Dr. Ling Zhu

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Shanghai Astronomical Observatory
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Personal information
Date of Birth: Oct. 12, 1986

Employment & Education

2018.09-	**Shanghai Astronomical observatory, China** Independent Research Group Leader
2013.09-2018.08	**Max Planck Institute for Astronomy, Germany** Post-doctoral Fellow
2008.09-2013.07	**Ph.D. in Astrophysics: Tsinghua University, China** Thesis title: galactic dynamics and structure
2010.09-2011.08	**Predoctoral fellow: Harvard-Smithsonian CFA, US**
2004.09-2008.07	**B.S. in Physics: Tsinghua University, China**

Research Interests

Extragalactic Archaeology: we uncover galaxies' 3D chemo-dynamical structures by applying a 'population-orbit' superposition model to data from IFU observations. We have applied the method to about 100 CALIFA galaxies, finding 'diverse origins of dynamical hot bulges', and applied it to Fornax galaxies observed by MUSE, uncovering the ancient mass mergers of nearby galaxies. Currently, we are deeply involved in a few MUSE projects like GECKOS and TIMER, trying to uncover the structure formation history of barred galaxies and identify a physically motivated bulge that may be more closely correlated with the black hole mass.
Dark matter distribution: We develop innovative dynamical methods to accurately measure dark matter distributions for all types of galaxies, using different types of observational data. Recently, we accurately measured the dark matter distribution of about 100 nearby galaxies by combining stellar kinematics from the MaNGA survey and HI spectra from FAST; using an innovative dynamical method with minimal assumptions that overcomes several limitations of earlier dynamical models, for the first time, we robustly determine the 3D shape of the dark matter halo out to 50 kpc by analyzing 6D position-velocity data of halo stars. We are extending the method to external galaxies for measuring the 3D dark matter distribution of a large number of dwarfs and nearby galaxies with the upcoming spectroscopic surveys, e.g., DESI, 4MOST, JUST, MUST, etc.

Funding

- 千人计划青年项目，2019年入选
- 面上基金：通过星族轨道叠加模型研究星系的形成历史, 2019-2023
- 中科院青年团队稳定支持项目：精确测量暗物质的分布, 2021-2026
- 马普伙伴合作小组，2022-2027

Supervision

I have built a research group with seven students, two post-docs, and an assistant researcher. Three of the students have graduated:

- Yuchen Ding, 2019-2024, PhD Thesis: environmental effects on the formation of dynamically cold disk, **Current status**: Pos-doc in Liverpool JM university, UK
- Behzad Tahmasebzadeh, 2018-2022, PhD Thesis: Orbit-superposition model of barred galaxies, **Current status**: Pos-doc in University of Michigan, US
- SunShun Yuan, 2019-2021, Master Thesis: Measuring dark matter distribution of M31 combing multiple tracers, **Current status**: work in industry

Academic achievements

- Referee astrophysical journals, incl. MNRAS, ApJ, Nature
- External reviewer of HST proposal (Cycle 28-30), JWST proposal (Cycle 4)

Organisation of international conferences

- The 12th Sino-German meeting: Galaxy Formation in the Cosmic Web: Bridging Simulations and Observations, Chengdou, China, 09/2025, 150 participants (co-chair)
- "Galaxy Transformation Across Space and Tim", Canberra, Australia, 08/2023, 120 participants (SOC)
- EAS 2023 SS20: "Reconstructing the Assembly History of Galaxies", krakow, Poland, 07/2020, 90 participants (co-chair)
- Dynamical Reconstruction of Galaxies, International Conference, Lorentz Center, Leiden, Netherlands, 17-21 February 2020, 55 participants (co-chair)

Selected talks

1. Invited Review Talk: review on kinematics and dynamics of massive galaxies, IAU Symposium (396) "Massive Galaxies across the Universe", Naples, Italy, 06/2025
2. Invited Talk: a Vertically Orientated Dark Matter Halo Marks a Flip of the Galactic Disk, SFB F68 "Tomography Across the Scales", Bad Ischl, Austria, 06/2025
3. Invited Colloquium: mapping dark matter distribution from the Mliky Way to nearby galaxies, Nanjing University, 05/2025
4. Invited Talk: dynamical models of nearby galaxies, GECKOS workshop, Liverpool, UK, 07/2024

