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, 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

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

Prof. Victor P. Debattista University of Central Lancashire
vpdebattista@gmail.com

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

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

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

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

PKU Undergraduate Astronomy Symposium Sep. 2020
(Oral presentation) *Hunting for Wandering Massive Black Holes*

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

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