

JAEDEN BARDATI

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SUMMARY

I am a Caltech Ph.D. student and NSERC Graduate Fellow interested in how supermassive black holes (SMBH) grow, evolve and influence their environments across multiple scales. This includes active galactic nuclei (AGN) feedback, structure and spectral evolution, multi-messenger signatures of merging SMBHs, and characterizing little red dots (LRDs). I often use radiative transfer (RT) and magnetohydrodynamics (MHD) hyper-refinement simulations on high-performance computing hardware, and data analysis including machine learning and various other statistical techniques.

EDUCATION

California Institute of Technology – CA, United States

Sept. 2023 – present

Ph.D. Physics

Advisor: Philip F. Hopkins

Coursework includes: General Relativity I & II, Quantum Field Theory I-III, Computational Astrophysics, Astroinformatics, Mathematical Methods of Physics, Applications of Physics (Fluid Dynamics), Learning Systems (Machine Learning), Radiative Processes, Principles of University Teaching

Bishop’s University – QC, Canada

Sept. 2020 – June 2023

B.Sc. Physics Honours (with distinction)

Minor in Mathematics, 4.0 GPA

Thesis: “Signatures of Massive Black Hole Mergers in Their Host Galaxy Morphologies”

Advisor: John J. Ruan

TECHNICAL SKILLS

Python	10+ years experience (numpy, matplotlib, scipy, pandas, scikit-learn, pytorch, tensorflow, etc.)
HPC	Used 10+ million CPU-hours on Compute Canada Cedar and TACC Frontera
MHD & RT Codes	GIZMO, SKIRT, Powderday (Hyperion + FSPS), Dedalus
Astro Tools	astropy, photutils, pynbody, tangos, yt, vorbin, statmorph, ppXF, Kinemetry
Other	C/C++ (including OpenMP, Kokkos), Java, Assembly, Bash, HTML/CSS, Javascript, R, LaTeX, git

AWARDS & SCHOLARSHIPS (LAST ~5 YEARS)

2025-2028	Canada Graduate Scholarship (CGS-D) , Natural Sciences and Engineering Research Council of Canada (NSERC)
2024-2025	Walter Burke Institute of Theoretical Physics Graduate Fellowship
2025	Certificate of Interest in University Teaching
2024	Caltech Y Hummel-Gray Award
2023-2024	Joshua and Beth Friedman Foundation Fund Scholarship
2023	Perimeter Scholars International Scholarship (declined)
2023	The Bishop’s University Prize in Physics and Astronomy (highest achievement)
2023	The David Savage Prize in Physics and Mathematics (highest achievement)
2022-2023	American Biltrite (Canada) Ltd Scholarship (merit scholarship)
2022-2023	Florence May Foreman Scholarship (merit scholarship)
2022	The Bishop’s University Undergraduate Prize in Physics and Astronomy (highest achievement)
2021-2023	<i>3x awarded</i> Undergraduate Student Research Award (USRA) , NSERC
2021-2023	<i>3x awarded</i> FRQNT Supplément au bourse de 1er cycle du CRSNG
2021-2022	Bourse d’Écellence Hydro-Québec (merit scholarship)
2021-2023	Bishop’s University Academic Honour Roll (every year)
2021	The Bishop’s University Faculty Prize in Physics
2020-2021	H. Greville Smith Memorial Scholarship (merit scholarship)

