Tianqing Zhang

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RESEARCH INTERESTS

Weak lensing cosmology — Image processing & simulation — Photometric redshift — Bayesian statistics & Machine learning — Data analysis & visualization — Open-source software development

EMPLOYMENT

Research Assistant Professor, *University of Pittsburgh* — *September. 2023 – Present.*

Graduate Research Assistant, *Carnegie Mellon University* — *Sep. 2018 – July. 2023*

Machine Learning Engineer, *internship*, *IBM* — *May. 2018 – Aug. 2018*

Undergraduate Research Assistant, *Duke University* — *Jan. 2017 – May. 2018*

EDUCATION

Carnegie Mellon University, *Pittsburgh, PA*
Ph.D. in Physics — *July 2023*
Thesis: Enabling the Weak Lensing Science of the 2020s; Advisors: Rachel Mandelbaum

Duke University, *Durham, NC*
B.S. in Physics (with high distinction), minor in Computer Science, Mathmatics — *May 2018*
Thesis: Measuring the Chromatic Effect of Point Spread Function, Advisor: Christopher Walter

Shanghai Jiao Tong University (SJTU), *Shanghai, China*
(*international program, transferred to Duke*)

SERVICE TO THE PROFESSIONS

Pixels-to-Objects Working Group co-convener, *LSST DESC* — *2023-Present.*
RAIL Topical Team co-lead, *LSST DESC* — *2024-Present.*
Collaboration Council, *LSST DESC* — *2022-2024*
Membership Committee, *LSST DESC* — *2022-2024*
2024 Sprint Week Tutorial Organizer, *LSST DESC* — *2024*
2023 Sprint Week Local Organizing Committee, *LSST DESC* — *2023*
2022 Summer Meeting Scientific Organizing Committee, *LSST DESC* — *2022*
AstroLunch Seminar Organizer, *McWilliams Center of Cosmology* — *2022-2023*
"Impossible Problems" Seminar Series Organizer, *McWilliams Center of Cosmology* — *2022-2023*
Software Development Series Organizer, *McWilliams Center of Cosmology* — *2020-2021*
Graduate Program Admission Committee, *Department of Physics, CMU* — *2021-2022*

COLLABORATION AFFILIATIONS

Research Scientist, LINCC Frameworks
Full Member (applying for Builder), LSST Dark Energy Science Collaboration (DESC)
Continuing Collaborator, Hyper-Suprime Cam (HSC)
Member of PSF and Photo-z Commissioning Team, Rubin Observatory
Member, Dark Energy Spectroscopic Instrument (DESI)
Member, Roman Space Telescope Project and Infrastructure Team (Roman PIT)

PUBLICATIONS

Citation Summary: 16 Published, 5 in press, citation: 542, h-index: 11.

First and Second Author Publications

T. Zhang, X. Li, R. Dalal, R. Mandelbaum, M. A. Strauss, A. Kannawadi et al., *A general framework for removing point-spread function additive systematics in cosmological weak lensing analysis*, MNRAS **525** (2023) 2441 [2212.03257]

T. Zhang, M. M. Rau, R. Mandelbaum, X. Li and B. Moews, *Photometric redshift uncertainties in weak gravitational lensing shear analysis: models and marginalization*, MNRAS **518** (2023) 709 [2206.10169]

X. Li, **T. Zhang**, S. Sugiyama, R. Dalal, R. Terasawa, M. M. Rau et al., *Hyper Suprime-Cam Year 3 results: Cosmology from cosmic shear two-point correlation functions*, Phys. Rev. D **108** (2023) 123518 [2304.00702]

T. Zhang, H. Almoubayyed, R. Mandelbaum, J. E. Meyers, M. Jarvis, A. Kannawadi et al., *Impact of point spread function higher moments error on weak gravitational lensing - II. A comprehensive study*, MNRAS **520** (2023) 2328 [2205.07892]

T. Zhang, R. Mandelbaum and LSST Dark Energy Science Collaboration, *Impact of point spread function higher moments error on weak gravitational lensing*, MNRAS **510** (2022) 1978 [2107.05644]

T. Ferreira, **T. Zhang**, N. Chen, S. Dodelson and LSST Dark Energy Science Collaboration, *Data compression and covariance matrix inspection: Cosmic shear*, Phys. Rev. D **103** (2021) 103535 [2010.15986]

