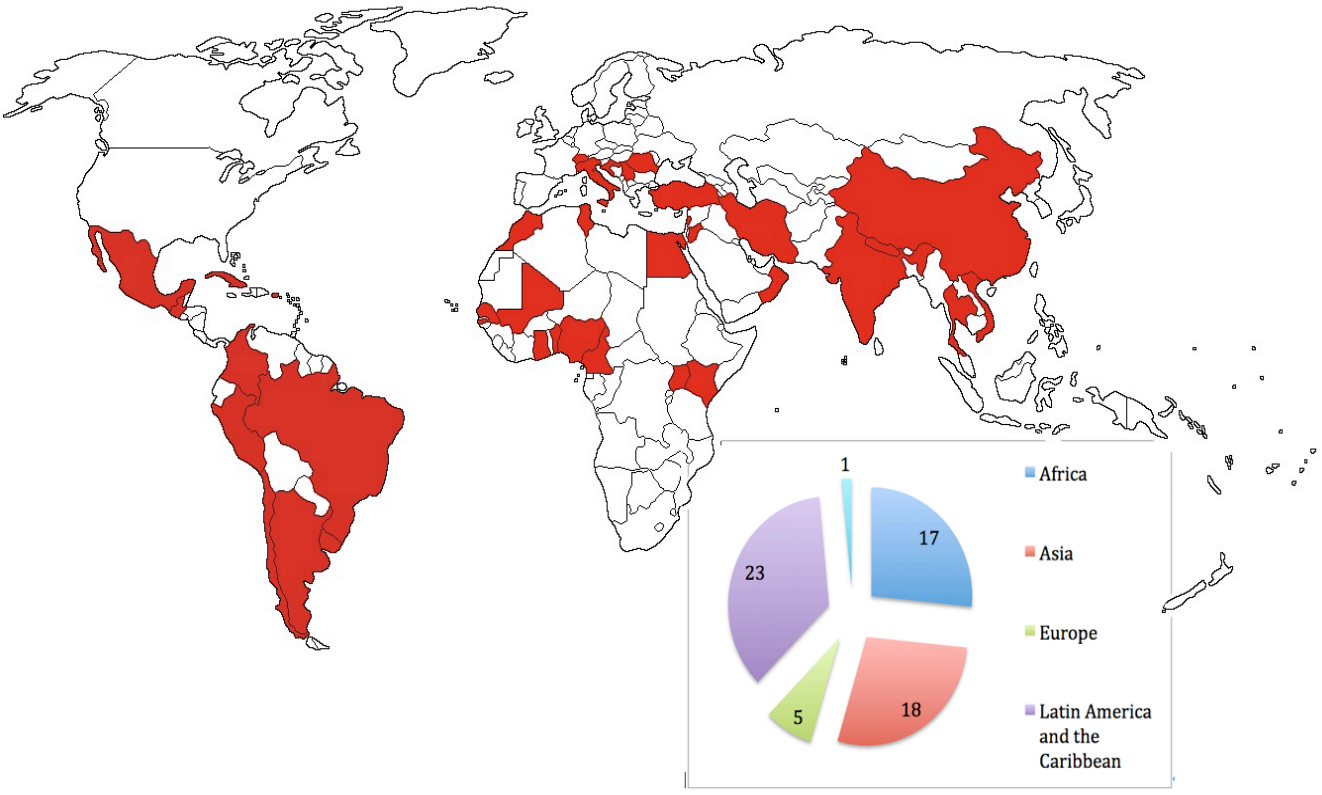
The role of the ICTP Office of External Activities (OEA) in Africa:

An Abdus Salam ICTP 25-year pathway for progress of science in the emerging world



A 5-year Report (2007-2011)

Foreword

The year 2010 was a significant date for the Abdus Salam International Centre for Theoretical Physics (ICTP). Firstly, that year was the 25 anniversary of the creation of the Office of External Activities (OEA), one of the major efforts of this Centre for sponsoring the progress of science in the emerging nations. Secondly, the ICTP started the Strategic Plan 2010-2014 ("*Science and Development for a Changing World*"). This forward-looking instrument for guiding the pathway that the ICTP is to follow in the near future intended to provide a vision and to identify clear goals, in order to move forward from the considerable and laudable achievements of OEA during its first 25 years.

We have organized this report along this line of action, stressing the achievements of the OEA during its first quarter of a century. For this purpose we have drawn a series of 11 diagrams and charts with the most significant year, namely, 2010, the data for which is available in the OEA files. This compilation of data is intended to serve as a basis for subsequent appreciation of the progress in years 2010-2014, beginning with a complete set of data in a large set of tables for the years 2007-2011. The initial step taken in this Report, uses the information received by the OEA, which is now complete and is fully incorporated in the present work.

In the appendices we have provided the set of 39 tables including the new 2011 data. (Subsequently, the same updating will be done for the remaining years covered by the ICTP Strategic Plan, namely the years 2012, 2013 and 2014.

To review the work of the OEA was a singular privilege, as well as a daunting challenge that in July 2010 the author gladly and eagerly undertook by the kind invitation of the ICTP Director Professor Fernando Quevedo.

There was no precedent for such a task, in spite of the considerable amount of excellent and significant work that the OEA—a cornerstone of ICTP influence in the emerging countries—had done for over a quarter of a century. In view of the considerable size of the OEA archives, it seemed reasonable to restrict our attention only to a brief and significant recent period for which the data available was complete and rapidly increasing due to the recent acceleration provided by the current ICTP Strategic Plan.

This report has been constrained to the period 2007-2011. Besides the present Report, three additional Regional Reports are in preparation for Africa, Asia and Latin American/Caribbean regions. They will also be focused on the same 5-year period as the present work.

We hope that this Report will help to fully appreciate the high priority that this Office has recently been granted within the well-focused ICTP Strategic Plan for the period 2010-2014.

Professor Julian Chela-Flores
http://www.ictp.it/~chelaf/
Adjunct to the OEA,
Staff Associate ICTP
1 December 2012

Table of contents

Appendices

Additional Information

Acknowledgments

The present report has benefitted from the collaboration of many colleagues:

First of all, we thank the ICTP Director Professor Fernando Quevedo for the privilege and challenge he granted the author in July 2010 to become associated with the OEA. Thanks are also due to Mrs. Dorotea Calligaro and Eleonora Crotta from the OEA Office, with their valuable experience, they have generously and continually given the author their precious advice and wise counselling in their special fields of expertise.

The ICTP Multimedia Publications and Printing Services have generously contributed to improve considerably the production of the preliminary part of the present work with their characteristic selfless efficiency and proficiency in digital and related matters.

Mr. Johannes Grassberger provided invaluable help, so that the author could master the digital techniques necessary for producing the diagrams that summarise so efficiently the worlwide influence of the OEA.

Mrs. Anna Triolo, from the Public Information Office, kindly helped to select the appropriate illustrations for Appendix 1 from the ICTP Archives.

Last, but certainly not least, thanks are due to the Head of the OEA Office, Dr. George Thompson, for his continued relevant, critical and constructive advice with timely suggestions since July 2010.

Introduction

The Office of External Activities (OEA) was established in 1985 and is currently headed by Professor George Thompson, research scientist of the High Energy, Cosmology and Astroparticle Physics Scientific Section, who joined the OEA in 2005.

The objective of OEA is mainly to help the research and training activities of physicists and mathematicians living and working in developing countries. OEA provides assistance to scientists in their home countries. Such support complements the training and research provided to scientists from developing countries at the Abdus Salam ICTP. The OEA programmes provide funds for student grants, fellowships for young researchers, visits of research collaborators and other activities.

The OEA actions are aimed at providing a backup to individuals, groups or institutes in the developing countries to accelerate their promotion to an international level (North-South collaboration) and to stimulate networking of scientists in the developing regions to reach a critical mass of researchers (South-South collaboration).

The present administration of the ICTP has undertaken a Strategic Plan for the period 2010-2014 "Science and Development for a Changing World". In this document it is ratified that the ICTP has a dual mission: to pursue high quality research and to nurture science in the developing world. In order to achieve these goals, the ICTP intends to enhance substantially the role of OEA by a complementary set of activities:

- Affiliated Centres
- Projects
- Networks
- Visiting Scholars/Consultants
- Scientific Meetings

with a new major activity focusing on the creation of ICTP branch institutes.

