Kai **Wu**

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Education

University of Liverpool, UK 2019 – 2024

PhD in Mathematical Sciences

*__Full-scholarship PhD__ student in Department of Mathematical Sciences, School of Physical Sciences, Liverpool; off-site at XJTLU

Supervisor: Prof. M. B. N. Kouwenhoven (link)

Nankai University, China 2015 – 2019

Bachelor of Science in Physics (Boling Program*)

*Boling Program is part of the Everest Plan of the Chinese Ministry of Education. The **top 10%** of students are enrolled in.

Cumulative GPA: 85.3/100

Professional Experience

Heidelberg University, Germany 2024 – Dec. 2026

Postdoc in Astronomisches Rechen-Institut, Zentrum für Astronomie (ARI-ZAH)

Work with apl. Prof. Rainer Spurzem (link)

Publications

ORCID https://orcid.org/0000-0003-0349-0079 | https://scholar.google.com/citations?user=zspJ42IAAAAJ

[1] **Kai Wu**, Francesco Flammini Dotti, Marcelo C. Vergara, Vahid Amiri, and Rainer Spurzem, "DRAGON-III simulation - I. Multi-messenger observations in the computer and comparison with observed astrophysical objects", in prep

[2] **Kai Wu,** M. B. N. Kouwenhoven, Rainer Spurzem, and Francesco Flammini Dotti, "Linking the survivability of planets in star clusters with the orbits of their host stars", in prep

[3] **Kai Wu,** Ataru Tanikawa, Francesco Flammini Dotti, Marcelo C. Vergara, Boyuan Liu, Albrecht W. H. Kamlah, Manuel Arca Sedda, Nadine Neumayer, and Rainer Spurzem, "Direct N-body simulations of rotating and extremely massive Population III star clusters", accepted in A&A, in press

[4] **Kai Wu**, Philip Cho, Rainer Spurzem, Long Wang, Francesco Flammini Dotti, and Vahid Amiri, "DRAGON-III simulations: modelling million-body globular and nuclear star clusters over cosmic time", accepted in Proceedings IAU Symposium 398

[5] Francesco Flammini Dotti, M. B. N. Kouwenhoven, **Kai Wu**, Abbas Askar, Peter Berczik, Mirek Giersz, Rainer Spurzem, and Ian Dobbs-Dixon, "Dynamical evolution of massless particles in star clusters with NBODY6++GPU-MASSLESS: II. The long-term evolution of free-floating comets", Astronomy and Astrophysics, 2026 706 A219. doi:10.1051/0004-6361/202557334

[6] Guimei Liu, Yu Zhang, Jing Zhong, Li Chen, Xiangcun Meng, and **Kai Wu**, "Formation and evolution of new primordial open cluster groups: Feedback-driven star formation", Astronomy and Astrophysics, 2025 696 A117. doi:10.1051/0004-6361/202452774

[7] Songmei Qin, Jing Zhong, Tong Tang, Yueyue Jiang, Long Wang, **Kai Wu**, Friedrich Anders, Lola Balaguer-Núñez, Guimei Liu, Chunyan Li, Jinliang Hou, and Li Chen, "Unveiling the binary nature of NGC 2323", Astronomy and Astrophysics, 2025 693 A317. doi:10.1051/0004-6361/202452962

[8] **Kai Wu**, M. B. N. Kouwenhoven, Rainer Spurzem, and Francesco Flammini Dotti, "Influence of planets on debris discs in star clusters - II. The impact of stellar densities", Monthly Notices of the Royal Astronomical Society, 2024 533(4). doi:10.1093/mnras/stae2067

[9] **Kai Wu**, M. B. N. Kouwenhoven, Rainer Spurzem, and Xiaoying Pang, "Influence of planets on debris discs in star clusters - I. The 50 au Jupiter", Monthly Notices of the Royal Astronomical Society, 2023, 523(4). doi:10.1093/mnras/stad1673

[10] Kouwenhoven et al. incl. **Wu**, "Planetary systems in dense stellar environments", Journal of Physics Conference Series, 2020, 1523(1): 012011. doi:10.1088/1742-6596/1523/1/012011

Honors & Awards

¥500 **Excellent Teaching Assistant Award (top 2%)**, 2022-2023, XJTLU 2023

¥1000	**Best Oral Presentation Award (top 5%)**, 2022 XJTLU Postgraduate Research Symposium	2022
¥500	**Best Poster Award (top 5%)**, 2021 XJTLU Postgraduate Research Symposium	2021
¥5000/month	**Full-scholarship PhD (top 20%)** of XJTLU, monthly stipend and tuition fee waiver	2019 – 2023
	Excellent graduation thesis (top 3%), Nankai University	2019
¥1000	**Boling Scholarship (top 10%)**, Nankai University	2017
¥2000	**Second-class Scholarship (top 8%)**, Nankai University	2016
¥1000	**Boling Scholarship (top 10%)**, Nankai University	2016
	Second Prize (top 10%), Nankai Physicists' Tournament	2016
¥1000	**Boling Scholarship (top 10%)**, Nankai University	2015

