Shivam Nitin Kajale

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I am a Ph.D. student in Prof. Deblina Sarkar's group at MIT Media Lab, with a background in electrical engineering and applied physics. My doctoral work focuses on **developing nanoelectronic devices using 2D magnetic materials and superconductors** to achieve energy efficient, beyond-CMOS computing devices. My core skills includes **cleanroom** nanofabrication processes, **materials characterization**, and electro-opto-mechanical **instrumentation and automation**.

Education

Present: **Doctor of Philosophy (Ph.D.) student in Media Arts and Sciences**
Massachusetts Institute of Technology, Cambridge, MA
Specializations - **Nanoelectronics and Material Science**

2023: **Master of Science (S.M.) in Media Arts and Sciences**
Massachusetts Institute of Technology, Cambridge, MA
Thesis: Study of vdW magnetic materials for spintronic applications

2020: **Dual Degree (B.Tech+M.Tech) in Electrical Engineering**
Indian Institute of Technology Bombay, Mumbai, India
Thesis: Interaction of Surface Acoustic Waves and Magnetization

Experiences

Present: **Research Assistant** — MIT, Cambridge, MA   *Guide: Prof. Deblina Sarkar*
- Designed brain-inspired stochastic computing hardware using atomically thin magnetic materials for ultra-low energy-dissipation in AI applications
- Developed the first all-van der Waals device for field-free, electrical switching of van der Waals magnets above room temperature for scalable and energy-efficient computing
- Formulated theoretical models and performed simulations to study thermal effects of photovoltaic neural implants, and their application in non-surgical, wireless biphasic stimulation of the brain
- Developed an experimental protocol and built apparatus for fabrication of stable nanoscale devices using air-sensitive 2D magnetic materials

2020: **Digital Hardware Design Engineer** — Intel Corporation, Bangalore, India
- Design and verification of DFX logic of AI oriented graphics core in the Alder Lake SoC

2018: **Research Intern** — Purdue University, IN   *Guide: Prof. Pramey Upadhyaya*
- Built a simulation suite to study ferromagentic nanoscale microwave source using LLG equation, driven by oscillating voltage, and induced Rabi oscillation in a qubit subjected to the nanomagnet's microwave field
- Developed a theoretical model for a room temperature voltage based driver for NV-centre qubits for quantum computing applications

2017: **Computer Vision Intern** — Superbolter$^{\text{TM}}$, Bangalore, India
- Designed and built a Python-based computer vision toolkit for a virtual reality interior designing platform

Technical Skills

Nanofabrication: Photolithography, e-beam lithography, 2D dry-transfer, atomic layer deposition, E-Beam deposition, sputter deposition, pulsed laser deposition, reactive ion etching
Characterisation: SEM, AFM, PFM, XRD, Raman spectroscopy, Magneto-transport, MOKE, Transistor I-V
Programming: LabVIEW, Python, MATLAB, VHDL, Verilog, C++, LaTeX, HTML
Software: COMSOL Multiphysics, Quantum Espresso, Cadence Virtuoso, Altera Quartus, Oommf

Awards & Achievements

2023: Awarded the MIT-HPI **Design for Sustainability Grant** for the design of brain-inspired low-energy computing devices for AI applications

2022: Delivered a talk at TEDxBoston's **Planetary Stewardship** forum, titled "A new race: making computation sustainable", creating awareness on the environmental impact of large scale AI and computation.

2020: Swastik Dhopte Memorial Award for securing **Rank 1** in Electrical Engineering - Microelectronics batch of 2020, IIT Bombay

2018: Nominated as the **Indian delegate to the Metropolitan Environmental Resource Management** (MERM) camp at Chulalongkorn University (CU), Bangkok. Awarded **first prize** for focus report on **Indoor Air Pollution mitigation**

2015: All India Rank (AIR) 296 in IIT JEE-Advanced out of 150 thousand candidates

2014: Awarded fellowship for pursuing research under Kishore Vaigyanik Protsahan Yojana (KVPY), with AIR 191, by Department of Science & Technology of the Government of India

2011: Granted scholarship under National Talent Search Exam, by the Govenrment of India

Publications

Kajale S.N., Nguyen T., Hung N.T., Li M., Sarkar D.,"Field-free deterministic switching of all-van der Waals spin-orbit torque system above room temperature", **Science Advances**, 10, eadk8669 (2024)

Kajale S.N., Nguyen T., Chao C.A., Bono D.C., Boonkird A., Li M., Sarkar D., "Current-induced deterministic switching of van der Waals ferromagnet at room temperature", **Nature Communications** 15, 1485 (2024)

Kajale S.N., Hanna J., Jang K., Sarkar D., "Two-dimensional magnetic materials for spintronic applications", **Nano Research** 17, 743–762 (2024)

Yadav S., Lee R., Kajale S., Joy B., Saha M., Bull Loey., Cao Sarah., Mitragotri S., Bono D., Sarkar D., "Non-surgical Bioelectronic Implant for Targeted Focal Brain Stimulation", 2024 (*under review at* **Nature Biotechnology**)

Kajale, S.N., "Study of vdW Magnetic Materials for Spintronic Applications". 2023. MIT, M.S. Thesis

Rustagi A., Kajale S.N., Upadhyaya P. "Manipulating quantum impurity spins via dynamical modes of nanomagnets", 2022 (*under review at* **Applied Physical Letters**)

Verma S., Kajale S., Gomez-Bombarelli, R "Machine learning for accurate and fast bandgap prediction of solid-state materials", 2022 IEEE High Performance Extreme Computing Conference (**IEEE HPEC**), pp. 1-2, 2022

Kajale S.N., Yadav S., Cai Y., Joy B., Sarkar D. "2D material based field effect transistors and nanoelectromechanical systems for sensing applications", **iScience** , Volume 24, Issue 12, 103513, 2021

Rustagi A., Solanki A. B., Kajale S., Bogdanov S., Dilley N. R., Shen T., Debashis P., Chen Z., Appenzeller J., Chen Y., Shalaev V. M., Upadhyaya P. "Quantum-classical spin hybrids: leveraging spintronic tools for information processing applications", Proc. SPIE 11470, **Spintronics** XIII, 114702B, 2020

Kajale, S.N., "Interaction of Surface Acoustic Waves and Magnetisation". 2020. IIT Bombay, M.Tech. Thesis

Seminars and Conferences

Dec, 2024: Poster presentation at NeurIPS workshop on Machine Learning with New Computing Paradigms (MLNCP), titled "Energy-efficient random number generation using stochastic MTJs" (upcoming)

Jun, 2024: Oral presentation at the 24th International Conference on the Science and Applications of Nanotubes and Low-Dimensional Materials (NT24), titled "Field-free deterministic switching of a van der Waals ferromagnet above room temperature"

Jun, 2024: Talk a delivered at the Spintronics Seminar series hosted by Trinity College Dublin

Apr, 2024: Seminar talk titled "Propelling van der Waals magnets towards energy-efficient spintronics" at the NanoBio Seminar Series

Jan, 2024: Poster presentation at the Microsystems Annual Research Conference (MARC) 2024