

## Leo C. Stein

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CONTACT INFORMATION	TAPIR 350-17 California Institute of Technology Pasadena, CA 91125 USA	<a href="mailto:leostein@tapir.caltech.edu">leostein@tapir.caltech.edu</a> <a href="http://duetosymmetry.com">duetosymmetry.com</a> 1-617-466-9536
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>May 2012</b>  <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>June 2006</b>	
EMPLOYMENT	<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>September 2015–Present</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>Guest Lecturer</b> , California Institute of Technology 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 8.286, The Early Universe <b>Teaching Assistant</b> , California Institute of Technology Ph 7, Nuclear and Quantum Physics Lab Ph 5, Analog Electronics for Physicists	<b>Spring 2016</b> <b>Spring 2011</b> <b>Fall 2011</b> <b>Spring 2011</b> <b>Fall 2009</b> <b>Spring 2005</b> <b>Fall 2004</b>

## 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**Member, American Physical Society**

2010–Present

Division of Gravitational Physics

Executive Committee Member-at-Large

2016–2019

Division of Astrophysics

**Conference organizer**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**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**

Astronomy on Tap public lecture series speaker and volunteer  
Close to a monthly basis

2016–2017

Caltech astronomy public lecture series panelist and emcee  
Approximately every three months

2016–2017

Invited video Q&A session, public high school physics class  
*The Nova Project* school, Seattle

June 2017

Guest on *The Titanium Physicists Podcast*[Episode 64: The edges of Einstein](#)

April 25, 2016

[Episode 62: Black Bells](#)

February 1, 2016

Quora <a href="#">Q&amp;A Session</a> on gravitational waves and first detection 83.9k+ views, 12.8k+ 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 for Chrome.

**PUBLICATIONS IN PROGRESS**

2. Chen, B., **Stein, L. C.** (2017) *Deformation of extremal black holes from stringy interactions*.
1. McNees, R., **Stein, L. C.**, (2017) *Cosmological perturbations in dynamical Chern-Simons*.

**ACCEPTED PUBLICATIONS**

2. Chen, B., **Stein, L. C.** (2017) *Separating metric perturbations in near-horizon extremal Kerr*, Accepted by PRD. [[arXiv:1707.05319](#)]
1. Okounkova, M., **Stein, L. C.**, Scheel, M. A., Hemberger, D. A. (2017) *Numerical binary black hole mergers in dynamical Chern-Simons: I. Scalar field*, Accepted by PRD. [[arXiv:1705.07924](#)]

**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**

19. 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](#)]
18. McNees, R., **Stein, L. C.**, Yunes, N. (2016) *Extremal Black Holes in Dynamical Chern-Simons Gravity*, *Class. Quantum Grav.* **33** 235013 [[arXiv:1512.05453](#)]
17. 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](#)]
16. Yagi, K., **Stein, L. C.** (2016) *Black Hole Based Tests of General Relativity*, *Class. Quantum Grav.* **33** 054001 [[arXiv:1602.02413](#)]
15. 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](#)]
14. 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](#)]
13. Tsang, D., Galley, C. R., **Stein, L. C.**, Turner, A. (2015) “*Slimplectic*” Integrators: Variational Integrators for General Nonconservative Systems, *ApJ* **809** L9 [[arXiv:1506.08443](#)]

12. 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](#)]
11. **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](#)]
10. **Stein, L. C.**, Yagi, K., Yunes, N. (2014) *Three-Hair Newtonian Relations for Rotating Stars*, *ApJ* **788** 15 [[arXiv:1312.4532](#)]
9. **Stein, L. C.**, Yagi, K. (2013) *Parameterizing and constraining scalar corrections to general relativity*, *Phys. Rev. D* **89** 044026 [[arXiv:1310.6743](#)]
8. 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](#)]
7. 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](#)]
6. Vigeland, S., Yunes, N., **Stein, L. C.** (2011), *Bumpy black holes in alternative theories of gravity*, *Phys. Rev. D* **83** 104027 [[arXiv:1102.3706](#)]
5. Yunes, N., **Stein, L. C.** (2011), *Nonspinning black holes in alternative theories of gravity*, *Phys. Rev. D* **83** 104002 [[arXiv:1101.2921](#)]
4. **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](#)]
3. 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](#)]
2. 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](#)]
1. 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](#)]

