

A look into the Physics education system in Zambia and Africa as a whole

Chilufya Mwewa¹, Benard Mulilo²

¹Brookhaven National Laboratory, ²University of Zambia

29 September 2023

3rd African Conference on Fundamental and Applied Physics



UNIVERSITY OF ZAMBIA

Outline

- ❖ Public education in Zambia and my personal experience with it
- ❖ Current status of physics education in Zambia
- ❖ Common physics education challenges faced by African countries
- ❖ Opportunities emerging for physics education on the continent
- ❖ What can we do to further improve physics education on the continent?

A brief introduction to Zambia



- ❖ Beautiful land-locked country in southern Africa with key natural resources ranging from copper and other minerals to a diverse family of wildlife
- ❖ Population is approximately 20 million and it's growing



Public education in Zambia

- Public education is a great challenge
 - Not enough public schools to meet the demands of the growing population
 - Average student to teacher ratio is ~42:1 in primary and secondary schools
 - Makes hands-on work difficult especially with limited equipment
 - It's difficult to get many students interested in subjects like physics
- Poverty levels are also quite high (> 50% of population living on ~2 US dollars per day)
 - Naturally, students look for careers that they think would get them a job
 - African culture expects us to support family members once we get an education



Career choices in Zambia

- In science, medicine and engineering are the common choices
- Careers in physics rarely come up even in high school career guidance sessions
 - Physics outreach is almost non-existent
 - Little access to the internet makes it difficult to learn about physics in other parts of the world



- There are only about 9 public universities country-wide
 - The University of Zambia (UNZA) is the largest and oldest - opened in 1966
 - ~ 800 students admitted into natural sciences when I was a student
 - Mostly competing for places in medicine or engineering

Studying for a physics degree at UNZA



- Failure to enter medical school led me to physics
 - Had no idea what I was going to do with this degree
 - Studying physics was not super interesting
 - Laboratory equipment was not very functional
 - Made it difficult to appreciate the beauty and importance of the subject
 - No opportunity to learn about research activities within the department
 - Research was likely non-existent due to lack of funding and huge teaching load for faculty
 - Postgraduate programs were only introduced recently
-
- Did not hear about research facilities like CERN until I went to the ASP2010 in my final year of undergrad

ASP 2010 – Stellenbosch, South Africa



- Learned about particle physics and CERN for the first time
- Learned about opportunities for postgraduate studies at institutes like the African Institute for Mathematical Sciences (AIMS)

My career path

Bachelor's degree in Physics – University of Zambia (2011)



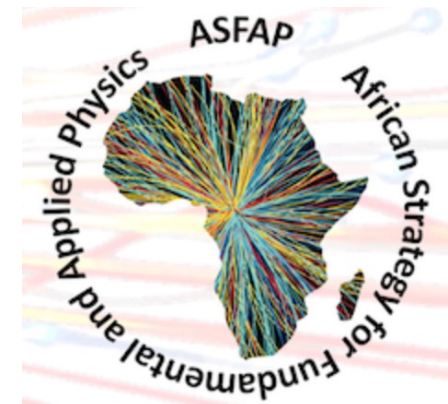
Postgraduate diploma – AIMS (2012)



- MSc. Experimental particle physics – University of Cape Town (2014)
- PhD Experimental particle physics – University of Cape Town (2020)
- Postdoc – University of Cape Town (July 2020 – October 2020)
- Postdoc at Brookhaven National Laboratory (November 2020 to date)

Current status of physics education at UNZA

- Direct admission of students into the physics degree program was recently introduced
 - Enrolling around 10 students per year
- Now offering postgraduate studies in a few research areas; medical physics, radiation protection, nuclear engineering, renewable energy, theoretical physics....
- Renewable energy is particularly attracting a good amount of research funds
- There's been a lot of effort towards collaboration with research institutes within Africa and internationally
 - Phenix experiment at Brookhaven National laboratory (BNL)
 - Square Kilometer Array (SKA)
 - Strong interest in the Electron Ion Collider experiment which is planned for construction at BNL
- Participation in the African Strategy for Fundamental and Applied Physics



