PROTOTYPING AND VERTICAL TEST FOR PEFP LOW-BETA ELLIPTICAL CAVITY*

Han-Sung Kim#, Hyeok-Jung Kwon, Yong-Sub Cho, PEFP, KAERI, KOREA

Sun An, Pohang Accelerator Laboratory, KOREA

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kimhs@kaeri.re.kr

www.komac.re.kr

Introduction to the PEFP SRF Program

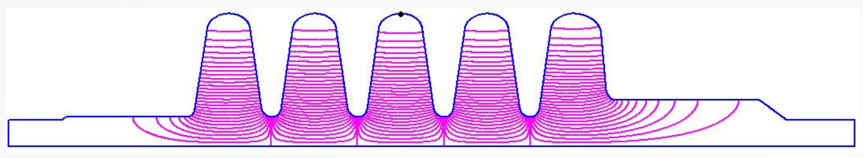
❖ **Program Goals :**

To develop a SRF linac to accelerate a proton beam from 80 MeV at 700 MHz.

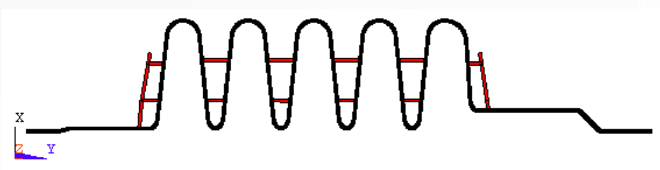
In the first phase, to develop & construct two low-beta cryomodules.

To develop SRF technologies at PEFP.

To setup basic SRF facilities at PEFP.



Electronic field profile of the TM01 0 π mode of PEFP low bate cavity

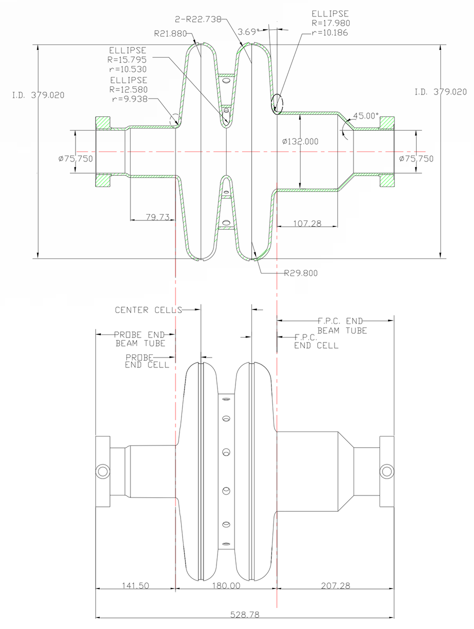


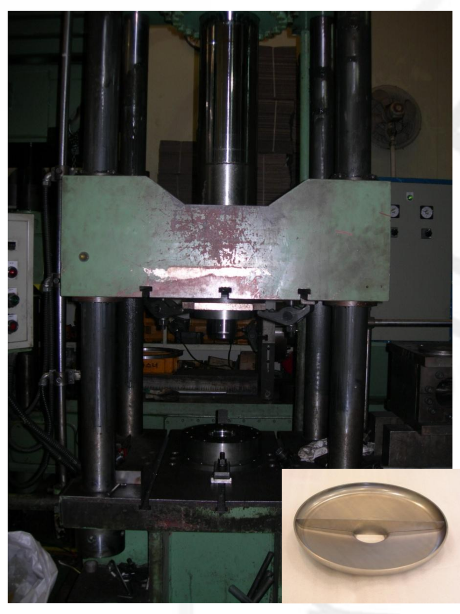
Stiffening structure of the PEFP Low beta cavity

