R&D of RF coupleres for Crab cavity

The Graduate University for Advanced Studies
(KEKB Crab Cavity Group)
NAKANISHI Kota

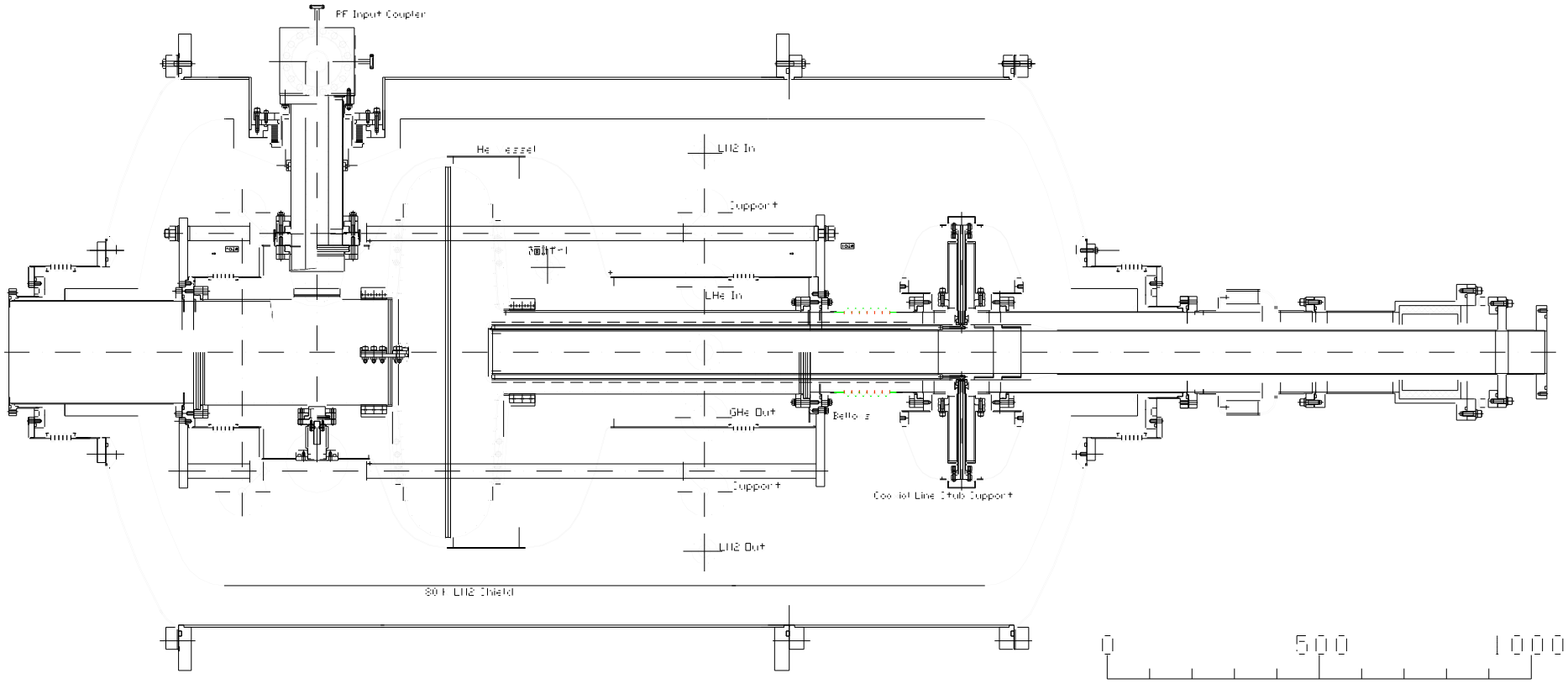
1. Design of Input coupler

2. Design of Coaxial coupler

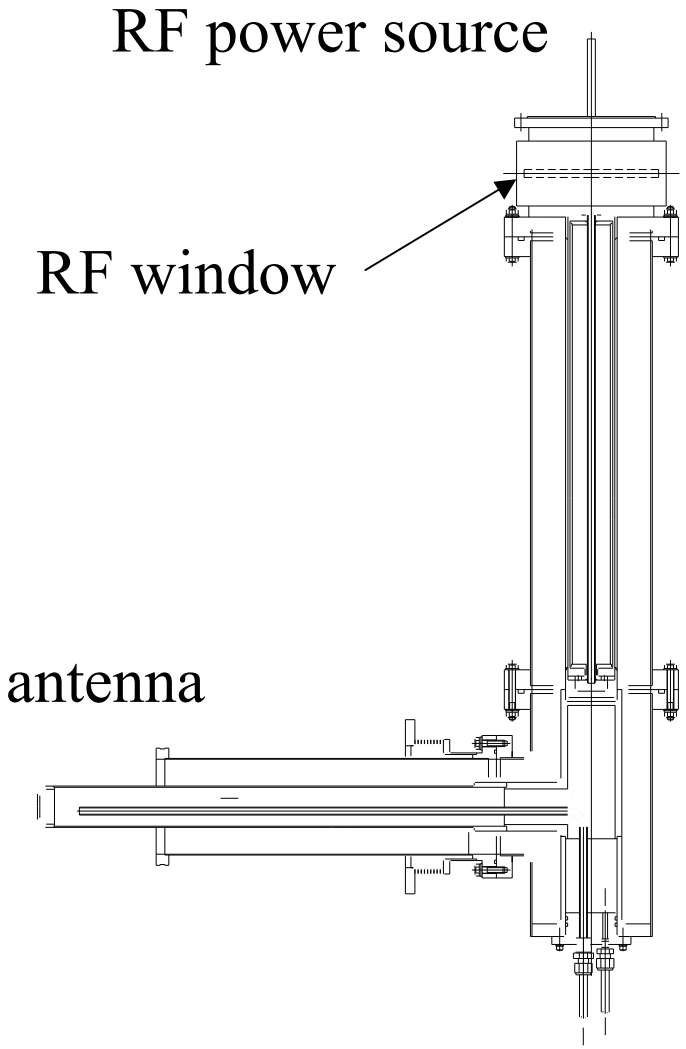
3. Development of Nb film on Cu substrate

