

Design and Fabrication of Superconducting Cavities for STF

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Contents

1. Company Profile
2. MHI's Superconducting Cavities
3. Design of STF Cavity
4. Fabrication of STF Cavity
5. Mass Production for ILC
6. Conclusion

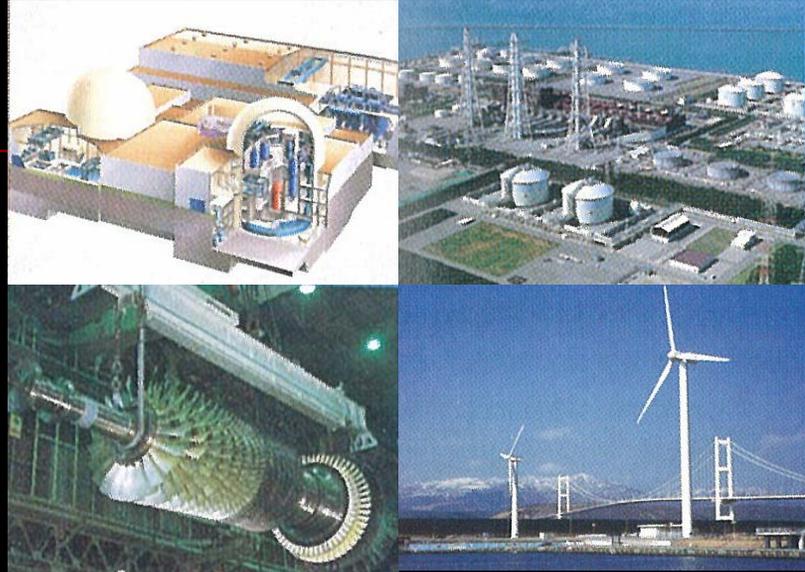
1. Company Profile

Employee : 32,627 people (Mar' 06)

SHIPBUILDING



POWER SYSTEMS



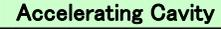
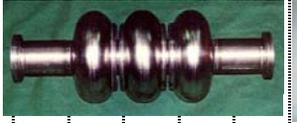
AEROSPACE



MASS & MEDIUM LOT MANUFACTURED MACHINERY



2.MHI's Superconducting cavities

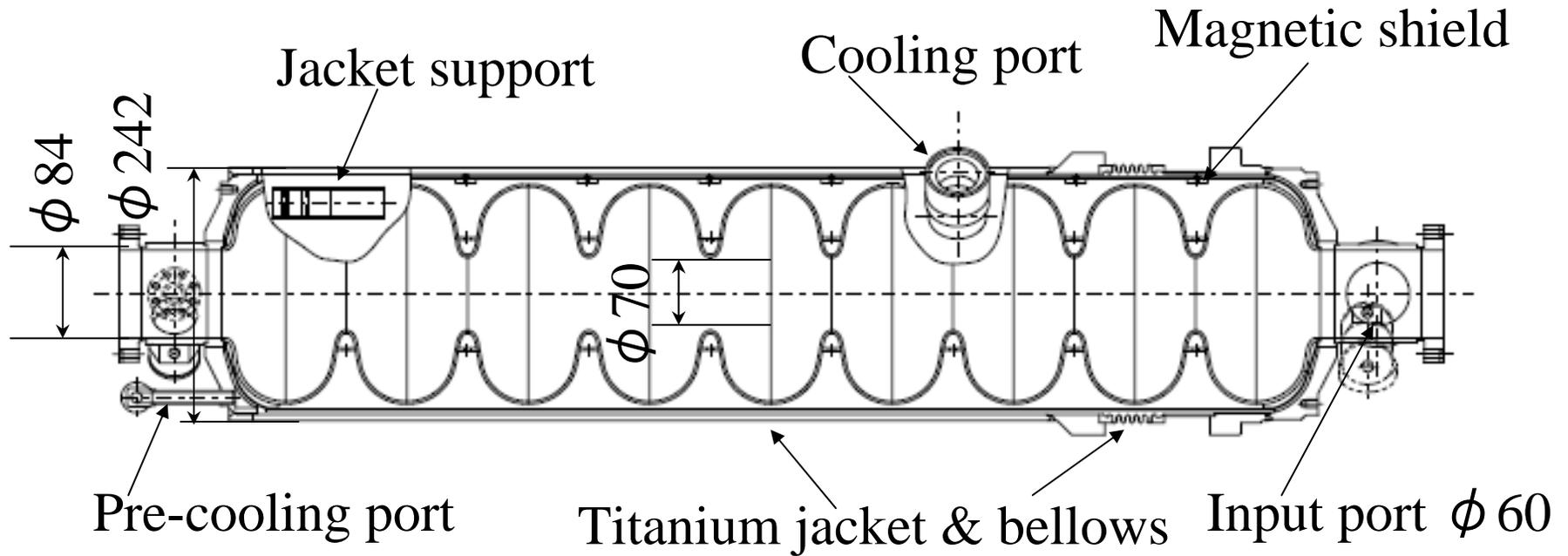
Customer	Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
TRISTAN		 <p>508MHz 5cell cavity (36sets)</p>															<p>★My debut year</p>															
																	 <p>508MHz 1cell cavity(1set)</p>															
KEKB B-Factory																	 <p>508MHz 1cell cavity (2sets)</p>															
		 <p>Accelerating Cavity</p>															 <p>Grab Cavity</p>															
KEK Linier Collider		 <p>L-band Cavity</p>															 <p>STF Cavity</p>															
																																
