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Workshop on a Project for a FZR-Beam Line at ESRF

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Rossendorf, 28. / 29. September 1993

Content

Introduction

The Research Center Rossendorf (FZR) investigates the possibilities to install its own beam line as a Cooperate Research Group-project (CRG) at the European Synchrotron Radiation Facility (ESRF) in Grenoble.
The main interests for the FZR to use high brillant synchrotron radiation are in the Institute of Radiochemistry and the Institute of Ion Beam Physics and Materials Research. This workshop was organized by these two institutes together with the FZR Study group Synchrotron. The purpose of the workshop was to achieve a better understanding for the technical needs of the projected beam line for the planned research projects. Experts with experience in beam line design met with the Rossendorf groups to discuss the best layout for such a beam line.

The summary of this workshop and the copies of transparencies of the lectures that were given are published in this booklet. Additionally, there was a short presentation of the capabilities of the Department for Research and Information Techniques of the FZR which will be strongly involved in the construction of such a beam line.

The organizer would like to thank Dr. Kevin D'Amico (X-ray Analytics, Upton, USA), Dr. Michael Hagelstein (ESRF, Grenoble), Dr. Ulrich Hahn (HASYLAB at DESY, Hamburg) and Dr. Philip Pattison (University of Lausanne) for coming to Rossendorf / Dresden and helping with their experience in the process of defining the technical project of an ESRF beam line.

The meeting was made possible in part by the financial support of the Saxonian Ministery for Science and Art.

Rossendorf, 1. October 1993

Summary of the Workshop

The following questions were discussed during the workshop:

1. Can the different demands be achieved in one beam line ?
   change of monochromator / mirror
   different experimental stations (sequence)
   option for additional surface sensitive techniques (e.g. XSW)

2. Which components can be ordered commercially ?
   Which solutions / construction blueprints / can be adapted from existing beam line or beam lines under construction ?
   delivery time ?

3. Which parts of the whole equipment should be designed and built in Rossendorf ?
   (vacuum system; sample chambers; detector electronics; remote control of optics and experimental stage; data handling)

4. Time schedule
   Cost estimation / cost distribution over the period of the project realization

5. Consequences of investigating radioactive samples

The following conclusions were made:

1. The demands of the different institutes can be achieved in one beam line by tuning the optics through remote control, according to the need of the different end-stations. Goals are to have available i) a focused beam with dimensions of about 0.5x0.5 mm^2 (full width) and ii) an unfocused beam (1:1 optics)
The optical component design for such a beam line is well established. Therefore, there is no need for further development work. The equipment needed is similar to that used at wiggler beam lines at low energy synchrotron radiation sources (e.g. SRS, NSLS,..). Furthermore, there are already four other bending magnet beam lines at the ESRF, from which technical solutions can be adapted.

2. The different experimental stations should be located in different hutches with independent radiation shielding. This demand is mainly due to the different scientific goals of the FZR institutes.
The demands for the different end stations (ion beam chamber, glove box) should be specified before making the decision about the optics layout.
The radiochemical hutch should be the first in the beam, to allow access to the ion beam equipment for preparation of the experiment (longer time needed).

3. It may desirable to split the beam into two beam lines (in analogy to the Swiss-Norwegian BL) to have the option for an additional end station for work with non-radioactive samples. The instrumentation of this end station can be build later. The technical complications due to the splitting should be considered.
The reduction of the acceptance angle of the incident radiation to 2.5 mrad is no serious intensity limitation. Other beam lines use at maximum 4 of the 6 mrad, where part of the 4 mrad has no proper optical performance.

4. Key components of the optical system can be ordered commercially. Further components can be produced in FZR or contract shops on the base of supplied drawings.
Lists of potential suppliers can be obtained from the different groups (HASYLAB, ESRF, SRS, ...). The experience of different institutions should be used on the base of the concept demands.
Drawing may have to be adapted in Rossendorf, but the principal layout can be used from existing solutions.

5. The main development effort for the FZR will be the construction of the experimental end-stations. Components of the vacuum system and other mechanical parts can also be build there.
Members of the construction team can be trained at existing SR-laboratories.
It is recommended to develop the electronics (data handling, control system) in Rossendorf on the base of experience of existing instruments at ESRF, HASYLAB and others. The ESRF standard should be used wherever possible. The special technical demands may result in electronics that differs from existing standard beam lines.

6. The time needed to construct a beam-line is *at minimum* two year after the decision on the base of a conceptual design report.
The cost estimation can be oriented on other CRG projects. The overall costs for the beam line including 2 experimental end-stations range between 4 and 6 Mio DM.

7. The aspects of radiological safety when investgating radioactive samples (including transport and storage of samples) should be investigated as early as possible. Requirements to the experimental end-station and their technical implications should be discussed with the ESRF management.

8. Because of the specialized end stations (radioactive glove box, ion beam chamber), it should be discussed what the beam line can offer to the ESRF for the general use (1/3 of beam time).

9. Personnel who will be located at the ESRF to operate the beam line should be identified as soon as possible and they should also be involved in the construction process in Rossendorf.

Requirements for a Radiochemistry/ Environmental Research Beam Line at ESRF

H. Nitsche

Research Center Rossendorf Inc.
Institut of Radiochemistry
Dresden

September 1993

FZR

Research of Metal Contaminant Transport in the Environment

* Fundamental knowledge required of aqueous, surface and solid state chemistry
    - liquids
    - solids
    - interfacial reactions

* Environmental Restoration
    - metals and radionuclides

* Nuclear Waste Repository Performance Assessment
    - radionuclides
    - actinides and fission products
    - lanthanide model systems

Research of Metal Contaminant Transport in the Environment (continued)

* Molecular-level mechanistic understanding
  - transported species in solution
    . oxidation state
    . complex formation (mono or multinuclear)
    . low concentrations

- sorption processes on liquid-solid interphase
  . minerals, soils, solids
  . biological materials
  . varying concentration range (high to low)

XANES and EXAFS are Our Methods of Choice

* Solutions and solids
  - XANES
    . oxidation state specificity
    - comparison with models ystems
    - speciation at low concentration levels
    - development of new detection systems
  - EXAFS
    . chemical environment of metal atoms
    - complexation reactions
      . ligand coordination

* Solids on surfaces / interfaces
  - XANES
    . change in oxidation state
      - comparison with model systems
  - EXAFS
    . binding mechanism
      - inner sphere vs. outer sphere
    . variations of chemical environment

* Bioinorganic systems
  - XANES
    . change in oxidation state

FZR

Experiments at Stanford Synchrotron Radiation Laboratory (SSRL)

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* Collaboration with
  D. Shuh, J. Bucher, N. Edelstein, LBL

* Wiggler Beam Line 4-1
  - double crystal monochromator
    . Si (220) or (400) crystals
  - transmission data collected using ion chambers
  - Stern-Heald or solid-state Si detector for fluorescence
  - standard detection geometry and set-up with energy calibration reference
  - motorized detector and sample stages
  - samples prepared at LBL and transported to SSRL
    . Se, Tc, U

Bioremediation of Se by *B.Subtilis*

* Environmental Selenium contamination of several sites in California and the Carson River Sink in Nevada
  - bioremediation is an attractive possibility for clean-up

* *Bacillus Subtilis* are common aerobic soil bacteria

* Large uptake of Se and incorporation in the vegetative bacteria
  - biological research program to explore uptake mechanism
  - takes up Se(IV), but not Se (VI)

* XANES to determine oxidation state of Se after microbial uptake
  - comparison with Se model systems
    . Na_2Se0_4, Na_2Se0_3, Se

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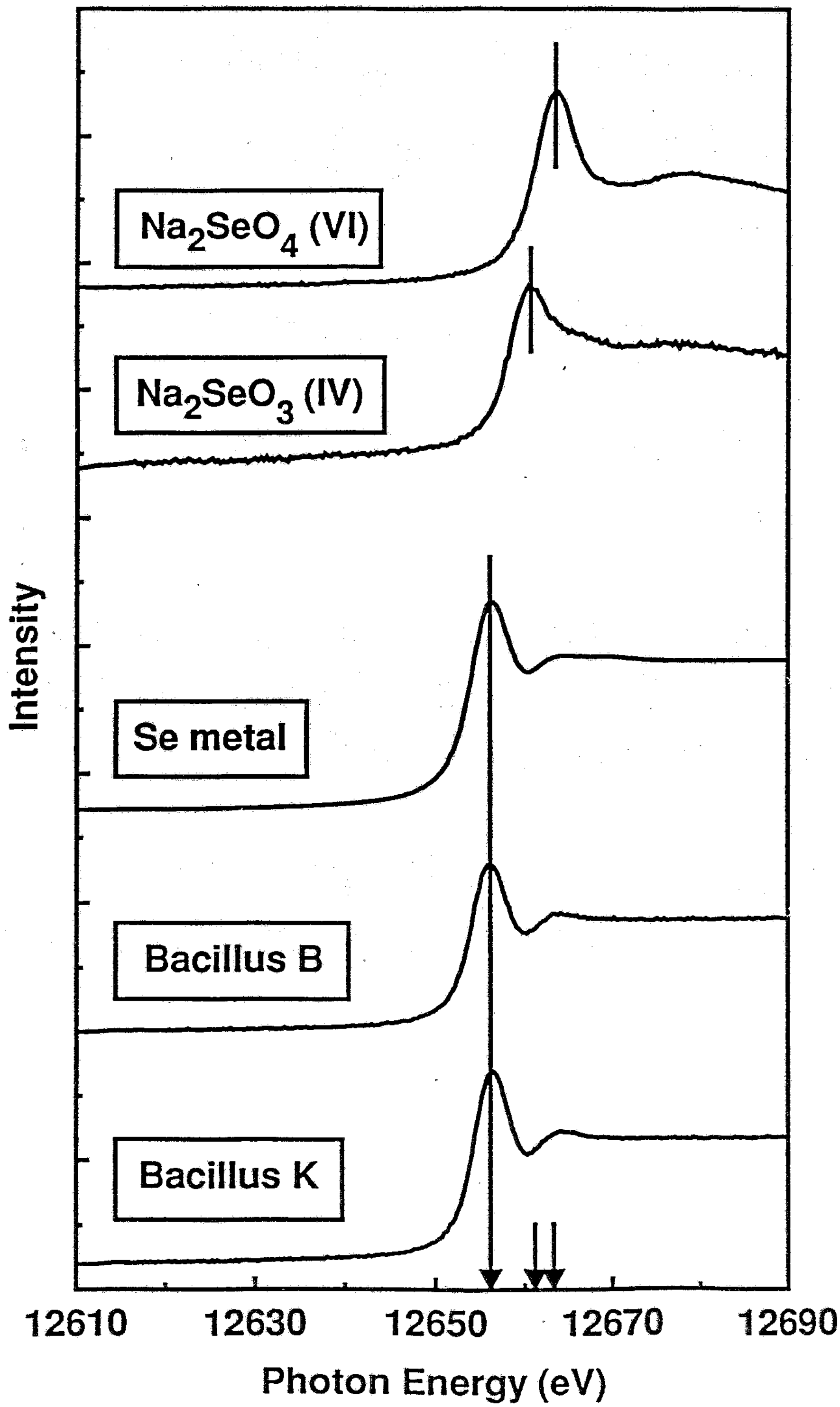
Selenium K-edge X-ray Absorption Spectra of Model Compounds and Bacillus Samples Containing Selenium



D. K. Shuh, H. Nitsche, P. Torretto, J. J. Bucher, N. M .Edelstein, T. Leighton, and B. Buchanan (1992)

Technetium Reduction by FeS (slag) in Cement

* TcO_4^- present in processing waste
  - very mobile
  - nearly no adsorption onto geologic material

* Proposed waste treatment to less mobile and insoluble Tc compound by adding FeS to the cement wasteform matrix

* XANES and EXAFS for technetium model systems and comparison with untreated and treated waste form
  - TcO_4^-, TcO_2, Tc metal

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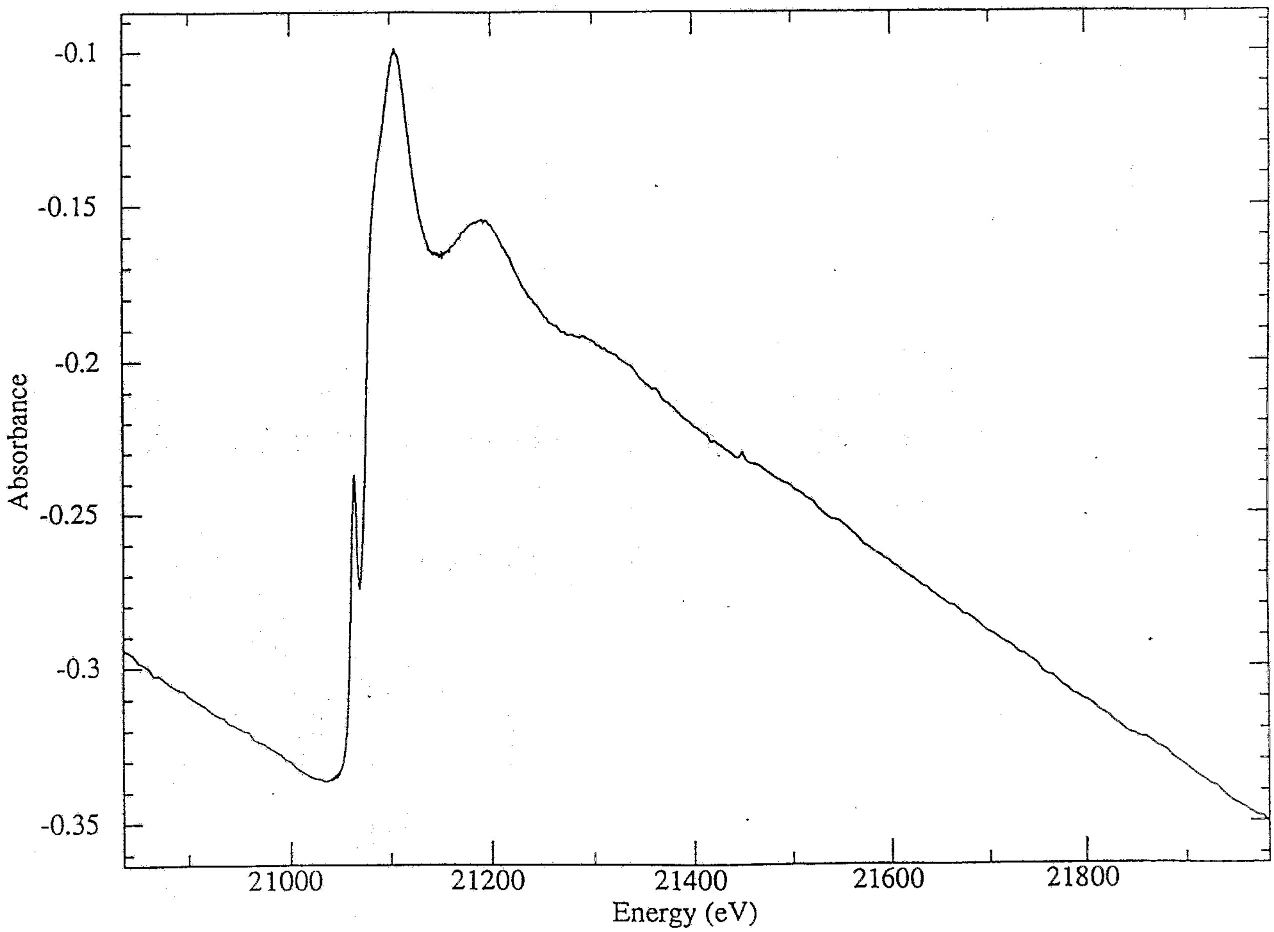
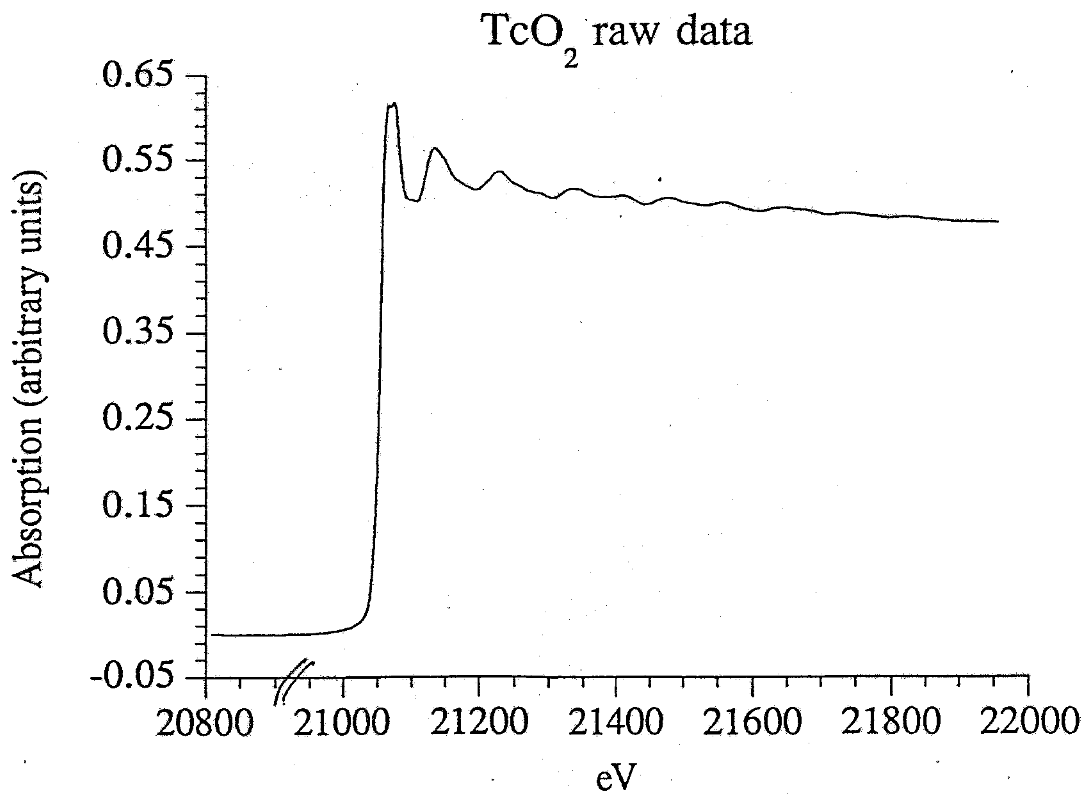
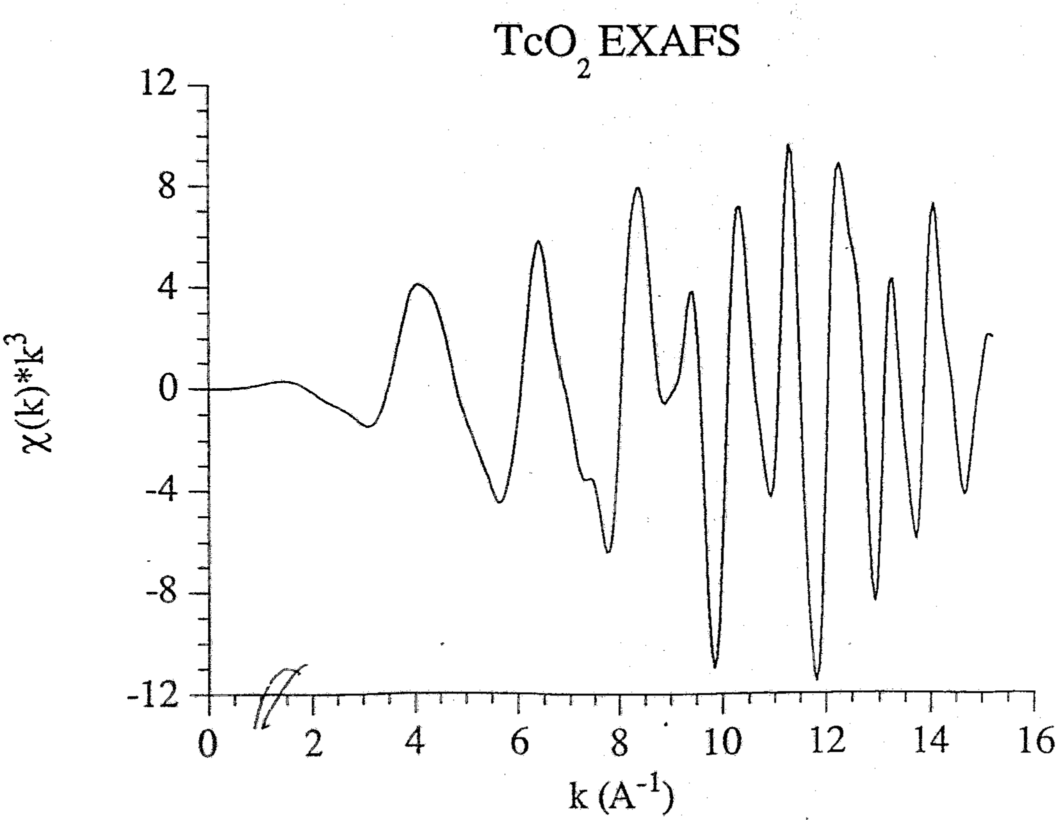
99TcO4- K-edge EXAFS Spectrum

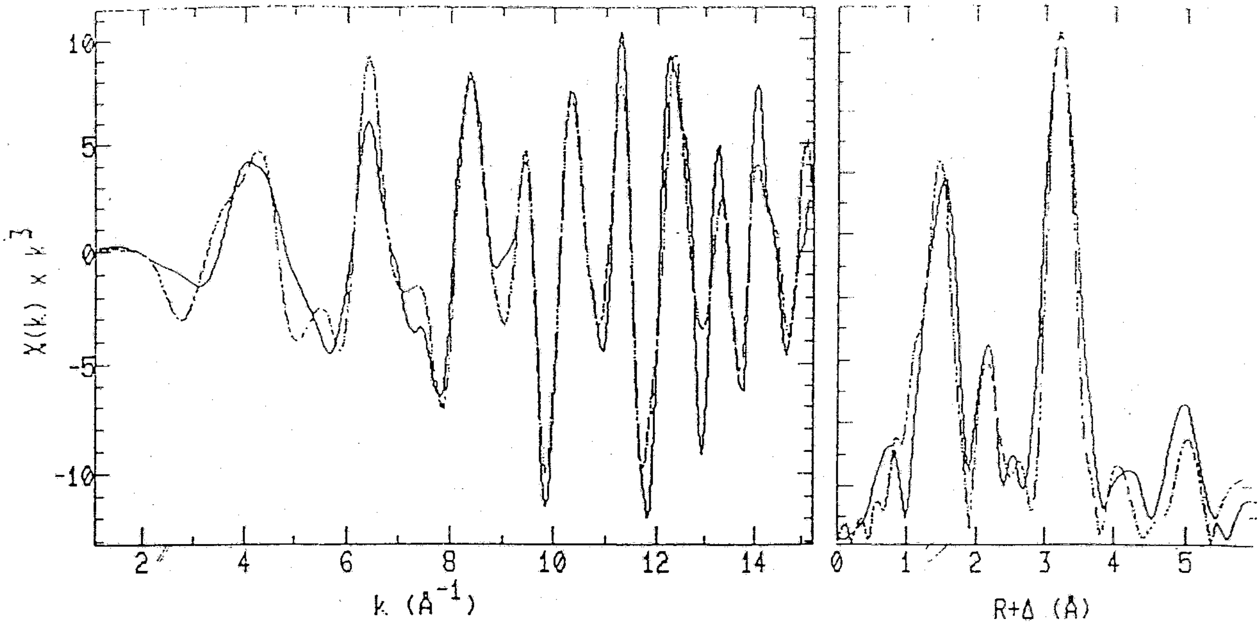




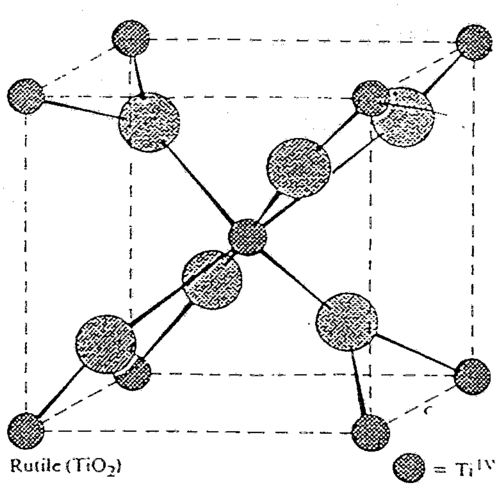
TcO2 raw data
Absorption (arbitrary units)
0.65
0.55
0.45
0.35
0.25
0.15
0.05
-0.05
20800
21000
21200
21400
21600
21800
22000
eV



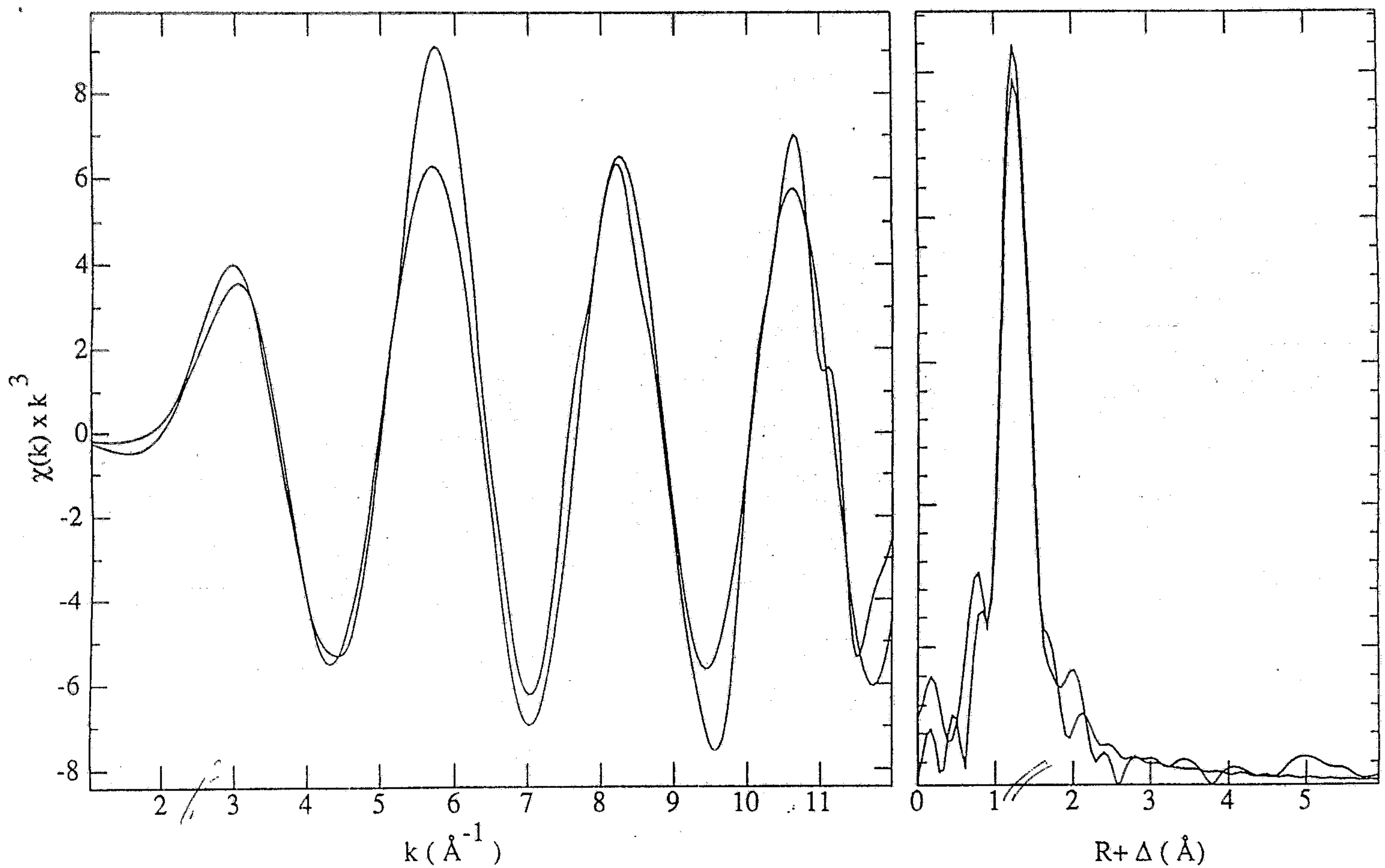
TcO2 EXAFS
χ(k)*k3
12
8
4
0
-4
-8
-12
0
2
4
6
8
10
12
14
16
k (A-1)



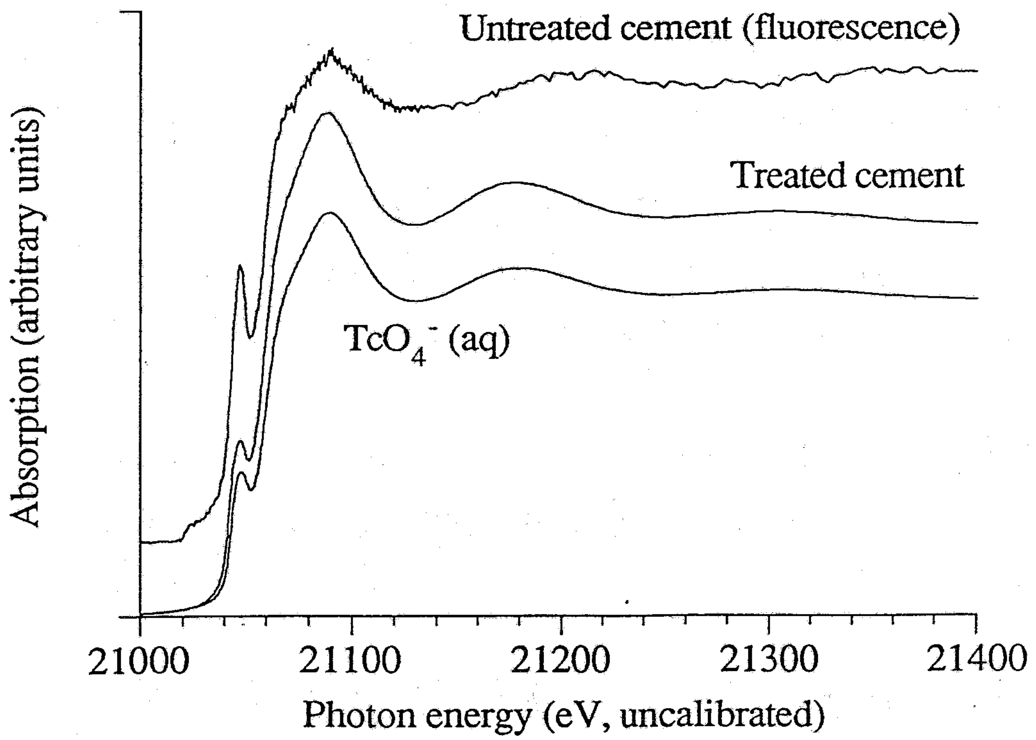
Tc-O	.N=	6.000	.R=	1.9725	.σ2=	0.00405	*Eo=	-23.885
Tc-Tc	.N=	1.000	.R=	2.6088	.σ2=	0.00420	/Eo=	-23.885
Tc-Tc	.N=	1.000	.R=	3.1014	.σ2=	0.00400	/Eo=	-23.885
Tc-Tc	.N=	8.000	.R=	3.6458	.σ2=	0.00480	/Eo=	-23.885
Tc-Tc	.N=	2.000	*R=	4.5454	.σ2=	0.00480	/Eo=	-23.885



