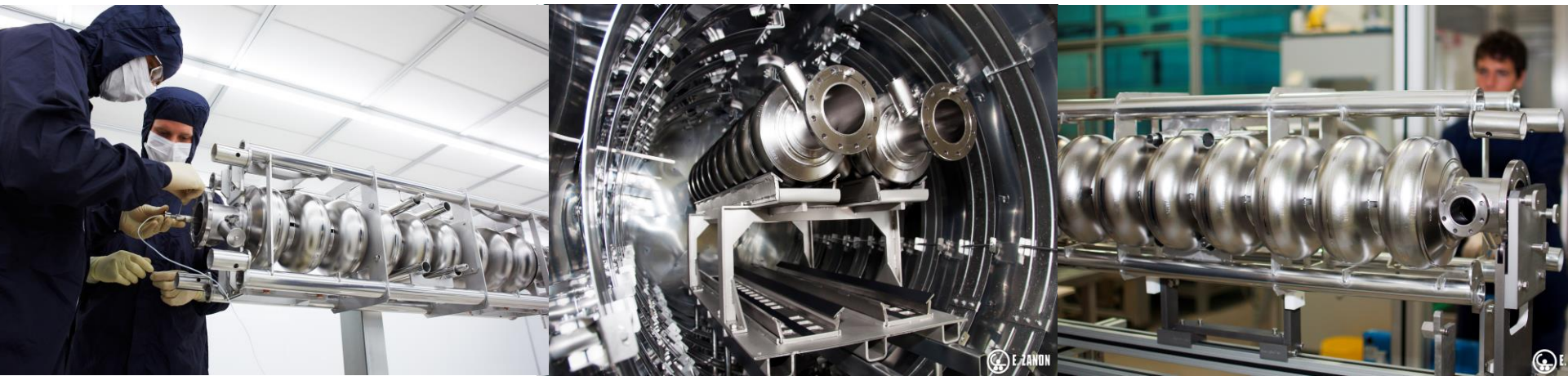


# SRF Cavities production at Zanon Research & Innovation and Outlook for ILC



Ambra Gresele

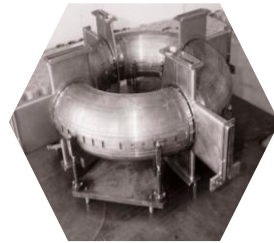
LCWS 2021 - 16<sup>th</sup> March



**1919**

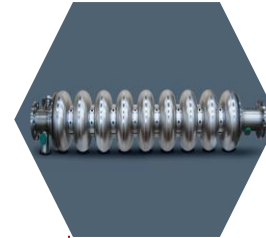
Ettore Zanon  
founded the  
company

First Industrial  
site in Schio,  
Vicenza



**1970**

Zanon enters in  
the Research  
field



**1990**

Electron Beam plant  
is installed. Zanon  
manufactures the  
first Niobium  
Cavities.



 **SIMIC** Spa

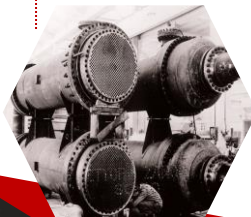
**2020**

SIMIC  
acquires  
Zanon, that  
becomes  
ZANON  
Research &  
Innovation Srl.



