Philippe Landry

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CURRENT POSITION

POSTDOCTORAL FELLOW • University of Toronto — Sep 2021 - Present

Postdoctoral fellow at the **Canadian Institute for Theoretical Astrophysics**; member of the **LIGO Scientific Collaboration** and the **Cosmic Explorer** project

RESEARCH INTERESTS

Gravitational waves • Neutron stars • General relativity • Dense matter equation of state • Relativistic tides • Compact object populations • Post-Newtonian theory • Perturbation theory

EDUCATION

PHD, PHYSICS
University of Guelph • 2017
Advisor: Eric Poisson
Thesis: Tidal response of a rotating neutron star in general relativity

MSC, PHYSICS
University of Guelph • 2014
Advisor: Eric Poisson
Thesis: Tidal deformations of compact bodies in general relativity

BSC (HONS.), PHYSICS
Queen's University • 2012
Advisor: Kayll Lake
Thesis: McVittie solution with a negative cosmological constant

RESEARCH EXPERIENCE

POSTDOCTORAL ASSOCIATE • California State University, Fullerton — Sep 2019 - Aug 2021

Postdoctoral research associate at the **Nicholas & Lee Begovich Center for Gravitational Wave Physics & Astronomy**; co-authored the NSF-mandated horizon study for **Cosmic Explorer**

POSTDOCTORAL SCHOLAR • University of Chicago — Sep 2017 - Aug 2019

Postdoctoral scholar at the **Enrico Fermi Institute** and associate fellow at the **Kavli Institute for Cosmological Physics**; worked in gravitational wave astronomy within the **LIGO Scientific Collaboration**

GRADUATE RESEARCH ASSISTANT • University of Guelph — Sep 2012 - Aug 2017

Contributed to the development of the theory of relativistic tides in binary neutron star systems, including gravitomagnetic and spin effects

UNDERGRADUATE RESEARCHER • Queen's University — Sep 2011 - Apr 2012

Studied the global structure of an exact solution in general relativity for an undergraduate thesis

UNDERGRADUATE RESEARCHER • Royal Military College of Canada — May - Aug 2011

Worked on an observational space science project about derelict satellites for **Defence Research & Development Canada** as part of an NSERC undergraduate student research award

RESEARCH GRANTS

NSF RUI GRANT • National Science Foundation — Jul 2021 - Present

Co-PI of the NSF Research in Undergraduate Institutions grant PHY-2110441, "RUI: Neutron-Star Matter in the LIGO A+ Era and Beyond," developed with PI Jocelyn Read and funded at $225k over three years to support research at Cal State Fullerton

FELLOWSHIPS & AWARDS

NSERC POSTDOCTORAL FELLOWSHIP • NSERC — Sep 2017 - Aug 2019

Fellowship awarded by the Natural Sciences & Engineering Research Council of Canada for research potential and academic achievement; held at the University of Chicago

DTP/WITP THESIS PRIZE • Canadian Association of Physicists — Jun 2018

Award for best PhD thesis by a graduate of a Canadian university in the field of theoretical physics

ALEXANDER GRAHAM BELL CANADA GRADUATE SCHOLARSHIP • NSERC — May '16 - Aug '17

Scholarship awarded for research potential and academic achievement; held at the University of Guelph

DEAN'S SCHOLARSHIP • University of Guelph — Sep 2012 - Aug 2017

Scholarship for academic achievement

HARTLE AWARD • GR21 — Jul 2016

Award for best student talk in section of GR21 gravity conference at Columbia University

ONTARIO GRADUATE SCHOLARSHIP • Province of Ontario — May 2015 - Apr 2016

Scholarship for academic achievement held at the University of Guelph

BEST STUDENT TALK • 17th Eastern Gravity Meeting — Jun 2014

Award for best student talk at gravity conference at West Virginia University

UNDERGRADUATE STUDENT RESEARCH AWARD • NSERC — May - Aug 2011

Research fellowship held at the Royal Military College of Canada

TEACHING, SERVICE & OUTREACH

REFEREE • AAS, Physical Review, Nature, Science — Sep 2017 - Present

Referee scientific articles for The Astrophysical Journal, The Astrophysical Journal Letters, Physical Review D, Physical Review Letters, Nature and Science