PUBLICATIONS

First-Author Refereed

- [1] **Bardati, J.**, Hopkins, P. F. (2026) The Nature of a Broad Line Region Generated from a Multiscale Quasar Simulation. *In prep.*
- [2] **Bardati, J.**, Hopkins, P. F. & Faucher-Giguère, C.-A. (2026). A Hot DOG Forged in FIRE: Nuclear and Starburst Spectral Decomposition of a Luminous Infrared Galaxy Simulation with a Resolved Dust Torus. *Submitted to ApJ*. [arXiv:2603.12328](https://arxiv.org/abs/2603.12328)
- [3] **Bardati, J.**, Hopkins, P. F. & Richards, G. T. (2026). Early Stages of Dusty Tori: The First Infrared Spectra from a Highly Multiscale Quasar Simulation. *The Astrophysical Journal*, 997(1), 10. [doi:10.3847/1538-4357/ae29af](https://doi.org/10.3847/1538-4357/ae29af)
- [4] **Bardati, J.**, Ruan, J. J., Haggard, D., Tremmel, M., & Horlavage, P. (2024). Signatures of Massive Black Hole Merger Host Galaxies from Cosmological Simulations II: Unique Stellar Kinematics in Integral Field Unit Spectroscopy. *The Astrophysical Journal*, 977(2), 265. [doi:10.3847/1538-4357/ad9471](https://doi.org/10.3847/1538-4357/ad9471)
- [5] **Bardati, J.**, Ruan, J. J., Haggard, D., & Tremmel, M. (2024). Signatures of Massive Black Hole Merger Host Galaxies from Cosmological Simulations I: Unique Galaxy Morphologies in Imaging. *The Astrophysical Journal*, 961(1), 34. [doi:10.3847/1538-4357/ad055a](https://doi.org/10.3847/1538-4357/ad055a)

Co-Author Refereed

- [6] Surprenant-Coache, A.-A., Ruan, J. J., **Bardati, J.**, Haggard, D. (2026). Signatures of Massive Black Hole Merger Host Galaxies from Cosmological Simulations: Unique Stellar Formation Histories. *In prep.*
- [7] Horlavage, P., Ruan, J. J., Eracleous, M., **Bardati, J.**, Runnoe, J. C., Haggard, D. (2025). Predicting Potential Host Galaxies of Supermassive Black Hole Binaries Based on Stellar Kinematics in Archival IFU Surveys. *Submitted to ApJ*. [arXiv:2504.21145](https://arxiv.org/abs/2504.21145)
- [8] Hopkins, P. F., et al., including **Bardati, J.** (2025). Zooming In On The Multi-Phase Structure of Magnetically-Dominated Quasar Disks: Radiation From Torus to ISCO Across Accretion Rates. *The Open Journal of Astrophysics*, 8. [doi:10.33232/001c.137296](https://doi.org/10.33232/001c.137296)

Non-Refereed

- [9] Ruan, J., **Bardati, J.**, Haggard, D., & Tremmel, M. (2024). Signatures of Massive Black Hole Merger Host Galaxies from Cosmological Simulations: Unique Stellar Kinematics in Spatially-Resolved Spectroscopy. *American Astronomical Society Meeting Abstracts*, 56(2), Article 456.11
- [10] **Bardati, J.**, Ruan, J. J., Haggard, D., & Tremmel, M. (2023). Host Galaxy Morphological Signatures of Massive Black Hole Mergers. *American Astronomical Society Meeting Abstracts*, 55(2), Article 268.17

PRESENTATIONS

- [1] **Invited seminar talk**, Diego Portales University, Santiago, Chile (virtual). Apr 2026
Simulation of a Hot Dust Obscured Galaxy with a Resolved Dust Torus
- [2] **Conference talk**, American Physical Society Global Physics Summit, Denver, CO. Mar 2026
Observational Predictions from a Cosmological Simulation of a Quasar Starburst Galaxy Zoomed to the Supermassive Black Hole's Innermost Stable Orbit
- [3] **Invited seminar talk**, Mathematics Teaching Seminar, Caltech. Nov 2025
Beyond the Lecture Room: How to Guide Student Learning and Give Effective Feedback
- [4] **Conference talk**, Massive Black Holes in First Billion Years, Kinsale, Co. Cork, Ireland. Apr 2024
Signatures of Massive Black Hole Merger Host Galaxies in Morphology and Stellar Kinematics
- [5] **Invited seminar talk**, LISA Multi-Messenger Astronomy Working Group telecon. Jun 2023
Host Galaxy Morphological Indicators of MBH Mergers

