Jorge García Ponce

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Education

HARVARD UNIVERSITY — Cambridge, MA
A.B. in Physics and Mathematics — *Expected 5/25*

Relevant coursework: Topics in the Physics of Quantum Information (Physics 271), Introduction to Quantum Information I,II (Physics 260a, 260b), Modern Atomic and Optical Physics I (Physics 285a), Inference, Information Theory, Learning and Statistical Mechanics (Physics 286)

Awards and Honors

HQI Summer Research Fellowship — 2023, 2024
Selective Harvard Quantum Initiative undergraduate summer research fellowship

HCRP Fellowship — 2023, 2024
Harvard College Research Program

PRISE Fellowship — 2022
Selective Harvard Program for Research in Science and Engineering. Only awarded once

International Chemistry Olympiad (IChO) — 2020, 2021
Bronze Medal (2021) and Honorable Mention (2020)

Publications

[1] **J. Garcia Ponce***, R. A. Bravo*, H.-Y. Hu, and S. F. Yelin, "Circumventing traps in analog quantum machine learning algorithms through co-design," *APL Quantum*, vol. 1, no. 4, p. 046121, Dec. 2024. https://doi.org/10.1063/5.0235279.
*Co-first authors.

[2] **J. Garcia Ponce**, M. L. Díaz-Ramírez, et al., "SO_2 capture enhancement in NU-1000 by the incorporation of a ruthenium gallate organometallic complex," *CrystEngComm*, vol. 23, no. 42, pp. 7479–7484, 2021, DOI:10.1039/D1CE01076J.

Presentations

[1] **J. Garcia Ponce**, L. Min, K. Van Kirk, M. Cain, S. Notarnicola, C. Kokail, and M. D. Lukin, "Learning from Logical Quantum Experiments." Poster presented at the Harvard Quantum Initiative Summer Research Showcase; August 2024; Cambridge, MA.

[2] **J. Garcia Ponce**, R. A. Bravo, and S. F. Yelin, "Studying the Loss Landscapes of a Quantum Perceptron Based Variational Quantum Eigensolver." Poster presented at the Harvard Quantum Initiative Summer Research Showcase; August 2023; Cambridge, MA.

Research Experience

Lukin Group | Harvard Department of Physics — Cambridge, MA
Quantum Error Correction and Quantum Information — *06/2024 – Present*

- Investigating the role of post-selection in early-fault-tolerant experiments with the Most-likely Error (MLE) decoder to reduce logical error rates and systematically improve observable estimates
- Implementing an efficient Classical Shadows protocol on the Lukin group's error-corrected quantum device, exploring the effectiveness of fault-tolerant non-Clifford gates in 3D quantum codes to generate fault-tolerant scrambling unitaries
- Analyzing how post-selection impacts the sample complexity of Classical Shadows protocols

Yelin Group | Harvard Department of Physics — Cambridge, MA
Quantum Machine Learning and Quantum Simulation — *08/2022 – 08/2024*

- Conducted a systematic study of the loss landscape of Analog Quantum Machine Learning (AQML) algorithms
- Developed best ansatz selection practices that steer away from Hamiltonian-agnostic settings and favor a co-design approach
- Developed a methodology to design AQML ansatzes and judge their quality based on their Magnus Expansion
- Developed simulation code from the ground up utilizing Xanadu's PennyLane library and harnessed its differentiable pulse programming in conjunction with the JAX framework for precise simulation of AQML ansatzes
- Executed numerical experiments to analyze and benchmark the efficiency of different AQML ansatzes in determining the ground state of a Transverse Field Ising Model
- Engaged extensively in literature review, staying updated with the latest advancements in the field
- Actively participated in regular group meetings, contributing insights, and engaging in collaborative discussions