ERL																	 <p>ERL Cavity (2sets)</p>															
																																
JAEA /KEK J-PARC																	 <p>ADS R&D 972MHz 9cell cavity(2sets)</p>															

█ : Construction
█ : R&D

3.Design of STF baseline Cavity - specification

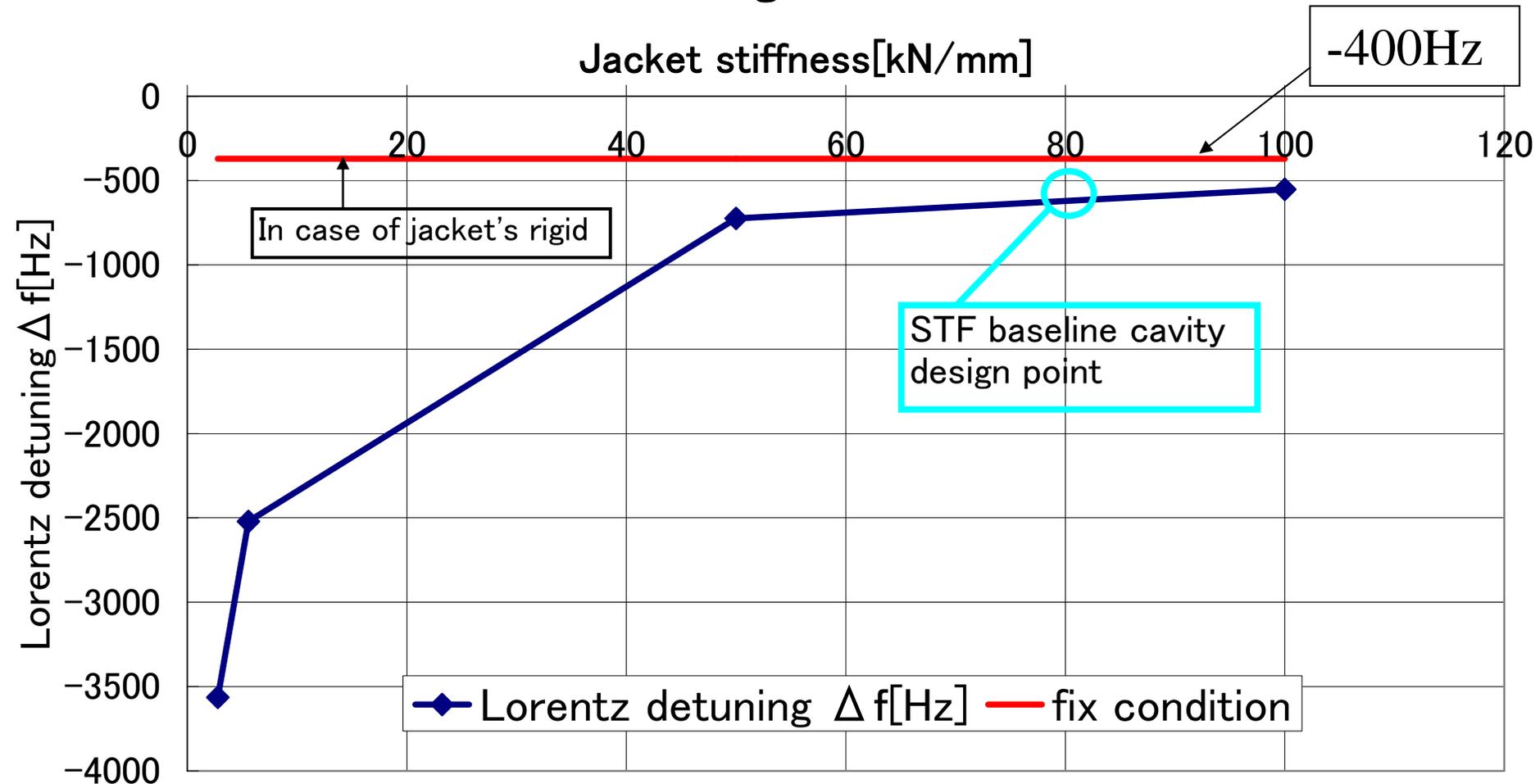
item	KEK Specification	MHI designed value & calculated value
Nb sheet thickness	Center-cell:2.8mm End-cell:3.5mm	—
iris, equator thickness	—	2.5mm
Stiffness of cavity	3,500N/mm	3,000N/mm
Stiffness of jacket with tuner	90kN/mm	72kN/mm
Lorentz detuning (@31.5MV/m)	600Hz	~550Hz
Magnetic shield	Inside a jacket	—

