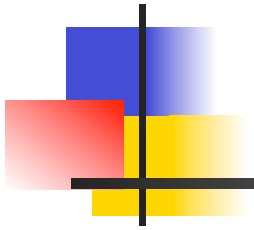
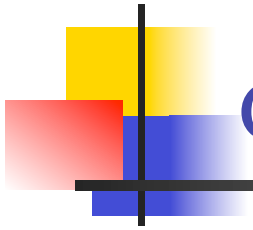


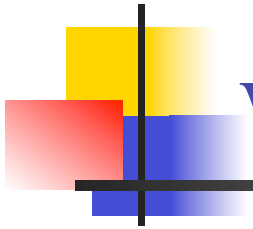
Special quadrupole magnets for Super KEKB

M. Tawada, N. Ohuchi,
H. Nakayama, K. Satoh



Contents

- Working parameters
- Super KEKB IR design
- Issues for special magnets
- Magnets design
- Summary



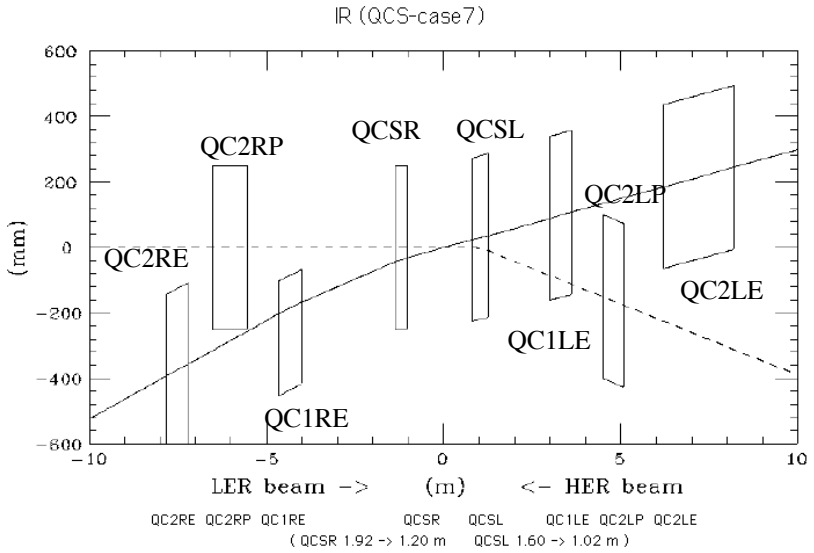
Working parameters

- IP beta function
  -Vertical: 6.5→3mm
  -Horizontal: 59→15cm

- Crossing angle ← special magnets design (Physical aperture)
  ±11→ ± 15mrad

- Required acceptance → Funakoshi -san's talk
  $\varepsilon_x / \varepsilon_y = 6.0*10^{-6} / 6.7*10^{-7}$m (KEKB-HER)
  $1.2*10^{-5} / 1.5*10^{-6}$m (KEKB-LER)
  => exchange particles for HER and LER
  $\varepsilon_x / \varepsilon_y = 6.0*10^{-6} / 6.7*10^{-7}$m (SuperKEKB-LER/HER)
  →might be tight for SuperKEKB-HER ?

