

Crab Cavity R&D and Future Plan

KEK Crab Cavity R&D Group

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KEKB Crab Crossing

Installation of Crab Cavities in Nikko

Characteristics of KEBB Crab Cavity

Fabrication and RF Performance Test

Cryostat for KEBB Crab Cavity

R&D Efforts 1 Cryostat

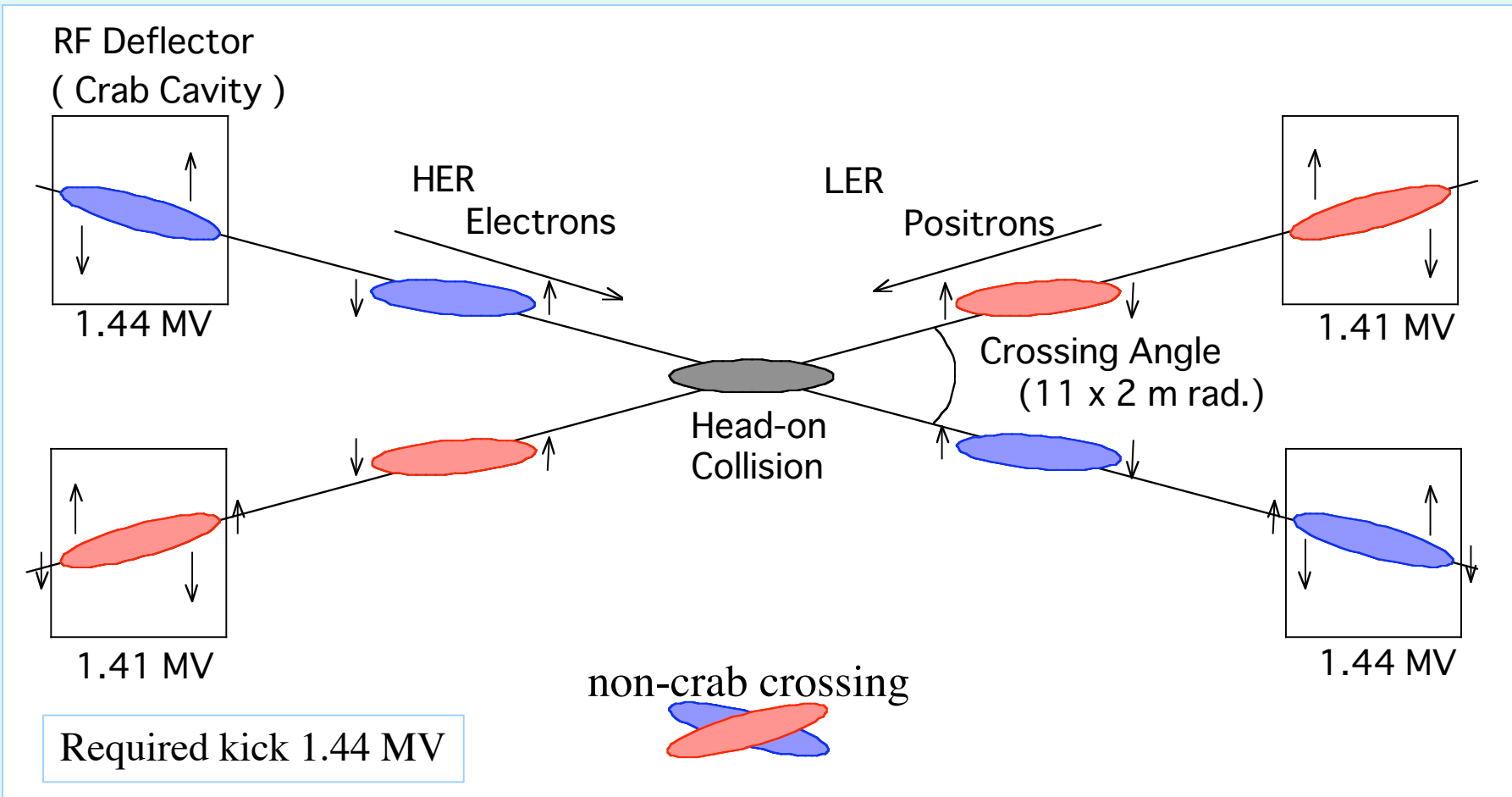
R&D Efforts 2 Nb-Cu Coaxial Coupler

Road Map to Beam Test

KEKB Crab Crossing

The crab crossing scheme allows a large crossing angle collision without introducing any synchrotron-betatron coupling resonances. ^{1, 2)}

- 1) R.B.Palmer, SLAC-PUB-4707,1988
- 2) K.Oide and K.Yokoya, SLAC-PUB-4832,1989



Installation of Crab Cavities in Nikko Straight Section

Installation of Crab Cavities in “Nikko Straight Section”!

Beam Test : Operation under high beam current

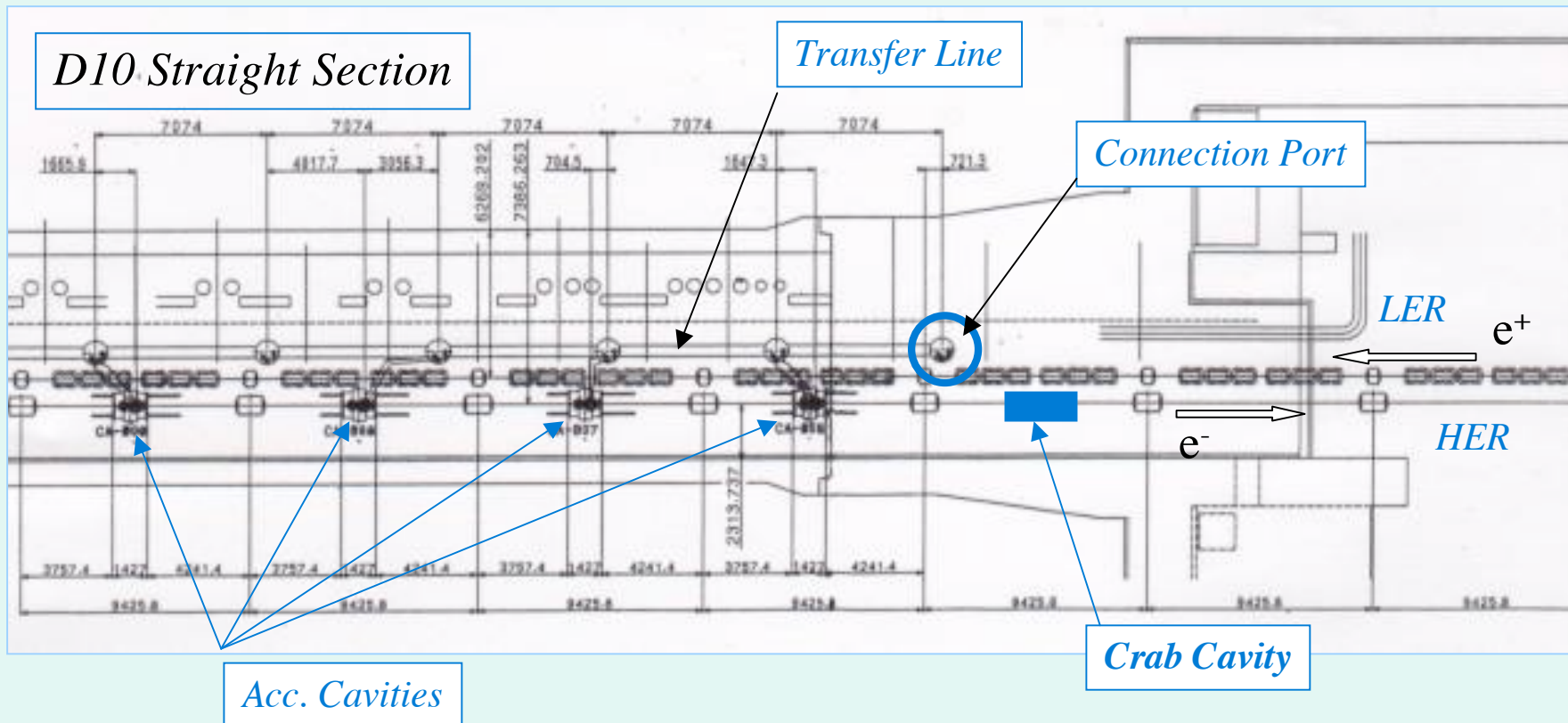
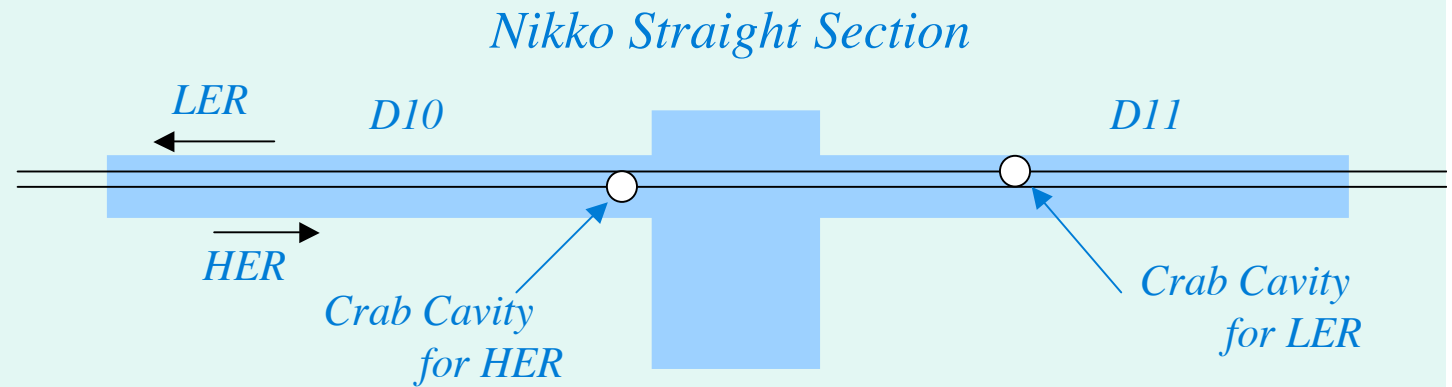
Advantage :