Co-authored Papers

A. Park, S. Singh, X. Li, R. Mandelbaum and **T. Zhang**, *A Consistent Cosmic Shear Analysis in Harmonic and Real Space*, *arXiv e-prints* (2024) arXiv:2404.02190 [2404.02190]

I. Mendoza, A. Torchylo, T. Sainrat, A. Guinot, A. Boucaud, M. Paillassa et al., *The Blending ToolKit: A simulation framework for evaluation of galaxy detection and deblending*, *arXiv e-prints* (2024) arXiv:2409.06986 [2409.06986]

Q. Hang, B. Joachimi, E. Charles, J. F. Crenshaw, P. Larsen, A. I. Malz et al., *Impact of survey spatial variability on galaxy redshift distributions and the cosmological 3×2-point statistics for the Rubin Legacy Survey of Space and Time (LSST)*, *arXiv e-prints* (2024) arXiv:2409.02501 [2409.02501]

R. Terasawa, X. Li, M. Takada, T. Nishimichi, S. Tanaka, S. Sugiyama et al., *Exploring the baryonic effect signature in the Hyper Suprime-Cam Year 3 cosmic shear two-point correlations on small scales: the S_8 tension remains present*, *arXiv e-prints* (2024) arXiv:2403.20323 [2403.20323]

M. Yamamoto, K. Laliotis, E. Macbeth, **T. Zhang**, C. M. Hirata, M. A. Troxel et al., *Simulating image coaddition with the Nancy Grace Roman Space Telescope - II. Analysis of the simulated images and implications for weak lensing*, MNRAS **528** (2024) 6680 [2303.08750]

C. M. Hirata, M. Yamamoto, K. Laliotis, E. Macbeth, M. A. Troxel, **T. Zhang** et al., *Simulating image coaddition with the Nancy Grace Roman Space Telescope - I. Simulation methodology and general results*, MNRAS **528** (2024) 2533 [2303.08749]

S. Sugiyama, H. Miyatake, S. More, X. Li, M. Shirasaki, M. Takada et al., *Hyper Suprime-Cam Year 3 results: Cosmology from galaxy clustering and weak lensing with HSC and SDSS using the minimal bias model*, Phys. Rev. D **108** (2023) 123521 [2304.00705]

S. More, S. Sugiyama, H. Miyatake, M. M. Rau, M. Shirasaki, X. Li et al., *Hyper Suprime-Cam Year 3 results: Measurements of clustering of SDSS-BOSS galaxies, galaxy-galaxy lensing, and cosmic shear*, Phys. Rev. D **108** (2023) 123520 [2304.00703]

R. Dalal, X. Li, A. Nicola, J. Zuntz, M. A. Strauss, S. Sugiyama et al., *Hyper Suprime-Cam Year 3 results: Cosmology from cosmic shear power spectra*, Phys. Rev. D **108** (2023) 123519 [2304.00701]

H. Miyatake, S. Sugiyama, M. Takada, T. Nishimichi, X. Li, M. Shirasaki et al., *Hyper Suprime-Cam Year 3 results: Cosmology from galaxy clustering and weak lensing with HSC and SDSS using the emulator based halo model*, Phys. Rev. D **108** (2023) 123517 [2304.00704]

M. M. Rau, R. Dalal, **T. Zhang**, X. Li, A. J. Nishizawa, S. More et al., *Weak lensing tomographic redshift distribution inference for the Hyper Suprime-Cam Subaru Strategic Program three-year shape catalogue*, MNRAS **524** (2023) 5109 [2211.16516]

T. Sunayama, H. Miyatake, S. Sugiyama, S. More, X. Li, R. Dalal et al., *Optical Cluster Cosmology with SDSS redMaPPer clusters and HSC-Y3 lensing measurements*, *arXiv e-prints* (2023) arXiv:2309.13025 [2309.13025]

M. A. Troxel, C. Lin, A. Park, C. Hirata, R. Mandelbaum, M. Jarvis et al., *A joint Roman Space Telescope and Rubin Observatory synthetic wide-field imaging survey*, MNRAS **522** (2023) 2801 [2209.06829]

M. Yamamoto, M. A. Troxel, M. Jarvis, R. Mandelbaum, C. Hirata, H. Long et al., *Weak gravitational lensing shear estimation with METACALIBRATION for the Roman High-Latitude Imaging Survey*, MNRAS **519** (2023) 4241 [2203.08845]

R. Mandelbaum, M. Jarvis, R. H. Lupton, J. Bosch, A. Kannawadi, M. D. Murphy et al., *PSFs of coadded images*, *The Open Journal of Astrophysics* **6** (2023) 5 [2209.09253]

