

Ish Dhand
Curriculum Vitae
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PERSONAL DETAILS

Office Address Xanadu Quantum Technologies Inc.,
2902-777 Bay St. Toronto (ON) M5G 2C8 Canada
Email, webpage ishdhand@gmail.com, <http://ishdhand.me/>
Date of Birth 04 February 1990 (Age: 29)
Citizenship Indian
Gender Male

RESEARCH EXPERIENCE

Mar. 2020 onwards Quantum Architecture Team Lead
Xanadu Quantum Technologies Inc., Toronto, Canada
Nov. 2019 – Feb. 2020 Quantum Architecture Researcher
Xanadu Quantum Technologies Inc., Toronto, Canada
Apr. 2016 – Oct. 2019 Postdoctoral Research Associate (19 months) and
Alexander von Humboldt Fellow (24 months)
Institute of Theoretical Physics, Ulm University, Germany
Host: Prof. Dr. Martin B. Plenio

EDUCATION

Sep. 2013 – Feb. 2016 Ph.D., Physics
University of Calgary, Canada
Supervisor: Prof. Dr. Barry C. Sanders
Thesis: Multi-Photon Multi-Channel Interferometry for
Quantum Information Processing. [arXiv:1603.07476](https://arxiv.org/abs/1603.07476)
Grade point average: 4.0/4.0
Sep. 2012 – Aug. 2013 M.Sc., Physics (switched to Ph.D.)
University of Calgary, Canada
Supervisor: Prof. Dr. Barry C. Sanders
Grade point average: 4.0/4.0
Jul. 2008 – Jun. 2012 B.Tech., Computer Science and Engineering
Institute: Indian Institute of Technology Kanpur, India

PEER-REVIEWED PUBLICATIONS

2020 A. Smirne, T. Nitsche, D. Egloff, S. Barkhofen, S. De, I. Dhand, C. Silberhorn, S. F. Huelga, and M. B. Plenio. Experimental control of the degree of non-classicality via quantum coherence. *Quantum Science and Technology*, 5(4):04LT01. [arXiv:1910.11830](https://arxiv.org/abs/1910.11830)

- 2020 A. Nüßeler, I. Dhand, S. F. Huelga, and M. B. Plenio. Efficient simulation of open quantum systems coupled to a fermionic bath. *Phys. Rev. B*, 101:155134. **(Editors' suggestion)** [arXiv:1909.09589](#)
- 2019 D. Su*, I. Dhand*, L. G. Helt, Z. Vernon, and K. Brádler. Hybrid spatiotemporal architectures for universal linear optics. *Physical Review A*, 99:062301. [arXiv:1812.07939](#)
- 2018 I. Schwartz, J. Scheuer, B. Tratzmiller, S. Müller, Q. Chen, I. Dhand, Z. Wang, C. Müller, B. Naydenov, F. Jelezko, and M. B. Plenio. Robust optical polarization of nuclear spin baths using Hamiltonian engineering of nitrogen-vacancy center quantum dynamics. *Science Advances*, 4(8):eaat8978. [arXiv:1710.01508](#)
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn, and M. B. Plenio. Proposal for quantum simulation via all-optically-generated tensor network states. *Physical Review Letters*, 120:130501. [arXiv:1710.06103](#)
- 2017 B. P. Lanyon, C. Maier, M. Holzzapfel, T. Baumgratz, C. Hempel, P. Jurcevic, I. Dhand, A. S. Buyskikh, A. J. Daley, M. Cramer, M. B. Plenio, R. Blatt, and C. F. Roos. Efficient tomography of a quantum many-body system. *Nature Physics*, 13(12):1158. [arXiv:1612.08000](#)
- 2017 J. Scheuer, I. Schwartz, S. Müller, Q. Chen, I. Dhand, M. B. Plenio, B. Naydenov, and F. Jelezko. Robust techniques for polarization and detection of nuclear spin ensembles. *Physical Review B*, 96:174436. [arXiv:1706.01315](#)
- 2016 I. Dhand, A. Khalid, H. Lu, and B. C Sanders. Accurate and precise characterization of linear optical interferometers. *Journal of Optics*, 18(3):035204. [arXiv:1508.00283](#)
- 2016 H. de Guise, D. Spivak, J. Kulp, and I. Dhand. \mathcal{D} -functions and immanants of unitary matrices and submatrices. *Journal of Physics A: Mathematical and Theoretical*, 49(9):09LT01. **(selected as letter — outstanding short paper)** [arXiv:1511.01851](#)
- 2015 I. Dhand, B. C. Sanders, and H. de Guise. Algorithms for $SU(n)$ boson realizations and \mathcal{D} -functions. *Journal of Mathematics and Physics*, 56:111705. **(featured article)** [arXiv:1507.06274](#)
- 2015 I. Dhand and S. K. Goyal. Realization of arbitrary discrete unitary transformations using spatial and internal modes of light. *Physical Review A*, 92:043813. [arXiv:1508.06259](#)
- 2014 I. Dhand and B. C. Sanders. Stability of the Trotter-Suzuki decomposition. *Journal of Physics A: Mathematical and Theoretical*, 47:265206. **(featured article)** [arXiv:1403.3469](#)

