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Lightsources for Africa, the Americas, Asia and Middle East project (LAAAMP): An IUPAP and IUCr ICSU-funded project

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Lightsources for Africa, the Americas, Asia and Middle East Project (*LAAAMP*): An IUPAP and IUCr ICSU-Funded Project

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Abstract. We describe a new initiative funded by a 3-year, 300K-Euro grant from the International Council for Science (ICSU) to the International Union of Pure and Applied Physics (IUPAP) and International Union of Crystallography (IUCr) in collaboration with over thirty partner organizations that include approximately fifteen advanced light sources to enhance the utilization of advanced light sources and crystallography in five targeted regions of the world, namely Africa, the Caribbean, Mexico, Southeast Asia, and Middle East. *LAAAMP*'s programs include the development of a Strategic Plan for each region; a Colloquium program that sends experienced advanced light source and crystallography users to those regions; establishment of new IUCr-UNESCO Crystallography OpenLabs; design and distribution of a Brochure that describes advanced light sources and crystallography for government officials and the layperson; 2-month Faculty-Student (FAST) Team training visits to advanced light sources, with approximately forty new users participating in 2018; and culminating in a December 2019 meeting to chart a path forward beyond the ICSU grant.

I. INTRODUCTION

In recent years, there has been a tremendous effort around the world, especially in the most developed countries, to construct ever brighter light sources, which we prefer to call advanced light sources (AdLSs), that are based upon either synchrotron electron storage rings or linear free-electron lasers (XFELs). In the Middle East, governments have pooled their resources to construct Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME), which was officially commissioned into service on 16 May 2017.

Among other developing regions of the world, Africa is the only habitable continent that does not host such a facility. Thus, there is an international movement to construct an AdLS somewhere in Africa. During November 2015, researchers from across Africa and other regions of the world assembled at the European Synchrotron Radiation Facility (ESRF) in Grenoble France to convene the *First African Light Source Conference and Workshop*. It was decided to host the meeting at the ESRF so that governmental officials attending could tour an operating AdLS. At that meeting, participants developed a set of resolutions, which they dubbed the Grenoble Resolutions, to provide the *Why?* for an African Light Source. They are as follows:

GRENOBLE RESOLUTIONS

1. *Advanced light sources are the most transformative scientific instruments similar to the invention of conventional lasers and computers.*

2. *Advanced light sources are revolutionizing a myriad of fundamental and applied sciences, including agriculture, biology, biomedicine, chemistry, climate and environmental eco-systems science, cultural heritage studies, energy, engineering, geology, materials science, nanotechnology, palaeontology, pharmaceutical discoveries, and physics, with an accompanying impact on sustainable industry.*
3. *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.*
4. *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.*
5. *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 collaborations among African nations and the wider global community.*

In addition to the Grenoble Resolutions, participants elected an Interim African Light Source Steering Committee, chaired by Simon Connell of the University of Johannesburg, and constructed a Roadmap to drive the African Light Source forward toward realization.

In related work, the International Union of Pure and Applied Physics (IUPAP) and the International Union of Crystallography (IUCr) decided to collaborate on an ambitious initiative to spread AdLS science and crystallography throughout the developing world. IUPAP and IUCr partnered with over thirty other scientific organizations, including approximately fifteen AdLSs, and applied for a 300,000 Euro grant from the International Council for Science (ICSU) as part of ICSU's 2016-2019 Grants Programme. Fortunately, the proposal was successful and a new initiative was born called *Lightsources for Africa, the Americas and Middle East Project (LAAMP)*. The goal of *LAAMP* is to enhance AdLS science and crystallography in Africa, the Caribbean, Mexico, and Middle East. After operating for a year, *LAAMP* expanded its targeted regions to include Southeast Asia, and therefore changed its name to *Lightsources for Africa, the Americas, Asia and Middle East Project (LAAAMP)*. The list of *LAAAMP* collaborative organizations and AdLS partners are found in Appendices I and II, respectively.

In the following, we will describe *LAAAMP* in more detail.

II. *LAAAMP* OBJECTIVES

LAAAMP has identified the following set of objectives/tasks:

- | | |
|---------|---|
| Task 1. | Develop a Strategic Plan for each region to grow and enhance its AdLS and crystallography user communities. |
| Task 2. | Establish a Colloquium Programme for each region to recruit new AdLS and crystallography users and to advertise <i>LAAAMP</i> projects via invited talks at targeted venues. Also, launch a series of new IUCr-UNESCO OpenLabs , which is a network of operational crystallography laboratories in developing countries aimed at increasing the access to, and utilization of, crystallography in all regions of the world. |
| Task 3. | Publish an Informational Brochure that describes AdLSs, crystallography, and the many fields that they impact. |

- Task 4. Facilitate **Researchers' Training Visits** to AdLS and crystallography facilities.
- Task 5. Convene a **Meeting at UNESCO** to present the regions' *Strategic Plans* and define the charge for more detailed *Business Plans* that include feasibility studies of constructing AdLSs in regions where they do not yet exist.

