Shivanshu Siyanwal

Quantum information and quantum machine learning

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Education

BS–MS (Dual Degree) — Major: Physics; Minor: Data Science Aug 2017 – May 2022
IISER Mohali, Punjab, India
MS thesis in the NMR Quantum Computing Group, advisor Prof. Kavita Dorai; the thesis work became the co-first-author paper in Quantum Information Processing (2025).

High School Diploma (CBSE) 2014 – 2017
Dayawati Modi Academy (DMA-I), Uttar Pradesh, India

Research experience

Quantum Applications Engineer Oct 2024 – Present
Centre for Development of Advanced Computing (C-DAC), Noida, India

- Co-developed quantum-assisted weather models (QGRU, QLSTM, QNN, VQC, QSVM) on ERA5 single-level data for Safdarjung, Delhi; equal-contribution preprint arXiv:2503.23408 and a related IEEE AIMLSystems 2025 paper.
- Compared quantum image encodings (NASS, QBIR, FTQR, FRQCI) in QNNs for binary classification; equal-contribution paper in The Journal of Supercomputing (2026).
- Co-authored the FPGA deployment of a hybrid variational circuit for temperature forecasting on an AMD Alveo U55C (HLS, HBM); IEEE TQCEBT 2026.

DRDO Junior Research Fellow — Quantum Networks and Linear Optics Mar 2024 – Oct 2024
Institute for Advancing Intelligence, TCG CREST (PI: Dr. Arpita Maitra), Kolkata, India

- Designed and simulated linear-optical QKD testbeds (DPS, COW, Twin-Field) in OptiSystem and ANSYS, including loss, noise, and photonic channel impairments.
- Modelled intercept-resend and photon-number-splitting attacks and benchmarked resource-state and entanglement generation.

Research Intern — Quantum Cryptography Aug 2023 – Mar 2024
Institute for Advancing Intelligence, TCG CREST (PI: Dr. Arpita Maitra), Kolkata, India

- Built quantum circuits for an 8-bit AES (Mini-AES / S-AES) and Galois-field arithmetic; ran them on Qiskit and IBM Quantum hardware.
- Implemented a plaintext–ciphertext attack with Grover search and amplitude amplification.

Quantum Computing Developer Sep 2022 – Jul 2023
Arqanum Technologies Pvt. Ltd., Pune, India

- Implemented and optimised VQC, QBM, and VQLS for time-series forecasting and financial analysis on AWS Braket and Rigetti hardware.
- Developed quantum data-encoding techniques (amplitude, phase, angle) and Ising-Hamiltonian circuits.
- Contributed code to MeitY–QCAL (Dicke-state simulation) and to an Arqanum–IIT Kharagpur project on a quantum cryptographic hash.

MS Research Student May 2021 – Aug 2022
NMR Quantum Computing Group, IISER Mohali (PI: Prof. Kavita Dorai), Punjab, India

- Designed an ANN that detects genuine multipartite entanglement and assigns one of six SLOCC classes to three-qubit states: 128 real features (Re and Im of the 64 elements of ρ), reduced to 18 (14 Re, 4 Im) by the canonical form, then ranked by ANOVA within the 18.
- Validated on 30 experimental three-qubit states from an NMR processor: GME detection at 0.954 ± 0.046 accuracy with 4 features, SLOCC classification at 0.867 ± 0.090 with 6. Equal contribution with V. Gulati.

Intern May 2018 – Jul 2018
Mesoscopic Physics Lab (PI: Dr. Ananth Venkatesan)
Summer 2018 (May–July), intern in Dr. Ananth Venkatesan's Mesoscopic lab, IISER Mohali. I worked on a theoretical design for a water-cooled solenoid reaching 0.5 T, studying Bitter and Swiss-roll magnet models.

Research Intern May 2019 – Jul 2019
Evolutionary Biology Lab (PI: Dr. N. G. Prasad), IISER Mohali
In summer 2019 (May–July) I was a research intern in Dr. N. G. Prasad's Evolutionary Biology Lab at IISER Mohali. I developed mathematical models of gene-frequency patterns of sexually dimorphic traits in Drosophila melanogaster, simulated population-genetic evolution in MATLAB, and analysed data in R.

Publications

Journal articles

[J1] A. Tiwari*, **S. Siyanwal***, S. Sakhuja, S. Kumar, P. Tyagi. Quantum image representation-based quantum neural networks for binary classification. *The Journal of Supercomputing*, 82(8):495, 2026. doi:10.1007/s11227-026-08621-3

[J2] V. Gulati*, **S. Siyanwal***, Arvind, K. Dorai. ANN-enhanced detection of multipartite entanglement in a three-qubit NMR quantum processor. *Quantum Information Processing*, 24(3):74, 2025. doi:10.1007/s11128-025-04696-8 · arXiv:2409.19739

Conference papers

[C1] **S. Siyanwal**, B. Kape, C. Pushkarna, K. Islur, T. Kumar, N. Khan, K. Dave. Variational Quantum Linear Solver for Time Series Forecasting: A Practical Implementation on Financial Data. *SASIGD 2026 (IEEE SSIT, CBIT Hyderabad)*, 2026, Accepted and presented; online later.

