Sihao Cheng (程思浩)
Curriculum Vitae / December, 2024

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POSITIONS

Member, *Institute for Advanced Study*, USA &
Senior fellow, *Perimeter Institute*, Canada 2022–present

Postdoc fellow, Physics and Astronomy, *Johns Hopkins University*, USA &
Visiting fellow, Centre of Data Science, *École Normale Supérieure*, France 2021–2022

EDUCATION

Ph.D. & M.A., Astronomy and Astrophysics, *Johns Hopkins University*, USA 2017–2021
Thesis title: Cosmology and Astrophysics with the Scattering Transform
advisor: Brice Ménard

B.Sc. (with Honors), Astronomy, *Peking University*, China 2012–2016
advisor: Eric W. Peng

RESEARCH INTEREST

I use innovative and interdisciplinary ideas to convert “big data" into discoveries and physical understanding. My work led to cosmological applications of a new statistic that borrows ideas from deep learning, the discovery of special stars powered by gravitational energy while they are freezing, and a new window to study planets around massive host stars.

I am currently working on cosmology and machine learning, Galactic dynamics, and planets inside and outside our solar system.

AWARDS

Outstanding Publication in Astrostatistics Award 2020
Wu-Si Scholarships and Lin-Qiao Prize for undergrads at Peking University 2014 – 2015
Gold Medals of international astronomical olympiads (IOAA, IAO, & APAO) 2008 – 2011

GRANT & TELESCOPE TIME

PI of *JWST* Cycle 3 program, NIRSpec-IFU observation and funding of $63,796 2025-2026
6 nights on 3.5m APO telescope 2019-2020
IAU travel grant for Symposium No.357, 1,000 euro Oct 2019
travel grant for white dwarf conference, 850 euro July 2019

MENTORING, TEACHING, & SERVICE

undergrad student: Vedant Chandra (JHU -> Harvard)	2019–2020
grad student: Jiaxuan Li (Princeton); Mesut Caliskan, Neha A. Kumar (JHU)	2024–
Teaching assistant, Johns Hopkins Univ., Stars & the Universe, Physics I & II	2017–2019
Referee for *Nature Astronomy*, *ApJ*, *MNRAS*, *A&A*, *Applied and Computational Harmonic Analysis*	
Organizing astrophysics seminar at IAS	2023–2024

REFERENCES

Prof. Brice Ménard, Johns Hopkins University	menard@jhu.edu
Prof. Scott Tremaine, Institute for Advanced Study	tremaine@ias.edu
Prof. Bhuvnesh Jain, University of Pennsylvania	bjain@physics.upenn.edu
Prof. Matias Zaldarriaga, Institute for Advanced Study	matiasz@ias.edu
Assoc. Prof. Yuan-Sen Ting, Ohio State University	ting.74@osu.edu

TALKS & PRESENTATIONS

Talk, *COSMO'24*, Kyoto	Oct 2024
Talk, *Cosmology in the Adriatic - From PT to AI*, Split	July 2024
Invited Talk, *TDLI Astrophysics Forum*, Shanghai	July 2024
Talk, *Exoplanets 5*, Leiden	Jun 2024
Invited Talk, *Statistical Challenges in 21st Century Cosmology*, Chania	May 2024
Talk, *Extreme Solar System V*, Christchurch	Mar 2024
Talk, *Lensing at different scales*, University of Chicago	Aug 2023
Talk, *Future Science with CMB x LSS*, YITP, Kyoto	Apr 2023
Talk, *Exoplanet Systems and Stellar Life Cycles*, Aspen Center for Physics	Mar 2023
Talk, *White Dwarfs from Physics to Astrophysics*, KITP	Nov 2022
Invited Talk, *TianQin Astro Workshop*,	Aug 2022
Talk, *European white dwarf workshop*, Tübingen	Aug 2022
Talk, *Kymatio'22*, Nantes	May 2022
Talk, *Cosmology with Weak Lensing: Beyond the Two-point Statistics*, YITP, Kyoto	Apr 2022
Talk, *Debating the potential of machine learning in astronomical surveys*, IAP, Paris	Oct 2021
Talk, *Learn the Universe – an ML x Cosmology Workshop*, CCA	Aug 2021
Invited Talk, *White Dwarfs from Physics to Astrophysics*, KITP	Mar 2021
Talk, *Cosmology from Home*	Aug 2020
Talk, *IAU Symposium No.357 on White Dwarfs*, Hilo, Hawaii	Oct 2019
Talk, *The Beginnings and Ends of Double White Dwarfs*, Copenhagen	July 2019
Poster, *Where the Earth Meets the Sky*	May 2021
Poster, 2019 Spring Symposium: *The Deaths and Afterlives of Stars*, STScI	Apr 2019

Colloquium at Stanford University	Jan 2025
Colloquium at Westlake University	Jan 2025

