

NELSON MANDELA  
UNIVERSITY



Physics, Policy, and Diplomacy: Leveraging International Cooperation from South Africa  
and the Rest of Africa for Global Scientific Progress

Azwinndini Muronga

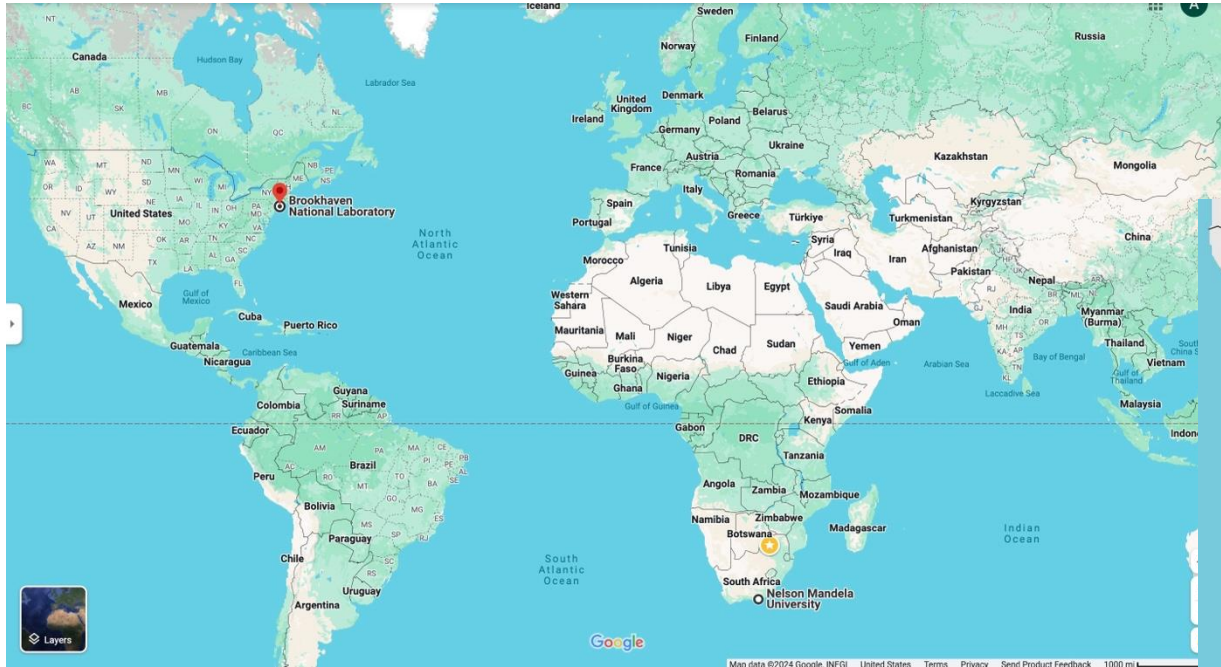
Brookhaven National Laboratory, Physics Colloquium, 10 September 2024

# Focus of the talk

- Science, Policy, & Diplomacy alignment

# Science is global

## Connecting Gqeberha and Brookhaven



From Google Maps



# Science is global – also virtually connected



Brookhaven National Laboratory, Long Island, NY

<https://www.flickr.com/photos/brookhavenlab/13929292007>



Summerstrand South Campus, Gqeberha, South Africa

<https://www.youtube.com/watch?v=ccuudrazJbU>

# About Nelson Mandela University

As of 4 September 2024:

More than **33 100** students

More than **2 400** permanent staff

**90%** undergraduate students

**10%** postgraduate students

**795** international students from **57** different countries

**74%** success rate

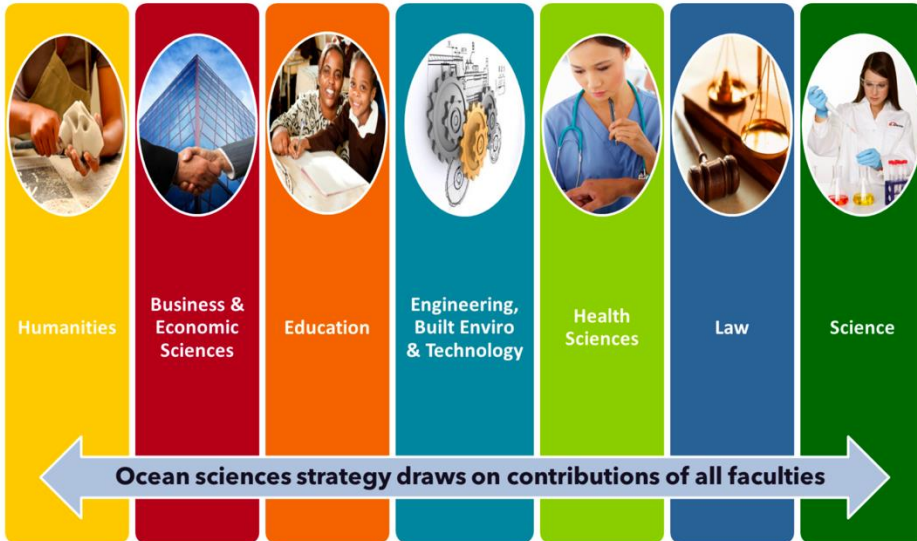
**7** campuses



# About Mandela University

One of the 7 campuses is in the WC Province – in George in the Southern Cape

## Faculty profile



## Campus profile



# Diversity & Inclusion @ Nelson Mandela University

Diversity and Inclusion at Mandela University

This starts at leadership level:

Chancellor - Geraldine Fraser-Moleketi,

Vice-Chancellor - Professor Sibongile Muthwa

Chair of Council - Ambassador Nosipho January-Bardill.

- Two of the four Deputy Vice-Chancellor positions are occupied by women
- Four of the seven Executive Deans are women

Building a culture of Diversity & Inclusion starts at home.



# Importance of Science Policy and Science Diplomacy

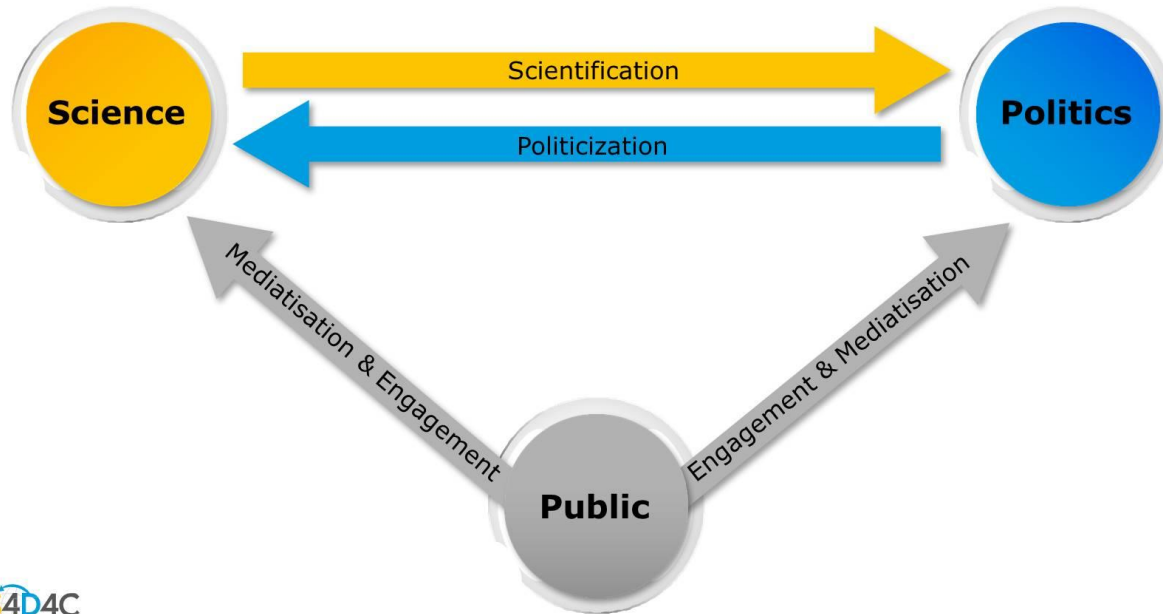
- Science Policy:
  - Helps governments and institutions set priorities for scientific research, allocate resources, and shape the future of technology and development
- Science Diplomacy:
  - Science can be used as a tool for diplomatic relations between countries
  - International collaborations in physics and science in general often transcend political barriers and address global challenges like climate change or pandemics.
- The [Royal Society](#) and the [American Association for the Advancement of Science](#) (AAAS) describes three main types of activities under science diplomacy:
  - "Science in diplomacy": Science can provide advice to inform and support foreign policy objectives
  - "Diplomacy for science": Diplomacy can facilitate international scientific cooperation
  - "Science for diplomacy": Scientific cooperation can improve international relations

[https://www.aaas.org/sites/default/files/New\\_Frontiers.pdf](https://www.aaas.org/sites/default/files/New_Frontiers.pdf)



# Science Diplomacy Triangle

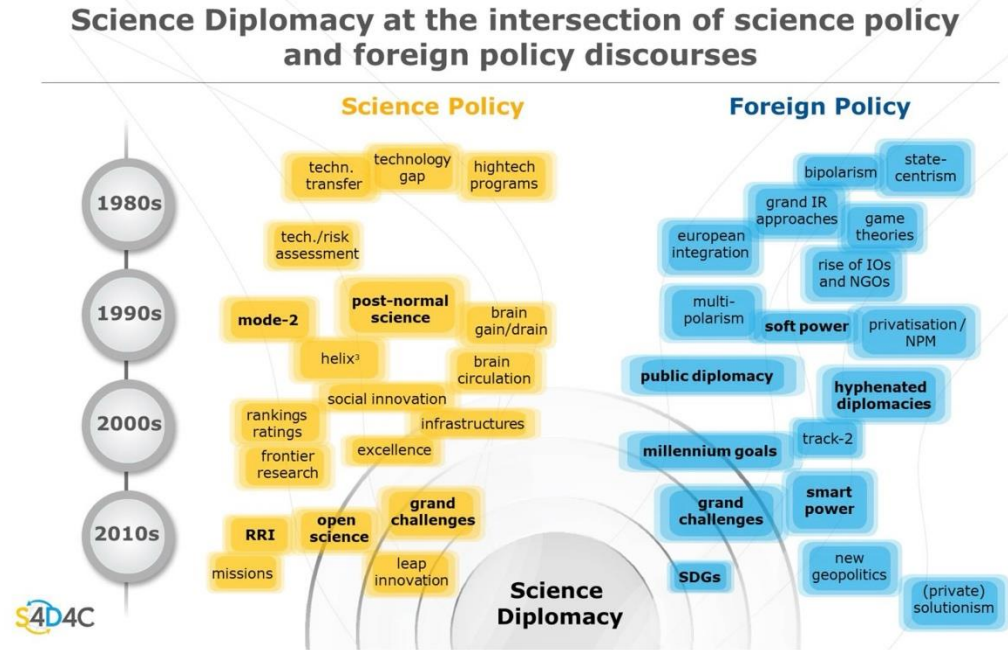
## Science Diplomacy triangle of society, policy and science



- links between science and policy.

# Emergence of science diplomacy

- the origins and gradual emergence of the science diplomacy concept in the discourse of academics and practitioners
- a sociohistorical evolution of concepts that expressed and structured leitmotifs in science policy on one hand, and foreign on the other hand.



