NEWS from ICTP

the
abdus salam
international centre for theoretical physics

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Kumar Narain
ICTP High Energy Physics Section

The Strings 2001 Conference, funded in part by ICTP, again displayed the intellectual fervour and public fascination driving one of physics' most exciting theoretical pursuits.

Indian Strings

The Strings 2001 Conference, held at the Tata Institute of Fundamental Research (TIFR) in Mumbai, India, from 5-10 January, was the fifth in an annual series of string theory conferences devoted to discussions of the latest developments in the field. What began in the mid-1990s as a small informal gathering of string theorists has been transformed into one of the largest and most prestigious gatherings of researchers in the field.

String theory contends that the universe in its most elemental form consists not of subatomic particles spotted like dots in three dimensions but of compressed strings that vibrate in many dimensions. Those involved in the study of string theory seek to make Einstein's theory of relativity, which explains the behaviour of large celestial bodies, compatible with quantum mechanics, which explains the behaviour of infinitesimally small subatomic particles. The source of incompatibility between these two pillars of 20th century theoretical physics lies with gravity, which has yet to be integrated with the other elementary forces of nature: the electromagnetic, weak and strong force.

As Edward Witten, who many consider the leading figure of string theory, observed at the Strings 2001 Conference: "If you take Einstein's theory of gravity and try to incorporate it into quantum mechanics, you run into a hopeless mess. String theory removes this contradiction. Indeed in string theory, quantum gravity is not just possible but inevitable."

This year's conference attracted 300 string theorists from more than 125 countries. The conference participant list, which reads like a 'who's who' in the field, included Edward Witten, Institute for Advanced Study, Princeton, USA; David Gross, Institute of Theoretical Physics at the University of California, Santa Barbara, USA; John Schwarz, California Institute of Technology, Pasadena, USA; Stephen Hawking, University of Cambridge, UK; Michael Green, University of Cambridge, UK; Ashoke Sen, Harish-Chandra Research Institute, India; Michael Douglas, Rutgers University, New Jersey, USA; Jeffrey Harvey, University of Chicago, USA; and Ignatios Antoniadis, *Ecole Polytechnique*, France.

The Strings 2001 Conference was noteworthy on two fronts. First, it marked the first time that the event was held in a developing country. Previous meetings took place in Amsterdam (The Netherlands), Santa Barbara (USA), Potsdam (Germany) and Ann Arbor (USA). Second, in addition to the technical talks focussing on such cutting-edge string theory issues as noncommunicative fields theories, tachyon condensation, and AdS-CFT correspondence (all of which speak to the behaviour of d-branes), the conference included public presentations by Gross, "Towards a Theory of Everything;" Hawking, "The Universe in a Nutshell;" and Witten, "The Quest for Unification."

The ambitious aim of string theory, which is to unify gravity with other elementary forces of nature, makes experimental verification a difficult and challenging problem. The reason is that the theory can be tested only by examining the behaviour of matter at energies that existing atom smashers cannot create. Researchers, however, hope that supersymmetry, which plays a central role in string theory, can be experimentally tested after the new and more powerful atom smasher, the Large Hadron Collider (LHC), currently under construction at CERN in Geneva, Switzerland, is up and running. Cosmology is another area that may provide a pathway for experimental verification of string theory.

The 100 Indian scientists attending the Strings 2001 Conference are testimony to India's place as a key centre for the study of string theory. In fact, over the past 15 years, India's theoreticians have made fundamental contributions to the study of string theory in black hole physics, strong-weak coupling dualities, and tachyon condensation and non-BPS branes. The string theory research team at the Tata Institute of Fundamental Research, which includes Atish Dabholkar, Sumit Das, Avinash Dhar, Gautam Mandal, Sunil Mukhi, Sandip Trivedi and Spenta Wadia, is one of the strongest within a single institution worldwide. The team served as part of the Strings 2001 Conference organising committee—as did 15 other Indian string theorists working in institutes and universities throughout the nation.

"Physicists," Witten observes, "have been studying string theory, trying to understand what is behind the bits and pieces that have been discovered so far, and wondering how many more layers of confusion still remain to be peeled away. The theory doesn't seem to give up its secrets easily."

While this is true, the Strings 2001 Conference with its large contingent of developing world scientists and the prominent role played by theorists from India also illustrates that the theory's secrets are as likely to be unlocked in the South as they are in North. That makes one of the world's most exotic intellectual adventures also one of the most international.□

Werner Burkart
Deputy Director General
Department of Nuclear Sciences and Applications
International Atomic Energy Agency
Vienna, Austria

COMMENTARY

IAEA's liaison officer with ICTP speaks about his department's broad mandate in nuclear science and technology as well as the Agency's close ties with the Centre.

Agency Ties

The International Atomic Energy Agency's (IAEA) Department of Nuclear Sciences and Applications may not be in the headlines as often as other IAEA departments—for example, those involved in issues related to nuclear energy and the non-proliferation of nuclear weapons. The department, nonetheless, is involved in a vital part of the IAEA's mission to promote peaceful uses of nuclear techniques to meet basic human needs. Our broad-ranging activities include research aimed at the generation of nuclear knowledge and technology and their application to practical problems facing IAEA member states, particularly those in the developing world.

The department, in short, focuses on areas of critical importance to global social and economic well–being, including food and agriculture, human health, water resources and environmental protection.

For example, we work closely with the United Nation's Food and Agricultural Organization (FAO), headquartered in Rome, on research and development initiatives designed, among other things, to produce higher yielding crop varieties, trace the migration of pesticides in soil and water, monitor the spread of such animal diseases as foot and mouth disease and rinderpest, and control insect pests. We also work closely with the World Health Organization (WHO) for introducing and improving diagnostic radiology, enhancing nuclear medicine and radiation therapies, monitoring non-radioactive pollutants and the accidental release of radionuclides into the atmosphere, and studying drug-resistance in malaria. In all our activities, researchers apply such nuclear techniques as isotope tracing, radionuclide imaging and radioimunoassays.

