# STEPHEN R. GREEN

Max Planck Institute for Gravitational Physics (Albert Einstein Institute)
Am Mühlenberg 1, 14476 Potsdam-Golm, Germany
+49 1520 8435588 • stephen.green@aei.mpg.de
https://www.stephenrgreen.com/


## EDUCATION

**University of Chicago**, Chicago, USA
- Ph.D. in Physics (general relativity) 08.2012
  - Thesis: *Nonlinear Backreaction in Cosmology*
  - Adviser: Robert M. Wald
- S.M. in Physical Sciences 06.2006

**University of Toronto (Trinity College)**, Toronto, Canada
- Honours B.Sc. in Mathematics and Physics with High Distinction 06.2005

## RESEARCH EXPERIENCE

**Max Planck Institute for Gravitational Physics**, Potsdam-Golm, Germany
- Senior Scientist 2021–present
- Junior Scientist / Postdoctoral Researcher 2017–2021
  - Member of LIGO Scientific Collaboration since 2018

**Perimeter Institute for Theoretical Physics**, Waterloo, Canada
- Postdoctoral Researcher 2014–2017

**University of Guelph**, Guelph, Canada
- CITA National Postdoctoral Fellow, Department of Physics 2012–2014
  - Adviser: Luis Lehner

**University of Chicago**, Chicago, USA
- Research Assistant, Enrico Fermi Institute 2006–2012
  - Adviser: Robert M. Wald

**University of Toronto**, Toronto, Canada
- NSERC Undergraduate Student Research Awards Summers 2002–2004
  - Departments of Mathematics and Physics
  - Advisers: Ue-Li Pen, Chistopher Matzner, Dror Bar-Natan, and Robert Almgren

## TEACHING EXPERIENCE

**Students supervised**
- Maximilian Dax 09.2020–present
  - PhD student at MPI for Intelligent Systems
  - Project to improve detector noise treatment for GW inference with deep learning
- Jérémie Gagnon-Bischoff 05.2017–08.2017
  - Undergraduate student at University of Ottawa, visiting PI
  - Co-supervised (with N. Ortiz) a project on tidal Love numbers of neutron stars

– Co-authored a paper in *Physical Review D*

Hugo Roussille 03.2017–07.2017
– Masters student at École Normale Supérieure, visiting PI
– Co-supervised a project on superradiant instabilities and hairy black holes

Pablo Bosch 09.2015–08.2017
– PhD student of L. Lehner studying superradiant instabilities of black holes
– Co-authored a paper in *Physical Review Letters*

Stanislav Fort 06.2015–08.2015
– Visited PI while an undergraduate student at University of Cambridge
– Co-supervised (with M. Heller) AdS instability project

Antoine Maillard 02.2015–08.2015
– Visited PI while a Masters student at École Normale Supérieure
– Co-authored a paper in *Physical Review D* on AdS instability

**Schools**

Numerical Methods in Gravity and Holography 11.2017–12.2017
Universidad de Concepción, Chile
– Lecturer, "Stability of Gravitational Systems on Bounded Domains"

**Courses**

University of Chicago Department of Physics
– Grader, graduate general relativity course Winters 2008, 2010-2012
– Teaching assistant, introductory physics courses 09.2005–06.2007

## SERVICE

**Organizational activities**

Co-organizer, AEI Colloquium Series 09.2019–present
Co-organizer, AEI Astrophysical and Cosmological Relativity Seminar 09.2018–08.2019
Scientific organizer, 26th Midwest Relativity Meeting, PI 10.2016
Chairperson, PI cosmology group meeting 08.2014–08.2016
Chairperson, University of Guelph general relativity group meeting 09.2013–08.2014

**Referee activities**

Astronomy & Astrophysics, Classical and Quantum Gravity,
European Physical Journal C, JCAP, JHEP, Nature Communications,
Physics Letters B, Physical Review Letters, Physical Review D

