International Centre for Theoretical Physics

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Science in the Service of Mankind

by Stig Lundqvist,
Chairman of the
ICTP Scientific Council

and

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Göteborg, Sweden

The following address was given at a reception in the honour of the 1987 Nobel Laureates in physics George Bednorz and Alex Müller at the Dolder Grand Hotel in Zürich on 30 March 1988.

It is a great honour for me to be invited to speak at this festive occasion in recognition of the path-breaking work by Georg Bednorz and Alex Müller, which promises nothing less than technological revolution within a near future. I would also like to congratulate IBM Research Laboratory Rüschlikon and the whole IBM Research organisation. It is a remarkable feat that the Nobel Prizes in physics in both 1986 and 1987 were awarded to scientists at the IBM Laboratory in Zürich. This shows not only the high calibre of the scientists themselves but is also a sign of the very special atmosphere which has been created here and which is conducive to new important developments. Of course this atmosphere has been created by the scientists themselves. Contrary to what many people believe, the IBM research is not always focussed on the more short time advances to reach particular technological goals. It also offers a large free sector in which their best scientists can take their own initiatives, and go out of the mainstream having the full support of the leaders and with little or no restrictions on time and resources. The prominent role of IBM in science has of course been well known for all of us in condensed matter physics for decades. The Nobel awards two years in a row have now attracted the attention of the entire international scientific community of IBM as a leading institution not only in high technology but also in basic science where it compares with the very best academic institutions. Because of the world-wide activity and program of IBM, this is not only a recognition but it involves also a great responsibility.

The theme of my talk tonight is about science in the service of mankind. My personal window looking out over this enormous problem is through my work at the International Centre for Theoretical Physics in Trieste since more than twenty years. This Centre was created by the genius of Abdus Salam, himself a Nobel Laureate in physics in 1979. It was created to help developing countries to contribute to the basic aspects of high energy, nuclear and condensed matter physics as well as geophysics and mathematics. Later on, areas of applied physics and high technology have been added for the reason that no new international centre with a similar mandate has been created for these areas. A proposal has now been made to extend the concept of Trieste to the other basic sciences like biology, chemistry and geology. The proposal is to create an **International Centre for Science and Technology**. Italy would be the major sponsor of such a centre. It should be mentioned that Italy since several years has been the major sponsor of the ICTP in Trieste.

There are four major areas of Science and Technology: (1) Basic Sciences, (2) Applied Sciences, (3) Classical Technology and (4) Science-based High Technology.

This planet is inhabited by two distinct types of humans, which I shall for simplicity call **the rich and the poor**. One quarter of mankind, or about 1.1 billion people are developed and they control 40% of the land area and about 80% of the natural resources. The developing humans - the 3.6 billion poor people - live on the remaining 60% of the globe. The rich countries enjoyed in 1983 an income of $800 monthly per capita, while the poor had an average of $60 per month per capita. Let me here focus on the 36 nations having a per-capita income less than $400 per year. **They correspond to nearly half the population of the world and they live on about $ 1 per day on the average!**

The rich countries suffer as a whole from two problems: (1) a nuclear psychosis and (2) unemployment. For the poor countries one can make a long list: (1) lack of food, (2) of shelter, (3) of clothing, (4) of health care, (5) of education, (6) of unemployment, (7) of overcrowding and (8) lack of security. They suffer also from the adverse terms of trade and the chronic indebtedness of the poor. There is presently a net outflow of funds - indeed the poor of this world is financing the rich!

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What do the rich do to help the poor?

Extremely little indeed. The international organisations like the United Nations and their professional agencies seem powerless. It really does not seem to help that they are in the hands of the Foreign Offices of the member nations and their Diplomatic Corps (the rich as well as the poor nations). Most developed nations have agreed to donate a mere 0.7 to 1% of their GNP to developing countries. However, in order to make this help really useful, the national aid agencies would need first-rate natural scientists on their staff rather than the third-rate social scientists, who are now dominating. **In addition to the official support, it would be very important if the educational and scientific institutions in developed countries would contribute in their own ways. IBM is definitely such an organisation.**

All our experiences from the ICTP in Trieste support the thesis that the situation of the poor countries can only be improved in a long-term perspective through an assisted **implantation of science and technology.** The economists have never appreciated the poor countries' need for Science and Technology - they have been mainly obsessed with the need of capital investment. Their favourite term has been the concept of **Technology Transfer.** We have seen too many examples of this with short-term investments to make use of cheap labour without permanent benefit for the host country. The movement of textile industry from the rich countries to, in turn, South Korea, Taiwan, Hong Kong, industry from the rich countries to, in turn, South Korea, Taiwan, Hong Kong, Malaysia, Thailand... is a good example.

