Crab Cavities: Cryostat R&D

KEKB Crab Cavity Group
NAKAI Hirotaka

Overview

- Design of Cryostat
- Parts Fabrication Techniques R&D
- Establishment of Assembly Site

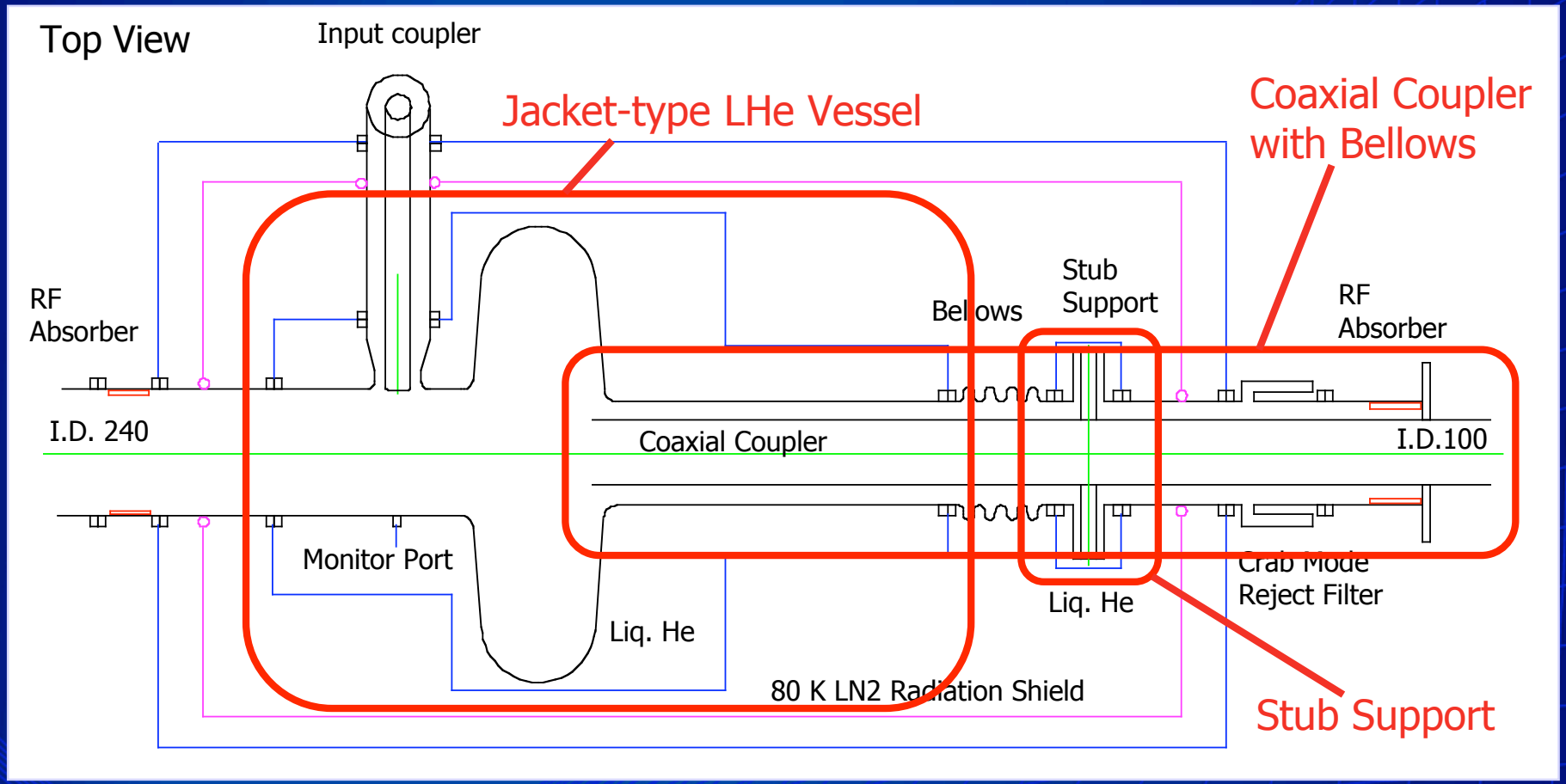
Cryostat Design Constraints

- Accommodation of Squashed-Cell Crab Cavity
- High Pressure Pure Water Rinsing (HPR) Applicable When Cavity Degraded
- Coaxial Coupler Movable for Tuning
- Support & Cooling for Long Coaxial Coupler

