

# Javier Roulet

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## Employment

<b>California Institute of Technology</b> <i>Sherman Fairchild Postdoctoral Scholar</i>	2022–2025
<b>Kavli Institute for Theoretical Physics</b> <b>University of California, Santa Barbara</b> <i>Postdoctoral Scholar</i>	2021–2022

## Education

<b>Princeton University</b> <i>Ph.D. in Physics</i> Thesis: The Binary Black Holes of LIGO and Virgo Advisor: Prof. Matias Zaldarriaga	2016–2021
<b>Universidad de Buenos Aires</b> <i>Licenciatura in Physics</i> Thesis: Average Activities in Populations of Excitable Phase Oscillators Advisor: Prof. Gabriel B. Mindlin	2011–2016

## Fellowships

Burke Fellowship, California Institute of Technology	2022–2025
President's Fellowship, Princeton University	2016–2017
Dean's Grant Research Allowance, Princeton University	2016
CONICET Doctoral Fellowship	2016

## Teaching

<b>Assistant in instruction</b> Princeton University <ul style="list-style-type: none"> <li>Physics for Future Leaders</li> <li>Advanced Electromagnetism</li> <li>Introduction to General Relativity</li> <li>Advanced Physics</li> <li>Introduction to the Quantum Theory</li> <li>General Physics</li> <li>Biophysics</li> </ul>	2017–2021
<b>Teaching assistant</b> Universidad de Buenos Aires <ul style="list-style-type: none"> <li>Fluid Dynamics</li> <li>Wave Mechanics</li> <li>Physics for Biologists</li> </ul>	2015–2016

## Publications

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### Lead author

- [1] **Javier Roulet**, Jonathan Mushkin, Digvijay Wadekar, Tejaswi Venumadhav, Barak Zackay, and Matias Zaldarriaga. “Fast marginalization algorithm for optimizing gravitational wave detection, parameter estimation, and sky localization”. In: *Phys. Rev. D* 110 (4 Aug. 2024), p. 044010. DOI: [10.1103/PhysRevD.110.044010](https://doi.org/10.1103/PhysRevD.110.044010) .
- [2] **Javier Roulet** and Tejaswi Venumadhav. “Inferring binary properties from gravitational-wave signals”. In: *Annual Review of Nuclear and Particle Science* (June 2024). ISSN: 1545-4134. DOI: [10.1146/annurev-nucl-121423-100725](https://doi.org/10.1146/annurev-nucl-121423-100725) .
- [3] **Javier Roulet**, Seth Olsen, Jonathan Mushkin, Tousif Islam, Tejaswi Venumadhav, Barak Zackay, and Matias Zaldarriaga. “Removing degeneracy and multimodality in gravitational wave source parameters”. In: *Phys. Rev. D* 106 (12 Dec. 2022), p. 123015. DOI: [10.1103/PhysRevD.106.123015](https://doi.org/10.1103/PhysRevD.106.123015) .
- [4] **Javier Roulet**, Horng Sheng Chia, Seth Olsen, Liang Dai, Tejaswi Venumadhav, Barak Zackay, and Matias Zaldarriaga. “Distribution of effective spins and masses of binary black holes from the LIGO and Virgo O1–O3a observing runs”. In: *Phys. Rev. D* 104 (8 Oct. 2021), p. 083010. DOI: [10.1103/PhysRevD.104.083010](https://doi.org/10.1103/PhysRevD.104.083010) .
- [5] **Javier Roulet**, Tejaswi Venumadhav, Barak Zackay, Liang Dai, and Matias Zaldarriaga. “Binary black hole mergers from LIGO/Virgo O1 and O2: Population inference combining confident and marginal events”. In: *Phys. Rev. D* 102 (12 Dec. 2020), p. 123022. DOI: [10.1103/PhysRevD.102.123022](https://doi.org/10.1103/PhysRevD.102.123022) .
- [6] **Javier Roulet**, Liang Dai, Tejaswi Venumadhav, Barak Zackay, and Matias Zaldarriaga. “Template bank for compact binary coalescence searches in gravitational wave data: A general geometric placement algorithm”. In: *Phys. Rev. D* 99 (12 June 2019), p. 123022. DOI: [10.1103/PhysRevD.99.123022](https://doi.org/10.1103/PhysRevD.99.123022) .
- [7] **Javier Roulet** and Matias Zaldarriaga. “Constraints on binary black hole populations from LIGO–Virgo detections”. In: *Monthly Notices of the Royal Astronomical Society* 484.3 (Jan. 2019), pp. 4216–4229. ISSN: 1365-2966. DOI: [10.1093/mnras/stz226](https://doi.org/10.1093/mnras/stz226) .
- [8] **Javier Roulet** and Gabriel B. Mindlin. “A diagrammatic representation of phase portraits and bifurcation diagrams of two-dimensional dynamical systems”. In: *International Journal of Bifurcation and Chaos* 27.13 (Dec. 2017), p. 1730045. ISSN: 1793-6551. DOI: [10.1142/s0218127417300452](https://doi.org/10.1142/s0218127417300452) .
- [9] **Javier Roulet** and Gabriel B. Mindlin. “Average activity of excitatory and inhibitory neural populations”. In: *Chaos: An Interdisciplinary Journal of Nonlinear Science* 26.9 (Sept. 2016). ISSN: 1089-7682. DOI: [10.1063/1.4962326](https://doi.org/10.1063/1.4962326) .