Gradually the poor countries seem to realize that their future lies in Science and Technology. Money lies with high technology today, which has been demonstrated by the experience of Japan, South Korea, Taiwan, Singapore and others. For example, biotechnology as one of the new science-based technologies in likely to revolutionize agriculture, energy and medicine in the next century. The Third World system deeply needs the creation of a network of interacting institutions in basic sciences and high technology to develop a potential for their future.

Quality rather than quantity must be the name of the game in our help to the poor countries. To build up an institute without first class leadership and without a good scientific programme is just a waste of money. The donation of expensive equipment to a place lacking the scientific leadership and having no good scientific program will give no progress. The lack of potential leadership is a very difficult factor. We are having many good people in our programs in Trieste but the number of scientists who could take on the responsibility to be leaders for new scientific directions in their countries is very small. In my mind, one would always have to identify the potential leaders and focus the support on them and by all means keep out all the entrepreneurs who are always around the corner to put their hands on whatever support is available. In my opinion, small is beautiful and in most countries one should start by supporting a few strong personalities who would develop into scientific leaders of the national efforts.

These remarks take me back to Georg Bednorz and Alex Müller, the IBM Research Laboratory in Rüschlikon and IBM International. The discovery of the new high temperature superconductors has given rise to great expectations in many of the developing countries that they could be in on the ground floor in the new technological revolution that most of us expect will come. The IBM Nobel Laureates and many other IBM scientists have already been of tremendous help in our Trieste program. The IBM Vice-president for Science, Dr. Praveen Chaudhari, has program. The IBM Vice-president for Science, Dr. Praveen Chaudhari, has recently arranged a major donation of computer equipment to ICTP as well as given other forms of support. IBM Italy has really become our friend and is giving generous support to our programme. Through the good offices of Dr. Chaudhari an IBM support of equipment to a new institute in Brasilia is now being worked out. I believe that this pattern started by Dr. Chaudhari might be expanded world-wide. IBM is in the unique position to be represented world-wide at the highest level of standards in high technology. I believe that creating contact between the IBM and the local scientific leaders, and with some modest donations and seed money, would in many countries result in a catalytic process speeding up the entrance into the high technology age.

I close here by congratulating the Nobel Laureates and the whole IBM research organisation and hope that these outstanding scientific achievements will not only lead to dramatic advances in high technology but in a time perspective also to a better life for the poor majority of mankind.

The poorest nations

There are 36 nations with a GNP income less than $400 per capita (each with a population of one million or more). They are:

Asia: China, India, Laos, Vietnam, Kampuchea, Burma, Bangladesh, Bhutan, Nepal, Pakistan, Sri Lanka and Afghanistan.

Africa: Madagascar, Mozambique, Malawi, Burundi, Tanzania, Rwanda, Zaire, Uganda, Kenya, Somalia, Ethiopia, Burkina Faso, Sudan, Chad, Niger, Mali, Central African Republic, Ghana, Guinea, Sierra Leone, Senegal, Togo and Benin.

They account for nearly half the world's population (from Gerald Segal, Guide to the World Today, 1987).

Science and technology

1. Basic sciences: physics, chemistry, mathematics and biology.

2. Applied science: agriculture, energy, environment, earth science.

3. Classical technology: bulk chemicals, iron and steel, metals, ceramics, power generation.

4. Science-based high technology: new materials, microelectronics,

4. Science-based high technology: new materials, microelectronics, microprocessors, computer-aided design, high T_c superconductors, lasers, fibre optics and photonics, space science, pharmaceutical chemicals and biotechnology.

Dirac Medal Presenting Ceremony

Bryce DeWitt

On 30 May 1988, one of the two 1987 Dirac Medals of the ICTP was presented to Professor Bryce DeWitt from the University of Texas at Austin, in a ceremony held in the Main Lecture

Hall of the Centre.

After the introduction of Bryce DeWitt to the audience by Professor Abdus Salam, Prof. Ugo Leone, Director of the UN Centre for Social Defence in Rome, presented the Medal to the recipient with the following citation:

"Professor Bryce DeWitt is honoured for his fundamental contributions to the study of classical and quantum gravity and non-Abelian gauge theory. His pioneering work with quantum, effective action underlies much of the modern formalism. Particularly important are the background field method which he invented, and the methodology of ghost loops in gauge theory, which he did much to develop. His name is associated with the Wheeler-DeWitt equation, which provides the basis for most work on quantum cosmology, and with the Schwinger-DeWitt expansion, which is widely used in studying field theories in curved space-time and in string theory computations".

