

Minghao Guo

PERSONAL INFORMATION

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EDUCATION

Princeton University

Graduate Student, Department of Astrophysical Sciences

Princeton, US

Sep. 2021 – Expected 2026

Peking University

Bachelor of Science in Physics, Yuanpei College

Beijing, CN

Sep. 2016 – July 2021

- Relevant Advanced Courses: Topology, General Relativity, Group Theory, Quantum Field Theory, Gravitational Wave Physics, Computational Physics, Computational Fluid Dynamics, Foundations of Parallel and Distributed Computing, and all lower-division courses
- Thesis: A Numerical Study of Scalar-tensor Gravity Theory

RESEARCH INTERESTS

- Black hole (BH) physics, high energy astrophysics, accretion disks, active galactic nuclei (AGN)
- Galaxy dynamics and evolution, galaxy structure
- Modified gravity, neutron stars, pulsars, gravitational waves, dark matter
- Numerical simulations, Numerical methods, New numerical techniques

PUBLICATIONS

1. **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 \[gr-qc\]](#) .
2. **Guo, Minghao**, Kohei Inayoshi, Tomonari Michiyama, and Luis C. Ho, “Hunting for Wandering Massive Black Holes,” [ApJ 901, 39 \(2020\)](#), [arXiv:2006.08203 \[astro-ph.HE\]](#) .
3. **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 \[astro-ph.GA\]](#) .

REFERENCES

Director, Chair Prof. Luis C. Ho lho.pku@gmail.com	Kavli Institute for Astronomy and Astrophysics, Peking University
Prof. Victor P. Debattista vpdebattista@gmail.com	Jeremiah Horrocks Institute, University of Central Lancashire
Prof. Kohei Inayoshi inayoshi.pku@gmail.com	Kavli Institute for Astronomy and Astrophysics, Peking University
Prof. Lijing Shao lshao@pku.edu.cn	Kavli Institute for Astronomy and Astrophysics, Peking University

RESEARCH EXPERIENCE

- Surrogate model of scalar-tensor gravity and application to neutron stars** Feb. 2020 – Present
Advisor: Prof. Lijing Shao Peking University, CN
- Designed and developed a method for computing derived quantities in scalar-tensor gravity of Damour and Esposito-Farèse (DEF) with pontaneous scalarization phenomena developed for neutron stars
 - Constructed reduced-order surrogate model for the derived quantities
 - Coded the model in a python package [pySTGROMX](#) that speeds up calculations at two order-of-magnitude yet still keeps accuracy, compared with the previous method
 - Applied pySTGROMX to constrain the parameters of the DEF theory with well-timed binary pulsars
 - Currently working on a first-author paper manuscript in prep for *Physical Review D*
- Evolution of black hole mass function at high redshift** Oct. 2020 – Present
Advisor: Prof. Kohei Inayoshi Peking University, CN
- Constructed a model for the evolution of black hole mass function based on AGN luminosity
 - Predicted the evolution of black hole mass function and AGN mass function using the latest Hyper Suprime-Cam (HSC) data
- Hunting for wandering massive black holes** Feb. 2019 – Present
Advisors: Prof. Kohei Inayoshi, Prof. Luis C. Ho Peking University, CN
- Performed three-dimensional simulations for gas accretion onto a wandering black hole at the outskirts of galaxies (e.g., massive ellipticals, Milky Way, dwarf galaxies)
 - Constructed radiative inefficient accretion-flow models for accretion near the horizon of a black hole
 - Applied the simulation results to the emission model and worked out the spectral energy distribution for the accretion flow onto a wandering black hole
 - Studied the detectability of wandering (massive) black holes in different types of galaxies, predicting that ALMA will enable us to hunt for a population of wandering black holes
 - This work resulted in a first-author publication in the *Astrophysical Journal*
- Quasar lifetime model** June 2020 – Sep. 2020
Advisor: Prof. Kohei Inayoshi Peking University, CN
- Constructed a model for lifetime of quasars based on standard disk model
 - Built a theoretical correlation between the mass, luminosity and lifetime of quasars
 - Compared the model with the observed quasar lifetimes from measurements of proximity zone size
- Coevolution of supermassive black holes and their host galaxies** Mar. 2018 - Jan. 2020
Advisors: Prof. Luis C. Ho, Prof. Victor P. Debattista Peking University, CN
- Made N-body simulations to investigate the dissolution of bars and the growth of bulges, under the dynamical influence of central black holes
 - Built morphological decomposition for the structures of the galaxy models using IRAF and GALFIT
 - Investigated the growth of a central black hole, the dissolution of the nuclear bar, and the gradual formation of an inner bulge through morphological decomposition as well as the dynamics of galaxies
 - Demonstrated that the initially boxy/peanut-shaped bulge is transformed into a more massive, compact structure that bears many similarities to a classical bulge, in terms of its morphology, kinematics, and location on standard scaling relations
 - Led to a first-author paper published in the *Astrophysical Journal*

HONORS AND AWARDS

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| Weiming Bachelor (“未名学士”称号) | June 2021 |
| Yuanpei Outstanding Young Scholars (“元培青年学者”称号) | Dec 2020 |
| Lin-bridge First Prize for Undergraduate Research (endowed by Prof. Douglas Lin) | Sep. 2020 |
| Yuanpei College First Award for Undergraduate Research | June 2020 |
| Xingcheng Award for Undergraduate Research | May 2019 |
| National Undergraduate Research & Training Program | May 2019 |
| Peking University Scholarship for Outstanding Freshmen (top 10%) | Sep. 2016 |

CONFERENCE EXPERIENCE

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

TECHNICAL SKILLS

Programming: Proficient in Python, C/C++, L^AT_EX, Mathematica, Git; Basic knowledge of Matlab and Fortran.

Software and Packages: emcee, MPI, OMP, cuda, SymPy, yt, VisIt, ParaView, PLUTO, IRAF, GALFIT

Techniques: Massive parallel computing on supercomputer, analyzing dataset and visualization.

Language: Mandarin (Native), English (Fluent; GRE General 320+3; TOEFL iBT 102)

ACTIVITIES

- 2020 Theoretical Physics and Particle Physics Summer School of Peking University Aug. 2020
- São Paulo School of Advanced Science on First Light:
Stars, Galaxies and Black Holes in the Epoch of Reionization Aug. 2019