Parameters of a PEFP low-beta cavity

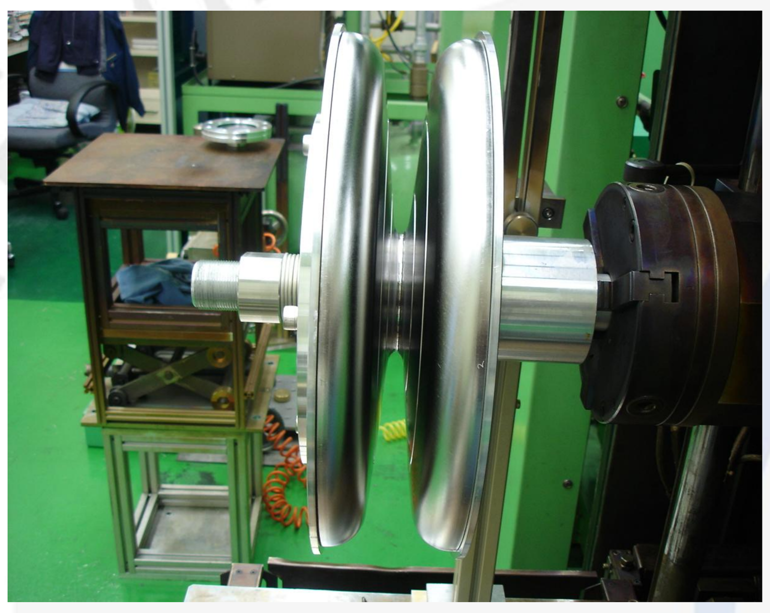
Frequency (MHz)	700	Stiffening structure	Double -ring
Cavity type	TRASCO-ASH type	Min. K_L [Hz/(MV/m)^2]	-1.1
Cavity geometrical b_g	0.42	Field flatness sensitivity (%/MHz)	49.1
Cavity effective b	0.45	Frequency sensitivity (KHz/mm)	188
Number of cell-die sets	3	Tuning sensitivity (N/mm)	4498
Cell-to-cell coupling (%)	1.41	Maximum Von Mises stress (MPa)	12.6
Cavity length (cm)	86.0		
Number of cells	5	HOM damping modes	M23, M31, M32, M 33, D11, D32
E_{pk}/E_{acc}	3.71	HOM damping mode Q_{ext}	≤ 3×10^5
B_{pk}/E_{acc} [mT/(MV/m)]	7.47	HOM average RF load	≤ 1.0 W
R/Q (Ohm)	102.30	TM010 π mode Q_0	≥ 6.26×10^{10}
G (Ohm)	121.68	TM010 π mode RF load (in the macro-pulse) at E_{acc}=8 MV/m	≤ 10 W

