MAYA FISHBACH

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RESEARCH INTERESTS

Gravitational-wave astrophysics and cosmology
Black holes and neutron stars
Massive stars
Bayesian statistics

EMPLOYMENT

Assistant Professor *2022–*
CITA, University of Toronto
NASA Einstein Postdoctoral Fellow *2020-2022*
CIERA, Northwestern University

EDUCATION

University of Chicago, PhD in Astronomy & Astrophysics *September 2020*
Thesis: "Astronomy and Cosmology with Gravitational Waves"
Supervisor: Daniel Holz
Yale University, B.S. Physics (Intensive); Mathematics *cum laude* *May 2015*

FELLOWSHIPS

CIERA Fellowship *2020-2025*
Northwestern University
NASA Einstein Fellowship *2020-2023*
Proposal: "Stellar Afterlives and Black Hole Cataclysms: Learning about Stars, Galaxies, and the Cosmic Expansion with Gravitational Waves"
William Rainey Harper Dissertation Fellowship *2019-2020*
University of Chicago
NSF Graduate Research Fellowship *2017-2020*
National Science Foundation
McCormick Graduate Fellowship *2015-2017*
University of Chicago

PUBLICATIONS

31 short-author list papers (with preprints), including 12 first-author

14 LIGO–Virgo–Kagra papers with significant contributions, including 1 as Paper Writing Team chair and 3 as Paper Writing Team member

Publications listed at end of CV, or ADS: https://ui.adsabs.harvard.edu/public-libraries/2FHJKhpDTTCx9VRUw7QRHA

INVITED CONFERENCE TALKS

KICP Workshop (Chicago) *September 19-23, 2022*
The Quest for Precision Gravitational-Wave Cosmology
Invited talk, What to expect from O4 and O5

GMT Community Science Meeting (Sedona) *September 1-3, 2022*
Black Holes at All Scales
Invited talk, Astrophysical Implications of LIGO–Virgo–KAGRA's Black Holes

Physics and Astrophysics at the eXtreme VIII (MIT) *August 1-3, 2022*
Invited speaker and panelist, Compact Binary Populations

EAS 2022: Shedding light on the dark side of the Universe with new cosmological probes (Valencia) *June 27-July 1, 2022*
Invited talk, Cosmology with gravitational-wave standard sirens

CIFAR Gravity and Extreme Universe Meeting (Montreal) *May 30-June 2, 2022*
Invited talk, Comparing black holes in gravitational-wave sources and X-ray binaries

Gravitational Waves Beyond the Boxes II (Perimeter Institute) *April 4-8, 2022*
Invited talk, Challenges for gravitational-wave cosmology

Heraeus Workshop (Bad Honnef, Germany) *April 25-28, 2022*
Gravitational-Wave and Multi-Messenger Astronomy
Invited talk, Black hole astrophysics with gravitational-wave populations

High Energy Astrophysics Division (HEAD) Special Session (Pittsburgh) *March 13-17, 2022*
Invited talk, LIGO-Virgo's black holes and implications for dynamical assembly

LIGO/Virgo Paper Webinar *December 9, 2021*
Constraints on the cosmic expansion history from GWTC-3

IPAM Workshop (Los Angeles) *November 15-19, 2021*
Source Inference and Parameter Estimation in Gravitational Wave Astronomy
Invited talk, Black hole astrophysics with gravitational-wave catalogs

Physics and Astrophysics at the eXtreme VII *August 23-27, 2021*
Invited panelist, Compact Binaries

Amaldi Conference on Gravitational Waves *July 19-23, 2021*
Plenary talk, Astrophysics with Gravitational Waves

Marcel Grossman Relativity Meeting *July 5-10, 2021*
Invited talk, Lessons from LIGO-Virgo's Biggest Black Holes

EAS 2021: Birth, Life, and Death of Black Holes *June 28-29, 2021*
Invited review talk, Black Hole Spin Measurements

APS April Meeting *April 17-20, 2021*
Invited talk, Cecilia Payne-Gaposchkin Doctoral Dissertation Award Finalist

Miami 2020 Conference *December 16, 2020*
Invited talk, Astrophysical Lessons from the Second Gravitational-Wave Transient Catalog

LIGO/Virgo Paper Webinar *November 12, 2020*
Population properties of Compact Objects from the Second Gravitational-Wave Transient Catalog

ICERM Workshop *November 16-20 2020*
Statistical Methods for the Detection, Classification, and Inference of Relativistic Objects
Invited talk, Gravitational-wave population statistics

First Cosmic Explorer Conference *October 26-30, 2020*
Invited panelist, Compact Binary Formation and Evolution

