Shivansh Malviya

Curriculum Vitae

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Professional Summary

Profile Applied quantum physicist (BS-MS Physics, IISER Pune) working across QKD-secured optical network simulation, post-quantum cryptography migration planning, ML-KEM/Kyber side-channel research scoping, and QML/materials-model diagnostics. MS thesis at IIT Indore focused on resource allocation for QKD-enabled optical data centre networks.

Tooling Python scientific computing and ML (NumPy, SciPy, Matplotlib, PyTorch, scikit-learn); Qiskit and PennyLane; C++ numerical methods; materials-modeling interfaces through SchNet/GNN workflows.

Focus QKD and quantum communications; PQC crypto-agility and side-channel assessment; validation discipline for hybrid QML systems; materials modeling and QM/MM-facing quantum/classical simulation interfaces.

Work Experience

Jun 2025 – Present

Applied Quantum Physicist
Third Ray Inc. | Ina Solutions Inc.
Develop technical roadmaps, research reviews, and simulation-facing reports across PQC migration, QML for 2D materials, quantum-algorithm feasibility analysis, and quantum workforce strategy. Work emphasizes bounded claims, source discipline, and practical migration or evaluation criteria.

Selected Technical Work

1. PQC Side-Channel Analysis (Quantum Cybersecurity)
Scoped an evaluation design for QML-assisted side-channel analysis of ML-KEM/Kyber. Framed ASCAD as an AES methodology baseline, Kyber/ML-KEM traces as a data-gated next stage, and key-rank curves as the evaluation metric. Compared QSVM/quantum-kernel hypotheses against classical CNN, MLP, CPA, and classical-kernel baselines. *Research-scoping only; no implemented attack result is claimed.*

2. Quantum Machine Learning for 2D Materials Property Prediction [github]
Built and audited hybrid quantum-classical materials pipelines for bandgap prediction across a 6,351-entry 2DMatPedia-derived dataset. Evaluated Coulomb Matrix/PCA/VQC, hybrid NN residual + VQC, and SchNet GNN + RX-encoded VQC variants. Documented a final SchNet + VQC result of $R^2 \approx 0.782$ and MAE = 0.439 eV as a **single-fold baseline**; cross-validation remained incomplete. The main contribution was diagnostic: variance-ratio checks, spatial-normalizer leakage discovery, and explicit collapse-to-mean failure analysis.

3. Quantum Algorithms for Infrastructure Optimization
Evaluated QAOA, QSVM, VQLS, HHL, and related methods for optimization, forecasting, fault detection, and linear-algebra-heavy infrastructure workloads. Mapped each method to data-loading constraints, hardware maturity, latency, and hybrid workflow assumptions. Output was a literature-grounded feasibility review, not deployed optimization software or a measured speedup result.

4. PQC Implementation Roadmaps
Developed PQC migration and inventory frameworks for long-retention deployment scenarios. Work covered CBOM-style cryptographic discovery, CycloneDX-oriented inventory structure, HNDL risk prioritization, hybrid transition patterns, vendor/supply-chain dependencies, and NIST-standardized algorithm families: **ML-KEM/Kyber (FIPS 203)**, **ML-DSA/Dilithium (FIPS 204)**, and **SLH-DSA/SPHINCS+ (FIPS 205)**. Used OMB/ONCD and NIST migration context without exposing client-specific system details.

5. Quantum Workforce Development Curriculum
Prepared a quantum workforce whitepaper structure around three skill pathways: technician-level deployment and troubleshooting, engineer-level protocol and hybrid-workflow design, and specialist-level research or cryptanalysis. The work connected PQC readiness, quantum sensing, and quantum algorithm literacy to concrete training needs rather than treating "quantum workforce" as a slogan.

6. Quantum Buzz QA: Articles & Technical Verification
Reviewed quantum articles through claim extraction, source checking, citation hygiene, and correction notes. Rewrote unsupported or overstated claims into defensible public explanations, with emphasis on separating real technical progress from marketing language.

Apr – Jun 2025

Subject Matter Expert – Physics
SciAstra
Mentored students preparing for JEE and IISER entrance pathways; developed tiered problem sets and explanatory material covering classical mechanics, electromagnetism, and modern physics.

