NEWS from ICTP

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abdus salam
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Antonio Masiero
Astrophysics Sector
International School for Advanced Studies (SISSA)

Dark matter may account for more than 90 percent of the matter in the universe. Yet its presence is so flimsy and whimsical that no one has ever been able to see it—not yet that is.

The WIMP Factor

Recent advances in detection equipment may bring the 70-year-old mystery of dark matter to a successful conclusion. A group of scientists participating in the Dark Matter experiment (DAMA) at Gran Sasso National Laboratories in Italy, with help from colleagues at the Chinese Academy of Sciences' Institute of High Energy Physics, claims that their experiments over the past 4 years have revealed the presence of 'weakly interacting massive particles' or WIMPs, which may contribute the largest share of energy to the universe. The research group is led by Rita Bernabei and Pierluigi Belli, who are affiliated with the University of Rome *Tor Vergata* and the National Institute of Nuclear Physics (INFN) in Italy.

No one should underestimate the importance of WIMPs' shadowy presence. Scientists believe that the gravitational pull they supply keeps the Milky Way from spinning out of control and flying apart.

Physicists have long suspected the presence of dark matter and there's plenty of proof—both theoretical and experimental—to back them up. Particles with verifiable mass—protons or neutrinos, for example—are simply not 'bulky' enough to create a force of gravity of sufficient strength to hold stars and other heavenly objects in place as they whirl around our universe at warp speed. For most physicists, the issue is not whether dark matter exists, but what is the nature of these elusive particles.

At times, researchers have pointed to such newly discovered particles as neutrinos or to massive stars labelled brown dwarfs. But subsequent theories and experiments have shown that neither these particles nor these stars have what it takes to fill the void: that is, they do not possess the physical features or act in ways that can account for the galaxies and clusters of celestial bodies that we observe in the sky. So the world's particle hunters have turned to WIMPs. These 'dark' particles, which have defied detection thus far, are now close to being cornered.

The conclusions of the DAMA researchers were first announced in Rome in January 1999 and subsequently presented to a group of physicists at the Fourth International Symposium on Sources and Detection of Dark Matter in the Universe held in Marina del Rey, California, in the United States, in February 2000.

Meanwhile, particle hunters from the Cold Dark Matter Search (CDMS) group at Stanford University in the United States, relying on another detection technique, suggested that their Italian counterparts may have detected not WIMPs but neutrons—a more ordinary particle that also emits flashes of light when subject to highly sophisticated laboratory conditions. Neutrons have already been ruled out as the constituent ingredient in dark matter; so, in the U.S. researchers' view, the hunt must continue.

The debate over dark matter, regardless of the outcome, holds the potential to both confirm and expand the research efforts of theoretical physicists at ICTP, the University of Trieste, the International School for Advanced Studies (SISSA) and elsewhere. After all, theoretical discussions during the past half century have provided the insights and inspiration for examining the deepest reaches of our universe and enhancing our understanding of the elementary constituents and forces that gave rise to the universe's birth and its current state of physical being.

As advances in technology place us on the threshold of discovering the makeup of dark matter, this historic finding is likely to raise as many questions as it solves. As one researcher recently noted, "the Copernican revolution told us we're not the center of the universe. The (imminent) discovery of dark matter will tell us we're not the main matter of the universe." All of which makes the 'WIMP factor' that much more intriguing. o

For more detailed information about the scientific debate on WIMPs, see G. Jungman, M. Kamionkowski and K. Griest, "Supersymmetric Dark Matter," *Physics Reports 267 (1996), pp. 195-373, and A. Masiero,* "Dark Matter in the Universe," *in S. Bonometto, J.R. Primack and A. Provenzale, eds., Proceedings of the International School of Physics "E. Fermi" Course CXXXII (Varenna, Italy: IOS Press, 1996).*

Julian Chela-Flores
ICTP Staff Associate
Physics of the Living State

COMMENTARY

The search for extraterrestrial life—from simple organisms to intelligent beings—is one of the most fascinating fields of science.

Life Beyond?

Does life exist beyond our planet and, if so, is that life comparable to the life forms we know here on Earth? These are questions that ICTP has been involved in since the Centre launched its first conference on "chemical evolution and the origin of life" nearly a decade ago. The Centre's focus on this subject will continue this year with the Sixth Trieste Conference on Chemical Evolution: First Steps in the Origin of Life in the Universe, to be held at the Adriatico Guesthouse on 18-22 September.

Three strategies have been devised in the search for extraterrestrial life: the study of the cellular makeup of exotic organisms on Earth; the search for organic matter and living micro-organisms beyond Earth; and the use of radiotelescopes to detect signals of intelligent life in the heavens above.

The first strategy has focussed on understanding how life began on Earth. Research has concentrated on the makeup of exotic organisms living in such inhospitable environments as ocean-floor bottoms, glacial lakes, and volcanic lava streams—all of which display temperatures and pressures that may have been present during the Earth's formation about 4 billion years ago. The research not only broadens our appreciation of the enormous diversity of life here on Earth, but helps us understand the environmental extremes that simple organisms can tolerate. Such extremes may be found on other celestial bodies, making it more probable that life can exist there.

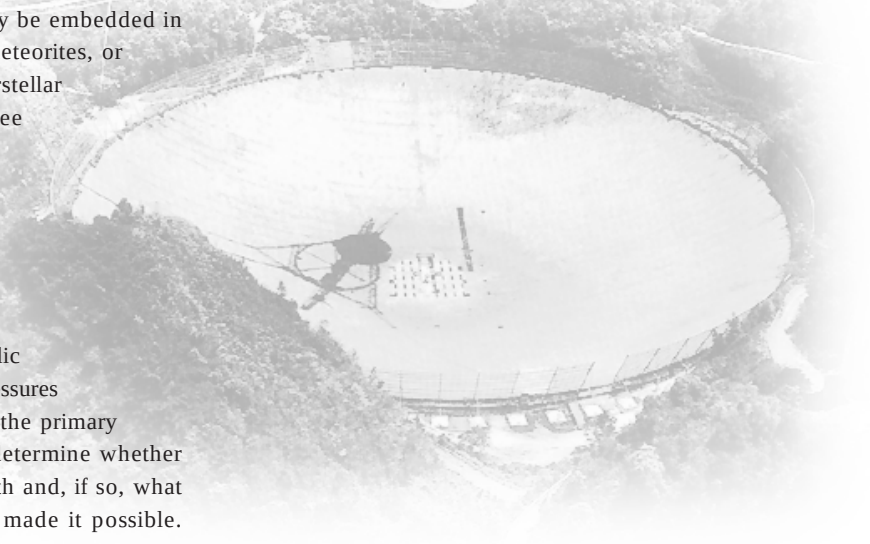
The second strategy for deciding if we are not alone in the universe is the search for the simplest forms of organic matter—aminoacids or proteins—that may be embedded in the ancient rock of planets, comets or meteorites, or suspended in the soupy mixture of interstellar clouds. The search has focussed on three celestial bodies: Mars, Europa (a moon of Jupiter), and Titan (a moon of Saturn).

