

Colm Talbot

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WORK EXPERIENCE **Eric and Wendy Schmidt AI in Science Fellow** 2023-
Kavli Institute for Cosmological Physics, *University of Chicago* Chicago, IL
Northwestern/CIERA Visiting Scholar 2023-
CIERA, *Northwestern University* Evanston, IL
Kavli Postdoctoral Fellow 2021-2023
Kavli Institute for Astrophysics, *MIT* Cambridge, MA
Postdoctoral Research Scholar 2020-2021
LIGO, *California Institute of Technology* Pasadena, CA

EDUCATION **Monash University, Australia** (2016 - 2020)
Ph.D.
• Thesis: *Astrophysics of Binary Black Holes at the Dawn of Gravitational-Wave Astronomy*.
• Supervisor: Eric Thrane
University of Cambridge, Cambridge, UK (2012 - 2016)
B.A. + M.Math.
• Mathematics Part III
• Natural Sciences Part I/II (Astrophysics)

AWARDS **Northwestern University**
Northwestern CIERA Fellowship 2026-2028
University of Chicago
Eric and Wendy Schmidt AI in Science Fellowship 2023-2026
Massachusetts Institute of Technology
MIT Kavli Postdoctoral Fellowship 2021-2024
Thesis Prizes
ASA Charlene Heisler Prize - *most outstanding PhD thesis in astronomy or a closely related field, accepted by an Australian university* 2021
Monash University Vice-Chancellor's Commendation for Thesis Excellence - *one prize awarded in Science faculty* 2020
Robert Street Doctoral Prize - *best thesis is Monash University School of Physics and Astronomy* 2020
GWIC-Braccini Prize (*Honourable mention*) - *outstanding Ph.D. thesis in the field of gravitational waves* 2020

Monash University

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| Monash Postgraduate Publications Award | 2019-2020 |
| Monash Graduate Scholarship | 2016-2019 |
| Monash International Postgraduate Research Scholarship | 2016-2019 |

PRESENTATIONS

† *Astrophysics and cosmology with gravitational waves from compact binaries: lessons learned and challenges ahead*, UMN, MN. (March 2024)

Growing Pains: Understanding the Impact of Likelihood Uncertainty on Hierarchical Bayesian Inference for Gravitational-Wave Astronomy, Midwest Relativity Meeting, IL. (November 2023)

† *Growing Pains: Understanding the Impact of Likelihood Uncertainty on Hierarchical Bayesian Inference for Gravitational-Wave Astronomy*, APS April Meeting, MN. (April 2023)

† *Searching for structure in the binary black hole spin distribution*, PI, ON. (October 2022)

† *Precision Astrophysical Inference with Binary Black Holes*, UMN, MN. (September 2022)

† *Precision Astrophysical Inference with Binary Black Holes*, RHUL, UK. (September 2022)

Growing pains: preparing for gravitational-wave astronomy at scale, APS April Meeting, NY. (April 2022)

† *(Toward) a holistic approach to astrophysical inference with compact binary coalescences*, AEI, Potsdam. (March 2022)

† *Adventures in practical population inference*, IPAM GWAWS3, UCLA. (November 2021)

† *Panel: CBC waveform and data analysis requirements*, PAXVII, Virtual. (August 2021)

† *An introduction to Bayesian inference*, LIGO SURF 2021, Caltech. (July 2021)

Inference with finite time series: Observing the gravitational-wave Universe through windows, Amaldi14, Virtual. (July 2021)

† *Binary black hole population inference: five years in*, Charlene Heisler Prize Talk, Astronomical Society of Australia, Virtual. (July 2021)

Fast, flexible, and accurate evaluation of Malmquist bias for Advanced LIGO/Virgo and beyond, APS April Meeting, Virtual. (April 2021)

Population gravitational-wave astrophysics in O4 and beyond: preparing for the flood, AAS Winter Meeting, Virtual. (January 2021)

† *Measuring mass gaps with gravitational waves*, AAS Winter Meeting, Honolulu. (January 2020)

† *Astrophysical inference with gravitational waves*, GRITTS, MIT. (October 2019)

