MATTHEW HEADRICK

Title Professor of Physics, Brandeis University

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https://scholarworks.brandeis.edu/esploro/profile/matthew_headrick
https://www.youtube.com/playlist?list=PL9BXLQ4wcldGKcnmzfXpbEh7Fzy-EXUFU
https://sites.google.com/view/matthew-headrick/

ORCID ID:
0000-0002-0064-3036

Research interests String theory, quantum field theory, quantum gravity, general relativity, holography, geometry, quantum information theory, statistical mechanics, convex optimization

Employment & education

Brandeis University, 2008–present
Martin Fisher School of Physics
Professor (2020–present)
Associate Professor (2015–2020)
Assistant Professor (2008–2015)

Undergraduate courses taught:
PHYS 30a: Electromagnetism
PHYS 31a: Quantum Theory I
PHYS 31b: Quantum Theory II
PHYS 110: Mathematical Physics

Graduate courses taught:
PHYS 162a: Quantum Mechanics I
PHYS 162b: Quantum Mechanics II
PHYS 164a: First-year Tutorial
PHYS 202: Quantum Field Theory

Graduate Advising Head & Director of Graduate Studies (2020–present)

Long-term visitor:
Center for Theoretical Physics, Massachusetts Institute of Technology (spring and fall 2017)
Center for the Fundamental Laws of Nature, Harvard University (fall 2009 and fall 2012)

Stanford University, 2006–2008
Postdoctoral Scholar, Stanford Institute for Theoretical Physics

Massachusetts Institute of Technology, 2003–2006
Pappalardo Fellow, Center for Theoretical Physics

Tata Institute of Fundamental Research, Mumbai, 2002–2003
Visiting Fellow, Department of Theoretical Physics

Harvard University, 1996–2002
Ph.D. in Physics (March 2003)
Thesis: "Noncommutative solitons and closed string tachyons"
Advisor: Shiraz Minwalla
Harold T. White Prize for Excellence in the Teaching of Physics (May 2002)
Certificate of Distinction in Teaching (May 2001)
Exchange scholar, Princeton University (spring 1999)
M.A. in Physics (June 1998)

Lycée d'Etat de Ndendé, Gabon, 1994–1996
Peace Corps Volunteer
Secondary-school mathematics, physics, and chemistry teacher

Princeton University, 1990–1994
A.B. in Physics with Highest Honors (June 1994)
Thesis: "$(2+1)$-dimensional spacetimes containing closed timelike curves"
Advisor: J. Richard Gott III
Inducted into Phi Beta Kappa and Sigma Xi (May 1994)
Kusaka Memorial Prize in Physics (May 1994)
Kusaka Memorial Prize in Physics (May 1993)
Exchange scholar, Ecole Normale Supérieure de Lyon (fall 1992)

Funding

Subcontractor: DOE Office of High-Energy Physics HEP-QuantISED Award, "Complex quantum systems and the quantum universe," 2021–2024

Co-principal Investigator: DOE Office of High-Energy Physics Award DE-SC0009986, "Experimental and Theoretical High Energy Physics at Brandeis University," 2020-present

Co-principal Investigator: Simons Collaboration in Mathematics and the Physical Sciences (Simons Foundation), "It from Qubit: Quantum Fields, Gravity, and Information," 2015–2023

Co-principal Investigator: DOE Office of High-Energy Physics HEP-QuantISED Award, "Structure and Dynamics of Entanglement in Large Quantum Systems," 2019–2021

Co-principal Investigator: DOE Office of High-Energy Physics Award DE-SC0009987, "Research in Quantum Field Theory, Cosmology, and String Theory," 2016–2020

Affiliated faculty: NSF Award DGE-1068620, "IGERT: Geometry and Dynamics—Integrated Education in the Mathematical Sciences", 2011–2018

Simons Fellow in Theoretical Physics (Simons Foundation), 2017

Co-principal Investigator: NSF Award IIA-1243369, "U.S.-India Advanced Studies Institute on Thermalization: From Glasses to Black Holes, Bangalore, Summer 2013," 2012–2017

