

PRATIK NANDY

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ACADEMIC APPOINTMENTS

- **Yukawa Institute for Theoretical Physics (YITP), Kyoto University & RIKEN Center for Interdisciplinary Theoretical and Mathematical Sciences.** *2022–2025*
Extreme Universe Collaboration postdoctoral researcher.

RESEARCH INTERESTS

Investigating quantum information aspects of quantum chaos in many-body systems and gravity, with a particular focus on non-Hermitian and open quantum systems. I utilize frameworks such as Random Matrix Theory, Krylov space methods, and quantum computational techniques.

VISITING RESERACH EXPERIENCES

- **Princeton Center for Theoretical Science, Princeton University, USA.** *2023*
Extreme Universe Collaboration visiting researcher.
- **Berkeley Center for Theoretical Physics, University of California, Berkeley, USA.** *2024*
RIKEN-Berkeley ASPIRE visiting researcher.

EDUCATION

- **Centre for High Energy Physics, Indian Institute of Science (IISc), Bengaluru, India.** *2017–2022*
PhD in Physics.
Supervisor: Prof. Aninda Sinha.
- **Indian Institute of Technology Kanpur (IIT-K), India.** *2015–2017*
Master of Science (M.Sc) in Physics (received academic excellence award).
- **Presidency University, Kolkata, India.** *2012–2015*
Bachelor of Science (B.Sc) in Physics.

PUBLICATIONS/PREPRINTS

All papers (except marked with *****) are arranged in alphabetical order of the authors' names, which is conventional in the high-energy theory (hep-th) community. Papers marked with ***** are arranged according to the contributions of each author.

***21.** Free Probability approach to spectral and operator statistics in Rosenzweig-Porter random matrix ensembles, V. Jahnke[†], **P. Nandy**[†], K. Pal, H. A. Camargo, K-Y. Kim [[arXiv:2506.04520](#) [[hep-th](#)]].

([†] equal contribution)

***20.** A Krylov space approach to Singular Value Decomposition in non-Hermitian systems, **P. Nandy**, T. Pathak, Z-Y. Xian, J. Erdmenger [[Phys. Rev. B 111, 064203 \(2025\)](#)].

19. Tridiagonal Hamiltonians modeling the density of states of the Double-Scaled SYK model, **P. Nandy** [[JHEP 01 \(2024\) 094](#)].

18. Krylov fractality and complexity in generic random matrix ensembles, B. Bhattacharjee, **P. Nandy** [[Phys. Rev. B 111, L060202 \(2025\) \(Letter\)](#)].

17. Probing quantum chaos through singular-value correlations in sparse non-Hermitian SYK model, **P. Nandy**, T. Pathak, M. Tezuka [[Phys. Rev. B 111, L060201 \(2025\) \(Letter\)](#)].
- *16. Quantum Dynamics in Krylov Space: Methods and Applications, **P. Nandy**, A. S. Matsoukas-Roubeas, P. Martínez-Azcona, A. Dymarsky, A. del Campo, [[Phys.Rept. 1125-1128 \(2025\) \(Invited review\)](#)].
15. Operator dynamics in Lindbladian SYK: a Krylov complexity perspective, B. Bhattacharjee, **P. Nandy**, T. Pathak, [[JHEP 01 \(2024\) 094](#)].
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](#)].
13. Operator growth in open quantum systems: lessons from the dissipative SYK, B. Bhattacharjee, X. Cao, **P. Nandy**, T. Pathak, [[JHEP 03 \(2023\) 054](#)].
12. Krylov complexity in large- q and double-scaled SYK model, B. Bhattacharjee, **P. Nandy**, T. Pathak, [[JHEP 08 \(2023\) 099](#)].
- *11. Probing quantum scars and weak ergodicity-breaking through quantum complexity, B. Bhattacharjee, S. Sur, **P. Nandy** [[Phys. Rev. B 106, 205150 \(2022\)](#)].
10. Operator growth and Krylov construction in dissipative open quantum systems, A. Bhattacharya, **P. Nandy**, P. P. Nath, H. Sahu, [[JHEP 12 \(2022\) 081](#)].
9. Krylov complexity in saddle-dominated scrambling, B. Bhattacharjee, X. Cao, **P. Nandy**, T. Pathak, [[JHEP 05 \(2022\) 174](#)].
8. Balanced Partial Entanglement and Mixed State Correlations, H. A. Camargo, **P. Nandy**, Q. Wen, H. Zhong, [[SciPost Phys. 12 \(2022\) 137](#)].
7. Q-curvature and Path Integral Complexity, H. A. Camargo, P. Caputa, **P. Nandy**, [[JHEP 04 \(2022\) 081](#)].
6. Bath deformations, islands and holographic complexity, A. Bhattacharya, A. Bhattacharyya, **P. Nandy**, A. K Patra, [[Phys. Rev. D 105, 066019 \(2022\)](#)].
5. Partial islands and subregion complexity in geometric secret-sharing model, A. Bhattacharya, A. Bhattacharyya, **P. Nandy**, A. K Patra, [[JHEP 12 \(2021\) 091](#)].
4. Eigenstate capacity and Page curve in fermionic Gaussian states, B. Bhattacharjee, **P. Nandy**, T. Pathak, [[Phys. Rev. B 104, 214306 \(2021\)](#)].
3. Capacity of entanglement in local operators, **P. Nandy**, [[JHEP 07 \(2021\) 019](#)].
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](#)].
1. Renormalized Circuit Complexity, A. Bhattacharyya, **P. Nandy**, A. Sinha, [[Phys. Rev. Lett. 124, 101602 \(2020\)](#)].

