African Light Source (AfLS)

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Conceptual Design Report (CDR)

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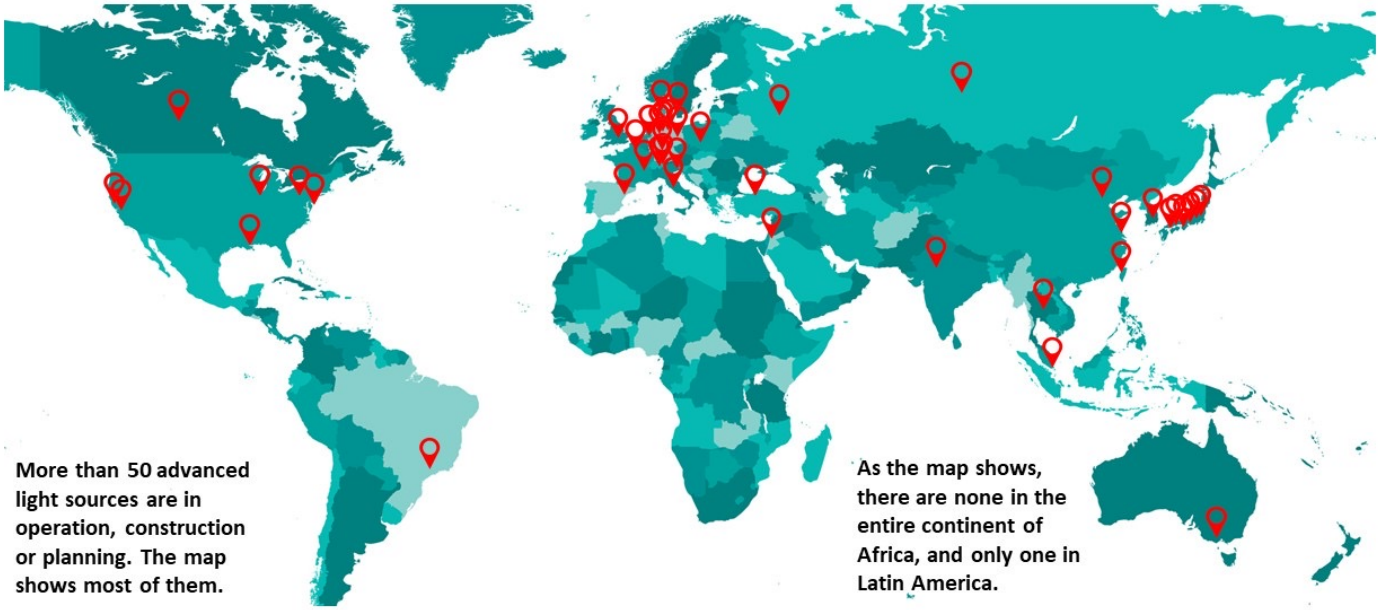
November 16, 2022

