals.aps.org/pra/abstract/10.1103/PhysRevA.93.062111

24. C. Pfister, N. Lütkenhaus, S. Wehner, **P. J. Coles**
Sifting attacks in finite-size quantum key distribution
New Journal of Physics. 18: 053001. (2016)
http://iopscience.iop.org/article/10.1088/1367-2630/18/5/053001/meta

23. D. B. S. Soh, C. Brif, **P. J. Coles**, N. Lütkenhaus, R. M. Camacho, J. Urayama, M. Sarovar
Self-referenced continuous-variable quantum key distribution protocol
Physical Review X. 5: 041010. (2015)
https://journals.aps.org/prx/abstract/10.1103/PhysRevX.5.041010

22. **P. J. Coles** and F. Furrer
State-dependent approach to entropic measurement-disturbance relations
Physics Letters A. 379: 105-112. (2015)
http://www.sciencedirect.com/science/article/pii/S0375960114011098

21. **P. J. Coles**, J. Kaniewski, S. Wehner
Equivalence of wave-particle duality to entropic uncertainty
Nature Communications. 5: 5814. (2014)

http://www.nature.com/doifinder/10.1038/ncomms6814

20. M. Berta, **P. J. Coles**, S. Wehner
Entanglement-assisted guessing of complementary measurement outcomes
Physical Review A. 90: 062127. (2014)
http://link.aps.org/doi/10.1103/PhysRevA.90.062127

19. **P. J. Coles** and M. Piani
Complementary sequential measurements generate entanglement
Physical Review A: Rapid Communications. 89: 010302(R). (2014) ***Selected for Editors' Suggestion***
http://link.aps.org/doi/10.1103/PhysRevA.89.010302

18. **P. J. Coles** and M. Piani
Improved entropic uncertainty relations and information exclusion relations
Physical Review A. 89: 022112. (2014)
http://link.aps.org/doi/10.1103/PhysRevA.89.022112

17. **P. J. Coles**
Role of complementarity in superdense coding
Physical Review A. 88: 062317. (2013)
http://link.aps.org/doi/10.1103/PhysRevA.88.062317

16. **P. J. Coles**
Collapse of the quantum correlation hierarchy links entropic uncertainty to entanglement creation
Physical Review A. 86: 062334. (2012)
http://link.aps.org/doi/10.1103/PhysRevA.86.062334

15. **P. J. Coles**, V. Gheorghiu, R. Griffiths
Collisional decoherence of tunneling molecules: a consistent histories treatment
Physical Review A. 86: 042111. (2012)
http://link.aps.org/doi/10.1103/PhysRevA.86.042111

14. **P. J. Coles**, R. Colbeck, L. Yu, M. Zwolak
Uncertainty relations from simple entropic properties
Physical Review Letters. 108: 210405. (2012)
http://link.aps.org/doi/10.1103/PhysRevLett.108.210405

13. **P. J. Coles**
Unification of different views of decoherence and discord
Physical Review A. 85: 042103. (2012)
http://link.aps.org/doi/10.1103/PhysRevA.85.042103

12. **P. J. Coles**, L. Yu, V. Gheorghiu, R. Griffiths
Information-theoretic treatment of tripartite systems and quantum channels
Physical Review A. 83: 062338. (2011)
http://link.aps.org/doi/10.1103/PhysRevA.83.062338

11. **P. J. Coles**, L. Yu, M. Zwolak
Relative entropy derivation of the uncertainty principle with quantum side information
arXiv:1105.4865. (2011)
http://arxiv.org/abs/1105.4865

10. **P. J. Coles**
    Non-negative discord strengthens the subadditivity of quantum entropy functions
    arXiv:1101.1717. (2011)
    http://arxiv.org/abs/1101.1717

9. J. King, **P. J. Coles**, J. Reimer
    Optical polarization of ^{13}C nuclei in diamond through nitrogen vacancy centers
    Physical Review B. 81: 073201. (2010)
    http://link.aps.org/doi/10.1103/PhysRevB.81.073201

