

Pratik Nandy

Kitashirakawa Oiwakecho,
Sakyo-ku, Kyoto, Japan
✉ pratik@yukawa.kyoto-u.ac.jp
Homepage, [INSPIRE-HEP](#)
[Google Scholar](#), [Researchgate](#)

Current affiliation

- 2022-present Extreme Universe (ExU) Postdoctoral fellow, *JSPS Grant-in-Aid for Transformative Research Areas (A) "Extreme Universe"*.
Center for Gravitational Physics and Quantum Information, Yukawa Institute for Theoretical Physics (YITP), Kyoto University, Japan.
- 2023-present RIKEN Interdisciplinary Theoretical and Mathematical Sciences Program (iTHEMS).
RIKEN, Wako and Kyoto University campus, Japan.

Research experiences

- 2024-present Visiting postdoc through RIKEN-Berkeley ASPIRE program, *Berkeley Center for Theoretical Physics (BCTP)*, University of California, Berkeley, CA, USA.
- 2023-2023 Visiting postdoc., *Princeton Center for Theoretical Science (PCTS)*, Princeton University, Princeton, New Jersey, USA.

Education

- 2017-2022 PhD in Physics, *Centre for High Energy Physics, Indian Institute of Science*, Bangalore, India.
PhD thesis: Complexity and Entanglement: From quantum gravity to many-body systems.
Supervisor: Prof. Aninda Sinha.
- 2015-2017 Master of Science (M.Sc) in Physics, *Indian Institute of Technology Kanpur*, India.
(received academic excellence award).
- 2012-2015 Bachelor of Science (B.Sc) in Physics, *Presidency University*, Kolkata, India.

Research interests

1. Complexity and entanglement in quantum field theory and holography, 2. Holography and many-body quantum chaos, 3. Non-Hermitian and open quantum systems, 4. Random matrix theory, SYK, double-scaled SYK model, and their relation to quantum gravity, 5. Quantum teleportation and wormhole geometry.

Publications/Preprints

[All papers (except marked with *****) are arranged in the alphabetical order of the authors' name, which is conventional in high-energy theory (hep-th) community and signifies equal contribution].

- 2024 **17.** Probing quantum chaos through singular-value correlations in sparse non-Hermitian SYK model, **P. Nandy**, T. Pathak, M. Tezuka, [arXiv:2406.11969 [quant-ph]].
- *16.** Quantum Dynamics in Krylov Space: Methods and Applications, **P. Nandy**, A. S. Matsoukas-Roubeas, P. Martínez-Azcona, A. Dymarsky, A. del Campo, [arXiv:2405.09628 [quant-ph]].
- 2023 **15.** Operator dynamics in Lindbladian SYK: a Krylov complexity perspective, B. Bhattacharjee, **P. Nandy**, T. Pathak, [JHEP 01 \(2024\) 094](#), [arXiv:2311.00753 [quant-ph]].

14. On Krylov complexity in open systems: an approach via bi-Lanczos algorithm, A. Bhattacharya, **P. Nandy**, P. P. Nath, H. Sahu, [JHEP 12 \(2023\) 066](#), [arXiv:2303.04175 [quant-ph]].
- 2022 13. Operator growth in open quantum systems: lessons from the dissipative SYK, B. Bhattacharjee, X. Cao, **P. Nandy**, T. Pathak, [JHEP 03 \(2023\) 054](#), [arXiv:2212.06180 [quant-ph]].
12. Krylov complexity in large- q and double-scaled SYK model, B. Bhattacharjee, **P. Nandy**, T. Pathak, [JHEP 08 \(2023\) 099](#), [arXiv:2210.02474 [hep-th]].
- *11. Probing quantum scars and weak ergodicity-breaking through quantum complexity, B. Bhattacharjee, S. Sur, **P. Nandy**, T. Pathak, [Phys. Rev. B 106, 205150 \(2022\)](#), [arXiv:2208.05503 [quant-ph]].
10. Operator growth and Krylov construction in dissipative open quantum systems, A. Bhattacharya, **P. Nandy**, P. P. Nath, H. Sahu, [JHEP 12 \(2022\) 081](#), [arXiv:2207.05347 [quant-ph]].
9. Krylov complexity in saddle-dominated scrambling, B. Bhattacharjee, X. Cao, **P. Nandy**, T. Pathak, [JHEP 05 \(2022\) 174](#), [arXiv:2203.03534 [quant-ph]].
8. Balanced Partial Entanglement and Mixed State Correlations, H. A. Camargo, **P. Nandy**, Q. Wen, H. Zhong, [SciPost Phys. 12 \(2022\) 137](#), [arXiv:2201.13362 [hep-th]].
7. Q-curvature and Path Integral Complexity, H. A. Camargo, P. Caputa, **P. Nandy**, [JHEP 04 \(2022\) 081](#), [arXiv:2201.00562 [hep-th]].
- 2021 6. Bath deformations, islands and holographic complexity, A. Bhattacharya, A. Bhattacharyya, **P. Nandy**, A. K Patra, [Phys. Rev. D 105, 066019](#), [arXiv:2112.06967 [hep-th]].
5. Partial islands and subregion complexity in geometric secret-sharing model, A. Bhattacharya, A. Bhattacharyya, **P. Nandy**, A. K Patra, [JHEP 12 \(2021\) 091](#), [arXiv:2109.07842 [hep-th]].
4. Eigenstate capacity and Page curve in fermionic Gaussian states, B. Bhattacharjee, **P. Nandy**, T. Pathak, [Phys. Rev. B 104, 214306 \(2021\)](#), [arXiv:2109.00557 [quant-ph]].
3. Capacity of entanglement in local operators, **P. Nandy**, [JHEP 07 \(2021\) 019](#), [arXiv:2106.00228 [hep-th]].
2. Islands and complexity of eternal black hole and radiation subsystems for a doubly holographic model, A. Bhattacharya, A. Bhattacharyya, **P. Nandy**, A. K Patra, [JHEP 05 \(2021\) 135](#), [arXiv:2103.15852 [hep-th]].
- 2019 1. Renormalized Circuit Complexity, A. Bhattacharyya, **P. Nandy**, A. Sinha, [Phys. Rev. Lett. 124, 101602 \(2020\)](#), [arXiv:1907.08223 [hep-th]].

