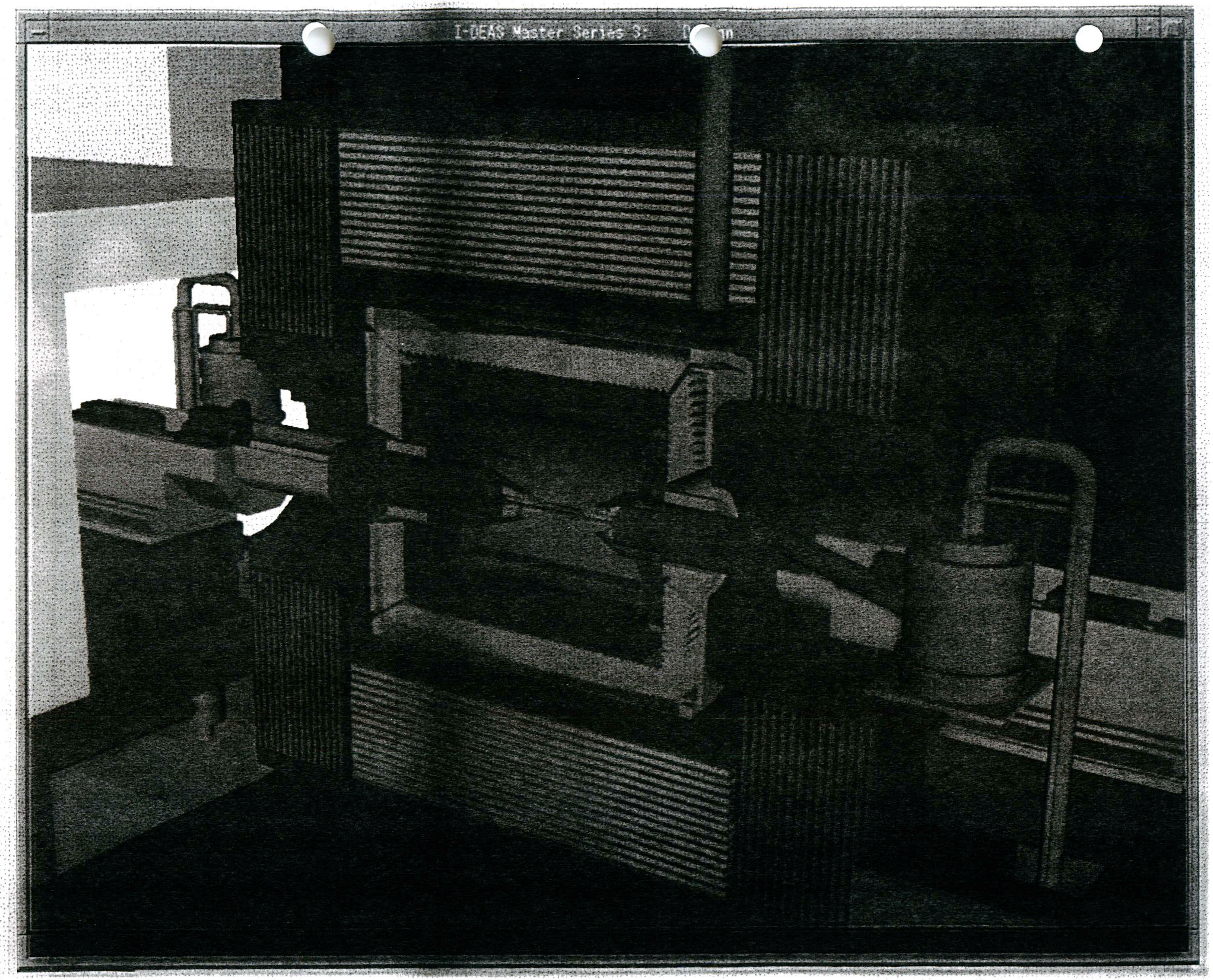
KEKB Interaction Region Overview

KEKB Accelerator Review (1/23/97)

Nobu Toge (KEK, Accelerator Department)

Cast

The Boss		S. Kurokawa
Parameter Committee chair.		K. Satoh
Beam-Beam theory / simulation		K. Hirata
		K. Ohmi
Superconducting magnets		K. Tsuchiya
		N. Oh-uchi
		T. Ogitsu
Normal-conducting magnets		H. Nakayama
Support, alignment		R. Sugahara
Vacuum system		K. Kanazawa
HOM evaluation		Y. Chin
Beam monitors		K. Hiramatsu
		M. Tejima
Near-IP lattice design		H. Koiso
		K. Oide
Detector facility	The Boss	F. Takasaki
	Coordination	J. Haba
	Structure	H. Yamaoka
	Background	S. Uno
	Vertex detector	T. Matsuda +++
Others		N. Toge


I-DEAS Master Series 3:

0. Development Since LCPAC 1996

1. Beam-line near the interaction point (IP): No changes to the principal scheme.

2. Have concluded beam-beam simulation studies. Fixed crossing angle at 2 x 11 mrad

3. Optics design is nearly frozen, i.e. Location of the IP, orbit angle, magnet parameters, etc.

4. Specifications for the QCS have been fixed. Contract has been signed. Anticipating delivery of completed cryostat modules in summer 97.

5. Engineering design of special normal-conducting magnets are progressing. Will conduct prototype tests of one or two magnets in summer 97.

6. Have designed magnet support and alignment schemes. Boundary conditions relative to BELLE fixed.

7. Radiation shield scheme is basically frozen. The base support bridge structures are being built, to be completed in spring 97.

8. Will do field-mapping measurements of BELLE solenoid and QCS magnets put together in fall / winter 97.

9. Started communicating with the monitor group.

10. Balancing HOM issues vs background masks. Designs of the vacuum system under development.

1. Beam Parameters (Reminder)

Luminosity goal	1×10^{34}	$cm^{-2}s^{-1}$
Crossing angle	2 x 11	mrad
Bunch spacing	0.59	m

	Positrons	Electrons	
Energy	3.5	8.0	GeV
Bunch inten.	3.3×10^{10}	1.4×10^{10}	/ bunch
Beam current	2.6	1.1	A
Energy spread	7.7×10^{-4}	7.8×10^{-4}	
σ_z	4	4	mm
Synch. tune	0.01 ~ 0.02	0.01 ~ 0.02	

	Horizontal	Vertical	
Betatron tune	45.52	45.08	(HER)
	47.52	43.08	(LER)
Emittance	1.8×10^{-8}	3.6×10^{-10}	m
β^*	0.33	0.01	m
σ_{IP}	77	1.9	µm
Max. tune shift	0.039	0.052	
σ_{IP} / σ_z	19.2	0.48	mrad
Inj. beam env.	1.2×10^{-5}	1.2×10^{-5}	m

No changes since 1996.

Notes: Constraints from (or Desires of) the Detector Facility

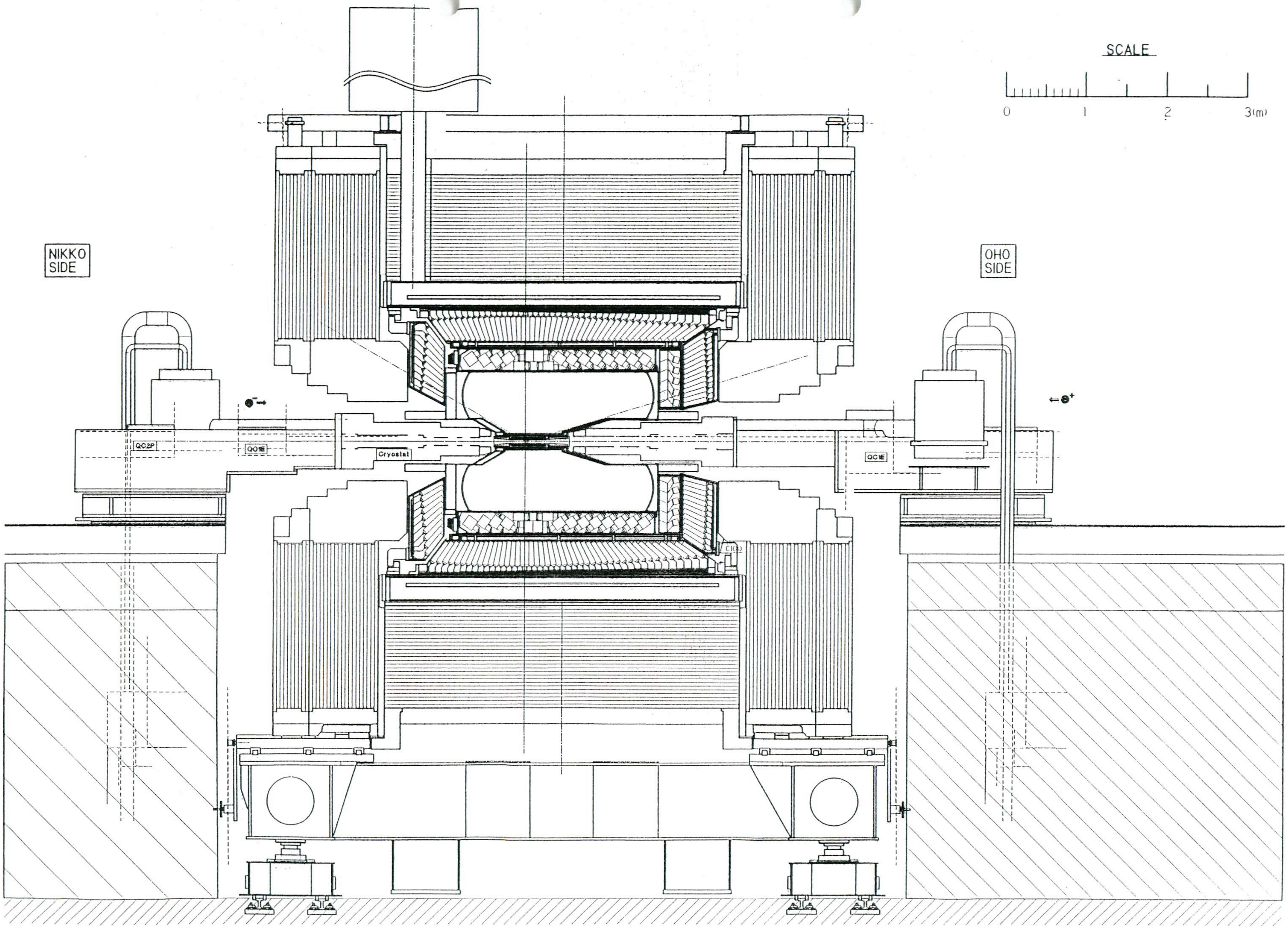
Component	Polar angle coverage (deg)
Fwd KLC / μ-det.	25 ~ 45
Bkd KLC / μ-det.	113 ~ 155
Fwd Calorimeter	11.5~ 32.5
Bkd Calorimeter	130 ~ 160
Central Drift Chamber	17 ~ 150
Silicon Vertex Detector	17 ~ 150

Barrel particle ID will be with Silica Aerogel (no DIRC).

Endcap particle ID still an open question. Decision in July.

Solenoid field	1.5	T
Iron length	3621 x 2	mm
IP position	–470	mm
CDC Inner Radius	278	mm
Vertex vac. ch. radius	20	mm

Need to allocate room for cabling and gas tubing as well.


SCALE
0
1
2
3(m)
NIKKO SIDE
OHO SIDE
QC2P
QC1E
Cryostat
QC1E

2. *Beamline Layout Overview (Reminder)*

1. **Two-beam separation based on the finite crossing angle of 11 mrad x 2.**

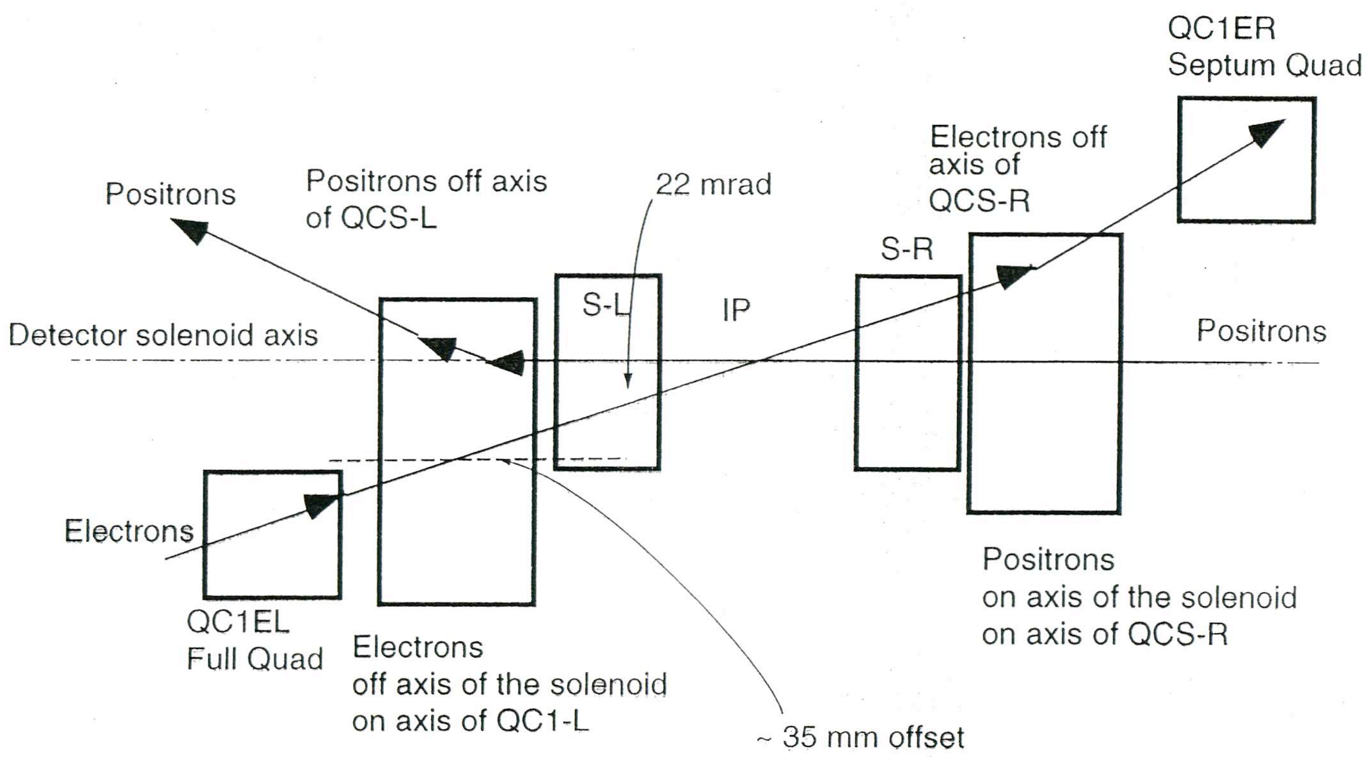
   - Allows the ultimate bunch spacing s_B ~ 0.6 m without a hitch.

   - Fexible choices of bunch intensity N vs. bunch spacing s_B .

   - Eliminates the need for separation bend dipoles, creating room for compensation solenoid.

   - Reduced SR / particle background.

   - Large e–/e+ beam separation. No worries on parasitic crossing. > +/– 3mm separation at Z = 0.3 m. *i.e.* >> 20 σ_x separation.



QC1ER
Septum Quad
Electrons off
axis of
QCS-R
Positrons
Positrons off axis
of QCS-L
22 mrad
S-R
S-L
IP
Detector solenoid axis
Positrons
Electrons
QC1EL
Full Quad
Electrons
off axis of the solenoid
on axis of QC1-L
Positrons
on axis of the solenoid
on axis of QCS-R
~ 35 mm offset

2. Final vertical focusing with common SC quadrupole magnets (QCS)

- Principle: Center the incoming beam.

  $dB / dx = 20.542$ T/m
  $L_{EFF} \sim 0.4 - 0.5$ m
  $I \sim 2900$ A

- Flexibility for operating at different beam energies (Energy asymmetry needs to be kept constant).

- Embed compensation solenoid within the same cryostat enclosure.

  $B_Z = 4.4 \sim 5.6$ T
  $L_{EFF} = 0.4 \sim 0.6$ m

  This is to make $\int Bz\, dz = 0$ on both sides of the IP.

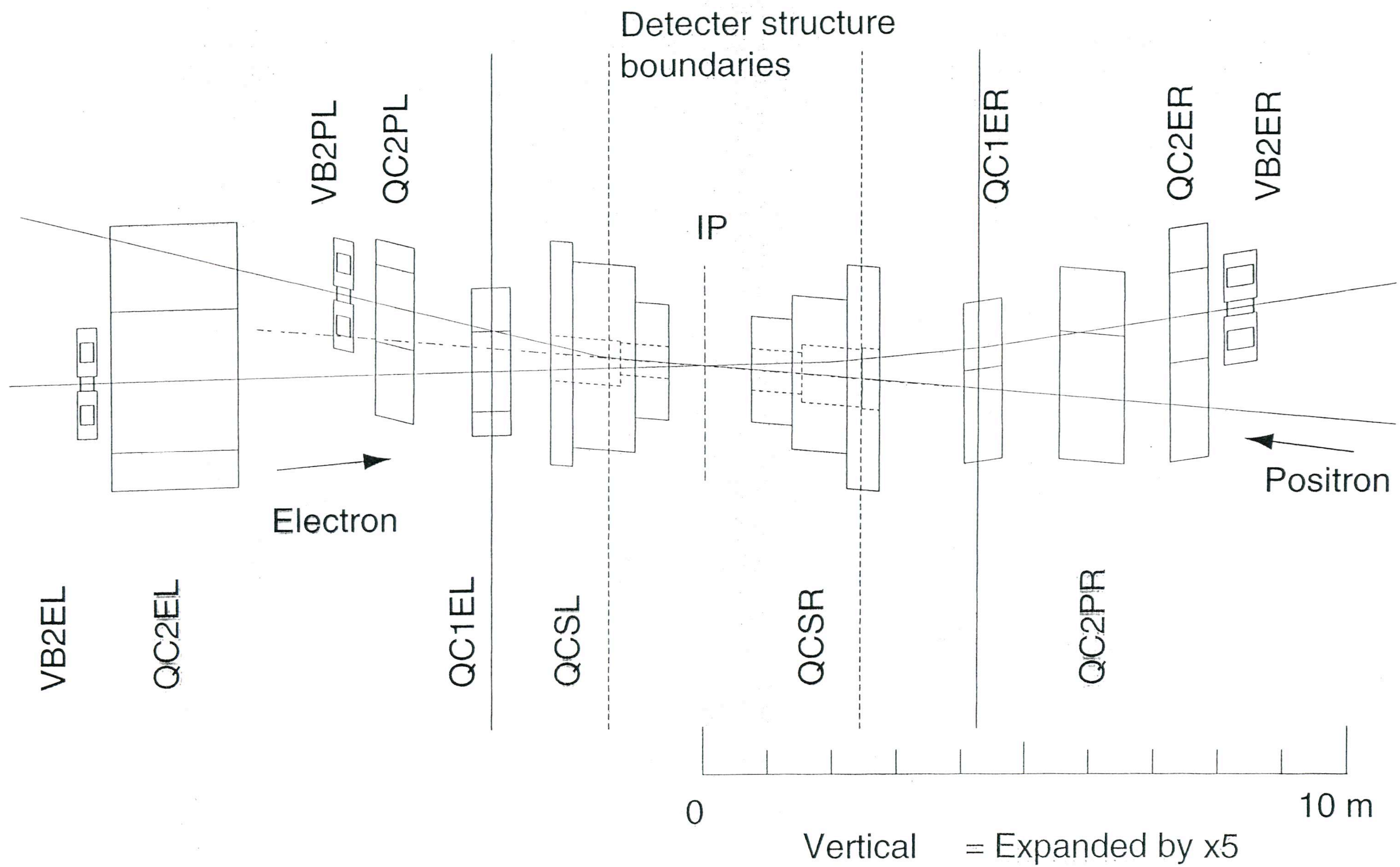
- Include correction dipole (x and y) and skew windings.

3. Special NC quadrupole magnets (QC1, QC2)

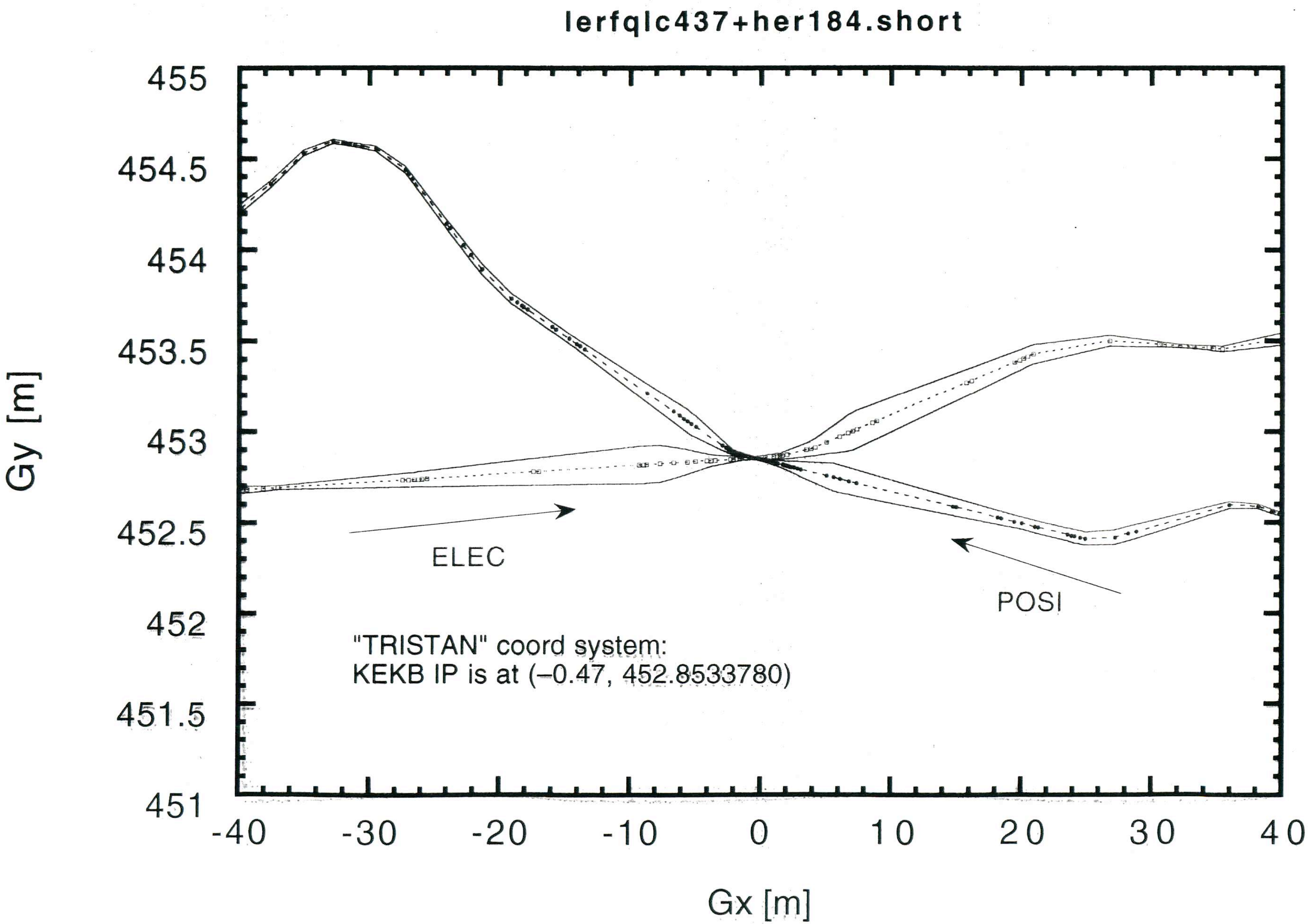
- Remaining e– final vertical focusing with QC1.

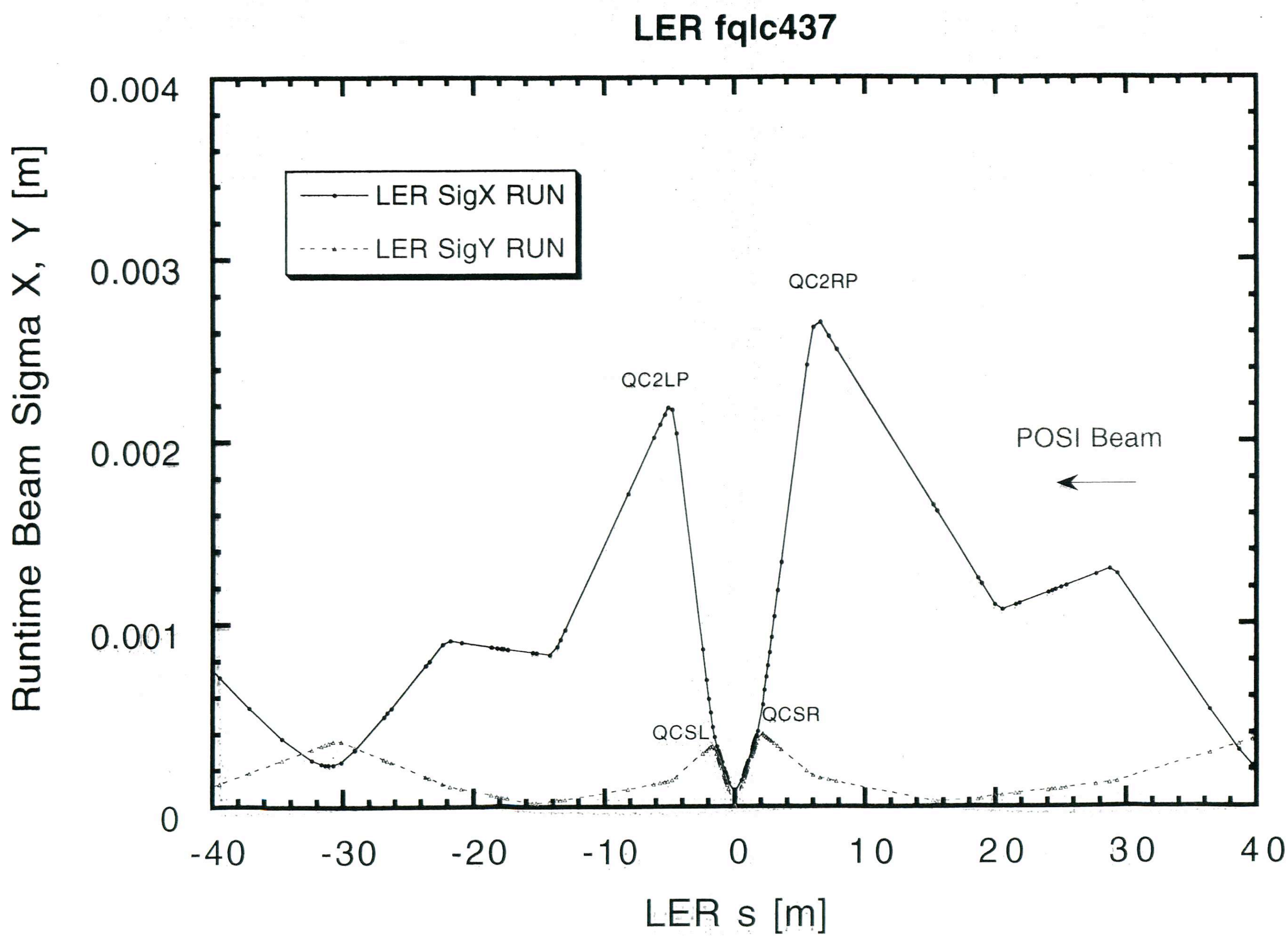
  $dB / dx = 12 \sim 14$ T/m
  $LEFF = 0.6$ m

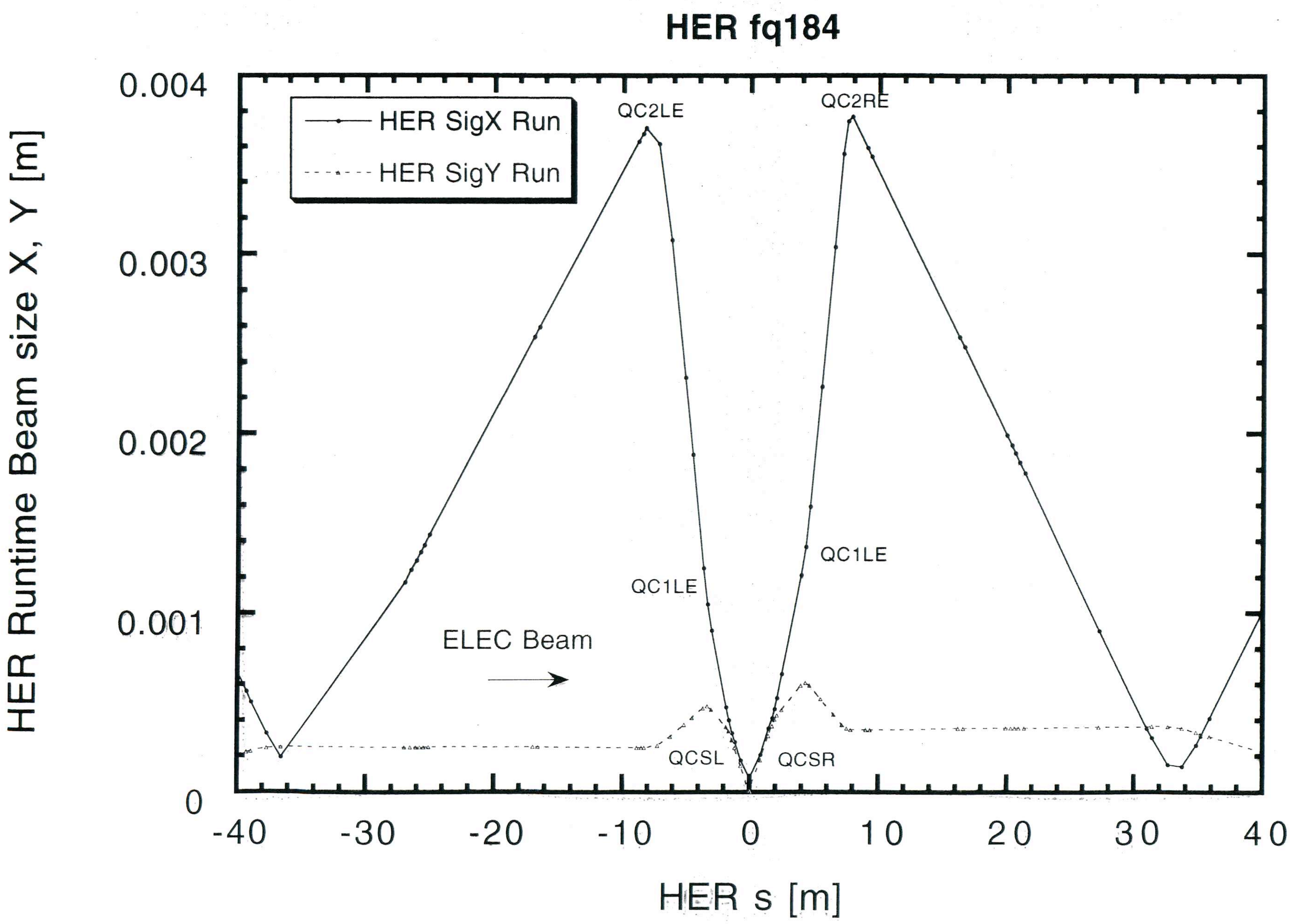
- "Septum-like" quads for separate focusing of electrons (QC1E, QC2E) and positrons (QC2P).

