Arpan Dey

Email: arpand2004@gmail.com
ORCID: https://orcid.org/0009-0005-6974-0642
LinkedIn: https://linkedin.com/in/arpand2004
Personal website: https://arpandey.net/homepage

SUMMARY

Arpan Dey is an undergraduate physics student and science writer based in India. He is mainly interested in physics (particularly in quantum mechanics, particle physics, chaos theory and complexity). He has written and edited many science articles (original research and review) for different journals and magazines. He has worked on several research projects and also presented at his college and beyond. He has published a popular science book on physics: *Our Physics So Far: A Journey through Spacetime, Consciousness and the Fundamental Nature of Reality*. He is also the founder of a physics blogging site, The Journal of Young Physicists, where students can submit their physics articles for review and publication.

EDUCATION

- **St. Xavier's College (Autonomous), Kolkata**

Undergraduate student, Physics (with Mathematics and Computer Science)
Sep 2022 – Present
Topics studied: Mathematical physics, computational physics, classical dynamics, electromagnetism, waves and optics, thermodynamics, digital electronics, analog electronics, modern physics, circuit design and simulation (LTSPICE), quantum mechanics and applications, solid state physics, nuclear and particle physics, statistical mechanics, electromagnetic theory, LASER physics and fiber optics
Undergraduate dissertation project: Feynman's path integral formulation of quantum mechanics (under the supervision of Dr Tanaya Bhattacharyya)

- **Delhi Public School, Burdwan**

Senior secondary high-school graduate, Science
2008 – 2022
Central Board of Secondary Education (CBSE), 10+2 score (Science): 95.2%
Subjects (10+2 level): English, Mathematics, Physics, Chemistry, Informatics practices, Physical education

EXPERIENCE AND EXTRACURRICULAR ACTIVITIES

- **Summer Research Fellow, Physical Research Laboratory**

Jun 2024 - Jul 2024

I received the Summer Research Fellowship (2024) offered by the Indian Academy of Sciences. As part of the fellowship, I studied the modular group and modular symmetries. More specifically, I investigated the fundamental domain of the modular group, and possible applications of the same in the Standard Model and other areas of theoretical high energy physics. I worked under the supervision of Dr Ketan Patel of the Theoretical Physics division at Physical Research Laboratory, Ahmedabad, India.

- **Senior Physics Editor, Young Scientists Journal**

Jul 2020 - Present

As senior physics editor, I review and manage all physics articles – research and review – that are submitted to the YSJ – an international, peer-reviewed publication for young students – as well as coordinate the junior physics editors. Before my appointment as a senior physics editor, I worked as a junior editor of physics, mathematics and astrophysics for the YSJ. I also briefly served as a curriculum developer for YSJ's *reSTEM* project, which is an initiative to set up an international network of research clubs and introduce high-school students to research.

- **Virtual SOAR Scholar, Emory University Laney Graduate School**

Jun 2023 - Aug 2023

I was selected to Emory University's 2023 LGS-SOAR (Laney Graduate School – Summer Opportunity of Academic Research) program, and was recognized by the university upon successful completion of the program.

- **Associate Student Editor-in-chief - Pebbles 2025, St. Xavier's College Science Association**

Nov 2024 - March 2025

I'm currently serving as the associate editor-in-chief of Pebbles 2025, the annual magazine of the Science Association of our college. Prior to this, I was a member of the editorial board of Pebbles 2024. As part of my role, I reviewed articles and interviewed researchers from different scientific disciplines.

- **Founder and Contributor, The Journal of Young Physicists**

Jul 2020 - Present

The Journal of Young Physicists is a platform for young physics aspirants to get their physics articles reviewed and published for free. We are committed to popularizing physics and fostering the growth of young physicists.

- **Research Guide, Xaverian Astronomical Society**

Oct 2024 - April 2025

As a research guide of the Xaverian Astronomical Society (XAS) of my college, I am currently working with a junior on a project about quantum information theory. I have also helped in other projects of the XAS like Newtonian cosmology and constraining astronomical parameters using Bayesian inference.

- **Young Member of The Junior Academy, The New York Academy of Sciences**

Sep 2020 - Jul 2022

The Junior Academy is a STEM program for high-school students, where students from all over the world are put in small groups and given the chance to work on real-life, challenging STEM problems. I worked in an international team of five students on two challenges: first, designing a telemedicine app and second, studying COVID vaccination statistics in different countries and designing an effective vaccine distribution scheme.

- **Member, American Physical Society**

Jun 2023 - Jul 2024

I was an undergraduate student member of the APS. During my membership, I connected with physicists from all over the world and attended interesting and important webinars on the most pressing topics in physics today.

- **Author, Notion Press**

Jul 2021 - Sep 2022

I have published two books with Notion Press: a popular science book on physics (*Our Physics So Far*) and a Sherlock Holmes adventure (*The Adventure of the Injured Cabman*).

- **Science communicator and content creator, YouTube**

Jun 2019 - Present

I create physics and science videos for my YouTube channel – Arpan D, as well as videos about aviation, travel and life in general. In my free time, I also write songs and produce music. I have collaborated with several vocalists worldwide and released thirteen original songs and an album (Unsettled Bliss). All of my songs can be found in my second YouTube channel – Arpan Amplified.