3.Design of STF baseline Cavity - shape

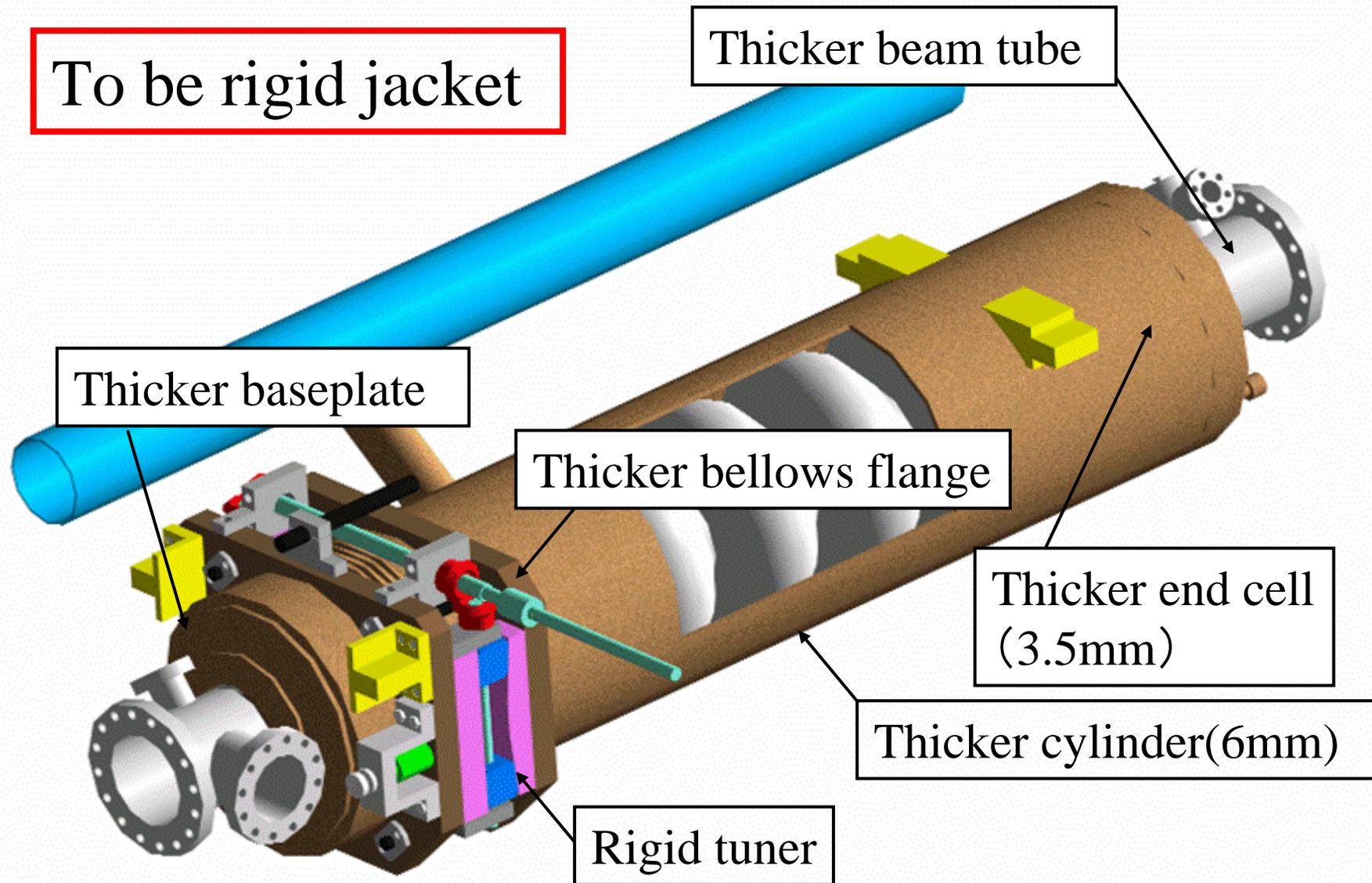


3.Design of STF baseline Cavity - Lorentz detuning

Lorentz detuning-Jacket stiffness



3.Design of STF baseline Cavity – jacket stiffness



4. Fabrication of STF Cavity –flowchart~center-cell parts

Center-cell parts



Deep
drawing



machining



CP,EBW



EBW



4. Fabrication of STF Cavity –flowchart~end-cell parts

