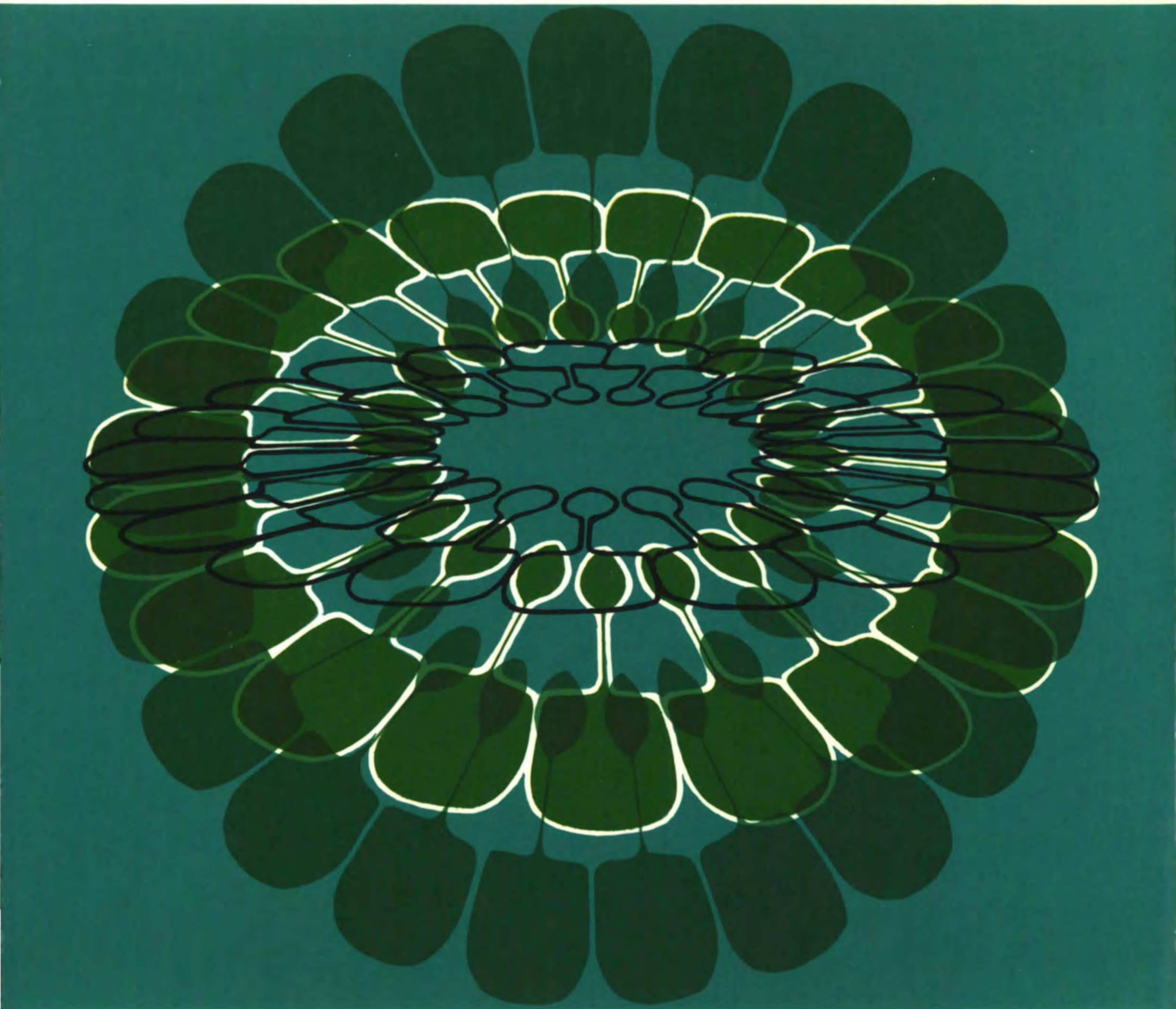
institut max von laue · paul langevin · grenoble · france



ANNUAL REPORT 1980

Applications for the use of ILL facilities

All research proposals have to be submitted to the Scientific Council for approval. The Council meet twice each year and the closing dates for the acceptance of applications are:

February 15 and August 31.

The completed research proposal forms should be sent to:

The Office of the Scientific Secretary
Institut Max von Laue - Paul Langevin
156 X
38042 Grenoble Cedex
France

Tel. (76) 97.41.11 Ext. 82.44 Telex: 320621 F

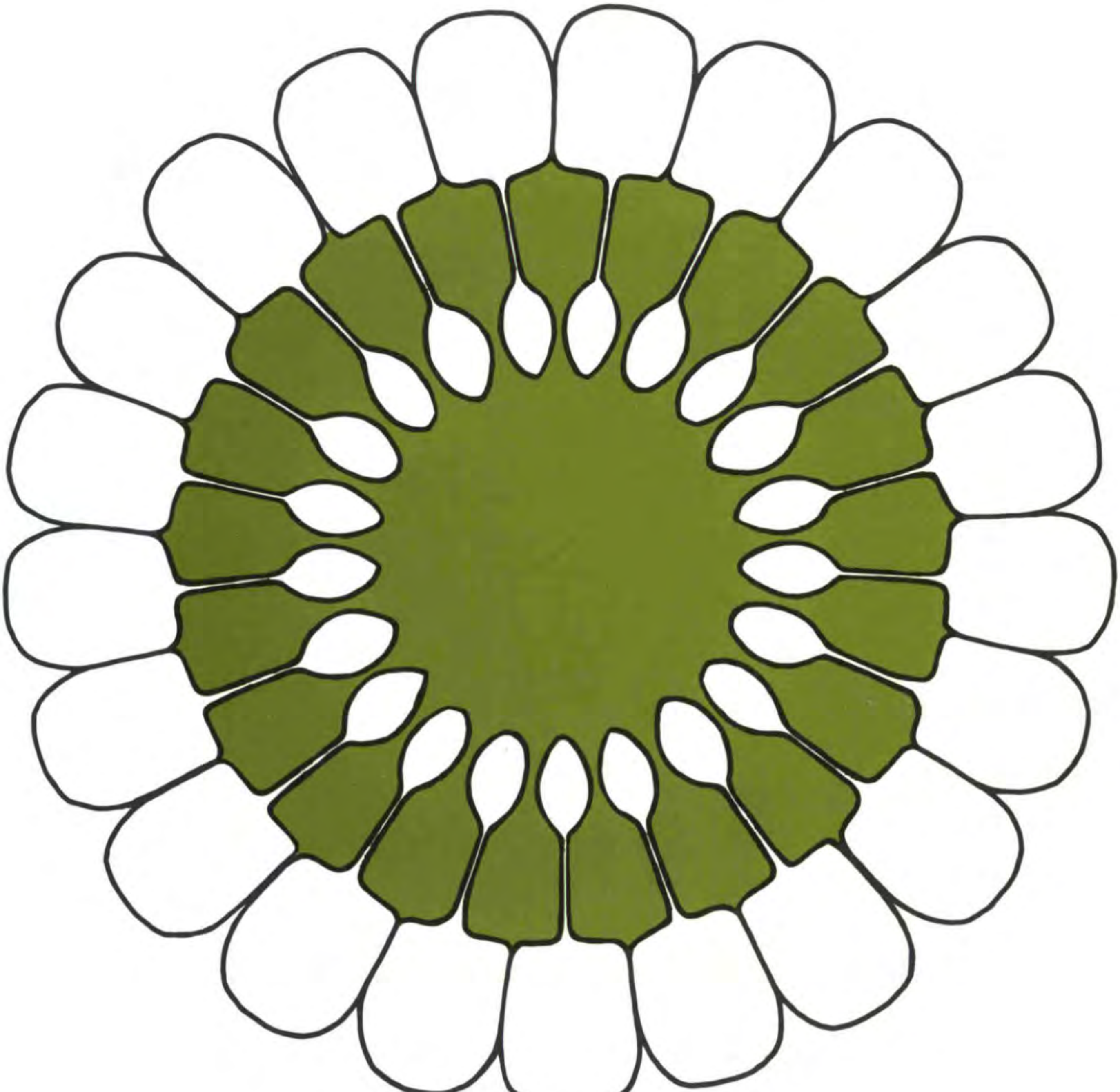
(Appropriate application forms may be obtained on request from the above office.)

Under normal circumstances the ILL makes no charge for the use of its facilities. However special equipment, (other than the existing instruments, counters, standard cryostats and shielding requirements) must be provided by the user. This applies particularly to the experimental samples which must, in all cases, be provided by the user. Chemistry and Biology laboratory facilities are available for any necessary sample preparation.

The ILL makes a limited contribution towards the travel and subsistance expenses for experimentalists coming from approved laboratories in the three member countries. (Details on request.)

FRONT-COVER DESIGN:
Artist's impression of the schematic diagram of the radial distribution of protein and RNA in tomato bushy stunt virus as shown on page 1.

ANNUAL REPORT 1980



Institut von Laue . Langevin Grenoble . France

Figure on page 1 :

Schematic diagram (spherically averaged model), showing the radial distribution of protein (white areas) and RNA (green areas) in tomato bushy stunt virus as determined by small angle neutron scattering from solution, obtained with the SAS camera D11 (from Chauvin, Jacrot, Witz, J. Mol. Biol. (1978), **124**, 641-651).

CONTENTS

External organisation of the Institut Laue-Langevin 1980

Associates of the Institut

Great Britain	France	Germany
SCIENCE RESEARCH COUNCIL (SRC)	COMMISSARIAT A L'ENERGIE ATOMIQUE (CEA) CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)	KERNFORSCHUNGSZENTRUM KARLSRUHE (KFK)

Steering Committee

(at its last meeting)

Great Britain		France		Germany	
Hobbis	- (SRC)	Mercouroff	- (CNRS)	Döll	- (BMFT)
Leadbetter	- (Univ. of Exeter)	Roux	- (CNRS)	Huber	- (Univ. Erlangen)
Wroe	- (SRC)	Horowitz (Chairman)	- (CEA)	Hofbauer	- (BMF)
Eggington	- (SRC)	Pascal	- (CEA)	Klose	- (KFK)

Audit Commission

Great Britain	France	Germany
Mead Millington	Gouzien Thomazeau	Riess Binder

Scientific Council
(at its last meeting)

Benoît	- CNRS Strasbourg
Bienfait	- Univ. Marseille
Blow	- Imp. College, London
Challis	- Univ. Nottingham
Coles	- Imp. College, London
Cowley	- Univ. Edinburgh
Cribier	- Léon Brillouin, Gif
Dachs	- HMI Berlin
Ebel	- IBMC Strasbourg
Faissner	- TH Aachen
Farge	- LURE, Orsay
Fender	- ILL
Fulde	- MPI Stuttgart
Galy	- CNRS Toulouse
Gläser	- TU München
Joffrin	- ILL
Leadbetter	- Univ. Exeter
Lemaire	- CNRS Grenoble
Mills	- Univ. Reading
Mitchell	- Univ. Oxford
Ottewill	- Univ. Bristol
Rigny	- CEN Saclay
Schmatz	- KfK Karlsruhe
Springer	- ILL (Chairman)
Stiller	- KfA Jülich
Stuhrmann	- DESY, Hamburg
Yoccoz	- IN2P3, Paris

SUBCOMMITTEES OF THE SCIENTIFIC COUNCIL

Fundamental and Nuclear Physics	Excitations in crystals	Crystal and Magnetic structures		Liquids, gases amorph. mat.	Imperfections	Biochemistry	Chemistry	Instruments
Faissner	Boccara	Delapalme	**Galy**	Cyrot	**Coles**	Blow	Bienfait	Dachs
Leroux	Rossat-Mignod	**Lemaire**	Lucas	Janot	Kleitz	Fuller	Higgins	Farnoux
Lynn	Fulde	Fuess	Becker	Charvolin	Peisl	Holmes	Monnerie	Forsyth
Sandars	Landwehr	Prandl	Hahn	Wölfle	Saada	Nierhaus	**Ottewill**	**Gläser**
Schult	Challis	Goodenough	Simon	Zeidler	Schmatz	Parello	Rivail	Rainford
Vinh Mau	**Cowley**	Wilkinson	Tofield	Schofield	Stewart	**Stuhrmann**	Weill	Schmatz
			Sim	**Mitchell**		Tardieu	Weiss	Windsor
						Blundell	Kilian	Steyerl
						Helene	Wegner	Renouprez
							North	Nifenecker
							Oudar	
							Ibach	
							Mills	
							Thomas	
							Hüller	

Internal organisation of the Institut Laue-Langevin at 1.1.81

SCIENCE BOARD

Beaufils, Brown, Dorner/Pynn, Faudou, Fender, Gönnenwein, Jacrot, Joffrin, Springer, Maier

DIRECTORATE

Springer - Director
Fender - Co-Director
Joffrin - Co-Director

MANAGEMENT BOARD

Springer
Fender
Joffrin
Grillo
Jacquemain

SCIENTIFIC SECRÉTARIAT AND LIBRARY

Maier

PROJECT OFFICE

Faudou

SAFETY & HEALTH PHYSICS

Sallé

DELEGUE TECHNIQUE

Jacquemain

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College 2: THEORY
Haldane

College 3: FUNDAMENTAL AND NUCLEAR PHYSICS
Faust

College 4: EXCITATIONS
Currat

College 5: CRYSTAL AND MAGNETIC STRUCTURES
Hewat/Vettier

College 6: LIQUIDS, GASES, AND AMORPHOUS MATERIALS
Cummings

College 7: IMPERFECTIONS
Scheuer

College 8: BIOCHEMISTRY
May

College 9: CHEMISTRY
Beaufils

INSTRUMENT GROUPS

3 - AXIS SPECTROMETERS
Dorner - Currat

INSTRUMENTS FOR FUNDAMENTAL AND NUCLEAR PHYSICS
Gönnenwein - Schreckenbach

DIFFRACTOMETERS
Brown - Lehmann

DIFFUSE SCATTERING AND TIME OF FLIGHT SPECTROMETERS
Beaufils - Heidemann

MONOCHROMATORS
Freund

DEPARTMENTS

INSTRUMENT OPERATION DEPARTMENT
Brown

REACTOR DEPARTMENT
Franzetti

TECHNICAL DEPARTMENT
Faudou

COMPUTING AND ELECTRONICS DEPARTMENT
Rimmer

ADMINISTRATION
Grillo

THE INSTITUT V. LAUE-LANGEVIN

The Institut Max von Laue - Paul Langevin (ILL) at Grenoble was formally founded in January 1967, with the signature of an intergovernmental convention between France and the Federal Republic of Germany. The aim was to provide the scientific comunity of the affiliated countries with a unique neutron beam facility applicable in fields such as the physics of condensed matter, chemistry, biology, nuclear physics and materials sciences. The construction of the Institut and its high flux reactor was undertaken as a joint French-German project, with a total capital investment of 335 million FF. The reactor went critical in August 1971 and reached its full power of 57 MW for first time in December 1971. The year 1972 saw the start-up of the cold and hot sources, the first instruments and the beginning of the experimental programme. On January 1, 1973, the United Kingdom joined the Institut as a third equal partner, contributing its share to the total capital investment. The corresponding intergovernmental convention was formally signed in July 1974 by the pertinent ministers from the three affiliated countries.

The ILL is a non-trading company under French civil law. The three countries are represented by the following Associates:

- Kernforschungszentrum Karlsruhe GmbH, Germany (formerly GfK)
- Centre National de la Recherche Scientifique, France
- Commissariat à l'Energie Atomique, France
- Science Research Council, United Kingdom

These Associates are represented on a Steering Committee, which establishes the general rules of the management of the ILL. The Institut is headed by a Director and two Assistant Directors, all with a five year tenure, the former to be nominated alternately by the German and the British Associate, the other two by the remaining Associates. A Scientific Council, nominated by the Associates, advises the Directors on the scientific programme and on practical aspects relating to its operation.

The scientific user's community of the ILL is represented in 8 Subcommittees of the Scientific Council, which meet twice a year to select those research proposals which are to be carried out at the neutron beam facilities of the ILL. A further Subcommittee of the Scientific Council deals with questions of instrumentation, serving as a discussion platform between the ILL and its external users.

The purpose of the ILL thus differs fundamentally from most other research institutes. It is a central facility created so that chemistry, physics, biology and metallurgy specialists from laboratories in the partner countries can use the unique power of neutron techniques to broaden the attack on their problems. Designing and operating instruments and helping the visiting users to carry out their experiments is thus the principal task of the Institute's own scientists. The experimental use of the instruments by ILL staff is subject to the same approval system as for external teams.

Photo A. : (A. Bresson)

Prof. Tasso Springer has been appointed Director of the ILL as from 1 April 1980. At the same time Dr. Brian Fender started his tenure as British Co-Director. The photograph shows Prof. Springer together with Dr. Fender (on the right) and Prof. Joffrin.

The meeting of the Steering Committee on December, 5, 1980 in Cadarache (France).

Photo C : (Dauphiné-Libéré)

M.P. Aigrin, Secrétaire d'Etat à la Recherche and M. Fréjacques, Délégué Général à la Recherche Scientifique et Technique, visited the ILL on July 21st. 1980. The photograph shows M. Aigrin and M. Fréjacques (6th and 5th from left) during their reactor visit accompanied, amongst others, by M. Aurousseau (Préfet de l'Isère) (4th from left), M. Taÿ (Recteur de l'Académie de Grenoble) (2nd from right) and Prof. Joffrin and Dr. Fender. (3rd and 13th from left).

Photo B : (A. Bresson)

Mr. Neil Macfarlane, the British parliamentary Undersecretary for Education and Science visited the ILL on March 28th, 1980. The picture shows Mr. Macfarlane (on the right) discussing with Prof. Rauch (Vienna) at the neutron interferometer D18.

Photo D : (A. Bresson)

Prof. H. Maier-Leibnitz, one of the founders and first Director of the ILL during his visit to the ILL on October 13th, 1980. In the picture he is accompanied by Dr. A. Heidemann (ILL).

INTRODUCTION

BERICHT DES DIREKTORS

Die Gesellschafter haben Ende des Jahres 1979 dem Modernisierungsprogramm für das Institut in einem Gesamtumfang von 104MF (Geldwert 1979) über die Jahre 1979 bis 1985 sowie der Verlängerung des Staatsvertrages bis 1992 zugestimmt. Das Berichtsjahr 1980 war deshalb vor allem gekennzeichnet durch die zügige Inangriffnahme der ersten grösseren Massnahmen im Rahmen des Modernisierungsprogramms :

— Die Bestellung des neuen Zentralrechners vom Typ DEC 1091 ist inzwischen erfolgt. Die Maschine wird in einer ersten Stufe Anfang 1981 und dann endgültig Ende 1981 verfügbar sein.

— Die Baumassnahmen für das gemeinsame Gebäude des ILL mit dem EMBL wurden inzwischen begonnen sowie auch das Gebäude für den Zentralrechner. Letzteres wird bereits im Sommer 1981 beziehbar sein.

— Auch die übrigen Vorhaben des Modernisierungsprogramms schreiten gut voran ; vor allem die beiden Instrumente an der heissen Quelle, nämlich das Dreiachsenspektrometer IN1B und das Flüssigkeitsdiffraktometer D4B werden 1981 testweise in Betrieb gehen sowie das Diffraktometer für biologische Probleme D16B.

— Der Einbau des Ersatzes der vertikalen kalten Quelle ist für 1982 vorgesehen. Er wird den Fluss an allen kalten Neutronenleitern nahezu um einen Faktor 2 erhöhen. Der Industrieauftrag wird Anfang 1981 erteilt.

— Das Carine-Ersatzprogramm ist, mit einigen Verzögerungen, bis Ende 1981 im wesentlichen abgeschlossen.

Mit diesen Aufgaben sind nahezu zwei Drittel der vorgesehenen Gesamtsumme des Modernisierungsprogramms gebunden. Zwei grössere Komplexe müssen nun noch in den folgenden Jahren in Angriff genommen werden :

— Vier neue Instrumente, und zwar das Dreiachsen-Spektrometer IN20, die Diffraktometer, D19 und D5B, und das Spaltprodukt-Koinzidenz-Spektrometer PN8. Sie werden das Potential des Institutes auf folgenden Gebieten stärken und erweitern : Hohe Auflösung, Vielfachzähler für komplizierte Kristalle oder für kinetische Experimente in der Strukturanalyse, Spinanalyse und Spaltungsphysik. Die Entscheidung über diese Instrumente hat die Direktion in Zusammenarbeit mit dem Wissenschaftlichen Rat im Oktober 1980 getroffen. Mit der Konstruktion dieser Instrumente wurde inzwischen teilweise begonnen.

— Die Projektstudie für die zweite kalte Quelle im H5-Kanal : Sie wird das Potential des Instituts auf dem Gebiet der langwelligen Neutronen und damit im Bereich der hochauflösenden Experimente in Bezug auf Energie und Impuls ausbauen und stärken. Dies ist ein Schwerpunkt in der Arbeit des Instituts, und ein Gebiet, wo es besonders erfolgreich ist, wie beispielsweise im Hinblick auf die Instrumente IN10, IN11, und D11, D17. Eine endgültige Entscheidung über die zweite Quelle fällt im Laufe des Jahres 1981. Voraussetzung für eine positive Entscheidung wird sein, ob die Quelle im Rahmen der vorgesehenen Finanzmittel realisierbar und zu betreiben sein wird.

Im Bereich der Arbeiten, die aus dem Normalbudget finanziert werden, heben wir die Fertigstellung der Instrumente IN13 (neues Rückstreuspektrometer) und IN6 (zeitfokussierendes Flugzeitspektrometer) hervor, welche 1981 zumindest für Testexperimente in Betrieb gehen werden. Auch das Interferometer D18 ist im wesentlichen betriebsfähig. Die Tabelle 1 zeigt die Gesamtheit der Instrumente und die jeweiligen Massnahmen, die aus dem Modernisierungs- oder Normalbudget getroffen werden.

Tabelle 1 - Zusammenstellung der ILL Instrumente

Diffractometers

Instrument 1980	Instrument 1981-1985	Beam hole	Financed from	Comments
D1B	D1B	H22		
D1A	D2B	H11	Norm. budget	Decided
D2	D20	H11	Norm. budget	Started
D3	D3B	Hot	Norm. budget	
D4	D4B	H8	Mod. progr.	Operational 1981
D5	D5B	Therm.	Mod. progr.	Site not decided
D7	D7B	H15	Norm. budget	To be decided 81
D8	D19	H11	Mod. progr.	Started
D9	D9	H3		
D10	D10B[a)]	H24		Operational 81
D11	D11	H15		
D12	D12	H23		Not scheduled
D13ABC	D13ABC	H24		Not scheduled
D15	D15	IH4		
D16	D16B[b)]	H16	Mod. progr.	Operational 1981
D17	D17	H17		
D18	D18	H25		Scheduled 1981

a) Neutron spin echo, TDS separation.
b) Multi-counter.
c) Magnetic bearings.
d) Fast Doppler drive.

Spectrometers

Instrument 1980	Instrument 1981-1985	Beam hole	Financed from	Comments
IN1	IN1B	H8	Mod. progr.	Operational 1981
IN1Be	IN1B-Be	H8		
IN2	IN20	H13	Mod. progr.	Started
IN3	IN3	H24		
IN4	IN4B[h)]	H12	Norm. budget	Not yet decided
IN5	IN5B[c)]	H16	Mod. progr.	
—	IN6	H15	Norm budget	Operational 1981
IN8	IN8B	H10	Norm. budget	Operational
IN10	IN10B[d)]	H15	Norm. budget	Not yet decided
IN11	IN11B[e)]	H14	Norm. budget	To be decided
IN12	IN12	H14		
-	IN13	H24	Norm. budget	Operational 1981

Nuclear physics instruments

PN1	PN1B[h)]	H9	Norm. budget	Not yet decided
PN2	PN2	V3		
PN3	PN3	H6-H7		
PN4	PN4	H6-H7		
PN5	PN5B[f)]	IH3	Norm. budget	
PN6	PN6	H23		
PN7	PN7[g)]	H14	Mod. progr.	
-	PN8	IH1	Mod. progr.	Started

e) Multi-counter.
f) He-source.
g) New polarizers.
h) Or eventually closed down.

Der Jahresbericht geht im folgenden ausführlicher auf diese Instrumentenvorhaben ein, sowie vor allem auf die Forschungsergebnisse, die an den verschiedenen Instrumenten gewonnen wurden. Die Frage, wo die interessantesten oder wichtigsten Resultate erzielt worden sind, ist im Hinblick auf die Vielfalt der Themen und Gebiete der Gastgruppen kaum in kurzer Form zu beantworten. Nach Diskussionen mit Teilnehmern der Unterausschüsse des Wissenschaftlichen Rates heben wir folgende Themen besonders hervor, mit den Vorbehalten, die bei einer subjektiven Auswahl angebracht sind:

— Magnetische und sonstige inkommensurable Strukturen ; Solitonen ;

— Struktur von metallischen Gläsern ;

— Struktur, dynamisches und kinetisches Verhalten von Polymeren, auch unter besonderen äusseren Bedingungen ; Oberflächen-Probleme ;

— Struktur oder Morphologie von Ribosomen und Viren ;

— Untersuchung besonderer Spaltprozesse, beispielsweise "kalte Spaltung" ; Erweiterung der bisherigen Messungen auf andere spaltbare Stoffe.

Die Untersuchungen aus der Elementarteilchen- und Neutronenphysik nehmen inzwischen einen ziemlich breiten Raum ein : Experimente zur Suche nach dem elektrischen Dipolmoment und der Ladung des Neutrons ; Messung der Lebensdauer des Neutrons ; Untersuchungen über die Paritätsverletzung ; Suche nach Neutrino- sowie Neutron-Antineutron-Fluktuationen. Es handelt sich dabei meist um wissenschaftlich risikoreiche Experimente, deren Resultat, sollte es positiv ausfallen, spektakulär wäre.

Wie üblich war der Reaktor fast ohne Unterbrechungen verfügbar. Wir erwähnen jedoch, dass sich im Laufe dieses Jahres ein Zusammentreffen von mehreren meldepflichtigen Strahlungsz wischenfällen ergab, wobei jedoch niemand eine nennenswerte Strahlungsdosis empfangen hatte. Die Direktion wird Massnahmen ergreifen, um die Wahrscheinlichkeit für solche Vorfälle weiter zu verringern, ohne die für den Experimentierbetrieb an der Reaktorperipherie nötige Flexibilität unnötig einzuschränken.

Die Fortschritte im Modernisierungsprogramm, sowie die Aussicht auf die bevorstehenden Vertragsverlängerung haben einen erfreulichen Einfluss auf die allgemeine Atmosphäre des Instituts. Andererseits wird in fast allen Bereichen die Belastung spürbar, neben den meist sehr personalintensiven Modernisierungmassnahmen den laufenden Instrumentenbetrieb für die Gastforscher unvermindert fortzusetzen. Besonders gross ist in den folgenden Jahren die Belastung in der Reaktorabteilung : Der Einbau der neuen Neutronenleiternasen, das Auswechseln der meisten Strahlrohre innerhalb der nächsten vier Jahre während des jährlichen Reaktorhaltes, der Einbau der vertikalen kalten Quelle, sowie die Planung der zweiten kalten Quelle stellen Anforderungen, die neben der Grundlast des Reaktor- Routinebetriebes geleistet werden müssen. Die Direktion muss dabei vor allem für 1981 bezüglich des verlängerten Reaktorhaltes (26. März - 30. Juni) um Verständnis für die Einschränkungen bitten, die durch diese und auch durch andere Massnahmen notwendig sind.

Als wichtige personelle Veränderung erwähnen wir das Ausscheiden von Dr. B. Jacrot am 1.9.1980, der als Nachfolger von Dr. A. Miller die Leitung der EMBL-Aussenstation in Grenoble übernahm. Herr Jacrot wird sich weiterhin in wissenschaftlichen Fragen dem Biologieprogramm des ILL widmen. Als Nachfolger von B. Jacrot wurde zum 1. Januar 1981 Prof. J.P. Beaufils in der Position des Senior Scientist ernannt.

Am Ende soll dem am 31. März 1980 ausgeschiedenen Direktor des Instituts, Dr. J. White, für seine Arbeit für das Institut gedankt werden ; dabei vor allem für sein Engagement im Hinblick auf die Konzeption des Modernisierungsprogramms und für seine Bemühungen, hierfür die Zustimmung der Gesellschafter zu erhalten. Mit dem Ausscheiden von Herrn Dr. White als Direktor wurde Dr. B. Fender am 1. April 1980 zum stellvertretenden Direktor ernannt. Dr. J. Joffrin bleibt bis Ende Juni 1981 als französischer stellvertretender Direktor am Institut.

Wir haben schliesslich die traurige Pflicht, den tragischen Tod unserer beiden Mitarbeiter, M. Claude Fonti und Mr. Patrick George, mitzuteilen. Die Direktion und die Belegschaft des ILL wird ihnen ein treues Andenken bewahren.

T. SPRINGER
Direktor
Dezember 1980

RAPPORT DU DIRECTEUR

A la fin de l'année 1979 les associés ont donné le feu vert pour la réalisation du programme de modernisation de l'Institut entre 1979 et 1985, d'un montant total de 104 MF (en valeur monétaire 1979). Ils ont en outre approuvé la prolongation de la convention intergouvernementale jusqu'en 1992. De ce fait le rapport de cette année est surtout caractérisé par la mise en œuvre suivie des mesures prises dans le cadre du programme de modernisation :

— Le nouveau calculateur central du type DEC 1091 a été commandé. Une première tranche de la machine entrera en service au milieu de l'année 1981. Il sera entièrement opérationnel à la fin 1981.

— La construction du bâtiment commun à l'ILL et à l'EMBL a débuté, ainsi que le bâtiment pour le nouveau calculateur, qui sera disponible dès l'été 1981.

— Les autres projets du programme de modernisation progressent également de manière très satisfaisante, notamment : les deux dispositifs expérimentaux sur la source chaude, c'est-à-dire le spectromètre à trois axes IN1B et le diffractomètre à liquides D4B entreront en service en 1981 pour les premières expériences d'essai, à l'instar du diffractomètre D16B pour les recherches en biologie.

— Le remplacement de la source froide verticale est prévu pour 1982. Cette nouvelle installation permettra d'augmenter d'un facteur 2 le flux des neutrons sur tous les guides de neutrons froids. Sa commande industrielle sera passée au début de l'année 1981.

— L'essentiel du programme de remplacement de Carine sera, avec quelques retards, achevé à la fin de 1981.

Les dépenses que représentent ces travaux engagent presque deux tiers du montant total alloué au programme de modernisation. Deux ensembles majeurs doivent encore être réalisés au cours des prochaines années.

— Quatre nouveaux dispositifs expérimentaux, c'est-à-dire le spectromètre à trois axes IN20, les diffractomètres D19 et D5B, et le spectromètre à coïncidence de fragments de fission PN8. Ces instruments renforceront, élargiront le potentiel de recherche de l'Institut dans les domaines suivants : haute résolution, multicompteurs pour l'analyse des cristaux complexes ou les études de cinétique, analyse de spin, et physique de fission. La décision de construire ces dispositifs a été prise en octobre 1980 par la direction de l'Institut en collaboration avec le Conseil Scientifique. La construction d'une partie de ces dispositifs a été commencée.

— L'avant-projet pour la deuxième source froide dans le canal H5 : là aussi l'Institut se dote d'un instrument qui élargit sa capacité de recherche sur le plan des neutrons de grande largeur d'onde, c'est-à-dire pour des expériences à haute résolution en énergie et en quantité de mouvement. C'est un des secteurs sur lequel l'Institut concentre ses efforts et où il réussit particulièrement bien grâce à des instruments aussi performants que par exemple IN10, IN11, D11 et D17. Une décision définitive pour la construction et l'exploitation de la deuxième source froide interviendra au cours de l'année 1981. Elle dépendra des fonds alors disponibles.

Parmi les travaux financés par le budget normal l'achèvement des dispositifs expérimentaux IN13 (nouveau spectromètre à rétrodiffusion) et IN6 (spectromètre à temps de vol avec focalisation dans le temps) méritent d'être mentionnés. Ils entreront en service, au moins pour les expériences d'essai, dès 1981. Le tableau 1 montre l'ensemble des instruments et des différentes mesures prises dans le cadre du programme de modernisation et du budget normal.

Table 1 — L'ensemble des instruments de l'ILL

Diffractometers

Instrument 1980	Instrument 1981-1985	Beam hole	Financed from	Comments
D1B	D1B	H22		
D1A	D2B	H11	Norm. budget	Decided
D2	D20	H11	Norm. budget	Started
D3	D3B	Hot	Norm. budget	
D4	D4B	H8	Mod. progr.	Operational 1981
D5	D5B	Therm.	Mod. progr.	Site not decided
D7	D7B	H15	Norm. budget	To be decided 81
D8	D19	H11	Mod. progr.	Started
D9	D9	H3		
D10	D10B[a)]	H24		Operational 81
D11	D11	H15		
D12	D12	H23		Not scheduled
D13ABC	D13ABC	H24		Not scheduled
D15	D15	IH4		
D16	D16B[b)]	H16	Mod. progr.	Operational 1981
D17	D17	H17		
D18	D18	H25		Scheduled 1981

a) Neutron spin echo, TDS separation.
b) Multi-counter.
c) Magnetic bearings.
d) Fast Doppler drive.

Spectrometers

Instrument 1980	Instrument 1981-1985	Beam hole	Financed from	Comments
IN1	IN1B	H8	Mod. progr.	Operational 1981
IN1Be	IN1B-Be	H8		
IN2	IN20	H13	Mod. progr.	Started
IN3	IN3	H24		
IN4	IN4B[h)]	H12	Norm. budget	Not yet decided
IN5	IN5B[c)]	H16	Mod. progr.	
-	IN6	H15	Norm budget	Operational 1981
IN8	IN8B	H10	Norm. budget	Operational
IN10	IN10B[d)]	H15	Norm. budget	Not yet decided
IN11	IN11B[e)]	H14	Norm. budget	To be decided
IN12	IN12	H14		
-	IN13	H24	Norm. budget	Operational 1981

Nuclear physics instruments

PN1	PN1B[h)]	H9	Norm. budget	Not yet decided
PN2	PN2	V3		
PN3	PN3	H6-H7		
PN4	PN4	H6-H7		
PN5	PN5B[f)]	IH3	Norm. budget	
PN6	PN6	H23		
PN7	PN7[g)]	H14	Mod. progr.	
-	PN8	IH1	Mod. progr.	Started

e) Multi-counter.
f) He-source.
g) New polarizers.
h) Or eventually closed down.

Dans la suite, ce rapport annuel décrira de manière plus détaillée ces projets d'instruments mais surtout les résultats de recherche obtenus sur les différents dispositifs. Il est difficile de dire dans quelle discipline les résultats les plus intéressants et les plus importants ont été obtenus, et, vu la vaste gamme des sujets et domaines de recherche ils sont presque impossibles à décrire de manière concise.

Après discussions avec des participants aux sous-comités du Conseil Scientifique nous mettons en lumière — avec toutes les réserves d'un choix aussi subjectif — les sujets suivants :

— structures magnétiques et autres structures incommensurables, solitons ;

— structure de verres métalliques ;

— structure, comportement dynamique et cinétique de polymères, également dans des environnements particuliers ; problèmes de surface ;

— structure et morphologie de ribosomes et de virus ;

— examen de processus de fission particuliers (par exemple la fission froide). Elargissement des mesures sur d'autres matières fissiles que celles examinées dans le passé.

Les recherches de la physique des particules élémentaires et des neutrons ont évolué de telle sorte qu'elles occupent aujourd'hui une place assez importante : expériences pour déterminer le moment dipolaire électrique et la charge du neutron ; mesures de la durée de vie du neutron ; études sur la violation de parité, recherche de fluctuations de neutrinos et de neutrons-antineutrons. Il s'agit la plupart du temps d'expériences assez risquées mais leur résultat, serait-il positif, qu'il en deviendrait d'autant plus spectaculaire.

Comme d'habitude, le réacteur a fonctionné presque sans interruption. Il faut néanmoins mentionner la coïncidence fortuite de plusieurs incidents qui ont dû être signalés aux autorités. Dans tous les cas la dose d'irradiation subie par le personnel n'a toutefois pas dépassé un niveau très faible. La Direction prendra les mesures appropriées pour réduire encore la probabilité de tels incidents, sans pour autant entraver la souplesse nécessaire aux expériences autour du réacteur.

Les progrès du programme de modernisation, ainsi que la perspective d'une prolongation de la convention intergouvernementale ont une influence positive sur le climat général de l'Institut. D'un autre côté la plupart des services éprouvent une surcharge de travail, du fait que la mise en œuvre des mesures de modernisation engage un grand nombre de personnel et se greffe sur le fonctionnement normal. Ce surcroît de travail est, et le sera dans les années à venir, particulièrement lourd pour le département réacteur : l'installation des nouveaux nez des guides de neutrons, le remplacement de la plupart des doigts de gants pendant l'arrêt annuel du réacteur au cours des quatre prochaines années, l'installation de la source froide verticale, la planification de la deuxième source froide, demandent un effort supplémentaire outre le service de fonctionnement habituel, maintenu dans son ensemble. En 1981, en particulier au cours de l'arrêt prolongé du réacteur du 26 mars au 30 juin, la Direction doit faire appel à la compréhension des utilisateurs pour les restrictions de fonctionnement qu'impose la mise en œuvre des travaux.

Quant à l'effectif de l'ILL le départ le 1.9.80 de Monsieur B. Jacrot est à signaler. Il prend la succession de Monsieur A. Miller à la direction de l'antenne de l'EMBL à Grenoble. Monsieur Jacrot continuera à s'occuper des questions scientifiques du programme Biologie de l'ILL. Le professeur J.P. Beaufils a été nommé pour succéder à Monsieur B. Jacrot dans la fonction de "senior scientist", à partir du 1er janvier 1981.

Pour conclure l'Institut exprime ses remerciements à son ancien Directeur, M. J. White, qui a cessé ses fonctions à ce titre le 31 mars 1980. Son travail à l'Institut a été fructueux, et son engagement pour la mise au point du programme de modernisation ainsi que ses efforts pour obtenir l'accord des associés ont été couronné de succès. Avec le départ de Monsieur White, Monsieur B. Fender a été nommé directeur adjoint le 1er avril 1980. Du côté français, Monsieur J. Joffrin assurera ses fonctions de directeur adjoint jusqu'à la fin juin 1981.

C'est avec émotion que nous avons enregistré les morts tragiques de deux de nos collègues, M. Claude Fonti et Mr. Patrick George. La direction et le personnel de l'Institut se souviendront avec tristesse de ces deux agents qui jouissaient de l'estime de tous.

T. SPRINGER
Directeur
Décembre 1980

DIRECTOR'S REPORT

At the end of 1979 the Associates approved the Modernisation Programme of the Institut at a total cost of 104 MF (1979 value of money) for the period 1979 to 1985, and also agreed to the extension of the intergovernmental agreement until 1992.

The year 1980 was therefore mainly characterized by the implementation of the first major measures under the Modernisation Programme:

— The new central computer type DEC 1091 has now been ordered and the first phase of the machine will be available early in 1981. The complete system will be fully operational at the end of 1981.

— Construction work on both the joint ILL/EMBL building and central computer building has started. The latter will be ready for occupation in summer 1981.

— Good progress is being made with the two instruments on the hot source, a triple-axis spectrometer IN1B and the liquid diffractometer D4B. They will start test operation in 1981, as will D16B, the diffractometer for biological studies.

— The installation of the replacement vertical cold source is planned for 1982 and will increase the flux on all cold neutron guides by almost a factor of 2. The contract will be placed at the beginning of 1981.

— The Carine replacement programme will, after some delay, be essentially completed by the end of 1981.

These projects amount to almost two thirds of the total cost of the Modernisation Programme. Work has started on two other major projects:

— Four new instruments, a triple-axis spectrometer IN20, two diffractometers D19 and D5B and the fission product coincidence spectrometer PN8. These will increase and expand the ILL's potential, particularly in the fields of high resolution multi-counters for complex crystals, kinetic experiments in structural analysis, spin analysis and fission physics. The decision to construct these instruments was taken by the ILL Management in collaboration with the Scientific Council in October 1980 and a start has now been made.

— The project study for the second cold source on the H5 beam: this will increase the ILL's potential in the field of long wavelength neutrons and high energy and momentum resolution experiments. These fields are one of the main subjects of work at the Institut, and an area where it is particularly successful, as for example in regard to the instruments IN10, IN11 and D11 D17. The final decision on a second cold source will be taken during 1981. A precondition for a positive decision will be whether the source can be built and operated with the funds available.

In the area of work to be financed under the normal budget, special mention should be made of the completion of the instruments IN13 (new back-scattering spectrometer) and IN6 (time-focussing time-of-flight spectrometer), which will start operation in 1981, at least for test experiments. The interferometer D18 is also essentially operational. Table 1 shows all the instruments and the various measures which will be implemented under the budget for the Modernisation Programme or the normal budget.

Table 1 — General view of ILL instruments

Diffractometers

Instrument 1980	Instrument 1981-1985	Beam hole	Financed from	Comments
D1B	D1B	H22		
D1A	D2B	H11	Norm. budget	Decided
D2	D20	H11	Norm. budget	Started
D3	D3B	Hot	Norm. budget	
D4	D4B	H8	Mod. progr.	Operational 1981
D5	D5B	Therm.	Mod. progr.	Site not decided
D7	D7B	H15	Norm. budget	To be decided 81
D8	D19	H11	Mod. progr.	Started
D9	D9	H3		
D10	D10B[a]	H24		Operational 81
D11	D11	H15		
D12	D12	H23		Not scheduled
D13ABC	D13ABC	H24		Not scheduled
D15	D15	IH4		
D16	D16B[b]	H16	Mod. progr.	Operational 1981
D17	D17	H17		
D18	D18	H25		Scheduled 1981

a) Neutron spin echo, TDS separation.
b) Multi-counter.
c) Magnetic bearings.
d) Fast Doppler drive.

Spectrometers

Instrument 1980	Instrument 1981-1985	Beam hole	Financed from	Comments
IN1	IN1B	H8	Mod. progr.	Operational 1981
IN1Be	IN1B-Be	H8		
IN2	IN20	H13	Mod. progr.	Started
IN3	IN3	H24		
IN4	IN4B[h]	H12	Norm. budget	Not yet decided
IN5	IN5B[c]	H16	Mod. progr.	
-	IN6	H15	Norm budget	Operational 1981
IN8	IN8B	H10	Norm. budget	Operational
IN10	IN10B[d]	H15	Norm. budget	Not yet decided
IN11	IN11B[e]	H14	Norm. budget	To be decided
IN12	IN12	H14		
-	IN13	H24	Norm. budget	Operational 1981

Nuclear physics instruments

PN1	PN1B[h]	H9	Norm. budget	Not yet decided
PN2	PN2	V3		
PN3	PN3	H6-H7		
PN4	PN4	H6-H7		
PN5	PN5B[f]	IH3	Norm. budget	
PN6	PN6	H23		
PN7	PN7[g]	H14	Mod. progr.	
-	PN8	IH1	Mod. progr.	Started

e) Multi-counter.
f) He-source.
g) New polarizers.
h) Or eventually closed down.

Later in this Annual Report these instrument projects are discussed in more detail and in addition the research results obtained on the various instruments.

It is scarcely possible to give a short answer to the question as to where the most interesting or more important results have been achieved, because of the number of subjects and varying fields of work of the visiting groups. After discussion with members of the subcommittees of the Scientific Council, we may make particular reference to the following subjects, with all the reservations appropriate to a subjective choice:

— Magnetic and other incommensurable structures; solitons;

— Structure of metallic glasses;

— Structure, dynamic and kinetic behaviour of polymers under variable external conditions; surface problems;

— Structure or morphology of ribosomes and viruses;

— Investigation of particular fission processes (e.g. "cold fission"), and of fissile materials other than those already investigated.

Research into the physics of elementary particles and neutrons is now occupying a very broad area: experiments to search for the electric dipole moment and a neutron charge; measurement of the neutron life-time; parity violation studies, and the quest for neutrino and neutron-antineutron fluctuations. These are mainly experiments involving a high scientific risk, the results of which, if positive, would be spectacular.

As usual, the reactor operated almost without interruption. It should however be mentioned that during the year a number of irradiation incidents occured within a short period although no-one received more than the permissible dose of radioactivity. The Directors however, will take steps to reduce the probability of such occurrences without unnecessarily limiting the flexibility essential for the experimental operation around the reactor.

The progress with the Modernisation Programme and the prospect of the forthcoming extension of the intergovernmental agreement have had a good effect on the general atmosphere at the Institut. On the other hand, the stress is perceptible in almost all areas due to a continuing high level of normal instrument operation for guest scientists in addition to the modernisation measures, which are generally very labour intensive. The work load in the Reactor Department is particularly heavy with the installation of the new neutron guide noses and the replacement of most of the beam tubes during the annual reactor shut-downs over the next four years. Also, the installation of the vertical cold source and the planning of the second cold source will impose demands which must be met in addition to the basic load of the routine operation of the reactor. The Directors, therefore, request your understanding of the restrictions necessitated by these and other measures, particularly in 1981 in connection with the extended reactor shut-down from 26 March to the end of June.

The departure of Dr. B. Jacrot on 1-9-80 should be mentioned as an important staff change. Dr. Jacrot succeeds Dr. A. Miller as head of the EMBL out-station at Grenoble, but will continue to deal with scientific questions in the ILL biology programme. Prof. J.P. Beaufils has been appointed to succeed Dr. Jacrot in his post as senior scientist with effect from 1 January 1981.

I should also like to thank Dr. J. White, who retired as Director of the Institut on 31 March 1980, for his work at the ILL and his efforts to obtain the agreement of the Associates to the concept of the Modernisation Programme. With the departure of Dr. White as Director, Dr. B. Fender was appointed assistant Director from 1 April 1980, while Dr. J. Joffrin continues as French assistant Director of the ILL until the end of June 1981.

Finally, it is with deep regret that we have to record the tragic accidental deaths of two of our colleagues, M. Claude Fonti and Mr. Patrick George. The Directors and staff of the Institut Max von Laue - Paul Langevin will remember their loss with sadness.

T. SPRINGER
Director
December 1980

1

INSTRUMENTATION

Einleitung

Im Bereich der Instrumente liegt das Hauptgewicht gegenwärtig auf der Entwicklung und Konstruktion derjenigen Projekte, deren Bau im Rahmen des Modernisierungsprogramms beschlossen worden war, nämlich IN1B, D4B, D16B (an welchen erste Testexperimente im Jahr 1981 erwartet werden), sowie IN20, D19 und PN8 (deren Konstruktion bereits begonnen hat). Der Bau von D5B wurde bis 1982 verschoben.

Zwei Instrumente (finanziert aus dem Normal-Budget) haben ihren Betrieb im Jahr 1980 aufgenommen : IN13 als Ergänzung zu IN10, mit einem grösseren Bereich für Energie- und Impulsübertrag sowie besserer Auflösung, und IN6 einem "up-scattering" Spektrometer von hoher Intensität. Das Interferometer D18 wird im April 1981 für Benutzerexperimente zur Verfügung stehen. Schliesslich sollte erwähnt werden, dass D1B jetzt mit einem eigenen SOLAR-Rechner arbeitet.

Die allgemeinen Aktivitäten und Entwicklungen im Instrumentenbereich können unter den folgenden Themen zusammengefasst werden :

– Entwicklung und Anwendung der Technik polarisierter Neutronen auf die Neutronen-Spin-Echo-Methode, der Diffraktion und Elementarteilchenphysik.

