The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific
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Energy Agency

NEWS from ICTP

SUMMER
2006

#117

ICTP's most recent Scientific Council meeting served as a forum for unveiling two new initiatives.

New Initiatives

ICTP's Scientific Council met on 11-12 May. Not only did this mark the first Council meeting presided over by Nicola Cabibbo, president of the Pontifical Academy of Sciences in Vatican City and one of Italy's most eminent physicists, but it also provided a forum for the discussion of two new ICTP initiatives.

The first initiative involves a collaboration with CERN, the European particle physics laboratory, that will enable ICTP scientists and students to interact closely with colleagues working at the Large Hadron Collider (LHC) in Geneva, Switzerland.

ICTP will be associated with LHC through a pair of separate, yet interrelated, arrangements with the Italian National Institute of Nuclear Physics (INFN) and CERN.

Nicola Cabibbo (centre) presides over Scientific Council meeting. From left: Claudio Tuniz, Lê Dung Tráng, Jean-Christophe Yoccoz and Chen Jia-Er

First, the Centre will draw on an existing memorandum of agreement (MoA) with INFN, Italy's pre-eminent nuclear research institute and an institution that has already signed a formal agreement with CERN, to participate in the LHC experimental programme. Second, the Centre is now in the process of finalizing a MoA with CERN to confirm ICTP's participation in the LHC programme (and also to work with CERN on issues involving open access to scientific literature).

Specifically, ICTP will offer two positions each year to doctoral students from the developing world to work at LHC as part of a 'sandwich' programme that will enable them to spend six months at CERN and six months at the institutions in their home countries where they will be enrolled as students. The Centre will also offer two posts each year to postdoctoral students to work either at the LHC or INFN-Trieste. In addition, if funding is available, ICTP will appoint two senior scientists as associates who will devote two to three months a year to research related to LHC experiments.

The ICTP-INFN-CERN partnership is significant because when the LHC comes online in 2007, scientists expect that experiments conducted there will shed new light on the properties and behaviour of the most elementary particles. More than 5000 scientists in some 500 research institutes and universities worldwide will participate in LHC experiments. As ICTP director K.R. Sreenivasan notes, "the LHC will set the agenda for high energy physics for the next 20 years."

On another front, the Scientific Council endorsed the director's proposal to form a new Earth System Physics section devoted to sustainable development. The section will be created by bringing together existing Centre activities in the fields of weather and climate, seismology and renewable energy. The Centre's Aeronomy and Radiopropagation Laboratory (ARPL) will also be part of this effort.

Specifically, the Earth System Physics section will seek to advance scientific understanding of global environmental changes, including natural hazards; study the impact that these changes are having on the Earth's resources; and educate and train scientists from developing countries to meet the challenges of sustainable development.

"In light of the Earth's finite resources," Sreenivasan notes, "our ability to increase our understanding of the mechanisms that control the planet as a system could prove instrumental in charting development paths that can be sustained over time. We are hopeful that ICTP's Earth System Physics section can make important contributions to this global effort both through its scientific research and modelling capabilities and by training scientists, especially scientists in the developing world, to become more adept at exploring sustainability issues."

"The Scientific Council," adds Cabibbo, "is pleased to see the Centre capitalize on its traditional strengths in physics and mathematics to move in new and exciting directions. The Council hopes that the Centre's Earth System Physics section can make important contributions both to our understanding of critical sustainability issues and to the ongoing need to train scientists in exploring and addressing issues related to sustainable development."□

For more information about the Large Hadron Collider (LHC), see lhc.web.cern.ch/lhc. For more information on ICTP's Earth System Physics section, see www.ictp.it/pages/research/esp.html.

Claudio Tuniz
ICTP Assistant Director

COMMENTARY

At the behest of the International Atomic Energy Agency (IAEA), Claudio Tuniz, ICTP's Assistant Director, recently visited Ghana to examine what it would take to build an ion accelerator there.

Accelerating Ghana

Should a poor country like Ghana build an ion accelerator?

The answer is a yes and not just because all countries, regardless of their economic status, need to build institutional and individual scientific capacity. More importantly, it's because an ion accelerator would likely be an invaluable tool for addressing critical economic and social challenges.

Claudio Tuniz with a group of researchers at Ghana Atomic Energy Commission's research reactor

To understand the role that an ion accelerator could play in Ghana's ongoing efforts for sustainable development, it is first necessary to understand the current circumstances that Ghana finds itself in.

With an annual per capita income of US$2500 a year, Ghana, a west African country of 22 million people, is indeed poor. Yet its annual per capita income is twice that of its neighbours—Burkina Faso, Côte d'Ivoire and Togo. Ghana is also well endowed with natural resources. It is home to rich deposits of diamonds and gold and has extensive forests and cocoa plantations. Over the past decade, the government has spent significant portions of its budget (up to 40 percent in some years) on education, enabling it to provide free schooling to all children through secondary school and to build five universities. Ghana's scientific infrastructure includes a research reactor, a radiation protection institute and a biotechnology agricultural research institute that operate under the Ghana Atomic Energy Commission.

So what does all this have to do with an ion accelerator? And what impact would such a sophisticated machine have on Ghana's immediate problems? Ghana may not be as poor as its neighbours but it is still plenty poor. There's also the AIDS epidemic, water shortages and looming problems associated with global warming. Shouldn't all of these critical issues—and more—take precedence over calls for the construction of an ion accelerator, which at first glance seems like nothing more than a scientists' plaything?

Well, the fact is that an ion accelerator could play a vital role in Ghana's overall development efforts—for example, in agriculture and environmental management (through its ability to pinpoint chemical contaminants in the soil and water and to trace air-borne pollutants); in plant cultivation and animal husbandry (through the use of accelerator-generated isotopes designed to improve crop output and animal health and weight); in mother and child nutrition (through accelerator analysis of micronutrients); and in public health (through its ability to assess drug content and the pace at which drugs are metabolized).

All of these issues are central to Ghana's larger efforts to devise an effective strategy for sustainable development. Nearly 40 percent of Ghana's economy and 60 percent of its workforce continue to depend on subsistence agriculture. As a result, any effort to boost agricultural production would help boost the economy. With an infant mortality rate of 55 per 1000 live births and an average life expectancy of less than 59 years, it is clear that measures designed to improve public health and reduce mortality and morbidity are urgently needed. An ion accelerator can help on both counts.

These direct impacts would be accompanied by increased educational and training opportunities for Ghana's young scientists and technicians. Knowledge acquisition in such fields as ion and radiation detection, ion sources, and high voltage and vacuum components would be significant long-lasting byproducts of a successful ion accelerator initiative.

Transforming this idea into reality will not be easy. Even the construction of a small (2 million volts) ion accelerator will require outside assistance. And so will the other aspects of a successful ion accelerator research facility—the management and maintenance of beam lines, target stations, fast-isotope cycling, and sample processing—that will allow samples to be both collected and analyzed.