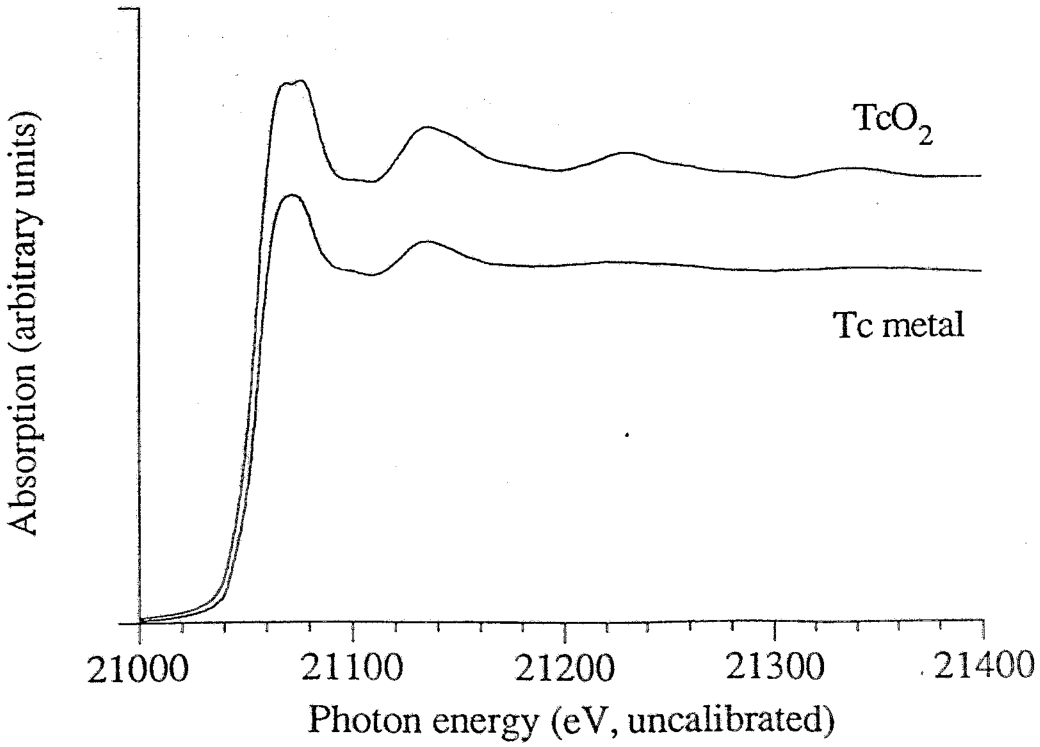
Backgroud-Subtracted Frequency Component of $^{99}TcO_4^-$ K-edge EXAFS Spectrum



...... .N= 4.000 *R= 1.7156 * $\sigma 2$= 0.00110 *Eo= -7.280



Untreated cement (fluorescence)
Treated cement
TcO4- (aq)
Absorption (arbitrary units)
21000
21100
21200
21300
21400
Photon energy (eV, uncalibrated)



TcO2
Tc metal
Absorption (arbitrary units)
21000
21100
21200
21300
21400
Photon energy (eV, uncalibrated)

Collaborators for SSRL Experiments

* LBL/Chemical Science Division
  D. Shuh, J. Bucher, N. Kaltsoyannis
  W. Lukens, N. Edelstein

* LBL/Earth Sciences Division
  I. Al Mahamid, K. Roberts, P. Torretto,
  H. Nitsche

* University of California Berkeley, UCB
  T. Leighton, Dep. Molecular and Cell Biology
  B. Buchanan, Dep. of Plant Biology

* Savannah River Ecology Laboratory
  S. Clark

ESRF is the Ideal Synchrotron Source for Our Experimental Work

* Allows to conduct cutting edge science

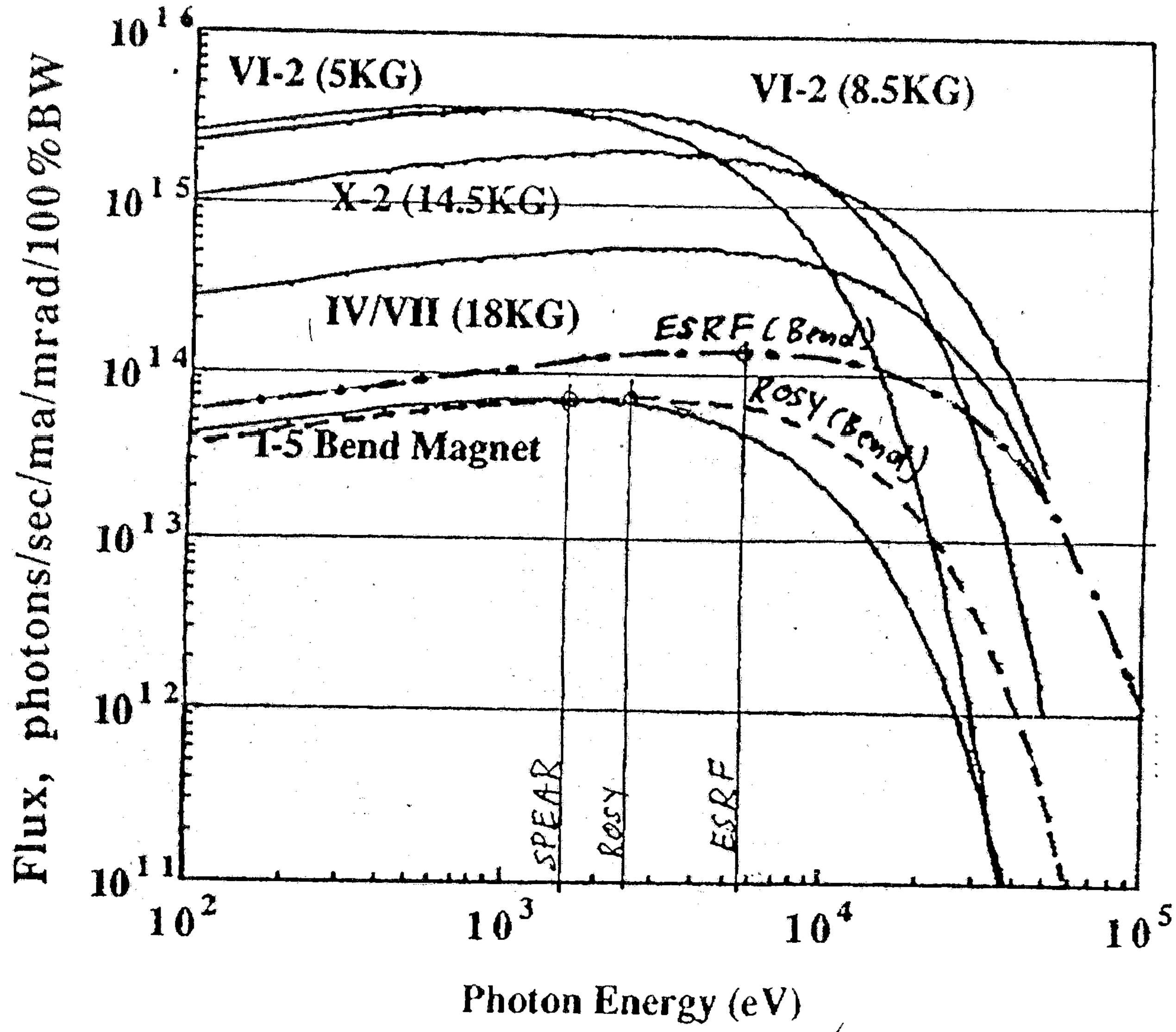
* Hard x-ray energy range required
  - ~ 5 - 20 keV
  - L and K edges

* High flux
  - for homogenous solutions

* High brilliance and excellent spatial resolution
  - for inhomogenous solids

* Great international / national interest in proposed beam line
  - Lawrence Berkely Laboratory
  - Lawrence Livermore Laboratory
  - Freie Universität Berlin
  - possible interest of other users

Flux from SPEAR, 3GeV



Radiological Aspects

* List of possible radioelements
  - Th, U, Np, Pu, Am and Tc
    - less than 37 MBq to 37 kBq (1mCi - 1μCi)
  - many non-radioactive samples

* Radioactive Samples are **not** directly **connected** to beam line
  - conventional beam line with Be window

* **Only** experimental station must be equipped to handle radioactive samples
  - samples are double contained
  - possibility of installing radioactive glove box with additional Be window in beam
    * negative pressure guarantees integrity

* Samples can be prepared at FZR or elsewhere

* Need for shipping and storage facility

Technical and Financial Project Participation

TOPIC	***FZR***	***ESRF***

* Beam line construction
  - monochromator design
    experimental table
  - control electronics
  - data collection
    electronics

* Experimental Station/Hutch
  - Table
    * synchronized with
      monochromator
  - glove box
  - sample positioning system
    * motor-driven table
    * video system
  - detection systems

Some Technical Specifications

* Conventional XAS beam line

* Double Crystal Monochromator

- e.g., Si (400)

- $\Delta E/E \approx 10^{-4}$

* Spot Size = $\sigma_x = 160\,\mu m$ \ $\sigma_x' = 140\,\mu rad$
$\sigma_z = 130\,\mu m$ $\sigma_z' = 5\,\mu rad$

* Macro beam

- flux = 10 keV: $1 \cdot 10^{13} \frac{Ph}{sec\ mrad\ 0.1\%BW}$ (100 mA) (Bend. M.)

* Micro beam

- brilliance =

Proposal

for an Experimental Station at the ESRF for the

Institute of Ion Beam Physics and Materials Research

W. Matz, W. Möller
Institute of Ion Beam Physics and Materials Research at FZR

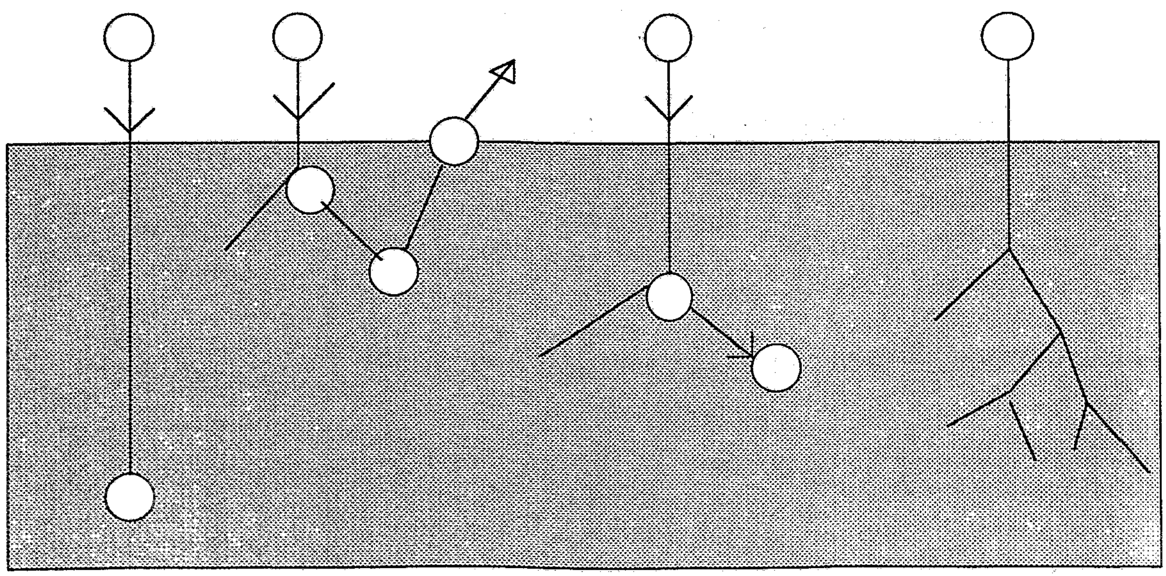
1. Surface modification by ion beams
2. Methods of investigation with synchrotron radiation
3. Demands for beam line parameters
4. Compatibility with the experimental setup of Radiochemistry

1. Surface modification by ion beams

Influence of ion bombardment to surfaces

- Surface Topography
- Surface Composition
- Surface Properties
- Thin Film Deposition
- Buried Layers

Elementary Processes



Implantation Sputtering Defect Formation Relocation

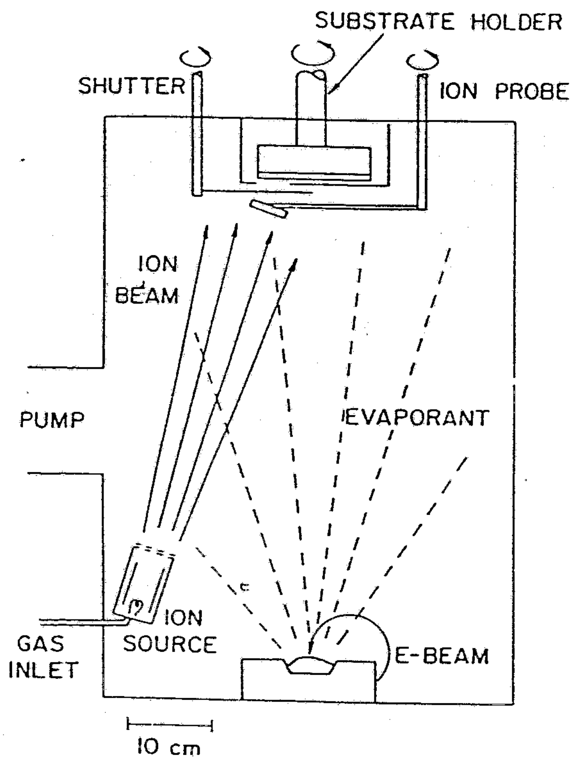
IBAD (ion beam assisted deposition)

(energy range of ions 100 eV - 1 keV)

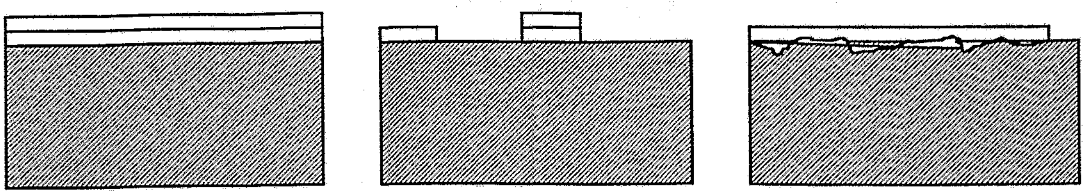
--> plain layers / minimum roughness

--> different ion beams - compound formation (hard covers)

--> adhesion



** Investigation of the process of the beginning of film growth (in-situ)



planar growth / island formation / surface mixing

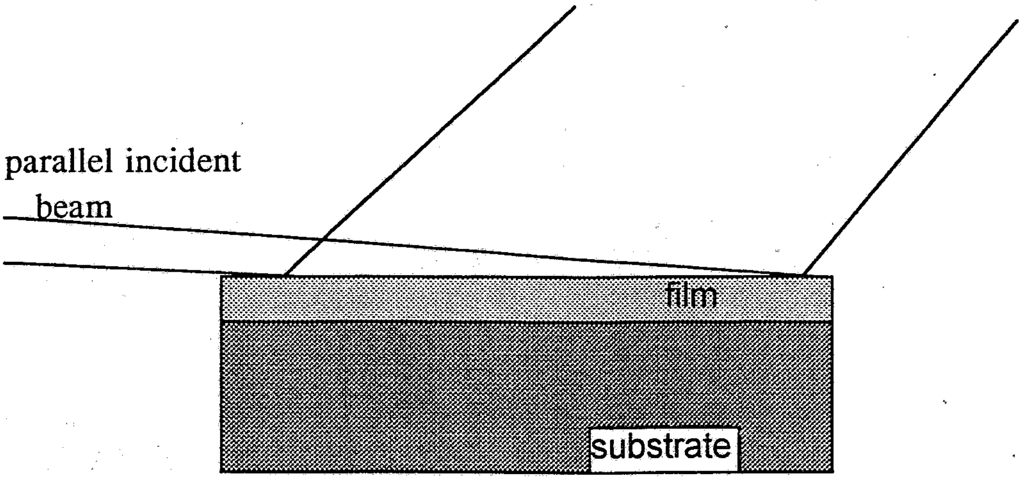
optional also investigation of buried layers after implantation (ex-situ)

Material systems: IBAD

	substrate:	iron (steel), titanium
	layer:	C-B-N
	buried layers:	Co, Fe, in Si, SiC

2. Methods of investigation with synchrotron radiation

in general for surface sensitive experiments:
grazing incidence technique



IBAD in situ

* beginning of growth change of neighborhood of substrate atoms

EXAFS with fluorescence radiation
Quick EXAFS for the study of growth process in-situ

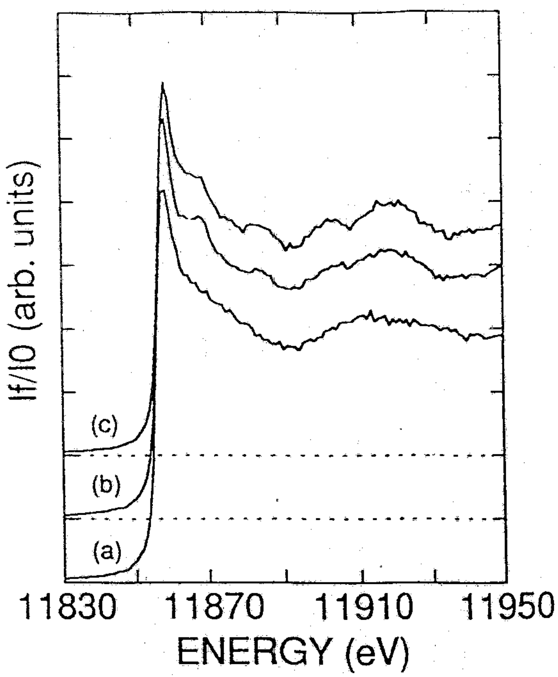


Figure 1. XANES spectra of 5 X 10^{16} cm^{-2} As implanted specimens; (a)as-implanted, (b)after 800°C annealed for 30 minutes and (c)after 1000°C annealed for 30 minutes.

* layer characterisation after growth: reflectivity or diffraction

3. Demands for beam line parameters

typical data of sample:	linear dimension up to 20 mm
	growth rate 1 monolayer $\leq$ 100 sec
	pressure during process 10^{-5} mbar

synchrotron radiation beam

energy range:	5-15 keV
resolution in energy:	$\Delta E/E \sim 10^{-4}$
scanning time (QEXAFS):	100 sec.

beam characteristics :	parallel beam for grazing incidence
(at sample)	fixed beam position (IBAD chamber)
	width up to 20 mm (?)
	high < 700 µm

Technical

* IBAD-chamber + window system for incident beam and detection (contamination problem from ion beam)
  + adjustable sample holder
  + sample holder with heating up to 600°C
  + vacuum system

alternatively
goniometer for reflectivity and diffraction experiments (?)

* Detector system

* Data accumulation
  + high data rate
  + synchronization with monochromator drive
  + correlation to deposition process

4. Compatibility with experimental set up of Radiochemistry

* same demands
  + energy range
  + energy resolution
    ==> double monochromator system Si (400)
    Si (311)

* additional demand
  + continuous change of incident energy for QEXAFS
    ==> precision drive of crystals with
    synchronization to detection unit

* different demands
  + beam size
  + parallel beam
    ==> change in optics design
    (? only influence to mirrors or also to
    monochromator crystals ?)

ESRF EXAFS Group

ID 12 BEAMLINE 6
Circular Polarization

José Goulon, Nicolas Brookes, Jeroen Goedkoop

ID 24 BEAMLINE 8
DEXAFS for time resolved studies

Michael Hagelstein

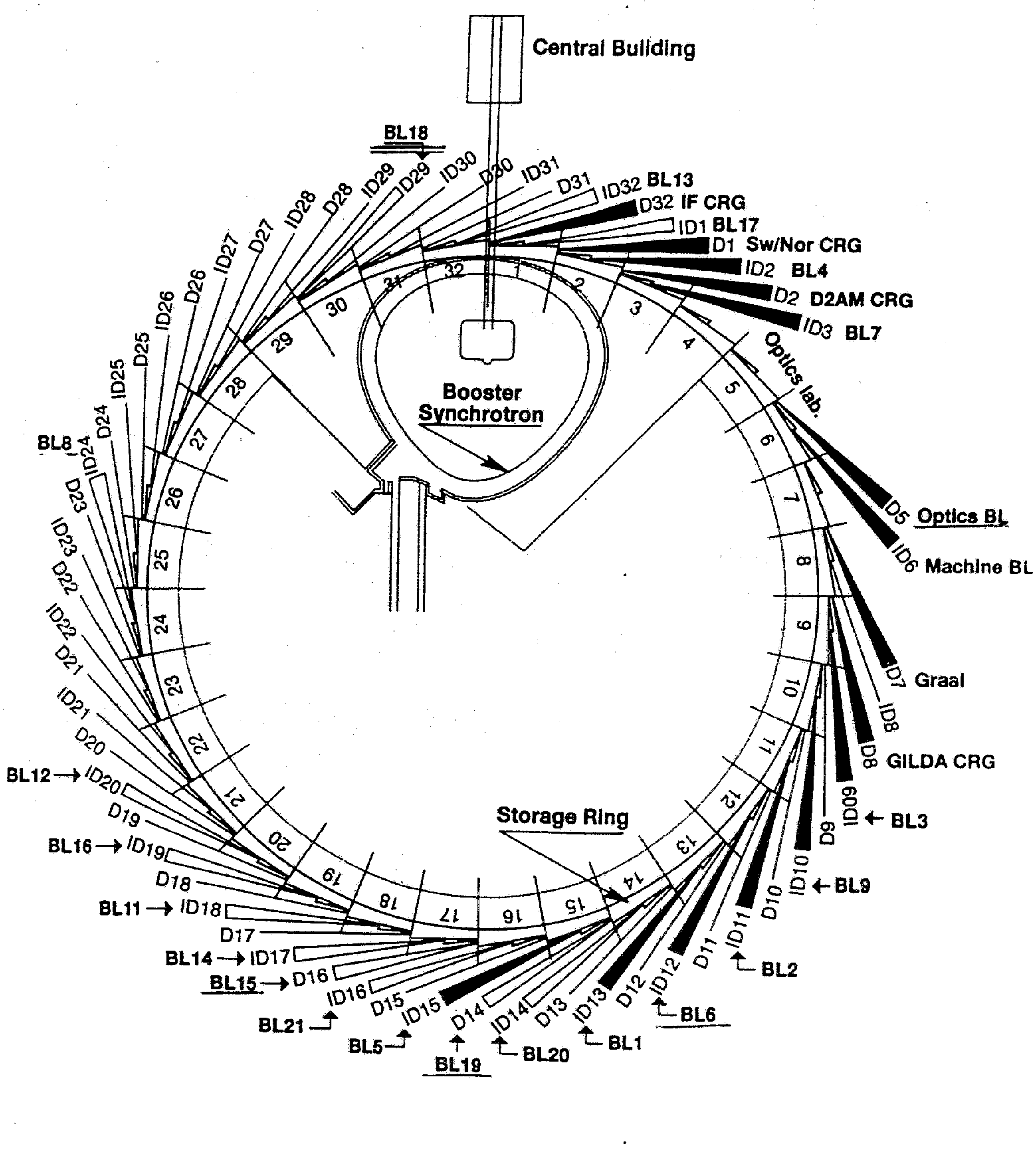
D 27 BEAMLINE 18
EXAFS

José Goulon, Nicolas Brookes

BEAMLINE 23
XAUS, XAS on ultradilute samples

ESRF-Funded Beamlines

BL No.	Source No.	Short Title	Scientist-in-charge
BL 1	ID13 (U)	Microfocus	C. Riekel
BL 2	ID11 (W)	Materials Science	Å. Kvick
BL 3	ID9 (W)	White Beam	M. Wulff
BL 4	ID2 (U)	High Brilliance	P. Bösecke
BL 5	ID15 (W)	High Energy	P. Suortti
BL 6	ID12 (W)	Circular Polarization	J. Goulon
BL 7	ID3 (U)	Surface Diffraction	S. Ferrer
BL 8	ID24 (U)	Dispersive EXAFS	M. Hagelstein
BL 9	ID10 (U)	Troika or "Open" Beamline	G. Grübel
BL 10	(BM)	Bending Magnet "Open" Beamline	
BL 11	ID18 (long) (U)	Mössbauer	R. Rüffer
BL 12	ID20 (W)	Magnetic Scattering	C. Vettier
BL 13	ID32 (U)	Surface Science	F. Comin
BL 14	ID17 (long) (W)	Medical Beamline	H. Moulin-Elleaume
BL 15	D16 (BM⇒U)	Powder Diffraction	A. Fitch
BL 16	ID19 (long) (W)	Topography	J. Baruchel
BL 17	ID31 (U)	Anomalous Scattering	S. Lequien
BL 18	D23 (BM)	EXAFS	N. Brookes
BL 19	D14 (BM)	M.A.D.	A. Thompson
BL 20	ID14	Macromolecular Crystallography	
BL 21	ID16 (U)	X-ray Inelastic Scattering	F. Sette
BL 22		X-ray Microscopy	
BL 23	ID22 (U)	XAUS	J. Goulon
	D5	Optics Test Beamline	A. Freund
	ID6	Machine Test Beamline	P. Elleaume



Central Building
BL18
Booster
Synchrotron
Storage Ring
Optics lab.
BL13
IF CRG
BL17
Sw/Nor CRG
BL4
D2AM CRG
BL7
Optics BL
Machine BL
Graal
GILDA CRG
BL3
BL9
BL2
BL6
BL1
BL20
BL19
BL5
BL21
BL15
BL14
BL11
BL16
BL12
BL8

BEAMLINE 8 on ID 24

The energy-dispersive

x-ray absorption spectroscopy beamline

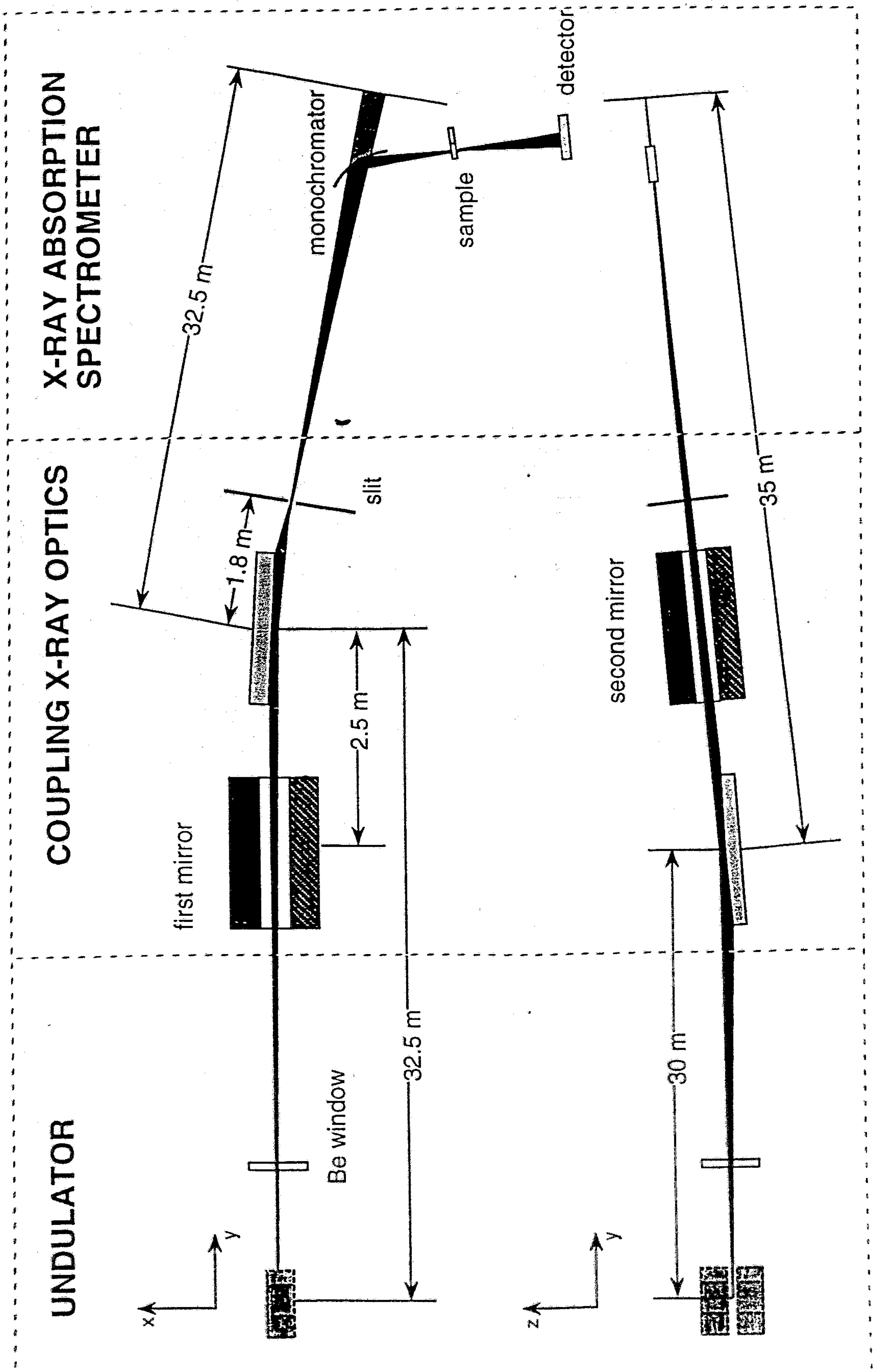
for time resolved studies

40 mm undulator (K_{max} = 1.38)

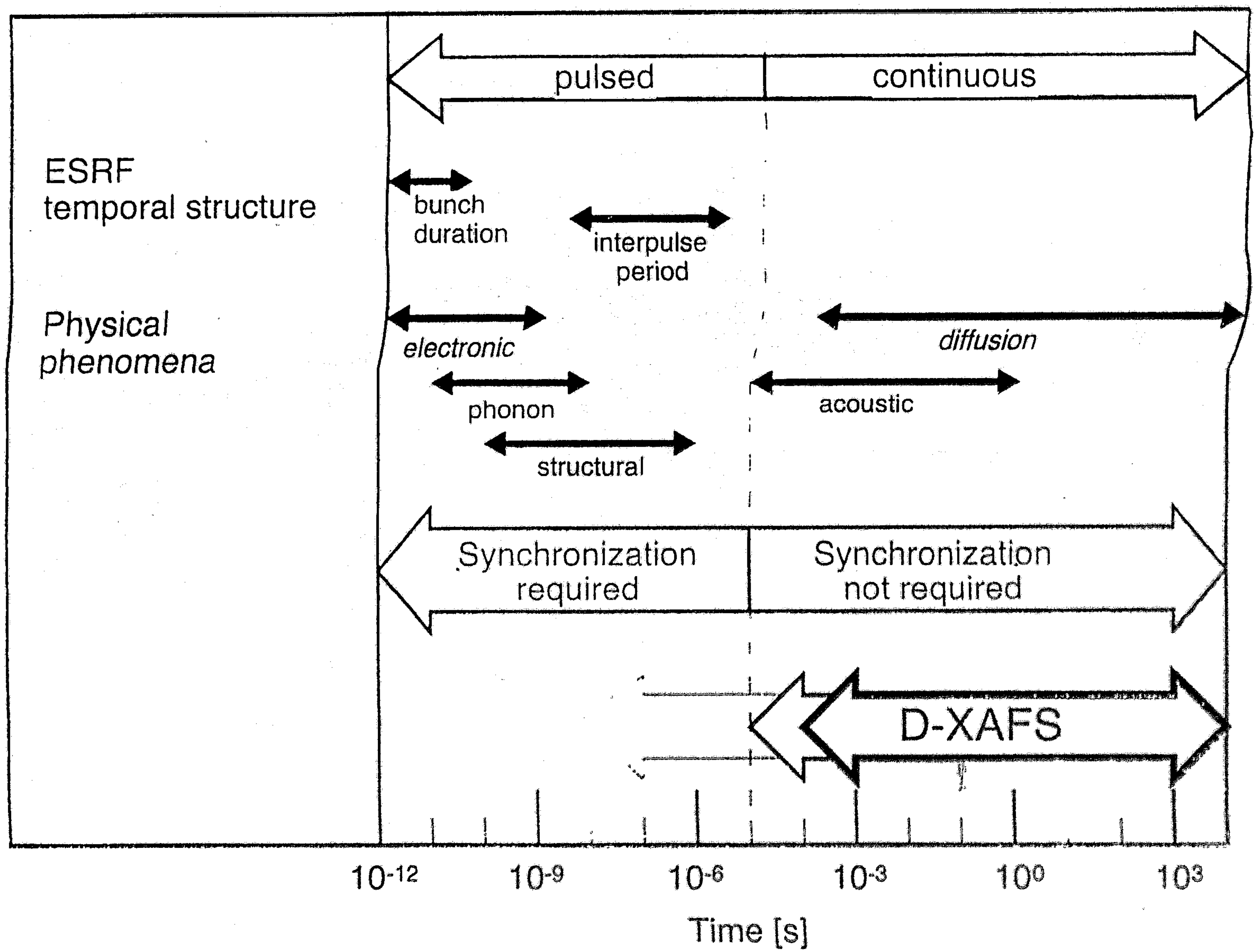
Coupling optics (Kirkpatrick-Baez)