Principal Investigator: NSF Award PHY-1053842, "CAREER: Holography, Quantum Information, and Elliptic Relativity," 2011–2017

Affiliated faculty: NSF Award DMS-1159049, "FRG: Collaborative Research: Generalized Geometry, String Theory and Deformations", 2012–2016

Affiliated faculty: NSF Award DMS-0854965, "FRG: Collaborative Research: Generalized Geometries in String Theory", 2009–13

Co-principal Investigator: DOE Office of High-Energy Physics Award DE-FG02-92ER40706, 2010–2011

NSF Graduate Research Fellowship, 1996–1999

Professional activities

Deputy Director, Simons Collaboration in Mathematics and the Physical Sciences (Simons Foundation), "It from Qubit: Quantum Fields, Gravity, and Information," 2015–2023

Co-organizer of the following conferences, workshops, and schools:

- *It from Qubit 2023*, Perimeter Institute for Theoretical Physics, July-August 2023
- *It from Qubit Annual Meeting*, Simons Foundation, December 2022
- *It from Qubit Annual Meeting*, Simons Foundation, December 2021
- *It from Qubit Annual Meeting*, Simons Foundation, December 2020
- *It from Qubit Annual Meeting*, Simons Foundation, December 2019
- *Derbes-fest*, University of Chicago, September 2019
- *It from Qubit Annual Meeting*, Simons Foundation, December 2018
- *It from Qubit Annual Meeting*, Simons Foundation, December 2017
- *It from Qubit Annual Meeting*, Simons Foundation, December 2016
- *Entanglement in Field Theory and Gravity*, Simons Center for Geometry and Physics, Stony Brook University, December 2016
- *It from Qubit School/Workshop*, Perimeter Institute for Theoretical Physics, July 2016
- *Entanglement in Strongly-Correlated Quantum Matter*, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, April–July 2015
- *US-India Advanced Studies Institute on Thermalization: From Glasses to Black Holes*, International Center for Theoretical Sciences, Bangalore, June 2013
- *RG Flows, Holography, and Entanglement Entropy*, Michigan Center for Theoretical Physics, University of Michigan, September 2012
- *Quantum Information in Quantum Gravity and Condensed-Matter Physics*, Aspen Center for Physics, May–June 2011

Organizer of It from Qubit virtual seminar series

Referee for the journals:
Nature Physics
Science
Journal of High Energy Physics (JHEP)
Journal of Statistical Physics (JSTAT)
Communications in Mathematical Physics
Classical and Quantum Gravity
Physics Letters B
Physical Review Letters
Physical Review D
Progress in Theoretical and Experimental Physics
Journal of Physics A
New Journal of Physics
SciPost
(named "Outstanding Referee for the Journals of the American Physical Society", 2017)

Grant reviewer & panelist for:
US National Science Foundation
US Department of Energy
European Research Council

Grant reviewer for:
National Science Centre, Poland
GIF (German Israeli Foundation for Scientific Research and Development)
Chilean National Science and Technology Commission
US-Israel Binational Science Foundation
UK Royal Society
FWF Austrian Science Fund
Swiss National Science Foundation
Netherlands Organisation for Scientific Research
Deutsche Forschungsgemeinschaft (German Research Foundation)
UK Science and Technologies Facilities Council (STFC)
Tata Institute of Fundamental Research

External examiner/opponent for doctoral dissertations:
Indian Institute of Technology Kharagpur, 2023
University of Amsterdam, 2022
University of British Columbia, 2016

Invited external evaluator for faculty promotion/hiring cases, 5 U.S. and 1 foreign institution

Author of *Mathematica* packages `diffgeo`, `grassmann`, `Virasoro`

Participant in TheoryNet, an NSF-sponsored program in which theoretical physicists visit and make presentations to Boston-area high-school science classes; visited:
Reading High School
Andover High School

