



The Abdus Salam
International Centre
for Theoretical Physics



IAEA
International Atomic Energy Agency

NEWS

from

ICTP

SPECIAL EDITION

#121-124

Summer 2007 – Spring 2008

9 Research and
Training-for-Research

73 Programmes

93 Prizes and Awards

97 Scientific Support
Services

109 Calendar 2007 and
Statistics



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News from ICTP

Special Edition #121-124

The Abdus Salam International Centre for Theoretical Physics

www.ictp.it

NEWS FROM ICTP

The Abdus Salam International Centre for Theoretical Physics (ICTP) is administered under a tripartite agreement between two United Nations Agencies—the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Atomic Energy Agency (IAEA)—and the Government of Italy. Katepalli R. Sreenivasan serves as the Centre's director.

News from ICTP is designed to keep scientists and staff informed on past and future activities at ICTP and initiatives in their home countries. The text may be reproduced freely with due credit to the source.

Scientific Editor/*Direttore Responsabile*

Sandro Scandolo

Guest Editor

Katepalli R. Sreenivasan

Special edition based on the Annual Report 2007 Abdus Salam International Centre for Theoretical Physics with information provided by ICTP research groups and offices

Produced by the cooperative efforts of: K.R. Sreenivasan; G. Comar; M. Fasanella; C. Fonda; G. Gamboz; and A. Triolo

Photos:

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Printed by:

Tipografia Opera Villaggio del Fanciullo, Trieste



EDITORIAL

Dear Reader:

For many years now, ICTP has produced a quarterly Newsletter and you may have wondered why the last three issues did not materialize. In large part, the reason is that the process of revamping of our Public Information Office is still under way. In part, we felt that the content, format and the frequency of the Newsletter ought to be changed. It is our goal to print a single Newsletter every year, but do it professionally. The format of the present version is not necessarily our final choice, but we hope that you will find it to be more informative than before; it is certainly bigger than those you may remember from the past. Much of the news needing immediate attention will henceforth be put on our website as appropriate, instead of waiting for insertion in the next printed Newsletter. Thus, by mixing better the electronic and printed media, we hope to be able to convey the work of our Centre to the larger scientific community with promptness and proper context. I welcome your comments.

I acknowledge with pleasure the contributions of Guido Comar, Mariuccia Fasanella, Carlo Fonda, Giuliana Gamboz and Anna Triolo for their work in producing this Newsletter. Without their part, there would have been no substance. I hold myself entirely responsible on the shortcomings of this version.

I look forward to seeing some of you at ICTP this year. Wherever you are, have a great Summer and Fall.
Sincerely,

K.R. Sreenivasan
Director and Guest Editor



CONTENTS

Editorial	iii
Contents	v
Introduction	1
RESEARCH AND TRAINING-FOR-RESEARCH	9
Applied Physics	11
Aeronomy	12
Radiopropagation	13
Fluid Dynamics	15
Plasma Physics	17
Biosciences	18
Medical Physics	19
Accelerator Mass Spectrometry	20
Optics and Laser Physics	21
Energy Systems	23
Condensed Matter and Statistical Physics	27
Mesoscopic and Strongly Correlated Electron Systems	28
Statistical Mechanics and Applications	29
Electronic Structure and Condensed Matter Computer Simulations	29
Synchrotron Radiation Related Theory	30
Earth System Physics	35
Climate Change and Impacts	37
Natural Climate Variability and Predictability	40
Mechanics of Earthquakes and Tectonophysics	43
Nonlinear Dynamics of the Earth	46
Soil Physics	47
High Energy, Cosmology and Astroparticle Physics	51
Phenomenology of Particle Physics	51
Cosmology	52
Strings and Higher Dimensional Theories	53
LHC Physics	54
Mathematics	59
Multidisciplinary Laboratory	65
ICTP-INFN Microprocessor Project	66
Plasma Focus Project	67
X-ray Imaging	67
Accelerator Mass Spectrometry	68
Remote Access to Large Experimental Facilities	69



PROGRAMMES	73
Associateship Scheme	75
Federation Arrangements Scheme	77
Diploma Programme	79
Sandwich Training Educational Programme (STEP)	83
Other Joint Programmes in Higher Education	84
ICTP-ELETTRA Users Programme	85
SESAME Project	87
External Activities (OEA)	88
Training and Research in Italian Laboratories (TRIL)	90
PRIZES AND AWARDS	93
Dirac Medal	95
ICTP Prize	95
ICO/ICTP Award	95
Ramanujan Prize	96
Prizes for Leadership in Science and Public Life	96
SCIENTIFIC SUPPORT SERVICES	97
Science Dissemination Unit	99
Library	102
Information and Communication Activities	104
CALENDAR 2007, PUBLICATIONS, STATISTICS	109
1. Calendar of Activities	111
2. Publications	121
3. Tables	145
List of Financial Contributors	145
Statistics of Visitors and Activities	147
Summary of ICTP Activities by Region	148
Visitors and Person-Months by Country	149
List of Sandwich Fellows	154





The early aim of the Abdus Salam International Centre for Theoretical Physics (ICTP) was to foster the growth of advanced scientific studies and research in theoretical physics, particularly in developing countries. Over time, the Centre has expanded its scope to include a few other subjects such as mathematics, condensed matter and statistical physics, and earth physics (including climate change, atmospheric physics and seismic activity); it has also embraced, to keep up with constant demands in developing countries, areas such as accelerator physics, communication, medical physics, optics and lasers and soil physics. Throughout this evolution, however, the fundamental focus on enhancing scientific activity in developing countries and the emphasis on the scientific values and excellence have remained unwavering.

From the time the Centre was created, it has had the vision that advanced research would be the vehicle for scientific – and, ultimately, economic – development. Doing advanced research at the highest possible level and disseminating that knowledge widely were regarded as two important ingredients of ICTP’s work; they are still its lynchpins. The areas that the Centre has incorporated lately also adhere firmly to this basic philosophy.

The Centre strives for excellence while embracing diversity: it cannot choose between the two. Without maintaining scientific excellence, the Centre can hardly be useful to its community; a dead battery cannot jump-start a drained one. On the other hand, the Centre will have lost its primary purpose if it does not remain attentive to scientists from disadvantaged countries. All competent scientists are welcome at ICTP, whether they come from famous institutions in scientifically advanced countries or from less known institutions of poor countries: the primary yardstick is scientific merit. Approximately one half of the scientific visitors to ICTP are from developing countries. It is our tacit faith that scientific talent is to be found in all cultures and countries, provided one makes the effort to discover and nurture it. Since the scientific level in many countries is still dismally poor, we have often had to work hard to identify the talent already there. We have devised a number of programs to nurture young researchers with promising potential, lacking only adequate opportunities to flourish. This emphasis on the young and emerging scientists is balanced by maintaining our connections with the mature and the accomplished; taken together, these considerations account for the diversity of programs carried out by ICTP both locally and elsewhere.

The Centre is administered under a tripartite agreement among the Government of Italy, the International Atomic Energy Agency (IAEA) and the United Nations Educational, Scientific and Cultural

“It is our firm belief that many scientists leave this place with the right sense of balance between scientific and human values”

Organization (UNESCO), with UNESCO as the lead. The Centre has been able to maintain a large measure of autonomy because of this marvellous agreement and to run its programs with an administrative structure that is relatively unfettered by bureaucratic constraints. This nimbleness – the ability to act in a timely manner



A Brief Retrospective

Already in 1985, the Centre had diversified its coverage. For example, in its annual report of activities held during 1985, the following main fields of research and training for research were listed:

- (a) Fundamental physics (elementary particles and fundamental theory);
- (b) Physics and energy (nuclear physics, nonconventional energy, plasma physics);
- (c) Physics of condensed matter (including atomic and molecular physics);
- (d) Applied physics (laser physics, fibre optics and microprocessor technology);
- (e) Physics of the living state;
- (f) Physics of the environment and of natural resources (physics of the atmosphere, soil physics);
- (g) Mathematics (applicable mathematics);
- (h) Physics teaching;
- (i) Experimental physics training at Italian laboratories and
- (j) Physics and development.

based on sound information, collective experience, and an awareness of the constantly changing world situation – is one of the open secrets of ICTP’s success.

Funding for the Centre derives from annual contributions from the Italian Government through its Ministry of Research, MIUR (€18,003,845), IAEA (€2,289,200), and UNESCO (€388,831). Other contributions, of largely programmatic variety and derived most often for supporting joint programs, are listed in Table 1 (see Appendix 4). These contributions add up to about €3,278,570.

Our sincere appreciation goes to all our sponsors. They should take the credit for the fact that many visitors from all parts of the world are engaged at the Centre in a task that is at once scientific and altruistic: this combination is almost a miracle in the “me-first” era in which the concern for the less privileged is not a high priority. It is our firm belief that many scientists leave this place with the right sense of balance between scientific and human values.

The report now in front of you is a summary of ICTP’s activities for the year 2007, prepared primarily for its Scientific Council and the Steering Committee but also, breaking from past tradition, for wider dissemination. It has been prepared on the basis of the material provided by the scientific and administrative sections of the Centre. The report is supposed to be comprehensive, though we are aware that some elements have been short-changed and the arrangement is somewhat uneven, chiefly because of the range and diversity of activities with which ICTP is concerned. In spite of its shortcomings, however, we are confident that you will get a good sense of our accomplishments. Each scientific section summarizes not only on its research but also its dissemination activities. The latter are listed and described more fully in subsequent sections.

The magnitude of work summarized in this report would have been impossible without the cooperation of many scientists and colleagues, within and outside of Trieste. We appreciate this involvement and derive our strength from it. It is heartening to see that many people of distinction desire to be part of the Centre’s work; its mission has captured a niche that one supposes was always there. Many of our activities are carried out jointly with

“The culture of caring for scientific work in developing countries, in which the Trieste institutions have excelled, has a large dose of ICTP’s influence”



other institutions and countries, as a measure of which we might cite that 47 memoranda of agreement, forming the basis of this cooperation, are presently in force at ICTP.

We take this occasion to emphasize a few further aspects. The quality of the resident scientists at the Centre can be witnessed by their scientific output (see Appendix 2) and the distinctions conferred upon them regularly. These aspects for the previous years are recorded in the respective annual reports, and, for 2007, in Appendix 5. A total of 217 journal papers were published in international journals including the broadest of them such as *Nature* and *Science*, with many more in various conference proceedings. With respect to the distinctions conferred, we particularly call attention to the Sakurai Prize of the American Physical Society shared by Alexei Smirnov of the High Energy Section, and take delight that Filippo Giorgi, the head of the Earth System Physics section, continues to be one of the vice-chairs of the Working Group I of the Intergovernmental Panel on Climate Change (IPCC), which shared the 2007 Nobel Peace Prize.

A few elementary statistics are in order. More details are contained in Table 2 (Appendix 4). The number of visitors to the Centre supported by ICTP's finances, at least in large part, was 4959 (including 488 participants in the G8 Forum, 266 from Italy); this number does not include the 2160 participants for hosted activities (which are activities deriving only modest support from ICTP). The total number of visitors is thus 7119, quite large by any measure. Out of the 4959, 1073 (22%) were female; 2631 of them (53%) were from the industrialized countries; the remainder were from countries that are developing or in economic transition. Alas, only 157 (3.2%) of our visitors were from the least developed countries. Finding and encouraging well-qualified people in these countries constitute our toughest challenges.

A complementary view may be appreciated by considering the person-months that the visitors spent at ICTP. The total number of person-months was 4515 (or 137,332 person-days). Those from industrialized countries spent about 1354 person-months (30%), while the remainder (about 70%) came from other parts of the world. The least developed countries fared slightly better in this respect (6.3% of the total). Altogether, the visitors came from 126 countries (of which 32 are industrialized).

Fifty-three research and training activities were held at ICTP in 2007; in addition, 28 activities were hosted (see Appendix 1). The sum total of these activities keeps the Centre busy nearly all through the year, with a bit of slack only during winter months. ICTP also organizes, in cooperation with local institutions and at their request, a number of regional training activities. There were 12 of them in 2007, 5 in Africa (2 in Nigeria, one each in Botswana, Egypt and South Africa); 2 in India; 1 in Greece; 4 in Latin America (2 in Argentina and one each in Brazil and Mexico). Add to it numerous research

“ICTP is a scientific institution, run by a few scientists for the benefit of many”

Cooperation

ICTP has at present 47 agreements of cooperation with scientific institutions around the world. The principal goal of these cooperation agreements is to leverage the resources of ICTP by drawing others into supporting the Centre's mission through both manpower and money. As an example, we might cite the new agreement with the National Institute of Telecommunications of Poland, in the field of radiocommunication science and technology, with particular emphasis on the development of information and communication technologies.





Adama Dieng, the Under-Secretary General of the United Nations and the Registrar for the International Criminal Tribunal for Rwanda, speaks at the Africa Day

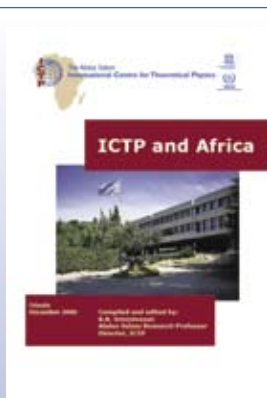
Africa Day

ICTP organized the Africa Day, a one-day symposium to discuss the role that the international institutions in Trieste can play in addressing Africa's issues. The proceedings were held in the ICTP Main Lecture Hall on 31 May, and were recorded and made available on-line at <http://www.ictp.tv>. On the occasion, ICTP issued the booklet ICTP and Africa.

seminars run in each scientific section, and it is easy to see that the place is alive and brimming with new people and new ideas all the time.

In addition, ICTP has placed more than 1,000 scientists at the post-doctoral level in various Italian Laboratories through the support derived for its programme on Training and Research in Italian Laboratories (TRIL) from the Italian Ministry of Foreign Affairs; joint programs with INFN and Sincrotrone Trieste have had long-standing and mutually rewarding histories; recently, joint Masters and Ph.D. programmes have been created with the University of Trieste, and efforts are on their way for creating similar programs with other institutions. Altogether, it is fair to say that the culture of caring for scientific work in developing countries, in which the Trieste institutions have excelled, has a large dose of ICTP's influence. This remark is less self-serving but more a tribute to the enlightened awareness of the scientific and research institutions in Trieste.

ICTP is a scientific institution, run by a few scientists for the benefit of many. It has to remain essentially that way. However, the Centre was created in the backdrop of political reality of the cold war and catered to it in outstandingly effective ways. Even today, people remember with pride the meetings between the Western and Soviet scientists, which led to seminal collaborative work. The world situation has changed since then, and this has necessitated changes of outlook and concerns at the Centre. It has adapted itself to these changing situations quite well. Essentially out of this necessity to adapt, the Centre is sometimes involved in policy issues of science in developing countries. The G8-UNESCO World Forum on 'Education, Research and Innovation: New Partnership for Sustainable Development' organized in collaboration with



ICTP and...

ICTP has worked for science in developing countries consistently since inception. Through this series of booklets, ICTP intends to summarize the activities that have been directed at different regions of the world. The two booklets shown here are available online at <http://publications.ictp.it/books.html>

Other booklets in the series are in preparation: ICTP and Asia, and ICTP and Italy – which will review the cooperation that ICTP has enjoyed for more than 40 years with its host country and major sponsor.





Italian Prime Minister Romano Prodi and UNESCO Director General Koichiro Matsuura at the G8-UNESCO World Forum

the Italian Ministry of Foreign Affairs, the UN Day organized in collaboration with the Trieste Municipality, as well as the Africa Day, belong in this domain. In particular, unless our support for scientists of developing countries is backed by the commitment of their governments to nurture and support their base of science, the Centre's efforts will lose their intended multiplicative effect. If we can do something to encourage policy makers to pay attention to science, we should do it – and, indeed, we do so.



ICTP Director K.R. Sreenivasan speaks at the Town Council Hall on the occasion of UN Day, 24 October

UN Day

As the leading UN institute in its host city of Trieste, ICTP organized the celebrations of the UN Day on 24 October. The particular purpose of the celebrations in 2007 was to involve young students even further into the implementation of the Millennium Development Goals (MDG). A special session of the Town Council was held, in which representatives of ICTP and several other local scientific institutions explained to the councillors and students how science helps in the attainment of the MDG. A guest of honour was Ana María Cetto, Deputy Director General and Head of the Department of Technical Cooperation of the International Atomic Energy Agency (IAEA). A video message by UN Secretary General Ban Ki Moon was released.

The second part of the programme followed in the Sala Tripovich theatre, with an estimated audience of 500 people, most of them young. Six high school students were awarded fellowships by Dr. Cetto in recognition of their high standing in the physics curriculum. The programme was concluded by a show of dance and music performed by several local groups.



What lies ahead? As Niels Bohr is supposed to have said, “It is hard to predict, especially the future.” But it is clear that some things must change at ICTP. First, the more applied areas that ICTP has harboured from inception but kept hidden below recognition level have to take their proper place; as we have said in the preface to the newly created Applied Physics section, the central proviso should be that the work must be of exemplary class and quality. Some structural changes in ICTP will be needed, especially if we keep in mind the burning issues of today, such as information and communication technology, science communication, intellectual property, bioethics and global change. Adapting to these expanding needs without sacrificing the core values of scientific rigor will be the challenge that ICTP will always have to face.

Second, while ICTP has nurtured a large number of individual scientists – and some have been very successful – that support has not always translated into building sustainable groups and institutions. This is a task of the next order of complexity but unless individuals build or transform institutions, our efforts will rank with emergency fire-fighting of brush fires – invaluable and immediate but not

lasting in impact. The task needs more resources and, even more important, an integrated action among many like-minded individuals and institutions. A certain level of pragmatism that does not ignore the reality on the ground is required: one size does not fit all. And this work will always have a modest level of political dimension.

Third, the Centre needs to make some high-class appointments in new areas so as not to remain stagnant: areas such as the interface between biology and physics, computer science, neurophysics, nanoscience, mathematical modelling of real-world problems (however imperfect the models may look at the moment), and so forth.

All of this brings us to the question of our inherited name, which to some seems to constrain us to theoretical physics of a certain variety; unnecessarily constraining; there are various ways of addressing this aspect while keeping perfect harmony with the past. Finally, of course, there are issues of resources, as we have already hinted earlier. If there is one dimension in which the Centre needs to develop, it is a stronger base of support that will take anxiety out of planning for measured growth.

*K.R. Sreenivasan
Abdus Salam Research Professor
Director*



Distinguished Visitors

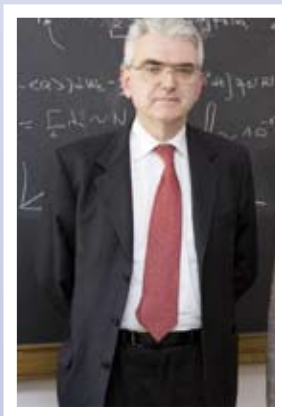
The Centre receives many delegations and distinguished visitors. They are both scientists and policy makers. Some scientific visitors are highlighted elsewhere as appropriate, but the photographs on this page serve to illustrate other visits.



13 May - US National Science Foundation Board representatives Michael Crosby, Executive Director of the National Science Foundation; Steven Beering, Chairman of the Board, President Emeritus of Purdue University; Arthur Reilly, Senior Director, Strategic Technology Policy at Cisco Systems; and Jon Strauss, President Emeritus of Harvey Mudd College



22 August - Susan Eisenhower, strategic advisor, President of the Eisenhower Group, Inc., granddaughter of Dwight D. Eisenhower, delivered the colloquium "The Politics of Nuclear Energy"



7 May - Francesco Romanelli, Director of JET (Joint European Torus)



26 October - A delegation from the National Natural Science Foundation of China

Research and Training-for-Research

Applied Physics
page 11

Condensed Matter and Statistical Physics
page 27

Earth System Physics
page 35

High Energy, Cosmology and Astroparticle Physics
page 51

Mathematics
page 59

Multidisciplinary Laboratory
page 65



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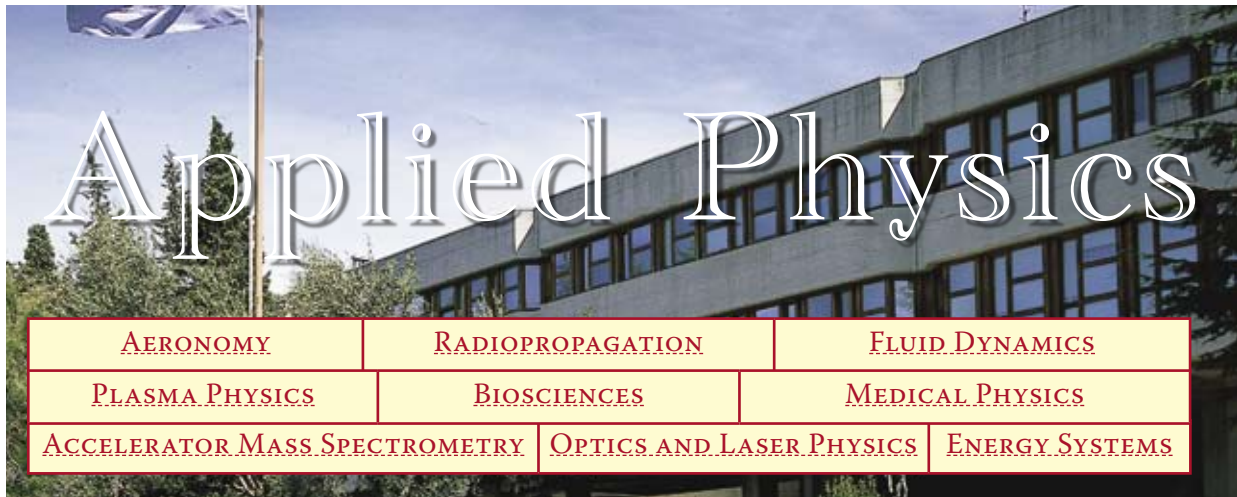


No Smoking

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ABOUT THE SECTION

Applied Physics at ICTP is both old and new at the same time. The other sections of the Centre have grown largely through conscious planning while the Applied Physics Section is presently a conglomeration of activities that the Centre has pursued, out of pure necessity, outside of these other sections. Such activities have always existed at the Centre as independent pursuits embedded within the Centre's broad mission, and responding to the most critical needs of the ICTP scientific community. These are, in fact, among the activities for which the demand in developing countries is enormous and growing, and ones which make more direct contact with the outside world; for instance, who in today's world can ignore issues dealing with energy?

The number of applied physics activities at ICTP has waxed and waned over time, and those described below is what one finds here today, in part for historical and opportunistic reasons. They were embedded together for the first time some three years ago in this newly created section. While the activities of the section are presently not yet well integrated into a cohesive whole, there are broad principles of convergence among them; and these apparently distant areas – ranging from the somewhat esoteric to the applicable – share a common philosophy on science.

One occasionally hears the view that some of these applied areas take the Centre away from its mainstream goals. At the bottom, however, the goal of ICTP is to support science for development, with the central proviso that the work should be done with exemplary quality: indeed, nothing can be used as a building block unless it is accompanied by quality. Science for its own sake is one of the greatest enterprises of the last few hundred years (if not longer), but it needs to be said that the Centre was created also to disseminate the benefits of science to underdeveloped countries. The Centre has not only been sensitive to the present and foreseen needs of its world-wide community, but has been extra careful to pursue only peaceful applications, as the reader can readily verify from the notes below.

Only a few of the applied physics activities are supported at ICTP through formally permanent positions, but the identification of all the activities with the Centre is quite important. Some activities receive only partial support from the Centre's budget, with the remaining funds coming from external sources. Indeed, since these activities have real-life connections, it is only natural that money should be generated at least in part from such connections; this could, in turn, effectively enlarge the range of opportunities for the ICTP community. Perhaps making appointments in more applied areas should be linked to the Centre's ability to raise external support, unless some new and unrestricted money arrives in significant measure. Finally, those areas that are closer to technology – especially to aspects of sustainable development – could perhaps be regrouped into a cohesive and separate unit. Such changes are currently under consideration.



A. Aeronomy

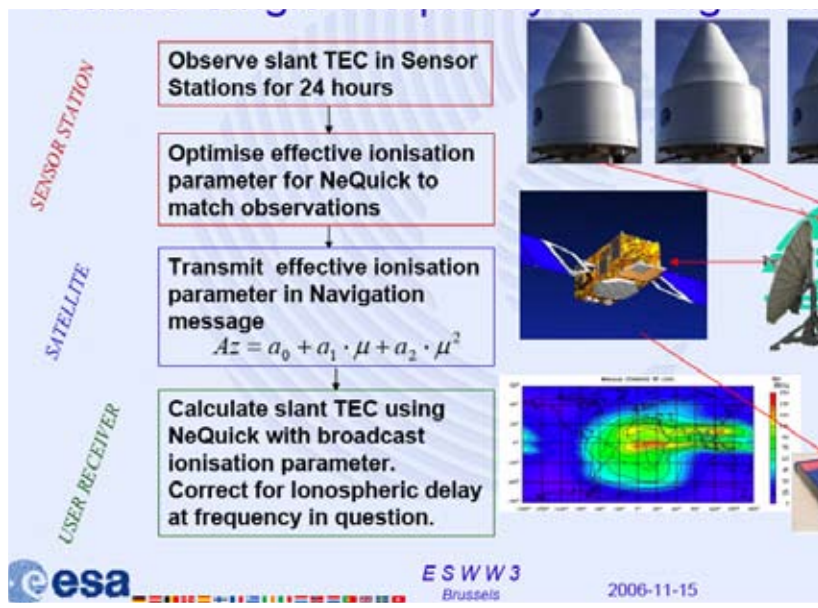
The aeronomy activities cover ionospheric modelling, with emphasis on 3D and time specification of the electron density in the ionosphere. The studies are oriented to ionospheric effects in satellite navigation and positioning using GPS, the augmented systems developed or being developed in the US, Europe, Japan, China and India, as well as the future GALILEO system. The activities are financed mainly through contracts related to the European projects in the area of satellite navigation, including the new GALILEO programme.

A1. Research Activities

Ionospheric model studies

Our earlier technique to reconstruct global and regional three-dimensional and time-varying electron density distribution in the ionosphere has been further investigated. Checks with independent ionospheric measurements to validate the method have been done using new data. The possibility to integrate the technique in the large Low Latitude Ionospheric Sensor Network (LISN) project of Boston College, USA – a distributed observatory scheme for South America – has been investigated.

Studies on the performance of the NeQuick model of the electron density in the ionosphere, originally developed here and at the University of Graz, Austria, have generated a new version of the model, called NeQuick2 model. An improved model for the topside of the electron density of the ionosphere has been introduced in NeQuick2 and is being adopted as the preferred option of the International Reference Ionosphere (IRI) model, which is an internationally established model that is being continuously improved in the last 25 years through studies carried out in different countries. The NeQuick model, adopted as single frequency ionospheric correction model by the GALILEO system (see figure below), is being internationally applied and studied as indicated by the 15 publications by authors outside ICTP in the period 2004-2007, including 3 Ph.D. (Spain) and 1 Masters thesis (Belgium).



From "The GALILEO single frequency ionospheric correction algorithm" by B. Arbesser-Rastburg, presented at the 3rd European Space Weather Week, Brussels, November 2006



Spatial gradients and time rate of change of TEC

The study of spatial gradients and time rate of change of the integrated values of the electron density at different latitudes has been continued. To perform this study, very accurate GPS-derived data on the total electron content, obtained over the United States by the US Wide Area Augmentation System community and in Brazil, are being used together with data from the International GPS Service global network of stations.

Equatorial plasma bubbles detection

A technique to detect electron density depletions observed at low latitudes in the ionosphere has been developed and is being used to characterize the occurrence and importance of the phenomenon in the African region. Electron density depletions are associated with satellite signal scintillations that affect satellite navigation. This investigation is done in collaboration with the Universidad Complutense of Madrid and is the basis of a Ph.D. thesis work.

A2. Participation in International Events

- S.M. Radicella and B. Nava continued as Work Package Leaders of two Work Packages of the European Commission COST 296 Action: 'Mitigation of Ionospheric Effects on Radio Systems' (MIERS) that started February 2005. S. M. Radicella has been confirmed as member of the URSI/COSPAR Working Group on IRI.
- Sixth Management Committee meeting of the European COST 296 Action, Rome, Italy, 15-17 March, 2007 (S. M. Radicella and B. Nava)
- European Geosciences Union, General Assembly 2007, Vienna, Austria, 15– 20 April 2007 (B. Nava and P. Coisson)
- International Beacon Satellite Symposium, Boston College, USA, 11-15 June 2007 (S.M. Radicella and B. Nava)

- Satellite Based Augmentation Systems – Ionospheric Effects, experts meeting # 13, Boston College, USA, 14-16 June 2007 (S.M. Radicella and B. Nava)
- Convegno Nazionale di Fisica della Terra Fluida e Problematiche Affini, Ischia, Italy, 11-15 June 2007 (P. Coisson)
- First Low-latitude Ionospheric Sensor Network Workshop, Lima, Peru, 1- 9 August 2007 (B. Nava)
- International Union of Geodesy and Geophysics, Perugia, Italy, 2-13 July 2007 (P. Coisson)
- IRI/COST296 Workshop on Ionosphere: Modeling, Forcing and Telecommunications, 10-14 July 2007 (S.M. Radicella, B. Nava and P. Coisson)
- International Heliophysics Year – Africa Space Weather Science and Education Workshop, Addis Ababa, Ethiopia, 11-16 November 2007, (S.M. Radicella, Discussion Panel invited member)

A3. Teaching Activities

B. Nava participated as lecturer in the Earth System Physics Diploma Course giving 6 lectures on "Electromagnetic Waves".

B. Radiopropagation

Activities in information technologies and radiocommunications were linked to the use of radio systems in information and communication technologies for developing countries. Research and application activities in the area of "wireless sensors" have been initiated to acquire the capacity to transfer this technology to developing countries. Under an agreement signed in February 2004 with the International Telecommunication Union – Bureau of Development of Telecommunications (ITU/BDT), a joint training unit was established and continued its operation in 2007.



B1. On Site Activities

A Task Force Activity on “Long Wireless Links for Development: Best Practices” was carried out from 12 to 24 November 2007 with the participation of experts on wireless ICT. During this activity, ICTP developed an experimental 133 km long-distance WLAN between the Galileo Building in Trieste and Monte Cesen (1500 m above sea level). The objectives of the experiments were: to collect preliminary data on long-distance propagation effects at 2.4 GHz and 5 GHz frequency bands, to compare the operation of various devices (hardware and software) used for long-distance radio links at 2.4 GHz and 5 GHz frequency bands and to collect preliminary data on mutual interactions between physically adjacent links at 2.4 GHz and 5 GHz frequency bands.

Carlo Fonda participated in a technical mission on long distance wireless network links establishment using WiFi low cost technology in the Galapagos Island (Ecuador) during 13-28 June 2007. The international team of experts has been coordinated by EsLaRed (E. Pietrosevoli) and the mission financed by UNDP Ecuador.

B2. Partnership and External Funding

The partnership with the ITU/BDT and with the Regione Autonoma Friuli Venezia Giulia has continued. The collaboration with the Consorzio Nuova Venezia to develop and test wireless systems using WiFi technologies for environmental monitoring is continuing. The experience gained will be applied to projects in developing countries.

Aeronomy activities: European and Italian institutions, Euro 12,0000

ITU/BDT: Euro 19,000

Regione Friuli Venezia Giulia: Euro 50,000

B3. Participation in International Meetings

1. ICTP-ITU-URSI School on Wireless Networking for Scientific Applications in Developing Countries, Trieste, 5-23 February 2007 (S.M. Radicella, Co-director, C. Fonda and M. Zennaro, Laboratory Directors and lecturers)
2. G8-UNESCO World Forum on Education, Innovation and Research: New Partnership for Sustainable Development, 10-12 May 2007 (S.M. Radicella, participant; C. Fonda and M.



Setup and alignment of antennas in top of Mount Cesen (1500 m), Italy, by the Task Force international team (Courtesy of C. Fonda)



- Zennaro, technical support)
3. senZations'07, Summer School on Applications of Wireless Sensor Networks, Warsaw University of Technology, Warsaw, Poland, 10 – 14 September 2007 (M. Zennaro: he received the Best Presentation Award of the conference)
 4. Wrecom (Wireless Rural and Emergency Communications Conference), University of Rome "Tor Vergata", Italy, 1-2 October 2007 (M. Zennaro)
 5. Connect Africa Summit organized by the ITU and the African Union, Kigali, Rwanda, 29 - 30 October 2007 (S.M. Radicella)
 6. Fourth Session of Web for Development Conference, Nairobi, Kenya, UN-Habitat Headquarters, 28-30 November 2007 (M. Zennaro)

C. Fluid Dynamics

The Research Group in Fluid Dynamics was established in 2003. The group interacts closely with other research groups at ICTP and elsewhere, in Trieste and beyond.

C1. Research

Turbulence in classical fluids

We have made the first direct and dynamic observation of a "superconducting" core in turbulent thermal convection, long hypothesized as important for models of turbulent convection in the limit of infinite Rayleigh numbers, but previously inferred only indirectly. The observation was made by monitoring the absence of attenuation of a heat wave propagating from a solid surface into a layer of cryogenic helium gas, using small semiconductor sensors obtained from a partnership with Ukrainian scientists.

Turbulence in quantum fluids

The first-ever direct visualisations were

made of quantized vortices since their indirect experimental discovery in 1956 by H.A. Hall and W.F. Vinen. This work was published in *Nature*. The observations were made by seeding the superfluid with solid hydrogen particles inside an optical cryostat. The photo on the next page shows vortex reconnections, which form one of the proposed mechanisms for the evolution of a turbulent quantized vortex line tangle.

C2. Participation in International Programmes

(This list excludes presentations made by K.R. Sreenivasan in his capacity as Director about ICTP and, generally, Science in Developing Countries.)
JJN= J.J. Niemela, KRS=K.R. Sreenivasan

Invited talks in international meetings

1. European Workshop on Turbulence in Cryogenic Helium, 23-25 April, CERN, Geneva (JJN, KRS)
2. Advanced School on Vortices and Turbulence at Very Low Temperature, 2-6 July, Udine, Italy (JJN, KRS)
3. First Kodai-Trieste Workshop on Plasma Astrophysics, Kodaikanal Observatory, India August 27 - September 7. (JJN)
4. Iberoamerican Conference on Optics (RIO) Latin-American meeting on Optics, Lasers and Applications(OPTILAS) Campinas-SP, Brazil (JJN)
5. A European Synergy for the Assessment of Wall Turbulence, 22-23 March, Viterbo, Italy (KRS)
6. Geneva International Conference on Euler Equations: 50 Years On (EE250), 18-23 June, Aussois, France (KRS)
7. Workshop on Scalar Dissipation Lengths, 25-27 July, Aachen, Germany (KRS)
8. First Kodai-Trieste Workshop on Plasma Astrophysics, Kodaikanal Observatory, India



August 27 – September 7 (JJN)

9. International Conference on New Energy Sources, 22-25 October, Tbilisi, Georgia (KRS)
10. Connect Africa Summit, 29-30 October, Kigali, Rwanda (KRS)
11. 60th Annual meeting of the APS Division of Fluid Dynamics, 18-20 November, Salt Lake City, USA (KRS)
12. Indian Academy of Sciences, Bangalore, 28 December (KRS)
13. Fluids Days, Engineering Mechanics Meeting, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, 31 December 2007-1 January 2008 (KRS)

Conferences held at ICTP

1. International Conference on Turbulent Mixing and Beyond, 18-26 August (JJN, KRS)
2. Advanced School on Lagrangian Techniques in Multiphase Flow, 5-7 September (KRS)

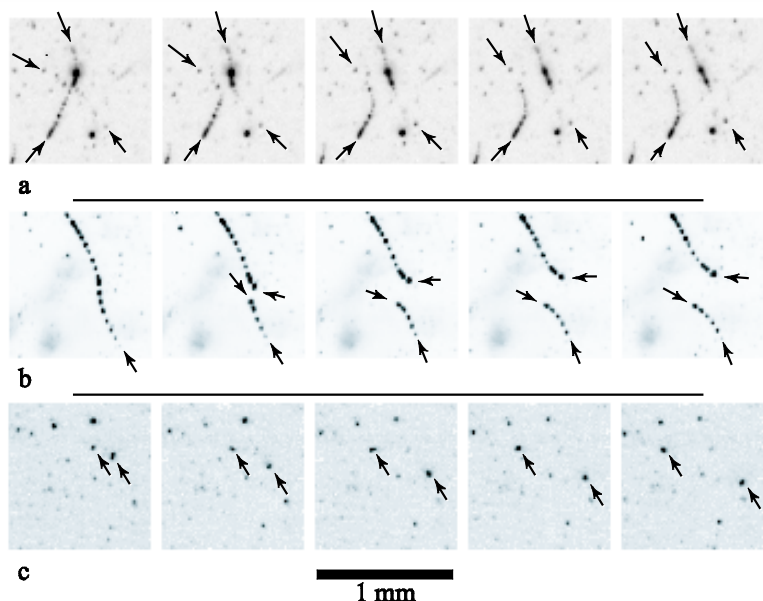
Teaching

1. Taught five lectures within the CISM Advanced School on “Vortices and Turbulence at Very Low Temperature”, July 2-7 2007 Udine, Italy (JJN)
2. Taught a course of Statistics and a course of Experimental Methods in the joint Ph.D. Program on Environmental Fluid Mechanics, University of Trieste (JJN)
3. Co-facilitator, laboratory training in UNESCO ALOP program in San Luis Potosi, Mexico, 5-11 December 2007. (JJN)
4. Taught a course on Instability and Turbulence in the joint Ph.D. Program on Environmental Fluid Mechanics, University of Trieste (KRS)

C3. Joint Ph.D. Programme in Environmental Fluid Mechanics

A new Ph.D. Programme in Fluid Dynamics has been running in Trieste under the joint responsibility of ICTP, the University of Trieste, OGS, CNR, OSMER and ISMER (the degree granted by the University). This program, the

Quantized vortex reconnections. Each series of frames in (a), (b) and (c) are images of hydrogen particles suspended in superfluid liquid helium, taken at 50 ms intervals. Some of the particles are trapped on quantized vortex cores, while others are randomly distributed in the fluid. Before reconnection, particles drift collectively with the background flow in a configuration similar to that shown in the first frames of (a), (b) and (c). Subsequent frames show reconnection as the sudden motion of a group of particles. In (a), both vortices participating in the reconnection have several particles along their cores. In (b), particles make only one vortex visible, the other vortex probably has not yet trapped any particles. In (c), we infer the existence of a pair of reconnecting vortices from the sudden motion of pairs of particles recoiling from each other.





first of its kind in Trieste, was in part the result of ICTP's initiative; it has generated new interactions among the fluid dynamicists in the institutions cited. Approximately five students have enrolled in the program each year in the past three years. The students have come in roughly equal numbers from Trieste and from other universities in Italy, with an occasional foreign student in the mix. It is expected that at least some students from the first batch will graduate in a year's time. A focal point of the program is the environment. This focus naturally links the fluid dynamics activities in Applied Physics with those in the Earth System Physics Section.

More details can be found on the website
<http://www.ictp.it/pages/education.html>

D. Plasma Physics

The Summer College on Plasma Physics was a four-week (30 July-24 August 2007) activity. There were more than 120 participants from more than 30 countries, many from developing countries. A considerable number of female students and lecturers were chosen from under-represented

countries.

The College dealt with both fundamental and applied aspects. During the first three weeks, the focus was the introduction of the fundamentals of collective processes that occur in magnetically and inertially confined fusion plasmas as well as in space and laboratory environments. Tutorial and rudimentary lectures were offered in the morning sessions, while in the afternoon the participants met in groups under team leaders to learn modern analytical and computational methods. Also introduced was a mini course on complex (dusty) plasma physics, giving priority to computer simulations and modern theoretical aspects. Young tutors from the industrialized and developing countries presented introductory simulation courses and exercises, and worked them out with students in classrooms. This mode of mentoring was beneficial to young researchers from developing countries.

Prominent faculty was drawn from Europe, India, Japan, Pakistan, and the US. Besides the College directors, several distinguished lectures including Roald Sagdeev, Chandrasekhar Joshi,



Photograph of participants in the programme on Plasma Physics held during the academic year 1965-66. This programme brought together experts from the East and the West and was hailed for the impetus that it produced on subsequent developments in the field (ICTP Photo Archives)



Chuan Liu, Stewart Prager, Zensho Yoshida, Jens Rasmussen and Lennart Stenflo participated in the College.

