

BEN FARR

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EDUCATION

Northwestern University
Ph.D. in Physics & Astronomy
Evanston, IL
2009 – 2014

Rochester Institute of Technology
B. S. in Physics
Minors in Astronomy, Mathematics, and Philosophy.
Rochester, NY
2005 – 2009

RESEARCH INTERESTS

Astrophysics of compact objects (neutron stars, black holes), particularly characterization of compact binary populations through gravitational wave and multi-messenger astronomy.

Advanced statistical techniques for analyzing astronomical data sets.

THESIS

“Extracting Astrophysical Information from Compact Binary Coalescence Gravitational Waves and their Electromagnetic Counterparts”

Advisor: Prof. Vicky Kalogera

My thesis focuses on developing the parameter estimation tools used to estimate the parameters of compact binary coalescences from their gravitational wave signatures. In particular I focus on developing new Markov-Chain Monte Carlo techniques that allow more efficient analyses, with the goal of producing estimates fast enough to inform searches for electromagnetic counterparts.

EXPERIENCE

Assistant Professor of Physics, University of Oregon	2017 –
Robert R. McCormick Postdoctoral Fellow, University of Chicago	2014 – 2017
Predocctoral Researcher, University of Birmingham, UK	2013 – 2014
Teaching Assistant, Northwestern University	2012 – 2013
NSF Graduate Research Fellow, Northwestern University	2011 – 2014
Visiting Lecturer, Chicago State University	2011 – 2012
NSF Graduate STEM Fellow in K-12 Education, Northwestern University	2010 – 2011
Huang Research Fellow, Northwestern University	2009 – 2010
Teaching Assistant, Rochester Institute of Technology	2007 – 2008

OUTREACH

- **2018 QuarkNet Lecture, University of Oregon**, June 2018.
A teacher professional development program funded by the National Science Foundation and the US Department of Energy.
- **2018 Intel Science Fair Lecture, University of Oregon**, Feb. 2018.
- **2018 Physics Slam Lecture, University of Oregon**, Jan. 2018.
- **Astronomy on Tap Lecture, Half Acre Beer Company**, June 2017.
- **Lifelong Learning Lecture, Montgomery Place Retirement Community**, Sept. 2016.
- **Compton Lecturer, University of Chicago**, 2015 – 2016.
Hosted a nine-part lecture series for the public on LIGO and gravitational wave astronomy.
- **Astronomy Lecturer, Adler Planetarium, Space Visualization Laboratory**, 2011 – *present*.
Hold several talks each month with the public on gravitational wave astronomy and other topics in astrophysics.
- **Telescope Operator, Dearborn Observatory, Northwestern University**, 2011 – 2013.
Operated the telescope for university classes and weekly public outreach sessions.
- **Astronomy Exhibitor**, 2009 – 2013.
Hosted booths at Adler Planetarium and several local elementary school science fairs, teaching the public about gravitational wave astronomy, compact objects, and exoplanets.

SERVICE

- **Compact Binary Parameter Estimation Group Chair, LIGO/Virgo**, 2018 – *present*.
Elected co-chair of the LIGO/Virgo Compact Binary Group.
- **Hubble Space Telescope Advising Working Group in Time Domain Astronomy**, 2018.
- **Compact Binary Parameter Estimation Group Chair, LIGO/Virgo**, 2016 – 2018.
Appointed co-chair of the LIGO/Virgo Compact Binary Parameter Estimation Group.
- **Scientific Organizing Committee Member, LIGO Scientific Collaboration Open Data Workshop**, 2018.
- **NSF Review Panel**, 2017.
- **Organizing Committee Member & Working Group Leader, SAMSI ASTRO Program**, 2016 – 2017.
Leader of the working group on multivariate and irregularly-sampled time series.
- **Student Representative, Elected, Executive Committee of the GGR**, 2012 – 2014.
Served a two year term as student representative on the executive committee of the topical group in gravitation, a topical group of the American Physical Society.

