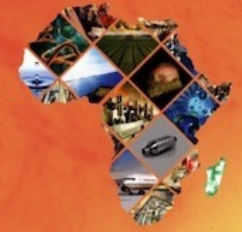




The African Light Source Foundation

Towards a Lightsource for the African Continent



AfLS Website <https://www.africanlightsource.org>

JSR Journal of Synchrotron Radiation

The African Light Source: history, context and future
JSR, 31(2024) 1-9
<https://doi.org/10.1107/S1600577523009682>

World Scientific www.worldscientific.com Modern Physics Letters A
Vol. 33, No. 9 (2018) 1830003 (19 pages)

Synchrotron light sources in developing countries
Sekazi K. Mtingwa Herman Winick*

<https://www.worldscientific.com/doi/abs/10.1142/S0217732318300033>

Institute of Physics **IOP** Institute of Physics
Learned society

Recent progress towards an African light source
Debating the Societal Impact of Big Science in the 21st Century
<https://iopscience.iop.org/book/edit/978-0-7503-3631-4/chapter/bk978-0-7503-3631-4ch54>

SCIENCE AND PUBLIC POLICY

2023-06-14 Science and Public Policy 00 (2023) 1-12
[“Science diplomacy from the Global South: the case of intergovernmental science organizations”](#)

*** Research Professional News**
African Light Source aims for science with ubuntu

By Katharina Cramer et al. Share

<https://www.researchprofessionalnews.com/rr-news-europe-views-of-europe-2022-5-african-light-source-aims-for-science-with-ubuntu/>

The African Review of Physics
formerly published as The African Physical Review

The African Review of Physics (2018) **13**: 0019
Proceedings of the first African Conference on Fundamental Physics and Applications 2018, Namibia.
Guest Editors: K. A. Assamagan, M. Backes, D. Charlton, S. Muanza, D. Sahu, and D. Singh

<http://lamp.ictp.it/index.php/aphysrev/article/view/1610/586> The African Light Source Project

nature reviews physics

Explore content About the journal Publish with us

<https://iop.wp.com/www.africanlightsource.org/wp-content/uploads/2022/12/Nature-Review-Physics.png?ssl=1>

Comment | Published: 19 October 2022

Building a brighter future for Africa with the African Light Source

Biophysical Reviews
pp 1-9 | Cite as

Towards an African Light Source
<https://link.springer.com/article/10.1007/s12551-019-00578-3>

Authors Authors and affiliations

World Scientific Connecting Great Minds

Subject Journals Books E-Products Partner With

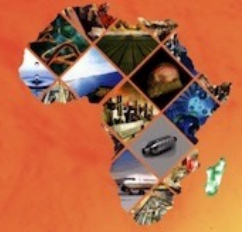
Modern Physics Letters A | Vol. 33, No. 09, 1830003 (2018)
| Brief Review No Access

Synchrotron light sources in developing countries
Sekazi K. Mtingwa and Herman Winick
<https://www.worldscientific.com/doi/abs/10.1142/S0217732318300033>



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What is a synchrotron light source?

Large Scale Research Infrastructure

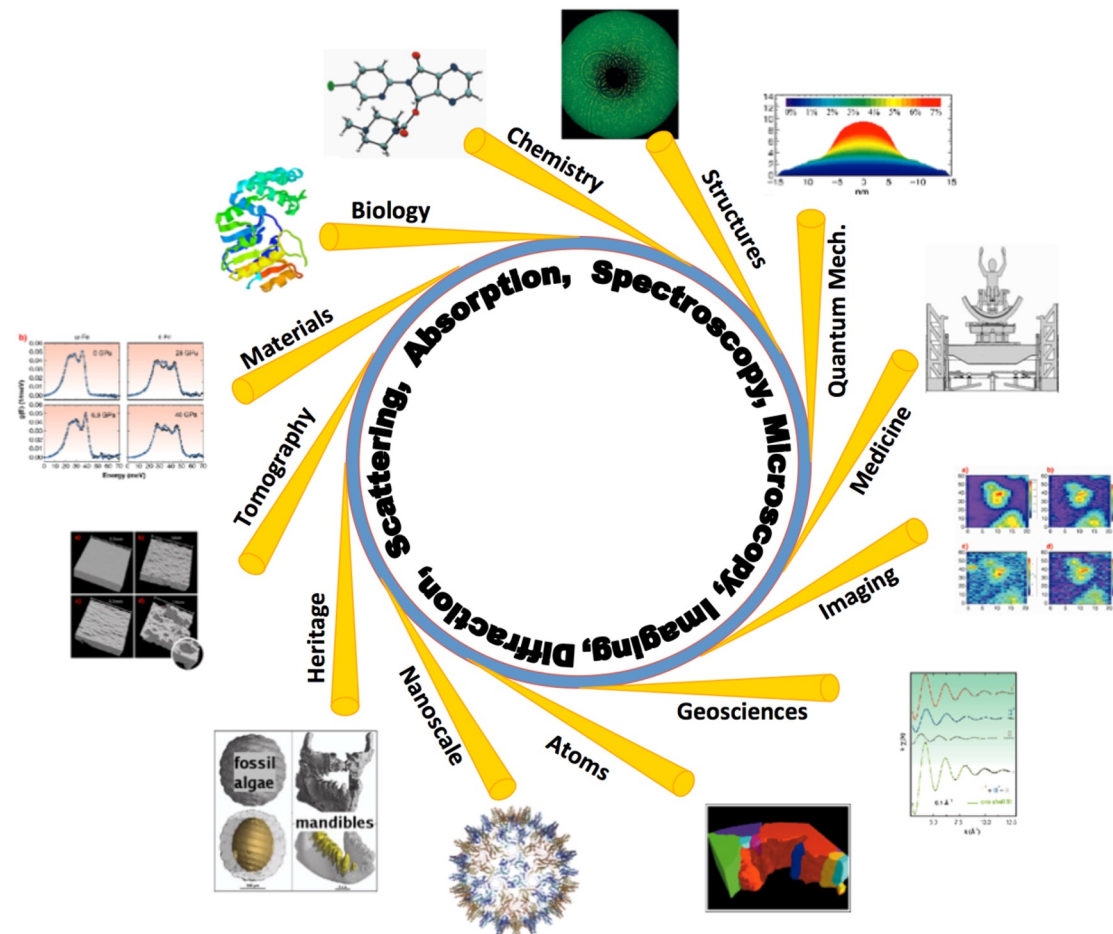
Super Microscope

- Up to atomic resolution
- 5D : x,y,z, t, parameter
- Spectroscopy, Imaging etc

Multidisciplinary

- Research
- Technology
- Industry

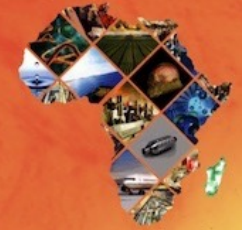
* Credit inferred from each slide



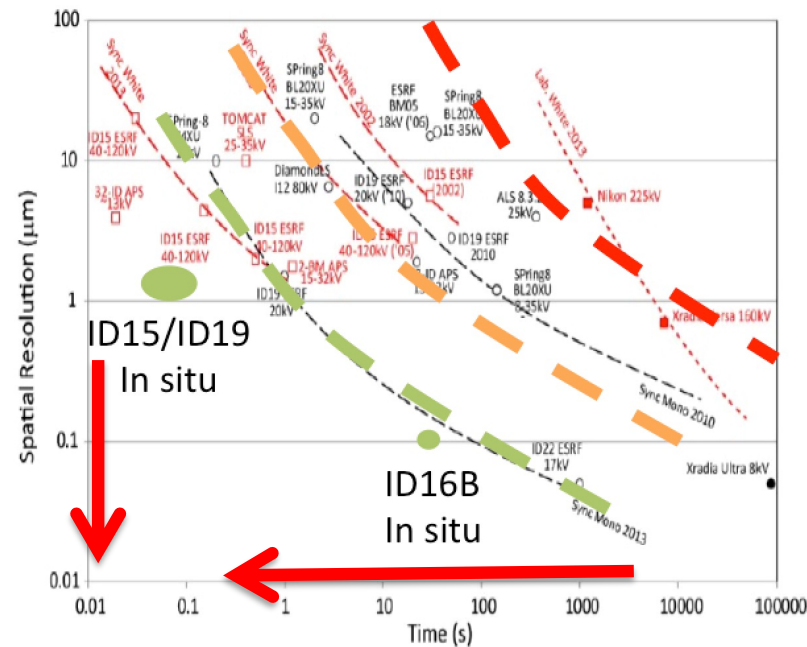


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What is a synchrotron – Technological Advances



- 4D tomography helps understanding material science phenomena if you like to see things !!
- Scans in less than 1s with 1µm resolution can be done
- Scans in less than 30s with 100nm resolution can be done
- It can help to validate numerical modelling
- Various set up have been developed for thermal treatment or mechanical testing
- Trends : faster and / or higher spatial resolution and multi resolution

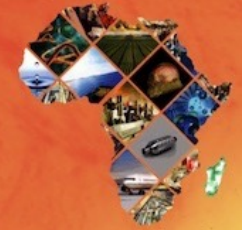
1 measured point
→ 5D data
(3 space and time) +
a parameter
improvements
of $10^2 - 10^4$





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What is a synchrotron – Technological Advances

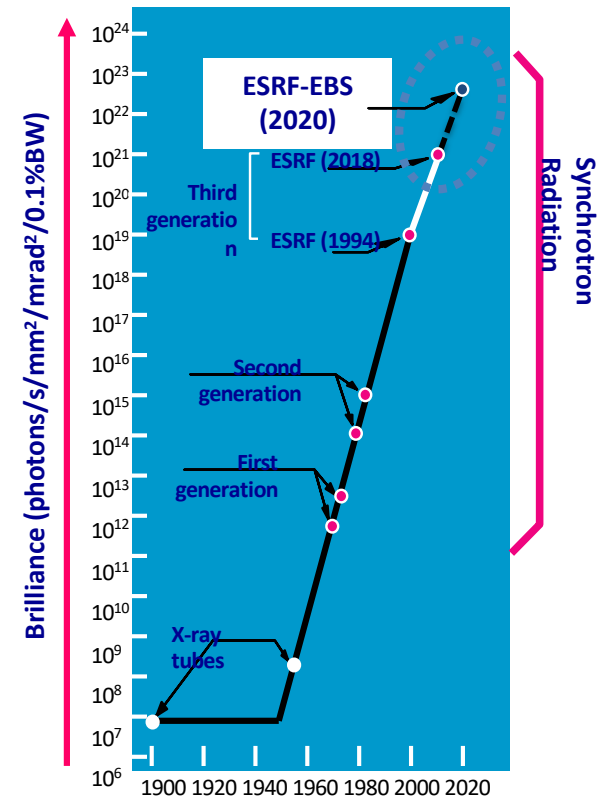
ESRF Extremely Brilliant Source

The 1st high-energy 4th-generation synchrotron light source

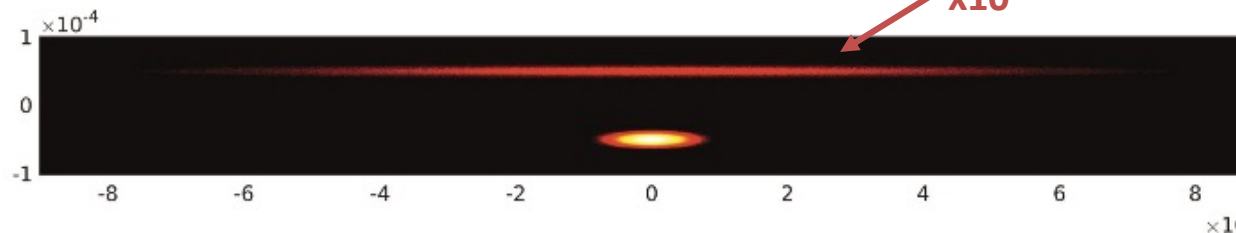


Pantaleo Raimondi wins the Gersch Budker IPAC17 Prize

For his invention of the “Hybrid Multi Bend Achromat” (HMBA) lattice, which has become the design basis of most future “fourth generation” synchrotron sources in the world



