

KEKB RING MAGNETS

MAC 99@KEK

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@MAC 98

(1) Fabrication update (>90% done).

(2) Results of the "series" field measurements (>90% done).

=> Satisfy the optics requirements.

Progress Since

(1) Fabrication (100% done).

(2) The series measurements (100% done).

(3) More detailed measurements (mapping in the beam direction etc) are in progress. → Leff

(4) Interference effect between a steering magnet and a quad (in the beam direction) has been measured.

Problems found

(1) "Clogging" in the coils of the LER dipole Magnets.

(2) Interference between LER and HER, from the wide-gap "C-type" steering magnets at Fuji straight section and the IR section.

Solutions To the Problems

(1) Checked all the coils of the LER dipole magnets with an optical fiber scope, scraped off the epoxy with a wire brush/chemical solvent.

(2) New types of steering magnets are being designed.

LER Magnet Parameters

LER	$g/2$ or r_B (mm)	L.lam (m)	B, B', B'' (T, T/m, T/m ²)	No. of mag.	Make
Barc	57 (54)	0.76	0.848	134	Hitachi
Blc	57 (55)	2.1	0.52	26	Toshiba
Bv	55	1.2	0.2	4	Mitsubishi
Bs	57 (54)	0.3	0.21	3	Mitsubishi
Bc	105 (100)	0.2	0.045	3	IHEP
wigg	55	0.75	0.77	192	Toshiba
Qarc	55	0.4	10.2	414	Hitachi
Qrf	83	0.5	6.32	36	Toshiba
Qsk	105	0.2	0.73	8	IDX
Sx	56	0.30	340	104	Hitachi
SxC	85	0.50	77.5	4	Hitachi

Total 170 LER Bending magnets

190 Wiggler magnets

458 LER Quadrupole magnets

108 LER Sextupole magnets

HER Magnet Parameters

HER	g/2 or rB (mm)	L.lam (m)	B, B',B'' (T,T/m,T/m ²)	No. of mag.	Make
Barc	35 (33.15)	5.804	0.3	117	TRISTAN
Bw	35 (33.15)	2.8	0.048	6	TRISTAN
BsFL	35 (33.15)	1.14	0.214	1	TRISTAN
BsFR	57 (54)	0.76	0.339	1	Hitachi(LER:B)
Bh*L	95 (86)	0.2	0.0745	5	BINP
Bc*L,R	105 (100)	0.2	0.08	5	IHEP
Qs	50	0.5	12.7	80	Hitachi
Qx	50	0.76	12.7	4	Hitachi
Qrf	83	1.0	6.32	43	Hitachi
Qsk_2 /_1	105 / 80	0.5 / 0.3	0.73 / 1.25	7 / 5	IDX
QA	50	0.762	8.5	199	TRISTAN
QB	50	0.95	8.5	110	TRISTAN
	56	0.3	340	56	Hitachi
	56	1.0	348	48	Hitachi

Total 135 HER Bending magnets

448 HER Quadrupole magnets

104 HER magnets

LER Steering Mag. Parameters

LER_ST	g/2 or rB (mm)	L.lam (m)	BL _{eff} [Tm]	No. of mag.	Make
STV	80 (76.5)	0.2	0.0198	413 (+7)	IHEP(CHINA)
STV_wide	105 (100)	0.2	0.0179	41 (+2)	IHEP(CHINA)
STV_w_h	105 (100)	0.2	0.0179	6 (+1)	IHEP(CHINA)
STH	64 (58)	0.2	0.0128	385 (+7)	BINP(RUSSIA)
STH_wide	95 (86)	0.2	0.0127	21 (+4)	BINP(RUSSIA)

Total 470 LER Vertical Steering magnets

417 LER Horizontal Steering magnets

HER Steering Mag. Parameters

HER_ST	g/2 or rB (mm)	L.lam (m)	BL _{eff} [Tm]	No. of mag.	Make
STV	80 (76.5)	0.2	0.0310	393 (+7)	IHEP(CHINA)
STV_wide	105 (100)	0.2	0.0309	48 (+2)	IHEP(CHINA)
STH	40 (36.5)	0.2	0.0286	353 (+7)	BINP(RUSSIA)
STH_wide	95 (86)	0.2	0.0287	49 (+5)	BINP(RUSSIA)

Total 450 LER Vertical Steering magnet

414 LER Horizontal Steering magnets

Grand Total of 3364(?) "ring" magnets.

(2) Summary of the measurements

Main Dipole Magnets

Magnet type	Make	σ (field strength, normalized by the average)	σ (field strength, normalized by the average) after shim correction
LER Barc	Skoda	4.7e-04	1.3e-04
LER Blc	Toshiba	3.5e-04	No correction
HER Barc	Hitachi (TRISTAN)	3.5e-04	No correction

Main Quadrupole Magnets

Magnet type	Make	$\sigma(\Delta x)$ μm	$\sigma(\Delta y)$ μm	$\sigma(B'L)$, normalized by the average)
LER QA I	Skoda	40	30	5.9e-04
LER QA II	Hitachi	40	40	6.6e-04
LER Qrf	Toshiba	30	30	3.8e-04 6.8e-04 @max 500A
HER QA	Hitachi (TRISTAN)	40	70	6.0e-04
HER QB	Hitachi (TRISTAN)	50	60	6.0e-04
HER QS	Hitachi	60	50	4.5e-04
HER Qrf	Hitachi	40	40	5.2e-04

Requirements for higher order multipole components:

$$B3/B1 < 0.12\%$$

$$B6/B2 < 0.12\%$$

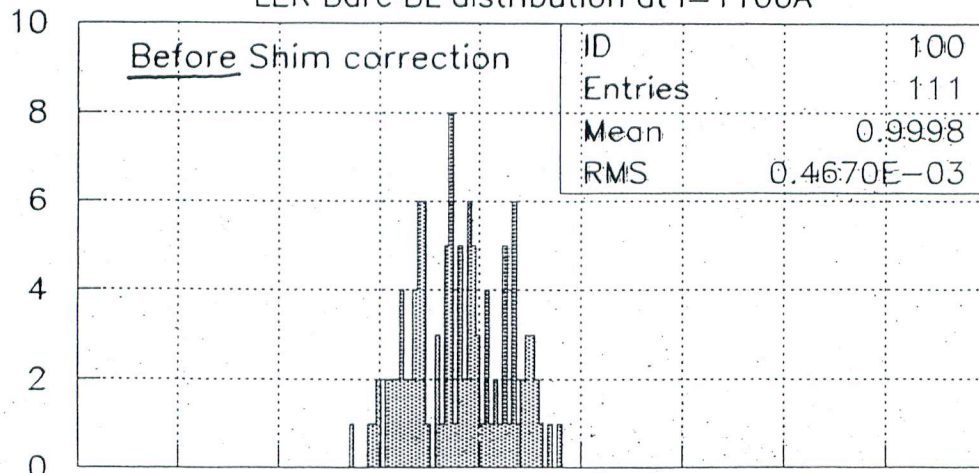
$$B5/B1 < 0.45\% \quad \text{for dipoles}$$