The purpose of the present report is to assess what the OEA has done regionally over a period of 5 years. The academic activities are illustrated with graphics and images. The emphasis has been placed on the turning point of the renewed efforts of the ICTP. The graphics show the OEA work for the first year of the ICTP Strategic Plan for the period 2010-2014, while the data for the period 2007-2011 has been reported in the appendices.

The Affiliated Centre Programme

An Affiliated Centre is an Institute or University Department of Physics or Mathematics that carries out a specific long-term research project on a definite subject with well-defined purposes. The Affiliated Centres have a regional character and are strongly supported by the local authorities and the hosting institute. The work corresponding to the period 2007- 2011 can be consulted in Appendix 1. In some more detail in 2011 the OEA supported 7 Affiliated Centres with 5 of them in Africa.

The OEA has encouraged, with special emphasis, graduate schools, which in 2011 had an ongoing set of 23 Ph.D. (or Troisième Cycle) students with partial, or full support from the OEA funds. The Centre de Physique Atomique Moleculaire et Optique Quantique (CEPAMOQ) defended successfully 6 PhD theses during 2011. The OEA has sponsored other graduate school programmes in Africa. These activities include Master, or Diploma courses.

In Fig. 1 we show the distribution when the major effort of the OEA began to line up with the current ICTP Strategic Plan:

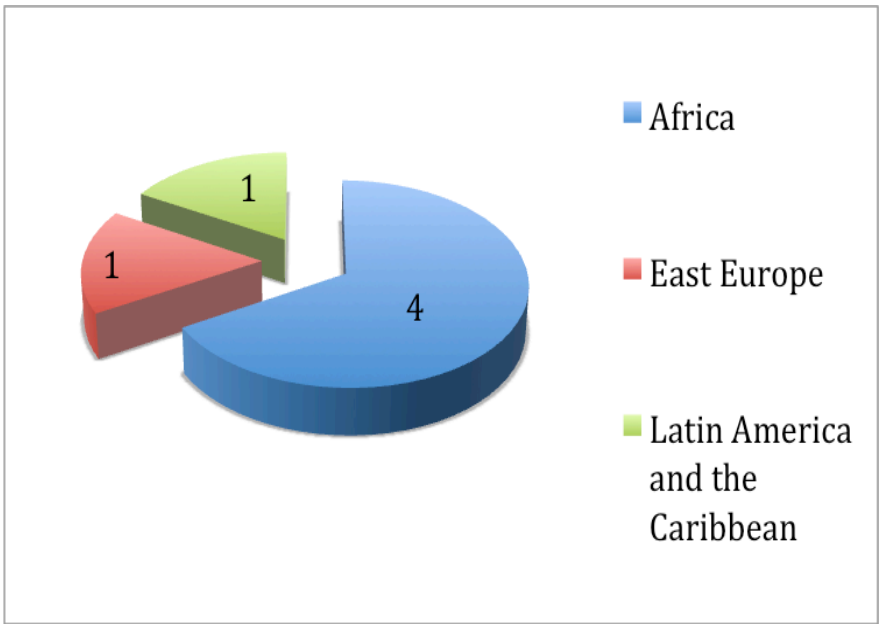


Fig. 1. Distribution of Affiliated Centres supported by the OEA. (The data refers to the year 2010.) The full data for the period 2007-2011 is shown in Appendix 1.

A remarkable success of the African centres is that at present they have continental coverage, while so far in the other three regions they are more restricted to their national area of influence.

THE AFRICAN AFFILIATED CENTRES

The Affiliated Centre located at L'Institut de Mathématiques et de Sciences Physiques (IMSP), at the University of Abomey-Calavi, Porto Novo,

Benin. The IMSP is a centre for education and research in pure and applied mathematics, physical sciences and engineering (cf., Fig. 2).

Fig. 2. L'Institut de Mathématiques et de Sciences Physiques (IMSP), Porto Novo, Benin.

IMSP is a focal point for Advanced Schools and conferences in the region. One striking example is represented by the biannual series of workshops in mathematical physics, the GIRAGA workshops. These events take place in alternative venues between IMSP and the University of Yaounde I (Cameroon). The abbreviation stands for the Inter-African Group of Research in Analysis, Geometry and Applications.

Their activities have created a stimulating environment for African mathematicians to keep abreast with current international trends in mathematical research [*From the IMSP Scientific Report, 2009-2010*.]. The considerable growth of IMSP in their Graduate School, as well as in their successful flow of research publications has been summarized in Appendix 1.

The Affiliated Centre located at Université Cheikh Anta Diop (UCAD), Dakar, Senegal is named after the Senegalese historian and anthropologist Cheikh Anta Diop. The Centre itself is at the UCAD Laboratory of Atoms and Lasers of the Physics Department. The OEA appointed them in 1992. The main vocation of the Dakar Affiliated Centre is to promote and to enhance teaching, training and research programmes in the field of lasers, atomic and molecular physics (LAM).

From the beginning their intention is to interact with similar centres in other African nations of that region, including amongst others Ghana, Sudan and the Ivory Coast. Through different academic activities the LAM Centre has developed strong partnerships with world organizations, such as SPIE (the International Society for Optical Engineering) and ICO. These affiliations clearly demonstrate that the visibility of the Dakar Centre has extended from a regional influence to the international Optics community (the International Commission for Optics). [*From the 2000 and 2009-2010 Annual Reports*.]

The high level of their Graduate School, as well as in their Research can be inferred from the corresponding table in Appendix 1. A total of 34 research papers

were published in the period 1999-2006. The figure shows the UCAD library (cf., Fig. 3 and also "Networks"). [*From the Evaluation Report, 1999-2006, Annex 3*.]

Fig. 3. The Cheikh Anta Diop University (UCAD), Dakar, Senegal.

The Laser and Fiber Optics Centre (LAFOC) is located at the University of Cape Coast, Ghana. This University was established in 1962, whereas its affiliation with OEA dates back to 1993 (cf., Fig. 4). The training program became a reality due to another ICTP initiative, the TRIL Program (Training and Research in Italian Laboratories).

LAFOC does research in Optical Metrology, namely light scattering in fluids, optoelectronics and interferometry. Other areas are laser-induced fluorescence, and fiber optics for optical communications. [*From "Optics Development in Africa", a 2006 Report P. K. Buah-Bassuah*.] Figure 4 recalls the inauguration of LAFOC.

Fig. 4. Professor Gallieno Denardo the OEA Director at the time of the inauguration of LAFOC.

The Centre of Atomic, Molecular Physics and Quantum Optics (CEPAMOQ) is an Affiliated Centre located at the University of Douala, Cameroon (cf., Fig. 5).

Fig. 5. The University of Douala, Douala, Cameroon.

Ever since the beginning of their collaboration with OEA, it has been evident that the CEPAMOQ Affiliated Centre is in a privileged position to help neighbouring countries at an academic level that includes both graduate-school training and in research. These collaborations have been implemented, for instance with Chad and the Central African Republic. The specific collaborations have encompassed the University of N'Djamena, the leading institution in Chad that was created in 1971 as the University of Chad, and was renamed to "University of N'Djamena" in 1994. The other outstanding example is the University of Bangui, a public university located in Bangui, Central African Republic. As of 2006, it is the only university in the Central African Republic. [*From the 2006 Report 012/06/UD/FS/FS/CEPAMOQ*.]

The presence of external collaborators at the UCAD Affiliated Centre from neighboring countries, including Congo, Gabon and Rwanda underlines their regional impact.

Finally, even though **The Affiliated Centre at the Zewail City for Science and Technology** (ZCST) lies outside the scope of this report, we make a brief reference to this important partner that the OEA has been supporting earlier.

It was originally a Project "Physics Beyond the Standard Model" going back to 2002 and reviewed in Appendix 2 for the period 2007-2011. Its scope at that time was to provide Egypt and the region of the Middle East and Africa with a preeminent scientific institute that contributes to fundamental research in physics, astronomy and their interfaces. [*From the Proposal for ICTP Affiliated Centre for Theoretical Physics 2008*.]

The Centre for Theoretical Physics (CTP, cf., Fig. 6) is now part of The Zewail City of Science and Technology: Egypt's National Project for scientific Renaissance. This initiative has received generous support from local sources. This is the most recent addition to the family of the Abdus Salam Affiliated Centres.