Groton-Dunstable Regional High School
Roxbury Latin School
Blackstone Valley Prep High School
Needham High School

Editorial consultant for publication of the following books:

- *Sidney Coleman's Lectures on Relativity* (Cambridge University Press, 2022)
- *Lectures of Sidney Coleman on Quantum Field Theory* (World Scientific, 2018)
- *Advanced Quantum Mechanics*, 2nd ed., by F. Dyson (World Scientific, 2011)
- *String Theory for Dummies* by A. Z. Jones and D. Robbins (Wiley Publishing, 2009)

Advisees

Undergraduate:
Divij Gupta (2023–2024)
Joel Herman (2019–2020)
Jesse Held (2018–2019)
Skyler Kasko (2013–2014)
Robert Callan (2010–2011)
Netta Engelhardt (2010–2011)

Master's:
Sreeman Reddy Kasi Reddy (2023–2024)

PhD:
Connor Wolfe (2023–present)
Guglielmo Grimaldi (2022–present)
Gurbir Arora (2021–present)
Aditya Dhumuntarao (visiting from University of Minnesota, 2021-2023)
Alastair Grant-Stuart (2020–2022)
Jonathan Harper (2017–2022)
Harsha Hampapura (2017–2021)
Andrew Rolph (2016–2020)
Reginald Caginalp (MIT, 2018–2019)
Zhibin Li (visiting from University of Chinese Academy of Sciences, 2018–2019)
César Agón (2013–2017)

Postdoctoral:
Martin Sasieta (2022–present)
Brianna Grado-White (2020–present)
Phuc Nguyen (2022–2023)
Djordje Radicevic (2019–2022)
Bogdan Stoica (2016–2019)
Brian Swingle (2016)
Ida Zadeh (2013–2016)
Masoud Soroush (2013–2015)
Jianyang He (2011–2013)
Hajar Ebrahim (2008–2010)

Interviews

B. Robertson, "The universe as a hologram", *Holowire:* https://www.lightfieldlab.com/-blogposts/the-universe-as-a-hologram (September 2023)

"Listen: Is our universe actually a hologram", *Futurity:* https://www.futurity.org/-holographic-principle-podcast-1966822/ (January 2019)

Invited research talks

"Pythons and holographic complexity"
What is String Theory? Weaving Perspectives Together Program, Kavli Institute for Theoretical Physics, University of California Santa Barbara (March 2024) video

"Geometric surprises in the python's lunch conjecture"
String seminar, Center for Theoretical Physics, Massachusetts Institute of Technology (February 2024)
Würzburg Seminar on Quantum Field Theory and Gravity, Julius-Maximilians-Universität Würzburg (February 2024)

"Covariant properties of holographic entanglement"
Jefferson Theory Seminar, Harvard University (December 2023)
Bridges between holographic quantum information and quantum gravity workshop, Isaac Newton Institute for Mathematical Sciences, Cambridge University (November 2023) video

"New faces of holographic entanglement"
ExU–YITP Workshop on Holography, Gravity and Quantum Information, Yukawa Institute for Theoretical Physics, Kyoto University (September 2023) video
Institute for Advanced Study, Tsinghua University, Beijing (September 2023)

"New formulas for holographic entanglement entropy"
Gravity — New perspectives from strings and higher dimensions workshop, Centro de Ciencias de Benasque Pedro Pascual, Spain (July 2023)
DanLennyFest, Stanford University (October 2022)

"Numerical solution of systolic minimal-area problems"
Computational Differential Geometry and Its Applications to Physics workshop, Simons Center for Geometry and Physics, Stony Brook University (November 2022) video

"Covariant bit threads, minimax surfaces, and entropy inequalities"
Amsterdam String Workshop, University of Amsterdam (July 2022)

"Covariant bit threads, minimax surfaces, and entropy inequalities"
IFQ-ExU joint mini workshop: Extreme Universe from Qubits (December 2021)