To accomplish these objectives, IUPAP and IUCr are taking the lead in partnership with the sixteen international organizations and sixteen world AdLSs listed in Appendices I and II, respectively.

Administratively, *LAAAMP* is led by an Executive Committee, consisting of the author as Chair; Sandro Scandolo, Head of Scientific Programmes & Outreach at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy; and Michele Zema, Executive Outreach Officer for the IUCr. The *LAAAMP* Budget Manager is Maitri Bobba, who is IUPAP Secretary at its Singapore Headquarters. The AdLS Usage and Strategic Plan Committees displayed in Appendix III perform much of the on-the-ground work in each of the regions. The overall project is critiqued by its Steering Committee listed in Appendix IV.

III. PROGRESS TO DATE

The first element of **Task 1** is the development of a database of AdLS and crystallography users in the regions. Lawrence Norris in the USA has developed a survey of instrumentation availability and usage, which can be accessed on the *LAAAMP* Website. Once completed, the database will form the basis for the development of a *Strategic Plan* in each region that will describe the present state of AdLS and crystallographic sciences in the region and short-, medium- and long-term goals for enhancing them. This will lead to the development of more detailed *Business Plans*, which will include studying the possibility of constructing an AdLS in each region if one does not already exist there.

An example of the implementation of **Task 2**, Prosper Ngabonziza, who is an AdLS user employed at the Max-Planck-Institute for Solid State Research, spent several days during December 2017 in his hometown of Kigali, Rwanda. He gave Colloquium presentations at the African Institute for Mathematical Sciences (AIMS-Rwanda) and at the ICTP-affiliated East African Institute for Fundamental Research, which is located in the College of Science and Technology (CST) at the University of Rwanda (UR). In addition to interacting with many students who were excited about the possibility of training at AdLSs under the *LAAAMP* initiative, Ngabonziza held discussions with a number of top university and governmental officials, including UR's Deputy Vice-Chancellor for Academic Affairs and Research, the Principal of its CST, and the Director-General for Science, Technology and Research in the Rwandan Ministry of Education.

In a similar effort, Thierry d'Almeida, Senior Research Engineer at France's Commissariat à l'Energie Atomique (CEA) and an experienced AdLS user, traveled to his home country of Benin during May 2018 to give a series of lectures on synchrotron radiation and its many applications in biochemistry, agriculture, and materials science. d'Almeida also had an opportunity to meet top university and governmental officials, including the Vice-Chancellor of the Université de Abomey-Calavi in Cotonou, the Director of the Institut de Mathématiques et Sciences Physiques (IMSP) in Porto-Novo, and the Scientific Advisor to the Benin's President, Patrice Talon. His visit was organized principally by Benin's Jean-Pierre Ezin, former Commissioner for Human Resources, Science and Technology for the African Union.

In another activity, *LAAAMP* co-organized a session at the World Science Forum 2017 held during November on the Dead Sea in Jordan. It was entitled *Light Sources and Crystallographic Sciences for Sustainable Development*. Moderated by Executive Committee member, Michele Zema, and Juste Jean-Paul Ngome Abiaga from UNESCO's Division of Science Policy and Capacity-Building, the session included a panel discussion and invited talks from a number of distinguished scientists, including Maciej Nalecz of the Polish Academy of Sciences, Giorgio Paolucci from SESAME, and Simon Connell from the University of Johannesburg and Chair of the Interim Steering Committee of the African Light Source Initiative.

LAAAMP established its first *OpenLab* in San José, Costa Rica during 4-9 December 2017, led by Michele Zema, with approximately 80 students in attendance. There was a Colloquium on the first day introduced by Zema and given by Diego G. Lamas from Universidad Nacional del Comahue in Argentina on *Técnicas de luz sincrotrón para caracterización avanzada de materiales*. Among those attending the Colloquium and providing welcomes were the Director of Scientific and Technological Development of Costa Rica's Ministry of Science and Technology; the Director of the Natural Science sector from UNESCO's Office for Costa Rica, El Salvador, Honduras, Nicaragua and Panama; the President of the National Research Council; and top officials from local universities and other academic institutions. Starting on the second day, the students were split into two courses, one on single crystal diffraction and the other on powder diffraction. Many countries, especially from throughout Central America, were represented.