ADVISING

Bruce Edelman, <i>Graduate Student</i> , University of Oregon	2018 –
Maya Fishbach, <i>Graduate Student</i> , University of Chicago	2016 – 2017
Zoheyr Doctor, <i>Graduate Student</i> , University of Chicago	2015 – 2017
Jessie Duncan, <i>Undergraduate Student</i> , Northwestern University	2015
Shriram Chennakesavalu, <i>High School Student</i>	2015
Leah Perri, <i>Undergraduate Student</i> , Northwestern University	2014 – 2015
Brian Klein, <i>Researcher</i> , Northwestern University	2013 – 2015
Ben Sandeen, <i>Undergraduate Student</i> , Northwestern University	2013 – 2015
Scott Coughlin, <i>Undergraduate Student</i> , Northwestern University	2011 – 2014
Atul Adhikari, <i>Undergraduate Student</i> , Northwestern University	2014
Claudeson Azuri, <i>Undergraduate Student</i> , Northwestern University	2014
Jeremy Vollen, <i>Undergraduate Student</i> , Rice University	2014
James Hu, <i>Undergraduate Student</i> , Northwestern University	2014
Aditya Manikantan, <i>Undergraduate Student</i> , Northwestern University	2014
Brandon Miller, <i>Undergraduate Student</i> , Rochester Institute of Technology	2014
Adam Liu, <i>High School Student</i>	2014
Jeff Wang, <i>High School Student</i>	2014
John Le, <i>Undergraduate Student</i> , Northwestern University	2011 – 2013
Alex Ayerdi, <i>Undergraduate Student</i> , Northwestern University	2012
Connor Skeehan, <i>Undergraduate Student</i> , Northwestern University	2011 – 2012

AWARDS

Compton Lecture Series University of Chicago	2016
Robert R. McCormick Postdoctoral Research Fellowship Enrico Fermi Institute, University of Chicago	2014 – 2017
NSF Graduate Research Fellowship	2011 – 2014
NSF Graduate STEM Fellowship in K-12 Education	2010
Huang Fellowship Northwestern University	2009
John Wiley Jones Award for Outstanding Students in Science Rochester Institute of Technology	2009

AWARDS with COLLABORATION

<i>Science's</i> Breakthrough of the Year	2017
IOP Physics World Breakthrough of the Year to the multi-messenger astronomy authors of the publication "Multi-Messenger Observations of a Binary Neutron Star Merger"	2017
Princess of Asturias Award for Technical and Scientific Research jointly to the LIGO Scientific Collaboration and to Weiss, Thorne, and Barish	2017
Einstein Medal from the Einstein Society in Bern, Switzerland to the LIGO Scientific Collaboration	2017
UK RAS Group Achievement Award in Astronomy to the LIGO Team	2017
Bruno Rossi Prize (AAS HEAD) to Gonzalez and the LIGO Scientific Collaboration	2017
CBC Science Story of the Year	2016
APS Physics Highlights of the Year, #1	2016
<i>Science's</i> Breakthrough of the Year	2016
Science News Magazine's Top Science Story of 2016	2016
IOP Physics World Breakthrough of the Year to the LIGO Scientific Collaboration	2016
Foreign Policy Magazine, Top 100 Global Thinkers to the LIGO Scientific Collaboration	2016
Distinguished Science Award, National Space Club - Huntsville Chapter to the LIGO GW150914 Discovery Team	2016
Gruber Cosmology Prize to Drever, Thorne, Weiss, and the LIGO Discovery Team	2016
Breakthrough Prize in Fundamental Physics to Drever, Thorne, Weiss, and the LIGO Discovery Team	2016

