

# Juan Pablo González-Aguilera

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## Education

- PhD in Physics** *University of Chicago* Chicago, IL 2025 (expected)  
Studying coherent synchrotron radiation in particle accelerators using high-dimensional ML-based phase space reconstruction algorithms.
- MSc in Physics** *University of Chicago* Chicago, IL 2022  
Characterized emittance in particle accelerator using Bayesian optimization.
- BSc in Physics (summa cum laude)** *Universidad de Los Andes* Bogotá, Colombia 2019  
Thesis: Classification of variable stars using supervised learning.

## Research Experience

- Graduate Research Assistant** *University of Chicago and Argonne National Laboratory* Chicago, IL 2020 - present
  - Characterizing coherent synchrotron radiation effects at the Argonne Wakefield Accelerator.
  - Developed six-dimensional phase space reconstruction method using neural networks and differentiable physics simulations.
  - Developed backward-differentiable particle tracking library in PyTorch.
  - Mentored three undergraduate students in accelerator physics summer projects.
  - Led accelerator group weekly meetings.
- Post-baccalaureate Research Scholar** *Cornell University* Ithaca, NY 2019 - 2020
  - Implemented genetic algorithms in particle accelerator multi-objective optimization.
  - Assisted in design, simulations and experiments of ultra-fast electron diffraction beamline.
  - Mentored an undergraduate student in experimental project.
- Undergraduate Research Assistant** *Universidad de Los Andes* Bogotá, Colombia 2018 - 2019
  - Implemented supervised learning methods in variable star classification.
  - Characterized entangled photon source in quantum optics lab.

## Teaching Experience

- Graduate Teaching Assistant** *University of Chicago* Chicago, IL 2020 - present
  - Conducting discussion sessions and labs of the following courses: Mechanics, Electromagnetism, and Waves and Heat.
- Python for Research program Mentor** *University of Chicago* Chicago, IL 2024
  - Designed a research project for the *Python for Research* program.
  - Mentored and guided five students.
- Trainee Teacher and Peer Tutor** *Universidad de Los Andes* Bogotá, Colombia 2018 - 2019
  - Served as tutor in the Physics Department and School of Sciences. Courses: Physics I-II, Waves and Fluids, Modern Physics, Mechanics, Precalculus, Calculus I-II-III, Linear Algebra I, Probability and Statistics.
  - Obtained first place in tutor evaluation ranking.
- Grader** *Universidad de Los Andes* Bogotá, Colombia 2017 - 2019
  - Graded the following undergraduate courses: Electromagnetism I, Mathematical Methods for Physicists, Physics I and II, Probability I.

## Honors and Awards

- Physical Sciences Division Fellowship** *Physical Sciences Division, University of Chicago* 2023
- Robert G. Sachs Fellowship** *Department of Physics, University of Chicago* 2021
- SURF Cornell Research Scholarship** *Universidad de Los Andes and Cornell University* 2019
- Summa Cum Laude degree in Physics** *Facultad de Ciencias, Universidad de Los Andes* 2019
- Distinción de Excelencia Semestral** *Departamento de Física, Universidad de Los Andes* 2018
- Distinción Alberto Magno** *Universidad de Los Andes* 2014
- First Place (Absolute Winner) - Colombian Physics Olympiad** *Olimpiadas Colombianas* 2013
- Honorable Mention - Iberoamerican Physics Olympiad** *Olimpiadas Iberoamericanas* 2013
- Second Place - Colombian Sciences Olympiad** *Olimpiadas Colombianas* 2012