LAAAMP held two Kick-Off events during the *24th Congress and General Assembly of the IUCr* (Hyderabad, India, 21-28 August 2017) organized by Michele Zema and the *29th IUPAP General Assembly* (São Paulo, Brazil, 11-13 October 2017) organized by another member of the *LAAAMP* Executive Committee, Sandro Scandolo.

For **Task 3**, a 24-page *LAAAMP* Brochure entitled *Advanced Light Sources and Crystallography: Tools of Discovery and Innovation* has undergone its first printing of 500 copies in addition to being posted on the *LAAAMP* and partner organizations' Websites. The Editor is Ernie Malamud, a retired professor and researcher from Fermilab and the University of Nevada in Reno, who has extensive experience producing high quality publications, including one for the American Physical Society, entitled *Accelerators and Beams, Tools of Discovery and Innovation*, which is currently in its 4th Edition. After receiving feedback from the initial printing, Malamud will proceed to a much larger printing and distribution during 2018. Moreover, Spanish and French editions will be donated by the International Atomic Energy Agency later this year.

For **Task 4**, the first *Call for Applications* for Faculty-Student (FAST) teams, consisting of one faculty and one graduate student to spend two months at participating AdLSs, was closed on 21 April 2017. To be eligible, the applicants had to have less than a year's experience in conducting research at an AdLS. Each of the original targeted regions, namely Africa, Mexico, Caribbean and Middle East, was awarded grants for two teams; however one team from the Caribbean ran into difficulty taking leave from its university. Thus, there were a total of seven teams, namely 14 individual grants of approximately 2,000 Euros each, mainly for airline travel expenses, which were arranged through ICTP. The host AdLSs provided all lodging and meal expenses not covered by the *LAAAMP* grant. Appendix V shows the 2017 FAST teams and the AdLSs that they visited.

A new *Call for Applications* for 2018 FAST teams ended on 15 November 2017 and the new awardees have been announced. They consist of a total of 16 FAST teams, or 32 individual grantees. With the current expansion of *LAAAMP* to Southeast Asia, three new FAST teams from that region also will be awarded during 2018, bringing the total number of teams to 19, or 38 awardees in training at AdLSs during 2018.

Finally for **Task 5**, discussions have begun with UNESCO to convene a meeting in December 2019 at UNESCO Headquarters in Paris consisting of the *LAAAMP* participants; Ministers of Science, Technology, Health, Education, Energy and Natural Resources; representatives from each region's research community; and other international stakeholders and interested parties. The purpose of the meeting will be to present the *Strategic Plan* for each region; set the charge for more detailed *Business Plans* with short-, medium- and long-term goals, including the charge to ascertain the feasibility of constructing an AdLS in each region that does not have one; and finalize a *Roadmap* for driving the *Business Plan* forward.

IV. CONCLUSION

LAAAMP is an ambitious project and has accomplished a tremendous amount in a small period of time. It has reached the midpoint and a *LAAAMP* Midterm Workshop will convene at ICTP on 24 August 2018. At the meeting, there will be detailed discussions of a number of world initiatives that seek to advance AdLS and crystallography usage in the targeted regions. Simon Connell, Chair of the *LAAAMP* Regional Committee for Africa will provide

updates on the African Light Source initiative. Matías Moreno, Chair of the Regional Committee for Mexico, will do the same for the Mexican Light Source initiative. Those and other talks will allow the Workshop participants to analyze how far *LAAAMP* has come and suggest optimizations of its programs. There is much work yet to be done.

APPENDIX I LAAAMP COLLABORATIVE ORGANIZATIONS

LEAD INSTITUTIONS

INTERNATIONAL UNION OF PURE AND APPLIED PHYSICS (IUPAP)

Contact: Bruce McKellar, President

INTERNATIONAL UNION OF CRYSTALLOGRAPHY (IUCr)

Contact: Sven Lidin, President

OTHER COLLABORATIVE ORGANIZATIONS

AFRICAN LIGHT SOURCE (AFLS) STEERING COMMITTEE

Contact: Simon H. Connell, Chair

ASSOCIATION OF ASIA PACIFIC PHYSICAL SOCIETIES (AAPPS)

Contact: Seunghwan Kim, President

CUBAN LIGHT SOURCE INITIATIVE

Contact: Fidel Antonio Castro Smirnov, Advisor to the President of the University of Informatics Sciences, Havana

