Letters of Interest Submission

Wednesday, 21 July 2021 - Friday, 31 March 2023

African Strategy for
Fundamental and Applied Physics

Book of Abstracts

Contents

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African Graphene Flagship Letter of Intent

Author: Sonia Haddad[1]

[1] *Faculty of Sciences of Tunis, University Tunis El Manar*

Abstract
Graphene, discovered in 2004, is considered as the wonder nanomaterial with astonishing properties which deeply marked the condensed matter and Materials Physics. This layer of one atom thick has revolutionized the nanotechnology and stimulated a race in the global market to dominate the emerging high-tech applications based on this material and its derivatives. In the context of this race, the European Union research council mounted a large action named EU Graphene Flagship, with budget of €1 billion, to take graphene from the realm of the academic research to industry.
We propose to build an African Graphene Flagship gathering academic laboratories, industrials, and NGO. We also suggest that South Africa coordinates this flagship regarding its large expertise in graphene like materials.

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

5

Energy WG

Author: Diouma Kobor[1]

[1] *University Assane Seck of Ziguinchor (UASZ)*

LOI: For Energy WG
Prof. Diouma KOBOR

CHALLENGES
The energy situation, which is very worrying in Africa, is evidenced by the absence, in most countries, of energy policies based on energy development master plans in the short, medium and long term. This situation is reflected, among other things, by a lack of integration of energy activities into development plans and a lack of awareness of the potential in terms of energy sources. It is therefore necessary to initiate and develop scientific cooperation at the national, sub-regional, regional and international levels to ensure that issues related to renewable energies are taken care of by qualified human resources. These renewable energies are more than ever the alternative solution to ensure the energy transition based on sustainable development. In this context ASFAP is a wonderful instrument to develop and accompanist African politics and stakeholders.

GOALS
The Energy Working Group objectives could be:
• Strengthen cooperation relations between African researchers and other actors in energy;
• Identify scientific communities working in the field of energy, energy efficiency and sustainable development;
• Create a dynamic of exchange and sharing of knowledge and know-how between academics, African elected officials and companies;
• Propose concrete solutions to the problems facing government authorities, local authorities and groups and non-governmental organizations (NGOs);
• Facilitate the professional integration of graduates through meetings and exhibitions of professionals in the field.
• Create Physics Excellent Centers dedicated to energy and renewable energy in the hole continent.

• Organize scientific meetings and support researchers and students to take part to African energy meetings

Primary Category:

Energy

Secondary Category:

6

The African School of Fundamental Physics and Applications (ASP)

Author: Ketevi Adikle Assamagan[1]

[1] *Brookhaven National Laboratory (US)*

International cooperation forms the common denominator of the today's culture of scientific activities. However, in many scientific disciplines and especially in fundamental and applied physics the cooperation among African countries and between them and the rest of the world is not well developed. This is especially the case for sub-Saharan Africa, which is one of the most rapidly developing regions in the world with great educational needs. In order to extend the existing international scientific ties to this geographical zone, we have established a biennial African School of Physics (ASP) [1] with a focus on fundamental and applied physics.

The ASP series started in 2010 in South Africa, then Ghana (2012), Senegal (2014), Rwanda (2016), and Namibia (2018) [2-6]. The 2020 edition of ASP was planned in Morocco; however, because of the COVID-19 pandemic, it was organized online in July 2021. The ASP is based on the close interplay between theoretical, experimental, and applied physics, as well as computing. It covers a wide range of topics in fundamental and applied physics. About eighty students are selected from all over Africa, from upwards of four hundred applications in each edition. International scientists are invited to prepare and deliver lectures according to the proposed topics considering the diverse levels and backgrounds of the students. The duration of the school allows for extensive networking between participants. A one-week training workshop for about seventy high school teachers and a one-week outreach for over fifteen hundred high school pupils are included in the program.

Research institutions, universities, government agencies, and foundations have sponsored ASP. The success of the school is sufficiently encouraging to provide motivation for a review of the ASP goals and for consideration of mechanisms that would make it sustainable. The central long-term objective of the School is to help improve higher education in Africa and in doing so, to contribute in a significant way to the development of science and technology on this continent. We believe that maintaining the leadership of the organization of the ASP series in partnership with other interested institutes and African governments and policy makers presents a unique opportunity to pioneer the scientific and technological development of a region of more than 1 billion people with large unmet needs but vast human potential. What is needed at this time to ensure the future of ASP and the success of its mission are partners that can provide sustained support for the participation of African School students, teachers and pupils.

The biennial support for the participation of African Students, teachers and pupils in future ASP can be realized in various ways: Direct financial support to the budget of the school to cover participant travels; Travel support for ASP organizers / lecturers in the activities that enhance the reach and coverage of the ASP; or travel coverage for ASP alumni to spend 2-3 months at international research labs.

The objective of ASP is achieved through an outreach effort, an increased awareness of the potential of high-quality training offered by large scale experiments in context of various scientific disciplines, and a system of networking on the international scale. There is a strong alignment between the mission and the vision of African governments and policy makers on education and capacity building and their programs with the goals of the ASP. The ASP is committed to include African governments

in the planning, in order to take advantage of aspects such as consolidating agreements and their goals, building on synergy with other programs, improving the sustainability and impact of capacity development and improving the measurement and visibility of the impact. By working with African governments and policy makers on education, ASP seeks to promote a culture of science that creates an attractive environment for African student alumni, thus encouraging their retention within Africa. ASP promotes sustainable scientific development in Africa by building a network between African and international researchers for increased collaborative research and shared expertise.

ASP2010–21 were very successful schools as can be seen from the final reports and the numerous press releases. The success of the school is due to the financial support from institutes in the USA, Europe, Asia and Africa, and to the dedication of the organizing committee, to the lecturers, and the students themselves. Many students in Africa face challenges in terms of the logistical support, the quality of education and the opportunity for higher education. It is often the case in Africa that even the best students do not have the needed support to succeed or to acquire the necessary skills to be competitive at an international level. It is important to help resolve some of the challenges to improve physics education and research in Africa. ASP serves at least two purposes: it provides a template for solving educational challenges, and offers opportunity for networking, which helps prepare the students to find practical answers to many issues.

Looking at the long-term objectives, the success of ASP is encouraging and allows us to review the goals and consider mechanisms to make it sustainable. To build upon the success of ASP2010–21, we propose to establish a longer partnership between international institutes and African governments and policy makers on capacity development for the component of funding, and to develop the ASP project goals and the key performance indexes further. These developments are timely given the progress made by the ASP and the synergy that can be established with the African policy makers on education and research.

References

[1] The African School of Fundamental Physics and Applications, https://www.africanschoolofphysics.org/
[2] Activity Report of the First Edition of ASP, 2010, http://africanschoolofphysics.web.cern.ch/2010/asp2010.pdf
[3] Activity Report of the Second Edition of ASP, 2012, https://africanschoolofphysics.web.cern.ch/asp2012/asp2012_final.pdf
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[5] Activity Report of the Fourth Edition of ASP, 2016, https://www.africanschoolofphysics.org/wp-content/uploads/2019/08/ASP2016-FinalReport.pdf
[6] Activity Report of the Fifth Edition of ASP, 2018, https://www.africanschoolofphysics.org/wp-content/uploads/2019/08/ASP2018.pdf

Primary Category:

Physics Education

Secondary Category:

Commnuity Engagement

7

Searches for heavy resonances decaying to top quarks with the ATLAS detector at LHC

Authors: Farida Fassi[1]; Badr-Eddine Ngair[1]

[1] *Universite Mohammed V (MA)*

Corresponding Author: badr-eddine.ngair@cern.ch

A search for new resonances that decay into top-quark pairs is performed using data collected from proton–proton collisions at a centre-of-mass energy of 13 TeV by the ATLAS detector at the Large

Hadron Collider. Events consistent with top-quark pair production are selected by requiring a single isolated charged lepton, missing transverse momentum and jet activity compatible with a hadronic top-quark decay. The invariant mass spectrum of hypothetical resonances is examined for local excesses or deficits that are inconsistent with the Standard Model prediction. No significant deviation from the prediction is found so far.

Primary Category:

Particle Physics

Secondary Category:

8

Jet energy scale and resolution in the High-Granularity Timing Detector in ATLAS upgrades at HL-LHC

Authors: Asmaa Aboulhorma[1]; Farida Fassi[1]

[1] *Universite Mohammed V (MA)*

The large increase of pileup is one of the main experimental challenges for the High Luminosity-Large Hadron Collider (HL-LHC) physics program. HL-LHC is expected to start in 2027 and to provide an integrated luminosity of 3000fb-1 in ten years, a factor 10 more than what will be collected by 2023. A powerful new way to address this challenge is to exploit the time spread of the interactions to distinguish between collisions occurring very close in space but well separated in time. A High-Granularity Timing Detector (HGTD), based on low gain avalanche detector technology, is proposed for the ATLAS Phase-II upgrade. Covering the pseudo rapidity region between 2.4 and 4.0, with a timing resolution of 30 ps for minimum-ionizing particles. The impact of HGTD in reducing pileup track contamination in the jets reconstruction in the forward region is investigated. The improvement of the jet energy scale and resolution in the forward region by reducing the pileup track contamination in hard scatter jets from nearby pileup interactions is presented. The performance is evaluated in terms of jet energy response and resolution as a function of pseudo rapidity η, transverse momentum pT .

Primary Category:

Particle Physics

Secondary Category:

Instrumentation & Detectors

9

The Importance of the financial and technical support for the improvement of Cosmology in Cameroon and in Africa

Author: Ragil NDONGMO[1]

[1] *University of Yaounde 1*

the details of my letter is in the attachment.

Primary Category:

Astrophysics & Cosmology

Secondary Category:

10

UNESCO-UNISA LoS and LoI

Author: Malik Maaza[1]

[1] *UNESCO UNISA ITL/NRF Africa Chair in Nanosciences & Nanotechnology*

Within the framework of the UNESCO-UNISA iTLABS/NRF Africa Chair in Nanosciences & Nanotechnology (U2ACN2), a trilateral partnership between the UNESCO, the University of South Africa (UNISA),and iThemba LABS, a national facility of the South African National Research Foundation (NRF) as well as the Nanosciences African Network (NANOAFNET), an African Union Network of Excellence, I wish to add their voices to this strategic initiative titled "The African Strategy for Fundamental & Applied Physics (ASFAP)".
Likewise, I wish to mention the following milestones in the Physics at the nanoscale that are implemented in support of ASFAP's vision & mission:

1. Implementation of a continental human capital development at postgraduate level in the sciences at the nanoscale,
2. Implementation of a continental human capital mobility in the sciences at the nanoscale,
3. Implementation of a co-diploma program in the sciences at the nanoscale,
4. Creation of an African Open Access Journal I the sciences at the nanoscale;"Nano-Horizons".

Within ASFAP, We would suggest the followings:

1. Advocating for an African Diploma in Physics,
2. Advocating for the introduction of AI & associated disciplines as a required component in the Physics national academic syllabus,
3. Working with African Physical Society to implement an indexed continental Physics Journal,
4. Implement an annual hybrid international African Conference in Physics,
5. Implement a specific program with the African Diaspora. This later is a pivotal corner up to now not harnessed at the deserved level.

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

11

World Health Organization - International EMF Project & Optical Radiation - South Africa National Report

Author: James Lech[1]

[1] *World Health Organization - International EMF Project & Optical*

Corresponding Author: jameslech@gmail.com

First 8 Pages are presented and published National Report.
Last 2 pages is the new International Advisory Committee formed for the National Report, South Africa. The report and new policies are in direct alignment with the objectives of the strategies listed in this call.

Primary Category:

Biophysics

Secondary Category:

Commnuity Engagement

12

Electrochemical study of A2B7-type hydrogen storage alloy prepared by ball milling

Author: Rakia Dahsa[1]

[1] *ENSIT*

Rakia Dahsa1, Yassine Ben Belgacem1, Bilel Hosni1, 2, Youssef Dabaki1, Chokri Khaldi1, Omar ElKedim2, Nouredine Fenineche3, Jilani Lamloumi1

Abstract. In this study, the hydrogen storage property of the La1.5Mg0.5Ni7 compound as a negative electrode in Ni-MH batteries was investigated. This compound was elaborated by ball milling in a mechanical grinder for 30 hours at a ball/powder weight ratio of 8:1. The characterization of the powder of the elaborated ally was examined both by X-ray diffraction and by scanning electron microscope.
In this context, the structural property for alloy has two major phases Ni, La2Ni7. The powder micrograph shows that the average grain size calculated is approximately 13 µm.
The electrochemical characterization of the La1.5Mg0.5Ni7 electrode was carried out by the galvanostatic charge and discharge polarization the open circuit potential and potentiodynamic polarization in alkaline solution (6M), and at ambient temperature..
The best discharge capacity is observed in the first cycle (58 mAh/g). Therefore the La1.5Mg0.5Ni7 alloy activation requires only one cycle of charge and discharge. After activation, the discharge capacity gradually decreases during long cycling because of the degradation of the active material of the electrode.
Keywords: A2B7-type hydrogen storage alloy; Mechanical alloying, nickel-metal hydride batteries, electrochemical polarization Methods.

Primary Category:

Young Physicist Forum

Secondary Category:

Energy

13

Higgs portal vector dark matter interpretation: review of Effective Field Theory approach and ultraviolet complete models

Authors: Farida Fassi[1]; Ketevi Adikle Assamagan[2]; Mohamed Zaazoua[1]; Thi Ngoc Loan Truong[3]

[1] *Universite Mohammed V (MA)*

[2] *Brookhaven National Laboratory (US)*

[3] *University of Johannesburg (ZA)*

The Higgs portal-vector dark matter interpretation of the spin-independent dark-matter nucleon elastic scattering cross section, using the invisible Higgs decay width measured at the LHC, is presented. The Effective Field Theory approach and ultraviolet complete models have been used and details description are discussed. Hence, the inclusion of these theoretical scenarios in LHC public results in comparison with direct detection results is proposed. We investigate the dark matter in the sub-GeV mass range as well.

Primary Category:

Particle Physics

Secondary Category:

Astrophysics & Cosmology

14

Observational astronomy in North Africa

Authors: Fairouz Malek[1]; Mourad Telmini[2]

[1] *LPSC-Grenoble, CNRS and UGA, France*

[2] *University of Tunis El Manar*

In this letter of Interest, we would like to address the opportunity for North African countries to unite in contributing to build and lead a series of local observatories and/or one large facility. In doing so, they will have to involve in many aspects of science and society such as building trades, geology, technology and in-strumentation, physics education and research. This will give the North African countries the opportunity to develop education, knowledge transfer skills and develop relations with local and regional industries and retain the scientists and the young people, thus improving employment. The increase of the scientific research and development (R&D) is known to have an impact in the increase of the development and progress of a country and its GDP.

Primary Category:

Astrophysics & Cosmology

Secondary Category:

Commnuity Engagement

15

Astro-particle and cosmology potential in the Underground of Africa

Authors: Fairouz Malek[1]; Yasmine Sara Amhis[2]

[1] *LPSC-Grenoble, CNRS and UGA, France*

[2] *IJCLab (Orsay)*

There are signals from the Universe that one can detect by performing experiments which are not that large, not so costly and not even located in space or at large observatories on Earth. Some of these signals can address the following questions: How did the Universe begin? How did it come to existence? What is hidden to our eyes and observatory facilities? Such experiments in astroparticle physics and cosmology would explore dark matter searches, studies of radioactive decays, and neutrino physics. They require careful shielding against cosmic rays which has motivated the construction of laboratory caverns in mines and adjacent to tunnels under mountains. There are currently about a dozen such laboratories, in existence or under construction, all in the northern hemisphere, mainly in Europe, USA and Canada, China and Japan. To cite a few known facilities and their specificities:

- IceCube (Antarctica) https://icecube.wisc.edu : the longest particle detector in the world, was completed in December 2010. The purpose of this detector is to investigate high energy neutrinos, search for dark matter, observe supernovae explosions, and search for exotic particles such as magnetic monopoles.
- ANTARES (telescope) https://antares.in2p3.fr/: is a neutrino detector located 2.5 km under the Mediterranean sea along the coast of Toulon, France. It is designed to locate and observe neutrino flux in the direction of the southern hemisphere.
- XENON http://www.xenon1t.org experiment: is a dark matter direct search experiment located at the Gran Sasso National Laboratories and will be sensitive to WIMPs with SI cross section of 10-48 cm^2.
- BOREXINO https://borex.lngs.infn.it/ experiment: is a real-time detector, installed at Laboratori Nazionali del Gran Sasso, designed to detect neutrinos from the Sun with an organic liquid scintillator target
- NESTOR https://www.europarl.europa.eu/news/en/headlines/security/20140327STO40046/nestor-unravelling-the-universe-s-mysteries-from-the-bottom-of-the-sea Project: the target of the international collaboration is the deployment of a neutrino telescope along the sea floor of Pylos, Greece.
- Kamioka Observatory https://www-sk.icrr.u-tokyo.ac.jp/: is a neutrino and gravitational waves laboratory located underground in the Mozumi Mine near the Kamioka section of the city of Hida in Gifu Prefecture, Japan.
- Laboratori Nazionali del Gran Sasso https://www.lngs.infn.it/en/lngs-overview: is a laboratory that hosts experiments that require a low noise background environment. Located within the Gran Sasso mountain, near L'Aquila (Italy). Its experimental halls are covered by 1400 m of rock, which protects experiments from cosmic rays.
- SNOLAB https://www.snolab.ca/: this facility is Canada's deep underground research laboratory, located in Vale's Creighton mine near Sudbury, Ontario Canada. It provides an ideal low background environment for the study of extremely rare physical interactions. SNOLAB's science program focuses on astroparticle physics, specifically neutrino and dark matter studies, though its unique location is also well-suited to biology and geology experiments. SNOLAB facilitates world-class research, trains highly qualified personnel, and inspires the next generation of scientists.

