Nicole Yunger Halpern — November 18, 2025

Contact Information

U. of Maryland/QuICS
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Current positions

Physicist (equivalent of tenure-track faculty position)
Laser-Cooling and -Trapping Group, Quantum-Measurement Division,
Physical Measurement Laboratory,
National Institute of Standards and Technology (NIST).
Sept. 2021–.

QuICS Fellow
Joint Center for Quantum Information and Computer Science (QuICS),
NIST and U. of Maryland.
Sept. 2021–.

Co-Leader
Maryland Quantum-Thermodynamics Hub,
Sept. 2022–.

Adjunct Assistant Professor of UMIACS
U. of Maryland Institute for Advanced Computer Studies (UMIACS)
Sept. 2021–.

Adjunct Assistant Professor of IPST
Institute for Physical Science and Technology (IPST), U. of Maryland.
Aug. 2020–.

Adjunct Assistant Professor of Physics
Dept. of Physics, U. of Maryland.
Aug. 2020–.

JQI Affiliate
Joint Quantum Institute (JQI),
NIST and U. of Maryland.
Sept. 2021–.

Associate
Harvard U. Dept. of Physics.
Sept. 2018–.

Associate Member
Institute for Quantum Computing
Dec. 2021–.

Education

PhD in Physics, California Institute of Technology
Aug. 2013–June 2018.

- Advisor: Prof. John Preskill.

- Affiliations: Institute for Quantum Information and Matter; Division of Physics, Mathematics, and Astronomy.
- Thesis: "Quantum Steampunk: Quantum Information, Thermodynamics, Their Intersection, and Applications Thereof Across Physics."
  - Recipient of the Ilya Prigogine Prize for Thermodynamics.
  - The subject of a *Scientific American* feature article translated into Spanish, Hebrew, German, and French and reported on in *Popular Mechanics*, *Nature Daily Briefing*, and *Fortune*.

MS in Physics and **Perimeter Scholars International (PSI)**,
Perimeter Institute for Theoretical Physics and U. of Waterloo
Aug. 2012–June 2013.

- Advisors: Prof. Robert W. Spekkens, Dr. Markus P. Müller.
- Specialization: Quantum information theory.

BA, Dartmouth College
Sept. 2007–June 2011.

- Major: Physics Modified.
- Co-valedictorian (top grade in college-wide graduating class).
- *Summa cum laude*, with Honors in the Major.
- Advisors: Profs. Miles Blencowe, Lorenza Viola, Marcelo Gleiser, and Chandrasekhar Ramanathan.

Other Research Positions Held

ITAMP Postdoctoral Fellow
Harvard-Smithsonian Institute for Theoretical Atomic, Molecular, and Optical Physics (ITAMP). Sept. 2018–Sept. 2021.

Visiting Scholar
Massachusetts Institute of Technology. Sept. 2018–Sept. 2021.

Visiting Researcher
Oxford U. Dept. of Physics.
Hosts: Profs. Vlatko Vedral and Jonathan Barrett. Sept.–Dec. 2013.

Research Assistant
Lancaster U. Dept. of Physics.
Condensed-matter-and-quantum-optics theory group.
Advisor: Prof. Henning Schomerus. Nov. 2011–July 2012.

Awards, Fellowships, and Honors

Early-Career-Scientist Prize in Statistical Physics
International Union of Pure and Applied Physics, 2025.

Femtum Leap Innovation Award
Quantum Innovation Summit, 2025.

Katharine B. Gebbie Young Scientist Award
Sigma Xi, NIST Chapter, 2024.
Awarded to 1 early-career NIST scientist annually.

SN10: Ten to Watch List
Science News, 2024.
10 early and mid-career scientists selected from across the globe.

Hermann Weyl Prize
International Colloquium on Group-Theoretical Methods in Physics, 2024.

Mary Somerville Medal and Prize
Institute of Physics, 2023.

US ASPIRE Prize
Asia–Pacific Economic Cooperation (APEC) and US Office of Science and Technology Cooperation, 2023.

PROSE Award
Association of American Publishers, 2023.
For best book of the year in popular science and mathematics.

***Journal of Physics A* Emerging Talent**
Journal of Physics A, Institute of Physics Publishing, 2020–2021.

International Quantum Technology Emerging Researcher Award
Institute of Physics Publishing, 2020.

Ilya Prigogine Prize for Thermodynamics
Joint European Thermodynamics Conference, 2018–2019.

ITAMP Postdoctoral Fellowship
Harvard-Smithsonian Institute for Theoretical Atomic, Molecular, and Optical Physics (ITAMP), Jan. 2018–Sept. 2021.

Miller Postdoctoral Fellowship
Miller Institute, U. California, Berkeley, Dec. 2018.
Declined for ITAMP Fellowship.

Hartree Postdoctoral Fellowship
Joint Center for Quantum Information and Computer Science (QuICS), U. of Maryland and NIST, Dec. 2018.
Declined for ITAMP Fellowship.

Barbara Groce Graduate Fellowship
Division of Physics, Mathematics, and Astronomy (PMA), Caltech, Oct.–Dec. 2017 and Mar.–June. 2018.
Competitively "awarded to [PMA's] most talented students to allow them freedom to focus totally on their research."

KITP Graduate Fellowship
Kavli Institute for Theoretical Physics; U. of California, Santa Barbara; July–Dec. 2017.

Burke Graduate Student Fellowship
Walter Burke Institute for Theoretical Physics, Caltech, Jan.–June 2017.

Institute for Quantum Information and Matter Graduate Fellowship
Caltech, NSF, and Gordon and Betty Moore Foundation, Oct. 2014–Oct. 2015.

Virginia Gilloon Fellowship
Caltech, Oct. 2013–Oct. 2014.
Awarded to incoming graduate students selected from across the university.

Cambridge International Fellowship
University of Cambridge, 2013–2016.
Declined for Caltech graduate fellowships.

Purcell Fellowship
Harvard University, 2013–2014.
Declined for Caltech graduate fellowships.

Named MIT Fellowship
Massachusetts Institute of Technology, 2013–2014.
Declined for Caltech graduate fellowships.
Name would have been chosen upon acceptance of fellowship.

Leigh Page Prize
Yale University, 2013.
Declined for Caltech graduate fellowships.

Perimeter Scholars International (PSI) Scholarship
Perimeter Institute for Theoretical Physics, Aug. 2012–June 2013.

Fulbright Scholarship
April 2012.
Declined for PSI Scholarship.

Dartmouth General-Campbell Fellowship
Dartmouth College, Aug. 2011–Aug. 2012.

Co-Valedictorian
Dartmouth College, June 2011.
Top grade in college-wide graduating class.

Mina H. Warren Scholarship Award
Dartmouth College, June 2011.

Summa Cum Laude
Dartmouth College, June 2011.

Honors in the Major
Dartmouth College, June 2011.

Physics and Astronomy Faculty Prize
Dartmouth College, June 2011.

4-time Rufus Choate Scholar
Dartmouth College, 2007–2011.
Annual GPA in top $\sim 5\%$ of college-wide class.

Phi Beta Kappa Prize
Dartmouth College, Nov. 2009.

James O. Freedman Presidential Scholarship
Dartmouth College, June 2009–Mar. 2010.
Research advisor: Prof. Marcelo Gleiser.

8 Academic Citations
Dartmouth College, 2007–2011. For exceptional performance in courses, including Statistical Physics, Reading Course in Introductory Quantum Mechanics, Introductory Physics III, Problem Solving with Computer Science, and Understanding the Universe.

Dale Carnegie Training Student Scholarship
Mar. 2011. To attend Dale Carnegie "High-Impact Presentations" public-speaking workshop.

Refereed Journal Publications

[1]

[2] S. Baiguera, V. Balasubramanian, P. Caputa, S. Chapman, J. Haferkamp, M. P. Heller, and N. Yunger Halpern, "Quantum complexity in gravity, quantum field theory, and quantum information science," *Phys. Rep.* **1159**, 1–77 (2026).

[3] A. Munson, N. B. Teja Kothakonda, J. Haferkamp, N. Yunger Halpern, J. Eisert, P. Faist, "Complexity-constrained quantum thermodynamics," PRX Quantum **6**, 010346 (2025). arXiv:2403.04828.
- Selected for inclusion in the *PRX Quantum* International Year of Quantum special collection.
- Accepted to WOST IV and QTD2024.

[4] M. A. Aamir, P. J. Suria, J. A. Marín Guzmán, C. Castillo-Moreno, J. M. Epstein, N. Yunger Halpern, and S. Gasparinetti, "Thermally driven quantum refrigerator autonomously resets a superconducting qubit," Nat. Phys. (2025).
- Featured in articles in *New Scientist*, *Nature Physics News & Views*, the American Physical Society's *Physics Magazine*, *Dagens Nyheter* (a top Swedish newspaper), *Radiotelevisión Española* (RTVE) (the state-owned Spanish radio and television corporation), *Science News*, *Laser Focus World,* etc.

[5] D. R. M. Arvidsson-Shukur, W. F. Braasch Jr., S. De Bièvre, J. Dressel, A. N. Jordan, C. Langrenez, M. Lostaglio, J. S. Lundeen, and N. Yunger Halpern, "Properties and Applications of the Kirkwood-Dirac Distribution," New J. Phys. **26**, 121201 (2024).

[6] Z. Davoudi, C. Jarzynski, N. Mueller, G. Oruganti, C. Powers, and N. Yunger Halpern, "Quantum thermodynamics of nonequilibrium processes in lattice gauge theories," Phys. Rev. Lett. **133**, 250402 (2024).
- Accepted for talks at QTD2024 and QSim2025.
- Featured on *APS TV*.

[7] J. A. Marín Guzmán, P. Erker, S. Gasparinetti, M. Huber, and N. Yunger Halpern, "Key issues review: useful autonomous quantum machines," Rep. Prog. Phys. **87**, 12 (2024).

- Featured in *New Scientist*.

[8] T. Upadhyaya; W. F. Braasch, Jr.; G. T. Landi; and N. Yunger Halpern, "What happens to entropy production when conserved quantities fail to commute with each other," PRX Quantum **5**, 030355 (2024).
- Featured in *New Scientist* and *Quanta Magazine*.

[9] L. P. García-Pintos, K. Bharti, J. Bringewatt, H. Dehghani, A. Ehrenberg, N. Yunger Halpern, and A. V. Gorshkov, "Estimation of Hamiltonian parameters from thermal states," Phys. Rev. Lett. **133**, 040802 (2024).
- Accepted to QTD2025.

[10] X. Song, F. Salvati, C. Gaikwad, N. Yunger Halpern, D. R. M. Arvidsson-Shukur, and K. Murch, "Agnostic phase estimation," Phys. Rev. Lett. **132**, 260801 (2024).
- Selected for featuring in *Physics*.

[11] D. R. M. Arvidsson-Shukur, A. G. McConnell, and N. Yunger Halpern, "Nonclassical Advantage in Metrology Established via Quantum Simulations of Hypothetical Closed Timelike Curves," Phys. Rev. Lett. **131**, 150202 (2023).
- One of the 10 most downloaded *Phys. Rev. Lett.* publications of 2023.
- Featured in news articles by *New Scientist* (cover article), *Gizmodo*, *Salon*, *Physics World*, *Science News*, U. of Cambridge, *Phys.org*, *Epoch Magazine*, etc.
- Featured in 2 Youtube videos with > 300K views collectively (here and here).

[12] S. Majidy; W. F. Braasch, Jr.; A. Lasek; T. Upadhyaya; A. Kalev; and N. Yunger Halpern, "Noncommuting conserved charges in quantum thermodynamics and beyond," Nat. Rev. Phys. **5**, 689 (2023).
- Highlighted in *Quantum Q&A* by the Institute for Quantum Computing.

[13] S. Majidy, U. Agrawal, S. Gopalakrishnan, A. C. Potter, R. Vasseur, and N. Yunger Halpern, "Critical phase and spin sharpening in SU(2)-symmetric monitored quantum circuits," Phys. Rev. B **108**, 054307 (2023).

[14] F. Kranzl, A. Lasek, M. K. Joshi, A. Kalev, R. Blatt, C. F. Roos, and N. Yunger Halpern, "Experimental observation of thermalization with noncommuting charges," Phys. Rev. X Quantum **4**, 020318 (2023).
- Accepted for talks at the Workshop on Stochastic Thermodynamics (WOST) III and Quantum Thermodynamics 2022.

[15] C. Murthy, A. Babakhani, F. Iniguez, M. Srednicki, and N. Yunger Halpern, "Non-Abelian eigenstate thermalization hypothesis," Phys. Rev. Lett. **130**, 140402 (2023).

