Shivansh Malviya

Applied Quantum Physicist

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Research Interests

Focus

Applied quantum systems under operational constraints: quantum communication security, post-quantum cryptography, QKD-secured optical networks, side-channel assessment, hybrid QML diagnostics, and infrastructure-facing quantum algorithm evaluation. Current work emphasizes technically honest deployment framing rather than unqualified quantum-advantage claims.

Research Experience

Jan – Nov, 2024 | **Study and Design of Efficient and Resilient QKD in Optical Data Centre Networks** [github]

Prof. Vimal Bhatia, IIT-Indore | Dr. M.S. Santhanam, IISER-Pune

Built a two-layer simulation framework: fully classical and Qiskit-based hybrid BB84 models for QBER/SKR behavior under noise and eavesdropping, plus a 14-node NSFNET allocation model with priority-based k-shortest-path routing and First-Fit wavelength/time-slot assignment. Implemented and evaluated SSL, ASSL, and AWSL security-level policies. **Analyzed SRCR, TUR, and NSP under increasing request load**, correcting indexing and logic defects before retaining the final comparisons. Evaluated Hamming and Cascade error correction across low- and higher-error regimes.

Jun – Aug, 2024 | **QML Weld Quality Classification** [github]

Womanium Quantum and AI $\langle W|Q\rangle$; QWorld

Explored hybrid transfer-learning workflows for aluminum weld-defect classification across six quality categories. Combined classical CNN feature extraction with variational quantum layers using PennyLane/Classiq-style QML tooling; used the project as a controlled prototype for understanding quantum-layer integration, encoding choices, and NISQ-era limitations.

May – Jul, 2023 | **Ising Hamiltonian and Concurrence Near Quantum Phase Transition** [github]

Harish-Chandra Research Institute, Prayagraj

Developed numerical simulations for a generalized Ising Hamiltonian across 1-D spin chains. Used brute-force diagonalization, sparse-matrix methods, and Lanczos exact diagonalization to extend tractable finite-size calculations up to $n = 22$ spins. **Analyzed finite-size concurrence behavior near the quantum phase transition** ($J/h = 1$), observing the expected sharpening of the inflection region with increasing system size.

Sep – Oct, 2022 | **Quantum-Classical Hybrid Architecture for Medical Imaging Classification**

Hackathon, QETCI

Proposed a hybrid neural-network architecture using VQC layers for medical imaging classification tasks. Advanced to the idea presentation round based on computational-efficiency analysis for large-scale datasets.

Education

2023 – 2024 | **Indian Institute of Technology (IIT)** — Indore, MP, India

MS-Thesis Research (thesis component of IISER BS-MS degree) — Project Grade: 7.8

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

BS-MS Dual Degree in Physics — CGPA: 7.1

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

Intermediate — 91.8%

Professional Experience

Jun 2025 – Present | **Applied Quantum Physicist**

Third Ray Inc. | Ina Solutions Inc.

Develop technical frameworks, research reviews, and simulation-facing documentation across post-quantum cryptography, hybrid QML, infrastructure-oriented quantum algorithm evaluation, and quantum workforce strategy. Work focuses on turning quantum theory and literature evidence into implementation roadmaps, risk analyses, and deployment-aware technical reports under confidentiality constraints. Selected work below.

Apr – Jun 2025 **Subject Matter Expert – Physics**

SciAstra
Mentored JEE and IISER-entrance students and developed tiered problem sets across classical mechanics, electromagnetism, and modern physics.

Selected Projects

1. Quantum ML for 2D Materials Property Prediction (Q2DM) [github]
Built and audited hybrid quantum-classical pipelines for bandgap prediction across a 6,351-entry 2DMatPedia-derived materials dataset. Evaluated three architecture directions: Coulomb Matrix/PCA/Amplitude VQC, hybrid NN residual + VQC, and SchNet GNN + RX-encoded VQC. Documented a final SchNet + VQC result of $R^2 \approx 0.782$ and MAE = 0.439 eV as a **single-fold baseline**, achieved after resolving target-leakage in spatial normalizers. Surfaced the collapse-to-mean failure mode that would have made an unqualified success claim misleading.

