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Born: September 7, 1990; Washington D.C.

Citizenship: United States of America

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Education

- B.S.** Physics Stanford University June 2012
GPA: 4.06 (overall); 4.13 (major); with honors and distinction
- Ph.D.** Physics Harvard University April 25, 2016
Advisor: Subir Sachdev; Committee: Eugene Demler, Daniel Jafferis
Thesis: “Transport and hydrodynamics in holography, strange metals and graphene”

Work

1. intern School of Medicine, University of California, Los Angeles 2006-2009
2. intern Center for Advanced Computing Research, California Institute of Technology 2010
3. grader Department of Mathematics, Stanford University 2011-2012
4. intern Department of Physics, Stanford University 2011
5. Ph.D. student Department of Physics, Harvard University 2012-2016
6. postdoctoral fellow Department of Physics, Stanford University 2016-2019
7. assistant professor Department of Physics, University of Colorado, Boulder 2019-2024
8. associate professor Department of Physics, University of Colorado, Boulder 2024-

Professional Societies

1. member American Physical Society (APS) 2015-

Honors

1. United States Physics Olympiad Finalist 2007-2008
2. Rose Hills Undergraduate Researcher 2011
3. J.E. Sterling Award for Scholastic Achievement 2012
(top 25 GPA in Stanford School of Humanities and Sciences)
4. Smith Family Graduate Science and Engineering Fellowship 2013-2014
5. Gordon and Betty Moore Postdoctoral Fellowship in Quantum Materials 2016-2019
(offered at Stanford and MIT; accepted at Stanford)
6. Alfred P. Sloan Fellow in Physics 2020
7. Journal of Mathematical Physics Young Researcher Award 2021
(best paper in the journal from an early career scientist in the prior year)

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| 8. George E. Valley, Jr. Prize
(APS annual prize to a promising early career scientist) | 2022 |
| 9. NSF CAREER Award | 2022 |
| 10. AFOSR Young Investigator Prize | 2024 |

Current and Former Group Members

Members with * denote group members whose official advisor was another faculty member.

Postdoctoral Fellows

- Xiao Chen (University of Colorado, Boulder: 2019; with R. Nandkishore) *
on to: assistant professor, Boston College.
- Aaron Friedman (University of Colorado, Boulder: 2020-2024; with R. Nandkishore)
on to: postdoctoral fellow, NIST Boulder
- Yiqiu Han (University of Colorado, Boulder: 2024-; with R. Nandkishore)
- Oliver Hart (University of Colorado, Boulder: 2021-; with R. Nandkishore) *
on to: scientist, Quantinuum.
- Jason Iaconis (University of Colorado, Boulder: 2020-2021; with R. Nandkishore) *
on to: scientist, IonQ.
- Umang Mehta (University of Colorado, Boulder: 2023-2025)
on to: postdoctoral fellow, University of Minnesota
- Amit Vikram (University of Colorado, Boulder: 2024-; with C. Akers and A. M. Rey) *
- Sergio (Jian-Hao) Zhang (University of Colorado, Boulder: 2024-)

Graduate Students

- Benjamin Bobell (University of Colorado, Boulder: 2024-; with R. Nandkishore) *
- Caleb Cook (Stanford University: 2017-2022; visiting, formal advisor: S. Kivelson) *
on to: industry
- Jack Farrell (University of Colorado, Boulder: 2021-)
- Koushik Ganesan (University of Colorado, Boulder: 2019-2023)
on to: quantitative finance industry
- Jinkang Guo (University of Colorado, Boulder: 2020-)
- Yifan Hong (University of Colorado, Boulder: 2019-2024)
on to: postdoctoral fellow, University of Maryland and NIST
- Xiaoyang Huang (University of Colorado, Boulder: 2020-2025)
on to: postdoctoral fellow, Perimeter Institute

- 8. Tianhao Liu (University of Colorado, Boulder: 2024-)
- 9. Yun Ma (University of Colorado, Boulder: 2024-)
- 10. Ben McDonough (University of Colorado, Boulder: 2024-)
- 11. Andrew Osborne (University of Colorado, Boulder: 2020-2024)
on to: postdoctoral fellow, Princeton University
- 12. Akshay Pal (University of Colorado, Boulder: 2024-)
- 13. Marvin Qi (University of Colorado, Boulder: 2020-2024; with M. Hermele) *
on to: postdoctoral fellow, University of Chicago
- 14. Chao Yin (University of Colorado, Boulder: 2020-2025)
on to: postdoctoral fellow, Stanford University
- 15. Isabella Zane (University of Colorado, Boulder: 2022-)

Undergraduate Students

- 1. Quintin Babcock (University of Colorado, Boulder: 2024-2025)
on to: masters student, Cambridge University
- 2. Chi-Fang (Anthony) Chen (Stanford University: 2017-2019)
on to: graduate student, California Institute of Technology.
- 3. Andrew Hicks (University of Colorado, Boulder: 2022-2024)
on to: graduate student, Yale University
- 4. Elijah Lew-Smith (Brown University: 2023 REU)
on to: graduate student, Massachusetts Institute of Technology
- 5. Henry Waldstreicher (University of Colorado, Boulder: 2021-2023)
on to: applied mathematics industry

Teaching

as Lecturer

- 1. PHYS 7450 (University of Colorado, Boulder) Fall 2019
“Solid-State Transport”
- 2. PHYS 4410 (University of Colorado, Boulder) Fall 2020
“Quantum Mechanics 2” Spring 2023
- 3. PHYS 5040 (University of Colorado, Boulder) Spring 2021
“Algebra and Topology in Physics”
- 4. PHYS 2170 (University of Colorado, Boulder) Fall 2021
“General Physics 3 for Majors”
- 5. PHYS 5210 (University of Colorado, Boulder) Fall 2022
“Graduate Classical Mechanics” Fall 2023
Fall 2024

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| 6. PHYS 7810 (University of Colorado, Boulder)
“Hydrodynamics” | Spring 2024
Spring 2026 |
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as Teaching Assistant or Grader

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| 1. MATH 106 (Stanford University)
“Functions of a Complex Variable” | Spring 2011 |
| 2. MATH 51 (Stanford University)
“Linear Algebra” | Fall 2011
Winter 2012 |
| 3. PHYSICS 251A (Harvard University)
“Graduate Quantum Mechanics 1” | Fall 2014 |
| 4. PHYSICS 143A (Harvard University)
“Quantum Mechanics 1” | Spring 2015 |
| 5. PHYSICS 143B (Harvard University)
“Quantum Mechanics 2” | Fall 2015 |
| 6. PHYS 1120 (University of Colorado, Boulder)
“General Physics 2” | Spring 2020 |

Research Articles

Articles noted with \triangle were highlighted by the journal.

Published

1. G. Bartzokis, P. H. Lu, S. B. Stewart, B. Oluwadara, A. J. Lucas, J. Pantages, E. Pratt, J. E. Sherin, L. L. Altshuler, J. Mintz, M. J. Gitlin, K. L. Subotnik and K. H. Nuechterlein, “In vivo evidence of differential impact of typical and atypical antipsychotics on intracortical myelin in adults with schizophrenia”, *Schizophrenia Research* **113** 322 (2009), [PMC:2862048](#).
2. A. Lucas and C. H. Lee, “Multistable binary decision making on networks”, *Physical Review* **E87** 032806 (2013), [arXiv:1210.6044](#).
3. A. Lucas, “Binary decision making with very heterogeneous influence”, *Journal of Statistical Mechanics* P09024 (2013), [arXiv:1306.5511](#).
4. P. Chesler, A. Lucas and S. Sachdev, “Conformal field theories in a periodic potential: results from holography and field theory”, *Physical Review* **D89** 026005 (2014), [arXiv:1308.0329](#).
5. A. Lucas, “Ising formulations of many NP problems”, *Frontiers in Physics* **2** 5 (2014), [arXiv:1302.5843](#).
6. A. Lucas, S. Sachdev and K. Schalm, “Scale-invariant hyperscaling-violating holographic theories and the resistivity of strange metals with random-field disorder”, *Physical Review* **D89** 066018 (2014), [arXiv:1401.7993](#).
7. A. Lucas, M. Stalzer and J. Feo, “Parallel implementation of fast randomized algorithms for the decomposition of low rank matrices”, *Parallel Processing Letters* **24** 1450004 (2014), [arXiv:1205.3830](#).