[16] S. Majidy, A. Lasek, D. A. Huse, and N. Yunger Halpern, "Non-Abelian symmetry can increase entanglement entropy," Phys. Rev. B **107**, 045102 (2022).

[17] N. Yunger Halpern, N. B. T. Kothakonda, J. Haferkamp, A. Munson, J. Eisert, and P. Faist, "Resource theory of quantum uncomplexity," Phys. Rev. A **106**, 062417 (2022).

[18] Z. A. Benson, A. Peshkov, N. Yunger Halpern, D. C. Richardson, and W. Losert, "Experimentally Measuring Rolling and Sliding in Three-Dimensional Dense Granular Packings," Phys. Rev. Lett. **129**, 048001 (2022).

[19] N. Lupu-Gladstein, Y. Batuhan Yilmaz, D. R. M. Arvidsson-Shukur, A. Brodutch, A. O. T. Pang, A. M. Steinberg, and N. Yunger Halpern, "Negative Quasiprobabilities Enhance Phase Estimation in Quantum-Optics Experiment," Phys. Rev. Lett. **128**, 220504 (2022).
- Featured in news article by *Quanta Magazine*.
- Selected for highlighting as an Editors' Suggestion.
- Featured as a top result of 2022 by *Optics & Photonics News*.

[20] J. Haferkamp, P. Faist, N. B. T. Kothakonda, J. Eisert, and N. Yunger Halpern, "Linear growth of quantum circuit complexity," Nat. Phys. (2022).
- Accepted for a talk at *QIP 2022*.
- Featured in news articles by *Nature Physics* "News & views," *Physics World*, and Helmholtz Zentrum Berlin.

[21] N. Yunger Halpern and S. Majidy, "How to build Hamiltonians that transport noncommuting charges in quantum thermodynamics," npj Quantum Information **8**, 10 (2022).
- Featured in three U. of Waterloo news articles [1, 2, 3].

[22] L. E. Hillberry, M. T. Jones, D. L. Vargas, P. Rall, N. Yunger Halpern, N. Bao, S. Notarnicola, S. Montangero, and L. D. Carr, "Entangled quantum cellular automata, physical complexity, and Goldilocks rules," Q. Sci. and Tech. **6**, 045017 (2021).

[23] D. Arvidsson-Shukur, J. Chevalier-Drori, and N. Yunger Halpern, "Conditions tighter than noncommutation needed for nonclassicality," J. Phys. A **54**, 284001 (2021).
- Highlighted in news articles by *Physics World* and *Daily Advent*.
- Submission invited for Emerging Talents 2021 issue.

[24] W. Zhong, J. M. Gold, S. Marzen, J. England, and N. Yunger Halpern, "Machine learning outperforms thermodynamics in measuring how well a many-body system learns a drive," Sci. Rep. **11**, 9333 (2021).

[25] J. Monroe, N. Yunger Halpern, T. Lee, and K. Murch, "Weak measurement of superconducting qubit reconciles incompatible operators," Phys. Rev. Lett. **126**, 100403 (2021).

[26] A. Bene Watts, N. Yunger Halpern, and A. Harrow, "Nonlinear Bell inequality for macroscopic measurements," Phys. Rev. A **103**, L0101202 (2021).
- Selected for publishing as a Letter.
- Selected for highlighting as an Editors' Suggestion.

[27] D. R. M. Arvidsson-Shukur, N. Yunger Halpern, H. V. Lepage, A. A. Lasek, C. H. W. Barnes, and S. Lloyd, "Quantum advantage in postselected metrology," *Nat. Comms.* **11**, 3775 (2020).

- Featured in news articles written by the *U. of Cambridge Research News* and *The Science Times* and picked up by 13 other news sites.
- Ranks amongst the 50 most downloaded *Nat. Comms.* articles of 2020, out of $> 6,400$ articles.

[28] N. Yunger Halpern, M. E. Beverland, and A. Kalev, "Equilibration to the non-Abelian thermal state in quantum many-body physics," Phys. Rev. E **101**, 042117 (2020).

[29] N. Yunger Halpern and D. T. Limmer, "Fundamental limitations on photoisomerization from thermodynamic resource theories," Phys. Rev. A **101**, 042116 (2020).

- Selected for highlighting as an Editors' Suggestion.
- Accepted for talk at *Beyond i.i.d. in Information Theory 8.*

[30] N. Yunger Halpern, A. Bartolotta, and J. Pollack, "Entropic uncertainty relations for quantum information scrambling," Comms. Phys. **2**, 92 (2019).

[31] N. Yunger Halpern and E. Crosson, "Quantum information in the Posner model of quantum cognition," Ann. Phys. **407**, 92-147 (2019).

- Selected, from across Elsevier Physics and Astronomy publications, for highlighting in an article by Elsevier News.

[32] J. R. González Alonso, N. Yunger Halpern, and J. Dressel, "Out-of-time-ordered-correlator quasiprobabilities robustly witness scrambling," Phys. Rev. Lett. **122**, 040404 (2019).

[33] N. Yunger Halpern, C. D. White, S. Gopalakrishnan, and G. Refael, "Quantum engine based on many-body localization," Phys. Rev. B **99**, 024203 (2019).

- Selected for highlighting as an APS Physics Focus.
- Selected for highlighting as an Editors' Suggestion.

[34] J. Dressel, J. R. González Alonso, M. Waegell, and N. Yunger Halpern, "Strengthening weak measurement of qubit out-of-time-order correlators," Phys. Rev. A **98**, 012132 (2018).

[35] N. Yunger Halpern, A. J. P. Garner, O. C. O. Dahlsten, and V. Vedral, "Maximum one-shot dissipated work from Rényi divergences," Phys. Rev. E **97**, 052135 (2018).

[36] B. Swingle and N. Yunger Halpern, "Resilience of scrambling measurements," Phys. Rev. A **97**, 062113 (2018).

[37] N. Yunger Halpern, B. Swingle, and J. Dressel, "Quasiprobability behind the out-of-time-ordered correlator," Phys. Rev. A **97**, 042105 (2018).

[38] N. Yunger Halpern, "Beyond heat baths II: Framework for generalized thermodynamic resource theories," *J. Phys. A* **51**, 094001 (2018), in special issue "Shannon's Information Theory, 70 years on."

- Selected as a *J. Phys. A* Highlight of 2018.

[39] N. Bao and N. Yunger Halpern, "Quantum voting system and violation of Arrow's Impossibility Theorem," Phys. Rev. A **95**, 062306-1–9 (2017).
- Selected for highlighting as an Editors' Suggestion.
- Mentioned in *Nature News*.

[40] O. C. O. Dahlsten, A. J. P. Garner, M.-S. Choi, D. Braun, N. Yunger Halpern, and V. Vedral, "Entropic equality for worst-case work at any protocol speed," New J. Phys. **19**, 043013-1–18 (2017).

[41] N. Yunger Halpern, "Jarzynski-like equality for the out-of-time-ordered correlator," Phys. Rev. A **95**, 012120-1–9 (2017).

[42] N. Yunger Halpern, P. Faist, J. Oppenheim, and A. Winter, "Microcanonical and resource-theoretic derivations of the Non-Abelian Thermal State," Nat. Comms. **7**, 12051-1–7 (2016).
- Featured in *Quanta Magazine*.

[43] N. Yunger Halpern and C. Jarzynski, "Number of trials required to estimate a free-energy difference, using fluctuation relations" Phys. Rev. E **93**, 052144-1–7 (2016).

[44] N. Yunger Halpern and J. P. Renes, "Beyond heat baths: Generalized resource theories for small-scale thermodynamics," Phys. Rev. E **93**, 022126-1–16 (2016).

[45] N. Yunger Halpern, A. J. P. Garner, O. C. O. Dahlsten, and V. Vedral, "Introducing one-shot work into fluctuation relations," New. J. Phys., Focus Issue on Quantum Thermodynamics **17**, 095003-1–22 (2015).

[46] G. Gour, M. P. Müller, V. Narasimhachar, R. W. Spekkens, and N. Yunger Halpern, "The resource theory of informational nonequilibrium in thermodynamics," Phys. Rep. **583**, 1-58 (2015).

[47] H. Schomerus and N. Yunger Halpern, "Uncompensated parity anomaly and Landau level lasing in strained photonic crystals," Phys. Rev. Lett. **110**, 013903-1–5 (2013).

Book Chapters

[48] N. Yunger Halpern, "Toward physical realizations of thermodynamic resource theories," *Information and Interaction: Eddington, Wheeler, and the Limits of Knowledge,* Springer, FQXi subset of the *Frontiers* book collection (2017), p. 135–166.

Preprints

[49] J. A. Marín-Guzmán, Y.-X. Wang, T. Manovitz, P. Erker, N. Linke, S. Gasparinetti, and N. Yunger Halpern, "Proposals for experimentally realizing (mostly) quantum-autonomous gates" (2025) arXiv:2510.07372.

[50] J.-D. Noh, A. Lasek, J. LeSchack, and N. Yunger Halpern, "Kubo-Martin-Schwinger relation for energy eigenstates of SU(2)-symmetric quantum many-body systems" (2025) arXiv:2507.07249.

[51] X. Song, S. S. Borjigin, F. Salvati, Y.-X. Wang, N. Yunger Halpern, D. R. M. Arvidsson-Shukur, and K. Murch, "Superconducting antiqubits achieve optimal phase estimation via unitary inversion" (2025) arXiv:2506.04315.

[52] S. Campbell, I. D'Amico, M. A. Ciampini, J. Anders, N. Ares, S. Artini, A. Auffèves, L. Bassman Oftelie, L. P. Bettmann, M. V. S. Bonança, T. Busch, M. Campisi, M. F. Cavalcante, L. A. Correa, E. Cuestas, C. B. Dag, S. Dago, S. Deffner, A. Del Campo, A. Deutschmann-Olek, S. Donadi, E. Doucet, C. Elouard, K. Ensslin, P. Erker, N. Fabbri, F. Fedele, G. Fiusa, T. Fogarty, J. Folk, G. Guarnieri, A. S. Hegde, S. Hernández Gómez, G. K. Hu, F. Iemini, B. Karimi, N. Kiesel, G. T. Landi, A. Lasek, S. Lemziakov, G. Lo Monaco, E. Lutz, D. Lvov, O. Maillet, M. Mehboudi, T. M. Mendonça, H. J. D. Miller, A. K. Mitchell, M. T. Mitchison, V. Mukherjee, M. Paternostro, J. Pekola, M. Perarnau-Llobet, U. Poschinger, A. Rolandi, D. Rosa, R. Sánchez, A. C. Santos, R. S. Sarthour, E. Sela, A. Solfanelli, A. M. Souza, J. Splettstoesser, D. Tan, L. Tesser, T. Van Vu, A. Widera, N. Yunger Halpern, and K. Zawadzki, "Roadmap on quantum thermodynamics" (2025) arXiv:2504.20145.

[53] Z. Davoudi, C. Jarzynski, N. Mueller, G. Oruganti, C. Powers, and N. Yunger Halpern, "Work and heat exchanged during sudden quenches of strongly coupled quantum systems" (2025) arXiv:2502.19418.
- Accepted for a talk at QSim2025.

[54] A. Lasek, J. D. Noh, J. LeSchack, and N. Yunger Halpern, "Numerical evidence for the non-Abelian eigenstate thermalization hypothesis" (2024) arXiv:2412.07838.

[55] L. E. Hillberry, L. Piroli, E. Vernier, N. Yunger Halpern, T. Prosen, and L. D. Carr, "Integrability of Goldilocks quantum cellular automata" (2024) arXiv:2404.02994.

Invited Conference and Workshop Talks

[1] "What happens to entropy production when conserved quantities fail to commute," *StatPhys29*, International Union of Pure and Applied Physicists, Florence, Italy (July 13–18, 2025).

[2] "Useful autonomous quantum machines," *CQS12: Rochester Conference on Coherence and Quantum Science,* U. of Rochester, Rochester, NY, USA (June 22–26, 2025).

[3] "Useful autonomous quantum machines," *5th Quantum Engineering Workshop*, Caltech, Pasadena, CA, USA and online (May 29, 2025).

[4] "Quantum thermodynamics for lattice gauge theories," *Kavli Foundation Special Symposium: It's a Quantum World, Global Physics Summit*, American Physical Society, Anaheim, CA, USA (Mar. 16–21, 2025).

[5] "What happens to entropy production when conserved quantities fail to commute"; *Berkeley Statistical-Mechanics Meeting*; U. of California, Berkeley; Berkeley, CA, USA (Jan. 1, 2025).

