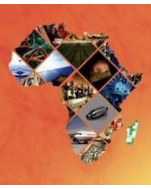
The African Light Source Virtual Workshop
Towards a brighter future



The African Light Source Virtual event (AfLS2020)

18 – 20 November 2020

Zoom Meeting – 2.5 hours from 15:00 CAT

http://afls2020.africanlightsource.org

Introduction

The AfLS2020 took place as a virtual event in over the three days of 18-20 November, Wednesday to Friday, 2020, as a Zoom Meeting. The virtual online event was a replacement for the postponed AfLS3 African Light Source conference planned for the same week. The conventional meeting was postponed by one year due to the COVID-19 Pandemic. The virtual event was attended by up to 140 scientists, students, politicians and funding representatives from around the world. The AfLS2020 virtual event was very compact, but nonetheless had several very noteworthy features. Four excellent multidisciplinary examples of excellent science very relevant to Africa were presented by Africans and Africans in the diaspora. There as a landmark session by partner-stakeholder organisations within the AfLS umbrella, where the significant progress of the capacity building, networking and regional infrastructure development could be highlighted. There was a further landmark session where the surge of support, in the form of Letters of Support (LoS) and Memoranda of Understanding (MoU), from Advanced Light Source (AdLS) facility directors and national and international organisations could be catalogued and the given profile. This session included presentations noting recent research highlights and messages of advice and wisdom from five selected AdLS facility directors. The LoSs and MoUs represent an important milestone on the Roadmap to the AfLS. Each message in the written communication is a source of inspiration and yet another expression of the strength of the mandate the AfLS has to realize the vision of an AdLS on the African continent, as well as a statement of the partnership in this process. The International Advisory Committee (IAC) had been recently formed and was officially launched in the virtual event. Another important milestone was a presentation launching the structure

and process for development and production of the Conceptual Design Report (CDR). The official opening was also not without very noteworthy contributions. It was combined with the official opening of the virtual event of the African Physical Society (AfPS). It also included the official launch of the African Strategy for Fundamental and Applied Physics (ASFAP), Lastly, one final point to note in this introductory paragraph is a further expression of support for the AfLS from the Ghanaian Government, delivered in the opening by the Honourable Minister: Environment, Science, Technology & Innovation - Prof. Kwabena Frimpong-Boateng. The following sections of this report go into further details for each of the points raised. Taken together, it was indeed a momentous and successful meeting.

This AfLS2020 follows the first and second African Light Source Conferences held at the European Synchrotron Radiation Facility (ESRF) in Grenoble in November 2015 and the University of Ghana in Accra, Ghana in January 2019 (AfLS1 and AfLS2). During this first meeting, the roadmap towards the ultimate establishment of an African Light Source was developed, together with a Steering Committee which had both a large African and global footprint. The Roadmap related to developing the user base, the scientific projects, deep capacity building, promoting networks, scientific and technical exchanges, building associated local infrastructural capacity, raising the profile of the project politically and developing the Pan-African strategic plan with involvement of African national governments and also Pan African structures. It therefore had both top-down and bottom-up components in progressing the Roadmap. It also involved the production of both the CDR and then the more detailed Technical Design Report (TDR). It is clear then that the AfLS2020 represents a considerable marking of milestones in terms of the original Roadmap.

Analysis of the Delegate Composition

The Virtual online event was hosted by the AfLS using its Zoom account. The website was managed with the Indico Conferencing system. The Zoom pre-registration showed 399 delegates planned to attend. This number would include delegates for the AfPS event, where we shared several plenary sessions. The AfLS2020 Conference site http://afls2020.africanlightsource.org had 140 registrations. The Zoom daily attendance data for the AfLS2020 event is then shown in Figure 1 below.

The breakdown for gender, student and faculty is shown in Figure 2 below. This indicates almost a third of the delegates were women. There were four invited scientific talks from different disciplines by senior African or African diaspora researchers, and 75% of these were women. This reflects an effort to move towards the representation of diversity that on would want to see in a future society, consistent with the vision of the AfLS. Just under half the participants were students. The proportional representation of women was higher in the student fraction, indicating a positive trend in the gender balance.

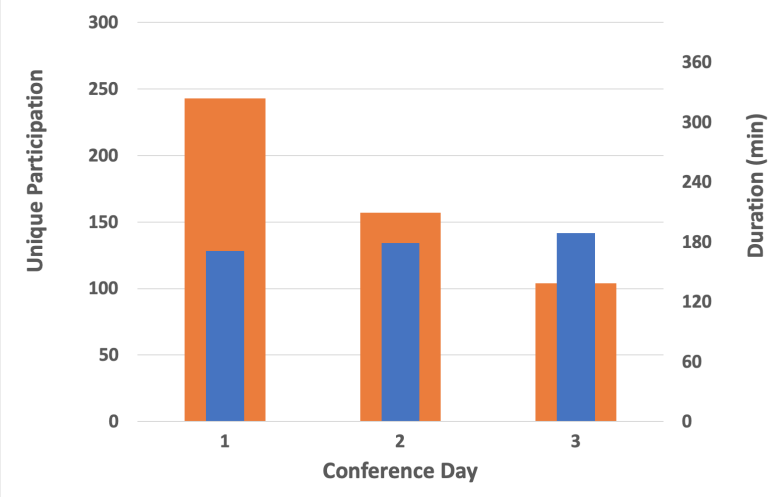


Figure 1. Daily attendance data shown in orange on the left vertical axis for the AfLS2020 virtual event (with shared plenaries with the AfS event) and the time duration of each daily virtual event shown in blue on the right virtual axis, for the three-day duration of the virtual event.