8. C. H. Lee and A. Lucas, “Simple model for multiple-choice collective decision making”, *Physical Review* **E90** 052804 (2014), [arXiv:1407.8350](#). \triangle
9. A. Lucas and P. Surówka, “Sound-induced vortex interactions in a zero-temperature two-dimensional superfluid”, *Physical Review* **A90** 053617 (2014), [arXiv:1408.5913](#).
10. A. Lucas and P. Surówka, “Phenomenology of non-relativistic parity-violating hydrodynamics in 2+1 dimensions”, *Physical Review* **E90** 063005 (2014), [arXiv:1403.5239](#).
11. A. Lucas and S. Sachdev. “Conductivity of weakly disordered strange metals: from conformal to hyperscaling-violating regimes”, *Nuclear Physics* **B892** 239 (2015), [arXiv:1411.3331](#).
12. B. Doyon, A. Lucas, K. Schalm and M. J. Bhaseen, “Non-equilibrium steady states in the Klein-Gordon theory”, *Journal of Physics* **A48** 095002 (2015), [arXiv:1409.6660](#). \triangle
13. A. Lucas. “Conductivity of a strange metal: from holography to memory functions”, *Journal of High Energy Physics* **03** 071 (2015), [arXiv:1501.05656](#).
14. M. J. Bhaseen, B. Doyon, A. Lucas and K. Schalm, “Energy flow in quantum critical systems far from equilibrium”, *Nature Physics* **11** 509 (2015), [arXiv:1311.3655](#).
15. A. Lucas and S. Sachdev. “Memory matrix theory of magnetotransport in strange metals”, *Physical Review* **B91** 195122 (2015), [arXiv:1502.04704](#).
16. A. Lucas. “Hydrodynamic transport in strongly coupled disordered quantum field theories”, *New Journal of Physics* **17** 113007 (2015), [arXiv:1506.02662](#).
17. S. Grozdanov, A. Lucas, S. Sachdev and K. Schalm. “Absence of disorder-driven metal-insulator transitions in simple holographic models”, *Physical Review Letters* **115** 221601 (2015), [arXiv:1507.00003](#).
18. J. Crossno, J. K. Shi, K. Wang, X. Liu, A. Harzheim, A. Lucas, S. Sachdev, P. Kim, T. Taniguchi, K. Watanabe, T. A. Ohki and K. C. Fong. “Observation of the Dirac fluid and the breakdown of the Wiedemann-Franz law in graphene”, *Science* **351** 1058 (2016), [arXiv:1509.04713](#).

see commentary: *Condensed Matter Journal Club*, *Quanta Magazine*, *Gizmag*, *Science*, *Harvard Press Release*
19. A. Lucas, J. Crossno, K. C. Fong, P. Kim and S. Sachdev. “Transport in inhomogeneous quantum critical fluids and in the Dirac fluid in graphene”, *Physical Review* **B93** 075426 (2016), [arXiv:1510.01738](#). \triangle
20. S. Grozdanov, A. Lucas and K. Schalm. “Incoherent thermal transport from dirty black holes”, *Physical Review* **D93** 061901 (2016), [arXiv:1511.05970](#).
21. T. N. Ikeda, A. Lucas and Y. Nakai. “Conductivity bounds in probe brane models”, *Journal of High Energy Physics* **04** 007 (2016), [arXiv:1601.07882](#).
22. A. Lucas. “Sound waves and resonances in electron-hole plasma”, *Physical Review* **B93** 245153 (2016), [arXiv:1604.03955](#).
23. A. Lucas, K. Schalm, B. Doyon and M. J. Bhaseen. “Shock waves, rarefaction waves and non-equilibrium steady states at quantum critical points”, *Physical Review* **D94** 025004 (2016), [arXiv:1512.09037](#).

24. A. Lucas, R. A. Davison and S. Sachdev. “Hydrodynamic theory of thermoelectric transport and negative magnetoresistance in Weyl semimetals”, *Proceedings of the National Academy of Sciences* **113** 9463 (2016), [arXiv:1604.08598](#).
- possible experimental confirmation; resulting commentary:** *New York Times*, *Gizmodo*, *IEEE Spectrum*, *Nature*, *phys.org*, *IBM Press Release*
25. A. Lucas and J. Steinberg. “Charge diffusion and the butterfly effect in striped holographic matter”, *Journal of High Energy Physics* **10** 143 (2016), [arXiv:1608.03286](#).
26. A. Lucas, S. Gazit, D. Podolsky and W. Witczak-Krempa. “Dynamical response near quantum critical points”, *Physical Review Letters* **118** 056601 (2017), [arXiv:1608.02586](#).
27. A. Lucas. “Stokes paradox in electronic Fermi liquids”, *Physical Review* **B95** 115425 (2017), [arXiv:1612.00856](#).
28. Y. Gu, A. Lucas and X-L. Qi. “Energy diffusion and the butterfly effect in inhomogeneous Sachdev-Ye-Kitaev chains”, *SciPost Physics* **2** 018 (2017), [arXiv:1702.08462](#).
29. A. Baumgartner, A. Karch and A. Lucas. “Magnetoresistance in relativistic hydrodynamics without anomalies”, *Journal of High Energy Physics* **06** 054 (2017), [arXiv:1704.01592](#).
30. A. Lucas, T. Sierens and W. Witczak-Krempa. “Quantum critical response: from conformal perturbation theory to holography”, *Journal of High Energy Physics* **07** 149 (2017), [arXiv:1704.05461](#).
31. V. Scopelliti, K. Schalm and A. Lucas. “Hydrodynamic charge and heat transport on inhomogeneous curved spaces”, *Physical Review* **B96** 075150 (2017), [arXiv:1705.04325](#).
32. Y. Gu, A. Lucas and X-L. Qi. “Spread of entanglement in a Sachdev-Ye-Kitaev chain”, *Journal of High Energy Physics* **09** 120 (2017), [arXiv:1708.00871](#).
33. A. Lucas and S. A. Hartnoll. “Resistivity bound for hydrodynamic bad metals”, *Proceedings of the National Academy of Sciences* **114** 11344 (2017), [arXiv:1704.07384](#).
34. C-F. Chen and A. Lucas. “Origin of the Drude peak and of zero sound in probe brane holography”, *Physics Letters* **B774** 569 (2017), [arXiv:1709.01520](#).
35. A. Lucas and S. A. Hartnoll. “Kinetic theory of transport for inhomogeneous electron fluids”, *Physical Review* **B97** 045105 (2018), [arXiv:1706.04621](#).
36. A. Lucas. “Kinetic theory of electronic transport in random magnetic fields”, *Physical Review Letters* **120** 116603 (2018), [arXiv:1710.11141](#).
37. C. B. Mendl and A. Lucas. “Dyakonov-Shur instability across the ballistic-to-hydrodynamic crossover”, *Applied Physics Letters* **112** 124101 (2018), [arXiv:1801.01501](#).
38. A. Lucas and S. Das Sarma. “Electronic sound modes and plasmons in hydrodynamic two-dimensional metals”, *Physical Review* **B97** 115449 (2018), [arXiv:1801.01495](#).
39. A. Lucas and S. Das Sarma. “Electronic hydrodynamics and the breakdown of the Wiedemann-Franz and Mott laws in interacting metals”, *Physical Review* **B97** 245128 (2018), [arXiv:1804.00665](#).
40. T. Banks and A. Lucas. “Emergent entropy production and hydrodynamics in quantum many-body systems”, *Physical Review* **E99** 022105 (2019), [arXiv:1810.11024](#).