2. Post-Quantum Cryptography Migration Roadmaps
Authored and submitted a confidential white paper and accompanying five-phase PQC migration roadmaps intended for federal deployment scenarios. The work connected CBOM-style cryptographic discovery, harvest-now-decrypt-later risk prioritization, NIST FIPS 203/204/205 algorithm families, hybrid transition design, cost and schedule constraints, and long-term crypto-agility.

3. PQC Side-Channel Analysis
Designed and presented a falsifiable ML-KEM/Kyber side-channel evaluation framework. Defined staged dataset gates, model families, key-rank benchmarks, reproducibility checks, and classical controls for testing quantum-kernel methods without overstating advantage. Retained as an independent research direction; no completed attack or key-recovery result is claimed.

4. Quantum Algorithms for Power-Grid Big-Data Analysis
Built a literature-grounded decision framework for power-grid quantum adoption. Mapped selected quantum algorithm families to optimization, forecasting, fault-classification, and linear-algebra workloads, then screened each against data-loading, hardware-maturity, classical-baseline, and hybrid-integration constraints. The work identifies which methods merit deeper validation without claiming an implemented grid optimizer or project-produced quantum speedup.

5. Quantum News Platform: Articles and Technical Verification
Performed source-grounded quantum-technology claim checking, technical explainer review, and hype reduction before publication. Work emphasized claim decomposition, citation hygiene, and rewriting unclear or overstated statements into defensible public-facing explanations.

6. Quantum Workforce Development
Sole-authored and delivered a power-sector quantum-readiness strategy centered on a three-tier National Quantum Grid Academy. Connected role-specific training to staged PQC migration, quantum-sensing pilots, benchmark-gated hybrid computing, governance, risk mitigation, and funding pathways. The final deliverable received positive stakeholder feedback.

Academic Background

Core Quantum Mechanics I & II, Quantum Information, Quantum Chemistry, Advanced Quantum Chemistry, Condensed Matter Physics, Statistical Mechanics, Optics, Electronics I, Physics Labs

Methods Linear Algebra, Advanced Linear Algebra, Numerical Analysis, Data Analysis, Data Science, Electrodynamics, Classical Mechanics, Thermal and Statistical Physics, Mathematical Methods for Physics, Nuclear and Particle Physics, Atomic and Molecular Physics

Skills

Quantum QKD, BB84, QBER analysis, Qiskit, PennyLane, VQE/QAOA framing, VQC, QSVM, Hamiltonian simulation, OpenFermion/PySCF familiarity

PQC ML-KEM/Kyber, ML-DSA/Dilithium, SLH-DSA/SPHINCS+, crypto-agility, side-channel assessment, CBOM-style inventory, migration-roadmap logic

ML/Compute	Python (NumPy, SciPy, Pandas, Matplotlib, PyTorch, scikit-learn), SchNet/GNN workflows, C++, numerical simulation, model diagnostics
Tools	Git/GitHub, VS Code, Jupyter, Docker, LaTeX, JavaScript/CSS, React/Vite, Vercel
Languages	English (bilingual), Hindi (native)

Certificates & Achievements

2024	Womanium Quantum + AI Program certificates across QML, quantum hardware, and applied quantum tracks
2024	Advanced Learning Algorithms (DeepLearning.AI / Stanford / Coursera)
2024	Supervised Machine Learning (DeepLearning.AI / Stanford / Coursera)
2022	Quantum Computation, IISER Tirupati (Distinction)
2022	QETCI Quantum Hackathon (Shortlisted – Idea Presentation Round)
2019	Medhavi Chhatravatti Scholarship (Government of Madhya Pradesh)
2019	JEE Main: **98.225** percentile

Positions of Responsibility

Title	**State Convenor** Dec 2022 – Dec 2023
Organization	Think India, Western Maharashtra
Overview	Coordinated academic and policy-facing programming, speaker logistics, and multi-day institutional events.
Title	**Director Visit Coordination** Nov 2022
Organization	Think India National Convention
Overview	Coordinated protocol and delegation logistics for Dr. S. Unnikrishnan Nair (Director, Vikram Sarabhai Space Centre, ISRO) and accompanying delegates during a three-day institutional visit.

References

Available	References available on request. Public portfolio copy intentionally omits third-party phone numbers and email addresses.