Tae-Geun Kim-Morgen

Postdoctoral Researcher • Publications under Tae-Geun Kim
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Appointments

Postdoctoral Research Associate, Fudan-RIKEN Joint Program — Nov. 2025 — Present
Key Laboratory of Nuclear Physics and Ion-beam Application (MOE), Fudan University, Shanghai, China;
RIKEN Center for Interdisciplinary Theoretical and Mathematical Sciences (iTHEMS), Wako, Japan
Supervisors: Prof. Guo-Liang Ma (Fudan University) and Prof. Lingxiao Wang (UTokyo / RIKEN iTHEMS)

Technical Research Personnel (alternative military service) — Sep. 2022 — Aug. 2025
Yonsei University, Seoul, Republic of Korea

Education

Ph.D. in Theoretical Particle Physics, *Yonsei University, Seoul, Republic of Korea* — Mar. 2017 — Aug. 2025
Thesis: *Intercommunication between Artificial Intelligence and Physics* (Supervisor: Prof. Seong Chan Park)

B.Sc. in Astronomy, *Yonsei University, Seoul, Republic of Korea* — Mar. 2012 — Feb. 2017

Honors & Fellowships

- APS DCOMP Travel/Registration Award, APS Division of Computational Physics, CCP2026 (2026)
- Shanghai Superpostdoc Fellowship, Shanghai Municipal Government (2025–2027)
- Fudan Superpostdoc Fellowship, Fudan University (2025–2027)
- Academy Research Fellowship, Yonsei University (2022–2023)
- Best Oral Presentation Award, KPS 70th Anniversary and 2022 Fall Meeting (2022)

Journal Publications

[*] Co-first authors

J1 Peroxide: A Batteries-Included Numerical Computing Library for Rust — 2026
T.-G. Kim, G. Comitini, J. Grage, B. Joens, M. Schreiber, et al.
J. Open Source Software **11**, 10366

J2 Primordial Black Holes as a Factory of Axions: Extragalactic Photons from Axions — 2026
Y. Jho[*], **T.-G. Kim**[*], J.-C. Park[*], S. C. Park[*], Y. Park[*]
Prog. Theor. Exp. Phys. **2026**, 023B07 arXiv:2212.11977

J3 Unsupervised sequence-to-sequence learning for automatic signal quality assessment in multi-channel electrical impedance-based hemodynamic monitoring — 2024
C. M. Hyun[*], **T.-G. Kim**[*], K. Lee
Comput. Methods Programs Biomed. **247**, 108079 arXiv:2305.09368

J4 Missing information search with deep learning for mass estimation — 2023
K. Ban[*], D. W. Kang[*], **T.-G. Kim**[*], S. C. Park[*], Y. Park[*]
Phys. Rev. Research **5**, 043186 arXiv:2212.12836

Preprints and Manuscripts in Preparation

P1 Interaction Geometry and Hidden Bias in Learning Equilibrium States — 2026
T.-G. Kim-Morgen, L. Wang, G.-L. Ma *In preparation*

P2 A Unified Mass Function for Primordial Black Holes and Its Evolution under Hawking Evaporation — 2026
T.-G. Kim-Morgen, J. Park, M. G. Park, Y. Park, H. Jung, S. C. Park *In preparation*

P3 What Gamma Rays Can Determine about Primordial Black Hole Mass Distributions — 2026
T.-G. Kim-Morgen, J. Park, M. G. Park, Y. Park, H. Jung, S. C. Park *In preparation*

P4 Identifying Ultraviolet Couplings from SMEFT Coefficients — 2026
T.-G. Kim-Morgen, V. Maura, Á. Pastor-Gutiérrez, L. Wang *In preparation*

P5 Learning Unknown Gravitational Fields for Spacecraft State Estimation: Temporal Hamiltonian Neural Network-based Adaptive Kalman Filtering — 2025
T. Kim[*], **T.-G. Kim**[*], A. Girard, I. Kolmanovsky
Second revision under review at *IEEE Trans. Aerosp. Electron. Syst.* earlier version arXiv:2501.18808

P6 Neural Hamilton: Can A.I. Understand Hamiltonian Mechanics? 2024
T.-G. Kim, S. C. Park
arXiv:2410.20951