SEMINARS, TALKS, LECTURES AND PRESENTATIONS

Invited talks/seminars

- At the 4th young researchers' workshop of the Extreme Universe Collaboration, Kyukamura Irago, Aichi, Japan [[link](#)]. *July 2025*
- At the CERN Heavy Ion Theory group, CERN, Switzerland [[link](#)]. *June 2025*
- At conference "Quantum Connections: Linking Information, Gravity, and Many-Body Physics, Jeju, South Korea [[link](#)]. *June 2025*

- At the Institute of Solid State Physics (ISSP), University of Tokyo, Japan [[link](#)]. *May 2025*
- At Department of Physics, Gakushuin University, Tokyo, Japan [[link](#)]. *May 2025*
- At the “Workshop on Low-dimensional Gravity and SYK Model”, Matsumoto, Japan [[link](#)]. *March 2025*
- At Department of Physics, Gwangju Institute of Science and Technology (GIST), Gwangju, South Korea. *March 2025*
- At NCTS, National Tsing Hua University, Hsinchu, Taiwan. *Nov. 2024*
- At the workshop “Focus Week on Non-equilibrium Quantum Dynamics” Kavli IPMU, University of Tokyo, Japan [[link](#)]. *Oct. 2024*
- At the 3rd young researchers’ workshop of the Extreme Universe Collaboration, Grand Park Otaru, Hokkaido, Japan [[link](#)]. *Sept. 2024*
- At the workshop “Holography in Beijing 2024”, Kavli Institute of Theoretical Sciences (KITS), UCAS, Beijing, China [[link](#)]. *July 2024*
- At Department of Physics and Astronomy, University of Kentucky, USA. *June 2024*
- At the Department of Physics, Osaka University, Osaka, Japan. *Feb. 2024*
- At the 2nd young researchers’ workshop of the Extreme Universe Collaboration, Shirahamaso, Shiga, Japan [[link](#)]. *Feb. 2024*
- At Dept. of Physics & Material Science, University of Luxembourg, Luxembourg. *Jan. 2024*
- At the Kobayashi-Masakawa Institute, Nagoya University, Nagoya, Japan. *Jan. 2024*
- At the Department of Physics, Saitama University, Saitama, Japan. *Dec. 2023*
- At the Department of Physics, The University of Tokyo, Tokyo, Japan. *Nov. 2023*
- At the Theory Division, Saha Institute of Nuclear Physics, Kolkata, India. *Oct. 2023*
- At the conference “Integrability, Deformations, and Chaos”, Okinawa Institute of Science and Technology (OIST), Okinawa, Japan [[link](#)]. *July 2023*
- At the workshop “Entanglement, Large N and Black Hole”, Asia Pacific Center for Theoretical Physics (APCTP), Pohang, South Korea [[link](#)]. *May 2023*
- At the 1st young researchers’ workshop of the Extreme Universe Collaboration, Nagoya University, Japan [[link](#)]. *Feb. 2023*
- NITHeCS lectures on “Recent progress on Krylov complexity” [[link](#)], Department of Mathematics & Applied Mathematics, University of Cape Town, South Africa. *June 2022*
- At the Department of Computer Science, Texas Tech. University, Lubbock, USA. *Dec. 2021*
- At the workshop “Quantum Information in QFT and AdS/CFT-II” [[link](#)]. *Aug. 2021*
- At the workshop “Quantum Information in QFT and AdS/CFT-I” [[link](#)]. *Aug. 2020*
- Three pedagogical lectures on “Tensor networks and complexity”, Student Talks on Trending Topics in Theory, ST4-2020, India [[link](#)]. *July 2020*

Contributed talks

- At the symposium on Physics of Open Systems: Resonance, Symmetry and Topology, University of Tokyo, Kashiwa, Japan. [[link](#)]. *Aug. 2025*

