Zehao Jin 金泽灏

Fudan Center for Astronomy and Astrophysics, Fudan University, Shanghai, China
zehaojin@fudan.edu.cn | Website | GitHub | ORCID

Research Profile

My research combines causal discovery and interpretable machine learning with astrophysical observations and simulations, with a focus on black hole–galaxy coevolution.

Academic Appointments

Postdoctoral Fellow, Fudan University 2025–present
Fudan Center for Astronomy and Astrophysics (CfAA) Postdoctoral Fellowship.
Supervisor: Prof. Feng Yuan.

Education

Ph.D. in Physics, New York University Abu Dhabi 2020–2025
Advisors: Prof. Andrea Valerio Macciò and Prof. Joseph Gelfand.

B.S. in Physics, University of Illinois Urbana-Champaign 2015–2019
Astronomy and Mathematics minors. Advisor: Prof. Gilbert Holder.

Publications

★ Highlighted paper; ∗ equal contribution; † corresponding author.

Journal Articles

[1] ★ **Causes of Hot Jupiter Inflation from Causal Discovery**
Z. Jin†, M. Ali-Dib, Y. Zheng, M. Pasquato, B. L. Davis, A. V. Macciò. *AJ* **172**, 208 (2026).

[2] ★ **Causal Reversal in the $M_\bullet - \sigma_0$ Relation: Implications for High-redshift Supermassive Black Hole Mass Estimates**
B. L. Davis, S. More, **Z. Jin**†, M. Pasquato, A. V. Macciò, F. Yuan. *ApJ* **1000**, 100 (2026).

[3] **Bridging simulations and observations: New insights into galaxy formation simulations via out-of-distribution detection and Bayesian model comparison**
L. Zhou†, S. T. Radev, W. H. Oliver, A. Obreja, **Z. Jin**, T. Buck. *A&A* **701**, A44 (2025).

[4] ★ **Causal evidence for the primordiality of colours in trans-Neptunian objects**
B. L. Davis*†, M. Ali-Dib*, Y. Zheng*, **Z. Jin***, K. Zhang, A. V. Macciò. *MNRAS Letters* **543**, L34–L42 (2025).

[5] **ZTF IC 10 Variable Catalog**
Z. Jin†, J. D. Gelfand. *ApJS* **278**, 31 (2025).

[6] ★ **Causal Discovery in Astrophysics: Unraveling Supermassive Black Hole and Galaxy Coevolution**
Z. Jin†, M. Pasquato*, B. L. Davis*, T. Deleu, Y. Luo, C. Cho, P. Lemos, L. Perreault-Levasseur, Y. Bengio, X. Kang, A. V. Macciò, Y. Hezaveh. *ApJ* **979**, 212 (2025).

[7] **Identification of Intermediate-mass Black Hole Candidates among a Sample of Sd Galaxies**
B. L. Davis†, A. W. Graham, R. Soria, **Z. Jin**, I. D. Karachentsev, V. E. Karachentseva, E. D'Onghia. *ApJ* **971**, 123 (2024).

[8] **HELLO project: high-z evolution of large and luminous objects**
S. Waterval†, A. V. Macciò, T. Buck, A. Obreja, C. Cho, **Z. Jin**, B. L. Davis, K. L. Dixon, X. Kang. *MNRAS* **533**, 1463–1484 (2024).

[9] **Quantitatively rating galaxy simulations against real observations with anomaly detection**
Z. Jin†, A. V. Macciò, N. Faucher, M. Pasquato, T. Buck, K. L. Dixon, N. Arora, M. Blank, P. Vulanovic. *MNRAS* **529**, 3536–3549 (2024).

[10] **Discovery of a Planar Black Hole Mass Scaling Relation for Spiral Galaxies**
B. L. Davis†, **Z. Jin**. *ApJL* **956**, L22 (2023).