Two-Cell Niobium Prototype Fabrication

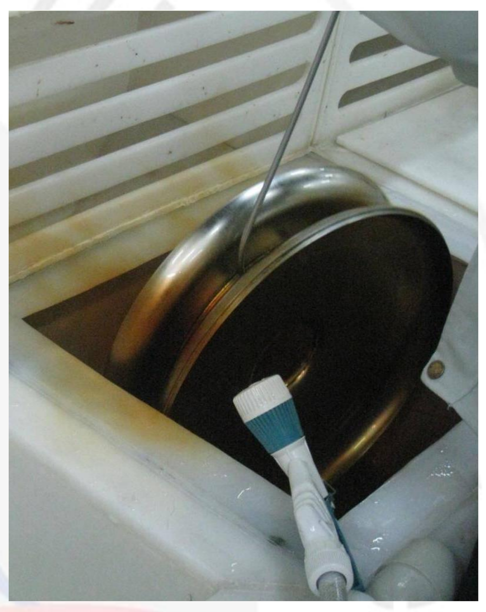




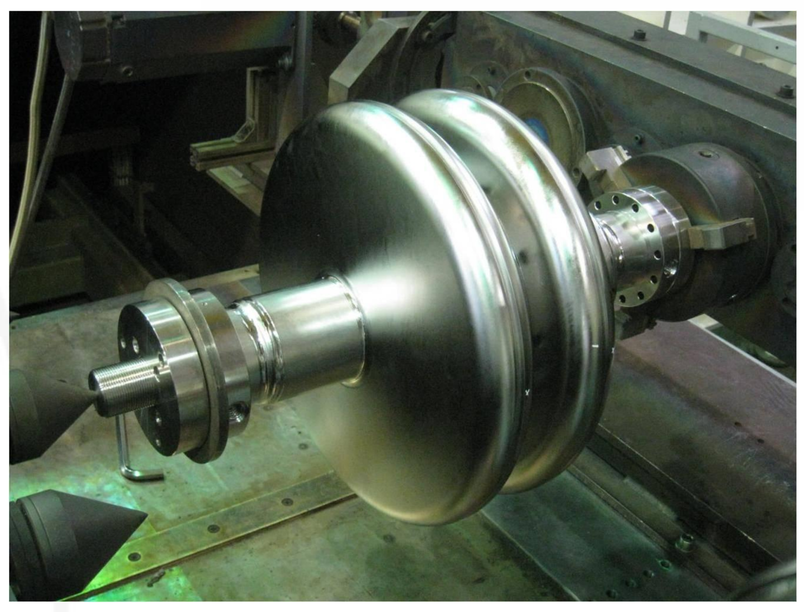
Deep Drawing



Electron Beam Welding to make sub-assembly



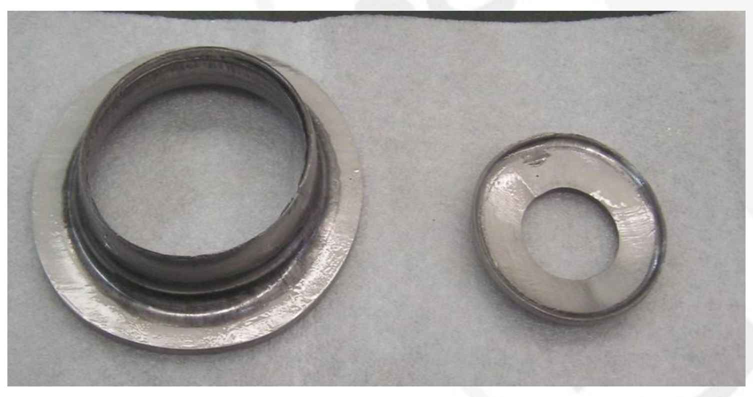
Chemical cleaning before welding



Final Electron Beam Welding

Broken Parts During Deep Drawing Process

Half cell iris part

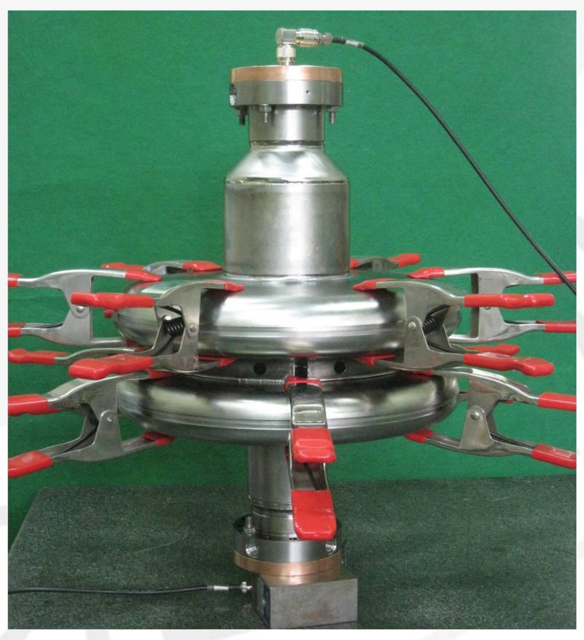


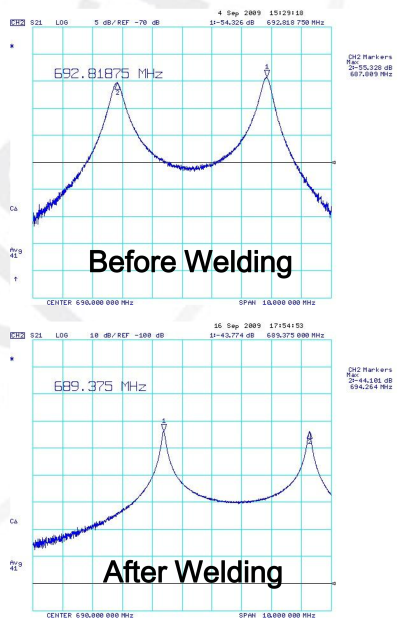
Probe End Transition part

FPC End Transition part

Deep drawing experiences show that the mechanical properties of niobium is much different from those of copper, especially when the sheet is thick (~4.5 mm).

