

# Minghao Guo

## PERSONAL INFORMATION

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Name:	👤 Minghao Guo (郭明浩)	Address:	📍 Peyton Hall, Princeton University, Princeton, NJ 08544, USA
Email:	✉️ <a href="mailto:mhguo@princeton.edu">mhguo@princeton.edu</a>	GitHub:	🐙 <a href="https://github.com/mh-guo">mh-guo</a>
Homepage:	🌐 <a href="https://mh-guo.github.io">mh-guo.github.io</a>	GitLab:	🏠 <a href="https://gitlab.com/mhguo">mhguo</a>
ORCID:	🆔 <a href="https://orcid.org/0000-0002-3680-5420">orcid.org/0000-0002-3680-5420</a>		

## EDUCATION

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<b>Princeton University</b> Graduate Student, Department of Astrophysical Sciences • Thesis: Multiscale multiphase modeling of black hole accretion and feedback	Princeton, US 2021 – Expected 2026
<b>Princeton University</b> Master of Arts, Department of Astrophysical Sciences	Princeton, US 2021 – 2023
<b>Peking University</b> Bachelor of Science in Physics, Yuanpei College • Thesis: A numerical study of scalar-tensor gravity theory	Beijing, CN 2016 – 2021

## EXPERIENCE

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<b>Institute for Advanced Study</b> Visiting Graduate Student, School of Natural Sciences	Princeton, US Dec. 2023 – Expected 2026
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## RESEARCH INTERESTS

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- 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

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See [ADS](#), [Google Scholar](#), or [ORCID](#) for full list

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1. **Guo, Minghao**, 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. **Guo, Minghao**, 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. **Guo, Minghao**, Chang-Goo Kim, and James M. Stone, “Evolution of Supernova Remnants in a Cloudy Multiphase Interstellar Medium,” [arXiv e-prints](#) , [arXiv:2411.12809 \(2024\)](#), [arXiv:2411.12809 \[astro-ph.GA\]](#) .
4. **Guo, Minghao**, 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. **Guo, Minghao**, 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. **Guo, Minghao**, 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. **Guo, Minghao**, 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. **Guo, Minghao**, 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, **Guo, Minghao**, 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, **Guo, Minghao**, 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, **Guo, Minghao**, Annabelle Richard-Laferrrière, 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, **Guo, Minghao**, Philipp Kempfski, 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 **Guo, Minghao**, “The Type Ia Supernova and AGB-Regulated Interstellar Medium of Massive Galaxies,” *arXiv e-prints* , [arXiv:2502.05329 \(2025\)](#), [arXiv:2502.05329 \[astro-ph.GA\]](#) .

## APPROVED PROPOSALS

<b>EuroHPC</b>	~ 1 M GPU hours
Multi-scale (GR)MHD modelling of accretion onto supermassive black holes	Mar. 2024 – Mar. 2025
<b>NSF ACCESS Maximize</b>	~ 100 k GPU hours
Investigating stellar and black hole heating in massive galaxies, groups and clusters	Oct. 2024 – Sep. 2025
<b>JWST Cycle 3</b>	~ 6 hours
Mapping a Black Hole Accretion Flow with JWST/NIRSpec	2024 – 2025
<b>NSF ACCESS Accelerate</b>	~ 42 k GPU hours
Multiscale GRMHD Modeling of Accretion onto Supermassive Black Holes	Nov. 2023 – Feb. 2025
<b>NSF ACCESS Explore</b>	~ 10 k GPU hours
Multi-scale MHD Modeling of Accretion onto Supermassive Black Holes	Jun. 2023 – Jun. 2024

## REFERENCES

<b>Charles A. Young Professor of Astronomy, Eliot Quataert</b> <a href="mailto:quataert@princeton.edu">quataert@princeton.edu</a>	Princeton University
<b>Professor James M. Stone</b> <a href="mailto:jmstone@ias.edu">jmstone@ias.edu</a>	Institute for Advanced Study

**Prof. Dr. Volker Springel**

[vspringel@mpa-garching.mpg.de](mailto:vspringel@mpa-garching.mpg.de)

Max Planck Institute for Astrophysics

**Ira S. Bowen Professor, Philip F. Hopkins**

[phopkins@caltech.edu](mailto:phopkins@caltech.edu)

California Institute of Technology

**Director, Chair Professor Luis C. Ho**

[lho.pku@gmail.com](mailto:lho.pku@gmail.com)

Peking University

**Professor Kohei Inayoshi**

[inayoshi.pku@gmail.com](mailto:inayoshi.pku@gmail.com)

Peking University

**Professor Lijing Shao**

[lshao@pku.edu.cn](mailto:lshao@pku.edu.cn)