<https://www.s4d4c.eu/tim-flink/>

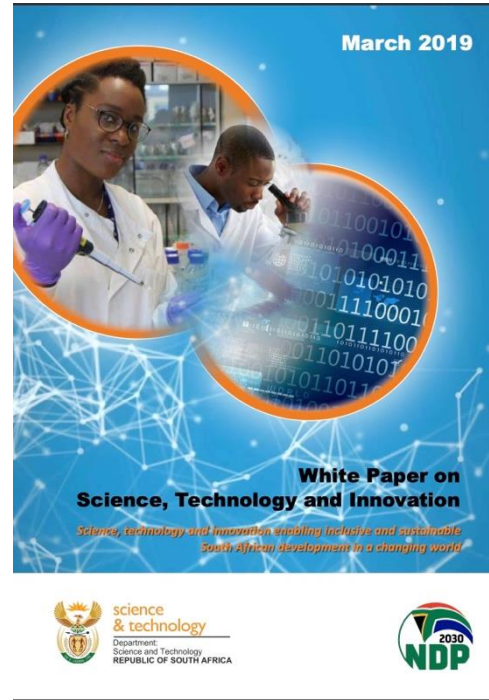


# South Africa : Policy Framework

From NDP → STI White Paper → STI Decadal Plan

## NDP, AGENDA 2063 AND SDGs

Long term plans that provide a shared development vision for all stakeholders within the country, in the continent and the world



@governmentZA on X

# Locating Physics within NDP, Africa Agenda 2063, and UN SDGs



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

## 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/>

As I have presented at ASP2024 in Marrakech

# South Africa Policy Framework

## From 2019 White Paper on STI

### 2.2.13 Deepening African collaboration

The Southern African Development Community (SADC) and African Union (AU) strategies highlight the potential role of STI in achieving the goals of SADC and the broader objective of pan-Africanism. South Africa's linkages with the rest of Africa present opportunities to build and consolidate national, regional and continental systems of innovation. South Africa's cooperation strategies in Africa should therefore prioritise efforts to strengthen its own and partner countries' STI systems. The aim should be to promote and facilitate cross-border research networks, shared technology innovation platforms, mutual learning, an integrated African STI agenda that encourages development and competitiveness, as well as funding partnerships.

South Africa's strategic science diplomacy focus has already recognised STI as an important means of driving the developmental agendas of the AU and SADC. For instance, major minerals beneficiation projects, as highlighted in the SADC Industrialisation Strategy and Roadmap, will depend on cross-border cooperation in energy and transport infrastructure and input supply, and on the development of globally competitive industry sectors.



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#### CHAPTER 5

#### INCREASED HUMAN CAPABILITIES AND AN EXPANDED KNOWLEDGE ENTERPRISE

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# South Africa Policy Framework

## From 2019 White Paper on STI

### 5.9 Policy intent: Expand internationalisation and science diplomacy

One of the strengths of South Africa's NSI, and a critical one given that it is comparatively small, is its extensive and active set of international partnerships. Over the past 20 years, global cooperation and support have contributed significantly to the growth and development of the NSI. However, well-resourced South African institutions find it much easier to take part in these programmes than historically disadvantaged institutions, and a more inclusive approach is needed.

South Africa will continue to prioritise support for the development of STI capacities in Africa, including through the implementation of the AU's Science, Technology, and Innovation Strategy for Africa and initiatives bolstering regional integration within SADC. Informed by the priority focus on pan-African partnership and solidarity of South Africa's foreign policy, South Africa is determined to meet its responsibility to contribute to STI capacity building as an instrument for growth and development in Africa. Partnership initiatives will focus on enhancing policy frameworks and institutional capacities, including research infrastructures, as well as human capital development with a special focus on the intra-African mobility of young African researchers.

It is important to emphasise the importance of international engagement, not as an objective in its own right, but as an integral part of the overall further evolution of the NSI. The focus for South Africa to contribute to building African STI capacities is, thus, not an altruistic endeavour, but very much one informed by national interest, as the South African NSI will only flourish as part of vibrant Southern African regional and broader continental innovation ecosystems. The government's initiatives below relate to the strategic policy context, implementation modalities, and planning and coordination of international cooperation.

*"Science knows no country, because knowledge belongs to humanity, and is the torch which illuminates the world."*

Louis Pasteur



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#### CHAPTER 5

#### INCREASED HUMAN CAPABILITIES AND AN EXPANDED KNOWLEDGE ENTERPRISE

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# Some of the outcomes from policy

- Hydrogen Society Roadmap (HSRM)
- Square Kilometre Array
- Academy of Science of South Africa (ASSAf)
- Council for Scientific and Industrial Research (CSIR)
- Human Sciences Research Council (HSRC)
- National Research Foundation
- South African Council for Natural Scientific Professions (SACNASP)
- South African National Space Agency (SANSA)
- Technology Innovation Agency (TIA)
- South African National Energy Development Institute (SANEDI)
- South African Astronomical Observatory (SAAO)
- National Institute for Theoretical and Computational Sciences (NITheCS)
- ....

# Some notable cooperations

## Cooperation in deep space missions



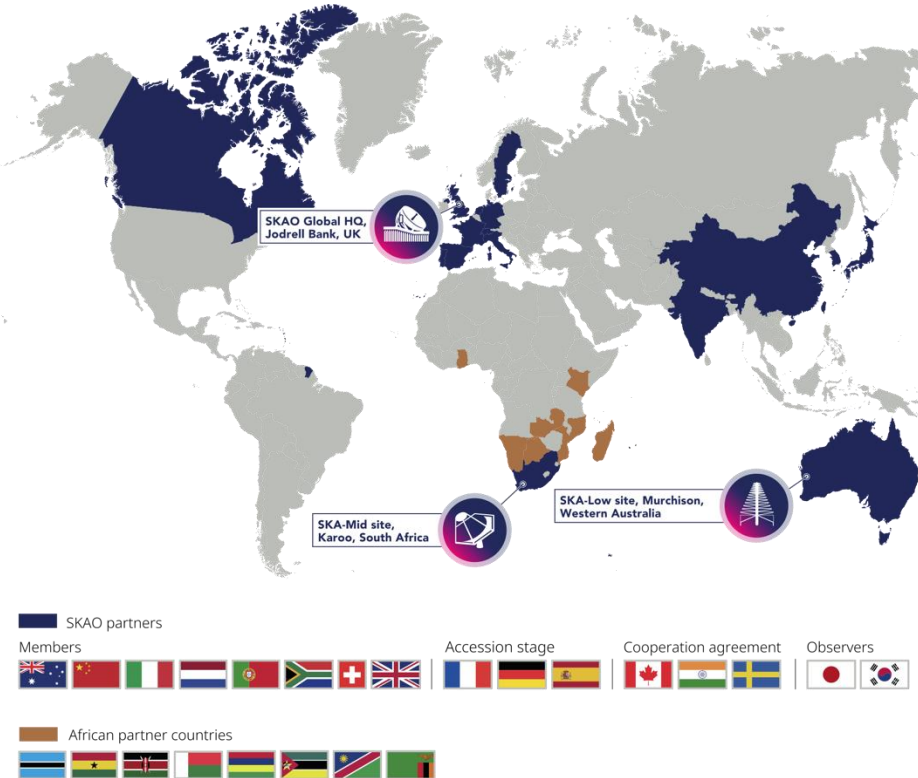
<https://www.sansa.org.za/2022/11/south-africa-nasa-renew-lunar-exploration-partnership/>





# Some notable global projects

## The Square Kilometre Array



MeerKAT

<https://newatlas.com/square-kilometre-array/53498/>

# My involvement in Snowmass

- Representing Africa and the Middle East Region
- Sharing the South African experiences and lessons at Snowmass21
- Contributing to the discussions on shaping the future of particle physics in the US

## The South African context

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Structural changes in support of public engagement with science  
in South Africa

**Azwinndini Muronga**  
Faculty of Science

CEF Plenary: Community Engagement Across the Frontiers

Snowmass21 Community Planning Meeting  
5-8 October 2020 @18:00 - 23:00 SAST

*SnowMass2021*

## Pre-1994 - A siege society under apartheid

- 1960s and 1980s represented the worst of times due to apartheid policies
- Progressive isolation of a science system – internationally and internally
- The apartheid ideology also had negative effects on the state of the SA science system itself
- The creation of historically black universities (HBUs) a.k.a 'bush colleges' in the 1960s led to a different kind of polarization

# The tide turns – transition to an inclusive democracy

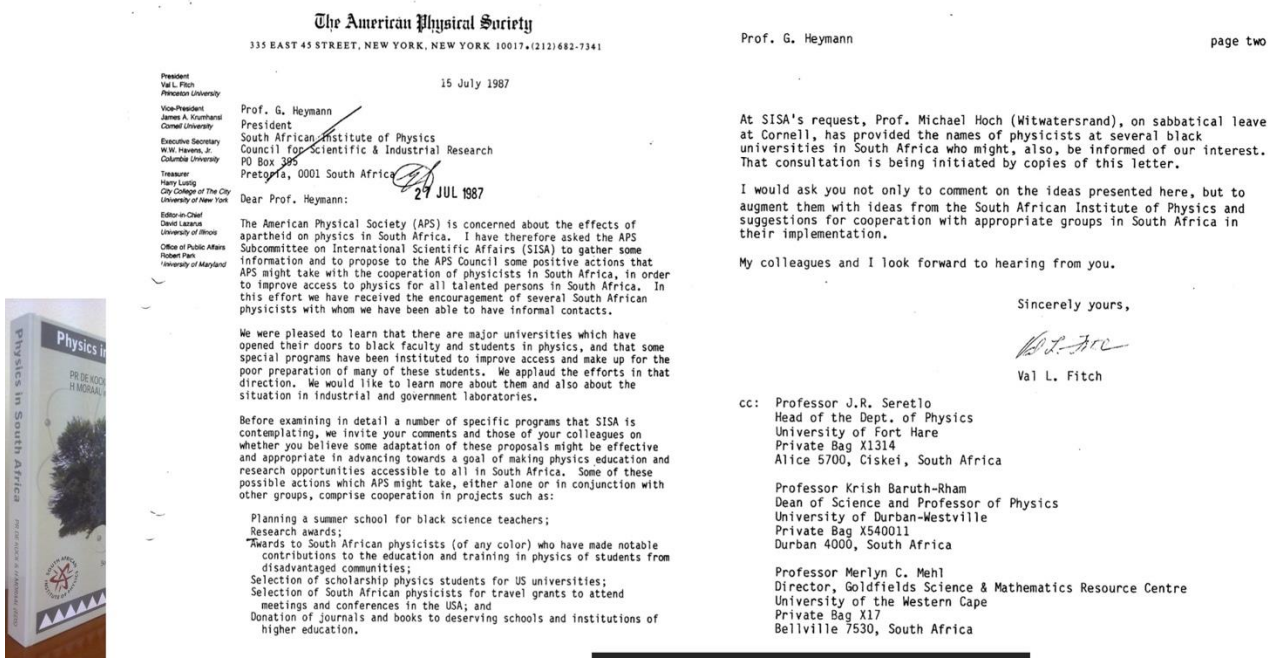
- South Africa becomes a democracy in 1994
- The period of isolation ends
- A new ministry of Science and Technology (S&T) is established
- Rapid evolution of a new and dynamic national S&T system
- A well-developed, newly reorganized university system
- Strategic high-level human capital development in S&T – the new priority
- Big science in South Africa – the SKA, MeerKAT and multi-messenger astronomy, iThemba LABS, Ocean Sciences, SA-CERN ...