### Coauthor

- [10] Ajit Kumar Mehta, Seth Olsen, Digvijay Wadekar, **Javier Roulet**, Tejaswi Venumadhav, Jonathan Mushkin, Barak Zackay, and Matias Zaldarriaga. “New binary black hole mergers in the LIGO-Virgo O3b data”. In: *Phys. Rev. D* 111 (2 Jan. 2025), p. 024049. DOI: [10.1103/PhysRevD.111.024049](https://doi.org/10.1103/PhysRevD.111.024049) .

- [11] Digvijay Wadekar, Tejaswi Venumadhav, Ajit Kumar Mehta, **Javier Roulet**, Seth Olsen, Jonathan Mushkin, Barak Zackay, and Matias Zaldarriaga. “New approach to template banks of gravitational waves with higher harmonics: Reducing matched-filtering cost by over an order of magnitude”. In: *Phys. Rev. D* 110 (8 Oct. 2024), p. 084035. DOI: [10.1103/PhysRevD.110.084035](https://doi.org/10.1103/PhysRevD.110.084035) .
- [12] Horng Sheng Chia, Thomas D. P. Edwards, Digvijay Wadekar, Aaron Zimmerman, Seth Olsen, **Javier Roulet**, Tejaswi Venumadhav, Barak Zackay, and Matias Zaldarriaga. “In pursuit of Love numbers: First templated search for compact objects with large tidal deformabilities in the LIGO-Virgo data”. In: *Phys. Rev. D* 110 (6 Sept. 2024), p. 063007. DOI: [10.1103/PhysRevD.110.063007](https://doi.org/10.1103/PhysRevD.110.063007) .
- [13] Digvijay Wadekar, Tejaswi Venumadhav, **Javier Roulet**, Ajit Kumar Mehta, Barak Zackay, Jonathan Mushkin, and Matias Zaldarriaga. “New search pipeline for gravitational waves with higher-order modes using mode-by-mode filtering”. In: *Phys. Rev. D* 110 (4 Aug. 2024), p. 044063. DOI: [10.1103/PhysRevD.110.044063](https://doi.org/10.1103/PhysRevD.110.044063) .
- [14] Hang Yu, **Javier Roulet**, Tejaswi Venumadhav, Barak Zackay, and Matias Zaldarriaga. “Accurate and efficient waveform model for precessing binary black holes”. In: *Phys. Rev. D* 108 (6 Sept. 2023), p. 064059. DOI: [10.1103/PhysRevD.108.064059](https://doi.org/10.1103/PhysRevD.108.064059) .
- [15] Seth Olsen, Tejaswi Venumadhav, Jonathan Mushkin, **Javier Roulet**, Barak Zackay, and Matias Zaldarriaga. “New binary black hole mergers in the LIGO–Virgo O3a data”. In: *Phys. Rev. D* 106 (4 Aug. 2022), p. 043009. DOI: [10.1103/PhysRevD.106.043009](https://doi.org/10.1103/PhysRevD.106.043009) .
- [16] Horng Sheng Chia, Seth Olsen, **Javier Roulet**, Liang Dai, Tejaswi Venumadhav, Barak Zackay, and Matias Zaldarriaga. “Signs of higher multipoles and orbital precession in GW151226”. In: *Phys. Rev. D* 106 (2 July 2022), p. 024009. DOI: [10.1103/PhysRevD.106.024009](https://doi.org/10.1103/PhysRevD.106.024009) .
- [17] Seth Olsen, **Javier Roulet**, Horng Sheng Chia, Liang Dai, Tejaswi Venumadhav, Barak Zackay, and Matias Zaldarriaga. “Mapping the likelihood of GW190521 with diverse mass and spin priors”. In: *Phys. Rev. D* 104 (8 Oct. 2021), p. 083036. DOI: [10.1103/PhysRevD.104.083036](https://doi.org/10.1103/PhysRevD.104.083036) .
- [18] Barak Zackay, Liang Dai, Tejaswi Venumadhav, **Javier Roulet**, and Matias Zaldarriaga. “Detecting gravitational waves with disparate detector responses: Two new binary black hole mergers”. In: *Phys. Rev. D* 104 (6 Sept. 2021), p. 063030. DOI: [10.1103/PhysRevD.104.063030](https://doi.org/10.1103/PhysRevD.104.063030) .
- [19] Barak Zackay, Tejaswi Venumadhav, **Javier Roulet**, Liang Dai, and Matias Zaldarriaga. “Detecting gravitational waves in data with non-stationary and non-Gaussian noise”. In: *Phys. Rev. D* 104 (6 Sept. 2021), p. 063034. DOI: [10.1103/PhysRevD.104.063034](https://doi.org/10.1103/PhysRevD.104.063034) .
- [20] Yiwen Huang, Carl-Johan Haster, **Javier Roulet**, Salvatore Vitale, Aaron Zimmerman, Tejaswi Venumadhav, Barak Zackay, Liang Dai, and Matias Zaldarriaga. “Source properties of the lowest signal-to-noise-ratio binary black hole detections”. In: *Phys. Rev. D* 102 (10 Nov. 2020), p. 103024. DOI: [10.1103/PhysRevD.102.103024](https://doi.org/10.1103/PhysRevD.102.103024) .
- [21] Tejaswi Venumadhav, Barak Zackay, **Javier Roulet**, Liang Dai, and Matias Zaldarriaga. “New binary black hole mergers in the second observing run of Advanced LIGO and Advanced Virgo”. In: *Phys. Rev. D* 101 (8 Apr. 2020), p. 083030. DOI: [10.1103/PhysRevD.101.083030](https://doi.org/10.1103/PhysRevD.101.083030) .