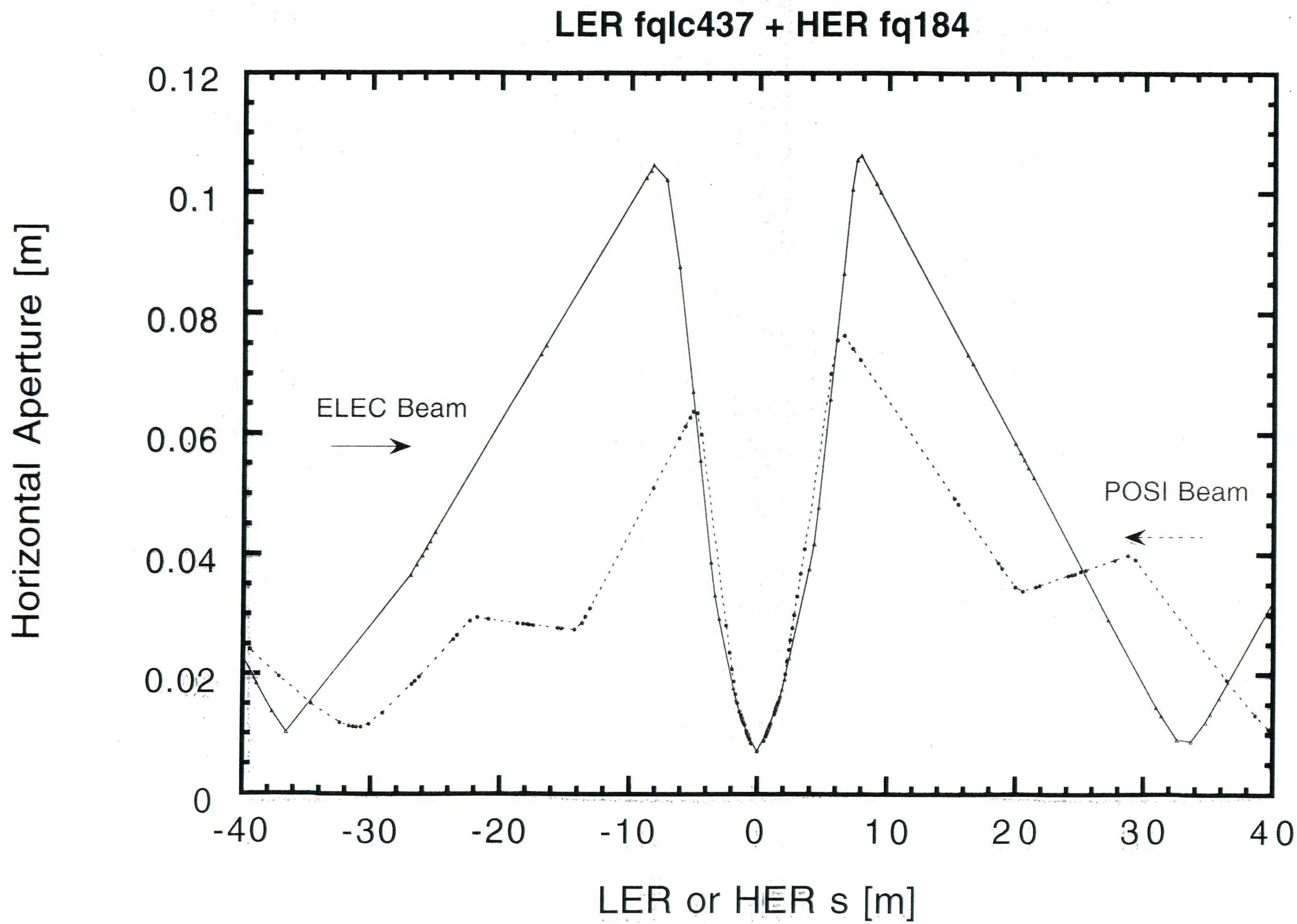


Detecter structure
boundaries
VB2PL
QC2PL
QC1ER
QC2ER
VB2ER
IP
Electron
Positron
VB2EL
QC2EL
QC1EL
QCSL
QCSR
QC2PR
0
10 m
Vertical = Expanded by x5

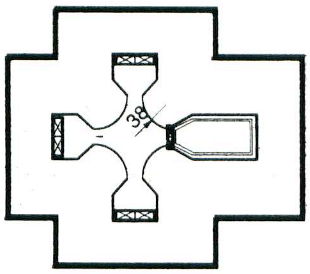

lerfqlc437+her184.short
455
454.5
454
453.5
453
452.5
452
451.5
451
-40
-30
-20
-10
0
10
20
30
40
Gy [m]
Gx [m]
ELEC
POSI
"TRISTAN" coord system:
KEKB IP is at (−0.47, 452.8533780)


LER fqlc437
Runtime Beam Sigma X, Y [m]
0.004
0.003
0.002
0.001
0
LER SigX RUN
LER SigY RUN
QC2LP
QC2RP
QCSL
QCSR
POSI Beam
-40
-30
-20
-10
0
10
20
30
40
LER s [m]

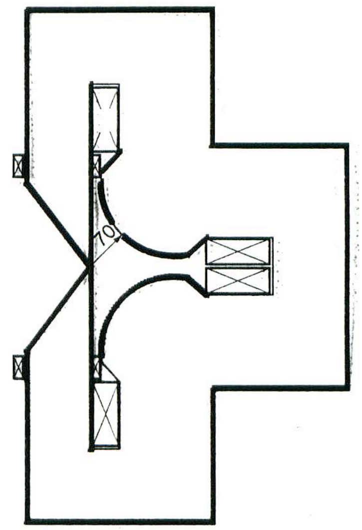

HER fq184
HER SigX Run
HER SigY Run
QC2LE
QC2RE
QC1LE
QC1LE
QCSL
QCSR
ELEC Beam
0.004
0.003
0.002
0.001
0
-40
-30
-20
-10
0
10
20
30
40
HER s [m]
HER Runtime Beam size X, Y [m]


LER fqlc437 + HER fq184
Horizontal Aperture [m]
0.12
0.1
0.08
0.06
0.04
0.02
0
-40
-30
-20
-10
0
10
20
30
40
LER or HER s [m]
ELEC Beam
POSI Beam

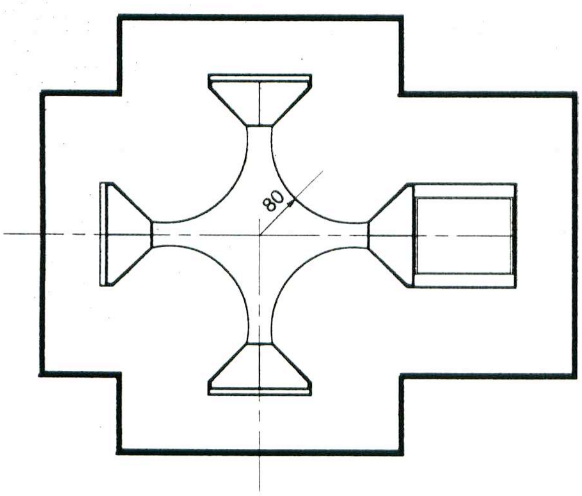
Example Cross Section of IR Special Quadrupole Magnets



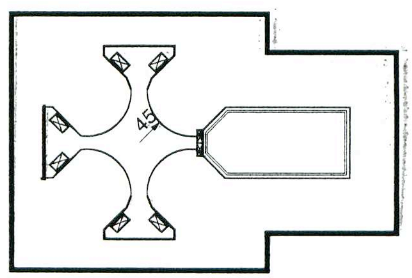
QC1E-L



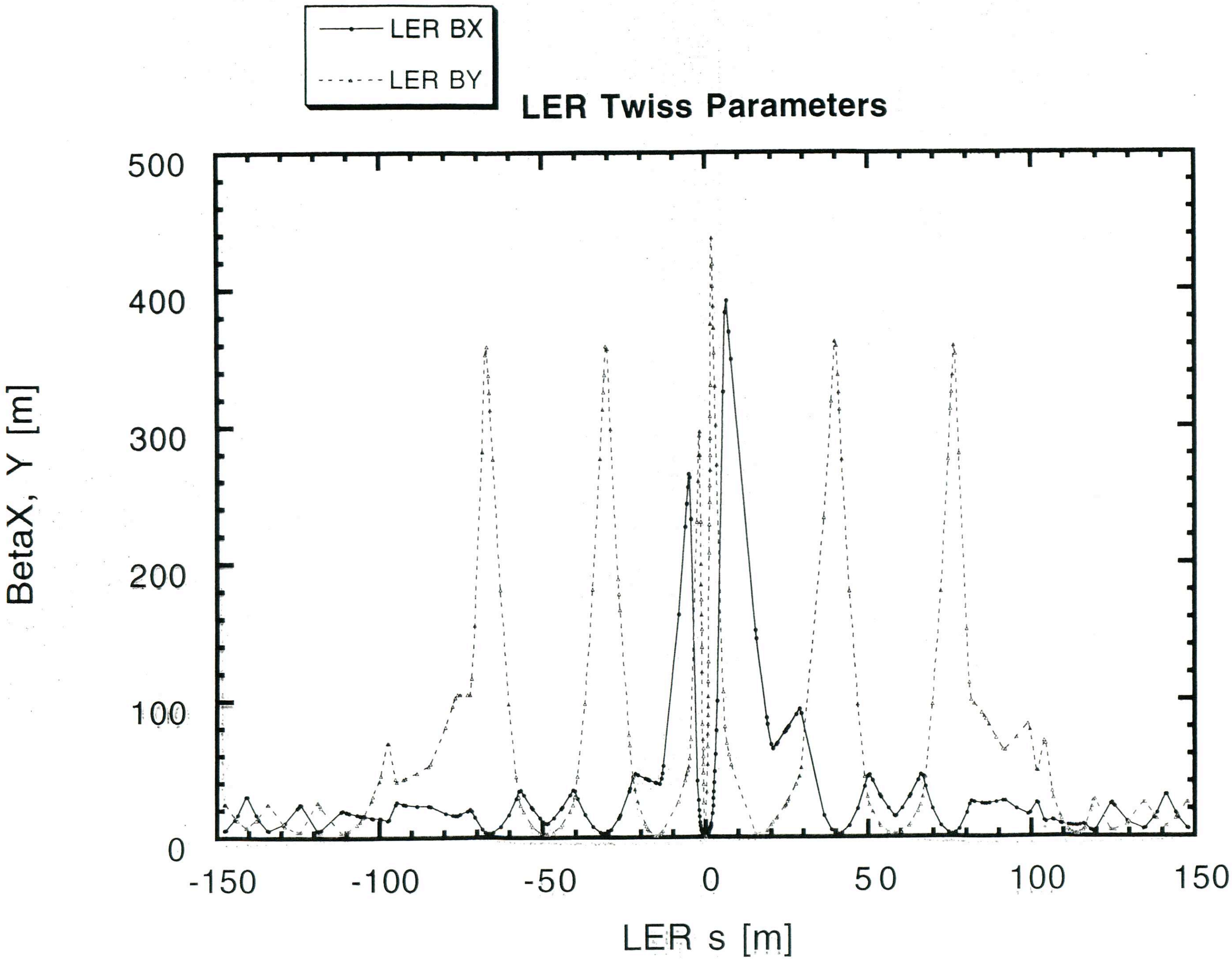
QC1E-R



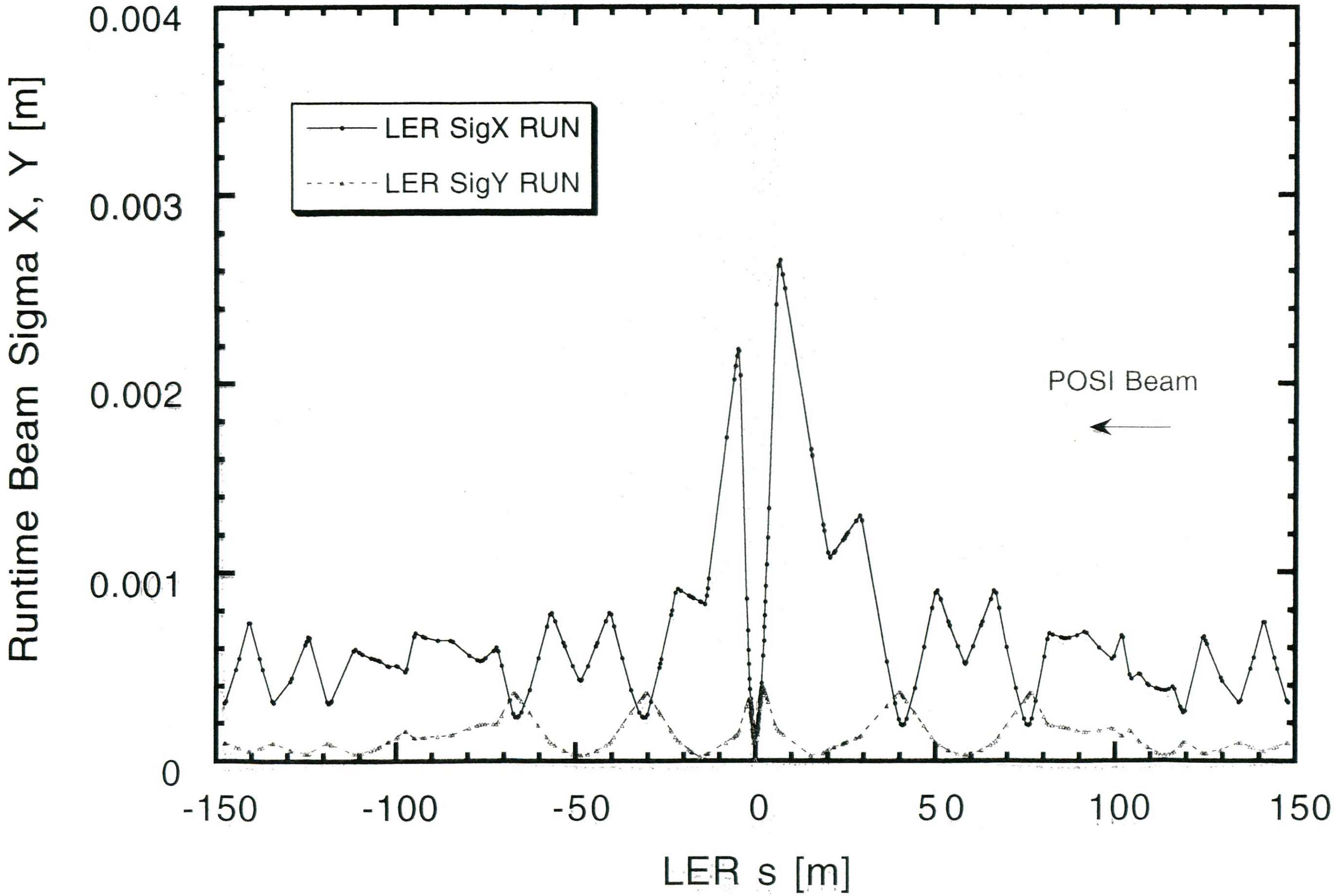
QC2E-L



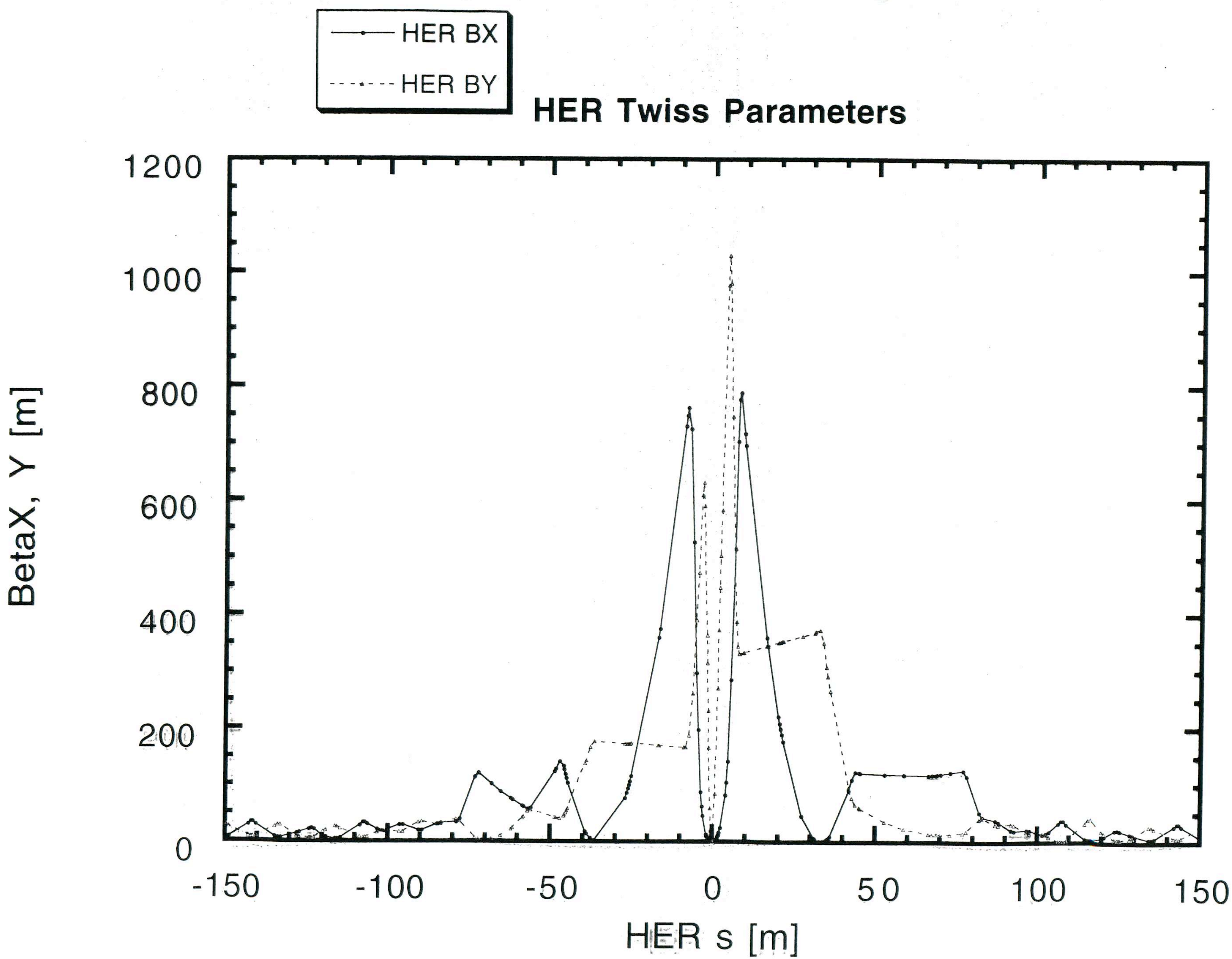
QC2P-R

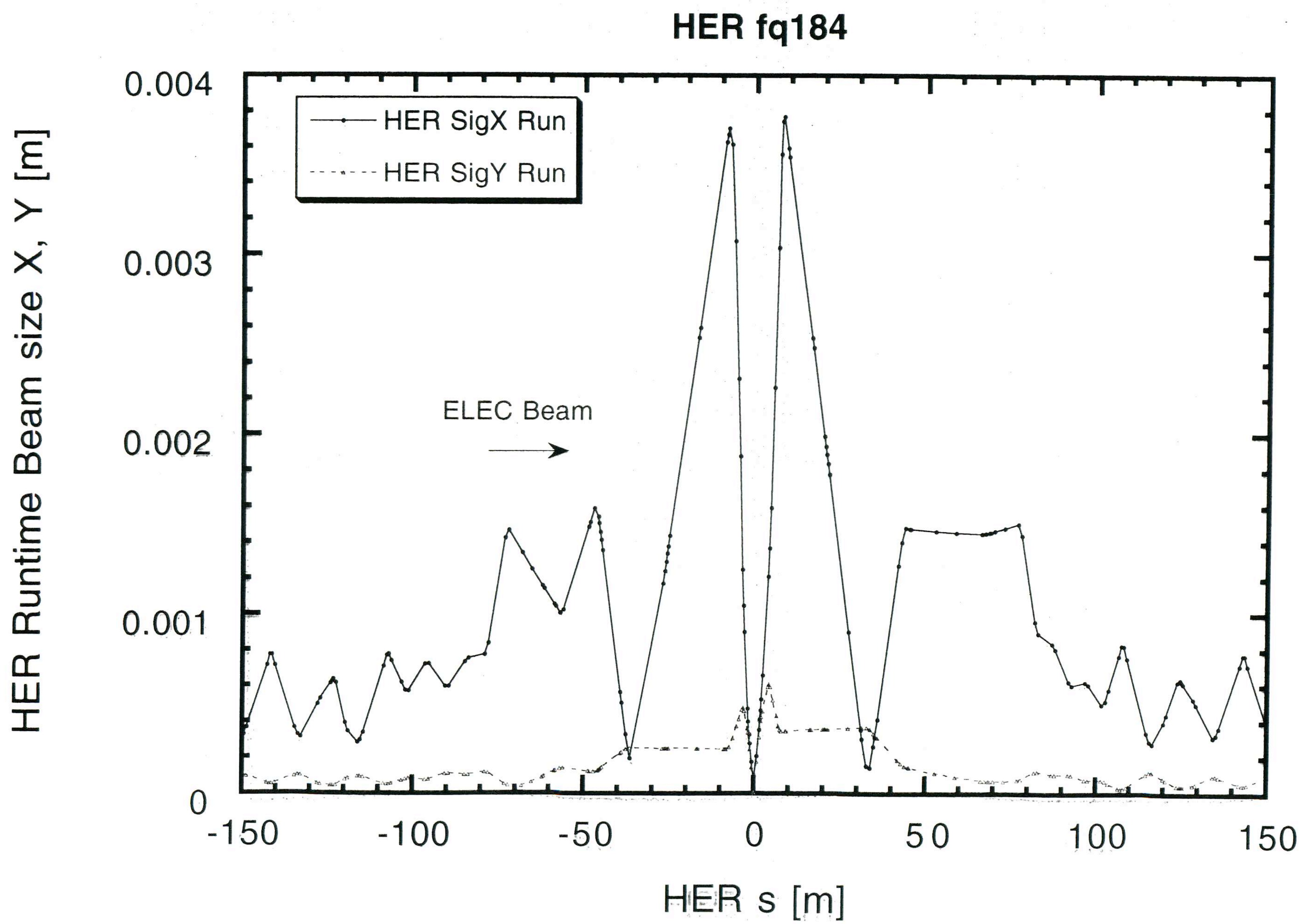

LER BX
LER BY
LER Twiss Parameters
BetaX, Y [m]
500
400
300
200
100
0
-150
-100
-50
0
50
100
150
LER s [m]

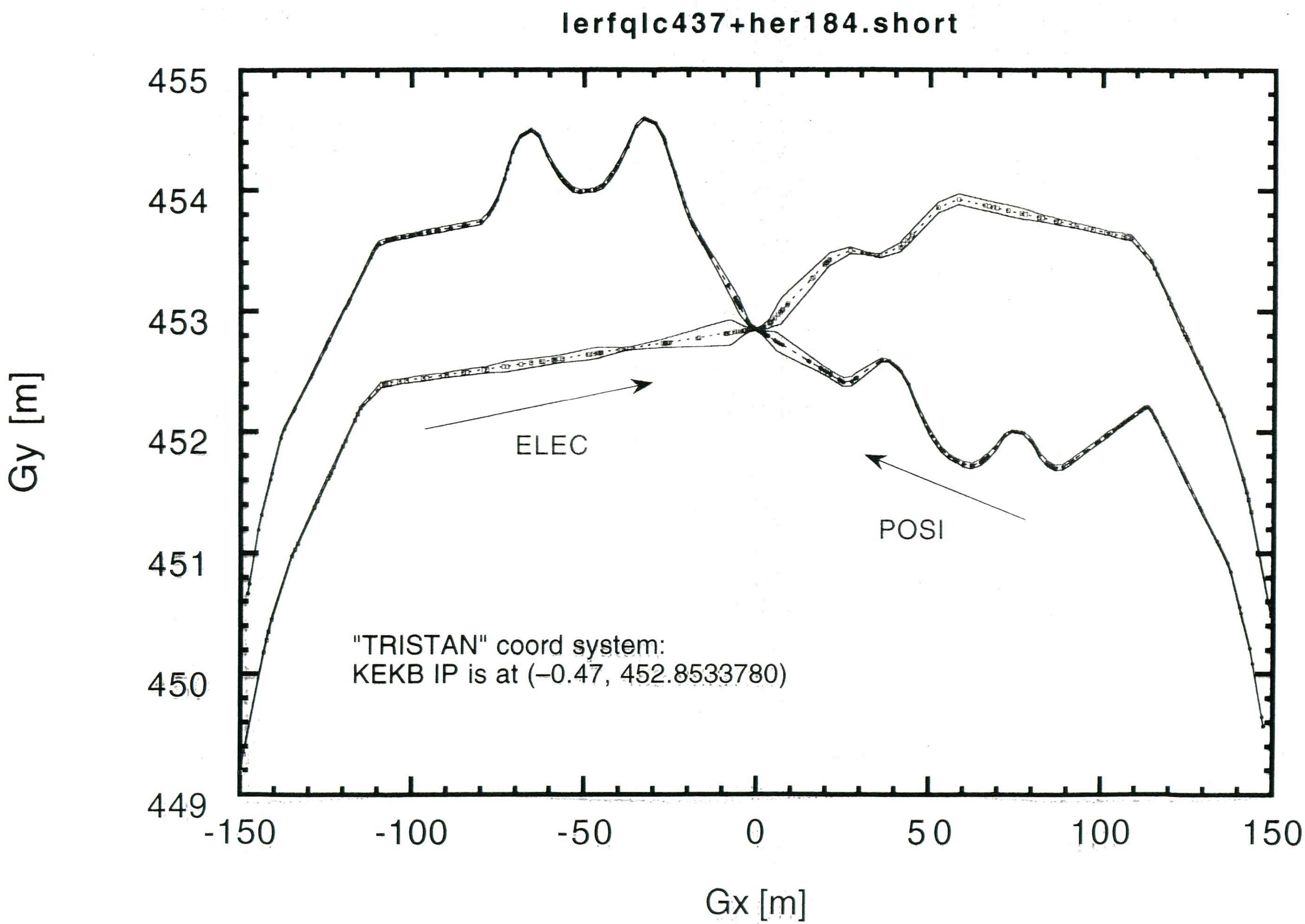
LER fqlc437



LER SigX RUN
LER SigY RUN
POSI Beam
Runtime Beam Sigma X, Y [m]
0.004
0.003
0.002
0.001
0
-150
-100
-50
0
50
100
150
LER s [m]


HER BX
HER BY
HER Twiss Parameters
1200
1000
800
600
400
200
0
-150
-100
-50
0
50
100
150
BetaX, Y [m]
HER s [m]


HER fq184
HER SigX Run
HER SigY Run
ELEC Beam
0.004
0.003
0.002
0.001
0
-150
-100
-50
0
50
100
150
HER Runtime Beam size X, Y [m]
HER s [m]


lerfqlc437+her184.short
455
454
453
452
451
450
449
-150
-100
-50
0
50
100
150
Gy [m]
Gx [m]
ELEC
POSI
"TRISTAN" coord system:
KEKB IP is at (−0.47, 452.8533780)

3. *Beam-Beam Interaction (Reminder)*

1. LCPAC95

- Luminosity optimization with nominal linear lattice.
  (νx, νy, νs) = (0.52, 0.08, < 0.02)

- Weak-strong simulation (WS)

2. Design Report (KEK 95-7)

- Luminosity evaluation with non-linear lattice (WS)

- Quasi-Strong-Strong simulation with linear lattice.

- Simulate development of beam tails with linear lattice using a brute-force method (WS)

3. Work since then

- Evaluated tail development, more brute-force calculations (21 slices) (WS)

- Comparison with Piwinski's algorithm

- Evaluated tail development with lattice calc including non-linear magnetic effects in brute-force method (WS)

BELLE demands $<10^{-5}$ particles at $> 10\sigma_x$, $30\sigma_y$

No symptoms of disasters.

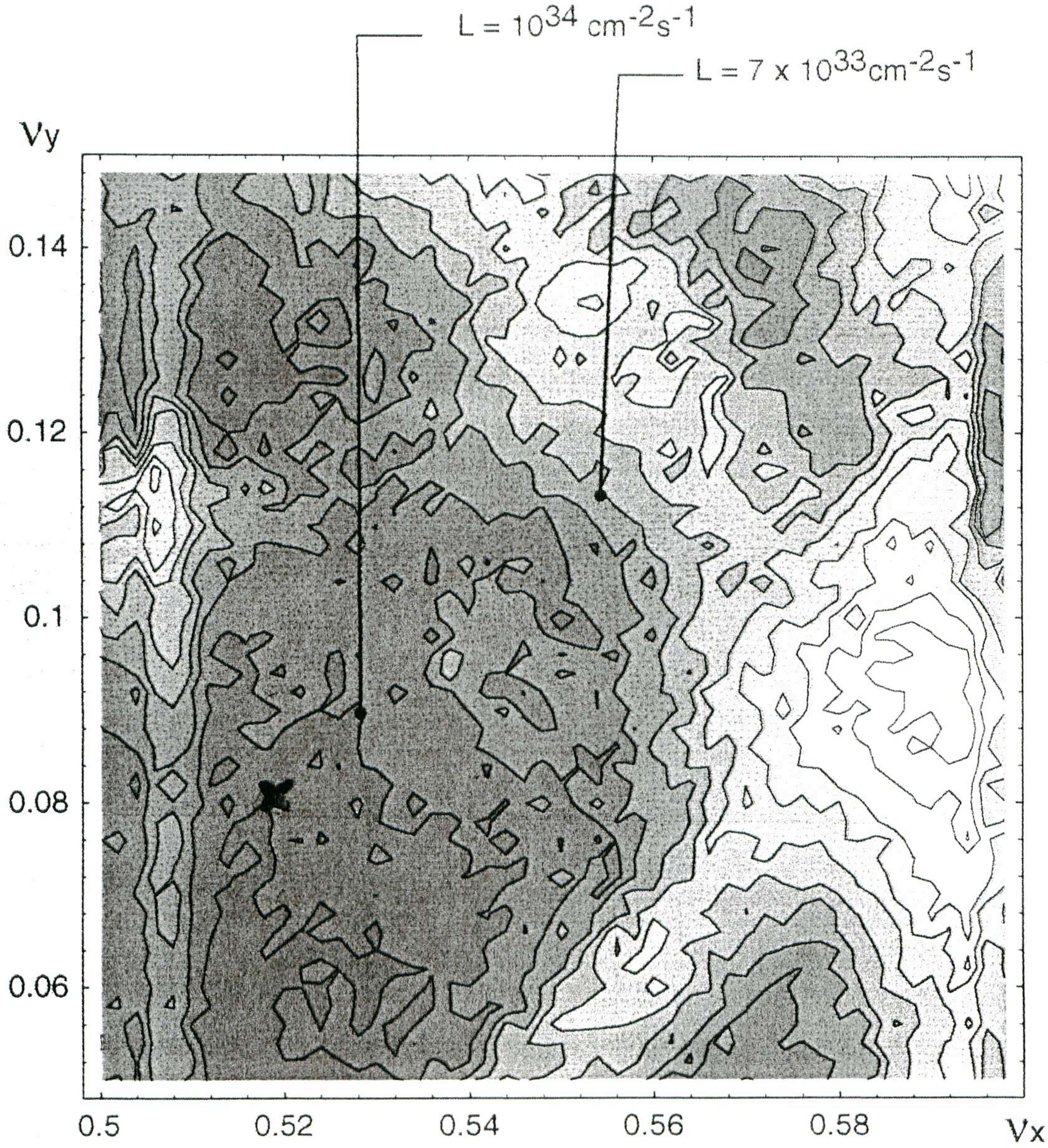


Figure 3: Luminosity evaluated as a function of (ν_x, ν_y).