First Pressure  
Equipment are  
manufactured

**1950**



Zanon manufactures the  
first Vacuum Vessels

**1980**

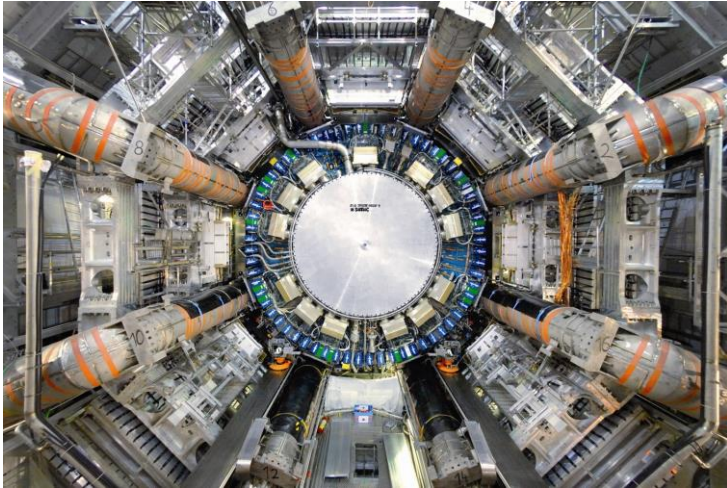


Ambra Gresele

- ✓ Main sectors:
  - Research, Nuclear Fusion, Oil&Gas, Petrochemical, Fertilizers, Power, Pharmaceutical, Food, Industry
- ✓ Company size:
  - 130 M€ revenue
  - 300 employees
- ✓ Present in 7 countries:
  - Italy, France, Germany, Romania, Mexico, Brazil, Turkey, Canada
- ✓ 2 industrial sites in Italy:
  - Camerana Site, Headquarters & workshop 85.000 sqm (capacity 100 tons)
  - Porto Marghera, Venice, High-capacity workshop (2000 tons)



SIMIC is working with CERN & many other Research Institutes for more than 20 years. SIMIC is among the main contributors of LCH Project, at CERN.



### **ENDCAP CRYOSTAT FOR ATLAS**

Material: Alluminium AL 5083  
Diam: 5.500 mm  
Thk: 160 mm  
Weight: 40.000 kg  
Cryogenic Tests at 90K  
Super Insulation Leak Test  $<1 \times 10^{-8}$  mbar. l/s



### **250 CRYOMODULES FOR LHC**

Material: AISI 304 L, Aluminium, Cu-Ni  
Weight: 2000 Kg  
Length: 6.650 mm

Pressure test up to 25 bar;  
He Leak test  $< 1 \times 10^{-8}$  mbar.l/s

3D Dimensional inspection,  
Instrumentation test

SIMIC is among the Leaders in the Fusion Energy sector and is among the main contributors to ITER project. Working in Fusion Energy for more than 15 years.

## ITER PROTOTYPES & SERIES PRODUCTIONS

- VACUUM VESSEL PROTOTYPE
- DIVERTOR PROTOTYPES and SERIES
- MAGNETS SYSTEM (70 Radial Plates and 10 TF Coils – very large and complex projects)

*Weight of TF COIL - 320 tons/ each*



Ambra Gresele

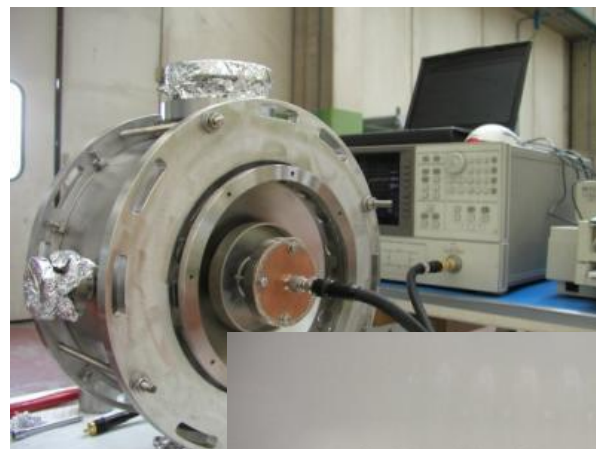


The company is located in Schio, North-East of Italy, 1 hour from Venice, where the mother company SIMIC has its main workshop.

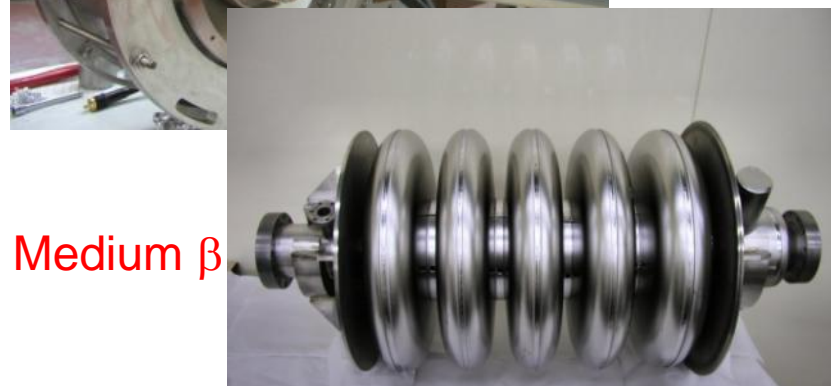
The company has been manufacturing special components for superconducting applications since more than 30 years.

