



African Strategy for Fundamental and Applied Physics



ASFAP MEETING: TOWARDS THE FINAL REPORT

Zewail City of Science, Cairo, Egypt

Stephane Kenmoe and Obinna Abah

Tuesday, December 17th 2024

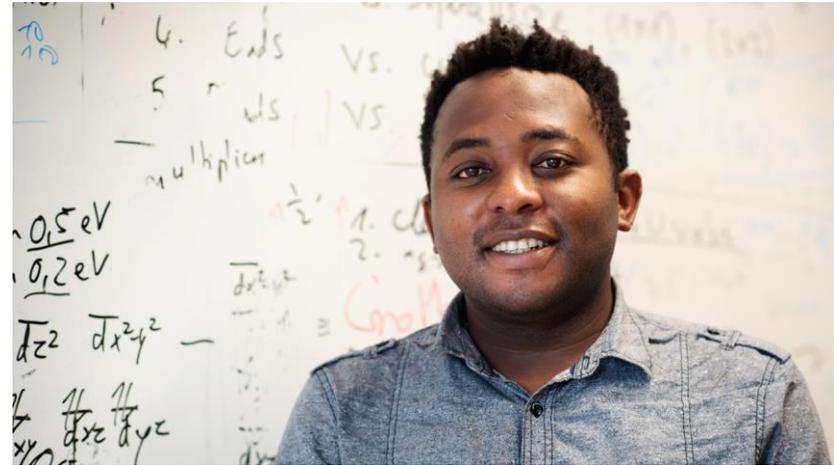
ATOMIC AND MOLECULAR PHYSICS WG



Obinna Abah, Nigeria
Theoretical Physics
Newcastle University
England



Quantum thermodynamics and
quantum control for technologies

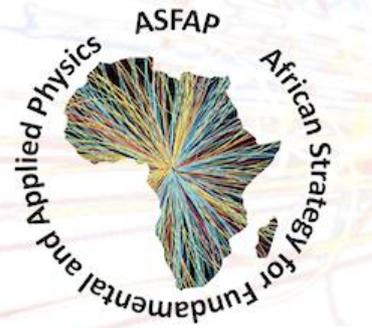


Stephane Kenmoe, Cameroon
Computational Physical chemistry
University of Duisburg-Essen,
Essen, Germany



Energy and fuels production
from molecules decomposition

1. Rationale



Interacting matter in the eV range

Atomic physics

Chemically bound



Molecular physics



Quantum mechanics
Quantum electrodynamics

Electronic structure

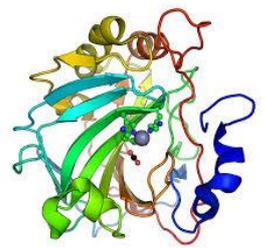
Quantum physics and chemistry
Dynamics, Spectroscopy



Biology, Medecine, Electronics, spintronics, heterogeneous catalysis...



