

# Minghao Guo

## PERSONAL INFORMATION

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## EDUCATION

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### Peking University

Beijing, CN

Bachelor of Science in Physics, Minor in Mathematics

Sep. 2016 – Expected June 2021

- GPA: 3.65/4.0; GRE Physics 990/990
- 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

## RESEARCH INTERESTS

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- 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

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1. Minghao Guo, Kohei Inayoshi, Tomonari Michiyama, and Luis C. Ho, “Hunting for Wandering Massive Black Holes,” *ApJ* **901**, 39 (2020), [arXiv:2006.08203 \[astro-ph.HE\]](https://arxiv.org/abs/2006.08203) .
2. 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 \[astro-ph.GA\]](https://arxiv.org/abs/1911.07002) .
3. Minghao Guo, Lijing Shao, and Junjie Zhao, “Extended reduced-order surrogate models for scalar-tensor gravity in the strong field and applications to binary pulsars,” *in preparation* (2020).

## REFERENCES

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**Director, Chair Prof. Luis C. Ho** Kavli Institute for Astronomy and Astrophysics, Peking University  
[lho@pku.edu.cn](mailto:lho@pku.edu.cn)

**Prof. Victor P. Debattista** University of Central Lancashire  
[vpdebattista@uclan.ac.uk](mailto:vpdebattista@uclan.ac.uk)

**Prof. Kohei Inayoshi** Kavli Institute for Astronomy and Astrophysics, Peking University  
[inayoshi@pku.edu.cn](mailto:inayoshi@pku.edu.cn)

**Prof. Lijing Shao** Kavli Institute for Astronomy and Astrophysics, Peking University  
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## RESEARCH EXPERIENCE

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**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 spontaneous 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

## Co-evolution between 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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<a href="#">Yuanpei Outstanding Young Scholars</a> (Awarded to 9/350)	Dec 2020
Lin-bridge First Prize for Undergraduate Research (endowed by Prof. Douglas Lin)	Sep. 2020
<a href="#">Yuanpei College First Award for Undergraduate Research</a> (Awarded to 3/350)	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

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

## TECHNICAL SKILLS

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**Programming:** Proficient in Python, C/C++, L<sup>A</sup>T<sub>E</sub>X, 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

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- 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