International Centre for Theoretical Physics

News from ICTP

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Visit of Minister G. Andreotti to the ICTP

Minister G. Andreotti, Minister of Foreign Affairs of Italy, accompanied by Prof. A. Zichichi from CERN (Geneva), President of the World Laboratory and Member of the Scientific Council of the ICTP, were in Trieste on 12 June for the official inauguration of the Trieste Branch of the World Laboratory. The President of the World Lab Branch in Trieste, Professor C. Villi, was also present.

In his introduction address, Prof. Zichichi recalled the role and the significance of the ICTP, the Ettore Majorana Centre for Scientific Culture and of the Third World Academy of Sciences for the development of science in the developing countries. For him, Trieste is the most natural place for a Branch Office which will deal with "Mitteleuropa" not only for its geographical location but and foremost for the enormous experience accumulated by the ICTP and more recently by the Third World Academy of Sciences, in their scientific relations with the whole world and for the cordial encouragement of Abdus Salam.

Professor Abdus Salam welcomed the creation of the World Laboratory branch and expressed his gratitude to Minister Andreotti and the Government of Italy for their continuing support to the ICTP and TWAS. He recalled that after a visit of Minister Andreotti in 1984, the ICTP had started new programmes (the training in Italian laboratories and the external activities) and consolidated the others thanks to the support of the Minister. In March this year, he had had the privilege of detailing to the Minister the current and future projects in Trieste and in particular the International Centre for Sciences (High Technology and Material Sciences, Pure and Applied Chemistry and Earth and Environmental Sciences) which is now entering the "pilot project" phase and expressed the hope that again the Minister and the Government of Italy will provide the necessary means for its full implementation.

Professor Abdus Salam welcoming the Foreign Minister of Italy, G. Andreotti, to the ICTP.

Contents

(From left to right) Prof. A. Zichichi, President of the World Lab, the Foreign Minister of Italy, G. Andreotti, Professor Abdus Salam assisted by the interpreter, Ms. C. Tebb, and Prof. C. Villi, President of the World Lab Branch in Trieste.

Prof. C. Villi also saw the World Lab Branch in Trieste as a most fortunate outcome of the collaboration between the ICTP and the Majorana Centre. He, as President of the Istituto Nazionale di Fisica Nucleare first and, later, as a Member of the Italian Parliament, was involved in the discussion and negotiations which gave birth to both institutions and which made them develop in a cooperative manner since 25 years, heading to the same goal on different tracks. The World Lab, in his view, was the coronation, on the operational level, of the vision of the two men who started the ICTP and the Majorana Centre, Abdus Salam and A. Zichichi. Old-timers of the ICTP will recall that Prof. C. Villi introduced nuclear physics in the curriculum of the ICTP in 1966 as a course director.

In his reply address, after having expressed his appreciation to Professor Abdus Salam for his achievements through the ICTP and TWAS and the interest of the Government of Italy for the Trieste programmes, Onorevole Andreotti said: "*We consider it important to allocate to such initiatives part of the resources for co-operation also because one has succeeded in developing a culture of the international dialogue which can anticipate and prepare the ground for political and international agreements on themes of vital relevance*".

The World Laboratory

"The World Lab is where the projects are" said Prof. A. Zichichi, President of the World Laboratory, shortly after the speech of Mr. Andreotti, and he showed several transparencies illustrating the various projects of the World Lab. We summarize them here and invite whoever needs more information to write to the address at the bottom of the article. World Lab has five main groups of projects. They are:

(1) ARCHIMEDES, covering the planetary monitoring for chemical-, nuclear-, meteorological- and seismic energy, with 19 projects;

(2) ELOISATRON with 12 projects for scientific and technical collaboration in frontier research (Forward-Backward Lepton Jet Analyser; Centre of Science and Technology; Centre for Astrophysics Studies; High Energy Detector R&D; Cosmic Rays and Gamma Ray Studies; Underground Physics; The Fifth Force; String Theory; Electron Spectroscopy for Materials; World Laboratory Section in India; Non-linear Dynamics; Centre of High Energy Physics and Cosmology in Pakistan).

(3) Improvement on modern life with 23 projects in medicine, conservation of cultural and environmental heritage and of production and conservation and transformation of food products;

(4) Three projects on new safe and clean energy sources and

(5) Transfer of Scientific and Technological Know-how (≈ 1,000 fellowships) to simulate the transfer of modern technology and scientific knowledge to the Third World Countries.

Prof. H.R. Dalafi is the Executive Secretary of the World Lab Branch in Trieste. He can be contacted c/o ICTP.

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Mwalimu J. Nyerere in Trieste

It was with great joy that the ICTP welcomed on June 9th, Mwalimu Julius Nyerere, one of the most prestigious African leaders and President of Tanzania from 1962 to 1985. The Mwalimu is now President of the South Commission, of which Abdus Salam, Director of the ICTP and President of the Third World Academy of Sciences, is the member responsible for the issue of science and technology in the developing countries[1]. He was met at the Italo-Yugoslav border – he had been the guest of the Slovenian authorities in Ljubljana – in the late afternoon and brought straight to a reception in his honour at the Adriatico Guest House. The day after, in an academic ceremony, the Deputy Director of the ICTP, Professor L. Bertocchi, and Prof. M.H.A. Hassan, Executive Secretary of the Third World Academy of Sciences (TWAS), expounded the scopes and modalities of both organizations.

Mwalimu Nyerere, who in the past had been invited several times by Abdus Salam to come to Trieste, expressed his happiness for what he had seen and his appreciation to the Director for what he had accomplished for the benefit of the Third World. After the ceremony, he met a group of scientists with whom he could discuss for nearly two hours on the problems of science in the developing countries. He left Trieste in the early afternoon to the seat of the South Commission in Geneva.

[1] A report on this issue entitled *Notes on Science, Technology and Science Education in the Development of the South* is available from the ICTP.

Interview with Mwalimu J. Nyerere

by

Fabio Pagan
"Il Piccolo", Trieste, Italy

Q.: You are one of the leaders of Marxism in Africa. What is your opinion about the present situation?
A.: I am not merely one of the leaders of Marxism in Africa because I am not a marxist.
Q.: You are a catholic.
A.: I am a catholic. It may sound as a contradiction in terms. I could not be both a catholic and a marxist and remain honest. No, I am a socialist, not a marxist. I remain a socialist. I know that, because there are economic problems now in the world and the socialist countries have a share over those problems, people think these problems are there because of socialism and therefore there is some disillusionment about socialism. I don't have this disillusionment at all because I am a convinced socialist.

Socialism is a process. We have to build just societies. I cannot believe that we will build just and peaceful societies by a philosophy of greed. I don't agree to this, I can't see how really you can glorify greed and think on the basis of greed, on the law of the jungle or the survival of the fittest and so forth in human society. That is the basis on which you cannot build society, so I continue to believe in human equality. I am not talking of the mathematical GNP as you put it in economics books; the GNP of Italy being something like 6-7 thousand dollars and in Tanzania it is 250, so everybody in Tanzania should get 250 dollars a year. This is not true, but you have to reject income inequalities or power inequalities or undemocratic organizations or regimes in societies, and as a socialist I believe in this and the fact that socialist countries are going through difficulties in their societies cannot make me feel that capitalism is what is needed.
Q.: In your Declaration of Arusha in 1967 you were very optimistic thinking that perhaps in 1980 or so the major problems of the African continent could be solved, but unfortunately this has not happened. For what reasons, in your opinion?
A.: I don't know whether I was that optimistic in 1967. My country was already one of the most backward countries in Africa. May I just say that my country, my Tanganyka, became indipendent in 1961 after 70 years of colonialism. Note that. We became indipendent in 1961 after 70 years of colonialism. We had 2 university engineers (after 70 years!), we had 12 doctors, we had 4-years primary school education, half the children did not go to school. The country was 85% illiterate. That was the situation when we became independent. I made the declaration in 1967, that is 6 years after independence. Now you want to know about the failure, why is it that we have not succeeded. Let me tell you, we still do not have enough engineers, after 25-26 years of independence we still do not have enough engineers but in those 26 years we have trained thousands of engineers. We still have a little illiteracy in the country but the population is 91% literate, one of the most literate countries in the world. We have 7 years education, every child goes to school for 7 years. Now, have we failed in the Arusha Declaration because we did not promise to solve the problems of the country in a short time but for a poor country like that, in those years, after 70 years, I tell you, 70 years of German and British rule we had 2 engineers. Now we do not have enough engineers, but we have thousands, every child goes to school, not for 3 or 4 years, but for 7 years. We took a country which was 85% illiterate, now it is 91% literate. Is that what is called the failure of socialism in Tanzania? These people have the media and they talk a lot of rubbish. I don't have the media. That is what they call the failure of my country, of the Arusha Declaration. In your mind that is failure?
Q.: Fine. Which is the situation of wildlife in East Africa? I think that in the Arusha Declaration you stated that...
A.: That is a different Arusha Declaration. Yes, we had an Arusha Declaration concerning the protection of wildlife. Well, we have still done very well but, you know, this is a big problem. Your free market and private enterprise and so forth – people make money, they kill rhinos, elephants, lions, tigers (in Asia), and they make money. There is a high price for ivory, for rhino horn, and at one time for leopard skin and so forth. It is very difficult for us while there are these tremendous prices in the world market for things like ivory. It is very difficult for us to protect these animals.
Q.: Also natural forests.

Professor Abdus Salam and Mwalimu J. Nyerere.

A.: Yes, there is a lot of poaching in the national parks. If we take rules, we go and try but one of the enemies is the market.
Q.: Surely. Another question. You are catholic. It seems to me that about one quarter of the Africans are christians – is it true? About a quarter?
A.: I really don't know.
Q.: But in which measure this fact in

your opinion affects the social development of the Africans? The fact that there are so many christians and local religions is an important thing for Africa, do you think, and for the development of the continent?