World Map of advanced Light Sources



Ghana to champion African Light Source – Akufo-Addo

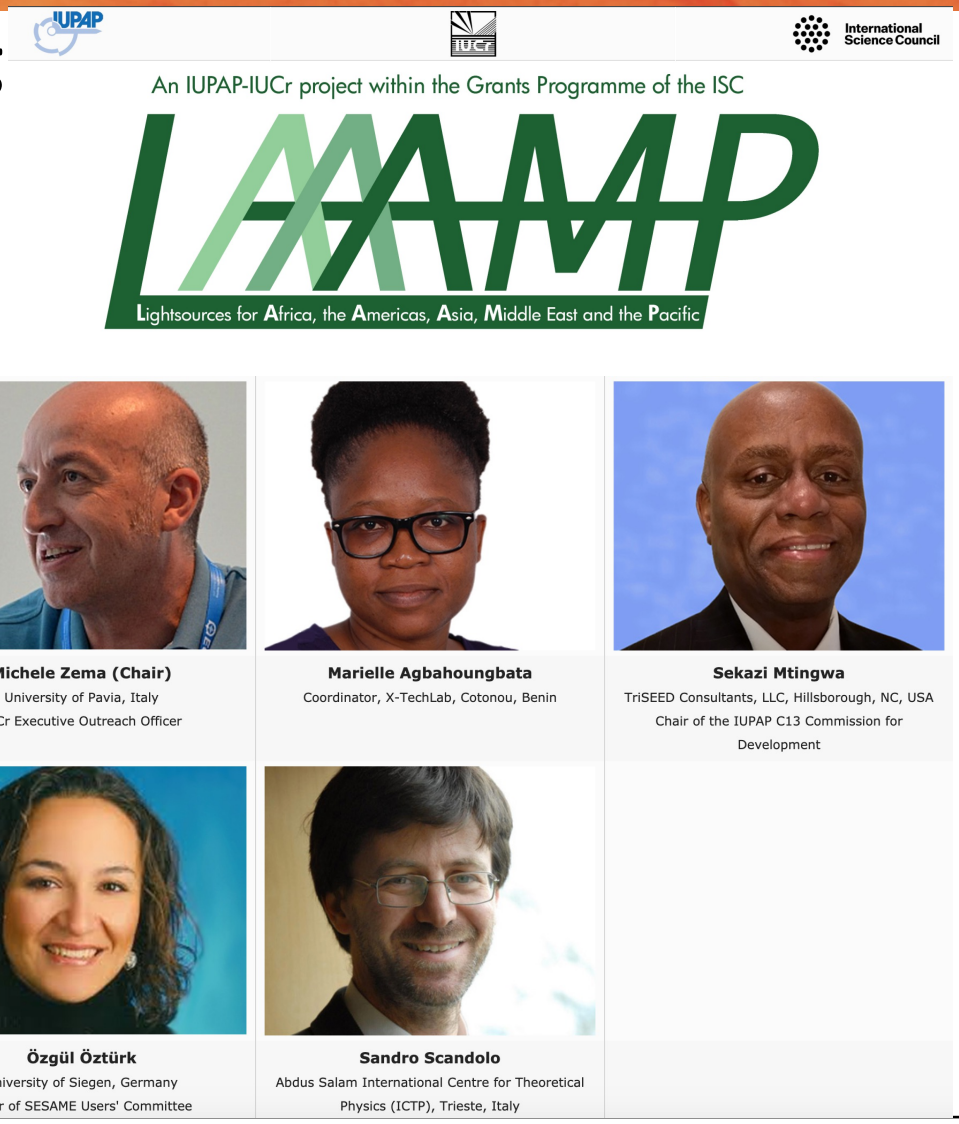
2 days ago General News Leave a comment

Ghana will champion the African Light Source (AfLS) to make it an official project of the African Union (AU) and ECOWAS, President Nana Addo Dankwa Akufo-Addo, has said.

President Akufo-Addo made the disclosure on Tuesday, in a speech read on his behalf at the opening of

Bottom Up Training

https://laaamp.iucr.org/



Bottom Up Training **X-Tech Lab, Benin (https://www.xtechlab.co/)**

Pan-African Students, 2 weeks, 2 x /yr

Crystallography, X-ray Diffract, Tomography, Math Engineering

Bottom Up

Capacity in Africa

START is a collaborative project that seeks to foster the development of Synchrotron Techniques for African Research and Technology.

Two lines of scientific investigation:

1. New energy materials (eg solar cells, novel catalysts)
2. Structural biology studying diseases and develop drug targets.

Jump-start Africa's entry into synchrotron based bioscience.
SA, Lesotho, Ethiopia participation so far ……

diamond

Bottom up **African Laser Centre Founders, Johannesburg, 2003**

ALC Founding Nodes

Facility	City and Country	Field of Specialisation
National Laser Centre	Pretoria, South Africa	Manufacturing, Machining, and Materials Processing
University of Cheikh Anta Diop	Dakar, Senegal	Atomic and Molecular Physics and Laser Spectroscopy and Processing
Laser and Fibre Optics Centre	Cape Coast, Ghana	Agricultural and Environmental Science
National Institute of Laser Enhanced Science	Cairo, Egypt	Medical and Biological Applications of Lasers
Tunis el Manar University	Tunis, Tunisia	Plant and Environmental Science and Molecular Spectroscopy
Advanced Technologies Development Centre	Algiers, Algeria	Laser Spectroscopy and Surface Studies