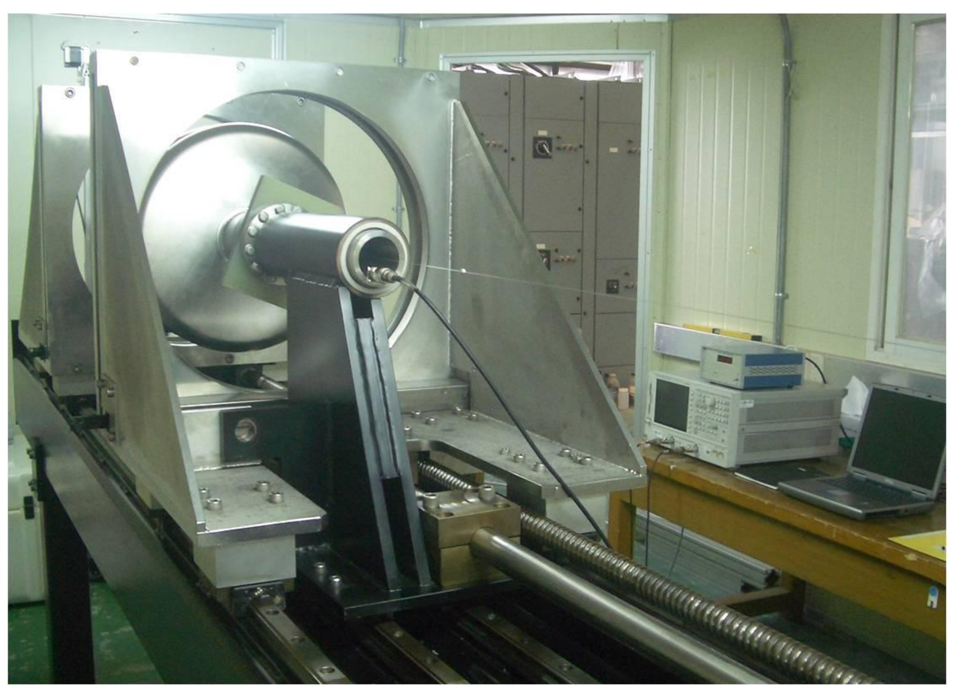
Frequency Spectrum Before and After EB Welding





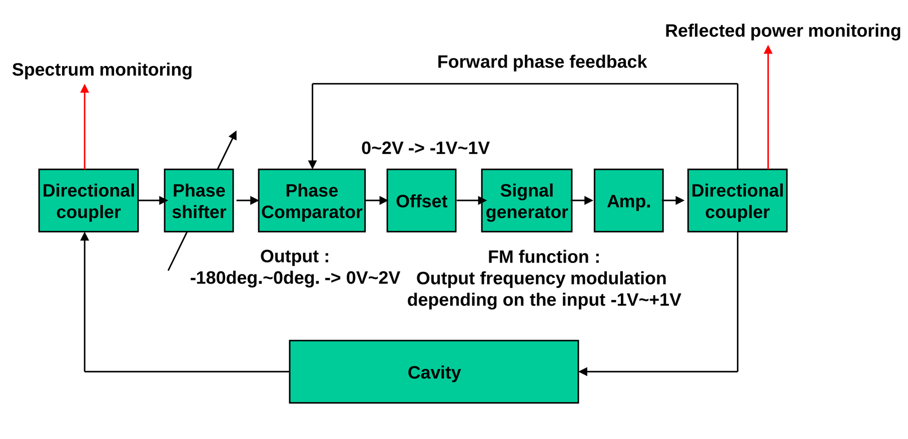
Mode	Before Welding	After Welding	Frequency Change
PI/2 mode [MHz]	687.810	689.375	1.565
PI mode [MHz]	692.813	694.264	1.451

Field Flatness Measurement

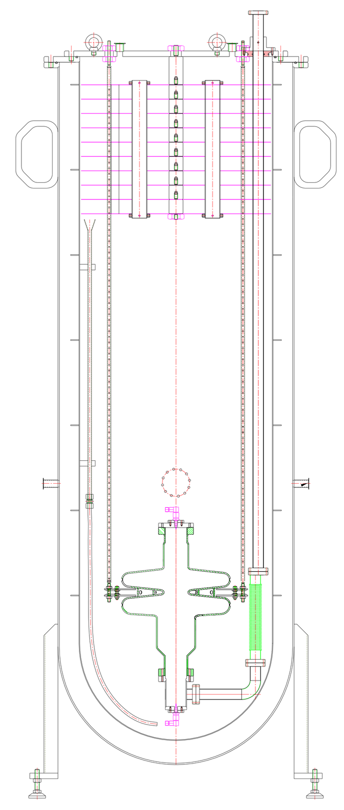


Measured field flatness:1.8%
Field flatness requirement of the PEFP cavity: 8.0%

Vertical Test Preparation



RF System Block Diagram



Cryostat for Vertical Test

Summary and Future Work

Prototype two-cell niobium cavity has been developed for the SRF program in PEFP. The cavity was fabricated through the deep drawing process and the electron beam welding method. We gained some experience on the deep drawing of the thick niobium sheet and the electron beam welding conditions during the fabrication of the cavity. We measured the frequency spectrum and the field flatness. The measured field flatness was 1.8%, which is well below the required field flatness of 8.0%. The vertical test is under preparation. We tested basic PLL test and confirmed that the setup works well. The cryostat is ready to be tested. The vertical test will be performed in near future