Renzo Kenyi Takagui Perez

Email: renzo.takagui@ib.edu.ar
Github | Webpage | LinkedIn

Education

Bariloche Atomic Center & Balseiro Institute Aug 2022 - Dec 2023 | GPA: 3.3
Master of Science, Theoretical Condensed Matter Physics. Bariloche, Argentina
Thesis: Effect of interatomic repulsion on Majorana zero modes in a coupled quantum-dot-superconducting-nanowire hybrid system.
Advisor: Dr. Armando Aligia

- **Graduate coursework in:** Quantum Theory of Solids, Quantum Field Theory, Open Quantum Systems, Topological Matter, Laser Physics, Many-Body Quantum Theory, Chemistry & Material Science, Photonics in Microwave Systems

Pontifical Catholic University of Peru (PUCP) Mar 2016 - Dec 2021 | GPA: 4.0
Bachelor of Science, Physics, minor in Electrical Engineering. Lima, Peru
Thesis: Holographic Entanglement Entropy. Advisor: Dr. Pablo Bueno, University of Barcelona

Experience

Artificial Intelligence Research Group, PUCP - Research Residency | Self-directed AI Studies Nov 2024 - Present
[Re]: reproduction, [link]: link to original paper

- **Monte Carlo Tree Search based AI bot**: Implemented a Monte Carlo tree search with upper bound confidence algorithm as a policy for an AI bot for the game of Connect4. **[code]**
- **[Re][link] A Neural Algorithm of Artistic Style**: Implemented a deep convolutional neural network in Pytorch for style transfer experiments between artworks and images through texture extraction and image reconstruction with feature maps. **[code]**

Remote Sensing Research Lab, Radio Astronomy Institute - Research Engineer Jun 2024 - Oct 2024
Ionosphere and Remote Sensing *Lima, Peru*

- Developed a novel computational inversion algorithm **[code]** that predicts/reconstructs the electron density per altitude profile given an ionogram. Published results as a sole author **[paper]**.
- Researched the use of Chebyshev polynomials as a parameter estimation method for the retrieval of plasma frequency profiles.
- Reproduced the *"Ionospheric Echo Detection in Ionograms Using Convolutional Neural Networks"* paper **[link]** in PyTorch **[code]**.
- Participated actively and independently in the whole development pipeline, from theoretical work to algorithm development.

Fromsolvers - Software Engineer Jan 2024 - Mar 2024

- Part of the backend development team for the implementation of a Multiplayer Trivia Game App for sports and esports.
- My work was mainly in Python and we developed a RESTful API with Django for the database and FastAPI framework.
- Technologies used: Python, Docker, Git, Django, Pydantic

Condensed Matter Theory Group, Bariloche Atomic Center - Research Assistant Aug 2022 - Dec 2023
Topological Systems in Condensed Matter Physics - Advisor: Dr. Armando Aligia *Bariloche, Argentina*

- Researched the robustness of the topological protection of Majorana zero mode quasiparticles in superconducting nanowire systems using simple effective low-energy Hamiltonians. Published in the Physical Review B Journal **[paper]**.
- Demonstrated that Coulomb repulsion compromises Majorana end states' topological protection only in short wires.
- Implemented advanced algorithms in computational condensed matter physics to calculate expectation values and energy spectra using the Hartree-Fock approximation **[code]**.

Combinatorics Research Group, Universidade de São Paulo - Visiting Researcher Feb 2022 - Apr 2022
Graph Theory and Quantum Information - Advisor: Dr. Yoshiharu Kohayakawa *Sao Paulo, Brasil*

- Investigated quantum communication protocols in which two spatially separated parties could solve a distributed task.
- Analyzed the quantum coloring problem and quantum chromatic number
- Along with researching, I attended the courses of graph theory, number theory, and a seminar on extremal graph theory.

