Zhuofu (Chester) Li

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Seattle, WA

Education

- **Ph.D. in Astrophysics, Advanced Data Science Track** *Expected June 2027*
  University of Washington, Seattle Seattle, WA, USA
- **Dual M.S. in Astrophysics and Statistics** *Sep 2022 - Sep 2026*
  University of Washington, Seattle Seattle, WA, USA
- **Dual B.S. in Astrophysics and Geophysics with Departmental Highest Honors** *Sep 2018 - Jun 2022*
  University of California, Los Angeles Los Angeles, CA, USA

Research Interests

Small-body and Solar System dynamics; asteroid and comet orbital evolution; orbit determination and propagation; uncertainty quantification; long-term numerical integration; high-performance computing for orbital simulations; survey-scale Solar System data processing; scientific pipeline development.

Research Experience

- **Identifying and Characterizing Jupiter Co-orbitals at Scale in the Rubin Era** *Jan 2025 – Present*
  University of Washington, Seattle Advisor: Prof. Sarah Greenstreet
  - Develop an automated, scalable pipeline that queries and analyzes all qualifying near-Jupiter objects in the JPL Small-Body Database; the current sample contains 14,801 objects. For each object, the pipeline obtains one best-fit orbit and 999 covariance clones using SBDynT and retrieves planetary state vectors from JPL Horizons.
  - Perform 0.5-Myr forward integrations using the SWIFT-RMVS4 symplectic integrator with a 0.01-yr timestep on high-performance computing systems, recording orbital elements at a 10-yr cadence.
  - Implement 1,000-yr running-window resonance analysis to classify stable Trojans, transient co-orbitals, non-resonant objects, and insecure cases.
  - Quantify uncertainties in resonance classifications, co-orbital residence times, and escape-time distributions using ensembles consisting of one best-fit orbit and 999 covariance clones per object.
  - Develop fine-cadence libration analysis to measure libration periods, amplitudes, and centers and assign objects to L4, L5, horseshoe, quasi-satellite, and retrograde states.

- **Jupiter Trojan Rotation Periods from ZTF Photometry** *Sep 2022 – Sep 2024*
  University of Washington, Seattle Advisor: Prof. Željko Ivezić
  - Led a first-author analysis of Zwicky Transient Facility g- and r-band time-series photometry for 216 Jupiter Trojans, including 80 objects with previously unknown rotation periods.
  - Developed light-curve preprocessing, statistical filtering, Lomb–Scargle period searches, and validation procedures for sparse multi-band photometry.
  - Measured rotation periods ranging from 4.569 to 447.8 hours and identified a concentration of objects near the 4–4.8-hour spin barrier.
  - Used the fastest reliably measured rotation period to infer a characteristic rubble-pile bulk density of approximately 0.52 $\mathrm{g\,cm^{-3}}$.

- **Forecasting Dark Matter Subhalo Constraints Using Implicit Likelihood Inference** *Sep 2024 – Aug 2025*
  University of Washington, Seattle Advisor: Prof. Nora Shipp
  - Applied neural posterior estimation with transformer-based neural networks and conditional normalizing flows to infer six dark-matter subhalo encounter parameters from stellar-stream kinematics.
  - Trained and validated models using more than 150,000 Lagrange-cloud particle-spray simulations and obtained well-calibrated posterior distributions.
  - Forecasted subhalo constraints for present-day and future observing scenarios involving LSST, Gaia, and 4MOST, including the effects of incomplete kinematic information.

Publications and Preprints

[1] **Z. (Chester) Li**, Y. A. Chowdhury, Ž. Ivezić, A. Mahabal, A. Heinze, et al. "Estimates of Rotation Periods for Jupiter Trojans with the Zwicky Transient Facility Photometric Lightcurves." *Icarus*, 438, 116609, 2025.

[2] S. Greenstreet, **Z. (Chester) Li**, D. E. Vavilov, D. Singh, et al. "Lightcurves, Rotation Periods, and Colors for Vera C. Rubin Observatory's First Asteroid Discoveries." *The Astrophysical Journal Letters*, 996, L33, 2026.