The fourth week of the College was devoted to a Symposium on New Aspects of Plasma Physics, on emerging areas such as plasmonics, quantum plasma physics, neutrino plasma physics, intense photon-photon and photon-plasma interactions, plasma-based charged particle-acceleration processes, dynamics of blobs and dust in fusion plasmas. The Symposium included both review and topical lectures. A poster session encouraged all participants to display their recent work. The Institute of Physics (UK) sponsored the best poster prize.

The College created successful and healthy scientific and social environments for exchanging and disseminating the cutting edge plasma science knowledge among the participants who came from both developing and industrialized worlds.

The plasma physics directors facilitate the visits of ICTP Associates at different laboratories and universities in Europe and in the US.

E. Biosciences

E1. Bioastronomy

The cosmic distribution of life still lacks solid theoretical or observational bases. Nevertheless, the question of distribution can be probed in terms of a wide range of planetary exploration missions especially dedicated to study whether or not we are alone in the universe, as for instance the Laplace Mission now in its planning stages.

The main space agencies have undertaken a sustained effort to search for biosignatures. The discoveries of the successful Galileo mission took place during its fourteen-year activity (1989-2003). Its Near-Infrared Mapping Spectrometer led to the discovery of a series of unexpected lines on the icy surface of the Jovian satellite Europa, due to patches of chemical element impurities.

The intriguing question is whether some of these new lines could be interpreted as biosignatures. The possibility remains an option for the future missions that are currently in their planning stages. (For an alternative suggestion for exploring biosignatures, see Fig. 1.)

In 2007 Chela-Flores discussed possible tests of the universality of biology by evaluating the relative roles that contingency and evolutionary convergence play on the Earth biota. The proposed test is feasible in terms of current technology. The work has been put into a wider perspective through continued collaboration with the Spanish philosopher Roberto Aretxaga, the Israeli microbiologist Joseph Seckbach, the Italian astronomers Giovanna Jerse and Mauro Messerotti, the Indian physicist Narendra Kumar, and Claudio Tuniz; the palaeontologists Nevio Pugliese (Italy), Maria Eugenia Montenegro (Venezuela)



Fig. 1: The hydrobot-cryobot technology, Horvath et al., (1997) (Courtesy of Jet Propulsion Laboratory) http://www.ictp.it/~chelaf/searching_for_ice.html



and Vinod Tewari (India) also played a role.

E2. Biophysics and Neurophysics

Biophysics is at present the subject of genuine interest for an appreciable number of ICTP Associates. This wave of renewed interest is partly due to advanced physical techniques that have allowed systematic study of all the main macromolecules of life, namely, proteins, nucleic acids such as DNA, and the macromolecules of the cell membrane, especially phospholipids that make up its corresponding bilipid layer.

Neuroscientists focus on the brain. In this area, physicists have approached computational aspects of neuron interactions. The hope has been to build computational models of biologically plausible artificial neural networks that can mimic certain aspects of the brain. Recent advances in determining the structure of molecules has given molecular biology a central role in the progress of molecular neuroscience.

Biophysics and neurophysics have developed at ICTP through a series of colleges and symposia in which many participants from the developing world and industrialized nations have been brought up to date in their areas of expertise.

E3. Participation in International Programmes and Meetings

1. The project "Fitness of the cosmos for life", sponsored by the John Templeton Foundation, was published in a multi-author book edited by John D. Barrow and colleagues.
2. Chela-Flores was selected in The LAPLACE Consortium as a Team Member of a proposal for a mission to Europa and the Jupiter System for ESA's Cosmic Vision Programme. The list of team members is available at: The LAPLACE Consortium: <http://www.ictp.it/~chelaf/ss164.html>.
3. Chela-Flores, J. Life habitability in the solar system: testing the universality of biology on

Europa with microprobes or landers", 18-21 April, Vienna, Austria.

4. Chela-Flores, J. Workshop on the Definition of a science-driven European scenario for space exploration, Athens, 15-16 May, dedicated to the setting of the scientific priorities for the European Space Agency (ESA) Exploration Programme at medium/long term.
5. M. Messerotti, G. Jerse, J. Chela-Flores (2007) Solar Weather and Life, COST 724 Meeting, Session, WG1, Sofia, Bulgaria 21-25 May.
6. Chela-Flores, J. Astrophysics and Astrobiology: A common search for our origins, Astrophysics Group, SISSA.

F. Medical Physics

The objective of the College on Medical Physics is to contribute to the development of competent medical physicists who can make direct contributions to the improvement of health care in their countries through better medical imaging diagnosis and proper and safe applications of radiation for diagnostic imaging purposes (Figs. 2 and 3).

There was no organized activity in the year 2007 on Medical Physics, as these events are biannual. (For 2008 the College is co-sponsored by ICTP and KFAS from 1-19 September 2008, directed by A. Benini, G.D. Frey, F. Milano, S. Tabakov. Director Emeritus: P. Sprawls. Its local organizer will be L. Bertocchi.) A corresponding activity was held in BARC in India, organized by the directors of the ICTP programme.

A number of Associate Members have visited the Centre during the year; for their research activities they have been put in contact with various research groups in Trieste (at the Trieste University, at ELETTRA, at the Trieste Hospital). Some of the scientists associated with the Medical Physics Programme presented seminars at ICTP.

1. *Radiobiological Models in Radiotherapy*. Arun Annappa Chougule, Department of Radiotherapy, S.M.S. Medical College and



Hospital, Jaipur, India, 9 May 2007.

2. *Techniques for the Analysis of Medical Image Quality: Cuban Experiences*. Marlen Perez Diaz, Central University "Marta Abreu" of Las Villas, Department of Physics, Santa Clara, Cuba, 16 August 2007.
3. *Patient Specific Dosimetry in the Local Radioimmunotherapy of Brain Tumours*. Leonel Alberto Torres Aroche, Centre For Clinical Research, Havana, Cuba, 6 September 2007.
4. *The Transport of Fallout CS-137 in the Soil*. Isaac Rotimi Ajayi, Department of Physics and Electronics, Adekunle Ajasin University, Akungba, Akoko, Ondo State, Nigeria, 31 October 2007.

G. Accelerator Mass Spectrometry

The science of Accelerator Mass Spectrometry (AMS) covers areas of interest to other ICTP programmes, including Earth Sciences, Medical Physics, Biophysics, Bioastronomy and the Multidisciplinary Laboratory.

G1. Research

AMS allows novel applications of long-lived radionuclides such as ^{14}C , ^{10}Be , ^{26}Al , ^{36}Cl , used as chronometers in palaeoclimate studies and cultural heritage, or as tracers in biomolecular medicine. The following joint projects are being scoped: analysis of long lived tracers with IAEA Marine Environmental Laboratories and ENEA; use of

the radiocarbon bomb pulse for dating human cells, with ICGEB and University of Caserta (see box), detection of uranium in the environment, in cooperation with the Department of Environmental Sciences, University of Caserta and IAEA. The network 'accelerators for sustainable development' is supported in Africa.

G2. Experimental

We are considering the development of collaborative programmes with the AMS Facilities of Caserta (University) and Florence (INFN and University). Access to these facilities by scientists from developing countries will be supported by the TRIL programme. An AMS service for groups in developing countries is being planned, in cooperation with the above facilities and the analytical laboratory GEOKARST in the Trieste AREA Science Park.

G3. Joint Programmes with IAEA

ICTP is providing scientific support to iThemba Laboratories in South Africa for the development of an AMS national programme based on the EN tandem accelerator in Johannesburg, presently upgraded with IAEA support.

The IAEA is supporting the Ghana Atomic Energy Commission for the acquisition of a tandetron accelerator. This facility will promote teaching and learning of nuclear physics and materials engineering research in Ghana. The main



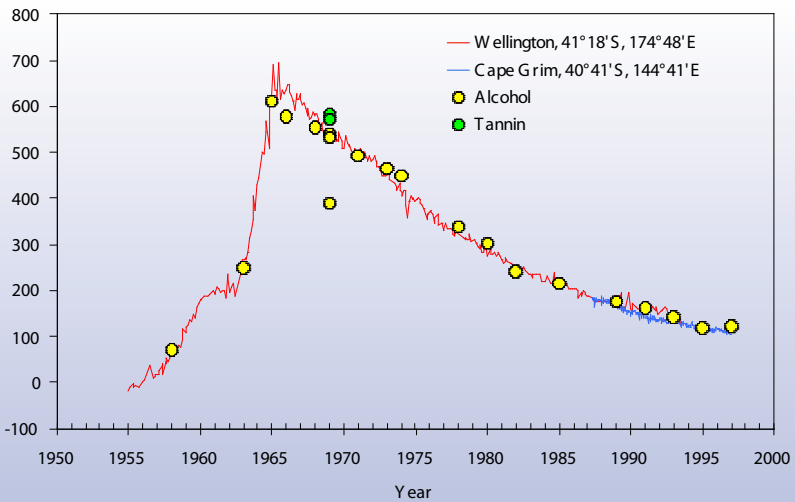
Fig. 2 (Courtesy Renata Longo)



Fig. 3 (Credit James Collins)



Wine dating using the radiocarbon bomb pulse and Accelerator Mass Spectrometry (Forensic applications of C-14 bomb-pulse dating, Zoppi, U, Skopec, Z, Skopec, J, C. Tuniz et al., Nuc. Instr. and Methods B 223: 770-775, 2004). An ICTP/ICGEP project is being developed to use this method for dating human cells at the AMS facility at the University of Caserta.



focus will be in national priority areas such as food and agriculture, human health, environmental studies and preservation of Ghanaian art works. ICTP is providing scientific advice to develop a national programme in collaboration with other tertiary and research institutions.

G4. Conferences, Workshops and Seminars

1. Workshop on Biomedical Applications of High Energy Ion Beams, ICTP, 12-16 February 2007.
2. X-Ray Emission Techniques for Forensic Applications, ICTP, 28 May - 1 June, 2007.
3. School of Nuclear Knowledge Management, ICTP, 24-28 September, 2007.
4. School on Pulsed Neutrons: Characterization of Materials, ICTP, 15-26 October, 2007.
5. Workshop on Understanding and Evaluating Radioanalytical Measurement Uncertainty (5-16 November) plus Fourth Coordination Meeting of the IAEA ALMERA Network (5-7 November), ICTP, 2007.
6. Workshop on Nuclear Data for Science and Technology: Medical Applications, ICTP, 12-23 November, 2007.
7. School on Physics, Technology and Applications of Accelerator Driven Systems (ADS), ICTP, 19-30 November 2007. International Conference

on Science for Cultural Heritage, 28-31 August, Losinj, Croatia.

8. International Conference on Accelerator Mass Spectrometry. Directors: F. Terrasi (University of Naples), L. Calcagnile (University of Lecce), P. Mandò (University of Florence) and C. Tuniz (ICTP), 2008, Rome.
9. Science for cultural heritage, International Meeting on Science and Technology for Cultural Heritage, La Habana, Cuba, 7-10 February 2007.
10. Accelerator Mass Spectrometry: Technical Developments and Recent Applications, International Conference on Ion Beam Analysis, 23-28 September, Hyderabad, India, 2007.
11. Nuclear Physics and Environment, 15 April, University of Damascus, Syria, 2007.
12. Human dispersals and impacts during the Pleistocene, International Conference on Science for Cultural Heritage, 28-31 August, Losinj, Croatia.

H. Optics and Laser Physics

The activity on Optical Physics includes an annual Winter College, every year on a different topic from Nonlinear Optics to Laser Spectroscopy to Quantum Optics and Photonics. The



programmes on optics avail of the long-standing collaboration of the International Commission on Optics (ICO), the Optical Society of America (OSA), the Society of Optical Engineers (SPIE), the International Society on Optics Within Life Sciences (OWLS), the European Optical Society (EOS) and other International organizations.

H1. Research and Collaborations

Applications of femtosecond lasers to free electron lasers

The laboratory is heavily involved in the development of the ultrafast laser systems for the Fermi@Elettra project. FERMI is a project for a seeded FEL facility at ELETTRA including several state-of-the-art laser systems. It includes the use of several modern laser systems. These will be based on commercially available oscillator and amplifier units, which will be further developed and upgraded in the laboratory.

Physics and applications of short pulse laser

Work on Microchip and Raman Lasers is being carried out in collaboration with the Institute of Physics, Minsk, and includes the following main directions: diode pumped microchip lasers; Raman conversion of laser radiation in solid state systems; continuous wave Raman generation in solid state laser systems.

The development of low cost ultrafast lasers is supported by ICTP and ICS. Applications include: time-resolved laser-synchrotron light measurements; UV Laser induced DNA-protein cross-linking (in collaboration with ICGEB); laser tweezers and manipulation of biological objects (participation in a work headed by LILIT (TASC-INFM).

Diagnostics of VUV and soft x-ray light pulses

This new research line is motivated by the need to have on-line diagnostic tools for laser pulses at wavelengths below 180 nm, delivered by the ELETTRA storage ring FEL and its harmonics,

as well as for the FERMI FEL radiation (100-10 nm range) and its harmonics (10-3 nm). The initial effort will be on the measurements of pulses with wavelengths in the 120-200 nm range, where some recently developed nonlinear crystals can be used. In parallel, the shorter wavelength range will also be considered, with particular attention to methods allowing higher sensitivity and single shot pulse measurements. The work will be partially supported by an EU project, as well as by the FERMI experimental task. STEP applications on the subject are encouraged. The development of low cost ultrafast lasers (solid state and fiber) has been jointly supported by ICTP, ICS and ELETTRA.

H2. Training Activities

A preparatory School to the Winter College on Fibre Optics, Fibre Lasers and Sensors (5-9 February 2007) was held during the week before the Winter College on Fibre Optics, Fibre Lasers and Sensors (12-23 February 2007). Some 50 participants of the Winter College were invited to attend the School. The School covered several mathematical tools relevant to understanding the lectures to be presented during the College. Each topic was presented in lectures and exercise sessions.



At the Winter College in 2006, SPIE Executive Director Eugene Arthurs presented the SPIE Educator Award to Gallieno Denardo



The Winter College on Fibre Optics, Fibre Lasers and Sensors was held from 12-23 February 2007. The main topics were: Fundamentals of fibre lasers and amplifiers; Spectroscopy of rare-earth-doped glasses; High-power fibre lasers and amplifiers; Ultrashort pulse fibre sources; Fibre sensors – Introduction and basic principles; Fibre sensors – Different architectures and applications; Optical fibre telecommunications; Photonic crystal (or microstructured) fibres – Theory and applications; Nonlinear effects in optical fibres and applications; Passive fibre components and integration; Fibre Bragg gratings – Theory, fabrication and applications.

The purpose of the College was to expose the participants to the scientific issues that are driving the progress of fibre lasers and modern fibre optics. The programme consisted of lectures by international experts as well as group discussions. The aim was to provide the background needed to follow the most advanced literature. More than 100 participants from 40 countries attended the College.

The preparatory School and the College were organized in collaboration with the International Commission for Optics (ICO), the Optical Society of America (OSA), the International Society for Optical Engineering (SPIE) and International Society on Optics Within Life Sciences (OWLS), the Società Italiana di Ottica e Fotonica (SIOF). The participants from Eastern European countries were supported by the Central European Initiative (CEI).

The ICTP-ICO Prize for the year 2007 has been awarded to Dr. Svetlana V. Boriskina from the School of Radiophysics, V. Karazin Kharkov National University, Kharkov, Ukraine. In 2008, the award has been renamed the ICO/ICTP Gallieno Denardo Award in honor of Professor Gallieno Denardo who passed away in July 2007.

Since August, Joseph Niemela of the Fluid Dynamics Group has taken over coordination of the Optics and Laser activities.

Co-supervision of 8 STEP fellows: at present the laboratory hosts for 3 months a year 4 STEP fellows from Belarus, one each from Ukraine, Senegal, India, and Tunisia.

Laboratory for laser and optical fibers (LFO)

The Laboratory is situated at the Synchrotron Light Facility-ELETTRA in Trieste. The close link with the ICTP is, however, kept through the ICTP Associates and STEP fellows, who may work in the laboratory, and through the annual ICTP Winter Colleges on Optics in which the laboratory is involved as organizer of demonstrations and experimental sessions.

The main activities of the lab are:

1. Training which include demonstrations and exercises during the ICTP Winter Colleges; hosts ICTP Associates and IAEA, ICTP and CEI STEP fellows working on optics.
2. Research lines which include applications of femtosecond lasers to free electron laser development; physics and applications of short pulse lasers; diagnostics of VUV and soft x-ray light pulses.

I. Energy Systems

In preparation to the G8-UNESCO Forum on “Education, Research and Innovation” held in May 2007, G. Furlan and A. Sayigh (WREN-UK) organized a 3-day (15-18 January) meeting of top experts on “Science and Technology of Renewable Energies”.

Thirty one participants from all over the world contributed to the lively sessions covering almost all aspects of the field, from Wave Energy to Fuel Cells, the focus being mainly on Solar Energy conversion. In



particular recent research avenues and perspectives were described for production of electricity via direct photovoltaic conversion and via high temperature thermal processes. As a conclusion a declaration, called “Adriatico declaration”, was prepared and communicated to the ICTP Director for discussion in the World Forum.

In addition, on the training side the ICTP-TRIL programme awarded a few fellowships in “Renewable Energies” and issued an announcement on “Science for Cultural Heritage” as a follow up to the Workshop on the subject held at the ICTP in 2006.

TRIL Programme scientists and Associate Members contributed to the series of the seminars of the Applied Physics Scientific Section:

1. *Medical Physics in Sudan*, Omer Abdul Aziz Ali, M-Lab, ICTP, Trieste, 23 May 2007 (TRIL Programme)
2. *Use of Solar Energy to Save Conventional Fuels and Disasters for our Environment*, Shyam S. Nandwani, Universidad Nacional Heredia, Costa Rica, 11 July, 2007 (Senior Associate, Non-Conventional Energies)
3. *Solar Air Heaters: Is It Possible to Use Artificial Neural Networks for New Models?* René

Tchinda, University Institute of Technology
 Fotso Victor, University of Dschang, Republic of Cameroon, 19 September 2007 (Regular Associate, Non-Conventional Energies)

Staff and Visitors

Research scientists

- J.J. Niemela (USA)
- K.R. Sreenivasan (USA/India)
- Claudio Tuniz (Australia/Italy)

Staff associates

- Julian Chela-Flores (República Bolivariana de Venezuela)
- Sandro M. Radicella (Italy/Argentina)

Consultants

- Luciano Bertocchi (Italy)
- Pierdavide Coisson (Italy)
- Miltcho Danailov (Bulgaria/Italy)
- (Late) Gallieno Denardo (Italy)
- Carlo Fonda (Italy)
- Giuseppe Furlan (Italy)
- Bruno Nava (Italy)
- Marco Zennaro (Italy)



1978: Solar Energy



Coordinators for plasma physics College

Swadesh M. Mahajan (USA)
Padma Kant Shukla (Germany)

Post-doctoral fellows

Simon Babuin (Italy)
Sameen Abdulvahab (India)

Associates

Emmanuel Temitope Akintayo (Nigeria)
Jonathan Oyebamiji Babalola (Nigeria)
Udensi Maduauchi Igwebuikwe (Nigeria)
Kamaluddin (India)
Aurel Popescu (Romania)
Vinod C. Tewari (India)

TRIL fellows

Eddula Maheshwar Reddy (India)

Short-term visitors

Snezhana Abarzhi (USA)
Robert Antonia (Australia)
Alexander Bershadskii (Israel)
Luminita Danaila (France)
Mohammed Emran (Bangladesh)

Joerg Schumacher (Germany)
Bimsen Shivamoggi (USA)
Roberto Verzicco (Italy)

Ph.D. students

Xsitaaz Twinkle Chadee (Trinidad and Tobago, STEP student)
K. Alazo Cuartas (Cuba, STEP student)
Marcelline Essoun (Benin, STEP student)
Olawayomi Faromika (Nigeria, STEP student)
Mubashra Hameed (Pakistan, with A. Ferrari, University of Torino)
Kaveri Joshi, Department of Physics, University of Maryland (with D.P. Lathrop)
Margarita Kuqali (Albania, STEP student)
O.A. Oladipo (Nigeria, STEP student)
Gabriella Silano (University of Trieste, with R. Verzicco)
Valentina Stocca (University of Trieste, with V. Armenio)
Vicky Taffoti Yolong (Cameroon, STEP student)

High school student (United World College of the Adriatic)

Atanas Petkov (Bulgaria)



Condensed Matter and Statistical Physics (CMSP)

<u>MESOSCOPIC AND STRONGLY CORRELATED ELECTRON SYSTEMS</u>	<u>STATISTICAL MECHANICS AND APPLICATIONS</u>	<u>ELECTRONIC STRUCTURE AND CONDENSED MATTER COMPUTER SIMULATIONS</u>	<u>SYNCHROTRON RADIATION RELATED THEORY</u>
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ABOUT THE SECTION

Condensed matter physics, which deals with the macroscopic physical properties of matter with many constituents that are strongly interacting, is perhaps the largest branch of contemporary physics. The most familiar examples of condensed phases are liquids and solids; indeed, condensed matter physics grew out of solid-state physics. More specialized condensed phases include superfluids, Bose-Einstein condensates, superconductors, ferromagnetic and antiferromagnetic materials.

The Condensed Matter section was created as a separate unit in 1974; this act embraced a larger definition of Theoretical Physics than had been implied, though perhaps subliminally, for some ten years since the creation of the Centre. Presently this section is active in research on mesoscopic and strongly correlated electron systems, electron structure and computer simulations, and related subjects. Many of the concepts and methods used in large areas of condensed matter physics are common to the field, and have at their core some elements of statistical and nonlinear physics. It is in recognition of this facet that the section houses a significant component of research on statistical physics (which, however, also deals with aspects outside of condensed matter). Another area of theoretical research is the relation between the synchrotron radiation and matter. Much of the training activity on synchrotron radiation occurs in cooperation with the facility at ELETTRA.

The permanent staff of this Section consists of 8 staff members. The new staff members, Professor N. Binggeli and Professor M. Kiselev joined in January 2007. However, one of the staff members, Professor S. Franz, moved to University of Paris at Orsay as of September 1, 2007.

The total number of postdoctoral fellows and long-term (> 3 months) visiting scientists in 2007 was 31; 15 of them were nationals of developing countries and 4 were nationals of Eastern European countries. The total number of months spent at ICTP by this category of scientists was about 270 so that the average number of visiting staff at a given time was about 23, essentially the same as in 2006.

In addition, 209 scientists (122 of them from developing countries, including 25 scientists from Africa, 39 from East European countries and 48 from developed countries) made short (< 3 months) visits in 2007 and took part in our research activities. These numbers are considerably larger than those in 2006 (158 short-term visits), mainly because of increasing number of scientists from developing countries (93 in 2006), in particular from Africa.

An active part in the research and training activities has been also taken by 5 consultants and 4 staff associates. As of October 1, 2007 a new scientific consultant, Professor G. Mussardo (SISSA), started to actively work in the area of statistical physics. On the other hand, two long-term visiting scientists who spent several years with us, Dr. O. Yevtushenko and Dr. B.N. Narozhny moved to Munich and Paris, respectively.



The scientific activities of the section follow four major directions:

1. Mesoscopic and Strongly Correlated Electron Systems

This direction was represented by the activities of the staff members V.E. Kravtsov and M.N. Kiselev; a staff associate A.A. Nersesyan, a tenure-track visiting scientist B.N. Narozhny; long-term visiting scientist O.M. Yevtushenko; consultants: B.L. Altshuler, M. Fabrizio, G. Santoro, E. Tosatti and a number of post-doctoral fellows.

2. Statistical Mechanics and Applications

This direction was represented by the activities of the staff members: S. Franz, M. Marsili, R. Zecchina, the new consultant G. Mussardo and a number of postdoctoral fellows.

3. Electronic Structure and Condensed Matter Computer Simulations

This direction was represented by the activities of the staff members: R. Gebauer, S. Scandolo; consultants E. Tosatti, G. Santoro and a number of postdoctoral fellows.

4. Synchrotron Radiation Related Theory

The aim of the group is to perform theoretical research and training in areas of condensed matter physics that are experimentally investigated by synchrotron radiation (SR). There is close collaboration with experimentalists at the nearby SR source ELETTRA and at other similar facilities.

Within the relatively large scope of problems that fall under this description, the group has two main focuses of activities. The first field of activities is the investigation of the electronic, magnetic, and structural properties of systems with strong electron correlations, including transition-metal oxides and related materials. The second, more recent, area of interest is the physics of low-dimensional systems and nanostructures.

5. Other scientific directions

In addition there was an activity on Physics of Friction (E. Tosatti and G. Santoro).

Research Activities

Publications

The research activities along the above directions resulted in 73 publications in the major peer-reviewed journals in 2007. They include 1 paper published in Science, 2 papers published in Nature and Nature Materials, 7 papers published in The Physical Review Letters, 5 in Europhys. Letters, 16 in The Physical Review.

Seminars

The intensity and diversity of scientific life inside the group is illustrated by the number and subjects of research seminars: seminars on Disorder and Strongly Correlated Systems (32 in 2007); Chemical Physics seminars (3). A new Joint ICTP-SISSA seminar on Statistical Physics has been established and regularly held on the weekly basis (16 seminars in 2007) thanks to an initiative of Professor G. Mussardo and Dr. A. Silva. In addition there were 9 Joint ICTP-SISSA Condensed Matter Seminars and 4 presentations during Associates' Meetings.

New Research Results

1. Mesoscopic and strongly correlated electron systems

a. Exotic magnetic properties of spin ladders and organic bi-radical crystals. (M.N. Kiselev)

A new spin-ladder model is suggested to describe exotic magnetic properties of certain class of organic quasi-one dimensional crystals. The magnetic order phase diagram of this model and spin excitations in it are studied at different filling factors.

b. Unsolved problem of one-dimensional Anderson localization: Eigenfunction statistics in the centre of the band. (V.E. Kravtsov, V.I. Yudson).

A long-standing unsolved problem of the simplest model of Anderson localization in one



dimension is the eigenfunction statistics at the centre of the band. From the exact integral equation for the generating function the differential transfer-matrix equation was obtained which appears to have an anomalous form at the band centre as well as at all energies which correspond to the Bragg resonance without disorder. The zero mode variant of this equation was shown to be exactly integrable and the unique solution for the generating function in the infinite chain was obtained which can be used to compute the anomalous eigenfunction statistics in the center of the band.

c. Multifractal metals and insulators (V.E. Kravtsov)

A comprehensive study of the statistics of critical and off-critical states in the three-dimensional Anderson model and certain random matrix ensembles enables to conclude that the multifractal features of critical wavefunctions at the mobility edge persist well above and well below the Anderson transition. The corresponding metallic and insulating phases are called “multifractal metal” and “multifractal insulator” and are characterized by specific eigenfunction correlations. Based on these results a cartoon of typical wavefunctions is suggested which consists of domains of a certain size x where the wavefunction is similar to the critical one, arranged in a mosaic structure in a multifractal metal and in a single-domain structure in the multifractal insulator. (see appended picture, Fig. 1, chosen for display at the new web site prb.aps.org of the Physical Review B).

2. Statistical mechanics and applications

a. Sociology from the statistical mechanics viewpoint (M. Marsili, S. Franz, L. Dall’Asta)

The Schelling model, which has been proposed by economists in order to explain the origin of social segregation, was analysed from the statistical mechanics point of view with the goal to find universality classes of statistical behaviour. A simple indicator was proposed to distinguish the effects of segregation and the simple homophily in empirical data by analysing the statistics as a function of the system size. This line of research aims at the general understanding of the origin of segregation in dynamical social networks.

b. New algorithms in statistical physics and optimization (R. Zecchina, A. Ramezanpour, L. Dall’Asta)

The new statistical physics algorithms were suggested for problems with global constraints (e.g. the Traveling Salesman Problem) and for the network optimization problems (the Steiner and the spanning tree problems). A connection was found between the Cavity method which was behind of many of these algorithms, and Linear Programming.

3. Electronic structure and computer simulations

a. Stabilizing “carbonia” at low pressure. (S. Scandolo, J.A. Montoya, R. Rousseau)

A recent discovery (by an experimental group in the University of Florence) of “carbonia”, an amorphous, non-molecular

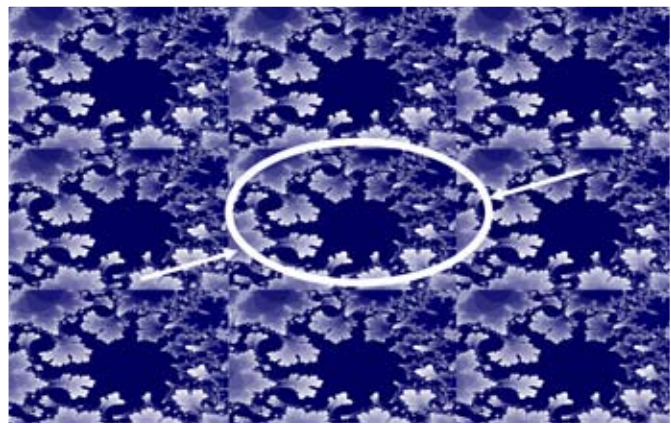


Fig. 1: Cartoon of a multifractal metal: the darker regions correspond to higher wavefunction amplitude; inside the white circle is the multifractal domain



form of CO_2 produced under pressure and believed to be similar to silica glass (SiO_2), provoked a quest for a proper theoretical model and suggestions how to stabilize this unusual phase at an ambient pressure. The model based on ab-initio molecular dynamic simulations and a comparison between theoretical and experimental vibrational spectra, consists of a mixture of carbon atoms in three and four-fold coordination with oxygen. An important extension of the model by chemical doping with transition metal impurities is proposed in this work. The simulations based on this model show that the transition to the non-molecular phase occurs at a pressure (12 GPa) much lower than that for the pure CO_2 (40 GPa), thus demonstrating that adding of transition metal impurities is a right route towards stabilizing carbonia at ambient pressure (see Fig. 2).

b. Novel Lanczos-based time-dependent density functional theory approach (R. Gebauer)

A new computational approach to the direct calculation of optical spectra within the framework of the time-dependent density functional theory was developed and applied to multi-atomic systems (150-200 atoms), including the biological molecules. The new method, which is based on a new non-Hermitian Lanczos algorithm, allows one to perform planewave-pseudopotential based calculations in rather large systems and over a broad spectral range.

The method was successfully applied to calculation of optical spectra of the chlorophyll-a molecule and to an interfacial photoinduced charge transfer in a semiconductor-dye system.

c. Oxygen packing in compressed silica (S. Scandolo, Y. Liang, C. Miranda)

It is shown that the pressure-induced transformation of SiO_2 from low pressure tetrahedral phases into denser octahedral phases takes place via the collapse of the oxygen sub-lattice into a close-packed arrangement. Upon the tuning of the hydrostatic stress new phases with close-packed oxygen sub-lattices are predicted, e.g. the phases with a cubic close packing, not seen in experiment yet.

4. Synchrotron radiation related theory

a. Combined pseudopotential and dynamical-mean-field-theory approach to address the structural and electronic properties of strongly correlated materials

The properties of transition-metal oxides and related strongly-correlated materials are known to be controlled by a complex interplay between electronic and structural degrees of freedom. The group is developing a method aimed at determining, within the dynamical-mean-field-theory (DMFT) framework, the structural properties and lattice relaxations of correlated materials together with their electronic properties. The new scheme is based on a joint implementation of DMFT with the pseudopotential plane-wave local-density-functional formalist via a Wannier-function representation. I. Leonov, G. Trimarchi (now at NREL, Golden), and N. Binggeli, in collaboration with colleagues in Russia, have implemented and successfully applied this scheme to the study of the electronic properties of paramagnetic V_2O_3 and NiO as well as to the study of the Jahn-Teller relaxation and orbital ordering in paramagnetic KCuF_3 .

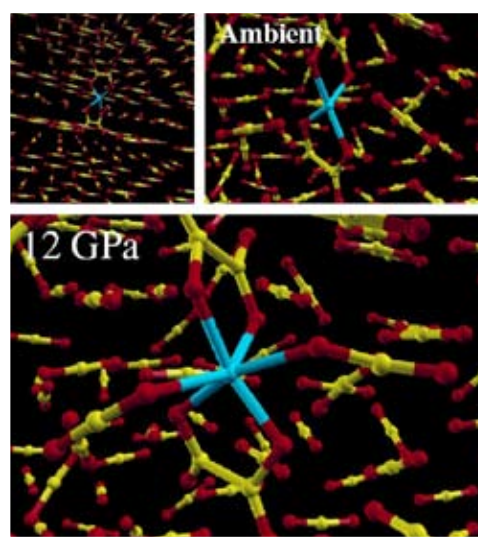


Fig. 2: Molecular crystal of CO_2 and carbonia stabilized by the transition metal impurity (shown in blue)



b. Electronic and magnetic properties of manganite-based heterostructures

B. Zheng and N. Binggeli have investigated the electronic and magnetic properties of $\text{La}_{2/3}\text{Sr}_{1/3}\text{MnO}_3/\text{SrTiO}_3(001)$ heterojunctions and provided theoretical support to experimental activities on such systems at the ELETTRA and TASC Laboratories in Trieste. The study, based on ab initio calculations, aimed at clarifying the effect of the interface atomic structure on the magnetic profile in the junctions. In particular, the study showed a drastic influence of the $\text{La}_{2/3}\text{Sr}_{1/3}\text{MnO}_3(001)$ atomic-layer termination at the interface on the magnetic profile, in abrupt junctions.

c. Electronic and structural properties of semiconductor nanowires

The properties of intrinsic and Si-doped GaAs nanowires have been investigated by means of ab initio calculations (N. Binggeli, in collaboration with N. Ghaderi (Democritos and Isfahan University of Technology, Iran) and M. Peressi (University of Trieste and Democritos). The study showed that, in contrast to the bulk phase, wurzite GaAs nanowires are more stable than zinc-blende GaAs nanowires, up to diameters of about 50\AA . The study of the defect formation energy also indicated an amphoteric behaviour of Si in the nanowires, with the lowest-energy configuration corresponding to the Si donor/acceptor impurity close to the nanowire surface.

5. Physics of friction

It is shown by molecular dynamics simulations that when the diamond tip penetrates the non-melting surface of NaCl and ploughs through the surface, the friction forces decrease when approaching the melting point. However, they increase when a flat tip merely grazes the surface. It is likely that such a

Computational Physics Community Meets at ICTP

More than 250 participants and over 50 speakers came together for the "13th International Workshop on Computational Physics and Materials Science" from all over the world to Trieste last January. This "Total Energy" conference, as the event is known in the community, was the latest instalment of a series of workshops, which started in Oxford, U.K. in 1983, continued in Braunschweig, Germany in 1984, and has been held in Trieste every two years since 1987.

While the early workshops were small with a few pioneers in the still young field of scientific computations, the "Total Energy" conference has since then grown to one of the most important gatherings of the fast growing community in this field.

The "Total Energy" workshop, which was organized by ICTP and co-sponsored by SISSA and the DEMOCRITOS National Simulation Center as well as the European ESF/Psi-K network, exemplifies the key role which Trieste's scientific institutions play in the field of scientific computing. Trieste not only hosts one of Europe's biggest conference series on computational physics, but also contributes very actively to the research in this field. ICTP, SISSA, the University of Trieste and the ELETTRA synchrotron radiation facility all have research groups dedicated to scientific computations in materials science.

One of the most important contributions from Trieste in this field of research is the so-called Car-Parrinello approach to molecular dynamics. This method, developed by Roberto Car and Michele Parrinello in 1985, allows for the precise simulation of materials properties without resorting to empirical parameters.

On the occasion of Roberto Car's 60th birthday, ICTP hosted a special symposium in June, recognizing Car's important scientific contributions in the field. That symposium, which had more than 90 participants, brought for the second time in 2007 many of the world's leading computational scientists to Trieste.

Ralph Gebauer



vanishing-friction “skating” is possible also on top of metal surfaces with obvious important applications for auto-aerospace engines (see Fig. 3).

Participation in International Programmes

The group members are involved in a number of international scientific projects/networks:

1. EC project GENNETEC (STREP)

GENetic NETwork: Emergence and Complexity (R. Zecchina)

2. EC project EVERGROW

Ever-growing global scale-free networks, their provisioning, repair and unique function (R. Zecchina)

3. EC project COMPLEXMARKETS (STREP)

Financial markets and complexity: Uncertainty, heterogeneous micro agents and aggregate outcomes (M. Marsili)

4. EC Marie Curie Outgoing Fellowship (V.E. Kravtsov, A. Garcia-Garcia)

5. CNR grant in context of ESF project “EuroMinSci” (S. Scandolo)

6. Support from CNR-INFM Democritos Center for two PhD fellowships (S. Scandolo)

7. I2CAM program (V.E. Kravtsov, M. Kiselev, S. Scandolo)

Training Activities

The training activities in 2007 included 12 Schools and Conferences. In all of them members of CMSP Group acted as Directors or Local organizers.

Activities held at ICTP

1. 13th International Workshop on Computational Physics and Materials Science: Total Energy and Force Methods; Organizers: N. Marzari, P.J. Ordejon, S. Scandolo, 10 April - 20 April

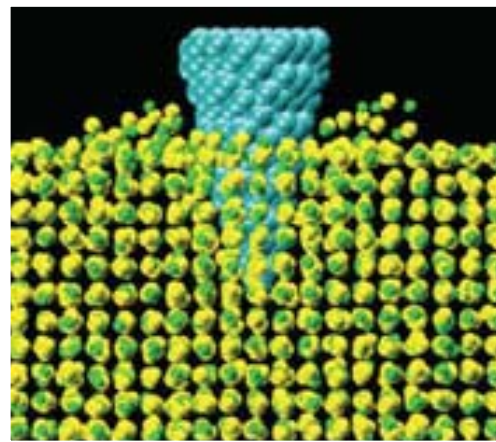


Fig.3: Diamond tip ploughing in NaCl

2. Spring College on Water in Physics, Chemistry and Biology; Organizers: M.L. Klein, D.D. Klug, G. Scoles. ICTP Local Organizer: S. Scandolo, 20 April - 21 April
3. Workshop on Statistical Physics and Financial Markets; Organizers: M. Marsili, A. Kirman, C. Hommes, T. Lux, M. Marchesi, M. Salmon, 4 June - 8 June
4. Conference on Quantum Phenomena in Confined Dimensions; Directors: V. Falko, J. Meyer, A. Millis; Local Organizer: B. Narozhny, 4 June - 8 June
5. Conference on Structure and Dynamics in Soft Matter and Biomolecules: From Single Molecules to Ensembles; Organizers: Hue-Sun Chan, C. Micheletti, M. Thorpe, 2 July - 6 July
6. Common Concepts in Statistical Physics and Computer Science; Organizers: S. Franz, M. Marsili, R. Zecchina, A. Montanari, G. Parisi, F. Ricci-Tersenghi, 16 July - 27 July
7. Conference and Research Workshop: Perspectives on Nonlinear Dynamics (Satellite Meeting of STATPHYS 23); Organizers: R. Ramaswamy, N. Gupte, M. Marsili, 30 July - 17 August
8. School and Workshop on Highly Frustrated Magnets and Strongly Correlated Systems: From Non-Perturbative Approaches to Experiments; Organizers: F. Becca, F. Essler, F. Mila, S. Shastry,



A. Tselvik, 27 August - 7 September

9. Summer School on Novel Quantum Phases and Non-equilibrium Phenomena in Cold Atomic Gases; Organizers: M. Cazalilla, J.M.F. Gunn, A.F.C.K. Ho, W. Zwerger

Activities held outside Trieste

1. 5-15 February, Second Latin-American School and Conference on Statistical Physics and Interdisciplinary Applications (Bento Gonçalves - Brazil); Organizers: J.J. Arenzon, D.A. Stariolo, M.C. Barbosa, S. Franz, M. Marsili and R. Zecchina
2. 5-16 November, School on Computational Condensed Matter Physics (Abuja - Nigeria); Organizers: S. Scandolo, G.A. Adebayo, local organizer: J.O. Daniel
3. 9-30 November, African Regional College on Science at the Nanoscale (Cape Town - South Africa); Organizers: A.C. Beye, M. Maaza, R. Gebauer, G. Scoles

Six staff members (R. Gebauer, S. Franz, M. Kiselev, M. Marsili, S. Scandolo, R. Zecchina), 1

consultant (G. Santoro) and 3 long-term visiting scientists (B. Narozhny, O. Yevtushenko, M. Sellitto) and 6 postdoctoral fellows (G. Bianconi, J.K. Christie, L. Dall'Asta, F. Franchini, A. Silva, M. Verissimo Alves) took part in teaching and tutoring in the ICTP Diploma Programme and the Joint ICTP-SISSA Ph.D. Programme on Statistical Physics.

