Anning Gao

+86 19800363861 ◇ anninggao211@gmail.com

RESEARCH INTERESTS

1. Observational cosmology: redshift survey / lensing / CMB, BAO, Lyman-α forest, non-standard statistics
2. Medium physics: IGM & reionization, CGM & galaxy ecosystem, multiband observation (UV / radio / ...)
3. Galaxy physics: co-evolution with dark matter halo & SMBH, star formation activity, feedback from AGN & SN
4. Statistics & machine learning: Bayesian methods, neutral network applications on observations & numerical simulations

EDUCATION

Tsinghua University 2020 - Present
Department of Physics Beijing, China
· B.S. in Physics **Major GPA: 3.94/4.00** **Overall GPA: 3.92/4.00**

PUBLICATION

A. Gao, J. X. Prochaska, et al., "Measuring the Mean Free Path of HI Ionizing Photons at $3.2 \leq z \leq 4.6$ using DESI Y1 Quasars", (2024), arXiv:2411.15838, submitted to *ApJL*.

RESEARCH EXPERIENCE

Measuring the Mean Free Path (MFP) of HI Ionizing Photons using DESI Data Jul. 2023 - Sep. 2024
Supervisor: Prof. Jason X. Prochaska (UC Santa Cruz)
· Constructed the dataset from DESI Y1 QSO spectra , which is ~ 10 times larger than previous datasets.
· Wrote the package for MFP calculation and measured the MFP at $3.2 < z < 4.6$ with unprecedented precision
· Validated our result on the selection of quasar SED, the treatment of Lyman series opacity and the MFP definition.
· Confirmed that MFP evolves much slower than previous estimates with high confidence.
· Our result presents challenges to the current IGM absorber models and gives new constraints on the reionization history.

Constraining the Cosmology with Void Size Function based on Delaunay Triangulation Mar. 2024 - Present
Supervisor: Prof. Cheng Zhao (Tsinghua University)
· Constructed the void catalog from 40,000 Quijote halo catalogs with different cosmological parameters.
· Trained an AI-based emulator to predict the void size function under different cosmologies.
· Tested the emulator on Quijote and performed MCMC fitting for the cosmological parameters.
· **Future:** Improve the method to remove the severe systematics and apply the method to the BOSS galaxy catalog.

High-redshift CGM OVI Absorption Analysis using DESI Data Feb. 2023 - Feb. 2024
Supervisor: Prof. Zheng Cai and Dr. Siwei Zou (Tsinghua University)
· Fitted the continuum of $\sim 15,000$ $z > 2.5$ DESI QSO spectra with a newly proposed unsupervised machine learning method.
· Visually inspected ~ 2000 spectra to find DLA-related OVI absorption features, found ~ 30 OVI absorption candidates and fitted the Voigt profile to extract column densities and the Doppler parameter.
· Statistically analysed the OVI absorption sample to find the properties of high-z warm-phase CGM.
· Performed simulations using Cloudy to get ionization parameters and hydrogen number densities that cannot be directly observed.

Study of the Transient AT2022jrp Sep. 2022 - Jan. 2023
Supervisor: Prof. Sharon Xuesong Wang (Tsinghua University)
· Selected the target, wrote the observing proposal with our group and conducted the observation at Xinglong Observatory.
· Checked the periodic characteristics of the transient's light curve together with AAVSO's data.
· Found the correlation between the transient's magnitude and Hα line EW using Pearson coefficient.

SCIENTIFIC TALKS

Measuring the Mean Free Path of HI Ionizing Photons using DESI Data Jul. 2024
· Oral Presentation, 2024 DESI Summer Meeting, Marseille, France

Introduction to Normalizing Flow May. 2024
· Machine Learning Seminar, Department of Astronomy, Tsinghua University

Measuring the Mean Free Path of HI Ionizing Photons using DESI Data Sep. 2023
· Oral Presentation, 2023 PKU Undergraduate Astronomy Symposium, Beijing, China

SKILLS

Skilled in: Python, C/C++, Mathematica, Shell/Bash, LaTeX, Git.

Experienced with:

- Packages & softwares for IGM and absorption analysis: Cloudy, VoigtFit, Pyigm, Linetools
- Manipulating catalogs, analyzing dataset and visualization
- Machine learning and building neural network models: normalizing flow, operator learning, ...
- Statistical analysis: MCMC sampling, Bayesian inference, nonparametric methods, ...

SELECTED COURSEWORK

Physics & Astronomy		**Mathematics & CS**	
Quantum Mechanics (1)	A-	Complex Analysis	A
Analytical Mechanics	A	Basic Topology	A-
Nuclear and Particle Physics	A	Group Theory	A-
Observational Astronomy	A	Probability Theory	A
Galaxies and the Universe	A	Multidimensional Statistical Inference	A
Stars and Planets	A	Machine Learning	A
Galatic Physics	A-	Deep Learning	A-

SCHOLARSHIPS AND AWARDS

Scholarship of the National Astronomical Observatory of China	2024
Lin-bridge Scholarship, Department of Astronomy, Peking University	2023
Chi-Sun Yeh Scholarship, Member of the Tsinghua Xuetang Talents Program	2021, 2022, 2023
Scholarship for Academic Excellence, Department of Physics, Tsinghua University	2021, 2022, 2024
Five-star Volunteer, Tsinghua University	2022

REFERENCES

Prof. Jason X. Prochaska	xavier@ucolick.org	University of California, Santa Cruz
Prof. Zheng Cai	zcai@mail.tsinghua.edu.cn	Tsinghua University
Prof. Cheng Zhao	czhao@mail.tsinghua.edu.cn	Tsinghua University