2.3 Beam-Beam Tail

Maximum Amplitude

- The maximum amplitude might indicate the amount of the tail formation
- but no proof for it
- no simple and reliable way

Long term tracking

tracking 50 super particles $\times$ 10^8 turns of revolution.

$$\simeq \begin{cases} \text{1000 seconds for 50 particles} \\ \text{14 hours for a single particle} \end{cases}$$

$$I_x = \frac{1}{2}\left[x^2/(\sigma_x)^2 + p_x^2/(\sigma_{p_x})^2\right]$$

$$I_y = \frac{1}{2}\left[y^2/(\sigma_y)^2 + p_y^2/(\sigma_{p_y})^2\right].$$

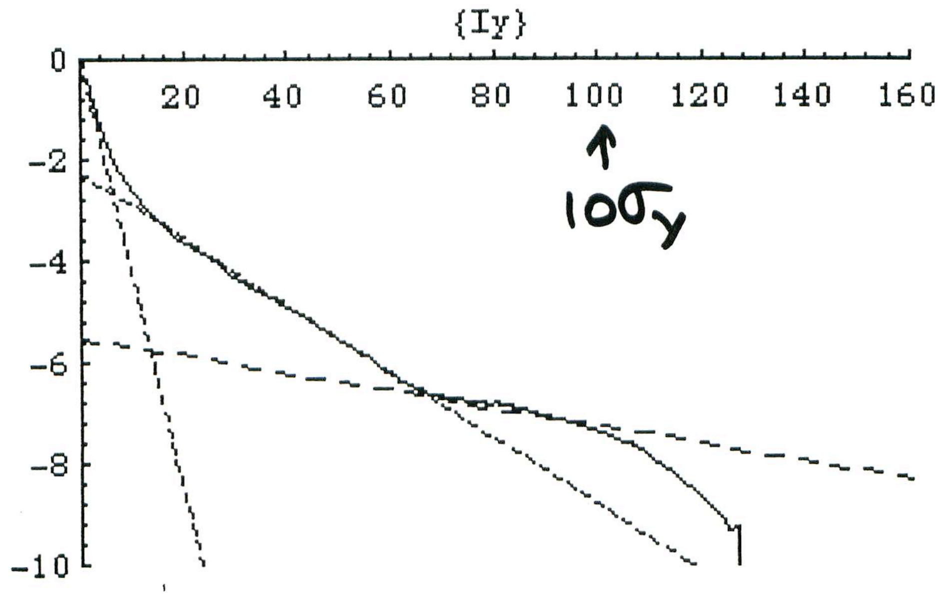
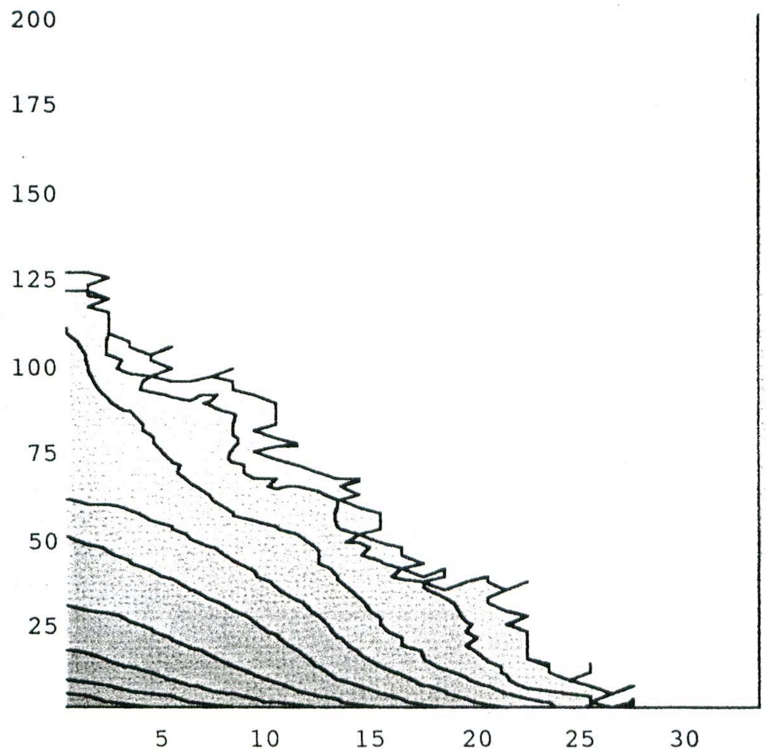
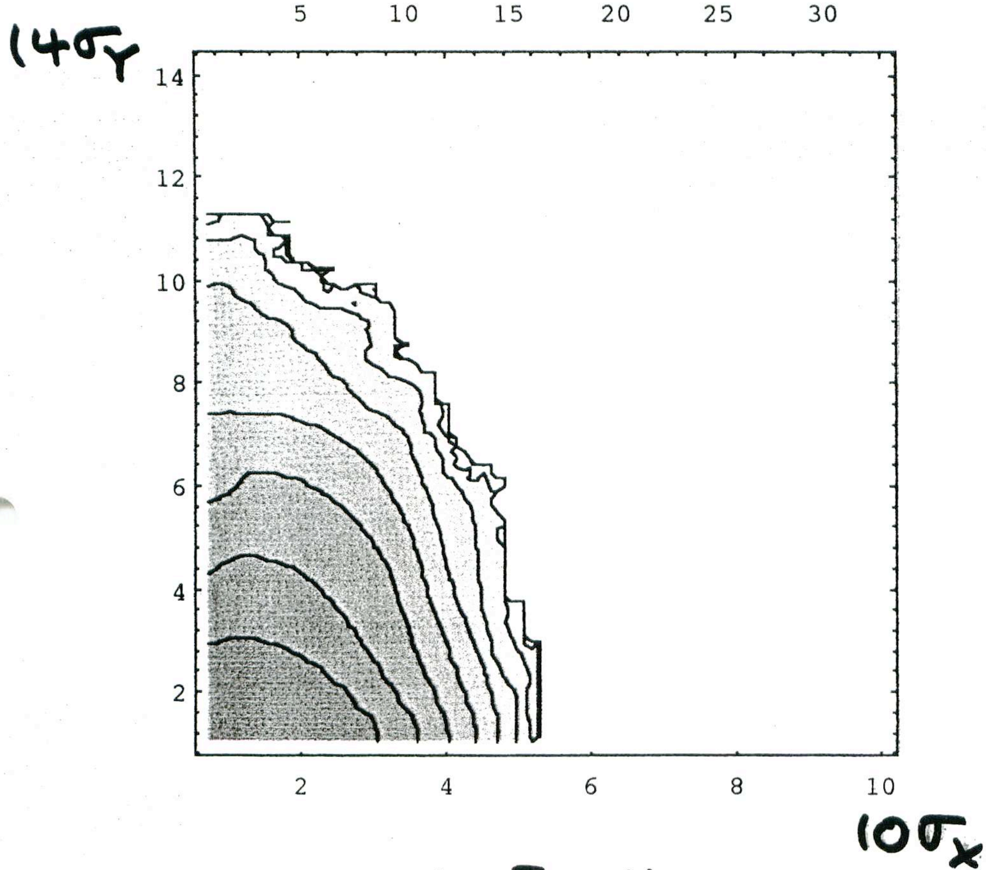
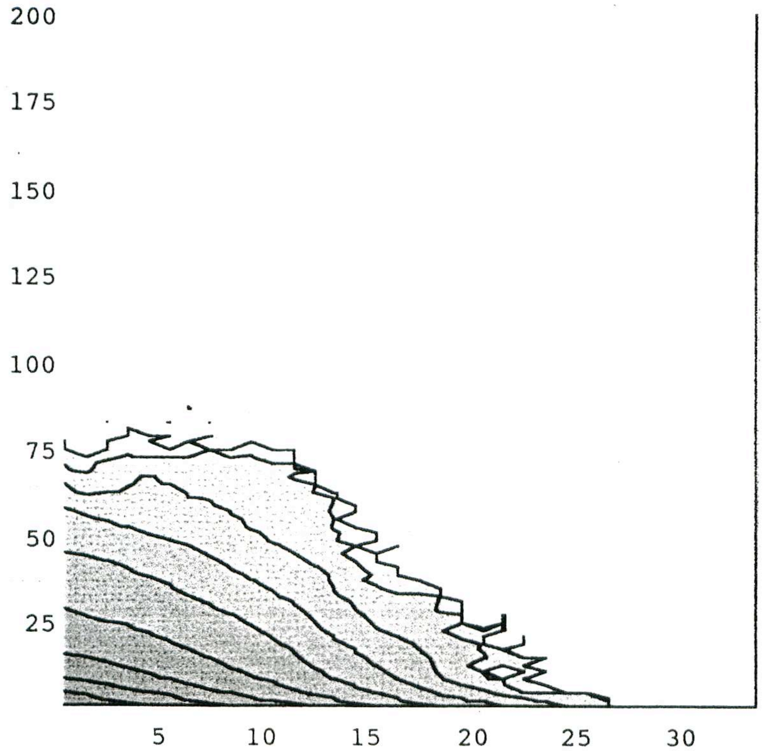


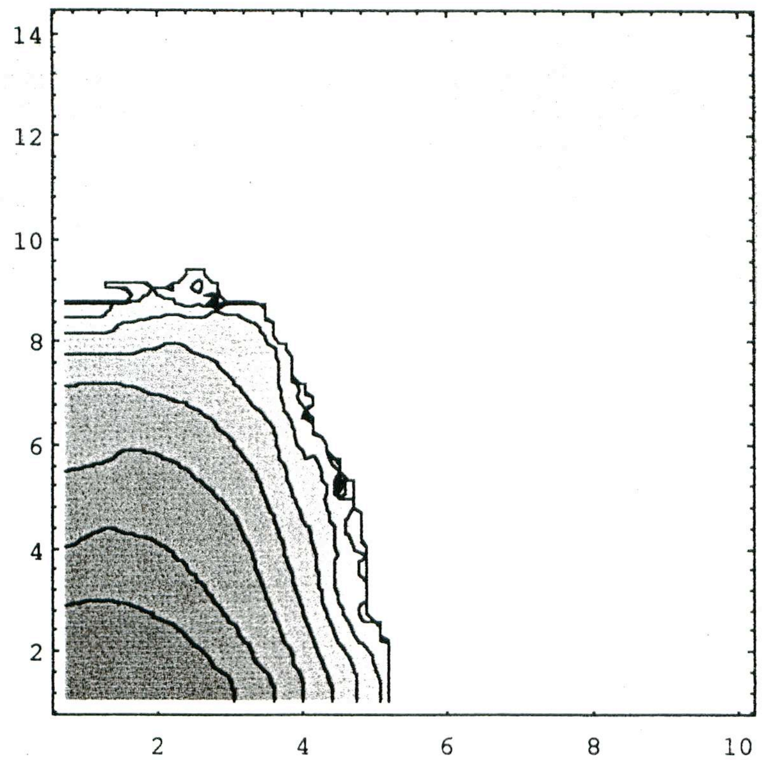
Figure 6: $\log_{10}(\rho(I_y))$ for the ideal linear lattice. $\int I_y \rho(I_y) = 1$.





Tail with 5 slices





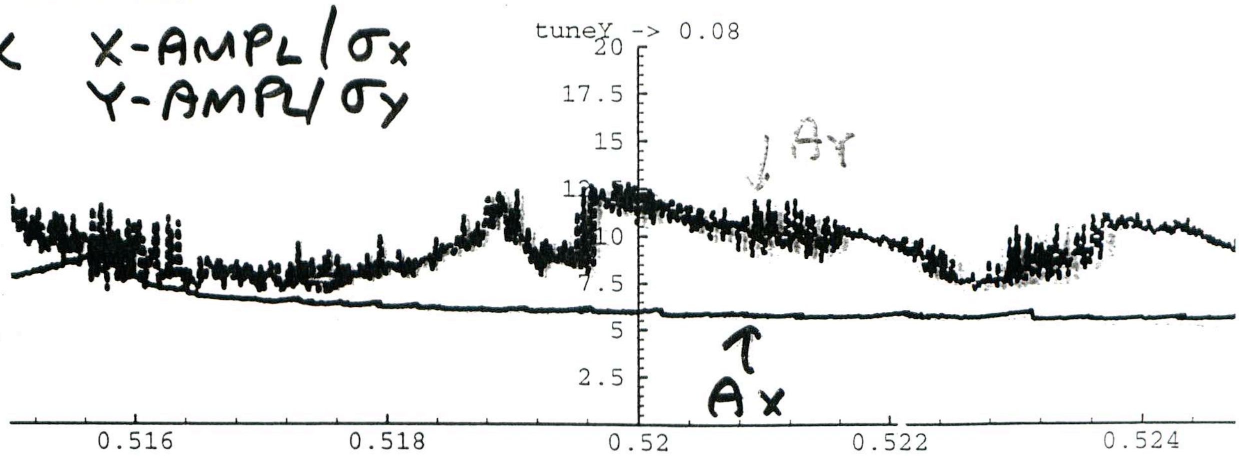
Tail with 21 Slices

$\nu_Y = 0.08$ FIXED

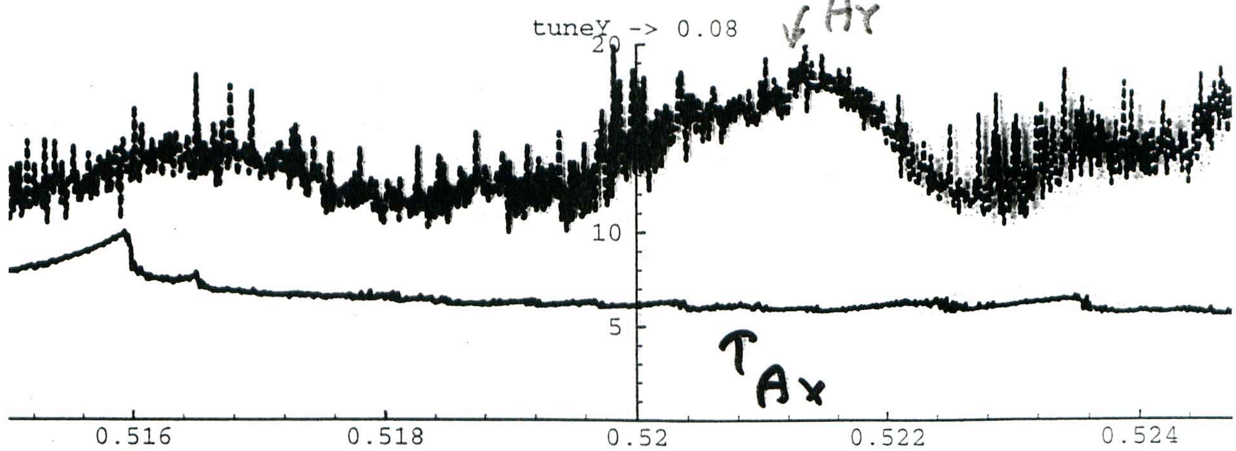
■ **200 particles on (6,6,6) 1000 turn 1000 steps (every 0.00001)**

Piwinski's Map

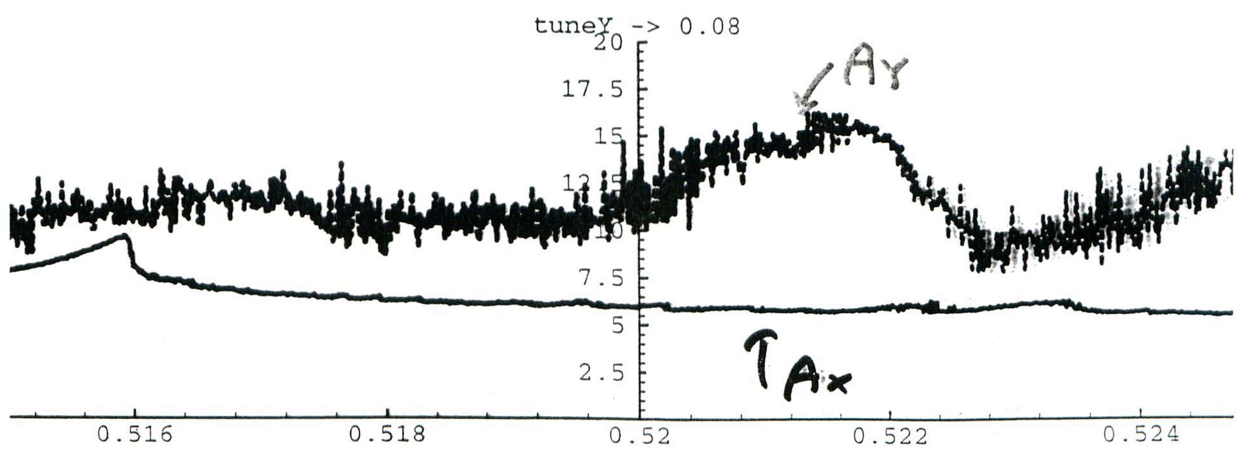
MAX X-AMPL/σ_x
Y-AMPL/σ_y



SB+Boost (1 slice)



SB+Boost (5 slice)



→ ν_x
(0.515-0.525)

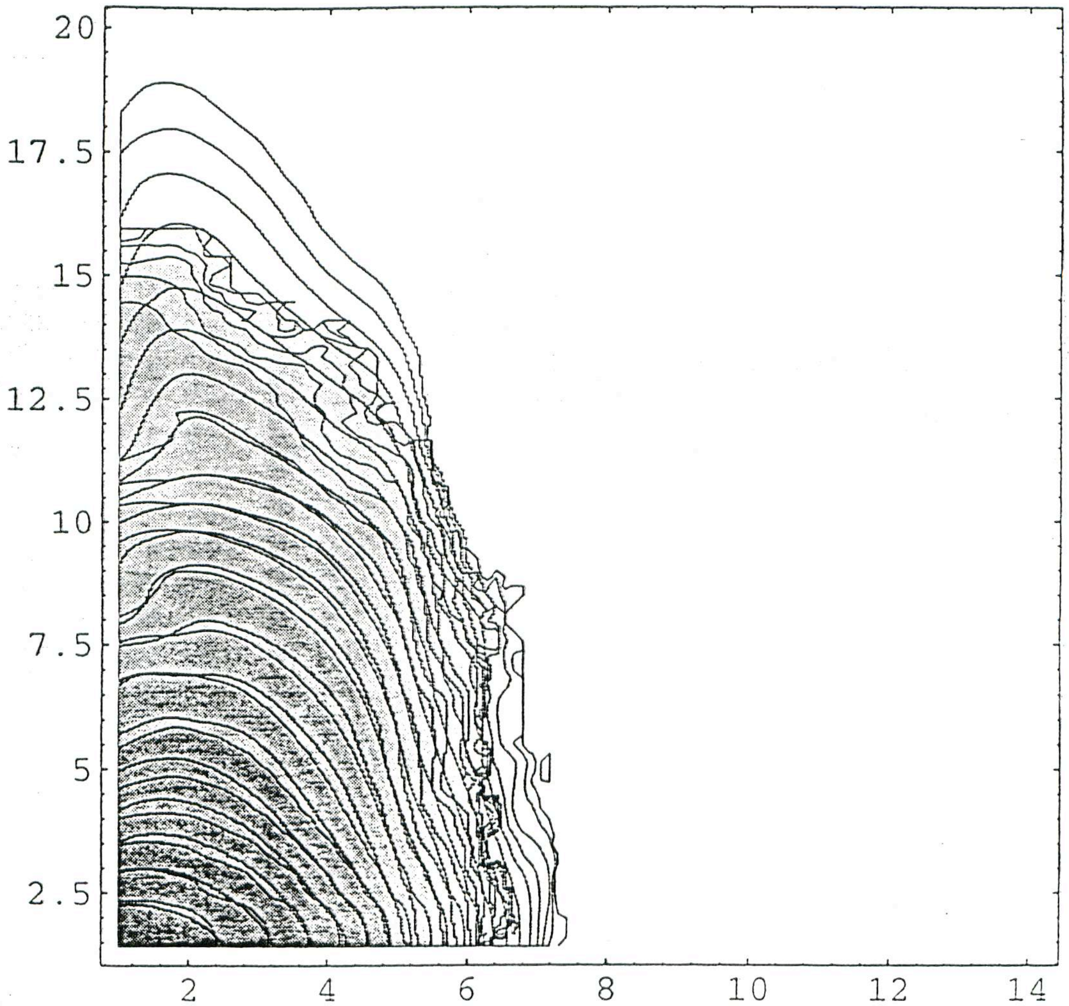
- **Tail Simulations with conserved-CPU Algorithm "LIFETRAC" (D.Satilov, KEK Report 96-14)**

ref. Particle Accelerators, **52**, p.65 (1996)

Similar to J.Irwin, T.Chen, R.Siemann

Assume linear lattice

Just many, many particle-turns



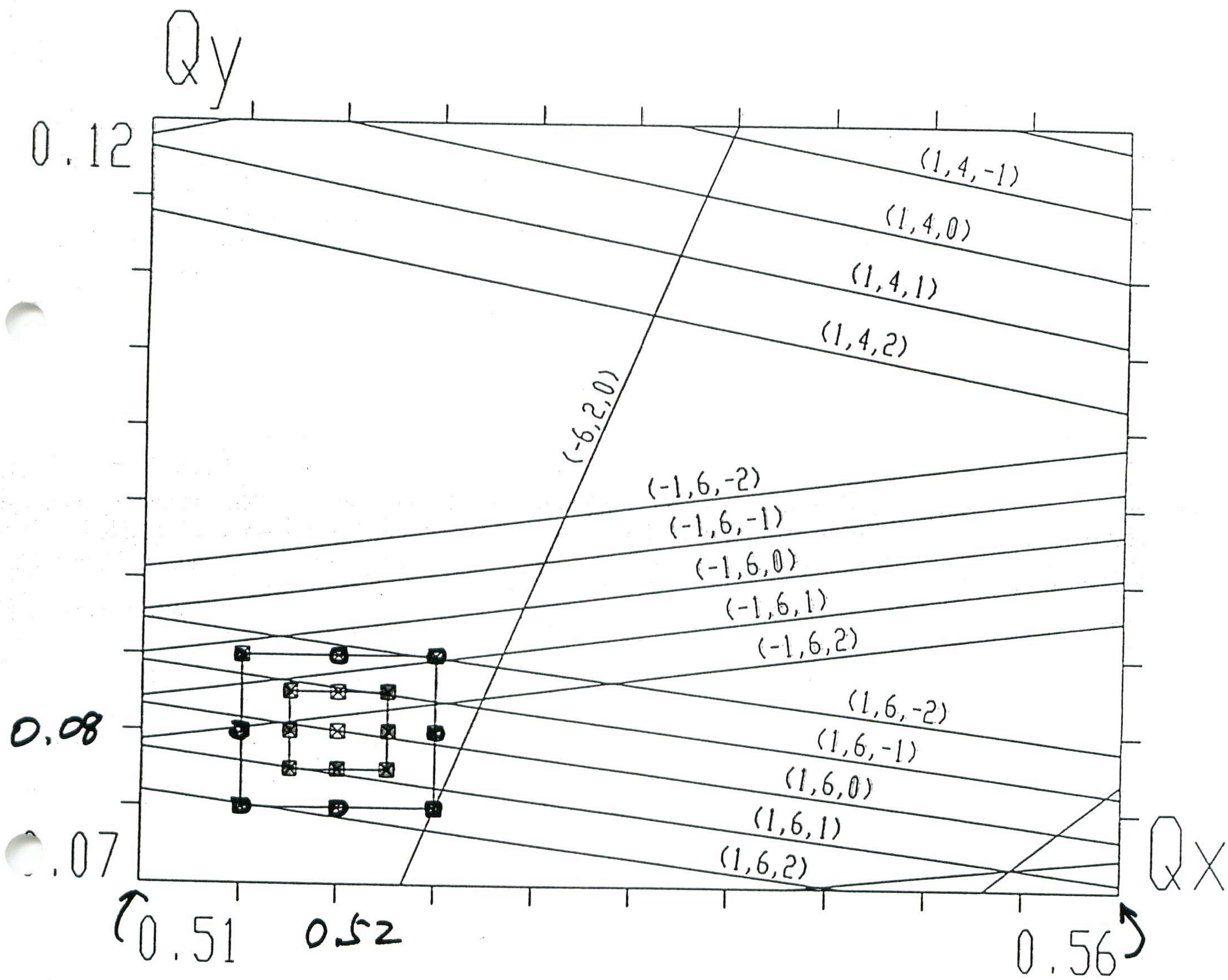
Shaded: Hirata's BBC (5E9 particle-turns)

Contour: LINFETRAC (1E13 particle-turns)

Contour levels: ratio by 2.718

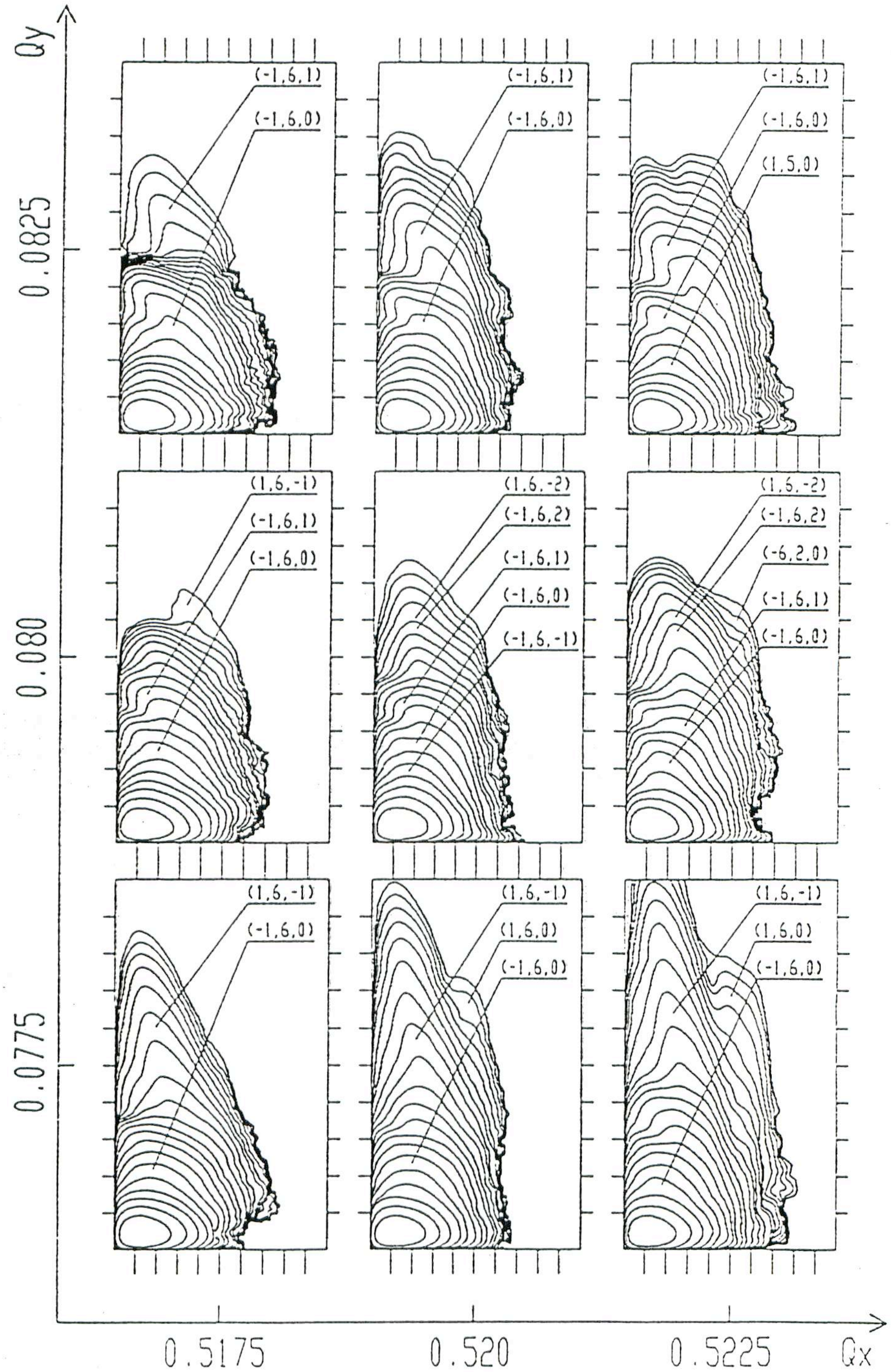
■ "Tune-scan" with LINFETRAC

Tested working points around the canonical (0.52, 0.08)



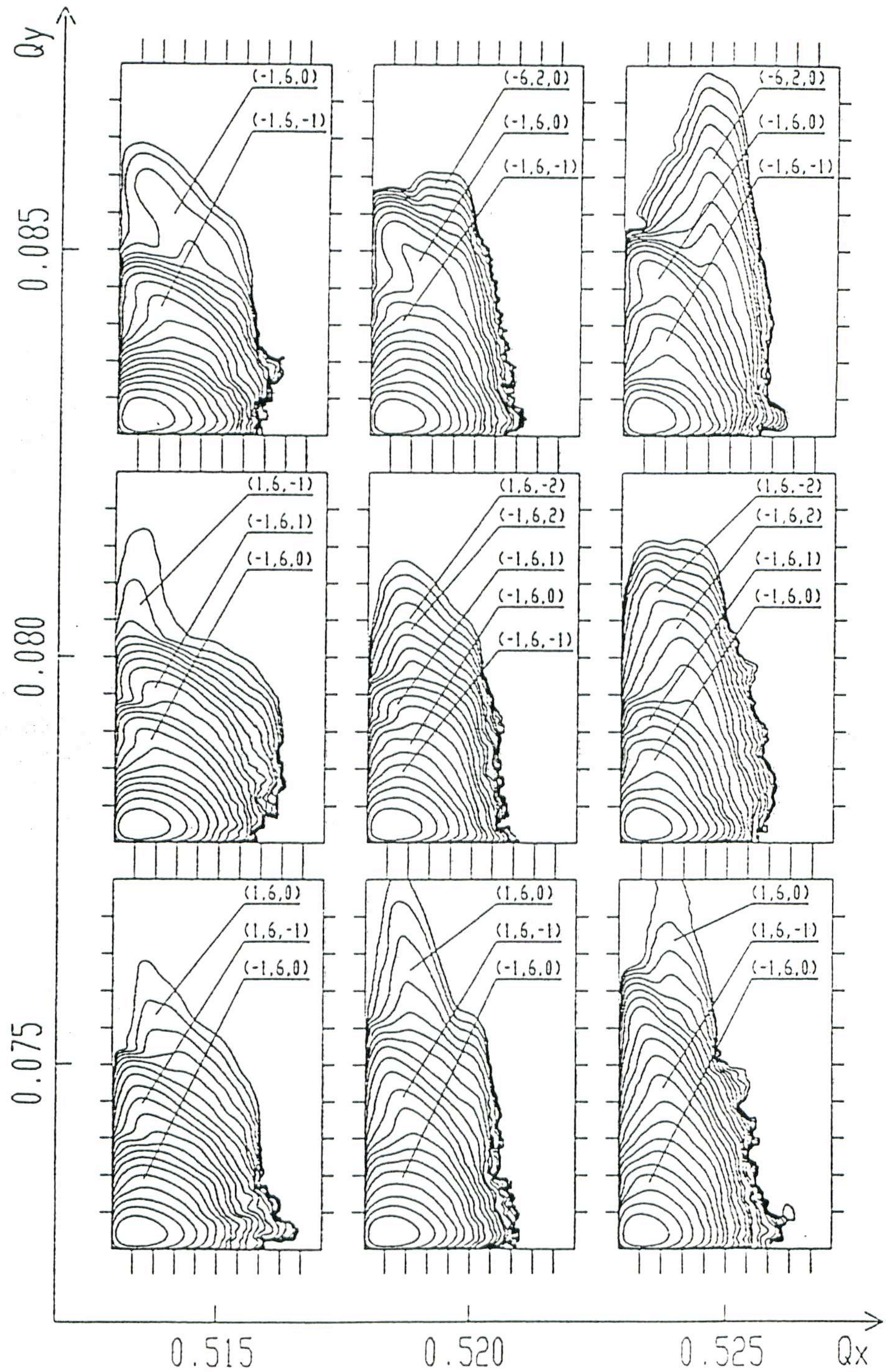
Resonace lines: l Qx + m Qy + n Qz = k are shown as (l, m, n)

"ORANGE" SPOTS



Contour plots ($10\sigma_x$, $25\sigma_y$) for working points shifted by 0.0025 from (0.52, 0.08)

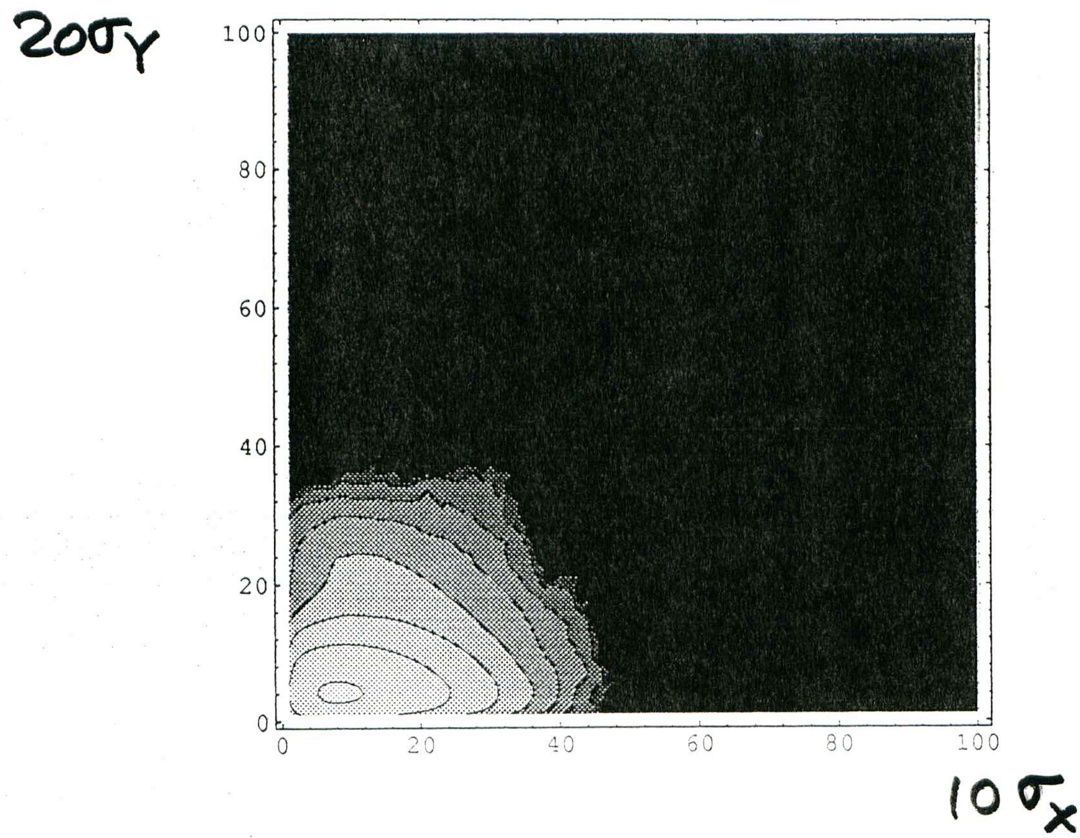
"GREEN" SPOTS



Contour plots ($10\sigma_x$, $25\sigma_y$) for working points shifted by 0.005 from (0.52, 0.08)

