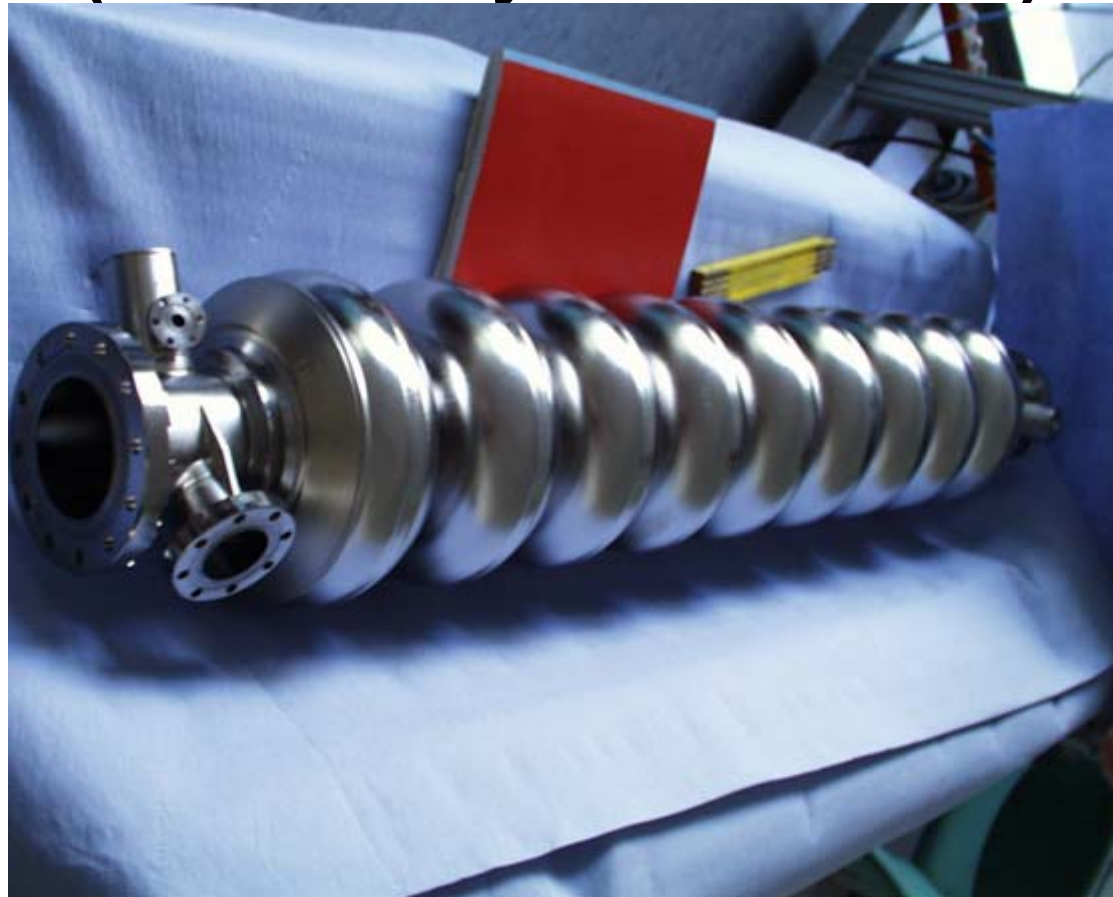


Actual cavity preparation sequences (under study for the XFEL)





CAVITY PREPARATION



The cavity preparation consists of 5 major steps

Inspection of incoming cavities

Preparation for acceptance test

Vertical TEST

Preparation for Module

Module assembly



CAVITY PREPARATION



Step 01 inspection of incoming cavities

- Optical inspection
 - tuning of cell for field flatness (frequency)
 - mechanical measurements (length/ eccentricity)
 - Optical inspection of surface
-
- ***Step 02 preparation for acceptance/ vertical test***
 - Damage layer removal
 - Annealing
 - Final surface treatment
 - assembly in class 10 Cleanroom
 - High pressure rinsing with Ultra pure water @ 100bar -
 - assembly of variable input power antenna for vertical test
 - Assembly to test insert