For now, interest has shifted toward discovering fossilised remnants of life that existed billions of years ago when our solar system was an extremely violent environment in which only extremophilic organisms (those that withstand extreme pressures and temperatures) could survive. One of the primary goals of this extraterrestrial search is to determine whether life ever existed in places other than Earth and, if so, what were the environmental conditions that made it possible.

The third strategy used in the hunt for life beyond Earth relies on radiotelescopes such as the huge telescope at the National Astronomy and Ionosphere Center in Arecibo, Puerto Rico, USA. These 'mega-dishes' actually have two roles to play: First and foremost, they help to examine wavelengths that cannot be seen by the human eye—for example, radiowaves and microwaves. Such information has proven essential for understanding the movement and behaviour of planets, stars and galaxies. Second, radiotelescopes seek anomalies in microwaves and radiowaves wafting across the universe. Such anomalies may represent the imprint of intelligent life in the heavens beyond.

Astronomers have been scanning the micro- and radiowave spectrum for four decades with no reliable signal from an extraterrestrial civilisation. But that doesn't mean the initiative is likely to be abandoned. The public's fascination with the search for extraterrestrial life, combined with the vast reaches of outer space, where Earth-bound scientific research continues to uncover new extrasolar planets and even solar systems, keeps hope alive that 'somewhere out there' intelligent life exists that will some day send us a signal. If a signal is ever received, this much is certain: It will be one of the most remarkable and influential discoveries ever made, with profound implications for science, philosophy and even theology. o

For additional information about the Sixth Trieste Conference on Chemical Evolution: First Steps in the Origin of Life in the Universe, see www.ictp.trieste.it/~chelaf/trieste2000.



The radiotelescope at Arecibo

Stig Lundqvist, a key figure in ICTP's history, died on 6 April after a lengthy battle with diabetes. Friends of Stig reminisce about this unique individual, who left an indelible mark on science and ICTP.

Stig: A Full Life

Teacher

On a corner shelf in my living room, lies a thick physics book with frayed pages and a faded soft green cover, once much used but now coated with dust. Not far away on the same shelf, there's a miniature reddish wooden horse, plain in appearance, nothing special to look at. For me, both objects are special because they evoke fond memories of Stig Lundqvist. The book contains lecture notes drawn from research activities that took place in Trieste in 1967; the horse is a present of the Lundqvists, Eva and Stig, who visited my house just after I had come to Trieste in the late 1970s. As a freshly enrolled Ph.D. student in physics in 1967, I was asked by my supervisor, Franco Bassani, to attend a winter school at the Trieste-based International Centre for Theoretical Physics (ICTP) a place whose existence, unlike my relatively famous "Scuola Normale" in Pisa, was then not well known. Indeed ICTP's existence was news to me. Yet the mission of the Centre seemed worthwhile, even noble: to bring together scientists and students from all over the world, poor and rich countries alike, to learn from one another in an atmosphere that encouraged the free exchange of ideas. The winter school was not only my first research activity; it was the ICTP's first school in condensed matter physics. And that's exactly what made it a magical event for lecturers and students alike: Everything took place more or less on the spot, including finding references mentioned at talks or during conversations, tracking down an empty desk in the library, or even locating a special place for dinner in downtown Trieste. In the eye of this intellectual and cultural hurricane of exchange, this whirlwind environment of learning and friendship, this unforgettable experience for both students and lecturers was Stig Lundqvist, a gregarious Swede who seemed just as at home detailing the intricacies of his 'many body theory,' which was new to many of us at the time, as he was finishing off a beer at a local bar (yes, Stig's Nordic roots were never far from the surface). The best moments for many participants often came after, not during, the lectures when Stig became even less formal and more loquacious than he had been during the formal presentations. Stig appeared to be one of us, only more knowledgeable, far different than the stand-offish image we had of the big influential university professor we were told he was. His do-good actions (Stig in fact lived his whole life by doing good) were rarely on display in his conversations after hours: he was just a plain-talking guy sharing a joke, a drink, a good meal. Stig, from the first day we met, impressed me as nothing more than a big student blessed with a big mind and a big heart. Yet, his jovial nature often hid how serious he was about science and about helping people. Indeed his good-natured behaviour proved an effective way for Stig to achieve his goals. Perhaps it worked so well because Stig after-hours was the same person as Stig during classroom lectures and discussions. I'm surely not alone in my admiration for this remarkable man and his remarkable career. His continuing presence and leadership in Trieste between the late 1960s and mid 1990s was certainly an element, perhaps the key element, that persuaded so many of us worldwide to come to Trieste and to ICTP as often as we could to learn about physics, to re-establish old friendships and develop new ones, and to participate in a learning experience that was both edifying and enjoyable. Stig's great gift was to make physics fun and to personalise his grand vision in ways that made everyone who joined him in his quest to feel as if they were a part of a glorious ride into the future with one glorious man leading the way.

Erio Tosatti
Professor of Physics, International School for Advanced Studies (SISSA)
Consultant, ICTP

