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INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

Scientific Activities in 1987

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INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS:
SCIENTIFIC ACTIVITIES IN 1987
IAEA, VIENNA, 1988
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PART I

A REVIEW OF THE SCIENTIFIC ACTIVITIES IN 1987 at the International Centre for Theoretical Physics, Trieste, Italy

GENERAL

The main fields of research and training-for-research at the Centre in 1987 were:

(a) Fundamental physics (high energy and particle physics, cosmology and astrophysics);
(b) Condensed matter, atomic and molecular physics (atomic and molecular physics, materials science, surfaces and interfaces);
(c) Mathematics (geometry, topology, differential equations, mathematical physics);
(d) Physics and energy (nuclear physics and fission, plasma physics and nuclear fusion, non-conventional energies);
(e) Physics and environment (soil physics, climatology and meteorology, physics of the atmosphere, magnetosphere, aeronomy);
(f) Applied physics and high technology (applicable mathematics, microprocessors, communications, instrumentation) and
(g) Physics and development.

Some 3700 scientists took part in the activities of the Centre, in three major projects outside Trieste and in the Programme for Training at Italian Laboratories, staying for a total of almost 3900 man/months. Over 58% of them were from developing countries, accounting for 83% of the total man/months. One-hundred and forty-nine of them were associated members from 45 developing countries and 576 of them were researchers from federated institutes in 56 developing countries.

FUNDAMENTAL PHYSICS

Research in high-energy physics was carried out throughout the year, with the participation of 120 physicists from developing countries out of a total of 201. A two-week school and workshop on superstrings held in April was attended by 75 physicists from developing countries out of a total of 258. The now traditional Summer Workshop in High Energy Physics (including, this time, a topical conference on scalar fundamental particles) was held in June-August, with an audience of 125 physicists from developing countries (out of a total of 206); it was preceded by a meeting on new scale effects in low-energy precision experiments.

CONDENSED MATTER, ATOMIC AND MOLECULAR PHYSICS

Research was conducted throughout the year with the participation of 75 scientists from developing countries out of a total of 102. Three high-level training courses (the Winter College on Atomic and Molecular Physics, the Spring College on Metallic Materials and the School on Polymer Physics) were attended by 228 scientists from developing countries out of a total of 299.

The annual Research Workshop in Condensed Matter, Atomic and Molecular Physics, which was held from the end of June to the beginning of September, was attended by 190 physicists from developing countries out of a total of 227. Other activities included: the Third International Workshop on Total Energy and Force Methods, a workshop on surface science and catalysis, a working party on the physics of porous media, and a workshop on non-linear charge density wave systems. They brought together 239 physicists, out of whom 99 were from developing countries.

MATHEMATICS

Research in mathematics, carried out throughout the year, brought together 36 mathematicians from developing countries out of a total of 47. The scientific meetings organized by the Mathematics Group included a topical meeting on fibre bundles and the College on Riemann Surfaces, attended by 88 scientists from developing countries out of a total of 141.

PHYSICS AND ENERGY

The Third Workshop on Perspectives in Nuclear Physics at Intermediate Energies, organized by the Centre in collaboration with the Italian National Institute of Nuclear Physics (INFN, Rome), was attended by 22 scientists from developing countries out of a total of 115. The Spring College on Plasma Physics, which included an international conference on cometary plasma physics followed by a workshop on the subject, was attended by 99 physicists from developing countries out of a total of 153. At the end of August and in September, the following activities took place: the Workshop on Material Science and the Physics of Non-conventional Energy Sources, co-sponsored by the Italian Department for Cooperation to Development and the Italian National Research Council; the Workshop on the Economics, Modelling and Management of Energy, co-sponsored by the Kuwait Foundation for the Advancement of Science; and the Workshop on the Interaction between Physics and Architecture in Environment Conscious Design. Two hundred and fifty-four scientists from developing countries took part in these activities out of a total of 329.

PHYSICS AND ENVIRONMENT

The Spring College on Geomagnetism and Aeronomy, the Third College on Soil Physics and the Second Workshop on Cloud Physics and Climate were attended by 226 scientists from developing countries out of a total of 286.

APPLIED PHYSICS AND HIGH TECHNOLOGY

The Second Workshop on Mathematics in Industry and the Workshop on Remote Sensing and Resource Exploration were held in February-March. In June, the International Committee for Future Accelerators held a School on Instrumentation in Elementary Particle Physics at the Centre. For the first time since its inception, the Centre organized a workshop on telematics, which was followed by the Fourth College on Microprocessors - Technology and Applications in Physics. Five-hundred and twenty-six scientists, of whom 351 came from developing countries, participated in these meetings.

ADRIATICO RESEARCH CONFERENCES

Seven "Adriatico Research Conferences" were held. They dealt with: one-dimensional organic conductors, vacuum in non-relativistic matter-radiation systems, scanning tunneling in microscopy, interatomic forces in relation to defects and disorder in condensed matter, high-temperature superconductors, path integral, and synchrotron radiation and free electron lasers. These meetings were attended by 133 scientists from developing countries out of a total of 503.

PHYSICS AND DEVELOPMENT

As in the past, a number of the experts and leading scientists taking part in the activities at the Centre lectured on physics and its relevance to development. Forty-nine lectures were given in 1987.

TRAINING AT ITALIAN LABORATORIES

One-hundred and four grants were awarded to scientists from developing countries for training at Italian academic and industrial laboratories under a programme which started in 1982 with the financial support of the Government of Italy.

EXTERNAL ACTIVITIES

A Workshop on Microcomputers in the Teaching of Physics and Mathematics was held in Sudan, the Workshop on the Fabrication of Low-cost Laboratory Equipment for Physics was held in Tanzania, and the Workshop on the Applicability of Environmental Physics and Meteorology in Africa was held in Ethiopia. In the field of training for physics and mathematics teachers, the Centre sponsored 79 courses, workshops and symposia in 33 countries. In addition, the Centre sponsored 5 scholarships for scientists wishing to work at 5 research institutions in developing countries; this programme was financed by the Government of Italy.

MEETINGS HOSTED BY THE CENTRE

The Centre hosted a meeting of the Initiative Committee of the International Foundation for Survival and a Workshop on Scientific and Technological Applications of Synchrotron Radiation.

BOOKS AND EQUIPMENT DONATION PROGRAMME

In 1987, the Centre distributed 10000 journals, 12000 sets of proceedings and 10000 books to more than 400 institutes in 96 developing countries.

Equipment from CERN (European Laboratory for Particle Physics) was sent to several universities in various developing countries.

AWARDS

The 1987 Dirac Medals were awarded to Professors Bryce DeWitt (University of Texas at Austin, USA) and Bruno Zumino (University of California at Berkeley, USA) for their outstanding contributions to theoretical physics.

Professor Li Jia Ming from the Institute of Physics of the Chinese Academy of Sciences was awarded the 1986 Alfred Kastler Prize for his outstanding contribution in the field of atomic and molecular physics.

Dr. Abdullah Sadiq of Pakistan was awarded the 1987 Nikolaj N. Bogolubov Prize in recognition of his contributions to scientific knowledge in the field of solid state physics.

PREPRINTS AND INTERNAL REPORTS

The overall production amounted to 421.

STATISTICAL DIGEST

Summary of participation in the research and training-for-research activities at the ICTP in 1987

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC

26x28 Third International Workshop on "Total Energy and Force Methods" (TOT=69 DEV=14)
2xxxxxxxxx27 Second Workshop on Mathematics in Industry (TOT=91 DEV=54)
9xxxxxxxxxxxx6 International Workshop on Remote Sensing and Resource Exploration (TOT=90 DEV=65)
2xxxxxxxx27 Spring College on Geomagnetism and Aeronomy (TOT=81 DEV=67)
9xxxxxxxxxx3 Winter College on Atomic and Molecular Physics (TOT=92 DEV=77)
22x31 Workshop on Microcomputers in the Teaching of Physics and Mathematics (Sudan, TOT=27 DEV=24)
1xxxxx15 Spring School and Workshop on Superstrings (TOT=258 DEV=75)
1xxxxxxxxxx30 Workshop on Fabrication of Low cost Laboratory Equipment for Physics (Tanzania TOT=37 DEV=37)
27x1 Espaces fibrés leur utilisation en physique (TOT=9 DEV=7)
27xxxxxx15 School on Polymer Physics (TOT=78 DEV=51)
4x9 Workshop on Surface Science and Catalysis (TOT=71 DEV=48)
4xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx17 Workshop "Nonlinear Charge Density Wave Systems" (TOT=42 DEV=16)
11xxxxxxxxxxxx19 Spring College in Materials Science on "Metallic Materials" (TOT=129 DEV=100)
18x22 Third Workshop on Perspectives in Nuclear Physics at Intermediate Energies (TOT=115 DEV=22)
25xxxxxxx19 Spring College on Plasma Physics (TOT=153 DEV=99)
8xxx19 ICFA School on Instrumentation in Elementary Particle Physics (TOT=104 DEV=32)
22x24 New Scales Effects on Low energy Precision Experiments (TOT=37 DEV=2)
Res Workshop in Cond Matter At & Mol Phys (TOT=227 DEV=190) 22xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx24
Synchrotron Radiation and Free Electron Lasers (TOT=48 DEV=5) 23x26
Summer Workshop in High Energy Physics and Cosmology (TOT=206 DEV=125) 29xxxxxxxxxxxxxxx7
One dimensional Organic Conductors Chem Phys and Appl (TOT=59 DEV=10) 30x3
High Temperature Superconductors (TOT=181 DEV=53) 6x8
Vacuum in Non relativistic Matter radiation Systems (TOT=32 DEV=10) 14x17
Scanning Tunnelling in Microscopy Fundam Experim and Theoret Progress (TOT=85 DEV=12) 28x31
Workshop on Applicability of Envir Physics and Meteorology in Africa (Ethiopia TOT=68 DEV=60) 10xxx21
Interatomic Forces in Relation to Defects and Disorder in Condensed Matter (TOT=26 DEV=9) 11x14
Working Party on "Physics of Porous Media" (TOT=57 DEV=21) 17x28
Workshop on Materials Science and the Physics of Nonconventional Energy Sources (TOT=185 DEV=153) 26xxxxxx18
The Path Integral Method with Applications (TOT=72 DEV=34) 1x4
Workshop on Telematics (TOT=93 DEV=80) 7xxxxxxxxxxx2
Workshop on Economics Modelling Planning and Management of Energy (TOT=80 DEV=63) 14xx25
Workshop in Interaction between Physics and Architecture in Environment Conscious Design (TOT=64 DEV=38) 21x25
Fourth College on Microprocessors Technology and Applications In Physics (TOT=133 DEV=114) 5xxxxxxxxx30
College on Soil Physics (TOT=105 DEV=81) 2xxxxxx20
College on Riemann Surfaces (TOT=132 DEV=81) 9xxxxxxxxxxxxxxx18
Second Workshop on Cloud Physics and Climate (TOT=100 DEV=78) 23xxxxxxxxx18
1xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx31

Throughout the year Research in Fundamental Physics (TOT=201 DEV=120)
Condensed matter (TOT=102 DEV=75)
Mathematics (TOT=47 DEV=36)
Other (TOT=266 DEV=222)

Physics and Development (TOT=5 DEV=0 another 30 scientists participating in other programmes gave lectures)

Microprocessors laboratory (TOT=15 DEV=6)

Training in Italian laboratories (TOT=108 DEV=108)

TOTALS	DEV	IND	TOTAL
1 36 courses	2007	1429	3436
2 Research	464	178	642
3 Italian Labs	108		108
TOTAL	2579	1607	4186

The following tables deal with all activities combined, therefore they show the *actual* number of visitors, i.e. those scientists who participated in more than one activity are counted only once.

Summary of participation 1987 vs. 1986

	Visitors		Man/Months		Total		Percentage (Dev. vs. total)	
	Dev.	Ind.	Dev.	Ind.	Visitors	M/M	Visitors	M/M
1986	2180	1471	3146.02	674.49	3651	3820.51	59.70%	82.34%
1987	2171	1529	3247.27	652.01	3700	3899.28	58.68%	83.28%
Increase/ Decrease	-0.41%	+3.94%	+3.22%	-3.45%	+1.34%	+2.06%		
The above figures for 1986 include:								
Regional college on microprocessors (Hefei, P.R. China)								
	95	29	64.45	6.58	124	71.03	76.61%	90.73%
Workshop on curriculum development (Nairobi, Kenya)								
	116	10	48.72	4.20	126	52.92	92.10%	92.10%
Training in Italian laboratories								
	127	-	773.92	-	127	773.92	100.00%	100.00%
The above figures for 1987 include:								
Workshop on microcomputers (Khartoum, Sudan)								
	24	3	7.92	0.99	27	8.91	88.89%	88.89%
Workshop on fabrication of low cost laboratory equipment (Dar-es-Salaam, Tanzania)								
	37	-	36.63	-	37	36.63	100.00%	100.00%
Workshop on the applicability of environmental physics and mathematics (Addis Ababa, Ethiopia)								
	60	8	21.60	2.88	68	24.48	88.24%	88.24%
Training in Italian laboratories								
	108	-	730.10	-	108	730.10	100.00%	100.00%

Participation by geographical areas in the research and training-for-research activities of the ICTP in 1987

Geographical Areas	Visitors		Man/months		Total for Area	
	Dev.	Ind.	Dev.	Ind.	Visitors	Man/Months
Africa	547	-	690.56	-	547	690.56
Asia	873	48	1589.28	38.45	921	1627.73
Europe	393	1108	359.66	416.83	1501	776.49
Indonesia and Oceania	19	14	18.47	21.44	33	39.91
North and Central America	88	323	113.86	166.14	411	280.00
South America	251	-	475.44	-	251	475.44
International Organizations	-	36	-	9.15	36	9.15
TOTAL	**2171**	**1529**	**3247.27**	**652.01**	**3700**	**3899.28**
% Developing vs. Total					**58.68%**	**83.28%**

Breakdown of the number of scientists who worked at the ICTP in 1987 and of man/months per activity

Other tables show that the total number of scientists who came to the ICTP is 3700 while the total number of man/months is 3899.28. In the tables which follow the number of scientists will be higher since several of them took part in more than one activity.

Table I shows a summary of the breakdown while Table III shows the details. Percentages refer to the total participation in the field vs. the grand total.

Table I
Summarized breakdown by field of activity

Activity	Number of Visitors				Number of Man/months			
	Dev.	Ind.	Total	%	Dev.	Ind.	Total	%
1. Fundamental Physics	322	380	702	16.77%	467.14	254.63	721.77	18.51%
2. Condensed Matter	592	275	867	20.71%	600.03	119.08	719.11	18.44%
3. Mathematics	124	64	188	4.49%	304.51	77.26	381.77	9.79%
4. Physics & Energy	375	222	597	14.26%	201.39	49.99	251.38	6.45%
5. Physics & Environment	226	60	286	6.83%	172.19	20.15	192.34	4.93%
6. Applied Physics	351	175	526	12.57%	315.23	60.10	375.33	9.63%
7. Adriatico Conferences	133	370	503	12.02%	27.33	57.00	84.33	2.16%
8. Other research	227	50	277	6.62%	363.20	9.93	373.13	9.57%
TOTAL	2350	1596	3946	94.27%	2451.02	648.14	3099.16	79.48%
Outside activities*								
1. Italian laboratories	108	-	108	2.58%	730.10	-	730.10	18.72%
2. Microcomputers (Sudan)	24	3	27	0.65%	7.92	0.99	8.91	0.23%
3. Low-cost equip. (Tanzania)	37	-	37	0.88%	36.63	-	36.63	0.94%
4. Applicability of environmental physics and meteorology (Ethiopia)	60	8	68	1.62%	21.60	2.88	24.48	0.63%
TOTAL	229	11	240	5.73%	796.25	3.87	800.12	20.52%
GRAND TOTAL	2579	1607	4186		3247.27	652.01	3899.28	

Hosted activities

1. Workshop on scientific and technological applications of synchrotron radiation
2. Initiative Committee of the International Foundation for Survival

* In addition, the Centre supported 79 regional courses, workshops and conferences in all regions of the world (see pages 67-68).

Table II shows a statistical summary of the activities at the ICTP itself and outside its premises.

Table II
Statistical summary on activities held at and outside the ICTP

Figures on research include long- and short-term scientists as well as Associate Members, some scientists from Federated Institutes and seminar lecturers.

As regards the activities held outside the ICTP, the 79 courses sponsored but not organized by ICTP are not included.

Activity	Number of Visitors			Number of Man/months		
	Dev.	Ind.	Total	Dev.	Ind.	Total
1. At the ICTP:						
(a) Research:						
Fundamental Physics	120	81	201	350.17	137.00	487.17
Condensed Matter	75	27	102	166.56	25.85	192.41
Mathematics	36	11	47	218.13	52.63	270.76
Microprocessors Lab	6	9	15	38.99	3.64	42.63
Other	227	50	277	363.20	9.93	373.13
Total	464	178	642	1137.05	229.05	1366.10
% Total vs. Grand Total			15.34%			35.03%
(b) Training for research (courses, workshops and conferences)						
Total	1886	1418	3304	1313.97	419.09	1733.06
% Total vs. Grand Total			78.93%			44.45%
2. Outside activities:						
(a) Italian laboratories	108	-	108	730.10	-	730.10
(b) Microcomputers (Sudan)	24	3	27	7.92	0.99	8.91
(c) Low-cost equip. (Tanzania)	37	-	37	36.63	-	36.63
(d) Applicability of environmental physics and meteorology (Ethiopia)	60	8	68	21.60	2.88	24.48
Total	229	11	240	796.25	3.87	800.12
% Total vs. Grand Total			5.73%			20.52%
GRAND TOTAL	2579	1607	4186	3247.27	652.01	3899.28

Table III
Participation in the research and training-for-research activities at the ICTP in 1987

Activity	Dates	Number of visitors			Number of Man/months		
		Dev.	Ind.	Total	Dev.	Ind.	Total
Fundamental Physics							
Research in high energy physics and fundamental theory	all year	120	81	201	350.17	137.00	487.17
Spring school and workshop on superstrings	1-15 Apr	75	183	258	30.27	79.10	109.37
Conference on indirect evidence of new energy scales from low energy precision experiments	22-24 Jun	2	35	37	0.17	3.14	3.31
Summer workshop in high energy physics and cosmology	29 Jun-7 Aug	125	81	206	86.53	35.39	121.92
TOTAL		**322**	**380**	**702**	**467.14**	**254.63**	**721.77**
% vs Grand Total				16.77%			18.51%
Condensed Matter, Atomic and Molecular Physics							
Research in condensed matter physics	all year	75	27	102	166.56	25.85	192.41
Third Int'l workshop on total energy & force methods	26-28 Jan	14	55	69	1.09	6.15	7.24
Winter college on atom & molecular physics	9 Mar-3 Apr	77	15	92	62.23	3.31	65.54
School on polymer physics	27 Apr-15 May	51	27	78	32.57	11.08	43.65
Workshop on surface science and catalysis	4-9 May	48	23	71	59.59	5.20	64.79
Workshop on nonlinear charge density wave systems	4 May-17 Jul	16	26	42	14.74	17.33	32.07
Spring college in materials science on "Metallic Materials"	11-19 Jun	100	29	129	86.19	10.93	97.12
Workshop in condensed matter, atomic and molecular physics	22 Jun-4 Sept	190	37	227	167.78	26.81	194.59
Working party on the physics of porous media	17-28 Aug	21	36	57	9.28	12.42	21.70
TOTAL		**592**	**275**	**867**	**600.03**	**119.08**	**719.11**
% vs Grand Total				20.71%			18.44%

contd.

