Naruo Ohga

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Third-year Ph.D. student at Department of Physics, Graduate School of Science, the University of Tokyo. I study the theoretical aspects of nonequilibrium thermodynamics.

Contact & Links

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Keywords

Nonequilibrium thermodynamics, Stochastic thermodynamics, Stochastic processes, Information theory

Education

The University of Tokyo (Tokyo, Japan), Apr. 2023–present
Doctoral Program, Department of Physics, Graduate School of Science

The University of Tokyo (Tokyo, Japan), Apr. 2021–Mar. 2023
Master's Program, Department of Physics, Graduate School of Science
Degree Title: **Master of Science** (Mar. 23, 2023)
Thesis: "Global structure in information geometry for nonequilibrium thermodynamics and its applications"

The University of Tokyo (Tokyo, Japan), Apr. 2017–Mar. 2021
Bachelor's Program, Physics, Faculty of Science
Degree Title: **Bachelor of Science** (Mar. 18, 2021)
[The School of Science Encouragement Award for the Undergraduate Program]

Research Articles

Publications

"Inferring nonequilibrium thermodynamics from tilted equilibrium using information-geometric Legendre transform"
Naruo Ohga and Sosuke Ito
Phys. Rev. Research **6**, 013315 (2024). [arXiv:2112.11008]

"Thermodynamic bound on spectral perturbations, with applications to oscillations and relaxation dynamics"
Artemy Kolchinsky, Naruo Ohga, and Sosuke Ito
Phys. Rev. Research **6**, 013082 (2024). [arXiv:2304.01714]

"Thermodynamic Bound on the Asymmetry of Cross-Correlations"
Naruo Ohga, Sosuke Ito, and Artemy Kolchinsky
Phys. Rev. Lett. **131**, 077101 (2023). [arXiv:2303.13116]
[Editors' Suggestion] [Highlighted in Physics Magazine Viewpoint] [Press Release (EN/JP)]

"Information-geometric structure for chemical thermodynamics: An explicit construction of dual affine coordinates"
Naruo Ohga and Sosuke Ito
Phys. Rev. E **106**, 044131 (2022). [arXiv:2112.13813]

Preprints

"Measuring irreversibility by counting: a random coarse-graining framework"
Ruicheng Bao, Naruo Ohga, and Sosuke Ito
arXiv:2508.11586 (2025).

"Improving variational counterdiabatic driving with weighted actions and computer algebra"
Naruo Ohga and Takuya Hatomura
arXiv:2505.18367 (2025).

"Characteristic oscillations in frequency-resolved heat dissipation of linear time-delayed Langevin systems: Approach from the violation of the fluctuation–response relation"
Xin Wang, Ruicheng Bao, and Naruo Ohga
arXiv:2501.01151 (2025).

"Microscopic theory of Mpemba effects and a no-Mpemba theorem for monotone many-body systems"
Naruo Ohga, Hisao Hayakawa, and Sosuke Ito
arXiv:2410.06623 (2024).

Presentations

Invited talks

"Topics on fundamental bounds based on the driving force (cycle affinity)"
Joint workshop between "ERATO Sagawa information-to-energy interconversion project" and "Information physics of living matters", Jun. 6–7, 2024, The University of Tokyo, Tokyo.

Seminars

"Universal and quantitative relations between two-time correlations and thermodynamic costs"
UBI meeting, Nov. 8, 2023, Universal Biology Institute, The University of Tokyo, Tokyo, Japan.

"Universal inequalities connecting two-time correlations and the strength of nonequilibrium driving"
Oct. 20, 2023, NTT Basic Research Laboratories, Kanagawa, Japan.

"Universal thermodynamic bounds on two-time correlations"
Jun. 20, 2023, Kyoto University, Kyoto, Japan.

"Information-geometric duality between nonequilibrium states and tilted equilibrium states"
Joint-group meeting between U. Washington (Qian group) and UNC-Chapel Hill (Lu group), Jul. 14th, 2022, University of Washington and UNC-Chapel Hill, US (Online).

International Conferences

"Universal microscopic theory of Mpemba effects and a rigorous no-Mpemba theorem" (Poster)
STATPHYS29, Jul. 13–18, 2025, Palazzo dei Congressi & Palaffari, Florence, Italy.

"Universality in cycle affinity: Driving force limits two-time correlations" (Oral)
Leuven school: Basics of nonequilibrium statistical mechanics, May 19–23, 2025, Aula Arenbergkasteel, KU Leuven, Leuven, Belgium.

"Universal microscopic theory of Mpemba effects for general classical systems" (Poster)
1st India-Japan Workshop on Physical Aspects of Living Systems, Feb. 19–21, 2025, Mishima Hall, ELSI, Institute of Science Tokyo, Tokyo, Japan.

"How hot cools faster than cold: Universal microscopic theory of Mpemba effects" (Oral)
FoPM International Symposium, Feb. 17–19, 2025, Ito International Research Center and Yayoi Auditorium, The University of Tokyo, Tokyo, Japan.

"Legendre duality between nonstationary and equilibrium entropy and its application to thermodynamic inference" (Oral)
STATPHYS28, Aug. 7–11, 2023, Hongo campus, The University of Tokyo, Tokyo, Japan.

"Thermodynamic bound on the asymmetry of cross-correlations" (Oral)
YITP-YSF Symposium "Perspectives on Non-Equilibrium Statistical Mechanics: The 45th Anniversary Symposium of Yamada Science Foundation," Aug. 3–5, 2023, Panasonic Auditorium, Yukawa Hall, Yukawa Institute

for Theoretical Physics, Kyoto University, Kyoto, Japan.