A.: Well, let me say, perhaps precisely because the problem for us is irrelevant, I can't answer it. I know that in my own country (I can't tell you how many christians there are there now, how many muslims) the three groups – the muslims, christians and the non-muslims and non-christians – are maybe possibly divided evenly. There are probably slightly more unbelievers than muslims and slighlty more muslims than christians, but for us this is not a problem, certainly not in Tanzania.

Mwalimu J. Nyerere and the Ambassador of Tanzania in Rome, A.K. Sykes (on his right), discussing with ICTP scientists.

Q.: I see. About agriculture, do you believe that agriculture is the main resource of the countinent, of East Africa especially?

A.: It is the main answer to our fundamentals of development. Agriculture is certainly very important for our countries. Whatever else we may do, we have to feed our own people and we cannot feed them with air or something like that. It is fundamental that we should feed ourselves and I still believe that if we give importance to agriculture and then, at least as a beginning of industrialization, we make industry not divorced from agriculture but to serve agriculture (to give emphasis to agriculture does not mean we remain with primitive agriculture and no industry at all), I believe this is the best way we can develop our countries in Africa – emphasize agriculture, industrialize yes, but get your industries to serve agriculture and the basic needs of the population.

Q.: Last question. The politics of the International Monetary Fund vs. the Third World and vs. Africa especially.

A.: I am not a great friend of the IMF because the IMF is not a great friend of the poor. At present, quite frankly, the IMF is used by the rich countries of the world to control the economies of the poor, the economies of the Third World. That is really the major function. At present, through that the poor countries of the South are making a net transfer of resources to the rich North of between 30 and 40 billion dollars a year. These countries need money for their development, for their children, for their health, just to invest money, but what is happening is that they are sending money to the North to a rate between 30 and 40 billion dollars a year. So every year many of these countries have what they call an adjustment agreement with the IMF programme and that is intended to serve one thing: to enable these countries to serve this debt. It has no other puropose, simply serve this debt. So this is the result. Today Jaruzelski is in London and the British, I think, are going to apply to him the same rule as they applied to the Third World as he is seeking for some aid – they will say yes, if you reach an agreement with IMF, then you can get some assistance from us. I mean, the IMF is a tax collector, a debt collector of the rich and this is causing a lot of trouble in these countries. They completely collapse, they don't care for the poor, they have to use the police or the army to enforce very difficult programs. Africa as a whole still gets a small net inflow of resources from the North, so Africa is not making net transfer, it has a small net inflow, but Africa vs. the IMF has a net flow of a billion dollars.

Q.: In your opinion, is there a future for science in Africa?

A.: Well, if there is no future for science in Africa there cannot be a future for Africa in the 21st century!

Q.: So there must be a future.

A.: I can't see how not only Africa. We have no place in the 21st century without a major development in science and technology.

New Stanford Collider Starts at Z

by courtesy of

CERN Courier
June 1989

On 11 April the new SLC Stanford Linear Collider created its first Z particle, inaugurating high energy physics research at this novel machine based on the two-mile linac at the Stanford Linear Accelerator Centre, SLAC.

The much-awaited event was identified early the next day (during offline analysis of the data) by Barrett Milliken of the California Institute of Technology – a member of the collaboration operating the 1800-ton Mark II detector at the SLC interaction point. By noon word of the find had spread around the globe, and electronic mail messages were pouring into the offices of SLAC Director Burton Richter, including one from CERN Director General Carlo Rubbia. 'Congratulations,' it read, 'And welcome to the club'.

(The Z, the electrically neutral carrier of the weak nuclear force, was discovered at CERN in 1983, leading to the award of the Nobel Physics Prize the following year to Carlo Rubbia and Simon van der Meer. Several hundred Zs have now ben

accumulated by the experiments at the big proton-antiproton colliders at CERN and at Fermilab. Stanford's Zs are the first to be found in electron-positron annihilations.)[2]

Over the following weekend the SLC produced another four Z particles. In the first four events the Z gave a pair of narrow, back-to-back jets of hadrons, the characteristic fingerprint of a pair of quarks. This is the first time such decays have been seen unambiguously. In the fifth , one of the two quarks also emitted a gluon, producing a three-jet pattern.

Produced in collisions of point-like electrons and positrons at an energy close to the Z mass (near 92 GeV), these Zs are very clean. To find Zs in the mass of particles produced in their proton-antiproton collisions, experimenters at CERN and Fermilab usually have to look for decays into pairs of electrons or muons.

The commissioning of the SLC started two years ago with high hopes of producing Zs by the end of 1987. But a series of technical problems delayed the onset of high energy physics research.

With the production of Z particles now routine, physics has clearly begun. The Mark II collaboration, including physicists from Caltech, Johns Hopkins, Berkeley, SLAC, and the Universities of Colorado, Hawaii, Indiana, Michigan and California (Santa Cruz), now has its first shot at studying hadronic decays.

During the initial week, the SLC proved capable of producing one or two Zs per day with its electron and positron beams operating at 30 pulses per second and about 10^{10} particles per pulse. Bunch sizes at the clashpoint have routinely measured 4 microns by 4 microns, with three-micron spots being attained occasionally. The principal improvement since last year has come in the stability and reliability of the SLC; the Mark II detector has frequently been able to log data for more than 30 percent of the time – a factor of 10 improvement over last summer.

SLC architect Richter was pleased but cautioned physicists working on the machine that 'many months of hard work lie ahead before we can bring this first-of-its-kind accelerator to its design performance.' A few Zs are enough to demonstrate that linear colliders work in principle, but dozens a day are needed if the SLC is to make important contributions to physics.

The long process of upgrading the machine's performance began in April. The first of many additional improvements went in – a series of four high-power collimators installed in the last sector of the linac. These are used to trim off any wayward tails of the electron ad positron bunches before injection into the arcs. Stray particles in these tails have been clipping other collimators in the SLC final focus, sending streams of troublesome penetrating muons into the Mark II detector. With the new collimators these muon backgrounds are markedly lower, with consequent benefits for Mark II.

Over the last weekend in April, the SLC showed the positive effects of this upgrade. A peak luminosity of 3×10^{27} cm^{-2} s^{-1} has been achieved, equivalent to 3 Zs per day given current operating efficiencies (and assuming the 92.2 GeV tuned collision energy is spot-on).

With CERN's mighty LEP electron-positron collider now readying to make its entrance, the contribution that the SLC makes to our knowledge of the Z, and to high energy physics in general, remains to be seen. But whatever the physics may bring, with the SLC a new kind of particle collider has made a successful debut on the high energy research stage.

[2] Note by the Editor – The existence of the Z particle had been predicted by Abdus Salam, S. Glashow and S. Weinberg, Nobel Laureates for Physics 1979.

Taiwan to Promote its Research on Superconductors

Courtesy of
TWAS Newsletter,
No. 11, April/June 1989

Courtesy of
TWAS Newsletter,
No. 11, April/June 1989

Superconductors are one of the 12 areas selected on the Island of Taiwan to strengthen science. Such a step will provide the Taiwanese companies' access to patents in high temperature superconductivity. As a first step, the government is trying to win back from the United States one of its most famous emigrant scientists, Maw-Kuen Wu of Columbia University. He won fame in 1987 for his work on superconducting materials.

Superconducting materials are those compounds that lose all electrical resistance at low temperatures (say, at liquid nitrogen temperatures).

Taiwan at present spends over 1 per cent of its GNP (Gross National Product) on research and development, about half of which is from the government and the rest from the private industrial sector. It is, however, much less than that of Japan which is spending 2.8% of its much bigger GNP on R&D in science. It already has 2000 patents in superconductivity. Taiwan aims to mount its effort so as to get at least 50 patents in the next 5 years.

Interaction between African and Black American Scientists

Courtesy of
TWAS Newsletter,
No. 11, April/June 1989

Launch pad: The International Centre for Theoretical Physics (ICTP) complex, housing the Third World Academy of Sciences and other catalytic institutions in Trieste. The prime mover: the untiring Prof. Abdus Salam. Shot into orbit: yet another body in the cause of the under-developed.

In the scenario this time are the African scientists who are being helped by their better equipped black American colleagues. Thus is born the Edward Bouchet-ICTP Institute.

Advisory Council Meeting

The first Bouchet Advisory Council meeting held deliberations from 13-15 April 1989 at the ICTP complex and decided to name the institute as "Edward-Bouchet-ICTP Institute" with the following programme: (i) Collaborations between Black American and African Physicists, including collaborations involving the transfer of equipment; (ii) Visits by African students to American universities for the purpose of completing their graduate studies; (iii) Visits by African scholars to American universities during the course of their research; (iv) Biennial Bouchet Conferences on themes of mutual interest of importance to the development on the African continent.

Edward A. Bouchet was the first Black American Ph.D. (he got that degree in 1876) and it was a befitting way to honour him in the dying years of the 20th century. The Council visualized that the collaborations will generally extend to periods of 2 to 3 years, comprising regular visits by Black

American physicists with their African Colleagues.

The African students, pursuing their research at American universities, would perform experimental or theoretical investigations in Physics, Technology and/or Mathematics under the joint supervision of both their African and Black American co-mentors; the final stages of the graduate work would be completed at their home (African) institution. The visits by African scholars would be facilitated by their Black American colleagues.

The Council resolved to convene the 2nd Bouchet International Conference in Accra, Ghana, from 14-17 August 1990. Further, it decided that the City College, CUNY (USA) will serve as a funding implementer for support from US government sources in connection with the Institute.

In general discussions, the Council agreed to include information on opportunities for the transfer of library materials and for equipment gifts through TWAS/ICTP in general mailings. The Council agreed to prepare a brochure on the Bouchet Institute, also to be included in general informational mailings. The Council explored various possible initiatives which could be undertaken with regard to the long term development of support resources, viz. funding.