"Holographic entropy inequalities"
HEP-QuantISED consortium "Complex quantum systems and the quantum universe" symposium (November 2021)

"Covariant bit threads"
University of Pennsylvania (November 2020)

"Bit threads for multiple regions"
HEP-QuantISED consortium "Complex quantum systems and the quantum universe" symposium (October 2020)
New England Strings Meeting, Brown University (April 2020)

Geometry from the Quantum, Kavli Institute for Theoretical Physics, University of California, Santa Barbara (January 2020)
It from Qubit Annual Meeting, Simons Foundation (December 2019)
Quantum Information in Quantum Gravity V, University of California, Davis (August 2019)

"Bit threads" (discussion leader)
Gravitational Holography, Kavli Institute for Theoretical Physics, University of California, Santa Barbara (March 2020)
Qubits on the Horizon, Aruba (January 2019)

"Bit threads and holographic monogamy"
University of Michigan (January 2020)
Gauge Theory and Black Holes, Weizmann Institute of Science (January 2020)
University of California, Santa Barbara (April 2019)
University of California, Berkeley (April 2019)
University of California, Davis (April 2019)
University of Illinois Urbana-Champaign (February 2019)
University of Toronto (January 2019)
SPOCK (Strings and Particles in Ohio, Cincinnati, and Kentucky), University of Cincinnati (November 2018)
String Club, Center for Theoretical Physics, Massachusetts Institute of Technlogy (October 2018)
Entanglement in Quantum Systems, Galileo Galilei Institute, Florence (June 2018)
AdS/CFT at 20 and Beyond, International Centre for Theoretical Sciences, Bangalore (May 2018)
Southwest Holography Meeting, University of Texas, Austin (March 2018)
University of Pennsylvania (February 2018)

"Bit threads in space and time"
Boston University (January 2018)
Entangle This: Tensor Networks and Gravity, Instituto de Física Teórica UAM-CSIC, Madrid (May 2017)
Simons Symposium on Quantum Entanglement, Schloss Elmau, Germany (May 2017)

"Bit threads and holographic entanglement"
Columbia University (December 2017)
Frontiers of Quantum Information Physics, Kavli Institute for Theoretical Physics, University of California, Santa Barbara (October 2017)
String Club, Center for Theoretical Physics, Massachusetts Institute of Technology (February and April 2017)

"Flow-cut theorems and covariant bit threads"
Gravity, Quantum Fields and Information Seminar, Albert Einstein Institute, Potsdam (November 2017)
Quantum Information in Quantum Gravity III, University of British Columbia (August 2017)

"A new perspective on holographic entanglement"

String Theory: Past and Present, International Center for Theoretical Sciences, Bangalore (January 2017)
Quantum Spacetime Seminar, Tata Institute of Fundamental Research, Mumbai (January 2017)
Strings 2016, Tsinghua University, Beijing (August 2016)
It from Qubit School/Workshop, Perimeter Institute (July 2016)
Quantum Matter, Spacetime and Information, Yukawa Institute for Theoretical Physics, Kyoto University (June 2016)
Northeast Gravity Meeting, Amherst Center for Fundamental Interactions, University of Massachusetts, Amherst (April 2016)
New Frontiers in Entanglement, University of Pennsylvania (April 2016)
Boston University (February 2016)
Berkeley Center for Theoretical Physics, University of California, Berkeley (October 2015)
Perimeter Institute (August 2015)
California Institute of Technology (June 2015)
Closing the entanglement gap: Quantum information, quantum matter, and quantum fields, Kavli Institute for Theoretical Physics, University of California, Santa Barbara (June 2015)
Simons Symposium on Quantum Entanglement, Puerto Rico (March 2015)

"Covariant bit threads: progress report"
It from Qubit Annual Meeting, Simons Foundation, New York (December 2016)

"Holographic holes and differential entropy"
Centre for Particle Theory, Durham University (December 2014)
Emergent Spacetime in String Theory, Aspen Center for Physics (July 2014)

