Nishant Chaudhari

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Education

University of Southern Mississippi *Hattiesburg, MS*
B.S. in Physics & B.S. in Mathematics (Double Major) *Aug 2023 – May 2027*

- **Cumulative GPA:** 3.971/4.0 **Major GPA:** 4.0/4.0 (Physics & Mathematics)
- **Honors:** President's List (5 semesters), Dean's List (1 semester).
- **Relevant Coursework:** Quantum Mechanics I (in progress), Electromagnetism I (in progress), Classical Mechanics, Mechanics I & II, Modern Physics I & II, Optics, Electronics, Partial Differential Equations, Numerical Analysis, Real Analysis (in progress), Linear Algebra, Probability & Statistics, Discrete Mathematics, Modern Algebra.

Research Experience

FTPP Research Intern - Space Plasma Physics *Huntsville, AL (UAH)*
Supervisor: Dr. Lingling Zhao, University of Alabama in Huntsville *May 2026 – Jul 2026*

- Analyzed in-situ spacecraft observations from **Parker Solar Probe (PSP)** and **Solar Orbiter** to detect and characterize **Heliospheric Current Sheet (HCS)** crossings.
- Built a Python / `PySPEDAS` data pipeline to process Level-2/3 products from three PSP instrument suites: FIELDS (magnetic field), SWEAP/SPAN-Ion (plasma moments), and SWEAP/SPAN-Electron (pitch-angle distributions).
- Successfully reproduced the baseline HCS crossing catalog of Fargette et al. (2026) for PSP Encounter 16, identifying three full crossings with reconnection jet signatures; extended analysis to Encounters 6–21.
- Investigated magnetohydrodynamic structure of the solar wind near the current sheet, focusing on energy flux, magnetic reconnection, and turbulence evolution across the sector boundary.

Fletcher Research Intern - Quantum Information Science *Remote / Provo, UT (BYU)*
Supervisor: Dr. Jean-François Van Huele, Brigham Young University *Jun 2024 – Present*

- Developed a **two-qubit noise model** for Bell-state combinations that applies **globally correlated depolarizing and phase damping** together with **independent local amplitude damping**, extending beyond standard single-qubit treatments.
- Derived closed-form expressions for **Wootters' concurrence** and **von Neumann entropy** across all 16 Bell-state superposition and mixing combinations under Depolarizing, Phase Damping, and Amplitude Damping noise channels.
- Discovered a **counterintuitive noise-assisted entanglement enhancement** regime for all three types of noise.
- Mapped **entanglement vs. non-locality phase boundaries** via the Horodecki CHSH criterion, producing complete phase diagrams for all three noise channels and five canonical Bell-state symmetry classes.
- Quantified entanglement dynamics in multi-qubit systems (GHZ, W states) under noise; analyzed concurrence and entropy for Werner states under depolarizing noise.
- **Presented** poster "Entanglement Dynamics for Bell State Combinations under Various Noise Conditions" at **APS Global Physics Summit 2026**, Denver; preparing oral presentation for APS Summit 2027.
- Manuscript posted to **arXiv** (August 2026).

Undergraduate Research Assistant - Radial Basis Functions & PDEs *Hattiesburg, MS*
Supervisors: Dr. Ching Shyang Chen, USM Dept. of Mathematics *Feb 2025 – Present*

- Designing and benchmarking **Radial Basis Function (RBF)** frameworks to solve PDEs on irregular, meshless domains using the Kansa method with Multiquadric and Thin Plate Spline kernels.
- Implementing the **Leave-One-Out Cross Validation (LOOCV)** algorithm in Multiquadric RBFs to optimally select shape parameters, improving solution stability and accuracy.
- Generating 3D isosurface visualizations and error analyses in MATLAB and Mathematica to validate convergence behavior.

Publications & Manuscripts

- **Chaudhari, N.** & Van Huele, J.F. (2026). *Characterizing Entanglement in Combinations of Bell States through Superposition and Mixing: An Increase in Entanglement on Introducing Depolarizing, Phase Damping, and Amplitude Damping Noise.* arXiv:2608.17500. In preparation for submission to Physical Review A.
- **Chaudhari, N.** (2024). *How Does Noise Affect Quantum Systems?* Research report, Brigham Young University.
- **Chaudhari, N.** (2024). *Properties of Noise in Quantum States.* Research report, Brigham Young University.