APS April Meeting (Washington, D.C.) *April 18-21, 2020*
Invited talk, Astrophysical Lessons from LIGO/Virgo's Black Holes

Cosmic Controversies (KICP, Chicago) *Oct 5-8, 2019*
Invited talk, Cosmology with Gravitational-Wave Standard Sirens

Merging Visions: Exploring Compact-Object Binaries with Gravity and Light (KITP, Santa Barbara) *Jun 24-27, 2019*

Invited talk, Measurements of H_0 with GW170817

Recontres de Moriond - Gravitation (La Thuille, Italy) *Mar 24-30, 2019*

Invited talk, Binary Black Hole Population Properties Inferred from the O1 and O2 Observations

Deep Learning for Multi-Messenger Astrophysics (NCSA, UIUC) *Oct 17-19, 2018*

Invited panelist, Signal-processing Algorithms to Enable Real-time Gravitational Wave Discovery

Physics and Astrophysics at the eXtreme III (Penn State) *Feb 5-7, 2018*

Invited panelist, Hubble Parameter

INVITED SEMINARS AND COLLOQUIA

Monash University Gravitational-Wave Seminar	*June 2, 2022*
Caltech Astronomy Colloquium	*May 11, 2022*
Stanford Institute for Theoretical Physics Colloquium	*May 9, 2022*
CITA Seminar	*April 7, 2022*
Perimeter Institute Colloquium	*March 21, 2022*
Johns Hopkins Physics Theory Group Seminar	*March 8, 2022*
UT Austin Astronomy Colloquium	*February 28, 2022*
Northwestern Physics & Astronomy Colloquium	*February 23, 2022*
UC Berkeley Astronomy Colloquium	*February 17, 2022*
UCLA Astronomy Colloquium	*February 16, 2022*
CMU-Pitt Astro Colloquium	*February 10, 2022*
Cornell Physics Seminar	*January 31, 2022*
Georgia Tech School of Physics Seminar	*January 24, 2022*
Rice Astronomy Seminar	*December 3, 2021*
UC Berkeley TAC Seminar	*September 27, 2021*
Los Alamos Astrophysics Seminar	*September 9, 2021*
Fermilab CPC Seminar	*April 26, 2021*
Royal Observatory, Edinburgh Astronomy Colloquium	*February 24, 2021*
Princeton Gravity Initiative Seminar	*February 22, 2021*
Harvard ITC Colloquium	*February 18, 2021*
Perimeter Institute Strong Gravity Seminar	*January 28, 2021*
University of Florida Theoretical Astrophysics Seminar	*October 14, 2020*
JILA Astronomy Seminar	*September 4, 2020*
University of Portsmouth ICG Colloquium	*September 3, 2020*
University of Wisconsin, Milwaukee CGCA Seminar	*November 18 2019*
Harvard ITC Galaxies & Cosmology Lunch	*November 12 2019*
Albert Einstein Institute Relativistic Astrophysics seminar (Potsdam)	*September 18, 2019*
Caltech TAPIR seminar	*December 14, 2018*
UC Santa Cruz Astronomy Seminar	*October 25, 2018*

PROFESSIONAL SERVICE

Chair, LVK Rates & Populations *2022-*

One of two co-chairs of the LIGO–Virgo–Kagra Collaboration compact binary populations group

DGRAV Executive Committee *2020-2022*

Student representative on APS Division of Gravitational Physics Executive Committee

Astronomy Seminar Committee, CIERA *2021-*

Social Justice Weekly Meetings Committee, CIERA *2021-*

Brinson Lecture Selection Committee, UChicago A&A *2018-2019*

Referee *2017-*

The Astrophysical Journal, The Astrophysical Journal Letters, Monthly Notices of the Royal Astronomical Society, Journal of Cosmology and Astroparticle Physics, Physical Review D, Nature Astronomy

TEACHING

Instructor, LSST Data Science Fellowship Program Session 13 *October 2021*
Matched Filtering for Time Series Analysis Workshop
Instructor, Northwestern University *Winter-Spring 2021*
DATA SCI 401: Data-Driven Research in Physics, Geophysics, and Astronomy
Co-Instructor, University of Chicago *Fall 2018*
Reading Seminar: Computational Methods for Gravitational-Wave Astrophysics
Teaching Assistant, University of Chicago *Fall 2016*
ASTR 241: Physics of Stars and Stellar Systems
Teaching Assistant, University of Chicago *Fall 2015-Spring 2016*
PHSC 12600-12620: Matter, Energy, Space and Time/ Black Holes/ The Big Bang