- At the conference “Hydrodynamics of low-dimensional interacting systems: Advances, challenges, and future directions”, YITP, Kyoto University, Japan [[link](#)]. *June 2025*
- At the conference “Kyushu IAS-iTHEMS workshop: Non-perturbative methods in QFT”, Kyushu University, Fukuoka, Japan [[link](#)]. *March 2025*
- At the workshop “East Asia Joint Workshop on Fields and Strings”
National Sun-Yat Sen University, Kaohsiung, Taiwan [[link](#)]. *Nov. 2024*
- At the conference “Quantum Extreme Universe: Matter, Information, and Gravity”
Okinawa Institute of Science and Technology (OIST), Okinawa, Japan [[link](#)]. *Oct. 2024*
- At the conference “Quantum Information, Quantum Field Theory and Gravity”
International Centre for Theoretical Sciences (ICTS), Bengaluru, India [[link](#)]. *Aug. 2024*
- At the “KEK Theory Workshop 2023”, Tsukuba, Ibaraki, Japan [[link](#)]. *Nov. 2023*
- At the conference “Quantum Information, Quantum Matter and Quantum Gravity”,
Yukawa Institute for Theoretical Physics (YITP), Kyoto, Japan [[link](#)]. *Sept. 2023*

Poster Presentations

- At the 19th Asian Winter School on Strings, Particles and Cosmology,
Tsinghua Sanya International Mathematics Forum (TSIMF), Sanya, China [[link](#)]. *Jan. 2025*
- At the fourth Annual Meeting of Extreme Universe Collaboration,
Osaka University, Osaka, Japan [[link](#)]. *Sept. 2024*
- At the 17th Kavli Asian Winter School on Strings, Particles and Cosmology,
Institute for Basic Science, Daejeon, South Korea [[link](#)]. *Jan. 2023*
- At the second Annual Meeting of Extreme Universe Collaboration,
Kobe Convention Center, Kobe, Japan [[link](#)]. *Dec. 2022*
- At the 14th Kavli Asian Winter School on Strings, Particles and Cosmology,
Tohoku University, Sendai, Japan [[link](#)]. *Jan. 2020*

ACADEMIC ACHIEVEMENTS

- Adopting Sustainable Partnerships for Innovative Research Ecosystem (ASPIRE) fellowship,
Japan Science and Technology Agency (JST), Grant No. JPMJAP2318, Japan. *2024*
- Extreme Universe Overseas researcher fellowship, KAKENHI Grant No. 21H05182, Japan. *2023*
- Extreme Universe Postdoctoral fellowship, Japan Society for Promotion of Science (JSPS),
Grant-in-Aid for Transformative Research Areas (A) “Extreme Universe” No. 21H05190. *2022–2025*
- SRF-Senior Research Fellowship (PhD), University Grants Commission (UGC), India. *2019–2022*
- JRF-Junior Research Fellowship (PhD), University Grants Commission (UGC), India *2017–2019*
- Academic Excellence Award (M.Sc), Indian Institute of Technology Kanpur, India *2017*
- INSPIRE Scholarship (B.Sc), Department of Science and Technology (DST), India *2012–2015*

NEWSLETTERS, PRESS RELEASES AND MEDIA COVERAGE

- Understanding dynamics & quantum chaos through Krylov space,
RIKEN newsletter [[link](#)]. *2025*
- Optimizing efficiency of quantum circuits at Phys.org [[link](#)]. *2020*
- IISc team proposes efficient design for quantum circuits [[link](#)] [[link](#)]. *2020*

TEACHING EXPERIENCES

- NITHeCS lectures on “Recent progress on Krylov complexity” [[link](#)], 2022
Department of Mathematics & Applied Mathematics, University of Cape Town, South Africa.
- Three pedagogical lectures on “Tensor networks and complexity”,
Student Talks on Trending Topics in Theory, ST4-2020, India [[link](#)]. 2020
- Graduate Teaching Assistant: General Relativity, Indian Institute of Science, Bengaluru. 2019–2020

ORGANIZING EXPERIENCES

- Workshop on Students talk on trending topics in Theory (ST4) - 2022,
Indian Institute of Technology, Indore, India [[link](#)]. 2022
- Math-Physics seminar series, Indian Institute of Science, Bengaluru, India. 2021–2022

REFEREED JOURNALS

- Journal of High Energy Physics (JHEP).
- SciPost Physics.
- Physical Review B (PRB).
- Physical Review D (PRD).
- Physical Review E (PRE).
- Physical Review Research (PRR).
- Progress of Theoretical and Experimental Physics (PTEP).

TECHNICAL SKILLS

Languages	Python, Mathematica.
Software	LaTeX, MS Office.

REFERENCES (NO PARTICULAR ORDER)

Prof. Aninda Sinha,
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