

Keefe Edward Alden Mitman

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EDUCATION **California Institute of Technology (Caltech), Department of Physics**
Ph.D. Candidate, Physics (fifth-year graduate student); GPA: 4.33/4.00.
 Dissertation Topic: Gravitational Memory and the BMS Group in Numerical Relativity.
 Dissertation Advisor: Professor Saul Teukolsky.

Columbia University in the City of New York
B.A. in Mathematics, B.A. in Physics, May 2019 (Cum Laude); GPA (Physics): 4.02/4.00
 Graduated with the Highest Honors in Physics.
 Dean's List — every semester.

HONORS/AWARDS [2022 John S. Stemple Memorial Prize](#) (for “outstanding progress in research”), *May 2022*
California Institute of Technology.
 [APS Division of Gravitational Physics Best Student Presentation](#), *Mar. 2022*
APS Division of Gravitational Physics.
 Rochus E. Vogt Graduate Fellowship, *Sep. 2019 - Dec. 2019*
California Institute of Technology.
 Erwin H. Leiwant Scholarship, *Sep. 2016 - May 2017*
Columbia University.
 Outstanding Achievement in German Language and Literature, *Sep. 2015 - May 2016*
Columbia University, Department of Germanic Languages.

RESEARCH INTERESTS General relativity, numerical relativity simulations, black holes, gravitational waves, memory effects, the BMS group (and other symmetries of asymptotic infinity), ringdowns, surrogate models. Specifically, focusing on the improvement of waveform modeling for binary black hole mergers by matching the data of numerical simulations to that of analytic models using BMS frame fixing. Other interests include improving our understanding of black hole ringdowns and the way nonlinearities escape to infinity.

RESEARCH EXPERIENCE **Theoretical AstroPhysics Including Relativity and Cosmology (TAPIR)**, *Aug. 2019 - Present*
California Institute of Technology, Simulating eXtreme Spacetimes (SXS) Group

Graduate Research Fellow in Theoretical Physics

European Organization for Nuclear Research (CERN), *Nov. 2015 - May 2019*
Columbia University, Heavy-Ion Group

Undergraduate Research Fellow in Experimental Physics

Columbia University, *Sep. 2018 - May 2018*
Independent Research with Professor Yuri Levin

Undergraduate Research Fellow in Theoretical Physics

PUBLICATION SUMMARY

- A total of **15** short-author papers, **5 as lead author**.
- Out of which, **1 covered by press release**.
- 2 other publications (notes, etc.)