– Entwicklung und Anwendung von Multidetektoren in der Strukturanalyse.

– Verbesserung der Methoden zur Erzeugung ultrakalter Neutronen und deren Anwendungen auf Experimente auf dem Gebiet der Elementarteilchenphysik.

Einen kurzen Überblick über den Betrieb der Instrumente gibt die Tabelle 2. Die Tabellen 3 und 4 stellen eine Zusammenfassung der Projekte im Bereich der Instrumententwicklungen dar. Anschliessend in diesem Kapitel werden einige spezielle und neue am ILL entwickelte Experimentiertechniken beschrieben.

Introduction

At present, the main effort is drawn towards the development and construction of projects which were agreed in the context of the modernisation programme, namely IN1B, D4B and D16B, which will be ready for test experiments in 1981 ; and IN20, D19, PN8, where the design work has started. The construction of D5B has been postponed until 1982.

Two instruments (from the normal budget) have started test operation in 1980, namely: IN13 which is supplementary to IN10 in having a larger range in energy transfer, resolution, and momentum transfer; and IN6, the high intensity upscattering spectrometer. The interferometer D18 will be available for routine scheduling in April 1981 and finally it must be mentioned that D1B is now operating with a dedicated Solar computer. The general activities and developments in the instrument sector can be summarized under the headings.

– development and application of polarised neutron techniques for neutron spin echo, diffraction, and particle physics,

– development and use of multicounters in structure analysis,

– the improvement of the methods for the generation of ultra-cold neutrons, and their applications for particle physics experiments.

A brief survey of the full instrument operation programme is given in table 2. Tables 3 and 4 give a summary of the instrument development projects. This chapter also gives a description of some special and new experimental techniques developed at the ILL.

Introduction

L'effort principal est actuellement dirigé vers le développement et la construction d'instruments qui ont été approuvés dans le cadre du programme de modernisation, c'est-à-dire IN1B, D4B et D16B, lesquels seront prêts pour des expériences test en 1981 ; ainsi que IN20, D19 et PN8, pour lesquels les études ont commencé. La construction de l'appareil D5B a été reportée en 1982.

Deux instruments dont la construction a été financée dans le cadre du budget normal ont fait leurs premiers essais de fonctionnement en 1980, à savoir : IN13, complémentaire à IN10 du fait de sa gamme plus étendue en matière de transfert d'énergie, de résolution et de transfert de moment ; IN6, spectromètre à gain d'énergie et à haut flux. L'interféromètre D18 sera disponible en avril 1981 pour la planification des expériences ; et enfin il faut signaler que D1B fonctionne actuellement avec son propre ordinateur SOLAR. Les différents secteurs d'activité en matière de développement instrumental sont les suivants :

– développement et application des techniques de polarisation pour la spectrométrie par écho de spin, la diffraction et la physique des particules,

– développement et utilisation des multicompteurs dans l'analyse des structures,

– amélioration des méthodes de production des neutrons ultra-froids, ainsi que le développement de leurs applications aux expériences dans le domaine de la physique des particules.

Un résumé du programme complet d'exploitation des instruments figure au tableau 2. Les projets de développement des dispositifs expérimentaux sont résumés aux tableaux 3 et 4.

Quelques exemples de techniques expérimentales nouvellement développées à l'ILL sont également décrites dans le chapitre ci-dessous.

STATISTICS AND INSTRUMENT TABLES

Table II — Instrument operating statistics*

Instrument	Total operating time (days)	Loss of beam-time (days)	Coll. 3	Coll. 4	Coll. 5	Coll. 6	Coll. 7	Coll. 8	Coll. 9	Internal tests, feasibility and instrument improvement experiments
IN1	246.2	17.8		76.0			4.0		140.0	26.2
IN2	241.6	22.4		210.6					9.5	21.5
IN3	246.9	17.1		204.3			14.1		24.4	4.1
IN4	234.9	29.1		24.3		17.0	79.5		86.2	27.9
IN5	253.6	10.4				17.6	32.8	10.0	176.3	16.9
IN8	252.1	11.9		242.2						9.9
IN10	237.0	27.0		9.7		22.4	32.2	7.0	135.3	30.4
IN11	213.7	50.3		10.0		16.7	36.8	28.0	80.3	41.9
IN12	255.2	8.8		167.6		50.4	8.7			28.5
D1A	248.6	15.4			212.9		8.7		5.5	21.5
D1B	242.9	21.1			100.3	14.2	10.0		48.2	70.2
D2	247.9	16.1			77.5	34.2	30.3		76.1	29.5
D3	204.2	59.8			177.1		13.6			13.5
D4	260.8	3.2			9.7	226.5				24.6
D5	250.0	14.0			116.0	16.0	54.9			63.1
D7	217.3	46.7			5.7		162.3			49.3
D8	235.5	29.5			192.9					42.6
D9	250.7	13.3			186.1					64.6
D10	233.4	30.6			78.9		70.2		11.3	73.0
D11	236.8	27.2			2.0	5.0	41.1	78.0	56.7	54.0
D15	182.9	81.1			159.5					23.4
D16	229.8	34.2					22.0	124.3		83.5
D17	241.8	22.2			3.0	20.5	10.0	77.0	89.4	41.9
PN1	229.0	35.0	212.0							17.0
PN2	223.0	41.0	199.0							24.0
PN3	246.0	18.0	246.0							
PN4	122.3	141.7	122.3							
PN6	241.0	23.0	201.0							40.0

* *During 1980 the reactor operated for 284 days (6.5 cycles).*
The above record refers only to the first 6 cycles i.e. 264 days of reactor operation.

Table III — Projects in Progress (normal budget)

Instruments	
IN6	High intensity TOF spectrometer in the range $4.1 < \lambda < 5.9$ Å. It is equipped with 3 vertically focussing monochromator crystals (pyrolitic graphite) using the full height (20 cm) of the guide, a Be-filter, a Fermi chopper as well as an anti-overlap chopper and a 2.5 m He flight path. 337 elliptical ^3He detectors cover a useful detection area of 3 m^2. The measured elastic resolution (FWHM) is 170 μeV at 4.1 Å and 60 μeV at 5.9 Å for the focussing speeds of the Fermi-chopper. Commissioning tests will be carried out during the first part of 1981 followed by routine operation in July 1981.
IN13	Backscattering spectrometer for short wave-lengths. The secondary spectrometer has been installed in 1980. First tests concerning background, resolution and intensity with the complete spectrometer have started at the end of 1980. Commissioning experiments will be carried out during the first 3 months of 1981. Routine operation is expected by autumn 1981.
IN8B	The extensive rebuild of the IN8 3-axis spectrometer is almost completed. It includes the installation of a dedicated computer, new electronics and shaft drive systems, and will operate in this new configuration from July 1981.
D7	A supermirror polariser has been developed in 1980 for the D7 instrument. It will be installed in early 1981. To allow the use of polarisation analysis in diffuse magnetic scattering, a detector bank for polarisation analysis is also foreseen. A "super-bender" to be used has been tested at the end of the year. Further benders are in production.
D10	The classical D10 triple-axis/four-circle diffractometer in its fully rebuilt and modernized version has operated successfully during 1980. Improved reliability, easier setting-up procedures and more extensive experimental possibilities have upgraded the efficiency of the D10 spectrometer. The Neutron Spin Echo option became operational this year and the first short test experiments have shown that NSE can indeed be used to improve very significantly the energy resolution of classical triple-axis spectroscopy. (Further details are given in the section "New Experimental Techniques").
Neutron Sources.	
PN5	Concurrently with its main purpose as a UCN source for the Neutron Electric Dipole moment experiment, PN5 is used for UCN storage experiments (studies and improvements of UCN bottles) and for TOF transmission experiments with very cold neutrons ($10 < V < 100$ m/s).
Liquid He UCN-Source	After the demonstration of UCN storage in superfluid He, emphasis has been put on the improvement of the bottle material and on the development of cryogenic membranes made of material with zero potential (Zr-Ti alloy or polyethylene). In this context it has been shown that reflections on interfaces are the primary reason for losses of UCN between source and experiment. The detailed studies of the final source are now complete and the construction has started. Its delivery is expected by mid 1981.
Supermirrors.	
S3	The S3 evaporator has been working very successfully during 1980 and supermirrors of good quality are being routinely produced. A new supermirror superimposed on an antireflecting layer has been developed and produced on thin glasses (0.1 mm) for "super-benders". A test facility for supermirror benders with polarized neutrons of 7 Å was set up and is now currently in use.

Table IV — Projects in Progress (modernization programme)

Instruments	
IN1B*	The construction of the new hot source 3-axis machine has considerably progressed during 1980 and it will be installed during 1981. It will use the Tanzboden principle and will have a dedicated SOLAR computer. Utilizing the total aperture of the beam-hole H8 as well as vertically curved monochromators and analysers, the neutron flux will be substantially increased. IN1B will also have higher and lower take-off angles with respect to IN1.
IN5B	The construction of the magnetic bearings is underway. The complete system of bearings allowing for a faster change of the chopper speed will be available in early 1982.
IN20	This triple axis spectrometer will replace the present IN2, the double monochromator being abandoned in favour of a single monochromator drum. Spin polarization and analysis by Heusler crystals will be available and the monochromator drum will be designed such that, later on, the spin echo mode can be implemented (e.g. for the determination of phonon widths with very high accuracy). The space available allows all desirable configurations of the spectrometer arms. Construction of this instrument is in progress.
D4B*	D4B (replacing D4) is a liquids diffractometer operating in the wavelength range of $0.3 < \lambda < 0.7$ Å. A considerably higher flux will be achieved by curved monochromators. It will be equipped with a 64 cell multidetector and a small angle scattering facility ($Q \geq 0.05$ Å^{-1}). The construction has progressed normally.
D16B	Further progress was made in the reconstruction of D16. During 1981 an area detector (64 horizontal and 16 vertical wires) will be mounted. The sample-detector distance will be variable from 50 - 100 cm. Thus the instrument will be well suited for partially oriented biological samples and low resolution studies of single crystals. D16B will be controlled by a dedicated PDP-11 and is expected to be in scheduled service by late 1981.
D19	D19, primarily designed for fast data collection in large molecule crystallography, will replace D8 and have a 16×512 He^3 multi-counter which is presently under construction. It will be installed on the H11 hole which will have a larger diameter liner (20 cm ⌀ instead of 10 cm). The prototype (subunit) of the D19 area detector has been used during 1980 at a test position on the H24 guide. Tests of the assembled prototype will be carried out after the long reactor shut-down in July 1981. (The new H11 liner will facilitate the installation of the multicounter powder instrument D20 and the powder instrument D2B without mutual interference and will replace diffractometers D2 and DIA, respectively. (D2B and D20 are funded, with high priority, from the normal budget).
D5B	This is a reconstruction of D5 at a thermal hole, with D3 going to the present D5 position. D5B will work as a spin and energy analysis diffractometer and the transfer will improve its resolution and allow access to smaller Q values. The choice of the beam-hole has not yet been decided and therefore construction has not yet started.
PN8 "Cosi fan tutte"	This fission product mass spectrometer measures the speed and energy of the primary fission products in coincidence by a nsec time-of-flight technique and two high resolution ionisation chambers and will allow greater flexibility in the choice of targets compared to PN1 where the target is in-pile. A very promising result was recently obtained concerning the performance of the TOF unit of the spectrometer PN8 which has been under test during 1980: a time resolution of about 100×10^{-12}s was achieved. Progress was also made with the mechanical construction. The instrument is expected to be operational during 1982.
New Sources.	
Improved vertical Cold Source	This re-designed cold source replaces the existing one and by virtue of a re-entrant thimble which penetrates to the centre of the D_2 moderator vessel, increases the intensity for all cold neutron guides by almost a factor 2. The installation of a vertical neutron guide is foreseen which will deliver neutrons of 50 m/sec which can be decelerated by a Steyerl-turbine to obtain ultra-cold neutrons. The expected UCN-flux will be much higher than that obtained at the present PN5 facility. The construction of this new cryogenic cell is under way and tenders for the construction of the plug have been received. The vertical guide tube for UCN extraction is being designed. UCN and VCN transmission tests for a thin stainless steel or Ni liner are in preparation.
Second Cold Source	A second cold source, to be installed in the H5 hole, has to be supported by the Instrument Committee and Scientific Council. A preliminary engineering study has also been approved by the Committee and a final decision on the construction should be taken in 1981. The source will feed neutrons into a straight guide with two instruments in the main reactor hall. This will make it possible to extract neutrons from a considerably larger solid angle compared to the existing curved guides. A higher intensity is therefore achieved in a wave length region between that of the existing cold source and an ordinary thermal hole. Behind these instruments, two guides will be installed to conduct the neutrons into a small experimental hall outside the reactor shell where probably four additional instruments can be installed (these will be instruments which cannot make use of large solid angles). This installation will strengthen the potential of the ILL in the field of low energy and large wave length neutrons which corresponds to high resolution work with respect to energy and momentum transfer. Neutron calculations are being carried out in order to optimize the inpile part of the source (choice between liquid H_2 and D_2, position in the reflector, antireactivity effects etc.). Investigations among potential users have shown that a straight Ni-coated guide could significantly increase the neutron flux in the range $2 < \lambda < 6$ Å at the instruments fed by this source, especially for backscattering and diffuse scattering spectrometers.

* *Both, IN1B and D4B, will operate in a time-sharing mode 50:50. 30 % of the time on IN1B is foreseen for high energy phonon spectroscopy. Both instruments are expected to be in routine operation by spring 1982.*

NEW EXPERIMENTAL TECHNIQUES

High resolution TOF techniques for a new fission product spectrometer

(A. Oed, G. Barreau, F. Gönnenwein, P. Perrin, C. Ristori, P. Geltenbort).

The measurement of fission fragment velocities and kinetic energies is the basis of the new spectrometer "Cosi fan tutte". From the above measured data the fragment mass is calculated event by event, the achievable mass resolution being dependent on the performance of the energy and velocity detectors. The Time-Of-Flight (TOF) detector to be presented here has been designed to produce a timing Start or Stop signal on the passage of a fission fragment over a flightpath of given length. The fragment velocity is then calculated from the time elapsed and the flightpath. The principle of the TOF-detector shown in the picture is the following: an extremely thin foil (below 20 $\mu g/cm^2$) is placed perpendicularly to the fragment path the fragments traversing the foil (losing less than $\sim$ 1 % of their initial velocity) and being allowed to continue on their flightpath. During their passage, electrons from the ionization process are ejected from the foil and are accelerated onto an annular electron multiplier centered co-axially around the fragment trajectory. The electron multiplier is a channel plate (1 mm thick, 25 mm outer diameter) with a central hole (ranging up to 15 mm in diameter) and in practise, two of these channel plates are used in a tandem arrangement to increase the gain. The electrons at the output of the second multiplier are collected on an annular anode and an extremely fast pulse (rise time 0.7 ns) of large pulse height (up to 50 V into 50 Ω) is obtained which is well suited for handling by commercial fast electronics[1]. The time resolution of this compact and light-weight TOF detector has been measured to be 70 ps = 0.07 ns. For a complete Start-Stop system made up of two of the above detectors the flight-time resolution is 100 ps. This means, for example, that velocities of fission fragments can be determined with a precision of roughly 0.1 % on a flightpath of 1 m. It has thus been proved that Cosi fan tutte is, technically speaking, completely viable.

(1) A. Oed, G. Barreau, F. Gönnenwein, P. Perrin, C. Ristori and P. Geltenbort: Nucl. Instr. and Methods, accepted for publication.

UCN storage in superfluid helium

(C. Jewel, P. Ageron, R. Golub, W. Mampe)

The achievable UCN density ϱ in a helium bottle depends not only on the conversion rate P of 1 meV neutrons to UCN by superfluid helium (which has been demonstrated earlier [1]), but also on the life time τ of UCN in helium (ϱ = px τ).

An experiment has been carried out at the ILL which has demonstrated the possibility of storing UNC in superfluid helium. The tail of a standard cryostat has been equipped with a UCN valve. When this small bottle, filled with superfluid helium, is irradiated by 1 meV neutrons, UCN are produced and built up. Subsequently the incident beam is shut off and after a given storage time, the UCN valve is opened and the stored UCN are guided to a detector. The pumping of the helium entails a temperature decrease down to 1.2 - 1.3 K. Despite this rather high temperature and the poor transmission of the guide between the valve and the detector, storage of UCN in superfluid helium has been possible and storage times of about 5 - 7 s at T = 1.3 K and 8 - 9 s at T = 1.2 K have been measured. These values are consistent with the calculated times [2][3]. Both ordinary He^4 simply purified from He^3 by pumping, or highly purified helium produced by a purifier built at the University of Lancaster, have been used, without a significant difference in the results. Impurities other than He^3, such as air or oil contamination, have apparently affected the storage to a much greater extent.

The upscattering cross-section of helium, being in theory proportional to the seventh power of the temperature, would no longer be the limiting factor for UCN life time in highly purified helium at 0.6. K which is the design temperature of the UCN helium source.

(1) ILL Annual report 1978, p. 30.

(2) (3) R. Golub: ILL notes on neutron life time in superfluid helium, 79 GO 12 T and 79 GO 25.

Test of the spin echo option on D10

(C. Zeyen)

This year the first triple-axis spectrometer with a Spin-Echo option to improve the energy resolution beyond the classical limits became operational on a testing basis. The principle of this option is the same as the one used on IN11 with cold neutrons.

We use the thermal neutron triple axis machine D10 as a host spectrometer which provides good momentum resolution and standard ($\frac{\Delta E}{E} \cong 2\text{-}5\ \%$) energy resolution. The NSE option improves this resolution so that $\frac{\Delta E}{E} \approx 10^{-3}$ can be achieved at high momentum transfers.

The present design of the NSE device consists of single crystal Heusler polariser and analyser systems. The Larmor precession fields are delivered by Iron-yoke electromagnets with the field transverse to the neutron path. 1200 Larmor precessions can be achieved at 1.7 Å (28 meV) incident wavelength and correspondingly more at larger wavelengths. For quasielastic scattering this boosts the energy resolution into the μeV region. Good NSE signals of the direct beam and from test scatterers could be obtained. It was shown that TDS separation is possible.

The development of this NSE option was done during short beam-time periods while D10 was operating on a user basis to perform classical experiments. Beginning 1981 one and a half reactor cycles have been allocated fully to the D10 NSE option. This period will first be used to improve certain elements of the present design such as: Vertically focussing Heusler systems to replace the flat crystals and give more polarized flux, new air-cooled π flipper which should operate without local field corrections and better magnetic shielding of the D10 surroundings. Scientific evaluation tests will then take place.

Production and testing of super-mirrors

(O. Schärpf, R. Gähler)

The production of good-quality super-mirrors of different kinds under complete computer control on S3 is now a matter of routine. It is possible to evaporate all the types of multilayered structures required, even from well-defined alloys. This is accomplished by evaporating very thin single layers (less than 10 Å) of the alloying constituents in some cases on a hot substrate. We used this method for the production of a super-mirror with the iron-cobalt alloy of 50 % Fe- 50 % Co and the other layer consisting of vanadium. This can also be done under complete computer control.

Nickel-manganese and nickel-titanium super-mirrors were also produced in order to test their suitability for neutron guides. The possible destruction of the super-mirror properties by interdiffusion of the layers is currently being tested by irradiating mirrors in a high neutron and γ-flux. Used in a neutron guide they have to withstand a high flux for more than ten years.

Other, polarising super-mirrors were produced on pyrex glasses for a new analyser at IN11, for a polariser on D7 and on PN7. In the photograph showing the test set-up one can see on the right the mounted super-mirror polariser for D7 with permanent magnets ensuring good polarisation. The problem

Photo K. : (Alsthom Atlantique)

The test facility for super-mirrors and super-benders. On the right is a mounted super-mirror polarizer. On the optical bench (in the middle) a super-bender is acting as analyser.

of obtaining good polarisation for a broad spectrum and simple handling led to the development of super-mirrors superimposed on an antireflecting layer. O. Schärpf succeeded in producing these layers on very thin glasses and in building a very versatile curved sollertype polariser which is shown in the picture together with the required magnets. With one evaporation 10 super-mirrors can be obtained on an antireflecting layer of 300 mm length and 65 mm width. From "super-benders" of this kind two have been produced 100 mm high and two 65 mm high. The larger ones are intended for a spin analysis test on D7, where in principle each of the 32 detectors needs a SM-analyser. The smaller ones will be used on S6 and PN7 to obtain a highly polarised flux for the whole spectrum from a cold or even from a thermal guide. It is possible to use 0.5 mm spacers of small glass strips between the plates, and in this way to obtain the very short characteristic wavelength of 2.17 Å. This is the condition for the use on a thermal guide.

These results have been achieved by means of the mirror test bed shown on the photograph. The facility was built by R. Gähler and is controlled by a Macamac computer. It is equipped with three step motors for the Θ and Θ-2Θ scans, a lateral movement and an xy plotter for which appropriate programs exist. The test bed makes use of a cold neutron beam reflected off the guide by a mica crystal, giving two wavelengths: λ = 2.4. Å and 7 Å. The tests with shorter wavelengths are of particular importance for the application of super-benders on thermal guides. Both wavelengths can be separated by a mechanical chopper or by a pseudo-random modulation of the polarized beam at present under test. In the photograph one can clearly distinguish from left to right: the neutron detector, a super-bender analyser, two flippers, a guide field, the sample holder for mirrors to be tested, a polarising mirror and the mechanical chopper.

2

INSTRUMENT OPERATION DEPARTMENT

Introduction

The Instrument Operation Department has overall responsibility for the operation and improvement of the instruments. It also provides necessary technical assistance to enable the visitors to carry out their experiments. The instruments are divided amongst four instrument groups which assure their operation and development. The other groups of the department provide facilities and expertise needed by all the instruments. As part of the modernisation program a substantial expansion is planned in the facilities provided by the sample environment group, the first stage of this program has begun during the year. The modernisation program also puts a heavy load on the monochromator group since the success of many of the instrument projects depends on the provision of large area monochromators. The central group in addition to providing services in the experimental halls needed by all groups continues to ensure co-ordination between the instrument groups the reactor department and security services.

Einleitung

Die Abteilung Instrumentenbetrieb ist allgemein verantwortlich für den Betrieb und die Verbesserung der Experimentiereinrichtungen. Sie leistet ausserdem den Gastforschern die notwendige technische Hilfe bei der Durchführung ihrer Experimente. Die Instrumente sind in vier Gruppen aufgeteilt, die für ihren Betrieb und ihre Weiterentwicklung sorgen. Die übrigen Gruppen der Abteilung erbringen die für alle Instrumente notwendigen Apparaturen und Fachkenntnisse. Als Teil des Modernisierungsprogramms soll das Potential der Gruppe Probenumgebung beträchtlich erweitert werden. Der erste Abschnitt des Programms wurde dieses Jahr in Angriff genommen. Das Modernisierungsprogramm bedeutet für die Monochromatoren-Gruppe eine erhebliche Belastung, da der Erfolg vieler Instrumentenprojekte von der Bereitstellung neuer Grossflächen-Monochromatoren abhängt. Ausser ihrem in den Experimentierhallen von allen Gruppen benötigten Service, ist die Zentralgruppe weiterhin für die Koordinierung der Instrumentengruppen mit der Reaktorabteilung und dem Sicherheitsdienst zuständig.

Introduction

Le Service Exploitation des Instruments a la responsabilité globale du fonctionnement et de l'amélioration des dispositifs expérimentaux. Il fournit en outre l'assistance technique nécessaire aux chercheurs invités, pour mener à bien leurs expériences. Les dispositifs expérimentaux sont répartis en quatre groupes qui assurent leur fonctionnement et mise au point. Les autres groupes du Service fournissent des prestations spécialisées nécessaires à l'ensemble des instruments. Une partie du programme de modernisation prévoit un élargissement substantiel des prestations du Groupe Environnement des Echantillons. La réalisation de la première étape de cet élargissement a commencé cette année. Le programme de modernisation soumet aussi le Groupe Monochromateurs à une charge de travail considérable du fait que la réussite d'un grand nombre de projets d'instruments dépend de la fourniture de monochromateurs à grande surface. Outre les services généraux dans les halls expérimentaux, le Groupe Central continue à assurer la coordination avec le Département Réacteur et le Service Sécurité.

INSTRUMENT GROUP FUNDAMENTAL AND NUCLEAR PHYSICS

PN1	:	Fission Product Separator (LOHENGRIN) on beam tube H9.
PN2	:	Beta Spectrometer (BILL) on the vertical beam tube V3.
PN3	:	Three Curved Crystal Gamma Spectrometers (GAMS 1, 2, 3) on the through going beam tube H6/H7.
PN4	:	Ge(Li) Pair Spectrometer on the through going beam tube H7.
PN5	:	Ultra-Cold Neutron (UCN) Source on the inclined beam tube IH3.
PN6	:	On-Line Mass Separator for Thermally Ionized Fission Products (OSTIS) on neutron guide H23L.
PN7	:	Cold Polarized Neutron Beam on neutron guide H142.
PN8	:	Fission Product Coincidence Spectrometer (COSI FAN TUTTE).
H17	:	Cold neutron guide: liquid helium UCN source (in preparation), magnetic storage of UCN (in preparation).
H18	:	Cold neutron guide: determination of the neutron charge, neutron optics and search for neutron-antineutron transitions.
H22	:	Thermal neutron guide: neutron induced particle emission (H22D); γ-γ angular correlation (H22F); neutron induced fission (H22E).
IH1	:	Very intense neutron beam: neutron-induced fission.
basement	:	Neutrino experiments.

PN1 fission product spectrometer "LOHENGRIN"

(H.R. Faust, J. Mougey, H. Schrader, I. Gartshore, J.M. Gandit)

In 1980 the parabola spectrometer LOHENGRIN was operational for about 88 % of the reactor time, including test measurements which took 11 % of the available beamtime. During the year 17 different experiments have been performed, such as measurements of mass and charge distributions from fissionable isotopes, determination of masses of neutron-rich nuclei and nuclear spectroscopy. Test time was required for ion-optical measurements, installation of computer programs and improvement of the high voltage stability. During the reactor shut-down periods the high voltage supply was checked for sources of instability and noise. Tests have been done to achieve a stability better than 10^{-5} by increasing the performance of the reference and the first amplifier stage. To increase the short-time stability a compensation technique via the input of the phase reversed error signal was studied. The vacuum system of the spectrometer was redesigned and the plans for a new control system were prepared. The device will be installed during the long reactor shut-down in 1981. A complete revision of a number of mechanical parts and motors of the target changing facility was performed by the reactor department. A set of programs has been installed or completed such that the spectrometer is now under control of the PDP 11 computer. The work on programs for data acquisition is still in progress.

In 1980 plans were prepared for the construction of a large volume ionisation chamber which will be used in the focal plane of LOHENGRIN. This device will increase the sensitivity of the spectrometer by a factor of 10. In November a new calibration of the instrument was performed using the time-of-flight technique and the detection of monoenergetic α particles and tritons from the ^{6}Li (n, α)t reaction.

PN2 beta spectrometer "BILL"

(K. Schreckenbach, H.R. Faust, G. Blanc)

In 1980 the beta spectrometer BILL was working continuously for about 90 % of the reactor time. More than 30 different measurements have been performed comprising investigations in nuclear structure physics, shapes of beta decays and atomic physics. The response function of the spectrometer with the detector system (proportional counters in transmission mode) has been carefully investigated in the region from 1 to 8 MeV electron energy. The ^{116}In ground state decay and various internal conversion lines following neutron capture to ^{198}Au and ^{208}Pb have been used as standards.

Thus the response has been found to be constant in the $\Delta p/p$ scale with an accuracy of 5 %. A new position sensitive electron detector of the avalanche type has been tested with α particles. A position resolution of better than 1 mm has been achieved.

PN3 curved crystal gamma spectrometer "GAMS 1" and "GAMS 2/3"

(H.G. Börner, G. Barreau, R. Brissot)

During 1980 the three curved crystal spectrometers GAMS 1, GAMS 2 and GAMS 3 were operational for about 90 % of the reactor time. Part of the GAMS 2/3 data acquisition system has been modified and is currently being installed. The new system will allow automatic photopeak stabilisation for the γ-ray detectors as already successfully incorporated in GAMS 1. A more precise determination of the intensities and a further improvement in sensitivity is expected. In addition the software system of GAMS 2/3 has been further developed. The GAMS 1 and GAMS 2/3 systems are now linked to a third central computer with the aim of speeding the data processing.

PN4 Ge(Li) pair spectrometer

(S. Kerr, R. Brissot, C. Hofmeyer)

The Ge(Li) pair spectrometer was operational for the whole year. Modernisation of the instrument has proceeded with total replacement of the analogue electronics and the building of a computer based multi-channel analyser. The incorporated processor with peripherals will be shared with PN2 and PN3 for data analysis. The anti-compton spectrometer has been taken out of service, single measurements being made instead with a 20 % efficiency Ge(Li) detector shared with special beam experiments.

PN5 ultra cold neutron source

(P. Ageron, W. Mampe, A. Beynet)

The UCN beams at PN5 have been used in 1980 to continue experiments on the electric dipole moment of the neutron, to study storage times in material bottles and for perparatory experiments for the liquid Helium UCN source. The transmission for very slow neutrons in tubes has been investigated for different materials in order to define the future vertical UCN guide, which will be installed in the present cold source.

PN6 on-line mass separator for thermally ionised fission products "OSTIS"

(B. Pfeiffer, L.J. Alquist, P. Hungerford, G. Jung, E. Koglin, B. Nief)

In 1980 the mass separator OSTIS was operational for about 90 % of the reactor time. Beamtime was highly demanded and 13 experiments and 4 test runs were performed. The most remarkable development was the implementation of the new indirectly heated high-temperature ion source. In first on-line tests at 2 400 °C the alkaline earth elements Sr and Ba as well as the rare earth elements Pr, Nd, Pm, Sm and Eu were ionised. Although measurements performed with this new source have already given very promising results, further improvements have to be made to increase the lifetime of the sources which is about 100 hours at present.

PN7 polarised neutron beam

(R. Gaehler, B. Nief)

The polarised neutron beam PN7 has been used extensively for investigations of parity violating effects in neutron spin rotations and in the neutron capture of deuterium. The present soller type polariser made of thin plastic foils with FeCo films showed a severe flux degradation within a few months. A new polariser made of supermirrors has been tested. In agreement with calculations a polarised flux of about 10 % of the incoming flux of $1.4 \times 10^9 n\ cm^{-2} sec^{-1}$ has been achieved. The wavelength distribution of polarised neutrons peaks at 5Å. Further developments in producing supermirrors on very thin glass will lead to a soller type polariser which will probably be installed on PN7 in Spring 1981.

PN8 fission product coincidence spectrometer "COSI FAN TUTTE"

(P.E.J. Perrin, A. Oed, B. Nief)

The new fission fragment spectrometer COSI FAN TUTTE is based on the coincident measurement of kinetic energies and velocities on both fragments in binary fission. The instrument will be installed on the external beam IH1.

A major effort has been invested in the development of time pick-off detectors being able to measure fission product velocities very accurately on the short flight path available on IH1, thus providing the high velocity resolution required.

Furthermore, various studies have been performed:

1) a new platform for IH1 to avoid interfering with neighbouring instruments,

2) the neutron spectrum of IH1 and possible improvements in the beam quality by inserting filters,

3) the multiparameter data acquisition system,

4) the mechanical set-up including the vacuum system,

5) health physics,

6) production of thin films (Al_2O_3 or plastic) for detector entrance windows.

The final approval to build COSI FAN TUTTE has been given in Autumn 1980. The spectrometer is expected to be operational in the second half of 1982.

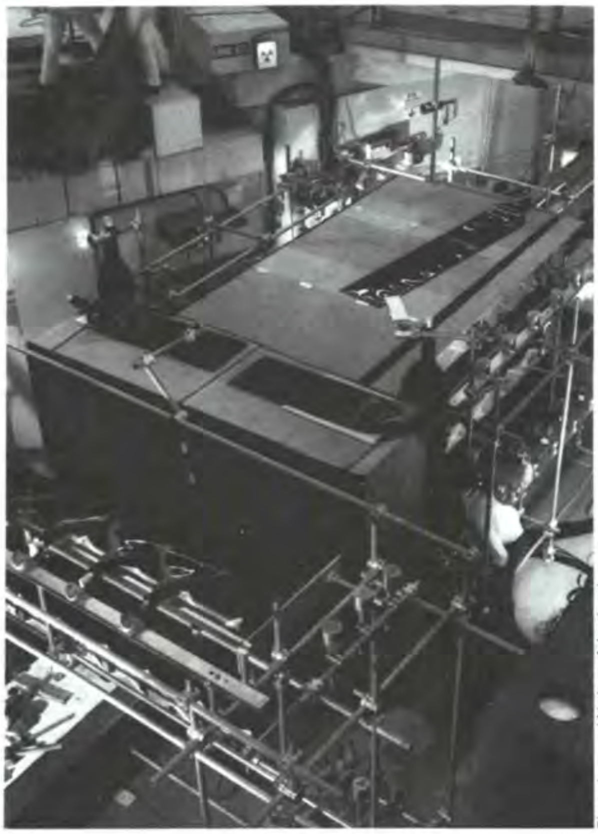


Photo L. : (Alsthom Atlantique)

Experimental set-up at H18 for the search of neutron-antineutron oscillations (CERN, Padua, Rutherford Lab., ILL). The neutrons propagate in a μ-metal shielded vaccum tube. The detector registering the events following an antineutron annihilation is placed within a 40 tons'iron shielding. On the picture this shielding is already partly covered with an anticoincidence shield.

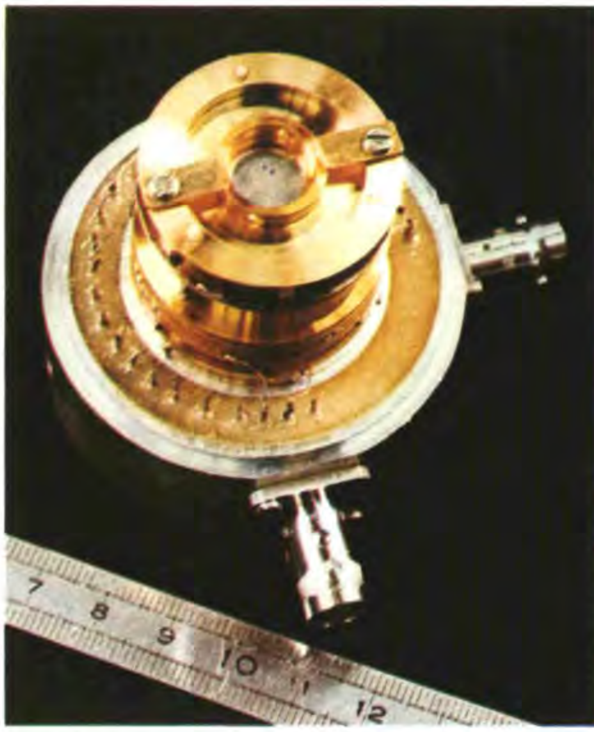


Photo M. : (Alsthom Atlantique)

The TOF-detector of the new fission product spectrometer PN8 under construction.

Special beam experiments

(G. Barreau, R. Brissot, J.F. Cavaignac, R. Gaehler, P. Hungerford, S. Kerr, W. Mampe, A. Oed, P.E.J. Perrin, F. von Feilitsch, B. Vignon, B. Nief)

The neutron beams H17, H18, H22 and IH1 were used continuously and successfully throughout 1979 for nuclear spectroscopy, fission and fundamental physics experiments.

On H17 preparatory experiments for the new super fluid Helium UCN source have been performed. The new source is now under construction. A UCN storage experiment aiming at a neutron life-time measurement is being prepared for H17 by the University of Bonn.

The instrumental set up at H18 built for the search of an upper limit of the neutron charge has been extensively used for neutron optics experiments. At the end of 1980 a group from CERN, Padua, Rutherford and ILL has mounted a large detector system at H18 designed for the detection of possible neutron - antineutron oscillations.

The multiparameter system for nuclear physics experiments has been up-graded to three parameters and operated successfully both on H22F and PN6. Replacement of the aging processor and parts of the analogue electronics is in progress to improve the performance and reliability of the device.

The neutrino experiment (basement) searching for neutrino oscillations worked continuously during the year. Detailed results are presented in the "College 3" section of the present Annual Report.

Co-ordinator:
K. SCHRECKENBACH

INSTRUMENT GROUP
THREE-AXIS SPECTROMETERS

IN1	:	3-Axis with beryllium-filter option on the hot source (beam tube H8).
IN2	:	3-Axis with a double monochromator on the thermal beam tube H13.
IN3	:	3-Axis spectrometer on the thermal guide tube H24.
IN8	:	3-Axis spectrometer on the thermal beam tube H10.
IN12	:	3-Axis spectrometer on the cold guide H14.

Introduction

All 5 ILL 3-axis spectrometers have operated continuously and satisfactorily throughout 1980.

Prospects for 3-axis instrument development are very promising, whether as part of the modernisation program (IN1B, IN20) or as part of the Carine Replacement Program (IN8B and later IN3). These projects are outlined in the following report.

Collaborative work with the ILL Monochromator Group has led to important development in the field of focussing monochromators and analysers. Results of recent tests on a vertically focussing Heusler-alloy polarising analyser are presented.

Also mentioned is the development of user oriented data treatment programs. With the advent of dedicated minicomputers, these programs will eventually be accessible on-line, on all 3-axis instruments.

IN1 hot source 3-axis spectrometer with Be-filter option

(H.J. Lauter, A. Kollmar, P. Cross)

The instrument operated 30 % of the time in the 3-axis mode and 70 % in the Be-filter mode. In the 3-axis mode the performance of the instrument has been significantly improved by the installation of a new analyser shielding together with boron-coated Rutherford-type collimators and a larger pyrolitic graphite analyser crystal. The improvement in signal-to-noise ratio is particularly appreciable at low scattering angles. The Be-filter analyser continues to be in high demand and plans for improvements are under discussion. In the Spring of 1981, IN1 and D4 will be shutdown. The H8 beam-tube will be replaced and a new monochromator drum installed. Until a better longterm solution is found, the new drum will be used on a time-sharing basis by IN1 (in both modes of operation) and D4. It is hoped that the flux increase arising from the improved drum optimisation as well as the use of large vertically focussing Cu monochromators, will more than offset the inconvenience associated with the 3-way time-sharing. The fully renovated machine, with dedicated Solar 16-40 computer control is expected to resume operation in early 1982.

IN2 thermal beam 3-axis spectrometer with a double-monochromator

(B. Dorner, R. Pynn, P. Flores)

The thermal-beam three-axis spectrometer IN2 has been in continuous operation since 1972. Although the spectrometer has functioned without serious breakdown this year it is clear that its age and unoptimised design make it ripe for replacement. The new instrument, to be called IN20, was approved by the steering committee at the end of 1980 as part of the ILL rejuvenation program. It is envisaged that IN20 will be a single-monochromator machine placed as close to the reactor as the territorial demands of its neighbour, PN3, will allow. Standard mechanical and electronic equipment developed for IN12, IN1B and IN8B will be the basis of this instrument. It will differ from the other reactor-face thermal three-axis instrument (IN8) by the provision of facilities for polarisation analysis and by a design concept which will allow the implantation of neutron spin echo equipment if this should prove desirable.

IN3 3-axis spectrometer on a thermal guide

(J. Lefebvre, R. Artaud)

IN3 operated without major modifications throughout the year. The wide range of available incident energies (5 to 30 meV) makes it a very flexible instrument, used more and more as a test bench for experiments, to be continued on the more efficient 3-axis spectrometers IN8 and IN12. The horizontally curved analyser technique, originally developed on IN3, has now been tried on several instruments and has proved fairly successful, particularly in the case of locally flat dispersion branches: intensity gains of a factor of 5 without loss in energy resolution have been obtained. The instrument control electronics is showing signs of wear and will soon be modernised as part of the Carine Replacement Program.

IN8 thermal beam 3-axis spectrometer

(R. Currat, A. Brochier)

IN8 operated continuously and satisfactorily through the year. The new $2\Theta_M$-drive installed late last year has proved very successful in terms of reliability and positioning speed. A vertically focussing Cu111 monochromator crystal was recently installed: this new variable curvature 15-block assembly, supplied by the ILL Monochromator Group, delivers 3 to 4 times as many neutrons (on a 5×5 mm² sample area) as the flat copper plate used so far. The gain is due both to higher crystal quality and to vertical focussing. Vertical focussing is now available on the analyser side as well. For most experiments the increased vertical spread of the outgoing wavevector is in fact tolerable and the gain in intensity is then typically a factor of two.

The new vertically curved Cu monochromator set-up on IN8.

Meanwhile the construction of IN8B is progressing: the mechanics, based on IN12-type drive-modules have been assembled. Comprehensive tests using the new standard electronics and the Solar 16-40 control computer will take place in the "Hall d'Essais" during Spring 81. The new machine will be installed on site during next year's long reactor shut-down.

IN12 3-axis spectrometer on a cold guide

(W.G. Stirling, J. Bouillot, R. Pratt)

IN12 operated very satisfactorily during 1980. The "central-drive" system controlled by the new step-motor electronics interfaced through the INTEL 8080 microcomputer to the Solar 16-40 mini computer, may thus be considered as a wholly viable and tested system for triple-axis spectrometers.

During the year, several modifications were made to the instrument to improve performance or widen the range of applications.

1) A 12 cm high, vertically focussing pyrolytic graphite monochromator was installed. With this device there is only graphite in the beam and so the whole height of the guide tube may be used permanently by IN12 without affecting the instruments at the end of the guide. This monochromator provides a gain of about a factor of two in flux at the sample position.

2) A motorised attenuator system was constructed for the incident beam.

3) Computer control of sample temperature changes was successfully tested using the Kepco D.A.C. and a Thor controller.

4) "Background" mode on the computer was used to run programs for calculation of instrumental resolution and simple data treatment; these programs run simultaneously with the measuring program. A hard-copy device is shared with D1B.

5) A 1200 Baud card was installed on the LA36 DEC writer. This reduces lost time particularly during program development and instrument alignment.

During the long shut-down in 1981, it is envisaged to install an IN8-type direct-drive module on the sample table-drive (angle $2\Theta_M$). This will avoid any future difficulties with the existing module which is a modified prototype unit. It is hoped to install automatic analyser shielding, a variable curvature analyser and a smaller detector, to further reduce the neutron background.

Heusler alloy polarising analyser

(R. Pynn)

During 1979 a number of monocrystalline ingots of Heusler alloy (CuMnAl) were produced for ILL by Dr. Perrier de la Bathie of CNRS Grenoble. A composite, polarising analyser has now been produced from this material and has been tested on D13 and IN12. The analyser is composed of five Heusler plates each of which is 75 mm long, 15 mm high and 7 mm thick. The plates are mounted one above the other on a flexible titanium backing plate between the poles of a $SmCo_5$ C-magnet which provides a horizontal field of about 1.5 kG. Tests on IN12 using 4Å neutrons and a beam 50 mm high and 25 mm wide have given extremely encouraging results. The mosaic of the composite analyser is a smooth, single peak of width (FWHM) 20'. A peak reflectivity of 73 % was measured for the neutrons of the desired spin state, and no change in the polarisation efficiency was detected when the analyser was vertically curved. In the near future a variable curvature monochromator will be fabricated to permit polarisation analysis experiments to be carried out routinely on IN12.

Data processing

(R. Pynn, W.G. Stirling)

During 1980 a substantial effort has been made to standardise and improve computer programs used for the initial reduction of data obtained by three-axis spectrometers. To this end, ILL has participated with AERE, Harwell and the Rutherford Laboratory in a contract with a programming group from the Polytechnic of Central London. This group has developed a number of programs which are now available on the DEC 10 computer (see relevant documentation, available from Scientific Secretary, for details). Among these programs the most widely appreciated by users seems to be PKFIT a routine which allows data to be fitted to simple spectral forms which are convolved with the instrumental resolution and corrected for systematic distortions such as the detailed balance factor. This program, together with RESCAL (a program which calculates resolution properties of a three axis machine) is available on-line at IN12 and has contributed significantly to the efficient use of this instrument.

Co-ordinator:
R. CURRAT

INSTRUMENT GROUP TIME OF FLIGHT, HIGH RESOLUTION AND DIFFUSE SCATTERING

IN4	:	Time-of-flight spectrometer on thermal tube H12.
IN5	:	Multichopper spectrometer on cold guide H16.
IN6	:	Focussing time-of-flight spectrometer on cold guide H15 (under construction).
IN10	:	Backscattering spectrometer on cold guide H15.
IN11	:	Spin echo spectrometer on cold guide H14.
IN13	:	Backscattering spectrometer for short wavelengths on thermal guide H24 (under construction).
D7	:	Diffuse scattering spectrometer on cold guide H15.
D11	:	Small angle and diffuse scattering spectrometer on cold guide H15.
D16	:	Four circle MK6 diffractometer on cold guide H16
D17	:	Low-q high resolution spectrometer on cold guide H17.

Introduction

The name of the group indicates that a number of rather different techniques is applied to a large range of science covering solid state physics, physical chemistry, metallurgy, bio-physics and other fields using neutron diffraction and spectroscopy with medium and high resolution.

The main effort in 1980 was concentrated on finishing the focussing TOF spectrometer IN6 and the short wavelength backscattering spectrometer IN13, both having entered the test phase end of 1980. With the help of the renewal programme the diffractometer D16 is being modernised as well as the secondary spectrometer of IN10. After the successful developments and progress in the field of production of normal and polarising supermirrors by O. Schärpf D7 will have a great chance of becoming a very versatile and attractive diffractometer and (or) spectrometer for diffuse scattering **with** polarisation analysis.

A clear-cut scientific case was made for the heavily overloaded time-of-flight spectrometer IN4. The ILL provides with this unique machine a powerful tool for research in the field of neutron spectroscopy for polycristalline, amorphous and liquid systems.

IN4 time-of-flight spectrometer

(A.P. Murani, J.B. Suck, D. Paul, H. Walter)

IN4 has continued to serve principally Colleges 7 and 9 also Colleges 6 and 4 to a lesser extent. A total of 32 different experiments were successfully performed during the year with minimal breakdowns caused mainly by minor electronic failures. The dedicated PDP 11/34 computer control of the instrument installed during the previous year has proven to be of great value for all users in providing immediate access to the data at the instrument console which enables the choice of the best possible course of the experiment to be made. The delay of a day or more in the transfer of the data to the PDP 10 Central Computer, however, still presents difficulties to users who must return with the data to their home laboratories soon after completion of their experiments. A major improvement of the spectrometer carried out during the previous year consisted of changing the available scattering angles to lie in the range $-9°$ to $140°$ and moving the sample position closer to the reactor by one meter. An overall gain in flux at the sample position resulting from the latter change has been verified during the year to be just over 50 %. The new flux calibration is included in the latest edition of the yellow book.

During the year a great deal of effort has been put into the installation of the single monochromator plus Fermi chopper system, to be used alternatively with the normal double monochromator system. The first tests carried out towards the end of the year show great promise in terms of gain of intensity (especially for the Cu monochromator) and the possibility of carrying out experiments at higher incident energies than available with the double monochromator system, owing to the smaller take-off angle of the single monochromator. At present, ways are being sought to reduce some of the increased neutron background. It is hoped to achieve the necessary improvements and to offer the single monochromator option to users during the next year.

