

Norihiro Iizuka

Curriculum Vitae

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Research Interests

Quantum gravity, black hole physics, holography, quantum information, and quantum many-body physics, with a current emphasis on multipartite entanglement and its physical and geometric content.

Citation summary (INSPIRE-HEP, 27 October 2026): 2,764 citations; h-index: 28.

Academic Appointments

Aug. 2024–present	Associate Professor (tenured) , Department of Physics, National Tsing Hua University, Taiwan.
Aug. 2024–present	Affiliate Associate Professor , Yukawa Institute for Theoretical Physics, Kyoto University (concurrent appointment).
Apr. 2014–Jul. 2024	Assistant Professor (tenured) , Department of Physics, Graduate School of Science, Osaka University.
Sep. 2013–Mar. 2014	Staff Scientist , RIKEN, Japan.
Sep. 2012–Aug. 2013	Specially Appointed Assistant Professor , Yukawa Institute for Theoretical Physics, Kyoto University.
Sep. 2009–Aug. 2012	Non-Member State Fellow and COFUND Fellow , Theory Unit, CERN, Switzerland.
Sep. 2006–Aug. 2009	Postdoctoral Researcher , Kavli Institute for Theoretical Physics, University of California, Santa Barbara, USA.
Sep. 2003–Aug. 2006	Visiting Fellow (postdoctoral) , Tata Institute of Fundamental Research, Mumbai, India.

Education

Ph.D. in Physics, Columbia University 2003

Degree conferred 15 October 2003. Advisor: Daniel Kabat.

Dissertation: *Holographic Description of Quantum Black Holes and Space-Time*.

M.A. in Physics, Columbia University 2001

B.Eng. in Applied Physics, The University of Tokyo 1998

Graduate studies in the Theoretical Astrophysics Group, Department of Physics, The University of Tokyo, April 1998 – August 1999.

Book

Quantum Theory of Black Holes (single-author; in Japanese).

Asakura Publishing, *Explorations in Theoretical Physics*, vol. 4, May 2026.

416 pages. ISBN: 978-4-254-13534-3.

Research Program Coordination

Served as principal investigator of research group B01 and as a coordinating-group member of the KAKENHI Transformative Research Area *Extreme Universe* (21H05182; area director: Tadashi Takayanagi).

Academic Service

FY2024: Member, JSPS Screening Committee for Young Researcher Fellowships.

External Research Funding

Principal investigator

National Science and Technology Council, Taiwan

2025–2027

Black Holes and Quantum Entanglement

General Research Project, no. 114-2112-M-007-025-MY3.

Period: 1 February 2025–31 July 2027.

KAKENHI: Transformative Research Areas (A)

FY2021–FY2025

Elucidating the interior physics of quantum black holes using quantum information

Principal investigator, planned research group B01, within the *Extreme Universe* research area.

[Project record: 21H05184](#).

KAKENHI: Scientific Research (C)

FY2018–FY2024

Emergent spacetime and black hole structure via gauge/gravity duality

Grant no. [18K03619](#).

KAKENHI: Young Scientists (B)

FY2013–FY2017

Challenges to open problems in condensed matter, nuclear, and gravitational theory centered on gauge/gravity duality

Grant no. [25800143](#).

Co-investigator

- **2020–2023: Scientific Research (C), [20K03975](#).**
Analysis of strongly coupled fields in curved spacetime via AdS/CFT duality.
- **2017–2019: Scientific Research (C), [17K05451](#).**
Analytical approaches to new black hole solutions using differential expansions.
- **2014–2016: Scientific Research (C), [26400280](#).**
Applications of AdS/CFT duality to nonlinear physical phenomena.

Honors and Fellowships

- **CERN COFUND and Non-Member State Fellowships**, 2009–2012.

Teaching Experience

National Tsing Hua University

- **Introduction to Quantum Theory of Black Holes and Holography I**
Fall 2024, 2025, and 2026. Graduate course covering black hole geometry and thermodynamics, Hawking radiation, entanglement, and the information problem.
- **Introduction to Quantum Theory of Black Holes and Holography II**
Spring 2025 and 2026; spring 2027 scheduled. Advanced topics include Haar random states, the Page curve, multipartite entanglement, gauge/gravity duality, and quantum chaos.
- **Introduction to String Theory**
Fall 2026. For advanced undergraduate and graduate students; fundamentals of string theory and string quantization, compactification, D-branes, and connections to particle physics and cosmology.

These courses include student presentations and discussion of research papers.

Osaka University: selected courses and seminars

Undergraduate teaching for students in physics, other sciences, engineering, and the humanities; senior research seminars and graduate-level training.

