Minghao Guo

Personal Information

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GitLab: mhguo

Education

Princeton University — Princeton, US
Graduate Student, Department of Astrophysical Sciences — 2021 – Expected 2026
- Thesis: Multiscale multiphase modeling of black hole accretion and feedback

Princeton University — Princeton, US
Master of Arts, Department of Astrophysical Sciences — 2021 – 2023

Peking University — Beijing, CN
Bachelor of Science in Physics, Yuanpei College — 2016 – 2021
- Thesis: A numerical study of scalar-tensor gravity theory

Experience

Institute for Advanced Study — Princeton, US
Visiting Graduate Student, School of Natural Sciences — Dec. 2023 – Expected 2026

Research Interests

- Black holes, high energy astrophysics, accretion disk, general relativistic magnetohydrodynamics (GRMHD)
- Active galactic nuclei (AGN), galaxy formation and evolution, multiphase interstellar medium (ISM)
- Numerical methods and simulations, GPU computing, new numerical techniques
- Neutron stars, pulsars, gravitational waves, modified gravity theory

Publications

See ADS, Google Scholar, or ORCID for full list. First-author citations: 150

1. **Minghao Guo**, James M. Stone, Eliot Quataert, and Volker Springel, "Cyclic Zoom: Multiscale GRMHD Modeling of Black Hole Accretion and Feedback," ApJ **987**, 202 (2025), arXiv:2504.16802 [astro-ph.HE] .
2. **Minghao Guo**, Eliot Quataert, Jonathan Squire, Philip F. Hopkins, and James M. Stone, "Idealized Global Models of Accretion Disks with Strong Toroidal Magnetic Fields," arXiv e-prints , arXiv:2505.12671 (2025), arXiv:2505.12671 [astro-ph.HE] .
3. **Minghao Guo**, Chang-Goo Kim, and James M. Stone, "Evolution of Supernova Remnants in a Cloudy Multiphase Interstellar Medium," ApJ **990**, 49 (2025), arXiv:2411.12809 [astro-ph.GA] .
4. **Minghao Guo**, James M. Stone, Eliot Quataert, and Chang-Goo Kim, "Magnetized Accretion onto and Feedback from Supermassive Black Holes in Elliptical Galaxies," ApJ **973**, 141 (2024), highlighted in @PlotAstro, arXiv:2405.11711 [astro-ph.HE] .
5. **Minghao Guo**, James M. Stone, Chang-Goo Kim, and Eliot Quataert, "Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies," ApJ **946**, 26 (2023), highlighted in AAS Nova, arXiv:2211.05131 [astro-ph.HE] .

6. **Minghao Guo**, Junjie Zhao, and Lijing Shao, "Extended reduced-order surrogate models for scalar-tensor gravity in the strong field and applications to binary pulsars and gravitational waves," PhRvD **104**, 104065 (2021), arXiv:2106.01622 [gr-qc] .
7. **Minghao Guo**, Kohei Inayoshi, Tomonari Michiyama, and Luis C. Ho, "Hunting for Wandering Massive Black Holes," ApJ **901**, 39 (2020), arXiv:2006.08203 [astro-ph.HE] .
8. **Minghao Guo**, Min Du, Luis C. Ho, Victor P. Debattista, and Dongyao Zhao, "A New Channel of Bulge Formation via the Destruction of Short Bars," ApJ **888**, 65 (2020), arXiv:1911.07002 [astro-ph.GA] .
9. Hai-Yang Wang, **Minghao Guo**, Elias R. Most, Philip F. Hopkins, and Aretaios Lalakos, "Galactic-scale Feeding Reveals Warped Hypermagnetized Multiphase Circumbinary Accretion Around Supermassive Black Hole Binaries," arXiv e-prints , arXiv:2504.03874 (2025), arXiv:2504.03874 [astro-ph.HE] .
10. Rebecca Diesing, **Minghao Guo**, Chang-Goo Kim, James Stone, and Damiano Caprioli, "Nonthermal Signatures of Radiative Supernova Remnants," ApJ **974**, 201 (2024), arXiv:2404.15396 [astro-ph.HE] .
11. Julie Hlavacek-Larrondo, Hyunseop Choi, **Minghao Guo**, Annabelle Richard-Laferrière, Carter Rhea, Marine Prunier, Helen Russell, Andy Fabian, Jonelle L. Walsh, Marie-Joëlle Gingras, Brian McNamara, Steve Allen, André-Nicolas Chené, Alastair Edge, Marie-Lou Gendron-Marsolais, Michael McDonald, Priyamvada Natarajan, Jeremy Sanders, James F. Steiner, Benjamin Vigneron, and Anja von der Linden, "Hubble Space Telescope Observations within the Sphere of Influence of the Powerful Supermassive Black Hole in PKS 0745-191," ApJ **980**, 170 (2025), arXiv:2501.03339 [astro-ph.GA] .
12. James M. Stone, Patrick D. Mullen, Drummond Fielding, Philipp Grete, **Minghao Guo**, Philipp Kempski, Elias R. Most, Christopher J. White, and George N. Wong, "AthenaK: A Performance-Portable Version of the Athena++ AMR Framework," arXiv e-prints , arXiv:2409.16053 (2024), arXiv:2409.16053 [astro-ph.IM] .
13. Rajsekhar Mohapatra, Eliot Quataert, Drummond Fielding, and **Minghao Guo**, "The Type Ia Supernova and Asymptotic Giant Branch Stellar Ejecta-regulated Interstellar Medium of Massive Galaxies," ApJ **989**, 103 (2025), arXiv:2502.05329 [astro-ph.GA] .

