Sumukh Vaidya

Purdue University, Indiana, USA

West Lafayette
Indiana, USA-47906
(+1) 765-479-9514
vaidya10@purdue.edu

Education

Jan'21-Current **Purdue University, Indiana, USA** GPA: 3.95/4.0.
PhD Candidate in the Department of Physics and Astronomy.
Advisor: Prof Tongcang Li, Department of Physics and Elmore Family School of Electrical and Computer Engineering, Purdue University

Jul'15-Aug'20 **Indian Institute of Technology Bombay, India** CPI: 8.32/10.0.
Dual Degree (Bachelors + Masters in Technology) in Engineering Physics. Specialisation: Nanoscience.

Publications

2022 **Nuclear spin polarization and control in hexagonal boron nitride**, *Nature Materials*.
X. Gao, **S. Vaidya**, K. Li, P. Ju, B. Jiang, Z. Xu, A.E.L. Allcca, K. Shen, T. Taniguchi, K. Watanabe, S.A. Bhave, Y.P. Chen, Y. Ping, T. Li
Link: https://www.nature.com/articles/s41563-022-01329-8

2022 **Light Induced Quasi-Fermi Level Splitting in Molecular Semiconductor Alloys**, *Materials Advances*.
N. Jain , R. Saxena , **S. Vaidya** , W. Huang , A. Welford , C.R. McNeill and D. Kabra
Link: https://pubs.rsc.org/en/content/articlehtml/2022/ma/d2ma00131d

2021 **Novel optoelectronic technique for direct tracking of ultrafast triplet excitons in polymeric semiconductor**, *Applied Physics Reviews*.
G. Banappanavar, **S. Vaidya**, U. Bothra, L.R. Hegde, K.P. Sharma, R.H. Friend, D. Kabra
Link: https://doi.org/10.1063/5.0054583

Technical skills

Software C++, Python, MATLAB, Mathematica, LaTeX, LabView, SolidWorks, Arduino,

Research: Optical Measurements, Optical System Design, Low Temperature Optical measurements, Ion Implantation, Data Acquisition System Design, 2-D heterostructure assembly

Trained User: Glove Box, Spin Coater, Plasma Asher, Screen Printer, Wet Bench based techniques

Research Projects

Aug'21-Present **Quantum Sensing with 2-D materials**, *PhD Research*.
Prof. Tongcang Li, Department of Physics and Astronomy and Elmore Family School of Electrical and Computer Engineering, Purdue University

- Built a setup to optically measure the electron spin resonance (ESR) of samples using the Optically Detected Magnetic Resonance (ODMR) Technique
- System programming in Labview and data analysis in MATLAB and Python
- Setup the and interfaced RF electronics with PC to run the experiments and collect data
- Gained expertise on the assembly and measurements of 2-D heterostructures involving materials like graphene and hexagonal Boron Nitride (hBN)
- Helped to build a low temperature vacuum system to take optical measurements at liquid Helium temperatures and investigate quantum materials

May'19-Jul'20 **Fourier Plane Imaging Microscopy of Thin Films and Fabrication of Large-Area Carbon-Based Perovskite Solar Cells**, *Dual Degree (Masters) Thesis*.

Prof. Dinesh Kabra, Department of Physics, IIT Bombay

- Fabricated Large-Area, carbon-based Perovskite Solar Cells via screen printing methods. Obtained chemical handling training and Usage Authorisation on wet bench and glove box apparatus
- Automated data acquisition for Time Delayed Collection Field Experiments using National Instruments VISA automation and control tools
- Built a setup to perform fourier plane imaging microscopy on samples of organic and perovskite thin films, to determine the emitter orientation in the films, enabling engineering of better devices
- Simulated fourier plane emission profiles of thin film emitters under laser excitation and successfully determined the emitter orientations in the films
- Simulated in MATLAB the outcoupling efficiency and delayed emission profiles of LEDs based on molecular semiconductors to improve emission characteristics of devices via interfacial engineering

Jul'18-Apr'19 **A study of recombination dynamics in Bulk Hetero-Junction Organic Solar Cells**, *Bachelors Thesis*.