IN5 multichopper spectrometer

(A.J. Dianoux, F. Douchin, J.P. Beaufils, S. Jenkins)

A total of 37 experiments, two thirds of them in the field of chemistry, and 12 preliminary tests have been performed in 1980. The spectrometer has worked continuously with no more than 4 % of total beam time lost. 1980 was the first year in which no time was lost due to ball bearing failures, a consequence of the preventive maintenance policy and the excellent work of the instrument support group. Three new power supply units from KFA Jülich are expected in early 1982. The complete system, including magnetic bearings, should be available in 1983. The whole detector bank (1200 detectors or 2.5 m^2 of detection area) has been operated successfully, but there was decrease in efficiency due to failures in preamplifiers which had to be changed. In 1981, a closed-circuit Helium refrigerator will relieve the pressure on the Helium cryostat and allow easier handling of cooling problems in the most needed range of temperatures. A non permanent defect in the "Time of Flight" electronic unit caused only a little trouble due to perfect continuity of control by the PDP11/34 computer. A clear choice on the basic software system is now necessary to allow hardware extensions and use of new programs for TOF being developed on IN6. It would also permit a complete updating of the instrument documentation to be carried out during the 1981 long reactor shut-down. Data transmission to the PDP10 control computer, which is still partly done manually has to be carried out automatically.

IN6 focussing time-of-flight spectrometer

(A.J. Dianoux, D. Cebula, Y. Blanc)

IN6 is a time focussing time-of-flight spectrometer designed for quasielastic and inelastic scattering for incident wavelengths in the range 4-6 Å. The elastic resolution is about the same as that on IN5 in this range, but with a three-fold increase in flux at the sample position. The mounting of the mechanical parts, including the shielding, has been terminated in October, 1980. Some tests of intensity and resolution using a 1mm Vanadium sample have already been performed. They have proved the excellent operation of the principle of time focussing using a variable speed of the Fermi-chopper. The overall background (electronic + neutron) is of the order of 8 counts/detector/hour, each detector having a detection area of 90 cm^2. The measured elastic resolution (FWHM) is 170 μeV at 4.1. Å and 60 μeV at 5.9 Å. During the first part of 1981 the instrument's performance and reliability will be tested. At the same time several functions, currently carried out manually, will be computer controlled. The data acquisition program will be developed and will allow any kind of regrouping of the 256 time-of-flight outputs and preliminary data treatment such as background subtraction. IN6 is scheduled for routine operation in July, 1981, after the long reactor shut-down.

IN10 backscattering spectrometer

(A. Heidemann, C. Poinsignon, J. Bauchat)

A final decision was taken at the end of February to modernise the secondary spectrometer. Design work started in March and was finished at the end of August. The new secondary spectrometer will be installed during the long shut-down in 1981. The replacement of the old system will entail a number of advantages: the positioning of the secondary spectrometer and of the analysers will be computer controlled. Therefore the time needed for changes of the instrument configuration (wavelength, scattering angles) will be greatly reduced and the reproducibility will be improved. The working conditions at the instrument will be considerably improved due to the increased height of the new analyser cabin. Essential parts such as the analyser crystals (surface area 3,6 m^2 Si 111 crystals), the sample table, the detectors with the holders, the chopper and the lifting and lowering device for the sample cryostat will be maintained. The decision to construct the fast Doppler drive (IN10B) was postponed. It will depend on the experiences with the new backscattering spectrometer IN13 and the scientific program on high resolution spectroscopy in general. Despite the unreliable functioning of the instrument computer (PD P11/40) the scientific programme was carried out without major losses.

IN11 spin-echo spectrometer

(J.B. Hayter, F. Mezei, O. Schärpf and J.P. Varini)

A complete experimental program was carried out successfully in 1980. Instrumental improvements were mainly aimed at increasing the intensity. To this end a new supermirror polarisation analyser with tenfold increased acceptance area (85 × 95 mm^2) has been installed, together with large thinfoil printed circuit Fresnel correction coils (Fig. 1). An optional circular Ni-coated guide may also be installed in the first precession coil. These features allow up to 20-fold counting rate increase for those experiments which can accept the reduced resolution ($\Delta\ 2\Theta \sim 2°$).

A wide variety of systems was studied, including liquid ^{4}He (ILL), liquid crystals (Exeter), spin-glasses (ILL) and a number of colloidal and polymeric systems. The latter make optimal use of the very high resolution of IN11 in the low-Q range ($0.02 < Q < 0.2.Å^{-1}$). Polymers have been studied in solution,

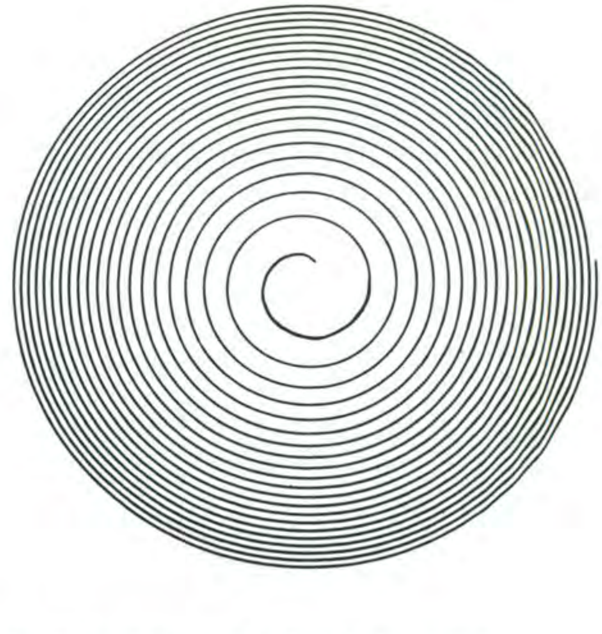


Fig. 1 - An etching mask for Fresnel spiral fabrication.

under both good and Θ-solvent conditions, and in the melt (London/Jülich/Mainz/Strasbourg). Biological materials studied include haemoglobin (Paris) and phycocyanin (London/Edinburgh). A highlight of the year has been the ability to study and interpret data from strongly interacting colloidal systems such as polyelectrolytes (Saclay/Paris), microemulsions (Bristol) and concentrated micellar solutions (ILL/Rutherford). The spin-echo technique is eminently suited to these dynamical studies, which have proved intractable to other scattering techniques (Fig. 2) shows typical energy width **vs** Q^2 data for a concentrated micellar system, where the effective diffusion at low Q is greatly enhanced by the osmotic compressibility. The ability to measure at finite Q is particularly important in the study of these systems, where the first peak in the structure factor S(Q) lies at about 0.1. $Å^{-1}$ and is completely inaccessible to light-scattering.

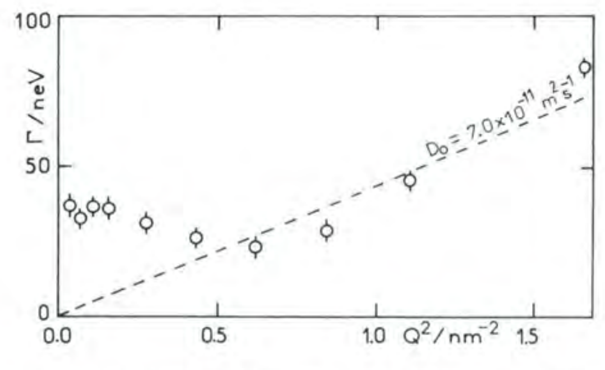


Fig. 2 - Energy width vs Q^2 for a strongly interacting micellar system. Note the energy scale.

IN13 backscattering spectrometer for short wavelengths.

(A. Heidemann, I. Anderson, J.F. Barthelemy)

The monochromator furnace which had been redesigned in collaboration with the sample environment group at the end of 1979 was tested without and with neutrons. It showed the required performance concerning temperature stability, gradients and scan speed. A prototype closed loop cooling circuit was tested for low temperature scans. The monochromator casemate has been rebuilt with a double door system together with a logical command security to allow the furnace to be withdrawn from the casemate for repairs during a reactor cycle. The secondary spectrometer consisting of a disc chopper running in vacuum, a sample table, five analysers, a detector bank and a Helium tight shielding, were installed at the site in September. First tests demonstrated that the specifications are fulfilled. At the end of 1980 background and resolution measurements have started. The instrument software is almost finished. A link between the PDP11/34 and the PDP10 was established. Programs for data treatment are in progress. Test experiments are planned for the first three months in 1981.

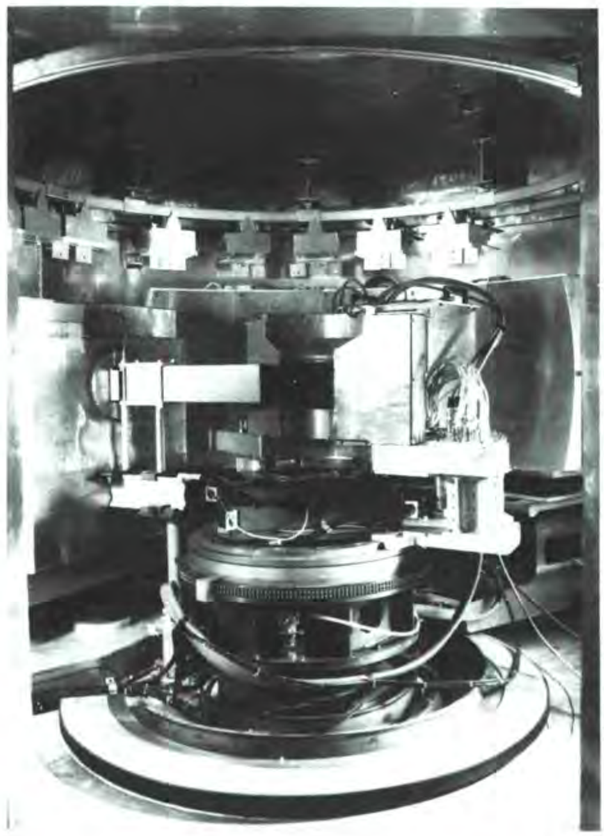


Photo H. : (Alsthom Atlantique)

An inside view of the new Backscattering Spectrometer IN13 under construction.

D7 diffuse scattering spectrometer

(W. Just, O. Schärpf, R. Rebesco)

The study of the new monochromator has been completed and its construction commenced. It is a prototype allowing both horizontal and vertical focussing with the possibility of continuously varying the radius of curvature. The assembly will be put into operation during the long reactor shut-down in 1981. Plans to install the supermirror polariser this year had to be postponed until January 1981 due to the experimental program on D7. On this occasion the spin analyser facility with supermirror will also be tested. The rest of the plans for the modernisation of D7 progressed to the point where final decisions on the future shape of the instrument can be taken. They include the setting up of 32 additional detectors, new detector supports also allowing vertical movement and a high field superconducting magnet.

Photo O. : (Alsthom Atlantique)

Polariser using curved supermirrors superimposed on an antireflecting layer on very thin glasses (< 0.1. mm) (super-bender).

D11 small angle and diffuse scattering spectrometer

(P. Timmins, R. May, R. Oberthür, Z.G. LI, P. Joubert-Bousson)

Two important modifications to D11 have taken place during 1980 both substantially improving the reliability and efficient use of the instrument. The new multidetector with its improved electronics was finally installed in July. The vacuum is made only in the volume before the detector thus decreasing substantially the time required for pumping when changing detector position. The automatically controlled beamstop is to be redefined and will become available in the coming year. An automatic position encoded sample changer has been constructed and can be installed on demand in positions B and C. The changer can be thermostatically controlled in the range 0-40 °C and can take up to 10 samples. A wide variety of sample holders may be accommodated. The changer is controlled by the computer enabling spectra to be measured in a sequence defined by the user and recycled if necessary.

D16 four-circle MK6 diffractometer

(G. Zaccai, S.A. Wilson, D. Worcester, J.M. Reynal)

This has been the last year in which D16 has operated in its original configuration. The new computers have been delivered as well as parts of the new shielding and mechanics. The area detector will be ready at the end of 1980. D16 will not be scheduled for 1981, to allow a suitable series of test experiments to be carried out. The new system has been designed with the following types of experiment in mind.

1) Large-spacing powder work (eg. membranes, fibres, clays, etc. ; these experiments should be done at least ten times more efficiently than at the present time).

2) Small angle scattering in the Q range $\gtrsim$ 0.1 Å^{-1} (the area detector and low background levels expected will allow experiments in this area, which overlaps with D17 and D11).

3) The study of satellite reflections and super lattices.

4) Low resolution single crystal diffraction from very large unit cells (eg. virus crystals, unit cell dimensions ~ 300 Å to resolutions of 20 Å).

D17 low-q high resolution spectrometer

(M. Roth, A. Lewit-Bentley, G. Bentley, M. Cruz)

The main effort, in 1980, in the development of D17 has been invested into the improvement of the machine for diffraction experiments i.e. for low resolution crystallography of biological macromolecules:

- a new collimator has been set up allowing an enhancement of the primary beam intensity on the sample by a factor of 2 to 3,
- the distance between sample and detector can now be set at 80 cm. This distance is, from now on, the standard distance for most of the diffraction experiments but this detector setting can also be used for conventional small angle scattering experiments.

The resolution in real space (ie. the smallest and the largest d-spacings measurable at a time without moving the detector) is about 16 Å - 300 Å in this setting.

An important effort was also spent for the development of calculations with the resolution function of the apparatus in order to improve the accuracy of the reflection integration and the background correction. The results obtained with the new programs are very good but the computing time of these programs has still to be reduced.

Concerning the ordinary small angle scattering experiments, it should be mentioned that the automatic sample changer can now be used on a routine basis with controlled temperature and atmosphere, and that the D11 programs for data treatment have been implemented (R. Ghosh) in addition to the existing D17 programs).

Finally some experiments with polarised neutrons have been done. The setting of D17 for this kind of experiment is not yet standard but it would be developed in this way if the future demand is large enough.

Co-ordinators :
A. HEIDEMANN
F. DOUCHIN

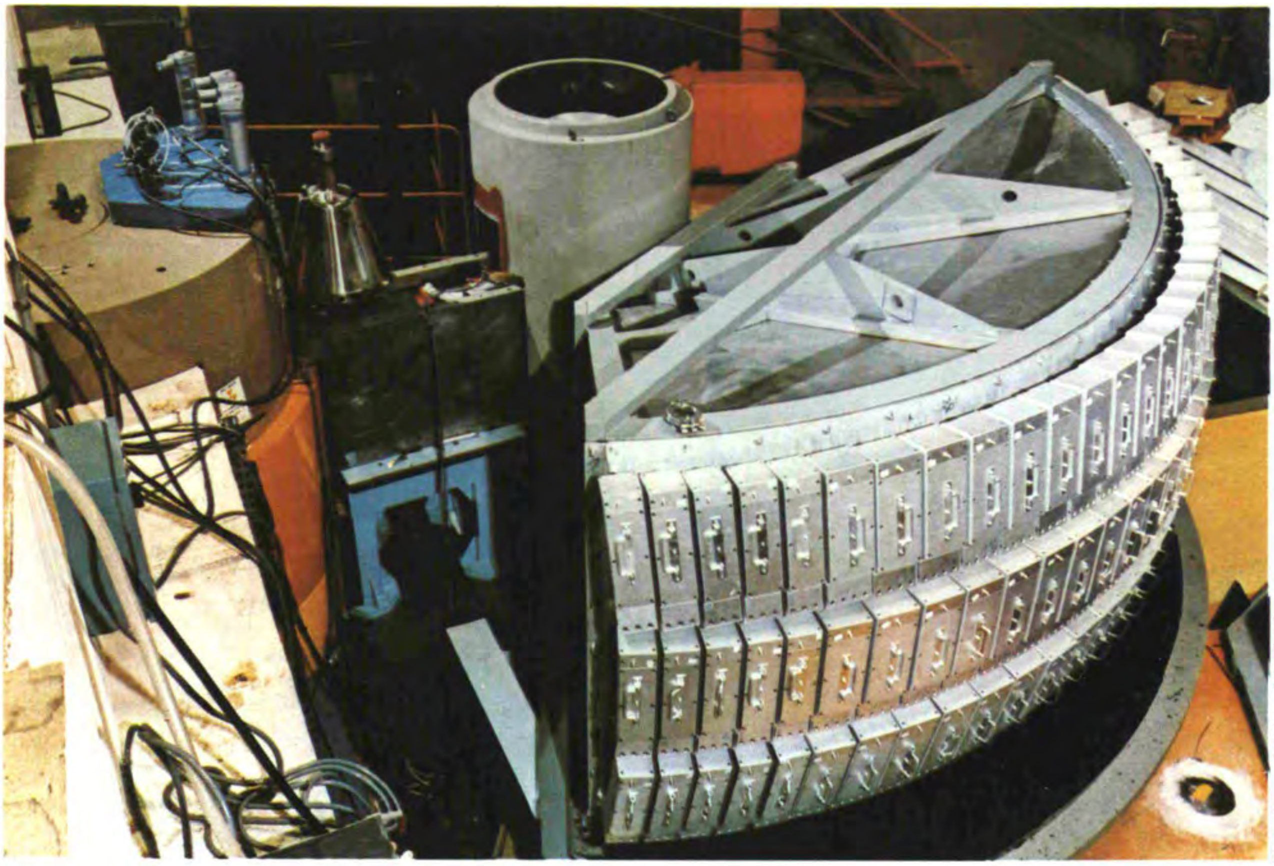


Photo F. : (Alsthom Atlantique)

Overall view of IN6 before installation of the shielding. The detector boxes can be seen on the right of the picture at the end of the 2.5 m, Helium filled flight path. They cover a range of scattering angles from 10 to 115° in the horizontal and ± 15° in the vertical plane, equivalent to a useful detector area of 3 m².

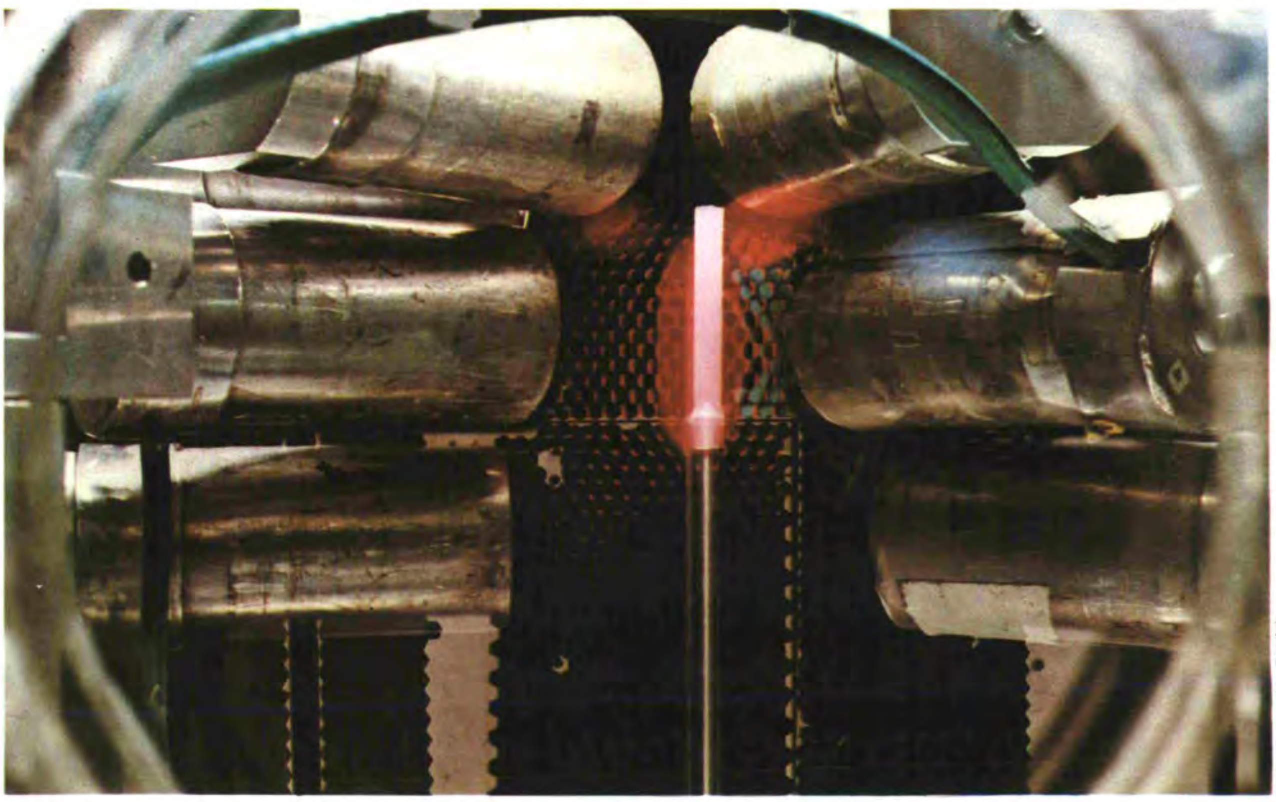


Photo S. : (A. Fradin)

A view through the window of the IN10 backscattering spectrometer. In the foreground are the BF_3 detectors, the analyser array is seen in the background.

INSTRUMENT GROUP DIFFRACTION INSTRUMENTS

D1A	:	High resolution powder diffractometer on thermal guide H22.
D1B	:	Two-axis diffractometer with multidetector on thermal guide H22.
D2	:	High flux 2-axis diffractometer with multidetector on thermal beam H11.
D3	:	Two-axis polarized neutron diffractometer with lifting counter on thermal beam H5.
D4	:	Liquids diffractometer on hot beam H8.
D5	:	Three-axis polarisation analysis spectrometer on hot beam H4.
D8	:	High flux four circle diffractometer on thermal beam H11.
D9	:	Four circle diffractometer on hot beam H3
D10	:	Four circle three-axis spectrometer on thermal guide H24 (neutron spin echo option).
D12	:	Neutron cameras on thermal guide H23.
D15	:	Four circle Mk6 diffractometer on inclined thermal beam IH4.
D18	:	Neutron interferometer on neutron guide H25.
D19	:	2D multidetector for tests on thermal guide H24.
L14/5/7	:	X-ray laboratories.

Introduction

The installation of individual computers for the instruments, which took place during 1978 and 1979, is now completed, and during 1980 many developments were made which used the new possibilities for computer-instrument interactions. This has resulted in much easier ways of handling the data, for example using interactive graphic treatment, and has also facilitated experimental work for example by the introduction of automatic temperature control.

Area detectors are becoming an increasingly important part of the diffraction equipment. In 1980 D2 was equipped with a small area detector and the first part of the large area detector D19 was commissioned and is now in test operation as a single reflection diffractometer. This, together with observations done by the multicounters on D4 and D1B, is rapidly increasing the experience in dealing with a larger amount of diffraction data from liquids, powders and single crystals.

The "H11 project", which contains a single crystal area detector D19, a multicounter D20 for high flux work on powders and liquids and a pluridetector D2B for high resolution work on powders, all placed at beam port H11 is now being worked out in detail. The plan is to install D19 during the long shut-down in 1982 followed as rapidly as possible by D2B and D20. This will temporarily stop the single crystal diffractometer at H11 (D8) and might give a somewhat longer down-time for the powder instrument. Provisions are presently being worked out to reduce these periods. Discussions on the rearrangement and rebuilding of D3 and D5 are still in progress, and an improved version of D12, which is currently not being scheduled, has been designed.

Throughout the year the group has been helped by all the technical services of the ILL, which all, as usual, have put in a very large and enthusiastic effort, for which the group is very grateful.

D1A high resolution powder diffractometer

(A.W. Hewat, A. Wright, S. Heathman)

D1A has continued to perform a large number of approved experiments, the average time allocation having dropped to 3.3 days. Some problems with the ancient Carine electronics were experienced at the end of 1979 and beginning of 1980, but the system has performed well since then. A major technical innovation has been the installation of a digital to analogue converter to allow computer control at the temperature. The control programs also allow the wavelength to be changed automatically between scans. These features are of great interest for the study of phase transitions, which continues to be the largest single application of D1A. In some cases, diffraction patterns suitable for profile refinement can be obtained in 1 to 2 hours, so that the temperature evolution of a structure can be followed in detail. Programs have been implemented to collect and display the data, and a new operators manual has been produced.

D1B two-axis diffractometer with multidetector

(P. Convert (until Nov.), J. Pannetier (from Nov.), H. Haesslin (from Feb.), A. Dorn (from Aug.)

The new D1B system of control and data acquisition, using completely new electronic modules and a solar 16/40, became operational in September, and now works very well. This has brought several improvements. The sample table rotation is under automatic computer control, and the same applies to a chi rotation, which can be added to the goniometer. The data are stored on removable disks and can be inspected using a 4010 Textronix display terminal (with hardcopy unit), which allows for some initial calculations on the data. Data are automatically transferred to the DEC 10 giving nearly instant access to a more sophisticated analysis, so that the experimentalist can improve on the measurement approach. The format of the data is compatible with the former Carine format, which has facilitated the change of instrument computer. The motor control unit for the monochromator has been entirely rebuilt, facilitating considerably the wavelength change, and a dedicated crane has been installed for manipulation of heavy objects. A chimney-furnace using a regulated gas-flow has been constructed and used successfully on many occasions. The temperature range is room temperature to 200 °C with stability of ± 1° and a gradient of 2° over a 5 cm sample. A furnace going up to 1600 °C adapted for multidetector geometry is being constructed, as well as a cryostat with vanadium tail similar to the one found on D2. Finally a focussing Ge(111) monochromator is presently being made by the ILL monochromator group, and it should be ready in the spring of 1981.

D2 high flux two-axis diffractometer with multidetector

(G. Bomchil, C. Marti (until Oct.), P. George)

A new 64 cell multidetector and independent RT11 computer is already in operation, replacing the 4 single counters classical diffractometer. The detector is a linear multidetector filled with He^3 at 10 bars and contains a system of multielectrodes separated by a distance of 2.54 mm. The detector covers an angular region of 12.8° with angular separation fo 0.2° between detector wires. The dispersion of the cell's efficiency is ± 5 %, and the stability of each cell is better than 0.5 % over several days which allows for counting rate corrections using vanadium calibrations. Due to its proximity to the reactor, a special shielding has been made which reduces the background level to low values. The angular measuring zone can be selected at will and is computer-controlled between 2 and 120°. The resolution is equivalent to the old D2 for sample diameters up to Ø = 8 mm. The line shape can be defined with good precision by registering the same diagramme several times at steps of 0.05°. The gain of counting time compared to the old D2 varies between a factor of 5 for most experiments to a factor of 12 for special experiments in limited angular region. This opens up many new applications within electro-chemistry, surface studies and analysis of the kinetics of a reacting system. This work is helped by analysis programs available at the instrument computer and facilitated by use of a Textronix terminal for visual inspection and interactions.

D3 two-axis polarized neutron diffractometer with tilting detector

(F. Tasset, S. Burke, K. Ben-Saidane)

The Mark VI diffractometer and the associated 4.6 Tesla cryomagnet have continued to operate extremely well under the very high load of measurements. The replacement of the old (non-supported) software by a new RT11 based Fortran language application program is well advanced with no disruptions in the experimental program. Much attention has been paid to ensuring that the effectiveness of the user's command in the old system is kept, at the same time taking advantage of the facilities offered by a modern computer system.

The main concern is now with the mechanics of the polarizing monochromator, which no longer allows a variation of the tilt angle. Plans have been made in collaboration with the design and project group for moving D3 to the D5 (H4) drum, where it would receive an ideally suited hot neutron beam with variable wavelength in the range 0.4 - 0.8 Å, but a final decision remains to be taken as this involves the future of D5 as well as the plans for a new horizontal cold source.

D4 two-axis liquids diffractometer

(P. Chieux, S. Cummings, A. Hawes)

The MICRO 1 computer is now fully operating on D4. New data analysis programs have been implemented. This combined with the use of a graph plotter allows an almost immediate display of the spectra. Except for possible computer failure, the multidetector operation on D4 is now as easy as with a conventional single detector, and a direct interaction with the experiment is again possible. The new 64-cell detector should be delivered and tested on

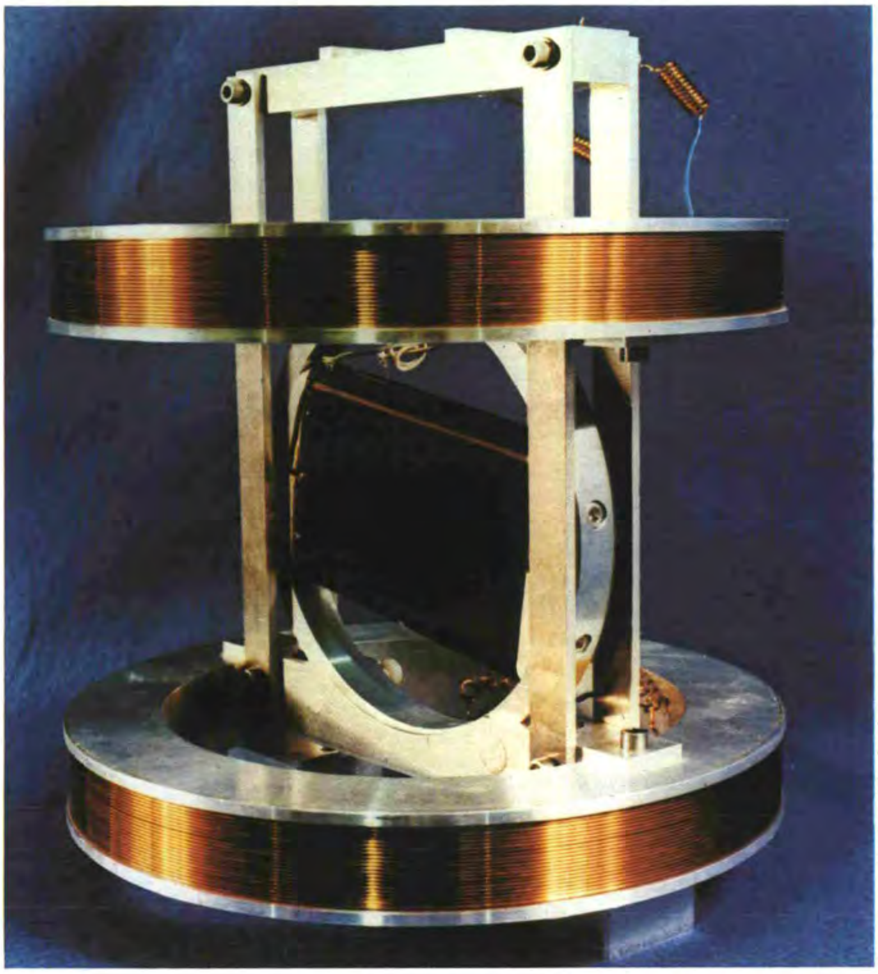


Photo R. : (Alsthom Atlantique)

One of the spin-flipper coils used on the spin-echo set-up of D10.

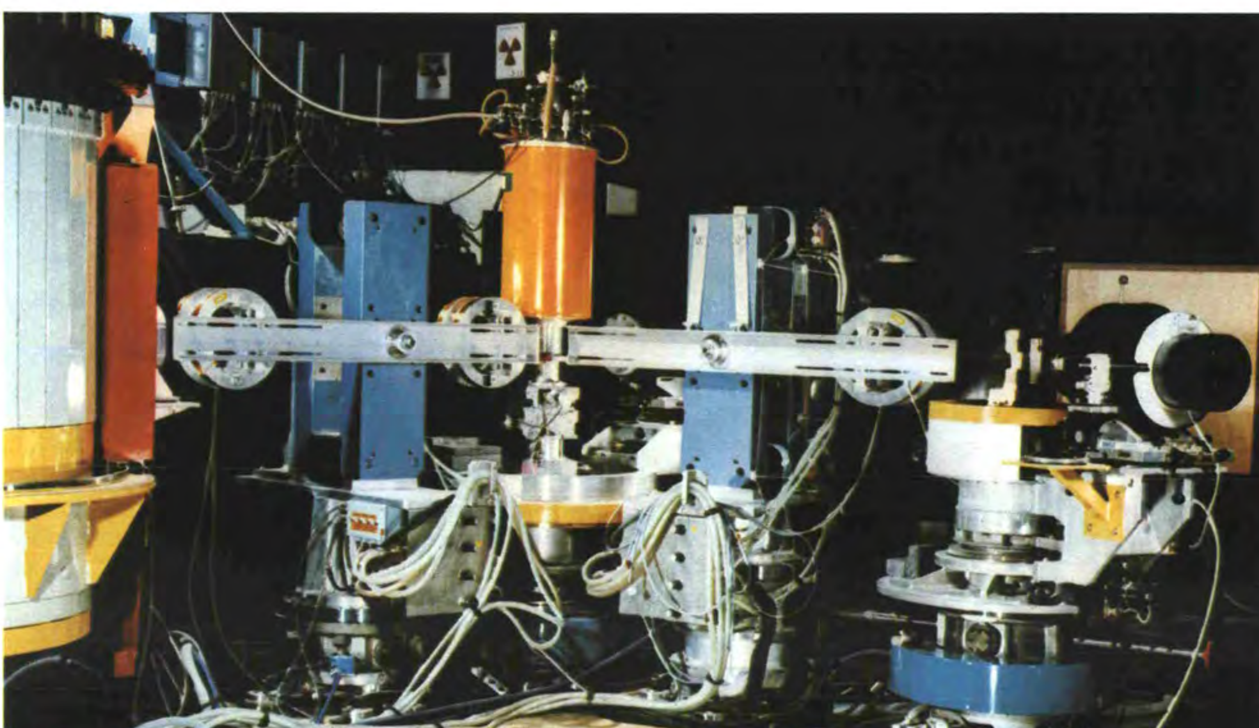


Photo J. : (A. Fradin)

The diffractometer D10 with the present neutron spin echo option. The precession magnets can clearly be seen on either side of the specimen position, the circular coils being the field correction coils around the flipper units.

D4 before the instrument is dismounted for reconstruction.

D5 three-axis polarisation analysis spectrometer

(K.R.A. Ziebeck, J. Schweizer, A. Perkins)

The time requested for polarisation analysis experiments once again exceeded the time available by a factor 3. Therefore the spectrometer was operated in this mode for approximately 80 % of the time. Improvements to the spectrometer were confined to guide fields, flipper and ancillary equipment. A new optic bench has been mounted before the sample position. The new bench supports the guide field and the new cryoflipper. The cryoflipper is of the same design as that successfully installed on D3, but on D5 a displex is used to cool the superconducting foils. A furnace for polarisation analysis experiments is currently available for temperatures between 20 - 1000 °C and a variable temperature cryostat is ordered.

The PDP 11/34 which arrived earlier in the year will be installed after the long shut-down in 1981. The programs will be compatible with the D3 package.

The high demand for polarisation analysis and the unsuitability of the current D5 location on a hot source has prompted the instrument subcommittee to strongly recommend an interchange of beam holes for D5 and D3. If the recommendation of the subcommittee is acceded to, the new D5 spectrometer will be rebuilt and in service during 1982 but the old D5 will continue until the new spectrometer is available.

D8 high flux four circle diffractometer

(S. Mason, J. Pannetier (until Nov.), J. Allibon, J. Archer (from Oct.)

D8 continued to function well, and direct transfer of data to the central computer has become routine. We expect the next major improvement to involve interaction between the experiment and the structure refinement (e.g. detection of errors in measurement, optimisation of statistics) when adequate central computer facilities are installed during 1981.

1981 will be D8's last year of operation in its present form. It will be replaced by D19 on a completely re-designed H11 beam position. For the new instrument there will no longer be interference from the D2 replacement; and for the first time high-resolution measurements will be possible. As well the $4^\circ \times 64^\circ$ area detector will mean an dramatic increase in the number and quality of diffraction data recorded.

D9 four circle diffractometer with short wavelength

(M.S. Lehmann, R. Feld, J. Allibon, J. Archer (from Oct.)

The instrument has continued to function extremely well under the new PDP 11/34 instrument computer. It was feared that the combination of the PDP 11/34 with the old electronics would cause problems, but this fear seems to have been unfounded. A study of new electronics for the motor unit is being done, and a decision on a replacement should be taken soon.

The central effort has been on improving the software and on development of environment control. A technique has been developed for cold transfer of the sample into the four-circle displex cryostat, and a sample has been transferred at a temperature not exceeding 120 K. High-pressure single-crystal work has been done at a pressure of 25 kbar in collaboration with a group from the University of Marburg, and towards the end of the year the diffractometer was temporarily converted into a double-monochromator instrument in order to reduce background from fast neutrons. This should allow for absolute measurements of structure factors of simple systems, and if the results of the first measurements are satisfactory a double monochromator system will be made a standard option.

D10 high resolution four circle three-axis spectrometer

(C. Zeyen, N. Lehner, R. Chagnon)

The name D10 now covers both D10A and D10B, since with the reconstruction of the instrument the double and triple-axis modes are available simultaneously. The instrument has given very satisfactory service to a somewhat reduced number of users because of the NSE tests (see below). This was to some extent compensated by the fact that the recent rebuild together with the dedicated PDP11 computer have improved the efficiency of the spectrometer very significantly.

D10/NSE: D10 with neutron spin-echo (NSE) option

(C. Zeyen, R. Chagnon)

The test of the various components of the NSE option and their computer control have been completed early this year. Altogether 40 beam days out of a total of 132 were used in connection with NSE. The first NSE signal was obtained at Easter and during August a few experiments described at the beginning of this volume could be performed. A number of practical improvements will have to be developed in early 81 before the first NSE triple axis spectrometer becomes available to the ILL users community.

D12 neutron film cameras

(A. Wright, S. Heathman)

D12A has been made easier to use as a result of increasing the film cassette diameter to 114.6 mm, and modifying the beam stop support, thus giving extra space at the sample position for increased orientation of the cryostat, and larger diameter cryostat tails. An improved radial collimator with Gd0 coated steel blades has been incorporated. New designs for the replacement of D12A and B have been drawn up based on experience with the existing prototype machines. These designs are being reviewed and costed, and construction of a replacement for D12A will begin early in 1981, with D12B to follow at a later date.

D15 four circle MK6 diffractometer

(W.J. Fitzgerald (until Aug.), G. Lander (from Nov.), S.A. Wilson, J.M. Reynal)

The D15 program has continued steadily, using the Displex Refrigerator, cryostats, pressure cells at room and low temperature, and the ILL furnace up to 1400 °C. Tests were carried out using the D3 cryomagnet, showing the feasibility of using this when it is available.

Toward the end of the year the controlling PDP 8 began to suffer a series of breakdowns, but the replacement PDP 11/34 has arrived. It may well be installed earlier than was originally scheduled, if only with a temporary system initially. When the new system is in full running order it will be possible to consider further hardware improvements, such as computer monitoring and control of temperature.

For the future, a number of experiments have indicated how useful a small area detector would be, to search for and study satellite reflections, for example.

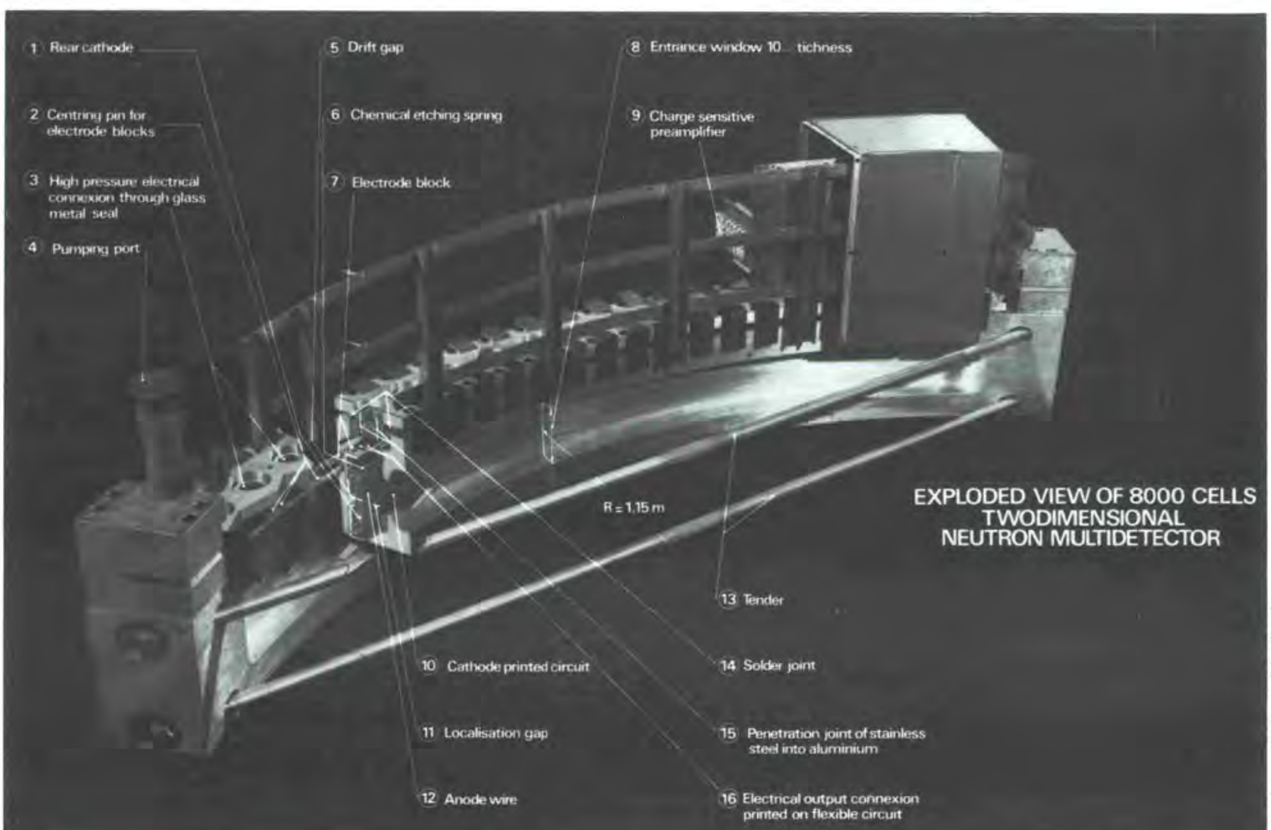
D18 neutron interferometer

(M. Schlenker (until Oct.), U. Kischko, G. Schmidt)

The MICRO-1 (RT11-system) and most of the electronics were installed and tested so that D18 could be used for a large variety of different experiments: neutron phase contrast, imagery using photographic detection, neutron optics and scattering length determination of gases, liquids, elements and isotopes.

Data output to cassette tape or to disk is possible; for plotting, the transfer to PDP 10 is necessary. Computer programs have been written for complete treatment of scattering length measurements, and software is presently also being developed for other purposes.

The third axis introduced for precise wavelength determination is now operational, and has been added as a user option.



View of the area detector for instrument D19, which is presently under construction. In the long direction the resolution is 1/8° and there are 512 resolution elements. In the short direction the resolution is 1/4° and there are 16 elements.

D19 2D multidetector test on H24

(M. Thomas, C. Wilkinson (until Sept.), M. Berneron)

The small area detector of 64 × 16 cells has been installed and constitutes together with the monochromator housing and a Eulerian cradle a versatile test bed for the further development of the 2 dimensional detector. Since September data have been collected which allow the groups from London and ILL to test the software for data collection and reduction. Presently it is being investigated how much improvement a fly's eye detector (a high resolution detector observing a single reflection) would give and how the environment control units such as cryostats or quartz capillary tubes affect the background treatment. The full 512 × 16 cell detector wil be delivered in mid-1981 (see table 5).

LI 4/5/7: x-ray laboratories

(P.J. Brown, G. Schmidt)

The facilities continued to function in 1980.

Co-ordinator:
K.R.A. ZIEBECK
(until Sept.)
M.S. LEHMANN
(from Sept.)

Table V

HORIZONTAL

2.	4.	4.	5.	7.	10.	8.	7.	14.	8.	7.	12.	3.	3.	3.
6.	0.	8.	11.	8.	10.	14.	12.	11.	12.	7.	9.	5.	6.	1.
9.	2.	5.	10.	8.	8.	14.	18.	11.	9.	12.	8.	3.	3.	4.
5.	7.	11.	9.	14.	15.	16.	27.	10.	16.	7.	4.	11.	4.	5.
6.	8.	15.	13.	13.	22.	36.	13.	24.	17.	13.	8.	2.	2.	4.
2.	1.	18.	17.	29.	32.	31.	35.	45.	26.	21.	14.	9.	9.	1.
4.	7.	15.	16.	33.	59.	63.	66.	58.	47.	17.	17.	8.	4.	9.
8.	9.	23.	80.	433.	769.	757.	651.	592.	425.	106.	10.	13.	13.	2.
5.	15.	20.	396.	3151.	6934.	6088.	5605.	6000.	4421.	648.	25.	23.	16.	7.
11.	11.	30.	632.	5068.	9478.	8770.	9434.	8821.	5062.	518.	33.	17.	13.	9.
9.	10.	14.	249.	935.	1461.	1612.	2043.	1550.	755.	84.	24.	15.	4.	12.
5.	12.	16.	29.	54.	97.	126.	146.	84.	48.	24.	16.	15.	2.	6.
3.	5.	10.	20.	23.	39.	33.	34.	35.	19.	19.	17.	11.	9.	7.
10.	11.	12.	17.	16.	21.	33.	25.	26.	17.	7.	14.	8.	7.	5.
6.	3.	5.	5.	14.	14.	16.	18.	23.	16.	8.	8.	8.	10.	5.
1.	4.	6.	13.	13.	12.	13.	14.	9.	19.	13.	15.	6.	3.	0.
4.	3.	5.	7.	9.	10.	10.	14.	10.	10.	11.	6.	4.	5.	2.
2.	6.	12.	6.	10.	5.	9.	12.	12.	5.	10.	4.	6.	0.	3.
4.	4.	7.	5.	10.	17.	4.	7.	5.	6.	8.	6.	3.	2.	4.
7.	7.	1.	7.	5.	6.	5.	11.	4.	6.	6.	5.	3.	6.	2.
4.	6.	7.	8.	6.	5.	7.	5.	5.	7.	3.	5.	1.	2.	2.
1.	4.	4.	3.	2.	3.	3.	6.	2.	VERTICAL .		---------->		6.	9.
3.	3.	3.	7.	4.	6.	9.	2.	5.	2.	2.	6.	3.	5.	5.

Bragg reflection as observed on the area detector D19 for one fixed position of the crystal counting 100 sec. Horizontal resolution 0.125° corresponding to 2.5 mm, vertical resolution 0.25° corresponding to 5.0 mm on the detector surface. The reflection is recorded using one segment of the total detector, which is presently under construction. The sample is phtalocyanine.

MONOCHROMATOR GROUP

D13A	:	Neutron double-crystal diffractometer on thermal guide H24.
D13C	:	Neutron single crystal orientation and mounting facility on thermal guide H23.
LI2A	:	X-ray double-crystal diffractometer.
LI2B	:	X-ray orientation unit for single crystals.
LI3	:	Gamma-ray diffractometer.

Laboratory for single crystal preparation.

Instruments

D13A

(A. Bœuf, A. Freund, F. Rustichelli)

As usual D13A was used for single crystal diffraction experiments, orientation procedures and in particular for neutron topography. After eight years of operation the electronics had to be replaced by a new system similar to that of D13C (Camac microprocessor).

D13C

(A. Freund, B. Hamelin, R. Hustache)

Many multicrystal monochromator and analyser systems have been assembled on D13C. The size of these systems has further increased, necessitating a reconstruction of the whole orientation facility. A set of programmes for several basic operations and data processing has been developed, permitting a considerable gain in efficiency. Many large single crystal ingots have been characterised with respect to their crystalline perfection by means of neutron topography.

