Jonah Kudler-Flam

Contact

Email: jkudlerflam@ias.edu
Office: 185 Bloomberg Hall, Institute for Advanced Study, Princeton, NJ 08544
Office Phone: (609) 734-8024:

Employment

Marvin L. Goldberger Member, Institute for Advanced Study, Princeton, NJ — 2022 - Present
Affiliated PCTS Postdoctoral Fellow, Princeton University, Princeton, NJ — 2022 - 2025

Education

University of Chicago — 2017 - 2022
M.S. in Physics
Ph.D. in Physics
Advisor: Shinsei Ryu

Princeton Univerity — 2021 - 2022
Visiting Student Research Collaborator
Trailing Student

Massachusetts Institute of Technology — 2020 - 2021
Visiting Student
Host: Hong Liu

Colgate University — 2013 - 2017
A.B. in Astronomy/Physics *magna cum laude*

King's College London — 2016
Study Abroad Student

Publications

1. **J. Kudler-Flam**, V. Narovlansky, N. Sopenko, "An optimal bound on long-range distillable entanglement " arXiv:2504.02926 [quant-ph]. Under Review.
2. **J. Kudler-Flam**, G. Penington, "It costs nothing to teleport information into a black hole" arXiv:2504.01058 [hep-th]. Awarded second prize in 2025 Gravity Research Foundation Essay Contest.
3. **J. Kudler-Flam**, K. Prabhu, G. Satishchandran, "Vacua and infrared radiation in de Sitter quantum field theory " arXiv:2503.19957 [hep-th]. Under Review.
4. D.L. Danielson, **J. Kudler-Flam**, G. Satishchandran, R.M. Wald, "How to Minimize the Decoherence Caused by Black Holes" arXiv:2501.04773 [hep-th]. Under Review.
5. H.J. Chen and **J. Kudler-Flam**, "Free Independence and the Noncrossing Partition Lattice in Dual-Unitary Quantum Circuits" arXiv:2409.17226 [hep-th]. Accepted To Physical Review B.
6. X. Dong, **J. Kudler-Flam**, and P. Rath, "Entanglement Negativity and Replica Symmetry Breaking in General Holographic States" arXiv:2409.13009 [hep-th]. Under Review.
7. **J. Kudler-Flam**, S. Leutheusser, and G. Satishchandran, "Algebraic Observational Cosmology" arXiv:2406.01669 [hep-th]. Under Review.
8. **J. Kudler-Flam**, S. Leutheusser, A. A. Rahman, G. Satishchandran, and A. Speranza, "A covariant regulator for entanglement entropy: proofs of the Bekenstein bound and QNEC" arXiv:2312.07646 [hep-th]. Under Review.