Presentations, Talks, and Lectures

- Jun 2024 Seminar on “Operator growth in open quantum systems: lessons from dissipative SYK model” at Department of Physics, University of Kentucky, USA
- Feb 2024 Invited talk on “Operator dynamics in Lindbladian Sachdev-Ye-Kitaev (SYK) model” at the 2nd Young researchers workshop, Shirahama-so, Shiga, Japan
- Feb 2024 Invited talk on “Operator dynamics in Lindbladian SYK” at the Osaka University, Osaka, Japan
- Jan 2024 Invited talk on “An operator growth hypothesis on open quantum systems” at the Department of Physics and Material Science, University of Luxembourg, Luxembourg.
- Jan 2024 Invited talk on “Introduction to double-scaled SYK” at Kobayashi-Masakawa Institute, Nagoya University, Nagoya, Japan.
- Jan 2024 Invited seminar on “Operator growth and quantum chaos in the SYK model” at Kobayashi-Masakawa Institute, Nagoya University, Nagoya, Japan.
- Dec 2023 Invited seminar on “Krylov complexity: a status-report” at Saitama University, Saitama, Japan.
- Nov 2023 Contributed talk on “Operator dynamics of Lindbladian SYK” at KEK Theory Workshop, Tsukuba, Ibaraki, Japan.

- Nov 2023 Contributed talk on “Operator dynamics of Lindbladian SYK” at Quantum Gravity Gatherings, RIKEN, Wako, Japan.
- Nov 2023 Invited talk on “An operator growth hypothesis on open quantum systems” at the Department of Physics, The University of Tokyo, Tokyo, Japan.
- Oct 2023 Invited talk on “An operator growth hypothesis on open quantum systems” at Saha Institute of Nuclear Physics, Kolkata, India
- Oct 2023 Invited talk on “Recent progress on Krylov complexity” at Centre for High Energy Physics, Indian Institute of Science, Bengaluru, India.
- Sept 2023 Contributed talk on “Operator growth and quantum chaos: lessons from SYK” at the conference Quantum Information, Quantum Matter and Quantum Gravity, YITP, Kyoto, Japan.
- July 2023 Invited talk on “An operator growth hypothesis on open quantum systems” at the conference Integrability, Deformations, and Chaos, Okinawa Institute of Science and Technology, Okinawa, Japan.
- May 2023 Invited talk on “Dissipative quantum chaos: lessons from SYK” at the workshop Entanglement, Large N and Black Hole, APCTP, Pohang, Korea.
- Feb 2023 Gong show and poster presentation on “An operator growth hypothesis on open quantum systems” at the young researchers’ workshop, Nagoya University, Nagoya, Japan.
- Jan 2023 Gong show and poster presentation on “An operator growth hypothesis on open quantum systems” at the 17th Kavli Asian Winter School on Strings, Particles and Cosmology, IBS, Daejeon, Korea.
- Dec 2022 Gong show and poster presentation on “An operator growth hypothesis on open quantum systems” at the ExU annual conference, Kobe, Japan.
- Sept 2022 Invited talk on “Complexity in the SYK: some analytic results” in ExU circular meeting, YITP, Kyoto University, Japan.
- June 2022 NITHeCS webinar (invited): Two lectures on “Recent progress on Krylov complexity” in the Department of Mathematics and Applied Mathematics, University of Cape Town, South Africa.
- Dec 2021 Invited (online) talk on “Quantum information: from quantum gravity to condensed matter physics” in the Department of Computer Science, Texas Tech. University, Lubbock, Texas, USA.
- Aug 2021 Invited (online) talk on “Q-curvature and Path Integral Complexity” in Quantum Information in QFT and AdS/CFT-II.
- Feb 2021 (Online) Talk on “Renormalized Circuit Complexity” in CHEP in-house symposium, IISc Bangalore.
- Aug 2020 Invited (online) talk on “Renormalized Circuit Complexity” in Quantum Information in QFT and AdS/CFT-I.
- Jul 2020 Invited (online) lectures (3 pedagogical lectures) on tensor networks and complexity in ST4-2020.
- Jan 2020 Gong show and poster presentation on “Renormalized Circuit Complexity” at the 14th Kavli Asian Winter School on Strings, Particles and Cosmology, Tohoku University, Sendai, Japan.

