

Nimish Sharma

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Education

Indian Institute of Science Education and Research Kolkata

August 2021 – May 2026

- BS-MS in Physics along with a minor in Computer Science.
- CGPA(Current) : 8.1

Research Interest

Nano-Photonics

- I am interested in exploring light-matter interactions, especially through photonics and metamaterials. My recent work involved analysis of the Mueller matrix of a waveguide plasmonic crystal using a dark-field polarisation microscopy setup to infer spin-orbit interactions of light and its implications, such as spin-orbit-spin coupling and spin hall effect. This gave me a solid foundation in experimental optics and polarisation analysis, which I hope to build on further.
- Through my recent works on implementing a theory for scattering tightly focused light beams with nanoparticles in host chiral media, I am motivated to bridge the gap between simulations and experiments.
- I aim to design optical setups to enhance and understand material properties. I use computational tools like MATLAB and Python to create models that theoretically back the experimental results and help guide the experiments. I believe combining simulations with hands-on lab work leads to a deeper and more accurate understanding.

Quantum and Non-Linear Optics

- I am eager to explore quantum and nonlinear optics, building on my background in quantum mechanics and optics. I am particularly interested in chiral and on-chip quantum optics, quantum communication, and quantum sensing using diamond NV centres and optically pumped magnetometers.
- I aim to contribute to quantum error correction and the development of fault-tolerant quantum architectures, while advancing quantum-enhanced metrology, spin qubits, and hybrid sensing with trapped ions.
- I am also fascinated by nanoscale quantum control, including single- and multi-photon emitters based on quantum dots, strong light-matter coupling in molecular cavities, and fibre-based nonlinear optics—covering frequency conversion, four-wave mixing, optical parametric amplification, and dual-comb spectroscopy through tailored dispersion in photonic crystals and $\chi^{(2)}/\chi^{(3)}$ media.

Research Experience

Bio-NaP Lab | IISER Kolkata

January 2025 - Present

Interaction of Nanoparticles in chiral host media

- Worked on building a setup for enhancing the optical properties of chiral nanoparticles by tight focusing of light. Additionally, I helped automate and speed up the procedure for measuring Mueller matrices by implementing scripts in MATLAB.
- Building MIE scattering theory for the interaction of a tightly focused light beam in a chiral host medium with nanoparticles to support and justify the enhancement of optical properties for the same as a part of my MS thesis.
- Implementation of the built theory by simulating scattering matrix in the far field, Mueller matrix, scattering cross-sections and other optical properties such as circular dichroism, and optical rotation for nanoparticles in Python and MATLAB.

Darkfield microscopy

- Worked on darkfield microscopy setup to measure the k-domain Mueller matrices for a waveguide plasmonic crystal.
- Integrating MATLAB simulations for the far-field Mueller matrix measurements and confirming experimental results, inferring spin-orbit interaction effects such as forward and backward optical spin hall effect.
- Involved in experimental research on light-matter interaction of various metasurfaces and analysis of spectral

and momentum domain Mueller matrices for the same.

- Investigating applications of plasmonic interactions for enhanced imaging and sensing technologies.

First Principle Investigations on Heusler Alloys | [IAS SRFP – SVNIT Surat](#)

May 2024 – July 2024

- Basics of Density Functional Theory and solid state physics were studied to grasp the theoretical understanding. It included reading research papers on Heusler alloys to understand their properties and structure.
- To get familiarised and gain confidence with the DFT software ([QE](#) and [WIEN2k](#)), results were replicated from a [paper on Ti2VGe](#) and the half-metallic nature was confirmed.
- Proceeding from the success, further first-principle calculations were performed for our chosen alloy. Structural optimisations, magnetic properties, elastic properties, dynamical stability and electronic properties were calculated.
- Finally, I compiled and submitted a report detailing DFT theory, software usage, and findings to the Indian Academy of Sciences.

Quantum Computing | Summer Internship – IISER Bhopal

May 2023 – July 2023

- Quantum Computing basics, including introduction to quantum gates, entanglement, quantum teleportation, and algorithms.
- Building a binary classifier for the Iris dataset by developing a Quantum Deep Learning Network.
- Tested the network on IBMQManila and compared its results with various Classical Machine Learning models such as Logistic Regression, K-Nearest Neighbour, and Decision Tree classifier.
- Creating a presentation and writing a report to conclude the results and learnings.