Emittance before and after EBS



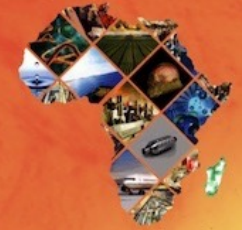
X 100 improvement in beam emittance, **x100** improvement in detectors

X 10000 Figure of Merit improvement

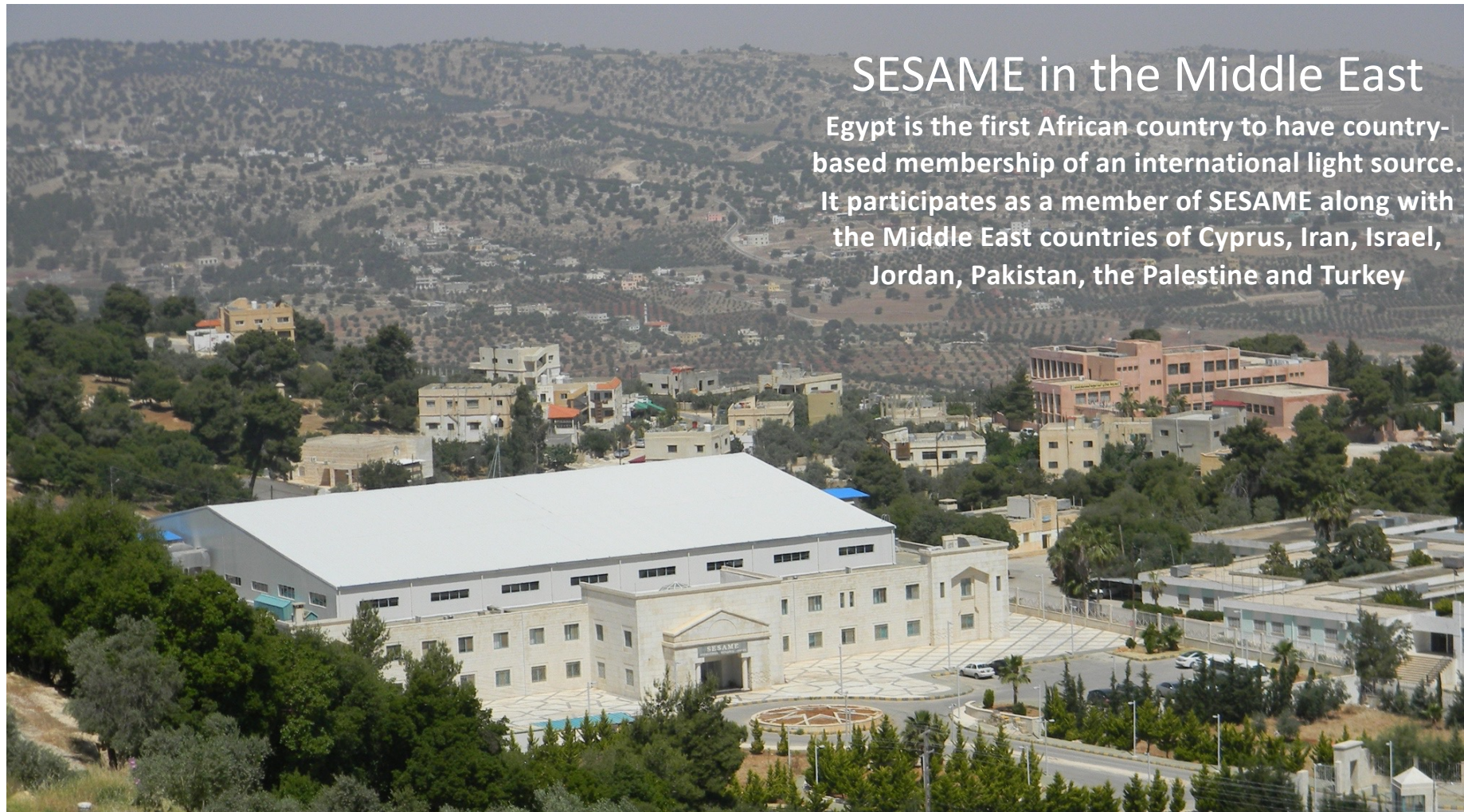


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Inspiration



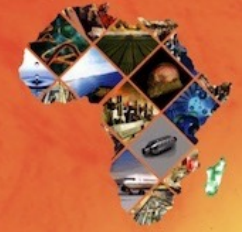
SESAME in the Middle East

Egypt is the first African country to have country-based membership of an international light source. It participates as a member of SESAME along with the Middle East countries of Cyprus, Iran, Israel, Jordan, Pakistan, the Palestine and Turkey



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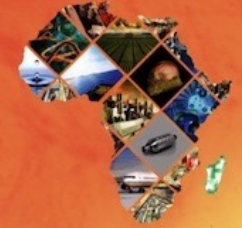
Inspiration



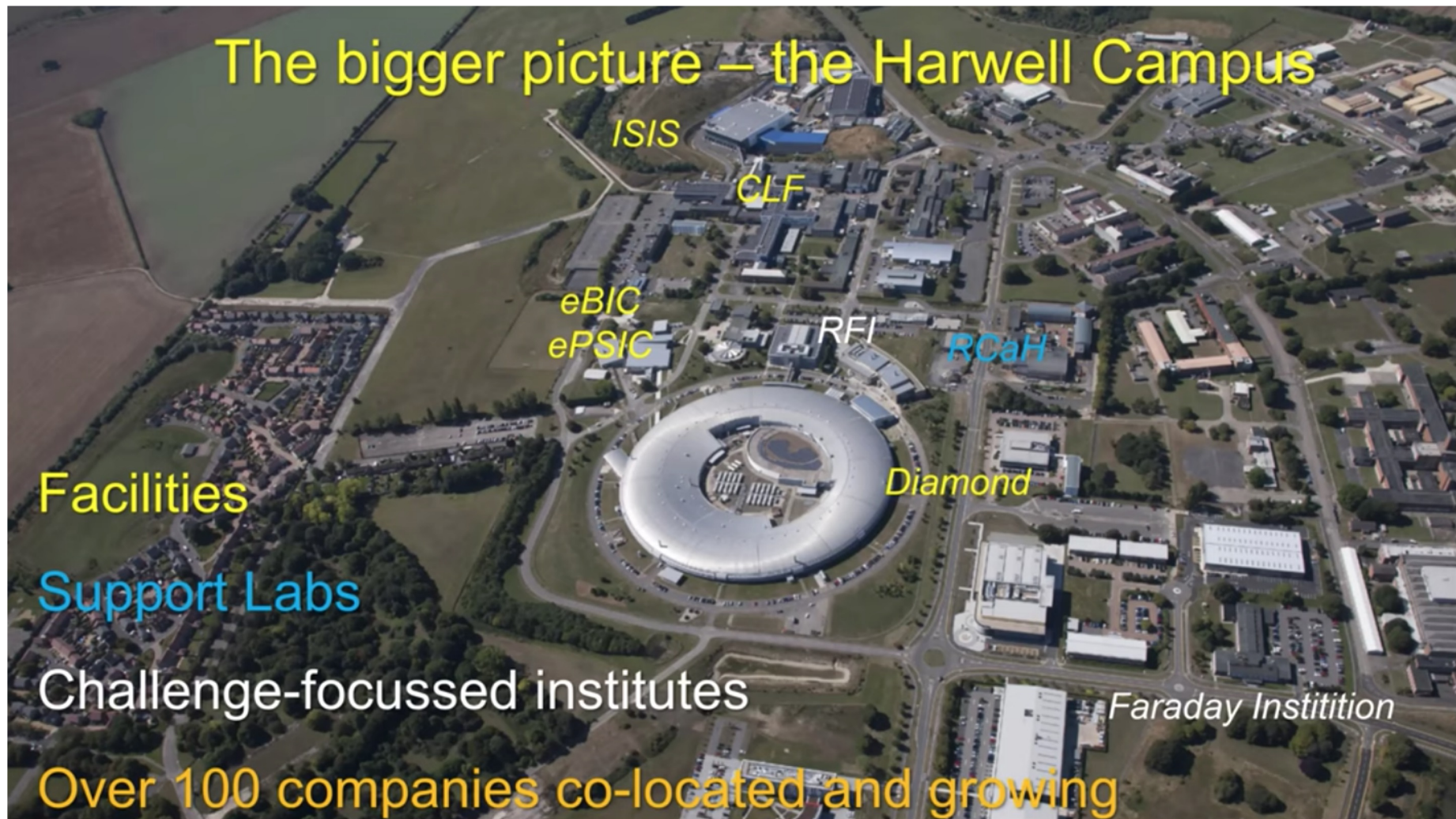


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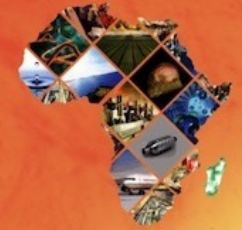
Inspiration: Science, Competitive Industry, UN SDGs



