

# **Final focus magnet and its cryogenic system at KEKB**

KEK

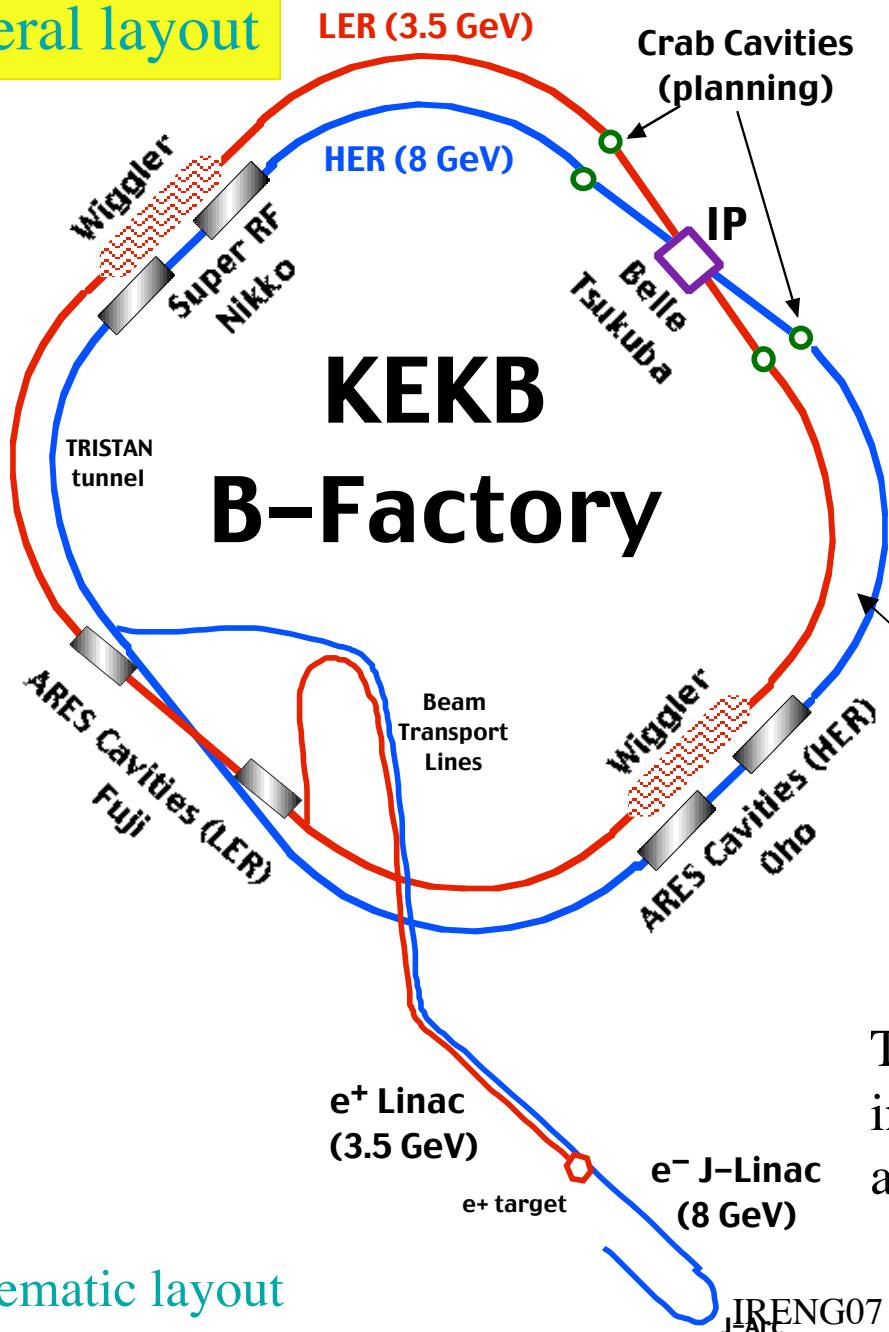
K. Tsuchiya

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# Contents

- Layout and support system
- SC Magnets
  - magnet, cryostats, excitation circuits
- Cryogenic System

## General layout



**KEKB**

KEKB: 8 GeV e<sup>-</sup> x 3.5 GeV e<sup>+</sup>  
collider for B-physics

Utilizing the ~3km  
TRISTAN tunnel

The KEKB construction was completed  
in 1997 and it has been working for  
about 10 years.

