

# Ignacio Magaña Hernandez

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Citizenship: USA

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Carnegie Mellon University

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## Research Interests

**Gravitational wave cosmology:** measurements of the Hubble constant and other cosmological parameters using gravitational wave standard sirens such as merging binary black holes and neutron stars.

**Gravitational wave lensing:** its detection, data analysis and cosmological applications.

**Modified gravitational wave propagation:** testing deviations of  $\Lambda$ CDM and general relativity with gravitational wave standard sirens.

## Employment

**Carnegie Mellon University**

*Postdoctoral Fellow*

Pittsburgh, WI

*June 2023 - Present*

**University of Wisconsin-Milwaukee**

*Research Assistant*

Milwaukee, WI

*September, 2017 - May 2023*

**The Chinese University of Hong Kong**

*Research Assistant*

Hong Kong

*March, 2016 - January 2017*

**Caltech**

*SURF Fellow*

Pasadena, CA

*June, 2015 - September, 2015*

## Education

**University of Wisconsin-Milwaukee**

*PhD in Physics*

Milwaukee, WI

*September 2017 - May 2023*

**University of California, Santa Barbara**

*B.S., Physics (Highest Honors)*

Santa Barbara, CA

*September 2014 - September 2017*

**Foothill College**

*Transfer Student, Physics*

Los Altos Hills, CA

*September 2012 - June 2014*

## Awards & Fellowships

**CMU McWilliams Postdoctoral Fellowship**

2023 - Present

**UWM Advanced Opportunity Program Fellowship**

2019 - 2023

**NSF Graduate Research Fellowship**

2017 - 2023

**NASA Wisconsin Space Grant Consortium Fellowship**

Summer 2020 and Summer 2022

**UWM Physics Department Lichtman Fellowship**

Spring 2020

**UCSB Physics Department Highest Academic Honors**

Summer 2017

**LIGO SURF Blanco Fellowship**

Summer 2015

**UCSB Dean's list**

Fall 2014 - Spring 2017

**NSF Science, Math and Engineering (S-STEM) Scholarship**

Fall 2013 - Spring 2014

## Student Supervision

- **Pratyusava Baral**  
*PhD student (co-advised)*
- **Anarya Ray**  
*PhD student (co-advised)*

University of Wisconsin-Milwaukee  
*September 2021 - Present*

University of Wisconsin-Milwaukee  
*September 2021 - Present*

## Short Author Publications

Citations according to [inspirehep.net](https://inspirehep.net) on October 27, 2022

1. *Dark siren cosmology with binary black hole mergers*  
**I. Magaña Hernandez**, V. D'Emilio and P. Brady  
 (In preparation)
2. *On the association of GW190425 with its potential electromagnetic counterpart FRB 20190425A*  
**I. Magaña Hernandez**, V. D'Emilio, S. Morisaki, M. Bhardwaj and A. Palmese  
 (In preparation)
3. *Localization of binary neutron star mergers with a single Cosmic Explorer*  
 P. Baral, S. Morisaki, **I. Magaña Hernandez** and J.D.E. Creighton  
 ([arXiv:2304.09889](https://arxiv.org/abs/2304.09889))
4. *Non-parametric inference of the population of compact binaries from gravitational wave observations using binned Gaussian processes*  
 A Ray, **I. Magaña Hernandez**, S. Mohite, J.D.E. Creighton and S. Kapadia  
 ([arXiv:2304.08046](https://arxiv.org/abs/2304.08046))
5. *The Hitchhiker's guide to the galaxy catalog approach for gravitational wave cosmology*  
 J. Gair et al. (including **I. Magaña Hernandez**)  
 ([arXiv:2212.08694](https://arxiv.org/abs/2212.08694))
6. *Measuring the polarization content of gravitational waves with strongly lensed binary black hole mergers*  
**I. Magaña Hernandez**  
 ([arXiv:2211.01272](https://arxiv.org/abs/2211.01272), [2 citations](#))
7. *Constraining the number of spacetime dimensions from GWTC-3 binary black hole mergers*  
**I. Magaña Hernandez**  
 Phys. Rev. D 107, 084033 (2023) ([arXiv:2112.07650](https://arxiv.org/abs/2112.07650), [5 citations](#))
8. *A Bayesian statistical framework for identifying strongly-lensed gravitational-wave signals*  
 R.K.L. Lo and **I. Magaña Hernandez**  
 ([arXiv:2104.09339](https://arxiv.org/abs/2104.09339), [20 citations](#))
9. *First measurement of the Hubble parameter from bright binary black hole GW190521*  
 S. Mukherjee et al. (including **I. Magaña Hernandez**)  
 ([arXiv:2009.14199](https://arxiv.org/abs/2009.14199), [34 citations](#))
10. *A joint ranking statistic for multi-messenger astronomical searches with gravitational waves*  
 B. Piotrkowski, A. Baylor and **I. Magaña Hernandez**  
 Class. Quantum Grav. 39 085010 (2022) ([arXiv:2111.12814](https://arxiv.org/abs/2111.12814), [1 citations](#))
11. *Current observations are insufficient to confidently associate the binary black hole merger GW190521 with AGN J124942.3 + 344929*  
 G. Ashton, K. Ackley, **I. Magaña Hernandez** et al.  
 Class. Quantum Grav. 38 235004 (2021) ([arXiv:2009.12346](https://arxiv.org/abs/2009.12346), [41 citations](#))
12. *Rapid model comparison of equations of state from gravitational wave observation of binary neutron star coalescences*  
 S. Ghosh, X. Liu, J.D.E. Creighton, **I. Magaña Hernandez** et al.  
 Phys. Rev. D 104, 083003 (2021) ([arXiv:2104.08681](https://arxiv.org/abs/2104.08681), [7 citations](#))
13. *Gravitational wave friction in light of GW170817 and GW190521*  
 S. Mastroianni, L. Haegel, K. Karathanasis, **I. Magaña Hernandez** and D.A. Steer  
 JCAP 02 043 (2021) ([arXiv:2010.04047](https://arxiv.org/abs/2010.04047), [22 citations](#))
14. *Identifying strong gravitational-wave lensing during the second observing run of Advanced LIGO and Advanced Virgo*  
 X. Liu, **I. Magaña Hernandez** and J.D.E. Creighton  
 ApJ 908 97 (2021) ([arXiv:2009.06539](https://arxiv.org/abs/2009.06539), [31 citations](#))
15. *Cosmological inference using gravitational wave standard sirens: A mock data analysis*  
 R. Gray, **I. Magaña Hernandez** et al.  
 ApJ 908 97 (2021) ([arXiv:1908.06050](https://arxiv.org/abs/1908.06050), [79 citations](#))