# Shaping the Future of Physics in SA -- 2004

- Declining levels of funding, the red-shifting of the age profile of productive scientists, and the poor appreciation by the public of the role of physics in society and for development
- 14 recommendations emerged, all implemented by now
  1. In many countries, elementary and secondary school teaching of mathematics and science is a considerable worry. In South Africa this situation is exacerbated in the historically black schools. Although beyond the scope of this inquiry, we must flag this very serious situation. We acknowledge that steps are being taken to address this matter, but urge the relevant authorities to pursue it with even more vigour, as it is a crisis situation. Individuals in the physics community are to be commended for their activity in this regard, but more involvement is needed, particularly at the structural level. [SAIP, NRF, Department of Education]
  2. The long-term sustainable future of physics in SA depends on the country's commitment and investment in the development of a workforce that is representative of its demographic diversity. Evidence indicates that, while there is a rapidly growing cadre of physics students from previously under-represented groups, there are perceived difficulties that need to be addressed by the established physics community and by the funding authorities. Apart from financial barriers to both undergraduate and postgraduate study (addressed below), there are others matters of concern, such as that relating to the integration of students of different cultures into existing departments, particularly in regard to the transfer of students from HBU's to HWU's. These questions need to be addressed urgently, and interpersonal communication is of the essence. [University community].
  3. Job prospects in Physics are perceived by many young people to be poor, and this affects the take-up of the subject in schools and universities, but this is illusory. Both industry and business welcome them, for both technical and managerial careers, but this is not made apparent. The fault appears to lie on both sides, employers not making it clear that physicists are welcome to apply for their vacancies, and physicists not being sufficiently proactive. We recommend that SAIP mount a "connectivity-campaign". [SAIP]
  4. The "Public Understanding of Science" is increasingly important, not least for a democratic nation where the wide appreciation of science is vital. Much is being done but we recommend more, particularly as "the public" consists of many constituencies, all of which are important. [SAIP]

# SA science community should be thankful to the international community for speaking up during our dark days

## Why South African science community should be very proactive in acting against racism



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SnowMass2021

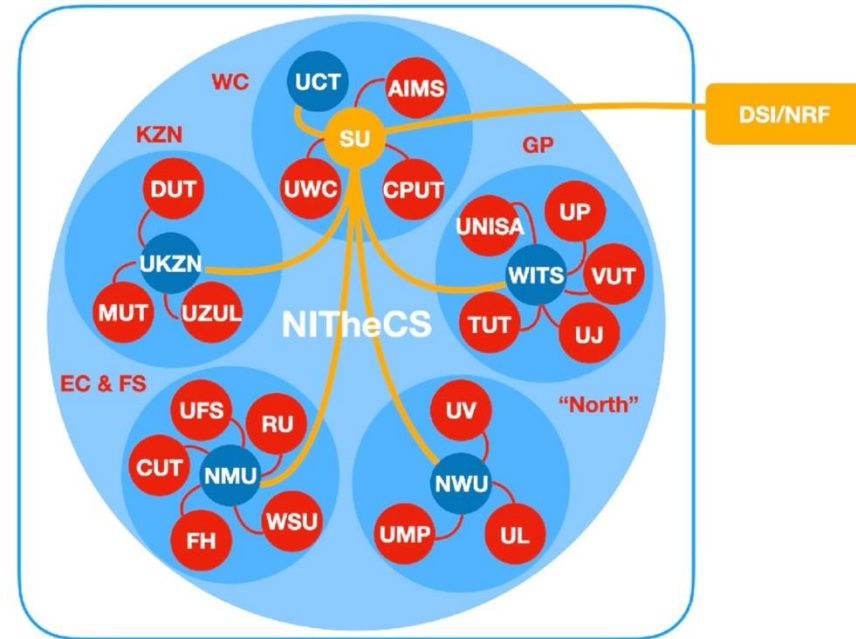
Change the World

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Change the World

# Some notable outcomes of the physics review in SA

- Support for the South African Institute of Physics Office
- Establishment of the National Institute for Theoretical Physics (NITheP) and recently reconfigured into National Institute for Theoretical and Computational Sciences (NITheCS)
- Science Awareness and Educators' development programs



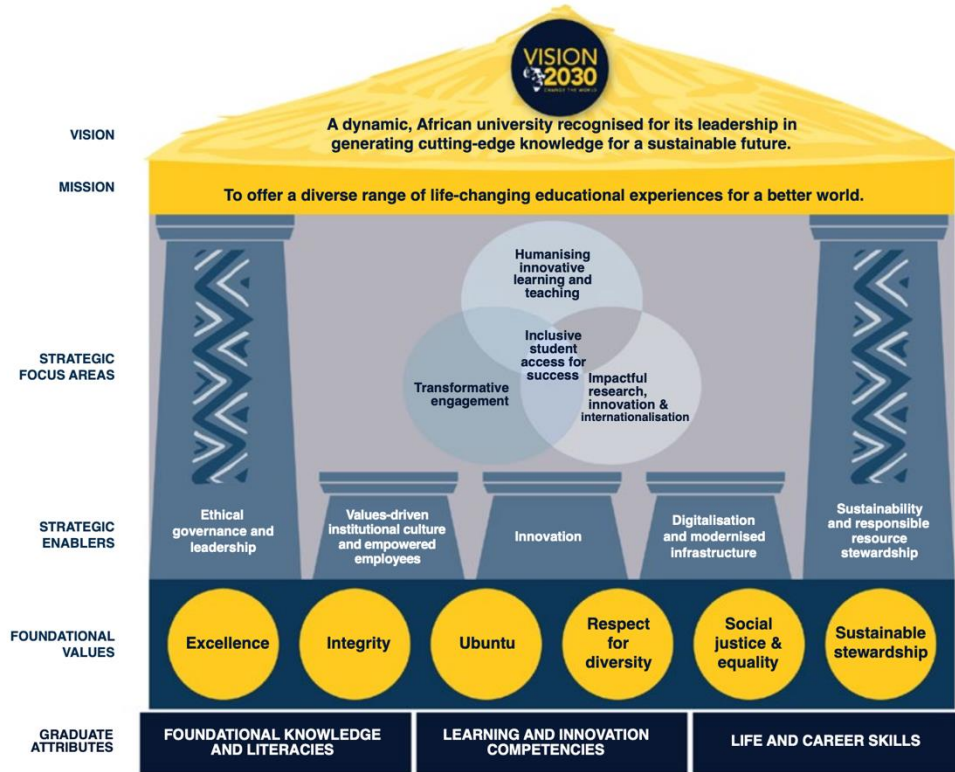
NITheCS Consortium inclusive of all SA institutions

I'm currently heading one of the 5 nodes  
- NMU

# Policy Framework: Mandela University



# Mandela University Vision 2030



Research, Innovation, and Internationalization (RII) is interconnected with L&T, and E&T

# Locating RII within VC's leadership

Taking Nelson Mandela University Boldly into the Future in Service of Society

Inaugural Address

Professor Sibongile Muthwa, Vice-Chancellor

*Nelson Mandela University*

*17 April 2018*



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Advancing Mandela University – Consolidating the Gains, Charting the Future

Together

Professor Sibongile Muthwa

Vice-Chancellor

*Business School Auditorium. 29 March 2023*



# Mandela University International Education

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Change the world

Mandela International Office

Menu ☰



[Mandela Global Footprint](#)



[Our Partners and Research Networks](#)



[Student Support](#)



[Exchange Opportunities](#)



[Online Short Programs](#)



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Courtesy – Prof Heather Nel

# Mandela University & Global Partners

Mandela International Office

## Global Partnerships Dashboard



From Mandela University International Office site

# Mandela University & Global Networks



The South Africa-Sweden University Forum (SASUF) started in 2018 as a strategic internationalization project running from 2018-2020, with the overall aim of strengthening ties between Sweden and South Africa in research, education and innovation

[MORE INFO](#)



The ACU is an international organization dedicated to building a better world through higher education collaboration is central to this from around the world – an within them – we help to broaden n



Southern African – Nordic Centre (SANORD) is committed to advancing strategic, multilateral academic collaboration between institutions in the Southern African and Nordic regions, as we seek to address new local and global challenges of innovation and development

[MORE INFO](#)

From Mandela University International Office site



The objective of GCUA 2030 is to equip the next generation of researchers, teachers and academic leaders with knowledge, tools and networks that will strengthen their capacity to work across disciplines and to conduct translational research

[MORE INFO](#)

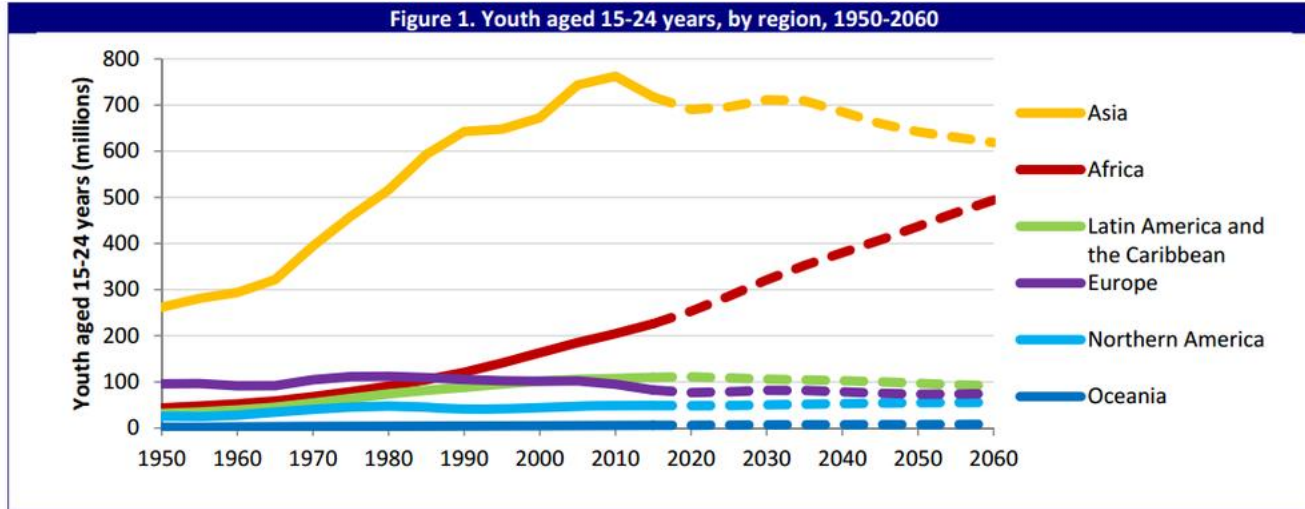


SDSN mobilizes global scientific and technological expertise to promote practical solutions for sustainable development, including the implementation of the Sustainable Development Goals (SDGs) and the Paris Climate Agreement

[MORE INFO](#)

# Africa Rising

# The rise of Africa's Youth population



Data source: United Nations (2013) *World Population Prospects: The 2012 Revision*.

