INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
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H4.SMR/676-9

SECOND SCHOOL ON THE USE OF SYNCHROTRON RADIATION IN SCIENCE AND TECHNOLOGY: *"JOHN FUGGLE MEMORIAL"*

25 October - 19 November 1993

Miramare - Trieste, Italy

3D Generation Sources

M. Eriksson
MAX - LAB
Lund, Sweden

3:RD GENERATION SOURCES

1:ST GENERATION: PARASITIC USE OF HIGH ENERGY PHYSICS MACHINES. (DORIS, SPEAR)

2:ND GENERATION: DEDICATED, BENDING MAGNET SOURCES. (DARESBURY, BROOKHAVEN)

3:RD GENERATION: DEDICATED, SMALL EMITTANCE, INSERTION DEVICE SOURCES.

X-RAY		VUV, SOFT X-RAY		
APS	7 GeV	ALS	1.5-2	GeV
ESRF	6 GeV	ELETTRA	2	"
SPRING8	8 GeV	PLS	2	"
		SRRC	1.3	"
		BESSY II	1.7	"
		MAX II	1.5	"

FIGURES OF MERIT

1. FLUX: $\Phi = \dfrac{N_f}{\text{mrad}, s, ‰}$

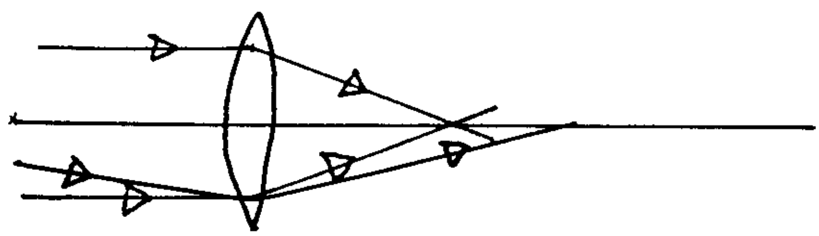
2. BRILLIANCE: $B = \dfrac{N_f}{s, ‰, \text{mm}^2, \text{mrad}^2}$

3. STABILITY, RELIABILITY

THE CHASE FOR BRILLIANCE

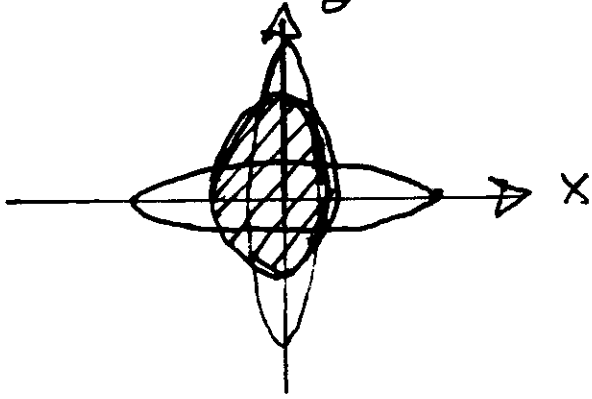
WHY?

EX.



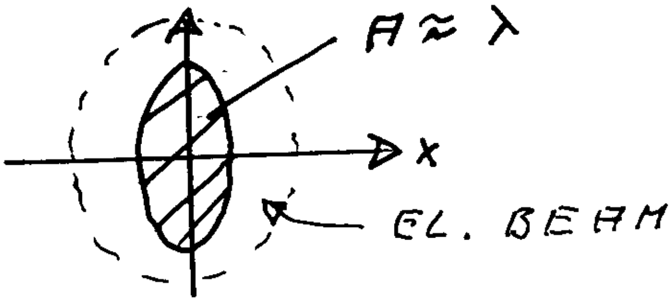
TO GET A HIGH INTENSITY AT FOCUS, WE NEED A SMALL AND PARALEL PHOTON BEAM.

IN PHASE SPACE (DIST AND ANGLE)



1. DIFFRACTION.

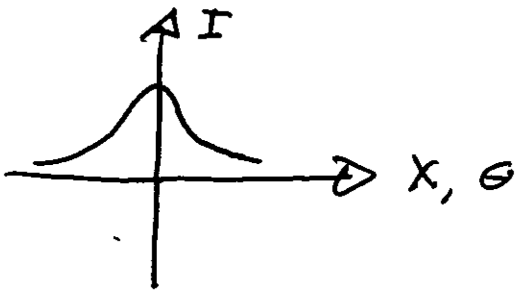
$$X \cdot \theta \approx \lambda$$



2. ELECTRON BEAM EMITTANCE.

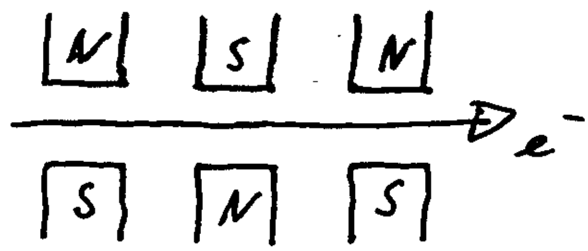
GAUSSIAN DISTRIBUTED INTENSITIES

$$\sigma_x \sigma_\theta = \frac{\lambda}{4\pi} \quad \text{(DIF. RELATION)}$$



HOW TO INCREASE BRILLIANCE?

