Zhaozhou Li

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Work Experience

• Marie Skłodowska-Curie Fellow	Hebrew University of Jerusalem, Israel	2023 –
• Postdoctoral Fellow	Hebrew University of Jerusalem, Israel	2021 – 2023
• Postdoctoral Researcher	Shanghai Jiao Tong University, China	2018 – 2021

Education

• Ph.D. in Astrophysics	Shanghai Astronomical Observatory, China	2011 – 2017
• B.S. in Applied Physics	Beihang University, China	2007 – 2011

Research Projects

My research focuses on the **dynamics and formation of cosmic structures** from the early to local Universe

- Star and galaxy formation at cosmic dawn with feedback-free starbursts
- Galaxy structural diversity: dynamical evolution driven by accretion, feedback and tidal stripping
- Dynamical structure of dark matter halos and their interplay with baryons
- Evolution of satellite galaxies: initial condition, evolution, and fate
- Novel dynamical modeling methods and the mass and boundary of the Milky Way halo
- Robust Gaussian process and application to modeling binary stars in open clusters

Professional Expertise

- Cosmological/isolated simulation & analysis
  Merger tree, (sub)structure finding, tidal field, correlation function, `GADGET`, semi-analytical models
- Galactic dynamics
  DF modeling, Jeans equation, violent relaxation, orbit integration, action analysis (`Agama`/`Gala`)
- Observational data analysis
  Analysis of survey catalogs (SDSS/BOSS, *Gaia*), modeling stellar populations with photometric data
- Statistics and machine learning
  Advanced Bayes, Gaussian process, robust statistics, clustering, active learning
- Programming (Expert – `Python`; familiar – `C`, `Fortran`, `SQL`)
  High performance computing (`OpenMP`, parallel `Python`, `Cython`), numerical analysis (`Scipy`, `GSL`)

Honors and Awards

• Marie Skłodowska-Curie Actions Fellowship (proposal score: 99/100), 200,000€, Europe	2023 – 2025
• Rosenblum Award for Excellence in Astrophysics (travel fund), 2,500$, HUJI	2022
• Second Prize of the National Mathematics Competitions for College Students, China	2010
• First Prize of the Physics Experiment Competition for College Students, Beijing	2009
• Outstanding Freshman Scholarship, Second Prize, Beihang University	2007

Teaching

• Guest lecturer	Advanced Cosmology (graduate course, 4h cumulative)	HUJI	2022S, 2023S
• Project advisor	Astrophysics Seminar (undergraduate research training, 20h)	HUJI	2022S
• Lecturer/advisor	Scientific Practice Projects (high school students, 100h)	Shanghai	2016 – 2018
• Lecturer	Intro to Astronomy (primary & middle schools, 25h)	Shanghai	2015 – 2017
• Lecturer	Applied Python in Astronomy (workshop, 4h)	Shanghai	Nov 2015

Advising (graduates)

- Close advising: Qi Guo (IPMU, modeling filaments), Yarone Tokayer (Yale, halo structure)
- As co-advisor: Yaofei He (THU, halo response to feedback), Feihong He (SJTU, subhalo evolution), Yanrui Zhou (SJTU, dynamical modeling), Axel Gross (UMN, halo structure) • As technical advisor: Rui Shi (SJTU), Xiaokai Chen (SJTU), Xianguang Meng (SHAO)

Services

- Referee for scientific journal: MNRAS — Since 2022
- Coordinator of the astrophysics seminar at HUJI — 2022 –
- LOC member of the conference *Studying the Universe with Galaxy Surveys*, Shanghai — 2018
- Founder and maintainer of the AstroPython wechat discussion groups (∼1000 users) — Since 2016
- Maintainer of the computing servers of the cosmology group at SHAO — 2014 – 2020
- Coordinator of the cosmology journal club at SHAO and SJTU — 2014 – 2016, 2018 – 2019

Open-source Contribution

- Selected open-source software, see more at `https://syrte.github.io/code`
  - `cyper`: running `Cython` codes on the fly for high performance Python
  - `robustgp`: proposed novel Gaussian process regression for contaminated data (∼20 citations)
  - `ndtest`: multi-dimensional statistical tests (incl. 2D K-S test, >50 citations)
  - `ParsecQuery`: querying isochrones from the PARSEC stellar evolution model
- Code cited by >60 papers of various disciplines (incl. exoplanets, bioinformatics, agriculture, etc.)
- Contributor of infrastructure libraries including `Numpy`, `Scipy`, `Cython`
- Ranking by public contribution: top 10% overall on StackOverflow with ∼2.8M people reached; top 500 in Israel on GitHub

