

PROJECT TITLE: *Growing and Enhancing the Community of Synchrotron Light Source Users in Africa with the Goal of Solving Significant Health, Energy and Other Socioeconomic Problems*

REQUESTED AMOUNT: € 30,000

APPLICANTS

Lead Applicant

Organization: IUPAP

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Supporting Applicants

Organization: ICSU Regional Office for Africa (ICSU ROA)

Contact name & Designation: Dr. Edith Madela-Mntla, Director

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Organization: African Light Source Steering Committee

Contact name & Designation: Prof. Simon H. Connell, Chair

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Other Collaborative Partners

The Abdus Salam International Centre for Theoretical Physics (ICTP)

United Nations Educational, Scientific and Cultural Organization (UNESCO)

The World Academy of Sciences (TWAS)/ *ICSU Scientific Associate*

European Synchrotron Radiation Facility (ESRF), France

National Synchrotron Light Source II (NSLS II), Brookhaven, USA

Office of Diversity & International Services, Brookhaven, USA

United States IUPAP Liaison Committee

Association of Asia Pacific Physical Societies

European Physical Society

American Physical Society

International Union of Crystallography

International Union of Materials Research Societies

Elettra School on Synchrotron Radiation

US Particle Accelerator School

International Centre for Materials Research (ICMR), USA

Interdisciplinary Consortium for Research and Educational Access in Science and Engineering (INCREASE), USA

African Laser, Atomic, Molecular, & Optical Sciences (LAM) Network, Headquarters in Senegal

African Laser Centre, Headquarters in South African

African University of Science and Technology, Nigeria

African Materials Research Society (AMRS)

Optical Society of Tunisia

Synchrotron Research Roadmap Implementation Committee (SRRIC), South Africa
National Research Foundation (NRF), Government of South Africa
Department of Science and Technology (DST), Government of South Africa
South African Institute of Physics (SAIP)
South African IUPAP Liaison Committee
University of Cheikh Anta Diop, Senegal
Moi University, Kenya
Dedan Kimathi University of Technology, Kenya
University of Dar Es Salaam, Tanzania
Kwame Nkrumah University of Science and Technology, Ghana
African Institute for Mathematical Sciences-Ghana (AIMS-Ghana)
National Institute of Laser-Enhanced Sciences (NILES), Egypt
African Physical Society (AfPS)
African Optics and Photonics Society Steering Committee

How will this proposal address ICSU's strategic priorities as defined for the Grants Programme?

Synchrotron light sources (SynLSs) are the most multidisciplinary scientific tool available, empowering studies in a myriad of disciplines, including biology, physics, chemistry, materials science, geoscience, energy, environment, and paleontology. Thus, enhancing the African SynLS user community would address directly ***planning and coordinating research*** by bringing African researchers together with other international researchers to solve such challenges as the Ebola virus and HIV; ***science for policy activities*** by strengthening links to such UN bodies as the World Health Organization and UNESCO, which assisted countries in the Middle East in establishing the SESAME SynLS; and ***strengthening the universality of science*** by building collaborations among African and other researchers to share massive quantities of SynLS data.

PROJECT PLAN

Objectives

The objectives of this proposed project are the following: (1) Ascertain the level of SynLS usage among African researchers; (2) Grow and enhance the use of SynLSs among African researchers; (3) Develop a *Strategic Plan* of short-, medium-, and long-term goals for Africa's SynLS user community to position it for the development of a more detailed and longer-term *Business Plan*; (4) Convene a meeting of African Ministers of Science, Technology, Education, Health, Energy and Natural Resources, representatives from the African research community, and other international stakeholders and interested parties at UNESCO's Headquarters in Paris during 2016 to launch the *African Light Source Business Plan* and update the *Roadmap for Enhancing the African Synchrotron Light Source User Community*, including plans for the possible construction of an African light source.

Project Description

In order to enhance the African SynLS user community, at a November 2015 Workshop at ESRF, an Interim African Light Source Steering Committee (ALSSC) plans to

establish a longer-term ALSSC consisting of representatives from a number of countries. That Interim ALSSC consists of the following: **Simon Connell**, Chair (University of Johannesburg, South Africa); **Tabbatha Dobbins** (Rowan University, USA); **Jonathan Dorfan** (President of the Okinawa Institute of Science and Technology, Japan); **Ken Evans-Lutterodt** (Brookhaven National Laboratory, USA); **Tarek Hussein** (Cairo University); **Brian Masara** (Executive Officer of the South African Institute of Physics); **Krystle McLaughlin** (Lehigh University, USA); **Sekazi Mtingwa** (African Laser Centre, MIT, USA); **Tshepo Ntsoane** (South African Nuclear Energy Corporation and Chair of SRRIC); **Philip Oladijo** (University of the Witwatersrand, South Africa, Nigeria); **Kennedy Reed** (Lawrence Livermore National Laboratory, USA); **Jürgen Härtwig** representing **Francesco Sette** (Director of the European Synchrotron Radiation Facility, France); **Ahmadou Wagué** (University of Cheikh Anta Diop, Senegal, and President of the LAM Network); **Herman Winick** (Assistant Director Emeritus of SLAC National Accelerator Laboratory, USA); **Sverker Werin** (Lund University, Sweden); **Mohammad Yousef** (Cairo University, Egypt). **ICSU ROA will work collaboratively with the new ALSSC to perform the tasks for this proposed project on behalf of IUPAP and its C13 Commission.**

