

Ashish Panigrahi

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About me

I am a pre-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
 - Project guides: Prof. Yuerui Lu & Dr. Giovanni Guccione.
 - 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 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

- **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

Markup languages

\LaTeX , Markdown, Groff

General computing tools

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.
 - Email: satyaprasad@niser.ac.in