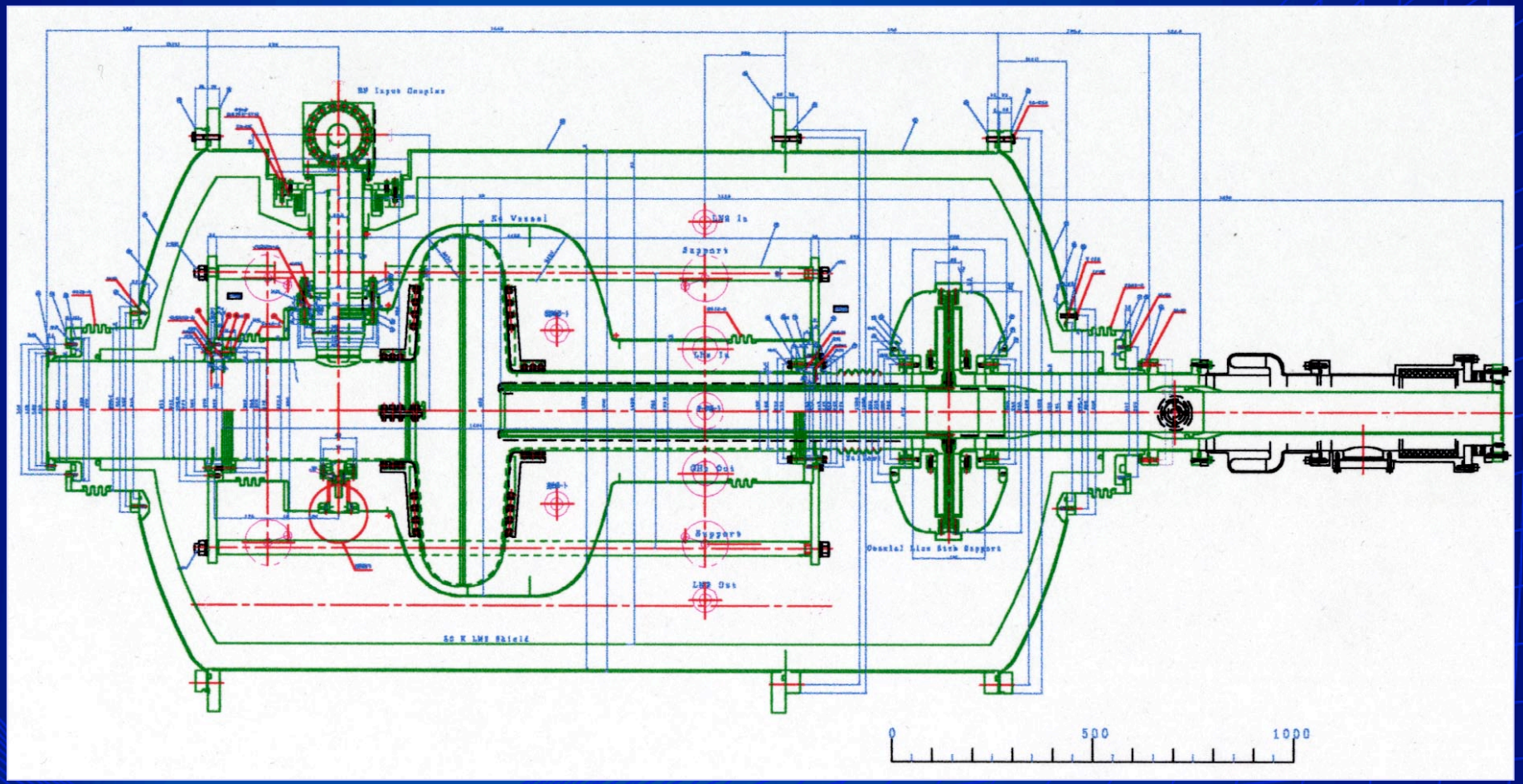
Cryostat Design Concept

- Jacket-Type Liquid Helium (LHe) Vessel
- Coaxial Coupler with Bellows
- Stub Support for Long Coaxial Coupler
- Jacket-Type Magnetic Shield around Cavity

