Curriculum Vitae

Junichi Haruna

Last updated: October 2026

Position	Program-Specific Researcher, group of Keisuke Fujii, Graduate School of Informatics, Kyoto University
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Research IDs	ORCID 0000-0002-1828-8183; arXiv `https://arxiv.org/a/haruna_j_1`; researchmap `https://researchmap.jp/jharuna`
Interests	Quantum error correction and fault-tolerant quantum computation; algebraic topology and obstruction theory; gauge theory; the renormalization group

Appointments

2026–	Program-Specific Researcher, group of Keisuke Fujii, Graduate School of Informatics, Kyoto University (from April 2026).
2023–2026	Specially Appointed Researcher, Center for Quantum Information and Quantum Biology (QIQB), Osaka University (April 2023 to March 2026). Research carried out in the group of Keisuke Fujii.
2018–2019	Research and Experiment Assistant, National Institute of Informatics (July 2018 to October 2019).

Education

2020–2023	Ph.D. course, Department of Physics and Astronomy, Graduate School of Science, Kyoto University (April 2020 to March 2023). Doctor of Science conferred March 2023. Doctoral thesis: *Gradient Flow Exact Renormalization Group for Scalar Field Theories*, supervised by Masafumi Fukuma.
2018–2020	Master's course, Department of Physics and Astronomy, Graduate School of Science, Kyoto University (April 2018 to March 2020). Master of Science, March 2020. Supervised by Hikaru Kawai.
2014–2018	Faculty of Science, Kyoto University (April 2014 to March 2018). Bachelor of Science, March 2018.

Awards and fellowships

2023	18th Particle Physics Medal: Young Scientist Award in Theoretical Particle Physics (Particle Theory Group of Japan), FY2023. Awarded to an early-career researcher for outstanding work in theoretical particle physics.
2021–2022	JSPS Research Fellowship for Young Scientists (DC2), principal investigator.
2018–2019	JASSO Category 1 graduate scholarship, full repayment exemption for outstanding achievement.

Publications

Twelve refereed papers and one preprint. The full list with links is on the website.

1. J. Haruna and K. Murakami, "Fast and accurate rare-event simulation by Markov chain Monte Carlo for general quantum codes", arXiv:2610.35498 (2026).
2. J. Haruna, "Homological origin of transversal implementability of logical diagonal gates in quantum CSS codes", PTEP **2026**, 083A03 (2026), arXiv:2602.14499.
3. J. Haruna, "Note on Logical Gates by Gauge Field Formalism of Quantum Error Correction", PTEP **2026**, 073B12 (2026), arXiv:2511.15224.
4. J. Haruna and K. Fujii, "Hierarchical Quantum Error Correction with Hypergraph Product Code and Rotated Surface Code", PTEP **2025**, 103A03 (2025), arXiv:2505.18592.
5. J. Haruna, K. Shimizu and M. Yamada, "Functional renormalization group analysis of the O(3) nonlinear sigma model and non-Abelian bosonization duality", Phys. Rev. D **111**, 045012 (2025), arXiv:2405.14627.
6. J. Haruna and M. Yamada, "Gradient Flow Exact Renormalization Group for Scalar Quantum Electrodynamics", JHEP **05**, 291 (2024), arXiv:2312.15673.

7. K. Sakamoto, H. Morisaki, J. Haruna, E. Itou, K. Fujii and K. Mitarai, "End-to-end complexity for simulating the Schwinger model on quantum computers", Quantum **8**, 1474 (2024), arXiv:2311.17388.
8. J. Liu, J. Haruna and M. Yamada, "Nonperturbative aspects of two-dimensional $T\bar{T}$-deformed scalar theory from functional renormalization group", Phys. Rev. D **109**, 065016 (2024), arXiv:2309.15584.
9. Y. Abe, Y. Hamada and J. Haruna, "Fixed Point Structure of Gradient Flow Exact Renormalization Group for Scalar Field Theories", PTEP **2022**, 033B03 (2022), arXiv:2201.04111.
10. J. Haruna, R. Toshio and N. Nakano, "Path integral approach to universal dynamics of reservoir computers", Phys. Rev. E **107**, 034306 (2023), arXiv:2112.01886.
11. J. Haruna, K. Sakai and K. Yoshida, "Burgers equation vs. large N limit in $T\bar{T}$-deformed O(N) vector model", Nucl. Phys. B **971**, 115499 (2021), arXiv:2104.05431.
12. J. Haruna, T. Ishii, H. Kawai, K. Sakai and K. Yoshida, "Large N analysis of $T\bar{T}$-deformation and unavoidable negative-norm states", JHEP **04**, 127 (2020), arXiv:2002.01414.
13. J. Haruna and H. Kawai, "Weak scale from Planck scale: Mass scale generation in a classically conformal two-scalar system", PTEP **2020**, 033B01 (2020), arXiv:1905.05656.

Invited talks

2026 — 2026 YITP QEC Workshop: Fault-tolerant logical processing, Yukawa Institute for Theoretical Physics, Kyoto (28 September to 9 October); QuantHEP 2026, Queen Mary University of London (July); CREST HEP-QC One-day Workshop 2026, Kyoto University (April).

2025 — Quantum Error Correction Theory Workshop for Young Researchers, Nagoya University (December); Lake Biwa Workshop (Biwako-han Kenkyukai), Shiga (March).

2024 — Functional Renormalization Group at Niigata 2024, Kaishi Professional University (January).

2023 — Functional Renormalization Group at RIKEN 2023, RIKEN Wako Campus (January).

2020 — Online 2020 NTU-Kyoto High Energy Physics Workshop (December).

2019 — Recent Progress on Field and String Theory: Kyoto-NTU 2019, Kyoto University (December).

In addition, 20 contributed talks, 9 seminars (including University College London, RIKEN, YITP and Heidelberg University) and 4 posters as of October 2026. The full list is on the website.

Lectures

2026 — Lecture on quantum error correction at "New computational methods in quantum field theory 2026", RIKEN Wako Campus (26 to 28 January). Lecture note available on the website.

Academic service

2026 — Local organizer, 2026 YITP QEC Workshop: Fault-tolerant logical processing, Yukawa Institute for Theoretical Physics (28 September to 9 October).

2024 — Lecturer, 3rd joint career forum, Nuclear, Particle and Cosmology Young Researchers Summer School.

2021 — Organizing committee (head of the preparatory school), Nuclear, Particle and Cosmology Young Researchers Summer School.

Teaching

2019–2020 — Six teaching assistant appointments at Kyoto University (quantum mechanics exercises, statistics, data science, and the MACS education program).

Software and data

`bockstein-gate-check`: feasibility checker for transversal diagonal logical gates in CSS codes (prototype backing arXiv:2602.14499). `https://github.com/junichiharuna/bockstein-gate-check`

Data and code for "Hierarchical Quantum Error Correction with Hypergraph Product Code and Rotated Surface Code" (with K. Fujii). Zenodo, `https://doi.org/10.5281/zenodo.15660987`

`PIReservoir`: numerical code for Phys. Rev. E **107**, 034306. `https://github.com/junichiharuna/PIReservoir`

`GLMCC`: Python code for the GLM-based cross-correlation method to estimate neuronal connectivity (with R. Kobayashi and S. Shinomoto). `https://github.com/NII-Kobayashi/GLMCC`