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INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
I.C.T.P., P.O. BOX 586, 34100 TRIESTE, ITALY. CABLE: CENTRATOM TRIESTE
19461
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY

SCHOOL ON "USE OF SYNCHROTRON RADIATION IN SCIENCE AND TECHNOLOGY" 14 October - 8 November 1991

FINAL REPORT

The International Centre for Theoretical Physics (ICTP), with the cooperation of the International Centre for Science and High Technology (ICS), the Sincrotrone Trieste and the European Synchrotron Radiation Society (ESRS), organized the first ICFA School on the use of Synchrotron Radiation, from 14 October to 8 November 1991. The School was directed by Professors J.C. Fuggle (University of Nijmegen, The Netherlands), A. Craievich (LNLS, Campinas, Brazil) and R. Rosei (Trieste University/Sincrotrone Trieste S.C.p.A., Italy), with Professor L. Fonda (I.C.T.P./Sincrotrone Trieste S.C.p.A., Italy) as local organizer. Professor J.C. Fuggle, through whose efforts the School was mainly organized, was then regretfully unable to join because of health reasons.

The aim of this School was to cover all aspects of synchrotron radiation (SR) from storage ring and insertion device design to actual use of SR. Emphasis was placed on practical training in vacuum technology and instrumentation, and the use of common experimental techniques. The course material was treated in lectures and in exercises on personal computers, since effective use of SR depends on data treatment which can be adequately done with small computers.

The School consisted of about 3 hours of lectures and approximately 4 hours of exercises per day. The lectures included :

General Overview of SR Utilization

Spectroscopy and diffraction techniques. Introduction to PS, XAS, EXAFS, small angle scattering, crystallography, microscopy etc.

Accelerator Physics and SR Sources

Ring construction, vacuum and mechanical stability requirements, bending magnets, insertion devices, the emitted spectrum, beam lifetimes etc.

This section was designed for the users rather than the machine builders. It gave the potential user an idea of the scope of the operation, (e.g. why an insertion device cannot be installed over one weekend), the

complexity of the problems and the origin of the costs and other factors which future potential decision makers should be aware of.

Beamline and Monochromator Design

Beamline design, heat loads, safety features, vacuum and vacuum interlocks, beam splitting, monocchromator design and optics, tolerances for components, reflectivities, monochromator throughput, spectral resolution, detectors etc.

This section was interfaced with the section on machine physics.

Photoemission Techniques

Spectrometer characteristics, ARUPS, XPS, Resonant PS, Cooper minimum, chemical shifts, variable surface sensitivity, quantitative and qualitative analysis, semiconductor research.

Tutorial work included analysis of spectra.

X-ray Absorption, XANES and EXAFS

Data collection and analysis.

Here the emphasis was on EXAFS which is a technique extensively used in life sciences, chemistry, catalysis and materials science, as well as (to a lesser extent) physics. A lot of tutorial work and training in data analysis using personal computers was organized.

SR in Biology

This section primarily involved diffraction techniques and small angle scattering which are also used extensively in materials science, physics and chemistry.

Total number of lecturers: 22
Total number of participants: 49

The School was a great success. It was very important to start early to train scientists from developing countries on the use of SR in view of their future participation in experimental activities at "Elettra" (Trieste SR facility) .

I strongly recommend to repeat this experience as soon as possible with the idea of running it on a yearly basis.

Prof. Luciano Fonda
Local Organizer

Trieste, 4 December 1991

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SCHOOL ON
"USE OF SYNCHROTRON RADIATION IN SCIENCE AND TECHNOLOGY"
14 October - 8 November 1991
FINAL PROGRAMME

Week 1
(14 - 18 October)

Monday, 14 October

8.30 - 9.30 Registration and administrative formalities
9.30 - 10.00 Opening Ceremony
10.00 - 11.00 L. FONDA
"ELETTRA: Progress Report"
11.00 - 12.00 DING CHANG XIAN
"A Report from Beijing Facilities"
12.00 - 14.00 Lunch Break
14.00 - 15.30 Talks on ICTP, TWAS and ICS:
14.00 - 14.15 M. FARCCCUE "General Information on ICTP"
14.15 - 14.45 G. DENARDO "ICTP Office of External Activities" & "I.C.S."
14.45 - 15.00 G. GHIRARDI "Associates and Federation Scheme"
15.00 - 15.15 T.K. SHAH "Donation Programme and TWAS"
15.15 - 15.30 M. ZINGARELLI "ICTP Library"
15.15 - 16.15 A. BALDERESCHI
"Interaction between radiation and matter"