Outreach

- Public lecture at a book club, "Ramble under the Starry Sky" (2h), Changsha — Jul 2023
- Expositor of the open day of physics and astronomy (20h), SJTU — 2017 – 2019
- Volunteer guide at the Shanghai Natural History Museum — 2016
- Member of the Interplanetary Immigration Agency, a near-future science fiction project — Since 2014
- Co-organizer of sidewalk astronomy nights and stargazing camps (> 20), Beijing — 2007 – 2011

Social Services

- Coordinator of the photography exhibition of migrant children, *Voice of Flowing Hearts*, Beijing — 2010
- Volunteer in a field survey of schools for migrant workers' children, Beijing — 2010
- Disaster volunteer of the Sichuan earthquake (1 month), Pengzhou — 2008

Seminar Talks

- Tsinghua University, China — Jul 2024

- Shanghai Jiao Tong University, China — Jun 2024
- Nanjing University, China — Jun 2024
- Ben-Gurion University, Israel — Jan 2024
- Purple Mountain Observatory, China — Dec 2023
- Nanjing University, China — Dec 2023
- Shanghai Normal University, China — Dec 2023
- CCA, Flatiron Institute, US — Oct 2023
- Yale University, US — Oct 2023
- National Astronomical Observatories, China ($\times 2$) — Jul 2023
- Shanghai Astronomical Observatory, China — Jun 2023
- University of Minnesota, US — Nov 2022
- Hebrew University of Jerusalem, Israel — Apr 2022
- Hebrew University of Jerusalem, Israel — Mar 2021
- Kavli IPMU, University of Tokyo, Japan — Sep 2020
- KIAA, Peking University, China — Jun 2020
- Shanghai Astronomical Observatory, China — Apl 2020
- SWIFAR, Yunnan University, China — Nov 2019
- ICC, Durham University, UK — Jul 2019
- Kavli IPMU, University of Tokyo, Japan — Aug 2018
- Shanghai Jiao Tong University, China — Nov 2017

Conference Presentations

- Cosmic Dawn Revealed by JWST: First Stars, Galaxies, and Black Holes, Santa Barbara — Aug 2024
  Feedback-free starbursts at cosmic dawn: Observable predictions for JWST
- XXXII IAU General Assembly 2024, Cape Town (remote) — Aug 2024
  Analytical Insights into Dark Matter Deficient Galaxies
- Santa Cruz Galaxy Workshop (*invited*) — Jul 2024
  Analytical Insights into Feedback Free Starbursts
- Santa Cruz Galaxy Workshop (*invited*) — Aug 2023
- Collaboration Workshop on Cosmology and Galaxy Formation, Shanghai (*invited*) — Jun 2023
- DDA54: Annual Meeting of the Division on Dynamical Astronomy of AAS, Remote — May 2023
  Modeling the formation of dark-matter deficient galaxies
- AI for Astronomy, Shenzhen/Online — Nov 2022
  Robust Gaussian process and its application to resolved stellar population
- Santa Cruz Galaxy Workshop (*invited*) — Aug 2022
  Modeling the Response of Halos to Gas Ejection and Tidal Stripping
- DDA53: Annual Meeting of the Division on Dynamical Astronomy of AAS, Remote — Apr 2022
  Modeling the response of dark matter haloes to gas ejection
- EAS: European Astronomical Society Annual Meeting, Online — Jul 2021
  Measuring the Milky Way mass profile from satellite galaxies kinematics
- DDA52: Annual Meeting of the Division on Dynamical Astronomy of AAS, Online — May 2021
  A novel dynamical modeling method based on the data-driven distribution function
- Guoshoujing Meeting on Galaxies and Cosmology, Hangzhou — May 2021
  The outer edges of the Milky Way halo from the motion of nearby galaxies
- Cross-Strait Symposium on Star Cluster Studies, Online — Dec 2020
  Precise determination of the main sequence of open clusters in the CMD
- Chinese Astronomical Society Annual Meeting, Online — Oct 2020

- Shanghai Assembly on Cosmology and Galaxy Formation, Shanghai — Nov 2019
  Constrain the Milky Way Mass Profile with Phase Space Distribution of Satellite Galaxies
- Galaxy Angular Momentum Alignment 2019, Shanghai — Oct 2019
  Satellite Kinematics and Milky Way Halo Mass
- The Milky Way 2019: LAMOST and Other Leading Surveys, Yichang — Oct 2019
  Measure the Milky Way Mass Profile with Satellite Galaxies in Phase Space
- Small Galaxies, Cosmic Questions, Durham (*poster talk*) — Jul 2019
  Milky Way Mass Profile from Satellite Dynamics
- Astrophysical Dynamics, Tsung-Dao Lee Institute, Shanghai — Jul 2019
- Galactic Dynamics in the Era of Large Surveys, Shanghai — Jul 2019
  Measure the Milky Way Mass Profile with Satellite Galaxies in Phase Space
- Halo and Galaxy Assembly Bias — from Theory to Observation, Shanghai — Jun 2019
  Constrain Massive Cluster Formation with SDSS
- The Life and Times of the Milky Way, Shanghai — Nov 2018
- Studying the Universe with Galaxy Surveys Revealing the Unlimited in Shanghai — Jun 2018
  Milky Way Halo Mass from Satellite Kinematics
- SHAO-PKU Bilateral Symposium, Shanghai — Aug 2017
- 11th Zhang Heng Meeting of the Chinese Astronomical Society, Guiyang — Jun 2017
  Determination of Milky Way Halo Mass from Kinematics of Satellite Galaxies