Experience with SC cavities started in the early 90's and has continued without interruption till now.

In a similar way, the production and testing of cryomodules were successfully completed for many different scopes and projects.



Low  $\beta$



Medium  $\beta$



High  $\beta$

## LHC Project at CERN-Geneve

Pre-series manufacturing and assembling of 10m. and 15m. long cryostats for the S.C. dipole magnets



## XFEL Project at DESY

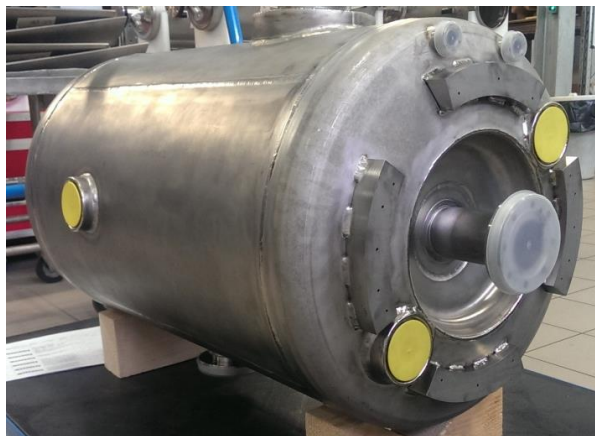
Production of 45 cryomodules for XFEL



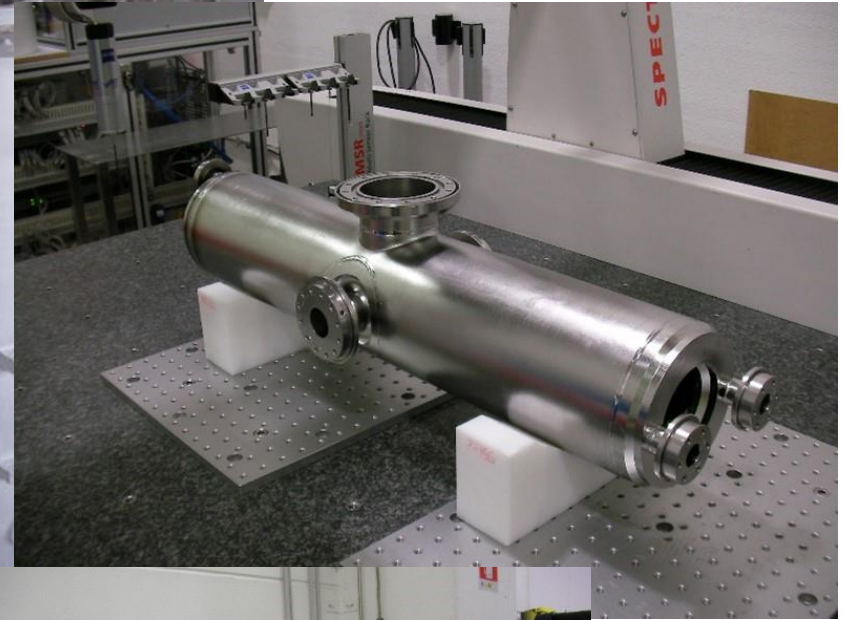
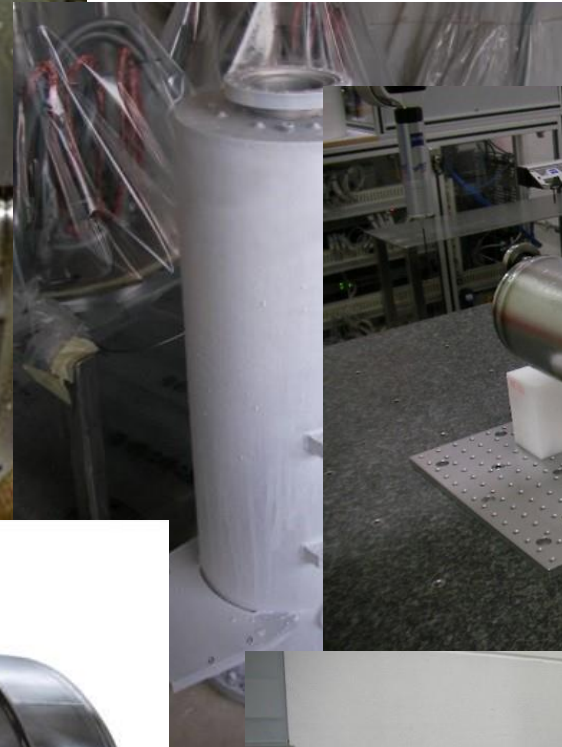