$$B10/B2 < 0.14\% \quad \text{for quads}$$

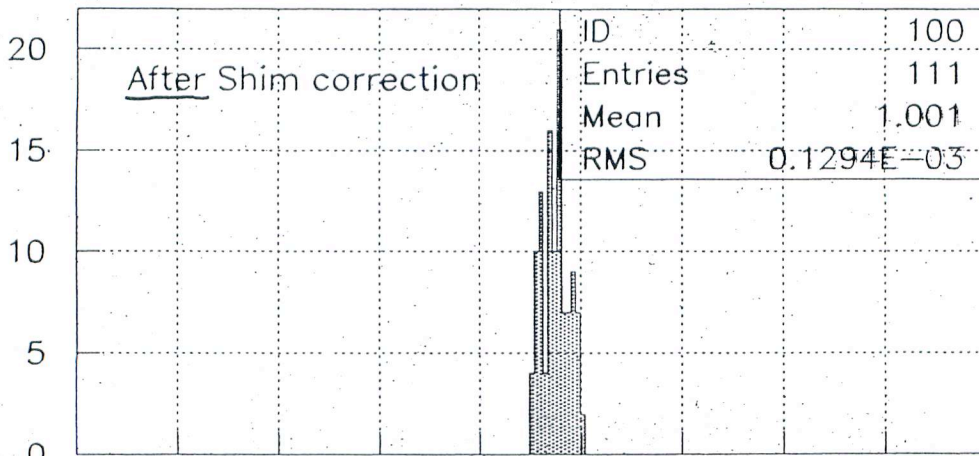
All satisfied

(NORMALIZED)

