Alan Junzhe Zhou

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Education

The University of Chicago July 2024 – Expected 2026
Ph.D. in Physics
Cosmological data analysis, large-scale probabilistic deep learning

Carnegie Mellon University Aug 2022 – July 2024
Ph.D. in Physics (M.S. May 2024)
Cosmological data analysis, large-scale probabilistic deep learning

Duke University Aug 2018 – May 2022
B.S. in Physics; B.S. in Mathematics; Minor in Classics
Highest Honors in Physics; Magna Cum Laude; GPA: 3.94/4.00
Dissertation: *Galaxy Clustering Statistics with the Dark Energy Survey*

The Inter-Collegiate Center for Classical Studies in Rome Jan 2020 – June 2020
GPA: 4.00/4.00
Coursework and fieldwork in classical archaeology and conservation

Research Experience

Observational and Theoretical Cosmology Aug 2022 – Present
The University of Chicago, Kavli Institute for Cosmological Physics
CMU, McWilliams Center for Cosmology, NSF AI Planning Institute
Advisor: Scott Dodelson
Main effort: Designing large-scale Bayesian networks and deep probabilistic models to reconstruct the 3D matter distribution evolution of the universe using large cosmological data sets. Simulation-based inference (SBI) of non-Gaussian statistics.
Other interests: Cosmic isotropy. Milky Way dark matter halos searches via SBI. Bayesian parameter estimation algorithms for time-series imaging.

Observational Cosmology Apr 2020 – Aug 2022
Duke Cosmology Group, The Dark Energy Survey
Advisor: Michael Troxel
Studied noise and systenatics dominated spatial correlation statistics of galaxies in cosmological survey data sets.

Theoretical High Energy Physics Dec 2020 – Mar 2022
Duke Physics
Advisor: Shailesh Chandrasekharan
Found a simple finite-dimensional quantum field theory that reproduces the statistical behavior of a class of infinite-dimensional theories. Designed efficient sampling algorithms and utilized distributed computing to validate theoretical results.

Experimental High Energy Physics Apr 2019 – Aug 2019
CERN (Switzerland), Duke High Energy Physics Group
Advisor: Ashutosh Kotwal
Searched for beyond-the-standard-model compositeness of the top quark at the Large Hadron Collider.

Publications

[1] **Alan Junzhe Zhou**, Scott Dodelson, and Daniel Scolnic. *The isotropy of cosmic expansion in the early and late Universe*. 2025. arXiv:2506.14878.

[2] **Alan Junzhe Zhou**, Marco Gatti, Dhayaa Anbajagane, Scott Dodelson, Matthieu Schaller, and Joop Schaye. *Map-level baryonification: unified treatment of weak lensing two-point and higher-order statistics*. 2025. arXiv:2505.07949.

[3] **Alan Junzhe Zhou**, Xiangchong Li, Scott Dodelson, and Rachel Mandelbaum. "Accurate field-level weak lensing inference for precision cosmology". In: *Phys. Rev. D* 110 (2 2024), DOI: 10.1103/PhysRevD.110.023539. arXiv:2312.08934.

[4] **Alan Junzhe Zhou**, Yin Li, Scott Dodelson, Rachel Mandelbaum, Yucheng Zhang, Xiangchong Li, and Giulio Fabbian. "A Hamiltonian, post-Born, three-dimensional, on-the-fly ray tracing algorithm for gravitational lensing". In: *Journal of Cosmology and Astroparticle Physics* 10 (2024), DOI: 10.1088/1475-7516/2024/10/069. arXiv:2405.12913.

[5] **Alan Junzhe Zhou** and Scott Dodelson. "Field-level multiprobe analysis of the CMB, integrated Sachs-Wolfe effect, and the galaxy density maps". In: *Phys. Rev. D* 108 (8 Oct. 2023), DOI: 10.1103/PhysRevD.108.083506. arXiv:2304.01387.

[6] **Alan Junzhe Zhou**, Hersh Singh, Tanmoy Bhattacharya, Shailesh Chandrasekharan, and Rajan Gupta. "Spacetime symmetric qubit regularization of the asymptotically free two-dimensional $O(4)$ model". In: *Phys. Rev. D* 105 (5 Mar. 2022), DOI: 10.1103/PhysRevD.105.054510. arXiv:2111.13780.

[7] Tanmoy Bhattacharya, Shailesh Chandrasekharan, Rajan Gupta, Hersh Singh, and **Alan Junzhe Zhou**. "Space-time symmetric qubit regularization of asymptotically freedom". In: *APS Division of Nuclear Physics Meeting Abstracts*. Vol. 2021. APS Meeting Abstracts. 2021.

Talks

"Taming the field-level likelihood of cosmological surveys," Cosmology lunch seminar, Department of astrophysical sciences, Princeton University	Apr 2025
"Reconstructing the cosmic origin through data-driven forward modeling," lunch talk, physics & astronomy, University of Pennsylvania	Apr 2024
"Reconstructing our cosmic origin," Jane Street graduate fellowship workshop	Apr 2024
"Reconstructing the origin of the universe through data-driven forward modeling," NSF AI & data-driven astronomy seminar	Apr 2024
"Accurate field-level weak lensing inference for precision cosmology," HSC weak lensing working group	Feb 2024
"Accurate and precise weak lensing field-level inference," IPMU, University of Tokyo	Jan 2024
"Accurate and precise weak lensing cosmology via field-level inference," CD3 x Simons Foundation Workshop, AI-driven discovery in physics & astrophysics, University of Tokyo	Jan 2024
"Theory and practice of Monte Carlo methods II," McWilliams software series, CMU	May 2023
"Field-level multiprobe analysis of the CMB, integrated Sachs-Wolfe effect, and galaxy density maps," invited paper presentation, ETH Zurich	May 2023
"Field-level multiprobe cosmological analysis," Future science with CMBxLSS, Yukawa Institute, Kyoto University	Apr 2023
"Field-level multiprobe cosmological analysis," the impossible problems seminar, McWilliams Center for Cosmology, CMU	Mar 2023
"Theory and practice of Monte Carlo methods I," McWilliams software series, CMU	Mar 2023
"Measuring the galaxy clustering statistics using the Dark Energy Survey's year 3 source catalog," Visible Thinking Symposium, Duke University	Apr 2022
"Galaxy clustering in the Dark Energy Survey's year 3 source catalog," Duke Senior Research Symposium, Duke University	Apr 2022
"Spacetime symmetric qubit regularization of asymptotic freedom," 2021 APS fall meeting	Oct 2021
"Self-calibration of intrinsic alignment," Dark Energy Survey weak lensing working group	Aug 2021

Awards

Jane Street Graduate Research Fellow	Feb 2024
Reconstructing the initial conditions of the universe (**PI**), NSF Advanced Cyberinfrastructure Coordination Ecosystem: Services & Support (ACCESS)	Sept 2023
Daphne Chang Memorial Award, Duke University	May 2022
CEU21 Award, 2021 American Physical Society Fall Meeting	Aug 2021
Duke University Dean's Summer Research Fellow, Duke University	May 2021
Duke University Summer IDEA Grant Award, Duke University	May 2021
Duke University Faculty Scholar Award Physics Department Nominee, Duke University	Mar 2021
Duke HEP Group ATLAS Research Grant, Duke University	May 2019