Step 03 Vertical TEST



CAVITY PREPARATION



Step 4 Preparation for Module

a) Tank welding

- Installation of in situ field measurement device
- Welding of Nb to Ti connections (EB/ Bellows & Inter-connection ring)
- Tuning of field profile and frequency
- Helium vessel welding (TIG)

b) Final preparation of dressed cavities

- Removal of in situ field profile device
- Assembly of HOM Coupler
- High pressure rinsing
- Assembly of Power coupler

Step 5 Module assembly

Horizontal test of cavity and all accessories (Chechia)

Module assembly



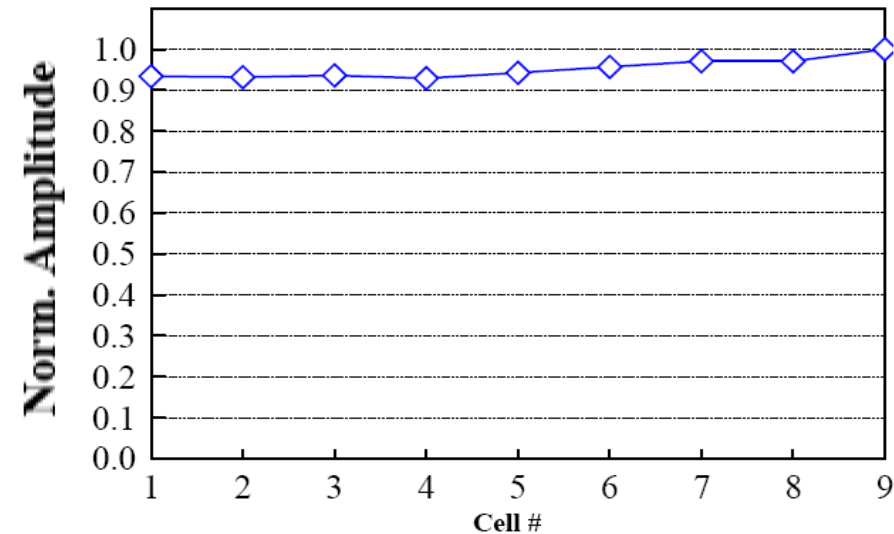
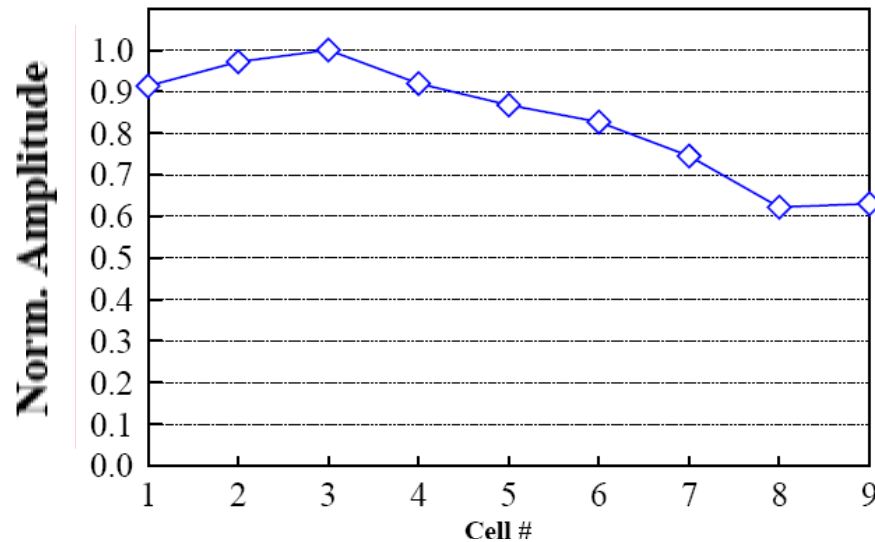
CAVITY PREPARATION (Tuning)



