

# Philippe Landry

Nicholas & Lee Begovich Center for Gravitational Wave Physics & Astronomy  
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## CURRENT POSITION

**POSTDOCTORAL RESEARCHER** • CALIFORNIA STATE UNIVERSITY, FULLERTON Sep 2019 - Present

Postdoctoral research associate at the **Nicholas & Lee Begovich Center for Gravitational Wave Physics & Astronomy**; member of the National Science Foundation funded **Cosmic Explorer** project tasked with the horizon study for the US's third-generation ground-based gravitational wave detector

## 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 SCHOLAR** • UNIVERSITY OF CHICAGO

Sep 2017 - Aug 2019

Postdoctoral research scholar at the **Enrico Fermi Institute** and associate fellow at the **Kavli Institute for Cosmological Physics**; worked on various projects in gravitational wave astrophysics

**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

## AWARDS & FELLOWSHIPS

### **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

### **LECTURER • LIFELONG LEARNING LECTURES**

Sep 2018 - Present

Participate 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 - Present

Conduct interviews and curate posts for public outreach blog profiling individual LIGO scientists

### **REFEREE • PHYSICAL REVIEW, THE ASTROPHYSICAL JOURNAL, SCIENCE**

Sep 2017 - Present

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

### **SPACE VISUALIZATION LAB PRESENTER • ADLER PLANETARIUM**

Jan 2018 - Aug 2019

Regular volunteer 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 a number of talks

**COMMITTEE MEMBER • GWPI COORDINATING COMMITTEE** Sep 2014 - Apr 2017  
Student representative on the graduate program committee for the Guelph-Waterloo Physics Institute and participant in the 2016 institute director search

**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

Bhaskar Biswas, IUCAA Mar 2019 - Present  
Bharat Kumar, Institute of Physics, Bhubaneswar Sep 2017 - Dec 2018

### UNDERGRADUATE STUDENTS

Abel 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  
J  r  mie Gagnon-Bischoff, Perimeter Institute May - Aug 2017

## AFFILIATIONS

### SCIENTIFIC COLLABORATIONS

LIGO Scientific Collaboration • Cosmic Explorer

### PROFESSIONAL SOCIETIES

American Physical 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 & PRESS

### INVITED

- <sup>1</sup> Dense matter science with Cosmic Explorer. **First Cosmic Explorer Conference**, Penn State, online (2020).
- <sup>2</sup> Compact binaries as probes of dense matter and dark matter. **Snowmass 2021 Community Planning Meeting**, online (2020).
- <sup>3</sup> Panel: QCD matter in equilibrium. **From Heavy Ion Collisions to Neutron Stars**, University of Illinois at Urbana-Champaign, online (2020).
- <sup>4</sup> GW190814: An unexpected compact binary coalescence from the mass gap. **DESY Astroparticle Seminar**, DESY Zeuthen, online (2020).
- <sup>5</sup> 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).
- <sup>6</sup> Insights on neutron-star matter from gravitational waves, hotspots and massive pulsars. **CaJAGWR Seminar**, Caltech (2020).
- <sup>7</sup> Neutron star tides and quasi-universal relations. **Merging Visions**, Kavli Institute for Theoretical Physics (2019).
- <sup>8</sup> New developments in gravitational-wave inference of the neutron star equation of state. **IUCAA Seminar**, Inter-University Center for Astronomy & Astrophysics (2019).
- <sup>9</sup> 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).
- <sup>10</sup> Tides in spinning neutron star binaries. **Theory Canada 13**, St Francis Xavier University (2018).
- <sup>11</sup> Dynamical tidal response of a rotating neutron star. **Canadian Institute for Theoretical Astrophysics Seminar**, University of Toronto (2016).
- <sup>12</sup> Photometry of derelict GEO and GPS satellites for rotation rate characterization. **Physics Department Colloquium**, Royal Military College (2011).

### CONTRIBUTED

- <sup>13</sup> Constraints on the neutron-star equation of state with gravitational-wave and pulsar observations. **APS April Meeting**, online (2020).
- <sup>14</sup> A nonparametric approach to gravitational-wave inference of the neutron star equation of state. **GR22 + Amaldi13**, University of Valencia (2019).
- <sup>15</sup> Inferring neutron star properties from GW170817 with universal relations. **28th Midwest Relativity Meeting**, University of Wisconsin - Milwaukee (2018); **APS April Meeting**, Denver CO (2019).
- <sup>16</sup> Rotational-tidal phasing of the binary neutron star waveform. **18th Atlantic General Relativity Meeting**, St Francis Xavier University (2018).
- <sup>17</sup> Extended I-Love relations for slowly rotating neutron stars. **27th Midwest Relativity Meeting**, University of Michigan (2017); **APS April Meeting**, Columbus OH (2018).
- <sup>18</sup> Dynamical tidal response of a rotating neutron star. **GR21**, Columbia University; **26th Midwest Relativity Meeting**, Perimeter Institute (2016); **APS April Meeting**, Washington DC (2017).

