International Atomic Energy Agency
United Nations Educational, Scientific and Cultural Organization

International Centre for Theoretical Physics

News from ICTP

No. 76 November 1993 – March 1994

Professor Abdus Salam, President of ICTP

Since 1 January 1994, Professor Abdus Salam is the President of the International Centre for Theoretical Physics of Trieste. This new function was created especially for him by the IAEA and UNESCO in view of his exceptional merits. The change was announced in a communication from Abdus Salam himself to the scientists and staff of the ICTP a few days before the 1993 Christmas vacation. Rumours in that sense had been circulating for some time, therefore the news was not quite unexpected. But still, though we realized that Professor Abdus Salam had directed the ICTP since its inception, we intimately hoped that he would have remained at the helm for several years. We know that we shall continue to benefit from his experience and from his experience and wisdom in his new position but we shall miss, in our day-to-day life, his strong leadership, his ability to involve scientists and staff in his own vision at all times, his sensitivity to the real needs of the developing countries and his talent for enlisting the collaboration of the best scientists in the programmes of the ICTP.

His achievements in these last thirty years, are admirable. In parallel to a brilliant scientific career which culminated in the Nobel Prize awarded to him in 1979, Abdus Salam has created the greatest scientific network ever seen in the world with Trieste as a basis. The ICTP founded by him in 1964 and which has now a record of 60 000 visits of scientists from every part of the world, is undoubtedly the corner stone of that network. Later, two more research institutions, the International Centre for Genetic Engineering and Biotechnology (ICGEB) and the International Centre for Science and High Technology (ICS) were established in Trieste — in 1983 and in 1988 respectively — under the aegis of the United Nations Industrial Development Organization, on the model of ICTP. Moreover, Abdus Salam created the Third World Academy of Sciences (1983) and the Third World Network of Scientific Organizations (1988). These two bodies encompass all branches of scientific knowledge and carry out programmes out programmes aiming at promoting and strengthening scientific collaboration in the countries of the South between themselves and with the industrialised nations. Finally, in the last five years, Abdus Salam has dedicated much of his efforts to the creation of a network of twenty International Centres of Excellence for Sciences, High Technology and Environment in the countries of the South. This initiative which is actively supported by UNIDO, UNESCO and ICSU, has been discussed on several occasions and will be taken up at a Ministerial Level Meeting convened by H.E. Benazir Bhutto, Prime Minister

continued on Page 3

Abdus Salam, Founder of the ICTP and Director from 1964 to 1993.

Inside:

Editorial Note

Editorial Note

We regret that the publication of News from ICTP was interrupted because of the departure of the ICTP Scientific Officer in December 1993. Temporary arrangements have recently been made by the Acting Director, Prof. L. Bertocchi, in order to secure a regular production of the publication until a new Officer is appointed. Therefore, News from ICTP will appear every three months. However and exceptionally, this issue covers the ICTP activities which took place in the last five months. We apologize for any inconvenience this may cause to the reader.

Professor Wiedeman on Synchrotron Radiation

The Second School on the Use of Synchrotron Radiation in Science and Technology organized by ICTP was held from 25 October to 19 November 1993. The School was particularly important because it represented for many scientists from developing countries a rare opportunity for getting acquainted with up-to-date investigation techniques offered by synchrotron radiation sources in general and, in particular, by the Trieste synchrotron facility which will be operational soon. In fact, the Trieste Synchrotron Laboratory headed by Nobel Laureate Carlo Rubbia was officially inaugurated on 26 February 1994 by the Prime Minister of Italy, Mr. Carlo Azeglio Ciampi, who was accompanied by Professor Umberto Colombo, Minister of the Universities and of Scientific and Technological Research. In the following interview, Professor H. Wiedeman from Stanford University and Lecturer in the School explains the many advantages resulting from the use of synchrotron light radiation.

Q. Professor Wiedeman, you lectured in the course on the applications of synchrotron light radiation. Could you please describe these applications to high technology, chemistry, physics and, possibly, to environment?

R. Synchrotron radiation is basically an electromagnetic radiation which is emitted in a wide spectrum of wave lengths, from microwaves to the X-ray regime. Electromagnetic radiation has been used in the past hundred years in many disciplines as an ideal probe to investigate on metals, chemical compounds, atoms, surfaces, biological molecules and these investigations were made mostly with rotating anode X-ray tubes.

With the development of synchrotrons, new sources have become available. They can produce much more intense synchrotron radiation than ever before and that allows now the investigation of materials which require a large flux. One can investigate, with much more sensitivity and resolution, solutions, very small impurities in metals and many others. Such techniques are now being used in the existing synchrotron light radiation laboratories in fields like materials science, surface physics, chemistry, biology, medicine, geology, industrial applications, industrial fabrication technology, and environmental sciences.

To be more specific, in high technology, it becomes more and more important that very pure materials be produced. There is nowadays a great effort towards the miniaturization of electronic devices, but the smaller the structure becomes for such devices, the more important it is that impurities in the materials are eliminated. In order to eliminate them, one must be able to detect them and so, for example, in high technology, one application of synchrotron radiation is the development of processes for the fabrication of smaller and smaller integrated computer chips with such a degree of purity that these devices can be mass-produced in a very reliable way. This implies that it must be possible to test these processes and this can be done with synchrotron radiation.

One can also develop new materials; synchrotron radiation makes it possible to measure the properties of new materials in very minute quantities so that one can try to compose new materials even if they are available in very small quantities. One can then think about their interesting properties and decide whether or not to proceed to the production of larger amounts of these materials.

In biology there is a great effort to study, for example, the structure of DNA and in order to do so, one needs synchrotron radiation once more. Normally, DNA decomposes while it is being investigated; its molecules are not easy to handle, but it has been found that if these molecules are irradiated in very short blasts with synchrotron radiation, the measurements can be done very quickly before the DNA biological substances decay. This has become a very important method for unravelling the structure of DNA.

It is also difficult to produce large protein crystals. Proteins can be produced only as very small crystals and therefore one needs intense radiation sources to study these small crystals. This, again, can be done only with synchrotron radiation.

In relation to applications in environment, for example, in America, at Stanford, we are just planning for a beam line or an experimental station which is entirely devoted to environmental studies. The problem which will be investigated is the safe disposal of radioactive wastes. Geologists study chemical compounds of these radioactive atoms and, in particular, their behaviour in a water environment or in any environment which is able to carry away these radioactive substances. This obviously has to be avoided. Therefore, they try to find a compound which would rest where it is placed forever: it would not be soluble in water, it would not migrate and react chemically. For such studies, synchrotron is an ideal tool because one does not need large quantities of that material.

There are also medical applications of synchrotron radiation. For instance, it is possible to make cardiovascular systems, heart arteries, visible with the use of synchrotron radiation; this would be a non-invasive method for looking at blockages of cardiovascular systems. For such an investigation one has to make a picture with a resolution of less than half a millimetre because these arteries are very small and one must be able to observe the blockage. The method is rather simple. A small quantity of an iodine compound is injected into the bloodstream and, by using X-rays from a synchrotron, one guides these X-rays to a monochromator and one takes monochromatic X-rays at below and above the K-absorption edge of iodine. Both pictures look pretty much the same except where there is iodine. Above the K-edge, the iodine absorbs much more radiation than below, and this allows to locate the blockage.

Q. I noted in your biodata that you have been contributing to the design and construction of a synchrotron in newly industrialized countries such as Brazil, Taiwan and Korea. But I see that you have been also in Thailand, a country which is less advanced than the other three from the industrial viewpoint and where scientists contemplate to build their own synchrotron source. It seems to me that there is quite an interest, even in not so advanced countries, in this way of looking at matter. What is the real benefit that these countries can obtain by using synchrotron sources? Another question which comes to my mind is why is it that there is no synchrotron source yet in Africa?

R. Newly industrialized countries were known in the past years for providing cheap labour for manufacturing. This was the case shortly after World War II for Japan and, later, for Taiwan, Korea and Singapore and now we also hear of Thailand and the Philippines. These countries started out by providing cheap labour, but now they have learned how to produce high-tech systems. If you look to the future ten or twenty years, for these countries it will no longer be sufficient to just provide cheap labour. They will have to develop and be able to create new technologies.

Labour in Thailand is still a little bit cheaper but this will not last for ever. When the big market in China will open, labour will be cheap there for some time and the small countries around it will have to do something else. So, it is important for these smaller countries to build up on their present state of technology and take part in the development of new technologies.

Japan shows how to do it: in Japan there are many synchrotron light sources. I am not saying that synchrotron light sources will solve all economic problems but they will contribute. The beauty of such synchrotron light sources is that their radiation can be applied in many areas of science, basic science, medicine and industrial applications.

At Stanford, a large number of
At Stanford, a large number of
industrial technologists experiment on their own products with the synchrotron radiation produced by our machine. So, as you can see, science can be very basic but it can be also very applied and immediately applicable to industrial processes. I therefore think that when we look at countries like Thailand, it will be useful for them to have, let us say in ten years, such a synchrotron light source.

There is another aspect to the whole situation and that is education. In many of these countries (and, especially ten years ago, in Taiwan and in South Korea), the majority of their bright students went abroad to get their PhD and very few came back, because of the lack of opportunities for doing experiments and participating in development. A synchrotron light source in a national laboratory provides that opportunity. Professor Yuan Tseh Lee, a chemist originally from Taiwan but who worked in the USA and won the Nobel Prize in chemistry in 1986, is now returning to his homeland. This is very significant. As you know, brain drain represents a great loss, especially for small countries. I could say that synchrotron light sources, among other types of facilities, are inexpensive as compared to the loss of young brains. The research with such a facility is mostly done by small university groups with one professor and two or three students. They collect data at the facility and return home where they analyze them. This feeds the educational process and it is high technology. It provides the opportunity for any developing country to catch up with forefront science right away and not to waste time on secondary science.

Coming to Africa, there is no synchrotron light source yet and there is no talk about it yet. But one must note that Africa has not yet entered in the production of high-tech components like Japan, Taiwan and South Korea have. Their advantage was cheap labour, but they have learned how to use the machines. After a while, they had to go by themselves and they progressed through incremental technology.

Q. You have already partially answered the question which I am going to ask you, but you might have something to add. I have seen many participants from developing countries in your audience. What is your message to them
audience. What is your message to them
in relation to the use of synchrotron light radiation sources and, in particular, in view of the fact that in Trieste a synchrotron facility will be operational very soon?