Immediately after the presentation, Bryce DeWitt delivered a brilliant lecture on curved space time propagators.

Professor Bryce S. DeWitt was born in Dinuba, California, on 8 January 1923. He studied at Harvard University, where he received his S.B., M.A. and Ph.D. in 1943, 1947 and 1950, respectively. He has been a Jane and Roland Blumberg Professor of Physics at the University of Texas at Austin since 1986. Professor DeWitt used to be a Member of the Institute of Advanced Study, Princeton, in 1949-50, 1954, 1964 and 1966. He worked as a Research Associate at the Eidgenössische Technische Hochschule (Zürich, Switzerland) in 1951-52, as a Fulbright Research Scholar at the Tata Institute of Fundamental Research (Bombay, India), and as a Senior Research Physicist at the Radiation Laboratory, University of California (Berkeley and Livermore) from 1952 to 1955. From 1956 to 1971, he was at the University of North Carolina at Chapel Hill as a Visiting Professor first, then as a Professor of Physics until 1965 and later as an Agnew Hunter Bahnson Professor of Physics. In 1972, he joined the University of Texas as a Professor of Physics where he also directed the Centre for Relativity (1972-1987). Professor DeWitt has held Visiting Professor positions at the University of Osaka, Japan (1964), Stanford University, California (1971), All Souls College, University of Oxford (1975-76) and many other special positions.

1964 and 1966. He worked as a Research Associate at the

Prof. B. DeWitt at the ceremony of presentation.

He is a Fellow of the American Physical Society and has been awarded the First Prize of the Gravity Research Foundation. He has lectured in the most prestigious Summer Schools like Les Houches and Cargèse in France and Varenna in Italy. He is the author of seventy scientific papers.

The other 1987 Dirac Medal will be seventy scientific papers.

The other 1987 Dirac Medal will be presented to Prof. B. Zumino from the University of California at Berkeley, on 26 July 1988.

The names of the 1988 Dirac Medal recipients will be announced on 8 August 1988 – the birthday of the late P.A.M. Dirac.

Activities at the ICTP from April to June 1988

Title: INTERNATIONAL MEETING ON LARGE-SCALE STRUCTURE AND MOTIONS IN THE UNIVERSE (6 - 9 April 1988).

Organizers: Professors J. Audouze, A. Cavaliere, G. Chicarini, G. Ellis, M. Geller, M. Hack, P. Osmer, M. Rees, D. Sciama, G. Setti, M. Abramowicz, G. Giuricin, F. Mardirossian, M. Mezzetti, M. Ramella.

Lectures: Structure and motion on large scales. Dwarf galaxies and large scale structure. The X-ray log N - log S relation. Distribution of dark matter in galaxies. Large-scale motions in the nearby universe as determined from elliptical galaxies and spiral galaxies. Space distribution of clusters of galaxies in X-rays. Information on the large-scale structure from the X-ray sky. The formation of the large scale structure. Distribution of gravitating matter. Theoretical framework on the formation of the large-scale structure in the universe. Theoretical implications of deviations from Hubble flow. Fractal and multifractal models, and the issue of the location of the crossover to homogeneity. The anisotropies of the cosmic background radiation. The model of baryonic islands of large structures. AGNs and large scale structure. Microwave background. The baryonic isocurvature model. The large-scale distribution of IRAS galaxies. Quasar clustering and the evolution of structure. A Redshift survey of faint galaxies. Structures 10% of the scale of the horizon. Constraints on galaxy formation scenarios from the IRAS point sources catalogue. X-ray background, discrete sources and diffuse processes.

The Meeting was attended by 129 lecturers and participants (10 from developing countries).

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Title: EXPERIMENTAL WORKSHOP ON HIGH TEMPERATURE SUPER-CONDUCTORS (11 - 22 April 1988).

Organizers: Dr. E. Babic (University of Zagreb, Yugoslavia), Dr. F.C. Matacotta (Istituto per la Tecnologia dei Materiali Metallici Non Tradizionali, ITM-CNR, Milan, Italy), Prof. C. Rizzuto (University of Genoa, Italy) and Prof. M. Tosi (University of Trieste and ICTP, Italy).