2004 KEKB Machine advisory committee

0. Cryostat of Crab Cavity (Top View)



1. Design of Input coupler

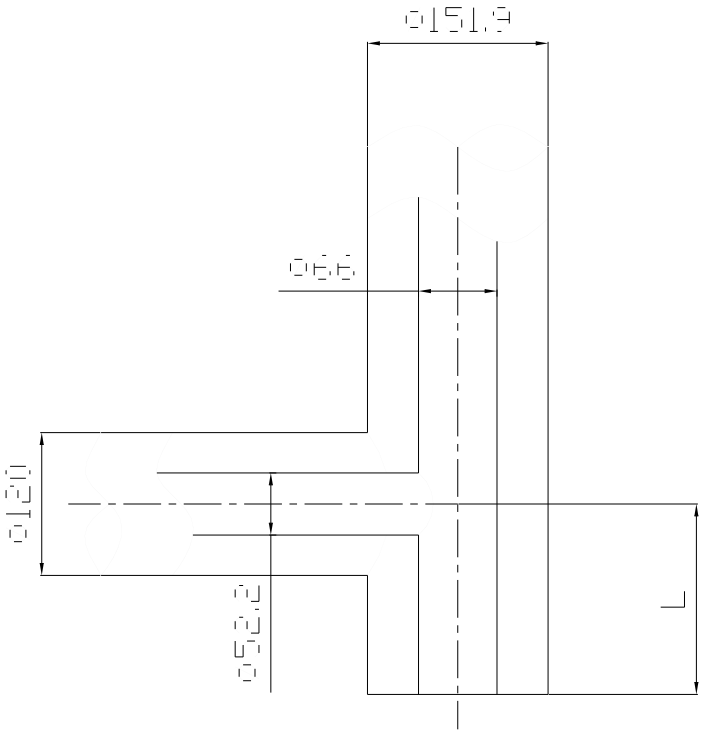


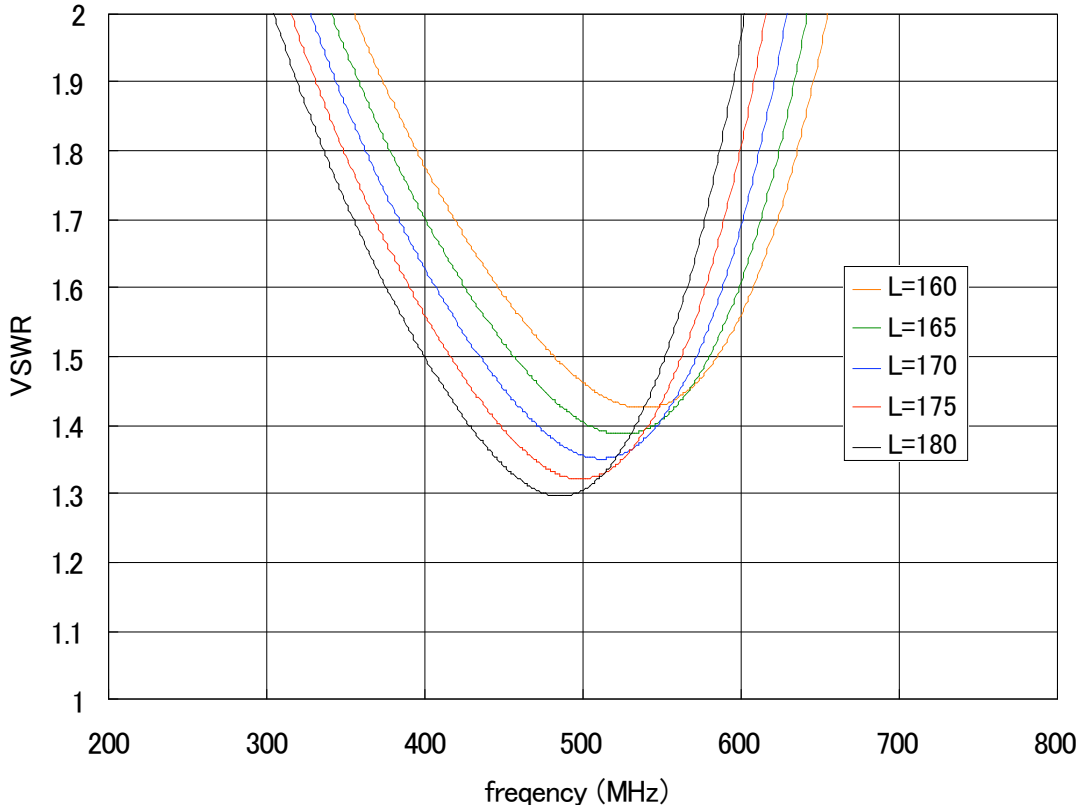
Design condition

Item	Requirement	Reason
Diameter of outerconductor (window side)	151.9 mm	To use RF window designed for acceleration cavities
Diameter of innerconductor (window side)	66 mm	
Diameter of outerconductor (cavity side)	120 mm	To use crab cavity for vertical measurement
RF frequency	509 MHz	KEKB specification

1. Design of Input coupler

Case 1 (Plain)



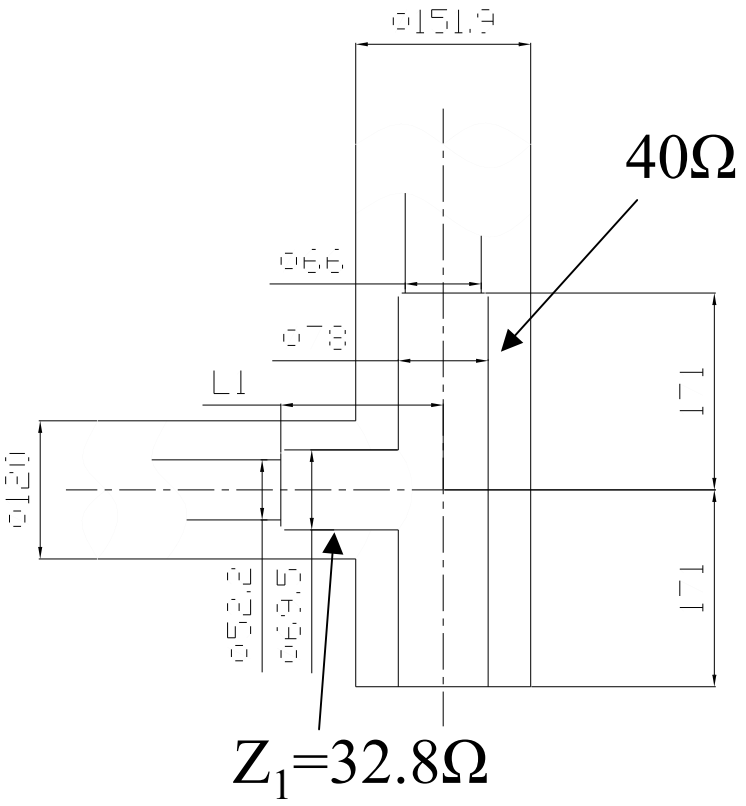


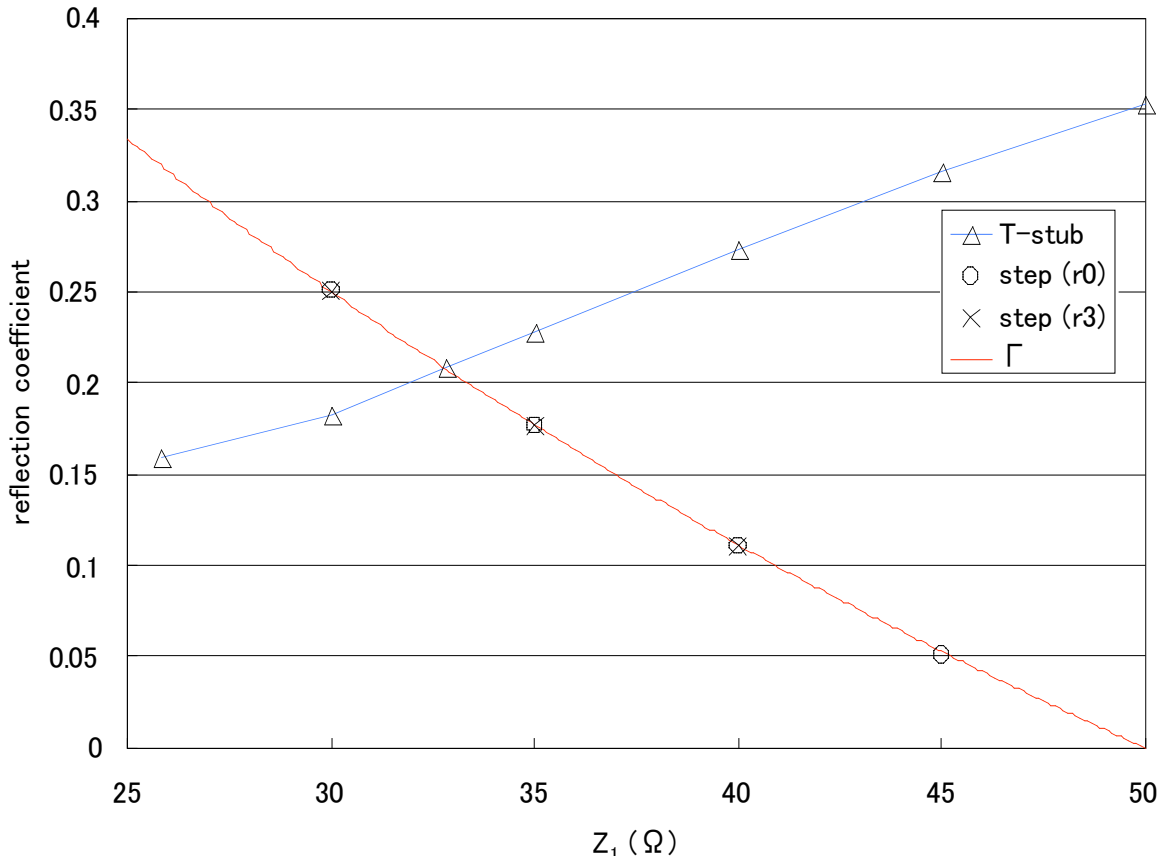
L=171mm

VSWR(@509MHz)=1.34

1. Design of Input coupler

Case 2 (step)