"Causality, holography, and entanglement entropy"
Sixth New England String Meeting, Brown University (October 2014)
Kyoto University (August 2014)
Yale University (April 2014)
New Perspectives on Thermalization, Aspen Center for Physics (March 2014)
Perimeter Institute (February 2014)
Princeton University (February 2014)
Brown University (February 2014)

"What can entanglement entropy teach us about general relativity?"
Holography: From Gravity to Quantum Matter, Isaac Newton Institute, Cambridge University (September 2013)

"Are quantum field theories characterized by their entanglement entropies?"
Tata Institute of Fundamental Research, Mumbai (June 2013)
University of Toronto (April 2013)
University of Amsterdam (April 2013)
Edinburgh Mathematical Physics Group (March 2013)
Entanglement in Discrete and Continuous Quantum Systems, Princeton Center for Theoretical Science (October 2012)

"Properties of entropy in holographic theories"
Austin Holography Workshop, University of Texas, Austin (May 2013)
Harvard University (November 2012)

RG Flows, Holography, and Entanglement Entropy, Michigan Center for Theoretical Physics, University of Michigan (September 2012)

"Bose-Fermi duality and entanglement entropies"
Massachusetts Institute of Technology (October 2012)

"Quantum information and entanglement in holographic theories"
Mextrings '12, National University of Mexico (UNAM) (May 2012)
Bits, Branes, and Black Holes, Kavli Institute for Theoretical Physics, University of California, Santa Barbara (May 2012)
University of Massachusetts, Amherst (October 2011)
University of Texas, Austin (October 2011)
Quantum Information in Quantum Gravity and Condensed-Matter Physics, Aspen Center for Physics (May 2011)
Massachusetts Institute of Technology (April 2011)
University of Michigan (January 2011)
University of New Hampshire (December 2010)
Applications of AdS/CFT to Condensed Matter Systems, Galileo Galilei Institute, Florence (November 2010)
SUNY Stony Brook (October 2010)
McGill University (September 2010)
Massachusetts Institute of Technology (June 2010)
Korea Institute for Advanced Study (May 2010)

"Calabi-Yau metrics for dummies"
Institute for the Physics and Mathematics of the Universe, Tokyo University (June 2010)
Massachusetts Institute of Technology (March 2010)
Durham University (November 2009)
Dublin Institute for Advanced Studies (October 2009)
Tata Institute of Fundamental Research, Mumbai (October 2009)
Harvard University (September 2009)

"Progress on numerical Calabi-Yau metrics"
Quantum Theory and Symmetries, University of Kentucky (July 2009)

"Tachyon actions in string theory: a no-go theorem"
Fundamental Aspects of Superstring Theory, Kavli Institute for Theoretical Physics, University of California, Santa Barbara (May 2009)
Massachusetts Institute of Technology (December 2008)
Brown University (October 2008)

"New approaches to numerical Calabi-Yau metrics"
Boston University Geometry Seminar (April 2009)

"Ricci flow, Kähler-Einstein manifolds, and numerical geometry"
University of California, Santa Cruz mathematics graduate colloquium (May 2008)

"Hedgehog black holes and the deconfinement transition"
Pacific Northwest String Seminar, Pacific Institute for the Mathematical Sciences, University of British Columbia (April 2008)
University of California, Davis (November 2007)

University of Oxford Mathematical Institute (November 2007)
Strong fields, integrability, and strings, Isaac Newton Institute (November 2007)
Queen Mary, University of London (November 2007)
Tata Institute of Fundamental Research, Mumbai (October 2007)
Imperial College London (June 2007)

"The uses of Ricci flow"
University of Texas, Austin (March 2007)
Stanford Linear Accelerator Center (March 2007)
Brandeis University (February 2007)
University of California, Berkeley (January 2007)

"Ricci flow and black holes"
Massachusetts Institute of Technology (October 2006)
Southern California Strings Seminar, University of Southern California (September 2006)
University of California, Santa Barbara (September 2006)
Recent Advances in Black Holes in String Theory, Aspen Center for Physics (August 2006)
University of Chicago (August 2006)
Brown University (April 2006)