Activity	Dates	Number of visitors			Number of Man/months		
		Dev.	Ind.	Total	Dev.	Ind.	Total
Mathematics							
Research in mathematics	all year	36	11	47	218.13	52.63	270.76
Séminaire sur les espaces fibrés: leur utilisation en physique	27 Apr-1 May	7	2	9	1.22	0.16	1.38
College on Riemann surfaces	9 Nov-18 Dec	81	51	132	85.16	24.47	109.63
TOTAL		**124**	**64**	**188**	**304.51**	**77.26**	**381.77**
% vs. Grand Total				4.49%			9.79%
Physics and Energy							
Third workshop on perspectives in nuclear physics at intermediate energies	18-22 May	22	93	115	2.74	15.88	18.62
Spring college on plasma physics	25 May-19 Jun	99	54	153	77.95	17.15	95.10
Workshop on materials science and the physics of nonconventional energy sources	26 Aug-18 Sept	153	32	185	106.38	9.61	115.99
Workshop on economics, modelling, planning and management of energy	14-25 Sept	63	17	80	11.73	3.73	15.46
Workshop on interaction between physics and architecture in environment conscious design	21-25 Sept	38	26	64	2.59	3.62	6.21
TOTAL		**375**	**222**	**597**	**201.39**	**49.99**	**251.38**
% vs. Grand Total				14.26%			6.45%
Physics and Environment							
Spring college on geomagnetism and aeronomy	2-27 Mar	67	14	81	54.96	5.53	60.49
College on soil physics	2-20 Nov	81	24	105	54.67	5.29	59.96
Second autumn workshop on cloud physics and climate	23 Nov-18 Dec	78	22	100	62.56	9.33	71.89
TOTAL		**226**	**60**	**286**	**172.19**	**20.15**	**192.34**
% vs. Grand Total				6.83%			4.93%

contd.

Activity	Dates	Number of visitors			Number of Man/months		
		Dev.	Ind.	Total	Dev.	Ind.	Total
Applied Physics and High Technology							
Second workshop on mathematics in industry	2-27 Feb	54	37	91	41.96	11.77	53.73
International workshop on remote sensing and resource exploration	9 Feb-6 Mar	65	25	90	50.14	7.18	57.32
ICFA school on instrumentation in elementary particle physics	8-19 Jun	32	72	104	15.45	25.86	41.31
Workshop on telematics	7 Sept-2 Oct	80	13	93	103.42	3.78	107.20
Fourth college on microprocessors: Technology and applications in physics	5-30 Oct	114	19	133	65.27	7.87	73.14
Microprocessors laboratory	all year	6	9	15	38.99	3.64	42.63
TOTAL		**356**	**218**	**574**	**318.32**	**65.16**	**383.48**
% vs. Grand Total				13.71%			9.83%
Adriatico Conferences:							
Undulator magnets for synchrotron radiation and free electron lasers (Adriatico Conference)	23-26 Jun	5	43	48	3.09	5.06	8.15
One-dimensional organic conductors: Chemistry, physics and applications (Adriatico Conference)	30 Jun-3 Jul	10	49	59	1.89	8.74	10.63
High temperature superconductors (Adriatico Conference)	6-8 Jul	53	128	181	8.37	18.47	26.84
Vacuum in nonrelativistic matter-radiation systems (Adriatico Conference)	14-17 Jul	10	22	32	1.11	4.21	5.32
Scanning tunnelling microscopy - Fundamental experimental and theoretical progress (Adriatico Conference)	28-31 Jul	12	73	85	2.04	11.50	13.54
Interatomic forces in relation to defects and disorder in condensed matter (Adriatico Conference)	11-14 Aug	9	17	26	4.47	2.47	6.94
Path integral method with applications (Adriatico Conference)	1-4 Sept	34	38	72	6.36	6.55	12.91
TOTAL		**133**	**370**	**503**	**27.33**	**57.00**	**84.33**
% vs. Grand Total				12.02%			2.16%

contd.

Activity	Dates	Number of visitors			Number of Man/months		
		Dev.	Ind.	Total	Dev.	Ind.	Total
Other Research							
Miscellaneous research	all year	227	45	272	363.20	9.30	372.50
Physics and Development Programme	all year	-	5	5	-	0.63	0.63
(Another 30 scientists participating in other programmes gave also lectures)							
TOTAL		**227**	**50**	**277**	**363.20**	**9.93**	**373.13**
% vs. Grand Total				6.62%			9.57%
Outside activities							
(a) Training in Italian laboratories	all year	108	-	108	730.10	-	730.10
Subtotal		**108**	**-**	**108**	**730.10**	**-**	**730.10**
% vs. Grand Total				2.58%			18.72%
(b1) Micros in physics and mathematics (Khartoum, Sudan)	22-31 Mar	24	3	27	7.92	0.99	8.91
(b2) Workshop on fabrication of low-cost laboratory equipment for physics (Dar-es-Salaam, Tanzania)	1-30 Apr	37	-	37	36.63	-	36.63
(b3) Workshop on the applicability of environmental physics and meteorology in Africa (Addis Ababa, Ethiopia)	10-21 Aug	60	8	68	21.60	2.88	24.48
Subtotal		**121**	**11**	**132**	**66.15**	**3.87**	**70.02**
% vs. Grand Total				3.15%			1.80%
GRAND TOTAL		**2579**	**1607**	**4186**	**3247.27**	**652.01**	**3899.28**

Hosted Activities

1. Workshop on scientific and technological applications of synchrotron radiation — 14 - 5 May
2. Initiative Committee of the International Foundation for Survival — 21 23 May

PART II

THE SCIENTIFIC PROGRAMME

FUNDAMENTAL PHYSICS

Title: RESEARCH IN HIGH ENERGY PHYSICS AND FUNDAMENTAL THEORY

Dates: Throughout the year.

Organizers: This research programme was organized by the Director of the Centre Professor Abdus Salam, the resident physicists Dr. J. Strathdee and Dr. E. Sezgin, the Deputy Director Prof. L. Bertocchi and the consultants Professors G. Furlan and R. Iengo (University of Trieste).

Purpose: To contribute to the advancement of physics at an international standard through individual and team research, stimulate interaction between physicists from developing and industrialized nations, and create genuine research conditions that will encourage Associate Members and visitors from Federated Institutes in their work after their return home.

Seminars were held on: the calculation of the smoother wave-functions for chaotic systems; spin and twisted fields 4-point functions in 2D conformal models; a search for light photino in neutral pion decay; orbifolds and Wilson lines: three generation models; comments about the geometry of nonlinear sigma models; loop groups, Grassmannians and conformal field theory; astrophysical axionic lasers; one-loop amplitudes and effective action in superstring models; introduction to thermal field dynamics and its applications; physics at SLC and LEP; gravity as a gauge theory on the lattice; quantization of the Green-Schwarz superstring; integrability of N = 16 supergravity; aspects of bosonization in field theory; gauge dependence of dynamical quark mass; constraints on light particles from the supernova; four dimensional superstring phenomenology; nonlocal BRS counterterms; critical phenomena in 2-d supersymmetric models; 0*(14), the spectroscopy of one family, and how local spin invariance, SL(2,c), leads to an understanding of Giorgi-Glashow, Pati-Salam, the standard model, and associated Higgs fields; Berry's phase: topology in atomic and molecular physics; chiral bosonization, determinants and the string partition function; generally covariant Q.F.T. and scaling limits; effective Lagrangians, anomalies and skyrmions; topological defects in supersymmetric field theories; string form of QCD; quark-lepton mass matrices in string theories on orbifolds; symplectic geometry of field theories; Beltrami parametrization for strings; the effective string action; toward observational neutrino astrophysics; review of light cone superstrings; one loop string corrections to effective field theory; 4-dimensional string theories; group theoretic approach to string theories; nonconventional behaviour of QCD at short and large distances; quark-gluon plasma: large N approach; effective hadronic Lagrangian in the strong coupling expansion of lattice QCD; symbiotic superstrings and manifestly super-Poincaré covariant quantization of Green-Schwarz superstrings.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	14		14
Asia	65	10	75
Europe	24	43	67
Indonesia and Oceania		3	3
North and Central America		20	20
South America	17		17
International Organizations		5	5
TOTAL	**120**	**81**	**201**

Title: SPRING SCHOOL ON SUPERSTRINGS

Dates: 1 - 11 April 1987

and

Title: WORKSHOP ON SUPERSTRINGS

Dates: 13 - 15 April 1987

Organizers: Professors L. Alvarez-Gaume (CERN, Geneva, Switzerland), M. Green (Queen Mary College, London, UK) and M. Grisaru (Brandeis University, Waltham, USA), in collaboration with the Italian Institute for Nuclear Physics (Istituto Nazionale di Fisica Nucleare, INFN).

Purpose: to introduce the subject of superstring theory to those interested in entering the field or learning its techniques in detail.

Programme: **Topics:**
Introduction to string theory.
Compactification and modular invariance.
Higher loop calculations and mathematical background.
Sigma model approach to strings.
Second quantized string field theory.
Algebras, lattices and strings.
The effective field theory from strings.
Phenomenology of strings.

Lectures were given on: *(School)* introduction to superstrings; introduction to conformal field theory; review of supersymmetry; introduction to Riemann surfaces; strings from a low energy point of view; superconformal field theory; introduction to string field theory; Kac-Moody and Virasoro algebras and their applications; introduction to heterotic strings and their compactification; complex manifolds and Calabi-Yau spaces; string theory as algebraic geometry; advanced string field theory; string theory and Riemann surfaces.

(Workshop): a class of Calabi-Yau spaces; superstring field theory; the BRST invariant, cyclic symm. 3 superstring vertex and superconformal field theory; covariant Fermi vertex operators; supersymmetry anomaly cancellation mechanism; the structure of the world sheet; quantization of Green-Schwarz string; effective Lagrangians for 4-D superstrings; coupled chiral and supersymmetry anomalies in supersymmetric Yang-Mills theories; Calabi-Yau compactification and N=1 supersymmetry in D = 4; nonlinear sigma models on arbitrary genus Riemann surfaces; relation between Polyakov's and Fradkin's integrals; thermofield dynamics and strings at finite temperatures; Grassmannians and string theory; supermoduli and divergences; the heterotic string cosmological constant; anomalies and modular invariance; lattice construction of 4-d heterotic strings; modular invariant partition functions; Ramond sector of the supersymmetric models; anomaly cancell. in 4-d heterotic strings; superconformal ghost partition functions from the bosonic string; heterotic strings in orbifold and Wilson lines backgrounds; affine superalgebras and the super-Sugawara construction; 4-dimensional superstrings; supersymmetrization of D=4 current algebra schemes; superstring phenomenology and Jordan algebras; superstring actions in curved spacetime; beta functions and string effect. act.; regularization schemes in string theories and sigma models; arithmetic strings; SO(4) extended superconformal field theory; superstrings from supermembranes; a harmonic approach to hyper-Kähler metrics; 4-d strings in the Green-Schwarz formalism; connections between WZW and free field theories; space dimensions from SUSY for N=2 spinning string; supergravity and superstrings theory with time-like extra dimensions.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	5		5
Asia	16	12	28
Europe	36	144	180
Indonesia and Oceania		2	2
North and Central America	3	17	20
South America	15		15
International Organizations		8	8
TOTAL	**75**	**183**	**258**

Title: CONFERENCE ON INDIRECT EVIDENCE OF NEW ENERGY SCALES FROM LOW ENERGY PRECISION EXPERIMENTS

Dates: 22 - 23 June 1987.

Organizers: Professors N. Paver (Italian National Institute of Nuclear Physics, INFN, and University of Trieste, Italy) and C. Verzegnassi (INFN and University of Trieste, Italy).

Purpose: To explore grounds and problems common both to theoretical and experimental physicists.

Programme: **Topics:**
Effects of a heavy Higgs.
New Neutral Gauge bosons.
B-B mixing.
Neutrino masses.
Supersymmetry.
Composite models.
Electroweak radiative corrections in high precision measurements: Monte Carlo generators and canonical cuts.

Lectures were given on: supersymmetry signatures from Z° physics; supersymmetry and rare B physics; Z' effects on Z° physics; new scales effects on fermionic static properties; search for compositeness at LEP 2; compositeness and z° physics; on the signature of compositeness in radiative BHABHA events; status of B-B mixing; heavy Higgs in nonsupersymmetric and in supersymmetric models; tests of new physics from high precision e^+e^- measurements; status of Monte Carlo techniques; experimental precision on A_{LR} at the Z pole at LEP; electroweak radiative corrections in high precision measurements: Monte Carlo generators and canonical cuts; neutrino masses; the solar neutrinos puzzle and the V_L-V_R transition probability; radiative corrections in the neutrino counting experiment; search for gravitational waves.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Asia	1		1
Europe	1	30	31
North and Central America		3	3
International Organizations		2	2
TOTAL	**2**	**35**	**37**

Title: SUMMER WORKSHOP IN HIGH ENERGY PHYSICS AND COSMOLOGY

Dates: 29 June - 7 August 1987.

Including

Title: CONFERENCE ON PHENOMENOLOGY IN HIGH ENERGY PHYSICS

Dates: 20 - 22 July 1987.

and

Title: MEETING ON: "SEARCH FOR SCALAR PARTICLES: EXPERIMENTAL AND THEORETICAL ASPECTS"

Dates: 23 - 24 July 1987.

Organizers: Professors G. Furlan (University of Trieste and ICTP, Trieste, Italy), R. Iengo (International School for Advanced Studies, ISAS-SISSA, and ICTP, Trieste, Italy), J.C. Pati (University of Maryland, USA), D. Sciama (International School for Advanced Studies, ISAS-SISSA, and ICTP, Trieste, Italy), Q. Shafi (University of Delaware, Newark, USA) and Dr. E. Sezgin (Turkey/ICTP, Trieste Italy).

Purpose: To be an informal environment for discussing topics of current interest in particle physics including superstrings, unified theories and cosmology.

Programme:

Lectures were given on:

Workshop: string theory; global supersymmetry; an overview of unified theories; anomalies in string theories; supergravity; cosmology; phenomenology of superstring theories; overview of superstring theories; string field theory; some applications of σ model to topology; introduction to orbifolds; open strings in background fields; new dynamics in Susy preon; theories and possible superstring origin of preons; string loop corrections to β function; blown-up orbifolds; string loop calculations of 3 point amp. or orbifolds; fields and symmetries from Calabi-Yau compactification; asymmetric orbifolds; introduction to lattice gauge theories; abstract formulation of string theory and conformal field theory; d = 4 strings from orbifolds; relation between space-time and World-Sheet supersymmetry; string formulation of the 3-dim Ising model; application of lattice gauge theories; parametrizing forms; an overview of supergravity theories from superstrings; cosmological and astrophysical constraints on neutrino masses and lifetimes; topics in cosmology; geometry in loop space and string field theory; introduction to string multiloops; covariant canonical quantization of the Green-Schwarz superstring; four dimensional superstring theories; supersymmetry at non-zero temperature; the BRS quantization of chiral bosons; the cosmological constant problem; string loops; blown-up orbifolds; a new formulation of path integral method for chiral anomaly; quantum supermembrane; chirality preserving confinement in models of composite weak bosons and quarks; large scale distribution of galaxies; phenomenology of superstring theories; supersymmetry breaking and cosmology in superstring theories.

Conference: status of proton decay searches; detection of supernova neutrinos; double beta decay and neutrino masses; physics of neutrinos from supernova SN1987a; implication of superlight gravitinos; implications of recent measurements of B^0-B^0 mixing; phenomenology of CP violation; signals of low energy supersymmetry; weakly coupled goldstone particles (axions, familons and all that) and their possible detection); high energy physics and cosmology; underground physics at Gran Sasso; the Tevatron, SSC and other colliders; summary and outlook on the interplay between theory and experiments in particle physics.

Meeting: the mass of the Higgs particle; the Higgs problem: theory and experiment; experimental research on Higgs particle at intermediate energy; linear-collider for Higgs search in the TEV range; Higgs search at LEP; information on Higgs particle from computation on the lattice; experimental problems on the Higgs particles detection at high energy pp and e^+e^- machines; strong coupling for heavy Higgs particle; survey for Higgs particle with the American facilities; the TEVATRON for Higgs search.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	14		14
Asia	59	3	62
Europe	44	44	88
North and Central America	3	31	34
South America	5		5
International Organizations		3	3
TOTAL	**125**	**81**	**206**

CONDENSED MATTER PHYSICS

Title: RESEARCH IN CONDENSED MATTER PHYSICS

Dates: Throughout the year

Organizers: Professors Yu Lu (Academia Sinica, Beijing, P R China, and ICTP), M Tosi (University of Trieste and ICTP, Italy) and E Tosatti (International School for Advanced Studies, ISAS-SISSA, and ICTP, Trieste, Italy)

Purpose: The research programme was organized to carry out research at the highest possible level in condensed matter physics and to stimulate scientific interaction between physicists from the developing world and from industrialized countries

Programme:

Seminars were held on: icosahedral order crystals, quasicrystals or glasses?, magneto-optical materials and their use in device applications, what is interesting about band offsets?, calculations of the structures and band offsets for semiconductor interfaces, optical studies in III-V semiconductor heterostructures, Coulomb gap on disordered semiconductors, the role of interatomic potentials in chemical processes occurring in solid and liquid phases, nuclear quadrupole interaction in dilute alloys of aluminium, frequency dependent local field correction extension of VS-theory for uniform electron gas, magneto-optics of superlattice and heterostructures; surface enhanced second harmonic generation at nonlinear crystal-metal interface, surface enhanced Raman scattering on Cu, Pt and Pd, bound excitons in semiconductors (1) size of shallow bound excitons (BE, (2) phonon replicas of BE radiative recombination and (3) electron-hole exchange interaction in BE, X-ray absorption in the region 200-2000 eV, surface melting and premelting an experimental viewpoint, intersubband transition in superlattice and quantum well (spectral study), predictions of anisotropic normal state transport in oxide superconductors, experimental investigations of surface melting, phase diagrams of liquid, amorphous and solid silicon by molecular dynamics, a possible explanation of the destruction of the antiferromagnetism in La_2CuO_4-based compounds, relaxation mechanisms for the decay of phonons in CO_2, ferromagnetic exchange coupling and relaxation through a tunneling barrier, light scattering by molten alkali halides theoretical and molecular dynamics study, liquid to amorphous transition in pure and doped silicon, variation Monte-Carlo studies of the Hubbard model and possible applications to superconductivity, diagrammatic technique for Hubbard model and Anderson model, diagrammatic technique for mixed valence in BCS superconductor, soft spheres model for the glass transition in binary alloys, simple model of superconductivity and disorder near the metal insulator transition, bimodality in a model for general atmosphere circulation, theory of band-offsets in semiconductor heterojunctions - some new results

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	13		13
Asia	38	1	39
Europe	13	20	33
North and Central America	3	6	9
South America	8		8
TOTAL	**75**	**27**	**102**

Title: THIRD INTERNATIONAL WORKSHOP ON "TOTAL ENERGY AND FORCE METHODS"

Dates: 26 - 28 January 1987.