Years	Course or seminar
2024	Thermodynamics and Statistical Mechanics Essentials (second-year physics).
2023–2024	Quantum Mechanics II: advanced problem-solving class (third-year physics).
2019–2022	Mechanics II (first-year mathematics and biology).
2020–2022	Mechanics I (first-year engineering).
2015–2019	Mathematical Physics: advanced problem-solving class.
2014–2017	Thermodynamics: advanced problem-solving class.
2014	Mechanics I: advanced problem-solving class.
2014, 2015, 2020	Physics Seminar: introductory physics and mathematics for humanities students (2014–2015); quantum information and entanglement for physics students (2020).
2018	Introductory Physics Laboratory (engineering).
2018, 2020–2022	Senior seminars: General Relativity (2018, 2021), Advanced Quantum Mechanics (2020), and Introduction to String Theory (2022).
2014–2017	Quantum Field Theory Seminar (first-year master’s students).

Student Supervision and Research Mentorship

Four former Ph.D. students and postdoctoral researchers under my supervision have obtained permanent faculty positions at academic institutions in Japan and India.

Completed Ph.D. supervision at Osaka University

- **Takanori Anegawa**, Ph.D., March 2024.
Research on hyperfast growth in de Sitter complexity.
JSPS DC1 Fellow, 2021–2024; Outstanding Research Award, Graduate School of Science, Osaka University, 2023.
Current position: Assistant Professor (permanent), National Institute of Technology, Yonago College.
- **Kotaro Tamaoka**, Ph.D., March 2019.
Emergence of bulk geometries from conformal field theory.
Current position: Associate Professor (permanent), Nihon University.
- **Tsuyoshi Yokoya**, Ph.D., March 2019.
Analysis on entanglement entropy for two-dimensional lattice gauge theories with matter fields.

Also supervised master's and undergraduate research at Osaka University in collaboration with other group members, including research-topic development, analytical calculations, presentations, and thesis preparation.

Postdoctoral Mentorship

- **Akihiro Miyata**: January 2025–March 2026, YITP, Kyoto University.
Current position: Assistant Professor (permanent), National Institute of Technology, Maizuru College.
- **Nicolò Zenoni**: February 2023–October 2025, Osaka University and YITP, Kyoto University.
Current position: Humboldt Research Fellow (postdoctoral), Germany.
- **Sunil Kumar Sake**: November 2022–October 2025, Osaka University and YITP, Kyoto University.
Current position: Assistant Professor (permanent), Indian Institute of Technology Palakkad.

Outreach and Public Lectures

Public Lectures

- **December 2024**: Invited public lecture, *Thought Experiments, Black Holes, and Quantum Theory*, Extreme Universe Research Area (A), online.
- **November 2023**: Outreach lecture, *Frontiers of Theoretical Physics: Thought Experiments and the Universe*, Osaka Prefectural Yao High School.
- **January 2023**: 36th Yukawa Memorial Lecture, *Frontiers of Superstring Theory*, Osaka University.
Public lecture for high school students, university students, and the general public.

Selected Review and Popular Science Writing (Titles translated from Japanese)

- *The Black Hole Information Loss Problem and Related Developments*. *Butsuri (Journal of the Physical Society of Japan)*, **81**(7), July 2026 (invited review article; in Japanese).
- *Toward Resolving the Black Hole Information Loss Problem: The Island Proposal*. In *Physics: The Year 2022*, Maruzen Publishing, January 2022.
- *Development of String Theory as a Quantum Theory of Gravity*. *Parity* **30**(11), 18–23, November 2015.

