# Minghao Guo

## Personal Information

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|----------------|-----------------------------------------------|----------|---------------------------------------------|
| Phone:         | +86 13001998064                               | Address: | Peking University, 5 Yi He Yuan Road,       |
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## Education

**Princeton University**                                                                 Princeton, US

Graduate Student, Department of Astrophysical Sciences                       Sep. 2021 – Expected 2026

**Peking University**                                                                          Beijing, CN

Bachelor of Science in Physics, Yuanpei College                                   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

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

## Publications

1. **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] .

2. **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] .

3. **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," arXiv e-prints , arXiv:2106.01622 (2021), arXiv:2106.01622 [gr-qc] .

## References

**Director, Chair Prof. Luis C. Ho**          Kavli Institute for Astronomy and Astrophysics, Peking University
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**Prof. Victor P. Debattista**          Jeremiah Horrocks Institute, University of Central Lancashire
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**Prof. Kohei Inayoshi**          Kavli Institute for Astronomy and Astrophysics, Peking University
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**Prof. Lijing Shao**          Kavli Institute for Astronomy and Astrophysics, Peking University
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## 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** Sep. 2020

(Oral presentation) *Hunting for Wandering Massive Black Holes*

**2019 PKU-DoA Undergraduate Astronomy Symposium** Sep. 2019

(Oral presentation) *A New Channel of Bulge Formation via the Destruction of Short Bars*

**2019 Annual Meeting of Chinese Astronomical Society** Sep. 2019

(Oral presentation) *A New Channel of Bulge Formation via the Destruction of Short Bars*

**IAU Symposium 353: Galactic Dynamics in the Era of Large Surveys** June 2019

(Poster presentation) *The Role of Short Bar Destruction in Regulating the Co-evolution of Black Holes and Bulges*

## Technical Skills

**Programming**: Proficient in Python, C/C++, LaTeX, 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 Unversity     Aug. 2020

- São Paulo School of Advanced Science on First Light:
  Stars, Galaxies and Black Holes in the Epoch of Reionization     Aug. 2019