EUROPEAN PHYSICAL SOCIETY

Contact: Christophe Rossel, President

ICSU REGIONAL OFFICE FOR AFRICA

Contact: Daniel Nyanganyura, Acting Director

ICSU REGIONAL OFFICE FOR LATIN AMERICA & THE CARIBBEAN

Contact: Manuel Limonta, Director

INTERDISCIPLINARY CONSORTIUM FOR RESEARCH AND EDUCATIONAL ACCESS IN SCIENCE & ENGINEERING (INCREASE)

Contact: Eric Sheppard, Chair of Executive Committee

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS (ICTP)

Contact: Sandro Scandolo, Head, Scientific Programmes & Outreach

INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES (IUMRS)

Contact: B.V.R. Chowdari

LABORATORY FOR PHYSICS AND APPLICATIONS OF HIGH BRIGHTNESS BEAMS

Contact: James Rosenzweig

LIGHTSOURCES.ORG

Contact: Andrea Lausi, Chair (Elettra)

PUERTO RICAN LIGHT SOURCE INITIATIVE

Contact: Carlos Cabrera, Chair

SOCIEDAD MEXICANA DE FÍSICA

Contact: Dario Nuñez, President

UNESCO - DIVISION OF SCIENCE POLICY AND CAPACITY BUILDING

Contact: Martiale Zebaze Kana

TRIANGLE SCIENCE, EDUCATION & ECONOMIC DEVELOPMENT (TRISEED CONSULTANTS), LLC

Contact: W. Estella Johnson, Managing Principal Partner

TWAS

Contact: Romain Murenzi, Director

**APPENDIX II
LAAAMP ADVANCED LIGHT SOURCE PARTNERS**

ADVANCED LIGHT SOURCE (ALS), LAWRENCE BERKELEY NATIONAL LABORATORY (LBNL)

Contact: Stephen Kevan, Interim Director

ADVANCED PHOTON SOURCE (APS), ARGONNE NATIONAL LAB

Contact: Dennis Mills, Director

ALBA LIGHT SOURCE

Contact: Miguel Angel Garcia Aranda, Scientific Director

AUSTRALIAN SYNCHROTRON, AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANIZATION (ANSTO)

Contact: Michael James, Head of Science

CANADIAN LIGHT SOURCE

Contact: Robert Lamb, CEO

DELTA LIGHT SOURCE

Contact: Shaukat Khan, Director

ELETTRA LIGHT SOURCE

Contact: Alfonso Franciosi, President and CEO

EUROPEAN SYNCHROTRON RADIATION FACILITY (ESRF)

Contact: Ed Mitchell, Head of Business Development

MAX-IV LABORATORY

Contact: To be announced

NATIONAL SYNCHROTRON LIGHT SOURCE-II (NSLS-II), BROOKHAVEN NATIONAL LAB (BNL)

Contact: Qun Shen, NSLS-II Deputy Director for Science

PHOTON FACTORY, INSTITUTE OF MATERIALS STRUCTURE SCIENCE (IMSS) OF KEK

Contact: Hitoshi Abe

POHANG ACCELERATOR LABORATORY, SOUTH KOREA

Contact: To be announced

SESAME LIGHT SOURCE

Contact: *Giorgio Paolucci, Scientific Director*

SIAM PHOTON SOURCE (SPS), SYNCHROTRON LIGHT RESEARCH INSTITUTE (SLRI)

Contact: *Pattanaphong Janphuang, Chief of User Office Division*

SLAC NATIONAL ACCELERATOR LABORATORY

Contact: *Kelly Gaffney, Director (SSRL)*

TAIWAN PHOTON SOURCE (TPS), NATIONAL SYNCHROTRON RADIATION RESEARCH CENTER (NSRRC)

Contact: *Chia-Hung Hsu, Secretary General and Staff Scientist*

**APPENDIX III
LAAAMP REGIONAL USAGE & STRATEGIC PLAN COMMITTEES**

AFRICA

Simon Connell (*Chair*), University of Johannesburg, South Africa

George Amulele, Macquarie University, Sydney, Australia

Djamel Bradai, University of Sciences and Technology Houari Boumediene, Algeria

Jean-Pierre Ezin, Université d'Abomey-Calabi, Benin

Claude Lecomte, Chair of IUCr "Crystallography in Africa" initiative and University of Lorraine, France

Ernie Malamud, Fermilab, University of Nevada, Reno, USA

Brian Masara, South African Institute of Physics, Zimbabwe

Prosper Ngabonziza, Max Planck Institute, Rwanda

Ahmadou Wague, University of Cheikh Anta Diop, Senegal

CARIBBEAN

Carlos Cabrera (*Chair*), University of Puerto Rico at Río Piedras

Fidel Antonio Castro Smirnov, Advisor to the President of the University of Informatics Sciences, Cuba