Some staff members have been invited to teach at internationally recognized Schools:

1. R. Gebauer - Regional College on Science at the Nanoscale (Cape Town, S. Africa)
2. V.E. Kravtsov – 4th Windsor Summer School in Condensed Matter Theory (Windsor Palace, London, UK); School on Nanophysics at Low Temperatures (Chernogolovka, Russia)
3. S. Scandolo – School on Simulation and Modelling Physics (Hanoi, Vietnam), 11-13 January

Formal Community Recognition

1. M. Marsili became a member of Editorial Board of JSTAT, Eur. Phys. Journal B, and Physical Review E

NADIA BINGGELI

Professor Binggeli joined the scientific staff of ICTP, as a research scientist and coordinator of the synchrotron-radiation theory group and ICTP-ELETTRA collaboration. She received her undergraduate and doctoral degrees in physics from the Ecole Polytechnique Fédérale de Lausanne (EPFL) in Switzerland. She held postdoctoral positions at the University of Minnesota and Minnesota Supercomputer Institute in Minneapolis, USA. She subsequently became a staff scientist with the Institut Romand de Recherche Numérique en Physique des Matériaux (IRRMA) in Switzerland, was a visiting scientist in the ICTP Condensed Matter Physics group in 2001-06, and an ICTP scientific consultant in 2006-07. Nadia Binggeli's major research interests are in the development of computational methods to address the fundamental properties of materials and predict the result of the interaction with synchrotron radiation of spintronic materials, transition-metal oxides, and nanostructures. Professor Binggeli coordinates joint activities with ELETTRA and is also responsible for the Sandwich Ph.D. Programme supported in part by IAEA and UNESCO.



**MIKHAIL KISELEV**

Professor Kiselev has joined the scientific staff of ICTP's Condensed Matter and Statistical Physics group. Mikhail, born in Moscow, was graduated in Moscow Engineering Physics Institute (Technical University). He earned his Ph.D. in the Russian Research Centre "Kurchatov Institute" in 1995. After two years of postdoctoral position in CEA-Saclay (France) he joined the Institute for Theoretical Physics, Würzburg University (Germany) as a Humboldt Fellow. Mikhail got his Habilitation in theoretical physics in Germany in 2003 and was appointed as a Privatdozent (lecturer) in Würzburg University. After spending a year as a visiting professor in Ludwig-Maximilians University, Munich in 2004 he returned to Würzburg to assume a Heisenberg Fellowship which he held until his recent appointment as staff researcher at ICTP. Professor Kiselev's major fields of interest are in physics of strongly correlated systems (heavy fermions, high-temperature superconductors, polymeric magnets) and low-dimensional spin structures. He also conducts studies of transport through the nanosystems (quantum dots, wires etc.) with an emphasis on strong electronic correlations, non-equilibrium phenomena and quantum magnetism in nanostructures.



2. Plenary lectures: S. Scandolo, 1st EuroMinSci Conference, (La Colle-sur-Loup, France, 26-29 March 2007)

Scientific Staff and Long-Term VisitorsScientific staff

- N. Binggeli (Switzerland)
S. Franz (Italy)
R. Gebauer (Germany)
M. Kiselev (Russian Fed.)
V.E. Kravtsov (Russian Fed.), head
M. Marsili (Italy)
S. Scandolo (Italy)
R. Zecchina (Italy)

Consultants

- B.L. Altshuler (USA)
M. Fabrizio (Italy)
G. Mussardo (Italy, as of 1 Oct. 2007)
G. Santoro (Italy)
E. Tosatti (Italy)

Staff associates

- N. Kumar (India)
A.A. Nersesyan (Georgia)
Yu Lu (P.R. China)
V.I. Yudson (Russian Fed.)

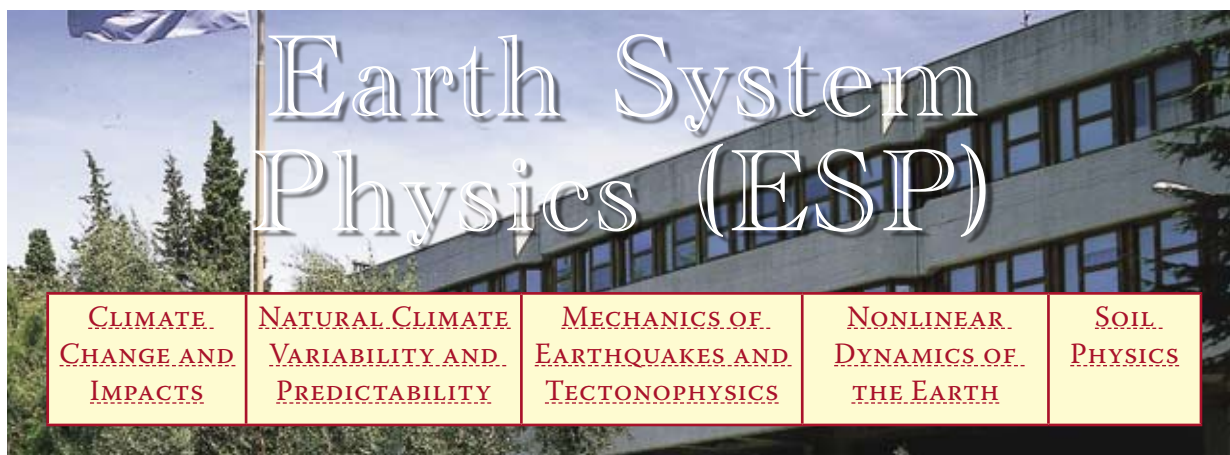
Long-term visiting scientists

- B.N. Narozhny (Russian Fed.)
O.M. Yevtushenko (Ukraine)

Post-Docs and Long-Term Visitors

- G.A. Adebayo (Nigeria)
G. Bianconi (Italy)
A. Chatterjee (India)
J.K. Christie (UK)
L. Dall'Asta (Italy)
L. De Sanctis (Italy)
O.V. Dimitrova (Bulgaria)
F. Franchini (Italy)
T. Galla (Germany)
A.M. Garcia Garcia (Spain)
P. Ghosh (India)
L. Giacomazzi (Italy)

- S. Lal (India)
M.-S. Lee (Korea)
I. Leonov (Russian Fed.)
Liang Yunfeng (P.R. China)
A. Maleki (Iran)
J.A. Montoya Martinez (Colombia)
T.K.T. Nguyen (Vietnam)
P. Pin (Italy)
A. Ramezanzpour (Iran)
R. Rousseau (Canada)
N. Sekkal (Algeria)
M. Sellitto (Italy)
A. Silva (Italy)
A. Smogunov (Russian Fed.)
N. Surendran (India)
M. Verissimo Alves (Brazil)
Bing Zheng (P.R. China)



ABOUT THE SECTION

Almost soon after the Centre was established, it was realized that aspects of Earth System Physics (although called by different names at different times) could not be ignored. It took many years of planning to establish a full-fledged Section on Earth System Physics. Given the importance of global change in the present age and their consequences to developing countries in particular, it is an opportune moment to emphasize these aspects. Work in this section is a bridge between basic work in this field and modelling of specific problems – both as lines of research and as tools of training of students and young researchers in developing countries.

The ESP section currently covers a wide spectrum of Earth System Physics, from the fluid earth (atmosphere and ocean) to the Earth's interior. The section conducts research, organizes workshops and conferences and carries out a diploma course in both solid and fluid earth physics. Two main research lines are conducted in fluid earth physics: Climate Change and Impacts (CCI) and Natural Climate Variability and Predictability (NCVP). Within the solid Earth's physics the main line of research is in Mechanics of Earthquakes and Tectonophysics (MET).

Two new staff members, Dr. Adrian Tompkins and Dr. K. Aoudia, were appointed in 2007. Dr. Tompkins is primarily an expert in seasonal to multi-decadal climate predictability and will work mostly within the NCVP line of research. Dr. Aoudia is an expert in earthquake mechanics and physics of the Lithosphere. He is in charge of coordinating the solid earth activities in ESP, which also include those of the group on Solid Earth and Nonlinear Dynamics (SAND). Another substantial development in the section is the increasing reliance on external funding. In 2007 three EU funded project were ongoing and two additional ones were awarded. Moreover, an agreement has been signed between the ICTP and the Centro Euromediterraneo per i Cambiamenti Climatici (CMCC) to provide additional funding to the ESP over the next three years. Starting from 2008, outside funding will provide roughly half of the expenditure budget for the section (not including staff).

The CCI line of research aims at improving the understanding of anthropogenic climate change and its impacts on human societies and natural ecosystems. Within this area, the section investigates the global and regional climate response to increased greenhouse gases and its effect on hydrology, agriculture and human health; the climatic effects of pollution emissions of natural and anthropogenic origin (chemistry-climate interactions); and the effects of land use modifications (biosphere-atmosphere interactions). These issues are addressed with a range of modelling tools. The central one is a regional climate modelling system (RegCM) which has been developed for over a decade. Other models used for climate change studies include a global atmospheric model (FVGCM) and models of chemistry/aerosol, hydrology and land surface processes. The ESP section also maintains the Regional Climate research NETwork, or RegCNET, a network of scientists mostly from developing countries involved in regional



climate research. This network currently includes over 400 participants and provides an important forum of interaction between scientists from developing countries and leading international experts.

The NCVP research line focuses on natural climate variability and predictability at temporal scales from intra-seasonal/seasonal to multi-year/multi-decadal. Particular attention is devoted to tropical variability processes (such as the El-Niño Southern Oscillation, the Madden-Julian Oscillation, the variability of monsoons) and how they interact with extratropical variability and flow regimes (e.g. the North Atlantic Oscillation). The main tool used to address these problems is a computationally efficient intermediate complexity atmospheric general circulation model (AGCM), named SPEEDY, a version of which is also coupled to the ocean model MICOM. However, consideration is now being given to the possible use of different global model systems. Another major area of development in the NCVP research line concerns seasonal climate prediction. This is aimed at improving both process understanding and forecast performance of seasonal prediction tools in order to provide potential users (e.g. farmers or water managers) useful predictions at intra-seasonal to seasonal scales. This effort involves the use of in-house global and regional modelling efforts, collection and diagnostic analysis of outside model results and educational activities. It is stressed that the CCI and NCVP research lines are deeply intertwined, since an understanding of anthropogenic climate change requires a deep understanding of natural climate variability.



I suppose I would broadly summarize my research domain to be clouds, and has involved the use of a variety of state-of-the-art atmospheric models as research tools. This research involved a variety of experiments, ranging from simulating individual clouds, all the way up to long-term integrations of the climate. The aim was to understand the role that clouds play in the present climate, to determine how this might change in the future, and ultimately to improve the representation of their physics in forecast and climate models. The research led to an entirely new cloud cover treatment for the Max Planck climate model ECHAM5, and many modifications to the ECMWF forecast model cloud schemes, including the treatment of ice crystal formation.

During my time at ECMWF I became increasingly interested in a particular region, namely Africa. This started with my involvement in JET2000, a UK-funded venture to investigate the African

Easterly Jet (a strong wind that forms at 700 hPa which is a key dynamical component of the summer monsoon) with high resolution 'dropsondes', parachuted devices that measure atmospheric wind, temperature and humidity. This 4 day campaign was an effective pilot study for the ongoing AMMA (African Monsoon Multidisciplinary Analysis) campaign; a multi-annual, multi-national effort to provide unprecedented monitoring of the West African atmosphere and land-surface system.

The challenge is to use this campaign data and experience to learn how to most effectively enhance the long-term measurement capability with limited resources, to improve our modelling capability to predict monsoon rains from short to seasonal timescales, and critically to develop the communication channels between operational forecast centres and the end-user in the local community.

This will be my focus at ICTP, developing a research and training programme involving partners such as ECMWF, the Kwame Nkrumah University of science and technology (KNUST) in Ghana, and the African Centre for Meteorological application and development (ACMAD) and its various member states spread throughout the African continent. In preparation for this move I spent my summer holidays backpacking in Mali, Burkina Faso, Niger and Ghana, in order to visit a number of research institutes and national met services to observe in-situ forecasting procedures and discuss future research directions. The attached photo is of me launching my very first radiosonde device (a balloon launched equivalent of the dropsonde) at Tamale in Ghana.

Adrian Tompkins



Activities in solid Earth mostly occur under the MET research line. MET aims at improving the understanding of the way earthquake faults stick and slip in time and on aspects of how the Earth's Interior deforms, with emphasis on the physics of interactions between the crust and the upper mantle. This research line relies on geophysical methods blending space geodesy, seismology, tectonics, tied through realistic numerical modelling. The MET research line seeks to build-up physical models of strain accumulation that carry a predictive power for both stress evolution and location. The joint use of MET research together with pattern recognition algorithms for earthquake prediction and wave field modelling developed by the SAND group is likely to contribute to the physical understanding of the length and time scales of the preparation of a destructive earthquake and to a more realistic and time-dependent simulation of the earthquake hazard. On a long run, this research line may find room for collaboration with the fluid Earth lines in studying the mutual relationships between climate and tectonics and the effects of global change on a wide spectrum of natural hazards.

The approach followed in ESP to transfer methodologies and know-how to scientists in developing countries is to complement the educational and outreach activities with joint research effort on specific projects. In addition, the ESP section maintains a range of models and datasets for use by visitors and the community at large.

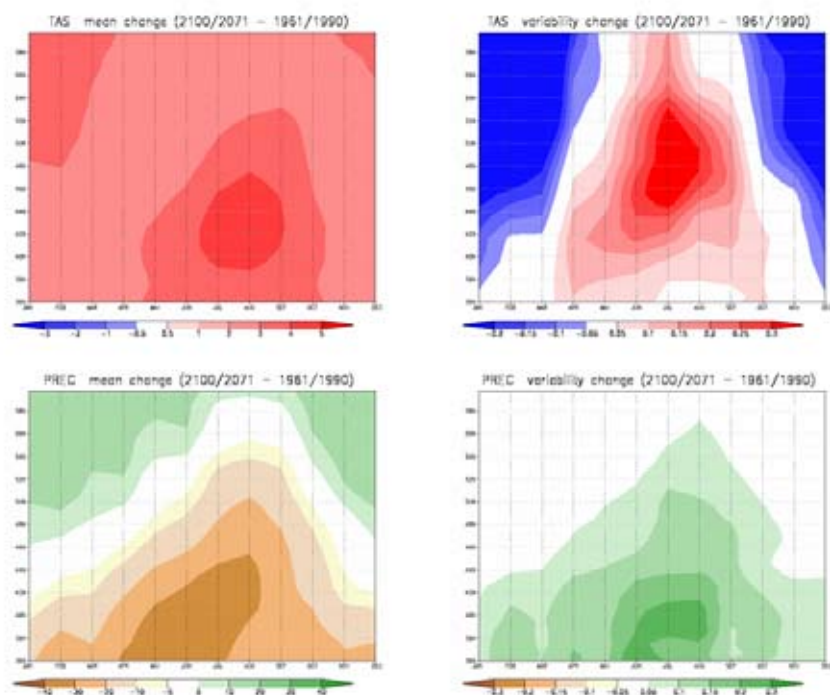
Research Activities

A. Climate Change and Impacts (CCI)

A1. Regional climate modelling and the RegCNET (Giorgi, Bi, Gao, Rauscher, Pal including associates and visitors)

During 2007 most regional modelling activities consisted in the further testing and application of the latest version of the ICTP regional climate model RegCM. Most of these applications involve the use of the model for high resolution multi-decadal simulations over different domains. In particular, simulations

Fig. 1: Monthly values of the zonally averaged changes in mean surface air temperature (top left panel), temperature interannual variability (as measured by the standard deviation, top right panel), mean precipitation (bottom left panel), precipitation interannual variability (as measured by the coefficient of variation, bottom right panel) over Europe; CMIP3 ensemble, A1B scenario, 2071-2100 minus 1961-1990. Units are degrees C for temperature and % of 1961-1990 values for mean precipitation (the coefficient of variation is unitless). The zonal average is taken over the region between 10°W and 25°E (From Giorgi and Coppola, 2007)





of both present day and future climate conditions at grid spacing of 20-25 km have been conducted for the European region as part of the project ENSEMBLES, East Asia (Gao et al., submitted), Central America (Rauscher et al., in preparation), South Asia (Ashfaq et al., in preparation) and Australia (Gao et al., in preparation). These simulations are providing good test-beds to assess the high resolution model performance and the effects of resolution on regional climate change projections. We highlight in particular the 150 year long transient climate change experiment over Europe, completed as part of the ENSEMBLES project (currently being analysed), this being the longest RegCM simulation performed to date.

The maintenance and development of the RegCNET network is another principal goal of this research line. In 2007 the RegCNET has expanded to include over 400 participants. Most of the RegCNET activities rely on the use of the RegCM model for a wide variety of applications (climate change, seasonal prediction, aerosol-climate interactions, land-atmosphere interactions); some activities also involve the analysis of ensembles of global climate change simulations over different regions. In this regard a workshop was organized in collaboration with the World Climate Research Program (WCRP) aimed at facilitating the use by scientists from developing countries of the recently completed CMIP3 ensemble of global climate change simulations completed in support of the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC).

A2. Climate change (Giorgi, Rauscher, Bi, Gao, Coppola, Piani including associates and visitors)

As in previous years, climate change studies proceeded in multiple directions. On the regional modelling side, multi-decadal high-resolution climate change simulations were performed for Europe, East Asia, South Asia, Australia and Central America and are currently being analysed.

On the global modelling side, Giorgi and

Coppola (2007) carried out an analysis of the CMIP3 multi-model ensemble and identified a latitudinal/seasonal oscillation in the climate change patterns over the European region, which they named ECO. The ECO appears to be a fundamental feature of the European climate change signal, involving changes in temperature and precipitation mean and inter-annual variability (see Fig. 1 on p. 37). This work was featured in the cover of Geophysical Research Letters. The CMIP3 model ensemble and the regional model simulation ensemble completed as part of the European project PRUDENCE were also used for targeted analyses of the climate change signal over the Mediterranean region (Giorgi and Lionello, in press) and the Italian Peninsula (Coppola and Giorgi, submitted).

In a different effort (Piani et al., 2007), a methodology for constraining climate forecasts, developed for application to the multi-thousand-member, perturbed-physics ensemble of simulations performed as part of the distributed computing project climateprediction.net, was extended to produce constrained forecasts of mean surface temperature and precipitation within 21 land-based regions. The methodology was also validated with climate simulations from other models available from the CMIP3 dataset.

A3. Chemistry-climate interactions (Zakey, Konare, Giorgi including associates and visitors)

Substantial work occurred in this research activity. A chemistry/aerosol module was extended to include most major aerosol components: sulfate, organic and black carbon aerosols, desert dust and sea salt. This module, which includes simplified chemistry, microphysics and aerosol radiative forcing is fully interactively coupled to the RegCM, representing the most advanced coupled aerosol/regional climate model system found in the literature. This places the ESP section at the forefront of this area of research. The coupled model has been applied to a range of studies in 2007: simulation of sea salt over different hot-spot



areas (Zakey et al., in press), effects of Saharan dust on the African monsoon (Konare et al., in review), effects of spring desert dust storms on the climate of East Asia (Zhang et al. submitted). Work is currently under way to extend the model and introduce more detailed gas phase and aqueous phase chemical mechanisms.

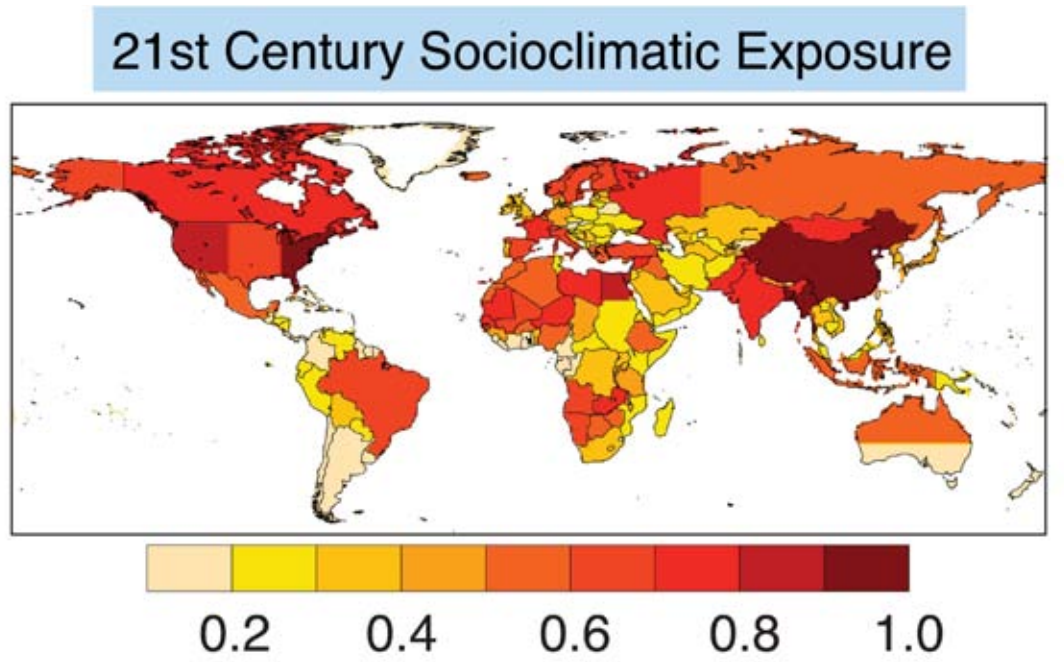


Fig. 2. Socioclimatic exposure index for different countries of the world (from Diffenbaugh et al. 2007)

A4. Climate change impacts (Giorgi, Gao, Coppola including associates and visitors)

During 2007 work on climate change impacts has proceeded in several directions:

1. Impact on human health: Further analysis has been conducted on the effects of climate change on summer ozone amounts over Europe (Meleux et al. 2007; Giorgi and Meleux 2007). This study was completed by running the air quality model CHIMERE driven by meteorological fields from climate change simulations with the regional model RegCM. It was found that summer ozone concentrations might substantially increase over Europe due to marked increases in temperature and decreases in precipitation and cloudiness. These results imply that summer ozone might pose an increasing threat to human health, agriculture and natural ecosystems over Europe because of increased greenhouse gas forcing. Another study of climate change impacts on human health is that of Diffenbaugh et al. (2007), who used the high resolution simulations of Gao et al. (2006) to find that pathologies associated with heat stress would substantially increase across the Mediterranean region, particularly along coastal area of the southern Mediterranean. Of particular importance is the increase in extreme temperature heat waves, which was projected to be much higher than the increase in mean temperature, further amplifying the related health effects.
2. Impact on water resources: Work continued on the analysis of increased aridity and water stress over the Mediterranean region caused by global warming. By analysing three different aridity indexes, the Koppen climate classification, the UNEP aridity index and the Budyko aridity factor, Gao and Giorgi (submitted) found that large areas of the southern Mediterranean, especially the southern Iberian, Italian, Hellenic and Turkish peninsulas are vulnerable to much increased aridity

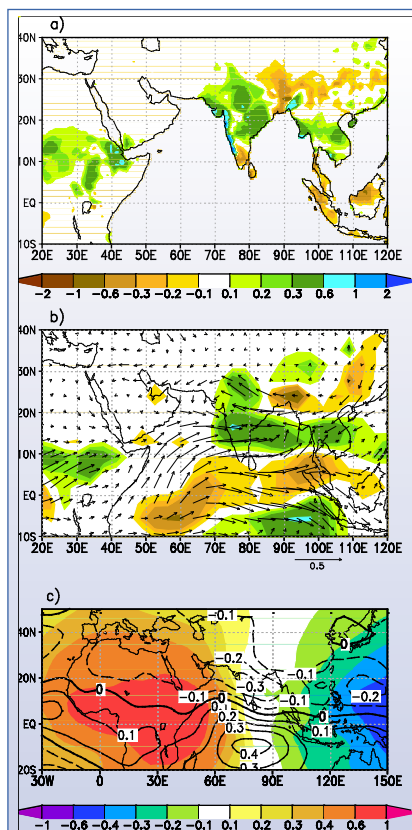


Fig. 3: *Precipitation response to the tropical Atlantic. Observations (upper panel) and simulations with the SPEEDY global model (middle panel) and associated modeled upper level velocity potential and low-level stream function (lower panel).* (From Kucharski et al. GRL, in press.)

and possible desertification under increased greenhouse gas forcing. In another direction, the surface hydrology model CHYM (Coppola et al. 2007) has been coupled to the RegCM to simulate the effect of climate change on the basin hydrology. CHYM is a flexible hydrology model that can be applied to any basin given topographical and soil information and with minimal parameter adjustments. It is currently being applied to investigate the effect of climate change on the hydrology of the Po river.

3. **Socio-economic impacts:** In a collaborative study between Purdue University and the ICTP, Diffenbaugh et al. (2007) combined the regional climate change index of Giorgi (2006) with key socio-economic indicators (population, poverty, and wealth) to produce indicators of socio-climatic exposure in the 21st century for all countries of the world. This was an innovative interdisciplinary approach to quantify the intersection of climate factors with socio-economic factors which eventually determines the vulnerability of a country to climate change. Based on the CMIP3 climate change projections and on a range of socio-economic data, countries such as China, India and the U.S., along with the Mediterranean region and a number of African nations, emerged as the most exposed to climate change (see Fig. 2 on p. 39). This work, which can provide the basis for information useful for the climate change negotiations, achieved substantial media exposure, both in Italy and the U.S.

B. Natural Climate Variability and Predictability (NCVP)

B1. Variability of the tropical ocean-atmosphere system (Kucharski, Yoo, including associates and visitors)

The ENSO-Indian monsoon relationship has been further analysed using the balanced complexity atmospheric model SPEEDY coupled to the ocean model MICOM in the Indian Ocean region. Sea surface temperature anomalies in the tropical Atlantic region, that have been previously (see report of 2006 and Kucharski et al., 2007) identified as responsible for the weakening of the ENSO-Indian Monsoon relationship in the 1980s and 1990s, have been further analysed regarding their influence on the Indian monsoon rainfall (IMR, see Fig. 3). Such a teleconnection has not been previously discovered and has been identified to have a strong impact on the predictability of IMR. The results of this research are in print (Kucharski et al.).

Furthermore, a multimodel AGCM ensemble intercomparison (within the CLIVAR Climate of the 20th Century Project) has been performed in order to assess the potential for Indian monsoon rainfall predictability on inter-annual to decadal timescales. It has been found that, whereas on inter-annual timescale there is modest predictability, on decadal timescale there is a large skill in simulating the IMR variability. Here the Interdecadal Pacific Oscillation and the Atlantic Multidecadal Oscillation may play an important role. This is consistent with previous studies, but provides an important confirmation



in this multimodel intercomparison framework. The results of this analysis have been submitted to Climate Dynamics.

The ENSO teleconnection to the South American monsoon system has been investigated within a Ph.D. collaboration (Zamboni), suggesting that the predictability of the South American monsoon is surprisingly large.

B2. Predictability of the African monsoon (Tompkins, including associates and visitors)

This is a new research area established in 2007. Experiments will be conducted using the new global model EC-Earth and the regional climate model RegCM3 in order to investigate the determinants of predictability for the African Monsoon. A pilot study was conducted in 2007 using the RegCM3 model to investigate the influence of the Mediterranean sea surface temperatures (MED-SSTs) on Monsoon rainfall. Previous studies using three different general circulation models showed that anomalously warm MED-SSTs increase rainfall in West Africa, a relationship that is seen in observational data, but whose mechanism is not well understood. The experiments showed that the RegCM3 model is able to reproduce the relationship between MED-SSTs and West African rainfall when a large domain is utilized, stretching from the Andes

to the Himalayas, due to the fixed forcing boundary conditions that constraint convective activity in small domains. Sensitivity tests using RegCM3 indicate that the increase in rainfall is likely to be a direct thermodynamic consequence of the more moist atmosphere resulting from the warmer sea surface, and that the indirect effect of the radiative forcing of the water vapour anomaly plays a minor role.

B3. European Climate Extremes (Feudale, Shukla, including associates and visitors)

The European heat-wave of summer 2003 has been analyzed to understand how the event developed and the factors that may have contributed to its occurrence. This work may improve seasonal forecasting and the assessment of the risk of such events in the future.

In the analysis, the COLA AGCM has been used. The AGCM was able to simulate the evolution and structure of the heat wave using observed global SST anomalies (comparison between Figs. 4a and 4b): this result suggests that the main features of the heat wave were potentially predictable. In addition, the possible role of the warm Mediterranean SST in enhancing the amplitude of the heat wave has been investigated through sensitivity experiments with and without Mediterranean SST anomalies. The experiment with Mediterranean SST anomalies was also able to reproduce some features of the heat

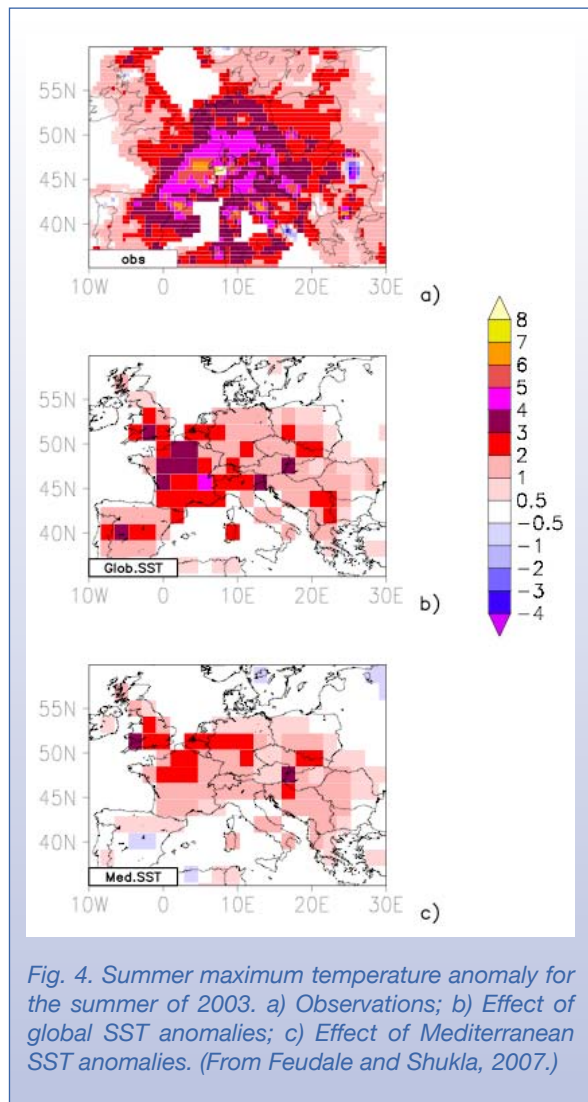


Fig. 4. Summer maximum temperature anomaly for the summer of 2003. a) Observations; b) Effect of global SST anomalies; c) Effect of Mediterranean SST anomalies. (From Feudale and Shukla, 2007.)



4th European Conference on Severe Storms (ECSS 2007)

The conference, held in September, was devoted to all aspects related to the convective severe weather phenomena, from the theoretical aspects of atmospheric convection and the microphysics of moist air, through the case studies, remote sensing data and the numerical simulations, to the social and economical consequences of the risks induced by severe storms. A special session of the conference was dedicated to the climatology of the severe storms and the connection between global climate change and the variations of intensity, distribution and frequency of the storms. Spectacular movies and photos showing particulars of severe storms were projected during a specific session of the conference. More than 200 participants came from all over the world, and a corresponding number of posters and oral presentations filled the intense working week.

The conference was jointly organized with the ARPA FVG, the Regional Agency for Environmental Protection of Friuli Venezia Giulia region, and supported by associations such as the European Meteorological Society, the European Severe Storms Laboratory and the Unione Meteorologica del Friuli Venezia Giulia.

D.B. Giaiotti and F. Stel (OSMER)



wave and to simulate the observed upper level anticyclone over central Europe, even though it was about half of the amplitude of the heat wave of the global SST anomaly experiment. The results show that the Mediterranean SST was responsible for more than half of the amplitude of the global SST effect. The first part of these investigations is published in a GRL paper while a second part will be submitted to Journal of Climate.

B4. Seasonal predictability in tropical and extratropical regions (Yoo, Shukla, Kucharski including associates and visitors)

Research has continued in the area of intraseasonal to seasonal prediction through the combined approach of statistical modelling (Hidden Markov Model, HMM) of monsoon rainfall and dynamical ensemble prediction. The intraseasonal variation of summer monsoon rainfall is reasonably well simulated by the HMM and the statistical prediction with HMM shows some skill in a few weeks lead time. In addition to the statistical modelling, combination of dynamical model output with HMM enhances seasonal predictability of mean rainfall as well as dry-wet spell length, which has a more practical utility than mean rainfall. As part of this activity, the Targeted Training Activities (TTA) has been continued. This time, some of key National Meteorological Services of south Asian countries were targeted and trained for efficient delivery of scientific knowledge to end users. In addition, databases and diagnostic tools are continued to be developed and maintained for use by scientists from developing countries.



C. Mechanics of Earthquakes and Tectonophysics (MET)

C1. Buoyancy driven deformation and stress in the lithosphere beneath the Central Mediterranean (Aoudia including the SAND Group collaborators: Ismail-Zadeh, Romanelli)

This work studied the continental deformation and modelled the contemporary flow and stress distribution in the lithosphere beneath the Central Mediterranean. Aoudia et al. (2007) used a revisited crust and uppermost mantle Earth structure that supports delamination processes. The model behaviour is primarily determined by the thick high density lithospheric root to the east and the low-viscosity shallow mantle wedge to the west. The rate of the modelled crustal motion is in agreement with GPS data and the pattern of lithospheric flow explains the heat flux and the regional geology, providing a new background for the genesis and age of the recent Tuscan magmatism. The modelled stress in the lithosphere (Fig. 5) is spatially correlated with the prevailing stress field and the gravitational potential energy patterns and shows that buoyancy forces, solely, can explain the coexisting regional contraction and extension and the unusual sub-crustal seismicity. This work was recently highlighted on the European Space Agency web site.

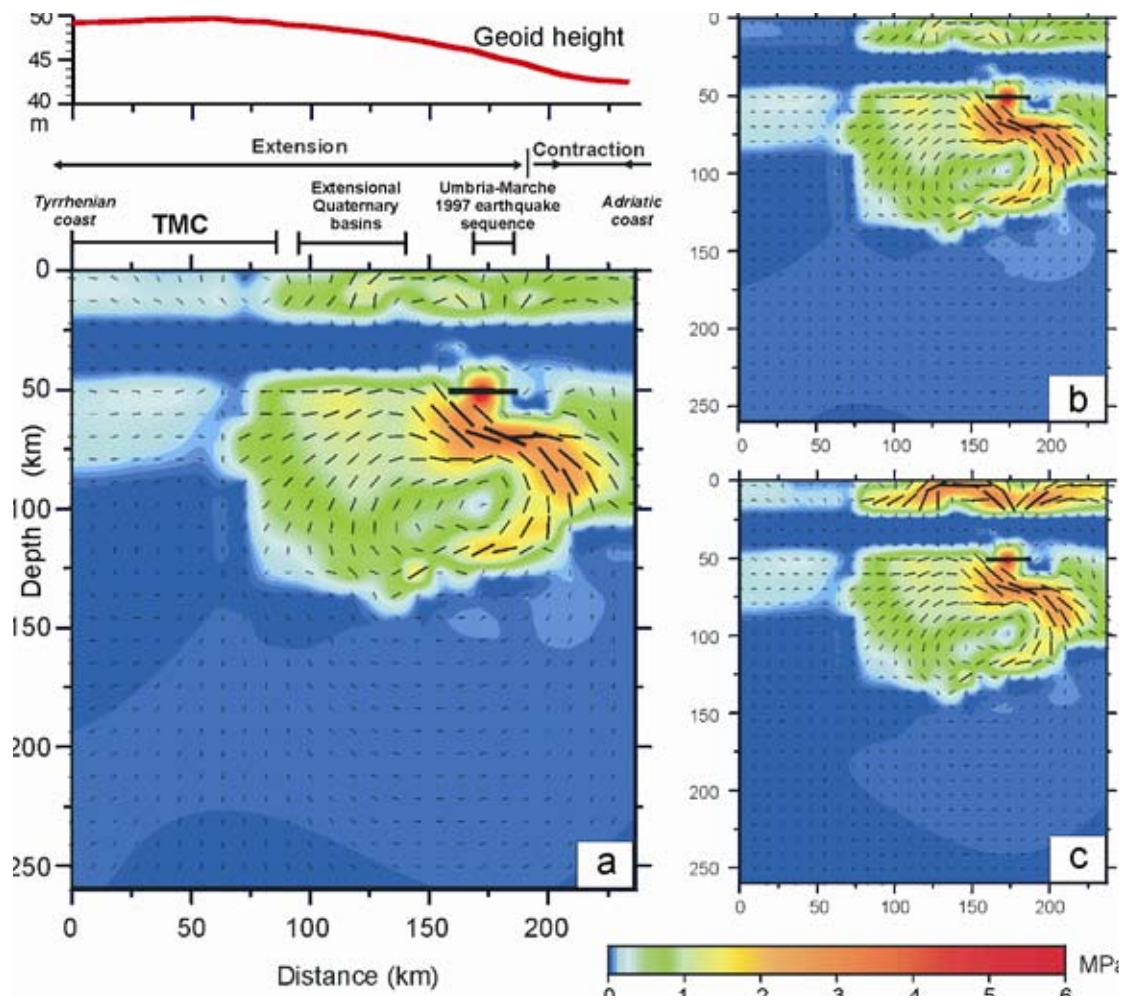


Fig. 5: Tectonic shear stress and compressional axes (ticks) predicted by different viscosity models along the studied profile (tensional axes are perpendicular to the compressional ones). The horizontal ticks indicate thrusting and vertical ticks indicate normal faulting. The geoid height exhibits its steepest gradient along the study profile and above the area of maximum deformation predicted in model a. (From Aoudia et al. 2007.)



ABDELKRIM Aoudia

has officially joined the scientific staff of ICTP's Earth System Physics section. Professor Aoudia who was born in Algeria, earned an engineering degree in geomechanics and a Ph.D. degree from the University of Trieste in solid-Earth geophysics and geodynamics. He has been involved with ICTP since 1994, and has been a long-term visiting fellow with the SAND group until his recent appointment as a staff scientist. Karim's major fields of interest are the mechanics of earthquakes and faulting and rheology of the lithosphere. His research is broadly concerned with both steady-state and transient deformation processes in the Earth, as they relate to tectonophysics and, particularly, to the physics of earthquake prediction. Since 2006 Professor Aoudia has also been serving as the coordinator of the Earth System Physics Diploma Programme.

C2. Modelling after-slip and poro-elastic rebound within the earthquake cycle (Aoudia, including former post-doc Riva)

This study refined the modelling procedure of the postseismic deformation leading for both the retrieval of the crust-upper mantle viscosity structure along with the preferred coseismic fault model. The visco-elastic simulation is done on the basis of upgraded normal mode relaxation models with a Maxwell visco-elastic rheology for a vertically stratified spherical Earth. Further to visco-elastic relaxation (Aoudia et al., 2003), Riva et al. (2007) include now in the modelling procedure the contribution of after-slip and poro-elastic rebound processes. By after-slip we mean either shallow fault creep, aseismic slip below the fault zone, or both. The poro-elastic rebound is due to changes in pore-fluid pressure. This approach allows us to compute the fully relaxed poro-elastic signal by calculating the difference between the elastic deformation induced by the earthquakes in undrained and drained crustal rocks. The elastic deformation is computed by means of an Okada dislocation model. This refinement of the modelling procedure was necessary also because of a higher quality and larger amount of GPS data set available in one of the test area: the Umbria-Marche and its normal faulting earthquake sequence. It is shown that for normal faulting earthquakes a long lasting after slip process is taking over the remaining processes during at least the first decade of the post-seismic phase.

