

NELSON MANDELA  
UNIVERSITY



## Physics for Sustainable Development

The Eighth Biennial African School of Fundamental Physics and Applications (ASP2024), Marrakesh, Morocco

Azwinndini Muronga

9 July 2024

- Thanks to the IOC and LOC for the invitation – Mounia, Ketevi, Farida, Mohamed
- I am happy to be at ASP2024 in Marrakesh, Morocco.
- Thanks to Ms Dolly Ntintili for arranging my trip.
- ASP is a fantastic school.
- Students – you should use every opportunity to network.



# THE EIGHTH BIENNIAL AFRICAN SCHOOL OF FUNDAMENTAL PHYSICS AND APPLICATIONS

(ASP2024)

Co-organized by Cadi Ayyad University and Mohammed V University  
at Faculty of Science Semlalia, Marrakesh, Morocco

April 15<sup>th</sup>–19<sup>th</sup> and July 7<sup>th</sup>–21<sup>st</sup>, 2024



**ASP MISSION**  
To increase capacity development in fundamental physics and related applications in Africa. The ASP has evolved to be much more than a school. It is a program of actions with directed ethos toward physics as an engine for development in Africa

**SCIENTIFIC PROGRAM**

**TOPICS**

- Nuclear & Particle Physics
- Medical and Radiation Physics
- Applied and Industrial Physics
- Theoretical and Computational Physics
- Space Physics, Astrophysics & Cosmology
- Physics for Sustainable Development
- Condensed and Materials Physics Biophysics
- Capacity Development and Retention Discussion
- Physics Education, Outreach and Communication

**ACTIVITIES**

- Outreach for Secondary Schools April 15<sup>th</sup>–19<sup>th</sup>, and July 15<sup>th</sup>–19<sup>th</sup>, 2024
- Physics lectures, tutorials and hands-on experimentation for students, July 7<sup>th</sup>–21<sup>st</sup>, 2024
- Workshop for High School Teachers, July 8-12, 2024
- ASP Forum, July 13<sup>th</sup>, 2024

**INTERNATIONAL ORGANIZING COMMITTEE (IOC)**  
B. Acharya (ICTP and King's College London), K. Assamagan (BNL), C. Darve (ESS), F. Ferroni (INFN), M. Laassiri (HIP)

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**CHAIRS**  
Mohamed Chabab (UCA)  
Farida Fassi (UM5)

https://www.africanschoolofphysics.org/asp2024/





















THE UNIVERSITY OF BIRMINGHAM





# Locating Physics within UN SDGs and Africa Agenda 2063



<https://www.un.org/fr/teach/SDGs>

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## AGENDA 2063 The Africa We Want

- Aspiration 1**  
A prosperous Africa based on inclusive growth and sustainable development
- Aspiration 2**  
An integrated continent, politically united and based on the ideals of Pan Africanism and the vision of Africa's Renaissance
- Aspiration 3**  
An Africa of good governance, democracy, respect for human rights, justice and the rule of law
- Aspiration 4**  
A peaceful and secure Africa
- Aspiration 5**  
An Africa with a strong cultural identity, common heritage, values and ethics
- Aspiration 6**  
An Africa where development is people-driven, unleashing the potential of its women and youth
- Aspiration 7**  
Africa as a strong, united and influential global player and partner