In addition, the department supports laboratories around the world and fosters international cooperation in the application of nuclear technology to everyday scientific, technological and socio-economic problems.

For example, we operate a dosimetry laboratory (in cooperation with WHO); an isotope hydrology laboratory; a physics, chemistry and instrumentation laboratory; an agriculture and biotechnology laboratory (in cooperation with FAO); and a marine environment laboratory (with support from the Principality of Monaco). All these laboratories play key roles not only in advancing research but in training scientists and technicians, especially from developing countries.

Werner Burkart

As head of the department, I also serve as the IAEA's liaison officer with ICTP and on 26-27 April, I visited Trieste to attend the Centre's Scientific Council meeting. I believe that IAEA's relationship with ICTP has grown stronger in recent years as indicated by the variety of joint training and research activities now taking place in Trieste. In 2001, these activities range in subject matter from desalination studies to radioactive-waste management, reactor performance simulation, and earthquake and climate change prediction.

For more than three decades, ICTP has served as a unique intellectual transfer point on subjects related to nuclear science. Moreover, it is an institution that enjoys close ties and enormous credibility in countries throughout the developing world. Given my department's mandate—to promote applications of nuclear science among IAEA's member states, particularly those in the developing world—I am delighted to have the Centre as part of the Agency's family and I look forward to even closer relations in the years ahead.□

For more detailed information about the activities of the IAEA's Department of Nuclear Sciences and Applications, please see its website at www.iaea.org/programmes/ri/.

ICTP's Diploma Course, one of the Centre's most 'youthful' programmes, celebrates its 10th anniversary this autumn.

Decade of Diplomas

Today ICTP Diploma Course graduates total more than 250. Some have returned to their home countries to teach; others have gone to graduate schools in Europe and the United States earning master's and doctorate degrees; still others are about to graduate with advanced degrees.

By almost any measure, the ICTP Diploma Course has been a success. But even more impressive than the programme's past track record is the impact that the graduates are likely to have both at home and abroad in the near future. That's because many Diploma Course graduates are only now beginning their careers, having spent time since receiving their ICTP Diplomas acquiring additional scientific training as graduate students and post docs.

As Subodh Shenoy, coordinator of the Diploma Course in condensed matter physics, notes: "The true measure of the Diploma Course can only be assessed in the years ahead as our young graduates begin to leave their mark as researchers and teachers. Many ICTP Diploma Course graduates will soon be teaching students of their own. That will have a rippling effect on scientific capacity-building across the globe, particularly in the developing world."

The ICTP Diploma Course began as a grand idea wrapped mundanely in a brief office memo. On 18 March 1989, Abdus Salam, the founding director of ICTP, distributed a one-page statement to ICTP staff and consultants saying that he "would be in favour of setting up a 'certificate' course in various disciplines..." His idea called for "six courses" to be "given by outsiders" and "attended by participants who come to the Centre for other activities. Such persons, upon passing an examination, would be given a certificate."

"This idea," he observed, "may be the beginning of something of interest."

Within two years, Salam's 'something-of-interest' memo would be turned into the ICTP Diploma Course.

To fully appreciate the circumstances in which the Diploma Course came into being, it would be useful to step back in time to examine the state of science at the Centre and in the developing world a decade ago.

1989 marked the 'silver anniversary' of ICTP. During this 25-year period, the Centre's training programmes had gained an international reputation, particularly among scientists in the developing world. At the same time, research programmes, although small, were earning increasingly high marks from colleagues throughout the world.

It was in this overall environment of steady progress that Salam suggested ICTP consider launching a certificate programme for young scientists from the world's poorest developing countries—most notably, students who had received bachelor's or master's degrees but who had little opportunity to continue their education at home or travel abroad.

The initial response from ICTP staff and consultants was less than enthusiastic. Here is a sampling of early sentiments towards the idea:

- *The initiative would create a remarkable burden.*
- *It would conflict with existing programmes next door at the International School for Advanced Studies (SISSA).*
- *Students will not have sufficient background for attending the courses.*
- *It is not feasible and would be thin in content.*
- *It is plain nonsense. It gives no background worth mentioning and could damage the credibility of ICTP.*
- *The proposal is ridiculous.*

Despite this initial round of internal opposition, Salam persisted—believing that the proposed certificate programme could help reduce the large deficit in scientific knowledge and skills in what he called the "real" South (countries with annual per capita incomes of less than US$400). At the same time, he was convinced that the initiative was a way of dealing with one of the Centre's most significant shortcomings: bringing young scientists from the developing world's weakest and poorest countries to the Centre without compromising the quality of training and research that took place here and had served as the foundation of ICTP's success.

Although convinced of the merits of his initial proposal, Salam reshaped the original plan in two fundamental ways in response to the criticisms from staff and consultants.

First, he agreed with a recommendation made most forcefully by Seifallah Randjbar-Daemi and Kumar Narain, staff members in the high energy physics group, that the programme "should be open to all students from the developing world" even if "special consideration was given to students from the 'real' South." Only such an arrangement, they contended, would create a pool of candidates large enough to ensure the quality of instruction and learning that everyone sought.

Second, in response to criticisms that 'certificate' courses would create a 'soft' curriculum that would undermine the

programme's long-term value to students and pose a potential risk to the Centre's reputation, Salam agreed to redesign the proposal into a more structured programme consisting of one year of intensive course work, a dissertation and a final examination.