R. I think that this School is very valuable for students coming from these developing countries. It is a unique School where people learn about a broad range of techniques used in the experimentation with synchrotron radiation. I believe that ICTP and ICS provide here a very important contribution for the students, including those from industrialized countries.

It is good that the School concentrates on developing countries because many of these countries are very far away from Europe, America and Japan. Here, they are exposed to the main themes in a condensed form and they can study them in greater detail. Every participant has already heard about synchrotron radiation experimentation and the majority of them actually comes from places where there are synchrotron light sources. They already know about these, but they need to know more about experimental techniques and that is what they can learn here.

Q. I suppose that at the next School, the Trieste facility will be available and this might attract scientists from less advanced countries, from countries with no access to synchrotron sources. Then, will it be possible for those scientists to come to Trieste, make their measurements or expose their samples, go back home and analyze the results without leaving the country for too long a time?

R. Yes, this is in fact the situation at Stanford. Anybody in the world can apply for an experiment. One has to submit a proposal that will be accepted if it is scientifically interesting. Beam line time is free of charge but travel and leaving expenses must be borne by other sources. That is the problem, I think, for scientists from developing countries. If they could come up with their own travel and subsistence support, they would not have to pay anything for the experimentation. In Stanford we welcome many university groups. They come mostly as graduated students accompanied by a scientist who is usually their professor. They do their experiments in one or two weeks and return home to exploit them. All the data
return home to exploit them. All the data
are on a magnetic tape and they analyze them at their institutes. These data are feeding the research in universities. _ ♦

André-Marie Hamende

continued from the Front Page

of Pakistan, towards the end of this year.

For all these unique accomplishments, all scientists and staff of the ICTP are immensely grateful to Abdus Salam. They wish him a good health and success in his new function. ____ ♦

King Faisal Foundation

HM King Faisal ibn Abdul Aziz, son of Saudi Arabia's founder and the Kingdom's third monarch, ruled from 1964 until his death in 1975. King Faisal was acclaimed at home and abroad as a great statesman who devoted his life to his people and his religion.

In 1976 the eight sons of King Faisal honoured their father's memory by establishing the King Faisal Foundation. Through its diverse philanthropic activities, the Foundation seeks to preserve religious values, advance education and health, promote cultural programmes, and raise the standards of living for the less fortunate, particularly in developing nations. To this end, the King Faisal Foundation offers scholarships to graduate students, contributes to scientific research projects, and provides grants to worthy causes.

Under the Foundation umbrella are the King Faisal Schools, the King Faisal Centre for Research and Islamic Studies (KFCRIS) and the King Faisal International Prize.

Following the example of King Faisal's commitment to learning, the first King Faisal School began operation in Riyadh in 1991. This non-profit, private institution offers an enhanced curriculum that provides a creative model of educational excellence for other schools in the Kingdom.

KFCRIS provides, free of charge, a wide range of research materials in several state-of-the-art libraries. The Centre's in-house experts train interested individuals in advanced techniques of manuscript preservation. In addition, the Centre sponsors cultural exhibitions and lectures on a wide range of topics.

Since its inception in 1979, the King Faisal International Prize has earned worldwide recognition. Merit alone governs the selection process. Nominations of qualified candidates come from leading institutions and organizations throughout the world. By 1993, 87 distinguished and internationally recognized individuals from 27 countries had won the King Faisal International Prize. Each award consists of a certificate containing an abstract of the winning work, a commemorative gold medallion and a cash endowment of SR350,000 (US$93,333). Joint winners in any category share the monetary grant.

The five prize categories are: Service to Islam, Islamic Studies, Arabic Literature, Science, and Medicine. Topics for the 1995 Prizes are: Islamic Studies (Studies Dealing with Thematic Commentary of the Holy Qur'an), Arabic Literature (Studies Dealing with Prominent Men of Letters in Modern Arabic Literature), Science (Chemistry), and Medicine(Molecular Immunology).

The King Faisal Foundation hopes that the incentive of internationally recognized prizes will encourage significant advances in areas which in 1994, the Prize for Science (Mathematics) was awarded to Professor Dennis Parnell Sullivan (USA), Albert Einstein Professor of Mathematics, New York City University, and Professor, Institut des Hautes Etudes Scientifiques, France, whose contributions as a gifted mathematician have had a tremendous impact on the development and understanding of contemporary mathematics.

The address of the Foundation is P.O. Box 352, Riyadh 11411, Saudi Arabia. Tel. 4652255, Fax 4656524, Telex 404694 Khairi. ♦

Lasers and Chemistry

Two seemingly distant scientific disciplines, lasers and chemistry, came closer together during two meetings held in 1993. These meetings, the School in Photochemistry and the Conference on Lasers in Chemistry, were the result of a collaborative effort between the ICS-ICTP Laboratory for Lasers and Optical Fibres (Head: Prof. G. Denardo) and the ICS International Institute for Pure and Applied Chemistry (Coordinator: Prof. N. Rahman). During the Conference, Prof. J.P. Mittal from India lectured on "Excitement in current chemical dynamics research: lasers in chemistry and chemistry in lasers". In the interview which follows, Prof. Mittal explains how these two fields interact and benefit from each other.

Q. Professor Mittal, lasers and chemistry specialists are working hand-in-hand. Could you please say why this collaboration is so exciting and important?

R. This very interesting topic has been quite dear to me for the last twenty years. As you are aware, chemistry deals with making and breaking chemical bonds. How much time it takes to break a particular bond and how much it takes for reallying bonds for generating a new chemical structure has always been a mystery. In many chemistry books, this transition is defined as intermediate transition states — and designated by stars and daggers — of which many people talk about but which we shall never observe in real time.

With the advent of lasers, we are on the threshold of directly having a peep into the reaction chamber thanks to the high-speed electronic diagnostic equipment which is now available to us. With the help of lasers, we can perturb a chemical system, break a chemical bond and look at the transition cinematographically, almost photographing step by step, from the initial stage to the final making of a new bond. This is the real excitement in chemistry today. We no longer depend on vague assumptions. We are able to see the real-time scale and the spectral mode, i.e. the temporal and spectral quantities related to these so-called free radicals or transition states in real-time scale. As the famous scientist Edward Teller said, lasers have enabled chemists to break and make bonds with their own fingers and to look directly at what is going on!

As you may have noticed, there was a second part in the title of my lecture: chemistry in lasers. This is because we think that time has come for us to give our return and thanks to the laser community. With our chemical knowledge, with new bonds and new components, we shall be able to give new types of lasers to the community. Chemists are now investigating chemiluminescent reactions giving rise to energy photons and, hence, to the invention of new lasers. Therefore, on one hand, lasers help chemistry in finding the fundamental reactive steps of chemistry and, on the other, the knowledge of these fundamental reactions provide information about possible chemical laser systems not available so far.

Q. This is really fascinating. But what is it that renders lasers so important for your work?

R. What is so new about lasers is not so basic after all. Lasers are a source of light but what ordinary sources cannot do, lasers will.

There are three fundamental differences between laser and ordinary chemical lamps. First, laser is a source of

African physicists discussing an experimental set-up in the Laboratory for Lasers and Optical Fibres.

coherent light while that of all other

other molecules are cold. Hence, there is

Q. You come from a

coherent light while that of all other optical lamps is incoherent. Hence, laser light can be focused to a diffraction limited size so that the power density per cm^2 or per mm^2 can be fantastically high. For example, a one millimeter He-Ne laser, in terms of the brilliance of its light in cm^2 or mm^2, is much more powerful than the sun. It provides the possibility of putting very high amounts of intensity per cm^2 into a system. The second difference, which is unique, is the high monochromaticity of the laser light. Presently there are lasers with a monochromaticity of the order of 0.001 wave number per cm — normal infrared spectrophotometers used in colleges have a resolution of about 2 wave numbers per cm. These lasers give us a unique opportunity to selectively pump the energy into various bonds of a molecule and for hoping that the energy will stay in a particular bond and that this bond will break. The hope of chemists is that they will be able to do selective laser photochemistry. Normally, when chemists start a chemical reaction, they take *a* and *b*, heat them and finally get *c* and *d*, hoping that the best reaction has taken place. Usually, the reaction follows the rule of thermodynamics and the lowest energy channel predominates. When lasers are used, one can pump the energy very fast and in a very short time scale, in a particular bond. This bond only will stretch while the rest of the other molecules are cold. Hence, there is the possibility of getting the bond selective chemistry which chemists have dreamed of for a long time and this can only be achieved if one uses lasers. The last specific property which lasers have and other sources do not have, is the ability of delivering very short pulses of light. Today, the world record of pulses is 6 femtoseconds or 10^{-15} sec. Therefore, one can start looking at one reaction at as an early time scale as 6×10^{-15}, and then go to picoseconds and nanoseconds, and then obtain the whole picture. These are the specific reasons why lasers are of such great help to the chemist today.

Q. Recently, ICTP and ICS have organized a meeting on the uses of synchrotron light radiation. Could this type of light source be of interest to your research field?

R. As a matter of fact, I gave a quite popular lecture on the use of lasers and accelerators, including synchrotrons, in chemistry. Synchrotrons provide a complementary tool to lasers. For instance, even today lasers do not provide sources in the far ultraviolet (UV) region i.e. less than 200 nanoseconds or so, while synchrotron can deliver an intense light in that region. Therefore, if one wishes to do photoelectron spectroscopy in the short UV region, then synchrotron light is the only way. At the same time, synchrotron radiation is a continuously tunable source which is a great advantage while, in the case of laser, complete tunability does not yet exist.

In this context, I should mention that a new concept of chemical dynamics is presently being pursued in Britain and at the Berkeley Laboratory in the United States and that funds have been requested to this end. The project would consist in using synchrotron, lasers and free electron lasers for the infrared region, which would cover the whole spectrum of electromagnetic radiation. These three radiation sources would be put in the reaction chambers and will allow for a comprehensive study of chemical dynamics. A similar idea was voiced by Academician Molin for an International Centre on Chemical Dynamics in Novosibirsk where a free electron laser could be coupled to other laser and synchrotron sources.

Q. You come from a technologically advanced developing country. Are other developing countries working in the area of lasers and chemistry and what are the benefits expected from this kind of research?

R. To my knowledge, there are several countries in a similar development status which are progressing at a very high speed in these areas. The first of them is China where I visited very advanced laboratories specifically devoted to lasers in chemistry and in particular, the Laboratory of the Chinese Academy of Sciences which is entirely dedicated to these studies. Two Latin American countries, Argentina and Brazil, are investing large amounts of funds and efforts in lasers and chemistry. In this respect, you will note that many participants are attending this meeting because this type of research looks particularly promising.