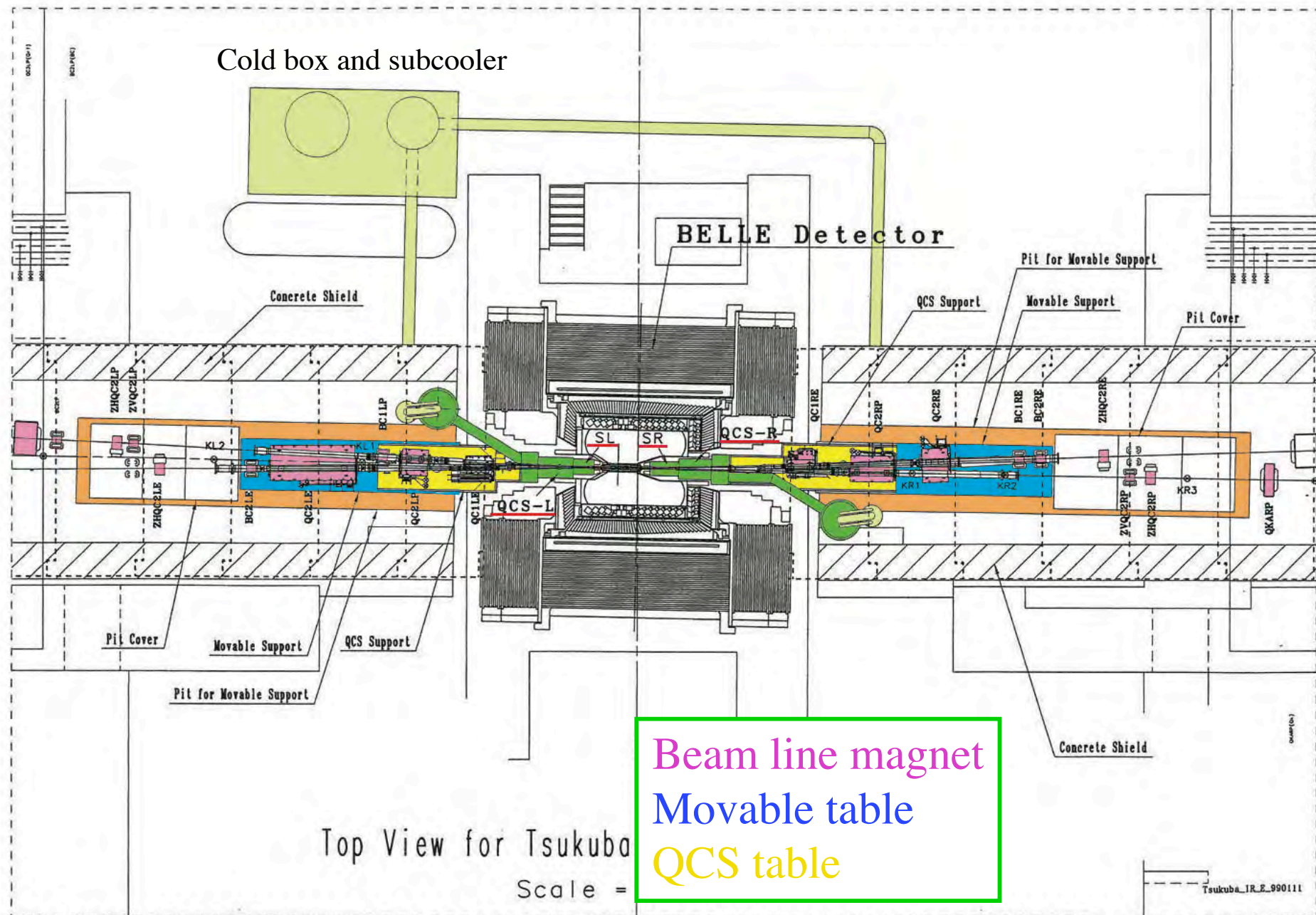
## Schematic layout

Peak Luminosity  $1.7 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$

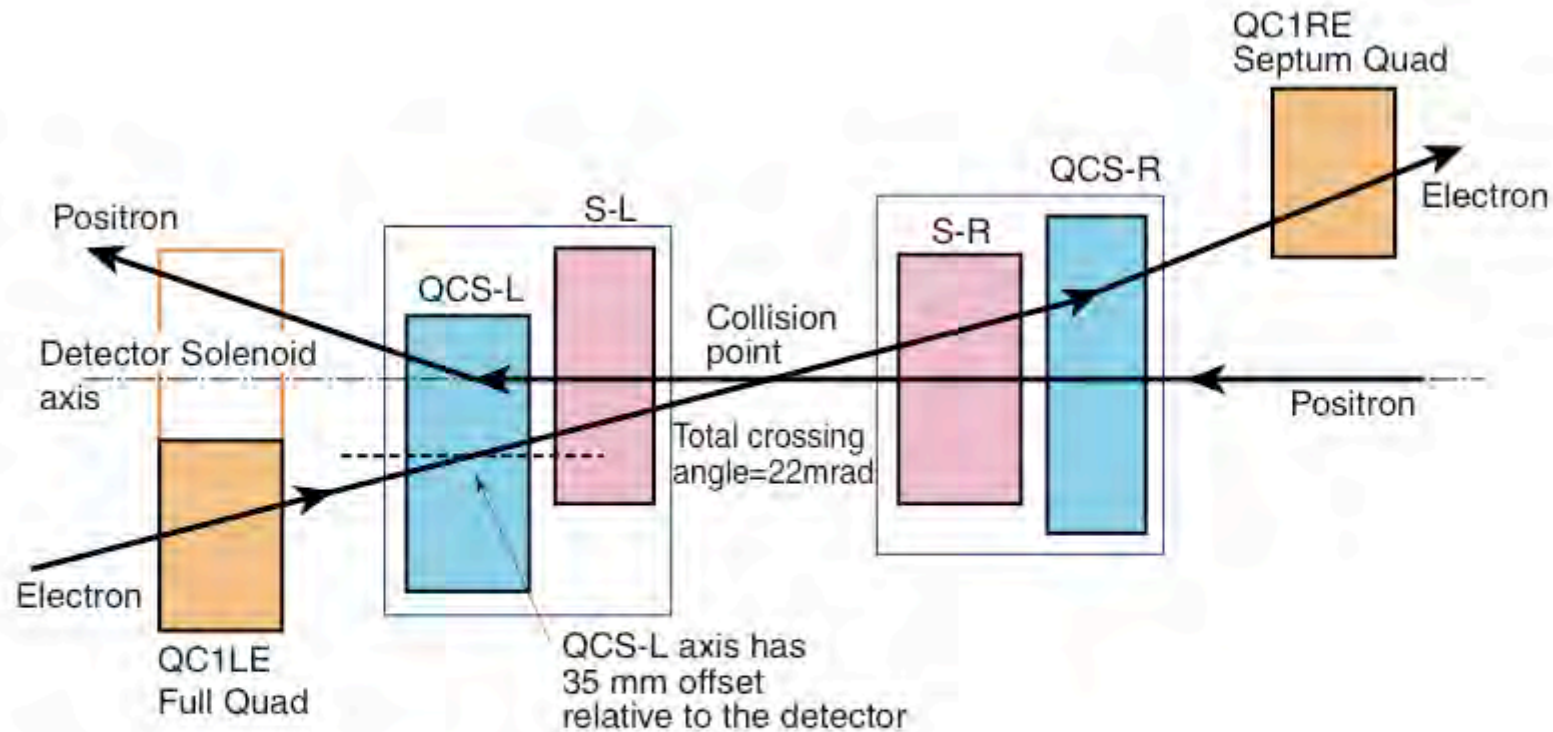
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## General layout

## Top view of the KEKB-IR



# Beam line layout near KEKB-IR

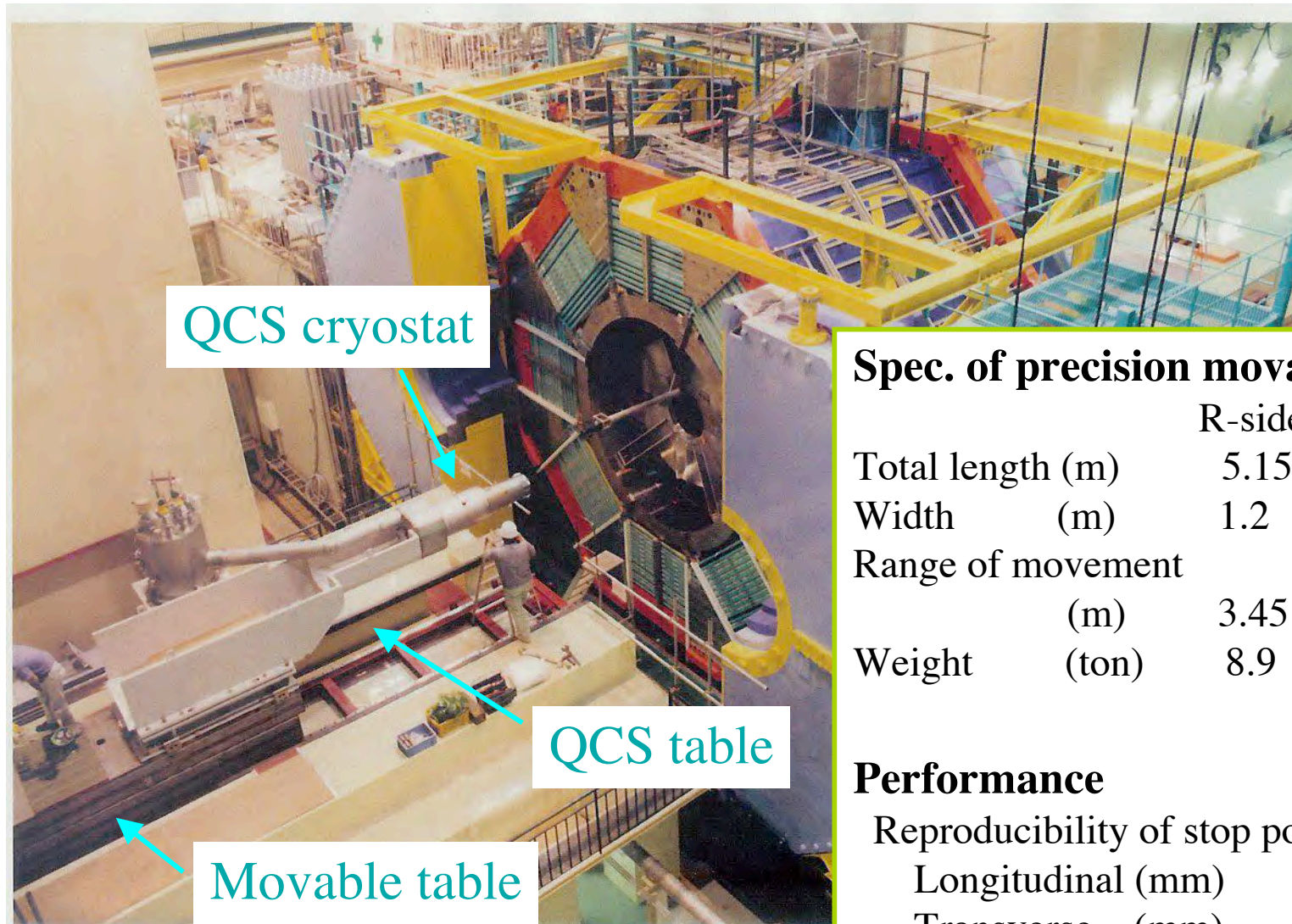