INVITED TALKS

- Plenary Speaker**
19th Annual Meeting of the APS-NW Section
GW170817: Astronomy's First Talkie, June 2018
- Astronomy Seminar**
New York University
*The Compact Binary Census
after LIGO/Virgo's Second Observing Run*, May 2018
- Invited Speaker**
10th Sackler Conference
in Theoretical Astrophysics:
Gravitational Wave Astrophysics
BBH Detections in O1/O2, May 2018
- Theory Seminar**
University of Oregon
*The Compact Binary Census
after LIGO/Virgo's Second Observing Run*, Feb. 2018
- Physics Colloquium**
Oregon State University
*The First 166 Days
of Gravitational Wave Astronomy*, Jan. 2018
- Physics Colloquium**
University of Oregon
GW170817: Astronomy's First Talkie, Nov. 2017
- Invited Speaker**
Kavli Summer Program in Astrophysics:
Astrophysics with GW detections
Niels Bohr Institute
Black Hole Spin Measurements with LIGO, Aug. 2017
- Invited Speaker**
The Mysteries and
Inner Workings of Massive Stars
Kavli Institute for Theoretical Physics
Measuring Spin with LIGO, Mar. 2017
- Physics Colloquium**
University of Guelph
*Compact Binaries in the Era
of Gravitational Wave Astronomy*, Mar. 2017
- Physics Colloquium**
Perimeter Institute
*Compact Binaries in the Era
of Gravitational Wave Astronomy*, Mar. 2017
- Physics Seminar**
University of Oregon
The Future of Gravitational Wave Astronomy, Mar. 2017
- Physics Colloquium**
University of Oregon
*The First Four Months
of Gravitational Wave Astronomy*, Mar. 2017
- Invited Speaker**
Gravitational-Wave Astrophysics
in the High Event Rate Regime
University of Tokyo
*Constraining Binary Populations
from Gravitational Wave Detections*, Dec. 2016
- Invited Speaker**
Astrophysics at the eXtreme
Penn State
*Challenges in Search Algorithms
and Analysis Pipelines*, Dec. 2016

Introductory Speaker Kavli Frontiers of Science	<i>Characterization of gravitational wave transients in Advanced LIGO</i> , Nov. 2016
KICP Colloquium University of Chicago	<i>The First Four Months of Gravitational Wave Astronomy</i> , Oct. 2016
Physics Colloquium Northern Illinois University	<i>LIGO: From Detector to Observatory</i> , Oct. 2016
Physics Colloquium Central Michigan University	<i>LIGO: From Detector to Observatory</i> , Sept. 2016
LIGO Academic Affairs Council LIGO-Virgo September Meeting	<i>Black Hole Population Studies</i> , Aug. 2016
ASTRO Opening Workshop SAMSI	<i>Characterization of Gravitational Wave Transients</i> , Aug. 2016
LIGO Rapid Response Workshop Kavli Institute for Theoretical Physics	<i>Characterizing Compact Binaries with LIGO</i> , Aug. 2016
Science Colloquium Center for Computational Sciences	<i>LIGO: From Detector to Observatory</i> , July 2016
High Energy Physics Seminar University of Chicago	<i>LIGO: From Detector to Observatory</i> , May 2016
Compton Lecture Series University of Chicago	<i>The Soundtrack to the Universe: LIGO and the Detection of Gravitational Waves</i> , nine-part public series, Spring 2016
Astro Seminar Fermilab	<i>LIGO: From Detector to Observatory</i> , Apr. 2016
Astro Seminar McGill	<i>From Detector to Observatory</i> , Feb. 2016
Seminar MIT	<i>From Detector to Observatory</i> , Feb. 2016
Physics Colloquium University of Iowa	<i>Advanced LIGO and the Beginning of Gravitational Wave Astronomy</i> , Oct. 2015
Compton Lecture University of Chicago	<i>Hunting for Gravitational Waves with LIGO</i> , May 2015.
CCRG Seminar Rochester Institute of Technology	<i>Bayesian Parameter Estimation from Gravitational Wave Signals</i> , Oct. 2011.