Fig. 6. The British University in Egypt, the former venue for the CPT, now an OEA Affiliated Centre that is hosted at the Zewail City for Science and Technology.

Throughout its Affiliated Centres, the OEA has always encouraged graduate schools. The full data for the period 2007-2011 is shown in Appendix 1. The distribution of all the graduate students supported by the OEA in the initial year of 2010 is shown in Fig. 7:

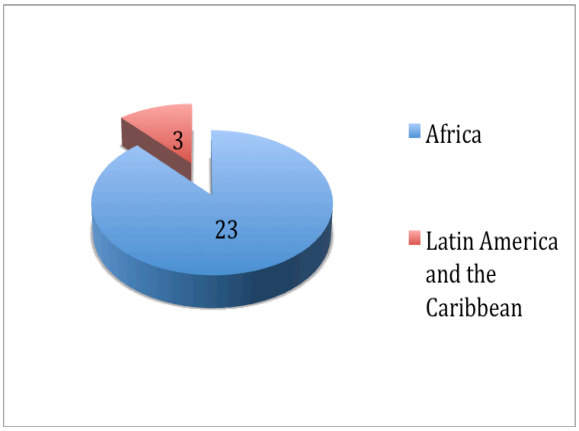


Fig. 7. In 2010, the typical year of our illustrations, the Office was supporting a group of 19 PhD (or Troisième Cycle) students with partial, or full support. The OEA has sponsored other graduate school programmes in Africa and Latin America, including Master, or Diploma courses. The full data for the period 2007-2011 is shown in Appendix 1.

Throughout all its Affiliated Centres the OEA has encouraged graduate schools. The distribution of all the graduate students supported by the OEA is shown in Fig. 10:

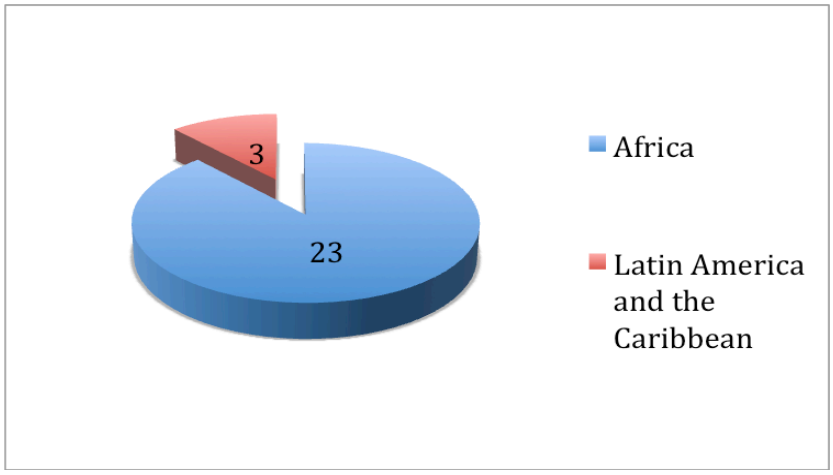


Fig. 8. In 2010 the Office was supporting a group of 19 PhD (or Troisième Cycle) students with partial, or with full support. The OEA has sponsored other graduate school programmes in Africa and Latin America, including Master, or Diploma courses.

Projects

There is a lack of trained personnel in physics and mathematics at universities in some developing countries. Consequently, many students from these countries who pursue their graduate studies in industrialized countries do not return to their countries of origin. To counteract this tendency the OEA supports specific PhD courses.

The OEA also supports several research projects that do not currently fit the category of Affiliated Centres. In 2011 there were 9 active projects, of which 3 were in Africa. The areas of research covered are: Earth Sciences, Mathematical Sciences, Physical Sciences and Space Sciences. Post-doctoral fellows and graduate school students, mainly Ph.D. candidates with a strong representation from African nations, are implementing the research projects. In the year 2011 the OEA was supporting altogether 20 Ph.D. students distributed amongst its 9 Projects. The Office is also supporting other graduate students amongst these projects.

In Fig. 9 we show how the situation stood in the year 2010:

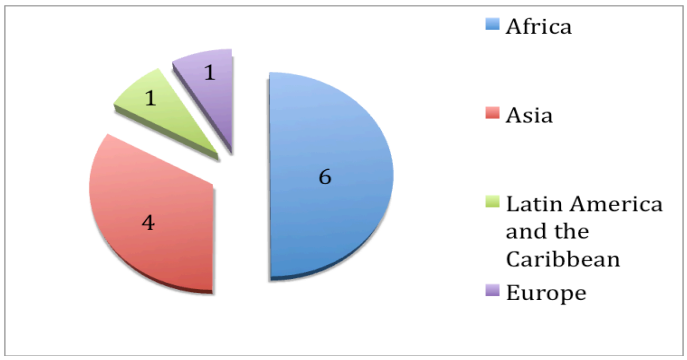


Fig. 9. Distribution of projects supported by the OEA in the year 2010.

Post-doctoral fellows and graduate school students, mainly PhD candidates with a strong representation from African nations, are implementing the research.

The graduate student distribution for the period 2007-2011 can be consulted in Appendix 2. This should be compared to how the Projects were distributed in 2010, shown in Fig. 10:

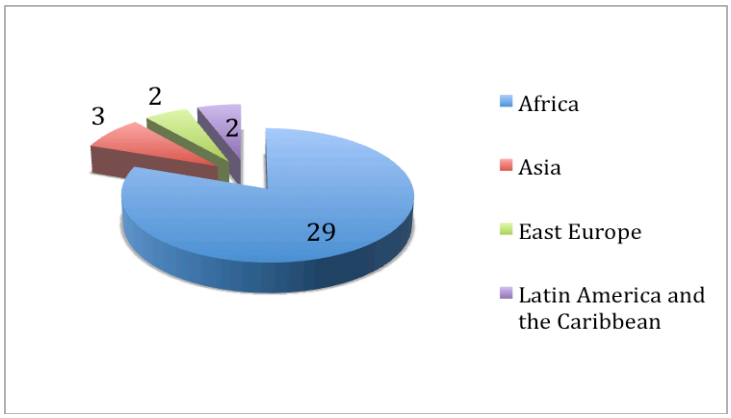


Fig. 10. The earlier distribution of graduate students supported as part of the Projects Programme.

THE AFRICAN PROJECTS

The PhD Program in Mathematics in Sub-Saharan Africa is based at Nsukka, Nigeria. This project has been focusing on a Graduate School with a significant number of doctoral students from the region. It was formerly based at the University of Nigeria and currently it is based at the African University of Science and Technology (AUST) in Abuja, Nigeria, which has an excellent library (cf., Fig. 11).

The long collaboration with the OEA goes back to 1998. The mission of AUST is to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the African continent in the 21st century. From its beginnings the intention was to establish 2 focal points in Sub-Saharan Africa for a PhD degree programme.

Fig. 11. The Sid Ahmed Baba Library, African University of Science and Technology (AUST) in Abuja, Nigeria

The International Chair in Mathematical Physics and Applications (ICMPA) is based at the University of Abomey-Calavi (UAC) at Cotonou in Benin (cf., Fig. 12) which was formerly called the Université Nationale du Bénin. This institution is the largest and oldest university in Bénin. It was established in 1970.

The ICMPA became the UNESCO Chair of Mathematical Physics and Applications in April 2006. Besides its Graduate School, ICMPA organizes an

International School every two years and has provided a fruitful venue for mathematicians, mathematical and theoretical physicists African continent scientists. The collaboration with the OEA goes back to 2005.

Fig. 12. University of Abomey-Calavi (UAC) at Cotonou in Bénin.

The PhD Programme in Mathematics is based at the Institute of Mathematical Sciences in Accra, Ghana. The Institute of Mathematical Sciences is a centre for the development and training of young mathematicians towards postgraduate study. Its Graduate School has students on Sandwich PhD and MSc/ MPhil programmes. The participating universities in Ghana are: The University of Ghana at Legon, the Kwame Nkrumah University of Science and Technology (KNUST) at Kumasi (cf., Fig 13) and the University of Cape Coast. This Project also organizes regional conferences, workshops and colleges in order to promote the mathematical sciences in the region.