We can use existing Cryogenic System for KEKB Acc. Cavities

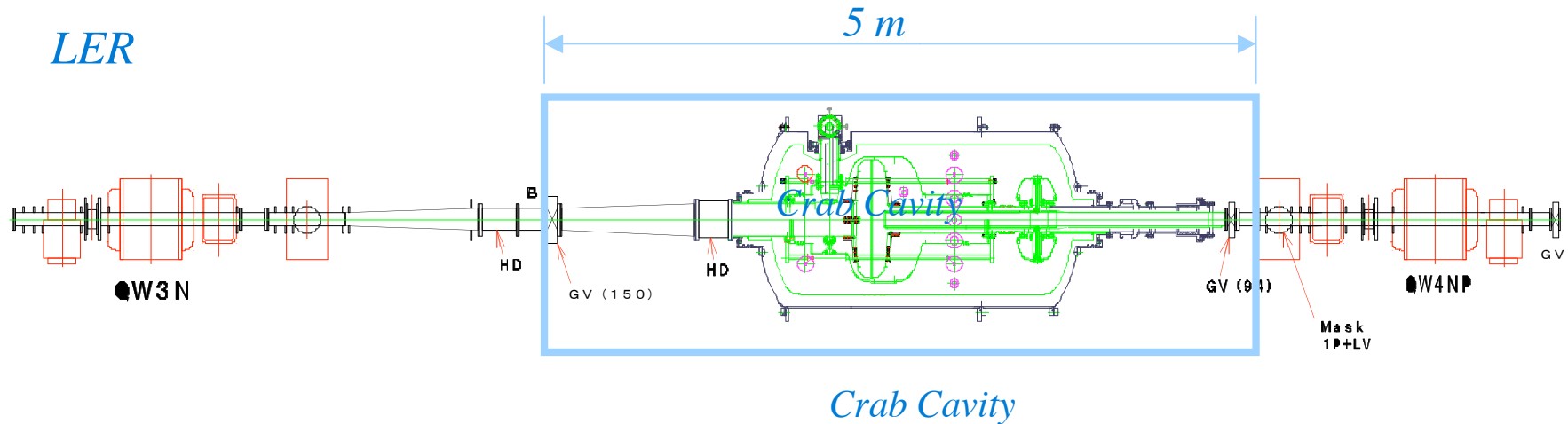
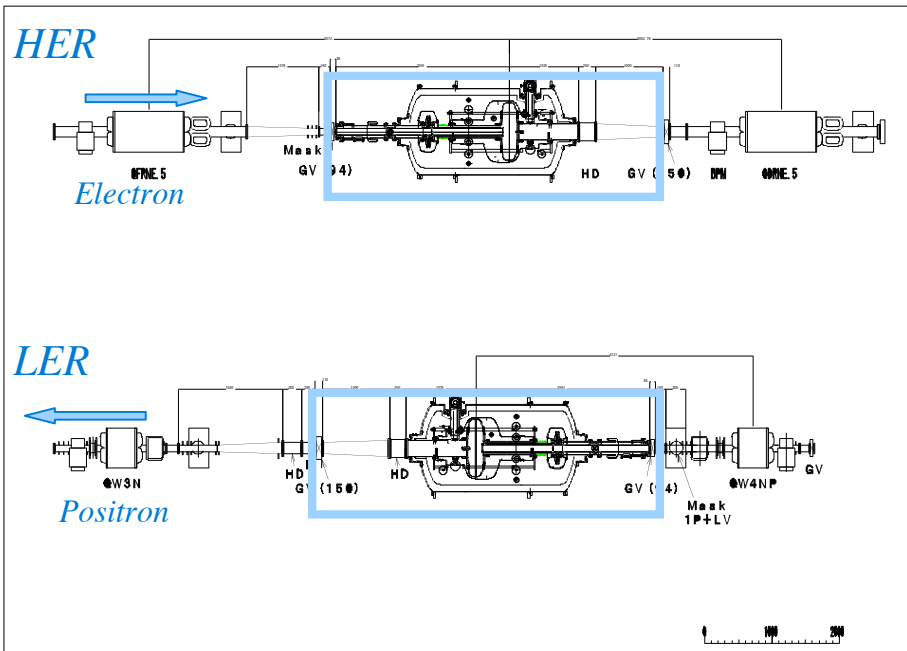
Cryogenic System (8 kW at 4.4K)