[3] C. O. Chandler, P. H. Bernardinelli, M. Jurić, et al., including **Z. (Chester) Li**. "NSF–DOE Vera C. Rubin Observatory Observations of Interstellar Comet 3I/ATLAS (C/2025 N1)." *The Astrophysical Journal Letters*, 1001, L35, 2026.

[4] T. Nguyen, R. Pei, **Z. (Chester) Li**, N. Shipp, et al., and the LSST Dark Energy Science Collaboration. "Forecasting Dark Matter Subhalo Constraints from Stellar Streams Using Implicit Likelihood Inference." *arXiv preprint*, arXiv:2512.07960, 2025.

[5] J. Román, R. M. Rich, N. Ahvazi, L. V. Sales, **Chester Li**, G. Golini, et al. "A Giant Thin Stellar Stream in the Coma Galaxy Cluster." *Astronomy & Astrophysics*, 679, A157, 2023.

[6] Y. Jiménez-Teja, J. Román, K. HyeongHan, et al., including **Chester Li**. "Deep View of the Intracluster Light in the Coma Cluster of Galaxies." *Astronomy & Astrophysics*, 694, A216, 2025.

[7] P. M. Ogle, I. E. López, V. Reynaldi, A. Togi, R. M. Rich, et al., including **Z. (Chester) Li**. "Radio Jet Feedback on the Inner Disk of Virgo Spiral Galaxy Messier 58." *The Astrophysical Journal*, 962, 196, 2024.

[8] J.-L. Margot, M. G. Li, P. Pinchuk, et al., including **Z. (Chester) Li**. "A Search for Technosignatures Around 11,680 Stars with the Green Bank Telescope at 1.15–1.73 GHz." *The Astronomical Journal*, 166, 206, 2023.

[9] C. Vidal, B. L. Fields, D. R. Sowinski, et al., including **Z. (Chester) Li**. "The Search for Technosignatures: A Review of Possibilities." *arXiv preprint*, arXiv:2605.21093, 2026.

Manuscripts in Preparation

[M1] **Z. (Chester) Li**, et al. "Identifying and Characterizing Jupiter Co-orbitals at Scale in the Rubin Era." Manuscript in preparation.

[M2] **Z. (Chester) Li**, et al. "Libration Properties of the Long-Term Stable Jupiter Trojan Population." Manuscript in preparation.

Technical Skills

- **Orbital Dynamics and Astronomy:** SWIFT-RMVS4, REBOUND, JPL Small-Body Database, JPL Horizons, orbit propagation, covariance-clone generation, mean-motion resonances, libration dynamics, long-term stability, and close-encounter characterization
- **Scientific Computing:** Python, NumPy, SciPy, Pandas, Astropy, C++, Linux, Git, Slurm, parallel computing, workflow automation, high-performance computing, large-scale simulation management
- **Statistical Methods:** Bayesian inference, Monte Carlo methods, uncertainty propagation, covariance analysis, simulation-based inference, time-series modeling
- **Machine Learning:** PyTorch, TensorFlow, neural posterior estimation, conditional normalizing flows, transformers
- **Astronomical Data Analysis:** ZTF and Rubin Observatory data, sparse multi-band light curves, Lomb–Scargle period analysis, photometric quality control, survey-scale catalog analysis

Teaching and Leadership

- **Teaching Assistant, UW** — Astrostatistics & Python for Astronomy *2022 – 2025*
- **President and Co-founder, Data Science Society at UW** *2024 – Present*
- **President, UCLA Astronomical Society** *2021 – 2022*

Selected Awards

- **Departmental Salutatorian**, UCLA Department of Earth, Planetary, and Space Sciences *2022*
- **UCLA Chancellor's Service Award** *2022*
- **Caltech Astronomy Summer Undergraduate Research Fellowship** *2021*