JEAN PIERRE TWAGIRAYEZU

Ph.D. in Physics | Astroparticle Physics

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EDUCATION

Doctor of Philosophy (Ph.D.) in Physics | Michigan State University

2020 – May 2026 | East Lansing, MI, USA

- Performance studies for the Pacific Ocean Neutrino Experiment (P-ONE)
- Advisor: Professor Tyce DeYoung

Master of Science in Physics | Michigan State University

2018 – 2020 | East Lansing, MI, USA

- Astroparticle Physics, IceCube Neutrino Observatory.

MS in Mathematical Sciences | African Institute for Mathematical Sciences

2017 – 2018 | Kigali, Rwanda

- Mathematical Sciences, Statistical Machine Learning

Bachelor of Education (Hons.) in Physics | University of Rwanda, College of Education

2011 – 2015 | Kigali, Rwanda

- Bachelor of Education in Physics (major) and Mathematics (minor)

RESEARCH EXPERIENCE

Research Assistant | Michigan State University, Pacific Ocean Neutrino Experiment

Aug 2021 – Dec 2025 | East Lansing, MI, USA

- Collaborated with a team of software engineers and scientists to study the performance of the Pacific Ocean Neutrino Experiment (P-ONE) using Monte Carlo simulations.
- Conducted statistical data analysis to forecast the sensitivity of the P-ONE to astrophysical point sources of neutrinos
- Co-developed track event reconstruction algorithms for the Pacific Ocean Neutrino Experiment (P-ONE).
- Processed large datasets of Monte Carlo simulations from neutrino event generation to detector response simulation for the P-ONE using high-performance computing clusters
- Member of the Pacific Ocean Neutrino Experiment Collaboration
- Skills: statistical data analysis, software development (Python, git) · scientific computing, teamwork, and presentation.

Research Assistant | Michigan State University, IceCube Neutrino Observatory

May 2020 – Aug 2021 | East Lansing, MI, USA

- Utilized likelihood method and photon propagation for energy reconstruction of cascade events from the IceCube Monte Carlo Simulation dataset on high-performance computing clusters and GPUs.
- Member of the IceCube Collaboration, IceCube monitoring shift for data quality and detector operation.

Student Researcher | African Institute for Mathematical Sciences (AIMS)

Apr 2018 – Jun 2018 | AIMS Rwanda, Kigali, Rwanda

- developed a kernel regression model with network cohesion data using graph-based regularization techniques.

Student Assistant | University of Rwanda, College of Education

Jul 2014 – Jul 2015 | Kigali, Rwanda

- Participated in monitoring the daily operation of the CALLISTO station at the University of Rwanda in Kigali, an e-CALLISTO antenna to collect data for monitoring solar radio flares

TEACHING EXPERIENCE

Teaching Assistant | Michigan State University, Physics and Astronomy

Spring 2026 | East Lansing, MI, USA

- Served as a teaching assistant for PHY 222 Studio Physics for Life Scientists II.
- Facilitated in-class group problem solving through integrated physics laboratory and discussion, graded lab reports, and provided academic support during office hours and recitation sessions.

Teaching Assistant | Michigan State University, Center for Integrative Studies in General Science

Spring 2019, Fall 2019, Spring 2020 | East Lansing, MI, USA

- Taught and graded three sections of introductory physics lab, ISP 209L, supporting over 90 students per semester.

Teaching Assistant | Michigan State University, Physics and Astronomy

Fall 2018 | East Lansing, MI, USA

- Conducted help room sessions, assisted in class demo setup for PHY 232 Introductory Physics II.
- Skills: Teaching and communication.

Physics Teacher | Kagarama Secondary School

Feb 2017 – Aug 2017 | Kigali, Rwanda

- Taught advanced high school physics courses (electromagnetism, oscillations and waves, introduction, modern physics), lower secondary physics courses, and upper-level mathematics courses for non-majors. Designed and delivered lessons, conducted laboratory sessions, and provided assessments.

Physics Teacher | Saint Paul International School (SPIS)

Jan 2016 – Aug 2017 | Kigali, Rwanda

- Taught Cambridge As & A Level Physics courses, upper-level high school physics courses (mechanics, heat and thermodynamics, geometric optics, electrostatics, electromagnetism, oscillations and waves, introduction to modern physics), and lower-level Mathematics courses. Designed and delivered course lessons, conducted physics laboratory sessions, and provided assessments.

