

NEELES KUMAR VIJ

Final Year Dual Degree Student
Department of Electrical Engineering, IIT Kanpur, India

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EDUCATION

- 2017 – Present **Bachelor of Technology - Master of Technology (Dual Degree)**, *Indian Institute of Technology, Kanpur, CGPA: 9.2/10*
- 2017 **Grade XII (CBSE)**, *Puranchandra Vidyaniketan, Result- 94.6%*
- 2015 **Grade X (CBSE)**, *Puranchandra Vidyaniketan, CGPA- 9.0/10*

PUBLICATIONS

- May '19 – **Optimization of ground-state cooling of a mechanical mode using a three-**
April '21 **level system**
[\[arXiv\]](#) **Supervisor:** Dr. Shilpi Gupta, *Asst. Prof., Dept. of Electrical Engineering, IIT Kanpur*
- Developed a theoretical framework using density matrix approach for open quantum system to characterize cooling of a phonon mode coupled to a three-level system. Three physical hybrid quantum systems were considered: Colloidal Quantum Dots coupled to its acoustic phonon mode, Polaritons, and Coupled Cavities, interacting with a nanomechanical resonator.
 - Simulated the open quantum systems using the quantum optics toolbox [QuTip](#) to check the validity of the developed theoretical framework against the exact simulated results.
 - Constructed an algorithm to measure the effective phonon decay rate from time dynamic phonon number simulations to get a measure of the efficiency of the cooling process.
 - Derived approximate analytical expressions for the system parameters that ensure optimal and efficient cooling. The analytical results were in good agreement with the exact simulation results.

RESEARCH EXPERIENCE

- Summer 2020 **Research Internship, University of Vienna**
[Invitation Letter](#) **Supervisor:** Dr. Markus Arndt, *Prof. of Quantum Nanophysics, University of Vienna*
Internship rescinded due to COVID-19 breakout
- July – **Second Order Correlations in Blinking Quantum Dots**
September '20 **Supervisor:** Dr. Shilpi Gupta, *Asst. Prof., Dept. of Electrical Engineering, IIT Kanpur*
- Assisted in the development of Kinetic Monte Carlo based statistical algorithm to simulate photo-luminescence in blinking Quantum Dots that includes the effects of trapping/de-trapping, exciton/biexciton generation and Auger recombinations.
 - Using a beam splitter module to assign photons emitted from the Quantum Dot into detectors, calculated the incoming intensity arrays of the detectors. The intensity arrays were used to calculate the correlation functions between the two detectors.
 - Analyzed the behaviour of correlation functions with changing trapping/de-trapping rates, generation rate and time bin size of detector.
- Jan – May '19 **Modelling Cavity Coupled Quantum Emitters**
Supervisor: Dr. Shilpi Gupta, *Asst. Prof., Dept. of Electrical Engineering, IIT Kanpur*
- Developed a model to quantify the experimentally observed shift in cavity resonance frequency; several colloidal quantum dots coupled to a single cavity mode.
 - Used Master Equation in the Schrodinger, Heisenberg and Interaction Pictures to calculate rate equations for density matrix and operators in different pictures to gain insight in dynamics of observables.

TEACHING EXPERIENCE

- Jan '21 – **Teaching Assistant, PSE607: Advanced Topics in Photonics**
Present [\[Link\]](#) ○ Responsible for developing tutoring students on QuTip: Quantum Optics Toolbox in Python, mentoring course projects and grading quizzes and assignments.

OTHER PROJECTS AND INTERNSHIPS

Oct – Nov'19 **Lasing Without Inversion**

[Report] *Term Paper for the course Modern Optics (PHY 307)*

- Learned about lasing without inversion in two and three-level systems and its realization by translating into a dressed state basis.
- Simulated a three level system to demonstrate the difference between the window of transparency obtained through the processes of Electromagnetically Induced Transparency and Autler-Townes splitting.

August '20 **India Challenge 2020**

[Certificate] *Hackathon organized by Qiskit, IBM*

- Participated in the two-week Quantum Machine Learning Challenge, which involved getting accustomed to Quantum Computing through the Qiskit python package.
- Using custom variational quantum circuit, developed a classifier with to classify digits from MNIST database and achieved an accuracy of 0.798.

