Emmanuel **Ofosu**

TA @ Knust · BSc Physics (Electronics) @ Knust '23 · Quantum Computing

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There are many links embedded in this Curriculum Vitae PDF. Please click almost anywhere with † for more information!

Education

SPIE-ICFO-KNUST Chair Research Fellowship†

Ghana-Spain

MPhil. Solid State Physics (KNUST), Quantum Information Theory (ICFO- Spain), *Nov. 2023 - Present*

Thesis Title: Quantum Information and Machine Learning on Photonics Quantum Computers for Drug Discovery
Supervisors: Prof. Dr. Antonio Acín† , Dr. Michael Edem Kweku Donkor†

Kwame Nkrumah University of Science and Technology†

Kumasi, Ghana

B.Sc. Physics (Electronics) *Sept. 2019 - Nov. 2023*

Thesis Title: Design of a Microbial Fuel Cell (MFC) coupled Microbial Electrolysis Cell (MEC)
Supervisor: Dr. Michael Edem Kweku Donkor†, Department of Physics, KNUST

Outside Coursework

Quantum Physics & Computing

- QBronze Quantum Diploma †**(QWorld)**
- QNickel7 Quantum Diploma †**(QWorld)**
- Introduction to Programming with Neutral Atoms †**(QuEra)**
- QZinc Quantum Diploma †**(QWorld)**
- IBM Quantum Challenge: Spring 2023 †**(IBM)**
- QMercury - Quantum Key Distribution - Intermediate †**(QWorld)**
- Womanium Quantum Hardware 2023 †**(Womanium)**
- QxQ Quantum Winter School 2023 †**(Microsoft)**
- Womanium Quantum Computing Software 2023 †**(Womanium)**
- Quantum Optics 1: Single Photons (Coursera)
- Quantum Optics 2 - Two photons and more (Coursera)
- Foundations of Quantum Mechanics (Coursera)
- Womanium Quantum Sensing †**(Womanium)**
- Modern Physics II: Quantum Mechanics and Atoms (Coursera)
- Introduction to Quantum Information (Coursera)

Computer Science, Machine Learning and Electronics

- Python 3 Tutorial Course †**(Sololearn)**
- HTML Fundamentals Course (Sololearn)
- Introduction to Embedded Machine Learning (Coursera)
- Introduction to Arduino †**(Erictronics)**
- C++ Basics (Solve 100 Problems) †**(JIGSAWMINDZ)**
- NFT for Dummies †**(Udemy)**
- Supervised ML: Regression and Classification (Coursera)
- Unsupervised ML, Recommenders, Reinforcement L (Coursera)
- Advanced Learning Algorithms (Coursera)
- Cryptography I (Coursera)

Qubit by Qubit - The Coding School†

Fully Online

Introduction to Quantum Computing (2 Semester Course), Grade: Sem 1: 105% || Sem 2: 110%† *Sept. 2022 - Apr. 2023*

Thesis Title: Comparing Hybrid Quantum-Classical Neural Network against Artificial Neural Network-based in Modeling and Optimization of Microalgae Microbial Fuel Cells using PyTorch and Qiskit
Supervisors: Amir Karamlou, PhD† , Adam Pearson†

Research Experience

STEM Mini-PhD†

ReachSci, University of Cambridge†

Researcher; Mentors: **Mohammed Alawami†** , Dr. Cyril D. Boateng† *July. 2023 - Oct. 2023*

During my four-month-long research internship, I honed critical research skills, beginning with effective **2 minutes research presentation** and project design. Subsequently, I developed compelling research proposals and refined my knowledge of research methods, statistical analysis, and result discussion. Notably, I actively engaged in weekly online sessions, diligently completed assignments, and participated in peer-review feedback sessions. My contributions culminated in submitting a manuscript of **Q1 Scopus-Indexed journals standard**. With the dedicated support of my mentor, I fine-tuned data analysis and gained proficiency in **literature reviews (Scopus, PubMed, Web of Science)** and systematic reviews, including the evaluation of **quartiles, impact factors, and citation metrics**.

Quantum Machine Learning Research†

QxQ, The Coding School†

Researcher; Mentors: **Amir Karamlou, PhD†** , Adam Pearson† *Sept. 2022 - Apr. 2023*

"Comparing Hybrid Quantum-Classical Neural Network against Artificial Neural Network-based in Modeling and Optimization of Microalgae Microbial Fuel Cells using PyTorch and Qiskit"

Within the scope of my capstone project, I led a comprehensive investigation into the **modeling and optimization of Microalgae Microbial Fuel Cells (MMFCs)**, focusing on an innovative **comparison between Hybrid Quantum-Classical Neural Networks (HQCNNs) and traditional Artificial Neural Networks (ANNs)**. Employing **PyTorch and Qiskit**, I creatively harnessed the potential of quantum computing integrated with machine learning to enhance MMFC efficiency. My role encompassed delving into quantum neural networks and their application in MMFC optimization, where I devised a novel approach using **yeast and wastewater concentrations as decision variables to concurrently maximize power density and Chemical Oxygen Demand (COD) removal**.