FUNDING

Gravitational Wave Astrophysics in the High Event Rate Regime (PI: B. Farr)
NSF – Support of LIGO Research

2018 – 2021

PUBLICATIONS

1. GW170817: Measurements of neutron star radii and equation of state.
B. P. Abbott, et al. Submitted to *Phys. Rev. Lett.* (2018).
2. Properties of the binary neutron star merger GW170817.
B. P. Abbott, et al. Submitted to *Phys. Rev. X* (2018).
3. exocartographer: A Bayesian Framework for Mapping Exoplanets in Reflected Light.
B. Farr, W. Farr, N. Cowan, H. Haggard, T. Robinson. Submitted to *Astron. J.* (2018).
4. Using Spin to Understand the Formation of LIGO and Virgo's Black Holes.
B. Farr, D. Holz, W. Farr. *Astrophys. J. Lett.*, **854**, L9 (2018).
5. GW170608: Observation of a 19 Solar-mass Binary Black Hole Coalescence.
B. P. Abbott, et al. *Astrophys. J. Lett.*, **851**, L35 (2017).
6. The Electromagnetic Counterpart of the Binary Neutron Star Merger LIGO/Virgo GW170817. IV. Detection of Near-infrared Signatures of r-process Nucleosynthesis with Gemini-South.
R. Chornock, et al. *Astrophys. J. Lett.*, **848**, L19 (2017).
7. The Electromagnetic Counterpart of the Binary Neutron Star Merger LIGO/Virgo GW170817. II. UV, Optical, and Near-infrared Light Curves and Comparison to Kilonova Models.
P. S. Cowperthwaite, et al. *Astrophys. J. Lett.*, **848**, L17 (2017).
8. The Electromagnetic Counterpart of the Binary Neutron Star Merger LIGO/Virgo GW170817. I. Discovery of the Optical Counterpart Using the Dark Energy Camera.
M. Soares-Santos, et al. *Astrophys. J. Lett.*, **848**, L16 (2017).
9. A gravitational-wave standard siren measurement of the Hubble constant.
B. P. Abbott, et al. *Nature*, **551**, 85–88 (2017).
10. Multi-messenger Observations of a Binary Neutron Star Merger.
B. P. Abbott, et al. *Astrophys. J. Lett.*, **848**, L12 (2017).
11. Gravitational Waves and Gamma-Rays from a Binary Neutron Star Merger: GW170817 and GRB 170817A.
B. P. Abbott, et al. *Astrophys. J. Lett.*, **848**, L13 (2017).
12. GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral.
B. P. Abbott, et al. *Phys. Rev. Lett.*, **119**, 161101 (2017).
13. GW170814: A Three-Detector Observation of Gravitational Waves from a Binary Black Hole Coalescence.
B. P. Abbott, et al. *Phys. Rev. Lett.*, **119**, 141101 (2017).
14. Distinguishing spin-aligned and isotropic black hole populations with gravitational waves.
W. Farr, S. Stevenson, C. Miller, I. Mandel, **B. Farr**, A. Vecchio *Nature*, **548**, 426–429 (2017).
15. Statistical gravitational waveform models: What to simulate next?
Z. Doctor, **B. Farr**, D. Holz, M. Pürrer *Phys. Rev. D*, **96**, 123011 (2017).
16. Are LIGO's Black Holes Made from Smaller Black Holes?
M. Fishbach, D. Holz, **B. Farr** *Astrophys. J. Lett.*, **840**, L24 (2017).
17. GW170104: Observation of a 50-Solar-Mass Binary Black Hole Coalescence at Redshift 0.2.
B. P. Abbott, et al. *Phys. Rev. Lett.*, **118**, 221101 (2017).
18. A Search for Kilonovae in the Dark Energy Survey.
Z. Doctor, R. Kessler, H. Y. Chen, **B. Farr**, et al. *Astrophys. J.*, **837**, 57 (2017).