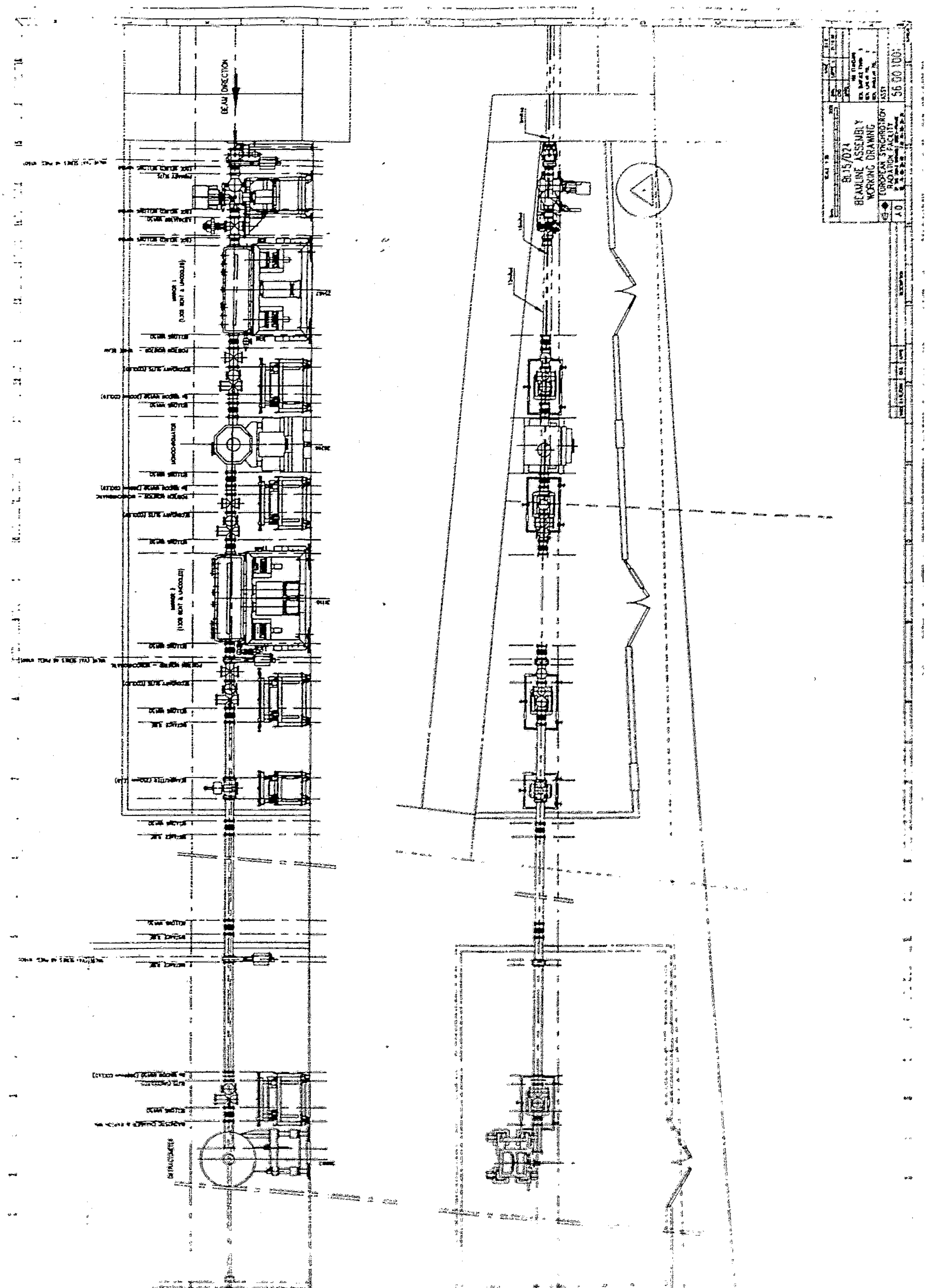
Energy dispersive X-ray absorption spectrometer

Michael Hagelstein



UNDULATOR
COUPLING X-RAY OPTICS
X-RAY ABSORPTION SPECTROMETER
x
y
z
y
Be window
first mirror
second mirror
slit
monochromator
sample
detector
32.5 m
2.5 m
1.8 m
32.5 m
30 m
35 m

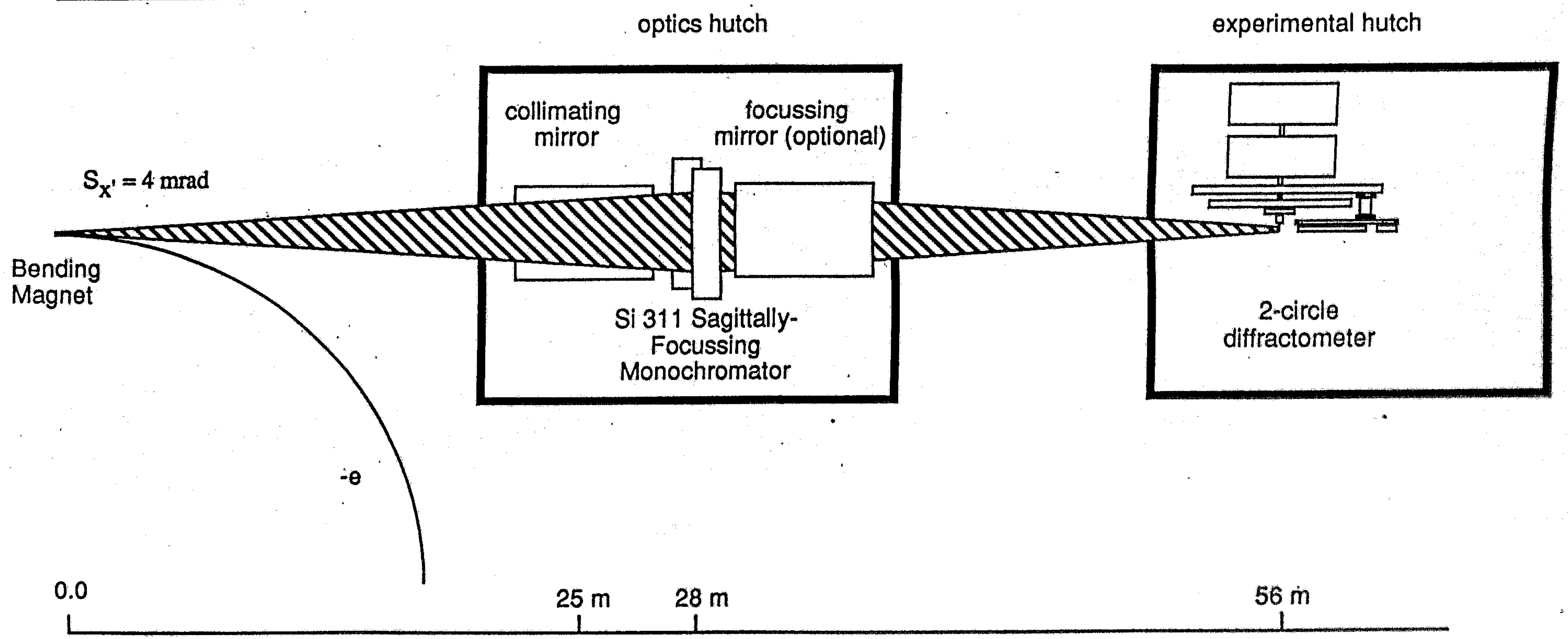

ESRF
temporal structure
Physical
phenomena
pulsed
continuous
bunch
duration
interpulse
period
electronic
diffusion
phonon
acoustic
structural
Synchronization
required
Synchronization
not required
D-XAFS
10-12
10-9
10-6
10-3
100
103
Time [s]



BEAM DIRECTION
BL15/ID24
BEAMLINE ASSEMBLY
WORKING DRAWING
EUROPEAN SYNCHROTRON
RADIATION FACILITY
A0
56 00 100

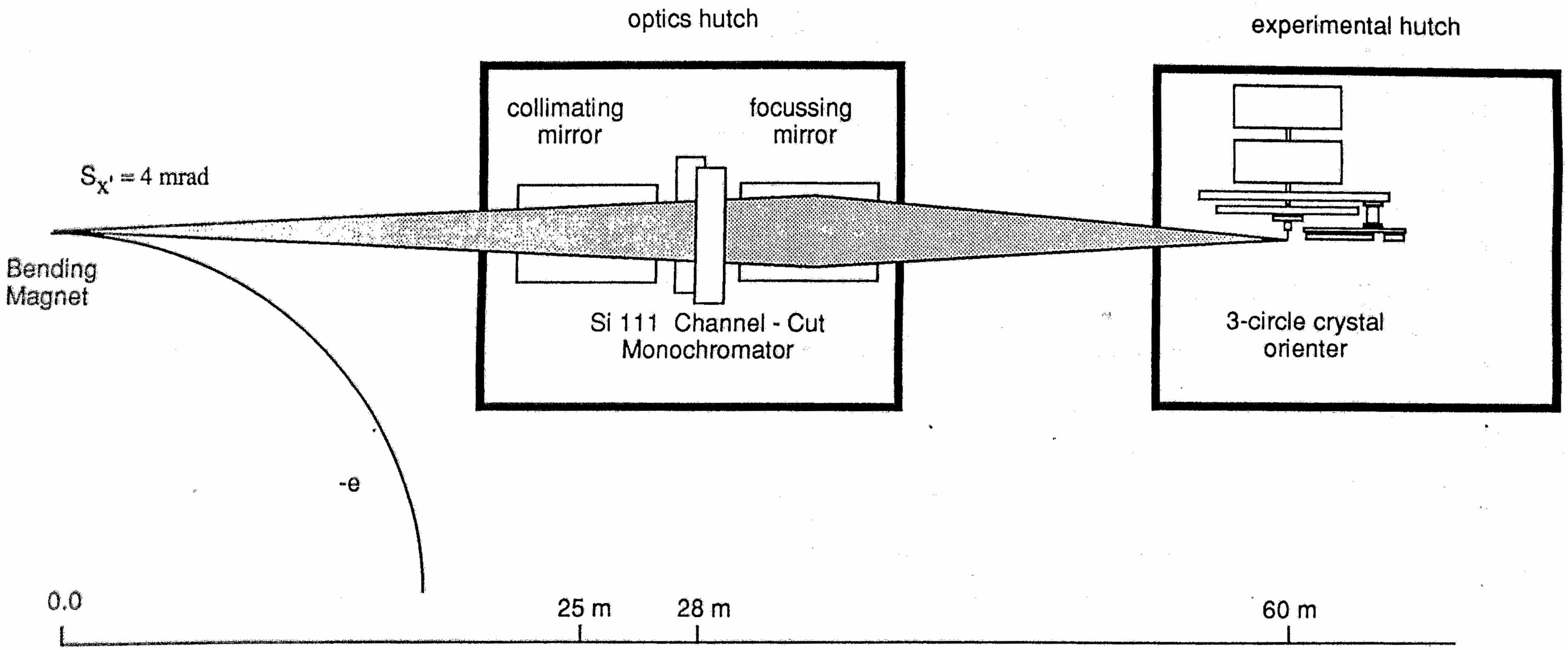
Optical Design
Powder Diffraction BL15

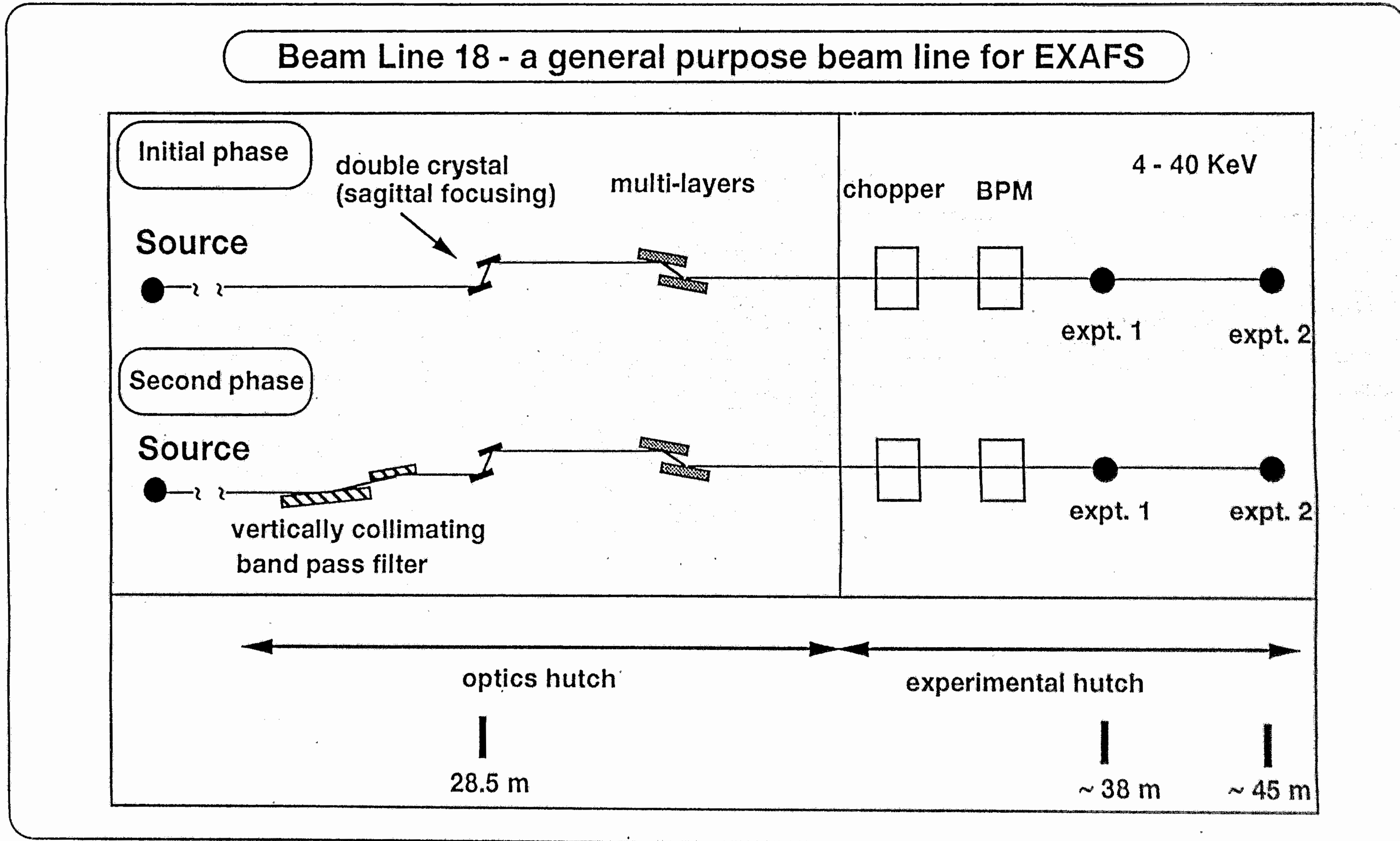
Horizontal Plane

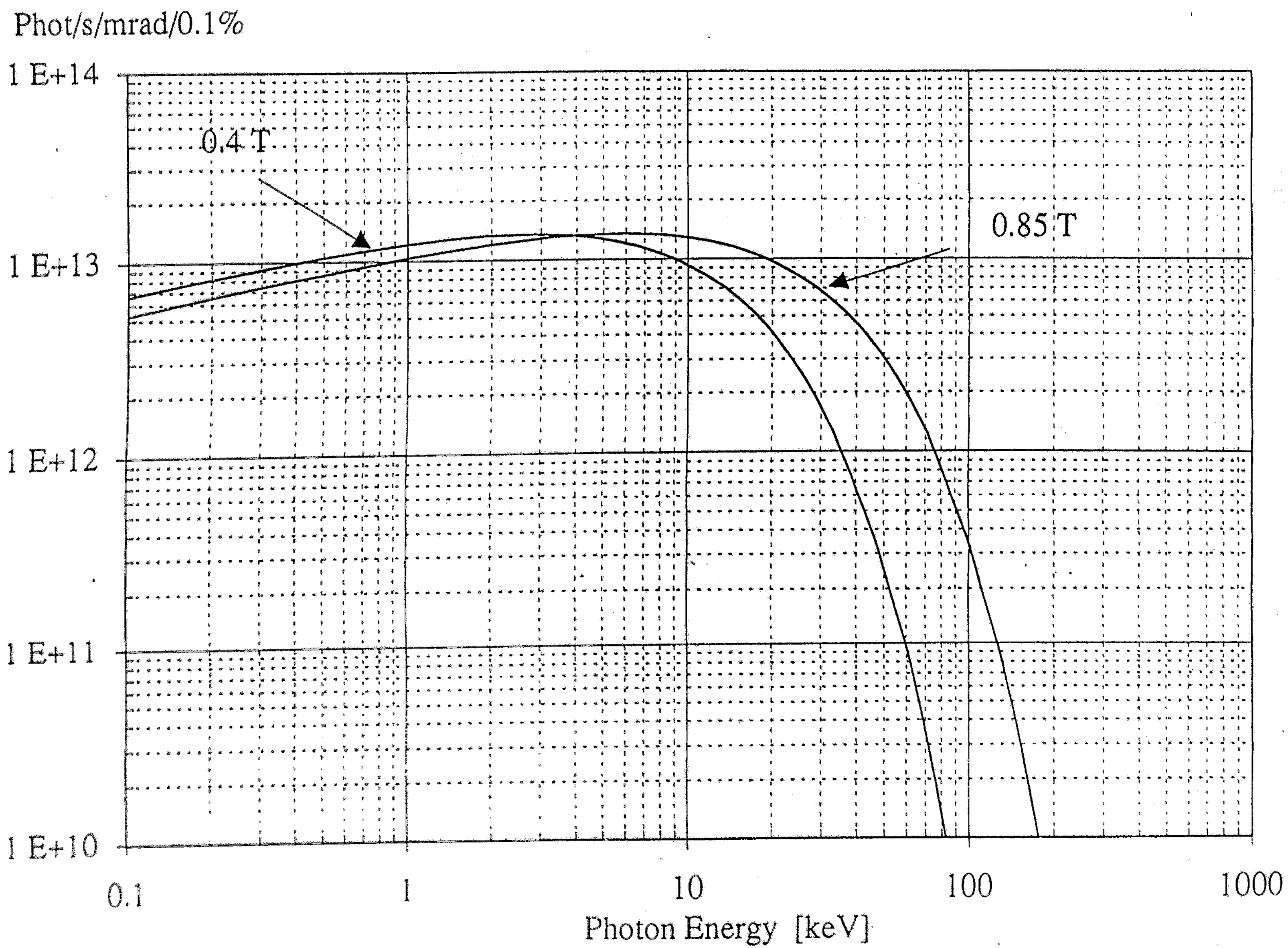


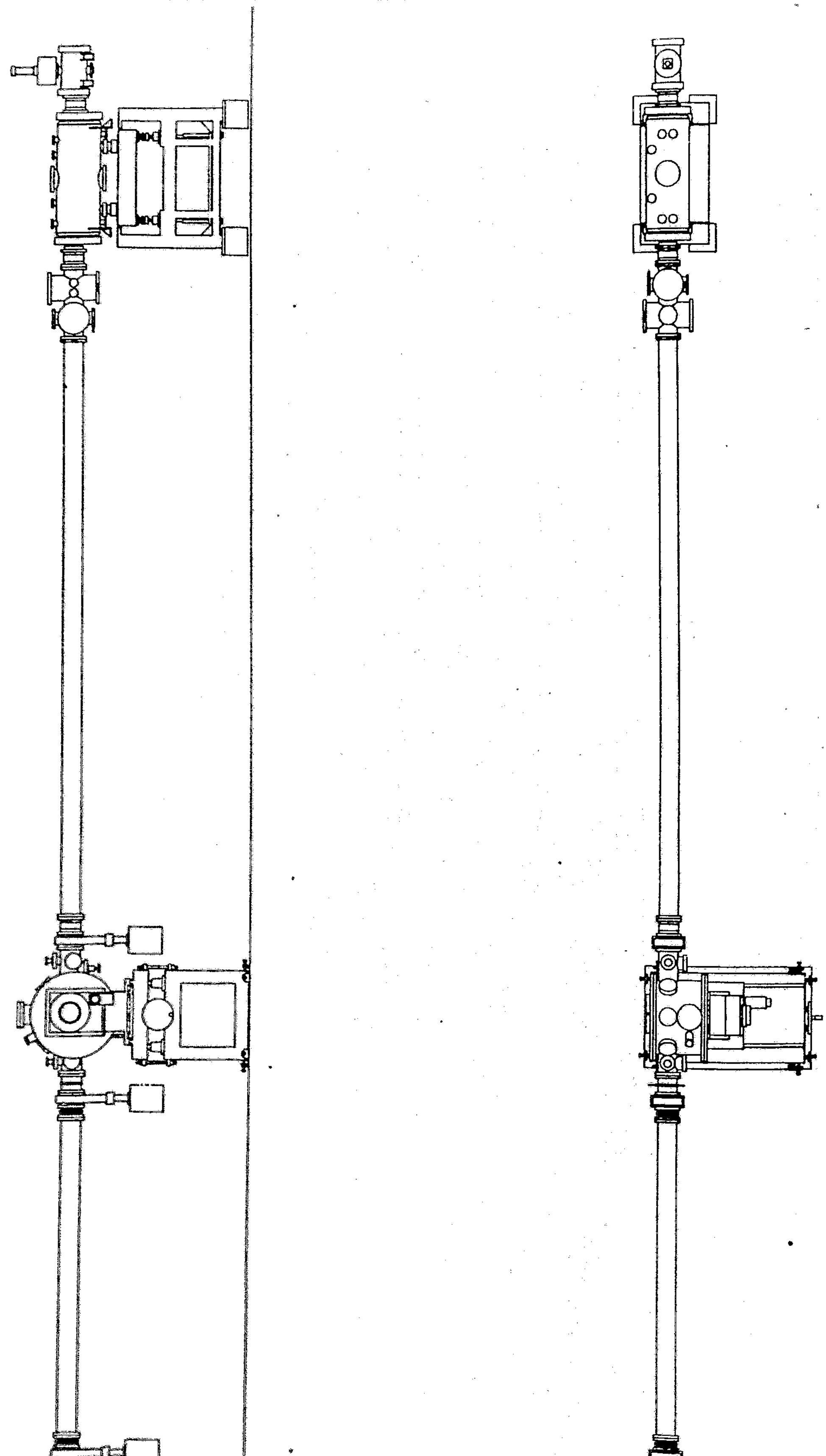
Optical Design
MAD (PX) BL19

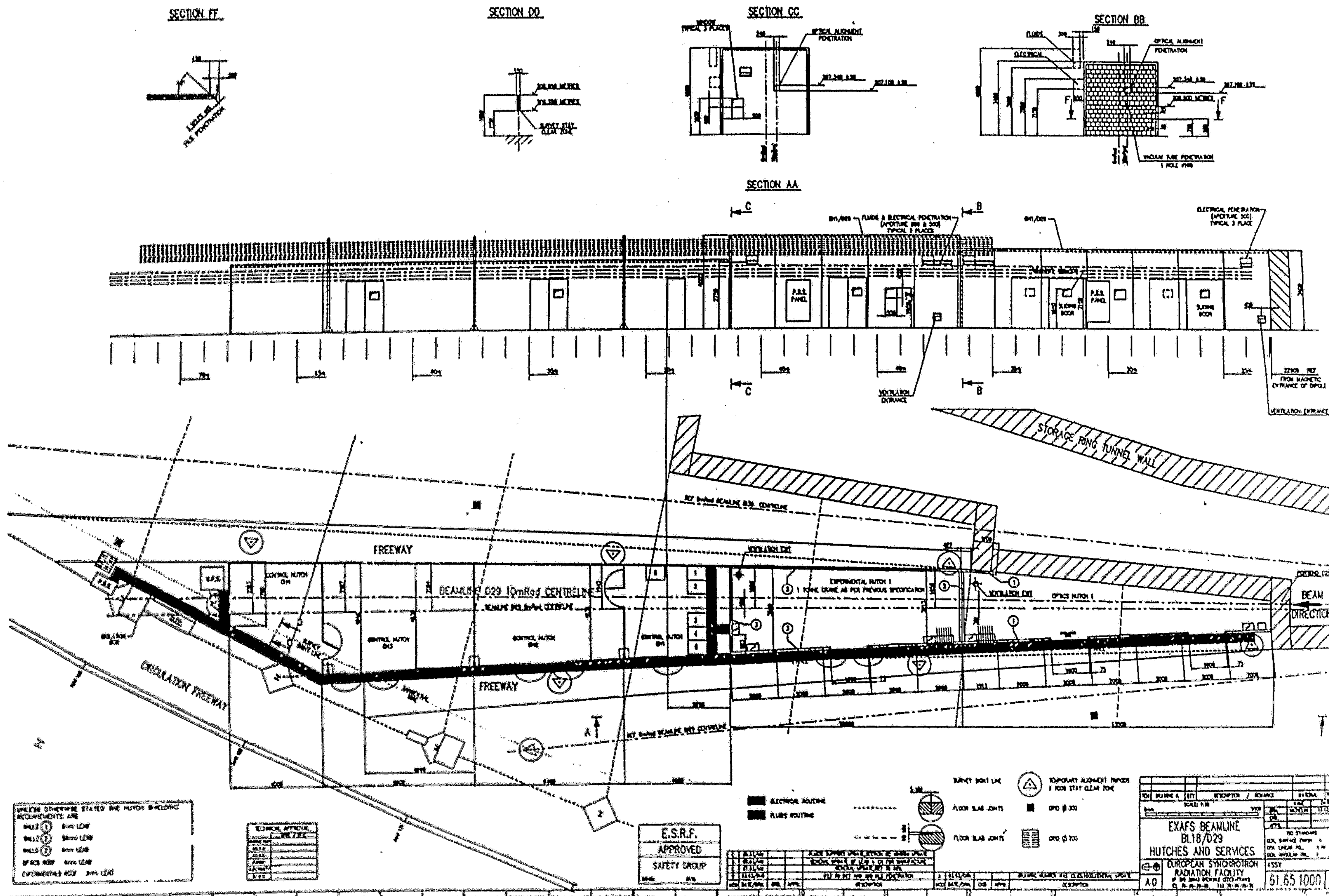
Horizontal Plane




Beam Line 18 - a general purpose beam line for EXAFS
Initial phase
double crystal
(sagittal focusing)
multi-layers
chopper
BPM
4 - 40 KeV
Source
expt. 1
expt. 2
Second phase
Source
expt. 1
expt. 2
vertically collimating
band pass filter
optics hutch
experimental hutch
28.5 m
~ 38 m
~ 45 m


Phot/s/mrad/0.1%
1 E+14
1 E+13
1 E+12
1 E+11
1 E+10
0.4 T
0.85 T
0.1
1
10
100
1000
Photon Energy [keV]




SECTION FF
SECTION DD
SECTION CC
SECTION BB
SECTION AA
STORAGE RING TUNNEL WALL
FREEWAY
BEAMLINE D29 10mRad CENTRELINE
CIRCULATION FREEWAY
BEAM DIRECTION
E.S.R.F.
APPROVED
SAFETY GROUP
EXAFS BEAMLINE
BL18/D29
HUTCHES AND SERVICES
EUROPEAN SYNCHROTRON RADIATION FACILITY
A0
61.65 1000

Kott zu :

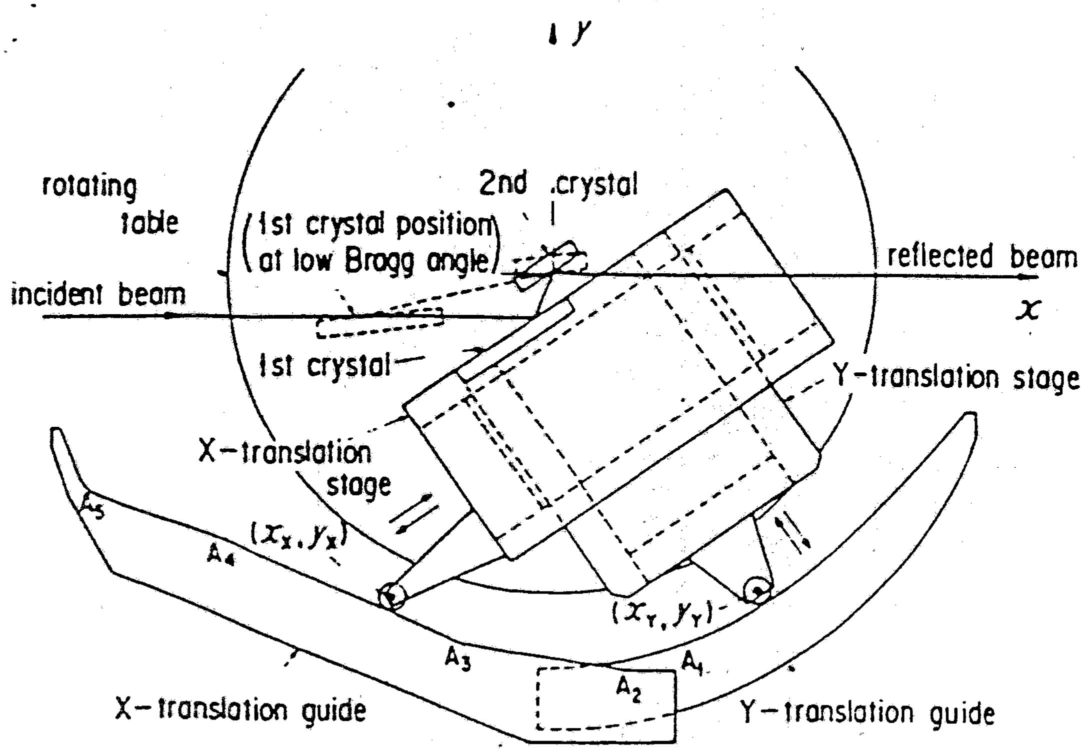
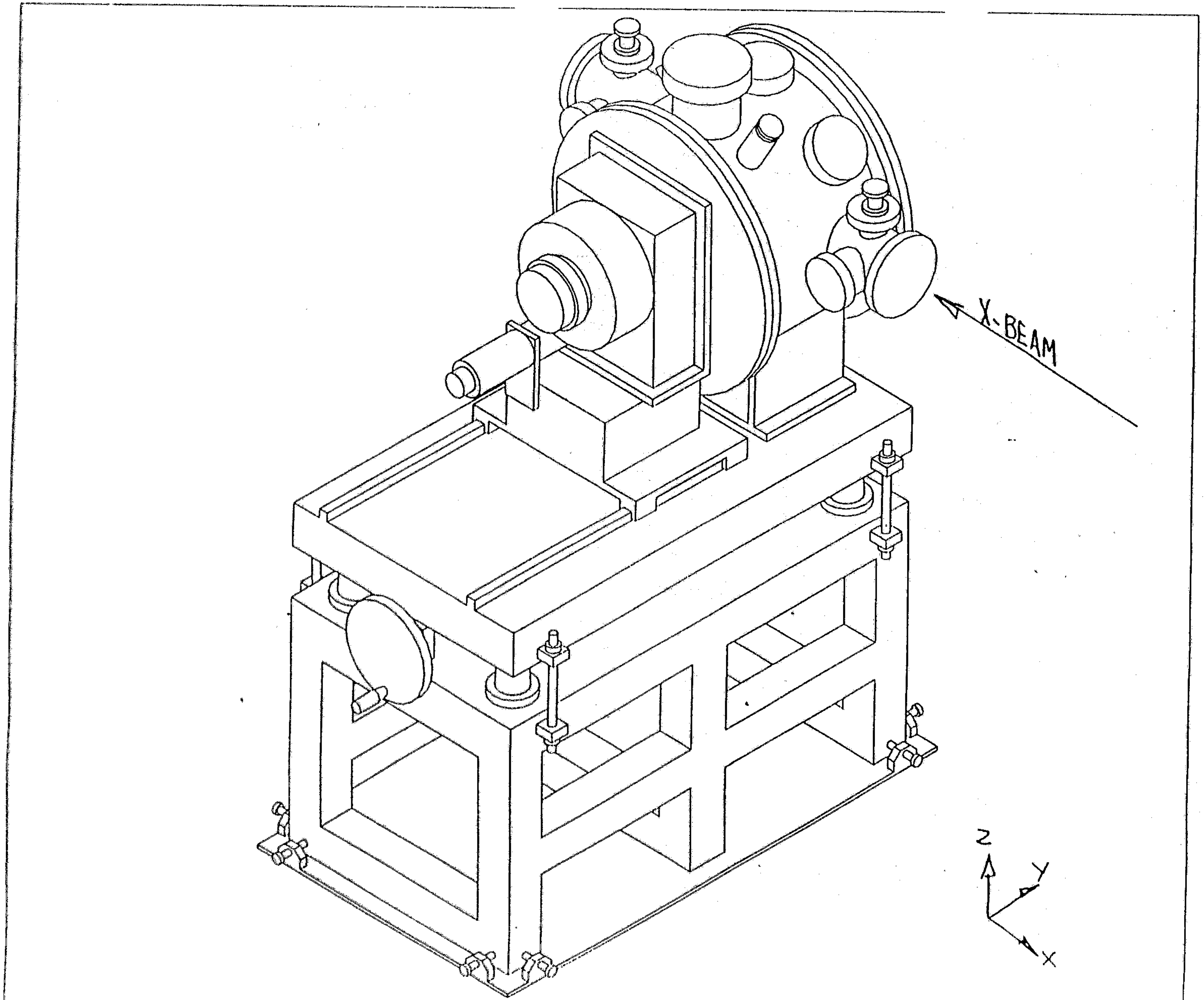


Fig. 1. A mechanism to keep the exit-beam height constant. The x and y axes are taken on the reflected beam from the second crystal and perpendicular to it, respectively, by choosing the position of the rotation axis as the origin. For more details, refer to the text.