[6] "How a paragraph by Jaynes grew into a field: Non-Abelian thermodynamics," *Jaynes Centennial Symposium*, Washington U. in St. Louis, St. Louis, MO, USA (Oct. 15, 2024).

[7] "Quantum thermodynamics for lattice gauge theories," *Quantum Information Science (QIS) Program Meeting & Review*, Canadian Institute for Advanced Research (CIFAR), Montreal, QC, Canada (Sept. 24–27, 2024).

[8] "Quantum thermodynamics for lattice gauge theories, or ten lessons I learned from John Preskill," *Conference on Quantum Information and Quantum Control (CQIQC) X*, Fields Institute, Toronto, ON, Canada (Aug. 26–30, 2024).

[9] "Non-Abelian thermodynamics," *Frontiers of Quantum and Mesoscopic Thermodynamics*, Institute of Physics, Czech Academy of Science, Prague, Czechia (July 21–27, 2024).

[10] "Non-Abelian thermodynamics," *Emergence of Classicality: New Perspectives on Measurements in Quantum Theory,* Trinity College Dublin, Dublin, Ireland (July 15–19, 2024).

[11] "Non-Abelian thermodynamics," *International Colloquium on Group-Theoretical Methods in Physics (ICGTMP) (Group 33/35),* ICGTMP, Cotonou, Benin and online (July 15–19, 2024).

[12] "Beyond the first law: Peculiarly quantum conservation laws," *Philosophy-of-Physics Workshop: Foundations of Thermodynamics 2024*, Rotman Institute of Philosophy, Western U., London, ON, Canada and online (June 16–18, 2024).

[13] "Non-Abelian thermodynamics," *Symposium on Science at ITAMP*, Institute for Atomic, Molecular, and Optical Physics (ITAMP), Cambridge, MA, USA (May 16–17, 2024).

[14] "Non-Abelian eigenstate thermalization hypothesis," *Entanglement, Thermalization, and Holography*, Simons Center for Geometry and Physics, Stony Brook, NY, USA (Apr. 8–12, 2024).

[15] "Beyond the first law: Peculiarly quantum conservation laws in thermodynamics," *125th Statistical Mechanics Conference*, Rutgers U., New Brunswick, NJ, USA (Dec. 17–19, 2023).

[16] "What happens to entropy production when conserved quantities fail to commute," *Quantum Thermodynamics Down Under*, U. of Brisbane, Brisbane, Australia and online (Nov. 7–10, 2023).

[17] "Quantum steampunk," *Quantum Thermodynamics Down Under*, U. of Brisbane, Brisbane, Australia and online (Nov. 7–10, 2023).

[18] "Building useful autonomous quantum machines"; *From Physics to Life*; Life on the Edge; U. California, Los Angeles; Los Angeles, CA, USA (Oct. 11–12, 2023).

[19] "Why negativity can be useful (in metrology)," *New Directions in Quantum Metrology,* Kavli Institute for Theoretical Physics, Santa Barbara, CA, USA (Sept. 11–Oct. 13, 2023).

[20] "What can quantum thermodynamics do for you?" *Thermalization, from Cold Atoms to Hot Quantum Chromodynamics*, InQubator for Quantum Simulation, U. of Washington, Seattle, WA, USA (Sept. 11–22, 2023).

[21] "Noncommuting conserved quantities in quantum thermodynamics," *Theory of Quantum Computation (TQC)*, U. of Aveiro, Aveiro, Portugal (July 24–28, 2023).

[22] "Experimental observation of thermalization with noncommuting charges," *Workshop on non-equilibrium quantum thermodynamics: Stochastic models and experimental platforms,* MIT, Cambridge, MA, USA and online (June 12–13, 2023).

[23] "What happens to entropy production when conserved quantities fail to commute," *Workshop on Stochastic Thermodynamics (WOST) IV,* International Centre for Theoretical Physics, Trieste, Italy and online (May 22–26, 2023).

[24] "Beyond the first law: Peculiarly quantum conservation laws," *Dynamical Foundations of Many-Body Quantum Chaos,* Institut Pascal, Paris, France (Mar. 13–Apr. 14, 2023).

[25] "Quantum steampunk: Quantum information meets thermodynamics," *QHack,* Xanadu, online (Feb. 13–18, 2023).

[26] "An informal introduction to the best little quasiprobability you've never heard of," *Non-Markovianity in Open Quantum Systems*, Banff, Canada (Feb. 12–17, 2023).

[27] "What happens when conserved quantities fail to commute with each other in quantum thermodynamics," Keynote talk, *Canada Quantum Days,* Deep Tech Canada, online (Jan. 17–19, 2022).

[28] "My favorite not-quite-probability distribution," Plenary talk, *Fifth International Conference on Mathematical Modeling,* Universidad Tecnológica de la Mixteca, Huajuapan de León, Oaxaca, Mexico and online (Oct. 20–21, 2022).

[29] "Learning about learning about many-body physics," *Charting large materials dataspaces: AI methods and scalability,* Centre Européen de Calcul Atomique et Moléculaire, Grenoble, France (Oct. 10–12, 2022).

[30] "A tale of two disciplines: Non-Abelian eigenstate thermalization hypothesis," *Quantum Thermodynamics Conference (QTD) 2022,* Queens University Belfast, Belfast, Northern Ireland and online (June 27–July 1, 2022).

[31] "The value of lacking complexity in quantum computation," *WINQ Workshop on Quantum Information and Quantum Processing,* Wallenberg Initiative on Networks and Quantum Information (WINQ) and Nordita, Stockholm, Sweden (June 8–10, 2022).

[32] "Quantum information in the Posner model of quantum cognition," *Quantum Meets Biology,* Army Research Office, online (Apr. 1, 2022).

[33] "Linear growth of quantum circuit complexity," *Probability and Quantum Information Sciences,* Banff International Research Station, Banff, Canada and online (Mar. 14–18, 2022).

[34] "Proofs of two complexity conjectures by Brown and Susskind," *Workshop on Quantum Information and Spacetime,* Institute for Advanced Study, Princeton, NJ, USA (Dec. 6–8, 2021).

[35] "When quantum-information scrambling met quasiprobabilities," *Probing Complex Quantum Dynamics through Out-of-time-ordered Correlators,* Max Planck Institute for the Physics of Complex Systems, Dresden, Germany and online (Oct. 11–15, 2021).

[36] "Noncommuting conserved quantities in thermodynamics," *DPG-Tagung (DPG Meeting) of the Atomic, Molecular, Plasma Physics and Quantum Optics Section (SAMOP),* German Physical Society, online (Sept. 20–24, 2021).

[37] "Introduction to quantum thermodynamics," *Non-Equilibrium Universality: From Classical to Quantum and Back,* Kavli Institute for Theoretical Physics, Santa Barbara, CA, USA (Sept. 23, 2021).

[38] "Noncommuting conserved quantities in thermodynamics," *Information Engines at the Frontiers of Nanoscale Thermodynamics,* Telluride Science Research Center, Telluride, CO, USA and online (July 22–30, 2021).

[39] "Noncommuting conserved quantities in thermodynamics," *NSF Workshop on Emerging Opportunities at the Intersection of Quantum and Thermal Sciences,* U. of Texas at Austin, Austin, TX, USA and online (June 28–30, 2021).

[40] "How effectively can a molecular switch switch?" *Workshop on Stochastic Thermodynamics (WOST) II,* Santa Fe Institute, Santa Fe, NM, USA and online (May 17–21, 2021).

[41] "Quantum-thermodynamics tutorial," *Sixth International Conference for Young Quantum Information Scientists,* Michigan State University, Michigan, USA and online (Apr. 12–16, 2021).

[42] "Learning about learning by many-body systems," *APS March Meeting,* American Physical Society, online (Mar. 15–19, 2021).

[43] "My favorite not-quite-probability distribution," *International Physics Symposium XII,* Tecnológico de Monterrey, Monterrey, Mexico and online (Mar. 4–6, 2021).

[44] "Noncommuting conserved quantities in thermalization," *Asian Quantum Information Science 2020,* Centre for Quantum Software and Information, University of Technology Sydney, Sydney, Australia and online (Dec. 7–9, 2020).

[45] "Noncommuting conserved quantities in quantum many-body thermalization," *Scientific Quantum Computing and Simulation on Near-Term Devices,* Institute for Nuclear Theory, University of Washington, Seattle, Washington and online (Oct. 5–Nov. 13, 2020).

[46] "Whence random-unitary-and-projective-measurement circuits? Motivation from the Posner model of quantum cognition," *Dynamics, Criticality, and Universality in Random Quantum Circuits,* Max Planck Institute for the Physics of Complex Systems, Dresden, Germany and online (Sept. 30–Oct. 2, 2020).

[47] "Everything you wanted to know about resource theories and haven't had the quantum information scientist to ask," *Complexity from Quantum Information to Black Holes,* Lorentz Center, Leiden, Netherlands (June 2–5, 2020).

[48] "Quantum information in the Posner model of quantum cognition"; *Coherent Spin Physics in Biology;* U. of California, Los Angeles; Los Angeles, CA, USA (Dec. 12–14, 2019).

[49] "The Non-Abelian thermal state," *Conference on Quantum Information and Quantum Control (CQIQC) VIII,* Fields Institute, Toronto, ON, Canada (Aug. 26–30, 2019).

[50] "How effectively can a molecular switch switch? A bound from thermodynamic resource theories," *Algebraic and Statistical Ways into Quantum Resource Theories,* Banff International Research Station, Banff, Canada (July 21–26, 2019).

[51] "Quantum steampunk: Quantum information, thermodynamics, their intersection, and applications thereof across science," Ilya Prigogine Prize Talk, *Joint European Thermodynamics Conference,* Barcelona, Spain (May 21–24, 2019).

[52] "Simple Bounds on Far-from-Equilibrium Machines (Hat Tip to Quantum Information Theory)," *Exploring Open Quantum Systems in Quantum Simulators,* Kavli Institute for Theoretical Physics, Santa Barbara, CA, USA (Apr. 29–May 3, 2019).

[53] "When quantum-information scrambling met quasiprobabilities," *Quantum Matter 3: Emergence and Entanglement,* Perimeter Institute, Waterloo, ON, Canada (Apr. 22–26, 2019).

[54] "Resource-theory models for thermodynamics," *APS March Meeting,* American Physical Society, Los Angeles, CA, USA (Mar. 5–9, 2018).

[55] "This is your brain on quantum information," *Physics of the Universe Summit (POTUS) 2018,* SpaceX and Caltech, Los Angeles, CA, USA (Jan. 12–14, 2018).

[56] "The skeleton of information scrambling," *Physics of Quantum Information Conference,* Kavli Institute for Theoretical Physics, Santa Barbara, CA, USA (Oct. 9–13, 2017).

[57] "The skeleton of information scrambling," *Quantum Information in Quantum Gravity III,* U. of British Columbia, Vancouver, CA (Aug. 14–18, 2017).

[58] "How much is that density operator in the window? Quantifying resources," *Power of Information Workshops: Information and Non-equilibrium Thermodynamics,* Beyond Center for Fundamental Concepts in Science, Arizona State U., Scottsdale, AZ, USA (Apr. 18–20, 2017).

[59] "Quantum chaos: A Jarzynski-like equality," *Fifth Quantum Thermodynamics Conference,* U. of Oxford, Oxford, UK (Mar. 13–17, 2017).

[60] "Beyond heat baths: Generalized resource theories for small-scale thermodynamics," *Beyond i.i.d. in Information Theory*, Banff International Research Station, Banff, Canada (July 5–10, 2015).

[61] "Information as a resource in small-scale thermodynamics," *Information and Interaction: Eddington, Wheeler, and the Limits of Knowledge* (FQXi workshop), U. of Cambridge, Cambridge, UK (March 20–24, 2014).

Colloquia

[62] "Beyond the first law: Peculiarly quantum conservation laws in thermodynamics," *Physics and Math Colloquium,* Science Faculty, University of Colima, Colima, Mexico and online (Oct. 21, 2025).

[63] "Beyond the first law: Peculiarly quantum conservation laws in thermodynamics," Dept. of Physics; U. of California, Berkeley; Berkeley, CA, USA (Jan. 27, 2025).

[64] "Beyond the first law: Peculiarly quantum conservation laws in thermodynamics," Dept. of Physics; U. of Maryland, Baltimore County; Baltimore, MD, USA (Nov. 6, 2024).

