Minghao Guo

Personal Information

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Education

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

- 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. 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] .
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] .
3. 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," in preparation (2020).

References

Director, Chair Prof. Luis C. Ho Kavli Institute for Astronomy and Astrophysics, Peking University
lho@pku.edu.cn

Prof. Victor P. Debattista University of Central Lancashire
vpdebattista@uclan.ac.uk

Prof. Kohei Inayoshi Kavli Institute for Astronomy and Astrophysics, Peking University
inayoshi@pku.edu.cn

Prof. Lijing Shao Kavli Institute for Astronomy and Astrophysics, Peking University
lshao@pku.edu.cn

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

Yuanpei Outstanding Young Scholars (Awarded to 9/350)	Dec 2020
Lin-bridge First Prize for Undergraduate Research (endowed by Prof. Douglas Lin)	Sep. 2020
Yuanpei College First Award for Undergraduate Research (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

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