Tuning

field profile tuning → Adjustment of individual cells

frequency tuning → Parallel adjustment of all cells / lengthening of resonator

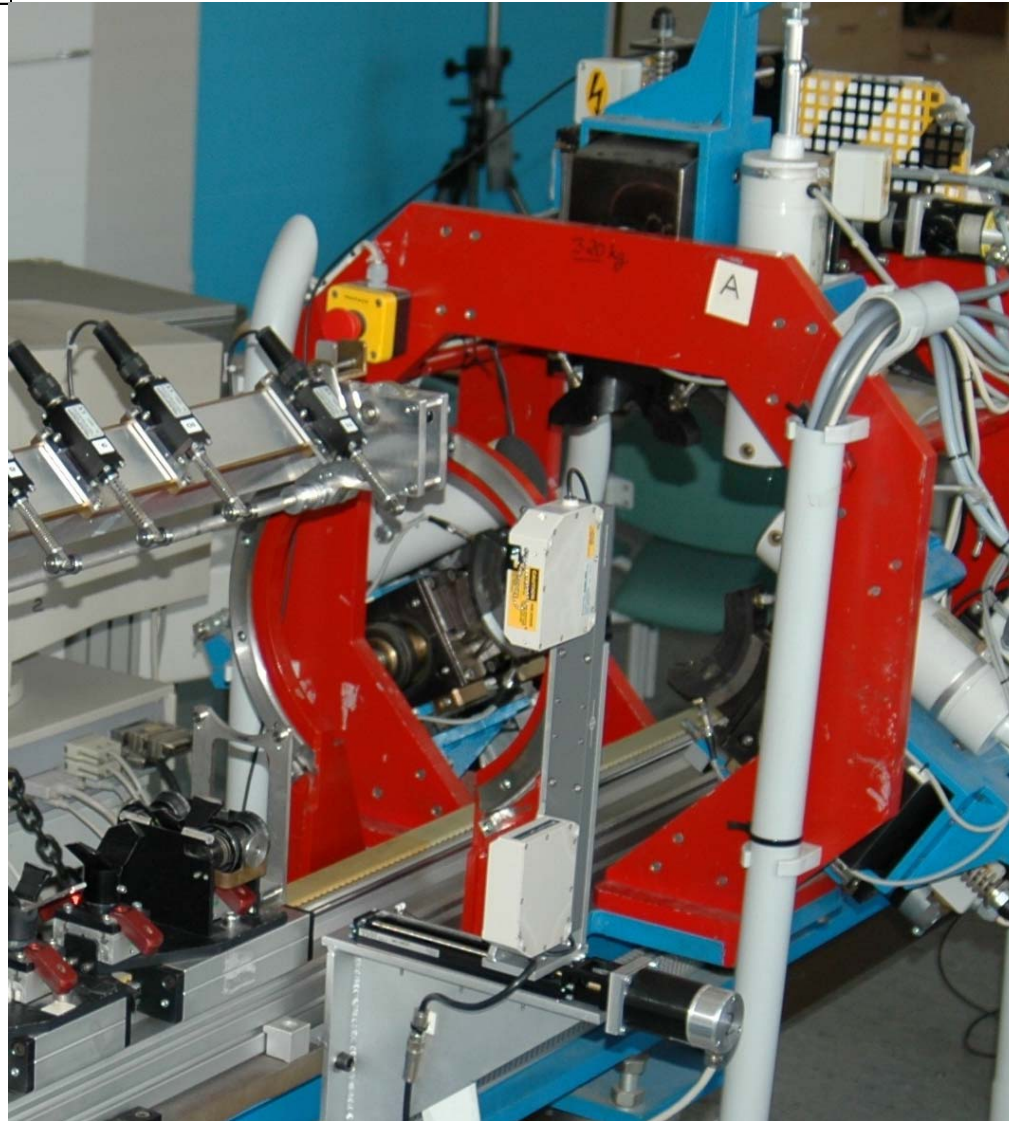


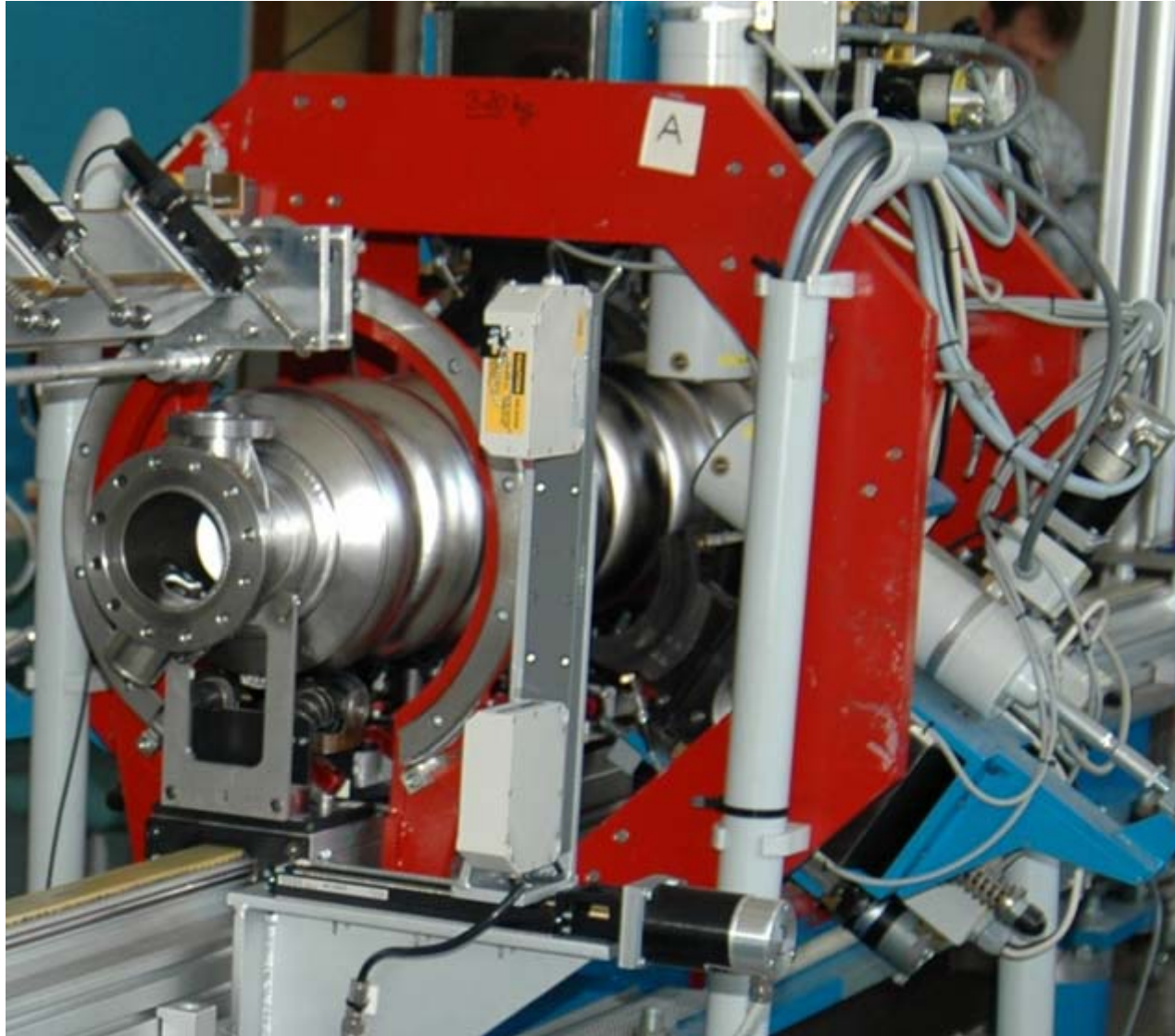


CAVITY PREPARATION (Tuning)



CAVITY PREPARATION (Tuning)







CAVITY PREPARATION



Damage Layer Removal

- Degreasing and rinsing of cavity
- Cleaning ELECTROPOLISHING/ Removal of 160-180 μm damage layer
(an about 6-8h lasting polishing process)
- Rinsing and drying
- Cleaning BCP / Removal of outside “dirt” layer (20-40 μm by BCP)

