Jiaru Li

Center for Interdisciplinary Exploration and Research in Astrophysics

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Research Interests

My research combines analytical theory and numerical simulations to study planetary dynamics, disk–planet interactions, hydrodynamics of protoplanetary disks, and gravitational-wave sources in AGN disks.

Education

Cornell University, Ithaca, NY, USA *Sept. 2017 - May 2023*

- **Ph.D.** in Astronomy and Space Sciences, May 2023
  - **Advisor:** Prof. Dong Lai
  - **Thesis:** Dynamical Evolution of Multi-Orbiter Systems: Application to Planets, Protoplanetary Disks, and Black Holes
- **M.S.** in Astronomy, Dec 2019

University of Toronto at Scarborough, Toronto, ON, Canada *Sept. 2013 - May 2017*

- **Honours B.Sc.** in Physics (Specialist) and Mathematics (Major), May 2017

Experience

CIERA Postdoctoral Fellow *2023 - present*
Center for Interdisciplinary Exploration and Research in Astrophysics, Northwestern University
Supervisor: Prof. Yoram Lithwick

Graduate Research Assistant *2017 - 2023*
Department of Astronomy and Space Sciences, Cornell University
Advisor: Prof. Dong Lai

CSES Graduate Student Fellow *2020 - 2022*
Theoretical Division, Los Alamos National Laboratory
Mentor: Dr. Hui Li

UTEA Undergraduate Research Assistant *2015 - 2017*
Department of Physical and Environmental Sciences, University of Toronto at Scarborough
Supervisor: Prof. Artur Izmaylov

Selected Honors and Awards

CIERA Postdoctoral Fellowship, Northwestern University *2023*
Competitive postdoctoral fellowship supporting independent research at CIERA.

CSES Student Fellowship, Los Alamos National Laboratory (LANL) *2020*
Graduate fellowship supporting research collaborations with scientists in LANL's Theoretical Division.

New Graduate Student Fellowship, Cornell University *2017*
University fellowship providing one year of funding for outstanding incoming graduate students.

Governor General's Silver Medal Nomination, University of Toronto *2017*
Nominated by the Scarborough campus as the graduating student with the highest academic standing.

Samuel Beatty In-Course Scholarship, University of Toronto *2017*
Awarded to top students in Mathematics, Physics, Statistics, or Computer Science based on academic excellence.

University of Toronto Excellence Award *2016*
Supports exceptional undergraduates to perform faculty-supervised research projects.

E-Fund Scholarship, University of Toronto at Scarborough *2013 - 2016*
Merit-based scholarship for Chinese students in the Green Path program with outstanding academic achievement.

Vincent Bladen Scholarship, University of Toronto at Scarborough *2015*
Awarded to two students per year for exceptional academic achievement.

A. D. Allen Memorial Scholarship, University of Toronto at Scarborough *2014*
Awarded to the most outstanding student of the year across all fields of study.

Selected Mentorship and Teaching Experience

Students Mentored:

Jesse Richter, undergraduate student at Northwestern University *2024 - 2025*

Dieran Wang, former undergraduate student at Shandong University, now Ph.D. student at Shanghai Jiao Tong University *2024 - 2025*

Kecheng Qian, former undergraduate student at Cornell University, now Ph.D. student at University of California, Berkeley *2023 - 2024*

Teaching Experience:

Teaching Assistant, Cornell University and University of Toronto *2016 - 2019*
Courses: *Our Solar System*, *From New Worlds to Black Holes*, *Calculus I & II*, *Physics I & II*, *Linear Algebra II*, and *Discrete Mathematics*

Selected Presentations

Invited Talks

- 12/2025 - **Conference:** International Conference on Exoplanets and Planet Formation, Shanghai, China
- 10/2024 - **Seminar:** Theoretical Astrophysics Center Seminar, University of California, Berkeley
- 10/2024 - **Conference:** Transient Phenomena and Physical Processes Around Supermassive Black Holes, Tsung-Dao Lee Institute, China
- 09/2024 - **Seminar:** Department of Astronomy Tea Talk, Indiana University Bloomington
- 08/2024 - **Conference:** New Ideas on the Origin of Black Hole Mergers, Niels Bohr Institute, Denmark
- 03/2024 - **Seminar:** Center for Theory and Computation Seminar, University of Maryland
- 01/2024 - **Seminar:** ET Science Seminar, Shanghai Astronomical Observatory, Chinese Academy of Sciences, China
- 03/2023 - **Conference:** AGN Santa Fe: "Where are the Objects in AGN Disks", Santa Fe, NM
- 11/2022 - **Seminar:** Center for Exoplanets and Habitable Worlds Seminar, Penn State University
- 10/2022 - **Seminar:** Center for Relativistic Astrophysics Seminar, Georgia Tech