Professional Skills

Programming in research context

- **Python** for 10 years, especially in
  - **SciPy** for interpolation, optimization, and statistics
  - **NumPy** and **Pandas** for efficient big data evaluation and process
  - **Matplotlib**, **Seaborn**, and **Plotly** for data visualization in 2D / 3D
  - **Multiprocessing** for parallel computing
- **Linux** for 6 years, with rich experience in bash and docker
- **C/C++** and **Fortran** for 5 years in high-performance scientific programming
  - Manually wrote 500+ lines, 2 files Fortran routines for NBODY6++GPU to implement planetary system evolution
  - Manually wrote 1000+ lines, 2 files C/C++ routines to manage REBOUND simulations with high-performance
- LaTeX for 5 years for efficient typesetting

AI application in computational astrophysics and software engineering

- Use **AI-assisted coding tools** (GitHub Copilot, Claude Code, Codex) to speed development, refactor code, and generate tests. Consume 300+ premium requests per month.
- Extensive use of **SOTA AI practices**: rag or agentic search, skills, MCP, cloud-based agent

Supercomputing and big data experience

- **4-year experience in using supercomputers** for research, for benchmarking and platform-wise optimization in terms of
- **30+ Terabytes big data** analysis in DRAGON-II astrophysics simulation
- Experience in **different HPC architectures**: experience in JUWELS supercomputer in Jülich (NVIDIA GPU using CUDA), LUMI supercomputer in Finland (Cray CCE + AMD GPU using HIP), Chinese Dongfang cluster (pure Chinese hardware, Chinese GPU using HIP), Silkroad servers in the National Astronomical Observatory of China (NVIDIA), Kepler cluster in Heidelberg (NVIDIA)

Leadership | Project management of open-source code

- 3 years as **code administrator** of star cluster simulator repository https://github.com/nbody6ppgpu
- Brought **version control** and **CI/CD** auto test workflows to the historical code since 2022
- Manage pull requests and issues; write detailed **documentation**. Support both developer and user teams.
- The code consists of 80000+ lines of hybrid FORTRAN / C++ × 3+ branches × 160+ commits.
- The well-known astronomy NBODYX code family has led to 18000+ journal publications in total, and this state-of-the-art version NBODY6++GPU has 167+ citations within 7 years.

Mastery of star cluster and planetary system numerical n-body simulations

- **NBODY6++GPU** for 6 years to simulate star clusters https://github.com/nbody6ppgpu
- **PeTar** for 2 years to simulate star clusters with large binary fraction https://github.com/lwang-astro/PeTar
- **REBOUND** for 4 years to simulate planetary systems with planets, comets, and disks https://github.com/hannorein/rebound
- **MERCURY** (Chambers 1999) for 2 years to simulate multi-planetary systems

Communication skills with written and spoken English

- **Verbal**: confident communicator with empathy, encouragement, positive attitude, and active listening
  - Gave 150+ hour lectures and training, 40+ academic speeches in spoken English, with excellent feedback
- **Written**: clear & informative writing
  - Sent 2500+ emails in English. Rich experience in Slack, Notion, and Trello for collaboration. Welcomed by peers.

Teaching Experience

Qualification: Associate Fellowship in **the Higher Education Academy, Advance HE** (link) 2024

- Teaching qualification that meets the **UK Professional Standards Framework** (link)

International High School Course | Part-Time Lecturer @ Suzhou Research Institute of Xi'an Jiaotong Univ. Jan. – July 2022

- 105-hour lecture in IB calculus (Preparatory Program of International Elites) (link to course, archive.org) (link to profile, archive.org)

Bilingual Undergraduate Course | Teaching Assistant @ XJTLU 2019 – 2023

- Highlight: **Best Teaching Assistant Award** 2023 of School of Mathematics and Physics, XJTLU
- Modules: PHY002/004 Physics Experiment; MTH019 Calculus, MTH107 Advanced Linear Algebra; MTH205 Statistical Methods
- 20-hour lecture for 6 physics lab classes in English
- Invigilated 70 hours in total for 23 exams
- Marked 2200+ lab reports, exam papers, and homework

Doctoral Courses | Invited Lectures @ Shanghai Astronomical Observatory (SHAO-CAS) Aug. 2023

- 30-hour course "N-body lecture: simulate star clusters with NBODY6++GPU"
- Invited by Prof. Li Chen and Prof. Jing Zhong to teach PhD students

Postdoctoral Professional Training | Invited Tutorial @ Rainer Spurzem's international seminar Apr. 2022