8. B. Li, **P. J. Coles**, J. Reimer, P. Dawson, C. Meriles
    Optical pumping nuclear spin magnetism in GaAs/AlAs quantum wells of variable electron density
    Solid State Communications. 150: 450-453. (2010)
    http://www.sciencedirect.com/science/article/pii/S0038109809007558

7. **P. J. Coles**
    Helicity asymmetry of optically pumped NMR spectra in GaAs
    Physical Review B. 78: 033201. (2008)
    http://journals.aps.org/prb/abstract/10.1103/PhysRevB.78.033201

6. **P. J. Coles** and J. Reimer
    Penetration depth model for optical alignment of nuclear spins in GaAs.
    Physical Review B. 76: 174440. (2007)
    http://journals.aps.org/prb/abstract/10.1103/PhysRevB.76.174440

5. A. Paravastu, **P. J. Coles**, J. Reimer, T. Ladd, R. Maxwell
    Photocurrent-modulated optical nuclear polarization in bulk GaAs
    Applied Physics Letters, 87: 232109. (2005)
    http://scitation.aip.org/content/aip/journal/apl/87/23/10.1063/1.2140484

4. T. Ali, **P. J. Coles**, T. Stevens, K. Stott, J. Thomas
    Two homologous domains of similar structure but different stability in the yeast linker histone, Hho1P
    Journal of Molecular Biology, 338:139. (2004)
    http://www.sciencedirect.com/science/article/pii/S0022283604002232

3. M. Thibonnier, **P. J. Coles**, A. Thibonnier, and M. Shoham
    Molecular Pharmacology and Modeling of Vasopressin Receptors
    Progress in Brain Research, 139:179-96. (2002)
    http://www.sciencedirect.com/science/article/pii/S0079612302390162

2. M. Thibonnier, **P. J. Coles**, A. Thibonnier, and M. Shoham
    The Basic and Clinical Pharmacology of Nonpeptide Vasopressin Receptor Antagonists
    Annual Review of Pharmacology and Toxicology, 41:175-202. (2001)
    http://www.annualreviews.org/doi/abs/10.1146/annurev.pharmtox.41.1.175

1. M. Thibonnier, **P. J. Coles**, D. Conarty, C. Plesnicher, and M. Shoham
    Molecular model of agonist and nonpeptide antagonist binding to the human V_1 vascular vasopressin receptor
    Journal of Pharmacology and Experimental Therapeutics, 294:195-203. (2000)
    http://jpet.aspetjournals.org/content/294/1/195.short

Media Coverage

Quantum key distribution

- Science Daily
  https://www.sciencedaily.com/releases/2016/05/160523104817.htm
- Phys.org
  http://phys.org/news/2016-05-secret-unbreakable-key.html
- Scientific Computing
  http://www.scientificcomputing.com/news/2016/05/computing-secret-unbreakable-key
- ECN
  http://www.ecnmag.com/news/2016/05/computing-secret-unbreakable-key
- EurekAlert!
  http://www.eurekalert.org/pub_releases/2016-05/uow-cas052016.php
- University of Waterloo
  https://uwaterloo.ca/news/news/computing-secret-unbreakable-key

Wave-particle duality

- Huffington Post
  http://www.huffingtonpost.com/2014/12/24/quantum-physics-easier-to-understand_n_6370570.html
- Ten of the biggest science and technology stories of 2014 (phys.org)
  http://phys.org/news/2014-12-ten-biggest-science-technology-stories.html
- Asian Scientist
  http://www.asianscientist.com/2014/12/in-the-lab/bridging-mysteries-heart-quantum-physics/
- University of Waterloo
  https://uwaterloo.ca/stories/quantum-physics-breakthrough-scientists-solve-100-year-old
- Motherboard Vice
  http://motherboard.vice.com/en_us/read/how-digital-information-unifies-quantum-mechanics
- Phys.org
  http://phys.org/news/2014-12-quantum-physics-complicated.html
- From Quarks to Quasars
  http://www.fromquarkstoquasars.com/particle-wave-duality-quantum-uncertainty-principle-united/
- EurekAlert! http://www.eurekalert.org/pub_releases/2014-12/cfqt-qpj121814.php
- International Business Times
  http://www.ibtimes.co.uk/quantum-physics-just-got-less-complicated-rosetta-stone-breakthrough-1480238
- Controlled Environments
  http://www.cemag.us/news/2014/12/making-quantum-physics-less-complicated
- Opli http://www.opli.net/opli_magazine/eo/2014/quantum-physics-just-got-less-complicated-dec-news/
- Science Daily http://www.sciencedaily.com/releases/2014/12/141219085153.htm
- Nanowerk http://www.nanowerk.com/nanotechnology-news/newsid=38529.php
- (e) Science News
  http://esciencenews.com/articles/2014/12/19/quantum.physics.just.got.less.complicated
- R&D Magazine http://www.rdmag.com/news/2014/12/quantum-physics-just-got-less-complicated
- Laboratory Equipment http://www.laboratoryequipment.com/news/2014/12/good-news-quantum-physics-just-got-less-complicated