**Outreach**

Ask-A-Scientist volunteer at PI open house 09.2016
Invited keynote lecturer at EinsteinPlus workshop at PI 07.2016
– for Canadian and international high school physics teachers
Ask-A-Scientist volunteer at PI public lecture 03.2015
Ask-A-Scientist volunteer at PI BrainSTEM Festival 10.2013
Judge at CPES Undergraduate Poster Session (University of Guelph) 2013

**Committees**

Member of PhD admissions committee 2020, 2021
– ACR Division, Max Planck Institute for Gravitational Physics
Member of graduate admissions committee 2007
– University of Chicago Department of Physics

**Mentoring**

University of Toronto Department of Physics mentoring program 2013–2014

## PUBLICATIONS

1. V. Toomani, P. Zimmerman, A. Spiers, S. Hollands, A. Pound, and S. R. Green, "New metric reconstruction scheme for gravitational self-force calculations", (2021), arXiv:2108.04273 [gr-qc].
2. N. Ortiz, F. Carrasco, S. R. Green, L. Lehner, S. L. Liebling, and J. R. Westernacher-Schneider, "Gamma-radiation sky maps from compact binaries", (2021), arXiv:2107.07020 [astro-ph.HE].
3. M. Dax, S. R. Green, J. Gair, J. H. Macke, A. Buonanno, and B. Schölkopf, "Real-time gravitational-wave science with neural posterior estimation", (2021), arXiv:2106.12594 [gr-qc].
4. S. R. Green and J. Gair, "Complete parameter inference for GW150914 using deep learning", Mach. Learn. Sci. Tech. **2**, 03LT01 (2021), arXiv:2008.03312 [astro-ph.IM].
5. S. R. Green, C. Simpson, and J. Gair, "Gravitational-wave parameter estimation with autoregressive neural network flows", Phys. Rev. D **102**, 104057 (2020), arXiv:2002.07656 [astro-ph.IM].
6. P. Bosch, S. R. Green, L. Lehner, and H. Roussille, "Excited hairy black holes: dynamical construction and level transitions", Phys. Rev. D **102**, 044014 (2020), arXiv:1912.05598 [gr-qc].
7. S. R. Green, S. Hollands, and P. Zimmerman, "Teukolsky formalism for nonlinear Kerr perturbations", Class. Quant. Grav. **37**, 075001 (2020), arXiv:1908.09095 [gr-qc].
8. J. Gagnon-Bischoff, S. R. Green, P. Landry, and N. Ortiz, "Extended I-Love relations for slowly rotating neutron stars", Phys. Rev. **D97**, 064042 (2018), arXiv:1711.05694 [gr-qc].
9. S. R. Green and R. M. Wald, "A simple, heuristic derivation of our 'no backreaction' results", Class. Quant. Grav. **33**, 125027 (2016), arXiv:1601.06789 [gr-qc].
10. P. Bosch, S. R. Green, and L. Lehner, "Nonlinear Evolution and Final Fate of Charged Anti–de Sitter Black Hole Superradiant Instability", Phys. Rev. Lett. **116**, 141102 (2016), arXiv:1601.01384 [gr-qc].
11. S. R. Green, S. Hollands, A. Ishibashi, and R. M. Wald, "Superradiant instabilities of asymptotically anti-de Sitter black holes", Class. Quant. Grav. **33**, 125022 (2016), arXiv:1512.02644 [gr-qc].
12. S. R. Green, A. Maillard, L. Lehner, and S. L. Liebling, "Islands of stability and recurrence times in AdS", Phys. Rev. **D92**, 084001 (2015), arXiv:1507.08261 [gr-qc].
13. V. Balasubramanian, A. Buchel, S. R. Green, L. Lehner, and S. L. Liebling, "Reply to Comment on "Holographic Thermalization, Stability of Anti-de Sitter Space, and the Fermi-Pasta-Ulam Paradox"", Phys. Rev. Lett. **115**, 049102 (2015), arXiv:1506.07907 [gr-qc].
14. S. R. Green and R. M. Wald, "Comments on Backreaction", (2015), arXiv:1506.06452 [gr-qc].
15. H. Yang, F. Zhang, S. R. Green, and L. Lehner, "Coupled Oscillator Model for Nonlinear Gravitational Perturbations", Phys. Rev. **D91**, 084007 (2015), arXiv:1502.08051 [gr-qc].
16. A. Buchel, S. R. Green, L. Lehner, and S. L. Liebling, "Conserved quantities and dual turbulent cascades in anti-de Sitter spacetime", Phys. Rev. **D91**, 064026 (2015), arXiv:1412.4761 [gr-qc].
17. A. Buchel, S. R. Green, L. Lehner, and S. L. Liebling, "Universality of non-equilibrium dynamics of CFTs from holography", (2014), arXiv:1410.5381 [hep-th].
18. S. R. Green and R. M. Wald, "How well is our universe described by an FLRW model?", Class. Quant. Grav. **31**, 234003 (2014), arXiv:1407.8084 [gr-qc].
19. V. Balasubramanian, A. Buchel, S. R. Green, L. Lehner, and S. L. Liebling, "Holographic Thermalization, stability of AdS, and the Fermi-Pasta-Ulam-Tsingou paradox", Phys. Rev. Lett. **113**, 071601 (2014), arXiv:1403.6471 [hep-th].