LER Barc BL distribution at I=1100A



$\sigma = 4.7 \times 10^{-4}$



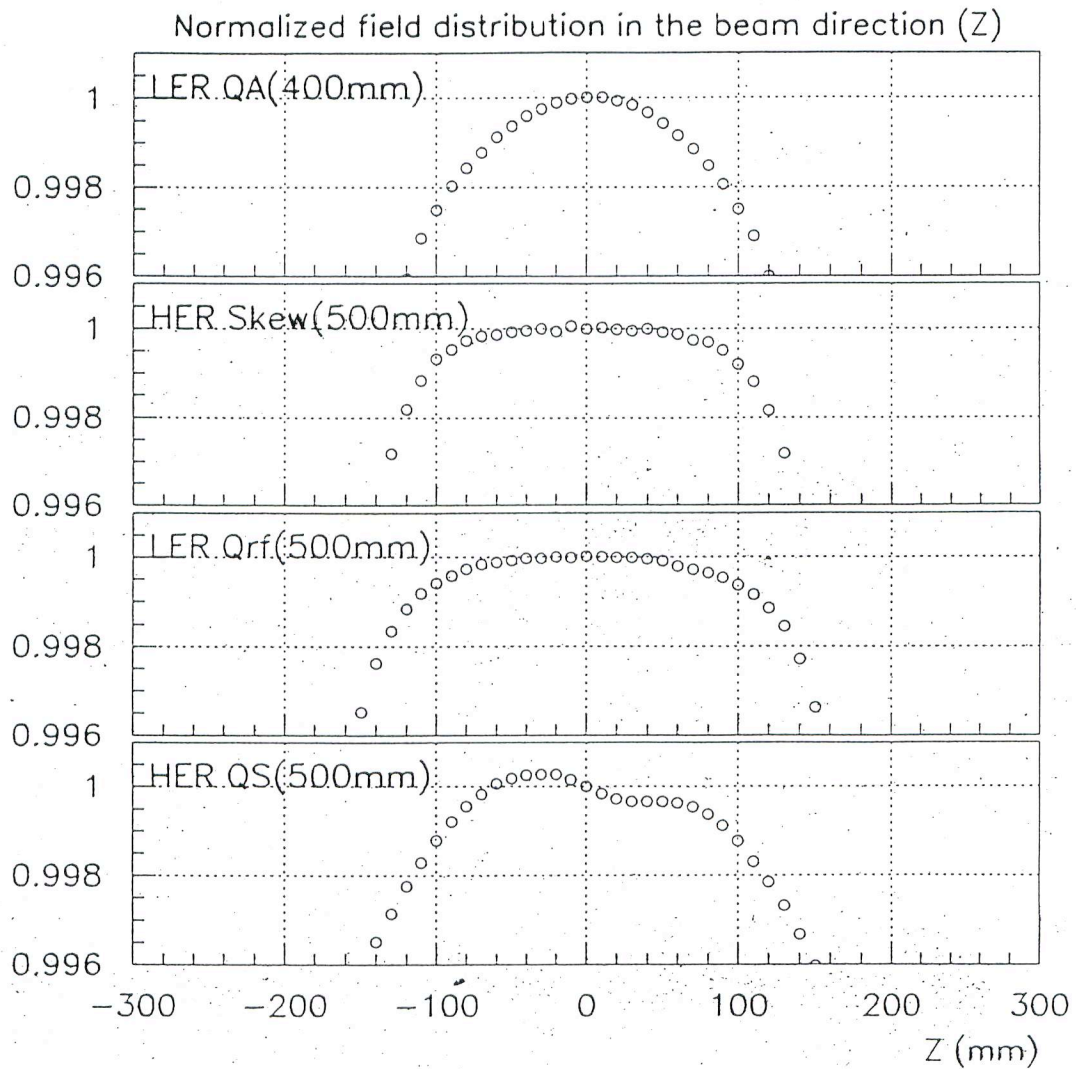
$\sigma = 1.3 \times 10^{-4}$

0.996 0.997 0.998 0.999 1 1.001 1.002 1.003 1.004 1.005
Normalized BL

1 shim plate = 0.5 mm thick

$\approx 4.5 \times 10^{-4}$

(3) Mapping in the beam direction

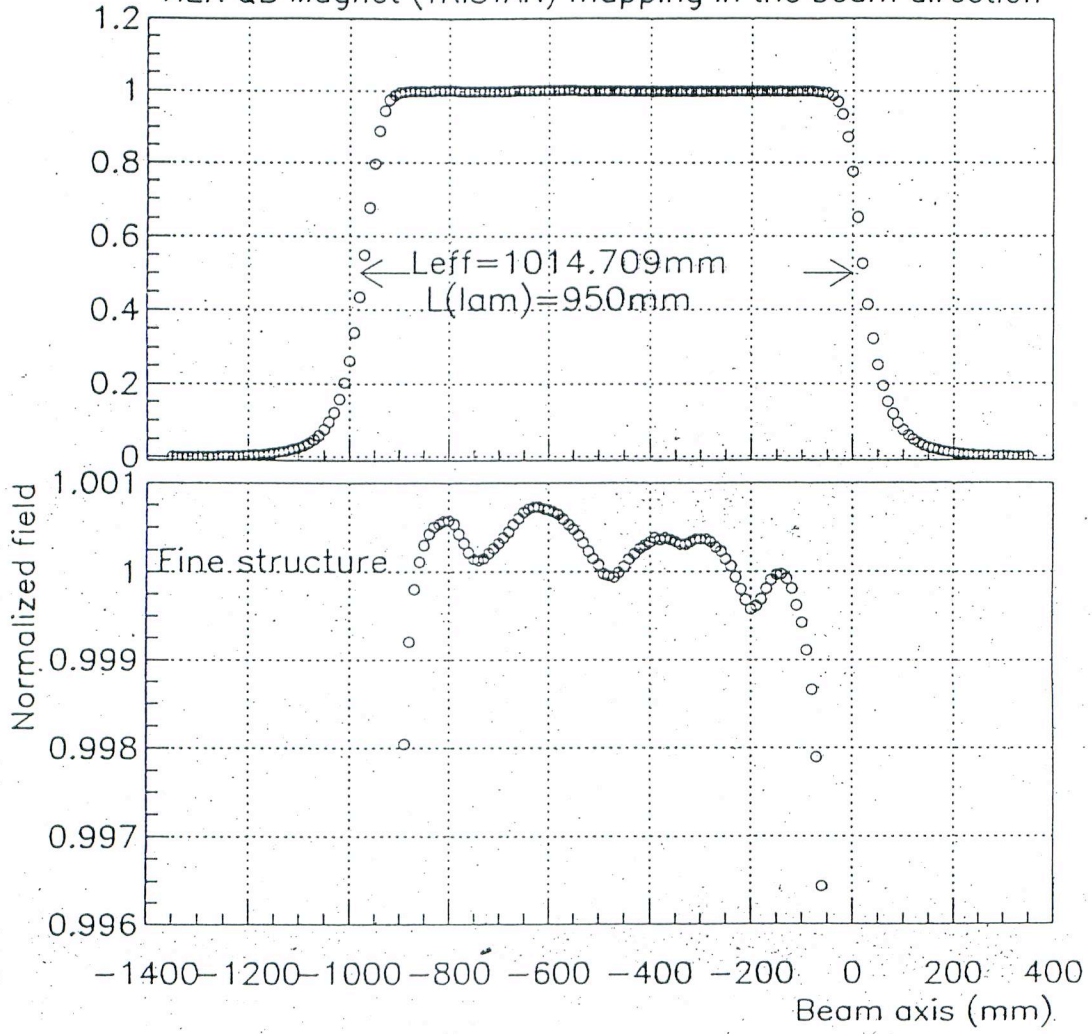


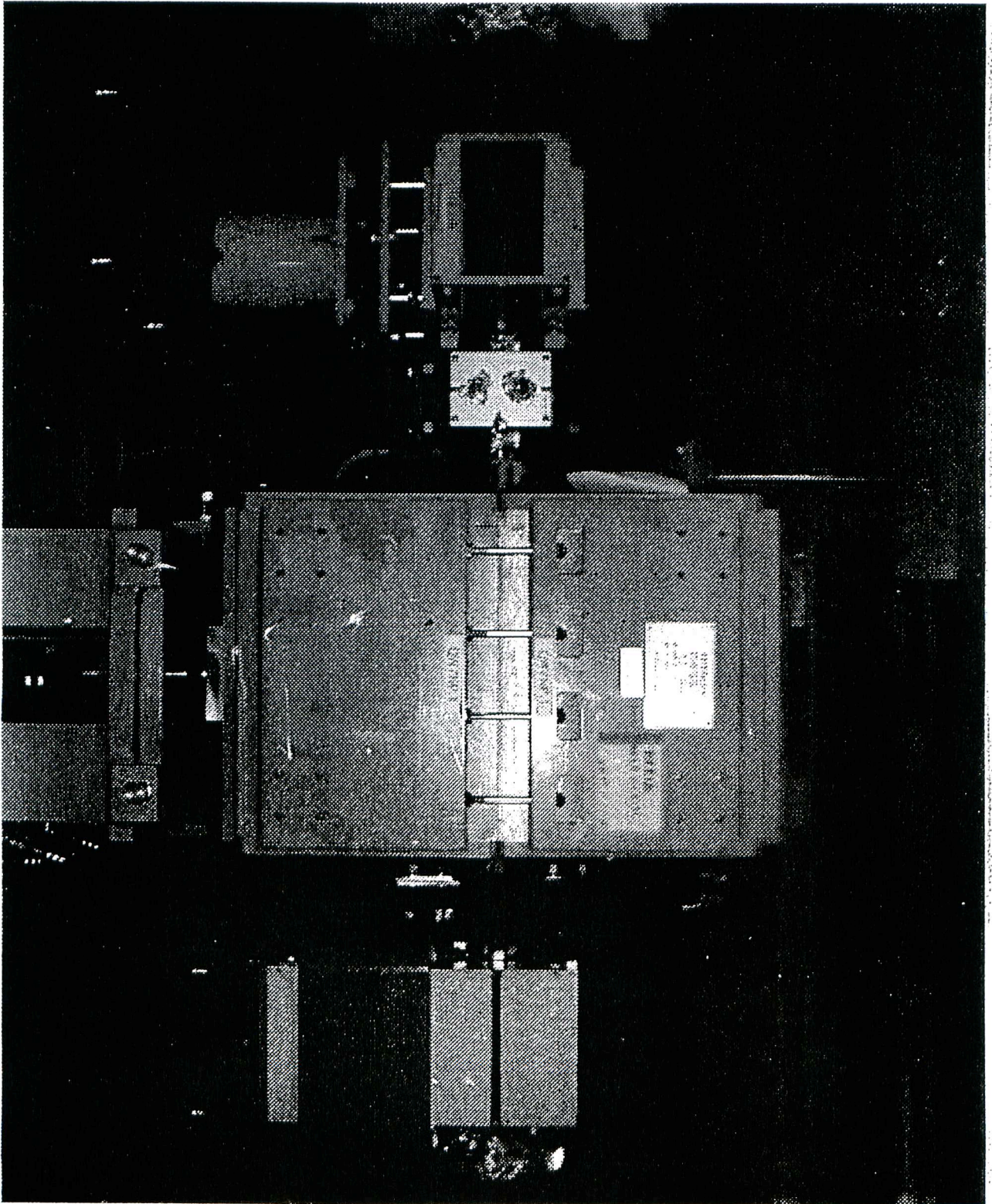
Comparison

"Fine" structure in the field distribution.