19. Parameter estimation on gravitational waves from neutron-star binaries with spinning components.
B. Farr, C. Berry, W. Farr, et al. *Astrophys. J.*, **825**, 116 (2016).
20. Going the Distance: Mapping Host Galaxies of LIGO and Virgo Sources in Three Dimensions Using Local Cosmography and Targeted Follow-up.
L. P. Singer, H.-Y. Chen, D. E. Holz, W. M. Farr, L. R. Price, V. Raymond, S. B. Cenko, N. Gehrels, J. Cannizzo, M. M. Kasliwal, S. Nissanke, M. Coughlin, **B. Farr**, et al. *Astrophys. J. Lett.*, **829**, L15 (2016).
21. Binary Black Hole Mergers in the first Advanced LIGO Observing Run.
B. P. Abbott, et al. *Phys. Rev. X*, **6**, 041015 (2016).
22. GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence.
B. P. Abbott, et al. *Phys. Rev. Lett.*, **116**, 241103 (2016).
23. Properties of the Binary Black Hole Merger GW150914.
B. P. Abbott, et al. *Phys. Rev. Lett.*, **116**, 241102 (2016).
24. Tests of General Relativity with GW150914.
B. P. Abbott, et al. *Phys. Rev. Lett.*, **116**, 221101 (2016).
25. Observing gravitational-wave transient GW150914 with minimal assumptions.
B. P. Abbott, et al. *Phys. Rev. D*, **93**, 122004 (2016).
26. Systematic Errors in Low-latency Gravitational Wave Parameter Estimation Impact, Electromagnetic Follow-up Observations
T. B. Littenberg, **B. Farr**, S. Coughlin, V. Kalogera. *Astrophys. J.*, **820**, 7 (2016).
27. Astrophysical Implications of the Binary Black-hole Merger GW150914.
B. P. Abbott, et al. *Astrophys. J. Lett.*, **818**, L22 (2016).
28. Observation of Gravitational Waves from a Binary Black Hole Merger.
B. P. Abbott, et al. *Phys. Rev. Lett.*, **116**, 061102 (2016).
29. Rapid gravitational wave parameter estimation with a single spin: Systematic uncertainties in parameter estimation with the SpinTaylorF2 approximation.
B. Miller, R. O’Shaughnessy, T. B. Littenberg, **B. Farr**. *Phys. Rev. D*, **92**, 044056 (2015).
30. Neutron stars versus black holes: probing the mass gap with LIGO/Virgo.
T. Littenberg, **B. Farr**, S. Coughlin, V. Kalogera, D. Holz. *Astrophys. J. Lett.*, **807**, L24 (2015).
31. Parameter Estimation for Binary Neutron-star Coalescences with Realistic Noise during the Advanced LIGO Era.
C. P. L. Berry, I. Mandel, H. Middleton, L. P. Singer, A. L. Urban, A. Vecchio, S. Vitale, K. Cannon, **B. Farr**, et al. *Astrophys. J.*, **804**, 114 (2015).
32. Parameter estimation for compact binaries with ground-based gravitational-wave observations using the LALInference software library.
J. Veitch, V. Raymond, **B. Farr**, et al. *Phys. Rev. D*, **91**, 042003 (2015).
33. The First Two Years of Electromagnetic Follow-Up with Advanced LIGO and Virgo.
L. Singer, L. Price, **B. Farr**, et al. *Astrophys. J.*, **795**, 105 (2014).
34. A more effective coordinate system for parameter estimation of precessing compact binaries from gravitational waves.
B. Farr, E. Ochsner, W. M. Farr, R. O’Shaughnessy. *Phys. Rev. D*, **90**, 024018 (2014).
35. A more efficient approach to parallel-tempered Markov-chain Monte Carlo for the highly structured posteriors of gravitational-wave signals.
B. Farr, V. Kalogera, E. Lijten. *Phys. Rev. D*, **90**, 024014 (2014).