- Not only Africa's challenge!
- It should be in everyone's interest

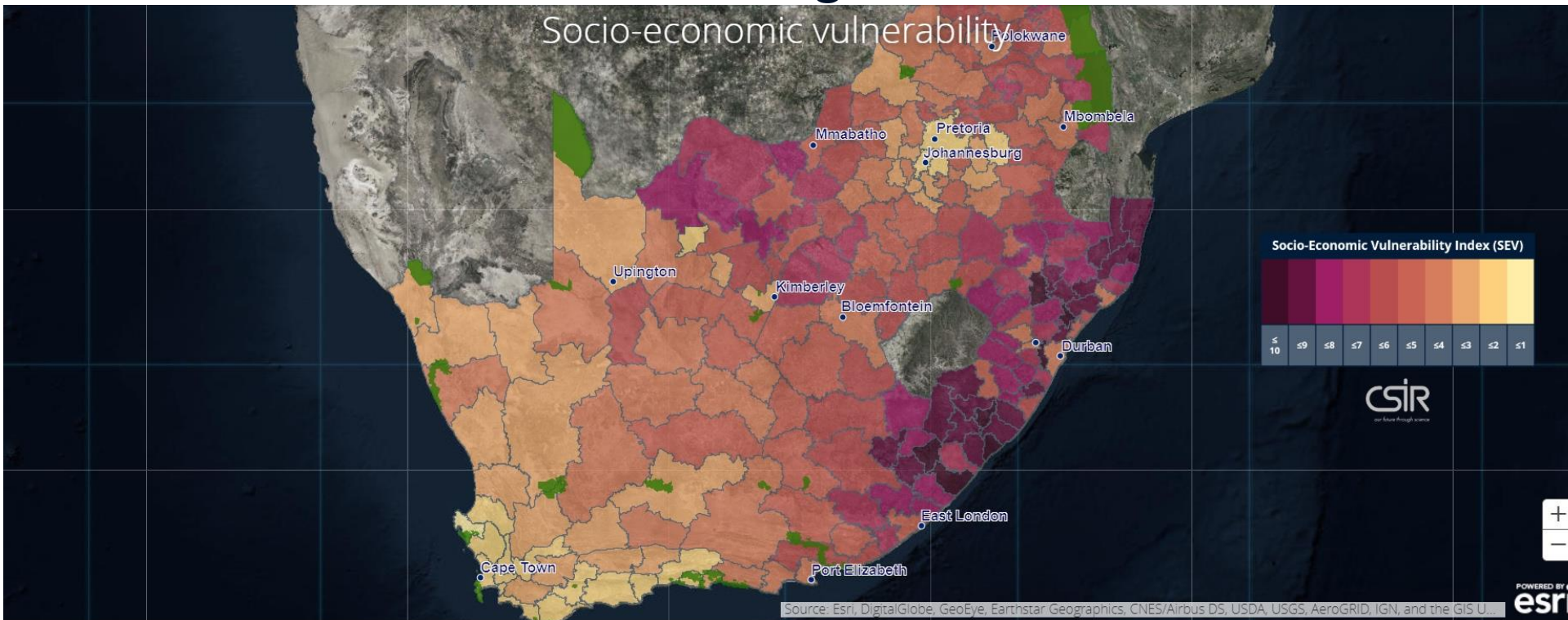


# UNESCO: Priority Africa Flagship Programmes and Actions

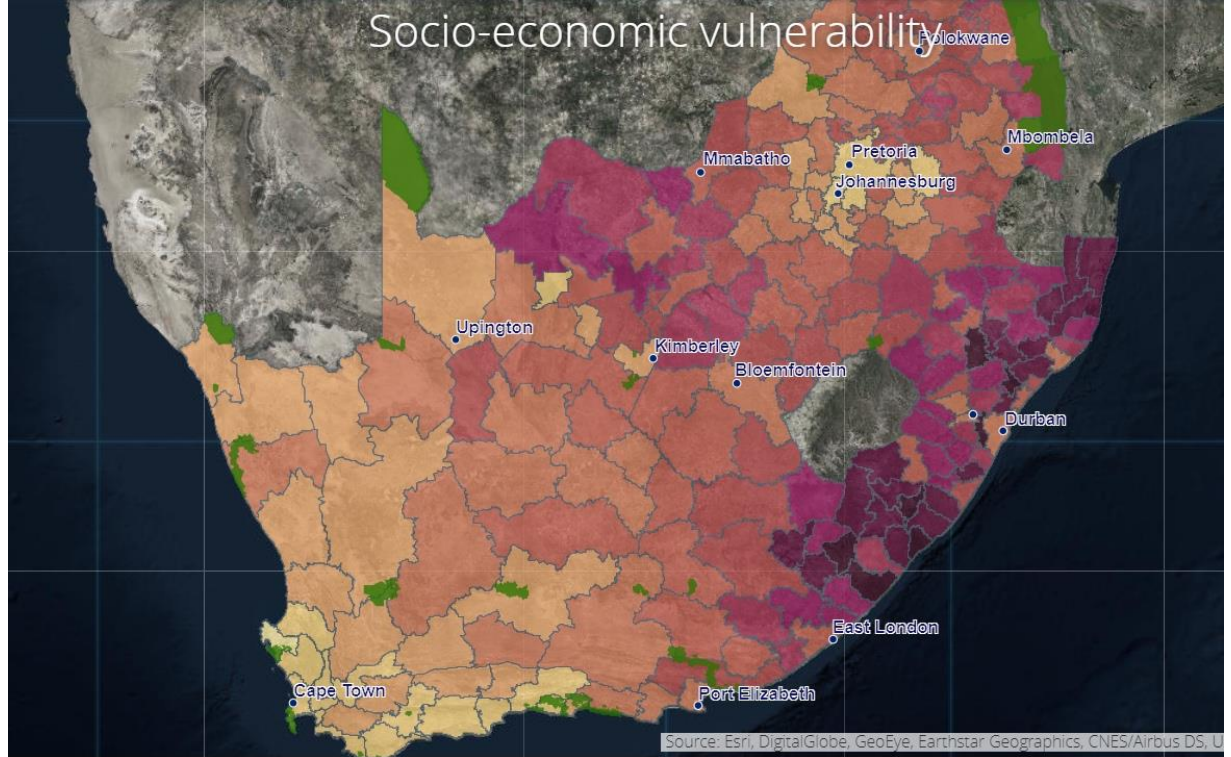
- **Strengthening education systems for sustainable development in Africa**
  - **Fostering science for the sustainable management of Africa's natural resources and disaster risk reduction**
  - **Harnessing STI and Knowledge for the Sustainable Socio-Economic Development in Africa**
- 
- Africa is positively changing at an extraordinary speed.
  - But with change also comes risk.
  - Rapid urbanization, growing population, youth unemployment, inequality and social exclusion, new natural resource finds and a changing climate as well as peacebuilding processes, all have the potential to place African societies under considerable strain.

<https://en.unesco.org/priorityafrica/flagshipprogrammes>

# Communities: Socio-economic vulnerability including to climate change hazards



- Communities in Africa are changing fast
- Cities and urbanisation
- Agriculture and pastoralism
- Food security, water security, human security
- Internet access, digital economies, social media
  
- Role of science potentially more useful than ever before
- Contribution to quality of life



# Science, policy, and diplomacy become very important!

The image displays five vertical panels, each representing a different level of policy and science engagement. Each panel has a colored circular graphic at the bottom.

- Global:** Features a world map, the text "Global Competitiveness", the SDGs wheel, and the label "global".
- Regional:** Features the BRICS logo, the OECD logo, and the G20 2023 India logo. The label "regional" is at the bottom.
- African:** Features a map of Africa, the "50th Year of Pan Africanism" logo, the "AGENDA 2063" logo, and a document titled "Africa: The economic and strategic challenges and solutions". The label "African" is at the bottom.
- South African:** Features the "2030 NDP" logo, the "science & innovation" logo from the Department of Science and Innovation, the "SCIENCE TECHNOLOGY AND INNOVATION DECADAL PLAN 2022-2032" document, the "SOUTH AFRICA FORESIGHT EXERCISE 2020" document, and the "National Research Big Data Strategy for South Africa" document. The label "South African" is at the bottom.
- Specific:** Features a document titled "South Africa: Science, Technology and Innovation", the "Science Engagement Strategy" document, and the "Basic Sciences Development and Support Frameworks" document. The label "specific" is at the bottom.

# We can leverage on the big projects

Some of the big projects and events:

- IYBSSD, the International Year of Basic Sciences for Sustainable Development, Chair of Steering Committee: Michel Spiro, <https://www.iybssd2022.org/>
- The call to action issued by IoP, the Institute of Physics, London <https://www.iop.org/strategy/physics-climate-change-sustainability/global-green-economy>
- The long-standing actions of ISC, the International Science Council <https://council.science/publications/the-international-council-for-science-and-climate-change/>
- The proclamation by the United Nations General Assembly of 2024 to 2033 as the "International Decade of Sciences for Sustainable Development" (IDSSD) <https://www.iybssd2022.org/en/an-international-decade-of-sciences-for-sustainable-development/>



INTERNATIONAL YEAR OF  
Quantum Science  
and Technology



**International  
Science Council**

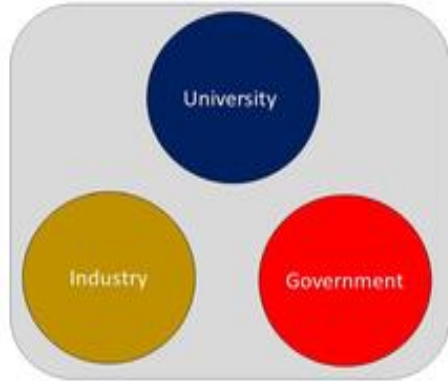


# Towards inclusive science diplomacy

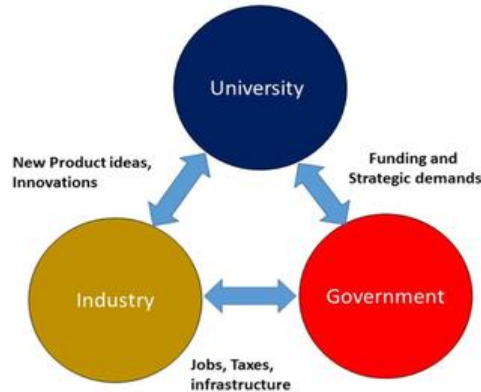
We should rethink how we want to tackle the grand challenges

- The triple helix model of innovation

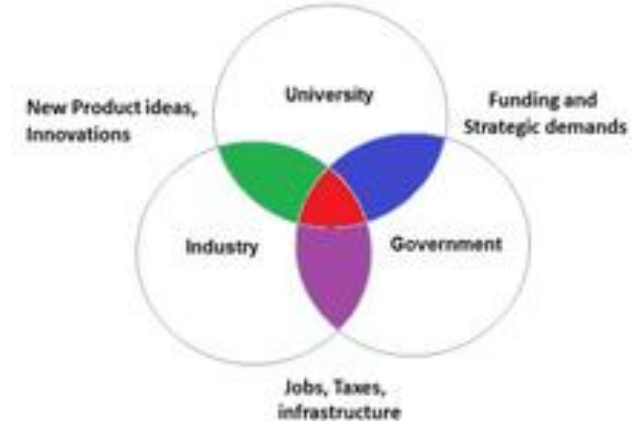
“silos” – no or low interaction



Beginning of triple helix



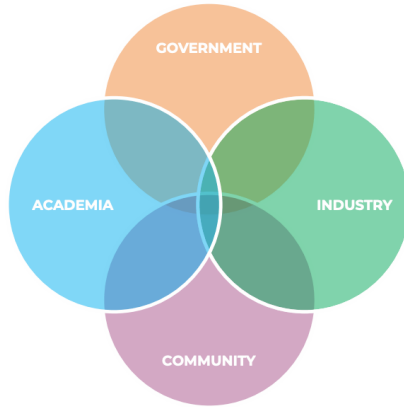
Developed triple helix; red - science park



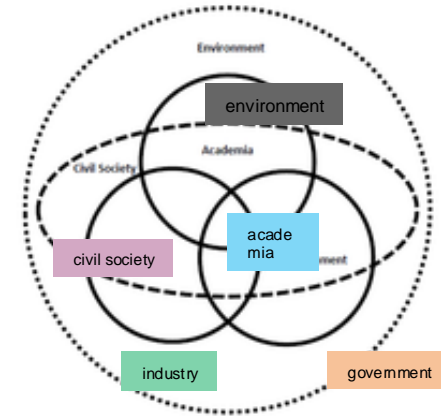
Etzkowitz, Henry; Leydesdorff, Loet (1995). *EASST Review*. 14: 14–19  
[https://en.wikipedia.org/wiki/Triple\\_helix\\_model\\_of\\_innovation](https://en.wikipedia.org/wiki/Triple_helix_model_of_innovation) images

# The need for higher order models – the Mandela way

- 4-helix: the public



- 5-helix: the natural environment

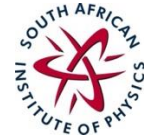


Peris-Ortiz, Marta; Ferreira, João; Farinha, Luís; Fernandes, Nuno (2016-05-27). *Multiple helix ecosystems for sustainable competitiveness*. Cham: Springer. pp. 1–14 . image <https://grip.eu/why-is-quadruple-helix-engagement-so-important/>

# Applications of science, policy, diplomacy intersections: SA



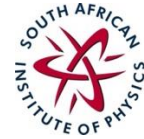
# District Development Model for Service Delivery



- 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

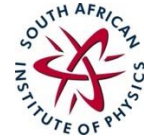
# Physics-Underpinned Needs Identified in DDM Reports



- 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>

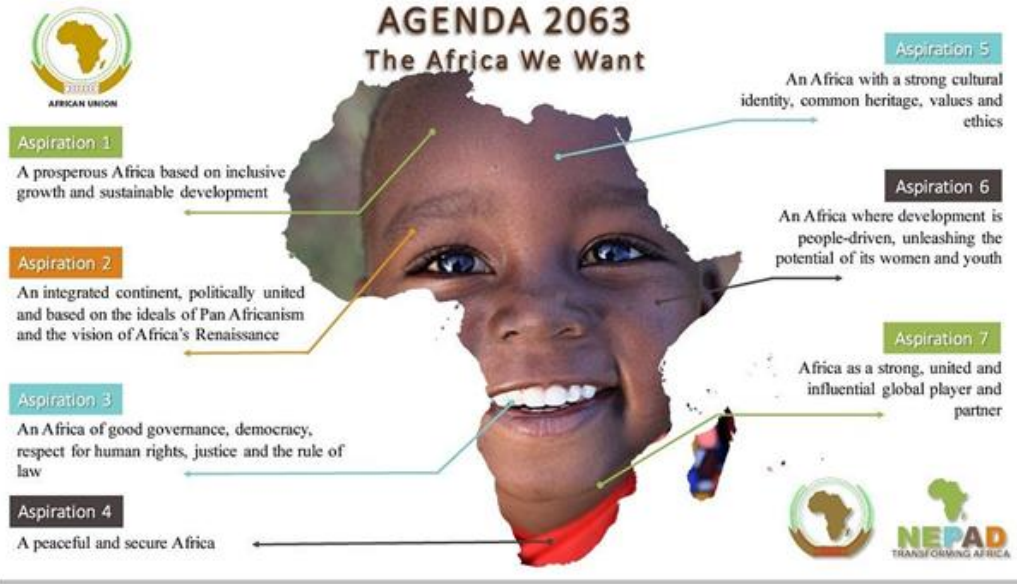
**“Physics in My Village”** is transforming a national programme that promotes physics research & capacity building while simultaneously promoting citizen science, grassroots socioeconomic development, and essential community service delivery infrastructure through Physics prototypes that are constructed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

Slide courtesy of Dr Brian Masara – CEO of SAIP

# Africa and the UN SDGs

Africa is expected to play a significant role in achieving the sustainable development goals.