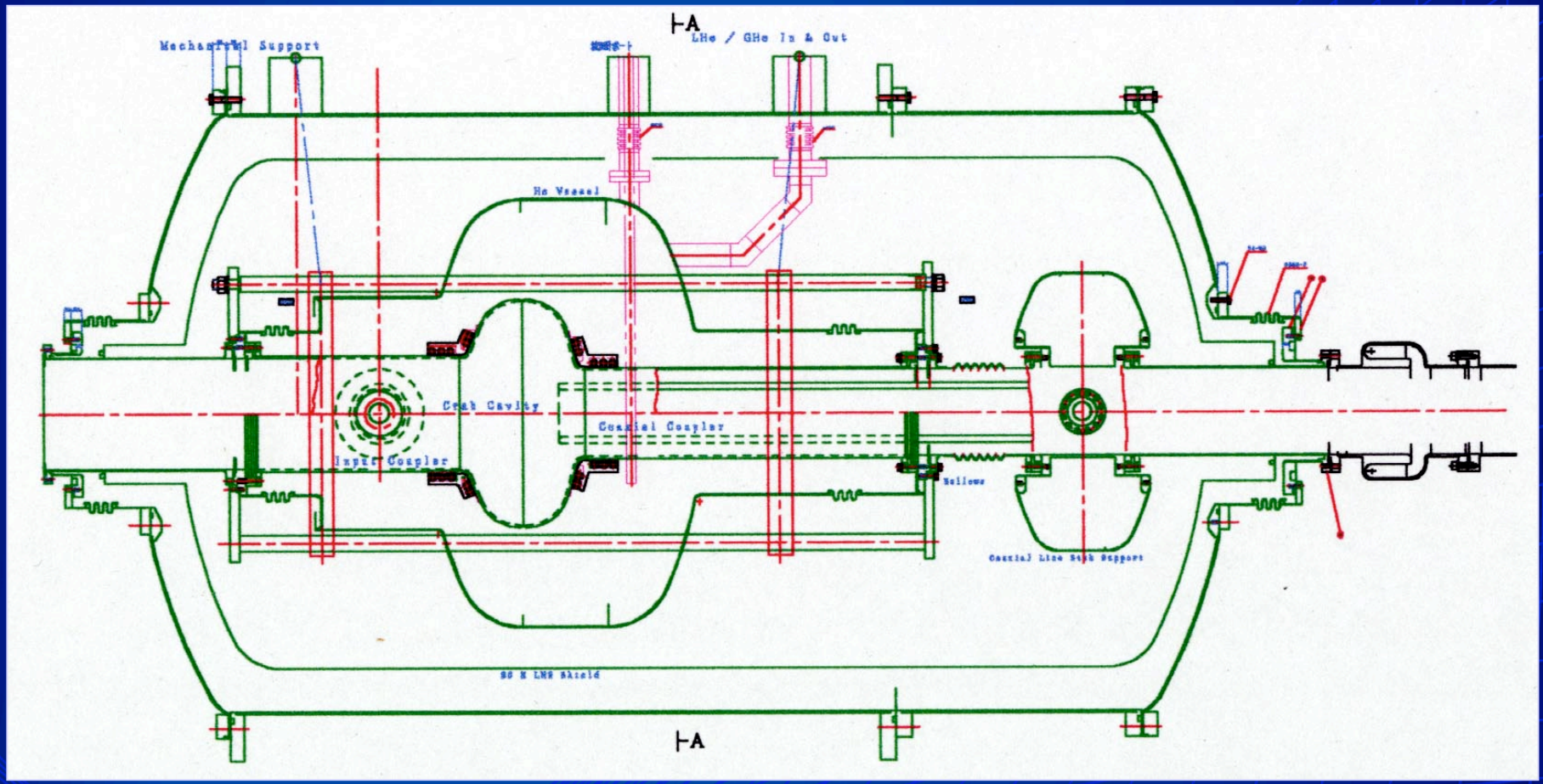
Cryostat Conceptual Design



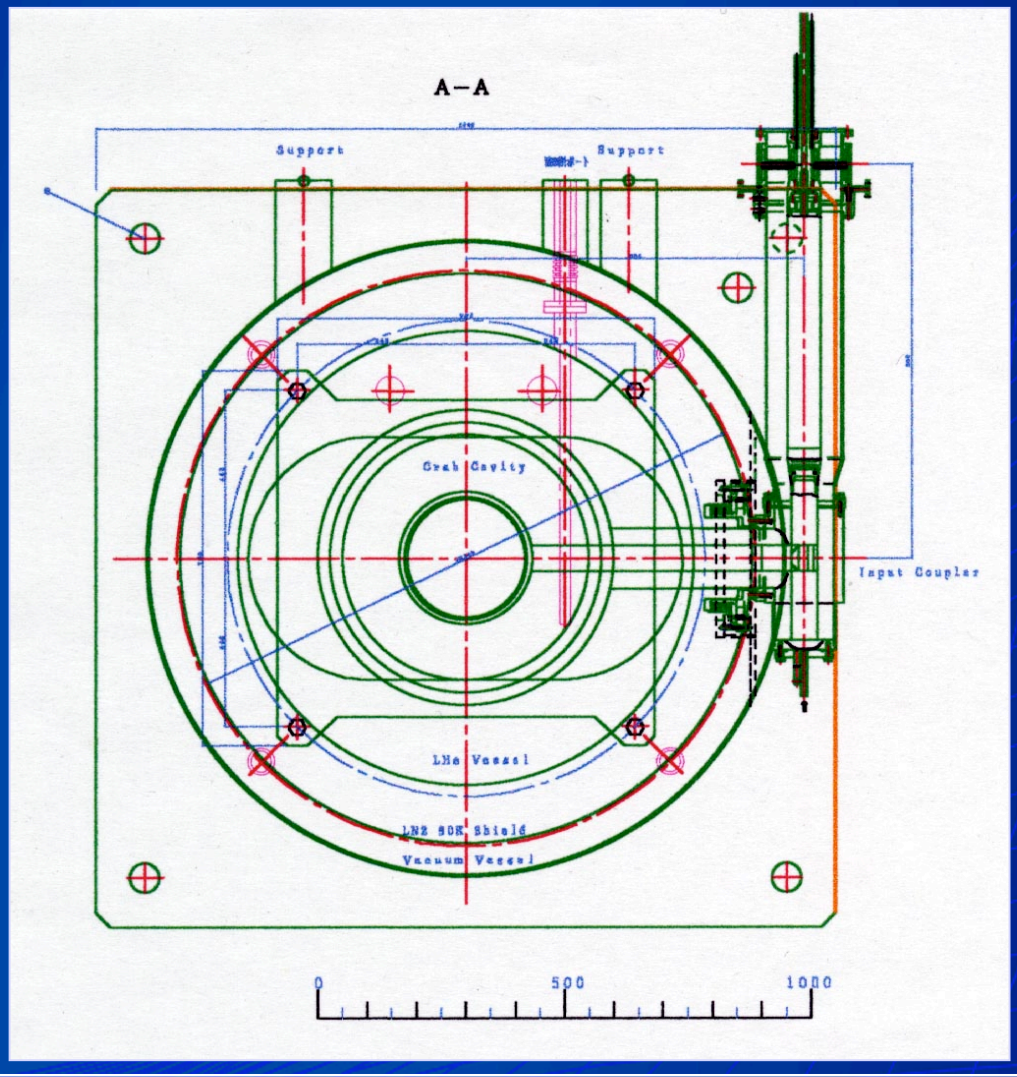
Cryostat Design (Top View)



