

Proposal for an LOI at ASFAP (DRAF, preliminary version !):

International Centre for Experimental Physics in Africa (ICEPA)

Introductory remark:

The following idea started during a conversation with Paul Guèye and Nieldane Stodart of the instrumentation and detector working group (IDWG).

It seems clear that this proposal should be worked out in more detail with the members of other working groups and institutions. In the following I tried to develop the idea a bit further and to sketch the way to become a credible proposal and project.

The concept of ICEPA

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.

The goal is to provide a solid and intensive training by a combination of high level lectures (50%) and many hands-on experiences (50%) using high level experiments and/or facilities installed at such a centre.

Teaching curriculum

Entrance level would be a Bachelor or Master or an equivalent degree of at least 4 years of university studies in physics. Applications with a degree in engineering or mathematics could be considered.

(At a later stage one could foresee preparatory courses of a few weeks for applicants with some deficiencies in a specific area.)

Lectures will be delivered by renown teachers from Africa and the international community.

The curriculum would typically span over one and a half year, advancing from standard experiments in the first semester to more complex experiments in the second, which may take up to several days to execute and a few days to analyse. The cursus will be concluded by an internship during the last semester:

1. Semester

50% lectures and 50% "simple" experiments which can be carried out in one or at most 2 afternoons and can be analysed within two further afternoons.

The goal is to consolidate the basic level of understanding of physics, electronics and DAQ, the basics of statistical treatment of measurements for analysis.

This semester should also level out different pre-knowledge of the students.

2. Semester

20% lectures and 80% advanced experiments. The advanced experiments will take typically 2 full days to carry out and 2-3 further days to analyse. The Students should chose around 10 experiments out of a pool of up to 15-20 existing ones.

The level and complexity of these experiments should correspond to the advanced laboratory courses for Master students at well-known universities of international reputation. The experiments should represent all major fields of physics, at least this should be the guideline for choosing a new set-up.

3. Semester

Internship in an experimental institute or facility concluded by a final written report:

The third semester is dedicated to the participation in an scientific activity in the form of a 4-5 months internship in a research centre in Africa or abroad. The work during this internship will be summarised in a master-like thesis and defended before a jury in order to obtain the diploma.

General skills acquired beyond the specific physics knowledge of the experiments provided by such a curriculum of lectures and hands-on experience would include

- Mechanics, design, technical drawings, some practical experience in a workshop
- Basics in electricity and electronics
- All steps of an experiment in physics from conception, planning to execution and analysis
- Learn to understand and if possible carry out some of the key experiments in modern physics including their respective physics
- Data acquisition systems and data analysis. Programming in C++ for example

- Statistical treatment of data and error analysis
- Transversal skills like collaborative working, communication skills, language skills, presentation
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Construction of ICEPA

The centre should be located in Africa in a country with a fairly stable political situation and which is willing to support and to contribute to the centre. A close link to a local university or research centre will be of great advantage to create the necessary intellectual atmosphere and exchanges of personnel. International and pan-African engagement for ICEPA is mandatory.

The ICEPA needs strong and important investments for infrastructure, the hardware and the needs for buildings:

- Accommodation for students and teachers during the terms
- Buildings and class rooms for teaching and learning
- Buildings well equipped with all technicalities to be able to install and develop instrumentational facilities, (electricity, water, internet, mechanical and electronics workshop...)
- Reliable energy supply
- Computing facilities and internet connection
- Scientifically trained staff to supervise and maintain the experiments and facilities. Some of this staff could come from the host university or research institute, some of them could be Post-docs, but some long term staff seems necessary to maintain continuity.
- Local technical staff for maintenance and development
- Administrative complex to run the centre
- Administrative staff, security
- Scientific directorate
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ICEPA needs and would live of international partnerships with universities and research laboratories around the world to seek support, funding and investments in kind.

How to construct these experiments ?

The idea is to establish partnerships between ICEPA and external institutes, laboratories, faculties for each individual experiment. The external institutions should provide the experiments (or parts of it) in kind according to their possibilities and resources (for example equipment not used anymore and superseded by more modern versions, where the equipment is still up-to date and functional). These partners should also take responsibility or at least help and advice in installing the experiments and forming the local staff, who will be responsible for a given experiment. These people could be local university staff or PhD students or post-docs, however it will be important to assure continuity by some "permanent" physicists.

Such a partnership between ICEPA and partners abroad will ensure reliability of the experiments and at the same time build the academic and international relations with them.

The partnerships would be an essential way to finance the scientific equipment at the start of ICEPA. However important investments coming from the host state and from international funds for the overall structure and the infrastructure are mandatory.

Time line:

It will be very difficult to create such a centre from scratch. The most promising way will be to associate it to an existing structure like an university physics faculty, like an AIMS or ITPC centre. Just to name one(!) example, without restraining the possible choices, could be the ICTP-East African Institute for Fundamental Research (EAIFR) on the campus of the university in Kigali, Rwanda. Also AIMS has a centre in Kigali so there could be a lot of possibilities for synergy. Other locations like South Africa would have the advantage of already existing experimental facilities but the draw-back of further concentrating high level education in a few countries.

To continue the Kigali thread, a first step would be to explore the research interests at the physics faculty and at EAIFR and to find a few sponsors for experimental equipment and training corresponding to the local research fields. In a further step the teaching curriculum and the necessary responsibilities have to be defined and more experimental set-ups implemented. Latest at this stage it will be mandatory to seek international, African and local funding. And from here on one could develop the centre over the years to come
