

Kana Moriwaki

Department of Physics, Graduate School of
Science, the University of Tokyo

7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, JAPAN

☎ +81-3-5841-4191

✉ kana.moriwaki@phys.s.u-tokyo.ac.jp

🌐 <http://www-utap.phys.s.u-tokyo.ac.jp/~moriwaki>

Research Interests

Galaxy formation and evolution, high-redshift galaxies, cosmic reionization, cosmological simulation, machine learning.

Education and Employment

since 2022 **Research Associate**, *Research Center for the Early Universe, Graduate School of Science, The University of Tokyo.*

2019–2022 **Doctor of Science**, *Department of Physics, Graduate School of Science, The University of Tokyo.*

- Thesis: *Analysis of the Large-Scale Structure of the Universe Using Cosmological Simulations and Machine Learning*
- Supervisor: Naoki Yoshida

2017 – 2019 **Masters of Science**, *Department of Physics, Graduate School of Science, The University of Tokyo.*

- Thesis: *The distribution and physical properties of emission line galaxies in the early universe*
- Supervisor: Naoki Yoshida

2013 – 2017 **Bachelor of Science**, *Department of Physics, Graduate School of Science, The University of Tokyo.*

Fellowships and Awards

2024 Third Marie Skłodowska Curie Award Grand Prize

2023 International Astronomical Union PhD Prize honourable mention

2022 Springer Thesis Award

2022 School of Science Encouragement Award, The University of Tokyo

2022 The University of Tokyo President's Award for Students, Grand Prize

2021 Young Scientist Presentation Award, 34th Rironkon Symposium

2020 – 2022 JSR Fellowship, the University of Tokyo

2019 – 2022 Japan Society for Promotion of Science (JSPS) Research Fellow, DC1

2017 – 2022 Advanced Leading Graduate Course for Photon Science (ALPS), the University of Tokyo

2017 School of Science Encouragement Award, The University of Tokyo

Teaching

University of Tokyo

- 2023 Course on Exercise in Physics (electromagnetics, physical mathematics)
- 2022 Seminar "Galaxy formation and evolution"

Invited Lectures

- Sep. 2023 "Galaxy formation with cosmological simulation and machine learning", NECO Summer School, Kyoto YITP, Japan

Grants and Funding

- 2024-2028 Grant-in-Aid for Specially Promoted Research (co-I, 463,900,000 JPY)
- 2023-2030 International Leading Research (co-I, 529,900,000 JPY)
- 2023-2026 Grant-in-Aid for Scientific Research (C) (PI, 3,700,000 JPY)
- 2023-2025 Program for Promoting Research on the Supercomputer Fugaku (co-I, 26,841,000 JPY for 2023)
- 2022-2024 International Exchanges 2022 Round 2, the Royal Society (co-I, 12,000 GBP)
- 2019-2022 JSPS Grant for JSPS Fellows (PI, 3,100,000 JPY)

Professional Activities

- Jan. 2024 LOC, UNIONS/JEC Joint Meeting, the University of Tokyo
- Oct. 2023 LOC, The 14th RESCEU International Symposium, the University of Tokyo
- Sep. 2023 SOC chair, Fugaku AstroAI 2023, Tsukuba University
- Aug. 2023 SOC, NECO Summer School 2023, Kyoto YITP
- Oct. 2021 SOC chair, SUBLIME Workshop 2021
- since 2021 Japan SKA Consortium member
- since 2021 Japan Euclid Consortium member

Publications

First Author

- [9] Kana Moriwaki, Angus Beane, and Adam Lidz, Insights into the 21 cm field from the vanishing cross-power spectrum at the epoch of reionization, *Monthly Notices of the Royal Astronomical Society*, 530(3):3183–3194, April 2024.
- [8] Kana Moriwaki, Takahiro Nishimichi, and Naoki Yoshida, Machine learning for observational cosmology, *Reports on Progress in Physics*, 86(7):076901, July 2023.
- [7] Kana Moriwaki. Deep learning application for reconstruction of large-scale structure of the universe. In Shelly Sachdeva, Yutaka Watanobe, and Subhash Bhalla, editors, *Big-Data-Analytics in Astronomy, Science, and Engineering*, pages 73–82, Cham, 2022. Springer International Publishing.
- [6] Kana Moriwaki and Naoki Yoshida, Deep-learning Reconstruction of Three-dimensional Galaxy Distributions with Intensity Mapping Observations, *ApJL*, 923(1):L7, December 2021.

