

## Leo C. Stein

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CONTACT INFORMATION	205 Lewis Hall University of Mississippi University, MS 38677-1848 USA	lcstein@olemiss.edu duetosymmetry.com 1-662-915-1941
EDUCATION	<b>Ph.D., Physics</b> , Massachusetts Institute of Technology, Cambridge, MA, USA Dissertation Advisor: Prof. Scott Hughes Dissertation Title: <i>Probes of strong-field gravity</i> <b>B.S., Physics</b> , California Institute of Technology, Pasadena, CA, USA Degree conferred with honor. Senior Thesis Advisors: Dr. Patrick Sutton and Prof. Alan Weinstein	<b>May 2012</b>    <b>June 2006</b>
EMPLOYMENT	<b>Assistant Professor</b> , University of Mississippi, Oxford, MS USA <b>Senior Postdoctoral Researcher</b> , Caltech, Pasadena, CA USA <b>NASA Einstein Fellow</b> , Cornell, Ithaca NY, USA <b>Research and Teaching Assistant</b> , MIT, Cambridge MA, USA <b>Teaching Assistant</b> , Caltech, Pasadena, CA, USA <b>Summer Research Fellow</b> , Caltech, Pasadena, CA, USA	<b>August 2018–Present</b> <b>September 2015–August 2018</b> <b>September 2012–August 2015</b> <b>September 2006–May 2012</b> <b>Fall 2004, Spring 2005</b> <b>June–September 2003/2005</b>
RESEARCH INTERESTS	General relativity (GR), gravitation, and astrophysical phenomena which can elucidate gravity. Recent work is focused on gravitational-wave predictions in beyond-GR theories of gravity. Work in progress and future work includes numerical simulations of black hole mergers in beyond-GR theories, cosmological signatures of beyond-GR theories, and investigations in near-horizon extremal Kerr.	
HONORS AND AWARDS	<b>Einstein Postdoctoral Fellow</b> , NASA <b>Henry Kendall Teaching Award</b> , Massachusetts Institute of Technology <b>Upperclass Merit Scholarship</b> , California Institute of Technology	<b>2012–2015</b> <b>2011</b> <b>2005–2006</b>
TEACHING EXPERIENCE	<b>Assistant Professor</b> , University of Mississippi Phys. 709, Advanced Mechanics I <b>Guest Lecturer</b> , California Institute of Technology Ph236, General relativity Ph237, Gravitational Waves <b>Guest Lecturer</b> , Massachusetts Institute of Technology 8.901, Graduate Astrophysics I <b>Teaching Assistant</b> , Massachusetts Institute of Technology 8.942, Cosmology 8.901, Graduate Astrophysics I	<b>Fall 2018</b>   <b>Fall 2017</b> <b>Spring 2016</b>  <b>Spring 2011</b>  <b>Fall 2011</b> <b>Spring 2011</b>

8.286, The Early Universe **Fall 2009**

**Teaching Assistant**, California Institute of Technology

Ph 7, Nuclear and Quantum Physics Lab **Spring 2005**

Ph 5, Analog Electronics for Physicists **Fall 2004**

MENTORING

**Graduate students**

Maria (Masha) Okounkova, Caltech **Fall 2015–present**

Baoyi Chen, Caltech **Fall 2016–present**

**Undergraduate students**

Wayne Zhao, Harvard **Summer 2016**

PROFESSIONAL  
ACTIVITIES,  
OUTREACH, AND  
SERVICE

**Simulating eXtreme Spacetimes collaboration**

**2015–Present**

Executive committee member **2018–Present**

**Member, American Physical Society**

**2010–Present**

Division of Gravitational Physics

Executive Committee Member-at-Large **2016–2019**

Division of Astrophysics

**Conference organizer**

Workshop on **Numerical Relativity beyond General Relativity**, Benasque **June 2018**  
Week-long international workshop, 59 participants

34<sup>th</sup> Pacific Coast Gravity Meeting (PCGM), Caltech **March 2018**  
Two-day conference, ~ 125 participants