Heat Load of KEKB Acc. Cavities ~ 3kW

Layout of Crab Cavities in Nikko Tunnel

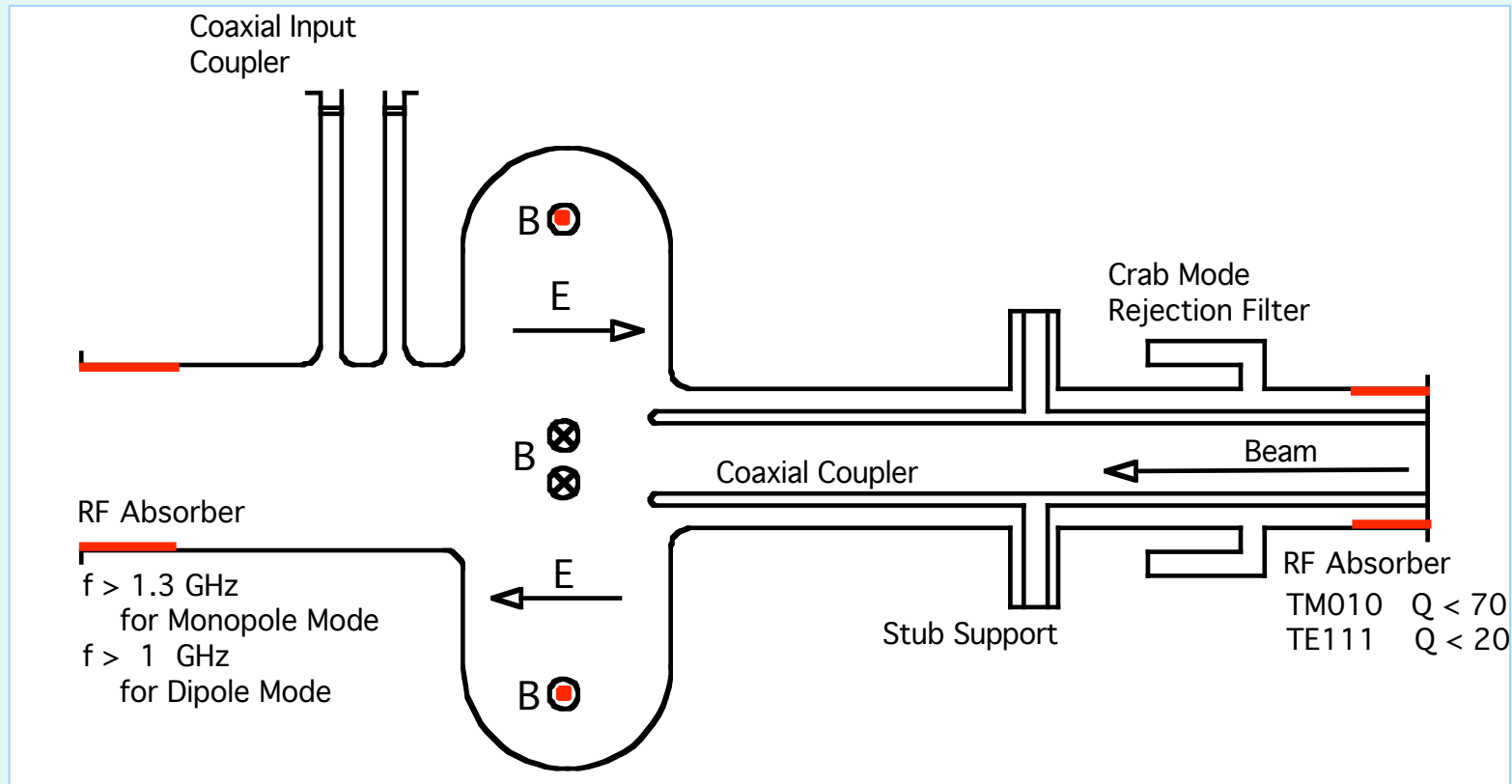


Crab Cavities Installed in KEKB Ring



Designed by Kanazawa

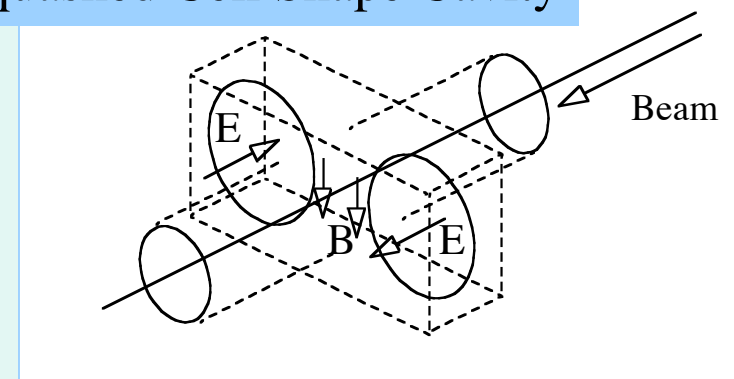
Conceptual Design of KEKB Crab Cavity



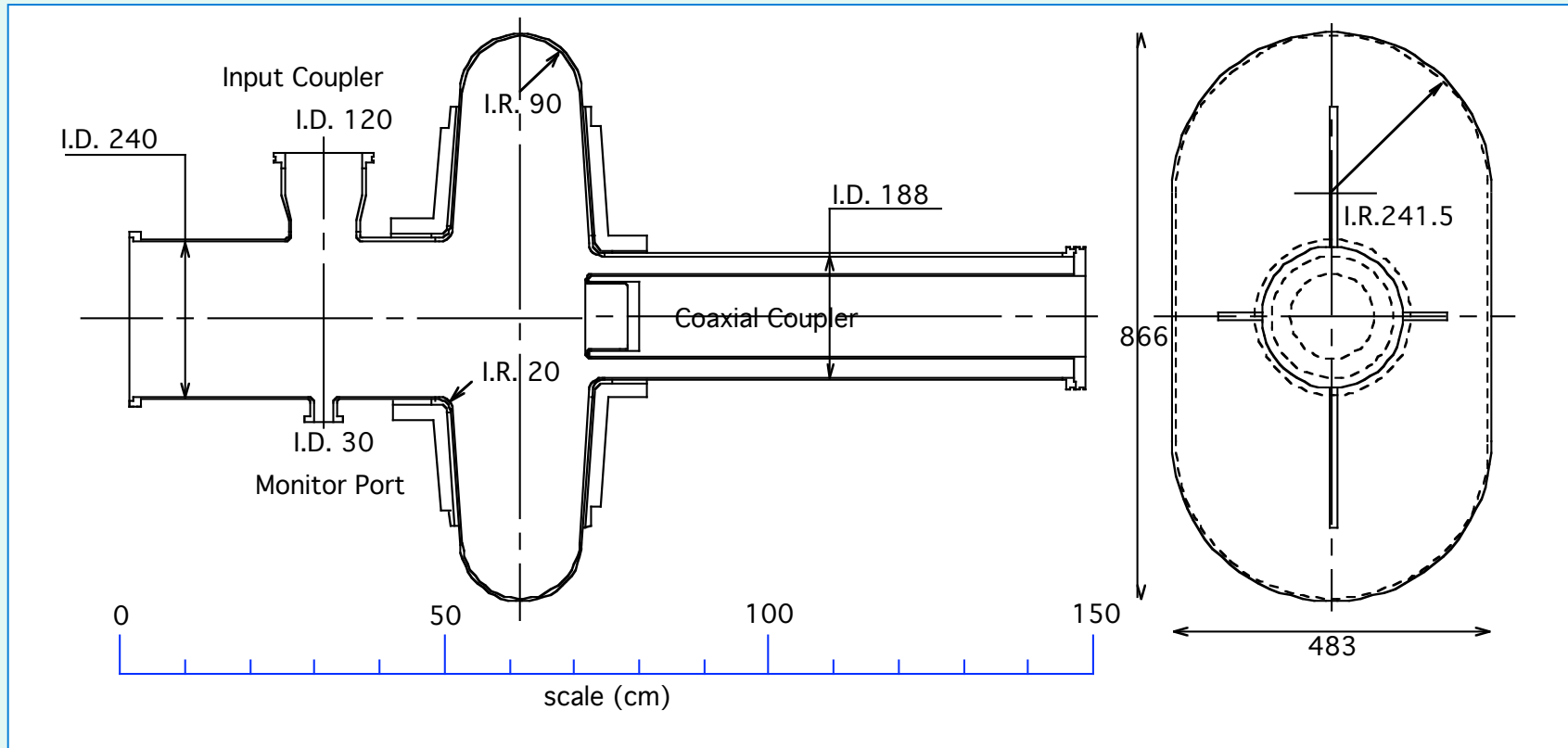
The squashed cell shape cavity scheme was studied extensively by Akai at Cornell in 1991 and 1992 for CESR-B under KEK-Cornell collaboration.

We adopted this design as “base design”!

Squashed Cell Shape Cavity



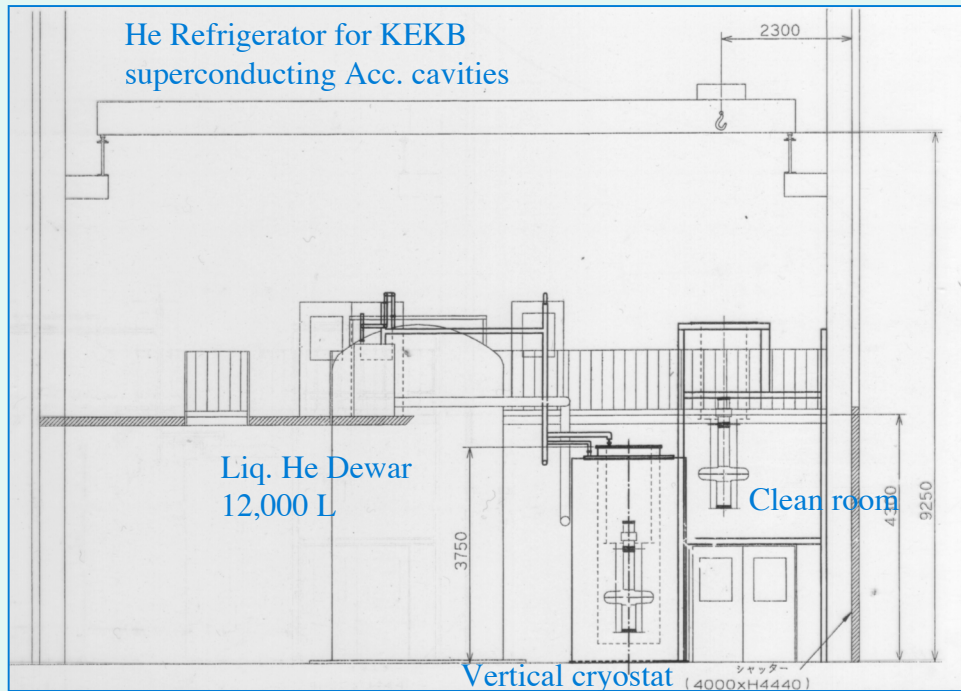
Superconducting Crab Cavity



Non-axial Symmetric Weak Structure
Thickness of 4.5 mm Nb Cavity
Reinforced by Ribs