- [6] **Seminar talk:** Bishop's University, Sherbrooke, QC, Canada. *Signatures of MBHs in their Host Galaxy Morphologies* Apr 2023
- [7] **Seminar talk:** Bishop's University, Sherbrooke, QC, Canada. *Multi-Messenger Prospects of Massive Black Hole Mergers* Mar 2023
- [8] **3 minute thesis,** Bishop's University, Sherbrooke, QC, Canada. *How Do We Find Supermassive Black Hole Mergers?* Jan 2023
- [9] **Poster,** American Astronomical Society Meeting 241, Seattle, WA. *Host Galaxy Morphological Signatures of Massive Black Hole Mergers* Jan 2023
- [10] **Conference talk:** LISA Canada Workshop 2022 (virtual). *Host Galaxy Morphological Signatures of MBH Mergers* Aug 2022
- [11] **Seminar talk,** Bishop's University Department of Physics & Astronomy Lunch Talk. Jul 2022

TEACHING EXPERIENCE

Teaching Assistant

Caltech Ph 12b: <i>Waves, Quantum Physics, and Statistical Mechanics</i> , Teaching Assistant	Winter 2026
Caltech Ph 2c: <i>Waves, Quantum Mechanics, and Statistical Physics</i> , Head TA	Spring 2025
Caltech Ph 21: <i>Computational Physics II</i> , Teaching Assistant	Winter 2025
Caltech Ph 20: <i>Computational Physics I</i> , Teaching Assistant	Fall 2024
Caltech Ph 1c: <i>Classical Mechanics & Electromagnetism (analytic & practical)</i> , Head TA	Spring 2024
Caltech Ph 1b: <i>Classical Mechanics & Electromagnetism (analytic track)</i> , Teaching Assistant	Winter 2024
Bishop's University Mat 82: <i>Enriched Calculus Laboratory II</i> , Teaching Assistant	Winter 2023
Bishop's University Phy 113: <i>Introduction to Astronomy</i> , Marker	Fall 2022
Bishop's University Phy 101: <i>Statistical Methods in Experimental Science</i> , Marker	Fall 2022
Bishop's University Mat 81: <i>Enriched Calculus Laboratory I (2 groups)</i> , Teaching Assistant	Fall 2022

Research Mentoring

<i>Dana Moradi</i> (Santa Monica College), Caltech Connection	2025 – present
<i>Shaun Chen</i> (Pasadena Community College), Caltech Connection	2025 – present
<i>Jasper Thorne-Lyman</i> (University of Maryland Undergrad), co-mentored with Saul Teukolsky	Summer 2025
<i>Anabelle Eisner</i> (Caltech Undergrad), FSRI program	Summer 2025
<i>Frank Gomez-Montalvo</i> (Caltech Undergrad), FSRI program	Summer 2025
<i>Isabella Torres</i> (Caltech Undergrad), FSRI program	Summer 2025
<i>Angel Guerra</i> (Caltech Undergrad), FSRI program	Summer 2025

Academic Mentoring

Served as a recurrent advisor for 8 students through various formal weekly/monthly academic mentoring programs.

Undergraduate students: *Jonathan Sar-Shalom* (University of Central Florida), *Christian Captain* (Clemson University), *Shai Toledano* (University of Michigan), *Varun Pritmani* (Hunter College), *Max Kogan* (UCSC), *Adrian Lam* (UCLA).

Graduate students: *Tryston Raecke* (Caltech), *Lihang Zhou* (Caltech).

Tutoring

Caltech Y-Tutor , Pasadena Community College students, online	2023 – present
Caltech Rise , John Muir High School Early College Magnet students, in-person	2023 – 2025
Math Help Center , Bishop's University students, in-person	2022 – 2023
Nimbus Learning Platform , Bishop's University students, online & in-person	2020 – 2023
R.D.W. Howson Enrichment Centre , Bishop's College School students, online & in-person	2020 – 2021
Math and Physics Workshop , Champlain College students, online & in-person	2019 – 2020