Workshop on **Unifying Tests of General Relativity**, Caltech **July 2016**  
Three day workshop, 52 participants

**Seminar organizer**

TAPIR seminar, Caltech **Fall 2015–Present**

General Relativity Informal Tea-Time Series (GRITTS), MIT **Fall 2011–Spring 2012**

MKI Journal Club, MIT **Fall 2007–Spring 2010**

**Conference session chair; Judge for best student speaker award**

April APS meeting, Columbus, OH **April 2018**

34<sup>th</sup> Pacific Coast Gravity Meeting (PCGM), Caltech **March 2018**

33<sup>rd</sup> Pacific Coast Gravity Meeting (PCGM), UCSB **March 2017**

“April” APS meeting, Washington D.C. **January 2017**

32<sup>nd</sup> Pacific Coast Gravity Meeting (PCGM), CSU Fullerton **April 2016**

Theoretical Astrophysics in Southern California (TASC), CSU Fullerton **November 2015**

**Journal referee**

Journal of Cosmology and Astroparticle Physics, General Relativity and Gravitation, Monthly Notices of the Royal Astronomical Society, Physics Letters B, Physical Review D, Physical Review Letters, Physical Review X, Reviews of Modern Physics

**Agency work**

External reviewer for NSF, NASA

**Outreach**

Caltech astronomy public lecture series speaker Lecture: “The truth about black holes”	<b>March 2018</b>
Astronomy on Tap public lecture series speaker and volunteer Close to a monthly basis	<b>2016–2018</b>
Caltech astronomy public lecture series panelist and emcee Approximately every three months	<b>2016–2018</b>
Invited guest lecture on black holes and gravitational waves <i>Science of Space and Time</i> , Hampshire College	<b>November 2017</b>
Invited video Q&A session, public high school physics class <i>The Nova Project</i> school, Seattle	<b>June 2017</b>
Guest on <i>The Titanium Physicists Podcast</i> Episode 64: The edges of Einstein Episode 62: Black Bells	April 25, 2016 February 1, 2016
Quora <a href="#">Q&amp;A Session</a> on gravitational waves and first detection 83.9k+ views, 17.5k+ followers	<b>February 17, 2016</b>
Invited guest host, public screening of <i>COSMOS</i> with Q&A, Science Cabaret/Cornell	<b>March/June 2014</b>
Invited public talk at <i>Frontiers of Cornell Astronomy</i> , Cornell Friends of Astronomy	<b>November 2013</b>
Invited video chat, <i>Topics in Physics</i> course, Stanford Education Program for Gifted Youth	<b>July 2013</b>

**COMPUTER SKILLS** **Languages**—Expert in MATHEMATICA. Proficient in C/C++. Experience in Python, Javascript, Java, Bash, Haskell; LaTeX, HTML, CSS.

**Operating systems**—Mac OS, Linux/\*nix.

**Software**—Most contributions can be found at <https://github.com/duetosymmetry>. Member of the *Simulating eXtreme Spacetimes* (SXS) collaboration, contributor to the Spectral Einstein Code (SpEC). Core collaborator on xACT (<http://xact.es/>) abstract tensor calculus package for MATHEMATICA. Coauthor of xTERIOR package for exterior differential geometry under xACT. Co-maintainer of community contributions at <http://contrib.xact.es/>. Developed [arXiv-keys](#) browser extension/add-on for Chrome/Firefox.

PUBLICATIONS IN  
PROGRESS

34. McNeese, R. **Stein, L. C.**, (2018) *Cosmological perturbations in dynamical Chern-Simons*.

SUBMITTED  
PUBLICATIONS

33. Varma, V., Gerosa, D., Hébert, F., **Stein, L. C.**, Zhang, H., (2018) *High-accuracy mass, spin, and recoil predictions of generic black-hole merger remnants*, [[arXiv:1809.09125](#)].
32. Isi, M., **Stein, L. C.** (2018) *Measuring stochastic gravitational-wave energy beyond general relativity*, [[arXiv:1807.02123](#)].
31. Barack, L., *et al.* (2018) *Black holes, gravitational waves and fundamental physics: a roadmap*, [[arXiv:1806.05195](#)].