Organizers: Professors A. Baldereschi (University of Trieste, Italy, and EPF, Lausanne, Switzerland), R. Car (International School for Advanced Studies, ISAS-SISSA, Trieste, Italy) and R. Resta (International School for Advanced Studies, ISAS-SISSA, Trieste, Italy), with the co-sponsorship of the International School for Advanced Studies, the Department of Theoretical Physics of the University of Trieste, and the Italian National Research Council (Consiglio Nazionale delle Ricerche, CNR, Rome).

Purpose: To provide an overview of present methods and future prospects of the field and to create a forum for discussions and exchange of ideas between the practitioners in the field of total energy and force methods.

Programme: **Topics:**
Novel techniques for self-consistent ab-initio computations.
Electronic correlation.
Applications of molecular dynamics.
Structural stability of clusters, surfaces, interfaces and bulk solids.
Structural phase transitions.
Ab-initio lattice dynamics and electron-phonon interaction.
Lattice relaxations.

Lectures were given on: density-functional theory and the band gap problem in semiconductors; electron correlation and quasiparticle energies; image potential at metal surfaces; electronic structure of semiconductor surfaces: local and nonlocal density-functional theory; dynamical screening for simple metals; self-consistent Green's function approach to linear response in solids; calculations on semiconductor interfaces and band-lineups; recent developments in high-temperature superconductivity; the unified approach to density functional theory and molecular dynamics; ab-initio molecular dynamics studies of surfaces and grain boundaries; improved Car-Parrinello method for electronic structure calculations; computer simulation of melting and amorphization of silicon; the BBC to HCP transition: in Ba via pressure, in Zr via temperature; ab-initio statistical mechanics of GeTe; dynamics of electron solvation in molten salts; quantum Monte Carlo methods; advances in total energy methods; interatomic interactions and the defect problem; new-concerted-exchange mechanism for impurity diffusion in semiconductors; metastable impurities in semiconductors: Si:Mg and Si:Be; surface properties of gold in the glue model; a full potential LAPW study of structural and electronic properties of berillium; electronic structure and total energies of polymeric sulphur; surface stress tensor in aluminium; the origin of polytypes in SiC.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	1		1
Asia	5		5
Europe	5	44	49
North and Central America		11	11
South America	3		3
TOTAL	**14**	**55**	**69**

Title: WINTER COLLEGE ON ATOMIC AND MOLECULAR PHYSICS

Dates: 9 March - 3 April 1987.

Organizers: Professors E. Arimondo (Department of Physics, University of Pisa, Italy), S.R. Svanberg (Department of Physics, Lund Institute of Technology, Sweden), B.C. Tan (Department of Physics, University of Malaya, Kuala Lumpur, Malaysia), and G. Denardo (Department of Theoretical Physics, University of Trieste, and ICTP, Trieste, Italy).

Purpose: To review applied atomic and molecular spectroscopy for diagnostic and analytical work.

Programme: **Topics:**
Atomic and molecular structure and spectra.
Analytical laser spectroscopy.
Combustion diagnostics.
Diagnostics for semiconductor fabrication processes.
Isotopic selective processes and diagnostics.
Atmospheric diagnostics.
Hydrospheric diagnostics.
Spectroscopic plant diagnostics.
Surface diagnostics.
Medical diagnostics using optical spectroscopy.

Lectures were given on: structure, spectra and fundamental interactions; analytical laser spectroscopy; advanced molecular spectroscopy; optogalvanic spectroscopy; chemical processing with lasers in semiconductors; basic spectroscopic instrumentation; hydrospheric diagnostics; atmospheric microwave spectroscopy; quantum defect theory: dynamics of excited atoms and molecules; fundamental problems of physics: dimensionless constants, symmetry and dynamics; combustion diagnostics; foundations of quantum theory in the light of new experiments: microscopic quantum effects, neutron interferometry; atmospheric diagnostics; plasma diagnostics; photothermal spectroscopy applied to agriculture; lasers in medicine; laser induced chemistry; medical diagnostics; surface diagnostics.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	11		11
Asia	46		46
Europe	8	15	23
Indonesia and Oceania	3		3
North and Central America	1		1
South America	8		8
TOTAL	**77**	**15**	**92**

Title: SCHOOL ON POLYMER PHYSICS

Dates: 27 April - 15 May 1987.

Organizers: Professors E. Martuscelli (Polymer Institute, Consiglio Nazionale delle Ricerche, CNR, Naples, Italy), A.M. Hindeleh (University of Amman, Jordan) and A. Cesaro (University of Trieste, Italy).

Purpose: To provide a coherent and comprehensive account of chemistry, physics and technology of polymeric materials.

Programme: **Topics:**
Introduction to polymer synthesis and structure.
Physical methods of molecular characterization.
Solid state polymers.
Mechanical properties.
Role of additives on polymers.
Technology and processing of polymers.
Advanced polymeric materials.

Lectures were given on: polymer synthesis; methods of molecular characterization; conformation, configuration and molecular packing; advanced spectroscopic methods; structure and thermodynamic properties of elastomers; morphology and crystallization of polymers; polymer morphology and structure; role of additives on polymers; mechanical properties; recent technology of advanced composites: problems and promises; Kevlar fibres.

Laboratory sessions: polymer blends; case histories; conducting polymer; melt rheology; transport properties; liquid-crystal polymers.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	15		15
Asia	15		15
Europe	11	26	37
Indonesia and Oceania	1		1
North and Central America	3	1	4
South America	6		6
TOTAL	**51**	**27**	**78**

Title: WORKSHOP ON SURFACE SCIENCE AND CATALYSIS

Dates: 4 - 8 May 1987.

Organizers: Professors H.P. Bonzel (Institut für Grenzflachenforschung, KFA, Jülich, Federal Republic of Germany), R. Rosei (Physics Department, University of Trieste, Italy).

Purpose: To provide a broad and up-to-date introduction to the field of model catalytic reactions on well characterized surfaces as well as to focus on the use of the most modern surface science experimental techniques.

Programme: **Topics:**
Historical concepts in catalysis.
Surface science and catalyst additives.
Complicated catalytic reactions.
Bridging the pressure gap.
New experimental approaches.

Lectures were given on: introduction to surface science and catalysis; surface analytical techniques; 2 resonance features in the electronic spectra of chemisorbed CO; Fourier transform infra-red spectroscopy; time-resolved HREELS; NMR and laser experiments of supported catalysis; study of submonolayer Cs adsorption on H saturated Si (111) - 7x7

surface; structure sensitivity in chemisorption and catalysis, electronic effect in catalysis, hydrogenation and hydrogenolysis; CO oxidation and NO reduction by metals, NH_3 synthesis, electronegative additives and poisoning, alkali metal additives; theory of additives, Fischer-Tropsch type synthesis

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	6		6
Asia	29		29
Europe	6	20	26
North and Central America	1	3	4
South America	6		6
TOTAL	**48**	**23**	**71**

Title: WORKSHOP ON NONLINEAR CHARGE DENSITY WAVE SYSTEMS

Dates: 4 May - 17 July 1987

Organizers: Professors A R Bishop (Los Alamos National Laboratory, USA), Yu Lu (Academia Sinica, Beijing, P R. China and ICTP, Trieste, Italy) and E Tosatti (International School for Advanced Studies, ISAS-SISSA, Trieste, Italy), with the co-sponsorship of the International School for Advanced Studies

Purpose: To review the state-of-the-art of this fast-moving field in order to promote the research and international collaboration in related areas

Programme: **Topics:** The relation of quantum relaxation of nonlinear excitations to classical nonlinear dynamics
The nature and description of metastable states in CDW and analogous systems, quantum and classical dynamics in the presence of such states
The quantum molecular-dynamics study of time evolution for nonlinear excitations

Lectures were given on: nonlinear transport in field-induced spin-density wave states, the one-dimensional Hubbard model, strong-coupling superconductivity, charge-density wave transport in a magnetic field, defects in charge density wave systems, nonlinear transport role of the CDW amplitude, polarons, halogen-bridged metal chain complexes, model for tunneling in normal junctions of very small capacitance, glassy decay in a Josephson array model, dissipative quantum systems, the Frenkel-Kontorova model with nonconvex interaction between the atoms, nonanalytic effects in discrete Peierls systems, nonlinear dynamics of driven charge-density waves, numerical simulations of classical models for charge-density wave systems, lattice relaxation approach for electron-phonon systems, screening and damping of charge density wave motion, introduction to the Bethe Ansatz the quantum spin chain, Bardeen's quantum tunneling model for charge-density wave systems, superconductivity from acoustic plasmons, solitons in CDW systems from chains to crystals, midgap states in CDW and SDW systems, motion of a heavy particle interacting with a degenerate electron gas, renormalization group theory of spin glasses, Gutzwiller treatment of mixed valence and the heavy-fermion problem, tunneling time for wave packets narrow in k-space, quantum tunneling dissipation and fluctuations, instability of the ferromagnetic state in the Hubbard model, solution

of the one-dimensional Hubbard model for arbitrary electron density; Coulomb interactions in CDW systems; dissipative classical and quantum dynamics - driven molecular vibrations; quantum chaos in spin systems; quantum chaos.

Summarized data on the participation (Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	2		2
Asia	4		4
Europe	8	17	25
North and Central America		9	9
South America	2		2
TOTAL	**16**	**26**	**42**

Title: SPRING COLLEGE IN MATERIALS SCIENCE ON "METALLIC MATERIALS"

Dates: 11 May - 19 June 1987.

Directors: Lung Chi Wei (Academia Sinica, Shenyang, P.R. China) and E.J. Savino (Comisión Nacional de Energía Atómica, Buenos Aires, Argentina).

Organizing Committee: Professors N.H. March (Chairman, University of Oxford, UK), G. Chiarotti (II University, Rome, Italy), F. Garcia-Moliner (Instituto de Ciencia de Materiales, CSIC, Madrid, Spain), F. Gautier (Université Louis Pasteur, Strasbourg, France), S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden), H. Reik (Albert-Ludwigs-Universität, Freiburg, Federal Republic of Germany), K.S. Singwi (Northwestern University, Evanston, USA) and M.P. Tosi (University of Trieste, Italy).

Purpose: To discuss a wide range of topics within the general area of the basic physics underlying the study of defects and microstructure in metals and alloys.

Lectures were given on: techniques of electron microscopy interatomic forces in transition metals; theory of defects and their interactions; dislocations; electron microscope techniques; cohesion and stability in alloys; Auger microscopy and spectroscopy, photoelectron spectroscopy; neutron and X-ray scattering from metallic alloys, EXAFS; physical understanding of fracture; positron annihilation; nondestructive testing; liquid metals and alloys; new materials and ion implantation; high temperature materials, including Ni-base superalloys and ordered intermetallic alloys; surface treatment and coatings of materials; surface segregation; dislocation dynamics and mechanical behaviour of structural materials; radiation damage; computer simulation of defects and mechanical properties; theoretical modelling of defects and embrittlement; pulse and dynamic techniques for the measurement of thermal properties: theory and experimental apparatus; real metallic surfaces; pulse and dynamic techniques for the measurement of thermophysical properties: applications of scanning pyrometry; fractals and fracture; field ion microscopy of alloys; corrosion; friction and wear; fatigue; amorphous metals; surface modification of metals by ion implantation and/or thin coatings; ion-beam-mixing and ion-assisted deposition studies in several systems.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	16		16
Asia	57		57
Europe	11	25	36
Indonesia and Oceania	1		1
North and Central America	4	4	8
South America	11		11
TOTAL	**100**	**29**	**129**

Title: RESEARCH WORKSHOP IN CONDENSED MATTER, ATOMIC AND MOLECULAR PHYSICS

Dates: 22 June - 4 September 1987.

Organizing Committee: Professors N.H. March (Chairman, University of Oxford, UK), F. Garcia-Moliner (Instituto de Ciencia de Materiales, CSIC, Madrid, Spain), S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden), Lung Chi Wei (Academia Sinica, Shenyang, P.R. China), K.S. Singwi (Northwestern University, Evanston, USA), E. Tosatti (International School for Advanced Studies, *ISAS-SISSA*, and *ICTP*, Trieste, Italy), M.P. Tosi (University of Trieste, Italy) and Yu Lu (Academia Sinica, Beijing, P.R. China, and ICTP, Trieste, Italy).

Purpose: To support condensed matter research in developing countries by inviting a selected group of physicists from these countries for a three-month programme under which they can interact with a large number of leading physicists from all over the world.

Programme: **Topics:**
Phase transitions.
Low-dimensional solids.
Surfaces and interfaces.
Heavy fermions and mixed valence materials.
Defects and mechanical properties.
Nonlinear physical systems.

Lectures were given on: stress induced anisotropic diffusion and its relevance to deformation under irradiation; electron-correlation in uniform electron gas; Landau theory of the wetting transition; neutral-ionic transition in organic stack compounds; photon localization; 1/f noise and critically unstable dynamics; theory of liquid to crystal transition; localization and superconductivity; properties of quantum wells; superconductivity from nonphonon mechanisms; cluster calculations: from atoms to solids; image potential states on metal surfaces; single and multiple interfaces; quasicrystals; tunneling conductivity in 1-D Anderson disordered systems; hydrogen in silicon: experimental investigations; lattice theory of surface melting; local field effects and plasmon excitations in periodic solids; electronic properties of incommensurate one-dimensional systems; scaling properties of incommensurate and quasicrystal models; collective and single - particle properties of a model Fermi liquid - ^3He; nonlocal electrostatics in condensed matter physics, physical chemistry and biology; nonlinear response of atoms and solids; momentum and pseudo-momentum of light and sound; an information-theoretic approach to the study of disordered conductors; quantum crystals; theory of acoustical activity in ionic crystals; a new approach for transition to superconductivity; dielectric response of small metal particles; topological phase transitions in metals; on the theory of ordered and disordered fast ion conductors; introduction to heavy fermions; existence of reentrant transitions in random-site systems; nonequilibrium statistical theory of fracture; neural networks: the Hopfield model; theory of simple and multiple interfaces; superconductivity at high temperatures; texturing of

polycrystalline surfaces under ion bombardment; effect of homogeneization of trapping centres in metallic glass on the positron annihilation parameters; flux penetration in superconductors; EPR line-width at T T_g in certain spin glasses; NMR/X-ray diffraction studies; intermediate valence in transition metal oxides - an example: $La_{1-x}Sr_x...O_3$; deep levels in semiconductors - an overview; insulator-to-metal transition in polyacetylene; spin-glass order in random ferroelectrics; γ–γ angular correlation on ionic compounds; energy spectra of shallow donors and acceptors in GaAs-GaA1As quantum wells; mixed valent Hg_{1-x} Fe_x Se; photoreflection of NiPi and compositional superlattices; effect of compressive uniaxial stress on the binding energies of D centres in Si:P and Si:As; Julia and Mandelbrot sets; atom scattering from surfaces; retardation effects: localized excitations of a soliton in polyacetylene; fractal dimension of the Julia sets as an order parameter; variational results fro the one-dimensional Hubbard model; electrical conductivity of ZnS:X luminescent compounds; improve adhesion of sputtered TiC coating to steel substrate; spin models and localized bosons; interband susceptibility in heavy electron systems; Gaussian approximation for partition function in disordered systems; optical absorption coefficient of quantum well wires; diagonal and off-diagonal disorder in impurity band of quantum well; texturing of polycrystalline surfaces under ion bombardment; wave function in incommensurate and disordered systems; electrical properties of semiconductor quantum wells; atom scattering from disordered surfaces; hopping transport in one, two and three dimensions; scaling relations in density-of-states in disordered one-dimensional systems; microclusters; electric field at surfaces; continued fraction method in relaxation phenomena: two exactly solvable models; electronic state and collective excitations for the quasi-1D semiconductor quantum wires; order-disorder at alloy surfaces; some applications of fast-ion conductors; a tentative mechanism of superconductivity in low dimensional system; A-B-C sandwiches and quantum wells; Grüneisen coefficient of lanthanides; GME and CTRW treatment of the polaron transport; some aspects on high-T_c superconductivity; magnetoresistance oscillations in mesoscopic systems; recursion methods; analytical study of the perturbation of $A^1\Sigma_u^+$ state in Na_2 molecule; multiphoton processes in solids; heterojunction band offsets and the interface dielectric functions; charged and compound clusters; localization in 1-D disordered systems with electric field: analytic approach; mathematical problems in polaron theory; theory of polarons in GaAs in magnetic field; defect complexes in metals; kinetics of many-particles systems interacting with boson fields; surface flux pinning effects on the critical state of a type-II superconducting slab; the surface and image virtual states in the presence of negative external electric field - Ni(110); disordered, incommensurate and quasi-periodic 1-D systems; pseudo binary compounds $(AsSe_x)_y(AsTe_x)_{1-y}$; the effective-range approximation for localized states - effects of corrections; quantum inverse scattering method and algebraic Bethe Ansatz; crystal growth of II-VI compounds; a fatigue crack propagation and its mechanism of a low-carbon steel; internal friction due to the stress field of defects during matensitic transformation in Fe-Mn-C alloys; a thermotropic liquid crystal (nematic) of non-migrating asymmetrical molecules; the atomic tunneling states in glasses; theory of pressure behaviour of N and NN_i isoelectronic traps in GaP; the cluster study of Cu-O interaction in $YBa_2Cu_3O_7$ superconductor; higher order Gor'kov equation: effects of electron concentration; superconductivity and disorder in a very simplified model; on superconductivity of heavy fermion systems; computer simulation of defects in metals I - computer simulation method; distribution of resistance of a disordered medium in the presence of an electric field; the deep levels of Cu in Si and their ionized Gibbs free energies; on superconductivity of heavy fermion systems; electric properties of electrode-electrolyte interfaces computer simulation of defects in metals II - interatomic potentials generally and some examples; Coulomb gap and variable range hopping; enhancement of T_c in layered compounds; simple model of a fluid mixture with phase transitions; SDW and CDW in heavy fermion systems; Green function for the phonon system in N-layered superlattices; self diffusion and shear viscosity in less simple liquid metals; coexistence of superconductivity and SDW in Cr compounds; distribution of resistance of a disordered medium in presence of an electric fluid; some aspects of secondary ion emission monitored by SIMS technique; datation of archaeological and geological materials by TL and EPR; time integration in particle models; central-limit theorems and universality in disordered conductors; the semi-infinite random field Ising model; electronic collective excitations in semiconductor superlattices; the wave functions and hyperfine interaction tensors of distorted single vacancies in silicon; mechanical Aharonov-Bohm effect; optical transmission of crystals with incommensurate modulation along one-direction; RVB theory and high-T_c superconductivity; some optical studies on surface and thin-fields; on the

band offset in PbTe-PbEuSeTe quantum wells; thermal and mechanical properties of metalglass $Ti_{50}Be_{40}Zr_{10}$; tunnel-hopping in disordered systems; experimental research on acoustic properties of high-T_c superconductor and superlattice; some semiconductor-like properties of high-T_c superconducting materials; local field distribution in Random dielectric media; anomalous bonding in thermal growing of SiO_2 and Si; Wilson's RG approach to single impurity in MV system; SAW velocity change and microstructure phase transition of solids.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	34		34
Asia	71		71
Europe	51	32	83
North and Central America	8	5	13
South America	26		26
TOTAL	**190**	**37**	**227**

Title: WORKING PARTY ON THE PHYSICS OF POROUS MEDIA

Dates: 17 - 28 August 1987.