The African continent is large and its landscape is so diverse that many places may qualify geologically and can host underground experiments requiring shielding against cosmic rays and radiations. In this Letter Of Interest, we would like to address the opportunity for African countries to contribute to the enhancement of the knowledge and the understanding of the fundamental aspects of Nature and Universe in contributing to build and lead underground experiments. This way, they will have the chance to be involved in many aspects of science and society such as excavation, geology, technology and instrumentation, physics education and research. This will give the country and the researchers the opportunity to develop physics education, knowledge transfer skills and develop relations with local and regional industries and retain the physicists and the young people, thus improving employment.

Primary Category:

Particle Physics

Secondary Category:

Astrophysics & Cosmology

16

My vision for Physics in Africa

Author: Bertrand TCHANCHE[1]

[1] *UADB*

My contribution will be on several points:

1. Physics education There are several challenges surrounding the teaching of Physics, the first being the lack of infrastructure - needed to put students and staff in good working conditions. Governments need to invest massively in education.

In order to draw a good vision, there is need to establish a discussion/collaboration with all ministries involved: Higher, secondary and basic education.

Curricula should be a compromise between local and international contexts. Physics books written by africans with local contents should be encouraged/sponsored.

A vision should be drawn for Physics in Africa: which physicists do we want in Africa?

For Research are needed at the continental level:
a. Database for theses (Msc/PhD)
b. Mobility programs
c. research facilities
d. African physics journals needed (high quality/low fees)
e. A continental fund for physics/science (African Science Foundation)

1. Energy Working group As topics should be added: Energy Fundamentals/Thermal Science (Thermodynamics & Heat Transfer), Energy Statistics/Accounting, Energy System Modeling, Energy Planning, etc.

Shall we integrate: energy economics ?

Several divsions/categories can be used here:
- energy forms
- energy technologies
- energy use
- conventional & unconventional energies

1. Additional topics a. Physics groups As Physics groups could be added: QUANTUM PHYSICS, HISTORY OF PHYSICS/SCIENCE b. An emphasis should be put on the collaboration with the African diaspora (mobility).

Primary Category:

Energy

Secondary Category:

Physics Education

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

YES

Additional Information:

Yes

17

Unique Research Facilities at the SSC Laboratory in South Africa

Authors: Iyabo Usman[1]; Mathis Wiedeking[2]

[1] *University of the Witwatersrand*

[2] *University of the Witwatersrand and iThemba LABS*

The intention of this letter is to engage with the organizers of the African Strategy for Fundamental and Applied Physics (ASFAP) and create awareness of the research facilities at the Separated Sector Cyclotron (SSC) Laboratory as well as its training and research mandates. These are elaborated on in the recently developed Long Range Plan which plays a prominent role in the future strategy of accelerator-based research and training on the African continent. We believe, that this Letter of Intent and associated research activities fits into the ASFAP Physics Groups such as Nuclear Physics, Medical Physics, Instrumentation and Detectors, Applied Physics, as well as Accelerators.

Research and training on nuclear reactions, structure, astrophysics, applications as well as radiation biophysics take place primarily at the SSC Laboratory of iThemba LABS. iThemba LABS is the largest multi-disciplinary accelerator facility in the southern hemisphere and competitive with other similar-sized facilities worldwide. The research infrastructure has been significantly to enable the SSC Laboratory to deliver on its research and training/education mandates in close collaboration with universities. Over the last five years, the SSC Laboratory has had well over 500 users and collaborators and is the academic home of 15 post-docs as well as 100 MSc and PhD students annually. The South African Isotope Facility (SAIF) is a major infrastructure investment and phase 1 is nearing completion with a new 70 MeV cyclotron which will become operational in 2022 allowing for the radiopharmaceutical production to be entirely shifted to the 70 MeV cyclotron. This will double the available SSC beam time for research and will ultimately lead to an increase in the number of users as well as student projects. Phase 1 of SAIF also includes the implementation of a low-energy radioactive ion beam facility. The second phase of SAIF will start in 2023 and will include a major photo-fission facility for the production of rare isotopes for science and medical applications. The SSC Laboratory has developed a sustainable and result driven strategy as part of iThemba LABS Long Range Plan which has already had a major impact on education and research and will continue to do so over the next decade. As the premier accelerator facility the research facilities and strategies are ideally suited to be included in the ASFAP strategic direction.

SSC Laboratory
The vision is to maintain and expand the role of accelerator-based research being a center of expertise and innovation in the field and by improving the public perception of the value of basic and applied research with accelerators. The mission is to perform and facilitate world-class research through in-house and collaborative projects and to fully exploit all training opportunities that arise from these research efforts.
The latest facility developments, together with the existing infrastructure lay the foundation for research during the next decades. Research is the cornerstone of economic development and for the establishment of innovation driven industries. The attractiveness to foreign investments lies in the availability of a technologically knowledgeable workforce of a location and these are increasingly dependent on research which generates innovative thinkers. International competitiveness is one

of the primary drivers of progress in research. South Africa is a developing country that has recognized that international excellence in research lays the foundation for technological leadership which is built on cutting-edge knowledge. The promotion of internationally competitive scientific research is an invaluable part of establishing a knowledge-based economy and the SSC Laboratory together with its stakeholders at universities play a major role in achieving this goal. In the spirit of internationalism, the SSC Laboratory facilitates access of university-based researchers to world-class research infrastructures such as CERN, GSI-FAIR and JINR in addition to many other collaborating institutions across the world.

Education and training
The SSC Laboratory, in collaboration with universities, addresses training needs by providing training opportunities to university students. These are:
a) Specialized and topical lectures relevant to the research programs of the students are organized by the Southern African Institute for Nuclear Science and Technology (SAINTS);
b) Supervision of research projects for Honours, M.Sc., and Ph.D. students;
c) Internships, in-service and short-term training (workshops, schools, vacation programs).
d) Mentorship of postdoctoral fellows and junior researchers.

SSC Laboratory research facilities
The available research facilities include an electron spectrometer, tape station, silicon detector arrays, and environmental radiation laboratories. The main research facilities are briefly summarized as follows:

Fast neutrons
One of the main niche facilities is the availability of quasi-monoenergetic neutrons with energies up to 200 MeV. Even at high currents and 200 MeV, excellent beam quality can be achieved and nanosecond-pulsed beam can be delivered with a background free interval between pulses possible.

K600
The K=600 magnetic spectrometer is a high-resolution kinematically corrected magnetic spectrometer for light ions. It has the capability to measure inelastically scattered particles and reactions at extreme forward angles that includes zero degrees, making it one of only two facilities worldwide where high-energy resolution is combined with zero-degree measurements. Coincident particle and gamma detection capabilities were also added to the K=600 repertoire.

Gamma-ray detection
A wide range of gamma-ray detectors is available. These include background-shielded single-crystal high-purity germanium (HPGe) detectors, a segmented Clover detector, eight low-energy photon detectors, eight fast-timing LaBr3:Ce detectors, the AFRODITE-PLUS and ALBA arrays. AFRODITE-PLUS consists of of 17 Compton suppressed Clover HPGe detectors. ALBA consists of 21 large-volume LaBr3:Ce detectors. In coincidence with the K600 these allow for experimental configurations which are among the most advanced in the world.

Biophysics
A new proton beam line is available for world-class research leading to a better understanding of biological effects on normal and cancerous cells. This provides insight into how to improve cancer treatment, by increasing efficacy, reducing side effects and finding new ways to overcome radiation resistance of specific tumours. Support is extended to the broader community by offering bio-dosimetric follow-ups to radiation incidents nationally and internationally.

The above is the proposal for a unique African facility for the strategic future of radiation biology and nuclear physics on the continent. The Long-Range Plan and list of collaborating institutions are available upon request.

Primary Category:

Nuclear Physics

Secondary Category:

Medical Physics

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Instrumentation and Detectors, applied physics, accelerators

18

Physics Energy Improvement and Application for New Africa

Author: Diouma Kobor[1]

[1] *University Assane Seck of Ziguinchor (UASZ)*

Letter of Interest Diouma KOBOR

What Orientation for Energy Research and Education for Africa: Contribution of AU
The fundamental problem of education and Research in Africa, particularly in strategic domains, is that there is no independent fund, funded by African countries to support strategic areas to be defined in collaboration with researchers and stake-holders.
For me, important decisions must be taken by the AU for total independence in terms of funding research in certain strategic areas for the continent in a world in perpetual competition. It's about:
- Set up an Autonomous Geostrategic Research Fund fully funded by AU member countries (at least a contribution of 30,000,000 Euro / year / country is mandatory to benefit from it), The participation of international firms present in Africa is compulsory with a percentage to be levied in the form of a tax.
- Decline the strategic areas including those of energy: Solar Energy, Civil Nuclear Energy, Bioenergy, Energy and Health, Energy and Industries, Energy and Transport, Energy and Education, Exploitation of Energy Resources, Local Materials for Energy, Technological Innovation in Energy, Energy and Mining and Natural Resources, Energy and Biotechnology, Energy and IT, Energy and Space and Energy and Army (military equipment) etc ...
The orientations of education and research in Physics in the field of energies must have applications in key sectors such as transport with the least impact on the environment. Personally, I think that Africa must orient itself more towards the inexhaustible resources at its disposal to be at the top:
- Use Renewable Energies for the African railway sector
- Use renewable energies to facilitate rural access to health care and diagnostics
- Use fossil fuels to strengthen industries and renewable energy manufacturing units
- Use fossil fuels to support energy efficiency in certain sectors such as Building materials (clay bricks, tiles, etc⋯) and solar PV fabrication etc ...

Primary Category:

Energy

Secondary Category:

Condensed Matter & Materials Physics

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

LOI for Energy Group and its Application

19

Development of Quantum Biology R&D in Africa

Author: Tjaart Krüger[None]

Quantum Biology is a new emerging research field with enormous potential for science and technology. During the past few years, large research efforts into Quantum Biology have been launched in various parts of the world [1-10]. It is important that Africa actively contributes to the development of Quantum Biology in order to tap into the scientific and technological developments.

Primary Category:

Biophysics

Secondary Category:

Optics & Photonics

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

YES

Additional Information:

NONE

20

Cell Mechanobiology Research for Health Development in Africa

Authors: Fatai BALOGUN[1]; Kayode DADA[2]

[1] *Centre for Energy Research and Development, Obafemi Awolowo University, Ile-Ife, Nigeria*

[2] *Centre for Energy Research and Development*

Corresponding Author: kayodeayodejidada@yahoo.com

LOI is in the attached file.

Primary Category:

Biophysics

Secondary Category:

Medical Physics

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Medical Physics

21

Computing in physics education

Author: Uli Raich[1]

[1] *retired*

Most of today's physics experiments are based on sensors converting physical parameters into electronic signals, which are then translated into binary numbers and read out by computers.

Today's microprocessors are used in almost all everyday devices and are therefore mass produced. This pushes prices to very low levels while their performance constantly increases. Microprocessors are ideally suited for small, low cost physics experiments and every physics curriculum should contain a course on interfacing them them with sensors and actuators and on programming them.

Unfortunately not many physics lecturers at African universities have experience in using these devices. Therefore we propose in this document a freely accessible experimental toolkit and information that would help prospective teachers in preparing and giving their lectures and exercises.

Primary Category:

Computing & 4IR

Secondary Category:

Physics Education

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

YES

Additional Information:

Relevant for any prospects concerning teaching, education

22

Embedded Systems Applications in Agriculture Letter of Intent

Author: Kwadwo Dompreh[None]

Call: Africa strategy for fundamental and Applied Physics

Primary Category:

Computing & 4IR

Secondary Category:

Physics Education

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

YES

Additional Information:

yes, I have

23

Towards Quantum Research, Quantum Computing and Quantum Technologies

Author: Farai Mazhandu[1]

[1] *President OneQuantum Africa*

We develop in the paper the importance for Africa to participate in the next quantum revolution and propose ways to meet this challenge. We illustrate the topics with the example of OneQuantum Africa initiative that is gathering researchers and students from all Africa and promoting quantum research, quantum computing and quantum technologies through education and sharing of experience. We propose some directions driven from experience to meet this ambitious but essential challenge.
Keywords: Quantum, Computing, Technologies, Revolution

Primary Category:

Computing & 4IR

Secondary Category:

Physics Education

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

It is relevant to Quantum Research and Education

24

Ion Beam Analytical Techniques at iThemba LABS

Authors: Morgan Madhuku[1]; Mlungisi Nkosi[2]

[1] *Acting head TAMS Laboratory*

[2] *Head of Tandetron Laboratory*

The Ion Beam Analysis (IBA) division at iThemba LABS conducts materials research for applications in information technology, electronics, air pollution, and energy. To this end, we make use of the various facilities at the Tandetron and Tandem Laboratories for synthesis, modification, and analysis of thin films and nanostructured materials. The analyzed materials range from semiconductors and oxides to metals and magnetic materials. These materials are investigated to optimize their structural, electronic, magnetic, and optical properties. The IBA division delivers specialized ion beam analytical expertise, materials characterization services and products to government, industry, and academia. Instrumentation for materials research at iThemba LABS include, amongst others, 3.0 MV Tandetron and 6 MV Tandem accelerators, a 200 KV ion implanter, nuclear microprobe facilities, a RF/DC sputtering unit, a dual electron beam evaporator system and high temperature furnaces. These ion beam analytical facilities ensure that the Tandetron and Tandem Laboratories continue to be at the forefront of accelerator science applied to materials research. These facilities are used annually by over 100 researchers and users including post-graduate students. These users include researchers from a variety of scientific disciplines at South African universities and other research organizations, and a number of international collaborators. As one of the IAEA Collaborating Centres we are committed to hosting researchers and scientists from the African continent and elsewhere, committed to organizing regional and international training workshops and schools for students and young researchers.

Research Infrastructure

Rutherford Backscattering Spectrometry (RBS)
The RBS analysis technique is used mostly for determining the composition and the depth distribution of elements by aligning the crystallographic axes of the sample to the incoming alpha particles and RBS channelling analysis provides information about the crystal structure of the sample.

Elastic Recoil Detection Analysis (ERDA)
In ERDA recoiled ions scattered off a thin film by an energetic heavy ion beam impinging the surface at a glancing angle are detected under forward direction and analysed for their nuclear charge or mass and energy.

Particle-Induced X-ray Emission (PIXE)
Charged particles are used to create inner-shell vacancies in the atoms of the specimen. Protons of 1-4 MeV energy are mostly used. Their slowing down in matter is smooth and well characterized, with little scattering and deflection. PIXE spectra are usually collected in energy-dispersive mode and all elements with atomic numbers above 10 can in principle be detected at once.

X-ray Diffraction (XRD)
The XRD lab houses a BRUKER X-ray diffractometer for microstructural characterization of specimens. Information obtained from the diffractogram benefits a wide range of academic disciplines such as Chemistry, Polymers, Physics, Geology, Engineering, Electronics and Pharmaceutics.

Atomic Force Microscopy (AFM)
The AFM imaging system, which has a lithography dedicated system, is capable of both nano-lithography and nano-manipulation in a humidity controlled ambient in virtually all three basic AFM imaging techniques, viz Tapping Mode, Contact Mode, and Non-Contact Mode.

Physical Properties Measurement System (PPMS)
This system allows for the measurement of electrical, thermal, and magnetic properties at magnetic fields up to an optional 7, 9 or 16T, and accurately controlled temperatures in the range $1.9 < T < 400K$.