- [22] Tejaswi Venumadhav, Barak Zackay, **Javier Roulet**, Liang Dai, and Matias Zaldarriaga. “New search pipeline for compact binary mergers: Results for binary black holes in the first observing run of Advanced LIGO”. In: *Phys. Rev. D* 100 (2 July 2019), p. 023011. DOI: [10.1103/PhysRevD.100.023011](https://doi.org/10.1103/PhysRevD.100.023011) .
- [23] Barak Zackay, Tejaswi Venumadhav, Liang Dai, **Javier Roulet**, and Matias Zaldarriaga. “Highly spinning and aligned binary black hole merger in the Advanced LIGO first observing run”. In: *Phys. Rev. D* 100 (2 July 2019), p. 023007. DOI: [10.1103/PhysRevD.100.023007](https://doi.org/10.1103/PhysRevD.100.023007) .

## Preprints

- [24] Ajit Kumar Mehta, Digvijay Wadekar, **Javier Roulet**, Isha Anantpurkar, Tejaswi Venumadhav, Jonathan Mushkin, Barak Zackay, Matias Zaldarriaga, and Tousif Islam. *Significant increase in sensitive volume of a gravitational wave search upon including higher harmonics*. 2025. arXiv: [2501.17939](https://arxiv.org/abs/2501.17939) [gr-qc] .
- [25] Digvijay Wadekar, **Javier Roulet**, Tejaswi Venumadhav, Ajit Kumar Mehta, Barak Zackay, Jonathan Mushkin, Seth Olsen, and Matias Zaldarriaga. *New black hole mergers in the LIGO–Virgo O3 data from a gravitational wave search including higher-order harmonics*. 2023. arXiv: [2312.06631](https://arxiv.org/abs/2312.06631) [gr-qc] .
- [26] Tousif Islam, **Javier Roulet**, and Tejaswi Venumadhav. *Factorized parameter estimation for real-time gravitational wave inference*. 2022. arXiv: [2210.16278](https://arxiv.org/abs/2210.16278) [gr-qc] .
- [27] Liang Dai, Barak Zackay, Tejaswi Venumadhav, **Javier Roulet**, and Matias Zaldarriaga. *Search for lensed gravitational waves including Morse phase information: an intriguing candidate in O2*. 2020. arXiv: [2007.12709](https://arxiv.org/abs/2007.12709) [astro-ph.HE] .