ACADEMIC SERVICE & OUTREACH

Caltech Project for Effective Teaching (CPET) Co-Director	2025 – present
Oversees graduate student certificate programs in university teaching, organizes and leads workshops, seminars and discussion groups on effective teaching for TAs and postdocs, and is responsible for training all new graduate students as teaching assistants. Spearheaded a rebranding campaign including renaming the organization to Caltech Future Faculty and Mentors (CFAM).	
Caltech PMA Graduate Student Advisory Board Representative	2025 – present
Member of an advisory board to the Division of Physics, Astronomy and Physics (PMA) at Caltech and helps organize and lead future and ongoing PMA graduate student programming.	
Caltech Astro Outreach Volunteer	2025 – present
Recurring volunteer for numerous Caltech Astro Outreach public events including Stargazing lectures, Pasadena Astro on Tap, and Pasadena City of Astronomy Science Festivals.	
Physics, Mathematics & Astronomy (PMA) Department Mentor, Caltech	2024 – present
Caltech Connection Mentor	2025 – 2026
Caltech Accountability Partners Program (CAPP) Advisor	2024 – 2026
Adopt-a-Physicist Outreach Program Volunteer, Sigma Pi Sigma	2026
Prospective Graduate Student Visit Volunteer, Caltech PMA Department	2026
Seminar Day Poster Judge, Caltech	2025
First-Year Success Research Institute (FSRI) Mentor, Caltech	2025
TA Conference Facilitator, Caltech PMA Department	2024 & 2025
Division of Dynamical Astronomy (DDA) Mentor, American Astronomical Society (AAS)	2023 – 2025
Physics & Astronomy (Senior) Category Award Judge, California Science & Engineering Fair	2024
International Science & Engineering Fair (ISEF) Selection Judge, Orange County Science Fair	2024
Co-Founder and Co-Lead, Bishop’s University Astronomy, Mathematics and Physics Society	2021 – 2023
Peer Note-Taker, Bishop’s University Student Accessibility & Accommodation Services	2021 – 2022
Student Ambassador, Champlain College	2019 – 2020

OTHER TRAINING & WORKSHOPS

PSI Students’ Training Accelerator for Research in Theory (PSI START) Summer 2022

Perimeter Institute

- Selective ten-week online school consisting of 4 courses in quantum information, path integral quantum mechanics, numerical methods, and symmetry mathematics, including a small project in general relativity.
- One of ten worldwide to be offered a summer research internship (declined).

DAWN Winter School Feb. 2022

Cosmic Dawn Center

- One-week school aiming to address practical knowledge in astrophysics for graduate students, from both observational and theoretical perspectives.

MEDIA COVERAGE

2025	Canadian News Corporation (CBC): U.S. science funding uncertainty reshapes grad school choices for Canadians
2024	BU Research Spotlights: Signatures of Massive Black Hole Merger Host Galaxies from Cosmological Simulations
2023	Sherbrooke Record: Bishop’s grad accepted to PhD physics program at Caltech
2023	BU Research Spotlights: Jaeden Bardati, Bishop Graduate 2023: Accepted in the PhD Physics Program at Caltech
2023	Bishop’s University Blog: Training the Physicists of Tomorrow
2023	Centre de Recherche en Astrophysique du Québec Calendar: Mergers of galaxies hosting supermassive black holes
2022	BU Research Spotlights: Undergraduate Student Accepted in Prestigious International Summer Training Program
2021	Sherbrooke Record: This is going to be a big thing

WRITTEN TEACHING/MENTORING TESTIMONIALS

FSRI Mentoring	“This will definitely be one of the most memorable projects that I will work on while at Caltech.”
FSRI Mentoring	“Thank you for giving this opportunity to explore an intriguing research topic, I truly learned a lot.”
FSRI Mentoring	“I have enjoyed getting to learn new skills on Python and learning about active galactic nuclei.”
FSRI Mentoring	“You helped make tackling something unfamiliar much more feasible.”
Ph 12b	“Overall very effective [teaching]. Thank you for great recitation!”
Ph 12b	“Jaeden is good at explaining things.”
Ph 1b (analytical)	“I really enjoyed your teaching.”