C3. Postseismic deformation vs. geodynamics: a 2D finite elements with a lateral heterogeneous lithosphere (Aoudia, including former post-doc Riva)

An improved postseismic relaxation model was developed consistent with lateral variations of the rheological properties of the lithosphere. By means of a 2D finite elements approach, Riva and



Nobel Laureate Roald Hoffmann, Cornell University, USA, presented the lecture "A Nonlinear Approach to Chemistry" on 12 October, during the Ninth Workshop on Nonlinear Dynamics and Earthquake Predictions



Aoudia (2007) modelled a SW-NE section through the Central Mediterranean, sampling the Adriatic sea, the Apennines, the Tuscan magmatic province and the Thyrrenian basin. A large level of heterogeneity characterizes the topography of both the Moho and the lithosphere-asthenosphere boundary. Focusing on a time window smaller than 1000 years, all regions with a viscosity above 1021 Pa s behave elastically. Figure 6 shows that this is the case for the whole lithospheric lid as well as for the whole upper crust: flow is hence concentrated in the lower crust and in the mantle wedge, where viscosity reaches values as low as 1016 Pa s. The next step consisted in inducing an earthquake with the characteristics of the 1997 main events. Vertical postseismic relaxation for the first 10 years (low viscosity layers, less than 1019 Pa s, are fully relaxed) after the earthquake revealed deformation patterns that mimic fairly well the kinematics of the long-term geodynamics. The postseismic deformation contributes effectively to the geodynamics of slow deforming plate boundaries. A submitted manuscript reporting on this work follows an invitation made by the Editor in chief of *Annals of Geophysics*.

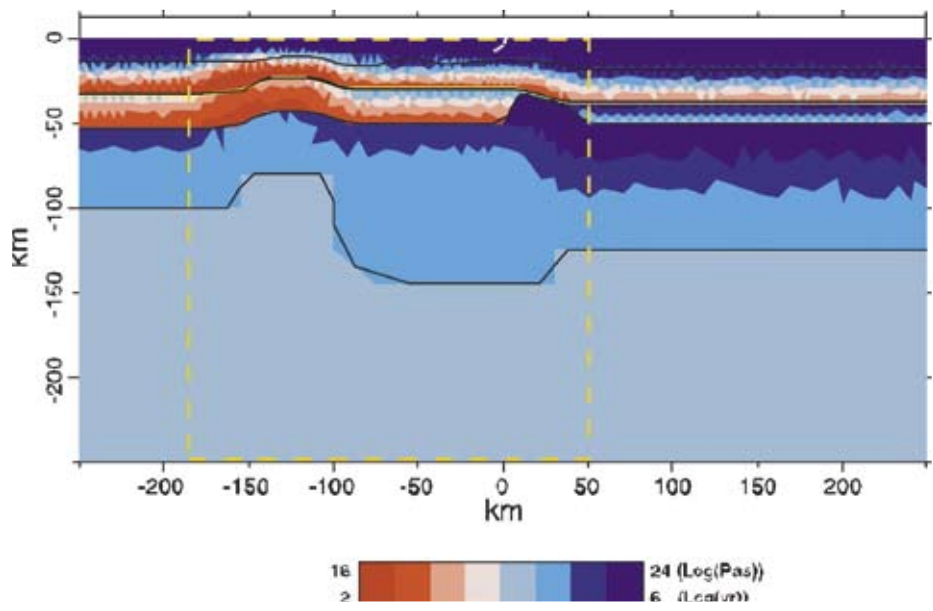


Fig. 6: Heterogeneous viscosity profile for a 2D section through the Central Apennines. The yellow dashed box highlights the continental part of the domain. The Umbria-Marche Fault (CF) is represented by the small white segment in the centre of the domain at shallow depth. (From Riva and Aoudia 2007)

C4. The EU project Alps-GPSquakeNet- Alpine Integrated GPS Network: Real-Time Monitoring and Master Model for Continental Deformation and Earthquake Hazard (Scientific Coordinator: Aoudia)

Alps-GPSquakeNet has promoted transnational cooperation in the field of space geodesy applied to natural hazards. It has set a transnational network of 40 continuous Global Positioning System (GPS) stations across the Alps. The transnational cooperation along with the developed infrastructure will, for the first time in the Alpine geodynamics, allow the quantification of the crustal deformation of the whole mountain range. This has already opened new research initiatives in earth and environmental sciences, therefore rising the value of the Alps as a natural laboratory.

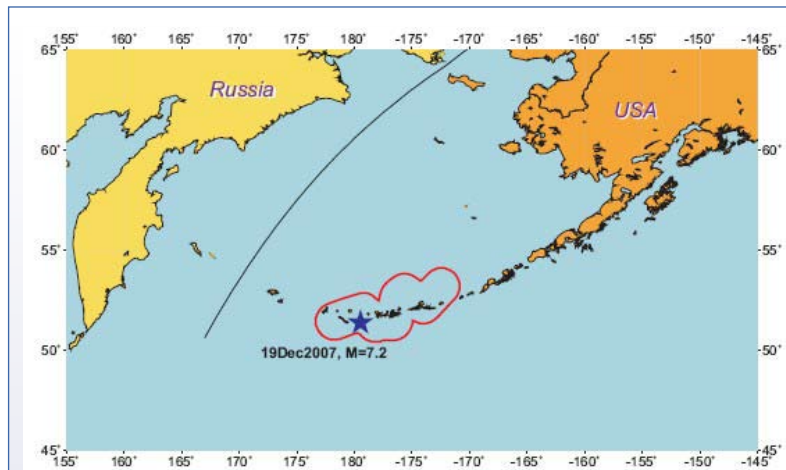
The project has investigated the continental deformation and the earthquake hazard within the Alpine space, mountains and surrounding foothills, where are concentrated attractive European metropolitan areas and rapidly growing urban centres with extensive infrastructures. It has developed pilot projects



on the use of GPS in meteorology, landslide studies and active faulting monitoring. It has favoured transnational know-how exchange between regional authorities and alpine universities and research centres.

D. Nonlinear Dynamics of the Earth

The research activities are divided into two main lines: Nonlinear Dynamics of the Earth's Lithosphere (led by Prof. V.I. Keilis-Borok,



Within the framework of the test of RTP (Reverse Tracing of Precursors) algorithm the advance prediction of Andreanof Islands earthquake (Aleutians, USA, Dec. 19, 2007, $M_w = 7.2$) has been made. An alarm for an earthquake with magnitude $M_w \geq 7.2$ in the area shown in the figure below was reported at RTP web site on July 28th, 2007 until January 28th, 2008.

Within the framework of the experiment aimed at a real-time intermediate-term medium-range earthquake (with magnitude $M \geq 8.0$) prediction at a global scale by means of M8 algorithm the following

Advance prediction of Andreanof Islands earthquake. A red curve delineates the area where an alarm for an earthquake with $M_w \geq 7.2$ was reported on July 28th, 2007 until January 28th, 2008. A blue star shows an epicenter of the earthquake that confirms the prediction.

earthquakes have been predicted in advance: Solomon Islands, $M_w = 8.1$, April 1st, 2007; Southern Sumatra, Indonesia, $M_s = 8.5$, September 12th, 2007; Kepulauan Mentawai region, Indonesia, $M_s = 8.1$, September 12th, 2007.

A theoretical analysis of the earthquake prediction problem in space-time has been considered. An explicit structure of the optimal strategy and its relation to the generalized error diagram have been provided. Issues of forecasting versus prediction, scaling laws versus predictability, and measure of prediction efficiency have been studied as well.

A total of sixteen nodes which are capable of $M \geq 6.0$ earthquakes have been delineated using large-scale cartographic data in the junction zone between Alps and Dinarides. Seven of them have already experienced the occurrence of sufficiently well located earthquakes with $M \geq 6.0$. Using these seven nodes as a learning set, three other nodes prone to earthquakes with $M \geq 6.0$ (one node in the Alpine domain and two in the northernmost Dinarides) have been identified by means of the pattern recognition techniques.

The parameters of the Unified Scaling Law for Earthquakes (USLE) have been mapped using the Friuli Venezia Giulia Seismometric Network Bulletins data and analysed accurately for the Friuli Venezia Giulia and the Western Slovenia region. The seismic risk estimates have been calculated for the principal cities of the Friuli Venezia Giulia region taking into account the fractal properties of earthquakes.

Several retrospective applications of M8S and MSc algorithms to the Friuli Venezia Giulia region have been performed. In all tests the only strong earthquake Bovec, 04.12.1998, $M = 5.6$ was predicted. The space-time volume of the alarm is about 38% and 10% for these two algorithms correspondently.

The available data on the seismicity of part of the collision zone between Eurasian and Indian continents within Pakistan and surroundings (i.e. Tien Shan, Pamir, Hindu Kush, and Quetta regions) have been investigated. It has been found that the regional (MSSP) and global (USGS NEIC, ANSS) earthquake catalogues could be used for a regional monitoring of the precursory B-pattern ("burst of aftershocks") aimed at events with $M \geq 6.5$ and the stabilized version (M8S) of M8 algorithm could be applied for prediction of events with $M \geq 7.0$.



International Institute of Earthquake Prediction Theory and Mathematical Geophysics, IIEPT, Russian Academy of Sciences, Moscow, Russia) and Structure of the Earth with Application to Seismic and Volcanic Risk Mitigation (led by Prof. G.F. Panza, Department of Earth Sciences, University of Trieste, DST-UNITS, Italy).

The activities within the framework of the first line aim at the development of a theoretical base for the study of critical phenomena in the Earth's lithosphere with special attention to earthquake prediction. The activities for this year included: numerical models of the lithosphere dynamics; study of block-and-fault structure dynamics for the Friuli area and precursory patterns in the block-and-fault model; mathematical models of non-linear systems and prediction of critical transitions in them: study of phenomena, preceding critical transitions in complex systems; earthquake prediction: launching the experiments aimed at earthquake prediction in global and regional scale, earthquake-prone areas determination, mapping the parameters of the unified scaling law for earthquakes, examining new regions for application of earthquake prediction algorithms.

The activities within the framework of the second line aim at the development of theoretical grounds for seismic and volcanic risk mitigation on the basis of 3D modelling of Earth structure and earthquake sources through the study of wave propagation in three-dimensionally heterogeneous, inelastic, and anisotropic media. The activities for this year included: Theoretical studies of seismic source along with applications (Solomon Islands and Great Sumatra earthquakes); studies of radiation by an extended seismic source for an efficient and realistic tsunami and ground motion modelling; geophysical, petrological modelling of the structure of the crust and upper mantle of the Western Mediterranean; geodynamics of the Western Mediterranean and upper mantle flow.

The developed methodologies are transferred to scientists of developing countries through joint research, with special attention to training the

potential leaders, and combining the workshops with subsequent individual projects.

Research activities in these two lines include numerical models of the lithosphere dynamics, mathematical models of nonlinear systems, earthquake prediction, structure of the Earth with Application to Seismic and Volcanic Risk Mitigation, seismic source studies, radiation by an extended seismic source: tsunami and ground motion modelling, the great Sumatra earthquake, relationships between magmatism and lithosphere-asthenosphere structure beneath the Western Mediterranean and implication for geodynamics, upper mantle flow in the western Mediterranean, integrated neo-deterministic seismic hazard scenarios for the Friuli Venezia Giulia region under a special agreement with ICTP.

E. Soil Physics

The College on Soil Physics held on 22 October-9 November was organized and directed by D. Gabriels (Department of Soil Management and Soil Care, Ghent University, Belgium), D. Nielsen (Department of Land, Air and Water Resources, University of California, Davis, USA), I. Pla Sentis (Facultad de Agronomia, Universidad Central de Venezuela, Maracay, Venezuela, and Departament de Medi Ambient i Ciències del Sol, Universitat de Lleida, Lleida, Spain), E. Skidmore U.S. Department of Agriculture, Manhattan, Kansas, USA). G.C. Ghirardi acted as Local Organizer.

The College aimed to provide participants with a knowledge of soil physical properties and processes so that they may understand and solve engineering, agronomic and environmental problems and activities such as drainage, irrigation, erosion, pollution, solute transport, and this in different climatological regions. The College was in part descriptive and theoretical, but special attention was also given to practical applications, instrumentation, measurement techniques and modelling of physical processes in the soil. Emphasis was also placed on the effects of climate on soil physical processes.



The main topics discussed were:

- Soil physical properties and processes (intrinsic, spatial, temporal)
- Soil degradation and desertification processes (physics, factors, prediction, control)
- Climate and soil-water-plant-atmosphere continuum (infiltration, evaporation, soil water balance).

Diploma Course in Earth System Physics

In 2007 the first “test” year of the ESP diploma course was successfully completed, with all six students obtaining their diploma with good performance. The second year of the diploma thus started following the same structure and guidelines of the other ICTP diploma courses (10 students mostly from least developed countries). The course is composed of two semesters. The first semester includes basic courses on Introduction to the Physics of the Earth’s System, Mathematical Methods in Geophysics, Wave Physics and Environmental Data Analysis. The second semester includes more specialized courses on Physics of the Atmosphere, Physics of the Oceans, Physics of the Solid Earth and Soil Physics. The course also includes seminars on specific topics.

Staff and Long-Term Visitors

Research scientists

K. Aoudia (Algeria)
 X. Bi (China)
 F. Giorgi (Italy), head
 F. Kucharski (Germany)
 F. Molteni (Italy), currently on leave
 A. Tompkins (U.K.)

Consultants

G.F. Panza (Italy)
 J. Shukla (U.S.A.)

Staff associates

C. Brankovic (Croatia)
 I. Kuznetsov (Russian Fed.)
 G. Molchan (Russian Fed.)
 A. Soloviev (Russian Fed.)

Post-doctoral fellows

E. Coppola (Italy)
 L. Feudale (Italy)
 E.-S. Im (Korea)
 J.-H. Joo (Korea)
 J. Kröger (Germany)
 S. Rauscher (U.S.A.)
 A. Zakey (Egypt)

Visiting scientists

G. Boyadzhiev (Bulgaria)
 S. Dimitrova (Bulgaria)
 P. Dineva (Bulgaria)
 M. El-Gabry (Egypt)
 L. Fang (China)
 Y. Farfanova (Russian Fed.)
 B. Grecu (Romania)
 A. Gusev (Russian Fed.)
 E. Gusev (Russian Fed.)
 A. Ismail-Zadeh (Russian Fed.)
 I.-S. Kang (Korea)
 A. Konaré (Ivory Coast)
 T. Kronrod (Russian Fed.)
 B. Moreno Toiran (Cuba)
 A. Nekrasova (Russian Fed.)
 I. Paskaleva (Bulgaria)
 A. Peresan (Italy)
 C. Piani (Italy)
 J.V. Ratnam (India)
 F. Romanelli (Italy)
 I. Rotwain (Russian Fed.)
 F. Vaccari (Italy)
 I. Vorobieva (Russian Fed.)
 D. Zhang (China)
 S. Zhang (China)
 X. Xhang (China)
 S. Zhou (China)



Associates

A. Bekele (Ethiopia)
 X. Gao (China)
 I. Parvez (India)
 R. Raykova (Bulgaria)
 H. Razfindrakoto (Madagascar)
 Y. Xu (China)

Visiting students

A.H. Ali (Egypt)
 P. Amponsah (Ghana)
 M. Shalabi (Egypt)

External Funding

ENSEMBLES, EU project, ~40,000 Euro/year (ongoing, 5-year duration).
 CECILIA, EU project, ~50,000 Euro/year (ongoing, 3-year duration).
 WATCH, EU project, ~50,000 Euro/year (ongoing, 4-year duration).
 MEGAPOLI, EU project, ~40,000 Euro/year (starting in 2008, 3-year duration)

ACQWA, EU project, ~40,000 Euro/year (starting in 2008, 5-year duration)

Contract with the Centro Euro-Mediterraneo per i Cambiamenti Climatici (CMCC), ~ 65,000 Euro/year (starting in 2008, 3-year duration).

Three year agreement between ICTP and the Civil Defense of the Friuli Venezia Giulia Region (DGR 2226 dd. 14.9.2005): for modeling of the Earth structure and the seismic sources in the Friuli Venezia Giulia Region: Euro 120.000 for a total of 3 years.

University of Naples, 10,000 Euro.

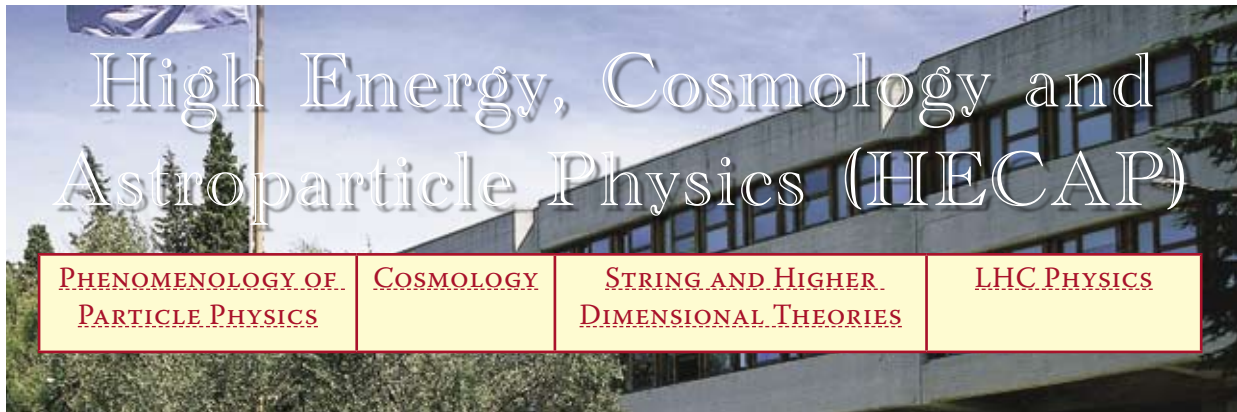
Research Centre for Disaster Reduction, Kyoto, 8,000 Euro.

Central European Initiative (CEI), 8,400 Euro.

University of Trieste, 3,000 Euro.

EU project: "Extreme events: Causes and Consequences", 11,000 Euro.





ABOUT THE SECTION

The Centre began its work in 1964 with high energy physics as its sole activity. Indeed, even though the Centre soon expanded its concerns to other areas of science (such as plasma physics and optics), there were only two permanent scientific positions at ICTP for some time (A. Salam and J. Strathdee), both in high energy theory. The section has had a rich history of ideas that it has contributed to physics. The section is well-known also for the Nobel Prize that Abdus Salam shared in 1979 with Sheldon Glashow and Steven Weinberg “for their contributions to the theory of unified weak and electromagnetic interaction between elementary particles, including, inter alia, the prediction of the weak neutral current”.

The section now has 8 permanent scientists, a scientific consultant and a staff scientist, a number of long-term and short-term visitors, of the order of 15 post-docs and many Associates from developing countries. Along with its numerical growth, it has also expanded its intellectual breadth, and has always played an important role in the frontiers of the field. It collaborates significantly with institutions such as SISSA and INFN and has a long tradition of links with other high energy centres around the world. In recent years, it has rejuvenated its interest in the LHC experiments and collaboration with CERN.

Research Activities

There are three broad research areas in the High Energy Section: I. Phenomenology of Particle Physics, II. Cosmology, and III. String and Higher Dimensional Theories. A new activity focusing on the LHC physics is emerging as well.

I. The Phenomenology of Particle Physics

The research activity in 2007 covered the following areas: neutrino phenomenology, origins of neutrino mass, physics at LHC (Large Hadron Collider), Grand Unification, proton decay and leptogenesis.

Neutrinos streaming off a supernova core can transform collectively by neutrino-neutrino interactions, leading to new phenomenon: “spectral splits” where certain energy divides the transformed spectrum sharply into parts of almost pure but different flavors. A detailed description of the spectral split phenomenon has been elaborated which is based conceptually and quantitatively based on an adiabatic treatment of neutrino-neutrino effects. Explicit analytic and numerical solutions for various neutrino spectra are obtained.

A comprehensive description of the three flavor neutrino oscillations inside the Earth in terms of neutrino oscillograms is developed. Effects of the 1-2 mass splitting and mixing as well the interference of 1-2 and 1-3 modes of oscillations are quantified.

It is shown that in the oscillograms the interference effects, in particular CP-violation, have a domain structure with borders determined by the so called “magic” lines and the lines of the interference phase condition.



Consequences of violation of the Pauli exclusion principle for the two-neutrino double beta decays are considered. This violation strongly changes the rates of the decays and modifies the energy and angular distributions of the emitted electrons. The upper bounds on parameters of mixed-statistics of neutrinos from the existing data and sensitivity of future measurements have been evaluated.

The possibility of detecting the origin of neutrino mass at large colliders such as LHC has been explored. The seesaw mechanism, the central way of understanding the smallness of neutrino mass, is based on the existence of new heavy particles, such as right handed neutrinos in type I, scalar triplet in type II or fermion triplet in type III seesaw. It was demonstrated that the minimal $SU(5)$ grand unified theory augmented by an adjoint fermion representation can account for both unification and realistic neutrino masses and mixings through the mixture of type I and type III seesaw. The theory predicts a light fermion triplet, below TeV. Such states could be produced directly at LHC, and then would decay into same sign di-leptons accompanied by jets. One could thus simultaneously observe directly lepton number violation and probe neutrino masses and mixings since these decays go through Yukawa Dirac couplings. The unification scale must be quite low, leading to a potentially observable proton decay in the next generation of experiments.

Another exciting possibility in this connection is a low lying left-right symmetry scale. It would result in a similar phenomenon of lepton number violation through same dileptons, enhanced by the on-shell production of the right handed gauge bosons, offering a hope of observing parity restoration. Unification constraints in the Pati-Salam and $SO(10)$ theories allow for such scenarios.

A possibility to detect usual right-handed neutrinos (mostly singlets of the Standard Model gauge group) at future accelerators is considered. The detection requires substantial mixing of these neutrinos with the active neutrinos requires and a

very strong cancellation of different contributions to the light neutrino mass matrix. Possible symmetries behind this cancellation are considered. Light neutrino masses can be generated by small perturbations violating these symmetries. With additional assumptions, correlations can appear between collider observables and features of the neutrino mass matrix.

Various extensions of the standard model have been proposed which provide with alternative (to seesaw) explanation of small neutrino masses, in particular the Dirac neutrino masses, and the baryon asymmetry of the Universe via new versions of leptogenesis. The models include new scalar particles and fermions and require an additional discrete symmetry such as Z_2 . New particles with masses below or at the TeV scale can be observable at LHC or the proposed future International Linear Collider.

New singlet fermion (in one of the models) or new Higgs doublet (in another one) can serve as the candidate for the cold dark matter in the Universe.

New origins of neutrino dark energy and baryon asymmetry in the universe are explored. The neutrinos acquire small masses through the Dirac seesaw mechanism. The pseudo-Nambu-Goldstone boson associated with neutrino mass-generation provides a candidate for dark energy. The puzzle of cosmological baryon asymmetry is resolved in a consistent way via neutrinogenesis.

II. Cosmology

In 2007 the activities in Cosmology in our group were mainly in the following directions:

- 1) Alternative cosmologies: Cosmologies alternative to inflation have been proposed and studied. They are based on a bouncing phase which connects a contracting regime to the current expanding one. Density perturbations are produced by a second scalar. The basic predictions of the model are a slightly blue spectrum of perturbations and a substantial presence of non-Gaussianities.



- 2) EFT for inflation: A useful way to parametrize all the possible models of single field inflation has been worked out giving an effective field theory approach to the subject. The formalism allows to parametrize all the possible high energy effects in inflation and to better understand the role of the symmetries.
- 3) Eternal inflation: Quantitative progress has been made in the study of slow-roll eternal inflation, in particular in its sharp definition. Varying the parameters of the inflaton potential, the onset of eternal inflation works as a sort of phase transition, where the volume of reheating acts as order parameter.
- 4) Cosmological fluid as a scalar: Using the equivalence between a perfect fluid with non-vorticious excitations and a derivatively coupled scalar, the theory of perturbations at second order during matter dominance has been carried out in analogy to what is done during inflation.
- 5) Experimental constraints on dark energy: They have been carried out following the newest results of supernovae and other cosmological datasets.

III. Strings and Higher Dimensional Theories

In 2007, the activities in String related topics in our group were mainly in the following directions:

- 1) String and M-theory Phenomenology: M theory vacua without fluxes are studied. Effective potential leads to the stabilization of all the moduli and results in a de Sitter vacuum. A characteristic feature of this class of vacua is that gaugino masses are suppressed as compared to the gravitino mass. It is also shown that in the vacua that have small energy the gravitino mass is of the order the electro-weak scale.
- 2) AdS/CFT duality: BPS geometries with $1/8$ supersymmetry and that are asymptotically 5 dimensional anti-de Sitter space times a 5-dim. compact space (5-dim. sphere or certain generalized Sasaki-Einstein manifolds) were constructed. These solutions respectively are dual to $1/8$ BPS operators in $N=4$ super Yang-Mills theories and $1/2$ BPS operators in certain conformal $N=1$ gauge theories. Formulae for conserved quantities (like mass and charge) for such solutions were also obtained. These results provide further evidences to support the gauge theory/ string theory duality.
- 3) Non-Critical strings: Non-supersymmetric deformations of the non-critical D-brane theories (that are dual to $N=1$ super Yang-Mills) are studied. The condensation of tachyonic quarks was shown to lead to stable non-supersymmetric vacua. In another work World-sheet of a macroscopic fundamental string was proposed to be the holographic dual of small black strings. Several checks were made to verify this proposal.
- 4) Topological String theory: New classes of $N=4$ topological string amplitudes were constructed and shown to satisfy certain Harmonicity equations. These Harmonicity equations were shown to result, within the framework of supergravity, from the requirement that these amplitudes correspond to half BPS operators in the effective action.
- 5) An ongoing program of research on the localization problem and the spectrum of fields with various spins on 3-brane solutions of anomaly free minimal gauged supergravities in six dimensions was further pursued. One of the unexpected and counterintuitive outcomes of this activity is that in the framework of these - not fully understood models - there are ways of going to the large volume limit in which certain mass gaps remain non zero.
- 6) The elementary particles of the Standard Model obtain their masses through what is known as the

Higgs mechanism. In order for this mechanism to take place a scalar field known as the Higgs doublet is introduced. The dynamics of this field gives rise to what is known as the hierarchy problem in particle physics. One speculative approach towards solution of this problem is the gauge Higgs-unification. An eight dimensional model with a built in Z_2 symmetry has been constructed which allows to lower the cut off to about 10 Tev. It is expected that the Z_2 symmetry will protect the tree level Higgs mass against large quantum loop corrections.

IV. LHC Physics

1. ICTP and the LHC

The ICTP has an obligation to be connected with the LHC experiments and a duty to enable scientists from developing countries, who are otherwise unable to contribute and participate in the scientific discoveries which will be forthcoming when the first proton collisions take place this year. To this end, the ICTP has begun a dedicated LHC physics program, coordinated by Bobby Acharya of the ICTP High Energy section (see Fig. 1) in collaboration with John Ellis from CERN. This program is already operational at several different levels including students, postdoctoral researchers and ICTP associate members. The program thus far has included Nadeesha Wickramage from Sri Lanka who has been given an ICTPSTEP fellowship and is working on the CMS experiment; Bobby and former ICTP Associate Gautam Bhattacharya (SAHA Institute India) are attempting to create a focused research environment. One of the main successes of the program has been the collaboration between the University of Udine ATLAS group and the ICTP.

2. University of Udine and the ICTP

The INFN Gruppo Collegato di Udine and University of Udine, lead by Carlo del Papa, has been involved with many of the foundational cornerstones necessary to build a complicated



Fig. 1 Bobby Samir Acharya in the ATLAS pit at CERN (Courtesy Marina Cobal)

apparatus such as ATLAS.

It has performed R&D for the pixel system, tested 1/3 of the sensors for the pixel detector (the part of the detector closest to the interaction region), participated in test beam analyses, cosmic ray tests and more. Physicswise, the Udine group has pioneered the use of Top-quark pair-production events for detector and new physics studies.

The collaboration between the University of Udine and ICTP started with some research together on Top quarks, and the first collaboration was realised with the supervision of an ICTP Diploma student, Muhammad Horoub, from Palestine. Soon they moved to the ATLAS official software and Monte Carlo data, and not much later on a post-doc joined (Aissa Belhouari, from Algeria). This small group – supported strongly by the INFN – has rapidly grown in ability and the expertise of this group is already widely recognize in ATLAS.

The INFN Gruppo Collegato di Udine (which includes now officially members of the University of Udine and of ICTP) has the ambition to take a leading role in ATLAS data taking and analysis. This ambition is supported by the presence of a grid farm in Trieste, which can provide all the supporting computing framework needed and by the fact that members of the group have already had active leadership roles in ATLAS:



Udine physicists are or have been Top-quark physics group convener, member of the Physics Coordination Committee, member of the Publications and Speakers Committee and editors of physics performance notes. We foresee to keep playing such roles in the future.

3. The ATLAS detector

The ATLAS detector (see Fig. 2) will observe and record the collisions between the protons. It consists of an Inner Detector close to the interaction region, which reconstructs the trajectories of charged particles. The tracking devices are based on silicon pixels (Pixel detector) and silicon strips (SCT tracker) at the inner layers and straw tubes at the outside (TRT tracker). The Inner Detector is embedded in a 2 Tesla magnetic solenoid magnetic field that curves the charged particles and allows the determination of their momentum. Around the Inner Detector, a number of calorimeters will be positioned that determine the energy of particles by effectively absorbing them. It consists of parts specialized to determine the electromagnetic energy flow (Liquid Argon Calorimeter), surrounded by a part that absorbs all hadronic energy to determine its energy (Tile Calorimeter). At the outer level, muon detectors are installed that records the muon particles that are able to penetrate through the calorimeters. The spectrometer is embedded in an air-core toroidal magnetic field brought about by the Toroid Magnets, to bend the muon trajectories.

Training Activities at ICTP

1. Spring School on Superstring Theory and Related Topics, 22 - 30 March. Organizers: J. de Boer, E. Gava, S. Kachru, N.S. Narain, S. Randjbar-Daemi
2. Workshop on QCD at Cosmic Energies - III, The Highest Energy Cosmic Rays and QCD, 28 May - 1 June. Organizers: Y. Dokshitzer, M. Strikman, D. Treleani
3. Summer School on Particle Physics, 11 - 22



Fig. 2 An ICTP student in the control room (Courtesy Marina Cobal)

June. Organizers: A. Masiero, V. Rubakov, A. Smirnov

4. Workshop on Cosmology and Strings, 9 - 13 July. Organizers: B. Acharya, P. Creminelli, F. Quevedo, J. Polchinski, U. Seljak, M. Serone, M. Zaldarriaga
5. Workshop on Grand Unification and Proton Decay (GUT 2007), 22 - 26 July. Organizers: C. Aulakh, K.S. Babu, B. Bajc, C.K. Jung, A. Melfo, P. Nath, G. Senjanovic, F. Vissani

Outside activities

1. ICTP-Latin American School in String Theory - CNPq (LASS 07) - Bariloche (Argentina), 8 - 25 January. Organizers: G. Aldazabal, K.S. Narain, C. Nunez, S. Randjbar-Daemi
2. Fourth Regional Meeting in String Theory - Patras (Greece), 10 - 17 June. Organizers: F. Ardalan, I. Bakas, E. Kiritsis, K.S. Narain, E. Rabinovici, S. Wadia, E. Witten

Participation in International Programmes

- E.U. Network "The quest for unification: theory confronts experiment"
- E.U. Network "Supersymmetry and the Early Universe"



The LHC and the Physics of the Next Decade

The Universe is vast. In our galaxy alone, there are about 1000,000,000,000 stars. There are also many galaxies in the observable Universe, numbering around 1000,000,000,000. Each of these galaxies is, broadly speaking, similar in size and structure to our own. There are about a million-billion-billion stars in the observable Universe.

Each of these stars, planets and other astronomical objects, is made out of atomic and subatomic particles. Moreover, by breaking apart the subatomic particles, we have understood that they themselves are complicated objects composed of, tightly bound, smaller particles called quarks and gluons. Electrons, on the other hand do not have substructure to the extent we have probed them. Thus, all stars are made from quarks, gluons and electrons.

On galactic and inter-galactic scales the laws of physics which govern the behaviour of the objects in the Universe are those of the Theory of Gravity, developed by Isaac Newton and, much later, refined by Einstein. However, on much smaller scales, the force of gravity no longer dominates. Instead, the Electromagnetic, Weak and Strong interactions dominate physics at these scales. There is an elegant Theory which describes all of these, non-gravitational forces, called the Standard Model (SM) of Particle Physics.

We have actually conducted high energy experiments which test the Standard Model down to distances of order 0.000000000000001 centimetres; remarkably, the SM has passed all of these tests with flying colours. Though, by human standards, this is an incredibly tiny distance scale (about one hundredth of the size of a proton), we need to do better. This is because of the one particle of the SM which has not yet been discovered, the infamous Higgs boson.

According to the SM there is a particle, called the Higgs boson, whose interactions with the quarks and leptons are responsible for the reason that these particles have mass. Finding the Higgs boson therefore sheds light on the fundamental question, what is the nature of mass? There is a problem, however. The scale of the Standard Model is about one hundredth the size of a proton. According to the theory however, the Higgs Boson mass scale has no right to be fixed at this scale, and must be adjusted "by hand". In fact, the theory predicts a much smaller length scale for the Higgs mass, rendering the Standard Model "unnatural". For these reasons, many believe that new physics will be found just below the 0.000000000000001 cm scale and may give a "natural" explanation for the Standard Model scale. These are some of the fundamental reasons for building the Large Hadron Collider (LHC) at CERN.

Located in a 27 km, circular tunnel 100 meters below ground on the Swiss/French border, next year the LHC will begin colliding protons into protons at energies which will probe the scales necessary to decide whether or not new physics exists which stabilises the Standard Mass scale and Higgs mass. Equally important as the energy scale is the collision rate: at full design capacity there will be about 1 billion collisions every second. This high rate ensures a very high physics discovery potential.

There are four collision points around the LHC ring, around which there are four detectors which will record the data from the events: ALICE, CMS, LHCb and ATLAS. Of these, ATLAS and CMS are the two general purpose detectors which are designed for new, fundamental physics discoveries. The LHC machine, detectors and experiments comprise one of the grandest scientific endeavours that mankind has ever undertaken, involving more than 5000 scientists and engineers from over 50 countries who have been working together on the project for more than 10 years. The discoveries made with the LHC will likely alter our understanding of matter and the Universe at a fundamental level. The LHC will dominate High Energy Physics for the next ten to twenty years.

Bobby Samir Acharya (ICTP) and Marina Cobal (Univ. Udine and INFN)

ESF Scientific Network

ATLAS and other activities of the LHC experiment

Teaching activities in SISSA, including Supervision of Ph.D. students



Staff and Long-Term Visitors

Scientific staff

B.S. Acharya (UK)
 P. Creminelli (Italy)
 K.S. Narain (India)
 S. Randjbar-Daemi (Iran/Italy), head
 U. Seljak (Slovenia)
 G. Senjanovic (Croatia)
 A. Smirnov (Russia)
 G. Thompson (Australia)

Consultants

E. Gava (Italy)

Staff Associates

A. Dabholkar (India)

Visiting Scientists (3 months or more)

E. Akhmedov (Russia)
 A. Belhouari (Algeria)
 A. El Mhamdi (Morocco)
 M.Y. Horoub (West Bank)
 S.A. Kim (Korea)
 M. Nemevsek (Slovenia)
 W.G. Ney (Brazil)

Post-doctoral Fellows

U. Alam (India)
 L. Boubekour (Algeria)
 T. Enkhbat (Mongolia)
 C. Gowdigere (India)
 P.-H. Gu (China)
 J. Kersten (Germany)
 S. Murthy (India)
 K. Suruliz (Bosnia and Herzegovina)
 M. Torabian (Iran)
 K. Tsumura (Japan)
 L. Velasco-Sevilla (Mexico)
 F. Vernizzi (Italy)
 H.-U. Yee (Korea)

In addition, there were 86 short-term visitors.

External Funding

Italian National Institute of Nuclear Physics (INFN):

- Spring School on Superstring Theory and Related Topics: Euro 12,000
- Summer School on Particle Physics: Euro 12,000
- Workshop on Cosmology and Strings: Euro 8,000
- Workshop on Grand Unification and Proton Decay (GUT 2007): Euro 7,000
- Postdoctoral Fellowship: E. Vernizzi - Euro 13,055
- Fellowships: S. Arianos, F. Borzumati, L. Mazzanti: Euro 8,011





ABOUT THE SECTION

By establishing the Mathematics section as a third independent unit in 1986, the Centre made a formal statement of its desire to broaden its scope. This section has had three heads so far (John Eells, M.S. Narasimhan and the present head, D.T. Lê). It has played an important role in fostering mathematics research and education in developing countries. It has a symbiotic relation with the mathematics department in SISSA. It is quite heavily involved in mathematics training and education in West Africa, extending its activities to East Africa recently. Its connections with other countries such as Brazil, India and Vietnam have also been strong. All of its post-docs and most of its visitors have been from developing countries.

The Mathematics Section did not add any new member to its staff in 2007. An opening for the Dynamical Systems or Probability and Statistics has been advertised in 2007. We are expecting the results in 2008. The Mathematics Section is still mainly oriented towards geometry and analysis. A particular effort has been made to have activities in the northern part of East Africa, Libya and Egypt.

The mathematical themes of the year were Theory of Numbers and Probability and Statistics; to reflect this, schools were organised in Analytic Number Theory and in Medical Statistics.

Research Activities

Staff

C.E. Chidume

Developed new algorithms and applied them to approximate solutions of equations involving nonlinear operators of the nonexpansive and accretive types, and their generalizations. Obtained new iterative methods and applied them to approximate solutions of variational inequalities and common fixed points for certain families of nonlinear mappings.

L. Göttsche

With B. Fantechi, proved a virtual Riemann-Roch Theorem, and used this to define virtual genera of singular moduli spaces. With Nakajima, Mochizuki, Yoshioka, works on applications of this to moduli spaces of vector bundles on surfaces. With Don Zagier he works on Le Potier's strange duality conjecture.

D.T. Lê

Studied the behaviour of complex polynomials with a rational curve as general fibre and applied his results to the Jacobian problem.

Jiayu Li

Studied the Type II singularities of the mean curvature flow from a symplectic surface or from a Lagrangian surface in a Kähler-Einstein surface, and studied the properties of Translating Solitons



Ramadas T. Ramakrishnan

Work in progress: Hodge conjecture for abelian four-folds, unitarity of Hitchin connection.

Consultants

A. Ambrosetti

Problems studied:

- Existence of standing waves of nonlinear Schrödinger systems: ground and bound states in the case of a nonlinear coupling; multi-bump solutions for linearly coupled autonomous systems.
- The non-autonomous case.
- Bound states for Systems of a Schrödinger eq. coupled with a Poisson equation: multiplicity results

Post-doctoral fellows and visitors

Several post-doctoral fellows obtained important results on the mean curvature flow, the construction and existence of foliations and laminations on manifolds of low dimension, on the geometry of polynomials, the study of analytic functions of several variable, properties of low dimensional differentiable manifolds, approximation of fixed points and the topology of real hyperplanes arrangements. Long-term visitors have made progress on a conjecture of Manin concerning rational points of elliptic curves and D-modules with group action.

Training Activities

1. School and Conference on Analytic Number Theory (23 April - 11 May). Directors: R. Balasubramanian, J.-M. Deshouillers, E. Kowalski
2. School and Conference on Algebraic K-theory and its Applications (14 May - 1 June). Directors: E. Friedlander, A.O. Kuku, C. Pedrini
3. Summer School and Conference on Automorphic Forms and Shimura

Varieties (9-27 July). Directors: B.C. Ngo, D. Prasad, R. Ramakrishnan

4. Advanced School and Conference on Statistics and Applied Probability in Life Sciences (24 September - 12 October). Directors: J. Fan, P. Jagers, Z.-M. Ma, X. Meng
5. External School in Alexandria, Egypt: School on Algebraic Approach to Differential Equations (12-24 November). Directors: M. Darwish, M. Fahmy, D.T. Lê, M. Yousif

Participation in International Programmes

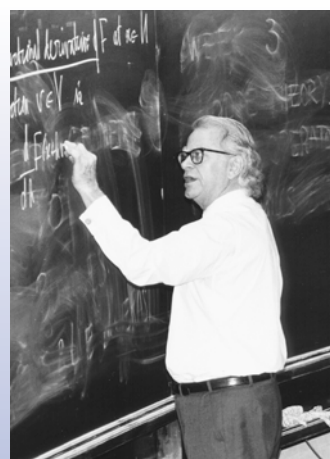
A. Ambrosetti

1. Organization and co-direction of the CIME Meeting on Geometric PDE, Cetraro, June 2007

C.E. Chidume

1. Guest Lecturer, Annual Conference of the Nigerian Mathematical Society, Akure, Nigeria.
2. Guest Lecturer; University of Ghana, Legon, Ghana (9-21 July, 2007). 13th Edward Bouchet Regional College on Functional Analysis and Applications to Differential Equations.
3. Ebonyi State University, Abakaliki, Nigeria, (5-25 November, 2007). Co-ordinator, co-organiser and resource person: A course on New Trends in Problems Solving Techniques in Mathematical Analysis.