LI3

(A. Freund, B. Hamelin, A. Escoffier, A. Rubio)

Some problems were encountered at the irradiation of the gold source at the CENG. An effort was made to compensate for the corresponding time loss by automation of the instrument. However, an irradiation facility of the source at the ILL high flux reactor would speed up the carrying through of experiments and, therefore, the monochromator production. 3000 CaF_2 crystals for the IN13 analysers were tested and in-beam plastic deformations at high temperature of Cu, Ge and Si single crystals were carried out for routine monochromator production. Several experiments were accepted and performed independently of monochromator activities, e.g. on phase transitions and crystal perfection.

Single Crystal Laboratory

(A. Freund, B. Hamelin, R. Hustache)

Most of the cutting, grinding and polishing work on monochromator crystals was carried out on the machines in this laboratory (spark erosion, diamond saw, grinding and polishing facility). A special device has been constructed allowing the orientation of large single crystals on the gamma-diffractometer and to transfer the oriented specimen to the cutting devices.

Basic studies of monochromator and filter materials

Beryllium

The production of Be monochromator crystals has been delayed considerably due to a production stop in the firm usually supplying high purity polycrystalline material. However, feasibility studies of growing Be crystals in a light furnace developed for Spacelab experiments were carried out and gave good results for samples of one cm diameter. An attempt is being made to extend the diameter to several cm (in collaboration with S. Jönsson, Max-Planck-Institut für Metallforschung, Stuttgart).

Heusler alloy polarisers

The development stage of this project has been terminated successfully. Plates as large as 5×8 cm² can be produced routinely with very uniform mosaic spread of 0.3° within the whole sample volume. A 96 % polarisation efficiency has been measured and peak reflectivities vary with wavelength from 50 % at 1.7 Å to 73 % at 4.0 Å. (magnetic case, crystal thickness 0.7 cm). (In collaboration with R. Perrier de la Bathie, CNRS Grenoble.)

Filters based on inelastic scattering

The experiments on Silicon perfect crystals with different purity were terminated (R. Scherm, F. Friedrich, PTB Braunschweig). A general formula has been developed describing with good accuracy the neutron transmission of monocrystalline materials in an energy range from the μeV region to energies of some eV.

Pyrolytic graphite

The efficiency of PG as neutron filter and monochromator was reviewed and complementary experiments were carried out showing that primary extinction cannot be neglected and that inhomogeneities are present also in this material. The development of intercalated PG as large wavelength neutron monochromator and analyser is going on (in collaboration with A. Hamwi, P. Touzain, ENS Electrochimie, Grenoble).

Monochromator production

The assembling of the new vertically focussing Ge monochromator for D1B is under way. A system of three focussing devices similar to the IN6 monochromator but with variable radius of curvature has been constructed for D7. The three axis spectrometer IN12 has been equipped with a new focussing PG monochromator and a Heusler alloy polariser also vertically focussing with variable curvature. A corresponding monochromator is under construction. IN8 received a new Cu (111) monochromator with anisotropic mosaic spread in order to increase the gain factor due to vertical focussing. Ongoing projects are four monochromators and three analysers for IN1B/D4 and a focussing Heusler alloy monochromator/polariser for D10.

General remarks

The increase of both size and complexity of new monochromators and analysers produced a considerable increase of the work in the Monochromator Group. The increase of demands for projects in the modernisation programme will require additional efforts in the next year in order to satisfy them within reasonable time.

Co-ordinator
A. FREUND

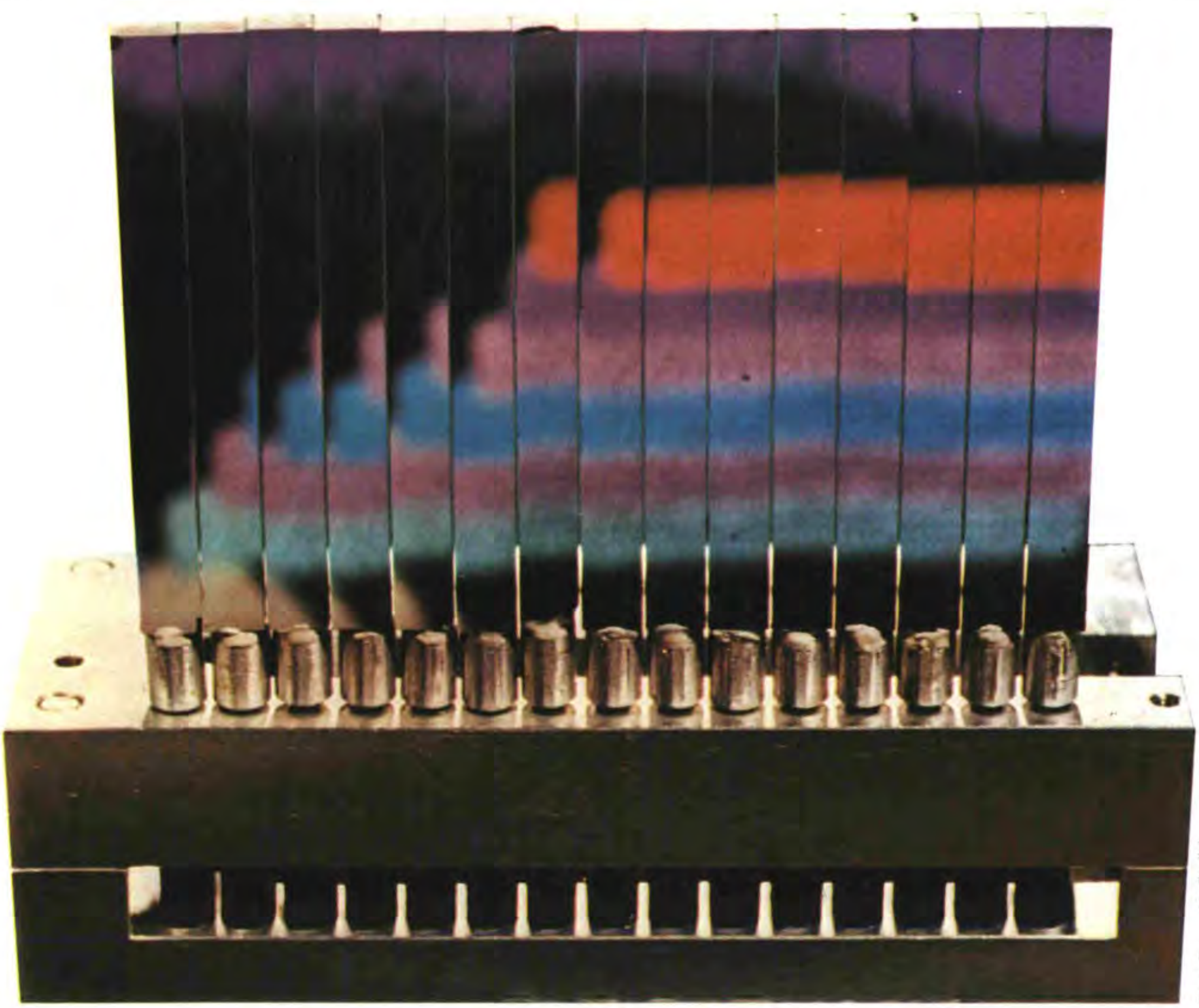


Photo T. : (A. Fradin)

Light reflection from the polished surface of a curved neutron monochromator.

CENTRAL GROUP

As in previous years the group has continued to provide, in direct collaboration with the other Departments of the ILL, routine assistance in the Experimental Halls for the carrying out of the scientific program. This has involved provision of general and special services (water, air, electricity, liquid gases, effluent recovery, etc.), the preparation of hazardous experiments, and the analysis and testing of safety systems on the instruments. In order to improve the design of future shielding, equipment has been assembled to allow measurement of the energy of the neutron background. Further developments and measurements are intended in this area next year.

Neutron and γ measurements have been made and shielding improvements carried out for a number of operating instruments including D11 - IN4 - PN7 - D7 etc., and in collaboration with the "Bureau d'Etudes" and the S.P.R. the protection for several new instruments has been defined: PN8 - IN1B - D4B etc. With the S.C.M. improvements have been made to the beam shutters and their visual displays. The modifications have also been made to improve the security systems on certain instruments, and to install vacuum alarms on the guides.

The A.R.C. clean electrical supply generator is now at the limit of its capacity and no other connections can be made until the Central Computer is connected to a second A.R.C. supply. An automatic restart system designed and constructed by SCIAD is being tested, this will allow less sensitive electronics to be connected to the normal supply, whilst still guaranteeing that the experiment restarts after a power failure.

Apart from the work indicated above, other members of the group have participated in the following special projects.

Multidetectors:

An engineer of the Central Group has been attached to the multidetector group of SCIAD and has assisted with the development and testing of multidetectors for D2 - D19 - D4 and D16. He has also taken part in a study of a detector using a deposit of boron, which may be used for very large two-dimensional multidetectors for cold neutrons.

Monochromators:

— Study and fabrication of a curved monochromator (Fan-type) using 6 pyrolitic graphite monocrystals.

— Modifications to variable curvature analyse for IN3.

— Preliminary study of curved monochromators for D7 - IN8 and D10.

Chemistry:

Construction and test of a ultra-high vacuum system using a turbomolecular pump for adsorption isotherms. Construction of equipment and carrying out of experiments on adsorption isotherms, particularly of H_20 on graphite and papiex using a microbalance.

Supermirrors:

— Development and maintenance of the evaporator S3.

— The fabrication and testing of approx. 300 super-mirrors, particularly for D10 and IN11, involving evaporation of titanium, gadolinium, cobalt, iron and silver on glass substrates of thickness 1 mm to 2 mm.

— Construction of support for variable curvature "Soller-Bender".

New instruments:

Design study and preliminary detailing of new neutron Weissenberg cameras.

Responsible:
D.A. WHEELER

SAMPLE ENVIRONMENT GROUP

Vacuum

Maintenance of the Institut's 410 pumps:

- 550 routine interventions
- 80 major repairs

Commissioning of:

- 14 secondary pumping groups
- 10 Helium pumping tables
- 2 Helium pumping table with Roots pump
- 1 leak detector ASM 10

Cryogenic liquids

Liquid nitrogen

355 916 ℓ (+ 1.7 %) at cost .37 F/ℓ.

Liquid Helium

— Consumption: 45 823 ℓ (− 2.6 %)

— Average cost per litre: 14.78 F (+ 16.4 %) including gas losses

— Gas losses: 76/4 m^3 (i.e. 22 % of consumption), (27 % in 1979).

After a marked decrease in 1979 (− 9 %), the helium consumption is now almost stabilised (− 2 %), due to several factors:

— The replacement of obsolete cryostats having high consumption is nearly completed.

— The increasing use of Displex machines on new experiments has limited the growth of the number of experiments using cryostats.

Cryogenics

The number of experiments requiring low temperatures is slightly increasing (288, i.e. + 10 %), as well as the number of cryostat days (3168, i.e. + 8 %).

Standard Cryostats

The use of ILL designed cryostats is becoming more widespread. A program to introduce 10 cryostats per year is now under way.

Displex Machines

Four new machines have been put into service. Following demand, a new system has been developed to enable rapid sample changes, without stopping the refrigerator.

Very low Temperatures

For temperatures between 20 mK and 1 K, we can now provide users with a full service, including everything from the sample holder design to the operation of the cryogenic system during neutron measurements.

Superconducting magnets

Two magnets are available:

- H = 5 T vertical
- H = 5 T horizontal

A 10 T, vertical H magnet should be delivered in the near future.

Furnaces

— 83 experiments using furnaces (664 furnace days).

— A very high temperature (2500 °C) furnace for neutron work is under construction.

— For temperatures < 400 °C a furnace has been developed. The stability and homogeneity obtained are better than .005 K.

— Special geometry furnaces are being studied for certain instruments.

High pressures

A new 3 kilobar compressor (Nova) has been commissioned and put into service.

Measurement and control

The group assumes responsibility for all electronics associated with measurement and control of temperatures. A project to develop a microprocessor-controlled temperature regulator is under way. These control systems will be able to work either autonomously or under control of an instrument computer thus allowing completely automatic temperature programming.

Responsible:
D. BROCHIER

3

COLLEGES

Introduction

All the internal scientific activity of the Institut is grouped into "colleges" with particular scientific interests.

The following is the current list of colleges:

College 2: Theory

College 3: Fundamental and Nuclear Physics

College 4: Excitations in crystals

College 5: Crystal and magnetic structures

College 6: Liquids, gases and amorphous materials

College 7: Imperfections

College 8: Biochemistry

Collège 9 : chimie

Each College corresponds to a Subcommittee of the Scientific Council of the ILL, which advises the Directors on the scientific programme. New research proposals submitted to the ILL will first be examined by the Colleges with respect to their technical feasibility and then be presented to the Council Subcommittees. A further task of the College is to contribute to a smooth carrying-out of the experiments by appointing local contacts and by advising the instrument responsible as well as the Scientific Secretary on the time schedules for the various instruments. The College Secretaries are normally elected for a 2 year term and have regular meetings with the Directors and Senior Scientists to ensure the flow of information on all matters concerning the scientific activity of the Institut.

Einleitung

Die gesamte wissenschaftliche Tätigkeit des Instituts ist in Kollegien mit spezifischen wissenschaftlichen Interessen aufgeteilt.

Zur Zeit sind folgende Kollegien am Institut tätig :

Kollegium 2 : Theorie

Kollegium 3 : Grundlagen- und Kernphysik

Kollegium 4 : Anregungen in Kristallen

Kollegium 5 : Kristallographische und magnetische Strukturen

Kollegium 6 : Flüssigkeiten, Gase und amorphe Substanzen

Kollegium 7 : Fehlordnungen in Festkörpern

Kollegium 8 : Biochemie

Kollegium 9 : Chemie.

Jedes Kollegium entspricht einem Unterausschuss des Wissenschaftlichen Rates des ILL, der die Direktion für das wissenschaftliche Programm berät. Die Kollegien prüfen als erste dem ILL unterbreitete Vorschläge zu neuen Forschungsvorhaben im Hinblick auf ihre technische Realisierbarkeit. Daraufhin werden sie den Unterausschüssen vorgelegt. Eine weitere Aufgabe der Kollegien ist es, zu einem reibungslosen Ablauf der Experimente beizutragen : Sie stellen den Gastforschern wissenschaftliche Hilfe vor Ort und beraten den Verantwortlichen der Experimentiereinrichtung und den Wissenschaftlichen Sekretär über die Zeiteinteilung für die Experimente an den verschiedenen Instrumenten. Die Sekretäre der Kollegien werden normalerweise für 2 Jahre gewählt, und halten mit der Direktion und den "Senior Scientists" regelmässig Sitzungen ab, um den notwendigen und alle wissenschaftlichen Tätigkeiten des ILL betreffenden Informationsfluss zu gewährleisten.

Introduction

L'ensemble de l'activité scientifique de l'Institut est réparti en collèges avec des intérêts scientifiques spécifiques.

La liste actuelle des collèges se compose comme suit :

Collège 2 : théorie

Collège 3 : physique fondamentale et nucléaire

Collège 4 : excitations dans les cristaux

Collège 5 : structures cristallographiques et magnétiques

Collège 6 : liquides, gaz et substances amorphes

Collège 7 : imperfections

Collège 8 : biochimie

Collège % : chimie

Chaque collège correspond à un souscomité du Conseil Scientifique de l'ILL, qui conseille la Direction en matière de programmes scientifiques. Les collèges examinent d'abord la faisabilité technique des propositions de recherche soumises à l'ILL. Elles sont ensuite présentées aux sous-comités du Conseil Scientifique. Les collèges contribuent également au bon déroulement des expériences en proposant des collaborateurs locaux aux chercheurs invités, et en conseillant le responsable d'instrument ainsi que le Secrétariat Scientifique de la répartition du temps d'expérience sur les différents instruments. Les Secrétaires de Collège sont normalement élus pour 2 ans et se réunissent régulièrement avec la Direction et les "Senior Scientists" dans le but d'assurer une bonne circulation de l'information dans tous les domaines d'activité scientifique de l'Institut.

COLLEGE 2
THEORY

Membership 1980

I. ILL. members
- P. Nozières
- F.D.M. Haldane
- P. Quentin*
- V. Vieira
- C. Aslangul (jan.-sept.)/T. Burkhardt (oct.-)
- D. Saint-James (jan.-sept.)/H. Capellmann (sept.-)
- B. Jancovici (jan.-sept.)/K. Fischer (sept.)
- K. Maki (jan.-mar.)/A. Hewson (apr.-sept.)/ J.-P. Hansen (oct.-)
- J. Loveluck (jan.-sept.)
- P. Ring* (jan.-sept.)
- P. Schuck* (jan.-nov.)
- R. Stinchcombe (jan.)/T. Lukes (apr.)

* Nuclear theorist

II. Thesis students:
- C. Comte
- J. Bartel*
- A. Alastuey (jan.-sept.)

III. Long term visitors:
- A. Griffin (oct.-) (Canada-France exchange fellow)
- P. Schuck* (nov.-) (Heisenberg fellow)

IV. Short term visitors:
- E. Balcar (2 wks)
- U. Krey (6 wks)
- H. Lustfeld (2 wks)
- P. Schofield (2 wks)
- H. Schuster (6 wks)

General summary

As can be seen above, the year 1980 saw a large change in the composition of the theory group, with only three (Haldane, Quentin, Vieira) of the eleven regular positions attached to the college unchanged, in addition to P. Nozières. However, one former member, P. Schuck, stays on as a long-term visitor on a Heisenberg fellowship. The year's end sees four of the theorists' positions temporarily unfilled. The new arrivals who started in October have been settling in and are establishing contacts with experimental colleges relevant to their interests, and it is hoped that their full integration into the scientific life of the ILL will lead to fruitful interactions. Particular interests of new members relevant to experimental work at the Institute include liquids, in particular ionic ones (Hansen), excitation dynamics in ^4He (Griffin), itinerant ferromagnetism near the Curie temperature (Capellmann), spin glasses (Fischer), and phase transitions in two-dimensional structures such as adsorbed monolayers (Griffin, Burkhardt). P. Schuck was college secretary for the first half of the year, but was succeeded in June by D. Haldane.

Scientific activity in 1980.

The research interests of the theory college concentrate in two areas: condensed matter theory, and a subgroup, nuclear theory. Selected topics are listed below. "Low-dimensional" physics was an active topic this year, corresponding to a recent upsurge of experimental and theoretical interest. Active research in magnetism and helium solids and liquids continued. Nozières and Saint-James gave a lecture course on non-linear phenomena for the Grenoble physics community, stimulating them to study fluctuation effects at "bifurcation" instabilities. Schuck and Quentin gave a course on pairing and superfluidity in nuclei. Haldane organised the regular ILL colloquium series for most of the year, being succeded by Fischer; quite a full and varied program was achieved.

Magnetism

Capellmann and Vieira worked on the "local band theory" picture of itinerant ferromagnetism at finite temperatures, which aims to account for short-range order and exchange splitting which apparently persist at temperatures above the Curie temperature. They aim to calculate the dynamic susceptibility above T_c from first principles, and account for observed spin wave modes in Iron in this range of temperature. Fischer worked on excitations in spin glasses and dilute ferromagnets, and the Kondo effect in spin glasses. Vieira applied a new representation of spin operators he has developed to renormalisation group treatments of the Kondo and Kondo lattice problems.

Liquid and solid helium

Nozières and Saint-James continued the study of the dynamics of the melting process in ^3He, in connection with experiments at Grenoble on spin-polarisation by rapid melting, and also considered melting in ^4He accompanying an acoustic wave. Nozières continued work on the description of liquid ^3He as an "almost solid" (rather than "almost ferromagnetic") Fermi liquid. Griffin brought his work on neutron scattering from thermally excited rotons in ^4He-II above 1K to the ILL. Hansen considered isotopic effects on the high-pressure melting curve of He (and H_2).

"One-dimensional" physics

"Quasi-one-dimensional" materials (weakly coupled chains) are of current interest: those studied at the ILL include the easy-plane spin chain Cs_2NiF_3. Maki and Loveluck carried out related theoretical studies. Maki investigated the contribution of "solitons" (mobile defects in the spin structure) to the dynamics, and discussed the observability of quantum effects using the Sine-Gordon model. Loveluck carried out numerical molecular dynamics simulations of the dynamics of classical Heisenberg chains, and discussed when it was possible to model easy-plane systems like Cs_2NiF_3 by the Sine-Gordon model. Stinchcombe studied scaling behaviour and field dependence of anisotropy crossovers in classical Heisenberg chains, extending and complementing earlier studies by Loveluck and Maki. Haldane developed "Luttinger Liquid Theory", a general theory of the low energy properties of 1-D conductors that replaces Fermi Liquid theory, which is not applicable in 1-D. Surprisingly, it turned into a more general theory of 1-D quantum fluids, including bosons and spin chains (where the "fluid" is magnetisation density): these behave much like fermion systems, as geometry prevents exchange and collision effects from being distinguished. The hitherto obscure properties of certain exactly soluble models have confirmed the theory.

"Two dimensional" physics

Alastuey calculated the melting curve of the 2-D Wigner crystal of electrons trapped on a Helium surface. Griffin calculated S(Q) for monolayers on **finite size** graphite surfaces, showing how the characteristic power-law singularities at Bragg points develop as the 2-D crystal size increases. The explicit results show earlier approximations to have been invalid, and will become important for the analysis of experimental data such as taken at the ILL. Burkhardt studied critical behaviour at free surfaces, and near internal defect planes; renormalisation group calculations for critical exponents showed non-universal behaviour was sometimes possible. Burkhardt also studied the localisation-delocalisation transition in magnetic domain walls.

Other condensed-matter topics

Comte and Nozières continued work on the transition from the electron-hole plasma to the bose-condensate of excitons in multi-valley semiconductors.

Jancovici and Alastuey considered the nearly-classical plasma in a field, and surface currents in diamagnetism.

Aslangul studied excitons in polymers, and photon-exciton coupling.

Hewson worked on the theory of "rotational tunnelling" in molecular crystals, and the interpretation of experiments on this carried out at the ILL. He developed a tractable Green's function scheme for calculating temperature-dependent lineshapes, that interpolates between limiting cases of coupling strength and temperature.

Vieira considered collective effects connected with fluctuating "two-level systems" in metallic glasses.

Hansen studied Coulomb gas problems: the microscopic dynamics of strongly correlated plasmas, and the miscibility of binary ionic mixture at $T = 0$.

Burkhardt worked on statistical mechanics and critical phenomena, in particular the renormalisation group study of the "Potts model".

Griffin studied the effects of substrate electronic fluctuations on chemisorbed hydrogen, while Schuck studied the desorbtion rate of chemisorbed atoms on transition metals.

Nuclear physics

Ring, Schuck, and Quentin continued their study of whether the fission process is adiabatic. A genuinely dynamical time-dependent harmonic oscillator model was studied. Ring and Schuck confirmed the validity of the weak-coupling approach for the low-lying collective states in the lead region. Schuck and Bartel worked on the microscopic derivation of the semiclassical description of nuclear collective motion. The study aimed at providing reliable approximations to substitute for otherwise unfeasible numerical calculations for determining the effective interactions to be used in the calculation of potential energy surfaces for the collective coordinates. Pairing effects were also investigated (Schuck). Quentin studied the spectroscopic properties of certain odd heavy nuclei (including fission isomers) with rotor + quasiparticle approximation, using self-consistently determined single-particle states.

Secretary:
D. HALDANE

COLLEGE 3 FUNDAMENTAL AND NUCLEAR PHYSICS

Members of the college

I. Internal members
Avenier M.
Barreau G.
Blakeway S.
Blönnigen F.
Börner H.G.
Brissot R.
Faust H.R.
Gähler R.
Gönnenwein F.
Hawerkamp K.
Jung G.
Kerr S.
Koglin E.
Mampe W.
Mougey J.
Oed A.
Pannicke J.
Perrin P.E.J.
Pfeiffer B.
Quentin P.
Schrader H.
Schreckenbach K.
Schuck P.
Snelling M.
Vuilleumier J.L.

II. External Members
Blachot J. (CENG)
Caitucoli F. (CENG)
Von Feilitzsch F. (Munich)
Mheemeed M (ISN)
Monnand E. (CENG)
Ristori C. (CENG)
Schussler F. (CENG)
Tokunaga Y. (Jülich)
Vignon B. (ISN)

III. Visiting Members
Alquist L. (Giessen)
Böhm F. (Caltech)
Cavaignac J.F. (ISN)
Crancon J. (CENG)
Engelhardt H.D. (Karlsrube)
Green J. (Havard)
Hart R. (ISN)
Heckel B. (Harvard)
Kane W. (Brookhaven)
Koang D.H. (ISN)
Kwon H. (Caltech)
Liaud P. (Compiègne)
Mössbauer R. (München)
Nifenecker H. (CENG)

General summary

In 1980 the scientific work of College 3 comprised the following subjects:

1) Study of thermal neutron induced fission was carried out on the parabola mass separator LOHENGRIN and on the external beam tubes IN1, H22D and H22E using high resolution ionisation chambers, time-of-flight techniques and surface barrier detectors. These measurements allowed the determination of fission cross sections in different actinides, of gross structures in the energy and mass distributions and of ternary events comprising the mass and energy distribution of light particles accompanying fission. In some actinides the fine structure in the charge and energy distribution was studied and the search of sub-fine structure in the energy distribution in cold fragmentation started. Angular momentum created at the scission point was determined via the measurement of the population probability of long living isomers in spherical and deformed nuclei by means of β and γ ray spectroscopy.

2) The study of nuclear structure near the valley of stability continued at the high resolution devices GAMS 1, 2, 3 for γ-spectroscopy and at the conversion electron spectrometer BILL. Energies, quantum numbers and transition probabilities have been determined in order to fix collective parameters and couplings in different regions of the nuclear chart. Nuclear spectroscopy at the neutron rich edges far from the valley was carried out at OSTIS and LOHENGRIN. On these fission spectrometers also the determination of masses of neutron rich nuclei via Q_β-values continued.

3) Electromagnetic interaction theory was tested at BILL by the measurement of the angular distribution of high energetic photoelectrons and the investigation of their polarization. The study of quantum electrodynamic effects (Delbrück scattering) was continued at GAMS by the use of strong γ-sources.

4) The measurement of parity violation in the weak nucleon-nucleon force in $\vec{n}d$ capture, and spin rotation due to parity violation in the tin isotopes were carried out on the polarized neutron beam at the PN7 site.

5) Fundamental physics problems, experiments involving ν oscillations, search for NN transitions, search for an electric dipole moment of the neutron and the investigation of properties of ultra cold neutrons were carried out at the different beam tubes of the ILL namely PN5, H17 and H18.

6) The final design of COSI FAN TUTTE, a time-of-flight spectrometer complementary to the parabola spectrometer LOHENGRIN has been fixed following the test of time-of-flight devices showing excellent performances.

7) In THEORETICAL PHYSICS studies on the adiabaticity in the fission process were carried out. Furthermore spectroscopic properties of nuclei with

rotor and quasi particle approximation were investigated.

For 1980 a total of 113 proposals were submitted, of which 92 were accepted.

Table 6

In 1980 collaboration of College III with the following institutes and universities are established:

Fission Darmstadt (GSI) Darmstadt (TH) Grenoble (CEN) Grenoble (University) Saclay (CEN) Geel (JRC) Gent Bordeaux Mainz München ISPRA Tübingen Dublin Lyon	**Nuclear Spectroscopy** Köln Belgrade Sussex Glasgow München London Manchester Orsay Giessen Marburg Fribourg Braunschweig Göttingen Buenos Aires (CNGA) Brookhaven Nat. Lab. Grenoble (CEN) Livermore Leningrad Jülich (KFA)
Electromagnetic Interaction Manchester München Göttingen	
EDM-experiment Sussex Harvard Oak Ridge Nat. Lab. Rutherford Lab.	**UCN storage** Lancaster Sussex
Optics with neutrons Berlin Melbourne Wien MIT	**Weak nucleon-nucleon force** Rutherford Lab. Harvard ISPRA Sussex Grenoble (ISN)
Neutrino-oscillations Caltech Grenoble (ISN) München (TU)	**Theoretical Physics** München Lyon Grenoble (CENG) Grenoble (ISN) Orsay (IPN) Orsay (CSNSM) Regensburg
N$\bar{N}$ transitions CERN Padua Rutherford Lab.	

Collaboration of College 3 with institutes and universities.

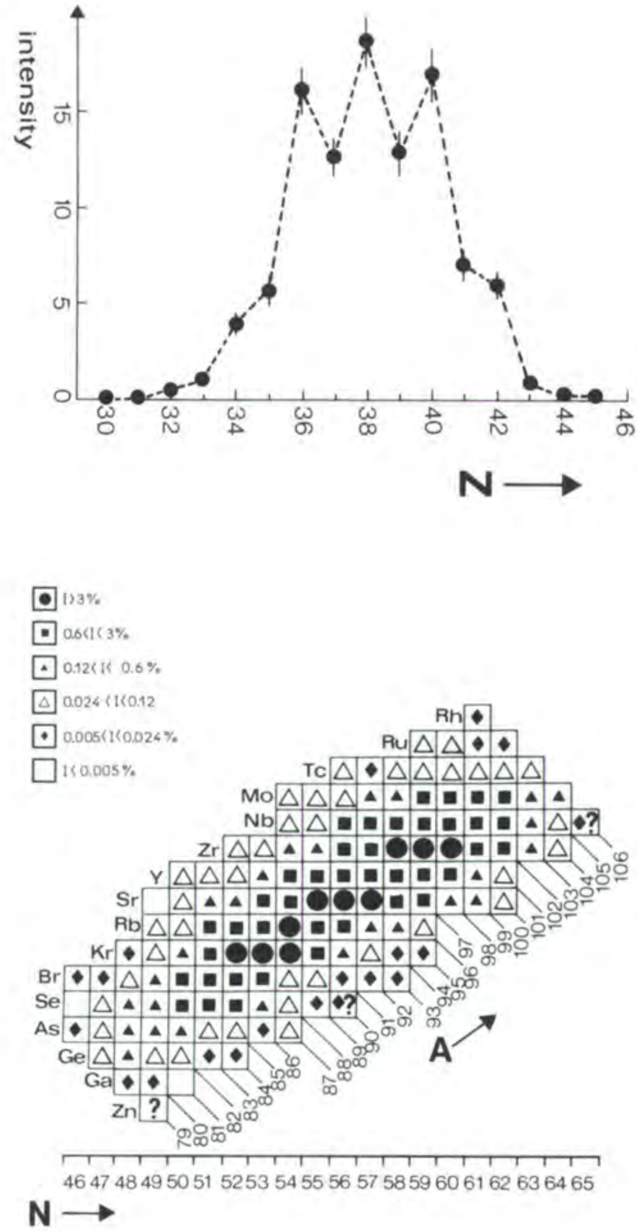


Fig. 3: Fragment yields from thermal neutron induced fission of ^{233}U. The projection on the Z-axis shows the strong proton odd-even effect observed in this nucleus. The data are not yet corrected for short living isomers (Quade et al.).

Scientific trends and highlights in 1980

Thermal neutron induced fission

At LOHENGRIN the mass, charge and energy distribution measurements of fission fragments from ^{235}U and ^{233}U were completed. In these experiments, carried out with newly developed high resolution ionization chambers, a fine structure in the fission process was definitely established in both isotopes. This fine structure manifests itself in a strong odd even effect in the fission product charge and energy distribution and appears to be one of the most spectacular characteristics of low energy fission, whose study has become feasible now (see fig. 3).

Furthermore, events have been found where the kinetic energy of the fragments exhausts the energy available in the fission process. The emission of neutrons becomes then impossible and a radiative fragmentation takes place. The search for a sub-fine structure, where during scission discrete states of the fragments are excited, is underway.

The observation of fine structure in the fission process and the existence of cold fragmentation provide a unique source of information on the dynamics of large amplitude motion in superfluid nuclear matter. It was shown that the coupling of the fission mode to two qp excitations is small. On the other hand the odd even effect tells us that most of the intrinsic energy is going into collective motion during fission.

At LOHENGRIN an approach to the understanding of angular momentum induced in thermal fission consists in the observation of the population probability of isomeric states in fragments. Isomers in ^{130}Sn, ^{100}Mo and ^{99}Y have been investigated. Such measurements provide information on bending modes, on the stiffness of fragments at the scission point and on the change of angular momentum as a function of deformation.

On the H22D beam-tube the thermal neutron induced fission of ^{229}Th was investigated. Furthermore the energy distribution and the absolute yield of light charged particles in ternary fission was measured in different systems. It was found that the energy distribution of the α-particles deviates from the gaussian shape as seen for other light particles. From these measurements information on the pre-scission kinetic energy of the fragments can be obtained.

At the IH1 beam-tube far out asymmetric mass distributions in low energy fission were completed, as well as the measurements of fission fragments energy correlations for sub-barrier fission in ^{241}Am and ^{243}Am.

Nuclear masses

At OSTIS and LOHENGRIN the determination of nuclear masses in neutron rich nuclei was continued. Q_β values for the Rb isotopes up to mass 98 were obtained at OSTIS, Q_β measurements in the vicinity of neutron number 50 were carried out at LOHENGRIN. Studies were started to improve the stability of the high tension stability at LOHENGRIN in such a way as to measure mass differences in the neutron rich region directly.

On the H22D beam-tube systematic studies of (n_{th},α) reactions comprising energy distributions and emission probabilities were performed. In the $^{238}U(n,\alpha)$ reaction precise Q_β-values have been derived. The ^{225}Th mass could be determined to a precision of 6×10^{-5} amu.

These mass determinations do not only complete our knowledge on masses, but they reflect nuclear structure in a direct way and show the onset of deformation and subshell closure.

Nuclear structure

On the conversion electron spectrometer BILL the level structure of the even nuclei ^{198}Pt, ^{188}Os and ^{136}Ba was studied in particular to test predictions of the Interacting Boson Approximation for E0 transitions in regions, where the 0(6) symmetry is expected to be a good approach. At the γ-spectrometer GAMS the above measurements have been extended to ^{131}Ba and ^{133}Ba, where a supersymmetric situation is expected from the Interacting Boson-Fermi-Model. This situation should occur for certain combinations of boson symmetry and particle spin, cases where bosonic and fermionic spectra can be described in the same group theoretical framework.

The predictions of the IBFA were furthermore tested by looking into odd proton isotopes in the Lu-and Ta-region. The special interest for these nuclei lies in the fact that spins up to 21/2 are populated in n-capture. A complete set of high spin members of unique parity bands can be expected. BILL and GAMS were also used to study ^{75}Se and ^{199}Au in the transitional regions to get information on the Coriolis force on particles coupled to a triaxial or β_4 deformed core.

The identification of (n,p)-multiplets in the level schemes of ^{134}Cs and ^{110}Ag were possible by experiments performed at GAMS and BILL. The investigation of the level schemes of ^{250}Bk and ^{232}Pa studied with GAMS gave insight in the (n,p) force and in the systematics of collective and single particle states within the fission barrier.

Nuclear structure of neutron rich nuclei

The study of level schemes of neutron rich nuclei obtained from the fission process was continued at OSTIS and LOHENGRIN. At OSTIS quite complete decay schemes have been obtained in the Y and Sr-region, where the onset of strong deformation was established. In the lower transitional region of the rare earths neutron rich Ba and Ce isotopes have been investigated. At LOHENGRIN the level scheme of ^{131}Sn has been derived and further work in the Zr, Sr, Y and Nb region was performed.

The study of β-delayed neutron emission continued on OSTIS. n-γ coincidences allowed the determination of the β-strengths function for the precursor of ^{95}Rb.

Electromagnetic interaction

At BILL the angular distribution measurements of the photoelectric effect at high energies up to 10 MeV have been completed. The results show at 1.3 MeV the filling in of the central minimum at small angles as predicted by Pratt. Measurements at 6.7 MeV are found to be in agreement with calculations of Hultberg.

Furthermore the investigation of the transversal polarization of photoelectrons at different energies was started in order to have a rather complete set of data to be compared with existing theories.

At BILL s-electron densities at the nuclear site for different In compounds were measured via the outer shell conversion electron intensities of pure M1 transitions. Although Mössbauer isomer shifts indicate large variations in the s-densities from one compound to another, the most extreme s-shell (O_1-shell) intensities didn't vary strongly, indicating that more subshells are involved in chemical binding in In than normally assumed.

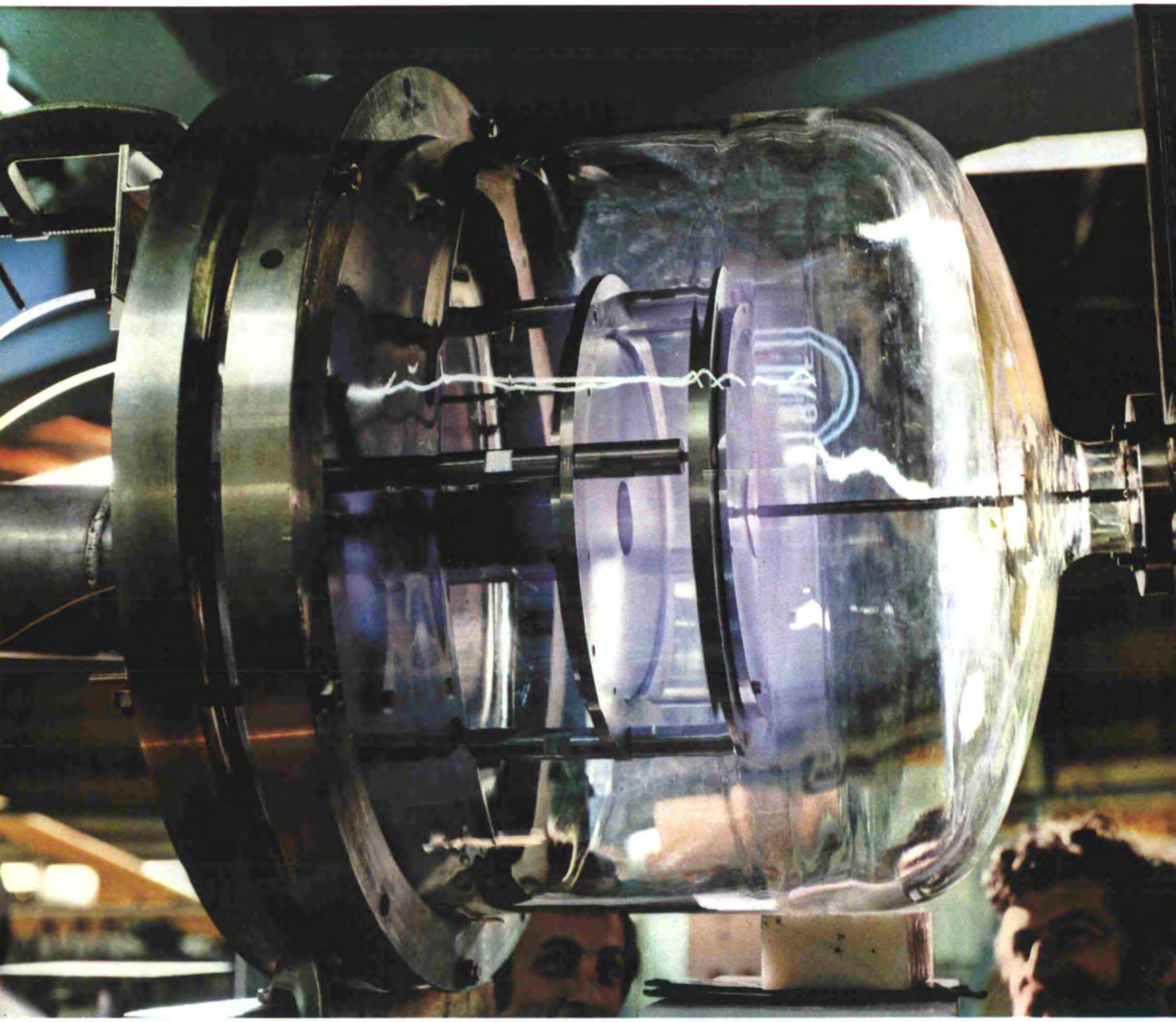


Photo N. : (Alsthom Atlantique)

Ultra cold neutron bottle for the electric dipole moment experiment (Sussex, Rutherford Lab., Harvard University, ILL). The bottle, enclosed in a glass vacuum vessel consists of 2 circular Beryllium electrodes separated by a quartz cylinder. The surface cleaning is ensured by a glow discharge within the neutron storage volume. The access port for neutrons, which is closed after filling procedures, can be seen on the left of the picture.

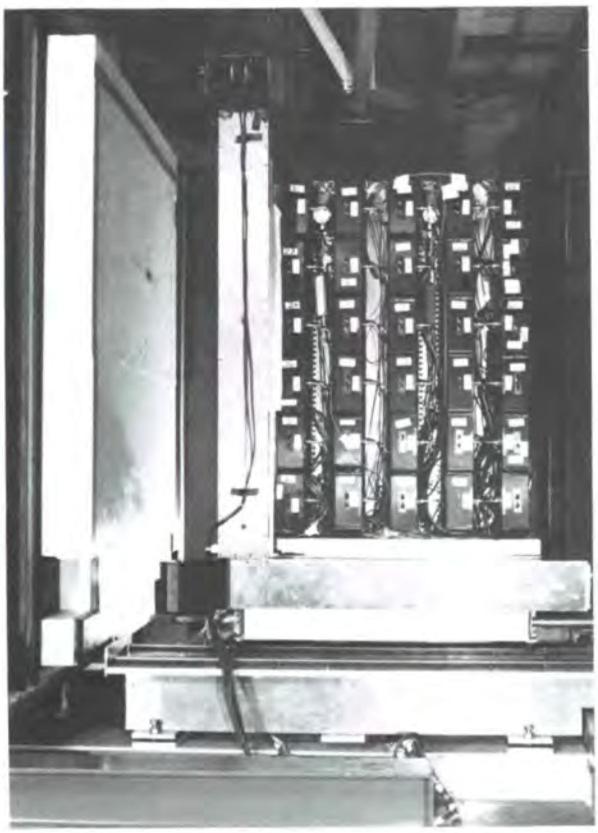
At GAMS the study of Delbrück scattering was continued to verify the need of higher order Coulomb correction terms. For this purpose on several targets elastic differential photon cross section were measured. Anomalies have been found for ^{208}Pb which are, however, attributed to peculiarities of the ^{208}Pb giant dipole resonance.

Parity violation in the weak nucleon-nucleon interaction

At the PN7 site the weak nucleon-nucleon coupling has been investigated using the polarized neutron beam. The $\overleftarrow{n}d$ capture experiment led to an asymmetry being an order of magnitude larger than predicted by theory. Tests of depolarizing effects and an improvement of the statistics is currently under way. The measurement of the coherent parity non conserving neutron spin rotation in the tin isotopes were completed in 1980. The rotation angles for ^{117}Sn, ^{124}Sn and natural Sn were found to be of the order of 10^{-5} to 10^{-6} mrad/cm. A more sensitive neutron polarimeter was constructed to measure the rotation angle in Bi, Pb and Be down to the 10^{-8} rad/cm limit. First tests of the apparatus have been performed.

Search for neutrino-oscillations

The electron antineutrino spectrum has been measured at a 8.75 m position from the "point"-like core of the ILL ^{235}U fission reactor, using the reaction $\bar{\nu}_e + p \rightarrow e + n$. Positrons and neutrons were detected in coincidence by means of a low background liquid scintillator and a ^3He detector system.



The detector for the measurement of neutrino oscillations.

At BILL the β-spectrum from fission products in thermal neutron induced fission was determined in the energy range from 2.0 to 7.5 MeV with an accuracy of better than 5 %. The electron spectrum was converted to the corresponding $\bar{\nu}_e$ spectrum, which was found to be in agreement with the calculated spectrum of Davis and Vogel.

The currently measured spectra are consistent with theoretical predictions assuming no ν oscillations (see fig. 4). Upper limits for oscillation lengths and miwing angles were calculated.

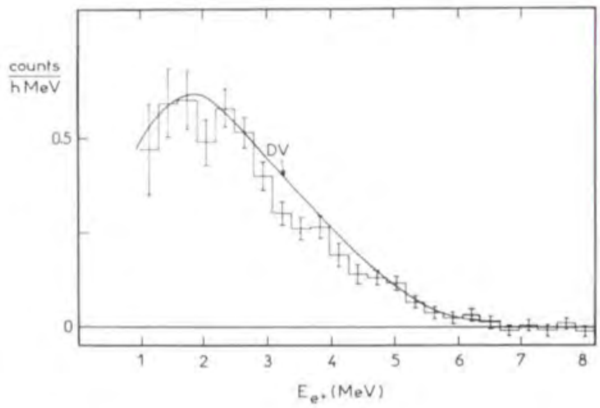


Fig. 4: Antineutrino spectrum measured at a distance of 8.75 m from the reactor core. The smooth solid line shows the calculated Davis-Vogel spectrum which is in agreement with the electron spectrum measured at BILL. Within the error bars the two spectra are identical, indicating the absence of ν oscillations.

Properties of the neutron

On PN5 the programme of studying storage times of neutrons in material bottles has been completed. It was intended to achieve longer confinement times in order to increase the sensitivity of the detection of an electric dipole moment of the neutron. The new EDM experimental set up is expected to become operational before March 1981.

At H17 a storage experiment of ultra cold neutrons has been performed in superfluid helium at 1.2 K. The loss rate has been found to be in agreement with theory at this temperature. Extrapolation to lower temperatures gives reasonable UCN densities for the new liquid helium UCN source, which is now under construction.

At H18 the optical bench for 20 Å neutrons was used to perform several diffraction experiments. From the diffraction pattern of a straight edge lower limits have been found for a certain class of nonlinear terms in the Schrödinger equation. The patterns of a single slit and a double slit assembly were found to be in agreement with standard optical theory (see Fig. 5 and 6). The double slit device was used to perform the Fizeau experiment. Also tests of Fresnel zone plates were continued.

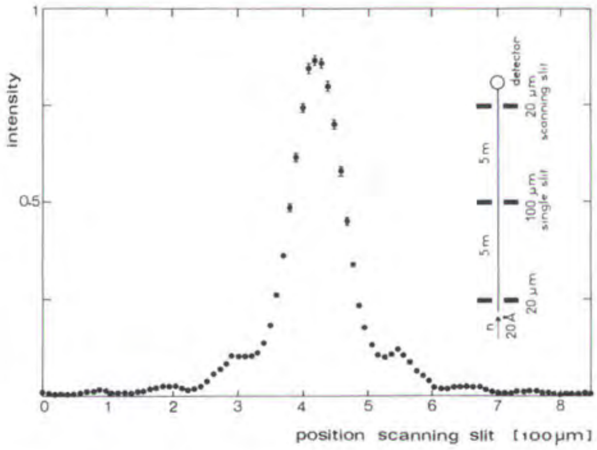


Fig. 5: Single slit diffraction pattern with cold neutrons.