Schematic layout of the beam line near IP



## General layout

# Support structure of SC magnet cryostat



### Spec. of precision movable table

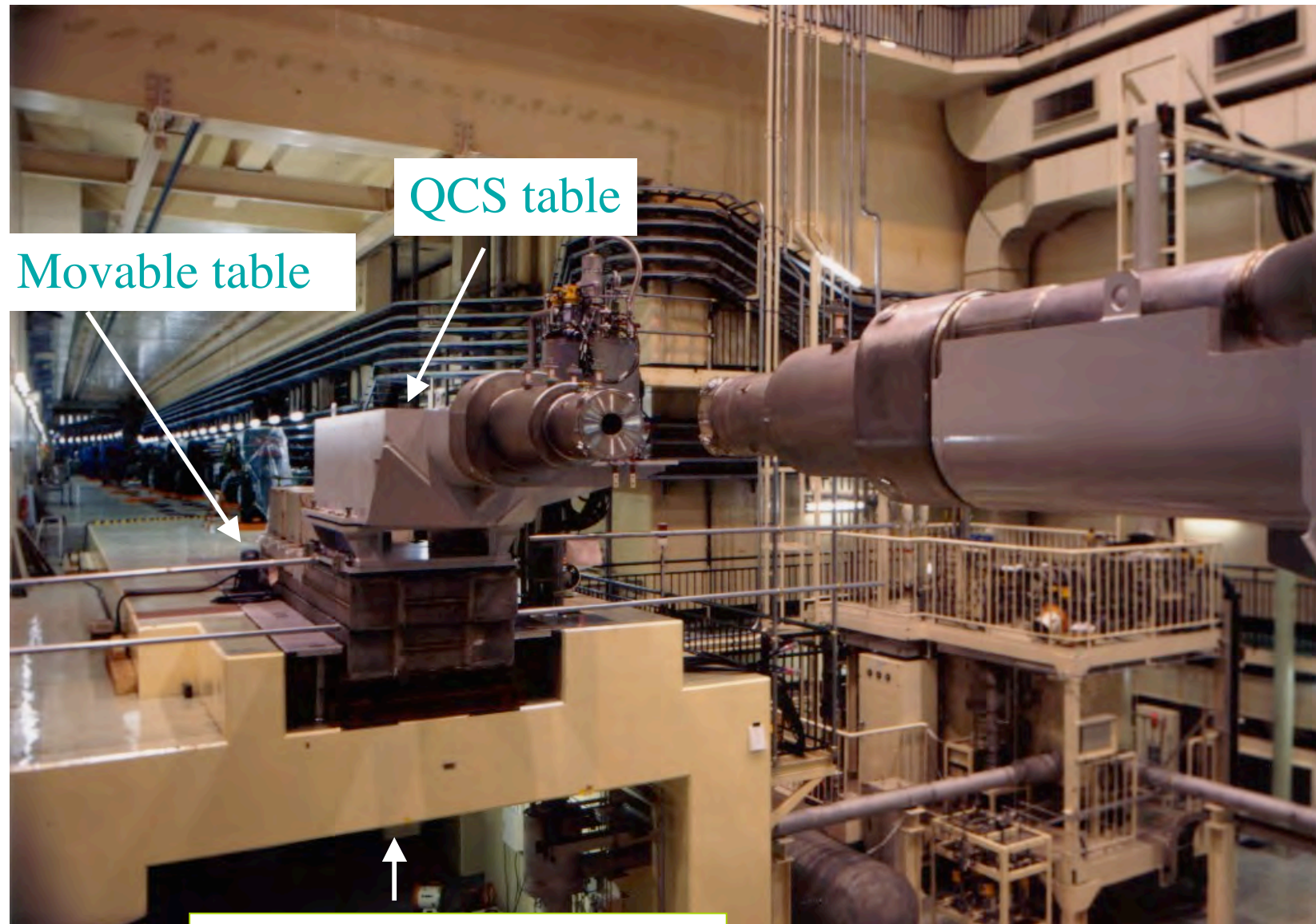
	R-side	L-side
Total length (m)	5.15	5.6
Width (m)	1.2	1.2
Range of movement		
(m)	3.45	4.24
Weight (ton)	8.9	9.6