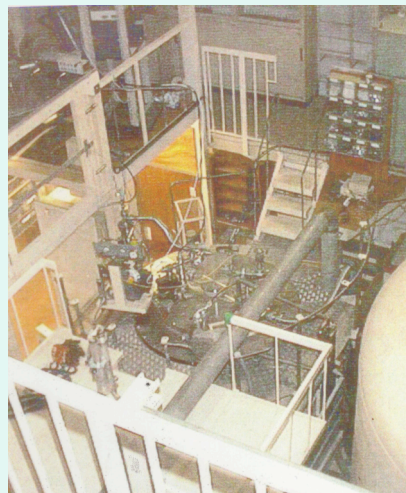


Cold Test Stand for KEKB Crab Cavity

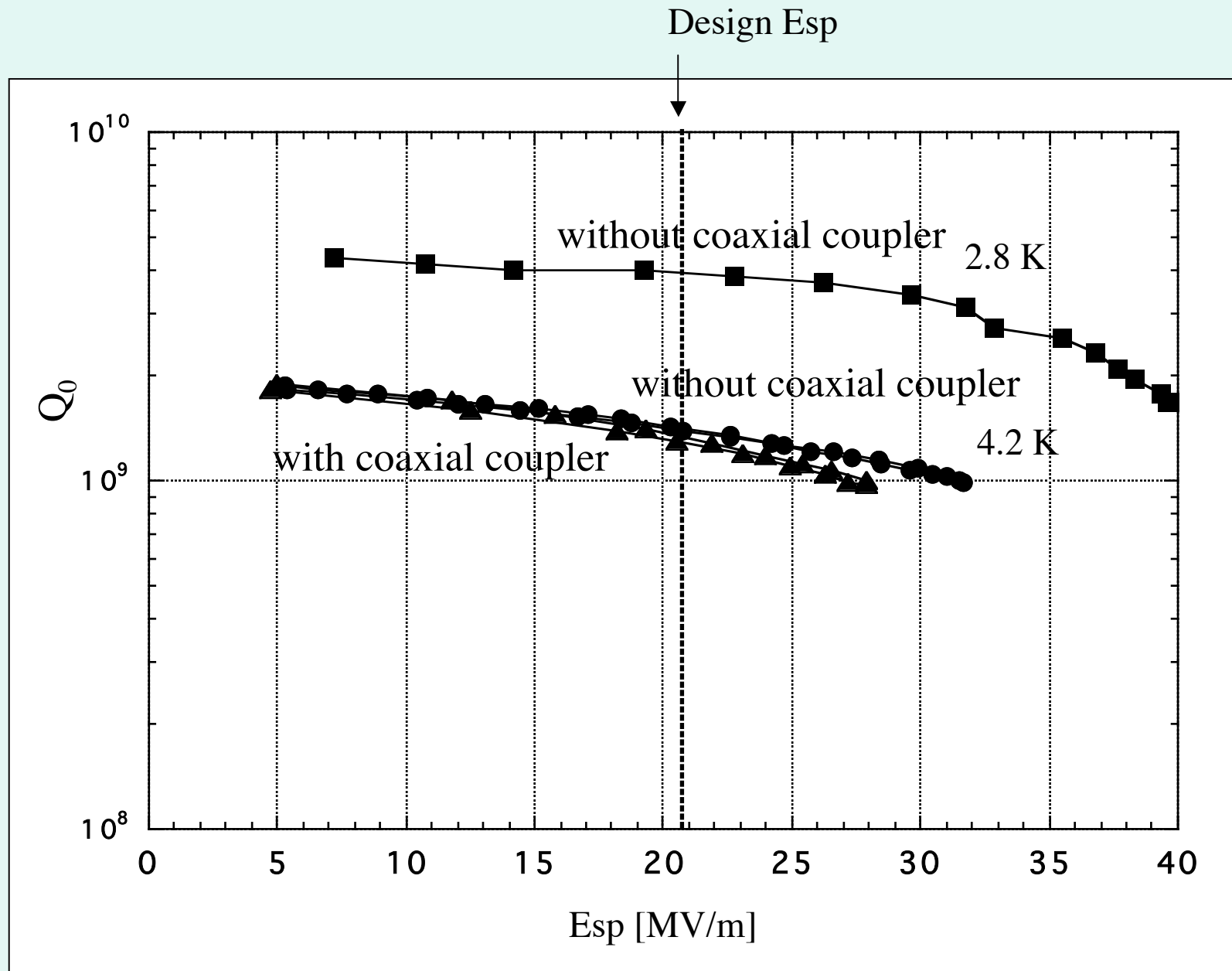


The crab cavity is taken out from clean room to install into the vertical cryostat.

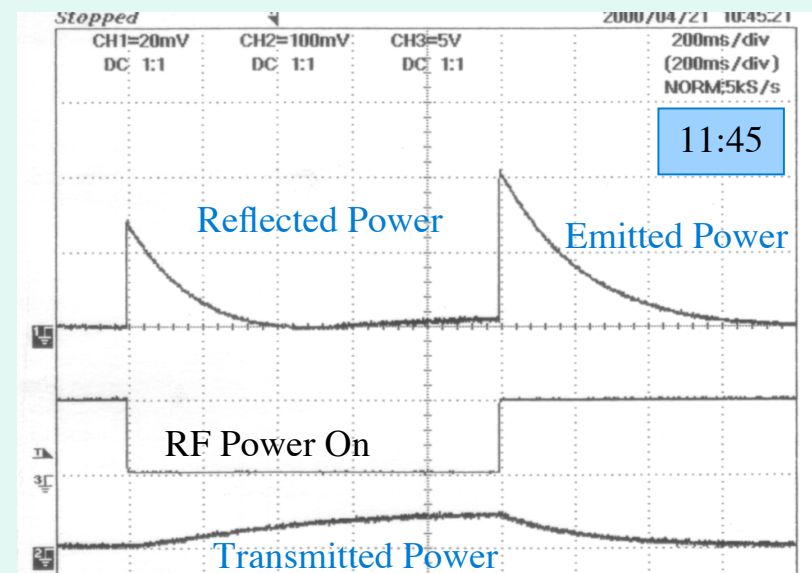
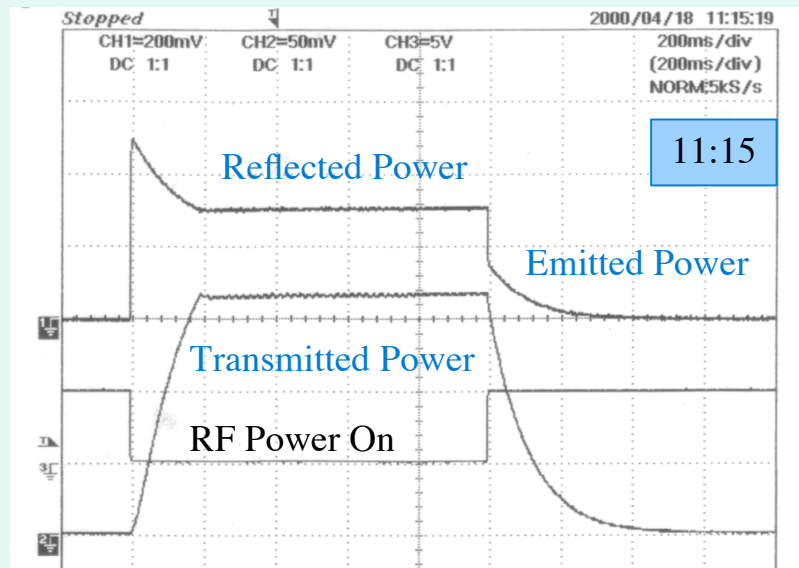
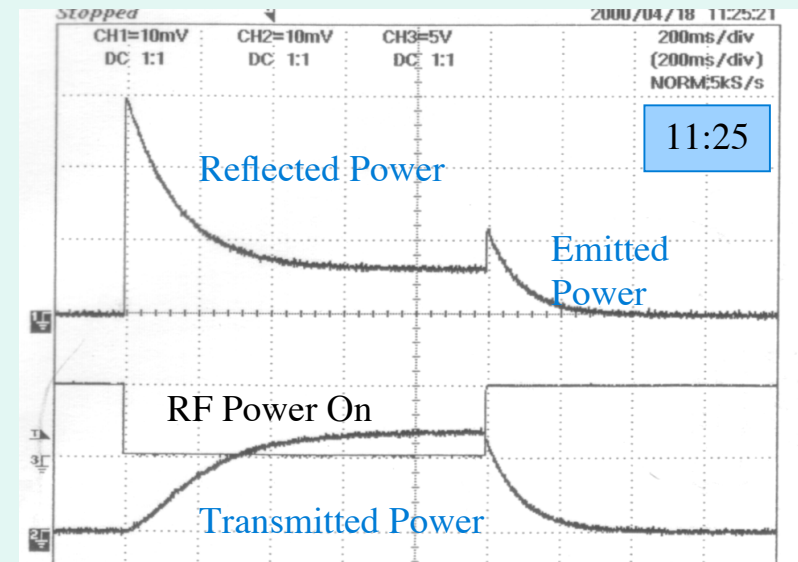
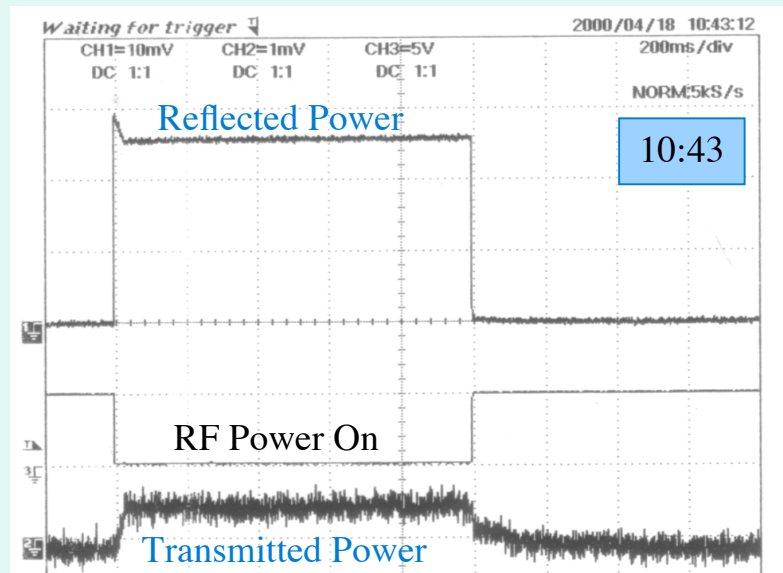
The crab cavity is set in the vertical cryostat



Test Result of KEKB Crab Cavity #1



Multipacting in Crab Cavity with Coaxial Coupler



Summary & Future Plan 1

Crab Cavity # 1, 2

Fabrication and Surface Treatment

RF Performance Test with a Coaxial Coupler

Multipacting could be overcome by RF process.