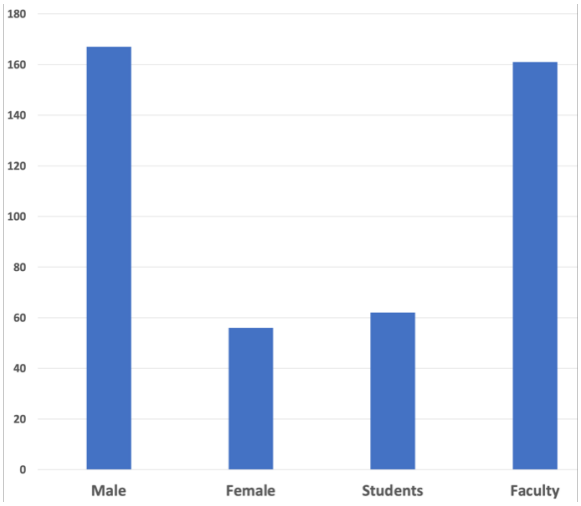


Figure 2. Participation in the AfLS2020 virtual event as broken down by gender and also level of development of career in the delegates.

The allocation of country for the delegates can be ambiguous, as there is a difference between country of origin and current citizenship. When auditing participation in AdLS based science, one finds the African science diaspora has a strong participation, and it is not easy to see the full African participation. Figure 3 shows country of each delegate, which is reflective of the current country of residence. One should keep in mind that the conditions to retain skilled young emerging scientists are not yet pertaining. Nonetheless, there is a substantial African and also a good international participation shown in the delegates

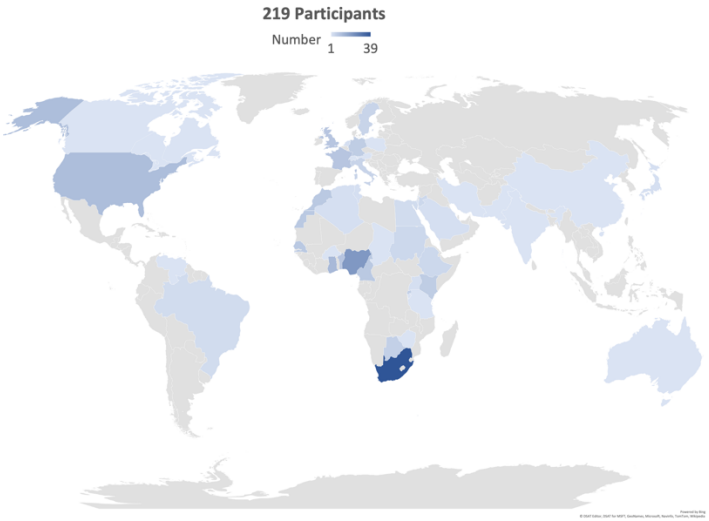


Figure 3. Participation in the AfLS2020 reflecting current country of the delegates.

Discussion of Opening

The opening session of the AfLS Workshop began with the passing of the AfLS Ceremonial Calling Stick. This opening has been maintained since the November 2015 Grenoble conference and marks the vision of African as "well on the road to being a knowledge-based economy at the forefront of innovation". The calling stick was pass by Dr. David Dodoo Arhin to Dr. Tabbetha Dobbins symbolizing the passing of the work from AfLS2 workshop (University of Ghana-Legon) to the virtual workshop.

The first half of the conference featured welcome talks delivered by Dr. Simon Connell representing the African Light Source Foundation, Dr. Amadou Wague representing the African Physical Society, and the Honorable Minister Dr. Kwabena Frimpong-Boateng representing the Ministry of Environment, Science, Technology, and Innovation for the country of Ghana. Another talk in the opening session represented delivered by Dr. Ketevi Assamagan represented the launch of the "African Strategy for Fundamental Physics and Applications (ASFPA)". ASFPA work is to be completed in a one to one and half year duration and will mark the assessment of physics done on the continent of Africa and develop a set of priorities under the various physics topical areas. The opening session was capped off with an excellent scientific talk by Dr. Mmantsae Diale (University of Praetoria) on her research topic of "Synchrotron Radiation-based X-Ray study on energy storage materials: a case for hematite." Dr. Diale inspired a lot of discussion about alternative energy in the landscape of African science and technology.

Discussion of Scientific Talks, African Science

Despite the African continent having a light source of its own, African scientists continue to do excellent work at other facilities as was shown in this conference. From the scientific point of view, the highlights of the conference are the four excellent talks presented by African scientists based both inside and outside the continent. The topics are of relevance to African

Science in fields of Energy materials, Environmental sciences, Structural biology and Paleosciences, and are indicative of the high-quality research enabled by light source facilities. The work presented emanated from the utilization of synchrotron-based techniques such Phase contrast imaging, X-ray Absorption Near Edge Structure (XANES), Protein crystallography as well diffraction.