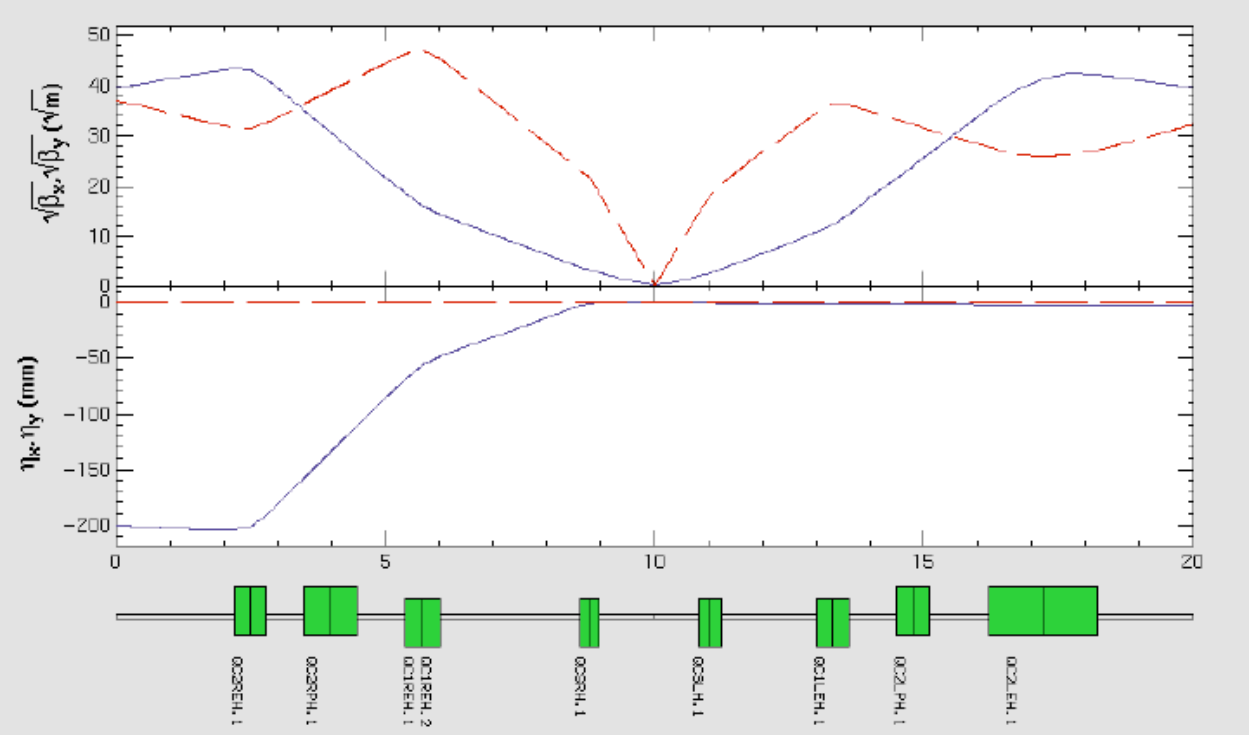
Super KEKB IR design



- The lower vertical beta function can be obtained by moving QCS closer to IP.
- QCS can be located closer to IP by making the compensation solenoids overlap with QCS.
- QC1, 2 magnets will be located at the same positions with KEKB.

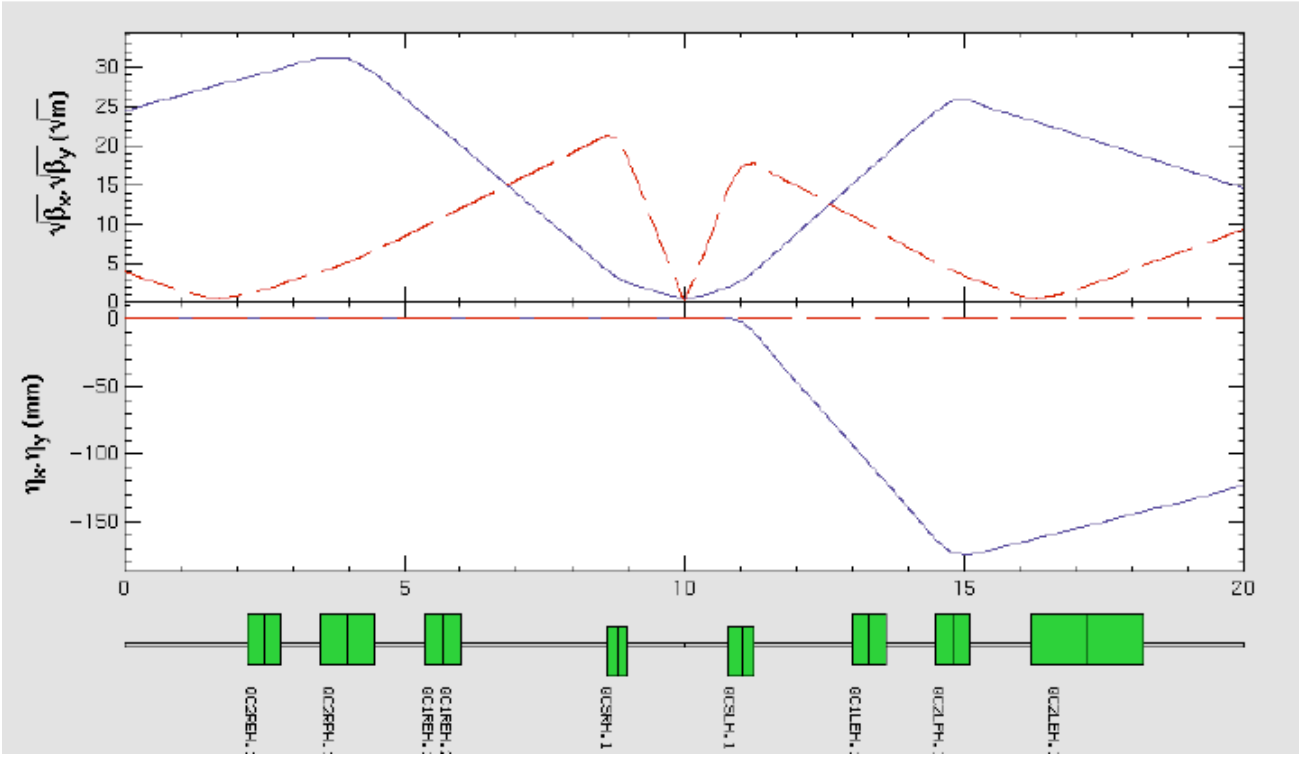
Super KEKB IR lattice (HER)