We have established these techniques!

Prototype Cryostat

Detailed Design and Fabrication

Fabrication of End Plate

Start of Construction

Complete and Cold Test End of FY 2004

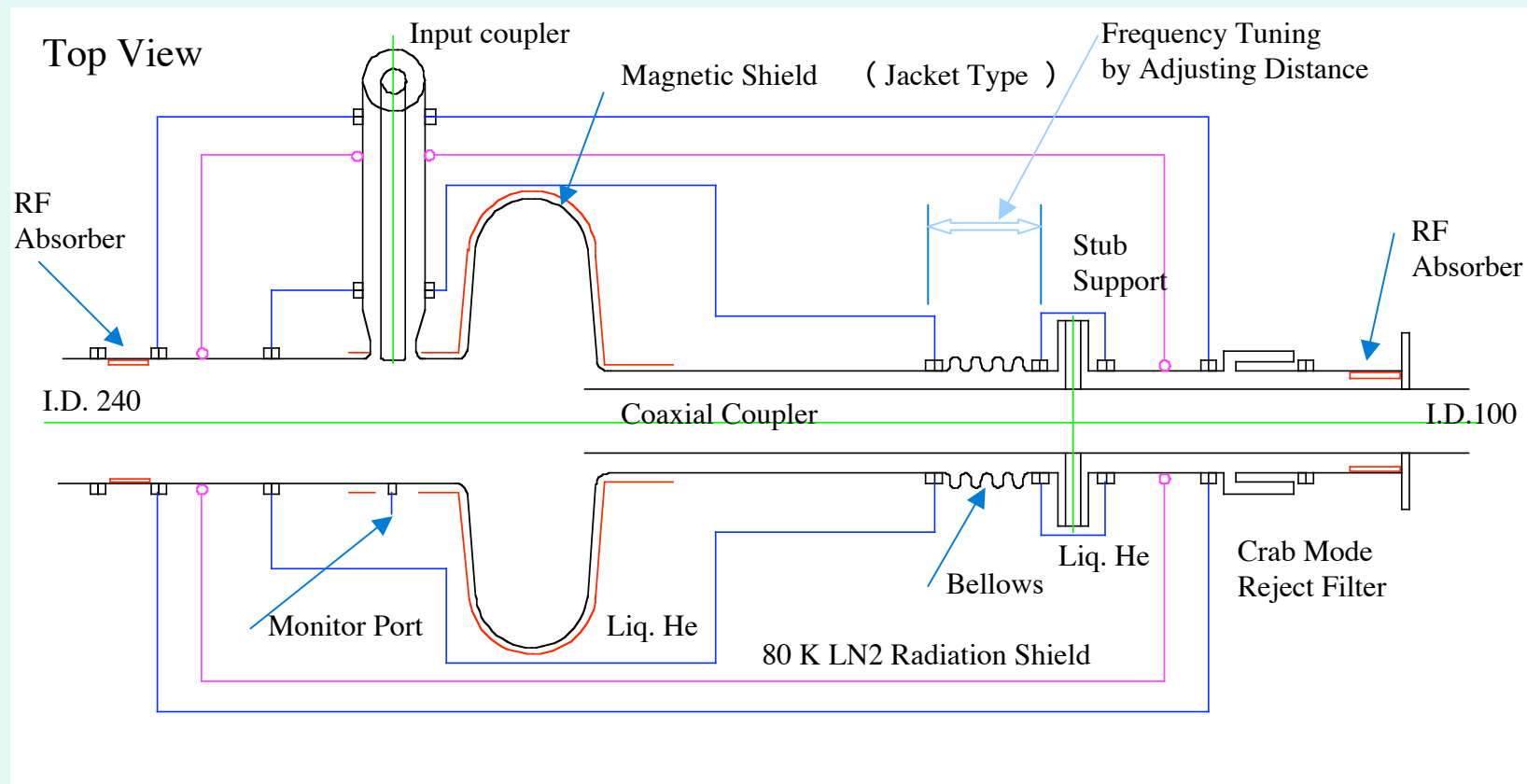
Collaboration with KEK Machine-Shop

Conceptual Design of Cryostat for KEKB Crab Cavity

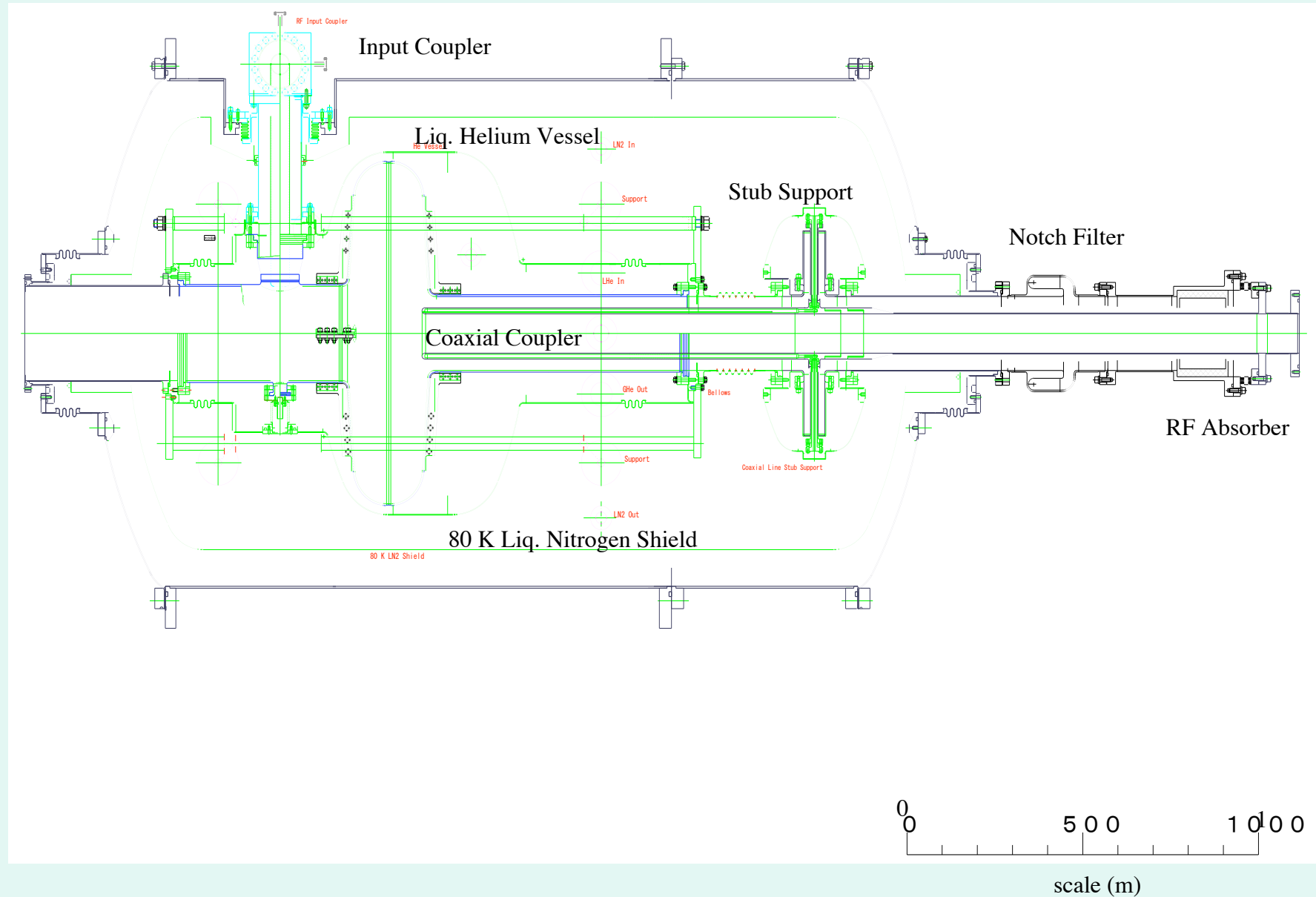
Frequency Tuning by Coaxial Coupler 28.3 kHz / mm