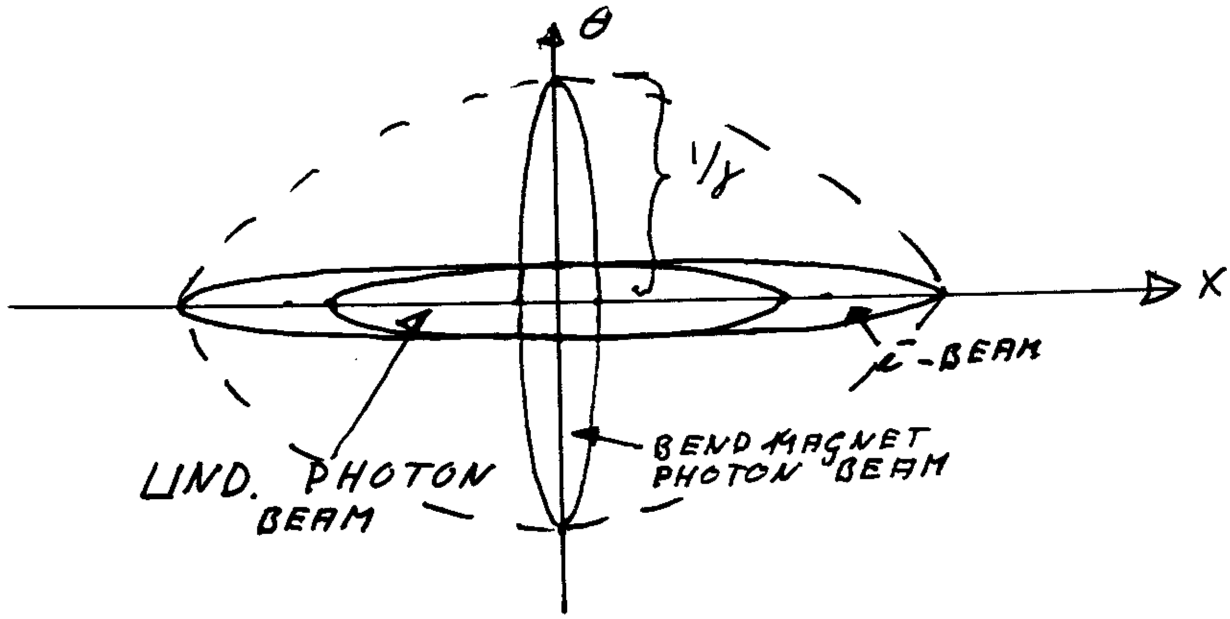
1. INCREASE THE FLUX BY ADDING POLES.



SIDE VIEW

TOP VIEW

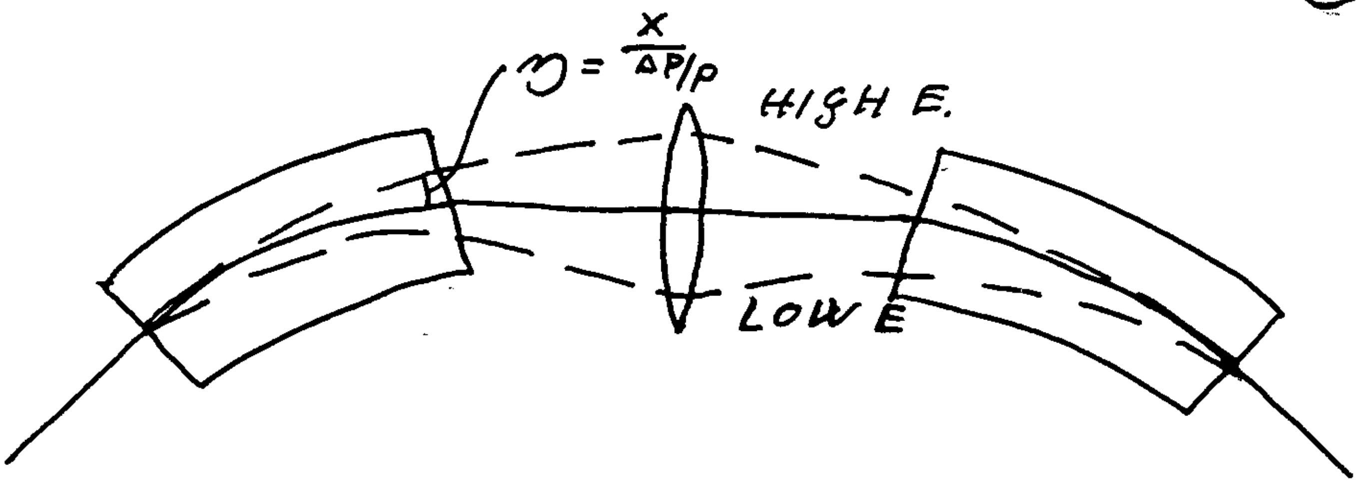
2. MATCH THE ELECTRON BEAM EMITTANCE TO THAT GIVEN BY DIFFRACTION



WHAT IS GAINED BY USING UNDULATORS?