Lectures: Phenomenology and Ginzburg-Landau theory. Chemistry of perovskite oxides. Josephson and related macroscopic quantum phenomena. The

crystal chemistry and structures of high T_c superconducting oxides. Granular aspects of high T_c superconductors, intergrain coupling, critical current, glassiness. Flux quantization and quantum devices. Applications of nuclear resonance techniques in high T_c superconductors. Critical currents, magnetization and susceptibility measurements in granular superconductors. Introduction to X-ray diffraction activity. Tunnel spectroscopy. High field applications of superconductivity.

Experimental activities: Compound stoichiometry. Powder weighing and mixing. First reaction. Quenching of samples. Grinding. Second reaction. Quenching and grinding. Die pressing. Final heat treatment. Compound final heat treatment. Flux quantization demo. Levitation check. Resistivity measurement. Compound first heat treatment. X-ray diffraction patterns. Compound: grinding, mixing, second heat treatment, final heat treatment and susceptibility measurement. X-ray data processing.

The Workshop was attended by 102 lecturers and participants (84 from developing countries).

Title: SPRING SCHOOL AND WORKSHOP ON SUPERSTRINGS (11 - 22 April 1988).

Organizers: Professors M. Green (Queen Mary College, London, UK), M. Grisaru (Brandeis University, Waltham, USA), A. Strominger (University of California, Santa Barbara, USA).

Lectures: *(Spring School):* Recent California, Santa Barbara, USA).

Lectures: *(Spring School):* Recent developments in string theory. σ-models and β-functions. String perturbation theory: bosons, fermions. Supermembranes. Overview of non-perturbative approaches. Conformal field theory. Four-dimensional strings. The covariant lattice construction of 4-D strings. Conformal field theory and statistical mechanics. Superstring model building. Fusion rules and modular transformations. Loop calculations for superstrings. Virasoro and modular invariance and string field theory topics. Super Riemann surfaces. Two loops computations. N = 4 super conformal algebra.

(Workshop): Open Riemann surfaces and strings. On partition functions in string theory. The partition function of the SO(8192) bosonic string. BRST extension of a string propagator. Equivalence of the scattering amplitudes of the light cone gauge and the Osp(26,212) invariant string field theories. Covariant field theory of interacting closed strings. On the operator solution of the Liouville theory. Genus two fermionic partition functions in the separating pinching limits. Hidden symmetries in superstrings. Asymmetric string compactification and chiral bosons. A gauge invariant Lagrangian in topological quantum field theory. Dynamical symmetry breakings on a nontrivial topology. Four-dimensional supergravity from 4-dimensional strings. Non-linear realization of the Virasoro-Kac-Moody algebra and the anomalies. Extended supersymmetric σ models on group manifolds. New N=4 superconformal current algebras from group manifold σ models. Hierarchy of the Yukawa couplings from orbifold compactification. On the supersymmetry anomaly at the (4,0) σ models. SUSY breaking in 4d strings. Operator formalism for superstrings. On the fermionic ambiguity in the superstring measure. String couplings from meromorphic differentials. Four-point p-adic string amplitudes. Connections on vector bundles over super Riemann surfaces. Operatorial formalism at genus g by using the Krichever-Novikov algebra. WKB quantization, massless states and supermembranes. Incurable p-brane anomalies. The supermembrane: a model in supersymmetric quantum brane anomalies. The supermembrane: a model in supersymmetric quantum mechanics. Properties of the stress tensor in more than two dimension. Curved superspace and extended objects. Strings and quantum gravity. Particle scattering at the Planck scale. The superparticle descriptions with Grassmann variables or with c-number spinors. The 3-loop β-function for the 2-dimensional nonlinear σ models with a Wess-Zumino-Witten term. Anomalies in membrane symmetry algebras. Supermembranes and signature of space time. Singletons. Off-shell singletons. Open p-branes. Light-cone auxiliary fields for ten-dimensional super Yang-Mills. Supercurrents and covariant lattices. Degenerate orbifolds.

The School and Workshop were attended by 231 lecturers and participants (69 from developing countries).

Title: SCHOOL ON NON-ACCELERATOR PHYSICS (25 April - 6 May 1988).

Organizers: Professors E. Bellotti (University of Milan, Italy), G. Giacomelli (University of Bologna, Italy) and J. Stone (Boston University, USA).