17. Teagan Clarke, Maximiliano Isi, Paul Lasky, Eric Thrane, *et al.* (12 authors w/ **Keefe Mitman**) *Striking the Right Tone: towards a self-consistent framework for measuring black hole ringdowns.* [arXiv:2402.02819](https://arxiv.org/abs/2402.02819). Feb. 2024. (submitted to PRD).
16. Hengrui Zhu, Justin Ripley, Frans Pretorius, Sizheng Ma, **Keefe Mitman**, Robert Owen, *et al.* *Nonlinear Effects In Black Hole Ringdown From Scattering Experiments I: spin and initial data dependence of quadratic mode coupling.* [arXiv:2401.00805](https://arxiv.org/abs/2401.00805). Jan. 2024. (submitted to PRD).
15. Hengrui Zhu, Harrison Siegel, **Keefe Mitman**, Maximiliano Isi, Will Farr, *et al.* *Black Hole Spectroscopy for Precessing Binary Black Hole Coalescences.* [arXiv:2312.08588](https://arxiv.org/abs/2312.08588). Dec. 2023. (submitted to PRL).
14. Alexander M. Grant, **Keefe Mitman** *Higher Memory Effects in Numerical Simulations of Binary Black Hole Mergers.* [arXiv:2312.02295](https://arxiv.org/abs/2312.02295). Dec. 2023. (submitted to CQG).
13. Matteo Boschini, *et al.* (21 authors w/ **Keefe Mitman**) *Extending black-hole remnant surrogate models to extreme mass ratios.* [arXiv:2307.03435](https://arxiv.org/abs/2307.03435). Jul. 2023.
12. Jooheon Yoo, **Keefe Mitman**, Vijay Varma, *et al.* *Numerical relativity surrogate model with memory effects and post-Newtonian hybridization.* *Phys. Rev. D* **108**, 064027 (2023). [arXiv:2306.03148](https://arxiv.org/abs/2306.03148). Sep. 2023.
11. Lorenzo Pompili, *et al.* (24 authors w/ **Keefe Mitman**) *Laying the foundation of the effective-one-body waveform models SEOBNRv5: improved accuracy and efficiency for spinning non-precessing binary black holes.* [arXiv:2303.18039](https://arxiv.org/abs/2303.18039). Mar. 2023.
10. **Keefe Mitman**, Macarena Lagos, Leo C. Stein, *et al.* *Nonlinearities in black hole ringdowns.* *Phys. Rev. Lett.* **130**, 081402 (2023). [arXiv:2208.07380](https://arxiv.org/abs/2208.07380). Feb. 2023.
Editors' Suggestion and Featured in Physics.
[In Press: Caltech, Columbia, UMiss, JHU, APS Physics, Physics World, Space.com, etc.](#)
9. **Keefe Mitman**, Leo C. Stein, Michael Boyle, *et al.* *Fixing the BMS frame of numerical relativity waveforms with BMS charges.* *Phys. Rev. D* **106**, 084029 (2022). [arXiv:2208.04356](https://arxiv.org/abs/2208.04356). Oct. 2022.
8. Sizheng Ma, **Keefe Mitman**, Ling Sun, *et al.* *Quasinormal-mode filters: a new approach to analyze the gravitational-wave ringdown of binary black-hole mergers.* *Phys. Rev. D* **106**, 084036 (2022). [arXiv:2207.10870](https://arxiv.org/abs/2207.10870). Oct. 2022.
7. Lorena Magaña Zertuche, **Keefe Mitman**, Neev Khera, Leo C. Stein, *et al.* *High precision ringdown modeling: multimode fits and BMS frames.* *Phys. Rev. D* **105**, 104015 (2022). [arXiv:2110.15922](https://arxiv.org/abs/2110.15922). May 2022.
6. **Keefe Mitman**, Neev Khera, Dante A. B. Iozzo, Leo C. Stein, *et al.* *Fixing the BMS frame of numerical relativity waveforms.* *Phys. Rev. D* **104**, 024051 (2021). [arXiv:2105.02300](https://arxiv.org/abs/2105.02300). Jul. 2021.
5. Dante A. B. Iozzo, Neev Khera, Leo C. Stein, **Keefe Mitman**, *et al.* *Comparing remnant properties from horizon data and asymptotic data in numerical relativity.* *Phys. Rev. D* **103**, 124029 (2021). [arXiv:2104.07052](https://arxiv.org/abs/2104.07052). Jun. 2021.
4. **Keefe Mitman**, Dante A. B. Iozzo, Neev Khera, *et al.* *Adding gravitational memory to waveform catalogs using BMS balance laws.* *Phys. Rev. D* **103**, 024031 (2021). [arXiv:2011.01309](https://arxiv.org/abs/2011.01309). Jan. 2021.

3. **Keefe Mitman**, Jordan Moxon, Mark A. Scheel, Saul A. Teukolsky, *et al.* *Computation of displacement and spin gravitational memory in numerical relativity.* *Phys. Rev. D* 102, 104007 (2020). [arXiv:2007.11562](https://arxiv.org/abs/2007.11562). Nov. 2020.

UNREFEREED
PUBLICATIONS

2. *Photo-nuclear dijet production in ultra-peripheral Pb+Pb collisions.* ATLAS Collaboration, [ATLAS-CONF-2017-011](https://arxiv.org/abs/1707.08621).
1. *Photo-nuclear dijet production in ultra-peripheral Pb+Pb collisions.* ATLAS Collaboration, ATLAS-INT. July 2016.