HER BX = 15 cm, BY = 0.3 cm



Super KEKB IR lattice (LER)

LER BX = 15 cm, BY = 0.3 cm



Issues for special magnets

- IR Physical Aperture
  →The design work is in progress.

- Dynamic aperture reduction due to the nonlinear field by special magnets.
  → Koiso-san's talk.

Magnet design

- Six septum quadrupole magnets.
  Four magnets for HER and two for LER.

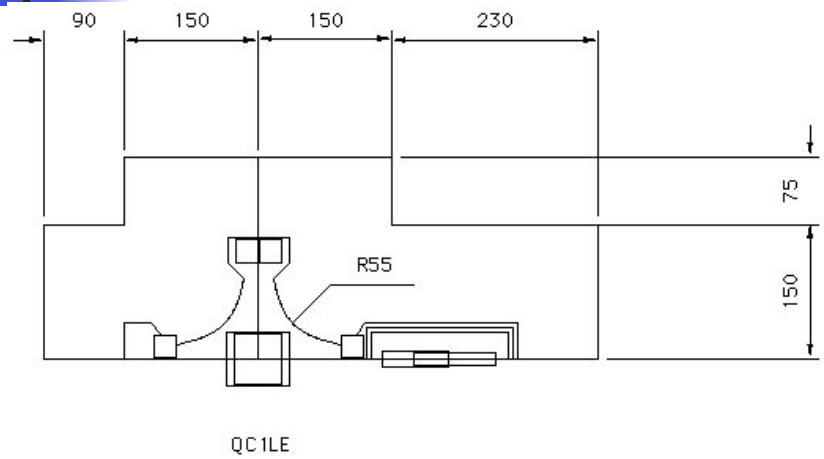
- For each magnet, we are designing both types of
  - normal-conducting magnets
  - super-conducting magnets →good field quality