Tuesday, 15 October

9.00 - 10.00 R. ROSEI
"Overview of SR uses"
10.00 - 10.15 Coffee Break
10.15 - 11.15 C. KUNZ/T. ISHII
"High Energy Spectroscopy"
11.15 - 12.15 C. KUNZ/T. ISHII
"High Energy Spectroscopy"
12.15 - 14.00 Lunch Break
14.00 - 15.00 C. KUNZ/T. ISHII
"High Energy Spectroscopy"
15.00 - 16.00 M. BERNARDINI
"Vacuum for Electron Storage Ring"
16.00 - 17.00 R. KERSEVAN
"Vacuum System Optimization: Computational Methods"

Wednesday, 16 October

09.00 - 10.00 C. KUNZ/T. ISHII
"High Energy Spectroscopy"
10.00 - 10.15 Coffee Break
10.15 - 11.15 M. ERIKSSON
"Electromagnetic Radiation"
11.15 - 12.15 M. ERIKSSON
"Electromagnetic Radiation"
12.15 - 14.00 Lunch Break
14.00 - 15.00 H. WIEDEMANN
"Transverse Focusing"
15.00 - 16.00 PHYSICS AND DEVELOPMENT
16.00 EXERCISES (General)

Thursday, 17 October

09.00 - 10.00 V. DHANAK
"Electron-energy Analyzers"
10.00 - 10.15 Coffee Break
10.15 - 11.15 H. WIEDEMANN
"Longitudinal and Transverse Focusing"
11.15 - 12.15 H. WIEDEMANN
"Synchrotron integrals""
12.15 - 14.00 Lunch Break
14.00 - 15.00 M. ERIKSSON/H. WIEDEMANN
"Facility Case Study"
14.00 - 15.00 EXERCISES (Spectroscopy)

Friday, 18 October

09.00 - 10.00 R. WALKER
"Machine Physics (Insertion Devices 1)"
10.00 - 10.15 Coffee Break
10.15 - 11.15 C. KUNZ/T. ISHII
"High Energy Spectroscopy"
11.15 - 12.15 C. KUNZ/T. ISHII
"High Energy Spectroscopy"
12.15 - 14.00 Lunch Break
14.00 Visit to ELETTRA

<u>Week 2</u>
(21 - 25 October)

Monday, 21 October

09.00 - 10.00 R. WALKER
"Machine Physics (Insertion Devices 2)
10.00 - 10.15 Coffee Break
10.15 - 11.15 W.B. PEATMAN/SAVOIA
"Beam Lines (General & Hard X-Rays)"
11.15 - 12.15 W.B. PEATMAN/SAVOIA
"Beam Lines (General & Hard X-Rays)"
12.15 - 14.00 Lunch Break
14.00 EXERCISES (Beamlines +Machines Physics)

Tuesday, 22 October

09.00 - 10.00 W.B. PEATMAN/SAVOIA
"Beam Lines (General & Hard X-Rays)"
10.00 - 10.15 Coffee Break
10.15 - 11.15 W.B. PEATMAN/SAVOIA
"Beam Lines (General & Hard X-Rays)"
11.15 - 12.15 W.B. PEATMAN/SAVOIA
"Beam Lines (General & Hard X-Rays)"
12.15 - 14.00 Lunch Break
14.00 EXERCISES (Beamlines +Machines Physics)

Wednesday, 23 October

09.00 - 10.00 W. JARK
"Special Optical Elements (Multilayers, Zone Plates)"
10.00 - 10.15 Coffee Break
10.15 - 11.15 W.B. PEATMAN/SAVOIA
"Comparison: Rowland Circle Spherical Gratina Monochronator and Petersen Type Plane Gratina Monochronator"
11.15 - 12.15 W.JARK
continued
12.15 - 14.00 Lunch Break
14.00 EXERCISES (Beamlines -Machines Physics)

Thursday, 24 October

09.00 - 10.00 W.B. PEATMAN/A.SAVOIA
"Beam Lines (A Case Study)"
10.00 - 10.15 Coffee Break
10.15 -11.15 S. BERNSTORFF
"Beam Lines (Detectors)"
11.15 - 12.15 Discussion on Beamline Lectures
12.15 - 14.00 Lunch Break
14.00 EXERCISES (Beamlines -Machines Physics)