* These authors contributed equally.

- 2018 [I. Dhand](#), A. D'Souza, V. Narasimhachar, N. Sinclair, S. Wein, P. Zarkeshian, A. Poostindouz, and C. Simon. Understanding quantum physics through simple experiments: from wave-particle duality to Bell's theorem. [arXiv:1806.09958](#) (This is a 30,000-word open-access preprint for a proposed undergraduate-level textbook that is under contract with Cambridge University Press.)

PREPRINTS

- 2020 A. Nüßeler, [I. Dhand](#), S. F. Huelga, and M. B. Plenio. Efficient construction of tensor-network representations of many-body gaussian states. [arXiv:2008.05243](#)
- 2020 M. Engelkemeier, L. Lorz, S. De, B. Brecht, [I. Dhand](#), M. B. Plenio, C. Silberhorn, and J. Sperling. Quantum photonics with active feedback loops. [arXiv:2002.08154](#)
- 2020 S. P. Kumar and [I. Dhand](#). Optimal modular architectures for universal linear optics. [arXiv:2001.02012](#)
- 2019 [I. Dhand](#). Circumventing defective components in linear optical interferometers. [arXiv:1912.08789](#)
- 2019 E. Meyer-Scott, N. Prasannan, [I. Dhand](#), C. Eigner, V. Quiring, S. Barkhofen, B. Brecht, M. B. Plenio, and C. Silberhorn. Exponential enhancement of multi-photon entanglement rate via quantum interference buffering. [arXiv:1908.05722](#)

All preprints are listed on [arXiv](#) and citations are available on [Google Scholar](#).

COMPETITIVE AWARDS AND ACHIEVEMENTS

- 2018 Awarded EUR 10,000 Forschungsbonus (research bonus) for excellence in research by Ulmer Universitäts Gesellschaft and University of Ulm. Three postdoctoral fellows out of all faculties at University of Ulm are awarded.
- 2017 Team leader of best team at Quantum Ideas Factory boot camp 11–13 September, 2017 organized by Physics Institute, Heidelberg University.
- 2016 Awarded two-year EUR 82,800 Humboldt Research Fellowship for Postdoctoral Research by Alexander von Humboldt Foundation.
- 2015 DAMOPC Best Student Oral Presentation Award (Second Prize) by Division of Atomic, Molecular and Optical Physics, Canadian Association of Physicists.
- 2015 Awarded CAD 2275 Departmental Graduate Student Excellence Award by Department of Physics and Astronomy, University of Calgary.
- 2014 Awarded CAD 2300 Departmental Graduate Student Excellence Award by Department of Physics and Astronomy, University of Calgary.
- 2013 Awarded CAD 3600 Queen Elizabeth II Fellowship, 2013 by University of Calgary.
- 2012 Awarded CAD 7200 Departmental Fellowship, 2012-2013 by the Department of Physics and Astronomy, University of Calgary.