### Performance

Reproducibility of stop position

Longitudinal (mm)	0.01
Transverse (mm)	0.02

## General layout

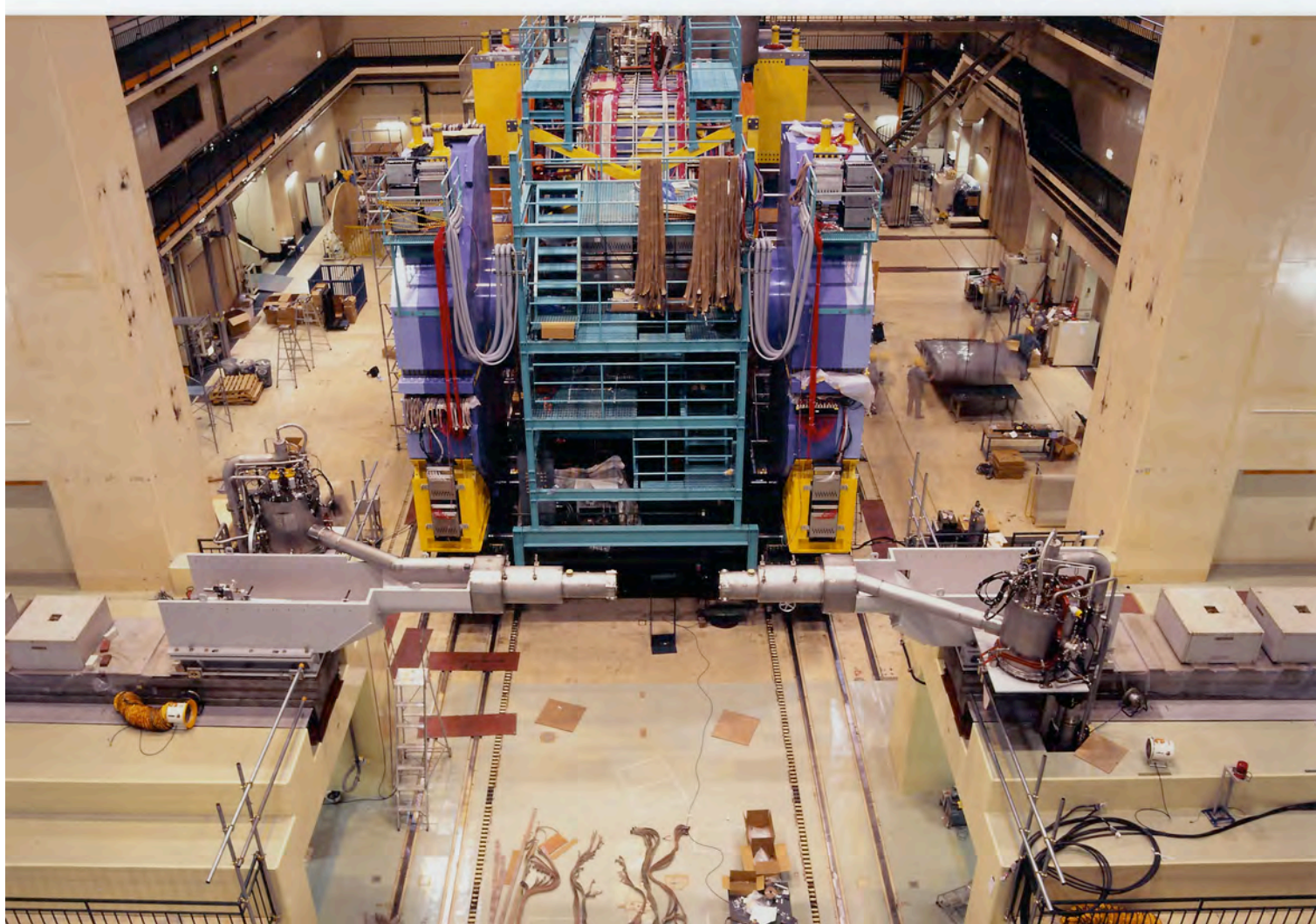


Bridge made of concrete



## General layout

### Installed cryostats and their support structure

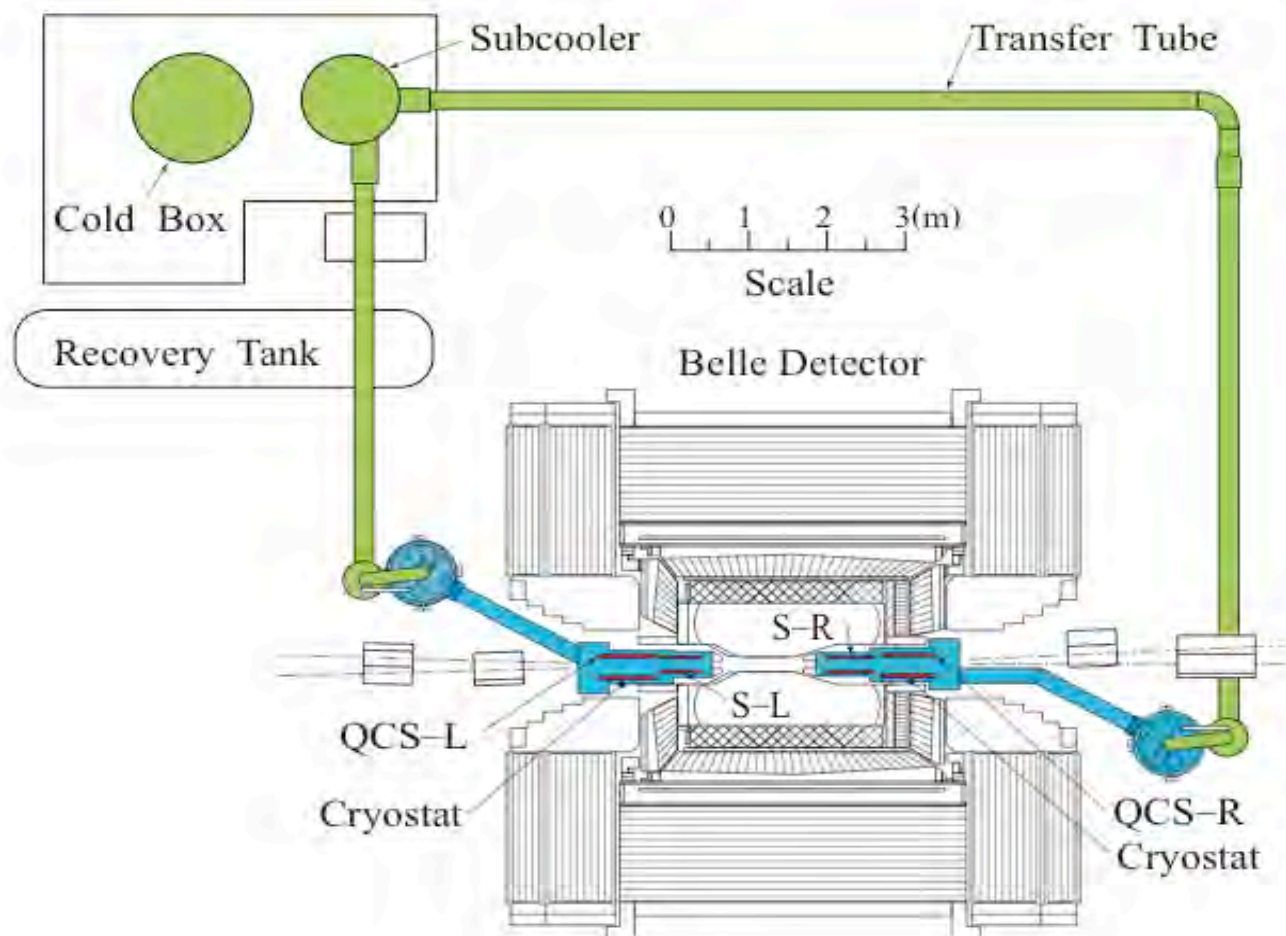


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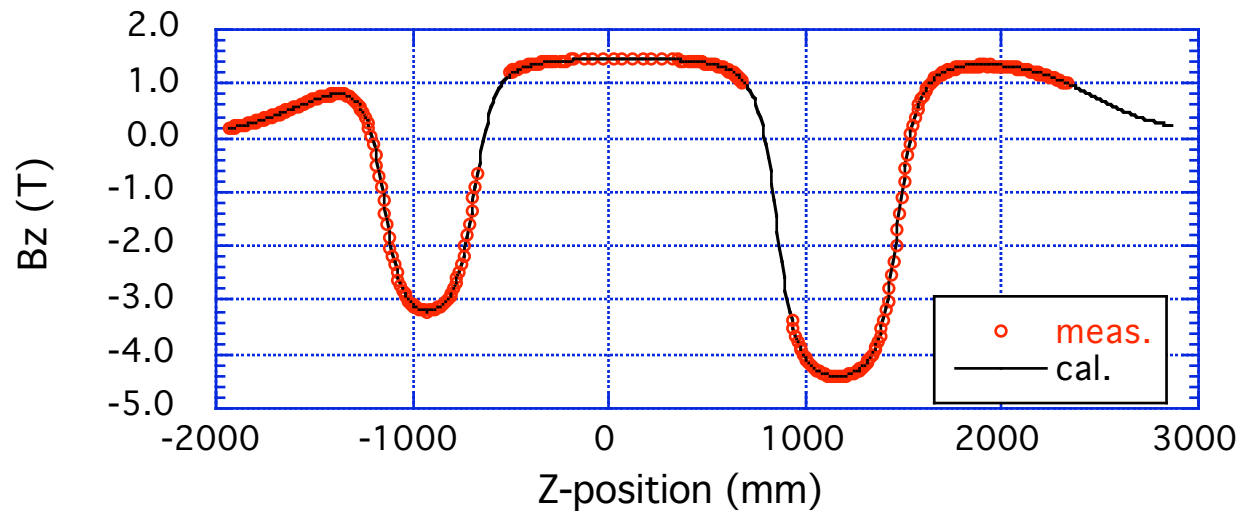
## General layout

### Layout of SC magnet system (top-view)



## Compensation solenoids (S-L and S-R)

	S-L	S-R
B(T)	4.53	5.80
I(A)	487	603
I/I <sub>c</sub> (%)	59	75
Coil length (mm)	461	616
ID (mm)	95	95



Function:  
cancel the detector  
integral  $B \cdot dl$

$B_z$  distribution along the beam line

## Main parameters of QCS magnets

Final focus quad.	QCS-L	QCS-R
G(T/m)	21.7	21.7
Coil IR (mm)	130	130
Overall length (m)	0.521	0.617
I (A)	2963	2963
I/I <sub>c</sub> (%)	68	68

quadrupole has three kinds of correction coils:  
skew quad, dipole(H), dipole(V)

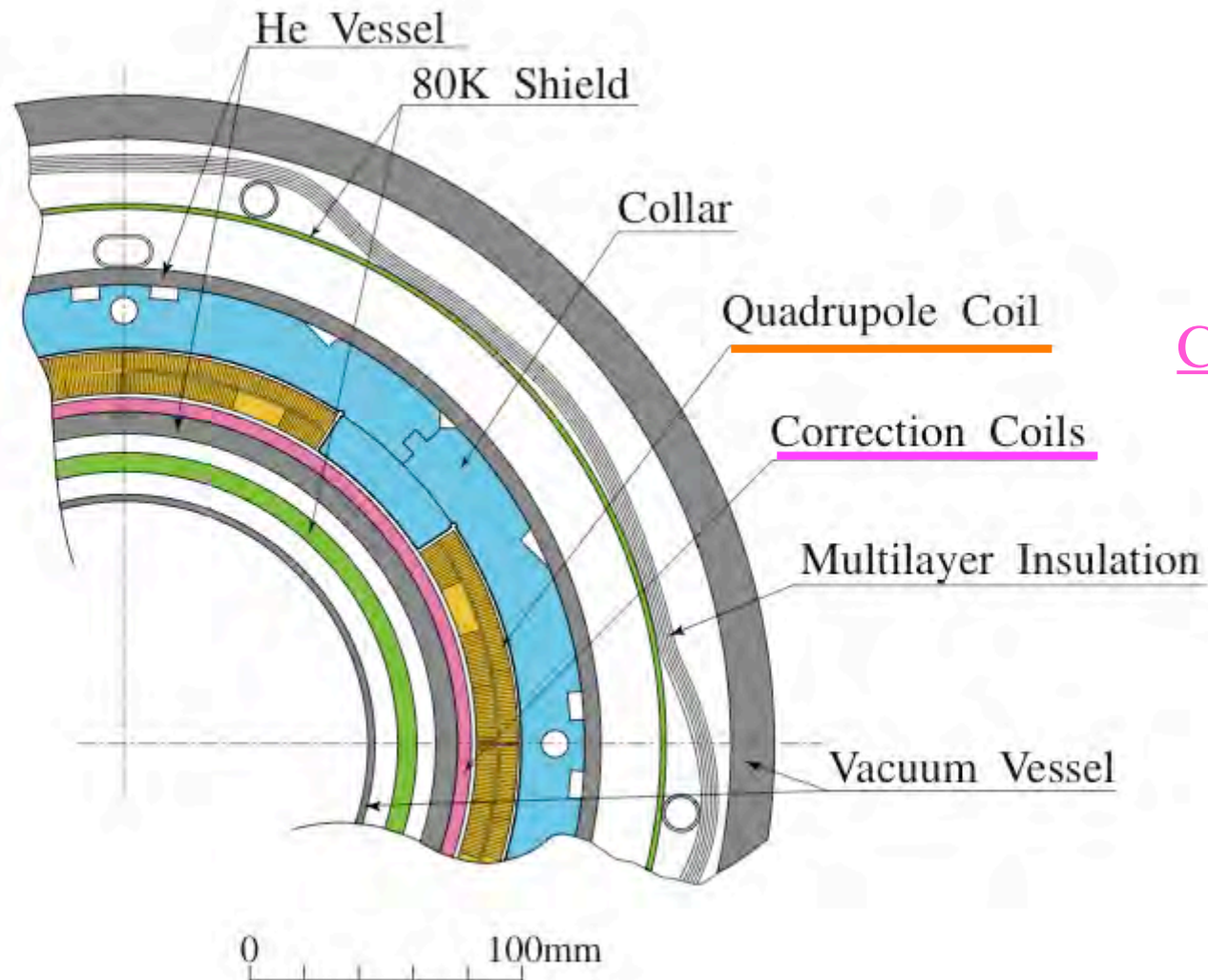
**Correction coils** (to correct the alignment errors of the QCS magnet  
by superimposing the magnetic field)

			correction capacity
skew quad	0.44 T/m	@ 50 A	$\pm 10$ mrad
dipole (H)	0.05 T	@ 50 A	$\pm 3$ mm
dipole (V)	0.05 T	@ 50 A	$\pm 3$ mm