Lasers in chemistry could lead to some very cheap methods of isotope separation. This is, in my opinion, the motivation why so many countries have started to use lasers in chemistry because they provide a handle for the production of various isotopes which are of great commercial importance like sulfur 34, oxygen +18 required for trace techniques, and nitrogen isotopes for agriculture. The price of a large number of isotopes is falling down because of the use of lasers. For instance, the sulfur isotope which used to be sold at US$1000 per gram is now produced in Germany at 30 cents per gram with the help of lasers.

Q. In this Conference, you are the only lecturer from a developing country. Would you think that if this Conference is replicated in 5 years from now there would be more lecturers from the developing countries?

R. There are two parts in your question. To the first, my answer is yes: there will be more speakers and lecturers in a future meeting because there is a great interest for this subject and many research activities are going on in many developing countries. As to the second part, I not only expect a larger number of lecturers from the Third World but I also believe that such conferences should be held in the developing countries like Argentina, Brazil, India and others. In India, for example, we can take on such conferences since we have the infrastructure needed. It may be even more economical for ICTP and ICS to hold regional meetings in the developing countries since a larger number of participants from the country or from the region could benefit from them. We would, of course, invite specialists from the industrialized countries as well. One more reason for holding meetings regionally, is that I always felt that when a lecturer talks to his own level people, he understands their basic difficulties and day-to-day problems while a person from an advanced country would take small problems such as air-conditioning for granted, while these are real troubles for most of us.

Dr. Jai Pal Mittal is the Director of the Chemistry Group of the Bhabha Atomic Research Centre in Trombay (India). He obtained his PhD in 1967 at the University of Notre Dame, USA, where he returned as a Visiting Professor in 1985. Prof. Mittal is a Fellow of the National Academy of Sciences (New Delhi), the Indian Academy of Sciences (Bangalore), the National Academy of Sciences (Allahabad) and of the Royal Society of Chemistry (London). He is the Vice President of the Indian Chemical Society. He has been honoured with several Medals and Awards. His research interests include the study of fast chemical reactions and the use of lasers and accelerators in chemistry. ♦

André-Marie Hamende

A view of the ICTP High Temperature Superconductivity Laboratory.

Thin Films: Applications and their Economic Importance

F.C. Matacotta
Head, ICTP High Temperature Superconductivity Laboratory, Trieste

and

M. Croset
Thompson Tubes Electroniques, Vélisy, France

The First Workshop on "Science and Technology of Thin Films" was held at ICTP from 7 to 25 March. The course was co-sponsored by the International Union of Vacuum Science, Technology and Applications (IUVSTA) in collaboration with the International Centre for Science and High Technology (ICS, Trieste, Italy), the Italian Vacuum Society (AIV) and the Italian National Research Council (CNR). The workshop was attended by 52 young scientists from 37 different countries. All the participants, selected among an eight-time larger number of applications, proved to have a solid working experience in the field of thin film production, characterisation and application. The course consisted of lectures, covering in detail a few aspects of the on-going research in the field, of practical activities using the experimental and computing facilities available at the ICTP High Temperature Superconductivity and Informatics available at the ICTP High Temperature Superconductivity and Informatics laboratories and of participant contributions divided in seminars (31) and poster sessions (26 posters), where all the attendees had the opportunity to show and discuss their research results with the invited experts. The workshop's main purpose was to provide up-to-date information on some frontier problems in the very wide field of thin films. The specialized character of this training activity derives from an assumption — that turned out to be correct — that in many Third World countries (specially where the electronic devices' industry is a fast growing economical issue) the research activities on thin films and related areas are particularly developed. In such cases there is usually a gap between the capability of the local academic and research institutions and that of the industries where extremely sophisticated technologies are imported and applied as "closed boxes" with no or little possibility of interaction with the local scientific community.

In a broad sense, a thin film may be defined as a solid layer of thickness ranging from some nanometers to some microns produced by dry either physical or chemical processes. A thin layer of any material can preserve some useful properties of the same material in massive form; in some cases the reduced thickness introduces new properties that are not found in the bulk; finally some materials are stable only in a thin film form. In all cases thin films can be of economical importance: in the first case because they allow the exploitation of functional properties (electrical, mechanical, chemical...) of a large variety of expensive materials using very limited amounts of them. The almost two-dimensional shape of thin films is particularly suited for automatic processing and, in general, allows a large degree of integration that is essential in any manufacturing process that takes advantage from miniaturisation.

Typical examples of this are the electronic devices that could be developed to the present state only thanks to the thin film technologies which were introduced for the first time on industrial scale in 1962. Practically all the components of any electronic device, from the most advanced Very Large System Integration (VLSI) circuit to the humblest carbon film resistor or gold-plated pin of a connector, are humblest carbon film resistor or gold-plated pin of a connector, are manufactured using thin film processes. The semiconductor thin film industry had a market of US$ 80 billion in 1993 and is expanding at an estimated rate of 14% per year. The time evolution of the complexity of semiconductor devices and their price are certainly one of the most impressive events which has occurred since the industrial revolution. For instance, the number of active components integrated in a single chip was 250 in 1966, reached 10,000 in 1975, one million in 1984 and is now approaching 100 million. Conversely the cost per unit, expressed in millicents of US$ per bit of memory (each bit requires a few active components), decreased from 12 in 1983 to less than 0.2 in 1993.

Two important and fast-growing thin film applications, i.e. flat panel displays and data storage, are connected to the electronic devices' markets.

The flat panel display production is increasing at an estimated rate of 20% per year. The value of the total market in 1993 approached US$ 4 billion. The introduction of thin film technologies and new light-emitting materials is making these all solid state thin film devices more and more competitive with respect to the traditional cathodic tubes of TV and computer monitor screens.

Thin films are again playing a major role in the data storage devices industry. In fact, in both magnetic memories (hard and floppy disks) and optical CD memories, the active part is a thin layer of a magnetic oxide or a high reflectivity metal. The market for these two applications together was US$ 2.2 billion in 1992 and is expanding at a rate close to 20% per year.

The applications related to the electronic industry represent 94% of the total world market of thin films. The remaining share is divided in a large number of particular applications; some of them are very important either for their everyday life use (for instance plastic and metal thin films for food processing and preservation, simple thin film optical devices in light bulbs, car projectors, windows) or for their advanced technological content. This last category of applications usually takes advantage from the unique functional performances displayed by special material thin films.

Hard coatings are a typical example: the hardest and the most heat-, wear- and corrosion-resistant materials are some the hardest and the most heat-, wear- and corrosion-resistant materials are some oxides, borides, nitrides and carbides. Those compounds of these classes that are found in nature, are usually considered gemstones, not only for the beauty of their colours or rarity, but also for their superior mechanical properties and chemical resistance. The best way to exploit such features is to deposit thin layers of these compounds on suitable substrates. These hard coatings are widely used in the production of long life cutting tools, mechanical parts of any kind, corrosion resistant materials, bio-compatible elements for surgery. Diamond and diamond-related thin films are one of the most advanced achievements of thin film technology. Surprisingly, the production process of diamond layers is relatively simple and their use as hard coatings or high heat conductivity substrates for sophisticated electronic circuitry is becoming economically attractive. The cubic structure of boron nitride is isomorphic with the structure of diamond. This recently synthesised material, which shows characteristics similar and even superior to diamond, is stable under standard temperature/pressure conditions only if its thickness is less than 10-20 nanometers.

When different thin layers are deposited one onto the other, the properties of the resulting thin films can be varied to a very large extent. These two-dimensional composite materials are called multilayers. The recent developments of the deposition techniques allow the perfect control of the deposited thickness for each layer down to the atomic scale. It is therefore possible to build artificial structures whose composition is determined atomic layer by atomic layer. This possibility widens the field of application of thin films well beyond the limits of simple materials: the possibility of varying the composition of the subsequent layers over very short distances opens totally new areas of application. As an example, multilayer growth techniques make it possible to vary (smoothly or stepwise) the refractive index in the film over distances comparable to, or even much shorter than, the visible light wavelengths. In this way it is possible to fabricate optical elements that use interference effects to obtain performance figures that can not be even approached by the classical reflection/ performance figures that can not be even approached by the classical reflection/ refraction mirrors and lenses. The spectral range of these devices is very broad and goes from medium infrared (IR) up to hard X-rays.

In a similar fashion multilayers of semiconducting compounds, magnetic and non-magnetic metals, superconductors and insulators and so on, are continuously expanding the areas of research and applications of thin films.

Despite the variety of fields, reflected in the different subjects of the Workshop's lectures, seminars, posters and experiments, thin film science finds its common ground in the fundamental aspects that regulate the way all thin layers grow and in the many experimental techniques that are used to characterise their properties.

Details on the content of this Workshop are shown on Page 16 of this issue. ♦

Young Scientist of the South Award for the Year 1993

Dr. Qaiser Mushtaq, ICTP Associate Member, has received the Young Scientist of the South Award for 1993 in appreciation of his research work in the field of mathematics. This Award is supported by the Third World Academy of Sciences (Trieste, Italy).

Dr. Mushtaq is currently an Associate Professor of Mathematics at University Brunei Darussalam. He is an expatriate from Pakistan where he is an Associate Professor at Quaid-i-Azam University (QAU), Islamabad. He did his doctorate at Oxford University under the supervision of Professor Graham Higman. Dr. Mushtaq has worked in Oxford, Berkeley, Harvard and at the Massachusetts Institute of Technology. He was a Royal Commission's Scholar in 1980 and a Senior Fulbright Scholar in 1990. He has been an Associate Member of ICTP since 1991.

Dr. Mushtaq is the author of 47 research papers and three books. He has also written numerous articles on science research papers and three books. He has also written numerous articles on science and education in various newspapers. He has supervised many M.Phil. and Ph.D. students.

Dr. Mushtaq was conferred the title of Khowarzmi Laureate by the President of Iran at the 5th Khowarzmi Festival in Iran in 1992. He has also been awarded the Gold Medal of Honour (USA), Salam Prize (Pakistan), Pakistan Academy of Sciences' Gold Medal in Physical Sciences, and Mathematician of the Year awards by the National Book Council of Pakistan in 1987 and 1990. ♦

In situ Techniques in Atmospheric Interactions Studies

From 21 February to 4 March 1994, the ICTP held a workshop on the study of atmospheric interactions by remote sensing directed by Dr. M.L. Chanin from the French National Council for Scientific Research, and Prof. S. Radicella, Head of the ICTP Laboratory of Atmospheric Physics and Radiopropagation. In this workshop, Prof. R.A. Goldberg from the Laboratory of Extraterrestrial Physics (Goddard Space Flight Centre/NASA, USA) delivered a series of lectures on the coordination of in situ *with remote sensing techniques in the studies of middle atmosphere computing. In the interview which follows, he explains how scientists from developing countries can contribute to these studies.*

Q. Professor Goldberg, you have been lecturing in the Workshop on the Study of Atmospheric Interactions and Remote Sensing. Could you please explain briefly what atmospheric interactions are and what is their relation to weather forecasting, to global change, ozone depletion, global warming and others?

