

# Ashish Panigrahi

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## About me

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I am a 4<sup>th</sup> year physics student studying at the *National Institute of Science Education and Research, Bhubaneswar, India*. My research interest lies in the experimental aspects of quantum information processing, specifically in quantum photonics investigating photon-photon and spin-photon entanglement using various quantum systems for applications in quantum technologies.

**Nationality:** Indian

## Education

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- **National Institute of Science Education and Research (NISER)** Bhubaneswar, India  
*Integrated Master's in Physics (Minor in Computer Science)* 2018 - 2023
  - Current Cumulative GPA: 9.16/10
  - My grades have been among the top two in my batch.
  - Relevant coursework:
    - \* *Physics*: Quantum Mechanics, Classical Mechanics, Statistical Mechanics, Electromagnetism, Mathematical Methods, Condensed Matter Physics, Quantum Optics, Quantum Information and Computation, Experimental Techniques, Non-linear Optics & Lasers, Computational Physics.
    - \* *Computer Science*: Theory of Computation, Discrete Structures in Computation, Design and Analysis of Algorithms, Programming & Data structures lab, Modern Cryptography, Machine Learning.
- **Maharishi Vidya Mandir Senior Sec. School** Chennai, India  
*All India Senior Secondary Certificate Examination (CBSE) - 95.6%* May 2018
- **PSG Public School** Coimbatore, India  
*All India Secondary School Examination (CBSE) - CGPA 10* May 2016

## Project Experience

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- **Research Assistantship** Bhubaneswar, India  
*Ultrafast TeraHertz Dynamics Group, NISER* December 2021 - Present
  - Project guide: Dr. Shovon Pal, Assistant Professor, NISER; Adjunct Advisor of Dept. of Materials Science, ETH Zürich.
  - Currently working on understanding electrodynamics and band structures in semiconductor heterostructures and the origin of two-dimensional electron gas.
  - The goal is to simulate and experimentally demonstrate cavity coupling using a solid state heterostructure cavity enclosing GaAs quantum dots.
- **P452 Term Project on Reliability Measurement of FETs** Bhubaneswar, India  
*Semester VII* January 2022 - Present
  - Project Guide: Dr. Satyaprasad Senanayak, Assistant Professor, Nano-electronics & Device Physics Laboratory, NISER.

- Worked on a computational/experimental project entailing the estimation of various electrical parameters such as conductivity, hysteresis characterization, threshold voltage and carrier mobility for two-terminal and three-terminal devices at various temperatures.
  - Also estimated the reliability factor for three-terminal device.
  - The experimental data was obtained for a DNA sample (two-terminal device) and an organic field effect transistor made of a perovskite layer.
  - Currently working on understanding the experimental trend for dependence of carrier mobility, threshold voltage with device temperature.
  - Relevant code is hosted on GitHub: <https://github.com/paniash/fetter>
- **P443/P444 OpenLab Project on Nd:YAG Laser** Bhubaneswar, India  
*Semester VII* *January - May 2022*
- Undertook a joint project with a colleague as part of the coursework for the P443/P444 laboratory course.
  - Worked and built a working Nd:YAG solid-state laser with light emission at a wavelength of 1064 nm.
  - The setup involved an optical rail, onto which a diode laser source, the Nd:YAG crystal, along with necessary optical components such as a collimator, focussing lens, DBR reflector mirror (for constructing an optical resonator cavity) were placed.
  - Studied various properties of the Nd:YAG crystal such as the lifetime of the metastable energy state which is responsible for the lasing 1064 nm emission.
  - Also explored other nonlinear phenomena such as second harmonic generation (SHG) using a Cr:YAG crystal which gave a light emission at a wavelength of 532 nm.
- **Computational Project & Term Paper on Photonic Crystals** Bhubaneswar, India  
*Semester VII* *August - December 2021*
- Worked on a computational project on the simulation of surface plasmon resonance in one-dimensional photonic crystals as part of the coursework for P441/P442 openlab course. The relevant code was written in pure Julia.
  - Worked separately on a term paper titled “*Fabrication and Characterization of Photonic Crystals*” as part of the coursework for the P473 Experimental Techniques elective course.
- **Bachelor’s Project on Inverse Spin Hall Effect** Bhubaneswar, India  
*Superconducting Spintronics Group, NISER* *April - July 2021*
- Project guide: Dr. Kartikeswar Senapati, Reader-F, NISER.
  - Worked on a semester project on the topic, “*Study of spin current in NM/HM bilayer and trilayer systems*”.
  - The goal was to analyse and be able to detect spin current emerging from a trilayer system involving a layer of Cu (for its large coherence length) sandwiched between two layers of Pt (for spin-coupling). The idea was to supply through one end of the H-gap sample, an electric current which would then get converted to spin current via the spin Hall effect and to measure this spin current via a simple non-local electrical measurement at the other end of the sample. On this end, the electric current which originated from the back-conversion of the spin current via the inverse spin Hall effect is measured via a micro-voltmeter.
  - Through the project, I obtained hands on experience with experimental techniques such as UHV systems, magnetron sputtering and focused ion beam.