Stub-Support ---- Mechanical Support & Cooling of Coaxial Coupler Tip

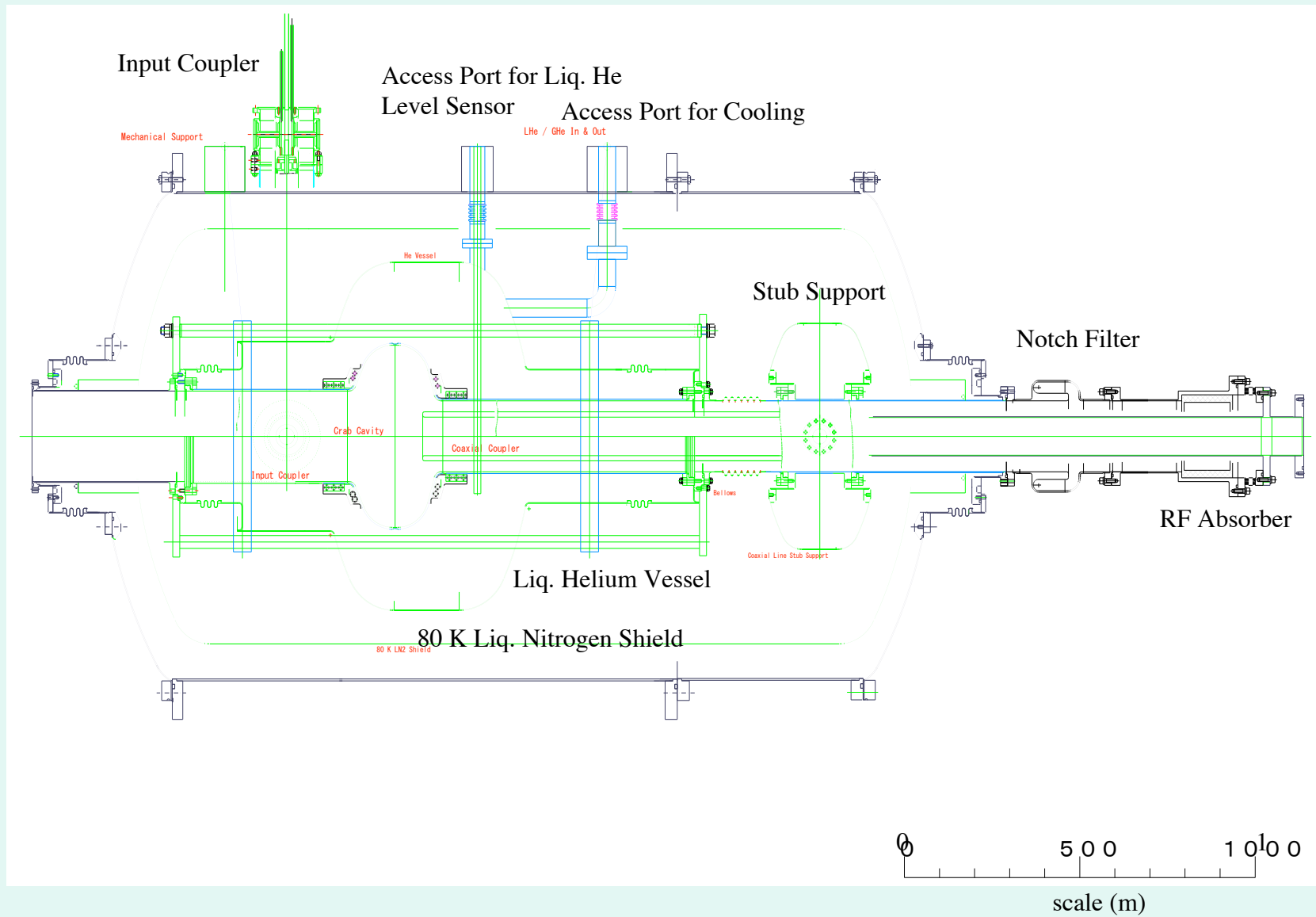
Jacket-type Helium Vessel



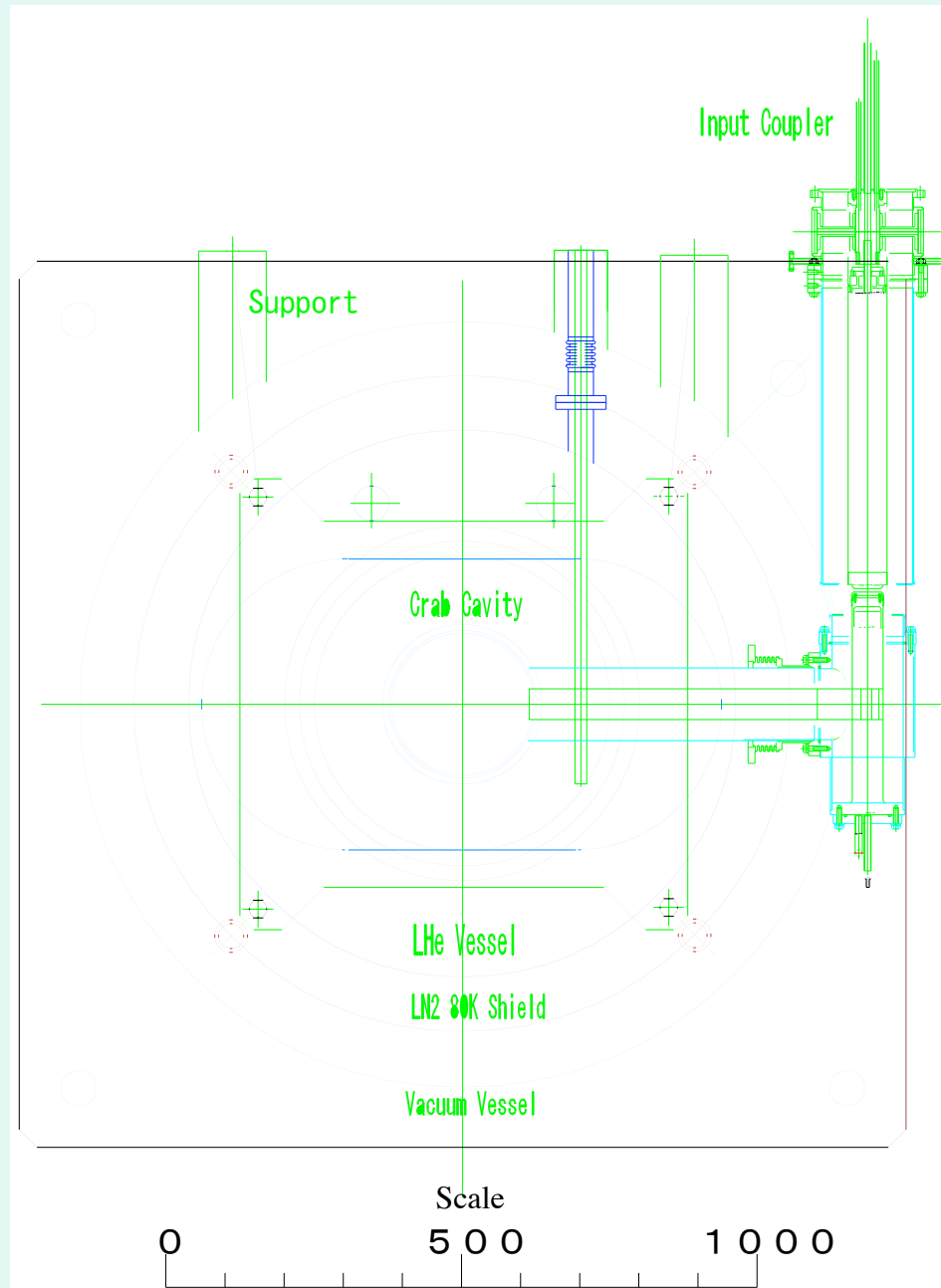
Cryostat for Crab Cavity (Top view)



Cryostat for Crab Cavity (Side view)



Cryostat for Crab Cavity (Front view)



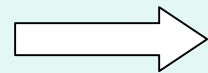
R&D Efforts 1 Cryostat

Seamless Cu Bellows

For Frequency Tuning --- Thin wall (0.4mm) Cu Bellows
(Nb-Cu)