Prof. Dinesh Kabra, Department of Physics, IIT Bombay

- Studied charge dynamics in blended bulk heterojunction solar cells via photocurrent measurements
- Simulated the emission in F8BT based organic LEDs via Dyadic Greens function based modelling
- Set up the Steady State Photocarrier Grating experiment to determine diffusion lengths and density of states in photoconductive materials. Investigated organic semiconductors and perovskite films under photoexcitation.

Jul'17-Nov'17 **Characterisation of Perovskite Nanoparticles**, *Supervised Learning Project*.

Prof. M. Aslam, Dept. of Physics, IIT Bombay

- Characterised Organolead Halide Nanoparticles by Absorption and Photoluminescence Spectroscopy
- Did literature survey reading 15+ papers to understand the emerging field of Perovskite Photovoltaics
- Perfomed a time decay study on nanoparticles, confirming their decay with time

May'16-Jul'16 **Positron Emission Tomography**, *Summer Research Project*.

Prof. Pragya Das, Department of Physics, IIT Bombay

- Studied various techniques of Positron Emission Tomography
- Wrote programs in C++ to process and visualise data acquired from PET scans

Research Internships

Dec'17 **Noise reduction for Central Drift Chamber**.

Prof. Hiroyuki Noumi, RCNP, Osaka University, Japan

- Implemented noise reduction measures in signal acquisition for cosmic ray tracking in drift chamber
- Used c++ & Root scripts to visualise data & see channel response for detection of incoming particles
- Characterised chamber response as function of gas flow rate & voltage to find best detection conditions
- Calculated efficiency of the different detection channel layers in the Drift Chamber
- Worked on c++ and Root scripts for tracking of individual particles to find real time trajectories

May'17 **Characterisation of PMTs as Muon Beam Counter**.

Prof. Tsutomu Mibe, g-2/EDM Collaboration, KEK, Tsukuba, Japan

- Received a letter of recommendation for applying to JPARC Asia Summer Student Program
- Studied properties, output characteristics, effect of magnetic fields on Photomultiplier Tubes (PMTs)
- Built a testing circuit testing PMTs as Muon Counters
- Wrote report detailing the experiment and findings regarding the effect of magnetic fields on PMTs

Key Course Projects

Sep'17-Nov'17 **Gesture Recognition with Arduino**.

Prof. Pradeep Sarin, Department of Physics, IIT Bombay

- Built a 3-axis setup to recognise 6 hand gestures and control music playback with a python backend
- Used 3 ultrasonic sensors to take input by Arduino Uno Board, recognise 6 hand gestures & send it to python program to pause/play, previous/next, & volume up/down music playback
- Generated data set of 540 unique hand gestures to enable high recognition accuracy of the gestures

Mar'17- Apr'17 **An n-body simulation on Altera DE0-Nano FPGA**.
Prof. Pradeep Sarin, Department of Physics, IIT Bombay
- Made a functional 8 body simulation on Altera FPGA board with output visualised on VGA monitor
- Incorporated inter-particle and boundary-particle collisions to observe time evolution of the system
- Constructed the required circuit board to interface the FPGA with VGA and enable communication

Nov'16 **Chaos Based Random Numbers**.
Prof. Amitabha Nandi, Department of Physics, IIT Bombay
- As part of group studied and used properties of non-linear maps and chaotic systems to generate and test for pseudo-random numbers
- Wrote python programs to implement the random number generators, and used the Dieharder suite of tests to verify randomness in generated sets. The sequences were found to pass Dieharder tests

Jan'16- Apr'16 **Digital Display**.
Prof. Mahesh B. Patil, Department of Electrical Engineering, IIT Bombay
- Designed a circuit for displaying numbers on 8X5 LED matrix with multiplexer based implementation
- Attempted to expand the scope of the circuit to display any arbitrary output

