

Leo C. Stein

CONTACT INFORMATION	205 Lewis Hall University of Mississippi University, MS 38677-1848 USA	lcstein@olemiss.edu duetosymmetry.com 1-662-915-1941
EDUCATION	Ph.D., Physics , Massachusetts Institute of Technology, Cambridge, MA, USA Dissertation Advisor: Prof. Scott Hughes Dissertation Title: <i>Probes of strong-field gravity</i> May 2012	
	B.S., Physics , California Institute of Technology, Pasadena, CA, USA Degree conferred with honor. Senior Thesis Advisors: Dr. Patrick Sutton and Prof. Alan Weinstein June 2006	
EMPLOYMENT	Assistant Professor , University of Mississippi, Oxford, MS USA August 2018–Present	
	Senior Postdoctoral Researcher , Caltech, Pasadena, CA USA September 2015–August 2018	
	NASA Einstein Fellow , Cornell, Ithaca NY, USA September 2012–August 2015	
	Research and Teaching Assistant , MIT, Cambridge MA, USA September 2006–May 2012	
	Teaching Assistant , Caltech, Pasadena, CA, USA Fall 2004, Spring 2005	
	Summer Research Fellow , Caltech, Pasadena, CA, USA June–September 2003/2005	
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	Einstein Postdoctoral Fellow , NASA 2012–2015	
	Henry Kendall Teaching Award , Massachusetts Institute of Technology 2011	
	Upperclass Merit Scholarship , California Institute of Technology 2005–2006	
TEACHING EXPERIENCE	Assistant Professor , University of Mississippi Phys. 402, Electromagnetism II Phys. 709, Advanced Mechanics I Spring 2019 Fall 2018	
	Guest Lecturer , California Institute of Technology Ph236, General relativity Ph237, Gravitational Waves Fall 2017 Spring 2016	
	Guest Lecturer , Massachusetts Institute of Technology 8.901, Graduate Astrophysics I Spring 2011	

Teaching Assistant, Massachusetts Institute of Technology

8.942, Cosmology	Fall 2011
8.901, Graduate Astrophysics I	Spring 2011
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–Summer 2019
Baoyi Chen, Caltech	Fall 2016–present

Undergraduate students

Wayne Zhao, Harvard	Summer 2016
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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 th 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–Spring 2018
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 th Pacific Coast Gravity Meeting (PCGM), Caltech	March 2018
33 rd Pacific Coast Gravity Meeting (PCGM), UCSB	March 2017
“April” APS meeting, Washington D.C.	January 2017
32 nd Pacific Coast Gravity Meeting (PCGM), CSU Fullerton	April 2016
Theoretical Astrophysics in Southern California (TASC), CSU Fullerton	November 2015

Journal referee

Classical and Quantum Gravity, 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

Guest on the <i>Starts With a Bang</i> podcast Episode 42: Black holes and gravitationa	March 25, 2019
Invited speaker for Latin American Webinar on Physics Webinar 75: “Testing Einstein with numerical relativity”	March 13, 2019
Caltech astronomy public lecture series speaker Lecture: “The truth about black holes”	March 2018
Astronomy on Tap public lecture series speaker and volunteer Close to a monthly basis	2016–2018
Caltech astronomy public lecture series panelist and emcee Approximately every three months	2016–2018
Invited guest lecture on black holes and gravitational waves <i>Science of Space and Time</i> , Hampshire College	November 2017
Invited video Q&A session, public high school physics class <i>The Nova Project</i> school, Seattle	June 2017
Guest on <i>The Titanium Physicists Podcast</i> Episode 80: Picturing the Bach Hole Episode 64: The edges of Einstein Episode 62: Black Bells	August 21, 2019 April 25, 2016 February 1, 2016
Quora Q&A Session on gravitational waves and first detection 83.9k+ views, 20.8k+ followers	February 17, 2016
Invited guest host, public screening of <i>COSMOS</i> with Q&A, Science Cabaret/Cornell	March/June 2014
Invited public talk at <i>Frontiers of Cornell Astronomy</i> , Cornell Friends of Astronomy	November 2013
Invited video chat, <i>Topics in Physics</i> course, Stanford Education Program for Gifted Youth	July 2013

COMPUTER SKILLS **Languages**—Expert in MATHEMATICA. Proficient in C/C++, Python, Bash, Javascript. Experience in Java, Haskell. Markup languages: L^AT_EX, HTML, CSS, Markdown.