† *Astrophysical inference with gravitational-wave observations*, LIGO seminar, Caltech. (October 2019)

Doing astrophysics with binary black holes, Astronomical Society of Australia, Brisbane. (June 2019)

† *An introduction to gravitational-wave transient inference with BILBY*, LVK meeting. (September 2019)

Doing astrophysics with binary black holes, Astronomical Society of Australia. (June 2019)

Accelerating Bayesian inference with graphics processing units, LIGO/Virgo parameter estimation face-to-face, Monash University. (February 2019)

Inferring population properties of binary black holes, Astrophysics with Gravitational-Wave Populations, Aspen Winter Conference 2019. (February 2019)

Inferring the population properties of binary black holes with gravitational waves., Astronomical Society of Australia. (June 2018)

† - indicates an invited talk

EDUCATION
EXPERIENCE

Supervision

Graduate:

- Jacob Golomb (*Caltech 2020-2023*)

Undergraduate:

- Ethan Payne - (*Monash 2019-2021*), with Eric Thrane, Paul Lasky
- Noah Wolfe - (*LIGO SURF 2021, NC State 2022*), with Jacob Golomb,
- Eli Wiston - (*LIGO SURF 2021*), with Arianna Renzini,
- Zoe Haggard - (*LIGO SURF 2020*), with Alan Weinstein,
- Jennifer Sanchez - (*LIGO SURF 2020*), with Alan Weinstein,
- Darin Mumma - (*LIGO SURF 2020*), with Alan Weinstein, Alvin Li
- Carter Hills - (*Monash 2020*), with Eric Thrane
- Chandana Anand - (*Monash 2019-2020*), with Eric Thrane
- Calley Tinsman - (*IREU 2018*), with Simon Stevenson
- Denyz Melchor - (*IREU 2018*), with Rory Smith
- Sophia Lin - (*IREU 2017*), with Eric Thrane, Paul Lasky

Teaching Assistant

Monash University

2017-2019

- PHS2061 - Quantum and Thermal Physics
- PHS2062 - Electromagnetism and Optics
- ASP2062 - Introduction to Astrophysics

SCHOOLS /
WORKSHOPS
ATTENDED /
ORGANIZED

LIGO-Virgo-KAGRA collaborations parameter estimation working group face-to-face meeting (*Planned and ran two-day meeting*)
September 2022 - Cardiff, UK

GWAWS3: Source Inference and Parameter Estimation in Gravitational Wave Astronomy
November 2021 - IPAM, UCLA, CA

LIGO/Virgo Collaboration parameter estimation face-to-face
February 2019 - Monash University, Melbourne, Australia
July 2018 - CITA, Toronto, Canada

73rd Scottish Universities Summer School in Physics (SUSSP73)
23 July-5 August 2017 - University of St Andrews, St Andrews, UK

LIGO/Virgo Collaboration Meeting
Many 2017-2024

PUBLIC OUTREACH **Leveraging machine learning to uncover the lives and deaths of massive stars using gravitational waves**
UChicago Data Science Institute [blog post](#) March 2024

“Detecting Gravitational Waves”
Astronomical Society of Victoria March 2017

Cambridge Hands On Science (CHaOS)
Demonstrator 2015

SERVICE **Co-chair**
LIGO-Virgo collaboration compact binary coalescence parameter estimation subgroup (2021-)

Referee
A&A, ApJ, ApJL, JOSS, MNRAS, Nat.Astr., PRD, PRL, PRR, PRX

OPEN-SOURCE SOFTWARE **Bilby:** A Python Bayesian inference library used widely for astrophysical inference with gravitational waves and beyond
git.ligo.org/lscsoft/bilby, [pypi](#), [conda-forge](#)
Primary developer/maintainer

GWPopulation: GPU-accelerated gravitational-wave population inference
github.com/ColmTalbot/gwpopulation, [pypi](#), [conda-forge](#)
Primary developer/maintainer

bilby.cython: Cython implementations of domain-specific functionality for Bilby
git.ligo.org/colm.talbot/bilby-cython, [pypi](#), [conda-forge](#)
Primary developer/maintainer

cached-interpolate: Efficient cubic spline interpolation
github.com/ColmTalbot/cached_interpolation, [pypi](#), [conda-forge](#)
Primary developer/maintainer