Outreach efforts: Particle physics masterclass

- High school students are invited to a university or national research facility for hands-on work in particle physics analysis
- Scientists give insight into fundamental physics and introduce students to the institute's research program
- Students join other students around the world to discuss their results, moderated by scientists from world-renowned research facilities like CERN



- Held our first masterclass in March 2023
- Very successful and fulfilling event
- Plan to have at least one every year



>>>>There has been a lot of progress in the recent years. However, like many African countries, Zambia still faces many challenges in the advancement of physics education

Challenges of physics education in Africa

- Generally, we're not proactive about physics outreach
 - Very little or no engagement between universities and high schools
 - Students lack mentorship
 - Physics is not the first choice for the majority of students
- Lack of national research facilities and industries that value the contribution of physicists
 - Jobs are usually limited to high-school teaching but this is not very attractive due to low income
 - Students that pursue careers in physics tend to leave the continent or switch to other fields (e.g banking)
- Universities are generally not interested in retaining people that can push research forward
- Lack of research funds makes it difficult to even travel to other research centers on the continent and abroad
 - Visa restrictions also contributes to lack on inter-regional collaboration on the continent
 - Virtual collaboration may be limited by load-shedding and poor internet connectivity
- ❖ Results in poor participation in large collaborations around the world

ATLAS collaboration at CERN

Status: August 2023



- | | |
|----------------|--------------|
| Argentina | Netherlands |
| Armenia | Norway |
| Australia | Palestine |
| Austria | Philippines |
| Azerbaijan | Poland |
| Belarus | Portugal |
| Brazil | Romania |
| Canada | Russia |
| Chile | Serbia |
| China | Slovakia |
| Colombia | Slovenia |
| Czech Republic | South Africa |
| Denmark | Spain |
| France | Sweden |
| Georgia | Switzerland |
| Germany | Taiwan |
| Greece | Türkiye |
| Israel | UAE |
| Italy | UK |
| Japan | USA |
| Mongolia | CERN |
| Morocco | JINR |

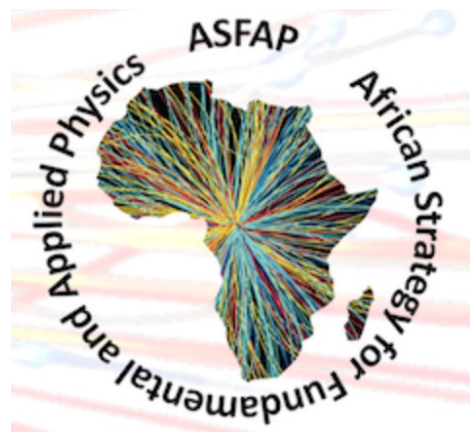
ATLAS Collaboration

182 institutions (250 institutes) from 42 countries



The future looks bright.....

- Many infrastructures coming up which will potentially attract collaboration within the continent and internationally
 - Possibility to retain African researchers through these infrastructures
- An African strategy for the future of fundamental and applied physics has been initiated
 - Increase African education and research capabilities and improve collaborations
 - Set the foundation and framework to draw the participation of African physicists in
 - defining education and physics priorities most impactful for Africa
- Many centers and schools for capacity building are emerging (ASP, AIMS....)



What more can we do??

- ❖ We should become more proactive about physics outreach in Africa
- ❖ Establish and strengthen national physics bodies
- ❖ Actively participate in initiatives that call for the advancement of physics education in Africa
- ❖ The beauty of physics is in giving back ~ Dr Ketevi Assamagan
 - ❖ Giving back our time to provide mentorship, reaching out to African students....
 - ❖ Giving back our resources. A little always goes a long way
 - ❖ I hope we can all go back and be a good Samaritan to someone in the simplest way we can

Thank you