Entrepreneur

Foresight was one of Stig's most striking characteristics. As chairman of the ICTP Scientific Council in the mid 1980s, Stig, with the support of Abdus Salam, expanded the scope of ICTP's annual summer workshops on condensed matter physics by adding the Adriatico Research Conferences. The intent was to discuss exciting and novel ideas in ways that scientists unacquainted with a particular field could understand. The first Adriatico Research Conference on Quantum Chaos, which was organised by Giulio Casati and Martin Gutzwiller, took place in June 1986. At the same time, Stig also inspired a new series of events in nonlinear dynamics, and then convinced Mario Tosi and Norman March to run the condensed matter physics group's spring college on condensed matter physics focusing on order and chaos in nonlinear systems. The conference and college took place simultaneously providing a synergism that helped elevate the presence of the Centre in these two emerging fields. My first encounter with Stig and the Centre came during the latter activity. I was impressed by the interest that Stig gave to everyone's inquiries and concerns (at the time, he not only headed the ICTP Scientific Council but presided over the Nobel Prize Committee in Physics in Sweden). I returned to the Centre for a lengthier stay in summer 1988. At the time, Stig was thinking of organising a conference to celebrate the Centre's 25th anniversary and he was looking for a person to help him. I was lucky to be the one he chose. What ensued was one of the most exciting summers in my career. Hours indeed days were spent discussing the topics we should cover and the people we should invite, all within the context of looking to the future as well as the past and using the occasion both to celebrate how far ICTP had come and examine where the Centre should go from here. The conference proved a success. More than a decade later, Abdus Salam's son, Umar, noted at the Abdus Salam Memorial Meeting in November 1997 that the anniversary event was one of the happiest moments in his father's long and memorable career. But such happiness was matched by growing sadness: During this period, Stig's long-term battle with diabetes began to take its toll. Poor health sometimes forced him to miss talks given by conference speakers whom he had carefully chosen, as well as some of the condensed matter physics advisory committee meetings where the agendas of the Adriatico Research Conferences were finalised. His absence left a void in our discussions and evaluations that no one could fill. In 1992, at the end of the Conference on Frontiers in Condensed Matter Physics, which celebrated the 25th anniversary of condensed matter physics activities at ICTP, Stig resigned as chairman of the Scientific Council. It marked the end of an era for both him and ICTP.

Hilda Cerdeira
Staff Member, ICTP Condensed Matter Physics Group
Head, ICTP/TWAS (Third World Academy of Sciences) Donation Programme

Statesman

In a sense, Stig Lundqvist was responsible for me coming to ICTP. I first met Stig in China in 1983 when he visited the Institute of Physics in Beijing, where I was a member of the research staff. He probably had heard about me from others, including Bob Schrieffer, the Nobel Laureate. Stig and I spoke as if we had known each other for years. Soon after our initial conversation, Stig arranged for me to visit ICTP, the Nordic Institute for Theoretical Physics (NORDITA) in Copenhagen, Denmark, and the University of Gothenburg, Sweden. These first encounters with Stig, in many ways, were emblematic of the man. His extraordinary enthusiasm for new things in physics and his irresistible warmth towards colleagues, especially young researchers, were inherent parts of his personality. I returned to Europe, specifically Trieste, the following year, having been named an Associate of ICTP. While here, Stig discussed with me the possibility of coming to Trieste for a longer period. Our conversation took place at the same time that ICTP's administrative oversight organisation, the International Atomic Energy Agency (IAEA), was examining whether to permit ICTP to create a permanent research staff something that Stig was very keen on. Since the Centre's inception, all researchers had come for a set period and then returned to their home institutions. It was largely through Stig's efforts, along with the vision and determination of Abdus Salam, that the Centre began to build a permanent research staff. I was fortunate enough to be in the right place at the right time. With Erio Tosatti and Mario Tosi in Trieste and Norman March and Paul Butcher from outside, Stig was a driving force behind the ICTP condensed matter physics programme. He was also the main attraction for a large number of distinguished ICTP visitors, like Nobel Laureates Bob Schrieffer, Phil Anderson and Walter Kohn. The Spring College on Order and Chaos in Condensed Matter Physics in 1986 was the first activity at the Centre that I was involved in running. Some members of the ICTP Solid State Advisory Committee apparently had reservations about whether the Centre should invest heavily in this new research area. Stig's enthusiasm convinced them to approve it and, thanks largely to Stig, the activity was an enormous success. In 1985-1986, just after the Centre received a substantial new infusion of funds, Stig proposed the creation of the Adriatico Research Conferences, where young scientists, particularly from the developing world, would be exposed to fundamental aspects of the field in morning lectures and then hear about cutting-edge ideas at more specialised afternoon talks. At a 1987 conference, for instance, participants learned about the scanning tunnelling microscope from the very person who won the Noble Prize for the invention, Heinrich Rohrer. Stig also led ICTP's efforts in 1987 to organise a conference on high-temperature superconductivity just after the topic had gained international attention in the press. The event, which was put together in just two months, turned out to be the second largest gathering on the topic in the world, eclipsed only by the so-called "Woodstock of Physics" session that took place during the American Physical Society meeting the same year. It was not only a first-rate scientific happening where Doug Scalapino first proposed the idea of d-wave superconductivity in high T_c cuprates, but it proved an important political event. Stig managed to bring 15 leading scientists from the Soviet Union. It marked the first time that such a large number of Soviet-trained scientists participated in a research activity in the West. Stig's two great qualities were his infectious enthusiasm for researching and teaching physics and his deep commitment for helping young researchers from the developing world. Both these aspects of Stig's personality played a key role in the development of ICTP. That's why his memory will ever remain present in the Centre for years and decades to come.

YU Lu
Head, ICTP Condensed Matter Physics Group

For additional comments on Stig Lundqvist's life by his colleagues and friends, including Elias Burstein, Robert Schrieffer and Alf Sjölander, please see the online edition of News from ICTP *on the ICTP homepage at www.ictp.trieste.it.*

Stig Lundqvist receiving the special Dirac Medal from Abdus Salam. On the left, Anders Sjöberg, President of Chalmers University of Technology

Group photo at the Symposium on Frontiers in Condensed Matter Physics in honour of Stig Lundqvist (August 1990). Left to right: Heinrich Rohrer, Philip W. Anderson, Abdus Salam, Stig Lundqvist, Paolo Budinich and J. Robert Schrieffer

A recent trip to Iran by the ICTP director and two senior scientists revealed a nation that is scientifically sophisticated and eager to participate in the international research community.

Journey to Iran

As Iran continues to slowly open its doors to foreign visitors after two decades of isolation, ICTP scientists have been among the first to receive invitations.

This spring, ICTP director Miguel Virasoro and two ICTP group leaders—Iranian-born Seifallah Randjbar-Daemi, head of the Centre's high energy physics section, and Massimo Altarelli, head of the ICTP synchrotron radiation theory group and chief executive officer and science director of *Elettra*, the Italian synchrotron radiation source—journeyed to Iran at the request of the Iranian government.