The Advisory Council meeting was attended by the following members from the USA: Dr. Charlie Brown; Dr. Anthony Johnson; Professor Joseph Johnson; Dr. Ronald Mickens; Professor Milton Slaughter. Those from Africa attending were: Professor Francis K.A. Allotey; Dr. Jean-Pierre Ezin; Professor Mohamed H.A. Hassan; Dr. Leonard K. Shayo.

Mohamed H.A. Hassan; Dr. Leonard K. Shayo.

The idea of enacting such an interaction through a permanent institution came from Prof. Abdus Salam, the Director of ICTP who also is the President of the Third World Academy of Sciences.

The first Edward Bouchet International Conference on Physics and Technology was held from June 9 to 11, 1988 in Trieste. This conference was the joint effort of ICTP and the National Society of Black Physicists (NSBP), a support group created for this purpose. From this Conference emerged the idea of the Institute. On 30 September 1988, Prof. Salam formally created the institution with the appointments made for the first Council of the Institute.

Prof. Joseph Johnson of the City College, CUNY, USA, said that the Council had agreed to the programme of the Institute and had discussed at length the development of long-term resources.

Optimistic

He was very optimistic about the future of the organization and had turned very hopeful about it during the course of the meeting. Prof. Johnson said that they expect that the U.S. government agencies will support the organization in view of the supportive response they have been getting in that regard. He also thought that the white physicists of the USA and their organizations would provide support to the programme of the Institute as the response from them to the idea has so far been positive.

Problems for Chinese Students in the U.S.

by

Betty M. Vetter

Courtesy of
The AAAS Observer, 6 March 1989

Thousands have come from the People's Republic of China to the United States to study each year since 1978. But many are not returning home, and China's concern over this brain drain has led to restrictions on overseas education that trouble both Chinese students and American educators.

A new report commissioned by the Committee on Scholarly Communication with the People's Republic of China notes that nobody knows precisely how many Chinese students and scholars are in the United States at any one time, but the State Department issued about 56,000 visas to these groups from 1979 through 1987.

Republic of China notes that nobody knows precisely how many Chinese

American melting pot

About 60 percent had been selected by Chinese institutions for official sponsorship and had J-1 visas (for exchange visitors). The rest were students with private support from family and friends and had less restrictive F-1 (student) visas. In January 1988, an estimated 21,000 Chinese with J-1 visas and about 7,000 with F-1 visas were enrolled in degree programs or doing research in US universities. Since 1978, an additional 8,000 Chinese who came on F-1 visas have managed to remain here, either by a legal change in status or simply by disappearing into the American melting pot. About 12,500 J-1 and 7,000 F-1 students returned to China.

By 1985, only 17 percent of the students with J-1 visas were supported by the Chinese government or their work units, down from 54 percent in 1979. The majority (57 percent) of these academically competitive and highly motivated people managed to find funding from other sources, principally US universities. Many are now deeply involved in university research, and are attempting to at least postpone their return to China.

There are frequent complaints about misuse of returning professionals, but those who study abroad tend to move up faster within both the administrative and research establishments. Complaints are partly due to unrealistic expectations about opportunities at home.

J-1 visas, which indicate financial assistance from the home government, require a return home for at least two years after the degrees are earned. But those who want to stay, and the institutions that want to keep them, insist that China's support has been minimal — in most cases only enough for two suits and a one-way ticket. They also insist that these students were given J-1 rather than F-1 visas without proper counseling from US officials.

Because of their work in physics and other high-tech fields, as well as a shortage of young US scientists, Chinese scientists are important in university research in the United States. A further complication is that many have children or spouses who are American citizens.

A further complication is that many have children or spouses who are American citizens.

Abandoning research

As many as 5,000 Chinese who have earned degrees here may be forced to abandon their research because of US insistence that they cannot stay without individual waivers, which are nearly impossible to obtain. Although both governments want the Chinese scientists to go home, they have become so vital to American university research that college officials are fighting to retain them.

Chinese officials say they will enforce their time limits (two years for master's and five years for Ph.D. candidates). Since 1987, students going

abroad have been required to make a contractual commitment to a specific course of study. Some contracts apparently require guarantors, the posting of bonds, and compensation if the student does not return as scheduled.

Despite these restrictions, China sent the second largest contingent (after Taiwan) of foreign students to the US in 1987-88, numbering 25,170, says the Institute of International Education.

Europe Gambles on High Tech

by

H. Garrett De Young

Courtesy of
The Scientist, 28 November 1988

In increasing numbers, European financiers are shrugging off their traditional conservatism and discovering the definition of venture capital that their US cousins have always embraced: taking a chance on an unproven idea or technology. To be sure, the spirit of risk-taking varies from country to country — the UK is much more daring than West Germany, for example. But according to accounting firm Peat Marwick McLintock, last year — for the first time ever — there was more venture capital available in Europe than in the US ($4.3 billion vs. $4.2 billion). And these funds are footing the bill for more and more European high-tech startups.

Entrepreneurism has long been stifled in Europe by high taxes and a staunch aversion to risky business. "Ten years ago we did a study of young technology-based firms in the UK and Germany, and could find hardly any examples," recalls Kamal Saad, vice president of Arthur D. Little Inc. in Brussels. Today, he says, the numbers are "orders of magnitude" higher — partly because of falling taxes in many countries (especially Holland and the UK), but also because of basic attitude changes prompted by the approach of the unified European market of 1992.

Innovation

Venture funds are not limited to technology companies, of course; food products and retailing are also popular targets in view of the larger marketplace. But the search for high-tech innovation, backed by a sound business strategy, has never been more intense, says finance director Tim Church at London's Advent Ltd., a venture capital firm capitalized at about $250 million. "And in terms of technology and management, the quality of today's deals are higher than ever," says Church.

One such venture, launched by Advent in 1985, is Computer Security International, of Brighton, England. The small firm designs and installs data security hardware and software for banks and other financial services firms throughout the UK. The package that Advent put together in founding the firm — in terms of both technological expertise and financial backing — was so appealing that Church was able to lure William Seabrook, a British businessman who had left the UK almost 25 years before to pursue high-tech opportunities in Silicon Valley, back in his home country. Today, as managing director of Computer Security International, Seabrook proudly notes that last year's revenues hit $7.2 million — a big jump from the $2.8 million the startup realized in 1986. Total investment in the company is divided between Advent and 14 other firms, and now stands at about $4.7 million.

New companies

Seabrook notes that there are several reasons for the new entrepreneurial climate. "Ten years ago it was almost impossible to raise startup money, mostly because it was such a novel idea and no one knew how to do it," he says. "Taxes were much higher than now, and the banks did not consider that their primary business. The US was the main source of funds, but most small business people felt it wasn't worth the effort." As a result, most new companies were people-driven, semi-hobbyist affairs. As a result, most new companies were spawned as corporate spin-offs or subsidiaries — or by the occasional daredevil with well-placed friends.

US science entrepreneurs also should note the change in the venture capital climate. Increasingly European investors are shucking their traditional parochialism and financing innovation in other countries, as well.

For example, Advent recently raised $7 million to help seven-year-old Xoma (a Berkeley, Calif., biotech company), and five other US companies set up British facilities; meanwhile, San Diego's Biomagnetic Technologies — a maker of neurological diagnostic equipment — is one of six US companies with backing from the $29-million Gilde Venture Fund in Utrecht, the Netherlands.

IAEA Programme on Fusion

Courtesy of
TWAS Newsletter,
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Extracted from a Report prepared by Dr. C.M. Braams for the International Atomic Energy Agency (IAEA).

The bi-annual IAEA International Conference on Plasma Physics and Controlled Nuclear Fusion Research is the world's most important meeting in the field. The Conference Proceedings, issued as Supplement to the Journal, "Nuclear Fusion", together with the Journal itself, are by far the richest sources of information on the subject. Both have been of invaluable help in creating a world-wide community of fusion scientists and they continue to help maintain and support that community, also through the World Survey of Activities in Controlled Fusion Research.

The Conference accepts only the most pertinent contributions and the Journal maintains the highest editorial standards; through these indispensable services the Agency has established itself as the most prestigious medium of communication in the area of nuclear fusion.

The Department of Nuclear Energy and Safety has, in several ways, been responsive to the needs of the fusion community. A series of workshops have produced important Technical Documents on safety of fusion, and the Department itself has produced a review paper on Fusion Power and the Environment. Moreover, it has provided input to the work of INTOR (International Tokamak Reactor) and is prepared to similarly serve ITER (International Thermonuclear Experimental Reactor). The broad subject area "safety-related research" is one in which all countries involved see a need for increasing international collaboration. The Agency is well-equipped to provide further help in this respect.

International collaboration

The International Atomic Energy Agency is contributing to international collaboration and exchange of

information in the field of nuclear fusion through various activities, including those listed below in approximately the order in which they appeared historically.

(a) The bi-annual International Conference on Plasma Physics and Controlled Nuclear Fusion Research, of which the 12th was held in Nice in October 1988;
(b) The monthly journal "Nuclear Fusion", now in its 29th year, and its special issues, such as the World Survey on Major Activities in Fusion, last issued in 1986, and the Conference Proceedings;
(c) The Status Report on Fusion Research, prepared by the IFRC in 1970 and 1978 and scheduled again in 1990;
(d) The work on nuclear fusion safety and radiation protection, including a series of workshops on fusion safety;
(e) The development of a nuclear data library for neutronics, shielding and safety-calculations for fusion reactors;
(f) The development of an evaluated numerical data base of atomic and molecular collision data relevant for fusion reactors;
(g) The development of an evaluated plasma-material interaction data base for fusion reactor technology;
(h) The series of Technical Committee meetings, held in conjunction with workshops on Fusion Reactor Design and Technology;
(i) Symposia, workshops, specialists' meetings, technical committee meetings, consultants' meetings, etc., many of which are in support of the activities under points (c) to (h) and (k), while others are topical meetings in their own standing;
(j) Fellowship programs, not used for fusion to the same extent as for other fields;
(k) International Tokamak Reactor (INTOR), until 1987; and International Thermonuclear Experimental Reactor (ITER) meetings. Having originated within the IAEA, they have now become a major international undertaking on its own, with strong links to the IAEA.