a) INTENSITY $\sim 10^2$ (NUMBER OF POLES)

b) PHOTON/ELECTRON BEAM MATCHING $\sim 10^3$



η SMALL $\Rightarrow$ ε SMALL

E LARGE $\Rightarrow$ ΔE LARGE $\Rightarrow$ ε LARGE

E DEFINED BY SPECTRAL RANGE,
BEAM LIFETIME

SO:

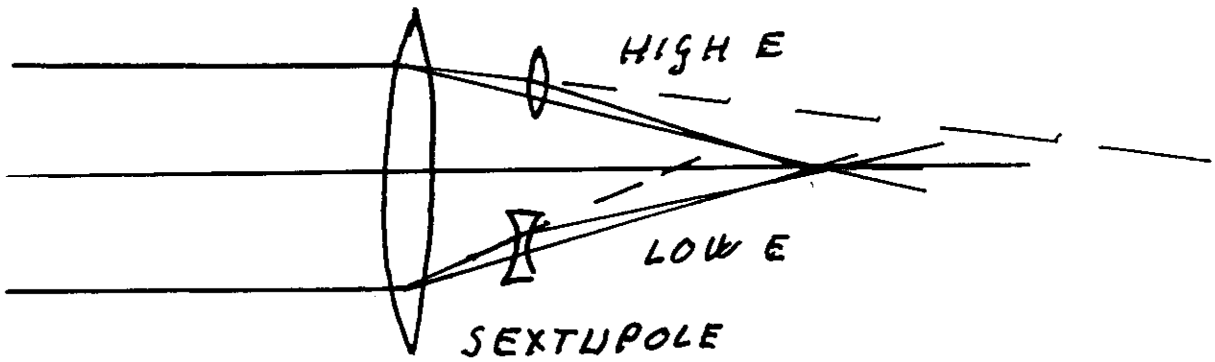
MINIMIZE ε BY DEACREASING η
BY INCREASING N_m

$$\varepsilon \sim \frac{E^2}{N_m^3}$$

BUT:

THIS GIVES YOU A LARGE AND EXPENSIVE MACHINE AND REDUCES YOUR STABLE APERTURE BECAUSE OF

$\boxed{\text{CHROMATICITY CORRECTION}}$



SMALL ε, SMALL η $\Rightarrow$ STRONG SEXTUPOLES AND LESS STABLE MACHINE

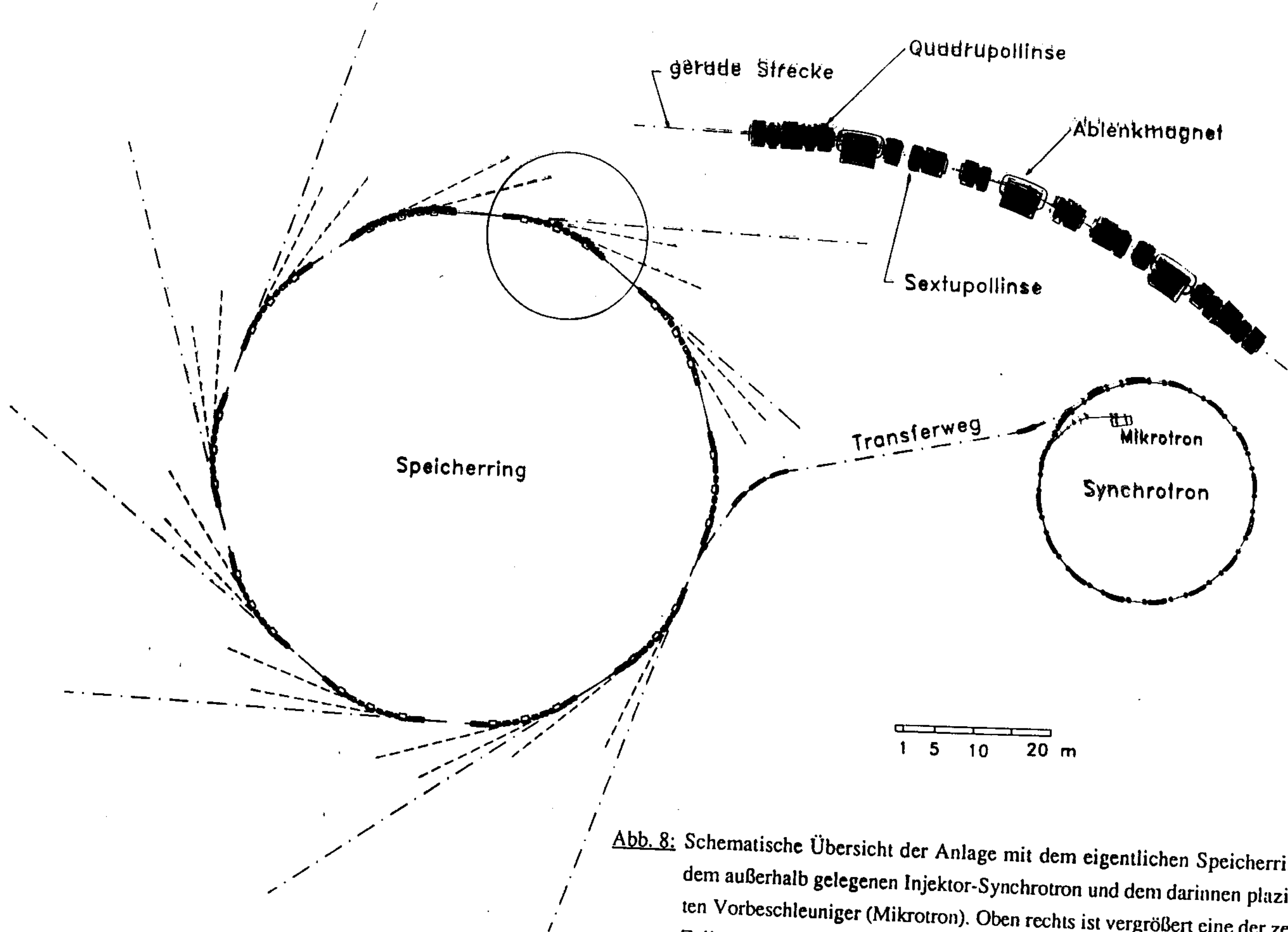


Abb. 8: Schematische Übersicht der Anlage mit dem eigentlichen Speicherring, dem außerhalb gelegenen Injektor-Synchrotron und dem darinnen plazierten Vorbeschleuniger (Mikrotron). Oben rechts ist vergrößert eine der zehn Zellen des Speicherrings mit Ablenkmagenten, Quadrupol- und Sextupollinsen und angrenzenden geraden Strecken dargestellt.