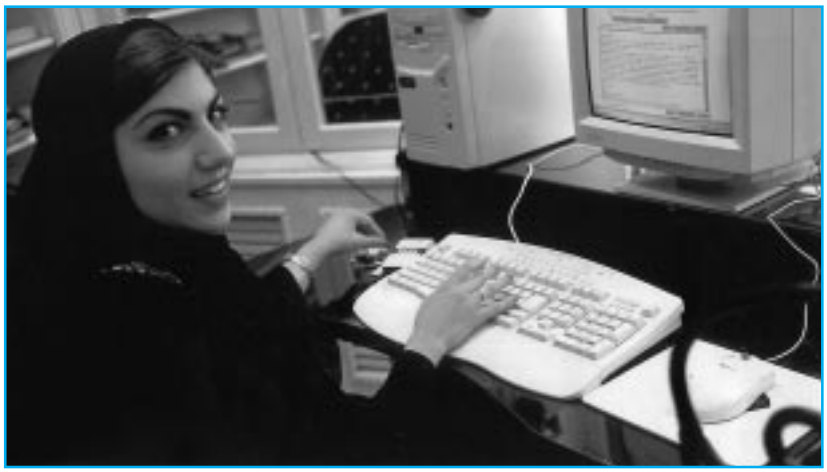
The director's itinerary included a meeting with the Minister of Science, Research and Technology; discussions with researchers at the Institute of Physics and Mathematics; and a tour of Sharif University in Tehran, Iran's most prominent institution of higher education. Virasoro also visited a cyclotron facility in Karadje and spoke to officials at Iran's National Science Foundation.

Meanwhile, Randjbar-Daemi and Altarelli were two of 15 scientists, including the director general of CERN Luciano Maiani, invited to attend a conference on the "Future of Physical Science in Iran and the Region," organised by the Ministry of Science, Research and Technology.

At the conference, Altarelli spoke about experiments with synchrotron radiation as well as the potential value that may be derived from participation in 'small' science projects. As Altarelli put it, "you don't need a synchrotron to do interesting science; less expensive lasers and tunnel microscopes often are sufficient tools to do first-class research." Randjbar-Daemi, on the other hand, emphasised "the importance of establishing centres of excellence in the basic sciences as a prerequisite for building a strong national framework in science and technology." While there, Randjbar-Daemi and Altarelli also had an opportunity to visit several of Iran's research and teaching facilities.

Virasoro describes the visit as "an encouraging sign of Iran's desire to reintroduce itself to the West" after a long absence characterised by tension and mutual hostility. "The exchange," he quickly observes, "was a learning experience" not just for the hosts but for the guests as well. Although burdened by isolation and poor facilities, "Iranian science is surprisingly strong in a number of areas, particularly mathematics, condensed matter physics and string theory." Sciences requiring expensive equipment or having strong links to technology are the weakest pillars in Iran's scientific infrastructure. "Persian culture's dedication to education is deeply rooted," notes Virasoro, "and that dedication remains vibrant today in all areas of study, including science and mathematics."

"The population," adds Randjbar-Daemi, "is both young and well-educated." In a country of 60 million people, "there are about 1.7 million university students—a percentage that compares favourably with Italy and other developed countries." The large number of university students reflects both Iran's youthful population—about 50 percent of the nation's population is 25 years of age or younger—as well as the emphasis and resources that the government has placed on education.



Altarelli also notes that the number of young women earning university degrees, including degrees in mathematics and science, is surprisingly high. Women, moreover, are not absent from university teaching positions. In fact, the head of the Department of Physics at Sharif University is a woman. "Iranian women," he says, " continue to wear 'chadors,' their traditional veils. Yet, when it comes to their quest for new knowledge, many young Iranian women seem to be thoroughly modern."

Such promising trends in Iranian scientific research and training do not mean that serious problems are a thing of the past. Randjbar-Daemi, for example, observes that heavy teaching loads make it difficult for university professors to pursue a vigorous research agenda. "Equipment," he adds,

"while adequate for teaching, is often inadequate for state-of-the art research."

Meanwhile, the number of mathematicians and physicists involved in research remains too small to create a critical mass of activity. Randjbar-Daemi estimates that there are only 350 physicists with doctorate degrees in all of Iran; Italy, on the other hand, has awarded about 1,300 doctorate degrees to physicists since 1987.

Such small numbers, combined with heavy teaching responsibilities, make it difficult for Iranian scientists to develop areas of specialisation. Under these circumstances, Altarelli notes, "it is remarkable that Iran's scientists have gained international presence in several fields of specialisation."

But for Iranian scientists to attain more prominence in the future, policies must be devised not only to promote the education of talented young people but to create broader channels of communication with the international scientific community. The latter concern is one of the reasons the Iranian government has been eager to encourage contacts with scientific communities in the West.

"Iran was never like the former Soviet Union," says Randjbar-Daemi. "It's true that the government has been reluctant to send young scientists abroad for fear that they would not return. But there have been few restrictions on travel for more mature scientists. The problem has been that several countries, notably the United States, have refused to extend visas to Iranian researchers. Hopefully, that will change in the near future."

While the Iranian government seeks to expand scientific co-operation with other nations, it also hopes to strengthen its own university system. "There are really only a few universities of excellence in Iran," says Randjbar-Daemi. "And even in these universities, meaningful reforms could make the learning environment more open, dynamic and productive."

That's why Randjbar-Daemi, along with Reza Mansouri, a researcher at the Institute for Studies in Theoretical Physics and Mathematics in Tehran and former ICTP Associate, have urged the Iranian government to radically transform one of the nation's existing universities into a new learning environment based on more modern principles of university governance and administration.

If successful, "such an initiative," Randjbar-Daemi notes, "could serve as a model for other universities." Officials from the Ministry of Science, Research and Technology have expressed support for this 'new university' concept and advocates are hoping that funding for this experiment in higher education will soon be forthcoming.

"Iran is a country that may surprise you," says ICTP director Virasoro. "Twenty years of isolation have not left the country frozen in time. In fact, the democratic reforms that recently have been enacted, regardless of how fragile they may be, suggest that even more dramatic changes may be on their way." The scientific foundation that has been built over the past few decades has positioned the nation's scientific community to make significant contributions to the nation's future progress.

"The Iranian people are fully aware that their nation is at a crossroads," Virasoro says, "and science, in the minds of the people I spoke to, is often seen as the best tool they have for shaping the future that lies before them." Indeed science-based policy options, such as those discussed during the recent visit of ICTP's director and section leaders, suggest that Iranian society and science may be ready to advance hand-in-hand into the future.o

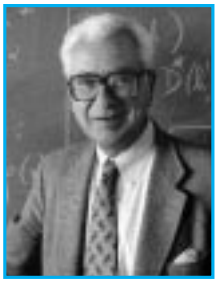
Massimo and Paola Altarelli in Tehran

IRAN / ICTP CONNECTIONS

ICTP and Iran have enjoyed a long and productive relationship since the Centre's inception more than 35 years ago. To date, nearly 1000 Iranian scientists have visited ICTP to attend research and training activities. In addition, more than 40 Iranian scientists have been selected as ICTP Associates. Last year, the Iranian Ministry of Culture and Higher Education opened a Scientific Meetings Office that drew on the ICTP experience for much of its inspiration and structure. The office plans to organise international and regional scientific research and training activities ranging in scope from two- to three-day workshops to six-week schools (see *News from ICTP*, Winter 2000, p. 9). Finally, in 1992, the Iranian government's generous offer of a US$3 million bridge loan enabled ICTP to overcome the greatest financial crisis in the Centre's history. Political and economic woes in Italy had delayed the Italian government's voluntary contribution to ICTP. That, in turn, created a cash flow crisis that nearly shut down the Centre. The situation was only resolved when Iran came to the rescue.