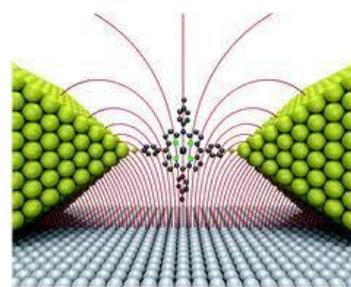
Agriculture



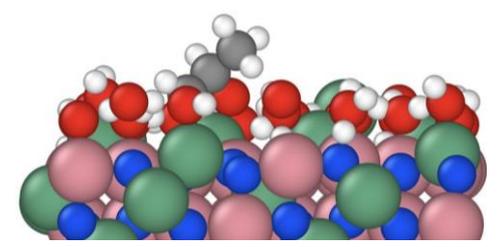
Drug design
Biology & medicine



Electronic devices

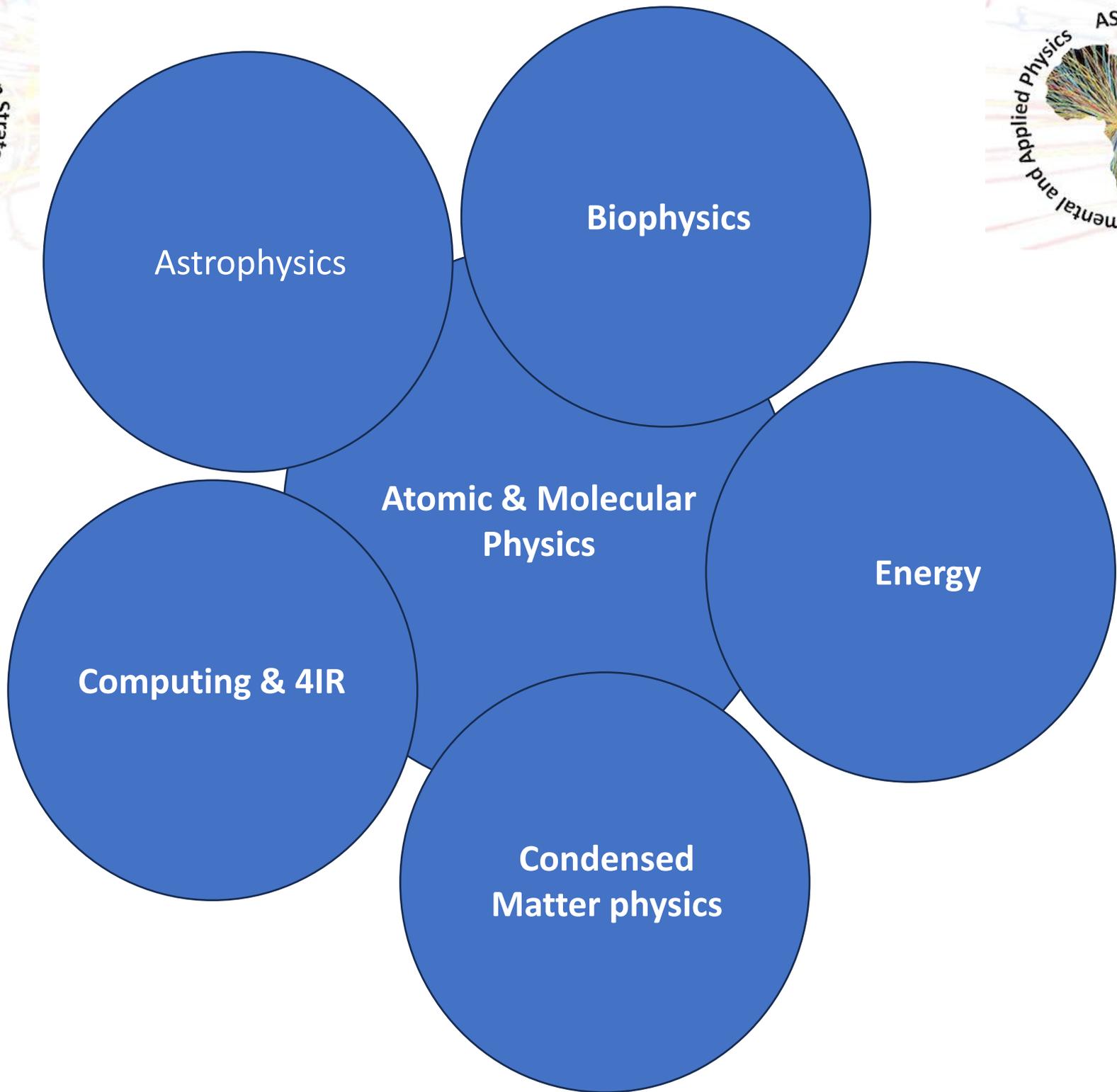


Single molecule
transistor



Chemicals production, Energy,
Atmospheric, astrophysics

2. Working circumference



Astrophysics

Biophysics

Atomic & Molecular
Physics

Energy

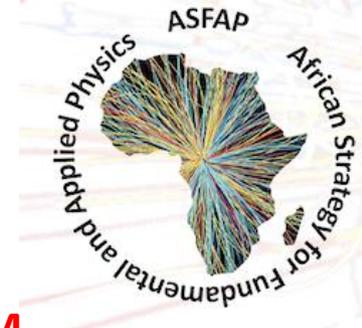
Computing & 4IR

Condensed
Matter physics

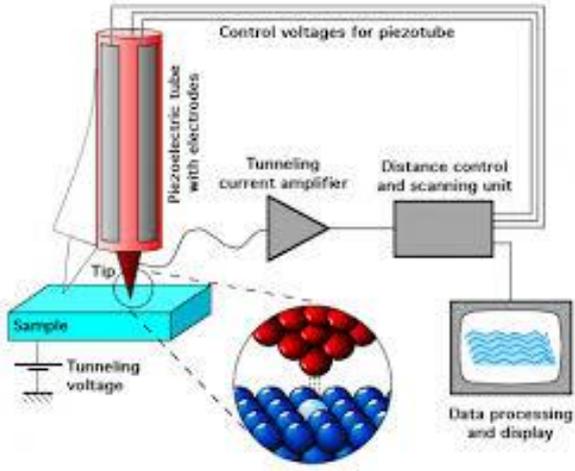
3. Education & Research landscape

3.1 The challenge of experimental physics

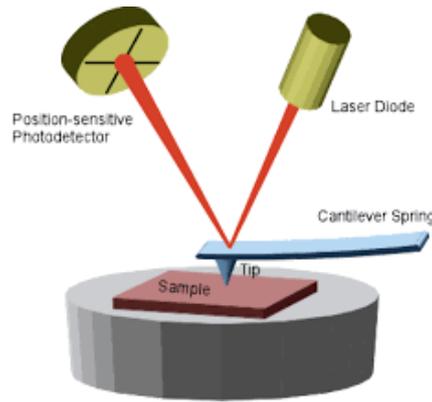
Probing matter at the atomic scale



More SPM are needed in Africa: STM, AFM,...



Scanning Tunneling Microscope (STM)