The talk delivered by Dr Mmantsae Diale (University of Pretoria) titled "**Synchrotron radiation-based X-ray studies on energy storage: a case for hematite**" showed how Africa's energy deficient challenges and its overreliance on biomass can be addressed through clean energy technologies such as hydrogen economy. This novel technology has the potential to keep the environment clean and safe while minimizing impact on climate.

The excellent talk by award-winning Prof Asmeret Berhe (University of California Merced) titled "**Phosphorus dynamics in soil and dust: a XANES applications**" showed how XANES, a light source-based spectroscopy technique, can be utilized to help understand the effects of changing environmental conditions on the essential soil processes in particular the phosphorus cycle in soil. With Africa's many rural communities relying on crop farming for their livelihood, this study has a potential to improve crop productivity hence it is of great relevance to the continent.

A brilliant talk by Dr Thandeka Moyo (National Institute for Communicable Diseases) titled "**The structural biology landscape in South Africa: what role do synchrotrons play in African Science**'' gave a brief overview of Structural biology labs in South African and the different activities they are involved in. Of particular interest and relevance to Africa was the work on HIV which aims to understand the role of neutralizing antibodies within the context of vaccine and drug development. Based on this excellent talk, the future is bright for growth of Structural biology on the continent and the fight against the pandemic and other diseases ravaging the African continent is promising.

In Paleo Sciences, synchrotron-based phase contrast imaging technique proved to be an indispensable tool for non-destructive investigation of fossilized materials. The talk by Dr Kudakwashe Jakata (ESRF)) titled "**Paleontology enabled by synchrotron light sources**" showed why high-energy radiation and high-resolution makes it possible to study fossil materials to high level of details. The talk gave us a glimpse into our distant past while showcasing the rich African heritage in Paleontological sciences and the large footprint on the continent (with samples from Kenya and South Africa to mention a few countries).

Discussion of LoS and MoU

The following are the Memoranda of Understanding (MoUs) and Letters of Support (LoSs) received by the African Light Source (AfLS) in the leadup to the AfLS2020 Virtual Event (18-10 Nov 2020). This represented a launch of the explicit written support for the AfLS by many institutions organisations in Africa and Internationally. The ordering recorded below is the

according to the time of receipt of the document, with the most recent at the top of each table.

Memoranda of Understanding

Advanced Light Source Facilities

SESAME	Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME)

International Institutions / Organisations

LAAAMP	Lightsources for Africa, the Americas, Asia and Middle East and the Pacific (LAAAMP)

Letters of Support

African Institutions / Organisations

	African Crystallography Association Steering Committee (AfCA-SC), Africa
	Ghana Academy of Arts and Sciences, Ghana
	African Seismological Commission (AfSC), Africa
	International Union of Geodesy and Geophysics (IUGG), Africa
NASAC	Network of African Science Academies (NASAC), Africa
	South African Institute of Physics (SAIP), South Africa
	Ministry of Environment, Science, Technology & Innovation (MESTI), Ghana
	Federation of African Medical Physics Organizations, FAMPO, Africa
	Mbarara University of Science and Technology, Faculty of Science, Uganda
AfPS	African Physical Society (AfPS)
	BioStruct Africa, Africa

AFRICAN MRS	African Materials Research Society (AMRS), Africa

Advanced Light Source Facilities

diamond	Diamond Light Source, UK
LSU CAMD	Centre for Advanced Microstructures and Devices (CAMD) Louisiana State University, USA
European XFEL	European XFEL , Europe
PAUL SCHERRER INSTITUT PSI	Paul Scherrer Institute (PSI), Switzerland
Elettra Sincrotrone Trieste	Elettra Sincrotrone Trieste, Italy
CERN	European Organization for Nuclear Research (CERN)
ESRF	The European Synchrotron Radiation Facility (ESRF)
MAX IV	MAX IV laboratory, Sweden
SOLEIL SYNCHROTRON	Synchrotron SOLEIL, France
NSLS-II	National Synchrotron Light Source II (NSLS II), USA
ANSTO	Australian Synchrotron (ANSTO), Australia
	Singapore Synchrotron Light Source NUS
NSRRC	National Synchrotron Radiation Research Center (NSRRC), Taiwan

International Institutions / Organisations

ICTP	International Center for Theoretical Physics (ICTP)
IUPAC	International Union of Pure and Applied Chemistry (IUPAC)
IUPAP	International Union of Pure an Applied Physics, (IUPAP)
IUCr	International Union of Crystallography (IUCr)

External National Institutions / Organisations

The Cockroft Institute	The Cockroft Institute of Accelerator Science and Technology, UK)
USPAS	US Particle Accelerator School (USPAS), USA
NSBP	National Society of Black Physicists (NSBP), USA

Discussion of Facility Directors Presentations

One of the most important sessions at the November 2020 AfLS Workshop was the one that invited five advanced light source (AdLS) Directors to offer comments on their experiences in constructing, upgrading and operating their AdLSs and suggestions for the planning of the AfLS. Those who presented were the following:

- Caterina Biscari, Director, ALBA
- Alfonso Franciosi, President and CEO, Elettra
- Andrew Harrison, CEO, Diamond Light Source
- Francesco Sette, Director-General, ESRF
- Khaled Toukan, Director, SESAME.

