Jaeden Bardati

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Summary

I am a Caltech Ph.D. student and NSERC Graduate Fellow using magnetohydrodynamics and radiative transfer super-zoom-in simulations to make observational predictions of supermassive black holes (SMBHs) and their galactic environments. This ranges from SMBH binary signatures, to active galactic nuclei structure and feedback evolution, to little red dots.

Education

California Institute of Technology – CA, United States *Sept 2023 – present*
Ph.D. Physics
Advisor: Philip F. Hopkins
Certificate of Interest in University Teaching
Graduate 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)
Thesis: "Signatures of Massive Black Hole Mergers in Their Host Galaxy Morphologies"
Advisor: John J. Ruan
Minor in Mathematics, 4.0/4.0 GPA

Technical Skills

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

Awards & Scholarships (last 5 years)

2025-2028	**Canada Graduate Scholarship** (CGS-D), Natural Sciences and Engineering Research Council of Canada (NSERC)
2024	**Walter Burke Institute of Theoretical Physics Graduate Fellowship**
2024	**Caltech Y Hummel-Gray Award**
2023	**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**
2020	**Champlain College Academic Excellence Award**

Teaching Experience

Teaching Assistant

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

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 mentor 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, plans 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 that included renaming the organization to Caltech Future Faculty and Mentors (CFAM).

Caltech Accountability Partners Program (CAPP) Mentor — *2024 – present*
Physics, Mathematics & Astronomy (PMA) Department Mentor, Caltech — *2024 – present*
Poster Judge for Seminar Day, Caltech — *2025*
First-Year Success Research Institute (FSRI) Mentor, Caltech — *2025*
PMA Department TA Conference Facilitator, Caltech — *2024, 2025*
Division of Dynamical Astronomy (DDA) Mentor, American Astronomical Society (AAS) — *2023 – 2025*
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 (AMPS) — *2021 – 2023*
Peer Note-Taker, Bishop's University Student Accessibility & Accommodation Services — *2021 – 2022*
New Student Orientation Ambassador, Champlain College — *2019 – 2020*

Publications

Refereed or Submitted for Review

[1] **Bardati, J.**, Hopkins, P. F. (2025). High-Redshift Luminous Infrared Galaxy Spectral Predictions from Simulation Resolving Dust Torus. *In prep.*

[2] **Bardati, J.**, Hopkins, P. F. & Richards, G. T. (2025). Early Stages of Dusty Tori: The First Infrared Spectra from a Highly Multiscale Quasar Simulation. *Submitted to ApJ.* arXiv:2509.09770

[3] 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. *Submitted to ApJ.* arXiv:2504.21145

[4] Hopkins, P. F., Su K., Murray N., Steinwandel, U. P., Kaaz N., Ponnada S. B., **Bardati, J.**, et al. (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

[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

Non-Refereed

[7] 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

[8] **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] **Conference talk**, Massive Black Holes in First Billion Years, Kinsale, Co. Cork, Ireland. *2024*

[2] **Invited seminar talk**, LISA Multi-Messenger Astronomy Working Group telecon. *2023*

[3] **Seminar talk**: *Signatures of MBHs in their Host Galaxy Morphologies*, Bishop's University. *2023*

[4] **Seminar talk**: *Multi-Messenger Prospects of MBH Mergers*, Bishop's University. *2023*

[5] **Seminar talk**: *How Do We Find Supermassive Black Hole Mergers?*, 3-min thesis, Bishop's University. *2023*

[6] **Poster**, American Astronomical Society Meeting 241, Seattle, WA. *2023*

[7] **Conference talk**: *Host Galaxy Morphological Signatures of MBH Mergers*, LISA Canada Workshop. *2022*

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

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*