For Q magnets L lamination ≤ 500 mm

HER QB Magnet (TRISTAN) mapping in the beam direction

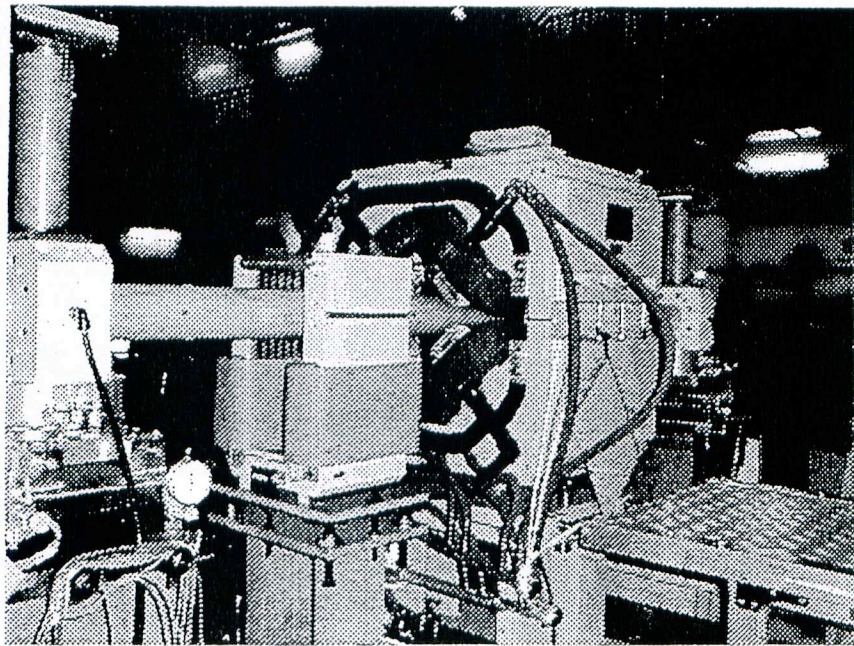




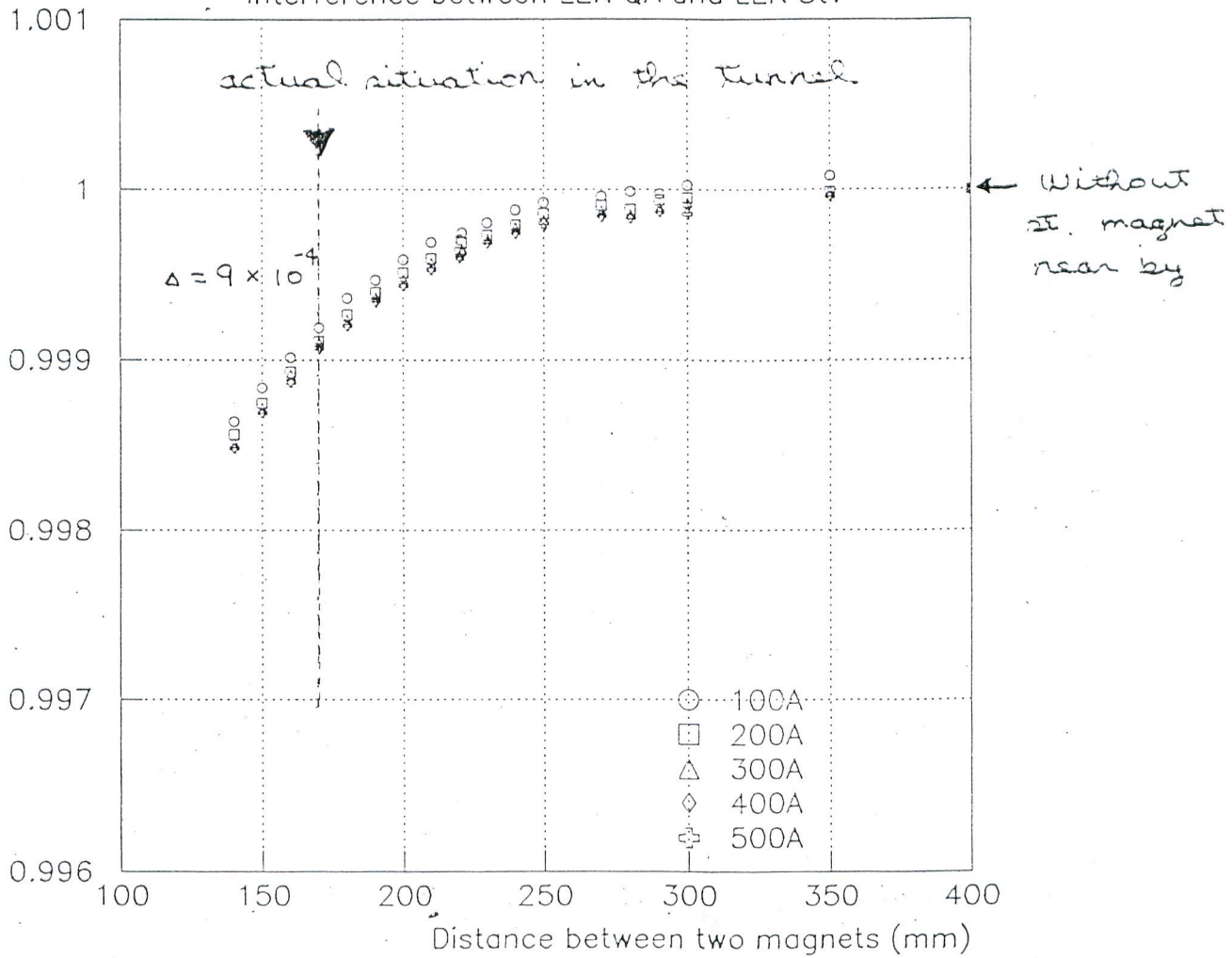
(4)