**NEPAD**  
TRANSFORMING AFRICA

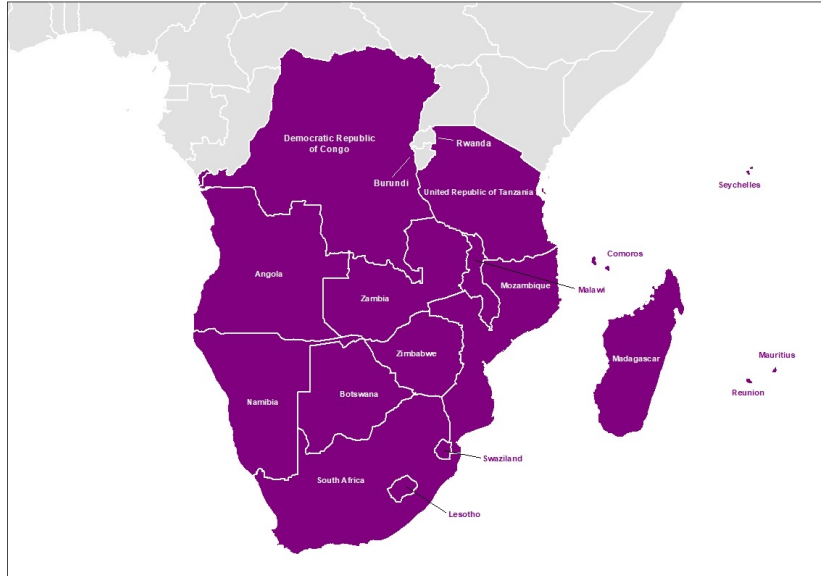
<https://au-watch.org/agenda-2063/>

## NATIONAL DEVELOPMENT PLAN

**2030 NDP**  
Change the World

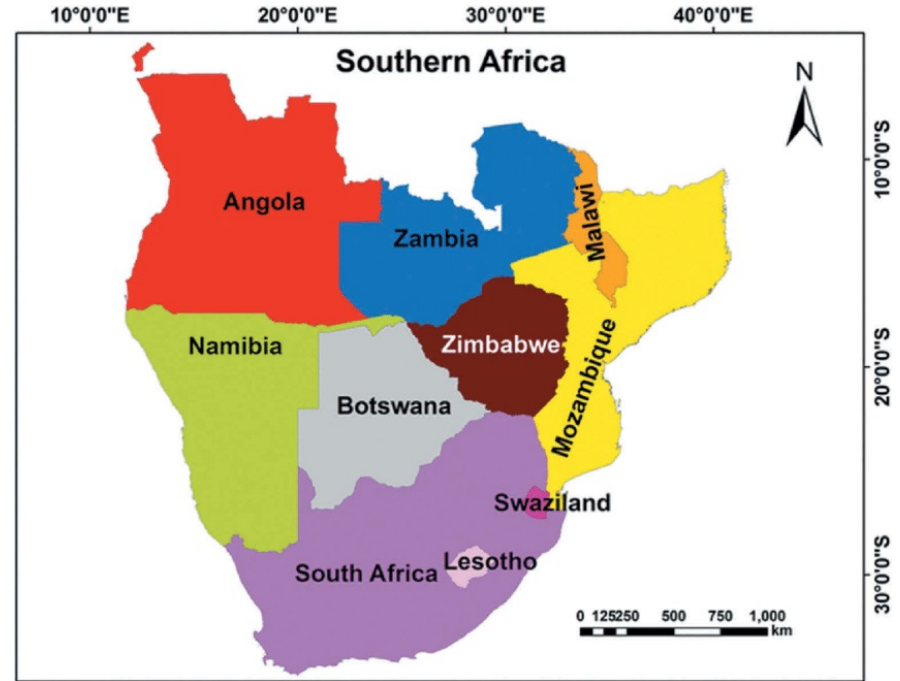
<https://www.dominofoundation.org.za/national-development-plan/>

## SADC Region



<https://eela-project.org/sadc>

## AU Regions: Southern Africa



[https://www.researchgate.net/figure/Countries-in-the-southern-African-region\\_fig2\\_331359647](https://www.researchgate.net/figure/Countries-in-the-southern-African-region_fig2_331359647)

# SDG 7: Affordable Clean Energy

Why is clean energy important for sustainability in Africa?



**Role of physics – Please add by end of ASP2024**

- Solar energy
  - Photovoltaic cells
- Advances in solar energy materials and efficiency
- Example of solar energy project –Morocco’s Noor Solar plant
- Wind energy
  - Design and physics of wind turbines
  - Aerodynamics and efficiency improvements
  - Example wind farm -Lake Turkana Wind Power Project in Kenya
- Hydropower and geothermal Energy
  - Fluid dynamics in hydro power
  - Heat transfer in geothermal systems
  - Examples - Grand Ethiopian Renaissance Dam, Olkaria Geothermal Plant in Kenya

# SDG 11: Sustainable Cities and Communities

Why is energy efficiency and sustainable urban planning important for Africa?



