

Twesh Upadhyaya

tweshu@umd.edu

Education

- **PhD in Physics** Sept. 2021 – present
University of Maryland, Joint Center for Quantum Information and Computer Science
- **MSc in Physics (Quantum Information)** Sept. 2019 – August 2021
Institute for Quantum Computing, University of Waterloo
- **BASc in Engineering Science**, Engineering Physics, with High Honours; Sept. 2015 – June 2019
Certificate in Engineering Business, University of Toronto

Research Experience

- **PhD Thesis**, University of Maryland, Joint Center for Quantum Information and Comp. Sci. (Sept. 2021 – present)
Supervisor: Prof. Nicole Yunger Halpern
Researching thermodynamics through the lens of quantum information. Studying the effects of noncommutation on entropy production and transport more broadly.
- **MSc Thesis**, University of Waterloo, Institute for Quantum Computing (Sept. 2019 – August 2021)
Supervisor: Prof. Norbert Lütkenhaus
Studied the theory of quantum key distribution. Developed techniques to reduce infinite-dimensional problems to tractable finite-dimensional ones; utilizing quantum entropies and semidefinite programs.
- **BASc Thesis**, University of Toronto (Sept. 2018 – April 2019)
Supervisor: Prof. John Sipe
Studied electronic and optical properties of graphene and graphite using a tight-binding model. Determined band structure and energy eigenstates, and calculated tensors of interest for coherent control.
- **Cdn. Reduced Gravity Experiment Design Challenge, Primary Mission Specialist** (Nov. 2017 – Aug. 2018)
Our team was one of four selected in national competition, run by SEDS in collaboration with Canadian Space Agency and National Research Council. Designed and conducted experiment in microgravity. Studied thermomagnetic convection of parafluids, visualized using Schlieren imaging.
- **Fields Undergraduate Summer Research Program**, The Fields Institute (July 2017 – Aug. 2017)
Supervisor: Prof. Konstantinos Georgiou
In a team of 4 students, studied the computational complexity of lift and project systems. Found novel lower bound on the integrality gap of the Lasserre Hierarchy on the t-partial-vertex cover polytope.

Publications

- S. Majidy, W.F. Braasch Jr., A. Lasek, **T. Upadhyaya**, A. Kalev, N. Yunger Halpern, *Noncommuting conserved charges in quantum thermodynamics and beyond*. Nat Rev Phys **5**, 689–698 (2023).
- **T. Upadhyaya**, W.F. Braasch, Jr., G.T. Landi, N. Yunger Halpern, *What happens to entropy production when conserved quantities fail to commute with each other*. arXiv:2305.15480 (2023).
- S. Nahar, **T. Upadhyaya**, Norbert Lütkenhaus, *Imperfect Phase-Randomisation and Generalised Decoy-State Quantum Key Distribution*. arXiv:2304.09401 (2023).
- F. Kanitschar, I. George, J. Lin, **T. Upadhyaya**, N. Lütkenhaus, *Finite-Size Security for Discrete-Modulated Continuous-Variable Quantum Key Distribution Protocols*. PRX Quantum **4**, 040306 (2023).
- **T. Upadhyaya**, T. van Himbeeck, N. Lütkenhaus, *An Improved Correction Term for Dimension Reduction in Quantum Key Distribution*. arXiv: 2210.14296 (2022).
- **T. Upadhyaya**, T. van Himbeeck, J. Lin, N. Lütkenhaus, *Dimension Reduction in Quantum Key Distribution for Continuous- and Discrete-Variable Protocols*. PRX Quantum **2**, 020325 (2021).
- J. Lin, **T. Upadhyaya**, N. Lütkenhaus, *Asymptotic Security Analysis of Discrete-Modulated Continuous-Variable Quantum Key Distribution*. Physical Review X **9**, 041064 (2019).
- K. Georgiou, A. Jiang, E. Lee, A. Olave, I. Seong, **T. Upadhyaya**, *Lift & project systems performing on the partial-vertex-cover polytope*. Theoretical Computer Science **820**, 1-16 (2020).