GWMemory: Gravitational-wave memory calculations for arbitrary waveforms
github.com/ColmTalbot/gwmemory, [pypi](#), [conda-forge](#)
Primary developer/maintainer

GPUCBC: GPU-accelerated gravitational-wave single event inference
github.com/ColmTalbot/gpubc
Primary developer/maintainer

Contributed open-source packages

- github.com/cupy/cupy
- github.com/joshspeagle/dynesty
- git.ligo.org/lalsuite
- github.com/htcondor/htcondor

Experience

- Python (5+ years)
- bash (5+ years)
- HTCondor (5+ years)
- Cython (2 years)
- SLURM (2 years)
- CUDA (1 year)
- C++ (1 year)
- Julia (1 year)

Other projects can be found on github.com/ColmTalbot and git.ligo.org/colm.talbot.

PUBLICATIONS

Published/in press

- [1] S. Morisaki, R. Smith, L. Tsukada, S. Sachdev, S. Stevenson, **C. Talbot**, A. Zimmerman,
Rapid localization and inference on compact binary coalescences with the Advanced LIGO-Virgo-KAGRA gravitational-wave detector network,
PRD, 108, 12040, [arXiv:2307.13380](#)
- [2] N. Wolfe, S. Vitale, **C. Talbot**,
Too small to fail: assessing the measurability of sub-solar mass compact object mergers,
JCAP, 11, 2023, 039 [arXiv:2305.19907](#)
- [3] **C. Talbot**, J. Golomb,
Growing Pains: Understanding the Impact of Likelihood Uncertainty on Hierarchical Bayesian Inference for Gravitational-Wave Astronomy,
MNRAS, 526, 3, 3495-3503, [arXiv:2304.06138](#)

- [4] J. Heinzl, **C. Talbot**, G. Ashton, S. Vitale,
Inferring the Astrophysical Population of Gravitational Wave Sources in the Presence of Noise Transients,
[MNRAS](#), 523, 4, 5972-5984, [arXiv:2304.02665](#)
- [5] A. Renzini, A. Romero-Rodriguez, **C. Talbot**, *et al.*,
pygwb: A Python-based library for gravitational-wave background searches,
[ApJ.](#), 952, 25, [arXiv:2303.15696](#)
- [6] J. Golomb, **C. Talbot**,
Searching for structure in the binary black hole spin distribution,
[PRD](#), 108, 103009, [arXiv:2210.12287](#)
- [7] S. Vitale, S. Biscoveanu, **C. Talbot**,
Spin it as you like: the (lack of a) measurement of the spin tilt distribution with LIGO-Virgo-KAGRA binary black holes,
[A&A](#) 668, L2, [arXiv:2209.06978](#)
- [8] N. Wolfe, **C. Talbot**, J. Golomb,
Accelerating Tests of General Relativity with Gravitational-Wave Signals using Hybrid Sampling,
[Phys. Rev. D](#), 107, 104056, [arXiv:2208.12872](#)
- [9] S. Biscoveanu, **C. Talbot**, S. Vitale,
Sources of systematic error in gravitational-wave measurements of the binary neutron star mass distribution,
[MNRAS](#), 511, 3, 4350-4359, [arXiv:2111.13619](#)
- [10] S. Galaudage, **C. Talbot**, *et al.*,
Building better spin models for merging binary black holes: Evidence for non-spinning and rapidly spinning nearly aligned sub-populations,
[ApJL.](#), 921, L15, [arXiv:2109.02424](#)
- [11] R. Essick, A. Farah, S. Galaudage, **C. Talbot**, M. Fishbach, E. Thrane, D. Holz,
Probing Extremal Gravitational-Wave Events with Coarse-Grained Likelihoods,
[ApJ.](#), 926, 34, [arXiv:2109.00418](#)
- [12] J. Golomb, **C. Talbot**,
Hierarchical Inference of Binary Neutron Star Mass Distribution and Equation of State with Gravitational Waves,
[ApJ.](#), 926, 79, [arXiv:2106.15745](#)
- [13] **C. Talbot**, E. Thrane, S. Biscoveanu, R. Smith,
Inference with finite time series: Observing the gravitational Universe through windows,
[Phys. Rev. R](#), 3, 043049, [arXiv:2106.13785](#)
- [14] G. Ashton, **C. Talbot**,
Bilby-MCMC: An MCMC sampler for gravitational-wave inference,
[MNRAS](#), 507, 2, 2037-2051, [arXiv:2106.08730](#)
- [15] D. Psaltis, **C. Talbot**, E. Payne, I. Mandel,
Probing the Black Hole Metric: Black Hole Shadows and Binary Black-Hole Inspirals,
[Phys. Rev. D](#), 103, 104036, [arXiv:2012.02117](#)
- [16] **C. Talbot**, E. Thrane,
Fast, flexible, and accurate evaluation of Malmquist bias with machine learning,
[ApJ.](#), 927, 76, [arXiv:2012.01317](#)
- [17] C. Kimball, **C. Talbot**, *et al.*,
Evidence for hierarchical black hole mergers in the second LIGO - Virgo gravitational-wave catalog,
[ApJ. Lett](#), 915, L35, [arXiv:2011.05332](#)

