



NEWS from ICTP

the
abdus salam
international centre for theoretical physics

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Franco Molteni
ICTP Physics of Weather and Climate Group

WHAT'S NEW

Can we distinguish climatic changes induced by human activities from those caused by natural variability? An ICTP scientist and his colleagues have devised a new research strategy that may help resolve this perplexing issue.

Changing of Regimes

Since the beginning of this century, scientists have observed a rise of about 0.5°C in global mean surface air temperature.

For most people, that rise may seem insignificant. But the average is derived from significant increases in temperature in some areas—for example, over the land masses of Canada, northern Europe and Siberia—counterbalanced by slight cooling in others—for example, over the northern Atlantic and Pacific oceans.

We know that human activities have substantially increased the concentration of carbon dioxide in the atmosphere during the past two centuries, and that carbon dioxide is one of the most important contributors to the atmospheric 'greenhouse effect.'

Yet, is the temperature rise observed during this century actually due to a rise of greenhouse gases? We can't be sure because we know that natural climate variability also affects global temperature. However, from a combination of observational studies and numerical simulations, most scientists now agree that human influences, not natural variability, are likely driving this trend.

One way to address issues surrounding the natural or anthropogenic origin of recent climate change is to examine spatial patterns of temperature change. Do these patterns conform to patterns generated by natural climate variability, or do they show the fingerprint of changes due to such human activities as the burning of fossil fuels?

The answer depends on how we examine the data. If we only study temperature changes in the atmosphere in relation to latitude and height, the increased greenhouse effect seems a better explanation than natural variability. But if we analyse the full horizontal pattern of the near-surface changes, we notice that, in the Northern Hemisphere at least, the alternating regions of warming and cooling resemble temperature anomalies induced by important patterns of natural variability.

So, are we back to square one? In a study recently published in *Nature*, Susanna Corti, Tim Palmer and I concluded that similarities between observed patterns of temperature change and the temperature 'signatures' of some natural oscillations do not contradict the hypothesis that recent temperature change has a non-natural origin. The reason has to do with the properties of complex systems like the Earth's atmosphere.

Such systems often tend to display characteristics of distinct 'regimes'—that is, a tendency to remain near a steady state for a long time. Moreover, in complex systems, more than one regime may exist, and the system as a whole may alternate between periods of relatively slow and periods of relatively rapid change.

Why are regimes relevant to the climate change debate? Because 'forcing' a small extra energy source or sink into a system with well-defined regimes may *not* substantially alter the regimes' existing pattern. Instead, the same regimes may persist for either a longer or a shorter period.

Consequently, if the Earth's climate has several regimes, then its response to the changes in the amount of greenhouse gases may reveal itself in the 'time frequency' of these regimes, rather than in dramatic changes of the regimes themselves. Even if these changes are not of natural origin, the patterns of temperature variation will look natural because they reflect the structure of the natural regimes.

By applying suitable statistical techniques to the record of observed data in the past 45 years, we found that the climate in the Northern Hemisphere does indeed have more than one regime, and that the time frequency of these regimes has changed substantially during the past few decades.

Franco Molteni

Reconciling a non-natural climatic perturbation with a 'naturally looking' response of surface air temperature poses a new challenge to climate modellers. If a model cannot reproduce the regimes of the current climate, simulations of the regional effects of increased greenhouse gases may not be very realistic. Climate scientists, as a result, may have a more difficult task, but also a new key to evaluate the reliability of their predictions. □

For more detailed information about these research findings, see S. Corti, F. Molteni, and T.N. Palmer, 1999: "Signature of recent climate change in frequencies of natural atmospheric circulation regimes," Nature *398 (29 April 1999), pp. 799-802. For a general account of the possible implications of these findings, see* The New York Times *18 May 1999, and* International Herald Tribune, *24 May 1999.*

Miguel A. Virasoro
Director of ICTP

COMMENTARY

The World Conference on Science, held this summer, called for the creation of a 'new contract' between science and society. Addressing the Conference's 1800 delegates, the ICTP director explored the universal values that drive science as a source of knowledge and culture.

Universal Value of Science

There is nowadays a fashionable attitude that claims there might be many different scientific systems, different methods of validation, multiplicity of truths, and that we should promote science diversity as a way of challenging Euro-centric Northern cultural dominance. In this simplistic vision, promoting modern science in developing countries is as wrong as invading their culture with the commercial products of the entertainment industries of the North.

But science, in fact, reflects a basic drive to examine nature, seek knowledge and search for the logical consequences of reasoning. It is a collective endeavour spanning generations and, as such, its practice and ability to flourish largely depends on the social and cultural contexts in which it is pursued.

To different degrees, all societies have practiced science, perhaps because the scientific method, despite its imposing name, is the simplest, most natural and universal way of acquiring knowledge. It is the extension of our innate instinct to discover regularities in the world surrounding us. Our brains are pre-wired to build models where assumptions of regularity are encoded. Our brains are also pre-wired to detect exceptions.

From the prehistoric hunter trying to uncover the traces of possible prey, to the ancient Egyptian seeking to understand the cycles of the Nile floods, to the modern-day geophysicist trying to predict the impact of El Niño, reasoning has always been the same. A farmer comes home to discover mice have been inside the pantry. How does he or she decide where to put the traps? A scientist examining the energy spectrum in a nuclear reaction notices mass is missing. Something is going on undetected. How does he or she design a new detector to uncover what is happening?

In both situations, the attitude is the same. In both situations, different hypotheses will be proposed and discarded. The only difference lies in the amount of past experience brought to bear on the situations.

The scientific method, simply put, is timeless and universal. It is neither Northern nor Southern. It is the "common heritage of all mankind."

Abdus Salam rejected the idea that modern science is a Western product. We certainly owe the basic philosophical foundations of science to the Greeks. But the Arabs, Persians and Hindus also played a crucial role in building and shaping all the sciences at a time when mediaeval Europe was still stepping backward. Moreover, we should remember the extraordinary Chinese contributions to science and how the Mayas seem to have followed a parallel path.

What should be a cause of concern is that in all historical civilisations, at some moment, progress in science slows and sometimes stops. Why this happens is an important question, if we care for the future.

Let me offer a possible explanation. Knowledge in general and scientific knowledge in particular mean power. Therefore, it is only natural that the dominant sectors of a society try to appropriate it and limit its access. They do that by ritualising knowledge, hiding its experimental roots and above all discouraging further questioning. They may even create a kind of 'clergy' in charge of preserving the 'truth,' but who in practice shields it from further scrutiny. The dominant sectors in power ultimately become content with this stasis.

Today, science seems to prevail. However, we should not underestimate the new dangers that could arise if more stringent intellectual property rights are approved, allowing new types of appropriations. At this moment when technological progress makes dissemination of information so easy, it would be tragic to see the rise of new obstacles inhibiting our access to information. Developing countries could be excluded from the common endeavour of creating knowledge, and I am convinced in the long run all of humanity would suffer.

The Abdus Salam ICTP urges that (at least basic) science results be declared an international public good and access to it made free for everyone. We should defend science as our common endeavour.