Quantum Image Classification Challenge† *IonQ, MIT iQuHACK*†

Researcher; Mentors: **Josh Throckmorton**† , Shreya Kumar† *January 2023*

"Quantum Image Classification on Trapped Ion Quantum Computers"

I played a pivotal role in a pioneering project with a mission to design a **quantum image classification algorithm**. Our goal was to develop an image classification algorithm to help Mr. Feynman locate his missing t-shirts in a cargo bay filled with various items. The code I worked on for this project was a **quantum image processing pipeline that begins by loading and preprocessing Fashion MNIST dataset images, rescaling them, and creating binary versions**. The code also provided a mechanism for **decoding images from quantum histograms** and running a part-one process. In this process, images are encoded into quantum circuits, **simulated to generate histograms, and subsequently reconstructed**. Additionally, the code included functions for **gate counting and mean squared error calculations**. An optional grading code evaluated the fidelity of image reconstruction, taking into account the mean squared error and the number of gates used.

Presentations & Conferences

Presentations

Aug 2023	***Physics Defense***†, Design of a Microbial Fuel Cell (MFC) coupled Microbial Electrolysis Cell (MEC), Ofosu E., Abekah, F. B., Sarkyi, B. B., Project Defense & Poster Presentation. (2023). ***10.13140/RG.2.2.29490.17608***†	*Physics Dept-KNUST*
Mar 2022	***PHY 381***†, OBOA Mosquitoes Trap and Repellant Project, Ofosu E., Dotse, K. O., et. al. PHY 381 Capstone Project Defense. (2022).	*Physics Dept-KNUST*
Apr 2021	***PHY 263***†, Cherenkov Detector, Particle Detectors Aimed at Detecting the Cherenkov Light, Ofosu E., Teye, S., et. al. PHY 263 Capstone Project Defense. (2021).	*Physics Dept-KNUST*
Mar 2021	***PHY 255***†, Building a Prototype Power Plant that Uses Steam (Steam Engine), Ofosu E., Otinkorang, F. A., et. al. PHY 255 Capstone Project Defense. (2021).	*Physics Dept-KNUST*

Conferences

Oct 2023	***Photonics Conference***†, ICFO-KNUST International School on the Frontiers of Light, Ofosu E., Abekah, F. B., Sarkyi, B. B., Poster Presentation. (2023). DOI: ***10.13140/RG.2.2.21101.56802***†	*CoS, KNUST*
Oct 2023	***ReachSci***†, Design of a Microbial Fuel Cell (MFC) coupled Microbial Electrolysis Cell (MEC), Ofosu E., Abekah, F. B., Sarkyi, B. B., Poster Presentation. (2023). DOI: ***10.13140/RG.2.2.29490.17608***†	*Virtual*
Nov 2023	***Participant***†, 1st K.N.U.S.T Astronomy & Space Science Conference. 2023	*KNUST*

Honors & Awards

2023	**Full Scholarship**†, Womanium Global Quantum & Entrepreneurship Program	*Virtual*
2023	**Best Project**†, PHYSAG-KNUST Week Celebration Exhibitions	*Physics Dept-KNUST*
2023	**Full Scholarship**†, ICFO-KNUST International School on the Frontiers of Light (Photonics)	*KNUST, Ghana*
2023	**Full Scholarship**†, 1st K.N.U.S.T Astronomy & Space Science Conference	*KNUST, Ghana*
2022	**Full Scholarship**†, Qubit by Qubit, Introduction to Quantum Computing	*The Coding School*
2020	**Full Undergraduate Tuition Scholarship**†, Bryan Acheampong Foundation	*BAF HQ, Ghana*

Work Experience

Teaching and Research Assistant (National Youth Service) *KNUST, Ghana*

Department of Physics, College of Science Knust, Kumasi. *Nov. 2023 - PRESENT*

Supervised electronics laboratory works, assigned grades to laboratory reports, and tutored undergraduate physics courses. Organized tutorials in courses such as Analogue and Digital electronics for undergraduate Physics students.

Qiskit Fall Fest - Ghana† *UEW, Ghana*

Facilitator & Part of Organizing Team *Aug. 2023 - Nov. 2023*

I assisted in organizing the Qiskit Fall Fest Ghana by creating four lab notebooks and final challenge notebooks for **120 online participants**. The fest was fully sponsored by **IBM Quantum**. Additionally, I contributed to setting up the Github repository, assessed the submitted lab notebooks, graded the challenge notebooks, and managed the certificate issuance process. I also delivered a lecture on **Dynamic Circuits in Qiskit** on Thursday, which received positive feedback. You can find my lecture notes **[here]**†.