Nucl. Inst & Methods A246, 377 (1986)
Matsushita et. al.

(Lemonnier et al. (1978))
(Goulon et al. (1983))



PERSONAL, BLATTMANN

5921MOKH15

ENSEMBLE MONOCHROMATEUR

KHOZU JMK23AAS.

16 JUIN 1993

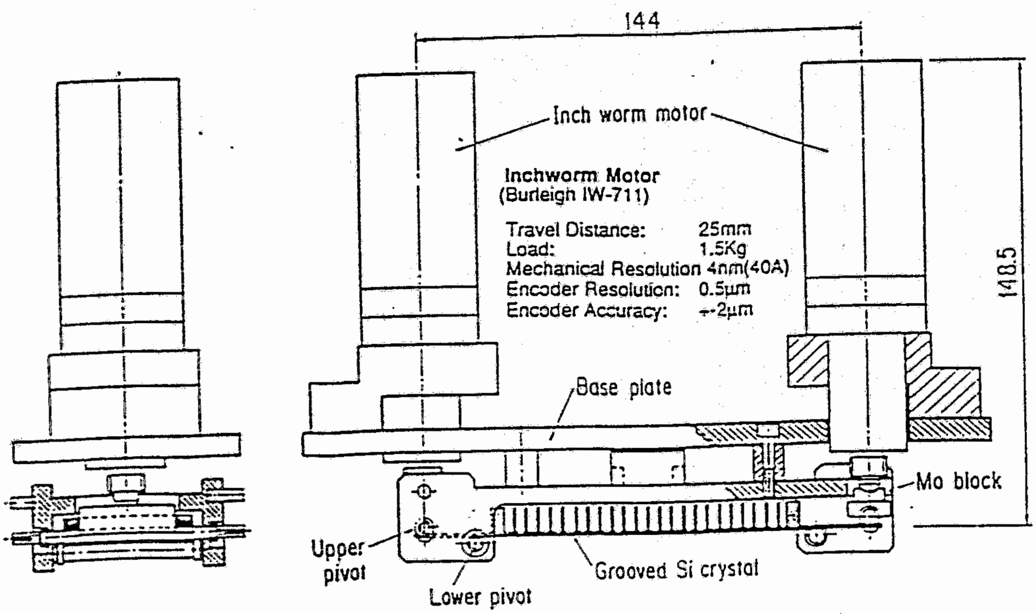
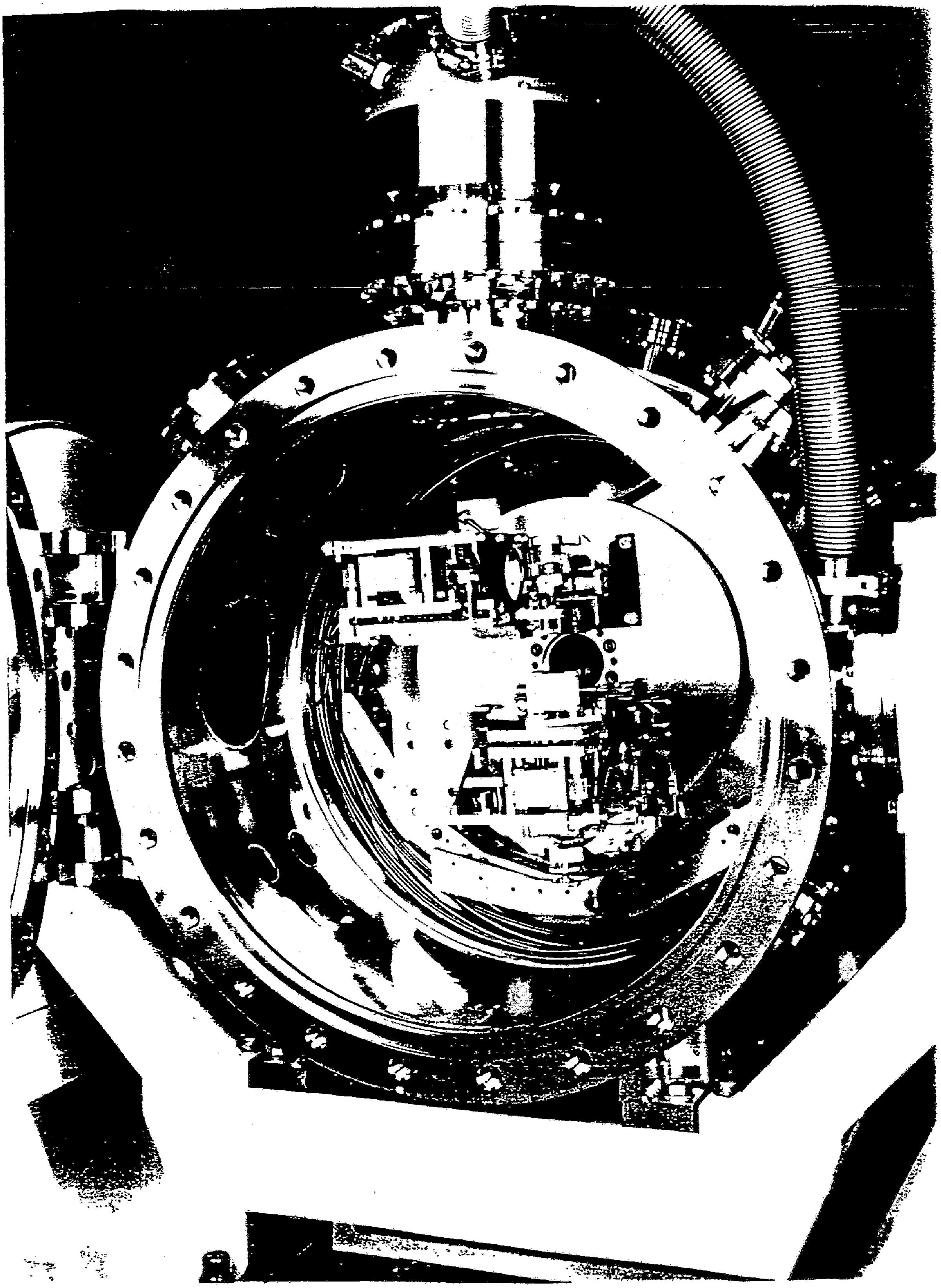
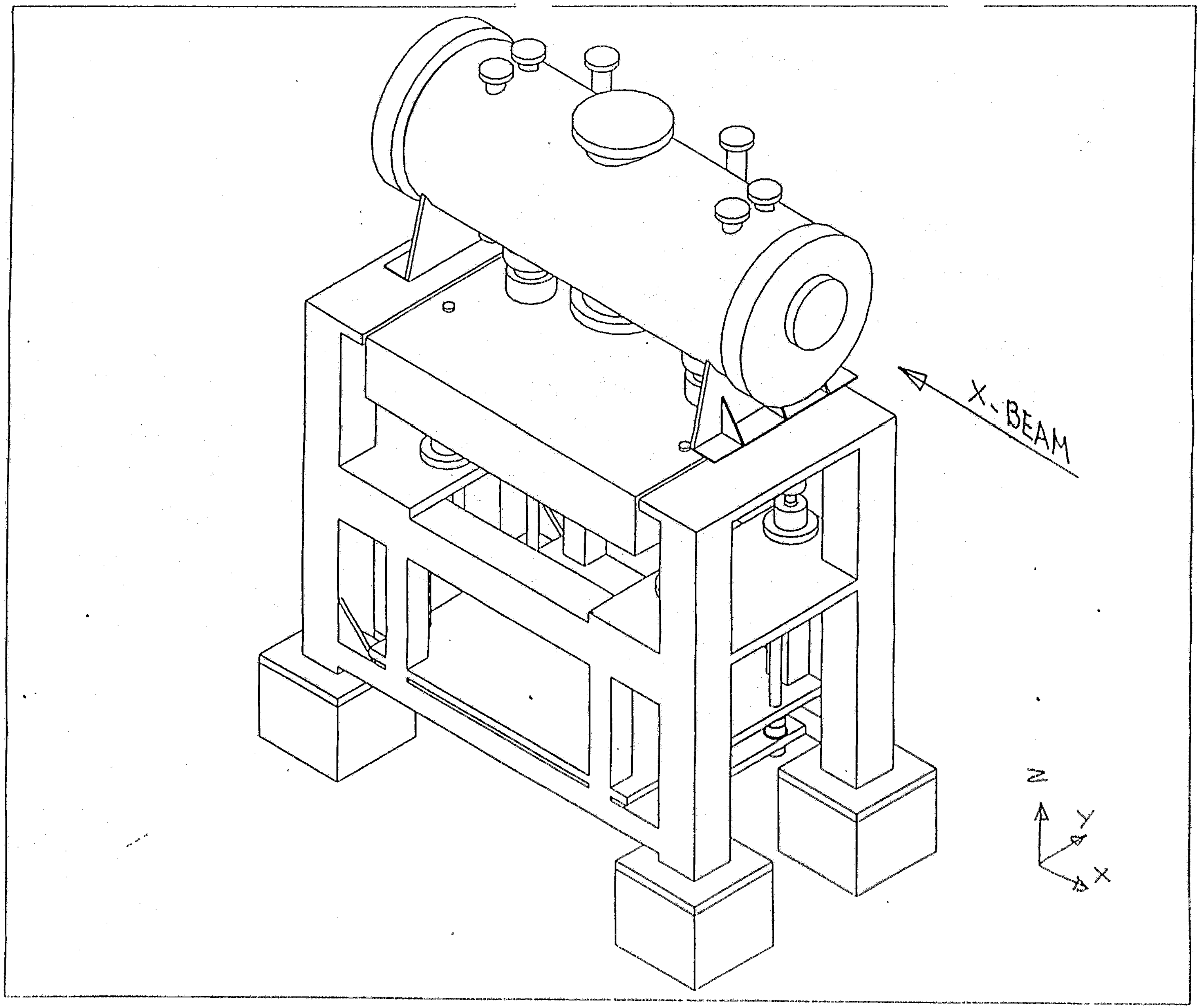


Fig. 10 An adaptive second crystal placed on a bender equipped with two inchworm motors.



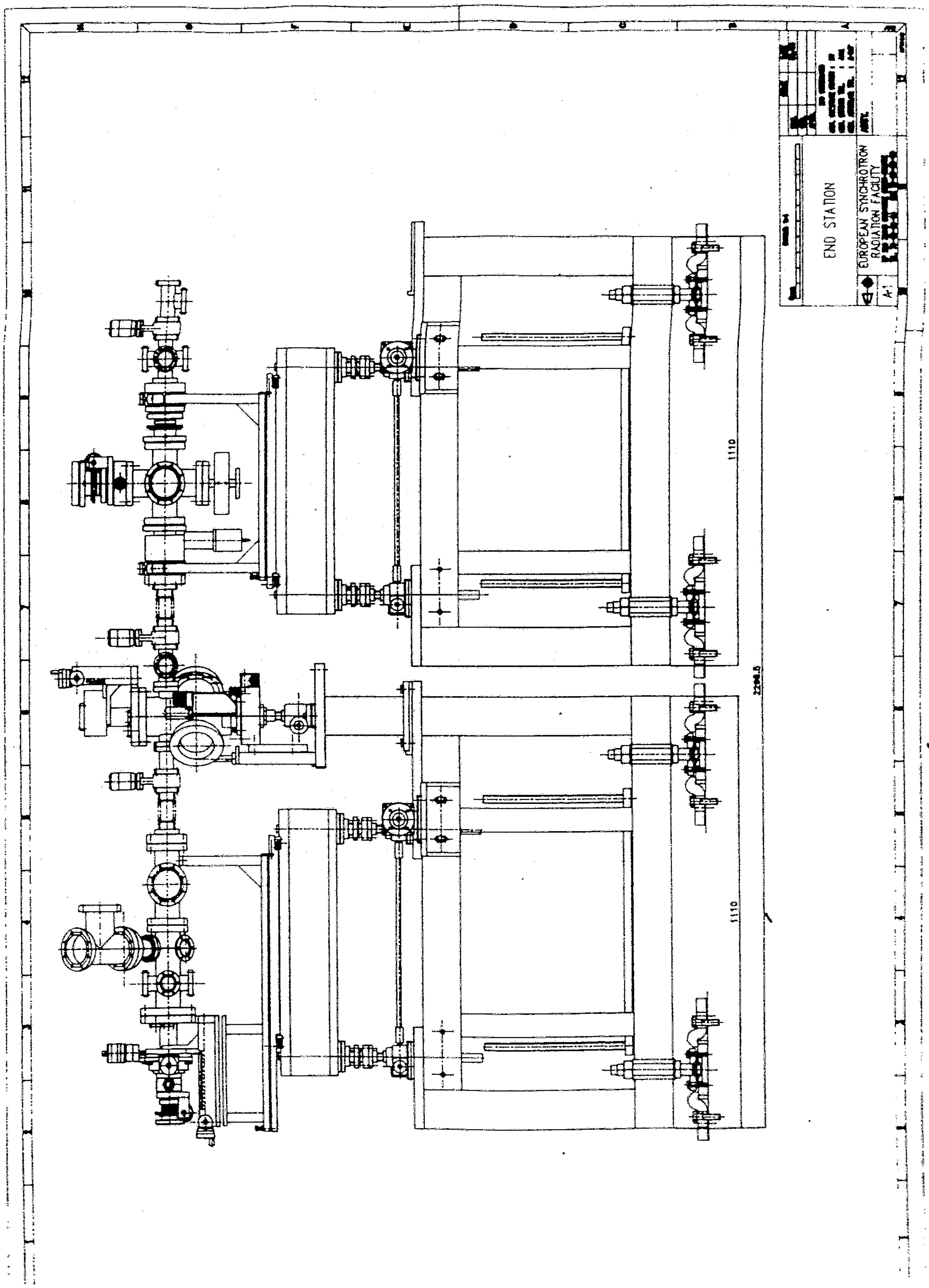


PERSONAL, BLATTMAN

59304MIR15

4 MIRROIRS (LECLERC)
VERSION 1 SUR BÂTI.

16 JUIN 1993



END STATION
EUROPEAN SYNCHROTRON
RADIATION FACILITY
A1
1110
1110

The Swiss-Norwegian Beam Line

UNIVERSITE DE LAUSANNE

Institut de Cristallographie
Université de Lausanne

An international collaboration between Norway and Switzerland to construct and operate a general purpose synchrotron radiation beamline at the European Synchrotron Radiation Facility (ESRF).

The beamline will be used for experiments in:

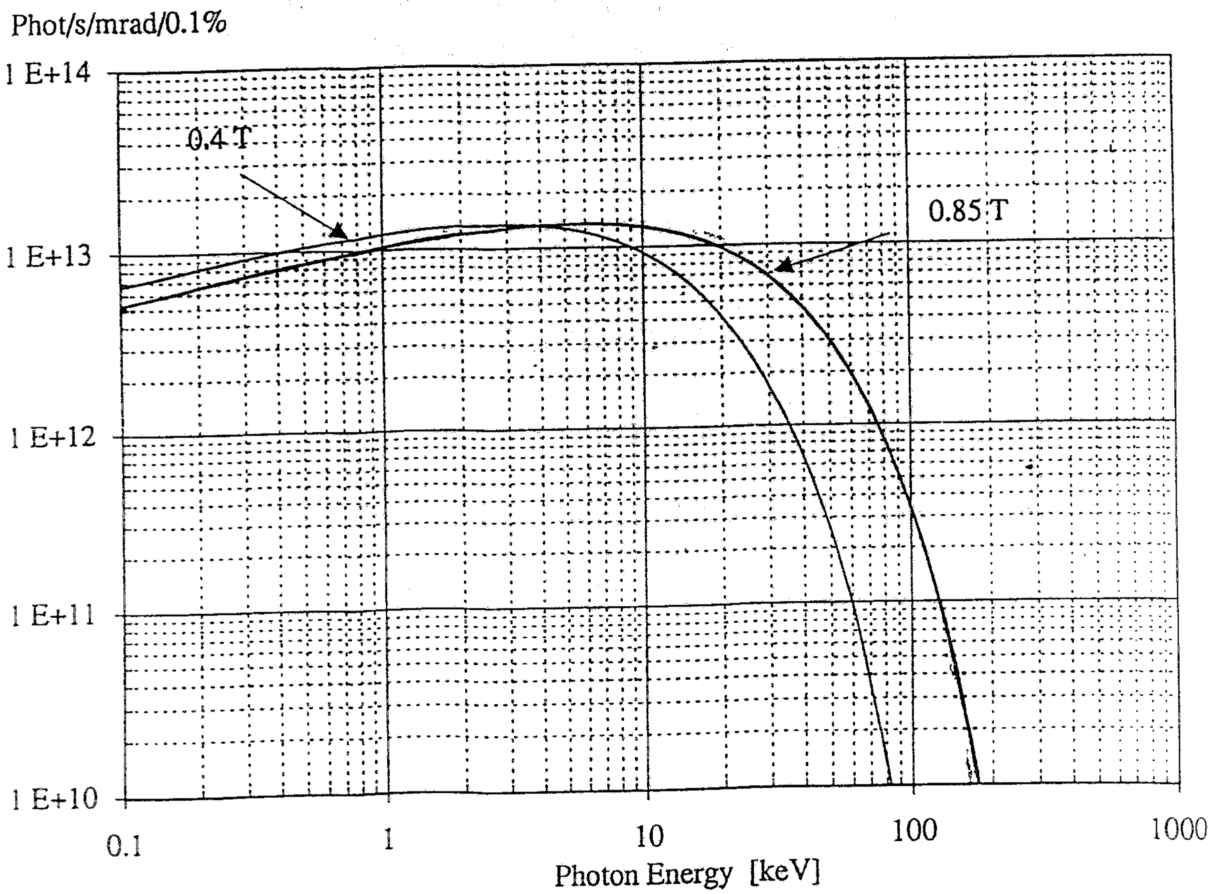
* **Single crystal diffraction**
* **Powder diffraction**
* **X-ray absorption spectroscopy (EXAFS)**
* **White beam diffraction (Topography)**