We must be proud of the capacity of science to build bridges across cultural rifts. In several parts of the world (for example, the Middle East), a process of peace has started. We hope that programmes of scientific cooperation in those regions, such as the recent proposal to locate a synchrotron laboratory in the Middle East, will help strengthen such movements. The ICTP stands committed to such goals and encourages other organisations to join us in these efforts. □

A new computing operating system could bring information to places that have found it difficult to connect to the world of electronic communications. The system works on low-end computers, can operate many software applications, and best of all is free.

The Linux Revolution?

Imagine a computer operating system, developed by some of the world's leading computer experts, that is reliable, flexible—and free. Well, it exists and it's here to stay. Known as Linux, this Unix-type system was developed during this decade by the Finnish computer expert Linus Torvalds.

Access and cost (or, more precisely, no cost) are what make Linux so attractive.

First, Linux is designed to operate on standard Intel-based PCs, which now represent more than 90 percent of the personal computer market worldwide. Second, Linux is made available free-of-charge. All you have to do is download it into your computer.

Moreover, this is one case in which free is better because Linux software undergoes continuous improvements through the ongoing work of groups worldwide who devise, test and introduce upgrades—all free-of-charge. It's like having a research and development centre in every corner of the Earth. Anyone, in fact, can contribute to the debugging and advancement of the system itself, as well as to the development of related applications.

As a result, while Torvalds has been busy optimising the operating system's so-called 'kernel' or 'heart,' groups in Mexico and Germany have been designing user-friendly desktop environments for its applications.

Such contributions have exciting implications for developing countries. Thanks to Linux, scientists throughout the South can now contribute to the latest advances in system-operating software. Because access is free and because upgrades can be developed on affordable 386 and 486 processors, no one needs to be excluded from the effort. Talent in computer software development is the only prerequisite.

It's not surprising, then, that ICTP is enjoying the 'Linux experience.' Linux, for example, is now the operating system driving all the Centre's PC workstations. And recently, a cluster of 20 PCs, with Linux inside, have been connected for low-cost parallel processing.

"We were and remain at the forefront of a trend that has become increasingly popular during the past 12 months," says Alvise Nobile, Head of ICTP Scientific Computing Section, who explains that strapping Linux-platform PCs together is bringing enormous computing power to ICTP. In fact, continues Nobile, "two similar clusters in the United States—one in Los Alamos National Laboratory, the other in Sandia National Laboratory—rank among the 100 most powerful computers in the world." And when it comes to networking, the system has become the globe's most common web-server platform—all in just a few short years.

Spurred by Catharinus Verkerk, Linux first came to ICTP in 1994 via the Microprocessor Laboratory as the software used at a Trieste-based 'college' on real-time systems and then at a 'regional college' held in 1995 in Cape Coast, Ghana. Experts at ICTP Scientific Computing Section soon configured Linux for use as ICTP's standard PC operating system. One year later, ICTP launched a programme for training and system development on networking that relies on Linux to improve electronic communications in the developing world, especially sub-Saharan Africa.

"The advantages of Linux software and standard radiocommunications are being put to work for the creation of local area networks and eventually global connectivity, initially in Nigeria, and later in Ghana and other countries in the African continent," explains Sandro Radicella, who is involved in this programme. "Several faculties at Nigeria's Obafemi Awolowo University," Radicella notes, "are connected both to each other and the internet, as a result of ICTP's efforts and the Linux revolution." (See "Memorandum Signed," p. 14.)

The network consists of Linux-driven PCs, which function as servers that provide university faculty and other local users with e-mail and access to other electronic-based information, including the internet.

Linux was chosen for all the reasons that its proponents had in mind when designing and then upgrading the system: the software is compatible with the modest computers found among university faculty and administrators; thanks to the work of Linux 'groupies' around the world, the system drives a host of software applications from accounting to word processing; and, most importantly, the 'sharing philosophy' that has propelled the system's development and growth means that it costs virtually nothing to operate.

ICTP's success in Nigeria has received worldwide acclaim, most notably through an article about the project in last December's *Linux Journal*. (That's right, the system has become so popular that it now has a journal bearing its name, a competitive publication cousin of *PC World* and *Mac World*.)

Readers' response to the *Linux Journal* article bodes well for the direction that the Centre is encouraging its partners to take when it comes to electronic communications. Here's what some had to say.

Michigan, USA: "We love Linux…keep up the good work, and keep those students learning." Nepal: "I am a Linux enthusiast operating an internet service provider business; only wireless data communications is feasible in the mountainous terrain." Washington, D.C.: "I am very envious of your success in Nigeria."

The success of Linux has also aroused a great deal of commercial interest, which seems to be growing even stronger as the system draws an increasing number of users into its ranks. Recognising Linux's low-cost and powerful computing solutions, its excellence in supporting databases, and its obvious value to users (which could be turned into profits), it should come as no surprise that some of the biggest and best known computer and software houses around the world are keen to get into the act.

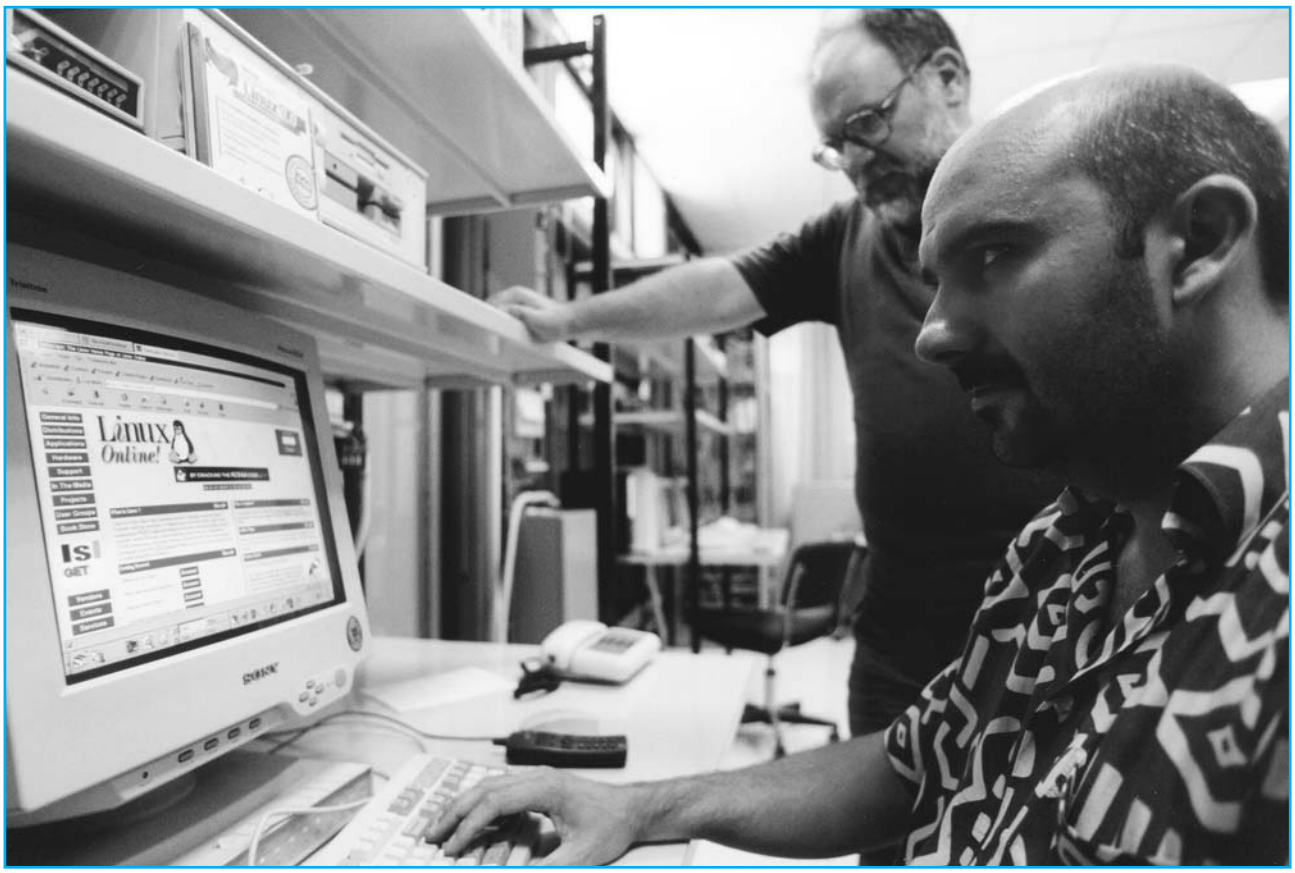
Sun, for example, is making its Linux-based code available; Hewlett Packard is researching the system; Intel and Netscape are investing in the commercial distribution of Linux; and Sega is using the software for its videogames. Linux was the electronic force behind the special digital effects in the film *Titanic*. And most recently, Stanford University in the United States has developed a server, run by a stripped-down version of Linux, that is the size of a matchbox. It's currently little more than a novelty item but future applications, as yet undiscovered, may be on the horizon.