Lectures: Standard model of particle physics. Beyond the standard model. Very high energy neutrinos and γ rays. The Gran Sasso Laboratory. Neutrino mass and double rate decay experiments. Dark matter and related experiments. Extensive air shower arrays. Superconducting detectors of weakly interacting particles. Cosmic rays and elementary particle physics (From the discovery of the mu-meson to the discovery of its leptonic nature). Gravitational waves. Very high energy γ ray astronomy in India. Optical and X-ray observations of the Supernova 1987A. Particle physics with balloons, satellites and space stations. Solar neutrinos or dark matter detection. Solar neutrinos, neutrino oscillations. Standard cosmology – status and experiments, superstrings implications to particle physics and cosmology. Large existing underground detectors. Magnetic monopoles searches. High energy collisions. Double β decay with accelerators or single atom counting techniques to search for hypothetical particles.

particles.

The School was attended by 55 lecturers and participants (29 from developing countries).

Title: SPRING COLLEGE IN CONDENSED MATTER ON "THE INTERACTION OF ATOMS AND MOLECULES WITH SOLID SURFACES" (25 April - 17 June 1988).

Organizers: Professors P. Butcher (University of Warwick, UK), G. Chiarotti (II Università di Roma, Italy), P. Fulder (Max-Planck-Institut für Festkörperforschung, Stuttgart, Federal Republic of Germany), F. Garcia-Moliner (Instituto de Ciencia de

Materiales, Madrid, Spain), F. Gautier (Université Louis Pasteur, Strasbourg, France), S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden), Chi Wei Lung (Institute of Metal Research, Academia Sinica, Shenyang, P.R. China), N.H. March (University of Oxford, UK), K. Singwi (Northwestern University, Evanston, USA) and M.P. Tosi (University of Trieste and ICTP, Italy).

Resident Directors: Professors V. Bortolani (University of Modena, Italy) and J.L. Moran Lopez (Universidad Autónoma de San Luis Potosí, Mexico).

Lectures: Chemical bonds outside solid surfaces. Basic structural and electronic properties of semiconductor surfaces. Basic electronic properties of metal surfaces. Gas-surface interactions (Basic thermodynamics and recent work on sticking). Basic vibration properties of surfaces. Atomic and molecular scattering from surfaces. The sticking of a reactive particle. Low energy electron diffraction. Adsorption (experimental and theoretical). Inelastic He atom-surface scattering: The surface phonons of metals. Scanning tunnelling microscopy. Surface ionization of polyatomic molecules and applications. Rate processes. Sructure of adsorbates. Surface ferromagnetism. Ion backscattering from clean and low coverage adsorbate surfaces. Surface phonons and their spectroscopy by He scattering. Adsorption-desorption kinetics, dynamical effects. Characterization of adsorbates by electron spectroscopy. Surface phonon calculations in noble metals. Magnetocatalytic and magneto-optic calculations in noble metals. Magnetocatalytic and magneto-optic processes. Molecular conformations outside surfaces. Photoemission from adsorbates. Surface reactivity and fundamentals of catalysis. Surface melting. Surface diffusion. Dynamical and dissipative effects in chemisorption (and catalysis) on metal surfaces. Molecular scattering from surfaces. Collective surface excitations. Defect structures at surfaces. Reactions on surfaces and catalysis. Surface phenomena in the theory of crystal growth. Growth processes at surfaces. High resolution He-scattering: surface perfection, damaging, roughening; lateral distribution and diffusion of adsorbates, thermodynamics, structure and dynamics of physisorbed layers. Tight binding method applied to tunnelling chemisorption and physisorption. Metal monolayers on surfaces. Oxygen/hydrogen-reaction on the (111)-surface of platinum.