As a result, the original proposal for 'certificate' courses was transformed into a 'diploma' course modelled in part on the diploma course in applied optics, mathematical physics, quantum fields, and semiconductor science and technology offered by Imperial College in the United Kingdom. ICTP's Diploma Course, in contrast, would be offered in the Centre's three major research fields—high energy physics, condensed matter physics and mathematics—and, in line with the Centre's historic mandate, it would be made available only to students from the developing world.

With the staff and consultants on board, arrangements for the first Diploma Course class were quickly put in place. The external announcement for the course was distributed in the summer 1990; applications were closed in February 1991; the first round of successful candidates was selected in March; and the full roster of students was announced by the end of May.

ICTP staff member Yu Lu, who was appointed the first overall coordinator of the Diploma Course, remembers it as a frantic time. "Not only did we have to sort through more than 800 applications, but we found it necessary to fine tune the review process as we went along. For example, initial plans called for bringing finalist candidates to ICTP for interviews until we realised that the cost of air tickets would be prohibitive."

Concetta Mosca, who was asked to serve as the secretary of the programme (a post that she has held ever since), recalls the logistical challenges created during the first months of operation. "Computers and copiers had to be set up, lecture and conference rooms reserved, contracts for lecturers arranged, and housing for students found. We realised that participants in the Diploma Course—young students who were often leaving their home countries (sometimes their villages) for the first time—would need more assistance from ICTP scientists and staff than other visitors. For many, this was not just an educational experience but a cultural experience as well."

The first year included the participation of 22 students: 11 in high energy physics and 11 in condensed matter physics. In 1992, 10 students in mathematics were added to the programme.

Over the past decade, the Diploma Course has responded to changes within the disciplines. As a result, certain course topics have been dropped while others have been added. Nevertheless, the original structure of the programme remains remarkably the same.

"The students are better than ever," notes Shenoy, "and the programme's reputation has grown as our graduates' performance in universities in the United States and Europe has earned high marks from professors and institutions. Today it's not uncommon for faculty from prominent schools to contact us to see if our students would be interested in applying to their institutions for masters' or doctorate degrees."

"What's most rewarding about the Diploma Course programme," adds Shenoy, "is not just the knowledge that these young people acquire during the year that they spend here in intensive study, but how the students grow in confidence as individuals."

"In fact, the programme's greatest strength may be that it allows students from poor, far away places to measure themselves against international standards of achievement. As they learn to hone their analytical skills and improve their ability to present their findings to their peers, they begin to attain a wider view of the world and their place in it. It may sound a bit inflated, but the Diploma Course changes peoples' lives. That, in turn, gives our students the opportunity to use the knowledge and skills they have acquired at ICTP to change the world in which they live."□

For additional information on the Diploma Course and 'snapshots' of 10 Diploma Course graduates, please see News from ICTP #97 online at www.ictp.trieste.it.

MODEL DIPLOMAS

Based on last year's successful experimental 'test run,' ICTP and SISSA will launch a joint two-year Master's Degree Programme, "Modeling and Simulation of Complex Realities." The programme's initial class will begin their studies this autumn. Students who successfully complete the first year of the programme will receive a Diploma similar to the one that has been offered by ICTP in high energy physics, condensed matter physics and mathematics for the past decade. This marks the first significant expansion of the ICTP Diploma Course since its launch a decade ago. For additional information about this ICTP/SISSA joint initiative, please see www.ictp.trieste.it/~mastercr.

An ICTP workshop on protein folding brought together biologists and physicists to discuss one of the most prominent issues in medical science and public health today.

Proteins, Foldings and Physics

Often the most fundamental questions are the most difficult to answer.

When you think about it, all living organisms, despite their endless complexity, are able to put themselves together without any outside help or direction. They have accomplished this task over eons of time through a process of self-replication that has defied scientific understanding.

How does an embryo evolve into a fetus and then into an infant? How are chemical and biological elements transformed into molecules and then into cells—and how are cells ultimately transformed into blood vessels, muscles, organs and bones? How do the physical and biological factors that distinguish one species from another—yet that make all organisms within the same species very much alike—reveal themselves time and again from one generation to the next?

All fundamental questions. All difficult to answer.

The 50,000 plus proteins found in human beings, each one with its own unique function and shape, constitute the building blocks of life. They are responsible for everything from haemoglobin that carries oxygen in our blood, to antibodies that fight infection, to insulin that allows us to convert sugar into energy, to actin and myosin that enable muscles to expand and contract.

Organically, proteins are molecules or chemical compounds. Physically, they may first appear as beaded strings but they quickly (in fact almost spontaneously) transform themselves into compact three-dimensional structures.

A protein's function, its very reason for existence, is determined by its shape in one of nature's most magnificent displays of how form can dictate function. The road to this discovery began some 50 years ago when the great 20th century chemist, Nobel Laureate Linus Pauling, detected that two simple arrangements of proteins—a-helix and b-sheet—are found in virtually all proteins.

Protein folding—its transformation from a beaded string into a compact structure—takes place spontaneously. That much we know. Ever since Pauling's discovery, however, scientists have been trying to determine what biological and chemical factors drive the folding of proteins and, equally important, how proteins inherently self-replicate themselves into the appropriate shape time and again given the endless possibilities that are available.

This research effort has spurred a great deal of progress in our understanding of protein structure and behaviour. It has also generated a great deal of data. Yet, the protein folding problem, as scientists have come to call it, remains one of the great unanswered questions in science—the biologists' equivalent to the physicists' inability to unify gravity with nature's other elementary forces.