Both the Conference and the Journal referred to above under-emphasize scientific aspects; other channels of communication are utilized by those working on fusion technology. Thus, the question arises if it would be possible and worthwhile for the Agency to gain a position in fusion technology equivalent to that which it holds in fusion physics.

Over the last decade, the Agency has organized an appreciable number of Technical Committee Meetings (TCM) each year. The subjects show a good spread over various aspects of fusion research with, as should be expected, emphasis on tokamak-related problems. In another category, Specialists' Meetings take place, particularly in recent years. Earlier there have been occasional Symposia and Advisory Group (AG) meetings.

The fellowship programme of the IAEA has not, so far, been used extensively for training fusion scientists and engineers.

It is probably no exaggeration to say that INTOR, which has been extremely important in drawing fusion physics and technology closer together in one mission-orientated effort, and in confronting the four major programs with each other, could not have originated and have been so successful if the IAEA had not previously earned confidence, both of the governments involved and of the R&D community, in its competence in the field.

ITER builds on the success of INTOR and is benefitting from IAEA support in many ways.

Tokamak

The tokamak is now the most advanced confinement system, and the only one for which construction of a test reactor is being considered for the near future. Hence, fusion reactor technology studies, inasmuch as they are not of a generic nature, relevant to any reactor concept, are mostly tokamak-oriented. In physics, there is also a strong concentration of activities on the problems of reactor-like tokamak plasmas, but in addition there are important programmes related to other confinement systems. Leaving these alternative systems aside for the moment, one may say that asking oneself to what extent the IAEA activities on generic fusion problems as well as on large-tokamak physics and technology do serve urgent needs of the fusion community, is almost tantamount to asking how well they serve tokamak reactor studies, of which ITER is now the prime example. Although the transient nature of the ITER organization might create future problems if the Agency were to rely too strongly on formal arrangements about consultations with ITER, nothing should be left undone to strengthen the ties between the Agency staff and the R&D community through semi-official consultations with ITER. For as long as it will exist, the ITER team provides the best source of information one can think of on generic, as well as tokamak-related, reactor problems. Moreover, by taking the specific needs of ITER into account, the Agency can only enhance the usefulness of its work.

Developing countries

It appears that interest in fusion research, which has traditionally been an area reserved mainly for highly industrialized nations, is gradually receiving more attention throughout the world, both in energy-orientated government-sponsored research establishments and in universities. As a consequence, the Agency increasingly receives calls for assistance, both from governments and from individual scientists. On different occasions, notably in a special meeting in the framework of the 1988 Nice Conference, exchanges between the Agency and representatives from long-standing, as well as from recently started fusion research centres have taken place which, however, have not yet crystalized into broad action programmes. Among ideas that have been put forward are: the creation of a tokamak-research laboratory especially for scientists from developing countries; Agency support in design and procurement of apparatus; bilateral cooperation between a developed and a developing country for that purpose; fellowships for training in established research institutes; bilateral exchanges of personnel etc.

The issue of selecting approaches that will work is a difficult one. Some remarks, however, can be made. Training programmes may lead to the opposite of what is desired — namely, to brain drain — unless there is, from the outset, an attractive homebase, with facilities and opportunities, to which the trainee will wish to return. If that condition is fulfilled, then almost automatically the scene is set for fruitful bilateral collaboration between institutes. The European programme has excellent results with the Mobility Fund, which supports costs above the normal salary (which continues to be borne by the employee's homebase) resulting from a

stay in an associated laboratory other than one's own. The Community comes in once two laboratory directors have agreed on a contract that lists names of persons to be exchanged for periods ranging from some weeks to two years. This scheme, supplemented by assistance in moving equipment, has promoted many exchanges, among which full-scale expeditions of teams with major equipment to other laboratories. Such a scheme can greatly facilitate access to large facilities for scientists from smaller institutes.

Research Fellowship at University of the West Indies

Applications are invited for the post of Research Fellow in the Centre for Nuclear Sciences. Applicants should hold a Higher Degree or equivalent in Chemistry or Geochemistry. Experience in the use of nuclear analytical techniques, such as Neutron Activation Analysis, X-Ray Fluorescence and Gamma Spectrometry and/or a sound knowledge of Analytical Chemistry would be desirable. Familiarity with scientific applications of micro-computers including the MICROVAX line would be valuable.

The Research Fellow will be responsible to the Director of the Centre for Nuclear Sciences and is expected to contribute to the research programmes of the Centre. This will include further development of the analytical techniques used by the Centre.

The Fellowship is for a period of two years beginning as soon as possible. Applications should include the names and addresses of three referees and should be sent to the Registrar, University of the West Indies, Mona, Kingston 7, Jamaica, from whom further particulars are available.

Further Particulars: The European Economic Community, the International Atomic Energy Agency, and the Government of Jamaica have assisted the University in forming a Centre, to demonstrate and apply "peaceful uses of the atom" in Jamaica and to carry out interdisciplinary research and training.

The Centre has been operational for four years with a small core of scientists and support staff who are now actively organizing, co-ordinating and participating in national an international research programmes. The main programmes presently include: regional soil and stream sediment analysis, radiation surveys, environmental monitoring, and atmospheric studies. Studies are now confined to Jamaica but are to be extended to other Caribbean territories shortly.

In addition to "Centre" programmes, individual researchers from University departments or other institutions carry out, with the core staff's guidance, their own research programmes. The Centre also provides postgraduate training for Higher Degrees.

The Centre also provides analytical and other services for the industrial community and a personnel dosimetry service for the hospitals and medical centres.

Facilities: The Centre presently consists of 4000 sq.ft. of space for: laboratories, staff room, liquid nitrogen manufacture, seminar, map and computer rooms and a reception area. The Centre is equipped with state-of-the-art instrumentation for multi-element determinations by means of neutron activation analysis, gamma spectrometry and X-ray fluorescence, liquid nitrogen manufacture and radiation monitoring. The Centre also has a computer network based on the Microvax-II and software for interpretation of gamma and XRF spectra, data processing, management and manipulation. This is being developed into an image processing geographical information system which will be made available university-wide.

Duties: The Research Fellow is responsible to the Director of the Centre for Nuclear Sciences and is expected to contribute to the research programmes of the Centre. This will include conducting research and the further development of the analytical techniques used by the Centre. Publication is expected.

Obituary

Prof. M. Moravcsik

The ICTP has lost one of his greatest friends. Professor Michael Moravcsik, from the University of Oregon, died unexpectedly in Turin (Italy) on 25 April while on leave from his University. He was to visit the Centre during the summer to finalize his review of the ICTP Associate Membership Scheme.

Those who met him will remember his untiring efforts to the cause of the developing countries, his outstanding contribution to high and intermediate energy tehoretical physics and the depth and warmth he put in anything he undertook.

Dr. S.K. Gupta Appointed Secretary General of Indian Physics Association

Dr. S.K. Gupta, Associate Member of ICTP and of Nuclear Physics Division of Bhabha Atomic Research Centre, Bombay, India, has been elected Secretary General of the Indian Physics Association for the term 1989-91.

The President of IPA is Dr. S.K. Joshi (Director of NPL in Delhi) and the Vice-President is Dr. Y.R. Waghmare (IIT, Kanpur) who are also associated with the International Centre for Theoretical Physics.

IPA awards every year the R.D. Birla Award which was won in 1979 by the Director of ICTP, Professor Abdus Salam. It also awards the N.S. Satyamurthy Award to young scientists.

Book Review:

The Physics of Nuclear Reactors

We learn that Prof. F. Ahmed, Associate Member of the ICTP, has published a book on reactor physics in collaboration with S. Garg and L.S. Kothari who have also been associated with the ICTP. We take pleasure in reproducing a review by Prof. M.M.R. Williams, Professor of Nuclear Engineering at the University of Michigan, Ann Arbor, USA.

By S. Garg, F. Ahmed and L.S. Kothari. Tata McGraw-Hill, New Delhi. (1986). 513 pages.

The authors have produced an interesting book on reactor physics which can serve as a graduate text and prove valuable to practising nuclear engineers. Although basically there is nothing new in this book, it does bring together in a consistent manner the fundamentals of fission and the associated methods of reactor theory. It commences with a detailed discussion of the interaction of the neutron with

matter with particular emphasis on cross sections. Although there is no discussion on the derivation of resonance cross sections from first principle, the outline is good and sets the scene for the work to come. The fission chain is discussed next and the concept of criticality introduced. We are then pitched directly into reactor types and some of their characteristics and then, after a brief discussion of breeding and fuel cycles, the more "meaty" reactor theory starts. Neutron slowing down, thermalization, transport theory, diffusion theory, criticality, heterogeneous systems, reactor kinetics, reactor control, heat generation and removal are all there. Some topics are treated more deeply than other, and there is nothing that cannot be found in other books. Closest to this book is Bell and Glasstone's *Nuclear Reactor Theory* now nearly 17 years old but still good reading. However, Garg, Ahmed and Kothari have done a good job and their book deserves to be in all nuclear engineering libraries.

Activities at ICTP February - June 1989

Title: WORKSHOP ON SPACE PHYSICS: MATERIALS IN MICROGRAVITY (27 February - 17 March).

Organizers: Professors A. Levi (Università di Genova, Italy), V. Manno and H.U. Walter (European Space Agency, Paris, France), with the co-sponsorship of the Italian Direzione Generale per la Cooperazione allo Sviluppo (Ministry of Foreign Affairs, Rome, Italy).

Lectures: Microgravity Rome, Italy).