Friday, 25 October

09.00 - 10.00 H. WIEDEMANN
10.00 - 10.15 Coffee Break
10.15 - 12.15 Exercises on Machines Physics & Insertion Devices
12.15 - 14.00 Lunch Break
14.00 - 15.00 A.C.T. NORTH
"Introduction to image formation"
15.00 - 16.00 A.C.T. NORTH
"Introduction to the structures of biological macromolecules"

Week 3
(28 October - 1 November)

Monday, 28 October

09.00 - 10.00 J. M. SQUIRE
"Diffraction Theory I: 1,2 and 3-D arrays. Miller indices. The reciprocal lattice. The Ewald Sphere construction"
10.00 - 10.15 Coffee Break
10.15 - 11.15 J.M. SQUIRE
"Diffraction Theory II: The structure factor. Friedel's Law. Systematic absences. Fourier synthesis."
11.15 - 12.15 A.C.T. NORTH
"Protein crystallography 1: The phase problem. Isomorphous replacement. Anomalous scattering"
12.15 - 14.00 Lunch Break
14.00 - 16.00 EXERCISES: Diffraction
OR
VACUUM EXERCISES (at ELETTRA)

Tuesday, 29 October

09.00 - 10.00 A.C.T. NORTH
"Protein Crystallography II: Data Collection and Data processing"
10.00 - 10.15 Coffee Break
10.15 - 11.15 A.C.T. NORTH
"Protein Crystallography III: Electron density maps and model building"
11.15 - 12.15 W. HENDRICKSON
"M.A.D. 1"
12.15 - 14.00 Lunch Break
14.00 - 16.00 DIFFRACTION EXERCISES
OR
VACUUM EXERCISES: Calculations (at ICTP)

Wednesday, 30 October

09.00 - 10.00 A.C.T. NORTH
"Protein Crystallography IV: Structure refinement and structure analysis of proteins"
10.00 - 10.15 Coffee Break
10.15 - 11.15 A.C.T. NORTH
"Protein Crystallography V: Results and Applications: Enzymes and their activity. Design of drugs"
11.15 - 12.15 W. HENDRICKSON
"M.A.D. 2"
12.15 - 14.00 Lunch Break
15.00 ROUND TABLE DISCUSSION (JMS, ACTN, WH)
"Prospects of Biological Research"

Thursday, 31 October

09.00 - 10.00 J.M. SQUIRE
"Fibre diffraction 1: Diffraction from helical structures"
10.00 - 10.15 Coffee Break
10.15 - 11.15 J. M. SQUIRE
"Fibre Diffraction 2: Experimental methods - beam lines - detectors"
11.15 - 12.15 J.M. SQUIRE
EXERCISES: FIBRE DIFFRACTION
12.15 - 14.00 Lunch Break
14.00 - 15.00 J.M. SQUIRE
"Fibre Diffraction 3: Data Analysis- Timeresolved Experiment"
15.00 - 16.00 EXERCISES (JMS): FIBRE DIFFRACTION

Friday, 1 November

09.00 - 10.00 A. FONTAINE
"XAS - Introduction"
10.00 - 10.15 Coffee Break
10.15 - 11.15 A. FONTAINE
"XAS - What is EXAFS ?"
11.15 - 12.15 J.M. SQUIRE
"Fibre Diffraction: Recent results - future prospects"
12.15 - 14.00 Lunch Break
14.00 - 15.00 J.M. SQUIRE
"Protein Crystallography VI: New approaches. Laue diffraction"
15.00 - 16.00 J.M. SQUIRE
Question Time

Week 4
(4 - 8 November)

Monday, 4 November

09.00 - 10.00 H. TOLENTINO
"EXAFS (Optics)"
10.00 - 10.15 Coffee Break
10.15 - 11.15 A. FONTAINE
"EXAFS (Theoretical Basis)"
11.15 - 12.15 A. MICHALOWICS
"EXAFS (Data Analysis)"
12.15 - 14.00 Lunch Break
14.00 EXERCISES (EXAFS)

Tuesday, 5 November

09.00 - 10.00 A. FONTAINE
"EXAFS (Review of Applications)"
10.00 - 10.15 Coffee Break
10.15 - 11.15 H. TOLENTINO
"EXAFS (Time dependence)"
11.15 - 12.15 A. FONTAINE
"EXAFS (High Pressure)"
12.15 - 14.00 Lunch Break
14.00 EXERCISES (EXAFS)