Group activities programme: *Interfaces* (Superlattices. Physicochemical changes in silicon surfaces due to Ar^+ ion bombardment, annealing effect. High resolution multipurpose ESCA instrument: application to silicon-platinum interfaces. Clean and cobalt covered tungsten carbide ARUPS study.). *Electronic properties* (Experiments on magnetism in 2D-systems. Electronic structure of metallic glasses. Surface segregation in gas-covered metal alloys. Ion neutralization spectroscopy of surface electronic states. Standardless methods of alloy analysis with electron beam. Core-level binding-energy shifts in adsorbed clusters (theory). The influence of the crystal band structure on image states. Collective modes in a quasi-two dimensional system of electrons.). *Atomic dynamics and diffusion* (SIMS and applications. Analysis of materials with high energy particles. Non additivity of Auger electron spectra on the bombardment of diatomic molecules on surfaces. Imaging of strain metal surfaces and changes of structure and composition of string region under ion bombardment. Methods of computer simulation in the study of atom-surface interaction. Ion-photon emission and ion-photon spectroscopy. Cluster's tight binding studies of secondary ion emission. Study of surface diffusion by the field emission method. secondary ion emission. Study of surface diffusion by the field emission method. Ion-induced Auger electron emission.). *Surface reactions and catalysis* (Transmission electron microscopy of catalytic materials. Interaction of SiH_n molecules with a-Si:H. Potential energy surface computation of adsorption of H_2 on Ni, Cu metal and bimetallic clusters. ^{29}Si, ^{27}Al and ^{31}P solid NMR and FI-IR studies on the nature of a silicon-aluminium phosphate with the zeolite structure of the Faujasite. Theoretical studies of the geometry and vibrations of molecular adsorption: Acetylene. Dynamic scaling for fragmentation of porous media (computer simulations). The chemisorption and methanation of CO on Rh surface – a FIM* atop probe study. Interaction of an ionic solution with charged porous media.). *Phase transitions on surfaces* (Oxygen ordering in the basal plane of the superconductor $YBa_2Cu_3O_{6+\delta}$. Construction of two-dimensional phase diagrams by tensiometric trajectories. Semimagnetic semiconductor superlattices. On the ordering of oxygen in the basal plane of the high T_c superconductors. Surface phase transitions in binary alloys: A phenomenological approach. Kinetics of recrystallization and precipitation in copper and copper-alloys.). *Adsorption and desorption* (Phonon spectra for metallic surfaces. *Ab initio* studies of CO adsorbed on copper surface. The dynamics of chemisorption of H_2 on Fe surface. Chemisorption of submonolayer alkali-metal on transition metal surface. Electron and energy properties of small clusters adsorbed on metal surfaces (theory). Angle-resolved thermal desorption of atoms from solid surfaces.). *Structural properties* (Structure determination from alternative LEED techniques. Radiation damages in zeolites in the electron microscopy. EXAFS study of local structure in non-crystallites. Calculation of surface phonons in covalent semiconductors. Monte Carlo simulation of surface oxidation: Application to Si(111) surfaces. The influence on non-structural parameters on LEED.). *Optical properties* (Modulation techniques for optical characterization of semiconductors. Optical constants determination using ATR. Thermoreflectance spectroscopy of FaAs:Ge. Optical properties of defects in ionic crystals. Raman spectra in FaAs:Ge. Optical properties of defects in ionic crystals. Raman spectra in YBaCuO and similar compounds.).

The College was attended by 131 lecturers and participants (84 from developing countries).

Title: WORKSHOP ON MODELLING OF THE ATMOSPHERIC FLOW FIELD (16 - 20 May 1988).

Organizers: Professors D.P. Lalas (Wayne State University, Detroit, USA) and C.F. Ratto (University of Genoa, Italy).

Lectures: Parametrization of turbulent fluxes in BL models. Observations and models of flow over

complex terrain. Boundary layer flow in complex terrain. Wind-flow estimations in complex terrain: Wind-energy and wind-loading applications. The sea-land breeze as a local wind. BZ and WAsP models for flow in complex terrain. The EDF simulation models. The use of a mass consistent model in wind energy siting.

The Workshop was attended by 45 lecturers and participants (27 from developing countries).

Title: COURSE ON PHYSICAL CLIMATOLOGY AND METEOROLOGY FOR ENVIRONMENTAL APPLICATIONS (23 May - 17 June 1988).

Organizers: Professors R. Guzzi (Institute for Geophysical and Environmental Methodologies of the National Research Council, IMGA-CNR, Modena, Italy), J. Shukla (University of Maryland, College Park, USA) and B. Primault (Institute of Meteorology, Zürich, Switzerland).