Visiting Research Invitations

Sandia National Laboratory **Feb. 2015**

Continuous-variable quantum key distribution

Host: Mohan Sarovar, Researcher

ETH Zurich **Oct. 2013**

Quantum information resource theories

Host: Joe Renes, Researcher

University of Waterloo **Jun. 2012**

Entanglement and the uncertainty principle

Host: Marco Piani, Assistant Professor

Perimeter Institute for Theoretical Physics **Jun. 2011**

General framework for proving uncertainty relations

Host: Roger Colbeck, Assistant Professor

Los Alamos National Laboratory **Feb. 2011**

Correlations in quantum systems

Host: Michael Zwolak, Assistant Professor

Invited Faculty Position

University of New Mexico

Center for Quantum Information and Control (CQuIC)

Adjunct Assistant Professor (January 2019 – Present)

Invited Talks

APS March Meeting **Mar. 2021**

"Trainability of Quantum Neural Networks: Barren Plateaus and Scalability"

QHACK – Quantum Machine Learning Hackathon **Feb. 2021**

"Variational Quantum Algorithms"

Q2B Conference – Practical Quantum Computing **Dec. 2020**

"Cost-function-dependent barren plateaus in quantum neural networks"

AQIS (Asian Quantum Information Science) Conference **Dec. 2020**

"Prospects and challenges for variational quantum algorithms"

QTML (Quantum Techniques in Machine Learning) **Nov. 2020**
"Prospects and challenges for variational quantum algorithms"

University of Toronto – Quantum Research Seminars **Oct. 2020**
"Barren plateau landscapes in variational quantum algorithms"

IEEE Quantum Week **Oct. 2020**
Panelist for Panel on Quantum Machine Learning

CQuIC Seminar, University of New Mexico **Jan. 2020**
Albuquerque, USA
"Variational Quantum Algorithms: An Overview"

Argonne QIS Workshop (Plenary Talk) **Sept. 2019**
Chicago, USA
"Variational quantum-classical algorithms"

Physics Department Colloquium, Louisiana State University **Apr. 2019**
Baton Rouge, USA
"Hybrid quantum-classical algorithms"

Quantum Computing and Information for Nuclear Physics **Jan. 2019**
Santa Fe, USA
"Machine Learning for Quantum Computing"

CQuIC Seminar, University of New Mexico **Jan. 2018**
Albuquerque, USA
"Automation in quantum information"

SPIE Conference on Quantum Communication **Aug. 2016**
San Diego, USA
"Unstructured quantum key distribution"

Workshop on Beyond I.I.D. in Information Theory **July 2016**
Barcelona, Spain
"Entropic uncertainty relations and their applications"

Quantum Foundations Seminar **Nov. 2014**
Perimeter Institute for Theoretical Physics, Canada
"Equivalence of wave-particle duality to entropic uncertainty"

Quantum Lunch Seminar **Feb. 2011**
Los Alamos National Lab, USA
"Diagrammatic approach to Consistent Histories"

Quantum Lunch Seminar **Nov. 2010**
Los Alamos National Lab, USA

"Information-theoretic treatment of tripartite systems and quantum channels"

Quantum Coherence and Decoherence Workshop **Sep. 2010**

Benasque, Spain

"Information-theoretic treatment of tripartite systems and quantum channels"

