

ASFAP Working Meeting Instrumentation & Detectors Group (December 15-17, 2024)

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Outline

- Instrumentation and Detectors Working Group Goals
- Non-exhaustive list of instruments in Africa
- Major Challenges
- Analysis of Letter of Intent
- High Priorities
- Closing Remarks

Instrumentation and Detectors Working Group Goals

<https://twiki.cern.ch/twiki/bin/view/AfricanStrategy/AfInstrumentationDetectors>

The Instrumentation and Detectors Physics Group aims at promoting physics, development, design, implementation and evolution for a broad range of instrumentation and detectors applications in Africa. It is a transverse working group in contact with all the physics groups

Goals

- Provide a coherent/flexible framework for efforts in I&D across Africa
- Target groups: laboratories/centers, universities, pre-college
- Bottom-up approach: individual and/or group collaborations
- First task (2021-2022): prepare call for Letters of Intent
- Identify projects in instrumentation across countries, like shared facilities
- Useful and meaningful efforts with tangible results
- Cost effective implementation



Non-exhaustive list of instruments in Africa [1]

- Represent all physics fields and across the continent!
- Accelerator based instruments
 - South Africa: iThemba Labs, South African Astronomical Observatory
 - Morocco: Center National de l'Énergie, des Sciences et des Techniques Nucléaires
- Non-accelerator based instruments
 - Namibia: High Energy Stereoscopic System
 - Algeria: Center for Development of Advanced Technologies
 - Senegal: Lasers Atoms Laboratory, Radiocarbon Laboratory of the Institut Fondamentale d'Afrique Noire
 - Nigeria: Center for Energy Research and Development

Non-exhaustive list of instruments in Africa [2]

- African networks
 - Square Kilometer Array: South Africa & Australia
 - African Laser Center: South Africa, Ghana, Senegal, Egypt, Algeria, Tunisia
 - African Light Source
 - iThemba Labs: Algeria, Senegal, Burkina Faso, and Nigeria
- International network
 - European Center for Nuclear Research (Switzerland)
 - Brookhaven National Laboratory (New York, USA)
 - Thomas Jefferson National Accelerator Facility (Virginia, USA)
 - Facility for Rare Isotope Beams (Michigan, USA)
- Other
 - See presentations from other physics working groups

Major Challenges

Three main outcomes

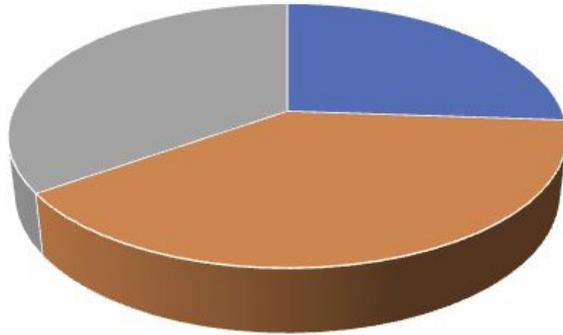
1. Strong consensus about main problem researchers face is the need and easy accessibility of experimental facilities to conduct their research
2. Overcome the lack of educational training centers in instrumentation for basic and advanced experimental physics
3. Instrumental centers
 - a. Concentrated in very specific regions: South Africa, Namibia and Northern Africa
 - b. Very few are located in Sub-Saharan countries

Analysis of Letter of Intent [1]

Focus	Topic	LOI
Extensions of existing facilities	Radio-Astronomy Accelerator centres	51, 54, 56, 67 17, 24
New facilities	Astronomy: local observatories for North Africa Astroparticle underground African millimetre telescope Am-Be neutron source AfLS Instrumentation for AfLS	14 15 33 39 not a special Loi 58, 59, 61,66
Centers of Excellence	Graphen Flagship Energy centre of excellence NANOAFNET Quantum physics and biology ICEPA Education, Internet of Things	4 5 10 19, 23, 27, 49 68

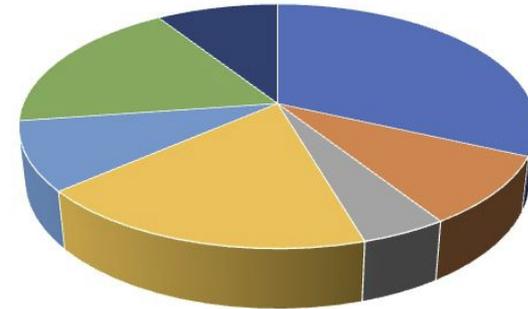
Analysis of Letter of Intent [2]

Type of Letter of Intent



- Extension of existing facility
- New facility
- Centers of Excellence

Field of Physics



- Astro- and astroparticle physics
- Accelerator physics
- Nuclear physics
- Instrumentation for African light source
- Material and condensed matter science
- Quantum physics and biology
- Education

High Priorities [1]

While it is difficult to prioritize any of the ideas presented in the LOIs, the Instrumentation and Detectors Working Group identified three areas that could serve as a basis for improving the state of scientific excellence in Africa

1. Proposal for an International Center for Experimental Physics in Africa
2. Small physics experimentation and the Internet of Things
3. Regional instrumental conferences

High Priorities: Proposal for an International Center for Experimental Physics in Africa

- **Goal**

- Address the lack of experimental training facilities in Africa but high need for experimental education and know-how in most African countries

- **Concept:** inspired from ...

- African Institute for Mathematical Sciences (AIMS, orig: South Africa)
- US Particle Accelerator School (Fermilab)
- Southern African Institute for Nuclear Technology and Sciences
- Sèmè City (Benin)

- **Format**

- Offer master-like curriculum of typically one and a half year
- 6-month research project and high-level lectures
- Major component on hands-on experience
- Instruments could contribute to international collaboration or donated

High Priorities: Small physics experimentation and the Internet of Things

- **Goal**
 - Use of micro-processors and controllers for education
- **Concept:** inspired from ...
 - Low-cost standardized interfaces like GPIO, I2C, I2S, Can bus ...
 - Sensors: sht30: temperature and humidity sensor, PlanTower pms5003, Analog devices MAX 2769 GPS receiver ...
- **Format (experiments: in-person and virtual [Internet])**
 - Experiments
 - Medical measurements like ECG, heart rate, oxygen content in the blood
 - Environmental measurements like air or water quality
 - Smart farming experiments
 - Internet
 - Data readout, readout, analysis
 - Web-based programming of digital electronics, data analysis, micro-controller ...

High Priorities: Regional instrumental conferences

- **Goal**
 - Exchange of knowledge and expertise between scientists of neighboring countries to stimulate new collaborations
- **Concept:**
 - Regional conferences focused on instrumentation and detectors across different fields
- **Format**
 - Discussion on specific topics
 - Complement existing conferences/workshops
 - Need a readily available database of existing events!!

Closing Remarks

- We can change the state of science in Africa if we work together
- Timing is key: many components seem to be aligned to make this a reality!!