- Software Developer Internship** Australia  
*Quantum Brilliance* *February - April 2021*
  - Project guide: Dr. Nariman Saadatmand, QBQE Product Manager.
  - Initially worked on language parsers especially the Earley parser for its use in natural language processing as a potential quantum application. Later transferred to the emulator division, where I worked on the quantum brilliance quantum emulator (QBQE) and enhanced the functionality of its QAOA (Quantum Approximation Optimization Algorithm) module. The relevant code was written in C++.
- Summer Project on Anisotropic Magnetoresistance** Bhubaneswar, India  
*Institute of Physics, Bhubaneswar* *May - June 2019*
  - Project guide: Dr. Debakanta Samal, Reader-F, Institute of Physics.
  - Did a reading project on “Study on Anisotropic Magnetoresistance”.
  - Topics covered: Origin of magnetoresistance, theory of magnetoresistance in real metals using the 2-band charge carrier model, origin of anisotropic magnetoresistance, its applications and current research scenario in the field.

## Honors/Awards

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- IBM Qiskit Advocate** 2021  
*IBM Quantum*
  - Selected from a global pool of applicants.
  - This achievement depicts a deep level of understanding with Qiskit including circuits, algorithms, simulators, qubits and noise.
  - Through my contributions to the Qiskit and the quantum community, I have demonstrated an ability and commitment to educate and influence others by sharing ideas, knowledge and expertise in the field of quantum computing.
- Zonal Topper** 2021  
*Mimamsa 2021* *IISER Pune*
  - Science quiz competition for undergraduates with participations from universities all over the country.
  - Our team became the zonal topper for the *Odisha and Paschim Medinipur district (WB)* zone.
- National Topper** 2020  
*National Graduate Physics Examination*
  - A country-wide competitive examination conducted by the *Indian Association of Physics Teachers* for students pursuing a bachelors in physics.
  - Secured a score within the top 1% in the country.
- Department Topper (1<sup>st</sup> & 2<sup>nd</sup> year)** 2018-2020  
*School of Physical Sciences, NISER*
  - Scored the highest grade in my department for four consecutive semesters (fall 2018, spring 2019, fall 2019, spring 2020).
- INSPIRE Fellowship** 2018  
*Department of Science and Technology, Govt. of India*
  - Eligible for this prestigious fellowship by the Department of Science and Technology, Government of India.

- Awarded to the top 1% students at their higher secondary (+2) level, for those pursuing a bachelors in basic sciences.
- **Kishore Vaigyanik Protsahan Yojana (KVPY) Fellowship** 2017  
*Indian Institute of Science* *Bengaluru, India*
  - A prestigious fellowship program funded by the *Department of Science and Technology*, Government of India.
  - Cleared the written examination (stage I) and an interview (stage II) to receive the fellowship.
- **National Talent Search Examination (NTSE) Scholarship** 2016  
*National Council of Education Research and Training* *New Delhi, India*
  - A national level scholarship program offered by the Government of India.
  - It is one of the oldest and most prestigious scholarship programmes in the country.

