

Carlos Romero

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EDUCATION

B.Sc. with Honors, Physics and Mathematics

Anticipated Graduation: December 2023

Elmhurst University, Elmhurst, IL

CGPA: 3.93, Physics Major GPA: 4.0

RESEARCH EXPERIENCE

Postgraduate Researcher in High-Energy Physics

Spring 2024 – Summer 2024

Professor Mayda Velasco's group – Northwestern University

Neural networks and dimensionality reduction for Higgs dataset

Summer 2023

US CMS PURSUE Intern – Fermilab / University of Alabama

Advisor: Professor Sergei Gleyzer

- Designed a deep neural network classifier for a beyond-standard-model particle search on a simulated particle collision dataset.
- Applied principal component analysis (PCA), linear and non-linear autoencoders, and feature selection as dimensionality reduction and feature extraction methods.
- Established performance benchmarks that can be used to determine the optimal method for other particle physics datasets.

Simulation of odor-tracking movement of octopuses with ML

Fall 2022 – Present

Undergraduate Researcher – Elmhurst University

Advisor: Professor Venkatesh Gopal

- Assembled smoke plume generation and optical systems to visualize plume dissipation.
- Explored the use of a generative adversarial network for the generation of smoke-plume's synthetic data.
- Designed machine learning models for emulation of octopuses' suckers to locate the plume's source.
- Contributed to developing a sensory dipole theory for octopuses' odor-plume tracking.
- Authored a publication detailing results and methodology (in preparation).

Third-degree polynomial approximation to PCA

Summer 2022

Undergraduate Researcher – Elmhurst University

Advisor: Professor Stephen Farnham

- Investigated third-degree polynomial approximations as an alternative to PCA.

Predicting ink color with quantum mechanical methods

Summer 2020

CASE Program Scholar – Elmhurst University

Advisor: Professor Álvaro Castillo

- Researched an affordable method to study the color properties of fountain pen dye molecules and some of their derivatives using Hartree Fock and DFT methods.

TEACHING EXPERIENCE

Physics laboratory assistant

Fall 2023

Elmhurst University

- Assisted in setting up experiments for the General Physics I laboratory.

Mathematics Teaching Assistant

Fall 2022 - Fall 2023

Elmhurst University.

- Served as a TA for three Mathematics courses directed to neurodivergent students of the Elmhurst Learning and Success Academy.

Physics and Mathematics Tutor

Fall 2021 – Fall 2023

Elmhurst University

- Tutored advanced Physics and Mathematics courses at the university's Learning Center.

SKILLS

- **Programming and Computer skills:** Python, PyRoot, Sklearn, Tensorflow, Keras, RDataFrame, C++, Matlab, Maple, Unix, Git.
- **Tutoring:** Introductory Physics I & II, General Physics I & II, Analytical Mechanics, Intermediate Physics, Modern Physics, Thermodynamics, Electricity and Magnetism, Calculus I, II, III, Linear Algebra, Discrete Math, Differential Equations.

AWARDS AND HONORS

- Swords Scholar Research Grant, Honors Committee, Elmhurst University (EU), 2023
- COFI Advanced Instrumentation and Analysis School Fellowship, Northwestern University, 2023
- Summer Student Fellowship, Woods Hole Oceanographic Institution (Declined), 2023
- Faculty/Staff Merit Scholarship; Awarded to 6 outstanding students at EU, 2022
- Presidential Scholarship, Elmhurst University, 2020-2023
- Dean's List six times, Elmhurst University 2020-2023
- Kranz Merit Award, Elmhurst University, 2020-2023
- Swords Honors Memorial Scholarship, Elmhurst University, 2023
- International Discovery Scholarship, Elmhurst University, 2020-2023
- Class of 1965 Merit Scholarship, Elmhurst University, 2020-2021

CONFERENCE ORAL AND POSTER PRESENTATIONS

- **Dimensionality Reduction for Classification using Higgs Dataset – Oral Presentation**
Gulf Coast Undergraduate Research Symposium, Physics, Rice University, October 2023
Emerging Researchers National Conference in STEM, Upcoming - March 2024
- **On the Color of Fountain Pen Ink – Poster Presentation**
National Conference of Undergraduate Research, January 2021