DATELINE

Trieste's Quarky Past



Murray Gell-Mann

There is an unusual link between Trieste, the stately city where ICTP was established and still flourishes, and the exotic field of subnuclear particles. Almost everyone knows that a quark is the most elementary particle of matter. The name was coined in the 1960s by the distinguished theoretical physicist and Nobel Laureate (1969) Murray Gell-Mann, who took it from James Joyce's *Finnegans Wake*. For Gell-Mann, however, the word was pronounced 'quork;' for Joyce, the word was meant to rhyme with 'dark.' Dublin-born Joyce, one of the most innovative writers of the 20th century, spent more than 10 years in Trieste, teaching English at the Berlitz School. In Trieste, Joyce began to write his masterpiece, *Ulysses*. Surely, he would have been delighted but perplexed by the strange use—and sound—of his word "quarks" by modern physicists.

The latest news about quarks arrived last February from CERN, the European Organization for Nuclear Research located near Geneva, Switzerland. Researchers from CERN's heavy ion programme presented compelling evidence for the existence of a new state of matter in which quarks, instead of being bound into more complex particles such as protons and neutrons, are free to roam. The same 'wanderlust' principle may hold true for gluons, the particles that bind quarks together like 'glue' to create quark-gluon plasma.

Theory predicts that this state of matter must have existed microseconds after the Big Bang, before the formation of matter as we know it today. The findings of the CERN researchers represent the first time that such a theory has been confirmed experimentally.

The new 'bridge' between the particles' world and cosmology offers intriguing proof of the unity of the universe as a whole—a concept that has sparked the imagination of many specialists in high energy physics working at ICTP.

Recognition from The Royal Society

T.V. Ramakrishnan, a member of the ICTP Scientific Council, and **M.S. Raghunathan**, recently appointed a staff associate of the ICTP Mathematics Group, have both been elected Fellows of The Royal Society. Ramakrishnan, who is a professor of physics at the Indian Institute of Science in Bangalore, India, is an internationally renowned researcher in the field of condensed matter physics and statistical mechanics. Raghunathan, who is a distinguished professor at the Tata Institute of Fundamental Research in Mumbai, India, is an expert on algebraic and discontinuous groups. Ramakrishnan recently thanked the Centre for the contribution it has made to his career, particularly when he was a young researcher. In a letter to the ICTP director, he wrote: "I have been very fortunate in my association with people and places such as ICTP, which was important for my continued activity and growth, especially in the 1970s." For an in-depth discussion of Ramakrishnan's view on the state of scientific research in India, see *News from ICTP*, Summer 1999. Ramakrishnan and Raghunathan were among 48 distinguished scientists from around the world elected to The Royal Society this year. Membership in the Society currently totals 1293.

T.V. Ramakrishnan

InterAcademy Panel Comes to Trieste

The Third World Academy of Sciences (TWAS), part of the legacy of ICTP founder Abdus Salam, has been chosen to host the secretariat of the InterAcademy Panel (IAP). The decision was made at the Conference of the World's Scientific Academies, "Transition to Sustainability in the 21st Century," held in Tokyo, Japan, in May. The purpose of IAP, which was created in 1995, is to foster co-operation, networking and capacity-building among scientific academies and to strengthen the voice of academies in discussions of science-related issues in both national and international fora. IAP membership currently consists of 80 scientific academies worldwide. For the past five years, the secretariat has been located at The Royal Society in London. The relocation of the secretariat to Trieste has received strong support from Italian officials at all levels of government. Several sites are now under consideration for a permanent home for IAP, which will be located with TWAS at the same site. Until the move takes place, IAP secretariat will be housed in offices at ICTP.

Dignity, Science and the Third World

"Abdus Salam helped to instill a sense of dignity among Third World scientists," observes **Nicola Cabibbo**,

Nicola Cabibbo

who represented the Italian government at the last meeting of the ICTP Scientific Council in April. A leading theoretical physicist at the University of Rome *La Sapienza*, Cabibbo is well versed in the political, social and cultural aspects of science. Former president of INFN (*Istituto Nazionale di Fisica Nucleare*, the Italian National Institute of Nuclear Physics) and ENEA (*Ente per le Nuove tecnologie, l'Energia e l'Ambiente*, the Italian Agency for New Technologies, Energy and the Environment), Cabibbo currently heads the *Accademia Pontificia delle Scienze*, the Pontifical Academy of Sciences, a scientific advisory panel for the Vatican. Salam was also a member.

What does dignity mean for a scientist from the developing world? Cabibbo explains: "It means not merely to maintain a good scientific level, but to be heard and respected in one's own country. It means not to be discriminated against in international scientific journals. It means to feel part of a larger community despite hailing from a country where political elites rarely display interest in science and where science rarely has a practical impact on society. Thanks to ICTP, these scientists share a common home away from home."

One of the major problems in the Third World is the lack of quality scientific libraries. A good technical library requires an annual budget of hundreds of thousand dollars—an impossible expense for a poor country. But Cabibbo is confident that the solution can come from the internet, whose costs are becoming lower and lower.

"By using a network of satellites in geosynchronous orbit," he says, "we could connect all Third World countries via the internet, even if many of these countries do not have reliable telephone lines. Such efforts could provide scientists in remote regions with access to the archives of the best electronic libraries in the world and offer them a way to communicate with their colleagues via e-mail even when separated by continents and oceans."

Luciano Reatto, professor of physics at the University of Milan and long-time visitor to the Centre, agrees that new technologies will help scientists from developing countries overcome the isolation that often poses the most serious obstacle to building a successful career. For instance, he emphasises the potential offered by remote sensing, a tool that can inexpensively provide a treasure trove of detailed scientific information about a region or area.

Luciano Reatto

"But don't ignore the value of more theoretical investigations," Reatto warns. "The study of mathematics, statistical mechanics and complex systems could provide important insights into critical interdisciplinary issues not only in industrialised nations but in developing countries as well."

