Yuanze Ding

Physics Ph.D. Candidate

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Education

Wuhan University, Wuhan, Hubei province, China — September 2018 - June 2022
B.S. in Physics, School of Physics and Technology & **Honor Science Program** of Hongyi College
Cumulative GPA: 3.88/4.00, rank 1/44

California Institute of Technology, Pasadena, CA, United States — September 2022 - Present
Ph.D. in Physics, Division of Physics, Mathematics and Astronomy
Advisor: Prof. Fiona Harrison

Publications

Yuanze Ding, Javier A. García, Timothy R. Kallman et al., *Next Generation Accretion Disk Reflection Model: High-Density Plasma Effects*, submitted to ApJ.

Yuanze Ding, Javier A. García, Timothy R. Kallman & Fiona A. Harrison, Implementing High Density Corrections in Accretion Disk Reflection Model, 2023, American Astronomical Society Meeting Abstracts, 55, Article 124.08

Yuanze Ding, Ruancun Li, Luis C. Ho and Claudio Ricci, *Accretion Disk Outflow during the X-ray Flare of the Super-Eddington Active Nucleus of I Zwicky 1*, 2022, ApJ, 931, 77.

Yuanze Ding et al., *QPOs and orbital elements of X-ray binary 4U 0115+63 during the 2017 outburst observed by Insight-HXMT*, 2021, MNRAS, 503, 4, 6045.

Yuanze Ding et al., *Timing and spectral variability of high mass X-ray pulsar GX 301–2 over orbital phases viewed by Insight-HXMT*, 2021, MNRAS, 506, 2, 2712.

X. Chen, W. Wang, Y. M. Tang and **Yuanze Ding** et al., *Relation of cyclotron resonant energy and luminosity in a strongly magnetized neutron star GRO J1008-57 observed by Insight-HXMT*, 2021, ApJ, 919, 33.

X. Chen, W. Wang, and **Yuanze Ding** et al., *Wavelet analysis of MAXI J1535-571 with Insight-HXMT*, submitted to MNRAS.

Q. Liu, W. Wang, and X. Chen and **Yuanze Ding** et al., *Variations of cyclotron resonant scattering features in Vela X-1 revealed with Insight-HXMT*, in prep.

Research Experience & Employment & Conference presentations

Intern, Kavli Institute for Astronomy and Astrophysics, Peking University — July 2021 – Present

Advisor: Prof. Luis C. Ho

Broad band spectroscopy of I Zwicky 1 with NuSTAR and XMM-Newton — July 2021 – present

- Found several bugs in *Xspec*. Contributed to the *Xspec* 12.12.0f patch.
- Found rapid corona cooling event, possibly being the result of strong pair production and runaway, supporting a disk-like corona with complicated inner structure.
- **Found correlation between outflow ionization state and velocity, $\xi \sim v^{3.58^{+0.50}_{-0.56}}$, consistent with a super-Eddington wind.**
- **Found two sequence of UFOs with distinct properties. Based on observation, I proposed a possible mechanism for the production of standard M-σ relation.**
- Complete the manuscript as first author, which will be submitted to ApJ in this month.

Keywords: Active galactic nucleus, AGN feedback, Ultra-fast outflow, reflection spectroscopy.

Conference presentation:

Multi-band reverberation mapping — KIAA AGN Workshop
August, 2021, Peking University, Beijing, China.

Research Assistant, Center of Astrophysics, Wuhan University — July 2019 – Present

Advisor: Prof. Wei Wang

Timing analysis of X-ray binary 4U 0115+63 with Insight-HXMT — July 2019 – March 2021

- Confirmed the spinning up and apsidal motion of 4U 0115+63.
- Obtained spin periods with period folding technique and derived orbital elements with apparent spin periods.
- Discovered new QPO with wavelet analysis technique, confirmed previous discovered ones.