Presentations & Conferences

- **APS Global Physics Summit 2025** (Denver, CO) — Poster: "Entanglement Dynamics for Bell State Combinations under Various Noise Conditions."
- **APS Global Summit 2026** (in preparation) — Oral presentation on quantum noise and entanglement.
- **USM Research Symposium 2025 and 2026** — **First Place Oral Presentation Award**, Department of Physics & Mathematics.
- **Quantum+Chips Summer School**, University of Minnesota (Aug 2025) — Hands-on training in superconducting qubits, ion-trap qubits, quantum error correction, and silicon chip fabrication.
- **CMAP Summer School**, University of Rochester (Jul 2025) — Condensed matter physics, plasma physics, laboratory astrophysics, and planet formation simulation in Python.
- **APS Thriving Departments Symposium**, Chicago (2025) — Departmental growth, diversity, and professional development in the physical sciences.
- **Nuclear Summer Science School**, Michigan State University (Apr–May 2024) — Nuclear processes (R-process, S-process) and connections to quantum mechanics.

Awards & Honors

- **APS Doc Brown Award** (2026).
- **APS National Mentoring Community (NMC) Award** (2026).
- **Wright W. & Annie Rea Cross Mathematics Undergraduate Research Scholarship** (2025).
- **First Place Oral Presentation Award**, USM Research Symposium (2025 and 2026).
- **Freshman Academic Excellence Scholarship**, University of Southern Mississippi (2023–2025).
- **President's List**, University of Southern Mississippi (5 semesters: Fall 2023 – Spring 2026, excl. Fall 2025).
- **Dean's List**, University of Southern Mississippi (Fall 2025).

Competitions

MIT iQuHACK 2026 (IonQ Challenge) — 1st Place *Cambridge, MA (Remote)*
Team: Q-gars *Jan 2026*

- Project: *Hybrid Quantum-Classical Optimization for Entanglement Distillation.*
- Engineered a Python "Auto Bot" agent for network optimization using a hybrid solver that integrated physics-based noise characterization (density matrix reconstruction for 5 noise channels) with graph-theoretic pathfinding (Dijkstra's algorithm, ROI, Betweenness Centrality) to maximize quantum network utility.
- Designed adaptive quantum circuits unifying bit-flip and phase-flip error correction, validated against theoretical fidelity thresholds.

Leadership & Outreach

Founder & President — Quantum Undergraduate Network (QUN) *International (Remote)*
May 2025 – Present

- Founded an international network connecting **100+ undergraduates** in quantum information science across institutions.
- Organized guest lectures from **IBM Quantum researchers** and academic leaders; hosted hands-on quantum computing workshops engaging **20+ students**.

Society of Physics Students (SPS), USM *Hattiesburg, MS*

- **President** (May 2026 – Present): Elected to lead the USM chapter for the 2026–2027 academic year, directing all programming, outreach, and chapter strategy, and managing chapter events and organizational funding.
- **Vice President** (Aug 2025 – May 2026): Led public physics demonstration events for high school students at STEM Carnival; organized faculty-student mentorship panels; managed chapter budgeting and resource allocation.

Technical Skills

Programming: Python (`PySPEDAS`, NumPy, SciPy, Matplotlib, Qiskit), MATLAB, Mathematica, LaTeX, Git/GitHub.

Quantum Computing: Qiskit circuit design, density matrix formalism, noise channel modeling (Kraus operators), entanglement measures (concurrence, von Neumann entropy, Horodecki criterion), quantum error correction.

Numerical Methods: Radial Basis Functions (RBF), Thin Plate Splines, meshless PDE solvers (Kansa method), LOOCV shape parameter optimization, 3D isosurface visualization.

Data Analysis: In-situ spacecraft data processing (PSP FIELDS, SWEAP), pitch-angle distribution analysis, magnetic field time-series analysis, signal processing.

Tools: GitHub, Overleaf, Jupyter Notebooks, Mathematica, MATLAB.

References

Dr. Jean-François Van Huele
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Dr. Ching Shyang Chen
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Dr. Lingling Zhao
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