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

CSIR
Touching lives through innovation

alc
african laser centre

Conceptual Design Report

Motivation for an African Light Source

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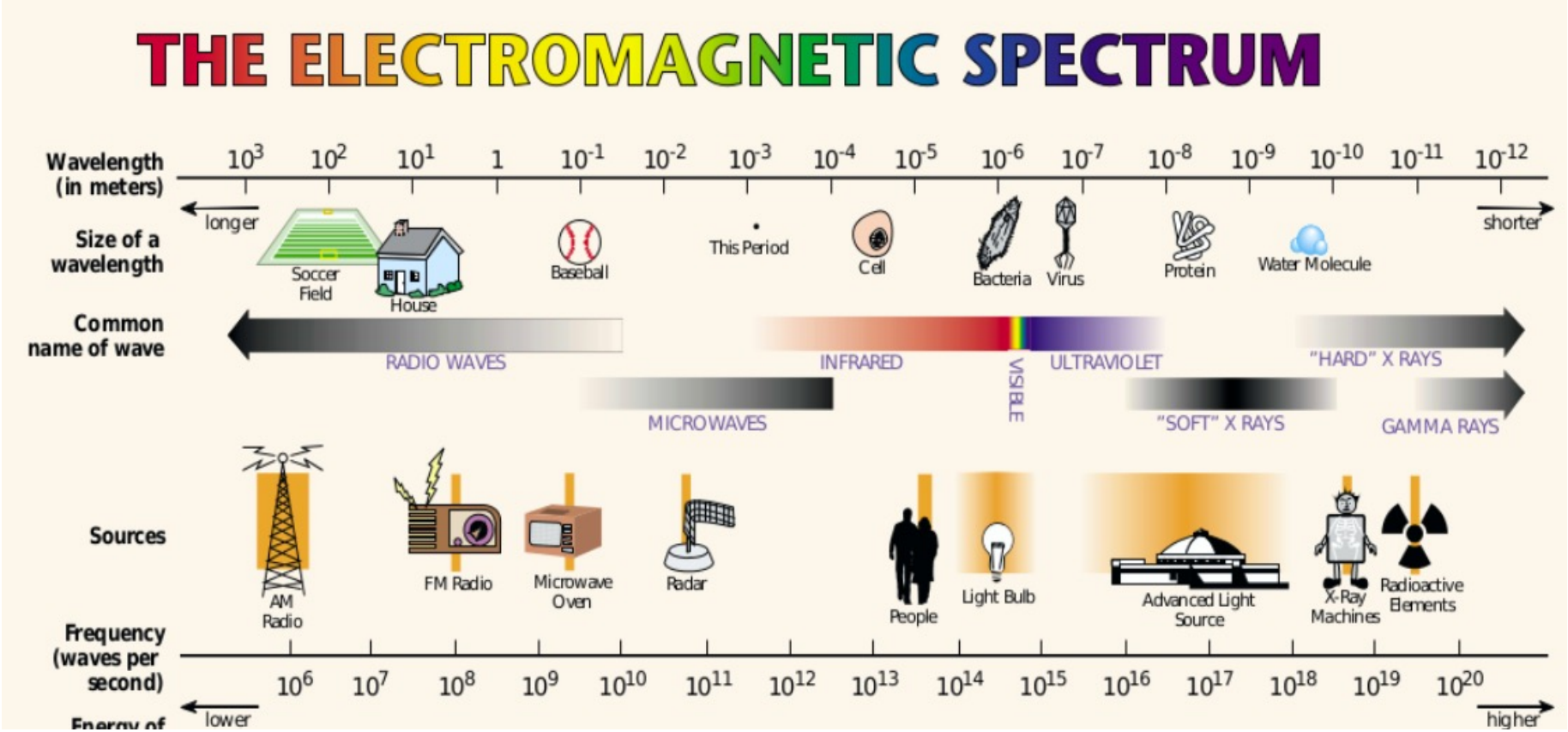
Chapter 1: Overview and Description of an Advanced Light Source



EM spectrum compared to well-known objects and sources of radiation (Figure courtesy of Lawrence Berkeley National Laboratory, USA)