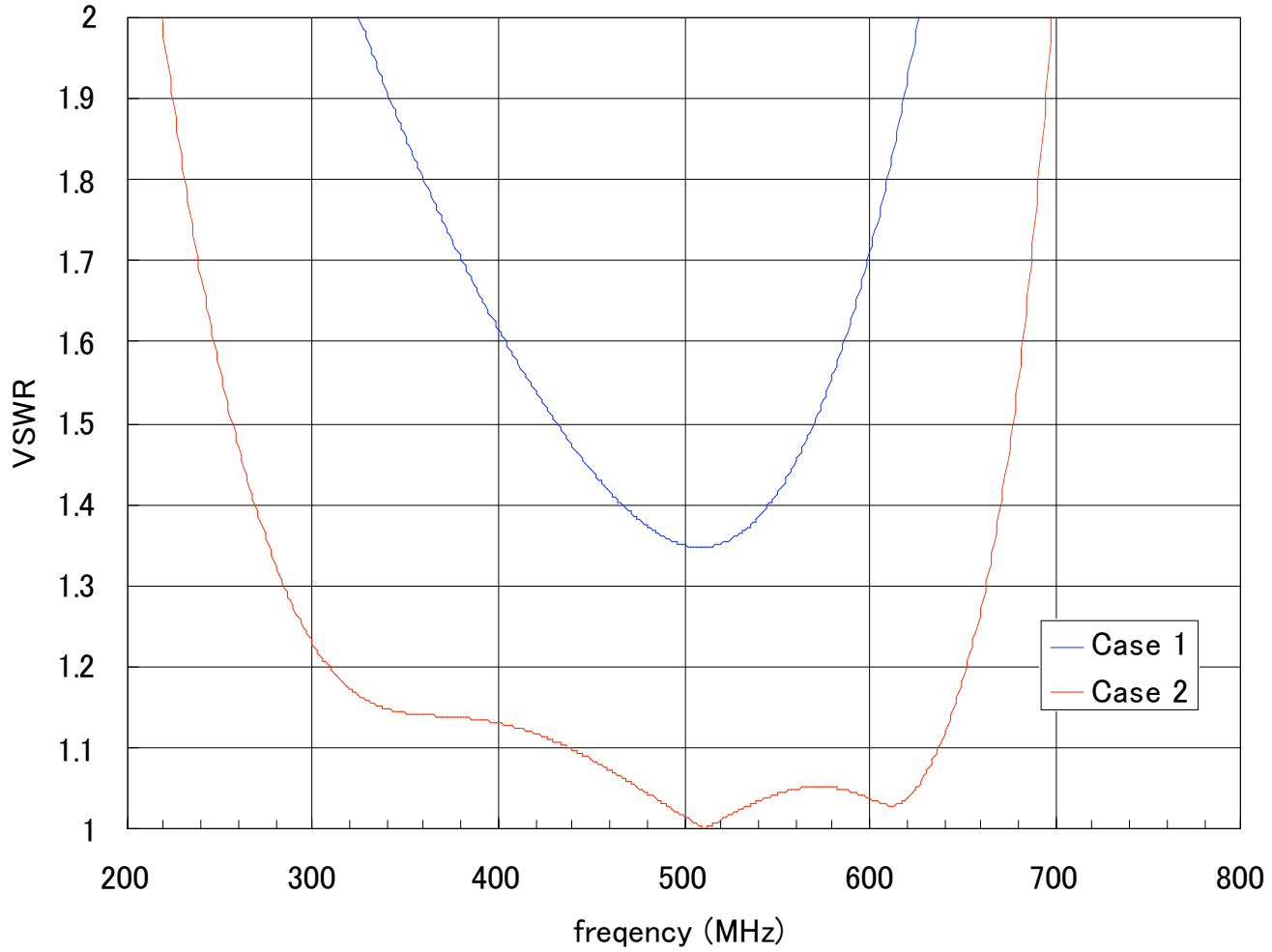


When Z_1=32.8Ω, reflection coefficient of T-stub and step are same.

The L1 must be decided to make these reflections are canceled.

→ L1=141mm

1. Design of Input coupler

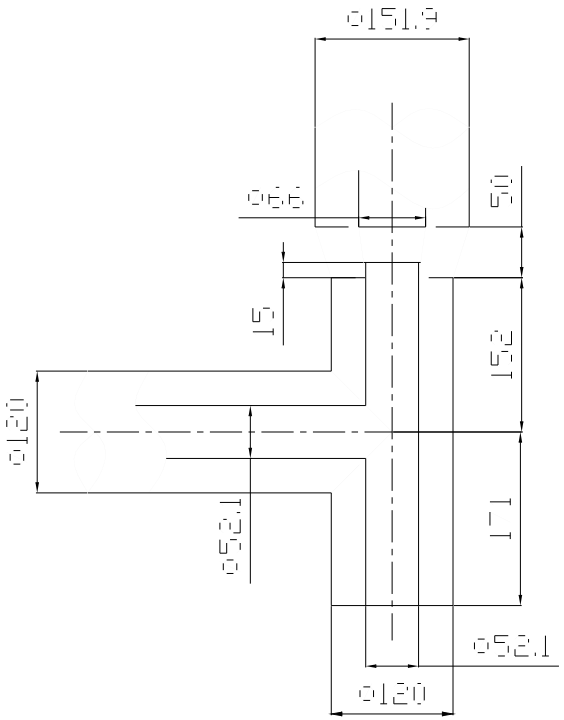


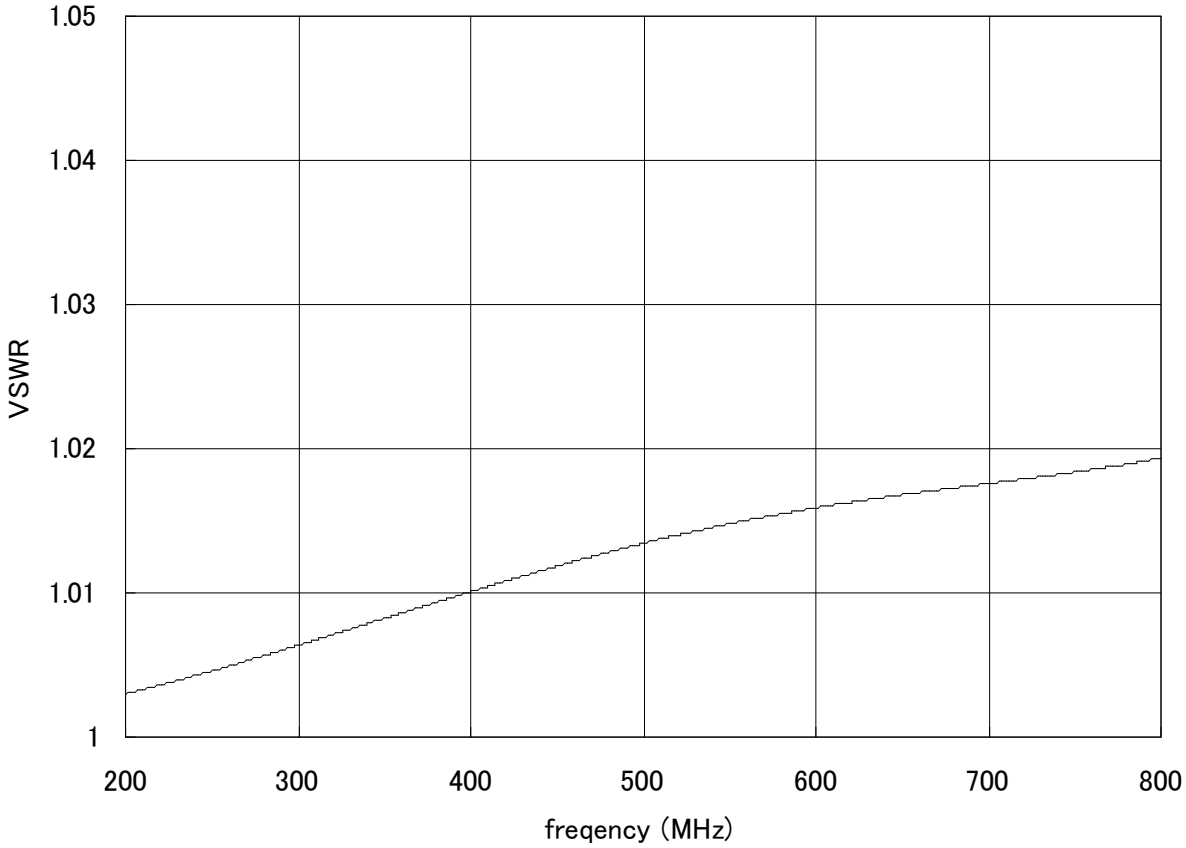
Low VSWR value and wide band width are obtained.

Passband (VSWR < 1.2) lies between 309 and 652 MHz.