end-cell parts



CP,EBW



CP,EBW



CP,EBW



CP,EBW



- Magnetic shield cap
- Baseplate
- End-cell

4. Fabrication of STF Cavity –flowchart



EBW



At KEK

- Barrel Polishing
- EP1
- Anneal
- Pre-tuning
- EP2
- HPR
- Baking
- Vertical test

$E_{acc,max}$

#1 20.8 MV/m

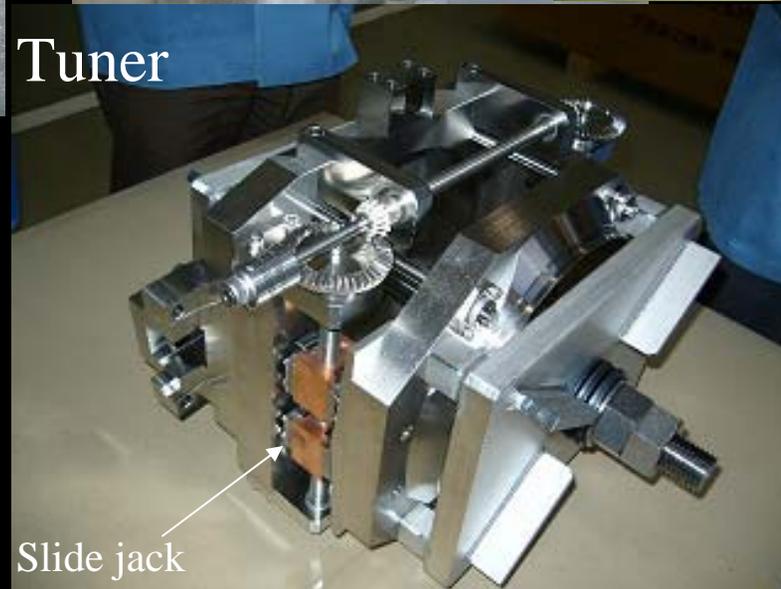
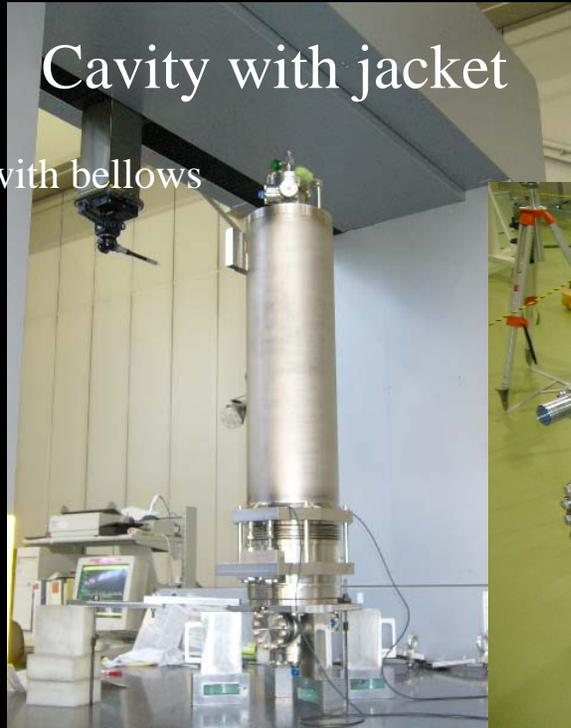
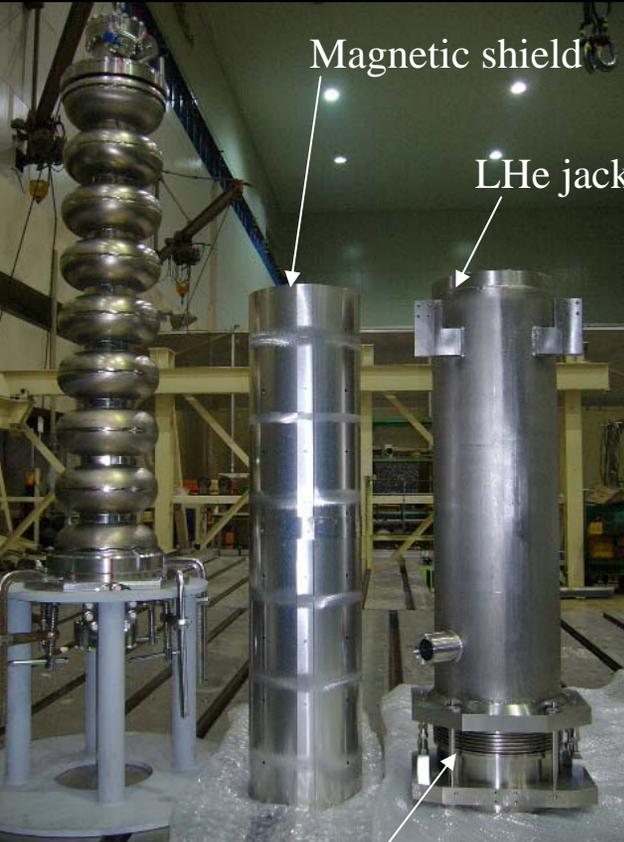
#2 29.4 MV/m