Jul'15- Nov'15 **Graphing Calculator**.
Prof. Varsha Apte, Department of Computer Science and Engineering, IIT Bombay
- Designed a graphing calculator using c++. Implemented graphing 1 variable and 2 variable functions using intensity plots
- Wrote c++ libraries to implement the various functions

Academic Achievements

2015 **All India Rank of 1053 in JEE Advanced**.
Out of 150,000 candidates appeared

2015 **All India Rank of 1296 in JEE Mains**.
Out of 1.35 million candidates appeared

2014 **91.8% in 12th Board Examination**.
Central Board of Secondary Education, New Delhi, India

2014 **Selected for Level II of Indian National Chemistry Olympiad (InChO)**.
Among Top 1% of students appeared

2014 **99.3875 Percentile in Problem Solving Assessment Examination** .
Conducted by Central Board of Secondary Education, New Delhi

Leadership Roles

Mar'19- Jun'20 **Head, Department Academic Mentorship Program(DAMP)**.
- Spearheaded a 3-tiered team of 16 Coordinators and 215 Mentors overseeing 12 UG departments
- Instituted DAMP in Departments of Mathematics and Environmental Sc. to cater to 40 sophomores
- Implemented the revamped Academic Rehab Policy to setup a support ecosystem for 130+ students
- Boosted the team's capabilities by organising targeted training by Tata Institute of Social Sciences
- Organised Technical Education Quality Improvement Program (TEQIP) workshops for 200+ faculty
- Handpicked 12 mentors from 22 applicants as the acting DAMPC of 3 newly inducted departments

Mar'18- Mar'19 **Institute Student Mentorship Program**.
- Helping and guiding 10 undergraduate freshmen to adjust to life at IITB and guiding them towards various opportunities at IIT Bombay. Among 80 selected students from 300+ applicants

Mar'17- **Department Academic Mentorship Program (DAMP) Mentor**.
- Helping 6 sophomore students resolve their academic problems and guide them towards the various opportunities in the Department of Physics at IITB. Among 8 selected students from 20+ applicants

Teaching Assistantships.
∘Introduction to Quantum Mechanics ∘ Electronics Laboratory: Op-Amps ∘ PHYS172- Modern Mechanics Lab and Recitation

Relevant Courses

Physics	○Quantum Mechanics ○Continuum Mechanics ○Non Linear Dynamics ○Waves and Oscillations ○Classical Mechanics ○Special Relativity ○Thermal Physics ○Photonics ○Intro to Nanoscience and Nanotechnology ○Intro to Condensed Matter Physics ○Statistical Physics ○Electromagnetic Theory ○Introduction to Nuclear and Particle Physics ○Atomic and Molecular Physics ○Analytical Techniques ○Semiconductor Physics ○ of Nanoelectronic Devices ○Solid State Devices ○Physics of Quantum Devices ○Physics of Nanostructures and Nanoscale devices ○Thin Films Physics and Technology ○Nanomaterials, Nanostructures and Nanofabrication
Mathematics	○Data Analysis and Interpretation ○Numerical Methods ○Complex Analysis ○Differential Equations ○Linear Algebra ○Calculus ○Group Theory Methods
Other	○Solar Photovoltaics- Fundamental Technologies & Applications ○Computer Programming & Utilisation ○Digital Systems ○Electronic Devices ○Organic-Inorganic Chemistry ○Physical Chemistry ○Biology ○Economics ○Capitalism:Theories, Histories & Varieties

Extracurricular Activities

2016	Won third position in Bazinga, the physics quiz of IIT Bombay.
2016	Won first position in Energize, the renewable energy quiz of IIT Bombay.
2015	Built a remote controlled (RC) plane, and competed in the RC plane competition at IIT-Bombay.
Others	Interested in reading popular fiction, manga comics, cycling and long distance running.

References

Prof. Tongcang Li.
Department of Physics and Astronomy and Elmore Family School of Electrical and Computer Engineering, Purdue University

Prof. Dinesh Kabra.
Department of Physics, Indian Institute of Technology Bombay

Prof. Pradeep Sarin.
Department of Physics, Indian Institute of Technology Bombay