Fig. 13. The main entrance of the KNUST, Kumasi, Ghana. In the foreground we can appreciate the statue of the first president of the Republic of Ghana, who was also the founder of this university.

The Regional Postgraduate Diploma in Mathematics is based at the University of Botswana in Gaborone, Botswana (cf., Fig. 14). The mission of the University of Botswana is to improve economic and social conditions for the Nation while advancing itself as a distinctively African university with a regional and international outlook. The OEA has been collaborating with the Graduate School both with at the PhD and MSc Levels.

Fig. 14. Regional Postgraduate Diploma in Mathematics based at the University of Botswana in Gaborone, Botswana.

The Graduate School of the Department of Physics is located at the Addis Ababa University in Ethiopia receiving its current status in 1975 (cf., Fig. 15). The University was originally named "University College of Addis Ababa It had been founded by the former Ethiopian emperor Haile Selassie I in 1962.

The OEA collaborated with this Graduate School from 2006 till 2009. This university had already developed a tradition in their Graduate School offering its first master's programs in 1979 and its first PhD programs in 1987.

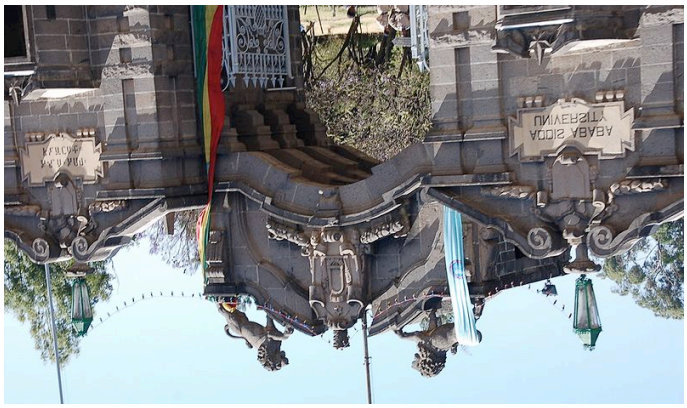


Fig. 15. Addis Ababa University, Ethiopia.

The Network Programme

A Network is a system of research groups in an entire region, or among different regions, that pursue a common scientific project over an extended period. The OEA supports networks because they are an efficient approach to overcoming the problem of isolation and counteracting the brain drain. The ICTP emphasises South-South collaboration and the sharing of expertise and facilities. At present the Centre supports 11 networks in mathematical and physical sciences. The 6 networks in Africa gather together efforts of African scientists worldwide. They are:

1. The African Lasers, Atomic, Molecular and Optical Science Network (LAM), based in Dakar, Senegal.
2. The North African Group for Earthquakes and Tsunamis (NAGET), based in Algeria.
3. Network on Lasers, Atomic Physics, based in Tunisia.
4. The Partial Differential Equations, Modelling and Control, based in Burkina Faso.
5. The African Network in Geometry and Algebra Applied to Development (RAGAAD), based in Yaounde, Cameroon.
6. The African Network for Solar Energy (ANSOLE), based at the Johannes Kepler University, Linz, Austria. We will consider them in some dertail below, but the present situation should be compared with the initial effort at the beginning of the implementaiton of the 4-Year ICTP Strategic Plan, which is illustrated in Fig. 16.

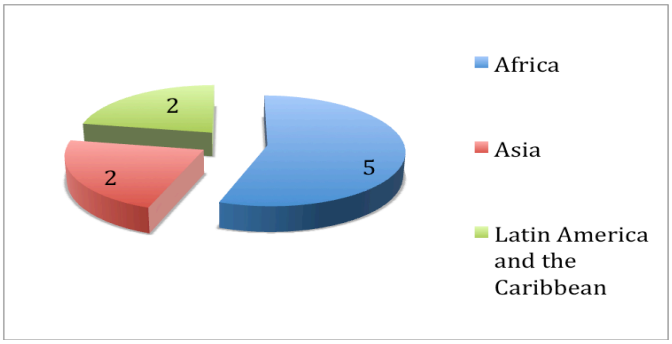


Fig. 16. Distribution of Networks supported by the OEA.

In Africa the networks have a continental coverage. The related research in 2010 is leading to 39 doctoral theses spread over the above-mentioned three regions, as well as by 19 other graduate school students. The regional distribution is shown in Fig. 17:

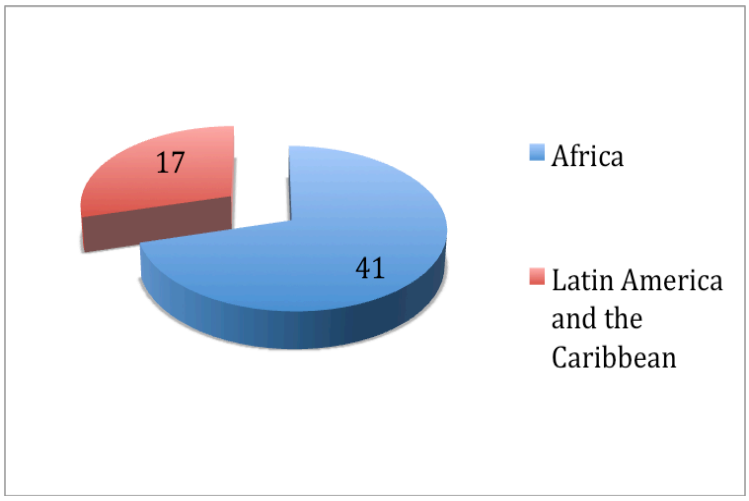


Fig. 17. The distribution of graduate students supported as part of the Network Programme.

THE AFRICAN NETWORKS

The African Lasers, Atomic, Molecular and Optical Science Network (LAM) has continental influence. It is based at the University of Cheik Anta Diop in Dakar, Senegal. We have already met this prestigious French West African University in the Section of Affiliated Centre Programmes (cf., Affiliated Centres). The Network itself was launched in Dakar in 1991 during the First International Workshop on the physics and Modern Applications of Lasers (held in Dakar, Senegal).

From its beginnings this Network defined its objectives firstly, to develop amongst its members exchange programmes in research and teaching in the fields of laser physics and secondly, to organize scientific meetings, including schools, conferences and workshops. [*From the Report for 1995-1996*.]

The North African Group for Earthquakes and Tsunamis (NAGET) is a Network that is based in Algeria. NAGET started its activities, once again, in 2011. Its main node is at the Centre of Research of Astronomy, Astrophysics and Geophysics (CRAAG), Algeria, cf., Figure, counting amongst its many disciplines Astronomy where the Algiers Observatory is located. It was founded as a Network in 2000 (cf., Fig. 18).

The renewed efforts of this significant Network are strongly motivated by the unprecedented range of seismic activity in the region of North Africa. Hence the Network has focused the attention of scientists and local communities on geo-hazards. Since the 1990s large earthquakes have caused severe damage and loss of life in the region, including Algeria itself, Morocco and Egypt. [*From the NAGET Annual Report 2011*.]

Fig. 18. The Algiers Observatory was built in the late nineteenth century.

The African Network on Lasers, Atomic and Medical Physics is based in Tunisia. It has widespread influence in both North Africa and Sub-Saharan Africa. The

specific countries involved are: influencing Algeria, Burkina Faso, Cameroon, Republic of Central Africa, Chad, Tunisia and Senegal. Its main node is located at the Laboratoire de Spectroscopie Atomique Moléculaire et Applications (LSAMA) in the Faculté des Sciences de Tunis, Université Tunis El Manar, Tunis, Tunisia (cf., Fig. 19).

Fig. 19. Faculty of Mathematical, Physical and Natural Sciences of Tunis. The Tunis El Manar University (UTM) is a university located in Tunis, Tunisia. It was founded in 2000 and is organized in 11 Faculties.

The network aims to continue the common research activities developed since 2001, especially aiming to strengthen South-South collaborations. Their project aims to study theoretical and experimental approaches to structural interactions, dynamics and kinetics of reactions of molecules with plasma, keeping in mind environmental applications, and the life sciences, including medical physics. [*From the Proposal for the 2012 Renewal of Network Project.*]

It is also remarkable the interaction of this network with one of the OEA affiliated centres. It has been training researchers from sub-Saharan Africa providing an excellent example of South-South cooperation that the OEA has been striving to implement. The CEPAMOQ has played an important role in the progress and direction of research, especially through the PhD programme

The Partial Differential Equations, Modelling and Control is a network based in Burkina Faso. Its main node is in Burkina Faso at the University of Ouagadougou, which was founded in 1974. It is located in the area of Zogona in Ouagadougou, Burkina Faso.