Interferance between Drag & S=

Measurement Bench

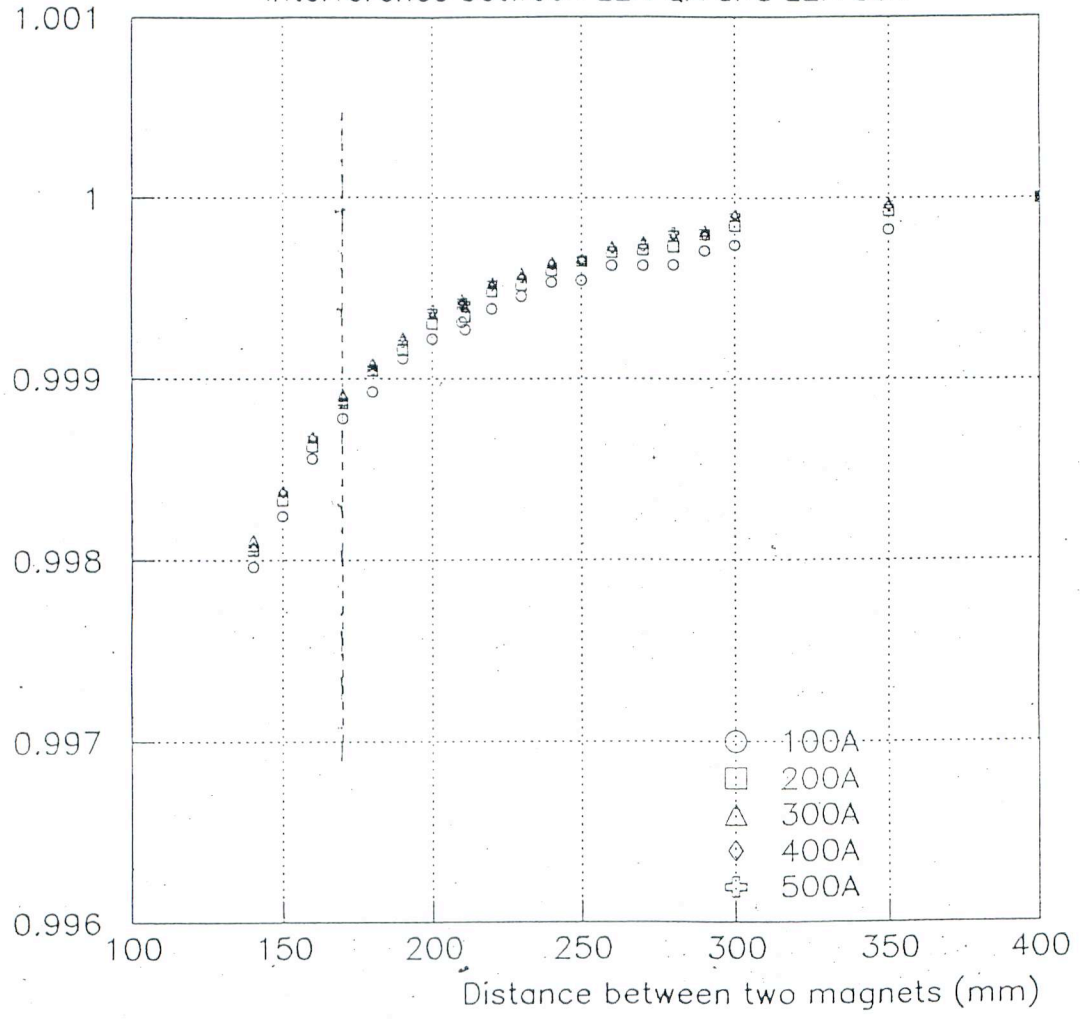


Interference between LER QA and LER StV



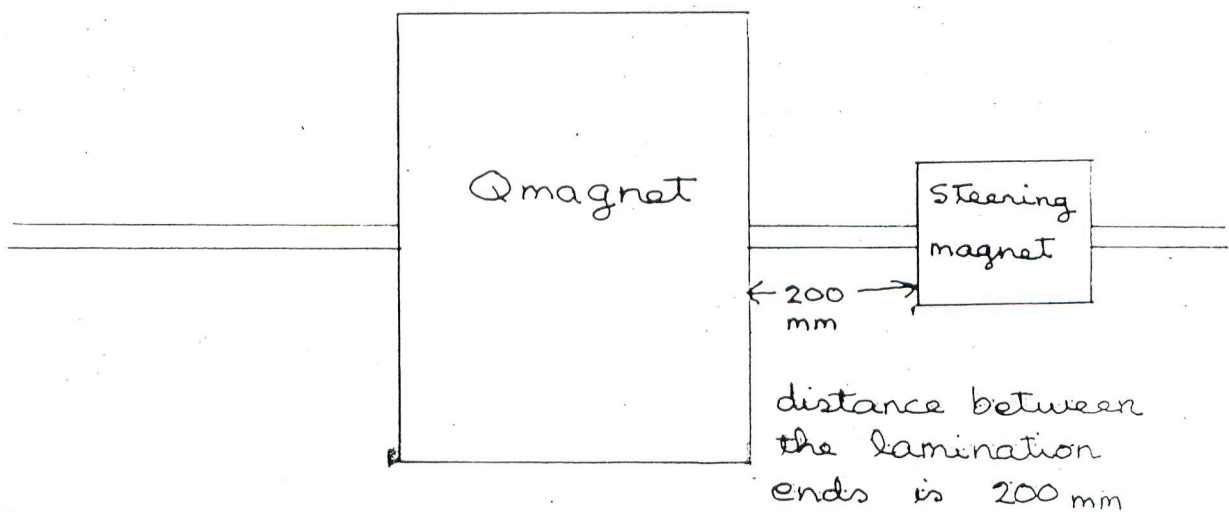
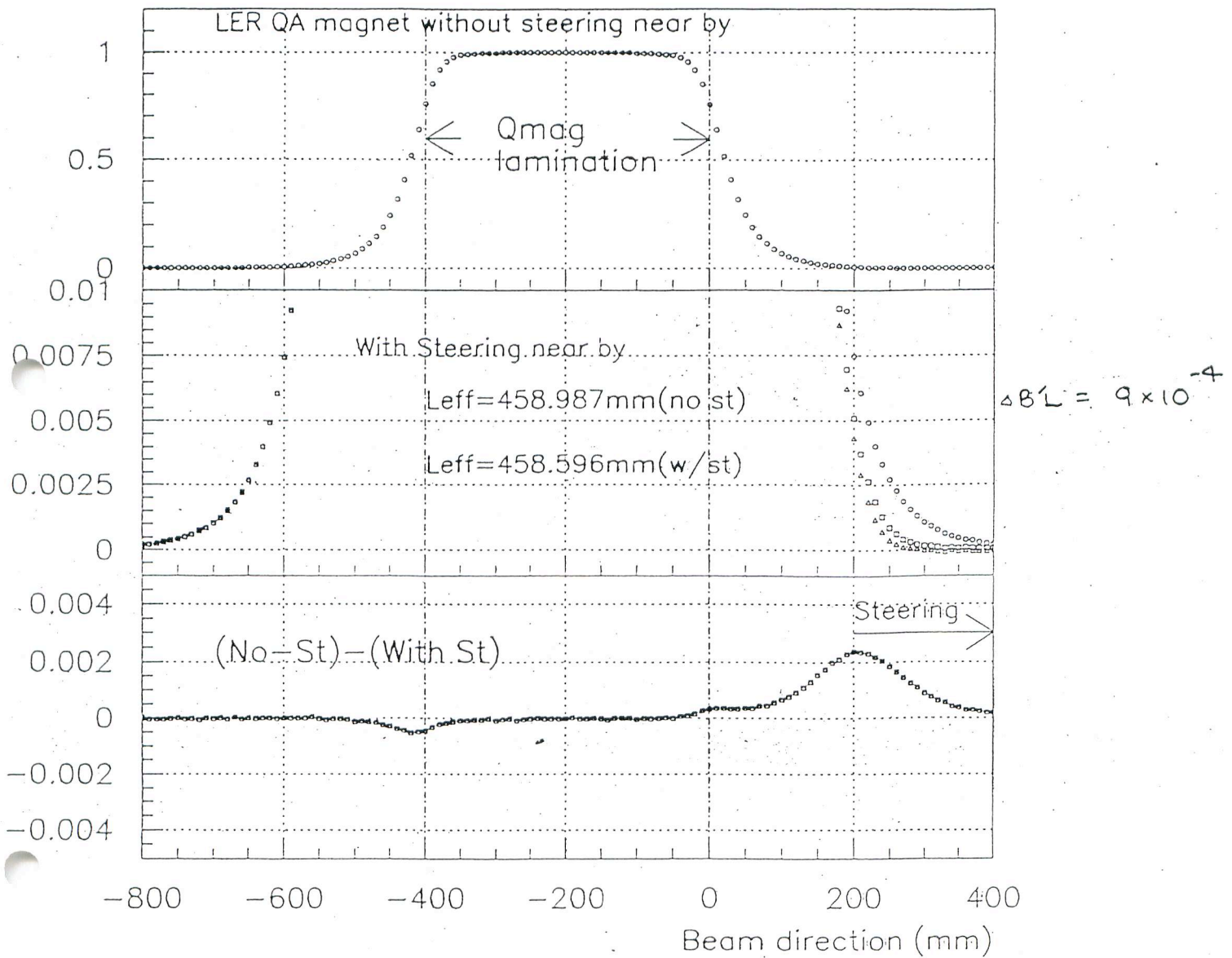
170 mm \approx 200 mm if
 measured between
 the lamination ends