- [18] E. Payne, **C. Talbot**, P. Lasky, E. Thrane, J. Kissel,
Gravitational-wave astronomy with a physical calibration model,
[Phys. Rev. D](#), **102**, 122004, [arXiv:2009.10193](#)
- [19] S. Biscoveanu, **C. Talbot**, E. Thrane, R. Smith,
Measuring the primordial gravitational-wave background in the presence of astrophysical foregrounds,
[Phys. Rev. Lett.](#), **125**, 241101, [arXiv:2009.04418](#)
- [20] I. Romero-Shaw, **C. Talbot**, S. Biscoveanu, V. D’Emilio, *et al.*,
Bayesian inference for compact binary coalescences with BILBY: Validation and application to the first LIGO–Virgo gravitational-wave transient catalogue,
[MNRAS](#), **499**, 3295-3319, [arXiv:2006.00714](#)
- [21] **C. Talbot**, E. Thrane,
Gravitational-wave astronomy with an uncertain noise power spectral density,
[Phys. Rev. R](#), **2**, 043298, [arXiv:2006.05292](#)
- [22] C. Kimball, **C. Talbot**, *et al.*,
Black hole genealogy: Identifying hierarchical mergers with gravitational waves,
[ApJ](#), **900**, 2, [arXiv:2005.00023](#)
- [23] R. Smith, **C. Talbot**, F. Hernandez Vivanco, E. Thrane,
Inferring the population properties of binary black holes from unresolved gravitational waves,
[MNRAS](#), **496**, 3, 3281-3290, [arXiv:2004.09700](#)
- [24] S. Galaudage, **C. Talbot**, E. Thrane,
Gravitational-wave inference in the catalog era: evolving priors and marginal events,
[Phys. Rev. D](#), **102**, 083026, [arXiv:1912.09708](#)
- [25] M. Hübner, **C. Talbot**, P. Lasky, E. Thrane,
Measuring gravitational-wave memory in the first LIGO/Virgo gravitational-wave transient catalog,
[Phys. Rev. D](#), **101**, 023011, [arXiv:1911.12496](#)
- [26] R. Smith, G. Ashton, A. Vajpeyi, **C. Talbot**,
Massively parallel Bayesian inference for transient gravitational-wave astronomy,
[MNRAS](#), **498**, 4492-4502, [arXiv:1909.11873](#)
- [27] F. Hernandez Vivanco, R. Smith, E. Thrane, P. Lasky, **C. Talbot**, V. Raymond,
Measuring the neutron star equation of state with gravitational waves: the first forty binary neutron star mergers,
[Phys. Rev. D](#), **100**, 103009, [arXiv:1909.02698](#)
- [28] S. Banagiri, M. Coughlin, J. Clark, P. Lasky, M. A. Bizouard, **C. Talbot**, Eric Thrane, V. Mandic,
Constraining the Gravitational-Wave Afterglow From a Binary Neutron Star Coalescence,
[MNRAS](#), **492**, 4, 4945-4951, [arXiv:1909.01934](#)
- [29] E. Payne, **C. Talbot**, E. Thrane,
Higher order gravitational-wave modes with likelihood reweighting,
[Phys. Rev. D](#), **100**, 123017, [arXiv:1905.05477](#)
- [30] **C. Talbot**, R. Smith, E. Thrane, G. Poole,
Parallelized Inference for Gravitational-Wave Astronomy,
[Phys. Rev. D](#), **100**, 043030, [arXiv:1904.02863](#)
- [31] G. Ashton, M. Hübner, P. Lasky, **C. Talbot**, *et al.*,
Bilby: A user-friendly Bayesian inference library for gravitational-wave astronomy,
[ApJS](#), **241**, 27, [arXiv:1811.02042](#)