41. G. Bentsen, Y. Gu and A. Lucas. “Fast scrambling on sparse graphs”, *Proceedings of the National Academy of Sciences* **116** 6689 (2019), [arXiv:1805.08215](#).
 42. S. Grozdanov, A. Lucas and N. Poovuttikul. “Holography and hydrodynamics with weakly broken symmetries”, *Physical Review* **D99** 086012 (2019), [arXiv:1810.10016](#).
 43. A. Lucas. “Hard combinatorial problems and minor embeddings on lattice graphs”, *Quantum Information Processing* **18** 203 (2019), [arXiv:1812.01789](#).
 44. A. Lucas. “Operator size at finite temperature and Planckian bounds on quantum dynamics”, *Physical Review Letters* **122** 216601 (2019), [arXiv:1809.07769](#). \triangle
 45. C. Q. Cook and A. Lucas. “Electron hydrodynamics with a polygonal Fermi surface”, *Physical Review* **B99** 235148 (2019), [arXiv:1903.05652](#). \triangle
 46. C-F. Chen and A. Lucas. “Finite speed of quantum scrambling with long range interactions”, *Physical Review Letters* **123** 250605 (2019), [arXiv:1907.07637](#).
 47. I. Mandal and A. Lucas. “Sign of viscous magnetoresistance in electron fluids”, *Physical Review* **B101** 045122 (2020), [arXiv:1908.04886](#).
 48. X. Chen, R. M. Nandkishore and A. Lucas. “Quantum butterfly effect in polarized Floquet systems”, *Physical Review* **B101** 064307 (2020), [arXiv:1912.02190](#).
 49. K. Ganesan and A. Lucas. “Breakdown of emergent Lifshitz symmetry in holographic matter with Harris-marginal disorder”, *Journal of High Energy Physics* **06** 023 (2020), [arXiv:2004.06543](#).
 50. X. Chen, Y. Li, M. P. A. Fisher and A. Lucas. “Emergent conformal symmetry in non-unitary random dynamics of free fermions”, *Physical Review Research* **2** 033017 (2020), [arXiv:2004.09577](#). \triangle
 51. M. C. Tran, C-F. Chen, A. Ehrenberg, A. Y. Guo, A. Deshpande, Y. Hong, Z-X. Gong, A. V. Gorshkov and A. Lucas. “Hierarchy of linear light cones with long-range interactions”, *Physical Review* **X10** 031009 (2020), [arXiv:2001.11509](#).
- see commentary:** *Physics, Joint Quantum Institute Press Release*
52. A. Gromov, A. Lucas and R. M. Nandkishore. “Fracton hydrodynamics”, *Physical Review Research* **2** 033124 (2020), [arXiv:2003.09429](#).
 53. C. Yin and A. Lucas. “Bound on quantum scrambling with all-to-all interactions”, *Physical Review* **A102** 022402 (2020), [arXiv:2005.07558](#).
 54. A. Lucas. “Non-perturbative dynamics of the operator size distribution in the Sachdev-Ye-Kitaev model”, *Journal of Mathematical Physics* **61** 081901 (2020), [arXiv:1910.09539](#). \triangle
 55. X. Chen, Y. Gu and A. Lucas. “Many-body quantum dynamics slows down at low density”, *SciPost Physics* **9** 071 (2020), [arXiv:2007.10352](#).
 56. A. Lucas and A. Osborne. “Operator growth bounds in a cartoon matrix model”, *Journal of Mathematical Physics* **61** 122301 (2020), [arXiv:2007.07165](#).
 57. K. Ganesan and A. Lucas. “Holographic subdiffusion”, *Journal of High Energy Physics* **12** 149 (2020), [arXiv:2008.09638](#).

58. J. Iaconis, A. Lucas and X. Chen. “Measurement-induced phase transitions in quantum automaton circuits”, *Physical Review* **B102** 224311 (2020), [arXiv:2010.02196](#).
59. G. Bal, A. Lucas and M. Luskin. “Homogenization of hydrodynamic transport in Dirac fluids”, *Journal of Mathematical Physics* **62** 011503 (2021), [arXiv:2004.10790](#).
60. C. B. Mendl, M. Polini and A. Lucas. “Coherent terahertz radiation from a nonlinear oscillator of viscous electrons”, *Applied Physics Letters* **118** 013105 (2021), [arXiv:1909.11093](#).
61. P. Glorioso, L. V. Delacrétaz, X. Chen, R. M. Nandkishore and A. Lucas. “Hydrodynamics of lattice models with continuous non-Abelian symmetry”, *SciPost Physics* **10** 015 (2021), [arXiv:2007.13753](#).
62. J. Iaconis, A. Lucas and R. M. Nandkishore. “Multipole conservation laws and subdiffusion in any dimensions”, *Physical Review* **E103** 022142 (2021), [arXiv:2009.06507](#).
63. C. Yin and A. Lucas. “Quantum operator growth bounds for kicked tops and semiclassical spin chains”, *Physical Review* **A103** 042414 (2021), [arXiv:2010.06592](#).
64. X. Huang and A. Lucas. “Electron-phonon hydrodynamics”, *Physical Review* **B103** 155128 (2021), [arXiv:2009.10084](#).
65. Y. Hong and A. Lucas. “Fast high-fidelity multi-qubit state transfer with long-range interactions”, *Physical Review* **A103** 042425 (2021), [arXiv:2009.06587](#).
66. C-F. Chen and A. Lucas. “Operator growth bounds from graph theory”, *Communications in Mathematical Physics* **385** 1273 (2021), [arXiv:1905.03682](#).
67. M. C. Tran, A. Deshpande, A. Y. Guo, A. Lucas and A. V. Gorshkov. “Optimal state transfer and entanglement generation in power-law interacting systems”, *Physical Review* **X11** 031016 (2021), [arXiv:2010.02930](#).
68. M. C. Tran, A. Y. Guo, C. L. Baldwin, A. Ehrenberg, A. V. Gorshkov, and A. Lucas. “Lieb-Robinson light cone for power-law interactions”, *Physical Review Letters* **127** 160401 (2021), [arXiv:2103.15828](#).
69. C. Q. Cook and A. Lucas. “Viscometry of electron fluids from symmetry”, *Physical Review Letters* **127** 176603 (2021), [arXiv:2101.08230](#).
70. M. Qi and A. Lucas. “Distinguishing viscous, ballistic, and diffusive current flows in anisotropic metals”, *Physical Review* **B104** 195106 (2021), [arXiv:2107.01216](#). \triangle
71. C-F. Chen and A. Lucas. “Optimal Frobenius light cone in spin chains with power-law interactions”, *Physical Review* **A104** 062420 (2021), [arXiv:2105.09960](#).
72. A. Osborne and A. Lucas. “Infinite families of fracton fluids with momentum conservation”, *Physical Review* **B105** 024311 (2022), [arXiv:2111.09323](#).
73. X. Huang and A. Lucas. “Hydrodynamic effective field theories with discrete rotational symmetry”, *Journal of High Energy Physics* **03** 082 (2022), [arXiv:2201.03565](#).
74. K. Ganesan, A. Lucas and L. Radzihovsky. “Renormalization group in quantum critical theories with Harris-marginal disorder”, *Physical Review* **D105** 066016 (2022), [arXiv:2110.11978](#).
75. O. Hart, A. Lucas and R. Nandkishore. “Hidden quasi-conservation laws in fracton hydrodynamics”, *Physical Review* **E105** 044103 (2022), [arXiv:2110.08292](#).

