# Chris Akers

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EMPLOYMENT

**Assistant Professor, University of Colorado, Boulder** Aug. 2024 - Present
**Postdoctoral Associate, Institute for Advanced Study, Princeton** Sep. 2023 - July 2024
**Postdoctoral Associate, MIT Department of Physics** Sep. 2019 - Aug. 2023
**It from Qubit Fellow, Simons Foundation IFQ Collaboration** Sep. 2019 - Aug. 2023

EDUCATION

**PhD in Physics, UC Berkeley** May 2019
**MA in Physics, UC Berkeley** May 2017

Thesis Advisor: Raphael Bousso. Thesis: *Entanglement and Geometry*

**BS in Physics, Texas A&M** May 2014

Research Advisor: Bhaskar Dutta. Minors: Math, Philosophy

PUBLICATIONS

23. **Chris Akers,** Adam Bouland, Lijie Chen, Tamara Kohler, Tony Metger, Umesh Vazirani, "Holographic pseudoentanglement and the complexity of the AdS/CFT dictionary," *JHEP* **12** (2024) 209, arXiv:2411.04978.
22. **Chris Akers,** Thomas Faulkner, Simon Lin, Pratik Rath, "Reflected entropy in random tensor networks. Part III. Triway cuts," *JHEP* **12** (2024) 209, arXiv:2409.17218.
21. **Chris Akers,** Jonathan Sorce, "Relative State Counting for Semiclassical Black Holes," *Phys.Rev.Lett* **133** (2024) 20, 201601, arXiv:2404.16098.
20. **Chris Akers,** Ronak M. Soni, Annie Y. Wei, "Multipartite edge modes and tensor networks," *SciPost Phys.Core* **7** (2024) 070, arXiv:2404.03651.
19. **Chris Akers,** Annie Y. Wei, "Background independent tensor networks," *SciPost Phys.* **17** (2024) 3, 090, arXiv:2402.05910.
18. **Chris Akers,** Adam Levine, Geoff Penington, Elizabeth Wildenhain, "One-shot holography," *SciPost Phys.* **16** (2024) 6, 144, arXiv:2307.13032.
17. **Chris Akers,** Thomas Faulkner, Simon Lin, and Pratik Rath, "Entanglement of Purification in Random Tensor Networks," *Phys. Rev. D* **109** (2024) 10 L101902, arXiv:2306.06163.
16. **Chris Akers,** Thomas Faulkner, Simon Lin, and Pratik Rath, "Reflected entropy in random tensor networks II: a topological index from the canonical purification," *JHEP* **01** (2023) 067, arXiv:2210.15006.
15. **Chris Akers,** Netta Engelhardt, Daniel Harlow, Geoff Penington, Shreya Vardhan, "The black hole interior from non-isometric codes and complexity," *JHEP* **06** (2024) 155, arXiv:2207.06536.
14. **Chris Akers,** Thomas Faulkner, Simon Lin, and Pratik Rath, "The Page curve for reflected entropy," *JHEP* **06** (2022) 089, arXiv:2201.11730.
13. **Chris Akers,** Thomas Faulkner, Simon Lin, and Pratik Rath, "Reflected entropy in random tensor networks," *JHEP* **05** (2022) 162, arXiv:2112.09122.
12. **Chris Akers** and Geoff Penington, "Quantum minimal surfaces from quantum error correction," *SciPost Phys.* **12** (2022) 162, arXiv:2109.14618.
11. **Chris Akers,** Sergio Hernandez-Cuenca, and Pratik Rath, "Quantum Extremal Surfaces and the Holographic Entropy Cone," *JHEP* **11** (2021) 177, arXiv:2108.07280.
10. **Chris Akers** and Geoff Penington, "Leading order corrections to the quantum extremal surface prescription," *JHEP* **04** (2021) 062, arXiv:2008.03319.
9. **Chris Akers,** Netta Engelhardt, Geoff Penington, and Mykhaylo Usatyuk, "Quantum Maximin Surfaces," *JHEP* **08** (2020) 140, arXiv:1912.02799.
8. **Chris Akers** and Pratik Rath, "Entanglement Wedge Cross Sections Require Tripartite Entanglement," *JHEP* **04** (2020) 208, arXiv:1911.07852.