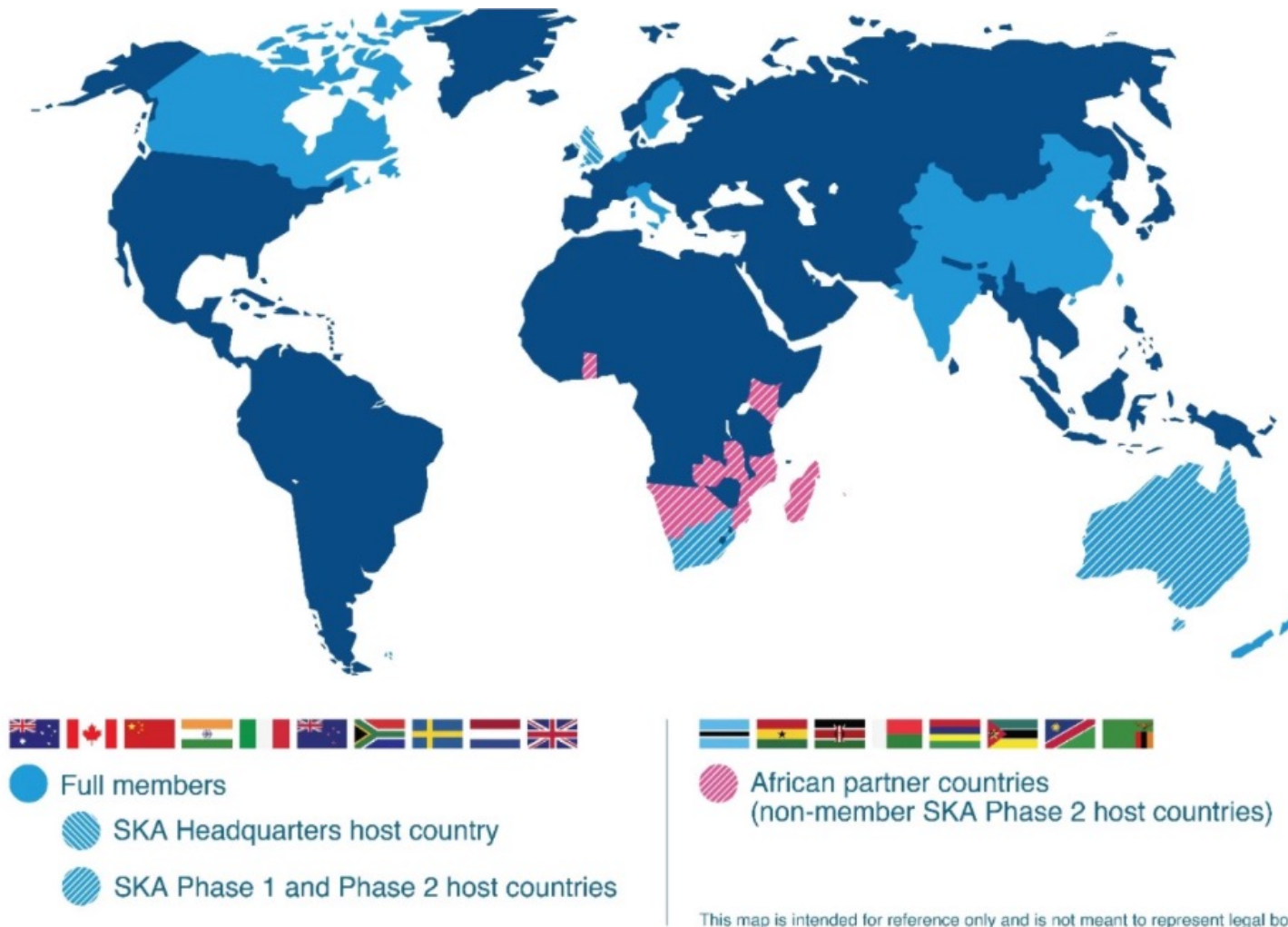


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Africa already has experience in International Large-Scale Research Infrastructures





The African Light Source Foundation

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Africa already has experience in International Large-Scale Research Infrastructures

Research with MeerKAT ... kernel of SKA

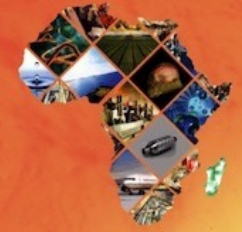
The screenshot shows the SARAO website with a blue header containing navigation links for 'Subscribe', 'Contact', and social media icons for Facebook, Twitter, Email, and LinkedIn. Below the header, there are four news articles:

- Fast and furious: A shock wave that extends for 6.5 million light years**
An international team of astronomers made the most detailed images of the largest cosmic shock wave visible from earth. These gigantic
- New MeerKAT radio image reveals complex heart of the Milky Way**
The South African Radio Astronomy Observatory (SARAO) has released today a new MeerKAT telescope image of the centre of our Galaxy, showing radio emission from the region
- Radio evidence of a minor merger in the Shapley Supercluster**
A group of radio astronomers led by the Italian National Institute of Astrophysics has conducted a multi-frequency and multi-band study of the Shapley Supercluster, where the formation of large
- Einstein wins again**
The theory of General Relativity passes a range of precise tests set by pair of extreme stars.
[Find out more](#)
- MeerKAT discovers mystery clouds**
An international team led by astronomers Professor Gyula Józsa, Professor Michelle Cluver, and Professor Thomas Jarrett has utilized the South African MeerKAT radio telescope to discover a mysterious chain of hydrogen gas clouds the size of a massive galaxy.



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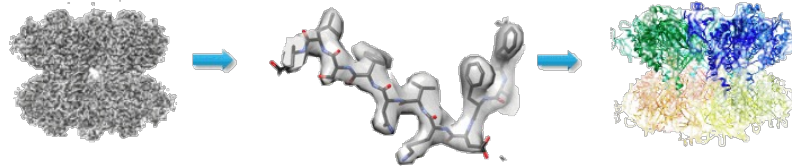
Towards a Lightsource for the African Continent



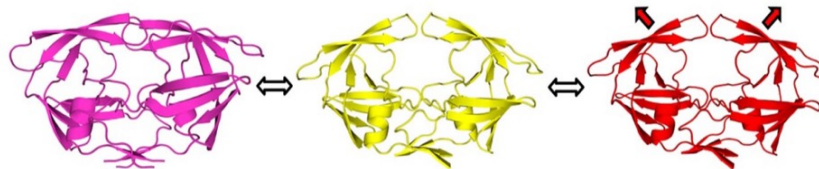
Global and Africa relevant Research and Innovation – by Africans and partners



African Cultural and Paleo Heritage



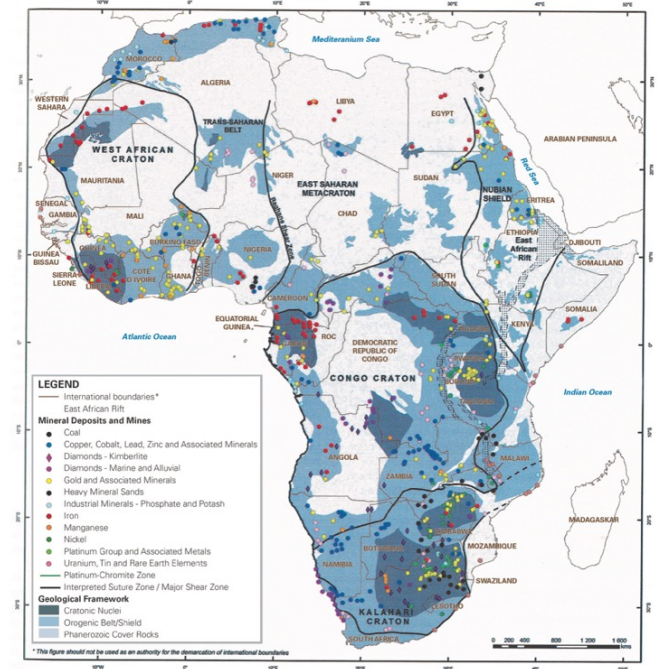
Developing medical interventions for Africa's disease burden, Malaria, HIV, TB, Ebola



Beneficiating Africa's mineral wealth: Mining Review Africa

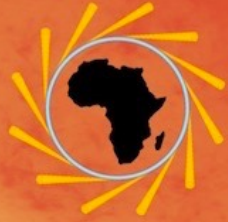


AFLS-CDR Conceptual Design Report



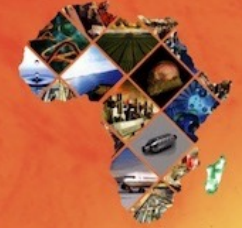
Energy Materials Innovations

..... and much more



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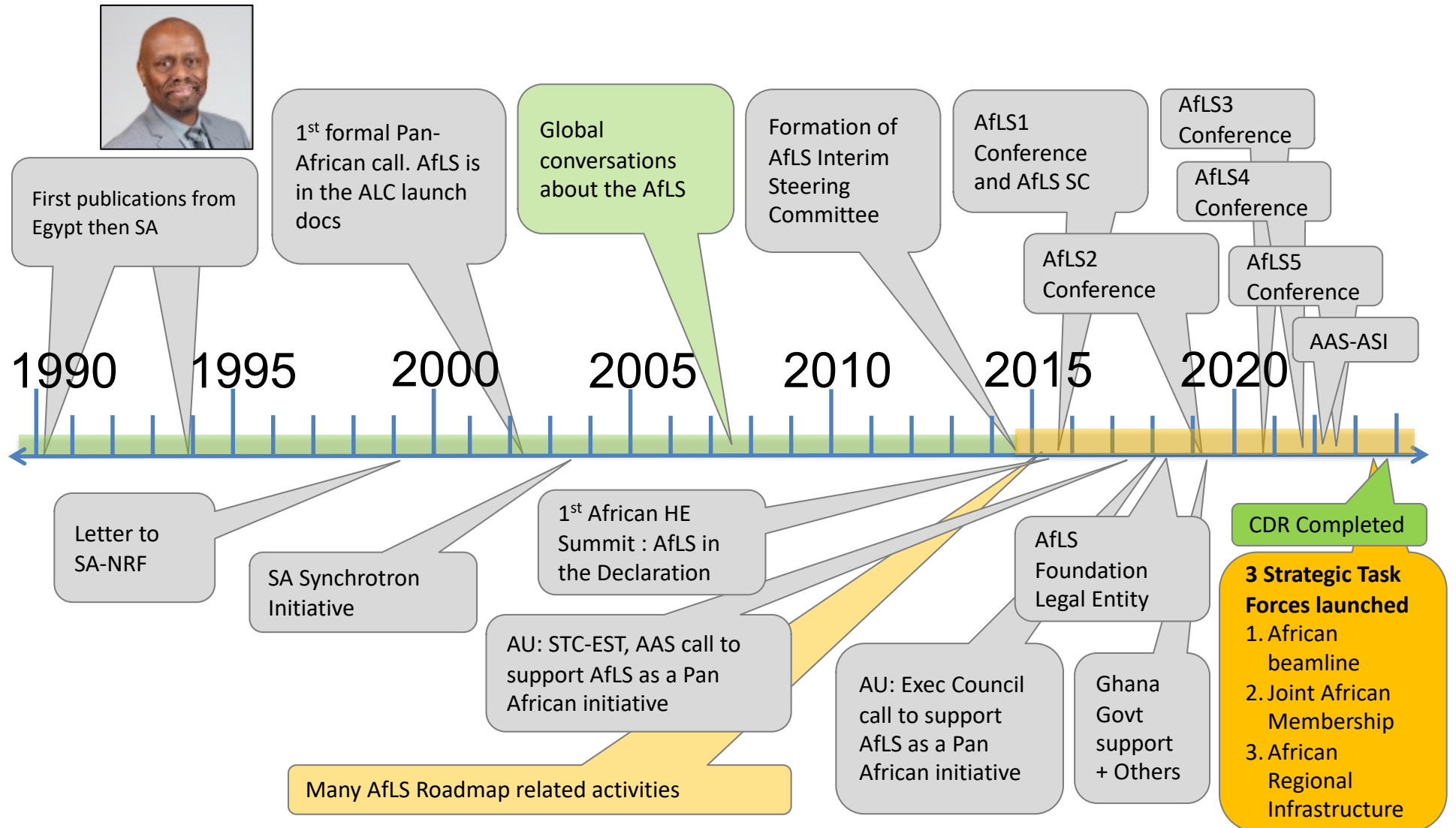
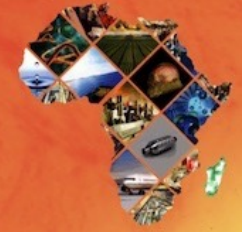
Why the AfLS ?

