Rojae Mighty

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Academic Profile

Physics undergraduate researcher exploring quantitative finance, machine learning, and data-driven modeling alongside nuclear physics, gluon saturation, geometric scaling, and computational methods for high-energy collisions. His work combines Python, numerical analysis, C++/ROOT, and computational modeling.

Research Interests

Electron-Ion Collider physics; QCD and gluon saturation at small x; Deep Inelastic Scattering kinematic reconstruction; scientific machine learning; Monte Carlo simulation; statistical modeling of complex physical and financial systems.

Education

Stony Brook University *Stony Brook, NY*

B.S. in Physics, Expected May 2028 | GPA: 3.7

Relevant Coursework: Electromagnetic Theory, Statistical Mechanics, Computational Methods, Calculus, Linear Algebra

Research Experience

Brookhaven National Laboratory *Upton, NY*

DOE Science Undergraduate Laboratory Internship Researcher *June 2025-August 2025; June 2026-August 2026*

- Developed ROOT, Python, and Linux scripts to support electron-ion collision research on 10 million simulated events.
- Built reproducible analysis workflows for studying particle behavior and nuclear effects after high-energy collisions.
- Implemented and tested analysis code for semi-inclusive electron-ion collision studies using spatially dependent nuclear structure inputs.
- Worked independently within an 8-person research team, translating physics requirements into validated code and organized outputs.

Brookhaven National Laboratory Mini-Semester Participant *2025*

- Completed an intensive introduction to nuclear science and accelerator-based research at BNL.
- Built early exposure to STAR and Electron-Ion Collider physics through lectures, lab visits, and research discussions.

Center for Frontiers in Nuclear Science (CFNS) *Stony Brook, NY*

Undergraduate Researcher, Nuclear and High-Energy Physics *January 2025-Present*

Advisor: Zhoudunming (Kong) Tu

- Built Python and scikit-learn pipelines to reconstruct key kinematic quantities from 10 million particle-collision events.
- Used C++, ROOT, Monte Carlo event generators, and numerical simulations to study gluon saturation and geometric scaling at the Electron-Ion Collider.
- Developed machine-learning approaches for Deep Inelastic Scattering kinematic reconstruction, including extraction of x and Q^2 for inclusive and extended scattering channels.
- Created reusable workflows that improved repeatability, verification, and sharing of analysis results across research tasks.
- Presented research at DIS, APS Global Physics Summit, Yale URC, NSBP, APS DNP, and Stony Brook Physics Colloquium.

Research and Technical Themes

- **Gluon saturation and geometric scaling:** Study how high-energy gluon growth may saturate in nuclear matter and how the EIC could observe these effects.
- **Electron-Ion Collider kinematics:** Use computational and machine-learning methods to reconstruct event-level physics quantities needed for electron-nucleus analysis.
- **Scientific machine learning:** Apply data pipelines, numerical simulation, feature engineering, and statistical validation to physical systems with large event samples.
- **Quantitative modeling:** Extend experience with simulation, uncertainty, and large datasets into market microstructure and systematic research projects.

Projects

Market Microstructure Forecasting *January 2025-Present*

GitHub: https://github.com/iRojae/market-microstructure-forecasting

- Built a Python machine-learning project with pandas, NumPy, and scikit-learn to forecast short-horizon price movement from limit-order-book data.
- Engineered trading features including order-flow imbalance and bid-ask spread changes.
- Evaluated models with walk-forward validation and transaction-cost-aware backtesting.
- Used the project to connect physics research habits - reproducibility, controlled validation, and uncertainty-aware modeling - with quantitative finance problems.

J.P. Morgan Quantitative Research Virtual Experience Program - Forage *January 2026*

- Completed 4 quantitative research tasks covering commodity analysis, derivatives pricing, credit-risk modeling, and FICO score grouping.
- Modeled natural gas prices using 48 monthly observations and built a storage-contract pricer for a 1,000,000 MMBtu sample contract valued at $583,118 net.
- Built probability-of-default models on 10,000 borrower records using 6 financial features; evaluated a 7,500/2,500 train-test split with AUC = 1.0000 and Brier score = 0.0031.

Honors and Awards

- 1st Place for Physical Sciences Presentation, Yale Undergraduate Research Conference, January 2026
- Outstanding Oral Presentation Award, National Society of Black Physicists Annual Conference, January 2025
- Barry Barish Undergraduate Research Travel Award, Stony Brook University, January 2026
- Edward Guiliano Global Fellowship, Stony Brook University, January 2026
- Project supported by the Edward Guiliano Fellowship: "Myth and Matter: Exploring Early Explanations of Nature," Greece

Presentations and Conferences

Geometric Scaling and Gluon Saturation at the EIC

- Deep Inelastic Scattering Conference (DIS 2026), Bologna, Italy - oral presentation
- APS Global Physics Summit, 2026 - oral presentation
- Yale Undergraduate Research Conference, 2026 - poster presentation
- National Society of Black Physicists Annual Conference, 2025 - oral presentation
- APS Division of Nuclear Physics Meeting, 2025 CEU - poster presentation
- Stony Brook Physics Colloquium, 2026 - invited oral presentation
- Stony Brook Undergraduate Research Day, 2026 - presentation

Leadership, Mentorship, and Community

Dean's Student Leadership and Advisory Council, College of Arts and Sciences *2024-Present*

- Represent undergraduates to the CAS Dean on policy, student experience, and campus services.
- Serve as a CAS Ambassador at admissions events and the Godfrey Excellence in Teaching Awards.
- Participated as an Admitted Seawolves Day panelist for prospective students and families.

Collegiate Science and Technology Entry Program, Stony Brook University *2024-Present*

- Mentor underrepresented STEM undergraduates on research pathways, academic planning, and professional development.
- Support a community focused on access, preparation, and persistence in science and technology fields.

Socially Just Seawolves Living-Learning Community *2023-Present*

- Lead food-insecurity awareness programming in partnership with campus support services.
- Participate in service-learning and community agriculture volunteering.
- Connect academic development with civic responsibility, peer support, and campus community work.

Technical Skills

Programming: Python, C++, C, Unix/Linux shell scripting
Data and Machine Learning: pandas, NumPy, scikit-learn, feature engineering, statistical analysis, walk-forward validation, dynamic programming
Research and Tools: ROOT, Monte Carlo event generators, numerical simulation, Git, GitHub, LaTeX, Linux/Unix environments
Domains: Electron-Ion Collider physics, particle-collision data, gluon saturation, geometric scaling, market microstructure
Languages: English, elementary French