PUBLIC OUTREACH

AAS Journal Author Series YouTube link
Interview on black hole results in Fishbach & Kalogera (2022) *July 2022*
Naperville Astronomical Association Public Talk *June 2022*
Gravitational Wave Open Data Workshop, GW Astrophysics Lecture *May 2022*
Star-B-Q Speaker, Astronomy Ireland *October 2021*
Livestreamed public talk and Q&A, 250 audience members
Alan Alda's Science Clear & Vivid Podcast link *July 2021*
Guest Lecture for Undergraduate Astronomy Course
Northwestern University *May 2022*
Northwestern University *June 2021*
University of Illinois at Chicago *March 2021*
Bad Astra YouTube Interview link *February 2021*
Ask-a-Scientist Speaker, Fermilab *November 2019*
Public talk and lab tours, 126 visitors
Astronomy Conversations Presenter, Adler Planetarium *2016- 2020*
Bimonthly, 2-hour sessions with planetarium visitors at the Space Visualization Lab
Soapbox Science Speaker, Navy Pier *July 2018*
Science demonstrations and soapbox talk, 400 visitors
Life Long Learning Presenter, KICP *2016-2017*
Delivered two public talks to older adult audiences
Upward Bound Science Tutor, University of Chicago *2016-2017*
Weekly, one-on-one tutoring to high school students

PRESS

Neutron Star–Black Hole Discoveries
NPR (*June 2021*)
`https://www.npr.org/2021/06/29/1011047410/city-sized-neutron-star-massive-black-hole-collide-gulps-universe-gravitational`
Science Magazine (*June 2021*)
`https://www.sciencemag.org/news/2021/06/ripples-spacetime-reveal-black-holes-slurping-neutron-stars`

Hierarchical Black Hole Mergers
AAS Nova (*October 2022*)
`https://aasnova.org/2022/10/10/insights-from-misaligned-black-hole-pairs/`
University of Birmingham News (*July 2021*)
`https://www.birmingham.ac.uk/news/latest/2021/07/on-the-hunt-for-%27hierarchical%27-black-holes.aspx`

AAS Nova (*May 2017*)
http://aasnova.org/2017/05/12/are-ligos-black-holes-made-from-smaller-black-holes/
Science News (*January 2017*)
https://www.sciencenews.org/article/spin-may-reveal-black-hole-history

Big Black Holes and Pair Instability Mass Gap
Symmetry Magazine (*December 2020*)
https://www.symmetrymagazine.org/article/physics-at-tiniest-scale-could-explain-impossible-black-holes
Sky & Telescope (*November 2020*)
https://skyandtelescope.org/astronomy-news/big-black-holes-dominate-new-gravitational-wave-catalog/
Astrobites (*September 2017*)
https://astrobites.org/2017/09/28/where-are-ligos-big-black-holes/

Second and Third Gravitational-Wave Catalogs
Sky & Telescope (*June 2022*)
https://skyandtelescope.org/sky-and-telescope-magazine/inside-the-june-2022-issue/
CNN (*November 2021*)
https://www.cnn.com/2021/11/09/world/gravitational-waves-most-detected-scn/index.html
Quanta Magazine (*February 2021*)
https://www.quantamagazine.org/new-black-holes-offer-physicists-a-radical-probe-of-the-cosmos-20210217/
Science Magazine (*October 2020*)
https://www.sciencemag.org/news/2020/10/universe-teems-weird-black-holes-gravitational-wave-hunters-find
Nature.com (*October 2020*)
https://www.nature.com/articles/d41586-020-03047-0
APS News (*June 2020*)
https://www.aps.org/publications/apsnews/202006/blackholes.cfm

First Gravitational-Wave Transient Catalog
AAS Nova (*April 2020*)
https://aasnova.org/2020/04/10/merger-partners-maybe/
Sky & Telescope (*December 2018*)
https://www.skyandtelescope.com/astronomy-blogs/what-ligo-teaches-us-about-black-holes/
AAS Nova (*September 2018*)
https://aasnova.org/2018/09/07/black-hole-mergers-through-cosmic-time/
Sky & Telescope (*June 2017*)
http://www.skyandtelescope.com/astronomy-news/ligo-detects-third-black-hole-merger-0106201723

Gravitational-Wave Cosmology
APS News (*June 2019*)
https://www.aps.org/publications/apsnews/201906/wave.cfm
UChicago News (*October 2018*)
https://news.uchicago.edu/story/gravitational-waves-could-soon-provide-measure-universes-expansion
UChicago News (*September 2018*)
https://news.uchicago.edu/story/gravitational-waves-provide-dose-reality-about-extra-dimensions
The Daily Beast (*February 2018*)
https://www.thedailybeast.com/are-we-closer-to-finding-a-fifth-dimension