The first step in such an effort is a firm commitment on the part of the host nation. I am delighted to note that Ghana, largely through officials at the Ghana Atomic Energy Commission that oversees much of the nation's efforts in nuclear matters, is eager to see an ion accelerator built. The second step will be marshalling international support for such an initiative so that sufficient financial resources and expertise are available both to build the facility and train expert personnel to operate it. The International Atomic Energy Agency (IAEA), headquartered in Vienna, Austria, and one ICTP's parent organizations, is leading efforts to garner such support. Together with ICTP, the Agency is also supporting an initiative to create a new African 'accelerators for sustainable development' network.

With the growing interest in scientific capacity building as a cornerstone of efforts to develop effective strategies for sustained economic growth, I am guardedly optimistic that we will soon see a plan to help Ghana 'accelerate' into the future.□

An ICTP workshop recently explored weather in space, focusing much of its attention on space weather's growing impact here on Earth.

The Weather in Space

What's the weather like in space? Too hot? Too cold? Too turbulent? Too serene? Too unpredictable? A flux of unending change in a sea of 'atmospheric' tranquillity. Do we need to know more?

Well, yes, say an increasing number of scientists. Space weather, they note, is having an ever-greater impact on life here on earth, most notably in its effect on satellite communications and computerized navigation systems.

Mauro Messerotti

The more we know about space weather, these experts say, the more we need to know.

Space weather was the theme of the international advanced school held at ICTP from 2 to 19 May. More than 80 scientists from 30 countries attended the meeting.

"The sun is the primary driver of space weather. So it is important to know what the solar climate is like," says Mauro Messerotti, head of the Astronomical Observatory of Trieste's Basovizza Observing Station, which is part of the Italian National Institute for Astrophysics (INAF).

"The solar climate is something we have learned a great deal about over the past decade," he adds, "thanks largely to satellite missions conducted by the US National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA), and to advances in ground- and space-based telescopes." Messerotti co-directed the school on space weather, the first of its kind at ICTP, with Jeffrey M. Forbes, professor of aerospace engineering sciences at the University of Colorado, USA. Sandro Radicella, head of the ICTP Aeronomy and Radiopropagation Laboratory (ARPL), was the local organizer.

"The sun is more than 100 times larger than the Earth and is located some 150 million kilometres from our planet," says Messerotti. "At its core, temperatures reach 15 million degrees Kelvin. That's just a tad less than 15 million degrees Celsius." In effect, that makes the sun a fireball of energy. But what is less well known is that the sun's temperature declines rapidly as you move from its core to its surface.

Temperatures at the surface, which can reach some 6000 degrees Kelvin, Messerotti is quick to add, "are still plenty hot. But that's still much cooler than the core itself."

Solar temperatures then rise again at the corona, the sun's outer halo, where they can reach 2 million degrees Kelvin.

"The sun is not just super hot, it's also super turbulent," says Messerotti. "And it's not just composed of hot gas but also of intense electric and magnetic fields that absorb and emit radiation in a hard wavy boil of attraction and repulsion." In effect, says Messerotti, the sun is a blob of plasma—"highly ionized gas with high conductivity that has the capacity to generate and store magnetic fields."

Some of the sun's photons, the name scientists have given to mass-less elementary particles that simultaneously embody the characteristics of light waves and particles, take millions of years to move from the core to the corona—a relentlessly violent journey marked by twists and turns that even the most dedicated pinball wizard or Nintendo player cannot begin to imagine.

If it sounds like a long turbulent journey, there's a reason for that. It is. But we shouldn't forget that the distances themselves are as daunting as the environment in which the journey takes place. It is, after all, nearly 700,000 kilometres from the sun's core to its corona.

The best-known feature of solar weather is sunspots, which Messerotti describes as "localized concentrations of magnetic fields and reservoirs of magnetic energy that are stronger than the general magnetic field of the sun itself."

Then there are solar flares, outbursts of radiation—gamma, x- and ultraviolet-rays, radio emissions and particle clouds that sometimes escape the sun's field of gravity. There are solar winds as well—continuous flows of particles, travelling up to 1200 kilometres a second. These winds are comprised of low-density plasma, a potpourri of electrons, protons and ions that carry solar magnetic fields from the sun to the Earth.

Other major elements that are part of space weather include geomagnetic storms, which are determined by the intensity and direction of magnetic fields, and sunspots, which occur on eleven-year cycles.

The point is that space weather is determined by alterations—perturbations as scientists call them—in solar temperatures, pressure and magnetic fields much like the Earth's weather is determined by wind currents, clouds, precipitation and atmospheric pressure.

Messerotti notes "we know a great deal about the specifics of solar weather—for example, the structure and behaviour of sunspots, the process by which the corona creates solar flares, and the physics that drives the sun to shower the earth with radiation." But what we don't know—and this is a critical shortcoming—is how all of the factors and forces work together to create the broad patterns that characterize solar weather. "In effect," Messerotti says, "we know the details but not the story."

And knowing the story—the narrative of space weather, if you will—has become more and more important in a world that relies increasingly on sophisticated high-tech communications and materials both to get its work done and then enjoy the fruits of its labour.

For example, in March 1989, a burst of electric currents short-circuited and ultimately caused irreparable damage to a major electric power station in Québec, Canada, which led to a blackout in southern Canada.

As Messerotti observes, "we know that variations in the Earth's magnetic fields and electrical currents, instigated by solar activity, accelerate the corrosion of pipelines that carry petroleum from remote oil fields to oil refineries. We also know that enhanced ionization in the Earth's atmosphere, created by bursts of solar radiation and particles, can play havoc with shortwave bands that are used by emergency workers. And we know that the sun's electromagnetic waves and particles adversely effect satellite transmissions and global positioning systems."

Solar weather? Too hot. Too cold. Too turbulent. Too serene. Too unpredictable. A flux of unending change in a sea of 'atmospheric' tranquillity. Sounds a lot like weather on Earth. And, as every one knows, we know a great deal about the weather here on Earth—knowledge that has been put to good use but knowledge that, in many ways, makes us even more respectful—and in awe—of the primal forces of nature.

These same sentiments are likely to drive our desire for increasing our knowledge of space weather in the years ahead—with scientists at ICTP and elsewhere leading the way.□

SPACE WEATHER COSPONSORS

As a sign of the growing interest in the field, the International Advanced School on Space Weather drew participation from a number of institutions both in Italy and abroad. The school's co-sponsors included European Cooperation in the Field of Scientific and Technical Research (COST), funded by the European Union; the Italian National Institute for Astrophysics (INAF); the Italian National Institute for Nuclear Physics (INFN); the International Council for Science's (ICSU) Scientific Committee on Solar Terrestrial Physics/Climate and Weather of the Sun-Earth System (SCOSTEP/CAWSES); and the US National Space Weather Programme.