Cryostat Design (Side View)



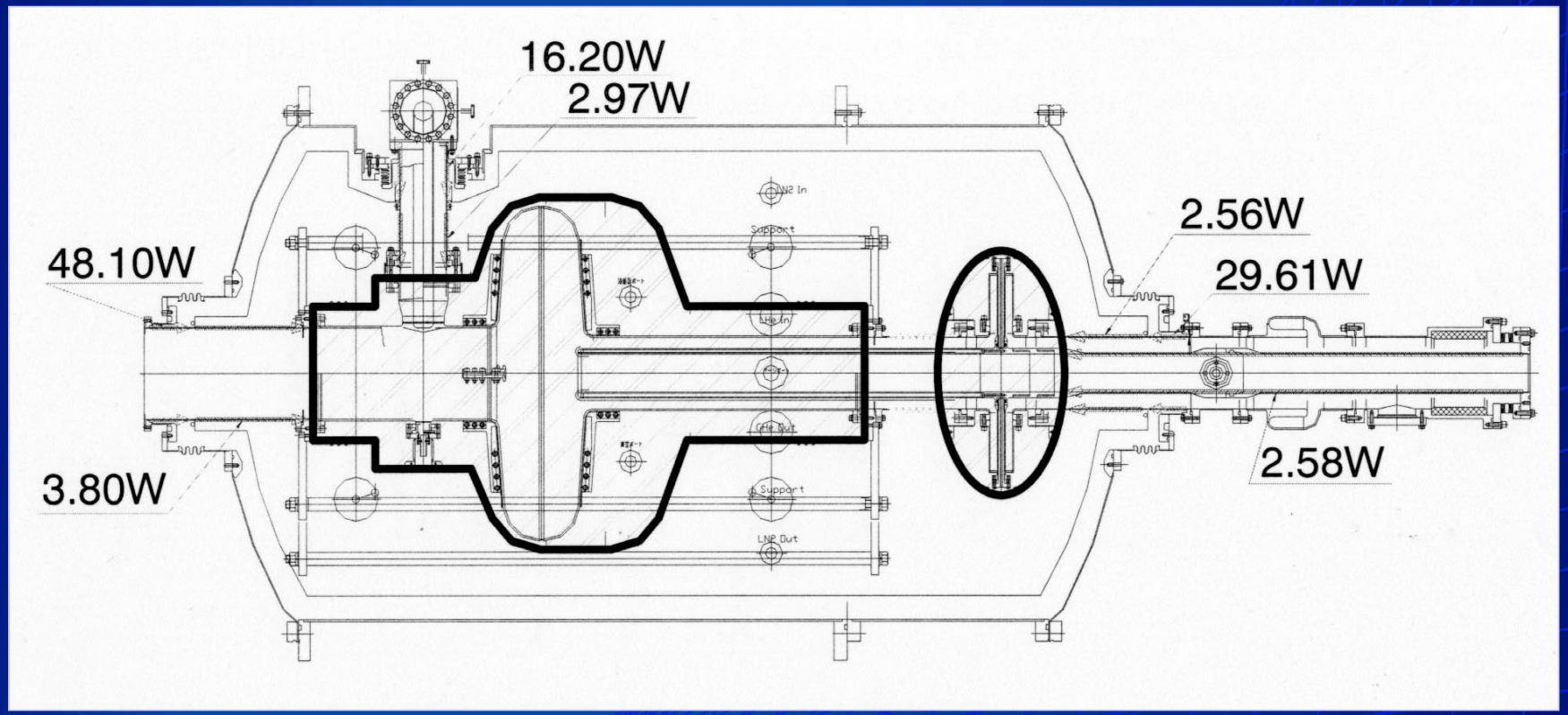
Cryostat Design (Front View)



