

# JEAN PIERRE TWAGIRAYEZU

## PhD in Physics | Astroparticle Physics

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## ABOUT ME

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I am a research assistant in the field of experimental astroparticle physics, working on neutrino research spanning data analysis and software development for tools designed for scientific applications. My primary research focus revolves around identifying point sources of astrophysical neutrinos using data from Neutrino Telescopes. Current research includes producing Monte Carlo simulation for the Pacific Ocean Neutrino Experiment (P-ONE), developing event reconstruction algorithms for the P-ONE, conducting statistical data analysis to forecast the sensitivity of the P-ONE to astrophysical point sources of neutrinos, and design and optimization studies for the P-ONE.

## EDUCATION

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

2020 – 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

- Experimental Astroparticle Physics, IceCube Neutrino Observatory.
- Advisor: Professor Tyce DeYoung

### MS in Mathematical Sciences | African Institute for Mathematical Sciences

2017 – 2018

Kigali, Rwanda

- Mathematical Sciences, Statistical Machine Learning
- Advisor: Professor Ernest Fokoue

### 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)

## TECHNICAL SKILLS

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- Python, SQL, C++ (basic), shell (basic), Icecube icetray, Latex
- Numpy, Pandas, Scipy, Sklearn, Tensorflow, Keras, Matplotlib, Jupyter Notebook, Git/Github
- Statistical Data Analysis, Machine Learning, Advanced Maths, Astroparticle Physics
- Scientific Computing, Software development, Teaching, Communication, Presentation, Team work

## RESEARCH EXPERIENCE

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### Research Assistant | Michigan State University, Pacific Ocean Neutrino Experiment

 Aug 2021 – May 2026

 East Lansing, MI, USA

- collaborated with a team of software engineers and scientists to study the performance studies of the Pacific Ocean Neutrino Experiment (P-ONE) using Monte Carlo simulations.
- conducting statistical data analysis to forecast the sensitivity of the P-ONE to astrophysical point sources of neutrinos
- co-development of track event reconstruction algorithms for the Pacific Ocean Neutrino Experiment (P-ONE).
- processing 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 the Pacific Ocean Neutrino Experiment Collaboration
- Skills: statistical data analysis, software development (python, git) · scientific computing, astroparticle physics, teamwork, and presentation.

### Research Assistant | Michigan State University, IceCube Neutrino Observatory

 May 2020 – Aug 2021

 East Lansing, MI, USA

- Use likelihood method and photon propagation for energy reconstruction of cascade events from 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.
- Skills: IceCube icetray software, C++, git, Python, Numpy, data visualization, scientific computing, astroparticle physics, teamwork and presentation

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

## TEACHING EXPERIENCE

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### Teaching Assistant | Michigan State University, Physics and Astronomy

 Spring 2026

 East Lansing, MI, USA

- Serve as a teaching assistant for PHY 222 Studio Physics for Life Scientists II
- Basics principles of electricity and magnetism including applications to biological systems. Problem-solving through integrated physics laboratory and discussion.

## Teaching Assistant | Michigan State University, CISGS

 Spring 2019, Fall 2019, Spring 2020

 East Lansing, MI, USA

- Teaching and grading three sections of Introductory Physics (Lab), ISP 209L.

## Teaching Assistant | Michigan State University, Physics and Astronomy

 Fall 2018

 East Lansing, MI, USA

- Conduct help room sessions, assist 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

- Teaching upper and lower secondary Physics courses. Designed and delivered course lessons, conducted physics laboratory sessions, graded assignments

## Physics Teacher | Saint Paul International School (SPIS)

 Jan 2016 – Aug 2017

 Kigali, Rwanda

- Teaching Cambridge As & A Level Physics courses. Designed and delivered course lessons, conducted physics laboratory sessions, graded assignments

## Physics Teacher | APRED Ndera Secondary School

 July 2015 – Jan 2016

 Kigali, Rwanda

- Teaching upper secondary Physics courses. Designed and delivered course lessons, conducted physics laboratory sessions, graded assignments

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

 Sep 2014 – Jul 2015

 Kigali, Rwanda

- Teaching Lower secondary school Physics classes. Designed and delivered course lessons, graded assignments

## MENTORING EXPERIENCE

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### 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 the different projects ranging from using computing clusters to produce Monte Carlo Simulation, development of neutrino events track reconstruction using Monte Carlo Simulation and do P-ONE geometry optimization studies.

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

 Dec 2017 – Apr 2018

 Kigali, Rwanda

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

## SELECTED PUBLICATIONS

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### 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. IceCube Collaboration\*†, R Abbasi, M Ackermann, J Adams, JA Aguilar, M Ahlers, M Ahrens, JM Alamed-dine, AA Alves Jr, NM Amin, et al. “**Observation of high-energy neutrinos from the Galactic plane**”. In: *Science* 380.6652 (2023), pp. 1338–1343
2. IceCube Collaboration\*†, R Abbasi, M Ackermann, J Adams, JA Aguilar, M Ahlers, M Ahrens, JM Alamed-dine, C Alispach, AA Alves Jr, et al. “**Evidence for neutrino emission from the nearby active galaxy NGC 1068**”. In: *Science* 378.6619 (2022), pp. 538–543
3. Inspire HEP: **J.P. Twagirayezu**, ARXIV, Google Scholar

## COMPUTATIONAL COURSES

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Machine Learning Application in Physics | [Michigan State University](#)

 Spring 2023

 East Lansing, MI, USA

Object Oriented Programming (Python) | [Educative.io](#)

 Fall 2022

 Online

Statistical Methods for Data Analysis (Python) | [Michigan State University](#)

 Fall 2020

 East Lansing, MI, USA

Methods in Computational Modelling | [Michigan State University](#)

 Fall 2019

 East Lansing, MI, USA

Big Data and Machine Learning (Theory & Application in R) | [AIMS Rwanda](#)

 Fall 2018

 Kigali, Rwanda

Scientific software development in Python | [AIMS Rwanda](#)

 Fall 2018

 Kigali, Rwanda

Scientific Computing and Latex (Unix Basics) | [AIMS Rwanda](#)

 Fall 2018

 Kigali, Rwanda

## LANGUAGES

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**English:** Proficient

**French:** Intermediate

**Kinyarwanda:** Native

## CONFERENCES AND WORKSHOPS

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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

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

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

International Conference on Neutrino and Astrophysics | [Poster](#)

 May 30 - June 4, 2022

 Virtual, Seoul, South Korea

Pacific Ocean Neutrino Experiment Collaboration Meeting | [talk](#)

 May 23-24, 2022

 Germany, Munich

IceCube Neutrino Observatory Collaboration Meeting | [Attendee](#)

 September 20-23, 2021

 Virtual, Madison, USA