- Requirements
  - |dB/dx|/|dB/dx@x=0|< 1E-3
  - Leakage fields < 1 Gauss

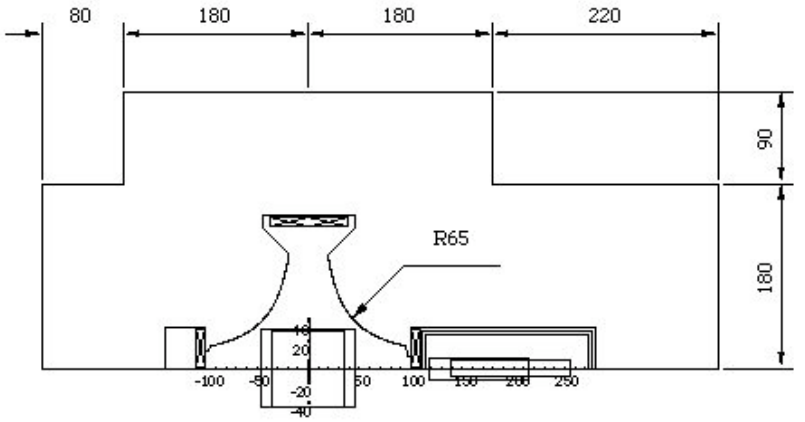
Specifications of special magnets

		QC1LE	QC2LE	QC1RE	QC2RE	QC2LP	QC2RP
Entrance(e+)	H(mm)	35.3	103.6	35.2	101.0	53.1	85.9
	V(mm)	30.4	22.8	37.9	27.3	27.2	29.7
Exit(e+)	H(mm)	26.5	86.7	45.4	106.2	65.0	64.3
	V(mm)	29.1	23.1	38.7	26.6	25.6	34.1
Entrance(e-)	H(mm)	46.1	45.8	48.8	73.2	60.0	76.6
	V(mm)	7.3	4.0	10.1	1.9	4.2	3.2
Exit(e-)	H(mm)	36.9	56.9	58.5	70.3	63.0	71.4
	V(mm)	9.2	0.5	8.2	0.9	2.6	5.5
Beam separation	Entrance (mm)	219.2	556.5	166.7	318.4	285.2	285.6
	Exit(mm)	175.2	409.9	197.2	346.5	329.2	238.6
Field gradient	T/m	13.2	3.1	11.7	10.0	6.1	2.9
Pole length	m	0.6	2.0	0.6	0.6	0.6	1.0

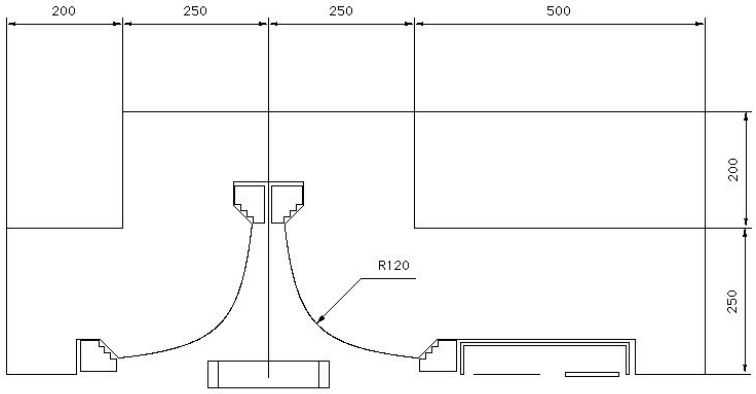
Preliminary design of special magnets (HER)



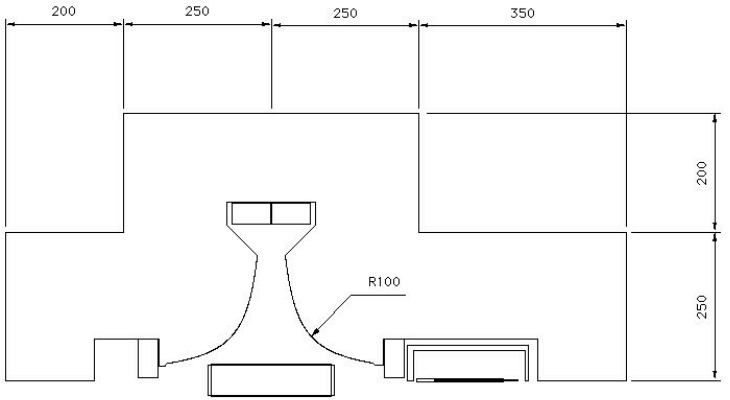
QC1LE



QC1RE

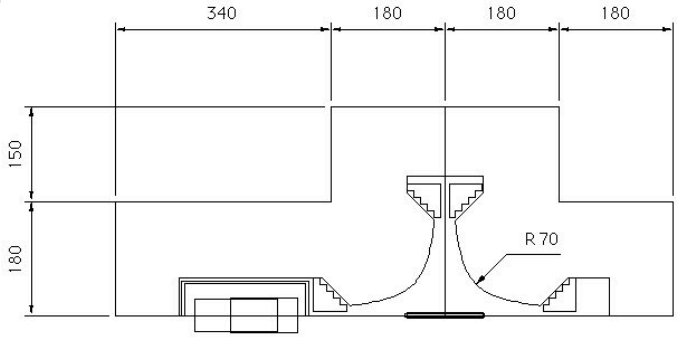


QC2LE

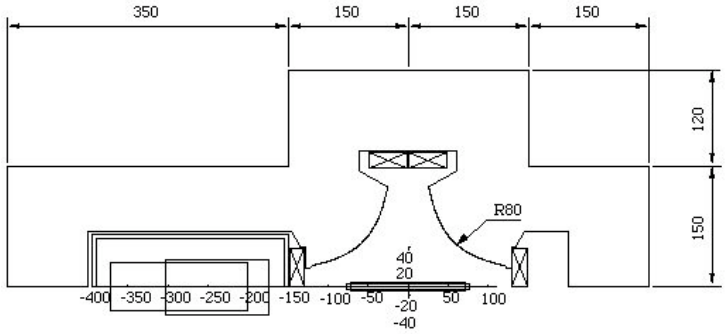


QC2RE

Preliminary design of special magnets (LER)