9. X. Dong, **J. Kudler-Flam**, and P. Rath, "A Modified Cosmic Brane Proposal for Holographic Renyi Entropy" arXiv:2312.04625 [hep-th]. Journal of High Energy Physics 06 120 (2024).
10. **J. Kudler-Flam**, S. Leutheusser, and G. Satishchandran, "Generalized Black Hole Entropy is von Neumann Entropy" arXiv:2309.15897 [hep-th]. Accepted to Physical Review D.
11. **J. Kudler-Flam**, M. Nozaki, T. Numasawa, S. Ryu, and M.T. Tan, "Bridging two quantum quench problems – local joining quantum quench and Möbius quench – and their holographic dual descriptions," arXiv:2309.04665 [hep-th]. Journal of High Energy Physics 08 213 (2024).
12. **J. Kudler-Flam**, L. Nie, and A. Vijay, "Rényi mutual information in quantum field theory, tensor networks, and gravity"arXiv:2308.08600 [hep-th]. Journal of High Energy Physics 06 195 (2024).
13. G. Cipolloni and **J. Kudler-Flam**, "Non-Hermitian Hamiltonians Violate the Eigenstate Thermalization Hypothesis," arXiv:2303.03448 [cond-mat.stat-mech]. Phys. Rev. B 109, L020201 *Editor's Suggestion*.
14. Y. Liu, **J. Kudler-Flam**, and K. Kawabata, "Symmetry Classification of Typical Quantum Entanglement," arXiv:2301.07778 [cond-mat.mes-hall]. Phys. Rev. B 108, 085109.
15. Y. Liu, Y. Kusuki, R. Sohal, **J. Kudler-Flam**, and S. Ryu, "Multipartite entanglement in two-dimensional chiral topological liquids," arXiv:2301.07130 [cond-mat.str-el]. Phys. Rev. B 109, 085108.
16. **J. Kudler-Flam** and Y. Kusuki, "On Quantum Information Before the Page Time," arXiv:2212.06839 [hep-th]. Journal of High Energy Physics 08 189 (2022).
17. **J. Kudler-Flam** "Rényi Mutual Information in Quantum Field Theory," arXiv:2211.01392 [hep-th]. Phys. Rev. Lett. 130, 021603.
18. G. Cipolloni and **J. Kudler-Flam** "Entanglement Entropy of Non-Hermitian Eigenstates and the Ginibre Ensemble," arXiv:2206.12438 [cond-mat.stat-mech]. Phys. Rev. Lett. 130, 010401.
19. **J. Kudler-Flam** and P. Rath, "Large and Small Corrections to the JLMS Formula from Replica Wormholes," arXiv:2203.11954 [hep-th]. Journal of High Energy Physics 08 189 (2022).
20. S. Vardhan, **J. Kudler-Flam**, H. Shapourian, and H. Liu, "Mixed-state entanglement and information recovery in thermalized states and evaporating black holes," arXiv:2112.00020 [hep-th]. Journal of High Energy Physics 01 064 (2023).
21. Y. Liu, R. Sohal, **J. Kudler-Flam**, and S. Ryu, "Multipartitioning topological phases by vertex states and quantum entanglement," arXiv:2110.11980 [cond-mat.str-el]. Phys. Rev. B 105, 115107.
22. S. Vardhan, **J. Kudler-Flam**, H. Shapourian, and H. Liu, "Bound entanglement in thermalized states and black hole radiation," arXiv:2110.02959 [hep-th]. Phys. Rev. Lett. 129, 061602.
23. **J. Kudler-Flam**, V. Narovlansky, and S. Ryu, "Negativity Spectra in Random Tensor Networks and Holography," arXiv:2109.02649 [hep-th]. Journal of High Energy Physics 02 076 (2022).
24. **J. Kudler-Flam**, V. Narovlansky, and S. Ryu, "Distinguishing Random and Black Hole Microstates," arXiv:2108.00011 [hep-th]. Phys. Rev. X Quantum 2, 040340.
25. **J. Kudler-Flam**, R. Sohal, and L. Nie, "Information Scrambling with Conservation Laws," arXiv:2107.04043. SciPost Phys. 12, 117 (2022).

