

# “650 MHz, Beta = 0.92 cavity”

## Processing, Tuning & preparation for Vertical Test

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## Facilities installed/available



**Barrel polishing machine for single-cell  
1.3 GHz SCRF cavity**



**Electropolishing setup  
for 1.3 GHz and 650 MHz cavities**



**High Pressure  
Rinsing setup**



**Ultrasonic degreaser**

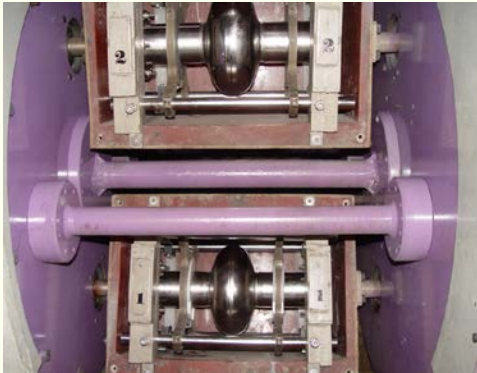


**High Vacuum Annealing Furnace**

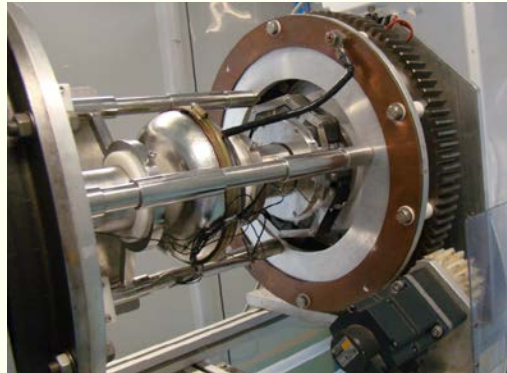
The visits of RRCAT personnel to Fermilab/ ANL to witness the cavity processing, provided better understanding

## Processing of 1.3 GHz single-cell cavities

- Three 1.3 GHz single-cell cavities have been processed at RRCAT



Barrel polishing process



Electropolishing process



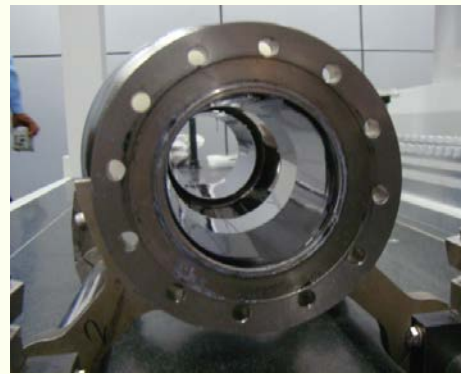
Annealing



HPR



Ultrasonic cleaning



Polished cavity

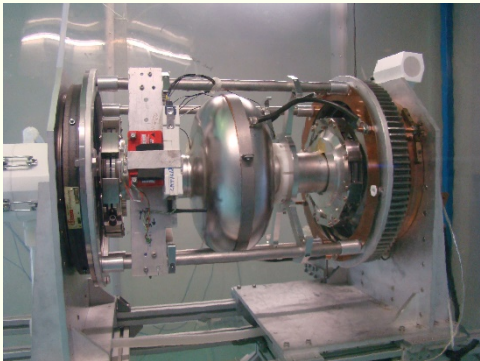


Preparation of cavity for VTS test  
in clean room

- *Processing of 1.3 GHz nine-cell cavity is planned after tuning*

## Processing of 650 MHz cavities

- One 650 MHz single-cell cavity has been processed at RRCAT



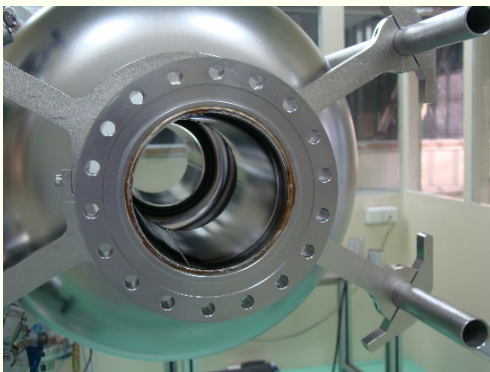
Electropolishing ~ 50 microns  
(to test the EP tool & RF supply  
for VTS)