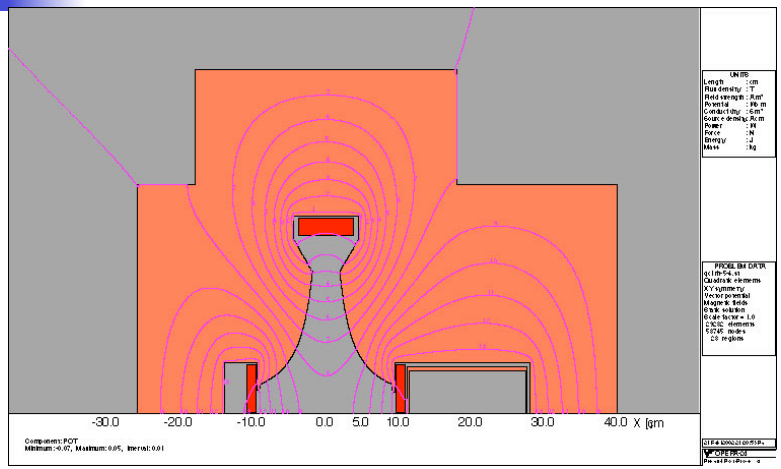


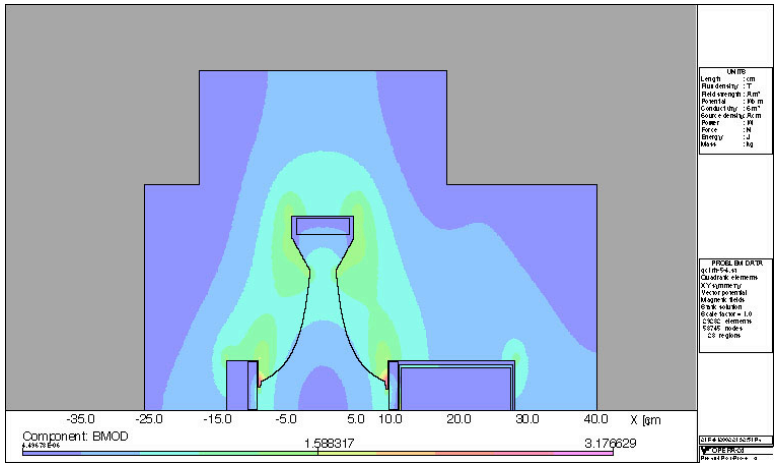
QC2LP

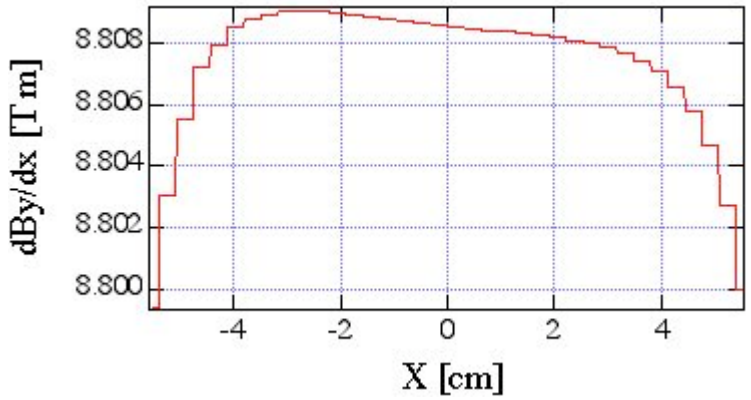


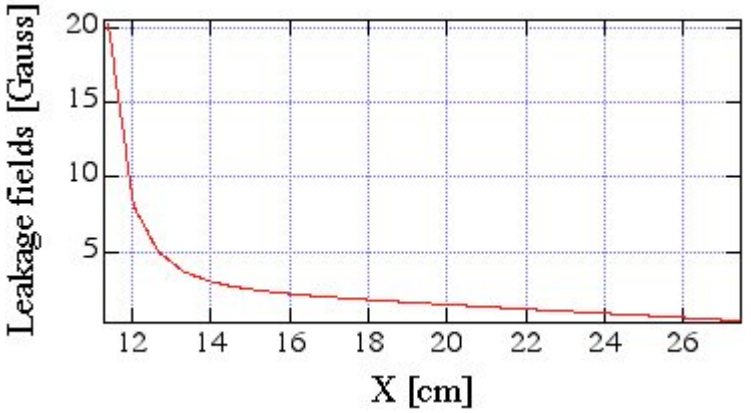
QC2RP

Preliminary design of QC1RE



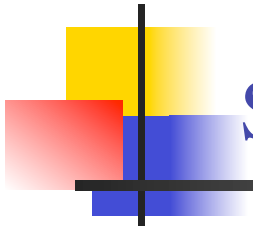






Preliminary design of special magnets (normal)

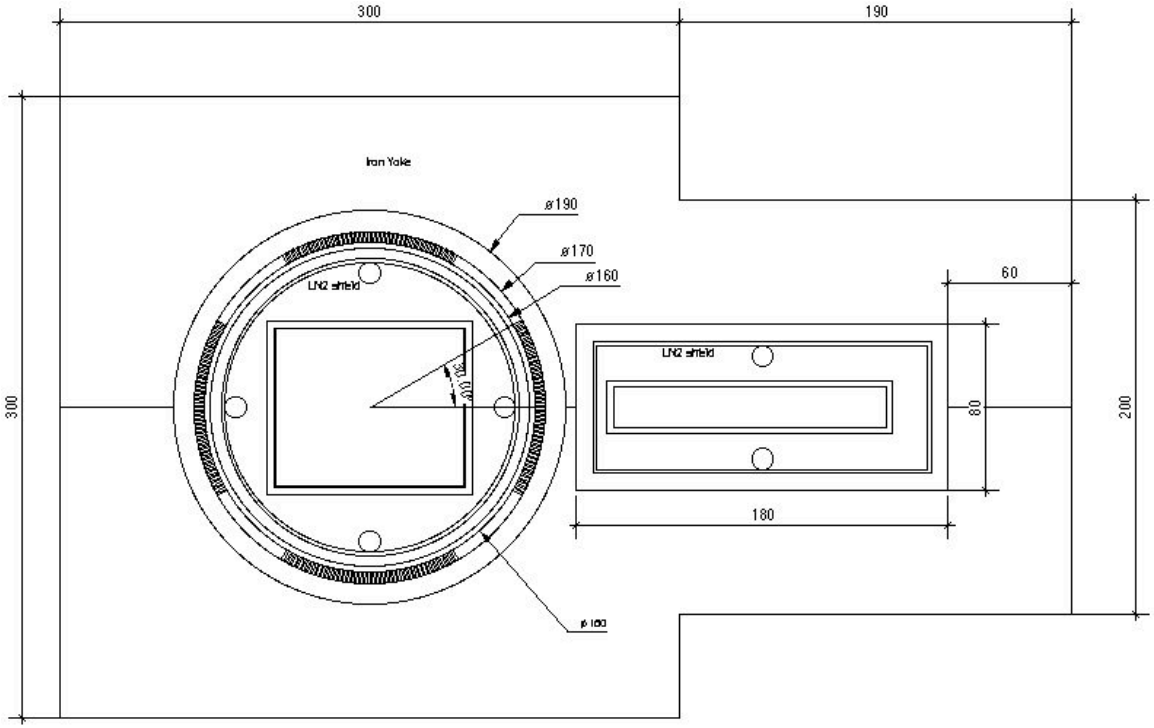
	unit	QC1LE	QC2LE	QC1RE	QC2RE	QC2LP	QC2RP
gradient	T/m	13.1	3.1	8.8	6.0	6.11	2.88
Bore radius	mm	55	120	65	100	70	80
Pole length	mm	600	2000	800	1000	600	1000
Width	mm	620	1200	660	1050	880	800
Height	mm	450	800	540	1000	660	510
Magnetm otive force	AT	16000	18000	15000	24000	12000	7500
No. of turns		9	26	8	12	15	10
Current density	A/mm^2	50	11.4	56	21	13	14