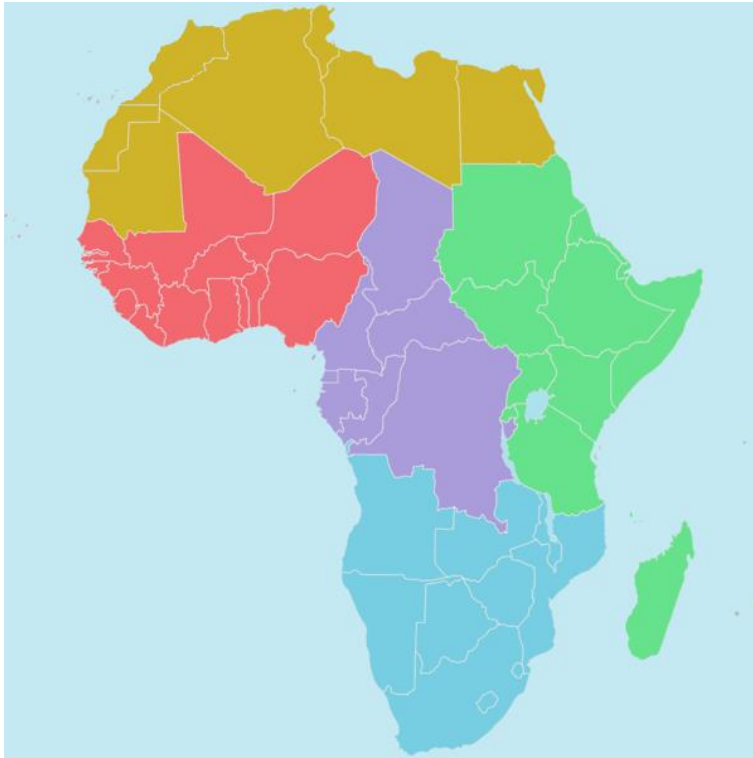
By harnessing the power of physics in several applications, Africa can unlock new opportunities for economic growth, social development, and environmental sustainability, contributing to the achievement of the SDGs and building a brighter future for its people.



By harnessing the power of physics, Africa can realize its vision of a prosperous, integrated, and peaceful continent by 2063.

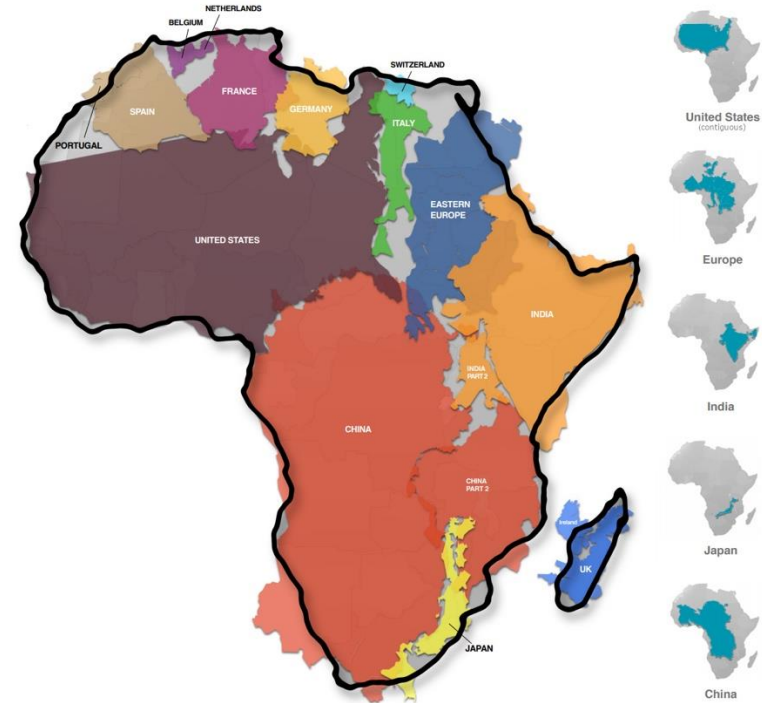


# Africa in perspective- the true size of Africa



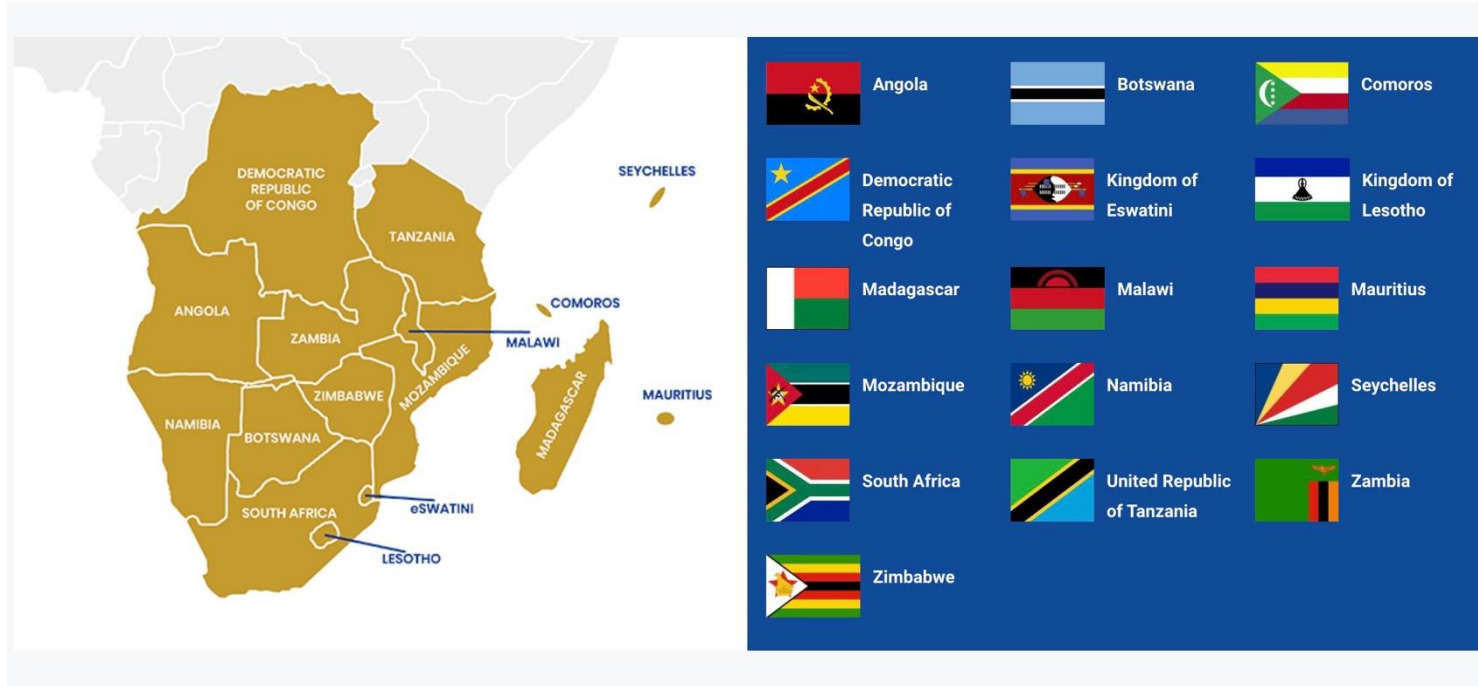
AU Regions of Africa:

North, West, Central, East, and Southern Africa



Until we acknowledge the sheer size and shape of Africa

# The Southern African Development Community



The Southern Africa Physics Network (SAPhysNet) will assist the SADC block to realize its vision. Just like SAIP is doing in South Africa through the DDM.

# Physics in Africa

## ■ **Physics in Africa Project**

- Phase One Report September 11, 2017
- a joint effort by members of the American Physical Society, the European Physical Society, the Institute of Physics, the South African Institute of Physics, the International Center for Theoretical Physics, and the Materials Research Society, aimed at promoting physics in Africa.

## ■ **Questionnaire**

- Does your country have a physical society?
- If not, are there plans to establish one?
- Upon receiving a bachelor's degree in physics, does the student typically seek an advanced degree in physics?
- Do post-doctoral opportunities exist within the country?
- Are there any physics courses taught online?

Partnerships with Physical Societies in other global regions  
should be mutually beneficial.

# Physics in Africa

<https://www.iop.org/about/international/africa-uk-physics-partnership-programme-feasibility-study>

## ■ Africa-UK Physics Partnership Programme

- Feasibility Study Report
- July 2020

- The feasibility study was carried out between March and June 2020 by the Association of Commonwealth Universities (ACU) and the UK Institute of Physics (IOP)
- **Five key thematic areas:** These areas include the **three research themes of energy, climate and weather and health**, and **access to large-scale research facilities and the advancement of big data and artificial intelligence (AI) as two key enablers**.

The nine SSA partner countries for the proposed programme are:

**Ethiopia, Ghana, Kenya, Malawi, Nigeria, Rwanda, South Africa, Tanzania and Uganda.**

## ■ Objectives

- Measure the current level of physics research and innovation in SSA based on the following dimensions: academic and research staff capacity, physics training and education pipeline, research infrastructure and access to large-scale research facilities, Research and Development (R&D) and innovation platforms, and collaborations and networks;
- Uncover the major challenges faced by students, academic and research staff and institutions in the discipline of physics in SSA;
- Recommend opportunities to enhance enabling factors and advance physics across all research themes.



# Key study findings

- **Academic and research human capital:** Energy has the highest number of researchers and technicians, followed by climate and weather, with the smallest number for big data and AI. However, big data and AI have higher ratios of early-career staff. There is a consensus amongst academic staff that **work overload, insufficient support for staff development and lack of skilled technicians to maintain research equipment are the main hindrances to their research and professional advancement.**
- **Physics training and education:** Universities are experiencing challenges in **attracting and retaining students in the physics education pipeline at both undergraduate and postgraduate levels.** Pipeline issues **originate at the school-level, where there is a general lack of encouragement for students to take up physics, a lack of understanding about the importance of the subject, and a lack of awareness about career paths and professional opportunities.**
- **Research infrastructure:** State-of-the-art research equipment and the technical skills to repair and service them are not readily available for all research themes. Energy and climate and weather are supported by a reasonable amount of equipment, while health and medical physics equipment often serve both research and clinical purposes. Although equipment for big data and AI is scarce, the study found several advanced big data research centres in South Africa and Kenya.

# Key study findings

- **Large-scale research facilities:** Of the institutions surveyed, 91% indicated they would benefit from increased access to large-scale research facilities for multiple reasons, including the opportunity to give young scientists international experience and to collaborate with top scientists. **The most significant large-scale research facility available on the African continent is the Square Kilometre Array (SKA),** and several significant large-scale African research facilities currently under development have also been identified.