May – June'20 **Internship at QueryBank**

Role: Data Scientist

- Developed an automatic data labelling code to provide smart labelling of data using various features extracted from the data given by clients.
- Revamped the existing SQL query parsing code by introducing new modules for improved parsing and extraction of features from the query itself.

Oct – Nov'19 **Semiconductor Nanostructures with Crystal Vibrations**

[Report] *Course project for Quantum and Wave Phenomena (EE 683A)*

- Reviewed the literature for existing models on perturbative analysis of moving infinite potential to gain insight on how the problem is solved analytically and computationally.
- Proposed a perturbative technique to model the inherent vibrations of atoms in infinite semiconductor lattices.
- Utilized techniques in Matlab to solve the obtained equations and plot the time varying dynamics of the approximated semiconductor lattice.

RELEVANT COURSEWORK AND SKILLS

Physics: Quantum Dynamics: Information and Computation[†], Quantum Mechanics II[†], Statistical Mechanics[†], Coherence and Quantum Entanglement, Modern Optics, Principles of Lasers and Detectors, Quantum and Wave Phenomenon, Introduction to Quantum Optics*

Electrical Engineering: Electromagnetic Theory, Digital Signal Processing, Image Processing, Digital Electronics, Power Electronics, Microelectronics

Algorithms: Computational Physics, Data Structures and Algorithms, Fundamentals of Programming

Machine Learning: Machine Learning for Wireless Communication[†], Introduction to Machine learning*, Deep Neural Networks and Deep Learning*, Convolutional Neural Networks*

Mathematics: Probability and Statistics, Partial Differential Equations, Mathematics I (Real Analysis), Mathematics II (Linear Algebra and ODE), Complex Variables

Skills: Python, Matlab, C/C++, Mathematica, GNU Octave, L^AT_EX

[†] Ongoing, * Course available on Coursera

ACADEMIC ACHIEVEMENTS

2019 **SURGE Fellowship** by IIT Kanpur (Awarded to 70 students all over India)

2019, '18 **Academic Excellence Award**, IIT Kanpur (Awarded to top 10% students of a batch)

2017 **All India Rank 1536** in JEE Mains among 1.5 million students

2017 **National top 1% in National Standard Examination in Chemistry (NSEC)** conducted by Indian Association of Physics Teachers (IAPT)

- 2016 **Kishore Vaigyanik Protsahan Yogna** (KVPY) Fellowship by Govt. of India, secured **All India Rank 1037** among 40,000 students
- 2016 Selected in the **Regional Mathematics Olympiad** and subsequently qualified for participation in **Indian National Mathematics Olympiad**
- 2015 **National Talent Search Examination** (NTSE) scholarship by the Govt. of India (Awarded to top 1000 students among 1 million candidates)

EXTRA CURRICULARS

- April '19 – **President's Nominee**, *Health Center and User's Committee*, IIT Kanpur
- April '21
- Responsible for handling and resolving the grievances related to Health Center and other medical facilities of IIT Kanpur alongside with other committee members.
 - Organized and managed Health Camp in coordination with Health Center, IIT Kanpur which had a participation of 550+ students.
- April '19 – **Associate Head**, *Media and Cultural Council*, IIT Kanpur
- April '20
- Leading a two tier team of Executives to work in tandem with the General Secretary to handle the working and affairs of the Media and Cultural Council that handles all the cultural events and clubs of the institute.
 - Planned and executed a Know Your Contingent series of posts on social media platforms for the pan IIT competition Cultural Meet 4.0 aimed to increase the outreach of the council and the contingent.
- July '18 – **Student Guide & Academic Mentor**, *Counselling Service*, IIT Kanpur
- July '19
- Provided academic guidance and emotional support to 5 first year students; helped them to adapt to the new college environment.
 - Took institute level remedial classes on the course Introduction to Biology - LIF101 and provided tutoring to academically deficient students in the above course.