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 *Departmento 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 Effects using Generative Phase Space Reconstruction — **Gyeongju, South Korea** *2024*
4th Machine Learning Applications for Particle Accelerators

Detailed Phase Space Reconstruction from a Limited Number of Beam Measurements Using Neural Networks and Differentiable Simulations — **San Sebastián, Spain** *2023*
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 Optimization at the Argonne Wakefield Accelerator Facility — **USA (online)** *2021*
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 in Particle Accelerators — **New York, NY** *2022*
American Physical Society April Meeting

Beam Diagnostics for Multi-Objective Bayesian Optimization at the Argonne Wakefield Accelerator Facility — **Brazil (online)** *2021*
12th International Particle Accelerator Conference

Publications

Gonzalez-Aguilera, J. P., Kim, Y.-K., Roussel, R., & Edelen, A. (2024). Detailed characterization of coherent synchrotron radiation effects using generative phase space reconstruction. *Proc. 15th Int. Particle Acc. Conf. (IPAC'24)*.

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 [Submitted to Phys. Rev. Accel. Beams]. *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 [Submitted to Phys. Rev. Accel. Beams]. *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, 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

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

References

Young-Kee Kim
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