- 2010 Academic Excellence Award at Indian Institute of Technology Kanpur. 7% of the students with the highest GPA across all departments in the institute are awarded
- 2009 Awarded INR 260,000 Aditya Birla Scholarship by Aditya Birla Group. 10 out of 10,000 incoming students to the Indian Institutes of Technology receive the Aditya Birla Scholarship.
- 2008 Stood 22nd all over India out of the 322,000 candidates in the Joint Entrance Examination conducted by the Indian Institutes of Technology.
- 2008 Awarded the Indian Physics Association prize for the Best Solution to a Challenging Theoretical Problem by Indian Physics Association. Awarded to 1 out of the 35 gold medalists in the Indian National Physics Olympiad.
- 2008 Awarded Gold Medal in Indian National Physics Olympiad. Awarded to 35 out of 30,000 participants in the Indian National Physics Olympiad.
- 2007 Represented India at the 8th Asian Physics Olympiad at Shanghai. 2 students were chosen to participate in the olympiad out of 30,000 participants in the Indian National Physics Olympiad.
- 2006 Awarded the National Child Award by the Prime Minister of India on behalf of Ministry of Human Resource Development, Government of India. One high-school student is nominated for this award from each state of India.
- 2004 Awarded National Bal Shree for creative scientific innovation by the President of India on behalf of Ministry of Human Resource Development, Government of India. Awarded to 20 out of 20,000 participants nationally.

TALKS AND CONFERENCE PARTICIPATION

- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, University of Toronto, Toronto, Canada (*Invited seminar*), 18 October 2018.
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, University of Waterloo, Waterloo, Canada (*Invited seminar*), 10 October 2018.
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, University of Calgary, Calgary, Canada (*Invited seminar*), 03 October 2018.
- 2018 I. Dhand, Tensor network states for fun and profit, Tata Institute of Fundamental Research, Mumbai, India (*Invited seminar*), 24 September 2018.
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, Indian Institute of Science Education and Research Mohali, Mohali, India (*Invited seminar*), 17 September 2018.
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, Tata Institute of Fundamental Research, Mumbai, India (*Invited seminar*), 14 September 2018.

- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, Indian Institute of Technology Bombay, Mumbai, India (*Invited seminar*), 13 September 2018.
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, Indian Institute of Science Education and Research Pune, Pune, India (*Invited seminar*), 11 September 2018.
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, Harish-Chandra Research Institute, Allahabad, India (*Invited seminar*), 06 September 2018.
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, Indian Institute of Technology Kanpur, Kanpur, India (*Invited seminar*), 04 September 2018.
- 2018 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, Proposal for Quantum Simulation via All-Optically Generated Tensor Network States, Institute of Mathematical Sciences Workshop on Quantum Metrology and Open Quantum Systems (*Contributed seminar*), 27 August 2018.
- 2017 I. Dhand, M. Engelkemeier, L. Sansoni, S. Barkhofen, C. Silberhorn and M. B. Plenio, All-optical generation of entangled multi-qubit states (*Contributed seminar*), International Conference on Integrated Quantum Photonics, Rome, Italy. 28 September 2017.
- 2015 I. Dhand, A. Khalid, H. Lu, and B. C. Sanders, Accurate and Precise Characterization of Linear Optical Interferometers (*Contributed seminar*), Canadian Association of Physics (CAP) Congress, Edmonton, Canada. 18 June 2015.
- 2015 I. Dhand, B. C. Sanders, and H. de Guise, Group-Theoretic Methods in Multi-Photon Interferometry. (*Contributed poster*), Canadian Association of Physics (CAP) Congress, Edmonton, Canada. 18 June 2015.
- 2015 I. Dhand, H. de Guise and B. C. Sanders, Algorithms for Boson Realizations of $SU(n)$ (*Contributed seminar*), Theory Canada 10, Calgary, Canada. 12 June 2015.
- 2015 I. Dhand, H. de Guise, A. Khalid, He Lu and B. C. Sanders, Design, Characterization and Simulation of Linear Optical Devices (*Invited Seminar*), Workshop on Multi-Photon Interferometry, Shanghai, China. 8 May 2015.
- 2014 I. Dhand and J. Ghosh, Quantum Simulation and Implementations (*Invited poster*), Alberta Quantum-Nano Workshop, Red Deer, Canada. 14 July 2014.
- 2013 I. Dhand and B. C. Sanders, Finite precision in Trotter-Suzuki decomposition (*Contributed seminar*), Canadian Quantum Information Students' conference, Calgary, Canada. 25 Jun 2013.
- 2013 I. Dhand and B. C. Sanders, Finite precision in Trotter-Suzuki decomposition (*Invited seminar*), Institute for Quantum Computing, University of Waterloo, Waterloo, Canada. 6 Jun 2013.