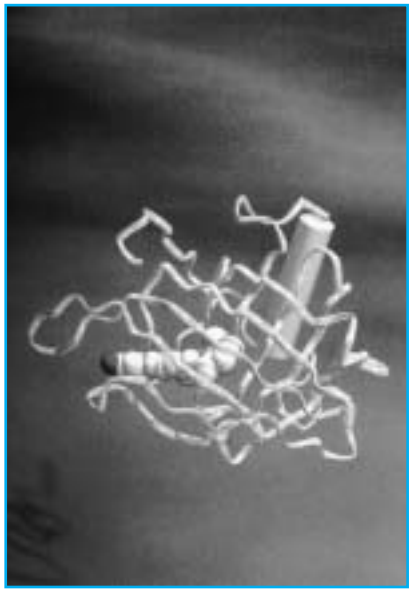
Until recently, this problem resided within the exclusive intellectual domain of biologists and chemists. Now, physicists, in another example of the increasing blurring of boundaries between disciplines, have begun to examine the problem using analytical tools usually associated with their discipline—theories related to thermodynamics and complex systems. The result has been a cross-fertilisation of ideas and techniques that have enriched both biology and physics and hinted at intriguing strategies for answering this perplexing question.

ICTP's Workshop on Protein Folding Structure and Design, held between 11-22 June 2001, was designed to foster discussion among biologists and physicists working on issues related to the protein folding problem. Some 40 scientists, divided equally among the two disciplines, were in attendance.

Workshop participant Arthur Lesk, a molecular biologist at the University of Cambridge (UK) and author of *Introduction to Protein Architecture* (Oxford University Press, 2001), makes the case for this marriage of disciplines by noting that "physicists are good at creating simplified computational models that show essential characteristics of real-world systems. Biologists, meanwhile, have acquired a vast storehouse of knowledge and understanding by carefully examining the real-life behaviour of these systems. By working together, we might be able to accelerate our research efforts ultimately providing important insights that help to explain the protein folding process."

Jayanth R. Banavar, a workshop organiser and physicist at Pennsylvania State University (USA), adds that the time is right for such a union of knowledge and skills.

"First," he notes, "there has been an explosion of data related to genes and proteins largely due to the monumental work associated with the Human Genome Project. But deciphering the sequence of genes—that is, pinpointing the genes' location on the DNA string—while an extraordinary feat, is only the beginning. The ultimate goal is to understand



Source: *Introduction to Protein Architecture* (Oxford University Press, 2001)

how proteins function—and that can only be accomplished by understanding protein folding."

"Second," Banavar notes, "the past decade has experienced a never-ending explosion in computer power that now allows scientists, particularly physicists and mathematicians whose training is well-grounded in these areas, to approximate the real-world behaviour of complex systems with greater and greater accuracy."

"Third, these new tools have been put to use in a variety of fields, including studies of ecosystems, climate change and stock market behaviour, that have enabled the physics and mathematics communities to enter into partnership with other disciplines in ways that were not even considered possible—or for that matter, interesting—a decade ago."

"And fourth, protein-folding research could have direct implications for public health." That's because protein folding—or, more precisely, protein misfolding—has been implicated in the rising incidence of some disturbing and deadly diseases, including Alzheimers' disease, mad cow disease and even some forms of cancer.

"Protein folding is a remarkable process not only for its precision but for its reproducibility," says Amos Maritan, who holds a joint appointment at the International School for Advanced Studies (SISSA, Trieste, Italy) and ICTP. Maritan, with his colleague Banavar, served as a local organiser of the workshop. "Yet the folding process sometimes goes awry and increasingly scientists are coming to believe that when such misfolding occurs it can have dire health-related consequences."

Here's why. Proteins consist of a greasy core of 'hydrophobic' aminoacids surrounded by an outer coating of 'hydrophilic' aminoacids. When proteins misfold, for reasons that cannot yet be explained, the greasy centre leaks through the watery coating to leave behind a pasty material—sometimes referred to as plaque or even less generously as gunk. This unwanted material can eventually create a mass of sticky fibers that cause an increasing number of proteins to lose their natural structure and thus their normal function.

Scientists are coming to believe that the unwelcome cumulative result of this process, which is driven by a complex array of biological, chemical and physical factors, may be responsible for such diseases as Alzheimer's and Creutzfeld-Jacob's (commonly called mad cow disease).

As a result, a better understanding of how proteins fold and misfold could set the stage for devising therapies for the treatment of these deadly diseases.

Such understanding will take time, as will efforts to design protein-based drugs targeted for specific protein structures deemed responsible for the ailments. For now, activities such as the ICTP Workshop on Protein Folding, Structure and Design offer an opportunity for biologists and physicists to learn more about each other's work in ways that will both strengthen and expand the foundation of basic science underlying this broad-ranging interdisciplinary initiative.

"At the turn of the 20th century," notes Maritan, "scientists had acquired a great deal of information about atoms but no unifying framework was in place to understand their general structure and behaviour. That unifying framework, which although impressive remains incomplete, was built by a group of theoretical physicists working hand-in-hand with their experimental counterparts. Perhaps we are in the same position today when it comes to questions of protein folding: Physicists working with biologists, chemists and other researchers may together synthesise the enormous amount of data, information and insight we have accumulated over the past half century to help unlock one of the great mysteries that has impeded understanding organic structures and protein behaviour."□

DATELINE

Monsoon Medal

Indian-born **Jagadish Shukla**, one of the driving forces behind the creation of ICTP's Physics of Weather and Climate Group, has been awarded the first Sir Gilbert Walker Gold Medal from the Indian Meteorological Society. The award honours international scientists who have made significant contributions to monsoon studies. Shukla is head of the Center for Ocean-Land-Atmosphere Studies and the School of Computational Science at George Mason University (USA). Shukla returns to ICTP this summer as one of the directors of the summer colloquium on the physics of weather and climate.