Publication in progress

T. Zhang, S. Sugiyama, X. Li, S. More, R. Mandelbaum, A. Kannawadi et al., *Cosmology and Source Redshift Constraints from Galaxy Clustering and Tomographic Galaxy-Galaxy Lensing with HSC Y3 and SDSS using the Point-Mass Correction Model*, *in prep.*

T. Zhang, S. Sugiyama, X. Li, S. More, R. Mandelbaum, A. Kannawadi et al., *3x2pt Cosmology from Galaxy Clustering and Tomographic Weak Lensing with HSC Y3 and SDSS using the Point-Mass Correction Model*, *in prep.*

T. Zhang, H. Almoubayyed, R. Mandelbaum, M. Rau, N. Sarcevic, J. Newman et al., *Forecasting the Impact of Photometric Redshift Uncertainties on the LSST 3x2pt Analysis*, *in prep.*

TALKS

(Invited talks denoted by "†")

Roman PIT workshop, *Caltech, Pasadena, CA* — *Oct. 2024*
Developing RAIL: a platform for photometric redshift production and research

DESC Forecast Topical Team, *online* — *Oct. 2024*
Forecasting the Impact of Photometric Redshift Uncertainties on the LSST 3x2pt Analysis

Rubin Community Workshop, *SLAC, Menlo Park, CA* — *Aug. 2024*
PSF Requirement for Cosmic Shear with LSST

Rubin Community Workshop, *SLAC, Menlo Park, CA* — *Aug. 2024*
RAIL Status updates: v1.0 release

† LSST Discovery Alliance Monthly Meeting, *online* — *Jul. 2024*
Developing RAIL: A platform for LSST photometric redshift production and research

† DES Weak Lensing Group Meeting, *online* — *Apr. 2023*
HSC Y3 Cosmology Results Seminar

DESC Photometric Redshift Group Meeting, *online* — *Apr. 2023*
HSC Y3 Cosmology Results Seminar: Photometric Redshift

HSC Y3 Cosmology Results Webinar, *online* — *Apr. 2023*
Source Redshift Distribution Inference, PSF Systematics Inference

† Research Faculty Seminar, *University of Pittsburgh, Pittsburgh, PA* — *Feb. 2023*
Weak Lensing Cosmology and its Technical Challenges in the 2020s

† Princeton Cosmology Discussion, *Princeton University, Princeton, NJ* — *Sept. 2022*
Why do we care about redshift distribution in cosmic shear for Cosmology?

Princeton HSC+PFS+Rubin Group Meeting, *Princeton University, Princeton, NJ* — *Sept. 2022*
Point Spread Function in Cosmic Shear: Simulation, Modeling and Marginalization

International High-Performance Computing Summer School, *Athens, Greece* *Jun. 2022*
Pixel to Catalog to Science: the weak lensing image processing and analysis pipeline

HSC Weak Lensing Group Meeting, *online* *May. 2022*
Impact of PSF Higher Moments on Cosmic Shear Measurement

DESC Collaboration Wide Presentation, *online* *May. 2022*
Impact of Point Spread Function Higher-moments Error on Weak Lensing II

DESC 2020 Winter Meeting, *University of Arizona, Tucson, AZ* *Jan. 2020*
Impact of Point Spread Function Higher-moments Error on Weak Lensing

DESC 2020 Winter Meeting, *University of Arizona, Tucson, AZ* *Jan. 2020*
Impact of Point Spread Function Higher-moments Error on Weak Lensing

DESC Theory and Joint Probe Group Meeting, *University of Arizona, Tucson, AZ* *Oct. 2019*
Data Compression and Covariance Matrices Inspection: Cosmic Shear

Asia-Pacific Astronomy & Engineering Summit, *University of Hawaii, Hilo, HI* *Aug. 2014*
Studies of Reaching and Going Beyond the Seeing Limit of Ground-based Telescopes: Adaptive Optics

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POSTERS

Rubin Project & Community Workshop 2022, *Tucson, AZ* *Aug. 2022*
Lensed by the atmosphere: PSF systematics in weak lensing analysis

Machine Learning Student Poster Session, *Carnegie Mellon University, Pittsburgh PA* *May. 2021*
Image Segmentation with Uncertainty Quantification using Bayesian U-Net

Cosmic Controversies Conference, *University of Chicago, Chicago IL* *Oct. 2019*
Data Compression and Covariance Matrices Inspection: Cosmic Shear