- 2013 I. Dhand and B. C. Sanders, Finite precision in Trotter-Suzuki decomposition (*Contributed seminar*), CAP Congress 2013, Montreal, Canada. 28 May 2013.

Note: Only those seminars or posters that I have presented are listed.

TEACHING

- 2015 Instructor, one day course on *A first encounter with quantum mysteries* at University of Calgary Continuing Education.
- 2015 Teaching assistant, *Quantum mysteries and paradoxes*. Designed and delivered two lectures. Assisted with designing and grading assignments and examinations.
- 2015 Teaching assistant, *Electromagnetic theory I*. Designed and delivered two review lectures. Assisted with designing and grading examinations and laboratory sessions.
- 2013 Teaching assistant, *Senior physics laboratory*.
- 2012 Teaching assistant, *Freshman mechanics*.

SUPERVISION AND SERVICE

- 20** Co-supervising one PhD student (two publications together), two Master students (one publication) and three Bachelor students.
- 20** Referee for New Journal of Physics, Physical Review A, Physical Review Letters, Physical Review X, Quantum Information Processing, Quantum Science and Technology, Science, and Scientific Reports.
- 2015 Organizer of Workshop on Multi-Photon Interferometry at Shanghai, China during 7-11 May 2015.
- 2013 Organizer of CQISC, Canadian Quantum Information Students' Conference held in June 2013 at University of Calgary.
- 2012 Organizer of PHAS Lunches, fortnightly lunch talks in the physics department at University of Calgary.
- 2010 Organizer and chair of ICARUS-2010, undergraduate research conference organized at IIT Kanpur.

REFEREES

- **Martin B. Plenio**
Alexander von Humboldt Professor, Universität Ulm
Director, Institute of Theoretical Physics, Universität Ulm
Director, Center for Quantum Bio-Sciences, Universität Ulm
Office Address: Institute of Theoretical Physics, Universität Ulm, Albert-Einstein-Allee 11, 89081 Ulm, Germany
Email: martin.plenio@uni-ulm.de
- **Christine Silberhorn**
Full Professor, Integrated Quantum Optics, Universität Paderborn
DFG Graduiertenkolleg Micro- and Nanostructures in Optoelectronics and Photonics, Universität Paderborn

Office Address: Integrated Quantum Optics, Universität Paderborn, Warburger Str. 100, 33098 Paderborn, Germany

Email: christine.silberhorn@uni-paderborn.de

- **Barry C. Sanders**

Director, Institute for Quantum Science & Technology, University of Calgary
Thousand Talents Chair at the University of Science and Technology China
Vajra Visiting Faculty member, Raman Research Institute, India

Office Address: Institute for Quantum Science and Technology, University of Calgary, 2500 University Dr. NW, Calgary, AB, Canada, T2N 1N4

Email: sandersb@ucalgary.ca

- **Hubert de Guise**

Professor, Department of Physics, Lakehead University, Canada

Office Address: CB 4033, Lakehead University, 955 Oliver Road, Thunder Bay, ON, Canada, P7B 5E1

Email: hubert.deguise@lakeheadu.ca