1. Design of Input coupler

Case 3 (taper)

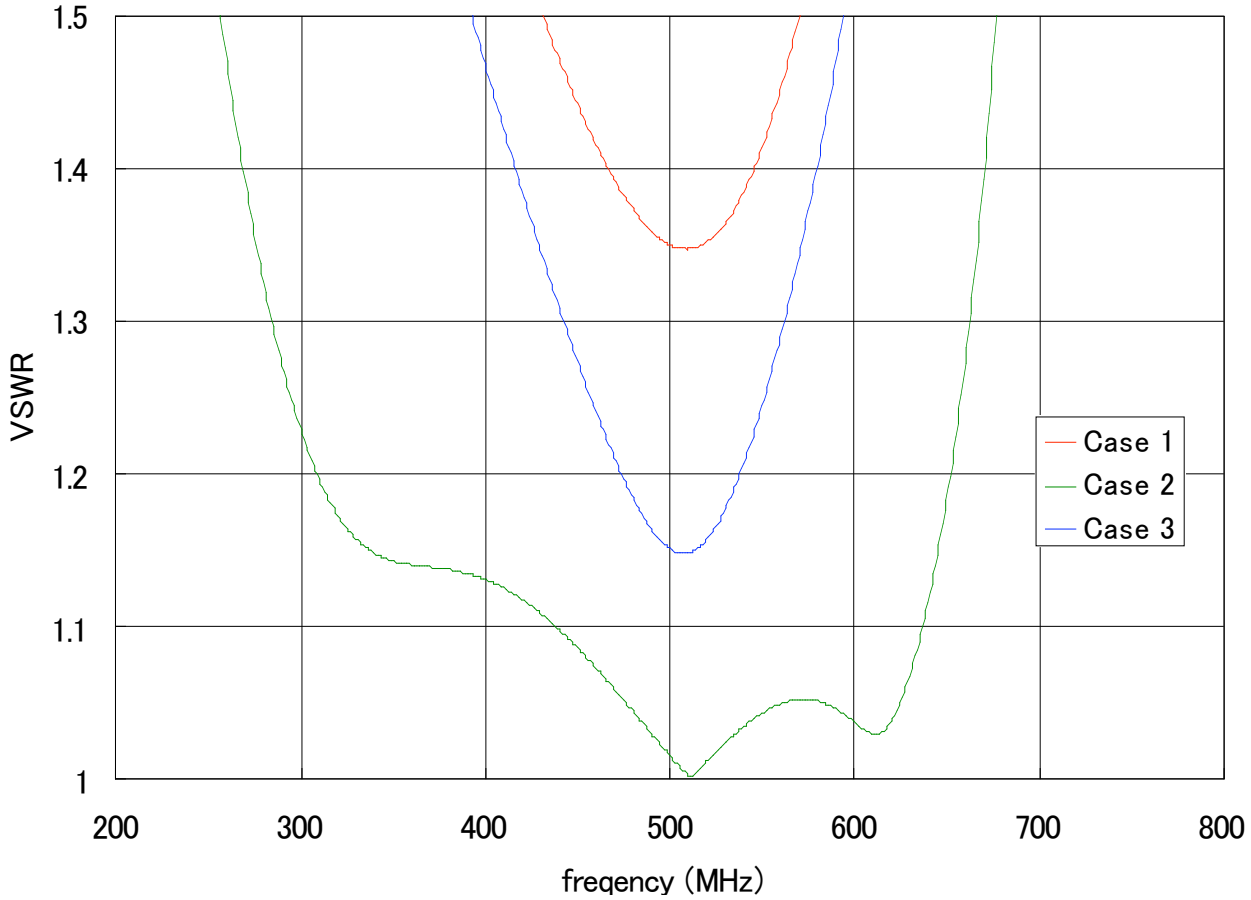




This model was proposed by a manufacturer.

Reflection caused by the taper is negligible.

1. Design of Input coupler



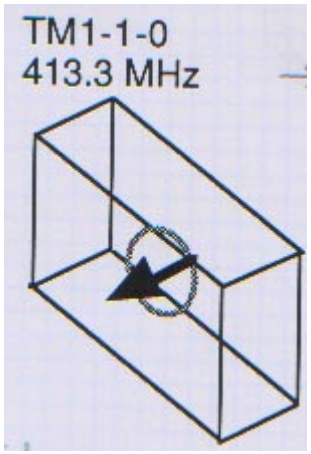
Passband (VSWR < 1.2) lies between 474 and 538MHz.

VSWR(@509MHz)=1.147

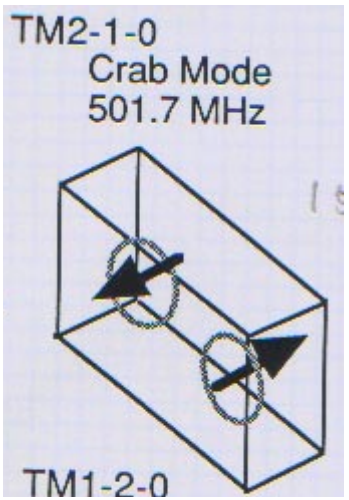
Model of case 3 is acceptable.

2. Design of Coaxial coupler

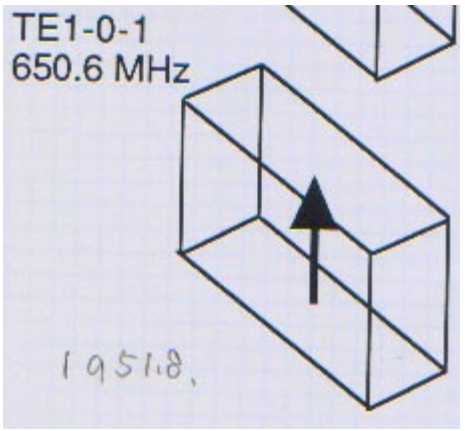
Coaxial coupler must behave as band stop filter.



