

# Carlos Romero

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## EDUCATION

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### **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

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### **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

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### 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

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- **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

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- Swords Scholar Research Grant, Honors Committee, Elmhurst University, 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 top 6 students at Elmhurst University, 2023
- 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

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- **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