With so many heavy hitters lined up to take advantage of Linux, there's little doubt that the system's full potential has a good chance of being realised. Little wonder one of Bill Gates' engineers warned last November that "Linux is a direct and short-term threat to the Microsoft revenue and platform."

No one is about to feel sorry for Microsoft if and when it begins to feel the heat of competition from Linux. Indeed, in the spirit of its creators and growing number of enthusiasts, the Linux operating system is not intended to be a tool used to gain a competitive edge. In fact, the opposite is true. Easy accessibility and cost-free application are designed to make the system available to everyone—rich and poor, North and South.

ICTP hopes to take every advantage of this revolution, not only to improve electronic communications on its campus in Trieste, but to lend a helping hand to universities and research centres in the developing world that have found it difficult to keep pace with endless advances taking place in electronic communications over the past two decades.

After watching events unfold from afar for many years, it may be no exaggeration to say that the information revolution has finally arrived at the South's doorsteps. □



Alvise Nobile and Marco Zorzini, ICTP Scientific Computing Section

Luis Masperi

With the help of ICTP, the Latin American Centre for Physics (CLAF) hopes to create an intricate network of physics research communities stretching from the Rio Grande to Cape Horn.

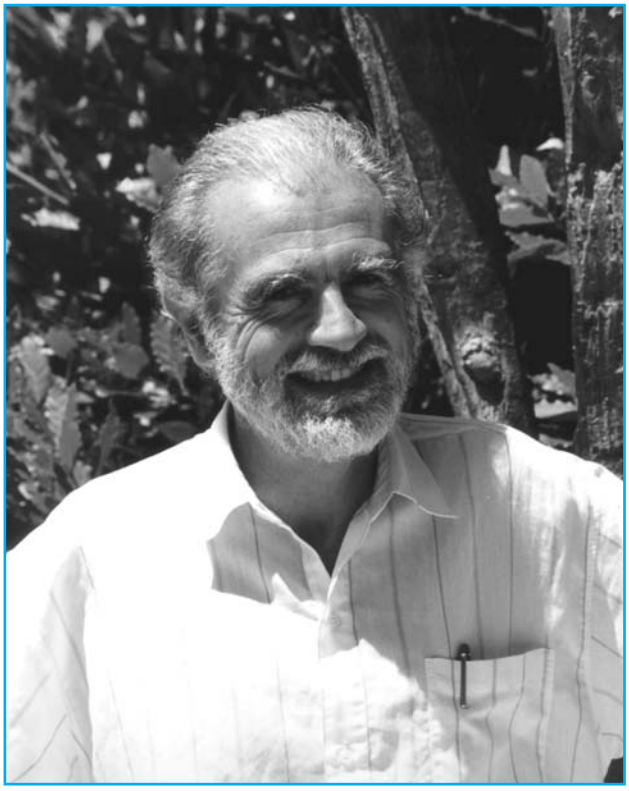
Fostering Physics in Latin America

What's the current and future state of physics in Latin America? The answer depends on where you look.

In Argentina, Brazil and Mexico, which enjoy strong traditions in physics research and training, the profession is in good health. In Chile, Colombia and Venezuela, which now have a critical mass of physicists, the prognosis is encouraging. In Costa Rica and Uruguay, which have built small but energetic research groups, the outlook is cautiously optimistic.

Meanwhile, in Cuba, which has a substantial number of well-trained but inadequately funded physicists, the forecast is cloudy. In Peru, home to a large number of young physicists struggling to construct a viable physics research community, it's unsettled. And in Bolivia, Paraguay, Ecuador, Panama and Guatemala, which still must develop postgraduate research and training facilities from the ground up, it's precarious.

The Latin American Centre for Physics (CLAF), an intergovernmental organisation that promotes the development of physics throughout the region, signed a memorandum of agreement with ICTP in 1997 to (1) assess the needs of physics communities in Latin America, particularly in countries with weak research and education facilities, and (2) devise a strategy of institutional co-operation to help physicists throughout the continent pursue fruitful and productive careers.



Luis Masperi

Why was this initiative launched? Because over the past few decades two closely related trends have placed physics programmes in Latin America in greater jeopardy. Many promising young physicists from Latin America's distinguished universities have sought to advance their careers abroad, either in Europe or the United States. At the same time, many undergraduate students from countries with inadequate physics research facilities have continued their studies in nearby countries—most notably, in Argentina, Brazil and Mexico—where they are likely to receive better training.

In either case, the most talented physicists in many Latin American nations often have left their homes for greener intellectual pastures. The scientists may have benefited from such freedom of movement but clearly the nations in which they were born, raised and received their early schooling have not, especially when you consider that many of these scientists often choose never to return home.

With ICTP's help, CLAF has sought to plug the internal and external brain drain of physicists through a co-operative Ph.D. programme established among Latin American universities. On another front, ICTP and CLAF have worked together to promote physics research among Latin America's relatively less developed countries.

The co-operative Ph.D. programme works like this: a pair of universities in different countries agree to jointly supervise the work of a Ph.D. graduate student. The student, in turn, agrees to spend time at each university.

At its best, the programme not only allows a student to keep in touch with his or her country, but builds an enduring framework for research collaboration between the two institutions. The latter serves as critical force for strengthening the state of physics research and training across the continent over the long term.