Final surface treatment

- Degreasing and rinsing of cavity
- Fine cleaning by EP/ Removal of 20-40 μm surface layer
(an about 2h lasting process)
- acid removal rinse
- cleaning of Cavity outside to enter cleanroom
 - rough cleaning by “car wash “ HP cleaner
 - Ultrasonic cleaning and rinsing
- Fine rise to 18M Ωcm with ultra pure water
- High pressure rinse at 100 bar



CAVITY PREPARATION



Electropolishing

General parameters

Mixture : 1/9 volume parts of HF (45-50%) / H₂SO₄ (>= 96%)

Process applied at DESY : constant voltage

Voltage applied :17V

Temperature goal : 30-35 C

Process power: 5-6 KW

Flow rates: 10-12l acid /min

Removal rates: 0,35-0,45 µm/min

Acid usage up: > 10gr/l acid of dissolved Nb

Orientation: horizontal during polishing process

Process timing

Rough EP removal of 160 µm Nb (6-8h)

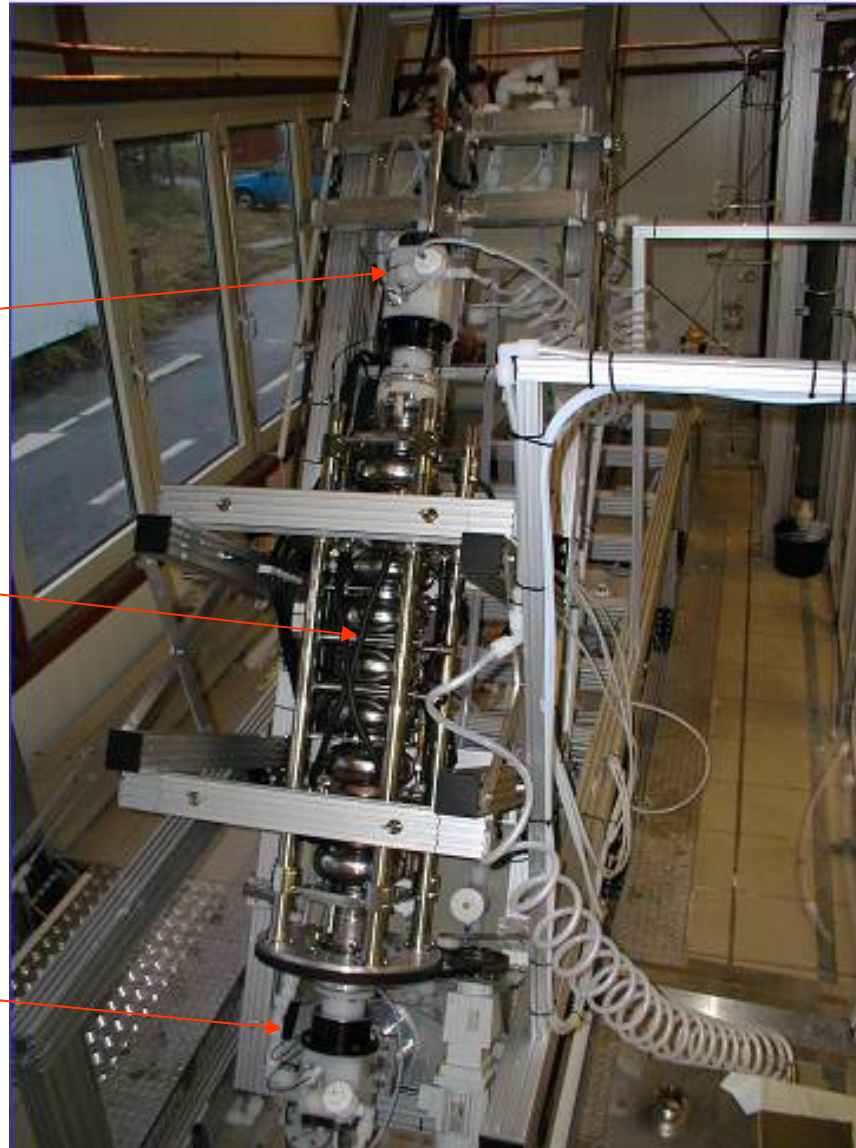
fine EP removal of 20-40 µm Nb (2h)