1. **African Challenges → Identify Science → Identify RI → AfLS**
 - a) Examples in these slides
 - b) Health (African vaccine IP), Big Data Analytics, Others → All RIs
2. **Insist on evolution towards major African funding**
3. **RI for Science Diplomacy → Developing Pan Africanism**
 - a) SESAME
 - b) CERN
4. AfLS profile for **African Government Science Policy**, Regional Science Policy
→ **Leave no country behind**
5. **Governance → African participation on RI Councils**
6. **African User Base development (Training, Youth)**
 - a) Schools, Workshops,
 - b) Medium term visits,
 - c) Sandwich programmes



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Conferences

2015, 2019, 2020,
2021, 2022,
2023, 2024

2021
Now 5 African
Governments involved
Many co-conveners
Prof bodies
Academies



2021
>500 registrations

2022
~1000 registrations

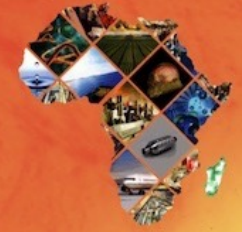


- AFLS1 2015
<https://events.saip.org.za/event/61/>
- AFLS2 2019
<https://events.saip.org.za/event/145/>
- AFLS3 2020
<https://events.saip.org.za/event/211/>
- AFLS4 2021
<https://events.saip.org.za/e/AFLS3>
- AFLS5 2022
<https://events.saip.org.za/e/AFLS2022>
- AFLS6 2023
<https://events.saip.org.za/event/243/>
- AFLS7 2024
<https://events.saip.org.za/event/249/>



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ESRF OVERVIEW

ESRF TOOLBOX

ESRF AS KNOWLEDGE HUB FOR INDUSTRY

ESRF SUCCESS STORIES

ESRF - A Knowledge Hub for industry



USING SYNCHROTRON X-RAY UNIQUE PROPERTIES



3 | AG Pole Avenia | 15 December 2023 | Thanos Papazoglou

BUSINESS DEVELOPMENT OFFICE



Confidential & rapid access



Mail-in services

>300 (71 unique 2023)
Clients

KPI 2024: 2.71 M€
Actual as of today: 3.6 M€

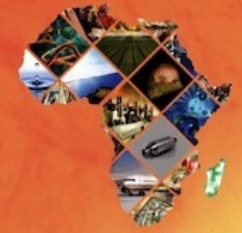
Grants and cooperation
with industry partners

The European Synchrotron | 



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Synchrotron X-rays and neutrons made EASY for industry

Ennio Capria Deputy Head of Business Development (ESRF)

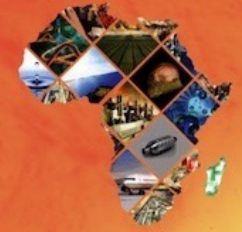
Many international leaders within 20km
Platform for Advanced Characterisation – Grenoble (PAC-G)





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Students → Startups to facilitate industry access



NOVITOM

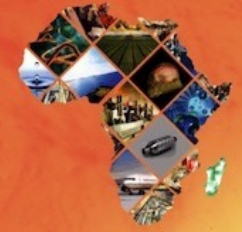
TILLER ALPHA





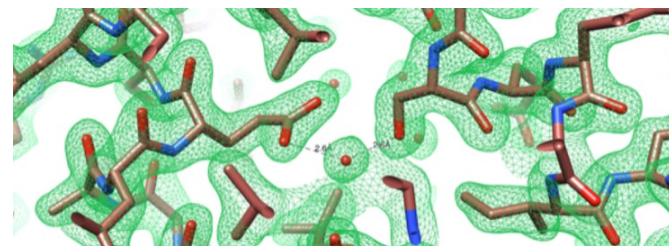
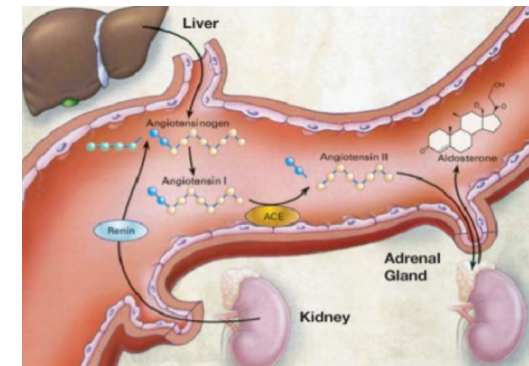
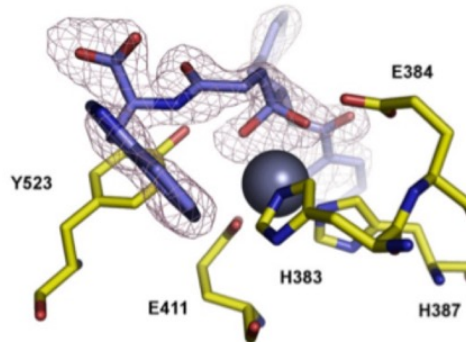
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Bio-Science

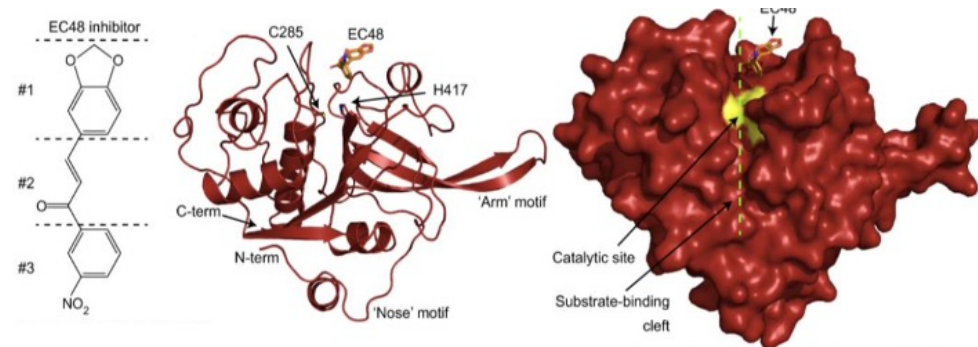
- SARS-CoV-2,
- snakebite envenomation,
- HIV, tuberculosis,
- malaria,
- bilharzia,
- human papilloma virus,
- cardiovascular disease,
- human metabolic disorders,
- African Horse Sickness virus,
- Industrial enzymes



HIV and its interaction with CD4

Fig. 1: A model representation of the structural organization of the HIV-1 virion and its associated proteins [2].

Fig. 2: Conformational changes in the gp120 trimeric spike induced by CD4 binding and the associated consequences for viral attachment to the target cell [3].





South African rock art

St. Hoerlé, S. Mguni, D. Pearce, C. Sandt, L. Jacobson, L. Bertrand...



McGregor museum



AHRI

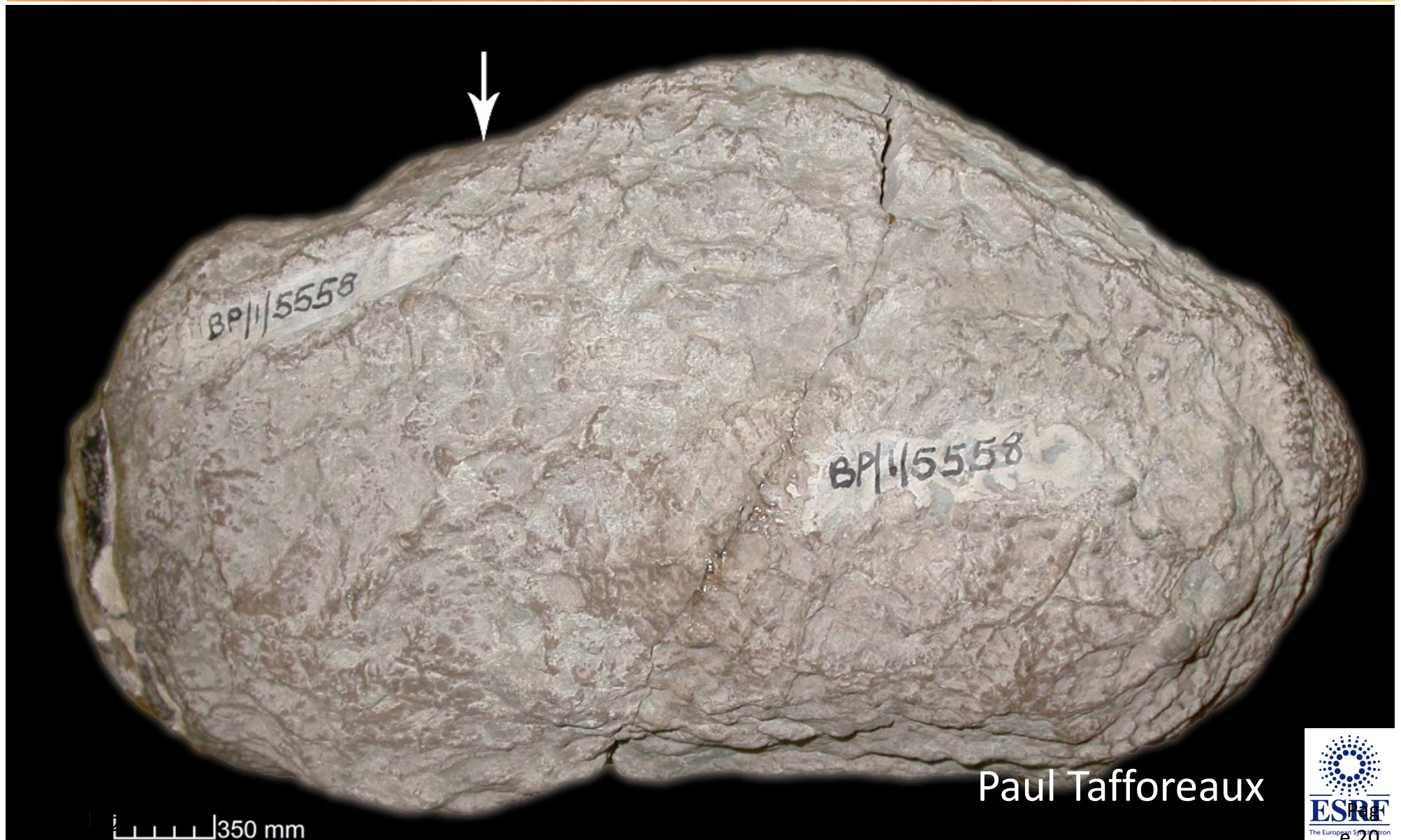
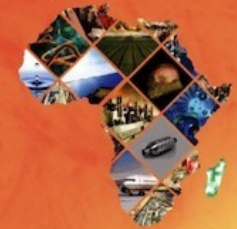
African Light Source Conference
Loïc Bertrand 17 November 2015