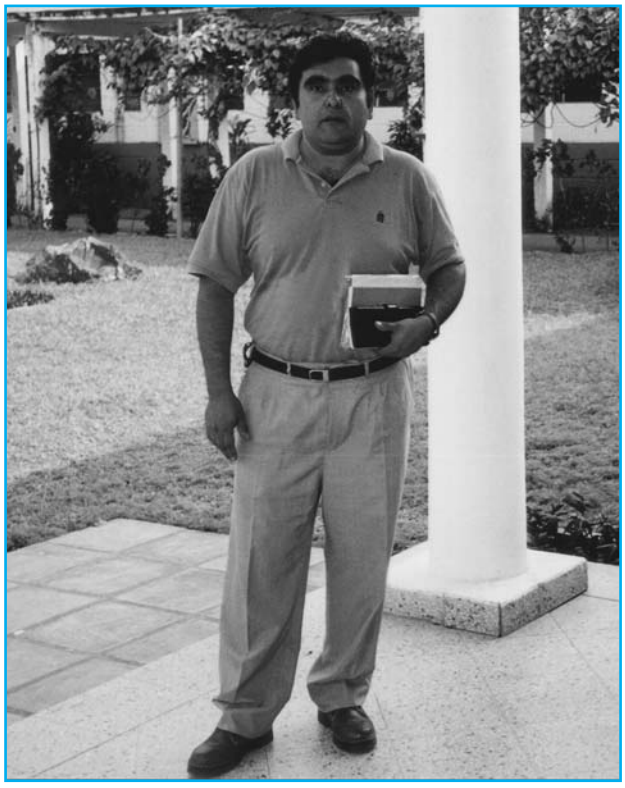
To date, eight students—five men and three women—involving seven countries (Argentina, Bolivia, Brazil, Mexico, Paraguay, Peru and Uruguay) have participated in the CLAF/ICTP Ph.D. programme.

This past April, the programme, less than six months after its inception, experienced its greatest success story when Paraguayan-born Alejandro Peruzzi, whose Ph.D. studies in Argentina had been interrupted for several years, completed his thesis on experimental thermodynamics of phase transitions. The *Instituto Balseiro* in Bariloche, Argentina, granted Peruzzi his degree with the agreement of his institution of origin, the *Universidad Nacional de Asunción* in Paraguay.

The two institutions were brought together under the auspices of the CLAF/ICTP Ph.D. programme. The bottom line is this: Paraguay would have lost one of its most promising physicists if not for the collaboration that took place between these two institutions.

Under the programme's umbrella, a common research activity in physics is now planned between one of the region's more developed countries (Argentina) and one of its less developed countries (Paraguay). In addition, a second doctorate degree will be awarded at the end of the year to a student who attended universities in Argentina and Uruguay, and a third doctorate degree likely will be granted in mid-2000 through a joint arrangement between universities in Mexico and Brazil.

The administrative framework for these partnerships has been built through CLAF, which currently has 13 Latin American member-countries and supports some 30 activities each year.



Alejandro Peruzzi

ICTP's role is simple, yet irreplaceable: Through its Office of External Activities (OEA), the Centre provides money to cover student transportation costs and, when necessary, offers fellowship money for expenses incurred abroad during the time of the recipient's studies.

With this help, the programme not only gives a young student a once-in-a-lifetime opportunity to fulfil his or her potential, but it also helps to nurture a positive environment for co-operation among the participating institutions.

For those nations that have yet to develop strong vehicles for advancing physics within their borders, the agreement between CLAF and ICTP holds the promise of jump-starting a discipline that has been stalled for too long. Peru, for example, recently became a full member of CLAF.

Physicists throughout the continent, in fact, view this membership as a confirmation of the progress that Peru has made in the development of its physics research and training activities—and as an indication that additional growth will take place in the future. In Paraguay, meanwhile, an Association of Physics has recently been launched, again thanks largely to the groundwork laid by the CLAF/ICTP initiative.

No programme alone can be expected to build a strong physics research community, especially in nations facing a host of difficult challenges related to economic and social development.

However, as the CLAF/ICTP partnership shows, dramatic progress can take place through modest investments at critical junctures in the careers of young researchers and timely support to incipient research groups. Moreover, as the quality of research institutions continues to rise in many developing nations, such efforts can increasingly take the form of neighbour helping neighbour.

Much has been written about the importance of South/South co-operation in science and technology in the developing world. The CLAF/ICTP initiative for aiding young doctoral students in physics offers a road map for transforming these lofty sentiments into a strategy that yields positive results for both scientists and society. □

An ICTP Senior Associate from 1975 to 1992, Luis Masperi is the director of the Latin American Centre for Physics (CLAF), headquartered in Rio de Janeiro, Brazil. For additional information about CLAF, contact claf@cbpf.br or ICTP Office of External Activities, fax 39 040 2240 443, or e-mail oea@ictp.trieste.it.

DATELINE

De Gennes on Franklin

He has been called "the Isaac Newton of our time" for his genius in turning what others present as complex phenomena into simple truths. Pierre-Gilles de Gennes, Nobel Laureate in Physics (1991), lectured this June at the Adriatico Research Conference on 'Wetting' (see "Report on Reports," p. 12). The conference examined such topics as interactions and phase transitions between liquids and solids, a field with important technological implications in materials science and biophysics.

Pierre-Gilles de Gennes

De Gennes, who received the Nobel Prize for his theories on polymers and liquid crystals that have become commonplace features in digital watches and visual display screens, is considered one of France's—indeed one of Europe's—most influential scientists. Currently, a professor of physics at the *Collège de France* and director of the *Ecole Supérieure de Physique et de Chimie Industrielles*, both in Paris, his theoretical work on ferromagnetism and superconductivity has led some observers to call him the prophet of soft matter.

In a recent interview with the editors of *News from ICTP*, de Gennes cited his admiration for Benjamin Franklin, the 18th century American scientist, inventor and statesman. "He was a man with enormous common sense," explains de Gennes. "Although less well known than his kite flying escapade, not the least of his accomplishments was a remarkable experiment in which he poured a spoon of oil on the surface of a pond."

By measuring the droplet, Franklin was able to extrapolate the volume of oil that would be required to coat the lake with a layer of this substance. "This experiment," de Gennes asserts, "represented the first rational measurement of the size of a molecule."

"Ancient Greeks believed that matter couldn't be divided eternally, but their notion was derived solely from logic." Through simple, yet insightful, experiments, de Gennes notes, "Franklin helped transform philosophy into science."

In fact, de Gennes considers the 'oil-on-the-pond experiment' a landmark in science that still carries valuable lessons for students, researchers, and engineers today. "Before asking for more money for expensive equipment," de Gennes says, researchers should pass 'the Franklin test' and "be sure that there isn't a simpler method for obtaining the same results.".

Obasi on Climate Change

"It cannot be emphasised enough how vitally important it is to involve scientists from developing countries in global climate change research, and to provide the means for them to contribute meaningfully to this research."

G.O.P. Obasi from Nigeria, who recently was elected to a fifth term as secretary-general of the World Meteorological Organization (WMO), made those remarks at the opening ceremony of ICTP's Global Change Conference held on 7 June in the Centre's Main Lecture Hall.

Obasi went on to note that "the formulation and implementation of many global environmental and climate-related activities have been dominated by scientists from the developed world."