LECTURER • Lifelong Learning Lectures — Sep 2018 - Dec 2020

Participated in lifelong learning programs, giving public outreach talks on the topic of tides in Chicago and on the topic of gravitational waves in Fullerton

CO-EDITOR • Humans of LIGO Blog — Jul 2018 - Dec 2020

Conducted interviews and curated posts for public outreach blog profiling individual LIGO scientists

SPACE VISUALIZATION LAB PRESENTER • Adler Planetarium — Jan 2018 - Aug 2019

Regularly volunteered as science presenter for Astronomy Conversations public outreach program

LECTURER • Undergraduate Physics Reading Seminar — Oct - Dec 2018

Helped design an interest-based non-credit course on computational methods in gravitational wave astrophysics for advanced undergraduates; delivered two lectures and devised a final assignment

COMMITTEE MEMBER • Guelph/Perimeter Institute Faculty Search — Jan 2016 - Apr 2017

Student representative on the joint University of Guelph/Perimeter Institute search committee for two faculty positions in theoretical physics

SEMINAR SERIES ORGANIZER • University of Guelph — Sep 2014 – Apr 2017

Co-founded, coordinated and secured funding for a series of outreach talks delivered by graduate students and aimed at physics undergraduates; also personally delivered several talks

COMMITTEE MEMBER • GWPI Coordinating Committee — Sep 2014 - Apr 2017

Student representative on the graduate program committee for the Guelph-Waterloo Physics Institute and member of the 2016 institute director search committee

TEACHING ASSISTANT • University of Guelph — Sep 2012 - Apr 2017

Served as a teaching assistant for undergraduate courses in introductory physics, mechanics and electromagnetism, leading tutorials, supervising laboratories, grading assignments and exams, and occasionally delivering lectures

POSTER SESSION ORGANIZER • University of Guelph — May - Aug 2013

Organized a poster session for undergraduate summer researchers in the College of Physical and Engineering Sciences

MENTORING

GRADUATE STUDENTS

Mary Usufzy, **California State University, Fullerton** — Sep 2021 - Present
Bhaskar Biswas, **IUCAA** — Mar 2019 - Dec 2020
Bharat Kumar, **Institute of Physics, Bhubaneswar** — Sep 2017 - Dec 2018

UNDERGRADUATE STUDENTS

Katherine Karababas, **University of Toronto** — Sep 2021 - Present
Kunal Mehta, **University of Toronto** — Sep 2021 - Present
Emily Wuchner, **California State University, Fullerton** — Sep 2021 - Present
Abel Jesus Hernandez, **California State University, Fullerton** — Jan 2020 - Present
Marc Penuliar, **California State University, Fullerton** — Sep 2019 - Present
Isabella Molina, **California State University, Fullerton** — Sep 2019 - Apr 2020
Jérémie Gagnon-Bischoff, **Perimeter Institute** — May - Aug 2017

AFFILIATIONS

SCIENTIFIC COLLABORATIONS

LIGO Scientific Collaboration • Cosmic Explorer

PROFESSIONAL SOCIETIES

American Physical Society • American Astronomical Society • International Society on General Relativity & Gravitation • Canadian Association of Physicists

SKILLS

LANGUAGES

English • French • Italian

PROGRAMMING

Python • C

COMPUTER ALGEBRA

Mathematica • Maple • Matlab

TALKS

INVITED

[1] Probing neutron star matter with gravitational waves. **CITA Seminar**, CITA, online (2021).

[2] Mapping the QCD phase diagram with LIGO's neutron star mergers. **Nuclear & Particle Physics Seminar**, Rice University, online (2021).

[3] Panel: Neutron stars and dense matter. **JINA Horizons Workshop**, Joint Institute for Nuclear Astrophysics, online (2020).

[4] Dense matter science with Cosmic Explorer. **First Cosmic Explorer Conference**, Penn State, online (2020).

[5] Compact binaries as probes of dense matter and dark matter. **Snowmass 2021 Community Planning Meeting**, online (2020).

