XIAOSHENG ZHAO

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RESEARCH INTERESTS

My research focuses on using machine learning (ML) to advance astronomy—from uncovering the composition and evolutionary history of the Milky Way and its neighbors, to probing the origin and contents of the Universe, and bridging these scales. I am currently as a member of the Subaru Prime Focus Spectrograph (PFS) JHU Galactic Archaeology group.

EDUCATION

Tsinghua University Sep 2018 - Jun 2024
PhD in Astronomy
Advisor: Prof. Yi Mao
Thesis title: Explore the epoch of reionization with machine learning

Wuhan University Sep 2014 - Jun 2018
BS in Physics

PROFESSIONAL POSITION

Johns Hopkins University Nov 2025 - Now
Assistant Research Scientist
Working with: Prof. Alex S. Szalay & Prof. Rosemary F.G. Wyse

Johns Hopkins University Aug 2024 - Nov 2025
Postdoctoral Fellow, focus–maximizing science return from PFS
Mentor: Prof. Alex S. Szalay & Prof. Rosemary F.G. Wyse

RESEARCH EXPERIENCE

University of Chinese Academy of Sciences/NAOC Jul 2024 - Aug 2024
Short-term visiting, focus–stellar spectra foundation models.
Host: Prof. Yang Huang

Institut d'Astrophysique de Paris Nov 2022 - May 2024
Long-term visiting, focus–(explainable) ML for astrophysics and cosmology
Mentor: Prof. Benjamin D. Wandelt

PUBLICATION

Refereed Journals

Generalization from Low- to Moderate-Resolution Spectra with Neural Networks for Stellar Parameter Estimation: A Case Study with DESI
Xiaosheng Zhao, Yuan-Sen Ting, Rosemary F.G. Wyse, Alexander S. Szalay, Yang Huang, László Dobos, Tamás Budavári, Viska Wei
2026, ApJ, 1006, 2

SpecCLIP: Aligning and Translating Spectroscopic Measurements for Stars.

Xiaosheng Zhao; Yang Huang; Guirong Xue; Xiao Kong; Jifeng Liu; Xiaoyu Tang; Timothy C. Beers; Yuan-Sen Ting; A-Li Luo
2026, ApJ, 998, 189

Ordered embeddings and intrinsic dimensionalities with information-ordered bottlenecks.
Matthew Ho; **Xiaosheng Zhao**; Benjamin D. Wandelt
2025, Machine Learning: Science and Technology (MLST)

Simulation-based Inference of Reionization Parameters from 3D Tomographic 21 cm Light-cone Images. II. Application of Solid Harmonic Wavelet Scattering Transform.
Xiaosheng Zhao; Yi Mao; Shifan Zuo; Benjamin D. Wandelt
2024, ApJ, 973, 41

Can Diffusion Model Conditionally Generate Astrophysical Images?
Xiaosheng Zhao; Yuan-Sen Ting; Kangning Diao; Yi Mao
2023, MNRAS, 526, 1699

Implicit Likelihood Inference of Reionization Parameters from the 21 cm Power Spectrum
Xiaosheng Zhao; Yi Mao; Benjamin D. Wandelt
2022, ApJ, 933, 236

Simulation-Based Inference of Reionization Parameters From 3D Tomographic 21 cm Lightcone Images.
Xiaosheng Zhao; Yi Mao; Cheng Cheng ; Benjamin D. Wandelt
2022, ApJ, 926, 151

How to evaluate the sufficiency and complementarity of summary statistics for cosmic fields: an information-theoretic perspective
Ce Sui; Yi Mao; **Xiaosheng Zhao**; Tao Jing; Benjamin D. Wandelt
2026, ApJ, 998, 2

Square Kilometre Array Science Data Challenge 3a: foreground removal for an EoR experiment.
A. Bonaldi; ...; **Xiaosheng Zhao**; ...
2025, MNRAS, 543, 2

Refereed Conference proceedings

Finetuning Stellar Spectra Foundation Models with LoRA
Xiaosheng Zhao; Yuan-Sen Ting; Alexander S. Szalay; Yang Huang
2025, ICML 2025 Workshop on Machine Learning for Astrophysics

3D ScatterNet: Inference from 21 cm Light-cones
Xiaosheng Zhao; Shifan Zuo; Yi Mao
2023, ICML 2023 Workshop on Machine Learning for Astrophysics