Wednesday, 6 November

09.00 - 10.00 A. FONTAINE
"EXAFS (Solid State Detectors)"
10.00 - 10.15 Coffee Break
10.15 - 11.15 A. FONTAINE
"X-Rays Dichroism"
11.15 - 12.15 A. FONTAINE
"X-Rays Dichroism (MXD)"
12.15 - 14.00 Lunch Break
14.00 EXERCISES (EXAFS)

Thursday, 7 November

09.00 - 10.00 A. FONTAINE
"EXAFS (Surfaces)"
10.00 - 10.15 Coffee Break
10.15 - 11.15 H. TOLENTINO
"EXAFS (Superconductors)"
11.15 - 12.15 A. FONTAINE
"EXAFS (Design of an integrated beamline)"
12.15 - 14.00 Lunch Break
14.00 - 15.00 FINAL OVERVIEW
15.00 EXERCISES (EXAFS)

Friday, 8 November

No lectures

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
Trieste, Italy

Training College on the Applications of Synchrotron Radiation

Trieste, 14 October- 8 November 1991

UNIDO Project US/GLO/89/104
UNIDO Contract No. 91/158/VK

FINANCIAL STATEMENT

(in US$)

1 DIRECTORS

Craievich, A.	Brazil	2,589.28
Fonda, L.	Italy	2,666.67
Fuggle, J.C.	United Kingdom	1,507.37
	Subtotal	**6,763.32**

2 LECTURERS

Baldereschi, A.	Italy	40.65
Bernardini, M.	Italy	119.05
Bernstorff, S.	Italy	40.65
De Groot, F.	Netherlands	1,547.31
Dhanak, V.R.	United Kingdom	40.65
Ding, C.X.	China	39.68
Eriksson, M.	Sweden	2,462.95
Fontaine, A.	France	1,989.69
Hendricksson, W.A.	USA	174.60
Ishii, T.	Japan	2,823.55
Jark, W.	Germany	83.33
Kersevan, R.	Italy	79.37
Kunz, C.	Germany	473.24
Michailowicz, A.	France	982.44
North, A.C.T.	United Kingdom	1,429.46
Peatman, W.	USA	773.81
Rosei, R.	Italy	41.67
Savoia, A.	Italy	125.00
Squire, J.	United Kingdom	1,354.44
Tolentino, H.	Brazil	752.84
Walker, R.	United Kingdom	119.05
Wiedemann, H.	Germany	1,063.50
	Subtotal	**16,556.93**

3 PARTICIPANTS

Ahmad, I.	Pakistan	1,100.85
Ascolani, H.	Argentina	2,639.29
Banerjee, M.	India	1,830.61
Bernerdes, L.A.	Brazil	2,827.64
Bozukov, L.	Bulgaria	892.86
Bucur, I.B.	Romania	929.00
Czarnecha-Such, E.	Poland	892.86
De Assis, T.J.	Brazil	1,010.64
Del Barco, J.L.	Argentina	2,551.22
Fonseca, P.	Brazil	2,827.64
Gomez De Anderez, D.	Venezuela	2,376.95
Guo, J.H.	China	1,116.59
Hu, N.	China	2,439.87
Hu, Z.W.	China	1,752.35
Islam, M.S.	Bangladesh	2,247.34
Jablonska, K.M.	Poland	928.73
Jimenez-Mier, J.	Mexico	1,566.08
Kamenskikh, I.A.	USSR	963.97
Kopecky, M.	Czechoslovakia	928.57
Kulkarni, S.K.	India	1,884.05
Landers, R.	Brazil	1,000.00
Nandekar, R.V.	India	2,084.68
Novikova, N.N.	USSR	1,007.23
Osiceanu, P.	Romania	964.28
Pedrosa, M.S.	Brazil	2,791.12
Rocco, L.M.	Brazil	2,791.12
Sakho, O.	Senegal	1,121.16
Sawhwnwy, K.J.S.	India	1,613.14
Souza Azevedo, A.C.	Brazil	2,671.58
Vevecka, A.	Albania	1,059.47
Vincze, L.	Hungary	892.86
Zampieri, G.	Argentina	2,568.10
Zhang, Z.	China	979.84
	Subtotal	**55,251.69**

4 OVERHEADS

UNIDO share of total overhead charges (inclusive of organization, supervision, technical assistance, secretariat, provision of facilities, etc.)	**11,428.06**
Total	**90,000.00**

ICTP Finance/am
1991-12-10