76. C. Yin and A. Lucas. “Finite speed of quantum information in models of interacting bosons at finite density”, *Physical Review* **X12** 021039 (2022), [arXiv:2106.09726](#).
77. P. Glorioso, J. Guo, J. F. Rodriguez-Nieva and A. Lucas. “Breakdown of hydrodynamics below four dimensions in a fracton fluid”, *Nature Physics* **18** 912 (2022), [arXiv:2105.13365](#).
see commentary: *Nature Physics*
78. X. Huang and A. Lucas. “Fingerprints of quantum criticality in locally resolved transport”, *SciPost Physics* **13** 004 (2022), [arXiv:2105.01075](#).
79. A. Jenkins, S. Baumann, H. Zou, S. A. Meynell, D. Yang, K. Watanabe, T. Taniguchi, A. Lucas, A. F. Young and A. C. Bleszynski Jayich. “Imaging the breakdown of ohmic transport in graphene”, *Physical Review Letters* **129** 087701 (2022), [arXiv:2002.05065](#). \triangle
see commentary: *Physics*
80. Y. Hong, J. T. Young, A. M. Kaufman and A. Lucas. “Quantum error correction in a time-dependent transverse field Ising model”, *Physical Review* **A106** 022432 (2022), [arXiv:2205.12998](#).
81. A. Lucas. “Non-equilibrium phase transitions in competitive markets with network effects”, *Proceedings of the National Academy of Sciences* **119** e2206702119 (2022), [arXiv:2204.05314](#).
82. J. Guo, P. Glorioso, and A. Lucas. “Fracton hydrodynamics without time-reversal symmetry”, *Physical Review Letters* **129** 150603 (2022), [arXiv:2204.06006](#).
83. M. Qi, O. Hart, A. J. Friedman, R. Nandkishore and A. Lucas. “Hydrodynamics of higher-rank gauge theories”, *SciPost Physics* **14** 029 (2023), [arXiv:2205.05695](#).
84. M. Qi, J. Guo, and A. Lucas. “Anomalous hydrodynamics with triangular point group in 2+1 dimensions”, *Physical Review* **B107** 144305 (2023), [arXiv:2209.08108](#).
85. P. Glorioso, X. Huang, J. Guo, J. F. Rodriguez-Nieva and A. Lucas. “Goldstone bosons and fluctuating hydrodynamics with dipole and momentum conservation”, *Journal of High Energy Physics* **05** 022 (2023), [arXiv:2301.02680](#).
86. A. J. Friedman, C. Q. Cook and A. Lucas. “Hydrodynamics with triangular point group”, *SciPost Physics* **14** 137 (2023), [arXiv:2202.08269](#).
87. C. Yin and A. Lucas. “Prethermalization and the local robustness of gapped systems”, *Physical Review Letters* **131** 050402 (2023), [arXiv:2209.11242](#).
88. X. Huang, S. Sachdev and A. Lucas. “Quantum critical fixed points in disordered holographic metals”, *Physical Review Letters* **131** 141601 (2023), [arXiv:2306.03130](#).
89. C. Stahl, M. Qi, P. Glorioso, A. Lucas and R. Nandkishore. “Fracton superfluid hydrodynamics”, *Physical Review* **B108** 144509 (2023), [arXiv:2303.09573](#).
90. A. Osborne, C. Yin and A. Lucas. “Locality bounds for quantum dynamics at low energy”, *Physical Review* **B109** 094310 (2024), [arXiv:2310.02856](#).
91. C. Yin and A. Lucas. “Heisenberg-limited metrology with perturbing interactions”, *Quantum* **8** 1303 (2024), [arXiv:2308.10929](#).

92. A. Osborne, T. Larson, S. G. Jones, R. W. Simmonds, A. Gyenis and A. Lucas. “Symplectic geometry and circuit quantization”, *PRX Quantum* **5** 020309 (2024), [arXiv:2304.08531](#).
93. C. Yin, A. Lucas and D. T. Stephen. “Frobenius light cone and the shift unitary”, *Physical Review A* **109** 052419 (2024), [arXiv:2402.07990](#).
94. A. Osborne and A. Lucas. “Flux-charge symmetric theory of superconducting circuits”, *Physical Review B* **109** 174524 (2024), [arXiv:2401.08549](#).
95. X. Huang, A. Lucas, U. Mehta and M. Qi. “Effective field theory for ersatz Fermi liquids”, *Physical Review B* **110** 035102 (2024), [arXiv:2402.14066](#).
96. Y. Hong, M. Marinelli, A. M. Kaufman and A. Lucas. “Long-range-enhanced surface codes”, *Physical Review A* **110** 022607 (2024), [arXiv:2309.11719](#).
97. C. Yin, R. Nandkishore and A. Lucas. “Eigenstate localization in a many-body quantum system”, *Physical Review Letters* **133** 137101 (2024), [arXiv:2405.12279](#). \triangle
see commentary: *New Scientist*
98. Y. Hong, E. Durso-Sabina, D. Hayes and A. Lucas. “Entangling four logical qubits beyond break-even in a nonlocal code”, *Physical Review Letters* **133** 180601 (2024), [arXiv:2406.02666](#).
99. Y. Hong, J. Guo and A. Lucas. “Quantum memory at non-zero temperature in a thermodynamically trivial system”, *Nature Communications* **16** 316 (2025), [arXiv:2403.10599](#).
100. J. Guo, O. Hart, C-F. Chen, A. J. Friedman and A. Lucas. “Designing open quantum systems with known steady states: Davies generators and beyond”, *Quantum* **9** 1612 (2025), [arXiv:2404.14538](#).
101. C. Yin, F. M. Surace and A. Lucas. “Theory of metastable states in many-body quantum systems”, *Physical Review X* **15** 011064 (2025), [arXiv:2408.05261](#).
102. X. Huang, M. Qi, J-H. Zhang and A. Lucas. “Hydrodynamics as the effective field theory of strong-to-weak spontaneous symmetry breaking”, *Physical Review B* **111** 125147 (2025), [arXiv:2407.08760](#).
103. A. Osborne and A. Lucas. “Stochastic theory of nonlinear electrical circuits in thermal equilibrium”, *Annals of Physics* **478** 169997 (2025), [arXiv:2406.11796](#).
104. X. Huang and A. Lucas. “Breakdown of hydrodynamics in Galilean quantum Hall crystals”, *Physical Review B* **111** L161107 (2025), [arXiv:2412.12535](#). \triangle
105. C. Yin and A. Lucas. “Low-density parity-check codes as stable quantum phases of matter”, *PRX Quantum* **6** 030329 (2025), [arXiv:2411.01002](#).
106. B. T. McDonough, C. Yin, A. Lucas and C. Zhang. “Lieb-Robinson bounds with exponential-in-volume tails”, *PRX Quantum* **6** 040322 (2025), [arXiv:2502.02652](#).
107. I. Zane and A. Lucas. “Quadrupole-conserving dynamics in the non-commutative plane”, *Physical Review B* **112** 224301 (2025), [arXiv:2508.14322](#). \triangle
108. C. Akers, A. Lucas and A. Vikram. “On the reconstruction map in JT gravity”, *Journal of High Energy Physics* **12** 045 (2025), [arXiv:2506.18975](#).
109. Y. Han, X. Huang, Z. Komargodski, A. Lucas and F. K. Popov. “Entropic order”, *Nature Communications* (accepted), [arXiv:2503.22789](#). \triangle

110. J. Guo, Y. Hong, A. Kaufman and A. Lucas. “Towards self-correcting quantum codes for neutral atom arrays”, *PRX Quantum* (accepted), [arXiv:2507.21396](#).
111. D. Devulapalli, C. Yin, A. Y. Guo, E. Schoute, A. M. Childs, A. V. Gorshkov and A. Lucas. “Quantum routing and entanglement dynamics through bottlenecks”, *PRX Quantum* (accepted), [arXiv:2505.16948](#).

Unpublished

1. A. Lucas, “Exact mean field dynamics for epidemic-like processes on heterogeneous networks”, [arXiv:1206.6294](#).
2. P. M. Chesler and A. Lucas. “Vortex annihilation and inverse cascades in two dimensional superfluid turbulence”, [arXiv:1411.2610](#).
3. A. Lucas. “Constraints on hydrodynamics from many-body quantum chaos”, [arXiv:1710.01005](#).
4. A. Lucas. “Quantum many-body dynamics on the star graph”, [arXiv:1903.01468](#).
5. K. Ganesan and A. Lucas. “Analogue viscous current flow near the onset of superconductivity”, [arXiv:2204.06567](#).
6. A. J. Friedman, C. Yin, Y. Hong, and A. Lucas. “Locality and error correction in quantum dynamics with measurement”, [arXiv:2206.09929](#).
7. J. H. Farrell, X. Huang, and A. Lucas. “Hydrodynamics with helical symmetry”, [arXiv:2208.12269](#).
8. C. Yin and A. Lucas. “Polynomial-time classical sampling of high-temperature quantum Gibbs states”, [arXiv:2305.18514](#).
9. M. Qi and A. Lucas. “Kinematically constrained vortex dynamics in charge density waves”, [arXiv:2310.00051](#).
10. X. Huang, J. H. Farrell, A. J. Friedman, I. Zane, P. Glorioso, and A. Lucas. “Generalized time-reversal symmetry and effective theories for nonequilibrium matter”, [arXiv:2310.12233](#).
11. J. Geurs, T. A. Webb, Y. Guo, I. Keren, J. H. Farrell, J. Xu, K. Watanabe, T. Taniguchi, D. N. Basov, J. Hone, A. Lucas, A. Pasupathy and C. R. Dean. “Supersonic flow and hydraulic jump in an electronic de Laval nozzle”, [arXiv:2509.16321](#).

see commentary: *New Scientist*

12. B. T. McDonough, M. Lemm and A. Lucas. “Non-perturbatively slow spread of quantum correlations in non-resonant systems”, [arXiv:2510.11831](#).
13. X. Huang, Z. Komargodski, A. Lucas, F. K. Popov and T. Sulejmanpasic. “Minimal models of entropic order”, [arXiv:2512.07980](#).