Accelerator Mass Spectrometry (AMS)
The AMS facility provides a platform for rare isotope measurements such as 14C, 26Al and 10Be that are all used in age dating in different contexts. The AMS facility at iThemba LABS is the only AMS facility on the African continent. Since it was commissioned it has been providing about 1000 dates annually. The impact on palaeoscience in South Africa is profound as more dates allow for fundamentally better science. Strategic platforms such as the African Origins Program, that look to exploit scientific advantages offered by South Africa as a location, are being substantially enhanced by this platform.

Education and Training
The IBA division offers high quality training to post-graduate students, thus ensuring that skilled capacity is created to fill the job market in Materials Sciences in South Africa. This include training

of university students through lectures such the SAINTS program; supervision of research projects for honors, MSc and PhD students; internships, in-service training and short-term training through workshops, summer/winter schools and vacation programs.

International collaborations
The research conducted within the IBA division for the past decades resulted in collaborations with local and international institutions including Instituut voor Kern- en Stralingsfysica in Belgium, Institut Pprime, CNRS, Université de Poitiers, in France, the Universidad Nacional de Colombia in Colombia, and the University of Saad Dahlab –Blida in Algeria.

Plans for the next 5 to 10 years
Our plans for the next 5 to 10 years are to conduct research under the following four themes: 1: Diffusion kinetics studies; 2: Ion irradiation induced effects on the structure of matter; 3: Interaction and slowing-down of energetic ions in solids and 4: Biological and Environmental studies.
The following developments and upgrades will be implemented in the next five to ten years:

Installation of a multifunctional scattering chamber ("Total IBA")
IBA techniques will be combined in a single run to complement each other. The old approach of IBA analysis where RBS was mainly on offer in one beamline and PIXE in another is not suitable for Total IBA.

Development of a dedicated beam-line for nuclear physics experiments
This beamline will be an added capability for the sub-atomic physics community and specific physics will become available to be studied which is not possible with the Separated Sector Cyclotron facility.

Development of a beamline dedicated to irradiation experiments
One of the urgent problems of modern radiation physics and nuclear reactor materials science is the study of the effects of insoluble atomic impurities on the structure and properties of solids. Atoms of inert gases, in particular helium, arise and accumulate in materials as a result of neutron irradiation, being products of nuclear reactions.

Development of an atmospheric (in-air PIXE) beam line
A new beam line will be set-up to carry out IBA measurement in-air for cultural heritage studies in relevant Southern African archaeological materials to decipher the non-written history of indigenous communities that were living in the area more than 500 years ago.

Primary Category:

Accelerators

Secondary Category:

Condensed Matter & Materials Physics

Subgroup categories:

MaterialsPhysics—Materials for energy

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

25

African Theoretical Physics Flagship Letter of Intent

Authors: Kwadwo Dompreh[None]; Yeboah Samuel [1]

[1] *University of Cape Coast*

The nanoribbons of two dimensional materials such as graphene has been verified theoretically and experimentally to be a good source of acoustoelectric current. This has specific applications in acoustic wave filter as tunable gate-controlled quantum information devices and phonon spectrometers as well as in the development of sound batteries. This has prompted the necessity to investigate other nanoribbons as such silicene, germanene, black phosphorene and many others. In view of this, we propose setting up an African center that can collaborate using theoretical, experimental and computational means to understand the materials properties of all known nanoribbons. This borders on the use of fundamental and applied physics in relation to acoustoelectric effect (AE), acoustomagnetoelectric effect (AME) acoustothermal effect (ATE) and acoustomagnetothermal effect (ATME) in Nanoribbons. Other materials such as Carbon nanotubes, Quantum dots/ Wells and graphene superlattices are also of intense interest. We further propose investigating what happens when the nanoribbons are used to form heterostructures. Since it is predicted that due to weak Van der waals forces, their heterostructures will be a good source of Gunn diodes.

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

Particle Physics

Subgroup categories:

MaterialsPhysics—Advanced 2D materials

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Nil

26

Posing Big Questions and Developing Tools for Learners: Physics Education and Outreach

Authors: Azwinndini Muronga[1]; Kenneth William Cecire[2]; Ketevi Adikle Assamagan[3]; Carolin Schwerdt[None]; Marge Bardeen[None]; Pedro Abreu[4]; Stefan Ohm[5]; Steven Goldfarb[6]; Uta Bilow[7]

[1] *Nelson Mandela University*

[2] *University of Notre Dame (US)*

[3] *Brookhaven National Laboratory (US)*

[4] *LIP Laboratorio de Instrumentacao e Fisica Experimental de Particulas (PT)*

[5] *DESY*

[6] *University of Melbourne (AU)*

[7] *Technische Universitaet Dresden (DE)*

LOI with author list in attachment.

Primary Category:

Physics Education

Secondary Category:

Commnuity Engagement

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

This LOI is potentially relevant to all categories.

27

Quantum Plasmonic Sensing

Author: Kelvin Mpofu[1]

[1] *Stellenbosch University*

This letter of interest is aimed at promoting research in plasmonic quantum biosensing. It is also aimed at encouraging more funding to this field of research. Plasmonic nanosensors have become a powerful tool for biosensing applications [1,2]. This is because they are able to overcome the limitations of conventional optical sensors in terms of sensitivity, flexibility and photostability [3]. As the field has grown new detection schemes have been developed and are being incorporated into a wide variety of biological and medical applications. The key driving force behind research in plasmonic nanosensors is the improvement of their sensitivity. Some of the strategies which are being considered in the improvement of sensitivity include sensing based on target induced local refractive index changes, colorimetric sensing based on localised surface plasmon resonance (LSPR) sensing, and the amplification of sensitivity based on nanoparticle growth [2].

While SPR-based plasmonic nanosensors are available commercially, the SPR instrumentation in use today is limited by the resolution they can achieve. Such limitations lead to problems in applications, for example in studying the drug kinematics for drugs used to treat various HIV-1 virus mutations it is important that the sensitivity be higher than currently available in commercially available SPR-based nanosensors. In order to overcome this, researchers need to look deeper into the physics of the sensor and consider more fundamental resources of optics, i.e., quantum mechanical resources [4,7].

The resolution limitations of currently available SPR-based nanosensors can be overcome by the study of the quantum nature of light. In particular, the preparation of light in the squeezed states that make use of the uncertainty principle can enhance the resolution [5,6], as well as entangled multi-photon states [7,8]. The potential enhancement in the sensing performance of plasmonic devices using quantum optical resources has been inspired by recent efforts to show that both quantum and plasmonic resonance features can be combined to give many beneficial properties [9-11].

The main goal of quantum SPR bio-sensing is to show how the use of quantum states of light in biosensing with surface plasmon resonance (SPR) gives an enhancement over using classical states. Here we focus primarily on a bio-sensing SPR setup known as the Kretschmann configuration in which surface plasmons are excited using a bulk prism and a gold coated microscope slide. The excitation is performed by means of an evanescent field arising from total internal reflection from the backside of the sensor surface.

It has been shown theoretically that using quantum states of light such as the Fock state, two mode squeezed vacuum and two-mode squeezed displaced state improve the precision in the estimation of kinetic parameters measured from the sensorgrams produced by the Kretschmann configuration [12]. In [12] a theoretical application of quantum bio-sensing was looked at in an immobilized Bovine serum albumin (BSA) interaction with anti-BSA and as well a theoretical application of quantum sensing was considered for a binding reaction between a phosphate-buffered saline (PBS) solution that contains Bovine carbonic anhydrase and its inhibitor benzene-sulfonamide.

An experimental implementation of the Kretschmann configuration with light from a single-photon source which shows an enhancement in sensitivity was also conducted [13]. The spontaneous parametric down conversion process to generate our single photons which we use to study the binding kinetics of BSA on a gold slide. Further research is necessary in quantum plasmonic sensing.

[1] L. Guo et al., Strategies for enhancing the sensitivity of plasmonic nanosensors, ScienceDirect, 213-239 (2015).
[2] A. Touhami, Biosensors and Nanobiosensors: Design and Applications. Nanomedicine, John Wiley & Sons,(2008)
[3] J. N. Anker et al., Biosensing with plasmonic nanosensors, Nat. Mat. 7, 442 (2008).
[4] L. Guo et al., Strategies for enhancing the sensitivity of plasmonic nanosensors, Nanotoday 10, 213-239 (2015).
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[7] W. Fan et al., Quantum plasmonic sensing, Phys. Rev. A 92, 053812 (2015).
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[9] J. Lee et al., Quantum noise reduction in intensity-sensitive surface plasmon resonance sensors, arXiv:1705.05120 (2017).
[10] C. Lee et al., Quantum Plasmonic Sensing: Beyond the Shot-Noise and Diffraction Limit, ACS Photonics 3, 992 (2016).
[11] M. Tame et al., Quantum Plasmonics, Nat. Phys. 9, 329 (2013).
[12] K. Mpofu et al., Measurement of binding kinetics using quantum plasmonic resonance sensing, https://arxiv.org/abs/2107.06214 (2021).
[13] K. Mpofu et al., Experimental measurement of binding kinetics using quantum plasmonic resonance sensing, https://arxiv.org/abs/2107.06737 (2021).

Potential impact
Biosensors have a wide range of applications in biology, medicine and industry. They can be used in fields from fundamental biological studies to clinical diagnosis applications [1]. Related applications of biosensors include the maintenance of food safety and environmental monitoring. Research in the field of nanosensing using SPR has led to the development simple, easy-to-use measurement devices for a diverse range of biological and medical applications [2]. Healthcare is the most important area for applications. The maintenance of health is an important technological objective for science and technology, and diagnosis is an essential prerequisite for treatment and prevention of disease [2]. The integration of nanoscale ultrasensitive biosensors with other medical instruments will open the door to new and emerging medical fields, including point-of-care diagnostics and ubiquitous healthcare.

In the developing world, i.e., most African countries, including South Africa, there is a desperate need for robust diagnostics. Infectious diseases account for around a quarter of worldwide deaths. South Africa in particular is faced with diseases of poverty such as HIV/AIDS and tuberculosis, which kills millions of people each year according to the World Health Organisation.

[1] L. Guo et al, Strategies for enhancing the sensitivity of plasmonic nanosensors, ScienceDirect, 213-239 (2015).
[2] A. Touhami, Biosensors and Nanobiosensors: Design and Applications. Nanomedicine, John Wiley & Sons (2008).

Primary Category:

Optics & Photonics

Secondary Category:

Biophysics

Subgroup categories:

LightSources—DynamicAndTime-resolvedTechniques

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

28

Review of Physics Educational System in African Universities

Authors: Jesutofunmi Fajemisin[1]; Toivo Samuel[2]

[1] *University of South Florida*

[2] *Eduardo Mondane University*

.

Primary Category:

Physics Education

Secondary Category:

NONE

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

29

Peer Assisted Physics Learning

Author: Jesutofunmi Fajemisin[1]

[1] *University of South Florida*

.

Primary Category:

Physics Education

Secondary Category:

Young Physicists Forum

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

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30

Gamma-Ray Astronomy in the Context of Multi-Wavelength Astronomy and Multi-Messenger Astrophysics

Author: Markus Boettcher[None]

Corresponding Author: markus.bottcher@nwu.ac.za

Gamma-ray astronomy is one of the three pillars of the South African multi-wavelength strategy, together with radio and optical astronomy. Southern Africa hosts some of the world's leading multi-wavelength facilities, in particular MeerKAT in the Karoo area of South Africa, which will expand into the Square Kilometre Array (SKA) mid-frequency array over the next decade, the Southern African Large Telescope (SALT) near Sutherland, South Africa, which is the largest single optical telescope in the Southern Hemisphere, and the High Energy Stereoscopic System (H.E.S.S. - see dedicated LoI submitted by the University of Namibia) near Windhoek, Namibia, which is the world' s largest ground-based gamma-ray observatory.

Astrophysical sources of gamma rays trace the sites of the most extreme particle acceleration in the Universe, often associated with violent, explosive events. As such, they are often variable on a variety of time scales, from years and months down to minutes or even seconds. They include the remnants of supernova explosions of massive stars (supernova remnants [SNRs] and neutron stars / pulsars), binary systems consisting of neutron stars or black holes and regular stars, active galactic nuclei (AGN), powered by mass accretion onto supermassive black holes, ejecting collimated outflows (jets) of ultra-relativistic material, and gamma-ray bursts (GRBs), among others. GRBs have only very recently (2018) been detected as sources of very-high-energy gamma rays (VHE: E > 100 GeV) [3,4], observable by ground-based Cherenkov telescopes, such as H.E.S.S. They are also the first true multi-messenger sources, with the detection of a gravitational-wave event (GW170817) due to the merger of two neutron stars, associated with a short GRB (GRB170817A) [1].
The production of VHE gamma rays requires the efficient acceleration of particles to at least TeV energies, and there are indications that some Galactic gamma-ray sources (such as SNRs) are capable of accelerating protons or heavier nuclei to PeV energies. They are therefore the likely sources of cosmic rays (CRs) up to the knee in the CR spectrum at E ˜ 3 PeV. Protons of PeV energies inevitably also produce neutrinos through the decay of charged pions produced in proton-photon or proton-proton interactions with photons or gas in or near their acceleration site. The tentative association of several AGN with VHE neutrinos detected by the IceCube neutrino detector at the South Pole (the most prominent example being the blazar TXS 0506+056 associated with the neutrino event IceCube-170922A [2] as well as a flare of neutrinos in 2014-15) has recently ushered in another facet of multi-messenger astronomy.

While activities in gamma-ray and associated multi-wavelength as well as multi-messenger astrophysics on the African continent is concentrated in Southern Africa, where activities of about 100 permanent staff, postdocs and students in South Africa and Namibia are co-ordinated through the South African Gamma-Ray Astronomy Programme (SA-GAMMA), research groups active in this field also exist in Ethiopia, Rwanda, Nigeria, and several other African countries. African researchers engaged in gamma-ray and multi-messenger astrophysics are involved in multi-wavelength studies of high-energy astrophysical sources using H.E.S.S., the Fermi Gamma-Ray Space Telescope, SALT and other ground-based optical telescope on the African continent, the MeerKAT radio telescope and the Event Horizon Telescope (EHT), to which the proposed Africa Millimetre Telescope (AMT) is anticipated to make a significant addition (see dedicated LoI submitted by the University of Namibia). There is also significant African participation in the IceCube neutrino detector at the South Pole and

the km3 Neutrino Telescope (KM3NeT), currently under construction in the Mediterranean Sea, as well as the Cherenkov Telescope Array (CTA), the next-generation ground-based gamma-ray observatory, which has just recently entered its construction phase, with Cherenkov telescope arrays in Chile and Spain. In addition to these observational aspects, significant efforts are also going into theoretical investigations and numerical simulations. These as well as the analysis of observational data require significant computational resources, which are currently available only in a few African institutions.

Astrophysical gamma-ray sources are inherently multi-wavelength sources, and their study often requires co-ordinated observations across the electromagnetic spectrum, from radio to gamma-rays, due to their often unpredictable multi-wavelength variability. The multitude of multi-wavelength astronomy facilities and their favourable geographic location (clear, dark skies, and a location in the Southern Hemisphere, with a privileged view of the central regions of our Milky Way) and the wide range of multi-wavelength and multi-messenger investigations in which African researchers are actively involved (detailed descriptions will be provided in a white paper), provides excellent opportunities for Africa to take on a driving role in the field of multi-wavelength and multi-messenger astrophysics, which is currently in its infancy.

References:

[1] Abbott, B. P., et al., 2017, Phys Rev. Lett., 119, 161101

[2] Aartsen, M. et al., 2018, Science, 361,

[3] Abdalla, H., et al., 2019, Nature, 575, 464

[4] Abdalla, H., et al., 2021, Science, 372, 1081

Primary Category:

Astrophysics & Cosmology

Secondary Category:

Particle Physics

Subgroup categories:

Astro&Cosmo—High-energy astrophysics and astro-particle physics

Did you / will you submit this LOI to another category?:

NO

Additional Information:

N/A

31

African Strategy for Fundamental and Applied Physics

Authors: Raymond Sparrow[1]; Thomas Franke[1]

[1] *University of Glasgow*

Glasgow University ⊠ Chair of Biomedical Engineering, School of Engineering ⊠ G12 8LT Glasgow

AFRICAN STRATEGY FOR FUNDAMENTAL AND APPLIED PHYSICS
Prof. Dr. Thomas Franke
School of Engineering
Chair of Biomedical Engineering

Oakfield Avenue
G12 8LT Glasgow
Phone +44 (0)141-330-2466
Thomas.Franke@glasgow.ac.uk
http://www.gla.ac.uk/schools/engineering/

Dr. Raymond Sparrow
Scientific Network Liaison Officer
raymond.sparrow@glasgow.ac.uk

30.11.2021

We wish to offer my support to the African Strategy for Fundamental and Applied Physics (ASFAP), in particular the Biophysics Working Group.