[6] Panel: QCD matter in equilibrium. **From Heavy Ion Collisions to Neutron Stars**, University of Illinois at Urbana-Champaign, online (2020).

[7] GW190814: An unexpected compact binary coalescence from the mass gap. **DESY Astroparticle Seminar**, DESY Zeuthen, online (2020).

[8] GW190814: Gravitational waves from the coalescence of a 23 $M_\odot$ black hole with a 2.6 $M_\odot$ compact object. **LIGO-Virgo-Kagra Webinar**, online (2020).

[9] Insights on neutron-star matter from gravitational waves, hotspots and massive pulsars. **CaJAGWR Seminar**, Caltech (2020).

[10] Neutron star tides and quasi-universal relations. **Merging Visions**, Kavli Institute for Theoretical Physics (2019).

[11] New developments in gravitational-wave inference of the neutron star equation of state. **IUCAA Seminar**, Inter-University Center for Astronomy & Astrophysics (2019).

[12] Inferring the neutron star equation of state from gravitational waves: a new, non-parametric approach. **Center for Gravitation, Cosmology & Astrophysics Seminar**, University of Wisconsin - Milwaukee (2018).

[13] Tides in spinning neutron star binaries. **Theory Canada 13**, St Francis Xavier University (2018).

[14] Dynamical tidal response of a rotating neutron star. **Canadian Institute for Theoretical Astrophysics Seminar**, University of Toronto (2016).

[15] Photometry of derelict GEO and GPS satellites for rotation rate characterization. **Physics Department Colloquium**, Royal Military College (2011).

CONTRIBUTED

[16] The Cosmic Explorer Horizon Study: Science, observatories, and community. **SACNAS National Diversity in STEM Digital Conference**, online (2021).

[17] Distinguishing the nature of the lighter compact object in the binary merger GW190814. **APS April Meeting**, online (2021).

[18] Constraints on the neutron-star equation of state with gravitational-wave and pulsar observations. **APS April Meeting**, online (2020).

[19] A nonparametric approach to gravitational-wave inference of the neutron star equation of state. **GR22 + Amaldi13**, University of Valencia (2019).

[20] Inferring neutron star properties from GW170817 with universal relations. **28th Midwest Relativity Meeting**, University of Wisconsin - Milwaukee (2018); **APS April Meeting**, Denver CO (2019).

[21] Rotational-tidal phasing of the binary neutron star waveform. **18th Atlantic General Relativity Meeting**, St Francis Xavier University (2018).

[22] Extended I-Love relations for slowly rotating neutron stars. **27th Midwest Relativity Meeting**, University of Michigan (2017); **APS April Meeting**, Columbus OH (2018).

[23] Dynamical tidal response of a rotating neutron star. **GR21**, Columbia University; **26th Midwest Relativity Meeting**, Perimeter Institute (2016); **APS April Meeting**, Washington DC (2017).

[24] Tidal deformation of a slowly rotating compact body. **International Conference on Black Holes**, University of Toronto; **General Relativity & Gravitation: A Centennial Perspective**, Penn State; **25th Midwest Relativity Meeting**, Northwestern University (2015).

[25] Tidal deformation of an irrotational fluid body. **18th Eastern Gravity Meeting**, Rochester Insitute of Technology; **Fields Institute Focus Program on General Relativity**, University of Toronto (2015).

[26] Relativistic theory of surficial Love numbers. **17th Eastern Gravity Meeting**, West Virginia University; **24th Midwest Relativity Meeting**, Oakland University (2014).

[27] Tides in higher-dimensional Newtonian gravity. **16th Eastern Gravity Meeting**, University of Toronto; **23rd Midwest Relativity Meeting**, University of Wisconsin - Milwaukee (2013).

PUBLIC

[28] Listening for black holes and neutron stars: LIGO's recent gravitational wave discoveries. **Osher Life-long Learning Institute Lecture**, Cal State Fullerton (2020).

[29] Tides in the solar system and the universe. **Art of Science Lecture Series**, Agitator Art Gallery, Chicago (2019).

[30] Tides: from the seas to the stars. **Lifelong Learning Lecture Series**, Chicago Cultural Center (2018); Sulzer Regional Library, Chicago (2019).