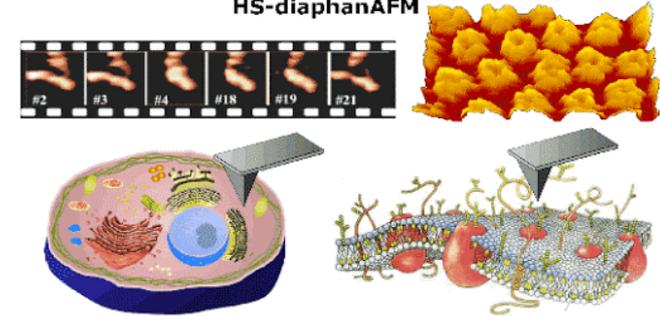


Atomic Force Microscope (AFM)

High-end HS-AFM

HS-diaphanAFM

HS-ncAFM



Structure of living cells from AFM



When Women Build Bridges

Stéphane Kenmoe

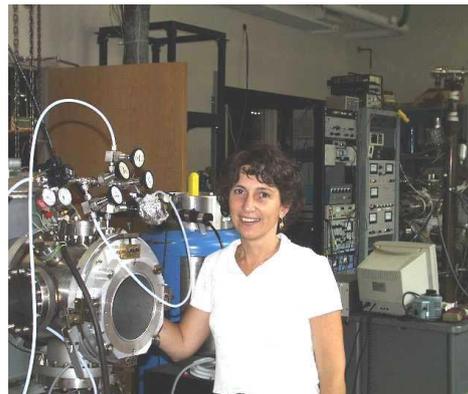
In the last issue of the African Physics Newsletter, Dr. Maryse Nkoua of the Nanomaterials and Nanotechnology Research Unit at the Marien Nguabi University described the struggle to complete the establishment of a laboratory at the university and the National Institute for Research in Exact and Natural Sciences located in Brazzaville, Republic of Congo. Following this article, which was relayed by the online news site Africotech [1], two important personalities reacted positively.