[65] "Beyond the first law: Peculiarly quantum conservation laws in thermodynamics," Dept. of Physics, McGill U., Montreal, Canada (Aug. 30, 2024).

[66] "Beyond the first law: Peculiarly quantum conservation laws in thermodynamics," Dept. of Physics, Brown U., Providence, RI (May 20, 2024).

[67] "Quantum steampunk: Quantum information meets thermodynamics," *Arizona Quantum Initiative Colloquium,* Arizona Quantum Initiative, U. of Arizona, Tucson, AZ, USA (Mar. 3, 2023).

[68] "Beyond the first law: Peculiarly quantum conservation laws in thermodynamics," *Adaptive Quantum Optics Group Colloquium*, U. of Twente, Enschede, Netherlands and online (Feb. 24, 2023).

[69] "What happens when conserved quantities fail to commute with each other in quantum thermodynamics," *Physics Colloquium,* William H. Miller III Dept. of Physics and Astronomy, Johns Hopkins U., Baltimore, MD, USA (Feb. 2, 2023).

[70] "Quantum steampunk: Quantum information meets thermodynamics," *Physics Colloquium,* Dept. of Physics and Applied Physics, U. of Mary Washington, Fredericksburg, VA, USA (Jan. 27, 2023).

[71] "Quantum steampunk: Quantum information meets thermodynamics," *IMSc Diamond Jubilee Colloquium,* Institute of Mathematical Sciences, Chennai, Chennai, India and online (Nov. 24, 2022).

[72] "Quantum steampunk: Quantum information meets thermodynamics," *Colloquium,* Dept. of Physics, Case Western Reserve U. Cleveland, OH, USA (Nov. 3, 2022).

[73] "Quantum steampunk: Quantum information meets thermodynamics"; *PAG Colloquium*; Dept. of Physics, Astronomy, and Geosciences (PAG); Towson U.; Towson, MD, USA (Oct. 14, 2022).

[74] "Quantum steampunk: Quantum information meets thermodynamics," *Quantum Science Seminar,* online (Sept. 1, 2022).

[75] "Quantum steampunk: Quantum information meets thermodynamics," *Perimeter Colloquium,* Perimeter Institute, Waterloo, ON, Canada (Mar. 18, 2022).

[76] "Quantum steampunk: Quantum information meets thermodynamics," *Physics Colloquium,* Dept. of Physics, U. of Maryland, College Park, MD, USA (Mar. 29, 2022).

[77] "Quantum steampunk: Quantum information meets thermodynamics," *Colloquium,* School of Physics and Astronomy, Rochester Institute of Technology, Rochester, NY, USA and online (Jan. 12, 2022).

[78] "Quantum steampunk: Quantum information meets thermodynamics," *Quantum Colloquium,* Princeton U., Princeton, NJ, USA (Dec. 13, 2021).

[79] "Quantum steampunk: Quantum information meets thermodynamics," *Physics and Astronomy Colloquium,* Dartmouth College, Hanover, NH, USA (Nov. 12, 2021).

[80] "Quantum steampunk: Quantum information meets thermodynamics," *Physics Colloquium*, University of North Carolina at Chapel Hill, Chapel Hill, NH, USA and online (Nov. 1, 2021).

[81] "Quantum steampunk: Quantum information meets thermodynamics"; *Physics Colloquium;* U. of California, Santa Barbara; Santa Barbara, CA, USA (Oct. 5, 2021).

[82] "Learning about learning by many-body systems," *PICS Colloquium,* Penn Institute for Computational Science, U. of Pennsylvania, Philadelphia, PA and online, USA (Feb. 26, 2021).

[83] "Quantum steampunk: Quantum information meets thermodynamics," *IQUIST Seminar,* Illinois Quantum Information Science and Technology Center (IQUIST), U. of Illinois at Urbana-Champaign, Urbana-Champaign, IL, USA and online (Sept. 1, 2020).

[84] "Quantum steampunk: Quantum information meets thermodynamics," *IQC Colloquium,* Institute for Quantum Computing (IQC), U. of Waterloo, Waterloo, ON, Canada (Mar. 3, 2020).

[85] "Quantum steampunk: Quantum information meets thermodynamics," *Special Physics Colloquium,* Carnegie Mellon U., Pittsburgh, PA, USA (Feb. 24, 2020).

[86] "Quantum steampunk: Quantum information meets thermodynamics," *Physics Colloquium,* U. Massachusetts Boston, Boston, MA, USA (Oct. 3, 2019).

[87] "Quantum steampunk: Quantum information meets thermodynamics," *Physics Colloquium,* Clark U., Worcester, MA, USA (Oct. 2, 2019).

[88] "Quantum steampunk: Quantum information meets thermodynamics," *IQC Colloquium,* Institute for Quantum Computing (IQC), U. of Waterloo, Waterloo, ON, Canada (Apr. 15, 2019).

[89] "Quantum steampunk: Quantum information meets thermodynamics," *Yale Quantum Institute Colloquium,* Yale Quantum Institute, Yale U., New Haven, CT, USA (Feb. 22, 2019).

[90] "Quantum steampunk: Quantum information meets thermodynamics," *Physics Colloquium,* Colorado School of Mines, Golden, CO, USA (Jan. 29, 2019).

[91] "Quantum steampunk: Quantum information applied to thermodynamics," *Physics and Astronomy Colloquium,* Cal State LA, Los Angeles, CA, USA (May 26, 2016).

Public Lectures

[92] "Quantum steampunk: The physics of yesterday's tomorrow"; Dept. of Physics, Oxford U. Physics Society, and Oxford U. Quantum Information Society; U. of Oxford; Oxford, United Kingdom (Nov. 17, 2025).

[93] "Quantum steampunk: The physics of yesterday's tomorrow," *Qreate*, Q^3 Initiative, College Park, MD, USA (Sept. 12, 2025).

[94] "Quantum steampunk: The physics of yesterday's tomorrow," Center for Coherence and Quantum Science, U. of Rochester, Rochester, NY, USA (June 26, 2025).

[95] "Quantum steampunk: The physics of yesterday's tomorrow," *Balticon 59,* Baltimore Science-Fiction Society, Baltimore, MD, USA (May 25, 2025).

[96] "Quantum steampunk: The physics of yesterday's tomorrow," *World Quantum Day Celebration,* Illinois Quantum Information Science and Technology Center, U. of Illinois Urbana-Champaign, Urbana-Champaign, IL, USA (Apr. 12, 2025).

[97] "Quantum steampunk: The physics of yesterday's tomorrow," *Spark After Dark: STEAMpunk*, TELUS Spark Science Centre, Calgary, Canada and online (Apr. 13, 2024).

[98] "Quantum steampunk: The physics of yesterday's tomorrow"; *Science on Tap;* College of Computer, Mathematical, and Natural Sciences; U. of Maryland; College Park, MD, USA (Mar. 28, 2024).

[99] "Quantum steampunk: The physics of yesterday's tomorrow," *ASIS&T Webinar,* ASIS&T (Association for Information Science and Technology), online (Jan. 18, 2024).

[100] "Quantum essentials," *Future Quantum,* Sparks! Serendipity forum at CERN, Geneva, Switzerland (Nov. 15, 2023).

[101] "Quantum steampunk: The physics of yesterday's tomorrow," CERN Library, Geneva, Switzerland (Nov. 14, 2023).

[102] "Quantum steampunk: The physics of yesterday's tomorrow"; *From Physics to Life*; Life on the Edge; U. of California, Los Angeles; Los Angeles, CA, USA (Oct. 11–12, 2023).

[103] "Quantum steampunk: The physics of yesterday's tomorrow," *Symposium in honor of Ludwig Boltzmann's 179th Birthday,* Ludwig Boltzmann Forum, online (Feb. 20–21, 2023).

[104] "Quantum steampunk: The physics of yesterday's tomorrow," *Institute for the Science of Origins,* Case Western Reserve U., Cleveland, OH, USA (Nov. 1, 2022).

[105] "What if the Victorians had discovered quantum computing?" *Ask a Physicist,* Beyond Center, Arizona State U., Tempe, AZ, USA and online (Oct. 24, 2022).

[106] "Quantum steampunk: The physics of yesterday's tomorrow," *PQI 2022,* Pittsburgh Quantum Institute (PQI), Pittsburgh, PA, USA (Sept. 15, 2022).

[107] "Quantum steampunk: The physics of yesterday's tomorrow," Physics Today *Webinar: Editor's Series*, online (Sept. 8, 2022).

[108] "Quantum steampunk: The physics of yesterday's tomorrow," Kavli Institute for Theoretical Physics, Santa Barbara, CA, USA and online (May 25, 2022).

[109] "Quantum steampunk: The physics of yesterday's tomorrow," Institute for Quantum Computing at the U. of Waterloo and Waterloo Public Library, Waterloo, ON, Canada (May 17, 2022).

[110] "Quantum steampunk: The physics of yesterday's tomorrow," Alumni Association and Dept. of Physics, U. of Toronto, Toronto, ON, Canada (May 12, 2022).

[111] "Quantum steampunk: The physics of yesterday's tomorrow," Institute for Quantum Information and Matter, California Institute of Technology, Pasadena, CA, USA (Apr. 29, 2022).

[112] "Quantum steampunk: The physics of yesterday's tomorrow," Institute for Quantum Studies, Chapman U., Orange, CA, USA (Apr. 27, 2022).

[113] "Quantum steampunk: The physics of yesterday's tomorrow," *Leonardo Art/Science Evening Rendezvous (LASER) Talk,* Stanford U., Palo Alto, CA, USA and online (Apr. 20, 2022).

[114] "Quantum steampunk: The physics of yesterday's tomorrow," *Talk at Google,* Google, online (Apr. 13, 2022).

[115] "Quantum steampunk: The physics of yesterday's tomorrow," *Harvard Science Book Talk,* Harvard Bookstore and Harvard U. Division of Science, Cambridge, MA, USA and online (Mar. 24, 2022).

[116] "Quantum steampunk: Victorian thermodynamics meets quantum computing," *PSW Lecture,* Philosophical Society of Washington (PSW Science), Washington, DC, USA (Feb. 25, 2022).

Other Invited Lectures and Panel Discussions

[117] "Experts discuss non-technical writing skills for researchers," *Career Connections,* Institute for Robust Quantum Simulation, Princeton, NJ, USA and online (Sept. 30, 2025).

[118] "Panel discussion: Quantum and arts: Bridging worlds to deliver accessibility, inspiration and creativity," *Quantum World Congress,* Tysons, VA, USA (Sept. 15–17, 2025).

[119] "Panel discussion: Demystifying quantum: How to communicate cutting-edge science to diverse audiences," *Quantum World Congress,* Tysons, VA, USA (Sept. 15–17, 2025).

[120] "Beyond the first law: Peculiarly quantum conservation in thermodynamics," *Katharine B. Gebbie Young Investigator Lecture,* NIST Sigma Xi Chapter, NIST, Gaithersburg, MD, USA (Dec. 5, 2024).

[121] "Field notes on the second law of thermodynamics from a quantum physicist," *ALS Lecture,* Center for Philosophy of Science, U. of Pittsburgh, Pittsburgh, PA, USA (Mar. 22, 2024).

[122] "Introduction to quantum thermodynamics," *ITAMP Winter School,* Institute for Theoretical Atomic, Molecular, and Optical Physics (ITAMP), Tucson, AZ, USA (Feb. 19–23, 2024).
- Presented 3 lectures.

[123] "Quantum steampunk: Quantum information meets thermodynamics," *CERN QTI Lecture,* Quantum Technology Initiative (QTI), CERN, Geneva, Switzerland (Nov. 16, 2023).

[124] "Panel discussion: Quo vadis, quantum thermodynamics?" *Quantum Thermodynamics (QTD),* TU Wien, Vienna, Austria (July 17–21, 2023).

[125] "Panel discussion: Thermodynamics and quantum computation," *Qalypso Summer School on Quantum Computation and Open Quantum Systems,* Gozo, Malta and online (Sept. 5–9, 2022).

[126] "Quantum thermodynamics," *Quantum Connections Summer School,* Stockholm U., Högberga Gård, Sweden (June 12–25, 2022).
- Presented 4 lectures.

[127] "Quantum steampunk: Quantum information meets thermodynamics," *QCourse511: Graduate Course on Quantum Computing and Programming,* QWorld, online (Nov. 25, 2021).

[128] "Panel discussion: Perspectives on thermodynamics and information in the quantum regime," *Thermodynamics and Information in the Quantum Regime,* online (June 7–9, 2021).