Education and Training

2023 – 2024 | **Indian Institute of Technology (IIT)** — Indore, MP, India
MS-Thesis Research (thesis component of IISER BS-MS degree)

2019 – 2024 | **Indian Institute of Science Education and Research (IISER)** — Pune, Maharashtra, India
BS-MS Dual Degree

2017 – 2019 | **Sri Sathya Sai Vidya Vihar** — Indore, Madhya Pradesh, India
Intermediate

Research Experience

Jan – Nov, 2024 | **Study and design of efficient and resilient QKD in Optical Data Centre Networks** [github]
IIT Indore | IISER Pune | Supervisor: Prof. Vimal Bhatia

Resource Allocation of Quantum Key Resources in Optical Data Centre Networks: Constructed NSFNET topology simulations with configurable quantum/classical resource pools. Implemented allocation algorithms (Priority Queue with adaptive security-level classification and First-Fit wavelength assignment) to evaluate Time-Slot Utilization Ratio (TUR), Success Rate of Connection Requests (SRCR), and Network Security Performance (NSP). Simulated BB84-style key exchange with quantum bit error rate (QBER) monitoring and error correction via modified Hamming codes; extended the reconciliation discussion to Cascade. Evaluated QKD behavior under varying traffic loads, security requirements, and noise assumptions across classical, hybrid, and quantum-assisted configurations.

Jun – Aug, 2024 | **QML Weld Quality Classification** [github]
Womanium Quantum and AI $\langle W|Q\rangle$; QWorld

Explored quantum-classical hybrid architectures for multi-class defect classification in aluminum weld joints (6 categories). Developed and benchmarked a classical CNN baseline alongside a VQC integration, evaluating quantum encoding strategies using Classiq (QMod) and PennyLane.

May – Jul, 2023 | **Ising Hamiltonian and concurrence near quantum phase transition** [github]
Harish-Chandra Research Institute, Prayagraj

Study of a Generalized Hamiltonian and Concurrence in a 1-D Spin Chain Near Quantum Phase Transition: Explored the **Ising model** for a 1-D spin chain, coding a general Hamiltonian for n spins. Adopted a segmented approach: brute-force diagonalization (feasible up to 12 spins due to memory constraints), transitioning to sparse-matrix data types (extending tractable system size to **n = 22 spins**), and finally applying the **Lanczos method** for efficient ground-state energy eigenvalue retrieval at larger system sizes. The derivative of concurrence exhibited the expected scaling behavior, with the inflection point converging toward J/h = 1 and sharpening monotonically with increasing system size.

Academic Background

Core | Quantum Chemistry, Quantum Mechanics, Quantum Physics I and II, Optics, Electronics I, Advanced Quantum Chemistry, Condensed Matter Physics, Statistical Mechanics, Quantum Information, Physics Lab (I, II, IV, V, VI)

Others | Linear Algebra, Advanced Linear Algebra, Data Analysis, Data Science, Numerical Analysis, Cognitive Basis of Science, Electrodynamics, Classical Mechanics, Thermal and Statistical Physics, Thermodynamics, Mathematical Methods for Physics I and II, Nuclear and Particle Physics, Atomic and Molecular Physics, Methods of Experimental Physics

Skills

Programming | **Python** (Pandas, Matplotlib, NumPy, SciPy, PyTorch, scikit-learn), C++, Fortran

Quantum | **Quantum Computing**: Qiskit, PennyLane
Quantum Techniques: QKD/BB84, QBER analysis, VQE/QAOA framing, VQC/QSVM, Hamiltonian simulation
Materials Interfaces: QM/MM-facing SchNet/GNN workflows, 2DMatPedia/JARVIS database, PySCF familiarity, DFT (ORCA, Avogadro)

Development | Git, VS Code, Jupyter, Kaggle, LaTeX

Languages | **English**: Bilingual Proficiency
Hindi: Native

Certificates & Achievements

2024	Womanium Quantum + AI Program (Certificates I–IV)
2022	Quantum Computation, IISER Tirupati (Distinction)
2022	QETCI Quantum Hackathon (Shortlisted – Idea Presentation Round)
2019	Medhavi Chhatravatti Scholarship (Government of Madhya Pradesh)
2019	JEE Mains: **98.225** percentile

Positions of Responsibility

Title **State Convenor** Dec '22 - Dec '23
Organization Think India
Overview Served as state convenor for the Western Maharashtra region. Coordinated national-level events like conventions and workshops, and managed logistics for multi-day conferences with participants from across India.

Title **Delegation Protocol Lead** Nov 2022
Organization Think India
Overview Led protocol and delegation logistics for Dr. S. Unnikrishnan Nair (Director, Vikram Sarabhai Space Centre, ISRO) and accompanying delegates at the Think India National Convention. Responsibilities included event coordination, guest logistics, and technical session facilitation.

References

Mr. Suresh Nair
CEO & President
Ina Solutions Inc., VA, USA

Mr. Abhijit Choudhury
CEO
Third Ray Inc., TX, USA

Prof. M.S. Santhanam
Professor, Physics
Master's Thesis Expert
IISER Pune, Maharashtra, India

Prof. Vimal Bhatia
Professor, Physics
Master's Thesis Supervisor
IIT Indore, Madhya Pradesh, India