Reatto, who represented the INFM, the *Istituto Nazionale per la Fisica della Materia* (Italian National Institute for the Physics of Matter) at the ICTP Scientific Council meeting, also stresses the importance of the recent agreement between ICTP and INFM that sets the stage for increasing the number of young scientists who may pursue research in both institutions under a co-operative exchange programme.

"Condensed matter physics is an important topic for developing countries," he notes. Theoretical studies in this field have potential implications for electronics, advanced materials and computer science.

"ICTP has a renowned theoretical staff in this field and a long and successful track record of training and research programmes. The agreement between the Centre and INFM will offer new opportunities for scientists from the Third World to become more knowledgeable about the state-of-the-art of science and technology in this field. At the same time, scientists from developed countries will become better acquainted with issues that are most relevant to their counterparts from the developing world. That's exactly the kind of exchange that has earned ICTP a reputation for serving as a viable scientific bridge between the South and North."

ICTP Prize: Nominations Please

ICTP recently announced the following ICTP prizes: 2000, in mathematics (in honour of Friedrich Hirzebruch); 2001, in high energy physics (in honour of Hans Bethe, Nobel Laureate 1967); and 2002, in condensed matter physics (in honour of Philip W. Anderson, Nobel Laureate 1977). The prizes, which include a medal, a certificate and US$1000, will be given for outstanding contributions in each of these fields. Candidates must be 45 or younger and nominated by a scientist familiar with their work. They also must be nationals of developing countries working and living in developing countries. For guidelines and nomination procedures, please see our web site at www.ictp.trieste.it, or e-mail danforth@ictp.trieste.it.

REPORT ON REPORTS

SPRING COLLEGE ON ELECTRONIC STRUCTURE APPROACHES TO THE PHYSICS OF MATERIALS

15 May - 9 June

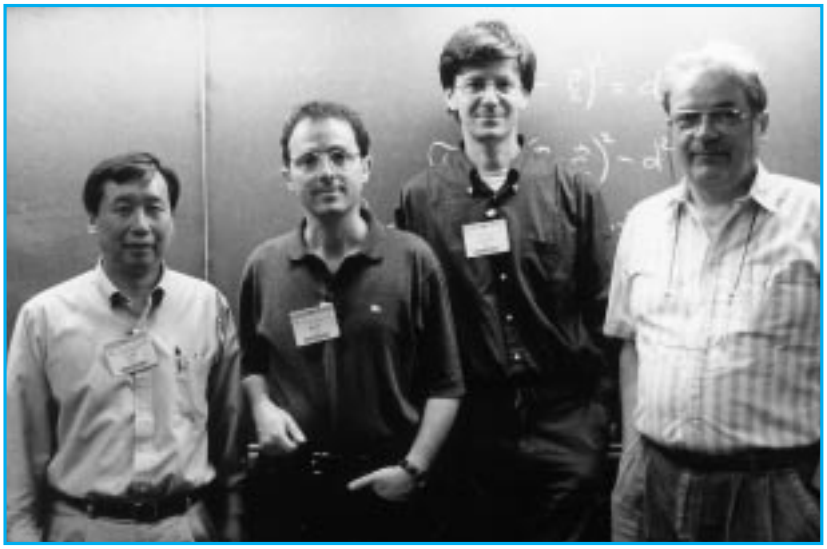
Directors: S. Louie (University of California at Berkeley, USA), F. Mauri (Université Pierre et Marie Curie, Paris, France) and D. Vanderbilt (Rutgers University, Piscataway, USA).

Local Organisers: S. Scandolo and E. Tosatti (International School for Advanced Studies, SISSA, and ICTP, Trieste, Italy).

The College's goal was to expose young condensed matter physicists to first-principle electronic structure calculations related to the understanding of real material properties. Lectures offered a broad and comprehensive perspective of the field, covering basic aspects of modern electronic structure theories and highlighting their application to the structural (ground state, dynamical and thermodynamical) and electronic (spectroscopic, dielectric, magnetic and transport) properties of real materials. The College featured both lectures and seminars.

Roberto Car

Richard Martin



Steven Louie, Francesco Mauri, Sandro Scandolo, Erio Tosatti

Volker Heine

SCHOOL ON VANISHING THEOREMS AND EFFECTIVE RESULTS IN ALGEBRAIC GEOMETRY

25 April - 12 May

Co-sponsor: European Commission (Brussels, Belgium).

Directors: J.-P. Demailly (Université de Grenoble I, France) and R. Lazarsfeld (University of Michigan, Ann Arbor, USA).

Local Organiser: L. Göttsche (ICTP).

A body of work has recently developed loosely centered on applications of vanishing theorems for Q-divisors and multiplier ideals to higher-dimensional algebraic varieties. Several classical theorems have been proven right and new results have been obtained that a decade ago seemed out of reach. The work has been marked by a lively and fruitful exchange between analytic and algebraic viewpoints. The School, designed in part for young researchers, surveyed this circle of ideas. Topics included adjoint linear series; Matsusaka's theorem; deformation invariance of plurigenera; local positivity of line bundles; numerically effective and pseudo-effective vector bundles; and hyperbolicity. The first two weeks featured instructional lectures; the third week consisted of a conference with expert lectures on recent developments in the field.

RESEARCH WORKSHOP ON GRAPH THEORY AND STATISTICAL PHYSICS

22 - 25 May

Directors: D. Cassi (University of Parma, Italy), R. Burioni (University of Parma, Italy) and R. Zecchina (ICTP).

Local Organiser: R. Zecchina.

The Workshop brought together researchers involved in fields of mathematics and physics working at the interface between statistical mechanics and graph theory. Both theoretical and applied studies were examined. Topics included: (1) statistical models on graphs, including general theory, exact solutions, combinatorial techniques and algorithms; (2) random graphs and their relevance in statistical mechanics of disordered systems, optimisation and modelling; and (3) spectral theory of graphs, potential theory on graphs, flows and optimisation, and harmonic analysis on groups.

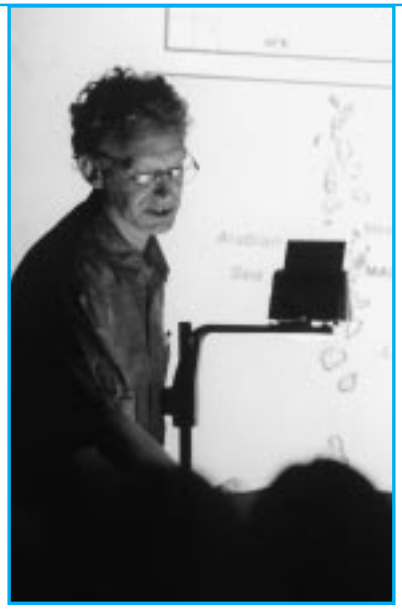
SUMMER COLLOQUIUM ON THE PHYSICS OF WEATHER AND CLIMATE: CHEMISTRY-CLIMATE INTERACTIONS

29 May - 14 June

Co-sponsor: Kuwait Foundation for the Advancement of Sciences (KFAS).