Such tendencies, Obasi observed, should not be surprising. The developing world, confronted with so many immediate challenges, has been hard pressed to invest money in basic science, including climate research. Yet, he maintained such geographical imbalances in scientific research not only "impede the advancement of science, but mean that global programmes may not adequately address regional needs and are not fully implemented."

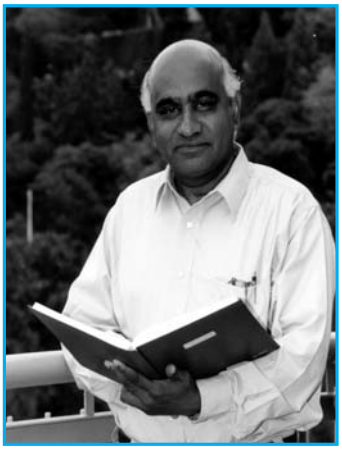
For all these reasons, Obasi congratulated the ICTP for launching a Physics of Weather and Climate Group.

This new group, he noted, "is a very exciting development that will offer new opportunities for research and educational activities. In particular, it will provide scientists from the Third World with an excellent foundation for exploring pressing environmental and climate change issues."

The Global Change Conference, attended by some 170 researchers, marked the first large event hosted by the ICTP Physics of Weather and Climate Group. The two-day opening conference was followed by three weeks of lectures and workshops devoted to the detection, modelling and theories related to regional climate change. Opening-day presentations were also made by Robert Watson, director of the Environment Department at the World Bank, Klaus Hasselmann, director of the Max Planck Institute for Meteorology, and Jagadish Shukla, director of the Center for Ocean-Land-Atmosphere Studies (see "Report on Reports," p. 11).

G.O.P. Obasi

Council on Science



Tiruppattur V. Ramakrishnan

Bangalore, India. "Nehru, India's first prime minister, called for the creation of a modern society nurtured by science," notes T.V. Ramakrishnan, ICTP Scientific Council member. "That sentiment has persisted throughout India's post-independence era regardless of the government in power."

"For example, over the past half century, the Indian Institute of Science in Bangalore, where I work, has been increasingly well supported. My institute recently created a Centre for Condensed Matter Theory. Researchers there work closely with the Institute's Department of Physics and the nearby Raman Research Institute. We also collaborate with the Institute's Departments of Chemistry and Materials Science."

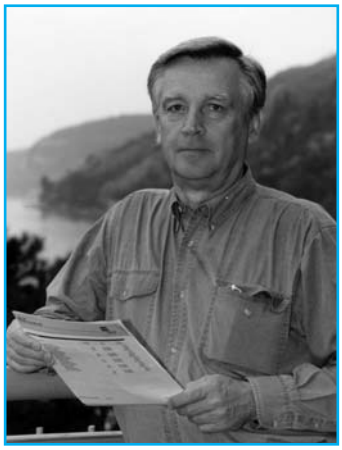
As Ramakrishnan notes, "The strength of India's research efforts reside largely in institutions supported by government agencies and ministries like the Department of Science and Technology, Department of Atomic Energy, Council of Scientific and Industrial Research (CSIR), and Indian Council for Agricultural Research. The university system, woefully underfunded for two generations, remains the weak link in India's intricate chain of scientific research. This, with the declining attraction of a career in science among the young, are two worrisome concerns."

Another issue relates to India's historic inability—with few exceptions—to connect its scientific research initiatives to effective economic development strategies. "The gap between scientific knowledge and social and economic progress," Ramakrishnan says, "is largely due to the economic model that shaped India's development initiatives during the first three decades of independence." The model, based on centralised planning and state-controlled enterprises, effectively decoupled scientific research from product development.

Ramakrishnan contends that India is currently addressing shortcomings in its scientific research agenda by requiring CSIR institutes, particularly those involved in applied research, to generate more revenue from sources other than the government. The National Chemical Laboratory now derives nearly a third of its income through licensing fees and royalty agreements. Meanwhile, research centres and laboratories involved in basic research will continue to be supported almost exclusively by the government.

Despite the progress that has been made, Ramakrishnan acknowledges that high technology is not the answer to all of India's problems. "People in India's remote villages often do not have access to safe drinking water and students continue to be taught in one-room school houses."

"Many such problems," Ramakrishnan says, "are driven by social and political forces that reside beyond the reach of science. India must devise effective strategies for addressing these issues if it hopes to spread the benefits of science and technology more equitably throughout the nation."



Alexander F. Andreev

Moscow, Russia. "In the former Soviet Union, science was everything," says A.F. Andreev, a member of the ICTP Scientific Council for the past 4 years. Andreev currently serves as director of the P.L. Kapitza Institute for Physical Problems in Moscow, Russia.

"Soviet officials claimed that the nation's prevailing ideology was based on scientific principles and that the Soviet Union's industrial progress was driven largely by its scientists, engineers and technicians."

"You can imagine how the people reacted towards science—and scientists—when communism collapsed," Andreev notes. "In some sense, they felt as if science had failed them."

As a result, Soviet scientists lost their lofty standing in society and funding for science plummeted. In fact, Andreev calculates that the overall budget for science "fell by a factor of 10 to 15 over the last decade."

Despite the severe obstacles that have brought Soviet science to a virtual standstill, Andreev cites several positive factors that have emerged from what may be the most dismal period in the long history of Russian science.

"Our scientists now travel more," he observes. "We do it to earn hard currency to supplement our paltry salaries at home. Continual interaction with colleagues from other nations—for example, I spent the month of April at Helsinki University of Technology in Helsinki, Finland—has helped to energise our research agendas."

Due to the crisis, the Russian government has been forced to open other potential sources of revenue for both scientists and scientific institutions. The primary reason has been to create emergency funds for survival. Yet, these decisions have had the added benefit of making Russian science more accountable and efficient.

Andreev hopes that the scientific crisis in the former Soviet Union has reached its lowest point and that research throughout Russia will soon be on the upswing. "Both our government and people now recognise that we must invest in science and technology if we are to achieve economic and social progress in the future."

"This summer, for example, the Russian (formerly the Soviet) Academy of Sciences celebrated its 275th anniversary, and the Kremlin organised a large celebration to honour the contributions that science has made to the nation's well being."

"The key to the future of Russian science," Andreev concludes, "lies in my nation's ability to solve its financial and political problems. Only then will the funding and management be in place to ensure that first-class scientific research can be pursued."

REPORT ON REPORTS

SCHOOL ON DIFFERENTIAL GEOMETRY

12 - 30 April

Directors: B. Dubrovin (International School for Advanced Studies, SISSA, Trieste, Italy), and G. Tian (Massachusetts Institute of Technology, MIT, Cambridge, USA).

Local Organiser: L. Göttsche (ICTP).

Following the ICTP Math Group's theme for 1999, the School's first two weeks were devoted to lectures in the following areas: new approaches to classical problems of the geometry of surfaces; Plateau problem for Lagrangian submanifolds; symplectic geometry and Gromov-Witten invariants; Frobenius manifolds and differential geometry of integrable hierarchies; and geometry of special Lagrangian foliations and mirror symmetry. Lectures were designed primarily for young researchers and graduate students. The School's third week was devoted to a conference, with lectures by experts on the most recent developments in the field.