Figure 1: Dr. Maryse Nkoua
© International Center for Theoretical Physics (ICTP)



Figure 2: Dr. Raissa Motta
© Next Einstein Forum



Loredana Casalis,
Elletra, Trieste Italy



Maryse Nkoua setting an
experiment with AFM

***The Atomic Molecular Spectroscopy and Applications Laboratory of the
University of Tunis-El Manar: the pride of Tunisia***

***Fluorescence Spectroscopy to study the impact of environmental
conditions on herbal drug integrity in Cape Coast Ghana***

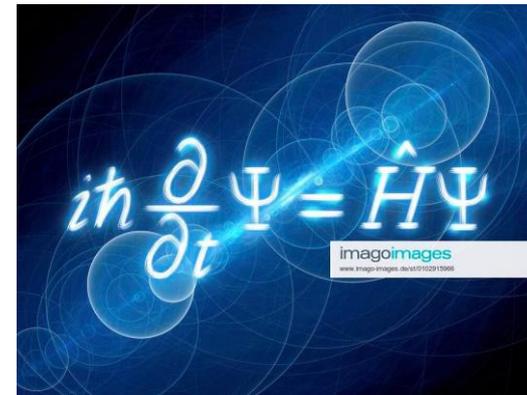
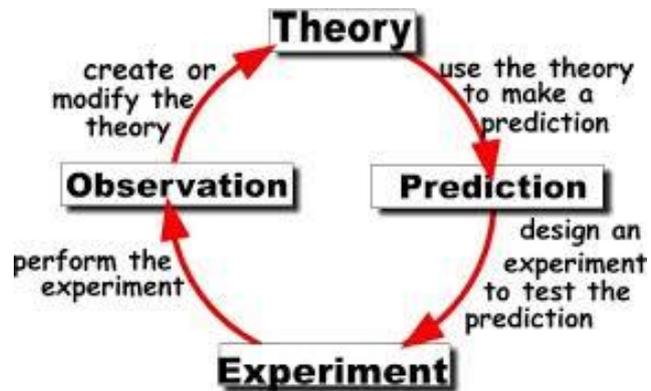
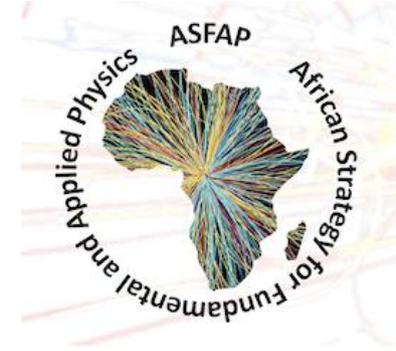
The Africa Microscopy Initiative in Cape Town South Africa

Challenge for low-cost experimental physics in Cameroon

***A burst of pride in the Republic of Congo: the laboratory for nanomaterials
and nanotechnologies***

3.2 Commendable efforts at the theoretical level

THEORY: WHICH SCHRODINGER EQUATION FOR AFRICA ?



High performance computing

Resources

ICTP, South Africa, Egypt,
Morocco
Tunisia, Algeria
Ivory Coast, Rwanda?

Cameroon & Congo take the lead in sub-Saharan Africa

Brazzaville

THE **AFRICAN PHYSICS** NEWSLETTER

Bernard M'Passi Mabilia: The Image of Capacity Building and Regional Integration in Central Africa

A profile on the physicist who impules electronic structure methods and applications in Congo and in Central Africa.