P7 HyperbolicLR: Epoch insensitive learning rate scheduler 2024
T.-G. Kim
arXiv:2407.15200

Research Software

Peroxide Rust numerical computing library Sep. 2018 — Present
Creator and lead maintainer. Linear algebra, numerical analysis, automatic differentiation, special functions, statistics and data frames, with pure-Rust and BLAS/LAPACK backends. Software paper in JOSS [J1].
github.com/Axect/Peroxide · 732 GitHub stars · 1.41M crates.io downloads

PyTorch Template Reproducible deep-learning experiments Aug. 2024 — Present
Creator. Configuration-driven PyTorch template with preflight checks, multi-seed runs, checkpoints, Optuna hyperparameter search and run provenance.
github.com/Axect/pytorch_template

Neural Hamilton Operator learning for Hamiltonian dynamics Sep. 2024 — Jun. 2026
Official implementation of [P6]. Operator-learning architectures (DeepONet, TraONet, VaRONet, MambONet) with a Rust dataset generator based on Gaussian random fields.
github.com/Axect/Neural_Hamilton

White Owl Primordial black hole evaporation framework May 2022 — Feb. 2026
Official implementation of [J2]. Hawking emission spectra, cosmological redshift and f_{PBH} constraints in Rust.
github.com/Axect/white_owl

Quantum Algorithms Gate-model algorithm notebooks Dec. 2023 — Jun. 2024
QFT, phase estimation, QAOA and others in PennyLane, Qiskit, Cirq and RustQIP, with explanatory notebooks.
github.com/Axect/QuantumAlgorithms

NCDataFrame.jl Julia NetCDF I/O package Feb. 2021 — Sep. 2021
Creator. Reads and writes NetCDF files as DataFrames; registered in the Julia General registry.
github.com/Axect/NCDataFrame.jl · JuliaHub package page

Other tools overleap (Overleaf sync, npm), tonz (disk-usage viewer, crates.io), Zellaygen (Zellij layouts)

Technical Skills

Programming	Python, Rust, C++, Julia
Machine learning	PyTorch, JAX (Equinox, Optax), scikit-learn, Optuna, Weights & Biases
Scientific computing	Peroxide, NumPy, SciPy, pandas/Polars, BLAS/LAPACK
Quantum computing	Qiskit, PennyLane, Cirq, RustQIP, IBM Quantum
Systems	Linux (Arch, Debian/Ubuntu, Fedora, openSUSE, Solus, CentOS/Rocky)
Physics	MadGraph, ROOT
Languages	Korean (native), English (fluent), German (A2)

Invited Talks

Can one see the mass of a PBH? 2026
Seminar @ Bielefeld University Bielefeld, Germany

Can you trust your neural sampler? 2026
ITP Seminar @ Heidelberg University Heidelberg, Germany

Can you trust your neural sampler? 2026
CCP2026 @ Sejong University Seoul, Korea

Can one see the mass of a PBH? 2026
KIAS Seminar Seoul, Korea

Neural Inverse Problems and Degeneracy: SMEFT and PBHs 2026
PARTIQAL @ IBS Daejeon, Korea

Inverse Problems in High Energy Physics 2026
DEEP-IN Starter Meeting @ RIKEN Wako, Japan

From Primordial Black Holes to Nuclei: Solving Inverse Problems in Physics with Operator Learning 2025
Nuclear Lunch Seminar @ Fudan University Shanghai, China

PBH Phenomenology with Operator Learning 2025
LSSU Seminar @ Jeonbuk National University Jeonju, Korea

Can A.I. Understand Hamiltonian Mechanics? 2025
DEEP-IN Seminar @ RIKEN Online

Can A.I. Understand Hamiltonian Mechanics? 2024
Invited Seminar @ KIAS Seoul, Korea

Contributed Talks

Interaction Geometry and Hidden Bias in Learning Lattice Spin Systems 2026
ATHIC 2026 (parallel talk) Shanghai, China

Trustworthy Neural Sampler 2026
ECT Workshop* Trento, Italy

A graph-bandwidth law for context windows in autoregressive samplers 2026
EuCAIFCon 2026 (parallel talk and poster) Heidelberg, Germany

Can you trust your neural samplers? 2026
AI Agents for Nuclear Physics @ Fudan U. Shanghai, China