CRG

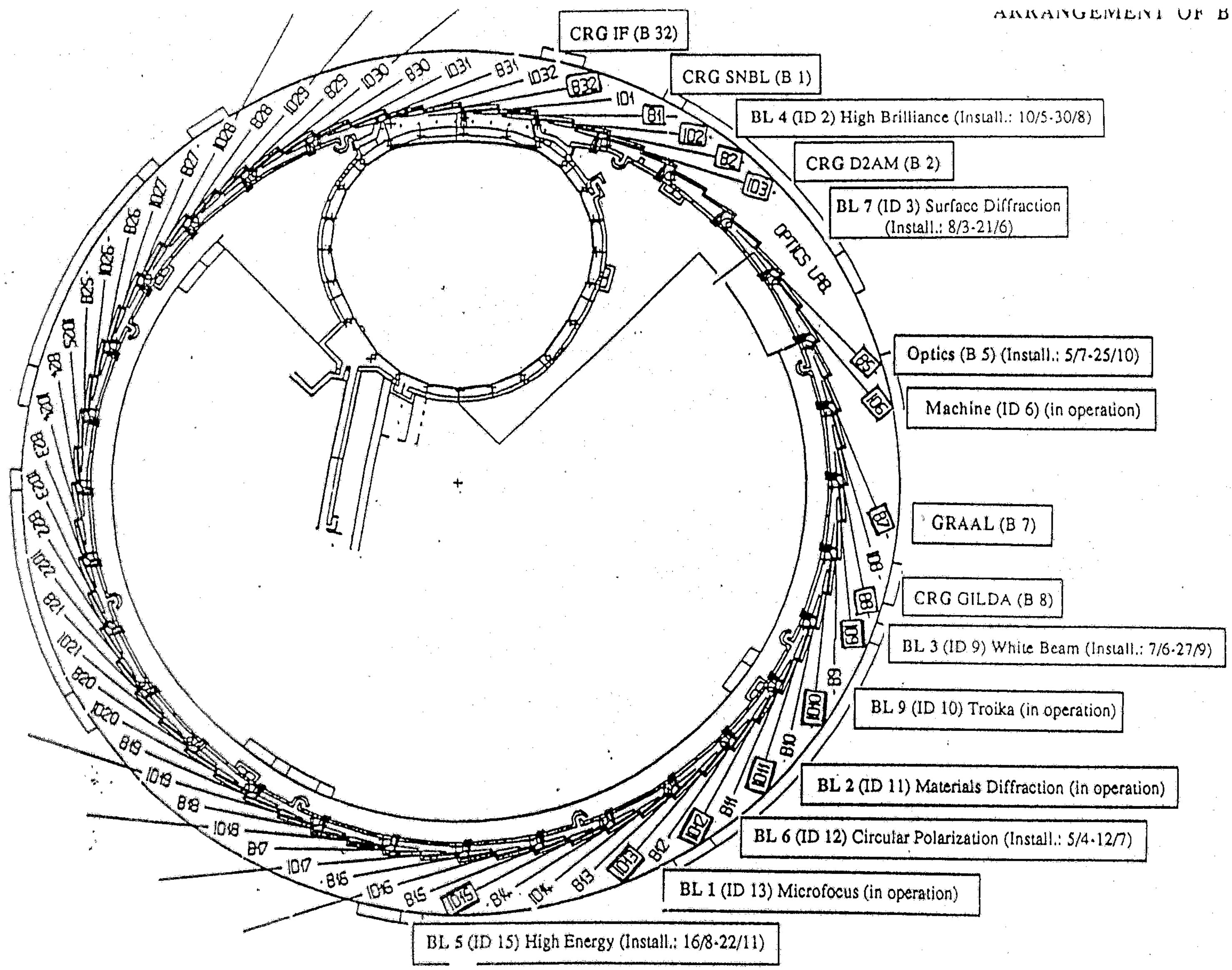
Spectral flux

ESRF bending magnet

photons / sec / horizontal mrad / 0.1% bandwidth

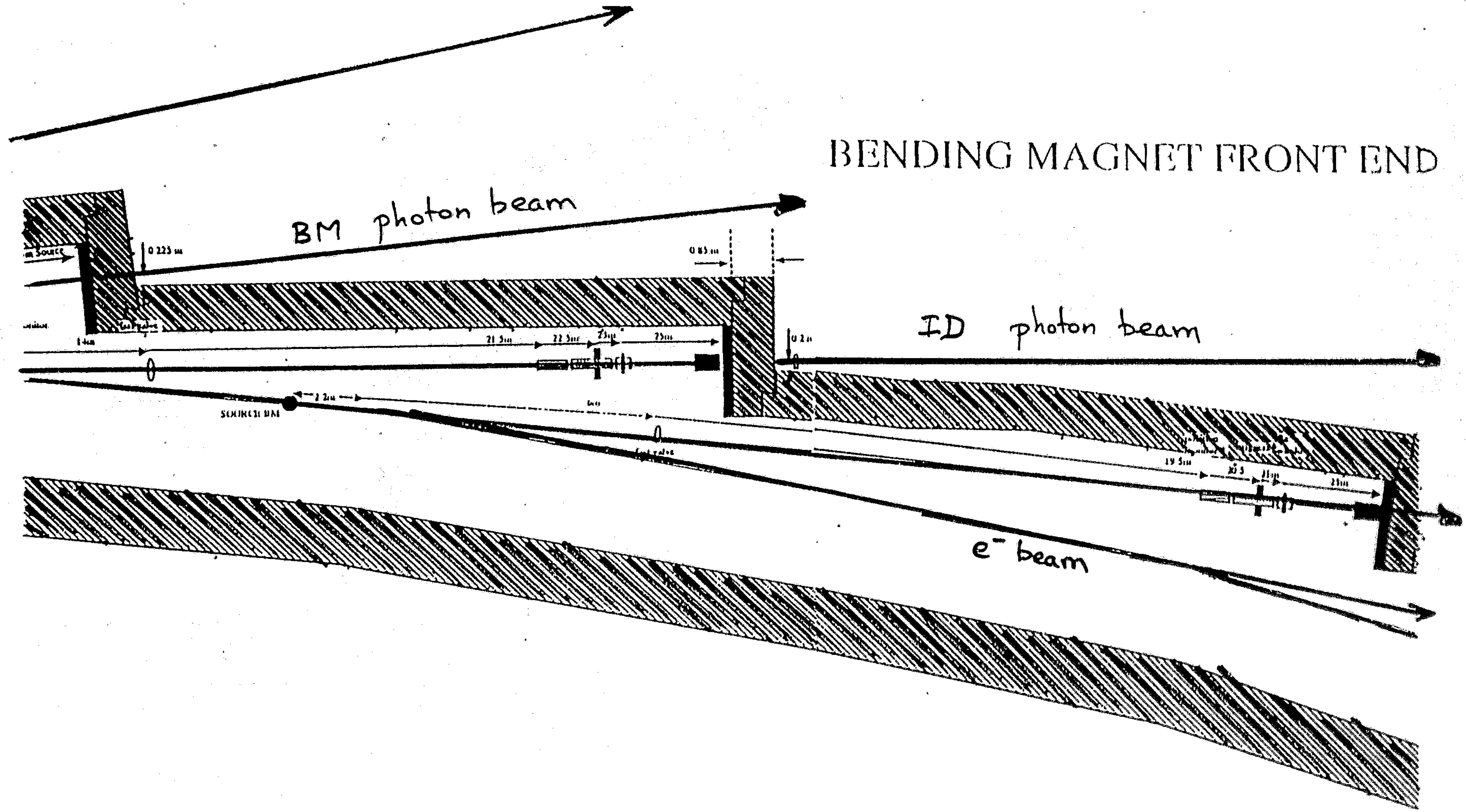


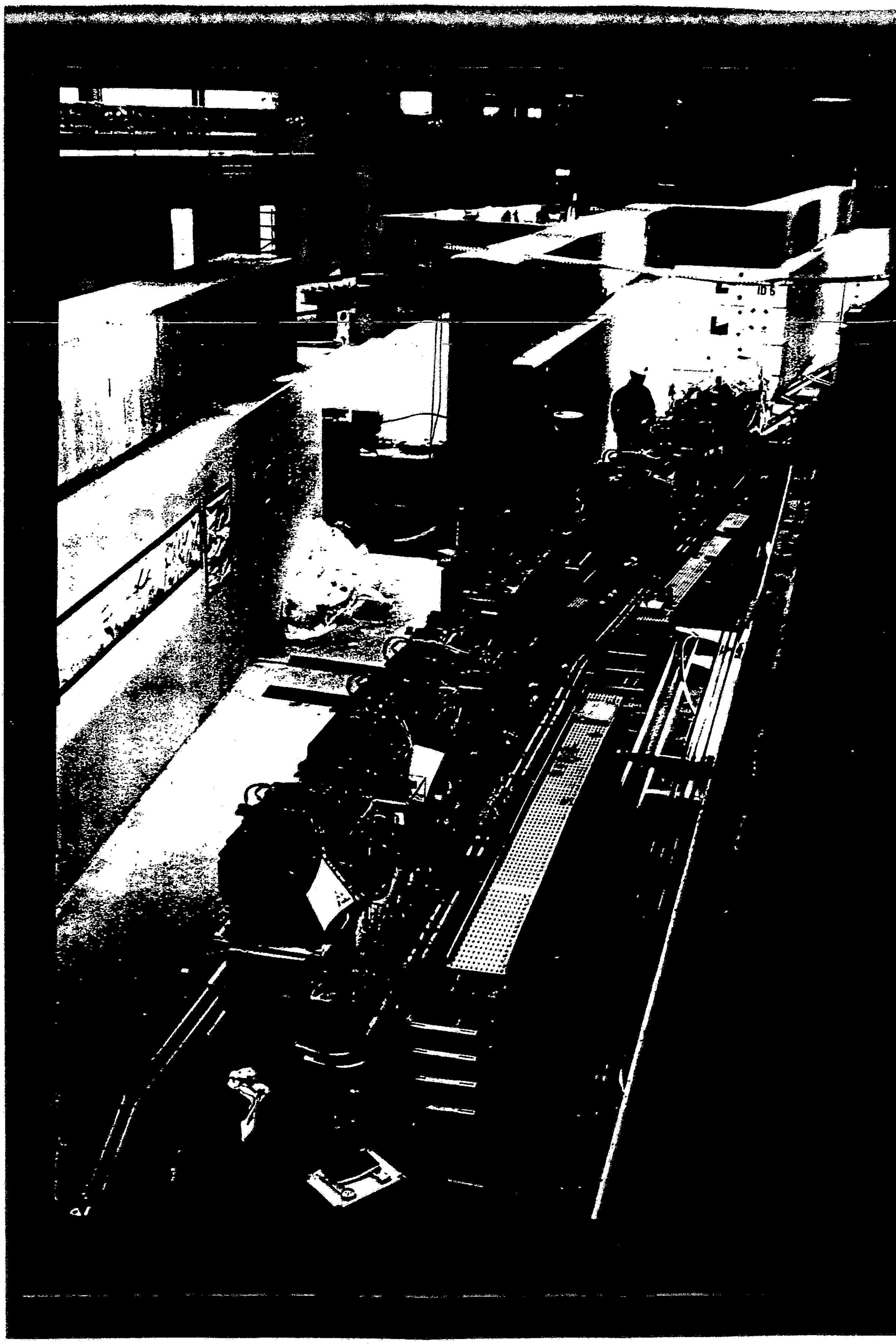
ARRANGEMENT OF BEAMLINES



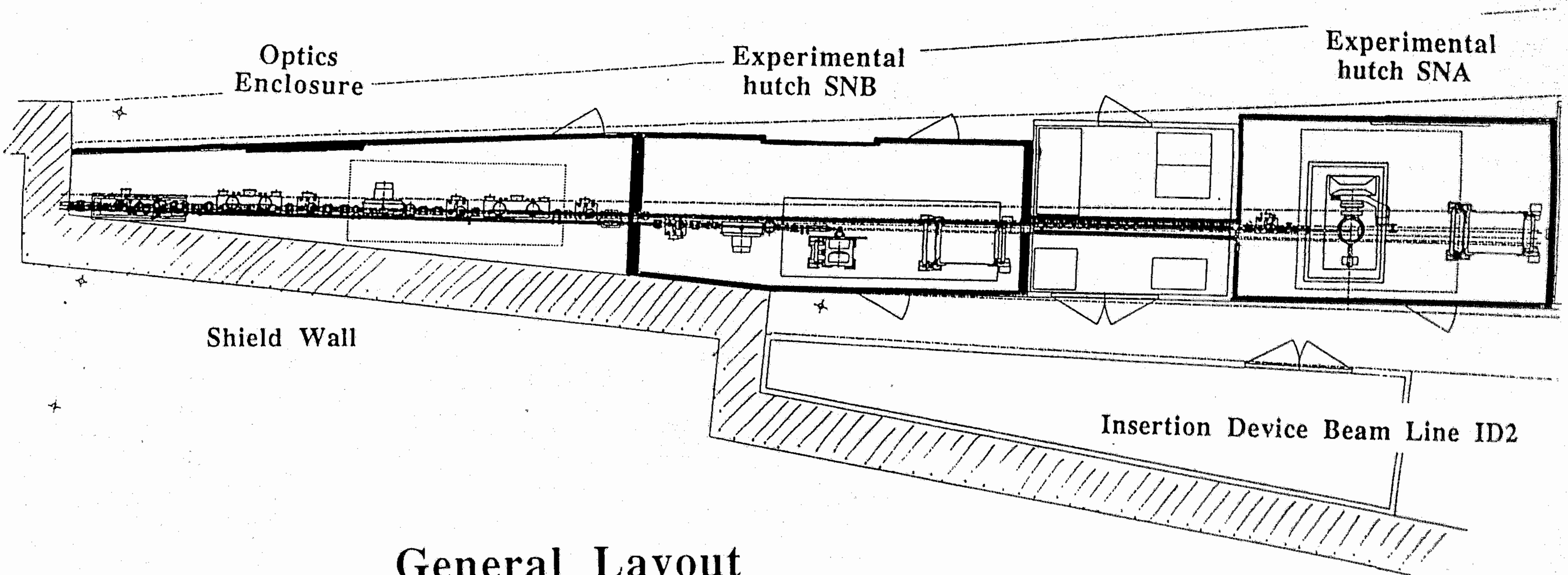
January 1993

BENDING MAGNET FRONT END



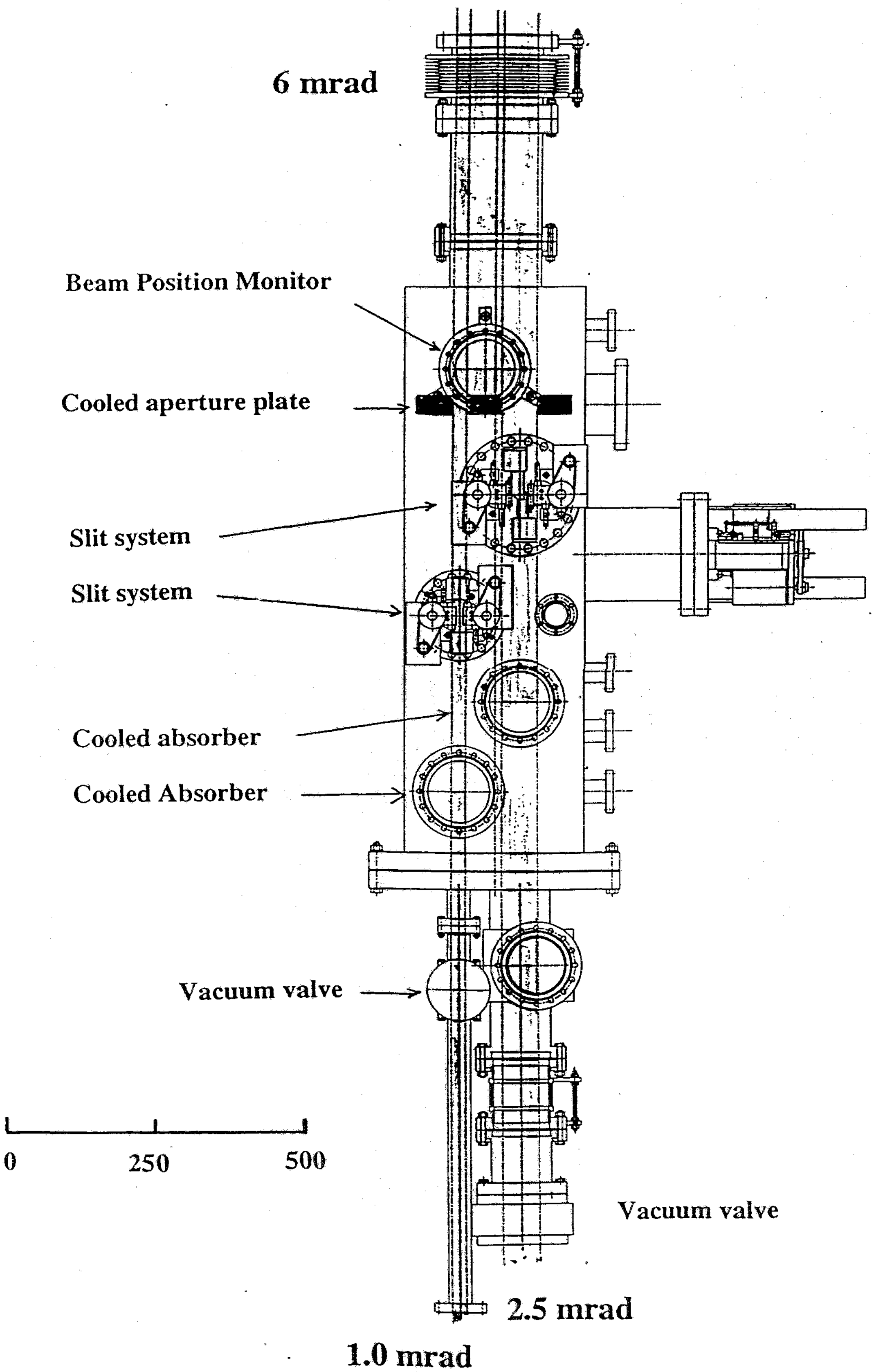


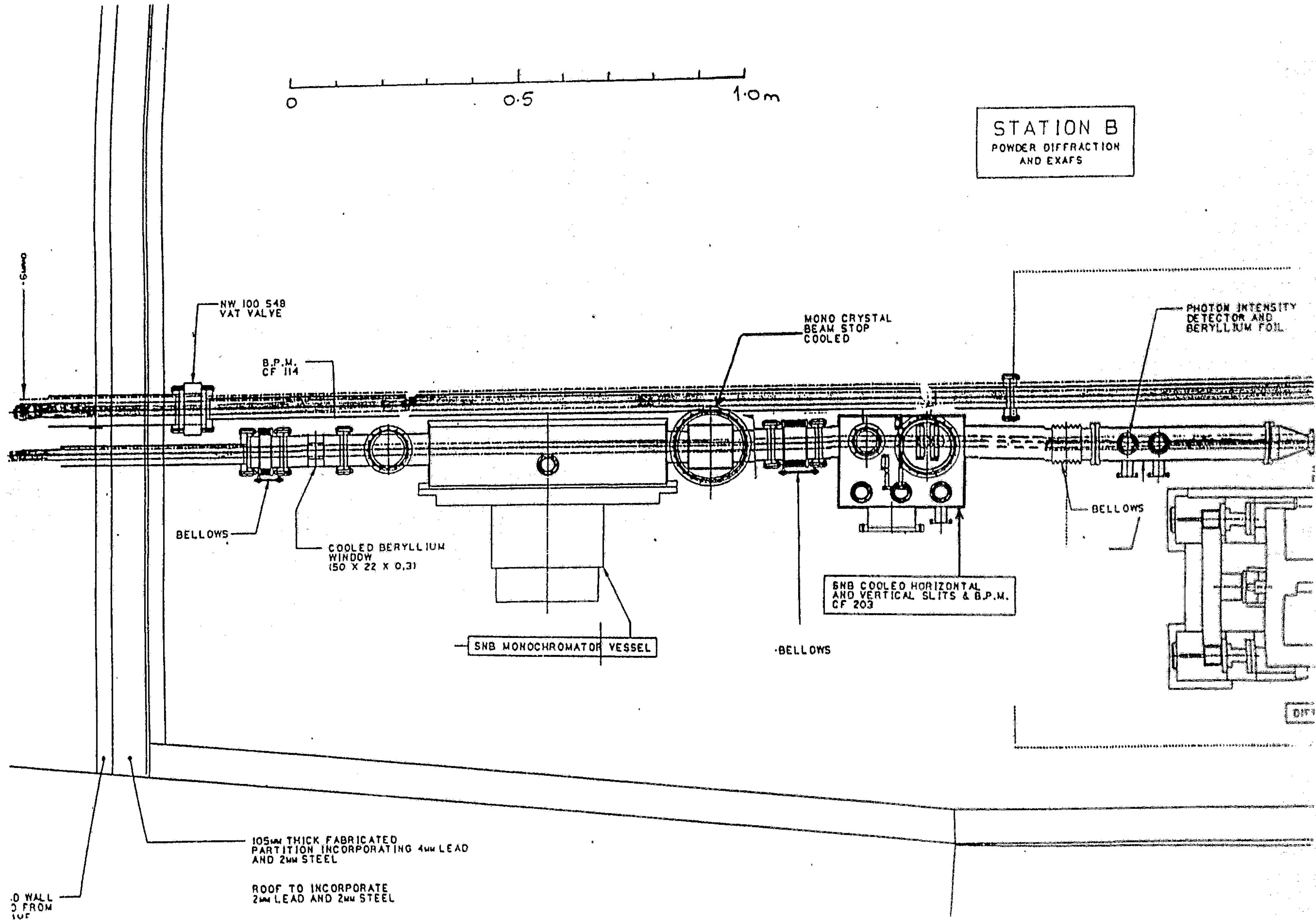
Swiss-Norwegian Beam Line



General Layout

Splitter vessel

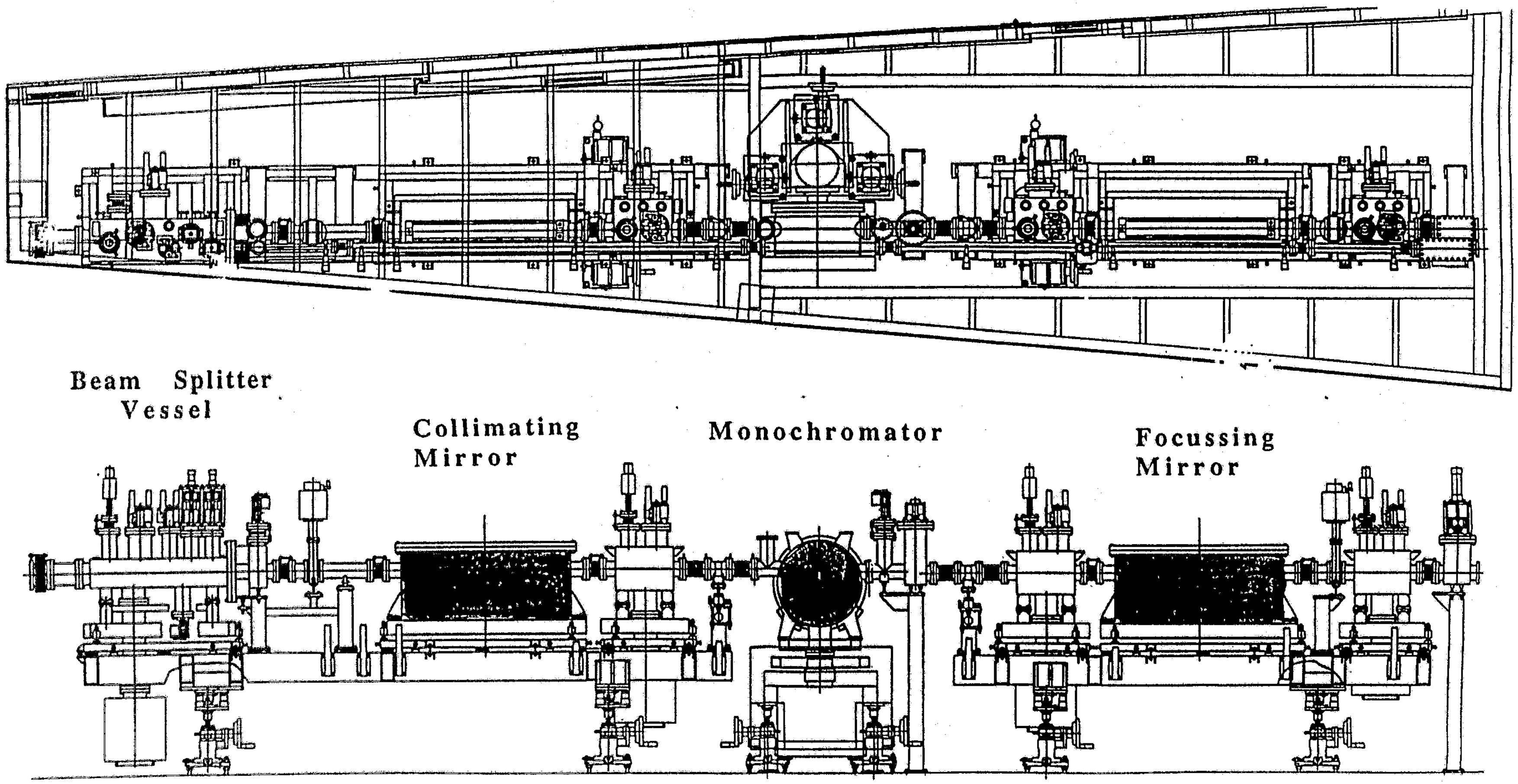




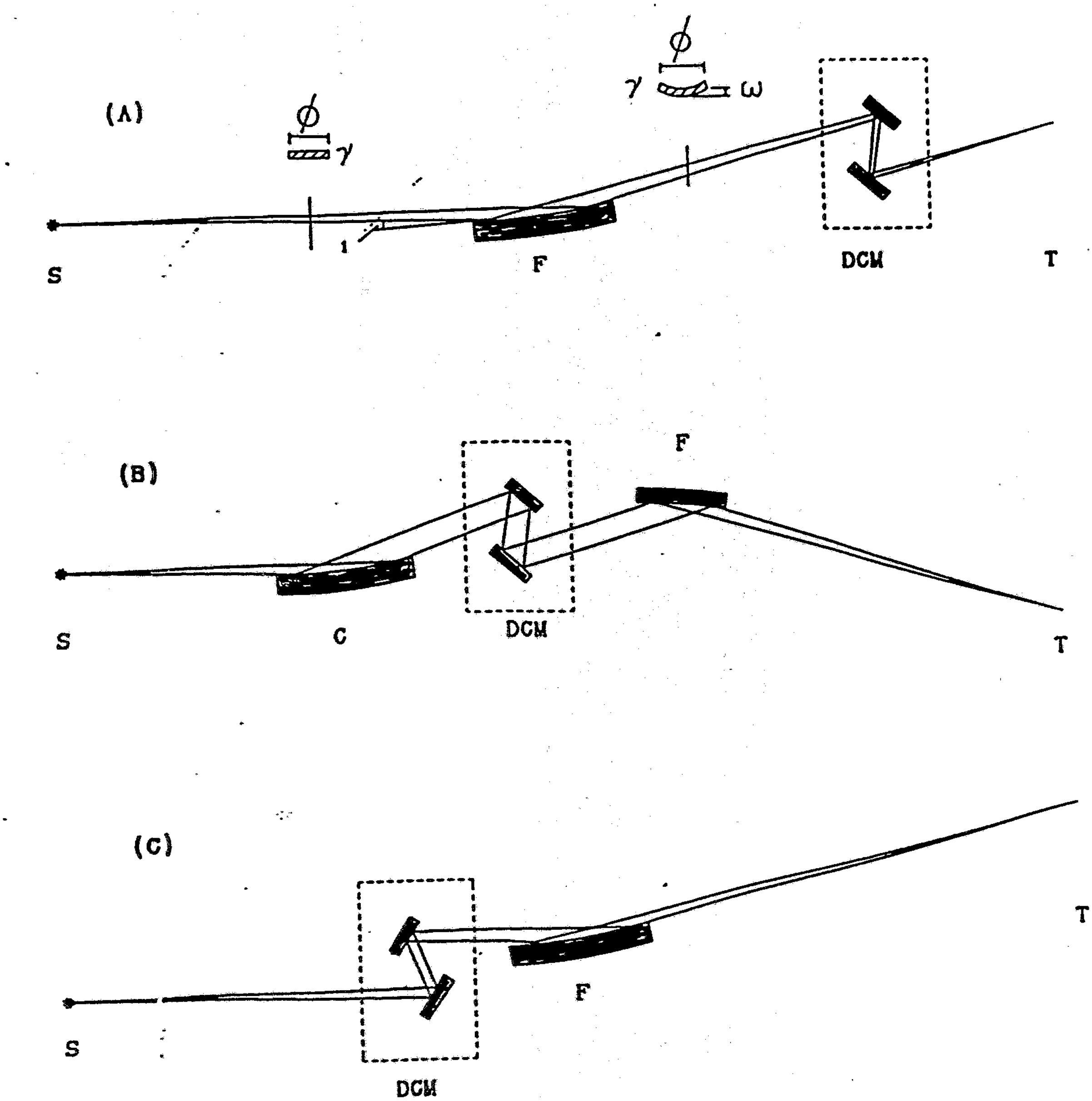
STATION B
POWDER DIFFRACTION AND EXAFS
0
0·5
1·0m
NW 100 S48 VAT VALVE
B.P.M. CF 114
BELLOWS
COOLED BERYLLIUM WINDOW (50 X 22 X 0,3)
SNB MONOCHROMATOR VESSEL
MONO CRYSTAL BEAM STOP COOLED
BELLOWS
SNB COOLED HORIZONTAL AND VERTICAL SLITS & B.P.M. CF 203
BELLOWS
PHOTON INTENSITY DETECTOR AND BERYLLIUM FOIL
105MM THICK FABRICATED PARTITION INCORPORATING 4MM LEAD AND 2MM STEEL
ROOF TO INCORPORATE 2MM LEAD AND 2MM STEEL