Organizers: Professors D.G. Stroud (Ohio State University, Columbus USA) and F. Brouers (University of the West Indies, Kingston, Jamaica).

Purpose: To stimulate awareness and new research in an area of great interdisciplinary import through an overview by a group of leading experts from different fields and in interaction with the participants in the Research Workshop in Condensed Matter

Programme: **Topics:**
Experimental probes of the structure of porous media.
electromagnetic and optical properties of porous media.
Elastic waves in porous media.
Fluid flow and fluid instabilities in porous media.
Fractal aspects of the structure and properties of porous media.
Percolation phenomena in porous media.
Microemulsions in relation to the properties of porous media.
Theories of the growth and structure of porous media.
Localization of classical waves and its relation to wave propagation in porous media.
D.C. transport and superconductivity in porous and granular materials.
Phase transitions and wetting in porous media.

Lectures were given on: percolation theory and porous media; porous media and rock physics; NMR in porous ,media; D.C. transport and superconductivity in granular materials; theories of D.C. transport in porous media; experiments and theories of transport in fluid saturated rock; models for A.C. transport in porous media; models for the structure of porous media: general principles, sedimentary rocks; what happens when a fractal lattice becomes Euclidean?; the energetics of an ion in a pore (structural effects) and selectivity in inverse osmosis; flow of particles through a single fluid-filled pore; acoustic and mechanical behaviour during rock failure; interpretation of small angle neutron scattering (SANS) experiments;

microstructures of complex porous materials, cements of clays, from SANS; anomalous diffusion in porous media via NMR - field gradient spectroscopy; viscous fingering on percolation clusters; fractal aspects of the dielectric properties of porous media; inversion of ultrasonic velocity measurements to obtain microcrack orientation distribution functions in rocks; elastic properties of composite and porous media; acoustic waves in porous media; elastic and dielectric damage in finely divided material; localization of classical waves; experiments on weak localization of photons; D.C. conductivity and permeability of a porous medium; fluid flow in porous media; experimental studies of fluids in porous media; experiments on viscous fingering in porous media; diffusion limited aggregation; neutron diffraction studies of porous media; microemulsions; phase separation in liquids bound in porous media; flow in porous media; interface motion of liquids bound in porous media; nonhydrodynamic aspects of particle transport through pores; effective permeability of a porous medium; particle size effect on the conductivity of dispersed ionic conductors; multipole effects in the optical properties of small particle clusters; wave propagation in random elastic media.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	3		3
Asia	9	2	11
Europe	7	22	29
North and Central America	1	12	13
South America	1		1
TOTAL	**21**	**36**	**57**

MATHEMATICS

Title: MATHEMATICS RESEARCH

Dates: Throughout the year.

Organizers: Professors J. Eells (University of Warwick, UK, and ICTP, Trieste, Italy) and A. Verjovsky (Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional, Mexico City, and ICTP, Trieste, Italy).

Purpose: To give continuity to the mathematics programmes and to set up a mathematics research group in order to provide Associate Members and visitors from Federated Institutes with the possibility of contact with high-level mathematicians throughout the year.

Programme:

Seminars were held on: topics in the classical theory of minimal surfaces in IR^3; Bezier methods in computer-aided geometric design; algebraic curves course; new applications of the Hopf techniques for immersed surfaces; nonlinear vibration of a beam; structure tensor of a field of geometric objects; prescribed scalar curvature Riemannian metrics within a conformal class: compact surfaces case and Yamabe problem, compact n-manifolds case ($n \geq 3$) (open problems); wave propagation in a slowly varying medium; introduction to C*-algebras; Poincaré inequalities and elliptic-parabolic equations; surfaces with prescribed Gaussian curvature; characterization problem for Moishezon spaces; Grauert-Riemenschneider's conjecture on Moishezon spaces and Siu's solution; convolution operators on nilpotent Lie groups; a proof of the surjectivity of symbol map of an algebra of operators generated by pseudo-differential operators; defining manifolds; natural bundles; geometry of 1-convex spaces and its relation to Moishezon spaces; geometry of (p,q)-convex -concave spaces and holomorphic convexity; structure tensor of a field of geometric objects; radiative heat transfer to chemically reacting flow between concentric rotating spheres; some points of extrinsic geometry; geometry of the Gauss section; the life span of the solutions for nonlinear wave equations; a Teichmüller theory for the solutions of polynomial vector fields in $\wedge^n$; the entropy of a dynamical system; Colombeau's generalized functions and the solution of the problem of multiplication of distributions; persistent cycles for perturbations of holomorphic flows having a first integral; a mathematical model for gasdynamics lasers; a geometry of double cosets and orbits of groups; fluid transport in the lymphatic circulation - a mathematical model for pulmonary circulation; solutions of asymptotically linear Hamiltonian systems via Morse theory; introduction to nonstandard analysis; regularity of solutions for nonlinear degenerate elliptic boundary value problems; directionally critical values of nonsmooth functionals; Levi curvature; complex methods in boundary value problems for partial differential equations; products in the Sobolev spaces H^s_p and the Besop $B^s_{p,q}$ and regularity for semi-linear equations; an index for singularities of holomorphic vector fields; strict topologies for continuous vector-valued functions; group theory: historical introduction, axiomatic, the early years, group theory in the years 1900-1940 and group theory after 1940; a remark by Glauberman; the results of Herman and Yoccoz on diffeomorphisms of the circle; propagation of gravitational electromagnetic and neutrino waves in a relativistic atmosphere; an acyclic extension of the braid group; finite soluble groups: general classification, finiteness conditions, linear soluble groups and polycyclic groups; quantum mechanics in nonstandard Hilbert space; ordered rings and the associated skew fields; Artin's conjecture on zeros of forms; optical variable metric methods for unconstrained optimization; the Fox-Jacobian and the cohomology of certain polycyclic groups; an inner product for a Banach* algebra; analytically solvable models of surface interactions in quantum mechanics; uniformization; nonlinear acoustics in soliton and chaos; the exact solution of the linear parabolic system; future tube: why is it interesting for mathematicians?; twistors and gauge fields; quasi-adequate semigroups; reduction of codimension of submanifolds of space-forms; harmonic maps between spheres; distribution of temperature in radioactive medium; asymptotic cycles and existence of cross-section for dynamical systems; the Bäcklund

transformation of Darboux type; complementarity problems and variational inequalities in Banach space; further results on nonresonant oscillations for some third order differential equations; weak harmonic maps into spheres; Cauchy-Riemann spaces in general relativity theory; lifts from a manifold M to its bundles TM and T*M; the convergence for the series of the tail probability in the law of large numbers; review of the papers *Non-Archimedean strings* by P.G.O. Freund and M.J. Olson and *Adelic string amplitudes* by P.G.O. Freund and E. Witten; representations of compact groups and Borel-Weil-Bott theorem.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	13		13
Asia	13	1	14
Europe	4	8	12
Indonesia and Oceania		1	1
North and Central America	2	1	3
South America	4		4
TOTAL	**36**	**11**	**47**

Title: SEMINAIRE SUR LES ESPACES FIBRES: LEUR UTILISATION EN PHYSIQUE

Dates: 27 April - 1 May 1987.

Organizers: Dr. J.-P. Ezin (Université Nationale du Bénin, Cotonou, Benin, and ICTP, Trieste, Italy).

Purpose: To give the participants an introduction to the differential and spinorial aspects of fibre bundles and their use in physics.

Programme: **Topics:** La géometrie dférentielle et spinorielle des espaces fibrés, avec une présentation des connexions naturelles spinorielles, des opérateurs de Laplace-Beltrami et de Dirac.
L'utilisation des espaces fibrés en physique théorique, rélativité générale, théories de jauge et systèmes hamiltoniens.

Lectures were given on: représentation des groupes de Lie compacts; connexions et courbures sur les espaces fibrés; fibre bundles and spinors; fibration de Hopf et le géometrie des monopoles; Yang-Mills foliations; locally free actions of the complex affine group; the geometrical significance of anomalies; opérateurs différentiels naturels; la recherche en mathématiques en Afrique; systèmes hamiltoniens; le groupe de Heisenberg et généralisation; equations d'Einstein; pseudo-differential operators over C*-vector bundles; twistor lifts, harmonic maps and Codazzi surfaces; formulation géometrique des théories da jauge; Einstein's equations and harmonic maps.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	6		6
Europe	1	2	3
TOTAL	**7**	**2**	**9**

Title: COLLEGE ON RIEMANN SURFACES

Dates: 9 November - 18 December 1987.

Organizers: Professors M. Cornalba (Università di Pavia, Italy), X. Gomez-Mont (Universidad Nacional Autónoma de Mexico, Mexico City) and J. Harris (Harvard University, USA).

Purpose: To introduce participants to the theory of Riemann surfaces and algebraic curves, to survey current related knowledge and to draw attention to research problems and applications.

Programme: **Topics:** Basic theory of algebraic curves and Riemann surfaces.
Special divisors and curves in projective space.
Moduli of curves and Teichmüller theory.
Relations to theoretical physics.

Lectures were given on: Riemann surfaces and discrete groups; cohomology and meromorphic functions; analytic aspects of Teichmüller theory; the theorems of Riemann-Roch and Abel; graph curves and curves on K3 surfaces; stable curves; uniformization of leaves of holomorphic foliations; Riemann matrices; theta functions of real variables; theta vanishing in Jacobians; the singular locus of M_4; the moduli space of stable curves: construction and divisor theory; ergodic measures in the modular orbifold and the Riemann hypothesis; gauge theory on Riemann surfaces; theta functions; field theory and hyperelliptic curves; Thurston's approach to Teichmüller space; cut-paste and light-cone Riemann surfaces; automorphisms of compact complex surfaces; the Fenchel-Nielsen-Weil-Peterson geometry; computations with divisors in moduli space; limit linear series; confocality of rational curves and scrolls; an elementary description of ˜g, the divisors at ∞ and H^2(˜g); introduction to string theory and its connection with Riemann surfaces; relating the two points of view, hyperbolic and analytic geometry; endomorphisms of vector bundles over a Riemann surface; construction of self-dual fields on surfaces; families of space curves; Abelian integrals; uniformization and algebraic correspondences; families of Riemann surfaces and n^{th} roots of the canonical bundle; Koszul techniques and algebraic curves; le problème de l'union avec des singularités; Bernstein polynomials and Gauss- Manin connection; Riemann surfaces and strings; Hilbert schemes of n-space curves; modular invariance for N-2 twisted conformal superalgebras in two dimensions; G analytic functions; moduli of curves and infinite dimensional Lie algebras; the osculating cone to the theta divisor; theta characteristics and moduli of curves; irreductibilité du schème d'Hilbert des courbes gauches; fixed flags under a unipotent element; linearizing flows on Prym-Tjurin varieties; Halphen's gap and the search for nice components of Hilb @^{3}; algebraic and arithmetic geometry in string theory; an interesting new family of curves; Prym varieties and intersection of quadrics; vector bundle techniques for curves and surfaces; non-reduced components of Hilb @^{3} and rational points of generic curves; operator formalism for string theory; the Schottky problem; calculus of conditions in algebraic geometry; deforming holomorphic flows; projective

properties of curves and moduli; the number of moduli of certain families of space curves; symmetric Riemann surfaces.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	16		16
Asia	19	1	20
Europe	19	36	55
North and Central America	12	13	25
South America	15		15
International Organizations		1	1
TOTAL	**81**	**51**	**132**

PHYSICS AND ENERGY

Title: THIRD WORKSHOP ON PERSPECTIVES IN NUCLEAR PHYSICS AT INTERMEDIATE ENERGIES

Dates: 18 - 22 May 1987

Organizers: Professors S Boffi (University of Pavia, Italy), C. Ciofi degli Atti (Italian National Institute of Nuclear Physics, INFN, Rome, Italy) and M M Giannini (Italian National Institute of Nuclear Physics, INFN, Genoa, Italy)

Purpose: To review recent advances and explore future trends in the investigation of nucleon and nuclear structure by electromagnetic and hadronic probes at intermediate energies

Programme:

Lectures were given on: electromagnetic interactions with nuclei, electroweak interactions with nuclei, hadronic interactions with nuclei, mesonic exchange currents and the swelling of nucleon in nuclei, π absorption by nucleon clusters, meson exchange currents and relativistic approaches, meson exchange currents, pionic delta-excitation of nuclei, relativistic effects in proton nucleus scattering, nucleon resonances in nuclei (experimental and theoretical), nucleon structure, recent searches for S = - 1 strange dibaryons, effective hadron degrees of freedom in nuclei, strange and nonstrange excitations in the nuclear quark modal at intermediate energies, looking for signatures of quark substructure in light nuclei, the deuteron and the 6-quark state, source driven final state interactions, Dirac phenomenology in (e,e'p) reactions, investigations of electroweak transitions amplitudes between 3-nucleon systems, how large are the occupation probabilities, Coulomb distortion of electrons in (e,l'p) scattering, nonlocalities and the optical Nodel, realistic many-body calculations of electron scattering observables, correlated nucleon in nuclei beyond the mean field approximation, structure functions and correlations in nuclei, proton momentum distributions and correlations in light nuclei, the nuclear surface in the charge response of light nuclei nucleon momentum distributions from inclusive and exclusive processes, correlations in nuclei 1, possible (e,e'2N) studies at CEBAF, a high energy deuteron polarimeter for use in ed scattering, quasi-elastic electron scattering in few-body nuclei, the (e,e'p) coincidence program at Bates and CEBAF, transverse and longitudinal responses for (e,e'p) electron scattering and nuclear medium effects on bound nucleons, scaling phenomena in nuclei, (e,e'gamma) a new probe for nuclear structure studies, deuteron two-body photodisintegration at intermediate energies, experimental investigations of photorections at Bonn, new data on the ^{16}O(gamma, p) ^{15}N reaction, the photodisintegration of Li in a neutron-proton pair and an alpha particle, Compton scattering by complex nuclei for energies below pion threshold, perspectives in photonuclear physics with a 4 PI detector, investigation of multi-hadron reactions at CEBAF, relativistic effects in proton-nucleus scattering, meson photoproduction, the EMC effect

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	3		3
Asia	8	1	9
Europe	10	75	85
North and Central America		17	17
South America	1		1
TOTAL	**22**	**93**	**115**

Title: SPRING COLLEGE ON PLASMA PHYSICS

Dates: 25 May - 19 June 1987.

Including

Title: INTERNATIONAL CONFERENCE ON COMETARY PLASMA PHYSICS

Dates: 9 - 11 June 1987.

Organizers: Professors B. Buti (Physical Research Laboratory, Ahmedabad, India), W. Grossman (New York University, USA) and M. Hassan (Third World Academy of Sciences and ICTP, Trieste, Italy).

Purpose: To review recent advances in plasma physics research and its applications to laser-plasma interactions, fusion plasmas and space plasmas.

Programme:

Lectures were given on:

(Workshop on laser-plasma interactions, 25 - 29 May): a review of plasma accelerators; progress on the beat wave, wake field, plasma lens and plasma wiggler concepts at UCLA; generation of EM radiation from beat waves; theoretical and experimental studies of beat wave accelerator at Naples University; ICF overview and introductory remarks; laser plasma interactions; Raman scattering and harmonic generation; laser plasma interaction; plasma simulation; linear and nonlinear magnetic electron modes in nonuniform plasmas; nonlinear plasma interaction with lasers; hot electron driven microexplosions; transport; ablation processes in laser irradiated solid planar targets; hydrodynamics of laser target compression; filamentation of strong laser beam in plasmas; generation of magnetic field due to Pondermotive force; fast particle kinetics of laser plasma interactions; recent work on laser matter interaction at Garching; recent hydrodynamics experiment at BARC.

(Symposium on small scale laboratory - plasma physics experiments, 1 June): investigations of CO_2 discharge; measurement of plasma potential in hydrogen arc discharge of duoplasmatron plasma source; a DC magnetron plasma sputtering experiment; snowplow operation of a plasma focus; the BATAN PFFF; intensity of focus action in various gases; design of a dense plasma focus facility; preliminary report on the FN dense plasma focus; a TEA nitrogen laser for optical diagnostics of the plasma focus; plasma sheath dynamics in plasma focus device - experiment and theory; optic plasma diagnostic technique applied to a low cost exploding - wire experiment; experimental investigation of electron beam formation in high-voltage low-pressure linear discharges; the design, construction and performance studies of a linear Z - pinch for current-stepping experiments; experimental studies on a small micro-pinch; temperature profile in thetatron using spectroscopic probe; experiment measurements of electron anomalous heat conductivity on CT-6B Tokamak; effects of the imposed pressure differential conditions on duoplasmatron performance; low frequency instabilities in a beam-plasma system; microwave plasma heating by cavity modes at electron cyclotron and lower hybrid frequencies; the influence of laser frequency bandwidth on the time and space resolves structures of the 2_0W harmonic generation.

(Space Physics, 2 - 8 June): the interaction of comets with the solar wind and solar radiation; solar magnetohydrodynamics; simulation of heating and transport in driven systems; role of wave-particle interaction in space plasmas; the interaction of comets with the solar wind and solar radiation; stochastic and nonstochastic transport in space plasmas; magnetic field reconnection; collective instabilities in cometary environment; simulation of heating and transport in driven systems.

(International Conference on cometary plasma physics, 9 - 11 June): plasma physics phenomena detected at Comet Giacobini-Zinner; an overview of Giotto observations; study of cometary plasma processes by means of barium plasma clouds injected into the solar wind; the

global morphology of the comet - solar wind interaction; kinetic processes associated with solar wind mass loading and their role on the nature of cometary shocks; ionization processes in the cometary coma after Giotto and Vega missions; anomalous acceleration of cometary ions; observations of the interaction between the solar wind and Comet Halley; upstream region acceleration of implanted cometary ions; generation of low frequency plasma turbulence by cometary ions; a nonlinear stability analysis of the cometary ionopause - observations of finite amplitude waves at the ionopause of Comet Halley; laboratory simulation experiments of solar wind interaction with comets; particle acceleration by nonlinear MHD turbulence; review of plasma observations by Vega 1 and 2 in the environment of Comet Halley; plasma transition layers in Halley's Comet; cometary bow shocks - myth vs. reality; MHD simulation of ion cyclotron and acoustic fluctuations in the vicinity of a comet; solar wind flow around a cometary tail; low-frequency plasma waves associated with boundaries encountered near Comet Halley.

(Symposium on small scale laboratory plasma experiments, 12 June): reversed field pinch; compact toroid experiment at UNICAMP; lower hybrid current drive experiment in linear LISA machine; density and temperature measurements in TBR Tokamak; study of inhomogeneous structures in laser produced plasmas; motion of charged particles in a hard core theta pinch; measurement of arc density and electron temperature in the hydrogen arc discharge of duo plasmatron plasma source; reaction rates in CO_2 discharge; high current ion source for basic plasma studies; development of a simple DC plasmatron for plasma arc metallurgy; a plasma source for neutron, soft X-ray and REB studies; numerical optimization of the dense plasma focus; limits of deuterium pressure range with neutron production in plasma focus devices; neutron yield scaling laws for plasma focus devices.