James Eells, first head of the ICTP Mathematics group, died on 14 February. He was 80 years old. An internationally known expert in differential geometry, Eells was professor emeritus at Warwick University (UK). He began his association with ICTP's mathematics activities in 1972, and served as head of the Mathematics section from 1986 to 1992.





- University of Nigeria, Nsukka, Nigeria (26 November - 13 December, 2007), Research seminar to Doctoral students in the ICTP Ph.D. Programme in Mathematics for Sub-Saharan Africa.

L. Götsche

- Moduli spaces: Program at Mittag-Leffler Institut, Djursholm, Sweden, 1-31 March, 2007. Invited talk: Virtual Riemann-Roch and applications.
- Conference: Principal bundles, Stacks and Gerbes at Physikzentrum, Bad Honnef, Germany, 17-22 June, 2007. Invited talk: Virtual Riemann-Roch and applications.

D.T. Lê

- At the request of the ambassador of Libya at UNESCO, a School of two weeks on Geometry was organized in Tripoli during the month of August.
- D.T. Lê has been appointed advisor for Mathematics of the Ministry of Education of Vietnam.
- Lecturer at the Singularity Meeting in Angers in September.
- Lecturer at a special meeting for Professor Santiago Lopez de Medrano at UNAM, Mexico, in October.
- Assessor in the Marie Curie scholarships of the EU at Brussels in October.

Jiayu Li

- Invited speaker on Minimal submanifolds and related problems, Banff International Research Station for Mathematical Innovation and Discovery (BIRS), Banff, Canada, Dec. 9-14, 2007
- Invited speaker on Three-City Seminar, Freiburg, Germany, Nov. 13, 2007.
- Invited speaker on Geometric Evolution Equations, Berkeley, USA, March 12-16, 2007.

- Invited lecturer on Geometric Flows, Summer school at Tripoli, 2007.
- Invited speaker on Zhongyuan International Conference on Partial Differential Equations, Henan, China, May 29 - June 3, 2007.
- Invited speaker on International Conference on Variational Methods, Tianjin, May 20-26, 2007

Ramadas T. Ramakrishnan

- Invited talk at Department of Mathematics, Kaiserlautern (May)
- Invited talk at Department of Mathematics, IISc., Bangalore (December)
- Colloquium at the TIFR Centre, Bangalore (December)

Services

Within ICTP

- L. Götsche: Member of ICTP prize committee
 R.T. Ramakrishnan: Oversight of the ICTP-DST programme. Organiser of the Mathematics Seminar at ICTP.

Outside ICTP

- C. Chidume: Associate Editor of J. Math. Anal. Appl. (Elsevier); J. Ineq. Appl. (Hindawi, USA); PanAmer. Math. J. (USA); and J. Nigerian Math. Soc.
 L. Götsche: Editor of the Journal: Geometry and Topology. Member of the scientific advisory board of the Max Planck Institute for Mathematics, Bonn.
 R.T. Ramakrishnan: Associate Editor, Mathematical Proceedings of the Indian Academy of Sciences.

Seminars

Twenty-nine Mathematics seminars were given.



A Joint ICTP/SISSA Colloquium in Mathematics is currently organized, and talks were given by Vieri Benci (Università di Pisa, Italy), Haïm Brézis (University of Paris 6 and Rutgers), Enrico Bombieri (Institute for Advanced Study, Princeton, USA), Luigi Ambrosio (Scuola Normale Superiore di Pisa, Italy), Jorge Lauret (Universidad Nacional de Córdoba, Argentina) and Vladimir I. Arnold (Steklov Mathematical Institute, Moscow, Russia)



A delegation from the National Mathematical Centre in Abuja, Nigeria, composed of NMC Director Sam O. Ale, Director of Library Services James O. Daniel, and Secretary Clement O. Adeyemo, visited ICTP on 1 March 2007

Educational Activities

A. Ambrosetti

Gave a series of lectures (5 one-and-a-half hour lectures) on Differential Equations for the Diploma Course. Co-organized the ICTP-SISSA Joint Colloquium in Mathematics.

C.E. Chidume

Gave two courses in the Diploma programme: Foundations of Mathematical Analysis and Functional Analysis. Supervised the diploma projects of Jeremiah Ezeora from Nigeria; H. Bindele from Congo; Alzaki from Sudan. Supervised MORI Fellow: Bashir Ali. Ph.D Supervision: E.U. Ofoedu (Ph.D.) (12 November, 2007) and Bashir Ali (Ph.D.) (12 November, 2007).

L. Göttsche

Gave a course (23 lectures) on Algebraic Geometry, and one jointly with R. Ramakrishnan on Abstract Algebra, in the Diploma Course. Supervised the diploma project of Lam X.C. Ngo, from Vietnam, and PhD student Yao Yuan (China, SISSA) (beginning).

Local organizer of the School and Conference on Algebraic K-theory and its applications (Trieste, 14 May-1 June).

D.T. Lê

Gave a course on non isolated singularities in Mexico (Cuernavaca) in January. Gave a course on Algebraic Geometry in the Libyan school held in August. Gave an introduction to Algebraic Methods to



study Differential Equations in Alexandria (Egypt).

Jiayu Li

Gave a course on Differential Geometry in the Diploma Course. Gave a course on ‘Geometric flows’ in Tripoli, Libya, in August 2007. Supervised Dr. Han Xiaoli (post-doc) and Prof. Zhang Xi (Junior Associate).

Ramadas T. Ramakrishnan

Gave courses in Linear algebra and Abstract algebra in the Diploma Course. Supervised Ph.D. student Alberto Celotto and Master’s student Khim Raj Shrestha.

Initiated and was local organiser of: Summer School and Conference on Automorphic Forms and Shimura Varieties (Trieste, 9-27 July).

Organised the Fourth East African Summer School on Topics in Algebra, Geometry and Combinatorics, Dar-es-Salaam (June 2007), preceded by a preparatory course at Nairobi (April 2007).

Staff and Long-Term Visitors

Staff

- C.E. Chidume (Nigeria)
- L. Götsche (Germany)
- Lê Dũng Tráng (Vietnam/France), head
- Jiayu Li (P.R. China)
- Ramadas T. Ramakrishnan (India)

Consultants

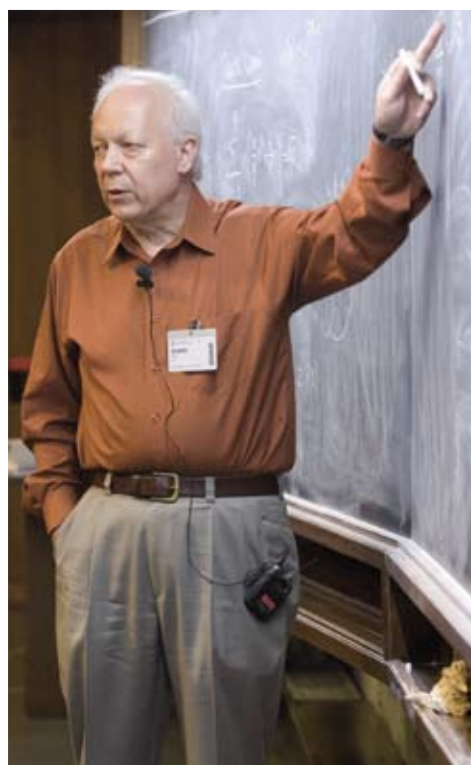
- A. Ambrosetti (Italy)

Post-doctoral fellows

- Han Xiaoli (P.R. China)
- Martinez-Ojeda Emigdio (Mexico)
- Najib Salah (Morocco)
- Nguyen Viet Anh (Vietnam)
- Rabanal Roland Montoya (Peru)
- Stefanov Alexander Gueorguiev (Bulgaria)
- Udomene Aniefiok (Nigeria)
- Uribe Vargas Eduardo Ricardo (Mexico)
- Yechoui Akila (Algeria)
- Yoshinaga Masahiko (Japan)

Long-term visiting scientists

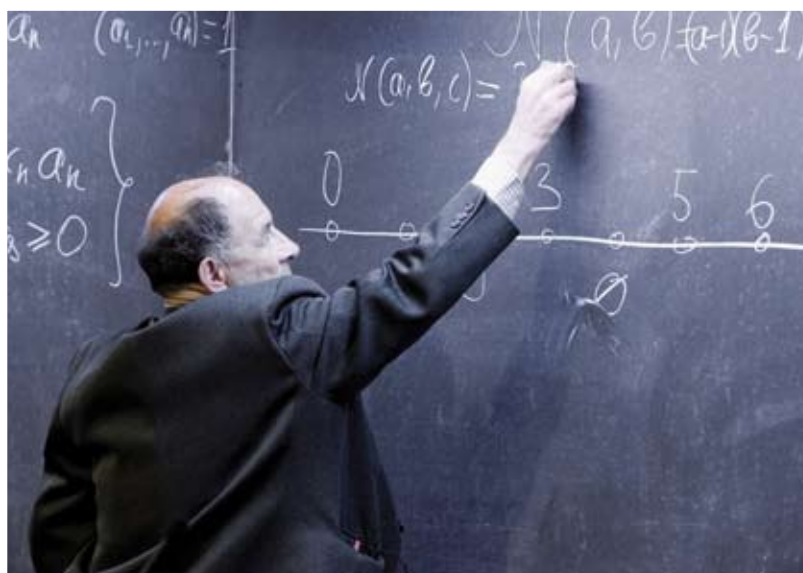
- Castano-Bernard Carlos (Mexico)
- Nang Philibert (Gabon)



Enrico Bombieri, Institute for Advanced Study, Princeton, USA, lectured on “Kahane polynomials and their derandomization” (joint work with J. Bourgain), 24 April 2007



Additionally, there were 83 short-term visitors. The total number of research visitors during 2007, including ICTP Associates and Affiliates, was 139, of whom 117 from developing countries.



V.I. Arnold lectured at the Mathematics Section, December 2007

Funding

Within the framework of existing agreements, the following travel grants were provided in connection with research:

<i>Source</i>	<i>No. of travel grants</i>
Commission on Development and Exchanges of the International Mathematical Union	7
National Natural Science Foundation of China	6

We still have a left-over of an external grant from the European Commission.

Miscellaneous

The Mathematics Section has been involved in very important activities, which increase the visibility of the ICTP outside:

The third Ramanujan Prize was awarded to Professor Jorge Lauret (Universidad Nacional de Córdoba, Argentina).

ERCOM Meeting (16-17 March): Meeting of the Directors of Mathematics Institutes in Europe.

School and Workshop on the Geometry and Topology of Singularities (7-27 January), Cuernavaca, Mexico (organized within the ICTP/CNPq Agreement)

Summer School on Geometry (4-16 August), Tripoli, Libyan Arab Jamahiriya.



ABOUT THE LABORATORY

The rationale for experimental activity in a Centre with focus in name on theoretical physics has long been an issue of some ambivalence. Its origin is clear to understand and can be summarized by a statement from 1983 made by A. Salam: “There is a pressing request from experimental physicists coming to the Centre to find here at least some of the experimental facilities which are not available in their home countries. Two kinds of laboratories have been therefore proposed... (a) Training and Demonstration Laboratories... in which scientists could spend a training period ...and (b) Permanent Research Laboratories... where high-level, modern research can be performed...” In a certain sense, the activities have oscillated between the two objectives, and the range of concerns has changed with time. The experimental effort is sometimes “hidden” in the Centre, but it ought to be replaced by a more stable alternative within the broad mandate of the Centre. The description below of the Multidisciplinary Laboratory is a summary of its current status.

The lines of research of the MLab are focused on interdisciplinary experimental activities where physics plays a central role. Special emphasis is given to synergic and complementary cooperation with other research institutions in the Trieste area, at national and international levels.

Activities cover from scientific instrumentation development to numerical simulations and theoretical analysis, promoting interactions with experts of different disciplines. The aim is to expose our visiting scientists and Ph.D. students to the instruments and methods of interdisciplinary research. The knowledge and experience gained through hands-on training enhances their professional autonomy and, at the same time, strengthens their ability to conduct interdisciplinary research in cooperation with heterogeneous research teams. This will allow young scientists to continue their professional career once they are back in their countries where they have to face limited availability of expertise and equipment.

Research Activities

The main research activities at MLab are organized through five projects:

- 1) ICTP-INFN Microprocessor Project
- 2) Plasma Focus Project
- 3) X-Ray Imaging
- 4) Accelerator Mass Spectrometry
- 5) Remote Access to Large Experimental Facilities

The projects are connected synergistically for the realization of different research projects and training activities.



1. ICTP-INFN Microprocessor Project

COMPASS experiment at CERN

COMPASS is a high-energy physics experiment at the Super Proton Synchrotron (SPS) at CERN in Geneva, Switzerland. The purpose of this experiment is the study of hadron structure and hadron spectroscopy with high intensity muon and hadron beams. COMPASS has generated hundreds of Terabytes of data during 2007. Around 30 percent of these data was generated by the RICH-1 detector. The initial readout system of this instrument was developed at the ICTP-INFN Microprocessor Laboratory with the collaboration of the INFN Trieste section. The group, as part of the COMPASS collaboration, participated at the shifts of the run 2007 at CERN, attended various COMPASS collaboration meetings, and co-authored several publications with important results.

Reconfigurable virtual instrumentation

In collaboration with the high-tech microelectronic company Actel Corp., the project is being carried out as a research initiative in the area of novel architectures for the implementation of reconfigurable virtual instrumentation systems using programmable logic devices. Its goal is to provide low-cost reusable hardware/software platforms for the implementation of multiple electronic and scientific instrumentation systems. A first modular platform prototype has been produced and partially tested. Preliminary results were presented at the International Conference on Microelectronic Systems Education (MSE 2007, Educating Systems Designers for the Global Economy and a Secure World); a hardware demonstration of the developed system was made at the SIGDA University Booth of the 44th Design Automation Conference, San Diego, California (US), June 2007.

Other initiatives

1. Neurotelemetry: This project has been explored as a joint collaboration project with SISSA for the development of a novel neuronal data acquisition and telemetry system for cutting edge neuroscience experimental research. The MLab will contribute with its expertise in high performance data acquisition and processing systems, and programmable logic devices. The project foresees hardware and software development including novel architectures and ad-hoc real time data processing algorithms.

2. Radiation impact on semiconductor devices: This research area has explored the possibility of setting up an experimental research line for the study of radiation impact on semiconductor devices focusing on pulsed neutron emission generated by the future dense plasma focus device being implemented at the MLab. The laboratory already has valuable specialized equipment for that purpose and only small accessory equipment should be needed to complete the necessary setup. Possible collaborations with some semiconductor companies are foreseen.



The laboratory in 1987



2. Plasma Focus Project

The MLab is establishing a Plasma Focus device for exploring applications in materials, medical, and plasma sciences.



ICTP RVI hardware setup for a reconfigurable virtual instrumentation system.

This programme is being carried out in collaboration with several international institutions and organisations¹. The overall goal is to establish a research activity for reference on plasma focus science and applications at ICTP with a visible contribution to main stream research, excellence of education, and innovative non-commercial and commercial applications. Applications of Plasma Focus include characterization of nano-technology materials; dynamical defectoscopy of moving or rotating objects, materials testing (ensuring extremely heavy radiation and plasma loads relevant to inertial and magnetic confinement fusion), explosives and other illicit materials detection, and production of isotopes for medical diagnosis and cancer therapy.

The Plasma Focus device is a relatively inexpensive, non-radioactive, compact and efficient source of plasma and radiation. With experienced guidance, it can be inexpensively reproduced in experimental laboratories around the world for use as a non-radioactive source of x-rays and neutrons for both applications and basic research.

A Plasma Focus device (5 KJ) is being constructed and is expected to be operational in 2008. The related works are under the supervision of Professor Vladimir Gribkov, Institute for Theoretical and Experimental Physics, Moscow and Dr. Ryszard Miklaszewski, Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland; and collaborations with Assistant Professor P. Lee, Plasma Radiation Sources Laboratory, Singapore and Dr. Leopoldo Soto, Chilean Nuclear Energy Commission, Chile. Scientists from INFN, Padua, are interested in getting involved in neutron research at the Plasma Laboratory. Pirelli Labs is interested in the development of new x-ray radiographies for car tyres.

Recently the official authorization from local authorities has been obtained to carry out experimental research activities with x-rays and neutrons at the MLab Dense Plasma Focus device.

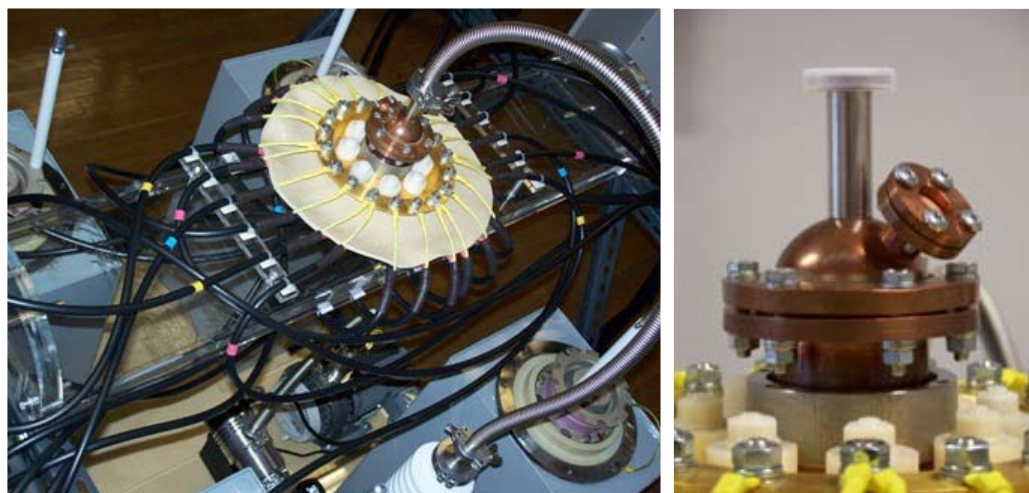
3. X-Ray Imaging

Preparation of a proposal for an experimental research project in collaboration with ELETTRA: "Development of a Portable X-Ray System for Non Destructive Characterization of Artistic and Archeological Materials."

¹ International Centre for Dense Magnetised Plasmas (ICDMP), Poland; Moscow Physical Society, Institute for Theoretical and Experimental Physics, Russia; University of Bologna and University of Ferrara, Italy; National Atomic Energy Agency of Chile; Buenos Aires and Tandil Universities, Argentina; Quaid-i-Azam University, Pakistan; BARC, India; Egyptian Atomic Energy Authority; African-Asian Association for Plasma Training (AAAPT); ENEA, INFN Trieste and Padua, and Pirelli, Italy.



The objective of the project is the development of a new portable radiation-based equipment that combine in a single unit, in addition to X-ray fluorescence and X-ray diffraction, as well as Near Infrared-Visible spectroscopy and Optical Microscopy. This will allow to better characterize inorganic and organic artistic or archeological materials, to perform depth profile analysis and to combine the obtained



Dense Plasma Focus chamber optimized for fusion neutron production at the MLab

chemical composition with the morphological information of the analysed area, in order to arrive to a more complete understanding of the artifact's physical characteristics in a non-destructive way. In addition to punctual chemical analysis the system will be able to perform structural analysis trough the scanning of local radiography and Visible-Near IR images.

In cooperation with ELETTRA, CSIRO (Australia) and other groups active in advanced imaging with X-rays, ICTP has established an International Consortium for Coherent X-ray Diffractive Imaging (I<CCXD>I). The main objective of this international initiative is to overcome the current limitations in advanced phase imaging and thus its full exploitation.

4. Accelerator Mass Spectrometry

AMS allows novel applications of long lived radionuclides such as ^{14}C , ^{10}Be , ^{26}Al , ^{36}Cl , used as chronometers in palaeoclimate studies and cultural heritage or as tracers in biomolecular medicine. Research programmes in these areas are being considered with relevant groups. In particular, the following joint projects are being scoped: analysis of long lived tracers with IAEA Marine Environmental Laboratories and ENEA; use of the radiocarbon bomb pulse for dating human cells, with ICGEB and University of Naples, detection of uranium in the environment, in cooperation with the Department of Environmental Sciences, University of Naples and IAEA.

ICTP is considering the development of collaborative programmes with the AMS Facilities of Caserta (University) and Florence (INFN and University). Access to these facilities by scientists from developing countries will be supported by the TRIL programme. An AMS service for groups in developing countries is being planned, in cooperation with the above facilities and with the analytical laboratory GEOKARST in the Trieste AREA Science Park.



5. Remote Access to Large Experimental Facilities

The modern trend in experimental facilities is to be highly specialized, large and expensive (e.g., JET, ITER). It will be useful for logistic reasons to access them remotely. Training the ICTP visitors in



Abdus Salam visiting the University of Malaya in Kuala Lumpur, Malaysia, on 20 January 1986, when the first version of the UNU/ICTP PFF (Plasma Focus Facility) was developed, assembled, and tested

remote access technology is an exercise that the MLab undertook recently as part of a joint program with ELETTRA. Our immediate goal is to make it work with ELETTRA since many visitors access those facilities. Whether this effort will eventually take off to a viable level depends mostly on the availability of funds.

Training Activities

At ICTP

Summer College on Plasma Physics (August 2007) Directors: S. Mahajan, P. K. Shukla, R. Bingham, L. Stenflo, Z. Yoshida; ICTP Local Organizer: C. Tuniz.

School on Pulsed Neutrons: Characterization of Materials (October 2007) Directors: C. S. Bauer, G. Mank, A. Markowicz; ICTP Local Organizer: C. Tuniz.

X-Ray Emission Techniques for Forensic Applications (May-June 2007). Directors: A. Markowicz (IAEA, Vienna); G. Paolucci (Sincrotrone SCpA, Trieste); G. Mank (IAEA, Vienna); ICTP Local Organizer: C. Tuniz.

Workshop on Biomedical Applications of High Energy Ion Beams (February 2007). Directors: K. Kirkby, M. Folkard, C. Tuniz, N. Dytlewski.

Advanced Training Workshop on Scientific Instruments and Sensors on the Grid (April 2007). Director: Roberto Pugliese (ELETTRA), Co-Director: Claudio Vuerli (INAF/OATs), Local Organizer: Alvise Nobile (ICTP).

Course on Natural Circulation Phenomena and Modelling in Water-Cooled Nuclear Reactors (June 2007) Directors: John Cleveland, Jong Ho Choi; ICTP Local Organizer: C. Tuniz.



School of Nuclear Knowledge Management (September 2007) Directors: Y. Yanev, A. Kossilov; ICTP Local Organizer: C. Tuniz.

Nuclear Power Plant Simulators for Education (October-November 2007) Director: John Cleveland; ICTP Local Organizer: C. Tuniz.

Workshop on Understanding and Evaluating Radioanalytical Measurement Uncertainty (November 2007) Directors: P. Martin, U. Sansone; ICTP Local Organizer: C. Tuniz.

Workshop on Nuclear Data for Science and Technology: Medical Applications (November 2007) Director: R. Capote Noy (IAEA, Vienna) ; S.M. Quaim (Institut fuer Nuklearchemie, Juelich); ICTP Local Organizer: C. Tuniz.

School on Physics, Technology and Applications of Accelerator Driven Systems (November 2007), in co-operation with International Atomic Energy Agency. Director: Alexander Stanculescu; ICTP Local Organizer: C. Tuniz.

Outside ICTP

Preparation of the “First Latin American Workshop on Distributed Laboratory Instrumentation Systems” 7 January - 1 February 2008, Valdivia, Chile, Directors: A.S. Induruwa, C. Kavka, U. Raich, J. Santamarina (local organizer in Chile).

Preparation of the experimental setups for the laboratory activity of the “First ICTP Regional Microelectronics Workshop and Training on VHDL for Hardware Synthesis and FPGA Design in Asia-Pacific”, June - July 2008, Kuala Lumpur, Malaysia. Directors: M.B.I. Reaz, N.S. Chin, A. Cicuttin, N. Abdallah, A. Marchioro; Local Organizers: M.A.M. Ali, F. Mohd-Yasin, C. Oh, A.A. Halim.

Seminars and conferences

“Recent Advances in NanoMOFSET Technology”. Professor Arezki Benfdila LMPDS, Faculty of Electrical Engineering and Computer Sciences. 10 September, 2007.

“Dense Plasma Focus, its physics and potential applications”. Professor V. A. Gribkov from the A. I. Alikhanov Institute for Theoretical and Experimental Physics, Moscow, Russia. 12 September, 2007.

“The VII International Conference on Science for Cultural Heritage. Technological Innovation and Case Studies in Marine and Land Archeology in the Adriatic Region and Inland” August 28-31, 2007. Veli Lošinj, Croatia. Directors of the Conference: Manuela MONTAGNARI, Marco Budinich and Claudio Tuniz.

“The 1st Croatian Synchrotron Radiation Summer School (SynCro’07)” September 3–7, 2007. Rijeka, Croatia, C. Tuniz, Co-organiser.

Science for culturale heritage, International Meeting on Science and Technology for Cultural Heritage, La Habana, Cuba, 7-10 February 2007, C. Tuniz, keynote speaker.

Accelerator Mass Spectrometry: technical developments and recent applications, International Conference on Ion Beam Analysis, 23-28 September, Hyderabad, India, 2007, C. Tuniz keynote speaker.



Nuclear Physics and Environment, 15 April, Damascus, Syria, 2007, C. Tuniz, Invited seminar.

Human dispersals and impacts during the Pleistocene, International conference on science for cultural heritage, 28-31 August, Losinj, Croatia, C. Tuniz, invited speaker.

Participation in International Programmes

1. A five-years research agreement between ICTP and IAEA has been approved for the creation of testbed at ICTP MLab based on repetitive Dense Plasma Focus device for applications in radiation material sciences as well as in nuclear medicine and for training of young researchers.

Some details of this device have been presented already. In addition, it is intended, as well, to use this device as a neutron/x-ray source for experiments in the sphere of nuclear medicine, in particular for the goals of Boron Neutron Capture Therapy (BNCT) of malignant tumors.

This device will be used for training them with modern diagnostics of fusion plasma.

2. The Asian African Association for Plasma Training (AAAPT) is an organization/network founded on 7 June 1988 to provide facilities for plasma research by small research groups in developing countries. Originally, it consisted of nineteen institutions from 12 countries, but it has now grown to 41 institutions from 23 countries.

3. ICTP is providing scientific support to iThemba Laboratories in South Africa for the development of an AMS national programme based on the EN tandem accelerator in Johannesburg, presently upgraded with IAEA support.

4. ICTP is providing scientific advice to develop a national programme at the Ghana Atomic Energy Commission on a project supported by IAEA.

The main focus will be in national priority areas such as human resources food and agriculture, health, environmental studies and preservation of Ghanaian art works.

The 2007 ALMERA (Analytical Laboratories for the Measurement of Environmental Radioactivity) coordination meeting and the Workshop on "Understanding and Evaluating Radioanalytical Measurement Uncertainty"

The 4th ALMERA meeting took place from 5th to 16th November 2007.

The ALMERA network, established by the IAEA in 1995, is a technical collaboration of existing institutions and makes available to its member states a world-wide network of analytical laboratories capable of providing reliable and timely analysis of environmental samples in the event of an accidental or intentional release of radioactivity. It provides an operational framework to link expertise and resources in particular when a boundary-transgressing contamination is expected or when an event is of international significance occurs. ALMERA currently (November 2007) consists of 106 laboratories representing 67 countries. The Chemistry Unit of the Physics, Chemistry and Instrumentation (PCI) Laboratory in the Agency's Seibersdorf Laboratory in Austria is the central coordinator of the ALMERA network's activities and the IAEA Marine Environment Laboratory in Monaco is also a member of the network.

The IAEA helps the ALMERA network of laboratories to maintain their readiness by coordination activities. In this framework, the Workshop represented a possibility for scientists to work on practical exercises and to refresh and up-date their knowledge and skills in uncertainty calculations. The workshop involved the participants in group exercises through the process of evaluation of radioanalytical results including the assessment of uncertainty budget, supported by a combination of lectures, interactive exercises on selected study cases, and practical demonstrations in the ICTP laboratories.

The meeting was attended by 61 participants from 34 different countries.

Umberto Sansone (IAEA-Seibersdorf Laboratories)





Staff and Long-Term Visitors

Scientific staff

Claudio Tuniz (Italy)

Staff associate

Vladimir Gribkov (Russian Federation)

Visiting scientist

Alexander Shapiro (Russian Federation) (until September 2007)

Post-doctoral fellow

Maria Liz Crespo (Italy/Argentina)

Technical staff

Andres Cicuttin (Italy)

Associates

Benfdila, Arezki (Algeria)

Mahmoud Imbaby Ismail (Egypt)

Palumbo, Felix Roberto Mario (Argentina)

Mendoza Cuevas, Anadria Yalecsi (Cuba)

Rammanjappa Thogata (India)

STEP students

Busari Mutiu Abolanle (Nigeria)

Omer Abdul Aziz Ali (Sudan)

Maridelin Ramos Aruca (Cuba)

Faycal Kharfi (Algeria)

Elena Robu (Romania)

Mohammed Khalil Saeed Salih (Sudan)

Funding

Two grant requests were submitted to the Friuli Venezia Giulia Region for the following experimental projects:

1. Sviluppo di un sistema portatile a raggi x per la caratterizzazione non distruttiva di materiale artistico e archeologico.
2. Sorgente pulsata al plasma di raggi x e neutroni per applicazioni mediche, ambientali ed industriali.

Programmes

Associateship Scheme
page 75

Federation Arrangements Scheme
page 77

Diploma Programme
page 79

Sandwich Training Educational Programme (STEP)
page 83

Other Joint Programmes in Higher Education
page 84

ICTP-ELETTRA Users Programme
page 85

SESAME Project
page 87

External Activities (OEA)
page 88

Training and Research in Italian Laboratories (TRIL)
page 90



carry the bits

(UTP) Cables -

(STP) Cables

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Only
different
operate at gigabit speed
UTP can operate at single
without repeaters.





ASSOCIATESHIP SCHEME

The Associate Scheme represents a main channel through which the vocation of the ICTP for the promotion and development of scientific knowledge in Developing Countries has been turned into reality. The Scheme enables individual scientists to maintain long term formal contacts with the stimulating and active scientific environment of the Centre. All evaluation committees of ICTP activities, both those of its mother Institutes, IAEA and UNESCO, as well as those of external bodies, like SIDA, have expressed their high appreciation for the excellence of this programme.

The Standard Scheme

The Associateship Scheme currently includes Junior, Regular, Senior, Group Associates.

- Junior Associates. Young Third World scientists coming from geographically isolated areas may be nominated Junior Associates. Starting from 1999 the Junior Associateship award has a six-year duration during which the Junior Associate is entitled to visit the ICTP three times, from six weeks to ninety days each time, with three fares paid. The age limit for a Junior Associate nomination is 35.
- Regular Associates are entitled to spend up to 270 days (with a maximum duration of 90 days for any single visit) at the Centre, in a period of six years, with three fares paid. A fare will be granted for visits having a minimum duration of 42 days. For each visit the Centre provides a daily living allowance. Age limits for Regular Associates are between 36 and 45, at the time of nomination.
- Senior Associates. Scientists who have acquired international scientific status may be nominated Senior Associates. They are entitled to the sum of Euro 7,250 to be spent during the six-year period of their appointment. These funds are made available in the form of a daily living allowance while at the ICTP and/or travel expenses. The age limit for a Senior Associate nomination is 62.
- Group Associates. Starting in 1999, the ICTP decided to reinstate the possibility of applying for Group Associations. Each Group will avail of a number of Associateship privileges depending on the number of Components of the Group, such as to allow each Member of the Group at least one visit at ICTP during the period allocated.
- Partnership visits. The Associates privilege may be utilized in other scientific institutions, in connection with agreements to be signed with the latter which should, in all cases, take care of part of the expenses involved, while the ICTP would grant the usual daily living allowance.

Obviously the implementation of this programme depends on the establishment of the agreements. Some preliminary steps to reach this goal, especially in fields in which a permanent activity at ICTP is not available, have been performed leading to 14 agreements. This number includes the recent Agreement with the Consorzio Nazionale Interuniversitario per le Telecomunicazioni – CNIT, established in December 2007. The Programme attempts to be flexible to suit the needs of the Associates as best as possible.

Identification and Selection of Candidates

The ICTP collects all applications from scientists who have often had some interaction with ICTP (typically participants in Courses and Workshops) and, at the end of the year, such applications are divided



according to the fields of interest of the applicants and sent to the appropriate scientific committees of ICTP, which are invited to prepare a priority list. The Office previously identified the number of appointments expiring, and, took this as well as the budget allocated for the Programme into account, to define the approximate number of new appointments for the subsequent year, so that the committees have a clear indication of how many new appointments would be issued in their field. Each Committee is requested to indicate – with an extra 50% margin – a foreseen number of new appointments in their field, so that in the end, when the general overview of the proposals is available, we can rearrange things in such a way as to respect the geographical distribution of the Associates. About 100 new positions open each year, but we analyse approximately 1,000 applications. For their evaluation, committees are invited to take into account the scientific level of the candidates as emerging from their academic titles and positions and particularly from their scientific production appearing on international journals. Finally, we require the committee to give priority to young active scientists and to women.

Also in 2007, as required by SIDA (Swedish International Development Agency), the Associateship Scheme catered to candidates working in least developed countries for which SIDA had earmarked its funds. Therefore, the Selection Committee was invited to focus on scientists from these countries for the appointment of new Associates.

Funding

This year, SIDA earmarked funds were sufficient to cover all visits from SIDA-funded countries. Unfortunately, 2007 is also the final year that SIDA is offering its generous financial contribution towards ICTP programmes, including ours. Considering that SIDA funds represented a large portion of the Associateship budget (about 35%), it is needless to say that its discontinuance will have a considerable impact on the Scheme in terms of significant budgetary setbacks in the years to come and unless the deficit is covered by other sources, there will be an unavoidable and substantial decrease in the number of Associate positions.

PROGRAMMES

**ICTP Associate Members Programme:
Appointments and visits, trend 1964–2007**



Among Associate Members are...

- > 1 President of a Republic
- > 11 Ministers or Deputy Ministers
- > 2 Members of Parliament
- > 7 Advisors to Presidents or Prime Ministers
- > 19 University Presidents or Vice Chancellors
- > 22 Deans of Faculty
- > About 150 Heads of Laboratory or Department

The Associates Scheme was established to provide support for distinguished scientists in developing countries in an effort to lessen the brain-drain.

Current status: In 2007, the programme generated 264 visits (36% of a total of 724 appointments of which 46 were new and 64 extended). They spent on average 46 days at the Centre.



FEDERATION ARRANGEMENTS SCHEME

The main difference between the Associateship Scheme and the Federation Arrangements Scheme derives from the fact that while the former is addressed to an individual scientist the latter involves an institution.

The Standard Scheme

Federation Arrangements are contracts of scientific collaboration signed by ICTP and a scientific institution in a Third World country, whereby the latter may send its junior representatives to ICTP, for periods ranging from 60 to 150 man-days per year on a cost sharing basis. No invitation is sent automatically. All cases are screened by the relevant activities' organizing committees or research groups. There are presently five standard types of arrangements, adopted according to geographical areas, which foresee different numbers of person-days.

The Scheme represents an interesting complementary programme to that of the Associates, in the sense that they differ under three important respects:

- If appropriately used, more scientists can be exposed to the scientifically stimulating atmosphere of ICTP because it is not addressed to an individual but to an institute.
- It should represent the basis of a long-term and fruitful co-operation between an institute and ICTP.
- It should stimulate the local community to make efforts to invest energy and resources to keep the important link with ICTP alive. In fact, the Scheme always foresees a financial commitment of the Federated Institute and if such commitments are not respected the agreement is cancelled.

Change of Policy

To increase the efficiency of the programme and to allow the Federated Institutes to make medium-term plans, starting 1999 the duration of the agreements was increased from one to three years. At the same time, taking into account the financial problems that the Associate and Federation Arrangements Schemes had to face in connection with the many new initiatives, the number of man-days per year allocated to each institution was slightly reduced.

Criteria for the Selection of the Institutions

Experience with this programme and efforts made to avoid misuses has allowed us to identify some general criteria which we believe should be followed in establishing new Federation Arrangements:

- We will consider only institutions of high scientific level and in which there is a rather consistent scientific population.
- We will pay specific attention to institutes in which there are brilliant young people scientifically active. In fact one of the drawbacks of the previous utilisation was that in many cases the institutes were proposing quite old scientists as visitors. If the Scheme has to contribute to the growing of new, high level competence, we have to —just as we do for the Associates — keep, as our primary objective,



that of performing actions which can have a long-term impact on the local situation. The obvious way to do so is to support active young researchers.

- Finally, even though this will not be an absolutely strict rule, we will try to establish agreements with institutes with which we already have serious collaborations, such as those in which there are (and/or were) prominent Associates or those which are included in other ICTP programmes, such as the ICAC Centres. To prevent this policy from leading to the exclusion of institutes of recent formation which are, however, promising, we will also make serious efforts to spread the information about the programme to receive more applications which will then be scrutinized to ensure the adequate scientific level already established for the programme.

Summary for 2007

In 2007 the ICTP had a total of 118 Federation Arrangements, 110 of which standard. The total number of visits under the programme was 101.

The total number of days available for the three-year period is 14,790 (i.e. an average total utilization per year of 4,930 days). In 2007, 2286 days were utilized. Accordingly, in terms of days, the total utilization was 46%.

The total expenditure (daily living allowance, and travel contribution when applicable) was Euro 121,548. A full utilization of one third of the total available would have implied an expenditure of Euro 251,270. Accordingly, in terms of funds, the total utilization was 48%.

Concise Forecast for 2008

- Total number of Federated Institutes: 111
- Visits from Federated Institutes already committed: 6



DIPLOMA PROGRAMME

Talented young science students in developing countries are sometimes limited in achieving their full potential by the absence of advanced postgraduate-level training that is up to international standards. It was in 1991 that the Centre instituted an intense 12-month Diploma Programme in the (then) main research fields of the ICTP: Condensed Matter Physics, High Energy Physics, and Mathematics. This report also includes information on a new diploma branch in Earth System Physics, which started in September 2006.

The Diploma Programme differs from other ICTP training/research activities such as Schools/Colleges: the Diploma period is one year; the level is pre-Ph.D; the participants are younger; and the number is small. From about 100 applicants to each of the four Diploma programmes, only 10 students are admitted in each. All 40 are given full support, covering airfare and living costs. The focus is especially on those developing countries for which high-quality advanced scientific training is less accessible. In the 2006-07 batch, the 34 students who joined came from 26 countries: Algeria, Azerbaijan, Cameroon, Chad, Colombia, Cuba, Democratic Republic of Congo, Egypt, Ethiopia, Guatemala, India, Iran, Kyrgyzstan, Madagascar, Mongolia, Nepal, Nigeria, Pakistan, Philippines, People's Republic of Congo, Senegal, Sudan, Thailand, Venezuela, Vietnam, Zambia.

The one-year academic programme itself is quite intense, and consists of three terms covering basic courses, advanced topics, and dissertation research under a supervisor. During the first and second terms, covering 9 months of the Diploma Programme, students attend around 10 hours a week of lectures, with problem sets and final exams in each of the 8-10 courses. (See Table on the next pages for 2006-07 courses). High standards are maintained: students are asked to leave if they fail in two or more courses; or if their final average grade is below a C; or if their dissertation is unsatisfactory. The vast majority of

Diploma Awards Ceremony

On 24 August, the Diploma students of the 2006-2007 academic year received their diplomas during a ceremony in the Main Lecture Hall. Their names are listed here below.

CONDENSED MATTER PHYSICS

Shimaa Abdelfatah, Egypt; Galbadrah Dagvadorj, Mongolia; Saheed Ganiyu, Nigeria; Otto Gonzalez, Cuba; Lister Mulindwa, Zambia; Thuong Manh Nguyen, Vietnam; John Realpe, Colombia; Belete Regassa, Ethiopia.

HIGH ENERGY PHYSICS

Nana Cabo Bizet, Cuba; Maria Cabrera Catalan, Guatemala; Ahmed Farag Ali, Egypt; Addishiwot Girma Woldesenbet, Ethiopia; Parinya Karndumri, Thailand; Gulmammad Mammadov, Azerbaijan; Badr A. Mohammed, Sudan; Thi Hong Van Nguyen, Vietnam; Martin Vollmann, Venezuela.