[129] *Mini Course on Quantum-Information Thermodynamics,* U. of São Paolo, São Paolo, Brazil and online (Nov. 23–Dec. 4, 2020).
- Enrollment: 420 participants from across the globe.
- Presented 5 of 9 lectures.

[130] "Quantum information in quantum cognition," *Quantum-biology course,* Koç U., Istanbul, Turkey and online (Sept. 2, 2020).

[131] "Introduction to quantum thermodynamics" and "Jarzynski-like equality for the out-of-time-ordered correlator," *Quantum Entanglement 2017*, Fudan U. and National Taiwan U., Shanghai, China and Taipei, Taiwan (Jan. 3–9, 2017).

Accepted conference talks

[132] "Noncommuting conserved charges in quantum many-body thermalization," *Quantum Thermodynamics 2021,* online (Oct. 4–8, 2021).

[133] "MBL-mobile: Many-body-localized engine," *Joint European Thermodynamics Conference,* Prague, Czech Republic and online (June 14–18, 2021).

[134] "Application of resource theory to bound a molecular switch's probability of switching," *52nd Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics,* American Physical Society, online (May 31–June 4, 2021).

[135] "Putting resource theories to work: Using thermomajorization to bound a molecular switch's probability of switching," *Beyond i.i.d. in Information Theory 8,* Stanford, CA, USA and online (Sept. 9–13, 2020).

[136] "MBL-mobile: Many-body-localized engine," *50th Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics,* American Physical Society, Milwaukee, WI, USA (May 27–31, 2019).

[137] "MBL-mobile: Many-body-localized engine," *Quantum Thermodynamics Conference 2018,* Kavli Institute for Theoretical Physics, Santa Barbara, CA, USA (June 25–29, 2018).

[138] "Quantum steampunk: Quantum information and thermodynamics," *Rising Stars in Physics,* Dept. of Physics, MIT, Cambridge, MA, USA (Apr. 24–25, 2018).

Seminars

[139] "Beyond the first law: Peculiarly quantum conservation laws in thermodynamics," APS Senior Group, College Park, MD, USA (Feb. 27, 2025).

[140] "Quantum thermodynamics of lattice gauge theories," *RPM Seminar,* Physics Division, Lawrence Berkeley National Lab, Berkeley, CA, USA (Jan. 23, 2025).

[141] "A tale of two disciplines: Non-Abelian eigenstate thermalization hypothesis," *Quantum-Science Seminar,* Dept. of Physics, Washington U. in St. Louis, St. Louis, MO, USA (Oct. 16, 2024).

[142] "Quantum steampunk: Quantum information meets thermodynamics," Dept. of Physics, Saint Joseph's U., Philadelphia, PA, USA and online (Apr. 24, 2024).

[143] "Quantum steampunk: Quantum information meets thermodynamics," *QMD Seminar,* Quantum Measurement Division (QMD), NIST, Gaithersburg, MD, USA (Mar. 12, 2024).

[144] "Updates to the second law from quantum thermodynamics," Foundations of Physics @Harvard, Harvard U., online (Feb. 13, 2024).

[145] "Building useful autonomous quantum machines," *VTQ Seminar,* Virginia Tech Center for Quantum Information Science and Engineering (VTQ), Blacksburg, VA, USA (Jan. 23, 2024).

[146] "A tale of two disciplines: Non-Abelian eigenstate thermalization hypothesis"; Narang Lab; U. California, Los Angeles; Los Angeles, CA, USA (Oct. 10, 2023).

[147] "The value of lacking complexity in quantum computation," Institute for Quantum Optics and Quantum Information (IQOQI) Vienna, Vienna, Austria (July 13, 2023).

[148] "What happens to entropy production when conserved quantities fail to commute," Atominstitut, University of Vienna, Vienna, Austria (July 12, 2023).

[149] "A tale of two disciplines: Non-Abelian eigenstate thermalization hypothesis," *ITAMP Seminar*, ITAMP, Cambridge, MA, USA (June 15, 2023).

[150] "A tale of two disciplines: Non-Abelian eigenstate thermalization hypothesis," *JQI Seminar,* Joint Quantum Institute, NIST and U. of Maryland, College Park, MD, USA (Sept. 19, 2022).

[151] "A tale of two disciplines: Non-Abelian eigenstate thermalization hypothesis," Quantum-Many-Body-Theory Group, LMU Munich, Munich, Germany and online (Aug. 22, 2022).

[152] "The value of lacking complexity in quantum computation," *QPequi Talk,* Quantum Optics and Information Group, Federal U. of Goiás, Goiânia, Brazil and online (Aug. 9, 2022).

[153] "MBL-mobile: Many-body-localized engine," International Institute of Physics, Natal, Brazil and online (July 11, 2022).

[154] "Linear growth of quantum complexity," *CQIQC Seminar,* Centre for Quantum Information and Quantum Control (CQIQC), U. of Toronto, Toronto, ON, Canada (May 13, 2022).

[155] "Linear growth of quantum complexity," *Quantum-Information-Theory Seminar,* U. College London, London, UK and online (May 5, 2022).

[156] "Understanding molecular switches through quantum information theory"; CQSE Seminar; Center for Quantum Science and Engineering (CQSE) and Dept. of Chemistry and Biochemstry; U. of California, Los Angeles; Los Angeles, CA, USA (May 3, 2022).

[157] "Why negativity is useful (in metrology)," Institute for Quantum Studies, Chapman U., Orange, CA, USA (Apr. 27, 2022).

[158] "Learning about learning by many-body systems," Physical-Biology Laboratory, California Institute of Technology, Pasadena, CA, USA (Apr. 26, 2022).

[159] "Resource theory of quantum uncomplexity," *"It from Qubit" Seminar,* Stanford Institute for Theoretical Physics, Stanford U., Palo Alto, CA, USA (Apr. 22, 2022).

[160] "Putting resource theories to work in chemistry," *Quantum-Information Seminar,* Perimeter Institute for Theoretical Physics, Waterloo, Canada and online (Mar. 30, 2022).

[161] "Linear growth of quantum complexity," *High-Energy-Theory Seminar,* Purdue U., West Lafayette, IN, USA and online (Mar. 8, 2022).

[162] "Resource theory of quantum uncomplexity," *UBC High-Energy Seminar,* U. of British Columbia, Vancouver, Canada and online (Feb. 21, 2022).

[163] "Linear growth of quantum complexity," Mila Institute, Montreal, Canada and online (Feb. 16, 2022).

[164] "My favorite not-quite-probability distribution and its usefulness in quantum metrology," *CQuIC Seminar,* Center for Quantum Information and Control (CQuIC), U. of New Mexico, Albuquerque, New Mexico, USA and online (Feb. 10, 2022).

[165] "My favorite not-quite-probability distribution," Centre for Theoretical AMO Physics, Queens U. Belfast, Belfast, Ireland and online (Feb. 9, 2022).

[166] "Linear growth of quantum complexity," *Qiskit Quantum Information Science Seminar,* IBM, online (Feb. 4, 2022).

[167] "Resource theory of uncomplexity," *ARQC Seminar,* Dept. of Energy Office of Science Accelerated Research in Quantum Computing (ARQC) Program, online (Feb. 2, 2022).

[168] "Resource theory of uncomplexity," Quantum and Complexity Science Initiative, Nanyang Technological U., Singapore and online (Jan. 27, 2022).

[169] "MBL-mobile: Many-body-localized engine," *Long-Range Colloquium*, Virtual Science Forum, online (Oct. 27, 2021).

[170] "MBL-mobile: Many-body-localized engine," *PCS-IBS Seminar*, Institute for Basic Science (IBS) Center for Theoretical Physics of Complex Systems (PCS), Daejeon, South Korea and online (Oct. 18, 2021).

[171] "My favorite not-quite-probability distribution," Quantum Information Science Group, Air Force Institute of Technology, Wright-Patterson AFB, OH, USA and online (Oct. 8, 2021).

[172] "My favorite not-quite-probability distribution," *iQuISE Seminar*, Massachusetts Institute of Technology, Cambridge, MA, USA and online (Oct. 7, 2021).

[173] "MBL-mobile: Many-body-localized engine," *Quantum-Matter Seminar*, Ohio State U., Columbus, OH, USA and online (July 26, 2021).

[174] "Noncommuting conserved quantities in thermodynamics," *Theory Group Seminar,* Ignacio Cirac's Theory Group, Max Planck Institute for Quantum Optics, Münich, Germany and online (July 7, 2021).

[175] "Tales of a not-quite-probability distribution," *IOP Prize Webinar*, Institute of Physics (IOP) Publishing, Bristol, United Kingdom and online (June 15, 2021).

[176] "Quantum Politics," Nanyang Quantum and Complexity Science Initiative, Nanyang Technological U., Singapore and online (Apr. 1, 2021).

[177] "Quantum steampunk: Quantum information meets thermodynamics," Oxford U. Quantum Information Society, Oxford U., Oxford, UK and online (Feb. 11, 2021).

[178] "My favorite not-quite-probability distribution," *Salaam Sessions Seminar,* LUMS Student Mathematics Society, Lahore U. of Management Sciences (LUMS), Lahore, Pakistan and online (Jan. 22, 2021).

[179] "Noncommuting conserved quantities in quantum many-body thermalization," *Cavendish QI Seminar,* Quantum Information Group, Cavendish Laboratory, U. of Cambridge, Cambridge, UK and online (Sept. 18, 2020).

[180] "Noncommuting conserved quantities in quantum many-body thermalization," *QICI Online Seminar,* Quantum Information and Computation Initiative (QICI), U. of Hong Kong, Hong Kong, China and online (Sept. 11, 2020).

[181] "Entropic uncertainty relations for quantum information scrambling," QChaos2020 (international online seminar series) (Aug. 6, 2020).

[182] "Learning about learning about many-body physics"; Complexity Sciences Center; U. of California, Davis; Davis, CA, USA (July 22, 2020).

[183] "MBL-mobile: Many-body-localized engine," Quantum Simulation and Technology Group, U. Federal do Rio Grande do Norte, Natal, Brazil and online (July 9, 2020).

[184] "Learning about learning by many-body systems," American Physical Society Topical Group on Data Science, online (May 29, 2020).

[185] "Putting thermodynamic resource theories to work: Bounding a molecular switch's probability of switching," *Quarantine Thermo,* online (Apr. 7, 2020).

[186] "Quantum steampunk: Quantum information meets thermodynamics," Dept. of Physics, U. of Toronto, Toronto, ON, Canada (Mar. 17, 2020).

[187] "Resource theories go to work: Bounding how effectively a molecular switch can switch, using quantum-information thermodynamics," *QuICS Seminar,* Joint Center for Quantum Information and Computer Science (QuICS), U. of Maryland and NIST, College Park, MD, USA (Feb. 19, 2020).

[188] "Learning about learning by many-body systems," *Informal Statistical-Physics Seminar,* Institute for Physical Science and Technology, U. of Maryland, College Park, MD, USA (Feb. 18, 2020).

[189] "Entropic uncertainty relations for quantum-information scrambling," *Special CUA Seminar,* Center for Ultracold Atoms, MIT, Cambridge, MA, USA (Feb. 5, 2020).

[190] "MBL-mobile: Many-body-localized quantum engine," Dept. of Physics and Astronomy, U. of Southern California, Los Angeles, CA, USA (Dec. 12, 2019).

[191] "Noncommuting conserved charges in quantum many-body thermalization," *Quantum Information Processing Seminar,* Center for Theoretical Physics, MIT, Cambridge, MA, USA (Nov. 1, 2019).

[192] "Noncommuting conserved charges in quantum many-body thermalization," *Theoretical-Physics Seminar,* Dept. of Physics and Applied Physics, U. of Massachusetts Lowell, Lowell, MA, USA (Oct. 31, 2019).

[193] "Entropic uncertainty relations for quantum-information scrambling," Institute for Quantum Studies, Chapman U., Orange, CA, USA (Sept. 5, 2019).

[194] "When quantum-information scrambling met quasiprobabilities," *Joint Condensed-Matter and High-Energy-Theory Seminar,* Dept. of Physics, Brown U., Providence, RI, USA (May 9, 2019).

[195] "Entropic uncertainty relations for quantum-information scrambling," *Perimeter Institute Quantum Discussions,* Perimeter Institute, Waterloo, ON, Canada (Apr. 18, 2019).

[196] "Quantum steampunk: Quantum information meets thermodynamics," *Special Theoretical Physics Seminar,* Dept. of Physics, Yale U., New Haven, CT, USA (Apr. 3, 2019).