Undergraduate Research Poster Session, *Duke University, Durham NC* *Apr. 2018*
Measuring the Chromatic Effect of Point Spread Function in Optical Wavelength

Undergraduate Research Poster Session, *Duke University, Durham NC* *Apr. 2017*
Building the Portable Neutron Beam Imager using 2-D Position-Sensitive Photomultiplier Tubes

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TEACHING & MENTORING

Student Supervision/Mentoring (UG=undergrad students, G=graduate students)

- **Michael Murphy (CMU, UG)**: Result in co-authorship of a publication ("PSFs of coadded images")
- **Mahitha Ramachandran (Pitt, UG)**: NASA Space Grant Spring 2024 "Impact of Background Residual on Shear Estimation"
- **Sean Maloney (Pitt, UG)**: NASA Space Grant Summer 2024 "Measure the Cosmic Proper Motion Using GAIA data"
- **Federico Berlfein (CMU, G)**: June 2023-present, "Chromatic Effects on the PSF and Shear Measurement for the *Roman* High-Latitude Imaging Survey "
- **Andy Park (CMU, G)**: Oct. 2021-Mar. 2024, "A Consistent Cosmic Shear Analysis in Harmonic and Real Space"

Graduate Teaching Assistant

- Physics I for Engineering Students (33-141), Fall 2018
- Electronics (33-228), Spring 2019
- Classical Electrodynamics I (33-761), Fall 2019

MEDIA COVERAGE

New Scientist, *Weird cosmic clumping hints our understanding of the universe is wrong* *2023*
https://www.newscientist.com/article/mg26034694-800-weird-cosmic-clumping-hints-our-understanding-of-the-universe-is-wrong/

Live Science, *Unexpected cosmic clumping could disprove our best understanding of the universe* *2023*
https://www.livescience.com/space/unexpected-cosmic-clumping-could-disprove-our-best-understanding-of-the-universe

Carnegie Mellon University Stories, *Weak Gravitational Lensing Tests the Cosmological Model* *2023*
https://www.cmu.edu/news/stories/archives/2023/april/weak-gravitational-lensing-tests-the-cosmological-model

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FUNDING PROPOSALS

Rubin Observatory Enabling Science Award, *$ 2,100* *2022*
Code Tutorial to Enable Participation, *PI, $ 14,220* *2023*

PUBLIC OUTREACH

Carnegie Mellon High School Astronomy Mentoring Project, *2022*
Galaxy.io: a pedagogical multiplayer game, *2022*
SJTU Astronomy Club, *Chair* *2015-2016*
Shanghai Science & Technology Museum Volunteer, *200 hours* *2015-2016*

AWARDS

Dean's List with Distinction, *2018*
Dean's List with Distinction, *2017*
Sigma Pi Sigma, *2018*
Guanghua Scholarship, *top 5%* *2016*
Pacific-Asia Astronomy Olympiad, *Second Diploma* *2012*
China Astronomy Olympiad, *First Diploma* *2012*

JOURNAL REFEREE

Monthly Notice of Royal Astronomical Society, Astronomy & Astrophysics, Astronomical Journal, Publications of the Astronomical Society of Australia, Publications of the Astronomical Society of the Pacific

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RELEVANT SKILLS

Python: NumPy, PyTorch, Pandas, TensorFlow, Matplotlib, Butler
Other Languages: Java, Swift 3.0, MATLAB, C#, SQL
Tasks: Version Control (git), Parallel Computing (MPI, Multiprocessing), Supervised Learning (PyTorch, TensorFlow), Job systems (SLURM, PBS)

REFERENCES

Dr. Rachel Mandelbaum,
McWilliams Center for Cosmology,
Department of Physics, Carnegie Mellon University,
Pittsburgh, PA 15213 *E-mail: rmandelb@andrew.cmu.edu*

Dr. Jeffrey A. Newman,
Department of Physics & Astronomy,
University of Pittsburgh,
Pittsburgh, PA 15260 *E-mail: janewman@pitt.edu*

Dr. Michael Jarvis,
Department of Physics & Astronomy,
University of Pennsylvania,
Philadelphia, PA 19104 *E-mail: mjarvis@physics.upenn.edu*

Dr. Masahiro Takada,
Institute for the Physics of Mathematics of the Universe (IPMU)
The University of Tokyo,
Kashiwa City, Chiba, Japan 277-8582 *E-mail: masahiro.takada@ipmu.jp*