[31] Neutron stars: dense, strange and not too bright. **Astronomy on Tap**, Marz Community Brewing, Chicago (2018).

[32] Gravitational waves and transient astronomy: a discussion of GW170817. **Public Lecture**, University of Chicago (2017).

PRESS

[1] F. Nicot, L'étoile à neutrons, astre de tous les extrêmes. **Sciences et avenir**, 2 Oct 2021.

[2] M. Koren, An Event So Wild It Could Make Anyone Feel Cosmically Small. **The Atlantic**, 29 Jun 2021.

[3] D. Cano Ramos, Neutron Stars Swallowed by Black Holes in Rare Cosmic Collisions. **CSUF News Service**, 29 Jun 2021.

[4] C. Wood, Mystery Object Blurs Line between Neutron Stars and Black Holes. **Scientific American**, 30 Jun 2020.

[5] D. Cano Ramos, CSUF Scientists Unravel Mystery Merger in the Universe. **CSUF News Service**, 23 Jun 2020.

[6] C. Wood, Why are big neutron stars like Tootsie Pops? **Popular Science**, 5 Jun 2020.

PUBLICATIONS

PEER-REVIEWED

[1] R. Essick, **P. Landry**, A. Schwenk & I. Tews, A Detailed Examination of Astrophysical Constraints on the Symmetry Energy and the Neutron Skin of ^{208}Pb with Minimal Modeling Assumptions, **Phys. Rev. C 104**, 065804 (2021), **arXiv**:2107.05528.

[2] **P. Landry** & J. S. Read, The Mass Distribution of Neutron Stars in Gravitational-wave Binaries, **Astrophys. J. Lett. 921**, L25 (2021), **arXiv**:2107.04559.

[3] R. Essick, I. Tews, **P. Landry** & A. Schwenk, Astrophysical Constraints on the Symmetry Energy and the Neutron Skin of ^{208}Pb with Minimal Modeling Assumptions, **Phys. Rev. Lett. 127**, 192701 (2021), **arXiv**:2102.10074.

[4] I. Legred, K. Chatziioannou, R. Essick, S. Han & **P. Landry**, Impact of the PSR J0740+6620 radius constraint on the properties of high-density matter, **Phys. Rev. D 105**, 063003 (2021), **arXiv**:2106.05313.

[5] C. Stachie *et al.* [incl. **P. Landry**], Predicting electromagnetic counterparts using low-latency gravitational-wave data products, **Mon. Not. R. Astron. Soc. 505**, 4235 (2021), **arXiv**:2103.01733.

[6] R. Abbott *et al.* [incl. **P. Landry**] (LIGO Scientific Collaboration, Virgo Collaboration and KAGRA Collaboration), Observation of Gravitational Waves from Two Neutron Star-Black Hole Coalescences, **Astrophys. J. 915**, L5 (2021), **arXiv**:2106.15163.

[7] R. Essick, I. Tews, **P. Landry**, S. Reddy & D. Holz, Direct astrophysical tests of chiral effective field theory at supranuclear densities [Editor's Suggestion], **Phys. Rev. C 102**, 055803 (2020), **arXiv**:2004.07744.

[8] R. Essick & **P. Landry**, Discriminating between Neutron Stars and Black Holes with Imperfect Knowledge of the Maximum Neutron Star Mass, **Astrophys. J. 904**, 80 (2020), **arXiv**:2007.01372.

[9] **P. Landry**, R. Essick & K. Chatziioannou, Nonparametric constraints on neutron star matter with existing and upcoming gravitational wave and pulsar observations, **Phys. Rev. D 101**, 123007 (2020), **arXiv**:2003.04880.

[10] R. Abbott *et al.* [incl. **P. Landry**] (LIGO Scientific Collaboration and Virgo Collaboration), GW190814: Gravitational Waves from the Coalescence of a 23 Solar Mass Black Hole with a 2.6 Solar Mass Compact Object, **Astrophys. J. Lett. 896**, L44 (2020), **arXiv**:2006.12611.