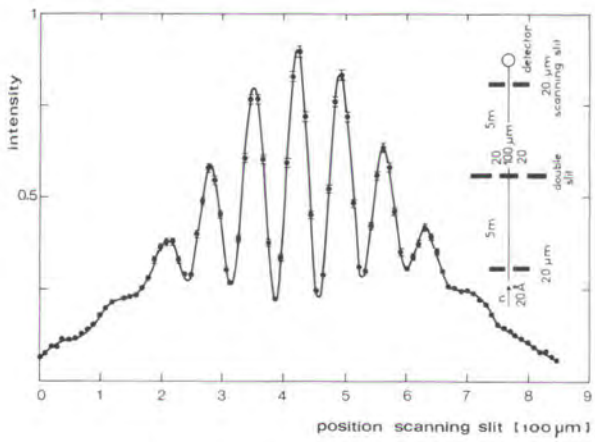


Fig. 6: Young's double slit experiment with cold neutrons.

In October 1980 a set up has been installed at the H18 beam tube to detect neutron-antineutron transitions, equivalent with the non-conservation of baryon number. The experiment is now operational and data are being collected.

Theory

In theoretical physics Bartel, Ring, Quentin and Schuck continued their studies on the adiabacity of the fission process. This is done on several "levels":

I) Strutinski calculations of potential energy surfaces

II) Semiclassical calculations of potential energy surfaces

III) Purely dynamical studies to which the inclusion of two body scattering is planned.

IV) In most of the preceeding cases the addition of pairing correlations is investigated.

Quentin studied spectroscopic properties of certain odd heavy nuclei (including fission isomers) with rotor + quasi particle approximation. Furthermore Schuck and Ring studied weak coupling in the lead region.

Seminars

In 1980 36 seminars dealing with nuclear structure, fission, heavy ion collision, atomic and fundamental physics and new experimental developments were given. In november a series of weekly lectures on problems of nuclear superfluidity held by Ph. Quentin and P. Schuck was started.

College Secretary:
H.R. FAUST

COLLEGE 4
EXCITATIONS

Members of the college

I. Experimentalists

Bernard L.
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II. Theoreticians

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General summary

The College's scientific activity is centred around 3 main subjects: lattice dynamics, magnetic and structural phase transitions and magnetic excitations. Most of the experimental work is performed on the 5 ILL three-axis spectrometers (IN1, IN2, IN3, IN8 and IN12), with some occasional use of diffractometers, time-of-flight or high resolution machines. Lately, other Colleges have shown a growing interest in three-axis beam-time, a trend which has already led to unreasonably high proposal rejection rates, particularly on the cold source (IN12) and hot source (IN1) spectrometers.

Fortunately, prospects for the development of three-axis instruments are on the whole very promising. The long-awaited rebuild of IN2 as a single-monochromator spectrometer with polarised neutron and spin-echo options, will undoubtedly open the way to a new class of experiments. In addition improved performances are expected on IN8 and IN3 from the implementation of the Carine Replacement Program, and on IN12 from a new cold source design. The rebuild of IN1 is also planned for next year, but no immediate improvement over the present situation is to be expected by College 4 users, since the new machine design, as it stands, involves beam-time sharing between 3 instruments: IN1-[3-axis], IN1-[Be-filter] and D4.

A survey of the experimental proposals addressed to Subcommittee 4 indicates that users' demands for sophisticated sample environments (high pressures, magnetic fields, very low temperatures, etc.) are still unevenly satisfied: while ILL capabilities are excellent in areas such as high pressures, additional investment in cryomagnets and the acquisition of a generally accessible dilution refrigerator is urgently needed.

Scientific trends and highlights in 1980

Over the years fewer proposals have been concerned with the experimental verification of lattice dynamical models as applied to simple solids. Currently such studies are carried out on materials of special interest and as part of a more general approach. This point is well illustrated by a recent series of inelastic measurements whose initial aim was to explore the nature of the magnetic interactions in uranium rocksalt compounds such as USb, UAs and UBi. Among other results this work has produced a set of unusual phonon dispersion curves [1], showing nearly degenerate transverse and longitudinal acoustic branches in certain high symmetry directions. So far this data has successfully resisted the standard shell-model analysis and may suggest that mixed valence effects are important in these materials.

One class of solids where lattice dynamics per se is a currently active subject, is that of molecular crystals. After the success of models based on Buckingham-type pair potentials between unbound atoms, researchers in the field turn to the more ambitious task of describing the coupling between internal and external molecular vibrations. Recent work on anthracene [2] and tetracyanoethylene [3] is along this line. The influence of molecular orientational disorder on collective modes is another active subject, as evidenced by recent neutron studies on a number of plastic crystals such as CBr_4, C_2Cl_6 and RbCN. In the latter case [4] the observation of well-defined optic modes has aroused theoretical interest, since the corresponding modes in KCN are washed out by CN^- orientational disorder.

In a broad sense, the relationship between ordering and collective excitations is central to the study of phase transitions by means of inelastic neutron scattering. In this field much of the current emphasis is put on transitions involving incommensurably modulated phases, where the (modulated) order parameter may be of structural or magnetic origin. In view of the unique value of neutron scattering for the study of these phases a two-day ILL workshop was devoted to this subject in October.

Incommensurably modulated structures are characterized by the appearance of "satellite" Bragg reflections displaced from the parent-structure Bragg peaks by a multiple of the modulation wavevector. As a function of an externally applied field such as temperature or pressure, the modulation wavevector may vary continuously or proceed by steps, each step corresponding to some commensurable (i.e. rational) wavenumber. In materials such as TTF-TCNQ [5] or $SC(ND_2)_2$ [6] both types of behaviour have been observed depending upon temperature and pressure conditions. Fig. 7 shows the temperature variation of the distortion wavevector in $[N(CH_3)^4]_2\,ZnCl_4$, a new insulator currently investigated on IN3. The intriguing discrepancy between the 2 curves, one measured with X-rays on the natural compound, the other with neutrons on a deuterated sample, is not yet understood and will be the object of further investigation.

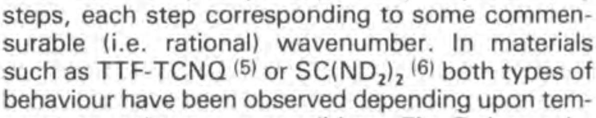

Fig. 7: Effect of isotopic substitution on the modulation wavevector in $[N(CH_3)_4]_2Zn\,Cl_4$. (▲: natural compound; ●: deuterated compound).

As far as dynamical properties are concerned, incommensurable phases are characterized by new types of collective excitations. In particular the presence of a phason branch with acoustic-like dispersion emanating from the satellite reflections, was predicted long ago. The first experimental evidence for the existence of the phason mode was reported a year ago [8], as a result of an inelastic study on deuterated biphenyl performed on IN12. This unique result, now fully confirmed by additional measurements, is sketched in Fig. 8: here, experimental conditions are such that the phason branch lay well below the 3 (independently measured) acoustic branches.

Many magnetic systems exhibit incommensurably modulated phases. The spin-density wave state of pure Cr is a classic example and the detailed elucidation of its static structure has proved to be one of the most perplexing problems in neutron crystallography. Equally difficult has been the elucidation

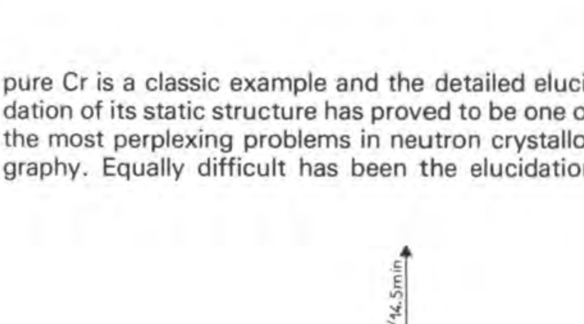

Fig. 8: Phason dispersion in Phase III (10K) of deuterated biphenyl. Each spectrum corresponds to a constant-Q scan at $(2\text{-}q,\ q_s,\ 0)$ where $q_s = 0.536$ is the modulation wavevector.

of the magnetic excitations. Spin wave dispersions emanating both from (100) points and from satellite peaks have been reported. A comprehensive study [9] of the magnetic excitations in the vicinity of the (100) positions in pure single-Q Chromium, recently undertaken using IN8, has indicated even greater complexity, as hitherto unexpected structure in the low frequency magnetic response was observed in both longitudinal and transverse phases.

Spin waves in Pt- and Pd-based transition metal compounds have been the subject of continued experimental effort, in view of the great variety of magnetic behaviour observed in these materials. In chemically ordered Pd_3Fe magnetic excitations are highly anisotropic and are thought to be strongly influenced by interactions with single-particle (Stoner) excitations near the (100) Brillouin zone boundary. Recent experiments [10] using IN1 have shown that these interactions are dependent upon chemical order since they are not observed in partially ordered Pd_3Fe nor in fully disordered $Pd_{81}F_{19}$, while in both compounds the spin wave anisotropy remains unchanged.

Fast progress has been achieved in the study of non-linear excitations in one-dimensional magnetic systems such as $N(CD_3)_4\ MnCl_3$ (TMMC) and $CsNiF_3$. In a recent investigation [11] of soliton scattering from TMMC, the high resolution of IN12 (21 μeV at $\lambda = 6$ Å) was used to investigate the energy and wavevector widths of the scattering due to spin fluctuations perpendicular to the applied magnetic field. Both widths were found to be in excellent agreement with current theories. Further the energy width was found to be wavevector dependent, as predicted by more sophisticated theories.

Workshops:

In October 1980, a two-day workshop devoted to "The Contribution of Neutron Scattering to the Study of Incommensurable Modulations" was organized by R. Pynn under the auspices of College 4 and College 5. The meeting, attended by some 80 scientists, was a considerable success.

Secretary:
R. CURRAT

References

(1) Exp. 04-03-159 (G.H. Lander and W.G. Stirling)

(2) Exp. 04-01-154 and 04-01-185 (B. Dorner et al.)

(3) Exp. 04-01-187 (S.L. Chaplot, A. Mierzejewski and J. Lefebvre)

(4) Exp. 04-02-128 (K.D. Ehrhardt, W. Press and J. Levebvre)

(5) Exp. 04-02-097 (S. Megtert, C. Vettier and R. Pynn)

(6) Exp. 04-02-114 (A.H. Moudden, F. Denoyer, M. Lambert and R. Currat)

(7) Exp. 04-02-119 (R. Almairac, R. Fouret, G. Marion, M. Ribet and J. Lefebvre)

(8) H. Cailleau, F. Moussa and C.M.E. Zeyen, Sol. St. Com., **33**, 407 (1980)

(9) Exp. 04-03-149 (S.K. Burke, J.B. Booth and K.R. Ziebeck)

(10) Exp. 04-03-160 (D. McK. Paul and W.G. Stirling)

(11) J.P. Boucher et al., Sol. St. Com **33**, 171 (1980)

COLLEGE 5 CRYSTAL AND MAGNETIC STRUCTURES

Members of the college

I. ILL and external members

Aime J.P. (Paris)
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Convert P.
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Feld R. (Marburg)
Fender B.E.F.
Filhol A. (CNRS/Grenoble)
Fitch A.
Freund A.
Fruchart D. (CNRS/Grenoble)
Garner P. (London)
Gillon B. (Paris)
Givors D. (CNRS/Grenoble)
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Schlenker M.
Schweizer J. (CEN-Grenoble)
Soubeyroux J.L. (Bordeaux)
Tasset F.
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Thorel P. (CEN-Grenoble)
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Vettier C.
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Wright A.
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Ziebeck K.

II. Visiting scientists

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Hidaka M. (Kyushu)
Wilkins S. (Melbourne)
Wilkinson C. (London)

Table 7

	D1A	D1B	D2	D3	D5	D8	D9	D10	D12	D15	Others	Total
No of experiments	37	25	10	17	11	14	16	6	4	16	7	163
No of days	181	107	77	203	122	214	194	54	49	163	62	

Instruments of main interest for College 5. Experiments accepted for execution in 1980.

General summary

Experiments carried out in college V are concerned with a wide variety of subjects, ranging from the investigation of stress distribution in the tibia of sheep[1] to the problem of a hypothetical multi-$\vec{q}$ structure in $CeAl_2$[2]. As in the last few years, the distribution of proposals among structural and magnetic studies remained roughly equal, but we have observed a continuous increase in the number of proposals (151 proposals in March 1980), despite the fact that proposals dealing with intercalated compounds and adsorbates had been transferred to College 9. At the Scientific Council of October 1980, there were still 121 proposals, even though the allocated beam-time had been drastically reduced due to the long shut-down planned in 1981.

As a consequence of this large number of proposals, two secretaries have been elected in two complementary fields.

The table 7 shows that most experiments proposed in College 5 have been performed on instruments in the diffraction group. This ensures a better matching of the users' needs and instrument development.

In particular the use of dedicated computers on all instruments (except D5) has allowed for a higher quality of measurements (better reliability, increased speed of data acquisition) as well as computer controlled variations of some experimental parameters such as temperature and wave length. These improvements will facilitate studies as a function of other intensive parameters such as hydrostatic pressure or uniaxial stress.

Furthermore, instrument development (area detectors) has continued; D2 is now equipped with a small area detector, while D19, the area detector for single crystal work is being tested. Data reduction programs have been developed especially for area detectors, in collaboration with the instrument control and data acquisition service(3). It should be pointed out that computing and data reduction improvements have benefited from the decision to buy a new DEC central computer.

Scientific trends and highlights in 1980

Ionic Conductivity

This is a field where neutron diffraction can make an important contribution to the understanding of the microscopic conduction mechanism in a number of solid state electrolytic candidates for new types of batteries. Harwell, Oxford, CNRS and ILL groups have been investigating changes in the ionic distribution in such electrolytes as the temperature is raised and the ions become free to move through the lattice. For example, Newson and Tofield (Harwell Report MPD/NBS/163), using powder diffraction and profile refinement, have studied different cations in beta alumina. In stoichiometric silver beta alumina ($AgAl_{11}O_{17}$) they have shown that at $T=4.2$ K the silver ions are perfectly ordered on a single three-fold location of unit occupancy. The group hopes furthermore to show how other positions become occupied with increasing temperature, thus separating the effects due to ionic mobility form those due to interstitial atoms in non-stoichiometric samples. Li^+ ionic conductors such as Li_5AlO_4, Li_xTiS_2 and $Li_9N_2Cl_3$ have been studied using similar powder techniques by Catlow, Brah and Steele(4) in order to measure the occupation of the different possible Li^+ sites, and to identify the channels for ionic conductivity. In some cases only dynamic channels are available(5).

In Na_2UBr_6, channels for Na^+ conduction are opened up by the libration of the rigid UBr_6 units which make up the remainder of the structure, Fender and Fitch(6) have also studied M_2UCl_6 where M = Li, Na or K. Chemists have a strong interest in such structures being intermediate between ionic and molecular compounds. The above studies have been carried out with powders, but where single crystals are available, very short wavelengths can be used to locate precisely the movement of the conducting ions. Roth, Anne, Tran-Qui and Lehmann(7) have used D9 data from H_3O^+ β''-alumina to show that there are two kinds of hydrogen, one strongly bonded and one weakly bonded, the latter being available for conduction.

Atomic Vibrations

The analysis of an extensive series of measurements on Be single crystals using short wavelength neutrons at several temperatures has been completed. The data served during this analysis as a test of a new quantum model of the one-particle potential formalism [Kara, M. and Merisals, M., to be published]. The agreement was very good between model predictions and observation in the range from 60 K to 800 K, with only a slight deviation above 600 K, indicating that the crystal softens in the hexagonal plane direction. In molecular crystals, librations of rigid groups have been studied using multipole expansions of the scattering density, with the Kurbi-Suonio programs implemented at the ILL by M. Athee.

Charge Density

Charge density studies continued to be of considerable interest, and were as usual divided between analysis of the surroundings of heavy atoms and the study of intermolecular interactions, essentially hydrogen bonds. Several sets of neutron data were collected for the study of metal-organic co-ordination, metal-hydrogen bonding and metal-carbon bonds. A series of neutron investigations were carried out on hydrates in order to study the charge distribution of water molecules. A study of the very short hydrogen bond in $NaHF_2$ was concluded: it shows an interesting depletion of density around the hydrogen atom, with a similar increase of density at the extremes of the FHF^- unit, especially at the ends of the group.

Reaction Kinetics and Electrochemistry

The rate of crystallisation of amorphous iron (III) hydride to α-Fe_2O_3 and α-FeOOD was investigated under hydrothermal conditions by measurements of neutron powder diffraction diagrams simultaneously with hydrothermal crystallization of the specimens. It was found that iron (III) hydroxide precipitated at pH = 10.0 is converted very quickly to a mixture of α-Fe_2O_3 and α-FeOOP when heated at 104 to 121 °C. The crystallization is complete within an hour. On the other hand an excess of protons seems to stabilize the amorphous products, and at pH = 4 crystallisation is only complete after 4 hours of treatment. The crystallisation was followed up to a temperature of 180 °C, and as expected, the reaction rate increased with tem perature(8). Such experiments have been pioneered at the ILL by Riekel, who has studied for example the electrochemical reaction of Mo_6S_8 with Li^+ and Cu^{2+} electrolytes. By plotting Bragg intensity, line position, width and electrode potential versus time (corresponding to the electron transfer or Li^+ content), the presence of different phases, with Li^+ incorporated in two different sites in Mo_6S_8, can be demonstrated.

Crystallite Orientation

A number of experiments have been proposed to measure variations in the orientation of crystallites in bulk specimens which cannot easily be examined with X-rays. Such studies can be applied to subjects as diverse as studying the history of geological formations and understanding the stresses in human jaw-bones. For example, Bacon and Griffiths(1) have investigated the preferred orientation of apatite in the tibia of sheep, and related these results of the stresses and strains recorded with the sheep walking on a moving belt.

Structural phase transitions

An incommensurate phase has been demonstrated in pure β-$ThBr_4$[10]; systematic Q-scans performed on the single crystal diffractometer D10 have demonstrated the existence of satellites below $T_c = 92$ K. These satellites appear at incommensurate, h,k,ℓ positions, with integer h, k values and non-integer $\ell = n \pm w(\frac{1}{3} - \delta)$ values ($\delta = 0.063$ being temperature independent down to 4 K). So far no lock-in transition has been observed. Further studies include the determination of the space group of the average low temperature phase. Another incommensurate modulation has been found in α-U[11]; the propagation wave-vector $\vec{q}$ (0.5, 0.176, 0.181) at T = 6.5 K has been obtained from film techniques with the Laue method on the special instrument S42; intensities have been collected on D10 in order to obtain more information on the modulation.

Magnetic Phases

Attention has recently been focussed on the possibility of coupling between Fourier components $\vec{M}_{\vec{q}}$ of the magnetisation density associated with different $\vec{q}$ vectors of the same star [$\vec{q}$]; occurrence of such coupling would lead to so-called multiple-$\vec{q}$ structures which describe multiaxial or non collinear magnetic structures. The application of a symmetry breaking field such as uniaxial stress has shown that muliple-$\vec{q}$ models do not describe the magnetic structures of pure Neodymium [12] and $CeAl_2$ [2] (see fig. 9). Unusual distribution of $\vec{q}$ vectors have been found in $Ni_{1-x}Zn_xBr_2$ systems[13].

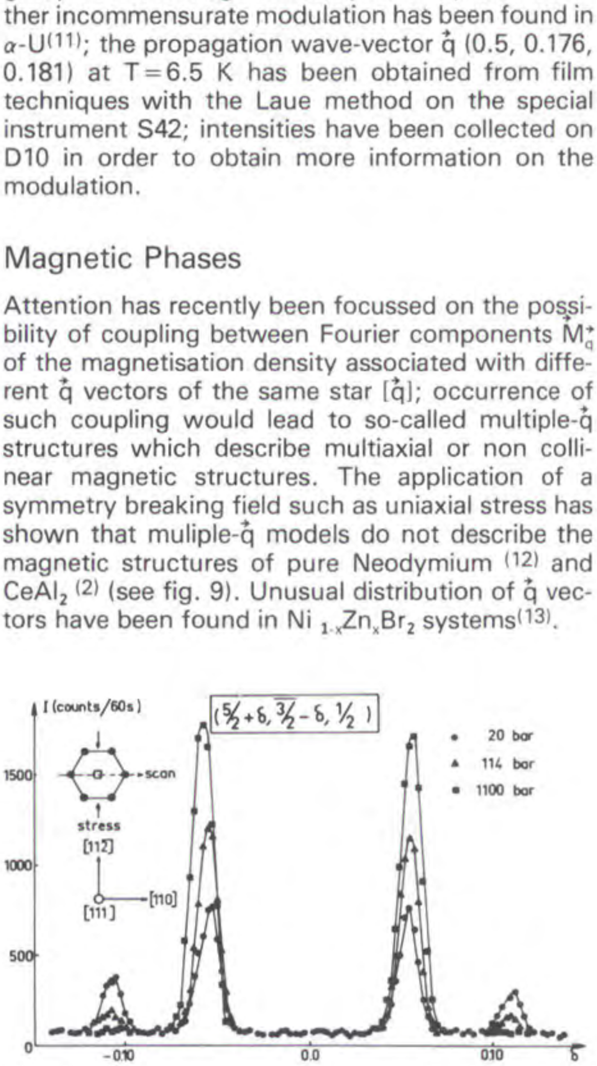

Fig. 9: Elastic scans in $CeAl_2$ showing the intensity of $\vec{q}$ domains as a function of applied uniaxial stress.

Magnetic structures of pure and carbon-doped europium hexaboride, $EuB_{6-x}C_x$, have been determined by powder diffraction experiments[14], pure EuB_6 is a simple ferromagnet, while highly carbon-doped samples exhibit helimagnetism which arises from a competition between ferromagnetic nearest neighbour coupling and antiferromagnetic interaction mediated via conduction electrons.

Natural clay minerals are now being extensively studied; in particular, Greenalite being an iron rich mineral, has been shown[15] to be a two-dimensional ferromagnet with weak antiferromagnetic coupling between ferromagnetic layers.

Polarisation analysis in metallic paramagnets

Work in this area continues, encouraged by a rising theoretical interest in metallic magnetism. The measurements of paramagnetic scattering by Fe_2Ce[16] and αMn[17] have been extended over a wider temperature range. The results seem to be consistent with recent models involving persistent local magnetic order in some magnetic metals well above the Curie or Néel temperatures. Work is in progress to determine the extent to which different possible models for the local order can be distinguished by the neutron measurements.

Magnetisation Density

The study of magnetisation density; in nearly magnetic materials has continued. Materials studied during the year include metallic rhodium[18] and $NbSe_2$[19]. In the former the considerable absorption cross-section entails a non-negligible effect of spin-orbit scattering (Schwinger effect). To confirm the correction to be made due to this effect a test experiment was carried out on D5 in which the polarisation dependence of the elastic cross-section of unmagnetized cadmium was measured at wavelengths between 0.5 and 0.7 Å. Both the magnitude and angular dependence of the effect were found to be in good agreement with experimental predictions.

The main features of the induced magnetisation density in $CeNi_5$[20] have been obtained from an experiment on D3. It turns out that observed susceptibility originates essentially from the two different Ni sites; the contribution of the Ce site is small and has a 5d rather than 4f character. Thus the observed magnetic susceptibility of $CeNi_5$ in the 100 K region arises from hybridized 3d-5d electron states rather than from an intermediate valence state for the Ce 4f-shell.

Neutron topography

Neutron topography consists of recording on a photographic detector, the diffracted beam emerging from a single crystal set for a chosen Bragg reflection. Local variations in intensity arising either from defects or from modifications of the magnetic structure (i.e. domains) produce images of these features. These possibilities have been exploited on S20 in order to study the growth of crystals[21] and growth defects in $PbHPO_4$[22], and also chirality domains in Tb[23]. This investigation has shown that the domain structure depends on the thermal history of the sample: when heating from the low temperature ferromagnetic phase, chirality domains form stripes normal to the C axis, whereas when cooling from the paramagnetic phase the domain walls do not have any preferred orientation.

Nuclear magnetic ordering

Solid He^3 is the subject of many investigations both on the theoretical and experimental sides. Experiments[24] have been performed in order to demonstrate the onset of antiferromagnetic ordering of nuclear spin in He^3 below Tc = 1 mK. First, the transmission of polarized thermal neutrons has been measured, on D5, to determine the polarization of the He^3 nuclei. At T = 34 mK, under an applied magnetic field H = 9 kOe, the He^3 nuclear spins were easily thermalized. On the other hand, conditions of helium solidification of He^3 and He^4 have been investigated on different instruments such as D1B and D2 at ILL, DN2 and DN3 at CEN-G. He^3 single crystals have been grown; the present objective is to cool down a single crystal of He^3 by using nuclear adiabatic demagnetization of Cu.

Secretaries:
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(16) Exp. 05-34-63 (J. Desportes, D. Givord, K. Ziebeck).
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(19) Exp. 05-32-113 (P.J. Brown).
(20) Exp. 05-32-118 (D. Gignoux, F. Givord, R. Lemaire, F. Tasset).
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(22) Exp. 05-16-112 (F. Lefaucheux, E. Manghi, M.C. Robert, J. Baruchel, M. Schlenker).
(23) Exp. 05-16-108 (S.B. Palmer, M. Schlenker, J. Baruchel).
(24) Exp. 05-35-058 (J. Flouquet, A. Benoit, J. Schweizer).

COLLEGE 6 LIQUIDS, GASES AND AMORPHOUS MATERIALS

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General summary

The topics covered by this college are the elastic and inelastic scattering of neutrons by gases, liquids and amorphous systems, although, in fact, no experiments on gases have been carried out during the past year. The main areas of interest were aqueous solutions and amorphous systems which together accounted for almost half of all proposals in 1980. Of the instruments used by the liquids college the most heavily over-subscribed were the diffractometer D4, which was requested for a total of 362 days although the number of scheduled days was only 138 and the time-of-flight spectrometer IN5 which was oversubscribed by a factor of 4.1. Other instruments in demand were the small angle camera D11, the time-of-flight spectrometer IN4 and the diffractometer D5. In April 1980, 39 experiments were proposed. Of these 15 were continuations, 5 resubmissions and the rest new proposals. 20 experiments were scheduled. In October 1980 out of a total of 34 experiments proposed, comprising 11 continuations, 5 resubmissions and 18 new proposals, 11 experiments were accepted.

Scientific trends and highlights in 1980

In the following sections the results of some of the more advanced studies are summarized.

Quantum liquids

In preparation for measurements on liquid ^3He using the new time of flight spectrometer IN6, a transmission cell consisting of two sapphire discs 0.1 mm apart was tested on IN12. The scattering from the cell appears to be very weak suggesting that small Q ($\lesssim 0.5$ Å^{-1}) inelastic scattering studies may be possible using this cell. An attempt to observe zero-sound excitations in superfluid ^3He using the triple axis spectrometer IN12 was largely unsuccessful reinforcing the view that the time-of-flight technique is necessary for the study of this highly absorbing sample. A new measurement was made of phonon frequencies in superfluid ^4He using the triple axis spectrometer IN12. Preliminary analysis of the data indicates good agreement with the "anomalous dispersion" measurements in this system made some time ago using the t.o.f. spectrometer IN5 (Stirling et al. "Neutron Inelastic Scattering", Vol. II, p. 45, IAEA Vienna, 1978). In contradiction to the result for ^4He on graphite, no evidence of nucleation of ^4He on MgO was observed. Also, the absorption of ^3He on graphite showed no nucleation of solid into bcc or hcp phases.

Monatomic liquids

The static structure factor of fluid selenium has been studied at high temperature (up to 1300 °C) and high pressure (up to 200 bar). The results are not yet available. Experiments were done, using the D2 diffractometer, on molten lithium and the results are to be combined with X-ray data in order to study electron correlations in this system. Due to parasitic scattering from the furnace shielding no quantitative results may be extracted from the data and the experiment must be repeated.

Binary alloys

The microscopic "structure" of liquid CuPb alloys was studied as a function of concentration using the D4-Diffractometer. Using the method of isotopic substitution, the Bhatia and Thornton partial structure factors S_{NN} and S_{NC}, which are related to density-density and density-concentration correlations respectively, were determined. It was found that, in the range of the miscibility gap, the alloy shows a large ion-size effect. Agreement with model calculations of disordered alloys having large size effects is good.

A small angle scattering study of clustering in Au-Si alloys has been carried out using the small angle camera D11. Three concentrations were studied, 16, 18.6 (eutectic) and 23.5 At % Au, in the temperature range 460 - 570 °C. A low small angle scatter-

Photo G. : (Alsthom Atlantique)

The new multi-detector of the Small Angle Scattering Camera D11

ing contribution was found only at the eutectic composition and a Guinier plot gives 100 Å as radius of gyration of the clusters formed.

Aqueous Solutions

Progress in the study of the "structure" of aqueous solutions, using the technique of isotopic substitution, has been maintained. Two experiments, one on 3.57 molal LiCl solution and the other on 9.95 molal LiCl solution have confirmed the existence of a well-defined hydration shell around the Li^{+} and its variation with concentration. A behaviour not unlike that of Ni^{++} in $NiCl_2$ solution and Ca^{++} in $CaCl_2$ solution is observed in spite of the different natures of the solute molecules. Experiments have also been carried out on the nitrate solutions with a view to elucidating hydration in the biologically very important system. Unfortunately the results have not yet been fully analysed and cannot be presented here. Inelastic neutron scattering has been performed, using the IN10 back-scattering spectrometer, on various concentrations of $CaCl_2$ solution (2 and 3 molal) and also on 3 molal CsCl solution. The CsCl solution was studied in order to confirm the assumption that the Cl^- ions have no retarding effect on the diffusional motion of the water. Such an assumption was confirmed. No dynamical information could be deduced about the properties of the second hydration sphere (of the Ca^{++} ion) in $CaCl_2$ solution due to the residence time being comparable to the instrumental resolution time.

A small angle scattering study of the halide solutions $ZnCl_2$, $ZnBr_2$, $CuBr_2$ and $NiCl_2$ using the small angle camera D11 was carried out and it was shown for example, that the radius of gyration in $ZnBr_2$ solution varied from 67 Å at saturation to 90 Å for a 0.5 M $ZnBr_1$ solution.

Molecular liquids

The program on the determination of the partial structure factors of liquid water was continued in spite of the major problems created by the inelasticity corrections in this system. The investigation of the partial structure factors in methylene chloride by selective deuteration was continued. The final experiments to such a determination have been carried out but not as yet analysed. The small angle scattering from supercooled water has been observed. Such a measurement is confounded by the scattering from the silica capillaries which are used to contain the supercooled water but the data may be analysed using a difference technique.

Amorphous Systems

Small angle scattering experiments have been carried out on the $Si_{(1-x)}H_x$ ($x = 0.06$ -0.25) films of thickness $\lesssim 25\ \mu m$ prepared by the glow discharge decomposition of silane under different conditions. For $x > 0.1$ the silicon hydride has a rod morphology with the average rod diameter $\sim$ 60 Å. Heat treatment (375° and 579°) revealed a two-stage hydrogen loss. The small angle scattering increased after the first stage indicating that the inhomogeneities are due to voids rather than two phases of different H content. An experiment was carried out on D4 to determine the local atomic structure in glow discharged silicon hydride but this was unsuccessful due to inadequate counting statistics.

Diffraction patterns were measured from the amorphous Sm_2O_3-GeO_2 glass system with a view to determining the local atomic order around a Sm atom, using the anomalous scattering of Sm. The diffraction was observed at wavelengths of 1.18 Å, 0.83 Å and 0.504 Å and the three patterns are now being analysed. Neutron scattering measurements were made on amorphous NiTi alloys. Combining these results with those of X-ray diffraction leads to the conclusion that there exists a preference for unlike neighbours in NiTi alloys. On heating to 500 °K and irreversible change in S(Q) and hence the extent of compositional fluctuations was observed.

The chemical short range order in CuTi metallic glass was observed over a wide concentration range. The data, which were obtained on D4, are similar to that obtained at Harwell and show a significant growth of the first peak in S(Q) as the copper content is increased. It is not possible to place any interpretation on this result without a full analysis of the data, which is proceeding at present.

The scattering law, $S(Q,\omega)$, of an amorphous CaMg alloy was measured using the IN4 time-of-flight spectrometer. The data are not yet analysed due to the difficult correction to be applied resulting from the presence of hydrogen in the sample but preliminary results seem promising. The experiment will be repeated with higher statistical accuracy when a hydrogen-free sample can be prepared.

Glass in glass micro-phase separation has been observed, preceding crystallisation, in a P_2O_5 doped lithium disilicate glass. It was shown that precipitation of the crystalline phase, in this glass, ocurred during the "ripening" stage of the silica rich separation.

Seminars

Several seminars of a general nature and some on more specialised topics of interest to the members of college 6 have taken place within the last year.

Secretary:
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COLLEGE 7
IMPERFECTIONS

Members of the college

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Jahnel F. (TU Munich)
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Schaerpf O.
Scheuer H.
Stirling W.
Wright A.
Zeyen C.
Ziebeck K.

Scientific trends and highlights in 1980

Coexistence of superconductivity and Long Range Magnetic Order

The rare earth ternary superconductor belonging to the $REMo_6X_8$ class of material has provided the first unambiguous realization in nature of the coexistence of superconductivity and long range magnetic order. The competitive nature of these two cooperative phenomena is illustrated by this compound which first becomes superconducting at a temperature T_s and then orders magnetically at lower temperatures. At first, the superconductivity is able to prevent ferromagnetic alignment and a compromise non-uniform magnetic state is established at intermediate temperatures; at sufficiently low temperatures however, the superconductivity is destroyed as ferromagnetism sets in. To prove the coexistence of the two collective states, a high resolution small angle neutron scattering experiment using D11 has been performed on a powder of $HoMo_6S_8$ in the range of temperatures between 1 K and 0.1 K. For decreasing temperatures a single magnetic Bragg peak develops below $T_M \cong 0.75$ K at a wavevector $Q_c = 0.030$ Å^{-1}, demonstrating that a transversely periodic magnetic structure has formed with the characteristic period of 200 Å; with further decrease of temperature additional scattering develops at smaller wavevectors and the Bragg peak intensity decreases as a transition to the ferromagnetic states proceeds. The spectrum of scattering below 0.71 K has no peak in the range of $0.002 < Q < 0.063$ Å^{-1}. The width of the Bragg peak observed is limited by the instrumental resolution (0.0047 Å^{-1}). Thus the coherence length of the oscillating magnetization exceeds 3100 Å or about 15 periods. From these experimental results (see figure 10), it has been concluded without ambiguity that on cooling a periodic magnetic structure develops in the superconducting state.

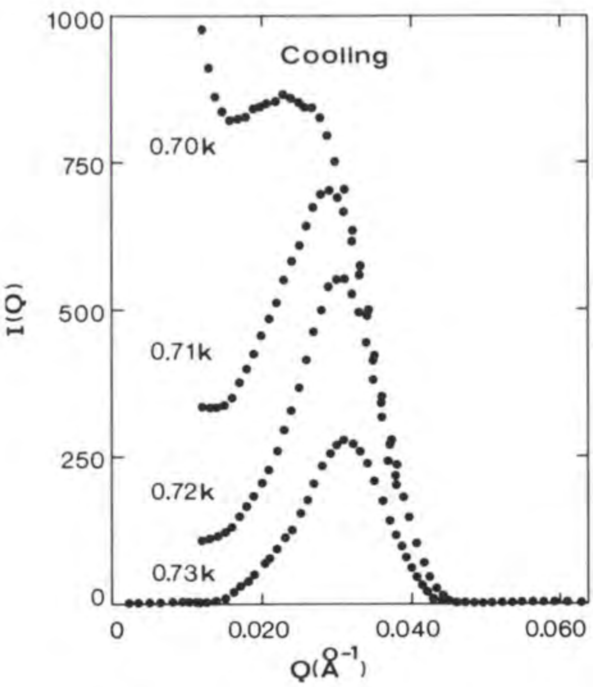

Fig. 10: Small angle neutron scattering of $HoMo_6S_8$ obtained on D11. The figure shows the evolution of the scattering during cooling . For wavevectors smaller than Q_c magnetic scattering develops below 0.73K.

A new experiment on D11 has been designed, in particular using magnetic fields, in order to discriminate between the two models which have been proposed to explain these results: either an oscillatory magnetization forming a helicoïdal structure or the spontaneous formation of a vortex lattice. These experiments ("Observation of long range magnetic order in the reentrant superconductor $HoMo_6S_8$" by J. Lynn, A. Raggazoni, R. Pynn, J. Joffrin; Journal de Physique-Letters, to be published) are an excellent example of ILL's unique experimental possibilities.

Intermediate valence compounds

TmSe is one of the most interesting intermediate valence (IV) compounds. Pressure is an important parameter for studying IV properties. Instead of pressure experiments, experiments on alloying systems are also often very useful. Therefore - in addition to TmSe - the spindynamics of two related alloys were studied: first $TmSe_xTe_{1-x}$ which shows a sharp phase transition at $x = 0.67$ from the stable divalent state into the IV phase; second the dilute IV system $Tm_{0.05}La_{0.95}Se$, which is more on the divalent side than the compound TmSe. In addition to the total magnetic cross-section, the spindynamic behaviour also shows quite well the phase transition in $TmSe_xTe_{1-x}$. In the stable divalent phase crystal field transitions are clearly detectable, while instead of this structured spectrum only a broad quasielastic magnetic line was found in the IV phase. This broadened line is typical for the IV-behaviour and reflects a very fast relaxation process ($\tau \approx 10^{-13}$ s) due to the valence fluctuation. With $Tm_{0.05}La_{0.95}Se$ it was possible - to our knowledge for the first time - to detect this broadening for a dilute IV system too, i.e. this fast relaxation process is a single ion effect. Qualitatively all three IV-systems (TmSe, $TmeSe_{0.05}Te_{0.15}$ and $Tm_{0.05}La_{0.95}Se$) show the same behaviour: at high temperatures the line width $\Gamma_{HT}/2$ is almost temperature independent and for $k_BT < \Gamma_{HT}/2$ the width becomes equal to the thermal energy ($\Gamma/2 \approx k_BT$). Quantitatively the high temperature line width depends on the valence of the Tm ion in the system: the lower the valence the lower the line width.

Amorphous magnetism

In the same way crystalline binary alloys such as EuSr-EuS, **Au**Fe or **Cr**Fe (which have been studied at ILL), the amorphous pseudobinary alloy system $(Mn_{1-x}Fe_x)_{80}(P_{16}C_4)_{20}$ shows a critical concentration for magnetic order. That is, for $x > 0.65$ these amorphous alloys are ferromagnetic whereas for $x < 0.65$ spin glass phenomena are observed. The spatial development of long range magnetic correlations in the vicinity of the critical concentration was studied using the small angle scattering instrument D17. One of the most striking conclusions of this work was that the systematic variation of the SAS as a function of temperature and concentration showed precisely the same features as in crystalline alloys. In particular the ferromagnetic alloys showed, in addition to the critical scattering at T_c, a sharply defined maximum in the SAS well below T_c. This perplexing feature of the SAS from disordered magnets has yet to be satisfactorily explained.

Hydrogen in Metals (Huang Scattering)

Correlations between deuterium dissolved in niobium were studied. Measurements over a wide concentration range (0.2...0.7 D/Nb) above the critical temperature of the α-α' phase transition were performed on the D10 triple-axis diffractometer. The Nb single crystals were loaded in situ at high temperatures and kept above the critical temperature. The neutron scattering intensity in different lattice directions, showed in the (110) direction, in addition to the strong fundamental (hho)-reflections, weak intensity peaks at the 1/2 (hho) positions. The intensity of these peaks increases with concentration, shows a maximum at about 0.5 D/Nb and decreases again for higher concentrations.. The existence of these 1/2 (hho) peaks indicates a partial ordering of the deuterium.

Ordering of this type was so far only observed in the low temperature phase Nb_2D. We suggest that the partial ordering observed here is caused by pretransitional fluctuations of the Nb_2D phase. In order to test this hypothesis we have cooled the crystal and observed a large increase of the scattering intensity when approaching the phase boundary. If the observed "superstructure" is due to "D" ordering there are two contributions: the scattering from the "D" itself and the scattering from the distortion induced superstructure modulation of the Nb-lattice. To examine the second part X-ray experiments are under-way.

In-beam NMR spectroscopy

Irradiation of AgCl and AgBr single crystals with thermal polarized neutrons creates polarized ^{110}Ag nuclei via the $^{109}Ag(n,\gamma)$ ^{110}Ag reaction. β-NMR measurements on these nuclei at low temperatures (1.5...30 K) have shown that due to the capture-γ cascade about 70 % of the ^{110}Ag nuclei are situated in a defect-disturbed environment. The corresponding defects have turned out to be cation Frenkel pairs, the intrinsic defect in these materials. Annealing of these Frenkel pairs, was detected and attributed to collinear interstitial migration. The electricquadrupole moment of ^{110}Ag was deduced from spin-Lattice relaxation measurements (Marburg group).

Secretary:
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COLLEGE 8
BIOCHEMISTRY AND EMBL GRENOBLE

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Timmins P.
Wilson S.
Worcester D.
Zaccai G.

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Rogan P.K. (Johns Hopkins University, Baltimore, USA)

General Summary

By giving a joint report on the activities of the ILL biology college and of the EMBL outstation at Grenoble, we wish to emphasize the close co-operation of the two laboratories for the successful development ot the application of neutron methods in molecular biology. The ILL physicists' main contribution is the efficient operation of the diffractometers used in biology (D8, D11, D16, D17) — their maintenance and improvement — and the know-how in neutron diffraction and small-angle scattering. The EMBL outstation additionally offers facilities which are necessary for good biological experiments with neutrons: extensive biochemical equipment, production of deuterated microorganisms as well as X-ray and light scattering and — in the near future — electron microscopy. The new joint building, which will accommodate the scientists of both groups from October 1981 is expected to improve even more the services offered to visitors and the cooperation beween EMBL and ILL staff. In order to keep and develop their scientific competence, which is necessary for the successful support of ILL visitors, both ILL and EMBL scientists perform their own experiments — in many cases in collaboration between the two laboratories. Often these in-house programmes involve a collaboration with other institutes, and in fact an important part of all ILL biology experiments is done with an active contribution by scientists of one or both groups.

Scientific trends and highlights of 1980

Table 8

	D11	D17	D16	D1B	IN5	IN10	IN11
Submitted March 1980	36 (107)	8 (63)	4 (97)	2 (20)	1 (4)	/	3 (39)
Accepted	25 (47)	6 (44)	4 (90)	1 (8)	1 (4)	/	1 (13)
* Submitted October 1980	20 (57.5)	7 (39)	3 (71)	1 (4)	1 (3)	1 (12)	2 (23)
Accepted	13 (20)	6 (20)	/**	1 (2)	1 (3)	0 (0)	2 (19)

Main instrument usage for biochemistry. The table shows the number of days requested and accepted (figures in brackets).
Notes:
* *Due to the extended shut-down in spring 1981, considerably less time was requested and allocated in October 1980.*
** *D16 will not be available in the first half of 1981 due to its modification.*

Ribosomes

This major project involves the deuteration facility at EMBL, biochemical preparation in Berlin (MPI für Molekulare Genetik) and data analysis at the ILL. It has already been shown to be possible to determine the radius of gyration in situ (21 Å) of protein L4 in the 50S subunit of the E-coli ribosome. This establishes the validity of a new approach to the determination of the quaternary structure, which, with a minimum of biochemical effort, will give more information than the methods used so far. We expect this project to take several years for completion.

Viruses

The interest in virus structures is developing towards animal viruses (Semliki Forest Virus, Influenza Virus and Adenovirus). The work in these cases is carried out following safety regulations established by a group of external experts.

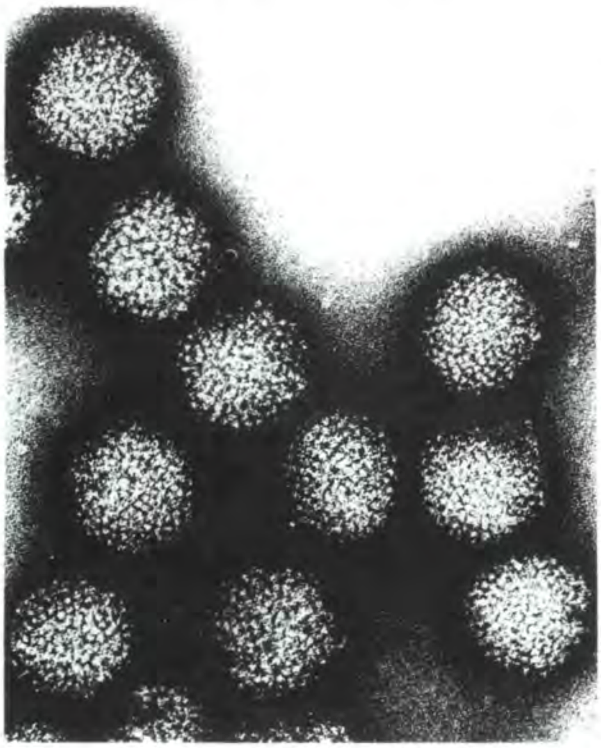

Photo V.: (E.M.B.L. Grenoble)

An electron-micrograph of the preparation of purified influenza virus vaccine. The virus diameter is approximately 1200 Å.

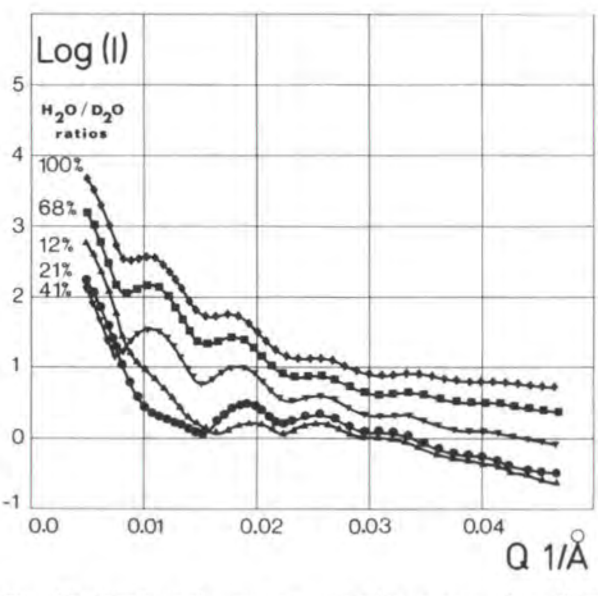

Fig. 11: Small angle neutron scattering curves of purified influenza virus vaccine in solutions containing five different H_2O/D_2O ratios. The curves were measured on D11 by S. Cusack (EMBL) and J.E. Mellema (University of Leiden). Analysis of the scattering curves allows the internal structure of the virus to be determined at low resolution.

The neutron data on inactivated influenza virus vaccine (a co-operation between EMBL and Leiden Rijksuniversiteit) show that this virus has a well defined spherical shape of 1200 Å diameter. The analysis is now being carried on to get the internal structure (see fig. 11). The project on Adenovirus (a co-operation with the INSERM at Lille) involves studies of the Adenovirus II, of defective mutants and of the isolated proteins. It has been shown that the penton is a trimer.

Progress has been made in the study of the self assembly at the Brome mosaic virus protein. This is a project using all laboratory techniques available.

The formation of a small T = 1 particle after limited tryptic digestion has been established. The low resolution crystallography with contrast variation, a new method developed at the ILL, has been applied to Satellite Tobacco Necrosis Virus (STNV) (a co-operation with the Wallenberg Laboratory, Uppsala). The analysis is still in progress, as well as that of the previously collected data on Tomato Bushy Stunt Virus (in collaboration with the IBMC, Strasbourg).