"On time dependence in string theory"
Cambridge University (May 2006)
Johns Hopkins University (April 2006)
University of Kentucky (March 2006)

"A string theorist's adventures in numerical relativity"
University of Kentucky Center for Computational Sciences (March 2006)

"Closed string tachyon dynamics"
Perimeter Institute (December 2005)

"Numerical Ricci-flat metrics on K3"
Biséminaire ENS/IHP de Physique et de Mathématiques, Paris (July 2005)
Zhejiang University Center of Mathematical Sciences (April 2005)
Brandeis University Math/CS/Physics Everyperson Seminar (February 2005)
Harish-Chandra Research Institute (December 2004)

"Closed string tachyon condensation on C/Z_n"
Modern Trends in String Theory II, Porto (June 2004)
Harvard University (March 2004)
University of Texas, Austin (February 2004)

"Progress in closed string tachyon condensation"
IPM String Workshop, Anzali, Iran (October 2003)
Theoretical Physics Colloquium, Tata Institute of Fundamental Research, Mumbai (September 2003)
Harish-Chandra Research Institute (September 2003)

"Spacetime energy decreases under world-sheet RG flow"
University of Chicago (December 2002)
Perimeter Institute (November 2002)

"String interactions from perturbative Yang-Mills theory"

Stanford University (October 2002)

"String interactions in the BMN correspondence"
Massachusetts Institute of Technology (October 2002)
University of Pennsylvania (September 2002)

Invited colloquia, lectures, panels, and overview talks

"Dynamics of entanglement in field theory and holography"
Entanglement, thermalization, and holography workshop, Simons Center for Geometry and Physics, Stony Brook University (April 2024)

"Black holes, quantum entanglement, and the geometry of spacetime"
Northeastern University Physics Colloquium (November 2023)
Pappalardo lunch talk, Massachusetts Institute of Technology (November 2020)

"Holography, AdS/CFT, and entanglement"
Experimental quantum gravity and quantum information, University of New Hampshire (October 2022)

"Discussion Panel: Entanglement, information, and quantum gravity"
Informational Architecture of Spacetime Workshop, Okinawa Institute of Science and Technology (June 2022)

"Quantum information and AdS/CFT"
Deciphering AdS/CFT, SwissMAP Research Station, Les Diablerets, Switzerland (April 2022)

"A spacetime view of entropy: From black holes to holography and back"
APS April meeting, New York (April 2022)

"Quantum entanglement and the geometry of spacetime"
High School Physics Teachers' Conference: Spacetime, Holography, and Entanglement, Kavli Institute of Theoretical Physics (January 2020) video
Spring Institute on Noncommutative Geometry and Operator Algebras: Algebra and Geometry Quantized and Quantified, Vanderbilt University (May 2019)
University of California, Davis Physics Colloquium (April 2019)
University of Kentucky Physics Colloquium (November 2018)
Bates College Physics Colloquium (November 2017)
University of Massachusetts, Boston Physics Colloquium (October 2017)
Carnegie-Mellon University–University of Pittsburgh Joint Physics Colloquium (February 2017)
City College of New York Physics Colloquium (February 2017)
University of Massachusetts, Lowell Physics & Applied Physics Colloquium (February 2016)
Brandeis University Physics Colloquium (September 2014)

"Gravity, entanglement, and bit threads"
Weizmann Institute of Science Physics Colloquium (January 2020)
Brandeis University Physics Colloquium (September 2019)

"Lectures on entanglement in field theory and holography"
Quantum Information and String Theory 2019: It from Qubit School/Workshop, Yukawa Institute for Theoretical Physics, Kyoto University (June 2019) video 1, video 2, video 3

Prospects in Theoretical Physics: From Qubits to Spacetime, Institute for Advanced Study, Princeton (July 2018) video 1, video 2, video 3