Lectures: Microgravity environment. The space environment (effects). The scientific programme of ESA: An overview. Testing Newtonian gravity in space. Present microgravity systems/facilities. Future microgravity systems/facilities. A case study in materials research: a-HgI_2, a room temperature semiconductor detector for x- and α-rays (Ground based research: development of the material properties; vapour growth mechanisms; diffusion coefficient measurement facility for vapour phase experiments; a new vapour growth facility for large single crystals in space. Experimental results under microgravity.). The space infrastructure of the nineties – The International Space station and the COLUMBUS Programme. Liquid menisci and their stability. Thermodynamics of capillarity. Interfacial instabilities in liquid layers (interfacial and volume instabilities in liquid layers; introduction to the phenomena and model approaches; cellular convection and other steady modes of instability; oscillatory instabilities and waves at interfaces; linear problems; harmonic oscillator description; oscillatory instabilities and waves at interfaces; nonlinear theories and comparison with experiments and suggested experiments.).Wetting and stability experiments performed in parabolic flights. Capillarity and materials processing in spaces. Competition between spontaneous transverse and longitudinal waves at liquid interfaces. Liquid-vapour and solid-liquid interfaces. Spacelab experiments on fluid statics and stability. Transparent model experiments on the separation of monotectic alloys. Thermodynamics and kinematics of surface phases. Volume and surface balance equations. Entropy production and phenomenological relations. Order of magnitude analysis, Marangoni, natural combined convection. Elements of thermodynamics and dynamics of line phases. Typical problems in fluid sciences. Marangoni Stokes flows. Marangoni boundary layers. Experiment classes, facilities and available platforms. Operational aspects of FS experiments. Tolerable G-levels. Recent results in fluid dynamics. Marangoni Navier Stokes flows. Marangoni Navier Stokes flows with deformable interfaces. Physiological effects of microgravity (heart and circulation; the body fluids; pulmonary gas exchange; muscles and locomotion; the working man.). Maintaining good health and performance in space. Life support requirements. Introduction to the role of gravity in the growth and development of plants and to the operation of the gravity sensing system in plant organs. Exploitation of the microgravity environment for study of basic developmental processing and sensory systems in plants. The interface of physics and biology in space. Experimental approach/results. Mechanisms/hypotheses. Basic research/biomedicine/biotechnology. Crystal growth from the melt. Segregation and diffusive-convective transport. Solidification of metals. Crystal growth techniques. Interfacial momentum, heat and mass transport. Gravity level requirements for Bridgman crystal growth. Crystal growth: results from experiments. Mass transport by diffusion. Theory of phase transitions. Crystal growth from aqueous solution on the ground and in space. Combustion (general introduction; turbulent combustion; droplet combustion; microgravity combustion.). Nucleation and crystallization in glass processing melts. Nucleation kinetics. Industrial perspectives in advanced glasses and possible contribution of microgravity experiments. Holographic diagnostic methods in crystal growth from solution. Containerless processing by electromagnetic levitation. Material science and microgravity: a Vietnamese point of view. Metallurgy. Alloys and composites.

The Workshop was attended by 74 lecturers and participants (32 from developing countries).

Title: WORKSHOP ON REMOTE SENSING TECHNIQUES WITH APPLICATIONS TO AGRICULTURE, WATER AND WEATHER RESOURCES (27 February - 21 March).

Organizers: Professors V. Cappellini (Istituto di ricerca sulle onde elettromagnetiche, IROE, Florence, Italy) and Prof. M.H.A. Hassan (Third World Academy of Sciences and ICTP, Trieste, Italy). Dr. R. Carlà (IROE) acted as Head of the laboratory. Co-sponsorship by the Italian Direzione Generale per la Cooperazione allo Sviluppo (Ministry of Foreign Affairs, Rome, Italy).

Lectures: Remote sensing of the air, land and sea. Remote sensing systems: basic concepts. Radiometers, scanners, multi-spectral scanners. Systems: basic concepts. Radiometers, scanners, multi-spectral scanners. Electromagnetic radiation: Plancks, Rayleigh-Jeans laws, radiation from sun, Maxwells equations. Concepts of remote sensing in visible IR, thermal and microwave regions of EMR. Atmospheric absorption/transmission bands – model for atmospheric corrections. Introduction to digital image processing for remote sensing applications. Operative sensors. Operational satellites. Dielectric concepts of moist soils – Emission/scattering properties. Radiative behaviour of ground features; concept of spectral signature. Image processing systems and design concepts. Digital image processing fundamentals. Ground receiving stations. Data distribution services. Geometric

correction techniques. Radiometric calibration and atmospheric correction fundamentals. Statistical based preprocessing techniques. Colour enhancement principles and techniques. Multispectral and multi-images processing. Principal component analysis. Fundamentals of pattern recognition and thematic information extraction. Frequency characterization and analysis techniques. 2-D digital transformations. Data compression techniques. Digital filtering and applications. Local operator techniques for structure detection. Image restoration and noise removal. Future perspective and trends on digital image analysis techniques for remote sensing applications. Cloud physics processes relevant to radar meteorology. Recent development in radar meteorology. Satellite investigation of clouds and clouds structure. Forecast of intense rainfall by satellites. Geographical information systems. Soil/atmosphere processes. Atmospheric boundary layer model. Analysis and interpretation of thunderstorm images. Rainfall estimation techniques. Applications of remote sensing for desert lands discrimination and soil classification in arid regions. Integrated remote sensing and aeromagnetic maps for localizing ground water mega-aquifers in arid regions: a case study in the Sinai peninsula. Geographical information systems. Analogical picture transmission (APT) – characteristics and ground receiving station. Flood plain mapping and monitoring of floods. Hydrological basin models. Analysis techniques for vegetation identification. Agricultural resource surveying and monitoring. Land surface processes: desertification. Arid and semi-arid land monitoring. SPOT imagery applications. Graphical and semi-arid land monitoring. SPOT imagery applications. Graphical demonstrations of fluxes in the atmosphere. Unconventional resorts in photographic analysis in geology. Surface dripping study on the Argentine Puna through synoptic processes low-cost orbital scenes analysis. Paleo-acolian morphology and natural obstruction of superficial water dripping at the Argentine pampean plain through orbital standard scenes observation. Microwaves remote sensing of soil moisture: elimination of texture effect. Remote sensing applications to hydrology in Nigeria: examples from Jos Plateau and South Central Nigeria. A temporal study of waterlogging in canal command area using remote sensing techniques. Convective storms – the AVHRR Channel 3 cloud top reflectivity as a consequence of internal processes. Remote sensing test site of Jingyuetan; an ideal test site for comprehensive remote sensing studies. Chinese polar orbit meteorological satellite FY1. Forest survey from satellite imagery. Detecting hydrobiological parameters with Landsat 3: summer 1981 data. Digital image processing of remotely sensed data and its applications in hydrology and agriculture – some case studies. Indian remote sensing satellite (IRS-1A) – an overview.

The Workshop was attended by 103 lecturers and participants (76 from developing countries).

Title: EXPERIMENTAL WORKSHOP ON HIGH T_C SUPERCONDUCTORS (30 March - 14 April).

Organizers: Dr. P. Ganguly (Indian Institute of Science, Bangalore, India), Dr. G. Leising (Technical University Graz, Austria), Dr. F.C. Matacotta (Istituto per la Tecnologia dei Materiali Metallici non Tradizionali, ITM, - Consiglio Nazionale delle Ricerche, Milan, Italy) and Prof. M. Tosi (University of Trieste, Italy), with the co-sponsorship of the Italian Direzione Generale per la Cooperazione allo Sviluppo (Ministry of Foreign Affairs, Rome, Italy).

Lectures: Phenomenology and theory of superconductivity. Introduction to experimental activity: materials preparation; materials characterization. Theoretical developments in HTC superconductivity. Structure investigations. High temperature superconductivity. Computer aided structural determinations. HTS superconductivity. Computer aided structural determinations. HTS chemistry. Infrared spectroscopy. Magnetic and transport properties. Devices and thin films. Thermodynamic properties. Critical current densities of high T_C superconductors. Neutron diffraction of YBCO-related compounds. Oxygen disordering phenomena in $YBa_2Cu_3O_{7\pm\delta}$. On the specific heat anomalies in the temperature range 200-240 K in CuO and $YBa_2Cu_3O_7$. Y-Ba-Cu-O high T_C superconductive thin films made by Y, BaF_2, Cu co-evaporation technique. Selective doping of iron in YBCO: a Mössbauer study. Magnetic properties of Cu-O planes in Gd_2CuO_4. Synthesis of Bi-Pb-Sr-Ca-O system through glass ceramic and ceramic routes. Transport properties of $REBa_2Cu_3O_{7-x}$ superconductors versus oxygen content (resistivity and thermoelectric power; thermal conductivity). Research and development of high T_C superconductors in Thailand: national project; research activity at Chiangmai University; research activity at Prince of Songkla University. Critical current of epitaxial $YBa_2Cu_3O_{7-x}$; thin films under high magnetic field. A possibility for obtaining $YBa_2Cu_3O_{7-x}$ superconductors of large range of x and distribution of the oxygen atoms on the basal plane. Hall effect and ^{205}Tl NMR Knight shift studies in $BiSrCaCu_2O_x$ and $TlCa_3BaCu_3O_x$ systems. Sr and O concentration effects on the electrical resistivity of Ba-Sr-Cu-O. Logarithmic to non-logarithmic flux creep transition in Bi-Sr-Ca-Cu-O system. Infrared and X-ray studies on Y-Ba-Cu-O and Bi-Sr-Ca-Cu-O system. Substitution and transport studies in 1-2-3 compounds. The effect of combining Nb and $YBa_2Cu_3O_{7-d}$ in a superconducting wire. Relaxations of the magnetization in high-T_C superconductors. Point-contact spectroscopy: techniques and results. Optical reflectivity studies of magnetically-oriented high T_C materials. Superconductivity at 156K in the multiphase La-Sr-Cu-O system.

The Workshop was attended by 110 lecturers and participants (77 from developing countries).

