

ANTHONY BWEMBYA

EXPERIMENTAL PHYSICIST • SCIENTIFIC COMPUTING • SIGNAL PROCESSING • INSTRUMENTATION • AI & DATA

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PROFILE

Experimental physicist and multidisciplinary researcher completing a PhD at Radboud University (2021 to 2026), in collaboration with the Pierre Auger Observatory and the broader Nikhef-linked research environment, with a thesis on cosmic-ray mass composition via radio interferometry (defence expected at the end of September 2026). Experience spans radio-frequency detection and timing calibration, distributed sensor arrays, scientific computing, machine learning, radiation measurement and nuclear instrumentation, radio astronomy, satellite/GIS-based environmental monitoring, and international research collaboration across Zambia, Russia, the Netherlands, Argentina, and Japan-linked programmes. Comfortable building reproducible Python/C++ data-analysis pipelines, running Monte Carlo simulations, and communicating technical results to both specialist and general audiences. Current interests include applied machine learning, generative and agentic AI, and responsible AI, alongside strong personal and professional motivation toward African-linked scientific infrastructure and development, particularly SKA-Mid, critical minerals supply chains, and energy security projects in Zambia. Holds an NL research visa; open to relocation and international travel; no visa sponsorship required.

AREAS OF EXPERTISE

- Experimental physics and detector systems; RF sensing; distributed sensor synchronisation; radio interferometry; antenna-response analysis
- Optical and imaging sensor calibration: LiDAR, fluorescence-camera, and PMT calibration, signal/image-quality assessment, and sensor-response validation
- Scientific computing, numerical optimisation, statistical analysis, Monte Carlo simulation, uncertainty quantification, and reproducible research
- Python and C++ development; data processing; machine learning; anomaly detection; automated diagnostics; scientific visualisation
- Radiation detection and protection; alpha/gamma spectroscopy; X-ray fluorescence; calibration; non-destructive analysis
- Research design, technical writing, presentations, interdisciplinary teamwork, teaching, and mentoring

PROFESSIONAL & RESEARCH EXPERIENCE

Doctoral Researcher, Radio Detection and Interferometry

2021 to 2026

Radboud University / Pierre Auger Collaboration, Netherlands and Argentina

- Developed precision timing and calibration methods for the AugerPrime Radio Detector, using stable beacon/broadcast carriers to estimate station-to-station clock offsets from measured phase differences, reaching approximately nanosecond/sub-nanosecond precision
- Implemented and cross-validated two independent timing-solution approaches, then redesigned the calibration and anomaly detection workflow, reducing failing automated data quality checks from 334 to zero and improving measurement precision by roughly two orders of magnitude
- Developed radio-interferometric reconstruction techniques for highly inclined air showers, coherently combining signals from spatially separated antennas, and contributed to the first successful interferometric reconstruction of a very inclined air-shower event
- Built Python/C++ pipelines for experimental and simulated data (CORSIKA/CoREAS), covering signal extraction, phase analysis, detector-quality diagnostics, noise cataloguing, and reconstruction, applying optimisation methods (L-BFGS-B, Powell, differential evolution) and evaluating atmospheric refractivity, detector geometry, and antenna-response effects
- Supported LiDAR and fluorescence-camera calibration and operations for atmospheric monitoring and detector-performance assessment
- Presented work at Pierre Auger Collaboration meetings and workshops, and gave a poster presentation at a Netherlands physics conference

Teaching Assistant

2021 to 2025

Radboud University, Netherlands

- Taught and supported courses in machine learning in particle physics, experimental particle physics, subatomic physics, and academic writing
- Supervised a student research visit to the Boulby Underground Laboratory (2023 to 2024)

Research & Technical Officer (Radiation Protection Officer)

2021 to 2022

Radiation Protection Authority of Zambia

- Supported radiation-protection assessments, technical investigations, and evidence-based regulatory work
- Performed radiation-instrument testing, calibration verification, and uncertainty-aware measurement interpretation

Master's Researcher, Nuclear Physics and Cosmic-Ray Modelling

2018 to 2021

National Research Nuclear University MEPhI, Department of Experimental Nuclear Physics and Cosmophysics, Russia

- Investigated the high-energy cosmic-ray positron excess using PAMELA and AMS-02 observational data, using GALPROP to model Galactic charged-particle propagation
- Research supervised by Prof. Vladimir Mikhailov; also served as Nuclear Ambassador for Rosatom during this period

Physics Tutor

2016 to 2017

University of Zambia

- Supported undergraduate students in physics, mathematics, laboratory methods, and scientific problem solving

Research / Laboratory Intern

Undergraduate period

National Institute for Scientific and Industrial Research (NISIR), Zambia

- Gained practical experience in radiation detection and nuclear instrumentation, working with alpha/gamma spectroscopy, X-ray fluorescence, and non-destructive radiation analysis

EDUCATION

PhD, Experimental Physics, Radboud University (with Pierre Auger Observatory)

2021 to 2026

Thesis: "In Phase With the Cosmos: Mass Composition of Cosmic Rays via Radio Interferometry" (defence expected at the end of September 2026)

MSc, Nuclear Physics and Technology, National Research Nuclear University MEPhI, Moscow

2018 to 2021

Thesis on the cosmic-ray positron excess, comparing GALPROP modelling against PAMELA/AMS-02 data

BSc, Physics, University of Zambia

2017

SELECTED PROJECTS

- JENNIFER2 Programme: CVD diamond sensors for LUMIBELLE2/Belle II at KEK
- GIS/satellite/IoT water-level monitoring project for Zambian energy security (externally funded, ~GBP 5,000)
- GIS river-change monitoring concept for Zambia, tracking long-term disturbance from small-scale mining and damming
- Research concepts for AI/ML-driven RFI classification and antenna-response/array calibration, transferring cosmic-ray radio-array methods to MeerKAT/SKA-relevant radio astronomy
- Development in Africa with Radio Astronomy (DARA): training in radio astronomy, RF systems, signal processing, and large-scale telescope environments
- Completed an ICTP Lidar/Optics course

TECHNICAL SKILLS

Programming: Python, C++, Bash

Libraries & tools: NumPy, SciPy, Pandas, scikit-learn, PyTorch, ROOT, Jupyter

Simulation: CORSIKA/CoREAS/ZHAireS, GALPROP; familiarity with AIRES

Methods: Signal processing, Fourier/spectral analysis, optimisation (L-BFGS-B, Powell, differential evolution), uncertainty propagation, machine learning (classification, regression, neural networks, anomaly detection)

Instrumentation: Radio antennas, radiation detectors, PMTs, LiDAR, fluorescence telescopes/cameras, VNA, DAC/AWG, CVD diamond sensors, IV/CV-related measurement familiarity

Computing: HPC/SLURM, Git, Linux

TEACHING, MENTORING & OUTREACH

- Undergraduate physics tutoring and student supervision in detector and field environments, including machine learning in particle physics
- Scientific presentations at collaboration meetings, workshops, and conferences; public-facing explanation of cosmic rays, radio detection, and interferometry
- Committee experience through UNZAPHYSA (University of Zambia Physics Association)
- Developed a concept for a Zambia-based research/innovation NGO focused on applied research, sustainability, and capacity building, aligned with UN SDGs 4, 6, 7, 9, 13, 15, and 17

LANGUAGES

English, Bemba and Nyanja (native); Russian (professional working level); Dutch (developing)