- <sup>19</sup> 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).
- <sup>20</sup> Tidal deformation of an irrotational fluid body. **18th Eastern Gravity Meeting**, Rochester Institute of Technology; **Fields Institute Focus Program on General Relativity**, University of Toronto (2015).
- <sup>21</sup> Relativistic theory of surficial Love numbers. **17th Eastern Gravity Meeting**, West Virginia University; **24th Midwest Relativity Meeting**, Oakland University (2014).
- <sup>22</sup> Tides in higher-dimensional Newtonian gravity. **16th Eastern Gravity Meeting**, University of Toronto; **23rd Midwest Relativity Meeting**, University of Wisconsin - Milwaukee (2013).

## PUBLIC

- <sup>23</sup> Listening for black holes and neutron stars: LIGO's recent gravitational wave discoveries. **Osher Lifelong Learning Institute Lecture**, Cal State Fullerton (2020).
- <sup>24</sup> Tides in the solar system and the universe. **Art of Science Lecture Series**, Agitator Art Gallery, Chicago (2019).
- <sup>25</sup> Tides: from the seas to the stars. **Lifelong Learning Lecture Series**, Chicago Cultural Center (2018); Sulzer Regional Library, Chicago (2019).
- <sup>26</sup> Neutron stars: dense, strange and not too bright. **Astronomy on Tap**, Marz Community Brewing, Chicago (2018).
- <sup>27</sup> Gravitational waves and transient astronomy: a discussion of GW170817. **Public Lecture**, University of Chicago (2017).

## PRESS

- <sup>28</sup> C. Wood, Mystery Object Blurs Line between Neutron Stars and Black Holes. **Scientific American**, 30 Jun 2020.
- <sup>29</sup> D. Cano Ramos, CSUF Scientists Unravel Mystery Merger in the Universe. **CSUF News Service**, 23 Jun 2020.
- <sup>30</sup> C. Wood, Why are big neutron stars like Tootsie Pops? **Popular Science**, 5 Jun 2020.

## PUBLICATIONS

### PEER-REVIEWED

- <sup>1</sup> 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](#).
- <sup>2</sup> 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](#).
- <sup>3</sup> **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](#).

- <sup>4</sup> 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](#).
- <sup>5</sup> 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](#).
- <sup>6</sup> 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](#).
- <sup>7</sup> B. Kumar & **P. Landry**, Inferring neutron star properties from GW170817 with universal relations, **Phys. Rev. D** **99**, 123026 (2019), [arXiv:1902.04557](#).
- <sup>8</sup> **P. Landry** & R. Essick, Non-parametric inference of the neutron star equation of state from gravitational wave observations, **Phys. Rev. D** **99**, 084049 (2019), [arXiv:1811.12529](#).
- <sup>9</sup> M. Lagos, M. Fishbach, **P. Landry** & D. Holz, Standard sirens with a running Planck mass, **Phys. Rev. D** **99**, 083504 (2019), [arXiv:1901.03321](#).
- <sup>10</sup> 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](#).
- <sup>11</sup> **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](#).
- <sup>12</sup> 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](#).
- <sup>13</sup> 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](#).
- <sup>14</sup> **P. Landry**, Tidal deformation of a slowly rotating material body: Interior metric and Love numbers, **Phys. Rev. D** **95**, 124058 (2017), [arXiv:1703.08168](#).
- <sup>15</sup> **P. Landry** & E. Poisson, Dynamical response to a stationary tidal field, **Phys. Rev. D** **92**, 124041 (2015), [arXiv:1510.09170](#).
- <sup>16</sup> **P. Landry** & E. Poisson, Gravitomagnetic response of an irrotational body to an applied tidal field, **Phys. Rev. D** **91**, 104026 (2015), [arXiv:1504.06606](#).
- <sup>17</sup> **P. Landry** & E. Poisson, Tidal deformation of a slowly rotating material body: External metric, **Phys. Rev. D** **91**, 104018 (2015), [arXiv:1503.07366](#).
- <sup>18</sup> **P. Landry** & E. Poisson, Relativistic theory of surficial Love numbers, **Phys. Rev. D** **89**, 124011 (2014), [arXiv:1404.6798](#).
- <sup>19</sup> **P. Landry**, M. Abdelqader & K. Lake, McVittie solution with a negative cosmological constant, **Phys. Rev. D** **86**, 084002 (2012), [arXiv:1207.6350](#).

## PREPRINTS

- <sup>20</sup> R. Essick & **P. Landry**, Discriminating between Neutron Stars and Black Holes with Imperfect Knowledge of the Maximum Neutron Star Mass, [arXiv:2007.01372](#) (2020).
- <sup>21</sup> **P. Landry**, Rotational-tidal phasing of the binary neutron star waveform, [arXiv:1805.01882](#) (2018).