#3 20.5 MV/m

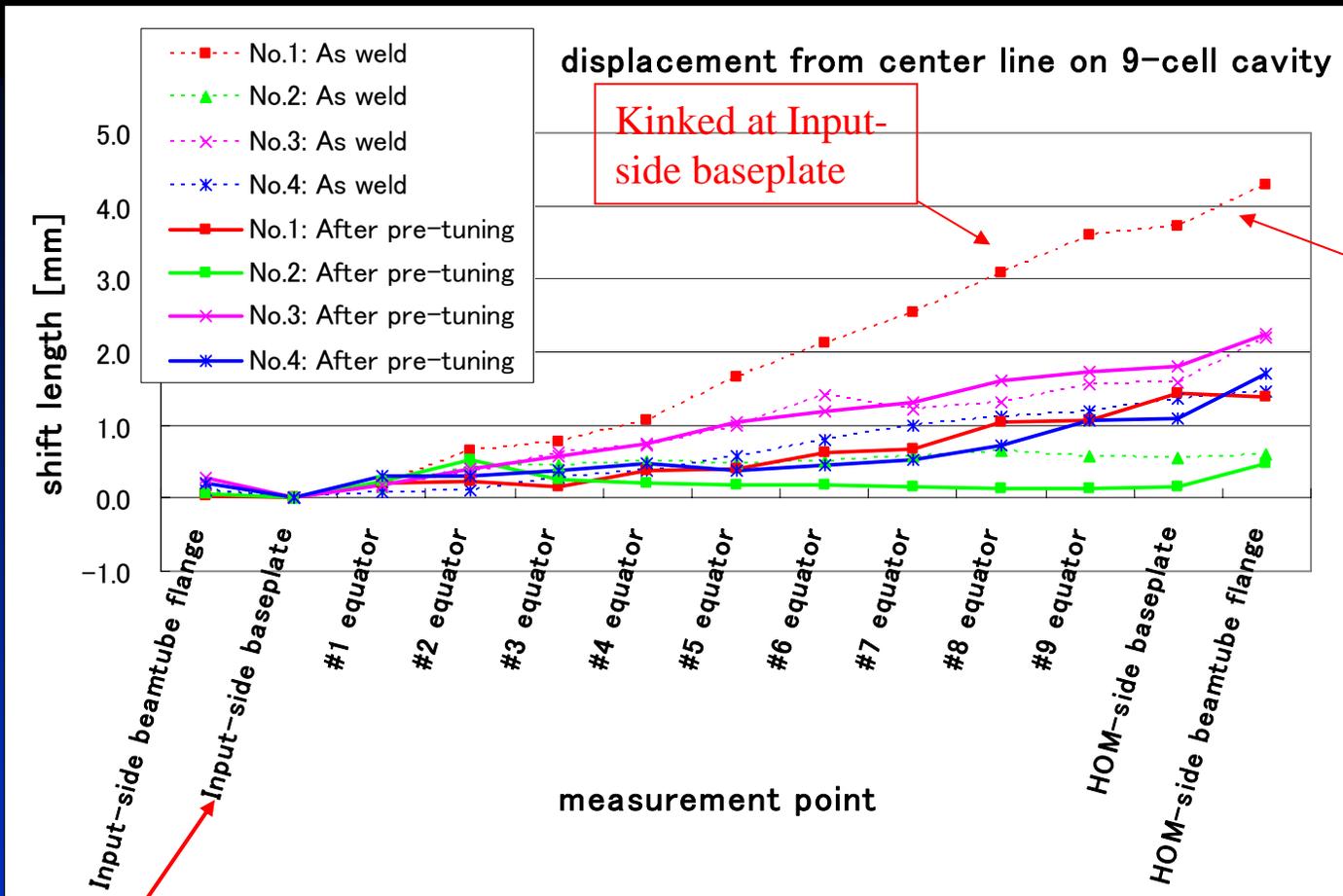
#4 20.2 MV/m

$Q_0 > 10^{10}$

4. Fabrication of STF Cavity - jacket



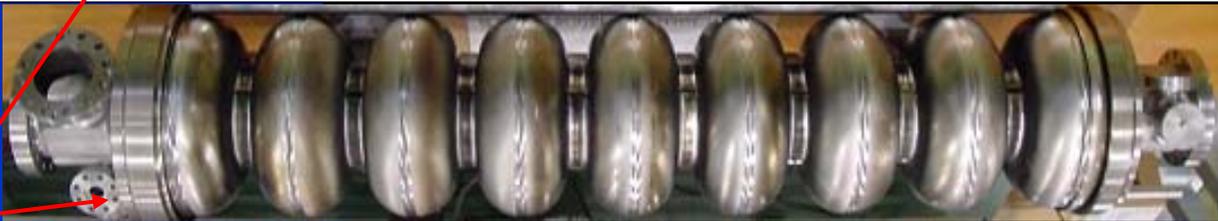
4. The Result of dimension inspection



No.1 cavity as weld

Kinked at Input-side baseplate

datum



4. Some problem at fabrication of STF baseline cavity

1. Design ; Some parts need brushing up by hand.

(HOM coupler, beam tube)

2. EBW ; Qualities of welding beads are not best.

(Inner beads are not smooth.)

3. Environment; We need more clean area in assembling the cavity.

4. Cleanness ; We have to do CP frequently to keep the edge of cell clean for EBW.

5. Mass Production for ILC

We have to consider about QCD in mass production.

- Quality ; What ILC make us guaranteed?

Performance (E_{acc} , Q) ?

- Cost

; Decrease not only the cost of production

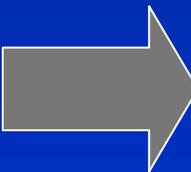
but also the cost of the surface treatment and vertical test

- Delivery time

; Delivery time of the material (Nb, Ti)?

Capacity of the production facility?

Capacity of the treatment & test facility?



We have to consider about the following idea to improve QCD. The problem is how we can achieve these procedure.

Decrease of welding line

Other welding method

Other material flange

Decrease of pre-tuning

No anneal

No barrel polishing

6. Conclusion

- We designed and fabricated four STF baseline cavities . And all cavities have done the vertical test at KEK. The performance of the cavities reached to Eacc 20 to 29MV/m.
- We recognized what we should do to the next step by fabricating 4 STF baseline cavities.
- In manufacturing 50 to 100 cavities, we will catch up the quality of European cavity.
- We need to improve our technologies to realize ILC.

Thank you for your attention

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