As a starting document, Winick and Mtingwa wrote a paper entitled, *A Synchrotron Radiation Research Facility for Africa*, in which they highlighted the role of SynLSs in the world. SynLSs have revolutionized research in many science and technology disciplines, leading to a proliferation of facilities worldwide. The Website lightsources.org has links to 47 SynLS facilities in 23 countries in various stages of operation, construction or planning. Unfortunately, not one SynLS facility operates in Africa. The largest African user community is in South Africa, and most of that country's users utilize ESRF in France due to its immense capabilities and closeness relative to most other facilities. In 2013, South Africa became an Associate Member of ESRF. To start the process of growing and enhancing Africa's SynLS user community, this project will undertake the following tasks:

Task 1: Develop a Strategic Plan.

The ALSSC will develop a database of African researchers who utilize any of the international SynLS facilities. It will use these data to develop the *Strategic Plan*, which will describe the present state of synchrotron science in Africa and set short-, medium and long-term goals for enhancing it. This will be completed within one year and set the stage for the development of a more detailed *Business Plan*, which will set short-, medium- and long-term goals, including the possibility of the construction of a SynLS in Sub-Saharan Africa. The latter is proposed since countries in North Africa already have close proximity to SESAME in the Middle East; however, they will be full partners in an African Light Source.

Task 2: Establish a SynLS Colloquium Programme.

Drawing from the database of SynLS users, the ICSU ROA will dispatch SynLS users to universities and other institutions and private enterprises for 3-day visits to give presentations on the capabilities of SynLSs and engage in discussions on how they can enhance researchers' investigations. Given the Ebola and HIV crises in Africa, the

Colloquium Programme should be extremely attractive to biological infectious disease researchers and governmental ministries of science, technology, health and education. ***The Colloquium Programme will serve as a recruiting tool for new SynLS users. Also, ESRF has offered to organize meetings, schools, and conferences on its site.*** The Colloquium Programme will assist in recruiting participants for such meetings.

Task 3: Develop a Synchrotron Light Source Informational Brochure.

Many researchers are not aware of the immense potential of SynLSs. Thus, ICSU ROA will appoint qualified people to develop various sections of a brochure that will explain in simple terms the various components of a SynLS, especially the storage ring and beamlines. Next, the brochure will summarize many of the fields for which SynLSs have elucidated phenomena that previously were extremely challenging to understand. SynLSs are front and center in efforts to develop dependable sources of clean energy and the energy storage technologies, such as advanced batteries, that make those technologies accessible. Finally, the brochure will explain in simple terms the various SynLS beamline techniques that are available, such as X-ray diffraction. The brochure will be educational for researchers, students, and various governmental Ministers.

Task 4: Promote and Facilitate Researcher and Student Studies at Various International SynLS Schools and Facilities.

There is a need to train as many students and researchers as possible in accelerator, beamline and instrumentation sciences. This is important, not only to prepare for the possible construction of an African SynLS, but also for African researchers to fully utilize SynLSs around the world. Luckily, there are many 1-2 week schools devoted to these subjects and the applications of SynLSs. In particular, ESRF has offered to organize such training experiences for African researchers and their students, and the Director of the Elettra School on Synchrotron Radiation has solicited applications from African students. Also, there are many possibilities for short- and long-term visits to SynLSs during periods of commissioning, maintenance, operations and upgrades. ICSU ROA and the ALSSC will encourage African governments to take advantage of these excellent opportunities to grow and enhance accelerator and SynLS expertise in their countries. ICSU ROA will administer the logistics of these travels.

Task 5: Convene a Meeting at UNESCO's Paris Headquarters to Present the African Light Source Strategic Plan and Launch the Business Plan.

To conclude the ICSU funding stage of this project, ICSU ROA and the ALSSC will convene a meeting at UNESCO Headquarters consisting of African Ministers of Science, Technology, Health, Education, Energy and Natural Resources; representatives from the African research community; and other international stakeholders and interested parties. The purpose of the meeting will be to present the *African Light Source Strategic Plan* with short-, medium- and long-term goals; set the charge for a more detailed *Business Plan* with short-, medium- and long-term goals, including the charge to ascertain the feasibility of constructing a SynLS in Sub-Saharan Africa; and update the *Roadmap for Enhancing the African Synchrotron Light Source User Community*. A similar meeting at UNESCO successfully launched the SESAME project.

