Nuclear, atomic and molecular physics and sustainable development: an issue within CEPAMOQ

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The perception of the relationship between scientific research and sustainable development in Cameroon is determined by a number of misconceptions and prejudices. The idea of development itself in our collective representations refers almost exclusively to economic data. In this context, to talk about nuclear, atomic and molecular physics and sustainable development is surprising, all the more given that the former suffers from a negative perception associated with the military use of nuclear energy. Above all, it is perceived as an academic discipline or an exclusively theoretical research topic influenced by fashion. It is argued that our technological and structural weakness, make it difficult to render this type of research applicable, which in addition is considered as essentially cut off from our real concerns and unable to lead to any transformation of our daily lives.

These misconceptions partly result from the lack of communication and of popularisation of scientific research in developing countries and in Cameroon in particular, calling for the promotion of scientific popularisation tools. This situation accounts for the false ideas on scientific research, both at the level of its quality and its relationship with development. The area of nuclear, atomic and molecular physics does not, obviously, limit itself exclusively to theoretical research. It is at the turning point of numerous development problems, for instance the outcome of modern applications of nuclear and optical technologies, which are bearers of sustainable development.

These problems, little known to the public, are at the core of the research activities of Centre for Atomic Molecular Physics and Quantum Optics (CEPAMOQ) created within the Faculty of Science of the University of Douala on December 17, 1999 by the Cameroon Minister of Higher Education. The missions of this Centre, which has a regional character, and is affiliated to the Abdus Salam International Centre for Theoretical Physics (Trieste), consist, among other things, of high-level doctoral training, but also of carrying out on the one hand theoretical research in the area of nuclear, atomic and molecular physics and, on the other hand, applied research likely to contribute to the solution of development problems (in its own domain) and thus rendering this research directly applicable. The Centre is also in charge of developing scientific and technical co-operation with African and international researchers in its domains of competence, through South-South and North-South exchange and research programmes, scientific meetings and co-operation with national and international organisations.

The Centre offers postgraduate training which lasts 4 to 5 years, organised in three phases: the first phase (2 years) takes place at CEPAMOQ. It is finalised by a Master's degree (DEA: Diplôme d'Etudes Approfondies in Physics of Matter and Radiation) at the end of the first year. Initiation into research continues during the second year, comprising advanced courses, seminars and research visits to one of the national laboratories or research groups working with the Centre. The second phase (12 to 18 months) takes place in a research laboratory in a country with advanced technology, in association with CEPAMOQ. The research student remains enrolled at CEPAMOQ. The third phase which lasts (12 to 18 months) takes place at the Centre. It is a period set aside for the completion and finalisation of research work followed by the defence of the doctoral thesis.

Since its creation, CEPAMOQ has trained, after a selection procedure by the Cameroon Ministry of Higher Education, two groups of thirteen students, one in 1999-2000 and one in 2001-02.

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Research is planned and organised according to the competencies of researchers of the Centre, regional needs and collaborations with our foreign partners. Research activities effectively started in 2001, with the thesis admission of the first batch of students. It is conducted by six permanent lecturer-researchers (University of Douala), eight lecturers-researchers from other state universities in Cameroon as associate researchers, external collaborators from partner institutions in industrialized and developing countries. The goal is the training of experts in radiation-matter interaction in view of radiological control of the environment and the professional milieus, and the study of atmospheric pollutants, in interaction with other disciplines (medicine, biology, climatology, etc.). Research is divided into the three following areas.

Optics and Applications

This area comprises four lecturers-researchers and five doctoral students. Research focuses on the fluorescence of tropical plants, excimer lasers (from the characterisation of beams to final applications), spectral structure and molecular concentration considered as atmospheric pollutants: organic (HCOOH) and inorganic (HCl, HF, HOBr, HNO_3 acids), nitrogenous compounds (NOx) and sulphur compounds (OCS, H_2S et SO_2), carbon dioxide (CO_2), and hydrocarbons (C_2H_2, C_2H_4, etc.), and their effects on climate change. It is important to stress that Cameroon, an essentially agricultural country, faces serious problems from atmospheric pollution. In the Douala region, this pollution results from many factors: imported industrial waste, massively imported second hand vehicles, soil fertilisation, and heavy deforestation, volcanic emanations from Mount Cameroon, and the degassing of crater lakes (Nyos, Monoun), which contain an enormous carbonic gas pocket that regenerates continuously and sends huge quantities of carbonic gas into the atmosphere.