Chapter 2: Scientific Benefits

2.1 Structural Biology

2.1.3 Role of Synchrotron Light Sources in Studying Infectious Diseases Prevalent in Africa

2.2 Materials for Energy Applications

2.2.2 Solar Energy

2.2.3 Rechargeable Batteries

2.3 Geoscience

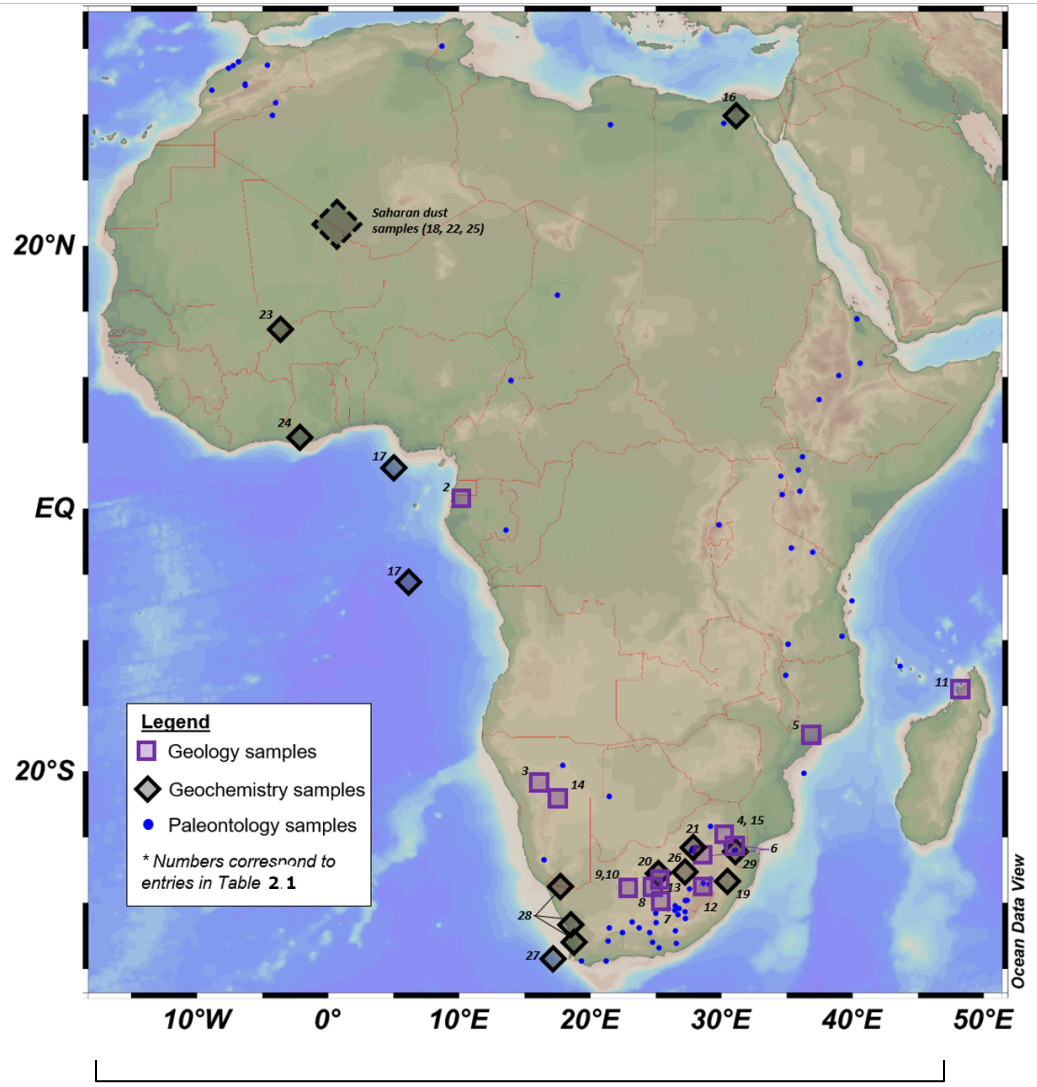
2.4 Environmental Science

2.5 Plant and Soil Science

2.6 Palaeontology and Archaeology

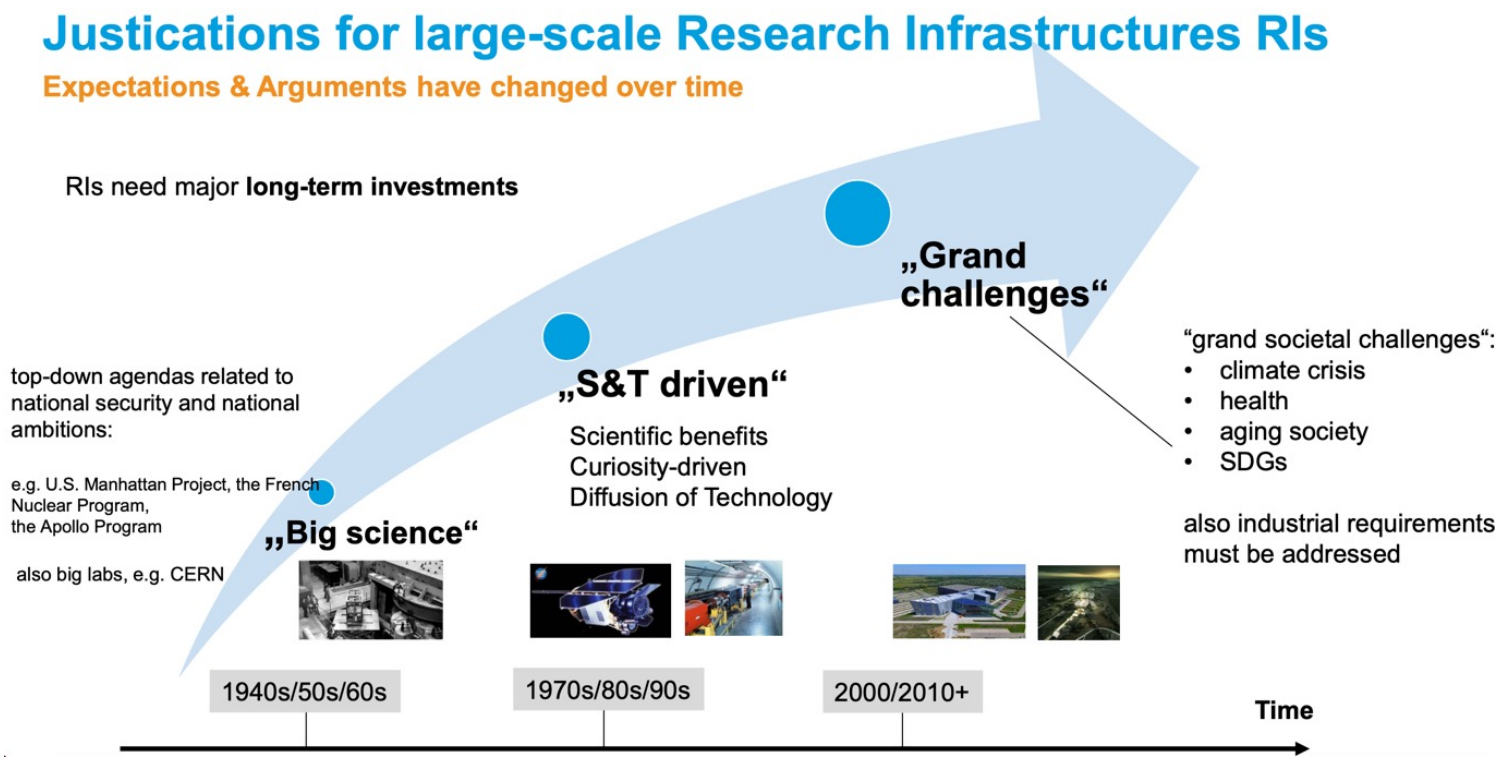
The Africa Light Source Foundation

Towards a Lightsource for the African Continent



Distribution of African Earth science sample materials that have been investigated utilising synchrotrons (*Figure from Bjorn von der Heyden*)

Chapter 3: Social and Economic Benefits



History of Big Science Infrastructures
(Figure Courtesy of DESY)

Social and Economic Benefits (cont'd)

3.1.1 Disease Prevention and Cure

3.1.2 Food Security

Improvements in food and packaging characterisation; structure determination of products, including chocolate, oils and fats; and determining the oxidation states of products used for agriculture .

3.1.3 Clean Energy

AfLS would prove to be a powerful tool for developing materials and processes, including batteries, fuel cells, catalysts and catalytic processes.