Role of physics – **Please add by end of ASP2024**

- Building design
  - Thermodynamics in insulation
  - Sustainable materials and architecture
  - Example – eco-friendly housing in Rwanda
- Sustainable Transportation
  - Advances in electric vehicles
  - Design of sustainable mass transit systems , e.g., Bus Rapid Transport Systems

# SDG 13: Climate Action

Why is climate action for sustainability important in Africa?



Role of physics – Please add by end of ASP2024

- Environmental Monitoring
  - Atmospheric physics and climate models
  - Remote sensing technology
  - Example - African Monitoring of the Environment for Sustainable Development program, AEON

# SDG 12: Responsible Consumption and Production

Why is sustainable consumption and production important in Africa?



Role of physics – Please add by end of ASP2024

- Waste Management and Recycling
  - Development of sustainable materials
  - Role of nuclear physics in waste management
  - Example –plastic recycling in Nigeria



# SDG 6: Clean Water and Sanitation

Why is water management for sustainability important in Africa?



Role of physics – Please add by end of ASP2024

- Water Management Development of sustainable materials
  - Fluid mechanics in water systems
  - Efficient irrigation methods, e.g., drip irrigation in Kenya

# SDG 2: Zero Hunger

Why sustainable agriculture for food important in Africa?



**Role of physics – Please add by end of ASP2024**

- Sustainable Agriculture
  - Soil physics and crop yields
  - Biophysics in developing resilient crops
  - Example - drought-resistant crops

# Role of physics in SDGs



- Physics improving agricultural productivity – e.g., irrigation techniques
- Enhancing access to affordable energy for economic development



- Medical physics: Imaging technologies (MRI, X-rays)
- Radiation therapy for cancer treatment
- Development of medical devices

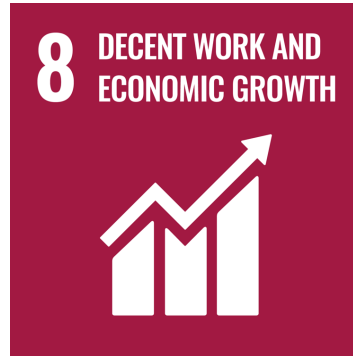


- Promoting STEM education
- Physics education and outreach programs
- Online learning technologies and platforms

# Role of physics in SDGs



- Encouraging gender equality in STEM fields
- Supporting women in physics through scholarships and initiatives



- Developing new technologies that create jobs
- Enhancing productivity through automation and robotics
- Renewable energy sector jobs



- Role of physics in developing sustainable infrastructure
- Innovations in material science for industry
- Advances in manufacturing technologies

# Role of physics in SDGs



- Technologies that improve access to information and resources
- Bridging the digital divide with affordable technology



- Oceanography and marine physics
- Monitoring and protecting marine ecosystems
- Sustainable fishing technologies



- Environmental physics in conservation efforts
- Monitoring deforestation and land degradation
- Developing sustainable agricultural practices

# Role of physics in SDGs



- Technologies for transparent and accountable institutions
- Physics in forensic science to solve crimes
- Ensuring cybersecurity through cryptography



- Collaborative research initiative
- Sharing of scientific knowledge and technology
- Global partnerships for sustainable development

# District Development Model for Service Delivery



- As a solution to uneven service delivery the South African President announced in 2019 the implementation of a district-level approach towards the effective coordination of 'all-of-government' programmes and projects within the 44 Districts and eight Metropolitan Municipalities. This has become known as the District Development Model (DDM).
- The DDM was adopted to help build a coherent State and to bring about inclusive economic growth, spatial transformation, strategic infrastructure investment and reliable service delivery for all.
- **This proposal is aimed at improving impact of physics education, research, and applications to service delivery starting at district level**