In[5]:=

```
Show[ContourGraphics[%]];
```



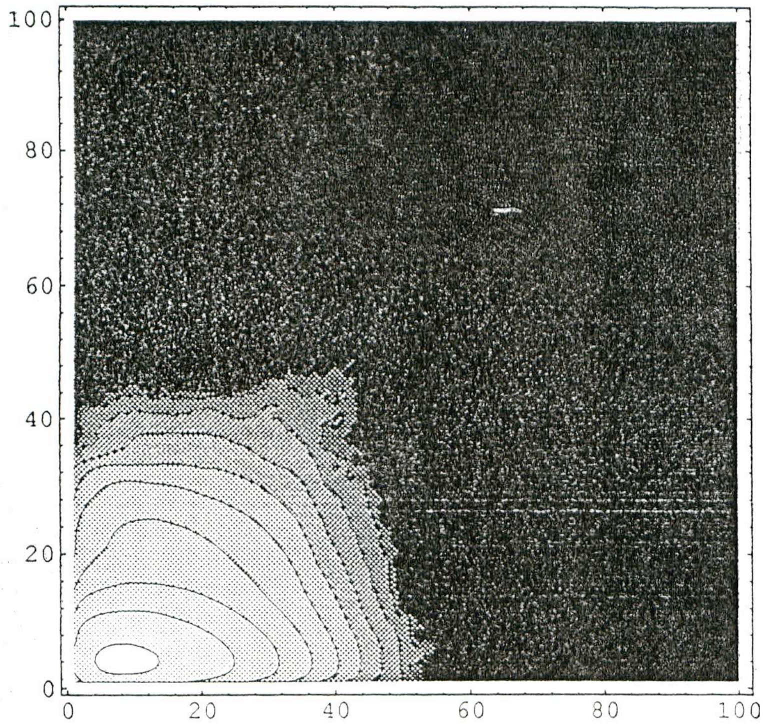
N= 1000
2×10^5 TURNS
LINEAR LATTICE

N = 1000
2×10^5 TURN
LINEAR

In[53]:=

```
Show[ContourGraphics[%]];
```

20 σ_y



10 σ_x

N = 100

1.6×10^8 Turn

Linear Lattice

In[27]:=

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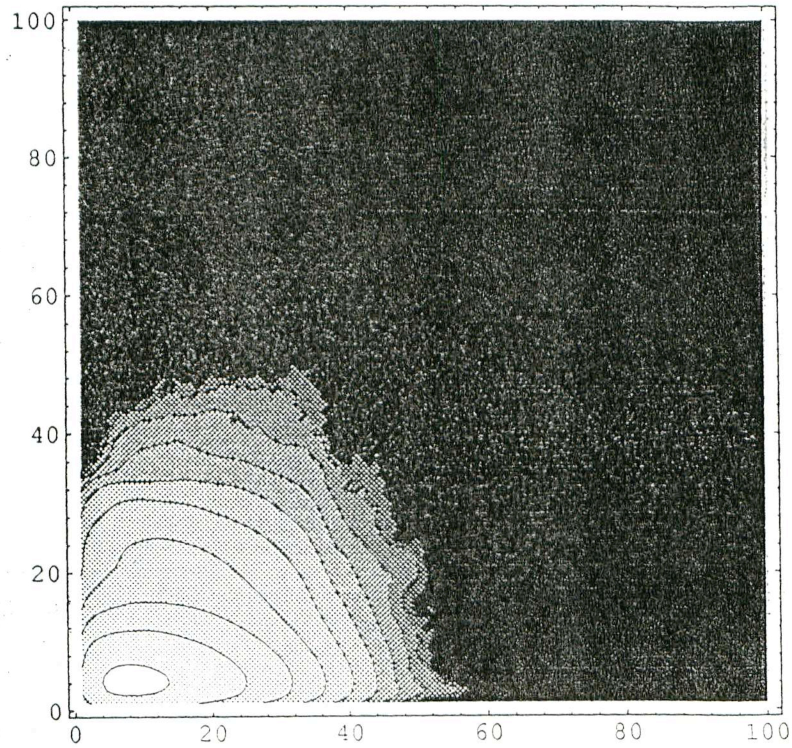
Show[ContourGraphics[%]];
```



N = 1000

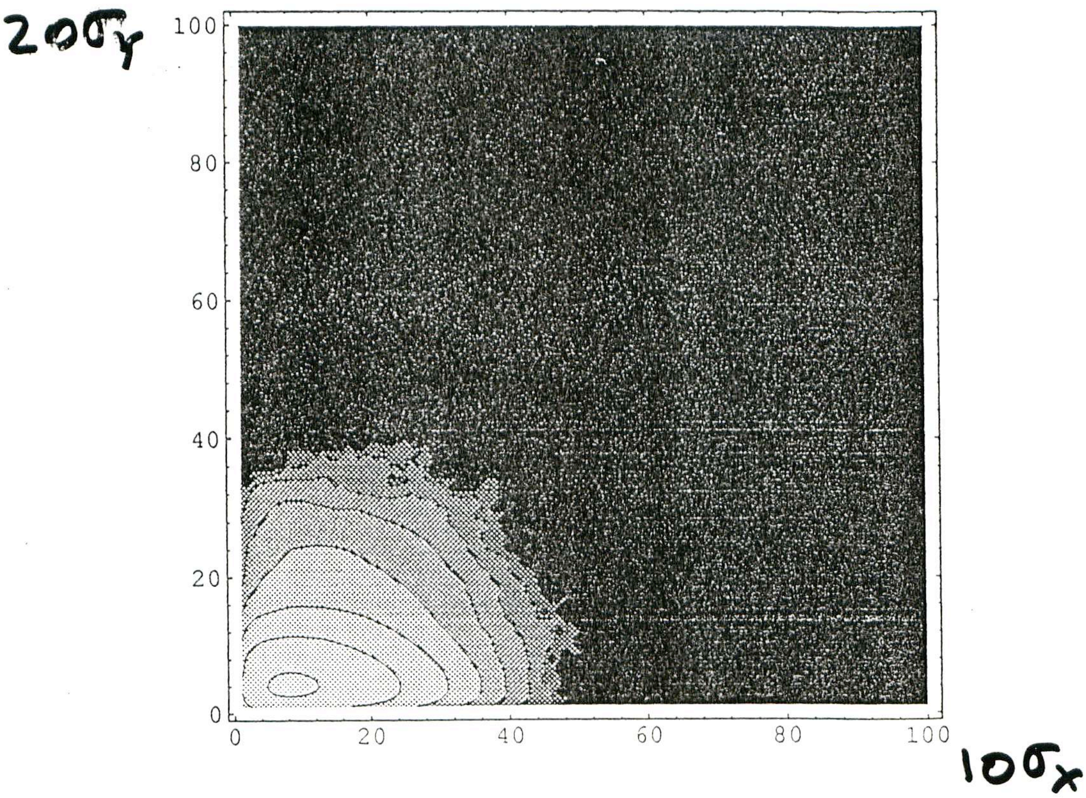
1.6×10^7 Turn

Linear Lattice

particle × turn is identical

[many particles with less #
of turns] is good for parallel
processor

```
Show[ContourGraphics[%]];
```

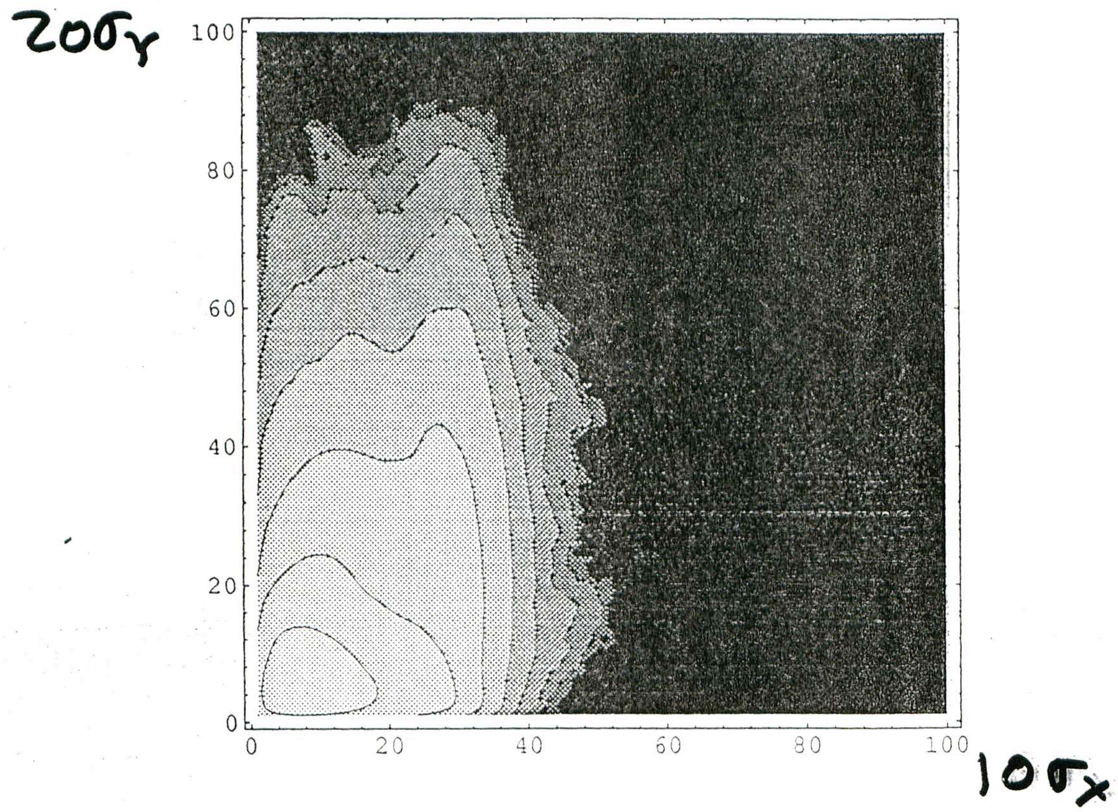


N = 1000

2×10^5 turn

<u>nonlinear</u> lattice (~30h)

In[58]:=
```
Show[ContourGraphics[%]];
```



Bad Tunes (0.56, 0.08)

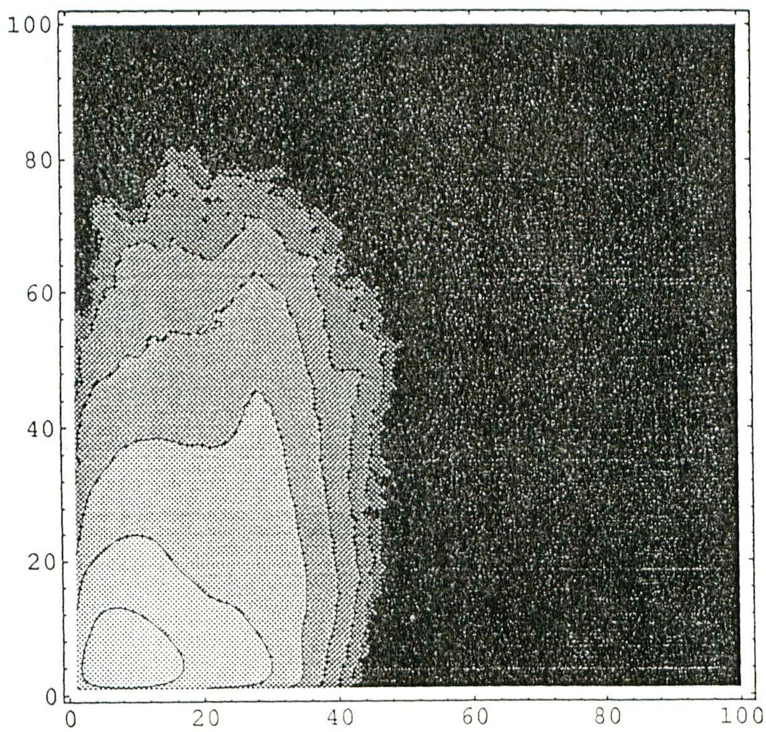
N = 1000

10^6 turn

Linear Lattice

In[72]:=