Roy J. Glauber, Nobel Prize winner in physics in 2005, has spent much of his career exploring the unusual world of quantum optics.

Laser Focus

Light and darkness mark our day and night, playing an indispensable role in the rhythms of our lives. And while we might define darkness as the absence of light, few of us would want to define light as the absence of darkness.

Light, simply put, is a welcome phenomenon central to our existence and as important to our physical (and psychological) well-being as the air we breathe and the water we drink.

Yet, what exactly is light? A century ago James Clerk Maxwell, the great Scottish mathematician and physicist, defined light as an electromagnetic wave. Or, as he put in a paper published in 1862, "light consists in the transverse undulations of that same medium which is the cause of electric and magnetic phenomena."

This insight, which Maxwell distilled in just four equations, remains one of the most profound discoveries in the history of science, standing alongside Newton's laws of motion as a fundamental pillar of classical physics. And while Maxwell thought light waves were propelled by ether, his belief that the speed of light is a constant laid the theoretical foundation for the revolution in optical physics that was to take place nearly a century later.

That revolution, as Roy J. Glauber, professor of physics at Harvard University and winner of the 2005 Nobel Prize in physics, has noted, was slow in coming. Glauber, who is a long-time friend and associate of ICTP's former acting director Luciano Bertocchi, visited the Centre in May to lecture at the Conference on Perspectives in Hadronic Physics. Italy's National Institute of Nuclear Physics (INFN) cosponsored the event, which was attended by some 100 scientists.

"Nearly 100 years after Maxwell's discovery," says Glauber, "the field of optics remained largely ensconced in Maxwell's shadow, operating under the mistaken belief that physicists had discovered everything that they needed to know about the physics of light."

"The sceptics," says Glauber, "were about to be proved wrong."

In the late 1950s, a consensus existed among the more established researchers in the field of optics that not much could be done with quantum particles of light either from an experimental or theoretical perspective, even though Einstein had shown some 50 years earlier that photons—the fundamental elements of visible light—simultaneously exist in dual states as both a wave and a particle. As Glauber recalls, "journal editors refused to publish articles on the subject. Young physicists like myself were well advised to choose other research topics."

Glauber says that in one sense the field of quantum optics did not exist until the late 1950s; yet, in another sense,

thanks to such scientific luminaries as Albert Einstein, Max Planck and Paul Dirac, it was a key aspect of our understanding of the phenomenon of light.

In fact, in the early 20th century, it had been indisputably proven that light has a granular structure. Yet practitioners of the 'older optics' had focused almost exclusively on light's average intensity and not on light's statistical properties, which would allow scientists to define light's innate characteristics with far more precision and examine its physical properties in greater and more revealing detail. And while the average intensity may have been good enough in the past, it simply would not do when researchers began exploring the contours of quantum electronic dynamics—the microscopic world of light-matter interaction.

The modern 'light revolution' essentially began in the late 1950s when the first lasers were being built.

Lasers themselves became operational in 1960, marking the first time scientists would be able to conduct meaningful experiments on photon correlations—that is, the intricate interactions of incredibly weak light waves and incredibly tiny light particles.

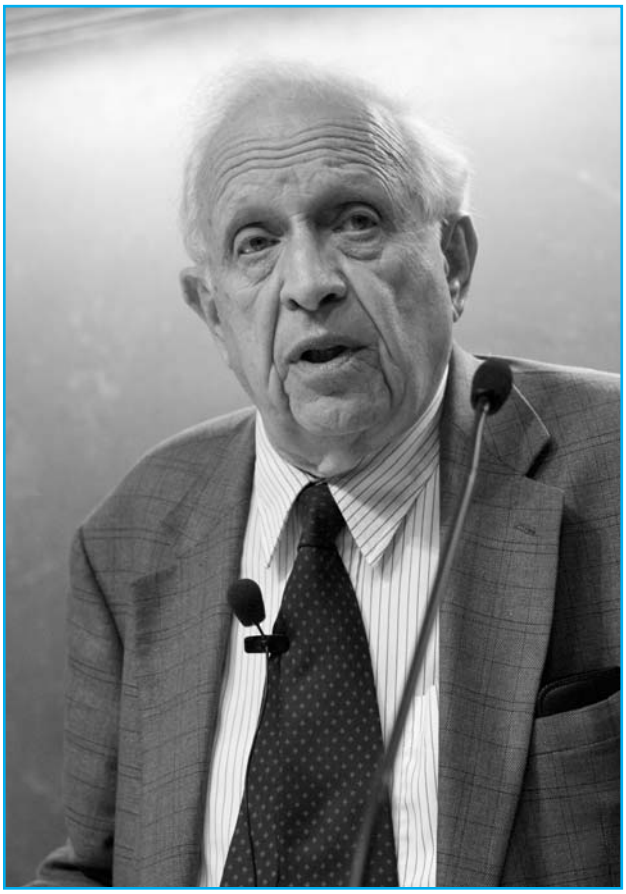
The word 'laser' is derived from the acronym Light Amplification by Stimulated Emission of Radiation and the verb 'to lase' means to 'produce coherent light.'

Photons—massless particles travelling at the speed of light—emitted from lasers behave in remarkably different ways than photons emitted, for example, from light bulbs. Light from the latter is comprised of a mixture of frequencies and phases, which in scientific terminology makes the light 'incoherent.' Lasers, in contrast, emit light within a single frequency and phase, which, again in scientific terminology, makes light 'coherent.' Indeed the intensity, power and focus associated with lasers are due to the singularity of its wavelengths and the fact that the photons are transmitted on a narrow beam, much like the intensity of a stream of water emitted from a hose depends on whether the nozzle is set at mist or jet.

In the late 1950s and early 1960s, Glauber helped to construct the theoretical framework that furnished optics with a quantum mechanical explanation. In short, Glauber observed that photons behaved in accordance with the laws and phenomena of the microscopic quantum world. That, in turn, meant that the behaviour of photons would often defy common sense—for example, photons, unlike particles in the non-quantum world that we are all familiar with, are capable of moving through matter or can be in two places at the same time.

Glauber's insights into the strange, counterintuitive world of quantum optics, where the behaviour of photons fail to conform to our accepted perceptions of reality, helped both theoretical and experimental physicists to better understand the quantum world of light, adding keen insights that would eventually propel the development of lasers forward—both in theory and practice.

When lasers were first introduced, critics scoffed at these radiation light amplification machines that they cynically claimed were nothing more than "a solution looking for a problem." The public was introduced to lasers in 1964 with the release of the film *Goldfinger*. In one of the film's most unforgettable scenes, laser beams shot from the back of a truck cut through the solid steel doors of gold-filled Fort Knox. Supermarket barcodes, introduced in 1974, marked the initial everyday use of lasers. Laser disk players were first marketed in 1978 and compact disks in 1982.