MATHEMATICS

Huybrechts F. A. Bindele, P. R. Congo; Jerry Ezeora, Nigeria; Eddy Kwessi, Cameroon; Teffera Mekonnen, Ethiopia; S. Molahajloo, Iran; Alzaki Mahmoud Muhammed Fadlallah, Sudan; El-Hassem Nayam, Chad; Lam X. C. Ngo, Vietnam; S. Phanzu, D. R. Congo; Khim R. Shrestha, Nepal.

EARTH SYSTEM PHYSICS

Muhammad Adnan Abid, Pakistan; Rondrotiana Barimalala, Madagascar; Samir Lamara, Algeria; Shantanu Pandey, India; Armelle Reca Remedio, Philippines; Mouhamadou Bamba Sylla, Senegal.





the 500+ students over the past sixteen years, have successfully surmounted these hurdles, whatever their initial background.

After the Diploma, most students go on to Ph.D. work in Europe or North America; or return to jobs as college teachers, or register for Ph.D. in their home countries. In the 2006-07 batch of 33 total students that received their Diplomas, the Ph.D. placements include: Syracuse University, EMPA-ETH Zürich and Politecnico di Torino, for CMP Diploma; Minnesota, Syracuse Universities and SISSA, for HEP Diploma; Universities of South Florida, Auburn, Tor Vergata, Pisa, Johannes Kepler in Linz, Austria, and York Canada, for MTH Diploma; Bochum and Trieste Universities for ESP diploma. The others took up Ph.D. registrations, or teaching positions in their home countries.

The ICTP Diploma Programme is a gateway for young people who might otherwise never have had a chance to reach international-level standards in physics and mathematics, and to more fully realize their intellectual potential. Former students from the very earliest batches, who have returned home (having completed the usual academic training of a Ph.D. and a couple of postdocs), are now applying for ICTP Junior Associateships, and for participation in ICTP Activities. They are training students of their own, some of whom may apply to the ICTP Diploma Programme, thus closing the circle.

A new diploma programme in Basic Physics started in September 2007. It admits 10 students from only Sub-Saharan African Countries, bringing the total number of diploma students to 50.

The 2006-2007 ICTP Diploma Programme in Brief

1 September 2006 through 31 August 2007

First term: September-December 2006

Second term: January-May 2007

Topic (hours of teaching)

Course of Study: Condensed Matter Physics

Co-ordinator: S. Scandolo

	Topics:	Faculty:
First term:	Advanced Quantum Mechanics (48) Numerical Methods (31.5) Statistical Mechanics (31.5) Symmetries, Electron Bands & Phonons (36)	R. Gebauer (ICTP), G. Santoro (SISSA) M. Sellitto, T. Galla (ICTP) M. Marsili (ICTP) S. Scandolo (ICTP)
Second term:	Many-Body Physics (18) Cooperative Phenomena in CMP (18) Stochastic Processes and applications (18) Semiconductors (18) Superconductivity (18) Models and Methods in Biological Phy. (18)	B. Narozhny (ICTP) M. Kiselev (ICTP) R. Zecchina, T. Galla (ICTP) M. Verissimo (ICTP) O. Yevtushenko (ICTP) C. Micheletti (SISSA), A. De Simone (SISSA)

Course of Study: High Energy Physics

Co-ordinator: K. S. Narain

	Topics:	Faculty:
First term:	Introduction to Particle Physics (33) Lie Groups and Lie Algebras (30) Quantum Electrodynamics: Introd. to Quantum Field Theory (36) Relativistic Quantum Mechanics (30)	A. Smirnov (ICTP) B. Acharya (ICTP) S. Randjbar-Daemi (ICTP) M. O'Loughlin (ICTP)
Second term:	General Relativity (32) Quantum Field Theory (38) The Standard Model (30) SUSY Field Theory (23)	P. Creminelli (ICTP) K.S. Narain (ICTP) G. Senjanovic (ICTP) E. Gava (Italy)



Course of Study: Mathematics
Co-ordinators: C.E. Chidume and D.T. Le

	Topics:	Faculty:
First term:	Abstract Algebra (30) Point-set Topology (30) Real Analysis (30) Complex Analysis (30) Ordinary Differential Equations (7.5)	R. Ramakrishnan and L. Götsche B. Zimmermann (Trieste University) G. Dal Maso (SISSA) O. Shatalov (Israel) A. Ambrosetti (SISSA)
Second term:	Functional Analysis (33) Differential Geometry (30) Algebraic Topology (15) Algebraic Geometry (34.5) Functional Analysis II (30) Real Analysis II (15)	C.E. Chidume (ICTP), O. Shatalov J. Li (ICTP) D. Repovš (Ljubljana) L. Götsche (ICTP) N. Djitte (Senegal) D. Waterman (Florida)

Course of Study: Earth System Physics
Co-ordinator: A. Aoudia

	Topics:	Faculty:
First term:	Intro to the Physics of the Earth System (36) Mathematical Methods in Geophysics (36) Wave Physics (39) Environmental Data Analysis I (17)	G.F. Panza (Trieste Univ./ICTP), C. Piani (ICTP) F. Kucharski (ICTP) F. Romanelli (Trieste University) A. Peresan (Trieste University)
Second term:	Physics of the Atmosphere (36) Physics of the Oceans (18) Physics of the Solid Earth (36) Environmental Data Analysis II (17) Specific Topics (36)	D. Giajotti and F. Stel (OSMER FVG) J. Kröger (ICTP) K. Aoudia (ICTP) A. Peresan (Trieste University), E. Coppola (ICTP) A. Aoudia (ICTP)



The ICTP Experience: Diploma and STEP Students

This book contains anecdotal experiences in the words of Diploma students, with a preface and analysis. The primary reason for conceiving this book was to gauge the impact of the programme. This impact is enormous. Indeed, without this programme, many of the students would have had no opportunity to go to graduate school. The book also describes the experiences of a few STEP students working for their Ph.D. degrees.

*The book is available on-line at
<http://publications.ictp.it/books.html>*



The Diploma Programme

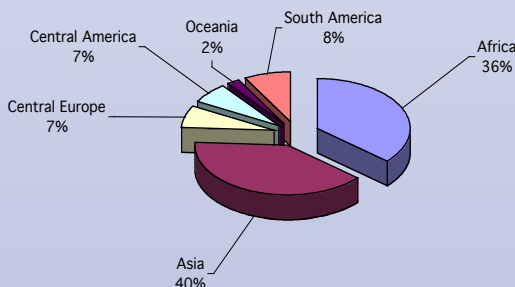
Towards the end of 1980's it was clear that ICTP needed to create a training programme targeted to a younger generation of students in developing countries. There were, and there still are, a large number of undergraduate or graduate students in these countries who have the ambition to become professional scientists but do not possess the means of realizing their dreams. After about a year or so of preparatory discussions and studying the graduate programmes of several universities in Europe and elsewhere, the Diploma Programme of ICTP was launched in the fall of 1991. Originally the programme covered only the fields of High Energy and Condensed Matter Physics. A year later Mathematics was included.

The idea of the Diploma Programme was, and is, to select up to 10 students in each field from those countries which do not have, in terms of quality and quantity, a well developed training system in physics and mathematics and expose them to an intensive one-year teaching. Some preference is given to female and African students. Out of a total of 518 students admitted so far, 108 were female and about 38% come from Africa. The course is rather intensive and is divided into two parts with an exam at the end of each part. The diploma is awarded to those students who successfully pass the exams and defend a dissertation at the end of the year. The success rate so far has been about 75%.

Since 2006 we have added a branch in Earth System Physics and in the year 2007 students have been admitted to a new division under the name of Diploma in Basic Physics. While the diploma in Earth System Physics is akin to the already existing ones in High Energy, Condensed Matter and Mathematics, that in basic physics has a slightly different structure. First, as far as possible, preference is given to younger applicants. Second, they are selected exclusively from sub-Saharan African countries. In addition, unlike the other four diploma programmes, the bulk of the teaching in the Diploma in Basic Physics is not in any specialized areas of physics. Indeed the reason for creating this branch was the experience acquired during the first 15 years, which convinced us that while the sub-Saharan African students are very hard working and talented, their background usually needs improvement before they can fully start to benefit from rather advanced topics covered in our own Diploma Programmes or any other graduate level lectures in other places. For the first year the selected students are from Cameroon, Ethiopia, Ghana, Kenya, Malawi, Nigeria, Senegal, Sudan.

The ICTP Diploma is largely recognized as an MSc degree equivalent. After being awarded the ICTP Diploma, some of our students manage to obtain admission to a Ph.D. programme in Europe or the US. A number of them also return to their home countries to continue their studies towards a higher degree. We have been able to trace the evolution trajectory of only a subset of our students after they leave the ICTP. Detailed statistics can be found in the book described on the previous page.

It is hoped that by giving a solid background in advanced learning in some areas of physics and mathematics to a group of aspiring young students our Centre will contribute to the training and capacity building in the most needy parts of our planet, in particular in sub-Saharan African countries. It is not hard to imagine the cumulative effect of the programme after a couple of decades.



S. Randjbar-Daemi Geographical distribution of Diploma students



SANDWICH TRAINING EDUCATIONAL PROGRAMME (STEP)

The Sandwich Training Educational Programme (STEP) aims to offer fellowship opportunities to Ph.D. candidates from developing countries. The scientific fields covered by the programme fall within the scientific and technical competence of the ICTP and its collaborating institutions. The programme is funded by ICTP, the IAEA's Department of Technical Cooperation, CEI (Central European Initiative), and the Japanese Government through the UNESCO-ICTP Mori Fellowship Scheme.

The programme is addressed to Ph.D. students in developing countries who are offered fellowships of 3-6 month stay each year, for 3 successive years at the ICTP or at collaborating institutions (Synchrotron Light Laboratory ELETTRA, Laser Laboratory, ICGEB, ICS-UNIDO, Universities of Trieste and Udine, ARPA, IAEA Laboratories in Seibersdorf, Jožef Stefan International Postgraduate School in Ljubljana, Hospitals of Udine and Trieste, and others). Fellows can thus work on their Ph.D. thesis on a sandwich basis with their supervisor at their home institute and a co-supervisor at the hosting institute. Their Ph.D. is awarded at their home institute.

In order to strengthen the STEP Programme, in 2007 the CEI supported the visit of a STEP fellow's home supervisor. This kind of visits should be encouraged as they improve the working conditions of fellows and offer the opportunity to strengthen scientific links between the ICTP and the home supervisors.

Sandwich Programme at a Glance

STEP Students: 19 supported by the IAEA, 6 from ICTP, 5 from CEI, 10 from UNESCO (Mori). See Table 5 in Appendix 4 for the full list of fellows.

Areas covered: nuclear physics, soil physics, lasers, environmental physics, synchrotron radiation, fluid dynamics, condensed matter

The programme started in 2002. Since then, it has supported 74 fellows:

- 36 from Africa (14 women)
- 13 from Asia (6 women)
- 20 from Europe (7 women)
- 4 from Central America (3 women)
- 1 from Latin America

Host institutions:

- 27 at the ICTP
- 19 at the Laser Laboratory
- 7 at the University of Trieste
- 4 at Jožef Stefan Institute, Ljubljana, Slovenja
- 2 at ICS
- 1 at ARPA (environmental laboratory)
- 1 at TASC (nanoscience laboratory)
- 1 at the Hospital of Udine



OTHER JOINT PROGRAMMES IN HIGHER EDUCATION

In addition to the ICTP-IAEA Sandwich Training Educational Programme and UNESCO-ICTP Mori Fellowship Scheme, the ICTP also has the following programmes in higher education, in cooperation with local research institutions:

1. Laurea Magistralis programme

- ICTP-University of Trieste Laurea Magistralis in Fisica with training tracks in
 - Condensed Matter Physics
 - Nuclear and Sub-Nuclear Physics
 - Theoretical Physics
 - Earth and Environmental Physics
- ICTP-University of Trieste Laurea Magistralis in Astrofisica e Fisica Spaziale

These two degrees can be compared to an advanced masters degree in the Anglo-Saxon system or to the last two years of the New European Educational System as fixed by the Bologna-Sorbonne agreement among the European Ministers of Education in the mid nineties.

This programme is open to anyone having the equivalent of a Bachelor degree in Physics or who has completed the first three years of the New European Educational System equivalent to 180 ECTS points (European-Credits-Transfer-System points). Before registration the academic degree will be checked by a joint committee of the University of Trieste and ICTP.

The courses are taught in English and are offered by scientists belonging either to the University of Trieste or ICTP. A course on Italian language is organized for the foreign students during the first academic year.

A limited number of fellowships is awarded to the best students from developing countries.

Upon successful completion of the entire study plan students will be awarded a degree from the University of Trieste.

2. Ph.D. programme in Environmental Fluid Mechanics

This programme is patterned after a Ph.D. programme in an American University. Now in its third year, it is run with the following participating institutions:

- Dipartimento di Matematica ed Informatica, Università degli Studi di Trieste
- The Abdus Salam International Centre for Theoretical Physics
- Scripps Institution of Oceanography, University of California, San Diego
- Mechanical and Aerospace Engineering, Jacobs School of Engineering, UCSD, La Jolla
- Laboratoire des Écoulements, Géophysiques et Industriels, Grenoble
- Osservatorio Meteorologico Regionale del Friuli Venezia Giulia
- Consiglio Nazionale delle Ricerche
- Istituto di Scienze Marine, Sezione di Trieste
- Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS

The following staff members from ICTP have regularly taught graduate courses and supervised Ph.D. students: F. Giorgi, F. Kucharski, J. Niemela and K.R. Sreenivasan. The number of Ph.D. students currently registered is about 15.



ICTP-ELETTRA USERS PROGRAMME

The ICTP-ELETTRA Users Programme offers access to the synchrotron radiation facility ELETTRA in Trieste in the years 2007-2011 to scientists from and working in developing countries. A minimum of an annual total of 1500 hours is made available within this programme for short projects such as measurements or other applications at any of the existing ELETTRA beamlines. The proposed experiments for beamtime assignment are selected on the basis of their scientific merit.

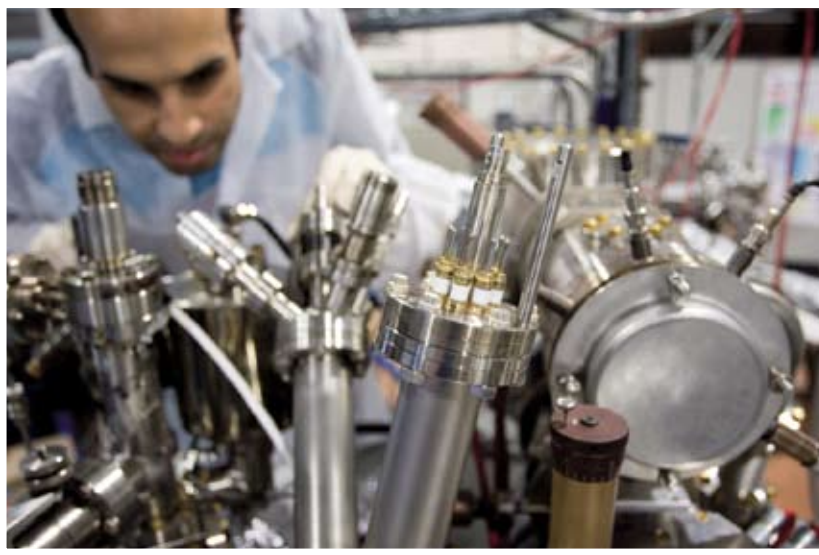
The programme offers a limited number of grants to cover travel and living expenses of individuals and small groups who are meant to participate in the beamtime at ELETTRA. Depending on the allocated beamtime and funds available, two or three scientists receive support for each project. In order to allow for experiment preparation and/or sample disposal, support can be offered towards stays up to 3 days before the beginning date of the experiment and 1 day after its completion. The programme is funded by the ICTP.

There are two deadlines every year: 28 February for proposals eligible for the user period 1 July-31 December of the same year; 31 August for proposals eligible for the user period 1 January-30 June of the following year.

In 2007, a scheduled three-month closure (October-December) of the ELETTRA Synchrotron Light Laboratory took place, for the installation of the new ELETTRA booster.

2007 Activities

A total of 2664 hours were allocated in 2007. The beamline hours allocated to scientists from developing countries indicates the overwhelming success of the programme.



A user working at one of the beamlines of the ELETTRA laboratory

Measurements were run on the following beamlines:

- Advanced Line for Overlayer, Interface and Surface Analysis (ALOISA): the beamline is a multipurpose beamline, which offers a wide range of complementary experimental techniques like photoemission spectroscopy, photoelectron diffraction, x-ray diffraction etc.



- Advanced Photoelectric-effect Experiments (APE): is a facility for advanced experiments on solid surfaces and nanostructured matter.
- Bending magnet for Emission Absorption and Reflectivity (BEAR): the BEAR apparatus, beamline and experimental station, is designed for the study of a wide class of samples with emphasis on joint structural and electronic (magnetic included) properties of reduced dimensionality systems including free surfaces, interfaces, multilayers and adsorbates.
- Laboratory for Interdisciplinary Lithography (LILIT): the beamline is devoted to the fabrication, by means of x-ray lithography, of structures at micro and nano resolution level, taking advantage of the high brilliance and wide x-ray domain spectrum of ELETTRA.
- Material Science Beamline (MASC): is dedicated to the study of solids and surfaces of industrial relevance.
- Nanospectroscopy (NANO): the Nanospectroscopy beamline consists of two branches designed for two imaging photo-electron microscopes.
- Small Angle X-ray Scattering (SAXS): is mainly intended for time-resolved studies on fast structural transitions in the sub-millisecond time region in solutions and partly ordered systems with a SAXS-resolution of 1 to 140 nm in real-space.
- Source for Imaging and Spectroscopic Studies in the Infrared (SISSI): the beamline extracts the IR and visible components of synchrotron emission for applications of spectroscopy, microspectroscopy and imaging.
- SYNchrotron Radiation for MEDical Physics (SYRMEP): the beamline has been designed for research in medical diagnostic radiology.
- X-ray Absorption Fine Structure (XAFS): EXAFS spectroscopy provides microscopic structural information of a sample through the analysis of its x-ray absorption spectrum.
- X-Ray Diffraction 1 (XRD1): designed primarily for macromolecular crystallography.

In 2007, ICTP supported 37 visits of participants coming from:

Brazil	5	Moldova	3
China	6	Pakistan	2
Croatia	4	Slovenia	5
Czech Republic	1	Ukraine	1
India	10		

Total expenditure: Euro 48,131.



SESAME PROJECT

The SESAME (Synchrotron light for Experimental Science and Applications in the Middle East) project aims to build a synchrotron light source in Jordan, at Al Bal'qa University, and to operate it as an international laboratory to all scientists from the region. SESAME is developed under the aegis of UNESCO and is overseen by a Council, chaired until recently by H. Schopper, former Director General of CERN, with representatives of the participating countries (Bahrain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestine Authority and Turkey). Sir Chris Llewellyn Smith, also former Director General of CERN, is the new chairman of the SESAME Council from 2008, when the SESAME Centre in Jordan will be officially inaugurated.

ICTP has a role in the training programmes of SESAME. In order to give Middle Eastern scientists and engineers an opportunity to contribute to the construction and the use of the future facility in the most productive way, it is essential that they acquire familiarity with the existing facilities. ICTP offers its assistance in the programmes aiming at giving young scientists from the region an opportunity to spend six months or more in a facility in Europe. ELETTRA and other facilities in Europe have agreed to welcome trainees from the SESAME countries and ICTP is assisting them in securing funds from the programs of the IAEA Division of Technical Cooperation or from the hosting facilities themselves. The STEP Programme offers opportunities for training of Ph.D. students from SESAME countries in the field of use of the synchrotron beamlines. The ICTP TRIL Programme also offers training at ELETTRA for both scientific studies using beamlines in operation as well as the engineering aspects of beamlines under construction. Finally, the Associates Scheme is available to involve scientists from SESAME countries in synchrotron research activities in Trieste.

After an initial phase in 2001-2003 devoted to the training of machine technicians, now attention is directed towards the training of experts on beamline maintenance and management, in close collaboration with ELETTRA.

The IAEA Technical Cooperation programme is providing USD 750,000 to support a training programme for the period 2007-2011.

Claudio Tuniz, ICTP's Assistant Director, attended the 11th meeting of the Council of Sesame, in Nicosia, Cyprus, on 11-12 December 2007. The confirmation of ICTP's involvement in the SESAME training programme was welcome by the Council.



EXTERNAL ACTIVITIES (OEA)

The Office of External Activities (OEA) was established in 1986 with the objective of helping the research and training activities of physicists and mathematicians living and working in the developing countries. The OEA provides assistance to scientists in their home countries. Such support complements the training and research that is provided to scientists from developing countries at the Centre. The OEA programmes can provide funds for student grants, fellowships for young researchers, visits of research collaborators, equipment, literature, etc. Funding comes mainly from the Centre's general budget but the OEA also received additional contributions from SAREC/SIDA for programmes in sub-Saharan Africa.

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 (South-North collaboration) and to stimulate networking of scientists in the developing regions to reach a critical mass of researchers (South-South collaboration).

Assistance is carried out within the following schemes:

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

Affiliated Centre (ICAC) 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. Affiliated Centres have a regional character and are strongly supported by the local authorities and the hosting institute.

In the year 2007 the OEA supported 6 Affiliated Centres, 4 in Africa, 1 in Latin America and 1 in Eastern Europe.

Projects

Given the lack of trained personnel in physics and mathematics at universities in some developing countries and the fact that many students from these countries who pursue their graduate studies in industrialised countries do not return to their countries of origin, the OEA supports specific Ph.D. courses, primarily in Africa. The OEA also supports several research projects that do not currently fit the category of Affiliated Centres. There are 14 active projects, of which 8 are in Africa, 5 in Asia and 1 in Latin America.

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 13 networks in various fields of physics and mathematics 1 of which is new. There are 5 Networks in Africa including North Africa; 3 in Asia and 4 in Latin America and the Caribbean. There is also 1 Network that spans Africa and Asia.

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.



78 scientific meetings received support in 2007:

28 in Africa:	2 Benin, 1 Cameroon, 1 Cote d'Ivoire, 3 Egypt, 3 Ghana, 1 Kenya, 2 Morocco, 1 Niger, 2 Nigeria, 2 Senegal, 3 South Africa, 2 Sudan, 2 Tanzania, 1 Tunisia.
28 in Asia:	1 China, 3 India, 5 Indonesia, 3 Iran, 1 Malaysia, 2 Mongolia, 3 Pakistan, 2 Philippines, 2 Thailand, 2 Turkey, 1 Ukraine, 1 Uzbekistan, 2 Vietnam.
6 in North and Central America:	1 Cuba, 3 Mexico, 1 Nicaragua, 1 Trinidad and Tobago.
14 in Latin America:	4 Argentina, 1 Bolivia, 3 Brazil, 4 Colombia, 1 Uruguay.
5 in other countries:	1 Australia, 1 Bulgaria, 1 Croatia, 1 Switzerland, 1 Serbia.

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 field of expertise. This is another effective way to counteract the isolation of scientists and to allow them to maintain contacts and collaboration with leading experts from other countries. During 2007 there were 15 new Visiting Scholars awarded.

Reorganization

The distribution of the OEA's activities has changed somewhat from previous years due to a reassessment of the programmes. Some of the activities previously listed as Affiliated Centres and Networks have been redesignated as Projects.

Collaborations

OEA collaborates with other institutions in promoting research and training in physics and mathematics in the developing countries. In particular there are collaborations with:

SAREC/SIDA

OEA has had a long-standing collaboration with SIDA, which provided the OEA and the Associate Office with substantial funds for programmes in sub-Saharan Africa. Those agreements came to a close at the end of 2007.

Centro Latino-Americano de Fisica (CLAF)

Since its inception, ICTP has maintained close links with CLAF. This collaboration was formalised in a Memorandum of Understanding signed with CLAF in 1996 and renewed in 2001 for another 5 years. Under this MoU the ICTP provides a substantial support for CLAF activities in Latin America that include research exchange visits and sandwich Ph.D. programmes. This collaboration has been very fruitful.



TRAINING AND RESEARCH IN ITALIAN LABORATORIES (TRIL)

Introduction

The Programme of Training and Research in Italian Laboratories (TRIL) offers scientists from developing countries an advanced experimental counterpart to ICTP's primarily theoretical research and lecture-based training programmes. The fields covered reflect the lines of interest to the Centre: for example, physics of condensed matter; physics and energy; physics and technology; earth and environmental sciences; physics of the living state and a few interdisciplinary subjects that are not emphasized at the Centre.

A more far-sighted view is to promote, through direct contacts and side-by-side research, collaborations between the Italian scientific community and individuals, groups and institutions in developing countries. TRIL can be viewed as a genuine 'Italian' project in advanced scientific training co-ordinated by ICTP. This project helps to implement an important aspect of the mission of ICTP – to form and strengthen a permanent scientific elite in developing countries who are aware of local needs and resources and cognisant of those frontiers of science and technology that are most likely to influence national progress.



The ICTP Experience: The TRIL Programme

This book consists of some 280 responses received from former TRIL fellows explaining the impact that the fellowships had on their careers. A preface and analysis is included. The primary reason for conceiving this book was for ICTP to gauge its impact on scientists and their careers. What transpires from the essays collected here may also be inspirational to readers, especially young scientists. Many of young researchers learnt to do research during their TRIL fellowship.

The book is available on-line at <http://publications.ictp.it/books.html>

About 380 Italian laboratories have contributed to TRIL, and 1125 scientists from developing countries (through December 2007 for a total of 1719 grants and 16,215 person-months) have been offered opportunities to participate in side-by-side high-level, mostly experimental, research enjoying access to Italian teams and advanced equipment and experiencing an international atmosphere.

Universities are the most numerous host institutions because of their historical ability to deal with a wide spectrum of scientific problems. On the other hand, laboratories of public and private research institutions such as CNR (Italian National Research Council), ENEA (Italian National Agency for New Technologies, Energy and the Environment), INFN (Italian National Institute of Nuclear Physics), APAT (Agency for Environmental Protection and Technical Services), ST (Sincrotrone Trieste), OGS (National Institute for Oceanography and Experimental Geophysics) and others often have special equipment better geared to a specific research purpose. The presence of foreign visitors can also provide a practical solution to temporary personnel shortages at these laboratories. In many cases, the visit of an individual



scientist has led to a more extended collaboration.

As a measure of the success, one can cite the high standard of the published reports, the often significant contribution offered by our fellows to laboratory research activities, and the fact that a TRIL fellowship frequently has been instrumental for promotions (to the rank of full professor, vice chancellor, high ministerial official, minister, etc.). More importantly, the visit of an individual scientist often represents the starting point for more extended collaboration that sometimes involves the institutions. It is no exaggeration to state that many participant fellows learnt how to do proper research during their tenure as TRIL fellows.

One should mention the fruitful collaboration programmes established among institutions in Italy and those in Argentina, China, Cuba, India, Nigeria, and other countries. This aspect of the programme, i.e. the 'follow-up' stage, represents one of the main objectives of TRIL and needs continued attention and support.

Demand from the fellows' side is high – 8867 applications through December 2007. This confirms that TRIL is a valuable component of ICTP's action to strengthen a scientific-technological elite in the developing world.

From the Italian side, a positive aspect is represented by the increasing interest and participation of Italian scientific institutions – universities and national agencies – which continue to offer the possibility of high-level scientific collaboration and often contribute financially to the costs of the grants. New agreements have been signed and existing ones strengthened. For 2007, the annual financial contribution from external sources was about double the budget provided by ICTP. We trust that such schemes of collaboration will represent a regular component of the TRIL programme.

The total number of new grants awarded in 2007 was 67. Additionally 43 extensions were awarded to existing grants to allow the fellows to continue the studies in Italy.

Activities in 2007

Funds available were used for fellowships (new fellowships and extensions):

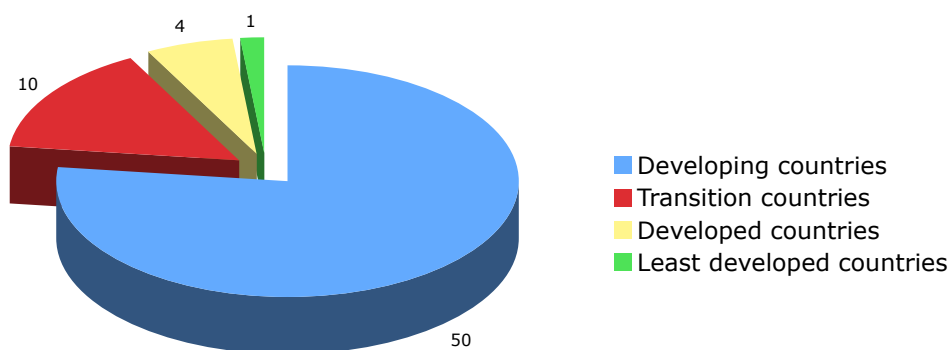
- in Medical Physics (which is a subject more and more requested by candidates);
- in Earth and Environmental Sciences (some of the fellowships were covered in the framework of the agreements with OGS, ENEA);
- in Materials Science, Optical Physics and Condensed Matter Physics (some of the fellowships were supported through the Agreement with ST and funds provided by the laboratories);
- in Renewable Energies. The relevant financial support is mainly coming from a generous grant of 300,000 Euro offered by MAE and from ENEA;
- As a follow-up to the successful workshop on "Science for Cultural Heritage", held at the ICTP in October 2006, a corresponding announcement was published and 5 candidates selected.
- The TRIL Programme was also involved in a meaningful initiative in higher education: A joint project by the University of Trieste, Faculty of Sciences and the ICTP concerning the access to young students from Developing Countries to the "Laurea Magistralis in Fisica" and "Laurea Magistralis in Astrofisica e Fisica Spaziale". Both are covered in two Academic Years. It is remarkable that all the courses and examinations are held in English and the goodwill to collaborate of both the Italian professors and students is gratefully acknowledged.



- In 2007 funds for eight fellowships (students from Armenia, Cameroon, China, Indonesia, Iran, Pakistan, Ukraine and Uzbekistan) have been provided by TRIL and the Italian Ministry of University and Research (MIUR) and three students graduated (Cameroon, China and Ukraine).

In 2006 a questionnaire was sent to all fellows who could be reached via e-mail (653). The 263 replies received were processed and a volume was issued and presented at the G8-UNESCO Forum on "Education, Research and Innovation: New Partnership for Sustainable Development" held in Trieste from 10 to 12 May 2007.

Special attention is being devoted by the Italian Government to Science and Technology for Sub-Saharan Africa. In this spirit the ICTP submitted a project "TRIL for Africa" to the Ministry of Foreign Affairs.



TRIL grants awarded in 2007

What next?

The need to maintain the contacts between the Italian laboratory and the scientists who have successfully worked there has been repeatedly stressed. Such follow-up action should become one of the main lines of action of TRIL and, in this connection, the creation of the TRIL-Associate scheme was advocated. Also the Laurea Magistralis Scheme (jointly with the University of Trieste) should become a regular component of the TRIL activities.

At present, owing to fund limitations, only 13 TRIL Associates have been appointed in: Condensed Matter (Nigeria, Uruguay, Cuba, India), Optical Physics (Ghana, China, Slovak Republic), Environment and Earth Sciences (India, Argentina, Cuba, Bulgaria), Instrumentation (Morocco, Nigeria) – with complete satisfaction of both the sides involved. Several other “return-visits” have been supported occasionally but it is clear that this new scheme must receive adequate attention and financial support in the near future.

A new project “TRIL for Balkans” is under preparation in cooperation with the Central European Initiative (CEI) and the Adriatic-Ionic Initiative (AII).

Prizes and Awards

Dirac Medal
page 95

ICTP Prize
page 95

ICO/ICTP Award
page 95

Ramanujan Prize
page 96

Prizes for Leadership in Science and Public Life
page 96







DIRAC MEDAL

ICTP instituted the Dirac Medal in 1985. The Medal is awarded yearly on Paul A.M. Dirac's birthday – 8 August – to individuals who have made significant contributions to physical sciences. An international committee selects the winners from a list of nominated candidates. The 2007 Committee consisted of Philip W. Anderson (Princeton), Nicola Cabibbo (Roma), David J. Gross (KITP, Santa Barbara), Leo P. Kadanoff (Chicago), Martin Rees (Cambridge) and Carl E. Wieman (Colorado).

The 2007 Medal was awarded to Professor John Iliopoulos, Laboratoire de Physique Théorique, Ecole Normale Supérieure, Paris, and Professor Luciano Maiani, Università degli Studi di Roma "La Sapienza," "for their work on the physics of the charm quark, a major contribution to the birth of the Standard Model, the modern theory of Elementary Particles." See <http://prizes.ictp.it/Dirac> for a list of previous Dirac Medallists.



The 2007 Dirac Medal was presented to Luciano Maiani and John Iliopoulos on 27 March 2008



Mohammad Mehdi Sheikh-Jabbari received the ICTP Prize on 31 March 2008

ICTP PRIZE

Annual ICTP Prizes were created in 1982 by the ICTP Scientific Council in recognition of outstanding and original contributions within mathematics and physics by young scientists from developing countries.

The 2007 Prize was awarded to Professor Mohammad Mehdi Sheikh-Jabbari, Institute for Studies in Theoretical Physics and Mathematics, Tehran, Iran. Sheikh-Jabbari was honoured "for his important contributions to non-commutative field theories in the context of D-branes and superstring theories, leading to interesting formal and phenomenological developments in theoretical and mathematical physics." The 2007 Prize is named after the great Russian physicist L.D. Landau, Nobel Laureate 1962. The 100th year of his birth will be celebrated in 2008. See <http://prizes.ictp.it/Prize> for a list of previous ICTP Prize winners.

ICO/ICTP AWARD

ICO, the International Commission for Optics, and ICTP have established a joint prize, called the ICO/ICTP Award, reserved for young researchers from developing countries who conduct research in one of them. The award is given to young scientists who contributed original research in optics and promoted the field. From 2008, the prize has been named also in honor of Professor Gallieno Denardo whose sudden death in 2007 robbed the Centre of an important person.

The 2007 Award was given to Dr. Svetlana V. Boriskina, School of Radiophysics, V. Kharazin



Kharkov National University, in Kharkov, Ukraine “for her original work in the development of numerical modelling techniques for optoelectronic devices, micro-optical resonators, dielectric lenses and waveguides and for her active commitment aimed at the diffusion of research in optics in Ukraine”. See <http://prizes.ictp.it/ICO/> for a list of previous ICO/ICTP Award winners.



Svetlana V. Boriskina was awarded the ICO/ICTP Prize on 16 February 2007

RAMANUJAN PRIZE



The 2007 Ramanujan Prize was awarded to Jorge Lauret on 3 December 2007

In 2004, ICTP created the Ramanujan Prize for young mathematicians from developing countries. The Prize is funded by the Niels Henrik Abel Memorial Fund, with the involvement of the International Mathematical Union.

The 2007 Srinivasa Ramanujan Prize was awarded to Professor Jorge Lauret of the Universidad Nacional de Córdoba, Argentina, “in recognition of his outstanding contributions to differential geometry and group representations”. See <http://prizes.ictp.it/Ramanujan> for a list of previous Ramanujan prize winners.

PRIZES FOR LEADERSHIP IN SCIENCE AND PUBLIC LIFE

In late 2004, ICTP established the following five annual Prizes for Leadership in Science and Public Life. The Prizes are being funded by the Templeton Foundation. Each Prize carries a cash award of USD 20,000. Prospective candidates should have a doctorate degree and be younger than 45 years old at the time of the award. Applications should be submitted in English within the following five prize categories:

- Abdus Salam Prize for Leadership in Islamic Thought and the Physical Sciences
- Ahmed Zewail Prize for Leadership in Islamic Thought and Biological Science
- Ahmed Zewail Prize for Leadership in Islamic Thought and Chemical Sciences
- ICTP Prize (two in number) for Leadership in Islamic Thought and Applied Sciences (Medicine, Agriculture, Engineering, Technology)

For additional information, see <http://prizes.ictp.it/prizes/Templeton/>

Scientific Support Services

Science Dissemination Unit
page 99

Library
page 102

Information and Communication Activities
page 104

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C
T
P







SCIENCE DISSEMINATION UNIT

The Science Dissemination Unit (SDU) was created in late 2004 with the broad aim of disseminating scientific contents to more people than are able to visit the Centre, and to the public in general throughout the world, via electronic media. Since science dissemination is part of ICTP's main role, and dissemination in the modern world is impossible without a strong component of modern technologies, this unit was put together to serve the ICTP community in every possible way. Website: <http://sdu.ictp.it>

SDU also works on special requests, and advice, related to Information and Communication Technologies (ICT). On-going SDU projects on ICT (within local, regional and international collaborations) are as follows.

Training Workshop at ICTP

In collaboration with Cambridge University, UK, and University of Bucharest, Credis department, Romania, the SDU organized a workshop on "Rich-Media Webcasting Technologies for Science Dissemination," 3-11 December 2007; 64 participants.

It consisted of theoretical lectures, hands-on sessions and demos. Software applications for on-demand and live broadcasting of seminars, lectures and peer-to-peer collaboration via Internet were discussed under conditions of low-bandwidth connectivity. Case studies by participants, describing their computing and networking environment, connectivity related problems and issues on content delivery, etc. were analysed. The Workshop was open to scientific computer consultants and network managers working in scientific institutions and isolated scientific environments with a minimal infrastructure. Website: <http://sdu.ictp.it/richmedia>.

Free Electronic Journals Delivery Service

The SDU supervised the free electronic Journals Delivery Service (eJDS). The aim of eJDS is to facilitate access to current scientific literature for scientists at institutions in developing countries who cannot afford to download articles from the Internet, due to insufficient bandwidth. After registering, scientists -residing in the approved countries, can receive via e-mail a number of articles per week. This is carried out in collaboration with the ICTP Library (for the agreements with the Publishers or Societies) and the Scientific Computing Section (for the e-Journal server admin). Website: <http://www.ejds.org>

An overview of the goals and achievements of eJDS was reported in the literature in 2006. As an example, the PDF downloads from African countries is shown in Fig. 1.

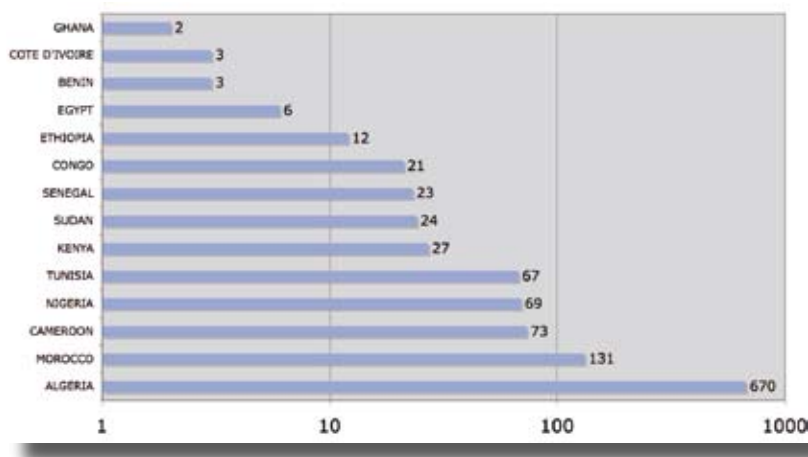


Fig. 1: PDF downloads using eJDS



Diploma Course On-line and Digital Lectures

The SDU has developed a completely automated and non-intrusive system for the webcasting of scientific lectures given at the ICTP Diploma Course and during conferences and workshops. The system is named EyA-“Enhance your Audience”. The main idea is that a Lecturer/ Speaker should not even notice the presence of any special equipment or be disturbed by any particular technological requests. After the initial test period with EyA carried out during October-December 2006, then from September 2007 the whole Diploma Course is being recorded and archived on the web. Plan for the future is to distribute this scientific material to developing countries on DVD. Website: <http://www.ictp.tv>

The use of the EyA automatic recording system in many selected ICTP activities, so called “Digital Lectures”, can be seen at the website: <http://sdu.ictp.it/>

We are pleased to report that this effort received the first prize for innovation in the region Friuli Venezia Giulia (see Fig. 2).