Ghana's First In-Person Quantum Computing Workshop† *KNUST, Ghana*

Organizer (Part of Organizing Team) *Mar. 2023 - May. 2023*

I was instrumental as one of three organizers for Ghana's inaugural in-person Quantum Computing Workshop, engaging over 150 selected participants alongside five international facilitators. I played a significant role in securing sponsorship from qBraid, enabling our participants to explore the capabilities of various quantum computers by running their quantum computing jobs.

MarkSense (Start-up company) *Kumasi, Ghana*

Co-founder & Chief Technology Officer *Feb. 2022 - Jun. 2023*

I spearheaded the development of an offline scannable sheet marking Flutter mobile app utilizing OpenCV for Optical Mark Recognition to grade high school exams. This project secured funding from the College of Engineering at KNUST and amplified its customer base by 60%.

EV4Africa (Mpact Lane)† *Kumasi, Ghana*

Program Manager *Jan. 2021 - May. 2022*

I led crucial initiatives such as intern recruitment, forming partnerships with Indian electric vehicle companies, collaborating with local mechanics in Kumasi Magazine, and contributing to successful EV concept papers. I also organized university hackathons, selecting top teams to join our startup accelerators and incubators.

Our Lady of Grace (OLAG) Senior High School† *Mamponteng, Ghana*

Assistant Robotics Tutor *Nov. 2019 - Jul. 2022*

I immersed students in **Python** learning using **LEGO EV3** and **NXT** robotics kits, leading engaging lab sessions and formulating lesson plans that fostered active participation and stimulated their exploration of **robotics and programming**. I actively contributed to student assessment by offering constructive feedback to amplify their skills and comprehension. With a focus on a spectrum of **technical areas**—from **fabrication** and coding **(Arduino, EV3, and Scratch)** to **electronics**, **mechanical design**, and **LEGO Technical building**—I aimed to enhance students' expertise in robotics and programming languages, specifically emphasizing Python and EV3.

Skills

Quantum Computing	Python, Qiskit, Q#, Cirq, Qiskit Metal, Pennylane, IBM Quantum, qBraid, Amazon Braket
Electronics	KiCAD, PlatformIO, C/C++, MicroPython, Arduino, ESP32, Raspberry Pi, Lego EV3 & NXT Robotics, PicoScope
Modeling	MATLAB, SolidWorks, Comsol MultiPhysics, AutoDesk Fusion 360
Mobile/Web	Git/GitHub, Flutter, FlutterFlow, CSS, FastAPI with Python, Latex, HTML, Javascript, WordPress
Formatting/Graphics	Inkscape, Microsoft Office Suite, Canva, Photoshop, OriginPro
Languages	English, French (Beginner), Akuapem Twi

Leadership

KNUST Office of Grants and Research *KNUST, Ghana*

Guest Speaker on Quantum Computing *July 2023*

I established my presence as a keynote speaker addressing Quantum Computing in the context of Africa's challenges during the **SO YOUNG RESEARCHERS** YouTube series facilitated by the Office of Grants and Research. My discourse delved into the pivotal role of Quantum Computing in resolving intricate challenges within Africa, emphasizing its potential applications in secure communication for space exploration using **post-quantum cryptography**, addressing issues like new drug discovery using **Variational Quantum Eigensolver** and **QAOA** for optimized route planning. At the forefront of this dialogue, I shared practical insights from my ongoing project focused on enhancing the efficiency and durability of a Microbial Fuel Cell integrated with a Microbial Electronic System by leveraging **Quantum Machine Learning** techniques. **Interview on YouTube**†

NASA's Human Exploration Research Analog, HERA (C6M3) *Virtual, YouTube*

Invited Speaker and Featured Participant *July 2022*

Featured in a NASA Human Exploration Research Analog (HERA) **Q&A Session**†, my question was selected and addressed by the esteemed crew during an enlightening and informative session, later posted on YouTube. This engagement showcased my proactive engagement and interest in cutting-edge research and space exploration, contributing to the global conversation on innovative frontiers in aerospace and human exploration.