```
Show[ContourGraphics[%]];
```



Bad Tunes

N = 1000

10^5 turn

nonlinear Lattice

4. Accelerator Component Support in the Exp Hall

1. What magnets do we have?

- QCS cryostat (~ 1.5 t / side)
  QC1E, QC2E, QC2P (~ 4.0 t / RIGHT side)
  (~ 5.6 t / LEFT side)

2. Magnetic forces to hold

- Axial direction ~ 25 kN due to Bz-Bz interaction on the compensation solenoid

3. Radiation Shield in the Exp Hall

- Act according to radiation safety rules for people working in the hall during run and KEK's self-imposed guidelines for radiation level at site boundaries.

- Concrete bridges and shield blocks: 75 cm thick.

- Top part of the shield bridge will accommodate the cantilever support of QCS + QC1 + QC2 (no other big magnets in the exp hall).

4. Support of QCS + QC1 + QC2

- Cantilever-style support. Retractable (4m in Z) moveable table to allow smooth roll-in / out of BELLE detector facility.

- The design permits BELLE end-plates to open and ECsI and ECAL be serviced without retractig the cantilever.

  Only the radiation shield covers need to be retracted somewhat in that case,

- "Moveable support" + "QCS support":
  total weight = t / side (without load)

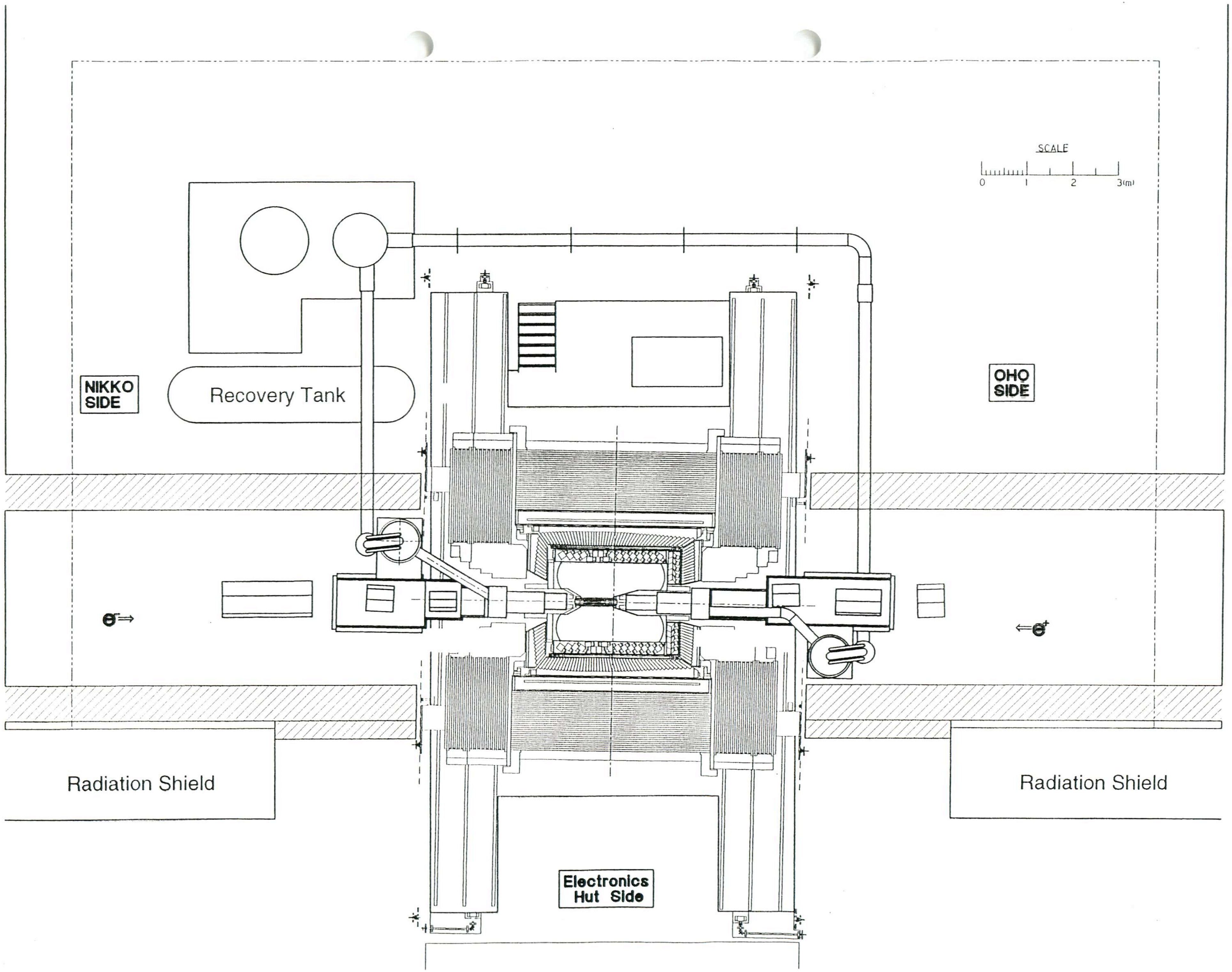
- Gravitational sag of the inner end of QCS is estimated to be < 0.2 mm.

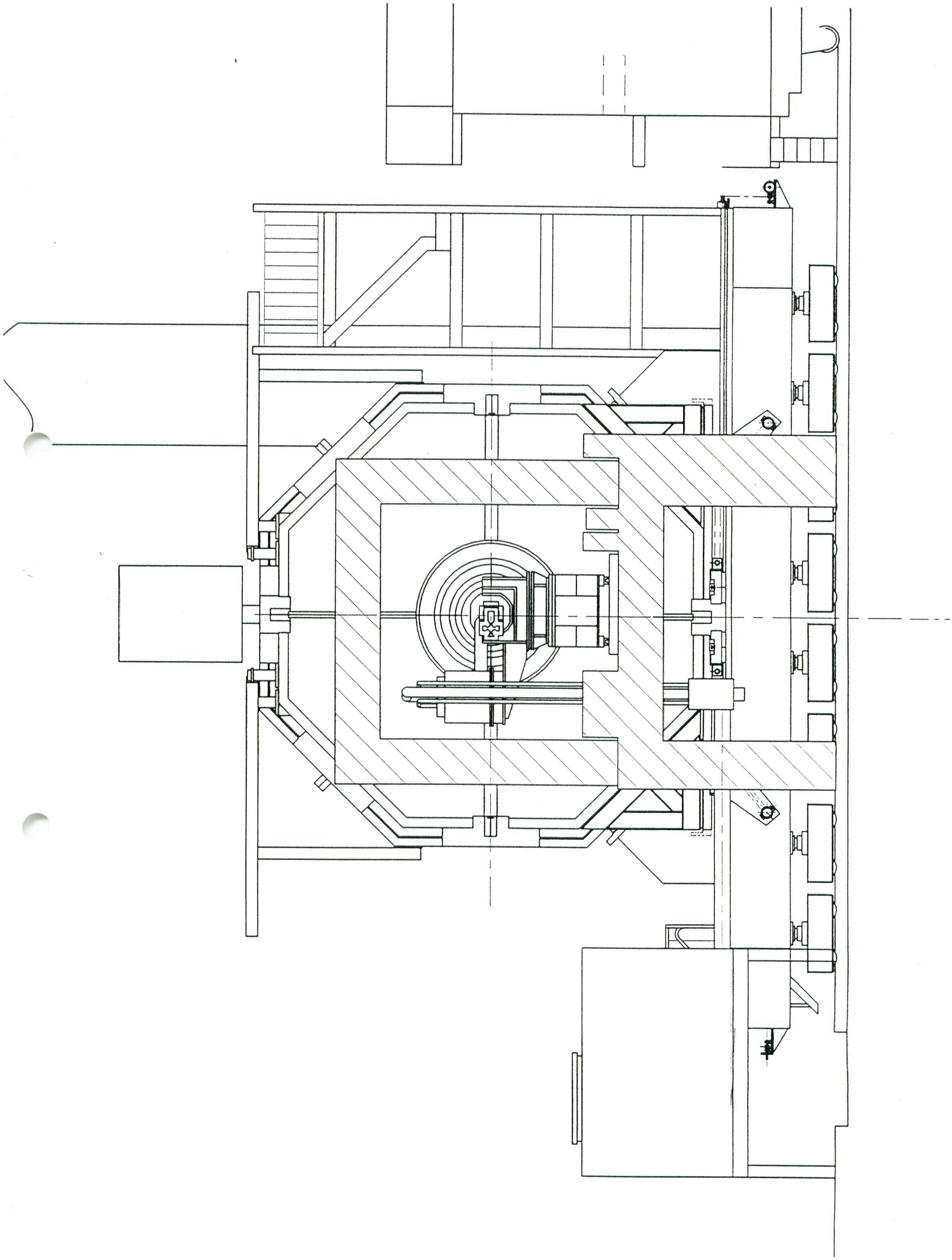
5. Notes

- No QCS magnet movers. Its position alignment is done by adjusting the support stage jacks. Finer adjustments are done by correction coil winding (eqv. a few mm).

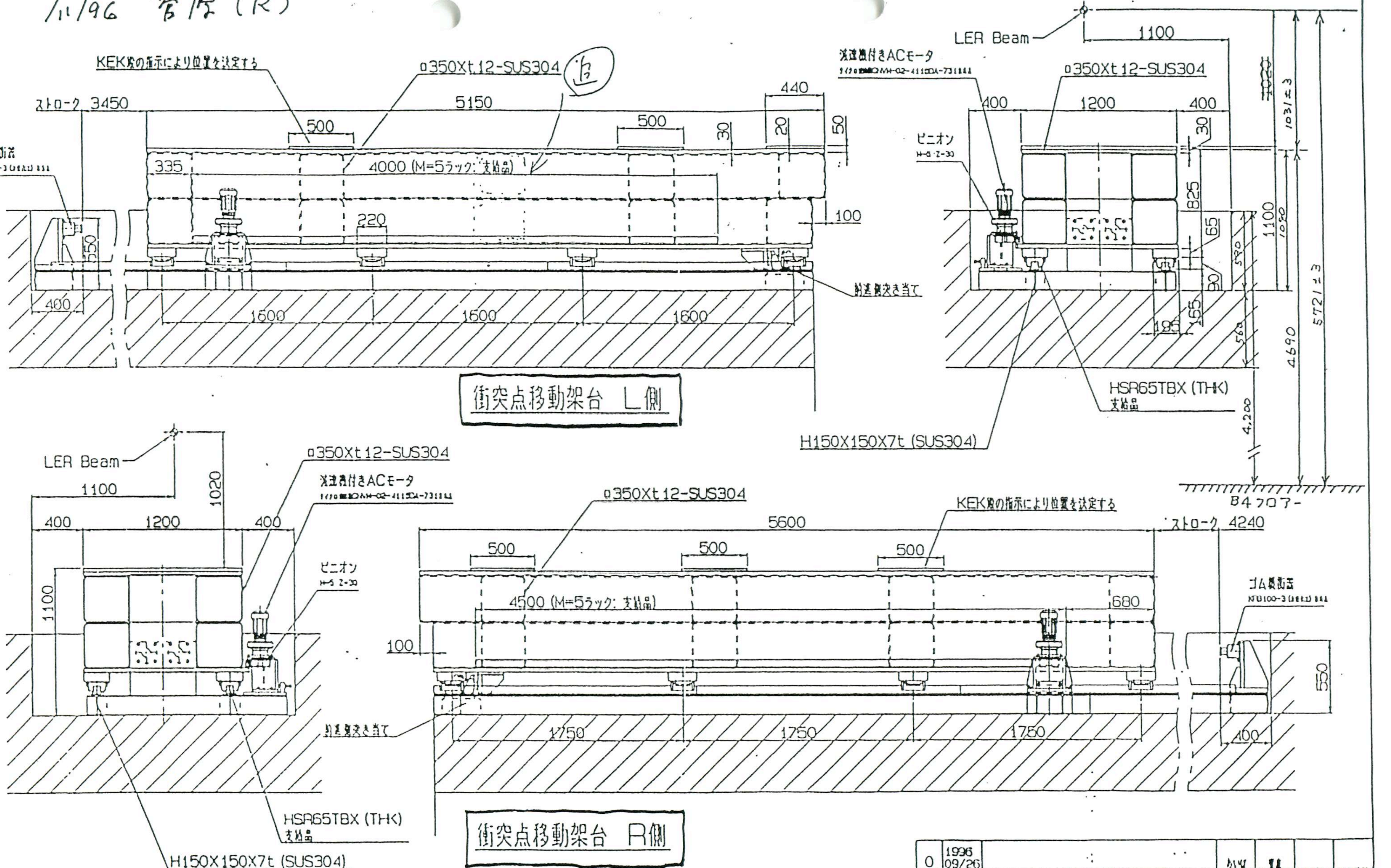
- Look-through windows on the end-plates of the CDC to help alignment work.

- QC1 / QC2 position adjustments by remotely controlled magnet movers.


SCALE
0
1
2
3(m)
NIKKO SIDE
Recovery Tank
OHO SIDE
e⁻⟶
⟵e⁺
Radiation Shield
Radiation Shield
Electronics Hut Side



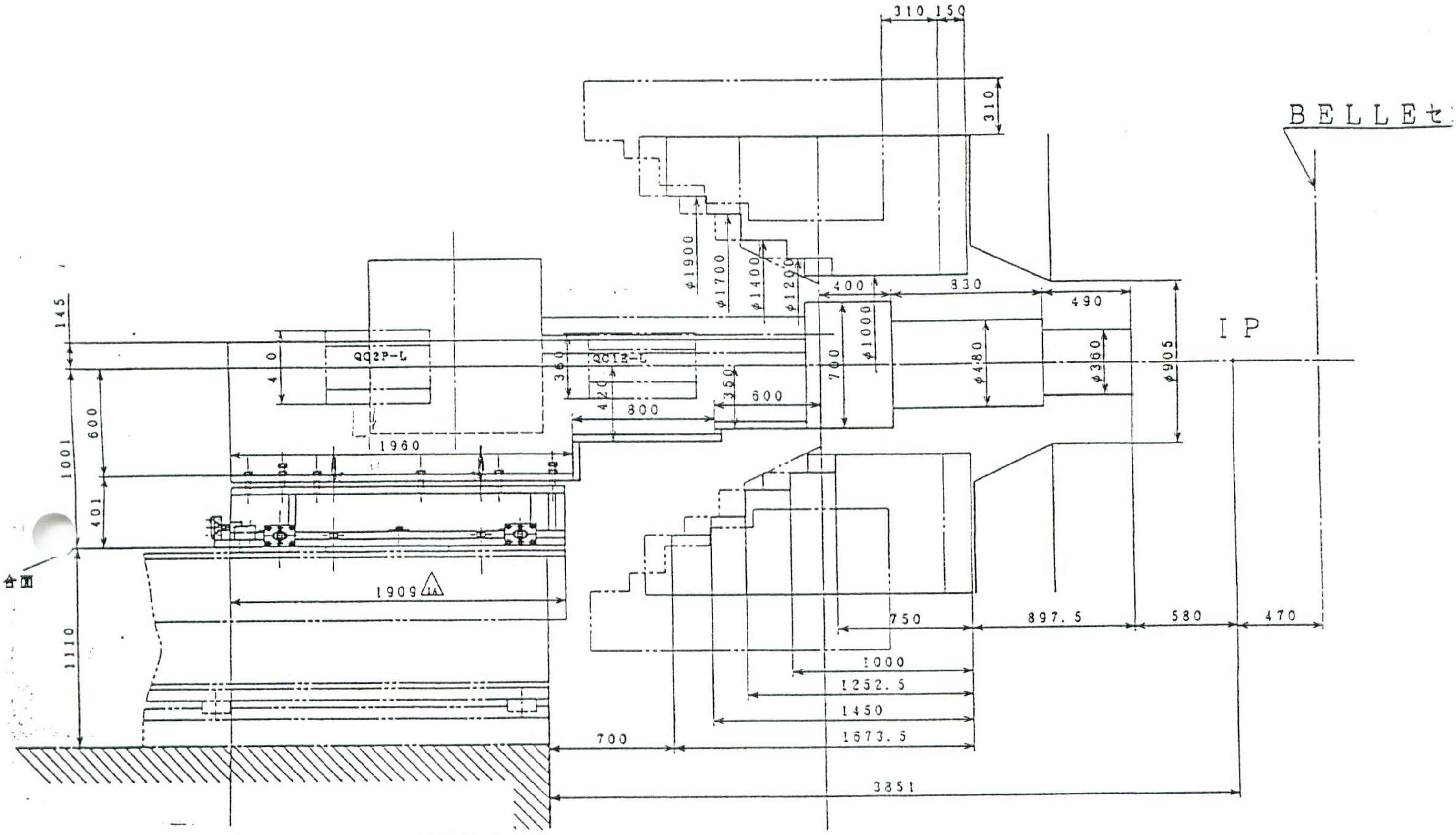
11/96 管原 (R)

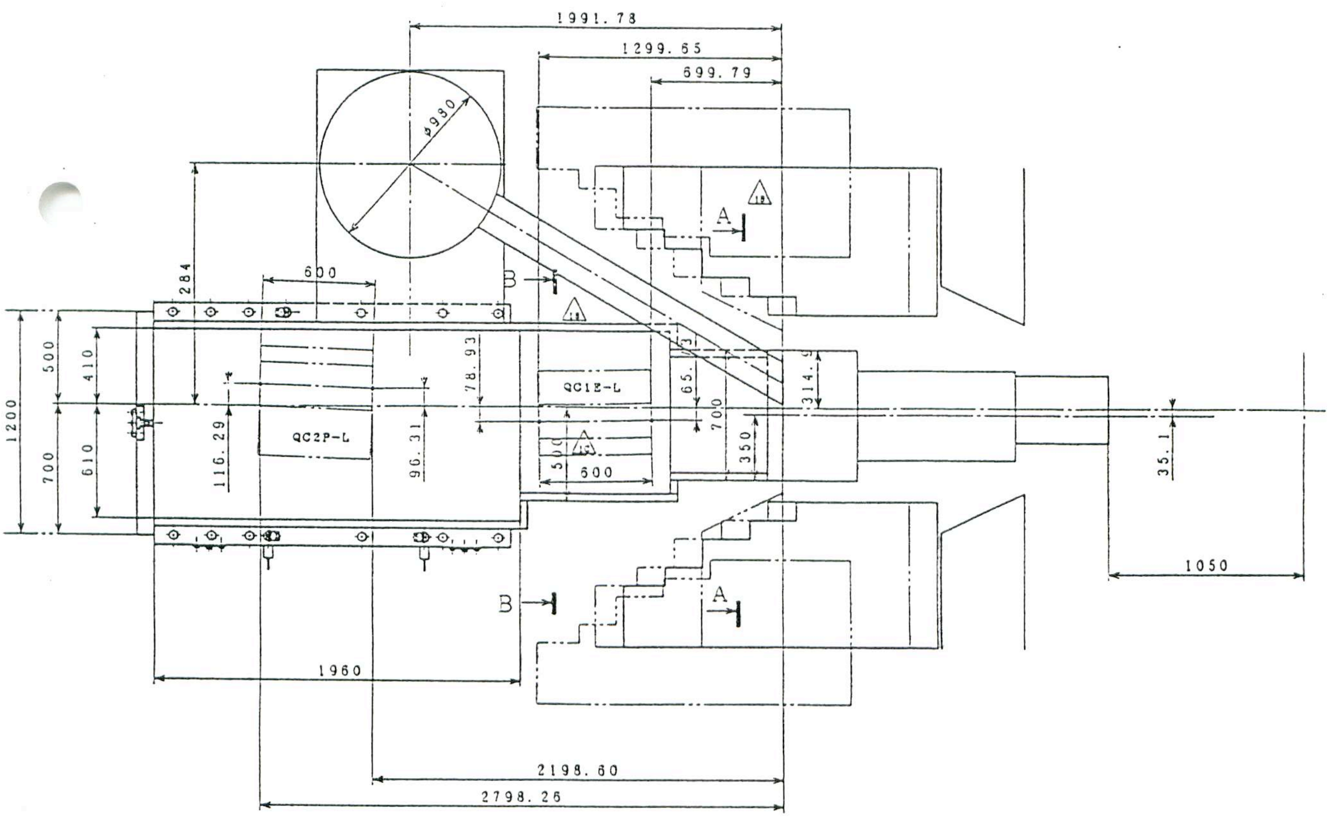


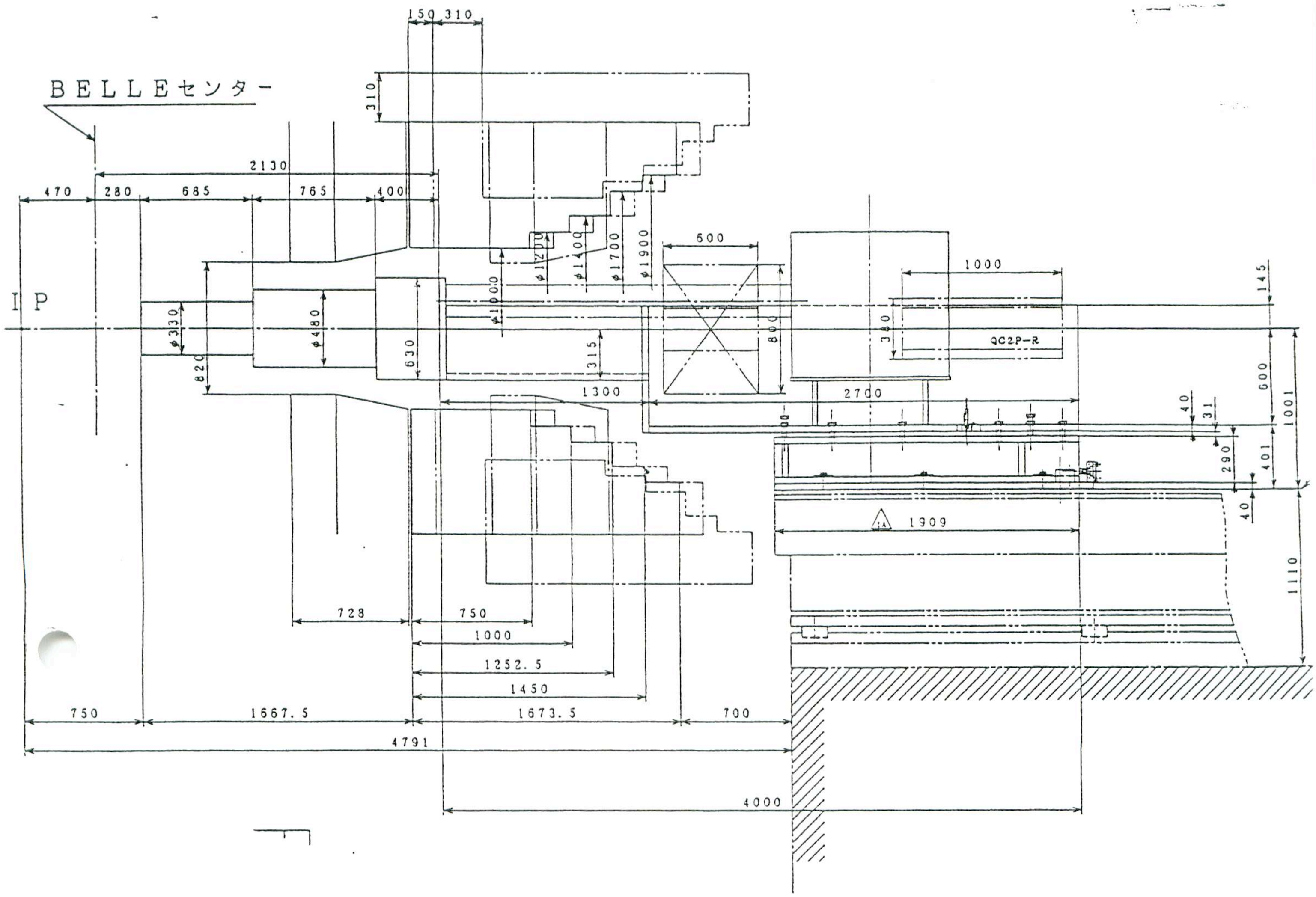
注1: 斜線部はコンクリート製基礎ベース (KEK殿設置)
2: 塗装はおこなわないが、購入品等既に塗装されているものについては不問とする
3: 本図は基本計画図のため、KEK殿との打合せにより変更することがある

設定 ~2W

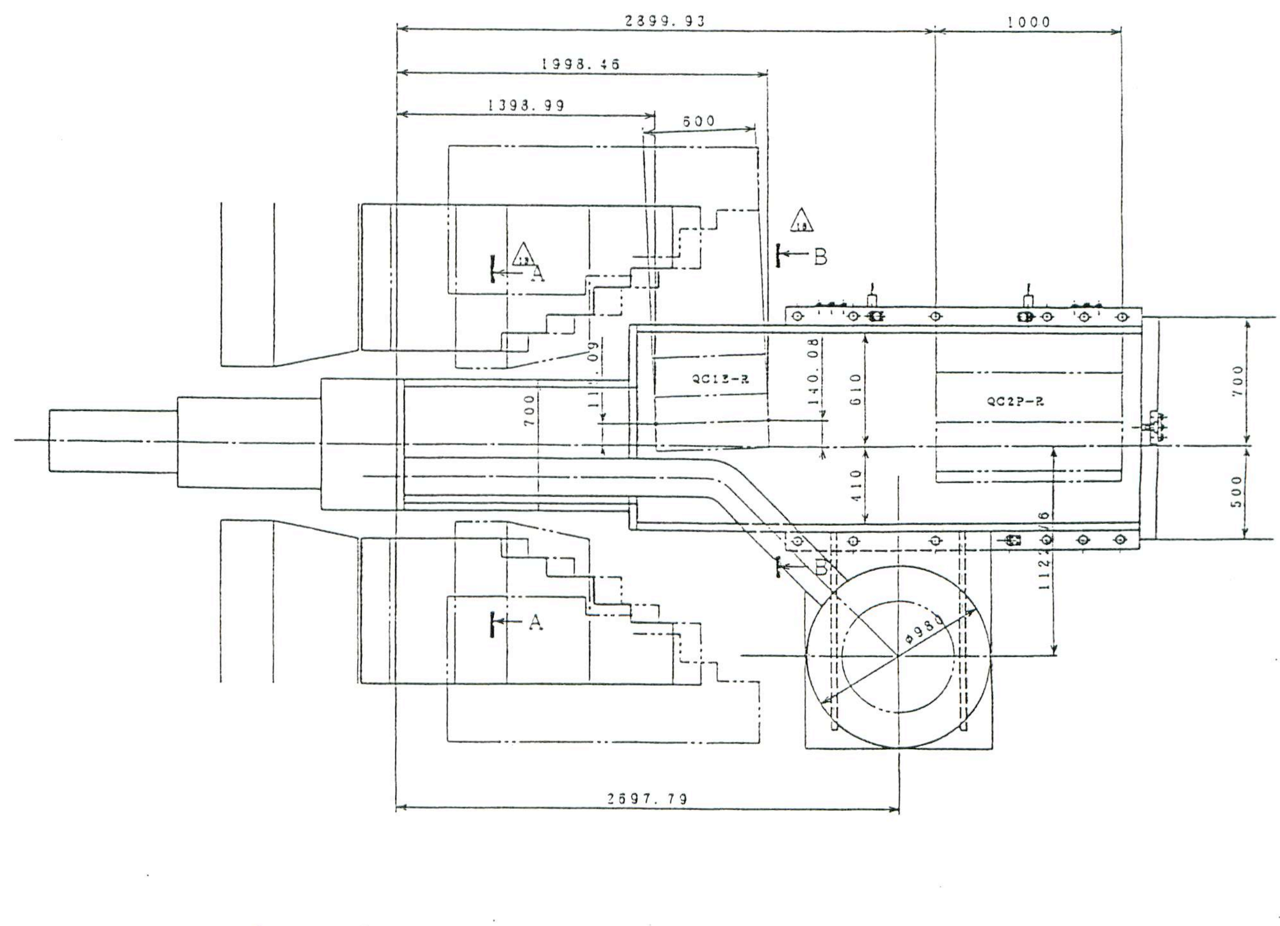
0	1996 09/26					
NO.	DATE	DESCRIPTION				
SCALE 1: 20		高エネルギー物理学研究所殿 向け				
		衝突点移動架台				
		基本計画図			計画図	
IHI 技本部 生産技術開発センター 生産装置開発部 装置設計グループ		JOB NO.				
		DRAWING NO. 99000576-1421				REV.


BELLEセ
IP
QC2P-L
QC1Z-L
1909
1960
合面
3851


1991.78
1299.65
699.79
QC1Z-L
QC2P-L
1960
2198.60
2798.26
1050



BELLEセンター
IP
150 310
310
2130
470 280 685 765 400
φ1200 φ1400 φ1700 φ1900
φ1000
φ330
φ480
820
630
315
600
800
1000
145
380
QC2P-R
1300
2700
600
1001
40
31
290
401
40
1909
1110
728
750
1000
1252.5
1450
750 1667.5 1673.5 700
4791
4000

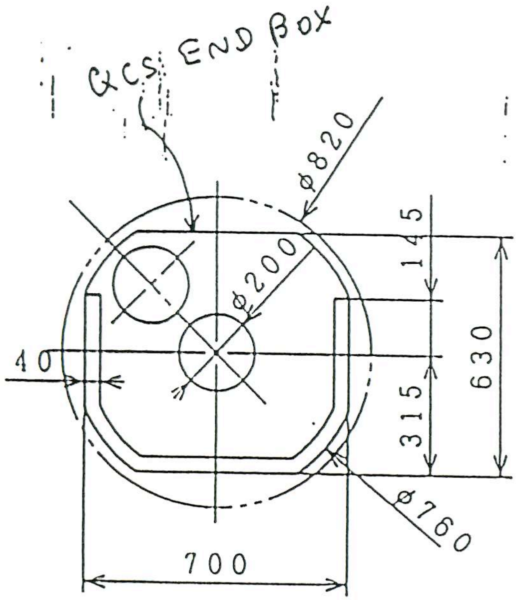


2899.93
1000
1998.46
1398.99
600
A
B
QC1S-R
QC2P-R
140.08
610
700
700
410
500
1122.06
φ980
2697.79

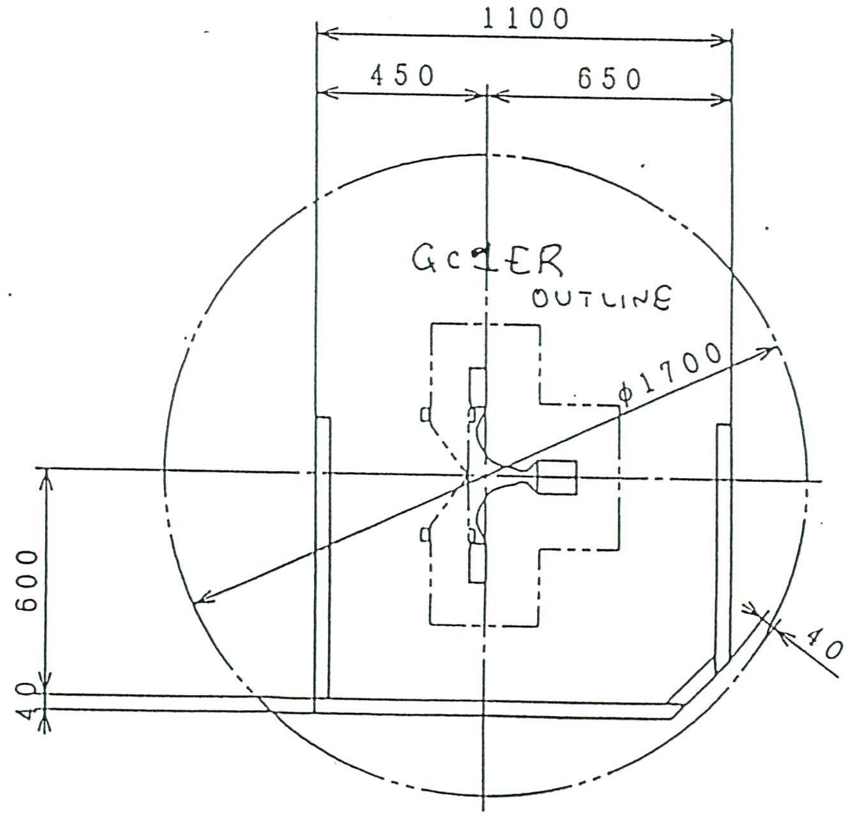
R側

11/11/96
荒居 (R)

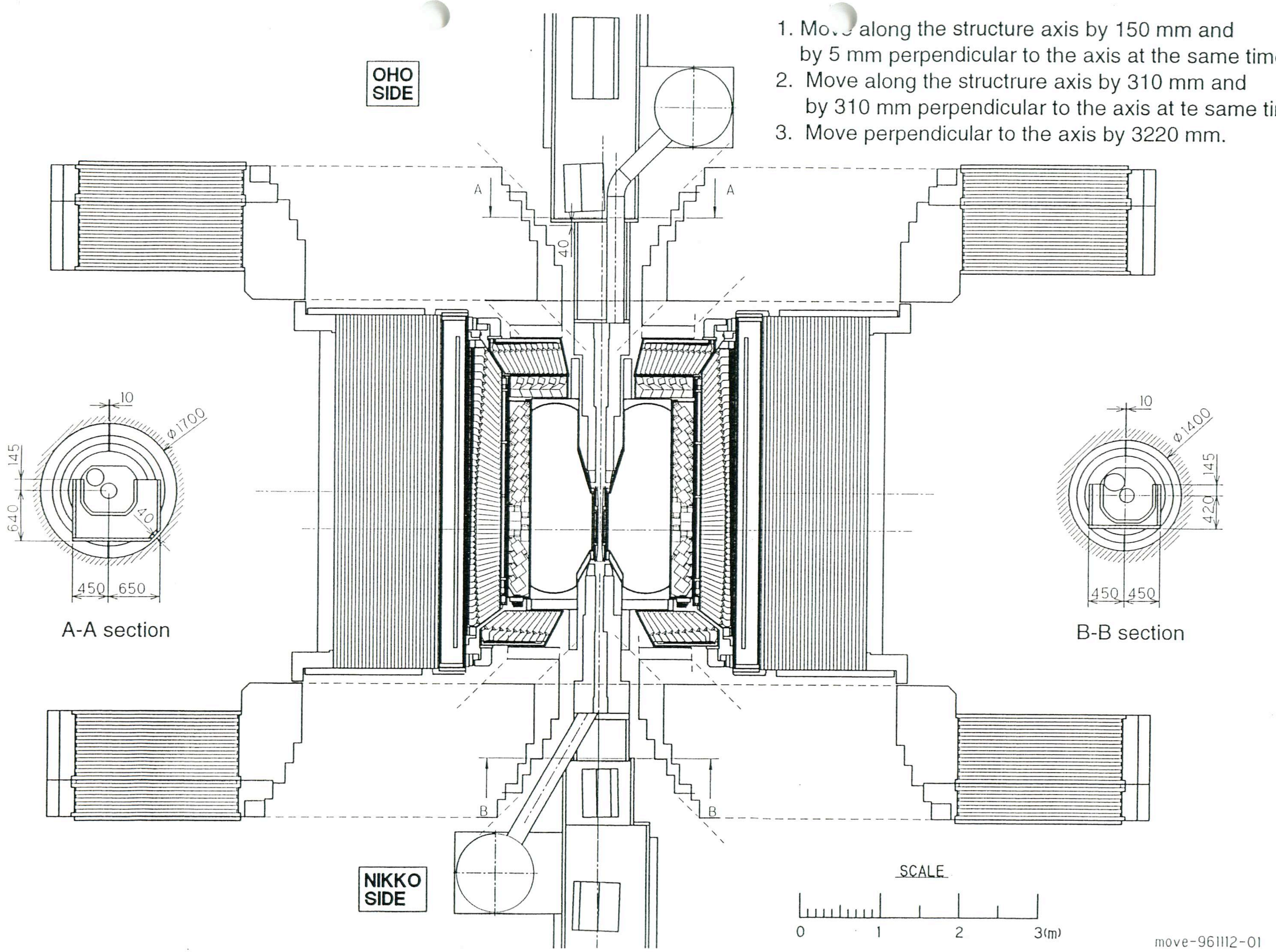
A—A



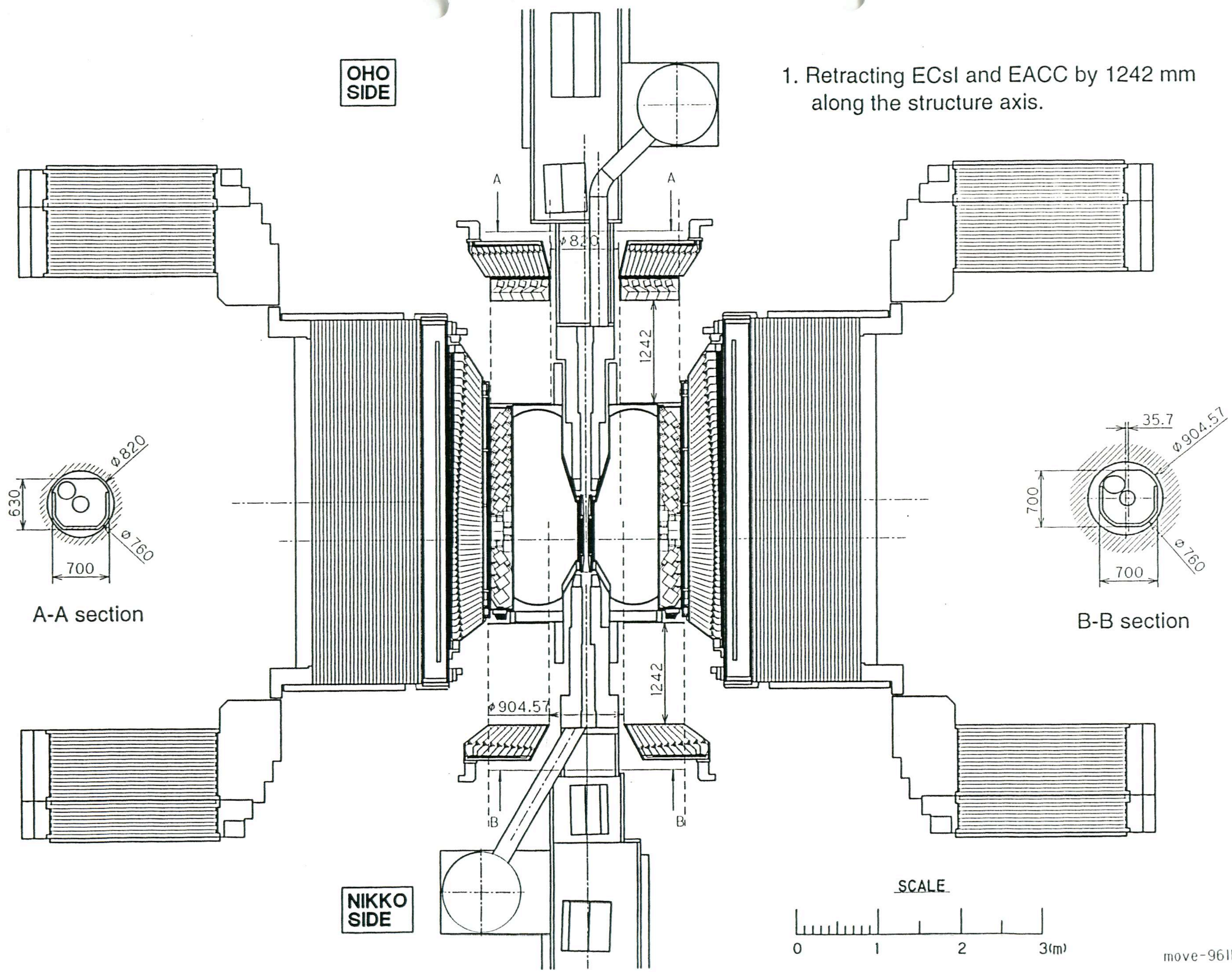
B—B



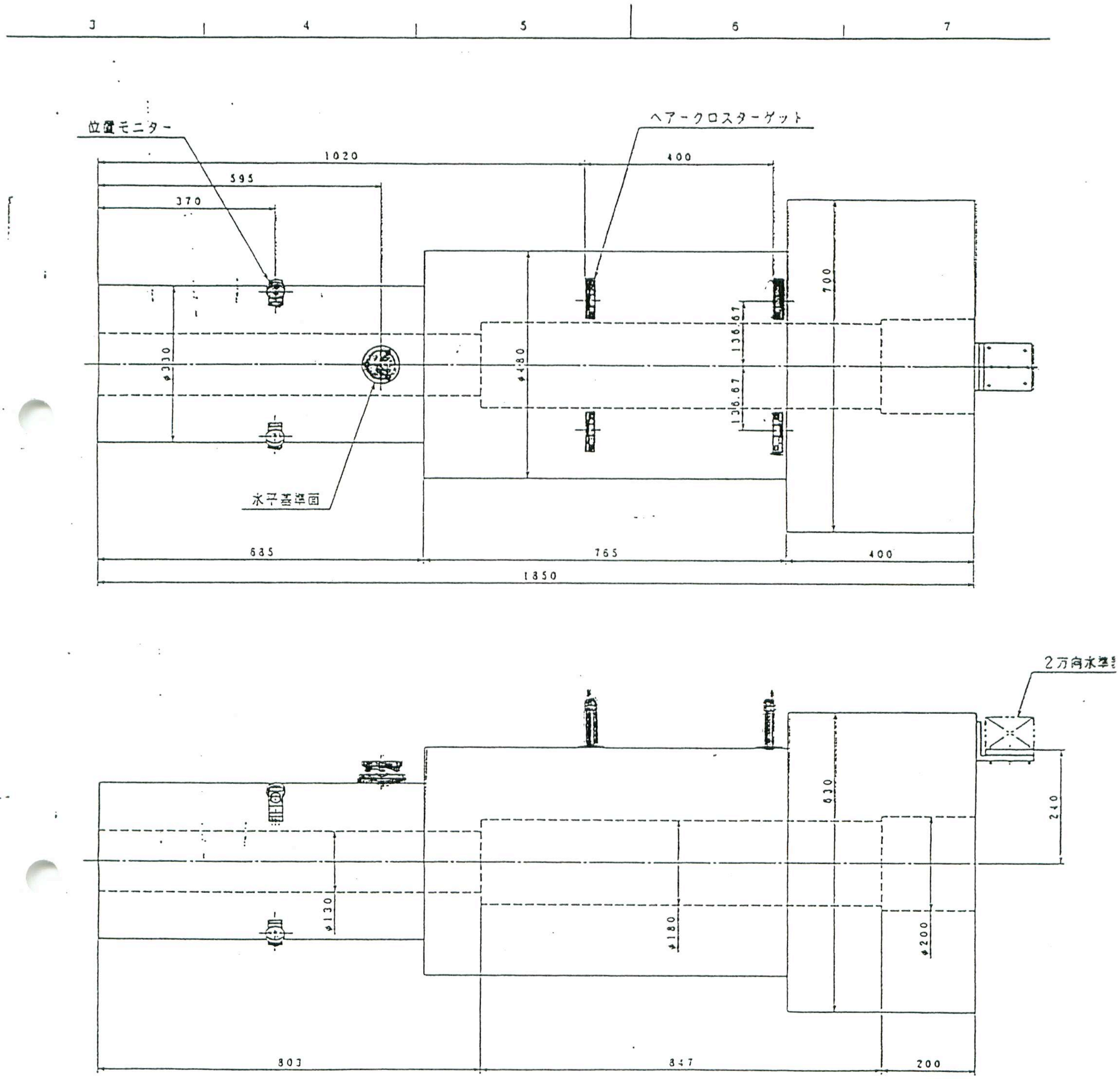
1. Mo[illegible] along the structure axis by 150 mm and by 5 mm perpendicular to the axis at the same time.
2. Move along the structrure axis by 310 mm and by 310 mm perpendicular to the axis at te same time.