[197] "Entropic uncertainty relations for quantum-information scrambling," *ITAMP Seminar,* Institute for Theoretical Atomic, Molecular, and Optical Physics (TAMP), Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA (Feb. 28, 2019).

[198] "Quantum information in quantum cognition," *MIT Quantum Information Processing Seminar,* Center for Theoretical Physics, MIT, Cambridge, MA, USA (Feb. 8, 2019).

[199] "Quantum steampunk: Quantum information meets thermodynamics," Special Kadanoff Seminar, Kadanoff Center for Theoretical Physics, U. of Chicago, Chicago, IL, USA (Jan. 31, 2019).

[200] "When quantum-information scrambling met quasiprobabilities," CTQM Seminar, Center for Theory of Quantum Matter (CTQM), U. of Colorado Boulder, Boulder, CO, USA (Jan. 25, 2019).

[201] "Reconciling two notions of quantum operator disagreement: Uncertainty relations and information scrambling," JILA, Boulder, CO, USA (Jan. 22, 2019).

[202] "Reconciling two notions of quantum operator disagreement: Uncertainty relations and information scrambling," Condensed-Matter Seminar, Dept. of Physics, Washington U. in St. Louis, St. Louis, MO, USA (Dec. 10, 2018).

[203] "The non-Abelian thermal state," CAMP Seminar, Dept. of Physics, Penn State U., State College, PA, USA (Dec. 5, 2018).

[204] "When quantum-information scrambling met quasiprobabilities," AP 483 Seminar, Dept. of Applied Physics, Stanford U., Palo Alto, CA, USA (Nov. 12, 2018).

[205] "When quantum-information scrambling met quasiprobabilities," Informal String-Theory Seminar, MIT, Cambridge, MA, USA (Oct. 15, 2018).

[206] "Quantum information in quantum cognition," Quantum Artificial Intelligence Lab, Google, Venice, CA, USA (July 20, 2018).

[207] "Resource-theory models for thermodynamics"; College of Chemistry; U. of California, Berkeley; Berkeley, CA, USA (July 9, 2018).

[208] "Quantum information in quantum cognition," *Ming Hsieh Institute Seminar on Quantum Information,* Ming Hsieh Institute, Dept. of Electrical Engineering, U. of Southern California, Los Angeles, CA, USA (Apr. 13, 2018).

[209] "Resource-theory models for thermodynamics," Beyond Center for Fundamental Concepts in Science, Arizona State U., Phoenix, AZ, USA (Jan. 29, 2018).

[210] "Quantum information and the brain," *coffee@beyond seminar*, Beyond Center for Fundamental Concepts in Science, Arizona State U., Phoenix, AZ, USA (Jan. 29, 2018).

[211] "MBL-mobile: Many-body-localized engine"; Complexity Sciences Center; U. of California, Davis; Davis, CA, USA (Oct. 4, 2017).

[212] "Quantum voting system and violation of Arrow's Impossibility Theorem"; Dept. of Electrical Engineering and Computer Sciences; U. of California, Berkeley; Berkeley, CA, USA (Sept. 28, 2017).

[213] "Go scramble yourself! Out-of-time-ordered correlators, the Second Law, and quasiprobabilities"; *BQIC Seminar*; Berkeley Quantum Information and Computation Center; U. of California, Berkeley; Berkeley, CA, USA (Sept. 27, 2017).

[214] "A Jarzynski-like equality for quantum chaos, with a side of quasiprobabilities," Statistical-Mechanics Group, U. of Maryland, College Park, MD, USA (June 8, 2017).

[215] "Truly quantum Gibbs: Thermal state of a system whose charges don't commute," *QuICS Seminar*, Joint Center for Quantum Information and Computer Science (QuICS), U. of Maryland and NIST, College Park, MD, USA (June 7, 2017).

[216] "A Jarzynski-like equality for quantum chaos, with a side of quasiprobabilities," *Quantum Seminar*, U. of Massachusetts at Boston, Boston, MA, USA (May 30, 2017).

[217] "Truly quantum Gibbs: Thermal state of a system whose charges don't commute," *Quantum/Nano Seminar*, Dartmouth College, Hanover, NH, USA (May 25, 2017).

[218] "MBL-mobile: Many-body-localized engine," Dept. of Chemistry and Chemical Biology, Harvard U., Cambridge, MA, USA (May 23, 2017).

[219] "Truly quantum Gibbs: Thermal state of a system whose charges don't commute," *Quantum-Information-Physics-Group Seminar*, MIT, Cambridge, MA, USA (May 19, 2017).

[220] "Go scramble yourself! Out-of-time-ordered correlators, fluctuation relations, and quasiprobabilities," *Condensed-Matter Seminar,* Harvard U., Cambridge, MA, USA (May 16, 2017).

[221] "Using many-body localization for thermodynamic advantage: MBL Otto engine," U. College London, London, UK (Mar. 9, 2017).

[222] "Bridging disciplines to comprehend chaos: Fluctuation theorem for the out-of-time-ordered correlator," Stanford U., Palo Alto, CA, USA (Sept. 22, 2016).

[223] "Truly quantum Gibbs: Thermal state of a system whose charges don't commute," Institute for Quantum Studies, Chapman U., Orange, CA, USA (Aug. 26, 2016).

[224] "Toward physical realizations of information-theory models for small-scale thermodynamics," *Q+ Google hangout* (online) (Jan. 25, 2016).

[225] "Toward physical realizations of information-theory models for small-scale thermodynamics," IBM Watson, Yorktown Heights, NY, USA (Nov. 19, 2015).

[226] "Toward physical realizations of information-theory models for small-scale thermodynamics," *IQIM Seminar,* Inst. for Quantum Information and Matter, Caltech, Pasadena, CA, USA (Nov. 6, 2015).

[227] "Beyond heat baths: Generalized resource theories for small-scale thermodynamics," QuTech, TU Delft, Delft, Netherlands (Aug. 18, 2015).

[228] "(One-shot) information theory and statistical mechanics," *Informal Statistical-Physics Seminar,* Institute for Physical Science and Technology, U. of Maryland, College Park, MD, USA (Mar. 24, 2015).

[229] "Quantum voting and violation of Arrow's Impossibility Theorem," *QuICS Seminar,* Joint Center for Quantum Information and Computer Science (QuICS), U. of Maryland and NIST, College Park, MD, USA (Mar. 20, 2015).

[230] "Beyond heat baths: Resource theories for small-scale thermodynamics," MIT, Cambridge, MA, USA (May 22, 2014).

[231] "Information as a resource in small-scale thermodynamics," Centre for Mathematical Sciences, U. of Cambridge, Cambridge, UK (Mar. 24, 2015).

[232] "Simple thermo, general tools: The resource theory of informational nonequilibrium," *Relativistic Quantum Information Seminar,* U. of Nottingham, Nottingham, UK (Dec. 11, 2013).

[233] "Simple thermo, general tools: The resource theory of informational nonequilibrium," Lancaster U., Lancaster, UK (Nov. 28, 2013).

[234] "Simple thermo, general tools: The resource theory of informational nonequilibrium," U. of Oxford, Oxford, UK (Oct. 17, 2013).

[235] "Single-shot entropies in the resource theory of nonuniformity," ETH Zürich, Zürich, Switzerland (Aug. 2013).

[236] "Single-shot entropies in the resource theory of nonuniformity," Perimeter Institute for Theoretical Physics, Waterloo, Canada (June 2013).

Academic and Professional Organizations

Institute for the Science of Origins
Member Nov. 2022–Present.

Philosophical Society of Washington (PSW Science)
Member Feb. 2022–Present.

Foundational Questions Institute (FQXi)
Member Mar. 2021–Present.

American Physical Society
Member Aug. 2010–Present.

Phi Beta Kappa
Member Nov. 2010–Present.
Inducted junior year of college.
Co-recipient of the Dartmouth College 2009 Phi Beta Kappa Prize.

Grants

[1] **Templeton Foundation Large Grant** (Co-PI)
"Maryland Quantum-Thermodynamics Hub: Resolving tensions in the thermodynamic emergence of classicality," John Templeton Foundation (2025–2028).

[2] **QuICS Seed Grant** (Co-PI)
"Quantum-Steampunk Creative-Writing Course," QuICS, U. of Maryland and NIST (2025).

[3] **QUANTUM x ArtsAMP Collaborative Faculty Grants** (Co-PI)
"The Quantum-Steampunk Engine: A dynamic, interactive sculpture and stories for broadening quantum awareness," Arts for All, U. of Maryland (2024–2025).

[4] **Research Training Group** (Senior Personnel)
"Mathematics of Quantum Information Science," National Science Foundation (2023–2028).

[5] **Templeton Foundation Large Grant** (Co-PI)
"Maryland Quantum-Thermodynamics Hub," John Templeton Foundation (2022–2025).

[6] **Quantum Leap Challenge Institute** (Senior Investigator)
"Institute for Robust Quantum Simulation," National Science Foundation (2021–2026).

[7] **FQXi Mini Grant**
"Illustrations for quantum-thermodynamics book for the public," Foundational Questions Institute (FQXi) (officially submitted by Jeffrey Bub) (2021–2022).

Service and Leadership

Thermodynamics Lunch
QuICS, U. of Maryland.
Founder, Leader Fall 2021–Present.

- Host weekly forum for interdisciplinary conversations about thermodynamics.

Refereeing for Academic Journals, Conferences, and Funding Organizations

- Banff International Research Station, Binational Science Foundation, *Europhysics Letters*, IOP Publishing Ebooks, *Journal of Physics: Condensed Matter*, *Journal of High Energy Physics*, National Science Foundation, *Nature Communications*, *New Journal of Physics*, *npj Quantum*

Information, *Optica*, *Physical Review A*, *Physical Review B*, *Physical Review E*, *Physical Review Letters*, *Physical Review X*, *Physical Review X Quantum*, *Physics Letters A*, *Proceedings of the Royal Society A*, *Quantum*, *QIP (Quantum Information Processing conference) Quantum Information Processing (journal)*, *Quantum Science and Technology*, *Science Advances*, *Studies in History and Philosophy of Modern Physics*, *TQC (Theory of Quantum Computation and Cryptography)*, *WERB (Washington Editorial Review Board)*.

- Designed an IOP Trusted Reviewer for submitting "a top-quality review report." ("Only the top 15% of our reviewers will achieve this recognition.")

Conference/workshop/school/session organization

[1] "Maryland Quantum-Thermodynamics Symposium 2025"; Maryland Quantum-Thermodynamics Hub; U. of Maryland, Baltimore County; Baltimore, MD, USA (May 27–28, 2025).

[2] "12th Rochester Conference on Coherence and Quantum Science," Center for Coherence and Quantum Optics, U. of Rochester, Rochester, NYH, USA (June 23–27, 2025).

[3] "Quantum Thermodynamics (QTD) 2024," Maryland Quantum-Thermodynamics Hub, U. of Maryland, College Park, MD, USA (Aug. 5–9, 2024).

[4] "Quantum thermodynamics: Quantum many-body meets thermodynamics," ITAMP Winter School, Institute for Theoretical Atomic, Molecular, and Optical Physics (ITAMP), Tucson, AZ, USA (Feb. 19–23, 2024).

[5] "Thermalization, from Cold Atoms to Hot Quantum Chromodynamics," InQubator for Quantum Simulation, U. of Washington, Seattle, WA, USA (Sept. 11–22, 2023).

[6] "Maryland Quantum-Thermodynamics Symposium 2023," Maryland Quantum-Thermodynamics Hub, College Park, MD, USA (Mar. 14, 2023).

[7] "Non-Markovianity in Open Quantum Systems," Banff International Research Station, Banff, Canada (Feb. 12–17, 2023).

[8] "Thermodynamics in Quantum Information I" Session, APS March Meeting 2022, Chicago, IL, USA (Mar. 14–18, 2022).

PhD-Thesis and PhD-Candidacy Committees

[1] Richard Barney (U. of Maryland, PhD Thesis, Sept. 2025).

[2] Debankur Bhattacharyya (U. of Maryland, PhD Thesis, June 2024).

[3] Amit Vikram Anand (U. of Maryland, PhD Thesis, June 2024).

[4] Greeshma Shivali Oruganti (U. of Maryland, PhD Candidacy, May 2024).

[5] Subhayan Sahu (U. of Maryland, PhD Thesis, July 2022).

[6] Zackery Benson (U. of Maryland, PhD Thesis, Nov. 2021).

Graduate-Admissions Committee
Dept. of Physics, U. of Maryland.
Committee Member 2023–2024.

International Quantum Technology Emerging Researcher Award
IOP Publishing.
Member of Prize-Selection Committee Mar.–Apr. 2023.