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Invited Talks

- *Non-Abelian transport distinguishes three usually equivalent notions of entropy production.* Information Engines Workshop. (07/2023)
- *Security Proofs for QKD Protocols in Infinite Dimensions.* International Conference on Quantum Cryptography. (08/2021)

Contributed Presentations

- *Non-Abelian transport distinguishes three usually equivalent notions of entropy production.* Cavendish Quantum Information Seminar Series. (Talk) (11/2023)
- *Non-Abelian transport distinguishes three usually equivalent notions of entropy production.* Robust Quantum Simulation Annual Workshop. (Poster) (06/2023)
- *Security Proof for Discrete-Modulated Continuous-Variable Quantum Key Distribution without Photon-Number Cut-off Assumption.* International Conference on Quantum Cryptography. (Poster) (08/2020)
- *Asymptotic Security Proof of DMCVQKD without Photon-Number Cutoff Assumption.* QKD Security Proofs Workshop. (Talk) (07/2020)

Research Awards

- Postgraduate Scholarship – Doctoral (NSERC, 2022)
- Canada Graduate Scholarship – Doctoral (NSERC, 2022) [*declined*]
- Lanczos Fellowship (Joint Center for Quantum Information and Computer Science, Sept. 2021)
- Dean's Fellowship (University of Maryland, Sept. 2021)
- Michael Smith Foreign Study Supplement (NSERC, Dec. 2020) [*declined*]
- Alexander Graham Bell Canada Graduate Scholarship (NSERC, May 2020)
- President's Graduate Scholarship (University of Waterloo, May 2020)
- Institute for Quantum Computing Entrance Award (University of Waterloo, Sept. 2019)

Leadership Roles

- **Student Senator**, University of Maryland Senate (May 2022 – Apr. 2023)
- **Student Governor**, University of Waterloo Board of Governors (May 2021 – Aug. 2021)
- **Student Senator**, University of Waterloo Senate (May 2020 – Aug. 2021)
- University of Waterloo **University Tenure and Promotion Committee** (Nov. 2019 – Aug. 2021)
- **Director**, UW Graduate Student Association Board of Directors (Oct. 2019 – Aug. 2021)
- **Founder**, University of Toronto Microgravity Experiment Design Team (Oct. 2018)
- **Engagement Manager, Volunteer Consultancy**, Raising the Roof (Not-for-Profit) (Sept. 2018 – Apr. 2019)
- University of Toronto Governing Council, **Committee for Honorary Degrees** (July 2018 – June 2019)
- University of Toronto Governing Council, **Discipline Appeals Board** (July 2018 – June 2019)
- **Student Governor**, University of Toronto Governing Council (July 2017 – June 2018)
- **Representative** on U of T Engineering Society Board of Directors (Sept. 2015 – April 2018)

Academic and Leadership Awards

- Gordon Cressy Student Leadership Award (University of Toronto, April 2019)
- Skule Cannon Award (University of Toronto Engineering Society, March 2019)
- Department of Engineering Science Award of Excellence (University of Toronto, March 2019)
- Class of 4T3 Engineering James Ham Award (University of Toronto Engineering, Aug. 2018)
- The F. W. Minkler Scholarship (University of Toronto, June 2018)
- Richard B. Nunn Student Leadership Award (University of Toronto, June 2018)
- #2 Canadian Army University Course Award (University of Toronto Engineering, Aug. 2017)
- Class of 5T6 Award of Merit (University of Toronto Engineering, Aug. 2016)
- Representative of the Year (University of Toronto Engineering Society, April 2016)
- University of Toronto Scholar Award (Sept. 2015)

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Skills

- Working knowledge of French
- Proficient at programming in Python, C, C++, MATLAB, Mathematica, R, Verilog, and ARM Assembly
- Certification in Machining, George Brown College

Academic Service

- Member of Program Committee for QTD 2024
- Referee for Quantum, QIP

Teaching

- Laboratory Assistant and Grader: Intro to Physics Lab (2019)
- Teaching Assistant: Praxis I (engineering design course) (2018)

Science Interviews

- Quantum Today <https://www.youtube.com/watch?v=QqKVrILZfOc>
- IQC Fireside Chat <https://www.youtube.com/watch?v=Bpwmr8MK94s>
- ISED Canada Innovation Live <https://www.facebook.com/CanadianInnovation/videos/538730616556161/>

Science Outreach

- Volunteer at physics department booth for Maryland Day (2022)
- IQC outreach volunteer for high school ask-a-researcher visits and lab demos (2019-2021)