Theory Winter School, National High Magnetic Field Laboratory, Tallahassee (January 2018)

Theoretical Advanced Summer Institute: Physics at the Fundamental Frontier, University of Colorado, Boulder (June 2017)

U.S.–India Advanced Studies Institute: Classical And Quantum Information, International Center for Theoretical Sciences, Bangalore (January 2017)

"Introduction to entanglement entropy in field theory and holography"
Theory Seminar, University of Massachusetts, Lowell (November 2017)
Geometry and String Theory Seminar, University of Texas, Austin (February 2017)

"Quantum entanglement, classical gravity, and convex programming: New connections"
Center for Mathematical Sciences and Applications Colloquium, Harvard University (February 2017)

"Holography, entanglement entropy, and bit threads",
Condensed Matter Physics Seminar, Harvard University (April 2016)

"Entanglement entropy, quantum field theory, and holography"
Centre for Particle Theory Colloquium, Durham University (December 2014)
YITP Workshop on Quantum Information Physics, Yukawa Institute for Theoretical Physics, Kyoto University (August 2014)

"Introduction to quantum information theory"
IGERT Summer Institute, Brandeis University (June 2014)

"Overview: Entanglement entropy"
Quantum Fields Beyond Perturbation Theory, Kavli Institute for Theoretical Physics, University of California, Santa Barbara (January 2014)

"Gravity, entropy, and entanglement"
Pappalardo Symposium, Massachusetts Institute of Technology (October 2010)
Brandeis University Physics Colloquium (October 2010)

"Ricci flow, and some applications"
Everytopic Seminar, Brandeis University Mathematics Department (November 2008)

"Scale transformations and the dynamics of string theory"
Brandeis University Physics Colloquium (February 2007)

"The shape of the extra dimensions"
University of Wisconsin, Milwaukee Physics Colloquium (April 2006)
Massachusetts Institute of Technology Pappalardo Symposium (May 2005)

"Time travel in general relativity"
MIT Media Lab (March 1997)

Research articles

G. Arora, M. Headrick, A. Lawrence, M. Sasieta, and C. Wolfe, "Geometric surprises in the python's lunch conjecture", arXiv:2401.06678 [hep-th] (2024)

M. Headrick and V. Hubeny, "Covariant bit threads", arXiv:2208.10507 [hep-th] *JHEP* 2023:180 (2023)

M. Headrick, J. Held, and J. Herman, "Crossing versus locking: Bit threads and continuum multiflows", arXiv:2008.03197 [hep-th], *Comm. Math. Phys.* DOI: 10.1007/s00220-022-04476-w (2022)

J. Harper and M. Headrick, "Bit threads and holographic entanglement of purification", arXiv:1906.05970 [hep-th], *JHEP* 2019:101 (2019)

T. He, M. Headrick, and V. Hubeny, "Holographic entropy relations repackaged", arXiv:1905.06985 [hep-th], *JHEP* 2019:118 (2019)

S.X. Cui, P. Hayden, T. He, M. Headrick, B. Stoica, and M. Walter, "Bit threads and holographic monogamy", arXiv:1808.05234 [hep-th], *Comm. Math. Phys.* DOI: 10.1007/s00220-019-03510-8 (2019)

J. Harper, M. Headrick, and A. Rolph, "Bit threads in higher curvature gravity", arXiv:1807.04294 [hep-th], *JHEP* 2018:168 (2018)

M. Headrick and B. Zwiebach, "Minimal-area metrics on the Swiss cross and punctured torus", arXiv:1806.00450 [hep-th]; *Comm. Math. Phys.* 377(3), 2287-2343, DOI: 10.1007/s00220-020-03734-z (2020)

M. Headrick and B. Zwiebach, "Convex programs for minimal-area problems", arXiv:1806.00449 [hep-th]; *Comm. Math. Phys.* 377(3), 2217-2285, DOI: 10.1007/-s00220-020-03732-1 (2020)