Alumni Advisory Board
Dartmouth College Dept. of Physics and Astronomy.
Board member Sept. 2011–Present.

Caltech Heritage Project
Caltech Archives.
Interviewee July 27, 2022.

Dartmouth Physics Society
Dartmouth College.
Co-Founder, Co-President Jan.–June 2011.

Outreach

***Quantum Frontiers* Blog**
Institute for Quantum Information and Matter, Caltech.
Blogger Apr. 2013–Present.

- Write monthly stories about science and how it gets under my skin.
- Number of times *QF* viewed per year: 200,000.
- Articles of mine have been featured in the *Scientific American* blog *Cocktail Party Physics,* in *Nature Briefing*, in *Physics World*, in the *Physics World* blog, in *Inside the Perimeter,* on *FYI This Week* by the American Institute of Physics, in *Science Seeker*, in the *KITP Newsletter*, and by Quantum Futures.

Science Podcasts, Videos, and Radio
Interviewee 2018–Present.

[1] "Quantum steampunk: we explore the art and science," *Physics World Weekly Podcast, Physics World* (2025).

[2] "Interview with Nicole Yunger Halpern," *Towards StatPhys 2025,* Fisica di Tutti i Giorni (2025).

[3] "Kavli Special - Quantum Thermodynamics for Lattice Gauge Theories," *Highlights from the Global Physics Summit,* APS TV (2025).

[4] "Quantum Q&A," U. of Maryland Institute for Advanced Computer Studies (2025).

[5] "Carnot's theorem," *My Favorite Equation,* FQxI, (2024).

[6] "Can Thermodynamics Go Quantum?" *The Joy of Why, Quanta Magazine*, (2024).

[7] "Quantum steampunk," *Qubites,* Valorem Reply (2022).

[8] "Nicole Yunger Halpern on quantum steampunk," *Conversations at the Perimeter*, Perimeter Institute for Theoretical Physics (2022).

[9] "Quantum steampunk: Thermodynamics meets quantum information," *It's About Time!*, Clubhouse, (2022).

[10] "The Future of Physics with Dr. Nicole Yunger Halpern," *Amichai Levy's Youtube Channel*, (2022).

[11] "Physicists Rewrite the Fundamental Law That Leads to Disorder," *Quanta Podcast* (2022).

[12] "Quantum Steampunk on the FQXi Podcast," *FQXi Podcast* (2022).

[13] "Quantum Thermodynamics: A Steampunk Adventure with Nicole Yunger Halpern," *Into the Impossible with Brian Keating* (2022).

[14] "This is Quantum," National Q–12 Education Partnership (2022).
- Featured on the blog of the White House Office of Science and Technology Policy.

[15] "Quantum Steampunk: The Physics of Yesterday's Tomorrow," *KPCW Cool Science Radio* (2022).

[16] "Quantum Steampunk," *Groks Science Radio Show and Podcast* (2022).

[17] "Podcast with Nicole Yunger Halpern, QuICS Physicist," *The Qubit Guy's Podcast,* Classiq (2022).

[18] "Nicole Yunger Halpern on Steampunk Quantum Thermodynamics," *Sean Carroll's Mindscape* podcast (2022).

[19] "Quantum Steampunk – With Theoretical Physicist Nicole Yunger Halpern!" *What The If?* podcast (2022).

[20] "Quantum Steampunk with Dr. Nicole Yunger Halpern & Isabelle Farrah," *Highbrow Drivel* podcast (2022).

[21] "When Physics Marries the Past to the Future," *Inside Science* podcast, American Institute of Physics (2022).

[22] "Episode #008," *Random Walks* podcast (2021).

[23] "Break Through: The power of big ideas," *Caltech Academic Media Technologies* (2018).

[24] "Quantum theory and our warm, wet, large brains," *The Caltech Effect*, Caltech Academic Media Technologies (2018).

Popular-Science Articles and Books

Interviewee 2015–Present.

[1] "A thermometer for measuring quantumness," by Philip Ball, *Quanta Magazine* (2025).

[2] "$5M in state, private funding supports hub to meld quantum science, thermodynamics," by Chris Cesare, *Maryland Today* (2025).

[3] "Getting a feel for quantum mechanics," by Conor Feehly, *Cosmos* (2025).

[4] "Celebrate World Quantum Day with quantum steampunk," by Linea Johnson, *Smile Politely* (2025).

[5] "A new take on the oldest physics: What actually happened right after the big bang?" by Dina Genkina, Institute for Robust Quantum Simulation (2025).

[6] "UMD physicist helps sculpt quantum mechanics into reality," by Georgia Jiang, U. of Maryland Dept. of Physics (2025).

[7] "Features interview: Now is the time to realise useful autonomous quantum machines," by Thomas Lewton, *New Scientist* (2025).

[8] "In the quantum realm, time's arrow might fly in two directions," by Gayoung Lee, *Scientific American* (2025).

[9] "'Quantum steampunk' creative writing course explores the science of science fiction," by John Tucker, *Maryland Today*, U. of Maryland (2025).

[10] "A physicist and steampunk enthusiast explores thermodynamics in the quantum world," by Ron Cowen, *NIST Updates*, NIST (2025).

[11] "Quantum refrigerator keeps qubits cool," by Susan Curtis, *Physics Magazine*, American Physical Society (2025).

[12] *Jobs If You Like Math,* by Stuart Kallen, Reference Point Press (2025).

[13] "Quantum computers get automatic error correction for the first time," by Karmela Padavic-Callaghan, *New Scientist* (2025).

[14] "Novel 'quantum refrigerator' is great at erasing quantum computer's chalkboard," by Chad Boutin, NIST News, (2025).

[15] "Record cold quantum refrigerator paves way for reliable quantum computers," by Lovisa Håkansson, (2025).

[16] "What is entropy? A measure of just how little we really know," by Zack Savitsky, *Quanta Magazine* (2024).

[17] "Quantum theory is challenging long-standing ideas about entropy," by Karmela Padavic-Callaghan, *New Scientist* (2024).

[18] "Why this physicist is bringing thermodynamics to the quantum age," by Emily Conover, *Science News* (2024).

[19] "Is it possible to send messages back in time?" by Rakefet Tavor, *Epoch* (2024).

[20] "Quantum time travel: The experiment to 'send a particle into the past,"' by Miriam Frankel, *New Scientist* (2024).

[21] *Canadians Who Innovate: The Trailblazers and Ideas That Are Changing the World,* by Roseann O'Reilly Runte, Simons and Schuster (2024).

[22] "If the multiverse theory is real, how soon can I ditch this sucky timeline?" by Carlyn Zwarenstein, *Salon* (2024)

[23] "Simulations of time travel send quantum metrology back to the future," by Unnati Akhouri, *Physics World* (2024).

[24] "Physicists find ultimate limit for how accurate clocks can be," by Alex Wilkins, *New Scientist* (2023).

[25] "Shaping the infrastructure that is woven into our everyday life: that's what quantum computing will do," by Antonella Del Rosso, *Sparks! Serendipity Forum at CERN* and *README.IT* (an internal publication of CERN) (2023).

[26] "Physicists Simulate Time Travel Using Quantum Entanglement," by Isaac Schultz, *Gizmodo* (2023).

[27] "Simulations of 'backwards time travel' can improve scientific experiments," by Vanessa Bismuth, *U. of Cambridge Research News* (2023).

[28] "Quantum mechanics and thermodynamics can both be true, say physicists," by Martijn Boerkamp, *Physics World* (2023).

[29] "The Most Surprising Discoveries in Physics," by Clara Moskowitz, *Scientific American* (2023).

[30] "In New Paradox, Black Holes Appear to Evade Heat Death," by George Musser, *Quanta Magazine* (2023).

[31] "What Tom Cruise's Weirdest Sci-Fi Movie Gets Wrong About Time Travel," by Tara Yarlagadda, *Inverse.com* (2023).

[32] "A Reboot of the Maxwell's Demon Thought Experiment—in Real Life," by Sophia Chen, *Wired* (2022).

[33] "The Universe Is Not Locally Real, and the Physics Nobel Prize Winners Proved It," by Dan Garisto, *Scientific American* (2022).

[34] "UMD graduate students reflect on end of Ford Foundation diversity fellowship," by Nene Narh-Mensah, *Diamondback* (2022).

[35] "Diving into UMD's Quantum Community," by Bailey Bedford, *U. of Maryland Physics Website* (2022).

[36] "Physicists Rewrite the Fundamental Law That Leads to Disorder," by Philip Ball, *Quanta Magazine* (2022).

[37] "The best sci-fi thriller on Netflix reveals a provocative spin on time travel," by Tara Yarlagadda, *Inverse.com* (2022).

[38] "Researcher's New Book Puts Physics' Past and Future in Literary Blender," by Chris Carroll, *Maryland Today* (2022).

[39] "Newest QuICS Fellow Ponders Quantum Mechanics, Thermodynamics, and Everything Else," by Dina Genkina, *QuICS website* (2022).

[40] "Alumni of PI: Quantum steampunker Nicole Yunger Halpern," by Erin Bow, *Inside the Perimeter* (2022).

[41] "Welcome to the Multiverse," by Jess Romeo, *Scholastic Science World Magazine* (2021).

[42] "The New Thermodynamic Understanding of Clocks," by Natalie Wolchover, *Quanta Magazine* (2021).
- Featured in the video "What is Time?" by Brian Keating (2021).

[43] "Understanding 'Loki' time travel through the real science of branching universes," by Tara Yarlagadda, *Inverse.com* (2021).

[44] "Quasiprobabilities shed light on quantum advantage," by Margaret Harris, *Physics World* (2021).

[45] "'Quantum negativity' can power ultra-precise measurements," by Sarah Collins, *U. of Cambridge Research News* (2020).

[46] "Does Time Really Flow? New Clues Come from a Century-Old Approach to Math," by Natalie Wolchover, *Quanta Magazine* (2020).

[47] "The Universal Law That Aims Time's Arrow," by Natalie Wolchover, *Quanta Magazine* (2019).

[48] "What makes a great qubit? Diamonds and ions could hold the answer," by Allison Eck, *PBS NOVA* (2019).

[49] "Here's what the quantum internet has in store," by Davide Castelvecchi, *Nature* (2018).

[50] "29 Smart Questions," *Amy Poehler's Smart Girls,* Legendary Entertainment (2015).

Popular-Science Writing

Writer June 2006–Present.
- See "Selected Science Writing," below.

Various Lecture Programs

Speaker Feb. 2022–Present.
- See "Public Lectures," above.

Student and Interest Groups

Faculty presenter Aug. 2021–Present.

[1] "Quantum steampunk: Not your great-great-grandmother's thermodynamics," Society of Physics Students, U. of Maryland, College Park, MD, USA (Oct. 30, 2025).

[2] "Quantum steampunk: Quantum information meets thermodynamics," *PHYS170: Professional Physics Seminar*, Dept. of Physics, U. of Maryland, College Park, MD, USA (Oct. 7, 2025).

[3] "Quantum steampunk," *Q^3 Initiative*, Center for Quantum Networks and United Nations International Telecommunications Union, College Park, MD, USA (Sept. 12, 2025).

[4] "Quantum steampunk: Quantum information meets thermodynamics," Research Experiences for Undergraduates, U. of Maryland, College Park, MD, USA (July 28, 2025).

[5] "Quantum steampunk: Quantum information meets thermodynamics," Oxford Quantum Information Society, Oxford U., Oxford, UK and online (Mar. 6, 2025).

[6] "Quantum steampunk: Quantum information meets thermodynamics," Society of Physics Students, U. of Maryland, College Park, MD, USA (Sept. 12, 2024).

[7] "Quantum steampunk: Quantum information meets thermodynamics," Workshop on Stochastic Thermodynamics (WOST) Women's Network, online (Oct. 26, 2023).

[8] Faculty lunch seminar, *"Training and Research in Nonlinear Dynamics" Research Experience for Undergraduates (TREND REU) Program*, Institute for Physical Science and Technology, U. of Maryland, College Park, MD, USA (June 27, 2023).

[9] High-school-class visit, *Computational Biology course,* Nueva School, San Matteo, CA, USA and online (May 8, 2023).

[10] "Meet the author: Nicole Yunger Halpern," *Lunch & Learn Series,* WiSTEM, NIST, online (Jan. 20, 2023).

[11] "Quantum Steampunk: Meet the author," Payne Lab, Dept. of Mechanical Engineering and Materials Science, Duke U., Durham, NC, USA and online (Jan. 13, 2023).