The fruitful relation with the Abdus Salam ICTP goes back to May 1999. It has been influencing researchers gathered from the Sub-Saharan region in the area of Mathematics, namely Ivory Coast, Mauritania, Senegal and Burkina Faso itself.

The network came into being in order to promote a sub-regional critical mass of active mathematics researchers in the fields of Partial Differential Equations and

Modelling and Control. It maintains good links with the international scientific community, maintaining a doctoral programme in Applied Mathematics with the additional intention of building research capacity in the regional universities. The network has contributed to avoid to some extent the problem of the brain drain. It has maintained an active academic programme of international events that in recent years have included schools and workshops.

Since 2003 the Network has maintained an International Conference on Mathematics and Applications to Development Problems in Sahel every three years. The major aim of the organizers has been to give an opportunity for mathematicians in the Network and in the African Region to present the result of their research. [*From the Network's 2009 Activity Report*.]

The African Network in Geometry and Algebra Applied to Development (RAGAAD) was founded in 2003. It has representatives in the following countries: Algeria, Benin, Burkina Faso, Cameroon, Congo, Ivory Coast, Guinea, Mali, Mauritania, Morocco, Niger, Senegal and Tunisia.

The network is based at the University of Yaounde 1 at the Department of Mathematics, Faculty of Sciences in Yaounde, Cameroon. This university was built with the help of France and opened in 1962. In 1993 there was a university reform splitting the original institution into two (Université de Yaounde I and Université de Yaoundé II).

This Network has made significant impact on the Sub-Saharan region, especially in its Least-Developed Countries with the collaboration of the University of Rennes. Two successful Graduate Schools have been maintained by the network: firstly at Niamey, Niger and, secondly, at Dakar, Senegal. Some additional details are provided in Appendix 3.

The Nano African Network Initiative (Nano-Afnet) is a network based in South Africa (continental influence). NanoAfNet has continental coverage. Its foundation originated in the ICS-UNIDO North-South Dialogue workshop held in Trieste-Italy in 2005. It was created the same year. It is coordinated from the iThemba Laboratory for Accelerator-Based Sciences, which is a group of multi-disciplinary research laboratories administered by the National Research Foundation, Somerset West (part of the City of Cape Town metropolitan municipality), and South Africa.

It is based at two sites in the Western Cape and Gauteng. The coordination of the Network is at iThemba LABS (laboratory for accelerator based sciences), a multidisciplinary facility aiming to become the leading African organisation for research, training and expertise in accelerator based science and technologies.

The objectives of the National Research Foundation (NRF) overlap considerably with those of the Abdus Salam ICTP: to support and promote research through funding, human capacity development and the provision of the necessary research facilities, in order to facilitate the creation of knowledge, innovation and development in fields of the natural sciences, and technology, including indigenous knowledge systems (cf., Fig 20).

Fig. 20. iThemba LABS (laboratory for accelerator based sciences), a multidisciplinary facility aiming to become the leading African organisation for research, training and expertise in accelerator based science and technologies.

Even though **The African Network for Solar Energy** (ANSOLE) lies outside the scope of this report, we make a brief mention to provide an indication of the growth of the OEA Networks. ANSOLE is based at the Johannes Kepler University, Linz, Austria (cf., Fig 21). This Network joined the ICTP System recently in 2011. ANSOLE aims to foster research activities in the field of solar energy among African scientists working in and out of Africa. For this reason countries in which there are already representatives are from four continents:

- **In Africa**: Algeria, Burkina Faso, Chad, Ivory Coast, Cameroon, Congo-Brazzaville, Egypt, Ethiopia, Kenya, Malawi, Morocco, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Togo, Tunisia and Zimbabwe.
- **In America:** USA
- **In Asia**: Jordan
- **In Europe:** Austria, Belgium, France, Germany, Greece, Italy, Netherlands and the Russian Federation.

The list is in the process of being extended. The network hopes to facilitate the exchange of ideas between students and scientists involved in solar energy research, formulate joint project proposals, put out joint publications, organize workshops and implement a graduate programme on solar energy.

Fig. 21. The Main Library of the Johannes Kepler University, Linz, Austria.

Visiting Scholars/Consultants

This programme promotes collaboration between scientists working in institutions in the developing countries and leading scientists throughout the world. The Visiting Scholar/Consultant is required to make at least two research visits over three years, each lasting at least a month. The Visiting Scholar/Consultant carries out joint research with his counterpart and lectures students in his or her field of expertise. This is another effective way to counteract the isolation of scientists and to allow them to maintain contacts and collaborate with leading experts from other countries. There are currently 21 active Visiting Scholars of which the African region has 9 of them.

In detail the programme of Visiting Scholars is being implemented in 2011 by a system of 21 grants that are distributed in the following areas: Earth, Life, Mathematical and Physical Sciences. In Africa this programme has benefited Benin, Ghana, Liberia, Morocco, Nigeria, Senegal and Zimbabwe.

The present situation should be compared with the initial effort at the beginning of the implementation of the 4-Year ICTP Strategic Plan, which is illustrated in Fig. 22:

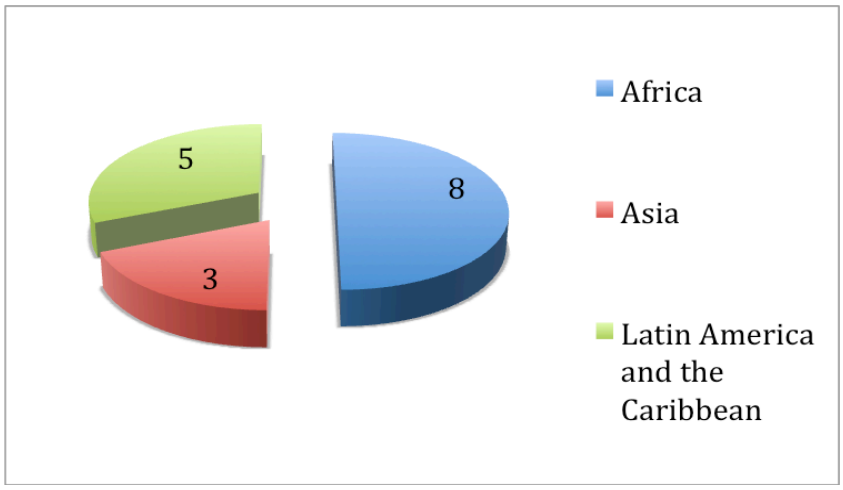


Fig. 22. Distribution of Visiting Scholars supported by the OEA.

The Visiting Scholar/Consultant is required to make at least two research visits over three years, each lasting at least a month. The Visiting Scholar/Consultant carries out joint research with his counterpart and lectures students in his or her field of expertise. This is another effective way to counteract the isolation of scientists and to allow them to maintain contacts and collaborate with leading experts from other countries.

Regional encouragement

We would like to emphasize two aspects of the regional encouragement of OEA: South-South and North-South cooperation. The active programme of Visiting Scholars for the emerging countries that we are supporting are, in a good proportion, scientists from the South itself—a fact that we are pleased to highlight. For the year 2011 these programmes included 5 South-South cooperation agreements that the OEA has been sponsoring. The scientists from Europe, North America and Oceania are distributed among 11 nations (Australia, Austria, Belgium, Canada, Denmark, France, Italy, Poland, Spain, United Kingdom and the United States).

The OEA has been supporting 2 South-South cooperation agreements in the African Region between Morocco and Brazil and between India and Nigeria.

On the other hand, the OEA has 16 North-South cooperation agreements. Those in African Region were 7 collaborations: Benin-Canada, Benin-USA, Ghana-UK, Ghana-USA, Liberia-Canada, Senegal-USA, and Zimbabwe-Austria.

The Visiting Scholars/Consultants awarded in 2011 are 8 of which 2 are South-South cooperation agreements between Nigeria/India and between Nepal/Malaysia. The other awards concern the African Region North South cooperation between: Benin/USA, Liberia/Canada, Senegal/USA and Zimbabwe/Austria.