African Connectivity as Measured from ICTP: Pinger project

Pinger (Ping End-to-end Reporting) is the name given to the Internet End-to-end Performance Measurement (IEPM) project to monitor end-to-end performance of Internet links, developed by the IEPM group at the Stanford Linear Accelerator Center (SLAC). Throughout 2007, the SDU has monitored sites in the African continent directly from ICTP premises. Website: <http://sdu.ictp.it/pinger>

Skype Telephony to Contact ICTP Scientists and Staff Members

The possibility to call an ICTP telephone during office hours via free Internet Telephony (Skype-VoIP) was implemented and administered by SDU as a prototype in collaboration with the ICTP Switchboard (the Internet call to ICTP

is re-directed to any phone extension within campus). From December 2007, this call-to-ICTP Skype possibility was passed on to the Scientific Computer Section to become a service for the whole scientific community. Website: <http://sdu.ictp.it/callictp.html>

Participation

- Comunicare Fisica 07, Trieste (Stazione Marittima) (Oct 2007). Seminar given.
- ICL - Interactive Computer Aided Learning, Austria (Sept 2007). Seminar given and paper accepted.
- IUPAP Working Group on Communication in Physics, UK (July 2007), by invitation.
- SALAM +50 DAY, Imperial College UK (July 2007).
- WWDC07 - Apple Developers Conference, USA (June 2007). Poster presented.
- FEST - International Science Media Fair, Trieste (Stazione Marittima) (May 2007). Seminar given.

Publications

- “The Video Revolution Made Simple” (interview to E. Canessa and SDU), Physics World, December 2007 issue, p.14.



Fig.2: SDU receives the prize from the President Riccardo Illy on 7 February 2008



The African Physical Review

ICTP is directing its efforts to improve the communication capabilities of scientists in Africa. A first step in this direction is the creation of the African Physical Review (APR) with the objective of bridging the knowledge gap resulting from the inability of a large number of academic institutions in African countries to subscribe to leading physics periodicals. APR is a free, on-line, peer reviewed, international journal that publishes reviews, research articles, and brief communications in all branches of experimental and theoretical physics and related interdisciplinary fields. The African Academy of Sciences, Nairobi, Kenya, is one of its first sponsors.

There were many reasons to organize and host this journal. First, the economics of the traditional mode of knowledge dissemination is not favorable to institutions in Africa. It is simply too expensive to publish or purchase technical journals. Second, low-cost, fast and easily accessible electronic publishing is rapidly replacing the traditional high-cost hard copy journal publishing. This trend is changing the future of peer-reviewed scientific publishing. In addition, an equally important reason was the absence of a high impact journal of physics in the African continent. There are some electronic journals but their quality suffers from a lack of experienced and highly qualified scientists managing its editorial functions. The low impact factor of such journals is another major inhibitive reason why good quality papers are sent for publication in technologically advanced nations.

APR was thus created to satisfy the demand of a critical mass of African scientists who produce good publications, but were unable to find high-impact and high-quality journals in their home countries meeting international standards. The impact factor of published research represents its quality and accessibility. APR strives for both – excellence and reaching far beyond the boundaries of a single continent. The quality of scientific material being published by APR is overseen by an international editorial team consisting of eminent scientists, including a Nobel Laureate, from more than 23 nations (16 of them from Africa). The editorial management and technical support team is provided by ICTP, whereas the editor, associate editors, and members of the international board of editors operate from their home institutions worldwide. Professor Zohra Ben Lakhdar from Tunisia is the first Editor and Professor Tahir Shah of ICTP is the Managing Editor.

Several issues have been published already. See <http://www.aphysrev.org>

- "Come Registrare Automaticamente e Pubblicare in Internet Conferenze e Lezioni e Raggiungere un Milione di Scienziati", E. Canessa, C. Fonda and M. Zennaro, QUALITATE: Rivista Italiana della Qualità, n.10, anno XVI, pp. 26-32, November 2007.
- "EyA System: Automated Audio-Video-Slide Recordings", E. Canessa, C. Fonda and M. Zennaro, Proceedings ICL-Interactive Computer Aided Learning Conference, September 2007.
- "Webcasting of Traditional Chalkboard Lectures: The EyA System", E. Canessa, C. Fonda and M. Zennaro, EURODL European Journal of Open and Distance Learning, September 2007.

Scientific Consultants

E. Canessa (Chile)
C. Fonda (Italy)
T. Shah (India/Italy)
M. Zennaro (Italy)



LIBRARY

Introduction

The ICTP library is one of the best equipped specialized science libraries in Europe with a collection of over 67,000 books, 400 printed journals and 4,000 electronic journals. Its functions transcend those of many other libraries. For instance, it acted as the central unit within ICTP for distributing to proper users some 22,000 text books and monographs gifted to ICTP by World Scientific. It has also taken on the task of providing access to scientific literature to needy users from developing countries through eJDS (electronic Journal Delivery Service) developed by the Science Dissemination Unit: several agreements have been forged with major scientific publishers to allow access to their journals.

New Library Software Gets Started

The Library went into production with ALEPH 500, the new Integrated Library Software at the beginning of the year, after having successfully completed data migration by the end of 2006. It replaced the outdated software that had been in use for thirteen years.

The circulation module was operative immediately. Users were almost unaffected by the transition, though several customizations were necessary to make circulation policies suitable to the new module.

The cataloguing and acquisitions/serials modules required a longer period of transition, for a series of post-migration issues. Functional testing and problem reporting went on throughout the year, with major issues being solved and full operation implemented.

The online catalogue was redesigned in order to adapt to software requirements and to take advantage of previously unavailable features and functionalities.

An additional module was purchased at the end of the year. It will further enrich services by enabling the management and delivery of digital assets such as photos and full-text documents, integrating electronic materials and traditional library items. It will be put to work in 2008 to re-organize ICTP archives, in collaboration with other sections.



Acting Library Head

Lucio Visintin has been appointed Acting Library Head. He replaces Maria "Mariuccia" Fasanella who retired at the end of July. Visintin has a 25-year-long work experience at the ICTP Library.

Euler Exhibition

2007 marked the 300th anniversary of the birth of one of the Enlightenment's most important mathematicians and scientists.

To celebrate the event, an exhibition consisting of material based on his life and work was prepared by the Library and displayed throughout the year.



100 Buone Ragioni

On the occasion of its 40th anniversary, ICTP contacted several distinguished scientists who were connected to the Centre and invited them to write about why they became scientists and how they contributed to scientific development. The main intent was to compile a book to show readers that science can be a passion.

Thus, the book "100 Reasons to be a Scientist" was published primarily for the benefit of students and young scientists. Thus far, the book has been reprinted by Scholars without Borders, in collaboration with Professor R. Ramaswamy, to better cater to the scientific community in India. Then it was republished, through the efforts of Professor Arne Sletsjoe, by the Abel Foundation, with a few added essays, for distribution to all Norwegian schools. Some selected articles were translated into Portuguese by Professor Ricardo Galvão and published by Centro Brasileiro de Pesquisas Físicas in Brazil. It has

been translated into Chinese by Shanghai Scientific and Technical Publishers through the efforts of Mr. Zhao Le Jing. The Marathi translation by Professor Pandit Vidyasagar has been produced by Gandharv Ved Prakashan. The Bengali translation by Professor Chandan Bhunia has now been published, and Hindi and Urdu translations are in progress. The Italian version was prepared by high school students.

The Library staff was involved over the entire year in the many aspects of the project, from the initial assignment to the compilation of the final document.

The Italian book was officially released during the UN Day celebrations and is available on-line at <http://publications.ictp.it/books.html>



INFORMATION AND COMMUNICATION ACTIVITIES

Introduction

It is universally accepted that wide access to knowledge, and the know-how to manage it, are crucial to science, and thus to a sustainable development of the society. In this era of ITC, it is hard to imagine doing competitive science without adequate access to internet and scientific literature. One of the major purposes of the ICT activity at ICTP is to provide support for the scientific staff and visitors. For historical reasons, the ICT resides in several different units: the Scientific Computing Section, the Science Dissemination Unit, Aeronomy and Radiopropagation Laboratory, Publications and Printing Unit, and so forth. The library forms a part of this support network as well. Some of these activities have already been discussed in other chapters.

1. Internet, Wireless and Science Dissemination

Since the ICTP community in developing countries is still weak in ICT, the Centre has been working on different aspects of the topic. For instance, the work done in Nigeria and Romania on wireless networking was crucial for the development of this technology in those countries. Similarly, the software developed for distributing scientific literature to scientists in developing countries has been found to be very useful by a large number of users; through this software (and agreements with many publishers throughout the world) it is possible to send PDFs of the most recently published papers automatically upon request. Similarly, new software has been developed to record and transmit large amounts of lecture material on the basis of lectures given at ICTP, in the form of audio and video, including the writing on the blackboard, with the possibility of zooming in on any particular part – all done very cheaply. Collaborative work with INFN has been continuing on the technology of GRID computing, which seems to open up further possibilities of doing large-scale computations. The activity also provides training for scientists from underdeveloped countries on issues such as clustering of computers, digital networking, the optimization of the available bandwidth, and so forth.

To take the example mentioned last, the availability of adequate bandwidth is probably the single most critical resource at the disposal of a modern organization: it enables access to worldwide electronic collaboration, informational resources, rapid and effective communication, and membership to a global community. The book “How to Accelerate Your Internet,” coauthored by the ICTP staff, provides practical information on how to gain the largest possible benefit from a connection to the internet. By applying the monitoring and optimization techniques discussed in that book, the effectiveness of a network can be significantly improved. This book, like much of the work done at ICTP, is available online digitally. Between October 2006 and May 2007, there have been 12,500 hits to the website <http://www2.clustrmaps.com/counter/maps.php?url=http://bwmo.net>. Surprisingly, large numbers of hits have come from industrialized countries.

2. Communications

The major activity for the year 2007 was the preparations for the planned upgrade of the INTERNET link of the ICTP to a 1 Gb/s capable link as part of the Trieste city “Lightnet” project. The Lightnet



project also foresees the installation of a second 1Gb/s link as a backup to the city, both links would use different routes to the Trieste.

In the light of this, the section planned and started implementing a complete upgrade to the internal ICTP inter-building links.

The basic idea is to create a closed fibre optic ring between the various buildings as this will improve significantly the reliability; that is, in the event of a break of a single link between two buildings, traffic would be routed automatically via a different building. The ring would be composed of the following segments:

- Main Building (MB) to Adriatico Guest House (AGH): old link to be upgraded
- Main Building (MB) to Enrico Fermi Building (EFB): existing link
- Enrico Fermi Building (EFB) to MB: existing link
- MB to Galileo Guest House (GGH): existing link
- Galileo Guest House (GGH) to Multidisciplinary Laboratory (MLab): new link to be installed
- Multidisciplinary Laboratory (MLab) to Adriatico Guest House (AGH): new link to be installed.

It is expected that the backup Lightnet link to Trieste (INTERNET) would be placed in the Galileo Guest House when it arrives in 2009, while the main link would arrive directly to the Main Building to be installed in 2008.

The new/upgrade links (MB-AGH, GGH-MLab, MLab-AGH) were negotiated under a 15 year leasing agreement with Telecom Italia (MB-AGH only) and ACEGAS companies. Payments would be completed in the first 2 years (2008/2009). The yearly maintenance of the whole ring would be about 2000 euro a year for the remaining 13 years. Previously, the maintenance cost of the (old) link between MB and AGH was in the order of 12000 Euro every year due to the fact that it was based on

old (15 years ago) technology. Similarly, the (old) link MB-MLab is also based on old technology and is quite at risk as it is impossible to covered it with a maintenance contract.

All upgrades would be completed in 2008. The changes to the inter-building links also affects the central PABX as there will no longer be a separate dedicated fibre link for the PABX connection between main unit in the MB and satellite unit in the AGH. It will be replaced by a Voice Over IP (VOIP) connection. That is both voice and data (INTERNET and computer network) between MB and AGH would share the new fibre link discussed above. The satellite unit in AGH has been upgraded to support using VOIP for the connection with the main PABX in MB. The main PABX required only an expansion of the VOIP facility, which is already used for the voice traffic to MLab.

As part of the efforts to improve end-user telecommunication facilities, the number of cordless phones (used by staff members of the ICTP) increased by 10.

3. Scientific Computing

The key focus of the year 2007 was on consolidation and upgrades. When possible the hardware upgrades were aimed at implementing the existing policy of having all 64bit capable servers.

January began with the hardware and software upgrade of the centre's email (imap) server as the old server was running out of disk space. The new server uses the Storage Area Network (SAN) technology and so it is scalable. Software changes included the use of the Cyrus imap server which is very stable and significantly faster. Each user now has a default email storage space of 2GB and the possibility of using shared folders. The SMTP server also had a software upgrade to using the Amavis anti-spam engine instead of Mail Scanner. The Amavis software does a much better job of reducing the amount of spam arriving to the end users.



Two new AFS file servers were deployed in order to improve the storage space available to the end users. 10 wireless access points were upgraded to support the 802.11a protocol.

The upgrade of the core network configuration was carried out successfully. The new configuration (prepared by an external consulting firm - SCC) is simpler. It is now possible to use the previously acquired graphical tools for easier configuration and monitoring of the network. It is also easier to set up and use a Virtual Private Network (VPN) connection for staff members.

For the web related activities, the external firm (NoGapWork) was able to define the procedure for migrating existing web data to a newer version of the PLONE/Zope Content Management System (CMS). Combined with our in-house expertise/efforts, the web sites of the Condensed Matter group, High Energy Physics group and Public Information Office were successfully migrated to the PLONE CMS system and the very technical issues such as the changing of passwords and setting of the vacation messages directly from PLONE were also resolved. New sites were also created for special events such as the G8 Forum meeting.

The section successfully carried out the complete process of designing and installing the audio-video equipment for the new Meeting Room and Lecture Room H (Diploma Programme) during the year.

The contract for access to Supercomputing grade High Performance Computing (HPC) facilities with CINECA was renewed for a new 3 year period with a doubling of the number of hours at no additional cost. This facility is used mainly by the Condensed Matter and Earth System Physics inhouse researchers.

The section organized (in cooperation with SISSA) a special extended training programme on High Performance Computing (October 15th 2007 – December 15th 2007) for 2 African Scientists (one from Kenya and the other from Sudan), a third participant from Ivory Coast was unable to attend. The programme was requested by several African

associates of the ICTP.

In 2007, the section continued to provide to visiting scientists assistance in the direct purchase of Dell laptop computers and providing and (sometimes installing) Mandriva Linux and an updated selection of Free and Open Source Software (FOSS) for the Microsoft Windows Operating System (including anti-virus, anti-spyware utilities, OpenOffice and other Scientific software for plotting and modelling) on DVD-ROM

The year-end analysis of monitoring data (for over 220 servers, network devices and over 480 services) shows the service availability level for email was 99.9%, central AFS file-servers was 99.995%, login (ssh, telnet & ftp) was 99.7% and proxy service was 99.95%.

4. Publications and Printing Unit

ICTP runs these services for the record and dissemination of the knowledge created or updated within its walls or transferred by means of its high-level training programmes. The publications and printing services have evolved from a craftsmanship set-up to one using up-to-date technology. From their debut, great importance was assigned to these services since their product (preprints, reports, lecture notes and preprint registries, see Appendix 3) was nearly the only connection of many scientific institutions in the developing countries and in Eastern Europe with advances in physics and mathematics achieved in the industrialized world. Presently, the office organizes preprints and reports published by the Centre's many visitors. Some 10,000 articles in various fields have been published since 1964. All these preprints may now be consulted on-line. The office provides editorial assistance, technical support for word processing programmes and support in the preparation of camera-ready documents for submission to journals or for presentations at conferences. It also provides graphical support for posters, books and other documents. The print shop produces



preprints, reports and copies of lecture notes presented at the numerous workshops, seminars and conferences of the Centre.

All lectures delivered at ICTP conferences are available in electronic format on the Agenda tool.

5. External Publishing

The proceedings of the following conferences have been published:

Bersuker, I., Manini, N., Vogel, E.E., Tosatti, E.: The Jahn-Teller effect : Proceedings of the International Symposium on the Jahn-Teller Effects: Novel Aspects in Orbital Physics and Vibronic Dynamics of Molecules and Crystals, held at ICTP, Trieste, Aug.26-30, 2006, Amsterdam : Elsevier, 2007. Reprint of: Journal of Molecular Structure, v.838, issues 1-3, 2007.

Brasselet, J.-P., Damon, J., Oka, M., Lê Dũng Tráng: Singularities in geometry and topology; Proceedings of the Trieste Singularity Summer School and workshop, held at ICTP, Trieste, Aug.15-Sept.3, 2005, Singapore: World Scientific, 2007.

Ciofi degli Atti, C., Treleani, D.: Perspectives in hadronic physics. 2006. Proceedings of the Fifth International Conference on Perspectives in Hadronic Physics, Particle–Nucleus and Nucleus–Nucleus Scattering at Relativistic Energies. Trieste, Italy, 22–26 May, 2006. Amsterdam: Elsevier, 2007. Special issue of: Nuclear Physics, v.A782, nos.1-4, 2007.

Calendar 2007, Publications, Statistics

I. Calendar of Activities
page 111

2. Publications
page 121

3. Tables
page 145



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A-SPLIT \Rightarrow A-G-SPLIT.

(b) $P \in \mathcal{P}_{A-G} \Rightarrow \exists P' \in \mathcal{P}_{A-G}, V \in \mathcal{P}_{k-G}$

s.t. $P \oplus P' \cong V_A := A \otimes_k V$

$\underbrace{\hspace{10em}}$
"FREE A-G-MOD"





Held at ICTP

11 - 13 January

13th International Workshop on Computational Physics and Materials Science: Total Energy and Force Methods

Co-sponsors: SISSA, INFN DEMOCRITOS National Simulation Center and ESF/Psi-K Network

Organizers: N. Marzari, P.J. Ordejon, S. Scandolo

15 - 18 January

ICTP Experts Meeting on "Science and Renewable Energy"

Organizers: Ali Sayigh, G. Furlan (local organizer)

15 - 19 January

Advanced Workshop on Nanomaterials: A Partnership between ICTP and ICMR

Organizers: Anthony K. Cheetham, C.N.R. Rao, Fred Wudl, Jean Fréchet

5 - 9 February

(Co-sponsored)

Preparatory School to the Winter College on Fibre Optics, Fibre Lasers and Sensors

Co-sponsor: Italian Society of Optics and Photonics (SIOF), Central European Initiative (CEI), National Science Foundation (NSF) through the Career Award number PHY-0449708.

Organizers: G. Denardo

5 - 23 February

ICTP-ITU-URSI School on Wireless Networking for Scientific Applications in Developing Countries, including Environmental Monitoring

Co-sponsor: CEI (Central European Initiatives), ITU (International Telecommunication Union)

Organizers: Sandro M. Radicella, Ryzard Struzak

12 - 16 February

Workshop on Biomedical Applications of High Energy Ion Beams

Co-sponsor: Co-sponsored by ICGEB and University of Surrey; in collaboration with IAEA

Organizers: K. Kirkby, M. Folkard, C. Tuniz, N. Dytlewski

12 - 23 February

(Co-sponsored)

Winter College on Fibre Optics, Fibre Lasers and Sensors

Co-sponsors: International Commission for Optics (ICO), Optical Society of America (OSA), International Society for Optical Engineering (SPIE), European Optical Society (EOS), International Society on Optics Within Life Sciences (OWLS), Central European Initiative (CEI)

Organizers: H. Fragnito, A. Clarkson, A. Mignani; G. Denardo (ICTP Local Organizer)

5 - 16 March

(Co-sponsored)

Advanced School in High Performance Computing Tools for e-Science - joint DEMOCRITOS/INFN-eLab/SISSA-ICTP activity



Organizers: Stefano Cozzini, Axel Kohlmeyer, Roger Rousseau

22 - 24 March

Conference on Milankovitch cycles over the past 5 million years

Organizers: G. Philander, A. Bracco, H. Achyuthan and F. Kucharski

22 - 30 March

Spring School on Superstring Theory and Related Topics

Organizers: E. Gava, K.S. Narain, S. Randjbar-Daemi, J. de Boer, S. Kachru

10 - 20 April

Spring College on Water in Physics, Chemistry and Biology

Organizers: M.L. Klein, D.D. Klug, G. Scoles; ICTP Local Organizer: S. Scandolo

20 April - 21 April

Workshop on Statistical Physics and Financial Markets

Co-sponsor: EU-NEST project COMPLEXMARKETS

Organizers: M. Marsili, A. Kirman, C. Hommes, T. Lux, M. Marchesi, M. Salmon.

23 - 28 April

Workshop on Scientific Instruments and Sensors on the Grid

Organizers: Director: Roberto Pugliese (ELETTRA), Co-Director: Claudio Vuerli (INAF/OATs), Local Organizer: Alvis Nobile (ICTP)

23 April - 11 May

School and Conference on Analytic Number Theory

Organizers: R. Balasubramanian, J.-M. Deshouillers, E. Kowalski; ICTP Local Organizer: Lê Dung Trang

30 April - 11 May

ICTP Advanced School on Oceanography (ASO): "World Climate and Overturning Circulation in Oceans and Mediterranean Seas"

Co-sponsor: in collaboration with IAEA-MEL (Marine Environment Laboratories, Monte Carlo)

Organizers: M. Gacic, P.-M. Poulain; ICTP Local Organizer: J. Kröger.

10 - 12 May

(Co-sponsored)

G8-UNESCO World Forum on "Education, Innovation and Research: New Partnership for Sustainable Development"

Organizers: Government of Italy through its Ministry of Foreign Affairs (MFA), ICTP and other Trieste Institutions. Contacts at ICTP: K.R. Sreenivasan, C. Tuniz

14 - 18 May

Workshop on the Physics of Tsunami, Hazard Assessment Methods and Disaster Risk Management (Theories and Practices for Implementing Proactive Countermeasures)

Co-sponsor: In collaboration with IAEA.

Organizers: A. Godoy, N. Okada, G.F. Panza.

14 May - 1 June

School and Conference on Algebraic K-Theory and its Applications

Organizers: E. Friedlander, A.O. Kuku, C. Pedrini; ICTP Local Organizer: L. Göttsche



21 - 25 May

Conference on "From Physical Understanding to Novel Architectures of Fuel Cells"

Co-sponsor: International Society of Electrochemistry, Nissan Motor Co. Ltd., General Motors Corporation

Organizers: M. Eikerling, A.A. Kornyshev. Local Organizer: E. Tosatti

28 May - 1 June

International Workshop on QCD at Cosmic Energies III

Organizers: Yuri Dokshitzer, Mark Strikman, Daniele Treleani

28 May - 1 June

X-Ray Emission Techniques for Forensic Applications

Co-sponsor: co-sponsored by: Central European Initiative

Organizers: A. Markowicz (IAEA, Vienna); G. Paolucci (Sincrotrone SCpA, Trieste); G. Mank (IAEA, Vienna);

ICTP Local Organizer: C. Tuniz

4 - 8 June

Topical Consultancy on the Effects of Climate Change on the Occurrence, Frequency and Intensity of Extreme Meteorological and Hydrological Events - **ACTIVITY CANCELLED** -

Organizers: A. Gürpınar, A.R. Godoy (IAEA); G. Panza (Univ. of Trieste & ICTP Local Organizer)

4 - 8 June

Conference on Quantum Phenomena in Confined Dimensions

Co-sponsor: NEC Laboratories America, Inc.

Organizers: V. Falko, J. Meyer, A. Millis; ICTP Local Organizer: B. Narozhny

4 - 8 June

Conference on Structure and Dynamics in Soft Matter and Biomolecules: From Single Molecules to Ensembles

Organizers: Hue-Sun Chan, C. Micheletti, M. Thorpe

11 - 22 June

(Co-sponsored)

Summer School on Particle Physics

Collaboration(s): The Italian Institute for Nuclear Physics (INFN)

Organizers: A. Masiero, V. Rubakov, A. Smirnov (Local organizer)

25 - 29 June

Course on Natural Circulation Phenomena and Modelling in Water-Cooled Nuclear Reactors

Organizers: John Cleveland, Jong Ho Choi; ICTP Local Organizer: Claudio Tuniz

25 June - 6 July

Conference and School on Predictability of Natural Disasters for our Planet in Danger. A System View: Theory, Models, Data Analysis

Organizers: F. Giorgi, V. Keilis-Borok, D. Straus

2 - 6 July

Common Concepts in Statistical Physics and Computer Science

Organizers: S. Franz, M. Marsili, R. Zecchina (ICTP), A. Montanari (ENS & Stanford University), G. Parisi, F. Ricci-Tersenghi (Univ. La Sapienza)



9 - 13 July

Workshop on Cosmology and Strings
Organizers: B. Acharya, P. Creminelli, U. Seljak

9 - 27 July

Summer School and Conference on Automorphic Forms and Shimura Varieties
Organizers: L. Fargues, B.C. Ngo, D. Prasad
Local Organizers: R. Ramakrishnan

16 - 27 July

Conference and Research Workshop: Perspectives on Nonlinear Dynamics (Satellite Meeting of STATPHYS 23)
Organizers: R. Ramaswamy, N. Gupte, M. Marsili

22 - 26 July

Workshop on Grand Unification and Proton Decay
Organizers: C.S. Aulakh, K. Babu, B. Bajc, C.K. Jung, A. Melfo, P. Nath, G. Senjanovic and F. Vissani.

30 July - 17 August

School and Workshop on Highly Frustrated Magnets and Strongly Correlated Systems: From Non-Perturbative Approaches to Experiments
Co-sponsor: European Science Foundation
Organizers: F. Becca, F. Essler, F. Mila, S. Shastry, A. Tsvetik

30 July - 24 August

2007 Summer College on Plasma Physics
Organizers: S.M. Mahajan, P.K. Shukla, R. Bingham, L. Stenflo, Z. Yoshida

6 - 10 August

Targeted Training Activity: Seasonal Prediction of South Asian Monsoon
Organizers: J. Shukla (GMU & IGES/COLA, USA), In-Sik Kang (CES/SNU, Korea);
Local Organizer at ICTP: Jin Ho Yoo

18 - 26 August

Workshop on Turbulent Mixing and Beyond
Organizers: Organizing Committee: S.I. Abarzhi, Chairperson, (Chicago, USA), S. Anisimov (Landau Institute, Russia), M. Andrews (LANL, USA), S. Gauthier (CEA), D. Lamb (U of Chicago, USA), K. Nishihara (ILE, Osaka, Japan), R. Rosner (U of Chicago and ANL, USA), B. Remington (LLNL, USA), K.R. Sreenivasan (ICTP, Italy), A. Velikovich (NRL, USA).

20 - 24 August

Introduction to Nanofluidics
Organizers: Elisabeth Charlaix, S. Raghu

27 August - 7 September

Summer School on Novel Quantum Phases and Non-equilibrium Phenomena in Cold Atomic Gases
Organizers: M. Cazalilla, J.M.F. Gunn, A.F.C.K. Ho, W. Zwerger

3 - 14 September

Borsellino College 2007. Spike Trains to Actions: Brain Basis of Behavior
Organizers: Mathew E. Diamond, Raffaella Rumiati



10 - 14 September

4th European Conference on Severe Storms (ECSS 2007)

Organizers: N. Dotzek, D.B. Giaiotti (OSMER), F. Giorgi (Local Organizer), R. Jayaratne , F. Stel

24 - 28 September

School of Nuclear Knowledge Management

Co-sponsor: co-sponsored by: Central European Initiative

Organizers: Director: Y. Yanev, A. Kossilov; Local Organizer: C. Tuniz

24 September - 12 October

Advanced School and Conference on Statistics and Applied Probability in Life Sciences

Organizers: J. Fan, P. Jagers, Z.-M. Ma, X. Meng; Local Organizer: Li Jiayu

1 - 13 October

Ninth Workshop on Non-linear Dynamics and Earthquake Predictions

Organizers: V.I. Keilis-Borok, G.F. Panza, A.A. Soloviev

15 - 26 October

School on Astrophysical Fluid Dynamics

Organizers: D. Bhattacharya, S. Massaglia, A. Rogava, S. Sridhar and K. Subramanian

15 - 26 October

School on Pulsed Neutrons: Characterization of Materials

Organizers: C.S.Bauer, G.Mank, A. Markowicz ; Local Organizer: C. Tuniz

22 October - 9 November

College on Soil Physics

Organizers: D. Gabriels, D. Nielsen, I. Pla Sentis, E. Skidmore; Local Organizer: G.C. Ghirardi.

29 October - 9 November

Nuclear Power Plant Simulators for Education

Organizers: Andrey Pryakhin (IAEA), Seong-Gyun Moon (IAEA), Claudio Tuniz (ICTP)

5 - 16 November

Workshop on Understanding and Evaluating Radioanalytical Measurement Uncertainty (5-16 November) plus
Fourth Coordination Meeting of the IAEA ALMERA Network (5-7 November)

Organizers: P. Martin, U. Sansone; Local Organizer: C. Tuniz

12 - 23 November

Workshop on Nuclear Data for Science and Technology: Medical Applications

Organizers: Director: R. Capote Noy (IAEA, Vienna); S.M. Qaim (Institut fuer Nuklearchemie, Juelich); Local
Organizer: C. Tuniz

12 - 24 November

Task Force Activity on "Long Wireless Links for Development: Best Practices"

Organizers: S.M. Radicella, M. Zennaro, C. Fonda

19 - 30 November

School on Physics, Technology and Applications of Accelerator Driven Systems (ADS)

Co-sponsor: in co-operation with International Atomic Energy Agency

Organizers: Director: Alexander Stanculescu. ICTP Local Organizer: C. Tuniz



26 - 30 November

WCRP and ICTP Interpreting Climate Change Simulations: Capacity Building for Developing Nations Seminar

Co-sponsor: WCRP and ICTP - Earth System Physics Section

Organizers: F. Giorgi and A. Henderson-Sellers

3 - 11 December

Workshop on Rich-Media Webcasting Technologies for Science Dissemination

Organizers: E. Canessa, C. Fonda, M. Zennaro (ICTP-SDU); Co-Organizers: B. Logofatu (CREDIS, Romania), B. Hassler (CARET Video Studio, Cambridge University, UK)

Held Outside Trieste

8 - 25 January

ICTP Latin American String School (Bariloche - Argentina)

Organizers: C. Nunez, G. Aldazabal, S. Randjbar-Daemi, K.S. Narain

8 - 26 January

(Co-sponsored)

School and Workshop on "Geometry and Topology of Singularities" (Cuernavaca - Mexico)

Co-sponsor: ICTP, UNAM, CIMPA, CMI, MSRI, CNPq

5-15 February

Second Latin-American School and Conference on Statistical Physics and Interdisciplinary Applications (Bento Gonçalves - Brazil)

Organizers: J.J. Arenzon, D.A. Stariolo and M.C. Barbosa (Brazil) and S. Franz, M. Marsili and R. Zecchina (ICTP)

26 February - 2 March

Seventh Workshop on the Applicability of Environmental Physics and Meteorology in Africa (Gaborone - Botswana)

Organizers: A. Adedoyin, F.K.A. Allotey, F. Semazzi; F. Giorgi and J. Pal (ICTP Local Organizers)

12 March - 4 April

Workshop on the Interdisciplinary Science of Global Climate Change: Basic Elements (Buenos Aires - Argentina)

Organizers: G. Philander, I. Orlanski, F. Giorgi. Local Organizer: Carolina Vera

10 - 17 June

Fourth Regional Meeting in String Theory (Patras - Greece)

Organizers: F. Ardalan, Kiristis, I. Bakas, E. Rabinovici, S. Randjbar-Daemi

27 August - 7 September

(Co-sponsored)

First Kodai-Trieste Workshop on Plasma Astrophysics (Kodaikanal - India)

Co-sponsor: ICTP

Organizers: Vinod Krishan and Siraj Hasan, Indian Institute of Astrophysics

5 - 16 November

School on Computational Condensed Matter Physics (Abuja - Nigeria)

Co-sponsor: ICTP, Trieste, Italy; Local sponsor: National Mathematics Center (NMC), Abuja, Nigeria

Organizers: S. Scandolo (ICTP, Italy), G.A. Adebayo (Univ. of Agric., Abeokuta), local organizer J.O. Daniel (NMC, Abuja)



5 - 25 November

Sub-Saharan Workshop on Mathematical Analysis and Optimization (Abakaliki - Nigeria)

Co-sponsor: The Abdus Salam International Centre for Theoretical Physics (ICTP) Trieste, Italy and The Ebonyi State University and Forum for Training and Research in Mathematics (FORTIM) Abakaliki, Nigeria

Organizers: C.E. Chidume (ICTP, Trieste) and Ugochukwu Osisiogu (Ebonyi State University, Abakaliki)

12 - 23 November

ICTP Regional College on Medical Physics (Mumbai - India)

Organizers: Jointly organized by ICTP and Bhabha Atomic Research Centre; ICTP Representative: Perry Sprawls

12 - 24 November

School on Algebraic Approach to Differential Equations (Alexandria - Egypt)

Organizers: Mohamed Darwish, Mohamed Fahmy, Lê Dũng Tráng, Mohamed Yousif

19 - 30 November

African Regional College on Science at the Nanoscale (Cape Town - South Africa)

Organizers: A.C. Beye, M. Maaza, R. Gebauer, G. Scoles

Throughout the Year

Research in:

- High Energy, Cosmology and Astroparticle Physics including Phenomenology of Particle Physics, Cosmology, String and Higher Dimensional Theories, and LHC Physics
- Astroparticle Physics and Cosmology
- Condensed Matter and Statistical Physics, including Mesoscopic and Strongly Correlated Electron Systems, Statistical Mechanics and Applications, Electronic Structure and Condensed Matter Computer Simulations, and Synchrotron Radiation Related Theory
- Fundamental and Applied Mathematics
- Earth System Physics, including Climate Change and Impacts, Natural Climate Variability and Predictability, Mechanics of Earthquakes and Tectonophysics, Nonlinear Dynamics of the Earth, and Soil Physics
- Applied Physics, including Aeronomy, Radiopropagation, Fluid Dynamics, Plasma Physics, Biosciences, Medical Physics, Accelerator Mass Spectrometry, Optics and Laser Physics, and Energy Systems
- Multidisciplinary Laboratory including ICTP-INFN Microprocessor Project, Plasma Focus Project, X-Ray Imaging, Accelerator Mass Spectrometry, and Remote Access to Large Experimental Facilities

Diploma courses in:

- Condensed Matter Physics
- Earth System Physics
- High Energy Physics
- Mathematics
- Basic Physics



Joint programmes in higher education:

- ICTP-IAEA Sandwich Training Educational Programme
- UNESCO-ICTP Mori Fellowship Scheme
- ICTP-University of Trieste-CNR ISMAR-OGS-OSMER FVG Ph.D. Program in Environmental Fluid Mechanics
- ICTP-University of Trieste Laurea Magistralis in Fisica
- ICTP-University of Trieste Laurea Magistralis in Astrofisica e Fisica Spaziale

Hosted Activities

18 - 19 January

Workshop on Pixel Detector

Organizers: Ralf Menk (ELETTRA, Trieste)

19 January

ICMR Advisory Board Meeting

Organizers: Jennifer Ybarra

1 - 2 March

Meeting on Communication in Science (European Meeting Programme LEONARDO)

Organizers: SISSA MEDIALAB.

12 - 16 March

Nineteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange (IODE-XIX)

Co-sponsor: ICTP

Organizers: Renzo Masetti, OGS Trieste

19 - 22 March

Secondo Meeting Annuale SeaDataNet

Organizers: Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy

2 - 5 April

Theoretical Course on RNA

Organizers: ICGB, Padriciano 99, Trieste; Director: G. Tocchini-Valentini

19 - 20 April

IAMP Executive Committee Meeting

Organizers: IAMP Secretariat

22 - 26 April

Scuola ARS2

Contact Person: Andrea Lausi

Organizers: Andrea Lausi (ELETTRA)

13 - 20 May

OLIFIS 2007 - Olimpiadi della Fisica

Organizers: Giuliana Cavaggioni



21 - 25 May

Friction and Wetting - Informal School and Workshop

Organizers: Antonio De Simone (SISSA) and Erio Tosatti (SISSA/ICTP)

29 - 31 May

Meeting of the IAP Programme on Water Research and Management

Organizers: TWAS-IAP

21 - 23 June

Roberto Car 60th Birthday Symposium

Organizers: Giulia Galli (UC Davis), Nicola Marzari (MIT), Sandro Scandolo (ICTP), Ralph Gebauer (ICTP)

27 - 29 June

International Conference on "Frontiers of Knowledge in the XXI Century. Sciences in Dialogue in the New Europe"

Organizers: The Italian Sector of the Alexander von Humboldt Foundation. Local Organizer: L. Dabrowski (SISSA)

1 September

Meeting of the IUPAP Commission on Physics for Development (C13)

Organizers: Contact in Trieste: D. Treleani (University of Trieste/ICTP)

4 - 7 September

Quinto Corso di Alta Formazione alla Ricerca - Lo Studio dell'Infrastruttura e la Sicurezza Stradale

Organizers: A. Marchionna (University of Trieste)

5 - 7 September

Training Workshop on Remote Sensing of Deep Convective Storms

Organizers: EUMETSAT (Darmstadt, Germany) and OSMER (Italy); Local Organizer: Fulvio Stel

15 - 19 September

European Brain and Behaviour Society 39th Meeting

Organizers: Co-hosted with SISSA; contact person: Alessandro Treves (SISSA)

20 - 22 September

TWAS/COSTIS/UNDP Workshop - Cities, Science and Sustainability

Organizers: TWNSO

24 - 28 September

International Workshop on Accelerators Operations - WAO 2007

Organizers: Sincrotrone TS; Workshop Chairman: E. Karantzoulis

16 - 23 October

XVII Giornata Archivistica Internazionale

Organizers: Grazia Tatò, Antonio Monteduro (International Institute for Archival Science of Trieste and Maribor)

22 - 26 October

Workshop on Noncommutative Manifolds

Organizers: L. Dabrowski (SISSA), G. Landi (University of Trieste)



9 - 10 November

The Right to Life in Africa “Everyone has the Right to Life, Liberty and the Security of Person”

Organizers: Roberto Costa, Università degli Studi di Trieste

13 - 14 November

TWAS 18th General Meeting

Organizers: M.H.A. Hassan

26 - 27 November

Workshop on “Biogeochemical processes and fish dynamics in food web (ecopath) models for end-to-end conceptualization of marine ecosystems. Theory and use of Ecopath with Ecosim”

Co-sponsor: ICTP

Organizers: Cosimo Solidoro (OGS, Trieste)

27 - 30 November

The 6th European Conference on Ecological Modelling, ECEM'07 “Challenges for ecological modelling in a changing world: Global Changes, Sustainability and Ecosystem Based Management”

Co-sponsor: ICTP

Organizers: Cosimo Solidoro (OGS, Trieste)

3 - 4 December

XV ELETTRA Users' Meeting

Organizers: Sincrotrone Trieste

14 - 15 December

Meeting on Reducing Maternal and Perinatal Mortality in Developing Countries

Organizers: InterAcademy Medical Panel c/o TWAS



APPLIED PHYSICS

Aeronomy

Published

1. J.O. Adeniyi, O.A. Oladipo and S.M. Radicella, "Variability of foF2 for an equatorial station and comparison with the foF2 maps in IRI model", *Journal of Atmospheric and Solar-Terrestrial Physics*, Volume 69, Issue 6, April 2007, Pages 721-733
2. J. O. Adeniyi, S. M. Radicella, I. A. Adimula, A. A. Willoughby, O. A. Oladipo, and O. Olawepo, Signature of the 29 March 2006 eclipse on the ionosphere over an equatorial station, *J. Geophys. Res.*, 112, A06314, doi:10.1029/2006JA012197. 2007
3. C. Brunini, E. Gularte, A. Meza, S. M. Radicella, B. Nava, P. Coisson, and M. Mosert, A method to ingest GPS-TEC into the NeQuick ionospheric model, *Radio Sci.*, 42, RS4013, doi:10.1029/2006RS003521, 2007.
4. L. Ciralo; Azpilicueta, F.; Brunini, C.; Meza, A and Radicella, S., Calibration errors on experimental slant total electron content (TEC) determined with GPS, *Journal of Geodesy*, Volume 81, Number 2, February 2007, Pages 111-120
5. P. Coisson, S.M. Radicella, L. Ciralo, R. Leitinger and B. Nava, "Global validation of IRI TEC for high and medium solar activity conditions", *Advances in Space Research*, doi:10.1016/j.asr.2007.09.002, 2007
6. M. Cueto, P. Coisson, S.M. Radicella, M. Herraiz, L. Ciralo and C. Brunini, Topside ionosphere and plasmasphere: Use of NeQuick in connection with Gallagher plasmasphere model, *Advances in Space Research*, Volume 39, Issue 5, 2007, Pages 739-743
7. B. Nava, S.M. Radicella, R. Leitinger and P. Coisson, Use of total electron content data to analyze ionosphere electron density gradients, *Advances in Space Research*, Volume 39, Issue 8, 2007, Pages 1292-1297
8. G. Miró Amarante and S.M. Radicella, Use of raytracing in models to investigate ionospheric channel performance, *Advances in Space Research*, Volume 39, Issue 5, 2007, Pages 926-931

In press

1. P. Coisson, S.M. Radicella, B. Nava and R. Leitinger, Low and equatorial latitudes topside in NeQuick, *Journal of Atmospheric and Solar-Terrestrial Physics*
2. A. Portillo, M. Herraiz, S.M. Radicella and L. Ciralo, Equatorial plasma bubbles studied using African slant total electron content observations, *Journal of Atmospheric and Solar-Terrestrial Physics*
3. B. Nava; P. Coisson; S. M Radicella, A new version of the NeQuick ionosphere electron density model, *Journal of Atmospheric and Solar-Terrestrial Physics*



4. O.A. Oladipo, J.O. Adeniyi, S.M. Radicella and O.K. Obrou, Variability of equatorial ionospheric electron density at fixed heights below the F2 peak, *Journal of Atmospheric and Solar-Terrestrial Physics*

Submitted

1. P. Coisson, B. Nava, S.M. Radicella, O.A. Oladipo, J.O. Adeniyi, S. Gopi Krishna, P.V.S. Rama Rao, and S. Ravindran, "NeQuick bottomside analysis at low latitudes", submitted to *Journal of Atmospheric and Solar-Terrestrial Physics*
2. P. Coisson, B. Nava, S.M. Radicella, "On the use of NeQuick topside option in IRI 2007" submitted to *Advances in Space Research*
3. N. Jakowski, J. Mielich, C. Borries, L. Cander, A. Krankowski, B. Nava, and S. Stankov, "Large scale ionospheric gradients over Europe observed in October 2003", submitted to *Journal of Atmospheric and Solar-Terrestrial Physics*

Radiopropagation

1. M. Zennaro, R. Struzak, S. M. Radicella, Rural Wireless Networking in Developing Countries: ICTP contribution, *IEEE Explore*, in press

Special publication

The book called "Wireless Networking in the Developing world", generated during the training activities carried out by the Radiocommunication Section of the ARPL, published in January 2006 in English (<http://www.wndw.net>) has been reedited in English with substantial additions. The book is being downloaded at a rate of about 2000/month. This book was created by a team of individuals including C. Fonda and M. Zennaro of this Laboratory, plus external lecturers that participate in the Trieste activities and other experts.