pass

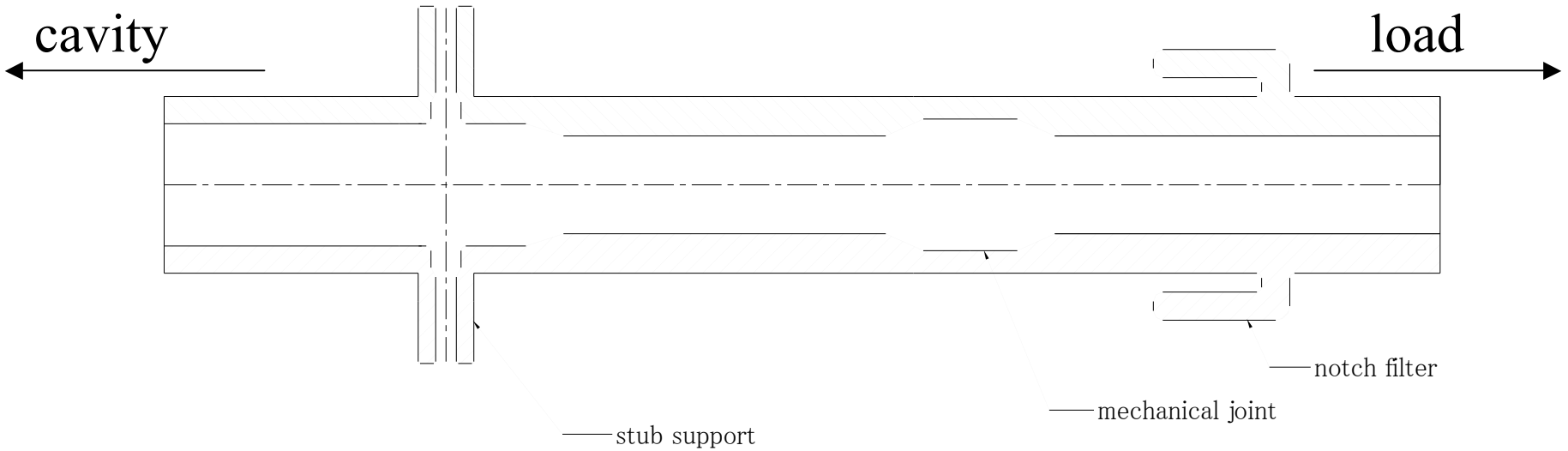


stop



pass

2. Design of Coaxial coupler



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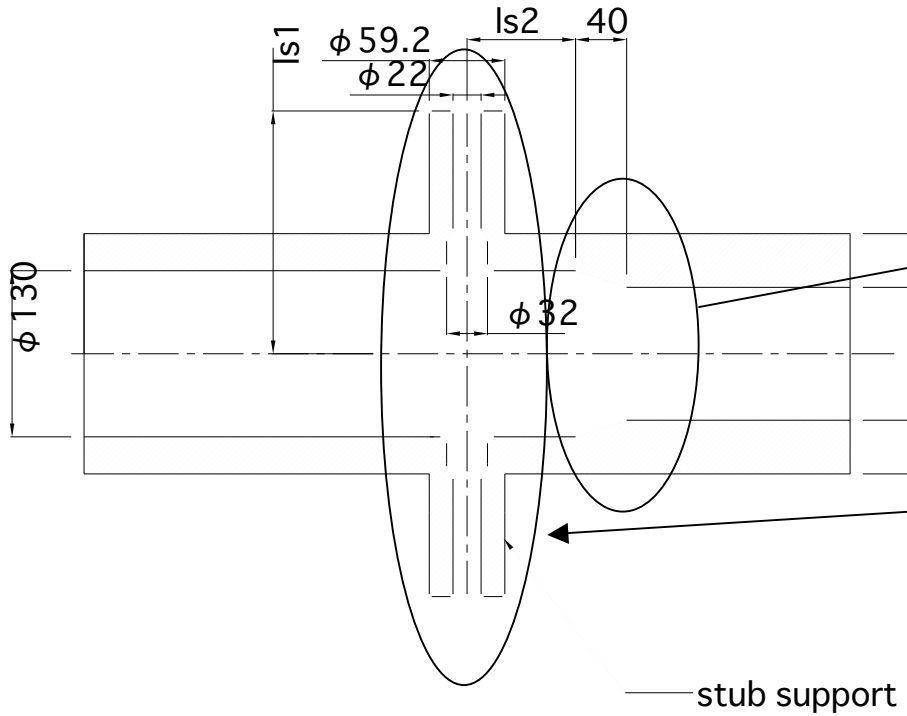
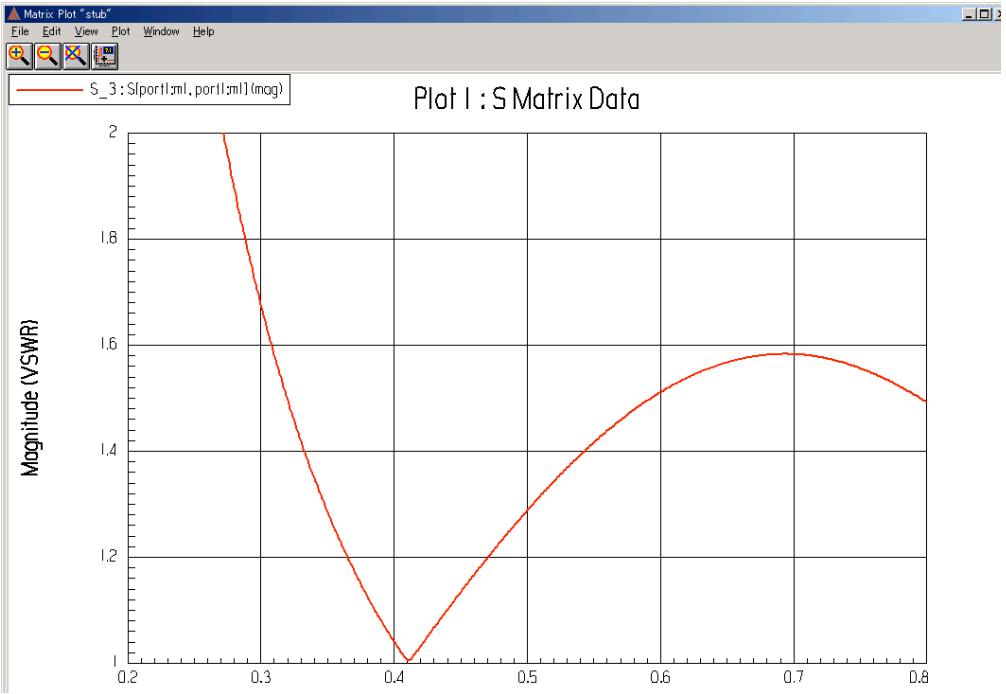


S11(@413)=0.228

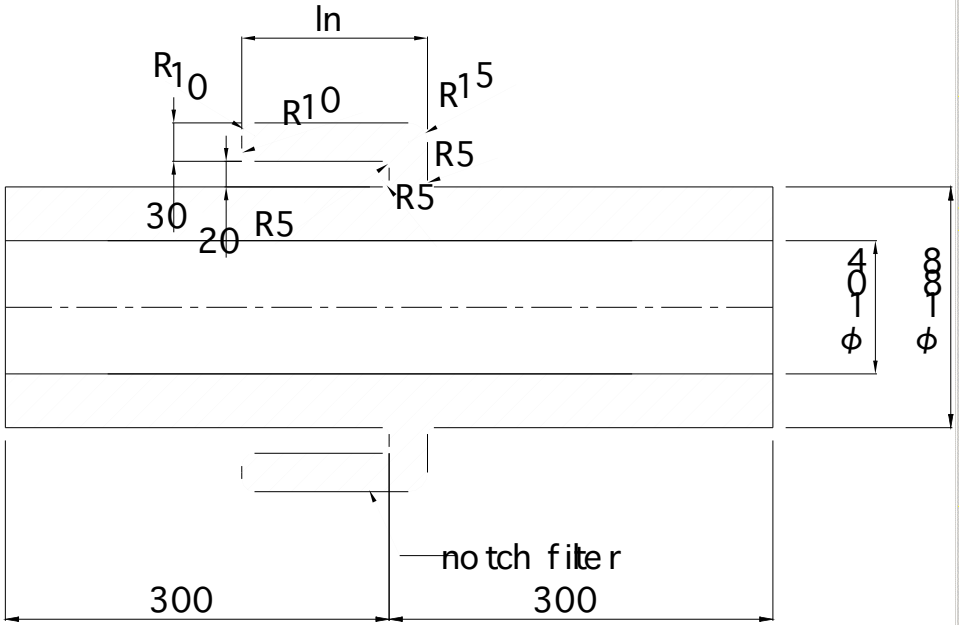
ls1=190mm
(to adjust magnitude of reflection)

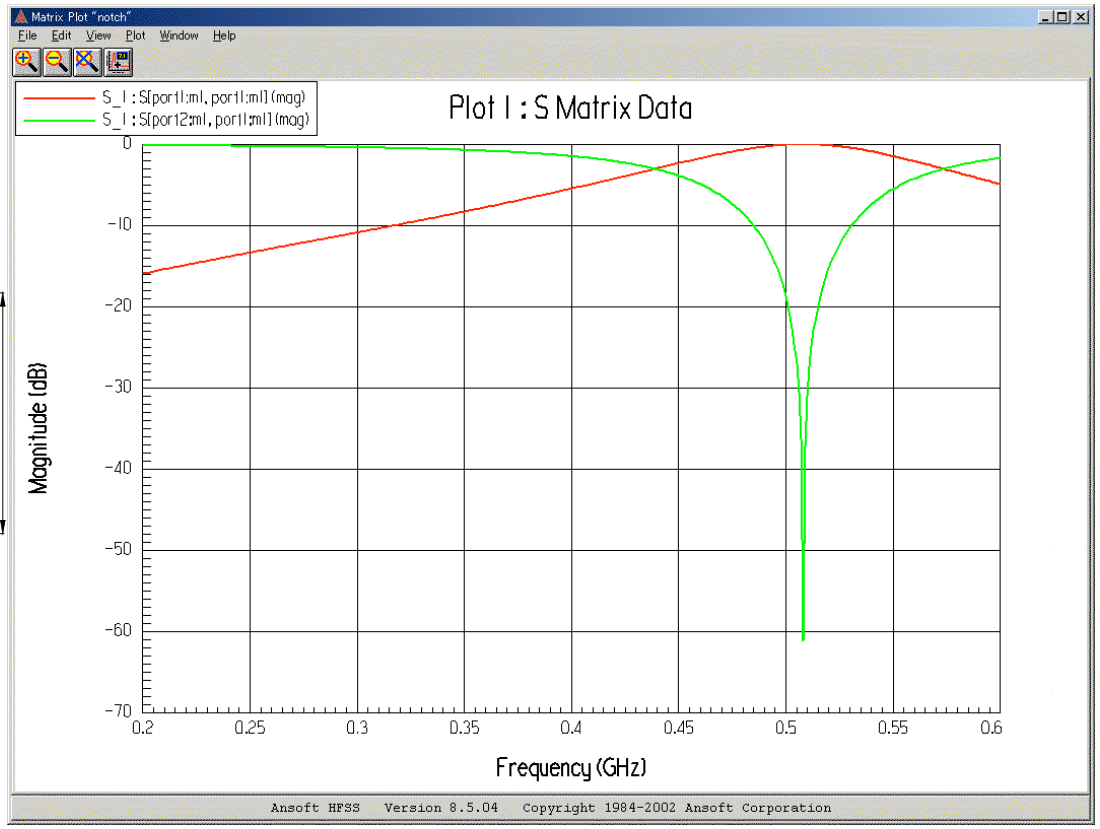


The ls2 was adjusted to make these reflections are canceled.

The ls2 must be chosen 85mm.