Approved Proposals

NSF ACCESS Maximize (PI: Eliot Quataert)	∼ 100 k GPU hours
Investigating stellar and black hole heating in massive galaxies, groups and clusters	Oct. 2025 – Sep. 2026
EuroHPC (PI: Volker Springel)	∼ 1 M GPU hours
Multi-scale (GR)MHD modelling of accretion onto supermassive black holes	Mar. 2024 – Jun. 2025
NSF ACCESS Maximize (PI: Eliot Quataert)	∼ 100 k GPU hours
Investigating stellar and black hole heating in massive galaxies, groups and clusters	Oct. 2024 – Sep. 2025
JWST Cycle 3 (PI: Julie Hlavacek-Larrondo)	∼ 6 hours
Mapping a Black Hole Accretion Flow with JWST/NIRSpec	2024 – 2025
NSF ACCESS Accelerate (PI: James M. Stone)	∼ 42 k GPU hours
Multiscale GRMHD Modeling of Accretion onto Supermassive Black Holes	Nov. 2023 – Feb. 2025
NSF ACCESS Explore (PI: Minghao Guo)	∼ 10 k GPU hours
Multi-scale MHD Modeling of Accretion onto Supermassive Black Holes	Jun. 2023 – Jun. 2024

References

Charles A. Young Professor of Astronomy, Eliot Quataert Princeton University
quataert@princeton.edu

Professor James M. Stone — Institute for Advanced Study
jmstone@ias.edu

Prof. Dr. Volker Springel — Max Planck Institute for Astrophysics
vspringel@mpa-garching.mpg.de

Ira S. Bowen Professor, Philip F. Hopkins — California Institute of Technology
phopkins@caltech.edu

Director, Chair Professor Luis C. Ho — Peking University
lho.pku@gmail.com

Professor Kohei Inayoshi — Peking University
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Professor Lijing Shao — Peking University
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Honors and Awards

Princeton First Year Fellowship in Natural Science & Engineering	2021
Weiming Bachelor, Peking University	Jun. 2021
Yuanpei Outstanding Young Scholars	Dec 2020
Lin-bridge First Prize for Undergraduate Research	Sep. 2020
Yuanpei College First Award for Undergraduate Research	Jun. 2020
Xingcheng Award for Undergraduate Research	May 2019
National Undergraduate Research & Training Program	May 2019
Peking University Scholarship for Outstanding Freshmen	Sep. 2016

Teaching and Mentoring

Co-advising Princeton Undergraduate: Milo Salvucci	2025
Teaching Assistant for Cosmology	Spring 2024
Teaching Assistant for General Relativity	Fall 2023
Co-advising Princeton Undergraduate: Sajia Shahrin Neha	2023
Lecture on Flatiron Institute CCA Fluid Dynamics Summer School *GPU Computing using AthenaK: Black Hole Accretion and Supernova Remnants*	Aug. 2023

Service and Outreach

Reviewer for the Astrophysical Journal (ApJ)	2024 – Now
Prison Teaching Initiative Teaching Astronomy	Jan. 2025 - Now
Member of the Learning the Universe Collaboration	Sep. 2022 – Now
Astronomy on Tap Trenton: How does a tiny black hole affect the entire galaxy?	Mar. 2025
Member of the Local Organizing Committee, Learning the Universe Collaboration meeting	Mar. 2025
Member of the Mental Health Working Group	2023 – 2024
Co-organizer of the Princeton Astrophysics Thunch, Astronomy	2022 – 2023

Technical Skills

Programming: Proficient in Python, C/C++, LaTeX, Mathematica, Git; Basic knowledge of Matlab, Fortran, and HTML/CSS.
Software and Packages: AthenaK, Athena++, MPI, OMP, cuda, SymPy, yt, emcee, VisIt, ParaView, PLUTO, IRAF, GALFIT
Techniques: Numerical simulations, massive parallel computing on supercomputer, dataset analyzing and visualization.