Publications

Since 2017: 35 papers (10 as lead author) + 2 proceedings, 640 citations, H=13 [ADS, arXiv]

As first/second author (12)

35. Scaling Relations in the Phase Space Structure of Dark Matter Haloes
    Gross, A., **Li, Z.**, and Qian, Y.-Z., 2024, arXiv:2409.00627
34. emPDF: Inferring the Milky Way mass with data-driven distribution function in phase space
    Li, Z., Han, J., Wang, W., Qian, Y.-Z., Li, Q., Jing, Y., and Li, T.S., 2024, arXiv:2408.11414
33. Phase space distribution functions and energy distributions of dark matter particles in haloes
    Gross, A., **Li, Z.**, and Qian, Y.-Z., 2024, MNRAS, 530, 836
32. Feedback-free starbursts at cosmic dawn: Observable predictions for JWST
    Li, Z., Dekel, A., Sarkar, K.C., Aung, H., Giavalisco, M., Mandelker, N., and Tacchella, S., 2024, A&A, 690, A108
31. The response of dark matter haloes to gas ejection: CuspCore II
    Li, Z., Dekel, A., Mandelker, N., Freundlich, J., François, T., 2023, MNRAS, 518, 5356
30. The outermost edges of the Milky Way halo from galaxy kinematics
    Li, Z. and Han, J., 2021, ApJL, 915, L18
29. Robust Gaussian process regression based on iterative trimming
    Li, Z., Li, L., and Shao, Z., 2021, Astronomy and Computing, 36, 100483
28. Orbital distribution of infalling satellite halos across cosmic time
    Li, Z., Zhao, D.-H., Jing, Y.P., Han, J., and Dong, F.-Y., 2020, ApJ, 905, 177
27. Constraining the Milky Way mass profile with phase-space distribution of satellite galaxies
    Li, Z., Qian, Y.-Z., Han, J., Li, T.S., Wang, W., and Jing, Y.P., 2020, ApJ, 894, 10
26. A versatile and accurate method for halo mass determination from phase-space distribution of satellite galaxies
    Li, Z., Qian, Y.-Z., Han, J., Wang, W., and Jing, Y.P., 2019, ApJ, 886, 69
25. The structure finders and the subhalo population in cosmological simulations (*Review in Chinese*)
    Li, Z., Han, J.-X., 2018, Progress in Astronomy, 36-3, 306 (w/ English abstract)
24. Determination of dark matter halo mass from dynamics of satellite galaxies
    Li, Z., Jing, Y.P., Qian, Y.-Z., Yuan, Z., and Zhao, D.-H., 2017, ApJ, 850, 116

Collaboration papers

23. The mass and redshift dependence of halo star clustering
Tan, Z., Wang, W., He, J., Zhang, Y., Rodriguez-Gomez, V., Han, J., **Li, Z.**, and Yang, X., 2024, arXiv:2410.02227

22. Growth of Massive Black-Holes in FFB Galaxies at Cosmic Dawn
Dekel, A., Stone, N.C., Dutta Chowdhury, D., Gilbaum, S., **Li, Z.**, Mandelker, N., and van den Bosch, F.C., 2024, arXiv:2409.18605

21. Why artificial disruption is not a concern for current cosmological simulations
He, F., Han, J., and **Li, Z.**, 2024, arXiv:2408.04470

20. How does the velocity anisotropy of halo stars, dark matter and satellite galaxies depend on host halo properties?
He, J., Wang, W., **Li, Z.**, Han, J., Rodriguez-Gomez, V., Zhao, D., Meng, X., Jing, Y., Shao, S., Shi, R., and Tan, Z., 2024, arXiv:2407.14827

19. Inferring the mass content of galaxy clusters with satellite kinematics and Jeans Anisotropic modeling
Shi, R., Wang, W., **Li, Z.**, Zhu, L., Smith, A., Cole, S., Gao, H., Chen, X., Li, Q., and Han, J., 2024, ApJ, 973, 82