Relevance to Review Criteria

This project directly addresses the five *Review Criteria*. It is *highly relevant to the ICSU Strategic Plan*, as discussed above, especially as regards the search for solutions to major challenges in Africa, such as the Ebola virus, HIV and other infectious diseases, as well as the need for clean and sustainable energy. As stated on its Website, ICSU ROA places top priority on ensuring that scientists from Africa are involved fully in international research programmes. This project accomplishes this and will address three of ICSU ROA's top priority projects, which focus on *sustainable energy, health and human well being* and *global and environmental change*. Acquiring beamtime on SynLSs is extremely competitive and will ensure that the projects granted beamtime will be *innovative and of the highest scientific quality*. Since this is a brand new initiative, it is *highly innovative*, and IUPAP partnering with ICSU ROA and the ALSSC will reach the *broadest possible community of current and potential African SynLS users*. The specified budget will be *adequate and cost effective*. Finally, SynLSs are the most *multidisciplinary* scientific tool in the modern portfolio of research facilities, affording researchers the ability to perform more than 50 experiments simultaneously.

Targeting of Priority Groups

There is an urgent need to involve African researchers in the utilization of SynLSs. *Every habitable continent in the world except Africa has at least one SynLS facility*, with some countries operating a number of them, with on the order of ten in the USA alone. Another measure of their importance is that most countries are involved in continual SynLS upgrades and construction of new facilities. Thus, this project will focus on growing and enhancing the African community of SynLS users so that a critical number of users and projects will lead to an irrefutable need for the construction of an African light source. Consistent with past efforts of the African Laser Centre, LAM Network, African Materials Research Society and other partners in this effort, there will be a focus on engaging women students and researchers in this enterprise. Moreover, those partners will play a crucial role in using their long-established networks to reach students and researchers who find themselves isolated from their international, or even domestic, peers.

EXPECTED RESULTS

This project will make a significant contribution to the growth and enhancement of Africa's SynLS user community and begin the process of evaluating the feasibility of constructing a SynLS in Sub-Saharan Africa. More specifically, this project will do the following: (1) develop a *Strategic Plan* of short-, medium and long-term goals; (2) establish an African Light Source Colloquium Programme, which will be the main recruiting tool for new researchers and students to use SynLSs; (3) develop an informational brochure that describes SynLSs and their many uses; (4) promote and facilitate African students' and researchers' visits to international schools and SynLS facilities; and (5) convene a meeting at UNESCO's Paris Headquarters to present the *African Light Source Strategic Plan* and set the charge for a more detailed *Business Plan* that will include ascertaining the feasibility of constructing a SynLS in Sub-Saharan Africa. The ICSU grant will enhance the visibility of IUPAP's C13 Commission, ICSU ROA and the ALSSC, especially in the eyes of African governmental officials who will

play a crucial role in allocating funds and deciding the future of SynLS usage by African researchers.

ROLE OF SUPPORTING APPLICANTS AND COLLABORATIVE PARTNERS

The roles of ICSU ROA and the ALSSC are delineated above in the descriptions of Tasks 1-5. IUPAP, through its C13 Commission, will ensure completion of the tasks within the 18-month timeframe specified by the grant guidelines. For the project to be successful, it will be necessary to reach out to institutions throughout the African continent and organizations and facilities throughout the world. Hence, the international professional unions and societies have a wealth of information that will be crucial for the development of the SynLS informational brochure. SynLSs worldwide will provide data on African researchers' usage of their facilities. The SynLS schools will continue to offer research and training opportunities for African scientists and students. The various African universities will play leading roles in promoting and facilitating the SynLS Colloquium Programme. The South African governmental agencies have an excellent track record in promoting its SynLS users and will assist in getting other African governments to do the same. Finally, the other African organizations will provide indispensable networks for reaching the most appropriate researchers for exposure to the immense possibilities of SynLSs.

PROJECT SUMMARY FOR ICSU WEBSITE

ICSU will partner with IUPAP and the African Light Source Steering Committee to grow and enhance the African synchrotron light source (SynLS) user community. Recognizing that SynLSs are revolutionizing many fields of study and providing valuable and timely solutions to many seemingly intractable problems, this effort will do the following:

(1) develop a *Strategic Plan* to enhance the African Light Source user community; (2) establish an African Light Source Colloquium Programme to recruit new researchers and students to join that community; (3) develop an informational brochure that describes SynLSs and their many uses, the fields that they impact, and the various techniques that they empower; (4) promote and facilitate African students' and researchers' visits to international schools and SynLS facilities; and (5) convene a meeting at UNESCO's Paris Headquarters to present the *African Light Source Strategic Plan* and set the charge for a more detailed *Business Plan*. In particular, the *Business Plan* will conduct a thorough analysis of the feasibility of constructing a SynLS in Sub-Saharan Africa, recognizing that the countries of North Africa already are located in relatively close proximity to the SESAME SynLS, whose construction is near completion in Jordan. By growing and enhancing the SynLS community in Africa, its many peoples will benefit from the research outputs that will tackle such devastating infectious diseases as the Ebola virus and HIV. Moreover, considerable progress will be achieved in addressing the need for sustainable sources of clean energy and the energy storage technologies, such as advanced batteries systems, that empower those technologies. Thus, a major outcome of this project will be a buy-in by African governments that SynLS facilities will bring major advances in their socioeconomic development.