C.A. Agón, M. Headrick, and B. Swingle, "Subsystem complexity and holography," arXiv:1804.01561 [hep-th], *JHEP* 2019:145 (2019)

M. Headrick and V.E. Hubeny, "Riemannian and Lorentzian flow-cut theorems," arXiv:1710.09516 [hep-th], *Class. Quant. Grav.* 35: 10 (2018)

M. Freedman and M. Headrick, "Bit threads and holographic entanglement," arXiv: 1604.00354 [hep-th], *Comm. Math. Phys.* 352, 407, DOI: 10.1007/s00220-016-2796-3 (2017)

M. Headrick, A. Maloney, E. Perlmutter, and I.G. Zadeh, "Rényi entropies, the analytic bootstrap, and 3D quantum gravity at higher genus," arXiv:1503.07111 [hep-th], *JHEP* 2015:59 (2015)

M. Headrick, V.E. Hubeny, A. Lawrence, and M. Rangamani, "Causality and holographic entanglement entropy," arXiv:1408.6300 [hep-th], *JHEP* 2014:162 (2014)

M. Headrick, R.C. Myers, and J. Wien, "Holographic holes and differential entropy," arXiv:1408.4770 [hep-th], *JHEP* 2014:149 (2014)

M. Headrick, "General properties of holographic entanglement entropy," arXiv:1312.6717 [hep-th], *JHEP* 2014:85 (2014)

C.A. Agón, M. Headrick, D.L. Jafferis, and S. Kasko, "Disk entanglement entropy for a Maxwell field," arXiv:1310.4886 [hep-th], *Phys. Rev.* D89: 025018 (2014)

M. Headrick, A. Lawrence, and M.M. Roberts, "Bose-Fermi duality and entanglement entropies," arXiv:1209.2428 [hep-th], *J. Stat. Mech.* P02022 (2013)

R. Callan, J. He, and M. Headrick, "Strong subadditivity and the covariant holographic entanglement entropy formula," arXiv:1204.2309 [hep-th], *JHEP* 2012:81 (2012)

P. Hayden, M. Headrick, and A. Maloney, "Holographic mutual information is monogamous," arXiv:1107.2940 [hep-th], *Phys. Rev.* D87: 046003 (2013)

H. Ebrahim and M. Headrick, "Instantaneous thermalization in holographic plasmas," arXiv:1010.5443 [hep-th]

M. Headrick, "Entanglement Rényi entropies in holographic theories," arXiv:1006.0047 [hep-th], *Phys. Rev.* D82: 126010 (2010)

M. Headrick and A. Nassar, "Energy functionals for Calabi-Yau metrics," arXiv:0908.2635 [hep-th], *Adv. Theor. Math. Phys.* 17: 867 (2013)

M. Headrick and A. Nassar "Energy functionals for Calabi-Yau metrics," *Proceedings of the 6th Annual Symposium on Quantum Theory and Symmetries*, *Journal of Physics: Conference Series* 462, 012019 (2013)

M. Headrick, S. Kitchen, and T. Wiseman, "A new approach to static numerical relativity, and its application to Kaluza-Klein black holes," arXiv:0905.1822 [gr-qc], *Class. Quant. Grav.* 27: 035002 (2010) [chosen by the editors as an IOPselect article and included in the annual highlights collection for 2009–2010]

M. Headrick, "A note on tachyon actions in string theory," arXiv:0810.2809 [hep-th], *Phys. Rev.* D79: 046009 (2009)

M. Headrick, "Hedgehog black holes and the Polyakov loop at strong coupling," arXiv:0712.4155 [hep-th], *Phys. Rev.* D77: 105017 (2008)

M. Headrick and T. Wiseman, "Numerical Kähler-Ricci soliton on the second del Pezzo," arXiv:0706.2329 [math.DG]

M. Headrick and T. Takayanagi, "A holographic proof of the strong subadditivity of entanglement entropy," arXiv:0704.3719 [hep-th], *Phys. Rev.* D76: 106013 (2007)

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