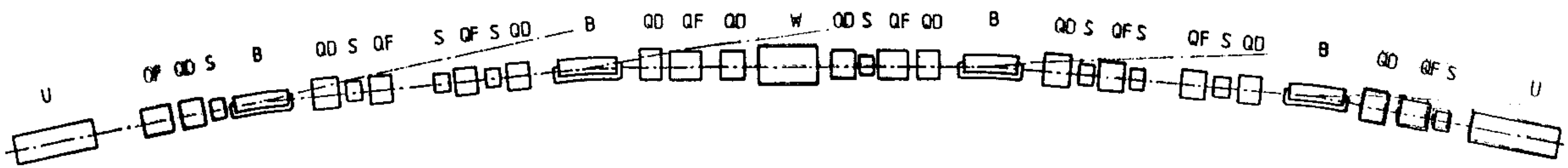
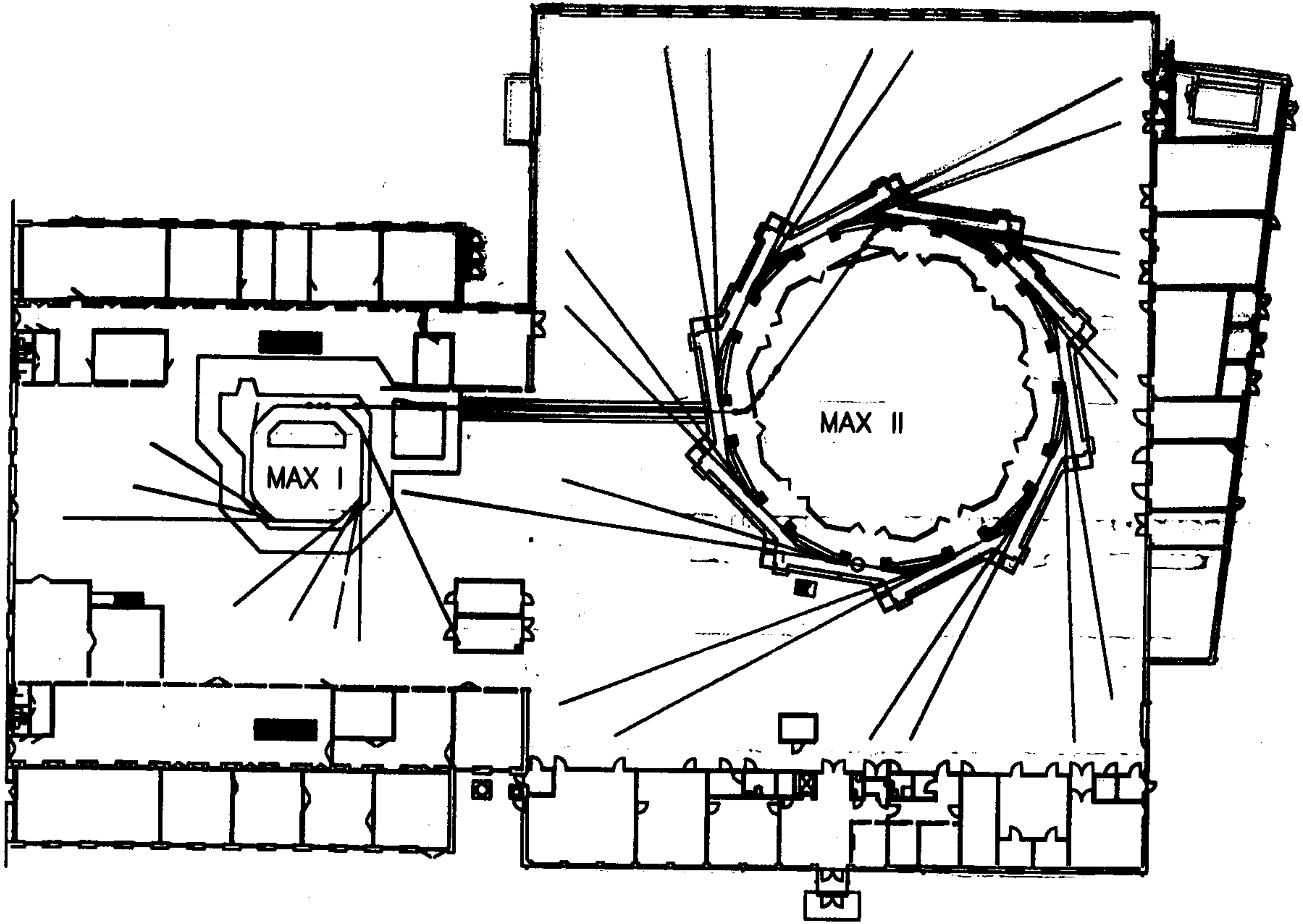