Optics Enclosure

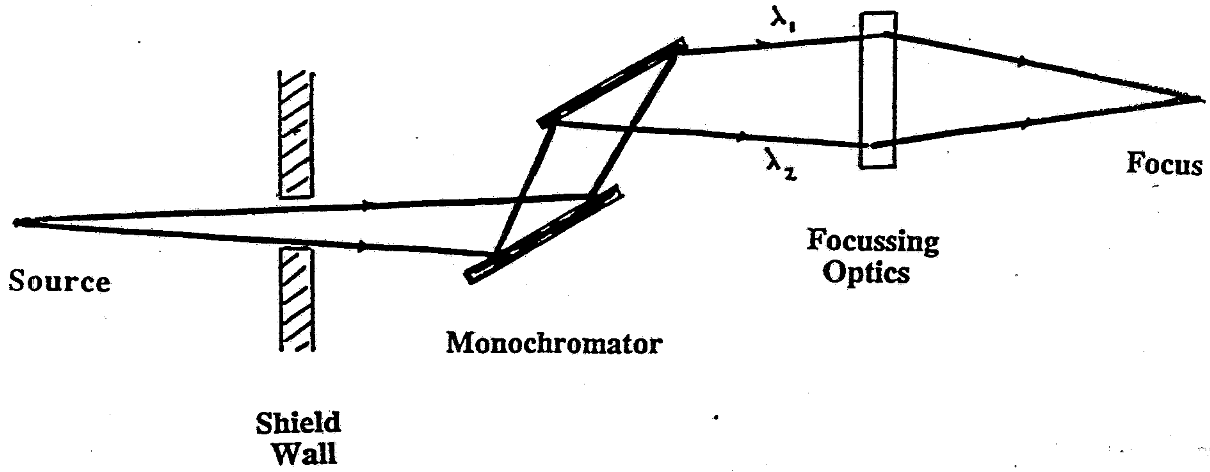
Swiss-Norwegian Beam Line

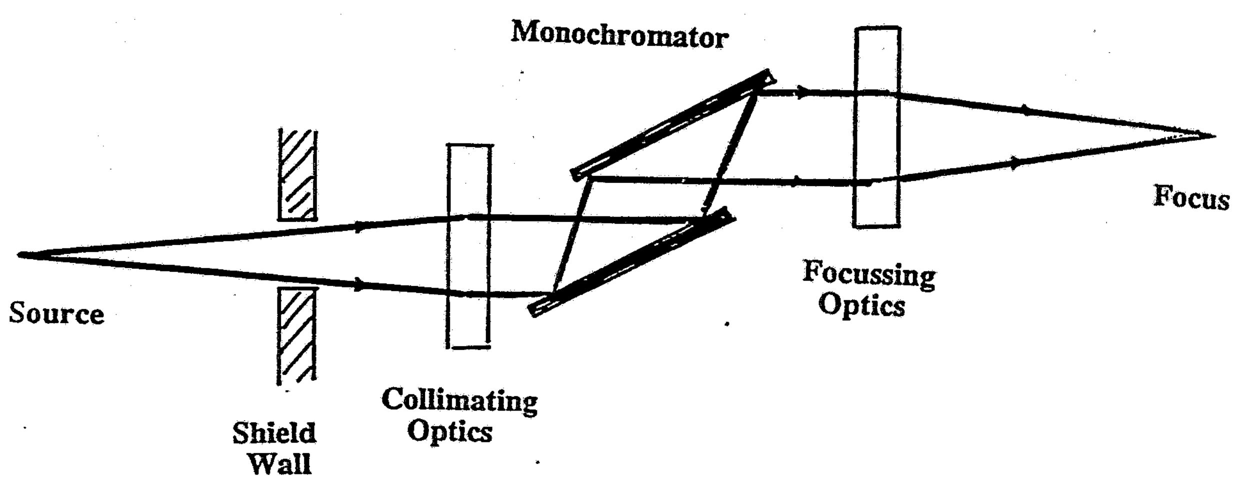


Beamline Optics

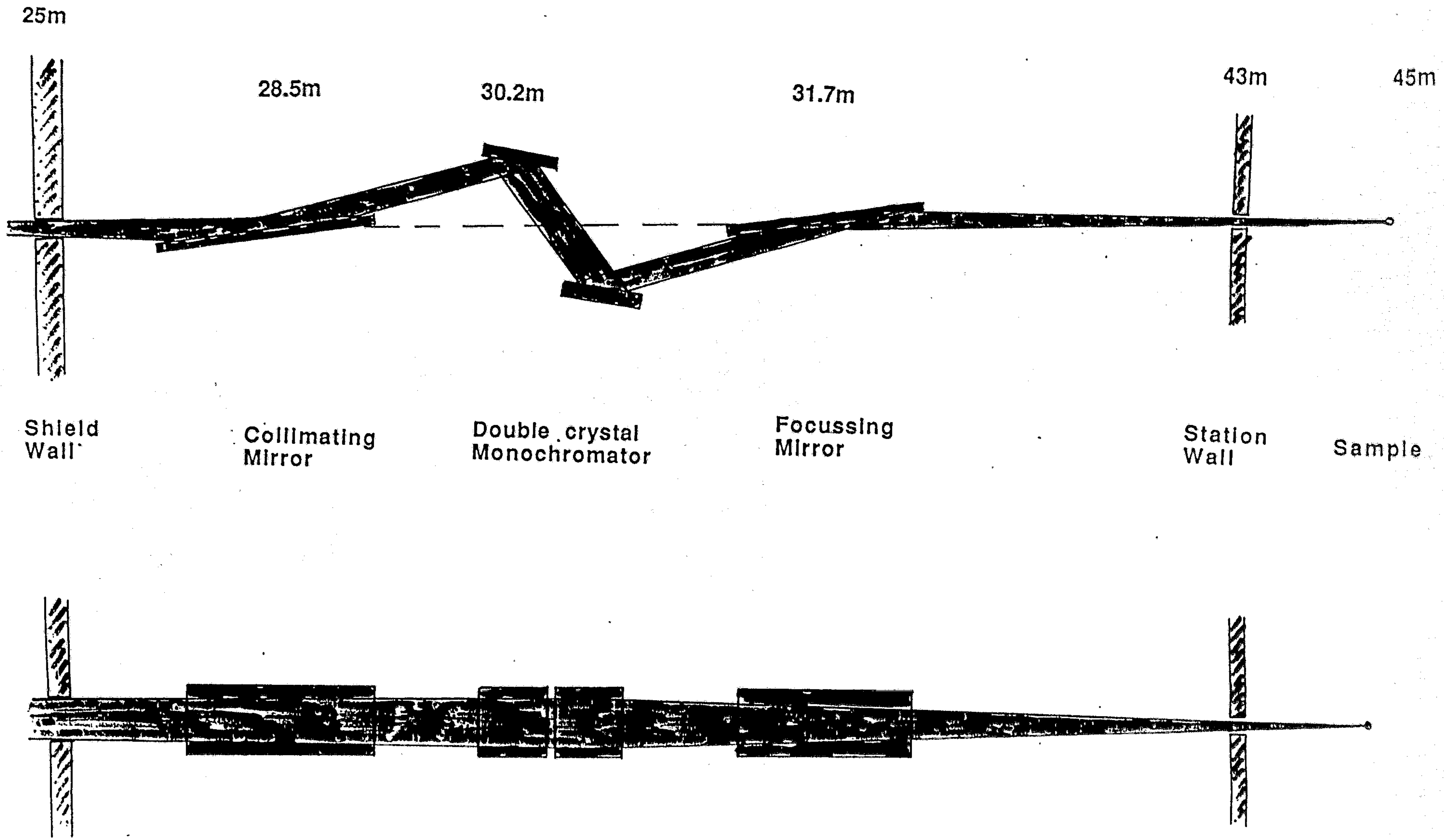


X-ray optics

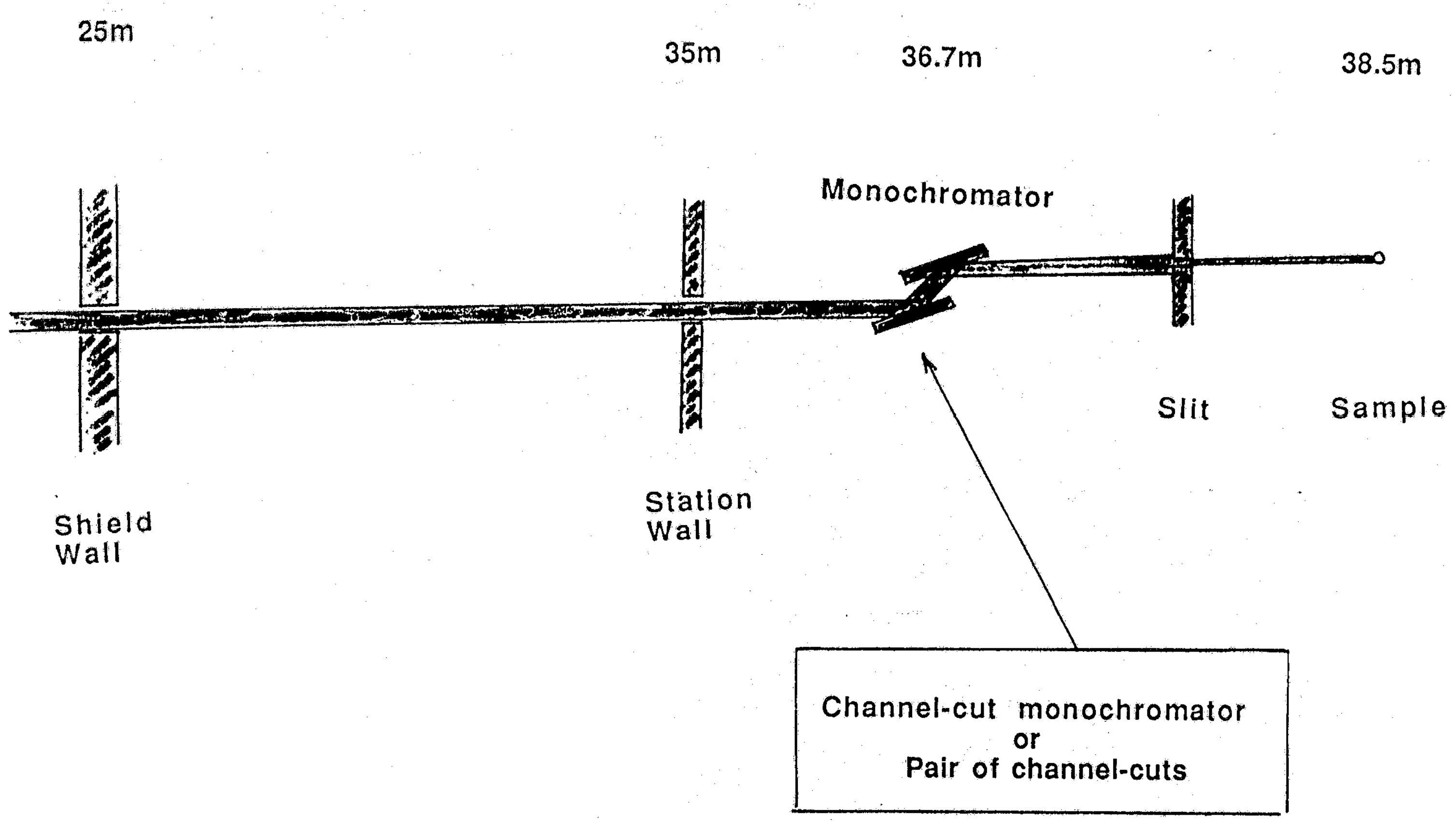

λ1
λ2
Focus
Focussing Optics
Source
Monochromator
Shield Wall

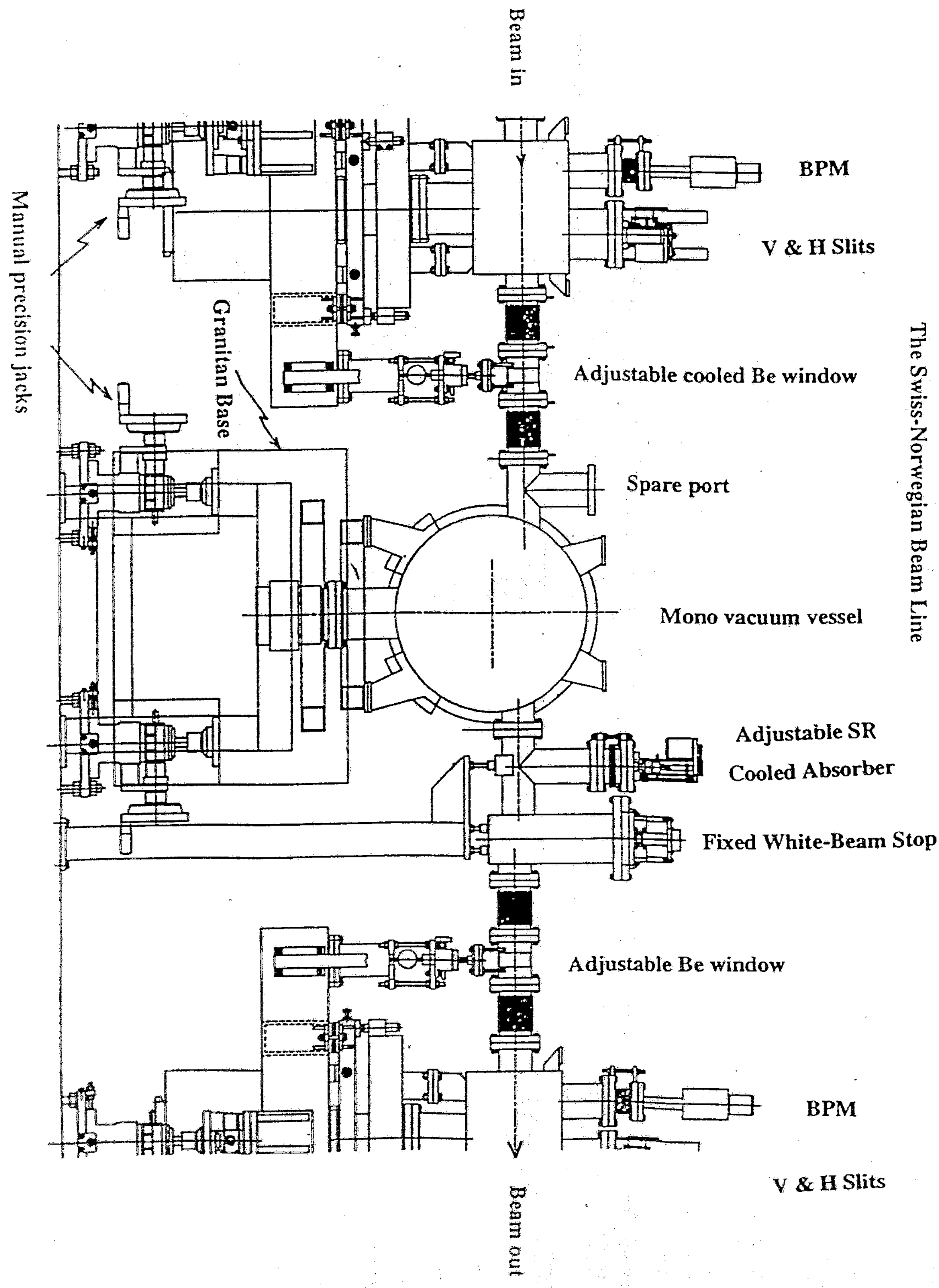

Monochromator
Focus
Focussing Optics
Source
Collimating Optics
Shield Wall

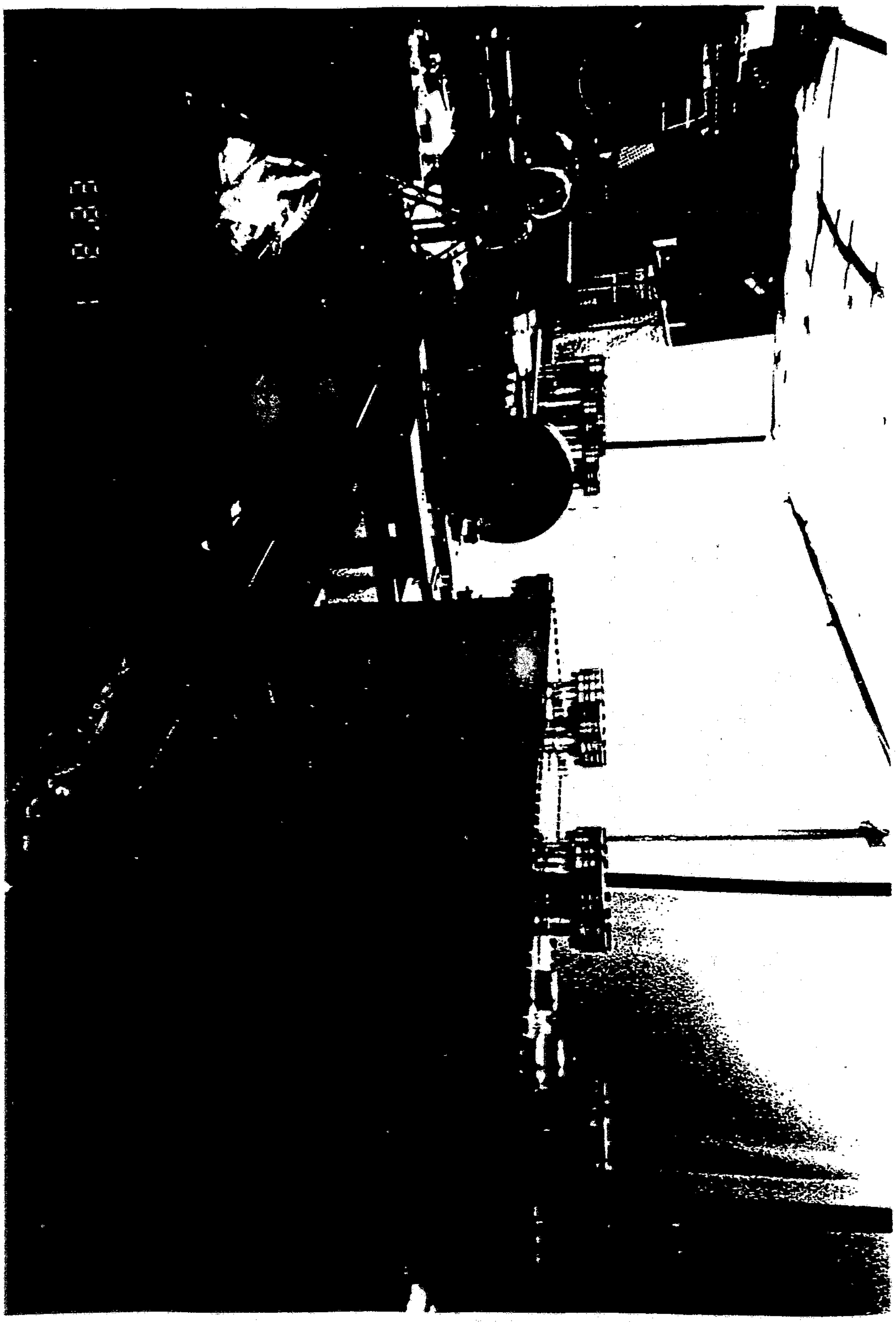
Focussed Beam Line SNA

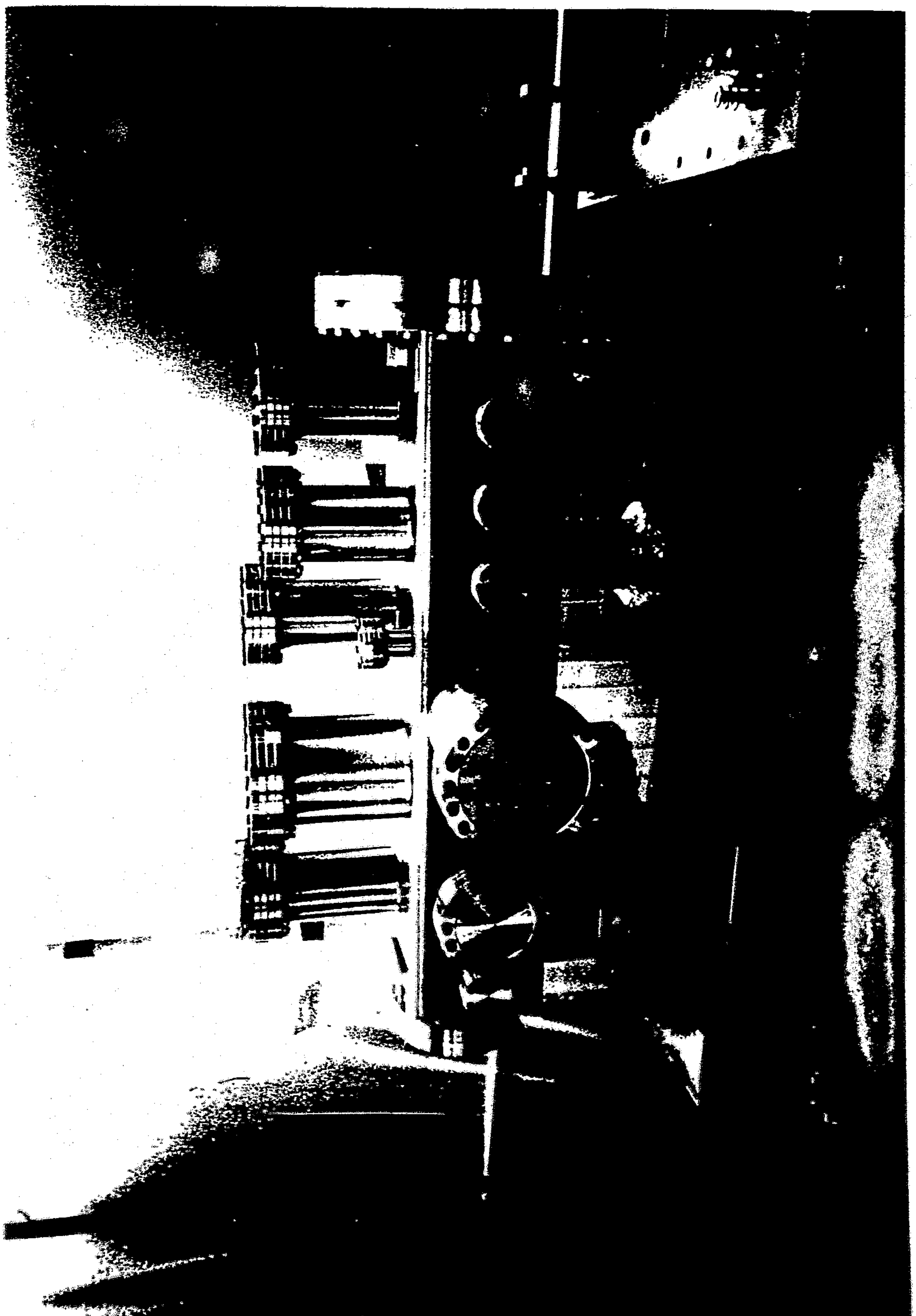


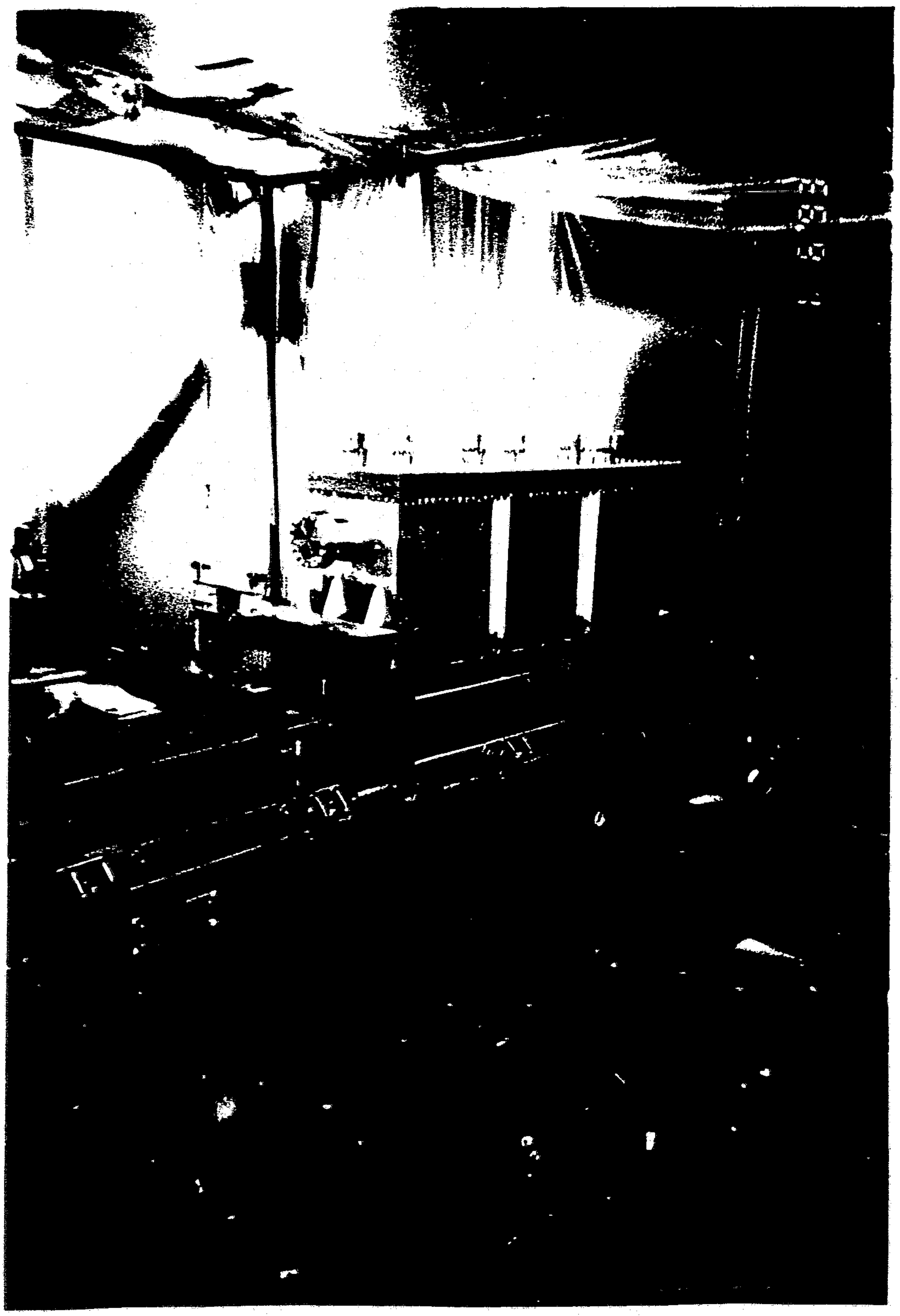
Unfocussed Beam Line SNB

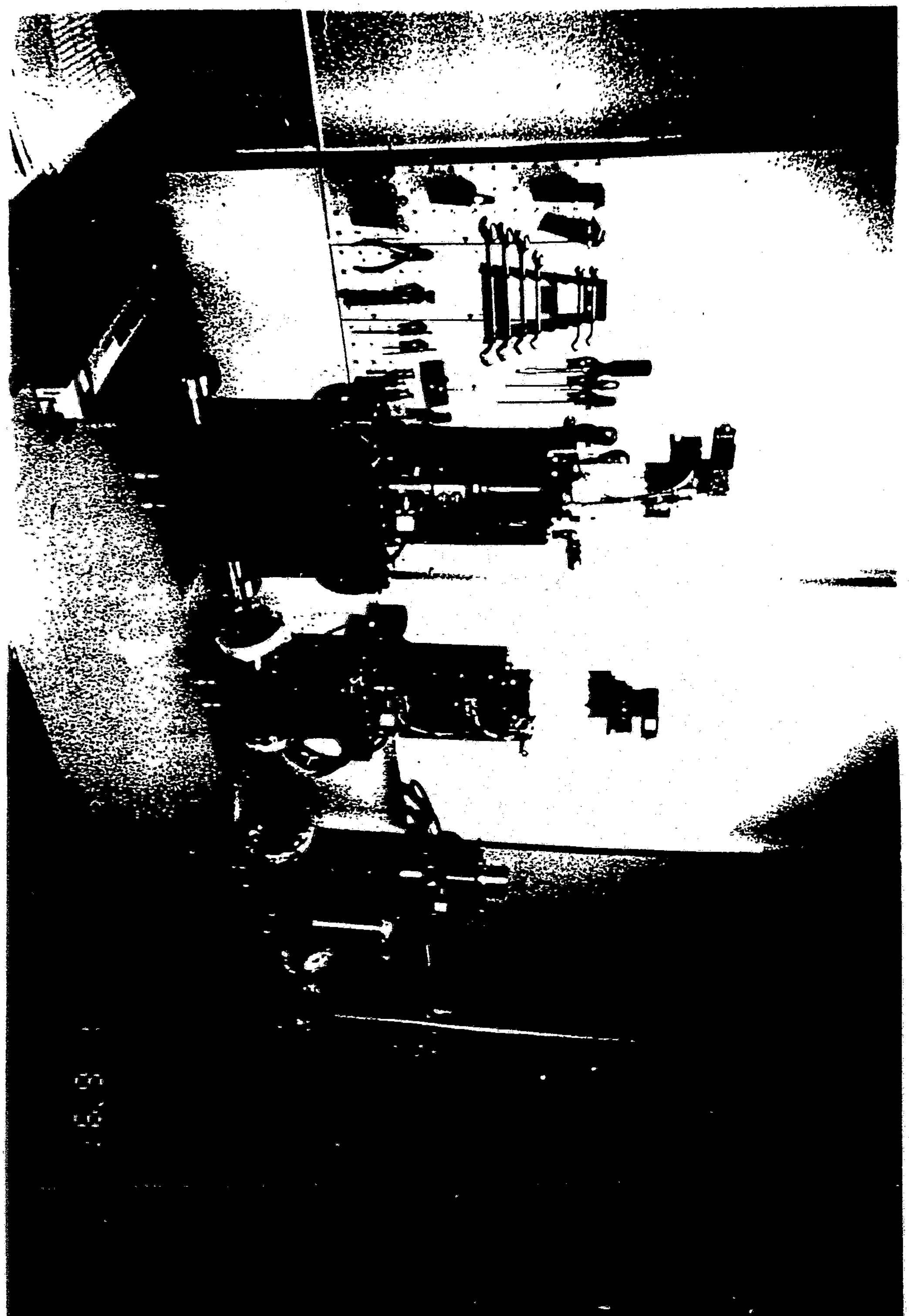


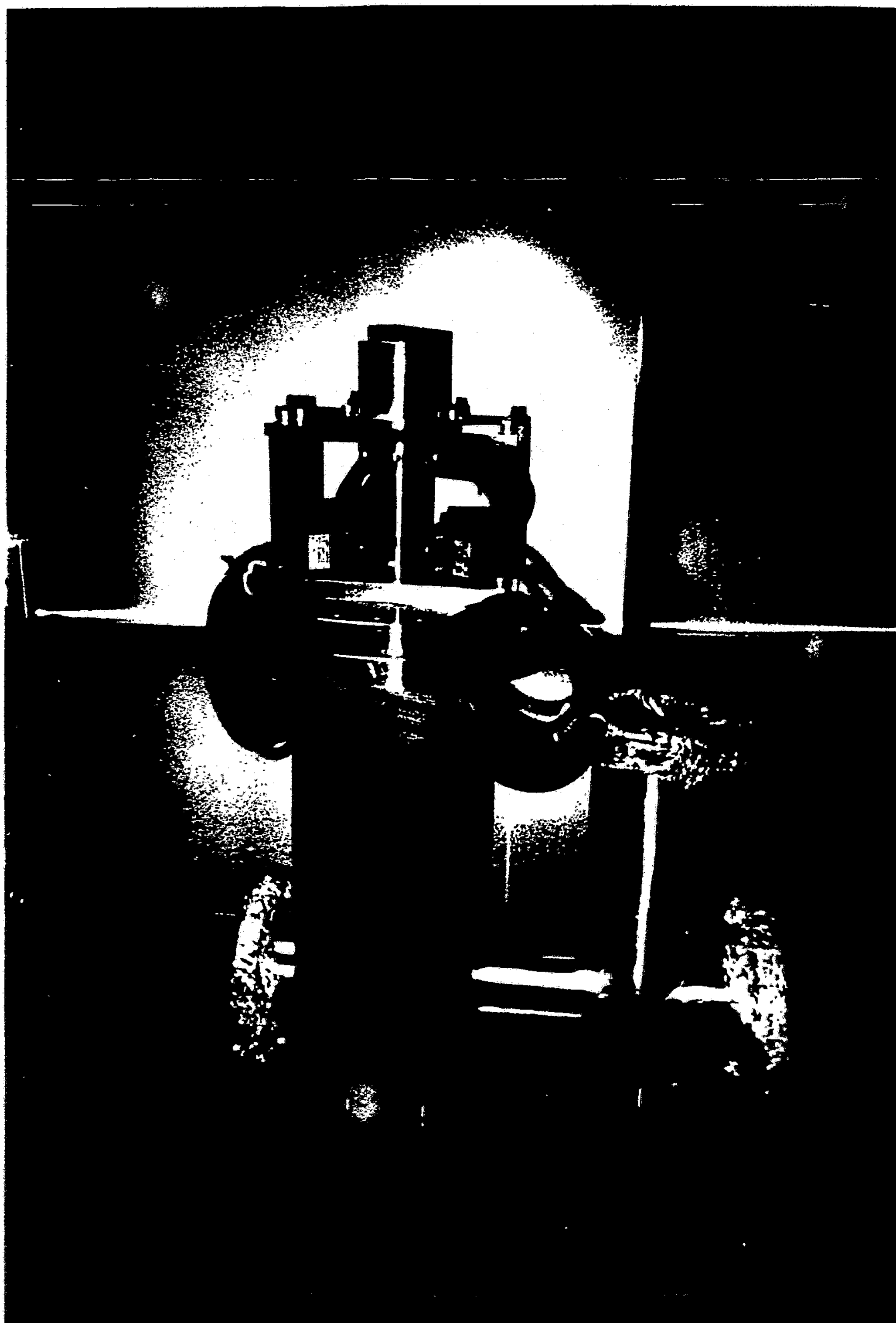

Beam in
BPM
V & H Slits
The Swiss-Norwegian Beam Line
Adjustable cooled Be window
Spare port
Mono vacuum vessel
Adjustable SR
Cooled Absorber
Fixed White-Beam Stop
Adjustable Be window
BPM
V & H Slits
Beam out
Manual precision jacks
Granitan Base



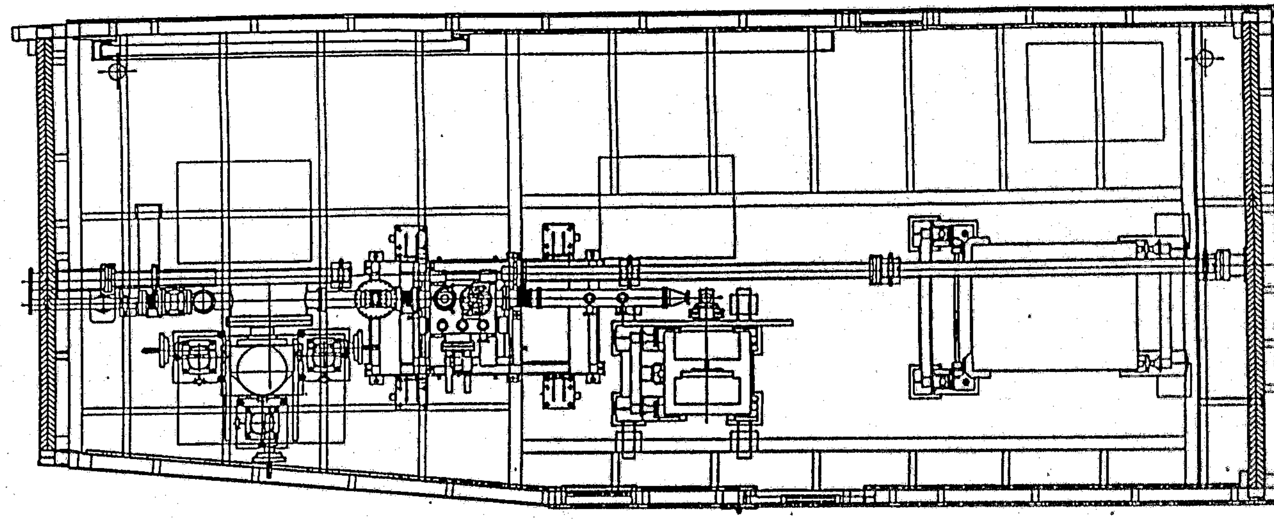


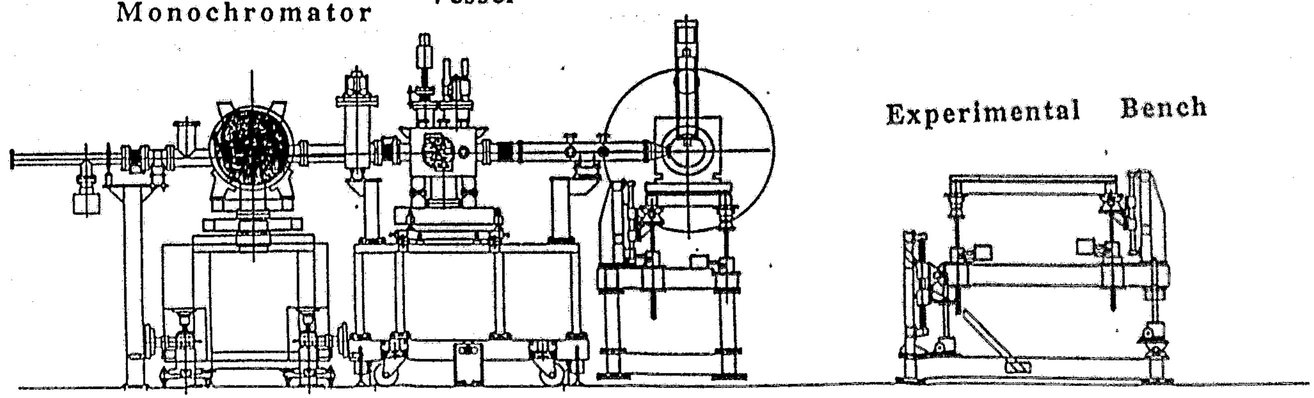




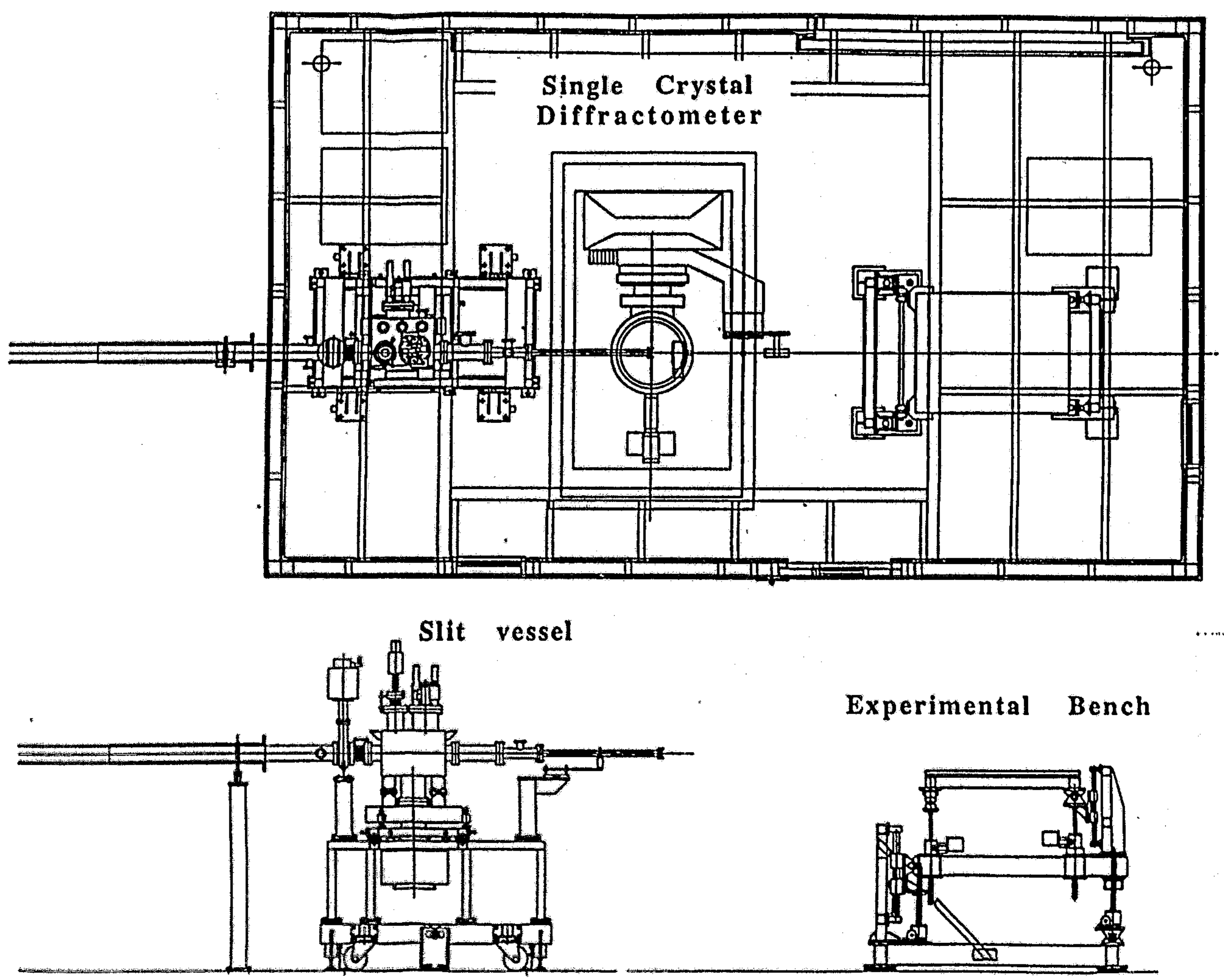


Station B
Swiss-Norwegian Beam Line





Station A
Swiss-Norwegian Beam Line



The Swiss-Norwegian Beam Line

Progress Report

1992

	Beamline design work completed
	Orders placed for all major beamline components
	Delivery of all vacuum pumping and controllers completed
	Many components (slits/absorbers/Be windows etc) delivered

1993

April/May	Delivery of all vacuum vessels Assembly, alignment and testing of vacuum components
June	Monochromator delivered and testing begins
July	Installation of radiation enclosured begins in Grenoble Electrical and fluid services installed
Oct	Beamline moved to Grenoble and installed
Dec/Jan	Beamline takes first beam

1994

Jan-March	All beamline components tested with beam
March-June	Test experiments start
July -	Scheduled beam ...