Review Articles and Monographs

Articles noted with \diamond are invited contributions.

Published

1. A. Lucas and K. C. Fong. “Hydrodynamics of electrons in graphene”, *Journal of Physics: Condensed Matter* **30** 053001 (2018), [arXiv:1710.08425](#). \diamond
2. S. A. Hartnoll, A. Lucas and S. Sachdev. *Holographic Quantum Matter*, (MIT Press, 2018), [arXiv:1612.07324](#).
book review: *Physics Today*
3. C-F. Chen, A. Lucas and C. Yin. “Speed limits and locality in many-body quantum dynamics”, *Reports on Progress in Physics* **86** 116001 (2023), [arXiv:2303.07386](#). \diamond

Unpublished

1. M. Blake, Y. Gu, S. A. Hartnoll, H. Liu, A. Lucas, K. Rajagopal, B. Swingle and B. Yoshida. “Snowmass White Paper: New ideas for many-body quantum systems from string theory and black holes”, [arXiv:2203.04718](#).

Teaching and Pedagogical Articles

Articles noted with \triangle were highlighted by the journal.

Published

1. L. Janson, M. Klein, H. Lewis, A. Lucas, A. Marantan and K. Luna, “Undergraduate experiment in point-contact spectroscopy with a Nb/Au junction”, *American Journal of Physics* **80** 133 (2012), [arXiv:1110.6254](#). \triangle

Unpublished

1. A. Lucas, “Lagrangian mechanics on Lie groups: a pedagogical approach”, [arXiv:1111.1275](#).
2. A. Lucas, “Connecting microscopic physics with the macroscopic properties of materials in introductory physics courses”, [arXiv:1402.2593](#).

Popular Articles

Published

1. A. Lucas, “An exotic quantum fluid in graphene”, *Science* **364** 125 (2019).

Presentations and Talks

Posters marked with \square . Talks marked with \diamond are invited; with \heartsuit are review talks; \textcircled{C} denotes remote seminars; \times denotes talks which were cancelled due to external circumstances. I have not listed talks where I am not the presenter.

1. “A parallel implementation of a fast randomized algorithm for the decomposition of low rank matrices”
Departments of Electrical Engineering and Computer Science Summer Research Presentations, California Institute of Technology August 26, 2010
2. “The $O(n)$ model in the large n limit” ♡
Condensed Matter Theory Informal Seminar, Stanford University July 15, 2011
3. “A functional approach to holographic duality” □
Department of Physics Summer Research Presentations, Stanford University August 26, 2011
4. “Linear, nonlinear and influential voting: an introduction” ♡
Condensed Matter Theory Journal Club, Stanford University February 10, 2012
5. “Functional methods for holographic duality”
Department of Physics Honors Thesis Presentations, Stanford University May 22, 2012
6. “A simple introduction to AdS/CFT” ♡
Graduate String Theory Seminar, Harvard University February 4, 2013
7. “Holographic RG” ♡
Graduate String Theory Seminar, Harvard University February 11, 2013
8. “Graphene vs. AdS-Einstein-Maxwell theory”
Quantum Matter Seminar, Harvard University September 20, 2013
9. “An introduction to CFT hydrodynamics” ♡
Graduate String Theory Seminar, Harvard University September 23, 2013
10. “Charged black holes and condensed matter physics” ♡
Graduate String Theory Seminar, Harvard University March 3, 2014
11. “Universal energy transport in quantum critical systems in any dimension” □
Department of Physics Prospective Students Poster Session, Harvard University March 27, 2014
Department of Physics Alumni Reunion Poster Session, Harvard University April 4, 2014
Field Theoretic Computer Simulations for Particle Physics and Condensed Matter; Boston University May 8, 2014
12. “A mechanism for vortex annihilation in two dimensional superfluid turbulence”
Strong Gravity Seminar, Perimeter Institute for Theoretical Physics May 22, 2014
13. “Vortex dynamics in finite temperature two-dimensional superfluid turbulence”
Condensed Matter Theory Seminar, University of Cologne ◇ August 11, 2014
Physics Informal Seminar, King’s College London ◇ August 15, 2014
14. “Interacting quantum critical heat baths”,
Condensed Matter Theory Informal Seminar , University of Cologne August 12, 2014
15. “NP-hard combinatorial problems as Ising spin glasses”
Workshop on Classical and Quantum Optimization; ETH Zürich ◇ August 20, 2014
16. “Holographic transport with random-field disorder”
Quantum Field Theory, String Theory and Condensed Matter Physics; Orthodox Academy of Crete, Kolymbari, Greece ◇ September 1, 2014

17. “Vortex dynamics in low temperature two dimensional superfluids”
Lorentz Seminar, Leiden University ◇ September 8, 2014
18. “Vortex annihilation and inverse cascades in two dimensional superfluid turbulence”
Condensed Matter Theory Kids Seminar, Harvard University November 18, 2014
APS March Meeting 2015; San Antonio Convention Center March 6, 2015
19. “Transport in weakly disordered strange metals via holography”
String Family Lunch Seminar, Harvard University December 5, 2014
20. “Memory matrix theory of magnetotransport in strange metals”
Quantum Matter Seminar, Harvard University February 27, 2015
21. “Hydrodynamic transport in holography and in clean graphene”
SITP Colloquium, Stanford University ◇ October 26, 2015
String Theory Seminar, University of British Columbia ◇ November 9, 2015
Informal Seminar, King’s College London March 8, 2016
22. “Hydrodynamic transport in the Dirac fluid in graphene”
Special Condensed Matter Seminar, Massachusetts Institute of Technology ◇ November 4, 2015
23. “When do the electrons in a metal behave hydrodynamically?”
Q Seminar, Raytheon BBN ◇ January 14, 2016
24. “Holographic conductivity bounds for disordered metals”
Gauge/Gravity Duality and Condensed Matter Physics; Banff International
Research Station ◇ March 1, 2016
25. “Dirty black holes and transport in strange metals”
String Theory Seminar, Imperial College London ◇ March 9, 2016
DAMTP Friday GR Seminar, Cambridge University ◇ March 11, 2016
Delta-ITP Holography Meeting, Utrecht University ◇ April 29, 2016
26. “Transport in inhomogeneous quantum critical fluids and in the Dirac fluid in graphene”
APS March Meeting 2016; Baltimore Convention Center March 17, 2016
27. “Revealing the Dirac fluid in graphene”
IQIM Seminar, California Institute of Technology ◇ April 1, 2016
28. “From black holes to graphene”
Physics Colloquium, University of Southern California ◇ April 4, 2016
29. “Hydrodynamic theory of transport for Dirac and Weyl semimetals”
Low-Energy Challenges for High-Energy Physicists II; Perimeter Institute
for Theoretical Physics ◇ August 24, 2016
30. “Fluid dynamics of electrons in graphene”
Condensed Matter Seminar, Princeton University © October 17, 2016
31. “Disordered spacetimes in AdS/CMT” ♥
Disorder in Condensed Matter and Black Holes; Lorentz Center, Leiden
University ◇ January 9, 2017