SELECTED ARTICLES

- **Investigations on the Fundamental Domain of the Modular Group**

https://zenodo.org/records/13915484 [DOI: 10.5281/zenodo.13915484]

This article investigates the nature of the transformations from any arbitrary point on the upper half of the complex plane into the fundamental domain of the modular group. The upper half complex plane has been divided into appropriate regions and a Python simulation has been run to verify the transformations that maps the points inside the fundamental domain for each region.

- **Path integral formulation of quantum mechanics**

https://zenodo.org/records/15125184 [DOI: 10.5281/zenodo.15125184]

This article presents a rigorous introduction to Feynman's path integral formulation of quantum mechanics. It begins by outlining the motivation behind the path integral formulation, and then builds the mathematics required for defining the sum-over-paths. Then it derives the free particle propagator, as well as the propagator for a particle with a non-zero potential energy, with particular focus on linear and quadratic potential energies. Using these results, the Planck-Einstein equation, de-Broglie equation and Schrödinger equation are derived. Then, using Python plots, the difference between the wave function and propagator is studied visually and mathematically. In the end, the article touches on the basic idea behind perturbation theory by using the free particle propagator to study a particle that moves between two potential-free points in spacetime, but via intermediate points with non-zero potentials. The article ends with a discussion on the broader implications of path integrals, and some speculations about the future of theoretical physics.

- **Complexity: The Next Big Thing in Physics**

https://www.journalofyoungphysicists.org/post/complexity-the-next-big-thing-in-physics

[DOI: 10.5281/zenodo.13913639]

This article aims to give a broad overview of the study of complexity and recent developments in the field. The article starts with a brief discussion on the various approaches to quantify complexity and then discusses assembly theory – a recent, novel and promising approach to study complex systems, touching upon other new and relevant theories like constructor theory. Then some interesting properties of complex systems – like emergence, self-organization and unpredictability – are discussed, along with how ordered complexity can arise from randomness and finally, the article discusses consciousness from a complexity perspective.

- **Our Physics So Far: A Journey through Spacetime, Consciousness and the Fundamental Nature of Reality**

ISBN: 978-1685090234, ASIN: B0BD8MC5NW

https://www.amazon.com/dp/b0bd8mc5nw

Our Physics So Far is a popular science book on physics which narrates the story of physics and science from Newton's days to the present. The book starts with a discussion on cosmology, then moves on to mathematics, classical physics, special and general relativity and quantum mechanics. The next part focuses on particle physics, information paradox and the hunt for a unified theory. Then, the book turns to the physics of complexity and chaos theory, following which the question of the nature of consciousness is addressed, with some brief discussion of neuroscience and psychology. Finally, there is a discussion on metaphysics, paradoxes and the fundamental nature of reality. Adding to the book's appeal is an interview with renowned physicist Edward Witten. The book has mostly received positive feedback from readers worldwide.

- **A Study on Improving Take-Off Efficiency of Airplanes**

https://zenodo.org/records/8284591 [DOI: 10.5281/zenodo.8284591]

This article explores the pros and cons of a movable forward-set split-flap-like structure in the main wing of an airplane, and its effectiveness in improving take-off efficiency and maneuvering capabilities of airplanes.

- **Can the de Broglie Relation be Modified for Accommodating Relativistic Modifications in the Schrodinger Equation?**

https://zenodo.org/records/8284632 [DOI: 10.5281/zenodo.8284632]

This is a study on the viability of using the mass-energy-momentum relation to derive de Broglie's equation, and in turn, Schrodinger's time-independent equation.

- **Investigations on Isotopic Elements in Terms of Quarks**

https://zenodo.org/records/8284563 [DOI: 10.5281/zenodo.8284563]

This article establishes certain relations, in terms of atomic number, number of up/down quarks in the nucleus (etc.), regarding isotopic elements.

- **Chaos Theory and Consciousness**

https://www.arpandey.net/chaos-theory-and-consciousness

This article introduces chaos theory and discusses the possible link between chaos and consciousness. To illustrate the different aspects of chaos theory, various concepts like logistic map, sensitivity to initial conditions, the Mandelbrot set, the Lorenz attractor, the Sierpinski triangle, fractal dimensions (etc.) have been discussed.

- **On the Black Hole Information Paradox**

Coauthor: Sanchari Sen

https://www.journalofyoungphysicists.org/post/on-the-black-hole-information-paradox

This article starts with the concepts of entropy and information and finally discusses the black hole information paradox, its significance and possible approaches towards a complete solution, like the holographic principle.

SELECTED PRESENTATIONS AND PODCASTS

- **Assembly Theory and the Evolution of Complex Systems – Spectrum 2024 Paper Presentation Competition** (St Xavier's College, Kolkata)

https://docs.google.com/presentation/d/1HV3gbNrkBa6oBoFCPuGZAl7GXYsLAjK5Xs08PPmqyHk/edit?usp=sharing

I presented on this topic at Spectrum 2024, , the annual fest of the physics department of my college, and was awarded the second position in the paper presentation competition.

