# Leo C. Stein


**Contact Information**

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**Education**

**Ph.D., Physics,** Massachusetts Institute of Technology, Cambridge, MA, USA **May 2012**

Dissertation Advisor: Prof. Scott Hughes

Dissertation Title: *Probes of strong-field gravity*

**B.S., Physics,** California Institute of Technology, Pasadena, CA, USA **June 2006**

Degree conferred with honor.

Senior Thesis Advisors: Dr. Patrick Sutton and Prof. Alan Weinstein

**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

Ph237, Gravitational Waves **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–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**

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, Monthly Notices of the Royal Astronomical Society, Physics Letters B, Physical Review D, Physical Review Letters, Reviews of Modern Physics

**Outreach**

Caltech astronomy public lecture series panelist — **June 10, 2016**, **February 19, 2016**

Guest on *The Titanium Physicists Podcast*
Episode 64: The edges of Einstein — **April 25, 2016**
Episode 62: Black Bells — **February 1, 2016**

Quora Q&A Session on gravitational waves and first detection — **February 17, 2016**
83.9k+ views, 12.8k+ followers

Invited guest host, public screening of *COSMOS* with Q&A, — **March/June 2014**
Science Cabaret/Cornell

Invited public talk at *Frontiers of Cornell Astronomy*, — **November 2013**
Cornell Friends of Astronomy

Invited video chat, *Topics in Physics* course, — **July 2013**
Stanford Education Program for Gifted Youth

## 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

4. **Stein, L. C.**, Okounkova, M. (2016) *First black hole mergers in dynamical Chern-Simons.*
3. **Stein, L. C.**, Zhao, W. (2016) *Metric of rapidly rotating black holes in dynamical Chern-Simons.*
2. **Stein, L. C.**, McNees, R. (2016) *Cosmological perturbations in dynamical Chern-Simons.*
1. **Stein, L. C.** (2016) *Separation of metric perturbations in near-Horizon near-Extremal Kerr.*

## Submitted Publications

2. Tso, R., Isi, M., Chen, Y., **Stein, L. C.** (2016) *Modeling the Dispersion and Polarization Content of Gravitational Waves for Tests of General Relativity*, (Proceedings of CPT '16) [arXiv:1608.01284]
1. Galley, C. R., Tsang, D., **Stein, L. C.** (2014) *The principle of stationary nonconservative action for classical mechanics and field theories*, [arXiv:1412.3082]

## Accepted Publications

1. McNees, R., **Stein, L. C.**, Yunes, N. (2015) *Extremal Black Holes in Dynamical Chern-Simons Gravity*, Accepted by Class. Quantum Grav. [arXiv:1512.05453]

## 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

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*, 2016 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*, 2015 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

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

12. *Black hole mergers: beyond general relativity*, Fellows at the Frontier 2016, CIERA.
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.
    Available at ▶ http://youtu.be/_ErPFnrQGnE?t=1m45s.
9. *Probing (beyond) general relativity with compact binaries and gravitational waves*, Strong gravity seminar, Perimeter Institute, October 2014.
    Available at ▶ http://www.pirsa.org/14100003/.
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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