32. “Building a theory of transport for strange metals”
290K Seminar, University of California, Berkeley \diamond February 13, 2017
33. “Hydrodynamics in the Dirac fluid in graphene”
APS March Meeting 2017; New Orleans Conference Center \diamond March 16, 2017
Fluid Flows from Graphene to Planet Atmospheres; Simons Center for
Geometry and Physics, Stony Brook University \diamond March 20, 2017
34. “Boltzmann transport revisited”
Special Theoretical Physics Seminar, University of California, Berkeley \diamond April 20, 2017
Condensed Matter Seminar, University of California, Irvine \diamond June 7, 2017
35. “Transport bounds for condensed matter physics”
High Energy Theory Seminar, University of Washington \diamond May 2, 2017
36. “Session on transport and chaos: introduction to transport” \heartsuit
Information in Quantum Field Theory; Aspen Center for Physics \diamond June 19, 2017
37. “Hydrodynamic theory of transport in condensed matter physics”
Basic Research Forum, Department of Defense \diamond July 27, 2017
38. “Theory of metallic transport in strongly coupled matter” \heartsuit
– 1. Introduction.
– 2. Memory matrix formalism.
– 3. Hydrodynamics and conductivity bounds.
– 4. Magnetotransport.
Geometry and Holography for Quantum Criticality; Asia-Pacific Center for
Theoretical Physics \diamond August 18-19, 2017
39. “Kinetic theory of transport for inhomogeneous electron fluids”
Physics Next: from Quantum Fields to Condensed Matter; Hyatt Place Long
Island \diamond August 25, 2017
40. “Transport bounds: from resistor networks to quantum chaos”
Condensed Matter Seminar; Perimeter Institute for Theoretical Physics \diamond September 26, 2017
41. “Constraints on hydrodynamics from many-body quantum chaos”
Many-Body Quantum Chaos, Bad Metals and Holography; NORDITA \diamond October 6, 2017
Condensed Matter Seminar, Oxford University \diamond October 11, 2017
High Energy Theory Seminar, McGill University \diamond December 13, 2017
Black Holes, Quantum Chaos and SYK Models; Tsinghua Sanya
International Mathematics Forum \diamond January 26, 2018
42. “Signatures of electronic hydrodynamics in electrical and thermal transport”
Condensed Matter Seminar, University of Maryland \diamond November 28, 2017
Condensed Matter Seminar, Université de Montréal \diamond December 11, 2017
Condensed Matter Seminar, Hong Kong University of Science and
Technology \diamond February 1, 2018
43. “Discussion on the Schwarzian action”
Black Holes, Quantum Chaos and SYK Models; Tsinghua Sanya
International Mathematics Forum \diamond January 29, 2018

44. “Exploring the hydrodynamic limit of many-body quantum systems”
 Special Physics Colloquium, University of Colorado, Boulder \diamond February 8, 2018
 Physics Colloquium, Rutgers University \diamond April 4, 2018
45. “Bounds on hydrodynamic data from many-body quantum chaos”
 APS March Meeting 2018; Los Angeles Convention Center March 5, 2018
46. “Solid-state physics at the ballistic-to-hydrodynamic crossover”
 – 1. Introduction.
 – 2. Open problems.
 Theory and Computation for Transport Properties in 2D Materials; Institute
 for Mathematics and its Applications, University of Minnesota \diamond March 26-27, 2018
47. “Fast scrambling on sparse graphs”
 High Energy Theory Seminar, Rutgers University \diamond April 3, 2018
 Joint Theory Colloquium, University of Maryland \diamond April 19, 2018
 It From Qubit Seminar, Stanford University May 4, 2018
48. “Thermoelectric transport across the ballistic-to-hydrodynamic crossover”
 Condensed Matter Seminar, Rutgers University \diamond April 5, 2018
 Condensed Matter Seminar, University of California, Santa Barbara \diamond April 26, 2018
 LASSP Seminar, Cornell University \diamond May 1, 2018
 Transport in Strongly Correlated Quantum Systems; International Institute
 of Physics, Federal University of Rio Norte do Grande \diamond July 19, 2018
49. “Transport, localization, and Planckian time scales”
 Workshop on Advances in Non-Fermi Liquids; Lawrence Berkeley National
 Laboratory \diamond August 16, 2018
50. “Planckian bound on the decay of simple operators”
 Bounding Transport and Chaos in Condensed Matter and Holography;
 NORDITA \diamond August 20, 2018
51. “Emergent entropy production and hydrodynamics in quantum many-body systems”
 Condensed Matter Seminar; Stanford University \diamond November 15, 2018
 Hydrodynamics in Low Dimensional Quantum Systems; International
 Institute of Physics, Federal University of Rio Norte do Grande \diamond May 17, 2019
52. “Theory of hydrodynamic electron fluids” \heartsuit
 Fluid Flows, from Graphene to Planet Atmospheres; Weizmann Institute of
 Science \diamond December 30, 2018
53. “Memory matrix methods and hydrodynamics” \heartsuit
 School on Electronic Hydrodynamics; Weizmann Institute of Science \diamond January 6-8, 2019
54. “Operator growth bounds, graph theory, and the SYK model”
 It from Qubit Seminar; Stanford University January 18, 2019
55. “Electron hydrodynamics with a polygon Fermi surface”
 Condensed Matter Seminar, Scuola Normale Superiore \diamond January 29, 2019
 Condensed Matter Seminar, Max Planck Institute for Chemical Physics of
 Solids \diamond January 31, 2019
 Special Seminar, Leiden University \diamond February 7, 2019

- Hydrodynamic Models for Transport in 2D Materials; Institute for Mathematics and its Applications, University of Minnesota \diamond June 3, 2019
- Spintronics Meets Topology in Quantum Materials; Kavli Institute for Theoretical Physics \diamond November 14, 2019
- Fluid Phases of Matter; City University of New York \diamond December 12, 2019
- Theory and Computation for 2D Models; Institute for Pure and Applied Mathematics, University of California, Los Angeles \diamond January 13, 2020
- 56.** “Exotic hydrodynamics in electron fluids”
Special Seminar, University of Würzburg \diamond February 5, 2019
- 57.** “Graph theory and bounds on operator growth”
APS March Meeting 2019; Boston Convention Center March 4, 2019
- 58.** “Operator growth bounds from graph theory”
Geoflow Group Meeting; Stanford University May 28, 2019
- 59.** “Recent developments on quantum chaos/OTOCs”
Amsterdam String Workshop 2019; University of Amsterdam \diamond July 22, 2019
- 60.** “Mathematics of operator growth in quantum many-body systems”
Quantum Matter Seminar, University of Colorado, Boulder December 6, 2019
Quantum Matter Seminar, The Ohio State University \diamond February 3, 2020
Kadanoff Center Seminar, University of Chicago \diamond February 24, 2020
- 61.** “Friendly introduction to AdS/CMT” \heartsuit
– 1. Equilibrium physics.
– 2. Non-equilibrium physics.
Theory Winter School 2020; Maglab, Florida State University \diamond January 7, 2020
- 62.** “Viscous fluid of electrons in graphene”
Physics Colloquium; The Ohio State University \diamond February 4, 2020
- 63.** “Finite speed of quantum scrambling with long range interactions”
APS March Meeting 2020; Colorado Convention Center $\diamond \times$ March 6, 2020
- 64.** “Viscous fluids of electrons”
HoloMatter2020; Autonomous University of Madrid $\diamond \textcircled{C}$ March 9, 2020
Quantum Fluids Seminar, Boston College \textcircled{C} April 16, 2020
Condensed Matter Seminar, Case Western Reserve University \textcircled{C} March 8, 2021
CIFAR Quantum Materials Summer School 2021 \textcircled{C} May 7, 2021
- 65.** “Fracton hydrodynamics”
Quantum Dynamics E-Seminar; Oxford University \textcircled{C} May 29, 2020
Condensed Matter Seminar; University of Colorado, Boulder \textcircled{C} September 3, 2020
- 66.** “Holography-inspired advances in mathematical quantum dynamics”
Holography: from High-Energy Physics to Quantum Information; Steklov Mathematical Institute $\diamond \textcircled{C}$ October 14, 2020
- 67.** “Electron hydrodynamics with phonon scattering and anisotropic Fermi surfaces”
Condensed Matter Seminar; Technical University of Munich $\diamond \textcircled{C}$ October 28, 2020