Fluid Dynamics

Published

1. J.J. Niemela and G. Ihas, "In-situ Variable Small Gap for Measurement of Finite-size Scaling near the Lambda Transition", *J. Low Temp. Physics*, 146, 499-510, 2007
2. Introduction: scaling and structure in high Reynolds number wall-bounded flows. *Phil. Trans. Roy. Soc. A* 365, 635-646, 2007 (KRS with B.J. McKeon)
3. A comparison of turbulent thermal convection between conditions of constant temperature and constant heat flux. *J. Fluid Mech.* 595, 203-219, 2007 (KRS with R. Verzicco)
4. Asymptotic exponents from low-Reynolds-number flows. *New J. Phys.* 9, 89-108, 2007 (KRS with J. Schumacher & V. Yakhot)
5. Inertial waves in rotating grid turbulence. *Phys. Fluids* 19, 071701-04, 2007 (KRS with G.P. Bewley & D.P. Lathrop)
6. K.R. Sreenivasan, "A perspective on the status of mathematics in India.", *Curr. Sci.* 93, 1080-1087, 2007



Books or book chapters

1. Book Chapter: Classical Turbulence Cryogenic Helium, in “Vortices and Turbulence at Very Low Temperature” CISM Advanced School Lecture Notes, Springer (edited by C.F. Barenghi and Y. Sergeev) [in press] (JJN)
2. Collective Phenomena in Macroscopic Systems, Proceedings of the Conference, Como, Italy 4 - 6 December, 2006, World Scientific, 2007 (edited with G. Bertin, R. Pozzoli & M. Rome) (KRS)

Conference papers and articles submitted or in press

1. “Active Learning in Optics and Photonics: Achievements and Outcomes to Date”, (JJN with M. Alarcon, E. Arthurs, Z. Ben Lakhdar, I. Culaba, V. Lakshminarayanan, J. Maquiling, A. Mazzolini, D. Sokoloff; ETOP 2007 (plenary talk)
2. “Large-scale Behaviour of Turbulent Convection Governed by Low-dimensional Fixed-points” (JJN with M. K. Verma, K. Kumar, S. Paul, and D. Carati, 2007 (Proceedings of ETC-11)
3. “High Rayleigh number Turbulence”, invited paper for International Conference “Turbulent Mixing and Beyond,” 18-26 August ICTP, Trieste (to appear in Physica Scripta) (JJN)
4. “Classical and Quantum Turbulence” to appear in Proceedings of First Kodai-Trieste Workshop on Plasma Astrophysics, Kodaikanal Observatory, India August 27 - September 7, 2007 (JJN)
5. “Cryogenics in Fluid Dynamics Cryogenics in Fluid Dynamics Research: Achievement of High Reynolds and Rayleigh Numbers, (JJN with R.J. Donnelly) Solicited review article submitted to Progress in Low Temperature Physics
6. “Particles for tracing turbulent liquid helium”. Experiments in Fluids (with G.P. Bewley & D.P. Lathrop)
7. “A personal account of Professor Abdus Salam”. Proceedings of “Salam +50” Conference celebrating the life and work of Abdus Salam, Imperial College Press (editor M. Duff) (KRS)
8. “CICLoPE - a response to the need for high Reynolds number experiments”. Fluid Dyn. Res. (KRS with A. Talamelli, F. Persiani, J.H.M. Fransson, P.H. Alfredsson, A.V. Johansson, H.M. Nagib, J.-D. Ruedi and P.A. Monkewitz)
9. “Visualization of quantized vortex dynamics”. Proc. IUTAM Symposium 2006, Nagoya, edited by Y. Kaneda (KRS with G.P. Bewley, M.S. Paoletti & D.P. Lathrop)
10. “Local dissipation scales in turbulence.” (KRS with J. Schumacher & V. Yakhot)
11. “A long pipe facility for detailed high Reynolds number measurements at CICLoPE”. (KRS with J.-D. Ruedi, A. Talamelli, P.H. Alfredsson, H.M. Nagib & P.A. Monkewitz)
12. “Non-Boussinesq effects on heat transport at moderate Rayleigh numbers in low temperature gaseous helium” (KRS with A. Sameen & R. Verzicco), Physica Scripta
13. “Dissipation and enstrophy in isotropic turbulence: resolution effects and scaling in direct numerical simulations” (KRS with D.A. Donzis & P.K. Yeung), Physics of Fluids



Biosciences

Published

1. Chela-Flores, J. (2007a). Testing the universality of biology. *International Journal of Astrobiology*, 6 (3): 241-248. (Cambridge University Press). <http://www.ictp.it/~chelaf/ss116.html>
2. Chela-Flores, J. (2007b). Bioseñales en el Sistema Solar, in: *Orígenes del Universo, la vida y la inteligencia*, ISBN 978-980-12-2752-6, Nelson Falcón and Yaquelin Loyo Editors, Published by T.B. Print C.A., Valencia, Republica Bolivariana de Venezuela, 241 pp. <http://www.ictp.it/~chelaf/ss153.html>
3. Messerotti, M. and Chela-Flores, J. (2007). Solar activity and solar weather in the framework of life origin and evolution on Earth, ESA's Publication Division, Special Publication, in Proc. of the workshop *Solar Activity: Exploration, Understanding and Prediction*, Lund, Sweden, Sept. 19-21, 2005, European Space Agency ESA CD 2007. <http://www.ictp.it/~chelaf/ss159.html>
4. Seckbach, J. and Chela-Flores, J. (2007). Extremophiles and Chemotrophs as Contributors to Astrobiological Signatures on Europa: A Review of Biomarkers of Sulfate-Reducers and Other Microorganisms, in *Instruments, Methods, and Missions for Astrobiology X*, edited by Richard B. Hoover, Gilbert V. Levin, Alexei Y. Rozanov, Paul C. W. Davies Proc. of SPIE Vol. 6694, 66940W, pp.1-11. <http://www.ictp.it/~chelaf/ss155.html>
5. Chela-Flores, J. (2008). Fitness of the cosmos for the origin and evolution of life: from biochemical fine-tuning to the Anthropic Principle, in *Fitness of the cosmos for life: Biochemistry and fine-tuning*, John D. Barrow, Simon Conway Morris, Stephen J. Freeland and Charles L. Harper, eds. Cambridge University Press, pp.151-166. <http://www.ictp.it/~chelaf/ss154.html>

In press

1. Chela-Flores, J. Jerse, G., Messerotti, M. and Tuniz, C. (2007). Astronomical and astrobiological imprints on the fossil records. A review. From Fossils to Astrobiology, Ed. J. Seckbach, *Cellular Origins, Life in Extreme Habitats and Astrobiology*, Springer, Dordrecht, The Netherlands, in press. <http://www.ictp.it/~chelaf/ss156.html>
2. Chela-Flores, J. (2008). La posibilidad de la existencia de vida extraterrestre inteligente, su búsqueda científica e interés filosófico, in: *Astrobiología y Filosofía (III)*, Letras de Deusto (Universidad de Deusto, Bilbao, Spain), in press. <http://www.ictp.it/~chelaf/ss157.html>
3. Chela-Flores, J. (2008). Astrobiological reflections on faith and reason. The Issues of Agnosticism, Relativism and Natural Selection, in: *Divine Action and Natural Selection: Science, Faith and Evolution*, eds. J. Seckbach and R. Gordon, Singapore: World Scientific, in press, <http://www.ictp.it/~chelaf/ss158.html>
4. Chela-Flores, J. and Seckbach, J (2008). Divine Action and Evolution by Natural Selection: A possible and necessary dialogue, in: *Divine Action and Natural Selection: Science, Faith and Evolution*, eds. J. Seckbach and R. Gordon, Singapore: World Scientific, in press. <http://www.ictp.it/~chelaf/ss170.html>
5. Chela-Flores, J. and Messerotti, M. (2008). Constraints on the origin of life due to the physics of the ancient Sun. IV Convegno della Ricerca Italiana in Fisica Solare e Relazione Sole-Terra, *Memorie della Società Astronomica Italiana Supplementi* (in press, in electronic form).



<http://www.ictp.it/~chelaf/ss160.html>

6. Messerotti, M. and Chela-Flores, J. (2008). Solar activity and life. A review. OPOCE, l'Ufficio delle pubblicazioni delle Comunità europee, (The Scientific Final Report of COST 724: Developing the scientific basis for monitoring, modelling and predicting Space Weather), in press. <http://www.ictp.it/~chelaf/ss161.html>
7. Blanc, M., and the LAPLACE consortium (2008). LAPLACE: a mission to Europa and the Jupiter System, *Astrophysical Instruments and Methods*, in press. (Abstract available at: <http://www.ictp.it/~chelaf/ss166.html>)

Accelerator Mass Spectrometry

Published

1. Science for Cultural Heritage, C. Tuniz, Proceedings, Sixth International Conference on Science, Art and Culture, 28-31 August 2007 – Losinj, Croatia

In press

1. Accelerator Mass Spectrometry: new trends and applications, C. Tuniz and G. Norton, *Nucl. Instr. and Methods in Phys. Res.*
2. Authentication of archaeological artefacts and works of art with AMS radiocarbon, C. Tuniz, *Accademia dei Lincei, Rendiconti Lincei: Scienze Fisiche e Naturali*
3. Astronomical and astrobiological imprints on the fossil records. A review, Chela-Flores, J. Jerse, G., Messerotti, M. and Tuniz, C. "From Fossils to Astrobiology", Ed. J. Seckbach, *Cellular Origins, Life in Extreme Habitats and Astrobiology*, Springer, Dordrecht, The Netherlands, in press

CONDENSED MATTER AND STATISTICAL PHYSICS

Published

1. Aravindh A., S. Baroni, R. Gebauer, M.S. Lee and S. Scandolo, SixC1-xO2 alloys: A possible route to stabilize carbon-based silica-like solids? *Solid State Comm.* 144, 273 (2007)
2. Aristov D.N., M.N. Kiselev and K. Kikoin, Single-pole ladder at quarter filling, *Phys. Rev. B* 75, 224405 (2007)
3. Baldassi C., N. Brunel and R. Zecchina, Efficient supervised learning in binary networks, *PNAS* 104, 11079-11084 (2007)
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In press

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3. Authentication of archaeological artefacts and works of art with AMS radiocarbon, C. Tuniz, Accademia dei Lincei, Rendiconti Lincei: Scienze Fisiche e Naturali

In preparation

1. Simulation of interaction of short pulsed fast neutron for BNCT using GEANT4 code. M. Ramos, F. Longo, G. Giannini, C. Tuniz, V. Gribkov
2. Use of Dense Plasma Focus device as a neutron/hard X-Ray and fast ion beam source for nuclear diagnostics and medicine and for Carbon Nanotubes production as boron carriers to selective cell's zones. V. Gribkov, F. Longo, M. Ramos, G. Gianni, C. Tuniz



Table 1: List of Financial Contributors

EUROPEAN COMMISSION through
 Charles University, Prague, Czech Republic
 Istituto Nazionale di Fisica Nucleare, Italy
 Met Office, Exeter, UK
 Natural Environmental Research Council, Swindon, UK
 Swedish Institute of Computer Science, Kista, Sweden
 University of Warwick, UK

EUROPEAN SCIENCE FOUNDATION (ESF): COST Office, Brussels

FRANCE Commissariat à l'Énergie Atomique (CEA), Bruyères-le-Châtel

GALILEO JOINT UNDERTAKING (through the France Développement Conseil, Vincennes, France)

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

INTERNATIONAL CENTRE FOR GENETIC ENGINEERING AND BIOTECHNOLOGY (ICGEB)

INTERNATIONAL MATHEMATICAL UNION (IMU)

INTERNATIONAL TELECOMMUNICATION UNION (ITU)

IRAN Ministry of Science, Research and Technology

ITALY

Agenzia Regionale per la Protezione dell'Ambiente del FVG (ARPA)

Centro di Biotecnologie Avanzate (CBA)

Centro di Ecologia Teorica ed Applicata (CETA)

Central European Initiative (CEI)

CNR/Istituto di Fotonica e Nanotecnologie (IFN)

CNR/Istituto di Scienza dell'Atmosfera e del Clima (ISAC)

CNR/Istituto per lo Studio dei Materiali Nanostrutturati (ISMN)

Comune di Trieste, Area Educazione Università e Ricerca

Consorzio Venezia Nuova

Eurotech S.p.A.

FINCANTIERI - Cantieri Navali Italiani S.p.A.

Fondazione CRTrieste

IBM Italia S.p.A.

Istituto Nazionale di Fisica della Materia (INFN)

Istituto Nazionale di Fisica Nucleare (INFN)

Istituto Nazionale di Geofisica e Vulcanologia (INGV)

Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS)

OGS/Dipartimento di Oceanografia e Geofisica Ambientale (DOGA)

Ministero degli Affari Esteri (through UNESCO)

Ministero dell'Istruzione, dell'Università e della Ricerca

Osservatorio Astronomico di Trieste (OAT)

Provincia di Trieste

Regione Autonoma Friuli Venezia Giulia

Scuola Internazionale Superiore di Studi Avanzati (SISSA)

Sincrotrone Trieste S.c.p.A.

Società Italiana di Ottica e Fotonica (SIOF)

Spring Firm S.r.l.



Trieste Trasporti S.p.A.
Università degli Studi di Milano - Centro Eccellenza CISI
Università degli Studi di Genova
Università degli Studi di Napoli
Università degli Studi di Padova
Università degli Studi di Pavia
Università degli Studi di Trieste, Dipartimento di Scienze della Terra
WIND (through the Università degli Studi di Trieste)

JAPAN

Nissan Motor Co. Ltd
Research Centre for Disaster Reduction Systems, Kyoto

KUWAIT Kuwait Foundation for the Advancement of Science

NORWAY Norwegian Academy of Science and Letters, Oslo

PAKISTAN Office of the Prime Minister, Islamabad

PROFESSOR K.R. SREENIVASAN

SWEDEN

International Science Programme, Uppsala University
Swedish International Development Cooperation Agency (SIDA)

SWITZERLAND Laboratoire de Mécanique des Fluides, Lausanne

THE NETHERLANDS Schlumberger Foundation, The Hague

UK

Canon Foundation for Scientific Research
Institute of Physics, London
University of Surrey
University of Warwick, Coventry

USA

General Motors
International Centre for Materials Research
International Commission for Optics
International Society for Optical Engineering (SPIE)
NEC Research Institute Inc.
Optical Society of America (OSA)

WORLD METEOROLOGICAL ORGANIZATION (WMO)



Table 2: Statistics of visitors and activities

Total number of visitors: 4959 [including 488 participants to the G8 Forum (266 from Italy)]; 2160 more visitors participated in hosted activities.

A. ICTP activities

Total visitors: 4959

Female: 1073 (22%)

Male: 3886

From Countries:

LDCs: 157 (3.17%)

Developing: 1834 (36.98%)

In transition: 135 (2.72%)

CIS: 202 (4.07%)

Developed: 2631 (53.06%)

Total number of person-months: 4515 (137332 days)

From Countries:

LDCs: 285.64 (6.33%)

Developing: 2421.33 (53.63%)

In transition: 164.05 (3.63%)

CIS: 289.61 (6.41%)

Developed: 1354.34 (30.00%)

Nations represented: 126

LDCs: 20

Developing: 62

In transition: 6

CIS: 6

Developed: 32

Number of ICTP training activities held at ICTP: 53

Number of ICTP regional research and training activities: 12

5 in Africa:

Botswana, Egypt, 2 in Nigeria, South Africa;

2 in India;

1 in Greece;

4 in Latin America:

2 in Argentina, one each in Brazil and Mexico

B. Hosted activities

Number of hosted activities: 28

Participations for hosted activities: 2160

Largest 10 activities for a total of 2073 participations (number of participants in brackets):

G8-UNESCO World Forum on "Education, Innovation and Research: New Partnership for Sustainable Development" May 10-12, 2007 (488)

13th International Workshop on Computational Physics and Materials Science: Total Energy and Force Methods January 11-13, 2007 (291)

School and Workshop on Highly Frustrated Magnets and Strongly Correlated Systems: From Non-Perturbative Approaches to Experiments July 30- August 17, 2007 (201)

4th European Conference on Severe Storms (ECSS 2007) September 10-14, 2007 (196)

Workshop on Cosmology and Strings July 9-13, 2007 (179)

Summer School on Particle Physics June 11-22, 2007 (176)

Summer School on Novel Quantum Phases and Non-equilibrium Phenomena in Cold Atomic Gases August 27 - September 7, 2007 (147)

Spring School on Superstring Theory and Related Topics March 22-30, 2007 (139)

Winter College on Fibre Optics, Fibre Lasers and Sensors February 12-23, 2007 (130)

Advanced School in High Performance Computing Tools for e-Science - joint DEMOCRITOS/INFM-eLab/SISSA-ICTP activity

March 5-23, 2007 (126)



Table 3: Summary of ICTP activities by region

Regions	Visitors from...					Person-months					Total	
	Least Developed Countries*	Developing Regions	Transition Countries	Commonwealth of Independent States**	Developed Regions	Least Developed Countries*	Developing Regions	Transition Countries	Commonwealth of Independent States**	Developed Regions	Visitors	Person-months
Africa	117	367	-	-	-	230.47	628.56	-	-	-	484	859.03
Asia[^]	40	1033	-	36	79	55.17	1248.11	-	60.72	29.19	1188	1393.19
Europe	-	-	135	166	2056	-	-	164.05	228.89	1139.69	2357	1532.63
Latin America and the Caribbean	-	407	-	-	-	0.00	515.97	-	-	-	407	515.97
Northern America	-	-	-	-	470	-	-	-	-	176.78	470	176.78
Oceania	-	27	-	-	26	0.00	28.70	-	-	8.68	53	37.38
GRAND TOTAL	157	1834	135	202	2631	285.64	2421.34	164.05	289.61	1354.34	4959	4514.98
% vs. Total Visitors	3.17%	36.98%	2.72%	4.07%	53.06%	6.33%	53.63%	3.63%	6.41%	30.00%		

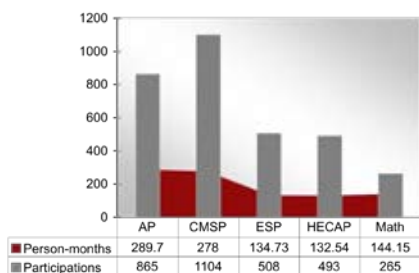
The Grand Total of visitors includes 488 participants to the G8-UNESCO World Forum on 'Education, Research and Innovation: New Partnership for Sustainable Development' under the High Patronage of the President of Italy and UNESCO. Trieste, Italy 10–12 May, 2007.

[^]Data includes 11 visitors and 8.58 person-months from Taiwan, China.

*Least Developed Countries.

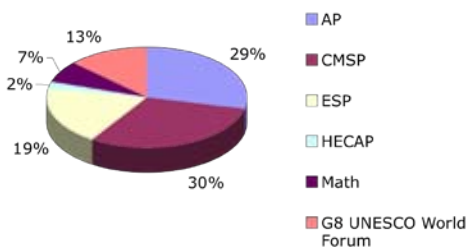
**Commonwealth of Independent States.

Person-months of training received by ICTP visitors in 2007 by field of study



In 2007, ICTP provided 980 months of training to 3235 course participants for an average length of stay of 9 days. Course participants were lectured to by more than 1000 tutors. The work-force of participants and tutors reached 4254. The field of study with most hits was CMSP with 1104 participants, receiving on average 7 days of training.

ICTP Training activities—Participation of women in 2007 by field of study



Applied Physics (AP)
 Condensed Matter and Statistical Physics (CMSP)
 Earth System Physics (ESP)
 High Energy, Cosmology and Astroparticle Physics (HECAP)
 Mathematics (Math)


Table 4: Visitors and person-months by country

<i>Regions and Countries</i>	<i>Total visitors</i>	<i>Visitors male</i>	<i>Visitors female</i>	<i>Person-months</i>
<i>Least Developed Countries (LDC's)</i>				
Bangladesh	28	26	2	30.54
Burkina Faso	2	2	-	1.38
Burundi	1	1	-	0.85
Central African Republic (the)	1	1	-	0.69
Chad	1	1	-	7.99
Democratic Rep. of the Congo	6	6	-	8.48
Ethiopia	29	27	2	64.14
Lesotho	3	3	-	5.40
Madagascar	5	2	3	21.44
Malawi	4	4	-	7.66
Mali	1	1	-	0.46
Mozambique	2	2	-	1.02
Nepal	12	12	-	24.62
Rwanda	4	4	-	1.68
Senegal	16	14	2	28.18
Sudan	26	19	7	66.57
Togo	3	3	-	1.68
Uganda	2	2	-	0.56
United Republic of Tanzania	9	9	-	4.21
Zambia	2	1	1	8.09
Total LDC's	157	140	17	285.63
<i>% vs. Grand total</i>	3.17%	3.60%	1.58%	6.33%
<i>Developing Regions</i>				
<i>Africa</i>				
Algeria	41	29	12	74.42
Benin	5	4	1	5.33
Botswana	4	4	-	3.39
Cameroon	37	28	9	98.96
Congo (the)	5	5	-	22.03
Côte d'Ivoire	11	9	2	14.04
Egypt	50	42	8	92.77
Gabon	1	1	-	4.04
Ghana	25	19	6	35.21
Kenya	13	11	2	20.19
Libyan Arab Jamahiriya (the)	2	2	-	0.76
Morocco	32	21	11	57.63



<i>Regions and Countries</i>	<i>Total visitors</i>	<i>Visitors male</i>	<i>Visitors female</i>	<i>Person-months</i>
Nigeria	86	76	10	167.64
South Africa	27	21	6	10.82
Tunisia	23	15	8	12.13
Zimbabwe	5	5	-	9.21
<i>Total Africa</i>	<i>367</i>	<i>292</i>	<i>75</i>	<i>628.56</i>
<i>Latin America and the Caribbean</i>				
<i>Caribbean</i>				
Cuba	54	33	21	105.34
Jamaica	2	1	1	1.02
Trinidad and Tobago	1	-	1	0.10
<i>Total Caribbean</i>	<i>57</i>	<i>34</i>	<i>23</i>	<i>106.46</i>
<i>Latin America</i>				
Argentina	95	68	27	108.74
Brazil	120	82	38	103.40
Costa Rica	3	3	-	1.97
Chile	16	12	4	14.14
Colombia	29	22	7	45.04
Ecuador	5	4	1	14.86
Guatemala	2	1	1	8.28
Mexico	43	36	7	58.32
Peru	9	5	4	20.05
Uruguay	7	5	2	4.47
Venezuela	21	14	7	30.22
<i>Total Latin America</i>	<i>350</i>	<i>252</i>	<i>98</i>	<i>409.51</i>
<i>Asia</i>				
Azerbaijan	5	4	1	19.40
Bahrain	2	1	1	2.04
China*	157	120	37	209.16
Hong Kong (China)	3	2	1	1.78
India	342	276	66	404.54
Iran (Islamic Republic of)	135	84	51	173.32
Iraq	6	6	-	20.22
Israel	41	35	6	14.27
Jordan	8	7	1	3.22
Kazakhstan	3	2	1	12.07
Kuwait	5	3	2	1.38
Lao People's Democratic Republic (the)	1	1	-	0.43



Regions and Countries	Total visitors	Visitors male	Visitors female	Person-months
Lebanon	2	2	-	0.62
Malaysia	15	12	3	6.12
Mongolia	6	4	2	13.74
Occupied Palestinian Territories	1	1	-	12.00
Oman	1	1	-	0.92
Pakistan	72	56	16	78.48
Philippines	17	5	12	17.69
Qatar	4	4	-	0.59
Rupublic of Korea (the)	41	36	5	34.98
Saudi Arabia	4	3	1	1.22
Singapore	7	7	-	3.65
Sri Lanka	19	17	2	15.71
Syrian Arab Republic (the)	11	10	1	7.26
Tajikistan	1	1	-	0.23
Thailand	16	12	4	31.40
Turkey	46	30	16	25.64
Uzbekistan	10	6	4	35.80
Viet Nam	52	45	7	100.24
<i>Total Asia</i>	<i>1033</i>	<i>793</i>	<i>240</i>	<i>1248.11</i>
<i>Oceania</i>				
Indonesia	26	20	6	27.98
Papua New Guinea	1	1	-	0.72
<i>Total Oceania</i>	<i>27</i>	<i>21</i>	<i>6</i>	<i>28.70</i>
Total Developing Regions	1834	1392	442	2421.33
% vs. Grand total	36.98%	35.82%	41.19%	53.63%
Transition countries of CIS and South-Eastern Europe				
<i>Commonwealth of Independent States (CIS)</i>				
<i>CIS Asia</i>				
Armenia	16	12	4	31.07
Georgia	20	17	3	29.65
<i>Total CIS Asia</i>	<i>36</i>	<i>29</i>	<i>7</i>	<i>60.72</i>
<i>CIS Europe</i>				
Belarus	20	15	5	34.19
Moldova (Republic of)	7	5	2	19.86
Russian Federation	99	81	18	122.53
Ukraine	40	27	13	52.31
<i>Total CIS Europe</i>	<i>166</i>	<i>128</i>	<i>38</i>	<i>228.89</i>
<i>Total CIS Asia and Europe</i>	<i>202</i>	<i>157</i>	<i>45</i>	<i>289.61</i>



<i>Regions and Countries</i>	<i>Total visitors</i>	<i>Visitors male</i>	<i>Visitors female</i>	<i>Person-months</i>
<i>Transition countries of South-Eastern Europe</i>				
Albania	5	2	3	6.90
Bulgaria	37	17	20	61.38
Macedonia (The Former Yugoslav Republic of)	4	1	3	11.05
Montenegro	1	1	-	0.26
Romania	69	33	36	75.68
Serbia	19	10	9	8.78
<i>Total Transition countries of South-Eastern Europe</i>	<i>135</i>	<i>64</i>	<i>71</i>	<i>164.05</i>
<i>Total Transition countries of CIS and South-Eastern Europe</i>	<i>337</i>	<i>221</i>	<i>116</i>	<i>453.66</i>
<i>% vs. Grand total</i>	<i>6.80%</i>	<i>5.69%</i>	<i>10.81%</i>	<i>10.05%</i>
<i>Developed Regions</i>				
<i>Europe</i>				
Austria	58	54	4	16.77
Belgium	48	41	7	11.11
Croatia	39	30	9	24.49
Czech Republic	23	19	4	7.43
Denmark	9	9	-	2.47
Estonia	3	2	1	1.41
Finland	14	10	4	4.11
France	197	159	38	106.74
Germany	262	227	35	104.58
Greece	17	14	3	4.93
Hungary	30	24	6	7.23
Ireland	5	3	2	1.12
Italy	803	588	215	620.78
Latvia	3	1	2	0.85
Lithuania	5	3	2	2.27
Malta	5	5	-	1.78
Monaco	2	1	1	0.43
Netherlands	41	35	6	11.08
Norway	7	6	1	1.58
Poland	40	28	12	15.98
Portugal	7	4	3	1.58
Slovakia	9	5	4	12.89
Slovenia	33	26	7	12.89
Spain	67	54	13	18.63
Sweden	29	23	6	8.48



Regions and Countries	Total visitors	Visitors male	Visitors female	Person-months
Switzerland	87	76	11	49.48
United Kingdom of Great Britain and Northern Ireland	213	185	28	88.60
<i>Total Europe</i>	<i>2056</i>	<i>1632</i>	<i>424</i>	<i>1139.69</i>
<i>Northern America</i>				
Canada	54	48	6	18.21
United States of America	416	357	59	158.57
<i>Total Northern America</i>	<i>470</i>	<i>405</i>	<i>65</i>	<i>176.78</i>
<i>Oceania</i>				
Australia	22	19	3	7.20
New Zealand	4	3	1	1.48
<i>Total Oceania</i>	<i>26</i>	<i>22</i>	<i>4</i>	<i>8.68</i>
<i>Asia</i>				
Japan	79	74	5	29.19
<i>Total Asia</i>	<i>79</i>	<i>74</i>	<i>5</i>	<i>29.19</i>
Total Developed regions	2631	2133	498	1354.34
<i>% vs. Grand total</i>	<i>53.06%</i>	<i>54.89%</i>	<i>46.41%</i>	<i>30.00%</i>
GRAND TOTAL	4959	3886	1073	4514.97

ICTP Visitors from Africa and the person-months of training received: Trend 1983–2007



More than 400 scientists from Africa visit ICTP each year to attend programmes held on site. Since 1983 more than 9,500 visitors from Africa have participated in ICTP programmes receiving 15,890 months of training. In 2007 the average length of stay of African visitors was 50 days. Nigeria and Egypt followed by Algeria were the countries most represented.

In 2007, five Regional activities were organized by ICTP in Africa: 1 each in Botswana, Egypt and South Africa, 2 in Nigeria. Training activities were related to environmental physics, computational condensed matter, mathematical analysis, differential equations and science at the nanoscale.





Table 5: Sandwich Fellows

Fellows financially supported by IAEA

Darya BAIRASHEUSKAYA (F), Belarus

Period of visit: 10 September - 10 December 2006

Topic or title of Ph.D. thesis: Radioactive Contaminated Terrestrial Ecosystems and Influence on Forming of the Internal Population Exposure Dose

Ehooman BOSSON (F), Côte d'Ivoire

Period of visit: 16 May - 30 June 2007

Topic: Modelling of Molecules for Biomedicine

Mutiu Abolanle BUSARI (M), Nigeria

Period of visit: 1 November 2007 - 26 January 2008

Topic or title of Ph.D. thesis: Transport of Pollutants Through the Vadose Zone of Fertilized Fields as Measured Using Stable Isotopes

Dmitry BUSKO (M), Belarus

Period of visit: 27 August - 24 December 2007

Topic or title of Ph.D. thesis: Low Threshold Raman Conversion in Crystals at a Coherent Pumping

Aliaksandr V. DANILCHYK (M), Belarus

Period of visit: 3 July - 30 September 2007

Topic or title of Ph.D. thesis: Semiconductor Lasers and Light Emitting Diodes Based on InGaN/GaN Heterostructures Grown on Silicon Substrate

Riadh HANNACHI (M), Tunisia

Period of visit: 2 - 27 August 2007

Topic or title of Ph.D. thesis: Spectroscopy of Plasma Induced by Laser

Anton Alyksandravich KANANOVICH (M), Belarus

Period of visit: 15 November 2007 - 14 February 2008

Topic or title of Ph.D. thesis: Generation Dynamics of Crystalline Continuous Wave Raman Lasers

Melalie KEITA (F), Côte d'Ivoire

Period of visit: 24 April - 22 July 2007

Topic: Modelling of Molecules for Biomedicine

Fayçal KHARFI (M), Algeria

Period of visit: 25 June - 9 August 2007

Topic: Material Inspection, 3d Image Reconstruction and Digital Images Processing in Neutron Tomography



Alexandru MARMUREANU (M), Romania

Period of visit: 8 October - 29 November 2007

Topic or title of Ph.D. thesis: Assessment of Seismic Hazard in Romania by Using Deterministic Approach and Comparison of the Results with Those Obtained from Probabilistic One

Wilbroad E. MUHOGORA (M), Tanzania

Period of visit: 15 November 2007 - 12 May 2008

Topic or title of Ph.D. thesis: Performance Analysis and Optimization of a Low Cost Prototype Photostimulable Phosphor Screen for Computed Radiography

Ababacar Sadikhe NDAO (M), Senegal

Period of visit: 15 August - 15 November 2007

Topic or title of Ph.D. thesis: Direct and Indirect Coupling of Resonance in H-Ion

Christiano Jorge Gomes PINHEIRO (M), Brazil

Period of visit: 1 March - 30 June 2007

Topic or title of Ph.D. thesis: Application of the Phase Contrast Image for Clinical Mammography at ELETTRA

Maridelin RAMOS ARUCA (F), Cuba

Period of visit: 2 November 2007 - 28 February 2008

Topic or title of Ph.D. thesis: Conjugation Boron Containing Agents to Biomecules for Potential Use in BNCT

Elena ROBU (F), Moldova

Period of visit: 1 April - 3 August 2007

Topic or title of Ph.D. thesis: Characterization of Radiation Detectors Using the Monte Carlo Simulation Method

Ola Sule SALAWU (M), Nigeria

Period of visit: 15 November 2007 - 14 May 2008

Topic or title of Ph.D. thesis: IR Reflection-Absorption and Attenuated Total Reflectance Spectroscopic Studies on Biomolecules

Vicky Yolande TAFFOTI YOLONG (F), Cameroon

Period of visit: 23 June - 19 October 2007

Topic or title of Ph.D. thesis: Dynamics, Control and Synchronization in a Network of Coupled Nonlinear Oscillators. Applications in Solid State Physics, Biological Physics and Engineering

Bidini Alade TALEATU (M), Nigeria

Period of visit: 5 August - 15 November 2007

Topic or title of Ph.D. thesis: Preparation and Characterization of Doped Zinc Oxide Thin Film for Solar Cell Applications

Jiafeng ZHAO (M), China

Period of visit: 14 April - 15 July 2007

Topic or title of Ph.D. thesis: ARPES Measurement and Epitaxy Growth of Strong Correlated Films



Fellows financially supported by CEI

Andrei A. LIUTSICH (M), Belarus

Period of visit: 14 June - 14 August 2007

Topic or title of Ph.D. thesis: Light Propagation, Emission and Scattering in Nanostructural Materials

Ina (Inna) SERANKOVA (SERENKOVA) (F), Belarus

Period of visit: 1 July - 9 September 2007

Topic or title of Ph.D. thesis: Search for and Identification of Extra Spatial Dimensions with ATLAS at LHC

Dmytro Nikolayevich TATYANKO (M), Ukraine

Period of visit: 15 September - 14 December 2007

Topic or title of Ph.D. thesis: Search for and Identification of Extra Spatial Dimensions with ATLAS at LHC

Suzana TOPUZOSKI (F), Macedonia

Period of visit: 11 February - 11 September 2007

Topic or title of Ph.D. thesis: Diffractive Optical Elements which Generate Nondiffractive Dark Beams

Andrei V. TSYTRINOV (M), Belarus

Period of visit: 1 July - 9 September 2007 and 13-30 November 2007

Topic or title of Ph.D. thesis: Searching for and Identifying New Physics Scenarios at Lepton and Hadron Colliders

2007 Fellows financially supported by ICTP

Katy ALAZO CUARTAS (F), Cuba

Period of visit: 16 September 2007 - 17 January 2008

Topic or title of Ph.D. thesis: Modelling of the Ionospheric GPS-TEC in Central America and the Caribbean Region

Ahmad Hosny ALI (M), Egypt

Period of visit: 20 October 2007 - 19 January 2008

Topic or title of Ph.D. thesis: A comprehensive 3-D crustal structure of Abu-Dabbab area

Yunier GARCIA BASABE (M), Cuba

Period of visit: 28 June - 18 September 2007

Topic or title of Ph.D. thesis: Crystal Chemistry of Natural Zeolites Tailored for Gas Absorption and Separation: the Role of the Extra-Framework Species

Margarita KUQALI (F), Albania

Period of visit: 1 November - 31 December 2007

Topic or title of Ph.D. thesis: Analysis and Turbulent Thermal Convection in Small-to-Intermediate Aspect Ratio Containers

Landry MOUKETO (M), Congo

Period of Visit: 31 May - 29 August 2007

Title of Ph.D. thesis: Interface Magnetism and Quantum-Confinement Effects in Nanostructures Including Transition Metals (TM) and Rare-Earth (RE) Noble Metals

Nadeesha Manohari WICKRAMAGE (F), Sri Lanka

Period of visit: 31 August 2007 - 1 January 2008

Topic: Experimental Physics with CMS Detector



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Mori Fellowship Scheme

Bashir ALI (M), Nigeria

Period of visit: 8 February - 6 August 2007

Topic or title of Ph.D. thesis: Interactive Methods for Nonlinear Equations in Banach Spaces

Omer Abdul Aziz ALI (M), Sudan

Period of visit: 2 February - 31 May 2007

Topic or title of Ph.D. thesis: Monitor Unit Calculations: a Study Comparing Use of Monte Carlo and Collapsed Beam Convolution Methods with Measurements

Paulina Ekuu AMPONSAH (F), Ghana

Period of visit: 15 August - 14 December 2007

Topic or title of Ph.D. thesis: Earthquake Hazard Assessment, Mitigation and Seismic Microzoning of Accra, Ghana

Nana Ama BROWNE (F), Ghana

Period of visit: 14 May - 15 September 2007

Topic or title of Ph.D. thesis: Mathematical Modelling and Computational Simulation of the Bloch NMR Flow Equations for Blood Flow Analysis

Marcelline ESSOUN (F), Benin

Period of visit: 1 March - 30 June 2007

Topic or title of Ph.D. thesis: Stability and Analysis of the Evolution of Vorticity in a Free Shear Layer of a Supersonic Flow

Brice Rodrigue MALONDA BOUNGOU (M), Congo

Period of visit: 4 February - 3 June 2007

Topic or title of Ph.D. thesis: Electronic and Magnetic Properties of Mn Nanostructures

Olushola Abel OLADIPO (M), Nigeria

Period of visit: 16 January - 13 May 2007

Topic or title of Ph.D. thesis: Variability of the Equatorial Ionospheric Electron Density at Fixed Heights Below the F2 Peak

Tunde RAJI (M), South Africa

Period of visit: 31 August - 30 December 2007

Topic or title of Ph.D. thesis: Computational Studies of Defects Dynamics and Their Influence on Macroscopic Mechanical Properties of Ion Implanted Materials

Hoby Njara Tendrisoa RAZAFINDRAKOTO (F), Madagascar

Period of visit: 16 February - 15 June 2007

Topic or title of Ph.D. thesis: Seismic Zonation of Antananarivo

Mohammad Khalil SALIH SAEED (M), Sudan

Period of visit: 15 August - 14 December 2007

Topic or title of Ph.D. thesis: Investigation on Activation Products in Medical Linear Accelerators and Consequences for the Radiation Dose of the Staff

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