PUBLICATION LIST

∗ indicates student project I advised
† indicates review article

Short author list publications

45. ∗ Gallegos-Garcia, M., **Fishbach, M.**, Kalogera, V., Berry, C.P.L., Doctor, Z. "Do high-spin high mass X-ray binaries contribute to the population of merging binary black holes?" ApJL 938 L19 (2022)

44. Essick, R., Farr, W.M., **Fishbach, M.**, Holz, D.E., Katsavounidis, E., "An Isotropy Measurement with Gravitational Wave Observations," arXiv:2207.05792

43. **Fishbach, M.**, Kimball, C., Kalogera, V., "Limits on hierarchical black hole mergers from the most negative $\chi_{\rm eff}$ systems," ApJL 935 L26 (2022)

42. Bavera, S., **Fishbach, M.**, Zevin, M., Zapartas, E., Fragos, T., "The $\chi_{\rm eff} - z$ correlation of field binary black hole mergers and how 3G gravitational-wave detectors can constrain it," A&A 665 A59 (2022)

41. ∗ Ye, C., **Fishbach, M.**, "Inferring the neutron star maximum mass and lower mass gap in neutron star-black hole systems with spin," ApJ 937 73 (2022)

40. † Moresco, M., ..., **Fishbach, M.** ..., "Unveiling the Universe with Emerging Cosmological Probes," arXiv:2201.07241, LRR accepted **Wrote chapter on standard siren cosmology**

39. ∗ Farah, A., **Fishbach, M.**, Essick, R., Holz, D.E., Galaudage, S., "Bridging the Gap: Neutron Stars, Black Holes, or Both?," ApJ 931 108 (2022)

38. **Fishbach, M.**, Kalogera, V., "Apples and Oranges: Comparing black holes in X-ray binaries and gravitational-wave sources," ApJL 929 L26 (2022)

37. Essick, R., Farah, A., Galaudage, S., Talbot, C., **Fishbach, M.**, Thrane, E., Holz, D.E., "Probing Extremal Gravitational-Wave Events with Coarse-Grained Likelihoods," ApJ 926 34 (2022)

36. **Fishbach, M.**, Kalogera, V., "The time delay distribution and formation metallicity of LIGO-Virgo's binary black holes," ApJL 914 L30 (2021)

35. † Gerosa, D., **Fishbach, M.**, "Hierarchical mergers of stellar-mass black holes and their gravitational-wave signatures," Nature Astronomy (2021)

34. Palmese, A., **Fishbach, M.**, Burke, C. J., Annis, J. T., Liu, X. "Do LIGO/Virgo black hole mergers produce AGN flares? The case of GW190521 and prospects for reaching a confident association," ApJL 914 L34 (2021)

33. ∗ Ye, C., **Fishbach, M.** "Cosmology with Standard Sirens at Cosmic Noon," Phys. Rev. D 104, 043507 (2021)

32. **Fishbach, M.**, Doctor, Z., Callister, C., Edelman, B., Ye, J., Essick, R., Farr, W.M., Farr, B., Holz, D.E. "When are LIGO/Virgo's Big Black Hole Mergers?" ApJ 912 98 (2021)

31. **Fishbach, M.**, Holz, D.E. "Minding the Gap: GW190521 as a straddling binary," ApJL 904 L26 (2020)

30. **Fishbach, M.**, Essick, R., Holz, D.E. "Does Matter Matter? Using the mass distribution to distinguish neutron stars and black holes," ApJL 899 L8 (2020)

29. Olejak, A., **Fishbach, M.**, Belczynski, K., Holz, D. E., Lasota, J. -P., Miller, M. C., Bulik, T. "The Origin of Inequality: isolated formation of a 30+10 $M_\odot$ binary black-hole merger," ApJL 901 L39 (2020)

28. Farmer, R. and Renzo, M. and de Mink, S., **Fishbach, M.**, Justham, S. "Constraints from gravitational wave detections of binary black hole mergers on the $^{12}C(\alpha,\gamma)^{16}O$ rate," ApJL 902 L36 (2020)

27. Farah, A., Essick, R., Doctor, Z., **Fishbach, M.**, Holz, D.E. "Counting on Short Gamma-Ray Bursts: Gravitational-wave Constraints of Jet Geometry," ApJ 895 108 (2020)

26. Callister, T., **Fishbach, M.**, Holz, D.E., Farr, W.M. "Shouts and Murmurs: Combining Individual Gravitational-Wave Sources with the Stochastic Background to Measure the History of Binary Black Hole Mergers," ApJL 896 L32 (2020)