Title: SPRING SCHOOL AND WORKSHOP ON SUPERSTRINGS (3 -14 April).

Organizers: Professors M. Green (Queen Mary College, London, UK), R. Iengo (International School for Advanced Studies, ISAS-SISSA, Trieste, Italy), R. Iengo (International School for Advanced Studies ISAS-SISSA, Trieste, Italy), A.M. Polyakov (Landau Institute of Theoretical Physics, Moscow, USSR), S. Randjbar-Daemi (ICTP), A. Strominger (University of California, Santa Barbara, USA) and E. Sezgin (ICTP).

Lectures: *(School)* Strings and conformal field theories. Baby universes. BRST coordinate invariant path integral measure and conformal properties in two dimensions. Conformal field theories. Spacetime supersymmetry in string theories. Covariant quantization of Green-Schwarz superstring. Chiral rings and N = 2 superconformal theories. Two loop computations in superstring and quantum gravity. Supergravity/

superstring. Sigma-models and renormalization of string loops. Superstrings, super-Grassmannians and superconformal manifolds. Topics in superstring theory. Introduction to rational conformal field theory. N = 2 string theory. Duality and canonical transformations in conformal field theory. Physics and mathematics at the frontier. String theory at high energies.

(Workshop) Classical and quantum gravity from strings. An approach to constructing rational conformal field theories. 2-dimensional approach to string field theory. Yukawa couplings in scalar field theories. 2-dimensional conformal gravity & supergravity SL(2,R) algebra and extension. A general action for topological quantum field theories. Construction of massless closed string states in open string field theory. Wess-Zumino-Witten-Novikov model as a theory of free fields. Extended algebras and modular invariant partition functions. Superstrings with spontaneously broken supersymmetry and their effective theories. Perturbing induced gravity in 1 + 1 dimensions. BRST quantization and renormalization of topological quantum field theories. Minimal conformal field theories at and away from criticality and Toda field theories. Correlation functions for minimal models on the torus. Strings in an expanding universe. Geometry and topology of the moduli space of Calabi-Yau manifolds. Covariant quantization of Green-Schwarz superstrings. Conformal field theory of twisted vertex operators. Tachyons, topology changing of defining polynomials and renormalization group flows in N = 2 superconformal models. Background field equations for the heterotic string at non-zero temperature. Extensions of conformal symmetry: unitary representations and the BRST construction. Review of KN bases and applications. 4-dimensional heterotic superstrings from 13 dimensions. Operator formalism on higher genus Riemann surfaces. B-function as a gradient in coupling constant space: consequences, limitations, applications to string effective actions. A c theorem in 4-dimensions. Null spinning strings. Continuum Lie algebras and associated non-linear dynamical systems. An attempt of p-adic one-loop computation in open strings. World-sheet versus space-time symmetries in 4-dimensional superstrings. On the quantization of the Abelian Chern-Simons theory. Higher spin symmetries and higher spin gauge theories. Effective actions via string field theory. Geometry of quantum loops and knot theory. Simple approach to BRST.

The School and Workshop were attended by 191 lecturers and participants (58 from developing countries).

Title: WORKSHOP ON RADON MONITORING IN RADIO-PROTECTION, ENVIRONMENTAL RADIOACTIVITY AND EARTH SCIENCES (3 - 14 April).

Organizers: Professors L. Tommasino (ENEA-DISP, Rome, Italy), H.A. Khan (Pakistan Institute of Nuclear Science and Technology, Islamabad, Pakistan), and M. Monnin (Laboratoire de Physique Corpuscolaire, Aubiere, France), with the co-sponsorship of ENEA (Comitato Nazionale per la Ricerca e per lo Sviluppo dell'Energia Nucleare e delle Energie Alternative, Rome, Italy) and the Italian Direzione Generale per la Cooperazione allo Sviluppo (Ministry of Foreign Affairs, Rome, Italy) and under the auspices of the International Nuclear Track Society.

Lectures: The natural environmental radioactivity and the radon gas. The evolution of radiation; surveillance of the environment – the Italian experience. Indoor radon, health effects and future research trends. Radon in indoor air. The dosimetry of Po-210. The sampling strategy of national survey of radon. The radon chamber at NRPB and the intercomparison results. Active radon monitors. Passive-type detectors. Damage track detectors for alpha particle registration – track formation and detector processing. Radon monitoring in radioprotection (Algeria, Brazil, Mexico). The Bare detector and survey results. Spark counter for alpha particle registration. Radon monitoring in Peru mines. Plastic-bag radon gas monitor and survey results. The Bare detectors for short-term measurements. Gamma spectrometry of natural radionuclides. Laboratory experiments. Physical basis for radon emission and measurements; techniques (radon emanation, diffusion and transport, models for precursor signals and techniques). Geological prospection. Earthquakes: history and background; water measurements; soil measurements; models. Radon monitoring aimed to the study of seismic processes. Radon measuring in Hungary. Volcanoes: history and background; water measurements; soil measurements; models. Geochemistry applied to volcanic surveillance. Results of the present international collaboration on radon monitoring. Radon measurements in dwellings (China). Radon measurements in Bangladesh. Radon measurements in mines and caves (Hungary). Radon measurements in North Eastern of India. Radon survey in Saudi Arabia. Radon monitoring in earth sciences (Mexico). Radon as a signal to locate geothermal energy fields. Exposure to radon in houses in Adana. Radon measurements in houses in Kuwait. Radon measurements and Monte Carlo programme for efficiency calculations. The measurement of volume activity of radon in soil gas of bedrock of buildings. Radon monitoring in Amritsar (India). Measurements of uranium, radium and radon emanation rates in Monica phosphate sample. Radon measurements in dwellings in Madras City. Environmental radioactivity programmes in Egypt. Different examples of international scientific networks.

The Workshop was attended by 87 lecturers and participants (68 from developing countries).

Title: TOPICAL MEETING ON HYPERBOLIC GEOMETRY AND ERGODIC THEORY (17 - 28 April).

Organizers: Professors G. Gallavotti (Università "La Sapienza", Rome, Italy), M. Misiurewicz (University of Warsaw, Poland) and C. Series (University of Warwick, UK).

Lectures: Hyperbolic geometry. Infinite groups as geometric objects. Ergodic theory and subshifts of finite type. Geodesic and horocycle flows. Structure of hyperbolic groups. Symbolic dynamics, concrete examples. The limit set and Patterson measure. Closed geodesics and zeta functions. Möbius structures and the circular flow on Riemann surfaces. Continued fractions and related transformations. Horocycle-like flows and diophantine approximations. Renewal theorems and tesselations. Ergodic theory of billiards with hyperbolic behaviour. Super-hyperbolic geometry. Sullivan's non-wandering domains theorem – a sketch of the proof.

The Meeting was attended by 87 lecturers and participants (48 from developing countries).

Title: SPRING COLLEGE IN

MATERIALS SCIENCE ON "CERAMICS AND COMPOSITE MATERIALS" (17 April - 26 May).

Organizers: Professor N.H. March (University of Oxford, UK), Chairman of the Advisory Committee on Condensed Matter Physics, and the Members of the Committee, Professors P.N. Butcher (Warwick University, UK), G. Chiarotti (II Università di Roma, Rome, Italy), P. Fulde (Max-Planck-Institut für Festkörperforschung, Stuttgart, Federal Republic of Germany), F. García-Moliner (Instituto de Ciencia de Materiales, Madrid, Spain), F. Gautier (Université Louis Pasteur, Strasbourg, France), I.M. Khalatnikov (Landau Institute for Theoretical Physics, Moscow, USSR), S. Lundqvist (Chalmers University of Technology, Gothenburg, Sweden), C.-W. Lung (Institute of Metal Research, Shenyang, P.R. China), K. Singwi (Northwestern University, Evanston, USA) and M.P. Tosi (University of Trieste, Italy).

Lectures: Chemical bonding. Structure determination. Plasticity and fracture. Electron microscopy (transmission, scanning, Auger). Defects, disorder and diffusion. Electrical and thermal conduction. Deformation and creep. Sintering and microstructures. Applications of advanced ceramic materials. Theoretical developments on high temperature superconductors. Wetting. Optical properties of materials. High toughness and high temperature ceramics. Porous media. Phase diagrams and liquid structure. Simulation of performance of non-homogeneous materials. Positron annhilation. The mechanical performance of a SiC fibres reinforced matrix composites. Processing of ceramics and composite materials. Fast ion conductors. Strengthening of ceramics and composite materials. Fast ion conductors. Strengthening mechanisms and strong microstructures. Microstructure design. A strong-coupling mechanism in the high-T_c copper oxides. Solid ionic ceramic conductors and their applications. Li-insertion compounds. Structural properties of oxide superconductors. Radiation damage of ceramics. Present applications and future trends of ceramics and composites. Fibre strengthening of ceramics and glasses. Ceramic coating. Quasicrystals.