5. Invited Colloquium: uncovering the assembly history of galaxies through population-orbit superposition modelling of IFU data, KIAA Peking university, 04/2024
6. Invited Colloquium: uncovering the assembly history of galaxies through population-orbit superposition modelling of IFU data, Yunnan university, 05/2024
7. Invited Talk: weighing and timing the ancient massive merger of nearby galaxies, Co-evolution of galactic eco-systems and their large-scale environments, Hangzhou, 04/2024
8. Contributed Talk: uncovering the assembly history of galaxies through population-orbit superposition model, "Resolving Galaxy Ecosystems Across All Scales", Hongkong, 01/2024
9. Contributed Talk: uncovering the assembly history of galaxies through population-orbit superposition model, "Galaxy Transformation Across Space and Time", Canberra, Australia, 08/2023
10. Invited talk: population-orbit superposition model to nearby galaxies, Dynamite workshop, Vienna, Austria, 12/2022

Selected publications

75 papers, 2000 citations, H index=30; 30 papers as first or corresponding author.
ADS library: https://ui.adsabs.harvard.edu/user/libraries/i5FgUorKTtK7-7fKMmQRUw

1. "*Uncover 3D Dark Matter Distribution of the Milky Way by an Empirical Triaxial Orbit-Superposition Model: Method Validation*" **ZHU, L**, et al, 2025, *A&A*, submitted
2. "*Distinguishing the formation paths of massive compact early-type galaxies through their internal dynamical structures*" **ZHU, L**, et al, 2025, *A&A*, 698, 195
3. "*Recovering the pattern speeds of edge-on barred galaxies via an orbit-superposition method*" Jin, Y, **ZHU, L**, et al, 2025, *A&A*, submitted
4. "*Schwarzschild modelling of barred s0 galaxy NGC 4371*" Tahmasebzadeh, B, **ZHU, L**, et al, 2024, *MNRAS*, 534, 861
5. "*The effects of environment on galaxies' dynamical structures: From simulations to observations*" Ding, Y, **ZHU, L**, et al, 2024, *A&A*, 686, 184
6. "*Dark matter measurements combining stellar and HI kinematics: 30 per cent* 1σ *outliers with low dark matter content at* $5R_e$" Yang,M, **ZHU, L**, et al, 2024, *MNRAS*, 528, 5295
7. "*Quantifying the stellar ages of dynamically separated bulges and disks of CALIFA spiral galaxies*" Jin,Y, **ZHU, L**, et al, 2024, *A&A*, 681, 95
8. "*The Fornax3D project: Environmental effects on the assembly of dynamically cold disks in Fornax cluster galaxies*" Ding,Y, **ZHU, L**, et al, 2023, *A&A*, 672, 84
9. "*Orbit-superposition Dynamical Modeling of Barred Galaxies*" Tahmasebzadeh, B, **ZHU, L**, et al, 2022, *ApJ*, 941, 109

10. "*The Fornax3D project: Discovery of ancient massive merger events in the Fornax cluster galaxies NGC 1380 and NGC 1427*" **ZHU, L**, et al, 2022, *A&A*, 664, 115

11. "*Mass of the dynamically hot inner stellar halo predicts the ancient accreted stellar mass*" **ZHU, L**, et al, 2022, *A&A*, 660, 20

12. "*Disentangling the formation history of galaxies via population-orbit superposition: method validation*" **ZHU, L**, et al, 2020, *MNRAS*, 496, 1579

13. "*A discrete chemo-dynamical model of M87's globular clusters: Kinematics extending to 400 kpc*" Li, C, **ZHU, L**, et al, 2020, *MNRAS*, 492, 2775

14. "*Mapping the dark matter halo of early-type galaxy NGC 2974 through orbit-based models with combined stellar and cold gas kinematics*" Yang, M, **ZHU, L**, et al, 2020, *MNRAS*, 492, 4221

15. "*The stellar orbit distribution of present-day galaxies*" **ZHU, L.**, van de Ven, G, van den Bosch, R, et al, 2018, *Nature Astronomy*, 2, 233