36. The NINJA-2 project: Detecting and characterizing gravitational waveforms modelled using numerical binary black hole simulations.
Ninja-2 Collaboration. *Classical Quantum Gravity*, **31**, 115004 (2014).
37. Systematic and statistical errors in a Bayesian approach to the estimation of the neutron-star equation of state using advanced gravitational wave detectors.
L. Wade, J. D. E. Creighton, E. Ochsner, B. D. Lackey, **B. Farr**. *Phys. Rev. D*, **89**, 103012 (2014).
38. Parameter Estimation of Gravitational Waves from Precessing BH-NS Inspirals with higher harmonics.
R. O’Shaughnessy, **B. Farr**, E. Ochsner, H. S. Cho, V. Raymond, C. Kim, C. H. Lee. *Phys. Rev. D*, **89**, 102005 (2014).
39. Reconstructing the sky location of gravitational-wave detected compact binary systems: Methodology for testing and comparison.
T. Sidery, B. Aylott, N. Christensen, **B. Farr**, et al. *Phys. Rev. D*, **89**, 084060 (2014).
40. Basic Parameter Estimation of Binary Neutron Star Systems by the Advanced LIGO/Virgo Network.
C. Rodriguez, **B. Farr**, V. Raymond, W. Farr, T. Littenberg, D. Fazi, V. Kalogera. *Astrophys. J.*, **784**, 119 (2014).
41. Parameter Estimation of Gravitational Waves from Nonprecessing BH-NS Inspirals with higher harmonics: Comparing MCMC posteriors to an Effective Fisher Matrix.
R. O’Shaughnessy, **B. Farr**, E. Ochsner, Cho H.-S., C. Kim, Lee C.-H. *Phys. Rev. D*, **89**, 064048 (2014).
42. Comparison of Gravitational Wave Detector Network Sky Localization Approximations.
K. Grover, S. Fairhurst, **B. Farr**, I. Mandel, et al. *Phys. Rev. D*, **89**, 042004 (2014).
43. Parameter estimation for compact binary coalescence signals with the first generation gravitational-wave detector network.
J. Aasi, et al. *Phys. Rev. D*, **88**, 062001 (2013).
44. Fortifying the characterization of binary mergers in LIGO data.
T. Littenberg, M. Coughlin, **B. Farr**, W. Farr. *Phys. Rev. D*, **88**, 084044 (2013).
45. Inadequacies of the Fisher Information Matrix in gravitational-wave parameter estimation.
C. Rodriguez, **B. Farr**, W. Farr, I. Mandel. *Phys. Rev. D*, **88**, 084013 (2013).
46. Gravitational wave science in the high school classroom.
B. Farr, G. Schelbert, L. Trouille. *Am. J. Phys.*, **80**, 898 (2012).
47. Estimating parameters of coalescing compact binaries with proposed advanced detector networks.
J. Veitch, I. Mandel, B. Aylott, **B. Farr**, V. Raymond, C. Rodriguez, M. van der Sluys, V. Kalogera, A. Vecchio. *Phys. Rev. D*, **85**, 104045 (2012).
48. Time Evolution of a Nonsingular Primordial Black Hole.
M. Mbonye, N. Battista, **B. Farr**. *Int. J. Mod. Phys. D*, **21**, 3 (2010).
49. Testing gravitational-wave searches with numerical relativity waveforms: results from the first Numerical INjection Analysis (NINJA) project.
B. Aylott, J. Baker, W. Boggs, et al. *Classical Quantum Gravity*, **26**, 165008 (2009).
50. Status of NINJA: the Numerical INjection Analysis project.
L. Cadonati, B. Aylott, J. Baker, et al. *Classical Quantum Gravity*, **26**, 114008 (2009).
51. Searching for binary coalescences with inspiral templates: detection and parameter estimation.
B. Farr, S. Fairhurst, B. S. Sathyaprakash. *Classical Quantum Gravity*, **26**, 114009 (2009).