R. First of all, let me point out that I came here not so much to talk about remote sensing techniques but rather on *in situ* techniques, and essentially to show how *in situ* techniques provide a powerful tool for studying interactions in the atmosphere when they are combined with remote sensing techniques. The example that I chose to use, for the purpose of making this point in my lectures, was the study of the electrodynamic characteristics of the middle atmosphere which is made up of the stratosphere and mesosphere, i.e. the atmosphere above about 50 km mainly. In this investigation, we study the various energetic radiations coming into that In this investigation, we study the various energetic radiations coming into that region, how these radiations affect the localized electrical structure, how that region is influenced by troposphere disturbances — such as lightning and other properties of electrical storms — and how all of these features affect the global electric circuit which is a circuit that has been presumed to exist as the result of the global occurrence of thunderstorms. The purpose of the measurements that we make right now is to better understand how the upper and lower atmosphere couple and whether there might be a connection between phenomena happening in the upper atmosphere and others occurring in the lower atmosphere. It is a little premature to start making weather forecasts and climatological predictions based on this kind of interactions. At this point in time we are just trying to understand the interactions themselves, how they occur and what their impact is on the general coupling properties of the atmosphere.

As far as ozone is concerned, it is mainly the energetic particles radiations, which are an object of our study, that do impact the atmosphere even down into the stratosphere and do have an effect on ozone. In fact, stratospheric ozone is known to be depleted when very energetic protons from the sun hit the earth environment and penetrate at high latitudes to altitudes as low as 20 km. This, once again, may not be a very important impact on climate or on weather but at least it is a property of the atmosphere which we have to be aware of for better understanding of interaction phenomena. We are also currently interested in the mesosphere which is from about 50 to 90 km, in terms of other types of energetic particles events like high-energy electron events which occur types of energetic particles events like high-energy electron events which occur much more frequently and may have a more lasting effect in terms of heating that region and affecting its dynamics. This can happen in several different ways. One is through the depletion of ozone which is also an important agent for heating in the mesosphere because the ozone layer absorbs ultraviolet radiation from the sun which is the primary way to heat the mesosphere. As a result, if the amount of ozone in that region is reduced because of these particle impacts, the ultraviolet radiation penetrates to deeper altitudes and the heating distribution is much different than it would be without these effects. But these particles can also directly heat the region through a process that we call dual-heating, the details of which might take too much time to describe here.

Q. What are the traditional and the new methodologies used to study atmospheric interactions?

R. As I just explained, for us atmospheric interactions in part relate to the coupling of the upper to the lower atmosphere, and of course this implies electrodynamic coupling and, consequently, measurements of such parameters as the electrical conductivity of the atmosphere, the ion density and the electron density. These measurements involve electric fields. Unfortunately, most of these parameters cannot be remote-sensed. They have to be measured *in situ*, and this requires a vehicle that will take you to the region where you want to make the measurement. In the troposphere, the lowest part of our atmosphere, one can use aircrafts, or even make measurements on the ground. In the stratosphere, one uses very high altitude aircrafts and balloons. The mesosphere, though, is restricted almost exclusively to the use of rockets because satellites cannot operate at such a low altitude and aircraft and balloons cannot get up to such a high altitude. The problem then is that one can only get short-term measurements of the various parameters that one wishes to make because rockets do not go into orbit; the payloads of rockets go up, they come right back down and often this snapshot may be no more than a few minutes. The information that one gets is radio-telemetered down to the ground and one has to be very careful to record the time and location where such measurements are made. Certain parameters in this area can be remote-sensed from the ground using radar and lidar techniques, and anything one can get one's hands on to help in providing the time history of the general character of the region where one wants to make these very specific measurements. Therefore, one always tries to coordinate ground-based remote sensing measurements of this type with the measurements made in space.

Q. What are the differences between *in situ* and remote-sensing techniques? How are the results obtained from these two techniques coordinated?

R. First of all, we are not talking about two techniques, we are talking about two *types* of techniques and there are many kinds of remote-sensing and of *in situ* techniques for this region. For example, for measuring the composition of the atmosphere and the various constituents that exist, say in the mesosphere, mass spectrometers or instruments of that nature are used. Various properties like conductivity are measured by using *in situ* techniques, with some sort of a Langmuir probe. For measuring properties like the charge mobility, one must resort to more sophisticated devices, such as gradient condensers. These are all instruments that can be flown on rockets. At the same time, if one needs to measure a basic parameter of the whole region, like the electron density, this can be done from at the ground by radiopropagation techniques or with probes on the rockets. From the ground, one can also measure some other properties of the atmosphere, such as a localized turbulence at a certain height, or various electron structures and things of that nature, by using new radars which we call mesosphere-stratosphere-troposphere (MST) radars. In other words, the remote sensing measures some of the basic parameters measured simultaneously on the rocket and provides us with a time evolution of what we want to measure and at the same time it may even give us a better coverage in space because we can have more than one of these instruments operating at the same time. We also take advantage of lidar techniques to look at certain properties in the atmosphere depending on temperature, and in the presence of certain constituents because some of these can act as tracers for some of the dynamics going on. This is the case of sodium, for instance.

As far as remote sensing is concerned, one can use satellites that will sense from above. For example, ultraviolet radiation may give us information about the presence of ozone and provides one of the primary ways to measure the global ozone in the stratosphere. In the mesosphere the ozone is no longer detectable at about 60 km, but below that height the primary way to see the "ozone hole" is through remote sensing with ultraviolet and other techniques aboard of satellites.

There are other phenomena in the upper atmosphere that we are interested in studying. For example at high latitudes in the polar summer, we look at noctilucent clouds which are the highest clouds in our atmosphere. They exist up around 83 km altitude, and they persist over summer as far as the satellites are concerned but from the ground they are much more infrequently observed. In fact, sometimes we are not sure that they are quite the same phenomena. We have tried combining *in situ* measurements with remote sensing to try understand these phenomena better.

I could go on and give you a long list of other phenomena but, in general, every experiment requires a coordinated set of remote sensing and *in situ* instruments that are properly designed to provide complementary information on the object of the study.

Q. Can you say a few words on international research in the field of atmospheric interactions, how is it organized and what contributions could be expected from scientists in the developing countries?

R. Most of the current experiments which involve collaboration between ground-based facilities, rockets, aircrafts, air balloons and even satellite require cooperation among large teams of scientists. In 1991, a campaign at high latitude for the study of noctilucent clouds involved scientists from 8 countries. This is not uncommon. Next summer a campaign in Brazil will involve tropical meteorology in the mesosphere including the study of the character of waves in that region, from planetary to internal gravity waves all the way down to small scale turbulence, in order to understand how these various waves interact. The various types of wave structures will be measured in many different ways and we will be dependent on ground-based facilities around the world including radars and lidars in order to carry out these activities. Therefore, this calls for the cooperation of people from developing and developed countries. In order to carry out the experiment properly we expect to be using MSTs and lidars from countries such as India and Brazil and radars from Peru and from Hawaii (USA). The rockets will be flown mostly by US scientists but in a few cases we shall have collaborators from Brazil and, in a particular part of our programme, scientists from the Technical University of Graz in Austria will cooperate as well. When a scientist has something to offer and wants to collaborate, he can become part of a group and then he has full access to all the activities, not just to his own little contribution. We try to operate that way so that everybody can enjoy working on science and make a contribution. Scientists from developing countries can certainly participate in any way that they have the capabilities to do so. If they have a strong interest, it does not require even for them to provide an instrument. The very fact that their country is involved in a joint programme or that they have some other way of connecting with the programme, is adequate for them to share the data once it is acquired.

Q. So they could get equipment if necessary?

R. As far as getting equipment is concerned that depends on the individual case and how such a thing could be worked out. The equipment could be lent, it might be bought and given to them, it could be also part of a proposal which includes its acquisition. There are many ways that people from developing countries can participate in these activities. I spent a whole hour the last Monday morning explaining to the participants ways of breaking into this type of activity if they are interested and I believe there is a good opportunity. The main point is that they have some background, not necessarily experience, so that they may contribute to the programme in some way. These possibilities apply to universities, possibilities apply to universities, government institutions, laboratories, scientists in general. For instance, in the case of the Brazilian scientists, they have been given the opportunity to participate as collaborating scientists if they choose to work with us on our data, and I believe that some of them will make measurements from the ground in conjunction with our rocket flights. This is still being negotiated but other activities of that nature may be considered on an individual basis. ♦

A.M. Hamende

Visits to ICTP

On 28-29 March 1994, Professor Belkhadir, Dean of the Faculty of Sciences (Meknès, Morocco), and J.P. Vary, Iowa State University (USA) visited ICTP and the Third World Academy of Sciences and discussed possibilities of collaboration with the Senior Staff of these two institutions.

Professor Belkhadir will direct the Faculty of Sciences of Mohammadia (Morocco) which will start functioning in September 1994. The Faculty, which is part of a network of seven other similar institutions in Morocco, is supported by the European Union and will specialize in industrial and environmental chemistry.

Professor J.P. Vary is the Acting Director of the International Institute of Theoretical and Applied Physics located in Ames (Iowa). The Institute which will be open to physicists from developing countries, will be operational very soon. Prof. Vary will participate in a meeting organized together with the National Council of Science and Technology of the National University of El Salvador, to the National University of El Salvador, to be held in October 1994. The issues for discussion in El Salvador include: setting up advanced study programmes (M.Sc. and Ph.D.) in Central America, new technologies for teaching and communications, development of research capacities in the universities, international cooperation and contribution of science to economic development and regional peace. ♦

Activities at ICTP from November 1993 to March 1994

Title: Second Workshop on Non-linear Dynamics and Earthquake Prediction, 22 November - 10 December.

Co-sponsors: Institute of Geodesy and Geophysics of the University of Trieste (Italy).