2. Design of Coaxial coupler

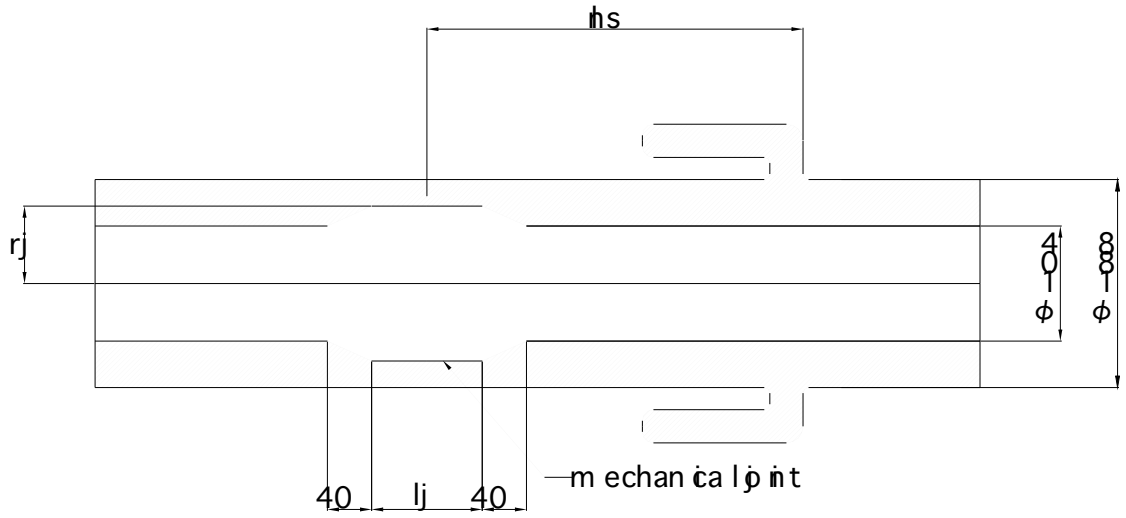




The ln must be chosen 142mm, because of stopping 509MHz.

Then S11(@413MHz) = 0.586

2. Design of Coaxial coupler

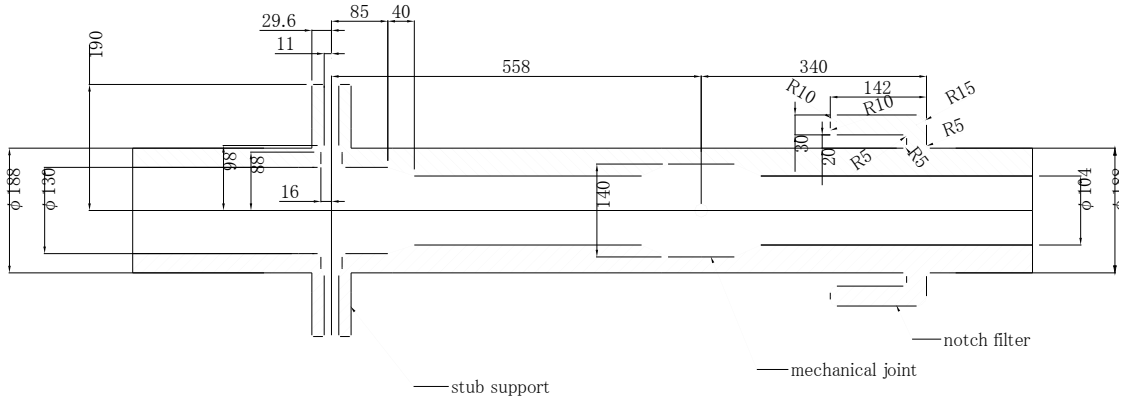


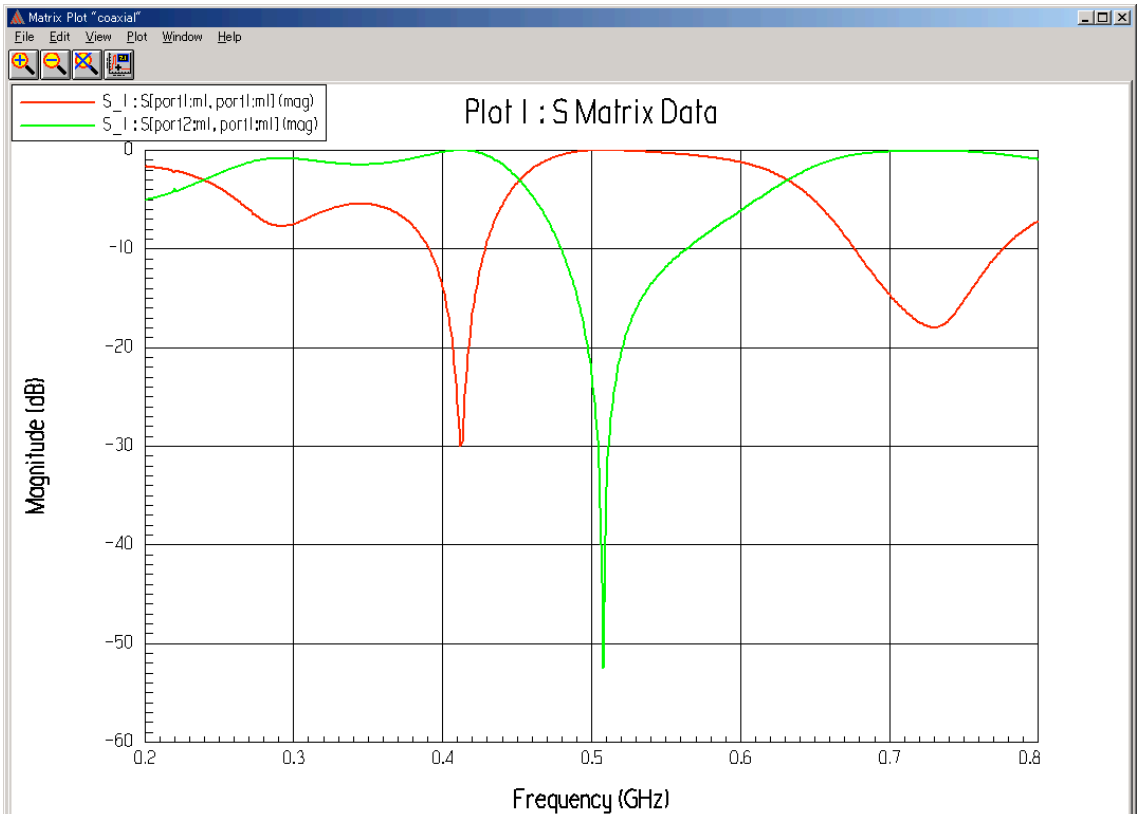
A mechanical joint also makes some reflection.

When lj=100mm and rj=70mm, reflection coefficients are almost same.

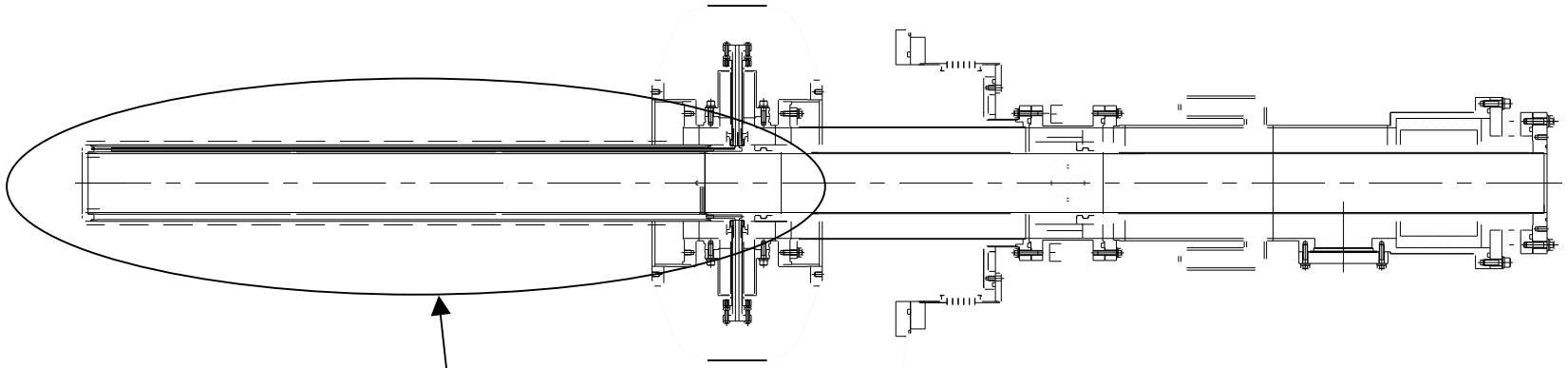
And if the lns is chosen =340mm, these reflections are canceled.