CAVITY PREPARATION (Electropolishing)

Electrode/
Top Head

Cavity

Bottom Head



Cavity installed in
the DESY EP apparatus
(Cavity tilts vertically
to dump the acid)



Annealing

(degassing of H₂ and stress annealing @800C in UHV oven)





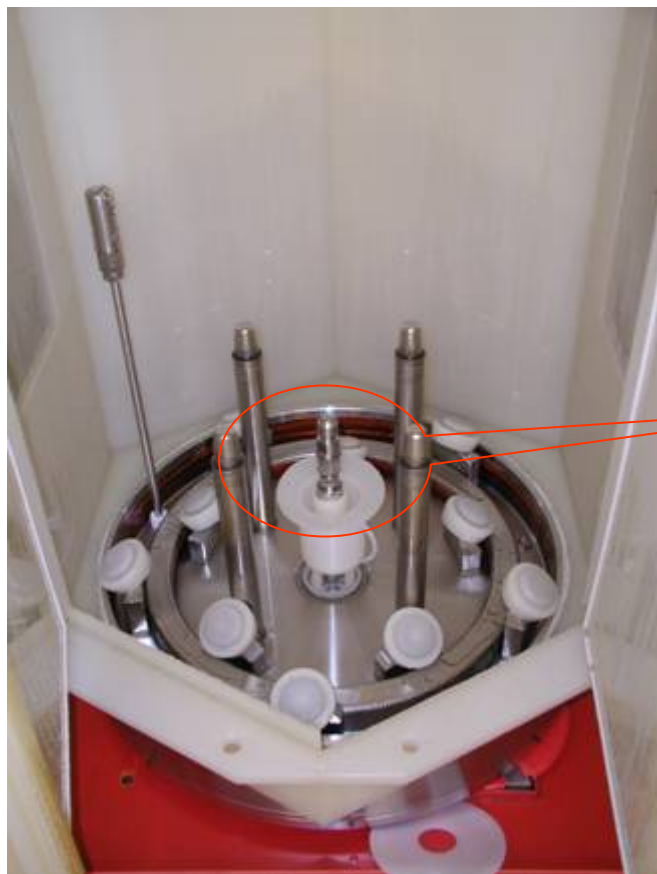
High pressure rinsing with Ultra pure water @ 100bar



“old “ HPR System Parameters
Pressure :25-200 bar
Quantity: 20 l/min @ 100 bar
Particle filter @100 bar line: 0,02 μm
Ultra pure water R spec. 18.2 M Ωcm
Special: N₂ gas overlay

Standard setting: 100 bar
Process duration >2h
Volume 2000 l total
2*4 jets
Nozzle : sapphire 0,4 mm ID

