# Sihao Cheng (程思浩)
## *Curriculum Vitae / August, 2022*

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### POSITIONS

Member, *Institute for Advanced Study*, USA &
Visiting fellow, *Perimeter Institute*, Canada 2022–
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., Physics and Astronomy, *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 analyze survey data and acquire new physical understandings. My work led to the discovery of a special population of stars shining out of gravitational sedimentation while they are freezing and the cosmological applications of a new statistic that borrows ideas from deep learning. I am working on observational cosmology, stellar physics, and extrasolar planets.

### AWARDS

2020 Outstanding Publication in Astrostatistics Award Jan 2021
Wu-Si Scholarships and Lin-Qiao Prize at Peking University 2014 – 2015
Gold Medals of international astronomical olympiads (IOAA, IAO, & APAO) 2008 – 2011

### GRANT & TELESCOPE TIME

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 EXPERIENCE

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| Mentoring undergrad student: Vedant Chandra (currently a PhD student at CfA) | 2019-2020 |
| Teaching assistant, Johns Hopkins University, Stars & the Universe | 2019 |
| Teaching assistant, Johns Hopkins University, Physics I & II | 2017–2018 |

## REFERENCES

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|---|---|
| Prof. Brice Ménard, Johns Hopkins University | menard@jhu.edu |
| Prof. Marc Kamionkowski, Johns Hopkins University | kamion@jhu.edu |
| Assoc. Prof. Yuan-Sen Ting, Australian National University | yuan-sen.ting@anu.edu.au |
| Prof. Stéphane Mallat, Collège de France | stephane.mallat@ens.fr |

## TALKS & PRESENTATIONS

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| **Invited Talk**, *TianQin Astro Workshop*, | Aug 2022 |
| Contributed Talk, *European white dwarf workshop*, Tübingen | Aug 2022 |
| Contributed Talk, *Kymatio'22*, Nantes | May 2022 |
| Contributed Talk, *Debating the potential of machine learning in astronomical surveys* IAP, Paris | Oct 2021 |
| Contributed Talk, *Learn the Universe – an ML x Cosmology Workshop*, CCA | Aug 2021 |
| **Invited Talk**, *White Dwarfs from Physics to Astrophysics*, KITP | Mar 2021 |
| Contributed Talk, *Cosmology from Home* | Aug 2020 |
| Contributed Talk, *IAU Symposium No.357 on White Dwarfs*, Hilo, Hawaii | Oct 2019 |
| Contributed Talk, *The Beginnings and Ends of Double White Dwarfs*, Copenhagen | July 2019 |

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| 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 | 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 |

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| 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 |
| (**invited**) 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 |
| (**invited**) The Stars & Planets Seminar at CfA, Cambridge, MA | Feb 2020 |

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| Poster, *Statistical Challenges in Modern Astronomy VII*, | Jun 2021 |
| Poster, *Where the Earth Meets the Sky* | May 2021 |
| Poster, 2019 Spring Symposium: *The Deaths and Afterlives of Stars*, STScI | Apr 2019 |

## PUBLICATIONS

First-author papers:

How to quantify fields and textures? A guide to the scattering transform
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

Weak lensing scattering transform: dark energy and neutrino mass sensitivity
Visualised what the statistics see from a lensing map, and emphasised the importance of robustness

**Sihao Cheng** and Brice Ménard
2021, *MNRAS*, 507, 1012

A new approach to observational cosmology using the scattering transform
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

Double White Dwarf Merger Products among High-mass White Dwarfs
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

A Cooling Anomaly of High-mass White Dwarfs
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

Meteor spectral observation with DSLR, normal lens and prism
**Sihao Cheng** and Simiao Cheng
2011, *JIMO*, 39, 39

Contributing-author papers:

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

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

Multi-Gigayear White Dwarf Cooling Delays from Clustering-Enhanced Gravitational Sedimentation
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

A Gravitational Redshift Measurement of the White Dwarf Mass–Radius Relation
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

Carbon star formation as seen through the non-monotonic initial–final mass relation
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`