3. Move perpendicular to the axis by 3220 mm.

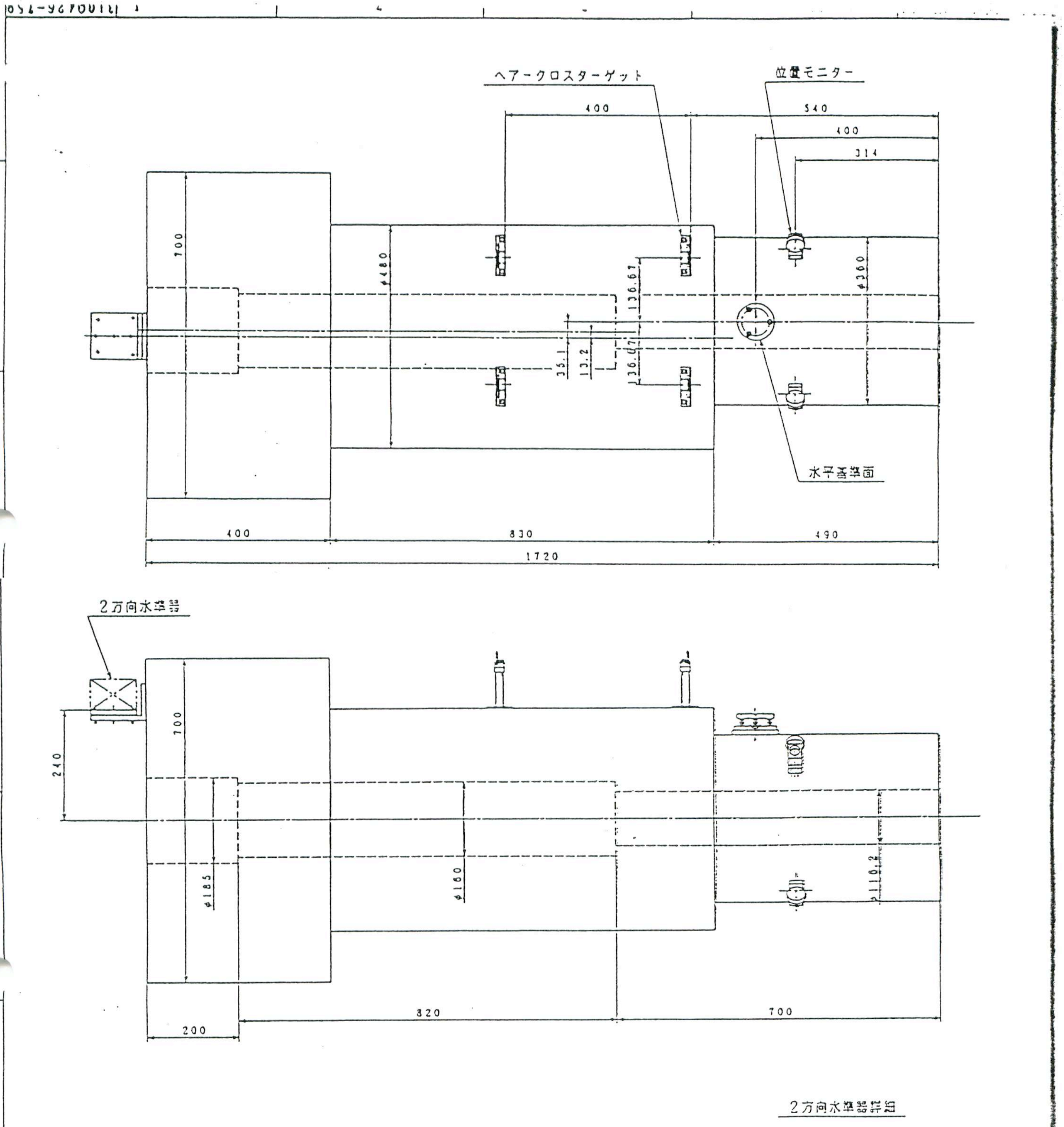


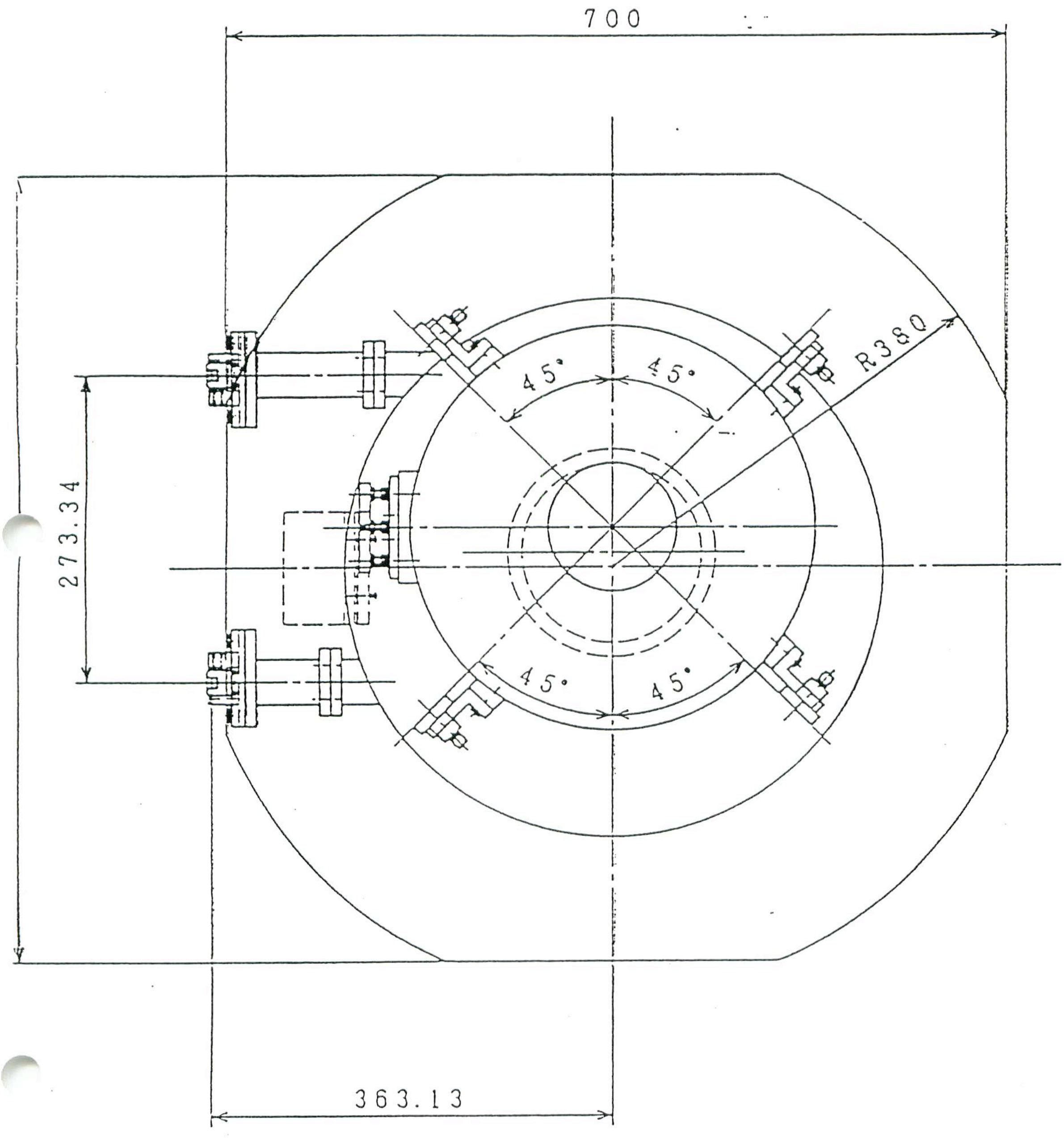
1. Retracting ECsI and EACC by 1242 mm along the structure axis.

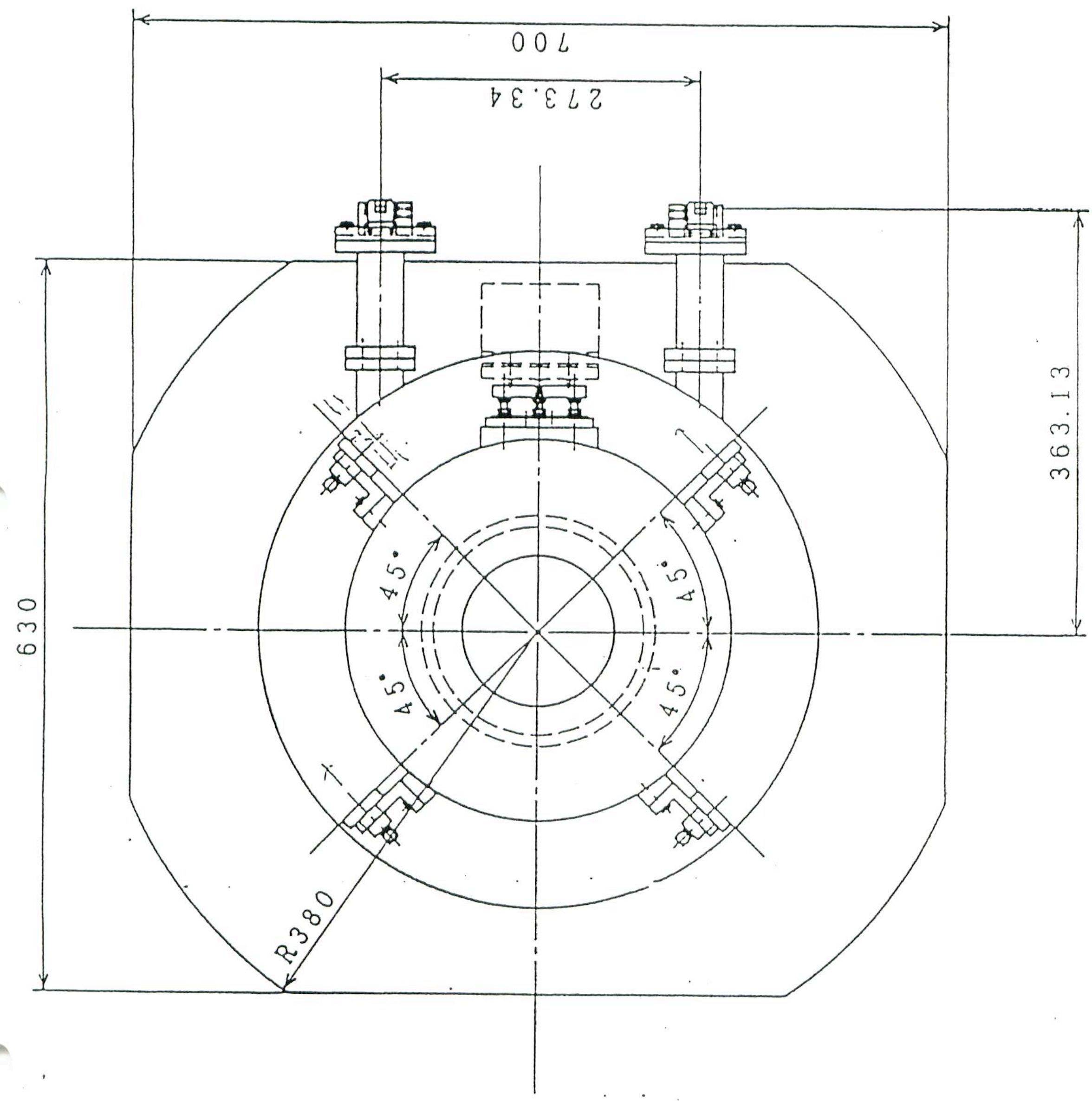


move-961112-02


3
4
5
6
7
位置モニター
ヘアークロスターゲット
1020
595
370
400
700
φ330
φ480
136.67
136.67
水平基準面
685
765
400
1850
2方向水準
830
240
φ130
φ180
φ200
803
847
200


ヘアークロスターゲット
位置モニター
400
540
400
314
700
φ480
φ360
136.67
35.1
13.2
136.67
水平基準面
400
830
490
1720
2方向水準器
240
700
φ185
φ160
116.2
200
820
700
2方向水準器詳細


700
R380
45°
45°
45°
45°
273.34
363.13


700
273.34
363.13
630
R380
45°
45°
45°
45°

5. *Mag-Field Issues Related to Solenoid Field Compensation*

- Up to 5 % field distortion will be created in the detector tracking volume (nominal 1.5 T solenoid field)

  Simulation studies by BELLE folks have shown that its effect can be corrected without degrading the momentum resolution.

  No ‘extra’ solenoid compensation.
  BUT, will do field mapping!! ~ Sep. ’97

- Effects of multipole fields near QCS on the dynamic aperture:

  They have been evaluated.

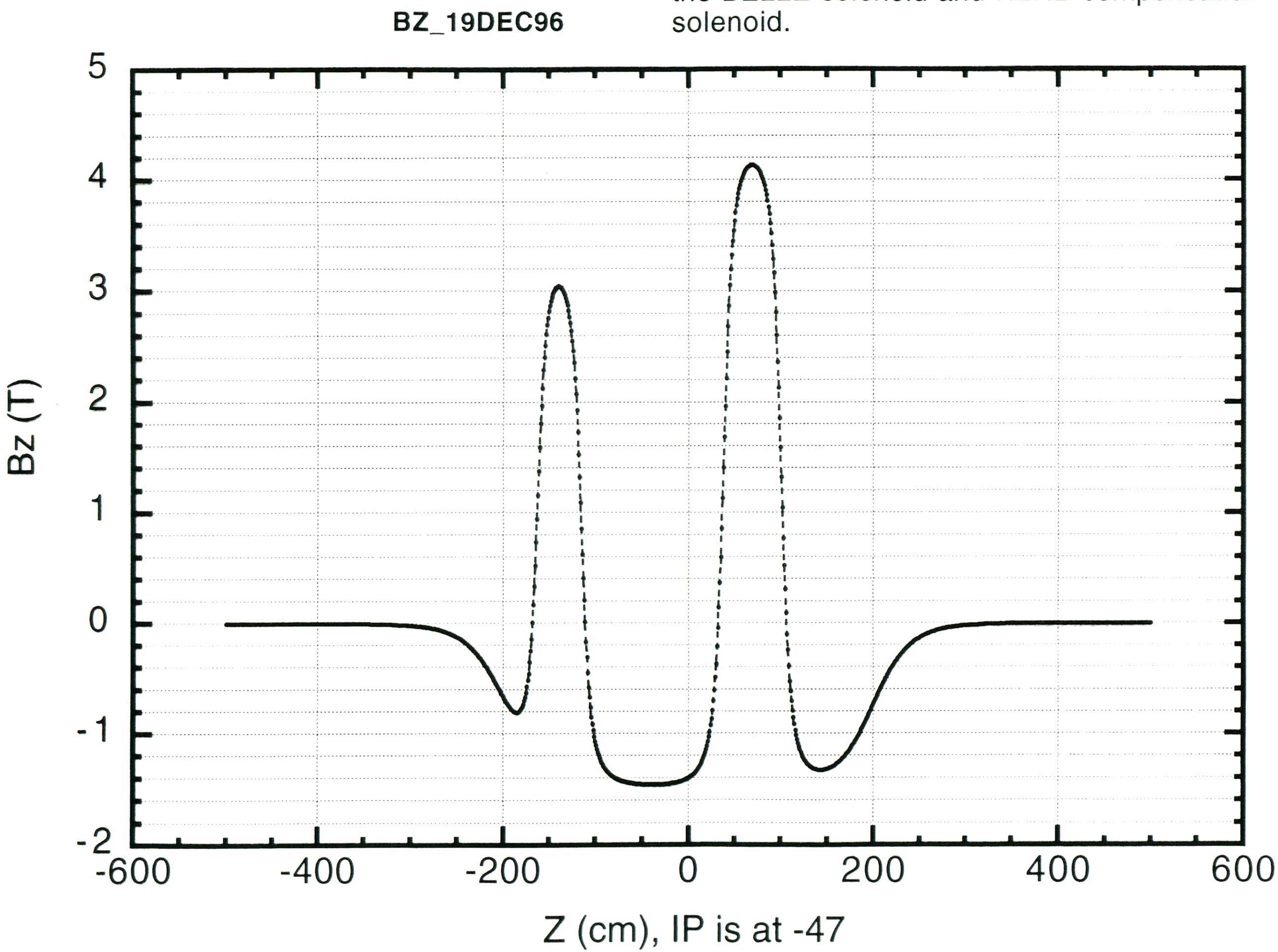
  Coil fringe fields . . . . . OK
  “Coupling” with the detector iron . . . . OK

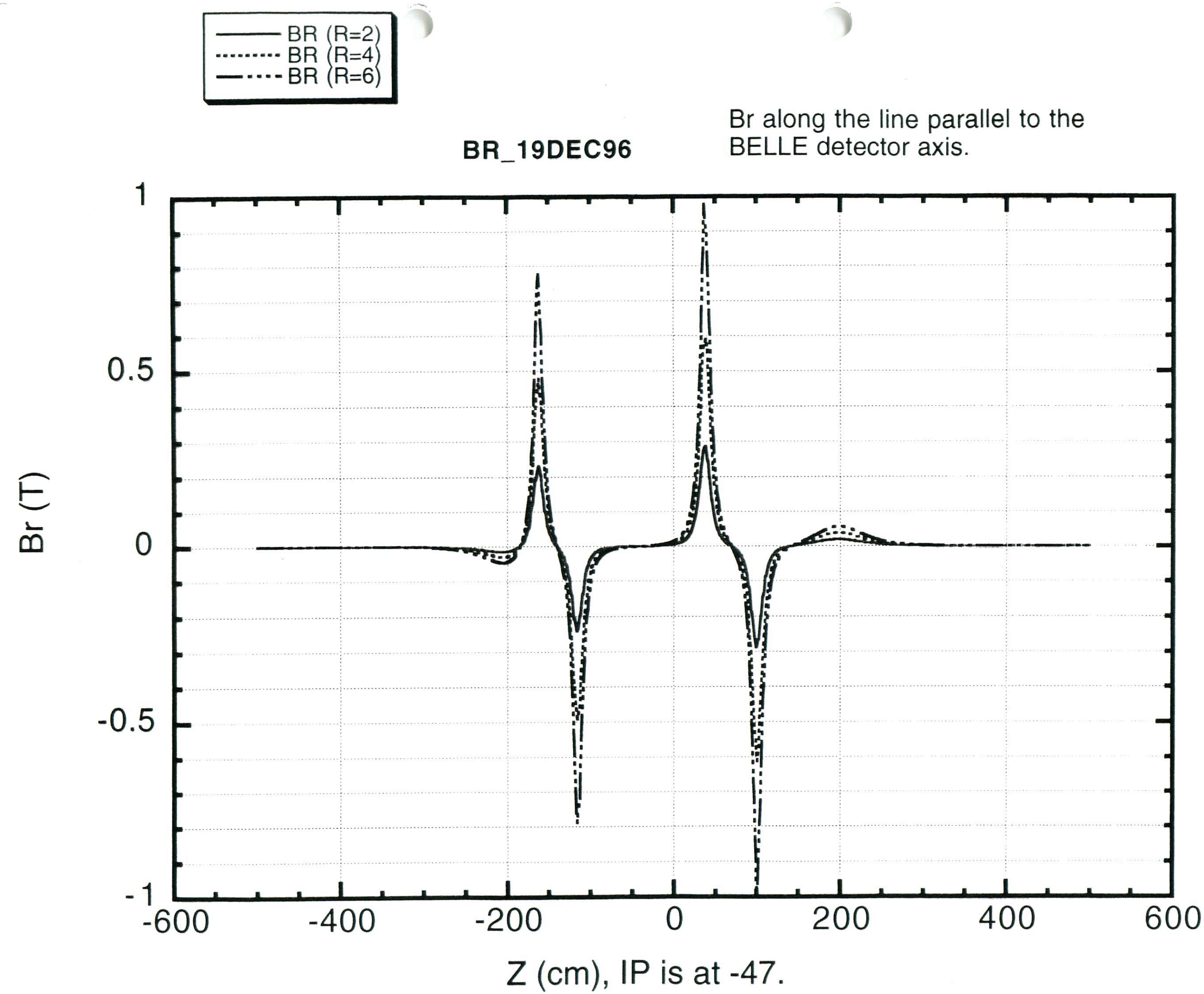
- Leak solenoid field from the detector iron near QC1:

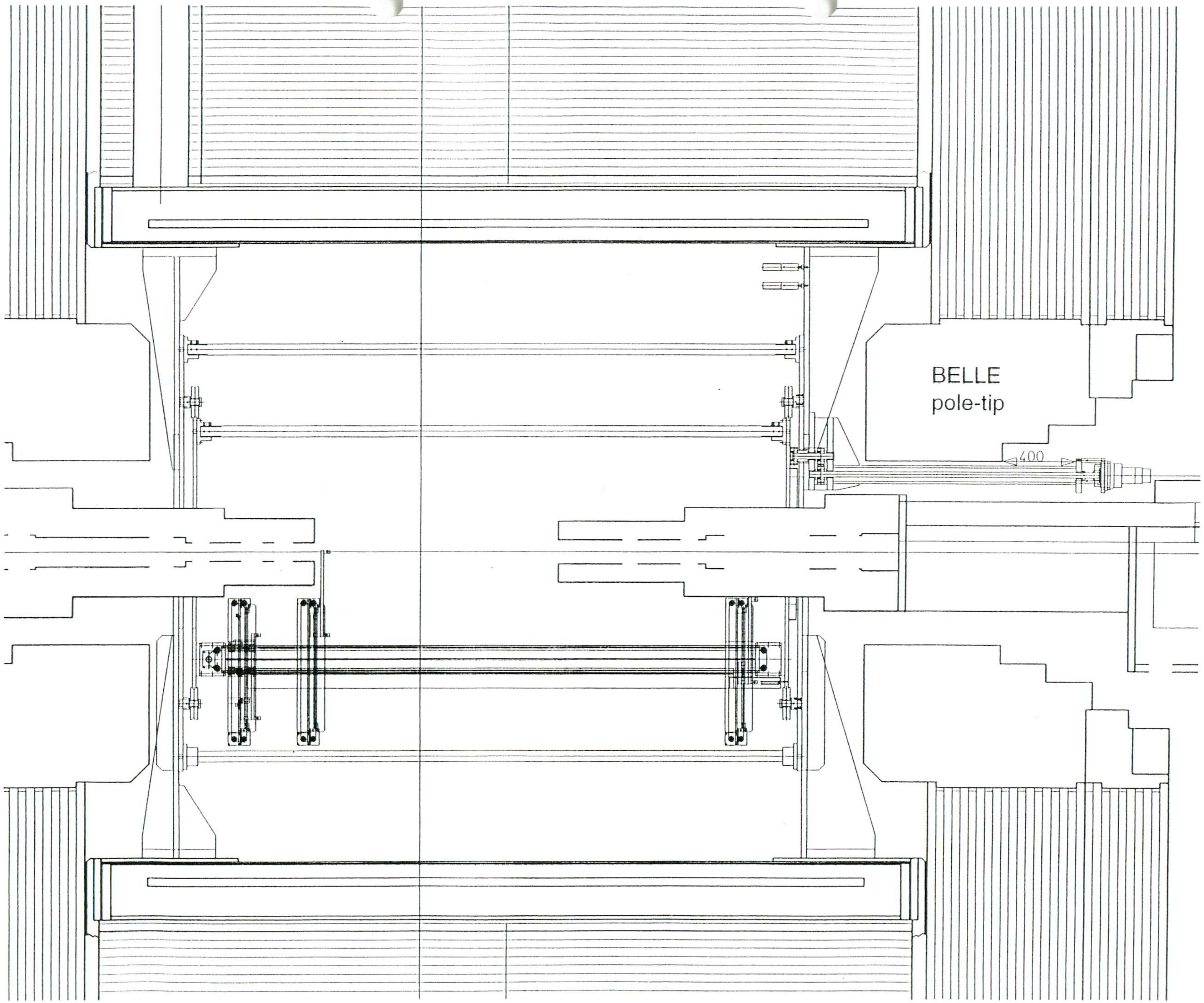
  Considered small "enough", but will be physically measured, too.

  Will have "dummy" QC1 irons at that time there.

Expected Bz along the BELLE detector axis, as result of combined mag fields from the BELLE solenoid and KEKB compensation solenoid.




BR (R=2)
BR (R=4)
BR (R=6)
BR_19DEC96
Br along the line parallel to the BELLE detector axis.
1
0.5
0
-0.5
- 1
Br (T)
-600
-400
-200
0
200
400
600
Z (cm), IP is at -47.



BELLE
pole-tip
400

6. Vacuum System Aperture Allocation

Injection time beam envelope has effective emittance of

$\varepsilon_x = 1.2 \times 10^{-5}$ m

$\varepsilon_y = 1.2 \times 10^{-6}$ m

- As "injection aperture" of QCSL/R and ESL/R, allocate

  $\varepsilon_x = 1.4 \times 10^{-5}$ m

  $\varepsilon_y = 1.4 \times 10^{-6}$ m

- SR (Synchrotron Radiation) aperture for QCS
  Not to intercept SR photons from 10σ particles during the regular run time (i.e. damped beam).

- Aperture allocations for QC1s and QC2s are based on inj. beam envelope:

  $\varepsilon_x = 1.3 \times 10^{-5}$ m (+ 5 mm)

  $\varepsilon_y = 1.3 \times 10^{-6}$ m (+ 5 mm)

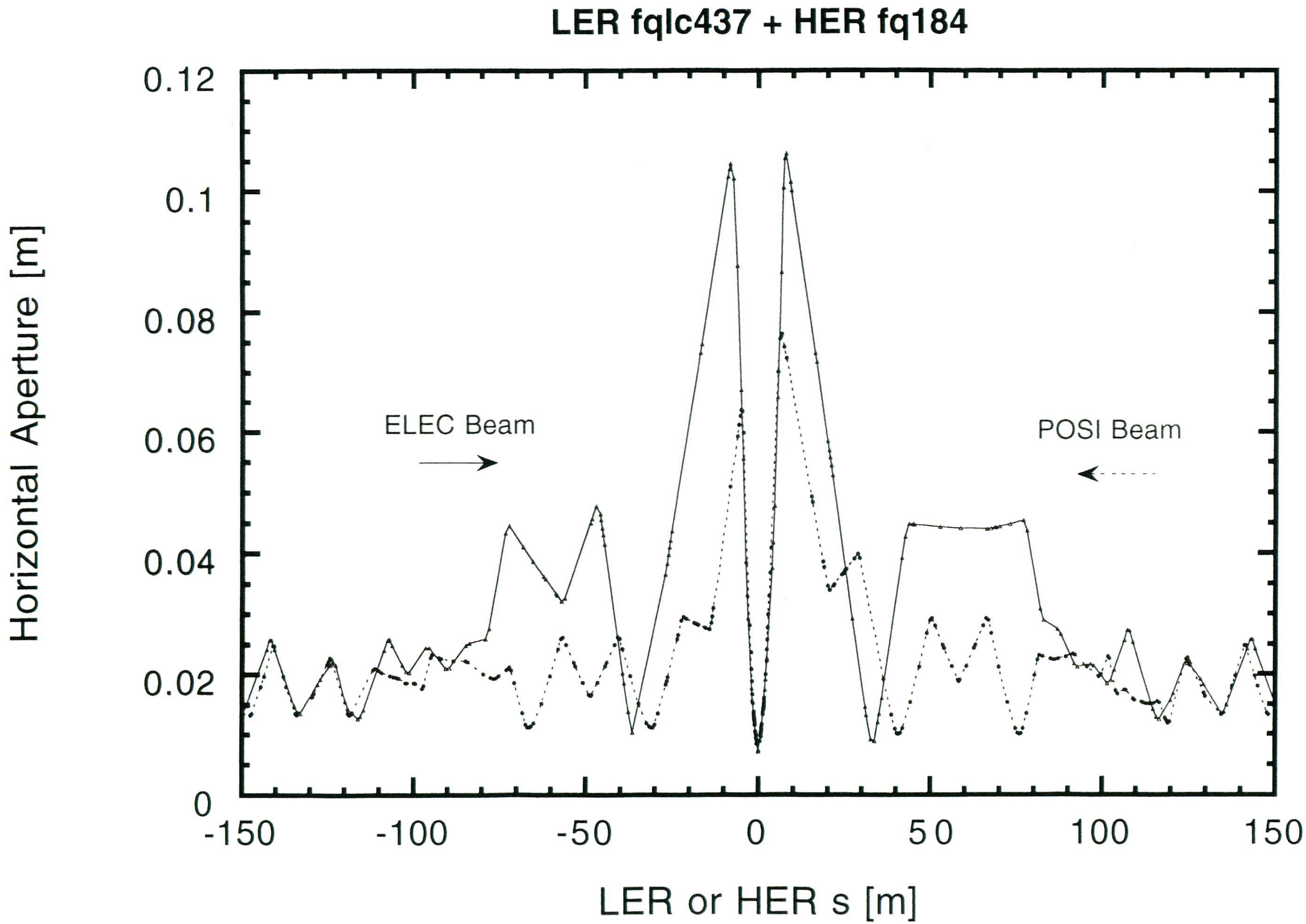
- The rest of Tsukuba Straight Section

LER:

IP - QCS - QC2:	Special shapes
QC2 - QC3:	Tapered transition
outside QC3:	75 mm x 47 mm (half aperture)

HER:

IP - QCS - QC2:	Special shapes
QC2 - QC3:	Tapered transition
QC3 - QC4:	75 mm x 47 mm (half aperture)
QC4:	55 mm x 27 mm after tapered transition


LER fqlc437 + HER fq184
Horizontal Aperture [m]
0.12
0.1
0.08
0.06
0.04
0.02
0
-150
-100
-50
0
50
100
150
LER or HER s [m]
ELEC Beam
POSI Beam

7. *Vacuum System HOM Issues*

- IR chamber:

  $k_L = 0.29$ V / pc

  Total HOM loss = 4 kW

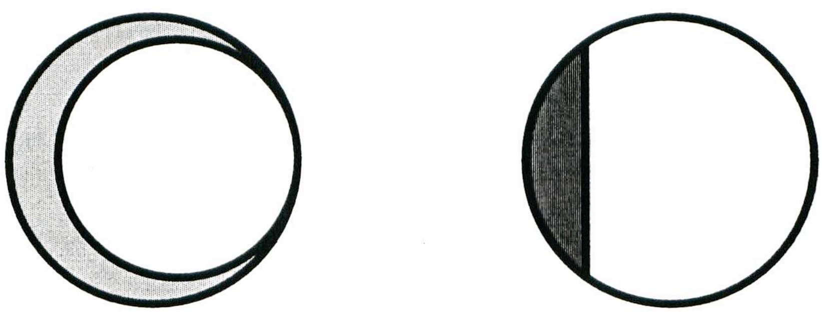
- Crotch area: with latest design

  $k_L = 0.11$ V/pc / side

  Total HOM loss = 3 kW

- Be IP chamber can take up to 200 W, meaning 3 % of the entire HOM loss.