26. **J. Kudler-Flam**, "Relative Entropy of Random States and Black Holes," arXiv:2102.05053 [hep-th]. Phys. Rev. Lett. 126, 171603.
27. H. Shapourian, S. Liu, **J. Kudler-Flam**, and A. Vishwanath, "Entanglement negativity spectrum of random mixed states: A diagrammatic approach," arXiv:2011.01277 [cond-mat.str-el]. Phys. Rev. X Quantum 2, 030347.
28. **J. Kudler-Flam**, Y. Kusuki, and S. Ryu, "The quasi-particle picture and its breakdown after local quenches: mutual information, negativity, and reflected entropy," arXiv:2008.11266 [hep-th]. Journal of High Energy Physics 03 146 (2021).
29. **J. Kudler-Flam**, M. Nozaki, S. Ryu, and M. Tian Tan, "Entanglement of Local Operators and the Butterfly Effect," arXiv:2005.14243 [hep-th]. Phys. Rev. Res. 3, 033182.
30. M. Asrat and **J. Kudler-Flam**, "$T\bar{T}$, the entanglement wedge cross section, and the breakdown of the split property," arXiv:2005.08972 [hep-th]. Phys. Rev. D 102, 045009.
31. I. MacCormack, M. Tian Tan, **J. Kudler-Flam**, and S. Ryu, "Operator and entanglement growth in non-thermalizing systems: many-body localization and the random singlet phase," arXiv:2001.08222 [cond-mat.str-el]. Phys. Rev. D 104, 214202.
32. **J. Kudler-Flam**, Y. Kusuki, and S. Ryu, "Correlation measures and the entanglement wedge cross-section after quantum quenches in two-dimensional conformal field theory," arXiv:2001.05501 [hep-th]. Journal of High Energy Physics 04, 74 (2020).
33. **J. Kudler-Flam**, L. Nie, and S. Ryu, "Conformal field theory and the web of quantum chaos diagnostics," arXiv:1910.14575 [hep-th]. Journal of High Energy Physics 01, 175 (2020).
34. **J. Kudler-Flam**, H. Shapourian, and S. Ryu, "The negativity contour: a quasi-local measure of entanglement for mixed states," arXiv:1908.07540 [hep-th]. SciPost Phys. 8, 063 (2020).
35. Y. Kusuki, **J. Kudler-Flam**, and S. Ryu, "Derivation of holographic negativity in AdS_3/CFT_2," arXiv:1907.07824 [hep-th]. Phys. Rev. Lett. 123, 131603.
36. **J. Kudler-Flam**, M. Nozaki, S. Ryu, and M. Tian Tan, "Quantum vs. classical information: operator negativity as a probe of scrambling," arXiv:1906.07639 [hep-th]. Journal of High Energy Physics 01, 031 (2020).
37. **J. Kudler-Flam**, I. MacCormack, and S. Ryu, "Holographic entanglement contour, bit threads, and the entanglement tsunami," arXiv:1902.04654 [hep-th]. J. Phys. A: Math. Theor. 52 (2019) 325401.
38. **J. Kudler-Flam** and S. Ryu, "Entanglement negativity and minimal entanglement wedge cross-sections in holographic theories," arXiv:1808.00446 [hep-th]. Phys. Rev. D 99, 106014.
39. J. Chen and **J. Kudler-Flam**, "Laplacian growth & sandpiles on the Sierpinski gasket: limit shape universality and exact solutions," arXiv:1807.08748 [math-ph]. Annales de l'Institut Henri Poincaré D 7 (4).

Invited Talks

1. Texas Tech, Lubbock, TX — Apr. 2025
   Quantum Information and Computing Seminar
   An optimal bound on long-range distillable entanglement
2. Brown University, Providence, RI — Apr. 2025
   Brown Theoretical Physics Center IDEA Seminar Series
   Entropy and the Hartle-Hawking State
3. Cornell University, Ithaca, NY — Feb. 2025
   LEPP Theory Seminar
   Aspects of the Hartle-Hawking State

4. Institute for Advanced Study, Princeton, NJ — Feb. 2025
   Physics Group Meeting
   An Energy Efficient way to send Qubits into Black Holes
5. University of Massachusetts, Amherst, MA — Jan. 2025
   NE Gravity Workshop
   Black Hole Entropy is von Neumann Entropy
6. Institute for Advanced Study, Princeton, NJ — Nov. 2024
   Quantum Aspects of Black Holes Meeting
   Vacua and Infrared Tails in de Sitter
7. Trinity College, Dublin, Ireland — June. 2024
   HMI Workshop: CFT and Holography for Heavy and Thermal States and Black Holes
   Black Hole Entropy is von Neumann Entropy
8. University of Toronto, Toronto, Canada — May. 2024
   Theoretical High-Energy Physics Seminar
   Algebraic Observational Cosmology
9. University of Chicago, Chicago, IL — Mar. 2024
   Quantum Aspects of Cosmology Workshop
   Algebraic Observational Cosmology
10. Institute for Advanced Study, Princeton, NJ — Mar. 2024
    Quantum Aspects of Black Holes Meeting
    Algebraic Observational Cosmology
11. Caltech University, Pasadena, CA — Mar. 2024
    High Energy Theory Seminar
    Algebras and entropies for quantum field theory, black holes, and inflationary cosmology
12. Institute for Advanced Study, Princeton, NJ — Oct. 2023
    Physics Group Meeting
    Entropy differences in quantum field theory and a rigorous proof of the Bekenstein bound
13. KTH Royal Institute of Technology, Stockholm, Sweden — May 2023
    Complex Systems and Biological Physics Seminars
    Horizons as eavesdroppers: decoherence from soft radiation
14. Institute for Basic Science, Daejeon, Republic of Korea — May 2023
    Center for Theoretical Physics of Complex Systems Seminar
    Non-Hermitian Hamiltonians Violate the Eigenstate Thermalization Hypothesis
15. Purdue University, West Lafayette, IN — Apr. 2023
    Department of Physics & Astronomy Seminar
    Horizons as eavesdroppers: decoherence from soft radiation
16. Oxford University, Oxford, UK — Apr. 2023
    Sondhi Group Meeting
    Horizons as eavesdroppers: decoherence from soft radiation
17. University of California Berkeley, Berkeley, CA — Apr. 2023
    Berkeley Center for Theoretical Physics String Seminar
    Horizons as eavesdroppers: decoherence from soft radiation
18. Stanford University, Stanford, CA — Apr. 2023
    Stanford Institute for Theoretical Physics Seminar
    Horizons as eavesdroppers: decoherence from soft radiation
19. City College of the City University of New York, New York, NY — Mar. 2023
    Theoretical Physics Seminar
    Horizons as eavesdroppers: decoherence from soft radiation