Interference between LER QA and LER StH



Q magnet (LER arc)

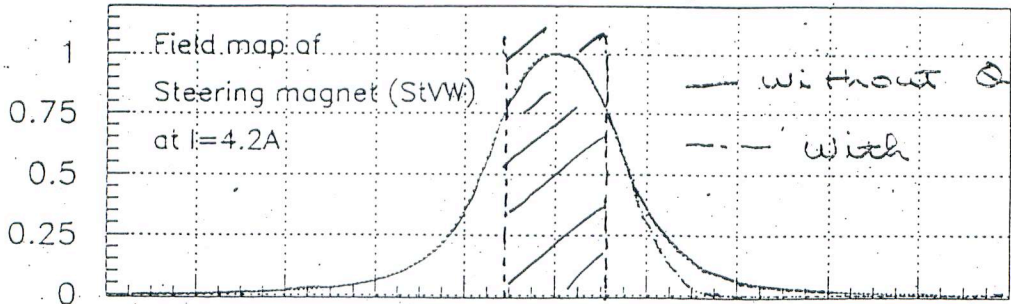
Field map in the beam direction



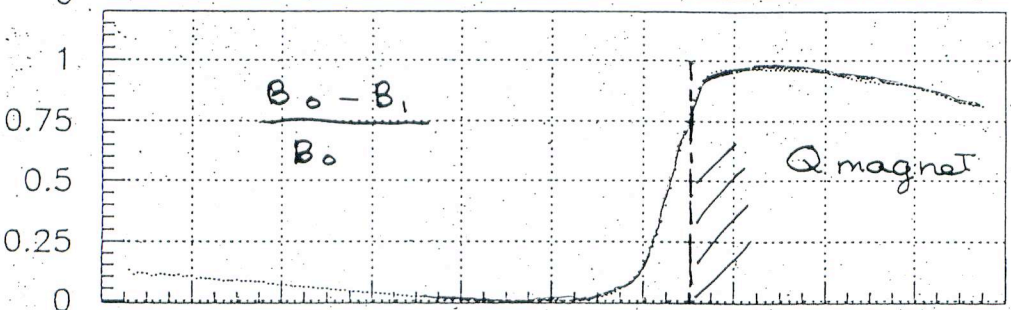
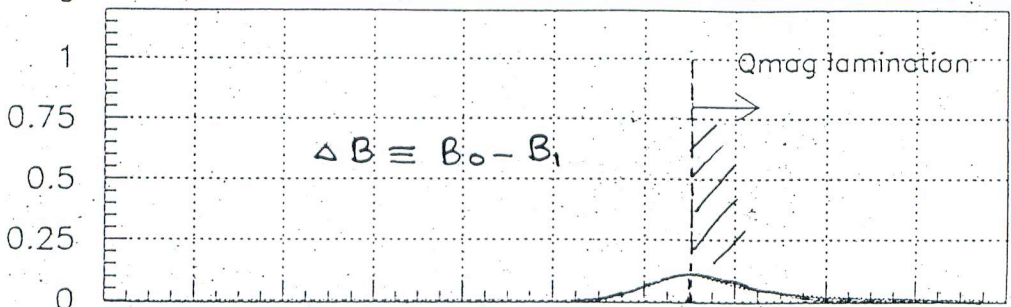
Interference from Q

Steering magnet

Interference from the QA magnet bear by



near by B_0
" B_1



-1000 -800 -600 -400 -200 0 200 400 600 800 1000
Z (mm)

Problems found

(1) "Clogging" in the LER dipole coils

Examined the inside the coil using a fiber scope

31 coils had epoxy resin

(out of 136 magnets + 4 spare coils = 276 coils)

Removed the epoxy resin

physically (brushing)

chemically (solvent, Methyl-Ethyl-Ketone)