In Fig. 23 we show how the world distribution of South-South cooperation stood in the year 2010:

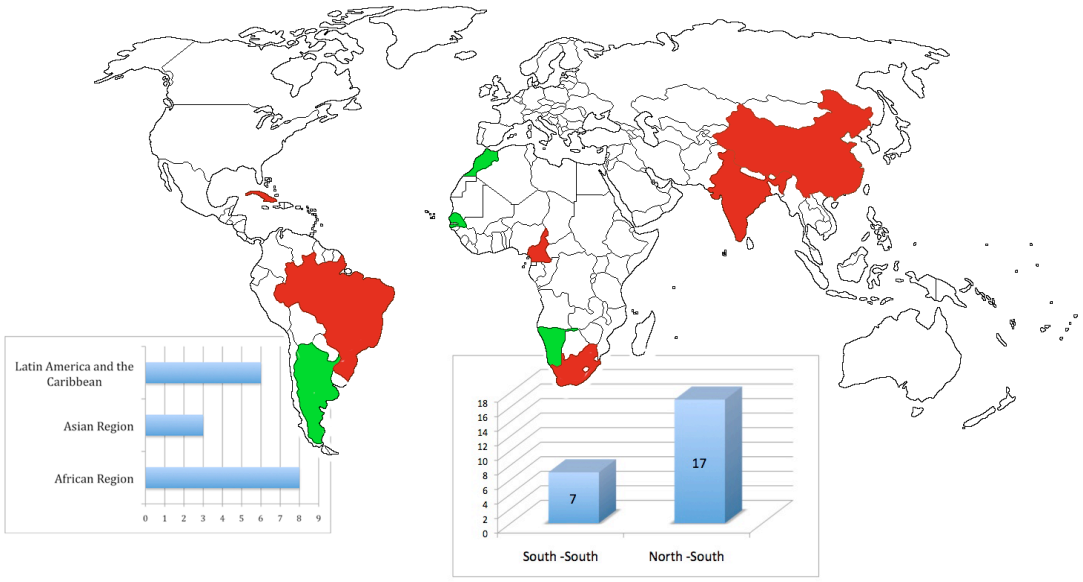


Fig. 23. Worldwide distribution of South-South cooperation supported by the OEA.[2] Colour code: Nation of origin of the Visiting Scholar (red), host country (green). The insets: (centre) comparison of the regional cooperation that has encouraged by the OEA; (left) relative distribution of the regional collaborations that have been encouraged by the OEA. [3]

On the other hand, the OEA in that reference year supported 17 North-South cooperation agreements that were distributed, as shown in Fig. 24.

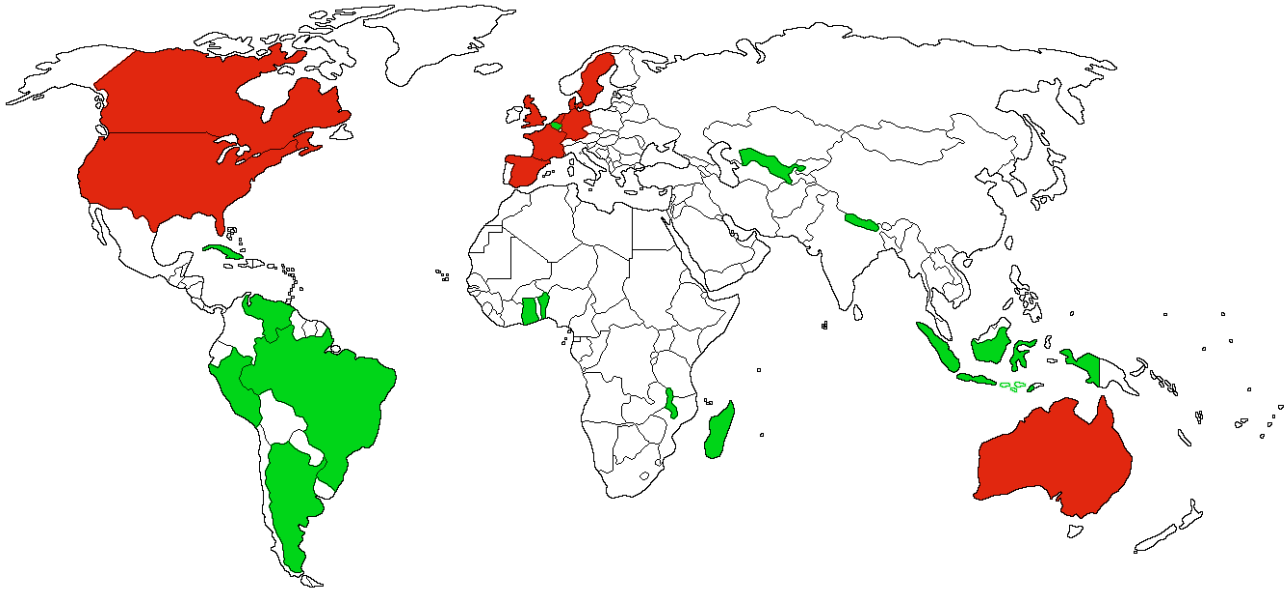


Fig. 24. Worldwide distribution of North (red)-South (green) cooperation supported by the OEA. [3]

Scientific Meetings

The OEA encourages the organization of international and regional scientific meetings in developing countries by offering financial assistance to the organizers of conferences, workshops, and schools.

In 2011 OEA has distributed 67 grants in five areas of knowledge: climate, education, mathematical sciences, physical sciences and space sciences. The grants assigned to the meetings in the African Region have been 20: Benin (2), Cameroon (2), Egypt, Ethiopia, Ghana (2), Madagascar, Morocco (5), Nigeria, Rwanda, Senegal, South Africa (2) and Tunisia.

The present situation should be compared with the initial effort at the beginning of the implementaiton of the 4-Year ICTP Strategic Plan, which is illustrated in Fig. 25.

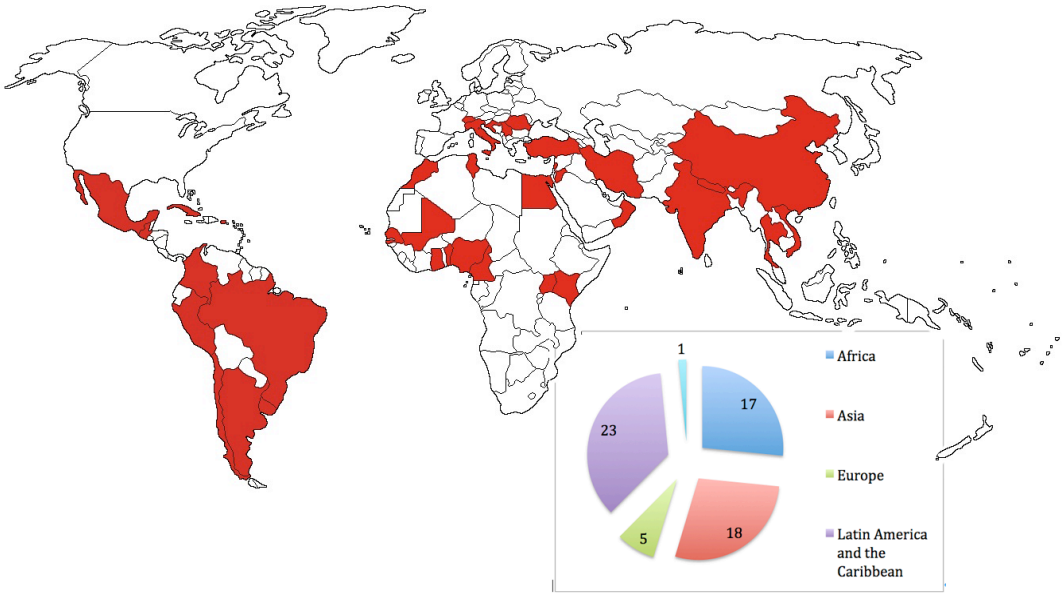


Fig. 25. Worldwide distribution of grants supported by the OEA for scientific meetings. [4] Inset: Distribution of grants for scientific meetings supported by the OEA.

APPENDIX 1:
Affiliated Centres (2007-2011)

In the tables below we list those students that were supported with ICTP funds. Research papers are listed as published or submitted. Those submitted in one year are most probably part of those that are accepted in the following year.