20. Institute for Advanced Study, Princeton, NJ — Mar. 2023
    Quantum Aspects of Black Holes Meeting
    The Information-Disturbance Tradeoff and Horizons as Eavesdroppers
21. University of Pennsylvania, Philadelphia, PA — Feb. 2023
    High Energy Theory Seminar
    Rényi mutual information in quantum field theory and gravity
22. Southeast University, Nanjing, China — Dec. 2022
    2022 Forum for Young Scholars in Mathematics and Mathematical Physics
    Rényi mutual information in quantum field theory
23. Institute for Advanced Study, Princeton, NJ — Sep. 2022
    High Energy Theory Seminar
    Quantum Information before the Page Time
24. Princeton University, Princeton, NJ — Sep. 2022
    Princeton Center for Theoretical Science Annual Retreat
    Distinguishability and its use: from spin chains to black holes
25. University of Amsterdam, Amsterdam, Netherlands — Mar. 2022
    Institute of Physics String Theory Seminar
    On the Information Content of Black Hole Radiation
26. Steklov Mathematical Institute, Moscow, Russia — Dec. 2021
    Frontiers in Holography Workshop
    Distinguishability in Random States, Eigenstates, and Gravity
27. Institute for Research in Fundamental Sciences, Tehran, Iran — Nov. 2021
    IPM Holography Virtual Seminar
    Distinguishability in Random States, Eigenstates, and Gravity
28. University of Illinois, Urbana Champaign, IL — Oct. 2021
    Mathematical and Theoretical Physics Seminar
    Distinguishability in Random States, Eigenstates, and Gravity
29. Harvard University, Cambridge, MA — Jul. 2021
    Vishwanath Group Meeting
    Distinguishability of random states and the subsystem ETH
30. Strings 2021 Gong Show, São Paulo, Brazil — Jun. 2021
    Distinguishing Random States and Black Holes
31. Yukawa Institute for Theoretical Physics, Kyoto, Japan — Feb. 2021
    Entanglement Meeting
    Entanglement Negativity Spectrum of Random Mixed States
32. University of Illinois Urbana Champaign, Champaign IL — Oct. 2020
    Condensed Matter-AMO Journal Club
    Universality of Entanglement Dynamics in Integrable and Chaotic Quantum Systems
33. Massachusetts Institute of Technology, Cambridge, MA — Aug. 2020
    CTP Group Meeting
    $T\bar{T}$, the entanglement wedge cross section, and the breakdown of the split property
34. Stanford University, Stanford, CA — Jun. 2020
    SITP $T\bar{T}$ Group Meeting Seminar
    $T\bar{T}$, the entanglement wedge cross section, and the breakdown of the split property
35. Colgate University, Hamilton, NY — Jun. 2020
    Physics & Astronomy Seminar
    Entanglement, Gravity, and the Holographic Principle

36. Massachusetts Institute of Technology, Cambridge, MA — Apr. 2020
Condensed Matter Theory Seminar
Universality of Entanglement Dynamics

37. Albert Einstein Institute, Potsdam, Germany — Dec. 2019
Gravity, Quantum Fields, & Information Seminar
Derivation of holographic negativity in AdS_3/CFT_2