Biophysics: bringing the disciplines and concepts of biology and physics together in a unique manner which can be applied across physical dimensions from the macro to the molecular and atomic level and timescales from centuries to attoseconds. One can gain an understanding of how energy flows through vast complex systems to obtaining information and manipulate entities on the molecular and atomic levels. As such this is an extremely powerful scientific platform which can address many of the critical challenges that face humanity today and in the future. To undertake this work requires highly skilled individuals collaborating across the globe. These individuals, skills and collaborations need to be identified and fostered.

Africa is a fundamental player in this endeavour with a vast, as yet, relatively un-tapped resource of human capital that needs to be mobilised. This initiative is a critical element in this process and Africa is on the brink of a renaissance which must be encouraged and allowed to grow.

Examples of the Grand Challenges that biophysics can address are in:
• Health, medical
• Environmental management (pollution / climate change)
• Energy security
• Food security
• Telecommunications / computing

The areas that I would consider to be essential to continue to support and develop are:
• The interactions between laser physics and biology towards developing new imaging and manipulation techniques such as the super-resolution and multi-modal microscopies.
• Synthetic biology and micro-fluidics for the development of new technologies for making new materials and products and manufacturing processes that are more environmentally friendly than currently used.
• Quantum biology in the spheres of communications, computing and security.
• Structural biology (such as the development of an African Synchrotron Light Source)

Coupled to Capital equipment and infrastructure developments is the need to develop the skills / educational / training programmes to support the science. These programmes would need to be established as a pipeline in developing curricula along both academic and vocational lines.

Dr. Sparrow was privileged to have been involved with assisting in developing biophysics in South Africa (2005 –2013) when he relocated from the UK to work at the CSIR in Pretoria. This has included founding Synthetic Biology as an Emerging Research Area (ERA) and as the first Chair of the Biophysics Initiative under the South African Institute of Physics and Department of Science and Technology (2009 –2012). As such he has a good understanding of the facilities and infrastructure already present in South Africa. There is a very good base here to work from and can be used as a model for growth in other African countries.

I would encourage the establishment and development of Leadership programmes to identify and support young researchers and entrepreneurs.

There is a global emphasis on developing the bio-economy. The UK1, EU2 and USA3 have all formulated strategies to move away from the traditional industrial base and develop a strong bio-economy. Within this, for example it is believed that the synthetic biology market will grow ten-fold by 2030 (Clarke –Chair Synthetic Biology Leadership Council1).

Biophysics underpins very large sections of the bio-economy and therefore a strong and diverse biophysics research and commercial sector is vital for the success of the African economy.

Yours faithfully,

Dr. Raymond sparrow Prof. Dr. Thomas Franke

1. Growing the Bioeconomy. Improving lives and strengthening our economy: A national bioeconomy strategy to 2030. HM Government, UK (2018)
2. A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment. Updated Bioeconomy Strategy. EC (2018)
3. National Bioeconomy Blueprint. The White House, Washington, USA (2012)

Primary Category:

Atomic & Molecular Physics

Secondary Category:

Biophysics

Subgroup categories:

MaterialsPhysics—Materials for biology

Did you / will you submit this LOI to another category?:

YES

Additional Information:

The African Strategy for Fundamental and Applied Physics

32

Opinion of an observer

Author: Avijit Kumar Ganguly[None]

The LOI is in attached file.

Primary Category:

Astrophysics & Cosmology

Secondary Category:

Particle Physics

Subgroup categories:

Astro&Cosmo—High-energy astrophysics and astro-particle physics

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

33

The first millimetre-wave radio telescope in Africa: the Africa Millimetre Telescope –Letter of Interest

Author: Michael Backes[None]

The Event Horizon Telescope (EHT) is an earth-size virtual telescope that comprises of several telescopes that observe together at mm to sub-mm wavelengths in the mode of very long baseline interferometry (VLBI). The EHT is used to image supermassive black holes (SMBH) such as Sagittarius A* and was recently used to image M87, the famous "first image of a black hole"in 2017 which was subsequently unveiled in 2019. Whilst EHT's antennas are distributed around the globe, none of these antennas are located on the African continent. The Africa Millimetre Telescope (AMT) will be Africa's first mm-wave radio telescope and is planned to be built on the Gamsberg Mountain in Namibia. The AMT will have aims to have significant impact on human capacity development in Namibia and Africa.

Primary Category:

Astrophysics & Cosmology

Secondary Category:

NONE

Subgroup categories:

Astro&Cosmo—Astronomical instrumentation and infrastructure

Did you / will you submit this LOI to another category?:

NO

Additional Information:

High-Energy Astrophysics; Astronomy for Development

34

Continued gamma-ray observations with H.E.S.S. –Letter of Interest

Author: Michael Backes[None]

The High Energy Stereoscopic System (H.E.S.S.) is an array of 5 Imaging Atmospheric Cherenkov telescopes (IACTs), located near Windhoek, Namibia, sensitive to very-high-energy (VHE) gamma rays with energies above ˜100 GeV. It is the World's largest and most sensitive ground-based gamma-ray telescope system and scientifically hugely successful in many different fields of high-energy astrophysics, including time-domain and multi-messenger astronomy. A successor, the Cherenkov Telescope Array (CTA), is being constructed in Chile and La Palma but the World's largest IACT will remain unrivalled in the foreseeable future. This, together with H.E.S.S.'s capabilities for and the importance of time-domain astronomy as well as the favourable aspect of time-zone difference, being able to observe 8 hours ahead of CTA south in Chile, makes it most desirable to keep H.E.S.S. in operation even after the CTA becomes operational.

Primary Category:

Astrophysics & Cosmology

Secondary Category:

NONE

Subgroup categories:

Astro&Cosmo—High-energy astrophysics and astro-particle physics

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Galactic and Extragalactic Astronomy; Transients and Pulsars

35

Challenges facing young African physicists in their research careers: postdoctoral opportunities in Africa

Author: Mounia Laassiri[1]

[1] *Mohammed V University*

LOI is in the attached file.

Primary Category:

Young Physicist Forum

Secondary Category:

Commnuity Engagement

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

36

Glass Research and Industry in Africa

Author: Raouf El-Mallawany[None]

A short overview of the glass research and glass industry in Africa will be presented.
Also, short future perspective is added to transfer and localization of technology and lessons learned from the Corona pandemic.
The number of published scientific research articles in year 1980- 2021 has been illustrated by using the search on Scopus [1] was about 14000. While, glass industry focused only in Egypt, Algeria, South Africa and Nigeria. The main glass products were single, double, triple sheet glass, colored and reflected glass. The prices were in the range few tens of US Dollars per m2. The smart glasses are the latest applications of glass materials, offering insights into innovative applications for radiation shielding, energy harvesting, laser devices, and temperature sensing [2-4]. In particular, there is a focus on optics, energy conversion technology and laser devices, structural and luminescence

properties for laser applications, optothermal and optical properties in the presence of gold nanoparticles, and lanthanide doped glasses as a new smart material. Additional smart glasses address the properties and uses of glasses in optical sensing, the significance of Near Infrared (NIR) emissions, solar cells, solar energy harvesting, luminescent displays, and the development of bioactive glasses for biomedical applications.
It has been conclude by the United Nations [5] that :noting the support of the International Commission on Glass, the Community of Glass Associations and the International Committee for Museums and Collections of Glass to promote the International Year of Glass, 2022, gathering more than 1,300 endorsements from the sector in 78 countries:
1. Decides to proclaim 2022 as the International Year of Glass (IYoG 2022);
2. Invites all Member States, organizations of the United Nations system, other international and regional organizations and other relevant stakeholders, including civil society, the private sector and academia, to observe the international year, in an appropriate manner and in accordance with national contexts and priorities, through activities aimed at raising awareness of and directing policy attention to the importance of glass in daily life.
The African economic growth is the lowest in the world, although Africa is very rich in human, natural resources and green energy. Africa (54 Countries, 17.5 % World Population) could work as a main player in the world of glass with the aim of improving the standard of living of the entire continent. Also, Africa can change the situation from importing to exporting High-Technology and improve the economy through the next directions:
1. The Future in Action,
2. Engaging stakeholders: transforming challenges to opportunities (a learning evolution).
References:
1. Scopus/glass (28 Dec. 2021).
2. R. El-Mallawany, Editor, Tellurite Glass Smart Materials: Applications in optics and beyond. ISBN 978-3-319-76568-6, Pages 1-297 (2018). http://www.springer.com/us/book/9783319765679
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5. United Nations A/75/L.84, General Assembly , Agenda item 136, Impact of rapid technological change on the achievement of the Sustainable Development Goals and targets 11 May 2021.

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

Condensed Matter & Materials Physics

Subgroup categories:

MaterialsPhysics—Advanced 2D materials

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

37

Rethinking African experimental physics

Author: Timmo van der Beek[None]

Rethinking experimental physics in Africa

More than in other fields of STEM, advancement in experimental physics has relied past decades on technological or material discoveries such as LASERs, the Large Hydron Collider quantum teleportation or graphene. These advancements have cost huge amounts of money and time to accomplish. Many of those experiments necessitate sophisticated lab environments and/or very specialized technicians to maintain and operate the equipment.
The African experimental reality is generally one of less means and a lack of maintenance culture or priority. This is one of the reasons why so much output from the continent relies on simulations. When a real experiment needs to be done, an African experimentalist would build an experimental plan and book lab space abroad for a determined amount of time. Working like this, there is barely time for a natural scientific process of discovery leading to new scientific questions leading to new discoveries. This is usually the process where the real innovation happens.

We need to rethink experimental physics in Africa. Not by imitating, but by doing things our own way. I offer three suggestions on how to do innovative experimental physics on this continent: (1) Let's be creative using accessible experimental equipment, (2) let's get a sense of urgency back, (3) let's find affordable solutions for local problems in society.

Creativity with experimental equipment

An experiment requires a reliable measurement instrument. Nowadays, a measurement tool can already be a smartphone (there is a camera, a microphone, a magnetometer, a GPS sensor, en antenna ⋯inside). With a creative mind and some clever programming, one can convert such a device into a spectrometer, an EMF detector or a sensor of some kind.
With a slightly larger budget, Ebay offers the next level equipment. Secondhand scientific tools are regularly sold for a fraction of the new price.

Sense of urgency

The biggest accelerators for science in the past decades have been the cold war and the big wars. Examples of what the cold war brought forth are the discoveries caused by the space race and the nuclear proliferation. Both historical events forced the scientific community to prioritize solutions for challenges that did not exist before.
What lacks in Africa is a sense of urgency. Governments and industry can create that sense of urgency by stimulating certain areas of research that target local challenges. The challenges themselves are urgent. Without solutions, some of these challenges (climate change being the greatest) can cause catastrophes with large consequences. Realizing this, the scientific community needs to take the first steps. With excellence. This requires research groups to become more flexible to leave their traditional research topics. This requires the research community to engage more with society to assess these challenges. It asks for a more humble, service-minded approach.

Local solutions for local challenges

Africa has its own particular sets of challenges that ask for specialized solutions. The challenges lie in the areas of agriculture, mining, disease mitigation, industrialization, internet accessibility, climate change, harnessing solar energy, water scarcity etc.
For every challenge, there are numerous solutions. Physics is able to solve many of them, if only physicists would work on these challenges. We should turn our eyes on what is happening around us, instead of being stuck in textbook topics. Finding solutions that help solving real problems is rewarding. Often, it produces new interesting research topics. Local solutions create a passion for science and have relevant impacts on society. Local physics solutions create an economy where society can profit and advance and physics can be funded locally. Let's use our physics knowledge to improve other areas of research such as biology, agriculture, computing or medicine.

This flexible approach is already being applied by several startups and research groups in Africa. My own Tunisian startup laboratoirelaser.com for example works on local challenges in agriculture by developing photonics innovations.

Primary Category:

Optics & Photonics

Secondary Category:

Condensed Matter & Materials Physics

Subgroup categories:

MaterialsPhysics—Materials for optics

Did you / will you submit this LOI to another category?:

NO

Additional Information:

This LoI is meant to inspire experimental physics in Africa.

38

Learn to make mistakes

Author: Timmo van der Beek[None]

Enhance creativity and problem solving by learning to make mistakes

Risk taking and creative expressions without boundaries are a part of essential youth development. Who has not fallen from a tree or burnt their hands on a stove. Africa the youngest continent in the world (almost 60% are under the age of 25). Advancement of science largely relies on youth (enthousiasm, intrinsic curiosity playful creativity are youthful properties). The real advancement of science is done by its workhorses: the PhD students. If Africa can embrace this and recognize it as its most valuable ressource, science can soar.
In a continent where many cultures often teach that old is better than young, a lack of confidence and a lack of error tolerance however often stifles cooperation, creativity and persistance.

One probably has heard of the expression: "Most winners have probably failed more often than losers ever tried". We should start teaching Africans on how to make mistakes. Creativity, problem solving and persistence are all best learnt that way.

I would like to propose a "trying and failing day", once per month at primary and junior high schools of Africa. Maybe also do something similar in college, adapted to the target audience. On these days, no matter the task (whether it be homework, experiments or field trips), the number of times a child tries and not he number of times he/she succeeds is celebrated or rewarded. There is no competition, but cooperation. Teachers are not supposed to intervene even when asked, unless for class order issues or real safety situations.

Examples of activities children/students could do:

–Recreate a recipe from the finished (food) product. (bread, lemonade, stew)
–Make a technical drawing of an everyday object (door lock, television, bicycle) with as much details as possible of its operation.
–Lego without instructions
–Puzzles
–Competitive geography guessing games (where does this food come from, and why)
–Building a (mini) house using real bricks and cement without instructions
–Honest evaluation exercices where a child is stimulated to share how making mistakes has lead to solutions.
–Talk by the teacher (or another adult) who tells and illustrates a couple of mistakes he/she has made in life.

I am convinced that learning how to make mistakes, how to deal with them and how to problem solve will advance science and scientific thinking on the continent in the long term. It will also build character, and enhance cooperation, creativity and persistence.

My Tunisian startup laboratoirelaser.com gives courses for young and old on how to use mistakes to become better researchers.

Primary Category:

Physics Education

Secondary Category:

Commnuity Engagement

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

This LoI is about general scientific methods principles.

39

THE USE OF An Am-Be NEUTRON SOURCE FOR TEACHING AND APPLIED RESEARCH

Author: Sunday. A. Jonah[1]

[1] *Centre for Energy Research and Training, Ahmadu Bello University, Nigeria*

See the attached PDF file for details

Primary Category:

Nuclear Physics

Secondary Category:

Physics Education

Subgroup categories:

NuclearPhysics—NuclearReactions

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Relevant for Physics Education to nuclear engineering

40

Letter of Intent - KJ Cloete

Author: Karen Jacqueline Cloete[1]

[1] *University of South Africa*

Karen Jacqueline Cloete (PhD), Senior Researcher
UNESCO-UNISA Africa Chair in Nanosciences & Nanotechnology Laboratories, College of Graduate Studies, University of South Africa, Muckleneuk Ridge, PO Box 392, Pretoria, 0003, South Africa
Nanosciences African Network (NANOAFNET), iThemba LABS-National Research Foundation, PO Box 722, Somerset West 7129, Western Cape Province, South Africa

Cape Town, 31 January 2022
Letter of Intent
Dear Sir/Madam,

As a senior researcher affiliated to the UNESCO-UNISA iTLABS/NRF Africa Chair in Nanosciences and Nanotechnology chaired by Professor Malik Maaza, it is an honor for me to share my letter of intent in building a strategy towards excellence in Fundamental and Applied Physics on our African continent.

Topic of interest
• Implementing a physics curriculum at school/undergraduate level focused on 1) connecting the fundamental and translational aspects of physics with its technological applications and 2) transforming physics curricula into a multidisciplinary curriculum by linking physics with other STEM fields
• Implementing a postgraduate module for physics fellows focused on science communication to promote communication of physics research and its the diverse and real-world applications to various stakeholders: the general public, policy makers, funding agencies, and industry

Why?
Many African governments are diverting funds and support away from basic sciences to support grand challenges. Physics in essence is viewed as a complex and fundamental or basic science field that aims to improve our understanding of our universe and the world we live in. Yet, its powerful multidimensional link with innovation and technology is often underscored. An example that comes to mind here is the diverse applications of materials physics, and more specifically, nanotechnologies in various fields. More needs to done at the grassroots level –education of young and early career postgraduate fellows in the fundamental, applied, and multidisciplinary links between physics and other STEM fields as well as the potential of public science communication to effectively share physics research with multiple stakeholders that may eventually lead to more robust governmental and industry support to promote innovation and technology underscored by fundamental physics principles.