- Sketched out local and global features of QPOs in different period with wavelet analysis and corresponding indication factors.
- **Proposed new hypothesis (Multi-vortex polygon) to account for the origin of QPOs in 4U 0115+63**, which is a kind of symmetry breaking phenomenon occurred in swirling flow.

Keywords: High mass X-ray binary, Neutron star, Accretion disc, Quasi-periodic Oscillations.
Conference presentation:
Wavelet analysis and QPOs of X-ray binary 4U 0115+63 3rd X-ray binary multi-band conference
December, 2020, Shandong province, Jinan, China.

Timing and spectrum variability of GX301–2 January 2021 – June 2021

- Confirmed a correlation between the equivalent width of iron line complex and local absorption column density, which indicates that the accretion flow is highly inhomogeneous.
- **Discovered a significant linear correlation between two CRSFs'(cyclotron resonant scattering features) centroid energy.**
- **Provide a firm detection of the accretion state transformation in neutron star X-ray binary (i.e. from subcritical Coulomb deceleration regime to supercritical radiation deceleration regime).**
- Proposed that the accretion parameter Λ in this case should between ~ 0.3 and 1, indicating a complex environment around neutron star including a blending of wind and disc accretion.

Keywords: High mass X-ray binary, Neutron star, Fe Kα line, Cyclotron resonant scattering features.
Conference presentation:
Spectral analysis of GX 301-2 with Insight-HXMT Annual meeting of Chinese Astronomical Society
December, 2021, Sichuan province, Nanchong, China.

Next Generation Accretion Disk Reflection Model September 2022 – November 2023

- Rewrote the atomic calculation Fortran routines for one of the widely used accretion disk reflection models: XILLVER
- Addressed some of the long-standing issues in XILLVER and almost all other kinds of reflection models
- This paper will be of interest to the general X-ray community, especially those who work on X-ray binaries and local AGNs

Keywords: High mass X-ray binary, Active Galactic Nuclei, Radiative Transfer, Atomic Lines Simulation.
Conference poster session:
Implementing High Density Corrections in Accretion Disk Reflection Model American Astronomical Society 242nd
June, 2023, New Mexico, Albuquerque, US.

Selected Honors and Awards

Caltech C Felloship
California Institute of Technology September 2022

Ramon Scholarship of Wuhan University
4/524, Wuhan University May 2022

First-class Scholarship of Wuhan University
top 5%, Wuhan University October 2019&21

First-class Scholarship for excellent young Astronomers
1/524, National Astronomical Observatories October 2019

Model Student at Wuhan University
top 10%, Wuhan University October 2019&20&21

National Astronomical Observatories Scholarship
3/524, National Astronomical Observatories October 2020

1st Prize, 12th Chinese Undergraduate Physics Tournament of Central and South China
Leader of Top 2 team, Ministry of Education of China May 2021

1st Prize, Outstanding Undergraduate Students in Academic Record
Top 7 undergraduate students in China, Ministry of Education of China November 2021

1st Prize, President scholarship for creative learning
12/30000, Wuhan University November 2021

Top 10 Most Influential Students at Wuhan University

10/30000, Wuhan University December 2021

Community Engagement & Volunteer Activity

Chorus of Physics Department October 2018 – January 2020
- Organize chorus training and performance.
- Accompany for the department chorus. We winned the highest place since 2016 in campus culture festival.

Reading to the Blind October 2018 – January 2020
- Read physics text book for the Blind
- Helped a talented blind person complete his book, which is about mathematical method in physics.

Leadership in the astronomy class October 2018 – January 2020
- Serve as a vice-monitor in the astronomy class of physics department.
- Organize class activity, introducing research field of astronomy faculties in WHU.
- Passing information from department to students

Skills and Languages

Programming language & software: Bash, Python, TCL, Fortran, C, Matlab, Mathematica, Zeus-mp and LaTex
Language: Mandarin Chinese (native), English (IELTS 7.5)