IPANEMA | ARCHAEOLOGY CONSERVATION SCIENCES PALAEOANTHROPOLOGY PALACE ENVIRONMENTS | ANCIENT MATERIALS RESEARCH PLATFORM



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Paul Tafforeaux



Dromastega : Temnospondyl amphibian, aquatic predator, the best skeleton ever discovered



Thrinaxodon :
Mammalian reptile,
close to the origin of
mammals

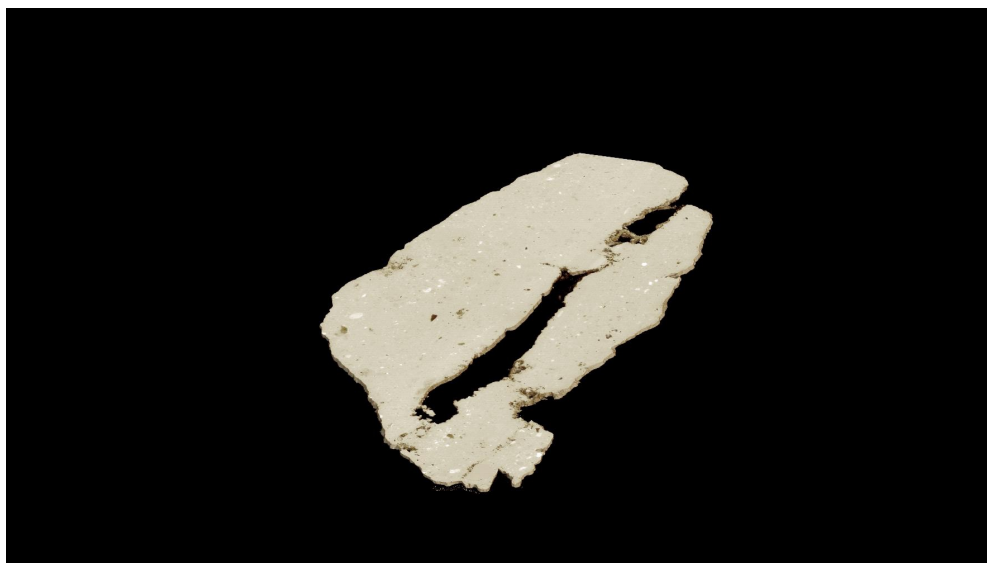
Paul Tafforeaux

350 mm



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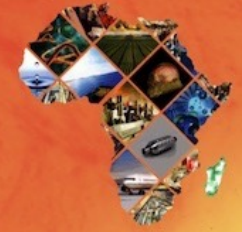


Berger shows fossils to South African President Jacob Zuma



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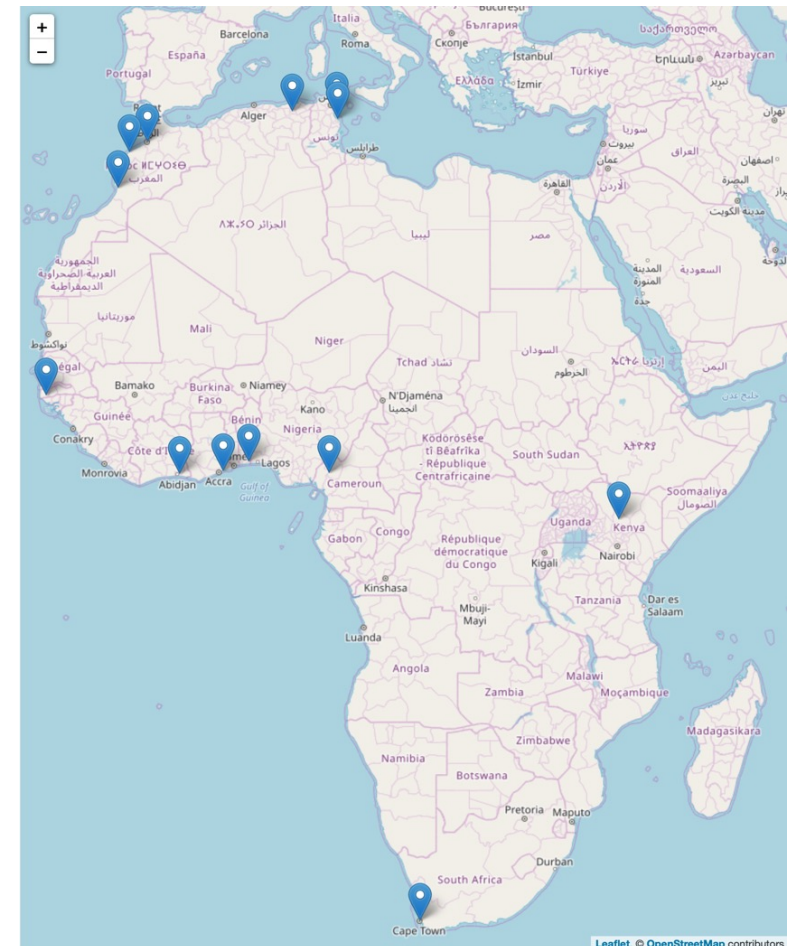


Feeder Facilities

- 1. South Africa**
 - Aaron Klug Centre, UCT, [link](#), U Witwatersrand, U Free State, U Stellenbosch, iThemba
- 2. Benin, X-TechLab, Benin, [link](#)**
- 3. Ghana, U Ghana, [link](#)**
- 4. Côte d'Ivoire, LaCPM, Universite Felix Houphouet Boigny, Abidjan, [link](#)**
- 5. Senegal, Ziguinchor, [link](#)**
- 6. Cameroon, Dschang, [link](#)**
- 7. Kenya, Kenyatta University, [link](#)**
- 8. Tunisia**
 - Monastir, [link](#), Nabuel, Tunisia, [link](#)
- 9. Algeria, Constantine 1, [link](#)**
- 10. Morocco**
 - U Rabat,, [link](#), El Jadida, Morocco, [link](#), Agidir, Morocco, [link](#)

Significant facilities

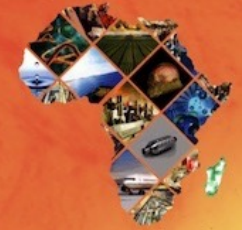
IUCr OpenLab venues with facilities





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Bottom Up

Bio-Science Capacity in Africa

Ghana

University of Ghana

Zambia

The University of Zambia

Algeria

Ecole Nationale Polytechnique de Constantine

Nigeria

Federal University of Technology, Akure

University Ile-Ife

Burkina Faso

Institute of Research in Health Sciences, Burkina Faso

Morocco

University Sidi Mohamed Ben Abdellah

Ivory Coast

Universite Felix Houphouet Boigny

Egypt

Helwan University, Ain Shams University

Lesotho

National University of Lesotho

Ethiopia

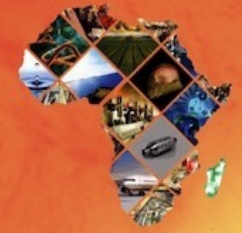
Addis Ababa University





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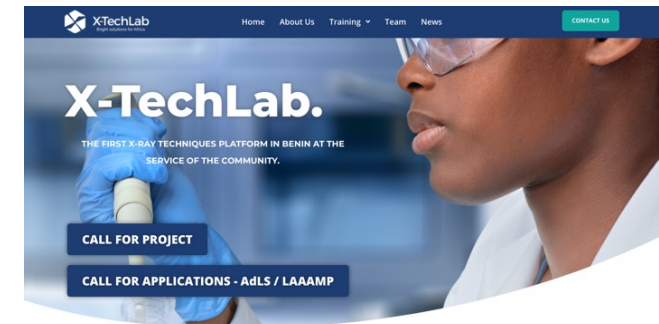
Towards a Lightsource for the African Continent



Some Existing Regional Facilities

X-TechLab - Benin

Materials analysis, spectroscopy for many disciplines.
Energy, health, environment, agriculture, materials



Microscopy Centre – UCT in SA

Structural biology resource widely used in SADEC region

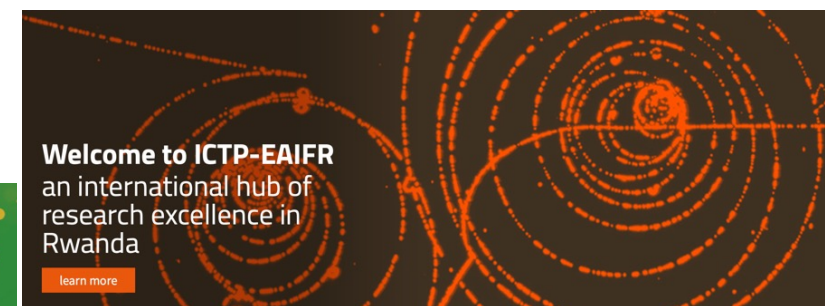
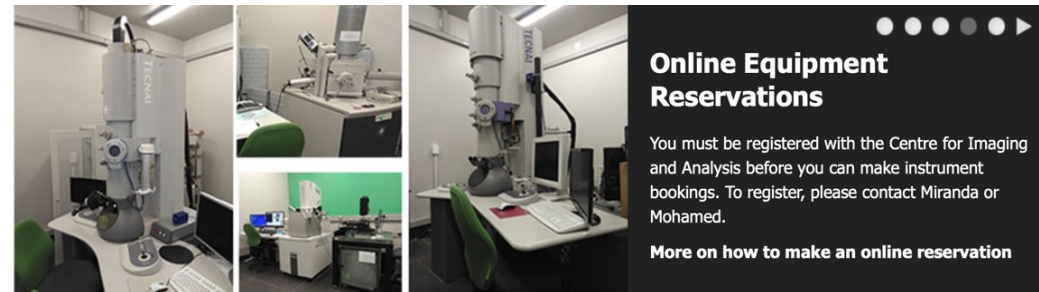
African Laser Centre

Pan-African NEPAD flagship initiative

ICTP-EAIFR - Rwanda

Condensed matter, Geology, Particle Physics,
Cosmology, Astroparticle physics

Partner with LAAAMP, IUCr – OpenLABS, START, Others





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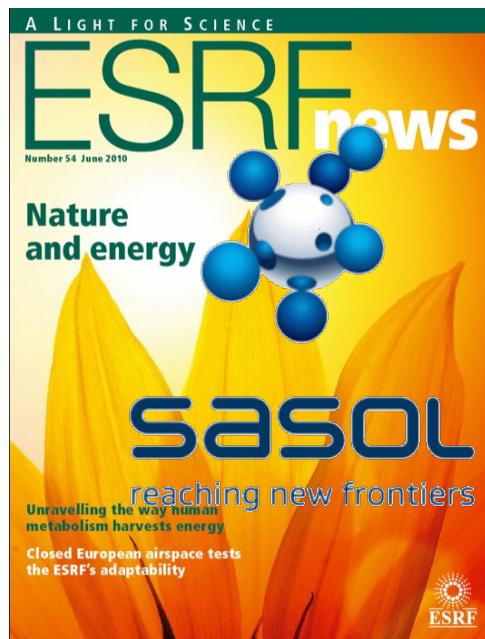