Nobel Laureate Roy J. Glauber

Today, of course, lasers represent a multibillion dollars enterprise that reaches into every aspect of our lives, from medicine (laser eye surgery), to business and industry (optic fibres and scanners), to consumer electronics and communications (DVDs), and to national defence (missile systems). Lasers heal us, help us do our jobs, entertain us, and, in the eyes of some, protect us from our enemies.

But just like 50 years ago, it is in basic science where the future lies. Whether it is additional research on laser spectroscopy designed to shed light on the structure of materials and genes, or improving holographic techniques to aid in critical measurements of objects and phenomena, or investigations into the behaviour of photons to enhance our ability to send encrypted messages, no one is scoffing at lasers today—or at the theoretical studies of the weird but revealing world of quantum optics that Roy J. Glauber, one of the fathers of the field, launched half a century ago.□

DATELINE

Director to Gulf

ICTP director **K.R. Sreenivasan** visited Saudi Arabia and Kuwait in April. In Saudi Arabia, he met with professors and officials from King Fahd University of Petroleum and Minerals and the King Abdulaziz City for Science & Technology (KACST). In Kuwait, he met with professors and officials from the University of Kuwait and the Kuwait Foundation for the Advancement of Science (KFAS). Discussions ranged from a general exchange of ideas on regional scientific priorities to the concrete steps that ICTP and scientific institutions in Italy and Saudi Arabia could take to forge stronger ties.

Friuli Earthquake

6 May marked the 30th anniversary of a violent earthquake that struck the Friuli Venezia Giulia region in northeastern Italy, killing nearly 1000 people. To examine this tragic event, *Regione Friuli-Venezia Giulia* organized several activities, including a scientific workshop exploring such topics as the region's seismology and the state of civil preparedness. **Giuliano F. Panza**, head of ICTP's Structure and Non-Linear Dynamics of the Earth (SAND) group, was among the speakers. Panza lectured on seismic risk in the region.

Eclipsed

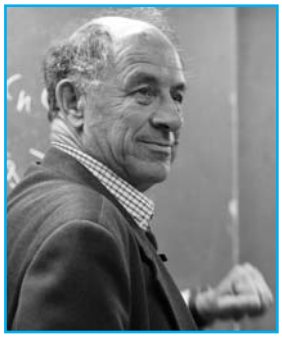
Speaking at ICTP on 27 April, **Claudio Tuniz**, ICTP assistant director, and **Mauro Messerotti**, head of the Astronomical Observatory of Trieste's Basovizza Observing Station, provided eyewitness accounts of the total eclipse of the sun that took place in Africa and Asia on 29 March. Tuniz travelled to Kenya and Messerotti went to Turkey to witness the event. Their talks were accompanied by photographs, videos and computer simulations of this rare occurrence.

Students at University of Cape Coast observe total solar eclipse, 29 March 2006

Distinguished Lecturers

Nobel Laureate **Pierre-Gilles de Gennes** (Physics 1991) lectured on 27 April during the Workshop on Driven States in Soft and Biological Matter. The title of his talk was "Some Thoughts on Friction." Following the workshop, a three-day Symposium on Statics and Dynamics of Interfaces was held in his honour.

Fields Medallist **Heisuke Hironaka**, president, Japan Association for Mathematical Sciences (JAMS), lectured at the Summer School on Resolution of Singularities, 12-30 June. In 1970, Hironaka won the Fields Medal, mathematics' equivalent to the Nobel Prize, for his work on the resolution of singularities of algebraic varieties. He has been a professor of mathematics at Columbia University, Harvard University, Kyoto University, and President of Yamaguchi University in Japan.



ICTP's Mathematics section invited **Vladimir I. Arnold**, Steklov Mathematical Institute, Moscow, to the Centre as a distinguished guest in April. During his stay, he gave a series of lectures. Arnold has achieved international renown for his work in a number of areas in mathematics, including dynamical systems theory, catastrophe theory, topology, algebraic geometry, classical mechanics and singularity theory. He is best known for the Kolmogorov-Arnold-Moser theorem.

Tsunami Workshop

On 8-12 May, ICTP held a workshop focusing on the hazards that tsunamis pose to nuclear facilities located in coastal zones. The workshop was cosponsored by the International Atomic Energy Agency (IAEA). Among the topics discussed were the status of the UNESCO/IOC (United Nations Educational, Scientific and Cultural Organization / Intergovernmental Oceanographic Commission) tsunami warning system, the effectiveness of existing building codes and regulations, and strategies for upgrading standards to mitigate the risks posed by tsunamis.

DATELINE

Templeton Prize

John D. Barrow, professor of theoretical physics, University of Cambridge, UK, has won the 2006 Templeton Prize. He is being honoured "for his writings about the relationship between life and the universe, and the nature of human understanding." The Templeton Prize, which is designed to honour and encourage those who examine the interface between science and religion, carries a US$1.4 million cash award. Barrow has visited ICTP on several occasions, including the summer workshops in high energy physics and cosmology in 1984 and 1987.

Royal Fellows

Two former members and one current member of the ICTP Scientific Council are among the six foreign members recently elected to the Royal Society for 2006. They are: Nobel Laureate **Kenneth Arrow** (ICTP Scientific Council member 2002-2005), **Edouard Brézin** (ICTP Scientific Council member 1996-2003) and Nobel Laureate **Paul Crutzen** (ICTP Scientific Council member since 2004). Other eminent scientists also earning membership in the Royal Society include the following participants in ICTP activities: **Stephen Barnett**, University of Strathclyde; **Charles Thomas Bayley Foxon**, University of Nottingham; **Karl John Friston**, University College London; **Mriganka Sur**, Massachusetts Institute of Technology, USA; **Peter Christopher West**, King's College London; and **David Phillip Woodruff**, University of Warwick. For the complete list of members in the Royal Society, one of the world's oldest and most prestigious science academies, see www.royalsoc.ac.uk.

APS Members

Yu Lu, former head of the ICTP Condensed Matter Physics section and now director of the Chinese Academy of Sciences' Interdisciplinary Center of Theoretical Studies (ICTS), Beijing, China, and **Riazuddin**, director of the National Centre for Physics (NCP) at Quaid-i-Azam University, Islamabad, Pakistan, and frequent participant in ICTP activities, have been elected as Fellows of the American Physical Society (APS). The award ceremony took place at the annual meeting of APS in Baltimore in March. Yu Lu was honoured "for his important and long-time contributions to a wide range of topics in condensed matter theory and for his significant role in fostering international collaboration in physics." Riazuddin was honoured "for original and outstanding contributions to theory and phenomenology of strong and electroweak interactions and for the internationalization of physics in developing countries."