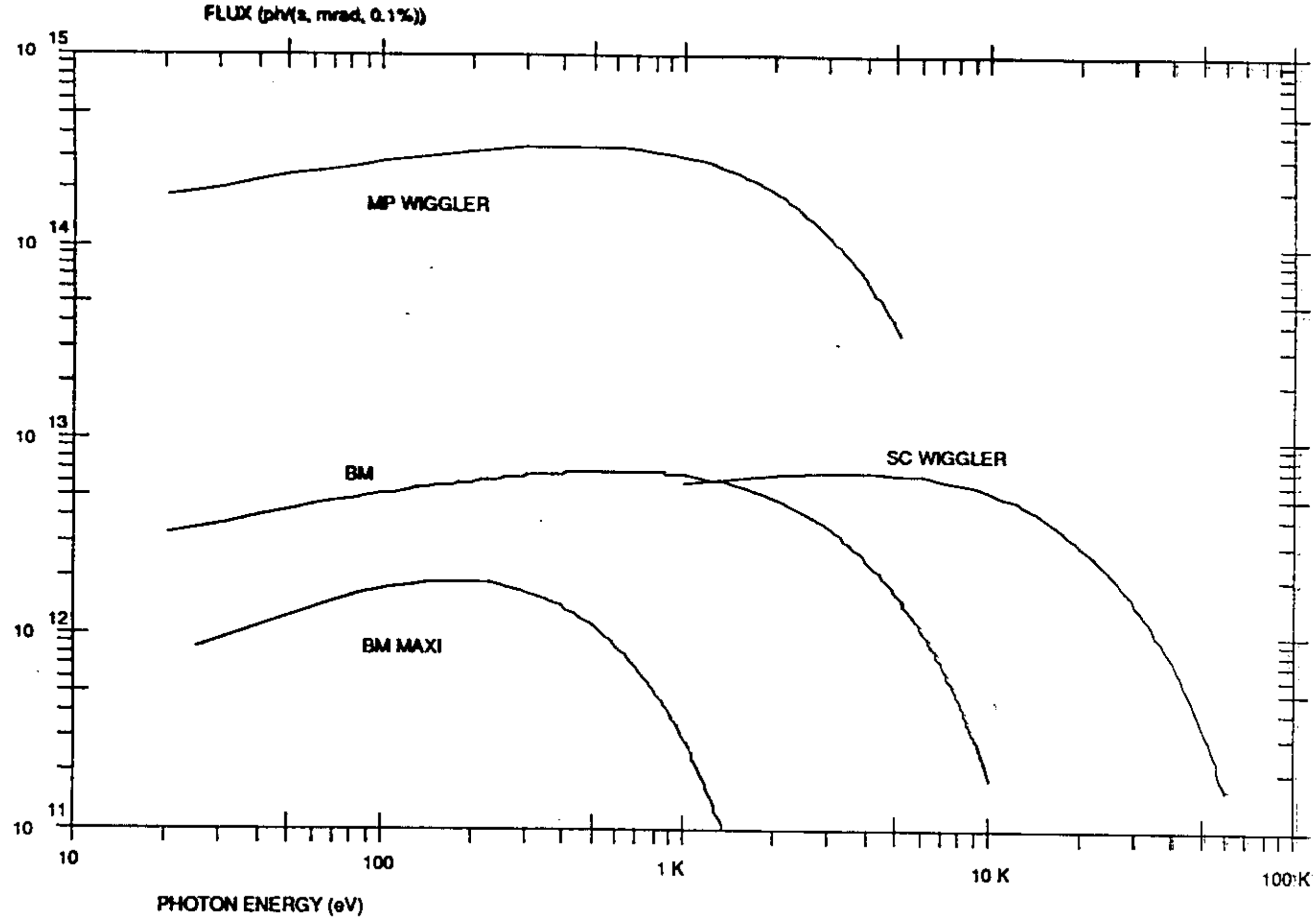