[11] R. Essick, **P. Landry** & D. Holz, Nonparametric inference of neutron star composition, equation of state, and maximum mass with GW170817, **Phys. Rev. D 101**, 063007 (2020), **arXiv**:1910.09740.

[12] B. P. Abbott *et al.* [incl. **P. Landry**] (LIGO Scientific Collaboration and Virgo Collaboration), GW190425: Observation of a Compact Binary Coalescence with Total Mass $\sim 3.4\ M_\odot$, **Astrophys. J. Lett. 892**, L3 (2020), **arXiv**:2001.01761.

[13] B. P. Abbott *et al.* [incl. **P. Landry**] (LIGO Scientific Collaboration and Virgo Collaboration), Model comparison from LIGO-Virgo data on GW170817's binary components and consequences for the merger remnant, **Class. Quantum Grav. 37**, 045006 (2020), **arXiv**:1908.01012.

[14] B. Kumar & **P. Landry**, Inferring neutron star properties from GW170817 with universal relations, **Phys. Rev. D 99**, 123026 (2019), **arXiv**:1902.04557.

[15] **P. Landry** & R. Essick, Nonparametric inference of the neutron star equation of state from gravitational wave observations, **Phys. Rev. D 99**, 084049 (2019), **arXiv**:1811.12529.

[16] M. Lagos, M. Fishbach, **P. Landry** & D. Holz, Standard sirens with a running Planck mass, **Phys. Rev. D 99**, 083504 (2019), **arXiv**:1901.03321.

[17] B. P. Abbott *et al.* [incl. **P. Landry**] (LIGO Scientific Collaboration and Virgo Collaboration), Properties of the binary neutron star merger GW170817, **Phys. Rev. X 9**, 011001 (2019), **arXiv**:1805.11579.

[18] **P. Landry** & B. Kumar, Constraints on the Moment of Inertia of PSR J0737-3039A from GW170817, **Astrophys. J. Lett. 868**, L22 (2018), **arXiv**:1807.04727.

[19] B. P. Abbott *et al.* [incl. **P. Landry**] (LIGO Scientific Collaboration and Virgo Collaboration), GW170817: Measurements of Neutron Star Radii and Equation of State, **Phys. Rev. Lett. 121**, 161101 (2018), **arXiv**:1805.11581.

[20] J. Gagnon-Bischoff, S. Green, **P. Landry** & N. Ortiz, Extended I-Love relations for slowly rotating neutron stars, **Phys. Rev. D 97**, 064042 (2018), **arXiv**:1711.05694.

[21] **P. Landry**, Tidal deformation of a slowly rotating material body: Interior metric and Love numbers, **Phys. Rev. D 95**, 124058 (2017), **arXiv**:1703.08168.

[22] **P. Landry** & E. Poisson, Dynamical response to a stationary tidal field, **Phys. Rev. D 92**, 124041 (2015), **arXiv**:1510.09170.

[23] **P. Landry** & E. Poisson, Gravitomagnetic response of an irrotational body to an applied tidal field, **Phys. Rev. D 91**, 104026 (2015), **arXiv**:1504.06606.

[24] **P. Landry** & E. Poisson, Tidal deformation of a slowly rotating material body: External metric, **Phys. Rev. D 91**, 104018 (2015), **arXiv**:1503.07366.

[25] **P. Landry** & E. Poisson, Relativistic theory of surficial Love numbers, **Phys. Rev. D 89**, 124011 (2014), **arXiv**:1404.6798.

[26] **P. Landry**, M. Abdelqader & K. Lake, McVittie solution with a negative cosmological constant, **Phys. Rev. D 86**, 084002 (2012), **arXiv**:1207.6350.

PREPRINTS

[27] B. P. Abbott *et al.* [incl. **P. Landry**], The population of merging compact binaries inferred using gravitational waves through GWTC-3, **arXiv**:2111.03634 (2021).

[28] M. Evans *et al.* [incl. **P. Landry**], A Horizon Study for Cosmic Explorer: Science, Observatories, and Community, **arXiv**:2109.09882 (2021).

[29] **P. Landry**, Rotational-tidal phasing of the binary neutron star waveform, **arXiv**:1805.01882 (2018).