Directors: F. Giorgi (ICTP) and P. Kasibhatla (Duke University, Durham, USA).

Local Organiser: F. Giorgi.



Philip Rasch

William Chameides

The Colloquium, which consisted of two segments, was intended for scientists and graduate students working in the areas of atmospheric physics, climatology, chemistry, physics and mathematics. The Workshop on "Theory and Modelling of Chemistry-Climate Interactions" (29 May - 9 June) included lectures on tropospheric chemistry, atmospheric aerosol properties and microphysics, modelling of atmospheric gaseous and particulate tracers, bio-geochemical cycles, and climatic forcing due to gases and aerosols. The Conference on "Chemistry-Climate Interactions" (12-16 June) included presentations on observation and modelling of radiatively active gases; observation and modelling of tropospheric aerosols (chemical and microphysical properties); and radiative forcing and associated climatic effects due to gases and aerosols—all at the regional to global scale; analyses of bio-geochemical cycles; use of remote sensing to observe radiatively active gases and aerosols; and studies of the effects of aerosols on clouds and related climatic forcing.

CONFERENCE ON GRAVITATIONAL WAVES: A CHALLENGE TO THEORETICAL ASTROPHYSICS

5 - 9 June

Co-sponsors: International School for Advanced Studies (SISSA, Trieste, Italy) and Italian Institute for Nuclear Physics (INFN).

Directors: V. Ferrari (University of Rome *La Sapienza*, Italy), J.C. Miller and L. Rezzolla (SISSA).

Local Organisers: J.C. Miller and L. Rezzolla (SISSA).

Organising Committee: M.A. Abramowicz (Chalmers University of Technology, Gothenburg, Sweden), F. de Felice (University of Padua, Italy), F. Fucito (University of Rome *Tor Vergata*, Italy), A. Lanza (SISSA) and S. Matarrese (University of Padua, Italy).

In the 20th century, the advent of radio and X-ray astronomy opened new windows on the universe. Advances in optical astronomy (both from the Earth's surface and space) revolutionised our understanding of the universe. We now await the opening of another new window—provided by gravitational waves—that promises a closer 'view' of black holes and neutron stars, and new insights into the early universe. These exciting developments pose a serious challenge for theoretical astrophysics. A new generation of laser interferometers and resonant detectors require input from theoreticians on possible mechanisms for generation of gravitational waves by astronomical sources and predictions of the waveforms produced. This input is essential to tune the detectors' parameters and create templates for extracting the tiny gravitational-wave signals from the ambient noise. The Conference, which included progress reports on different types of detectors, surveyed the response of theoreticians to these challenges.

Jean-Pierre Lasota

Fernando de Felice

Guido Pizzella

WORKSHOP ON CORRELATION EFFECTS IN ELECTRONIC STRUCTURE CALCULATIONS

12 - 23 June

Directors: V. Anisimov (Institute for Metal Physics, Yekaterinburg, Russian Federation) and G. Kotliar (Rutgers University, Piscataway, USA).

Local Organisers: S. Scandolo and Erio Tosatti (International School for Advanced Studies, SISSA, and ICTP, Trieste, Italy).

In the past few years, great advances have been made in the calculations of the physical properties of correlated materials starting from first principles. The Workshop's first segment, which offered an introduction to the main methods of research now in use, was complemented with practical demonstrations of computer codes. The second segment focussed on recent methodological advances and research results on specific strongly correlated materials (ruthenates, manganites, titanites, organics, bucky balls, heavy fermions and actinites). The latter, which was more research-oriented, included many brief presentations and discussion sessions designed to expose participants to cutting-edge research in the field.

SUMMER SCHOOL ON ASTROPARTICLE PHYSICS AND COSMOLOGY

12 - 30 June

Co-sponsors: International School for Advanced Studies (SISSA, Trieste, Italy) and Italian National Institute for Nuclear Physics (INFN).

Directors: G. Senjanovic, A. Smirnov and G. Thompson (ICTP).

Topics included introduction to the standard cosmological model; finite temperature field theory; structure formation; nucleosynthesis; neutrino astrophysics; high energy cosmic rays and gamma-ray bursts; black holes and neutron stars; baryogenesis and leptogenesis; inflation; and unification of particle forces and cosmology.

PROFILE

ICTP Associate Marie-Claudine Andriamampianina has altered her field of study to take advantage of the opportunities presented by ICTP's Weather and Climate Group.

Islands of Information

A geophysicist by training, ICTP Associate Marie-Claudine Andriamampianina has recently shifted the focus of her research to the physics of weather and climate. The reason: Although surrounded by water, Madagascar has been increasingly plagued by drought and spreading desertification, especially the southern third of this island nation. While other island nations worry about the erosive impact of rising sea levels on the integrity of their shorelines (some nations even fret about eventually being swallowed up by sea water), Malagasy scientists fear that alterations in the environment will accelerate evaporative processes and create even drier conditions in regions of their country that already thirst for more water.

"The problem," explains Andriamampianina, "is due to two factors. First, unwise land use practices—notably, widespread careless cutting of forests and burning of underbrush—have reduced the soil's water-retaining qualities. Second, the regional effects of global warming have made southern Madagascar a bit warmer and drier."

Studying trends in the regional climate of Madagascar, Andriamampianina explains, could help her nation better understand the forces at work and thus become a critical factor in devising effective solutions—or, perhaps more realistically, adjustments—to climate-related problems that threaten the future environmental well-being of a third of Madagascar's land mass.

"We are a relatively small country with a sparse population," notes Andriamampianina. "Our per capita income is less than US$300 a year; our economy is largely resource-based (coffee, cloves, vanilla beans and rice constitute our major crops); and, despite a lush humid corridor along the east coast and fertile valleys in the central plateau, the fact is that less than 5 percent of the land is arable. All these factors mean that we can ill-afford to ignore the potential adverse impacts of a drier, more arid, climate."