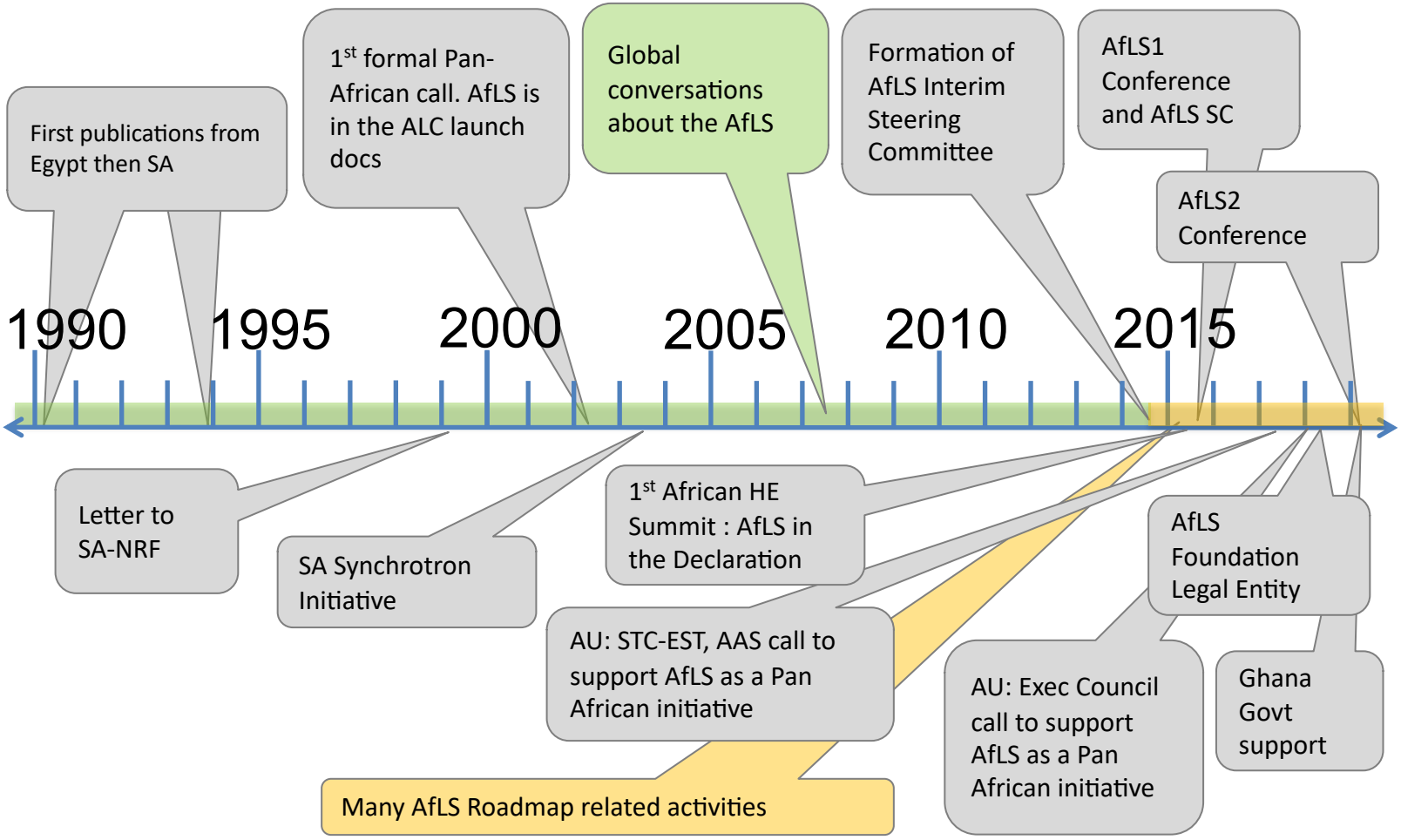
AfLS would characterise sources of ecological damage, such as CO_2 and asbestos, and develop catalysts and materials to convert them to less harmful products.

3.2 Economic Benefits

According to Andrew Harrison, Former CEO, Diamond Light Source

"For every English pound put into the facility, 3.5 pounds come back into the economy."

Chapter 4: History of the African Light Source



The Africa Light Source Foundation

Towards a Lightsource for the African Continent

Group Photo of the *1st African Light Source Conference and Workshop*

ESRF, Grenoble, France, 2015

Why is an AfLS essential?

ource

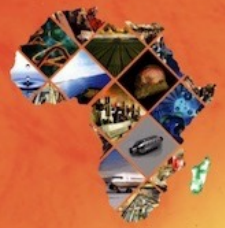
The Grenoble resolutions

- Advanced light sources are the most transformative scientific instruments, similar to the invention of conventional lasers and computers.
- Advanced light sources are revolutionising a myriad of fundamental and applied sciences, with an accompanying impact on sustainable industry.
- The community of researchers around the world are striving collaboratively to construct ever more intense sources of electromagnetic radiation, specifically derived from synchrotron light sources and X-ray free-electron lasers (XFELs), to address the most challenging questions in living and condensed-matter sciences.
- The African Light Source is expected to contribute significantly to the African science renaissance, the return of the African science diaspora, the enhancement of university education, the training of a new generation of young researchers, the growth of competitive African industries, and the advancement of research that addresses issues, challenges and concerns relevant to Africa.
- For African countries to take control of their destinies and become major players in the international community, it is inevitable that a light source must begin construction somewhere on the African continent in the near future, which will promote peace and collaboration among African nations and the wider global community.