Origins: A Conference

Julian Chela-Flores, ICTP staff associate, was invited to speak at the conference, "The Origins: How, When and Where It All Started." The conference, sponsored by the *Accademia Nazionale dei Lincei*, took place in Rome. Chela-Flores lectured on the "Evolution of the Universe: From Astrophysics to Astrobiology." Other speakers, who have been frequent ICTP visitors, included **Gabriele Veneziano**, CERN, the European particle physics laboratory, Geneva, Switzerland; **Antonio Lazcano**, National University of Mexico; and **George Coyne**, *Specola Vaticana*, Vatican City.

Abel Prize

Lennart A.E. Carleson, Royal Institute of Technology, Sweden, and professor emeritus at the University of California at Los Angeles, UCLA, USA, has been awarded the 2006 Abel Prize. Carleson is being recognized "for his profound and seminal contributions to harmonic analysis and the theory of smooth dynamical systems." The Abel Prize, inaugurated in 2003, is designed to honour the world's most accomplished mathematicians. It carries a US$920,000 cash award. Carleson lectured at the ICTP Workshop on Dynamical Systems in 1992.

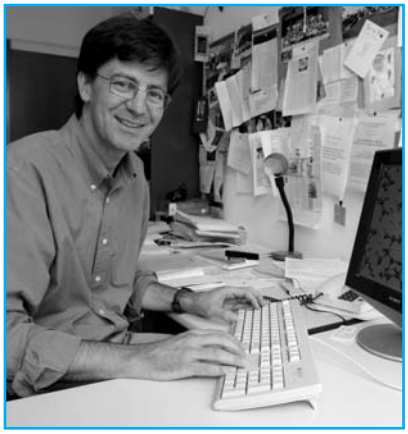
Science Ministry in Rwanda

Romain Murenzi, who attended the ICTP Course on Basic Telecommunication Science in 1989, has been appointed to the newly created post of Minister of Science, Technology and Scientific Research in Rwanda. Murenzi, who previously served as Minister of Science, will shoulder additional responsibilities for enhancing the integration of science and technology into all sectors of the national economy. Last year, Rwanda published its first detailed science strategy, outlining plans to apply the findings of scientific research to improve health, agriculture and the environment.

In *Nature* Twice

Sandro Scandolo, ICTP staff member in the Condensed Matter Physics section, co-authored a paper titled "Amorphous Silica-Like Carbon Dioxide" in the 15 June edition of *Nature*. The paper focuses on a new kind of glass in which carbon atoms replace silicon atoms. The material is named "carbonia". Scientists from European Laboratory for Non-linear Spectroscopy (LENS) and Italian National Institute for the Physics of Matter (INFM) in Florence created carbonia by heating solid carbon dioxide at pressures of 500,000 times greater than atmospheric pressure.

ICTP director **Katepalli R. Sreenivasan** and two scientists from the University of Maryland and Yale University published a brief communication on "Superfluid Helium: Visualization of Quantized Vortices" in the 1 June issue of *Nature*. The paper describes the behaviour of liquid helium when cooled below its phase transition at 2,172 degrees Kelvin.



Sandro Scandolo

ACTIVITIES

WORKSHOP ON DRIVEN STATES IN SOFT AND BIOLOGICAL MATTER

18 - 28 April

Organizers: G. Menon (The Institute of Mathematical Sciences, IMSc, Chennai, India), J. Prost (*Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris*, ESPCI, Paris, France), S. Ramaswamy (Indian Institute of Science, IISc, Bangalore, India) and M. Rao (Raman Research Institute and National Centre for Biological Sciences, NCBS, Bangalore, India).
Local Organizer: S. Franz (ICTP).

ICTP-COST-USNSWP-CAWSES-INAF-INFN INTERNATIONAL ADVANCED SCHOOL ON SPACE WEATHER

2 - 19 May

Cosponsors: COST Actions 724 and 296 of the European Union, Italian National Institute for Astrophysics (INAF), Italian National Institute for Nuclear Physics (INFN), ICSU Scientific Committee on Solar Terrestrial Physics / Climate and Weather of the Sun-Earth System (SCOSTEP/CAWSES), and US National Space Weather Program.
Organizers: J.M. Forbes (University of Colorado, Boulder, CO, USA) and M. Messerotti (INAF-Astronomical Observatory, Trieste, Italy).
Local Organizer: S. Radicella (ICTP).

TOPICAL CONSULTANCY ON TSUNAMI HAZARDS, IN PARTICULAR, AND COASTAL FLOODING, IN GENERAL, FOR NUCLEAR FACILITY SITES

8 - 12 May

Organizers: A.R. Godoy (International Atomic Energy Agency, IAEA, Vienna, Austria) and A. Gürpinar (IAEA).
Local Organizer: G. Panza (University of Trieste and ICTP).

THE CONDUCT OF SEISMIC HAZARD ANALYSES FOR CRITICAL FACILITIES

15 - 19 May

Organizers: A.R. Godoy (International Atomic Energy Agency, IAEA, Vienna, Austria) and A. Gürpinar (IAEA).
Local Organizer: G. Panza (University of Trieste and ICTP).

ICTP SCHOOL ON SYNCHROTRON RADIATION AND APPLICATIONS – IN MEMORY OF J.C. FUGGLE AND L. FONDA

8 - 26 May

Organizers: M. Altarelli (DESY, Hamburg, Germany, and ICTP) and M. Kiskinova (*Elettra* Synchrotron Light Laboratory, Trieste).

INTERNATIONAL WORKSHOP ON X-RAY SPECTROMICROSCOPY AND IMAGING FOR IMPROVING LIFE CONDITIONS AND HUMAN HEALTH

20 - 22 May

Organizers: C. Tuniz (ICTP) and B. Kaulich (*Elettra* Synchrotron Light Laboratory, Trieste).

FIFTH INTERNATIONAL CONFERENCE ON PERSPECTIVES IN HADRONIC PHYSICS: PARTICLE-NUCLEUS AND NUCLEUS-NUCLEUS SCATTERING AT RELATIVISTIC ENERGIES

22 - 26 May

Cosponsors: Italian National Institute for Nuclear Physics (INFN), University of Perugia (Italy), and *Consorzio per la fisica* (Trieste, Italy).
Organizers: C. Ciofi degli Atti (INFN, Perugia) and D. Treleani (INFN, Trieste).

CONSULTANCY ON OPTIONS FOR POST-KYOTO REGIMES AND THEIR IMPLICATIONS FOR SUSTAINABLE ENERGY DEVELOPMENT

22 - 26 May

Organizers: A.I. Jalal (International Atomic Energy Agency, IAEA, Vienna, Austria) and F. Toth (IAEA).
Local Organizer: F. Giorgi (ICTP).

THIRD ICTP WORKSHOP ON THE THEORY AND USE OF REGIONAL CLIMATE MODELS

29 May - 9 June

Organizers: X. Bi (ICTP), F. Giorgi (ICTP), X. Gao (National Climate Center, Beijing, China), W. Gutowski (Iowa State University, Armes, IA, USA) and J. Pal (ICTP).