Note :	Beamline will begin operation without mirrors Mirrors installation planned for winter shutdown 1994

Beamline Equipment at HASYLAB

by Ulrich Hahn - HASYLAB

Outline

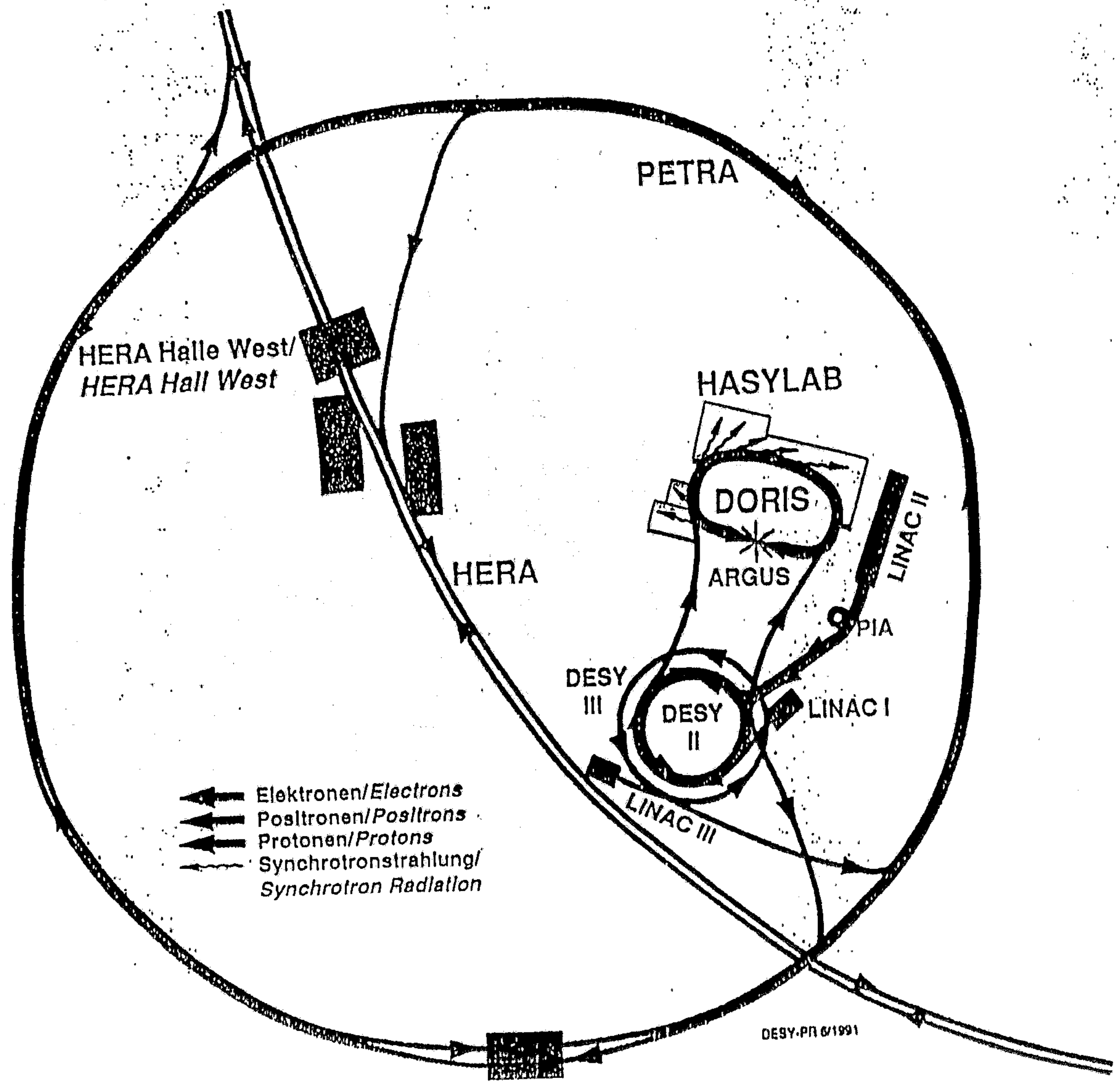
Introduction

Layout of SR Beamlines

Front End Components

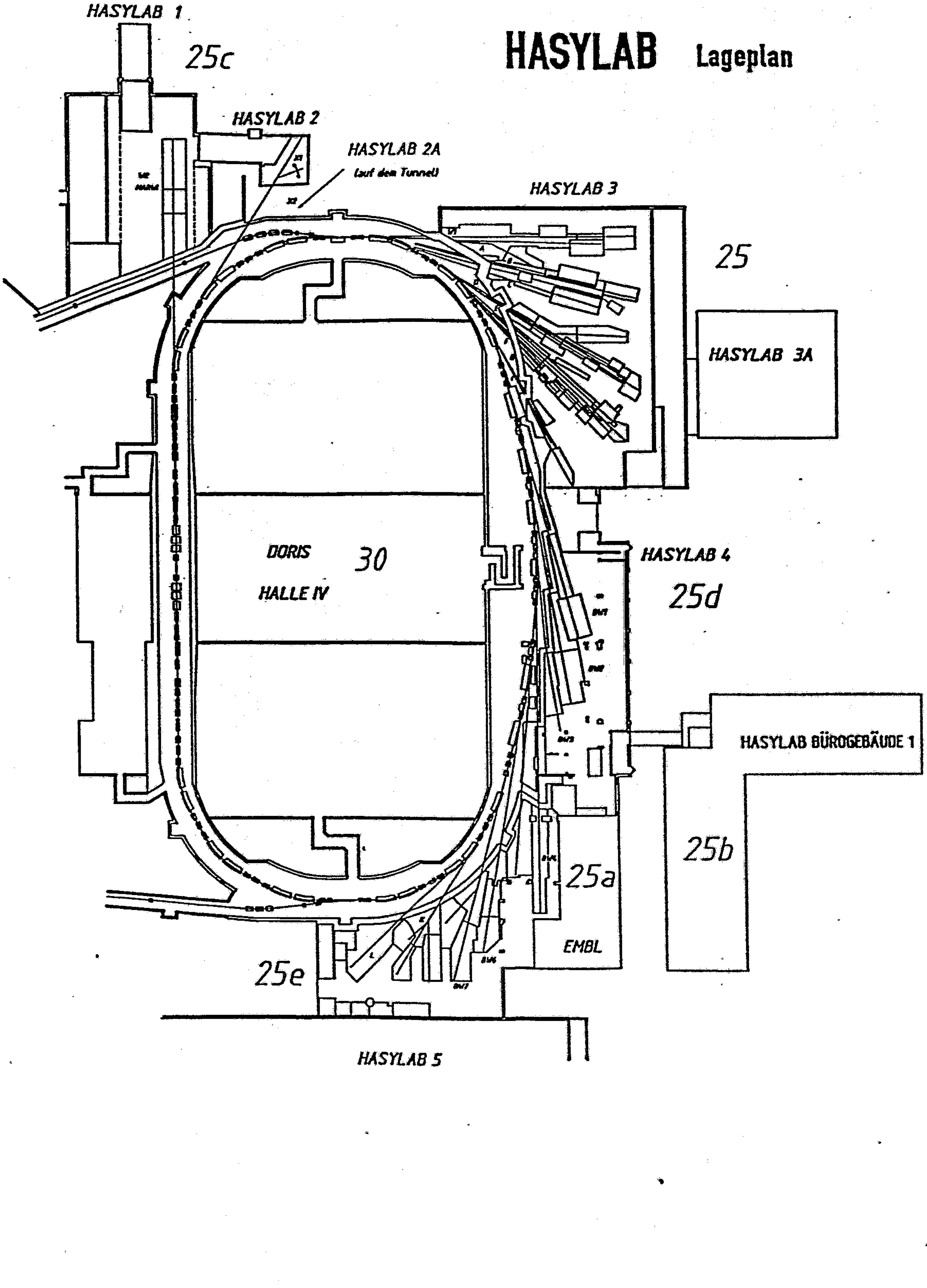
Beamline Components

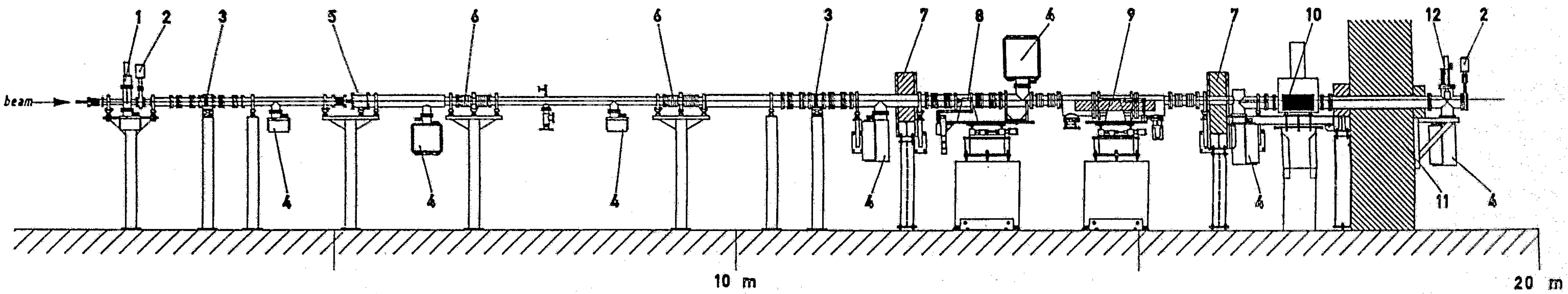
Running a Beamline



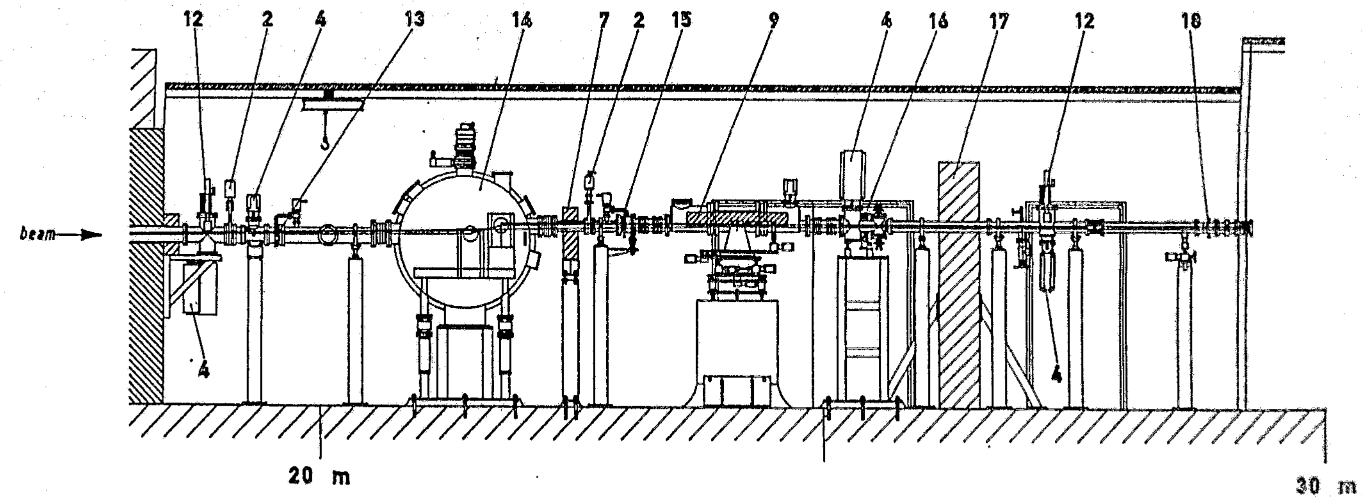
PETRA
HERA Halle West/
HERA Hall West
HASYLAB
DORIS
LINAC II
ARGUS
HERA
PIA
DESY
III
DESY
II
LINAC I
LINAC III
Elektronen/Electrons
Positronen/Positrons
Protonen/Protons
Synchrotronstrahlung/
Synchrotron Radiation
DESY-PR 6/1991

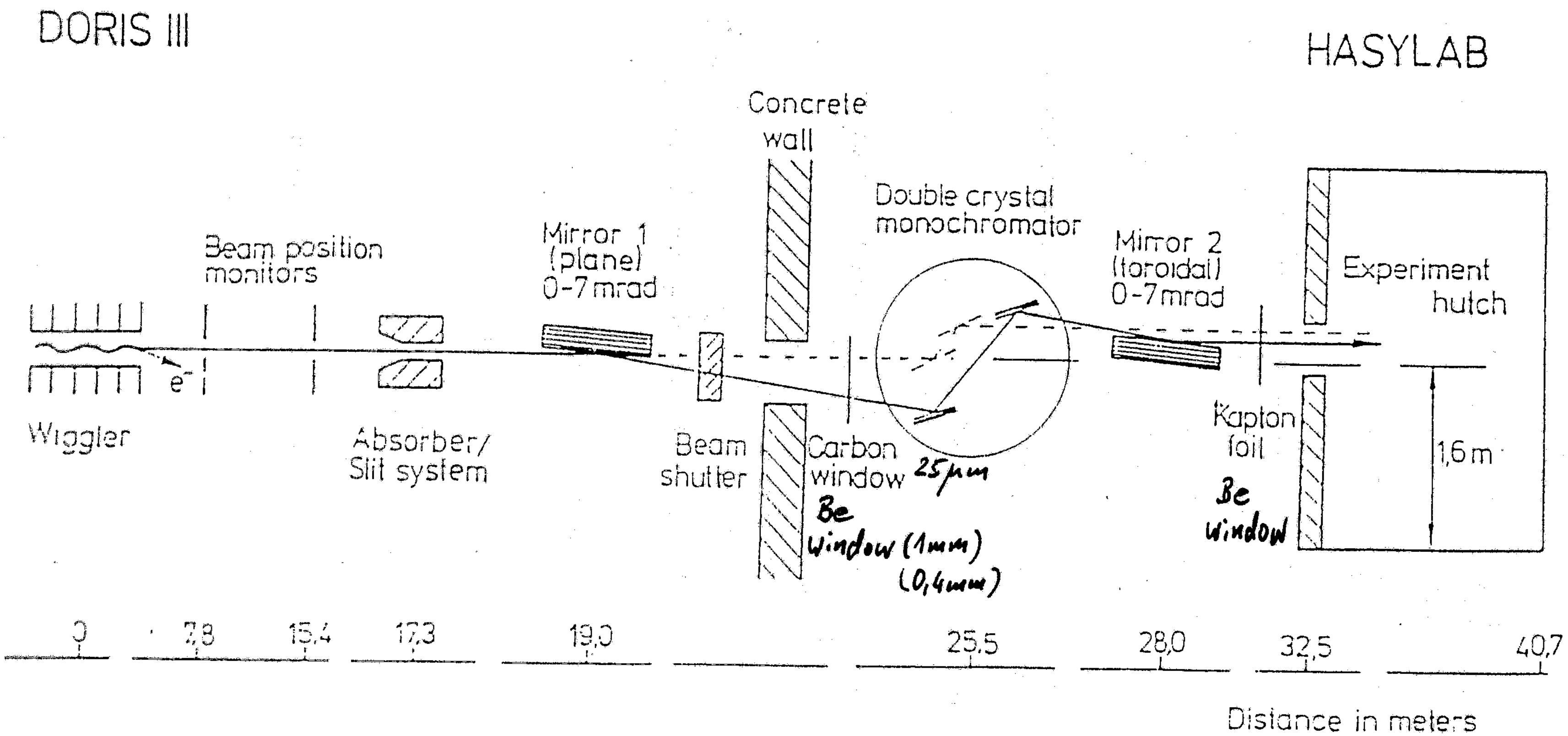
HASYLAB Lageplan





1 absorber
2 gate valve
3 beam position monitor
4 ion pump
5 fast acting valve
6 water cooled aperture
7 lead collimator
8 tilt-adjustable vertical slit and horizontal slit
9 mirror chamber
10 beamshutter
11 tunnel wall
12 fluorescence screen
13 Be-window
14 monochromator
15 C-foil-window
16 horizontal-vertical slit system
17 concrete wall
18 vertical movable Be-Al-window

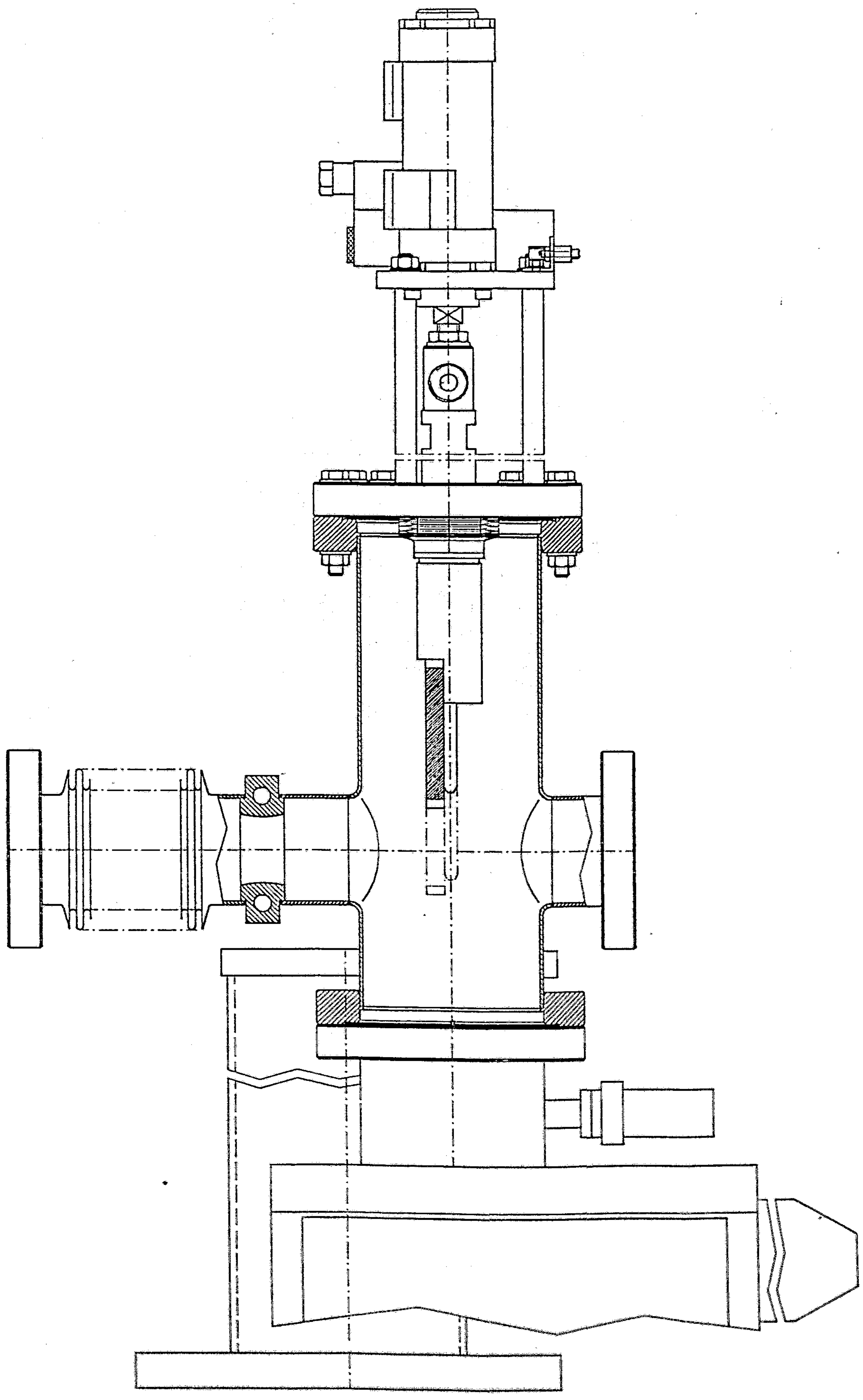


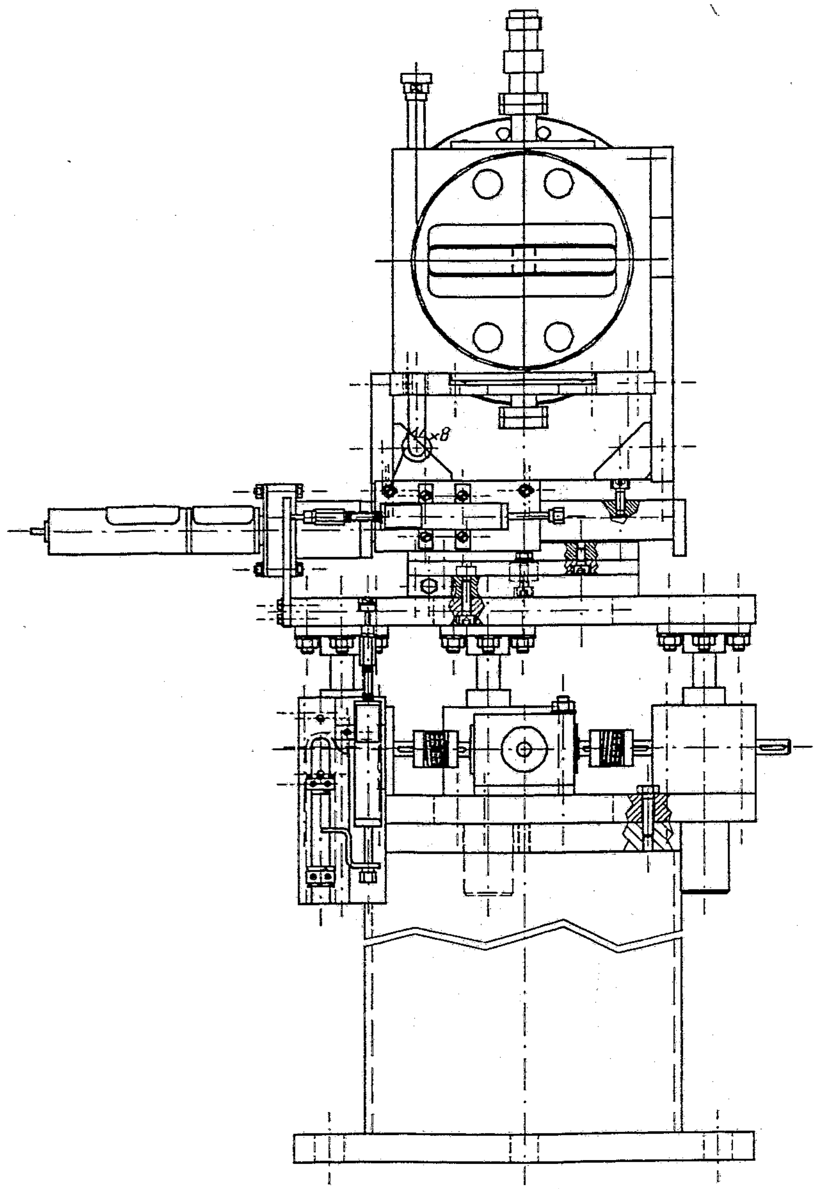


HASYLAB beamline BW 2
BW 1

Major Components of a X-Ray Beam Line

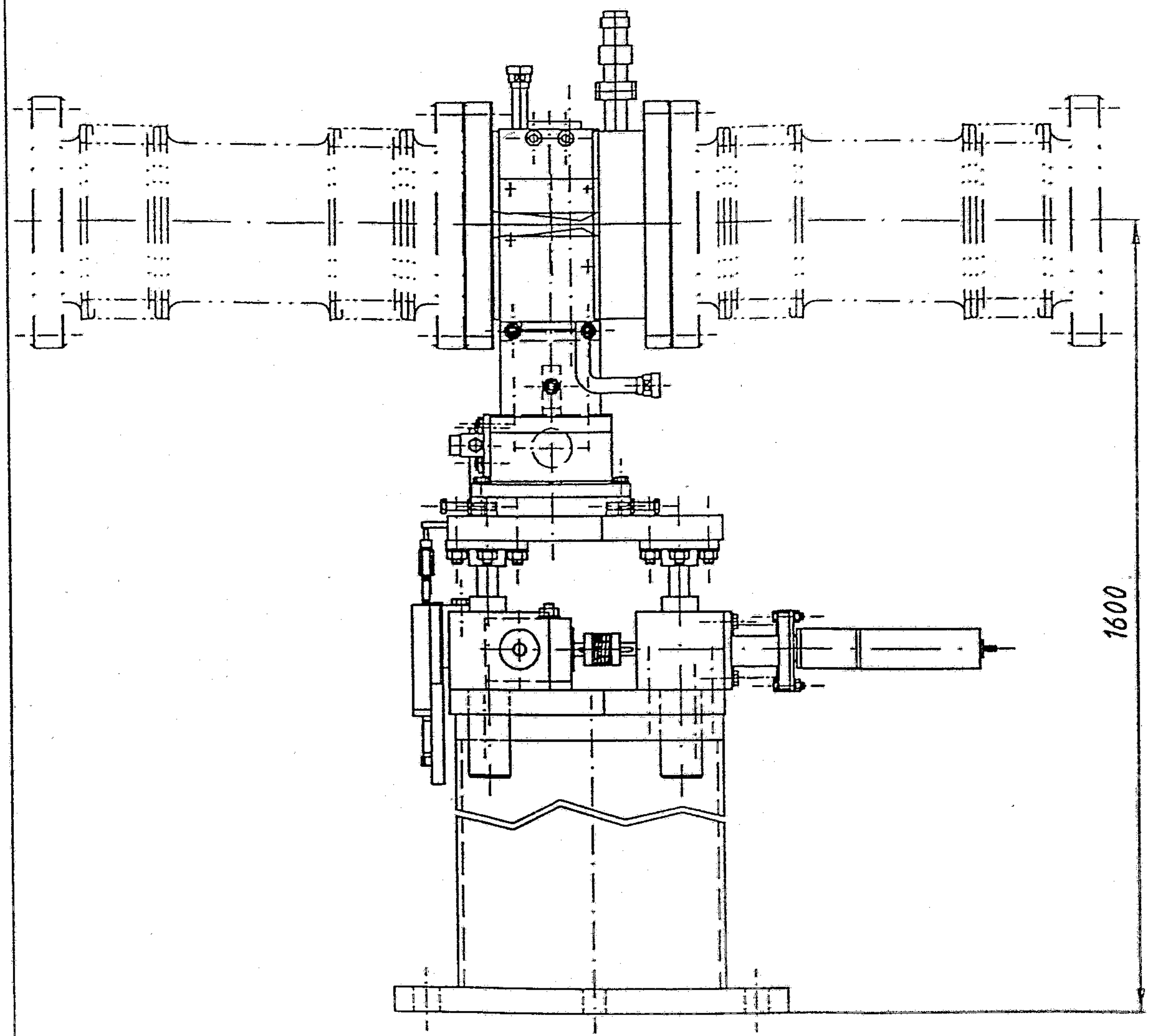
Storage Ring	SR - Source
Absorber	Protects the valves from BM radiation (50 W/mrad at DORIS with 4.5GeV and 0.1A)
Ring Valve	Vacuum separation of Storage Ring and beamline
Fast Acting Valve	Protection against accidental venting
Beam Position Monitor 1	Beam alignment for the experiment (position)
Beam defining Apertures	Protection of the beam pipe
Beam Position Monitor 2	Beam alignment for the experiment (angle)
Beamshutter	Radiation safety
Front End Valve	Vacuum separation front End - beamline
Slits (horizontal - vertical)	Beam definition for the experiment
Mirror	Focussing of the beam
(Window or differential pump)	UHV <--> HV
Monochromator	--> Monochromatic beam
(Window or differential pump)	UHV <--> HV
Monitor	Definition of the monochromatic beam
Experiment	





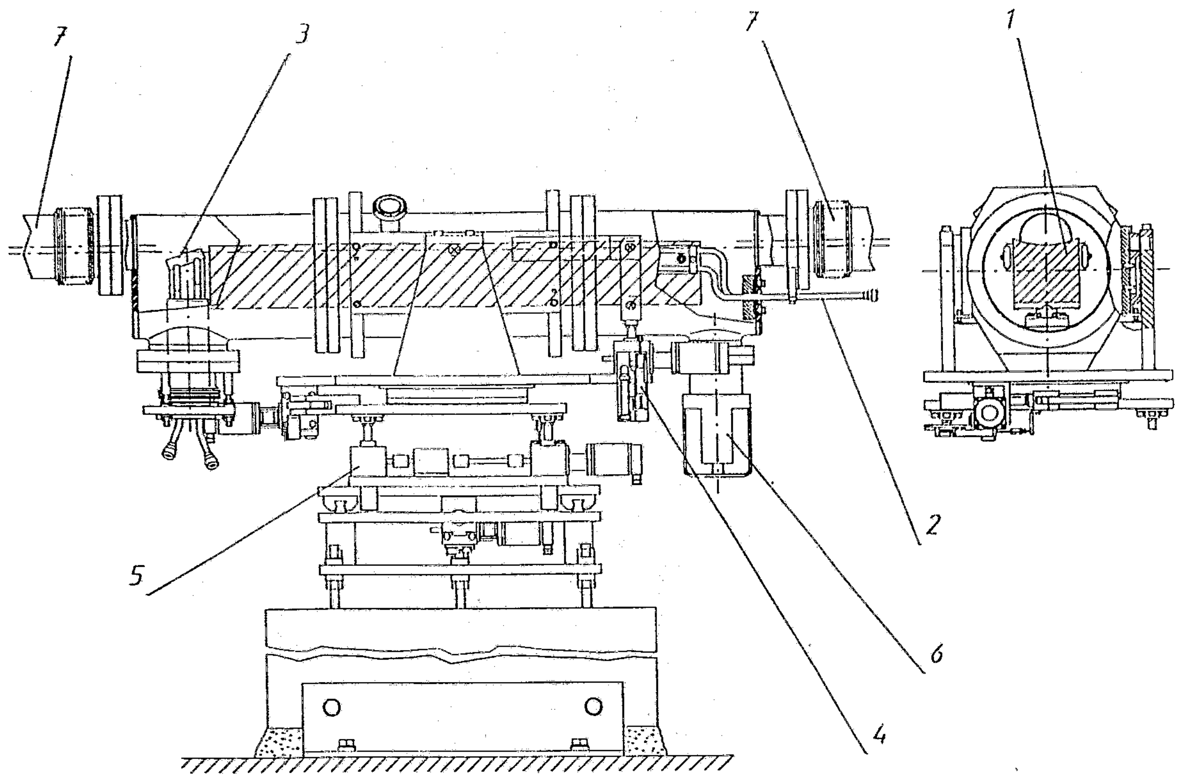
Strahllagemonitor NW 150

Vorderansicht



Strahllagemonitor NW 150

Seitenansicht



X - ray mirror chamber for high power beamlines at HASYLAB

Design criteria:

- mirror alignment by moving the whole mirror chamber
- linear and rotational movings mechanically decoupled
- rigid central chamber frame as mirror support
- friction-free rotation of the deflection angle (resolution < 1μrad)
- chamber movement decoupled from the beamline by formed bellows range of linear movement ±.25 mm

1 toroidal mirror (1000 x 130 x 130)
2 water cooling
3 water-cooled absorber (protection of the mirror face)
4 linear encoder
5 mirror support and aligning system
6 ion pump
7 bellows