Nucleosomes

The low resolution crystallography is now well advanced. The DNA has been analysed also in 3-D by crystallographic least-squares refinement using an ideal helical model. This gave a helical radius of 42 Å, a pitch of 27.5 Å and 1.8 turns of super coiled DNA (in cooperation with the MRC Molecular Biology Laboratory, Cambridge).

The solution work of the Portsmouth Polytechnic group is continuing on histone depleted nucleosomes. Preliminar studies of deuteration of eukaryotic chromatin from Physarum, a slime mould, are in progress.

Membranes and Membrane proteins

Diffraction studies on the purple membrane of Halobacterium Halobium are continuing on D16. It has been shown that the protein lattice diffracts well even in very dry conditions and that most of the hydration is in the lipids. The protein shows higher exchanged hydrogen density in its interior parts supporting the hypothesis that this membrane protein has a hydrophilic interior. The same result was found from preliminary work in a collaboration project (Yale University New Haven) to locate the amino-acids in the structure by specific deuteration using special bacterial cultures. The aim of this project is to abtain the three dimensional structure of the purple membrane protein, bacteriorhodopsin, by using its known amino-acids. Data are still being collected. In a third approach purple membrane has been grown with deuterated retinal (collaboration with the MRC Laboratory of Molecular Biology, Cambridge). In a collaboration with the universities of Rome, of l'Aquila and the Instituto Superiore di Sanità the interaction of the small polypeptide mellitin with lipids is being investigated with both X-ray and neutron diffraction. These diffraction studies should provide valuable information to guide the present attempts to understand the mode of action of membrane proteins.

In collaboration with the Chemistry Department of the University of Illinois and the Biochemistry Department of the Royal Free Hospital School of Medicine, London, the structure of sciatic nerve myelin membranes was investigated using neutron diffraction and "in vivo" deuterion labelling of membrane components. By feeding laboratory rats choline deficient diets to which deuterated choline had been added, nearly 100 % labelling of the lecithin and sphingomyelin lipids of the membrane was achieved. Neutron diffraction from labelled and from normal membranes shows that the choline groups are asymmetrically distributed between the two sides of the membrane, with more on the extracellular side.

Similar studies on cholesterol in myelin membranes showed a symmetrical distribution of the cholesterol.

The major protein from the outer membrane of E. coli can be solubilized and crystallized with short (C_8) non-ionic detergents. This protein-detergent complex has been studied (a cooperation between EMBL and Biozentrum BASEL) with neutron and light scattering. The amount of detergent bound to the protein depends on the temperature, suggesting that the protein surface interacts with the detergent by providing nucleation centres for the micelles, rather than simply binding a monolayer of detergent molecules.

Work with complexes of mitochondrial membrane proteins and detergents has been initiated during 1980; this is based primarily on cytochrome c reductase, but includes also cytochrome c oxidase and succinate ubiquinone reductase, and is planned in such a way as to complement the structural information from the electron microscopy projects at EMBL-Heidelberg.

Proteins involved in protein synthesis

The neutron studies on amino-acyl tRNA synthetases and the interaction with tRNA have been extended to include mammalian systems which has led to interesting generalisations about the structure and mode of action of these enzymes (in collaboration with the University of Bordeaux, Ecole Polytechnique and the University and CNRS at Strasbourg). An EMBL project involving EMBL Heidelberg, on the complexes between aminoacylated tRNA and elongation factors TU and TS is close to completion. A model of the three dimensional arrangement of the DNA dependent RNA polymerase subunits has been obtained by triangulation studies (collaboration ILL/MPI für Biochemie, Martinsried).

Ion distribution and hydration around macromolecules.

The perturbation of water by ions, and the difference of the scattering length density between H_20 and D_20 for neutrons offer a possible way to localize the ions around nucleic acids (DNA and tRNA, in the latter case, a cooperation with IBMC Strasbourg). Very spectacular effects were observed (an imaginary radius of gyration of Na-DNA in D_20). The quantitative analysis is still in progress.

Glycoprotein

The scattering densities of polysaccharides have been measured (an EMBL project) providing the basis for the studies of glycoprotein. Such a glycoprotein (transcortin) has been investigated (a cooperation between ILL and Institut du Cancer at Lille), giving information on the sugar distribution.

Deuteration

This is becoming a more and more important activity of the EMBL outstation. The new development is to go beyond the stage of producing deuterated cells, to that of producing deuterated components (ribosome, tRNA, DNA, enzymes etc.). This should provide a source of material available to all neutron users. Methods of estimation of the level of deuteration by NMR have been thoroughly investigated.

College Secretary:
R. MAY

EMBL Grenoble:
B. JACROT

COLLEGE 9
CHEMISTRY

Members of the college

I. Internal members

Aime J.P.
Aldebert P.
Beaufils J.P.
Bomchil G.
Chenevas P.
Chieux P.
Croset B.
Dianoux J.
Duplessix P.
Ghosh R.
Hayter J.
Harris N.
Hässlin H.
Ibel K.
Jacrot B.
Jenkin G.
Jobic H.
Joffrin J.
Lauter H.J.
Lehmann M.
Leslie M.
Marti C.
Mason S.
Oberthür R.
Pautrot P.
Poinsignon C.
Rawiso M.
Soubeyroux J.-L.
Tabony P.
Tomkinson J.
White J.
Wright A.

II. External members

Heitjans P. (Universität Marburg)
Kiese G. (Universität Marburg)
Thorel P. (CNRS)
Volino F. (CNRS)

General Summary

Table 9

	Number of days								
Instrument	D1B	D2	D11	D17	IN1	IN4	IN5	IN10	IN11
Submitted	188	126	148	152	156	130	308	265	196
Accepted	72	87	61	99	141	84	132	144	78

Proposals submitted and accepted for College 9.

After the increase observed last year the demand for small angle scattering has reached a plateau. The demand for spectroscopic experiments has greatly increased, especially on IN1, IN5, IN10. The time sharing between the various chemical systems usually studied with neutrons does not seem to have changed very much. However this quantitative stability hides a qualitative variation of the subjects treated. A trend can be recognized towards the study of systems closer to possible applications though of real fundamental interest. Although many reasons contribute to this development, one important factor is that the progress of techniques and the interpretation of experiments makes it possible to treat more complex systems, closer to real life conditions, as will be seen from examples given below.

Most of the time allocated on IN1 is given to chemists operating in the Be filter mode. However, the decrease of pressure on the 3 axis mode of operation might be partly due to experimental features of the instrument and the rebuilding of IN1 will probably modify the situation in that respect. To favour a new balance between the two modes of operating IN1, it has been decided that the time sharing between Be filter and 3 axis modes would be fixed a priori rather than calculated on a pro rata basis. This practice will be reconsidered after one year.

Scientific trends and highlights of 1980

Polymers

The techniques of small angle scattering using D11 and D17 and isotopic substitution still dominate this field. They are operated on a routine basis and many aspects of the interpretation are well understood. This allows the study of more complex systems such as mixtures, copolymers, strained polymers, polymers in flow gradients, polyelectrolytes... All these systems are of immediate industrial interest.

Besides the structural work, movements of chains are studied. The neutrons spin echo spectrometer is now in routine use to provide unique information on the dynamics of a number of polymeric systems. The technique allows the extension of photon correlation spectroscopic measurements to much higher Q (> 0.02 Å^{-1}) and much shorter times ($t \lesssim$ 10 ns). These two features allow the internal dynamics of polymers to be probed, and considerable progress has been made in understanding polymers in dilute and semi-dilute solution (in good and Θ-solvents), and in the melt. A particularly interesting development has been the application to studies of polyelectrolytes in solution, where the strong Coulomb forces considerably modify the polymer structure and dynamics.

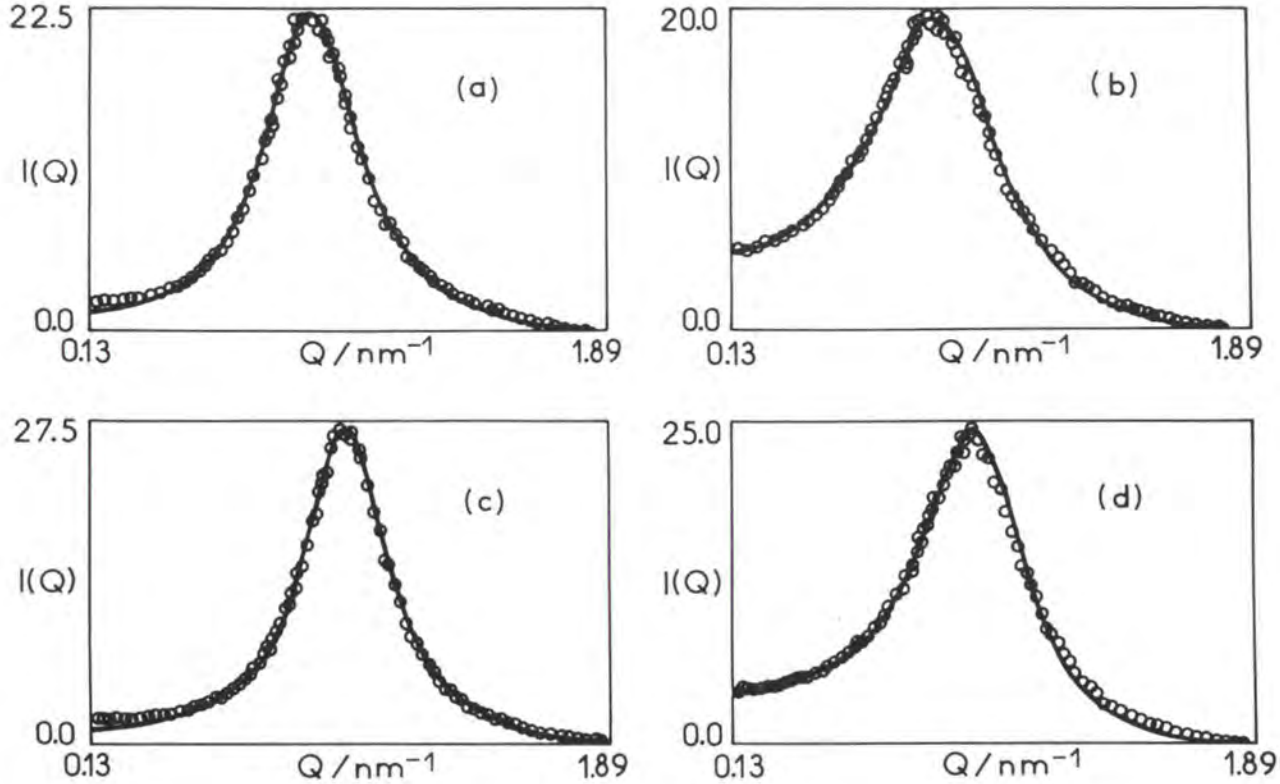

Fig. 12: Intensity **vs** *Q for SDS micelles. o = experiment, — = theory. (a) 0.4 M SDS; (b) + 0.1 M NaCl; (c) 0.6 M SDS; (d) + 0.1 M NaCl.*

Micelles

The first fully self-consistent study of micelle structure and dynamics in concentrated solution has been successfully completed, using small-angle static and dynamic scattering (D17 and IN11) coupled with a theoretical breakthrough in the calculation of the interaction structure-factor. Figure 12 shows a comparison of theory and experiment for a concentrated system in which the potential screening has been varied. The dynamics of the system are then calculated from the structure and confirmed by absolutely-scaled dynamic measurements. An interesting feature of this approach is that it allows determination of the screened charge on the micelles.

Spectroscopy

The interest of vibrational spectroscopy is presently focussed on co-ordination compounds. It is expected that the investigation of a broad range of molecules will bring progress in the understanding of the chemical binding in those molecules. A by-product of these studies is to serve as a guide for modelling surface complexes.

The rotations in plastic crystals can now be studied in great detail. It has been shown that a method proposed by Sears to correct multiple scattering is as efficient as the Monte Carlo method but less demanding in computing time. Group theory has been used to take into account the great variety of movements in a simple way. The theory was used to choose the most appropriate orientations of monocrystals for IN5 experiments discriminating between different models. By these techniques a range of compounds have been compared, in particular a series of substituted adamantanes.

A similar trend towards very detailed models is observed for liquid crystals. In fluid mesophases of TBBA the picture has two main features: the consideration of the most probable conformation and the uniform rotation of the molecules around their long axes. This accounts for a large set of data varying from neutron scattering to deuterium magnetic resonances in temperature dependent smectic C, A and nematic phases. This picture is likely to be extended to other cases.

The movement of water in heterogeneous structures of various kinds was extensively studied. For instance in a Nafion® membrane the long range diffusion, which is difficult, can be separated from the short range (8Å) movement, comparable to that of free water. The theoretical model calculating the incoherent scattering law of a substance diffusing inside a sphere, developed for that case, may be useful in many other cases.

Physisorption

The use of neutron diffraction to collect structural information about surface phases resulting from physisorption is still very intensive. It turns out that the variety of situations that can be encountered in phase diagrams, even for rather simple molecules such as NO, CF_4, C_2H_6, is unexpectedly large. In addition many of these phase transitions raise new physical problems. This field promises to remain very lively for some years. The adsorption of rare gases are oxide surfaces which are not well defined, exposing many crystal faces to the gas phase, has been used to evaluate the area of the faces of various orientations. Although the quantitative results are not very precise and many perturbing features have been recognized, the sum of the areas of the individual faces agrees reasonably with the total area calculated from adsorption isotherms. In this way very useful information for catalysis studies can be obtained.

The study of the simultaneous or consecutive adsorption of two different gases is an interesting way to investigate the adsorbate-adsorbate interactions. Tunneling spectroscopy of adsorbed methane gave very clear evidence of such interactions.

Chemisorption and catalysis.

Spectroscopic studies have been extended successfully to the study of chemisorption of hydrogen on powders of the family of hydrodesulphurization catalysts. The study of chemisorption of hydrocarbons by metals has been continued.

The interest in zeolites is increasing including attempts to study the movement of probe molecules such as CH_4, NH_4 + in the high electric field prevailing at the surface of the cages in these solids.

Some attempts have been made to obtain structural information on chemisorbed species: Methods analogous to those used for the study of physisorbed molecules have been applied to deuterium adsorbed on oxides.

Adsorbed layers

Neutron interference studies have been done on monolayers of stearic acid deposited on glass by the Langmuir trough technique, to determine the sensivity of the method. Preliminary measurements show that films less than 3 molecules thick (75 Å) may be fairly easily studied using simple techniques.

Seminars

A number of lectures were given on subjects pertaining to the field of adsorption by Drs Bauer (Clausthal), Engel (Zürich), Kaindl (Berlin), Marx (Duisburg), Vidal Madjar (Palaiseau), Vilches (Seattle). Other subjects were polymer chain simulation by Dr. Baumgartner (Jülich), tunnelling spectroscopy by Dr. Clough (Nottingham), electrochemistry by Dr. Costa (Paris) properties of bilayers of long chain alkyl compounds by Dr. Weiss (Munich). ILL contributors to seminars were J. Hayter, R. Oberthür, M. Rawiso, A. Wright.

College secretary:
J.P. BEAUFILS

4

SECTIONS WITH SPECIAL TASKS

PROJECT OFFICE

For the Project Office the main projects in 1980 were:

— the continuation of the Carine replacement, which is being implemented for the 3-axis spectrometers, and is at the prototype testing stage for the diffractometers;
— the completion and testing of IN6, IN13, and the D19 prototype;
— the construction of IN1B and D4B and reconstruction of D1B, D7, D16, IN8B, IN10;
— the preliminary projects for PN8, IN20 and D5B;
— planning for the new buildings;
— start of production of the new vertical cold source.

In addition to its normal function of preparing preliminary studies and of coordinating and implementing the technical and financial aspects of the work, the activities of the Project Office have been in three main directions.

1. The initiation of the modernisation programme, which necessitated:

(a) the preparation of a timetable and of multiannual financial estimates;

(b) the coordination of the definition of requirements and recruitment of temporary staff detached by the Associates;

(c) adaptation of the data processing for the accounts group to facilitate the handling of projects, which is still manual, despite a considerable increase in this load.

2. A particular effort to increase the share of ILL purchases in the member countries other than France by:
— contributing to the preparation and translation of technical specifications suited to the characteristics of each country (terminology, standards etc);
— identifying and making technical contacts with new firms in conjunction with the purchasing group;

3. Improving safety and protection against radiation (including background noise aspects), by means of systematic listing of the risks involved in the preliminary project or during installation work.

SAFETY AND HEALTH PHYSICS GROUP

The group has continued its normal work, consisting essentially of: monitoring of radioactivity around the experimental instruments and reactor installations:
— dosimetry for all staff;
— support for experimentalists by the provision of radioactive sources and an alpha laboratory;
— improvement of health and safety conditions at individual working positions following measurements and requests by the Committee on Health and Safety (CHS);
— implementation of legal requirements on the monitoring of pressurized equipment and lifting and electrical equipment;
— distribution of information on safety to the staff.

Particular features of the work in 1980 have been:
— assistance with design studies for the biology and computer buildings, and the specification for a building for decontamination and other work involving hazardous materials;
— assistance with studies on new instruments or modifications to existing instruments.

OFFICE OF THE SCIENTIFIC SECRETARY

External user programme

For the beam time available during 1980, 1036 research proposals were submitted to the sub-committees of the Scientific Council. Accurate processing of these requests and the necessity of communicating with scientists on a world-wide scale, has been assisted by a modernisation programme in the Secretariat, with a computer now processing letters on Council decisions, experiment invitations, and presently, a comprehensive file on all neutron beam experiments performed. Despite this machine assistance it remains the policy of the Office to ensure a personal service to external users of our facilities, and although a reduction in staff has been a direct result of the mechanisation, contact with the Secretariat is still very welcome.

Organisation of workshops and conferences

In 1980, the Office organised a major workshop in collaboration with the local responsible (R. Pynn) on "The contribution of Neutron Scattering to the Study of Incommensurable Modulations". In addition, considerable work has been devoted to the preparation of the "4th International Symposium on (n,γ)-Spectroscopy and Related Topics" to be held in September 1981 and organised by the ILL.

Public relations

In January 1980 the Office issued a revised version of the coloured brochure, "Neutron Research Facilities at the ILL High Flux Reactor", giving an up-to-date account of the instruments available at the Institut. Preparation of a revised version of the instrument brochure "Neutron Beam Facilities available for users" (Yellow Book) took place during 1980 and is intended to provide specific details, both scientific and technical, of all the research facilities either currently in use or in an advanced stage of construction. It will be issued in January 1981. Also, during the year an "ILL News Letter for Reactor Users" was created and the first issue will be available in January 81. This publication will appear bi-annually and reports on major improvements or modification to instruments, on the progress of the construction of new instruments, on appointments of new staff and on other major events which would be of interest to external users.

5

TECHNICAL DEPARTMENT

Introduction

Dans le domaine de l'instrumentation scientifique, le département technique assure l'étude, la construction, la maintenance de la partie mécanique des instruments, et l'ensemble des aménagements des zones expérimentales.
Pour l'ensemble du site hors réacteur, il est chargé de l'étude et la construction des bâtiments ou aménagements des bâtiments. Enfin il est responsable de l'entretien des bâtiments et des installations techniques correspondantes, et des ateliers de fabrication.
Ses efforts ont porté en 1980 sur :
— La recherche des firmes britanniques — un contrat a été conclu permettant l'exploitation en Grande-Bretagne de procédés mis au point par l'ILL pour la construction modulaire des spectromètres.
— Le renforcement temporaire des moyens d'étude et la poursuite de développements technologiques.
— L'inventaire systématique des besoins en locaux affectés à des fonctions précises et l'étude des solutions permettant d'y faire face en optimisant l'utilisation des surfaces existantes (service médical, magasin central), et en limitant les constructions nouvelles aux problèmes spécifiques (ateliers pour travaux contrôlés) qui exigent une localisation particulière.
— La réorganisation et le réaménagement des ateliers d'entretien dont la charge est toujours croissante malgré des moyens très limités.
— L'animation d'un groupe de travail chargé d'examiner tous les aspects de protection biologique et bruit de fond en vue d'une optimisation du choix des matériaux (filtres ou absorbants) et de leur dimensionnement.

Einleitung

Die technische Abteilung ist im Bereich der wissenschaftlichen Instrumentierung für Entwurf, Bau und Wartung der Instrumentenmechanik sowie für die Vorverteilung der Experimentierflächen verantwortlich. Darüberhinaus ist sie für Entwurf und Ausführung der Gebäude und deren Ausstattung der übrigen Gebäude auf dem Institutsgelände (mit Ausnahme des Reaktors selbst) zuständig. Schliesslich ist sie für die Instandhaltung des Gebäudekomplexes und die entsprechenden technischen Einrichtungen sowie für die Fertigungswerkstätten verantwortlich. Das Jahr 1980 war für die Abteilung insbesondere gekennzeichnet durch:

— Verstärkte Kontaktaufnahme mit britischen Firmen als potentielle Lieferanten des Instituts. Ein Vertrag zur Nutzung von am ILL entwickelten Herstellungsverfahren in Grossbritannien für Spektrometer im Bausteinsystem wurde in diesem Zusammenhang abgeschlossen.
— Vorübergehende Verstärkung der Mittel für Konstruktionsentwürfe und Weiteruntwicklung der Technologie in verschiedenen Bereichen.
— Systematische Bestandsaufnahme der für bestimmte Aufgaben benötigten Räume und Suche nach Lösungen, um die bestehenden Räume optimal auszunützen (Betriebsarzt, Hauptlager) und die Neubauten auf spezifische Probleme (Schadstoffwerkstatt), die eine besondere örtliche Lage erfordern, zu begrenzen.

— Umorganisierung, Neueinteilung der Werkstätten für Gebäudeinstandhaltung, die trotz sehr begrenzter Mittel immer grösseren Anforderungen ausgesetzt sind.

— Koordination einer Arbeitsgruppe zur Untersuchung aller Aspekte des Strahlenschutzes und der Untergrundstrahlung, um die bestmöglichen Konstruktionsmaterialien für Filter und Abschirmungen sowie ihre Abmessungen zu bestimmen.

Introduction

In the scientific instrument sector, the Technical Department deals with the design, construction and maintenance of the mechanical part of the instruments, and the complete equipping of the experimental areas. For the whole site except the reactor it is responsible for the design, construction and modification of buildings, and for the maintenance of the buildings, their technical services and the workshops. In 1980 particular efforts were devoted to:
— the search for British firms; a contract was signed granting a licence in the UK for processes developed by the ILL for the modular construction of spectrometers;
— the temporary increase in facilities for the design and implementation of technological developments;
— a systematic inventory of the requirements for rooms for particular functions, and a study of possible solutions to meet these requirements by optimising the use of existing areas (medical service, general stores) and limiting new constructions to specific problems (workshops for decontamination and other work with materials involving risks) which require particular facilities;
— the reorganisation and re-equipping of the maintenance workshops, whose workload is continually increasing, despite very limited means;
— the organisation of a working group to examine all aspects of biological shielding and background noise, with a view to optimising the choice of materials (filters or absorbents) and their dimensions.

MECHANICAL CONSTRUCTION AND MAINTENANCE SECTION

Organisation - Activities

Design studies, relations with firms

The design of new equipment under the modernisation programme, and of additional equipment for modifications to existing instruments, has again necessitated the use of external personnel. The transfer of the drawing office into a prefabricated building did not cause too much disturbance to its work. The conclusion of a contract with a British firm for the manufacture under licence of ILL designs means that in future modular spectrometers on air cushions can be built in the three member countries.

Assembly and Testing

This field of activity can be broken down into the following areas: assembly in the workshop, installation of experimental instruments in situ, maintenance of instruments, management of spares, inspections, tests and measurements. A particular effort has permitted the equipment of this sector with excellent facilities for dimensional and positioning checks, and for vibratory phenomena.

New Instruments and Projects

New instruments under test: IN6, IN13, D13C, D10 spin echo (first instrument with general use of modular systems).

New instruments under construction: IN1B (equipment with monochromators) IN8B, IN10B, D16B, and the new in-pile part of the neutron guides.

New instruments under study: PN8, D4B, D7B, IN1B (sample, analyser, detector), IN20.

Instruments wich have undergone major changes or received additional equipment; major maintenance work:

D19	optical beam system
D11	new detector equipment
IN4	conversion of the sample box
S3	equipment for commissioning the evaporation system
PN1	new ionisation chamber
IN8	change in the drum drive

Fields of Activity

Development of new air cushion support systems with inflatable skirt and adjustable height for use on floors simply coated with resin paints.

Adjustment of the various measuring and control facilities to the various maintenance requirements of equipment in operation and the repair of standard components.

MANUFACTURING, BUILDING AND INSTRUMENT MAINTENANCE SECTION

Manufacturing

The main mechanical engineering workshops and sheet metal workshops they permit:

— the construction of a major part of the experiments or their infrastructure, the construction of new instruments, and the modification or improvement of existing equipment;

— an important contribution to maintenance work for the reactor, laboratories and general technical facilities.

In 1980, with an unchanged staff of 10, the main workshops dealt with approximately 500 requests for work (260 mechanical engineering and 240 sheet metal work).

The most important jobs were: 2500° furnace for sample environment; double armed translation modules with universal joint for IN1B, IN8 and D4; pivot and carriage for IN10; carriage for D16; Doppler effect machine for IN10; spare counters for PN7; equipment for dismantling tests for reactor beam tubes; neutron shielding for IN10, IN13 and D11; extension of the experimental area SI1; platform and stairs for IN13.

Approximately one third of the potential capacity is always reserved for small urgent jobs, which form the second main function of the main ILL workshops.

The "self-service" mechanical and sheet metal workshops

The machine tools here are used daily by 9 - 12 technicians doing small items of mechanical work of a very high quality. The two staff in these workshops have:

— given the necessary advice to users;

— done small jobs requested by technicians outside their speciality;

— maintained the stock of machine tools and other tools kept outside the main workshops.

The "special products" workshop, with one part-time employee, has continued to be responsible for the production and installation of health physics material and normal neutron absorbents. This work is in the form of moulding, sintering, gluing, machining and painting.

The "primary materials" store is operated by one employee from the production section controlled by the Administration and Finance Department.

Building and Instrument Maintenance

The fittings group (4 staff) is employed in the general infrastructure, buildings and instrument areas.

Its work in 1980 included:

Design Studies

— Major contribution to the engineering and architect's work for the design of the new buildings and preparation of the associated contracts;

— project and invitation to tender in the three countries for the decontamination building;

— design study on the access to the ILL and EFCIS sites;

— study for an ILL telephone switchboard;

— extension of the medical service;

— fitting out of the extension to ILL7 (Chartreuse side);

— contribution to the search for optimum solutions for the use of existing buildings.

General projects implemented

— New access control system and changing rooms for the reactor level D;

— conservation work on building facades and roofs;

— fitting out of the vacuum pump group rooms and various EDEX laboratories in ILL7;

— construction of second (emergency) mains water and fire fighting supply;

— temporary installation of the new DEC 1091 computer (preparation);

— start and monitoring of the site for the new building.

Work at instrument positions

— Final assembly of shielding for IN13;

— modification to liquid supply conduits for D17 and D19;

— modification of access to casemate PN6;

— construction of soundproof casemate for D18;

— assistance with the assembly of the CERN neutron/antineutron transition experiment on H18.

The maintenance workshops have specialised as follows:

The maintenance and electrical installation workshop (4.5 staff) deals with repairs, maintenance and improvement of the existing electricity supply installations, low voltage and lighting (outside the reactor).

The general technical installation maintenance workshop (3.5 staff) deals with repairs, maintenance and improvement, in some cases with the assistance of outside firms, of all technical installations (outside the reactor) and all the ILL lifting and handling equipment.

The handling and general maintenance workshop (4 staff) deals with minor maintenance work on buildings and the general site infrastructure, the maintenance of general furniture and ILL vehicles, all internal removals and supervision of cleaning of buildings.

The recent and forthcoming extensions to the general installations and buildings, and the aging of the original buildings and equipment, also lead to increasing requirements as regards maintenance.

As the staff figure remained constant in 1980, there was a definite increase in the number of maintenance contracts signed.

Photo E. : (Alsthom Atlantique)

The construction site for the new Computer- and EMBL/Biology buildings (state in December 1980)

6

REACTOR DEPARTMENT

Introduction

Le rythme de fonctionnement adopté depuis 1975 a été maintenu avec, toutefois, une modification justifiée par l'arrêt de longue durée programmé début 1981 pour changement du doigt de gant H8 et travaux sur le bloc mécanique H1/H2 : l'arrêt annuel qui a lieu, habituellement, en octobre a été supprimé et un demi-cycle de fonctionnement rajouté en fin d'année. Le programme prévu pour 1980 comprenait donc 284 jours de fonctionnement du Réacteur, répartis en 6 cycles de 44 jours et 1/2 cycle de 20 jours, chaque cycle étant suivi d'un arrêt de 12 jours permettant de changer d'élément combustible et de réaliser les opérations de maintenance courantes.

Einleitung

Das seit 1975 eingeführte Betriebsprogramm wurde auch dieses Jahr aufrechterhalten, bis auf folgende Ausnahme: Im Frühjahr 1981 ist ein längerer Reaktorhalt eingeplant, um den Strahlkanal H8 auszuwechseln und an dem Einschub der Neutronenleiter H1 und H2 Ausbesserungsarbeiten vorzunehmen; der normalerweise im Oktober vorgesehene jährliche Reaktorhalt ist deshalb weggefallen und am Jahresende folglich ein halber Reaktorzyklus hinzugefügt worden. Das für 1980 vorgesehene Reaktorprogramm betrug also insgesamt 284 Betriebstage, aufgeteilt in 6 Zyklen von je 44 Tagen und einem halben Zyklus von 20 Tagen. Die 12-tägige Pause zwischen jedem Zyklus diente wie üblich dazu, das Brennelement auszuwechseln und die laufenden Wartungsarbeiten durchzuführen.

Introduction

The system of operation used since 1975 has been maintained, with a change due to the long reactor shut-down planned for early 1981 to change the H8 beam tube and for work on the H1/H2 unit. The annual shut-down, which normally occurs in October, was omitted, and a further half-cycle of reactor operation was added at the end of the year. The original schedule for 1980 therefore included 284 days' reactor operation, divided into 6 cycles of 44 days and a half-cycle of 20 days, each cycle being followed by a 12-day shut-down enabling the fuel element to be changed and current maintenance operations to be carried out.

REACTOR OPERATION IN 1980

Actual Timetable

Cycle 1-80 Commenced Thursday 3 January 1980, ended 16 February at 8.00 am. The scheduled dates were maintained. There were two short shut-downs, followed by immediate restarts, on 7 January (error on the cold source control panel) and 29 January (short power cut on the EDF mains).

Cycle 2-80 Commenced 26 February, ended 10 April. The scheduled dates were maintained. There was a brief interruption during this cycle on 7 March, as a result of a voltage drop on the EDF supply; the reactor restarted immediately.

Cycle 3-80 Operation from 22 April to 5 June. The scheduled dates were maintained. There was a short shut-down on 25 April, following a voltage cut at one point in the safety loop; the reactor restarted immediately.

Cycle 4-80 Commenced 17 June, ended 2 August. The failure of a main pump on the heavy water circuit necessitated a reduction in the power of the reactor to 45MW from 24 June at 15h00, followed by a complete shut-down of the reactor from 25 June at 11h00 until 26 June at 18h00 to change the pump.

The time lost as a result of this shut-down was recovered by delaying the shut-down at the end of the cycle by two days.

Cycle 5-80 As a result of incidents which occurred during this cycle (shut-down of the reactor accompanied by an evacuation of the reactor hall following an operation error which resulted in the release of activated argon) the reactor shut-down planned for 25 September was postponed by 3 days. The reactor accordingly operated from 3 August to 28 September.

There were three shut-downs during this cycle; two of them were followed by Xenon poisoning; the first two were due to incorrect operations, while the third was deliberate, in order to change a faulty D_2O pump.

Cycle 6-80 Operation as planned from 7 October to 20 November. The only event of note during this cycle was a reactor shut-down due to an operating error followed by an immediate restart.

Cycle 7-80 (1/2 cycle)

This half cycle, included because of the omission of the annual shut-down, started 24 hours later than originally planned as a result of an incident connected with a fault in the reactor control network.

Data for 1980

Number of days originally scheduled	284	
Actual number of days operation	283,7	
Actual operating time	77,7	%
Actual operating time in relation to time scheduled	99,9	%
Number of equivalent days at full power	278,65	
Number of fuel elements used	6,45	
Number of fuel elements actually despatched for reprocessing	6	
Number of unscheduled shut-downs	11	
including: brief shut-downs	8	
shut-downs with Xenon poisoning	3	
Number of times the safety circuit operated (excluding tests)	5	

Analysis of unscheduled shut-downs

Intervention by operation staff	8
EDF power cuts	1
Mechanical reasons	2

Analysis of reasons for operation of the safety circuit

The number of unscheduled shut-downs (10) is comparable with that in 1979 (13). The increased number of shut-downs with Xenon poisoning (3 instead of one) is explained by two mechanical incidents which necessitated work to change a pump on the heavy water circuit.

On the other hand there was a considerable reduction in the number of times the safety circuit operated, particularly during start-ups (3 in 1980 in comparison with 22 in 1979). This improvement is partly due to the procedure of manœuvring the electrical control valves of the safety rods several times before raising them and partly to the modification in the control circuit for the displacement of start-up rate chambers, which made it possible to eliminate unnecessary activation of the period-meters on parasitic frequencies when the chambers start to move out.

OPERATION OF THE SUB-ASSEMBLIES

Detritiation plant

The detritiation plant operated only until July, the remainder of the year being occupied with inspections and repairs.

Heavy water processed in 1980		Tritium extracted
HFR	16 000 l	26 000 curies
Saclay (EL 3)	10 700 l	44 000 curies
Harwell (PLUTO)	9 600 l	116 000 curies
Jülich (FRJ 2)	9 600 l	84 000 curies

During the year 236 000 curies of tritium were despatched either to COGEMA at Marcoule or to Harwell.

Reactor Block

In this area the year 1980 was concentrated on the preparation of the major work for the extended shut-down in 1981, and in particular:
- replacement of the H8 beam tube
- replacement of the H1/2 units
- new natural convection valves for the D_2O circuit
- modification of the control circuits of the safety valves.

The pneumatic controll circuit for the safety rods has been completely rebuilt to facilitate intervention work and to improve the reliability of the whole circuit. Safety rod n° 3 has been replaced (upper part and absorber) as have the upper parts of safety rods 1, 4 and 5. The Project Office is continuing its work on the new cold source.

The starter-source carrier tube has been replaced and pneumatic tube V5 has been temporarily removed and blanked off.

Fuel Element Handling

The sensors for measuring the weight of the fuel element in the three handling containers and the associated measuring electronics have been replaced.

Electricity

The battery of the 48 V DC network has been replaced during the year.

The aging of the rectifiers and inverters in the reactor control circuit has resulted in faults on this circuit which are to be improved in 1981.

Electronics

This year two systems have been installed for treating faults by microprocessors connected to the monitoring facilities of experimental beams, the safety valves and the valves through the outer shell. The information on these installations is now directly accessible in the control room.

Short-term Project

It is proposed to replace in 1982 the in-pile part of the present vertical cold source, with a view to:

1. increasing the neutron flux in the cold guides,
2. permitting an intense neutron beam of very long wavelength (greater that 20 Å) to emerge at level D of the reactor.

The preliminary safety studies of the whole experiment have been agreed by the supervisory organisations and the design study of the in-pile part of the vertical neutron guide is currently in progress.

Table 10

Year	N° of days scheduled	N° of days actual operation	Equivalent days at full power	Days operation /year	Rate of of availability	N° of unscheduled shut-downs	N° of Xenon poison-outs	N° of fuel elements used
1972	Test period	125	83	34 %	75 %	11		2.7
1973	258	245	218	67 %	95 %	13	4	5.3
1974	263	254	253 8	70 %	96.6 %	18	6	6
1975	262	257	250.8	70.5 %	98 %	25	8	6
1976	264	262.5	262	71.9 %	99.4 %	26	2	6
1977	264	257	253.66	70.4 %	97.3 %	38	7	6
1978	264	262.6	256.2	71.9 %	99.5 %	12	4	6
1979	264	260	254.8	71.2 %	98.5 %	11	1	6
1980	284	283.7	278.65	77.7 %	99,9 %	11	3	6.45

HFR-operation statistics from the beginning.

7

COMPUTING AND ELECTRONICS DEPARTMENT

Introduction

In July the Steering Committee approved the Institut's proposal to acquire a DEC 1091S to replace the DEC 1070 as the Institut's central computer. The new machine will have approximately three times the processing power of its predecessor, and will be able to support about 35 on-line terminals for visiting and resident scientists. The 1091S will be installed in a new building which is due for completion in the summer of 1981. The electronics and computers which make up the many instrument control systems showed much improved reliability compared with previous years. The changeover to individual control systems for each instrument is proceeding satisfactorily. In the interests of holding down manpower requirements, a determined effort is being made to adapt standard systems even if this results in some instruments having a slightly deoptimised performance. There is a very active programme of development and installation of multidetectors, whose use on crystal diffractometers, in particular, is growing rapidly.

The very large amounts of data which will be created on these instruments has highlighted the growing importance of data treatment in general. Some new posts have been created and a Group of data handling specialists has been formed. The Department is using its computing expertise to advise and assist the rest of the Institut in the introduction of automated management information systems.

Einleitung

Im Juli 1980 genehmigte der Lenkungsausschuss den Vorschlag des Instituts, als Zentralrechner des ILL eine DEC 1091S als Ersatz für die DEC 1070 zu erwerben. Die Datenverarbeitungskapazität der neuen Maschine ist etwa dreimal so hoch wie die des derzeitigen Rechners, mit 35 Terminals, die Instituts- und Gastwissenschaftlern zur Verfügung gestellt werden können. Die 1091S wird in einem neuen Gebäude untergebracht werden, das voraussichtlich im Sommer 1981 fertiggestellt sein wird. Die Betriebssicherheit der aus einer Vielfalt von Kleinrechnern und elektronischen Geräten zusammengesetzten Instrumentierungssysteme der Experimentiereinrichtungen konnte gegenüber den Vorjahren bedeutend verbessert werden. Die Umstellung auf ein eigenes Kontrollsystem für jedes Instrument schreitet zufriedenstellend fort. Um den Bedarf an zusätzlichem Personal so niedrig wie möglich zu halten, werden grosse Anstrengungen unternommen, um Standardgeräte an die Instrumente anzupassen, wobei versucht wird, eine optimale Lösung zu erzielen. Die Abteilung arbeitet ausserdem sehr aktiv am Programm der Entwicklung und Installierung von Multidetektoren, deren Anwendung insbesondere auf dem Gebiet der Kristalldiffraktometrie stark anwächst. Die dadurch auf diesen Instrumenten entstehende sehr beachtliche Datenmenge hebt die wachsende Bedeutung der Datenverarbeitung im allgemeinen hervor. Einige neue Planstellen sowie eine Gruppe von Datenspezialisten wurden daher geschaffen.

Die Abteilung berät und unterstützt ausserdem mit ihrem Fachwissen und ihrer Erfahrung das Institut bei der Einführung von Datenverarbeitungssystemen für verwaltungstechnische Aufgaben.

Introduction

En juillet 1980 le Comité de Direction a approuvé la proposition de l'Institut d'acquérir un DEC 1091S pour remplacer l'ancien calculateur central DEC 1070.

La nouvelle machine aura une puissance environ 3 fois supérieure à celle de la précédente, et sera capable de supporter 35 terminaux en ligne pour les chercheurs de l'Institut et les chercheurs invités. Le 1091S sera installé dans un nouveau bâtiment dont la construction sera sans doute terminée en été 1981. La fiabilité des équipements électroniques et des ordinateurs qui composent les nombreux systèmes de contrôle des instruments a été considérablement améliorée par rapport aux années précédentes. La transition à des systèmes de contrôle individuels pour chaque instrument progresse de manière satisfaisante. Dans le but de limiter les besoins en personnel, de grands efforts sont entrepris pour standardiser les systèmes, même s'il en résulte pour certains instruments une légère réduction en performance. Le programme de mise au point et d'installation de multidétecteurs progresse rapidement et plus particulièrement sur les diffractomètres à cristal.

Les très grands volumes de données qui seront produits par ces instruments font ressortir de manière générale l'importance croissante du traitement des données. De ce fait quelques nouveaux postes, et un groupe de spécialistes dans ce type de traitement ont été créés. Le département met également son savoir faire et son expérience à la disposition de l'Institut dans son ensemble, pour fournir conseils et assistance quant à l'informatisation de sa gestion.

INSTRUMENT CONTROL AND DATA ACQUISITION SERVICE

This Service is responsible for the construction, improvements and maintenance of instrument control systems, detectors, and general electronic equipment.

The year has been marked by:

— A generally good performance record for system controlling operational instruments.

— Continuing progress on the installation of dedicated systems on instruments.

— Some progress on general development projects, but this being held back by lack of manpower.

— Work on multidetector development and installation being pursued as rapidly as possible, under pressure from the scientists who see this as a critical growth area.

The assignment of instruments to control systems at the end of 1980 was as follows:

In Routine Operation:

CARINE 1	D5
CARINE 2	IN1, IN2, IN3, IN8.
PDP 11 network	(11/55 concentrator: 11/34 on each instrument) D7, IN4, IN5, PN1.

Free-standing systems:

PDP 11s (various)	IN10, IN11, D3, D8, D9, D10, D11, D17, PN2, PN3 (GAMS 1), PN3 (GAMS 2/3)
Plessey Micro 1	D1A, D2, D4, D18, S3.
Solar 16/40	IN12, D1B.
PDP 8/E	D15/D16.

Under development and test:

PDP 11 network	IN6.
Free-standing PDP11	IN13, D5, D15, D16, D19.
Plessey Micro 1	PN4.
Solar 16/40	IN1, IN8.

Instrument Control Systems

The changeover from centralised to dedicated control systems is now entering its final phase, only 5 instruments now remaining on CARINE. A determined effort is being made to standardise on a minimum number of designs. This applies both to computer hardware and software, and to electronics. Shortage of manpower obliges this policy to be followed even if it results in some instruments having a slightly less-than-optimal performance.

Principal instrument projects have been as follows:

IN1	Start of reconstruction of electronics, allied to installation on a Solar 16/40.
IN6	This new instrument with 350 detectors and 256 time-of-flight channels has been a major project. The complete control system, based on a PDP 11/34 and 256K words of external memory is nearly finished.
IN8	As for IN1.
IN10	Reconstruction of motor control started.
IN13	This new instrument uses a PDP 11/34, with an INTEL 8080 microprocessor to control the furnace.
D1B	New control system based on Solar 16/40 became operational.
D2	Installation of a 64-cell multidetector, with necessary software adaption.
D7	New motor control introduced.
D10	Software to support spin-echo option now available.
D18	New instrument using a Plessey Micro 1 and M 6800 microprocessor.
D19	Became operational, with a 64 × 16 cell multidetector, controlled by a PDP 11/34.
PN1	PDP 11/34 system is now fully operational.

Detectors

The detector group has been strengthened this year in response to the growing load of work in the multidetector area. Technical problems have continued to delay the construction of the 512 × 16 cell detector for D19. A 64 × 16 cell detector has been provisionally installed to enable the instrument to be tested. Smaller multidetectors have been installed on D2 and D4. Besides improving the efficiency of these instruments they are providing information for the design of the 1600 cell detector planned for D20. It seems likely that the large detectors currently being planned represent the limit of what is technically feasible for gas-filled detectors. The group is therefore closely following development studies at centres such as CERN, Orsay and Rutherford Laboratory into various types of solid-state detectors. It may become appropriate to undertake such studies at ILL in the near future.

Studies, prototypes and long-term developments

This covers:

— General design studies aimed at increasing the efficiency of existing instruments.

— Work associated with future instruments, not yet fully defined.
— Projects not associated with instruments.

These areas necessarily suffer from being accorded low priority by comparison with maintenance of existing instruments and the completion of instruments under construction.

However significant progress can be reported on the following projects:
— The closed loop motor controller which is now available for step motors.
— The BASIC language is available on the Solar 16/40 CAMAC controller.
— A centralised surveillance and restart system is being implemented, in order to facilitate the supervision of instruments outside normal working hours.

Maintenance

On the computer side a good balance now seems to have been achieved between equipment maintained in-house and that maintained under contract by manufacturers. Breakdowns involving lengthly loss of service are now rare. This has been achieved in spite of very large growth both in the number of systems and their complexity. Electronics maintenance continues to pose a problem, since this involves not only modules in instrument systems but a great deal of stand-alone equipment. It is hoped that greater standardisation, together with larger stocks of spare parts, will improve this situation.

CENTRAL COMPUTER

Replacement of the DEC 1070

In July the Steering Committee approved the Institut's proposal to acquire a DEC 1091S as the new central computer to replace the DEC 1070. The new machine will have approximately three times the processing power of its predecessor. With corresponding increases in memory it is expected that it will support about 35 active terminals for visiting and resident scientists.

The operating systems will be the same as on the present machine, so that the change-over should be straightforward, a fact which influenced the decision. However some system features will be modernised, particularly the network of links to the instrument control computers. A study of the implementation of this using standard DEC communications software (DECNET) has started. The possibility of establishing a link to the Rutherford Laboratory to facilitate the exchange of programs and data with U.K. centres is being investigated. In order to relieve pressure on the existing machine at the earliest possible moment, a minimum configuration 1091S was due for delivery at the end of 1980, to be provisionally installed in existing accommodation. The remaining units will be delivered in Summer 1981 when the whole system can be installed in the building currently being constructed. The Department has been involved in the design of the new building, with a view to avoiding the environmental deficiencies of the existing machine room.

1070 Operations

The DEC 1070, which has been running at the limit of its capacity for several years has been subjected to yet greater demands. To alleviate the situation the system is left running in self-service mode overnight and a contract operator has been hired to enable the machine to be used more efficiently at week-ends. However the demand has remained very high and has led to a problem over priorities for access to terminals during normal working hours. Restrictions on terminal access for visitors had to be introduced but these were lifted towards the end of the year in anticipation of the arrival of the 1091S. There were certain fears for the reliability of the machine during the early part of the year following a series of break-downs. The situation subsequently improved, although magnetic tape and disc units have continued to give trouble.

Data Handling

In view of the change-over, developments on the 1070 system have been kept to a minimum. The links to the instrument computers have been improved. A utility has been written to facilitate the transfer of files between the DEC-10 and PDP-11s (RSX11M and RT11 operating systems).

General Support for Users

The central computer staff spend a considerable part of their time resolving minor problems for both ILL staff and visitors. The possibility that this load could be reduced by providing the users with more information and training is being examined.

Other Activities

In the field of applied mathematics, work has been oriented towards multiple precision procedures and facilities for symbol manipulation, in addition to routine work to maintain the mathematical subroutine libraries. The Service also maintains the program package to handle ILL travel records and statistics, which are run by the Relations Sociales on the DEC-10.

DATA TREATMENT

The continuing introduction of new and modified instruments which produce far more data than their predecessors (for example, by the use of multidetectors, or runs having very short measuring periods) is obliging the Department to pay special attention to the problems of handling large amounts of data, and of the data treatment process in general. A new group is being established, using, posts created under the Modernisation Programme. It is hoped that this Group will be fully functioning by early 1981.

Principal achievements during 1980 have been:
- Revision and unification of programs for D11 and D17 for both the PDP 11/40s and the DEC-10.
- Participation in the design of IN6 control program.
- Improvements to data treatment programs for D17.
- Interactive peak analysis program for D16.