Caterina Biscari, Director, ALBA

ALBA is a public institution that receives 50% of its budget from the national government and 50% from the regional government. The proposal to build an AdLS was made in 1992. During the preparatory period (1990-2003), persons were sent to other AdLSs for training in order to return when construction started at ALBA. Biscari recommended that African governments start now providing funds to send researchers and students to world AdLSs for training. ALBA started with 7 beamlines, will have 10 operating in 2021, and 3 more are under construction. ALBA is located close to a nearby university. It is important for an AdLS to be well connected to an airport and roads. When ALBA's proposal was accepted in 2003, there were only about 200 users from Spain using AdLSs in other countries. Now there are about 3,000 users from Spain. Two thirds of users come from Spain. Users come from 45 different countries. There are plans to create the ALBA Science, Technology & Innovation Park as shown. To forge greater collaborations, European AdLSs have formed LEAPS (League of European Accelerator-based Photon Sources) as shown in the slide.

Alfonso Franciosi, President and CEO, Elettra, Italy

Elettra started from funds left over from a previous allocation to bid on a European AdLS that eventually became the ESRF in France. Elettra is the only AdLS that operates at two different energies: 2.0 and 2.4 GeV, depending on the request of the users. Currently, Elettra operates with 27 beamlines, with a third of the beamtime for internal use, another a third for competitive proposals and the last third for international users. It has one of the few beamlines in the world that can be used to image human patients, with higher specificity, improved image quality, and large reduction of X-ray dose. Elettra received funding for a 400

meter seeded XFEL (world's only), as opposed to the self-amplified version at other facilities. Hence, it has a higher stability of pulses. It has two beamlines: soft X-ray and Extended UV. Franciosi that a threshold for Africa of about 100 users would be sufficient to keep a few beamlines busy as a start. He suggested for the AfLS:

- Select a type of legal entity that will allow some measure of flexible operation and administration
- A solid primary national sponsor/host will be needed
- Pursue an international approach and involve institutions from neighboring countries capable of providing collaborations (a critical mass is needed, not just funds)
- Looking for scientific "niche markets" will help characterizing what your have to offer
- Innovative funding instruments should be explored
- (development loans)
- Involve companies as early as possible
- International organizations (UNESCO, IAEA, etc.) are often bureaucratic, but contain "true believers" who can help

Andrew Harrison, CEO, Diamond Light Source

The UK had the world's first synchrotron facility at Daresbury. The government wanted to know what was in it for industry and society; however, industrial partners lobbied the government for Diamond. For every English pound put into the facility, 3.5 pounds come back into the economy. Diamond Light Source Ltd. was created in 2002 as a Joint Venture between the UK government (86%) and Welcome Trust (14%). They had to ensure that the beamlines were tailored to the specific needs of UK researchers and industry. Construction started in 2003, with the first light in 2007. They built 33 beamlines in 3 phases. There are about 6,000-7,000 users per annum, accounting for about 12,000 visits, with about 40% remote. Engagement with industry has been extremely important. About 170 companies pay for access. 30% of all competitive beamtime involves industry. They established DISCo (Diamond Industrial Scientific Council), an advisory body drawn from key companies across several industrial sectors. Diamond encourages industry–university collaborations. An industrial park has grown up around Diamond.

Francesco Sette, Director General, ESRF

The ESRF, which is located in Grenoble, France, is funded by 23 partner countries, with France and Germany contributing the largest shares of the budget at 27% and 24%, respectively. Among the partners, there are 13 that are considered Member States, with each contributing at least 4% of the ESRF budget. The remaining 10 partner countries include South Africa, which contributes 0.3% of the budget. The ESRF recently received a 150 million Euro upgrade that includes a new high energy X-ray storage ring called the Extremely Brilliant Source (EBS), accompanied by new state-of-the art beamlines, major new scientific instrumentations, and a new data strategy to fully exploit the performances of the EBS. The EBS has been operating since August 2020. Number one among the top ten scientific discoveries listed by Smithsonian Magazine in 2019 was the new human relative, Australopithecus Sediba, which was studied at the ESRF. One of the goals of the EBS is to uncover the brain circuitry at the neuronal level to understand learning, cognition processes,

and neurological diseases by resolving neural circuits to the synaptic level and enabling rapid imaging of large tissue volumes. Another goal is to chart the path to manufacturing faster, better and safer batteries by studying the evolution of atomic structure at extremely fast charging/discharging rates and enabling a direct connection with sample processing and AI-driven smart design. Finally, the ESRF will continue training the next generation of scientists to continue tackling global challenges through the use of synchrotron science, thereby ensuring a sustainable and peaceful future.