Several Centres of Excellence (CoEs) were found for all research themes, although the field of medical physics had the fewest number. **Most CoEs are country-focused and there is a need to establish ones that encompass multiple countries.**

- **Gender inclusivity:** Most PhD holders and academic and research staff are male. **The shortage of women in physics is not unique to Africa; however, in the African context, participants reported gender norms, cultural barriers, family responsibilities and workplace harassment as significant barriers for gender inclusivity in physics.**

- .

# Key study findings

- **R&D and innovation outputs:** Relatively **low levels of innovation and commercialisation outputs** are attributable to **a lack of targeted training, weak industry-academic collaborations, and traditional teaching approaches that value theory over experimental or applied physics.**
- **Collaborations and networks:** The **main types of existing partnerships are joint-research, co-supervision of students, and staff and student exchanges.** Energy research collaborations are particularly prominent followed by collaborations for climate and weather. Less than half of universities undertake consultancy work for industry or have industry-funded research programmes, indicating relatively **weak links between the private sector and academia.**

# Recommendations

1. Provide funding and support to enhance the physics education pipeline beginning at the school-level through to university in order attract and retain more students in physics;
2. Provide encouragement for students, particularly young women and girls, to pursue physics education by clarifying career opportunities, raising awareness about the importance of physics, and promoting the value of academia;
3. Grant financial support for post-graduate students;
4. Develop R&D infrastructure and strengthen commercialisation support systems through strengthening academia-industry ties and increasing placement and opportunities for consultation work;
5. Engage governments on the need to have more academic staff, and to appoint research-only staff in universities;
6. Address gender-based cultural stereotypes and workplace harassment to reduce barriers for women in physics;
7. Improve access to large-scale research facilities and build multilateral Centres of Excellence, particularly in the field of health and medical physics;
8. Enhance opportunities to establish new bilateral and multilateral research collaborations and strengthen existing networks.

There is hope!

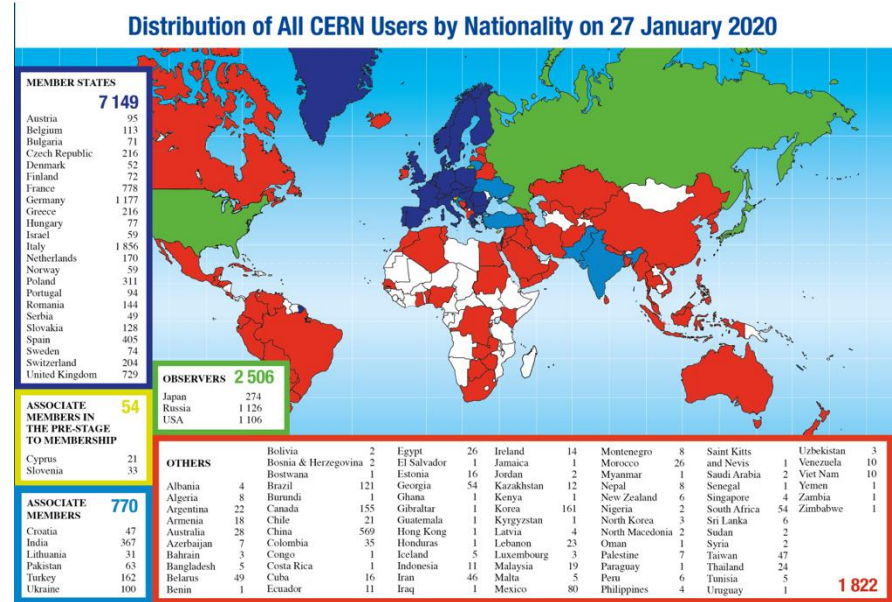


# Africa's participation in international HEP

- Africa's participation in international HEP facilities remains extremely low.

About 1.1% of CERN users are African Nationals

Not limited to CERN, but a broader issue



# Africa's participation in international HEP

- About 43 countries with one African country
- About 178 institutes of which 2 are from South Africa
- Over 1900 members of which 5 are from South Africa



**South Africa**  
**SA-CERN programme**  
 ATLAS, ALICE, ISOLDE, CERN, Theory



Participating institutions : 1 National Facility (iThemba LABS) and 10 Universities

	ATLAS	ALICE	ISOLDE	Theory	Total
PhD	6	5	6	8	25
MSc	19	2	7	15	43
Accad Staff	7	6	6	7	26
Tech Staff	3				3
Post Docs	5	2	2	2	8

2017 numbers, increasing trajectory

- SA has a long history in High Energy Physics, eg : 1<sup>st</sup> neutrino discovered and studied in nature 1965
  - Long history at CERN, BNL, JLAB, JINR, others
  - Also a long history of theoretical contributions
- **SA-CERN Co-operation Agreement 1992**
- Now formal participation at CERN and JINR

- Most HEP now in the SA-CERN and JINR Programmes
- ALICE since 2001
  - ATLAS since 2010
  - ISOLDE since 2017
  - Theory
  - JINR since 2005

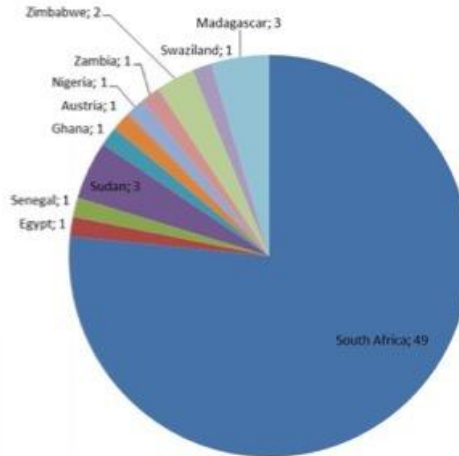
*Decades of "ad hoc" participation*

**ALICE nowadays**  
 42 countries, 174 institutes, 1800 members

ALICE COLLABORATION  
 AS NOVEMBER 2016

□ A world-wide Collaboration  
 □ Goal → exploit the unique physics potential of nucleus-nucleus interactions at LHC energies

E. Scapparini, Overview of recent ALICE results, Kruger, December 2016



Courtesy of Simon Connell

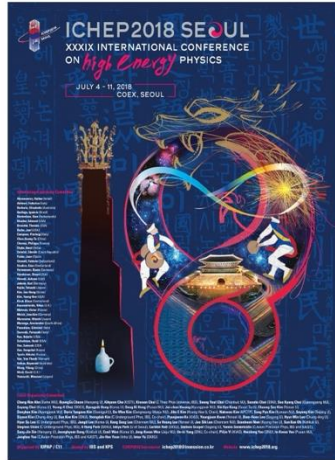
**Change the World**



# Africa participation at ICHEP

ICHEP is the largest international conference of high energy physics

## Summary and Outlook



ICHEP 2018, Seoul (7/11/18)

- Introduction
- Happy 50<sup>th</sup> birthday Standard Model!
- ICHEP 2018
- Thoughts for the future

Paul Langacker (IAS)

- **Broad and exciting conference**

- Experiment, phenomenology, theory, astro-particle, accelerator, detector, computing, education, diversity, applications
- 1119 participants (213 women, 906 men)
- 835 parallel talks in 16 sections
- 41 plenary talks
- 2 award lectures
- 6 satellite meetings
- 2 public lectures
- 226 posters (3 award talks)
- Director's panel

- **Not a detailed/complete summary**

- Asia/Pacific: 560
- Europe: 414
- N/S America: 137
- Africa: 8
- Antarctica: 0



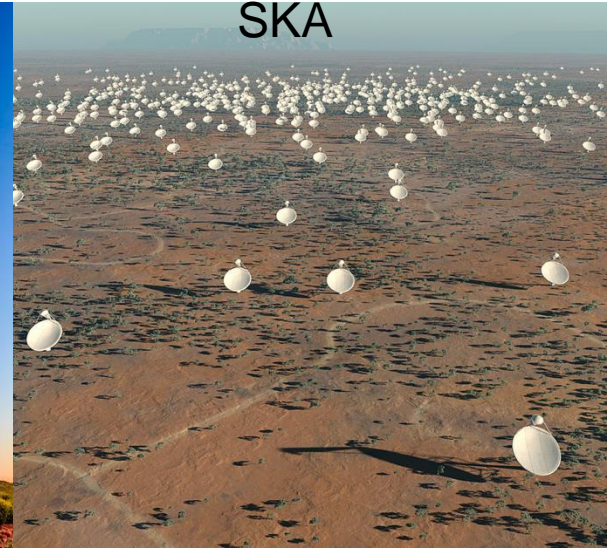
Paul Langacker (IAS)

Africa is fertile with possibilities.

# Why is physics capacity building in Africa important?

- Major research research facilities coming to Africa
- SKA - The largest radio astronomy observatory to be (co-) hosted by South Africa (70%) and Australia (30%) : meaning that two Global/Geographical South nations will be at the heart of managing and driving the project; and this will need a large African STEM workforce
- Africa and in particular Southern Africa has geographic advantage in astronomy research (besides being the point of human origins)
- In Africa the diversity challenge is both local and global.

## Multi-messenger Astronomy



# SKA science and the birth of multi-messenger astronomy

THE ASTROPHYSICAL JOURNAL LETTERS, 848:L12 (59pp), 2017 October 20

<https://doi.org/10.3847/2041-8213/aa91c9>

© 2017. The American Astronomical Society. All rights reserved.

**OPEN ACCESS**

Africa is taking its place as a leader in big science.



CrossMark

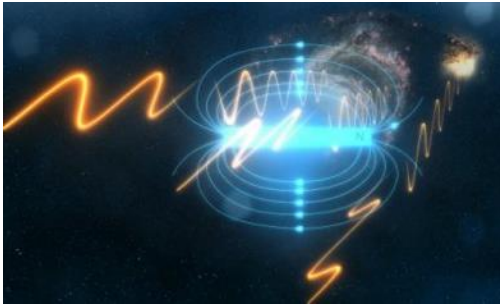
## Multi-messenger Observations of a Binary Neutron Star Merger

LIGO Scientific Collaboration and Virgo Collaboration, Fermi GBM, INTEGRAL, IceCube Collaboration, AstroSat Cadmium Zinc Telluride Imager Team, INiC Collaboration, The High Energy Astrophysics Science Analysis Center, ANTARES Collaboration, The Swift Collaboration, AGILE

A comparison between SALT/SAAO observations and kilonova models for AT 2017gfo: the first electromagnetic counterpart of a gravitational wave transient – GW170817

Buckley et al.

McCully et al.



# Rural capacity building

- Science engagement in primary and secondary schooling education system
- Going from province to province visiting schools and HEIs
- Talking about wonders of nuclear physics, particle physics, astrophysics, and cosmology
- Science Centres in SA have transformed into training Centres for STEM learners and educators

A growing movement on human capital development is on the rise in Africa, by African scientists.

Consider partnering with them.



# From Soweto to Limpopo & EC

*Inspiring, engaging and educating*

- National Science Week brings science engagement to massive number of intended stakeholders





# A state-of-the-art Science Centre launched at Nelson Mandela University 15/03/2024



The next generation should receive better science education than we had.