68. “How locality bounds quantum information dynamics”
Condensed Matter Seminar; California Institute of Technology \diamond  November 12, 2020
69. “Speed limits on quantum dynamics with long-range interactions”
APS DAMOP Meeting 2021 \diamond  June 4, 2021
70. “Fingerprints of quantum criticality in locally resolved transport”
HoloTube Seminar \diamond  June 8, 2021
Condensed Matter Seminar; University of California, San Diego \diamond  October 27, 2021
Condensed Matter Seminar; University of Maryland \diamond December 17, 2021
71. “Frobenius bounds on quantum information spreading”
JMP Young Researcher Award Talk, International Congress of
Mathematical Physics 2021; Geneva Conference Center \diamond  August 4, 2021
72. “Breakdown of hydrodynamics below four dimensions in a fracton fluid”
Hydrodynamics and Fluctuations – Microscopic Approaches in Condensed
Matter Systems; International Centre for Theoretical Sciences \diamond  September 7, 2021
Non-Equilibrium Universality in Many-Body Physics; Kavli Institute for
Theoretical Physics \diamond September 29, 2021
73. “Bounding quantum dynamics using many-body quantum walks”
Probing Complex Quantum Dynamics through Out-of-time-ordered
Correlators; Max Planck Institute for the Physics of Complex Systems \diamond  October 12, 2021
74. “Viscous hydrodynamics of electrons”
Physics Colloquium, Colorado State University \diamond March 7, 2022
75. “New universality classes of hydrodynamics in constrained systems”
APS March Meeting 2022; McCormick Place Convention Center \diamond March 16, 2022
76. “Fracton hydrodynamics without time-reversal symmetry”
Emergent Hydrodynamics in Condensed Matter and High-Energy Physics;
Max Planck Institute for the Physics of Complex Systems \diamond  May 3, 2022
77. “Fracton hydrodynamics with and without time-reversal”
Geometrical Aspects of Topological Phases of Matter: Spatial Symmetries,
Fractons and Beyond; Simons Center for Geometry and Physics \diamond May 23, 2022
78. “Spatially resolved electrical transport in correlated quantum materials”
Special Seminar, Stanford University June 7, 2022
Recent Developments in Strongly-Correlated Quantum Matter;
NORDITA \diamond June 22, 2022
Condensed Matter Seminar, University of Manchester \diamond  July 13, 2022
79. “Analogue viscous current flow near the onset of superconductivity”
Topology and Correlations: Long-Range Entanglement in Many-Body
Systems; Gordon Research Conference, Mount Holyoke College \diamond June 29, 2022
Gordon and Betty Moore Foundation EPiQS Symposium 2022; Seascape
Hotel \diamond August 8, 2022
80. “Panel on future directions for holography and many-body physics” \heartsuit
HoloTube Discussion Panel \diamond  July 5, 2022

81. “Viscous electrons” ♡
Hydrodynamics Across Scales: Boulder Summer School 2022, University of Colorado Boulder ◇ July 19, 2022
82. “Locality and error correction in quantum dynamics with measurement”
AFOSR QI/AMO Program Review 2022; Arlington, VA ◇ August 3, 2022
APS March Meeting 2023; Caesar’s Forum March 6, 2023
83. “Hydrodynamics with kinetic constraints”
Simons UQM Mini-Meeting; University of Texas, Austin ◇ August 12, 2022
84. “Hydrodynamics of kinematically constrained fluids”
Physics Colloquium; IIT Roorkee ◇📄 September 12, 2022
Kadanoff Seminar; University of Chicago ◇ October 24, 2022
Particle Theory Seminar; University of Washington ◇ January 10, 2023
Low-Dimensional Quantum Systems; University of Chile ◇ March 16, 2023
85. “Locality bounds for quantum dynamics with measurement”
Quantum Matter Seminar; Perimeter Institute ◇📄 November 8, 2022
86. “Hydrodynamics with dipole and momentum conservation”
Frontiers of Quantum Condensed Matter Physics 2022; Graduate Center, City University of New York ◇ November 14, 2022
87. “Lieb-Robinson bounds for power-law interactions, bosons, and dynamics with measurement”
Mathematical Challenges in Quantum Physics; Princeton Center for Theoretical Science ◇ March 22, 2023
88. “Prethermalization and the local robustness of gapped systems”
Simons UQM Meeting, University of Colorado Boulder ◇ May 4, 2023
Virtual Lattice Seminar (mathematical physics) ◇📄 November 9, 2023
89. “Wilsonian perspective on thermal and active fluids: generalized KMS and beyond”
The Many Faces of Relativistic Fluid Dynamics; Kavli Institute for Theoretical Physics ◇ June 20, 2023
90. “Disordered quantum critical fixed points from holography”
SYK Models: From Strongly Correlated Systems to Quantum Gravity; Solvay Institute ◇ June 27, 2023
HoloTube Seminar ◇📄 November 28, 2023
Particle Theory Seminar, University of Washington ◇ February 27, 2024
High Energy Theory Seminar, Oxford University ◇ May 28, 2024
91. “Lieb-Robinson bounds” ♡
Non-equilibrium Quantum Dynamics: Boulder Summer School 2023; University of Colorado, Boulder ◇ July 7, 2023
92. “Fundamental speed limits on quantum information dynamics”
AFOSR QI/AMO Program Review 2023; Arlington, VA ◇ August 2, 2023
93. “Speed limits and locality in many-body quantum dynamics”
Physics Colloquium; University of Colorado, Boulder ◇ August 30, 2023

- Out-of-Equilibrium Dynamics and Quantum Information of Many-Body Systems with Long-Range Interactions; Kavli Institute for Theoretical Physics \diamond October 17, 2023
Quantum Colloquium; Princeton University \diamond November 20, 2023
Theory Seminar; Washington University in St. Louis \diamond January 25, 2024
- 94.** “Spatially resolved transport of interacting electrons”
Electron Correlations Beyond the Quasiparticle Paradigm: Theory and Experiment; Kavli Institute for Theoretical Physics \diamond September 21, 2023
- 95.** “Constraints from stationarity on effective theories for stochastic dynamics”
Hydrodynamics at All Scales; NORDITA \diamond September 25, 2023
- 96.** “Long-range-enhanced surface codes”
Exploring Non-Equilibrium Long-Range Quantum Matter; Kavli Institute for Theoretical Physics \diamond November 15, 2023
- 97.** “Generalized time-reversal symmetry and effective theories for nonequilibrium matter”
Field Theory and Turbulence; International Centre for Theoretical Sciences \diamond December 21, 2023
 \diamond \textcircled{c}
Nuclear Theory Seminar, University of Illinois, Urbana-Champaign \diamond March 25, 2024
- 98.** “Holographic quantum matter” \heartsuit
– 1. Introduction to AdS/CFT.
– 2. Phases of matter.
– 3. Transport.
– 4. Planckian dynamics.
Topological and Holographic Quantum Matter; Pontifical Catholic University of Chile \diamond January 11-13, 2024
- 99.** “Hydrodynamics as an effective field theory” \heartsuit
Classical, Quantum and Active Fluids; City University of New York \diamond March 11, 2024
- 100.** “Quantum memory at nonzero temperature in a thermodynamically trivial system”
Coogee 2024; Coogee Bay Hotel, Sydney, Australia \diamond April 3, 2024
- 101.** “Quantum materials as a possible host for new kinds of hydrodynamics”
Phonon Club, JILA May 1, 2024
Quantum Light and Matter Seminar, Columbia University October 11, 2024
- 102.** “Two tales about quantum statistical mechanics in LDPC codes”
Condensed Matter Theory Seminar, Oxford University \diamond May 29, 2024
- 103.** “Quantum self-correction, logical gates, and beyond with LDPC codes”
ARO/LPS Quantum Computing Review; DoubleTree Thornton \diamond August 8, 2024
- 104.** “Disorder in holography” \heartsuit
– 1. Metallic transport.
– 2. Disordered fixed points.
Holography 2024: Correlation and Entanglement in Quantum Matter; Asia-Pacific Center for Theoretical Physics \diamond August 12-13, 2024
- 105.** “Effective field theory for superfluidity, the chiral anomaly, diffusion, and the ersatz Fermi liquid” \heartsuit
Holography 2024: Correlation and Entanglement in Quantum Matter; Asia-Pacific Center for Theoretical Physics \diamond August 14, 2024