Organizers: Professors V.I. Keilis-Borok (International Institute of Earthquake Prediction Theory and Mathematical Geophysics of the Russian Academy of Sciences, Moscow, Russia) and G.F. Panza (Institute of Geodesy and Geophysics, University of Trieste, Italy).

Lectures: Earthquake sequences. Computer information: introduction to the software. Analysis of earthquake catalogs. Some recent developments in mining seismology. Functions on earthquake flow. Numerical simulation of block structure dynamics. Seismicity as an example of self-organized criticality. The role of the characteristic earthquake. Pattern recognition. Lithospheric roots in the Mediterranean area: a challenge for plate tectonics. Deterministic approach to seismics hazard evaluation. Magnetic field generation due to the helical flow of an electrically conducting fluid — numerical analysis and asymptotic analysis. Regionalization and stability of CN algorithm: the case of Italy. Expert CN algorithm: the case of Italy. Expert system.

Computer exercises: Analysis of earthquake catalogs. Functions on earthquake flow. Numerical simulation of block structure dynamics. Pattern recognition.

Projects: Numerical simulation of block structure dynamics.

In co-operation with Accademia Nazionale dei Lincei (Rome, Italy) and Fondazione IBM Italia (Rome, Italy):

Lezioni Lincee (delivered by Prof. V.I. Keilis-Borok): Lithosphere as a chaotic system. Dynamics of seismicity and earthquake prediction. Hierarchy of active faults and pattern recognition of earthquake-prone areas. Seismic risk. Earthquake prediction and earthquake preparedness. On understanding and prediction of critical transitions in large systems.

The Workshop was attended by 51 lecturers and participants (30 from developing countries).

Title: SECOND SCHOOL ON THE USE OF SYNCHROTRON RADIATION IN SCIENCE AND TECHNOLOGY: "JOHN FUGGLE MEMORIAL", 25 October - 19 November.

Co-sponsors: International Centre for Science and High Technology (ICS, Trieste, Italy) and Sincrotrone Trieste S.p.A.

Organizers: Professors A. Craievich (National Laboratory for Synchrotron Radiation, LnLs, Campinas, Brazil), L. Fonda (Sincrotrone Trieste S.p.A.), A. Fontaine (Laboratoire pour l'utilization du rayonnement électromagnétique, Orsay, France), W. Peatman (Berliner Elektronenspeicherring für Synchrotronsstrahlung, Berlin, Germany) and H. Wiedemann (Stanford Synchrotron Radiation Laboratory, Stanford, CA, USA).

Lectures: Machine. UV and X ray interaction with matter. Vacuum. Machine design. Synchrotron radiation. Insertion devices. Design goals: conservation of brilliance; ray tracing. Source characteristics. Introduction to ray tracings — a source and one mirror. Optimising the beamline to the needs of the experiment. Grating theory: spherical (toroidal) and plane gratings. Reality: tangent errors and thermal loads. Mirror systems. Fresnel based optics and microlab. A complete beamline. Crystal monochromators. Several beamline designs. X-ray detectors. SR applications to biology. Surfaces. The scientific programmes of ELETTRA. XAS absorption spectroscopy: introduction. X-ray absorption fine structure. XAS practical examples. XAS instrumentation for X-ray spectrometry. XAS polarisation and XAFS. XAS dichroism. Diffraction applied to materials science: introduction. XAS X-ray spectrometry. Anomalous X-ray scattering. SAXS. XAS oxygen K-edges. Dynamical diffraction: introduction. Standing wave and x/2 diffraction. XAS multiplet effects. Atomic and molecular spectroscopy. The National Laboratory for Synchrotron Radiation in Campinas, Brazil. Inorganic single-crystal crystallography. XAS X-ray MCD.

Second School on the use of synchrotron radiation in science and technology: "John Fuggle Memorial", 25 October - 19 November 1993.

Special session: Fuggle's contribution to science.

Exercises: Insertion devices. Ray tracing. EXAFS.

Visit to ELETTRA (Trieste).

The School was attended by 73 lecturers and participants (47 from developing countries).

Title: SECOND CONFERENCE ON LASERS IN CHEMISTRY, 15-19 November.

Co-sponsors: International Institute for Pure and Applied Chemistry, IIC, of the International Centre for Science and High Technology, ICS (Trieste, Italy).

Organizers: Professors G. Denardo (ICTP), M. El-Sayed (University of California, Los Angeles, USA), and N. Rahman (International Centre for Science and High Technology, ICS, Trieste, Italy).

Lectures: Control of molecular dynamics: the dream is alive. Dissociating molecules by lasers. Nanosecond and picosecond laser flash photolysis studies of charge transfer interactions in the mechanisms of quenching by molecular oxygen. Clocking of energy redistribution for molecules falling apart. Femtosecond protein dynamics. Molecular dynamics in intense laser fields. Lasers in chemistry: analysis and synthesis. Ultrafast four-wave mixing studies of molecular dynamics. Laser IR multiphoton photoselective chemistry and applications. Excitement in current chemical dynamics research — lasers in chemistry and chemistry in lasers. ZEKE spectroscopy — a new look at molecular ions. Lasers studies of interfaces. Spectroscopy on aligned samples. Photoactive [2]rotaxanes. Photoinduced energy and electron transfer processes in supramolecular species. High resolution spectroscopy of organic molecules in solids: from fluorescence line narrowing and hole-burning to single molecule spectroscopy. Strong-field dissociation dynamics. Femtosecond spectroscopy of molecular systems in condensed phases.

The Conference was attended by 67 lecturers and participants (42 from developing countries).

Title: SEMINAR ON RADIOWAVE PROPAGATION IN TROPICAL REGIONS (with special reference to ITU recent measurements in Africa), 29 November - 3 December.

Co-sponsor: Telecommunications Development Bureau of the International Telecommunications Union (ITU, Geneva, Switzerland).

Organizers: Professors S.M. Radicella (Programa Nacional de Radiopropagación, PRONARP, Buenos Aires, Argentina, and ICTP) and A. Yousif (International Telecommunication Union, ITU, Geneva, Switzerland).

Lectures: Brief introduction on BDT activities in the field of propagation in Africa. Brief introduction on ICTP

Seminar on radiowave propagation in tropical regions, 29 November - 3 December 1993.

activities on propagation. Importance of radiowave propagation data in the work of ITU. Radiowave propagation data from tropical regions: brief review. Multipath propagation and fade statistics in Sudan. Characterization of multipath fading phenomena in Egypt. Slant path rain attenuation measurements in Africa. Rainfall rate cumulative distribution modelling for determination of rain attenuation statistics on terrestrial and satellite radio links in tropical areas and satellite radio links in tropical areas and everywhere else. The INTELSAT Ku-band radiometric measurements in Tropical Africa: propagation measurement equipment. Microwave attenuation in dust storms: theory and measurements. Statistical characterization of multipath fading in Egypt. Line of sight microwave propagation characteristics at 6GHz band in Ghana. Rain intensity and raindrop size measurements in Nigeria. The INTELSAT Ku-band radiometric measurements in Tropical Africa: data acquisition and quality control. Propagation measurements techniques: demonstration by ICTP. First time concurrent Ku-band beacon and radiometer measurements in the Tropics. Rain characteristics in a tropical locality (Cameroon). The INTELSAT Ku-band radiometric measurements in Tropical Africa: measurements results. African Joint Radiometric Research Programme. Superrefractivity and ducting. Radiowave propagation measurements in Burkina Faso. Computer analysis of filed strength measurement data from Senegal. Use of computer programmes for analysis of field strength measurements at the ICTP.

General Discussion: Future ITU

General Discussion: Future ITU radiowave propagation measurements campaign.

Visit to the ICTP Laser and Optical Fibres Laboratory.

The Seminar was attended by 33 lecturers and participants (24 from developing countries).

Title: FOLLOW-UP TO THE WORKSHOP ON PREPARATION OF RADIOMARITIME MASTER PLANS FOR ENGLISH-SPEAKING AFRICAN COUNTRIES, 14-18 February.

Co-sponsor: Telecommunications Development Bureau of the International Telecommunications Union (ITU, Geneva, Switzerland).

Organizer: Professor S.M. Radicella (Programa Nacional de Radiopropagación, PRONARP, Buenos Aires, Argentina, and ICTP).

Presentation of Master Plans for coastal countries: Angola, Cape Verde, Gambia, Guinea-Bissau, Kenya, Liberia, Mauritius, Mozambique, Seychelles, Sierra Leone, Sudan, Tanzania.

Presentation of Master Plans for bordering lakes: Lake Victoria (Kenya, Tanzania and Uganda). Lake Malawi/Nyasa (Malawi, Mozambique and Tanzania). Lake Tanganyika (Tanzania Tanzania). Lake Tanganyika (Tanzania and Zambia). Lake Kariba (Zambia).

Master Plan of Ethiopia.

Rehabilitation of maritime radiocommunications in Ghana.

Experts' lectures: ITU, IMO, INMARSAT, Norway.

Visit to the coast radio station in Trieste.

Round Table discussions.

The Workshop was attended by 24 lecturers and participants (20 from developing countries).

Title: WINTER COLLEGE ON QUANTUM OPTICS, 14 February – 4 March.

Organizers: Professors G.S. Agarwal (University of Hyderabad, India), G. Denardo (ICTP), P.L. Knight

(Imperial College of Science, Technology and Medicine, London, UK), and L. Lugiato (University of Milan, Italy).

Lectures: Noise in quantum optical systems. Noise quenching in linear amplifiers. Squeezed light. Correlated spontaneous emission laser. Two-photon interference effects and nonlocality. Perfect correlations of three-particle entangled states. Classical limit of quantum nonlocality. Introduction to nonclassical light. Superpositions and quantum interference. Incoherent atom optic: introduction to experimental laser cooling, applying spontaneous dipole force for basic and advanced experiments. Quantum propagation in optical fibres. Coherent atom optic: atom optics with running and standing evanescent waves, coherent mirrors and beamsplitters for atoms. Atom interferometry: introduction and discussion of different interferometry schemes resp. experiments. Guided acoustic wave Brillouin scattering. Self phase modulation and squeezing. Dissipation and decoherence. Controlling the linear and nonlinear properties of media. Nonlinear optics and cold atoms. An introduction to dissipation in quantum optics: density matrices, the master equation, the quantum regression theorem. Pump-probe spectroscopy of 1-D optical molasses. 2-D and 3-D optical lattices. The Monte Carlo wave-function method(s) and the(ir) physical interpretation. Controlling the quantum noise properties by atomic coherence effects. Laser cooling and optical molasses. Metrology with cold atoms. Atomic cavities. Examples of numerical applications and of new insights from Monte Carlo wave functions. Experiments on cavity quantum electrodynamics. The one-atom maser. Atoms in cavities and strong microwave fields. Coherence theory. Coherent population trapping in spectroscopy and quantum optics. Propagation of partially coherent fields. Spectral changes due to source correlations. How to deal with squeezed light experimentally. Squeezed light generation using parametric processes. Atomic coherence effects in laser physics and quantum optics. Quantum noise reduction using opto-mechanical systems. Quantum noise in lasers. Squeezed light generations in atomic and semiconductor media. Atomic coherence effects in laser physics and quantum optics. Quantum and classical effects in nonlinear patterns. Property attribution to individual quantum systems, entanglement, EPR-type correlations, nonlocality, Bell's inequality, aspect's experiments. Micro-macro entanglement, the objection problem, some proposals for a solution. Experimental realizations using khi-3 and khi-2 nonlinearities. Jaynes-Cummings model and novel characteristic quantum field effects in cavity QED. General concepts and criteria for QND measurements. Effects of cavity damping on the JC Hamiltonian and vacuum field Rabi splitting. Competing nonlinear processes in cavity QED and quantum interference effects. Experiments with semiconductors and future prospects.

