Shurui Zhang

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Research Interests

My research interests are on AGNs and compact objects via multi-messenger approaches.

- Modeling compact objects (BHs, NSs, WDs) in AGN disks: investigating the roles and fates of compact objects in galactic nuclei, and predicting/interpreting the associated multi-messenger signals.
- Theoretical physics of black holes (BHs): unveiling the mechanisms of energy supply and transfer in extreme environments, and exploring new physical processes around/in BHs.
- Investigating special transients and peculiar objects, including GRBs and the lightest neutron stars.

Employment History

2025.12 – present **Postdoc Fellow**, International Center for Relativistic Astrophysics Network.

Education

2016. 09 – 2020. 07 **B.Sc. in Basic Science of Mathematics and Physics (National Elite Program in Mathematics and Physics), Yunnan University**.

2020. 09 – 2025. 12 **M.Sc. & Ph.D. in Astrophysics, University of Science and Technology of China (USTC)**.
Thesis title: *Accretion and dynamics of compact objects in AGN disks.* *(PDF link)*

2022. 12 – 2023. 12 **Visiting Ph.D., International Center for Relativistic Astrophysics Network**.
Conducted through the *Joint International Relativistic Astrophysics Doctorate Program*.

2023. 12 – 2024. 12 **Joint Ph.D. in Astrophysics, University of Ferrara, Italy**.

Skills

Languages Strong reading, writing and speaking competencies for English, Chinese (native)

Coding Mathematic, Python, Linux Shell, LaTeX, …

Basic Knowledge General Relativity, Radiation Mechanisms, Physics of AGN, Physics of Compact Object, Stellar Structure and Evolution, Probability and AI,…

Techniques

- Proficient in accretion modeling of compact objects
- Proficient in radiative transfer
- Proficient in neutrino energy spectrum calculations
- Proficient in particle trajectories in Kerr and Kerr–Newman spacetimes
- Proficient in the Penrose process
- Specialized in post-Newtonian methods for binary compact objects
- Specialized in semi-analytic modeling for the formation and co-evolution of galaxies and BHs
- Specialized in ray-tracing methods
- Familiar with machine learning techniques
- Familiar with GW and high-energy EM data analysis
- Familiar with N-body simulation
- Familiar with star evolution code MESA

Service

Teaching Assistant	Served as teaching assistant for the courses *General Relativity* and *Celestial Mechanics and Astrometry*	Spring 2022, Spring 2025
Reviewer	Reviewer for The Astrophysical Journal (ApJ)	Spring 2024
Popular Science	Wrote a popular science article on compact objects in AGN disks	Jan. 2024
Collaboration	Facilitated and coordinated scientific collaboration between Italy and China.	

Selected Conference and Report

- 2023. 04 The Second International NIP Conference in Academy of Sciences of Albania.
  Roport title: *The transformation of the rotational energy of a Kerr BH*.
- 2023. 06 The 5th Zeldovich meeting in ARMENIA.
  Roport title: *The transformation of the rotational energy of a Kerr BH*.
- 2024. 02 Looking AHEAD to Soft Gamma-Ray Astrophysics: Prospects and Challenges.
  Roport title: *Electromagnetic Signatures of White Dwarf Collisions in AGN Discs*.
- 2024. 04 **Plenary speaker**, at the 6th Galileo - Xu Guangqi Meeting.
  Roport title: *The transformation of the rotational energy of a Kerr BH*.
- 2024. 07 **Plenary speaker**, at the 17th Marcel Grossmann Meeting.
  Roport title: *The lightest neutron star formed from a binary system*.
- 2025. 04 The Annual Meeting of the Division of Gravitation and Relativistic Astrophysics of the Chinese Physical Society.
  Roport title: *Neutron star accretion events in AGN disks: multi-messenger implications*.
- 2025. 05 The 3rd Workshop on "Astrophysical Phenomena of AMS in AGN Disks".
  Roport title: *S241125n: Binary BH Merger Produces Short GRB in AGN Disk*.
- 2025. 11 The Annual Meeting of the Chinese Astronomical Society.
  Roport title: *Probe the Role of Compact Objects in AGN Disks Through Multi-messenger Approaches*.
- **The excellent prize of oral presentation**, at the Annual Meeting for Postgraduate Students of the University of Science and Technology of China.
  Roport title: *Accretion and dynamics of compact objects in AGN disks: multi-messenger implications*.
- 2025. 12 Report at Peking University.
  Roport title: *NS Accretion in AGN Disks: Multi-messenger Implications*.