25. Adhikari, S., **Fishbach, M.**, Holz, D.E., Wechsler, R.H., Fang, Z. "The binary-host connection: astrophysics of gravitational wave binaries from their host galaxy properties," ApJ 905 21 (2020)

24. **Fishbach, M.**, Farr, W.M., Holz, D.E. "The Most Massive Binary Black Hole Detections and the Identification of Population Outliers," ApJL 891 L31 (2020)

23. **Fishbach, M.**, Holz, D.E. "Picky Partners: The Pairing of Component Masses in Binary Black Hole Mergers," ApJL 891 L27 (2020)

22. Farr, W.M., **Fishbach, M.**, Ye, J., Holz, D.E. "A Future Percent-Level Measurement of the Hubble Expansion at Redshift 0.8 With Advanced LIGO," ApJL 883 L2 (2019)

21. Lagos, M., **Fishbach, M.**, Landry, P., Holz, D.E. "Standard sirens with a running Planck mass," Phys. Rev. D 99, 083504 (2019)

20. **Fishbach, M.**, et al. "A standard siren measurement of the Hubble constant from GW170817 without the electromagnetic counterpart," ApJL 871 L13 (2019)

19. **Fishbach, M.**, Holz, D.E., Farr, W.M. "Does the Black Hole Merger Rate Evolve with Redshift?" ApJL 863 L41 (2018)

18. Pardo, K., **Fishbach, M.**, Holz, D.E., Spergel, D. N. "Limits on the Number of Spacetime Dimensions from GW170817," JCAP 07 048 (2018)

17. Chen, H.-Y., **Fishbach, M.**, Holz, D.E. "A 2 per cent Hubble constant measurement from standard sirens within 5 years," Nature 562 545-547 (2018)

16. **Fishbach, M.**, Holz, D.E. "Where are LIGO's Big Black Holes?" ApJL 851 L25 (2017)

15. **Fishbach, M.**, Holz, D.E. Farr, B. "Are LIGO's Black Holes Made From Smaller Black Holes?" ApJL 840 L24 (2017)

LIGO-Virgo-Kagra publications to which I contributed significantly

14. Abbott, R. et al. "Constraints on the cosmic expansion history from GWTC-3," arXiv:2111.03604 **Member of paper writing team**

13. Abbott, R. et al. "The population of merging compact binaries inferred using gravitational waves through GWTC-3," arXiv:2111.03634

12. Abbott, R. et al. "Upper limits on the isotropic gravitational-wave background from Advanced LIGO and Advanced Virgo's third observing run," Phys. Rev. D 104, 022004 (2021)

11. Abbott, R. et al. "Search for lensing signatures in the gravitational-wave observations from the first half of LIGO-Virgo's third observing run," ApJ 923 14 (2021)

10. Abbott, R. et al. "Population Properties of Compact Objects from the Second LIGO-Virgo Gravitational-Wave Transient Catalog," ApJL 913 L7 (2021) **Chair of paper writing team**

9. Abbott, R. et al. "GW190412: Observation of a Binary-Black-Hole Coalescence with Asymmetric Masses," Phys. Rev. D 102, 043015 (2020)

8. Abbott, B.P. et al. "A gravitational-wave measurement of the Hubble constant following the second observing run of Advanced LIGO and Virgo," ApJ 909 218 (2021)

7. Abbott, B.P. et al. "Binary Black Hole Population Properties Inferred from the First and Second Observing Runs of Advanced LIGO and Advanced Virgo," ApJL 882 L24 (2019)
Member of paper writing team

6. Soares-Santos, M. et al. "First Measurement of the Hubble Constant from a Dark Standard Siren using the Dark Energy Survey Galaxies and the LIGO/Virgo Binary-Black-hole Merger GW170814," ApJL 876 L17 (2019) **Member of paper writing team**

5. Abbott, B.P. et al. "Tests of General Relativity with GW170817," Phys. Rev. Lett. 123, 011102 (2019)

4. Abbott, B.P et al. "Properties of the Binary Neutron Star Merger GW170817," Phys. Rev. X, 9, 011001 (2019)

3. Abbott, B.P. et al. "GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral," Phys. Rev. Lett. 119, 161101 (2017)

2. Abbott, B.P. et al. "Gravitational Waves and Gamma-Rays from a Binary Neutron Star Merger: GW170817 and GRB 170817A," ApJL 848, L13 (2017)

1. Abbott, B.P. et al. "A gravitational-wave standard siren measurement of the Hubble constant," Nature 551, 8588 (2017)