The Centre of Atomic, Molecular Physics and Quantum Optics (CEPAMOQ), The University of Douala, Douala, Cameroon

Year	Fellowships		Obtained (PhD)	Gender	Research papers	
	PhD	MSc			Published	Submitted
2007	1	9	2	—	10	6
2008	2	9	1	—	13	1
2009	7	—	1	—	9	7
2010	10	—	2	—	6	6
2011	7	—	6	—	6	1

L'Institut de Mathématiques et de Sciences Physiques (IMSP), Porto Novo, Benin

Year	Fellowships		Obtained (PhD)	Gender	Research papers	
	PhD	MSc			Published	Submitted
2007	15	—	—	1 (F)	—	—
2008	11	—	3	—	7	2
2009	11	—	2	1 (F)	4	—
2010	11	—	2	2 (F)	5	4
2011 (*)	12	14	5	2(F)	19	4

(*) Twelve Fellowships were funded by the OEA.

Department of Physics, Cheikh Anta Diop University (UCAD), Dakar, Senegal

Year	Fellowships		Obtained (PhD)	Gender	Research papers	
	PhD	MSc			Published	Submitted
2007	9	—	—	2 F	1	—
2008	10	—	—	—	2	—
2009	8	—	—	1 F	1	—
2010	4	—	—	1 F	2	2
2011	4	—	—	—	4	2

Laser and Fiber Optics Centre (LAFOC), The University of Cape Coast, Ghana

Here, while the number of fellowships appears small, roughly half of the ICTP funds are spent on equipment that benefits all the students.

Year	Fellowships	Obtained	Gender	Research papers

	PhD	MSc	PhD	MSc		Published	Submitted
2007	5	4	—	1	2 F	2	—
2008	4	3	—	2	2 F	3	—
2009	1	4	—	—	—	—	—
2010	3	4	—	—	1 F	—	—
2011	1	4	—	—	1 F	—	—

For the CPT Affiliated Centre, we refer the reader to Project Physics Beyond the Standard Model based at the Center for Theoretical Physics (CPT). This project has been promoted to an Affiliated Centre in 2011.

Year	**Fellowships**		**Obtained**		**Gender**	**Research papers**	
	PhD	MSc	PhD	MSc		Published	Submitted
2011	—	3	—	—	1 F	13	7

APPENDIX 2:
Projects (2007-2011)

PhD Program in Mathematics in Sub-Saharan Africa

Year	Ph. D	Obtained (PhD)	Gender	Research Papers	
				Published	Submitted
2007	6	1	—	3	9
2008	7	—	—	11	6
2009	7	2	—	4	—

The International Chair in Mathemtical Physics and Applications based at Cotonou, Bénin (ICMPA)

Year	PhD	MSc	Obtained (PhD)	Obtained (MSc)	Gender	Research Papers	
						Published	Submitted (or in press)
2007	14	—	4	—	2F	16	13
2008	4	—	—	—	—	—	—
2009	5	—	2	—	—	13	3
2010	4	—	—	—	—	11	2
2011	1	9	1	9	—	10	6

The research has also been communicated in several book chapters. It has also been recorded in numerous internal reports and preprints.

Ph. D. Programme in Mathematics based at Accra, Ghana

Year	Ph.D	MPhil	Obtained (PhD)	Obtained (MPhil)	Gender	Research Papers

						Published	Submitted
2007	8	11	1	4	—	4	1
2008	7	8	4	—	1F	6	3
2009	9	13	1	2	4F	—	—
2010	6	8	1	14	1F	—	—
2011	3	8	4	8	—	—	—

Regional Postgraduate Diploma in Mathematics based at Gaborone, Botswana

Year	Ph.D	MSc	Obtained (PhD)	Obtained (MSc)	Research Papers	
					Published	Submitted
2007	1	2	1	1	1	
2008	2	1		—	—	—
2009	1	1	1		—	—
2010	—	2	—	—	—	—
2011	1	1	—	—	—	—

Physics Beyond the Standard Model based at the Center for Theoretical Physics (CPT) based at the British University of Egypt

Year	PhD	Obtained (PhD)	Research Papers	
			Published	Submitted
2007	8		13	-
2008	5		8	6
2009	6		-	-
2010	3		18	5

In 2011 the Project became an Affiliated Centre.

Department of Physics, Addis Ababa University, Ethiopia

Year	Ph.D	Obtained (PhD)	Research Papers	
			Published	Submitted
2007	1	—	—	—
2008	1	—	—	—
2009	1	1	1	1

APPENDIX 3:
Networks (2007-2011)

African Lasers, Atomic, Molecular, Optical Science Network (LAM), based in Senegal (continental influence)

Year	Support for training, fellowships and field work	Other activities	
		Conference organization	Travel support
2007	3 (Mauritania). 2 (Mali). 1 (Senegal).	• 1 meeting in Algiers. • Support for an Affilieted Centre (Cameroon).	• 1 for promoting the Network. •1 for an Egyptian to attend a conference in Algiers.
2008	• 4 PhDs (1 Mauritania, 3, Senegal). •1 sandwich (Dakar/Mali).	•1 meeting in Douala, Cameroon. •1 meeting in Dakar, Senegal. • 1 regional African meeting (ICT).	•3 for the Network coordination. • 2 students from Senegal sent to Nigeria and Kenya.
2009	• 2 students (Mauritania), • 4 students (Senegal), • 1 research grant to a female student in Algiers.	• 3 workshops. • Contributed as a Founding Member to the African Laser Centre (ALC). • Launching ot the African Physical Society.	• 1 student from the University of Bamako (Mali) sent to Senegal. • 3 students from Senegal sent to Ghana.
2010	• 2 students (Mauritania). • 5 students (Senegal). • 1 PhD. sandwich student at the universities CAD of Dakar and Bamako, in Mali.	• 1 International Conference on Optical Science and Applications for Sustainable Development. • 1 workshop (LAM 9). • 1 Training Course on Mass Spectrometry in Nutrition.	• A programme of exchange of scientific visits. • Financial support to the ETOP • Meeting in Tunisia (US$ 1,000). • Support of a Morrocan Research Fellow to attend a meeting in Tunisia.
2011	• Continued the student support of 2010.	• LAM/IAEA African Regional training Course on Mass Spectrometry. • Multispectral Imaging Spectroscopy in nutrition (Bamako, Mali).	• The LAM President participated in the ICO Congress in Puebla, Mexico, and in the ICTP Winter College.

North African Group for Earthquakes and Tsunamis based in Algeria, starting once again in 2011 (influencing Egypt, Lybia, Morocco, Sudan and Tunisia)

Year	Support for training, fellowships and field work	Other activities	
		Conference organization	Travel support
2007	A scientist from Maulay Ismail University in Morocco did some field work in Egypt at the National Reserch Instituite for Astronomy and Geophysics	—	2 Visiting Scientists form Egypt to Morocco
2011	—	—	—

African Network on Lasers, Atomic and Medical Physics based in Tunisia (influencing Algeria, Burkina Faso, Cameroon, Republic of Central Africa, Tchad, Tunisia and Senegal)

Year	Other activities		Publications	
	Support for training, fellowships and field work	Events (organized)	Published	Submitted
2007	2 PhD students (Tunisia and Morocco) 1 postdoc 1 sandwich course	3	2	4
2008	3 PhD students (including 1 from Algeria, female) Travel grants for 2 scientists	4 Workshops 2 Advanced Schools	8	3
2009	4 PhD students (including 1 Senegal, 1 Republic of Central Africa, 1 Tchad (female) 1 Algeria (female)	4 Workshops	1	1
2010	7 PhD students (including 3females)	Workshops in Education for Trainers	1	1
2011	7 PhD students: Burkina Faso (1) Cameroon (2) Central African Republic (1) Senegal (1)	Alop International Workshop (Tunis)	1	1

Partial Differential Equations, Modelling and Control, based in Burkina Faso (influencing Senegal and Mauritania)