Khaled Toukan, Director, SESAME

In early 1995, scientists from Egypt and Israel met to promote scientific cooperation in the region. An AdLS was chosen as an international facility in the region since, it can accommodate researchers from many disciplines. No single country in the Middle East could have constructed an AdLS on its own, so cooperation was essential. UNESCO stepped in to support the project in 1999 and established an Interim Council under the Presidency of Herwig Schopper, former Director-General of CERN. SESAME officially came into existence on 15 April 2004. Jordan was selected as the location after a competition with five other countries. SESAME has had a major impact on politics in the region. It is a 3rd generation AdLS. The original proposal was to use the old BESSY I AdLS from Germany; however, they decided that it would not be wise to accept a 20 year-old machine. Rather, it would be better to construct a new one. Experiments started in 2018 with the six beamlines below:

- The (XAFS/XRF) X-ray Absorption Fine Structure/ X-ray Fluorescence Spectroscopy
- The IR (Infrared Spectra Microscopy)
- The MS (Materials Science)
- MX (Macromolecular Crystallography)
- Soft X-ray Beamline {HESEB)
- Tomography Beamline (BEATS)

The first 3 are active already and the last three are still in progress

At the first Users meeting, there were only about 50. Now there are about 500 applications to participate and about 200 attend. SESAME has users from Africa, representing Egypt, Kenya, and South Africa. SESAME has helped to reverse the brain drain from the Middle East; however, some researchers trained at SESAME go elsewhere in the world to work, while others trained elsewhere in the world come to SESAME to work. The net increase in the number of users shows the human capacity-building resulting from SESAME. Many university professors find it advantageous to collaborate with researchers from around the world based upon the work at SESAME. Technological challenges have been mitigated by the assistance and collaborations from other international facilities like CERN and Soleil. The biggest challenge has been economical, given the political instabilities in the region.

Discussion of the CDR Launch

The CDR is one of the most significant documents envisaged for the Roadmap of the AfLS. This document concretises any conversation with African governments, Pan African organisations, and any national and international organisations. Its intended audience includes policy makers, politicians, academics, engineers, technicians, business persons,

industrialists, financiers, strategic thinkers, all possible stakeholders and stakeholder organisations and of course, the general public. For many large-scale multinational research infrastructures, the true day zero, from which the path to the actual commissioning of facility could be dated, is in fact the date of completion of the CDR. This will represent the transition from a dream to a vision that has been concretised and described in detail. Its motivation, its context, its purpose, and its content. The CDR will still not indicate the site and the source of funds of the future AfLS facility. However, it will indicate the criteria for site selection. Furthermore, it will include and a reasonably accurate conception of the what must be constructed, including all site preparation, supporting infrastructure and staff requirements. This means the CDR enables and concretises the real detailed conversations from the political level, through the scientific level, to all other levels, engineering, technical and financial.

It is very important that the AfLS2020 virtual event represented a launch of the CDR structure and process. As to the structure, four volumes are envisaged.

Volume I. Scientific, Socio-Economic, Educational and Political Benefits

1. Science Case
2. Socio-Economic Benefits and Impact
3. Educational Benefits/Human Capacity Building
4. Enhancement of Governmental Policies
5. Roadmap Forward

Volume II. Machine Design Concepts

1. Lessons Learned from Global AdLSs
2. Machine Components
3. Other Facilities

Volume III. Scientific Capabilities and Beamline Technical Concepts

1. Gamma-ray Spectroscopy and Crystallography
2. Macromolecular X-ray (MX) Crystallography
3. Materials and Chemical Crystallography
4. Micro-crystallography
5. Small/Wide-angle Scattering (SAXS/WAXS)
6. Powder X-ray Diffraction (PXD)
7. X-ray Spectroscopy (XAS/XES, XAFS, EXAFS, XANES, XFS, Auger)
8. UV-vis, Electronic and Optical Spectroscopy
9. Infrared Spectroscopy
10. Pump-probe, Multi-color, and Time-resolved techniques
11. Computed Micro- and Nano-Tomography
12. Surface Microscopy and Imaging
13. Beamlines for Medical Use
14. Experimental Hutch Mechanical Systems
15. Detectors and Electronics
16. Data Handling, Algorithms, Software and Analysis
17. Theory Centres
18. Other Technical Capabilities for other Instruments, Fields of Study and Innovations

Volume IV. Technical Infrastructure and Building Design

1. Site Selection Criteria

2. Conceptual Design Specifications
3. On-site User Support Facilities
4. Computational infrastructure

Volume V. Multinational Project Finance and Governance Concepts

These volumes are presented in terms of the detail of their chapter content in the AfLS Website, CDR section.

The procedure for the production of the CDR will embody the African concept of *ubuntu*. This means, it will be a document by the community for the community. The procedure will be explicitly consultative, democratic and inclusive. Each volume of the CDR will have its own Sub editor, and there will be an overall CDR Editor. Each chapter or sometimes each group of chapters of the various CDR Volumes will have their own set of Lead authors. The Lead authors have the dual roles of Convenors, to take the lead in arranging virtual online well-advertised and carefully planned Community Consultative Workshops (CCWs). The CCWs reach out to the community, on a per discipline basis, inviting all to become Co-authors. Each of the Co authors or groups of Co authors submit at the Workshop a Letter of Interest (LoI), supported by a presentation. The LoI and presentations define the research and science the community would like to do, or any other aspect of the CDR where they make input. The community will have the opportunity discus this in the context of similar or related presentations. The Lead Authors can then facilitate collaboration among Co authors and groups of Co authors, if they choose to accept this. Ultimately the Co authors will then produce White Papers. The White Papers motivate and describe the contributions of the (groups of) Co Authors. These will be the final outcome of the CDR Workshops, as mentioned before, on a per discipline basis. The White Papers will be peer reviewed. This step assures the (groups of) Co authors retain their rights to recognition of their role in the CDR production process. It establishes the full authorship of the CDR, including the Editor, Sub editors, Lead authors and Co authors. The AfLS will edit, arrange the reviewing of and produce a dedicated Volume for the publishing of the White Papers. The particular Journal for this part is still under discussion, it will however be an African publication. The Lead Authors, under supervision of the Sub Editors, will join the White Papers smoothly into the content of the four volumes of the AfLS CDR. The CDR editor of course has overall responsibility for the CDR. The CDR Editor and Sub editors will take the material of the White Papers as processed by the Lead Authors and retire for several months together in a context of an Institute of Advanced Study funded working visit. The identification of the Editor, Sub editors, and Lead Authors nearly complete. We hope to launch the advertisement of the per-discipline CCWs early in the next year. The CDR is planned for completion by the end of 2021.