(Workshop): applications of Z-pinches; plasma instabilities of Z-pinches an their stabilization by axial magnetic field; modelling of Z-pinch with entrained magnetic field to fusion conditions; overview of FRC physics and experiments; an overview of the JET programme; Tokamak stability; Tokamak heating by ECRH; anomalous transport models for Tokamaks; dynamics of non-Maxwellian plasmas - theory and applications to experiments; Tokamak heating by ICRH; neo-classical MHD; high field Tokamaks; ICRH theory; non ideal MHD; Vlasov theory and simulations; resistive MHD; particle simulation of FRC physics.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	20		20
Asia	43		43
Europe	16	32	48
Indonesia and Oceania	3	1	4
North and Central America	3	21	24
South America	14		14
TOTAL	**99**	**54**	**153**

Title: WORKSHOP ON MATERIALS SCIENCE AND THE PHYSICS OF NONCONVENTIONAL ENERGY SOURCES

Dates: 26 August - 18 September 1987.

Organizers: Professors G. Furlan (University of Trieste and ICTP, Italy), D. Nobili (LAMEL, Bologna, Italy), A.A.M. Sayigh (Energy Resources Department, OAPEC, Kuwait) and B.O. Seraphin (University of Arizona, USA), with the co-sponsorship of the Dipartimento per la

Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy) and Italian National Research Council (Consiglio Nazionale delle Ricerche, CNR), Italy.

Purpose: To discuss specific research projects and realizations.

Programme: **Topics:** Solar energy conversion.
Storage.

Lectures were given on: materials for solar energy conversion; characterization of solar cells; recent progress in crystalline silicon solar cells; power conditioning aspects of small photovoltaic systems; recent developments in storage; technical-economical aspects of geothermal energy; silicon fabrication; recent developments in amorphous silicon cells; fundamentals and properties of coatings for solar energy conversion; Stirling engine technology; compound semiconductors for photovoltaics; wind energy; nonconventional energy in India; GaAs cells; power conditioning and storage for photovoltaic installations; impurities and defects in amorphous silicon; the activity of the UNAM; overview of Italian research in the field of materials for solar energy conversion; recent advances of solar materials research in the People's Republic of China; recent advances in a-Si solar cells and their industrialization; material research on a-Si based alloys: applications to low-cost efficient solar cells; recent results on photovoltaic materials; solar energy in Australia; modelling of solar systems; physics and key technologies for improving the conversion efficiency in a-Si solar cells; fundamental physics of amorphous semiconductors; feasibility, structure and optoelectronic properties of amorphous carbon-tin semiconducting alloys; European policy in photovoltaic conversion; high temperature superconductors; nonconventional electrochemical energy sources; the LAMEL activities.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	53		53
Asia	53	1	54
Europe	31	24	55
Indonesia and Oceania	1	1	2
North and Central America	6	6	12
South America	9		9
TOTAL	**153**	**32**	**185**

Title: WORKSHOP ON ECONOMICS, MODELLING, PLANNING AND MANAGEMENT OF ENERGY

Dates: 14 - 25 September 1987.

Organizers: Dr. A.M. Khan (Applied Systems Analysis Group, P.A.E.C., Islamabad, Pakistan) and Dr. H. Rogner (I.I.A.S.A., Laxenburg, Austria), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy) and Kuwait Foundation for the Advancement of Science.

Purpose: To provide participants with an overview of global and regional issues and familiarize them with analytical tools and modelling techniques appropriate for the analysis and planning of national energy systems.

Programme: **Topics:** Energy-economy interaction.
Modelling for energy demand and supply.
Tecno-economic evaluation supply alternatives.
Energy demand management.

Lectures were given on: introduction to energy system modelling; engineering economics; energy system in transition; case study of engineering economics; energy balance tables and flow diagrams; technoeconomic aspects of nonrenewable energy sources; technoeconomic aspects of renewables; case study on energy balance tables; econometric methods; linear program; input/output analysis; technology substitution; energy demand modelling; case study on energy demand projection by econometric methods; energy supply demand balancing; electric sector expansion planning; case study on linear programming; assessment of environmental risks of energy systems; energy investment planning; market penetration, modelling and application to energy systems; energy supply and demand management; energy-economy interaction; case study on energy pricing and its impact; simulation of technoeconomic performance parameters of energy technologies - a computer demonstration; power system model WASP-III - methodology; a case study of power generation expansion planning based on WASP-III; energy economy interaction - a computer demonstration.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	25		25
Asia	23		23
Europe	7	15	22
North and Central America	2	1	3
South America	6		6
International Organizations		1	1
TOTAL	**63**	**17**	**80**

Title: WORKSHOP ON INTERACTION BETWEEN PHYSICS AND ARCHITECTURE IN ENVIRONMENT CONSCIOUS DESIGN

Dates: 21 - 25 September 1987.

Organizers: Professors F.M. Butera (University of Palermo, Italy), O. Corbella (University of Porto Alegre, Brazil) and S. Yannas (Architectural Association, London, UK), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy) and the Bioclimatic Architectural Group of the International Solar Energy Society, Italian section.

Purpose: To join physicists, engineers, computer analysts and architects for a multidisciplinary critical analysis of the topics mentioned below.

Programme: **Topics:** The impact on the architectural design process of the tools developed for the management of energy and environmental issues: their structure and characteristics.
The impact of new technologies and materials.
Architects' needs and expectations and research areas to be developed.

Lectures were given on: environment conscious design in traditional architecture; the application of research results to architectural practice; architecture and building science for energy saving; operational aspects of using meteorology for energy purposes; the use of high resolution satellite image for land planning and urban development management; climatic data availability and modelling; building energy simulation; computer design tools for climate-responsive architecture; can we draw a line between heat transfer and architecture?; architecture and the African world: innovations and traditions; applying the solid modelling language to build-form representation and evaluation; a case study of passive houses built for three climatic conditions of India; the actors in building design: is there any reason for new design team strategies?; experiences from different climates and cultures; translucent installation for passive solar energy utilization in building; environmental and engineering conscious architectural design.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	10		10
Asia	15		15
Europe	2	23	25
North and Central America	2	3	5
South America	9		9
TOTAL	**38**	**26**	**64**

PHYSICS AND ENVIRONMENT

Title: SPRING COLLEGE ON GEOMAGNETISM AND AERONOMY

Dates: 2 - 27 March 1987.

Organizers: Professors F. Mariani (Università Tor Vergata, Rome, Italy) and R.G. Rastogi (Indian Institute of Geomagnetism, Bombay, India).

Purpose: To give an in-depth perspective of the interdisciplinary nature of geomagnetism and aeronomy.

Programme: **Topics:**
Earth's main magnetic field, its secular variation and model of the core field.
Electromagnetic induction processes.
Upper atmosphere.
Hydromagnetic waves and magnetic pulsations.
Geomagnetic disturbances, magnetospheric processes, sub-storms and indices of geomagnetic activity.
Solar, interplanetary and planetary magnetic fields and planetary ionospheres.

Lectures were given on: main magnetic field: morphology, origin and kinematics, energy sources, reversals, secular variation and changes in the length of the day; separation of the field - internal and external; magnetospheric processes: solar wind, magnetosphere, ionosphere system; indices of geomagnetic activity; the physics of imagination and creativity; global model, local anomalies and secular variation; interaction between plasmas and plasma dynamics; quiet day field at low latitudes; planetary ionopsheres; magnetospheric processes: convection - electric fields and polar caps; radio wave propagation: physics of the ionosphere; magnetospheric processes: particle motion, ring current and radiation belts; signal processing: statistical preliminaries; disturbed magnetic field: recurrent disturbances; project tethered satellite system: science and applications; radio wave propagation: H.F. propagation characteristics; signal processing: time series (auto corr. Fourier transforms and ARMA); electric currents in space, fully or partially ionized medium; ionospheric absorption; the international geosphere-biosphere programme: a forthcoming "Megaprogram" of the International Scientific Cooperation; radio wave propagation: ionospheric measurement techniques; signal processing: spectral estimation; magnetic storms and substorms; history of geomagnetic observation in the world; transionospheric radio wave propagation; signal processing: maximum entropy method; ionosphere for research and practical communications in developing countries; some problems of transionospheric propagation systems; signal processing: multi channel spectral estimation; electric currents for quiet and disturbed fields (film); South Atlantic anomaly; radio beacon satellite experiments; hydromagnetic waves: theory and experiments; electromagnetic induction in the earth: global distribution of electrical conductivity; Antarctic research: main tasks; relationship with arctic; E.M. induction in the earth: magnetometer arrays; comparison of ground and satellite magnetic data; geomagnetic phenomena at high latitudes; E.M. induction in the earth: magnetotellurics; interplanetary magnetic field polarity effects at low latitudes; interplanetary magnetic field: origin in the sun; magnetic field of solar system planets; magnetic field measurement close to a comet: Halley's encounter; equatorial electrojet; radar studies of the ionosphere: motivation, experiments and results; ionosphere through airglow: atmospheric/ionospheric emission; key parameters and future perspectives; basic concepts in data processing; incoherent scatter: theory, techniques and results; airglow: optical techniques; equatorial E region; magnetics in oil prospecting; equatorial F region; non-thermal scatter techniques and results; airglow: low latitude and ionospheric dynamics; study of earth by E.M. induction methods; dynamics of F region at low latitudes; mid and high latitude ionospheric dynamics through airglow.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	15		15
Asia	29	1	30
Europe	5	9	14
Indonesia and Oceania	2		2
North and Central America	3	4	7
South America	13		13
TOTAL	**67**	**14**	**81**

Title: COLLEGE ON SOIL PHYSICS

Dates: 2 - 20 November 1987.

Organizers: Dr. D. Gabriels (State University of Ghent, Belgium), Dr. E.L. Skidmore (US Department of Agriculture, Manhattan, Kansas, USA) and Dr. K. Reichardt (Centro de energia nuclear na agricultura, Piracicaba, Brazil), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy).

Purpose: To provide participants with a fundamental understanding of soil physical properties and processes so that they may apply knowledge gained to solving problems in soil physics.

Programme: **Topics:** General properties of soils.
Soil-water-plant-atmosphere continuum.
Soil and water conservation.

Lectures were given on: the soil resources: soil genesis and classification of the soils of the world; soil composition; soil structure formation, degradation, stability; soil porosity aspects; particle size distribution parameters; effects of soil management practices on soil structure; soil-water potential - tensiometer; soil moisture determination; estimating soil water retention from soil properties; qualification of soil moisture through micro-wave remote sensing techniques; computerized tomography as a method for physical studies of soil water; flow of water in saturated soils - Darcy's law; determination of hydraulic conductivity in saturated soil; estimating hydraulic conductivity from soil properties; unsaturated waterflow; introduction to the infiltration process; theoretical solution of infiltration as the one-dimensional flow process in the hornogeneous soil; application of theoretical solutions to field infiltration rate; quasi-analytical solutions of the flow equation for infiltration with and without crusts; gravity drainage for a homogeneous and stratified profiles; rainfall and infiltration; theory and practice of the field infiltration tests; soil consistency; movement of solutes - convection, diffusion and dispersion; some aspects of uptake of water and solutes by plant roots; general aspects of spatial variability; neutron-scattering - gamma ray attenuation; spatial variability of soil physical properties; soil surface sealing and crusting; thermal physical properties and moisture measurements in soils; heat transfer and soil temperature; infiltration and salinity; salinity and salt balance; waterbalance and irrigation techniques; irrigation principles: methods and equipment; drainage principles; modelling evaporation processes; water erosion process: parameters; mechanics of the water erosion process; mechanics of wind erosion processes and wing erosion control; integration of factors affecting soil erosion and soil conservation principles; soil conservation techniques.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	25		25
Asia	28		28
Europe	3	21	24
Indonesia and Oceania	1		1
North and Central America	4	2	6
South America	20		20
International Organizations		1	1
TOTAL	**81**	**24**	**105**

Title: SECOND AUTUMN WORKSHOP ON CLOUD PHYSICS AND CLIMATE

Dates: 23 November - 18 December 1987

Organizers: Professors A E Kalu (Anambra State University of Technology, Enugu, Nigeria), J Latham (University of Manchester, UK), R P Pearce (University of Reading, UK), M P Singh (Indian Institute of Technology, Delhi, India) and G Denardo (University of Trieste and ICTP, Trieste, Italy), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy).

Purpose: To encourage research collaboration on projects involving meteorology departments and universities in developing countries affected by the drought problem

Programme: **Topics:** General meteorology
Cloud physics
Weather modification
Satellite meteorology
General atmospheric circulation climate or arid zones and monsoon meteorology

Lectures were given on: cloud microphysical processes, general meteorology, satellite image processing and interpretation, atmospheric waves, early history of cloud seeding; electrification, cloud models, cloud drop spectra, microphysics and climatological effects of Saharan dust; cumulus entrainment, remote sensing, the use of climatic data in the design of buildings, remote sensing, satellite and radar meteorology, African monsoons, atmospheric cloud physics measurements, World Climate Programme of the WMO, numerical weather prediction, cloud physics and weather modification, general atmospheric circulation and climate of arid zones, monsoon meteorology, meteorology and navigation

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	31		31
Asia	38		38
Europe	8	18	26
North and Central America		4	4
South America	1		1
TOTAL	**78**	**22**	**100**

APPLIED PHYSICS

Title: SECOND WORKSHOP ON MATHEMATICS IN INDUSTRY

Dates: 2 - 27 February 1987.

Organizers: Professors A. Fasano (University of Florence, Italy), H. Neunzert (Universität Kaiserslautern, Federal Republic of Germany) and C. Storey (University of Technology, Loughborough, UK).

Purpose: To introduce the participants to the art of applying mathematics to real problems, i.e. to mathematical modelling theory.

Programme: **Topics:** Free boundary problems.
Optimization.
Control theory.
System theory: identification and model reduction.
Numerical aspects of free boundary problems and optimization.

Lectures were given on: a general introduction to optimizations; an introduction to free boundary problems; introduction to the concepts of linear systems and control theory; numerical methods in ground water flows; stochastic aspects and time series analysis; modern optimization software; optimal control; basic mathematical theories for the flow of liquids in porous media; economic applications of optimal control; linear geometric control theory; distributed parameter optimal control with particular reference to the glass industry; some mathematical modelling problems from the micro-electronics industry; flow of immiscible fluids in porous media; nonlinear control theory; identification of linear dynamical systems; optimization of fuel consumption in cars; modelling and parameter optimization of a thermal system; optimization of hydro-energy storage plant systems; a mathematical model for beneficial floods downstream of a hydro-power dam with reference to Steigler's Gorge in Tanzania; some practical experiences in and some examples from our cooperation with industry; mathematical problems in gear design; identification of seismic events using zero crossings - a procedure for evaluation of conditional seismic risk; methods for generating pseudo-random numbers; mathematical problems in the theory of liquid crystals; coordination of flood control in water reservoir systems; methods and application of multi-objective optimization problems; optimality conditions for distributed systems with boundary conditions involving lags; optimization of precast concrete framed structures; a nonlinear theory of hydrodynamic lubrication; Eddy-currents and magnetic field problems in electrotechnical applications: numerical methods; a game-theoretical look at transportation network equilibrium; a multi-objective cutting stock problem with stochastic demand in the aluminium industry; autocatalytic phenomena; some approximation problems of geological models; introduction to Liapunov stability.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	15		15
Asia	20		20
Europe	8	36	44
North and Central America	4	1	5
South America	7		7
TOTAL	**54**	**37**	**91**

Title: INTERNATIONAL WORKSHOP ON REMOTE SENSING AND RESOURCE EXPLORATION

Dates: 9 February - 6 March 1987.

Organizers: Dr. F. El-Baz (Boston University, USA) and Dr. V. Cappellini (University of Florence, Italy).

Purpose: To study in depth the application of remote sensing technology to the fields of archaeology, astronomy, geography, geology and physics.

Programme: **Topics:**
Remote sensing methods and techniques.
Data acquisition and handling.
Monitoring of change in the environment.
Mapping and charting.
Land resource surveys.
Mineral detection by remote sensing.
Underground water exploration.
Agriculture and food resources.
Forestry and rangeland resources.
Use of remote sensing in developing countries.
Regional centres and their uses.
Data bases and their utilization.
Space laboratories.

Lectures were given on: remote sensing: a new field or a new tool?; utilization of space photographs in resource exploration; data acquisition and handling; remote sensing image processing; some applications of remote sensing techniques; remote sensing of deserts and arid lands; case study on Eastern Sahara; future trends in remote sensing; computer image enhancement; application of remote sensing to archaeology; wind directions from dune patterns; remote sensing of dune fields in the Sahara; remote sensing and modelling in the Adriatic Sea; remote sensing in developing countries; space images in tropical studies; remote sensing for crop forecast; lineaments and lineation analysis; the basics of remote sensing of natural vegetation; modern mapping from imageries; remote sensing of the East African rift; remote sensing for soil survey; regional centre for services in surveying mapping and remote sensing; forest classification and inventory; mapping structures by remote sensing; global vegetation monitoring; data bases and their management; remote sensing in groundwater exploration in arid lands; planetary remote sensing; evaluation of thermal satellite data in the municipal information system of Würzburg; study of ice in the solar system by remote sensing techniques; use of remote sensing in meteorology; remote sensing activities in Egypt; a low cost digital image processing system as an alternative to application of standard photographic products; lithological and structural mapping by remote sensing; remote sensing in geology; satellite remote sensing of rainfall: manual and interactive and objective techniques; some digital transformations and filtering techniques for image processing; remote sensing activities in Pakistan; hydrological indicators and river flood previsions in West Africa; satellite remote sensing for the monitoring of major environmental hazards; detecting crop water stress by means of infrared remote sensing; the Space Shuttle large format camera; remote sensing of the Eastern Sahara; resolution and detection with small format air photo systems; commercial aspects of remote sensing; an advance technology aerial camera; monitoring dunes by remote sensing; thermal infrared remote sensing: a case study of the Po River; electro-optical and photo-optical aids to improved mapping data acquisition.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	21		21
Asia	32		32
Europe	3	18	21
North and Central America	3	7	10
South America	6		6
TOTAL	**65**	**25**	**90**

Title: ICFA SCHOOL ON INSTRUMENTATION IN ELEMENTARY PARTICLE PHYSICS

Dates: 8 - 19 June 1987.

Organizers: Professors T. Ekelof (Panel for Future Instrumentation of the International Committee for Future Accelerators, ICFA, CERN, Geneva, Switzerland), C. Fabjan (CERN, Geneva, Switzerland) and J. Pilcher (University of Chicago, USA), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy), the Trieste Section of the Italian National Institute of Nuclear Physics (Istituto Nazionale di Fisica Nucleare, INFN, Italy), the European Organization for Nuclear Research (CERN, Switzerland) and the United States Department of Energy (DoE).

Purpose: To cover the two main avenues in the research in particle detection, i.e. the physics and technology of detectors.

Programme: **Topics:** Physics of detectors.
Systems and applications of detectors.

