# Alejandro Montanez-Barrera

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Quantum computing researcher with 5+ years of experience developing algorithms, benchmarking QPUs, and contributing to open-source projects (Qiskit, OpenQAOA, Pennylane, DWave-Ocean). Proven track record of publishing in leading journals and leading collaborative projects that bridge quantum hardware and software.

## EDUCATION

**PHD. MECHANICAL ENGINEERING**
University of Guanajuato
2018- 2022 | Salamanca, GTO
GPA: 10.0/10.0 | Summa Cum Laude

**MSC. MECHANICAL ENGINEERING**
University of Guanajuato
2016- 2018 | Salamanca, GTO
GPA: 9.0/10.0

**B.E. ELECTORMECHANICAL ENGINEERING**
Universidad Pedagógica y Tecnológica de Colombia
2010- 2015 | Duitama, BOY
GPA: 4.0/5.0 | First Class Honors

## LINKS

LinkedIn:// **alejandromontanez**
GitHub:// **alejomonbar**
Google Scholar:// **J.A. Montanez-Barrera**

## SKILLS

**QUANTUM PROGRAMMING**
Qiskit • Pennylane • Amazon Braket • Qutip • DWave-Ocean • MPS simulations

**MACHINE LEARNING**
TensorFlow • PyTorch • KLearn

**PROGRAMMING**
Python • Jupyter • Git, Github • C++ • OpenMP • MPI

## AWARDS & RECOGNITION

• **QDC IBM 2024** - Transpiler manager & Accuracy and execution challenges
• **Winner QHack 2023** - Quantum Computing Today, Amazon Braket challenges
• **Winner QHack 2022** - Financial, QAOA, and Entrepreneur challenges
• **Winner iQCHack 2022** - Social for good
• IBM Quantum Excellence 2020
• **Qiskit Advocate**

## INTERESTS

• Quantum Computing • Quantum & HPC integration • Benchmarking Quantum Processing Units • Optimization • Quantum Error Correction • Circuit transpilation

## EXPERIENCE

**POSTDOCTORAL RESEARCHER | FORSCHUNGSZENTRUM JÜLICH (JSC)**
June 2022-Present| Optimization in quantum computing | Benchmarking and characterization of quantum computing hardware | HPC and MPS Simulation of large quantum systems.

**OPEN SOURCE PROJECTS**
**Metriq-gym** (Mar 2025 – Present) Developed a new scalable quantum computing benchmarking for assessing QPUs' performance at Unitary Foundation.
**OpenQAOA** (Jan 2023 – Feb 2024) Designed and implemented optimization problem structures for OpenQAOA, an open-source QAOA framework.
**Qiskit BasicAer** (Jan – May 2022). Added new functionalities to the Qiskit BasicAer backend. **Qiskit Optimization** (Sep – Dec 2021) Developed new applications and benchmarking codes for the Qiskit Optimization library.

## SELECTED RESEARCH PAPERS

• (2025) Evaluating the performance of quantum process units at large width and depth. https://arxiv.org/abs/2502.06471

• (2025) Optimizing QAOA circuit transpilation with parity twine and SWAP network encodings. https://arxiv.org/abs/2505.17944

• (2025) Toward a Linear Ramp QAOA protocol: Evidence of a scaling advantage in solving some combinatorial optimization problems. **npj Quantum Information** https://doi.org/10.1038/s41534-025-01082-1

• (2024) Unbalanced penalization: A new approach to encode inequality constraints of combinatorial problems for quantum optimization algorithms 23–25. **Quantum Science and Technology** https://iopscience.iop.org/article/10.1088/2058-9565/ad35e4

## SELECTED PROJECTS

**QUANTUM COMPUTING BENCHMARKING WITH LR-QAOA**
2025|https://github.com/alejomonbar/LR-QAOA-QPU-Benchmarking|A benchmark of 26 QPUs from 6 quantum computing vendors
Language: **Python**    Libraries: **Qiskit•aws-braket•Python**

**QUANTUM SUPPLY CHAIN MANAGER**
2022| https://github.com/alejomonbar/Quantum-Supply-Chain-Manager | The quantum supply chain manager is a quantum solution for logistics problems.
Language: **Python**    Libraries: **Qiskit•Numpy**

**QUANTUM COUNSELOR FOR PORTFOLIO INVESTMENT**
2022| https://github.com/alejomonbar/Quantum-Counselor-for-Portfolio-Investment | Stock Forecasting using QNN and Portfolio optimization with a novel heuristic equation using QAOA and VQE
Language: **Python**    Libraries: **Qiskit•Numpy • Cirq • Pennylane**

## INVITED TALKS

• Evaluating the performance of quantum processing units at large width and depth. Quantum Computing User Forum (QCUF) ORNL. 2025.
• Improving Performance in Combinatorial Optimization Problems with Inequality Constraints: An Evaluation of the Unbalanced Penalization Method on D-Wave Advantage. IEEE Quantum Week (QCE). 2023.

## COURSES & CERTIFICATIONS

• GPU Programming - **FZJ-JSC** - Instructors: Jan Meinke & Andreas Herten
• Introduction to parallel programming with MPI and OpenMP - **FZJ-JSC**