2. Design of Coaxial coupler





3. Development of Nb films on Cu substrate

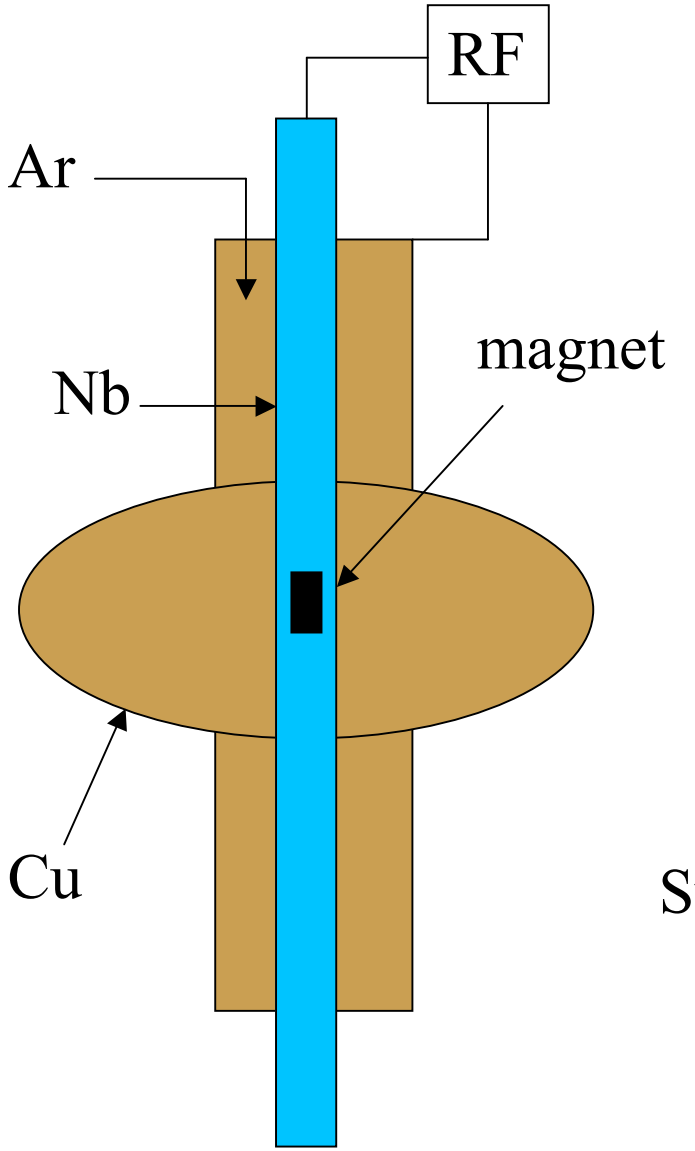


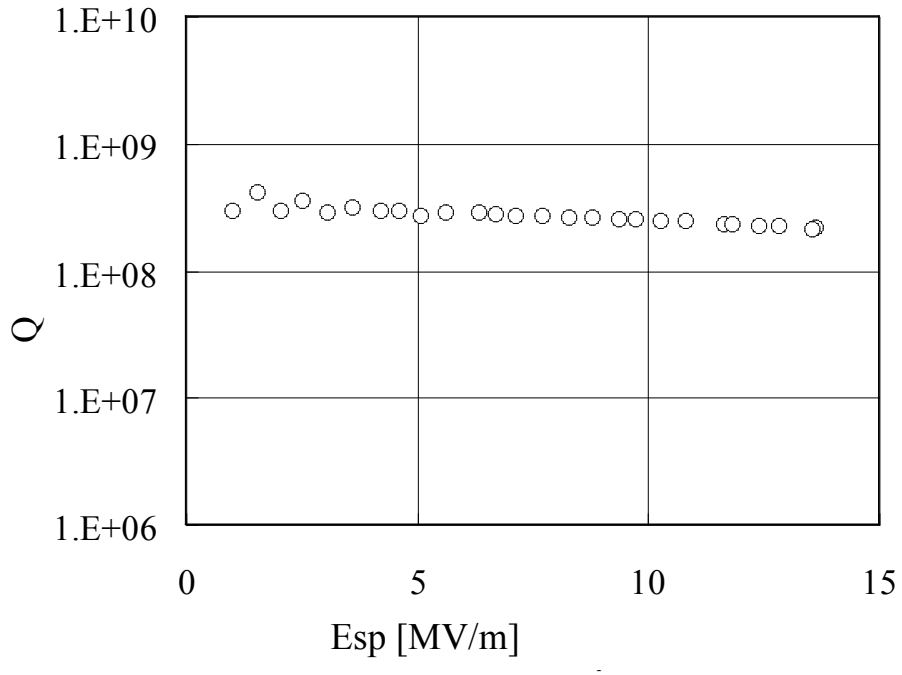
The coaxial coupler is exposed high electric and magnetic field only the tip.

It is very luxury that this part is made of Nb.

If Nb/Cu technique can be applied, everyone may be happy.

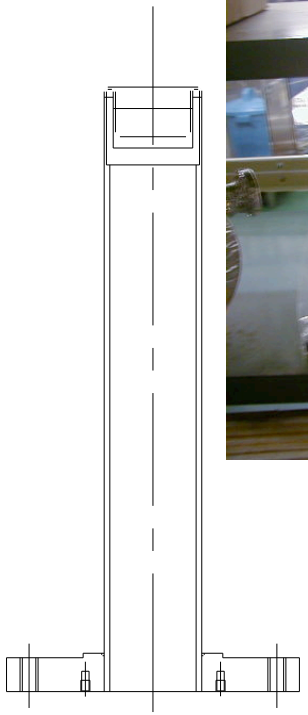
3. Development of Nb films on Cu substrate

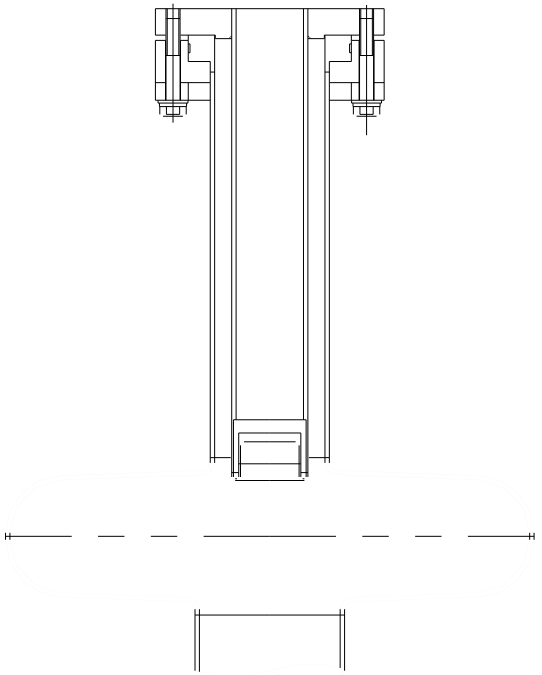




Superconducting film was obtained.

3. Development of Nb films on Cu substrate

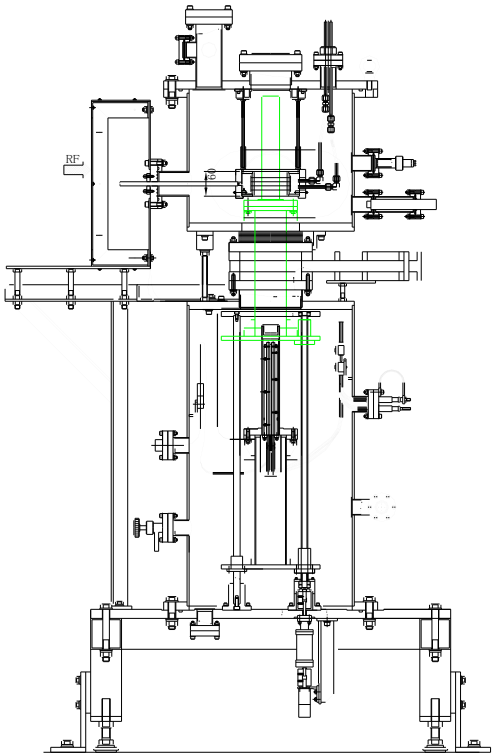


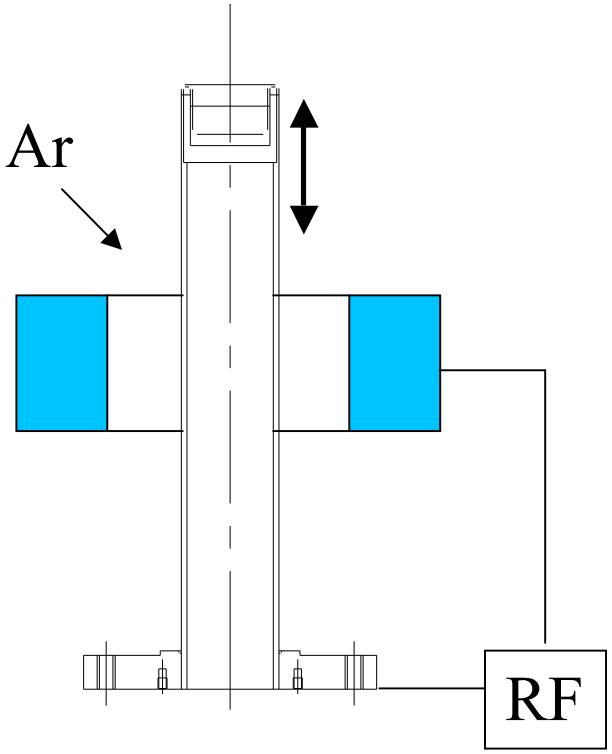


Simplified coaxial coupleres ware made.