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). Member of the *Black Hole Perturbation Toolkit*. Author of qnm python package (<https://github.com/duetosymmetry/qnm>). 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.

SUBMITTED
PUBLICATIONS

40. Okounkova, M., **Stein, L. C.**, Moxon, J., Scheel, M. A., Teukolsky, S. A., (2019) *Numerical relativity simulation of GW150914 beyond general relativity*, [[arXiv:1911.02588](#)].

ACCEPTED
PUBLICATIONS

39. **Stein, L. C.**, Warburton, N., (2019) *The location of the last stable orbit in Kerr spacetime*, [[arXiv:1912.07609](#)].

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

38. Okounkova, M., **Stein, L. C.**, Scheel, M. A., Teukolsky, S. A., (2019) *Numerical binary black hole collisions in dynamical Chern-Simons gravity*, *Phys. Rev. D* **100**, 104026 [[arXiv:1906.08789](#)].
37. Varma, V., *et al.* (2019) *Surrogate models for precessing binary black hole simulations with unequal masses*, *Phys. Rev. Research* **1**, 033015 [[arXiv:1905.09300](#)].
36. **Stein, L. C.**, (2019) *qnm: A Python package for calculating Kerr quasinormal modes, separation constants, and spherical-spheroidal mixing coefficients*, *J. Open Source Softw.*, **4**(42), 1683 [[arXiv:1908.10377](#)].
35. Boyle, M., *et al.* (**LCS** is corresponding author) (2019) *The SXS Collaboration catalog of binary black hole simulations*, *Class. Quantum Grav.* **36** 195006 [[arXiv:1904.04831](#)].
34. Barack, L., *et al.* (2019) *Black holes, gravitational waves and fundamental physics: a roadmap*, *Class. Quantum Grav.* **36** 143001 [[arXiv:1806.05195](#)].
33. Varma, V., **Stein, L. C.**, Gerosa, D., (2019) *The binary black hole explorer: on-the-fly visualizations of precessing binary black holes*, *Class. Quantum Grav.* **36** 095007 [[arXiv:1811.06552](#)], [[project website](#)].
32. Varma, V., Gerosa, D., **Stein, L. C.**, Hébert, F., Zhang, H., (2019) *High-accuracy mass, spin, and recoil predictions of generic black-hole merger remnants*, *Phys. Rev. Lett.* **122**, 011101 [[arXiv:1809.09125](#)].
31. Isi, M., **Stein, L. C.** (2018) *Measuring stochastic gravitational-wave energy beyond general relativity*, *Phys. Rev. D* **98**, 104025 [[arXiv:1807.02123](#)].
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. McNees, 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) “*Symplectic*” *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. (2014) *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 Inspirational Gravitational Waves from a Post-Newtonian Expansion*, Contribution to the Wolfram Demonstrations Project, <http://demonstrations.wolfram.com/BinaryInspirationalGravitationalWavesFromAPostNewtonianExpansion/>
1. **Stein, L. C.** (2006), *Gravitational Wave Burst Source Localization in a Coherent Network Analysis*, Senior thesis at California Institute of Technology

INVITED TALKS

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|---|------------------------|
| 33. UVA, physics department colloquium | November 2019 |
| 32. UT Dallas, physics department colloquium | October 2019 |
| 31. Northwestern University, CIERA astrophysics seminar | May 2019 |
| 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)

19. American Physical Society Meeting	April 2019
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 st 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 th 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
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 Cambridge, MA 02139
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 237B Loomis Laboratory
 1110 West Green Street
 Urbana, IL 61801-3003
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Éanna É. Flanagan, Professor of Physics and Astronomy, Cornell University
 606 Space Sciences, Cornell University
 Ithaca, NY 14853
 email: flanagan@astro.cornell.edu
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Yanbei Chen, Professor of Physics, California Institute of Technology
 TAPIR 350-17, Caltech
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 Pasadena, CA 91125
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