Other Recent Talks

- 05/2025 - **Conference:** The 56th AAS Division on Dynamical Astronomy Meeting, Georgia Tech
- 12/2023 - **Conference:** Exoplanets and Planet Formation Workshop, Beijing, China
- 12/2023 - **Conference:** The 32nd Texas Symposium on Relativistic Astrophysics, Shanghai, China
- 10/2022 - **Workshop:** Recent Advances in Supermassive Black Holes, Cornell University
- 08/2022 - **Seminar:** Astrophysics Seminar, Los Alamos National Laboratory
- 05/2021 - **Conference:** Distorted Astrophysical Discs, Kavli Institute for Cosmology, Cambridge, UK

Selected Service

Reviewer (2023–present) — Astrophysical Journal Letters, MNRAS, Astronomy & Astrophysics.
Panelist reviewer (2024) — NASA research program proposals.
Organizer (2024-2025) — CIERA main Journal Club series, CIERA summer arXiv coffee.
SOC member (2025) — CIERA Fellows at 15 conference.

List of Publications

Full list available on ADS. Astronomy papers (published + submitted or in prep): 13+3; non-astronomy papers: 3; with 363 citations as of October 2025.

First-Author and Mentored Papers (*indicates students supervised by J.L.)

- **Li** & Lithwick, *Steady Warps: Linear, Nonlinear, and Breaking*, 2025, in preparation
- **Li**, O'Connor, & Rasio, *Intruder Alert: Breaking resonant chains with planetesimal flybys*, 2025, submitted to ApJL
- Wang*, **Li**, & Lai, *Spin and Obliquity Distributions of Low-mass Planets Shaped by Dynamical Instability*, 2025, submitted to ApJ
- **Li**, Rodet, & Lai, *Dynamical instability in multi-orbiter systems with gas friction*, 2024, MNRAS, 528, 1198
- Qian*, **Li**, & Lai, *Dynamical Friction Models for Black Hole Binary Formation in Active Galactic Nucleus Disks*, 2024, ApJ, 962, 143
- **Li** & Lai, *Resonant Excitation of Planetary Eccentricity due to a Dispersing Eccentric Protoplanetary Disk: A New Mechanism of Generating Large Planetary Eccentricities*, 2023, ApJ, 956, 17
- **Li**, Dempsey, Li, Lai, & Li, *Hydrodynamical Simulations of Black Hole Binary Formation in AGN Disks*, 2023, ApJL, 944, L42
- **Li**, Lai, & Rodet, *Long-term Evolution of Tightly Packed Stellar Black Holes in AGN Disks: Formation of Merging Black Hole Binaries via Close Encounters*, 2022, ApJ, 934, 154
- **Li**, Dempsey, Li, & Li, *Ring Formation in Protoplanetary Disks Driven by an Eccentric Instability*, 2021, ApJ, 910, 79
- **Li**, Lai, Anderson, & Pu, *Giant planet scatterings and collisions: hydrodynamics, merger-ejection branching ratio, and properties of the remnants*, 2021, MNRAS, 501, 1621
- **Li** & Lai, *Planetary Spin and Obliquity from Mergers*, 2020, ApJL, 898, L20

Other Astrophysics Papers

- Li, Dempsey, Li, Li, & **Li**, *Hot Circumsingle Disks Drive Binary Black Hole Mergers in Active Galactic Nucleus Disks*, 2022, ApJL, 928, L19
- Li, Dempsey, Li, Li, & **Li**, *Orbital Evolution of Binary Black Holes in Active Galactic Nucleus Disks: A Disk Channel for Binary Black Hole Mergers?*, 2021, ApJ, 911, 124

Non-astrophysics Papers (Computer sciences and chemical physics)

- Zhao, Zhang, **Li**, Niu, Hu, Min, & Penn, *Tiny Budgets, Big Gains: Parameter Placement Strategy in Parameter Super-Efficient Fine-Tuning*, 2025, Empirical Methods in Natural Language Processing (EMNLP)
- **Li**, Joubert-Doriol, & Izmaylov, *Geometric phase effects in excited state dynamics through a conical intersection in large molecules: N-dimensional linear vibronic coupling model study*, 2017, The Journal of Chemical Physics, 147, 064106
- Izmaylov, **Li**, & Joubert-Doriol, *Diabatic Definition of Geometric Phase Effects*, 2016, Journal of Chemical Theory and Computation, 12, 5278-5283