Ultrasonic cleaning



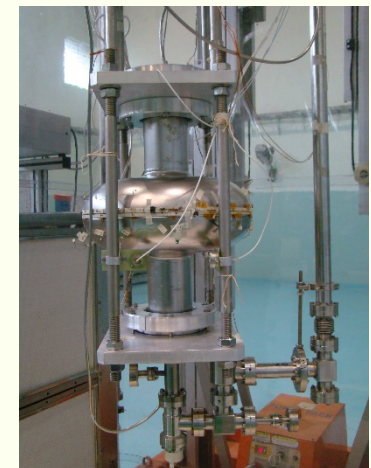
HPR



Polished cavity



Cavity in clean room



Cavity on VTS insert

## Recipe proposed for 650 MHz five-cell cavities

Processing Steps	Comments from Fermilab
Vacuum leak testing at room and at LN2 temperature	
Dimensional inspection on CMM machine	
Optical inspection of the internal surface	
In case any defect is observed during inspection, RTV replica to be casted for quantifying the defect using 3D Laser Scanning Confocal Microscope.	
Barrel polishing	
High temperature annealing @ 600°C/ 800°C.	
Light electropolishing, 30-50 microns	
Ultrasonic cleaning with 2% Micro-90 @ 50°C for 1 hour	
High pressure rinse with ultra-pure water, 3-5 passes. Drying in Class 100 clean enclosure.	
Preparation for vertical test in clean-room	
Low temperature baking @ 120°C for 48 hours	

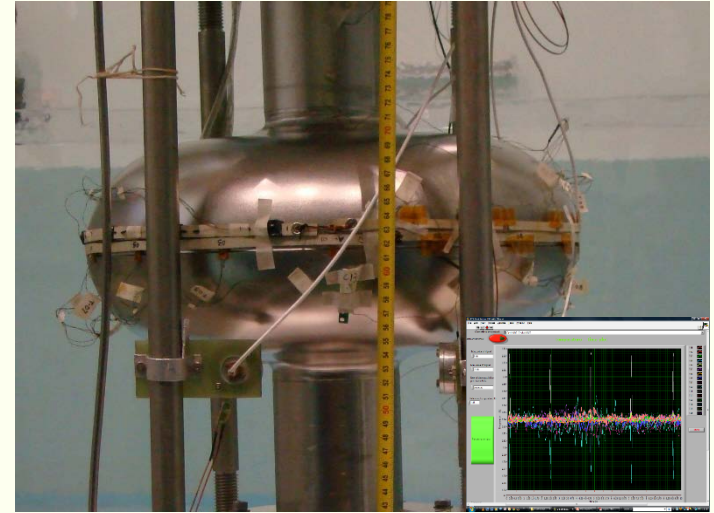
## Initial inputs required from Fermilab – related to processing of 650 MHz cavities

- Details of cavity processing methodologies/recipe to be discussed & finalized for 650 MHz five-cell cavities :
  - Tumbling (Centrifugal Barrel Polishing) procedure :
    - Selection and qualification of media
    - Inspection procedure after tumbling.
    - Fixtures & tooling
  - Electropolishing procedure :
    - Parameters for electropolishing – Voltage, rotation speed, optimum removal rate, acid & cavity temperature, external cavity cooling requirement etc.
    - Details of EP tool, fixtures, supply, instrumentation etc.
    - Post EP procedure – ultrasonic, rinsing etc.