Slide courtesy of Dr Brian Masara – CEO of SAIP

# Physics-Underpinned Needs Identified in DDM Reports



- Shortage of Engineers and Technical Skills at District level
- Clean Sustainable Energy
- Clean Water
- Food Security
- Health, Environment, and Waste Management
- Employment, Women Empowerment & Youth Skills Development
- Quality Education Delivery (Physical Science)
- Early Childhood Development – DDM is 25-year plan hence skills shortage needs to be addressed from ECD up (USA, Japan, China learners start science very early and participate in science and engineering innovation competitions)

Slide courtesy of Dr Brian Masara – CEO of SAIP



# Physics in My Village - The Story



Project started during the International Year on Basic Sciences for Sustainable Development prework in 2021 <https://www.saip.org.za/Physicsinmyvillage/>

Started as a learner competition on **“How Physics Improves Everyday Life in Villages, Townships and Communities”**

Proceeded in 2023 to a mini-documentary on how physics can help us address energy, load-shedding, climate change and rural development challenges in the nexus of Energy, Water, Climate and Food Security.  
<https://www.youtube.com/watch?v=t836XYUWLz0>

**“Physics in My Village”** is transforming a national programme that promotes physics research & capacity building while simultaneously promoting citizen science, grassroots socioeconomic development, and essential community service delivery infrastructure through Physics prototypes that are constructed in communities and villages.

Slide courtesy of Dr Brian Masara – CEO of SAIP

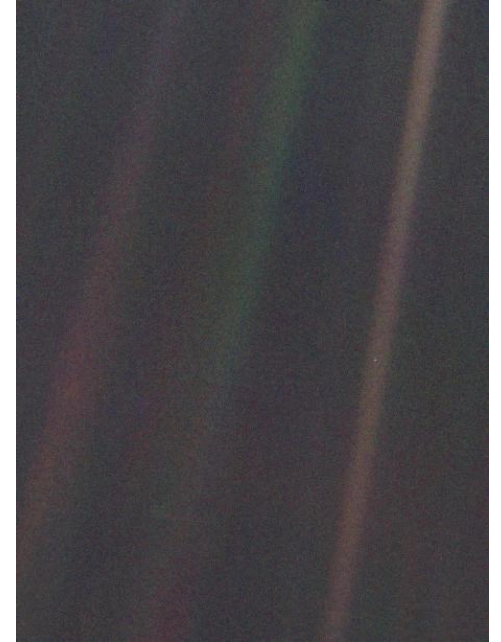
# 21<sup>st</sup> Century – the century of complexity science



<https://www.nelsonmandela.org/>

*In 2000, Stephen Hawking, in response to a question about the way that science is developing, replied: "I think the next [21<sup>st</sup>] century will be the century of complexity".*

*Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves. - Carl Sagan*



*Image: NASA / JPL*

*The Pale Blue Dot –  
Earth from ~ 6 billion km*

# Contact me

## Physics/Science for Sustainable Development Projects in Africa

- What is physics/science doing for sustainable development in your country/village/city/township?
- What are you doing to contribute to sustainable development in your village/township/city/country?

[Azwinndini.Muronga@mandela.ac.za](mailto:Azwinndini.Muronga@mandela.ac.za)

The Office of the DVC: Learning and Teaching

presents the

### SOCIAL CONSCIOUSNESS AND SUSTAINABLE FUTURES (SCSF) MODULE

SCSF Presents a multidisciplinary platform to engage students across different faculties on the big questions facing our society today. These include the links between Science, Society and the Planet? What makes us human? The values attached to Nelson Mandela- the Name, the Person and Intellectual legacies that should define our common humanity. Please join us for a **free registration** to explore some of these questions.

All Students are Welcome to Apply for this Module.

Prof Nomalanga Mkhize

Prof Pumla Gqola

Prof Azwinndini Muronga



Click Here to Apply

Closing Date:  
18 July 2024

Platform:  
Blended Learning

- 23 July 2024: Mandela Name, Person, Intellectual legacy and Institutional values, presented by Prof Nomalanga Mkhize
- 20 August 2024: On Makings of Gender and Sexuality, presented by Prof Pumla Gqola
- 17 September 2024: Designing Science for Society, presented by Prof Azwinndini Muronga

This module will be offered between July - September 2024

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