16. *Bayesian inference for compact binary coalescences with BILBY: Validation and application to the first LIGO–Virgo gravitational-wave transient catalogue*  
I.M. Romero-Shaw et al. (including **I. Magaña Hernandez**)  
MNRAS 499, 3295 (2020) ([arXiv:2006.00714](#), [155 citations](#))
17. *A statistical standard siren measurement of the Hubble Constant from the LIGO/Virgo gravitational wave compact object merger GW190814 and Dark Energy Survey galaxies*  
A. Palmese et al. (including **I. Magaña Hernandez**)  
ApJL 900 L33 (2019) ([arXiv:2006.14961](#), [60 citations](#))
18. *A standard siren measurement of the Hubble Constant from GW170817 without the electromagnetic counterpart*  
M. Fishbach, R. Gray, **I. Magaña Hernandez** et al.  
ApJL 871 L13 (2019) ([arXiv:1807.05667](#), [137 citations](#))

## LIGO-Virgo Publications to which I highly contributed:

1. *GW190814: Gravitational Waves from the Coalescence of a 23 Solar Mass Black Hole with a 2.6 Solar Mass Compact Object*  
LIGO Scientific and Virgo Collaborations (including **I. Magaña Hernandez**)  
ApJL 871 L13 (2019) ([arXiv:2006.12611](#), [871 citations](#)) **Led and wrote the Hubble constant analysis**
2. *A Gravitational-wave Measurement of the Hubble Constant Following the Second Observing Run of Advanced LIGO and Virgo*  
LIGO Scientific and Virgo Collaborations (including **I. Magaña Hernandez**)  
ApJ 909 218 (2021) ([arXiv:1908.06060](#), [185 citations](#)) **Paper writing and analysis team member**
3. *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*  
M. Soares-Santos, A. Palmese et al. and LIGO Scientific and Virgo Collaborations (including **I. Magaña Hernandez**)  
Astrophys. J. 875, 161 (2019) ([arXiv:1901.01540](#), [169 citations](#)) **Validated analysis using gwcsmo**

## Invited Seminars

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|---|----------------|
| 1. <b>Cardiff University</b><br><i>Cosmology and modified gravity with binary black holes</i>   | September 2022 |
| 2. <b>UC Berkeley</b><br><i>Constraining the number of spacetime dimensions from GWTC-3 binary black hole mergers</i>                               | June 2022      |
| 3. <b>University of Wisconsin-Milwaukee</b><br><i>Cosmology and modified gravity with binary black hole mergers</i>                                 | April 2022     |
| 4. <b>Eotvos Lorand University</b><br><i>Gravitational wave cosmology with large galaxy surveys</i>   | September 2019 |
| 5. <b>University of Glasgow</b><br><i>Measuring the Hubble constant with gravitational-wave standard sirens</i>                                     | August 2019    |
| 6. <b>The Chinese University of Hong Kong</b><br><i>A measurement of the Hubble constant from the second observation run of Advanced LIGO-Virgo</i> | February 2019  |
| 7. <b>Nagoya University</b><br><i>A measurement of the Hubble constant from the second observation run of Advanced LIGO-Virgo</i>                   | February 2019  |