Discussion of the Launch of the IAC

The IAC was launched at the AfLS2020 Virtual Workshop on the 20th November 2020. The role of the IAC is paramount in supporting the endeavour of the AfLS. Figure 4 below shows a screen shot of the actual launch during the virtual event. The speakers visible on the right panel are Dr Khotso Mhokele, the interim Chair of the IAC, and Prod Simon Connell, the

current Chair of the AfLS Steering Committee Executive, Dr Ken Lutterodt, the Session Chair and Prof Sekazi Mtingwa, the AfLS Deputy Chair. The main panel is a screen shot of the first meeting of the IAC, four days earlier. This shot also shows Dr Ed Mitchell, the Chair of the AfLS Committee that formed the IAC. The main panel has been annotated to indicate the Membership of the IAC. There are currently nn members, in alphabetical order, Prof Hitoshi Abe (Japan), Prof Caterina Biscari (Italy), Prof Tom Blundell (UK), Prof Jim Gates (US), Prof Rolf Heuer (Switzerland, Prof Khotso Mokhele (SA), Dr Melissa Denecke (UK), Dr Daniel Nyanganyura (Zimbabwe), Prof Francesco Sette (Italy), Prof Mary Teuw Niane (Senegal), and Prof Harry Westfahl Jr (Brazil),

The key missions of the IAC are to

- Provide advice and recommendations on all scientific, technical and capacity-building issues during the completion of a conceptual design report for the African Light Source.
- Promote the high-level liaison and networking at national, pan-African and high-level world institutions to drive forwards a Light Source for Africa.
- Engage in incisive strategic reflections ensuring wisdom and judgement in developing the actions to be implemented by the AfLS Committees.

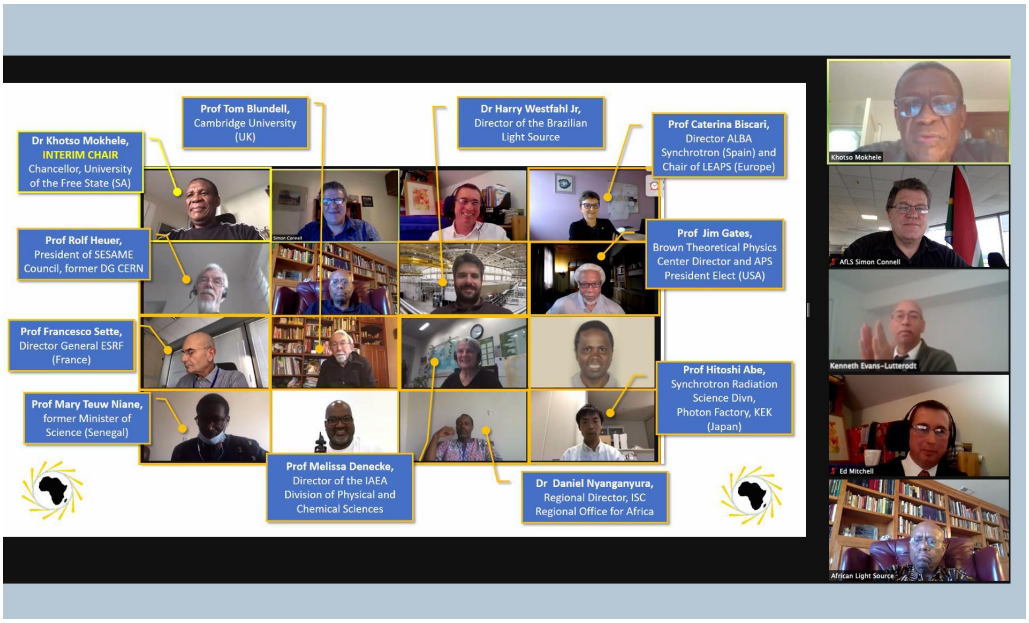


Figure 5. A screen shot of the actual AFLS IAC launch during the AfLS2020 virtual event. The Membership of the IAC and further details are to be found in the text.