## Talks

**Detailed Characterization of Coherent Synchrotron Radiation**

Gyeongju, South Korea 2024

**Effects using Generative Phase Space Reconstruction**

4th Machine Learning Applications for Particle Accelerators

**Detailed Phase Space Reconstruction from a Limited Number of Beam**

San Sebastián, Spain 2023

**Measurements Using Neural Networks and Differentiable Simulations**

Physics and Applications of High Brightness Beams

**Towards End-to-End Differentiable Accelerator Modeling**

Chicago, IL 2022

3rd Machine Learning Applications for Particle Accelerators

**Novel Accelerator Diagnostic Development for Multi-Objective Bayesian**

USA (online) 2021

**Optimization at the Argonne Wakefield Accelerator Facility**

American Physical Society April Meeting

## Poster Presentations

**Towards Fully Differentiable Accelerator Modeling**

Venice, Italy 2023

14th International Particle Accelerator Conference

**Bayesian Active Learning for Autonomous Parameter Space Exploration**

New York, NY 2022

**in Particle Accelerators**

American Physical Society April Meeting

**Beam Diagnostics for Multi-Objective Bayesian Optimization at the**

Brazil (online) 2021

**Argonne Wakefield Accelerator Facility**

12th International Particle Accelerator Conference

## Publications

Roussel, R., **Gonzalez-Aguilera, J. P.**, Edelen, A., Wisniewski, E., Ody, A., Liu, W., Kim, Y.-K., & Power, J. (2024). Efficient 6-dimensional phase space reconstruction from experimental measurements using generative machine learning. *arXiv:2404.10853*. <https://doi.org/10.48550/arXiv.2402.18244>

Kim, S., **Gonzalez-Aguilera, J. P.**, Piot, P., Chen, G., Doran, S., Kim, Y.-K., Liu, W., Whiteford, C., Wisniewski, E., Edelen, A., Roussel, R., & Power, J. (2024). Four-dimensional phase-space reconstruction of flat and magnetized beams using neural networks and differentiable simulations. *arXiv:2402.1824*. <https://doi.org/10.48550/arXiv.2402.18244>

**Gonzalez-Aguilera, J. P.**, Kim, Y.-K., Roussel, R., Edelen, A., & Mayes, C. (2023). Towards fully differentiable accelerator modeling. *Proc. 14th Int. Particle Acc. Conf. (IPAC'23)*, 2797–2800. <https://doi.org/10.18429/JACoW-IPAC2023-WEPA065>

Roussel, R., Edelen, A., Mayes, C., Ratner, D., **Gonzalez-Aguilera, J. P.**, Kim, S., Wisniewski, E., & Power, J. (2023). Phase space reconstruction from accelerator beam measurements using neural networks and differentiable simulations. *Phys. Rev. Lett.*, 130, 145001. <https://doi.org/10.1103/PhysRevLett.130.145001>

Roussel, R., Edelen, A., Ratner, D., Dubey, K., **Gonzalez-Aguilera, J. P.**, Kim, Y.-K., & Kuklev, N. (2022). Differentiable Preisach modeling for characterization and optimization of particle accelerator systems with hysteresis. *Phys. Rev. Lett.*, 128, 204801. <https://doi.org/10.1103/PhysRevLett.128.204801>

Roussel, R., **Gonzalez-Aguilera, J. P.**, Kim, Y.-K., Wisniewski, E., Liu, W., Piot, P., Power, J., Hanuka, A., & Edelen, A. (2021). Turn-key constrained parameter space exploration for particle accelerators using Bayesian active learning. *Nat. Commun.*, 12(1), 5612. <https://doi.org/10.1038/s41467-021-25757-3>

**Gonzalez-Aguilera, J. P.**, Roussel, R., Kim, Y.-K., Liu, W., Power, J. G., & Wisniewski, E. E. (2021). Beam diagnostics for multi-objective Bayesian optimization at the Argonne Wakefield Accelerator Facility. *Proc. 12th Int. Particle Acc. Conf. (IPAC'21)*, 960–962. <https://doi.org/10.18429/JACoW-IPAC2021-MOPAB304>

## Skills

- **Programming Languages:** Python, PyTorch, C++, Mathematica, Fortran, Julia, Java.
- **Computer Skills:** Git, Linux, Bash, High-Performance Computing, Parallel Computing, GPU Acceleration,  $\text{\LaTeX}$ .
- **Experimental Skills:** Image post-processing, Electronics, Data Acquisition, Control System (EPICS), Laser Alignment, Particle Accelerator Components.
- **Soft Skills:** Leading Meetings, Teamwork, Collaboration (remote and in-person), Presentation, Communication, Adept,

Receptive, Resilient, Critical Thinking, Teaching, Mentoring.

## Areas of Expertise

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Differentiable Simulations - Accelerator Physics - Computational Physics - Experimental Physics - Data Analysis  
Probability - Statistics - Machine Learning - Bayesian Optimization - University Teaching - University Mentoring

## References

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### Young-Kee Kim

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### John Power

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