Lectures: The observational network and data collection. The equations of the atmosphere. Data assimilation and initialization. Model equation and types of models. Introduction to parameterization. Introduction to basic numerical techniques. Global boundary conditions. High frequency variability. The planetary boundary layer. The dynamics of mid-latitude cyclones. Continuous four-dimensional assimilation. Assimilation and initialization. The parameterization of land processes. The low frequency variability in the tropics. The parameterization of moisture effects. The parameterization of vertical mixing. Frontogenesis. Prediction of Easterly waves over Africa and the North Atlantic by the ECMWF model: synoptic and statistical results. Global tropical variability: Inter-annual, intra-seasonal and decadal variability. Predictability of the tropical atmosphere: Short range. Current NWP activity in Japan. Predictability of the tropical atmosphere: long range. Forecasting the monsoon. Numerical weather forecasting in Japan. Studying of 1982/83 El Niño and S.O. with unoccupied GCMs. Theories of the low-frequency variability. Atmosphere-land interaction. NWP activity in India. Current forecasting research at ECMWF. Current forecasting research at NMC. Numerical simulation of Monsoons in East Asia. Atmosphere energetics in the Tropics. Synoptic aspects of the Central Chile rainfall variability associated with warm and cold events in the central equatorial Pacific. A review of the research on long-range forecasting in China. The inter-annual climatic variability of the Caribbean and South America related to ENSO. Current problems and perspectives of NWP. Seasonal forecasts with a coupled model: preliminary studies. Current forecasting at the Italian meteorological services. Predictability of extended range forecasts. Current NWP activity in China. Systematic and transient errors of current forecasting models: descriptions and causes. Satellite meteorology. Mathematical inversion techniques. Application of radiative transfer equations in the atmosphere. Remote sensing of the atmosphere. Cloud clearing. Diffuse solar radiation measurement in Malaysia. Turbidity over Cairo. Estimation of solar energy in Peru. Global solar radiation in Ethiopia. Surface properties from satellite. Estimation of radiation on slopes. Processing and analysis of research class solar radiation data. The importance of model year solar radiation data for use in solar applications. Ground solar measurements: present and future applications. Estimation of long-wave radiation. Atmospheric minimization: Case studies. Estimation degree days. Introduction to agrometeorology studies. Agrometeorological service in Switzerland. Modelling the phenology. Perspectives of the agrometeorological service in the Sahel. Phenology as an aid in climate studies. Italo-Yugoslavian research on hailstorms. Research in the field of IR radiative transfer at IMGA. Use of Markov chains to predict the probability of different incident solar radiation levels in Guatemala. Soil moisture availability from a boundary layer model combination with satellite imagery. Radiation measurements and data processing in Czechoslovakia. Gaussian plume model as applied to two tropical stations. Numerical simulation of tropical cyclones. Climatic aspects related to forest fires in Southern Argentina. Modification of air flow due to the formation of a reservoir. Spectral irradiance model. An agrometeorological information system based on image processing and computer mapping. A crop yield model for cropping strategies in the seasonally arid tropics. Climatic water budget elements as a determinant of agriculture with reference to Nepal. Atmospheric ozone distribution over Iraq. The regional meteorological service of Emilia-Romagna. Net radiation for agricultural purposes in Egypt. Hail studies in Bulgaria. Evaporation measurement and analysis in the Dead Sea area.

The Course was attended by 103 lecturers and participants (65 from developing countries).

Title: ADRIATICO RESEARCH CONFERENCE ON: "UNOCCUPIED ELECTRONIC STATES" (21 - 25 June 1988).

Organizers: Under the chairmanship of Professor S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden): Professors J.C. Fuggle (Katholieke Universiteit, Nijmegen, The Netherlands), R. Rosei (University of Trieste, Italy) and G.A. Sawatzky (Rijksuniversiteit Groningen, The Netherlands), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy), Sincrotrone Trieste (Italy), the University of Groningen (The Netherlands) and the University of Nijmengen (The Netherlands).

Lectures: Optical studies. DOS calculations and corrections for comparison with spectroscopies especially for unoccupied states. The DOS and multiple scattering approaches to unoccupied states. Matrix elements in BIS. Core hole effects in XAS. BIS and measurements of Coulomb correlation energies. Self energies, real and imaginary. Theoretical studies of self-energies and lifetime broadening. Transition metal compounds. Multiplet structure in XAS and its use as a probe of ground state electronic structure in the solid state. Some thoughts on the theory of multiplet structures in XAS of solids. ELS studies of unoccupied DOS. Multiphoton studies of unoccupied states at surfaces and in adsorbates. Angle resolved inverse photoemission. Spin

polarized inverse photoemission. Many-body effects on the single particle band structure of single metals. Photon emission with the scanning tunnelling microscope. Computation of excited and negative affinity states in molecules and clusters. Inverse photoemission of surfaces and adsorbates. Uses of symmetry in XAS, especially for adsorbates. The electronic structure of surfaces. Theoretical studies of the scanning tunnelling microscope. Unoccupied surface states and resonances on transition metal surfaces: theoretical aspects. On semiconductors and metal-semiconductor interfaces.