Lectures were given on: the present state of high energy physics; interaction of charge particles and photons in matter; drift and detection of charges; accelerator experiments in elementary particle physics; detector signal processing; cosmic ray physics and astrophysics; energy loss of particles in dense matter-calorimetry; elementary particle physics detectors for non-accelerator experiments; detectors in medicine and biology; drift and detection of charges in solid detectors; an experimentalist's overview of accelerators.

(Laboratory sessions): principles of MWPC detectors; drift chamber studies; measurements of the lifetime of cosmic ray muons; signal processing and noise studies.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	5		5
Asia	19		19
Europe	3	45	48
North and Central America	1	21	22
South America	4		4
International Organizations		6	6
TOTAL	**32**	**72**	**104**

Title: WORKSHOP ON TELEMATICS

Dates: 7 September - 1 October 1987.

Organizers: Professors G. Perucca (Centro Studi e Laboratori Telecomunicazioni, CSELT, Turin, Italy) and M.V. Pitke (Centre for Development of Telematics, New Delhi, India), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy).

Purpose: To focus on the fundamental aspects of digital communications and computers and their role in evolving information networks in the future.

Programme: **Topics:**
Fundamentals of digital communications.
Packet switching.
Networks and protocols.
ISDN.
New transmission and distribution media.
Video services.
Communications software.
Satellite networks.

Lectures were given on: introduction to telematics; introduction to telephony; telephone network basics; basic switching techniques; digital signal processing; hardware for digital signal processing; fibre optics; optical fibre measurements; speech processing; architecture of a modern switch; signalling aspects; LANS; photonic switching; communication software; satellite based networks; future technologies; television's teletext; communication software; overview on CSELT research activities; new switching techniques; first trials of ISDN services; new switching system architectures; ISDN developments for the Italian switching system; technology issues: IBI network experiments; networks software; projects: some ideas; evolution of microprocessors; broadband ISDN standards; advanced switching techniques; technology for developing countries.

Practical experiments: telephony and speech codecs; demonstration of DSP; digital switching; bit synchronisation; digital signal processing.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	16		16
Asia	38		38
Europe	4	8	12
Indonesia and Oceania	4		4
North and Central America	4	3	7
South America	14		14
International Organizations		2	2
TOTAL	**80**	**13**	**93**

Title: FOURTH COLLEGE ON MICROPROCESSORS: TECHNOLOGY AND APPLICATIONS IN PHYSICS

Dates: 5 - 30 October 1987.

Organizers: Mr. C. Verkerk (CERN, Geneva, Switzerland), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy), the Kuwait Foundation for the Advancement of Sciences and the United Nations University (Tokyo, Japan). Dr. A. Colavita (Argentina/ICTP) acted as Head of the Laboratory.

Purpose: To bring participants, in a period of 4 weeks, to a level which will enable them to develop microprocessor-based systems and to use them efficiently.

Programme: **Topics:** General introduction to microprocessors.
Microcomputer hardware (architecture and interfacing).
Assembly language programming.
Techniques for microprocessor project development.
Applications of microprocessors in various fields.

Lectures were given on: introduction to logic; introduction to (micro)computers; characteristics of the 6809; assembly language programming; introduction to FLEX; I/O and interfacing; hardware of the Colombo '84 board; hardware debugging; digital/analog conversion; floating point operations; sensors; buses and data communication; software tools and techniques; introduction to projects; Kernel software for Colombo bears; 16 and 32-bit microprocessors; hardware maintenance; system analysis; case study on a data acquisition system; simulation, optimization and control of engineering systems; microprocessors in modern instrumentation: pulse height analyzer.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	24		24
Asia	52	1	53
Europe	8	12	20
Indonesia and Oceania	5		5
North and Central America	9	1	10
South America	16		16
International Organizations		5	5
TOTAL	**114**	**19**	**133**

ADRIATICO RESEARCH CONFERENCES

Title: ADRIATICO RESEARCH CONFERENCE ON UNDULATOR MAGNETS FOR SYNCHROTRON RADIATION AND FREE ELECTRON LASERS

Dates: 23 - 26 June 1987.

Organizers: Under the chairmanship of Professor S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden): Professors R. Bonifacio (University of Milan, Italy), C. Pellegrini (Brookhaven National Laboratory, Long Island, USA), L. Fonda (University of Trieste, Italy) and R. Rosei (University of Trieste, Italy), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy).

Purpose: To discuss and compare the proposed designs of undulators, and review the experimental results obtained to-date.

Programme: Topics:
Characteristics of undulators for synchrotron radiation.
Characteristics of undulators for free electron laser.
Analysis of effects of undulator errors on synchrotron radiation spectra.
Analysis of effects of undulator errors on free electron lasers.
Hybrid undulators: performances and experimental results.
Electromagnetic undulators.
Undulator pole shaping for beam focusing.
Very short period undulators, and other future developments.
Microwave undulators.
Effects of undulators on beam dynamics and storage ring performances.

Lectures were given on: status of undulator development; characterization of undulator radiation; analysis of undulators field errors for FELs; the TOK undulator; FEL wiggler development at LLNL; undulator at BESSY; design and measurement of undulators at Daresbury; measuring and correcting wiggler errors; undulator development at Spectra Technology; undulator design at Orsay; field configuration for microundulator; submillimeter period undulator; undulator development at field effects; electomagnetic wave undulators; cost optimization of induction linacs drivers for radiation sources; effects of undulators on storage ring beam dynamics; the state of the art of FEL in Italy and abroad; undulator development at ENEA; near fields undulator radiation; FEL programme at Spectra Technology - Boeing.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Asia	4		4
Europe		23	23
North and Central America	1	20	21
TOTAL	**5**	**43**	**48**

Title: ADRIATICO RESEARCH CONFERENCE ON ONE-DIMENSIONAL ORGANIC CONDUCTORS: CHEMISTRY, PHYSICS AND APPLICATIONS

Dates: 30 June - 3 July 1987.

Organizers: Under the chairmanship of Professor S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden): Professors Kouand-An Chao (Linköping Institute of Technology, P.R. China), G. Harbeke (RCA Laboratories Ltd., Zürich, Switzerland), Yu Lu (Academia Sinica, Beijing, P.R. China, and ICTP, Trieste, Italy) and G. Zerbi (Politecnico, Milan, Italy), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy).

Purpose: To present a critical review of the status of the field and the new developments in the field of one-dimensional organic conductors.

Programme: **Topics:** Materials survey. Synthesis. Chemical and physical concepts.
Solid state theory. Quantum-chemical approach. Correlation effects. Lattice dynamics. Semiconductor-metal transition. Nonlinear effects.
Optical spectroscopy. Photoexcitation. Fast spectroscopy. Resonance techniques. Electron energy loss.
Technological applications. New developments.

Lectures were given on: chemical aspects of conducting polymers; physical aspects of conducting polymers; transport phenomena in conducting polymers; chemistry of polyaniline and model compounds; anisotropic optical properties of pure and doped polyacetylene; electronic structure of conducting polymers - investigations by electron energy-loss spectroscopy; special properties of conducting polymers: ultra-high electrical conductivity and third order (nonlinear optical) susceptibility; simple theory of conducting polymers; optical excitations and properties of polydiacetylenes; femtosecond dynamics and nonlinear optical properties of polyacetylene; picosecond optical probes; spectroscopic studies of polyene molecules; experimental studies of organic ferromagnets; modern version of valence bond theory: applications to poyacetylene and organic ferromagnets; Fröhlic conduction in field induced spin density waves in Bechgaard salts; lattice dynamics in polyacetylene - amplitude, phase and shape modes; molecular vibrations and structures of conjugated polymers; magnetic resonance studies in one-dimensional organic conductors; lattice vibrations in trans-polyacetylene with a soliton and the optical activities; lattice dynamics (spectroscopic approach); ESR and optical studies of doped (3-methylthiophene); CDW dynamics: a progress report and optical properties; charge transfer crystals; solitons in CDW crystals: the way to survive; properties and application potentials of highly conducting organic polymers; numerical simulations of conducting polymers - kinks, polarons and breathers; lattice relaxation approach to soliton and polaron dynamics in conducting polymers; role of electron-electron correlations in conducting polymers.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Asia	4	4	8
Europe	3	31	34
North and Central America		14	14
South America	3		3
TOTAL	**10**	**49**	**59**

Title: SPECIAL ADRIATICO RESEARCH CONFERENCE ON HIGH TEMPERATURE SUPERCONDUCTORS

Dates: 5 - 8 July 1987.

Organizers: Under the chairmanship of Professor S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden): Professors E. Tosatti (International School for Advanced Studies, ISAS-SISSA, and ICTP,Trieste, Italy), M. Tosi (University of Trieste and ICTP, Trieste, Italy) and Yu Lu (Academia Sinica, Beijing, P.R. China, and ICTP, Trieste, Italy), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy) and IBM Italy.

Purpose: To discuss the latest experimental discoveries, the theoretical interpretations of the results obtained and the possible technical applications.

Programme:

Lectures were given on: high T_c superconductivity - general overview; history of the theory of superconductivity; a road to high temperature superconductivity; possible applications of high temperature superconductors; ideas on high T_c superconductivity; recent theoretical ideas on high temperature superconductors; high temperature superconductivity from magnetism: the resonating valence bond state; the nature of the pairing in a resonating valence bond superconductor; Van Hove singularities and high temperature superconductivity; our present understanding of the new high T_c superconductors; recent structural developments in copper oxides, high T_c superconductors; macro- and micro-structure of superconducting Cu oxides; structure property correlations high temperature superconducting oxide; the temperature factor of the X-ray scattering in superconducting polycrystalline ceramics; high resolution neutron powder diffraction studies of high temperature superconductors; discovery and physics of superconductors above 90 K; physical properties and superconductivity in layered perovskite oxides; high T_c superconductivity in Ba-Re-Cu-O (Re = rare earth); thin films of the high T_c perovskites; superconducting and magnetic properties of $MBa_2Cu_3O_7$-compounds; antiferromagnetism in La_2CuO_4; X-ray absorption fine structure studies of high T_c superconductors; submillimeter conductivity spectrum of the new superconductors; bonds, bands, charge transfer excitations and superconductivity of $YBa_2CuO_{7-\delta}$; theory of high T_c superconductivity in oxides; Jahn-Teller-effect mediated hole-pair tunneling and superconductivity in high T_c copper oxides; antiferromagnetism and superconductivity in the 2D Hubbard model: scaling theory; neutron diffraction images and refinement of $Ba_2YCu_3O_7$ structures; glass state properties of high T_c superconductors; high critical currents in high temperature superconductors; space applications of high temperature superconductivity; structure and properties of oxide superconductors; flux quantization in ceramic superconductors and application to SQUID devices; low field magnetic relaxation effects in Sr-La-Cu-O and La-Ba-Cu-O; recent measurements on lanthanum barium copper oxides; high temperature superconductivity research at Los Alamos; some results on new superconductors obtained in Sverdlovsk; Hall measurements on high T_c oxides; instability of the ferromagnetic state in the Hubbard model; some aspects of the high T_c problem; hole pairing mechanism induced by antiferromagnetic spin fluctuations; strong superconductivity in nested electronic systems; light-metal hydrides as high T_c superconductors; properties of strong coupling superconductors; superconductivity as a synchronous alteration of valence bonds; dynamics of twin boundaries and high T_c superconductors; influence of structure and antiferromagnetic transitions on superconductivity; superconductivity in alkaline-earth substituted La_2CuO_4: a theoretical model; Raman scattering in superconductors; spin fluctuation mediated superconductivity in a two-band model.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	2		2
Asia	19	6	25
Europe	21	88	109
Indonesia and Oceania		1	1
North and Central America	2	30	32
South America	9		9
International Organizations		3	3
TOTAL	**53**	**128**	**181**

Title: ADRIATICO RESEARCH CONFERENCE ON VACUUM IN NON-RELATIVISTIC MATTER - RADIATION SYSTEMS

Dates: 14 - 17 July 1987.

Organizers: Under the chairmanship of Professor S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden): Professors F. Persico (University of Palermo, Italy) and E.A. Power (University College, London, UK), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy).

Purpose: To review in particular those aspects of the field which lend themselves to a unified description in terms of the structure of the vacuum electromagnetic field and its modifications.

Programme:

Lectures were given on: perturbation of the e.m. vacuum by atoms/molecules; the Lamb shift in hydrogen; spontaneous emission in the vacuum; quenching quantum noise via the correlated spontaneous emission laser; optical cavity radiation in microscopic cavities; the micromaser: from cavity QED to quantum chaos; dressed and half-dressed sources in non-relativistic QED; vacuum fluctuations and intermolecular interactions; dressed atomic ground state and optical detection; detection of half-dressed sources in non-relativistic QED; cross correlation in two-mode and two photon lasers; vacuum effects induced by radiation and matter fields; cloning photons in the presence of vacuum fluctuations; quantum jumps; e.m. field commutations in the presence of matter; QED in cavities based on self-energy; squeezing the vacuum in atom-field interactions; macroscopic manifestations of vacuum fluctuations in quantum dynamical initiation; environmental effects on spontaneous emission and Lamb shift according to stochastic electrodynamics; different ways of looking at the e.m. vacuum; nonlinear structure of the e.m. vacuum; virtual cloud effects in perturbate atoms; correction to the electron spin magnetic moments near mirrors; gauge transformation in semiclassical radiation theory.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	3		3
Asia	1		1
Europe	4	12	16
Indonesia and Oceania		3	3
North and Central America	1	7	8
South America	1		1
TOTAL	**10**	**22**	**32**

Title: ADRIATICO RESEARCH CONFERENCE ON SCANNING TUNNELLING MICROSCOPY - FUNDAMENTAL EXPERIMENTAL AND THEORETICAL PROGRESS

Dates: 28 - 31 July 1987.

Organizers: Under the chairmanship of Professor S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden): Professors El Burstein (University of Pennsylvania, Philadelphia, USA) and E. Tosatti (International School for Advanced Studies, ISAS-SISSA, and ICTP,Trieste, Italy), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy).

Purpose: To bring together a number of leading experimentalists and theorists for in-depth presentations and discussions of the fundamental physics underlying the scanning tunnelling microscope.

Programme: **Topics:**
One- and two-atom tunnelling experiments.
Single atom imaging and spectroscopy theory.
Local density of states, image potential, field emission and other issues.
Role of the tip in imaging and spectroscopy.
Resonant tunnelling.
Inelastic tunnelling - vibrational and electronic excitations
Spin polarized tunnelling.
Tunnelling in a magnetic field.
Electron tunnelling at metal, superconductor, semiconductor, semimetal, magnetic and organic (including biological and polymer) surfaces.
Tunnelling as a probe of charge density waves.
Tunnelling at solid-liquid interfaces.
Electron tunnelling at defects and at adsorbates.
Limits to stability and resolution of the scanning tunnelling microscope.
The atomic force microscope.

Lectures were given on: tunnelling microscope studies of new structures on semiconductor surfaces; tunnelling spectroscopy of clean and metallized Si surfaces; similarities and differences in field ion microscopy and scanning tunnelling microscopy; properties and applications of ultra-sharp tips; a low-temperature, high-field scanning tunnelling microscope; restoration and pictorial representation of scanning tunnelling microscope data; tunnelling in a magnetic field with spin-polarized electrons; capillary condensation between tip and sample: did ever anybody tunnel through air?; spin polarized electron microscopy; theory of single-atom

imaging in the scanning tunnelling microscope; topography versus electronic structure in scanning tunnelling microscope images; inelastic electron tunnelling from a metal tip; tunnelling microscopy at 4° K: prospects for observing inelastic tunnelling; tunnelling with coupling to a surface phonon and plasmon; new design for a high stability STM for ultra-high vacuum; STM of gold on silicon; semi-empirical and phenomenological instrument functions for scanning tunnelling microscope; scanning tunnelling spectroscopy for probing the density of states: applications to semiconductors and superconductors; diffraction effects and contrast in STM and STS; small forces and force microscopy; scanning tunnelling microscopy of adsorbed atoms on semiconductor surfaces; scanning tunnelling microscopy studies on metal surface reconstructions; study of frictional forces with the atomic force microscope; force microscopy by laser heterodyne sensing; nonperturbative theory for metal superconductor tunnelling; scanning tunnelling microscopy of novel materials polymers, quasicrystals, thin films, clusters and high T_c superconductors; the new high T_c materials: STM, AC susceptibility and grain/domain model of superconductivity; point contact and STM studies of high T_c superconductors YBaCuO and GdBaCuO; looking at electron trapping with STM; scanning tunnelling microscopy of graphyte; scanning tunnelling spectroscopy of graphite and intercolates; atomic force microscopy, scanning tunnelling microscopy and lithography at liquid-solid interfaces; applications of scanning tunnelling microscopy to the study of charge density waves; scanning tunnelling microscopy in air, gas and liquid; scanning tunnelling microscopy on thin organic films; STM in biology; use of an STM to rectify optical frequencies and measure an operational tunnelling time; metal submonolayers on graphyte: imaging of Ad-atoms, Ad-clusters and large islands by scanning tunnelling microscopy; classic and new trends in scanning tunnelling microscopy; unresolved issues.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	2		2
Asia	4	4	8
Europe	3	40	43
Indonesia and Oceania		1	1
North and Central America	3	28	31
TOTAL	**12**	**73**	**85**

Title: ADRIATICO RESEARCH CONFERENCE ON INTERATOMIC FORCES IN RELATION TO DEFECTS AND DISORDER IN CONDENSED MATTER

Dates: 11 - 14 August 1987.

Organizers: Under the chairmanship of Professor S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden): Professors A.B. Lidiard (Atomic Energy Authority, Harwell, UK), Chi-Wei Lung (Academia Sinica, Shenyang, P.R. China) and M.P. Tosi (University of Trieste and ICTP, Trieste, Italy), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy).

Purpose: To review and discuss recent progress and future prospects.

Programme: **Topics:** The electronic theory of interatomic interactions, especially in simple metals, transition metals, semiconductors and ionic substances.

The prediction of the defect properties of solids, e.g. point defects, dislocations, internal and external interfaces, and of their atomic and ionic transport properties, e.g. thermal activation, fast ion conduction.
The prediction of the thermodynamics and internal dynamics of liquids.
The inference of interatomic forces by analysis of experimental data on structure and on thermodynamic, defect and transport properties.

Lectures were given on: the influence of interatomic forces on the structure of liquids: an experimental approach; interatomic force modelling of local coordination and extended structure in ionic-covalent liquids; the inference of interatomic forces from structural data on liquids; what is the law of interionic interaction in a polar solvent?; LDA and refractive index of rare-gas liquids; new approach to triplet correlation functions in dense fluids; interatomic forces in semiconductors and insulators from both fundamental and empirical viewpoints; interatomic potentials for oxides and their use in defect calculations; interatomic forces in semiconductors - first principle calculations; prediction of glass-forming concentration range in binary transition metal alloys; role of defects and disorder in CdI_2 polytypic crystals at low temperatures; pair potential trend of alkali metals under external pressure; interatomic forces in transition metals; interatomic forces in relation to the theory of dislocations; interatomic forces in relation to the properties of point defects, dislocations and clusters; molecular dynamics of metal surfaces; Morse potential function and the temperature dependence of CRSS of Mo and Fe single crystals; computer simulation of plane defects in Ni_3Al using a volume dependent potential; simulation of metal/molten salt interfaces; experimental studies of solute-defect interactions in metals and alloys; molecular dynamics and defects in metals in relation to interatomic force laws; the quantum simulation of hydrogen in transition metals.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	5		5
Asia	2		2
Europe		16	16
North and Central America	2	1	3
TOTAL	**9**	**17**	**26**

Title: ADRIATICO RESEARCH CONFERENCE ON THE PATH INTEGRAL METHOD WITH APPLICATIONS

Dates: 1 - 4 September 1987.

