PRATIK NANDY

Homepage, INSPIRE-HEP, Google Scholar, Linkedin, Researchgate
Email: pratiknandy94@gmail.com, ORCID iD: 0000-0001-5383-2458

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 conference "Da Nang, Holography and String Theory, 8th", *Aug. 2025*
Duy Tan University, Da Nang, Vietnam [link].

• At iTHEMS Theoretical Physics Seminar, RIKEN, Japan [link]. *July 2025*

• 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], *June 2022*
Department of Mathematics & Applied Mathematics, University of Cape Town, South Africa.

• 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-Jenior 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, *2025*
RIKEN newsletter [link].
- 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 (PETP).

TECHNICAL SKILLS

Languages	Python, Mathematica.
Software	LaTeX, MS Office.

REFERENCES (NO PARTICULAR ORDER)

Prof. Aninda Sinha,
Centre for High Energy Physics, Indian Institute of Science, Bengaluru, India.
Email: asinha@iisc.ac.in

Prof. Tadashi Takayanagi,
Yukawa Institute for Theoretical Physics (YITP), Kyoto University, Japan.
Email: takayana@yukawa.kyoto-u.ac.jp

Prof. Anatoly Dymarsky,
Department of Physics and Astronomy, University of Kentucky, USA.
Email: a.dymarsky@uky.edu

Prof. Adolfo del Campo,
Department of Physics and Materials Science, University of Luxembourg, Luxembourg.
Email: adolfo.delcampo@uni.lu

Prof. Tatsuma Nishioka,
Department of Physics, University of Osaka, Japan.
Email: nishioka@het.phys.sci.osaka-u.ac.jp