MANAGEMENT INFORMATION SYSTEMS AND OFFICE AUTOMATION

It is clear that the Institut, like any other organisation beset by paperwork, ought to be able to increase its efficiency by the judicious introduction of computers for managerial and secretarial activities. The Department is giving a lead in this area, using its professional expertise to advise other Departments and implement systems where appropriate.

The situation is most critical in the Scientific Secretariat, with a very large amount of information to be processed relating to experimental proposals, Scientific Council decisions and scheduling of approved experiments. A system was installed at the end of 1979, and during 1980 has been much improved. The system has been extended to enable the Library to handle scientific reports. The transfer of the Travel Package from the DEC-10 is also in hand, it being more appropriate to associate this with the experiment schedule since much of the travel refers to visitors.

A number of other possible applications are under study.

8

ADMINISTRATION

Einleitung

Die Verwaltungsabteilung ist für die administrativen Aufgaben des Instituts zuständig. Sie unterstützt den Direktor, den wissenschaftlichen Bereich sowie alle übrigen Abteilungen und Dienste bei der Abwicklung ihrer Tätigkeiten und erbringt die dazu notwendigen verwaltungstechnischen Leistungen. Sie stellt sicher, dass die zur Verfügung stehenden Mittel richtig und wirtschaftlich genutzt und die entsprechenden Regelungen, Richtlinien und Anweisungen beachtet werden.

Die Verwaltungsabteilung ist in drei Gruppen aufgeteilt : Personalabteilung, Finanzabteilung, Sozialabteilung. Zur Verwaltungsabteilung gehören ausserdem die betriebsärztliche Betreuung und das Übersetzungsbüro. Sie stellt das Sekretariat für den Lenkungsausschuss, bereitet seine Sitzungen sowie die der Unterausschüsse vor und führt seine Beschlüsse durch.

Das Jahr 1980 war für die Verwaltung insonderheit dadurch gekennzeichnet, dass die administrative Datenverarbeitung (mit kleinen Ausnahmen) auf Terminalbetrieb mit Datenfernverarbeitung umgestellt wurde. Die mit einer solchen Umstellung notwendigerweise verbundenen Schwierigkeiten konnten in Grenzen gehalten und dank der Einsatzbereitschaft der betroffenen Mitarbeiter gemeistert werden.

Die nachhaltigen Bemühungen um eine Verbesserung der Beschaffungsaufteilung auf die drei Mitgliedsländer zeigten erste Erfolge und werden auch in Zukunft fortgesetzt.

Introduction

The Administration Department is responsible for dealing with the matters arising in this field at the ILL. It is required to give effective support to the Director, the scientific area, and all departments and other units in the Institut in carrying out their functions, and to perform the necessary services in the administrative field. It ensures that the available resources are correctly and economically used and that the appropriate regulations, guide-lines and instructions are observed.

The administrative functions are carried out by three groups: personnel, finance "relations sociales" (welfare). The Administration Department also includes the medical service and the translation office and provides the Secretariat of the Steering Committee, prepares its meetings and those of its Subcommittees, and implements its decisions.

The year 1980 was characterized by the transfer — with minor exceptions — of the administrative data processing to terminal operation linked to a remote data handling centre. The difficulties necessarily involved with such a conversion were kept to a minimum and were overcome by the efforts of the staff concerned.

The unremitting effort to improve the distribution of purchases among the three member countries achieved its first successes and will be continued in the future.

Introduction

Le Département Administratif et Financier est chargé de traiter les affaires à caractère administratif de l'ILL. Il a pour tâche d'apporter un soutien efficace au Directeur, au domaine scientifique et à tous les départements et autres unités de l'Institut afin de leur permettre d'exécuter leurs fonctions et d'accomplir les travaux concernant le domaine administratif. Il assure l'utilisation correcte et économique des moyens disponibles ainsi que l'observation des règlements, directives et instructions.

Trois groupes accomplissent les fonctions administratives : Service du Personnel, Service Financier et Achats, Service Relations Sociales. Le Département Administratif et Financier comprend également le Service Médical, le Bureau de Traduction et assure le Secrétariat du Comité de Direction, prépare ses réunions et celles de ses sous-comités, puis met en pratique ses décisions.

L'année 1980 a été caractérisée par le transfert (à quelques exceptions près) du traitement informatique des données administratives sur un système de terminaux connectés à un centre de traitement à distance. Les difficultés qui ont forcément été rencontrées lors de ce transfert ont été réduites au minimum et maîtrisées grâce aux efforts du personnel concerné.

Les efforts constants, en vue d'améliorer la répartition des achats entre les trois pays membres, ont été couronnés de leurs premiers succès et seront poursuivis à l'avenir.

PERSONNEL

The Personnel Section is responsible for the recruitment of ILL staff, Social Security and related problems, staff management and salaries. It is responsible for studies and analyses in connection with personnel, some of which have been selected for this report. Following an organisational change, the responsibility for work for the ILL "Société Mutualiste" was transferred to the Personnel Section during the year.

Staff

Table 11 below shows staff changes in 1980 and Fig. 13 the breakdown of staff by category and nationality. Fig. 14 gives overall information on staff changes since the foundation of the Institut.

Table 11

Categories	Position on 31.12.79	Changes in 1980: Recruitment and internal changes	Changes in 1980: Departures and internal changes	Difference + or −	Position on 31.12.80	Change % column 4 compared with column 2
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Scientists	77	20	26	−6	71	33.80 %
2. Technical and administrative "Cadres"	59	6	3	+3	61	5.20 %
3. Thesis students	30	7	9	−2	28	30 %
4. Technicians	150	20	14	+6	157	9.30 %
5. Others	105	8	8	—	105	7.60 %
Total	421	60	61	+1	422*	14.50 %

Staff changes in 1980
** In addition, 12 persons were detached to the ILL under the Modernisation Programme (7 from KFK, 1 from KFA, 3 from CEA, 1 from SRC).*

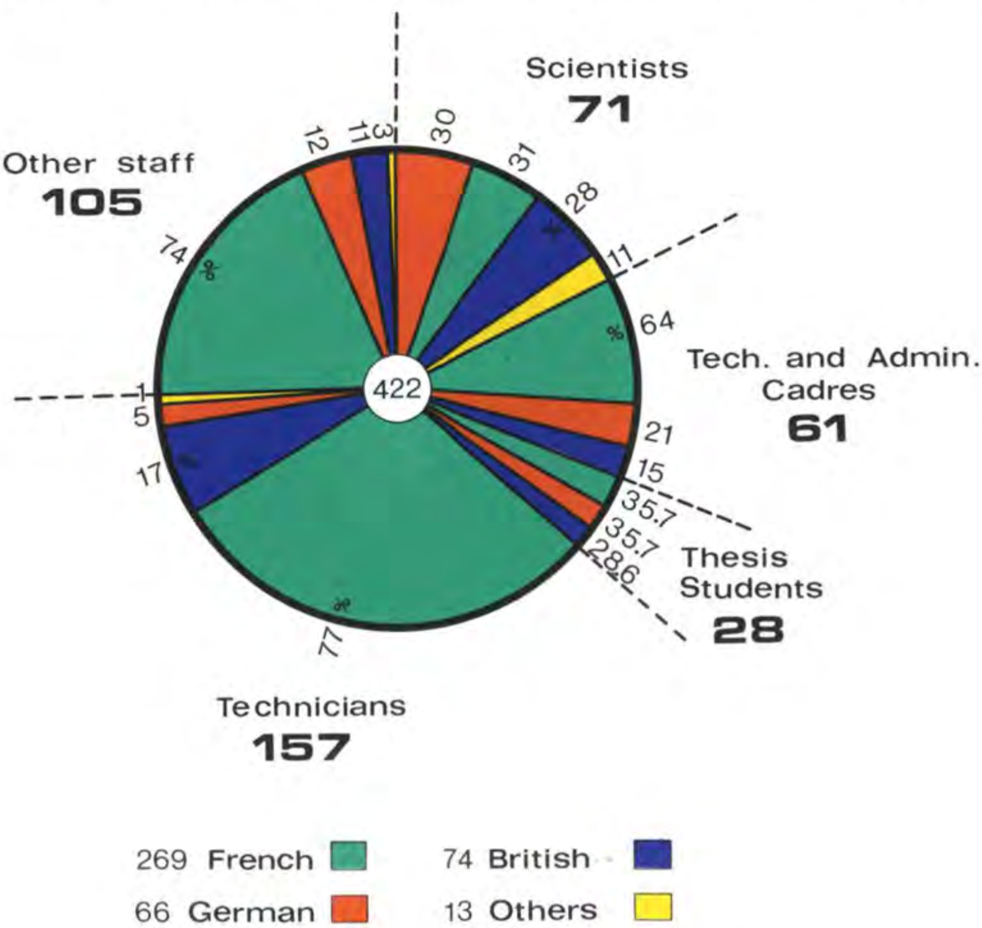

Fig. 13: Break-down of staff by category and nationality.

Seniority

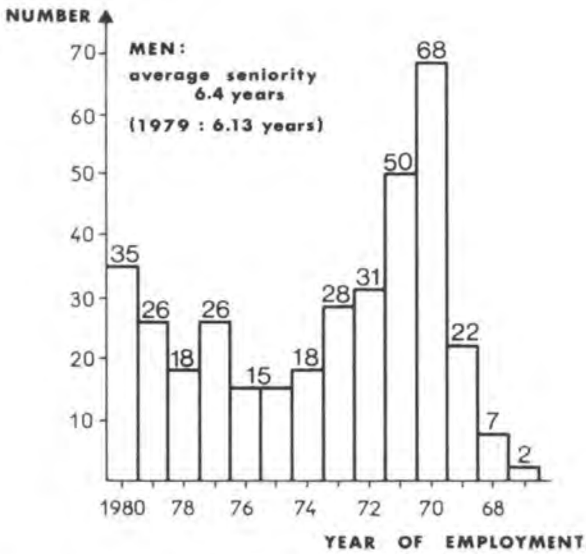

Fig. 16 a: Seniority of ILL staff (men).

Fig. 16 shows the seniority position. This has increased for male staff by 0.37 to 6.4 years and fallen by 0.22 to 6.06 years for female staff.

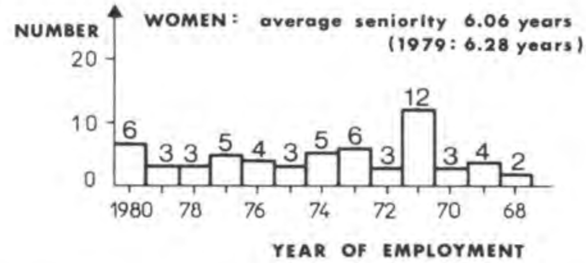

Fig. 16 b: Seniority of ILL staff (women).

Sick leave

Fig. 17 shows the percentage for 1980 of sick leave in relation to the theoretical number of calendar days and the breakdown by reasons for absence.

2.3% in 1980

illness	2354
ind. acc.	457
maternity	647
cures	105
TOTAL	3563 **days**

Fig. 17: Absences (illness, maternity, industrial accidents, health cures) representing 2.3 % of the number of calendar days.

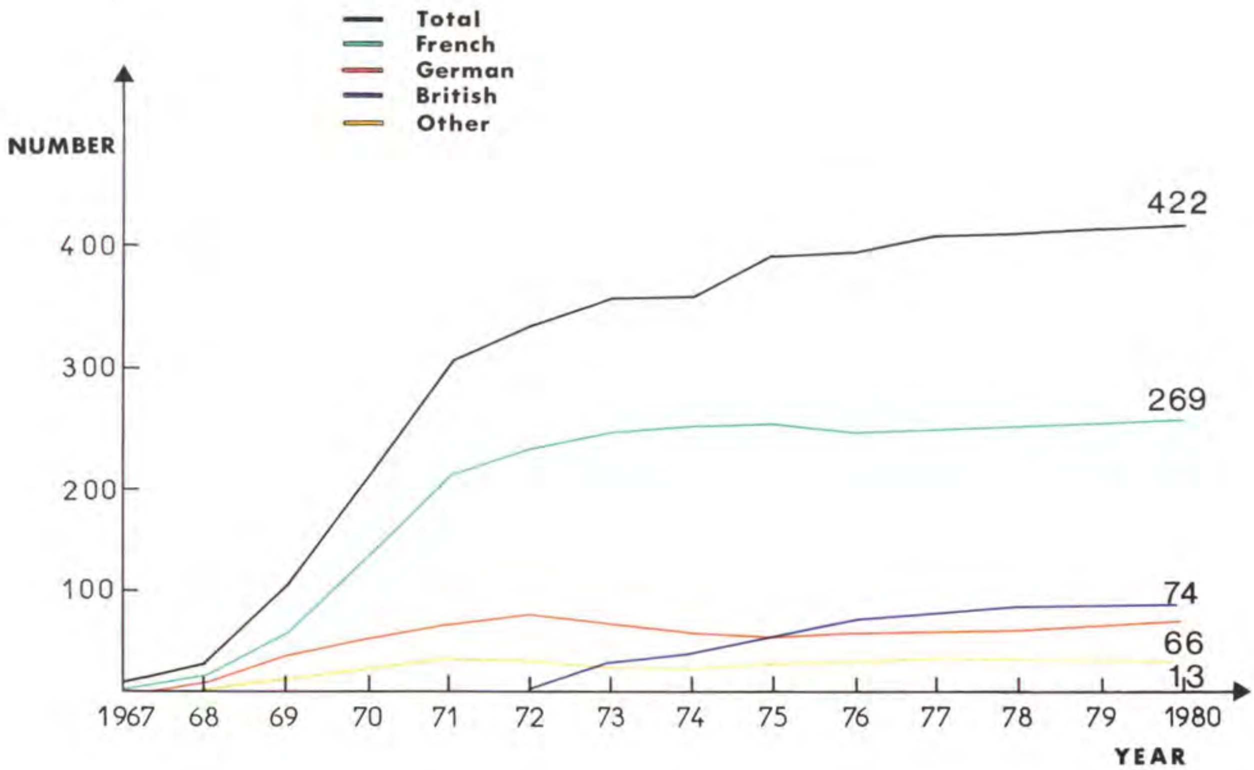

Fig. 14: Staff changes 1967 to 1980.

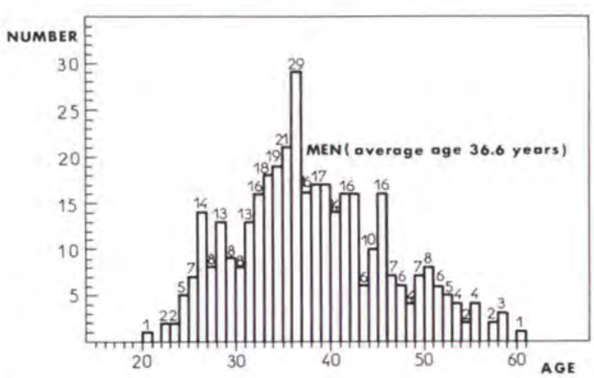

Fig. 15 a: Age structure of the ILL (men).

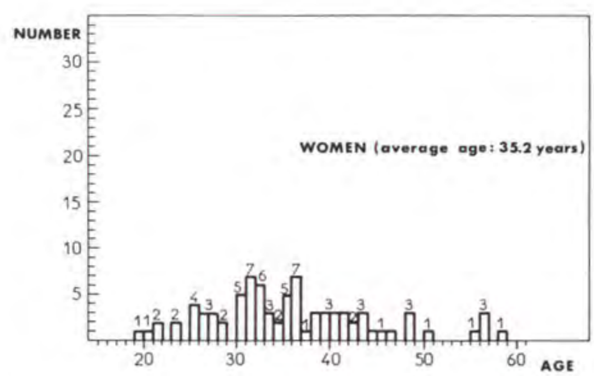

Fig. 15 b: Age structure of the ILL (women).

The considerable number of movements in 1980, 14.50 % in comparison with 11.99 % in 1979, is mainly attributable to the scientific staff, more than 60 % of whom have limited-term contracts.

Salary changes

As regards general salary increases, ILL implements the various measures applied at the CEA. The 1980 Salary Agreements signed at the CEA caused a salary increase of 14.02 %, of which 0.37 % of the payroll is for an improvement in purchasing power, mainly for the lower paid categories.

Age structure

As Fig. 15 shows, the average age of ILL staff is 36.6 years for male and 35.2 years for female staff. The average for all staff is 36.4 years, which is slightly lower than in the previous year. The average age of the scientists, 36.5 years, has not changed in comparison with the previous year.

FINANCE

Budget and Accounts

General Presentation

In 1980 satisfactory progress was made with the implementation of the aims of the Modernisation Programme. The first stages of the construction of the new biology laboratory financed jointly with EMBL (European Molecular Biology Laboratory) and of the new computer building started at the beginning of September. In addition, the installation and commissioning of the new computer will probably take place by the end of 1981. In parallel with this, the construction programmes for the new instruments are in progress.

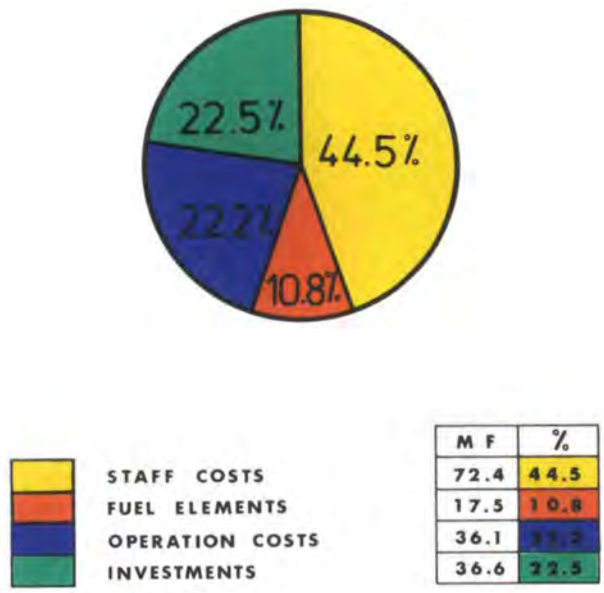

Fig. 18: Display of the budget 1980 (normal budget and budget of the renewal programme).

Modernisation Programme Budget

The budget authorised in 1980 for the Modernisation Programme amounts to 22.9 MF, including 2.6 MF covered by the ILL's own income.

In addition, the sum of 2 MF not used in 1979 was brought forward. The Associates' contributions amount to 22.3 MF (excluding taxes).

The budget headings for the Modernisation Programme are as follows for 1980:

Table 12

	1980 (1 000 F)	% of total
a) Operation		
Consumable materials and small equipment	164	0.7
Staff costs	752	3.4
Other work, supplies and services from third parties	2 861	12.8
Transport, removal and travel expenses	110	0.5
Miscellaneous administrative costs	164	0.7
Total operation expenditure	4 051	18.1
ILL's own income	−2 642	−11.8
Total operation	1 409	6.3
b) Investments		
Buildings	1 303	5.9
Experimental instruments	11 826	53.0
Other investments	7 774	34.8
Total investments	20 903	93.7
Total expenditure	**22 312**	**100.0**

1980 Budget for the Modernisation Programme (excluding taxes).

The Modernisation Programme budget for 1980 is implemented within the medium term investment plan. The beginning of the work on the new buildings in September and the problems associated with the choice of the new computer, which have now been resolved, have not permitted the Institut to implement the whole of its Modernisation Programme budget. The direct consequence of this is that it is necessary to carry forward to 1981 the funds not used in 1980, and to make allowance for this in replanning the medium term financing of the programme.

Normal Budget

The ILL's current operation and investment expenditure is financed annually under the normal budget. For the year 1980 the normal budget as authorised provided for total expenditure of 137.6 MF, 2.9 MF to be covered by ILL's own income and 134.7 MF by the Associates.

In comparison with the previous year, the operation expenditure increased from 111.6 to 122.5 MF (9.8 %). The increases were spread over the whole of the operation budget, particularly the "staff costs" budget (see Fig. 18).

The investment budget was maintained at a constant real level in 1980 in comparison with the previous year, with the aim of giving financial support to the implementation of the first aims of the modernisation programme.

The implementation of the normal budget for 1980 necessitated major economy measures on the part of the management in order to contain the effects of inflation and their immediate repercussions, particularly on the staff costs budget.

In 1980, the fall in the value of money will probably be about 14 %. When the budget was prepared, an inflation rate of 8.8 % was provided for by the ILL over the whole of its normal budget. This comparison shows clearly the financial difficulties which the Institut has had to surmount in the implementation of its budget.

According to the provisional annual accounts for 1980, the normal budget expenditure situation in comparison with 1979 was as follows (excluding taxes):

Table 13

	1979 (× 1 000 F)	% of total	1980 (× 1 000 F)	% of total
a) Operation				
Consumable materials	8 273	6.6	9 221	6.7
Fuel Elements	17 663	14.1	17 526	12.7
Staff costs	62 207	49.6	72 252	52.5
Taxes	331	0.3	276	0.2
Long-term service and supply contracts	10 811	8.6	11 001	8.0
Other work, supplies and services from third parties	7 744	6.2	7 435	5.4
Transport, removal and travel expenses	995	0.8	1 024	0.8
Miscellaneous administrative costs	3 610	2.8	3 816	2.8
Total operation	111 636	89.0	122 551	89.1
b) Investments				
Buildings	320	0.4	383	0.3
Equipment (except experimental instruments)	1 665	1.3	1 763	1.3
Experimental instruments	9 467	7.5	9 991	7.3
Other investments	2 344	1.8	2 802	2.0
Total investments	13 796	11.0	14 939	10.9
Total expenditure	125 432	100.0	137 490	100.0
c) Income				
ILL's own income	4 202	3.4	4 163	2.3
Grants from Associates	121 230	96.6	134 327	97.7
Total income	125 432	100.0	137 490	100.0

Comparison of expenditures in 1980 and 1979.

Implementation of the Budget (1967-1980) and Outlook for 1981

The graph (Fig. 19) showing the implementation of the ILL's budget since the beginning (1967) shows the various phases of the development of the organisation. The period 1967 to 1972 covered the construction of the buildings and of the reactor and its ancillary installations before the reactor went critical at the end of 1971, then normal operation from 1973 to 1979. In 1979 the ILL's Associates decided on the implementation of the aims of the Modernisation Programme under a six-year finance plan.

On the other hand, the curve showing the total budget in "constant francs - 1967 prices" shows the difficulties the Institut has to face increasingly to contain the effects of inflation within the limits of its budget. In 1980 the financial situation of the ILL was particularly difficult in view of the inflationary trend and its immediate effects on the staff costs budget. The inflation rate, which will probably be close to 14 % for the year, is considerably higher than the figures used in the preparation of the budget. In 1981, as in 1980, the ILL will do its best to ensure that major economy measures contribute to the normal operation of the Institut.

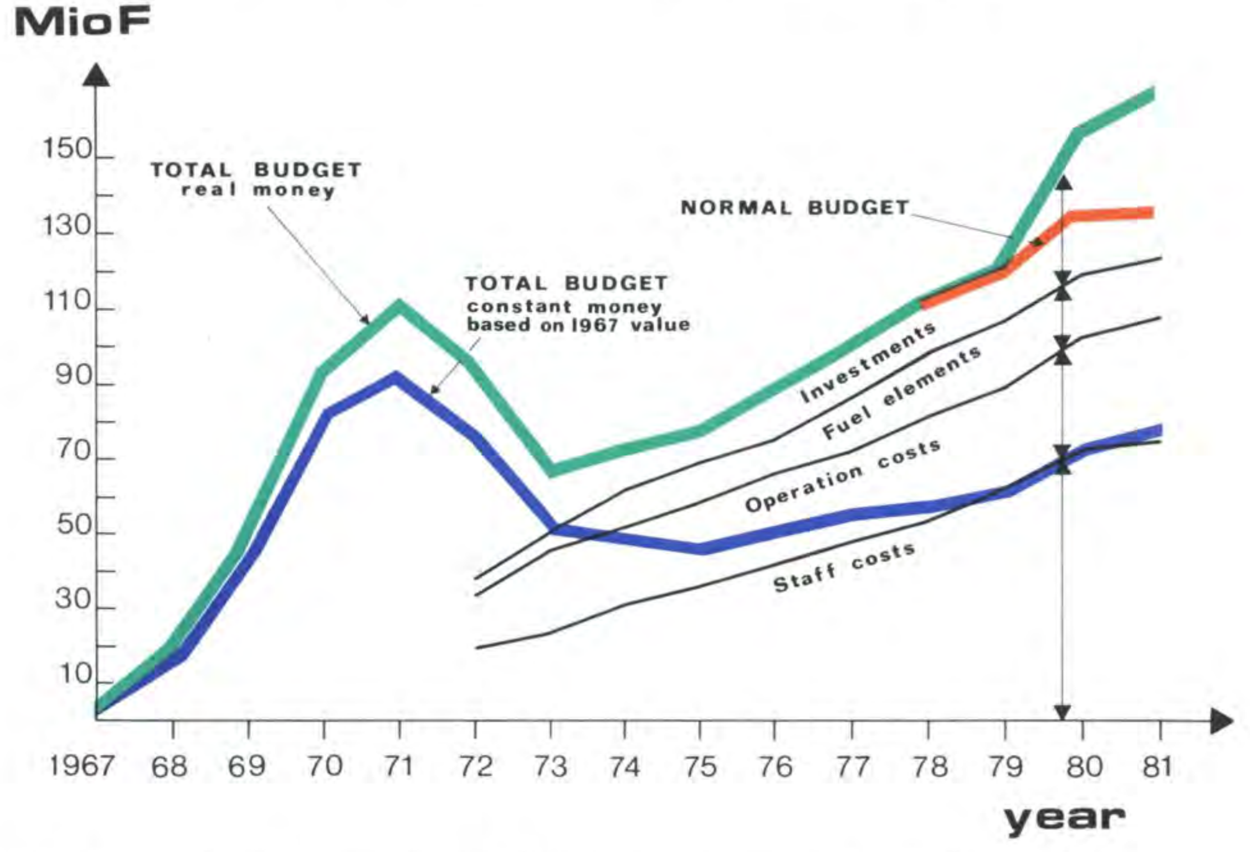

Fig. 19: The budget of the ILL: Implementation 1967 - 1980 and forecast 1981 (money based on the 1980 value).

PURCHASING

1980 was marked by numerous effort and changes in this area in order to improve the distribution of our purchases within the three member countries, with some success.

The percentage of orders in terms of value placed with UK companies came up to 15.3 % of the total against 4.8. % in 1979, and the value alone increased by 248 %: 7.08 Million Francs in 1980 against 2.03 Million in 1979. These results were achieved with the Federal Republic of Germany increasing its traditional share: 14.7 % in 1980, (i.e.: 6.7 MF) when no orders for fuel elements were placed, against 23.2 % in 1979 which included 6.3 MF for fuel elements out of a total of 9.7 MF.

Efforts of the enlarged Purchasing Commission, the Purchasing Group and all other ILL staff involved will continue in 1981 in order to confirm, and if possible improve further this year's more even distribution of orders among the member countries.

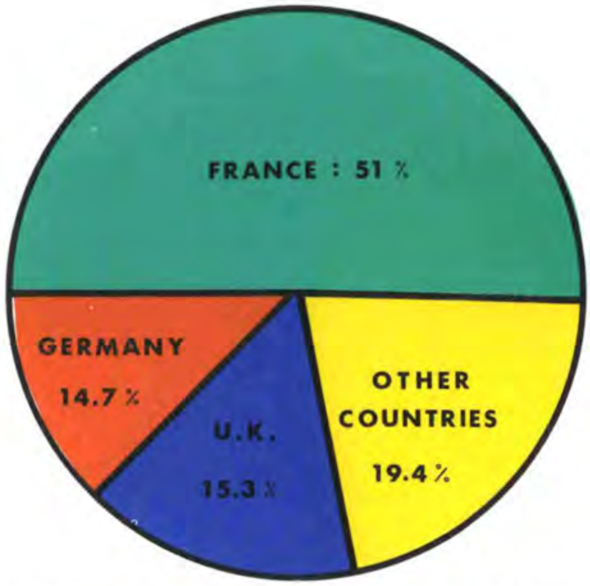

Fig. 20: Distribution of orders in the 3 member states and other countries.

Table 14

	1980		1979		Variation 80/79
	in OOO'FF	% of total	in OOO'FF	% of total	
Total (1)	46 188	100	42 023	100	+ 10 %
France	23 359	51 %	26 559	63.2 %	− 12 %
Germany (2)	6 769	14.7 %	9 742	23.2 %	− 31 %
U.K. (3)	7 085	15.3 %	2 034	4.8 %	+ 248 %
Others	8 974	19.4 %	3 689	8.8 %	+ 143 %

Geographical distribution of orders (Including fuel elements, but not Uranium, reprocessing and other regular contracts such as energy, maintenance, etc.)

1) includes biology & computer building (7.1 MF) and central computer (7.5. MF) but no orders for fuel elements in 1980.

2) includes 1.0 MF for window frames for the biology & computer building.

3) includes 27 % of value (i.e. 2.0 MF) of computer-DEC's statement of European content of manufacture - and 0.2 MF for building.

RELATIONS SOCIALES

This section deals in particular with the reception of staff and guest scientists, the administrative aspects of medical and related problems, travel, training and general services (mail, receptionists, reprography and cafeteria).

Reception

Settling in Grenoble:

New arrivals (new staff and guest scientists) are assisted in finding suitable accommodation. About 40 families have contacted the section and 25 have found accommodation through it.

Schooling: a ministerial decree of 28 May 1980 has made official the status of the "Houille Blanche" International Primary School. In september 1980 there were 40 children of German mother tongue, 15 English and 66 French at this school.

The ILL and the local education authorities are continuing their contacts with the French Ministry of Education with a view to setting up a coherent and efficient structure for the international sections at the "Eaux Claires" secondary school.

Medical and Related Problems

The ILL has a half-time works doctor and a full-time nurse. In addition to medical examinations of staff and long-term guest scientists, the doctor collaborates with group heads in a study of working conditions and takes an active part in the meetings of the Commitee on Health and Safety (CHS).

Medical examinations up to 30.11.80 were as follows:

Regular examinations for ILL staff and long-term guest scientists normally working in restricted areas	538
Examinations prior to recruitment of ILL staff	58
Examinations for long-term guest scientists on arrival	17
Examinations for reactor users arriving without authorization to work under ionizing radiation (3 weeks to 3 months)	45
Examinations on return from sick leave of more than 3 weeks	38
Examinations requested by the staff	11
Examinations requested by the doctor	24

In conjunction with the Departmental Blood Transfusion Centre, two blood donor sessions were organised, and 92 persons gave blood. Twelve staff members have received the voluntary blood donor diploma issued by the French Ministry of Health.

The Welfare Assistant is at the ILL twice a week. She has had approximately 470 visits during the year. She has made 25 hospital visits and 12 visits to the homes of ILL staff at their request. She attends meetings of the "Société Mutualiste du Personnel", particularly to submit special requests for financial assistance from this organization where financial problems arise, for example in connection with illness, hospitalization or expensive treatment. She attends meetings of various sub-committees of the Works Committee: committees on assistance, holidays, etc... The Welfare Assistant also enrols the children of staff in summer or winter holiday centres: 127 children have benefited from holidays subsidized by the Works Committee. In addition to her days at the ILL, the Welfare Assistant deals with the necessary formalities with the Family Allowances organization for new applications or complaints (76 cases in 1980). She is also regularly in contact with the various welfare organizations in Grenoble and the Isère department.

Guest scientists

The graph below shows the increase in the number of guest scientists, which has more than quadrupled since 1973.

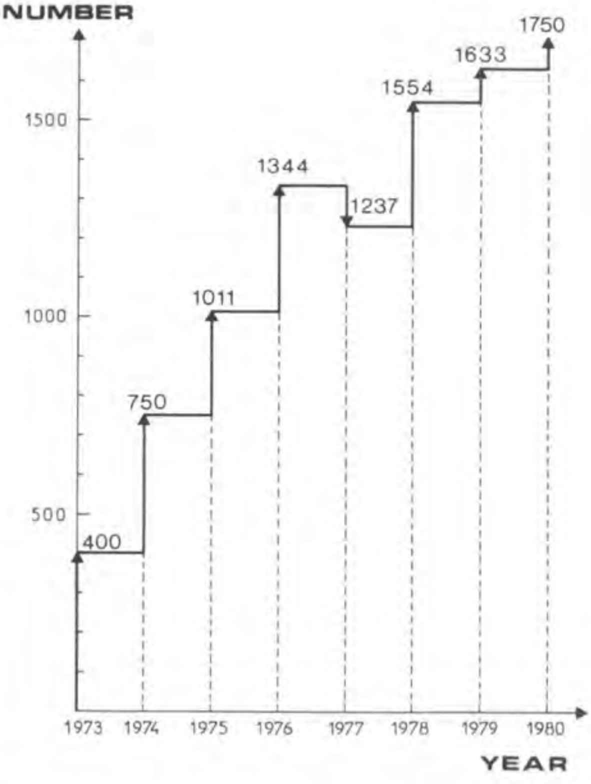

Fig. 21: The development of the number of guest scientists.

This Section deals with:

— the reception of the scientists (accommodation, schooling for children, French courses, leaflets and information to assist long-term visitors to settle in Grenoble).

— administrative questions in connection with the guest scientists (liaison with home laboratories on social security, liaison with the medical group and the health physics group, payment of subsistence and travel expenses in agreement with the Scientific Secretariat - related documents and statistics).

Reprography

Two staff, one of whom works half-time, are employed in the reprography workshop, which is equipped with two Gestetner off-set machines and various machines for printing, sorting and binding. The quality of the documents produced by the workshop is appreciated by all: reports for the scientists and for the various departments (e.g. Reactor cycle report, theses for PhD students, the ILL Organigramm, Users Guide to the DEC System 70, etc. and all internal notes and similar documents). Almost 4 000 documents were dealt with by this workshop during the year.

Staff Training

In Spring 1980 a survey based on a questionnaire available at the CNRS Grenoble was carried out among the staff, to obtain a better idea of their wishes, motivation and opinions on various aspects of training. 25 % of the staff concerned replied, anonymously or otherwise. An analysis of the results shows the interest of the staff in training connected with their work ("to obtain a better understanding of one's work, acquire new techniques, keep up with progress"), while not neglecting general culture. A certain number of replies also indicate the clear link between training and professional career. As every year, the "Relations Sociales" / Training Section received about 220 requests for training in September 1980, which were analysed jointly with the applicants, the group and department heads and the Training Sub-Committee of the Works Committee. Almost 80 % of the courses requested were approved under the budget authorized.

Housing Loans

A total of 23 loans for housing, with the aid of the "1 % fund", were awarded, averaging 35,500 Francs (including 5 for the purchase and improvement of or simply the improvement of "old" accommodation, in comparison with 10 and 18 loans during the two previous years). One employee has obtained a loan from IPRIS (Institution de Prévoyance et de Retraites Interprofessionnelle de Salariés) for a house for his retirement.

In future years the new rules which set a limit on grants as a function of income are likely to be unfavourable to ILL scientists and engineers.

Origin of proposals submitted to the ILL during 1980

Photo O. : (A. Bresson)

A fish-eye's view of the ILL.

9

MISCELLANEOUS

EXPERIMENTS CARRIED OUT AT THE ILL

The following is the list of the experiments performed at the ILL in 1980 for which experimental reports were received before January 10, 1981. (It also includes some reports submitted in 1980 for experiments performed previously).

Please refer to the Annex of the Annual Report 1980 for a detailed study of the results.

(* Reports marked with an asterisk are not available for publication).

COLLEGE 3 (Fundamental and Nuclear Physics)

03 01 076	See 03 11 069	
03 01 082 03 01 084	Spectroscopy on mass chains A = 99 and A = 131. E. Monnand, J.A. Pinston, F. Schussler (CEN-G) H. Lawin, Kawade (Jülich)	PN1
03 01 086 03 11 059	Q_β-measurements of light fission products in the vicinity of the neutron number N = 50. F. Münnich, H. Berg, U. Keyser, B. Pahlmann (Braunschweig) H. Weikard, K. Hawerkamp (Braunschweig and ILL) B. Pfeiffer, H. Schrader (ILL) E. Monnand (CEN-G)	PN1
03 11 044	Nuclear charge distribution in symmetric mass-region. J.P. Bocquet, J. Crançon, C. Ristori, H. Nifenecker (CEN-G) R. Brissot, J. Mougey (ILL)	PN1
03 11 045	Kinetic energy distributions for symmetric fission of U^{236}. J.P. Bocquet, C. Ristori, J. Crançon, H. Nifenecker (CEN-G) R. Brissot (ILL)	PN1
03 11 048	Alpha accompanied fission of ^{236}U investigation of the low energy part of the alpha spectrum. F. Caitucoli (CEN-G) G. Barreau (ILL) T. Benfoughal, N. Carjan, T.P. Doan, F. El Hage, A. Sicre, B. Leroux (CEN Bordeaux-Gradignan)	PN1
03 11 052	Nuclear charge distribution of heavy mass region fission products and isomeric yield ratios (chains 138 and 141, ^{235}U (n_{th}, f). W. Pörsch, H. Braun, H.O. Denschlag, R. Sehr, B. Sohnius (Mainz) H. Schrader (ILL)	PN1
03 11 055	Kinetic energy distributions for symmetric fission of U^{233}. D. Belhafaf, J.P. Bocquet, J. Crançon, H. Nifenecker, C. Ristori (CEN-G) R. Brissot, J. Mougey (ILL)	PN1
03 11 059	See 03 01 086	
03 11 062	Search for high kinetic energy discrete spectrum in U^{235} (n,f) J.P. Bocquet, J. Crançon, G. Mariolopoulos, H. Nifenecker, C. Ristori (CEN-G) R. Brissot, H. Faust, F. Gönnenwein, J. Mougey (ILL)	PN1
03 11 063	Nuclear charge distribution of heavy mass region fission products at various kinetic energies and ionic charge states [chains 143-145 in ^{235}U (n_{th},f)]. H.O. Denschlag, B. Sohnius, Z. Alfassi, H. Braun, W. Pörsch (Mainz) H. Faust (ILL)	PN1
03 11 065	Plasma delays in radiation damaged semiconductor detectors. E.C. Finch, C.F.G. Delaney, G.E. Nolan (Dublin)	PN1
03 11 068	Time of flight measurements on fission fragments. A. Oed, G. Barreau, P. Perrin, F. Gönnenwein (ILL) C. Ristori (CEN-G) P. Geltenbort (Tübingen)	PN1
03 11 069	Search for micro-second isomers in A = 100 and A = 130 mass chains. G. Battistuzzi (Jülich) E. Monnand, F. Schussler (CEN-G) B. Pfeiffer (ILL)	PN1
03 02 094	See 03 02 101	
03 02 100 03 02 118	Measurements of the angular distribution of the photoelectric effect as a function of photon energy for Z = 92. S. Blakeway (Manchester and ILL) K. Schreckenbach, H.R. Faust (ILL) W. Gelletly (Manchester)	PN2
03 02 101 03 02 094	Study of the $^{194}Pt(n,\gamma)^{195}Pt$ reaction. D.D. Warner (Brookhaven and ILL) H.G. Börner, G. Barreau (ILL) R.F. Casten, M.L. Stelts (Brookhaven)	PN3
03 02 118	See 03 02 100	
03 02 122 03 02 136	Radiative decay modes in ^{74}Ge. C. Hofmeyr (Pelindaba and ILL) G. Barreau, H. Börner, R. Brissot (ILL)	PN3, PN4
03 02 134 03 02 156	Reinvestigation of low-lying states in ^{134}Cs. M. Bogdanovic, J. Simic (Belgrade) R. Brissot, G. Barreau, K. Schreckenbach (ILL)	PN2, PN3
03 02 135	Determination of primary γ-rays after double neutron capture in ^{74}Se. Y. Tokunaga, O. Schult (Jülich) C. Hofmeyr, H.G. Börner (ILL)	PN4

03 02 135	Nuclear structure study of ^{75}Se by thermal neutron capture γ-ray spectroscopy. Y. Tokunaga, O.W.B. Schult (Jülich) G. Barreau, H.G. Börner, R. Brissot, H. Faust (ILL)	PN3, PN2
03 02 136	See 03 02 122	
03 02 138	The level structure of ^{114}Cd. A. Mheemed, J. Valentin (ISN Grenoble) H.G. Börner, H.R. Faust, K. Schreckenbach, R. Brissot, G. Barreau, T. von Egidy (ILL)	PN2, PN3
03 02 140	Detailed study of the ^{28}Al level structure by means of ^{27}Al (n,γ). H. Daniel, H.H. Schmidt, T. von Egidy (München) K.P. Lieb (Göttingen) P. Hungerford, H.G. Börner, R. Brissot (ILL)	PN3
03 02 141	Prompt gamma rays in the ^{109}Ag(n,γ)^{110}Ag reaction. T.D. MacMahon, T. Mitsunari (London)	PN3, PN4
03 02 146	QED-effects and photonuclear interaction close to the neutron emission threshold. M. Schumacher, F. Smend, P. Rullhusen, W. Mückenheim (Göttingen) H.G. Börner (ILL)	PN3
03 02 147	See 03 02 171	
03 02 150	The ^{135}Ba(n,e$^-$)^{136}Ba reaction. W. Gelletly (Manchester)	PN2
03 02 151	Study of EO transitions from K=0$^+$ bands in ^{188}Os and ^{196}Pt. W.R. Kane (Brookhaven) H.R. Faust, K. Schreckenbach (ILL)	PN2
03 02 155	Radiative decay modes in ^{74}Ge. C. Hofmeyr (Pelindaba and ILL) H. Faust, K. Schreckenbach (ILL)	PN2
03 02 156	See 03 02 134	
03 02 165	Coulomb corrections to Delbrück scattering investigated in the energy range 8-11 MeV. M. Schumacher, W. Mückenheim, P. Rullhusen, F. Smend (Göttingen)	PN3
03 02 170	Relative and absolute measurement of the shape of the β-spectra in neutron induced fission of ^{235}U and ^{239}Pu. A.A. Hahn, J.L. Vuilleumier (Pasadena) F. von Feilitzsch (München) H.R. Faust, K. Hawerkamp, K. Schreckenbach (ILL)	PN2
03 02 171 03 02 147	Measurement of the transverse polarisation of photo-electrons produced by unpolarised γ-rays. S. Blakeway (Manchester and ILL) W. Gelletly (Manchester) H. Faust, K. Schreckenbach (ILL) J. Byrne (Sussex)	PN2
03 02 172	S- and p-electron densities of In compounds in the near zone of the nucleus. G.M. Kalvius (München) K. Schreckenbach (ILL)	PN2
03 03 136	Low-lying states of Ba^{144} and ^{146}Ba from conversion electron and γ-ray measurements. E. Monnand, J. Pinston, F. Schussler (CEN-G) B. Pfeiffer, G. Jung (ILL)	PN6
03 03 147	Fragment energy correlation measurements. M. Asghar (Ispra) G. Barreau (ILL) F. Caitucoli, P. Perrin (CEN-G)	IH1
03 03 154 03 03 174	Q_β-measurements of neutron-rich Cs isotopes using the mass separator OSTIS. F. Münnich, U. Keyser, B. Pahlmann (Braunschweig) K. Hawerkamp (Braunschweig and ILL) B. Pfeiffer (ILL)	PN6
03 03 155 03 03 175	Q_β-measurements of very neutron-rich Rb isotopes using the mass separator OSTIS. F. Münnich, U. Keyser, B. Pahlmann (Braunschweig) K. Hawerkamp (Braunschweig and ILL) B. Pfeiffer (ILL)	PN6
03 03 157	γγ-coincidence measurements on ^{95}Rb decay. E. Monnand, J.A. Pinston, F. Schussler (CEN-G) B. Pfeiffer, G. Jung (ILL)	PN6
03 03 158 03 03 172	Spectroscopy of β-delayed neutrons in coincidence with γ-rays depopulating excited states in the final nucleus. K.L. Kratz, A. Schröder, O. Tharun, M. Kronenburg, Prussin (Mainz) L.J. Alquist (Giessen) G. Jung, B. Pfeiffer (ILL)	PN6
03 03 160	Spin assignments and multipole mixing ratio measurements in ^{140}Ba. W.D. Hamilton, S. Robinson W. Snelling (Sussex) P. Hungerford, B. Pfeiffer, G. Jung (ILL)	PN6
03 03 161 03 03 185	Study of (n,α) - and (n,f)-reactions for several heavy isotopes. C. Wagemans, P. D'Hondt, A. Deruytter, Allaert, De Clercq (Mol) G. Barreau (ILL) A. Emsallem (Lyon)	H22D
03 03 167	See 03 03 188	
03 03 169	See 03 03 188	
03 03 172	See 03 03 158	
03 03 173	Delayed neutron energy spectra from ^{93,94,95}Rb by time of flight. G.I. Crawford, J.D. Kellie (Glasgow)	PN6
03 03 174	See 03 03 154	
03 03 175	See 03 03 155	

03 03 178*	Directional correlation measurements in $^{143,145}La$ and ^{145}Ce. D. Hamilton, M. Snelling, S. Robinson (Sussex) G. Jung, B. Pfeiffer (ILL) E. Monnand, J. Pinston, F. Schussler (CEN-G)	PN6
03 03 179	The β^--decay of ^{99}Sr ($T_{1/2}$ = 290 ms). E. Monnand, J.A. Pinston, F. Schussler (CEN-G) B. Pfeiffer (ILL) J. Münzel (Giessen)	PN6
03 03 180	Half live measurements on γ-lines of neutron rich strontium and barium isotopes. J. Münzel (Giessen) E. Koglin, B. Pfeiffer (ILL)	PN6
03 03 181	Conversion electron measurements in the mass chains A = 145 and A = 147. F. Schussler, J.A. Pinston, E. Monnand (CEN-G) B. Pfeiffer (ILL) J. Münzel (Giessen) H. Lawin (Jülich)	PN6
03 03 182	Fragment energy correlation measurements. M. Asghar (Ispra) G. Barreau (ILL) F. Caitucoli, P. Perrin (CEN-G)	IH1
03 03 184	Search for symmetric fission in the thermal neutron induced fission of low Z-actinides. C. Wagemans, P. D'Hondt, Allaert (Mol) P. Perrin (ILL) F. Caitucoli (CEN-G)	IH1
03 03 185	See 01 03 161	
03 03 186	Charge distribution of ^{229}Th induced fission. G. Mariolopoulos, J.P. Bocquet, H. Nifenecker, C. Ristori (CEN-G) R. Brissot (ILL)	S51
03 03 188* 03 03 167 03 03 169	γγ correlation experiments. D. Hamilton, S. Robinson (Sussex) P. Hungerford, M. Snelling (ILL)	H22
03 03 189	Stability of Macrofol KG, a solid state nuclear track detector, to cold neutron exposure. H.O. Denschlag, B. Sohnius (Mainz) H.G. Börner, R. Brissot (ILL)	H17
03 03 Test	Test of high temperature ion source. J. Münzel (Giessen) B. Pfeiffer, G. Jung (ILL)	PN6
03 05 003	See 03 05 023	
03 05 021	See 03 05 023	
03 05 023	Parity violating neutron spin rotation. (Ispra), (Harvard), (Oak Ridge), (Rutherford), (Sussex)	S43, PN7
03 05 027	A search for neutron-antineutron transitions using free neutrons. M. Baldo-Ceolin, G. Fidecaro (Padua) K. Green (Birmingham) (CERN), (Rutherford), (Sussex)	H18
03 05 028	Development of Fresnel diffraction techniques. A.G. Klein, G.I. Opat (Melbourne) R. Gähler (ILL)	H18