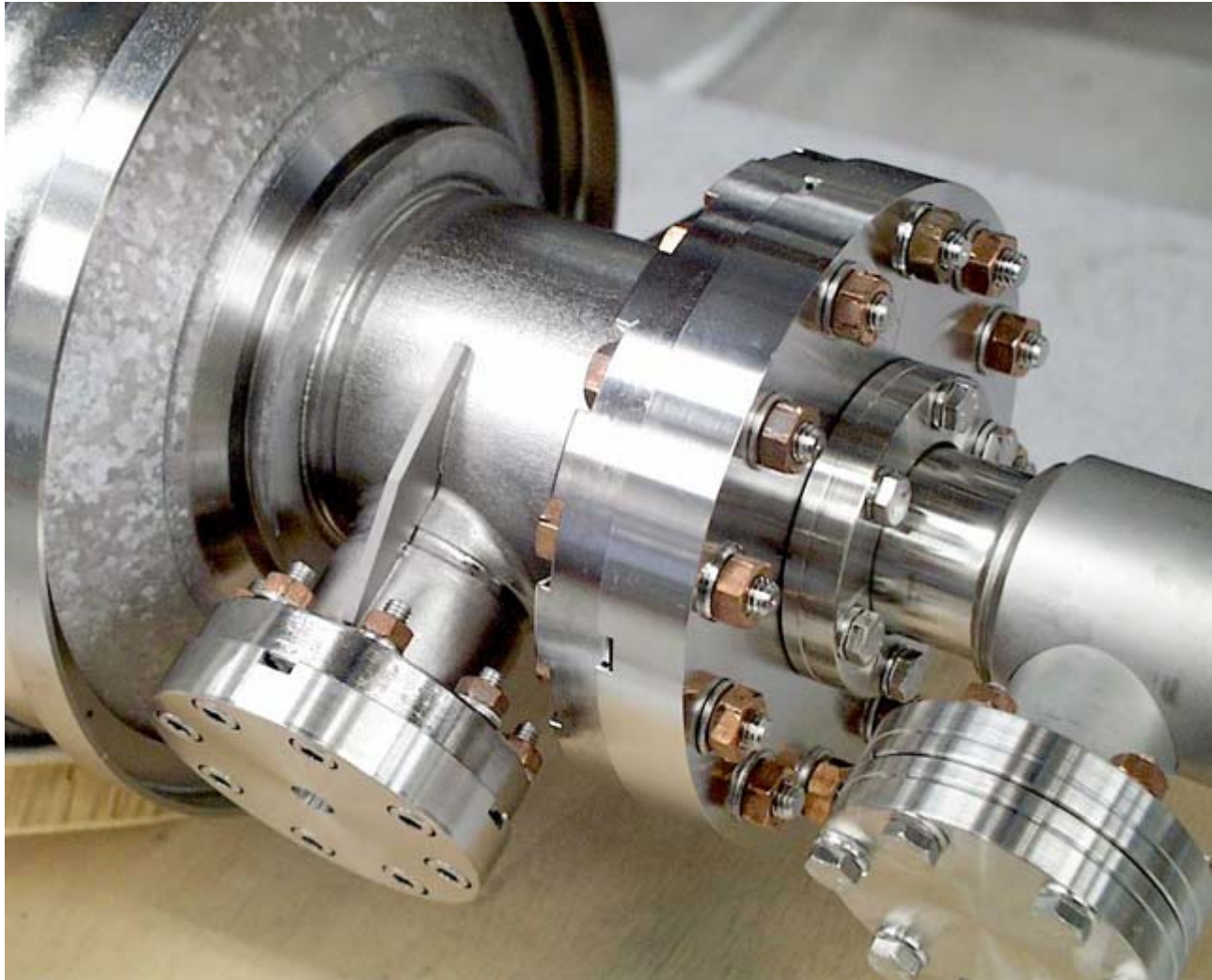
High pressure rinsing with Ultra pure water @ 100bar





CAVITY PREPARATION

Cavity assembly in class 10 Cleanroom



Cavity beampipe
Location @
Power coupler port



CAVITY PREPARATION

Assembly in Class 10 Cleanroom





**Cavity in test insert
ready for acceptance test
(vertical test)**



CAVITY PREPARATION

Helium vessel welding



CAVITY PREPARATION (module assembly)





CAVITY PREPARATION (Cleanroom)



Assembly in Class 10 Cleanroom

Assembly for Module String in Class 10 Cleanroom

But what does it mean assembly in class 10 cleanroom?

Some impression



CAVITY PREPARATION (Cleanroom)





CAVITY PREPARATION (Cleanroom)



CAVITY PREPARATION (Cleanroom)





CAVITY PREPARATION (Cleanroom)





CAVITY PREPARATION



Outlook

(Something to be discussed @ EIF ast ?)

What can / may / should ? DESY offer as consultant during start up of the XFEL project to those companies that have “the pleasure” to do the cavity preparation and assembly?

- FAST PROTOTYPING of tools and fixture
(3DIM - 1:1 prototype made in 24 hours)
- TEST of fixtures and tool (Influence on laminar flow conditions @ class 10)
- Quality control of tool @ class 10 level (Particulates)
- Test of function ability on the object (before start up at the new facility!)
- Training of personal
- Qualification of tools and man power on the object including RF Test of cavities @2K