Press (in English)

- 2024. 05 What Can AI Learn About the Universe? **Universe Today**.
- 2025. 03 New Study Sheds Light on the Penrose Process and Energy Extraction from Kerr Black Holes, **ICRANet press releases**.

Selected Fellowship and Honor

Fellowship

- 2022 **CSC scholarship**, a scholarship from the China Scholarship Council (CSC) to pursue studies in Italy as a Joint PhD Student for 24 months.

Selected Fellowship and Honor (continued)

Awards

2025
- **National Scholarship**. Granted by the Chinese government to outstanding doctoral students within the top 3%.
- **Outstanding Graduate**. Awarded by University of Science and Technology of China.

Research Publications

Journal Articles

1. **S. R. Zhang**, Y. Luo, X.-J. Wu, J.-M. Wang, L. C. Ho, and Y.-F. Yuan, "Electromagnetic signatures of white dwarf collisions in AGN discs," *MNRAS*, vol. 524, no. 1, pp. 940–951, Sep. 2023. DOI: 10.1093/mnras/stad1855.
2. **S. R. Zhang**, Y.-F. Yuan, J.-M. Wang, and L. C. Ho, "Neutron star accretion events in AGN discs: mutimessenger implications," *MNRAS*, vol. 532, no. 2, pp. 1330–1344, Aug. 2024. DOI: 10.1093/mnras/stae1546.
3. **S. R. Zhang** et al., "LVK S241125n: Massive Binary Black Hole Merger Produces GRB in AGN Disk," *ApJ*, Jan. 2026. DOI: 10.3847/1538-4357/ae3319.
4. **S. R. Zhang** and M. Prakapenia, "The transformation of the rotational energy of a Kerr black hole," *Classical and Quantum Gravity*, vol. 41, no. 13, 135019, p. 135 019, Jul. 2024. DOI: 10.1088/1361-6382/ad51c2.
5. **S. R. Zhang**, J. A. Rueda Hernandez, and R. Negreiros, "Can the Central Compact Object in HESS J1731–347 Be Indeed the Lightest Neutron Star Observed?" *ApJ*, vol. 978, no. 1, 1, p. 1, Jan. 2025. DOI: 10.3847/1538-4357/ad96b5.
6. **S. R. Zhang**, Y. Luo, and Y.-F. Yuan, "White dwarf collisions in AGN disks and the observational effects," *Chinese Science Bulletin*, vol. 70, no. 3, pp. 423–431, Dec. 2024. DOI: 10.1360/TB-2024-0603.
7. Y. Luo, X.-J. Wu, **S. R. Zhang**, J.-M. Wang, L. C. Ho, and Y.-F. Yuan, "White dwarf-white dwarf collisions in AGN discs via close encounters," *MNRAS*, vol. 524, no. 4, pp. 6015–6023, Oct. 2023. DOI: 10.1093/mnras/stad2188.
8. R. Ruffini, M. Prakapenia, H. Quevedo, and **S. R. Zhang**, "Single versus the repetitive penrose process in a kerr black hole," *PRL*, vol. 134, p. 081 403, 8 Feb. 2025. DOI: 10.1103/PhysRevLett.134.081403.
9. R. Ruffini, C. L. Bianco, M. Prakapenia, H. Quevedo, J. A. Rueda, and **S. R. Zhang**, "Role of the irreducible mass in repetitive penrose energy extraction processes in a kerr black hole," *PRR*, vol. 7, p. 013 203, 1 Feb. 2025. DOI: 10.1103/PhysRevResearch.7.013203.
10. Y. Aimuratov et al., "GRB-SN Association within the Binary-driven Hypernova Model," *ApJ*, vol. 955, no. 2, 93, p. 93, Oct. 2023. DOI: 10.3847/1538-4357/ace721.
11. C. L. Bianco et al., "Probing Electromagnetic Gravitational-wave Emission Coincidence in a Type I Binary-driven Hypernova Family of Long Gamma-Ray Bursts at Very High Redshift," *ApJ*, vol. 966, no. 2, 219, p. 219, May 2024. DOI: 10.3847/1538-4357/ad2fa9.

Conference Proceedings

1. **S. R. Zhang**, "The Transformation of the Rotational Energy of an Accreting Kerr Black Hole," in *Proceedings of the Fifth Zeldovich meeting, an international conference in honor of Ya.B. Zeldovich held in Yerevan, Armenia on June 12–16, 2023.*, vol. 67, Dec. 2023, S97–S101. DOI: 10.1134/S1063772923140202.