

# XIAOSHENG ZHAO

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## EDUCATION & EXPERIENCE

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**Tsinghua University, China**

Sep 2018 - Jun 2024

*PhD in Astronomy*

*Thesis title: Explore the cosmic dawn and the epoch of reionization with machine learning*

**Institut d'Astrophysique de Paris (IAP), France.**

Nov 2022 - May 2024

*Visitor*

**Wuhan University, China**

Sep 2014 - Jun 2018

*BS in Physics*

## RESEARCH INTERESTS

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I am interested in interactions between machine learning (ML) techniques and astrophysics/cosmology, to understand the origin, content, and evolution of our universe. Currently, my research interests mainly focus on cosmological inference from (synergies of multi-modal) cosmological probes with the aid of ML. Broadly, my research interests include but are not limited to, implicit-likelihood (or simulation-based) inference from the 3D fields, generative modeling as an alternative to cosmological simulations, geometric ML for large-scale surveys, interpretable ML, and automatic knowledge discovery by symbolic regression from multi-modal information of the universe.

## AWARDS

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Comprehensive Scholarship (First-class)

2021 - 2022

*(University-level scholarship)*

AMD Scholarship

2020 - 2021

*(Top fellowship awarded to two graduate students in the department per year)*

Future Scholar Scholarship of Tsinghua University

2018

*(University-level scholarship)*

National Scholarship

2015 - 2016

## TALKS & PRESENTATIONS (SELECTED)

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**Astro Coffee**

Sept 2023

Invited talk: *Can Diffusion Model Conditionally Generate Astrophysical Images?*

*IAS*

**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*

*Virtual*

*3D Tomographic 21 cm Lightcone Images*

### SKA CD/EoR Science Telecon

Contributed talk: *Simulation Based Inference of Reionization Parameters From 3D Tomographic 21 cm Images*

July 2021  
Virtual

### HERA telecon

Invited talk: *Simulation Based Inference of Reionization Parameters From 3D Tomographic 21 cm Images*

Jun 2021  
UC, Berkeley

## SKILLS

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**Coding languages:** {Python, Jax} (Fluent), {C, Shell, html&CSS} (Basic)

**General:** Data science and Machine learning application with Pandas, Scikit-learn, Tensorflow and Pytorch.

## TRAINING AND SUMMER SCHOOL

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### Big Data Capability Enhancement Project

Courses: *e.g. big data system, big data analysis, big data application*

Big-data challenge: *Multi-modal short-video classification*

Sep 2021 - July 2022  
Tsinghua University

### Chinese Survey Space Telescope (CSST) summer school

Got certification of data processing practice

July 2022  
Peking University

## OUTREACH & SERVICE

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I am a member of [Simons Foundation on Learning the Universe \(LtU\)](#)

I organized the [machine learning session](#) at DoA, Tsinghua.

I co-organized the joint machine learning session among  
DoA (Tsinghua), JBCA (Manchester) and SKAO.

Jul 2023 - Present  
Mar 2021 - Mar 2022  
Oct 2021 - Mar 2022

## MENTORING & TEACHING EXPERIENCE

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Teaching Assistant in undergraduate *Physics* course.

Feb - Jun 2019

## REFERENCES

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Prof. Yi Mao, Tsinghua University

[ymao@mail.tsinghua.edu.cn](mailto:ymao@mail.tsinghua.edu.cn)

Prof. Benjamin D. Wandelt, Sorbonne Université & Flatiron Institute

[bwandelt@iap.fr](mailto:bwandelt@iap.fr)

Prof. Yuan-Sen Ting,

Australian National University & The Ohio State University

[yuan-sen.ting@anu.edu.au](mailto:yuan-sen.ting@anu.edu.au)

## PUBLICATION

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**Refereed (first author, 56 cited from ads)**

[Can Diffusion Model Conditionally Generate Astrophysical Images?](#) (5 cited)

**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](#) (18 cited)

**Xiaosheng Zhao**; Yi Mao; Benjamin D. Wandelt

2022, ApJ, 933, 236

[Simulation-Based Inference of Reionization Parameters From 3D Tomographic 21 cm Lightcone Images.](#) (33 cited)

**Xiaosheng Zhao**; Yi Mao; Cheng Cheng ; Benjamin D. Wandelt  
2022, ApJ, 926, 151

### Conference proceedings

[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

[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  
2023, Submitted to ApJ, a more detailed complement to the accepted ICML paper “3D ScatterNet: Inference from 21 cm Light-cones”.

[Information-Ordered Bottlenecks for Adaptive Semantic Compression.](#)

Matthew Ho; **Xiaosheng Zhao**; Benjamin D. Wandelt  
2023, submitted to The International Conference on Learning Representations (ICLR) 2024.