Physics Teacher | APRED Ndera Secondary School

Jul 2015 – Jan 2016 | Kigali, Rwanda

- Taught upper secondary school Physics courses, designed and delivered course lessons, conducted physics laboratory sessions, and provided assessments.

Physics Teacher | Nu-Vision High School (N.V.H.S)

Sep 2014 – Jul 2015 | Kigali, Rwanda

- Taught Lower secondary school Physics classes. Designed and delivered course lessons and designed assessments.

MENTORING EXPERIENCE

Mentoring Undergraduate Students | Michigan State University, P-ONE Group

Spring 2023 – Spring 2025 East Lansing, MI, USA

- I have mentored two Undergraduate students working in the MSU P-ONE Research Group to work on different projects, ranging from using computing clusters to produce Monte Carlo simulations, development of neutrino event track reconstruction using Monte Carlo simulations, and performing P-ONE geometry optimization studies.

Mentoring High School | UN Ivy STEM Connect - AIMS Rwanda, Lycée de Kigali

Dec 2017 – Apr 2018 Kigali, Rwanda

- Provided mentorship to students from Lycée de Kigali, a secondary school, in Mathematics and Physics with AIMS Rwanda students and Ivy League students studying in the USA.

SELECTED PUBLICATIONS

As Primary Author

1. Jean Pierre Twagirayezu, Hans Niederhausen, Stephen Sclafani, Nathan Whitehorn, Mehr Nisa, Shiqi Yu, and Robert Halliday. "**Performance of the Pacific Ocean Neutrino Experiment (P-ONE)**". in: *PoS* ICRC2023 (2023), p. 1175

Co-author, P-ONE collaboration

1. Felix Henningsen. "**Pacific Ocean Neutrino Experiment: Expected performance of the first cluster of strings**". In: *PoS* ICRC2023 (2023), p. 1053

Co-author, IceCube collaboration

1. Inspire HEP: **J.P. Twagirayezu**, **ARXIV**, **Google Scholar**

TECHNICAL SKILLS

- **Programming tools:** Python, SQL, C++ (basics), shell (basics), Icecube icetray, Latex.
- **Data Analysis tools:** Numpy, Pandas, Scipy, Sklearn, Keras, Matplotlib, Jupyter Notebook, Github, Excel.
- **Research & Teaching:** Statistical data analysis, Machine Learning, Software development, Advanced maths, Astroparticle physics, Teaching, Communication, Presentation, Team work.

LANGUAGES

- **English** (fluent), **French** (Intermediate), **Kinyarwanda** (Native)

CONFERENCES AND WORKSHOPS

Pacific Ocean Neutrino Experiment Collaboration Meeting | talk

13-16 Nov 2024 — Chicago, IL, USA

Pacific Ocean Neutrino Experiment Collaboration Meeting | talk

13-17 May 2024 — Erlangen, Germany (Online)

The American Physical Society's April Meeting 2024 | Parallel talk

3-6 April 2024 — Sacramento, California

Workshop on the Science Prospects and Optimization of P-ONE | talk

8-12 Jan 2024 — Erlangen, Germany

Pacific Ocean Neutrino Experiment Collaboration Meeting | talk

13-18 Nov 2023 — Philadelphia, PA, USA

National Society of Black Physicists 2023 Conference | Parallel talk

09 Nov - 12 Nov 2023 — Knoxville, TN, USA

38th International Cosmic Ray Conference (ICRC2023) | Poster

July 26 - August 3, 2023 — Nagoya, Japan (Online)

Pacific Ocean Neutrino Experiment Collaboration Meeting | talk

May 8-12, 2023 — Krakow, Poland

National Society of Black Physicists 2022 Conference | Poster

November 6 - November 9 2022 — Charlottesville, VA, USA

Pacific Ocean Neutrino Experiment Collaboration Meeting | talk

September 23-24, 2022 — Vancouver, Canada (Online)

International Conference on Neutrino and Astrophysics | Poster

May 30 - June 4, 2022 — Seoul, South Korea (Online)

Pacific Ocean Neutrino Experiment Collaboration Meeting | talk

May 23-24, 2022 — Munich, Germany (Online)

IceCube Neutrino Observatory Collaboration Meeting | Attendee

September 20-23, 2021 — Madison, USA (Online)