Colloquium at Peking University	Jan 2025
Colloquium at Tsinghua University	Jan 2025
Seminar at University of Chicago	Dec 2024
Seminar at University of Florida	Dec 2024
Seminar at Columbia University	Sept 2024
OPINAS seminar at MPE, Munich	July 2024
Cosmology seminar at University of Pennsylvania	May 2024
Seminar at Peking University	Dec 2023
Seminar at Tsinghua University	Dec 2023
Cosmology seminar at University of Pennsylvania	May 2023
Theoretical astrophysics seminar at Caltech	May 2023
Astrocoffee talk at Carnegie Observatories	May 2023
Seminar at University of California, Los Angeles	May 2023
Cosmology seminar at Stanford University, Stanford	May 2023
Cosmology seminar at Yale University	Mar 2023
Bahcall lunch talk at Princeton University	Feb 2023
Seminar at IAS, Princeton	Feb 2023
Thunch talk at Princeton University	Dec 2022
Euclid flash talk	Nov 2022
Astrolunch seminar at University of California, Santa Barbara	Nov 2022
Seminar at University of California, Santa Cruz	Nov 2022
Cosmology journal club at University of California, Berkeley	Nov 2022
Astrolunch seminar at LPENS, Paris	Jun 2022
Cosmology seminar at ETH, Zurich	Jun 2022
Cosmology seminar at Ludwig Maximilian University, Munich	Apr 2022
Seminar at Northwestern University	Apr 2022
Astro Machine Learning session at Tsinghua University	Mar 2022
Thunch seminar at Princeton University	Mar 2022
Cosmology seminar at MPA, Munich	Mar 2022
ICAP seminar, Paris	Jan 2022
Cosmology group meeting at Perimeter Institute	Dec 2021
Seminar at CEA Paris-Saclay	Dec 2021
Cosmology journal club at Harvard	Nov 2021
Data Science Seminar at École Normale Supérieure, Paris	Nov 2021
Cosmology seminar at University of California, Berkeley	Sept 2021
HotSci Seminar at STScI,	July 2021
Cosmology group meeting at Ohio State University	July 2021
Science coffee at STScI	July 2021
LSST DESC telecon	Jun 2021
Seminar at the German Center for Cosmological Lensing	May 2021
Cosmology group meeting at University of Edinburgh	May 2021
Seminar at Shanghai Jiao Tong University	Apr 2021
Cosmology group meeting at CfA	Mar 2021
Lunch talk at Peking University	Mar 2021
Seminar at Tsinghua University	Mar 2021

Colloquium (with Brice Meńard) at University of British Columbia	Mar 2021
Cosmology group meeting at Leiden	Jan 2021
Cosmology seminar at IPMU	Jan 2021
Cosmology seminar at IAP	Dec 2020
Lunch talk at University of Virginia/NRAO	Nov 2020
Euclid US telecon	Nov 2020
Cosmology/machine learning journal club at Fermilab	Oct 2020
Seminar at DIRAC, University of Washington	Oct 2020
Cosmology seminar at Duke University	Oct 2020
Seminar at Columbia University	Oct 2020
Astrophysics and Cosmology Seminar at University of Arizona	Sep 2020
Wine & Cheese seminar at Johns Hopkins University	Sep 2020
Cosmology journal club at University of Oxford	Sep 2020
Euclid Modelling working group	Sep 2020
Astrocoffee at Weizmann Institute of Science	Aug 2020
LSST DESC weak lensing mass mapping working group	Aug 2020
Astrophysics/Cosmology Seminar at University of Sussex	July 2020
Compact object journal club, STScI	Apr 2020
Lunch Seminar at Indiana University, Bloomington, IN	Mar 2020
CTC seminar at University of Maryland, College Park, MD	Mar 2020
Thunch seminar at Princeton University and astro-coffee at IAS, Princeton, NJ	Feb 2020
Seminar at Boston University, Boston, MA	Feb 2020
The Stars & Planets Seminar at CfA, Cambridge, MA	Feb 2020
Poster, *Statistical Challenges in Modern Astronomy VII*,	Jun 2021

PUBLICATIONS

(updated on Dec 30, 2024)

First-author and essential-contribution papers (3 are highlighted by *):

*10. A Candidate Giant Planet Companion to the Massive, Young White Dwarf GALEX J071816.4+373139 Informs the Occurrence of Giant Planets Orbiting B Stars
Opened a new window to probe planets around massive stars, which have been extremely difficult to find (3 citations)
Sihao Cheng, Kevin C. Schlaufman, and Ilaria Caiazzo
2024, arxiv:2408.03985, submitted to *ApJ*

9. Cosmological constraints from weak lensing scattering transform using HSC Y1 data (14 citations)
Applied the scattering transform to weak lensing data for the first time, and showed evidence of photo-z issue in HSC
Sihao Cheng et al.
2025, *JCAP*, 01, 006

8. Scattering spectra for physics (7 citations)

Built generative models for a variety of physical fields based on a small set of statistics
Sihao Cheng, Rudy Morel, Erwan Allys, Brice Ménard, and Stéphane Mallat
2024, *PNAS Nexus*, 3, Issue 4, 103