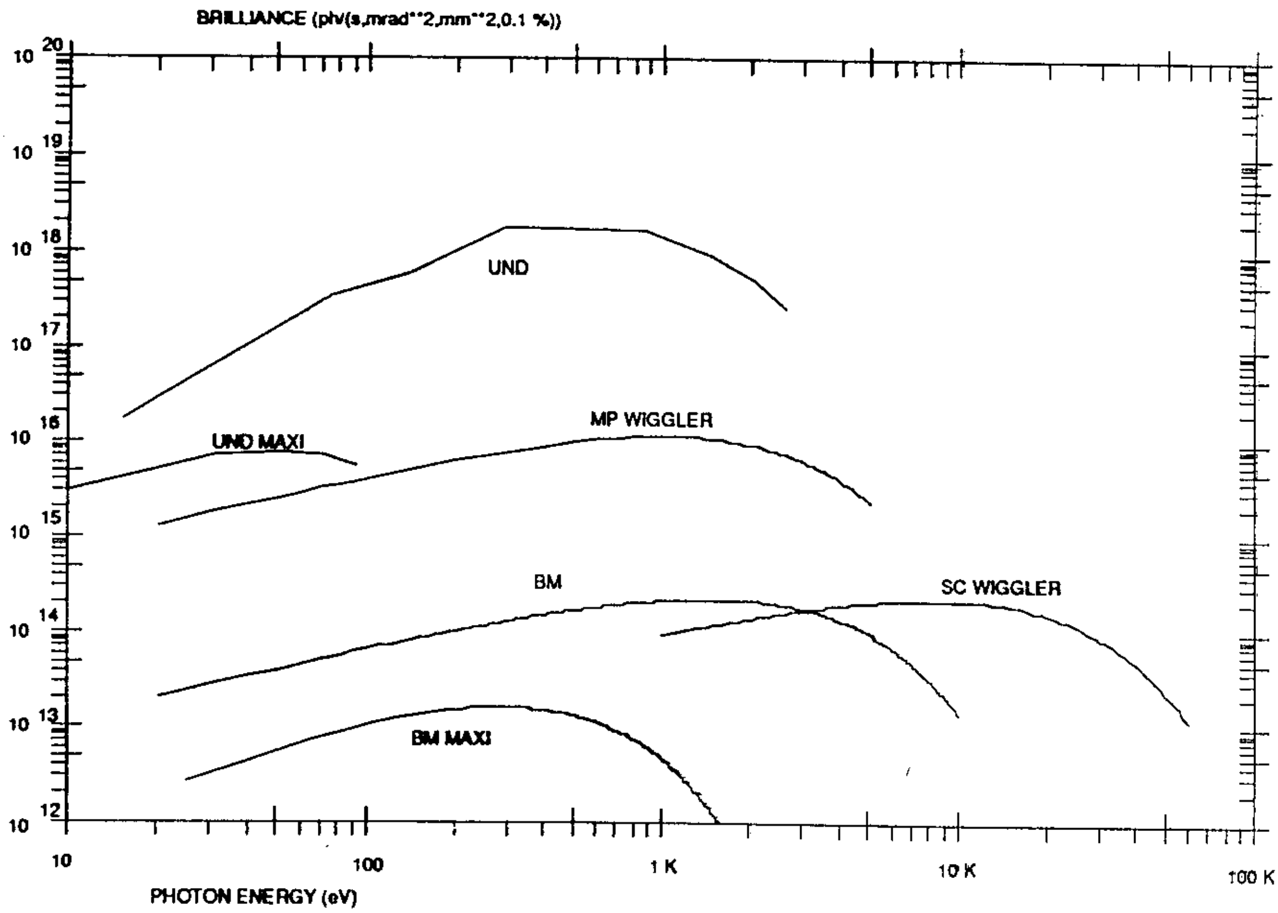
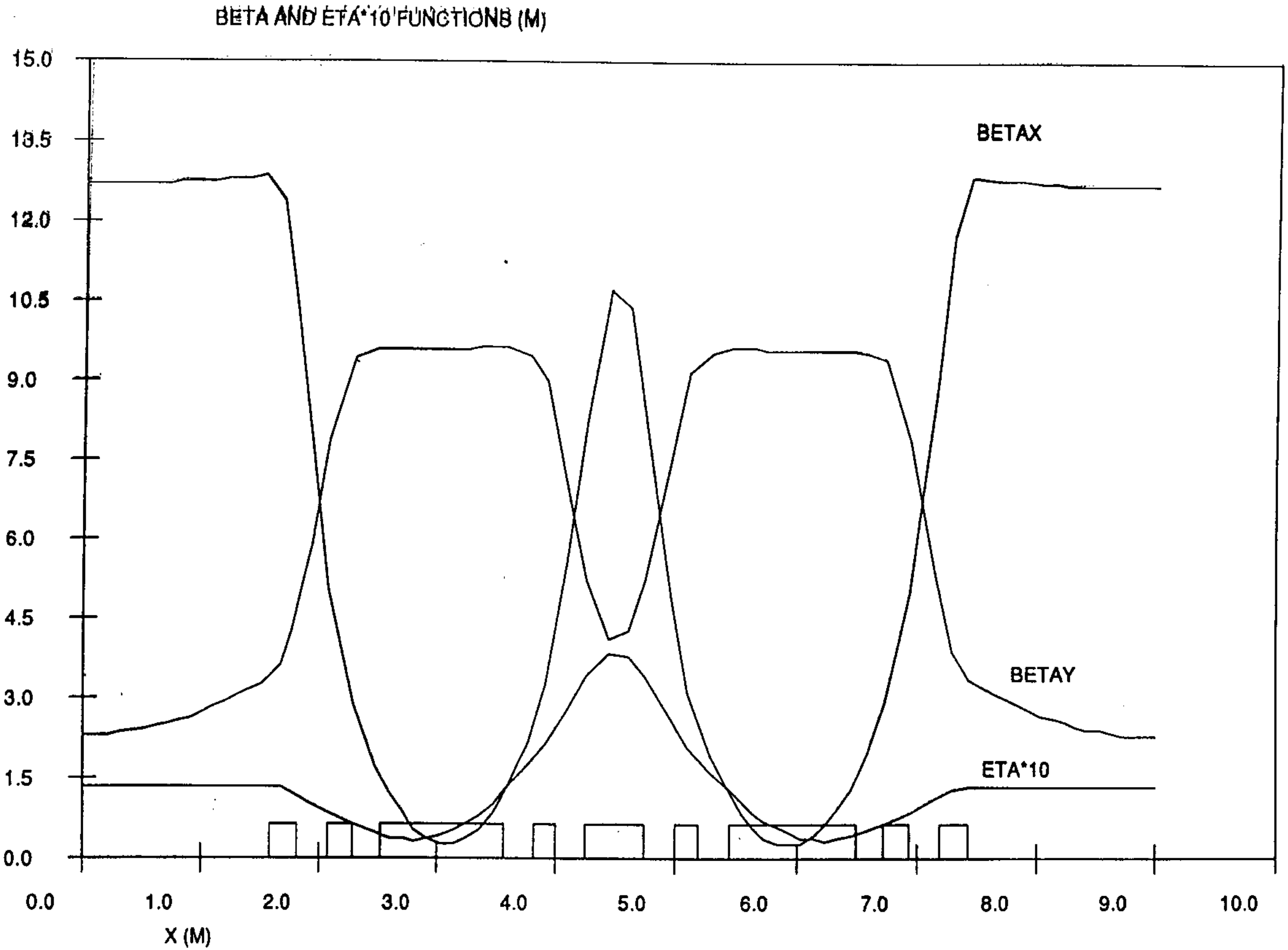