7. **Chris Akers,** Netta Engelhardt, and Daniel Harlow, "Simple holographic models of black hole evaporation," *JHEP* **08** (2020) 032, arXiv:1910.00972.
6. **Chris Akers,** Stefan Leichenauer, and Adam Levine, "Large Breakdowns of Entanglement Wedge Reconstruction", *Phys. Rev. D* **100** no. 12, (2019) 126006, arXiv:1908.03975.
5. **Chris Akers** and Pratik Rath (2018), "Holographic Renyi Entropy from Quantum-Error Correction", *JHEP* **04** (2020) 208, arXiv:1811.05171.
4. **Chris Akers,** Raphael Bousso, Illan F. Halpern, and Grant N. Remmen (2017), "Boundary of the Future of a Surface", *Phys. Rev. D* **97** (2018) 024018, arXiv:1711.06689.
3. **Chris Akers,** Venkatesh Chandrasekaran, Stefan Leichenauer, Adam Levine, and Arvin Shahbazi Moghaddam (2017), "The Quantum Null Energy Condition, Entanglement Wedge Nesting, and Quantum Focusing", *Phys. Rev. D* **100** no. 12, (2019) 126006, arXiv:1706.04183.
2. **Chris Akers,** Jason Koeller, Stefan Leichenauer, and Adam Levine (2016), "Geometric Constraints from Subregion Duality Beyond the Classical Regime", arXiv:1610.08968.
1. **Chris Akers,** Omer Ben-Ami, Vladimir Rosenhaus, Michael Smolkin, Shimon Yankielowicz (2015), "Entanglement and RG in the $O(N)$ vector model", *JHEP* **03** (2016) 002. arXiv:1512.00791.

## Teaching

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|---|---|
| Professor, Quantum Mechanics II, CU Boulder | Spring. 2025 |
| Professor, Classical Mechanics and Math Methods I, CU Boulder | Fall. 2024 |
| Guest lecturer, General Relativity MIT course with Professor Engelhardt | Sep. 2022 |
| Graduate Student Instructor, Graduate Quantum Mechanics II | Spring 2019 |
| Graduate Student Instructor, Quantum Computation and Information | Spring 2018 |
| Graduate Student Instructor, Mathematical Methods for Physicists | Fall 2017 |
| Graduate Student Instructor, General Relativity | Spring 2017 |
| Graduate Student Instructor, Advanced Classical Mechanics | Fall 2016 |
| Graduate Student Instructor, Quantum Mechanics II | Spring 2016 |
| Graduate Student Instructor, Classical Mechanics | Fall 2014 - Spring 2015 |

## Conference talks and lectures

13. Quantum Extreme Universe, OIST, Okinawa — October 2024
    *The reconstruction map of JT gravity*
12. Strings 2024 — June 2024
    *Review: Black hole interiors*
11. Black Hole Initiative, Harvard — May 2023
    *One-shot holography*
10. Workshop on "Entanglement, Large $N$, and Black holes" in Pohang, South Korea — May 2023
    *One-shot holography*
9. ICTP Spring school on "Superstring theory and related topics " — Apr. 2023
    *Lectures: Quantum error correction and black holes*
8. Kavli Asian Winter School — Jan. 2023
    *Lectures: Quantum error correction and black holes*
7. GGI, Reconstructing the Gravitational Hologram with Quantum Information — Jun. 2022
    *Lectures: Entanglement wedge reconstruction: state-independent and state-specific*
6. Aspen Winter Conference, Low-Dimensional Quantum Gravity — Feb. 2022
    *Black holes as non-isometric codes*
5. MURI Collaboration Meeting — Aug. 2021
    *Quantum minimal surfaces*
4. It from Qubit conference, Institute for Advanced Study, Princeton — Dec. 2020
    *Quantum minimal surfaces from quantum error-correction*
3. Beyond IID 8 — Nov. 2020
    *How one-shot quantum Shannon theory saves holography*
2. D-ITP Holography Meeting, Leiden University — Mar. 2020

*A simple model of black hole evaporation*

1. Quantum Information and String Theory Workshop, Kyoto University — Jun. 2019
   *Large breakdowns of entanglement wedge reconstruction*

