Juan Montoya Sanchez

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Profile

Enthusiastic physics student pursuing a bachelor's degree in physics, interested in the DESY Summer Student Programme 2025. Hands-on experience in experimental and computational techniques, including data analysis, software development (C++, Python), and collaborative research in fundamental science projects.

Education

Universidad de Antioquia 2019 – *Expected* 2026.

- Bachelor's degree in Physics GPA: 3.8/5.0
- **Relevant coursework**: Big Data in the Cern and Other Contexts, Introduction to fundamental particle physics, Theoretical mechanics, Experimental physics and Computational physics.

Research Experience

Undergraduate Research Assistant, Phenomenology and Fundamental Interactions Group (GFIF) — Universidad de Antioquia 2024 – Present.

- Developed a C++ ROOT script to read branches from `.root` files, perform necessary calculations, and save the results as plots. This script aimed to characterize the geometric and energetic properties of b-jets and $\bar{b}$-jets at low p_T (< 30 GeV). This project can be found on **GitHub** were my main focus is found in the *V1* folder.

Research Intern, Condensed Matter Group — Universidad de Antioquia 2023 – 2024.

- Contributed to research on quantum dots, focusing on their electronic and optical properties under external fields:
  - **Electronic and optical properties of tetrapod quantum dots under applied electric and magnetic fields** *European Physical Journal Plus, 2024*
    - **My contribution**: Ran half of the COMSOL simulations and exported both numerical and graphical data. Processed simulation outputs in OriginLab, improved figure clarity and references in Overleaf with LaTeX, and created final figures in Inkscape.
  - **Hopf-link GaAs-AlGaAs quantum ring under geometric and external field settings** *Physica E: Low-Dimensional Systems and Nanostructures, 2024*
    - **My contribution**: Verified the correct implementation of the potential model in COMSOL and Python. Adjusted the manuscript format in Overleaf to meet the journal's guidelines.

Conferences & Presentations

9th Colombian Meeting on High Energy Physics (COMHEP) Pasto, December 2024.

- Oral Presentation: *Systematic Study of the Structure of b-Jets and $\bar{b}$-Jets at Low p_T* (< 30 GeV). Presented the results of the C++ ROOT script developed during my undergraduate research assistantship.
- One of the leaders at the CMS Masterclass activity in Pasto on December 3, 2024. I was responsible for explaining to the attendees how to classify events using graphical tools.

ICTP Physics Without Frontiers: Colombian Network for High Energy Physics School Ibagué, December 2023.

- Attended theoretical and experimental HEP lectures, covering tools such as MadGraph5, applications of neural networks for Higgs signal and background discrimination, and Compton scattering.
- Collaboratively developed a neural network for Higgs signal and background discrimination, where I was responsible for cross-validation. After the school, I attended the **8th COMHEP in 2023**.

Personal Projects

United Nations Datathon 2024 – Sustainable Tourism Analysis *GitHub link* Medellín, November 2024.

- Contributed to collecting data, cleaning and preprocessing it, and developing a Python script to analyze the impact of tourism on Medellín. Utilized `GeoPandas` and `Plotly` to visualize results in an interactive map.

NASA Space Apps Challenge 2024 – Community Mapping *GitHub link* Medellín, October 2024.

- This project aimed to create a clear representation of socioeconomic conditions in Medellín. My role involved gathering data, cleaning it, and exporting it as GeoJSON files so my teammates could integrate it into a web app.