7. Buoyant crystals halt the cooling of white dwarf stars (17 citations)
Antoine Bédard, Simon Blouin, and **Sihao Cheng**
Explained the 10-Gyr cooling delay I discovered in 2019 by buoyant-crystal driven convections. I designed the project and heavily contributed to the writing
2024, *Nature*, 627, 286

6. How to quantify fields and textures? A guide to the scattering transform (34 citations)
Introduced the scattering transform in a non-technical way and showed new interesting interpretations of this estimator
Sihao Cheng and Brice Ménard
2021, arXiv:2112.01288

5. Weak lensing scattering transform: dark energy and neutrino mass sensitivity (55 citations)
Visualised what the statistics see from a lensing map, and emphasised the importance of statistical robustness of estimators
Sihao Cheng and Brice Ménard
2021, *MNRAS*, 507, 1012

*4. A new approach to observational cosmology using the scattering transform (114 citations)
Introduced to observational cosmology a new statistic inspired by Convolutional Neural Nets, and demonstrated that it has CNN-level performance
Sihao Cheng, Yuan-Sen Ting, Brice Ménard, and Joan Bruna
2020, *MNRAS*, 499, 5902

3. Double White Dwarf Merger Products among High-mass White Dwarfs (57 citations)
Measured the white dwarf merger rate with unprecedented high precision using a novel kinematic method
Sihao Cheng, Jeffrey D. Cummings, Brice Ménard, and Silvia Toonen
2020, *ApJ*, 891, 160

*2. A Cooling Anomaly of High-mass White Dwarfs (102 citations)
Discovered a special type of stars that shine out of gravitational sedimentation using Gaia data
Sihao Cheng, Jeffrey D. Cummings, and Brice Ménard
2019, *ApJ*, 886, 100

1. Meteor spectral observation with DSLR, normal lens and prism (3 citations)
Sihao Cheng and Simiao Cheng
2011, *JIMO*, 39, 39

Contributing-author papers:

13. Cosmology from HSC Y1 Weak Lensing with Combined Higher-Order Statistics and Simulation-based Inference (2 citations)

Novaes, C., **et al.**
2024, arXiv:2409.01301, submitted to *PRD*

12. Impact of baryonic feedback on HSC Y1 weak lensing non-Gaussian statistics (8 citations)
Grandón, D., **et al.**
2024, *PRD*, 110, 103539

11. A new code for low-resolution spectral identification of white dwarf binary candidates
Liu, G., **et al.**
2024, *A&A*, 690, A29

10. Dynamical masses across the Hertzsprung-Russell diagram (4 citations)
Hsiang-Chih Hwang, Yuan-Sen Ting, **Sihao Cheng**, and Joshua Speagle
2023, *MNRAS*, 528, 4272

9. Cosmology from weak lensing peaks and minima with Subaru Hyper Suprime-Cam survey first-year data (21 citations)
Marques, G. A., **et al.**
2023, *MNRAS*, 528, 4513

8. A Systematic Search for Short-period Close White Dwarf Binary Candidates Based on Gaia EDR3 Catalog and Zwicky Transient Facility Data (22 citations)
Ren, L., **et al.**
2023, *ApJS*, 264, 39

7. Euclid preparation-XXVIII. Forecasts for ten different higher-order weak lensing statistics (46 citations)
Euclid Collaboration, **et al.**
2023, *A&A*, 675, A120

6. Potential scientific synergies in weak lensing studies between the CSST and Euclid space probes (14 citations)
Liu, D. Z., **et al.**
2022, *A&A*, 669, A128

5. Forever young white dwarfs: when stellar ageing stops (44 citations)
Camisassa, M. **et al.**
I interpreted the simulation results
2021, *A&A Letters*, 649, 7

4. An Increase in Small-planet Occurrence with Metallicity for Late-type Dwarf Stars in the Kepler Field and Its Implications for Planet Formation (24 citations)
Cicero X. Lu, Kevin C. Schlaufman, and **Sihao Cheng**
I participated in the statistical analysis and writing
2020, *AJ*, 160, 253

3. Multi-Gigayear White Dwarf Cooling Delays from Clustering-Enhanced Gravitational Sedimentation (61 citations)
Evan B. Bauer, Josiah Schwab, Lars Bildsten, and **Sihao Cheng**

We together developed the idea, and I interpreted the simulation result
2020, *ApJ*, 902, 93

2. A Gravitational Redshift Measurement of the White Dwarf Mass–Radius Relation (25 citations)
Vedant Chandra, Hsiang-Chih Hwang, Nadia L. Zakamska, and **Sihao Cheng**
I proposed and conducted the debias process and wrote part of the paper
2020, *ApJ*, 899, 146

1. Carbon star formation as seen through the non-monotonic initial–final mass relation (55 citations)
Marigo, P. **et al.**
I conducted the conversion between white dwarfs photometry and physical parameters
2020, *Nature Astronomy*

Conference proceeding:

Two delays in white dwarf evolution revealed by *Gaia*
Sihao Cheng
2019, *Proceedings of IAU*, 15 (S357), 175

Software:

`scattering_transform`

`WD_models`