Sumukh Vaidya

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Skills: Photonics, Optics, Tidy3d FDTD, COMSOL FEM, Instrument Automation, Nanofabrication.

Summary

- Researcher with 5+ years of academic experience in photonics, optics, programming and instrument control.
- Author and coauthor on 10 publications. Co-inventor of 2 patents (provisional).

Publications (Google Scholar)

- Single nuclear spin detection and control in a van der Waals material. Nature *2025*
- Coherent Spins in van der Waals Semiconductor GeS_2 at Ambient Conditions. Nano Letters (accepted) *2025*
- A Power-Efficient Coplanar Waveguide Design for Enhanced Optical Readout in h-BN Quantum Sensors ACS Nano Letters *2025*
- Spin-State Selective Excitation in Spin Defects of Hexagonal Boron Nitride. ACS Nano Letters *2025*
- Nanotube spin defects for omnidirectional magnetic field sensing. Nature Communications *2024*
- Quantum sensing and imaging with spin defects in hexagonal boron nitride. Adv. In Phys. X *2023*
- Quantum sensing of paramagnetic spins in liquids with spin qubits in hexagonal boron nitride. ACS Photonics *2023*
- Nuclear spin polarization and control in hexagonal boron nitride. Nature Materials *2022*
- Light induced quasi-Fermi level splitting in molecular semiconductor alloys. Materials Advances *2022*
- Novel optoelectronic technique for direct tracking of ultrafast triplet excitons in polymeric semiconductor. Applied Physics Reviews *2021*

Internship Experience

- **Display Hardware Engineering Intern.** *Apple Inc,* Cupertino, California. *05/24-08/24*
  - Working with the Panel Process and Optics team on OLED display characterization.
  - Automated a setup for photometry, radiometry and colorimetry of thermal shifts in luminance and color.
  - Performed panel spectral analysis and color shift quantification.
  - Analyzed spectral data and proposed new metrics to track panel defects and drive development decisions.
- **Visiting Student Researcher.** *JPARC,* Tokai, Japan. *12/17*
  - Implemented trajectory tracking algorithms for cosmic rays to reduce spurious noisy signals.
  - Used C++ & Root scripts to visualise data & see channel response for detection of incoming particles.
  - Calculated efficiency of the different detection channel layers in the Drift Chamber.
- **Visiting Summer Student Researcher.** *KEK,* Tsukuba, Japan. *05/17*
  - Studied Photomultiplier tubes in simulated experimental conditions for the Muon g-2/EDM experiment.
  - Built a testing circuit for testing PMTs as Muon Counters.

Work Experience

- **Quantum Sensing and Photonics.** *Purdue University*, PhD Thesis. *01/21-Current*
  - Research in quantum sensing and quantum memory based on 2D and 1D materials.
  - Python, LabVIEW, Matlab programming for automated instrument control of laser and RF experiments.
  - Experience with using and programming PulseStreamer, Function Generator, AWG, Oscilloscopes, Single Photon Counters, NI FPGA, Piezo controllers, Acousto-Optic Modulators and RF Switches for experiments.
  - Used LabVIEW and Python to write programs for precise microwave pulse control to perform pulsed qubit characterization experiments such as Rabi, Ramsay, T_1, T_2, Hahn Echo and coherence time measurements.
  - Built a confocal laser microscope for spin-qubit characterization at room and cryogenic temperatures.
  - Built a high-vacuum ion implantation machine for creating and studying solid state quantum emitters.
  - Matlab simulations of large electron-nuclear spin qubit system involving 40000 x 40000 matrices. (link)
  - Worked with Toyota Research on development of on-chip quantum sensors for the real world. (link)
  - Used COMSOL RF simulations for stripline MW waveguide design and optimizing S-parameters. (link)
  - Used Tidy3d FDTD to design waveguide grating couplers for single photon emitter- fiber coupling. (link)
  - Cleanroom fabrication of simulated and optimized devices for used in experiments. (link)

- **Graduate Data Science Researcher.** *Purdue University,* The Data Mine. *01/24-04/24*
  - Worked with Howmet Aerospace on an ML model for manufacturing defect inspection in X-Ray scans.
  - Built ML models with PyTorch to improve anomaly detection accuracy to 94% from 87% for humans.
- **Organic Semiconductor Imaging, Perovskite Solar Cell Fab.** *IIT Bombay,* Master's Thesis. *07/18-08/20*
  - Fabricated next-gen large-area Perovskite Solar Cells in a clean room environment.
  - Did MATLAB simulations of charge transport in organic semiconductors to study OLED efficiency.
  - Built an imaging setup for thin film organic semiconductors to determine photoemitter orientation via Fourier Plane Imaging Microscopy.
  - Simulated fourier plane emission profiles of thin film emitters under laser excitation and successfully determined the emitter orientations in the films.
  - Built and deployed the research group website using Jekyll. (link)
  - Automated data acquisition for Time Delayed Collection Field Experiments using NI VISA and python.

Education

- **PhD, Physics.** Purdue University, Indiana (GPA 3.91/4.0) *Advisor: Prof. Tongcang Li.* *2021-2025*
- **B.Tech + M.Tech in Nanoscience.** IIT Bombay (IITB), India. *Advisor: Prof. Dinesh Kabra.* *2015-2020*

Skills

- **Programming:** Python, Machine Learning (PyTorch), MATLAB, LabView, LATEX, C++, Mathematica, Zemax OpticStudio, Comsol Multiphysics, Tidy3D FDTD, KLayout, FPGA, git, github.
- **Experimental:** Display Radiometry and Colorimetry, Lasers, Optical system design, Optical Measurements (Room and Low-Temperature), Ion Implantation, Nanofabrication, RF circuits, Instrument Automation, Atomic Force Microscopy, Scanning Electron Microscopy, Confocal Microscopy, Photolithography, High-Vacuum systems, 2-D materials, Raman Spectroscopy.

Service

- **Webmaster, Purdue Physics Graduate Student Association (PGSA)** *Purdue University* *2021-2022*
  - Maintaining the website of the Purdue Physics Graduate Student Association (PGSA)
- **Head, Department Academic Mentorship Program (DAMP).** *IIT Bombay* *2019-2020*
  - 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
- **Institute Student Mentorship Program.** *IIT Bombay* *2018-2020*
  - Helping and guiding 10 undergraduate freshmen to adjust to life at IIT Bombay and guiding them towards various opportunities at IIT Bombay.
  - Among 80 selected students from 300+ applicants.

Teaching

- **Modern Mechanics,** *Purdue University* *2021*
- **Electronics Laboratory,** *IIT Bombay* *2019-2020*
- **Introduction to Quantum Mechanics,** *IIT Bombay* *2019*

References

- **Prof Tongcang Li:** Python, Machine Learning (PyTorch), MATLAB, LabView, LATEX, C++, Mathematica, Zemax OpticStudio, Comsol Multiphysics, Tidy3D FDTD, KLayout, FPGA, git, github.
- **Prof Dinesh Kabra:** Display Radiometry and Colorimetry, Lasers, Optical system design, Optical Measurements (Room and Low-Temperature), Ion Implantation, Nanofabrication, RF circuits, Instrument Automation, Atomic Force Microscopy, Scanning Electron Microscopy, Confocal Microscopy, Photolithography, High-Vacuum systems, 2-D materials, Raman Spectroscopy.