38. AMS Special Sessions on Analysis and Geometry of Fractals, Riverside, CA — Nov. 2017
Strong shape theorems in cellular automata models on fractal graphs

Teaching Experience

Prison Teaching Initiative Course Coordinator — 2024-Present
Princeton University, Princeton, NJ

- **PHYS-130**: *Astronomy* (Spring 2025)
- **PHYS-130**: *Astronomy* (Fall 2024)

Prison Teaching Initiative Instructor — 2023-Present
Princeton University, Princeton, NJ

- **PHYS-130**: *Astronomy* (Sprint 2025) Northern State Prison
- **PHYS-130**: *Astronomy* (Fall 2024) East Jersey State Prison
- **MATH-110**: *Statistics* (Spring 2024) South Woods State Prison
- **MATH-015**: *Basic Mathematics* (Fall 2023) South Woods State Prison

Guest Lecturer — 2024-Present
Princeton University Department of Physics, Princeton, NJ

- **PHY 101**: *Introductory Physics I.* Lecture on "Vibrational Motion and Mechanical Waves."

Tyler School of Art and Architecture, Philadelphia, PA

- **ART 3505**: *Color.* Lecture on "The Physics of Light and Color."

Princeton University Teaching Transcript Program — 2022-2024
The McGraw Center for Teaching and Learning, Princeton University, Princeton, NJ

- Includes five pedagogy workshops, guest lecturing with classroom observation and analysis, and the development of an original syllabus. Completed Fall 2024.

Reading Course Instructor — 2019
University of Chicago, Chicago, IL

- Designed and taught reading course on *"Quantum Information and Quantum Chaos"* to undergraduate physics majors at University of Chicago.

Splash! Chicago Teacher — 2018
University of Chicago, Chicago, IL

- Designed and taught a (5 week) course *"Introduction to Quantum Mechanics"* to local high school students.
- Designed and taught a (1 day) course *"Introduction to Quantum Mechanics and Quantum Computing"* to local high school students.

Graduate Teaching Assistant — 2017 - 2021
Department of Physics, University of Chicago, Chicago, IL

- **PHSC 116**: *Physics for Future Presidents: Fundamental Concepts*,
- **PHSC 117**: *Physics for Future Presidents: Energy & Sustainability*,
- **PHYS 121-123**: *General Physics I-III*

- **PHYS 133**: *Waves, Optics, & Heat*
- **PHYS 142**: *Honors Electricity & Magentism*
- **PHYS 341**: *Graduate Quantum Mechanics I* (Grader)
- **PHYS 484**: *String Theory II* (Grader)

Undergraduate Teaching Assistant and Tutor 2015-2017
Department of Physics & Astronomy, Colgate University, Hamilton, NY

- **PHYS 232**: *Introduction to Mechanics*
- **CORE 101**: *Energy and Sustainability*
- **PHYS 111**: *Fundamental Physics I*
- **ASTR 102**: *Stars, Galaxies, and the Universe*

Mentorship

Research Advisor
Chang-Han Chen - 4^{th} year undergraduate Physics student at Massachusetts Institute of Technology (2020-2021). Senior Thesis
Hyaline Chen - 3^{rd}-4^{th} year undergraduate Physics student at Princeton University (2024). Resulting publication. Winner of PACM Undergraduate Certificate Prize for Best Research Project

Professional Activities

Journal Referee
Physical Review Letters, Physical Review E, Nature Physics, Journal of High Energy Physics, SciPost Physics, European Physical Journal Plus, European Physical Journal C

Organizer
Princeton Center for Theoretical Science Workshop: "Observables in Quantum Gravity: From UV to IR" (Dec 2025)
Princeton Center for Theoretical Science Workshop: "Random Physics" (May 2024)
Princeton Center for Theoretical Science Lunch Seminars (Fall 2023-Spring 2024)
Princeton Center for Theoretical Science Workshop: "Quantum Information, Dynamics and Ergodicity: From Many-Body Systems to Gravity" (Feb.-Mar. 2023)
Kadanoff Center for Theoretical Physics Journal Club (University of Chicago)
Kadanoff Center Group Meeting → Theory Group Meeting (University of Chicago)