Super-conducting special magnets

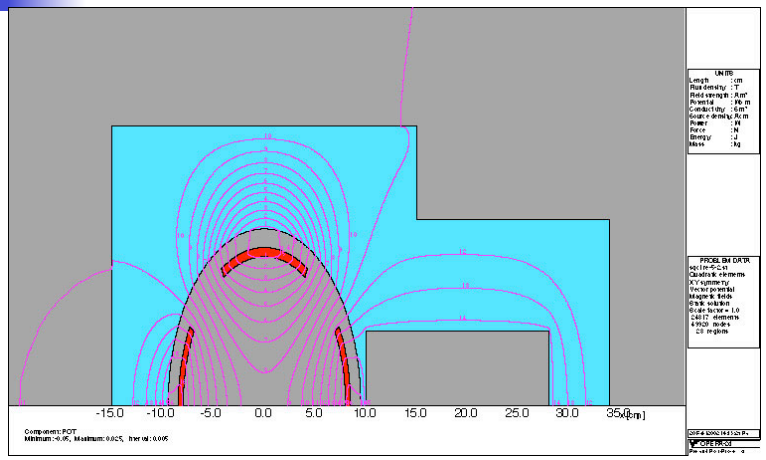
- The design work has just started.
- Assumption
  - Each magnet should be separated.
  - These magnets should be warm bore type.
  - We need another He-cooling system.
- Issues
  - These magnets have an asymmetrical iron-yoke. How can we control the field quality ?
  - Can we connect the vacuum chamber in the limited space?
  - Heating of vacuum chamber due to synchrotron radiation from QCS-R
  - …

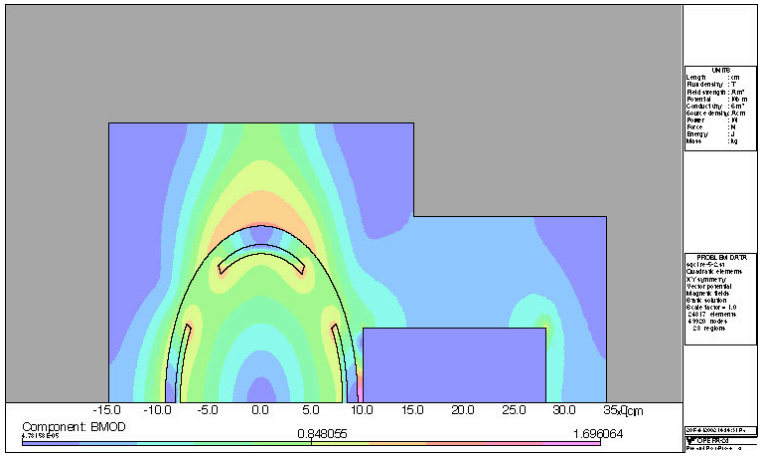
Preliminary design of super-conducting QC1RE by N. Ohuchi

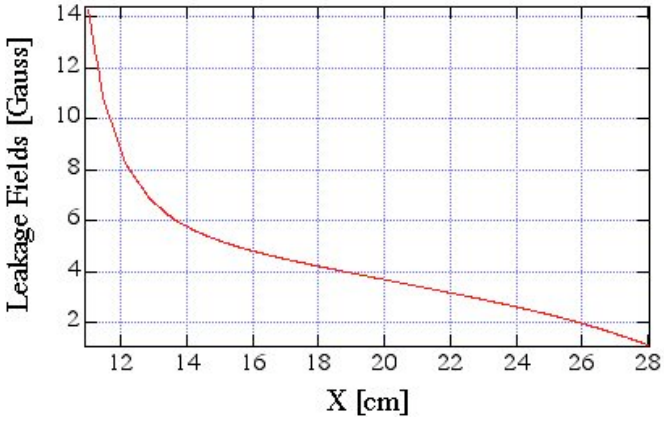


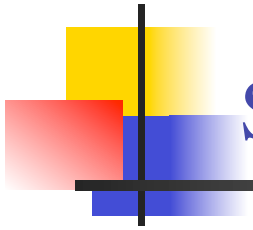
Super-conducting QC1RE
designed by N. Ohuchi

Preliminary design of super-conducting QC1RE









Summary

- The design work of special magnets has just started.
- At present, we are considering both type of normal-conducting and super-conducting magnets for each magnet.
  - The design for normal conducting magnets may be acceptable.
  - The design for super-conducting magnets is now in progress.