- Comment on the mask shape:



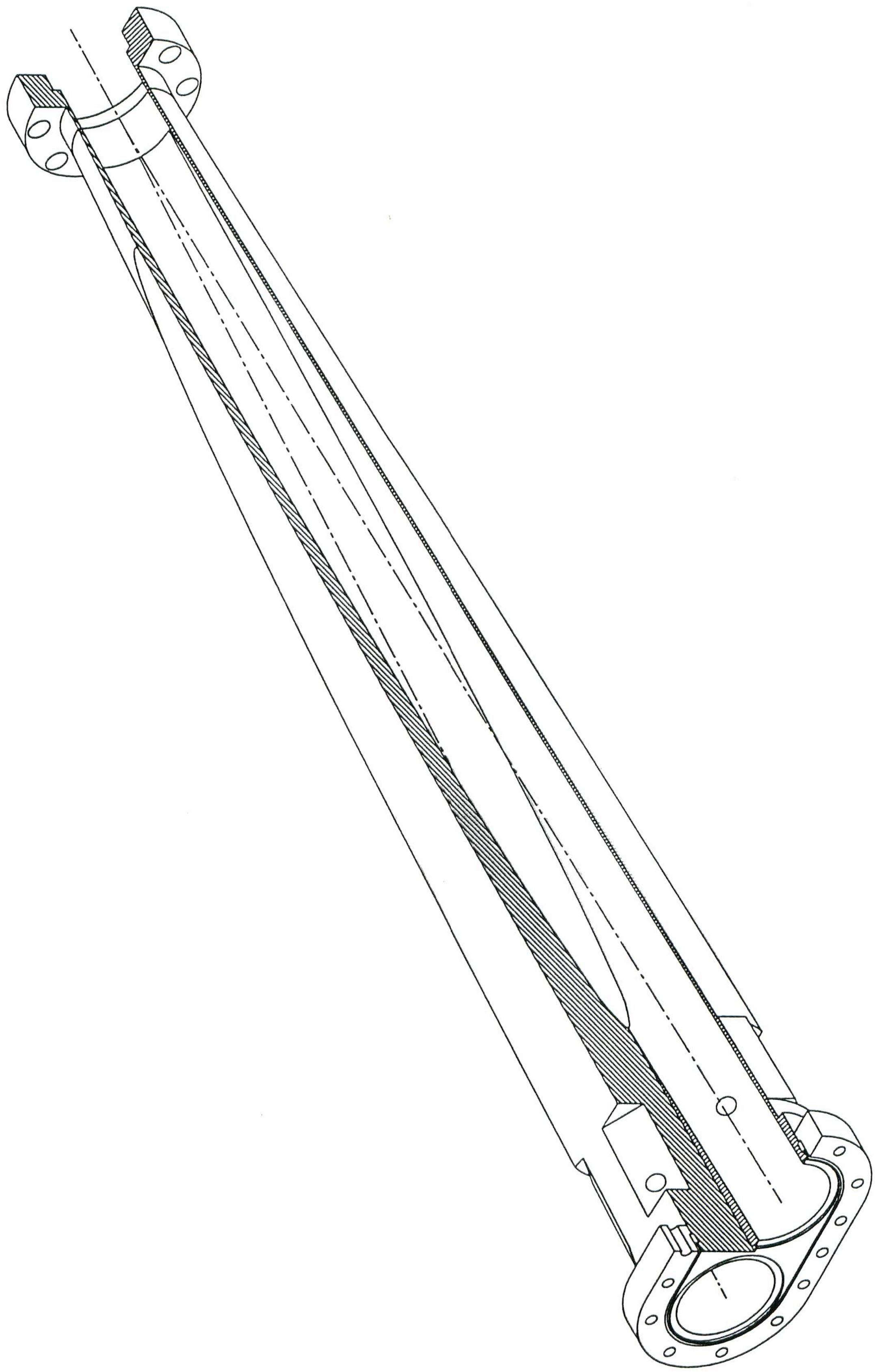
(A) (B)

(A) is preferred to (B).

With (B), the TE11 cut-off freq of the collimated area can become lower than the uncollimated (i.e. circular cross section).

- HOM power flowing in from ARC sections (20KW)

  Will implement SiC absorbers near QC2 - QC3



8. *Vacuum System Hardware*

1. Berillium ch at IP

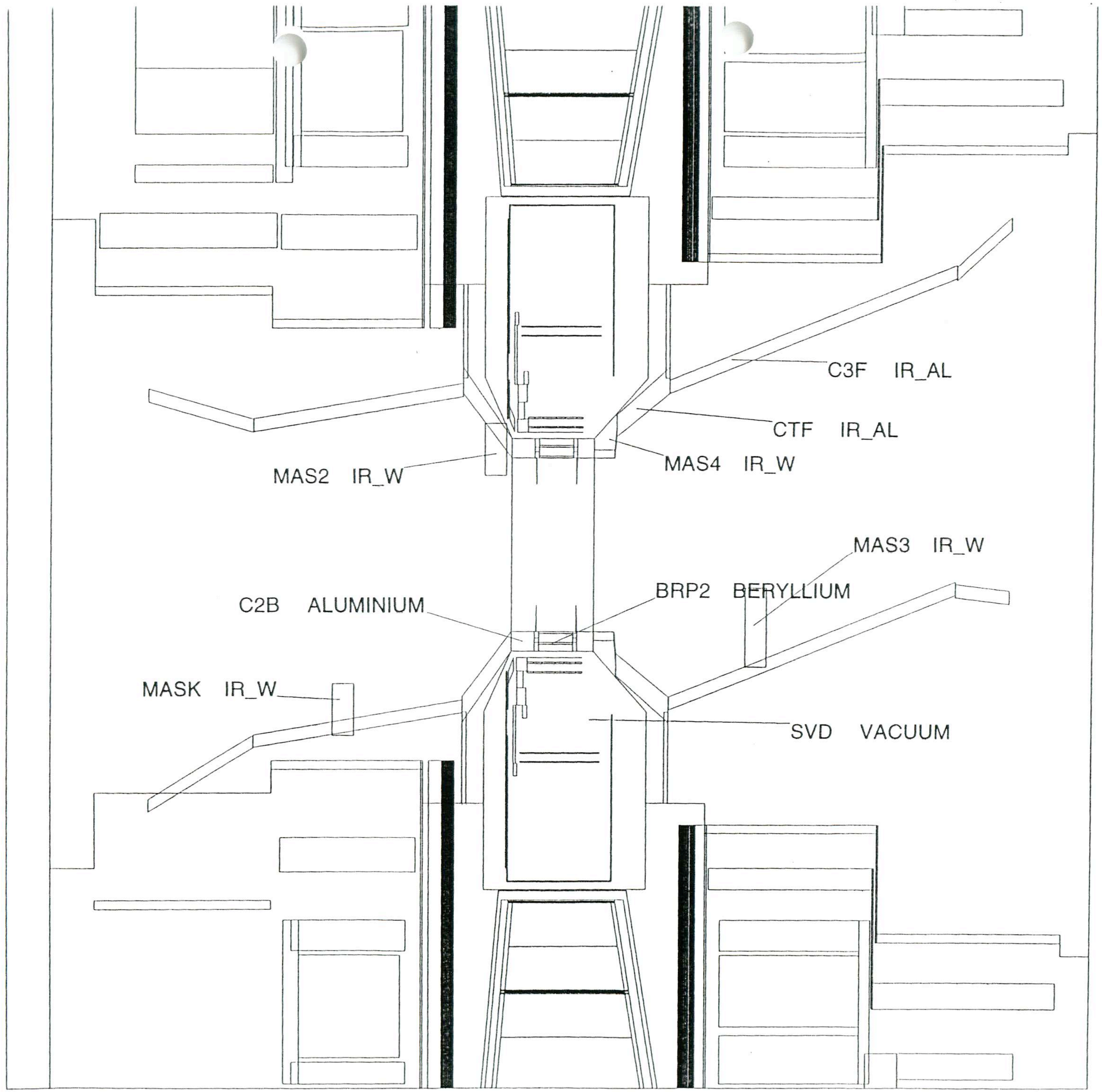
- Inside Si VTX detector (20 mm R) + Tapered Cu chamber (total length = 1m):
- To be fabricated by BELLE folks.
- Mechanically supported by frames extending off CDC.

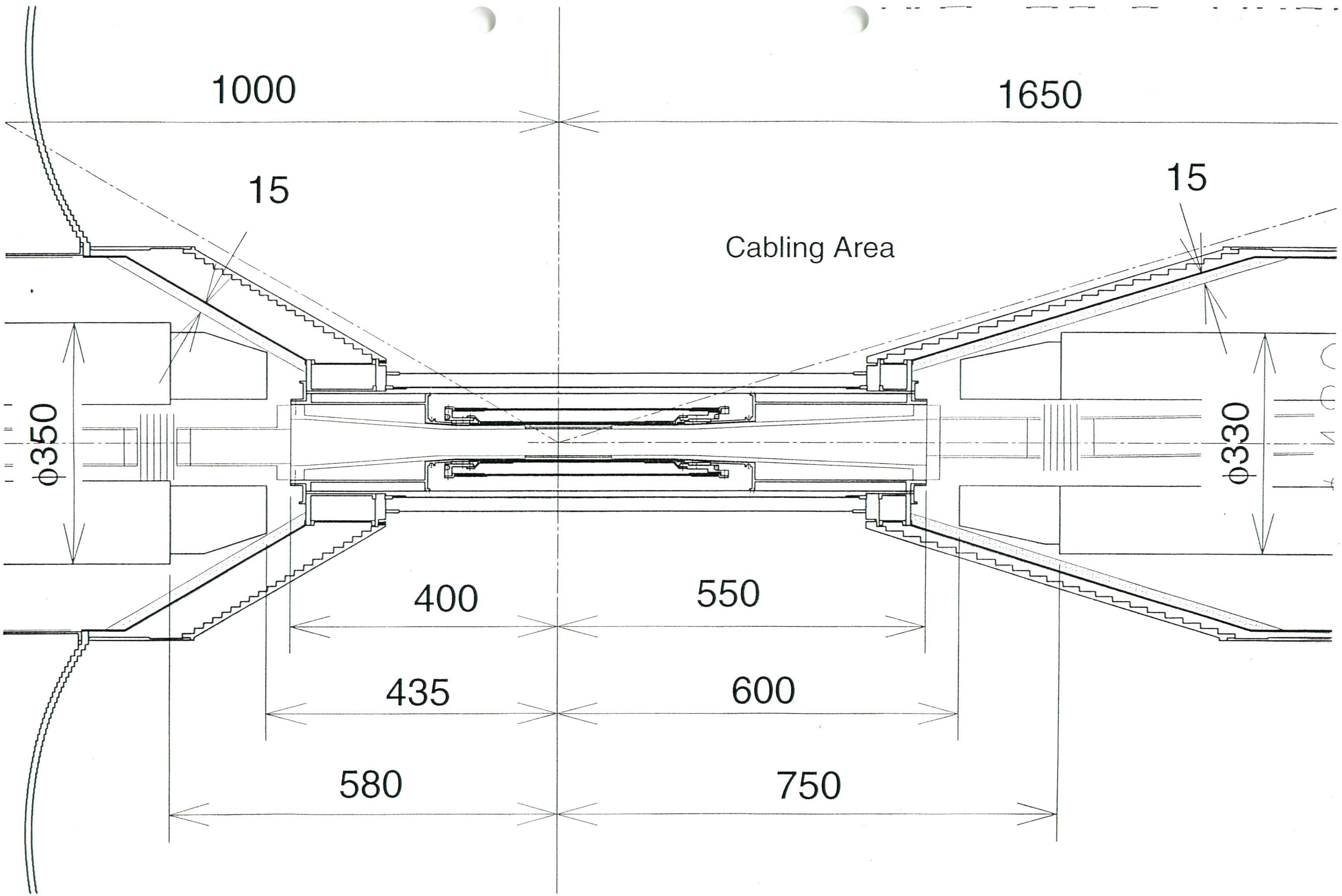
2. Vac. Ch. Inside QCS

- To be fabricated by KEKB vac. Group.
- Made of Al alloy, 3 mm t.
- Implement masks as per requests by BELLE.
- The IP end is connected to the Be/Al chamber (see 1 above) via bellows.
- The aperture pattern approximately follows that of QCS inner bore.

  QCSL part: Split in two pieces, length-wise.
  QCSR part: one-piece

  Also implement separate BPMs for electrons and positrons near the crotch area
- Will build a prototype, and exercise installation procedure this year (97).


C3F IR_AL
CTF IR_AL
MAS2 IR_W
MAS4 IR_W
MAS3 IR_W
C2B ALUMINIUM
BRP2 BERYLLIUM
MASK IR_W
SVD VACUUM


1000
1650
15
15
Cabling Area
φ350
φ330
400
550
435
600
580
750

3. QCS - QC1 - QC2

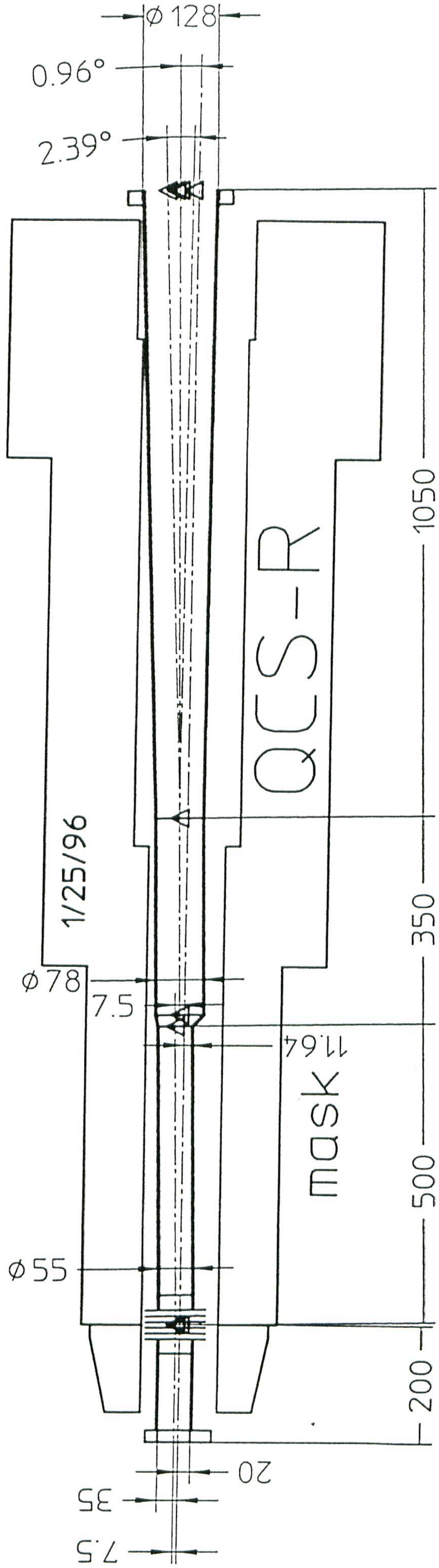
- Plan: Total pumping power > 500 *l* / sec per side.

  This is expected to give ~ 7 x 10–9 Torr at IP, *if no outgassing* from HOM absorbers.

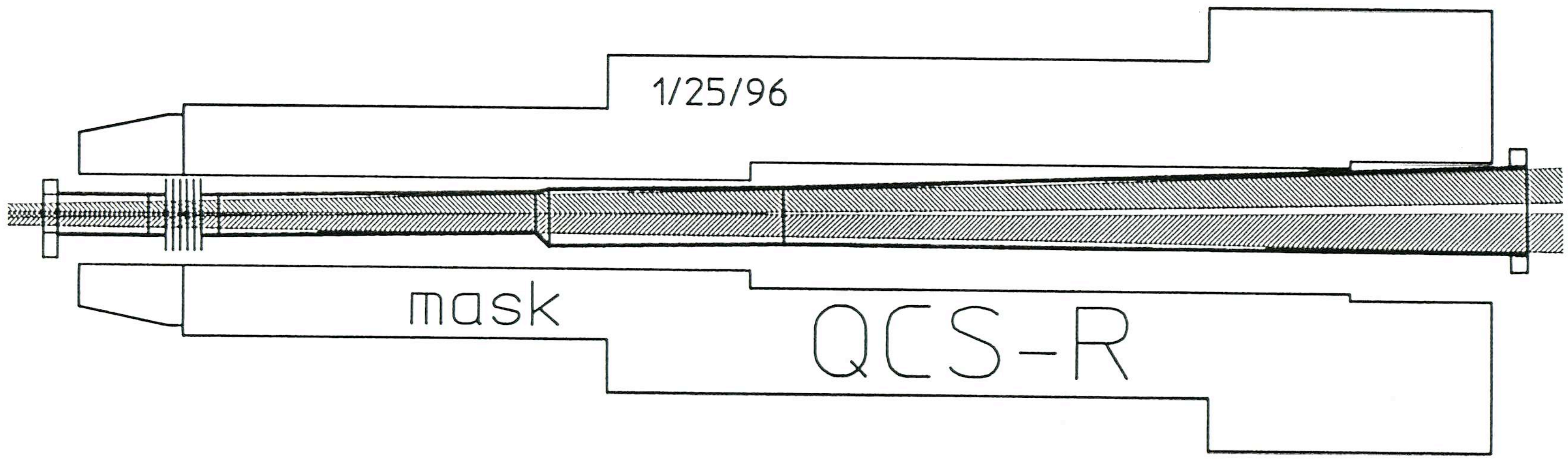
- Will do:
  - Pumping power as much as possible
  - Mostly NEG
  - Add Ion Pumps to deal with methane emission from getter.

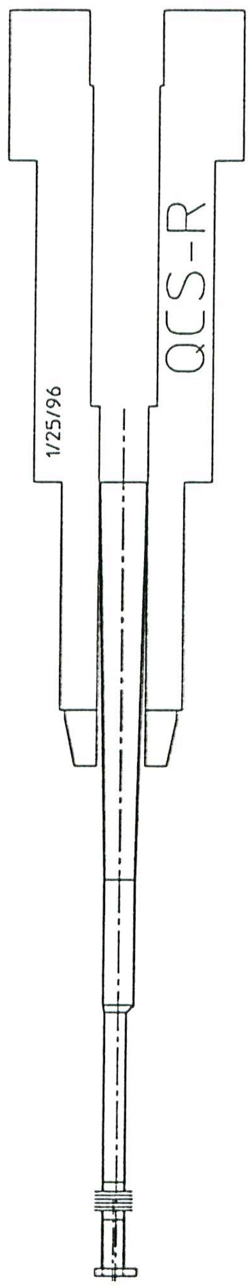
- Cooling as much as possible

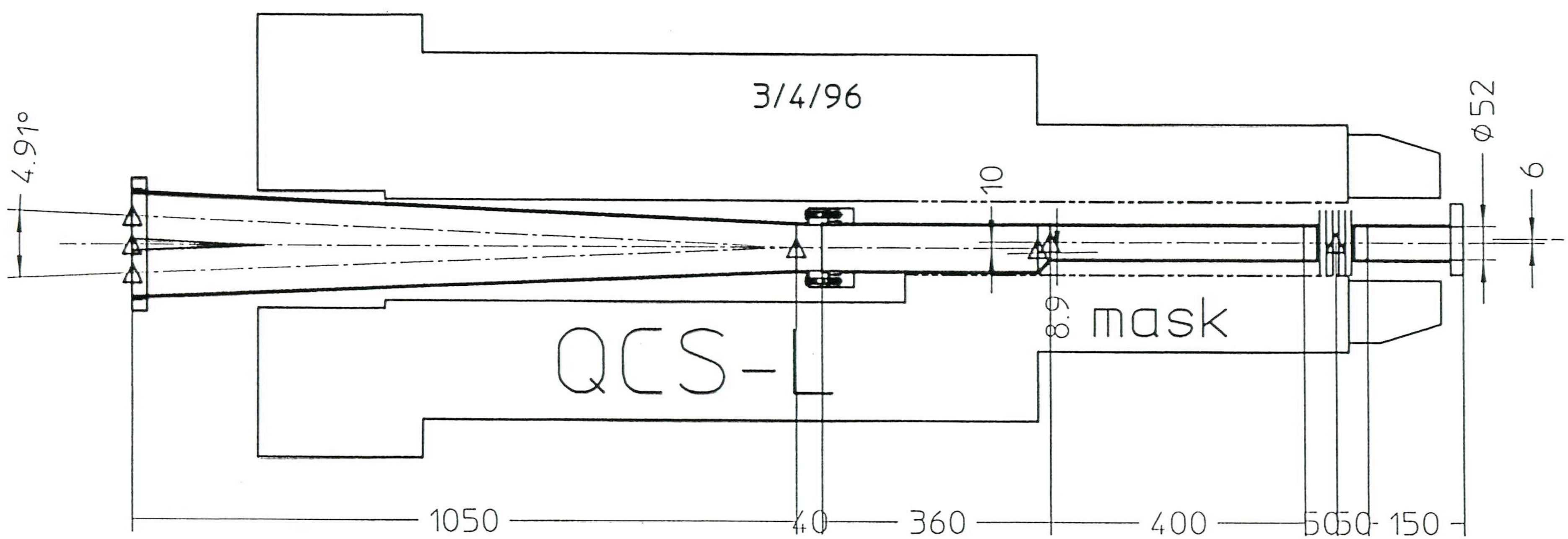
- Details are yet to be worked-out.



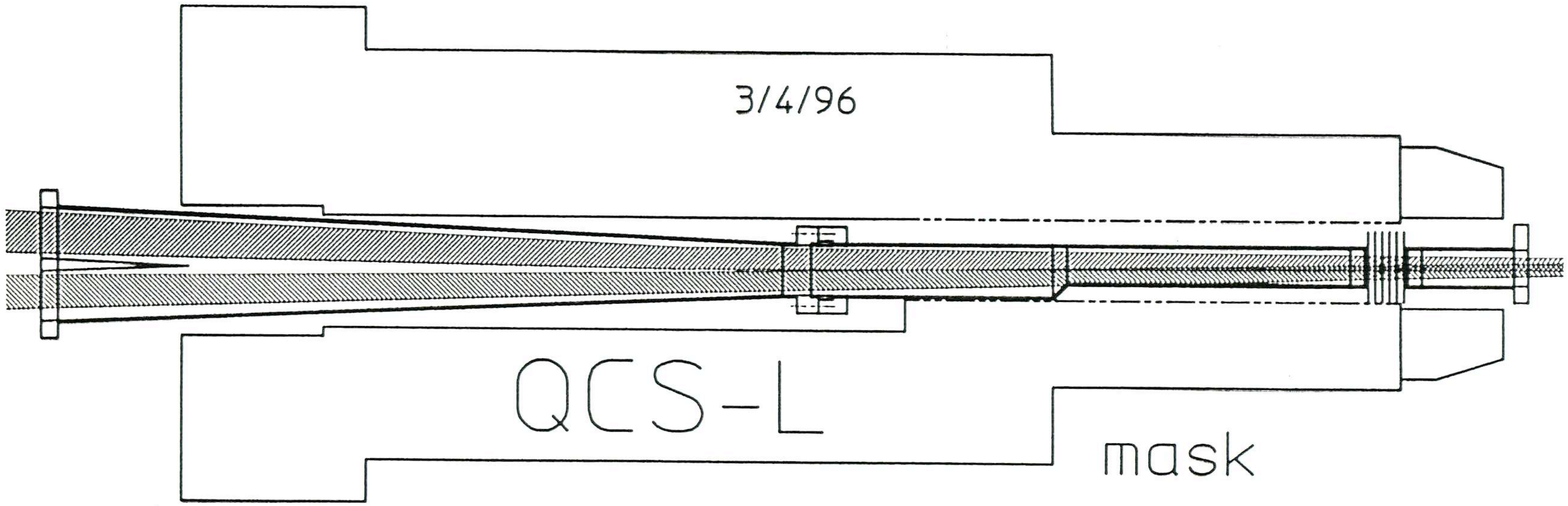
Ø 128
0.96°
2.39°
1050
QCS-R
1/25/96
350
Ø78
7.5
11.64
mask
500
Ø55
200
20
35
7.5

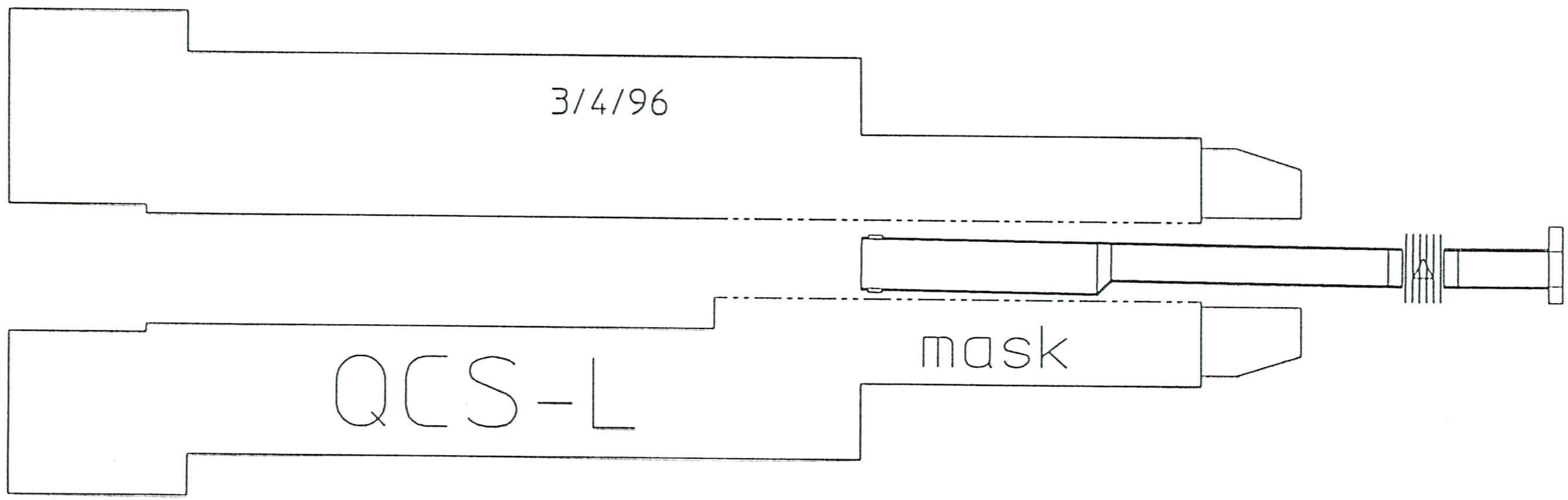

1/25/96
mask
QCS-R

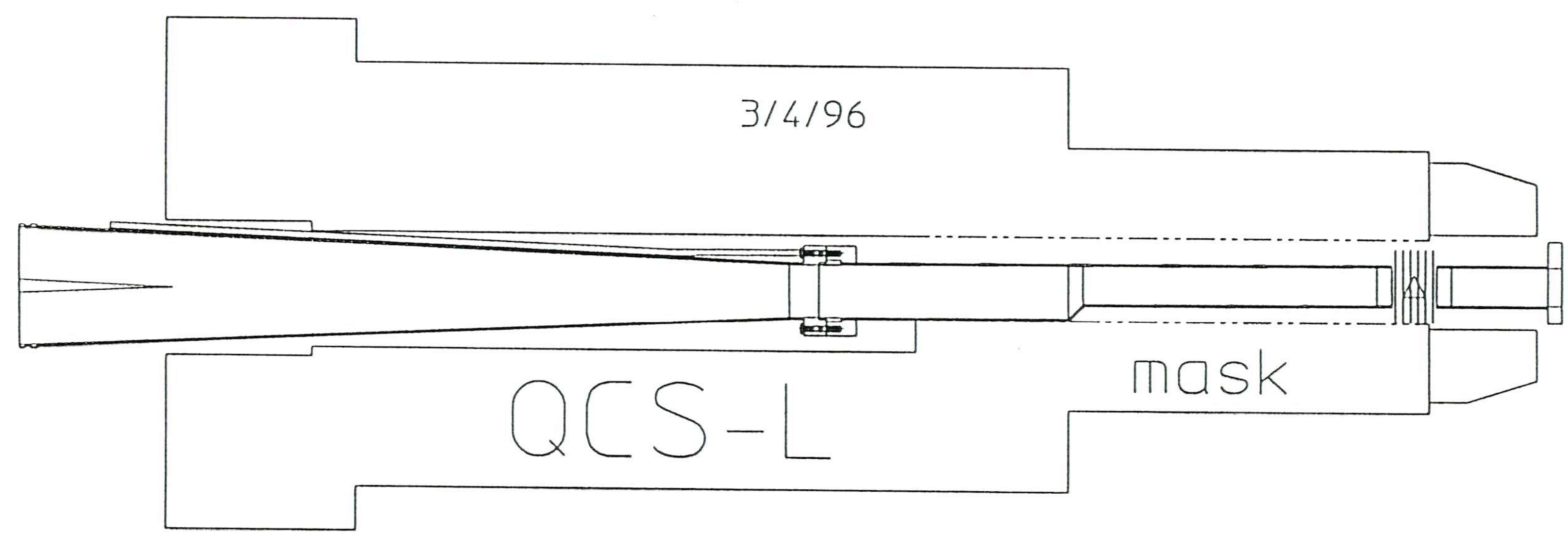

QCS-R
1/25/96

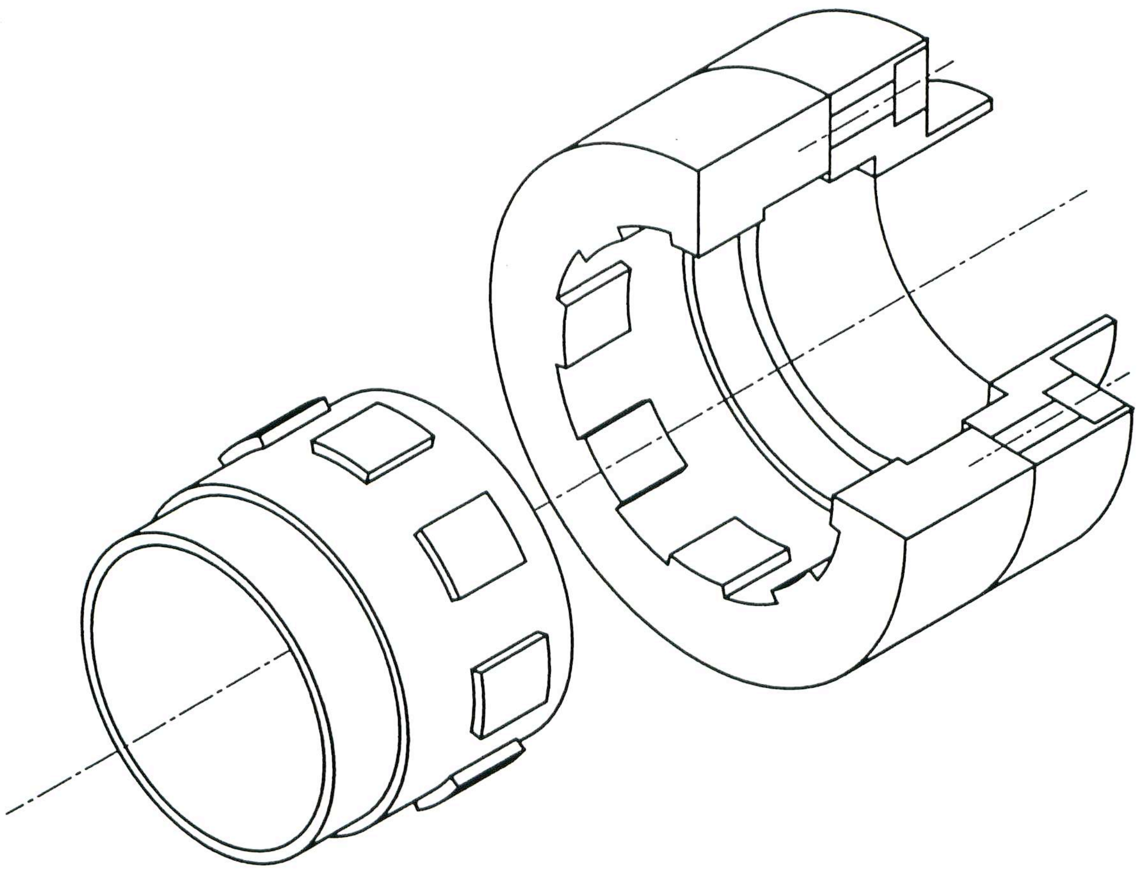


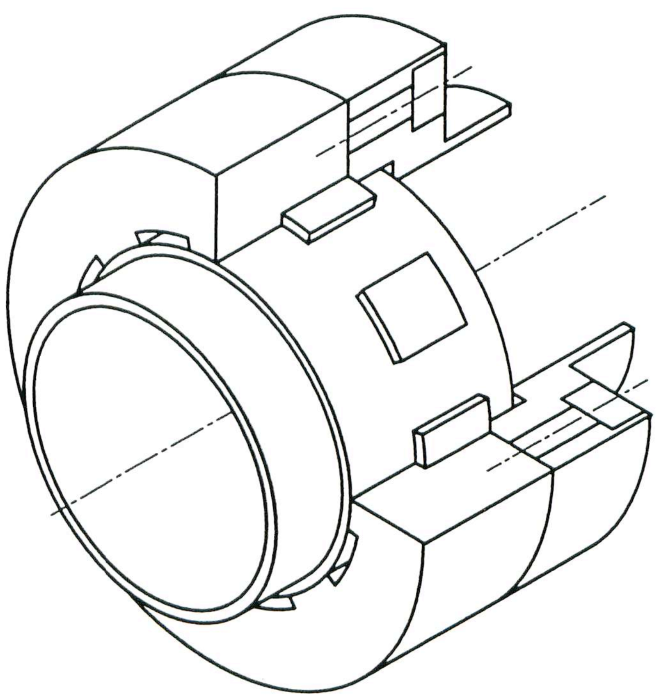
3/4/96
4.91°
10
ϕ52
6
8.9
mask
QCS-L
1050
40
360
400
50
50
150

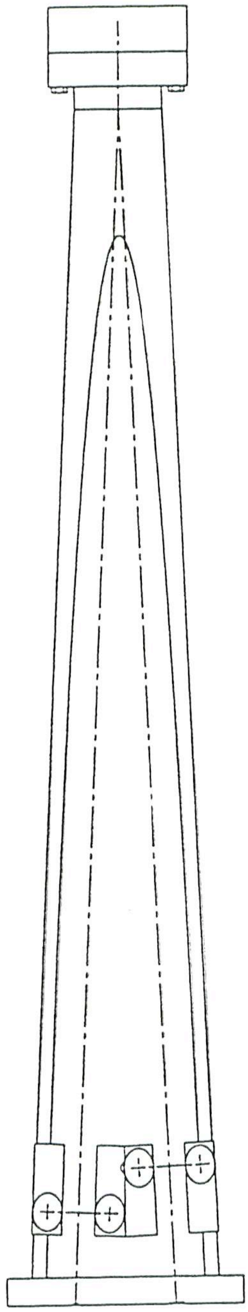

3/4/96
QCS-L
mask

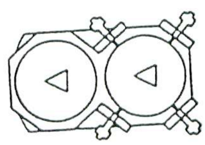

3/4/96
mask
QCS-L

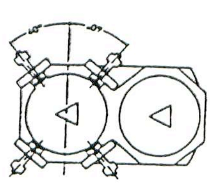

3/4/96
mask
QCS-L

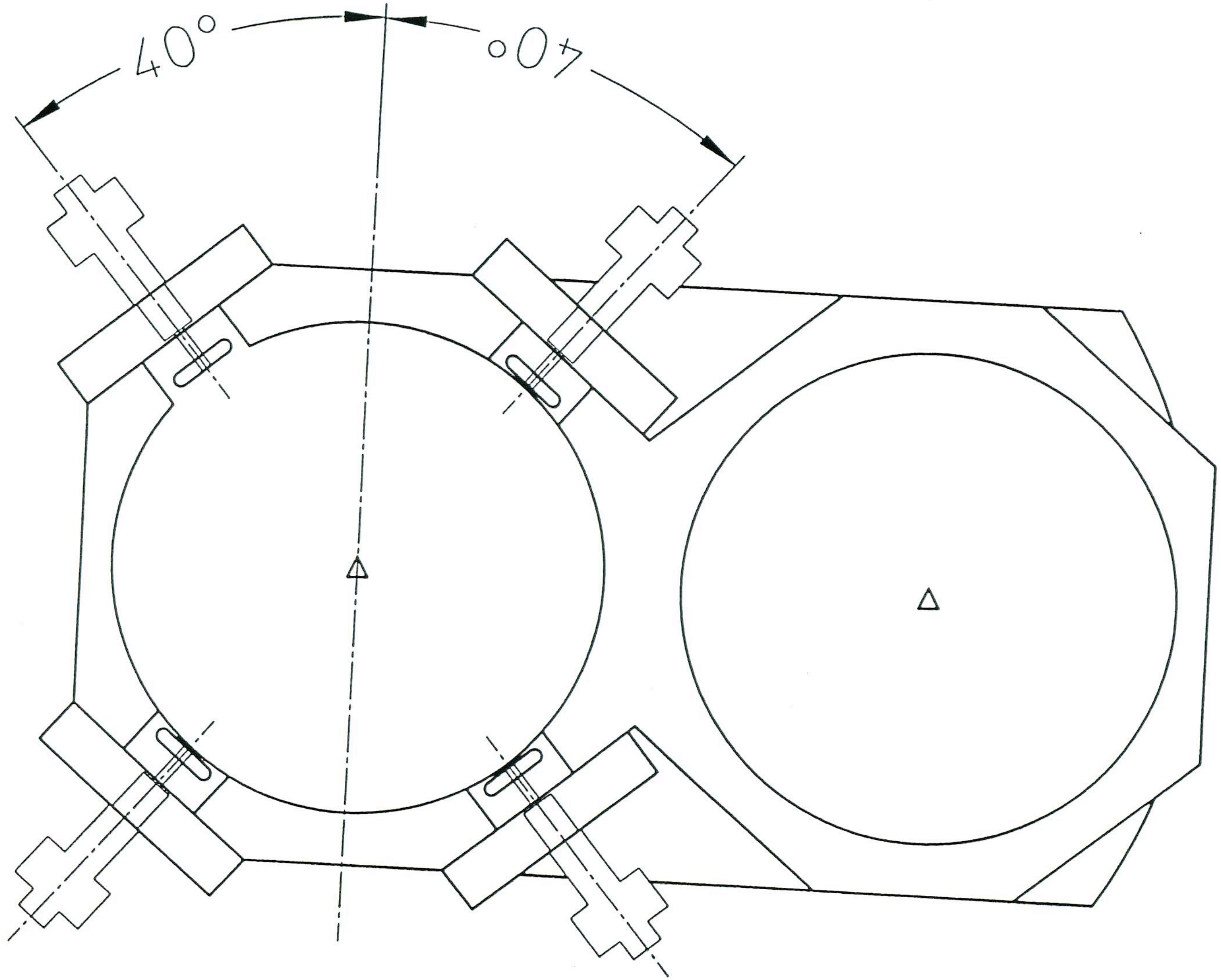











40°
40°

9. *Important Milestones in 1997 and 1998*

A. Completion of radiation shield bridge, pre-alignment of BELLE and installation of movable tables (Spring, 97).

B. Installation and testing of QCS and BELLE solenoid cryogenics, cryostats.

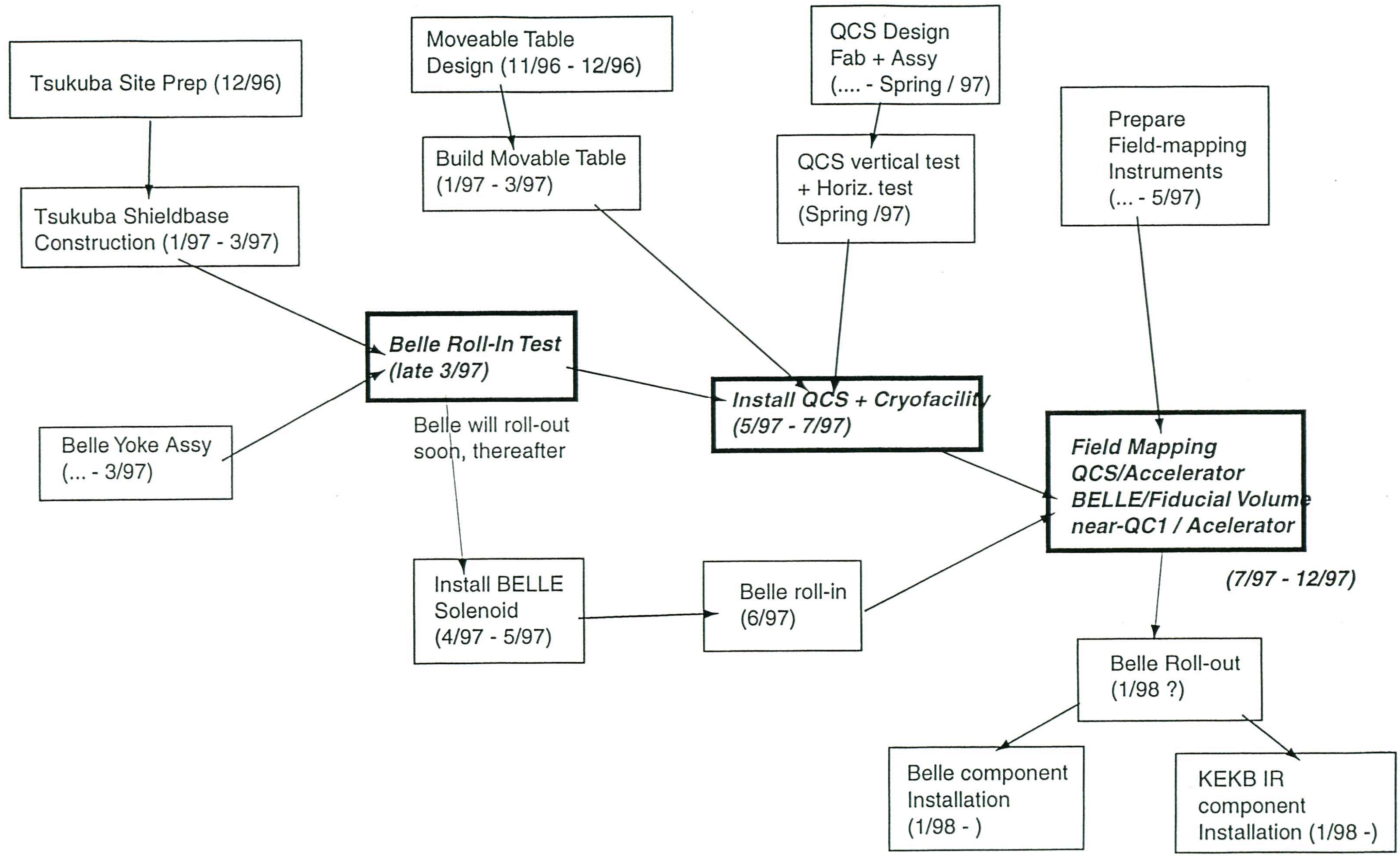
C. Simultaneous operation of QCS + BELLE soilenoid and magnetic field mapping (Fall, 97), before "stuffing" the BELLE detector.

D. Test run. BELLE may or may not be at the IP (Early summer or Fall, 98)

Schedule plans for A, B and C exist.

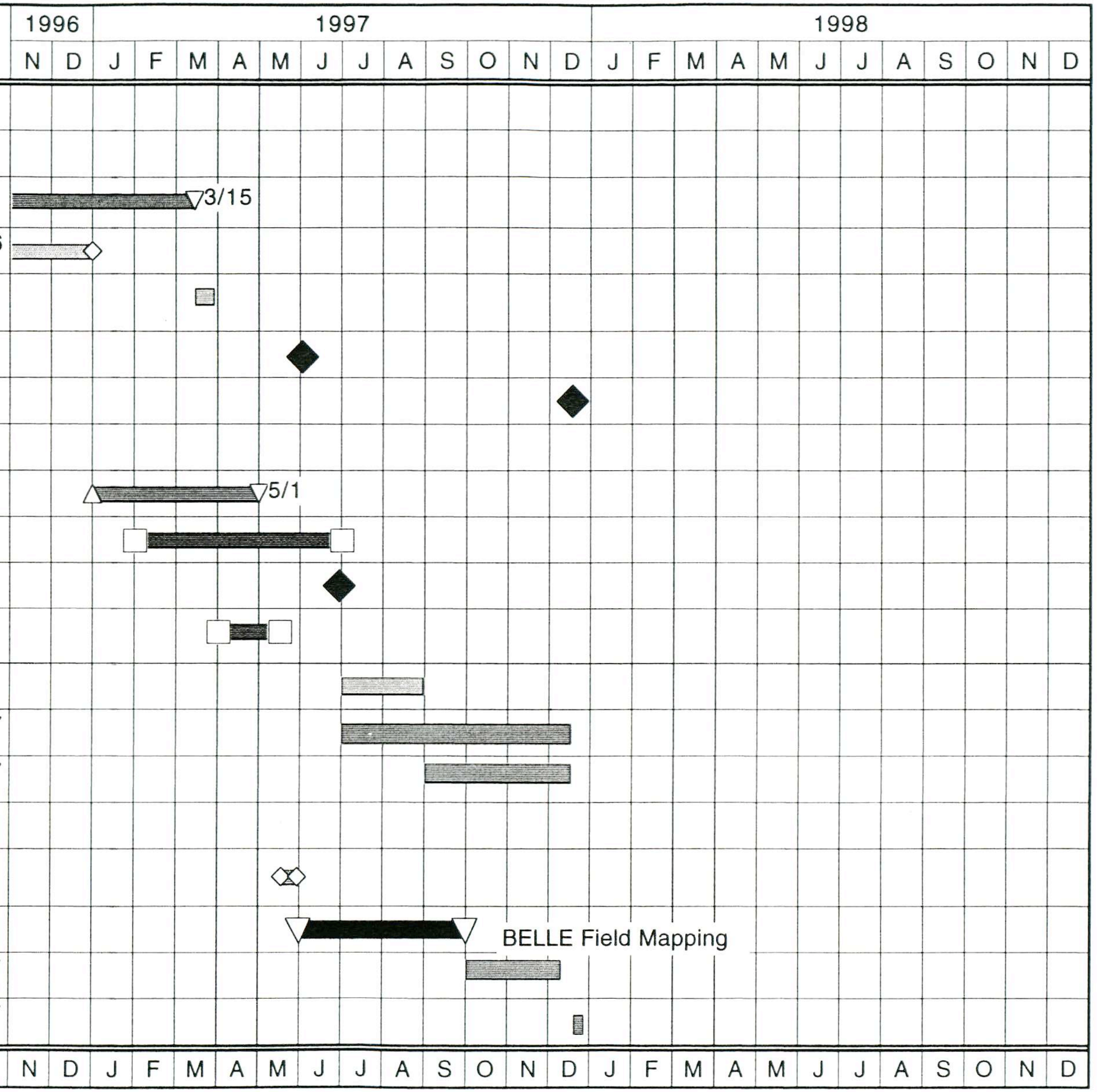
For D, we need to integrate plans for the vacuum system, monitors, QC1/QC2 magnets, and the rest of the TSUKUBA straight section. Task for this summer and after.

