Lazaro Raul Diaz Lievano

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Education

Autonomous University of Puebla Puebla, Mexico

Bachelor of Science in Physics. GPA: 9.3/10 *2019 – 2024*

Thesis: *Quantum Generative Adversarial Networks for High Energy Physics. Advisor: Dr. Isabel Pedraza.*

Research Interests

- Phenomenological and experimental approaches in High-Energy Physics.
- Development and application of computational techniques to address scientific and real-world challenges.
- Integration of machine learning and quantum computing methods to solve complex problems in physics and beyond.

Experience

Google Summer of Code with ML4SCI May 2024 – Sep 2024

Open Source Contributor *Remote*

- Investigated the potential of Equivariant Quantum Neural Networks (EQNNs) for High-Energy Physics data classification tasks. Code on GitHub and Blog.
- Formulated and tested data encoding schemes including amplitude, angle, and basis with various ansatzes to classify images corresponding to quark and gluon events.
- Trained quantum models on different datasets, achieving 97% accuracy on MNIST and 90% on Fashion MNIST.
- Benchmarked ANN and CNN models and evaluated the performance of EQNNs, summarizing the results.

Quantum Open Source Foundation Mentorship Program April 2024 – June 2024

Quantum Intern Researcher *Remote*

- Explored hybrid optimization models on binary functions using the Walsh-Hadamard Transform.
- Reduced the complexity of binary functions by up to 40%, accelerating quantum computer processing.

CERN CMS Collaboration Sep 2023 – present

Data Analyst Collaborator *Remote*

- Conducted data analysis projects using Python on the Resistive Plate Chambers detectors of the Compact Muon Solenoid (CMS) at CERN.
- Prepared and presented weekly reports on analysis to the project team, fostering effective communication and collaboration.
- Provided data-driven solutions and suggested alternatives to improve data analysis processes.
- Collaborated with international researchers and actively engaged in discussions to enhance research outcomes, emphasizing teamwork and interdisciplinary cooperation.

BUAP Aug 2023 – Feb 2024

Internship: Data Analysis for High Energy Physics *Puebla*

- Investigated the operational principles of the CMS detector and explored the structure of the data it collects.
- Processed and analyzed CMS Open Data, cleaning data to reconstruct particles like W and Z bosons and distinguish signal from background noise, presenting results weekly.

Projects

Qubit by Qubit Final Project | *BB84 Quantum Key Distribution (QKD) protocol* March 2024 – Oct 2024

- Developed Python code for secure key generation using the BB84 quantum protocol, along with custom functions for message encryption and decryption via binary addition. Final project for the Quantum Computing course by The Coding School.

LXVI National Congress of Physics | *Machine learning to Cosmic Rays* Jun 2023 – Oct 2023

- I participated in the project titled "Xmax Prediction using Quantum Machine Learning." I applied quantum and classical machine learning models to characterize cosmic ray atmospheric showers from Pierre-Auger Observatory.

Summer Research Intership | *Standard model of Physics* June 2023 – Aug 2023

- I participated in the "Study of new physics in the context of the inert 2 Higgs Doublet Model" project.
- I explored the Standard Model's theoretical structure and the Higgs mechanism. I focused on the Two Higgs Doublet model's inert variant, proposing Higgs fields as potential dark matter candidates.

Technical Skills

Languages:Python, Root, C++, R, SQL, Wolfram Mathematica.
Developer Tools: Git, GitHub, Linux, VS Code, Jupyter Notebook, Google Colab.
Libraries: Pandas, NumPy, Matplotlib, Tensorflow, Pytorch, scikit-learn, Qiskit, Pennylane, Cirq, PyROOT, Uproot, Scikit-HEP.

Courses and diplomas

Course on Quantum Field Theory I | *ICTP* — Sep 2024 - Jan 2025
Machine Learning for Fundamental Physics School 2024 | *Lawrence Berkeley National Laboratory* — Aug 2024
Introduction to software packages for HEP Data Analysis. | *HEP Software Foundation* — June 2024
Workshop on classical and Quantum machine learning for Condensed Matter Physics | *ICTP* — June 2024
Diploma in Data Engineering | *National Major University of San Marcos* — Jan 2024 - Mar 2024
Quantum Explorer badge 2023 | *IBM Quantum* — Mar 2024
Two semesters program: Intro to Quantum Computing | *Qubit by Qubit* — Sep 2023 - April 2024
Quantum Scholars Program | *National Major University of San Marcos* — July 2023 - Aug 2023
Diploma in Data Science | *BUAP* — Jan 2023 - June 2023
Diploma in Data Science and Artificial Intelligence | *Santander Open Academy* — Mar 2021 - Nov 2021

Presentations

Student Group: Seminars on Particle Physics | *UNI, Lima, Peru* — Oct 2024
Division of Particles and Fields Annual Meeting | *UNAM, Mexico City* — June 2024
RPC Detector Performance Group Meeting. CMS CERN | *Remote* — Nov 2023
Best final project Data Science Santander | *Remote* — Nov 2021

Posters

LXVII National Congress of Physics | *UACH, Chihuahua* — Oct 2024
Luis Rivera Terrazas Fair of Science 2024 | *BUAP, Puebla.* — Sep 2024
Division of Quantum Information Annual Meeting | *UNAM, Mexico City* — June 2024
LXVI National Congress of Physics | *Morelia, Michoacan* — Oct 2023
Luis Rivera Terrazas Fair of Science 2023 | *BUAP, Puebla* — Sep 2023

Professional Affiliations

Mexican Particle Accelerator Community (CMAP) member — 2024 - present
CMS experiment Collaborator — 2023 - present

Scholarships and Grants

Santander-FUNED Scholarship: Leaders in Development — 2023 - present
BUAP: Academic Grant — 2023
Telmex-Telcel Foundation: Scholarship of Excellence — 2022 - 2024