Software development

- AthenaK (Developer): Block-based AMR framework with fluid, particle and numerical relativity solvers in Kokkos.
- AthenaKit (Owner): Toolkit for analysis and visualization of simulations by AthenaK
- pySTGROMX (Owner): Extended reduced-order surrogate models for scalar-tensor gravity of Damour and Esposito-Farèse (DEF)

Presentations and Conferences

Caltech TAPIR Seminar — Pasadena, CA
(Oral talk) *Accretion and Feedback from Galaxies to Event Horizons* — Oct. 2025

UC Santa Barbara Astro Lunch — Santa Barbara, CA
(Oral talk) *Accretion and Feedback from Galaxies to Event Horizons* — Oct. 2025

KIPAC Compact Objects Group meeting — Stanford, CA
(Oral talk) *Multiscale structure of black hole accretion flows* — Oct. 2025

KIPAC Tea Talk — Stanford, CA
(Oral talk) *Accretion and Feedback from Galaxies to Event Horizons* — Oct. 2025

Theoretical Astrophysics Center Seminar — Berkeley, CA
(Oral talk) *Accretion and Feedback from Galaxies to Event Horizons* — Oct. 2025

Flatiron Institute CCA Numerical Series — New York
(Invited talk) *Cyclic Zoom: Multiscale GRMHD modeling of Black Hole Accretion and Feedback* — Jun. 2025

Northwestern CIERA Theory Group Meeting — Evanston, Illinois
(Oral talk) *Accretion and Feedback from Galactic to Horizon Scales* — Jun. 2025

Flatiron Institute CCA Coffee Talk — New York
(Oral talk) *Accretion and Feedback from Galactic to Horizon Scales* — May 2025

Caltech TAPIR Astronomy Talk — Pasadena, CA
(Oral talk) *Evolution of Supernova Remnants in a Cloudy Multiphase Interstellar Medium* — May 2025

The Institute for Theory and Computation (ITC) luncheons — Boston, MA
(Oral talk) *Magnetized Accretion onto and Feedback from Supermassive Black Holes* — Apr. 2025

UMich extreme-astroph seminar — Ann Arbor, Michigan
(Oral talk) *Multi-scale GRMHD Modeling of Black Hole Accretion and Feedback over Galactic Scales* Apr. 2025

The 245th Meeting of the American Astronomical Society — National Harbor, Maryland
(Oral talk) *Magnetized Accretion onto and Feedback from Supermassive Black Holes* — Jan. 2025

DCC Workshop: Deciphering the Cosmic Code for Galaxy Formation — Puerto Varas, Chile
(Oral talk) *Magnetized Accretion onto and Feedback from Supermassive Black Holes* — Dec. 2024

Harvard BHI Workshop: Bridging Scales in the Black Hole Accretion-Feedback Problem — Boston, MA
(Invited talk) *Multi-Scale Simulations of Galaxy-SMBH Feeding* — May 2024

UC Santa Barbara Astro Lunch — Santa Barbara, CA
(Oral talk) *Evolution of Supernova Remnants in a Cloudy Multiphase Interstellar Medium* — Jan. 2024

KITP Program: Turbulence in Astrophysical Environments — Santa Barbara, CA
(Oral talk) *Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies* — Jan. 2024

Black Holes on Broadway: The Next Generation of AGN Models in Galaxy Formation — New York
(Oral talk) *Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies* — Dec. 2023

PKU KIAA Seminar — Beijing, China
(Oral talk) *Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies* — Oct. 2023

Galaxy Formation in Hangzhou: Observations and Physics of AGN Feedback — Hangzhou, China
(Oral talk) *Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies* — Oct. 2023

The Second Athena++ Workshop — New York
(Oral talk) *Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies* — May 2023

Learning the Universe Annual Meeting — New York
(Oral talk) *Accretion of Supermassive Black Holes in Elliptical Galaxies* — Sep. 2022

The 240th Meeting of the American Astronomical Society — Pasadena, CA
(Poster presentation) *Accretion of Supermassive Black Holes in Elliptical Galaxies* — Jun. 2022

2020 PKU-DoA Undergraduate Astronomy Symposium — Beijing, China
(Oral talk) *Hunting for Wandering Massive Black Holes* — Sep. 2020

2019 PKU-DoA Undergraduate Astronomy Symposium — Beijing, China
(Oral talk) *A New Channel of Bulge Formation via the Destruction of Short Bars* — Sep. 2019

2019 Annual Meeting of Chinese Astronomical Society — Delingha, China
(Oral talk) *A New Channel of Bulge Formation via the Destruction of Short Bars* — Sep. 2019

São Paulo School of Advanced Science on First Light — São Paulo, Brazil
Aug. 2019

IAU Symposium 353: Galactic Dynamics in the Era of Large Surveys — Shanghai, China
(Poster) *The Role of Short Bar Destruction in Regulating the Co-evolution of Black Holes and Bulges* — Jun. 2019