Working Group Seminars: Silicate-bonded ceramics of lateritic coils. Conductivity and dielectric properties of composite materials. Field ion microscopy in the study of topography. Demixing in doped transition metal oxides. Fast ion conducting materials – application to solid state ionic devices. Dielectric and optical properties close to the percolation threshold in thin films. Piezoelectric properties of polymer-ceramic composites. Sensitive nondestructive methods for dynamic defects characterization. A numerical calculation for the enhancement factor in X-ray fluorescence spectroscopy. NDT method for elastic modulus. Processes of glass-ceramics formation in a model metaphosphate glass: $NaPO_3$. Molecular and dynamic studies on the liquid-glass transition. Experimental methods for the determination of K_{1c} and slow crack growth parameters. Development of material resistant to radiation damage by fast neutrons. Bio-ceramics. Preparation of silicon nitride ceramics-mechanisms. Glass structure by Mössbauer and IR spectroscopy. Sulphate based solid electrolytes. Electron spin resonance in high temperature superconductors. Mechanics of deformed solids. Preparation and properties of hot pressed high T_c superconducting ceramics. Microstructure of high T_c superconducting ceramics. Glass forming ability in metallic alloys. Effect of heterogeneity on the chemical and mechanical properties of glasses. Fracture characteristics of three dimensional carbon-carbon composites. A model for transformation toughening in ZrO_2 alloys. Mechanical properties of high polymers: Time-temperature superposition. Heat resistant polymers. On critical currents in superconductors. Ferroelectric properties of $Ba_4Na_2Nb_{10}O_3$ doped with rare earth metallic ions. Microstructure of Al-SiO_2-Al_2O_3 composites obtained by liquid phase reactive sintering. Pencil lead tips for scanning tunneling liquid phase reactive sintering. Pencil lead tips for scanning tunneling microscopy – a field ion and field emission microscopic study. Development of sulphate based and other solid electrolyte materials for solid state batteries. Thick films of high temperature superconductors. Fabrication of thin films of high T_c superconductors. Thermodynamic properties of point defects in solids. Finite size effects in high T_c superconductors. The formal theory of nucleation and growth and its applications. Electrical and optical properties of glasses. Application of fracture mechanics to brittle materials. Hertzian fracture in ceramic single crystals. Microstructure and properties relations in ferroelectrics. Materials technology research at IGCAR, Kalpakkam (DAE), India. Effect of fast neutron irradiation on the phase transition of the A'A"BX_4 family. Preparation of Si_3N_4 and related materials. Steel surface coating by nitriding. Superionic conduction in some protonic materials. Physical properties of LISICON ceramic sample. Transport properties of YBaCuO granular and single crystal epitaxial films. XRD studies of the superconducting $SmBa_2Cu_3O_{7-\delta}$ phase. Effects of He absorption in BiSrCaCuO superconductors. Research in high T_c materials at the Centre for Space in Argentina. Surface segregation in alloys. Improvement of Iraq's building ceramics by sulphur impregnation. S.G. iron production in pit furnace. Structure and properties of 'non-linear optics' (NLO) materials. Some comments on the $YBa_2Cu_3O_7$ systems. Absorption on heterogeneous surfaces. Diffusion of gases in polymer films. Plastic instability in metallic tubes under multiaxial stress conditions. Surface fracture toughness for ceramics.

The College was attended by 137 lecturers and participants (107 from developing countries).

Title: CONFERENCE ON OXYGEN DISORDER EFFECTS IN HIGH T_C SUPERCONDUCTORS (18 - 21 April).

Organizers: Professors J.L. Moran-Lopez (Universidad Autónoma de San Luis Potosí, Mexico) and I.K. Schuller (University of California, San Diego, USA).

Lectures: Neutron diffraction studies of the role of oxygen in oxide high-temperature superconductors. studies of the role of oxygen in oxide high-temperature superconductors. Oxygen ordering in $YBa_2Cu_3O_{6+\delta}$: a phase diagram calculation. Neutron diffraction studies of oxygen ordering in high T_c compounds. Ordering of oxygen vacancies in YBaCuO. Electron microscopy and electron diffraction of short- and long-range order in $YBa_2Cu_3O_{7+\delta}$. Pseudo-binary phase equilibrium in 1-2-3 superconductors. Pulsed neutron studies of oxygen displacements. Oxygen kinetics in high T_c ceramics. Current-voltage characteristics of high T_c superconductors. High T_c superconducting oxide thin films. Configurational disorder and correlation effect on the electronic structure of $YBa_2Cu_3O_{6+\delta}$.

Tight-binding investigation: the electronic properties of ordered and disordered defects in the YBaCuO system. Electronic structure of cuprate and bismuthate superconductors. Cation and copper substitution studies of high T_c cuprate superconductors. Study of superconducting and parent phases by chemical substitutions. Oxygen disorder effects in $YBa_2(Cu_{1-x}M_x)3O_{7-y}$. Intrinsic superconducting properties of high T_c materials obtained through magnetization measurements. Characterization of twins and twin domains of YBaCuO single crystals by micro-Raman scattering. The effect of Fe substituents on the Cu superconductor oxides. Neutron diffraction evidence for oxygen-pairing in Bi-Ca-Sr-Cu-O superconductors. Oxygen effect on T_c for the oxide superconductor $YBa_2Cu_3O_x(6.3<x<7)$. Pseudobinary phase relations of $Ba_2YCu_3O_x$, $Li_2MgCu_3O_x$ and $La_4BaCu_5O_x$. Effect of oxygen vacancy concentration (δ) on the magnetic ordering of rare earth (R) ions in $RBa_2Cu_3O_{7-\delta}$ high T_c superconductors. Flux planning and thermally activated flux flow behaviour in single crystalline YBa_2CuO_7 and $Bi_2Sr_2CaCu_2O_8$. Magnetic vortex-antivortex pairing mechanism in La_2CuO_{4+y} superconductors. Dynamics of holes in Heisenberg antiferromagnets.

The Conference was attended by 74 lecturers and participants (39 from developing countries).

Title: FOURTH WORKSHOP ON PERSPECTIVES IN NUCLEAR PHYSICS AT INTERMEDIATE ENERGIES (8 - 12 May).

Organizers: Professors S. Boffi (Università di Pavia, Italy), C. Ciofi degli Atti (Università di Perugia and INFN, Italy) and M. Giannini (Università di Genova and INFN, Italy), in co-operation with the Istituto Nazionale di Fisica Nucleare (INFN, Rome, Italy).

Lectures: QCD and nuclei. Nucleon structure. Nucleon structure and chirality. Photo- and electro-disintegration of relativistic nuclei. Electromagnetic production of mesons and nucleon resonances from the nucleon and the deuteron. Coherent (γ, π°) on nuclei. Deuteron photodisintegration. One- and two-nucleon emission in photonuclear reactions. Exclusive photoreactions on light nuclei. Photonuclear reactions at intermediate energies. Hard processes in nuclei. Nucleon structure functions in nuclei. Deep inelastic lepton scattering. Many-body treatment of deep inelastic lepton scattering. The CEBAF status report. The TRIUMF kaon factory. Realistic nucleon-nucleon potentials in application to few-body systems. The structure of the nuclear wave function. The role of tensor force in magnetic states of heavy nuclei. Single particle occupation numbers and natural orbitals in the generator coordinate method. Medium effects on the form factors of the nucleon. Intermediate energy nuclear physics with electrons and protons. (p,n) and (n,p) reactions. Few-body problems in relativistic light cone dynamics. Projectile fragmentation on light nuclei. Single particle energies in local density approximation. High momentum transfer experiments on the nucleon and the deuteron. Inclusive electron scattering at high momentum transfer. NN correlations and electron scattering. Proton polarization in quasi-free (e,e'p) reactions. Vacuum fluctuation contribution to quasi-elastic scattering. Spectral function and electromagnetic responses in nuclear matter. Longitudinal and transverse inclusive response functions. Coincidence experiments in the GeV region. Inclusive electron scattering on nucleon and few-nucleon systems. Inclusive experiments on lead at Saclay. Exclusive experiments on ^{6}Li. (e,e'p) coincidence experiments at Bates. Exclusive experiments on heavy nuclei. Antiproton-proton scattering. Proton-antiproton annihilation in the quark model. Low energy antinucleon-nucleon physics. Antinucleon-nucleus interactions. Electric polarisability of the physics. Antinucleon-nucleus interactions. Electric polarisability of the nucleon. Quadrupole excitation of the Δ resonance. Threshold π° photoproduction and chiral symmetry. Excitation of the Δ resonance. Pion photoproduction in nuclei. Pion electro- and photoproduction in nuclei.

The Workshop was attended by 127 lecturers and participants (26 from developing countries).

Title: SPRING COLLEGE ON PLASMA PHYSICS (15 May - 9 June).

Organizers: Professors R. Bingham (Rutherford and Appleton Laboratories, Chilton, UK), B. Buti (Physical Research Laboratory, Ahmedabad, India), V. de Angelis (University of Naples, Italy), M.H.A. Hassan (Third World Academy of Sciences, Trieste, Italy), Yu-Ping Huo (Institute of Plasma Physics, Hefei, P.R. China), Sing Lee (University of Malaya, Kuala Lumpur, Malaysia), S. Mahajan (University of Texas at Austin, USA), B. McNamara (Leabrook Computing Ltd., Oxford, UK), P.H. Sakanaka (Universidade Estadual de Campinas, Brazil), N.L. Tsintsadze (Academy of Sciences of the USSR, Tbilisi, USSR).