## SC magnet

### Cross-section of Quadrupole magnet

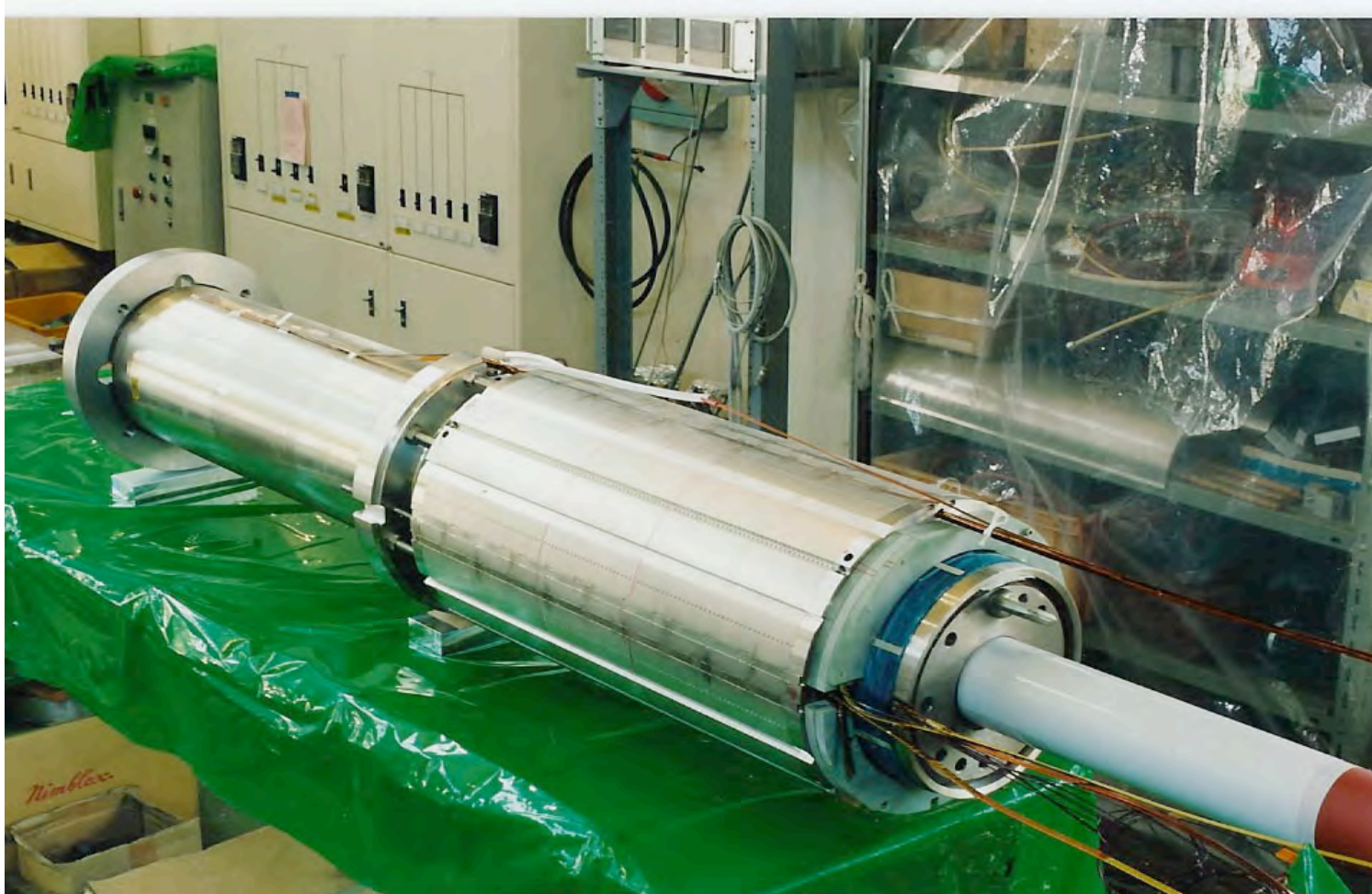


#### Correction coils:

- H dipole
- V dipole
- Skew quad

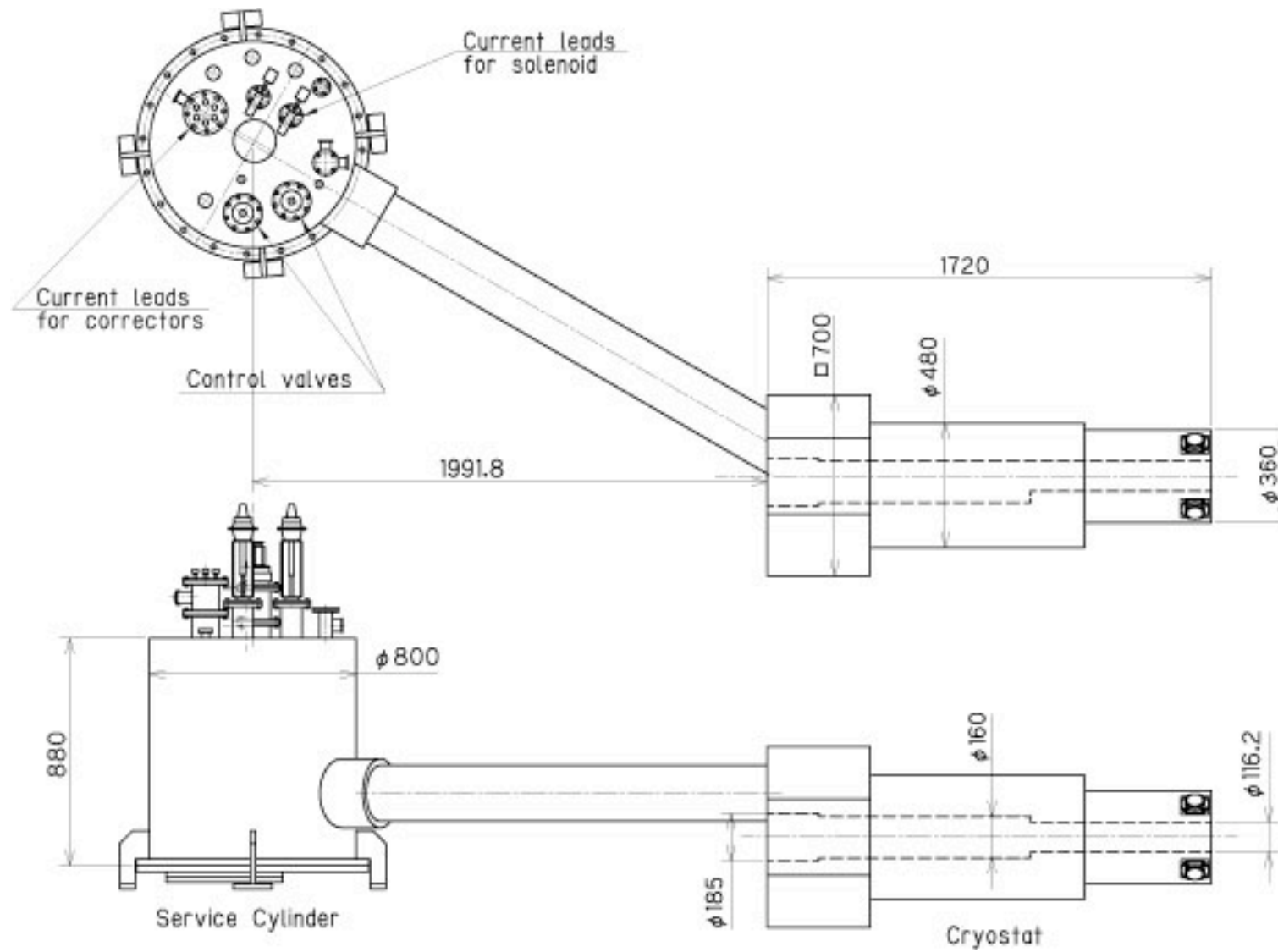
## SC magnet

### KEKB-IR SC magnet (Compensation solenoid and QCS magnet)



## SC magnet

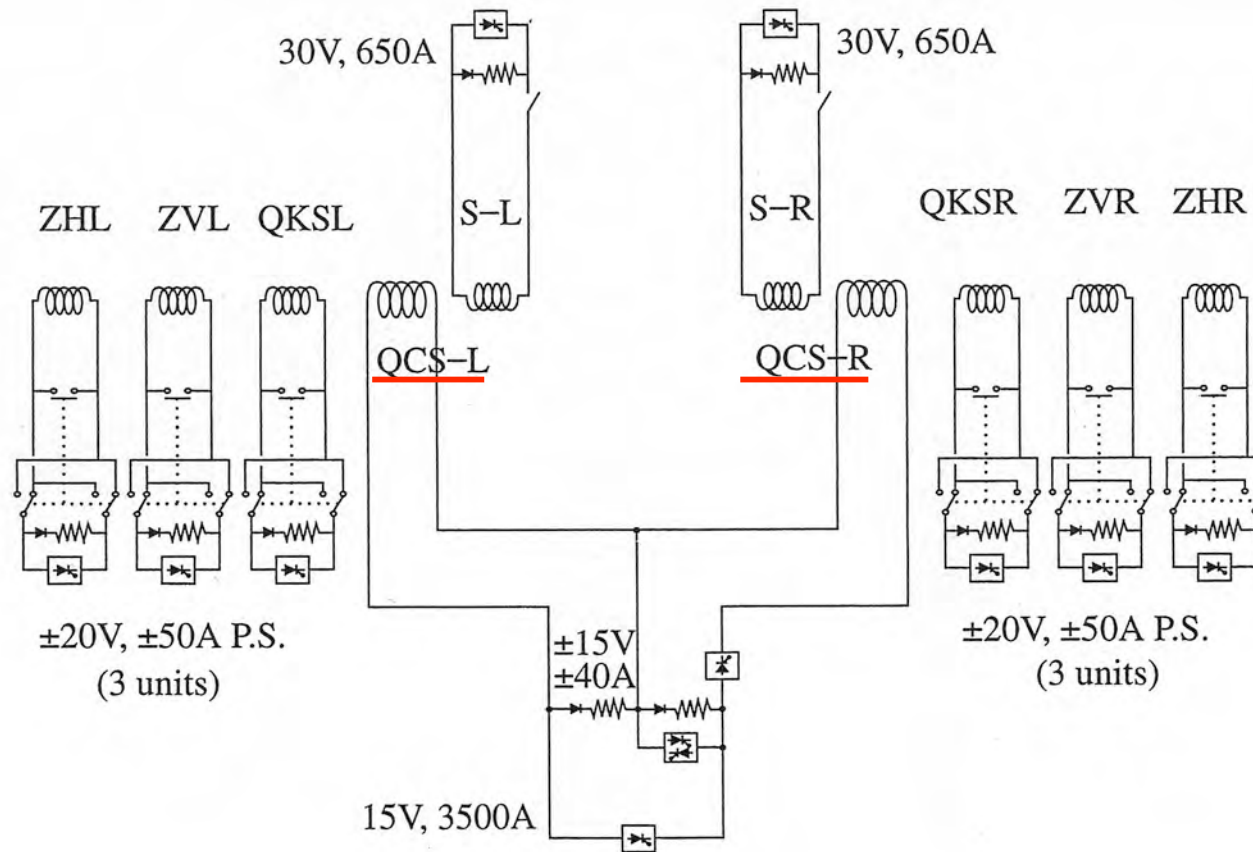
### L-side cryostat (1)