Noel Blackburn, Brookhaven National Laboratory, USA (from Trinidad and Tobago)

Eric Sheppard, Hampton University, USA

MEXICO

Matías Moreno (*Chair*), Universidad Nacional Autónoma de México

Abel Moreno Cárcamo, Coordinator of the Red de Usuarios de Luz Sincrotrón (RedTULS) and Instituto de Química, UNAM

Mayra Cuellar, Universidad de Guanajuato
José Reyes Gasga, President of the Sociedad Mexicana de Cristalografía and Instituto de Física, UNAM
José Ignacio Jiménez, Universidad Nacional Autónoma de México
Tomás Viveros, Universidad Autónoma Metropolitana-Iztapalapa

MIDDLE EAST

Özgül Öztürk (*Chair*), Universität Siegen, Germany
Roy Beck-Barkai, Tel-Aviv University, Israel
Musa Mutlu Can, Istanbul University, Turkey
Ahmed Farghaly, Crystallography Lab., National Research Center, Cairo, Egypt
Jamal Ghabboun, Bethlehem University, Palestine
Kirsi Lorentz, The Cyprus Institute, Nicosia, Cyprus

SOUTHEAST ASIA

Rungrueang Phatthanakun (*Chair*), Head of Research Facility, Synchrotron Light Research Institute (SLRI), Thailand
Nuttawan Pramanpol, Protein Crystallography Beamline Scientist, SLRI, Thailand
Shangjr (Felix) Gwo, Vice President of Asia-Oceania Forum on Synchrotron Radiation Research (AOFSRR) and Director, National Synchrotron Radiation Research Center (NSRRC), Taiwan
Chia-Hung Hsu, Secretary General and Staff Scientist, NSRRC, Taiwan
Michael James, Head of Science, Australian Synchrotron

APPENDIX IV LAAAMP STEERING COMMITTEE

Hitoshi Abe, Photon Factory, KEK
John Baglin, IBM and International Union of Materials Research Societies
Carlos Cabrera, Puerto Rican Light Source Initiative and University of Puerto Rico-Río Piedras
Simon Connell, African Light Source and University of Johannesburg
Thierry d'Almeida, Commissariat l'Energie Atomique, France
Tabbatha Dobbins, Rowan University, USA
W. Estella Johnson, Managing Principal Partner, TriSEED Consultants, LLC
Diego G. Lamas, President, Latin American Crystallographic Association
Andrea Lausi, ELETTRA and Lightsources.org
Manuel Limonta, Director, ICSU Regional Office for Latin America & Caribbean
Ernie Malamud, Fermilab and University of Nevada-Reno (Retired)
Connie McNeely, Co-Director of George Mason University's Center for Science and Technology Policy

Ed Mitchell, ESRF

Matías Moreno, Mexican Light Source Initiative

Lawrence Norris, African Light Source Interim Steering Committee

Tshepo Ntsoane, South African Nuclear Energy Corporation and African Light Source Interim Steering Committee

Daniel Nyanganyura, Director, ICSU Regional Office for Africa

Özgül Öztürk, Chair of SESAME Users Committee and Universität Siegen, Germany

Giorgio Paolucci, Scientific Director, SESAME

Eric Sheppard, INCREASE and Hampton University

Fidel Antonio Castro Smirnov, Cuban Light Source Initiative and Advisor to the President of the University of Informatics Sciences, Cuba

Herman Winick, SLAC National Accelerator Laboratory/Stanford University

APPENDIX V 2017 FAST TEAMS AND THEIR ADVANCED LIGHT SOURCE HOSTS

Faculty	Institution/Department	AdLS	Mentor(s)
Erika Salas Munõz	University of Chihuahua (Mexico) Chemistry	ESRF	Hiram Castillo-Michel
Ibrahim Serroukh	University Autonomous of Querétaro (Mexico) Engineering	ESRF	Alberto Bravin
Richard Taylor	University of the West Indies (Trinidad and Tobago) Chemistry	NSLS-II	Eric Dooryhee
Shehab E. Ali	Suez Canal University (Egypt) Physics	Elettra	Giuliana Aquilanti
Kirsi Lorentz	The Cyprus Institute Science and Technology in Archaeology Research Center	ESRF	Jean Susini
Diouma Kobor	University Assane Seck of Ziguinchor (Senegal) Physics	ESRF	Fabrice Wilhelm Manfred Burghammer
		IM2NP in Marseille	Marcel Pasquinelli
Oluseyi Philip Oladijo	Botswana Int'l Univ. of Science & Technology	Photon Factory	Hitoshi Abe