COLLABORATION  
PUBLICATIONS

From 2008–2012, I was coauthor on 34 refereed LIGO and/or LIGO/Virgo collaboration publications. The short author-list publications appear below.

REFEREED  
PUBLICATIONS

30. Prabhu, K., **Stein, L. C.** (2018) *Black hole scalar charge from a topological horizon integral in Einstein-dilaton-Gauss-Bonnet gravity*, *Phys. Rev. D* **98**, 021503(R) (Rapid Communication) [[arXiv:1805.02668](#)].
29. Gerosa, D., Hébert, F., **Stein, L. C.** (2018) *Black-hole kicks from numerical-relativity surrogate models*, *Phys. Rev. D* **97**, 104049 [[arXiv:1802.04276](#)].
28. Chen, B., **Stein, L. C.** (2018) *Deformation of extremal black holes from stringy interactions*, *Phys. Rev. D* **97**, 084012 [[arXiv:1802.02159](#)].
27. Chen, B., **Stein, L. C.** (2017) *Separating metric perturbations in near-horizon extremal Kerr*, *Phys. Rev. D* **96**, 064017 [[arXiv:1707.05319](#)].
26. Okounkova, M., **Stein, L. C.**, Scheel, M. A., Hemberger, D. A. (2017) *Numerical binary black hole mergers in dynamical Chern-Simons: I. Scalar field*, *Phys. Rev. D* **96**, 044020 [[arXiv:1705.07924](#)].
25. Tso, R., Isi, M., Chen, Y., **Stein, L. C.** (2017) *Modeling the Dispersion and Polarization Content of Gravitational Waves for Tests of General Relativity, CPT and Lorentz Symmetry*: pp. 205–208 [[arXiv:1608.01284](#)].
24. McNeese, R., **Stein, L. C.**, Yunes, N. (2016) *Extremal Black Holes in Dynamical Chern-Simons Gravity*, *Class. Quantum Grav.* **33** 235013 [[arXiv:1512.05453](#)].
23. Flanagan, É. É., Nichols, D. A., **Stein, L. C.**, Vines, J. (2016) *Prescriptions for Measuring and Transporting Local Angular Momenta in General Relativity*, *Phys. Rev. D* **93**, 104007 [[arXiv:1602.01847](#)].
22. Yagi, K., **Stein, L. C.** (2016) *Black Hole Based Tests of General Relativity*, *Class. Quantum Grav.* **33** 054001 [[arXiv:1602.02413](#)].
21. Yagi, K., **Stein, L. C.**, Yunes, N. (2016) *Challenging the Presence of Scalar Charge and Dipolar Radiation in Binary Pulsars*, *Phys. Rev. D* **93** 024010 [[arXiv:1510.02152](#)].
20. Berti, E., (5 authors), **Stein, L. C.**, (46 more authors) (2015) *Testing General Relativity with Present and Future Astrophysical Observations*, *Class. Quantum Grav.* **32** 243001 [[arXiv:1501.07274](#)].
19. Tsang, D., Galley, C. R., **Stein, L. C.**, Turner, A. (2015) “Simplictic” Integrators: Variational Integrators for General Nonconservative Systems, *ApJ* **809** L9 [[arXiv:1506.08443](#)].
18. Yagi, K., **Stein, L. C.**, Pappas, G., Yunes, N., Apostolatos, T. (2014) *Why I-Love-Q: Explaining why universality emerges in compact objects*, *Phys. Rev. D* **90** 063010 [[arXiv:1406.7587](#)].
17. **Stein, L. C.** (2014) *Rapidly rotating black holes in dynamical Chern-Simons gravity: Decoupling limit solutions and breakdown*, *Phys. Rev. D* **90** 044061 [[arXiv:1407.2350](#)].
16. **Stein, L. C.**, Yagi, K., Yunes, N. (2014) *Three-Hair Newtonian Relations for Rotating Stars*, *ApJ* **788** 15 [[arXiv:1312.4532](#)].
15. **Stein, L. C.**, Yagi, K. (2013) *Parameterizing and constraining scalar corrections to general relativity*, *Phys. Rev. D* **89** 044026 [[arXiv:1310.6743](#)].