Jagadish Shukla

TRIL Fellow

Cuban-born TRIL (Training and Research in Italian Laboratories) Fellow **Carlos Alonso** has received a national award for his research article, "Applications of Innovative Technology for Understanding the Geochronology of Marine Sediments." Alonso, who works at the Centre of Environmental Studies in Cienfuegos, Cuba, shared the prize with his colleague Misael Diaz, who hails from the same institution. Their findings were presented at the Ninth National Cuban Exposition, "Forging the Future." Research for the paper was conducted at the Marine Environment Research Centre of the Italian Commission for New Technologies, Energy and the Environment (ENEA) during Alonso's tenure as a TRIL Fellow in 1999-2000.

Academy Honours

Two scientists, well known to ICTP, were among 15 new foreign associates named to the US National Academy of Sciences: **Jacob Palis** (Instituto de Matemática Pura e Aplicada, Rio de Janeiro, Brazil) has been a member of the ICTP Scientific Council since 1989 and course director of the schools and workshops on dynamical systems since 1983; **Partha Dasgupta** (University of Cambridge, UK) was a lecturer at the School on the Mathematics of Economics—A Primer in Economics for Physicists and Mathematicians in 1998. The US National Academy of Sciences, one of the world's most prestigious science academies, now has 325 foreign associates and 1874 members overall.

Jacob Palis

Partha Dasgupta

ICTP Prize 2000

Sheng-Li Tan (East China Normal University, Shanghai, China) and **T.N. Venkataramana** (Tata Institute of Fundamental Research, Mumbai, India) will share the ICTP Prize for 2000, which will be given in honour of the famed German mathematician Friedrich Hirzebruch. Sheng-Li Tan has made significant contributions to algebraic geometry, particularly to the theory of algebraic surfaces. T.N. Venkataramana has made significant contributions to the theory of discrete groups. The date of the award ceremony, which will take place in Trieste, will be announced later this year.

Dirac Medallists

Jogesh Pati

Howard Georgi, Helen Quinn and Miguel Virasoro

Jogesh Pati, professor of physics at the University of Maryland at College Park, USA, received the 2000 Dirac Medal during a ceremony held on 21 June in the ICTP Main Lecture Hall. Pati, a long-time collaborator of ICTP's founding director Abdus Salam, was awarded the medal for his "pioneering contributions to the quest for a unified theory of quarks and leptons and of the strong, weak, and electromagnetic interactions." The other Dirac Medallists 2000 who shared the prize with Pati—**Howard Georgi**, professor of physics at Harvard University, Cambridge, USA, and **Helen Quinn**, staff scientist in theoretical physics, Stanford Linear Accelerator Center, Menlo Park, USA—were honoured on 3 July. The ceremonies took place in conjunction with the ICTP Summer School in Particle Physics.

Nobel Lecturer

Walter Kohn, 1998 Nobel Laureate for Chemistry, gave a special ICTP/SISSA condensed matter seminar on 22 June. Kohn, who was born in Vienna, Austria, in 1923, became a naturalised US citizen in 1957 after escaping Nazi Germany in the late 1930s and earning university degrees in Canada and the United States in the 1940s. Renowned for his work as a condensed matter theorist, Kohn has made seminal contributions to our understanding of the electronic function of materials. He played a leading role in the development of density functional theory, which has proved an invaluable concept for physicists, chemists and material scientists. Kohn is also founding director of the Institute of Theoretical Physics at the University of California, Santa Barbara, USA. Since 1985, Kohn has visited the Centre seven times.

Walter Kohn

Sida-SAREC Workshop

The Department for Research Cooperation of the Swedish International Development Cooperation Agency (Sida-SAREC) organised the Workshop on Future Development of Support to Basic Sciences in Developing Countries on the ICTP campus from 13-15 June. Participants included representatives from ICTP, the Third World Academy of Sciences (TWAS), Third World Organization for Women in Science (TWOWS), International Foundation for Science (IFS), and International Science Programme (ISP) at Uppsala University in Sweden. A unique interactive electronic environment enabled participants to record their ideas and opinions instantaneously on laptop computers. Sida-SAREC hopes to use the information and opinions generated at the workshop in a broad-based reassessment of its basic science programmes scheduled to take place next year.

Workshop on Future Development of Support to Basic Sciences in Developing Countries

NEWS FROM ASSOCIATES

Jean Bio Chabi Orou, newly appointed Senior Associate (2001-2006) from the *Institut de Mathématiques et de Sciences Physiques* (IMSP), in Porto Novo, Benin, has been named Benin's Minister of Education. Chabi Orou, 45, received his doctorate degree from IMSP in 1994. As a participant in ICTP's "sandwich programme," he pursued a portion of his Ph.D. studies at Florida State University (USA). Chabi Orou's research fields include condensed matter physics and physics of the environment. In his capacity as minister, he assumes primary responsibility for the nation's overall policies and programmes concerning primary and secondary education.

REPORT ON REPORTS

SPRING SCHOOL ON SUPERSTRINGS AND RELATED MATTERS

2 - 10 April

Directors: C. Bachas (*Ecole Normale Supérieure, Paris*, France), J. Maldacena (Harvard University, Cambridge, Mass., USA), K.S. Narain (ICTP) and S. Randjbar-Daemi (ICTP). In collaboration with: International School for Advanced Studies (SISSA) and Italian Institute for Nuclear Physics (INFN). *The School, designed for theoretical physicists and mathematicians with knowledge of quantum field theory, general relativity and string theories, focussed on the following topics: gauge theory/gravity duality, tachyon condensation in open string theory, noncommutative field theories, and d-branes on Calabi-Yau spaces.*

