

Ashish Panigrahi

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About me

I am a final year physics masters 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

- **National Institute of Science Education and Research (NISER)** Bhubaneswar, India
Integrated Master's in Physics (Minor in Computer Science) 2018 - 2023 (Expected)
 - Current Cumulative GPA: 9.15/10
 - 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

- **Research Internship** Canberra, Australia
Australian National University May 2022 - Present
 - Currently working on spontaneous parametric down conversion (SPDC) using nonlinear two-dimensional materials such as transition metal dichalcogenides (TMDCs).
 - The goal is to realize single-photon sources for potential quantum communication applications.
- **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/AlGaAs 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 Hall bar 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

- **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 (1st & 2nd 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

- 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

- **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

- **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

- **Project Lovelace**
Scientific Programming Problems *May 2021 - Present*
 - 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**
Community-driven, Opensource Education Resources *December 2020 - Present*
 - Part of the team as a curator of various articles on quantum technologies, submitted by volunteers.
 - Website: <https://fullstackquantumcomputation.tech>
- **Volunteer**
NISER Open Day *April 2019*
 - 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

Programming and scripting languages

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

General computing tools

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

References

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.
 - Email: shovon.pal@niser.ac.in, shovon.pal@mat.ethz.ch
2. **Dr. Pratap Kumar Sahoo**, *Ion Beam & Nanomaterials Laboratory*
 - Associate Professor of Physics at NISER, Bhubaneswar.
 - Email: pratap.sahoo@niser.ac.in
3. **Dr. Satyaprasad Senanayak**, *Nano-electronics & Device Physics Laboratory*
 - Assistant Professor of Physics at NISER, Bhubaneswar.
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