Organization of Workshops and Conferences

International conferences and workshops

- **29 Sep.–2 Oct. 2026** Lead co-organizer, *Taiwan String Workshop 2026*.
National Tsing Hua University, Hsinchu, Taiwan.
- **1–5 Dec. 2025** Lead co-organizer, *Taiwan String Workshop 2025*.
Hsinchu, Taiwan.
- **29 Sep.–3 Oct. 2025** Lead co-organizer, *Holography and Quantum Information Workshop*.
Taipei, Taiwan.
- **20–24 Jan. 2025** Lead co-organizer, *Recent Developments in Black Holes and Quantum Gravity*.
YITP residential workshop, Kyoto University, Japan.
- **Oct. 2024** Co-organizer, *Quantum Extreme Universe: Matter, Information, and Gravity*.
OIST, Okinawa, Japan.
- **4 Sep.–6 Oct. 2023** Co-organizer, *Quantum Information, Quantum Matter and Quantum Gravity*.
YITP long-term workshop, Kyoto University, Japan.
- **Aug. 2023** Initiator and lead co-organizer, *Beijing–Osaka String/Gravity/Black Hole Workshop*.
KITS, Beijing, China. Initiated research exchange between string theorists in Beijing and gravity and black hole researchers at Osaka University.
- **Apr. 2023** Co-organizer, *Recent Developments in Quantum Physics of Black Holes 2023*.
YITP, Kyoto University, Japan.
- **Jan. 2022** Lead co-organizer, *Kagoshima Workshop on Quantum Aspects of Gravity*.
Hayato, Kagoshima Prefecture, Japan.
- **Sep. 2021** Lead co-organizer and lecturer, *Quantum Information and Quantum Black Holes*.
Online international workshop.
- **May 2021** Lead co-organizer, *Black Holes, Swampland, and Quantum Gravity*.
Online international workshop.
- **Apr. 2019** Co-organizer, *Recent Developments in AdS/CFT*.
OIST, Okinawa, Japan.
- **Sep. 2008** Lead co-organizer, *Quantum Black Holes Focus Week*.
IPMU (now Kavli IPMU), University of Tokyo, Kashiwa, Japan.

Forthcoming

- **23–26 Mar. 2027** Lead co-organizer, *Recent Developments in Black Holes and Quantum Gravity*.
YITP residential workshop, Kyoto University, Japan (approved and funded).

Domestic workshops

- **Oct. 2022** Lead co-organizer, *First Black Hole/Quantum Gravity Study Meeting*.
Nambu Hall, Osaka University, Japan.
- **Mar. 2022** Lead co-organizer, *New Directions in Gravity and String Theory*.
Black hole workshop for postdoctoral researchers and faculty; Alliance Tower Z, Beppu, Japan.

- **Aug. 2021** **Lead co-organizer**, *Kyoto–Osaka–Kobe/Awaji Island Black Hole Workshop*. Research exchange among graduate students, postdoctoral researchers, and junior faculty at Kyoto, Osaka, and Kobe Universities, Japan.

Seminar and interdisciplinary initiatives

- **East Asian String Webinar**: co-founded in 2020 and co-organized with researchers in Japan, Taiwan, and Korea, sustaining international research exchange during the COVID-19 pandemic. Co-founded with Koji Hashimoto; the series had 244 registered participants as of March 2022 and more than 1,000 cumulative attendances.
- **Science Connected by Equations**: co-organizer of a cross-department research exchange workshop at Osaka University, March 2015, with colleagues in physics, biology, and mathematics. Researchers introduced their work through a single central equation to encourage exchange across disciplines.

Invited Lecture Courses

- **Jul. 2022** **Extreme Universe School** (online). Introduction to Gauge/Gravity Duality; 6 hours, Japanese.
- **Aug. 2019** **APCTP, Korea**. Applications of String Theory to Condensed Matter Physics: Exotic Non-Fermi Liquids; 3 hours, English.
- **Aug. 2014** **Kyushu University, Japan**. From Basics of Quantum Black Holes to the Firewall Paradox; 8 hours, Japanese.
- **Jan. 2013** **International String Theory School, Taipei, Taiwan**. Introduction to AdS/CFT Correspondence; plenary invited lecture course, 6 hours, English.
- **Jun. 2012** **Mathematical Methods in Materials Science and Mathematical Physics**, RIKEN, Japan. Gauge/Gravity Duality and Strongly Correlated Electron Systems; plenary invited lectures, 3 hours, Japanese. Joint workshop hosted by MEXT, RIKEN, Tohoku University, and Hokkaido University.
- **Dec. 2011** **13th Singularity Workshop**, National Astronomical Observatory of Japan. Black Holes, Holography, and Non-Fermi Liquids; invited lectures, 3 hours, Japanese.

Additional invited and workshop lectures

- **Sep. 2021** *Workshop on Quantum Information and Quantum Black Holes* (online). Organizer and lecturer: “Islands, the Page curve, wormholes and quantum noise.”
- **Jul. 2019** *Kansai Regional Seminar*, Osaka University, Japan. Invited lecture: “String Theory: An Introduction for Beginning Graduate Students.”