UC Berkeley, Dept. of Chemical Engineering Colloquium **Apr. 2007**

Berkeley, USA

"Laser-Induced Nuclear Spin Alignment in GaAs"

Honors

Research Awards

- Best-poster-award in the physics category of LANL's 2018 summer student symposium
- Best-poster-award at the largest international conference on quantum cryptography (QCRYPT) in 2012

Miscellaneous Awards

- LANL Certificate of Recognition for organizing the quantum computing summer school
- Outstanding Reviewer for the journal *Physics Letters A*, awarded in 2015

Graduate Fellowships

- Churchill Fellowship
  (11 awarded nationwide annually, for US students to pursue a Masters Degree at Cambridge)
- National Science Foundation Graduate Fellowship
- NDSEG Fellowship from the Department of Defense (Declined due to NSF Fellowship)
- University of California, Berkeley Fellowship (Declined due to Churchill Fellowship)

Undergraduate Scholarships

- Society for Analytical Chemists of Pittsburgh (SACP) $16,000 College Scholarship
  ($16,000 scholarship awarded based on my score on annual ACS high-school chemistry exam.)
- Case Western Alumni Scholarship
- Case Western Presidential Scholarship
- Zeta Beta Tau Fraternity 4.0 Scholarship

Undergraduate Awards

- AICHE (American Institute of Chemical Engineers) Research Award
- Bahnsen Award: achievement in Chemical Engineering and outstanding research projects
- Case Alumni Prize: senior with best academic record in the Case School of Engineering
- Outstanding Junior Award of the Case School of Engineering
- Outstanding Sophomore Award of the Case School of Engineering
- Kilpatrick Award: senior varsity athlete with highest GPA
- UAA All-Academic (1998 – 2001)
- NSCAA/Adidas Scholar Athlete - Honorable Mention (1999)
- Tau Beta Pi Honor Society (HS), Mortar Board HS, Gamma Sigma Alpha HS, Golden Key HS

Teaching Experience

Los Alamos National Laboratory

- Lecturer and mentor for LANL Quantum Computing Summer School. Mentored over 20 summer students on quantum computing research projects since 2018.

University of Waterloo

- Lecturer on quantum information theory: Developed and taught a special topics course on quantum information theory, offered to graduate students in June 2016.
- Lecturer at the Undergraduate School for Experimental Quantum Information Processing (USEQIP), from 2015 to present.
- Mentored three undergraduate students and two graduate students on quantum optics and quantum information research projects.

National University of Singapore

- Mentored graduate and undergraduate students on quantum information research projects.

Carnegie Mellon University

- Lecturer on Quantum Optics: Developed and taught a graduate course, the first quantum optics course ever offered at Carnegie Mellon. Topics covered included field quantization, field states, characteristic functions, field-atom interaction, spontaneous emission, open systems, quantum jumps, lasers, experimental paradigms, Casimir's effect, optical devices (beam splitters, interferometers, detectors), quantum information, and optical tests of quantum foundations.

University of California, Berkeley

- Graduate Student Instructor: Chemical Engineering 162 - Process Dynamics and Control.
- Graduate Student Instructor: Chemical Engineering 137 - Transport Laboratory

Case Western Reserve University

- Supplemental Instructor: Organic Chemistry I and II.

Additional Experience

Machine Learning and Neural Networks

- Certification in Machine Learning course offered by Coursera, Stanford University (Dec. 2016).
- Certification in Neural Networks course offered by Coursera, University of Toronto (March 2017).

Conference Organizer

- Organizing committee member for the largest international conference on quantum cryptography (QCRYPT), hosted by National University of Singapore in 2012.

LANL Committees

- Member of LANL hiring committee for new staff scientist in quantum computing, CCS-3 group.
- Member of LANL LDRD review committee for Directed Research (DR) proposals in 2020.

Referee

- Referee for Physical Review Letters, IEEE Transactions on Information Theory, Physical Review A, New Journal of Physics, International Journal of Quantum Information, Quantum Information Processing, Scientific Reports, Physical Letters A, and Journal of Physics A.