SCHOOL ON SYNCHROTRON RADIATION

19 April - 21 May

Co-sponsors: *Sincrotrone Trieste* and Italian Association for Synchrotron Light (SILS).

Directors: M. Altarelli (ICTP and *Sincrotrone Trieste*), A. Craievich (University of São Paulo, Brazil), C.S. Fadley (Lawrence Berkeley Laboratory, Berkeley, USA), A. Fontaine (French National Centre of Scientific Research, CNRS, and European Synchrotron Radiation Facility, Grenoble, France), A. Savoia (*Sincrotrone Trieste*) and H. Wiedemann (Stanford Synchrotron Radiation Laboratory, Stanford, USA).

The School's aim was to cover all aspects of synchrotron radiation (SR) from machine physics, insertion devices and beamline design, to actual applications. Emphasis was placed on practical training in vacuum technology and instrumentation, and use of common experimental techniques. Industrial and environmental applications were also discussed and visits to the Trieste synchrotron radiation laboratory Elettra organised. The School consisted of morning lectures on the following topics: accelerator physics and SR sources; beamline and monochromator design; application of SR to physics, chemistry, materials and surface science and engineering, geophysics, biophysics and the environment. Afternoons were dedicated to data-management exercises on PCs.

Chuck Fadley

SCHOOL ON NEURAL INFORMATION PROCESSING

3 - 28 May

Directors: J.A. Hertz (Nordic Institute for Theoretical Physics, NORDITA, Copenhagen, Denmark), S.A. Solla (Northwestern University, Evanston, USA) and R. Zecchina (ICTP).

School on Neural Information Processing

Local Organisers: S. Franz (ICTP) and R. Zecchina (ICTP).

The School focused on the development of theoretical tools for investigating the processing, transmission and storage of information in the brain. Techniques based on the principles of statistical physics and information theory were presented and analytically applied to problems in computational neuroscience, especially neural encoding and sensory processing. Lectures concentrated on biological neural networks, developments in artificial networks and optimisation theory. Computer-based experiments were also organised.

SECOND INTERNATIONAL CONFERENCE ON PERSPECTIVES IN HADRONIC PHYSICS

10 - 14 May

Co-sponsor: Italian National Institute of Nuclear Physics (INFN).

Directors: S. Boffi (University of Pavia, Italy), C. Ciofi degli Atti (University of Perugia, Italy) and M. Giannini (INFN, Genoa, Italy).

The Conference is part of a series of research activities (co-sponsored by ICTP and INFN) that have been held every other year since the early 1980s. The most recent Conference focused on theoretical and experimental investigations of nucleon and nuclear structure by electromagnetic and hadronic probes at intermediate and high energies. The aim was to review recent advances and explore future trends in the following areas: nucleon form factors, correlations in nuclei, excited baryons and mesons, relativistic many-body approaches, deep inelastic scattering, and spin structure of hadrons and nuclei.

MEETING ON NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS, MODELLING AND CONTROL

24 - 28 May

Co-sponsor: International Centre for Pure and Applied Mathematics, (CIMPA, Nice, France).

Directors: C. Lobry (CIMPA) and M.S. Narasimhan (ICTP).

Local Organiser: C. Chidume (ICTP).

The week-long meeting was attended by 17 mathematicians from five French-speaking African nations (Burkina Faso, Central African Republic, Mauritania, Morocco, and Senegal) and four mathematicians from France. The purpose of the meeting was twofold: to bring together for the first time mathematicians from Europe and Africa who share common research interests in the field of non-linear partial differential equations, and to lay the groundwork for co-ordinated research activities allowing continued interaction among these scientists in the future through workshops, seminars and conferences. Most lectures were delivered in French.

EXTENDED WORKSHOP IN STRING THEORY

1 June - 16 July

Directors: E. Gava (Italian National Institute of Nuclear Physics, INFN, Trieste, Italy), K. S. Narain (ICTP), S. Randjbar-Daemi (ICTP) and A. Sen (Mehta Institute, Allahabad, India).

including

CONFERENCE ON BLACK HOLE PHYSICS

12-16 July

Directors: M. Blau (ICTP) and S. Wadia (Tata Institute of Fundamental Research, Mumbai, India).

The Workshop sought to create a framework for discussions on the latest developments in the field of string theory and related topics. With a small number of long-term participants serving as discussion leaders, the Workshop provided an arena for discussion and interaction among the participants. Participants, in turn, presented their own work in a limited number of more formal seminars. Topics included: string dualities; AdS/CFT correspondence; BPS and non BPS states in string theory; and black hole physics.

Ashoke Sen

SUMMER COLLOQUIUM ON THE PHYSICS OF WEATHER AND CLIMATE. THE PHYSICS OF CLIMATE CHANGE: A REGIONAL PERSPECTIVE

7 - 25 June

Directors: F. Giorgi (ICTP) and G. Philander (Princeton University, USA).

The Colloquium consisted of three segments:

Conference on Global Climate Change

7 - 8 June

Directors: F. Giorgi (ICTP), G. Philander (Princeton University, USA) and J. Shukla (Center for Ocean-Land-Atmosphere Studies, COLA, Calverton, USA).

The Conference's objective was to review and discuss the main issues in global change research through a series of invited keynote lectures and a panel discussion.

Conference on Detection and Modeling of Regional Climate Change

9 - 12 June

Directors: F. Giorgi (ICTP), R. Jones (Hadley Centre for Climate Prediction and Research, Bracknell, UK) and P. Stott (Hadley Centre for Climate Prediction and Research, Bracknell, UK).

Conference topics included: detection and attribution of climatic trends, with emphasis on the regional scale; simulation of regional climate change due to increased greenhouse gas concentration, sulphate aerosol effects and land use changes; coupled Atmosphere/Ocean General Circulation Model (A/OGCM) experiments; analysis of the performance of GCMs and limited area climate models at the regional scale; application of limited area climate models to seasonal predictability; regional climate variability and sensitivity; paleoclimate studies; and coupling of different components of the climate system at the regional scale.

Workshop on Theory and Modeling of Regional Climate Change

14 - 25 June

Directors: F. Giorgi (ICTP) and R. Jones (Hadley Centre for Climate Prediction and Research, Bracknell, UK).

The Workshop included seminars, lectures, exercises and projects on the physical processes driving regional climate change and the models that can be used to study such processes. Emphasis was placed on the use of limited area atmospheric models for regional climate studies and other applications. The Workshop included extended hands-on sessions with limited area atmospheric models in which students designed small projects.

Panel Discussion on Global Change Research Strategies and Capacity Building in Developing Countries at the Summer Colloquium on the Physics of Weather and Climate

SUMMER SCHOOL IN PARTICLE PHYSICS

7 June - 9 July

Directors: E. Kolb (Fermi National Accelerator Laboratory, Batavia, USA), A. Masiero (SISSA), S. Randjbar-Daemi (ICTP), G. Senjanovic (ICTP) and A. Smirnov (ICTP).