Thank you for your consideration

Yours sincerely,

Karen Jacqueline Cloete

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

Commnuity Engagement

Subgroup categories:

MaterialsPhysics—Nanomaterials

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Yes - community engagement

41

Glass Research and Industry in Africa

Author: Raouf El-Mallawany[1]

[1] *Menofia University, EGYPT*

A short overview of the glass research and glass industry in Africa will be presented.
Also, short future perspective is added to transfer and localization of technology and lessons learned from the Corona pandemic.
The number of published scientific research articles in year 1980- 2021 has been illustrated by using the search on Scopus 1 was about 14000. While, glass industry focused only in Egypt, Algeria, South Africa and Nigeria. The main glass products were single, double, triple sheet glass, colored and reflected glass. The prices were in the range few tens of US Dollars per m2. The smart glasses are the latest applications of glass materials, offering insights into innovative applications for radiation shielding, energy harvesting, laser devices, and temperature sensing [2-4]. In particular, there is a focus on optics, energy conversion technology and laser devices, structural and luminescence properties for laser applications, optothermal and optical properties in the presence of gold nanoparticles, and lanthanide doped glasses as a new smart material. Additional smart glasses address the properties and uses of glasses in optical sensing, the significance of Near Infrared (NIR) emissions, solar cells, solar energy harvesting, luminescent displays, and the development of bioactive glasses for biomedical applications.
It has been conclude by the United Nations [5] that :noting the support of the International Commission on Glass, the Community of Glass Associations and the International Committee for Museums and Collections of Glass to promote the International Year of Glass, 2022, gathering more than 1,300 endorsements from the sector in 78 countries:
1. Decides to proclaim 2022 as the International Year of Glass (IYoG 2022);
2. Invites all Member States, organizations of the United Nations system, other international and regional organizations and other relevant stakeholders, including civil society, the private sector and academia, to observe the international year, in an appropriate manner and in accordance with national contexts and priorities, through activities aimed at raising awareness of and directing policy attention to the importance of glass in daily life.
The African economic growth is the lowest in the world, although Africa is very rich in human, natural resources and green energy. Africa (54 Countries, 17.5 % World Population) could work as a main player in the world of glass with the aim of improving the standard of living of the entire continent. Also, Africa can change the situation from importing to exporting High-Technology and improve the economy through the next directions:
1. The Future in Action,
2. Engaging stakeholders: transforming challenges to opportunities (a learning evolution).
References:
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2. R. El-Mallawany, Editor, Tellurite Glass Smart Materials: Applications in optics and beyond. ISBN 978-3-319-76568-6, Pages 1-297 (2018). http://www.springer.com/us/book/9783319765679
3. R El-Mallawany, Some physical properties of tellurite glasses, Tellurite Glass Smart Materials, Springer, 1-16 (2018), (Springer) (http://www.springer.com/us/book/9783319765679) ISBN 978-3-319-76568-6, Pages 297 (2018)
4. R El-Mallawany, Radiation Shielding Properties of Tellurite Glasses, Tellurite Glass Smart Materials, Springer 17-27 (2018), (Springer) (http://www.springer.com/us/book/9783319765679) ISBN 978-3-319-76568-6, Pages 297 (2018)
5. United Nations A/75/L.84, General Assembly , Agenda item 136, Impact of rapid technological change on the achievement of the Sustainable Development Goals and targets 11 May 2021.

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

NONE

Subgroup categories:

MaterialsPhysics—Soft matter

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

42

Opportunities and challenges in consolidating the Moroccan Digital Research Infrastructure for Multi-Disciplinary Science and Big Data Particle Physics Analysis

Author: Farida Fassi[1]

Co-authors: Bouchra Rahim [1]; Redouane Merrouch [1]

[1] *Universite Mohammed V (MA)*

Opportunities and challenges in consolidating the Moroccan Digital Research Infrastructure for Multi-Disciplinary Science and Big Data Particle Physics Analysis

Farida Fassi, Redouane Merrouch, Bouchra Rahim
Mohammed V University in Rabat, Faculty of Science. Morocco
Centre National pour la Recherche Scientifique et Technique (CNRST), Rabat, Morocco

Abstract:
Rapid advances in Digital Research Infrastructure constantly translate into new technologies in multiple aspects of knowledge and technology transfer. Big Data promises to revolutionise the Knowledge Outcomes within and beyond Multi- Disciplinary science, by enabling novel, highly efficient ways to plan, conduct, disseminate and assess research. The last few decades have witnessed the creation of novel approaches to produce, store, and analyse data, culminating in the emergence of the field of data science. This brings together Digital Research Infrastructure that includes computational, algorithmic, statistical and mathematical techniques towards extrapolating knowledge from Big Data. Particle physics field looks at the most fundamental structure of the universe –the particles that are its most basic building blocks, and the ways they interact with each other. The field has always been an early adopter of new technologies, applying them in the state-of-the-art discovery machines and experiments that produce floods of Big Data that can be analysed anytime and anywhere using shared and interlinked of heterogeneous research data via large digital infrastructures. The availability of vast amounts of data in machine-readable formats provides an incentive to create efficient procedures to collect, organise, visualise and model these data. Big Data challenges like these are not limited to high-energy physics. Researchers across Multi-Disciplinary Science see the newfound ability to link and cross- reference data from diverse sources as improving the accuracy and predictive power of scientific findings. Big Data are widely viewed as ushering in a new way of performing research and challenging existing understandings of what counts as scientific knowledge. Hence, the Digital Research Infrastructure must be discussed in what direction scientific computing should be going in order to address increasing computational demands and expected shortfalls. The challenges and opportunities of the Moroccan High Performance computing facility will be discussed. The building of a sustainable African networking framework to enhancing the collaboration between African countries in the digital Research Infrastructure will be addressed.

Primary Category:

Computing & 4IR

Secondary Category:

Commnuity Engagement

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

This abstract is relevant for all physics working groups

43

Materials Research to improve the quality of trainings

Author: Evance Obara[1]

[1] *Materials Researcher at Donghua University*

There is need to train, and to improve the quality of trainings for our young scientists in Materials Research for the gain of international career. Currently, unemployment rate of university graduates from material science in Africa, especially in Kenya, is medium to high.This can be linked to: lack of innovations:- most graduates nearly add no value to the companies they are employed in, regardless of whether they graduated with upper honors from the university or not. This is due to the fact that the quality of our research facilities is going low. These facilities lack adequate resources for materials research. The time taken by most university professors to offer quality research is low since the learner- teacher ratio is high. Therefore, AMRS and any other relevant authorities should come up with training schedules in each member country to train short courses, Msc modules both for credit and CPD and offer Remote trainings via virtual classroom. There is need to have a distinctive AMRS office in each member country to oversee the researches in these countries. These departments should be headed by active members of AMRS.
The vision of Africa, from training in Materials Research is; improvement in metallurgy, healthcare, mining, and quality graduates who can change the face of the current world.
The available resources for training materials science in Africa (Kenya to be specific) include; materials labs, equipments, and professors. However, the major factor of concern is the number of trainers (professors) to offer the trainings. There is need to train more scientists in this field in order to realize it's implementation. Our laboratories need to be fully equipped with updated equipments to facilitate accurate findings. Exchange programs from our Researchers need to be considered at regional levels and the participants to be heavily awarded, regardless of who won or who didn't.
Lastly, we need to empower young women in Technology with regard to materials research. I suggest a-third-gender-rule in the considerations for Trainings and scholarships for the young innovative Researchers

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

Condensed Matter & Materials Physics

Subgroup categories:

MaterialsPhysics—Nanomaterials

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

44

Short LoI summarising the case for the African Light Source

Author: Simon Connell[1]

[1] *University of Johannesburg (ZA)*

Short LoI summarising the case for the African Light Source

Prof SH Connell
University of Johannesburg
February 2022

Africa faces significant challenges. These include its high disease burden, the exploration and beneficiation of its mineral wealth, development of innovation pipelines for competitive industry towards established African wealth, the need to urgently address all 17 of the UN SDGs, discovering and curating its rich evidence of global human heritage, both as the cradle of human-kind and also early human civilisation, the largest projected youth population of the world - requiring massive capacity building, amongst other challenges. Many of the sciences that address these challenges can be very well stimulated and enhanced continent-wide with a focus on an Advanced Light Source. Of course, here, "light"refers to electromagnetic radiation from the infra-red to the hard X-ray regime, enabling the most quantitative analytical microscopies down to atomic length scales.

The concept of a large scale research infrastructure benefits the entire continent. The African Light Source (AfLS) project leaves no African country behind. Each country benefits from the same upgrade in terms of human capital and improved local and regional research infrastructure. This infrastructure simultaneously offers premier training opportunities and competitive research infrastructure, as well as enabling feeder infrastructure to all light sources world-wide, but especially to the AfLS on the African continent. The country that wins the bid to host the AfLS will of course become a regional hub, but in many cases, the COVID era has boosted our capacity for remote work. Researchers can take advantage of 4IR technologies in science experimentation, as robotic technologies allow experiments to be planned and controlled remotely from the home institution.

The mega-innovation hub that will spring up in the science-industry park that surrounds the AfLS will benefit all industry on the continent. There are other socioeconomic benefits. One particular current focus for Africa is to have its own Intellectual property in its own vaccine for a future pandemic. In the current pandemic, Africa has the capacity to produce vaccines under license at several pharmaceutical installations on the continent. However, for a safer planet, as shown in the current pandemic, it is preferable that all habitable continents have independent capacity to develop their own medical interventions, which then compliment the global search for solutions.

Furthermore, the AfLS represents successful Pan African science diplomacy. Boosting Africa to participate fully in the global science endeavour will lead to the increased profile for African Science, as well as increased professional travel and communication. This ultimately builds appreciation of our human diversity. Ubuntu holds us all to be one human community.

Africa is now the last habitable continent which does not have a light source. Other continents not only have several such large scale infrastructures, but they are implementing or planning the upgrade to the so-called fourth generation instrument. This upgrade is not a factor of two superior, as might be expected, but a factor of ten thousand superior, considering the product of improvements in both beam and detector instrumentation. It is also the case that the training of students at such facilities has long since overflowed to industry, leading to the concept of second generation of student training. The Industry supervisors now demand a next generation of young emerging scientists at the Advanced Light Sources. The Advanced Light Source has become a premier research solution for these countries. It is therefore imperative that Africa get started on a light source of its own. It is also worth noting that the African User Base of such facilities, and their excellence in their own scientific communities, in Africa and in the Diaspora, has long surpassed the custom-of-practice threshold for the minimum size of User base for the initiation of a continental Advanced light Source programme, the AfLS. Indeed, an AfLS would be an essential feature of reducing the current brain drain, and encouraging some of the African science diaspora to return.

Taking the contributions to capacity building, research, technology, innovation, wealth generation and Pan Africanism all together, this also contributes to the goal of the final decolonisation of Africa and the deracialisation of the world.

Primary Category:

Light Sources

Secondary Category:

Light Sources

Subgroup categories:

LightSources—AcceleratorPhysics

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Really is Socio-Economic motivation of a Light Source

46

NUPHAPHA-Nuclear Photonics Accelerated Physics for Africa

Author: HUDSON ANGEYO KALAMBUKA[None]

Abstract: Embracing nuclear photonics enabled by accelerators can play a key role in accelerating capacity building in both nuclear (basic and applied) and laser physics in Africa that would likely lead to a revision of African Union's Agenda 2063 of the strategic framework for sustainable development and economic growth based on nuclear science and technology.

Introduction
Today more than 20,000 particle accelerators are operating world-wide. As reviews of their landscape and future will be taking place this May 1 at the first IAEA International Conference on Accelerators for Research and Sustainable Development the renaissance in nuclear physics wrought by new high-power, short-pulse lasers and novel sources highly brilliant, intense gamma ray beams will continue to open up unprecedented perspectives for applied photonuclear physics [2]. These dynamics of the developments are good but present the danger that the research gap in accelerator physics between North and South, large as it already is, will widen even further.

Nuclear Photonics
Born in 2010 nuclear photonics uses the unique capabilities of two disciplines namely heavy ion physics and physics of super-strong laser fields to fashion out a new cross-disciplinary field of Physics and Engineering applying controlled photo-nuclear reactions with artificial γ-ray beams.

With the new low-energy, pulsed, polarized neutron beams of high intensity and brilliance [3] as well as new positron sources with significantly increased fully polarized brilliance [4] radically new clinical applications are expected in the use of radioisotopes [5], non-invasive tomography and microscopy, management of nuclear materials and nuclear forensics, and materials science. If as expected a seeded quantum FEL for γ beams becomes possible, with much higher brilliance and spectral flux, the nuclear resonance fluorescence (NRF) method will be boosted drastically.

Most of these developments are taking place at the Extreme Light Infrastructure –Nuclear Physics (ELI-NP) in Bucharest (Romania), MEGaRay in Livermore (USA), NICA (Nuclotron based Ion Collider fAcility) in Dubna (Russia) and the IγS facility at Duke University (USA). At Nuclear Research (Dubna) the NICA (Nuclotron based Ion Collider fAcility) will soon be used to study the properties of dense baryonic matter [6-9].

The Proposal: NUPHAPHA
We propose in this LOI a conceptual academic-industry partnership in Africa to act as a contact point for large group participation in nuclear-photonics research world-wide initially concentrating on the already homegrown topics of (i) Laser Physics and (ii) Radiation Physics and Applied Nuclear physics. International cooperation is the core of today's successful scientific culture. For instance about 2000 specialists from 90 institutes of 26 countries of the world take part in the creation of the NICA collider. Such networks are not well developed in Africa, the most rapidly developing region in the world and with the greatest educational/scientific needs. This North-South divide deprives the global research community of the substantial intellectual capital located in Africa and hinders the effectiveness of our collective scientific responses. NUPHAPHA will be part of the structural initiative to address the imbalance. Networks are a proven modern way of organizing knowledge production processes.

Although the dismal state of laser-related research on the African continent is well documented [10] this initiative could be co-coordinated by ALS at CNRS and iThemba LABS in South Africa (the pre-eminent laboratory in the African continent for nuclear physics research) to:
• Steer a continental capacity building initiatives
• Coordinate human capital mobility in nuclear photonics within Africa and across borders
• Promote and optimize R&D infrastructure sharing in the continent
• Pool resources through various North-South and South-South research cooperation
• Improve access to the scientific research Infrastructure that is available in the North
• Initiate linkages of scientists and institutions committed to nuclear photonics
• Identify and promote adoption of best practices in accelerator technology transfer

Conclusion
The NUPHAPHA initiative and research partnerships are envisaged to break old patterns for real change. The research groups and networks involved in NUPHAPHA should agree to exchange scientists and experts as well as mount joint projects within working groups.

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[3] Barty, C. P. J. MEGa-rays, petawatts, and nuclear photonics, SPIE Opt. Optoelectron., Paper 8080B-30 (2011).
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[8] http:www.eli-np.ro
[9] http:www.tunl.duke.edu/higs2.php
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Primary Category:

Nuclear Physics

Secondary Category:

Optics & Photonics

Subgroup categories:

NuclearPhysics-NuclearApplications

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Relevant also for accelerator physics

47

Push to Address Long-term Challenges for Young African in physics

Author: Mounia Laassiri[1]

Co-authors: Benard Mulilo [2]; Diallo Boye [3]

[1] *Mohammed V University*

[2] *University of Zambia*

[3] *Brookhaven National Laboratory*

Corresponding Author: mounia.laassiri@gmail.com

LOI is in the attached file.

Primary Category:

Young Physicist Forum

Secondary Category:

Commnuity Engagement

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

None

48

ASFAP—YPF: Going Beyond the ASFAP Process

Author: Mounia Laassiri[1]

Co-authors: Benard Mulilo [2]; Diallo Boye [3]

[1] *Mohammed V University*

[2] *University of Zambia*

[3] *Brookhaven National Laboratory*

LOI is in the attached file.

Primary Category:

Young Physicist Forum

Secondary Category:

Commnuity Engagement

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

None

49

Quantum computing, Quantum Optics and Quantum biology

Author: Serge Guy NANA ENGO[1]

[1] *University of Yaoundé I*

Topic of interest
- Implementation of a postgraduate module for physics fellows that integrate quantum computing, quantum optics, quantum biology, data science, machine learning and intellectual property.
- Implementation of a regional human capital mobility in these domains.
- Promoting the establishment of intensive undergraduate coding learning communities.