Refereed journals

SciPost Physics, Physical Review D, Physical Review Research.

Teaching experiences

- 2019-2020 Graduate course: General relativity.
Course instructor: Prof. Justin R. David, Indian Institute of Science, Bangalore.

Organizing experiences

- 2022 Workshop on Students talk on trending topics (ST4) - 2022, Indian Institute of Technology, Indore, India.

2021-2022 Math-Physics seminar series, CHEP, Indian Institute of Science, Bangalore, India.

Research visits

- Jun. 2024 Department of Physics, University of Kentucky, Lexington, USA.
Host: Prof. Anatoly Dymarsky.
- May/Jun. 2024 (Visiting postdoc.) Berkeley Center for Theoretical Physics (BCTP),
University of California, Berkeley, CA, USA.
Host: Prof. Yasunori Nomura.
- Feb 2024 Department of Physics, University of Basque Country, Bilbao, Spain
Host: Prof. Adolfo del Campo and Prof. Inigo L. Egusquiza.
- Jan./Feb 2024 Department of Physics, University of Luxembourg, Luxembourg.
Host: Prof. Adolfo del Campo.
- Jan. 2024 Department of Physics, Kobayashi-Masakawa Institute, Nagoya University, Japan.
Host: Prof. Masamichi Miyaji.
- Dec. 2023 Department of Physics, Saitama University, Japan.
Host: Prof. Kentaroh Yoshida.
- Nov. 2023 Department of Physics, The University of Tokyo, Japan.
Host: Prof. Hosho Katsura.
- Feb/Mar. 2023 (Visiting postdoc.) Princeton Center for Theoretical Science (PCTS),
Princeton University, New Jersey, USA.
Host: Prof. Shinsei Ryu.
- Aug. 2022 Department of Physics, Indian Institute of Technology, Gandhinagar, India.
Host: Prof. Arpan Bhattacharyya.
- Jun. 2022 Department of Mathematics and Applied Mathematics, University of Cape Town, South Africa.
Host: Prof. Shajid Haque and Prof. Jeff Murugan.

Academic achievements, grants, awards, and scholarships

- 2024 Adopting Sustainable Partnerships for Innovative Research Ecosystem (ASPIRE) fellowship, iTHEMS, RIKEN, Japan, and University of California, Berkeley, USA, Japan Science and Technology Agency (JST), Grant Number JPMJAP2318..
- 2023 Extreme Universe Overseas visiting researchers grant, KAKENHI No. 21H05182.
- 2022-2025 Extreme Universe (ExU) Postdoctoral fellowship, JSPS Grant-in-Aid for Transformative Research Areas (A) "Extreme Universe" No. 21H05190, Japan.
- 2019-2022 SRF-Senior Research Fellowship (PhD), University Grants Commission (UGC), India.
- 2017-2019 JRF-Junior Research Fellowship (PhD), University Grants Commission (UGC), India.
- 2017 Academic Excellence Award (M.Sc), IIT Kanpur.
- 2012-2015 INSPIRE Scholarship (B.Sc), Department of Science and Technology, India.

Press releases and media coverage

- 2020 Optimizing efficiency of quantum circuits at Phys.org, [link here].
- 2020 IISc team proposes efficient design for quantum circuits (IISc press release), [link here]. (NDTV), [link here].

Personal

DOB, Gender 30 June 1994 (Age: 29), Male.
Citizenship India.

Residence Japan.

Languages English, Bengali (native), Hindi, Japanese (basic).

Comp. skills Mathematica, Python.

Last updated: Friday 21st June, 2024