Fig. 5.3 Physical layout of 1/16 of the ring


MAX I
MAX II


FLUX (ph/(s, mrad, 0.1%))
MP WIGGLER
SC WIGGLER
BM
BM MAXI
PHOTON ENERGY (eV)
10
100
1 K
10 K
100 K


BRILLIANCE (ph/(s,mrad**2,mm**2,0.1 %))
UND
UND MAXI
MP WIGGLER
BM
SC WIGGLER
BM MAXI
PHOTON ENERGY (eV)
10
100
1 K
10 K
100 K


BETA AND ETA*10 FUNCTIONS (M)
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
BETAX
BETAY
ETA*10
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
X (M)

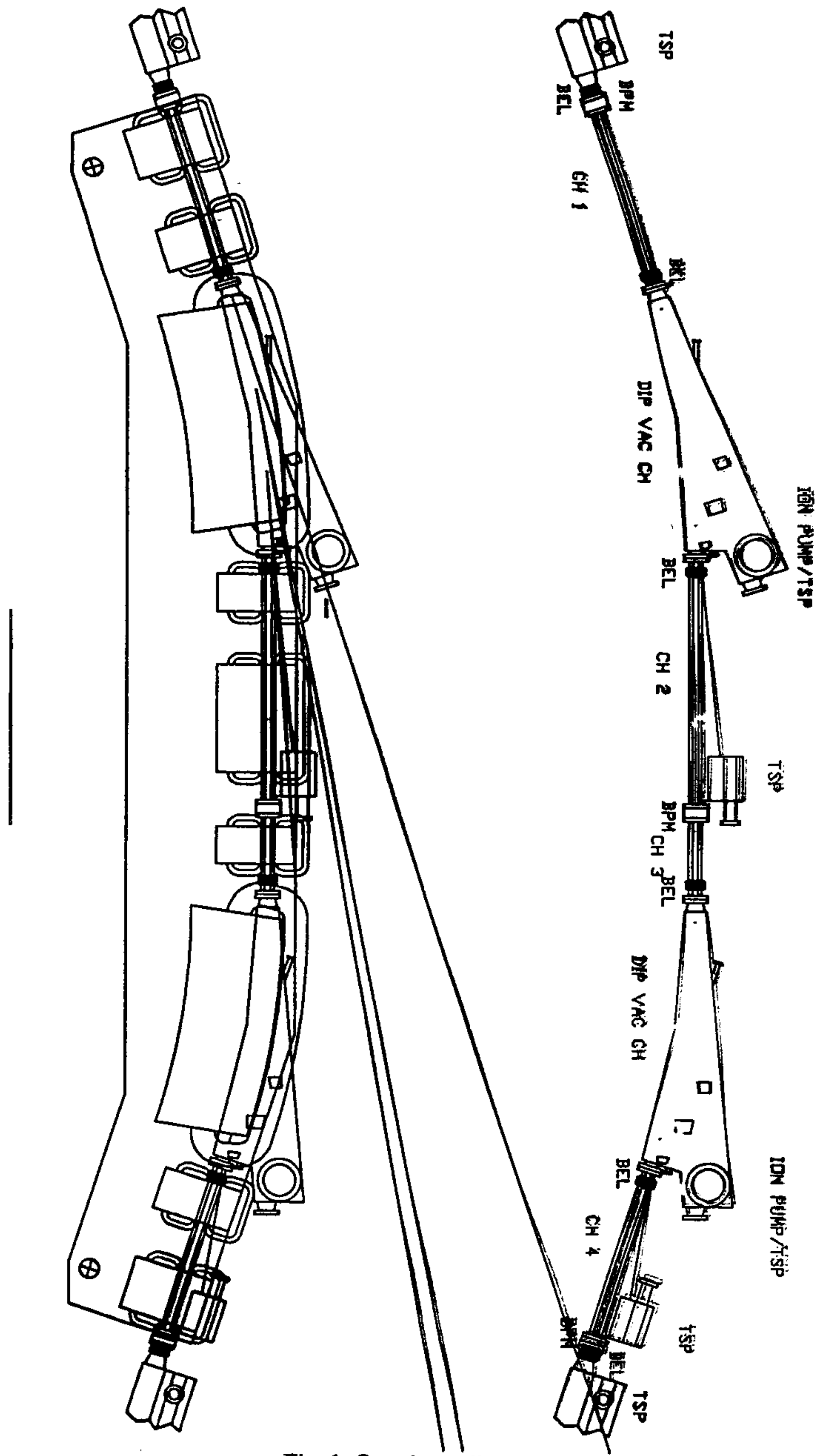


Fig. 1. One ring cell.

MAX II, Lund.

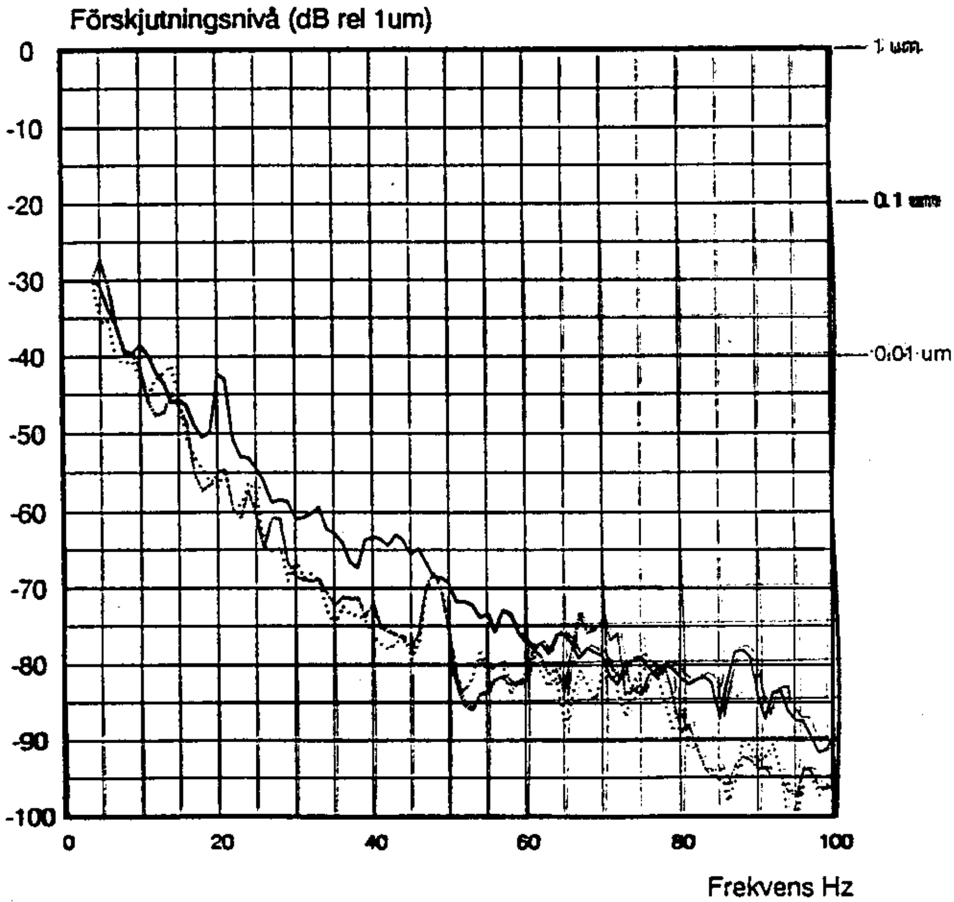
Mätpunkt 1-3.
Jämförelse med bakgrundsnivå

DIAGR.	2
ARBNR	0798.02
DATUM	90-01-10
SIGN.	SiI

Linjärt bw 1 Hz — MP1 Normal trafik, med lastbilspassage utan hinder. Totalnivå -21.3 dB (0.09 um)

Linjärt bw 1 Hz — MP3 Normal trafik, med lastbilspassage utan hinder. Totalnivå -20.7 dB (0.09 um)

Linjärt bw 1 Hz .... MP3 Normal trafik, med lastbilspassage utan hinder. Totalnivå -22.1 dB (0.08 um)



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