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## Excitation circuits

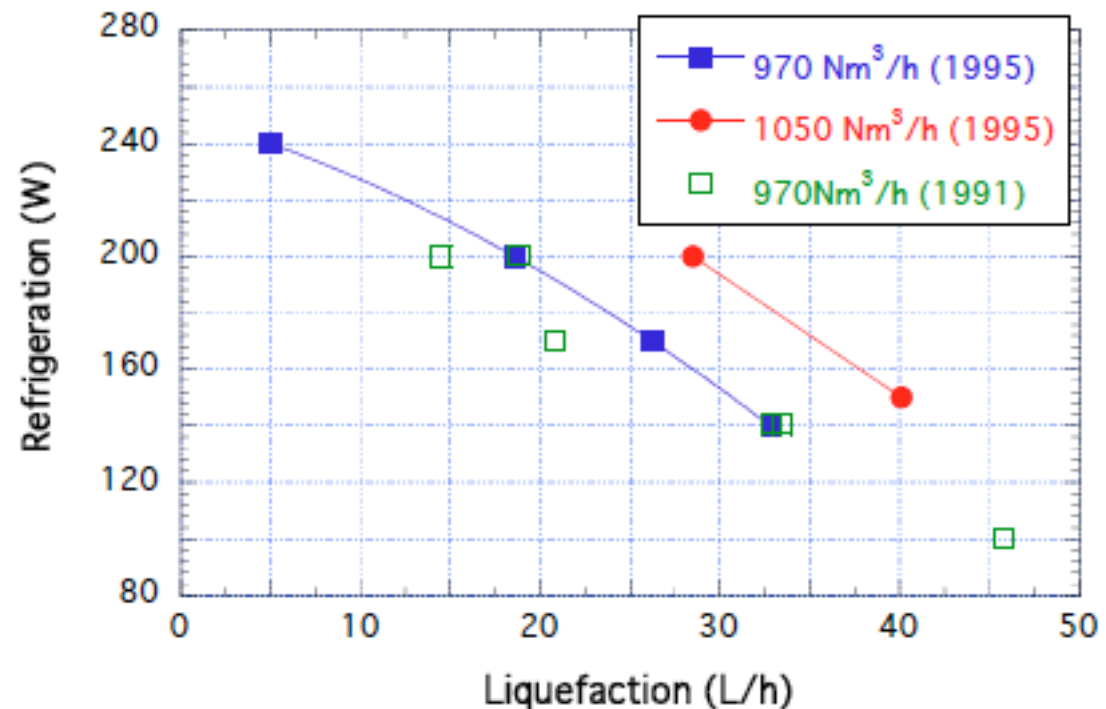


Main quadrupoles (QCS-L and QCS-R) are excited in series by one PS.

## Cryogenic system

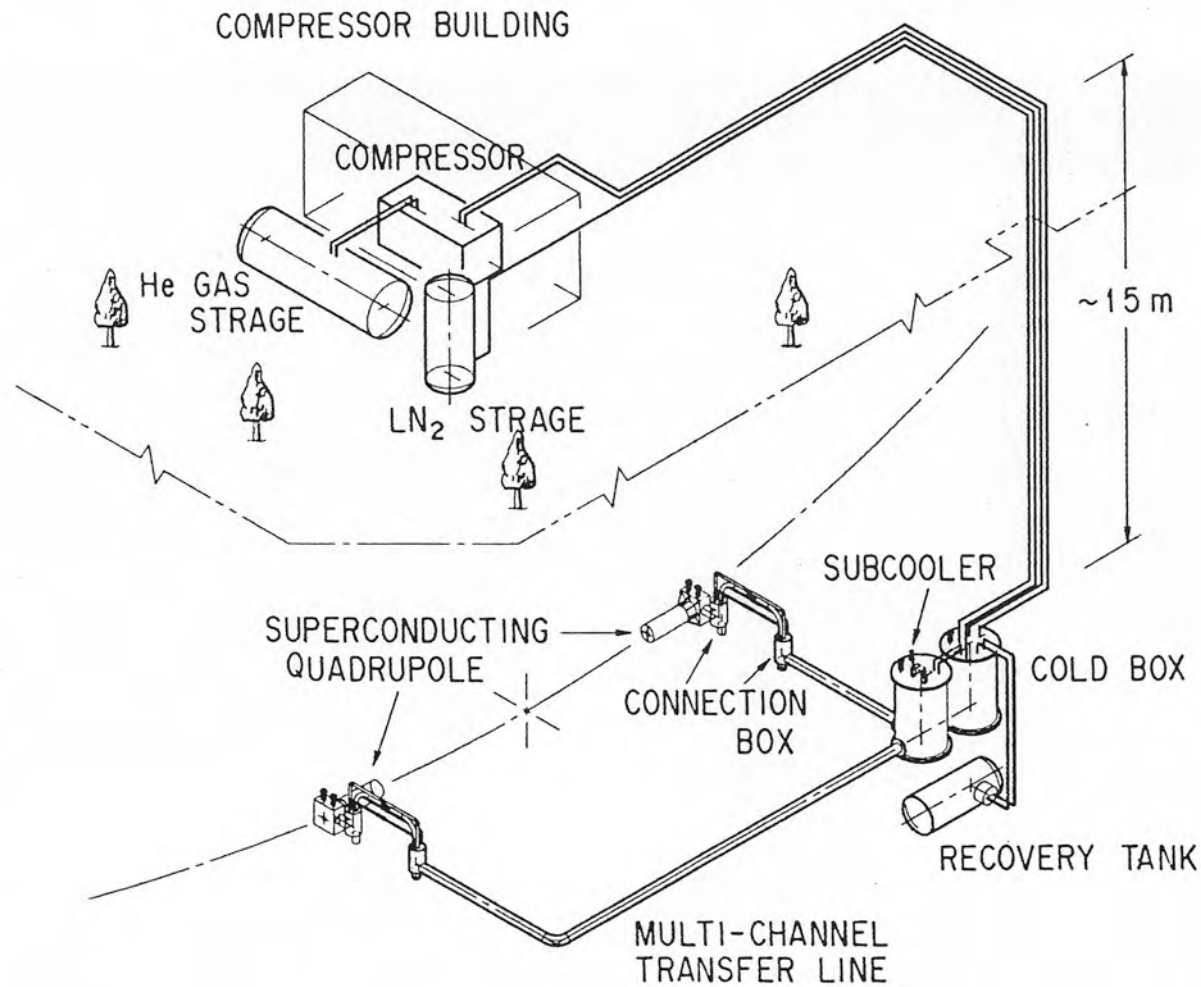
### Cryogenic System

- Features;
- cooling capacity: 150 W+30 L/h (250 W)
  - magnets are cooled by a single phase LHe  
4.5K, 0.16 Mpa
  - computerized automated system



## Cryogenic system

## Schematic layout of cryogenic equipment



### Compressor building:

9 m x 14 m x 5.5 m H

compressor:

2.3 m x 4.6 m x 2.6 m

### Tank yard:

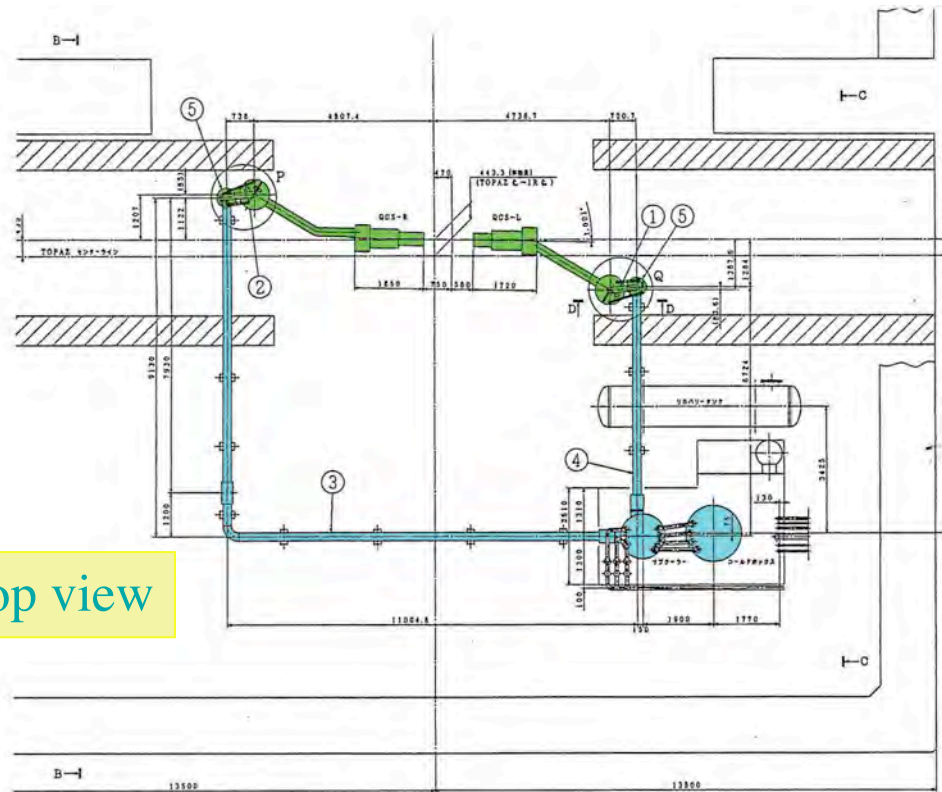
6.5 m x 14 m

### Cold box + subcooler

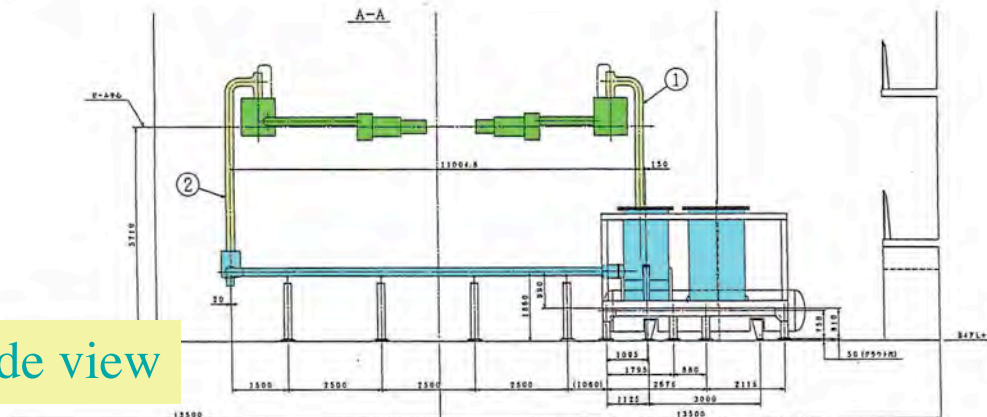
5 m x 3 m



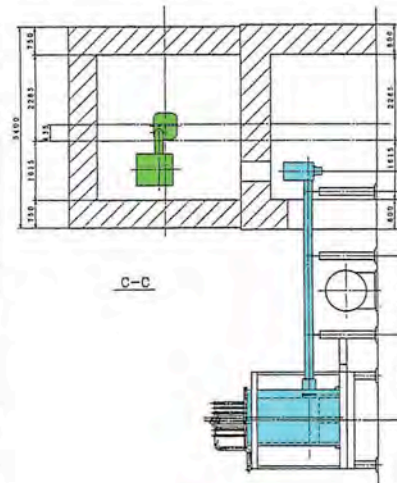
# Cryogenic system



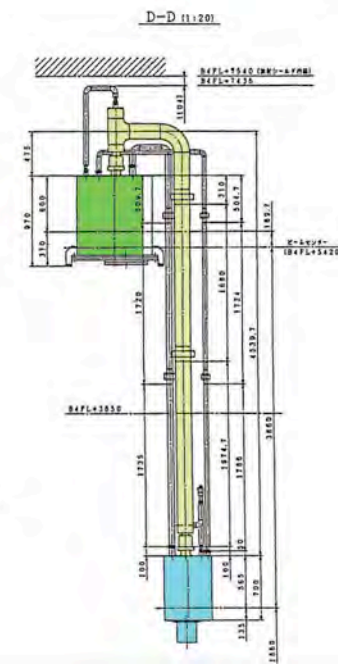
Top view



Side view



Side view

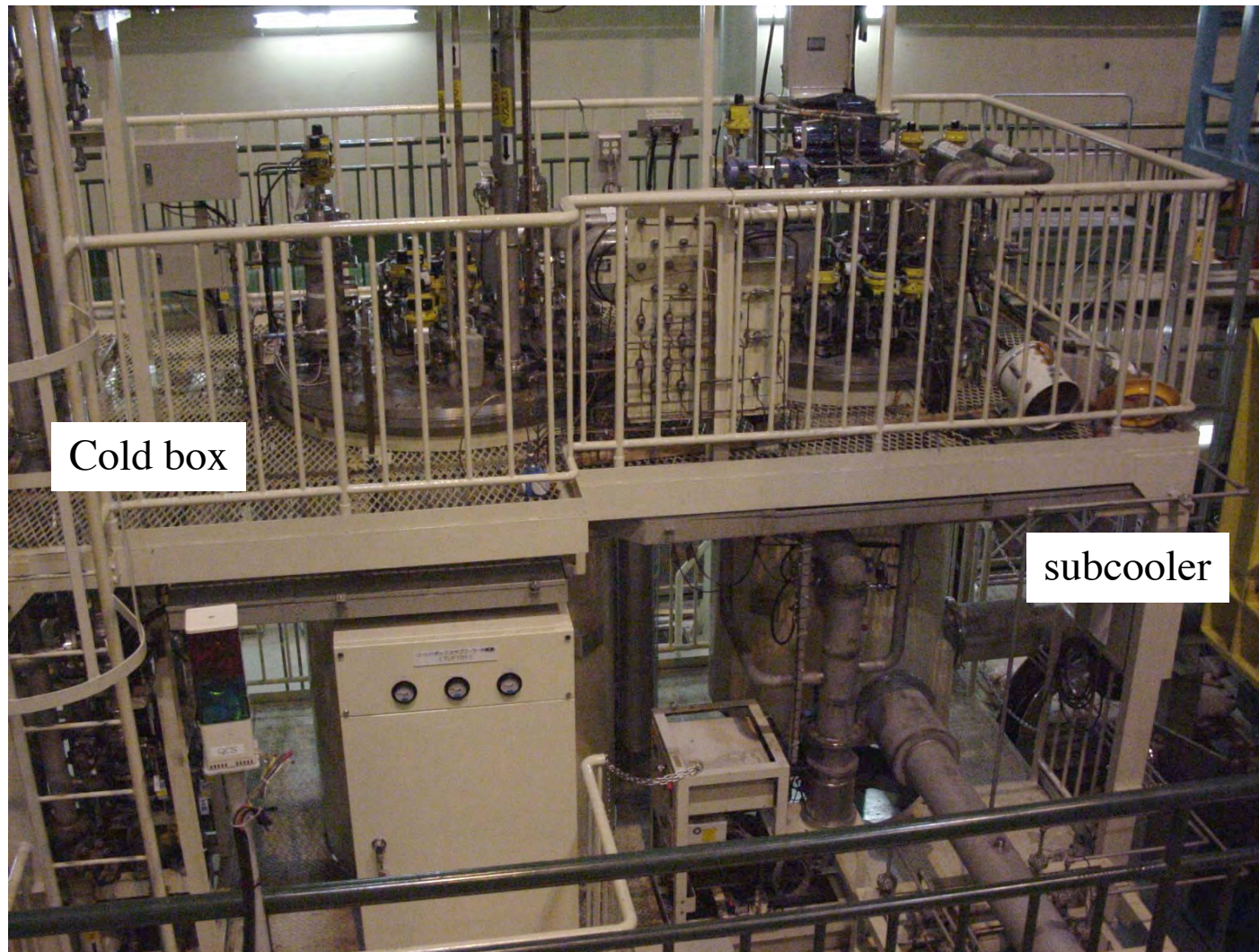


Transfer line

## Cryogenic system

Cold box and subcooler

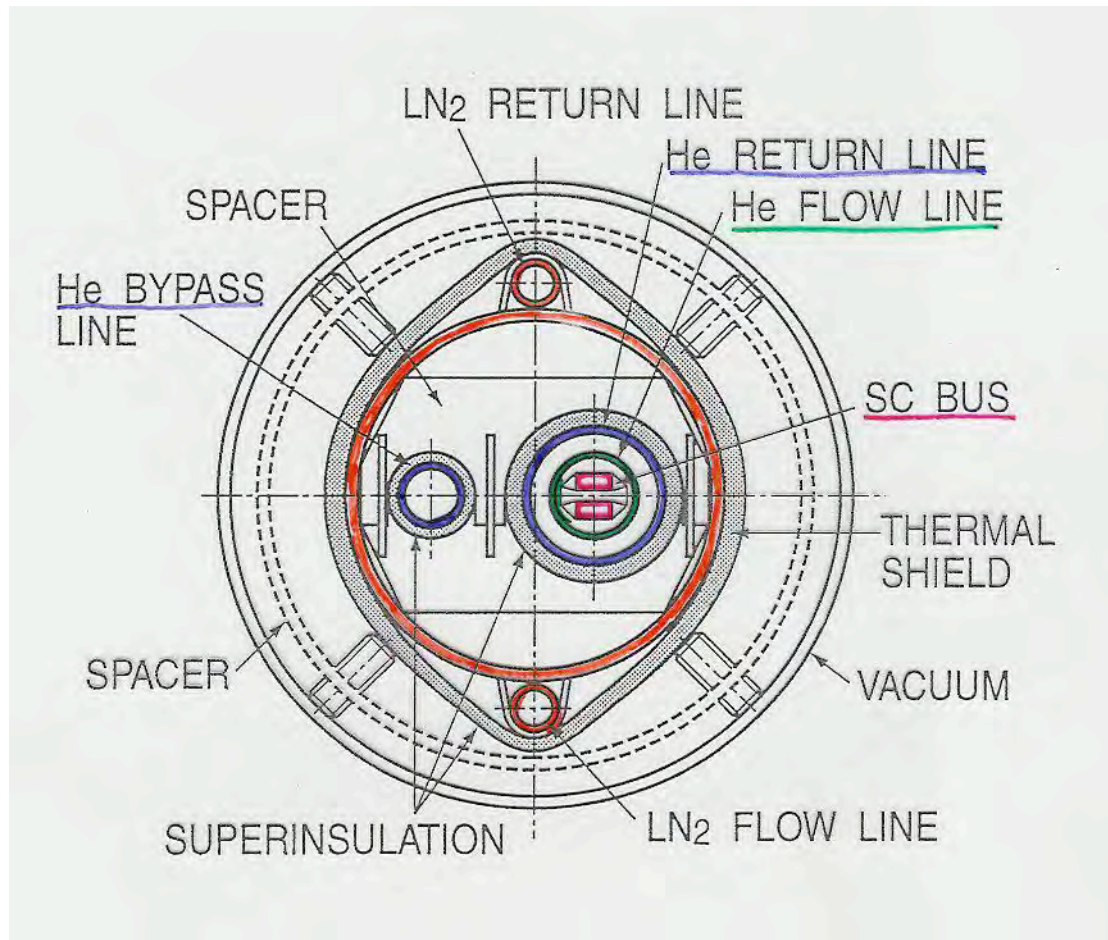
size : 5 m x 3 m x 5 m H



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# Multi-channel Transfer Line