Measurement of Nb film property can be simplified.

3. Development of Nb films on Cu substrate





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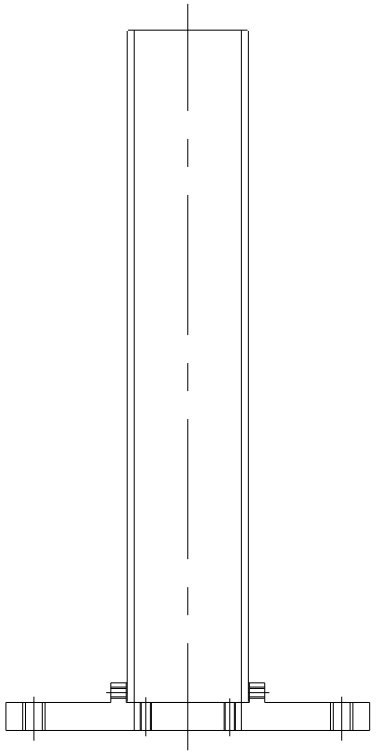
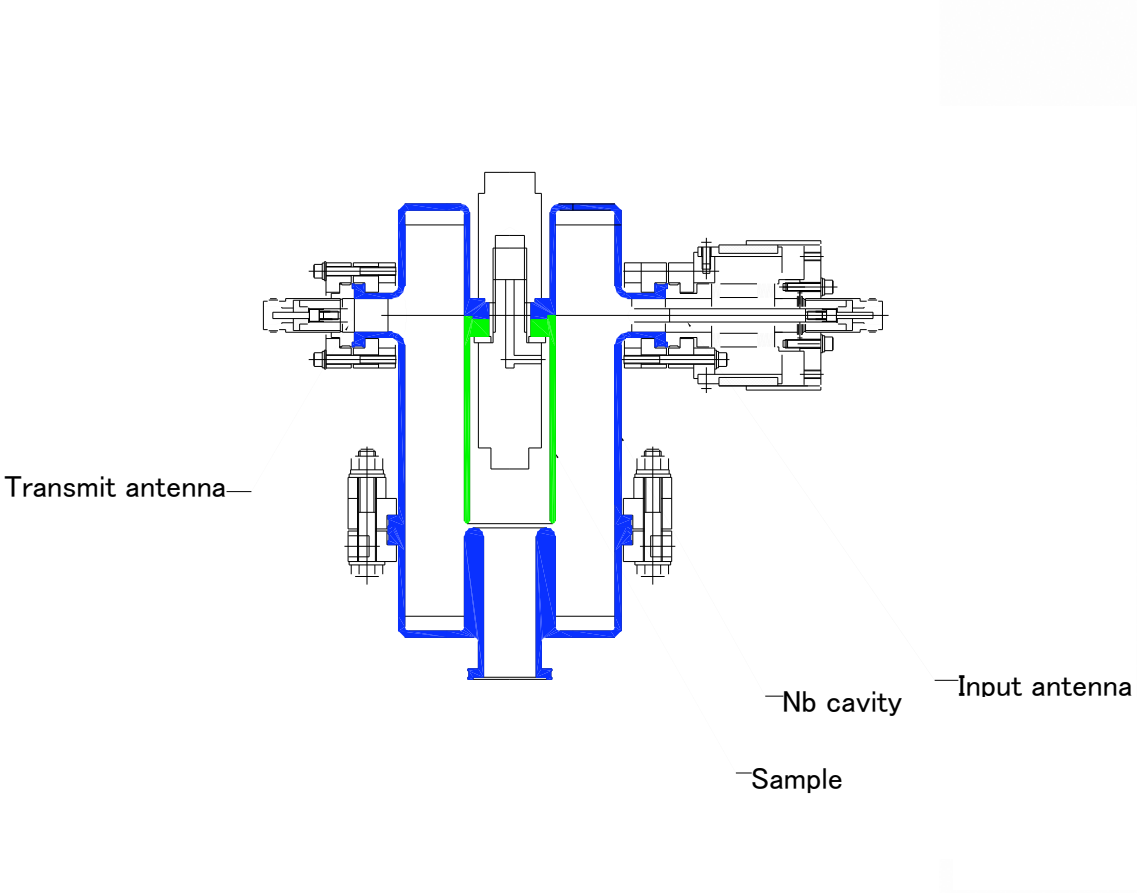
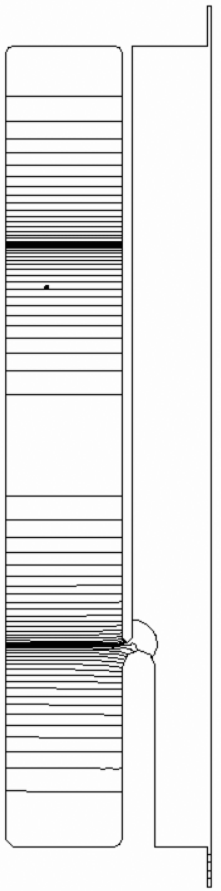


Nb film was obtained.

The film was not peeled by thermal cycles. (10times 77K ⇔ RT)

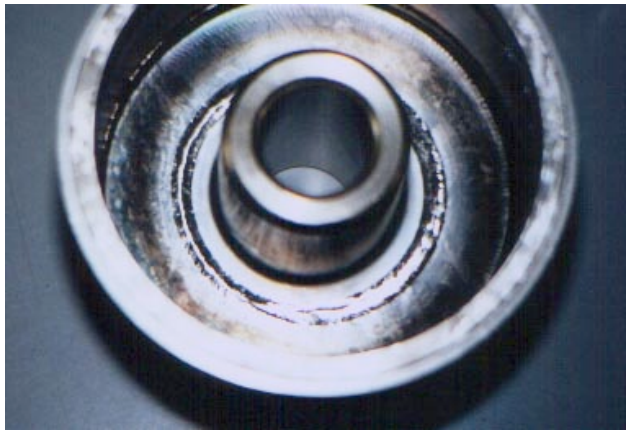
3. Development of Nb films on Cu substrate



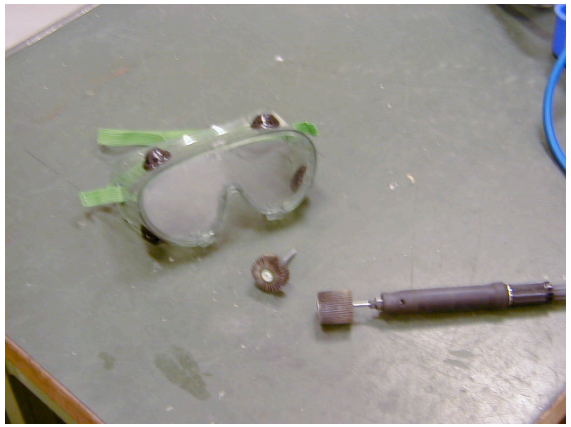


The Nb film property may be easily measured using the coaxial cavity.

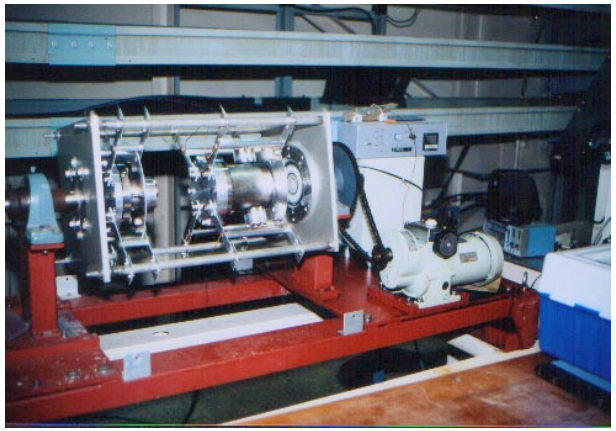
3. Development of Nb films on Cu substrate



As welding



Grinding



Barrel polishing

After barrel polishing

3. Development of Nb films on Cu substrate

Electro polishing

The sample measurement setup was readied.

We must make Nb/Cu samples, as next step.