PUBLICATIONS (with the LIGO Scientific Collaboration)

- [1] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. Search for Tensor, Vector, and Scalar Polarizations in the Stochastic Gravitational-Wave Background. *Phys. Rev. Lett.*, 120:201102, May 2018.
- [2] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. Full band all-sky search for periodic gravitational waves in the O1 LIGO data. *Phys. Rev. D*, 97:102003, May 2018.
- [3] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. Constraints on cosmic strings using data from the first Advanced LIGO observing run. *Phys. Rev. D*, 97:102002, May 2018.
- [4] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. A Search for Tensor, Vector, and Scalar Polarizations in the Stochastic Gravitational-Wave Background. *ArXiv e-prints*, page arXiv:1802.10194, February 2018.
- [5] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. GW170817: Implications for the Stochastic Gravitational-Wave Background from Compact Binary Coalescences. *Phys. Rev. Lett.*, 120:091101, March 2018.
- [6] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, M. R. Abernathy, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. Effects of data quality vetoes on a search for compact binary coalescences in Advanced LIGO's first observing run. *Classical and Quantum Gravity*, 35:065010, March 2018.
- [7] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, M. R. Abernathy, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. All-sky search for long-duration gravitational wave transients in the first Advanced LIGO observing run. *Classical and Quantum Gravity*, 35:065009, March 2018.
- [8] B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, R. X. Adhikari, V. B. Adya, and et al. First Search for Nontensorial Gravitational Waves from Known Pulsars. *Physical Review Letters*, 120(3):031104, January 2018.
- [9] B. P. Abbott, R. Abbott, T. D. Abbott, M. R. Abernathy, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. Prospects for observing and localizing gravitational-wave transients with Advanced LIGO, Advanced Virgo and KAGRA. *Living Reviews in Relativity*, 21:3, April 2018.
- [10] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. GW170817: Implications for the Stochastic Gravitational-Wave Background from Compact Binary Coalescences. *ArXiv e-prints*, October 2017.
- [11] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. First search for nontensorial gravitational waves from known pulsars. *ArXiv e-prints*, September 2017.
- [12] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. First narrow-band search for continuous gravitational waves from known pulsars in advanced detector data. *ArXiv e-prints*, October 2017.

- [13] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, and et al. Constraints on cosmic strings using data from the first Advanced LIGO observing run. *ArXiv e-prints*, December 2017.
- [14] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, M. R. Abernathy, F. Acernese, K. Ackley, C. Adams, T. Adams, and et al. Effects of Data Quality Vetoes on a Search for Compact Binary Coalescences in Advanced LIGO's First Observing Run. *ArXiv e-prints*, October 2017.
- [15] The LIGO Scientific Collaboration, the Virgo Collaboration, B. P. Abbott, R. Abbott, T. D. Abbott, M. R. Abernathy, F. Acernese, K. Ackley, C. Adams, T. Adams, and et al. All-sky search for long-duration gravitational wave transients in the first Advanced LIGO observing run. *ArXiv e-prints*, November 2017.
- [16] A. Albert, M. André, M. Anghinolfi, M. Ardid, J.-J. Aubert, J. Aublin, T. Avgitas, B. Baret, J. Barrios-Martí, S. Basa, and et al. Search for High-energy Neutrinos from Binary Neutron Star Merger GW170817 with ANTARES, IceCube, and the Pierre Auger Observatory. *ApJ*, 850:L35, December 2017.
- [17] A. Albert, M. André, M. Anghinolfi, G. Anton, M. Ardid, J.-J. Aubert, T. Avgitas, B. Baret, J. Barrios-Martí, S. Basa, and et al. Search for high-energy neutrinos from gravitational wave event GW151226 and candidate LVT151012 with ANTARES and IceCube. *Phys. Rev. D*, 96(2):022005, July 2017.
- [18] B. P. Abbott, R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, R. X. Adhikari, V. B. Adya, and et al. Upper Limits on Gravitational Waves from Scorpius X-1 from a Model-based Cross-correlation Search in Advanced LIGO Data. *ApJ*, 847:47, September 2017.
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