Evaluating Summary Statistics with Mutual Information for Cosmological Inference.
Ce Sui; **Xiaosheng Zhao**; Tao Jing; Yi Mao
2023, ICML 2023 Workshop on Machine Learning for Astrophysics

Under review

Foundation Models for Astrophysics
Xiaosheng Zhao; Yuan-Sen Ting
Invited chapter for the edited book "Machine Learning Techniques for Astrophysics and Cosmology"

Machine Learning and the SKA for Cosmic Dawn and the Epoch of Reionization
Anshuman Acharya; ...; **Xiaosheng Zhao**
Published in Advancing Astrophysics with the SKA II (AASKAII)

Galactic Archaeology with the Subaru ʻŌnohiʻula Prime Focus Spectrograph Strategic Program
Masashi Chiba; ...; **Xiaosheng Zhao**

Likelihood-free Model Selection in Cosmic Reionization with Three-dimensional Tomographic 21 cm Lightcone Images.
T Binnie; **Xiaosheng Zhao**; JR Pritchard; Yi Mao
2025, Submitted to AAS Journals

TALKS & PRESENTATIONS (SELECTED)

2nd Annual Cosmic Horizons Conference Jul 2026
Contributed talk: *Decoding the Chemical Fossil Record: Machine Learning and Foundation Models for Near-Field Cosmology* *UVA, USA*

LSST Discovery Alliance Regional Meeting May 2026
Contributed talk: *Cross-Modal Learning for Galactic Archaeology: Prospects in the Rubin Era JHU, USA*

BCCP/Cosmology seminar Apr 2026
Seminar: *Decoding the Chemical Fossil Record: Machine Learning and Foundation Models for Near-Field Cosmology* *UC Berkeley, USA*

Center for Decoding the Universe Journal Club Apr 2026
Journal Club: *Decoding the Chemical Fossil Record: Machine Learning and Foundation Models for Near-Field Cosmology* *Stanford, USA*

247th AAS Meeting Jan 2026
Contributed talk: *SpecCLIP: Aligning and Translating Spectroscopic Measurements for Stars Phoenix, USA*

ICML2025 ML4Astro Jul 2025
Spotlight talk: *Finetuning Stellar Spectra Foundation Models with LoRA* *Vancouver, Canada*

JHU/STScI CAS wine & cheese seminar Apr 2025
Seminars: *From 21 cm Astrophysics to Galactic Archaeology: Enriching Physics-Driven Analysis with Machine Learning* *JHU, USA*

Astro Coffee Sept 2023
Informal talk: *Can Diffusion Model Conditionally Generate Astrophysical Images?* *IAS, USA*

Understanding the epoch of reionization Mar 2023

Contributed talk: *Implicit Likelihood Inference of Reionization Parameters from 21 cm Power Spectrum and solid harmonic wavelet scattering coefficients* — *Sexten, Italy*

SAZERAC 21cm 2022 — Mar 2022
Contributed talk: *Implicit Likelihood Inference of Reionization Parameters from the 21 cm Power Spectrum* — *Virtual*

SAZERAC SIP, learning the high-redshift universe — Feb 2022
Contributed talk: *Simulation Based Inference of Reionization Parameters From 3D Tomographic 21 cm Lightcone Images* — *Virtual*

SKA CD/EoR Science Telecon — Jul 2021
Contributed talk: *Simulation Based Inference of Reionization Parameters From 3D Tomographic 21 cm Images* — *Virtual*

HERA telecon — Jun 2021
Invited talk: *Simulation Based Inference of Reionization Parameters From 3D Tomographic 21 cm Images* — *UC, Berkeley, USA*

OUTREACH & SERVICE

Reviewer for ApJ, MNRAS, A&A, JCAP, RAA, and JATIS.

MENTORING & TEACHING EXPERIENCE

Teaching Assistant in undergraduate *Physics* course. — Feb - Jun 2019

SKILLS

Coding languages: {Python, Jax} (Fluent), {C, Shell, html&CSS}(Basic)
General: Astrophyscal data science and machine learning application with Pytorch, Pandas, Scikit-learn, Tensorflow, particularly for astronomy.

AWARDS

Comprehensive Scholarship (First-class) — 2021 - 2022
(*University-level scholarship)*
AMD Scholarship — 2020 - 2021
(*Top scholarship awarded to two graduate students in the department this year)*
Future Scholar Scholarship of Tsinghua University — 2018
(*University-level scholarship)*
National Scholarship — 2015 - 2016