Integration of Payment Portal | Summer Project – IISER Kolkata

May 2023 – July 2023

- Built an Integration for a Payment Gateway into the existing mess website for my Institute.
- Used the Django framework and SQLite. Learned front-end webpage designing using CSS and JavaScript.
- Finally, I wrote a report concluding the work and things learned during the project.

Teaching Experience

Teaching Assistant | IISER Kolkata

[Modern Physics and Optics Lab](#)

August 2025 - Dec 2025

Relevant Courses

- | | |
|---|---------------------------------------|
| • Advanced Electricity, Magnetism, and Optics | • Quantum Field Theory |
| • Advanced Optics Laboratory | • Quantum Mechanics - I, II, III |
| • Chemistry of Materials | • Computational Physics |
| • Quantum Information Processing | • Data Structures and Algorithms in C |

Workshops and Courses

[Nonlinear Fiber Optics](#) | [IKAA](#)

May 2025 - July 2025

- The course lays a solid foundation on the theory and simulations of how light behaves inside optical fibers, starting right from Maxwell's equations.
- I learned about various nonlinear effects like self-phase modulation and four-wave mixing, and how they influence pulse propagation in fibers.
- We used tools like MATLAB and MEEP to simulate light behaviour in fibers, which helped connect theory with hands-on application.
- Overall, the course built a solid foundation in nonlinear fiber optics, with interesting real-world applications like communication systems and radar signal distribution.

[Physics through Computational Thinking](#) | [NPTEL – IISER Bhopal](#)

Feb 2023 - April 2023

- Wolfram Alpha and Fortran programming language.
- Introduction to Monte-Carlo Simulations and simulating statistical models.
- Application of Numerical Methods (Euler, Runge Kutta(2,4), etc.)

- Relating the application of Classical Mechanics, Quantum Mechanics and Statistical Mechanics to the Real World.
- Online DFT and running MD simulations(on NanoHub) on basic molecules and predicting their thermal and electronic properties.

Lunar Exploration through Artificial Intelligence | Spartificial

May 2022 - June 2022

- Introduction to various Unsupervised Machine Learning Algorithms.
- It also familiarised me with techniques like classification, clustering, and different state-of-the-art machine learning models like ResNet.
- The platform used was Kaggle.

Winter School for Quantum Computing | IISER Kolkata

December 2022

- Introduction to basic quantum gates and quantum algorithms. Discussion of the issue of decoherence of quantum particles.
- Vast applications in the fields of medicine, finance, material sciences, etc.

Extra-Curricular

Summer Volunteer | [Ek Pehal foundation](#)

June 2023

- Volunteered to teach underprivileged middle and high school kids as part of the Ek Pehal Foundation.
- Taught English, Maths and Physics for 6 hours per week

Menstrual Hygiene Drive | [FARZ foundation](#)

November 2022

- Facilitated logistics and organised a menstrual hygiene campaign for schools in rural areas.
- Educated and lectured middle school students about the importance of menstrual hygiene in the modern day.
- Successfully helped organise the sanitary pad distribution drive for rural school students.

Additional Experience And Awards

- **Research Fellow:** Completed a [Summer Research Fellowship Program 2024](#) offered by the [Indian Academy of Sciences](#) at SVNIT Surat.
- Part of the OPTICA community as a member of SPIE student chapter of IISER Kolkata.
- Secured a rank of 165 in Joint Entrance Screening Test (JEST).
- Cleared JEE Mains and Advanced.
- Represented my Institute as a part of the Football Team at Parakram - ISM Dhanbad.
- Participated and won 1st place in the Interbatch Football Tournament 2025.
- Participated and won the Spring Pong - annual Table Tennis auction tournament
- Won gold medal in the International English Olympiad.
- Participated as a guitarist in RAMPAGE - the annual inter-college Band tournament.
- Won gold medal in annual inter-college Futsal tournament.

Technological Skills

Coding: MATLAB, Python, Bash scripts, C, Qiskit, MySQL, Latex, HTML, CSS, Javascript

Softwares: Quantum ESPRESSO, Origin, NanoHub(MD software), WIEN2k

Others: Unsupervised Machine Learning, Fundamentals of DFT and MD.