[12] "Quantum steampunk: The physics of yesterday's tomorrow," Cavendish Inspiring Womxn, Cavendish Laboratory, U. of Cambridge, Cambridge, UK and online (Nov. 10, 2022).

[13] "Quantum steampunk: The physics of yesterday's tomorrow," Zen4Quantum, Santa Clara, CA, USA and online (Oct. 29, 2022).

[14] "Quantum steampunk: Quantum information meets thermodynamics," Undergraduate Quantum Association, University of Maryland, College Park, MD, USA (Oct. 25, 2022).

[15] "Quantum steampunk," *Casual Conversations,* Dartmouth Class of 1969, online (Sept. 20, 2022).

[16] "Quantum steampunk: Quantum information meets thermodynamics," *Stanford Program for Inspiring the Next Generation of Women in Physics (SPINWIP),* Palo Alto, CA and online (July 26, 2022).

[17] "Q&A with Dr. Nicole Yunger Halpern, author of Quantum Steampunk," Qubit by Qubit, online (April 26, 2022).

[18] "Quantum steampunk: Quantum information meets thermodynamics," Oxford U. Quantum Information Society, U. of Oxford, Oxford, UK and online (May 26, 2022).

[19] "Quantum steampunk: Quantum information meets thermodynamics," Society of Physics Students, U. of Maryland, College Park, MD, USA and online (Mar. 17, 2022).

[20] "Quantum steampunk: Quantum information meets thermodynamics," *Chilloquium*, Society of Physics Students chapters at Harvard U. and UC Berkeley, Cambridge, MA, USA and online (Aug. 9, 2021).

Mary Somerville Medal and Prize
Recipient Oct. 2023.

Quantum-Steampunk Engine Sculpture
Co-Creator Sept. 2024–Jan. 2025.

- Helped design and garner funding for a kinetic, interactive sculpture that educates viewers about engines, quantum physics, and information theory. Collaborated with steampunk art company ModVic and design-engineering company Empire Group.
- Organized exhibitions of the sculpture (at the APS Global Physics Summit, UMD Physical Sciences Complex, etc.).
- Shared the story of the sculpture's development and journey via social media (blogging, X, LinkedIn, etc.).
- Sculpture featured on the *Physics World Art and Science blog* and in *Maryland Today*.

Quantum-Steampunk Short-Story Contest
Maryland Quantum-Thermodynamics Hub.
Principal Event Coordinator Sept. 2022–May 2023.

- Coordinated contest for short stories written in a steampunk style and featuring quantum physics.
- Received 167 entries from 29 countries, from diverse participants (professional writers, physicists, middle-school students, librarians, etc.).
- Recruited 8 judges with expertise from across writing and quantum science, including a Hugo Award–winning author, philosopher of quantum theory, and Hollywood advisor.
- Garnered 261 votes in the People's Choice Award competition.

Tucson Festival of Books (third-largest book festival in the US)
Speaker and Panelist Mar. 2023.

- Participated in the panel discussion "The Future of Tech"
- Spoke at the session "The Future is Quantum!"

Boskone (oldest annual science-fiction convention in New England)
New England Science-Fiction Organization.
Presenter and Panelist Feb. 2023.

- Presented the talk "Quantum steampunk: The physics of yesterday's tomorrow."
- Participated in the panel discussion "Putting the 'real' in 'real good science fiction."'

Quantum-Steampunk Photo Shoot
U. of Maryland Institute for Advanced Computer Studies.
Photographee Oct. 2021.

- Winner of silver CASE award.
- Included in the U. of Maryland "The Year in Pictures."

"Einstein's Quantum Riddle" Premier
NOVA and MIT.
Panelist Jan. 2019.

- Participated in public panel discussion at premier of NOVA film about quantum entanglement.

"Experimenting with Megan Amram" Webshow
Amy Poehler's Smart Girls, Legendary Entertainment.
Guest-Scientist Interviewee Aug. 2015.

"Famelab" Science-Communication Contest
NASA.
National Finalist Mar.–Apr. 2012.

- "I Love the Smell of Evolution in the Morning; It Smells Like Physics."
- "Zombies Versus Evolution: How Physics Enables Complex Life to Form."

TEDx Dartmouth
Dartmouth College.
Speaker May 2010.

- "Once Upon a Time in Linear Algebra."

XKCD Comes to Dartmouth!
Dartmouth College.
Principal Event Coordinator May–Nov. 2008 (event held in Oct.).

- Speech by, and festivities with, Randall Munroe, creator of the hit science webcomic xkcd.
- Conceived and planned the event; structured a $4,500 budget; garnered funds from 12 organizations; coordinated 28 volunteers.

Advising of Student and Postdoctoral Research

[1] **Hubert Pugzlys** (REU Student, U. of Maryland; Undergraduate in Physics, U. of Florida)
June 2025–Present.

[2] **Vikram Kashyap** (PhD Student in Physics and Lanczos Fellow, U. of Maryland)
May 2025–Present.

[3] **Yuxin Wang** (Hartree Postdoctoral Fellow, QuICS)
Jan. 2024–Present.

[4] **William Braasch** (NRC Postdoctoral Fellow, NIST and Postdoctoral Scholar, QuICS)
June 2022–Present.

[5] **Twesh Upadhyaya** (PhD Student in Physics and NSERC Fellow, U. of Maryland)
Sept. 2021–Present.

[6] **José Antonio Marín Guzmán** (PhD Student in Physics, U. of Maryland)
June 2021–Present.

[7] **Anthony Munson** (PhD Student in Physics and Ford Predoctoral Fellow, U. of Maryland)
June 2021–Present.

[8] **Aleksander Lasek** (Postdoctoral Scholar, QuICS)
May 2021–Aug. 2025.

[9] **Jade LeSchack** (Undergraduate in Physics, U. of Maryland)
Sept. 2021–Present. May 2021–July 2025.

[10] **Connor Powers** (PhD Student in Physics, U. of Maryland)
Coadvised with Prof. Zohreh Davoudi. May 2022–Present.

[11] **Greeshma Shivali Oruganti** (PhD Student in Physics, U. of Maryland)
Coadvised with Prof. Christopher Jarzynski. May 2022–Present.

[12] **Shayan Majidy** (PhD Student in Physics and Wanier Scholar, U. of Waterloo)
Coadvised with Prof. Raymond Laflamme. Dec. 2020–May 2024.
Current employment: Banting Postdoctoral Scholar at Harvard.

[13] **Jeffrey M. Epstein** (NRC Postdoctoral Fellow, NIST)
Coadvised with Prof. Jacob Taylor. Feb.–June 2021.
Current employment: Atom Computing.

[14] **Jacob Chevalier-Drori** (Undergraduate in Physics, U. of Cambridge)
Primary advisor: Prof. Crispin Barnes. Aug. 2020–June 2021.

[15] **Nicholas Materise** (PhD Student in Physics, Colorado School of Mines)
Primary advisor: Prof. Eliot Kapit. Aug. 2020–June 2022.

[16] **Adam Bene Watts** (PhD Student in Physics, MIT)
Primary advisor: Prof. Aram Harrow. Mar. 2019–Jan. 2021. Current employment: U. of Waterloo (Postdoctoral Fellow).

[17] **Jacob M. Gold** (PhD Student in Physics, MIT)
Primary advisors: Dr. Jeremy England, Prof. Jörn Dunkel.
Mar. 2019–Apr. 2021.

[18] **Weishun Zhong** (PhD Student in Physics, MIT)
Primary advisors: Dr. Jeremy England, Prof. Isaac Chuang.
Mar. 2019–Apr. 2021.
Current employment: Institute for Advanced Study.

[19] **Jonathan Tyler Monroe**
(PhD Student in Physics, Washington U. in St. Louis)
Primary advisor: Prof. Kater Murch. Apr. 2019–Mar. 2021.
Current employment: Boeing.

[20] **Taeho Lee** (PhD Student in Physics, Washington U. in St. Louis)
Primary advisor: Prof. Kater Murch. Oct. 2018–Mar. 2019.

[21] **Richard Zhu** (Undergraduate in Physics, Caltech)
Primary advisor: Prof. Gil Refael. June 2016–June 2017.
Current employment: Whisper.ai.

[22] **Patrick Rall** (Undergraduate in Physics, Caltech)
Primary advisor: Prof. John Preskill. Apr. 2015–Mar. 2016.
Current employment: IBM.

[23] **Logan Hillberry** (Masters Student in Physics, Colorado School of Mines)
Primary advisor: Prof. Lincoln D. Carr. Apr. 2015–Mar. 2016.
Current employment: NIST (NRC Postdoctoral Fellow).

[24] **Timothy Maxwell** (Undergraduate in Physics, Caltech)
Primary advisor: Prof. John Preskill. Apr.–Sept. 2015.
Current employment: Software engineer at Stripe.

Teaching

See "Other Invited Lectures," above.

ARHU270/PHYS299Q/CMSC298Q/CHEM298Q/ENME299Q Writing Quantum Steampunk: Science-Fiction Workshop
U. of Maryland Co-Instructor: Edward Daschle.
Co-Instructor Jan.–May 2025.
- Featured in *Maryland Today*.

Ph 219/CS 219c: Quantum Computation: Black Holes, Chaos, and Scrambling; and Topological Quantum Computation, Majoranas, and Anyons
Caltech. Instructor: Prof. Alexei Kitaev.
Teaching Assistant Mar.–Jun. 2016.

Ph 219/CS 219b: Quantum Computation: Quantum Error Correction and Quantum Shannon Theory
Caltech. Instructor: Prof. John Preskill.
Teaching Assistant Jan.–Mar. 2016.

Ph 219/CS 219a: Quantum Computation: Formalism, Algorithms, and Complexity
Caltech. Instructor: Prof. Alexei Kitaev.
Teaching Assistant Sept.–Dec. 2015.

Perimeter Public-Speaking Group
Perimeter Institute for Theoretical Physics.
Group Founder and Leader Oct. 2012–June 2013.

Berkeley Preparatory School
Philosophy-of-Physics Guest Teacher Sept. 2010.

Rocky VoxMasters Public-Speaking Group
Rockefeller Center for Public Policy at Dartmouth College.
Group Co-Leader Mar. 2008–June 2011.

Selected Science Writing

[1] "When Timekeeping Turns Quantum," *Lost in Space-Time newsletter* by *New Scientist* (2022).

[2] "Quantum Steampunk: A new frontier in quantum physics," Q&A with Marcelo Gleiser, *Big Think* (2022).

[3] "On the romance and wonder of Victorian science," *Literary Hub* (2022).

[4] *Quantum Steampunk: The Physics of Yesterday's Tomorrow,* Johns Hopkins U. Press (2022).
- Winner of the PROSE Award, from the Association of American Publishers, for best book of the year in popular science and mathematics.
- Shortlisted for the Phi Beta Kappa Award in Science.
- Highlighted as one of "the best books coming your way in 2022" by *New Scientist.*
- Highlighted as one of "the books that stood out in 2022" by *Physics Today.*

[5] "A tribute to Dr. Chiamaka Okoli," *Inside the Perimeter,* Perimeter Institute for Theoretical Physics (2022).

[6] "Beyond the second law," *Quanta Magazine* (2022).

[7] "Quantum steampunk," *Scientific American* (2020).
- Reported on in *Popular Mechanics*, *Nature Daily Briefing*, *Fortune*, and *Physics Today*.
- Translated into Spanish, Hebrew, German, and French.

[8] "What Makes Extraordinary Science Extraordinary," Sean Carroll's *Preposterous Universe* (2018).

[9] "Several kinds of hairy mouldy spots," *Verso*, Huntington Library (2014).

[10] "Hermitian Conjugation," *Mathematics Magazine* (2013).

[11] "Quantum Information," *Quantum Times* **7**, 2 (2013).

[12] "Poetry for Physicists," *Inside the Perimeter,* Perimeter Institute for Theoretical Physics (2013).

[13] "Words about Numbers," *Mathematical Intelligencer* **35**, 1 (2013).

[14] "Fiddling Around with Physics," *Physics World* **25** (2012).

[15] "Perturbation Theory," *Quantum Times* **6**, 2 (2011).

[16] "What's the Physics Du Jour?" *Tampa Tribune: Thinking Out Loud* (2011).

[17] "Willebrord Snellius," *APS Newsletter* **20**, 4 (2011).

[18] "Statistics," *Math Horizons,* Mathematical Association of America **25** (2011).

[19] "Three Poems," *College Mathematics Journal,* Mathematical Association of America **41**, 233 (2010).

[20] "Schrödinger Manuscript Collection," *Smithsonian Institution Libraries Blog* (2009).