Organising Committee: G. Dvali (New York University, USA, and ICTP), Choong Sun Kim (APCTP and Yonsei University, Seoul, Korea), A. Masiero (SISSA), G. Senjanovic (ICTP), A. Smirnov (ICTP) and G. Thompson (ICTP).

Local Organisers: G. Senjanovic (ICTP) and A. Smirnov (ICTP). In collaboration with the International School for Advanced Studies (SISSA), Italian National Institute of Nuclear Physics (INFN) and Asia Pacific Centre for Theoretical Physics (APCTP, Seoul, Korea).

This School consisted of (1) a training course designed mainly for participants who needed to improve their background knowledge, and (2) lectures covering precision tests of the standard model and a wide spectrum of physics beyond the standard model. Emphasis was placed on areas in which new experimental results may lead to significant progress: for example, neutrino and B-physics. Main topics included: status of the standard model and QCD; CP-violation; B-physics; fermion masses; neutrino physics; SUSY violation; phenomenology of SUSY; unification of particles and forces; and astroparticle physics and cosmic rays.

Antonio Masiero

George Thompson

ADRIATICO RESEARCH CONFERENCE ON WETTING

15 - 18 June

Co-sponsors: International School for Advanced Studies (SISSA, Trieste, Italy) and Department of Theoretical Physics of the University of Trieste.

Directors: M.W. Cole (Pennsylvania State University, University Park, USA) and J. Treiner (*Ecole Normale Supérieure*, Paris, France).

Local Organiser: E. Tosatti (SISSA and ICTP).

The Conference, which consisted largely of discussions and poster sessions, examined experimental and theoretical problems in the field of wetting. Topics included: statistical mechanical principles and applications; simple atomic and complex molecular adsorption systems; equilibrium properties and dynamics; phase transitions; quantum and classical simulations; applications to friction and adhesion; density functional calculations; and pure systems and mixtures.

ADRIATICO RESEARCH CONFERENCE ON LIQUID STATE OF MATTER: OPPORTUNITIES FROM ADVANCED RADIATION SOURCES

28 June - 2 July

Directors: N.W. Ashcroft (Cornell University, Ithaca, USA), F. Barocchi (University of Florence, Italy), L. Reatto (University of Milan, Italy) and M.P. Tosi (*Scuola Normale Superiore*, Pisa, Italy).

About 100 participants attended the Conference, including about 50 invited speakers. Topics included: experimental developments in advanced X-ray and neutron sources; electron correlations in metallic fluids; Coulomb liquids; complex liquids; criticality and phase transitions; liquid state under extreme conditions; triplet correlations (theory and experiment); bounded liquids; liquids in reduced dimensionality and at interfaces; and wetting phenomena and non-equilibrium fluid systems.

WORKSHOP ON COMPUTATIONAL TECHNIQUES FOR STRONGLY CORRELATED SYSTEMS

28 June - 9 July

Directors: R. Scalettar (University of California, Davis, USA), S. Sorella (International School for Advanced Studies, SISSA, Trieste, Italy) and N. Trivedi (Tata Institute of Fundamental Research, Mumbai, India).

Local Organiser: S. Sorella (SISSA).

The Workshop combined presentations emphasising new results in strongly correlated and disordered systems, including lectures on computational methods. Topics included: quantum magnetism; strongly correlated systems; Hubbard, t-J and other models; heavy fermions; transition metal oxides; disordered systems; and quantum phase transitions. Afternoon tutorials focused on: exact diagonalization; Quantum Monte Carlo (QMC) methods; electronic structure using QMC; density matrix renormalisation group; numerical methods for disordered systems; and dynamical mean field theory.

PROFILE

Rula Tabbash first learned about physics as a young child growing up in Syria. Some two decades later, Tabbash is expanding her knowledge of physics with the help of ICTP and the International School for Advanced Studies (SISSA).

High Energy Commitments

Throughout her education and travels, Rula Tabbash has maintained a childlike fascination with the physical world in which we live. Such enduring interest has taken her from her hometown, Aleppo, Syria, where she studied physics at Aleppo University, to Trieste, Italy, first as a student in ICTP Diploma Course in high energy physics and now as a doctoral student in elementary particle physics at the International School for Advanced Studies (SISSA).

When it came to physics, Tabbash excelled within her own country. Yet, her performance at school, which won her many accolades at home, tended to leave her somewhat behind when she arrived in Trieste in 1995 to begin her year-long studies in ICTP Diploma Course.

"Texts used by students in Syria," Tabbash explains, "were often out of date and the teaching not on par with the instruction that other Diploma students had received."

As a result, Tabbash adds, "I found myself at a disadvantage during the early weeks and months of ICTP Diploma Course."

Luckily for Tabbash, the Diploma Course recognises that incoming students will possess different levels of knowledge and skills, largely as a result of the previous schooling they have received. For this reason, the first few months of the course are devoted to 'levelling the playing field' to ensure that all students—regardless of their backgrounds—can keep pace during the second half of the course when the instruction picks up steam and delves into new subject areas that none of the students have learned before.

Rula Tabbash

"I really took advantage of the first few months of the Diploma Course to build a strong foundation in university-level physics that has served me well ever since. The doors of the professors teaching the courses were always opened and I was not shy about asking for assistance. Antonio Masiero, Seifallah Randjbar-Daemi and George Thompson were particularly helpful. I don't think I would have been able to make it through without their guidance."

"Despite the competition, the students themselves also supported one another both inside and outside the classroom," Tabbash adds. "Through our study groups and after-study activities, we nurtured a sense of community that has led many members of the class to stay in touch despite the vast distances now separating us. Weekly e-mails among my friends in Brazil, Germany, the Netherlands and the United States are not uncommon, and I suspect that they will continue as our careers and lives unfold."

After successfully completing the ICTP Diploma Course, Tabbash was accepted to doctoral programmes at both the National Institute for Nuclear Physics and High Energy (NIKHEF) in Amsterdam, the Netherlands, and *Scuola Normale Superiore* in Pisa, Italy.

"I decided to turn down those offers when I learned that I was accepted to SISSA's doctoral programme," she says. "The close interaction between SISSA, ICTP and the University of Trieste's Department of Theoretical Physics creates a unique learning environment that I don't think is replicated in many other places."

Tabbash was only one of four students (out of nearly 40 who had applied) to be accepted into SISSA doctoral programme in physics in 1998—testimony to the progress she had made since her arrival in Trieste two years earlier. Her field of study at SISSA is elementary particle physics and her supervisor is Antonio Masiero, her former Diploma Course professor.

"I'm convinced," Tabbash says, "that there's a direct link between childhood fascination in physics and my current studies at the ICTP and SISSA. It's all part of a life of learning that never begins too soon and never ends."

"After completing my studies in Trieste and a postdoc either in Europe or the United States, I hope to convey some of the joy of learning that I have experienced here when I return to Syria. Giving something back to the scientific community in my country is the least I could do to express my appreciation for what so many others have done for me." □

IAEA Ambassador

Zhang Yishan, Resident Representative of China to the International Atomic Energy Agency (IAEA), visited the ICTP in early May. Zhang met ICTP director, Miguel Virasoro, toured the library and computer facilities, and spoke to Faheem Hussain, Head of the Office of External Activities, and Yu Lu, Head of the Condensed Matter Physics Group. Ambassador Zhang also held an informal meeting with about 15 visiting scientists and students from China currently studying and pursuing their research at ICTP and the International School for Advanced Studies (SISSA).