Potential impact
Pooling this different knowledge will allow us to have the human resources capable of carrying out research activities related to innovation and technology, in order to respond effectively to our various issues in energy, materials, health, metrology and climatic changes.

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

Biophysics

Subgroup categories:

MaterialsPhysics—Theoretical and computational Condensed Matter Physics

Did you / will you submit this LOI to another category?:

YES

Additional Information:

Computing &4IR, Physics Education, Optics & Photonics

50

The importance of Artificial intelligence for applications in high energy and other Scientific Disciplines

Authors: Farida Fassi[1]; JOSE SALT[2]; Maria Moreno Llacer[3]

[1] *Universite Mohammed V (MA)*

[2] *IFIC-VALENCIA*

[3] *Univ. of Valencia and CSIC (ES)*

Artificial Intelligence (AI) is an essential tool for a good decision making model and has been used in a wide variety of scientific disciplines from bioinformatics to aeronautical engineering to image processing. Computational intelligence has also found its way to detector physics, especially for high-energy physics experiments, and has been used to determine detector performances, as well as extract physical information of interacting particles. In high-energy physics experiments, one of the essential steps in the extraction of physical information from particle detectors is to reconstruct the characteristics of the particles produced in the accelerators. Through the use of statistical methods, algorithms are trained to make classifications or predictions, uncovering key insights within data mining projects. These insights subsequently drive decision making within HEP applications, ideally impacting key growth metrics. AI technologies are playing, and will play for sure, a key role in LHC Run-3 and beyond (ie. HL-LHC). They are not only expected to be more accurate and need less developer time, but in principle could be faster. The demand for HEP data scientists will increase requiring the assessment in the identification of the most relevant questions to faster decision making across more complex data sets. In this letter we will address and discuss how to strengthen the collaboration between IFIC and Mohammed V University in Rabat, including the African institutions whom are interested to learn and use the Artificial Intelligence for the applications in other scientific disciplines. A global effort for transferring this technology is needed to speed the participation of the African physicist in this revolution.

Primary Category:

Computing & 4IR

Secondary Category:

Particle Physics

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

YES

Additional Information:

For particle physics

51

Development in Africa with Radio Astronomy

Author: Melvin Hoare[1]

[1] *University of Leeds, UK*

The Development in Africa with Radio Astronomy project (DARA www.dara-project.org) and has provided a basic training in radio astronomy to over 300 young graduates across the eight African countries that partner South Africa in hosting the mid-frequency SKA. Postgraduate training has also been provided to 26 MSc and 9 PhD African students, mostly at UK universities. The training provided entrepreneurial skills and an awareness of how the research, technological, computing skills in radio astronomy translate in to the space sector through partnerships with industrial a commercial SME in the UK and the South African National Space Agency. The sister project DARA Big Data (www.darabigdata.com) expanded this to show how the data intensive skills in radio astronomy can be applied to the health and agricultural sectors. Partly in response to the pandemic a repository of recorded lecture material and workshop exercises have been built up. The Ghana Radio Astronomy Observatory is also now in a position to host practical radio astronomy training events in addition to the Hartebeesthoek Radio Astronomy Observatory in South Africa. The networks and partnerships built up as part of DARA are looking for ways to continue and expand the project.

Primary Category:

Astrophysics & Cosmology

Secondary Category:

NONE

Subgroup categories:

Astro&Cosmo—Astronomy for development

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

53

Searching for subtle signs of new physics via novel top quark measurements

Authors: James Michael Keaveney[1]; Maria Moreno Llacer[2]

[1] *University of Cape Town (ZA)*

[2] *Univ. of Valencia and CSIC (ES)*

Searching for subtle signs of new physics via novel top quark measurements

This letter describes a programme of experimental particle physics research undertaken by the University of Cape Town and IFIC Valencia ATLAS groups that commenced in 2020. The programme is concerned with the electroweak couplings of the top quark as they pertain to the search for new physics and comprises analyses of data within the ATLAS collaboration and reinterpretation of published LHC data outside experimental collaborations. We hope to highlight the importance of a thematic long term research programme in enriching the African particle physics community and maximising its impact on the field's most prominent research questions.

No evidence of direct production of new light states has been observed in the LHC data. Thus attention has naturally turned to scenarios of new physics in which the new states have masses at an energy scale Lambda that is so large in comparison to the scales directly probed at the LHC that direct production of these states in LHC collisions is kinematically suppressed. Significant deviations of measurements of the SMEFT coefficients from the SM expectation may be the first evidence of new physics and would constitute a major discovery. The top quark is involved in many scenarios of new physics [1-4]. As the African particle physics community prepares for the unprecedented datasets of the HL-LHC it is crucial to identify previously unexplored measurements that have the potential to improve the precision at which SMEFT coefficients can be determined. Through execution of such measurements and their interpretation in the SMEFT, the African particle physics community can maximise its impact on the HL-LHC programme.

Recent data from the LHC allow for a robust and precise characterisation of the electroweak interactions of the top quark [6]. State of the art inclusive and differential cross section measurements of the associated production processes of top quarks and neutral gauge bosons, using LHC data allow to further study the top quark electroweak couplings and set constraints on several EFT operators. The combination of numerous observables allows constraints so-called blind directions in the SMEFT parameter space. Blind directions refer to linear combinations of SMEFT coefficients that, due to cancellation effects between parameters, remain entirely constrained by analyses that utilise limited sets of LHC data even when individual parameters appear constrained. This emphasises the need for global analyses that consider vast arrays of experimental results simultaneously.

The tWZ process refers to the rare electroweak production of a single top quark in association with a W boson and a Z boson. The tWZ process is sensitive to multiple SMEFT operators. The advantages of tWZ measurements in constraining the SMEFT coefficients are detailed in [5]. The effect of the SMEFT operators on the tWZ process shows an energy dependence that is more pronounced than that of alternative processes such as tZq. Thus constraints on SMEFT coefficients from tWZ will continue to improve after constraints from processes with weaker energy dependence become systematically limited. We identify differential measurements of the tWZ process as an example of a research goal in which the African community can have a unique impact on the search for new physics at the HL-LHC.

The results of the analyses fully detailed in [6] and [7] are summarised in Figure 1. The figure shows examples of the confidence intervals on the CtZ and CtW SMEFT coefficients from a fit to a range of top quark measurements based on LHC Run-II data [6]. Similarly the figure shows credible intervals on a set of coefficients that includes CtZ and CtW that are expected to be obtained from a single measurement of the differential cross section of the tWZ process with the full HL-LHC dataset [7]. These plots emphasise the qualitative and quantitative complementarity of the measurement of top quark related processes as a means of constraining the SMEFT.

Figure: 1 In the left-hand plot, the confidence intervals on the CtZ and CtW SMEFT coefficients are illustrated as regions in the corresponding 2-D parameter space obtained from a fit to a wide range of top quark measurements based on LHC Run-II data. In the right-hand plot 1- and 2-D marginalised credible intervals on a set of coefficients that includes CtZ and CtW that are expected to be obtained from a measurement of the differential cross section of the tWZ process with the full HL-LHC dataset.

To conclude this letter, we discuss our progress so far in the long term project of devising and executing novel top quark measurements to constrain the SMEFT. In 2020, the UCT and IFIC established a collaboration to measure, for the first time, the leptonic charge asymmetry in the ttW process using the full Run-II data of the ATLAS experiment. The inclusive and differential ttW cross sections are sensitive to SMEFT coefficients. The ttW measurements has gone from a novel idea to a full-fledged ATLAS analysis that has recently entered the formal ATLAS approval process. We hope that the ttW project is the first step in a long and fruitful collaboration that yields an unprecedented African impact on the LHC physics programme.

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Primary Category:

Particle Physics

Secondary Category:

Particle Physics

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

54

Low Frequency (< 1GHz) Radio Interferometric Arrays and Radio-Astronomy/Cosmology

Author: Patrice Okouma[1]

[1] *Rhodes University, South Africa*

See the attacched file

Primary Category:

Astrophysics & Cosmology

Secondary Category:

Physics Education

Subgroup categories:

Astro&Cosmo—Astronomical instrumentation and infrastructure

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Also of interest to computing

55

African Radio Astronomy Network

Author: James Chibueze[1]

[1] *North-West University, Potchefstroom, South Africa.*

The idea of the African VLBI Network (AVN) is an excellent one especially if Africa is to become a serious player in the global VLBI network but as experience with the conversion of the Ghana 32m telescope has shown, big dish astronomy can be an expensive both to build and to maintain. Nevertheless, radio astronomy can be done at grassroots with small, cheaper instruments/telescopes. These could include LWA antennas, Yagi antennas, Michelson "adding"interferometers, and small parabolic dishes.
The objective would be to provide training programmes in radio astronomy at universities and national facilities and to undertake research with the ultimate aim of getting African astronomers to participate in the SKA science.

Primary Category:

Astrophysics & Cosmology

Secondary Category:

Astrophysics & Cosmology

Subgroup categories:

Astro&Cosmo—Astronomical instrumentation and infrastructure

Did you / will you submit this LOI to another category?:

NO

Additional Information:

None

56

THE LOFAR GLOBAL CITIZENSHIP RADIO ARRAY "GLORAY"

Author: George Miley[None]

THE LOFAR GLOBAL CITIZENSHIP RADIO ARRAY "GLORAY"
George Miley, Sterrewacht, Leiden University,The Netherlands

This is a summary of a proposal to be submitted to ASTRON and the Board of the International LOFAR Telescope Board later in 2022 to carry out a design study for a project that would transform LOFAR into a multidisciplinary facility that would span 3 continents. Countries in North Africa would be crucial partners of GLORAY, a facility that could eventually link with SKA-Africa. The project would impact astrophysics, geophysics and capacity building in Africa is therefore relevant for ASFAP.

The International LOFAR Telescope (ILT) is the world's largest, most sensitive high-resolution radio telescope at low frequencies (<300 MHz) and a pathfinder for the ESFRI Landmark SKA (Square Kilometre Array). It is a pan-European facility, with a network of mutually dependent antenna stations that stretch across Europe, from Ireland to Latvia. A dense sensitive 'core'is located in the Netherlands and additional ILT antenna stations are located in 9 European partner countries.

The GLORAY vision builds on the ILT by increasing the number of antenna stations, thereby adding substantially to the antenna collecting area at strategically located parts of the array and extending the array to North Africa and the Middle East. The resultant baseline coverage would improve the sensitivity and resolution of the ILT by large factors and provide observational capabilities for observing the Sun and the ionosphere at lower latitudes. GLORAY would probe hitherto unexplored discovery space in astrophysics, ionospheric physics, space weather and solar physics. Because GLORAY will operate at the lowest frequencies of the electromagnetic spectrum observable from earth, it will access many unique physical diagnostics that are crucial for understanding our own planet and the Universe in which we live. GLORAY discovery space will complement that of the Square Kilometre Array (SKA). It will probe a lower relatively unexplored frequency band below 50 MHz, and because of its much longer baselines (factor ˜ 50 compared with SKA-low), it will produce pictures of the low-frequency sky with unprecedented clarity and depth. GLORAY will also complement SKA-low by providing low-frequency access to the northern sky and its plethora of exotic and unique astrophysical objects.

The diagnostics observable with GLORAY will complement those from much more expensive ground and space facilities, resulting in a whole that is greater than the sum of the parts. The low-frequency high-resolution capabilities of GLORAY will produce important new information about fundamental issues, such as our cosmic history, the extreme physics of stars, galaxies and clusters of galaxies and new types of exotic exoplanets. GLORAY will also contribute to the solution of practical problems on our planet, by monitoring the propagation of ionospheric perturbations and storms throughout Europe, North Africa and the Middle East, by studying space and solar weather from an intercontinental perspective and by investigating differences in the characteristics of lightning strikes between diverse climates. An important feature of GLORAY is that its individual stations can be used separately by local scientists for local climate-related monitoring of the ionosphere, lightning etc., as

well as participating in pan-GLORAY observations with the array as a whole.

However, the most important and ground-breaking aspect of the GLORAY vision is the transformation of the ILT from its present main function as a world-leading tool for astronomical discovery, into a multidisciplinary intercontinental facility that will be a unique engine for capacity building and development within all GLORAY countries, in Europe, North Africa and the Middle East. Radio interferometry is a particularly effective technique for stimulating international partnerships because it requires simultaneous operation of antenna stations in all the partner countries and a combination of their data, using advanced ICT techniques, to produce beautiful high-resolution pictures of the radio sky. This creates interdependence between partner countries to produce a whole that is greater than the sum of the parts. The interdependence, inspirational science mission and cutting-edge technological expertise make GLORAY an ideal platform for initiating multidisciplinary and interdisciplinary partnerships, that will advance the SDGs and stimulate a sense of global citizenship and respect throughout the partner countries and the 3 GLORAY regions. This aspect of the GLORAY mission would be carried out in close consultation or collaboration with UNESCO and following the precepts of UNESCO's Education Sustainable Development ESD for 2030.

In accomplishing its globalist international development mission, GLORAY will exploit:
• the mutual interdependence between the partner countries that will equip the array for multidisciplinary bridge-building and a potentially important role in science diplomacy;
• the technological ICT expertise and skills needed to develop and operate the array that will stimulate advances in image processing, distributed sensor fields, GRID and Exabyte computing, with societal applications, including medical imaging and precision agriculture;
• an SDG-based educational programme that will use the cosmic perspective and innovative high-tech aspects of the array to target citizens with the message of global citizenship "from the cradle to the grave".

This unique combination of assets will be used to pursue a strategically focused programme of capacity building, in collaboration with the International Astronomical Union Office of Astronomy for Development in Cape Town and its relevant regional offices. The GLORAY capacity building programme will focus on advancing the United Nations Sustainable Development Goals, particularly that of stimulating global citizenship (SDG4.7) in GLORAY partner countries and associated regions. This is reflected in the naming of the new facility as the "LOFAR Global Citizenship Radio Array" . GLORAY will build on the pioneering work in the development of Africa by the Meerkat and SKA-Africa radio telescopes. It would be a model for a new generation of scientific infrastructures, in which cutting edge curiosity-driven scientific discovery is combined with highly practical societal relevance, to establish visible scientific, educational and diplomatic bridges of mutual respect between partner countries.

Primary Category:

Astrophysics & Cosmology

Secondary Category:

Earth Physics

Subgroup categories:

Astro&Cosmo—Astronomy for development

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Also Ionospheric physics, solar physics, lightning,educatio

57

FURTHERING THE SUSTAINABLE DEVELOPMENT GOALS IN

AFRICA BY EXPOSING YOUNG CHILDREN TO THE BEAUTY, EXCITEMENT AND PERSPECTIVE OF ASTROPHYSICS

Author: George Miley[None]

Following the recommendation of a virtual United Nations Dialogue held during UNGA75, this letter of intent suggests that ASFAP incorporates the use of physics in the education of very young children aged between 4 and 10, particularly those in underprivileged communities into its strategy.

WHY VERY YOUNG CHILDREN?
There are three reasons:
1. Early educational interventions during the young formative years are crucial in stimulating child development (OECD, 2006, Worth & Grollman, 2003, Rocard 2007).
2. There is an enormous untapped potential and talent in underprivileged communities. Such communities are frequently alienated from society at large and this alienation begins at childhood. According to a UNICEF report (UNICEF 2006), "The opportunity to help disadvantaged children have a more equal start in schooling is in the earliest years when the basis for their cognitive, social and emotional development is being formed".
3. Educating very young children from underprivileged communities is highly cost effective (Schweinhart et al 2005), but needs a special approach. The Early Years Learning Framework for Australia (Commonwealth of Australia 2009) states, "When early childhood educators respect the diversity of family and communities…they are able to foster children's motivation to learn"and further "Poor math trajectories in low-socioeconomic status children begin early…. Studies suggest that early interest can be influenced"(Arnold and Doctoroff: 2003). A series of important studies by Nobel prize winner James Heckman and his group emphasizes the cost effectiveness of early educational intervention in underprivileged communities with pre-school activities that motivate very young children (Cunha, Heckman et al: 2006), Heckman and Masterov (2007), and Heckman (2000,2008).

WHY EMPHASISE ASTROPHYSICS?
The excitement of astrophysics is an important vehicles for capturing the imagination of very young children, helping to stimulate their ethical value systems and introducing them to science and engineering. There are several reasons for this.
1. Consideration of the vastness and beauty of the Universe and of our place within it provides a special perspective that can help broaden the mind and stimulate a sense of global citizenship.
2. The ability of space and astronomy to interest and motivate young children can be used to stimulate education in a broad holistic sense. Space-based themes can be encapsulated in stories to further language skills and to pose and solve problems that develop numerical skills.
3. Astronomy provides a seductive introduction to science and technology. Many scientists and engineers trace their first interest in science to exposure as very young children to the fascinating Universe.
4. Exposure to intriguing aspects of space can "light a spark"in a young child that several years later causes them to embark on a scientific or technical career.