THIRD ANTONIO BORSELLINO COLLEGE ON NEUROPHYSICS: EVOLUTION OF INTELLIGENT BEHAVIOUR

23 April - 4 May

Co-sponsors: International Brain Research Organization (IBRO, Paris, France), International Centre for Genetic Engineering and Biotechnology (ICGEB, Trieste, Italy), *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq, Brazil) and International School for Advanced Studies (SISSA, Trieste, Italy).
Directors: M.E. Diamond (SISSA) and L. Krubitzer (University of California at Davis, USA).
Local Organiser: J. Chela-Flores (ICTP and *Instituto Internacional de Estudios Avanzados*, Caracas, Venezuela). *The College, which examined issues related to the functioning of neuronal networks, encouraged interaction among participants and researchers in a range of disciplines in the neurosciences, including developmental neurobiology, evolution, neuro-philosophy, neuromodelling and functional imaging. Topics discussed included: How do neocortical areas develop? How does an increase in the size and number of neocortical areas foster increased processing capacity? How have such higher order processes as language and consciousness evolved? How does the neocortex contribute to perceptual learning?*

Pasko Rakic

WORKSHOP ON TECHNOLOGIES FOR DESALINATION

23 - 27 April

and

WORKSHOP ON DESALINATION ECONOMIC EVALUATION

30 April - 4 May

Organiser: Nuclear Power Technology Section of the International Atomic Energy Agency (IAEA, Vienna, Austria).
Co-sponsor: Kuwait Foundation for the Advancement of Sciences (KFAS, Safat, State of Kuwait).
Director: P.J. Gowin (IAEA).

The Workshops provided a forum for scientists and engineers to receive information on technical and economic assessments of nuclear desalination. Their scope and format were patterned after previous workshops taught in IAEA member states. The objective was to train scientists and engineers from developing and developed countries both in desalination technology and economic evaluations for nuclear desalination plants, drawing largely on methodologies IAEA has developed in its Desalination Economic Evaluation Program (DEEP) software package. Participants were familiarised with fundamentals of seawater desalination technologies suitable for coupling with nuclear plants and applications of DEEP in assessing generic nuclear desalination projects.

THIRD INTERNATIONAL CONFERENCE ON PERSPECTIVES IN HADRONIC PHYSICS

7 - 11 May

Co-sponsor: National Institute for Nuclear Physics (INFN, Italy).

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

The Conference is part of a series of conferences on perspectives in hadronic physics and workshops on perspectives in nuclear physics at intermediate energies jointly organised by ICTP and INFN. It focussed on theoretical and experimental investigations of nucleon and nuclear structure by electromagnetic and hadronic probes at intermediate and high energies, reviewing recent advances and exploring future trends in the structure of hadrons, correlations in nucleons and nuclei, hadrons in the nuclear medium, relativistic approaches, unusual states of nuclear matter, and experimental developments. The Conference included expert presentations followed by discussions.

SPRING COLLEGE ON NUMERICAL METHODS IN ELECTRONIC STRUCTURE THEORY

7 - 25 May

Co-sponsor: National Institute for the Physics of Matter (INFM, Italy).

Directors: S. Baroni, A. Dal Corso and S. de Gironcoli (International School for Advanced Studies, SISSA, and INFM, Trieste, Italy).

The College aimed at a general introduction to electronic structure calculations within density functional theory and use of the plane-wave pseudopotential method. The focus was on the physical principles and numerical algorithms underlying the implementation of state-of-the-art computer codes. The activity opened with colloquia given by top scientists on the present status and future perspectives of electronic structure calculations. Theoretical lectures followed, illustrating how an electronic structure computer code is created in practice. These lectures were complemented by hands-on computer sessions demonstrating how a simple plane-wave pseudopotential computer code is developed. At the conclusion of the College, a state-of-the-art pseudopotential package, PWSCF, was distributed to participants for the purpose of conducting tutorials illustrating its applications.

ICTP/TWAS/UCSB WORKSHOP ON FRONTIERS IN ADVANCED MATERIALS

15 - 19 May

Co-sponsors: Materials Research Laboratory of the University of California at Santa Barbara (UCSB), *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq, Brazil) and Third World Academy of Sciences (TWAS, Trieste, Italy).

Directors: A.K. Cheetham (UCSB) and C.N.R. Rao (TWAS and Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India).

Local Organiser: S. Shenoy (ICTP).

Workshop themes included examinations of structural and inorganic materials; biomolecular materials; conducting polymers; and theory and modelling in materials science. The next Workshop in this UCSB series is scheduled to take place in Latin America in 2002.

Subodh Shenoy, Miguel Virasoro, C.N.R. Rao and Anthony K. Cheetham

WORKSHOP ON STATISTICAL PHYSICS AND CAPACITY-APPROACHING CODES

21 - 25 May

Directors: D. Forney (Massachusetts Institute of Technology, Cambridge, Mass., USA), N. Sourlas (*Ecole Normale Supérieure*, Paris, France) and R. Urbanke (*Ecole Polytechnique Fédérale de Lausanne*, Switzerland).

Local Organiser: S. Franz (ICTP).

The Workshop drew on the increasing recognition of important points of contact between the field of 'codes on graphs' and models and algorithms of statistical physics, particularly pairwise Markov and Ising models (in the presence of disorder). Several prominent researchers have already exploited these connections. Nevertheless, coding theorists remain unfamiliar with the methods of statistical physics and statistical physicists remain unfamiliar with the objectives of coding theory. The Workshop encouraged a dialogue among statistical physicists, coding theorists, and other researchers in such cognate fields as inference and convex optimisation in the hope of breaking down disciplinary barriers.

SCHOOL ON HIGH-DIMENSIONAL MANIFOLD TOPOLOGY

21 May - 8 June

Co-sponsors: European Commission (Brussels, Belgium) and US National Science Foundation.

Directors: F.T. Farrell (State University of New York at Binghamton, USA) and W. Lück (*Westfälische Wilhelms-Universität Münster*, Münster, Germany).