- **The Journey of a Young Physicist – STEMz Perspectives** (Young Scientists Journal science podcast)

https://www.youngscientistsjournal.com/podcast/episode/1aaf8292/episode-15-the-journey-of-a-young-physicist-an-interview-with-arpan-dey

In this episode of STEMz perspectives, a science podcast run by the Young Scientists Journal, I talk about my journey, science communication, how aspiring scientists should start their journey in STEM etc., with host Mayank Dora.

- **The Fundamental Domain of the Modular Group – Spectrum 2025** (St Xavier's College, Kolkata)

https://www.canva.com/design/DAGi1p0ws6A/7B7BdHwxl4VYb2DgZ6sZGw/view?utm_content=DAGi1p0ws6A&utm_campaign=designshare&utm_medium=link2&utm_source=uniquelinks&utlId=hda02da703a

I delivered a talk on the fundamental domain of the modular group and the applications of modular symmetry in theoretical high energy physics at Spectrum 2025, the annual fest of the physics department of my college.

- **Emergence and Consciousness – Spectrum 2023 Paper Presentation Competition** (St Xavier's College, Kolkata)

https://www.journalofyoungphysicists.org/post/emergence-and-consciousness

I and my classmate Sanchari Sen presented on this topic at Spectrum 2023, the annual fest of the physics department of our college. We were awarded the second position in the paper presentation competition.

- **The Black Hole Information Paradox – Meera Memorial Paper Reading Competition** (St Stephen's College, Delhi)

https://docs.google.com/presentation/d/1l3IAoZuj4z-wSwHtapoOR7ulyiHXYCSk1hSV7UylRjc/edit?usp=sharing

I and my classmate Sanchari Sen delivered a talk on the information paradox and possible solutions, at St Stephen's College, Delhi.

COURSES AND CERTIFICATES

- **Introduction to Complexity – Santa Fe Institute**

https://www.complexityexplorer.org/courses/185-introduction-to-complexity/certificates/4053598210.pdf

- **Particle Physics: An Introduction – University of Geneva – Coursera**

https://www.coursera.org/account/accomplishments/certificate/KUFWDBP8AUYY

- **Understanding Modern Physics I: Relativity and Cosmology – The Hong Kong University of Science and Technology - Coursera**

https://www.coursera.org/account/accomplishments/certificate/VDDYH2WPG37N

- **Understanding Modern Physics II: Quantum Mechanics and Atoms – The Hong Kong University of Science and Technology – Coursera**

https://www.coursera.org/account/accomplishments/certificate/A5MW98UAAZC5

- **Understanding Modern Physics III: Simplicity and Complexity – The Hong Kong University of Science and Technology – Coursera**

https://www.coursera.org/account/accomplishments/certificate/LWTTR5323LDJ

- **Summer Research Fellowship Program 2024 – The Three National Science Academies**
  https://drive.google.com/file/d/1WJL2zSACZ0DBcIqpy0Dv9VhA98y2MTq0/view

- **Summer Internship Program 2024 – Physical Research Laboratory**
  https://drive.google.com/file/d/1j75TsuS0wD4YXhuV93r1BGIdiSGJmaL9/view

- **Physics behind Biology: International Colloquium – St. Xavier's College (Autonomous), Kolkata**
  https://drive.google.com/file/d/1lL_r5ErP-oOFyatK6nMYJQWzOHVs4Oau/view?usp=sharing

- **Summer Opportunity for Academic Research 2023 – Laney Graduate School – Emory University**
  https://drive.google.com/file/d/1FjobvYBJ-EL0oBn30OXWu36sWd6byznP/view

- **Top 100 Innovators – Student Innovation Challenge 2020 – Smartcircuits Innovation Pvt. Ltd.**
  https://drive.google.com/file/d/1YvspMZ96eQ65Thf8x-zpnJ4YkIs6vTq7/view

- **The Unknowable and the Counterintuitive: International Exchange Program on Science and Religion 2024 – Santa Clara University; St. Xavier's College (Autonomous), Kolkata**
  https://drive.google.com/file/d/17gJxogT5uOt6qLX1p55A-Vj9p7WZD-LF/view

- **Young Member – The New York Academy of Sciences**
  https://www.credly.com/badges/cc3a3d4a-6164-4baf-b5dd-09cee1cb8ac1

SKILLS AND INTERESTS

- **Areas of Interest in Physics** – Quantum mechanics, Quantum field theory, Particle physics/High energy physics, Nonlinear dynamics, Complex systems
- **Hard skills** – LaTeX, Python, LTSPICE, Gnuplot, Scientific writing, Academic writing, Editing
- **Soft skills** – Research, Science communication, Popular science, Creativity and innovation, Conflict resolution, Team management, Paper presentation, Public speaking
- **Interests beyond academics** – Writing, songwriting, music production
- **Languages** – English (Full professional proficiency), Hindi (Limited working proficiency), Bengali (Native or bilingual proficiency)

CV last updated in January 2025