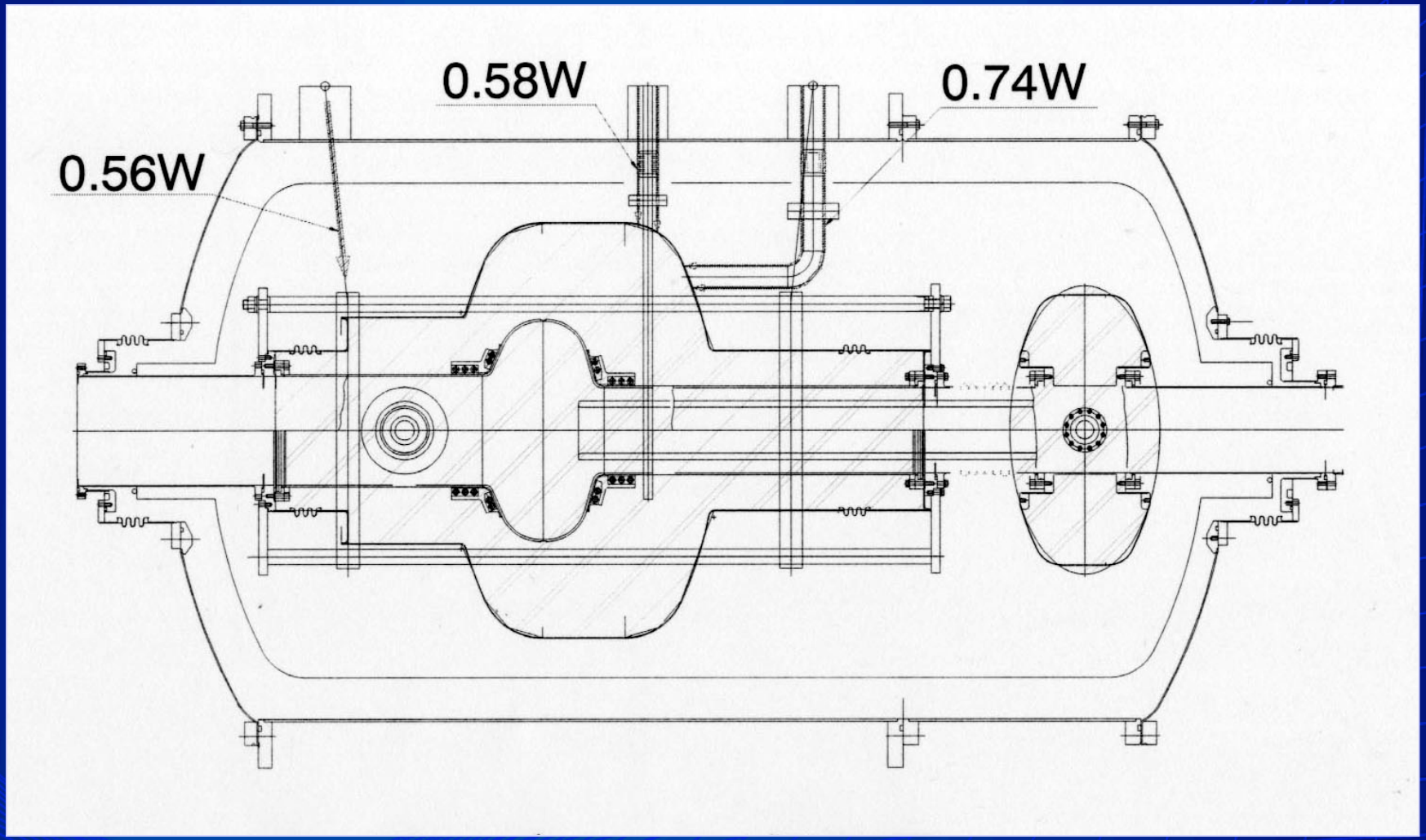
Analyses of Cryostat Design

- Thermal Analyses
  - Heat Leak to Cryostat
  - Heat Leak Through Tuner
- Structure Analyses
  - Stress of Cryostat (End Shells, etc.)
  - Stress of Stub Support
  - and so on …