20. S. R. Green, J. S. Schiffrin, and R. M. Wald, "Dynamic and Thermodynamic Stability of Relativistic, Perfect Fluid Stars", Class. Quant. Grav. **31**, 035023 (2014), arXiv:1309.0177 [gr-qc].
21. S. R. Green, F. Carrasco, and L. Lehner, "Holographic Path to the Turbulent Side of Gravity", Phys. Rev. **X4**, 011001 (2014), arXiv:1309.7940 [hep-th].
22. S. R. Green and R. M. Wald, "Examples of backreaction of small scale inhomogeneities in cosmology", Phys. Rev. **D87**, 124037 (2013), arXiv:1304.2318 [gr-qc].
23. S. R. Green, "Nonlinear backreaction in cosmology", PhD thesis (University of Chicago, 2012).
24. S. R. Green and R. M. Wald, "Newtonian and Relativistic Cosmologies", Phys. Rev. **D85**, 063512 (2012), arXiv:1111.2997 [gr-qc].
25. S. R. Green, E. J. Martinec, C. Quigley, and S. Sethi, "Constraints on String Cosmology", Class. Quant. Grav. **29**, 075006 (2012), arXiv:1110.0545 [hep-th].
26. S. R. Green and R. M. Wald, "A new framework for analyzing the effects of small scale inhomogeneities in cosmology", Phys. Rev. **D83**, 084020 (2011), arXiv:1011.4920 [gr-qc].
27. B. Pang, U.-L. Pen, C. D. Matzner, S. R. Green, and M. Liebendorfer, "Numerical Parameter Survey of Nonradiative Black Hole Accretion – Flow Structure and Variability of the Rotation Measure", Mon. Not. Roy. Astron. Soc. **415**, 1228–1239 (2011), arXiv:1011.5498 [astro-ph.GA].

For a complete list of publications see
http://inspirehep.net/search?p=exactauthor%3AS.R.Green.1&sf=earliestdate.