[C2] **S. Siyanwal**, N. Khan, S. S. Pandey, K. Y. Islur, K. Dave, S. Chhipa. TensNet: Memory-Efficient Tensor Network Methods for 2D Incompressible Flow Simulation. *ICSSCC 2026*, Accepted, in processing.

[C3] N. Khan, **S. Siyanwal**, K. Islur, A. Tiwari, H. Gupta. Hybrid variational quantum circuits based temperature forecasting with low-latency FPGA inference. *IEEE TQCEBT 2026*, pp. 1–6.

[C4] A. Tiwari, S. Kumar, P. Tyagi, R. Jaware, **S. Siyanwal**, K. Dave, H. Gupta. Adaptive Multi-Algorithm Imputation Pipeline for Weather and Environmental Time Series. *6th International Conference on Emerging Trends and Technologies on Intelligent Systems (ETTIS 2026), C-DAC Noida, 1–3 July 2026*, Accepted and presented; proceedings (Springer LNNS) not yet published.

[C5] A. Tiwari, S. Kumar, P. Tyagi, **S. Siyanwal**, S. Sakhuja. Quantum machine learning models for enhanced weather prediction. *IEEE AIMLSystems 2025*, pp. 446–451. arXiv:2503.23408

Thesis

[Th1] **S. Siyanwal**. Entanglement detection and gate optimization in the system of three and four NMR qubits using deep learning and machine learning. *IISER Mohali*, 2022.

Manuscripts in preparation

- Simulated DPS, COW, twin-field and MDI QKD over linear-optical channels, with attack modelling. TCG CREST, Aug 2023 – Oct 2024.
- Quantum circuits for a scaled-down AES (Mini-AES / S-AES) and a Grover-search plaintext–ciphertext attack. TCG CREST, Aug 2023 – Mar 2024.
- Quantum Optimization for Urban Heat Island. With Vikramaditya Bisani, since March 2025.

*Equal contribution.

Posters and talks

[Po1] **S. Siyanwal**. Detecting and Classifying Tripartite Entanglement using Neural Networks. Poster, *Quantum Techniques in Machine Learning (QTML) 2024, University of Melbourne*, 2024.

[Po2] **S. Siyanwal**. Quantum Communication and Computation (QCC) 2025. Poster, *IAI, TCG CREST*, 2025.

Awards and fellowships

Honorable Mention, Quandela Q-volution Hackathon (Track B, photonic quantum computing) — FinTeQ: Photonic Quantum Kernel for Swaption IVS Forecasting 2026

INSPIRE-SHE Fellow, Department of Science and Technology, Government of India 2017–2022

DRDO Junior Research Fellowship, TCG CREST 2024

IBM Certified Associate Developer — Quantum Computation using Qiskit v0.2X 2026

Qiskit Global Summer School, Quantum Simulations, Advanced Level 2022

Qiskit Global Summer School, Quantum Machine Learning, Certificate of Excellence 2021

IBM Quantum Challenge Africa, Advanced Achievement 2021

TOEFL iBT 96 2022

Certificates and events

ETTIS 2026 (6th International Conference on Emerging Trends and Technologies on Intelligent Systems), C-DAC Noida 2026

SASIGD 2026, IEEE SSIT, CBIT Hyderabad (VQLS paper presented as a talk and paper) 2026

12th International Conference on Mathematics and Computing (ICMC) 2026, LNMIIT Jaipur (attended) 2026

QGSS 2026, Qiskit Global Summer School 2026

Trainer, faculty programme, C-DAC Mohali

Skills

Quantum frameworks	Qiskit, Cirq, PennyLane, Perceval, Amazon Braket, CUDA-Q, QTensorFlow
Quantum domains	Variational algorithms, Linear-optical QC, Quantum network simulation, Tensor networks, ZX calculus, Circuit compilation
Software engineering	Python (production), C++, Rust, Git, Linux
Machine learning	PyTorch, TensorFlow, NumPy, SciPy, Scikit-learn
Hardware & cloud	AMD Alveo FPGA, HLS, HBM, REST APIs, Rigetti QPUs, NVIDIA RTX A6000 GPUs
Simulation	OptiSystem, ANSYS, QuTiP, QETLAB

References available on request.