AUTHOR & CONTRIBUTING EDITOR
Stephane Kenmoe

Nigeria, Ghana & Kenya on the track (Abeokuta, Nairobi)

Douala

FEATURES

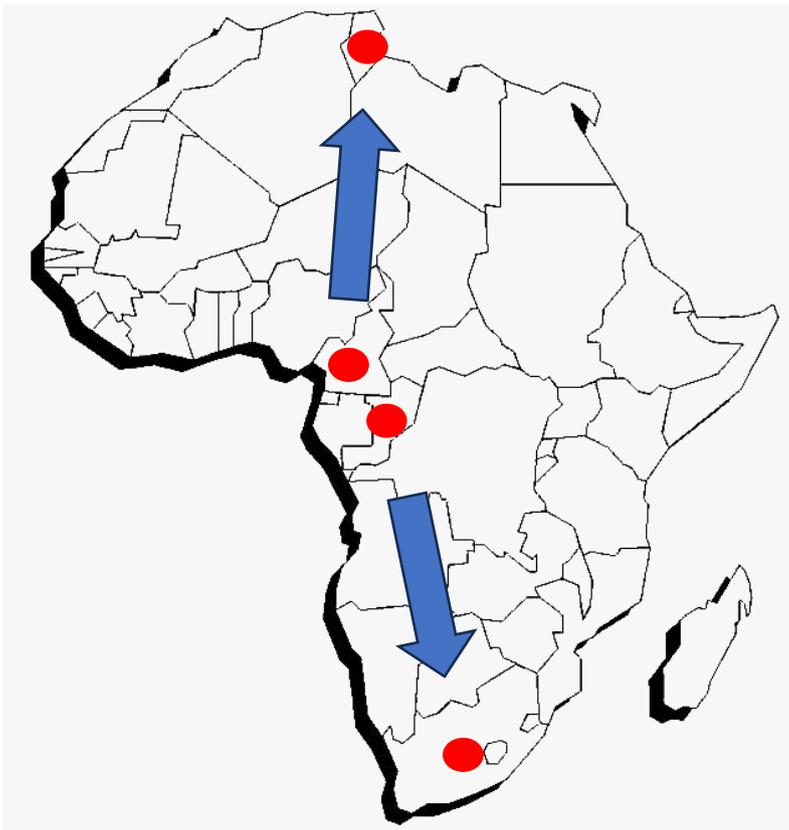
Nuclear, atomic and molecular physics and sustainable development: an issue within CEPAMOQ

*M.G. Kwato Njock,
Centre for Atomic Molecular Physics and Quantum Optics,
Faculty of Science, University of Douala, Douala, Cameroon*