Organizers: Under the chairmanship of Professor S. Lundqvist (Chalmers University of Technology, Göteborg, Sweden): Professors A. Ranfagni (Istituto di Ricerca sulle Onde Elettromagnetiche del Consiglio Nazionale delle Ricerche, IROE-CNR Florence, Italy), V. Sa-yakanit (Chulalongkorn University, Bangkok, Thailand) and L.S. Schulman (Clarkson University, Potsdam, USA), with the co-sponsorship of the International School for Advanced Studies (ISAS-SISSA, Trieste, Italy).

Purpose: To present an overview of the theory with emphasis on the fundamental concepts and the functional integral techniques.

Programme: **Topics:** Basic theory of the Feynman path-integral method.
The problem of quantum fluctuations.
Tunnelling processes. Complex time description.
Dissipation in tunnelling systems. Temperature effects.
Non-radiative processes: vibrational relaxation and tunnelling.
Thermodynamics of non-linear systems.
Applications to disordered systems, quantum Hall effect, Josephson junctions, optical phenomena etc.
Path integrals in field theory.
Topology and path integrals.
Exact solutions and semiclassical approximation.

Lectures were given on: introduction to the Feynman path integral; semiclassical approaches; recent applications of the Feynman path integral in two and three dimensions; Hamiltonian path integrals; asymptotic calculation of Wiener functional integrals; functional integral generalization of the coherent potential approximation; variational approach to quantum statistical mechanics; space-time transformations for the path-integral; the path integral in chaotic Hamiltonian systems; the Feynman integral, the Feynman-Kac formula with a Lebesgue-Stieltjes measure and Feynman's operational calculus; operator ordering and supersymmetry; path integral formula for non-equilibrium quantum field theory; the frozen false vacuum; application of the path integral to heavily doped semiconductors; functional integrals for spin-Bose systems; path integrals, Lifshitz tails and Urbach tails; the functional integration measure for the dynamical systems with constraints; applications of path integral methods to electromagnetic scattering and diffraction problems; certain inequalities for partition functions by path integral methods; quantum decay of dissipative systems; the tunnelling time and trajectory; a path integral approach to topological conservation; two-point distribution function for a polyelectrolyte model; path integrals for particles under the influence of gravity and electromagnetism; application of the Josephson effect to the determination of fundamental constants and precision electrical metrology; particle interacting with a bath: thermal averages and density matrix.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	10		10
Asia	6		6
Europe	17	31	48
North and Central America	1	7	8
TOTAL	**34**	**38**	**72**

OTHER RESEARCH

Dates: Throughout the year.

Purpose: To allow scientists wishing to avail themselves of the Centre's facilities (library and computers) and of the presence of ICTP consultants and other experts to carry out independent research in periods when no activity is scheduled in their fields of interest.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	57		57
Asia	118		118
Europe	24	37	61
Indonesia and Oceania	1		1
North and Central America	5	3	8
South America	17		17
International Organizations		4	4
TOTAL	**222**	**44**	**266**

Figures also include short-term visitors coming for organizational activities only.

MICROPROCESSOR LABORATORY

The activities of the Microprocessor Laboratory (ICTP - INFN, Istituto Nazionale di Fisica Nucleare, Italy), sponsored by the United Nations University (UNU, Tokyo, Japan) were articulated along the following lines:

(1) training activities in microprocessors and technical support given to these activities;

(2) activities of the joint ICTP/INFN Microprocessor Laboratory.

(1) Training activities:

During the year, the Laboratory had a very heavy load of activities. The following training

(a) from September 7th to October 2nd 1987 the "Workshop on Telematics" took place in the premises of the Microprocessor Laboratory. Rosy stations were used for the practical sessions as well as other instruments and facilities. The Laboratory gave to the organizers of the Workshop all the support needed, including the participation of its technical staff. Ninety-three scientists attended the workshop.

(b) From October 5th to October 30th, the regular biannual home based course took place at the Laboratory. Including lecturers and participants, one hundred and thirty-three scientists participated in the "Fourth College on Microprocessors: Technology and Applications in Physics", showing its enormous popularity and timeliness (more that four hundred applications were received). The staff of the Laboratory was involved in the preparation of the course as well as during its implementation. The college was directed by Prof. C. Verkerk from CERN.

(c) During the last part of the following year, the laboratory started the preparation of the equipment, lecture notes, etc. for the forthcoming courses:

- Second Latin American College on Microprocessors, San Luis, Argentina, 11 - 29 April 1988;
- Workshop on Microprocessor Application in Instrumentation, Bogota, Colombia, 16
- First African Regional College on Microprocessors: Technology and Applications in

(d) Starting at the beginning of August to mid-September, Prof. Colavita taught a course for future instructors for the forthcoming Second Latin American College on Microprocessors. The course took place at San Luis, Argentina, with the attendance of ten participants.

(e) The ICFA School on Instrumentation in Elementary Particle Physics took place in the premises of the Laboratory from June 8th to June 19th 1987. The School had all the technical support of the Laboratory as well as the support of INFN and the University of Trieste. One-hundred and four participants attended the School.

(2) Activities of the joint ICTP/INFN Microprocessors Laboratory

(a) New equipment

The Laboratory has four new Mitac-Halley 80386 powered stations equipped with multisynch screens and mice. These stations are used for CAE systems and graphic software development. Also the Laboratory has incorporated two IBM Personal System/2, model 50, donated by IBM to ICTP together with two token ring network servers. They will also be used for CAE systems.

Four Epson FX-800 and one FX-1000 printers as well as ten Ampex 220 terminals were

Three new CAE software packages, PCAD, XILINX (Silo) and Silvar Lisco were installed in different computers to cover the need of different projects being carried out at the Laboratory.

As the number of scopes was not enough to handle the increased activity of the laboratory, a very nice Tektronic oscilloscope of 350 Mhz bandwidth was purchased.

(b) Technical projects:

This is necessarily a short summary of the scientific projects being carried out or started in the laboratory. The following projects are included:

1. first prototype for the single board, 68B09, Rosy Jr. teaching station;
2. development of a Forth environment for the 68020 based Gimix single board computer;

3. development of RomDisk for the Rosy Jr. station;
4. feasibility study for the installation of the MINIX Operating system in a 68000 based Force VME card;
5. study of the preliminary specifications of a single board 68020 powered computer;
6. development of Graphic software, under Microsoft's Windows, to control a Burr and Brown A/D D/a IBM compatible card;
7. development of Graphic software, under Microsoft's Windows Operating System written to control a Multichannel Analyzer IBM compatible board;
8. development of a Multichannel Analyzer board using a Digital Signal Processor as on board "sequencer" and resident processor;
9. development of IBM compatible data acquisition card with a MC6809 microprocessor and with the ROSY Development System;
10. development of a Rosy/Flex and OS-9 hardware and software compatible development station;
11. Delphi Experiment (INFN, Group 1);
12. Clue Experiment (INFN, Group 2)
13. Anne Experiment (INFN, Group 2);
14. PM2 Experiment (INFN, Group 5).

More comprehensive reports on these activities are available on request

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Asia	1		1
Europe		5	5
South America	5		5
International Organizations		4	4
TOTAL	**6**	**9**	**15**

NETWORK OF ASSOCIATE MEMBERS AND FEDERATED INSTITUTES

REPORT ON THE ASSOCIATE MEMBERSHIP SCHEME IN 1987

Reports on the Network of Associates and Federated Institutes are available on request.

1 - REGULAR ASSOCIATES

Associate Members are scientists from and working in developing countries who are appointed, upon recommendation of the Scientific Council, for a period of six years during which they are entitled to pay three research visits to the ICTP. Each of such visits should not exceed 90 days but should last more than six weeks during the appointment period. Then, if the 3x90 = 270 days have not been fully utilized during the 6-year period, the remaining days may be used for additional visits for which the ICTP will not bear the costs of the travel expenses. During their period at the ICTP, Associate Members work either independently or in collaboration with other scientists in residence and attend workshops, conferences or extended courses.

The Centre expects that they will be engaged, in their home countries, in enhancing physics and mathematics education at the secondary, polytechnical and college levels as well as teaching and research at the university level. Moreover, they should also pay attention, in their research work, to problems of physics and mathematics connected with their locale.

In 1987, the list of appointed Associates included 319 scientists. Forty-one appointments expired at the end of 1986, one new Associate Members was appointed and 10 appointments were extended. One hundred and thirty-seven Associate Members (42.95%) came to the ICTP for a total of 291.29 man/months with an average duration of stay of 2.13 man/months (nearly the same average as in 1986). The number of visits is somewhat lower than that normally expected because the number of new appointments did not compensate the number of expired appointments. Some of the Associate, of course and for various reasons like academic requirements or family situations, break the 2-year cycle by anticipating or differring the timing of their visits with respect to the time they would normally be expected at the ICTP. Tables I and II show to what extent the Associate Membership scheme has been used from the geographical areas and from the research interests viewpoints respectively.

Table I

Number of Associates Entitled to a Research Visit in 1987 and Number of Associates who Actually Came, per Geographical Areas

Areas	Number of Associates		Number of Visits			
	#	% vs. total	Visits	% vs. total	Man/Months	% vs. total
Africa	86	26.96%	43	31.39%	90.98	31.23%
Asia	159	49.84%	64	46.72%	133.53	45.84%
Europe	11	3.45%	8	5.84%	16.65	5.72%
Indonesia & Oceania	5	1.57%	1	0.73%	0.82	0.28%
North & Central America	11	3.45%	4	2.92%	8.65	2.97%
South America	47	14.73%	17	12.41%	40.66	13.96%
Total	**319**		**137**		**291.29**	

Table II

Number of Associates Entitled to a Research Visit in 1987 per Scientific Field of Interest

Fields of Interest	Number of Associates		Number of Visits	
	#	%	#	%
Fundamental physics	64	20.06	31	22.63
Condensed matter	68	21.32	45	32.85
Mathematics	47	14.73	21	15.33
Physics and energy	66	20.69	24	17.52
Physics and environment	30	9.40	9	6.57
Living state	14	4.39	3	2.19
Applied physics and high tech.	30	9.40	4	2.92
Total	**319**		**137**	

Table III

Summary

1.	Regular Associates appointed in 1987	319
2.	Regular Associates appointed in 1986	349
3.	Appointments expired at the end of 1986	41
4.	New appointments starting in 1987	1
5.	Extensions and renewals starting in 1987	10
6.	Member states represented in 1987	62
7.	Regular Associates visiting ICTP in 1987	137
8.	Number of man/months	291.29
9.	Average duration of stay	2.13 man/months
10.	Number of preprints produced	119

The intellectual benefits which Associates derive from their research period visit at the ICTP are numerous. Many of them succeed in publishing a paper. This year, 119 preprints were prepared by Associate Members, either alone or in collaboration with others (an average of 0.87 papers/Associate against 1 paper/Associate in 1986).

Associates, while at the ICTP, have an opportunity to re-orient their research, to collaborate at a distance, once they are back home, with their colleagues of other developing countries or from industrialized countries or to update their scientific literature and, for many of them, to improve their teaching at their home universities.

2 - SENIOR ASSOCIATES

Some of the former Associates of the ICTP who have acquired an international reputation and/or have distinguished themselves as "entrepreneurs" in their home countries in the research or in academic training, may be appointed Senior Associates of the ICTP upon recommendation of the Scientific Council. The duration of the appointment is 6 years during which they may draw from a fund of 4,000 US$ for each of them which can be used for subsistence and travel in relation to their visit to the ICTP.

Senior Associates come to the Centre for various reasons. Some take advantage of their visits for carrying out their research since they can concentrate on their work being relieved from their administrative duties. Others come for boosting the collaboration between their colleagues and the scientists of the ICTP. Others take advantage of their being in Europe to come to the ICTP in order to attend a workshop or conference which can be interesting for themselves or their collaborators, or to give a seminar.

In 1987, the ICTP list of Senior Associates included 36 names from 17 Member States.

Eleven Senior Associates representing 6 Member States came for a total of 15.04 man/months. Therefore, the average duration of a research visit was 41.55 days (1.37 man/months). They produced 6 preprints and came from the following geographical areas:

Asia	7
Europe	1
South America	3

3 - JUNIOR ASSOCIATES

Junior Associates are selected among those participants in the ICTP extended courses and workshops who work at institutions in developing countries with poor library facilities. A Junior Associate is appointed for four years and is entitled to a 350 US$ grant for buying scientific books and/or subscribing to scientific periodicals which must be made available to his/her colleagues. At the expiration of their appointments, Junior Associates are considered candidates to the Regular Associate Membership Scheme.

In 1987, 122 scientists held a Junior Associate appointment.

Table I shows the distribution of the 122 Junior Associates by field, while Table II shows their distribution by geographical areas.

Table I

Distribution of Junior Associates by Fields

Fundamental physics:	Elementary particles	4
Condensed Matter:	Atomic physics	9
	Solid state	24
Mathematics:		20
Physics and energy:	Nuclear physics	7
	Plasma physics	3
	Renewable energies	8
Physics and environment:	Climatology/meteorology	1
	Ecology	2
	Geophysics	21
	Soil physics	9
Physics of the living state:	Biophysics	5
	Medical physics	1
Applied physics:	Communications physics	2
	Microprocessors	6
	TOTAL	**122**

Table II

Distribution of Junior Associates by Geographical Areas

Africa	55
Asia	56
Europe	1
Indonesia and Oceania	1
North & Central America	4
South America	5
TOTAL	**122**

4 - FEDERATION AGREEMENTS

As in the past, the ICTP concluded Federation Agreements with institutions in developing countries whereby these institutions may send their scientists to the ICTP for a specified number of days, depending on the location of the institution with respect to Trieste. A limited number of agreements is also concluded with European institutions, mainly in Eastern Europe.

Federated Institutions are encouraged to send their junior scientists to Trieste when activities of their interest are taking place at the ICTP. Scientists from Federated Institutes, therefore, attend extended courses, workshops, conferences or discuss their research projects with ICTP scientists and use its computer and library facilities.

The terms of *some* of the Agreements are at variance with those of types A, B, C and D in order to take particular local conditions into account.

Special Agreements are concluded with institutions from Argentina, Brazil, Kuwait, Pakistan, Qatar and Saudi Arabia.

The utilization of the resources offered by the Standard Federation Agreements is summarized in Table I.

Table I

Standard Agreements

1.	Agreements proposed	266
2.	Agreements signed	229
3.	Agreements utilized	188
4.	Scientists who benefited from the Agreements	544
5.	Member states which benefited from the Agreements	50
6.	for a total number of man/months	434.03
7.	Total man/months allocated for the 186 agreements utilized	544
8.	Utilization rate	79.77

For the Special Agreements, the utilization of the resources was as shown in Table II.

Table II

Special Agreements

Institutions	# visitors	# days	Man/months
1. KFAS	22	750	24.66
2. Kuwait University			
a) from Arab and Islamic Countries	10	545	17.92
b) from Kuwait University Fund	6	137	4.50
3. Islamic Republic of Iran	1	31	1.01
4. University of Qatar	1	25	0.82
5. Argentina	12	402	13.22
6. CNPq, Brazil	1	84	2.76
7. Arab Bureau of Education, Saudi Arabia	9	282	9.27
TOTAL	**62**	**2256**	**74.16**

Table III shows totals for Standard and Special Agreements.

Table III

Type of agreement	# Visitors	# Man/Months
Standard	544	434.03
Special	62	74.16
Total	**606**	**508.19**

Note - 508.19 man/months represent 13% of the total man/months for ICTP activities held in Trieste.

PHYSICS AND DEVELOPMENT

Title: PHYSICS AND DEVELOPMENT PROGRAMME

Dates: Throughout the year.

Organizers: Professor H.R. Dalafi (ICTP).

Purpose: To increase the awareness of scientists of the role of physics in social and economic development, and to inform Third World scientists of potential sources of assistance for physics research and its applications to the development needs of their countries.

Programme:

Lectures were given on:

Physics and Development Weekly Programme: an American nuclear physicist looks at the arms race; SDI: "Star Wars" - the strategic defense initiative between physics and science fiction; technology and development; the participation of developing countries in space research; the International Geosphere-Biosphere Programme: a forthcoming "Megaprogram" of international scientific cooperation; ionosphere for research and practical communciations in developing countries; the role of scientific networks in the Third World; influence of space processes on technology; information technology and the Third World; emerging issues of vital importance to both the industrialised and developing countries; the efectiveness of economic and social development policies in developing countries; new technologies and the third world; the status of conventional disarmament policy; inspection and maintenance of engineering reliability principle with applications to nuclear plants; the role of science in the process of development; the development of interdisciplinary material science in the USA: a case study for developing countries; science education and development; science and technology for development: concrete examples; international cooperation in science and technology, its significance for developing countries; cultural identity and scientific-technological development; Latin American project of metallurgy; science, technology and development; the implications of modern technological changes for the developing countries; institution-building for science and technology policy making in the Third World; general aspects of agrophysics; elements of ground water management: the unsaturated zone; Uppsala programme for research co-operatio with developing countries; technical co-operation with Third World countries: the role of the International Atomic Energy Agency; some contributions of meteorology to development.

General Lectures: history of geomagnetic observations in the world; the collections and thoughts of an old physicist.

Colloquium: the physics of imagination and creativity; fundamental problems of physics, dimensionless constants - symmetry and dynamics; foundations of quantum theory in the light of new experiments, macroscopic quantum effects, neutron interferometry; light and matter, tests of QED, experiments on single atoms, electrons and photons; models of matter, status of fundamental symmetries, C.P.T. neutrinos, monopoles and tachyons; why Minkowski's space time is not sarisfactory for particle physics; Erwin Schrödinger and the revival of his interpretation of quantum mechanics; experiments on gravitation; the motion of the moon; reminiscenceof the early days of quantum mechanics; transmembrane channels and disease; Riemann surfaces and discrete groups; analysis of the difficlties met by the formalism; some attempts for a solution; a mathematical model for neural networks; the spinorial chessboard; the problem of quark confinement.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Europe		4	4
North and Central America		1	1
TOTAL		**5**	**5**

In addition to these invited lecturers, 30 scientists participating in other programmes also gave lectures.

THE ICTP DONATION SCHEME

BOOK DONATION PROGRAMME

This scheme was initiated at the Centre some years ago to provide universities in developing countries with books, journals and proceedings. These publications are normally donated to the International Centre for Theoretical Physics by individuals, libraries, publishing companies, international conferences and international organizations in industrialized countries for distribution among libraries in developing countries.

Within this programme, an agreement was established with various publishing companies, such as the North-Holland Publishing Company, the World Scientific Publishing Company in Singapore, as well as the Physical Society of Japan etc., which have agreed to provide the ICTP with 150 surplus copies of all their publications for distribution among libraries in developing countries.