CONFERENCE ON DRUG DEVELOPMENT FOR THE THIRD WORLD

5 - 9 June

Organizers: E. Arnold (Rutgers University, Piscataway, NJ, USA), Wim G.J. Hol (University of Washington, Seattle, WA, USA), W. Hunter (University of Dundee, UK) and E. Lattman (Johns Hopkins University, Baltimore, MD, USA).
Local Organizer: P. Carloni (International School for Advanced Studies, SISSA, and Italian National Institute for the Physics of Matter INFM-Democritos, Trieste, Italy).

SCHOOL AND WORKSHOP ON THEORY AND TECHNOLOGY IN QUANTUM INFORMATION, COMMUNICATION, COMPUTATION AND CRYPTOGRAPHY

12 - 23 June

Cosponsor: European Commission, Eurotech S.p.A. (Amaro, Udine, Italy), and International School for Advanced Studies (SISSA, Trieste, Italy).
Organizers: F. Benatti (University of Trieste), M. Fannes (*Katholieke Universiteit Leuven*, Leuven, Belgium), R. Floreanini (Italian National Institute for Nuclear Physics, INFN, Trieste) and D. Petritis (*Université de Rennes I*, France).
Local Organizer: R. Zecchina (ICTP).

WORKSHOP ON ION BEAM STUDIES OF NANOMATERIALS: SYNTHESIS, MODIFICATION AND CHARACTERIZATION

26 June - 1 July

Organizers: G. Lulli (Italian National Research Council Institute for Microelectronics and Microsystems, CNR-IMM, Bologna, Italy), P. Mazzoldi (University of Padua, Italy), A.P. Pathak (University of Hyderabad, India) and E. Rimini (CNR-IMM, Catania, Italy).
Local Organizer: C. Tuniz (ICTP).

WORKSHOP ON STRING VACUA AND THE LANDSCAPE

29 May - 3 June

Cosponsor: *Max-Planck-Institut für Physik - Theorie* (Munich, Germany), and Italian National Institute for Nuclear Physics (INFN).
Organizers: B. Acharya (ICTP), F. Denef (*Katholieke Universiteit Leuven*, Leuven, Belgium), M. Douglas (Rutgers State University, Piscataway, NJ, USA), S. Kachru (Stanford University, CA, USA), D. Lüst (*Max-Planck-Institut für Physik*, Munich, Germany) and E. Silverstein (Stanford University).

INTRODUCTORY SCHOOL ON STRING THEORY, Beijing, People's Republic of China

5 - 17 June

Cosponsors: Interdisciplinary Center of Theoretical Studies of the Chinese Academy of Sciences (ICTS, Beijing, China) and National Natural Science Foundation of China (NSFC).
Organizers: Miao Li (ICTS), K.S. Narain (ICTP), S. Randjbar-Daemi (ICTP) and G. Thompson (ICTP).

SUMMER SCHOOL ON RESOLUTION OF SINGULARITIES

12 - 30 June

Organizers: D. Cutkosky (University of Missouri, Columbia, MO, USA), J. Kollár (Princeton University, NJ, USA) and B. Teissier (*Institut de Mathématiques de Jussieu*, Paris, France).
Local Organizer: Lê Dung Tráng (ICTP).

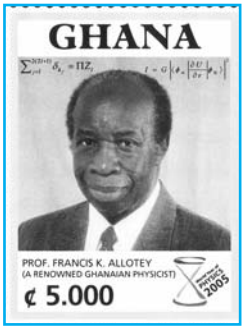
PROJECT-ORIENTED ADVANCED TRAINING ON WIRELESS NETWORKING

26 June - 8 July 2006

Organizer: S.M. Radicella (ICTP).

MONITOR

Allotey Honoured



Ghana has honoured **Francis K.A. Allotey**, former vice chancellor of Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, and member of the ICTP Scientific Council since 1996, by placing his image on a postage stamp. The official ceremony took place on 29 March during Ghana's nation-wide celebration of the total eclipse of the sun. Allotey, an internationally renowned physicist and mathematician, is one of Africa's most eminent scientists.

Italy-China Ties

Dong Jinyi, China's Ambassador to Italy, visited ICTP on 12 May to speak with director **K.R. Sreenivasan** on possible avenues

of future collaboration between ICTP and China's scientific community and to tour the Centre's facilities. Dong also met with **Mohamed H.A. Hassan**, executive director of TWAS (The Academy of Sciences for the Developing World).

Visitors from Middle East

On 6-7 April, ICTP director **K.R. Sreenivasan** met **Abdullah Hussain Al-Kubaisi**, Qatar's minister of technological sciences, and Savino Selvaggio, director of the Qatar Science and Technology Park, to discuss possible collaborations in the fields of biotechnology, telecommunications, space research, and environmental modelling. **Maria Cristina Pedicchio,** president of AREA Science Park, organized the visit.

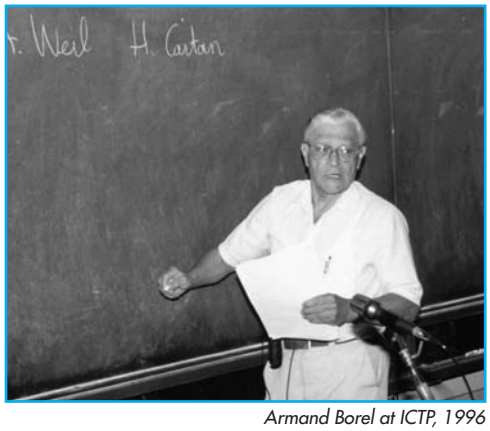
EC Cooperation

Gregorio Medrano, adviser in charge of developing countries at the European Commission (EC) Directorate General for Research, visited ICTP on 11 May to meet with ICTP and TWAS officials to explore opportunities for cooperation between the EC and Trieste's scientific community. He also gave a talk on the Seventh Framework Programme (2007-2013) of the European Commission to ICTP scientists and staff.

ICTP Prize

Xiaohua Zhu, professor, Peking University School of Mathematical Sciences, was officially awarded the ICTP Prize for 2005 on 16 May. The award ceremony was followed by Zhu's ICTP Prize lecture, "Canonical Metrics in Kähler Geometry". The ICTP Prize 2005 was given in honour **Armand Borel**, long-time professor at the Institute for Advanced Study at Princeton.

Xiaohua Zhu



Armand Borel at ICTP, 1996

Geometry and Bubbles

Michele Emmer, professor of mathematics, University of Rome *"La Sapienza"*, was the most recent scientist to participate in ICTP's public lecture series when he spoke on "Geometry and Soap Bubbles" at the University of Trieste on 25 May. This year's public lecture series is being co-sponsored by the University of Trieste and *Immaginario Scientifico*. Emmer is an internationally renowned scientist and scholar who has explored the intricate interface between science, culture and psychology.