- 4-hour lecture on using Git and GitHub for NBODY6++GPU management and collaboration, invited by R. Spurzem
- Highlight: Prof. Spurzem shows the recording & slides on his homepage (https://wwwstaff.ari.uni-heidelberg.de/spurzem/#teaching, archive.org)

Invited Talks/Seminars

Invited talk @ **Chen Xian's group meeting in KIAA-PKU** "Dynamics of debris disks in star clusters" July 2023

Invited talk @ **Shanghai Astronomical Observatory** "An in-depth introduction to numerical cluster simulation" July 2023

Invited talk @ School of Mathematics and Physics, **XJTLU** "New invigilator training: on-site invigilation" Apr. 2023

Invited lecture @ **Rainer Spurzem's group meeting**, "Use Git & GitHub for NBODY6++GPU collaboration" Apr. 2022

Rainer Spurzem's group meeting (link) "Influence of planets on debris disks in star clusters I: the 50 au Jupiter" Mar. 2023

Conference Talks

Annual Meeting of the German Astronomical Society 2025 (link) in Goerlitz, Germany, "DRAGON-III simulation: modelling million-body globular and nuclear star clusters over cosmic time" + "Dynamical stability of debris discs with planets in star clusters" (two talks) Sept 2025

European Astronomical Society Annual Meeting 2025 (link) in Cork, Ireland, "Dynamical stability of debris discs with planets in star clusters" June 2025

IAU Symposium 398 & MODEST-25: Compact Objects and Binaries in Dense Stellar Systems (link) in Seoul, Korea , "DRAGON-III simulation: modelling million-body globular and nuclear star clusters over cosmic time" June 2025

Gas Accretion in Planet formation (link) in MPIA, Germany "The role of star clusters in shaping protoplanetary disks & Evolution of debris disks in star clusters" Mar. 2025

12th Kazakhstan-China-Korea (KCK12) Workshop (link) in Astana, Kazakhstan, "Dynamical stability of debris disks with planets in star clusters" May 2024

SPP 1992 Final Colloquium (link) in Berlin, Germany, "Dynamical Evolution of Planetary Systems in Star Clusters" Mar. 2024

Star Cluster Workshop: From Observations to Simulations in Suzhou, China, "Dynamical stability of debris disks in star clusters and linking open cluster fundamental plane evolution with CSST observation" Oct. 2023

2023 Annual Meeting of the Chinese Astronomical Society (link) in Weihai, China, "Influence of star cluster environments on planetary systems: the debris disks" Aug. 2023

Structure, Formation and Evolution of Star Clusters (link) in Sun Yat-sen University, China, "Influence of star cluster environments on planetary systems" June 2023

5th Young Scientist Forum of Planetary Science (link) in Sanya, China, "Influence of planets on debris disks in star clusters I: the 50 au Jupiter" Mar. 2023

PFE-SPP 1992 joint meeting 2022 (link) online, "Influence of planets on planetary debris particles in star clusters" Sept. 2022

10th Kazakhstan-China-Korea (KCK10) Workshop on Stellar Dynamics (link) in Suzhou, China, "Does the Giant Impact Phase exist?" Dec 2018

Professional Activities

Reviewer of peer-reviewed journal, Astronomy & Astrophysics (IF: 6.1) 2026 – present
Reviewer of peer-reviewed journal, Planetary and space science (IF: 2.0) 2025 – present
Member, Silk Road Project (link) 2019 – present
Member, European Cooperation in Science & Technology (COST) Action CA22133 (link) "the birth of solar systems" 2023 - present

Academic Visits

National Astronomical Observatory of China & KIAA at Peking Univ. as a visitor of Dr. Shuo Li and Prof. Spurzem. June 2025
Frankfurt Institute for Advanced Studies, Germany as a visitor of director Prof. Dr. Volker Lindenstruth (newsletter link) Jan 2025
National Astronomical Observatory of China & KIAA at Peking Univ. as a visitor of Dr. Shuo Li and Prof. Spurzem. Dec 2024
Universität Heidelberg, Germany as a guest researcher of Prof. Rainer Spurzem, funded by DFG-SPP1992 Mar. – Apr. 2024
National Astronomical Observatory of China as a visiting scholar of Prof. Rainer Spurzem, funded by XJTLU Dec. 2019
CITA, University of Toronto as a visiting student of Prof. Yanqin Wu, funded by Nankai Univ. July – Oct. 2018
STScI, JHU as a visiting student of Prof. Christine Chen, funded by Nankai Univ. June – Sept. 2017
Purple Mountain Observatory as a visiting student of researcher Hongchi Wang, funded by Nankai Univ. May 2016
National University of Singapore and **Nanyang Technology University**, funded by Nankai Univ. Feb. 2016