APhRICA: Advanced Physics tRainIng and Collaboration with Africa

Motivations

ASESMA

Starting from 2008 several institutions in Europe and USA, under the endorsement of IUPAP, have implemented a series of bi-annual schools as part of the ***African Schools on Electronic Structure Methods and Applications (ASESMA)*** project.

ASESMA schools have been organized in: Capetown (2008, 2010), Kenya (2012), Johannesburg (2015), GHana (2016), Ethiopia (2018), Virtuali (2021), Rwanda (2023).

The ASESMA experience fueled a series of regional schools organized by ASESMA members and more focused on specific scientific topics. RASESMA (Regional African School on Electronic Structure Methods and Applications) schools have been organized in: South Africa (2019), Kenya (2021, 2023), Ethiopia (2021), Congo (2019, 2024), Cameroon (2018, 2019, 2024).

ICTP-EAIFR

A crucial role in the science development in Africa has been played by the ICTP-EAIFR institute, located in Kigali, Rwanda. ICTP-EAIFR has organized numerous courses and seminars in physics and condensed matter physics[1]. More importantly after the 2023 ASESMA school in Rwanda few ASESMA members (A. Marini (CNR, Italy), N. Marzari (EPFL, Switzerland) and S. Bonella (CECAM, Switzerland)) started a close collaboration with the institute.

This collaboration has considerably grown in the last year and it is now composed of:

- Basic course on Quantum Mechanics and Many-Body theory taught by A. Marini to the ICTP-EAIFR master students
- A two year agreement where CNR, EPFL and CECAM are committed in funding one master bursary each per year.
- Participation of CNR, EPFL and CECAM in the yearly students selection for the master program.

KENYA

1. Technical University of Kenya (Mike & George)
2. Catholic University of Eastern Africa (James)
3. Masinde Muliro University of Science and Technology (Viktor)
4. Moi University (Korir)

Objectives of the present proposal

The ASESMA official and regional schools attracted numerous students from all over Africa over the years and made it possible to create links with local communities. Moreover, ASESMA made it manifest the limitations of the scientific training programs in Africa and the consequent gap in the student's background. As teachers of the ASESMA events we witnessed severe problems and gaps in the student's preparation that, in many cases, made the impact of the ASESMA training limited.

What is clear is that a more structured action is the necessary condition to create a community of advanced scientists. This action must be extended over a time longer than just two weeks and be focused on selected, brilliant students, whose training must be followed from the master up to the PhD.

[1] Foundational School in Research Data Science (2018), Orientation in the plane as quantum states (2019), Nanotechnology: Introduction and Prospects (2019), Advancing Science in the Global South: The role of The World Academy of Science (TWAS) (2019), Mini-African School on Electronic Structure Methods and Applications (MASESMA) (2019), Regional-African School on Electronic Structure Methods and Applications (RASESMA) with ABINIT (2020), First Workshop of the U.S.-Africa Initiative in Electronic Structure (USAfrI) (2021), Lectures Series - The second quantum revolution: implications for science and technology (2022), Introduction to Computational Materials Science (2023), 7th African School on Electronic Methods and Applications (2023), Introductory course in quantum information theory (2023), Seminar in Condensed Matter Physics (2023), Condensed Matter Physics Seminar (2024).

Methodology

This proposed initiative is meant to be a multi-year activity, laying on three pillars, preceded by a selection of brilliant students at the Bachelor level in the TU-K:

1. Participation of these selected students to the basic master course held at EAIFR
2. Advanced training courses with the support of visiting experts from Europe to Africa to students and lecturers at the TU-K and EAIFR
3. Organization of exchange programs for the most excellent students selected at the end of the above steps.

Pillar #1: basic training

Starting from Dec. 2024, a periodic training effort is to be carried out, targeting select advanced students and early career faculty, starting from the foundational topics beyond graduate level Quantum Mechanics. The first part of the training is proposed to take place physically at ICTP-EAIFR, for 2 weeks, which will cover these foundational topics.

Pillar #2: advanced training

With the foundation laid, further training is proposed in-country, to be done in Nairobi, in May-2025, for two weeks. This training event targets the same cohort of students, to be taken through further advanced topics beyond those covered in prior lectures at ICTP-EAIFR. This is proposed to be physical, to be done at the Technical University of Kenya in Nairobi, with the participants provided with road transport and accommodation.

This training is to be followed up every six months, until the end of a three year period, at which it will conclude, and local experts are expected to then be responsible for advanced methodological training, research and advancement thereafter.

Pillar #3: exchange programs

The exchange programs consist in short (from 2 to 4 weeks) and/or medium (from 1 to 6 months) research visits by the most excellent students to the participating institutions (see Annex). The students will be hosted and will take part in the research activities, carrying on / delving deeper into the contents of their training course, participating in workshops and seminars. The travel, room, board and health insurance expenses will be charged by the general program or by the hosting institution.

The hosting institutions will offer instruments, room and laboratories under the guide of a scientific supervisor.

Annex

Participating Institutions

KENYA:

1. Technical University of Kenya
2. Catholic University of Eastern Africa
3. Masinde Muliro University of Science and Technology
4. Moi University

ITALY:

1. CNR-ISM, Rome

FRANCE:

1. CNRS, Paris

RWANDA:

1. ICTP-EAIFR, Kigali