ICTP Scientific Council

The ICTP Scientific Council held its annual meeting on 11-12 May. This marked the first Scientific Council in which Italy's internationally renowned physicist **Nicola Cabibbo**, University of Rome *"La Sapienza"*, presided as chairperson. **José Antonio de la Peña**, an eminent professor of mathematics from *Universidad Nacional Autónoma de México*, participated in his first Council meeting. The Council reviewed ICTP's activities over the past year and discussed possible future activities (see p. 2).

UNESCO Science Report 2005

The *UNESCO Science Report 2005* is now available online. **Mohamed H.A. Hassan**, executive director of TWAS (The Academy of Sciences for the Developing World), served as a co-author, and **Daniel Schaffer**, ICTP/TWAS public information officer, as a contributing author for the chapter on Africa. Other authors, who are closely associated with ICTP, include: **Adnan Badran**, former deputy director general of UNESCO and former prime minister of Jordan, who authored the chapter on the Arab States, and **Ana María Cetto**, IAEA deputy director general and head of Department of Technical Cooperation, and a frequent visitor to ICTP, who co-authored the chapter on Latin America.

One Hundred Reasons in Portuguese

A Portuguese version of *One Hundred Reasons To Be A Scientist*, *Algumas razões para ser um cientista*, has been published by *Centro Brasileiro de Pesquisas Físicas* (CBPF). **Ricardo Galvão**, CBPF director and winner of the ICTP Prize in 1984, has written an introduction to the book. *One Hundred Reasons To Be A Scientist*, a compilation of personal accounts by eminent scientists from around the world assembled by ICTP director **K.R. Sreenivasan**, was first published in 2004. Both books are on display at the ICTP Library.

Science Café

"Science Is Art" was the title of the Science Café held at *Caffè San Marco* in Trieste on 13 June. **Claudio Tuniz**, ICTP assistant director, and **Gianrossano Giannini**, professor of physics at the University of Trieste, discussed how physicists and archaeologists are working together to improve our understanding of the past and to solve many historical mysteries.

Cultural Committee

The art exhibition "quantum_kaos" was on display from 27 April to 24 May. The exhibit closed with a concert featuring the local soprano **Marianna Prizzon** who sang arias from Giuseppe Verdi's opera *La traviata*. She was accompanied by pianist **Corrado Gulin**.

The art exhibition "Creative Synergy = Energy" was opened to the public from 13 to 30 June. The exhibition featured works by 20 artists from Bologna and Trieste, Italy.

IN MEMORIAM

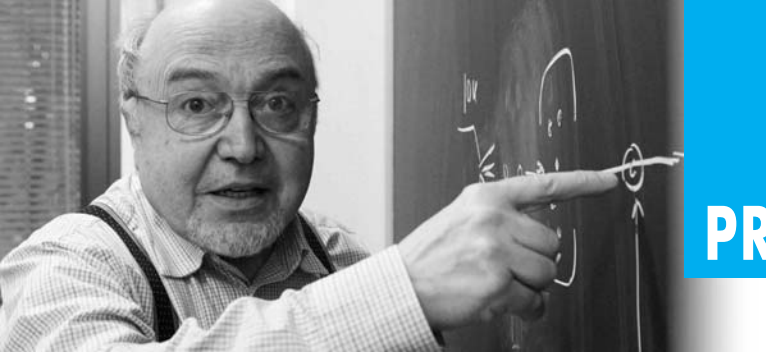
Yuval Ne'eman, world-renowned theoretical physicist, founder of Israel's space programme and a key figure in the nation's nuclear efforts, died on 26 April in Tel Aviv following a stroke. He was 80.

Trained as an engineer at the Technion in Haifa, Ne'eman fought with the Jewish resistance against the British troops and later in Israel's 1948 war of independence against the country's Arab neighbours. He served as Israel's military attaché in London while enrolled as a graduate student of Abdus Salam's at Imperial College. His first publication examined the so-called Eightfold Way classification of elementary particles (developed simultaneously with Murray Gell-Mann in the early 1960s). Ne'eman was the first to suggest that particles experiencing the strong nuclear force (protons and neutrons) are made of three fundamental "bricks," later to be known as quarks.

Upon leaving military service in 1961, Ne'eman returned to Israel where he became scientific director of the Nahal Soreq Nuclear Research Center, one of the nation's nuclear weapons centres. He founded the physics department of Tel Aviv University, subsequently becoming its president. In 1979 Ne'eman strongly opposed the Camp David accords and the return of the Sinai to Egypt where he had spent much of his childhood. He helped to found a far-right political party, Tehiya (Renaissance), and was a member of the Knesset (the Israeli parliament) from 1982 to 1992, serving also as its first science minister. In 1983 he established the Israeli Space Agency and headed it until shortly before his death. Under his direction, ISA launched a series of scientific and military satellites for monitoring the Middle East region.

Ne'eman participated in ICTP activities three times, including the Conference on Irreversible Quantum Dynamics in 2002.

Mainuddin Ahmed, Department of Mathematics, Rajshahi University, Bangladesh, and ICTP Senior Associate (1998-2003), died on 1 April. He was 63. Mainuddin Ahmed visited ICTP several times from 1988 to 2005 to attend high energy physics activities. His major research topics were the theory of general relativity and black hole physics.



PROFILE

Giacinto Scoles has spent the past 30 years studying the intricate behaviour of atoms and molecules, especially the behaviour of helium atoms and their nanodroplets.

Molecular Motion

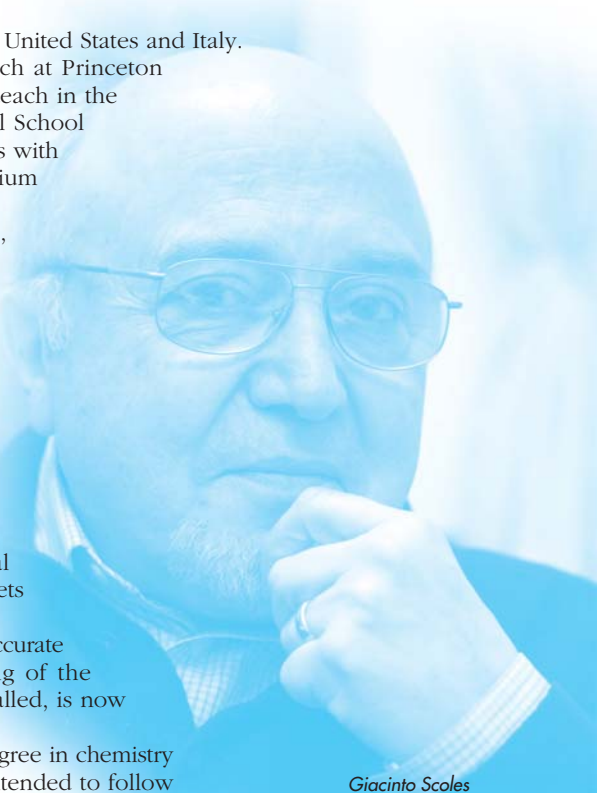
"My passion for science began in Barcelona, Spain, at an Italian high school that I attended in the late 1940s and early 1950s when my family was living there," says Giacinto Scoles, a world-renowned physicist. "Surprisingly, it was a history and philosophy teacher, Elio Rossi, who opened the doors of science to me by conveying the excitement and power that lies in the freedom of ideas."