In 1987 the Centre was able to distribute 10,000 journals, 12,000 proceedings and 10,000 books to more than 400 institutes in 96 developing countries.

This programme will hopefully be increased substantially in the near future to help more institutions in developing countries.

EQUIPMENT DONATION PROGRAMME

This scheme was initiated at the Centre in 1984 for the purpose of providing laboratories in developing countries with equipment for teaching and research purposes. In the past three years the Centre has been able to help 15 to 20 institutes in developing countries which have received several items of equipment donated by various leading laboratories in Europe within this scheme. The European Centre for Nuclear Research (CERN) which have joined this programme on a permanent basis has offered a considerable amount of surplus equipment suitable for teaching and research purposes.

Every year we try to send two or three teams of guest scientists to visit CERN for the purpose of selecting and assisting in packing the surplus equipment for laboratories in developing countries. The equipment selected by the visiting team is packed and shipped directly by CERN to laboratories which have extended their specific requests to the Centre. So far, within this programme, we have been able to help various laboratories in the following countries: Argentina, Bangladesh, Brazil, Colombia, Ghana, India, Malaysia, Nigeria, Pakistan, Sudan and Zaire.

HOSTED ACTIVITIES

N°	Title	Dates	Organizer
1	Workshop on Scientific and Technological Applications of Synchrotron Radiation	14-15 May	Sincrotrone Trieste
2	Initiative Committee of the International Foundation for Survival	21-23 May	International Foundation for Survival

TRAINING AND RESEARCH AT ITALIAN LABORATORIES

Dates: Throughout the year.

Organizers: The programme was co-ordinated by Professors G. Furlan (University of Trieste and ICTP, Trieste, Italy), G. Denardo (University of Trieste and ICTP, Trieste, Italy) and E. Tosatti (International School for Advanced Studies, ISAS-SISSA, and ICTP, Trieste, Italy), in collaboration with Advisory Committees in each of the fields concerned. The Italian National Commission for Nuclear and Alternative Energies (ENEA, Rome, Italy) offered a special contribution.

Purpose: To give participants in ICTP activities the opportunity of widening their experience by becoming directly involved in different branches of physics with the research work of laboratories at Italian universities, governmental and industrial research centres.

Programme: In 1987, 108 scientists representing 29 developing Member States worked - with grants from the Centre - in 76 Italian laboratories for a total of 730.10 man/months.
The research subjects included:

Atomic molecular physics and lasers
Biophysics
Climatology and meteorology
Computational physics
Condensed matter physics
Energies
Geophysics
Medical physics
Microprocessors
Plasma physics
Soil physics

A detailed report is available on request.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	20		20
Asia	63		63
Europe	8		8
North and Central America	4		4
South America	13		13
TOTAL	**108**		**108**

ACTIVITIES AND SPONSORED PROJECTS OUTSIDE THE ICTP

REGIONAL ACTIVITIES ORGANIZED BY THE CENTRE

Title: MICROCOMPUTERS IN PHYSICS AND MATHEMATICS

Place and Dates: University of Khartoum, Sudan, 22 - 31 March 1987.

Organizer: Dr. I.A. Ali (University of Khartoum, Sudan), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry for Foreign Affairs, Rome, Italy).

Purpose: To equip participants to implement applications of microcomputers in the teaching of physics and mathematics, at the undergraduate level.

Programme: **Topics:** Practical experience in using and writing educational software.
Practical experience in interfacing microcomputers to physics experiments.
Lectures on applications of microcomputers to physics and mathematics, both in training for research and in teaching.
Lectures on new developments in physics, mathematics and computing, and their relevance to training for research and to physics and mathematics teaching.

Lectures were given on: languages and expert systems; Logo - a high level interpreted language; games nature plays (statistical simulations); calculating orbits (role of approximations in mechanics); dynamic modelling (computers as theory-machines); interface and control (experiments connected to BBC); continuous or discrete? (cellular automata); electronics and interfacing (electronics connected to BBC); science and games (use of games in science education); limits to Newton (chaotic motion in classical mechanics); economic game (computer aided decision game); limits of computation?; artificial intelligence and education; Einstein's world on computer.

Summarized data on the participation (Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	22		22
Europe	2	3	5
TOTAL	**24**	**3**	**27**

Title: WORKSHOP ON FABRICATION OF LOW COST LABORATORY EQUIPMENT FOR PHYSICS

Place and Dates: University of Dar-es-Salaam, Tanzania, 1 - 3 April 1987.

Organizers: Professor B. Saraf (Centre for Development of Physics Education, University of Rajasthan, Jaipur, India), Dr. E.M. Lushiku and Dr. L.K. Shayo (University of Dar-es-Salaam, Tanzania), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry of Foreign Affairs, Rome, Italy) and Swedish Agency for Research Co-operation with Developing Countries (SAREC, Stockholm, Sweden).

Purpose: To generate required capabilities among school and university physics teachers in the art of fabricating low-cost laboratory equipment.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	34		34
Asia	3		3
TOTAL	**37**		**37**

Title: WORKSHOP ON THE APPLICABILITY OF ENVIRONMENTAL PHYSICS AND METEOROLOGY IN AFRICA

Place and Dates: Addis Ababa University, Ethiopia, 10 - 21 August 1987.

Organizer: Dr. B. Workalemahu (Addis Ababa University, Ethiopia), with the co-sponsorship of the Dipartimento per la Cooperazione allo Sviluppo (Ministry of Foreign Affairs, Rome, Italy) and other external funding agencies. The local organization was undertaken by the University of Addis Ababa and the Ethiopian National Meteorological Services. This Workshop was proposed by the ICTP Society of African Physicists and Mathematicians.

Purpose: To show scientists how to apply their skills to help overcome problems in agricultural production, drought and desertification, and water and energy supplies.

Programme: **Topics:** Large scale climate.
Water resources.
Biomass production.

Lectures were given on: introduction to atmospheric dynamics; physical basis of atmospheric models; modelling the ocean-atmosphere system; computer requirements for models; data needs for models; principles of radiation transfer; radiation in atmospheric models; observations from satellites; putting satellite data into dynamic models experimenting with simple models; uses and limitation of GCMs: 10 days - 100 years and 1-10 days; predictability of large scale precipitation; measuring area rainfall conventionally; measuring rainfall from satellites; infiltration, evaporation and run-off; modelling water yields from catchments; measuring soil water; water movement in soil: physical basis and modelling; water use by plants; climate change - facts about rainfall; rainfall data, processing and presentation; CLICOM; photosynthesis and respiration; phenology - physical control of development; modelling crop growth and yield; optimizing irrigation with models; measuring crops in the field; crop monitoring by satellite; agro-ecological zoning - crop selection; climate applications referral system environmental measurements.

Summarized data on the participation
(Number of scientists by world regions)

World regions	Developing	Industrialized	TOTAL
Africa	59		59
Europe	1	6	7
Indonesia and Oceania		1	1
North and Central America		1	1
TOTAL	**60**	**8**	**68**

REGIONAL ACTIVITIES CO-SPONSORED BY THE CENTRE

A report on the external activities in 1987 is available on request.

In 1987, the International Centre for Theoretical Physics through its Office for External Activities was co-sponsor of 79 activities, as set out in the table below. In addition to that, 5 fellowships for visiting scholars/consultants came into operation.

Africa	Burundi	1	Workshop
	Egypt	1	Conference
		1	Physics and mathematics teaching
	Ethiopia	1	Training activity
	Ghana	1	Physics and mathematics teaching
	Ivory Coast	1	Training activity
		1	Conference
		1	Physics and mathematics teaching
	Nigeria	1	Workshop
	Rwanda	1	Physics and mathematics teaching
	Sudan	1	Training activity
		1	Physics and mathematics teaching
	Tanzania	1	Workshop
		1	Physics and mathematics teaching
Asia	China	1	Training activity
		3	Workshops
		2	Conferences
	India	6	Workshops
		4	Conferences
	Jordan	1	Training activity
		1	Workshop

	Malaysia	1	Conference
		1	Physics and mathematics teaching
	Philippines	1	Conference
	Pakistan	1	Training activity
		1	Workshop
	Singapore	1	Workshop
	Sri Lanka	1	Conference
		1	Physics and mathematics teaching
	Thailand	1	Training activity
		1	Workshop
	West Bank	1	Physics and mathematics teaching
Europe	Bulgaria	1	Conference
	Czechoslovakia	2	Conferences
	Turkey	3	Conferences
	Yugoslavia	2	Conferences
North and Central America	Cuba	1	Conference
	Dominican Rep.	1	Workshop
	Mexico	1	Training activity
		2	Workshops
		1	Physics and mathematics teaching
	Puerto Rico	1	Workshop
South America	Argentina	2	Training Activities
		1	Workshops
	Brazil	3	Training Activities
		2	Workshops
		1	Conference
	Chile	1	Workshop
		2	Conferences
	Colombia	3	Training activities
		1	Workshops
	Ecuador	1	Workshop
	Peru	2	Training activities
		1	Workshop
		1	Physics and mathematics teaching

PRIZES AND OTHER CELEBRATIONS

Annual ICTP Prizes were created in 1982 by the Scientific Council of the Centre in recognition of outstanding contributions to physics and mathematics by scientists from and working in a developing country. They consist in a medal, a certificate and a 1 000 US$ cheque. One Prize is awarded each year. Until now, the Prizes have been awarded in honour of the late Alfred Kastler (France), Chairman of the Scientific Council from 1970 to 1983, the late Manuel Sandoval Vallarta (Mexico), Nobel Prize 1966 and Chairman of the Scientific Council from 1964 to 1970, Sigvard Eklund (Sweden), Director General Emeritus of the International Atomic Energy Agency (IAEA, Vienna, Austria) and Nikolaj N. Bogolubov (USSR), a great friend of the ICTP. Posters announcing the Prizes are circulated through the Centre's mailing list.

ALFRED KASTLER PRIZE

31 March 1987

Prof. **Li Jia Ming** from the Institute of Physics of the Chinese Academy of Sciences was awarded the 1986 ICTP Prize for his outstanding contributions in the field of atomic and molecular physics. He is an expert in the multichannel quantum defect theory (MQTD) and has made significant contributions towards the development of this theory. His main achievements include:

- the establishment of the relativistic version of MQTD;
- the application of MQTD to photoionizatin, photodetachment and other processes with a large number of good results;
- the establishment of the multiple scattering method for calculating the MQTD physical parameters, namely the energy levels of molecular Rydberg states;
- the proposal of a method to measure the compressed core density of high-power laser imploded spehrical targets;
- the investigation of the atomic shell effect on the equation of state at high temperature and high pressure and the application of quantum electrodynamics to high energy atomic processes.

NIKOLAJ N. BOGOLUBOV PRIZE

7 August 1987

Dr. **Abdullah Sadiq** of Pakistan was honoured in recognition of his contributions to scientific knowledge in the field of solid state physics. His diverse research interests in condensed matter physics have included Ising models, correlated percolation and its relations to spin glass transition and long chain polymers. He has been active in the area of computer simulation of physical systems and his current studies relate to the kinetics of irreversible chemical processes. Dr. Sadiq is a staff member of the Pakistan Institute of Nuclear Science and Technology in Rawalpindi, Pakistan.

DIRAC MEDALS

8 August 1987

To honour one of the greatest physicists this century and a staunch friend of the Centre, the International Centre for Theoretical Physics has instituted two Paul Adrien Maurice Dirac Medals. These Medals are awarded yearly both to a senior and to a younger physicist, on Dirac's birthday – 8 August – for contributions to theoretical physics.

The selection committee includes Professors S. Lundqvist, R. Marshak, J. Schwinger, L. Van Hove, S. Weinberg and Abdus Salam. The Dirac Medals are not awarded to Nobel Prize of Wolf Foundation Prize winners.

The **1987** Medals were awarded to Professor **Bruno Zumino** and Professor **Bryce S. DeWitt** for their outstanding contributions to theoretical physics.

Prof. **Bruno Zumino** has been for the last twenty years one of the leading experts in field theory. Together with Prof. Julius Wess, he has made fundamental contributions to the study of chiral anomalies in gauge theories with fermions. Also in collaboration with Prof. Wess, he proposed the first renormalizable Lagrangian field theories to realize supersymmetry in 4-dimensional space-time. With Prof. Stanley Deser he constructed one of the first supergravity theories in four dimensions. In addition to this important early work, he has been a leader in the application of modern geometrical ideas in field theory. In particular he has illuminated the role of Kähler geometry in extended supergravities and, more generally, the value of differential geometric methods in the study of anomalies.

Prof. **Bryce S. DeWitt** has made 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.

PART III

PUBLICATIONS ISSUED IN 1987

N°	Date	Title of Proceedings	Publisher	Pages
1	14 November - 3 December 1983	*Perspectives in Communications*	World Scientific Publishing Co. Pte. Ltd., Singapore (WSPC)	1,482
2	10-12 June 1985	*Tests of Electroweak Theories, Polarized Processes and Other Phenomena*	WSPC	461
3	17-21 June 1985	*Fourth Marcel Grossmann Meeting on General Relativity*	North Holland, The Neterlands	1,862
4	2-20 September 1985	*Conference and Workshop on the Physics of Nonconventional Energy Sources and Material Science for Energy*	WSPC	551
5	17 February - 21 March 1986	*Applications in Nuclear Data and Reactor Physics*	WSPC	994
6	7-15 April 1986	*Supergravity, Supersymmetry and Superstrings*	WSPC	565
7	17-20 June 1986 and 1-5 September 1986	*Quantum Chaos/Structure and Complexity*	Physica Scripta, Sweden	199
8	24-27 June 1986	*Dynamical Screening and Spectroscopy of Surfaces*	Physica Scripta	167
9	30 June - 4 July 1986	*Relativistic Many-body Problems*	Physica Scripta	228
10	30 June - 15 August 1986	*Superstrings, Unified Theories and Cosmology, ICTP Series, Vol. 3*	WSPC	464
11	5-8 July 1987	*High Temperature Superconductors*	WSPC	508

PREPRINTS AND INTERNAL REPORTS

Number of preprints and internal reports issued in 1987: 421

PREPRINTS AND INTERNAL REPORTS IN FUNDAMENTAL PHYSICS

	Authors	Title	ICTP Serial Number
1.	A.O. Barut, M. Pavsic	Classical model of the Dirac electron in curved space	1
2.	A.O. Barut, A. Inomata, R. Wilson	A new realization of dynamical groups and factorization method	2
3.	A.O. Barut, A. Inomata, R. Wilson	Algebraic treatment of second Pöschl-Teller Morse-Rosen and Eckart equations	3
4.	A.O. Barut, M. Bozic	Classical and quantum 'EPR'-spin correlations in the triplet state	7
5.	A.O. Barut, Y.I. Salamin	Relativistic theory of spontaneous emission	8
6.	E. Bergshoeff, E. Sezgin, P.K. Townsend	Supermembranes and eleven dimensional supergravity	10
7.	E. Bergshoeff, E. Sezgin, C.N. Pope, P.K. Townsend	The Born-Infeld action from conformal invariance of the open superstring	11
8.	A. Yu. Ignatiev, V.A. Kuzmin	Is small violation of the Pauli principle possible?	13
9.	M.I. Doroliubov, A. Yu. Ignatiev, V.A. Matveev	A search for light photino in neutral pion decays	14
10.	I.I. Tkachev	Astrophysical axionic lasers	15
11.	Chuan-jie Zhu, Yu-jie Zhu, Ke Wu, Yuang-zhong Zhang	New BRST quantization of the bosonic string and string field theory	17
12.	M. Carena, C. Wagner, L. Masperi	Non-Abelian theory for massive vector bosons and canonical quantization	19

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1.	Lin-Jian-Cheng	Charge density wave scattered by single impurity	6
2.	K.K. Singh	Scaling and grossover in a fermion boson mixture	12
3.	Yong-Liang Wang	The calculation of deep levels in semiconductors by using a recursion method for super-cells	18
4.	Teng Da, Zhuang Weihua, Sun Dianzhao, Jiang Desheng	Photoreflectance of GaAs/AÚGaAs multiple quantum wells	20
5.	M.J. Ponnambalam	Effects of a cubically symmetric electron density on the field gradient in cubic metal alloys	22
6.	Zhang-Yong De, Ren Yong, Fan Hongyi	New application of boson's coherent states of double medoes at regular product	27
7.	Wang Yong-Liang, U. Lindefelt	A local environment approach for deep-level defects in semiconductors: application to the vacancy in silicon	33
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10.	Zhang Yong-De	The neutron's Dirac equation: its rigorous solution at slab-like magnetic fields; non-relativistic approximation; energy spectra and statistical characteristics	38
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12.	Lin Jian-Cheng	Inverse scattering with mixed spectrum from δ-potentials	55
13.	Lin Jian-Cheng	A generalized model for site percolation with two independent concentrations	63

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2.	Duong Minh Duc	The Poincaré inequality for flow domains and its applications	5
3.	G.R. Jensei, M. Rigoli	Harmonically immersed surfaces of R^M	9
4.	N. Mohammad, A.B. Thaheem	Best approximations in topological vector spaces	25
5.	Duong Minh Duc	Coercive properties of elliptic-parabolic operators	30
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13.	Duong Minh Duc	Properties of functions in weighted Sobolev spaces	51
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2.	H.M. Sen Gupta, M.S. Chowdhury, F. Watt, M.J. Hurst	A study of some $(sd)^4$ shell model states in ^{20}F via the ^{18}O (^{3}He,p) reaction	24
3.	Tang Lin, Zhou Hongyu, Yan Yiming, Wen Shenlin, Wang Qi, Sun Shuxu, Ding Xiaoji, Wang Wanhong	The study of 90° gamma ray production cross sections for interactions of 14.9 MeV neutrons with C, Al, V, Fe, Co, Nb samples	48
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7.	M.Y. El-Ashry, N.A. Papuashvili	Modulational instability of electric helicons and a magnetized collisional plasma	143
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2	G R Dargahi-Noubari	On application of mean frequency for seismic differentiation	Geophysics	29
3	W E Senanayake	Spatial power spectrum of the geomagnetic field since 1945	Geophysics	49
4	A Wague	Calculation of the photo-electron's angular distribution asymmetry parameter β_{2p} near the (3S3P)'P resonance of He	Atomic physics	56
5	S N Tiwary	Inner-shell excitation of alkali-metal atoms	Atomic physics	57
6	A Teshome, A Spartakove	Determination of size distribution function	Atomic physics	58
7	A N Pandey, R K Sharma	Electron impact ionization cross-section of some organic compounds	Atomic physics	60
8	A N Pandey, D R Singh, D K Sharma	Vibrational analysis of the Raman spectra of selenium oxide dihalides	Molecular spectroscopy	99
9	A R Bestman	Non-equilibrium flow of a radiating gas in a vertical channel with axial temperature variation	Non equilibrium flows	100
10	A R Bestman	Non-equilibrium flow of a dissociating gas in a horizontal channel with axial temperature variation	Non equilibrium flows	101
11	A R Bestman	Hydrodynamic stability of a chemically reacting fluid in a porous medium	Hydrological process	102
12	A R Bestman	Radiative heat transfer to chemically reacting flow between concentric rotating spheres	Geomagnetism and aeronomy	103
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