- [32] E. Thrane, **C. Talbot**,
An introduction to Bayesian inference in gravitational-wave astronomy: parameter estimation, model selection, and hierarchical models,
[PASA](#), 36, E010, [arXiv:1809.02293](#)
- [33] **C. Talbot**, E. Thrane, P. Lasky, F. Lin,
Gravitational-wave memory: waveforms and phenomenology,
[Phys. Rev. D](#), 98, 0.64031, [arXiv:1807.00990](#)
- [34] **C. Talbot**, E. Thrane,
Measuring the binary black hole mass spectrum with an astrophysically motivated parameterization,
[ApJ.](#), 858, 2, [arXiv:1801.02699](#)
- [35] **C. Talbot**, E. Thrane,
Determining the population properties of spinning black holes,
[Phys. Rev. D](#), 96, 023012, [arXiv:1704.08370](#)

Preprints/under review

- [1] K. Krishna, *et al.* inc. **C. Talbot**,
Accelerated parameter estimation in Bilby with relative binning,
[arXiv:2312.06009](#)
- [2] H. Chen, **C. Talbot**, E. Chase,
Mitigating the counterpart selection effect for standard sirens,
[arXiv:2307.10402](#)
- [3] S. Vitale, S. Biscoveanu, **C. Talbot**,
The orientations of the binary black holes in GWTC-3,
[arXiv:2204.00968](#)

See also: [all \(non-collaboration\) my papers](#) or [first-author papers](#) on the astrophysics data system.

Collaboration papers

I am also an author on many LIGO/Virgo collaboration and OzGrav papers. The following are collaboration papers for which I contributed significantly to either the analysis or writing.

- [1] LIGO/Virgo/Kagra Collaboration inc. **C. Talbot**,
The population of merging compact binaries inferred using gravitational waves through GWTC-3,
[Phys. Rev. X](#), 13, 011048, [arXiv:2111.03634](#)
- [2] LIGO/Virgo/Kagra Collaboration inc. **C. Talbot**,
GWTC-3: Compact Binary Coalescences Observed by LIGO and Virgo During the Second Part of the Third Observing Run,
accepted in PRX, [arXiv:2111.03606](#)
- [3] LIGO/Virgo Collaboration inc. **C. Talbot**,
Population Properties of Compact Objects from the Second LIGO-Virgo Gravitational-Wave Transient Catalog,
[ApJL](#), 913, L7, [arXiv:2010.14533](#)

- [4] LIGO/Virgo Collaboration inc. **C. Talbot**,
GWTC-2: Compact Binary Coalescences Observed by LIGO and Virgo During the First Half of the Third Observing Run,
[Phys. Rev. X 11, 021053](#), [arXiv:2010.14527](#)
- [5] LIGO/Virgo Collaboration inc. **C. Talbot**,
Directional limits on persistent gravitational waves using data from Advanced LIGO's first two observing runs,
[Phys. Rev. D, 100, 062001](#), [arXiv:1903.08844](#)
- [6] LIGO/Virgo Collaboration inc. **C. Talbot**,
Binary Black Hole Population Properties Inferred from the First and Second Observing Runs of Advanced LIGO and Advanced Virgo,
[ApJL, 882, 2](#), [arXiv:1811.12940](#)
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