<https://youtu.be/mRC-uMTLa8c>



# Capacity building through educator training

- Programmes for STEM educators
- Training teachers has ripple
- Effects – as evidenced by schools which improved their results
- SAIP has an educator's development programme which has been very successful
- The programme is now rolled to the provinces and neighbouring African countries



# Physics for Africa –training students at/from HBUs

*Training the next generation of African explorers and innovators*

- Annual Hot and Dense Matter in Heavy Ion Collisions and Astrophysics (HDM) school and workshop
- Annual Hot and Dense Matter in Heavy Ion Collisions and Astrophysics (HDM) school and workshop
- The HDM schools are aimed at students who just finished their BSc up to PhD level
- The school curriculum covers introductory topics including mathematical physics, computational physics, nuclear physics, particle physics, astrophysics and cosmology
- These schools are mainly hosted by rural universities in order to attract students from these universities
- We also partner with visiting academics - e.g., LHC in Kruger



# Capacity building at/for rural universities

- Annual Hot and Dense Matter in Heavy Ion Collisions and Astrophysics (HDM) school and workshop
- The school curriculum covers introductory topics including mathematical physics, computational physics, nuclear physics, particle physics, astrophysics and cosmology
- The HEPP Workshop series - The topics to be covered will be high-energy theory and phenomenology (heavy ions, pp, ep, ee collisions), ATLAS physics and ALICE physics.
- National Institute for Theoretical and Computational Sciences (NITheCS) Internship Programme. The NMU-NITheCS internship programme is a 4 weeks+ programme in topics spanning nuclear and particle physics, astrophysics and cosmology



# NITheCS Internship & Complexity Science Summer Study & Research Program

**From Research Experience for Undergraduates to Theoretical and Computational Sciences Summer Study Programme**

About 170 students between 2005 -2023



Summer study programme in Theoretical and Computational Sciences has been successful

To scale it up and make it beyond the borders of South Africa will require sustained funding

# NITheCS Internship Programme goes virtual ~30 interns online for 6 months

thuthukile khu...	Wandile's Nzuz	KMorebodi	James Hloniph...	
Sanele Scelo G...	Netshamutsh...	Remember Ay...	Shonisani	Nephembani R
		mercy molla	Ignituous Chau...	Dr Dawit Worku
	Pelonomi Thak...	Refiloe Maphoto		Alusani Munyai
	ngwadlax@gm...	odwa	Thendo Nema...	Nombuso
Pelonomi Thak...	Refiloe Maphoto		Alusani Munyai	
ngwadlax@gm...	odwa	Thendo Nema...	Nombuso	Vhangangwele ...
MASHABA		Netshikweta R		Tshianeo Prisc...
Prince majoz		Siyalo A		
	Molla Mercy		Ndingano Man...	

	tckhumalo		ZIDE MASHI LUME	GCOBANI MTW...
Pebetsi	Asakundwi	Rendani	Vhangangwele M...	
	Noko Monyebodi	Beatrice		Netshamutshedz...
Musawenkosi Kh...		tebogo ledwaba	mulalo marandela	Brian Ramogaya...
sumeera	fulufhelo mukosi	Chantel Mare	Khodani Mafune	

thuthukile khu...				
		Remember Ay...	Shonisani	Nephembani R
		mercy molla	Ignituous Chau...	Dr Dawit Worku
	Pelonomi Thak...	Refiloe Maphoto	Asenathi Qushu	Alusani Munyai
	ngwadlax@gm...	odwa	Thendo Nema...	Nombuso
thuthukile khumalo				
		Remember Ay...	Shonisani	Nephembani R
		mercy molla	Ignituous Chau...	Dr Dawit Worku
	Pelonomi Thak...	Refiloe Maphoto	Asenathi Qushu	Alusani Munyai
	ngwadlax@gm...	odwa	Thendo Nema...	Nombuso

# NMU-NITheCS Internship 2022

NELSON MANDELA UNIVERSITY NMU-NITheCS Internship 2022/2023 NITheCS

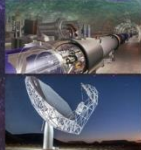
"Connecting Quarks with the Cosmos, Connecting people with the Universe"

Do you want to boldly go where no one has been before? Apply now for the NMU-NITheCS 2022/2023 Internship programme under the Quarks to Cosmos Africa programme at Mandela University. At the Q2C Africa programme we address Big Questions and Explore the Unknown.

The interdisciplinary and transdisciplinary subject and the theme of the NMU-NITheCS internship program brings together South African final year BSc, BSc(Honours), MSc, and PhD students from mathematics, physics, statistics, and computing to learn and to find solutions to interdisciplinary and transdisciplinary scientific questions. The objectives of multiple disciplinary approaches are to resolve real world or complex problems, to provide different perspectives on problems, to create comprehensive research questions and to provide comprehensive solutions to the problems.

## RESEARCH TOPICS:

- Theory and Phenomenology of Relativistic Heavy-Ion Collisions
- Relativistic Fluid Dynamics in Heavy-Ion Collisions and Particle & Nuclear Astrophysics
- Statistical and Thermal Physics in Heavy-Ion Collisions and Particle & Nuclear Astrophysics
- Relativistic Kinetic Theory in Heavy-Ion Collisions and Particle & Nuclear Astrophysics
- Theoretical and Computational Biophysics
- Compact Stars as Laboratories for Matter at Extremes and Fundamental Physics
- Theoretical and Computational Space Physics
- Physics of Core-Collapse Supernovae
- Physics and Evolution of the Early Universe
- The IYBSSD and IUPAP Centenary-100 Years of Physics in Africa (The Past, Present, and Future)



## ACTIVITIES:

- 28 November-23 December 2022: Interns will spend four weeks of interactive sessions at Nelson Mandela University.
- Mid-January-End-April 2023: The interns will continue the internship programme online. Each intern is expected to submit a final research report.
- June & July 2023: Interns will present their findings at conferences, webinars, and seminars under the banner of NMU-NITheCS 2022/2023 Internship programme.
- 28 November-09 December 2022: There will be a parallel event hosted by NMU, i.e. The African School of Fundamental Physics and Applications (ASP 2022).

The ASP 2022 program can be found here <https://www.africanschoolofphysics.org/asp2022/> where you will also find the poster outlining the scientific topics here <https://www.africanschoolofphysics.org/wp-content/uploads/2022/05/ASP2022-Poster.png>

## FACILITATING TEAM:

- A. Guga (UCT)
- T. C. Khumalo (WITS)
- T. M. Ledwaba (UL)
- V. Makumbane (IFS)
- D. Matheba (UNISA)
- M. M. Moila (UL)
- S. H. Mithembu (UWC)
- T. E. Nemaikhavhani (UJ)
- R. Netshikweta (UNIVEN)
- M. Paradza (CPUT)
- M. M. Seabi (UWC)
- D. Worku (CPUT)



Applicants must be university students; final year BSc, BSc(Honours), MSc and first year PhD, with majors in Mathematics, Physics, Statistics, or Computing. To Apply for the NMU-NITheCS Internship Program: Please visit the NITheCS websites (<https://nithecs.ac.za/>) OR email Mrs René Kotzé at [rene.kotze@nithecs.ac.za](mailto:rene.kotze@nithecs.ac.za) for more info Closing date 10 August 2022



NELSON MANDELA UNIVERSITY

The 7th Biennial African School of Fundamental Physics and Applications

28 November - 9 December 2022



## Scientific Program

### Topics

- Space Physics, Astrophysics & Cosmology
- Nuclear and Particle Physics
- Medical and Radiation Physics
- Biophysics
- Physics Education, Outreach, & Communication
- Diversity Equity & Inclusion in Physics
- Condensed and Material Physics
- Photonics
- Applied and Industrial Physics
- Theoretical and Computational Physics
- Physics for Sustainable Development
- 100 Years of Physics in Africa and the Future



100 years of Physics in Africa Past, Present, And Future

### Activities

- Workshops for High School Teachers
- Outreach for Secondary Schools
- Physics Lectures and Tutorials for Students
- Forums to Discuss Capacity Development & Retention

Gqeberha (Formerly Port Elizabeth)



NELSON MANDELA UNIVERSITY

# The largest cohort of interns after Cov-19

A national interdisciplinary summer study and research program at Mandela University





# NITheCS Summer Study & Research Programme and 2nd SA-JINR Workshop on Theory and Computation



We welcome partners who can come and engage our students during the summer study and research program

# Capacity building in Africa

- The African School of Fundamental Physics and Applications (ASP)
- The African Conference on Fundamental Physics and Applications (ACP)
- The African Strategy on Fundamental & Applied Physics (ASFAP)
- Towards the Southern African Physical Society



# The African School of Fundamental Physics and Applications a.k.a. NEEL African School of Fundamental Physics



UNIVERSITY (ASP)

## Assessment of impact

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

Dr. Kétévi A. Assamagan  
on behalf of the ASP-IOC , IAC and LOC

[ketevi@bnl.gov](mailto:ketevi@bnl.gov)

Physicist at  
Brookhaven National Laboratory (USA)





# African School of Fundamental Physics and Applications

- Also known as “The African School of Physics”
- Acronym: ASP; Logo: as above
- <https://www.africanschoolofphysics.org>
- Organized biennially in different African countries since 2010 by an International Organizing Committee (IOC), [ASP-IOC@CERN.CH](mailto:ASP-IOC@CERN.CH)

From Ketevi’s talk at NRF

ASP	Host Country	Applicants	Students	Mentorship	Teachers	Pupils	Conference
2010	South Africa	125	65	Continuously, even when there is no formal school			
2012	Ghana	138	50				
2014	Senegal	330	70				
2016	Rwanda	429	75	Program formalized in 2016. Runs continuously	20	150	
2018	Namibia	523	85		63	> 1200	+60
2020	Morocco						
2021	Online	N/A	94				

# Physics for Africa

## ASP- Biennial African School of Fundamental Physics and Applications

- *Astrophysics and Cosmology;*
- *Nuclear and Particle Physics;*
- *Accelerator, Medical and Radiation Physics;*
- *High Performance Computing;*
- *Physics Education;*
- *Physics Communication;*
- *Renewable Energies and Energy Efficiency;*
- *Material Physics.*

THE FIFTH BIENNIAL

### AFRICAN SCHOOL OF FUNDAMENTAL PHYSICS AND APPLICATIONS

University of Namibia, and  
Namibia University of Science and Technology  
Windhoek, Namibia  
June 24 - July 14, 2018

**APPLICATION** [asp2018-registration@cern.ch](mailto:asp2018-registration@cern.ch)

**DEADLINE** Open for application from November 1, 2017 to January 31, 2018. Bursaries & full support for selected students. Provide a CV, transcripts, letter of motivation & one recommendation letter with your online application.

**CONTACT** [ASP-IOC@CERN.CH](mailto:ASP-IOC@CERN.CH)

**WEBSITE** [www.africanschoolofphysics.org](http://www.africanschoolofphysics.org)

**The Scientific Program Includes:**

- Workshop for High School Teachers  
<https://www.africanschoolofphysics.org/teachers/>
- Outreach for Secondary Schools  
<https://www.africanschoolofphysics.org/teachers-program/>
- Physics Lectures and Tutorials for Students  
<https://www.africanschoolofphysics.org/asp2018/>
- Forum to Discuss Capacity Development & Retention  
<https://www.africanschoolofphysics.org/forum/>
- African Conference on Fundamental Physics & Applications  
<https://www.africanschoolofphysics.org/acp2018/>



# ASP workshop for high school teachers

- **Formalized and started in 2016**
  - during ASP2016 in Rwanda
- **In ASP2016**
  - 2016, 20 teachers for 2-day workshop
- **In ASP2018, 70 teachers from 14 regions of Namibia**
- **Teachers selected by the Ministry of Education of host country**



**Windhoek, Namibia, July, 2018 ASP2018  
Dr. Milind Diwan with high school teachers**

# ASP Outreach Program for learners

- **Formalized and started in 2016**
  - during ASP2016 in Rwanda
- **In ASP2018, we covered**
  - 39 high school around Windhoek
  - About 2000 learners
  - In one week
- **High schools selected by LOC, Ministry of Education of host country; pupils selected by the high schools**



**Windhoek, Namibia, July, 2018 ASP2018  
Dr. Kenneth Cecire with learners**

# ASP Structured Mentorship Program

- **Informal networking between ASP alumni and lecturers**
  - Always present and encouraged
- **Structure mentorship formalized and integrated in 2016**
  - Open to ASP alumni at PhD level
  - Runs on 2-year cycle
  - Pair alumni with ASP lecturers
  - Work with alumni academic advisors
    - **Does not replace them**
  - Light, information engagements
    - **Between mentor / mentee**
    - **For extra assistance / support if needed**



