

Leo C. Stein

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| CONTACT INFORMATION | TAPIR 350-17 California Institute of Technology Pasadena, CA 91125 USA | leosteин@tapir.caltech.edu duetosymmetry.com 1-617-466-9536 |
| 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 | Senior Postdoctoral Researcher , Caltech, Pasadena, CA USA September 2015–Present | |
| | 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 | 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 8.901, Graduate Astrophysics I 8.286, The Early Universe Fall 2011 Spring 2011 Fall 2009 | |
| | Teaching Assistant , California Institute of Technology Ph 7, Nuclear and Quantum Physics Lab Ph 5, Analog Electronics for Physicists Spring 2005 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**Member, American Physical Society**

2010–Present

Division of Gravitational Physics

Executive Committee Member-at-Large

2016–2019

Division of Astrophysics

Conference organizerWorkshop on *Numerical Relativity beyond General Relativity*, Benasque

June 2018

Week-long international workshop, ~ 60 participants

34th Pacific Coast Gravity Meeting (PCGM), Caltech

March 2018

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 award33rd Pacific Coast Gravity Meeting (PCGM), UCSB

March 2017

“April” APS meeting, Washington D.C.

January 2017

32nd 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

2016–2017

Close to a monthly basis

Caltech astronomy public lecture series panelist and emcee

2016–2017

Approximately every three months

Invited video Q&A session, public high school physics class

June 2017

The Nova Project school, Seattle

Guest on *The Titanium Physicists Podcast*

Episode 64: The edges of Einstein

Episode 62: Black Bells

April 25, 2016

February 1, 2016

Quora [Q&A Session](#) on gravitational waves and first detection
83.9k+ views, 17.5k+ followers

February 17, 2016

Invited guest host, public screening of *COSMOS* with Q&A,
Science Cabaret/Cornell

March/June 2014

Invited public talk at *Frontiers of Cornell Astronomy*,
Cornell Friends of Astronomy

November 2013

Invited video chat, *Topics in Physics* course,
Stanford Education Program for Gifted Youth

July 2013

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

3. Isi, M., **Stein, L. C.** (2017) *Stochastic gravitational-wave energy density in beyond-GR gravity*.
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*.

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

21. Chen, B., **Stein, L. C.** (2017) *Separating metric perturbations in near-horizon extremal Kerr*, [Phys. Rev. D **96**, 064017](#) [[arXiv:1707.05319](#)]
20. 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](#)]
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) “*Symplectic*” 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](#)]
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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 Inspirals Gravitational Waves from a Post-Newtonian Expansion*, Contribution to the Wolfram Demonstrations Project, <http://demonstrations.wolfram.com/BinaryInspiralsGravitationalWavesFromAPostNewtonianExpansion/>
 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

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

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