LAMP (Laser, Atomic and Molecular Physics) **seminars.**

The College was attended by 99 lecturers and participants (68 from developing countries).

Title: WORKSHOP ON STUDY OF

Follow-up to the Workshop on preparation of radiomaritime master plans for English-speaking African countries, 14-18 February 1994.

Workshop on study of atmospheric interactions by remote sensing, 21 February – 4 March 1994.

ATMOSPHERIC INTERACTIONS BY REMOTE SENSING, 21 February – 4 March.

Co-sponsors: Scientific Committee on Solar-Terrestrial Physics (SCOSTEP), International Association of Meteorology and Atmospheric Sciences (IAMAS), World Meteorological Organization (WMO).

Organizers: Professors M.L. Chanin (Service d'Aéronomie du CNRS, Paris, France) and S.M. Radicella (Programa Nacional de Radiopropagación, PRONARP Buenos Aires Argentina Nacional de Radiopropagación, PRONARP, Buenos Aires, Argentina, and ICTP).

Tutorial Lectures:

Optical remote sensing of the atmosphere: Introduction to lidars, basic processes. The Mie lidar, results from a single wavelength lidar. The use of multi-wavelengths lidar for the determination of aerosol and cloud characteristics. The Rayleigh lidar, determination of density and absolute temperature. The vibrational and rotational Raman lidar, composition and temperature determination in the low atmosphere. Atmospheric variability as studied by lidar: waves and tides, stratosphere-troposphere exchange. The Doppler lidar: wind horizontal component from Mie and Rayleigh lidars. Differential absorption lidar (DIAL). Application to ozone and sources of errors in lidar measurements; how to avoid them. The future of lidars for atmospheric research: networks, long term monitoring, airborne and space borne lidars.

Coordination of in situ with remote sensing techniques for studies of middle atmospheric coupling: The global electric circuit and related problems. Measurement approach. New thrusts: the problems and the campaigns. Other Measurement approach. New thrusts: the problems and the campaigns. Other problems of interest for atmospheric coupling. Examples of middle atmospheric response to external influences. New thrust: MALTED — a study of tropical mesospheric dynamics.

The lectures were complemented with experimental demonstrations with a Nd:YAG lidar equipment installed in the ICTP Laser and Optical Fibres Laboratory.

Workshop sessions:

Session A: The use of rocket with remote sensing techniques for the study of the middle and upper atmosphere coupling. Updating of the topic and discussion.

Session B: Specific projects carried out by scientists of developing countries, based on the analysis of long series of data obtained from ground measurements. Updating on the topic. Presentation and discussion of results by participants. Computer work.

Session C: Possible new initiatives for the study of long term variations of tropospheric parameters using available series of data. Updating of the topic. Discussion. Preliminary data analysis with computers.

The Workshop was attended by 31

The Workshop was attended by 31 lecturers and participants (28 from developing countries).

Title: WORKSHOP ON FLUID MECHANICS, 7 – 25 March.

Co-sponsors: Commission of the European Communities and Kuwait Foundation for the Advancement of Science.

Organizers: Professors F. Busse (Universität Bayreuth, Germany), P.G. Drazin (University of Bristol, UK), I.A. El Tayeb (University of Khartoum, Sudan, and Sultan Qaboos University, Muscat, Oman), and W.R. Young (University of California, La Jolla, CA, USA).

Lectures: Transitions from simple to complex forms of fluid flow. Thermal turbulence. Instability of nonparallel flows. Modelling geothermal reservoirs — injection or bust. Mode interaction in counter-rotating Taylor Couette flow. Effect of variable surface tension on water waves. Compositional convection. Self-similarity in drop breaking and sprays. Calculations of viscosities for liquid crystals. The main geomagnetic field and its secular variations. The flow at the top of the core. A new proof of the existence of weak solutions for the equations of MHD. Inverse problems for the Navier-Stokes equations. Core mantle coupling. On quasi-geostrophic boundary conditions in a non-zonal channel. Stokes flow past a composite porous spherical shell with a solid core using Brinkman model. A note on stenosis. Phase turbulence. Critical layer and evolution of disturbances in shear flows. On the stability of a simply supported pipeline on an elastic foundation. Exact solutions for patterns of ship waves. Shear dispersion in the natural environment. Pressure fluctuations in turbulence. A multigrid solution of compressible Navier Stokes problem. Nonlinear stability of parallel flows. Dispersion of contaminant in time dependent flows. Introduction to atmospheric blocking and its diagnostics. Simple derivation of Darwin's theorem on drift. Nonlinear theory of convective instability. Variable viscosity flows with conserved energy. Interaction between buoyancy-driven flow and an array of annular cavities. Numerical solution of a class of diffusion and sorption problems. Parametric instabilities. Convective pattern theory. Computational singular perturbation method in combustion simulations. Numerical simulation of flow in river confluences. Selective withdrawal from stratified fluids. The atmospheric boundary layer — mean vertical structure. Synoptics and theory. On the explosion with chain branching and chain breaking kinetics. Liquid spreading on a horizontal solid surface driven by both gravity and surface tension. The atmospheric boundary layer — temporal and spatial variations. The atmospheric boundary layer — modelling. Two-phase pipe flows: Prandtle turbulence, unsteady flows with inertial effects. On the numerical simulation of convection dominated flows in porous media. Modelling soil transport by wind in drylands. On the structure and dynamics of solid-liquid phase-change systems — introduction; governing equations; some simple solutions. Liquid and vapour flows in porous media — fundamentals; phase change. Lattice-gas models of phase separation. Capillary effects on spreading of wetting liquids. Liquid spreading experiments. Hydrodynamic instabilities in open flows — fundamentals; spatial mixing layers; wakes and plane Poiseuille flow. The magnetohydrodynamic unsteady flow between two squeering disks. Thermocapillary flow in a cylindrical liquid bridge — linear stability analysis. Solar convection and the solar cycle. Peristaltic motion of viscous flow with variable viscosity. Periodic structures appearing in nematic liquid crystals by means of electrohydrodynamical flows. Turbulence.

Computer demonstrations and work sessions.

General discussion.

Round table discussion.

The Workshop was attended by 63

Workshop on fluid mechanics, 7 – 25 March 1994.

Workshop on science and technology of thin films, 7 – 25 March 1994.

lecturers and participants (42 from developing countries).

Title: WORKSHOP ON SCIENCE AND TECHNOLOGY OF THIN FILMS, 7 – 25 March.

Co-sponsors: International Centre for Science and High Technology (ICS, Trieste, Italy), International Union for Vacuum Science, Technique and Applications (IUVSTA) and Italian Vacuum Society (AIV).

Organizers: Professors P. Barna Vacuum Society (AIV).

Organizers: Professors P. Barna (Hungarian Academy of Science, Budapest, Hungary), J. Geerk (Kernforschungszentrum Karlsruhe, Germany), F.C. Matacotta (Istituto per la tecnologia dei materiali metallici non tradizionali, Milan, Italy, and ICTP), and G. Ottaviani (Università di Modena, Italy).

Lectures: Thin film interactions. Characterization of thin films — overview. Industry of thin films, their market and quality control. Crystal structure and morphology. Electronic materials. Nonconventional CVD. Hard coatings. Diamond thin films. Ion beam applications in thin film characterization. Compositional analysis. Optical coatings. Thin films for information storage. Pulsed electron beam ablation. Growth and characterization of quantum confined structures. Deposition by means of channel spark ablation. Stress analysis of thin films. Superconducting thin films. Epitaxial growth. Semiconductor quantum electron devices.

Seminars: SIMS (Secondary Ion Mass Spectrometry) characterizations of MgO-diffused $LiNbO_3$ as optical waveguide materials. Magnetooptical

MgO-diffused $LiNbO_3$ as optical waveguide materials. Magnetooptical

investigations of magnetic properties of ultrathin Au/Co/Au films. Influence of hydrogen bound as SiH_2 on the structural and optical properties of hydrogenated amorphous silicon. Degradation of hydrogenated amorphous silicon (a-Si:H) solar cells. Excess noise in polycrystalline silicon. Scanning electron microscopy and its application to thin films. $CuGaSe_2$ thin films for solar energy conversion. Electrical studies of the thin films of chalcogenide glasses. Deposition and characterization of thin film hydrogenated amorphous silicon (a-Si:H) thin films. Mechanism of growth of heterophase PbTe and PbSe films at non-equilibrium deposition. Structural and electrical properties of reactively sputtered molybdenum nitride thin films. Preparation and characterization of pyrolytically deposited TiN thin films. Laser scattering at fluid interface for surface tension monitoring. TEM studies on MeV energy a-irradiated Ta foils. Optical and electrical properties of thin ZnO films prepared by atmospheric pressure chemical vapour deposition. electronic properties of conducting polymer films. Analysis of polycrystalline diamond deposited on x-

polymer films. Analysis of polycrystalline diamond deposited on x-

Si and mc-SiC/x-Si substrates. Use of oxide (Y-ZrO_2) as a buffer layer for diamond thin films: a new approach. The phase transition peculiarities in thin ferroelectric films: the influence of structure imperfection and film-substrate interaction. Ferroelectric integrated thin films — design, preparing and devices. An investigation of the resistivity-thickness relation of manganese thin film resistors deposited in vacuum. Multilayer coatings as the x-uv optical devices. Synthesis and deposition of high quality compound thin films by laser-based methods. Superconducting thin films by laser ablation (PLD) using YBCO 10% Ag target. Preparation, microstructure and interfaces of high T_c superconducting $YBa_2Cu_3O_{7-x}$. Thin films and $YBa_2Cu_3O_7$ /$PrBa_2Cu_3O_7$ superlattices. Growth and structure of metallic multilayered film in dual-bath electrodeposition. Electronic structure of small metallic particles. Growth dynamics of YBaCuO thin films by high pressure oxygen sputtering. Epitaxial vanadium films: investigation of structural and superconducting properties and application as absorber films in X-ray detectors based on superconducting tunnel junctions. Anomalous behaviour of critical currents in Josephson junctions.