## RESEARCH TALKS

1. Observational Relativity and Cosmology Group Meeting Seminar, AEI Hannover, Germany (2021).
2. GW Mull Workshop, Scotland (2021).
3. 14th Edoardo Amaldi Conference on Gravitational Waves, online (2021); (video).
4. 24th Capra Meeting on Radiation Reaction in General Relativity, Perimeter Institute, Waterloo, Canada (2021); (video).
5. Nikhef Gravity Group Meeting Seminar, Amsterdam, Netherlands (2021).
6. SISSA & IFPU Gravity Webinar, Trieste, Italy (2021); (slides) (video).
7. American Physical Society April Meeting, online (2021).
8. Third Workshop on Machine Learning and the Physical Sciences (NeurIPS 2020), Vancouver, Canada; (extended abstract) (poster).
9. Astrophysics Seminar, Technion – Israel Institute of Technology (2020).
10. Physics Seminar, University of Western Australia (2020).
11. Workshop on Statistical Methods for the Detection, Classification, and Inference of Relativistic Objects, ICERM (2020); (video).
12. Applied and Computational Mathematics Seminar, University College Dublin (2020); (video).
13. 23rd Capra Meeting on Radiation Reaction in General Relativity, University of Texas at Austin (2020); (video).
14. Gravity Seminar, University of Southampton, UK (2020).
15. GWverse COST Action Meeting, IFPU, Trieste, Italy (2020).
16. BIRS-CMO Workshop on Time-like Boundaries in General Relativistic Evolution Problems, Casa Matématica Oaxaca, Mexico (2019); (video).
17. 22nd International Conference on General Relativity and Gravitation, Valencia, Spain (2019).

18. Cosmology and Gravitational Physics with Lambda Workshop, Nordita, Sweden (2018).
19. Mathematical General Relativity Workshop, Mathematisches Forschungsinstitut Oberwolfach, Germany (2018).
20. CENTRA Seminar, Instituto Superior Técnico, Lisbon, Portugal (2018).
21. Reduced-Order Model Workshop, Albert Einstein Institute, Potsdam, Germany (2018).
22. Workshop on Singularities of General Relativity and their Quantum Fate, Banach Mathematical Center, Warsaw, Poland (2018).
23. University of Amsterdam String Seminar, Amsterdam, Netherlands (2018).
24. Institute for Theoretical Physics Seminar, Universität Leipzig, Leipzig, Germany (2018).
25. Gravity at UCEN 2017: Black holes and Cosmology, Universidad Central de Chile, Santiago, Chile (2017).
26. Astrophysical and Cosmological Relativity Group Seminar, AEI Potsdam, Germany (2017)
27. Gravity – New Perspectives from Strings and Higher Dimensions Workshop, Benasque, Spain (2017).
28. American Physical Society April Meeting, Washington, DC (2017).
29. PI-CITA Day, University of Toronto, ON (2016).
30. 21st International Conference on General Relativity and Gravitation, Columbia University, New York, NY (2016).
31. Numerical Relativity and Holography Workshop, Santiago de Compostela, Spain (2016).
32. Cosmological Frontiers in Fundamental Physics Conference, Perimeter Institute, Waterloo, ON (2016); (video).
33. American Physical Society April Meeting, Salt Lake City, UT (2016).
34. Quantum Gravity Seminar, Perimeter Institute, Waterloo, ON (2016); (video).
35. Particle Seminar, Perimeter Institute, Waterloo, ON (2016); (video).
36. Leipzig University Seminar, Leipzig, Germany (2015)
37. University of Cambridge DAMTP Lunch Seminar, Cambridge, UK (2015)
38. 25th Midwest Relativity Meeting, Northwestern University, Evanston, IL (2015)
39. Fields Institute Focus Program on 100 Years of General Relativity, Toronto, ON (2015)
40. PI-CITA Day, Perimeter Institute, Waterloo ON (2015)
41. American Physical Society April Meeting, Baltimore, MD (2015)
42. CERN-CKC TH Institute on Numerical Holography, Geneva, Switzerland (2014)
43. 24th Midwest Relativity Meeting, Oakland University, Auburn Hills, MI (2014)
44. 15th Canadian Conference on General Relativity and Relativistic Astrophysics, University of Winnipeg, Winnipeg, MB (2014)
45. Eastern Gravity Meeting, West Virginia University, Morgantown, WV (2014)
46. Compute Ontario Research Day, Perimeter Institute, Waterloo, ON (2014)
47. Gravity Theory Seminar, University of Maryland, College Park, MD (2014)
48. American Physical Society April Meeting, Savannah, GA (2014)
49. CITA National Fellows Meeting, University of Toronto, Toronto, ON (2014)
50. 23rd Midwest Relativity Meeting, University of Wisconsin-Milwaukee, Milwaukee, WI (2013)
51. Astrophysics Lunch Talk, Cornell University, Ithaca, NY (2013)