Buea

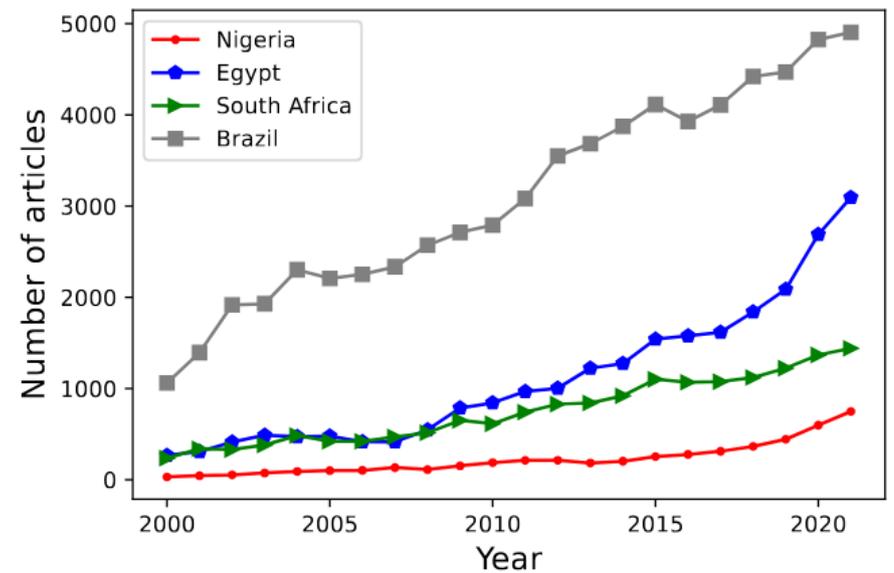


3.3 Intra-continental synergies

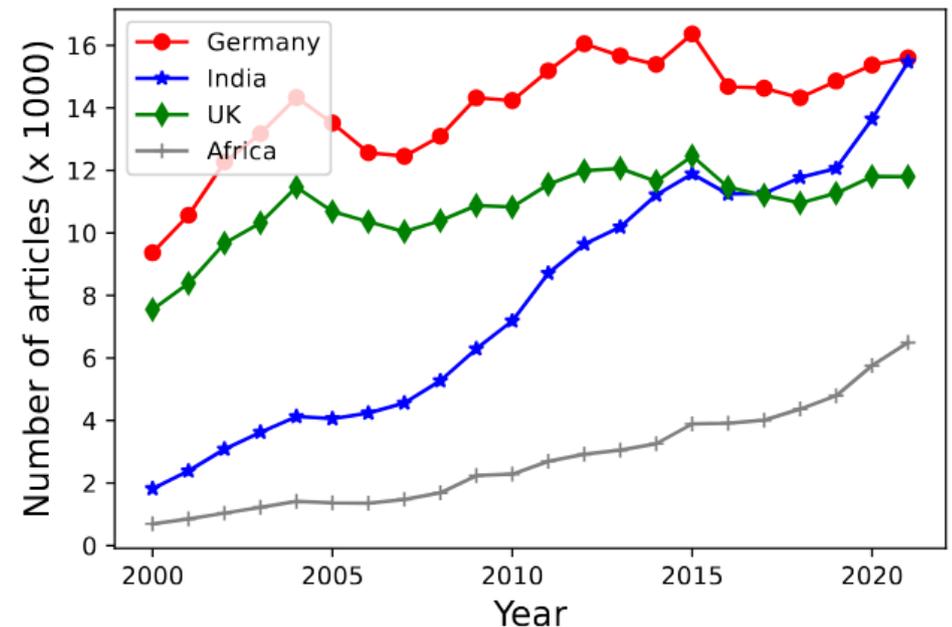


Meridional flow

Total articles published by African scientists (Algeria, Cameroon, Congo, Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria, South Africa, Tunisia) compared western countries (Germany and UK) and India.



Number of articles published by some African countries (Egypt, Nigeria, South Africa) compared to Brazil