As mentioned before, the Chair of IAC of the AfLS is Dr Khotso Mokhele. He has obtained his PhD (Microbiology) from the University of California, Davis, USA in 1986 and has performed Post-Doctoral study firstly at the Johns Hopkins University School of Medicine (1986-1987) and secondly at the University of Pennsylvania School of Medicine (1990/91). His current roles include: Chairperson of the Advisory Council of the African Open Science Platform, Chairperson of Boards of Directors two companies listed on the Johannesburg Securities Exchange (Tiger Brands Limited and AECI) and the President of the Hans Merensky Foundation. His previous Relevant Roles include : Chancellor of the University of the Free

State, South Africa (2010-2020), President of the Foundation for Research Development of South Africa (1996-1999), Founder President of the National Research Foundation of South Africa ((1999-2006), Founder President of the Academy of Science of South Africa (1996-1999), Member of the Executive Board of UNESCO, Representing South Africa (1997-2001), Vice President for Scientific Planning and Review of the International Council for Science (ICSU) (2005-2008), Chairperson of the Board of Directors of Impala Platinum Holdings (2009-2015) and Adcock Ingram (a Pharmaceutical company) (2008-2016). Dr Mhokele has broad experience of in research policy leadership. For example, he was founding president of the National Research Foundation (NRF), the South African funding agency at the time of South Africa's new democracy. As President of the NRF, Dr Mhokele led the fundraising and formation of the consortium to build the Southern African Large Telescope (SALT) (a 10 metre Class Optical Telescope) in Sutherland, South Africa. The success of this project provided the platform that South Africa used to launch the bid to host the Square Kilometre Array (SKA) Telescope. Dr Mhokele provided strategic leadership to the iThemba LABS (Laboratory for Accelerator Based Sciences), one of the national research facilities managed by the NRF. Indeed we wis the IAC Chair and his Committee

Partners, Stakeholder Activities and African Profile

There are several categories of stakeholders in the concept of an African light source, ranging from national governments and the African Union, universities, corporations on the continent, and several Pan African and global scientific professional societies.

In 2019, the President Akufo-Addo of Ghana engaged the light source by pledging to champion the project in the African Union. In 2020, the science minister, Dr. Kwabena Frimpong-Boateng, reaffirmed Ghana's support for the African light source. He went beyond the 2019 commitment and said that an African light source is a flagship project of the Ghanaian government. He committed the government to creating an office of African Light Source affairs with the University of Ghana. This office would have the mandate to, *inter alia*, advise the government as it makes the African light source a continental project similar to the Square Kilometre Array.

The South African government has supported the human capacity development in light source related sciences. South African maintains an active scientific associate status in the European Synchrotron Radiation Facility (ESRF). South African is also entertaining the prospect of membership in the European Spallation Source (ESS). ESS membership would complement South Africa's plans for the neutron source facility at the SAFARI-2 reactor. South Africa has an active grant with Diamond Light Source to develop human capacity and produce research results in the areas of structural biology and materials science. The University of Cape Town operates a cryoEM center (named after Nobel Laureate Aaron Klug), and the Nelson Mandela University operates a transmission electron microscope facility.

Ghana to champion African Light Source – Akufo-Addo

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President Akufo-Addo

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 the Joint Second International Conference of the African Light Source (AfLS2) and Pan African Conference on Crystallography (PCCr2) in Accra.

Above Left : 2019 Announcement by Ghanaian President Akufo-Addo that Ghana will champion the African Light Source project, Above Right, Ghanaian Science Minister Dr. Kwabena Frimpong-Boateng, speaks in the opening session of AfLS2020.

Upon being briefed on the African light source project, the government of Benin funded X-Tech Lab, a national laboratory for crystallography training and research. Since its inauguration, the X-Tech Lab has held several training courses in crystallography techniques and in mathematical engineering relevant to X-ray imaging.

In 2012, the Botswana government created the Botswana Institute for Technology Research and Innovation (BITRI, a parastatal under the Ministry of Tertiary Education, Research, Science and Technology. Its mandate is to conduct needs-based research, development, and sustainable problem solving in the areas of building materials science, nanotechnology, climate change. In the doing, BITRI scientists have used light source related methods to solve problems touching on all these areas.

In 2011 the Zewail City of Science, Technology and Innovation began operation in Egypt. The government called it a National Project for Scientific Renaissance. It consists of a university, several research institutes containing various research centers, and a technology park. The academic programs include biomedical, Earth, space, environmental, and materials sciences. Three particular relevant research centers are their Center for X-Ray Determination of the Structure of Matter, Center for Imaging and Microscopy, and Center for Materials Science.

On the Pan African, African Union level, we take note of the establishment of the African Center for Disease Control and Prevention. The Ebola crisis and COVID pandemic have shown African the importance of being in a participant in the global structural biology community. The African Light Source Foundation along with Biostruct Africa and a few other Pan African NGOs plan to engage the African CDC to establish an Institute of Structural Biology within the agency. Through this institute, the partners hope to focus government and donor support for researchers in chemistry, biochemistry, molecular pharmacology and other fields towards the elucidation of molecular pathologies and therapeutics relative to African health outcomes.

Several Pan African and global NGOs have initiated programs that are relevant to the African light source project. For instance, the International Union of Crystallography (IUCr) has for a long time been embarked upon its Crystallography in Africa initiative. There have been several schools and two major conferences, one of which was with the African Light Source Foundation in Ghana in 2019. Significant momentum is growing towards establishment of African Crystallographic Association.

IUCr has collaborated with the International Union of Pure and Applied Physics (IUPAP) to fund the project, Utilisation of Light Source and Crystallographic Sciences to Facilitate the Enhancement of Knowledge and Improve the Economic and Social Conditions in Targeted Regions of the World (LAAAMP). LAAAMP's mission is to enhance advanced light sources (AdLS) and crystallographic sciences in Africa, Mexico, the Caribbean, Southeast Asia, Middle East and the Pacific Islands. LAAAMP led directly to X-Tech Lab in Benin as mentioned above. Several researchers in African have benefited from research support from LAAAMP.