Local Organiser: L. Göttsche (ICTP).

Manifold classification has been one of the most important research areas in mathematics for the past four decades. The School aimed to help young mathematicians learn the key techniques and basic results derived from such fields as topology, geometry, K-theory and operator theory. The first two weeks consisted of lectures on the following topics: surgery theory; algebraic K- and L-theory; homotopy groups of the group of diffeomorphisms; controlled topology; isomorphism conjecture in algebraic K- and L-theory; Borel, Novikov, and Baum-Connes conjectures; and exotic aspherical manifolds. A high-level conference in the final week examined the most recent developments in the field.

SUMMER COLLOQUIUM ON THE PHYSICS OF WEATHER AND CLIMATE: LAND-ATMOSPHERE INTERACTIONS AND THE HYDROLOGICAL CYCLE

28 May - 15 June

Co-sponsor: PROMISE project of the European Union.

Directors: F. Molteni and F. Giorgi (ICTP), J. Slingo (University of Reading, UK), and J. Shukla (Center for Ocean-Land-Atmosphere Studies, COLA/IGES, Calverton, MD, USA).

The Colloquium consisted of a Workshop on Land-Atmosphere Interactions in Climate Models and a Conference on Climate Variability and Land-Surface Processes: Physical Interactions and Regional Impacts. The first week of the Workshop examined modelling issues; the second week concentrated on experimental results and impact studies dealing with different regions of the world. The Workshop also included practical sessions in which students designed and completed small projects. The Conference addressed the following issues: predictability of interannual and interdecadal variability of the atmospheric hydrological cycle; land-atmosphere interactions at the regional scale; use of climate simulations in studies of land-use changes and hydrological/agricultural impacts; and research on land-atmosphere interactions and the impact of such interactions in developing countries.

Julia Slingo

WORKSHOP ON PROTEIN FOLDING, STRUCTURE AND DESIGN

11 - 22 June

Co-sponsor: National Institute for the Physics of Matter (INFM, Italy).

Directors: J.R. Banavar (Pennsylvania State University, University Park, Penn., USA) and A. Maritan (International School for Advanced Studies, SISSA, and ICTP, Trieste, Italy).

Local Organiser: A. Maritan.

The Workshop offered state-of-the-art perspectives on experimental, theoretical and computational approaches to the vital problem of protein folding, structure and design, and fostered discussions on the challenges and new strategies facing this field (see "Proteins, Foldings and Physics," p. 6-7.)

Workshop on Protein Folding, Structure and Design

SUMMER SCHOOL ON PARTICLE PHYSICS

18 June - 6 July

Co-sponsors: International School for Advanced Studies (SISSA, Trieste, Italy) and National Institute for Nuclear Physics (INFN, Italy), in collaboration with Asia Pacific Centre for Theoretical Physics (APCTP, Seoul, Korea).

Directors: A. Masiero (SISSA), S. Oh (APCTP), G. Senjanovic (ICTP), A. Smirnov (ICTP) and G. Thompson (ICTP).

The School explored the following topics: status of the standard model and Higgs physics; QCD and quark-gluon plasma; CP violation and B physics; fermion masses and the flavour problem; neutrino physics; phenomenology of supersymmetry; unification of particles and forces; aspects of astroparticle physics; and physics of extra dimensions.

PROFILE

Arbab Ibrahim Arbab, assistant professor of physics at Omdurman Ahlia University in Sudan, was a student in ICTP's first Diploma Course. His road to success began in Trieste.

Sudan Success

The year 1990 was not a good year for Arbab Ibrahim Arbab. Although he had graduated with a bachelor's degree from the University of Khartoum in his native Sudan a year before, he had spent much of his time since then in search of secure employment—first in the Department of Physics at his *alma mater*, where he had hoped to teach while earning a master's degree, and then in Libya, where he taught high school physics part-time.

"I wanted to stay in Sudan to continue my education. While the University of Khartoum had shown some promise in the 1970s and 1980s, by the time I was ready to begin graduate school almost all the good people had left. Political uncertainties were making a difficult situation even worse."

"I was running out of options," Arbab recalls, "when my former professor at the University of Khartoum, Mohammed Saeed, suggested that I apply to the newly created Diploma Course at ICTP in Trieste, Italy. I didn't know anything about ICTP but Saeed was a frequent visitor to the Centre and he assured me that it would be a good place for me to be."

Arbab was accepted and, with 21 other young students from the developing world, he became a member of the inaugural class of the Diploma Course.

Arbab's first few months as a Diploma Course student were not easy. "The courses not only proved difficult in content," he explains, "but they required me to think and learn in entirely new ways. Previously I could excel by simply memorising information. Now I had to solve problems. I'll never forget that one of the first examinations in the Diploma Course was an open book test. That surprised me because having the text book in front of my eyes made me think I could look up the answers. Nothing could have been farther from the truth."

Arbab also credits the Diploma Course with teaching him how to teach. He notes that for the first time in his life, he was "required to make oral presentations and to defend his arguments before his peers," helping him acquire the organisational skills and gain the confidence that he needed to be a good teacher.

After adjusting to the rigours of his new environment, Arbab enjoyed a successful second semester and was among those who received ICTP's first Diplomas. "It was a proud moment for all of us. We had come from many different countries and cultures and had both competed and cooperated throughout the year to attain our goal. As members of the Centre's first Diploma Course, we enjoyed both a feeling of individual and collective achievement that made the moment special." Today some of the Diploma students with whom he graduated are among Arbab's friends, including Egyptian-born Shaaban Khalil, who is now a post doc at the University of Sussex in the UK, and West Indies-born Surujhdeo Seunarine, who is a post doc at Christchurch University in New Zealand.