- [5] Kana Moriwaki, Masato Shirasaki, and Naoki Yoshida, Deep Learning for Line Intensity Mapping Observations: Information Extraction from Noisy Maps, *ApJL*, 906(1):L1, January 2021.
- [4] Kana Moriwaki, Nina Filippova, Masato Shirasaki, and Naoki Yoshida, Deep learning for intensity mapping observations: component extraction, *MNRAS*, 496(1):L54–L58, July 2020.
- [3] Kana Moriwaki. The distribution and physical properties of high-redshift [O III] emitters in a cosmological hydrodynamics simulation. In M  d  ric Boquien, Elisabeta Lusso, Carlotta Gruppioni, and Patricia Tissera, editors, *Panchromatic Modelling with Next Generation Facilities*, volume 341, pages 249–252, January 2020.
- [2] Kana Moriwaki, Naoki Yoshida, Marius B. Eide, and Benedetta Ciardi, Cross-correlation between the 21-cm signal and [O III] emitters during early cosmic reionization, *MNRAS*, 489(2):2471–2477, October 2019.
- [1] Kana Moriwaki, Naoki Yoshida, Ikkoh Shimizu, Yuichi Harikane, Yuichi Matsuda, Hiroshi Matsuo, Takuya Hashimoto, Akio K. Inoue, Yoichi Tamura, and Tohru Nagao, The distribution and physical properties of high-redshift [O III] emitters in a cosmological hydrodynamics simulation, *MNRAS*, 481:L84–L88, November 2018.

Co-Author

- [10] Keiya Hirashima, Kana Moriwaki, Michiko S. Fujii, Yutaka Hirai, Takayuki R. Saitoh, Junichiro Makino, and Shirley Ho. Surrogate modeling for computationally expensive simulations of supernovae in high-resolution galaxy simulations. In *NeurIPS 2023 AI for Science Workshop*, 2023.
- [9] Keiya Hirashima, Kana Moriwaki, Michiko S. Fujii, Yutaka Hirai, Takayuki R. Saitoh, and Junichiro Makino, 3D-Spatiotemporal forecasting the expansion of supernova shells using deep learning towards high-resolution galaxy simulations, *MNRAS*, 526(3):4054–4066, December 2023.
- [8] Yoichi Tamura, Tom J. L. C. Bakx, Akio K. Inoue, Takuya Hashimoto, Tsuyoshi Tokuoka, Chihiro Imamura, Bunyo Hatsukade, Minju M. Lee, Kana Moriwaki, Takashi Okamoto, Kazuaki Ota, Hideki Umehata, Naoki Yoshida, Erik Zackrisson, Masato Hagimoto, Hiroshi Matsuo, Ikkoh Shimizu, Yuma Sugahara, and Tsutomu T. Takeuchi, The 300 pc resolution imaging of a $z = 8.31$ galaxy: Turbulent ionized gas and potential stellar feedback 600 million years after the big bang, *The Astrophysical Journal*, 952(1):9, jul 2023.
- [7] Tsuyoshi Tokuoka, Akio K. Inoue, Takuya Hashimoto, Richard S. Ellis, Nicolas Laporte, Yuma Sugahara, Hiroshi Matsuo, Yoichi Tamura, Yoshinobu Fudamoto, Kana Moriwaki, Guido Roberts-Borsani, Ikkoh Shimizu, Satoshi Yamanaoka, Naoki Yoshida, Erik Zackrisson, and Wei Zheng, Possible Systematic Rotation in the Mature Stellar Population of a $z = 9.1$ Galaxy, *ApJL*, 933(1):L19, July 2022.

- [6] Keiya Hirashima, Kana Moriwaki, Michiko S. Fujii, Yutaka Hirai, Takayuki Saitoh, and Junichiro Makino, Predicting the expansion of supernova shells for high-resolution galaxy simulations using deep learning, *Journal of Physics: Conference Series*, 2207(1):012050, mar 2022.
- [5] Masato Shirasaki, Kana Moriwaki, Taira Oogi, Naoki Yoshida, Shiro Ikeda, and Takahiro Nishimichi, Noise reduction for weak lensing mass mapping: an application of generative adversarial networks to Subaru Hyper Suprime-Cam first-year data, *MNRAS*, 504(2):1825–1839, June 2021.
- [4] Shigeki Inoue, Hiroshi Matsuo, Naoki Yoshida, Hidenobu Yajima, and Kana Moriwaki, Capturing the inside-out quenching by black holes with far-infrared atomic line ratios, *arXiv e-prints*, page arXiv:2102.10752, February 2021.
- [3] Kotaro Kohno, Ryohei Kawabe, Yoichi Tamura, Akira Endo, Jochem J. A. Baselmans, Kenichi Karatsu, Akio K. Inoue, Kana Moriwaki, Natsuki H. Hayatsu, Naoki Yoshida, Yuki Yoshimura, Bunyo Hatsukade, Hideki Ume-hata, Tai Oshima, Tatsuya Takekoshi, Akio Taniguchi, Pamela D. Klaassen, Tony Mroczkowski, Claudia Cicone, Frank Bertoldi, Helmut Dannerbauer, and Tomoka Tosaki. Large format imaging spectrograph for the Large Submillimeter Telescope (LST). In *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, volume 11453 of *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, page 114530N, December 2020.
- [2] Yuichi Harikane, Masami Ouchi, Akio K. Inoue, Yoshiaki Matsuoka, Yoichi Tamura, Tom Bakx, Seiji Fujimoto, Kana Moriwaki, Yoshiaki Ono, Tohru Nagao, Ken-ichi Tadaki, Takashi Kojima, Takatoshi Shibuya, Eiichi Egami, Andrea Ferrara, Simona Gallerani, Takuya Hashimoto, Kotaro Kohno, Yuichi Matsuda, Hiroshi Matsuo, Andrea Pallottini, Yuma Sugahara, and Livia Vallini, Large Population of ALMA Galaxies at $z > 6$ with Very High [O III] $88 \mu\text{m}$ to [C II] $158 \mu\text{m}$ Flux Ratios: Evidence of Extremely High Ionization Parameter or PDR Deficit?, *ApJ*, 896(2):93, June 2020.
- [1] Yoko Oya, Kana Moriwaki, Shusuke Onishi, Nami Sakai, Ana López-Sepulcre, Cécile Favre, Yoshimasa Watanabe, Cecilia Ceccarelli, Bertrand Lefloch, and Satoshi Yamamoto, Chemical and Physical Picture of IRAS 16293-2422 Source B at a Sub-arcsecond Scale Studied with ALMA, *ApJ*, 854(2):96, February 2018.