Lectures: MHD oscillations in the sun. Plasma turbulence and electrojet phenomena. Alfvenic turbulence in beam-plasma systems. Auroral electron acceleration. Planetary plasma physics. Chaotic Alfven waves. Plasma physics via solar radioastronomy. Introduction to the physics of large amplitude plasma waves. Nonlinear effects in plasmas. Excitation of large amplitude plasma waves. Modulational instabilities. The modulational instability of copropagating and counterpropagating waves. Relativistic effects in plasmas. The compression of plasma by the self-focusing of short e.m. pulses. Nonlinear dynamics of e.m. waves/beams in plasmas. Relativistic instabilities of large amplitude waves in plasmas. Theory of phase conjugation in plasmas. Nonlinear evolution of Raman scattering. Accelerators for the 21st century. Laser plasma interactions. The nonlinear optics of plasmas: experimentalists' view. The beat-wave accelerator: simulation results and thermal wavebreaking. Laser-plasma interactions: recent experimental results. The beat-wave experiments. The wake-field experiments. A scaled beat-wave experiment with microwaves. Acceleration of charged particles at the non-linear stage of long-wavelengths Acceleration of charged particles at the non-linear stage of long-wavelengths plasma instabilities. Cold nuclear fusion – a recent review. Plasma turbulence: introductory review. Cavition dynamics in strong Langmuir turbulence. Phase space diffusion in turbulent plasmas. Kinetic processes for high energy particles in magnetic active laser-produced plasma. Stimulated scattering of large amplitude waves in the ionosphere: a theoretical review and experimental results. Simulations of ultra-strong Langmuir turbulence. Driven Alfven vortices. Statistical acceleration of auroral electrons. Plasma lenses. Plasma wigglers. Saturation and cross-field coupling of beat-driven 3-D plasma waves. Wave envelope simulations of beat waves. Short laser pulses: wake-beat

excitation of large amplitude plasma waves. Parametric processes in plasmas. Fluctuations and anomalous transport. R.F. heating and current drive. Magnetohydrodynamics. Muon catalyzed fusion. Reduced kinetic descriptions: gyrokinetics and quiver kinetics. Computer simulation. Kinetic theory. Cold fusion. Overview of the Third World Fusion programmes. Fusion programmes in: Argentina, Brazil, China, Egypt, India, Malaysia, Pakistan. International collaboration in fusion research. Small Tokamak experiments. Field reversed configuration experiments. Rotamak. Muon-catalysed fusion: a brief history. Hydrogen in metals. D20 – Electrolysis with Pd-cathode. Experiments on the verification of cold fusion. Electric probe measurements. Technology of REB & FEL. Plasma focus. Pulse technology. Pinches/plasma focus. State of the art of "cold fusion". Optical diagnostics. Basic plasma experiments. Diagnostics. A small research Tokamak-Central Research Institute for Physics, Budapest, Hungary. Dimensionality of density fluctuations in TBR-1. Model for decay of field reversal configurations. Observation of low-frequency instabilities in a toroidal magnetic field. Anomalous particle diffusion through a magnetic picked fence. Study of insulator sleeve and ceiling effect in matter-type plasma focus. Plasma focus neutrons: half life measurements of short-lived isotopes. Magnetic field and current field distribution profiles in 3.6 KJ UNU/ICTP PFF device. Studies of the operational modes of a low energy vacuum spark. Target techniques for the study of neutron production mechanism in a focus plasma. Effect of magnetic field and its configuration on the output of duoplasmatron. A current – stepping technique to enhance pinch compression – an experimental study. Ion acoustic Eigen modes in a collisionless bounded plasma. Ion diagnostics. Effect of edge electric field in a toroidal plasma.

The College was attended by 173 lecturers and participants (79 from developing countries).

Title: WORKING PARTY ON MODELLING THERMOMECHANICAL BEHAVIOUR OF MATERIALS (29 May - 16 June).

Organizer: Professor E.J. Savino (Comisión Nacional de Energía Atómica, Buenos Aires, Argentina).

Lectures: Introduction. Modelling plastic behaviour of polycrystalline metals. Description of the facilities available. Introduction to thermoelasticity. Introduction to finite element methods. Use of a finite element programme (SAP4). Demonstration from Convex and use of programmes as scheduled. Continuum and lattice models for composite materials. Plastic behaviour of anisotropic polycrystals. Informatics laboratory: Green's function; LAPP; QUEST; G.F.; dislocation model for thermal and irradiation creep; comparison between finite elements and finite difference methods for modelling thermomechanical properties; nuclear fuel modelling; implicit and explicit methods for modelling creep deformation. Elastoplastic behaviour of polycrystals. Rate theory of point defects. Deformation and failure modes for structural mechanics analysis. Nuclear fuel modelling. Fundamentals of fracture mechanics. Summary and conclusive remarks.

The Working Party was attended by 30 lecturers and participants (21 from developing countries).

Title: WORKING PARTY ON FRACTURE PHYSICS (29 May - 16 June).

Organizers: Professor C.W. Lung (Institute of Metal Research, Academia Sinica, Shenyang, People's Republic of China) and Dr. R. Thomson (National Bureau of Standards, Gaithersburg, MD, USA).

Lectures: Introduction. Elasticity and plasticity. Dislocations. Simulated annealing. Green functions. Statistical fracture mechanics. From dislocation dynamics to self-organized behaviour of dislocations. Different fractal structures dynamics to self-organized behaviour of dislocations. Different fractal structures along different directions on the fractured surface. Fractal dimension of H-cracking surface of metals. Tight binding approaches to defect structures. Simulation of cracks. Dislocation shielding. Molecular dynamical study of deformation and fracture for Cu bicrystals. Lattice models. Electron microscopy of crack. Observations of dislocation shielding. Cracks and fracture in silicon. Interfacial segregation. Dislocation dynamics and the brittle-ductile transition. Elastic theory of dynamic cracks. Observation of dislocation free zones at crack tips. Transformation toughening. Environmental effects in metals. Fracture in ceramics. Fracture and deformation in brittle and geologic materials. Cleavage crack tip deformation in Zn single crystal. Fatigue behaviour of SiC(P)/Al(6061) composite. Theory of chemical effects at cracks. Surface fracture of perspex as a fractal growth process.

The Working Party was attended by 37 lecturers and participants (16 from developing countries).

Title: SECOND ICFA SCHOOL ON INSTRUMENTATION IN ELEMENTARY PARTICLE PHYSICS (12 - 23 June).

Organizers: Professors C.W. Fabjan (CERN, Geneva, Switzerland), J.E. Pilcher (University of Chicago, USA) and P. Poropat (University of Trieste, Italy), with the assistance of the ICFA Panel for Future Instrumentation, Innovation and Development. Co-organizers: ICFA and Istituto Nazionale di Fisica Nucleare (INFN, Trieste, Italy). Co-sponsorship of the Direzione Generale per la Cooperazione allo Sviluppo, the European Organization for Nuclear Research (CERN) and the United State National Science Foundation (NSF).

Lectures: Introduction to laboratory sessions. Gaseous detectors. Physics limitations to particle detection. Electronics. Data acquisition and processing with small computers. Conceptual design of collider experiments. Calorimetry. Detectors for astroparticle physics.

The School was attended by 98 lecturers and participants (36 from developing countries).

Title: ANNIVERSARY ADRIATICO RESEARCH CONFERENCE ON "INTERFACE BETWEEN QUANTUM FIELD THEORY AND CONDENSED MATTER PHYSICS" (20 - 23 June).

Organizers: Professors E. Brézin (Ecole Normale Supérieure, Paris, France), H.A. Cerdeira (Brazil/ICTP) and Yu Lu (P.R. China/ICTP), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy).

Lectures: Overview of some uses of quantum field theory in condensed matter physics. Conformal field theory and statistical mechanics: an overview. Conformal field theory. Renormalization

of statistical parameter in three-dimensional Chern-Simons electrodynamics. Spin-Peierls ground state of low dimensional quantum antiferromagnets. Holes in a quantum antiferromagnetic: new approach and exact results. Conformal invariance and the operator content of general Heisenberg models. The simplest S-matrix of all. Fractional quantum statistics: possible relevance to high T_c superconductivity. Spontaneous generation of quantum holonomy – fractional Hall effect vs. anyon superconductivity in strongly correlated electron systems. Statistics transmutations in three dimensions. Renormalization group studies of anomalous diffusion in random media. Surfaces and polymers in random media. Flux phases in tight binding models. Recent results in the theory of random surfaces. The dynamic toughness of crystal surfaces. Compressibility and superfluidity in the fractional statistics liquid. Stochastic equations and BRS symmetry. Quantum gravity in 2-dimensions and string theory. Statistics for strings and gravity. Anderson transition. Universal singularities in the quantum Hall effect. The Landau-Boltzmann approach to localization. Introduction to quantum groups and some of their applications. Spin glasses: the order parameter and its interpretation. Slave bosons, 1/N expansion and the Anderson lattice model of heavy fermion systems. Large N limit of the two-Kondo impurity problem. Coulomb gas representation of conformal field theories. Fluctuations in granular superconductors: some hints towards new perspectives. Emergence in DLA growth of the shape of classical diffusion-controlled fronts. Path integrals with topological constraints: entanglement of strings. The integrable XXZ chain at criticality. Quantization of topological excitations in continuum models for high T_c superconductors. String statistical mechanics at high energy densities. Application of themo-field dynamics to the quantum spin glass problem.

The Conference was attended by 66 lecturers and participants (13 from developing countries).

Future Activities at ICTP in 1989

Quasicrystals (Anniversary Adriatico Research Conference)	4 - 7 July
Workshop on Superstrings	12 - 14 July
Conference on Supermembranes and Physics in 2+1 Dimensions	17 - 21 July
Strongly Correlated Electron Systems (Anniversary Adriatico Research Conference)	18 - 21 July
Symposium on "Highlights in Condensed Matter Physics"	1 - 3 August
Workshop on Phenomenology in High Energy Physics and Cosmology	16 - 18 August
Topical Meeting on Variational Problems in Analysis	28 August - 8 September
Computations in Physics and and Physics in Computation (Anniversary Adriatico Research Conference)	5 - 8 September
Adriatico Working Party on Condensed Matter Properties of Neutron Stars	11 - 29 September
Workshop on Materials Science and Physics of Nonconventional Energy Sources	11 - 29 September
Conference on Lasers in Chemistry	18 - 22 September
Workshop on Interaction between Physics and Architecture in Environment Conscious Design	25 - 29 September
Trieste Conference on Recent Developments in Conformal Field Theories	2 - 4 October
Fifth College on Microprocessors: Technology and Applications in Physics	2 - 27 October
Workshop on Soil Physics	9 - 27 October
College on Differential Geometry	30 October - 1 December
25th Anniversary Conference on "Frontiers in Physics, High Technology	
25th Anniversary Conference on "Frontiers in Physics, High Technology and Mathematics"	31 October - 3 November
Workshop on Telematics	6 - 24 November
ICTP & INFN Course on Basic VLSI Design Techniques	6 November - 1 December
Third Autumn Workshop on "Atmospheric Radiation and Cloud Physics"	27 November -15 December

For information and applications to courses, kindly write to the Scientific Programme Office.

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