Cross section

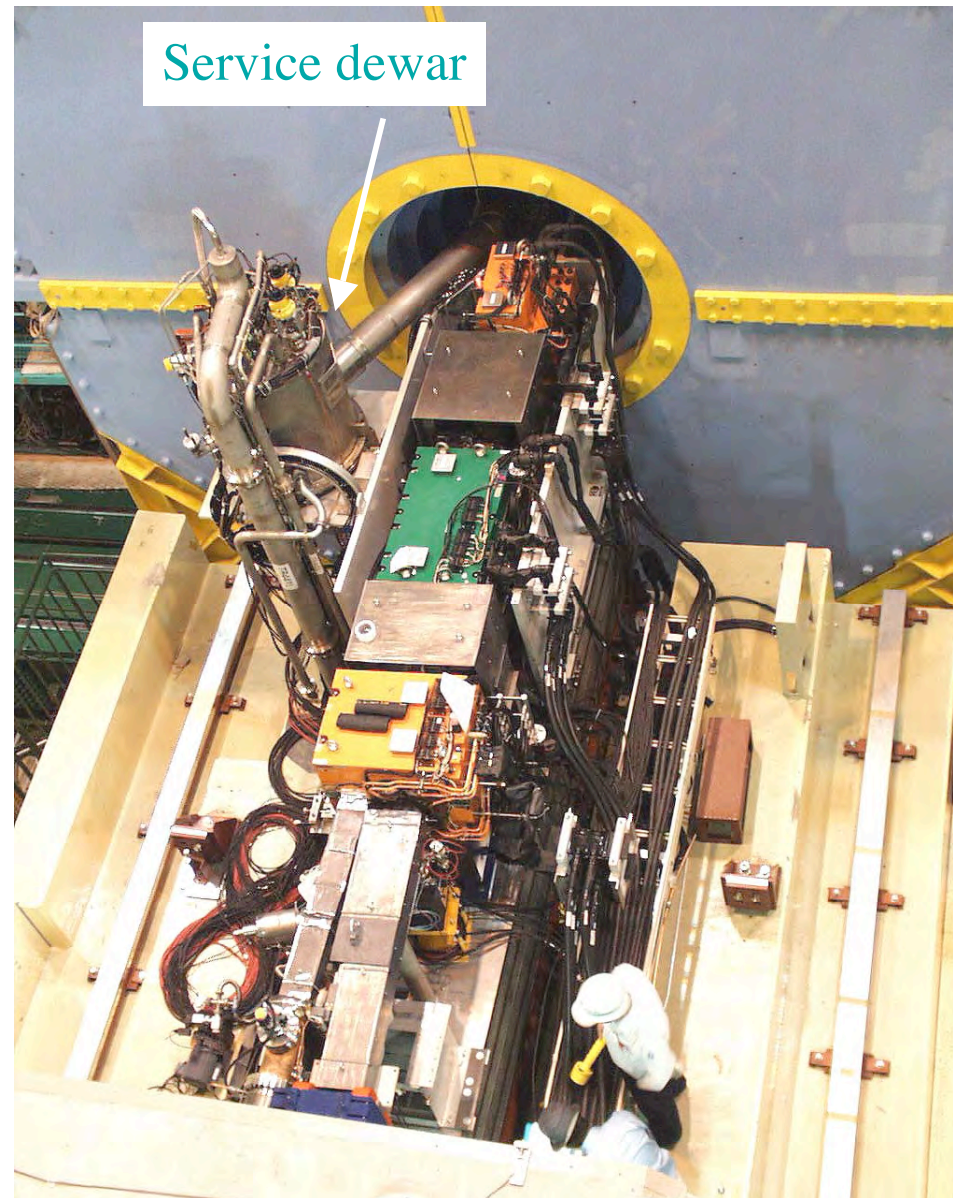
## Features:

- 5 lines are included in a pipe with 216.3 mm dia.
- SC bus lines are also installed in the flow line.
- Total length of this transfer line is 27 m.



## Cryogenic system

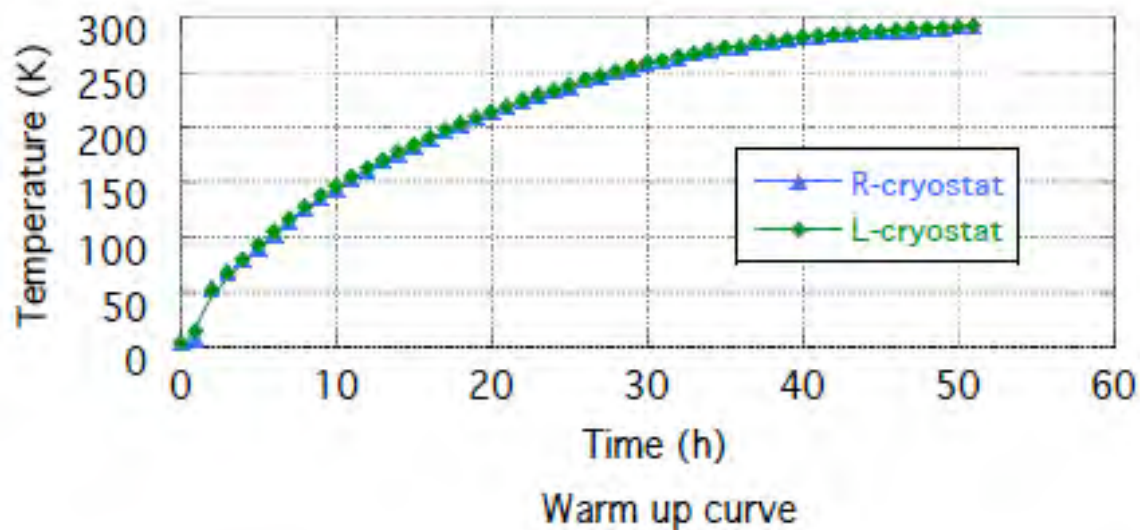
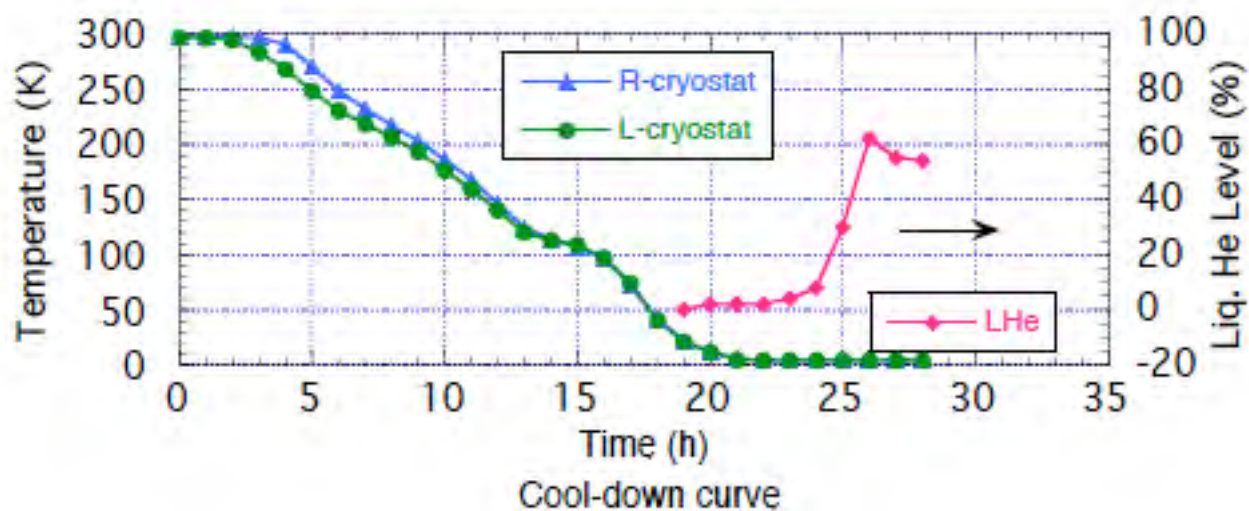
Cryostat installed into the final position



## Cryogenic system

Cool down time: ~27 h

Warm up time: ~48 h



# Summary

- Overview of the SC magnet system for KEKB-IR was shown.
- Although the operational experience has not been shown, the system has been working very stably.
- It would be very happy if the experience in KEKB-IR is useful for the design of ILC-IR.