Biostruct Africa is an NGO that specifically focused on capacity building in the area of structural biology, i.e., bio-macromolecular crystallography, cryogenic electron microscopy, and several spectroscopies. BioStruct-Africa achieves this by organizing workshops onsite at our partner universities and institutions based in Africa, followed by post-hoc online mentoring of participants. Biostruct Africa has planned workshops with the Federation of African Immunological Societies (FAIS), to raise the incidence of structural biology work being part of molecular immunology research in Africa. The Federation of African Societies of Chemistry (FASCHEM) and Federation of African Societies of Biochemistry and Molecular Biology (FASBMB) are expected to be active in developing molecular biophysics/structural biology capacity in Africa, as will the International Union of Pure and Applied Biophysics (IUPAB). In fact, South Africa submitted a very competitive bid to host the 2023 IUPAB International Congress. While Japan eventually won out, South Africa might have the inside position to win the 2026 congress.

The African Materials Research Society has grown into a vibrant organization with a large bi-annual conference. Across the continent, there are scores of materials scientists working on samples that are ripe for interrogation by neutrons and photons. We can expect several schools and workshops on the applications of small angle X-ray scattering, neutron tomography, and imaging, especially as applied to Earth sciences, biomaterials, and palaeontology.

The Federation of African Medical Physics Organizations (FAMPO) has engaged the African Light Source Foundation on the notions of (1) imaging beamlines that might have actual patient care duty cycles, and (2) an accelerator machine that might have a bleed channel for medical isotope production.

The African Physical Society has recently endorsed the development of a comprehensive African Strategy for Physics. There are several working groups relevant to advanced light sources, including biophysics, materials physics, and accelerator physics. The expectation is

that these working groups, and perhaps several others, will develop strategies that will influence and depend upon an African advanced light source.

Finally, across many scientific disciplines, including astronomy, space and planetary sciences, is the problem of data management. The Square Kilometre Array (SKA) is envisioned to collect more data than what the internet currently contains in terms of bytes of information. Advanced light sources have a similar problem, and data storage, openness and ownership, transmission, and analysis become deep scientific and legal issues. The African Light Source Foundation has been in touch with African Institute of Space and Planetary Sciences to engage on these ICT infrastructures and work rules problems.

The African Union is aware of and supports the notion of the African Light Source. Its first recorded document on the light source originated from the Declaration and Action Plan of 10-12 March 2015, Dakar, Senegal. Article 5.3.2 p 22: recommends establishing a Synchrotron as a centralized African scientific facility. Following this, the Executive Council (32nd ordinary Session 23-26 Jan 2018 in Addis Ababa, Ethiopia) recorded a Decision on the Reports of the Specialised Technical Committees (STCs), specifically for the STC on Education, Science and Technology and called upon Member States to support the Pan-African Synchrotron Initiative.

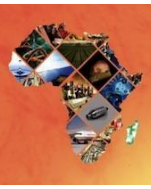
Conclusions

The AfLS2020 was a therefore a milestone event in the Roadmap of the African Light Source. The Community was able to further cement and invigorate their commitment, relationships and networks, across many disciplines of scholarly research and training, as well as industry, and African policy makers. Several milestones were established

1. The formation of the International Advisory Committee
2. The launch of the Conceptual Design Report process
3. The launch of the Letters of Support as well as the Memoranda of Understanding, broadening the mandate of the AfLS.
4. The showcasing of African Science at Advanced Lights Sources, especially by young Africans, representing the diversity of Africa.
5. The showcasing of the support from the community, African and International, towards the African Light Source.

Once again, a solid foundation and progress towards the AfLS was made.

The African Light Source Virtual Workshop
Towards a brighter future



Appendix - Project Financial Report

The summary of income and expenses is outlined below.

Item		Description	Amount
1	Donation Sponsorship	BROOKHAVEN Laboratory	R 152 576.98
2	Donation Sponsorship	Sekazi Mtingwa Zoom Support	R 1 902.44
	Total Income		**R 154 479.42**

EXPENSES

General Conference Running Expenses			
1	Bank Charges	Incoming Brookhaven payment	R 791.00
2	Bank charges	Transaction fees	R 250.00
3	Zoom Subscription	Upgrade to 1000 participants professional version	R 7 041.31
4	Administrative costs	10% Income to cover running and admin expenses	R 15 721.90
Student Support			
5	data - Thabang Lebese (South Africa)		R 455.00
6	data - Lateef Olajuwon Mustapha (Nigeria)		R 455.00
7	data - Christelle Ekosso Mankem (Cameroon)		R 477.75
8	data - Ibrahim Ayodeji Bello (Nigeria)		R 477.75
9	data - Jean Pierre Nkunzwenayo (Rwanda)		R 477.75
10	data - Joseph Asare Awuah (Ghana)		R 477.75
11	data - Happy Abarame (Rwanda)		R 455.00
12	data - Austine Amukayia Mulama (Kenya)		R 477.75
13	data - Tsigie Getie Adane (Ethiopia)		R 477.75
14	data - Chimdessa Gashu Feyisa (Ethiopia)		R 477.75
Total Expenses			**R 28 513.46**
Project Balance			**R 125 965.96**