The Africa Light Source Foundation

Towards a Lightsource for the African Continent

Papers Published by AfLS Participants



Chapter 5: Local Technical Infrastructures and Human Capacity Building

5.1 African Laser Centre (ALC, *https://africanlasercenter.org/*)

To Transform the Laser Community in Africa

5.2 Atomic, Molecular and Optical Sciences Network (LAM Network)

To Develop Optics and Photonics in Africa (https://lamoptinet.org/)

5.3 Lightsources for Africa, the Americas, Asia, Middle East and Pacific (*LAAAMP, https://laaamp.iucr.org/*)

To Enhance the Utilisation of Crystallography and Advanced Light Sources in the Developing World

5.4 X-TechLab (*https://www.xtechlab.co/)*

To Transform Crystallography Research and Training in Africa

Local Technical Infrastructures and Human Capacity Building (cont'd)

5.6 ICTP School on Synchrotron Light Sources and their Applications

https://indico.ictp.it/event/10057/ 23 Jan – 3 Feb 2023 (Free Virtual School)

5.9 African Crystallographic Association

(AfCA, *https://www.iucr.org/outreach/africa/afca/*)

To advance science on the African continent via crystallography

5.10 BioStruct-Africa (*https://www.biostructafrica.org/*)

To build capacity in the field of structural biology for Africa-based scientists.

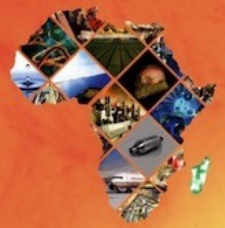
5.11 Synchrotron Techniques for African Research and Technology

(START, *https://start-project.org/*)

Seeks to foster the development of synchrotron techniques for African research and technology, with initial emphasis on structural biology and energy materials.

Continued Support from the African Physical Society

Inaugural AfLS Council, Dakar, Senegal, *January 2010*



Chapter 7: Proposed Statutes of the African Light Source

ARTICLE I Purpose and Functions

ARTICLE II Membership and Participation

ARTICLE III The Council

ARTICLE IV Standing Committees

ARTICLE V Directorate

ARTICLE VI Duties of the Director-General

ARTICLE VII Legal Status

ARTICLE VIII Financial Arrangements

ARTICLE IX Contributions

ARTICLE X Other Contributions from the African Union *et al.*

ARTICLE XI Loss of Membership

ARTICLE XII Final Clauses

Chapter 8 4th Generation Synchrotron Light Source Accelerator

Explain why 4th Generation Multi-Bend Achromat (MBA) lattices improve electron beam emittances compared to 3rd Gen.

Describe a prototype 3 GeV, ~500 meter, ~100 psec horizontal emittance storage ring.