Accelerating Primordial Black Hole Phenomenology: An Operator Learning Approach 2026
The 2nd AI+HEP in East Asia @ KEK Tsukuba, Japan

Can AI Understand Hamiltonian Mechanics? 2025
29th International Summer Institute on Phenomenology of Elementary Particle Physics and Cosmology Yeosu, Korea

A Neural Operator for Primordial Black Hole Physics 2025
The 4th Workshop on Symmetry and Structure of the Universe Jeonju, Korea

AI with Hamiltonian Mechanics: From Predictions to Understanding 2025
AI+HEP in East Asia 2025 Daejeon, Korea

Can A.I. Understand Hamiltonian Mechanics? 2025
Dark Matter as a Portal to New Physics 2025 Pohang, Korea

Can A.I. Understand Hamiltonian Mechanics? 2025
Focused Workshop on AI in High Energy Physics 2025 Seoul, Korea

Can A.I. Understand Hamiltonian Mechanics? 2024
2024 Korea-France STAR Workshop Seoul, Korea

Can A.I. Understand Hamiltonian Mechanics? 2024
21st Saga-Yonsei Joint Workshop Seoul, Korea

Primordial Black Hole dominant Axion background 2024
2024 KPS Fall Meeting Yeosu, Korea

Exploration of PBHs and ALPs through a novel decay model on cosmological scale 2023
27th International Summer Institute on Phenomenology of Elementary Particle Physics and Cosmology (poster) Nantou, Taiwan

Exploration of PBHs and ALPs through a novel decay model on cosmological scale 2022
16th International Conference on Interconnections between Particle Physics and Cosmology Daejeon, Korea

Constraining ALPs via PBH with time-varying decay process 2022
Workshop on Physics of Dark Cosmos: dark matter, dark energy, and all Busan, Korea

Constraining ALPs via PBH with time-varying decay process Part.2 2022
KPS 70th Anniversary and 2022 Fall Meeting, **Best Oral Presentation Award** Busan, Korea

Bird's eye view of Neutron star cooling 2019
16th Saga-Yonsei Joint Workshop Saga, Japan

Teaching

Lecturer, *Advanced Research in Quantum Universe 4* (PHY9901), Yonsei University Mar. 2025 — Jun. 2025
Graduate course taught in English: lectures on deep learning for physics

Teaching Assistant, Yonsei University Mar. 2017 — Jun. 2022
Introduction to General Relativity (PHY4208, 2021), Quantum Mechanics I and II (PHY3101, PHY3102, 2019–2020), Elementary Particle Physics I (PHY8050, 2019), Gravity I: General Relativity (PHY8030, 2017), Mathematical Physics I (PHY4205, 2017)

Instructor, Jungjin Academy (now The Smart Academy), Gimpo Nov. 2014 — Feb. 2022
High-school mathematics, science (physics, chemistry, biology, earth science), programming and statistics

Service

Peer Reviewer 2026
APL Computational Physics

Judge, SPARCS Science Hackathon 2024, "SW for Science" Oct. 2024
Hosted by KAIST and Daejeon Metropolitan City

Beta Reader, Jpub Publishing Oct. 2019 — Mar. 2025
Technical review of 16 books on Rust and deep learning

Webmaster, Yonsei HEP-COSMO group Mar. 2017 — Aug. 2025
Developed and maintained the group website (Django on the group server; since 2023, Zola on GitHub Pages)

Web Assistant, College of Science, Yonsei University Mar. 2017 — Aug. 2022
Took part in planning the College website from the first meetings and in running its server; then managed the site

Study Groups

Founder and Organizer, SYTEARK machine-learning study group Mar. 2019 — Present
Weekly presentations on machine-learning papers and members' research for theoretical physicists · github.com/SYTEARK

Co-organizer, Yonsei Cosmo-Chalk Mar. 2024 — Aug. 2025
Weekly blackboard talks of the Yonsei HEP-COSMO group · github.com/Yonsei-HEP-COSMO/Yonsei-Cosmo-Chalk

Participant, Machine Learning and Quantum Machine Learning Study Group, KIAS Mar. 2021 — Aug. 2024
Led by Prof. Myung Hoon Park (Seoultech) and Prof. Kyoungchul Kong (University of Kansas)