ASP alumni of 2018, some of whom has benefitted from the ASP Mentorship Program



# The African Conference on Fundamental and Applied Physics (ACP)

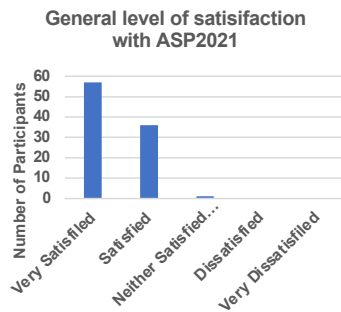
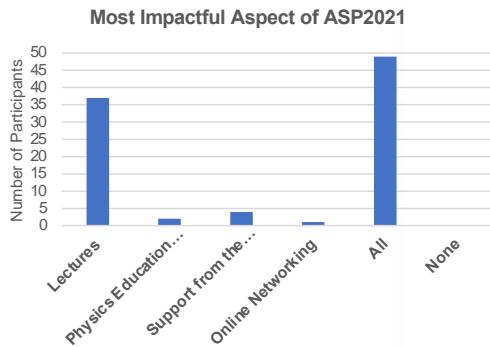
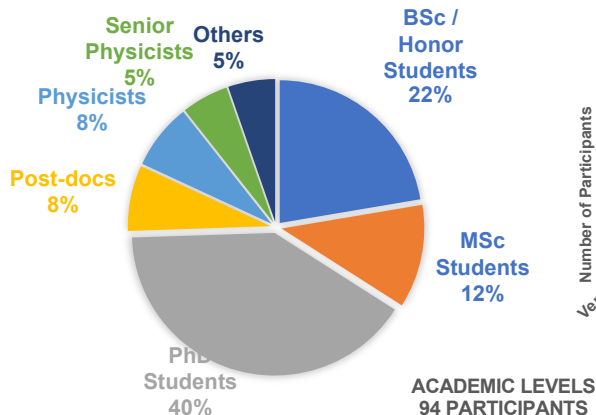
- One week, integrated in ASP since 2018
- The first ACP took place in Namibia in July 2018
- Formalized to promote
  - Participation of African research faculties
  - Encourage participation of African students not selected for ASP due to budget constraints
  - International conference open to anyone



**Prof. Lerothodi Leeuw at ACP2018**

# ASP2021, July 19-30, 2021; online school

- **ASP2020-Morocco**
  - Cancelled because of COVID-19
  - A 2-week online version organized as ASP2021



## THE SIXTH BIENNIAL

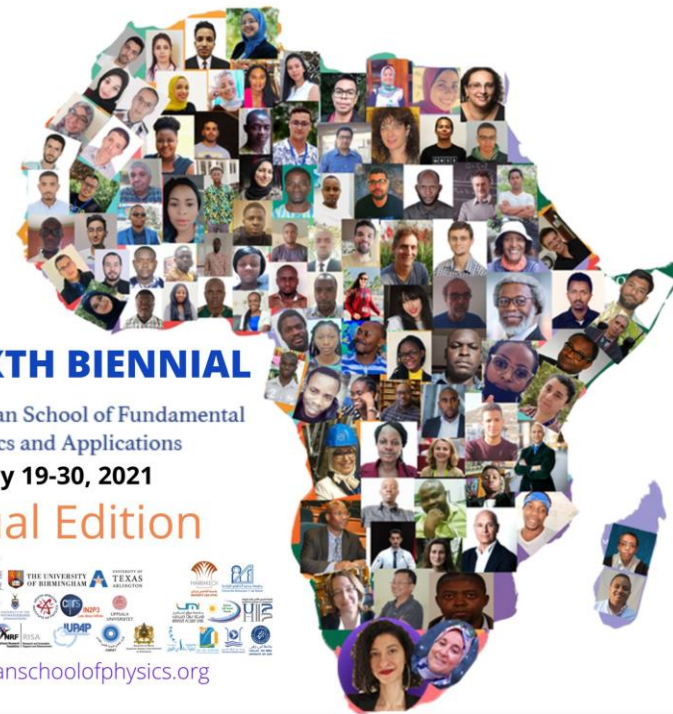


African School of Fundamental  
Physics and Applications  
July 19-30, 2021

Virtual Edition



[www.africanschoolofphysics.org](http://www.africanschoolofphysics.org)



# BNL supports ASP2022



Newsroom Media & Communications Office

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## African School of Physics Brings New Opportunities

Brookhaven Lab supports the 7th African School of Physics, to be held in Gqeberha, South Africa, this fall

September 19, 2022

By Ian Guan and Karen McNulty Walsh



Thank you BNL for supporting the ASP2022 hosted by Nelson Mandela University.

<https://www.bnl.gov/newsroom/news.php?a=220799>

# 2022 was a very busy year in Gqeberha



**NELSON MANDELA**  
UNIVERSITY

The 7th Biennial African School of  
Fundamental Physics and Applications

28 November - 9 December 2022



**Scientific Program**

**Topics**

- Space Physics, Astrophysics & Cosmology
- Nuclear and Particle Physics
- Medical and Radiation Physics
- Biophysics
- Physics Education, Outreach, & Communication
- Diversity Equity & Inclusion in Physics
- Condensed and Material Physics
- Photonics
- Applied and Industrial Physics
- Theoretical and Computational Physics
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- 100 Years of Physics in Africa and the Future

**Activities**

- Workshops for High School Teachers
- Outreach for Secondary Schools
- Physics Lectures and Tutorials for Students
- Forums to Discuss Capacity Development & Retention

100 years of Physics in Africa Past, Present, And Future

Gqeberha (Formerly Port Elizabeth)



## International Organising Committee (IOC)

- B. Acharya (ICTP and King's College London)
- K. Assamagan (BNL)
- A. Dabrowski (CERN)
- C. Darve (ESS)
- J. Ellis (King's College London)
- F. Ferroni (GSSI-INFN)
- S. Muanza (CNRS-IN2P3)

## Regional Organising Committee

- S. Connell (University of Johannesburg)
- M. Diale (University of Pretoria)
- E. Maluta (University of Venda)
- B. Mellado (University of the Witwatersrand) (iThemba LABS)
- I. Gledhill (University of the Witwatersrand)
- E. Kasai (University of Namibia)
- RE. Simon (University of Botswana)
- JM. Tshitenge (University of Kinshasa)
- TD. Bucher (Cape Peninsula University of Technology)
- Z. Katamzi - Joseph (South African National Space Agency)
- JB. Habarulema (South African National Space Agency)
- R. Maphanga (Council for Scientific and Industrial Research)
- S. Mullins (Botswana International University of Science and Technology)

## Local Organising Committee (LOC)

- V. Bongela (Nelson Mandela University)
- N. Hashe (Nelson Mandela University)
- A. Muronga (Nelson Mandela University)
- R. Mosia (Nelson Mandela University)
- S. Ngesi (Nelson Mandela University)
- A. Tabalaza (Nelson Mandela University)
- S. Thwala (Nelson Mandela University)
- T. Trantaal (Nelson Mandela University)
- EE. van Dyk (Nelson Mandela University)
- A. Venter (Nelson Mandela University)
- B. Masara (South African Institute of Physics)
- N. Mahani (South African Institute of Physics)



**NELSON MANDELA**  
UNIVERSITY



**100 years of Physics in Africa**  
Past, Present and Future

**Gqeberha**  
formerly Port Elizabeth

**Date:**  
4-8 July 2022

**ANNUAL CONFERENCE OF THE SOUTH AFRICAN INSTITUTE OF PHYSICS (SAIP 2022)**  
Virtual Conference

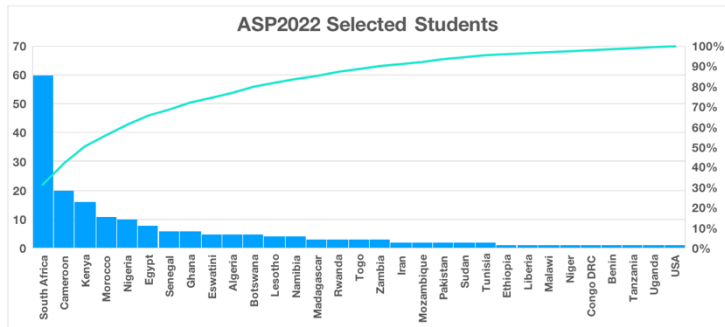


Figure 7: Distribution of selected students for ASP2022 as a function of country of citizenship.

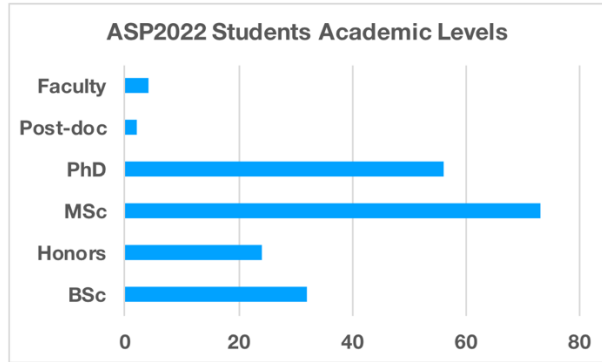


Figure 8: Academic levels of the selected students at ASP2022.



Figure 1: Interactions between students and lecturers during ASP2022.

- 416 students applied from 41 countries
- 191 students selected
- Of 191, F:M ratio was 9:10

<https://arxiv.org/abs/2302.13940>



Figure 3: Engagement with high school pupils during ASP2022.

ASP2022 was a full program of activities



Figure 2: High school teachers during ASP2022.



Figure 4: ASP forum for discussion with policymakers on capacity development and retention in Africa.

# Ketevi and Mounia summarize ACP2023 hosted by Mandela University in George, South Africa

## Acknowledgements — organizers and participants



September 28

Some of the women physicists at ACP2023



September 27

The application of physics in weather and climate sciences



The in-person attendance is 1 : 2. Participants.

IDIA Science Gateway  
For Radio Astronomy



# September 28

- Togo will host ACP2025 at the University of Lome, September / October 2025

We hope to see you in Togo next year!

Please continue to support ASP and ACP.



- A Local Organizing Committee is already formed; more discussions with the ASP IOC forthcoming

*The exact date will be communicated later*





# The Future of Physics in Africa

# African Strategy for Fundamental Physics & Applications (ASFAP)



- ASFAP is an opportunity for African physicists (including particle physicists) to come together, identify and document a scientific vision for the future of physics (including particle physics) in Africa.
- The particle physics community will define the particle physics' direction for the next decade: identify and prioritize the actions/activities in the coming years.
- This initiative will refine Africa's needs and capacities in particle physics in order to present them as Letters of Interest (LoI).
- Subsequent sessions are planned to emerge with a collective strategy of physics (including particle physics).

## Towards the Southern African Physical Society (c.k.a SAPHysNet)

- The Southern African region should be united by physics
- A network of physicists and physics establishments in the region will be beneficial to all
- There is a recently established Western Africa Physical Society
- Talks of establishing North Africa Physical Society are under way
- Strong regional physics establishments will strengthen the physics in the African continent
- Please support and participate in the growing movement
- At SAIP 2024 in Makhanda, there was a session dedicated to strengthening physics in the Southern Africa region within the SADC economic block.

Lessons from other regions across the

# Lessons from other regions

- US has Snowmass for HEP community, Long Range Plan for Nuclear Physics, ....
- Europe has European Strategy for Particle Physics, European Strategy for Nuclear Science in Europe, Astronet - a Strategic Plan for European Astronomy, European Astroparticle Physics Strategy, ...
- Latin America has their first Strategy Plan for High Energy, Cosmology and Astroparticle Physics (HECAP) was concluded in 2020
- Asia was moving towards an Asian Strategy for Particle Physics?
- Africa has started its Strategy on Physics.

# Lessons from Snowmass 2021

- These Snowmass contributed papers are of particular interest in today's talk
- I strongly recommend anyone interested in the topics of Diversity & Inclusion, Public Engagement and Public Education, and Physics Education, to study these white papers and their recommendations.
- 
- Why should the U.S. care about high energy physics in Africa and Latin America? [arXiv:2203.10060](https://arxiv.org/abs/2203.10060)
- The Necessity of International Particle Physics Opportunities for American Education [arXiv:2203.09336](https://arxiv.org/abs/2203.09336)
- 
- The need for structural changes to create impactful public engagement in US particle physics [arXiv:2203.08916](https://arxiv.org/abs/2203.08916)
- 
- Building a Culture of Equitable Access and Success for Marginalized Members in Today's Particle Physics Community
- [arXiv:2206.01849](https://arxiv.org/abs/2206.01849)

Cultural and structural change at all levels within the physics community and its stakeholders is necessary for a strong physics in Africa. Let us start at home!

# 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”.

“Education is the most powerful weapon which you can use to change the world”

— Nelson Mandela

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- 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 Azwinnindini Muronga**

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