Invited Talks at Conferences and Workshops

- **15–21 Dec. 2025** *East Asian Joint Workshop 2025*, Okinawa, Japan.
Invited talk on genuine multi-entropy and holography.
- **13–15 Dec. 2025** *Workshop on Quantum Gravity*, Seoul, Korea.
Invited talk on genuine multi-entropy and holography.
- **27 Oct.–1 Nov. 2025** *Extreme Universe 2025*, Kyoto, Japan.
Invited talk on genuine multi-entropy, holography, and black hole multi-entropy curves.
- **Nov. 2024** *East Asia Joint Workshop on Fields and Strings*, Kaohsiung, Taiwan.
Invited talk on dissipation in large- N matrix models and the $1/D$ expansion.
- **Aug. 2024** *Quantum Information, Quantum Field Theory and Gravity*, ICTS–TIFR, Bengaluru, India.
Invited talk on the IP matrix model and Krylov complexity.
- **Oct.–Nov. 2023** *14th Taiwan String Workshop*, Kaohsiung, Taiwan.
Invited talk on Krylov complexity and chaos in the IP matrix model.
- **Aug. 2023** *Beijing–Osaka String/Gravity/Black Hole Workshop*, KITS, Beijing, China.
Invited talk: “Krylov complexity in the IP matrix model.”
- **Jul. 2023** *Quantum Black Holes, Quantum Information and Quantum Strings*, APCTP, Pohang, Korea.
Invited talk: “Krylov complexity in the IP matrix model.”
- **Jan. 2022** *Kagoshima Workshop on Quantum Aspects of Gravity*, Hayato, Kagoshima Prefecture, Japan.
Invited overview talk: “Islands, the Page curve, wormholes and quantum noise.”
- **16–18 Dec. 2021** *Extreme Universe from Qubits*, IFQ–ExU Joint Mini Workshop, YITP, Kyoto University (online).
Plenary invited talk: “Defining entanglement without tensor factoring.”
- **1–5 Mar. 2021** *Recent Progress in Theoretical Physics based on Quantum Information Theory*, YITP, Kyoto University, Japan.
Plenary invited talk: “Wormholes and holographic decoherence.”
- **Nov. 2020** *String Theory, Gravity, and Cosmology (SGC 2020)*, APCTP, Korea (online).
Plenary invited talk: “Islands and the Page curve in asymptotically flat spacetime black holes.”
- **Sep. 2020** *Autumn Symposium on String Theory*, Korea Institute for Advanced Study, Korea.
Plenary invited talk on the conformally invariant averaged null energy condition from AdS/CFT.
- **Aug. 2020** *Quantum Matter and Quantum Information with Holography*, APCTP, Korea (online).
Plenary invited talk: “ANEC, No! It’s ‘CANEC’”
- **Aug. 2019** *Quantum Matter from the Entanglement and Holography*, APCTP, Pohang, Korea.
Plenary invited talk: “Various Phase Structures of AdS gravity/Condensed matter theory.”
- **Apr. 2019** *Recent Developments in AdS/CFT*, OIST, Okinawa, Japan.
Plenary invited talk: “What do you know behind the horizon?”
- **Mar. 2018** *RIKEN–Osaka–OIST Joint Workshop*, OIST, Okinawa, Japan.
Invited talk: “Some thoughts on complexity.”
- **Mar. 2018** *Holography, Quantum Entanglement and Higher Spin Gravity II*, YITP, Kyoto University, Japan.
Plenary invited talk: “Some thoughts on complexity.”