Bottom Up

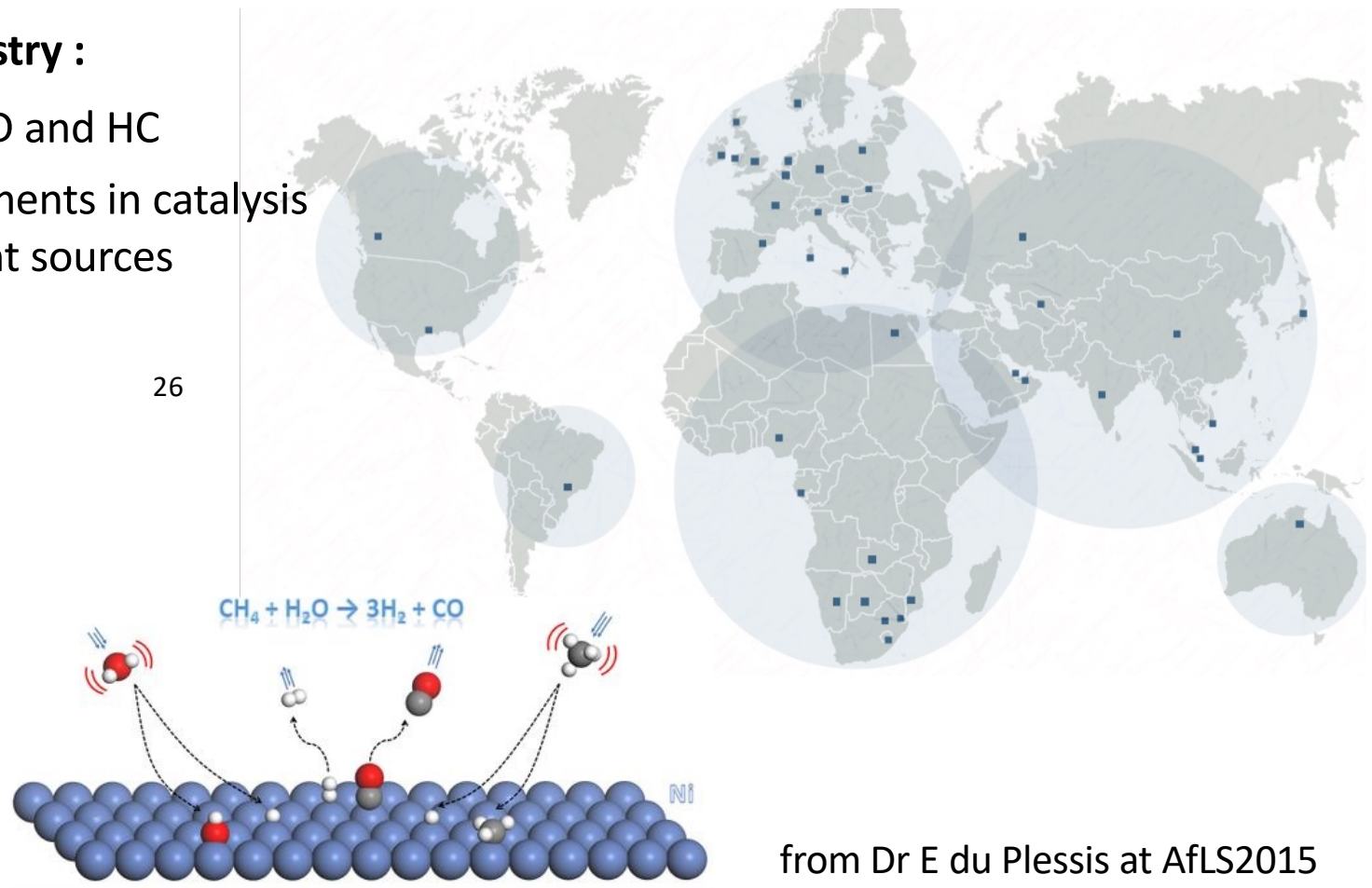
Example of African Industry :

SASOL investment in R&D and HC

SASOL capacity, achievements in catalysis studies – local and at light sources



26

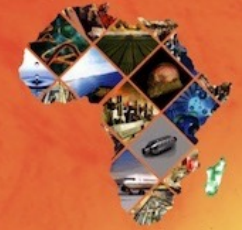


from Dr E du Plessis at AfLS2015



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Accelerator Physics Capacity in Africa

Ghana: [Accelerator Laboratory](#) at the Obafemi Awolowo University. 1.7MV Pelletron Tandem Accelerator

Nigeria: [Accelerator Laboratory](#) at the Obafemi Awolowo University. 1.7MV Pelletron Tandem Accelerator

Egypt: [Nuclear Research Centre](#) (NRC).

MGC-20 cyclotron,

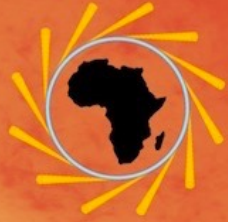
3 MV Tandetron (commissioned ?)

Algiers: [Nuclear Research Centre](#) of Algiers (CRNA).

3.75 MV Van de Graaff accelerator

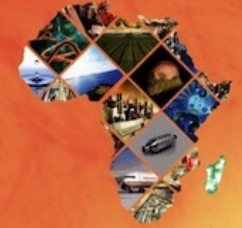
South Africa: [iThemba LABS](#) 200 MeV separated-sector cyclotron with two injector cyclotrons., 11 MeV PET Isotopes, 6 MV Tandem accelerator, 3 MV Tandetron.





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Instrumentation and Control Systems Capacity in Africa

South Africa:

[iThemba LABS](#)

Instrumentation / Control

[SARAO](#)

Instrumentation / Control

[SKA](#)

Instrumentation / Control

[Necsa](#)

Nuclear Energy Corporation of SA

Instrumentation / Control

St James Software

JlogBook - e-log-book

With ESRF interfaces to TANGO

[Stellenbosch U](#)

Presenting at ICALEPCS

[CERN participation by African Countries](#)

Algeria, Egypt, Ghana, Madagascar, Morocco, Mozambique, Rwanda, South Africa, Tunisia, Many others

Tech Transfer, Operations, Upgrade, Instrumentation, AI etc





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IAEA

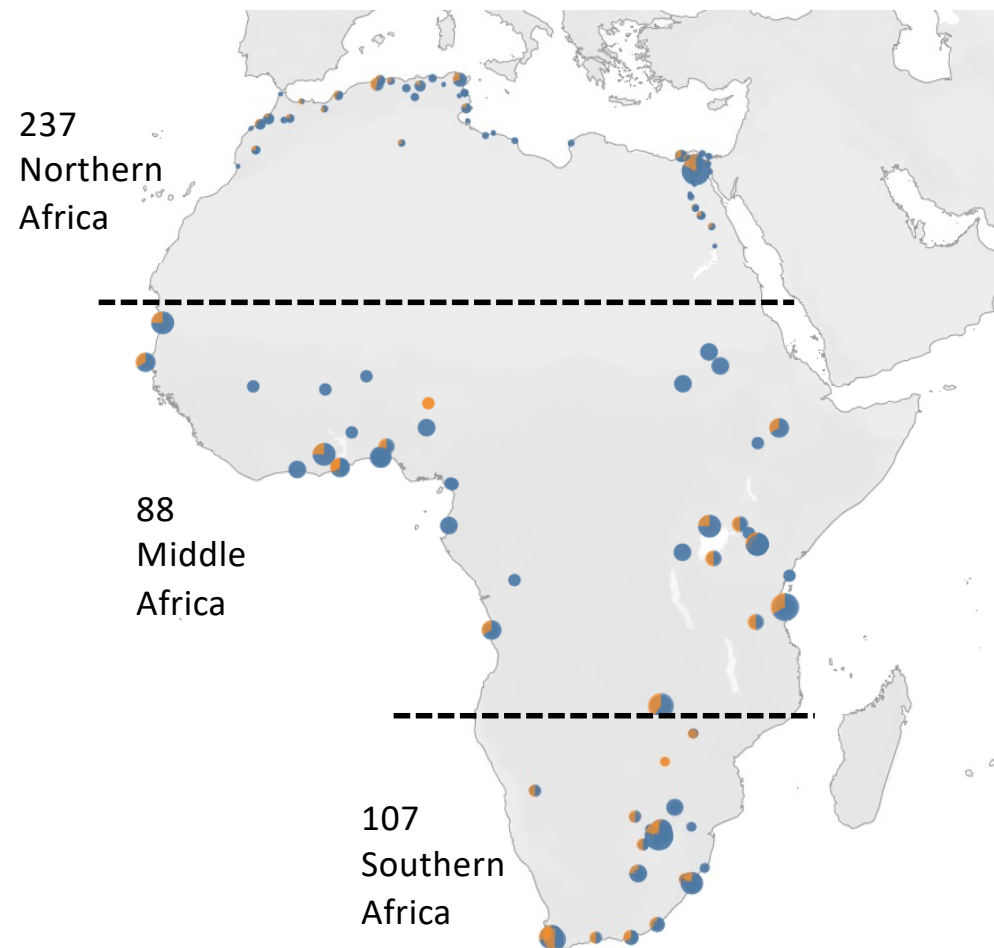
DIRAC

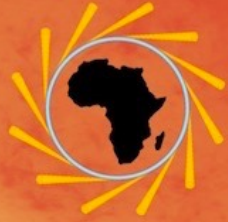
Directory of
RAdiotherapy Centres

Clinical Linacs

Possible extra route to
skills development ?