14. Yagi, K., **Stein, L. C.**, Yunes, N., Tanaka, T. (2013) *Isolated and Binary Neutron Stars in Dynamical Chern-Simons Gravity*, **Phys. Rev. D** **87** 084058 [[arXiv:1302.1918](#)]
13. Yagi, K., **Stein, L. C.**, Yunes, N., Tanaka, T. (2012), *Post-Newtonian, Quasi-Circular Binary Inspirals in Quadratic Modified Gravity*, **Phys. Rev. D** **85** 064022 [[arXiv:1110.5950](#)]
12. Vigeland, S., Yunes, N., **Stein, L. C.** (2011), *Bumpy black holes in alternative theories of gravity*, **Phys. Rev. D** **83** 104027 [[arXiv:1102.3706](#)]
11. Yunes, N., **Stein, L. C.** (2011), *Nonspinning black holes in alternative theories of gravity*, **Phys. Rev. D** **83** 104002 [[arXiv:1101.2921](#)]
10. **Stein, L. C.**, Yunes, N. (2011), *Effective gravitational wave stress-energy tensor in alternative theories of gravity*, **Phys. Rev. D** **83** 064038 [[arXiv:1012.3144](#)]
9. Lutomirski, A., Tegmark, M., Sanchez, N. J., **Stein, L. C.**, Urry, W. L., Zaldarriaga, M. (2011), *Solving the corner-turning problem for large interferometers*, **MNRAS** **410** 2075 [[arXiv:0910.1351](#)]
8. Sutton, P., Jones, G., Chatterji, S., Kalmus, P., Leonor, I., Poprocki, S., Rollins, J., Searle, A., **Stein, L.**, Tinto, M., Was, M. (2010), *X-Pipeline: an analysis package for autonomous gravitational-wave burst searches*, **New J. Phys.** **12** 053034 [[arXiv:0908.3665](#)]
7. Chatterji, S., Lazzarini, A., **Stein, L.**, Sutton, P., Searle, A. (2006), *Coherent network analysis technique for discriminating gravitational-wave bursts from instrumental noise*, **Phys. Rev. D** **74** 082005 [[arXiv:gr-qc/0605002](#)]
6. Galley, C. R., Tsang, D., **Stein, L. C.** (2014) *The principle of stationary nonconservative action for classical mechanics and field theories*, [[arXiv:1412.3082](#)]
5. **Stein, L. C.** (2014), *Note on Legendre decomposition of the Pontryagin density in Kerr*, [[arXiv:1407.0744](#)]
4. **Stein, L. C.** (2012), *Probes of Strong-field Gravity*, Ph.D. thesis at Massachusetts Institute of Technology [[hdl:1721.1/77256](#)]
3. Betancourt, M., **Stein, L. C.** (2011) *The Geometry of Hamiltonian Monte Carlo*, [[arXiv:1112.4118](#)]
2. **Stein, L. C.** (2009), *Binary Inspiral Gravitational Waves from a Post-Newtonian Expansion*, Contribution to the Wolfram Demonstrations Project, <http://demonstrations.wolfram.com/BinaryInspiralGravitationalWavesFromAPostNewtonianExpansion/>
1. **Stein, L. C.** (2006), *Gravitational Wave Burst Source Localization in a Coherent Network Analysis*, Senior thesis at California Institute of Technology

