Jaeden Bardati

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Summary

I am a Caltech Ph.D. candidate and NSERC Graduate Fellow studying how supermassive black holes grow, evolve, and shape their environments from accretion disk to galactic scales. My work often involves semi-analytic modeling, radiative transfer and magnetohydrodynamics simulations, and data analysis including statistical and machine learning techniques.

Education

California Institute of Technology – CA, United States
Ph.D. Physics *Expected in 2028*
Thesis: *A Multiscale View of Active Galactic Nuclei: Predictions from Bridging Scale Simulations*
Advisor: Philip F. Hopkins

M.S. Physics completed en route.
Coursework includes GR I & II, QFT I-III, multiple computational physics and ML courses, etc.

Bishop's University – QC, Canada
B.Sc. Physics Honours with Distinction (Minor in Mathematics, 4.0 GPA) *June 2023*
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/JS, LaTeX, Git

Awards & Scholarships

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	*3x awarded* **Undergraduate Student Research Award** (USRA), NSERC
2021-2023	*3x awarded* **FRQNT Supplément au bourse de 1er cycle du CRSNG**
2021-2022	**Bourse d'Éxcellence 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)
2020	**Champlain College Highest Achievement in Physics**

Publications

First-Author

[1] **Bardati, J.**, et al. (2026). Zooming in to a Little Red Dot Candidate. *In prep.*

[2] **Bardati, J.**, Hopkins, P. F. (2026) The Nature of a Broad Line Region Generated from a Multiscale Quasar Simulation. *In prep.*

[3] **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

[4] **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

[5] **Bardati, J.**, Ruan, J. J., Haggard, D., Tremmel, M., & Horlaville, 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

[6] **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

Major Co-Author

*Student-led paper under my direct supervision in a project of my design. In all other papers found in this section, I contributed significantly to the project design, data collection, and/or interpretation of results.

[7] *Moradi, D., **Bardati, J.**, Hopkins, P. (2026). Comparing Phenomenological Spectra to a Self-Consistently Simulated Dust Torus. *In prep*.

[8] Surprenant-Coache, A.-A., Ruan, J. J., **Bardati, J.**, Haggard, D., & Tremmel, M. (2026). Signatures of Massive Black Hole Merger Host Galaxies from Cosmological Simulations: Unique Stellar Formation Histories. *In prep*.

[9] Horlaville, 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. doi:10.3847/1538-4357/ae6662

Other Co-Author

[10] Hopkins, P. F., et al., including **Bardati, J.** (2026). Zooming Out From Magnetically-Dominated Quasar Disks: Radiation and Outflows from ISCO to Parsec Scales. *In prep.*

[11] 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

Presentations

[1] **Conference talk**, Supermassive Black Holes and Blue Notes, Montreal, QC. *July 2026*
Spectral Predictions from a Super- Eddington Quasar Simulation Zoomed in to Innermost Stable Orbit

[2] **Poster**, American Astronomical Society Meeting 248, Pasadena, CA. *June 2026*
Predictions from a Super-Eddington Quasar Simulation Spanning Extragalactic to Sub-pc Scales

[3] **Workshop talk**, Bridging Scales in Black Hole Feedback, Harvard CfA, Cambridge, MA *May 2026*
Observational Predictions of AGN Structure in Multi-Scale Quasar Simulations

[4] **Invited seminar talk**, Diego Portales University, Santiago, Chile (virtual). *Apr 2026*
Simulation of a Hot Dust Obscured Galaxy with a Resolved Dust Torus

[5] **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

[6] **Invited seminar talk**, Mathematics Teaching Seminar, Caltech. *Nov 2025*
Beyond the Lecture Room: How to Guide Student Learning and Give Effective Feedback

[7] **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

[8] **Invited seminar talk**, LISA Multi-Messenger Astronomy Working Group telecon. *Jun 2023*
Host Galaxy Morphological Indicators of MBH Mergers

[9] **Seminar talk**: Bishop's University, Sherbrooke, QC, Canada. *Apr 2023*
Signatures of MBHs in their Host Galaxy Morphologies

[10] **Seminar talk**: Bishop's University, Sherbrooke, QC, Canada. *Mar 2023*
Multi-Messenger Prospects of Massive Black Hole Mergers

[11] **3 minute thesis**, Bishop's University, Sherbrooke, QC, Canada. *Jan 2023*
How Do We Find Supermassive Black Hole Mergers?

[12] **Poster**, American Astronomical Society Meeting 241, Seattle, WA. *Jan 2023*
Host Galaxy Morphological Signatures of Massive Black Hole Mergers

[13] **Conference talk**: LISA Canada Workshop 2022 (virtual). *Aug 2022*
Host Galaxy Morphological Signatures of MBH Mergers

[14] **Seminar talk**, Bishop's University Department of Physics & Astronomy Lunch Talk. *Jul 2022*

Teaching Experience

Teaching Assistant

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

Research Mentoring

Dana Moradi (Santa Monica College), Caltech Connection *2025 – present*
Shaun Chen (Pasadena Community College), Caltech Connection *2025 – present*
Jasper Thorne-Lyman (University of Maryland Undergrad), co-mentored with Saul Teukolsky *Summer 2025*
Anabelle Eisner (Caltech Undergrad), FSRI program *Summer 2025*
Frank Gomez-Montalvo (Caltech Undergrad), FSRI program *Summer 2025*
Isabella Torres (Caltech Undergrad), FSRI program *Summer 2025*
Angel Guerra (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 many 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 Connnection Mentor *2025 – 2026*
Caltech Accountability Partners Program (CAPP) Advisor *2024 – 2026*
Caltech Mentoring Conference Planning Committee & Facilitator *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

Ivy+ Graduate Student Teaching Transformations Summit May 2026
Ivy League Universities (virtual)

- Yearly gathering of graduate students across Ivy Plus institutions who are committed to improving the support, discourse, and practice of pedagogy in higher education. I was sent on behalf of Caltech for 2026.

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."
Caltech Connections	"Jaeden [is] an amazing teacher, mentor, and friend."
Caltech Connections	"I've been able to learn so much [...] all thanks to Jaeden's guidance."