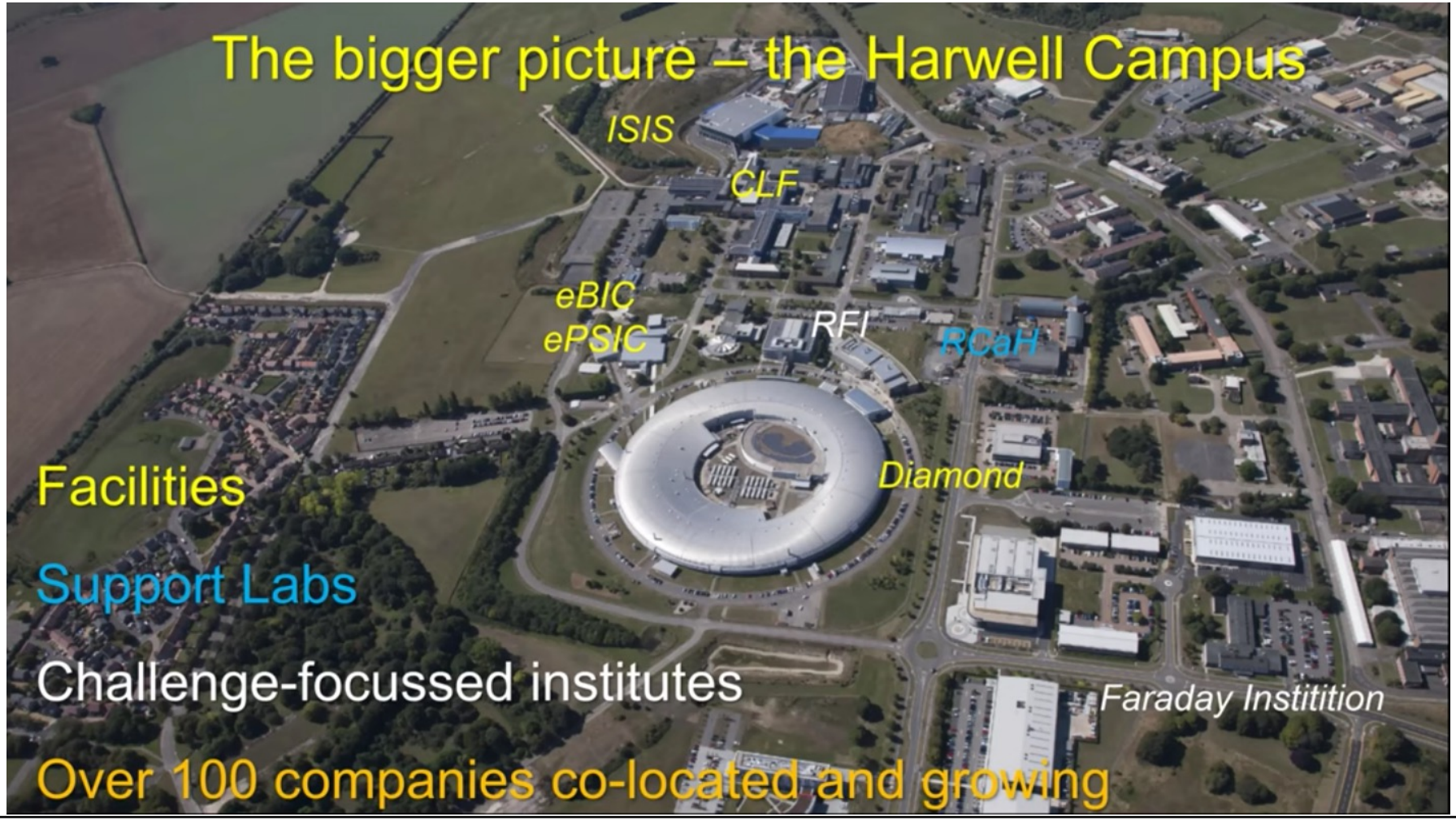
Describe Ancillary Requirements

- ***Offices***
- ***Food Services***
- ***Guest Housing***
- ***Water***
- ***Waste Disposal***

Describe Electrical Power Plant

- ***Provide schematic for a nominal 10 MW Solar Power Plant à la SESAME.***

Chapter 9: Integrated Science and Technology Park



Chapter 10: Recent Beamline Experiments Sponsored by *LAAAMP*

10.1 Study of Diagenesis in Ancient Egyptian Bones

Ahmed El-Hussein and Mostafa Zeidan (Student)
National Institute of Laser Enhanced Sciences, Cairo University, Egypt
Research Conducted at the ALBA Advanced Light Source, Barcelona, Spain

10.2 Study of Materials for Possible Energy Applications

Diouma Kobor and Ndèye Coumba Yandé FALL (Student)
University Assane Seck of Ziguinchor, Senegal
Research Conducted at the ESRF, Grenoble, France

10.3 Study of Nano-Crystalline WC-Co Films

Oluseyi Philip Oladijo and Resego Phiri (Student)
Botswana Int'l U. of S&T, Gaborone, Botswana
Research Conducted at the Synchrotron Light Research Institute
Nakhon Ratchasima 30000, Thailand

Recent Beamline Experiments Sponsored by LAAAMP (cont'd)

10.4 Determining the Spectra and STXM Images of HAp, TiO_2 and the Composite HAp/TiO_2

María Josefina Robles Águila and Ana Karen Sánchez Hernández (Student)
Benemérita Universidad Autónoma De Puebla, Mexico
Research Conducted at the Canadian Light Source

10.5 Applications of XAS to Studies of ZnS Sphalerite Material and Cameroon Volcanic Ashes

Bridinette Thiodjio Sendja and Tchana Kamgne Duclair (Student)
University of Yaounde I, Cameroon
Research Conducted at Elettra Trieste, Italy

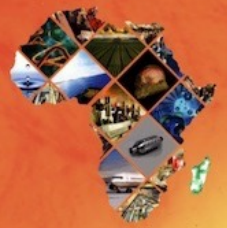
Chapter 11: Summary

To be extracted from

The Concept of Ubuntu and African Identity in the Development of Initiatives in Africa

by

Gihan Kamel, Oumar Ka, and Prosper Ngabonziza



THANKS FOR YOUR KIND ATTENTION!

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