COLLEGE 4 (Inelastic scattering in simple solids)

04 01 154	Lattice dynamics of anthracene. E.L. Bokhenkov, E.F. Sheka (Chernogolovka) U. Schmelzer, J. Kalus (Bayreuth) G.S. Pawley, S.L. Chaplot (Edinburgh) I. Natkaniec (Krakov) B. Dorner (ILL)	IN3
04 01 160	Phonons in systems of highly anisotropic molecules; p-dibromo tetrafluoro-benzene. G.S. Pawley, S. Overell, D. Kirin (Edinburgh) G.A. Mackenzie (Riso) W. Fitzgerald (ILL)	IN3
04 01 161	Phonons in TCNE S.L. Chaplot, A. Mierzejewski (Edinburgh) J. Lefebvre (ILL)	IN3
04 01 163	Smectic B phase of TBBA. J.J. Benattar, F. Moussa (LLB, Saclay) A.M. Levelut (Orsay)	IN12
04 01 164	Phonon dispersion in NbO. P. Roedhammer, J. Hufnagl (Konstanz) W. Reichardt (Karlsruhe)	IN8
04 01 166 04 01 182	Phonon anomalies in transition metal nitrides: HfN. A.N. Christensen (Aarhus) W. Kress (Stuttgart) N. Lehner (ILL)	IN8, IN1
04 01 171	Study of electron-phonon interaction in Mg and $Mg_{.75}Cd_{.25}$. A. Rumyantsev, P. Alekseev, A. Chernyshov (Moscow) B. Dorner (ILL)	IN2
04 01 172	Anharmonicity in PdD_x. J.P. Burger (Orsay) G. Pepy (Saclay, LLB) O. Blaschko, P. Weinzierl, R. Klemencic (Seibersdorf)	IN8
04 01 173	Magnetic contribution to the phonon frequencies of iron. C.G. Windsor (Harwell) A.M.B.G. de Vallera (Lisbon)	IN3
04 01 177	Acoustic modes in K_2ZnF_4. R. Geick, K. Strobel, H Rauh (Würzburg) W.G. Stirling, N. Lehner, J. Bouillot (ILL)	IN3
04 01 179	H-potential in α-TaH_x. A. Kollmar (ILL) D. Richter, R. Hempelmann (Jülich)	IN1
04 01 180	Phonons in graphite intercalation compounds. I. Rosenman, F. Batallan (ENS, Paris) H. Lauter (ILL)	IN8
04 01 182	See 04 01 166	
04 01 183	Phonon dispersion in EuS H. Bohn, W. Press (Jülich) W. Kress (Stuttgart)	IN8

04 01 185	Lattice dynamics of anthracene. E.L. Bokhenkov, E.F. Sheka (Chernogolovka) I. Natkaniec (Krakov) J. Kalus, Jindal, U. Schmelzer (Bayreuth) B. Dorner (ILL) G.S. Pawley, S.L. Chaplot (Edinburgh)	IN3
04 01 187	Phonons in TCNE. S.L. Chaplot, A Mierzejewski (Edinburgh) J. Lefebvre (ILL)	IN3
04 01 188	Phonons in the OD phase of C_2Cl_6. P. Gerlach, J. Lefebvre (ILL) W. Prandl (Tübingen)	IN2
04 02 084	Phonon dispersion curves near the displacive transition temperature in an InTl alloy. D. Abbé, P. Costa (ONERA, Châtillon)	IN3
04 02 085	Phonon frequencies for (110) TA_2 modes in a CuZnAℓ cubic B_2 alloy. D. Abbé, P. Costa (ONERA Châtillon)	IN3
04 02 087	Dynamics in the plastic phase of KOD. H.J. Bleif, H Dachs, M. Kabs (Berlin)	IN2
04 02 097	Charge density waves in TTF-TCNQ under pressure: lock-in. R. Comes, S. Megtert (Orsay) C. Vettier, R. Pynn (ILL)	IN8
04 02 098 04 02 121	Structural phase transformation in Rb_2ZnCl_4. M. Quilichini, R.M. Pick (Paris)	IN2, IN3
04 02 100	Study of some phonon frequencies and their thermal behaviour in α-$LiIO_3$. J.M. Crettez (Dijon) J.C. Damien (Lille) J. Bouillot, J. Lefebvre (ILL)	IN3
04 02 102	Neutron scattering study of the incommensurate phases of $BaNaNb_5O_{15}$. C. Joffrin (ILL) C. Lamborelle, J.C. Toledano, J. Schneck (CNET, Bagneux)	IN2
04 02 103	Measurement of critical phonons in the mixed crystals $Ba_xSr_{1-x}TiO_3$. B. Jannot (Dijon) J. Bouillot, C. Escribe (ILL)	IN1, IN8
04 02 104	Central peak in Hg_2Cl_2. J.P. Benoit, G. Hauret (Orsay)	IN3
04 02 106	Diffusion rotationnelle dans CBr_4. M. More (Lille) J. Lefebvre (ILL) B. Hennion (LLB, Saclay)	IN8
04 02 116	Incommensurate phase of $NaNO_2$. D. Durand, F. Denoyer (Orsay) L. Bernard (ILL)	IN2, IN12
04 02 117	Incommensurable phase transitions in biphenyl. H. Cailleau, J. Meinnel (Rennes) F. Moussa (LLB, Saclay) C. Zeyen, J. Bouillot (ILL)	IN12
04 02 119 04 02 120	Neutron study of the incommensurability in d-$TMAZnCl_4$. R. Almairac, M. Ribet (Montpellier) J. Lefebvre (ILL) G. Marion (Lille)	IN3
04 02 120	See 04 02 119	
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04 02 125	Study of local disorder in substituted adamantanes: cyano-adamantane ($C_{10}D_{15}C{\equiv}N$). J. Lefebvre (ILL) J.L. Sauvajol, J.P. Amoureux, M. Bee, R. Fouret (Lille)	IN3
04 02 127	Corrélations dans la phase plastique de CBr_4. M. More (Lille) J. Lefebvre (ILL)	IN12
04 02 128	Phonons in RbCN. K.D. Ehrhardt, W. Press (Jülich)	IN8
04 02 130*	Sublattice melting in Ag_2S. G. Collin, J.P. Boilot (Orsay) L. Bernard (ILL)	IN2
04 02 132	High resolution studies of critical scattering in ND_4Br and quasielastic scattering in $(KCN)_{0.25}(KBr)_{0.75}$. J.M. Rowe, J.J. Rush (Washington) K.H. Michel (Saarbrücken)	IN10
04 03 36	Temperature dependence of magnetic excitations in the ISDW phase of a Cr-Re alloy. K. Mikke, Jankowska (Swierk) J.G. Booth (Salford) K.R.A. Ziebeck (ILL)	IN8
04 03 088	Influence of local ordering on the spin waves in NiMn alloys. M. Hennion, B. Hennion (LLB, Saclay) P.v. Blanckenhagen (Karlsruhe)	IN8
04 03 091	Spin wave dispersion and exchange interactions in EuS. H. Bohn, W. Zinn (Jülich) A. Kollmar (ILL)	IN2
04 03 098	Spin waves in amorphous ferromagnets. D.McK. Paul, R.A. Cowley (Edinburgh) N. Cowlam (Sheffield) W.G. Stirling (ILL)	D5
04 03 101	Magnon dispersion on $Pd_2MnIn_{1-x}Sn_x$. P.J. Webster, R.M. Mankikar (Salford) K. R.A. Ziebeck (ILL)	IN8
04 03 108	Magnetic ordering in praseodymium at millikelvin temperatures K.A. McEwen (Salford) W.G. Stirling (ILL)	IN2
04 03 111	Magnetic excitations in FeI_2. D. Petitgrand, B. Hennion (LLB, Saclay) C. Escribe (ILL)	IN2
04 03 113	Magnetic excitations and magnetoelastic coupling in TbCu antiferromagnet. B. Hennion (LLB, Saclay) J. Pierre (CNRS, Grenoble)	IN2

04 03 120	Magnons in a 3d helical intermetallic compound. P.J. Webster, R.M. Mankikar (Salford) K.R.A. Ziebeck (ILL)	IN8
04 03 123	Magnon dispersion in $Pt_3(Cr, Mn)$ alloys. D.E.G. Williams (Loughborough) K.R.A. Ziebeck (ILL)	IN8
04 03 124	Magnetic excitations in antiferromagnetic iron oxide in function of stoichiometric composition. G.E. Kugel, C. Carabatos (Metz) B. Hennion (LLB, Saclay)	IN8
04 03 125	Magnetic excitations in TmCu. P. Morin, D. Schmitt (CNRS, Grenoble)	IN2
04 03 129	Magnetic excitations in Cobalt. K.R.A. Ziebeck (ILL) W. Prandl (Tübingen)	IN1
04 03 132	Breakdown of spin waves and eventual spin diffusion in the 1-D ferromagnet $CsNiF_3$. M. Steiner, K. Kakurai (Berlin) B. Dorner, R. Pynn (ILL)	IN12
04 03 133	Collective excitations in the 1-D ferromagnet $CsFeCl_3$ with singlet ground state. M. Steiner, K. Kakurai (Berlin) B. Dorner (ILL) U. Happek (Regensburg) P. Day (Oxford)	IN2
04 03 134	Excitations in $RbFeCl_3$. D. Petitgrand, P. Radhakrishna, B. Hennion (LLB, Saclay) C. Escribe (ILL)	IN3
04 03 135 04 03 145	Soliton excitations in TMMC. Evidence for soliton excitations in the 1-D antiferromagnet TMMC. J.P. Boucher, L.P. Regnault, J. Rossat-Mignod (DRF, CEN-G) J.P. Renard (Orsay)	IN12
04 03 137	Magnetic excitations in quadrupolar coumpound $Tm_{0.9}Lu_{0.1}Zn$. P. Morin, D. Schmitt (CNRS Grenoble)	IN2
04 03 138	Magnetic excitations in the mixed halide $Fe_{.87}Co_{.13}Cl_2$. K.R.A. Ziebeck (ILL) A.D. Woods, P. Day (Oxford)	IN2
04 03 145	See 04 03 135	
04 03 149	Dynamic susceptibility in incommensurate chromium. S.K. Burke, K.R.A. Ziebeck (ILL) J.G. Booth (Salford)	IN8
04 03 152	Spin wave excitations in manganite (MnOOH) between 13 K and 65 K. F. Kasper, H. Dachs, A. Axmann (Berlin)	IN3
04 03 158	Magnetic excitations in CeBi. J. Rossat-Mignod, D. Delacotte (DRF/DN, CEN-G)	IN8
04 03 160	Spin waves in disordered Pd_3Fe. D.McK. Paul (Edinburgh) W.G. Stirling (ILL)	IN1
04 03 162	Magnetic excitations in $Eu_xSr_{1-x}S$. H. Maletta, W. Zinn (Jülich)	IN12
04 03 163	Spin-wave renormalization in EuS. H. Bohn, W. Zinn (Jülich)	IN2
04 04 065	Polarization analysis of spin-wave scattering in K_2CuF_4. C. Perry, J. Sokoloff (Boston) V. Wagner (Braunschweig)	IN3
04 04 068	Critical dynamics of a two dimensional Ising system : Rb_2CoF_4. H. Ikeda (Tokyo) E. Janke (Oxford) M.T. Hutchings (Harwell)	IN12

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05 11 072	Localisation of the oxygen positions in metastable $Rb_{6.3}O$. H.J. Deiseroth (Stuttgart)	D1B
05 11 077	Neutron diffraction of lead fluoride at high temperatures. C. Smith, W. Hayes (Oxford) M.T. Hutchings (Harwell)	D8
05 11 081	Nuclear structure refinement of $K_3Cr(CN)_6$ at 4.2 K. B.N. Figgis, P.A. Reynolds, G.A. Williams (Perth, Australia) A.R.P. Smith (Sussex)	D15
05 11 085	Neutron study of layer silicates. The brittle mica margarite $Ca(A\ell,Li)_{2-3}OH_2/A\ell_2Si_2O_{10}$. W. Joswig, H. Fuess (Frankfurt) Y. Takeuchi (Tokyo)	D8
05 11 086	4.2 K Structure of $Ni(ND_3)_4(NO_2)_2$. B.N. Figgis, P.A. Reynolds, G.A. Williams (Perth, Australia)	D15
05 11 092	A single crystal study of La^{3+} doped CaF_2. J. Corish (Dublin) C.R.A. Catlow (London) A.V. Chadwick (Kent)	D9
05 11 094	Structural investigation of anharmonic behaviour of the ions in the Cu^+ ionic conductor Cu_6PS_5Cl. W.F. Kuhs (Freiburg) G. Heger (Karlsruhe)	D9
05 11 095	Anion disorder at high temperatures in fluorite ThO_2. W. Hayes, P. Schnabel (Oxford) M.T. Hutchings (Harwell)	D15
05 12 073	The high resolution crystal structure of anthracene-d_{10} at low temperature. G.S. Pawley, S.L. Chaplot (Edinburgh)	D15
05 12 121	Anion disorder in CaF_2 at high temperatures. M.H. Dickens, W. Hayes, C. Smith (Oxford) M.T. Hutchings (Harwell)	D15
05 13 066	Proton vibration in hydrogen bonds, $Al(OH)_3$. F. Zigan, W. Joswig (Frankfurt)	D10
05 13 093	Neutron diffraction study of a seven coordinated molybdenum monohydride compound. R. Mathieu, R. Poilblanc, J.M. Savariault (Toulouse)	D8

05 13 094*	H_3O^+ in a sodium phosphotellurate. M. Averbuch-Pouchot, A. Durif (CNRS, Grenoble)	D9
05 13 097	Hydrogen bonds in $SnCl_4$, $4C_6H_{11}OH$. F. Theobald (Besançon) J.M. Savariault, F. Fournet (Toulouse)	D9
05 13 103	Neutron diffraction study of a tungsten hydride $[(Pr^i_2PhP)_3WH_6]$. J.A.K. Howard, J.L. Spencer (Bristol) D. Gregson (ILL)	D8
05 14 097	Charge density studies on SiP_2. T.K. Chattopadhyay, H.G.v. Schnering (Stuttgart) J. Pannetier (ILL)	D9
05 14 098	Electron density study of Cu_2O. K. Fischer, D. Mullen (Saarbrücken)	D9
05 14 099	Dynamic deformation density studies in $Na_2S_2O_6.2H_2O$ and $Na_2S_2O_6.2D_2O$. A. Kirfel, G. Will (Bonn)	D9
05 14 105	Densité électronique de déformation du β DL arabinose à 74 °K. F. Longchambon, R. Wiest, P. Becker (Paris) R. Feld (ILL)	D9
05 14 107	Deformation density in salts of complex anions: sodium thiosulfate $Na_2S_2O_3$. H. Fuess, S.T. Teng, J.W. Bats (Frankfurt) J. Allibon (ILL)	D9
05 14 108	Deformation density in salts of complex anions: $KC\ell O_3$. J.W. Bats, H. Fuess (Frankfurt)	D9
05 14 116	High precision neutron diffraction measurements for electron density work of $C\ell(CO)_4CrCC_6H_5$. E.O. Fischer (Garching) P. Becker (Paris) N.Q. Dao, H. Fevrier, D. Neugebauer (Châtenay-Malabry)	D8
05 15 123	Identification of fast diffusion protons in $H_3O^+\beta''$-alumina. W.L. Roth (New York) M. Anne, D. Tran Qui (CNRS Grenoble) M.S. Lehmann (ILL)	D8, D9
05 15 131	Pressure dependence of the temperature of a displacive phase transition in dimethylnitramine (DMN). G. Bravic (Bordeaux) A. Filhol (ILL)	D15
05 15 132	Etude de la transition de phase du chloranile en fonction de la pression. J.L. Baudour, J. Meinnel (Rennes)	D15
05 15 133	Determination of low temperature structure of PTS monomer. M. Schott, M. Bertaut (GPS, Paris) J.P. Aimé, J. Lefebvre (ILL) J.O. Williams (Aberystwyth)	D8
05 15 135	The phase transformation in urea-inclusion compounds. H. Jagodzinski, H. Boysen, R. Forst (München)	D10
05 15 136	Accurate determination of the pressure dependence of the structures of tetragonal KH_2PO_4 and KD_2PO_4. R.J. Nelmes, G.J. McIntyre, J.E. Tiballs (Edinburgh)	D15
05 15 138	Determination of the low temperature structure of Ni_2MnGa. P.J. Webster, M.S. Peak (Salford)	D12
05 15 140	Pressure dependence of incommensurate magnetic phase of $NiBr_2$. P. Day (Oxford) C. Vettier (ILL)	D1A
05 15 141	Structure of incommensurate low temperature magnetic phase of $NiBr_2$ in an applied field. P. Day (Oxford) K.R.A. Ziebeck (ILL)	D15
05 15 148	Anharmonicity and the structural transition in indium-thallium alloys. S. Wilkins (ILL and Australia) T. Finlayson (Australia) M.S. Lehmann (ILL)	D9
05 15 150	Low-temperature phase transition in alpha-uranium. J.C. Marmeggi (CNRS, Grenoble) A. Delapalme (LLB, Saclay) G.H. Lander (ILL)	D10
05 15 Test	Incommensurate phase in β-$ThBr_4$. C.M.E. Zeyen (ILL) R. de Kouchkowsky (Saclay)	D10
05 16 051	Photographic studies of neutron Laue diffraction related to phase transitions. J.C. Marmeggi (CNRS, Grenoble)	S42
05 16 103	Photographic measurements of protein single crystal intensities. D. Hohlwein (Tübingen) S.A. Mason (ILL)	D12
05 16 108	Study of the spiral spin antiferromagnetic phase of Tb using neutron topography. S.B. Palmer (Hull) J. Baruchel (CNRS, Grenoble) M. Schlenker (ILL)	S20
05 16 109	Investigation of the behaviour of neutrons in Bloch walls as helical magnetic structures. O. Schärpf (ILL) R. Seifert, H. Strothmann (Braunschweig)	D11
05 16 110	Domain distribution in $RbCaF_3$ under biaxial stress. H. Jex, M. Müllner, H. Tietze (Frankfurt) N. Lehner (ILL)	D15
05 16 111	The superstructure of mullite. M. Korekawa, T. Tagai, W. Joswig (Frankfurt)	D8

05 16 114	The space group of $LiTa_3O_8$-type compounds. M. Marezio, H.L. Hodeau (CNRS, Grenoble) A. Santoro, R.S. Roth (Washington)	D12
05 16 118	Co-operative reorientations and the phase transition in T-butyl cyanide. A.J. Leadbetter, R.C. Ward (Exeter) R.M. Richardson (Rutherford)	D7, D8
05 16 119	Study of the incommensurable phase in the monomer and mixed monomer-polymer crystals of PTS. J.P. Aimé, J. Lefebvre, C. Zeyen (ILL) M. Schott, M. Bertaut (GPS, Paris)	D10
05 16 122	The incommensurable phase transition in biphenyl as a function of pressure. H. Cailleau, J. Meinnel, J.C. Messager (Rennes) C. Zeyen, C. Vettier (ILL)	D10
05 16 123	A high resolution neutron diffraction study of the orientation of benzene in $C_{24}K(C_6H_6)_2$. C. Riekel (Stuttgart) A. Hamwi, P. Touzain (Grenoble)	D9
05 16 124	Anharmonicity in $AuCu_3$. G.H. Lander (ILL)	D9
05 17 123	Magnetic behaviour of the quasi two-dimensional mixed system $Rb_2Cr_{1-x}Mn_xCl_4$. G. Münninghoff, E. Hellner, W. Treutmann (Marburg) G. Heger (Karlsruhe)	D15
05 17 125	Study of spiral magnetic modulations in the series RMn_2O_5. G. Wilkinson (London) P. Gardner (ILL)	D12
05 17 133	Magnetization and magnetic structures of mixed metamagnets $Fe_pCo_{1-p}Cl_2$. P. Day, T.E. Wood (Oxford)	D15
05 17 134	Effect of a uniaxial stress on the behaviour of $CeAl_2$. B. Barbara, M.F. Rossignol (CNRS, Grenoble) C. Vettier (ILL) J.X. Boucherle (DRF/DN, CEN-G)	D1A
05 17 140	Magnetic structure of $Co_{1/3}NbS_2$. A.D. Yoffe, E.A. Marseglia, S.S.P. Parkin (Cambridge)	D15
05 21 087	Hydrogen bonding in copper hydroxide. F. Zigan, H. Fuess, W. Joswig (Frankfurt)	D1A
05 21 090	Chemical formula and magnetic structure determinations of $YCu_3Mn_4O_{12}$. A. Collomb (CNRS, Grenoble) J.L. Buevoz (ILL) D. Samaras (Thessaloniki)	D1B
05 21 092	Profile refinement of clay minerals. J.M. Adams (Aberystwyth)	D1A
05 21 105	Structure of M_2UCl_6 where M = Li, Na, K. B.E.F. Fender, A. Fitch (Oxford)	D2, D1A
05 21 106	Crystallographic structure of Y_2O_3, Nd_2O_3 and Nd_2O_2S (at low temperature). M. Faucher (Meudon-Bellevue)	D1A
05 21 109	Crystallite orientation in the tibia of the sheep. G.E. Bacon (Sheffield) R.K. Griffiths (Birmingham)	D1B
05 21 116	Low temperature structure of β-$ThBr_4$. R. Guillaumont, P. Delamoye, M.F. Le Cloarec (IPN, Orsay) R. de Kouchkovsky (CEN, Saclay)	D1A
05 21 121	Structure determination and refinement of ternary oxide phases. P.G. Dickens, D.J. Palmer (Oxford)	D1A
05 21 122	Structure of metastable phases in the $A\ell$-Zn-Mg alloys. J. Bouvaist, M. Régnier (Voreppe)	D1A
05 21 126	Determination of the γ-structure of $LiIO_3$. E. Coquet, M. Crettez (Dijon) J. Bouillot (ILL)	D1A
05 21 127	Neutron powder diffraction of vanadyl phosphate dihydrate. M. Tachez (Saint-Etienne) F. Theobald (Besançon)	D1A
05 21 128	Neutron powder diffraction vanadyl hydroxysulphate. M. Tachez (Saint-Etienne) F. Theobald (Besançon)	D1A
05 22 134	Li based fast ion conductors. C.R.A. Catlow, A. Brah, B.C.H. Steele (London)	D1A
05 22 143	Transformation of three-dimensional three-connected silicon nets in $SrSi_2$. J. Evers, G.Oehlinger (München)	D1A
05 22 146	Research of a cooperative Jahn Teller distortion in NpO_2 single crystal. J.M. Fournier (CEN-G) A. Bœuf, F. Rustichelli, L. Manes (ILL and EURATOM)	D10
05 22 147	See 05 23 169	
05 22 148	Structure determination of the three phases of Rb_2ZnCl_4. M. Quilichini, R.M. Pick (Université VI, Paris) J. Pannetier (ILL)	D1A
05 22 149	Phase transitions in ammonium fluoberyllate $(ND_4)_2BeF_4$. M. Ahtee (Helsinki)	D1A
05 22 150	Structural studies of proustite and pyrargyrite. A.M. Glazer, S. Allen (Oxford)	D1A
05 22 152	Neutron powder diffraction study of α and β-P_4S_3 close to the transition temperature. T.K. Chattopadhyay, H.G. von Schnering (Stuttgart) G.S. Pawley (Edinburgh) J. Pannetier (ILL)	D1B

05 22 157	Structural phase transitions in $RbAlF_4$. A. Bulou, J. Nouet (Le Mans) A.W. Hewat (ILL)	D1A
05 22 160	Unit cell parameters and critical behaviour of order parameter in antiferroelectric phase of TSCC. V.H. Schmidt (USM, Grenoble)	D1A
05 22 162	Pressure and temperature dependence of Debye Waller factors in $KZnF_3$ and $CsCaF_3$. C. Ridou, M. Rousseau (Le Mans) A.W. Hewat, C. Vettier (ILL)	D1A
05 22 163	Localisation de l'hydrogène dans les pyrochlores $H_2Ta_2O_6$, $HTaWO_6$ et H_3OTaWO_6. D. Groult, B. Raveau (Caen) J. Pannetier (ILL)	D1A
05 23 152	Spin density waves in dilute CrRu alloys. R.J. Papoular (CEN Saclay)	D1B
05 23 168	Magnetic structure of europium hexaboride, EuB_6 (pure and doped with carbon). O. Massenet (CNRS, Grenoble) J.M.D. Coey (CNRS, Grenoble and Dublin) J. Etourneau, J.M. Tarascon (Bordeaux)	D1B
05 23 169 05 22 147	Magnetic structure of the neptunium triselenide $NpSe_3$. D. Damien, C.H. de Novion (CEN Fontenay-aux-Roses) A. Tabuteau, Simoni (Paris)	D2,D1B
05 23 175	Nuclear ordering of $PrCu_5$. A. Benoit, J. Flouquet, J. Palleau (CNRS, Grenoble) P. Convert (ILL)	D1B
05 23 180	Détermination de la structure magnétique du composé supra-conducteur ternaire $YbMo_6S_8$. P. Bonville (CEN Saclay)	D1B
05 23 183	Magnetic structure of $GdBe_{13}$. M. Bonnet, A. Herr, F. Vigneron (LLB Saclay)	D4
05 23 185	Structural and magnetic studies on some mixed metal oxides. A.K. Cheetham, D.A.O. Hope (Oxford)	D1A
05 23 200	Magnetic phase diagram of Cr-Ge alloys. J.G. Booth (Salford) M.M.R. Costa (Coimbra) K.R.A. Ziebeck (ILL)	D2
05 23 204	Crystallographic and magnetic structure of cobalt vanadate $Co_3V_2O_8$. H. Fuess, R. Müller (Frankfurt)	D1A
05 23 210	Structural and magnetic studies on some mixed metal oxides. D.A.O. Hope, A.K. Cheetham (Oxford)	D1A
05 23 216	Magnetic structure of $Ti_{.40}Mn_{.60}$-hydride. R. Hempelmann, E. Wicke (KFA, Jülich) D. Fruchart (CNRS, Grenoble) J. Pannetier (ILL)	D1B
05 24 117*	Ar on graphite. P. Thorel (DRF, CEN-G) C. Marti, B. Croset (ILL) T. Ceva (Paris)	D17
05 24 127	Further diffraction studies of the adsorption of hydrophylic polymers by montmorillonite and by laponite, a synthetic hectorite-type clay mineral. M.H.B. Hayes, D.K. Ross, J.I. Langford, W.R. Livingston, R. Harrison (Birmingham)	D16
05 24 145	Structure of acetylene monolayer physisorbed on papyex. P. Thorel, J.M. Allonneau (CEN-G) G. Bomchil, C. Marti (ILL) T. Ceva (Paris)	D1B
05 24 151	Neon on graphite. H.J. Lauter (ILL) C. Tiby, H. Wiechert (Mainz)	D2
05 24 153	The melting properties of two dimensional clusters. T. Rayment, E. Matthews (Oxford)	D2
05 24 155	Study of calcium deuteroxide dehydration. D. Ciosmak, J.C. Niepce, O. Pluchery (Dijon) J. Bouillot (ILL) F. Freund (Köln)	D1B
05 24 157	Neutron powder diffraction study on the electrochemical reaction of Mo_6S_8 with Li^+ and Cu^{2+} electrolytes. C. Riekel (Stuttgart) R. Schöllhorn (Münster)	D1B
05 25 124*	Diffusion paths in perovskite-like structure $(Na,Ca)_nNb_nO_{3n+2}$. J. Galy, J.M. Savariault (Toulouse) P. Aldebert (Paris)	D1B
05 25 129	Neutron diffraction studies of the cubic $ZrCr_2D_x$ and $ZrV_2D_x(H_x)$ phases. D. Fruchart (DRF, CEN-G) A. Rouault (INPG, Saint-Martin-d'Hères) C.B. Shoemaker, D.P. Shoemaker (Oregon)	D1B
05 25 130	Reaction kinetics of hydrothermal crystallization of amorphous $Fe(OD)_3$ to α-FeOOD and α-Fe_2O_3. A.N. Christensen (Aarhus) M.S. Lehmann (ILL)	D1B
05 25 131	A kinetic study on the intercalation of potassium vapour into graphite single crystals. C. Riekel (Stuttgart) A. Hamwi, P. Touzain (Saint-Martin-d'Hères)	D1B
05 25 132	Neutron diffraction study on the phase diagram Li/TiS_2. C. Riekel (Stuttgart) R. Schöllhorn (Münster)	D2
05 31 049	Form factor and magnetization density in NpO_2. A. Delapalme (LLB, Saclay) M. Forte (Ispra) J.M. Fournier (DRF, CEN-G)	D3, D1B
05 31 051	The low temperature atomic structure and antiferromagnetism of K_xVF_3. J.B. Forsyth (Rutherford) P.J. Brown (ILL)	D15

05 31 061	The spatial distribution of the field-induced moment in K_xVF_3 at 4.2 K. J.B. Forsyth (Rutherford) P.J. Brown (ILL)	D3
05 32 091	Magnetization density in USn_3. G.H. Lander (Argonne) A. Delapalme (LLB, Saclay)	D3
05 32 093	The paramagnetic moment and band structure of $NbSe_2$. K.R.A. Ziebeck, P.J. Brown (ILL)	D3
05 32 099	Polarised neutron diffraction and spin density in $Cs_2KFe(CN)_6$, a low-spin $3d^5$ compound. P. Day (Oxford) A. Lüdi, H.U. Güdel, P. Bernhard (Bern) P. Fischer (Würenlingen)	D3
05 32 108	Spin density and bonding in the $[CoCl_4]^{2-}$ ion. B.N. Figgis, G.A. Williams, P.A. Reynolds (Perth, Australia) R. Mason (Sussex)	D3
05 32 114	Magnetization density distribution in $Mn_{1/4}TaS_2$. A.D. Yoffe, E.A. Marseglia, S.S.P. Parkin (Cambridge)	D3, D15
05 33 052	Polarisation analysis of diffraction from bone. G.E. Bacon (Sheffield) K.R.A. Ziebeck (ILL)	D5
05 34 064	Itinerant antiferromagnetism in Cr-Ga alloys. J.G. Booth, V.S. Moore (Salford) K.R.A. Ziebeck (ILL)	D2
05 34 067	Paramagnetic scattering from iron phosphides. C. Wilkinson (ILL) R. Waeppling (Uppsala)	D5

COLLEGE 6 (Fluids and amorphous substances)

06 01 054	Measurement of the Landau parameters in helium four at very low temperatures. P.A. Hilton, W.G. Stirling (ILL) S. McKirdy (Edinburgh)	IN12
06 01 057	Nucleation of solid ^3He on exfoliated graphite. H. Wiechert, C. Tiby (Mainz) H.J. Lauter (ILL)	D1B
06 01 060	Nucleation of solid ^4He on MgO. H.J. Lauter (ILL) H. Wiechert, C. Tiby (Mainz)	D2
06 01 063	Neutron scattering from liquid ^3He. R. Cowley, K.S. Pedersen (Edinburgh) W. Stirling (ILL)	IN12
06 01 064	The surface roton of superfluid ^4He on graphite. H. Wiechert, C. Tiby (Mainz) J. Joffrin, H.J. Lauter, W.G. Stirling (ILL)	IN12
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06 04 019	Crystal field in amorphous $Pr_{80}Au_{20}$. P. Panissod, J. Durand (Strasbourg)	IN5
06 05 024	Frequency distribution function of cyclopropane. J. Lascombe, J.C. Lassegues, M. Besnard (Bordeaux)	IN4
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06 05 034 06 05 039	Partial structure factor of formic acid. H. Bertagnolli, H.G. Hertz (Karlsruhe)	D4
06 05 035	Neutron diffraction by H_2O/D_2O mixtures: structural studies of water. J.D. Dore, J. Reed, M. Chowdhury (Kent)	D4
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06 06 007	Measurement of the Van der Walls coefficients in molten alkali halides by small angle neutron scattering. E.W.J. Mitchell, R. McGreevy (Oxford) R.J. Stewart, S. Messoloras (Reading)	D17
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06 07 014	Pressure dependence studies of aqueous solutions. G.W. Neilson, J.E. Enderby (Bristol)	D2
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06 08 017	Neutron scattering from amorphous Si-H films. A.J. Leadbetter, A. Rashid (Exeter)	D4
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06 08 037	Structure of CuTi metallic glass. N. Cowlam, H.A. Davies, Sakata (Sheffield)	D4
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07 01 135	Valence change by chemical alloying. S. Horn (Köln) M. Loewenhaupt (Jülich) F. Steglich (Darmstadt)	D7
07 01 139	Magnetic inhomogeneities in iron nickel and iron platinum alloys. A. Menshikov (Sverdlovsk) A. Chamberod (CEN-G) M. Roth (ILL)	D17
07 01 143	Critical behaviour and critical exponents in ferromagnetic Au-Fe alloys. A.P. Murani (ILL)	D2, D11
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07 01 147	Spin correlations in Stoner spin glasses. B.R. Coles, J.R. Davis (London)	D5
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07 02 065	Crystal field transitions in $CeCu_2Si_2$. S. Horn (Köln) M. Loewenhaupt (Jülich) F. Steglich (Darmstadt)	IN4
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07 03 098	Small angle scattering in $FeA\ell$ alloys. J.G. Booth, J.G. Prince (Salford) B.D. Rainford (London)	D11A
07 03 106	Effect of electron concentration on magnetic properties of Co(GaT) alloys. J.G. Booth, J. Prince (Salford) E. Gray, B.D. Rainford (London)	D11A
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07 06 105	Influence of impurities on non adiabatic H tunneling hopping processes in Nb. T. Springer, D. Richter (Jülich) H. Wipf (München)	IN5
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07 07 026	Neutron diffraction study of the anionic conductor $Bi_{1-x}Pb_xO_{1.5-x/2}$. D. Thomas (Lille)	D1B
07 07 028	High temperature study of the local arrangement of the fluorine atoms in $Na_{0.41}Y_{0.59}F_{2.18}$ ionic conductor by neutron diffuse scattering (D.S.) G. Patrat, L. Pontonnier, M. Brunel, F. de Bergevin (CNRS, Grenoble)	D10
07 07 029	Copper diffusion in the high temperature β-phase of CuCl. J. Dupuy, J.F. Jal, G. Chabrier (Lyon) A.J. Dianoux (ILL)	D1B, IN5
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08 02 070	Neutron scattering studies of ribosomes and ribosomal complexes. I.N. Serdyuk, A. Gudkov (Moscow)	D11
08 02 071	RNA-Protein interaction in the 30S subunit of the E. Coli Ribosomes. R. Oesterberg, J.A. Littlechild, B. Sjöberg (Berlin)	D11
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08 02 075 08 02 082	Interactions of tyrosyl-tRNA synthetase and methionyl-tRNA transformylase with tRNA. S. Blanquet, G. Fayat, P. Dessen (Palaiseau) G. Zaccai (ILL)	D11
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08 02 079 08 02 095	Quaternary structure of DNA dependent RNA polymerase by the label triangulation method. W. Hoppe, W. Zillig, Z. Cejka, H. Heumann, P. Stöckel, I. Strell (Martinsried)	D11
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08 02 090	Interaction between EF-Tu and tRNA and EF-Ts. S.J. Perkins (EMBL, Grenoble) A. Miller (Oxford) R. Leberman, A. Wittinghofer (MPI, Heidelberg)	D11
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08 03 057	See 08 03 048	
08 03 062	Neutron scattering studies of chromatin with deuterated histones. J.P. Baldwin, B.G. Carpenter, A. Poland, J. Nixon (Portsmouth)	D11
08 04 022 08 04 023 08 04 025	Molecular dynamics of deuterated proteins. J. Randall (Edinburgh) H.D. Middendorf (London)	IN10, IN5, D1B
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08 05 040	Structural basis for membrane permeability. Interaction of bee melittin with phospholipids. R. Strom, C. Crifo, F. Podo (Roma) G. Zaccai (ILL)	D16
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08 06 008	Brome mosaic virus (BMV) structure. M. Cuillel, B. Jacrot (ILL) M. Zulauf (EMBL, Grenoble)	D11
08 06 009	Structure of Semliki forest virus and Semliki forest virus nucleocapsid. H. Soderlund (Helsinki) M. Cuillel, B. Jacrot (ILL)	D11

08 06 011	Electrostatic potential around the filamentous fd-phage. R. Oberthür (Mainz) J. Torbet, G. Maret, R. Oldenbourg (MPI, Grenoble)	D17
08 06 016	Structural studies of alfalfa mosaic virus. A. Miller, S. Cusack (EMBL, Grenoble) J.E. Mellema, P. Krijgsman, G. Oostergetel (Leiden)	D11
08 06 017	Plant viruses. J. Witz, J. Krüse (IBMC, Strasbourg) P. Timmins, B. Jacrot (ILL)	D11
08 06 021	Structural studies of influenza virus. S. Cusack (EMBL, Grenoble) A. Miller (Oxford) P.C. Krijgsman, J.E. Mellema (Leiden)	D11
08 06 022	Structure of mature adenovirus type 2. P. Boulanger (Lille) C. Devaux (Lille and ILL) P. Timmins, B. Jacrot (ILL)	D11
08 06 023	Contrast variation studies on single crystals of satellite tobacco necrosis virus. B. Strandberg (Upssala)	D17
08 07 013	Binding of cartilage proteoglycans to hyaluronic acid. T.E. Hardingham, H. Muir (London) S.J. Perkins, A. Miller (EMBL, Grenoble)	D11
08 07 021 08 02 055	Small-angle neutron scattering studies of the conformation of myeloma protein MOPC315 and its FAB fragment, and the interaction with a monovalent dinitrophenyl hapten. S. Gilmour, J. Randall (Edinburgh) J. Torbet (Grenoble) Dwek, Wain-Hobson, Dower, Van Schravendijk (Oxford)	D11
08 07 024	Test on the use of neutrons to study glycoproteins. M.H. Loucheux (Lille)	D11
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09 01 276	Study of polymer-surfactant aggregates in water. B. Cabane (Orsay) R. Duplessix (ILL)	D17, D2
09 01 277	Long range fluctuations in polymer solutions. C. Picot, J. Koberstein (CRM, Strasbourg) J.P. Cotton (Saclay)	D11A, D17
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09 01 285 09 01 253	Conformation of polymers in the crystalline state. M. Stamm, J. Schelten (Jülich) D.G.H. Ballard (Runcorn)	D1B
09 01 286	Neutron scattering by partially labelled chains in theta solvent. R. Duplessix (ILL)	D11, D17
09 01 287	Electrostatic potential and conformation of polyelectrolytes in solution. M. Ragnetti, R. Oberthür (Mainz)	D11A, D17
09 01 288	Cyclic polystyrenes in solution. R. Oberthür, M. Ragnetti (Mainz) H. Höcker (Bayreuth)	D17
09 01 292	The effect of temperature and concentration on the dimensions of a polymer chain in solution. R.W. Richards (Glasgow) A. Maconnachie (London)	D17
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WORKSHOPS ORGANISED BY THE ILL

Workshop organized in 1980

Workshop on "The Contribution of Neutron Scattering to the Study of Incommensurable Modulations" (organized by R. Pynn, ILL) — ILL, 13-14 October 1980

ILL workshops published in 1980

"Neutron Spin Echo"
Lecture Notes in Physics n° 128
F. Mezei Ed. (Springer Verlag, 1980)
Proceedings of a Laue-Langevin Institut Workshop, Grenoble
ILL, 15-16 October 1979

"Nuclear Spectroscopy of Fission Products"
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Workshop held at the ILL, Grenoble
ILL, 21-23 May 1979

LIST OF THESES

The experimental work of which was carried out at ILL.

P. ALDEBERT	Thèse de Doctorat d'Etat, Université Paul Sabatier de Toulouse (Sciences) (mai 1980) Etude par Diffraction et Diffusion Quasiélastique des Neutrons de la Mobilité Anionique présentée à Haute Température par des Oxydes Réfractaires : Application à l'Alumine et aux Formes de Haute Température de la Zircone et des Sesquioxydes de Terres Rares (La_2O_3 et Nd_2O_3).
M. BESNARD	Thèse de Doctorat d'Etat. Université de Bordeaux I (Sciences) (octobre 1980). Etude Expérimentale des Mouvements Moléculaires du Cyclopropane Liquide.
Vanessa CHEEL	Thesis, Oxford University (June 1980). Diffraction Properties of Deformed Copper Single Crystals.
J.-M. GANDIT	Diplôme d'Ingénieur CNAM en électronique (février 1980). Amélioration de la Stabilité de la Tension de Sortie des Générateurs Electrostatiques de 400 kV.
N. HARRIS	Thesis, Oxford University (Dec. 1980). Neutron Scattering from Colloidal Systems.
K. HAWERKAMP	Doktorarbeit, Technischen Universität Carolo-Wilhelmina, Braunschweig (1980). Messung des Betasummenspektrums der Spaltprodukte von ^{235}U nach Thermischer Spaltung.
R. JOHNSTON	Thesis, Imperial College, London (July 1980). Some Aspects of the Theory of Disordered Solids.
G. JUNG	Doktorarbeit. Universität Giessen (1980). Kernspektroskopie an neutronenreichen Rubidium — Spaltprodukten mit gerader Massenzahl.
H. KRAXENBERGER	Doktorarbeit, Universität Bayreuth (1980). Bau and Anwendung eines gekrümmten Kristalls in der Neutronenstreung.
H. KWON	Thesis, in partial fulfillment of the requirements for the degree of Doctor of Philosophy — California Institute of Technology, Pasadena, California 1981 (submitted Oct. 10, 1980). Experimental Investigations of Neutrino Oscillations at a Fission Reactor.
W. LANG	Doktorarbeit, Technischen Hochschule Darmstadt (Dezember 1979). Nuklidausbeuten bei der Reaktion $^{235}U(N_{th}, F)$ als Funktion der Kinetischen Energie der Spaltprodukte. Ein Experimenteller Zugang zur Dynamik des Spaltprozesses.
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T.J. SUMNER	Thesis, Sussex University (September 1979). Progress towards a New Experiment to Search for the Electric Dipole Moment of the Neutron using Ultra-Cold Neutrons. (Scientific Report 80SU09S).

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T = Technical Report

S = Scientific Report

80HE01S
A. HEIDEMANN, G. JENKIN, Neutronenspektrometer mit μeV Auflösung unter Benutzung von Flugzeit- und Rückstreumethoden.

80MH02S
A. MHEEMEED, **H.R. FAUST, G. BARREAU, K. SCHRECKENBACH**, T. VON EGIDY, J. VALENTIN, Etude de la réaction ^{113}Cd (n,e$^-$) ^{114}Cd auprès du spectromètre β de l'ILL.

80FA03S
H.R. FAUST, Design and Suggested Applications of a High Transmission Conversion Electron Spectrometer for Accelerator Oriented Research and Off-Beam Use.

80MU04T
J. MUNNIER, Cristaux liquides, Applications industrielles.

80TI05T
O. TILLIER, Spooler de Communication avec les Calculateurs d'Expérience.

80LE06T
Y. LEFEBVRE, Experience IN12.

80HA07S
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80BR08T
A. BRESSON, Préamplificateur pour Thermocouples à Compensation Automatique de Soudure Froide.

80SU09S
T.J. SUMNER, Progress Towards a New Experiment to Search for the Electric Dipole on the Neutron Using Ultra-Cold Neutrons.

80PY10S
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80PY11S
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A. BARTHELEMY, Unité Graphique Couleur. Etudes et Propositions. (Software 1).

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Papers with ILL authors and coauthors which have been accepted for publication (arranged by subject - in alphabetical order).

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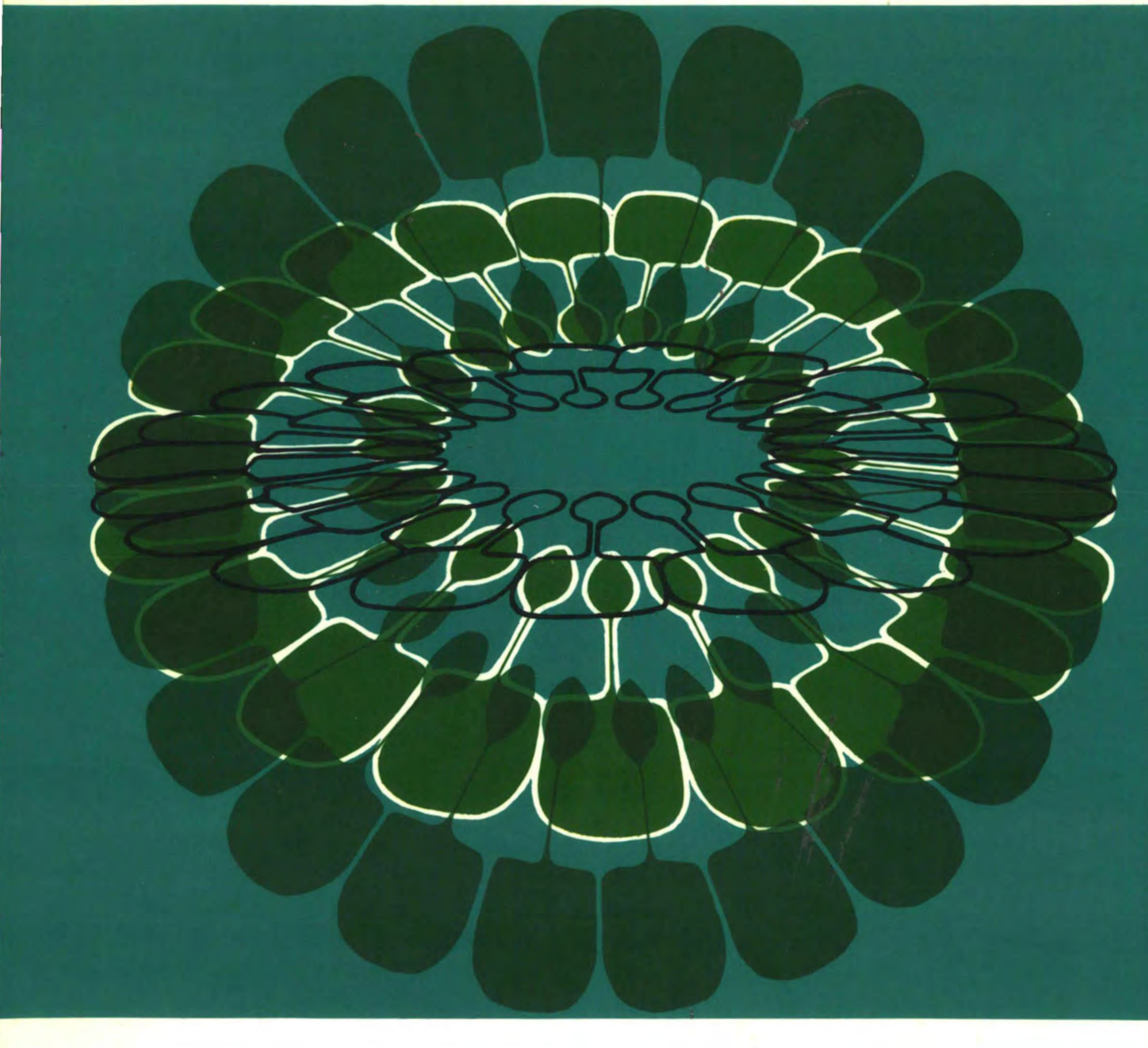

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