- 106.** “Hydrodynamics as the effective field theory of strong-to-weak spontaneous symmetry breaking”
 Theory Seminar, Carnegie Mellon University \diamond September 11, 2024
 Effective Field Theory Beyond Ordinary Symmetries; Institute for Basic Sciences, Daejeon \diamond December 5, 2024
 Effective Field Theory of Hydrodynamics; Ecole Polytechnique Federale de Lausanne \diamond December 16, 2025
- 107.** “Theory of metastable states in many-body quantum systems”
 Physics Seminar, Simons Center for Geometry and Physics \diamond October 9, 2024
- 108.** “The reconstruction map in JT gravity”
 Observables in Quantum Gravity; Aspen Center for Physics \diamond January 17, 2025
 Black Hole Physics from Strongly Coupled Thermal Dynamics; Simons Center for Geometry and Physics \diamond June 11, 2025
- 109.** “Low-density parity-check codes as stable phases of quantum matter”
 Quantum Spain Seminar \diamond \textcircled{C} January 28, 2025
- 110.** “Quantum statistical mechanics of low-density parity check codes”
 Theoretical and Experimental Advances in Quantum Error Correction; Princeton Center for Theoretical Science \diamond February 7, 2025
 Kloster Heiligkreutzal \diamond February 11, 2025
- 111.** “The implications of locality in many-body quantum physics”
 Mathematics Colloquium, University of Tübingen \diamond February 13, 2025
- 112.** “Introduction to the Lieb-Robinson Theorem”
 New Directions in Correlated Quantum Systems; Oberwolfach Research Institute for Mathematics \diamond \heartsuit February 17, 2025
- 113.** “From computer science to many-body quantum physics and back”
 DOE ASCR Review 2025; Embassy Suites Frisco \diamond \square March 26, 2025
- 114.** “Quantum codes as robust phases of matter”
 Quantum Computer Science Seminar, University of Maryland \diamond April 2, 2025
- 115.** “Ordered phases of matter at arbitrarily high temperature”
 Simulation of Far-From-Equilibrium Many-body Quantum Dynamics; Ludwig-Maximilians University, Munich \diamond April 15, 2025
 Effective Theories for Many-Body Systems Out of Equilibrium; Hotel Les Sources, Les Diablerets \diamond May 13, 2025
 Condensed Matter Meets cQED; Hotel Caliopolis, Sitges \diamond May 16, 2025
 Theoretical Physics Seminar, University of Florence \diamond September 22, 2025
 Theoretical Physics Colloquium, KU Leuven \diamond September 26, 2025
- 116.** “Error-correcting codes as counterexamples to the postulates of quantum statistical mechanics”
 Colloquium, Simons Center for Geometry and Physics \diamond June 10, 2025
- 117.** “How to build an ordered phase at arbitrarily high temperature”
 Dynamics of Strongly Correlated Electrons; Boulder Summer School 2025 \diamond \heartsuit July 21-22, 2025
- 118.** “Making ordered phases of matter at arbitrarily high temperature”
 Physics Colloquium, Lehigh University \diamond August 28, 2025

119. “Non-perturbatively slow spread of quantum correlations in non-resonant systems”
Universality in non-equilibrium quantum matter: thermalization, September 16, 2025
hydrodynamics, entanglement; Castello dei Principi Capano ◇
Mathematical Physics Seminar, KU Leuven ◇ September 24, 2025

Additional Event Attendance

Events marked with ♡ were winter/summer schools or lecture series; events marked with ◇ were invitation only.

1. Summer School on Gauge-Gravity Duality and Condensed Matter Physics; August 5-9, 2013
Ludwig-Maximilians-Universität ♡
2. 8th Asian Winter School on Strings, Particles and Cosmology; Blue Lily January 9-19, 2014
Hotel, Puri, India ♡◇
3. ARO/AFOSR MURI Program Review; University of Chicago September 26-27, 2016
4. Order from Chaos; Kavli Institute for Theoretical Physics ◇ December 10-14, 2018
5. Non-equilibrium Quantum Dynamics; Aspen Center for Physics ◇ August 14-18, 2023

Reviewing

Journals

Been a reviewer for approximately 137 papers and 36 grants. Invited to review for the following journals or (repeat) conference proceedings:

1. *ACM Transactions on Quantum Computing*
2. *Annalen der Physik*
3. *Annals of Physics*
4. *Applied Physics Letters*
5. *Canadian Journal of Physics*
6. *Communications in Mathematical Physics*
7. *Communications in Partial Differential Equations*
8. *Communications Physics*
9. *Computers and Fluids*
10. *Entropy*
11. *European Physical Journal C*
12. *European Physical Journal Plus*

13. *Europhysics Letters*
14. *Frontiers in ICT*
15. *Frontiers in Physics*
16. *International Journal of Modern Physics B*
17. *Journal of High Energy Physics*
18. *Journal of Low Temperature Physics*
19. *Journal of Mathematical Physics*
20. *Journal of Parallel and Distributed Computing*
21. *Journal of Physics A*
22. *Journal of Statistical Mechanics*
23. *Nano Letters*
24. *Nature*
25. *Nature Communications*
26. *Nature Computational Science*
27. *Nature Physics*
28. *New Journal of Physics*
29. *npj Quantum Information*
30. *npj Quantum Materials*
31. *Nuclear Physics B*
32. *Physical Review B, D, X*
33. *Physical Review Applied*
34. *Physical Review Letters*
35. *Physics Letters A, B*
36. *Proceedings of IEEE Conference on Decision and Control*
37. *Proceedings of IEEE Symposium on Foundations of Computer Science*
38. *Proceedings of the National Academy of Sciences* (reviewer and guest editor)
39. *PRX Quantum*
40. *Quantum*
41. *Quantum Information Processing*

- 42. *Quantum Science and Technology*
- 43. *Reviews of Modern Physics*
- 44. *Reports on Progress in Physics*
- 45. *Science*
- 46. *Science Advances*
- 47. *Science Bulletin*
- 48. *SciPost Physics*

Grants

- 1. *Air Force Office of Scientific Research*
- 2. *Department of Energy*
- 3. *German Research Foundation (DFG)*
- 4. *Gordon and Betty Moore Foundation*
- 5. *National Science Foundation*
- 6. *Simons Foundation*
- 7. *Swiss National Science Foundation*
- 8. *US-Israel Binational Science Foundation*

Organizing

Conferences and Workshops

- 1. Hydrodynamic Models for Transport in 2D Materials; Institute for Mathematics and its Applications, University of Minnesota
(with M. Luskin, D. Margetis) June 3-7, 2019

Winter/Summer Schools

- 1. Dynamics of Strongly Correlated Electrons; 2025 Boulder Summer School in Condensed Matter Physics; University of Colorado, Boulder
(with M. Lee, D. Chowdhury, S. Hartnoll) June 30-July 25, 2025

Seminars

- 1. Condensed Matter Family Lunch Seminar, Stanford University 2017-2018
- 2. CTQM Theory Colloquium, University of Colorado, Boulder 2021-2023
- 3. Physics Research Opportunity Seminar, University of Colorado, Boulder 2021-2022
- 4. Physics Colloquium, University of Colorado, Boulder 2023-2024

Grants

Cumulative money raised to date for my group (including indirect costs): \approx \$3,652,000.

1. Alfred P. Sloan Foundation; Grant FG-2020-13795 9/2020-9/2024
“2020 Sloan Research Fellowship in Physics”
A. Lucas
Budget: \$75,000 direct costs
2. Air Force Office of Scientific Research; Grant FA9550-21-1-0195 5/2021-5/2024
“Fundamental speed limits on quantum information dynamics”
A. Lucas
Budget: \sim \$311,000 direct costs; \$450,000 total.
3. Gordon and Betty Moore Foundation; Grant GBMF10279 7/2021-7/2025
Awarded from 2020 EPiQS Flexible Funding Competition.
“Investigating spatially resolved electrical transport in strange metals”
A. Bleszynski Jayich, A. Lucas
Budget: \sim \$407,000 direct costs to me, \sim \$447,000 total costs to me, \$1,096,058 total.
4. National Science Foundation; Grant DMR-2145544 2/2022-1/2027
Awarded from 2022 NSF CAREER call for early career scientists.
“CAREER: Infinitely many new universality classes of hydrodynamics”
A. Lucas
Budget: \sim \$337,000 direct costs, \$500,000 total.
5. Office of Naval Research; Grant N00014-23-1-2533 6/2023-5/2026
“Measurement-accelerated preparation of entangled quantum states”
A. Kaufman, A. Lucas
Budget: \sim \$107,000 direct costs to me, \$150,000 total to me, \$690,000 total.
6. Department of Energy; Grant DE-SC0024324 7/2023-6/2027
Awarded from 2023 DOE ASCR Quantum Pathfinder call.
“What does qubit connectivity tell us about what quantum computers can and cannot do?”
A. Gorshkov, A. Childs, A. Lucas
Budget: \sim \$779,000 direct costs to me, \$1,200,000 total to me, \$2,400,000 total.
7. Air Force Office of Scientific Research; Grant FA9550-24-1-0120 4/2024 - 4/2027
Awarded from the 2024 Young Investigator Award call.
“Quantum computing: Active quantum matter”
A. Lucas
Budget: \sim \$311,000 direct costs; \$450,000 total.
8. Heising-Simons Foundation; Grant 2024-4848 3/2024-2/2027
“Quantum emergent spacetime revealed with ultracold alkaline earth atoms”
A. M. Rey, A. Lucas, C. Akers, J. K. Thompson, A. M. Kaufman.
Budget: \sim \$330,000 direct costs to me, \sim \$380,000 total to me, \$1,500,000 total.