#### UNREFEREED PUBLICATIONS

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

#### INVITED TALKS

20. *Probing strong-field gravity: black holes and mergers in general relativity and beyond*, University of Nottingham, July 2017
19. *Numerical black holes and mergers beyond general relativity*, New Frontiers in Gravitational-Wave Astrophysics, Sapienza University of Rome, June 2017
18. *Numerical black holes and mergers beyond general relativity*, CCRG seminar, RIT, March 2017
17. *Numerical black holes and mergers beyond general relativity*, IGC seminar, Penn State, March 2017
16. *Bumpy black hole parameterizations*, Strong Gravity and Binary Dynamics workshop (StronG BaD), University of Mississippi, February/March 2017

15. *Modifications and tests of general relativity*: round table discussion at The universe through gravitational waves conference, Stonybrook, December 2016
14. *Numerical black holes and mergers beyond general relativity*, New Frontiers in Gravitational Radiation workshop, UPenn, December 2016
13. *Present and future tests of general relativity*, Event Horizon Telescope collaboration meeting, Cambridge MA, November/December 2016
12. *Black hole mergers: beyond general relativity*, Fellows at the Frontiers 2016, CIERA, August/September 2016.
11. *Alternative theories of gravity, novel physics around compact objects*: panel discussion at GR@100++ conference, Princeton, April 2016
10. *Rapidly rotating black holes in dynamical Chern-Simons gravity: Decoupling limit solutions and breakdown*, Einstein fellows symposium, October 2014.
9. *Probing (beyond) general relativity with compact binaries and gravitational waves*, Strong gravity seminar, Perimeter Institute, October 2014.
8. Friends of astronomy outreach event, Cornell, November 2013
7. *Parameterizing and constraining scalar corrections to general relativity*, Einstein fellows symposium, October 2013
6. *Corrections to general relativity, and where to look for them*, Physics colloquium, SUNY Geneseo, October 2013
5. *Parameterizing scalar corrections to general relativity*, UMD gravity seminar, University of Maryland, October 2013
4. *Corrections to general relativity, and where to look for them*, YCAA seminar, Yale University, September 2013
3. *Scalar gravitational effects*, YITP long-term workshop, Kyoto University, June 2013
2. *Conditions for Preheating*, Einstein fellows symposium, October 2012
1. *Signatures of strong gravity corrections to GR*, Cornell Relativity Lunch, November 2011

CONTRIBUTED  
TALKS (SELECTED)

12. *Numerical black holes and mergers in dynamical Chern-Simons gravity*, GR21, July 2016
11. *Extremal black holes in dynamical Chern-Simons gravity*, April APS Meeting 2016
10. *Hiding corrections to GR with topology*, Eastern Gravity Meeting, May 2015
9. *Why neutron stars have three hairs*, April APS Meeting 2015
8. *Rapidly rotating black holes in dynamical Chern-Simons gravity: Decoupling limit solutions and breakdown*, NEB 16—Recent developments in gravity, September 2014
7. *Three-Hair Newtonian Relations for Rotating Stars*, April APS Meeting 2014
6. *Parameterizing and constraining scalar corrections to general relativity*, XXVII Texas symposium, December 2013
5. *Eccentric binary effects in dynamical Chern-Simons gravity*, April APS Meeting 2013
4. *Signatures of strong gravity corrections to GR*, Caltech TAPIR Seminar, December 2011
3. *Effective gravitational wave stress-energy tensor in alternative theories of gravity*, Eastern Gravity Meeting, June 2011
2. *Effective gravitational wave stress-energy tensor in alternative theories of gravity*, April APS Meeting 2011
1. *Tuning advanced gravitational-wave detectors to optimally measure neutron-star merger waves*, April APS Meeting 2010

## REFERENCES

**Scott A. Hughes**, Professor of Physics, Massachusetts Institute of Technology  
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