## Academic Exposure

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- **Qiskit Global Summer School** Virtual  
*IBM Quantum* *July-August 2020*
  - An intensive 2 week virtual summer school on quantum computation and designing quantum circuits and algorithms using Qiskit.
  - Did hands-on coding exercises to learn various quantum algorithms, pulse level control of qubits and concepts in quantum chemistry.
  - Also did a project on simulating the ground energy level of LiH molecule using variational quantum eigensolver.
- **National Initiative on Undergraduate Science (Physics)** Mumbai, Maharashtra  
*Homi Bhabha Centre for Science Education, TIFR* *June 2019*
  - Selected as one of top 70 students in the country to participate in this camp.
  - An extensive 12-day course containing lectures, independent lab work and a field trip for 2 days.
  - Lecture series on quantum mechanics, quantum information theory and quantum computation, basic condensed matter physics, many body physics, astronomy and astrophysics.
  - Performed around 30 hours of independent lab work.

## Contributions

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- **Qiskit Textbook** [GitHub](#)  
*Collaborator* *April 2020 - Present*
  - Qiskit is IBM's software development kit for building software to interact with IBM's quantum devices and OpenQASM.
  - The textbook is equivalent to a university level course for learning quantum computation and beyond.
  - I am a collaborator for this project and have actively contributed with over 50+ commits since April 2020.

## Licenses & Certifications

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- **IBM Certified Associate Developer** IBM  
*Quantum Computation using Qiskit v0.2X* July 2021
  - This certification demonstrates fundamental knowledge of quantum computing concepts and the ability to express them using the Qiskit open source software development kit (SDK).
  - Shows experience in using the Qiskit SDK from the Python programming language to create and execute quantum computing programs on IBM Quantum computers and simulators.
- **Introduction to Quantum Computing Course** Qubit by Qubit  
*IBM Quantum & The Coding School* October 2020 - May 2021
  - Developed a foundational understanding of quantum computing, with topics including introductory linear algebra, coding with Qiskit, quantum mechanics, quantum algorithms, and quantum applications.
- **Challenge Fall 2020 Achievement - Intermediate** IBM  
*IBM Quantum* December 2020
  - Demonstrated an ability to implement near-future quantum data structures and design a quantum game solver using Grover's algorithm.
  - Showed an understanding of quantum circuits, the gates that comprise such circuits, Grover's algorithm, and qRAM (quantum random access memory) as a way to implement complex data structures.
- **CS-191x: Quantum Mechanics and Quantum Computation** edX  
*University of California, Berkeley* August 2020
  - Coursework involved ranging from the basics of the qubit to quantum algorithms such as Grover's, Shor's etc. to the Bloch sphere and Schrödinger's wave equation.
  - Final score: 97%

## Volunteering

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- **Project Lovelace** May 2021 - Present  
*Scientific Programming Problems*
  - Project Lovelace is a platform to learn science through programming.
  - Member of the team to add new problems and maintain the website (both frontend and backend).
  - Website: <https://projectlovelace.net>
- **Full-Stack Quantum Computation** December 2020 - Present  
*Community-driven, Opensource Education Resources*
  - Part of the team as a curator of various articles on quantum technologies, submitted by volunteers.
  - Website: <https://fullstackquantumcomputation.tech>
- **Volunteer** April 2019  
*NISER Open Day*
  - Outreach programme for depicting the wonders of science to school students from grades 9 to 12.

- I was involved in the demonstration of plasma generation using grapes and a microwave oven as part of our team's project.
- **Mentor**  
*Avanti Fellows NGO* *January - April 2019*
  - Duties included mentoring students from grades 11 and 12.
  - My weekend work involved having a one-to-one discussion with students on physics and general advice on college entrance exams.

## Technical Skills

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### Programming and scripting languages

Python (Libraries: *Scipy*, *Numpy*, *Matplotlib*), Julia, C/C++, Bash

### Markup languages

L<sup>A</sup>T<sub>E</sub>X, Markdown, Groff

### General computing tools

Git, GitHub, vim, tmux, gnuplot, unix-shell

## References

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1. **Dr. Shovon Pal**, *Ultrafast TeraHertz Dynamics Group*
  - Assistant Professor of Physics at NISER, Bhubaneswar;  
Adjunct Advisor of Department of Materials Science at ETH Zürich, Switzerland.
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2. **Dr. Pratap Kumar Sahoo**, *Ion Beam & Nanomaterials Laboratory*
  - Associate Professor of Physics at NISER, Bhubaneswar.
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3. **Dr. Satyaprasad Senanayak**, *Nano-electronics & Device Physics Laboratory*
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