While Andriamampianina is convinced that her new research focus can make a difference for her nation, she realises that Madagascar's isolation (another consequence of geography), combined with its limited resources, make it impossible for her to study regional climate patterns at home. "We have internet access," she says, "but the connections are slow and prohibitively expensive to use. That's why when I come to ICTP, I download and print as much information as possible. I then take the printed copies home with me to use as source material both for my research and teaching."

But it's not just the data that she finds valuable; it's also the training she receives at ICTP that has helped place her research and teaching on a firm footing. Andriamampianina was selected as an ICTP Associate in 1997 and visited Trieste for the first time in 1998 to attend the Colloquium on the Physics of Weather and Climate: The Effect of Topography on the Atmospheric Circulation. She has returned this summer for the Colloquium on Chemistry-Climate Interactions.

"When people read about global warming, the first question they often ask is whether the world is getting warmer. But the most meaningful impacts are likely to take place on a regional scale, and depend largely on how global climate trends interact with environmental conditions that vary from one place to the next. The regional focus of ICTP's Weather and Climate Group, together with its emphasis on the developing world, make the group a particular useful member of the climate change research community. As the potential impacts of global warming move to the top of the science agenda in nations like my own, there's a good chance that the Centre will be one of the places that we turn to both for access to the latest data and for high-quality training."o

Marie-Claudine Andriamampianina

MONITOR

Mongolian President Visits Centre

Natsagyn Bagabandi, President of Mongolia (far right), met with Miguel A. Virasoro, Director of the Abdus Salam International Centre for Theoretical Physics, and several of the Centre's scientists, at the ICTP's headquarters in Miramare on 3 June. Their talks focussed on areas of expanded co-operation between the Centre and Mongolia's scientific community. The launching of a joint project on laser spectroscopy between ICTP and the National University of Mongolia was among the major items discussed. The two institutions hope to finalise the agreement within the next few months. The President was visiting the Centre as part of a larger tour of governmental, business and educational facilities in Trieste and the surrounding area.

Indonesia's Minister Comes to ICTP

M.A.S. Hikam (far left), Indonesia's Minister of State for Research and Technology, visited ICTP on 31 May. He was accompanied by a delegation of 10 scientific researchers and administrators. Alessandro Merola, newly appointed Italian ambassador to Indonesia, and Michele Miele, Italian advisor to the Minister of State for Research and Technology, were also in attendance. At the meeting, Minister M.A.S. Hikam and ICTP Director Miguel Virasoro signed a letter of intent that called for enhancing existing collaboration between ICTP and Indonesian scientific institutions and for pursuing strategies that would lead to new programmes of co-operation.

Stockholm Challenge Award

ICTP's "www4mail-Web Navigator & Database Search by E-Mail," which is part of the Centre's homepage, was a finalist in the category "Equal Access" in the Stockholm Challenge Award. More than 600 entries from 84 different countries participated in the competition. Winners of The Stockholm Challenge Award 2000 were announced on 5 June. The Stockholm Challenge Award is given every year for Information Technology (IT) projects that focus on people and society. For further information, see www.challenge.stockholm.se.

Scientific Week

The Tenth Italian Scientific and Technological Culture Week was held between 22 and 28 May under the sponsorship of the Italian Ministry of University and Scientific and Technological Research. ICTP, in co-operation with *Laboratorio dell'Immaginario Scientifico*, helped organise a series of lectures for high school students in Trieste and the surrounding area. Lectures took place in the Kastler Lecture Hall of the Adriatico Guesthouse. On 26 May, **Filippo Giorgi** and **Franco Molteni** (in the photo), of ICTP's Physics of Weather and Climate Group, discussed the impact of climate change on human activities.

Colours of Peace

To help celebrate the UN's International Year for the Culture of Peace, the ICTP Cultural Committee organised a "Colours of Peace" happening, which took place on 14 April in the Adriatico Guesthouse. Sponsors included ICTP, *Laboratorio dell'Immaginario Scientifico*, UNESCO and UNICEF. Speakers included Miguel Virasoro, ICTP director; Roberto Damiani, deputy-mayor of Trieste; Paolo Budinich, founder of *Laboratorio dell'Immaginario Scientifico*; Nicola Lenoci, director of the Board of Education in Trieste; Luigi Milazzi, representing the UNESCO Centre in Trieste; and David Sutcliffe, director of the United World College of the Adriatic. In addition to the unveiling of a painting exhibition, the choir of the United World College performed a brief concert. The highlight of the event was the electronic signing of "Manifesto 2000," a UNESCO initiative for the collection of 100 million signatures for peace worldwide to be presented to the UN General Assembly in September. Computer hook-ups gave all those attending the event an opportunity to sign the manifesto. If you wish to enter your signature, please see the ICTP homepage or http://www3.unesco.org/iycp.

WHAT'S NEXT

3 - 5 July
Symposium on Synchronization of Chaotic Systems

3 - 6 July
Conference on Physics beyond Four Dimensions

3 - 7 July
International Topical Conference on Plasma Physics: Colloidal Plasma Science

17 - 28 July
XII Workshop on Strongly Correlated Electron Systems

31 July - 18 August
School on Automorphic Forms on GL(n)

1 - 4 August
Minisymposium on Correlation in Mesoscopic Systems

15 August - 15 September
Nordic-Trieste Workshop: Black Holes and Optical Geometry

21 August - 2 September
Second School on the Mathematics of Economics

21 August - 15 September
EU Advanced Course in Computational Neuroscience

4 - 22 September
School on Mathematical Problems in Image Processing

11 - 15 September
Adriatico Research Conference on Lasers in Surface Science

18 - 22 September
First Steps in the Origin of Life in the Universe. A Euroconference (Trieste Conference on Chemical Evolution - VI)

25 September - 6 October
5th Workshop on Three-Dimensional Modelling of Seismic Waves Generation, Propagation and Their Inversion

26 - 29 September
Conference on Nonlinear Phenomena in Global Climate Dynamics

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 2000`
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.

(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.trieste.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.trieste.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. Miguel Virasoro 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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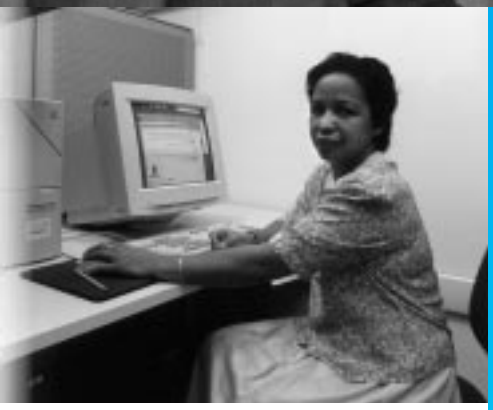

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