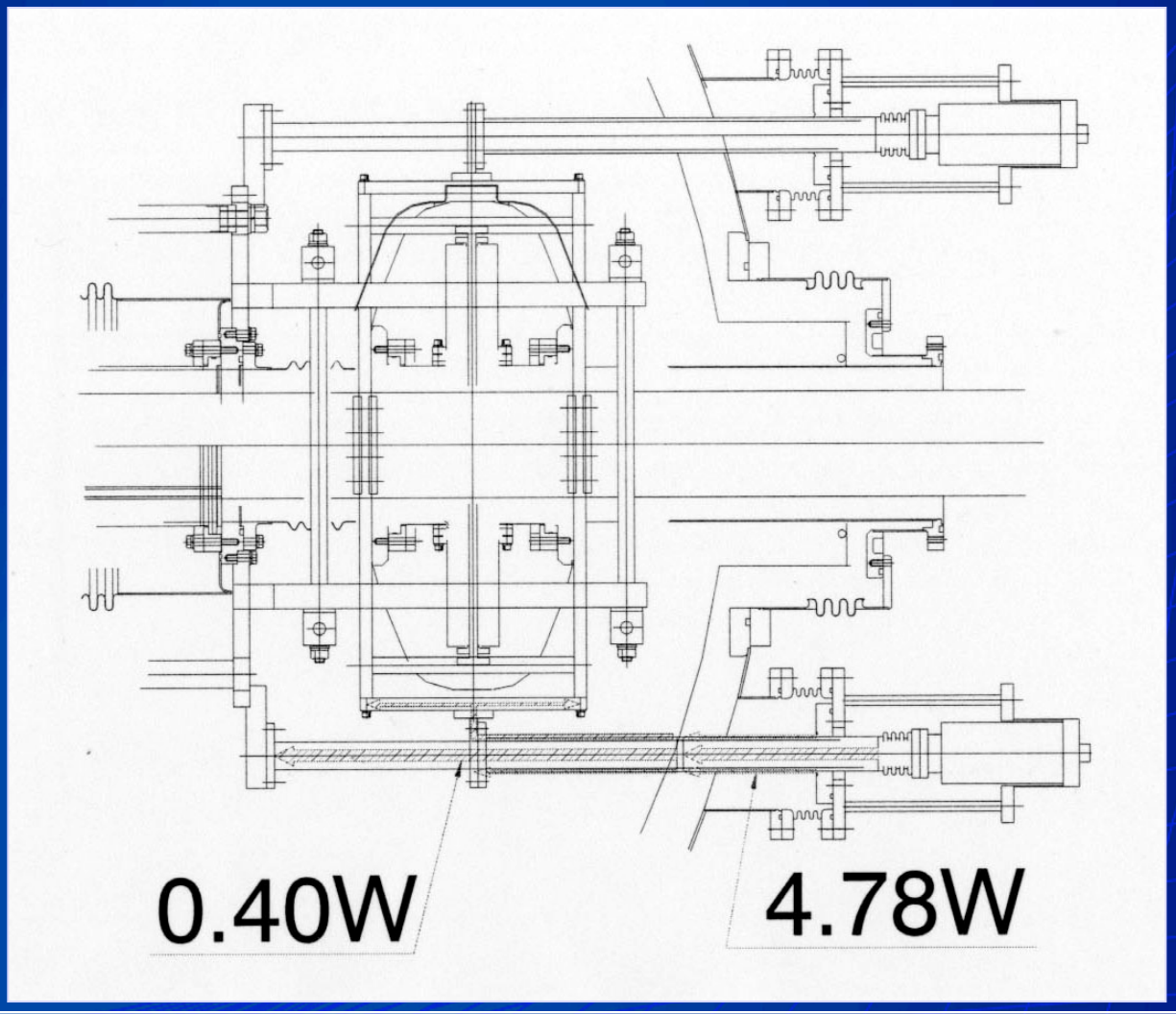
Heat Leak Calculation (Top View)



Heat Leak Calculation (Side View)



Tuner and Heat Leak Calculation (Top View)