## Presentations

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### Invited

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| ◦ Panel, Gravitational Wave Physics and Astronomy Workshop 2022                                    | 2022 |
| ◦ Seminar, Perimeter Institute for Theoretical Physics   | 2022 |
| ◦ Seminar, International Center for Theoretical Sciences<br>Tata Institute of Fundamental Research | 2022 |
| ◦ Seminar, Department of Applied Math and Theoretical Physics<br>University of Cambridge           | 2022 |
| ◦ Seminar, LIGO seminar, California Institute of Technology  | 2022 |
| ◦ Talk, Astrophysics Coffee, Weizmann Institute of Science   | 2020 |
| ◦ Talk, Brown Bag Lunch, MIT Kavli Institute   | 2020 |
| ◦ Seminar, Max Planck Institute for Gravitational Physics<br>(Albert Einstein Institute)           | 2020 |
| ◦ Talk, High Energy Physics Journal Club, Princeton University                                     | 2020 |
| ◦ Seminar, Institut de Ciències del Cosmos, Universitat de Barcelona                               | 2019 |

### Contributed

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| ◦ Talk, Gravitational Wave Physics and Astronomy Workshop 2024 | 2024 |
| ◦ Talk, American Physical Society April Meeting 2024           | 2024 |

- Talk, XVII Latin American Regional IAU Meeting 2023
- Talk, ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav), Swinburne University of Technology 2022
- Talk, American Physical Society April Meeting 2022 2022
- Local's Friday blackboard talk, Kavli Institute for Theoretical Physics 2021
- Talk, Gravitational Wave Physics and Astronomy Workshop 2021 2021
- Poster, Workshop III: Source Inference and Parameter Estimation in Gravitational Wave Astronomy, Institute for Pure and Applied Mathematics, University of California, Los Angeles 2021
- Talk, American Physical Society April Meeting 2021 2021
- Institute for Advanced Study / Princeton University Bahcall Lunch 2021
- Talk, American Physical Society April Meeting 2020 2020
- Talk, 22nd International Conference on General Relativity and Gravitation – 13th Edoardo Amaldi Conference on Gravitational Waves 2019
- Talk, Gravitational Wave Physics and Astronomy Workshop 2018 2018

## Mentoring

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- Charles Gibson (undergraduate) 2024–
- Tousif Islam (graduate) 2021–2022
- Cuishan Liu (undergraduate) 2021–2022

## Outreach

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- Talk at *Noche de las estrellas*, Norton Science and Language Academy 2024
- Volunteer at *Exploring Caltech*, California Institute of Technology 2024
- Talk at *Astronomy Festival*, Great Basin National Park 2024
- Talks and volunteering at total solar eclipse viewing and star party, Piedras Negras, Mexico 2024
- Volunteer at annular solar eclipse viewing and star party, Bryce Canyon National Park, UT 2023
- Talk at *Astronomy on Tap*, Grand Canyon National Park 2023
- Panelist at *Stargazing in Spanish*, California Institute of Technology 2023
- Volunteer at *International Astronomy Day* 2023
- Santa Barbara Museum of Natural History; Astronomical Unit
- Poster at *Princeton Research Day*, Princeton University 2017

## Software

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[cogwheel](#): A code for parameter estimation of gravitational wave sources implementing several original methods for efficiency.

## Academic service

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**Organizer** 2023  
 Giambiagi Winter School on Cosmology [🔗](#)  
 International Center for Theoretical Physics; Universidad de Buenos Aires

## Referee

- Astronomy & Astrophysics
- Astrophysical Journal
- Astrophysical Journal Letters
- Chaos, Solitons and Fractals
- Monthly Notices of the Royal Astronomical Society
- Physical Review D
- Physical Review X

## References

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Weizmann Institute of Science  
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- Katerina Chatziioannou  
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