High School Physics Outreach *Kumasi High, Kumasi*

Electronics and Quantum Computing Lead *January 2022 - May 2023*

I enthusiastically engaged and educated over **500 high school students** on fascinating fields like electronics, quantum computing, and space exploration. My responsibilities included spearheading engaging workshops, leading discussions on **space science**†, and demonstrating projects I had worked on, such as the **solar-powered traffic light**, research on utilizing quantum machine learning to enhance battery performance, and **golf-playing robots.**†

Focus FM KNUST *KNUST, Ghana*

Guest Speaker and Trainer *August 2022 - July 2023*

Guest appearance on Focus FM of KNUST discussing physics, quantum computing, electronics, and embedded systems. Conducted science communication training for undergraduate students, highlighting the physics department's contributions to national development. Emphasized the department's solar-powered traffic lights and their impact on alleviating traffic congestion across various locations in the country. **Focus FM Interview - Physics, the foundation of technology**†

Disability Inclusive Hackathon (Di-Hack) *Accra, Ghana*

Electronics Lead - Team Supernova, Inclusive Tech Group *November 2021 - December 2021*

I led as the team and electronics lead for team Supernova, spearheading the development of an offline visual hearing aid tailored for the hearing impaired. My role encompassed the utilization of **Arduino and ESP32 microcontrollers**, audio-visual sensors, and Edge Impulse **TensorFlow** C model to create an **edge machine learning** model for seamless speech-to-text and text-to-speech transcription. Our team was honored with 4th place in the project. Subsequently, the product underwent rigorous testing on over **250 Persons with Disabilities (PWDs)** and further enhancement by devising the **Printed Circuit Board in KiCAD** and crafting the 3D model in **Autodesk Fusion 360**.

Giants Synchronizer Project *Takoradi, Ghana*

Junior Project Lead *November 2019 - December 2019*

I served as the **junior project lead**† in a team comprising two MSc students and a senior lecturer, tasked with developing a **tabletop-embedded electronics gift for the President of Ghana**, a mere two months after my university admission. Successfully passing **military inspection**, the device was endorsed as a **secure gift for the president** and ultimately presented to him during his visit to the lecturer's Alma mater **senior high school**. This accomplishment led to our invitation to the **Jubilee House, the presidential palace** in Accra, for engagement on a **classified military project**.

Volunteer Work

Ghana Science and Tech Explorer Challenge Prize (GSTEP)† *Obuasi, Ghana*

Technical Coach *July 2023 - November 2023*

I assisted two teams, The Brainers, and Team Ecobalance, in developing their tech solutions addressing environmental challenges. The Brainers worked on **reducing the spreading of Malaria** in remote rural areas in tropical rainforests with no electricity through their genius **solar-powered Dyson mosquito-repellent electronic device**. Team Ecobalance, on the other hand, was working on **purifying and reducing the water dissolved with mercury and lead** and the **turbidity level of water in illegal mining areas** for safe domestic use.

Stanbic-KNUST Women in STEM (WiSTEM)† *KNUST, Ghana*

Mini-Project Facilitator *September 2023*

Actively facilitated and mentored 40 female students during the 2023 Stanbic-KNUST Women in STEM (WiSTEM) event's 'Mini-Projects' session, guiding their exploration and construction of Microbial Fuel Cell coupled Microbial Electrolysis cell.

Kwahu STEM Team† *Kwahu, Ghana*

Co-founder and President *November 2021 - January 2023*

I was the President and Co-founder of the Kwahu STEM Team, responsible for leading its growth to encompass a community of 35 active tertiary student members across various STEM disciplines. Our team organized annual boot camps, educating over 500 students between 2021 and 2023 in coding, robotics, IoT, 3D printing, and artificial intelligence. This initiative received support from the Municipal Assembly, a local Member of Parliament, the Kwahu Professionals Network, and various prominent businesses passionate about empowering youth activities. Additionally, we established 20 STEM clubs in 12 towns made up of 200 basic school students.

Bryan Acheampong Foundation† *Abetifi, Ghana*

Scholars Mentor *April 2022 - June 2023*

As a Bryan Acheampong Foundation (BAF) undergraduate scholar and mentor for high school scholarship awardees, I provided mentorship and academic guidance to two female students. I supported their academic progress, assisting them in developing effective time management skills and a stronger commitment to their education. As a result, these students achieved top-tier academic performance, ranking in the **top 1% of their class**.

Professional Affiliations

2023	**Ghana Science Association**, MEMBER	*Ghana*
2022	**American Physical Society**, MEMBER	*USA*
2022	**OneQuantum Ghana**, MEMBER	*Ghana*
2022	**QGhana**, MEMBER	*Ghana*
2022	**Photonics Ghana**, MEMBER	*Ghana*
2019	**Physics Students Association Ghana (PHYSAG)**, MEMBER	*Ghana*

Contact Referees

1. ***Dr. Cyril Dziedzorm Boateng***† *(Senior Lecturer, Department of Physics, KNUST).*
   Email: cyrilboat@knust.edu.gh (+233559580392).
2. ***Dr. Michael K. E. Donkor***† *(Senior Lecturer, Department of Physics, KNUST).*
   Email: mkedonkor.cos@knust.edu.gh (+233268716215).
3. ***Dr. Isaac Nkrumah***† *(Senior Lecturer, Department of Physics, KNUST).*
   Email: inkrumah.sci@knust.edu.gh (+233540987552).