Between 1993 and 2000, Arbab earned his Ph.D. in physics at the University of Khartoum, where he also taught undergraduate students first as a lecturer and then as an assistant professor. Insufficient resources, large class sizes and poor pay made life as a scientist difficult. "The department," he says, "lacked both the size and energy to be a dynamic centre for teaching and research." Reflecting a problem common to many university physics departments in Africa, Arbab noted that the next youngest faculty member in his university was more than 20 years older than him. He also observes that he had to teach four classes and 200 students each semester, leaving little time for research.

Things are now looking up for Arbab. Last year, he became an assistant professor at Omdurman Ahlia University in Sudan, one of the best institutions of higher education in the country. "The teaching load is lighter and the facilities are better equipped." More importantly, he notes, "professors are given a greater sense of autonomy and are able to devise and pursue their own research agendas." In Arbab's case that means time to study and publish in the fields of cosmology and astrophysics with special attention to questions related to vacuum decaying and fluid repulsion.

Arbab was appointed an ICTP Regular Associate in 2000 and, just this spring, was named dean at Comboni Computer College in Khartoum. Recent changes in Sudanese law will allow him to simultaneously hold both his professorship at Omdurman Ahlia and his administrative job at Comboni.

All of this means that he will now be able to meld his skills in research, teaching and administration in ways that professors in Northern universities take for granted.

There is no better testimony to the success of the ICTP Diploma Course than Arbab's current good fortune. Much of this has to do with Arbab's own skills and drive, but much also has to do with the strong foundation in analysis, research and teaching that the Diploma Course provided him with a decade ago.□

MONITOR

Additional Funding

The Italian government, which has been the primary source of funding for ICTP since the Centre's inception in 1964, has announced that it will increase its annual contribution to ICTP from 26 billion lire (US$13 million) to 36 billion lire (US$18 million), beginning this year. On behalf of the Centre, ICTP Director Miguel Virasoro has expressed his gratitude to the Italian government for its vision, generosity and sustained commitment to the Centre's goals. The additional funds will be used to deepen and expand ICTP research and training activities. Over the past 36 years, more than 75,000 scientists, a majority from the developing world, have participated in ICTP workshops, conferences, schools and seminars.

Search Committee for New Director

Following Miguel Virasoro's announcement that he will be retiring in May 2002, the ICTP Steering Committee, meeting in Trieste last month, announced the formation of a Search Committee for a new director. Members of the Search Committee include: Walter Rudolf Erdelen, Assistant Director-General for Natural Sciences, UNESCO (chair); Daniele Amati, Director, SISSA, Italy; Philip W. Anderson, Professor, Department of Physics, Princeton University, USA; Attia A. Ashour, Professor, Department of Mathematics, Cairo University, Egypt; Werner Burkart, Deputy Director General, Department of Nuclear Sciences and Applications, IAEA; Praveen Chaudhari, Chair, ICTP Scientific Council; David Gross, Director, Institute of Theoretical Physics, University of California at Santa Barbara, USA; Luciano Maiani, Director General, CERN, Switzerland; and C.N.R. Rao, President of the Third World Academy of Sciences (TWAS) and of the Jawaharlal Nehru Centre for Advanced Scientific Research, India. Announcements calling for nominations for the director's post have been published in *CERN Courier*, *Nature*, *Physics Today*, *Physics World* and *Science*.

Nature Yearbook

Nature Publishing Group has published the first edition of *The Nature Yearbook of Science and Technology*, which it expects to reissue on an annual basis. The 2000-page volume, a mix of lengthy features, editorials and profiles, includes three entries outlining the research and training activities of ICTP, TWAS and the InterAcademy Panel on International Issues (IAP).

Chinese Delegation

On 18 June, a delegation from the **China Atomic Energy Authority** (CAE), headed by its chairman, Zhang Huazhu, visited the Centre. The delegation met ICTP Director Miguel Virasoro, heads of ICTP's scientific groups, and Chinese scientists who were at the Centre to attend research and training activities. The delegation also toured the library and computer facilities.

AGH Lower Level

The refurbishing of Lower Level 1 of the Adriatico Guesthouse, which began in 1999, is now complete. New meeting rooms, computer laboratories and secretarial offices, as well as additional hallway space for poster sessions, informal gatherings and exhibitions, have increased the area by 870 square metres. Moreover, 46 new workstations are now available for internet connections.

WHAT'S NEXT

2 - 6 July
The Second Stig Lundqvist Research Conference on the Advancing Frontiers of Condensed Matter Physics: Non-Conventional Systems and New Directions

9 - 20 July
Sixth School on Non-Accelerator Astroparticle Physics

16 - 27 July
Summer School on Low-Dimensional Quantum Systems: Theory and Experiment

30 July - 17 August
School and Workshop on Dynamical Systems

30 July - 24 August
EU Advanced Course in Computational Neuroscience—An IBRO Neuroscience School
followed by
25 - 26 August
ESF Symposium

7 - 11 August
Research Workshop on Challenges in Granular Physics

mid August - mid September
Nordic-Trieste Workshop

27 - 31 August
Adriatico Research Conference on Interaction and Assembly of Biomolecules

3 - 7 September
Workshop on Hybrid Nuclear Systems for Energy Production, Utilisation of Actinides and Transmutation of Long-Lived Radioactive Waste
followed by
10 - 21 September
Workshop on Nuclear Data for Science and Technology: Accelerator Driven Waste Incineration

3 - 14 September
Second European Summer School on Microscopic Quantum Many-Body Theories and Their Applications

3 - 28 September
Summer School on Mathematical Control Theory

24 - 28 September
Conference on: Anderson Localization, Quantum Chaos and Random Matrices: Rigorous Methods vs. Physical Intuition

24 September - 5 October
School on Physics of the Equatorial Atmosphere

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 2001`
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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