WHY PBD-UNAWE?
Based on the rationale presented above, Universe Awareness (UNAWE) was initiated in 2005 to exploit scientific, educational and social dimensions of astronomy for the education of young children. Now renamed Pale Blue Dot –Universe Awareness (PBD-UNAWE) has been conducted in more than 60 countries and is a flagship project of the International Astronomical Union Office for Astronomy for Development in Cape Town. It is directed at children between 4 and 10 years, aims to broaden children's minds, awaken their imagination and curiosity in science and encourage respect, tolerance and global citizenship. A major goal of PBD-UNAWE is to stimulate children to develop into curious, tolerant and internationally oriented adults (Ödman et al. 2006, Ödman 2007, 2011).

The main ingredients of PBD-UNAWE are:
• Provision of an international network for astronomy as an educational tool for motivating very young children.
• Development of country-specific educational resources,
• Organisation and stimulation of training for teachers,
• Development and implementation of a consistent evaluation framework.

A virtual United Nations Dialogue held during the 75th UN General Assembly was devoted to Astronomy for Development. A highlight was the participation by the South African Foreign Minister,

H.E. Grace Naledi Pandor, who gave an inspirational keynote address. The GA75 Dialogue concluded with the unanimous adoption of a motion that advancement of the SDGs should include the following goal:
"Before they are 10 years old, every child should be introduced to the inspiring notion that we all inhabit a tiny planet in a vast wonderful Universe, illustrated by the iconic pictures of our earth taken from space. This will help them realise that we all belong to a common humanity (SDG 4.7), who must respect and protect our planet (SDG 13) and advance the cause of peace (SDG16)"

For these various reasons, PBD-UNAWE, supplemented by exciting aspects of other branches of physics beyond astrophysics, could be an important component of ASFAP, in partnership with the IAU OAD in Cape Town and its African regional offices.

Primary Category:

Physics Education

Secondary Category:

NONE

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Reach young children during formation of their value systems

58

Letter of Intent (LoI): The Need for an African Synchrotron Lightsource

Author: Prosper Ngabonziza[None]

This letter of intent (LoI) is to show my strong interest for the African synchrotron lightsource; and also, to demonstrate how having it set up in Africa would be very beneficial to the continent as a whole. Research infrastructures are facilities used by the scientific community to carry out exploratory research in different fields using diversified scientific instruments to address well-defined questions. Answering such questions often leads, both in the short- and long-term, ultimately to a wide range of practical applications and defines pathways for addressing global challenges, such as tackling endemic diseases, food security and scarcity of clean water.

To address Africa's huge challenges in the long-term requires research activities in nearly all scientific disciplines and the utilization of scientific infrastructures that are both multi- and interdisciplinary. Such infrastructures should bring together research activities in medical sciences, environmental sciences, energy sciences, materials sciences, and cultural heritage sciences amongst others. One of the reasons Africa needs such infrastructures is that scientists could, for example, develop cures for diseases of particular relevance to Africa that may not be receiving sufficient research attention from outside. Africa cannot continue waiting for those outside the continent to take the lead in developing treatments for diseases like Ebola and malaria.

The evident choice of such a large scale multi- and inter-disciplinary research infrastructure is a synchrotron light source (SLS). A SLS is a mega-scale research and industrial infrastructure that delivers light that can be billions of times brighter than our sun. This extremely bright light is useful for imaging viruses, bacteria, cells and nanostructures, to name but a few. Knowledge from such images can be extremely useful in addressing health/medical/biomedical problems, environmental

problems, and in the development of novel materials and devices that could lead to diversified technological applications for Africa and even the world at large. An SLS also could generate a combined science and industrial park that springs up around it and become a clustered science-megalopolis of globally competitive research activities, training and innovations. However, for now, Africa is the only habitable continent without an SLS. African researchers and scientists have to travel abroad to perform experiments at facilities in Europe, South and North America, Asia and Australia.

Having such an advanced light source in Africa would be very beneficial to the continent as a whole. Currently Africa is losing many of its talented and energetic young scientists to the African science Diaspora. The research work that we are doing abroad is not possible with the current research and scientific facilities in Africa. An SLS would play an important role in retaining talented scientists and preventing the best-trained researchers and multi-disciplinary innovators from emigrating. Thus, setting up such a mega-scale infrastructure somewhere in Africa would make that region a unifying point and a leader in bringing many African and international scientists together. In addition to the above scientific benefits, such a large-scale infrastructure would also play a pivotal role in seeding local competitive industries on the continent.

In particular, an SLS in Africa would enhance the advancement of basic and applied scientific research and capacity-building on the continent. Advanced techniques employed at an SLS would be applied for research in many fields that are relevant for Africa. For example, in agriculture for the analysis of soil and environmental pollutants; in health for tackling and development of new drugs for malaria, HIV, tuberculosis and Ebola, which are amongst the top challenges facing Africa today.

Furthermore, SLSs are complex machines requiring an enormous range of scientific, mathematical, engineering, technological and industrial skills. Thus, it is envisaged that the African SLS would open employment opportunities for Africans, international engineers, and people having a diversity of qualifications. Other socio-economic benefits for an African SLS include the growth of spin-off companies for technological development and innovation and the generation of employment opportunities for qualified African youth. The African SLS would also give African countries another opportunity to work together in taking control of their destinies and becoming major players in the international community.
This document is part of my reflection about the need for multidisciplinary scientific infrastructures in Africa, in particular the importance of an African Synchrotron Lightsource, which can be accessed on online here 1.

Primary Category:

Light Sources

Secondary Category:

Instrumentation & Detectors

Subgroup categories:

LightSources—ExperimentalInstrumentationSamplePreparationAndDataAnalysis

Did you / will you submit this LOI to another category?:

YES

Additional Information:

Yes, research infrastructures in Africa

59

LOI BioStruct_Africa

Authors: Daouda Traore[None]; Emmanuel Nji[None]

Corresponding Author: daouda.traore@biostructafrica.org

Tropical Diseases and Antibiotic Resistant Microorganisms constitute a significant health, social and economic burden to the African continent. Structural Biology is an important tool used to understand the molecular basis of these diseases. In fact, knowledge of the molecular structures guides the rational design of new drugs and the optimisation of existing medicine. However, due limited resources but most importantly the lack of trained persons, exodus of skilled scientists, the majority of the countries across the continent of Africa do not conduct research in structural biology. This led to the establishment in 2017 of BioStruct-Africa to help bridge this gap. Indeed, "the poverty gap is a technology gap".

At BioStruct-Africa, our main objective is to build capacity in the field of structural biology in Africa. This is done this through the organisation workshops at universities and research institutes in Africa that have active biological research programmes. The workshops are followed by a mentoring to ensure sustainable capacity building. The short-term goal is to demonstrate that structural biology can be done in Africa. By doing so, we hope to ignite the interest of Africa-based scientists to pursue endeavours in structural biology thereby planting the seed for BioStruct-Africa's long-term goal: to develop world class structural biologists working in Africa on the diseases that are a burden for the continent. "Give a man a fish he can feed his family for a day, but teach him how to catch fish he can feed his family for a life time". This adage is true when considering structural biology and its impact in containing the prevalent diseases in Africa.

Synchrotron light sources are indispensable tools for structural biologists around the globe and access is always based on scientific merit and economical priorities. For African to build and operate their own light source and beamlines will remove one of the greatest hurdles for African scientists as they will be able to prioritise projects that are relevant to the continent. With BioStruct-Africa, the structural biology community will be ready before the light source is turned on.

Primary Category:

Light Sources

Secondary Category:

Biophysics

Subgroup categories:

LightSources—MacromolecularX-rayCrystallography

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

60

Code parallelization for Computational Physics: Challenges, solutions, and future direction

Authors: Yacine HAKIMI[None]; Riyadh Baghdadi[None]; Yacine Challal[None]

LOI is in the attached file

Primary Category:

Computing & 4IR

Secondary Category:

NONE

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

61

African Advanced Energy Materials Research & Development

Author: Marcus Newton[1]

[1] *University of Southampton*

Advanced Energy Materials research is focussed on the design, fabrication, characterisation and theoretical understanding of materials that have use in energy generation, storage and distribution applications. An energy revolution is currently underway as governments worldwide seek to reduce dependence on fossil fuels and transition to a low carbon energy supply. Achieving this will require the development of cost-effective innovation in energy technologies.

Africa faces numerous challenges to generate and distribute an adequate supply clean energy that is required to maintain infrastructure including transportation, communication, industry, education, security and healthcare. Energy security is vital for a robust and sustainable economy. There is great potential to develop new materials for generating and harvesting energy from renewable sources including photovoltaic devices and mechanical energy recouperation devices that can enable low-cost and innovative renewable sources of energy while eliminating negative effects on the environment that are inherent when non-renewable sources of energy are utilised.

Synchrotron light sources are bright terrestrial sources of light ranging from extreme X-rays to infra-red and are enabling tools for probing the properties of materials. Light sources underpin innovation in virtually all fields of research and development. Energy materials characterisation with synchrotron x-rays is a vital tool for the development of modern and next generation energy technologies. Africa however is the only habitable continent that does not currently have a synchrotron light source facility. The African Light Source (AfLS) Project is leading the drive towards establishment of the first light source on the African continent.

For Africa to adequately leverage its potential for developing energy technologies and realise the utility of a light source, a coordinated effort between African countries is needed to ensure that a sustained stream of investment is directed towards key strategic domains, as identified by domain experts, and retention of skilled scientists to support the relevant science communities.

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

Light Sources

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

62

"African Light Source: recognition and demand"

Author: Gihan Kamel[1]

[1] *SESAME Light Source*

"African Light Source: recognition and demand"

Dr. Gihan Kamel
SESAME Light Source
February 28, 2022

The impact of advanced light sources on science and society in the developing world on addressing national and global concerns cannot be underestimated. Through collective brainpower and constructive partnerships and collaborations, establishment of light sources has begun in developing countries decades ago, now in operation, with upgrades, besides new facilities those are either under construction or in the planning phase. They provide free access to scientific user communities that is exclusively based on the scientific excellence and merit. In this context, "light sources operate in a democratic mode, conventionally attained by using scientific cooperation to promote understanding between people from different traditions, religions, races, and political systems –Herman Winnick" .

No one can argue that Africa is facing many challenges. Some are common, but others are still unique. This has shed its light on all aspects of life including science and technology and the future of the young generations including many African scientists and diasporas. In this regard, the African Light Source (AfLS) can play a crucial role in the region, for the African community and elsewhere. Therefore, and in an attempt to grow various communication channels with established light sources facilities, a recent Memorandum of Understanding, MoU, has been signed in 2020 between the AfLS Foundation and SESAME, the Synchrotron-light for Experimental Science and Applications in the Middle East. SESAME pursue to establish the Excellency of Science and technology, besides, functioning as bridge between its diverse culturally and politically divergent societies, building a stronger community that will be able to deal with scientific challenges and hopefully beyond. Similar to SESAME, the AfLS can open wide doors to scientists from all over the world to demonstrate their capacity and to overcome traditional and technical obstacles as much as they can. From this perspective, it can –and will- show credible contributions in improving and advancing societies.

Among many other applications, taking human health as an example, advanced light sources do tackle human health in a multifold approach from understanding, to prevention, and consequently to treatment. From studying the molecular basis of diseases to the development of diagnostic methods that leads to early preventive actions, or treatment by innovative therapies relying on complementary information on relevant subjects. Furthermore, they can shed light on cultural heritage resources and unique archaeological findings. With this, they advance not only scientific discoveries but also the predictable economic strength by developing different industries taking into account the scarce resources and incomes.

Herewith, the concrete vision that Africa, too, should take its equivalent position as a co-leader within the global scientific arenas becomes stronger even more. Also, as the necessity of initiating ASFAP (African Strategy for Fundamental and Applied Physics) has become essential for Africa, the implementation of the AfLS is further witnessed with no single doubt. Reasons comprise establishing world-class large scale infrastructure, creating a healthy environment for joint collaborations, attracting scientists working abroad in an attempt to diminish the brain drain gap, as well as, addressing local and/or regional concerns (health, environment, water, human heritage, etc.).

This Letter of Intent is to highlight the importance of an African Light Source establishment to fulfill its community's demands, as well as, its major challenges and concerns in conjunction with the AS-FAP Light Sources Working Group strategy. The African Light Source Foundation seeks instituting a synchrotron facility in Africa being the only continent that is left so far without such an advanced technology. Above all, and as perceived; human capacity building, diaspora networking, brain-drain reversal - are all foreseen. And the impact will robustly go beyond any "national"science, with no borders and with no personal labels.

Primary Category:

Light Sources

Secondary Category:

Light Sources

Subgroup categories:

LightSources—InfraredSpectroscopy

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Almost relevant to all categories.

63

Computational Methods for Correlated Quantum Systems in Condensed Matter

Author: Anas Abdelwahab[None]

LOI on Computational Methods for Correlated Quantum Systems in Condensed Matter

Primary Category:

Condensed Matter & Materials Physics

Secondary Category:

Comouting & 4IR

Subgroup categories:

MaterialsPhysics—Theoretical and computational Condensed Matter Physics

Did you / will you submit this LOI to another category?:

YES

Additional Information:

It can enhance interdisciplinary researches

64

A synchrotron light source for Africa, by Africa, in Africa

Author: Ed Mitchell[None]

A synchrotron light source for Africa, by Africa, in Africa

Author: Ed Mitchell,
Affiliation: The European Synchrotron Radiation Facility, Grenoble, France

The science strategies of many Global North countries have included a synchrotron light source on their roadmaps. This has been the case for many decades now with the resulting large-scale research infrastructures acting as hubs for, arguably, the most diverse user community of any such research infrastructure.

The European Synchrotron (ESRF) in Grenoble (France) is one such example and is an international synchrotron, supported by 22 countries with over 40 nationalities represented on its staff. The user community of the ESRF is growing, counting today around 9,000 user visits every year and around 6 publications every day using data and results from its 43 X-ray beamlines.

This is just one light source. There are over 50 around the world. But none in Africa.

Advanced synchrotron light sources benefit a wide range of science, being transversal in supporting chemistry, biology, physics, cultural heritage, medicine, environment, materials, geology, nanoscience, engineering amongst many other disciplines, from both academic institutes and industrial enterprises. As such, they can lead to new and better drugs, vaccines, better exploitation of natural resources, understanding human history and origins, enhancing catalysts and paving the way for materials innovation and tailoring. The mostly X-ray, but also IR and UV, beamlines at such synchrotrons provide a deep vision into materials and living matter, with spatial and time resolutions far beyond conventional laboratory-based techniques. The extreme intensity and coherence in modern synchrotron beams provides unparalleled opportunities for unique research and innovation.

The time is now for Africa to also benefit from a large-scale synchrotron research infrastructure as a trans-national project, benefitting all researchers, younger and more senior, across Africa and further afield. It is important to note that such centres are breeding grounds for interdisciplinary and cutting-edge science, as well as training grounds for the next generation of scientists, technologists and engineers, thereby both nurturing talent and retaining trained resources for Africa.

A light source is not a panacea. But synchrotrons have proven themselves to be a strong provider of return on investment, through science, socio-economic impact, training, technology and public-science awareness, wherever constructed and operated around the world. Africa deserves its own light source and not to be dependent upon other facilities. It will take time and concrete plans, capacity building and a vision to be constructed. This has already been initiated by the African Light Source Foundation (www.africanlightsource.org) which is putting the African concept of "ubuntu" first and foremost in its approach to building the case for the African Lightsource, and it is encouraging to see the AAS taking now a stronger interest in such an initiative.

Primary Category:

Light Sources

Secondary Category:

Light Sources

Subgroup categories:

LightSources—MacromolecularX-rayCrystallography

Did you / will you submit this LOI to another category?:

NO

Additional Information:

LOI intended as general support for an African light source

65

Using Astronomy for Development in Africa

Author: Kevin Govender[1]

[1] *IAU Office of Astronomy for Development*

Using Astronomy for Development in Africa

Background:
In 2011 the International Astronomical Union (IAU), through a joint partnership with the South African National Research Foundation, and with strong support from the South African Department of Science and Innovation, established the global Office of Astronomy for Development (OAD), hosted at the South African Astronomical Observatory in Cape Town, South Africa. The OAD's vision is simply "Astronomy for a better world!"and its mission is: "To help further the use of astronomy as a tool for development by mobilizing the human and financial resources necessary in order to realise the field's scientific, technological and cultural benefits to society."During its first decade (2011 to 2021) the OAD granted € 961,903 to 181 projects around the world through its annual call for proposals, targeting audiences in more than 100 countries. It established 11 regional offices around the world, with 3 located in Africa (in Ethiopia, Nigeria, Zambia) and two with target countries in Africa (the Portuguese language office and the Arab World). The OAD also registered over 700 volunteers and formed 17 partnerships with organisations sharing in the OAD vision. In 2020, with the onset of the global COVID-19 pandemic, the OAD issued an extraordinary call for proposals in addition to the annual call, and awarded € 40,000 to 43 projects using some aspect of astronomy to address the negative effects of the pandemic. More can be found on the OAD website: www.astro4dev.org. The purpose of this LOI is to ensure that as we grow the field of astronomy on the continent, we build on the experience of the OAD to ensure that developmental impacts are fully realised.