## Talks at Conferences

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|--|---------------|
| 1. <b>APS April Meeting</b><br><i>Measuring the polarization content of gravitational waves with strongly lensed binary black hole mergers</i>   | April 2023    |
| 2. <b>11th Australasian Conference on General Relativity and Gravitation</b><br><i>Constraining the number of spacetime dimensions from GWTC-3 binary black hole mergers</i>                 | February 2022 |
| 3. <b>Midwest Relativity Meeting</b><br><i>Constraining the number of spacetime dimensions from GWTC-3 binary black hole mergers</i>   | October 2021  |
| 4. <b>Midwest Relativity Meeting</b><br><i>On the candidate electromagnetic counterpart of GW190521 and its implications on the Hubble constant</i>  | October 2020  |
| 5. <b>Gravitational Waves Physics and Astronomy Workshop</b><br><i>A gravitational-wave measurement of the Hubble constant following the second observing run of Advanced LIGO and Virgo</i> | October 2019  |

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|--|----------------|
| 6. <b>Multi-Messenger Astrophysics in the Gravitational Wave Era</b>   | September 2019 |
| <i>A gravitational-wave measurement of the Hubble constant following the second observing run of Advanced LIGO and Virgo</i> |                |
| 7. <b>YITP Asian-Pacific Winter School and Workshop on Gravitation and Cosmology</b>   | February 2019  |
| <i>A standard siren measurement of the Hubble constant from GW170817 without the electromagnetic counterpart</i>             |                |
| 8. <b>Midwest Relativity Meeting</b>   | October 2018   |
| <i>Cosmological inference using gravitational wave standard sirens: A mock data challenge</i>                                |                |
| 9. <b>19th Annual Physical Society of Hong Kong</b>  | June 2016      |
| <i>Feedforward Seismic Noise Cancellation at the 40m Prototype Interferometer</i>  |                |

## Posters

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|--|----------------|
| 1. <b>LVK Meeting: Cardiff University</b>  | September 2022 |
| <i>Measuring the polarization content of gravitational waves with strongly lensed binary black hole mergers</i>          |                |
| 2. <b>Merging Visions: Exploring Compact-Object Binaries with Gravity and Light</b>                                      | June 2019      |
| <i>Identifying Strong Gravitational-wave Lensing during the Second Observing Run of Advanced LIGO and Advanced Virgo</i> |                |
| 3. <b>Gravitational Waves Physics and Astronomy Workshop</b>   | December 2018  |
| <i>Cosmological inference using gravitational wave standard sirens: A mock data analysis</i>                             |                |

## Additional Training

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|---|-----------------|
| 1. <b>Black Holes and Neutron Stars with Gravitational Waves</b>                | October 2019    |
| <i>Yukawa Institute for Theoretical Physics</i>                                 |                 |
| 2. <b>The New Era of Gravitational-Wave Physics and Astrophysics</b>            | May - July 2019 |
| <i>Kavli Institute for Theoretical Physics</i>                                  |                 |
| 3. <b>Asian-Pacific Winter School and Workshop on Gravitation and Cosmology</b> | February 2019   |
| <i>Yukawa Institute for Theoretical Physics</i>                                 |                 |
| 4. <b>Les Houches Summer School: Gravitational-Wave Astronomy</b>               | July 2018       |
| <i>Ecole de Physique des Houches</i>  |                 |
| 5. <b>Summer School on Gravitational-Wave Astronomy</b>                         | August 2016     |
| <i>ICTS-TIFR</i>  |                 |

## Societies/Affiliations

- LIGO Scientific Collaboration member since June 2015
- American Physical Society
- Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS)
- National Society of Hispanic Physicists

## Skills

- **Programming skills:**
  - Proficiency with: Python (NumPy, SciPy, Pandas, Scikit-learn), JAX, C, Mathematica, LaTeX.
  - Familiar with: Stan, C++, MATLAB/Simulink.
  - LVK related software: Bilby, LALSuite, PyCBC, ligo.skymap, gwcosmo, hanabi.
- **Data Analysis:**
  - Bayesian model selection and parameter estimation, Monte Carlo methods.
  - Digital signal processing, machine learning, and basic numerical relativity experience.
- **Languages:** English (fluent), Spanish (fluent), Korean (intermediate), and Japanese (beginner).

## References

**Patrick R. Brady** (PhD Supervisor)  
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