18. The true number density of massive galaxies in the early Universe revealed by JWST/MIRI
Wang, T., Sun, H., Zhou, L., Xu, K., Cheng, C., **Li, Z.**, et al., 2024, arXiv:2403.02399

17. Are Odd Radio Circles virial shocks around massive galaxies? Implications for cosmic-ray diffusion in the circumgalactic medium
Yamasaki, S., Sarkar, K.C., and **Li, Z.**, 2024, MNRAS, 528, 3854

16. Evidence for a Shallow Evolution in the Volume Densities of Massive Galaxies at z=4 to 8 from CEERS
Chworowsky, K., Finkelstein, S.L., Boylan-Kolchin, M., et al. (incl. **Li, Z.**), 2024, AJ, 168, 113

15. Effects of feedback-free starburst galaxies on the 21-cm signal and reionization history
Libanore, S., Flitter, J., Kovetz, E.D., **Li, Z.**, and Dekel, A., 2024, MNRAS, 532, 149

14. DESI Legacy Imaging Surveys Data Release 9: Cosmological Constraints from Galaxy Clustering and Weak Lensing using the Minimal Bias Model
Xu, H., Li, H., Zhang, J., et al. (incl. **Li, Z.**), 2023, Science China: Physics, Mechanics & Astronomy, 66, 129811

13. Unraveling the Complexity of Dwarf Galaxy Dynamics: A Study of Binary Orbital Motions
Wang, W., Zhu, L., Jing, Y., Grand, R.J.J., **Li, Z.**, et al., 2023, ApJ, 956, 91

12. Physical evolution of dark matter halo around the depletion boundary
Gao, H., Han, J., Fong, M., Jing, Y.P., and **Li, Z.**, 2023, ApJ, 953, 37

11. Efficient Formation of Massive Galaxies at Cosmic Dawn by Feedback-Free Starbursts
Dekel, A., Sarkar, K.S., Birnboim, Y., Mandelker, N., and **Li, Z.**, 2023, MNRAS, 523, 3201

10. Is the core-cusp problem a matter of perspective: Jeans Anisotropic Modeling against numerical simulations
Wang, W., Zhu, L., **Li, Z.**, Chen, Y., Han, J., He, F., Yang, X., et al., 2022, ApJ, 941, 108

9. The growth pattern of liver metastases on MRI predicts early recurrence in patients with colorectal cancer: a multicenter study
Cai, Q., Mao, Y., Dai, S., et al. (incl. **Li, Z.**), 2022, European Radiology, 32, 7872

8. The Universal Specific Merger Rate of Dark Matter Halos
Dong, F., Zhao, D., Han, J., **Li, Z.**, Jing, Y., and Yang, X., 2022, ApJ, 929, 120

7. A machine learning approach to infer the accreted stellar mass fractions of galaxies
Shi, R., Wang, W., **Li, Z.**, et al., 2022, MNRAS, 515, 3938S

6. What to expect from dynamical modelling of cluster haloes - I. The information content of different dynamical tracers
Li, Q., Han, J., Wang, W., Cui, W., **Li, Z.**, and Yang, X., 2021, MNRAS, 505, 3907

5. Weak equivalence principle, swampland and H_0 tension with fast single radio bursts FRB 180924 and FRB 190523
Wang, D., **Li, Z.**, and Zhang, J., 2020, Physics of the Dark Universe, 29, 100571

4. Modeling Unresolved Binaries of Open Clusters in the Color-Magnitude Diagram. I. Method and Application of NGC 3532
   Li, L., Shao, Z., **Li, Z.**, Yu, J., Zhong, J., and Chen, L., 2020, ApJ, 901, 49
3. The mass of our Milky Way (*Invited Review*)
   Wang, W., Han, J., Cautun, M., **Li, Z.**, and Ishigaki, M.N., 2020, Science China: Physics, Mechanics & Astronomy, 63, 109801
2. The first constraint from SDSS galaxy-galaxy weak lensing measurements on interacting dark energy models
   Zhang, J., An, R., Luo, W., **Li, Z.**, Liao, S., and Wang, B., 2019, ApJL, 875, L11
1. Fully self-consistent cosmological simulation pipeline for interacting dark energy models
   Zhang, J., An, R., Liao, S., Luo, W., **Li, Z.**, and Wang, B., 2018, Phy. Rev. D, 98, 103530

Conference proceedings

2. Dynamical interaction in the stellar cluster – Evidence from binaries of NGC3532
   Li, L., Shao, Z., **Li, Z.**, 2021, Joint Statistical Meetings (JSM) proceedings, 2021.317202
1. Satellite galaxies as better tracers of the Milky Way halo mass
   Han, J., Wang, W., and **Li, Z.**, 2020, Galactic Dynamics in the Era of Large Surveys, IAU Symposium, 353, 109

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