Book

- [1] Kana Moriwaki. *Large-Scale Structure of the Universe – Cosmological Simulations and Machine Learning*. Springer Theses. Springer Singapore, 2022.

Conferences and Workshops (Selected)

- Feb. 2024 Invited Talk, "Machine Learning in Cosmology and Astrophysics", Third Mini-Workshop on the Early Universe (Okinawa, Japan)
- Jan. 2024 Invited Talk, "Reconstruction of the Large-Scale Structure of the Universe with Conditional GAN", AI-driven discovery in physics and astrophysics, (Chiba, Japan)

- Oct. 2023 Invited Talk, "Deep learning application to large-scale structure of the universe traced by line intensity", The 14th RESCEU Symposium, From Large to Small Structures in the Universe, (Tokyo, Japan)
- Feb. 2022 Contributed Talk, "Deep learning for line de-confusion in large-scale line intensity maps", SAZERAC: Learning the high-redshift Universe (online)
- Dec. 2021 Invited Talk, "Deep Learning Application for Reconstruction of Large-Scale Structure of the Universe", Big Data Analytics in Science and Engineering (BASE), 9th International Conference Data Models and New Query Languages in Big Data Analytics (Fukushima, Japan + online)
- Oct. 2021 Contributed Talk, "Signal extraction from line intensity data cubes with 3D conditional GAN", SUBLIME Workshop (online)
- Jul. 2021 Contributed Talk, "Component extraction from line intensity maps with conditional GAN", UChicago/KICP Line Intensity Mapping Workshop 2021 (online)
- Jun. 2021 Poster Presentation, "Deep Learning for Line Intensity Mapping: Information Extraction", Statistical Challenges in Modern Astronomy VII (online)
- Jan. 2021 Contributed Talk, "[OIII] line emitters as a probe of galaxy-21 cm cross-correlation signals from the early stage of reionization" SAZERAC The 21-cm Signal from Cosmic Dawn and the Epoch of Reionization (online)
- Nov. 2020 Invited Talk, "Deep learning application for line intensity mapping" The 9th KIAS Workshop on Cosmology and Structure Formation (Seoul, Korea + online)
- Jan. 2020 Contributed Talk, "Emission line as a tracer of ISM properties and the large-scale structure of the universe", Sexten workshop: The interstellar medium of high redshift galaxies (Sesto, Italy)
- Aug. 2019 Poster Presentation, "Cross-correlation between the 21-cm signal and [OIII] emitters during early cosmic reionization", FIRST LIGHT: STARS, GALAXIES AND BLACK HOLES IN THE EPOCH OF REIONIZATION (Sao Paulo, Brazil)
- Feb. 2019 Contributed Talk, "The distribution and physical properties of high-redshift [OIII] emitters in a cosmological hydrodynamics simulation", New Frontiers of Submillimeter Astronomy (Nagano, Japan)
- Nov. 2018 Contributed Talk, "The distribution and physical properties of high-redshift [OIII] emitters in a cosmological hydrodynamics simulation", IAU Symposium 341: PanModel2018: Challenges in Panchromatic Galaxy Modelling with Next Generation Facilities (Osaka, Japan)

Seminars

- June. 2023 Colloquium Talk, The Kavli Institute for Astronomy and Astrophysics, Peking University
- Oct. 2022 Seminar Talk, Institute for Physics of Intelligence, the University of Tokyo
- Apr. 2022 Colloquium Talk, Yunnan University, SWIFAR
- Jan. 2021 Seminar Talk, Flatiron Institute, Simons Foundation

Nov. 2020 Seminar Talk, University of Tsukuba

Nov. 2019 Seminar Talk, Waseda University

Jul. 2019 Seminar Talk, Nagoya University

Outreach

Aug. 2022 Public Talk at Open Campus, School of Science, the University of Tokyo

Feb. 2020 Public Talk at Diversity Cafè, Tokyo Metropolitan Hakuo High School

Apr. 2019 TA at Toshiko Yuasa Laboratory School for Female Students in Science 2019