Source: Scopus – accessed October 8, 2022

3.4 Capacity building:

regional and continental initiatives

The ASESMA and ASESMANET initiatives

Credit: Nicola Seriani



ASESMA 2023

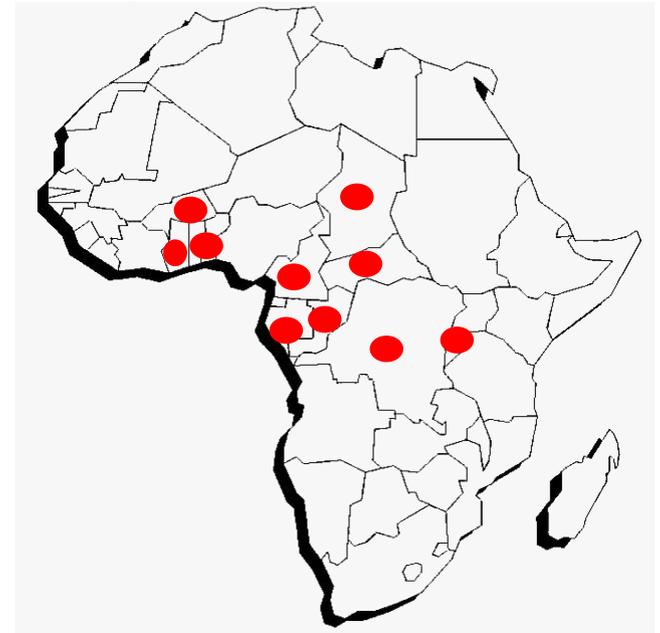
Map of tutors and participants



Map participants

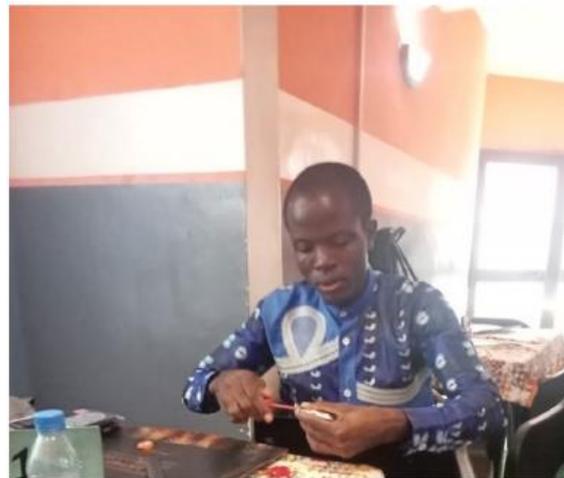


The pivotal role of CEPAMOQ



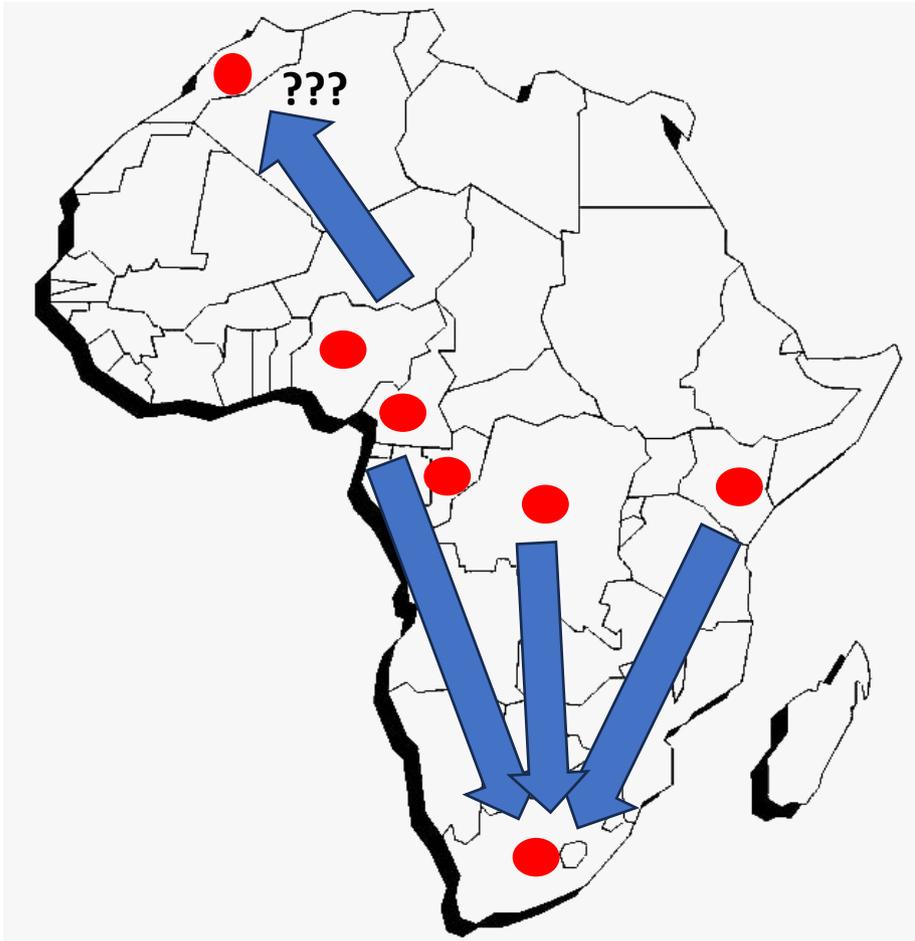
The CASESMA initiative as a remarkable multiplier

A screw-driver to solve the Schoedinger equation !!!