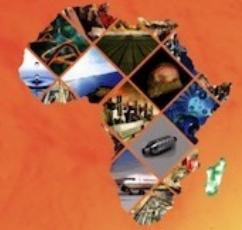
<https://dirac.iaea.org/Query/Map2?mapId=2>





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DECISION ON THE REPORTS OF THE SPECIALISED TECHNICAL COMMITTEES (STCs)

The Executive Council,

C. STC ON EDUCATION, SCIENCE AND TECHNOLOGY

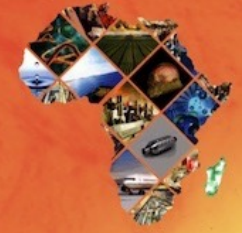
21. CALLS UPON Member States to support the Pan-African Synchrotron Initiative;

| | | |
|---|---|--|
| AFRICAN UNION الاتحاد الأفريقي |  | UNION AFRICAINE UNIÃO AFRICANA |
| P. O. Box 3243, Addis Ababa, ETHIOPIA Tel.: Tel: +251-115- 517 700 Fax: +251-115- 517844 / 5182523 Website: www.au.int | | |
| EXECUTIVE COUNCIL Thirty-Second Ordinary Session 25 – 26 January 2018 Addis Ababa, ETHIOPIA | | |
| EX.CL/ Dec.986-1007(XXXII) | | |
|  | | |



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Conceptual Design Report

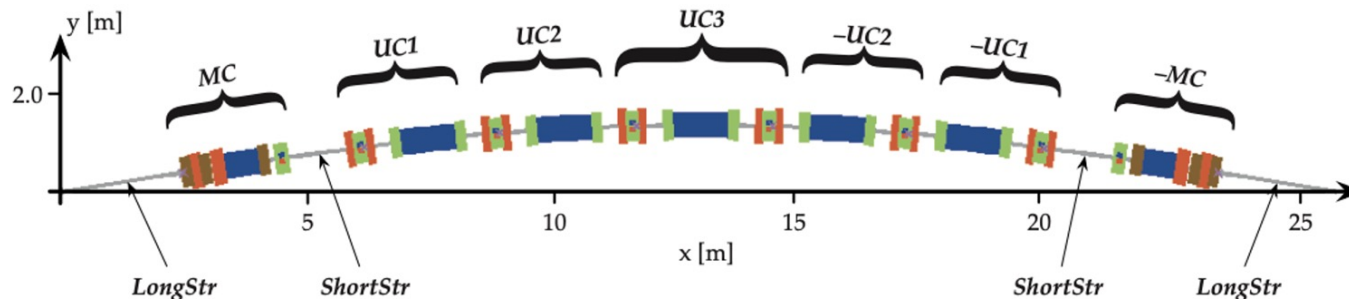
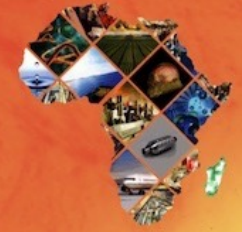


Complete: Launched at AAS event in Nigeria, Dec 2024



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$$\varepsilon = C \frac{E^2}{N_d^3}$$

• 4th Generation - MBA Upgrades

• 10⁴ x better :

- x100 – emittance,
- x100 - detectors

• ESRF upgrade → EBS

• Sirius in Campinas, Brazil

• MAX IV in Lund, Sweden

• 3 GeV, MBA, 20 Beamlines

- Imaging
- Diffraction
- Spectroscopy

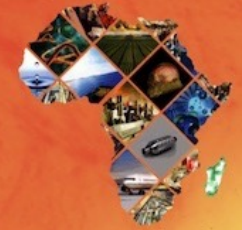
• 5th Generation ?





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3 Strategic Task Forces launched: Dec 2024 @ AAS GA and Scientific Conference

The African Beamline at an international AdLS

This is an African designed and operated beamline at an International AdLS that can address selected African Research Imperatives. It leads additionally to the training of engineers and technologists and will result in Technology Transfer.

The Collective African membership of an international AdLS

Here several African countries jointly acquire formal membership of an international AdLS. They leverage a threshold of participation that allows African Government involvement in the Council of the Facility, so that there is increased African Access of Researchers, technologists, Industries and also Governments.

African Regional Infrastructure

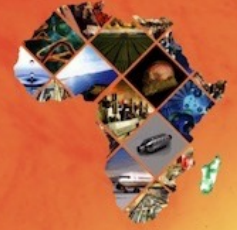
This is research infrastructure that is both highly competitive in its own right but which is also seen as important training and feeder infrastructure to an AdLS.

“Leave no country behind.”



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UNESCO Proposal

Together with other Developing regions

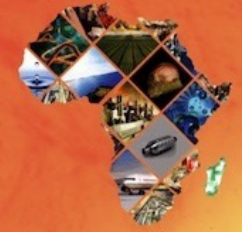
- GCLS / LAMISTAD
- SESAME
- Iranian ILSF
- Uzbek LS

Kenya Ambassador to UNESCO leading

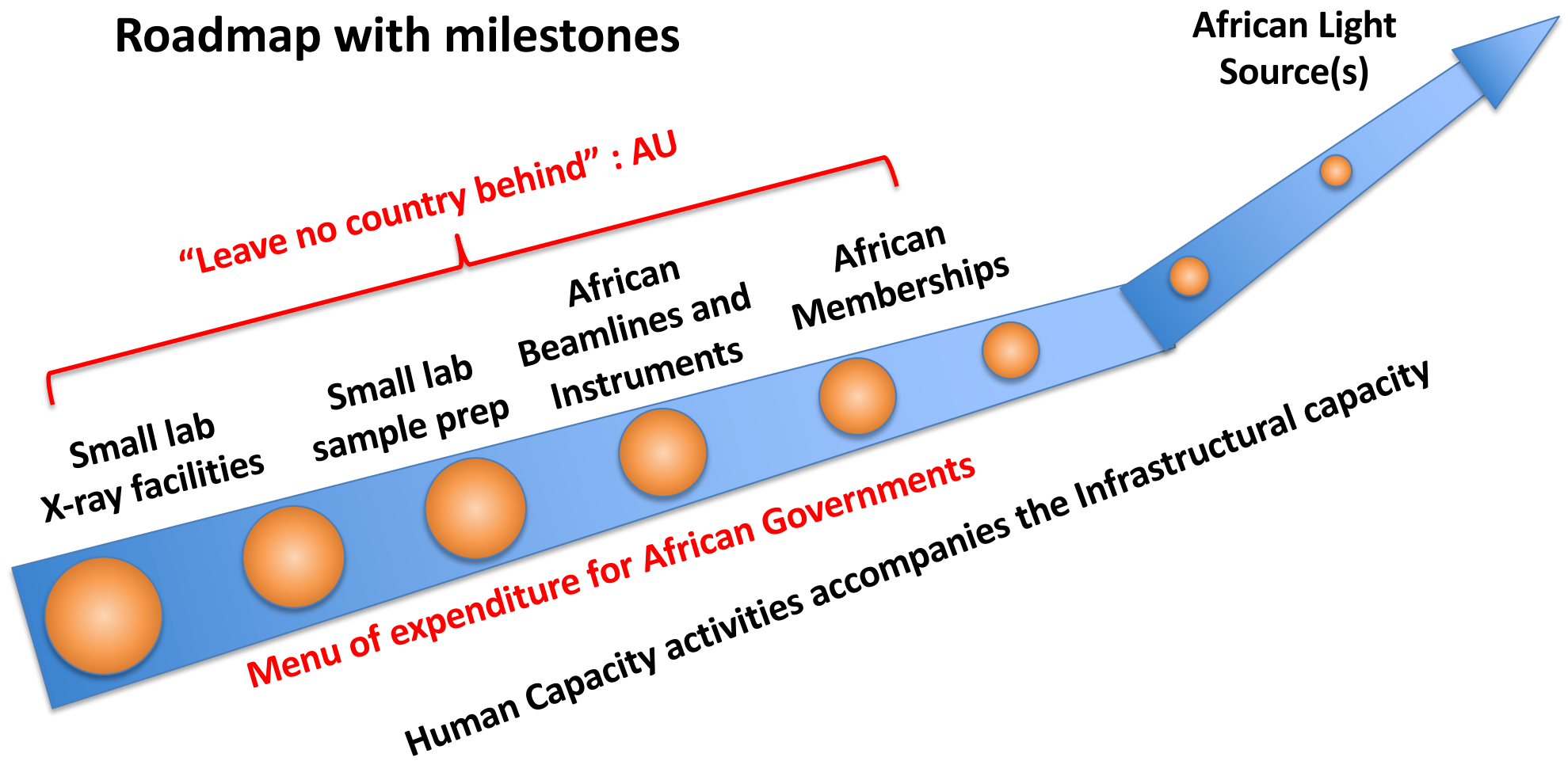


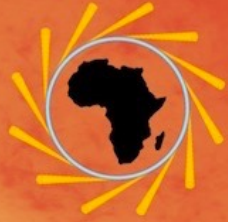
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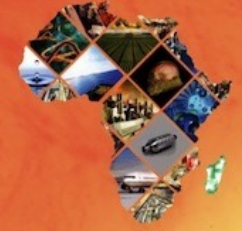
AfLS Infrastructure Roadmap with milestones





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STF: Local and Regional Research Infrastructure towards AfLS

- Less expensive → Early spend
- Training Opportunities (Scientific, Engineering, Technical)
- Competitive Research, African challenges
- Facilitating Access to International Light Sources
- Broaden the footprint in Africa

Lab X-ray Facilities, Sample Preparation, Neutrons, CLS

A Compact Light Source @ Necsa

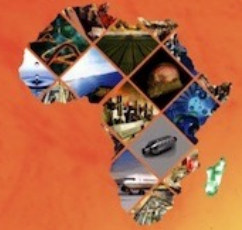
AfLS and SA Synchrotron Users leverage proposal with Necsa

Dr Ntsoane Chair of SA Synchrotron Users



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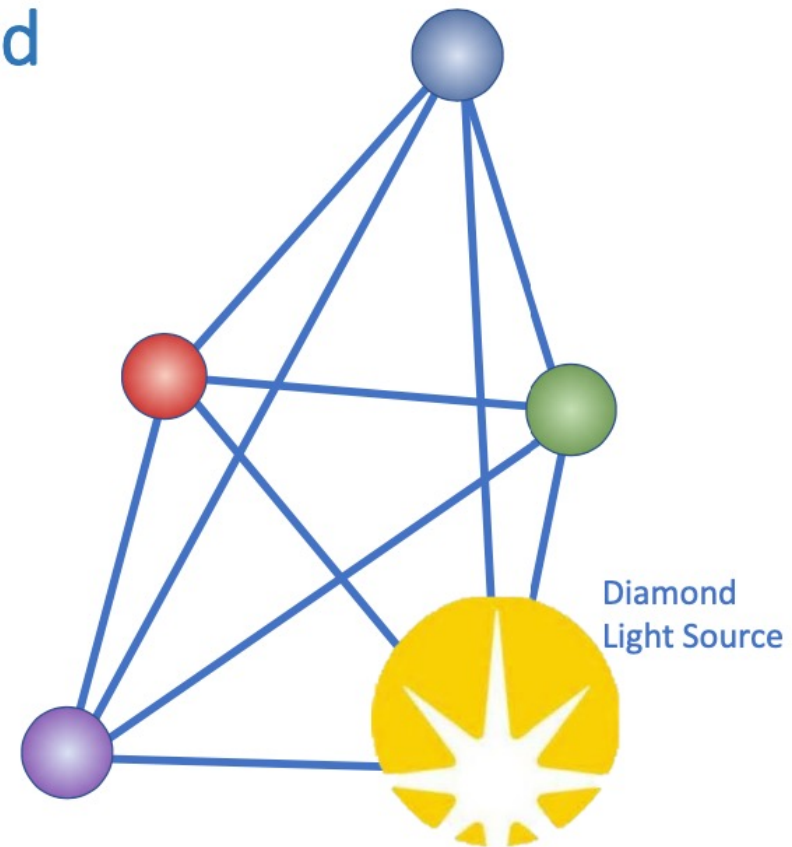


Recent example in UK → Grid of CLS to support Diamond (synchrotron)

Compact Light Source Grid

Concept: to establish the first nationally connected grid of (X-ray) light sources in the world to undertake world leading science and to deliver regional and national economic and societal benefits

Aim: This workshop we will explore potential research applications at a Life Science Node and a Cultural Heritage Node.