Heat Leak to Cryostat

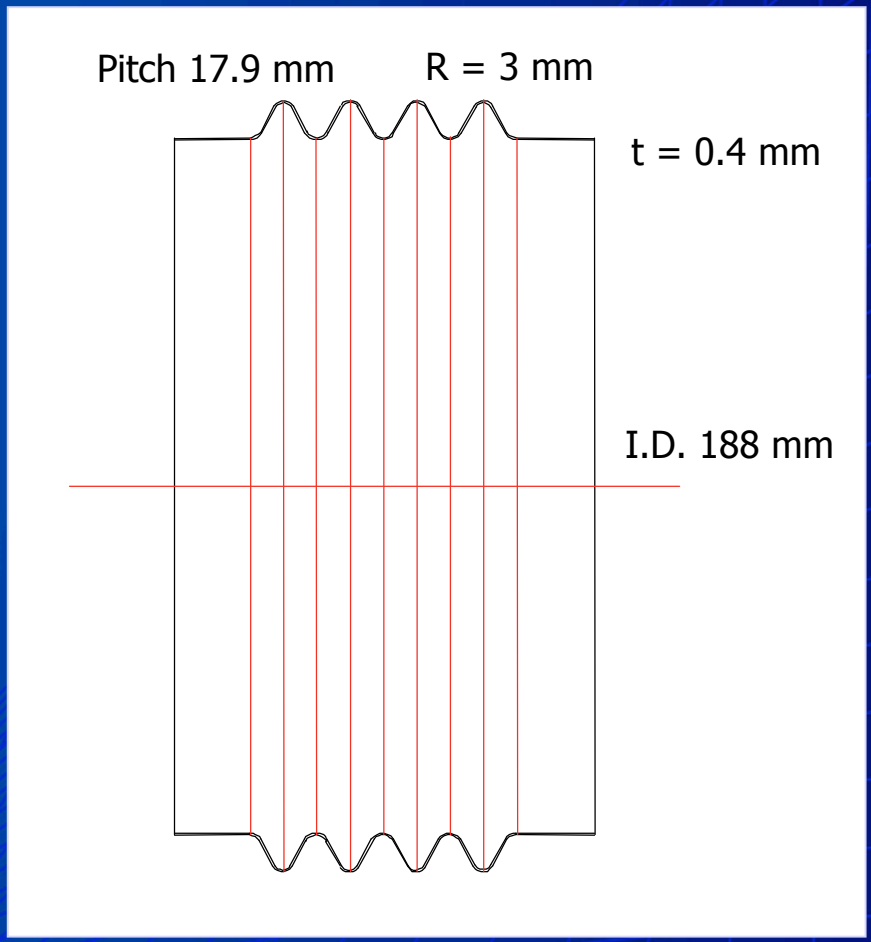
Heat Transfer Mode	Heat Leak Path			Heat Leak [W]	
				To 80 K Region	To 4 K Region
Conduction	Coaxial Coupler	Inner Conductor	Stainless Steel Tube	–	1.8
			Copper Plating	–	0.8
		Outer Conductor	Stainless Steel Tube	24.2	1.1
			Copper Plating	5.4	1.5
	Input Coupler	Outer Conductor	Stainless Steel Tube	13.0	1.0
			Copper Plating	3.2	1.9
	Beam Pipes	Beam Pipes	Stainless Steel Tube	41.2	1.9
			Copper Plating	6.9	1.9
	Tuner	Inner Rods (2 Rods)		1.4	0.1
		Outer Sleeves (2 Sleeves)		3.4	0.3
	Supports	Cavity Supports (4 Wires)		–	0.6
		80 K Shield Supports			–
	Plumbing	LHe Transfer Tubes (2 Tubes)		–	0.7
		Liquid Level Sensor Support		–	0.6
		Safety Valve Plumbing			
	Wiring	Thermocouples, Cables, etc.			
Radiation	Vacuum Vessel to 80 K Shield			10.6	–
	80 K Shield to LHe Vessel			–	0.4
Total Amount of Heat Leak				**109.3**	**14.6**

Parts Fabrication R&D

- Seamless Copper Bellows for Coaxial Coupler
- End Shells of Cryostat
- Thin Pipes for Beam Pipes & Input Couplers