Scoles, now 71, currently divides his time among several institutions in the United States and Italy. Each autumn he travels to the United States to conduct research and to teach at Princeton University. Each winter and spring, he journeys across the Atlantic Ocean to teach in the departments of biophysics and condensed matter physics at the International School for Advanced Studies (SISSA), ICTP's neighbour. In Trieste, he also collaborates with researchers at ICTP, the *Elettra* Synchrotron Light Laboratory and the Consortium for Molecular Biomedicine.

In April, Scoles was awarded the 2006 Benjamin Franklin Medal in Physics, sharing the prize with his German colleague J. Peter Toennies, an adjunct professor of physics at the University of Göttingen and former director of the Max Planck Institute for Dynamics and Self-Organization. The two were honoured for developing new techniques to study 'hard-to-study' molecules by embedding the molecules in extremely small and ultra-cold droplets of helium. Their work has vastly enhanced our understanding of the extraordinary properties of superfluid helium.

In 1992, Scoles and his colleagues at Princeton University showed that other substances could be mixed with superfluid helium if the helium was in the form of small droplets, called nanodroplets, which contain just a few thousand atoms. They then measured the spectra of molecular impurities in the nanodroplets. Three years later, Toennies precisely measured the rotational structure of the spectra, thereby measuring the temperature of the helium droplets for the first time.

Scoles' discovery and Toennies' measurement techniques allowed for a very accurate probing of molecular clusters, ultimately leading to a better understanding of the mechanisms driving superfluidity. Helium-nanodroplet spectroscopy, as it is called, is now recognized as a fundamental tool in the promising field of nanotechnology.



Giacinto Scoles

Scoles was born in Turin, in northern Italy. He earned his undergraduate degree in chemistry at the University of Genoa, on Italy's northwestern coast, in 1959. "I initially intended to follow in my father's footsteps and become an engineer. Then I turned my attention to chemistry. It was not until I almost completed my course work that I decided to concentrate on physics." His thesis topic, not surprisingly, focused on mass spectroscopy.

From 1961 to 1964, Scoles was a post-doctoral fellow at the University of Leiden, The Netherlands, where he began to examine the topic that would ultimately earn him international recognition: molecular interactions. Three years later, he returned to Genoa to teach and do research at his alma mater. In 1971, he was on the move again, this time taking an oceanic journey to Canada to become a professor of chemistry and physics at the University of Waterloo where he also launched and then served as the director of the Center of Molecular Beams and Laser Chemistry. In 1987, he accepted a position as Donner Professor of Science at the Chemistry Department of Princeton University, where he has remained ever since. He plans to retire shortly.

Scoles' passion for research is matched by his passion for teaching. His interdisciplinary pursuits at the intersection of chemistry and physics took place long before these pursuits became fashionable. Today such studies are at the heart of one of science's most promising fields: nanotechnology.

"Some researchers are convinced that biomolecules will function as transistors and ultimately serve a key role in other electronic components," says Scoles. "But there is increasing recognition that biomolecules do not have the stability necessary for building stable circuitry."

Nevertheless, Scoles believes that "we will eventually have electronic devices, including computers, with hybrid components consisting of a mixture of organic and nonorganic materials. These devices," he continues, "may be less stable than devices comprised totally of nonorganic material but they will be more flexible, enabling, for example, cell phones to be placed into shirt collars. They will also be biodegradable and thus more environmentally friendly."

Historical and philosophical inquires may have first opened Scoles' mind to the wonders of science. But today his broad knowledge and irrepressible excitement for a cutting-edge science may not only lead us to new products and services but also lay the foundation for the next generation of researchers who, like Scoles himself, will refuse to be saddled within the confines of a single discipline.□

WHAT'S NEXT

3 - 7 July
Fourth Stig Lundqvist Conference on Advancing Frontiers of Condensed Matter Physics

10 - 21 July
College on Physics of Nano-Devices

10 - 22 July
Summer School and Workshop on Electronic Structure Methods and Their Applications, Bangalore, India

10 - 28 July
Summer School in Cosmology and Astroparticle Physics and Workshop on Nongaussianity in Cosmology

24 - 29 July
Conference and School on Modelling Elastic Manifolds: From Soft Condensed Matter to Biomolecules

31 July - 8 August
School and Conference on Complex Systems and Nonextensive Statistical Mechanics

7 - 18 August
Targeted Training Activity: Seasonal Predictability in Tropical Regions. Research and Applications

14 - 25 August
Miniworkshop on New States of Stable and Unstable Quantum Matter

14 - 25 August
ICTP-NCNST-ICTS Asian/Pacific Regional College on Science at the Nanoscale, Beijing, People's Republic of China

20 - 31 August
Joint IIEES - ICTP International Training Course on: Seismology, Strong Ground Motion and Seismic Waveform Modeling, Tehran, Iran

21 August - 1 September
International Workshop on Frontiers of Plasma Science

28 - 31 August
International Symposium on the Jahn-Teller Effects: Novel Aspects in Orbital Physics and Vibronic Dynamics of Molecules and Crystals

28 August - 8 September
Atomic and Molecular Data for Fusion Energy Research

4 - 29 September
College on Medical Physics

11 - 16 September
School on Physics at LHC: "Expecting LHC"

11 - 22 September
School/Conference on Statistical Physics and Interdisciplinary Applications, Beijing, People's Republic of China

18 - 22 September
Annual Technical Meeting on Managing Nuclear Knowledge

25 September - 7 October
8th Workshop on Three-Dimensional Modelling of Seismic Waves Generation, Propagation and Their Inversion

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.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 Scientific Calendar of Activities
Create a new e-mail message and type
To: `smr@ictp.it`
Subject: `get calendar 2007`
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 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.it`
Under the e-mail's subject, type
Subject: `get index`
Leave the body of the message blank and send it.
You will receive automatic reply messages containing all documentation available on that particular activity.

(3) For Information on All ICTP Activities
A free online service for the dissemination of information on all ICTP activities, programmes and related announcements is available via e-mail. To subscribe, create a new e-mail message and type:
To: `courier-request@ictp.it`
Leave the subject line empty.
In the body of the message type
`subscribe`
and your e-mail address. Send the message.
Any comments or suggestions on this service are most welcome. Please address them to `pub_off@ictp.it`.

NEWS from ICTP

The Abdus Salam International Centre for Theoretical Physics (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. Katepalli R. Sreenivasan serves as the Centre's director.

News from ICTP is a quarterly publication 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.

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