INVITED TALKS/
WORKSHOPS

10. [Gravitational Memory Effects: From Theory to Observation](#) (invited workshop) *Jun. 2023*
Queen Mary University of London.
9. [Nonlinearities in Black Hole Ringdowns](#), *Feb. 2023*
APS DGRAV Seminar Series.
APS DGRAV.
8. [The Future of Numerical Relativity: Gravitational Memory, BMS Frames, and More](#), *Nov. 2022*
Perimeter Institute Strong Gravity Seminar.
Perimeter Institute.
7. [Holography and Gravitational Waves](#) (invited workshop), *Jul. 2022*
Institute for Fundamental Physics of the Universe.
6. [Black Holes and BMS Frames in Numerical Relativity](#), *Mar. 2022*
Black Hole Initiative Colloquium.
Black Hole Initiative at Harvard University.
5. [Ringdown Modeling: Multimode Fits and BMS Frames](#), *Nov. 2021*
Caltech LIGO Seminar.
Caltech LIGO.
4. [Gravitational Waves in Numerical Relativity and BMS Frames](#), *Nov. 2021*
Princeton Gravity Initiative Fall Seminar Series.
Princeton Gravity Initiative.
3. [Cauchy-characteristic Extraction and its Memorable Consequences](#), *Sep. 2021*
Numerical Relativity Community Call Monthly Meeting (virtual),
Numerical Relativity Community.
2. [Gravitational Memory and BMS Frames in Numerical Relativity](#), *Jun. 2021*
LISA Waveform Working Group Monthly Meeting (virtual),
LISA Waveform Working Group.
1. [Gravitational Memory in Numerical Relativity](#), *May 2021*
Conference on Gravitational Scattering, Inspiral and Radiation (virtual),
Galileo Galilei Institute

CONTRIBUTED
TALKS

8. [Nonlinearities in Black Hole Ringdowns](#), *Apr. 2023*
APS April Meeting.
7. [Nonlinearities in Black Hole Ringdowns](#), *Mar. 2023*
Pacific Coast Gravity Meeting.
6. [What Gravitational Waves Actually Look Like](#), *Oct. 2022*
Astrophysics, Relativity, and Cosmology Seminar, California Institute of Technology.
5. [The Importance of BMS Frames for Gravitational Wave Modeling](#), *Apr. 2022*
APS April Meeting.
4. [The Importance of BMS Frames for Gravitational Wave Modeling](#), *Mar. 2022*
Pacific Coast Gravity Meeting. ([Awarded DGRAV's Best Student Presentation](#)).

3. *Thanks for the Memories*,
Caltech Three Minute Thesis Competition. *Apr. 2021*
2. *Gravitational Memory in Numerical Relativity*,
APS April Meeting. *Apr. 2021*
1. *Gravitational Memory in Numerical Relativity*,
Pacific Coast Gravity Meeting. *Mar. 2021*

ORGANIZED
CONFERENCES

1. APS DGRAV Pacific Coast Gravity Meeting (at Caltech), *April. 2023*

GRANTS

1. APS Division of Gravitational Physics Travel Grant,
APS Division of Gravitational Physics. *Feb. 2022*

JOURNAL REFEREE European Physical Journal C, Astrophysics and Space Science.

TEACHING
EXPERIENCE

- ☐ TA for Ph205A (Quantum Field Theory) with Professor Sergei Gukov. *Sep. 2020 - Dec. 2020*
California Institute of Technology.

Pinned Review:

“Perfect. Best TA I’ve ever seen, would be a phenomenal professor. Problem sets were difficult, and would have been demoralizing in the extreme without help in TA sessions. Especially remarkable was the fact that Keefe knew the material and the problems (as well as the solutions) absolutely inside and out, so no matter where I was stuck he immediately had a helpful suggestion. Plus, the TA demonstrated extensive knowledge of the material beyond the course itself, and could adroitly field questions related to current research and applications of QFT, recommend other texts that addressed the problems differently, or offer a different approach when (as was usually the case) the course text’s presentation was lacking.

Extremely approachable and available outside of organized office hours – genuinely concerned about the students in the class.

All things considered, HW troubles would have made this class an exceptionally unpleasant experience but for the excellent TA, thanks to whom I had a pretty good time overall.”

- ☐ TA for Ph129C (Complex Analysis) with Professor Hiroshi Oguri. *Mar. 2020 - Jun. 2020*
California Institute of Technology.
- ☐ TA for GU4040 (General Relativity) with Professor Rachel Rosen. *Jan. 2019 - May 2019*
Columbia University.

Tutoring:

- ☐ Caltech Y – Rise Tutor. *Sep. 2019 - Present*
- ☐ Columbia One-to-One Tutoring – One-to-One Tutor. *Sep. 2015 - May 2019*
- ☐ Mathematics and Physics Tutor (private). *Oct. 2016 - Sep. 2019*

OUTREACH

- ☐ Caltech Visiting Scientists Program –
Visiting Scientist at Madison Elementary School (Pasadena, CA). *Sep. 2019 - Nov. 2022*

ADDITIONAL
EXPERTISE

Languages: English (fluent), German (proficient), Spanish (elementary).
Computing: C/C++, Python (scipy, numpy), numerically solving PDEs, spectral methods, finite difference methods, ROOT, Matplotlib, Mathematica, LaTeX, Java/HTML.