Machine Learning Conference and Workshop Papers

[11] ★ **Causal Discovery of Latent Variables in Galactic Archaeology**
Z. Jin[*†], Y. Lu[*], Y.-S. Ting, Y. Zheng, T. Buck. ICML Machine Learning for Astrophysics Workshop (2025); arXiv:2507.00134.

[12] **Beyond Causal Discovery for Astronomy: Learning Meaningful Representations with Independent Component Analysis**
Z. Jin[†], M. Pasquato, B. L. Davis, A. V. Macciò, Y. Hezaveh. NeurIPS Causal Representation Learning Workshop (2024); arXiv:2410.14775.

[13] **Causa prima: cosmology meets causal discovery for the first time**
M. Pasquato[†], **Z. Jin**, P. Lemos, B. L. Davis, A. V. Macciò. NeurIPS Machine Learning and the Physical Sciences Workshop (2023); arXiv:2311.15160.

[14] **Discovering Black Hole Mass Scaling Relations with Symbolic Regression**
Z. Jin[†], B. L. Davis. NeurIPS Machine Learning and the Physical Sciences Workshop (2023); arXiv:2310.19406.

[15] **Learning the Principle of Least Action with Reinforcement Learning**
Z. Jin[*†], J. Y. Y. Lin[*], S. F. Li. AAAI Spring Symposium on Combining Artificial Intelligence and Machine Learning with Physical Sciences (2021); *CEUR Workshop Proceedings* **2964**, extended abstract.

Submitted Manuscript

[16] ★ **Causal Discovery Reveals Latent Structure in Galactic Chemodynamics**
Z. Jin, Y. Lu, Y.-S. Ting, Y. Zheng, T. Buck. Submitted to *ApJ*, October 2026; extends the 2025 galactic-archaeology workshop study.

Talks and Presentations

Jul 2026	Second Annual Cosmic Horizons Conference, Charlottesville, USA. *Contributed talk*
Jul 2026	KIAA, Peking University, Beijing, China. *Seminar*
Jun 2026	Nanjing University, Nanjing, China. *Seminar*
May 2026	Shanghai Normal University, Shanghai, China. *Seminar*
May 2026	Annual Shanghai Astronomical Society Meeting, Shanghai, China. *Contributed talk*
Dec 2025	3rd Conference on Galaxy and AGN Coevolution, Nanjing, China. *Contributed talk*
Oct 2025	Shanghai Astronomical Observatory, Shanghai, China. *Seminar*
Oct 2025	3rd Conference of Machine Learning and AI Applications in Astronomy, Yichang, China. *Contributed talk*
Jan 2025	245th American Astronomical Society Meeting, Washington, DC, USA. *Dissertation talk*
Dec 2024	NeurIPS Causal Representation Learning Workshop, Vancouver, Canada. *Poster*
Dec 2023	NeurIPS Machine Learning and the Physical Sciences Workshop, New Orleans, USA. *Poster*
Oct 2023	Astroinformatics, INAF Observatory of Capodimonte, Naples, Italy. *Contributed talk*
Aug 2023	CZS Summer School, IWR, Heidelberg, Germany. *Poster*
May 2023	Cosmic Connections Symposium, Flatiron Institute, New York, USA. *Poster*
Jun 2021	UAE Graduate Student Research Conference, online. *Contributed talk*
Mar 2021	AAAI Spring Symposium on Combining Artificial Intelligence and Machine Learning with Physical Sciences, online. *Contributed talk*

Research Visits and Academic Service

Visiting Student, Ciela Institute, Université de Montréal Feb–Mar 2024
Montréal, Canada.

Local Organizing Committee, Timescales in Astrophysics Jan 2023
New York University Abu Dhabi, UAE.

References

Prof. Andrea Valerio Macciò New York University Abu Dhabi; Ph.D. advisor.
maccio@nyu.edu

Prof. Feng Yuan Fudan University; postdoctoral supervisor.
fyuan@fudan.edu.cn

Prof. Benjamin Lee Davis Missouri State University; close collaborator.
ben.davis@nyu.edu