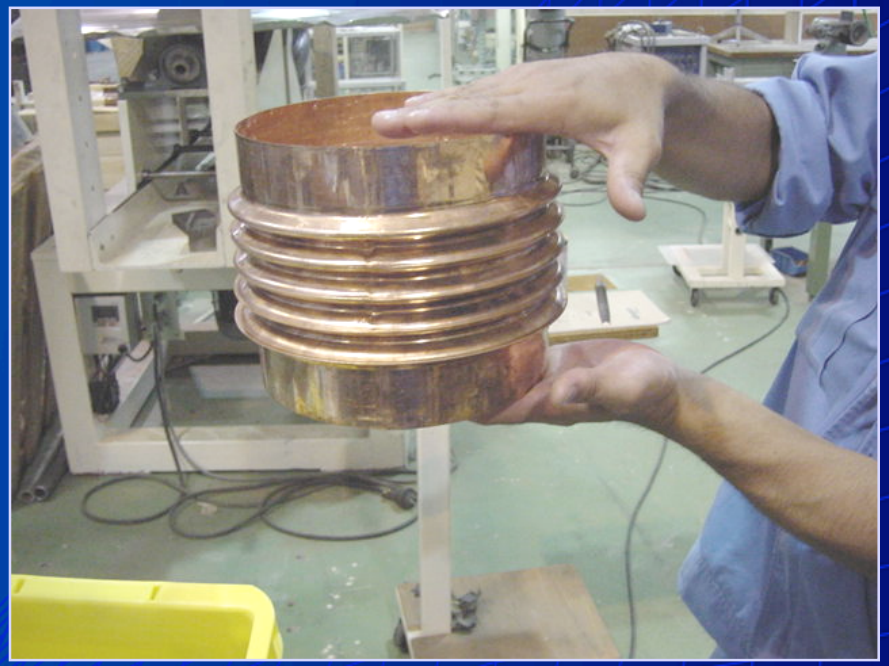
Copper Bellows - Purposes

- Coaxial Coupler Connection to Cavity
- Tuning with Coaxial Coupler Position



Copper Bellows - Seamless Pipes

Drawing Bench:
Capacity 30 tons



Fabricated 5-cell Bellows

End Shells - Dimensions

- Vacuum Vessel
  - Diameter 1200, thickness 2
- Liquid Helium Vessel
  - Diameter 600, thickness 1.5
  - Diameter 920, thickness 2

End Shells

Vacuum Vessel End Shell

Liquid Helium Vessel End Shells

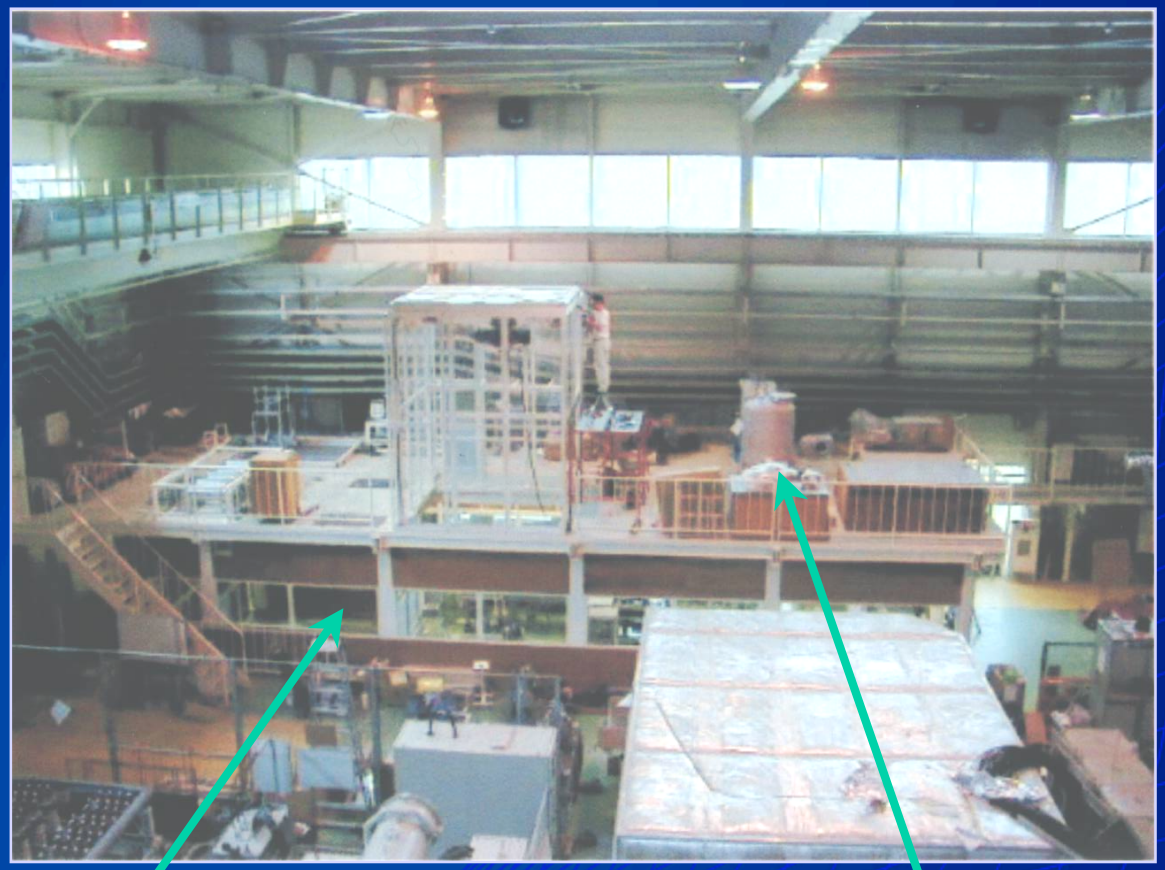
Thin Pipes - Dimensions

- Input Coupler
  - Diameter 120, thickness 0.5
- Beam Pipes
  - Diameter 188, thickness 0.8
  - Diameter 240, thickness 0.8

Thin Pipes - Drawing Bench

Drawing Bench:
Capacity 100 tons

Assembly Site



Clean Room for Cavity and Cryostat Assembly

Ultra Pure Water Plant for High Pressure Pure Water Rinsing

Summary

- 1st Cryostat Construction in FY 2004
- Parts Fabrication R&D in Progress
- Fabrication of Vacuum Vessel Started
- Collaboration with Mechanical Engineering Center of KEK