Physics Department, PUCP Mar 2021 - Dec 2021
Undergraduate Researcher - Advisor: Dr. Pablo Bueno, University of Barcelona

- Conducted a review on holographic entanglement entropy in quantum mechanics and quantum field theory **[thesis]**.
- Thesis manuscript awarded the highest score among final year physics students.

Teaching Assistant

- Courses: Introduction to Physics, Physics I: Classical Mechanics, Algorithms, and Introduction to Programming.
- Evaluated up to 30 students during each laboratory session and presented specific topics during some lectures.

Publications

Effect of interatomic repulsion on Majorana zero modes in a coupled quantum-dot-superconducting-nanowire hybrid system
R. Kenyi Takagui-Perez and Armando Aligia
2024 Physical Review B (PRB)
DOI: https://doi.org/10.1103/PhysRevB.109.075416

A note on an inversion algorithm for vertical ionograms for the prediction of plasma frequency profiles
R. Kenyi Takagui-Perez
2024 arXiv Preprint
arXiv: https://arxiv.org/abs/2411.09215

Competitions

- **ACM-ICPC(International Collegiate Programming Contest) South America/South Finals**
  Top 25 among 150 teams and 450 students from 6 countries. Last phase before World Finals. - 2020 and 2019
- **IEEExtreme (24h algorithmic programming competition hackathon)**
  Top 1.7% or Top 94 among 5570 teams and $\sim$ 14683 students in 2021
  Top 2.6% or Top 97 among 3722 teams in 2020
- **International Theoretical Physics Olympiad for Undergraduate**
  Top 10 from 148 teams in 2019

Honors and Awards

- **National Atomic Energy Commission Scholarship** - Full financial support for graduate studies at the Balseiro Institute 2023,2022
- **Single Best Undergraduate Thesis in Physics** - Highest mark among final year undergraduate physics students theses 2022
- **ICPC(International Collegiate Programming Contest) Regional Finalist Top25** 2020,2019
- **IEEExtreme(IEEE 24h Annual Hackathon) Top 100** - Out of more than five thousand teams globally 2021,2020

Skills

Programming:	(most to least experience) Python, C++, Julia, Mathematica, Java, HTML, CSS
ML Tools:	PyTorch, TensorFlow, NumPy
Teaching:	Undergrad: Classical Mechanics, Intro to Physics, Intro to Programming, Algorithms Mentor and Lecturer for the competitive programming ICPC-PUCP team, and Serendipity program.
Languages:	English (advanced), Spanish (native), Portuguese (basic), French (basic)
Other:	Fingerstyle guitarist with a passion for Sungha Jung arrangements. Last but not least, LaTeX.

Pet Projects

MCTS tictactoe bot | ionogram trace extraction with CNNs | small image search engine | classification of horizons in causal graphs | Pong Game in Tiva Microcontroller

Relevant Courses

Online MOOCs: Deep Learning Specialization by DeepLearning.AI (Sep 2024), CS234 Reinforcement Learning by Stanford (ongoing).

Expository Talks

- *Inversion-Breaking Weyl Semimetals*, Topological Matter Course Final Project 2023
  Presented a model of topological Weyl semimetals breaking inversion symmetry.
- *Characterization and Non-Markovian Measures*, Open Quantum Systems Course Final Project 2023
  Showed when an open quantum system is non-Markovian based on decoherence rates from the master equation.
- *Radio-over-Fiber System Design*, Photonics in Microwave Systems Final Project 2023
  Presented a design of three-channel Radio-over-Fiber system with single-sideband modulation to improve signal transmission by reducing the carrier-to-sideband ratio.
- *Holographic Entaglement Entropy*, CESPreFi PUCP 2021
  Presented aspects of entanglement entropy in quantum field theory and holography.
- *Black Holes and Entropy*, PUCP Physics Seminar 2021
  Showed the proposal that black holes possess entropy proportional to the surface area of their event horizon.
- *On Conformal Algebras*, PUCP Physics Seminar 2021
  Discussed the algebraic structure of conformal transformations, focusing on the generators of the conformal group.