Videocassettes: Ion beam applications in thin film characterization. Polycrystal film formation.

Laboratory activity.

Visit to TASC Laboratory (Trieste).

The Workshop was attended by 68 lecturers and participants (49 from developing countries).

Title: TRAINING COURSE ON DOSIMETRY AND DOSE REDUCTION TECHNIQUES IN DIAGNOSTIC RADIOLOGY, 16 – 25 March.

Co-sponsors: Commission of the European Communities and International Atomic Energy Agency (IAEA, Vienna, Austria).

Organizers: Professors A.M. Benini (IAEA), L. Bertocchi (ICTP), J. Chela-Flores (Instituto Internacional de Estudios Avanzados, Caracas, Venezuela, and ICTP) H.M. Kramer (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany), and K. Schnuer (Commission of the European Communities, Luxembourg).

Lectures: Quantities and units. Implementation of the units. Dissemination of the units, calibration. Usage of diagnostic dosimeters and other measuring instruments. Scattered radiation. Acceptance tests standards and procedures. Radiographic and radioscopic units. Mammography. DSA and CTs. Film-screen combination. Film processing, dark room, viewing boxes. Image receptor. European Quality Assurance Programmes. Clinical Quality Assurance Programmes. Special techniques, digital systems. Generators. Tubes, imaging systems, radioscopy. Imaging systems, radiography. Advice for implementation. Quantities and experimental methods. Computational methods. Radiation protection of the staff. Activities at the Commission of the European Communities. Administration responsibilities and motivation. IAEA dose reduction programme. Norwegian dose reduction programme.

Presentations and discussion on the situation of diagnostic radiology in Central and Eastern European countries.

Round table discussion.

Practical demonstrations at Cattinara Hospital (Trieste).

Visit to COMECER (Bologna, Italy).

The Course was attended by 58 lecturers and participants (31 from developing countries). ♦

Training Course on dosimetry and dose reduction techniques in diagnostic radiology, 16 – 25 March 1994.

Pre-prints and Papers Accessible via E-mail Free-of-charge

(as at April 1994)

Enrique Canessa
Scientific Computing Section, ICTP

Fully automated bulletin boards for storing and retrieving electronic-mails ("e-mails") containing Pre-prints have been operative and freely accessible to anyone with an electronic mail address for some years.

By means of this automatized system, copies of full papers can be requested (and received) by e-mail with a command in the subject field (e.g. "Subject: help" to retrieve a list of commands and details of how to subscribe) or, in some cases, in the body of the e-mail message. Subscribers to most topical bulletin boards receive mailings on a regular basis containing information on papers submitted to the archive.

In a few cases, besides the e-mail interface, papers can also be retrieved via anonymous "ftp" (Fast Transfer Protocol) or directly through the Internet "gopher" and the most recent World-Wide Web (WWW) graphic protocol "mosaic" — when available.

A list of most such services that can be requested via e-mail (selected by fields) is given below, in the hope that this list is useful to those individuals working in the Third World under scientific isolation. The list includes electronic preprint Archives from universities, institutions, scientific research centers and international (refereed) journals which are presently accessible free of charge.

1. MATHEMATICS

1.1 ALGEBRAIC GEOMETRY (Duke University, USA)

e-mail: alg-geom@publications.math.duke.edu
subject: help
pre-prints format: file extention ".tex"
restrictions: papers whose primary AMS (American Mathematical Society) subject classification would lie in area 14.
archive lifetime: pre-prints are kept about 6 months.
distribution details: author(s), title, and abstract are distributed to a
archive lifetime: pre-prints are kept about 6 months.
distribution details: author(s), title, and abstract are distributed to a mailing list.
server software: developed by Paul Ginsparg from LANL.

1.2 BANACH-SPACES (Oklahoma State University, USA)

e-mail: banach-files@hardy.math.okstate.edu
subject: (leave it empty and write in the body of your e-mail)
BEGIN
SEND instructions.txt
END
pre-prints format: file extentions ".tex",".atx",".ltx"
restrictions: Banach space theory and related fields.
distribution details: notices of additions to the archive, meeting announcements and other information is forwarded to all subscribers.
ftp: ftp.math.okstate.edu
gopher: hardy.math.okstate.edu

1.3 FUNCTIONAL ANALYSIS (SISSA-Intern. School for Advanced Studies, ITALY)

e-mail: funct-an@babbage.sissa.it
subject: help
pre-prints format: file extention ".tex" (figures in ".ps").
distribution details: author(s), title, and abstract are distributed to a mailing list.
server software: developed by Paul Ginsparg from LANL.
ftp: babbage.sissa.it
gopher: babagge.sissa.it
mosaic: http://babbage.sissa.it/

1.4 COMBINATORIAL and GEOMETRIC GROUP THEORY (Magnus Preprint Archive, USA)

e-mail: mail-server@e-math.ams.org
subject: (leave it empty and write in the body of your e-mail)
HELP
pre-prints format: file extention ".tex"
restrictions: the archive is open to submissions from everyone. It accepts preprint articles or only abstracts.
server software: special extention of the e-mail server software "Squirrel" developed by Johan Vromas.

1.5 IMS-INSTITUTE for MATHEMATICAL SCIENCES (Stony Brook University, USA)

e-mail: preprints@math.sunysb.edu
subject: send info
pre-prints format: file extention ".tex" (some preprints require psfig, atob and/or compress)
restrictions: preprints available from the Stony Brook IMS Electronic Pre-print Library.
server software: modified version of a program called "netlib".
ftp: math.sunysb.edu

2. MATHEMATICAL PHYSICS

2.1 MATHEMATICAL PHYSICS PRE-PRINT ARCHIVE (University of Texas, USA)

e-mail: mp_arc@math.utexas.edu
subject: (leave it empty and write in the body of your e-mail)
REQUEST: send info
pre-prints format: TeX files (figures in ".ps").
distribution details: author(s), title, and abstract are distributed weekly to a mailing list.
ftp: math.utexas.edu
gopher: henri.ma.utexas.edu

3. CHEMICAL PHYSICS

3.1 JPC- JOURNAL of CHEMICAL PHYSICS Express (USA)

e-mail: express@jcp.uchicago.edu
subject: help (or: get help)
pre-prints format: file extentions ".ps",".dvi",".tex".
restrictions: after acceptance in JPC, authors submit electronic
pre-prints format: file extentions ".ps",".dvi",".tex".
restrictions: after acceptance in JPC, authors submit electronic versions of their manuscripts.
distribution details: up-to-date information is forwarded to all subscribers.
warning: e-mail messages limited to 160kbytes.
ftp: jcp.uchicago.edu
gopher: jcp.uchicago.edu

4. PHYSICS

4.1 GENERAL RELATIVITY and QUANTUM COSMOLOGY (LANL-Physics Information Service, USA)

e-mail: gr-qc@xxx.lanl.gov
subject: help
pre-prints format: file extention ".tex" (figures in ".ps").
distribution details: new titles/abstract are forwarded to all subscribers on days papers are received.
server software: developed by Paul Ginsparg from LANL.
ftp (USA): xxx.lanl.gov
ftp (Europe): babbage.sissa.it
gopher: mentor.lanl.gov
mosaic: http://mentor.lanl.gov/

4.2 HIGH ENERGY PHYSICS - PHENOMENOLOGY (LANL)
e-mail: hep-ph@xxx.lanl.gov
(... continue as in Section 4.1)

4.3 HIGH ENERGY PHYSICS - THEORY (LANL)
e-mail: hep-th@xxx.lanl.gov
(... continue as in Section 4.1)

4.4 NUCLEAR PHYSICS (LANL)
e-mail: nucl-th@xxx.lanl.gov
(... continue as in Section 4.1)

4.5 CHAOS and DYNAMICAL SYSTEMS (LANL, Nonlinear Science Information Service, USA)
e-mail: chao-dyn@xyz.lanl.gov
subject: help
restrictions: dynamical systems/quantum chaos/ topological dynamics/cycle expansions/ turbulence/propagation.
ftp: xyz.lanl.gov
gopher: xyz.lanl.gov

4.6 PATTERN FORMATION and SOLITONS (LANL, Nonlinear Sci)
e-mail: patt-sol@xyz.lanl.gov
(... continue as in Section 4.5)
restrictions: pattern formation/ coherent structures/solitons.

4.7 ADAPTATION and SELF-ORGANIZING SYSTEMS (LANL, Nonlinear Sci)
e-mail: adap-org@xyz.lanl.gov
(... continue as in Section 4.5)
restrictions: adaptation/self-organizing systems/statistical physics/fluctuating systems/stochastic processes/interacting particle systems/machine learning.

4.8 COMPUTATIONAL METHODS and DATA ANALYSIS (LANL, Nonlinear Sci)
e-mail: comp-gas@xyz.lanl.gov
(... continue as in Section 4.5)
restrictions: computational methods/time series analysis/ signal processing/wavelets/lattice gases.

4.9 EXACTLY SOLVABLE and INTEGRABLE SYSTEMS (LANL, Nonlinear Sci)
e-mail: solv-int@xyz.lanl.gov
(... continue as in Section 4.5)
restrictions: exactly solvable systems/ integrable PDEs/ integrable ODEs/Painlevé analysis/integrable discrete maps/solvable lattice models/integrable quantum systems.