Peking University

## HONORS AND AWARDS

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Princeton First Year Fellowship in Natural Science & Engineering	2021
Weiming Bachelor, Peking University	Jun. 2021
<a href="#">Yuanpei Outstanding Young Scholars</a>	Dec 2020
Lin-bridge First Prize for Undergraduate Research	Sep. 2020
<a href="#">Yuanpei College First Award for Undergraduate Research</a>	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

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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	Aug. 2023
<i>GPU Computing using AthenaK: Black Hole Accretion and Supernova Remnants</i>	

## SERVICE AND OUTREACH

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<a href="#">Prison Teaching Initiative</a>	Jan. 2025 - Now
Teaching Astronomy	
Member of the Learning the Universe Collaboration	Sep. 2022 – Now
Reviewer for the Astrophysical Journal (ApJ)	2024 – Now
<a href="#">Astronomy on Tap Trenton: How does a tiny black hole affect the entire galaxy?</a>	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

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**Programming:** Proficient in Python, C/C++,  $\text{\LaTeX}$ , 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

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

## TALKS & PRESENTATIONS

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Flatiron Institute CCA Numerical Series (Invited talk) <i>Cyclic Zoom: Multiscale GRMHD modeling of Black Hole Accretion and Feedback</i>	New York Jun. 2025
Northwestern CIERA Theory Group Meeting (Oral talk) <i>Accretion and Feedback from Galactic to Horizon Scales</i>	Evanston, Illinois Jun. 2025
Flatiron Institute CCA Coffee Talk (Oral talk) <i>Accretion and Feedback from Galactic to Horizon Scales</i>	New York May 2025
Caltech TAPIR Astronomy Talk (Oral talk) <i>Evolution of Supernova Remnants in a Cloudy Multiphase Interstellar Medium</i>	Pasadena, CA May 2025
The Institute for Theory and Computation (ITC) luncheons (Oral talk) <i>Magnetized Accretion onto and Feedback from Supermassive Black Holes</i>	Boston, MA Apr. 2025
UMich extreme-astroph seminar (Oral talk) <i>Multi-scale GRMHD Modeling of Black Hole Accretion and Feedback over Galactic Scales</i>	Ann Arbor, Michigan Apr. 2025
The 245th Meeting of the American Astronomical Society (Oral talk) <i>Magnetized Accretion onto and Feedback from Supermassive Black Holes</i>	National Harbor, Maryland Jan. 2025
DCC Workshop: Deciphering the Cosmic Code for Galaxy Formation (Oral talk) <i>Magnetized Accretion onto and Feedback from Supermassive Black Holes</i>	Puerto Varas, Chile Dec. 2024
Harvard BHI Workshop: Bridging Scales in the Black Hole Accretion-Feedback Problem (Invited talk) <i>Multi-Scale Simulations of Galaxy-SMBH Feeding</i>	Boston, MA May 2024
UC Santa Barbara Astro Lunch (Oral talk) <i>Evolution of Supernova Remnants in a Cloudy Multiphase Interstellar Medium</i>	Santa Barbara, CA Jan. 2024
KITP Program: Turbulence in Astrophysical Environments (Oral talk) <i>Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies</i>	Santa Barbara, CA Jan. 2024
Black Holes on Broadway: The Next Generation of AGN Models in Galaxy Formation (Oral talk) <i>Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies</i>	New York Dec. 2023
Galaxy Formation in Hangzhou: Observations and Physics of AGN Feedback (Oral talk) <i>Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies</i>	Hangzhou, China Oct. 2023
The Second Athena++ Workshop (Oral talk) <i>Toward Horizon-scale Accretion onto Supermassive Black Holes in Elliptical Galaxies</i>	New York May 2023
Learning the Universe Annual Meeting (Oral talk) <i>Accretion of Supermassive Black Holes in Elliptical Galaxies</i>	New York Sep. 2022
The 240th Meeting of the American Astronomical Society (Poster presentation) <i>Accretion of Supermassive Black Holes in Elliptical Galaxies</i>	Pasadena, CA Jun. 2022

2020 PKU-DoA Undergraduate Astronomy Symposium (Oral talk) <i>Hunting for Wandering Massive Black Holes</i>	Beijing, China Sep. 2020
2019 PKU-DoA Undergraduate Astronomy Symposium (Oral talk) <i>A New Channel of Bulge Formation via the Destruction of Short Bars</i>	Beijing, China Sep. 2019
2019 Annual Meeting of Chinese Astronomical Society (Oral talk) <i>A New Channel of Bulge Formation via the Destruction of Short Bars</i>	Delingha, China Sep. 2019
IAU Symposium 353: Galactic Dynamics in the Era of Large Surveys (Poster) <i>The Role of Short Bar Destruction in Regulating the Co-evolution of Black Holes and Bulges</i>	Shanghai, China Jun. 2019