52. 20th International Conference on General Relativity and Gravitation, Warsaw, Poland (2013)
53. American Physical Society April Meeting, Denver, CO (2013)
54. CITA National Fellows Meeting, University of Toronto, Toronto, ON (2013)
55. Gravitation and Cosmology Lunch Seminar, University of Wisconsin-Milwaukee, Milwaukee, WI (2012)
56. 22nd Midwest Relativity Meeting, University of Chicago, Chicago, IL (2012)
57. American Physical Society April Meeting, Atlanta, GA (2012)
58. Strong Gravity Seminar, Perimeter Institute, Waterloo, ON (2012)
59. Cosmology Lunch Talk, Institute for Advanced Study, Princeton, NJ (2012)
60. 21st Midwest Relativity Meeting, University of Illinois at Urbana-Champaign, Urbana-Champaign, IL (2011)
61. Inhomogeneous Cosmologies Workshop, University of Jyväskylä, Jyväskylä, Finland (2011)
62. American Physical Society April Meeting, Anaheim, CA (2011)
63. 20th Midwest Relativity Meeting, University of Guelph, Guelph, ON (2010)
64. 19th International Conference on General Relativity and Gravitation, Mexico City, Mexico (2010)
65. American Physical Society April Meeting, Washington, DC (2010)
66. 19th Midwest Relativity Meeting, University of Michigan, Ann Arbor, MI (2009)
67. 18th Midwest Relativity Meeting, University of Notre Dame, South Bend, IN (2008)
68. 17th Midwest Relativity Meeting, St. Louis University, St. Louis, MO (2007)

## SCHOLARSHIPS AND AWARDS

**Postdoctoral**

Marie Sklodowska-Curie Actions Seal of Excellence (2017)
National Fellowship (Canadian Institute for Theoretical Astrophysics, 2012–2014)

**Graduate**

Nathan Sugarman Award (Enrico Fermi Institute, 2012)
– for excellence in graduate research
Blue Apple Award (Midwest Relativity Meeting, 2011)
– for best student talk (out of 29)
Harvey B. Plotnick Fellowship (Chicago, 2010)
Postgraduate Scholarship D (NSERC, 2007–2010)
Sachs Fellowship (Chicago, 2006)

**Undergraduate**

Chancellor's Gold Medal in Science (Trinity College, 2005)
Governor General's Silver Academic Medal Nominee (Trinity College, 2005)
Prince of Wales Prize (Trinity College, 2005)
– for high achievement in mathematics
University of Toronto Scholarship (2002–2005)
Dean's List (2002–2005)
Beatrice Evelyn Rodgers Scholarship (Toronto, Math and Physics, 2005)
Margaret Ronald Taylor and Thomas Paxton Taylor Award (Toronto, Math, 2004–2005)
Isaac Chapman Boyd and Sarah Edith Boyd Scholarship (Trinity College, 2004)
– for highest overall average in third year
Provost's Scholar (Trinity College, 2004)

3T0 M. & P. and Associates Scholarship (Toronto, Physics, 2004)
James Scott Scholarship (Trinity College, 2004)
Ivan Szak Scholarship (Toronto, Math, 2004)
William R. Hossack Memorial Scholarship (Toronto, Math and Physics, 2003)
William Mulock Prize (Toronto, Math and Physics, 2003)
Coxeter Scholarship (Toronto, Math, 2003)
Drew Thompson Scholarship (Trinity College, 2003)
Canadian Association of Physicists University Prize Examination, 10th place (2003)
Elizabeth Kingstone Scholarship (Trinity College, 2002)
Samuel Beatty In-Course Award (Toronto, Math, 2002)
National Biology Competition Scholarship, 4th place (Toronto, 2001)
Trinity College Entrance Scholarship (2001)
Aiming for the Top Scholarship (Government of Ontario, 2001–2004)

**High School**

Governor General's Bronze Academic Medal (2001)
– for highest overall average in the graduating class
Ontario Scholar