"Universal relations on nonequilibrium entropy in classical fluctuating systems" (Poster)
FoPM International Symposium, Feb. 6–8, 2023, Ito Hall, The University of Tokyo, Tokyo, Japan.

"Legendre duality in stochastic thermodynamics: A construction based on information geometry" (Oral)
Workshop on Stochastic Thermodynamics III, May 26–Jun. 3, 2022, Japan (Online).

Conferences in Japan

"Universal microscopic theory of Mpemba effects in fluctuating classical systems" (Poster)
ERATO & Gakujutsu-henkaku B Joint Meeting, Mar. 26–28, 2025, Fukushima Bandai-atami-onsen Hotel Hananoyu, Fukushima, Japan.

"General framework for analyzing Mpemba effects by comparing microstates" (Oral)
79th Annual Meeting, The Physical Society of Japan, Sep. 16–19, 2024, Hokkaido University (Sapporo Campus), Hokkaido, Japan.

"Research on thermodynamic bounds on the asymmetry of cross-correlations (award talk)" (Oral)
8th Conference, Grant-in-Aid for Scientific Research on Innovative Areas: "Information physics of living matters," Mar. 4–5, 2024, Tetsumon Memorial Hall, The University of Tokyo, Tokyo, Japan.

"Thermodynamic costs behind two-time correlations" (Oral)
7th Conference, Grant-in-Aid for Scientific Research on Innovative Areas: "Information physics of living matters," Sep. 21–22, 2023, Toki Messe Niigata Convention Center, Niigata, Japan.

"Thermodynamic bounds on correlation functions and their applicability to biological energetic costs" (Poster)
7th Conference, Grant-in-Aid for Scientific Research on Innovative Areas: "Information physics of living matters," Sep. 21–22, 2023, Toki Messe Niigata Convention Center, Niigata, Japan.

"Thermodynamic inference of nonstationary processes from tilted equilibrium measurements" (Oral)
78th Annual Meeting, The Physical Society of Japan, Sep. 16–19, 2023, Tohoku University (Aobayama Campus, Kawauchi Campus), Miyagi, Japan.

"Thermodynamic bound on the eigenvalues of the time evolution generator" (Oral)
The 68th Condensed Matter Physics Summer School, Aug. 12–15, 2023, Makino Parkhotel & Seminarhouse, Shiga, Japan.

"Thermodynamic bound on the cross-correlations and its application to oscillatory eigenvalues" (Oral)
2023 Spring Meeting, The Physical Society of Japan, Mar. 22–25, 2023, Japan (Online).

"Thermodynamic bound on the time-reversal symmetry breaking in cross-correlations" (Poster)
6th Conference, Grant-in-Aid for Scientific Research on Innovative Areas: "Information physics of living matters," Mar. 6–7, 2023, ACROS Fukuoka International Conference Hall, Fukuoka, Japan.

"Thermodynamic duality between nonequilibrium states and tilted equilibrium states in stochastic systems" (Oral)
The 67th Condensed Matter Physics Summer School, Aug. 2–5, 2022, Japan (Online).

"Thermodynamic duality between nonequilibrium relaxation processes and tilted quasi-static processes in stochastic systems" (Poster)
5th Conference, Grant-in-Aid for Scientific Research on Innovative Areas: "Information physics of living matters," Jun. 20–21, 2022, Awaji Yumebutai International Conference Center, Hyogo, Japan.

"Legendre duality in stochastic thermodynamics based on information geometry" (Oral)
77th Annual Meeting, The Physical Society of Japan, Mar. 15–19, 2022, Japan (Online).

"Information-geometric dual affine coordinates in non-equilibrium chemical thermodynamics" (Oral)
2021 Autumn Meeting, The Physical Society of Japan, Sep. 20–23, 2021, Japan (Online).

"A global structure of stochastic thermodynamics based on dually flat geometry" (Oral)
The 66th Condensed Matter Physics Summer School, Aug. 2–5, 2021, Japan (Online).

Awards & Fellowships

Mar. 5, 2024 — Research award, Grant-in-Aid for Scientific Research on Innovative Areas: "Information physics of living matters"

Sep. 22, 2023 — Presentation award, 7th Conference, Grant-in-Aid for Scientific Research on Innovative Areas: "Information physics of living matters"

Aug. 16, 2023 — Editors' Suggestion, Physical Review Letters

Apr. 2023–Mar. 2026 — Research Fellowship for Young Scientists (DC1), Japan Society for the Promotion of Science (JSPS).

Apr. 2021–Mar. 2026 — Forefront Physics and Mathematics Program to Drive Transformation (FoPM), a World-leading Innovative Graduate Study (WINGS) Program, The University of Tokyo.

Mar. 18, 2021 — The School of Science Encouragement Award for the Undergraduate Program, School of Science, The University of Tokyo

Outreach & Popular science

May 2024 — Article "Physical constraints on biological functions, explored by the mathematics of inequalities" (in Japanese), Rigakubu News Vol. 56, No. 1, School of Science, the University of Tokyo

May 2020 — Biophysics Group & Quantum Information Group in Physics Lab 2020, Students' presentation at the school festival of the University of Tokyo

May 2019 — Quantum Information Group in Physics Lab 2019, Students' presentation at the school festival of the University of Tokyo

Skills

Programming: Python (numpy, sympy, matplotlib, pandas), C++ (modern)

Software & Service: LaTeX, Adobe Illustrator

Languages: Japanese (native), English (fluent), French (basic)