SDRC I-DEAS V: Solid_Modeling

24-OCT-91 14:05:24

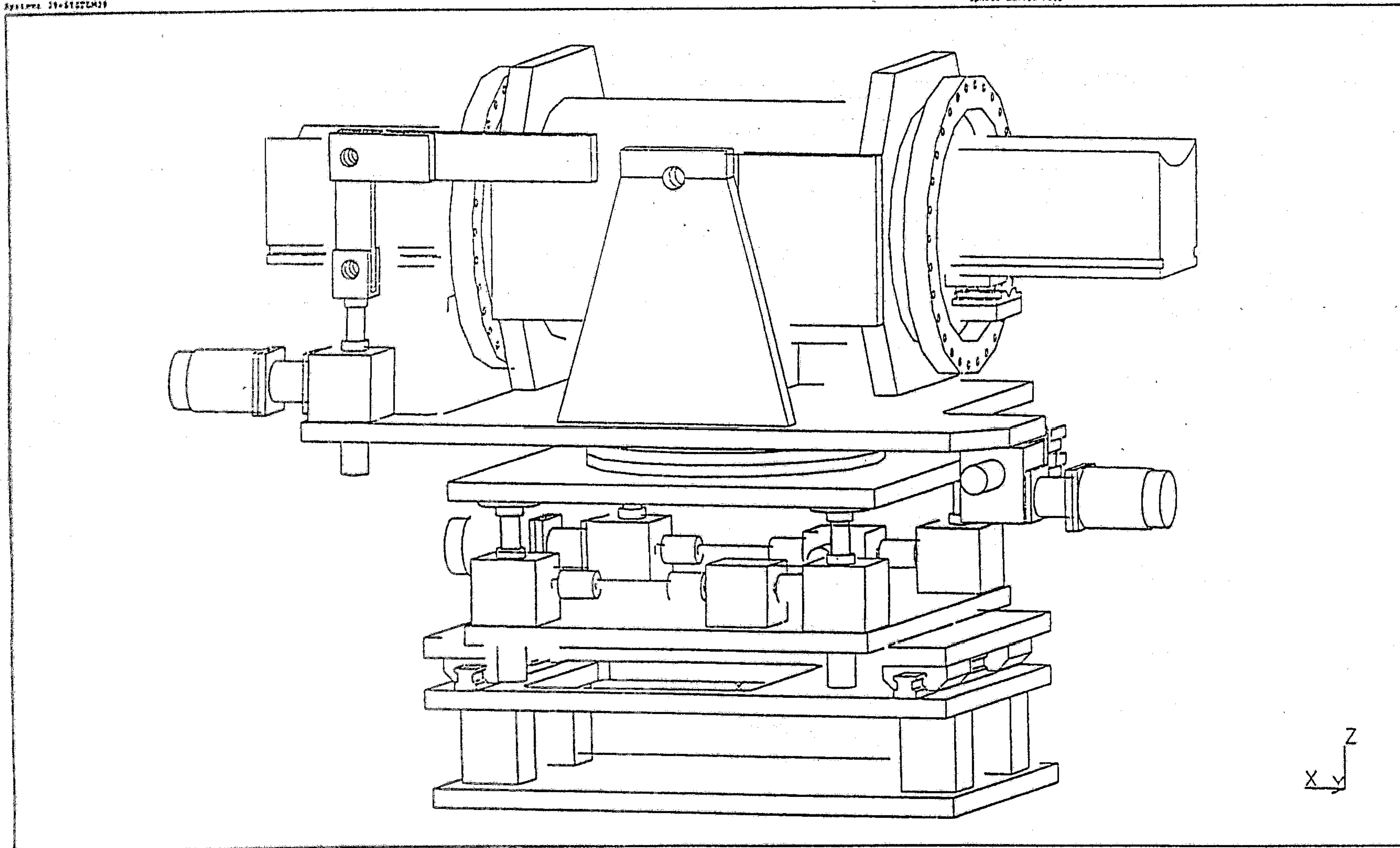
Units : MM

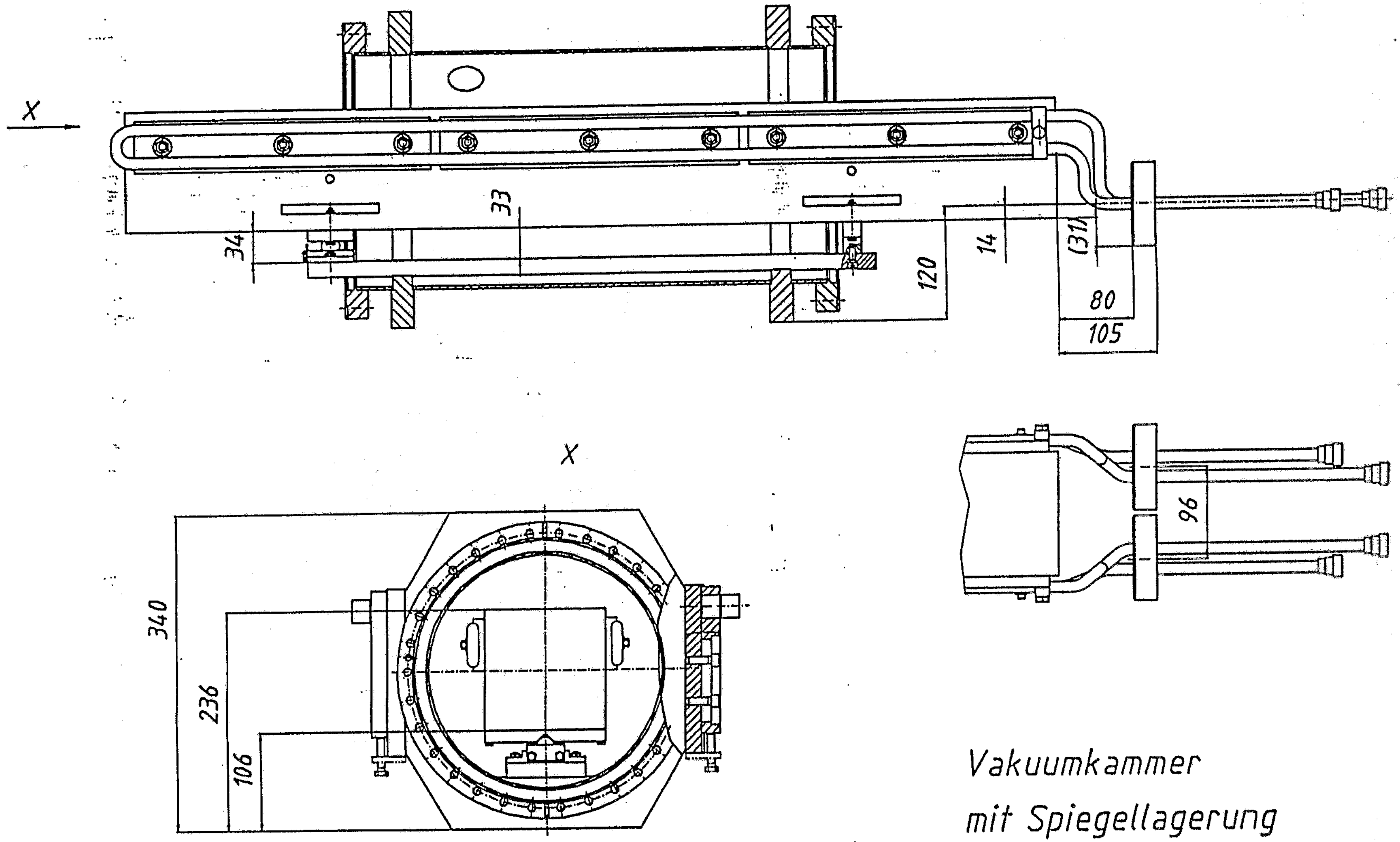
Display : No stored Option

Bin: 1-MAIN

Update Level: Full

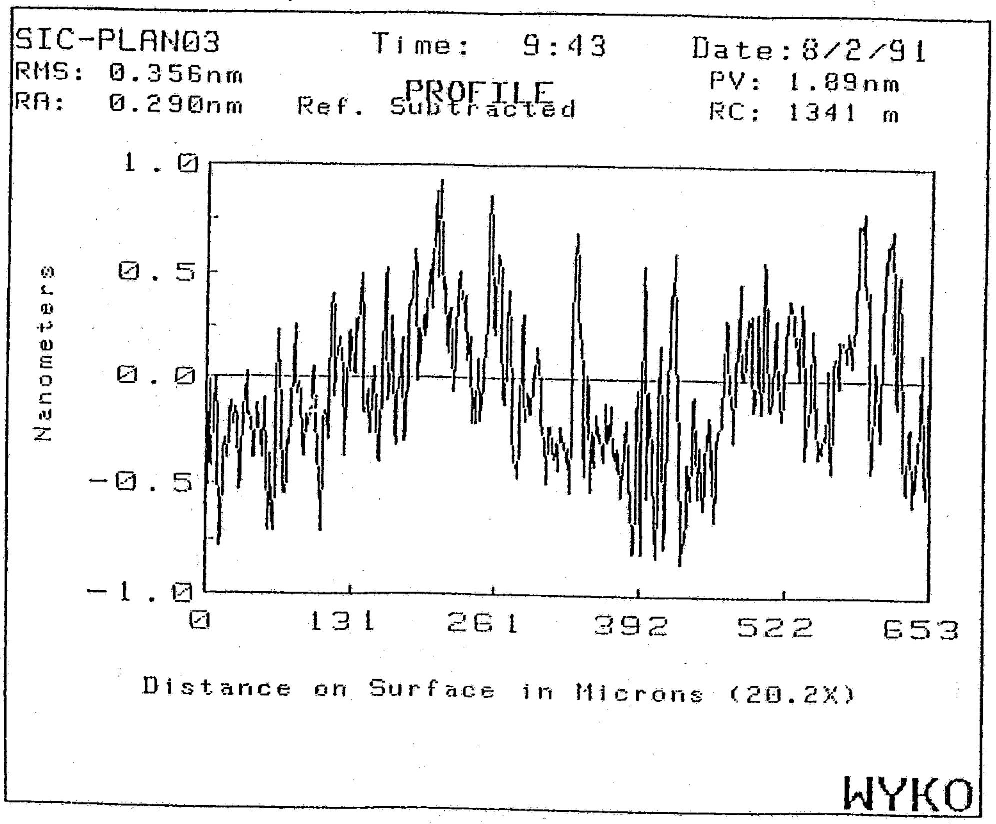
Database:
View : No stored View
Task: ASSEMBLY
System:



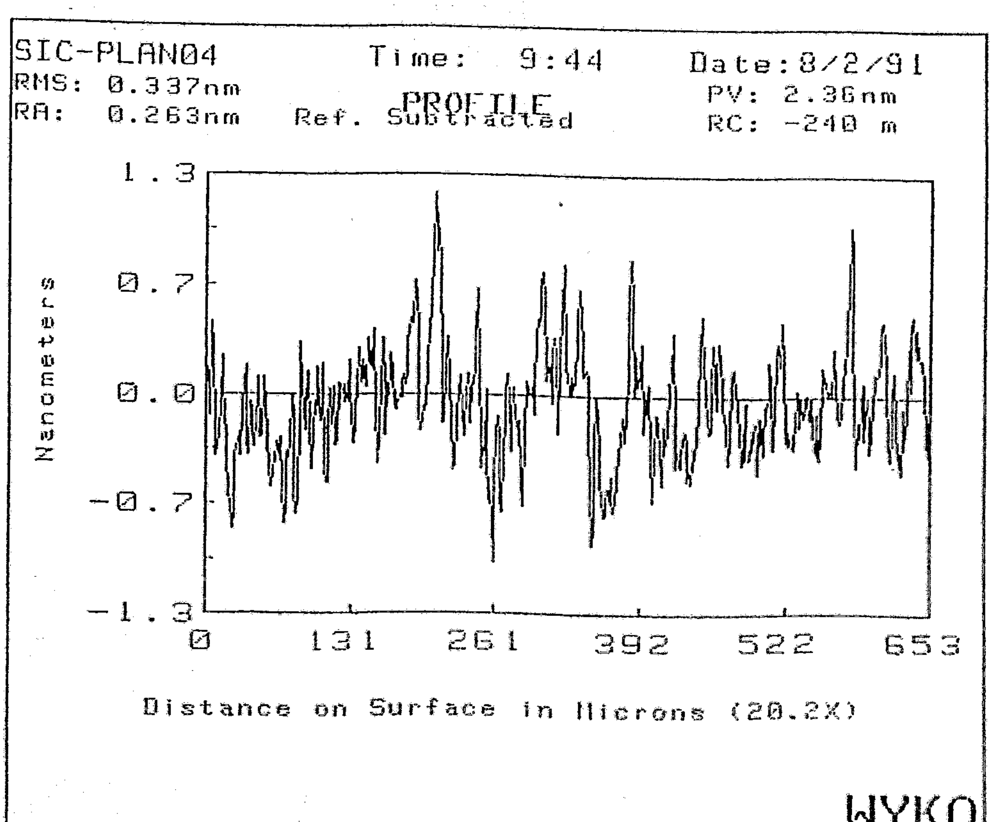


Vakuumkammer
mit Spiegellagerung
Montagezeichnung

28.01.92 B
ZUSAWBPL 2(



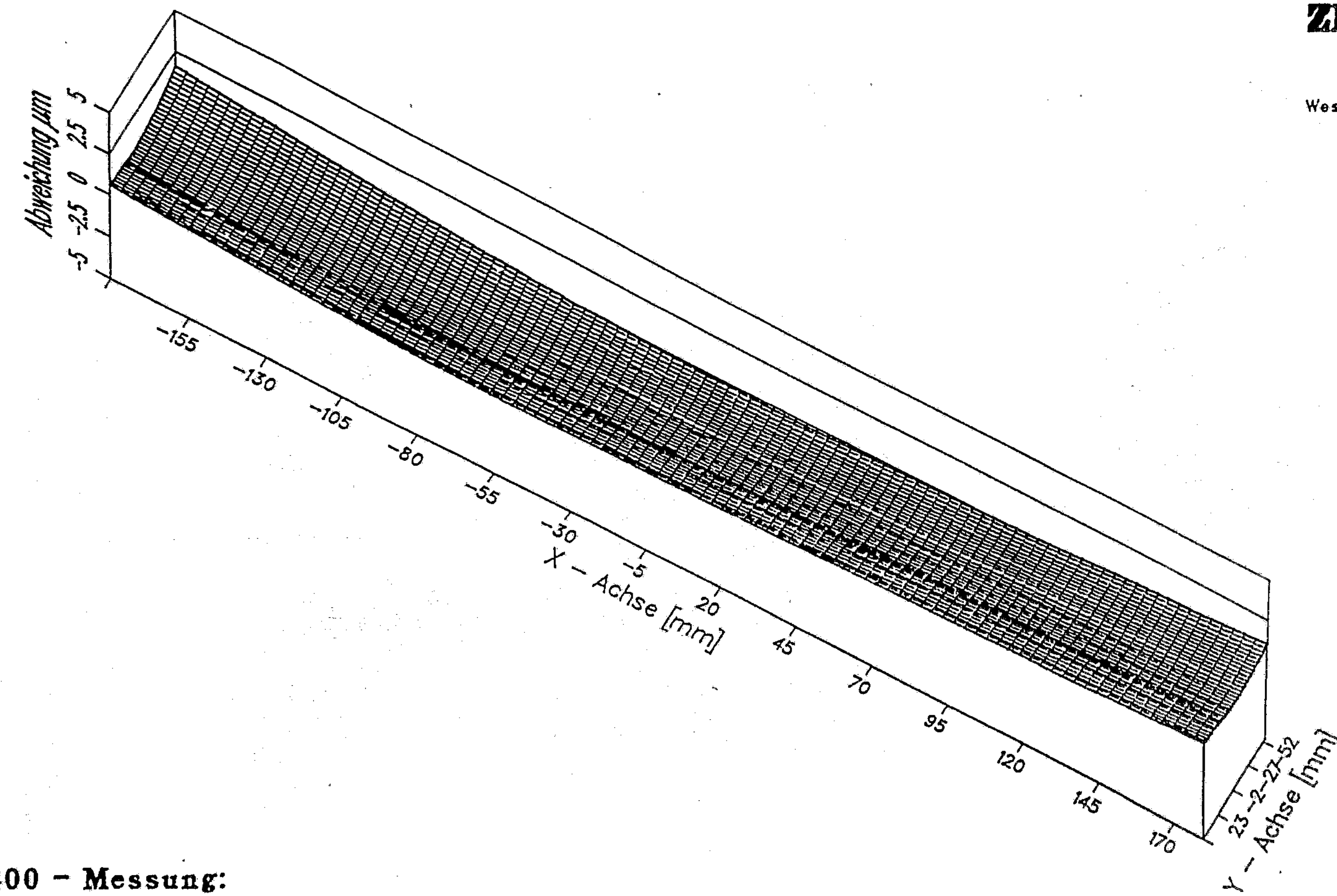
SIC-PLAN03
Time: 9:43
Date:8/2/91
RMS: 0.356nm
RA: 0.290nm
PROFILE
Ref. Subtracted
PV: 1.89nm
RC: 1341 m
1.0
0.5
0.0
-0.5
-1.0
Nanometers
0
131
261
392
522
653
Distance on Surface in Microns (20.2X)
WYKO



SIC-PLAN04
Time: 9:44
Date:8/2/91
RMS: 0.337nm
RA: 0.263nm
PROFILE
Ref. Subtracted
PV: 2.36nm
RC: -240 m
1.3
0.7
0.0
-0.7
-1.3
Nanometers
0
131
261
392
522
653
Distance on Surface in Microns (20.2X)
WYKO

ZEISS

West Germany



M400 – Messung:

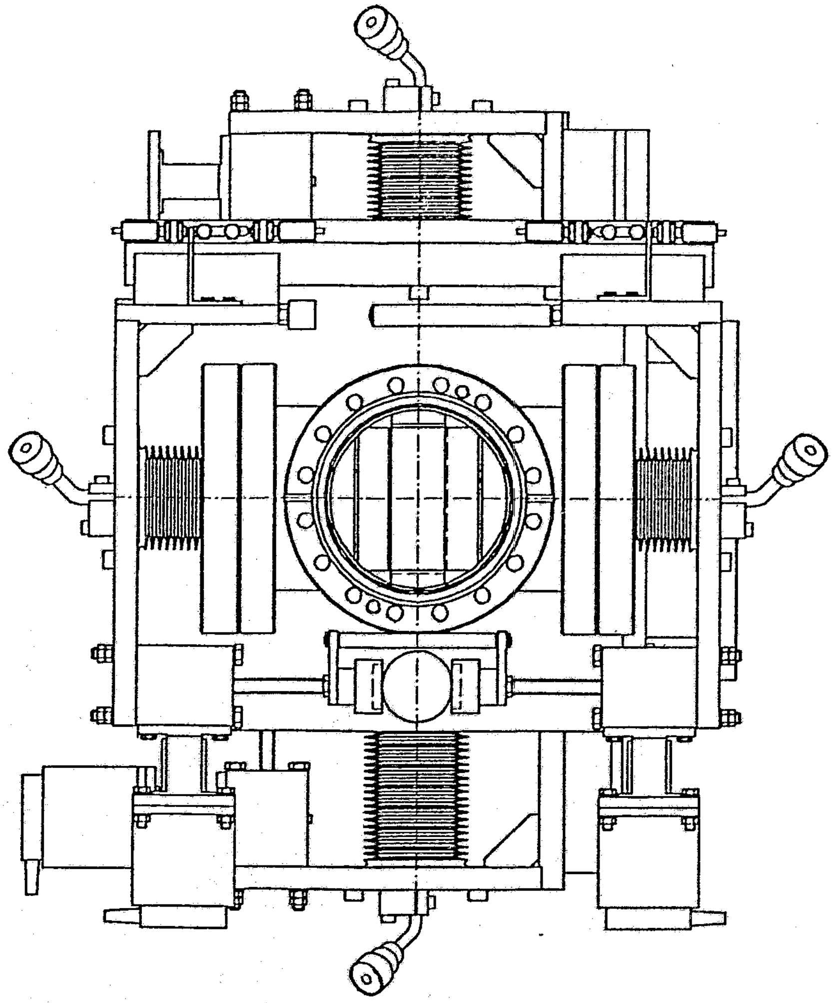
Datensatz: FSICD0702

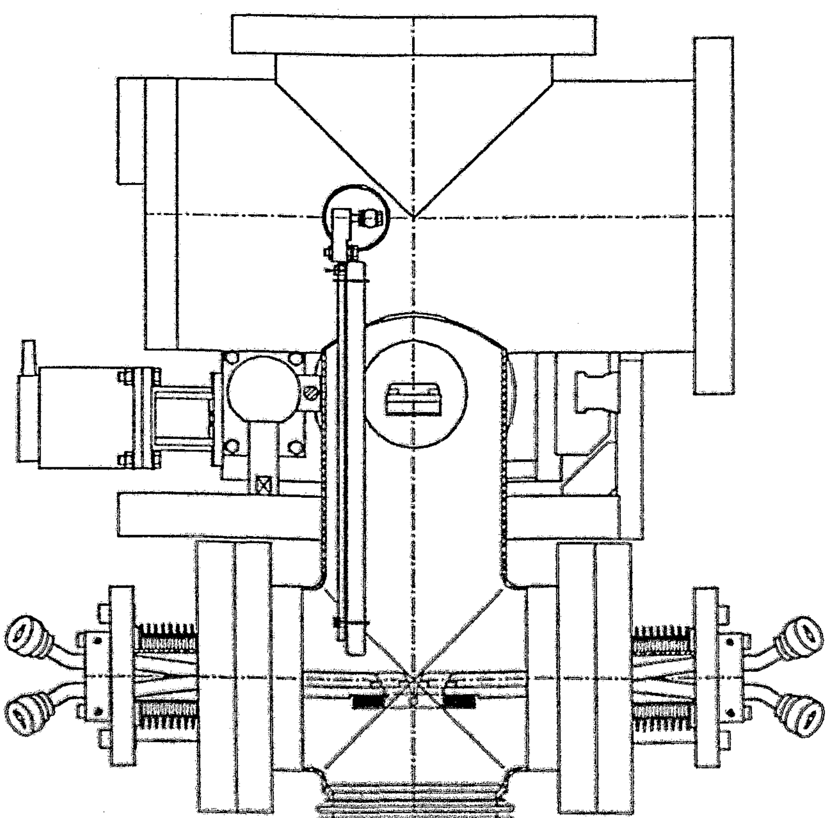
RMS – Tangentenfehler:

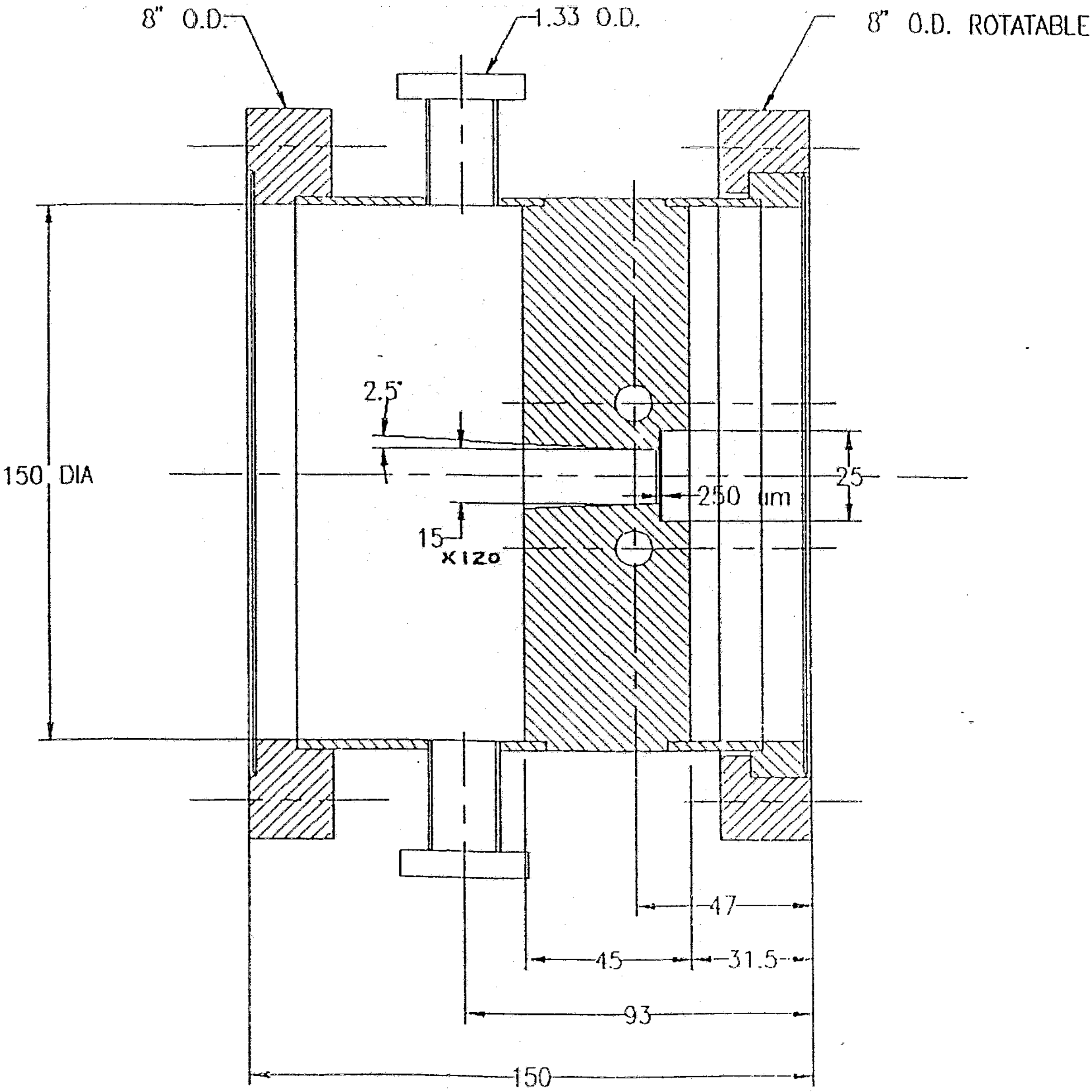
x–Richtung: 1.63 arcsec

y–Richtung: 3.01 arcsec

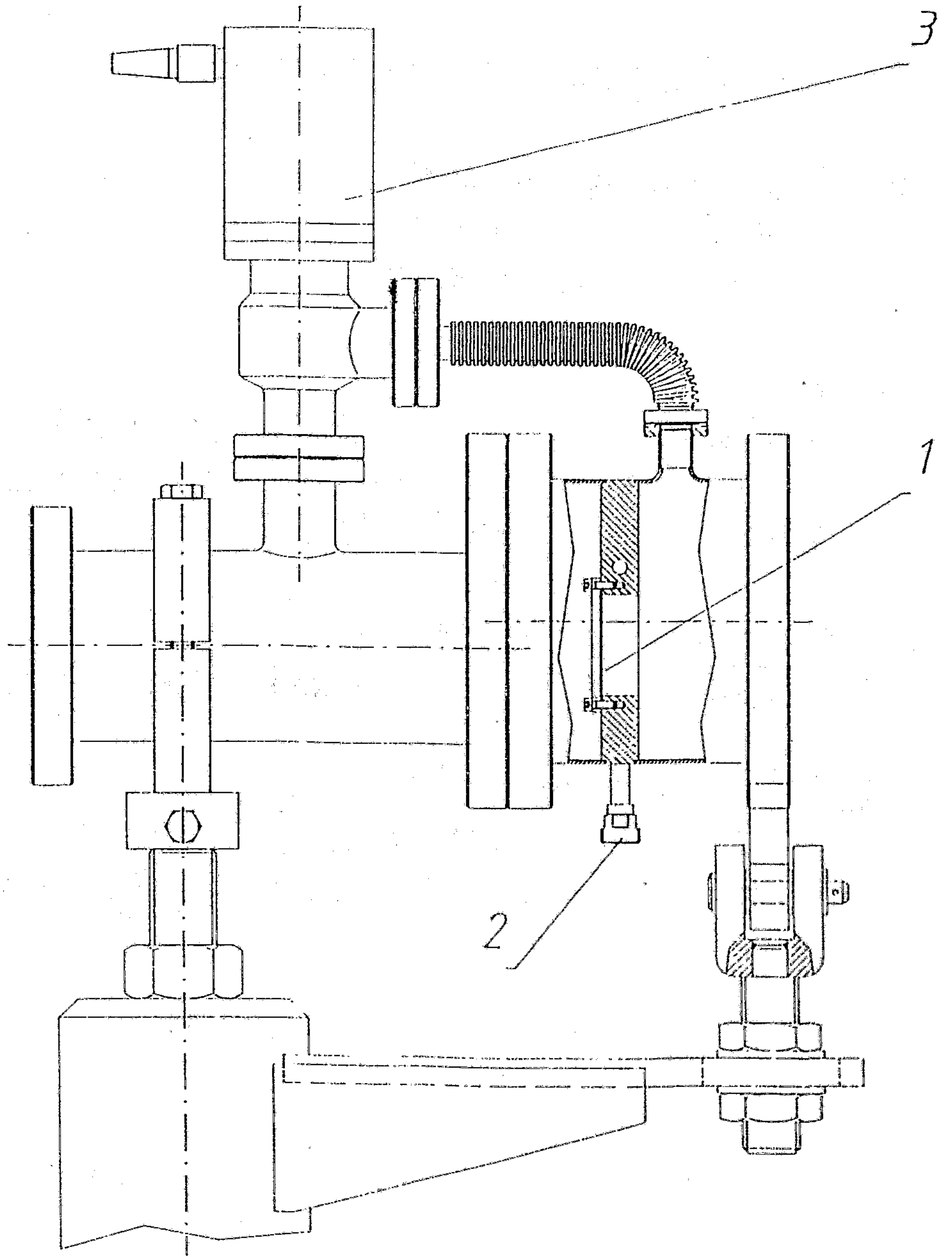
26–JUL–91







BM WHITE BEAM WINDOW



Carbon foil window

Contamination barrier window for high power x-ray beamlines

1 Carbon foil (50 x 80 mm, 130 μm thick)
2 Water-cooled Cu - Block
3 Vacuum bypass with valve

Guiding Philosophy for running a beamline

Electron beam dump of the Storage Ring only when

- there is danger of irradiating a person
- there is danger to damage equipment

Personnel protection:

The personnel protection always requires a device which is controlled by at least two redundant circuits to stop the beam. In the white beam an additional power absorber is required. The white beam has to be terminated by a beam stop.

Storage Ring and front end protection:

The beamline has to fullfill the vacuum requirements downstream the front end valve

Fast valve action: (Triggered by an accidental vacuum break down)

- beam dump at ID beamlines when the ID gap is closed
- no beam dump at bending magnet lines and at ID beamlines when the ID gap is open

Before venting a beamline section, two upstream valves must be closed.

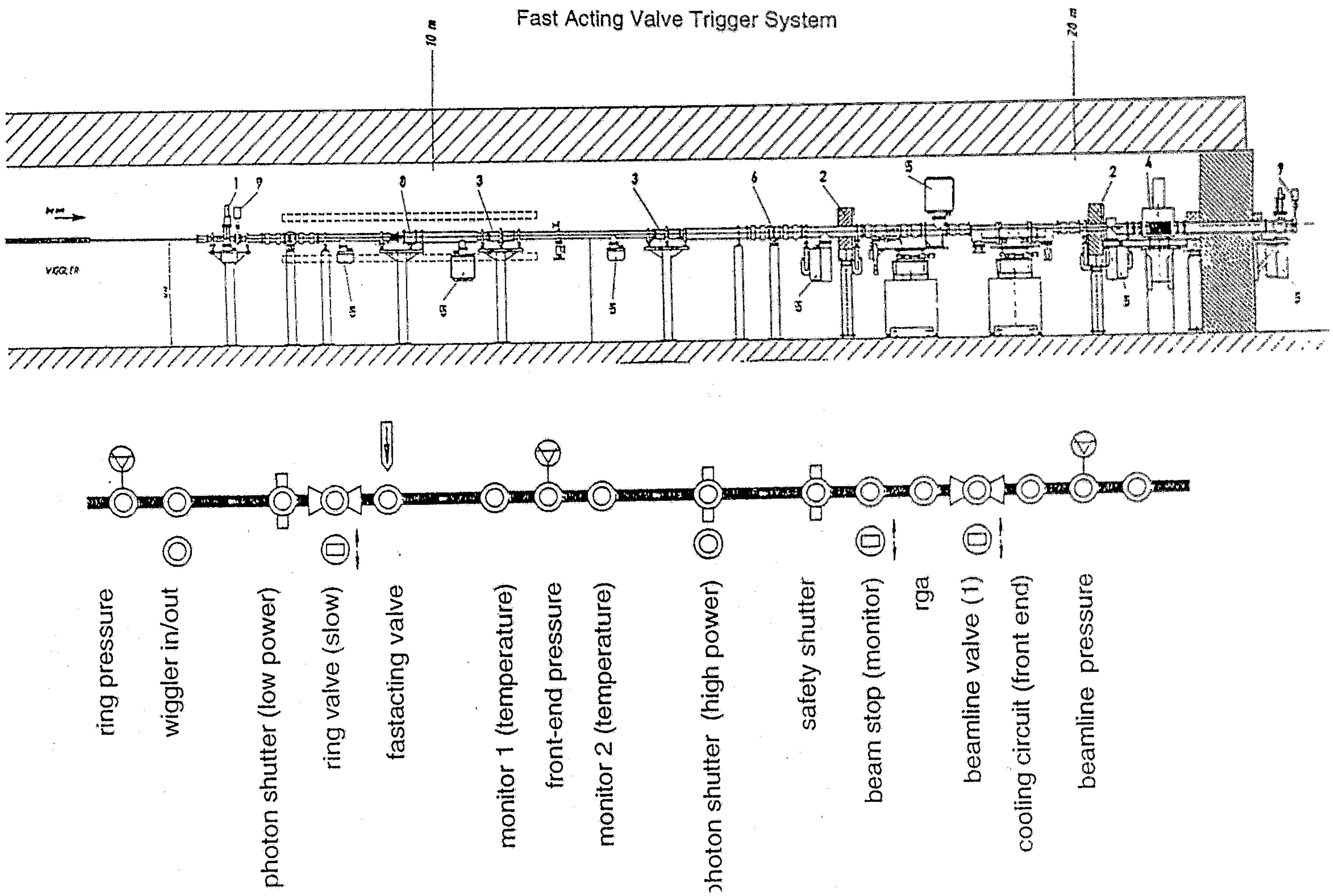
Beamline equipment protection

Before closing a beamline valve or moving an unsufficient cooled device into the beam a power absorber must be in the beam

Front End Interlock Systems at HASYLAB

Personal Safety System   Equipment Protection System

Fast Acting Valve Trigger System



Kevin D' Amico

Experience in EXAFS Beam - Line Design

General Issues Associated with Beamline Planning

Phases of Project

I. Define Technical Boundaries

II. Produce a Workable Concept

III. Design and Engineering

IV. Fabrication / Construction / Testing

V. Assembly / Installation

VI. Commissioning

VII. Operation

Details of Phases I. and II.

I. Define Technical Boundaries :

- scientific justification
- information from ESRF
- (particular issues, e.g. safety)
- determine technical requirements

II. Produce Workable Concept " Conceptual Design Report " :

- assess existing technology
- understand necessary infrastructure :
  - financial
  - technical
  - logistical
- equipment needed " Work Breakdown Structure "
- cost estimate
- manpower estimate and timetable :
  - design
  - engineering
  - scientific
- final document for external and internal purposes

CDR becomes roadmap or blueprint for carrying out project