- Thermal processing procedure :
  - Temperature, time, pressure etc. Whether ends are to be covered with niobium/ titanium foil ?
  - Nitrogen doping to be adopted ? If yes, details of the same like temperature, partial pressure of nitrogen, time etc
  - Fixtures & tooling
  - Post annealing procedure – Tuning/ rinsing etc
  - Low temperature baking/ HF rinse (?) procedure
  
- Preparation for Vertical Test:
  - Details of high pressure rinsing setup, parameter, fixtures etc
  - Details including drawings of the fixtures for cavity assembly & loading on VTS insert, design & drawings for couplers etc.
  - Procedure & precautions during assembly in clean-room
  - Kyocera connectors ; Supply from Fermilab (connectors or flange assembly)

## Present status

- A band with 16/32 sensors is mounted on the equator for thermometry during vertical test



## Initial inputs required from Fermilab

- Single cell and Five cell Cavity FTS , T-Map and second sound requirements
- Design details, document and reports on FTS, T-Map & second sound used for testing 1.3 GHz cavities at Fermilab
- Measurement procedure used for testing 1.3 GHz cavities at Fermilab
- Specification and FNAL approved sources of Hardware for system used for testing 1.3 GHz cavities at Fermilab

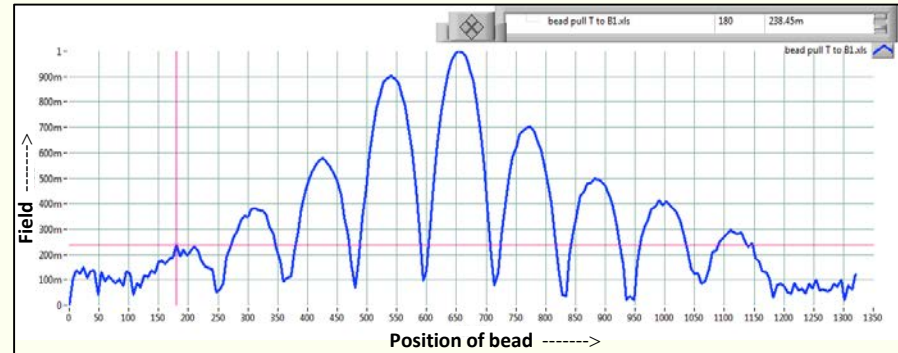


## Present Status

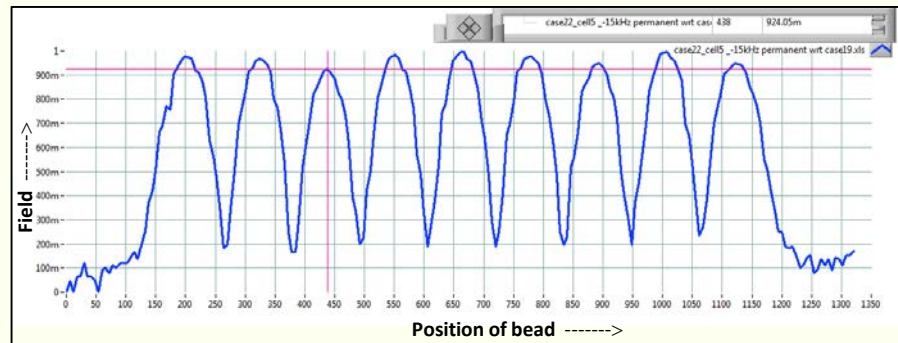
- Manual tuning trials are underway for an aluminum 1.3 GHz nine-cell cavity.
  - *Field flatness improved from 24% to 92%*
  - *Further tuning trials are underway*



Tuning of 1.3 GHz nine-cell cavity



Field distribution in un-tuned cavity – field flatness ~ 24%



Field distribution after tuning – field flatness >92%

## Present Status

- Tuning of Niobium 1.3 GHz nine-cell cavity will be taken-up after successful tuning of the aluminum cavity
- Tuning of 650 MHz five-cell cavities –
  - ❖ Semi-automatic tuning machine is under development

## Initial inputs required from Fermilab – related to tuning of 650 MHz cavities

- ❖ Functional and Technical requirement specification for tuning of 650 MHz SCRF cavities.
- ❖ Procedure for tuning of 650 MHz SCRF cavity.

THANK YOU