The Conference was attended by 61 lecturers and participants (8 from developing countries).

Future Activities at ICTP

1988	
Computer Simulation Techniques for the Study of Microscopic Phenomena	19 - 22 July
Towards the Theoretical Understanding of High T_c Superconductors	26 - 29 July
Fifth Trieste Semiconductor Symposium (IUPAP): 4th International Conference on Superlattices, Microstructures and Microdevices	8 - 12 August
Summer School on Dynamical Systems	16 August - 9 September
The Application of Lasers in Surface Science	23 - 26 August
Working Party on "Electron Transport in Small Systems"	29 August - 16 September
Frontier Sources for Frontier Spectroscopy	30 August - 2 September
Summer Workshop on Dynamical Systems	5 - 23 September
Fourth Summer College in Biophysics	12 September - 7 October
Course on Ocean Waves and Tides	26 September - 28 October
College on Medical Physics	10 October - 4 November
First Atumn Workshop on Mathematical Ecology	31 October - 18 November
College on Neurophysics: "Development and Organization of the Brain"	7 November - 2 December
Workshop on Global Geophysical Informatics with Applications to Research in Earthquake Predictions and Reduction of Seismic Risk	15 November - 16 December
College on Global Geometric and Topological Methods in Analysis	21 November - 16 December

1989	
Fourth Workshop on Total Energy and Force Methods	4 - 6 January
Workshop on Theoretical Fluid Mechanics and Applications	9 - 27 January
Course on Basic Telecommunications Science	9 January - 3 February
College on Atomic and Molecular Physics: Photon Assisted Collisions	[illegible]
College on Atomic and Molecular Physics: Photon Assisted Collisions in Atoms and Molecules	30 January - 24 February
College on Theoretical and Experimental Radiopropagation Physics	6 - 24 February
Workshop on Space Physics: Materials in Microgravity	27 February - 17 March
Workshop on Remote Sensing Techniques with Applications to Agriculture, Water and Weather Resources	27 February - 21 March
Experimental Workshop on High Temperature Superconductors	30 March - 14 April
Spring School and Workshop on Superstrings	3 - 14 April
Workshop on Radon Monitoring on Radioprotection, Environmental Radioactivity and Earth Sciences	3 - 14 April
Topical Meeting on Hyperbolic Geometry and Ergodic Theory	17 - 28 April
Spring College on Materials Science on "Ceramics and Composite Materials"	17 April - 26 May
Conference on Oxygen Effects in High T_c Superconductors	18 - 21 April
Fourth Workshop on Perspectives in Nuclear Physics at Intermediate Energies	8 - 12 May
Spring School on Plasma Physics	15 May - 9 June
Working Party on Modelling Thermomechanical Behaviour of Materials	29 May - 16 June
Working Party on Fracture Physics	29 May - 16 June

Second ICFA School on Instrumentation in Elementary Particle Physics	12 - 23 June
Research Workshop in Condensed Matter, Atomic and Molecular Physics	19 June - 29 September
Interface between Quantum Field Theory and Condensed Matter Physics (Adriatico Conference)	20 - 23 June
Conference on Supermembranes	26 - 30 June
Summer School in High Energy Physics and Cosmology	26 June - 18 August
Quasicrystals (Adriatico Conference)	4 - 7 July
Strongly Correlated Electron Systems (Adriatico Conference)	18 - 21 July
Topical Meeting on Variational Problems in Analysis	28 August - 8 September
Computations in Physics and and Physics in Computation (Adriatico Conference)	5 - 8 September
Workshop on Nonconventional Energy Sources	11 - 29 September
Workshop on Physics in Environment Conscious Design	25 - 29 September
25th Anniversary Conference on "Frontiers in Physics, High Technology and Mathematics"	2 - 6 October
Workshop on Soil Physics	9 - 27 October
College on Microprocessors	9 October - 3 November
College on Differential Geometry	30 October - 1 December
Workshop on Telematics	6 - 24 November
Workshop on "Atmospheric Radiation and Cloud Physics"	27 November -15 December
College on Electron Microscopy	27 November - 22 December

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

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EDITORIAL NOTE - *News from ICTP* is not an official document of the International Centre for Theoretical Physics. Its purpose is to keep scientists informed on past and future activities at the Centre and initiatives in their home countries. Suggestions and criticisms should be addressed to Dr. A.M. Hamende, Scientific Information Officer.