Potential areas of focus:
a. Flagship projects: The OAD coordinates global "Flagship projects"identified from its funded projects, regional offices and development trends globally. The African continent could benefit from carrying out some of the flagships. Such flagships in Africa should respond to a significant number of SDG indicators and there should be evidence of their impact through relevant monitoring, evaluation and impact assessment studies. The three global astronomy-for-development flagships identified by the OAD are currently (i) Astronomy for economic development (largely through astrotourism); (ii) Astronomy for Mental Health (and bringing global perspectives); and (iii) Astronomy knowledge and skills for development (applying data skills to development challenges).
b. Regions: A structure of regional offices across the continent is beneficial for rolling out flagship projects, as these offices help localise and implement specific activities. The already existing three OAD regional offices in Africa, as well as potential new regional coordinating centres, could be called upon to support these flagships and other initiatives.
c. Call for proposals: The OAD's annual call for proposals is a core activity which both supports activities on the ground and stimulates new ideas in using astronomy for development. Thus far, Africa has been the region where the most OAD projects have been funded through this call. New funding sources specifically for Africa could be secured for an expanded targeted call around "Physics/Science for Development". The OAD's resources can be used and adapted accordingly for this. These tools should also enable all projects to incorporate monitoring and evaluation principles, while taking into account lessons and resources from past projects, thus ensuring a strong positive feedback loop. Projects supported through this call could demonstrate significant contributions to SDG indicators.
d. Partnerships: In order to realise the impact of astronomy (or Physics) on development, it is essential to establish strong, functional partnerships with organisations across disciplines, especially those that have expertise in development. Establishing these interdisciplinary partnerships will be important both to successfully implement flagship projects and enhance the call for proposals. The OAD's Collaboration Gateway can be used for this purpose and the OAD can serve as a facilitator for interdisciplinary conversations. A specific goal can be to establish new partnerships with development-related organisations and development specialists at regional universities.
e. Fundraising: It will be essential to secure sufficient funding to realise the developmental benefits in Africa from astronomy (and Physics). The OAD uses the skills from the IAU fundraiser and could contribute to possible fundraising activities for this strategy. The fundraising should include a suite of approaches to funders, from submitting specific proposals to international funding calls

to lobbying specific governments on the African continent (both local and regional) to support the investment in science for development.
f. The 2024 IAU General Assembly and related vision for Astronomy in Africa: Following a bid led by South Africa, on behalf of the continent, the 2024 IAU General Assembly will be held on African soil for the first time in the IAU's 100-year history. The support for the bid was overwhelming, and the pro-Africa spirit that prevailed was significant and memorable. A shared document has been put together which attempts to capture that spirit and consolidate that support into a vision for 2024 that we can strive towards as a united astronomical community. This document and other information can be found on www.astronomy2024.org. The following is an extract from the Prologue of that vision document: *When the world descends onto African soil in 2024, what do we want them to experience? This is not simply an opportunity for astronomy, this is an opportunity to change the way the world sees Africa. When a continent so often looked down upon can lead the world in a field as technical as astronomy, then we change perceptions, we challenge preconceptions, we shake unconscious biases – we make the world think differently about the potential of all people in the world to contribute to the human endeavour. Africa also has a rich culture to share with the world and many stories to tell (both Astronomy and otherwise). 2024 is an opportunity like no other – it is up to us to maximise on that opportunity for the benefit of Africa and the world. We need to be "audacious" in our thinking and carry the continent forward to 2024 and beyond.*

Primary Category:

Astrophysics & Cosmology

Secondary Category:

Commnuity Engagement

Subgroup categories:

Astro&Cosmo—Astronomy for development

Did you / will you submit this LOI to another category?:

NO

Additional Information:

This could potentially be related to others

66

The Need for an African Synchrotron Light Source

Author: Sekazi Mtingwa[None]

See attachment.

Primary Category:

Light Sources

Secondary Category:

Light Sources

Subgroup categories:

LightSources—AcceleratorPhysics

Did you / will you submit this LOI to another category?:

NO

Additional Information:

N/A

67

The South African Radio Astronomy Observatory (SARAO)

Corresponding Author: rob@ska.ac.za

See the details in the attached

Primary Category:

Astrophysics & Cosmology

Secondary Category:

NONE

Subgroup categories:

Astro&Cosmo—Astronomical instrumentation and infrastructure

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Physics Education

68

International Centre for Experimental Physics in Africa (ICEPA)

Authors: Nieldane Stodart[1]; Paul Gueye[2]; Ulrich Goerlach[3]

[1] *iThemba LABS, National Research Foundation (ZA)*

[2] *Facility for Rare Isotope Beams*

[3] *Centre National de la Recherche Scientifique (FR)*

Corresponding Author: ulrich.goerlach@iphc.cnrs.fr

We propose to create an educational centre for the training of young African students, postdocs and junior faculty members in instrumentation for fundamental and applied experimental physics. The educational programme foreseen would be equivalent to a Master curriculum at a university. Many African universities do not have the necessary number of experimental facilities and instruments at their disposal for training in experimental techniques and tools.
The concept of the proposed centre (named provisionally ICEPA in the following) has been inspired by the successful AIMS centres for mathematical sciences and ICTP for theoretical physics. But for ICEPA the focus is on experimental physics, strongly oriented towards instrumentation. The attachment to or at least a very close link to a university or to an existing research centre will be necessary to train and recruit qualified staff for the supervision of the experiments and to be able to issue an international recognised diploma.

Primary Category:

Instrumentation & Detector

Secondary Category:

Physics Education

Subgroup categories:

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Instrumentation of all physics domains
Education in physics

69

The Pan African Virtual Nuclear University

Authors: Dave Nicholls[1]; Simon Connell[2]; Pathmanathan Naidoo[1]; Rotondwa Mudau[3]

[1] *University of Johannesburg*

[2] *University of Johannesburg (ZA)*

[3] *Necsa*

This LoI supports the establishment of a Virtual University for a broad scope of disciplines related to the beneficiation of nuclear technology.
It has been proposed by AFCONE to the AU and the Pan African University, as a new department at the PAU, initiated as a virtual University. Such a process is also forseen by the AFRA-NEST founding documents. AFRA-NEST has facilitated the development and audit of many nuclear related training activities by country within Africa.
The aim is to configure the Pan African umbrella, where real Universities can adhere in terms of an MoA that defines the Quality, Operations, Governance and Financial aspects. The early registering real Universities contribute material in virtual courses as a pilot. The Pan African Virtual Nuclear University can grow from there and be rolled out to include other many other African countries. As such it would evolve from a national to a Pan-African programme. This lowers the threshold to participation by African Universities in Nuclear training, as they benefit from the pool of training material and presenters within the Pan African Virtual Nuclear University.
This Nuclear Science Training Programme is primarily oriented to ensure high level human capacity for the safe, sustainable operation and development of nuclear energy for electricity in South Africa. However the benefits of peaceful uses of harnessing the science of the atom are far broader. There are therefore also programmes which are enabled by green, nuclear electricity and process heat. In the water sector, these include the water grid, desalination and clean water. In the energy carrier sector these include the hydrogen economy and synthetic fuels. The synthetic fuels would be derived from carbon capture, and therefore be as carbon neutral and green as the hydrogen economy. Then there are the medical applications of nuclear technology, diagnostic and therapeutic. In fact the full suite of nuclear applications including health generally, the mining sector, agriculture, the environment and others are represented in the training programmes. The scope also includes capacity building in the processing and storage of nuclear waste. In addition, the scope includes capacity building in the management of nuclear projects, the economics of energy and the legal and regulatory issues.
The educational material would be derived from the best educators in academia and industry. An inclusive model has been developed which allows multiple Universities and other Tertiary Institutions to partner in the production and delivery of the material, and in the provision of post graduate research opportunities. In addition to the internal tertiary institutions contributing to development and delivery of the training material, there are also external stakeholder partners. These are for example vendors of major nuclear energy equipment. Clearly there is a need for a component of the nuclear energy training to be targeted to specific systems that are destined to be purchased and operated within Africa. Some examples of participating Vendors could be Rosatom (Russia), Areva, EDF (France), Kepco (Korea), HTR-PM (China), NuScale, USNC, Westinghouse (USA) and so on. The participation model is characterized by inclusivity. The new model builds on other national multi-University training programmes in South Africa such as National Astronomy and Space Science

Programme (NASSP) which delivers for the SKA projct in Africa and the National Nanoscience Postgraduate Teaching and Training Programme. There are other models, such as the Erasmus mobility programmes and the World Nuclear University, as well as the many MOOCs on offer. The training material and programmes would be coursework at the NQF 7 and 8 levels (i.e. bridging courses at 3rd year level and 4th year level courses aimed at a post graduate honors level qualification in the fields mentioned above). There are also advanced courses at the NQF 9 level which would be constitute a taught MSc by Coursework or a MSc partly by Coursework and Dissertation. There would also be research opportunities for the dissertation component of a MSc and also for a PhD by Thesis. The students would formerly register at one of the participating Universities. However the tuition and/or supervision would be provided by a collective of Universities and Institutions, within the Virtual University concept.
The primary branding will be that of the new Pan African Virtual University, or similar. The participating institutions will be co-branded, according to their contributions.

Primary Category:

Energy

Secondary Category:

Energy

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

Nuclear

70

African Day For Physics

Author: FAICAL BARZI[1]

[1] *IBN ZOHR UNIVERSITY*

In Order to popularize physics among all Africans and spread love of physical sciences within all walks of life. I propose to celebrate an African Day For Physics within which all enthusiasts can campaign for the betterment of African life through physics. Also this will be a day to celebrate all physics achievements accomplished by researchers, educators and students within a year which could be motivating to work hardly and steadily.

Primary Category:

Physics Education

Secondary Category:

NONE

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

A Day to recognize achievements in all African physics.

71

Science Advocacy in Africa

Author: Harris Sop Nkuiate[1]

[1] *University of Exeter, England, United Kingdom*

Introduction
According to Merriam-Webster dictionary, an "advocate"is a person who works for a cause or group. It follows from this definition that a science advocate is a person who works for a scientific cause. This cause can be research funding and policies, climate change, low enrolment in basic sciences, lack of awareness about the role of science in development, among others. The importance of advocacy lies in its ability to cause students to choose careers in science, help the government to understand the value of science in development, and to educate the public on healthy living. In Africa, the term science advocacy has been limited by many scientists to talking to the government on policies. As such, many passionate young students and scientists get discouraged due to lack of expertise, no motivation, limited time, among others. Engaging young people and scientists into science advocacy by setting a platform on which they can flourish would go a long way to foster the study of science and secure the future workforce of science—Africans would grow to support their own scientists/research and would not over depend on "Western funders,"which might lead to crisis like the one that happened in AAS 1. In this letter of interest, I would present some advocacy initiatives that can help us to advance the study of science in Africa.

1. Introduction of science advocacy in graduate programs
The concept of science and citizen implies that everyone who does science should advocate for it. Postgraduate should be taught about challenges in science advancement and how they can contribute to solving them. During this course, students should be educated on the scientific challenges faced by their communities and ways to solve them. As a follow-up of this training, the students would be expected to render some services to their communities like coordinating science club activities in secondary schools, organising science expos and cafés, attend a meeting at the parliament, commemorate scientific events, organise science competitions, and so on. Science communication should also be included in such program in a bit to help students know how to communicate their research to the public—Africans can fund big research projects if they are well communicated. If there is resistance from the administration to introduce this course, a series of workshops should be organised at the departmental levels to initiate students into advocacy [2]. During these workshops, experts should be invited to share their experiences with the students.

2. Institution of a rewarding system for science advocates
Incentives should be given to people involved in grassroot advocacy in a bit to motivate them, for advocacy is demanding both financially and otherwise. This recognition would open the eyes of others to see the worth of what they are doing. The reward must not be financial; these people can be given the opportunity to participate in decision making forums in their domain of interest. While the IUPAP focuses on senior scientists, there should be other bodies that focus on younger scientists and local scientists.

3. Identifying and networking with non-governmental organisations involved in advocacy
Many organisations advocate for scientific causes, though they do not have adequate knowledge like scientists. They mostly do it out of passion, and they usually have a better understanding of the public than scientists. Scientists should partner/collaborate with such bodies, since they are advocating for the same cause. Another way of partnering with these organisations is to join our voices with them on social media platforms and welcoming their invitations for talks.

4. Annual conferences and workshops on science advocacy and policy in Africa by science societies like AAS

An annual workshop should be organised by the African Academy of Science (AAS) where scientists can talk about the advancement of science in African. Some policy makers can also be invited, to build network with them. This initiative has been adopted by the American Association for the Advancement of Science (AAAS) [3]. Science societies in Africa should be strongly encouraged in such gatherings to commemorate international scientific events as is not the case. Such days are dedicated to the science communities to showcase their works, worth, and products to the public, but they often neglect such opportunities.

5. Awareness on the need for increased online (social media) presence of scientists
Tweeting by renowned scientists in America and Europe is a way of communicating science to the larger audience, but this altitude is not practiced in Africa reason why the public remain disconnected from science. For instance, this year has been set aside by UNESCO as the International Year of Basic Science for Sustainable Development (IYBSSD2022) and there exist a Facebook page with almost zero engagement [4]. We are the ones to sell ourselves to the public. Scientists should develop the habit of engaging with the public through social media, especially in things that concern them, for they are better trusted than the politicians due to their expertise. A workshop would help them to achieve these skills.

References

1 doi: 10.1038/d41586-021-02991-9
[2] doi: 10.7490/f1000research.1113687.1
[3] https://www.aaas.org/programs/catalyzing-advocacy-in-science-and-engineering
[4] https://www.facebook.com/IYBSSD2022/

Primary Category:

Community Engagement

Secondary Category:

Physics Education

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

72

Search for invisible Higgs bosons produced via vector boson fusion at the LHC using the ATLAS detector

Author: Mohamed Zaazoua[1]

Co-authors: Ketevi Adikle Assamagan [2]; Farida Fassi [1]; Diallo Boye [3]

[1] *Universite Mohammed V (MA)*

[2] *Brookhaven National Laboratory (US)*

[3] *Brookhaven National Laboratory*

Corresponding Author: mohamed.zaazoua@cern.ch

Despite dark matter abundance, its nature remains elusive. Many searches of dark matter particles are carried out using different technologies either via direct detection, indirect de- tection, or collider searches. In this work, the invisible Higgs sector was investigated, where Higgs bosons are

produced via the vector boson fusion (VBF) process and subsequently decay into invisible particles. The hypothesis under consideration is that the Higgs boson might decay into a pair of weakly interacting massive particles (WIMPs), which are candi- dates for dark matter. The observed number of events are found to be in agreement with the background expectation from Standard Model (SM). Assuming a 125 GeV Higgs boson with SM production cross section, the observed and expected upper limits on the branching fraction of its decay into invisible particles are found to be 0.145 at 95% confidence level.

Primary Category:

Particle Physics

Secondary Category:

Instrumentation & Detectors

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

NO

Additional Information:

NONE

73

Status of the Computing for Research in Africa

Author: Ghita Rahal[1]

[1] *Centre National de la Recherche Scientifique (FR)*

Research in any Science needs nowadays strong computing services to extract results and make discoveries.
What we define as computing services might rank from the underlying structure, namely networks, computers, storage, to the applications and the software but as well new techniques such as Artificial Intelligence to extract the expected results.
In order to estimate the overall needs in this field, we have launched a survey including all the people that we could reach, participants in ASFAP as well as the attendants to the 2021 ACP conference that was held in mars 2022.
In this paper we summarize the information that was gathered in the different questions of the survey and extract some general observations. Possible guidelines to improve the situation are drawn in the conclusion.

Primary Category:

Computing & 4IR

Secondary Category:

Physics Education

Subgroup categories:

NONE

Did you / will you submit this LOI to another category?:

YES

Additional Information:

This is an LOI that is transverse to the categories