UNREFEREED  
PUBLICATIONS

## INVITED TALKS

- |   |               |
|---|---------------|
| 30. ETH-ITS Zurich, “New horizons for gravity” workshop                           | May 2018      |
| 29. UC San Diego, astrophysics seminar  | March 2018    |
| 28. UC Berkeley, 4D particle physics seminar                                      | March 2018    |
| 27. Kyoto University, YKIS2018a Symposium   | February 2018 |
| 26. Oakland University physics seminar  | February 2018 |
| 25. University of Wisconsin-Milwaukee gravity seminar                             | January 2018  |
| 24. Caltech/JPL Gravitational-Wave (CaJAGWR) seminar                              | January 2018  |
| 23. ICN UNAM, Relativity seminar  | December 2017 |
| 22. University of Mississippi, Astrophysics seminar                               | November 2017 |
| 21. University of Florida, Astrophysics seminar                                   | November 2017 |
| 20. University of Nottingham, Mathematical Physics seminar                        | July 2017     |
| 19. Sapienza University of Rome, New Frontiers in Gravitational-Wave Astrophysics | June 2017     |
| 18. Rochester Institute of Technology, CCRG seminar                               | March 2017    |
| 17. Penn State, IGC seminar   | March 2017    |

16. University of Mississippi, Strong Gravity/Binary Dynamics workshop February/March 2017
15. SUNY Stony Brook, “The universe through gravitational waves” December 2016
14. University of Pennsylvania, New Frontiers in Gravitational Radiation workshop December 2016
13. Cambridge MA, Event Horizon Telescope collaboration meeting November/December 2016
12. Northwestern University CIERA, “Fellows at the Frontiers” August/September 2016
11. Princeton University, GR@100++ panel discussion April 2016
10. Cambridge MA, Einstein fellows symposium October 2014
9. Perimeter Institute, Strong gravity seminar October 2014
8. Cornell University, Friends of astronomy outreach event November 2013
7. Cambridge MA, Einstein fellows symposium October 2013
6. SUNY Geneseo, Physics colloquium October 2013
5. University of Maryland, UMD gravity seminar October 2013
4. Yale University, YCAA seminar September 2013
3. Kyoto University, YITP long-term workshop June 2013
2. Cambridge MA, Einstein fellows symposium October 2012
1. Cornell University, Relativity lunch November 2011

CONTRIBUTED  
TALKS (SELECTED)

18. American Physical Society Meeting April 2018
17. Pacific Coast Gravity Meeting March 2017
16. American Physical Society Meeting ~~April~~ January 2017
15. Testing Gravity 2017 January 2017
14. 21<sup>st</sup> International meeting on GR (GR21) July 2016
13. American Physical Society Meeting April 2016
12. Eastern Gravity Meeting May 2015
11. American Physical Society Meeting April 2015
10. NEB 16 Recent developments in gravity September 2014
9. American Physical Society Meeting April 2014
8. XXVII Texas symposium on relativistic astrophysics December 2013
7. 20<sup>th</sup> International meeting on GR (GR20) July 2013
6. Eastern Gravity Meeting June 2013
5. American Physical Society Meeting April 2013
4. Caltech TAPIR Seminar December 2011
3. Eastern Gravity Meeting June 2011
2. American Physical Society Meeting April 2011
1. American Physical Society Meeting April 2010

## REFERENCES

**Scott A. Hughes**, Professor of Physics, Massachusetts Institute of Technology  
77 Massachusetts Avenue, Bldg. 37-602A  
Cambridge, MA 02139  
email: [sahughes@mit.edu](mailto:sahughes@mit.edu)  
office phone: 1-617-258-8523

**Nico Yunes**, Associate Professor of Physics, Montana State University  
Barnard Hall Room 203, MSU  
Bozeman, MT 59717-3840  
email: [nicolas.yunes@montana.edu](mailto:nicolas.yunes@montana.edu)  
office phone: 1-406-994-6182

**Éanna É. Flanagan**, Professor of Physics and Astronomy, Cornell University  
606 Space Sciences, Cornell University  
Ithaca, NY 14853  
email: [flanagan@astro.cornell.edu](mailto:flanagan@astro.cornell.edu)  
office phone: 1-607-255-6534

**Yanbei Chen**, Professor of Physics, California Institute of Technology  
TAPIR 350-17, Caltech  
1200 E. California Boulevard  
Pasadena, CA 91125  
email: [yanbei@caltech.edu](mailto:yanbei@caltech.edu) (please send correspondence to [joann@caltech.edu](mailto:joann@caltech.edu))  
office phone: 1-626-395-4258