- **Dec. 2017** *Counting Problems in Quantum Field Theory and String Theory*, Joburg Workshop on String Theory, Mandelstam Institute for Theoretical Physics, University of the Witwatersrand, South Africa.
Plenary invited talk: “Exact Path Integral for 3d Quantum Gravity.”
- **Apr. 2017** *KPS–JPS Joint Special Symposium*, Daejeon Convention Center, Daejeon, Korea.
Invited talk: “Various Phase Structures of AdS gravity/Condensed matter theory.”
- **Jun. 2016** *Quantum Matter, Spacetime and Information*, YITP, Kyoto University, Japan.
Invited talk: “Exact Path Integral for 3D Quantum Gravity.”
- **Jan. 2015** *Second International Workshop on Developments in M-theory*, KIAS, High1 Resort, Korea.
Invited talk: “What does condensed matter physics tell us about general relativity?”
- **May 2014** *Holographic Vistas on Gravity and Strings*, YITP long-term workshop, Kyoto University, Japan.
Plenary invited talk: “What does condensed matter physics tell us about general relativity?”
- **Aug. 2013** *Field Theory and String Theory*, YITP, Kyoto University, Japan.
Plenary invited talk: Applications of the AdS/CFT Correspondence to Condensed Matter Systems (title translated from Japanese).
- **Sep. 2011** *Holography and Universality of Black Holes, Part Deux*, McGill University, Montreal, Canada.
Invited talk: “Holographic Fermi and Non-Fermi Liquids with Transitions in Dilaton Gravity.”
- **Jan. 2011** *Fifth Indian Strings Meeting (ISM11)*, Puri, India.
Invited talk: “Rapid Thermalization by Baryon Injection in Gauge/Gravity Duality.”
- **Sep. 2010** *Physical Society of Japan Autumn Meeting*, Kyushu Institute of Technology, Tobata Campus, Japan.
Invited talk: Black Holes and Condensed Matter Physics (title translated from Japanese).
- **Dec. 2009** *Frontier of Research in Higher Dimensional Black Holes*, YITP, Kyoto University, Japan.
Invited talk: “Matrix Quantum Mechanics for the Black Hole Information Problem.”
- **Oct. 2009** *Branes, Strings and Black Holes*, YITP, Kyoto University, Japan.
Invited talk: “Matrix Quantum Mechanics for the Black Hole Information Problem.”
- **Jan. 2009** *First Taiwan String Workshop*, Taipei, Taiwan.
Plenary invited talk: “Matrix Quantum Mechanics for the Black Hole Information Problem.”
- **Dec. 2008** *Fourth Indian Strings Meeting (ISM08)*, Pondicherry, India.
Invited talk: “Matrix Quantum Mechanics for the Black Hole Information Problem.”
- **Sep. 2008** *Quantum Black Holes*, IPMU Focus Week, University of Tokyo, Kashiwa, Japan.
Invited talk: “Matrix Quantum Mechanics for the Black Hole Information Problem.”
- **Apr. 2006** *IPM International String Theory School 2006*, Tehran, Iran.
Plenary invited talk: “Non-supersymmetric Attractors.”
- **Jan. 2005** *IPM International String Theory School 2005*, Qeshm Island, Iran.
Invited talk: “An Inflationary Model in String Theory.”

Research program reports

- **Dec. 2022** *Second Annual Meeting of Extreme Universe*, Kobe Convention Center, International Conference Center, Japan.
B01 group activity report.

Invited Seminars at Universities and Institutes

Japan

- Nagoya University: 2023, 2022, 2021, 2011, 2009.
- Osaka Metropolitan University: 2022.
- Osaka University: 2022, 2021, 2014, 2013, 2006.
- KEK: 2019, 2014, 2013, 2011, 2006.
- Rikkyo University: 2016, 2014.
- University of Tokyo, Komaba: 2014, 2011, 2006.
- RIKEN: 2014, 2012, 2011, 2010.
- Yukawa Institute for Theoretical Physics, Kyoto University: 2013, 2012, 2011, 2006.
- Nihon University: 2012.
- University of Tokyo, Hongo: 2011, 2006.
- IPMU, University of Tokyo: 2011.
- Ibaraki University: 2011.
- Kyoto University: 2008.

Asia outside Japan

- Seoul National University, Korea: 2026.
- Korea Institute for Advanced Study, Korea: 2026.
- National Yang Ming Chiao Tung University, Taiwan: 2026 (March; seminar on genuine multi-entropy and the junction law).
- Tata Institute of Fundamental Research, Mumbai, India: 2022, 2006, 2005, 2003; September 2022: seminar on defining entanglement without tensor factoring.
- National Taiwan University, Taiwan: 2025, 2019, 2011.
- HKUST Jockey Club Institute for Advanced Study, Hong Kong: 2018.
- National Tsing Hua University, Hsinchu, Taiwan: 2026, 2025, 2024, 2011, 2009.
- Harish-Chandra Research Institute, Allahabad, India: 2003.

Europe

- University of Cambridge, UK: 2011.
- Utrecht University, Netherlands: 2011, 2008.
- International Centre for Theoretical Physics, Trieste, Italy: 2011.
- Max Planck Institute, Munich, Germany: 2011.
- Institut de Physique Théorique, Saclay, France: 2011.
- University of Amsterdam, Netherlands: 2010, 2008.
- Imperial College London, UK: 2009.

North and South America

- ICTP South American Institute for Fundamental Research, São Paulo, Brazil: 2012.
- University of British Columbia, Vancouver, Canada: 2009.
- University of Texas at Austin, USA: 2008.
- Texas A&M University, USA: 2008.

- University of Kentucky, USA: 2008.
- University of California, Santa Barbara, USA: 2008, 2006.
- University of California, Berkeley, USA: 2008.
- California Institute of Technology, USA: 2008, 2007.
- University of California, Los Angeles, USA: 2006.
- Stanford University, USA: 2004.
- Harvard University, USA: 2004.
- Massachusetts Institute of Technology, USA: 2004.
- Columbia University, USA: 2004, 2003, 2002, 2001.
- Stony Brook University, USA: 2002.
- University of Pennsylvania, USA: 2002.