'A national facility distributed regionally'



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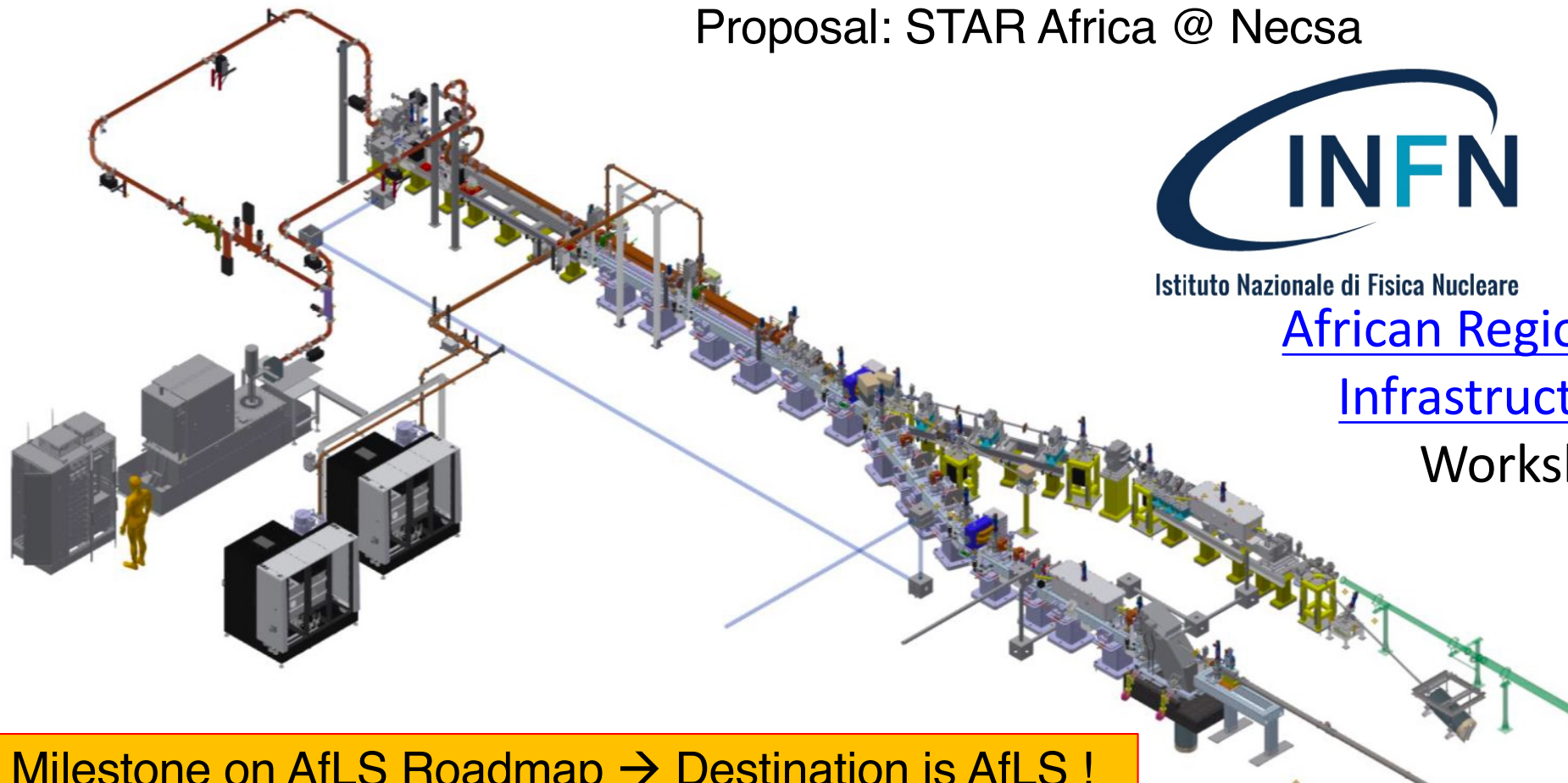
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Compact Light Source : Inverse Compton Scattering : STAR in Calabria

Logarithmic performance : lab source - CLS – synchrotron

Proposal: STAR Africa @ NeCSA



Istituto Nazionale di Fisica Nucleare

African Regional
Infrastructure

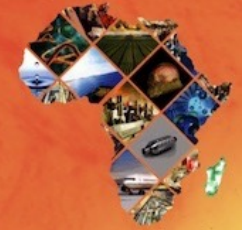
Workshop

Milestone on AfLS Roadmap → Destination is AfLS !



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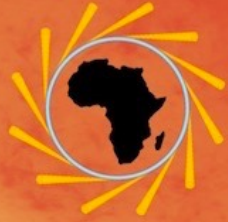
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AAS and the AfLS

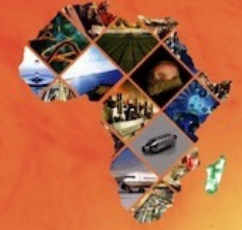
AAS and AfLS drafted agreement for a partnership





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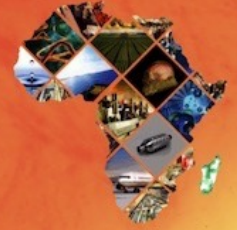
Consultancy Meeting of IAEA TC Project INT0104 Increasing Transnational Cooperation between Light Sources Bangkok, Thailand, June 24-28, 2024





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IAEA TC Project - INT0104

- Enhancing Transnational Collaboration among Light Sources and Expanding the User Base
- **Training Platform / Material, Mapping →**
Pan African Virtual University

Opportunity to expand Footprint within Africa,
and increase international linkages

49/56 Countries in Africa
within AFRA, NEST and with TC Support

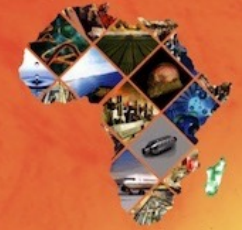
African Country → National Liaison Office → Community





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Why Training ? Synchrotrons + Science

- Address African Challenges through Science
- Address the SDGs (all)
- Massive Human Capacity Building
- Leverage networks at Int. Synchrotrons
- Highest caliber Science
- Interdisciplinary
- Science Diplomacy
- Involve industry
- Innovation, Competitive Industry
- A wealthy Africa

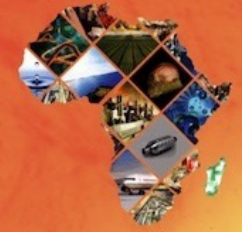


Need a massive open online African solution → PAVU



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The Concept of Ubuntu and African Identity in Pursuit of the African Light Source

To be an African,
you do not need to be born in Africa,
..... Africa must be born in you



Kwame Nkrumah
1st President of Independent Ghana
Pan Africanist

Africans, Old Diaspora, recent Science Diaspora, Friends of Africa around the world.

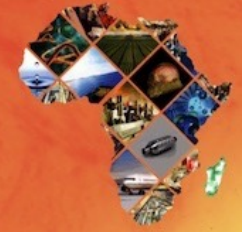


AfLS and AALS to partner in this venture.

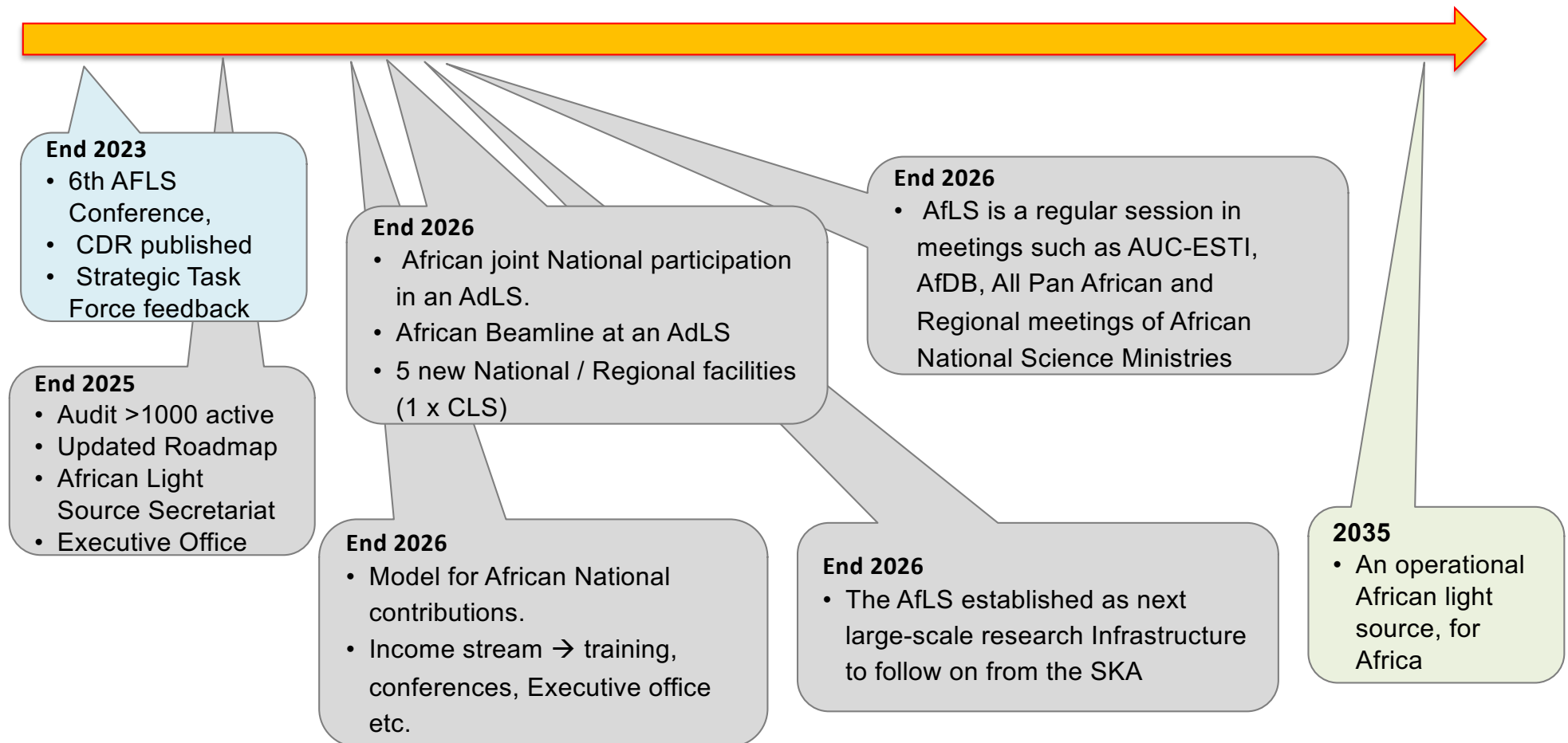


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Milestones on the Timeline of the Roadmap





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Thuma mina – Send Me

<https://www.youtube.com/watch?v=d4Bwux-btq0>

Musician Hugh Masekela



“ I WANNA BE THERE WHEN
THE PEOPLE START TO TURN
IT AROUND / WHEN THEY
TRIUMPH OVER POVERTY / I
WANNA BE THERE WHEN THE
PEOPLE WIN THE BATTLE
AGAINST AIDS / I WANNA LEND
A HAND / SEND ME.”

HUGH MASEKELA

Simon Connell shconnell@uj.ac.za