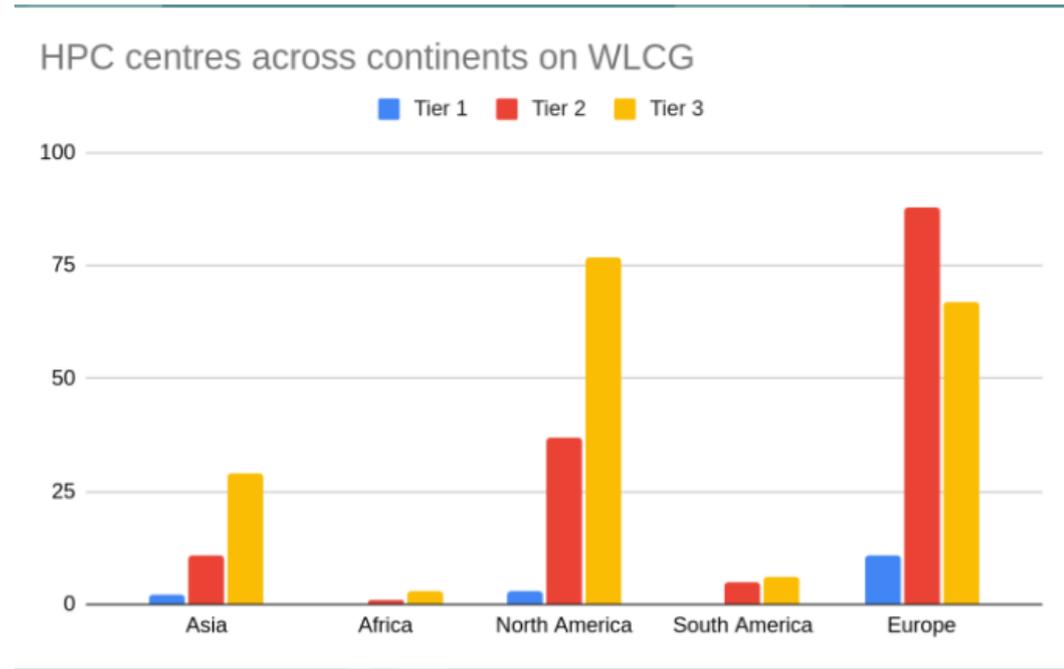


3.5 Supercomputers and High-performance computing in sub-Saharan Africa: an imperative need

Where do we run calculations?



Credit: B.J. Odetayo, CERN



Centre for High Performance Computing (CHPC),
in Cape Town, South Africa: **Lengau Cluster**.

University Mohammed VI Polytechnic (UM6P)
Morocco: **Toubkal supercomputer**.

4. Call for action: recommendations

1. More regional centers like CEPAMOQ or the UB-CeDD as well as more frequent capacity building initiatives like CASESMA in other regions are needed.
2. Replicate the Tunisian AMOP laboratory and implement its model of collaboration throughout the continent.
3. Experimental facilities: STM, AFM, FTIR, spectrometers and other probes.
Capacity building for instrument usage.
4. Supercomputers & HPC centers: high peak density in South Africa.
Each region should have at least one computing infrastructure.

5. Promote complementary research particularly in sub-Saharan Africa to rationalize experimental research

6. Establish Collaborative Research Centers (CRC) e.g. via transregional research projects between theoretical centers in Cameroon and experimental groups in Ghana.

7. Align research to local needs: earth abundant hard and soft matter: heterogeneous catalytic supports, plants, dyes and others chemical compounds relevant for health, pharmaceutical chemistry, agriculture or energy.

8. Promote locally funded research via tax incentives: this will allow making good use of the young scientists trained during regional and continental events and limit the brain drain.



THANK YOU