Dosimetry and Radiation Protection

This area comprises four lecturers-researchers and four doctoral students. Research developed in this sector stems from the effective relaunching in 2001 of nuclear activities in Cameroon: the rehabilitation of CATEN (National Centre for Nuclear Technology

Application), the remobilization of professionals in this domain within the framework of technical co-operation projects with the IAEA and the AFRA Programme, and the creation on 31 October 2002 of the National Agency for Radiation Protection. This stresses the importance that the Cameroon Government attaches to peaceful applications of nuclear energy in the priority sectors of development in order to fight poverty. The work in progress or in preparation at CEPAMOQ is on radiotherapy (quality control of conformational treatment and IMR, dosimetric calculations using the Monte-Carlo method around radioactive grains), radiology (evaluation of doses of X-rays delivered by helicoidal scanners), nuclear instrumentation and spectrometry (mounting of a gamma detection set up and measuring of radioactivity of environmental samples) and the management of radioactive waste.

Atoms and molecules

Six lecturers-researchers and six doctoral students are involved in this area. Research of a theoretical nature is oriented towards fundamental studies of atomic physics (life times of heavy radioactive ions including highly ionised lanthanides, atoms in intense laser fields, electron-atom scattering), molecular physics (dissociative recombination of molecular ions, molecules in intense laser field), cluster physics (stability of highly charged metallic clusters).

The interest triggered by CEPAMOQ is demonstrated today by the number of cooperations which have been initiated, and fruitfully implemented. At the national level, CEPAMOQ constitutes the research focal point in nuclear, atomic and molecular physics for lecturers from the five state universities of Cameroon with a scientific nature. Contacts have been established with national Institutions capable of benefiting from our activities: the General Hospitals of Yaounde and Douala, the Institute of Geological and Mining Research (IRGM), the National Committee on Climate Change, the Permanent Secretariat of Environment (Ministry of Environment and Forests), the National Programme for Agricultural Research and Popularisation, the Department of Civil Protection (Ministry of Territorial Administration) and the Mount Cameroon Observatory based at the IRGM.

At the African level, CEPAMOQ already welcomes foreign students and collaboration has started with the Physics Department of the Marien Ngouabi University (Brazzaville, Congo), the Lasers Atoms Laboratory of the Cheikh Anta Diop University (Dakar, Senegal), the Atomic Molecular Spectroscopy and Applications Laboratory of the University of Tunis-El Manar (Tunisia), and the Medical University of Southern Africa (South Africa).

Out of the African continent, CEPAMOQ has singled out itself through research and training missions in European and Northamerican universities and institutions (e.g. Université Paris-Sud, CEA-Saclay, Université de la Méditérranée in France, Université Catholique de Louvain in Belgium, Division of Applied Physics of the ENEA Centre at Frascati and the Abdus Salam ICTP centre in Italy, and the Université de Laval in Canada). Support has been provided by the partner institutions, their Embassies, ICTP and the AUF (Agence Universitaire Francophone).

Chosen to host the 7th LAM (African Laser Atomic Molecular and Optical Science Network) conference, CEPAMOQ hopes to establish its position within the network by succeeding in the organisation of this event planed for December 2004 at the University of Douala.

All these achievements give us hope and and make us ambitious, given the interest we have aroused both from local and international partners. Hence the necessity of supporting this dynamic trend in its success.

"Unless it has its own scientists and technicians, no country can call itself free. This involves the whole problem of scientific and technical training from secondary education to fundamental research..."

René Maheu, UNESCO Director General (1965)

The ICTP TRIL Programme: Training and Research in Italian Laboratories

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The International Centre For Theoretical Physics (ICTP) in Trieste set up in 1983 a fellowship scheme indicated as Programme for Training and Research in Italian Laboratories (TRIL). The main motivation was the increasing demand from many developing countries scientists to have an advanced experimental counterpart to the theoretical research and lecture-based training offered at the Trieste Centre.[1]

A more farsighted view was to favour, through direct contacts and side-by-side research, the regular development of collaborations between the Italian scientific community and individuals, groups, and institutions in developing countries, enlarging substantially the line of action of the ICTP. The main objective remains to strengthen a permanent elite which, being aware of the needs of their own country and cognisant of the frontiers of science and technology, may properly influence the decision-makers' choices.

The specific purpose of the TRIL Programme is to offer scientists from developing countries who have participated in the ICTP scientific activities (conferences, workshops, schools), the opportunity of widening their experience by getting actively involved, in different branches of physical sciences, with the research work of laboratories at Italian universities and at public and private research centres. This includes academic studies as well as practical applications and industrial projects. In general, stays in the laboratory last several months (mostly one year and longer), but shorter visits are also envisaged.

The fields covered, which reflect current activities held at the ICTP, can be broadly classified as[2]:

- Physics of Condensed Matter
- Physics and Energy
- Physics and Technology
- Earth and Environmental Sciences
- Physics of the Living State
- Miscellaneous (Instrumentation, Topics at the interface with other sciences i.e. Chemistry, Biology, Mathematics)