Forming of Thin End Plate

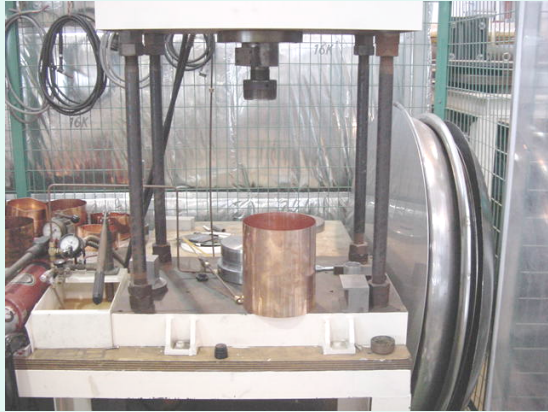
End Plates for Cryostat



$\phi 600, 920$: *for Helium Vessel*

$\phi 1200$: *for Vacuum Vessle*

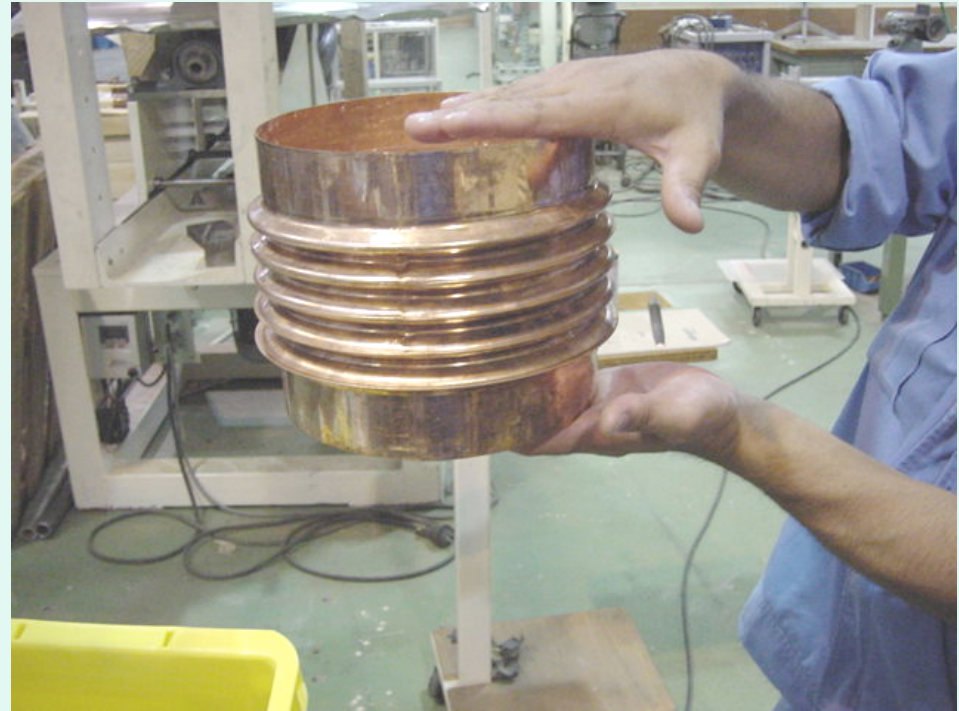
Fabrication of Bellows



Press Unit and
Pressure Water Pump



Set the Female Die



Fabricated 5-cell Bellows

Female Die
and Outer
Guide Pipe



Fabrication of End Shell



ϕ 1200, 1.5 t SUS 316L
End Shell for Vacuum Vessel



ϕ 600, 1.5 t SUS 316L
End Shell for Helium Vessel



ϕ 920, 2 t SUS 316L
End Shell for Helium Vessel

R&D Efforts 2 Nb-Cu Coaxial Coupler

Nb-Cu Coaxial Coupler

(Designing and Fabrication is very easy !)

1.5 GHz Nb-Cu Cavities

RF Characteristic Test in Nb Coaxial Cavity

 Optimization of Nb Spattering

Full Size Nb-Cu Simplified Coaxial Coupler

 RF Characteristic Test with Nb Crab Cavity

Full Size Nb-Cu Coaxial Coupler

 Installed in Horizontal Cryostat

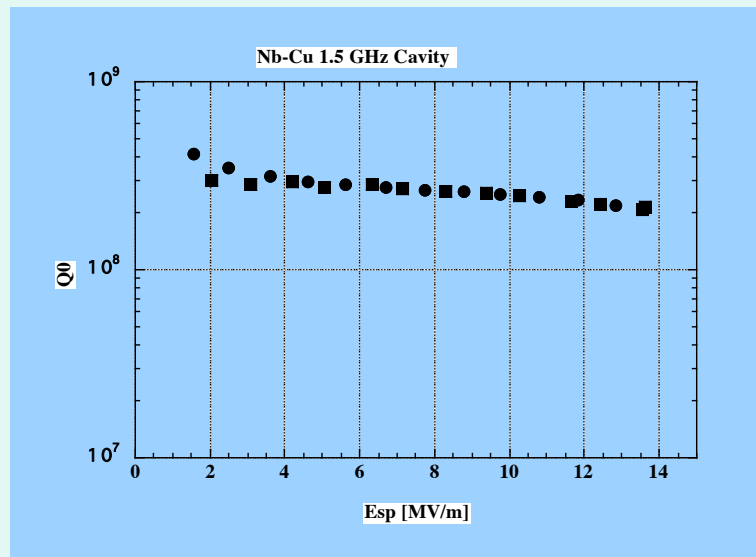
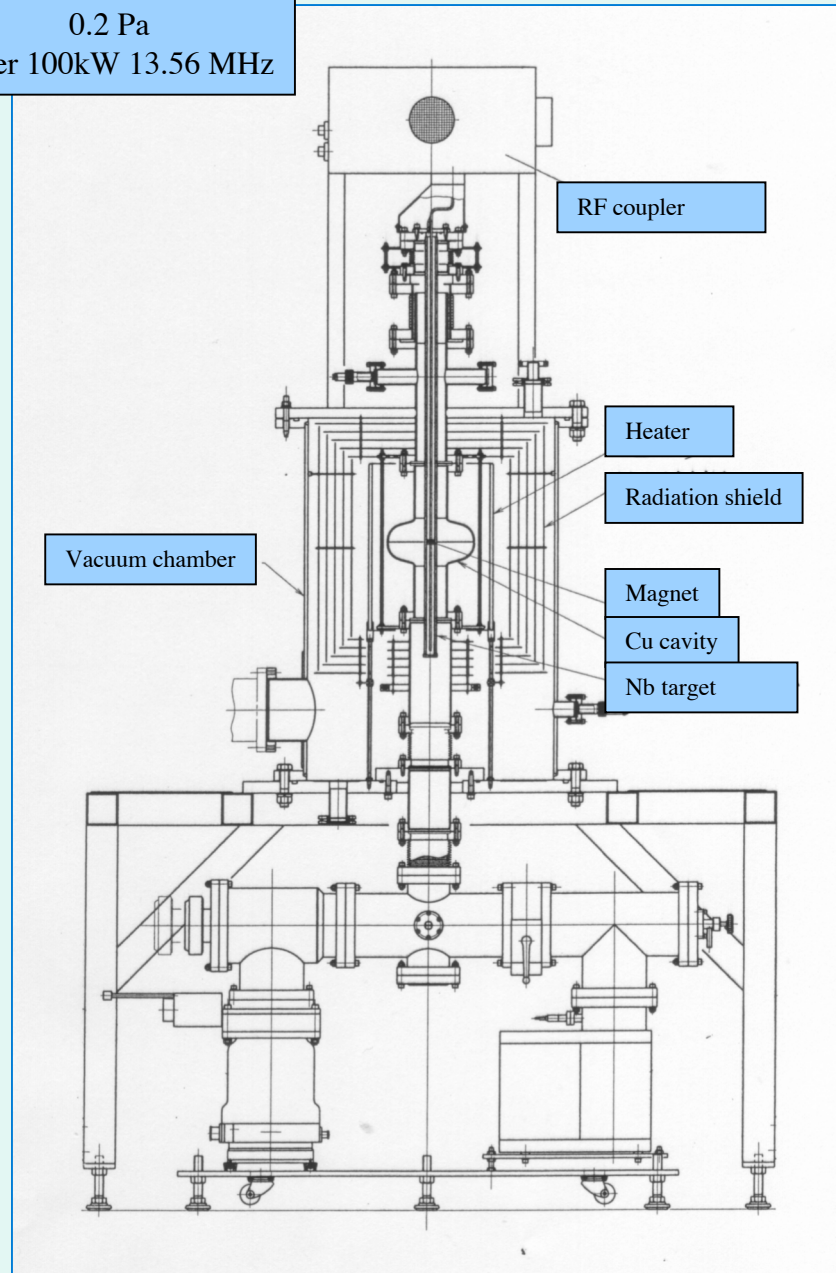
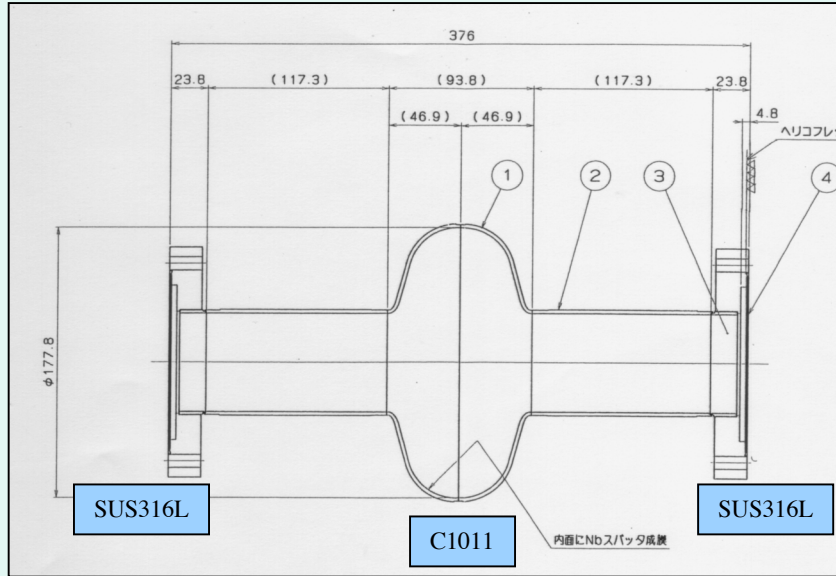
Input Coupler

