# Zhaozhou Li

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## Work Experience

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|---|---|---|
| • 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

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

## Research Projects

Project series that I lead, with focus on **dynamics and formation of cosmic structures**

- Galaxy formation at cosmic dawn with feedback-free starbursts 2023 –
- Galaxy structural diversity: evolution in response to feedback and tidal stripping 2021 –
- Gaussian process and open clusters in color-magnitude diagram (CMD) 2019 – 2020
- Dynamical modeling with non-parametric distribution functions (DFs) 2018 – 2021
- Mass profile and boundary of the Milky Way halo from satellite kinematics 2017 – 2021
- Initial and final orbital distribution of satellite galaxies 2013 – 2018

## Professional Expertise

- Cosmological/isolated simulation & analysis
  Merger tree, (sub)structure finding, tidal field, 2PCF, `GADGET`, semi-analytical models
- Galactic dynamics
  DF modeling, Jeans equation, violent relaxation, orbit integration, action analysis (`Galpy/Agama`)
- Observational data analysis
  Analysis of survey catalogs (SDSS/BOSS, *Gaia*), modeling stellar populations in CMD
- Statistics and machine learning
  Hierarchical Bayes, mixture model, Gaussian process, Bayes optimization, robust statistics, clustering
- Programming (Expert – `Python`; familiar – `C`, `Fortran`, `SQL`)
  High performance computing (`OpenMP`, parallel `Python`, `Cython`), numerical analysis (`Scipy`, `GSL`)

## Open-source Practice

- Ranking by public contribution: top 10% overall on StackOverflow with ∼2.8M people reached
  top 500 in Israel on GitHub
- 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.)
- Occasional contributor of infrastructure libraries including `Numpy`, `Scipy`, `Cython`

## 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

## Services

- Referee for scientific journal: MNRAS 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) 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

## Teaching

- Guest lecturer Advanced Cosmology (graduate course, 4h) 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

## Supervision

- As project advisor: Yarone Tokayer (Yale, halo structure), Qi Guo (IPMU, filaments)
- 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)

## 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 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 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, Online/Shenzhen — 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: 33 papers (10 as lead author) + 2 proceedings, 580 citations, H=13 [ADS, arXiv]

**Major contributions** (12)

33. Scaling Relations in the Phase Space Structure of Dark Matter Haloes
    Gross, A., **Li, Z.**, and Qian, Y.-Z., 2024, arXiv:2409.00627
32. 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
31. 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
30. 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., 2023, arXiv:2311.14662
29. 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
28. The outermost edges of the Milky Way halo from galaxy kinematics
    **Li, Z.-Z.** and Han, J., 2021, ApJL, 915, L18
27. Robust Gaussian process regression based on iterative trimming
    **Li, Z.-Z.**, Li, L., and Shao, Z., 2021, Astronomy and Computing, 36, 100483
26. Orbital distribution of infalling satellite halos across cosmic time
    **Li, Z.-Z.**, Zhao, D.-H., Jing, Y.P., Han, J., and Dong, F.-Y., 2020, ApJ, 905, 177
25. Constraining the Milky Way mass profile with phase-space distribution of satellite galaxies
    **Li, Z.-Z.**, Qian, Y.-Z., Han, J., Li, T.S., Wang, W., and Jing, Y.P., 2020, ApJ, 894, 10
24. A versatile and accurate method for halo mass determination from phase-space distribution of satellite galaxies
    **Li, Z.-Z.**, Qian, Y.-Z., Han, J., Wang, W., and Jing, Y.P., 2019, ApJ, 886, 69
23. The structure finders and the subhalo population in cosmological simulations (*Review in Chinese*)
    **Li, Z.-Z.**, Han, J.-X., 2018, Progress in Astronomy, 36-3, 306
22. Determination of dark matter halo mass from dynamics of satellite galaxies
    **Li, Z.-Z.**, Jing, Y.P., Qian, Y.-Z., Yuan, Z., and Zhao, D.-H., 2017, ApJ, 850, 116

**Collaboration papers**

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, arXiv:2407.11721
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.-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.-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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