## Invited Seminars

29. Institute for Advanced Study — Mar. 2024
    *Multipartite Edge Modes and Tensor Networks*

28. Princeton Gravity Initiative — Aug. 2023
    *Leading order corrections to the quantum extremal surface formula*

27. University of California, Berkeley — Apr. 2023
    *Toward non-commuting areas in tensor networks*

26. University of Colorado, Boulder — Feb. 2023
    *Colloquium: The black hole information paradox and quantum codes*

26. University of Amsterdam — Jan. 2023
    *Black holes and quantum codes*

25. Princeton University — Oct. 2022
    *Black hole interiors from non-isometric codes and complexity*

24. University of Texas, Austin — Oct. 2022
    *Black hole interiors from non-isometric codes and complexity*

23. University of Chicago — Oct. 2022
    *Black hole interiors from non-isometric codes and complexity*

22. California Institute of Technology — Oct. 2022
    *Black hole interiors from non-isometric codes and complexity*

21. University of Michigan — Sep. 2022
    *Black hole interiors from non-isometric codes and complexity*

20. Boston University — Apr. 2022
    *Black holes as non-isometric codes*

19. Purdue University — Apr. 2022
    *Black holes as non-isometric codes*

18. University of Pennsylvania — Mar. 2022
    *Black holes as non-isometric codes*

17. International Centre for Theoretical Sciences, India — Mar. 2022
    *Black holes as non-isometric codes*

16. Harvard University — Mar. 2022
    *Black holes as non-isometric codes*

15. Brandeis University — Dec. 2021
    *Quantum minimal surfaces*

14. University College London — Nov. 2021
    *Quantum minimal surfaces*

13. UC Berkeley — Nov. 2021
    *Quantum minimal surfaces*

12. University of Texas, Austin — Oct. 2020
    *Leading order corrections to the quantum extremal surface prescription*

11. University of British Columbia — Sep. 2020
    *Leading order corrections to the quantum extremal surface prescription*

10. Gravity, Quantum Fields and Information Virtual Seminar — Feb. 2020
    *A simple model of black hole evaporation*

9. University of Kentucky — Apr. 2020
   *A simple model of black hole evaporation*

8. Harvard University — Feb. 2020
   *Large tripartite entanglement in holographic CFTs*

7. Kavli Institute for Theoretical Physics, UC Santa Barbara — Jan. 2020
   *Discussion on bulk reconstruction*

6. University of Illinois at Urbana-Champaign — Sep. 2019
   *Large Breakdowns of Entanglement Wedge Reconstruction*

5. Kavli Institute for Theoretical Physics, UC Santa Barbara — Nov. 2018
   *Holographic Renyi Entropy from Quantum Error-Correction*

4. West Coast Gravity Meeting — Mar. 2017
   *Geometric Constraints from subregion duality*

3. Berkeley String Theory meeting — Dec. 2016
   *Geometric Constraints from subregion duality*

2. Berkeley String Theory meeting — Apr. 2016
   *Entanglement and RG in the $O(N)$ vector model*

1. Berkeley Chemistry group meeting — Apr. 2016
   *Entanglement Entropy, Quantum Gravity, and the $O(N)$ vector model*

## Professional Activities & Community

Organizer, IAS Black holes and qubits seminar — Sep. 2023 - May 2024

Lecturer, MIT Spark! — March 2023

Outreach talk, *Black holes and the information paradox*, Astronomy club at the King's School Canterbury in England — Jan. 2023

Organizer, MIT String and gravity seminar — Sep. 2019 - May 2022

Organizer, MIT String and gravity group meeting — Sep. 2019 - May 2022

Lecturer, SPLASH at Berkeley — Aug. 2014 - May 2019

Vice President, Texas A&M Society of Physics Students — May 2012 - May 2014

Presenter in "Discover, Explore, and Enjoy Physics" outreach organization — Apr. 2012 - Apr. 2014

Undergraduate Representative, Texas A&M's Physics Undergraduate Curriculum Committee — Oct. 2013 - Jul. 2014

Fish Camp Co-chair, Texas A&M's freshman orientation program — Nov. 2012 - Sep. 2014

Executive Vice President, Texas A&M Honors student council — Aug. 2012 - May. 2013

Volunteer Mentor for "Aggies Reaching Out" outreach program, Texas A&M — May 2012

## Honors and Awards

**Outstanding Graduate Student Instructor,** UC Berkeley — 2018-2019
Awarded to less than 9% of GSIs at Berkeley

**John B. Beckham Award,** Texas A&M College of Science — 2013
Awarded to top graduating seniors, 2 recipients chosen from College of Science

**Grants**

1. Heising-Simons Foundation; Grant 2024-4848 Mar. 2024 - Feb. 2027
   *Quantum emergent spacetime revealed with ultracold alkaline earth atoms*
   A.M. Rey, A. Lucas, C. Akers, J.K. Thompson, A.M. Kaufman.
   Budget: $\sim \$380,000$ to me, $\$1,500,000$ total.