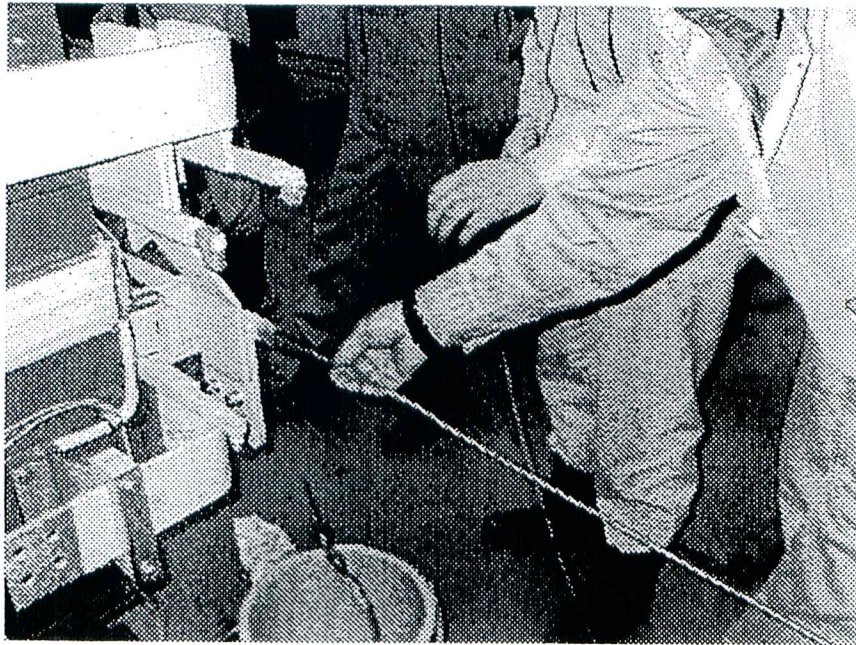
Sampling check

30 quadrupoles and 22 sextupoles, found no problem

Monitoring

Attached "thermo-labels" to all the coils for monitoring

brushing

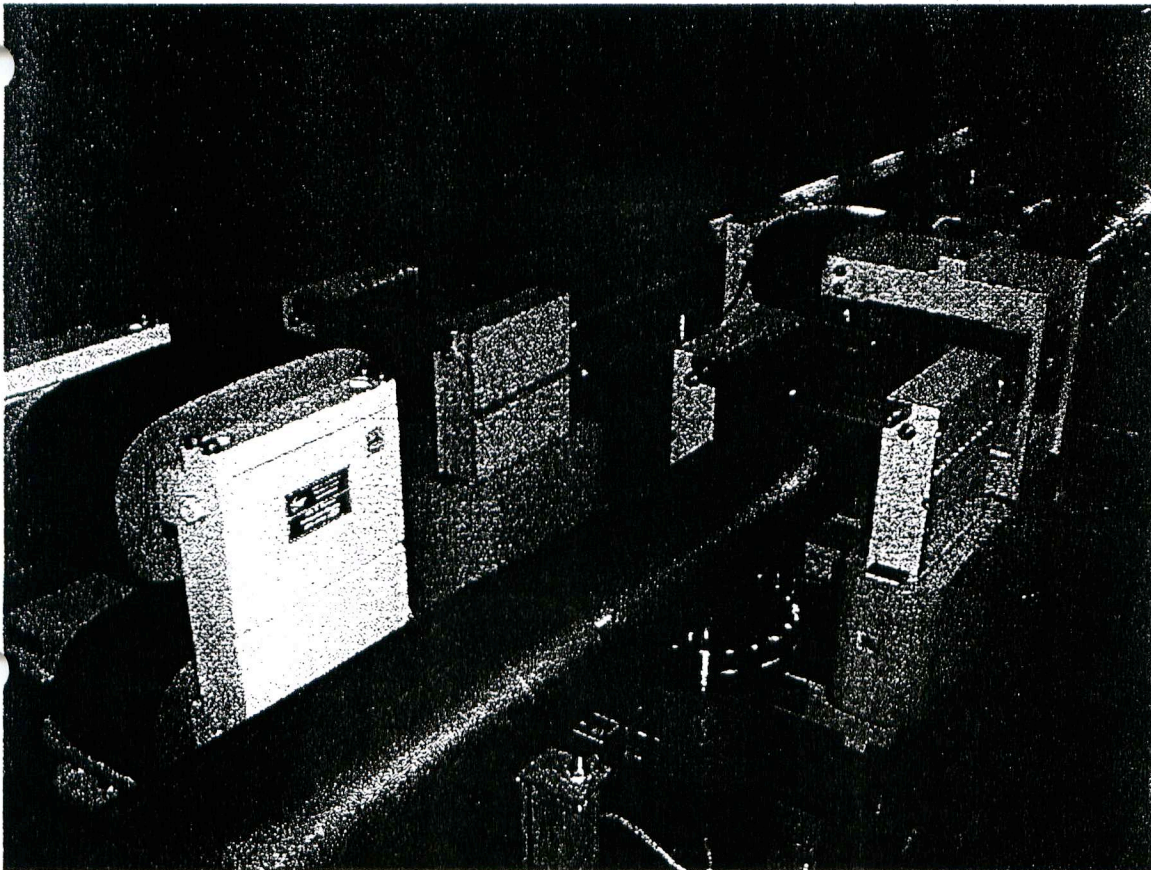


(2) "Interference" between two rings at
IR and Fuji straight sections

Steering magnets are causing the problem to the other
ring when the rings are close.