 Fabrication of Prototype

Nb-Cu Spattering Cavity

1.5 GHz Nb-Cu Cavity

Temperature 300 ~ 350 °C
 Ar Gas 0.2 Pa
 RF Power 100kW 13.56 MHz



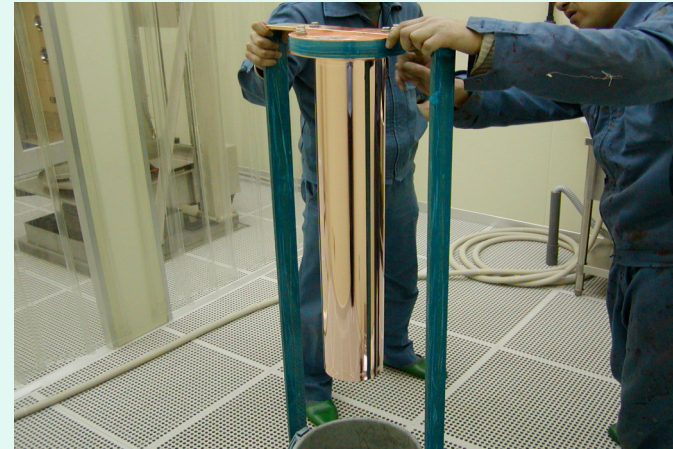
Simplified Nb-Cu Coaxial Coupler



Assembled Cu Coaxial Coupler



Electro-polishing



Electro-polished Cu Coaxial Coupler

High Pressure Rinsing

Nb Spattering

High Pressure Rinsing

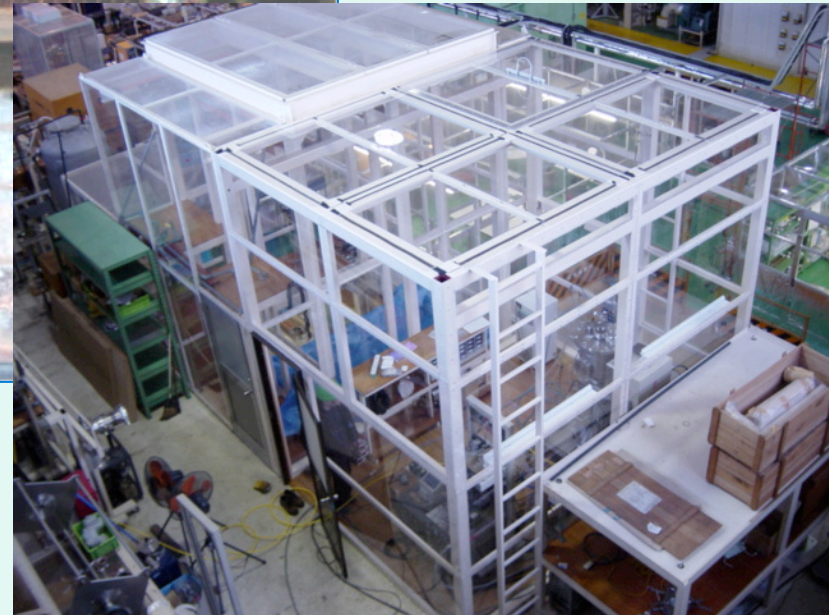
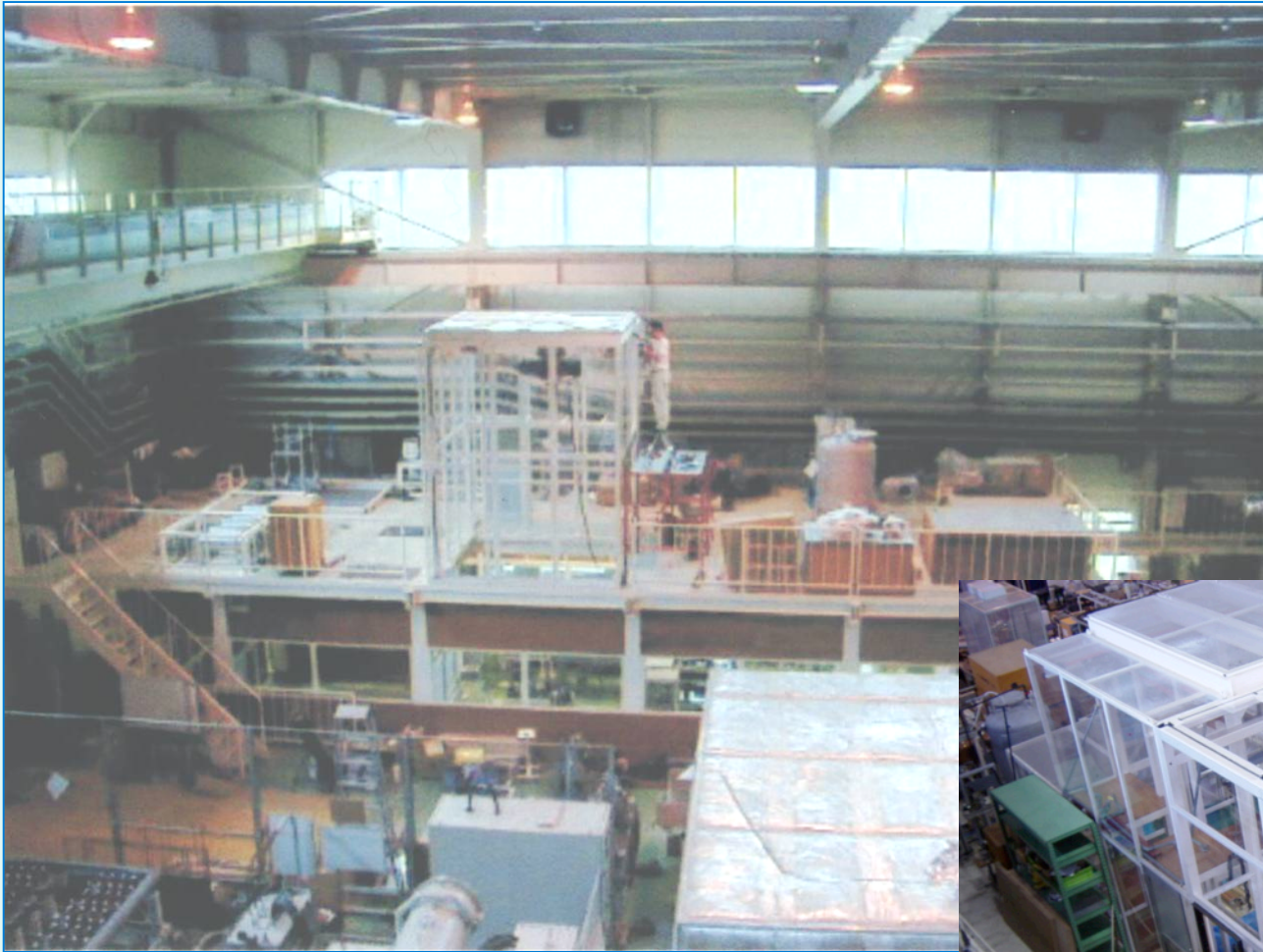
RF Test with Crab Cavity in V-cryostat

Clean Room for Cavity and Cryostat Assembling

Clean Room (Class 100)
for Cavity Assembling

High Pressure Pure
Water Rinsing

Clean Room
for Cryostat Assembling



Clean Room
for Nb-Cu Spattering

Road Map to Beam Test