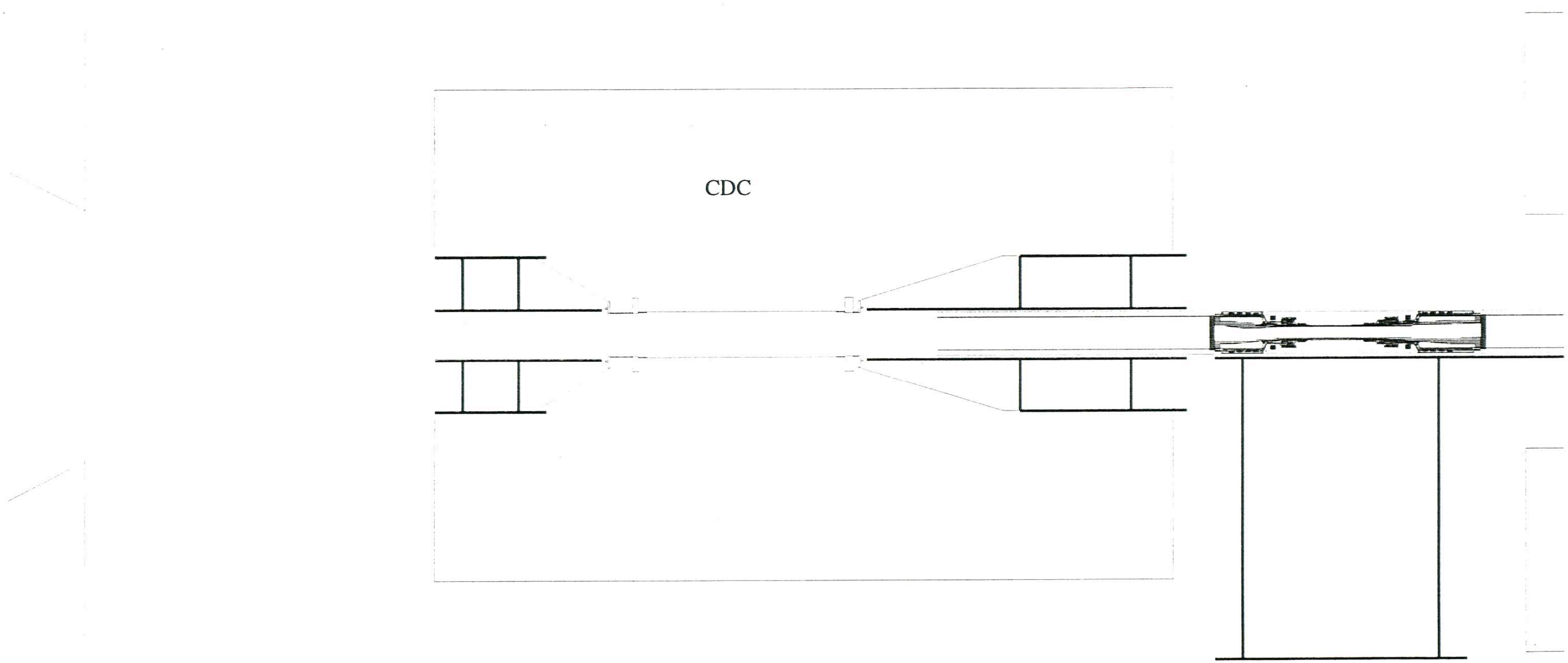
KEKB Tsukuba IR Work Flow-chart *(11/12/96, N.Toge)*



Activity Name	Start Date	Finish Date	1996 (N D) – 1997 (J F M A M J J A S O N D) – 1998 (J F M A M J J A S O N D)
Prep work for Tsukuba Shield Bridge			
Hall Preparation	10/13/96	11/2/96	ve anti-fire wall, and straight section decks
Secure recylable QCS elements	11/3/96	11/16/96	
Remove old moveable table	11/17/96	11/30/96	
Tsukuba Shield Bridge			
Bridge Construction	12/1/96	2/28/97	2/28
Establish survey marks	3/1/97	3/16/97	
Painting	4/1/97	4/27/97	
QCS Construction and Installation			
support structure Installation	4/1/97	4/30/97	
Cryostat Installation	7/1/97	7/31/97	
He System Installation	5/1/97	7/31/97	
BuildPowersupply + Control	10/1/96	3/31/97	3/31
Install PowerSupply + Control	6/1/97	7/31/97	
Operate PowerSupply + Control	9/1/97	12/16/97	
Commission QCS System	8/1/97	8/31/97	
Field Mapping	9/1/97	9/30/97	
Operate for BELLE Fleld-Mapping	10/1/97	11/30/97	
QC1 field mapping	12/1/97	12/15/97	
			N D J F M A M J J A S O N D J F M A M J J A S O N D

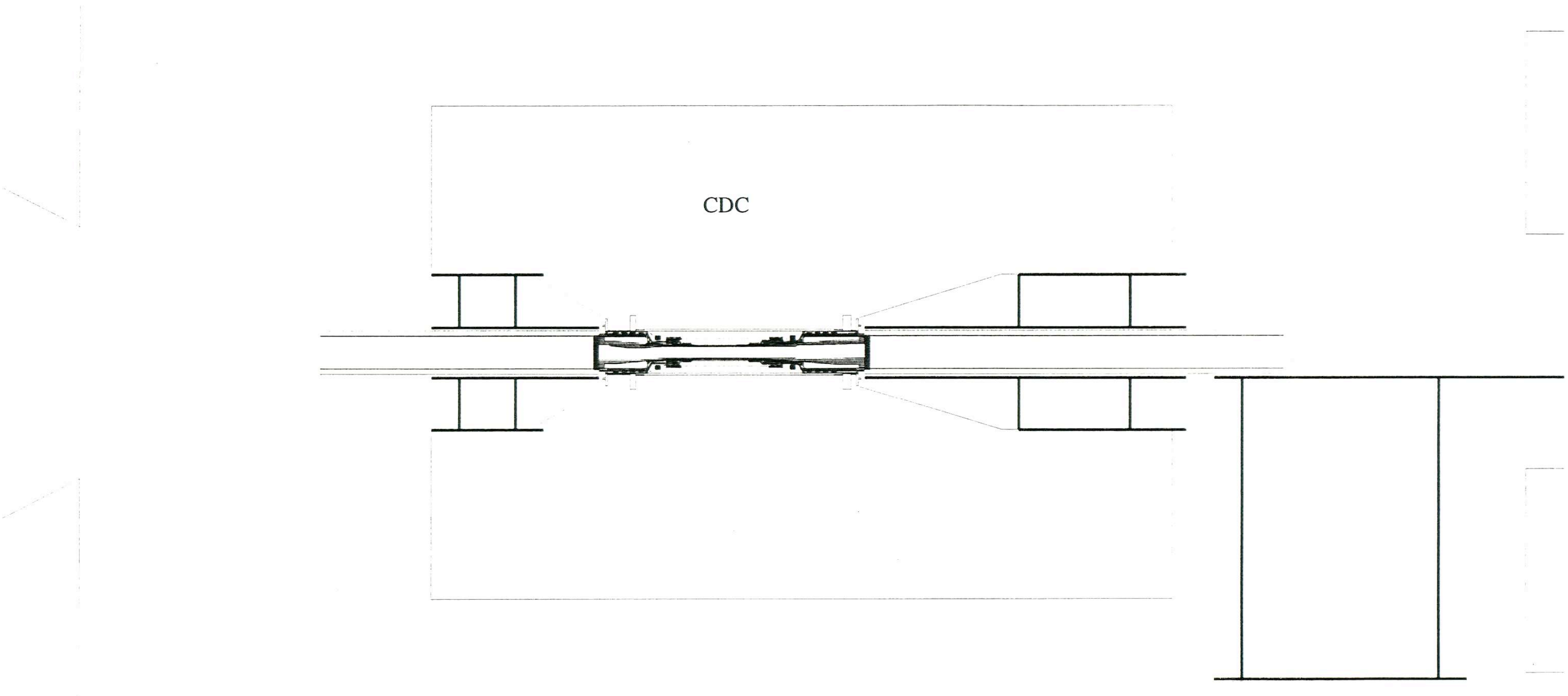
Activity Name	Start Date	Finish Date
BELLE Iron Yoke		
Modify Base Frame	7/15/96	8/17/96
Assembly	8/18/96	3/15/97
Cable tray/detector bridge	10/15/96	12/31/96
Roll-in/Inspection/RollOut	3/15/97	3/29/97
Roll-in for QCS& filed mapping	6/1/97	
Roll-out for detector installtion	12/19/97	
BELLE Solenoid		
Cryogenics Assembly	1/1/97	5/1/97
Cryogenics Installation	2/1/97	6/30/97
Cryogenics Inspection	6/30/97	
Coil Installation	4/1/97	5/15/97
Coil Operation Test	7/1/97	8/30/97
Cryogenics Operation	7/1/97	12/15/97
Coil Operation	9/1/97	12/16/97
BELLE Field Mapping		
Install Devices in BELLE	5/18/97	5/31/97
Debug Devices/software	6/1/97	9/30/97
BELLE Field Meas.	10/1/97	12/10/97
Disassemble device/Roll-out	12/20/97	12/26/97





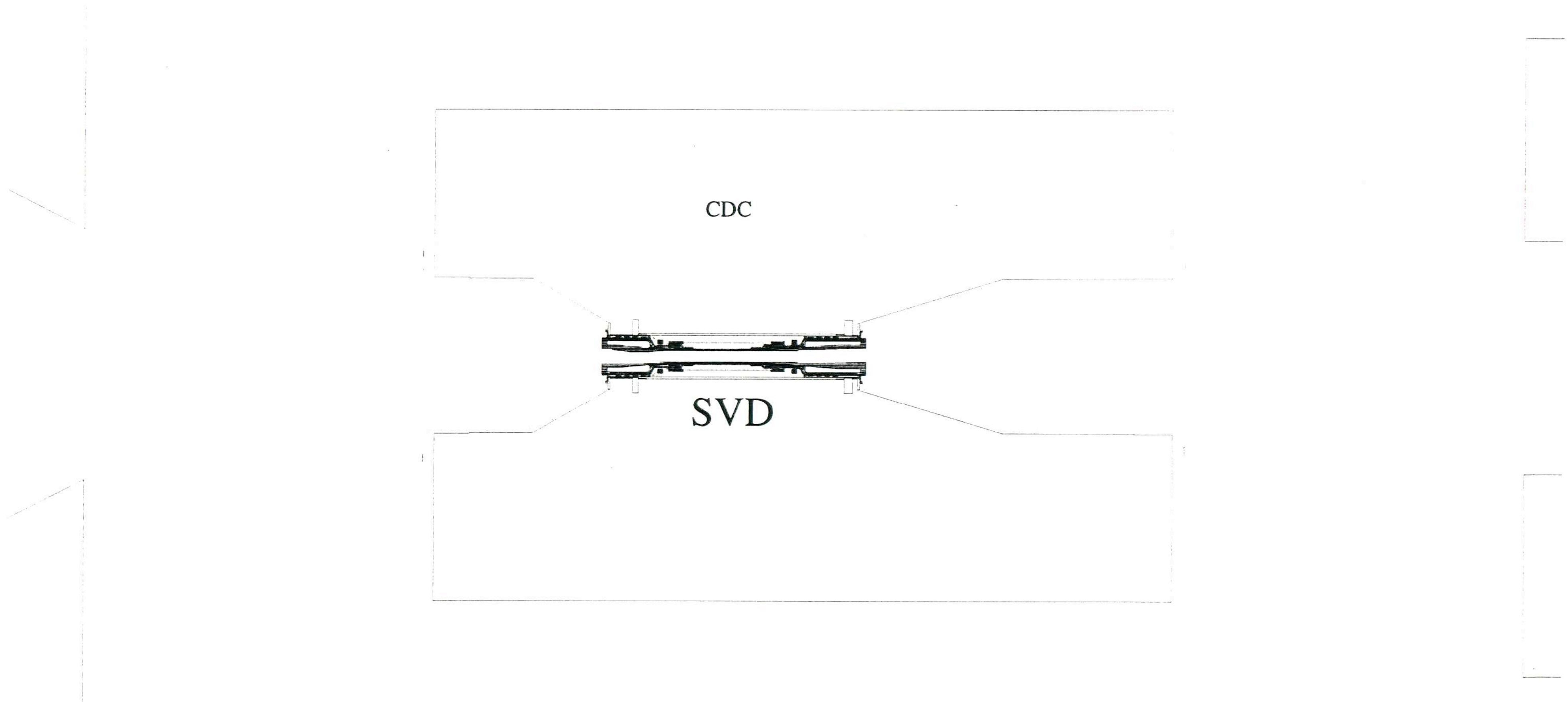
Z-R view of SVD (1/20 size, mm)

Postscript by Y.Yamada (Version 1.18 November 26 1996)



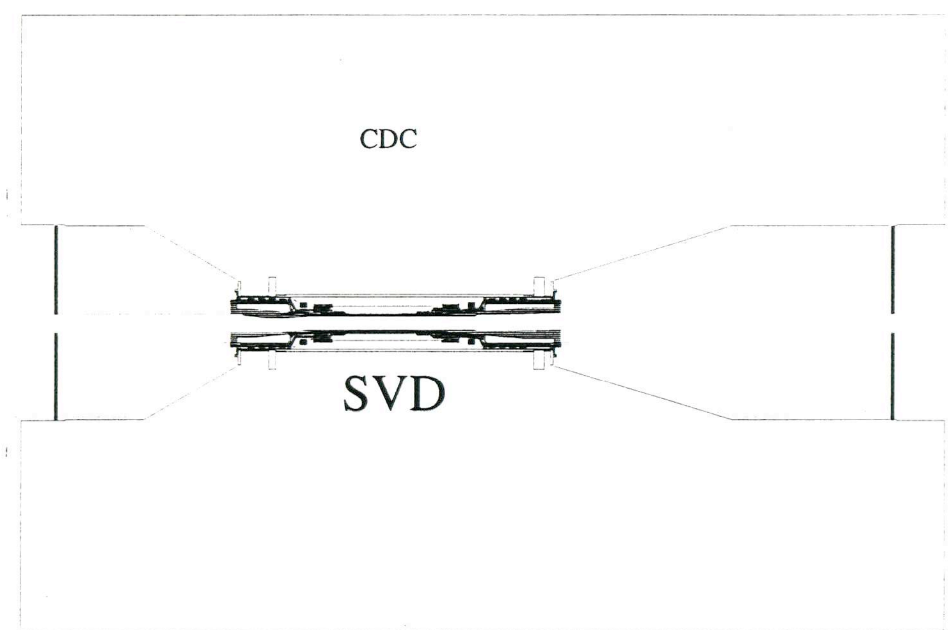
Z-R view of SVD (1/20 size, mm)

Postscript by Y.Yamada (Version 1.18 November 26 1996)



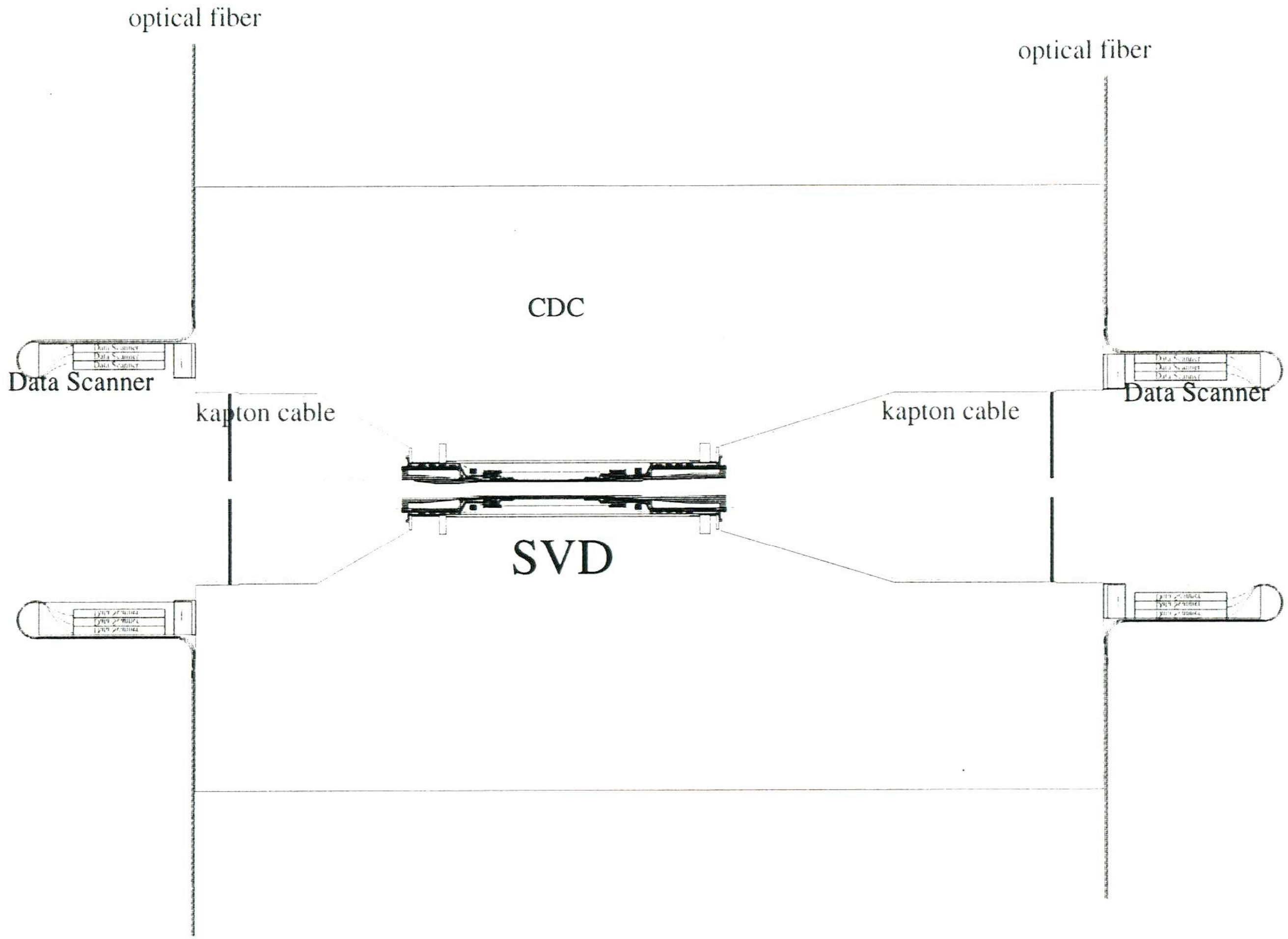
Z-R view of SVD (1/20 size, mm)

Postscript by Y.Yamada (Version 1.18 November 26 1996)



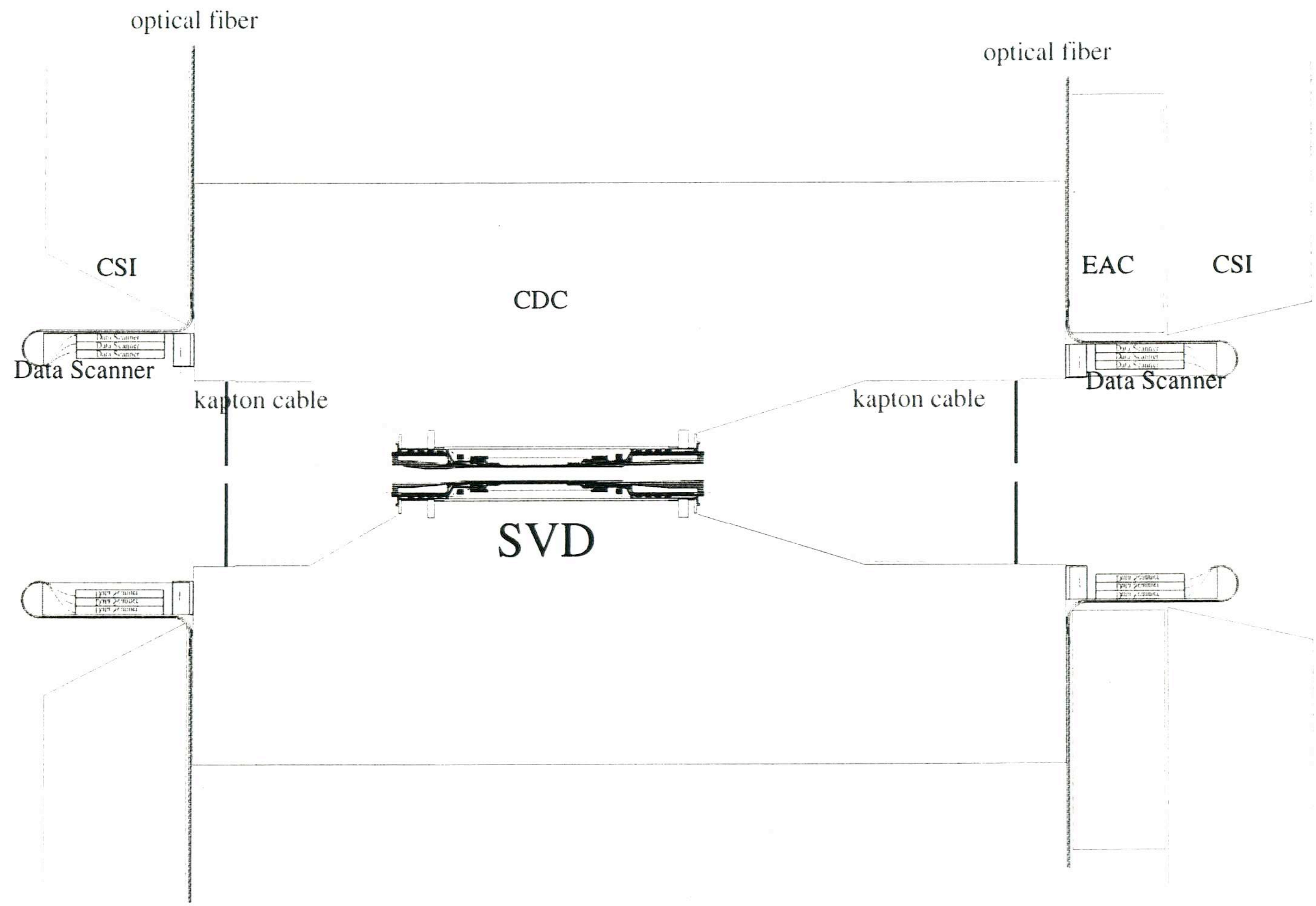
Z-R view of SVD (1/20 size, mm)

Postscript by Y.Yamada (Version 1.18 November 26 1996)



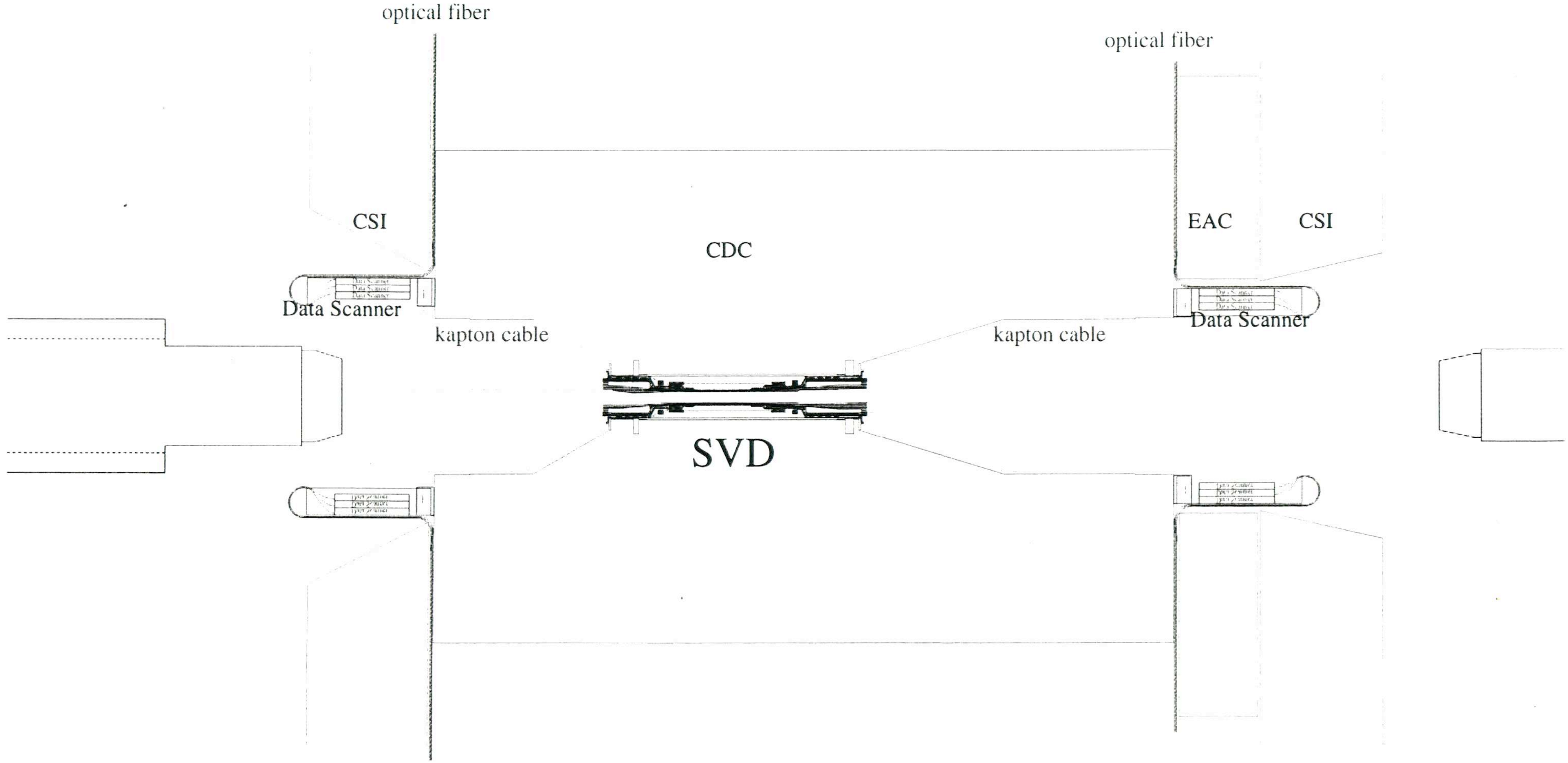
Z-R view of SVD (1/20 size, mm)

Postscript by Y.Yamada (Version 1.18 November 26 1996)



Z-R view of SVD (1/20 size, mm)

Postscript by Y.Yamada (Version 1.18 November 26 1996)



Z-R view of SVD (1/20 size, mm)

Postscript by Y.Yamada (Version 1.18 November 26 1996)

10. Remaining Burning Issues

1. BPMs at QCS front.

2. Details of vac frange etc -- space allocation near the QCS front. Concrete vac system design over-all.

3. More gory details of IR component installation procedure (e.g. BPMs)

4. Access method to magnet movers, vac components within the QCS / QC1-2 support structure. Allocation of LCW lines, power cables, busbars, etc.

5. Prepare instrumentations for field mapping work; detailed procedures.

6. Must layout the road-map of commissioning work.