Year	**Support for training, fellowships at PhD level**	**Support for training, fellowships at MSc (Memoire DEA) level**	Conference organization	**Publications**	
				Published	Submitted
2007	7 PhD (defenses) 1 Thèse d'Etat (defense)	6 MSc (defenses)	• 1 Workshop of mathematical modelling • 1 Training School • 1 African Conf. on Applied Mathematics • 1 Conf. in honor of C. Lobry	7	6
2008	2 PhDs (defenses)	1 M.Sc (defense)	• PDE and nonlinear analysis	16	7
2009	6 PhD (defenses) including 1 female	2 MSc (defenses)	—	15	13
2010	4 PhD (defenses)	7 MSc (defenses)	• 1 International School of models of epidemiology • 1 Colloquium on Informatics	15	15
2011	4 PhD	—	• Workshop of Mathematical Models and Data Processing of Water and Sound • Workshop on Control of Systems and Modelling (Senegal)	Not available	Not available

African Network in Geometry and Algebra Applied to Development (RAGAAD), based in Cameroon (influencing Benin, Burkina Faso, Congo, Mali, Mauritania, Niger, Senegal and Tunisia)

Year	Support for training, fellowships and field work	Other activities		Publications	
		Conference organization	Travel Support	Published	Submitted (or preprints)
2007	4 PhD	• WATS 1 (West African Training School).	2 students for a colloquium.	24	—
2008	10 PhD 4 MSc	• WATS 2 • A Workshop in Nigeria. • Conf. on African cryptology.	• 9 student travel grants. • 5 other travel grants.	20	—
2009	8 PhD 4 MSc (2 PhD defenses)	• WATS 3 • School on algebraic topics and cryptology.	• 4 scientists for local academic supervision • 5 student travel grants grants.	4	—
2010	12 PhD (3 PhD. defenses) 4 MSc	• WATS 4 • School of cryptology in Cameroon. • A Workshop in Nigeria. • Ecole CIMPA-UNESCO-MICNN Theorie de Nombres e Algoritmiques (in Bamaco, Mali)	• For 4 doctoral students in Niamey, Niger, and for doctoral and master students from sub-Saharan countries. • For scientists from Senegal and Tunisia to travel to Cameroon.	—	—
2011	6 PhD (2 PhD. defenses)	• Atelier de Combinatoire • African Cryptology at UCAD, Dakar, Senegal	• For 2 scientists from Burkina Faso to visit the University of Aix Marseilles 2, and for doctoral students from Niamey, Dakar and Yaounde.	13	2

Nano African Network Initiative (Nano-Afnet), based in South Africa (continental influence)

Year	Support for training, fellowships and field work	Other activities		Publications	
		Conference organization	Travel Support	Published	Submitted
2007	—	—	—	—	—
2008	1 PhD 4 MSc 30 graduate school trainees, including 6 females	9 conferences	• 15 Visiting Scientists. • 14 travel grants for scientists.	14	1
2009	1 PhD 33 graduate school trainees, including 12 females	—	14 Visiting Scientists. 13 travel grants for scientists.	67	—
2010	—	—	—	—	—

African Network for Solar Energy, based in the Johannes Kepler University, Linz, Austria (of continental influence).

Year	Support for training, fellowships and field work	Other activities		Publications	
		Conference organization	Travel Support	Published	Submitted
2011 (*)					

(*) No information has ben received corresponding to the Academic Report for 2011, since the funds began to be assigned at the end of 2011.

APPENDIX 4:
Visiting Scholars/Consultants (2007-2011)
Total number of collaborations supported in the region: 24

COUNTRY	2007	2008	2009	2010	2011
Benin	—	—	1	—	2
Egypt	1	—	—	—	—
Ghana	2	—	1	1	2
Liberia	1	—	—	—	1
Madagascar	—	—	1	—	—
Malawi	—	—	1	—	—
Morocco	1	—	1	—	—
Namibia	2	—	—	—	—
Senegal	—	—	1	1	1
Zimbabwe	1	—	—	—	1
TOTAL	**8**	**1**	**6**	**2**	**7**

APPENDIX 5:
Scientific Meetings (2007-2011)
Total number of events supported in the region: 90

COUNTRY	2007	2008	2009	2010	2011
Algeria	—	—	1	—	—
Benin	2	2	—	2	2
Burkina Faso	—	—	1	—	—
Cameroon	1	3	2	1	2
Congo	—	1	—	—	—
Côte d'Ivoire	1	—	—	—	—
Egypt	3	6	2	2	1
Ethiopia	—	1	1	—	1
Ghana	3	2	2	2	2
Kenya	1	—	—	1	—
Madagascar	—	1	—	—	1
Mali	—	—	—	1	—
Morocco	2	1	2	3	5
Niger	1	—	—	—	—
Nigeria	2	1	1	1	1
Rwanda	—	—	—	—	1
Senegal	2	—	2	1	1
South Africa	3	1	—	—	2
Sudan	2	—	—	—	—
Tanzania	2	1	1	—	—
Tunisia	1	1	1	1	1
Uganda	—	1	—	1	—
Zambia	—	1	—	—	—
TOTAL	**26**	**22**	**16**	**16**	**20**

Footnotes

1. All data in the diagrams refers to the year 2010. The data reported in the Appendices cover the period 2007-2010.

2. We write our data as host country—country of origin of the Visiting Scientist. In the African Region the OEA sponsored the following South-South collaborations, Morocco-Brazil, Namibia-South Africa, Namibia-India, Senegal-Cameroon.

3. In the African Region for the year 2010 there were the following 8 collaborations: Benin-Canada, Benin-USA, Egypt-USA, Ghana-Netherlands, Ghana-Sweden, Ghana-UK, Madagascar-France and Malawi-USA.

4. The 17 nations of the African Region were in the year 2010: Benin (2), Cameroon (2), Egypt (2), Ghana (2), Kenya, Mali, Morocco (3), Nigeria, Senegal, Tunisia and Uganda.

Photographic credits

Affiliated Centres

Fig. 2. L'Institut de Mathématiques et de Sciences Physiques, Porto Novo, Benin. Credit: *ICTP and Africa*. Compiled and edited by K. R. Sreenivasan. Printed in Trieste by the ICTP Publications and Printing Services (2007), p. 13.

Fig. 3. The Cheikh Anta Diop University (UCAD), Dakar, Senegal. Credit Wikipedia: http://en.wikipedia.org/wiki/File: BibliothèqueCheikhAntaDiop.JPG

Fig. 4. Professor Gallieno Denardo the OEA Director at the time of the inauguration of LAFOC. Credit: ICTP and Africa. Compiled and edited by K. R. Sreenivasan. Printed in Trieste by the ICTP Publications and Printing Services (2007), p. 14.

Fig. 5. The University of Douala, Douala, Cameroon. Credit: http://www.cameroon-today.com/university-of-douala.html.

Fig. 6. The British University in Egypt, the former venue for the CPT, now the OEA Affiliated Centre at Zewail City for Science and Technology. Credit Wikipedia: http://en.wikipedia.org/wiki/File:British_University_in_Egypt.jpg

Projects

Fig. 11. The Sid Ahmed Baba AUST in Abuja, Nigeria. Credit: http://aust.edu.ng/library.

Fig. 12. University of Abomey-Calavi (UAC) at Cotonou in Bénin. Credit: http://safe-africa.net/Abomey.htm.

Fig. 13. The main entrance of the KNUST, Kumasi, Ghana. Credit Wikipedia: http://en.wikipedia.org/wiki/Kwame_Nkrumah_University_of_Science_and_Technology.

Fig. 14. Regional Postgraduate Diploma in Mathematics at the University of Botswana in Gaborone. Credit Wikipedia: http://en.wikipedia.org/wiki/University_of_Botswana.

Fig. 15. Addis Ababa University, Ethiopia. Credit Wikipedia: http://en.wikipedia.org/wiki/File:Addis_Abeba_University_(Sam_Effron).jpg.

Networks

Fig. 18. The Algiers Observatory was built in the late nineteenth century. Credit Wikipedia: http://en.wikipedia.org/wiki/Algiers_Observatory.

Fig. 19. Faculty of Mathematical, Physical and Natural Sciences of Tunis.
Credit: Official website: http://www.utm.rnu.tn/documents/presentation/annuaire/utm.jpg

Fig. 20. iThemba LABS (laboratory for accelerator based sciences), a leading African organisation for research Credit the Official Site: http://www.tlabs.ac.za/

Fig. 21. The Main Library of the Johannes Kepler University, Linz, Austria. Credit Wikipedia: http://en.wikipedia.org/wiki/Johannes_Kepler_University_of_Linz