Ni Group | Harvard Department of Chemistry and Chemical Biology Cambridge, MA

Experimental AMO Physics *06/2022 – 08/2022*

- Designed an optical cavity under ultra-high vacuum using Fusion360 to enhance the precision of the Rydberg excitation laser in the group's KRb project
- Developed MATLAB scripts for efficient analysis and visualization of time-of-flight spectrometry data
- Created an interactive dashboard to display real-time wavemeter data and relevant information of the lab's lasers
- Acquired hands-on training at Harvard's Instructional Machine Shop
- Became familiar with optical table work and setup

Argüelles-Delgado Group | Harvard Department of Physics Cambridge, MA

Computational Particle Physics *02/2022 – 05/2022*

- Collaborated on simulation code to study High Energy Tau Neutrino detection events for the proposed TAMBO neutrino detector, located in the Colca Valley, Peru
- Implemented a charged lepton propagation tool in the Julia programming language using the PROPOSAL Python API

Teaching Experience

Quantum Mechanics I (Physics 143a) | Harvard University Cambridge, MA

Course Assistant *Spring and Fall 2023, Spring 2024*

- Hosted weekly office hours to assist students with questions and provide guidance on the problem sets
- Graded weekly homework assignments

Wave Phenomena (Physics 15c) | Harvard University Cambridge, MA

Course Assistant *Fall 2024*

- Hosted weekly office hours to assist students with questions and provide guidance on the problem sets
- Graded weekly homework assignments

Extracurricular and Leadership Activities

Society of Physics Students (SPS) | Harvard University Cambridge, MA

President *Fall 2023 – Spring 2024*

- Organized events to connect undergraduate students with faculty and professionals in the physics community
- Fostered an inclusive and supportive environment by strengthening community among physics students and leading collaboration and mentorship initiatives

First-Generation Low-Income Students in Physics | Harvard University Cambridge, MA

Chair *Fall 2023 – Present*

- Organized events and study breaks to foster community among FGLI undergraduate and graduate students in the physics department
- Planned faculty lunches to connect students with faculty and encourage collaboration on research opportunities
- Advocated for a supportive and inclusive environment for FGLI students in the broader physics community

Harvard Chemistry Club | Harvard University Cambridge, MA

Academic Chair *Fall 2022 – Spring 2024*

- Organized faculty lunches to connect chemistry undergraduates with faculty, fostering community and encouraging collaboration
- Coordinated Concentration Declaration Days for two consecutive years, celebrating new sophomore chemistry concentrators
- Served as a peer advisor, guiding underclassmen through chemistry and physics course selections
- Assisted in organizing the inaugural CCB Undergraduate Research Symposium, which featured a keynote address, oral presentations, a roundtable discussion, and poster sessions covering diverse topics such as quantum chemistry, chemical biology, and inorganic chemistry

Outreach

Science Day 2024 with PBHA ExperiMentors | Harvard University Cambridge, MA
Organizer *Spring 2024*

- Collaborated with PBHA's ExperiMentors program to organize Science Day, a science outreach event for Cambridge elementary schools
- Supervised children as they conducted fun, hands-on chemistry experiments, teaching basic scientific concepts and encouraging enthusiasm for science

Concurso Virtual de Química (CVQ) Mexico City, Mexico
Founder *05/2020 – 08/2021*

- Established a virtual chemistry contest to promote and support Latin American students' interest in chemistry during the COVID-19 pandemic
- Developed web development and managerial skills to organize and manage the contest effectively

Skills

Laboratory Skills: Optical table setups, spectroscopy techniques (NMR, IR), and instrumentation design for experimental physics
Programming and Simulation: Python, Julia, PyTorch, JAX, PennyLane, Qiskit, Stim, NumPy, pandas, Matplotlib
Quantum Computing and Algorithms: Stabilizer codes, hybrid quantum-classical algorithms (e.g., VQE, QAOA)
Data Analysis and Visualization: Python libraries including NumPy, pandas, and Matplotlib; MATLAB; and Wolfram Mathematica
High-Performance Computing: SLURM workload manager, Harvard FASRC cluster for parallel processing and job scheduling
Technical Tools: LaTeX for academic writing and presentations