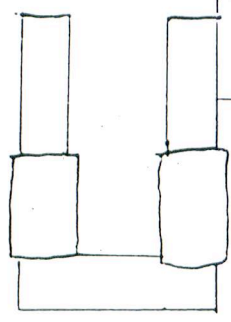
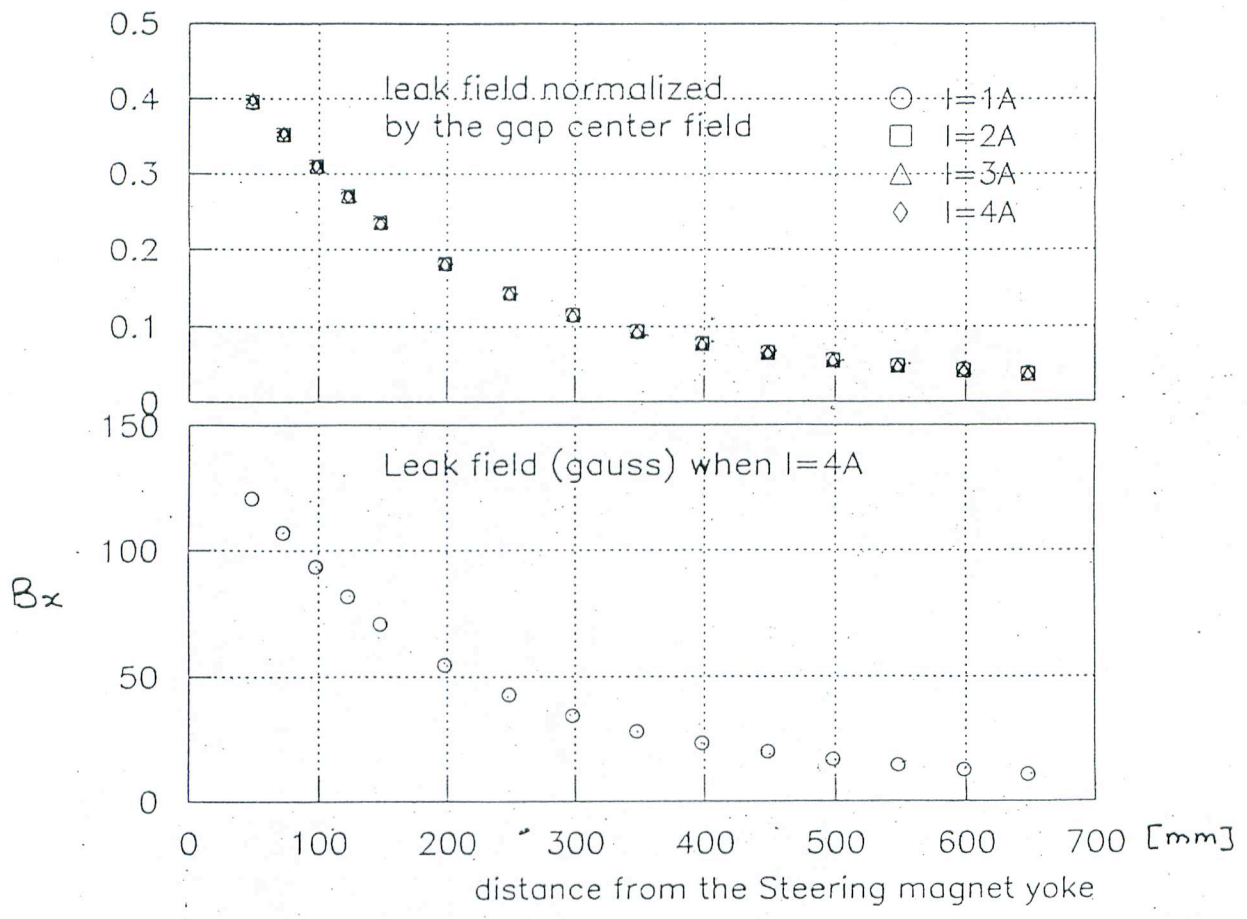
Thursday, March 4, 1999

JPEG 画像 640x480 ピクセル

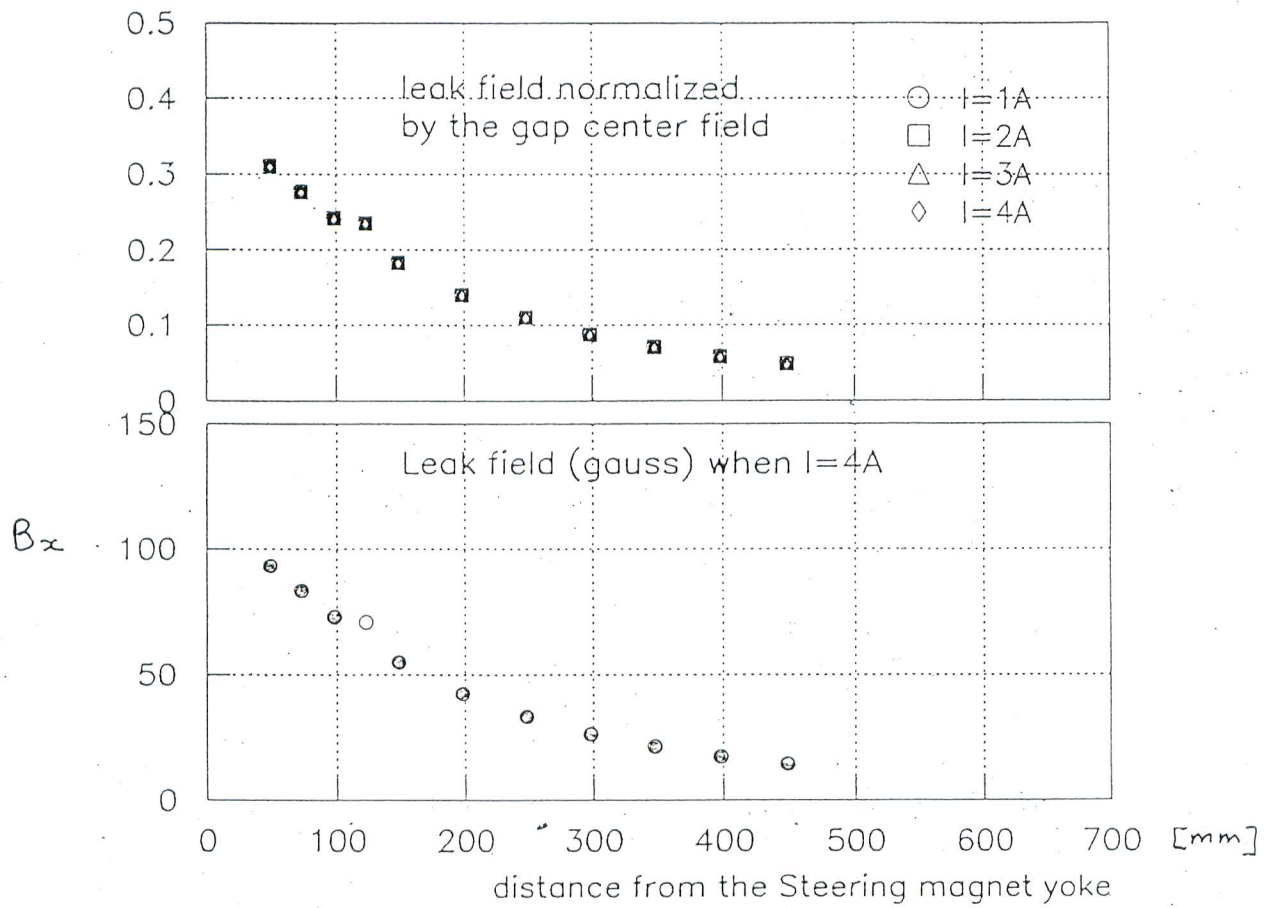


*Interference between
the rings, due to the steering magnets.*

Vertical steering (wide gap)



Vertical steering (normal gap)



Horizontal steering (wide gap)