Dirac Medal and ICTP Prize

Stephen L. Adler of the Institute for Advanced Study, in Princeton, New Jersey (USA), who shared the 1998 ICTP Dirac Medal with Roman Jackiw of the Massachusetts Institute of Technology in Cambridge, Massachusetts (USA), delivered his Dirac Lecture, "What Chiral Symmetry Teaches Us About Particle Properties," on 10 June. Anamaría Font from *Universidad Central de Venezuela*, Caracas, and Fernando Quevedo of *Universidad Nacional Autónoma de Mexico* were awarded the 1998 Prize in the field of High Energy Physics (in honour of Nobel Laureate Chen Ning Yang) on 24 June.

V.K. Sharma Honoured

Vinod Kumar Sharma, a Fellow with ICTP Programme for Training and Research in Italian Laboratories (TRIL), now on assignment with the Italian Commission for New Technologies, Energy and the Environment (ENEA) at a research centre in Trisaia, in southern Italy, was awarded two gold medals for a pair of research papers he presented at the 7th International Energy Conference (ENERGEX '98).

Memorandum Signed

Wale Omole, Vice Chancellor of Obafemi Awolowo University (OAU) in Ile-Ife, Nigeria, visited the ICTP in late May to sign a three-year extension of a memorandum of understanding (MOU) with the Centre that will facilitate the extension of the OAU communications network. The initial MOU was signed in 1995. Under the terms of the agreement, ICTP Programme of Training and System Development on Networking and Radiocommunications will continue to help the University make use of its network to enhance research activities in physics and the physical sciences; promote an exchange of information between the Centre and the University; and facilitate co-operative activities between OAU and the University of Cape Coast in Ghana, in the fields of optical physics, radiocommunications and space science. The latter activities will take place under the sponsorship of the ICTP Office of External Activities (OEA).

TRIBUTES

Efim Samoilovich Fradkin, 75, a professor at the Lebedev Physical Institute, Moscow, Russia, and winner of the ICTP Dirac Medal in 1988, died on 25 May. Fradkin's university studies began at the University of Minsk in 1940. A member of the Russian Army during World War II, he was wounded during the Battle of Stalingrad in 1942. After the war, Fradkin continued his studies at the University of Lvov, receiving his undergraduate degree in 1948. The same year, he began his post-graduate studies at the Lebedev Physical Institute of the Russian Academy of Sciences, where he was awarded a doctorate degree in physics. For more than 50 years, Fradkin worked as a scientist at the institute, earning an international reputation in the study of quantum field theory and quantum statistics. In addition to the ICTP Dirac Medal, Fradkin won the Soviet State Prize in 1953 and the Academy Tamm Prize in 1980.

Pakistani-born **Munir Ahmad Khan**, 73, a close associate of ICTP's founding director Abdus Salam, died on 22 April in Vienna, Austria. Khan, a nuclear engineer by training, joined the International Atomic Energy Agency (IAEA) in 1958. From 1986 to 1987, he was Chairman of the IAEA's Board of Governors. He also served as Scientific Secretary of the UN Geneva Conference on the Peaceful Uses of Atomic Energy from 1964 to 1971, and Chairman of the Pakistan Atomic Energy Commission from 1972 to 1991. Khan last visited the ICTP during the Abdus Salam Memorial Meeting, held on 19-22 November 1997. He was the first person at the IAEA to whom Salam went to broach the idea of an international centre for theoretical physics. Their conversation took place in September 1960 in Vienna.

WHAT'S NEXT

5 - 9 July
International Conference on Macroscopic Quantum Coherence Phenomena

12 - 23 July
XI Workshop on Strongly Correlated Electron Systems

26 - 30 July
The First Stig Lundqvist Research Conference on the Advancing Frontiers in Condensed Matter Physics: Quantum Phases in Electron Systems of Low Dimensions

26 July - 13 August
School on Algebraic Geometry

9 - 18 August
Workshop on Calculation of Material Properties Using Total Energy and Force Methods and Ab-Initio Molecular Dynamics

10 - 13 August
Adriatico Research Conference on High Field Transport in Superlattices

15 August - 15 September
1999 Nordic-Trieste Workshop: Astronomical Sources for Gravitational Radiation

16 - 27 August
Workshop on Dynamics of Nonequilibrium Systems

23 - 26 August
Adriatico Research Conference on Non-Hermiticity and Disorder

23 August - 3 September
International Summer School on Statistical Physics and Probabilistic Methods in Computer Science: A Primer for Physicists, Mathematicians and Computer Scientists

followed by

6 - 10 September
Topical Conference on Np-Hardness and Phase Transitions

23 August - 11 September
Second African Regional College on Microprocessor-Based Real-Time Systems in Physics — Theory and Applications, to be held in Dakar, Senegal

23 August - 17 September
EU Advanced Course in Computational Neuroscience

6 - 24 September
School on Modern Statistical Methods in Medical Research

15 - 18 September
Conference on Unifying Concepts in Glass Physics

20 September - 15 October
College on Medical Physics and Workshop on Nuclear Data for Science and Technology: Medical Applications

27 September - 2 October
COSMO-99

27 September - 22 October
Workshop on Modelling Real Systems: A Hands-On First Encounter with Industrial Mathematics

Throughout the year, the most up-to-date information on ICTP activities may be found on the World Wide Web and via e-mail. Here's how to find out what's going on.

ON THE WORLD WIDE WEB (WWW)
Our address is
`http://www.ictp.trieste.it/`
The site includes detailed information on our research groups and activities, and a listing of our preprints, awards and job opportunities.

ON E-MAIL
(1) *For Yearly Calendar of Scientific Activities*
Create a new e-mail message and type
`To:` `smr@ictp.trieste.it`
`Subject:` `get calendar 1999`
Leave the body of the message blank. Send it.
Your e-mail will generate an automatic reply from the ICTP server containing the most updated version of the yearly Calendar.

(2) *For Information on a Specific ICTP Activity*
Each activity in the Calendar has its own 'smr' code number, which is located on the last line of each activity description. The 'smr' number will enable you to obtain more information—if available—on those activities you are interested in. To receive this more detailed information, create a new e-mail message and type the smr code number that you found on the Calendar:
`To:` `smr####@ictp.trieste.it`
Under the e-mail's subject, type
`Subject:` `get index`
Leave the body of the message blank and send it.
You will receive an automatic reply listing all documentation available on that particular activity—the `announcement` or `bulletin` and, in most cases, a separate `application_form`.
To receive the full text of the announcement and/or application form, you will need to send another e-mail message to the same smr code
`To:` `smr####@ictp.trieste.it`
`Subject:` `get announcement application_form`
Again, leave the body of the message blank, and send it.

NEWS from ICTP

The ICTP is administered by two United Nations Agencies—the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Atomic Energy Agency (IAEA)—under an agreement with the Government of Italy. Miguel Virasoro serves as the Centre's Director. On 21 November 1997, the ICTP changed its name to The Abdus Salam International Centre for Theoretical Physics to honour its founder.

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

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