4.10 LATTICE/COMPUTATIONAL PHYSICS (Florida State University, USA)
e-mail: hep-lat@ftp.scri.fsu.edu
subject: help
pre-prints format: file extention ".tex" (figures in ".ps").
distribution details: new titles/abstract are forwarded to all subscribers.
restrictions: particle spectrum, finite temp. QCD, weak interaction physics, QED algorithm, spin systems, random surfaces/quantum gravity, special purpose computers.
server software: developed by Paul Ginsparg from LANL.
ftp: ftp.scri.fsu.edu

4.11 ASTROPHYSICS (SISSA)
e-mail: astro-ph@babbage.sissa.it
(... continue as in Section 1.3)

4.12 CONDENSED MATTER (SISSA)
e-mail: cond-mat@babbage.sissa.it
(... continue as in Section 1.3)

4.13 HIGH-T_c UPDATE E-MAIL VERSION (Iowa State University, USA)
e-mail: mitra@ameslab.gov
subject: (please direct all e-mail to the Editor at the address above)
pre-prints format: RTF and BINHEX formats (LATEX to be available soon)
distribution details: information exchange newsletter is forwarded twice monthly.
restrictions: accepts
(i) pre-prints, reprints and other T_c-related reports or publications.
(ii) descriptions of on-going work,
(iii) meeting news, etc.
ftp: hightc.ameslab.gov

5. ECONOMICS

5.1 WORKING PAPERS in ECONOMICS (Washington University, USA)
e-mail: econ-wp@econwpa.wustl.edu
subject: help
pre-prints format: file extentions ".tex",".ps", word, aschii test.
restrictions: all areas of economics
distribution details: announcements, etc., are distributed to a mailing list.
server software: developed by Paul Ginsparg from LANL.
ftp: econwpa.wustl.edu
gopher: econwpa.wustl.edu

6. PHILOSOPHY

6.1 INTERNATIONAL PHILOSOPHICAL PRE-PRINT EXCHANGE (IPPE, York University, USA)
e-mail: phil-preprints-admin@Phil-Preprints.L.Chiba-u.ac.jp
subject: (please direct all e-mail to the Administrator at the address above)
pre-prints format: file extentions ".txt",".ps",".wp",".msd", ".msm",".msw",".tex",".rtf",".sgm", ".tr","hqx",".dvi"
ftp: mrcnext.cso.uiuc.edu
gopher(s): apa.oxy.edu or kasey.umkc.edu
www: http://csmaclab-www.uchicago.edu/ philosophyProject/philos.html

7. SOCIOLOGY

7.1 THE VIRTUAL CAFE FOR PROGRESSIVE SOCIOLOGY (PSN, Colorado University, USA)
e-mail: gimenez_m@cubldr.colorado.edu
subject: (please direct all e-mail to the Martha Gimenez at the address above)
restrictions: Integrate electronic discussion and electronic archival on Sociology.
ftp: csf.colorado.edu

****

KEY:

".txt"	means	plain ASCII text
".ps"		Postscript
".wp"		WordPerfect
".msd"		Microsoft Word for DOS
".msm"		Microsoft Word for Macintosh
".msw"		Microsoft Word for Windows
".tex"		Tex or Latex
".dvi"		TeX DVI
".rtf"		Microsoft Rich Text Format
".sgm"		SGML/TEI
".tr"		Troff
".hqx"		Macintosh Binhex

Getting Information on ICTP Activities via Computers

Information on the various ICTP activities throughout the year can be retrieved via electronic mail, the Internet Gopher and WWW. The procedure is as follows.

Using Electronic Mail

(1) Scientific Program of ICTP Activities

The complete Scientific Program can be obtained by sending an e-mail to

`smr@ictp.trieste.it`

using as `Subject:` **`get calendar`**

Note: The Scientific Program is constantly updated. So, please check the issue date.

To each activity listed in the Scientific Program there is an associated **`smr-`*`number`*** from which you can obtain more detailed information, when available.

(2) Information on a specific ICTP activity

To receive a list with the names of documents available for a particular activity, you should first identify the `smr###` code as indicated above. Then send an e-mail to

`smr###@ictp.trieste.it`

using as `Subject:` **`get index`**

If you send another mail to

`smr###@ictp.trieste.it`

using as `Subject:` **`get`** *`document_name`* (e.g., **`announcement`**, etc.)

you will receive detailed information on the topic *`document_name`*

Note: If you wish more than one document of an activity then use

`Subject:` **`get`** *`doc1 doc2`*... etc.

Using Internet Gopher

The ICTP Gopher server allows you to explore, search and retrieve general information regarding the many scientific activities carried out at ICTP. It is possible to access the Gopher space by issuing the Gopher command and exploring the branch *"Other Gopher servers in the world"* pointing to the geographical region: `Europe→Italy→ICTP`.

To access directly to the ICTP server, you can issue the command:

To access directly to the ICTP server, you can issue the command:

`gopher   gopher.ictp.trieste.it`

Using World-Wide Web

The ICTP WWW server allows you to obtain basically the same information available on the ICTP Gopher server, but through the World-Wide Web protocol.

The ICTP WWW server URL is:

`http://www.ictp.trieste.it/`

****

For further information please write to
SCS-Scientific Computing Section, International Centre for Theoretical Physics,
P.O. Box 586, 34100 Trieste, Italy

Calendar of Activities at ICTP

1994

SMR		
751	Follow-up to the Workshop on preparation of radiomaritime master plans for English-speaking African countries	7-18 February
752	Winter College on quantum optics	14 February – 4 March
753	Workshop on study of atmospheric interactions by remote sensing	21 February – 4 March
755	Workshop on fluid mechanics	7 – 25 March
754	Workshop on science and technology of thin films	7 – 25 March
803	Training Course on dosimetry and dose reduction techniques in diagnostic radiology	16 – 25 March
756	Spring School and Workshop on string theory, gauge theory and quantum gravity	11 – 22 April
757	Workshop on nuclear reactors — physics, design and safety	11 April – 13 May
758	Spring College on quantum phases	3 May – 10 June
759	International Conference on monsoon variability and prediction	9 – 13 May
887	World Climate Research Programme: Indian Ocean Panel Meeting	14 – 18 May
761	Workshop on commutative algebra and its relation to combinatorics and computer algebra	16 – 27 May
760	College on atmospheric boundary layer and air pollution modelling	16 May – 3 June
766	Workshop on submicron quantum dynamics	13 June – 1 July
762	Summer School in high energy physics and cosmology	13 June – 29 July
	including	
	Workshop on perspectives in theoretical and experimental particle physics	7 – 8 July
	Workshop on strings, gravity and related topics	28 – 29 July
764	Research Workshop on condensed matter physics	13 June – 19 August
	including	
	Miniworkshop on nonlinear time series analysis	8 – 12 August

	Working Group on disordered alloys	8 – 19 August
765	Quantum transport in nanostructures (Adriatico Research Conference)	20 – 24 June
767	Miniworkshop on strong correlations and quantum critical phenomena	4 – 22 July
814	Electronic and geometric structure of solids and surfaces (Adriatico Research Conference)	12 – 15 July
768	Cooperative effects in many-electron systems and their response to external fields (Adriatico Research Conference)	26 – 29 July
769	Workshop on non-linear electromagnetic interactions in semiconductors	1 – 10 August
806	Lasers in surface science (Adriatico Research Conference)	9 – 12 August
770	Advanced Workshop on algebraic geometry	15 – 26 August
771	Conference on the structure and model of the first cell	29 August – 2 September
773	College on medical physics: Radiation protection and imaging techniques	5 – 23 September
772	International Workshop on parallel processing and its applications in physics, chemistry and materials science	5 – 23 September
775	College in biophysics: experimental and theoretical aspects of biomolecules	26 September – 14 October
774	Third College on microprocessor-based real-time control — principles and applications in physics	26 September – 21 October
777	3rd Trieste Conference on recent developments in the phenomenology of particle physics	3 – 7 October
779	Workshop on variational and local methods in the study of Hamiltonian systems	10 – 28 October
750	College on advanced techniques in archaeometry and conservation of works of art	17 – 28 October

750 College on advanced techniques in archaeometry and conservation of works of art 17 – 28 October

780	Fourth Autumn Course on mathematical ecology	24 October – 11 November
781	Suivi de l'atelier sur la préparation des plans directeurs radio-maritimes pour les pays africains francophones	7 – 11 November
782	Second Workshop on three-dimensional modelling of seismic waves generation, propagation and their inversion	7 – 18 November
748	ICTP-UNU-Microprocessor Lab: Third Course on basic VLSI techniques	21 November – 16 December
804	Ultrafast phenomena and applications (Adriatico Research Conference)	6 – 9 December

*****

1995

SMR

838 Seventh international workshop on computational condensed matter physics: total energy and force methods ... 11 - 14 January

841 Fourth ICTP-URSI-ITU (BDT) college on radiopropagation: propagation, informatics and radiocommunication system planning ... 30 January - 3 March

followed by

846 Second workshop on rural communications in developing countries ... 6 - 10 March

842 Conference on ultrafast transmission systems in optical fibres ... 13 - 17 February

843 Theoretical and experimental workshop on the physics of semiconductor microstructures, to be held at UNICAMP, Campinas, Brazil ... 13 - 24 February

844 Adriatico research conference on lower dimensionality semiconductor systems ... 20 - 24 February

845 Second winter college on optics ... 20 February - 10 March

847 Conference on topological and geometrical problems related to quantum field theory ... 13 - 24 March

848 Spring school and Workshop on string theory, gauge theory and quantum gravity ... 27 March - 7 April

849 Conference on recent developments in statistical mechanics and quantum field theory ... 10 - 12 April

852 Conference on nuclear physics at intermediate energy ... 8 - 12 May

853 Antonio Borsellino College on neurophysics ... 15 May - 9 June

854 College on computational physics ... 15 May - 9 June

855 Workshop on dynamical systems ... 22 May - 2 June

856 Trieste Conference on physical and mathematical implications of mirror symmetry ... 5 - 9 June

865 Workshop on computational methods in material science and engineering ... 12 - 24 June

865 Workshop on computational methods in material science and engineering ... 12 - 24 June

858 Summer school in high energy physics and cosmology ... 12 June - 28 July

including

864 Workshop on the search for new elementary particles ... 27 - 29 July

859 Research workshop on condensed matter physics ... 12 June - 18 August

860 Adriatico research conference on physics of sliding friction ... 20 - 23 June

862 Workshop on biological models (tentative) ... 29 June - 7 July

including

866 Adriatico research conference on theoretical models in biological systems ... 4 - 7 July

857 Miniworkshop on strong electron correlations ... 3 - 21 July

880 **International conference on ultrafast processes in spectroscopy (UPS '95)** .... **20 - 24 November**

News from ICTP is also available on Gopher server.

International Centre for Theoretical Physics
of IAEA and UNESCO
P.O. Box 586
34100 Trieste
Italy

Telephone: (40) 22401
Cable: CENTRATOM
Telex: 460392 ICTP I
Telefax: (40) 224163
E-mail: sci_info@ictp.trieste.it