## SUPERCONDUCTING RF CAVITIES

- SC Quadrupole for ALPI Linac Project
- SC Quarter Wave cavity for ALPI Linac, ISAC-II, SPIRAL II, FRIB projects
- SC Half wave cavity for COSY-SCL, TRASCO, IFMIF, DONES projects
- 1 or 2 gap spokes SC cavity for Los Alamos National Lab, FNAL Proton Driver, ESS, MYRRHA projects
- SC crab cavity for HiLumi project
- SC elliptical cavities from 600 MHz to 3.9 GHz for TRASCO, EUCARD, XFEL, ESS, LCLS-II, PIP-II projects

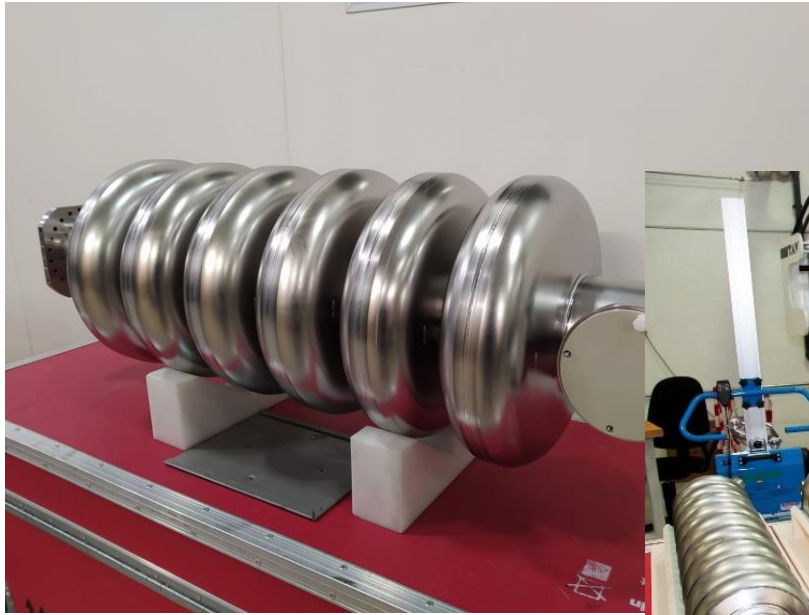


# Low Beta SRF cavities

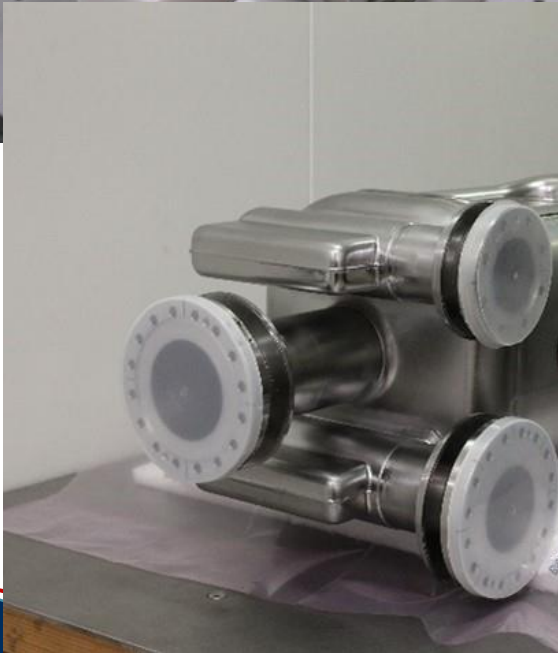
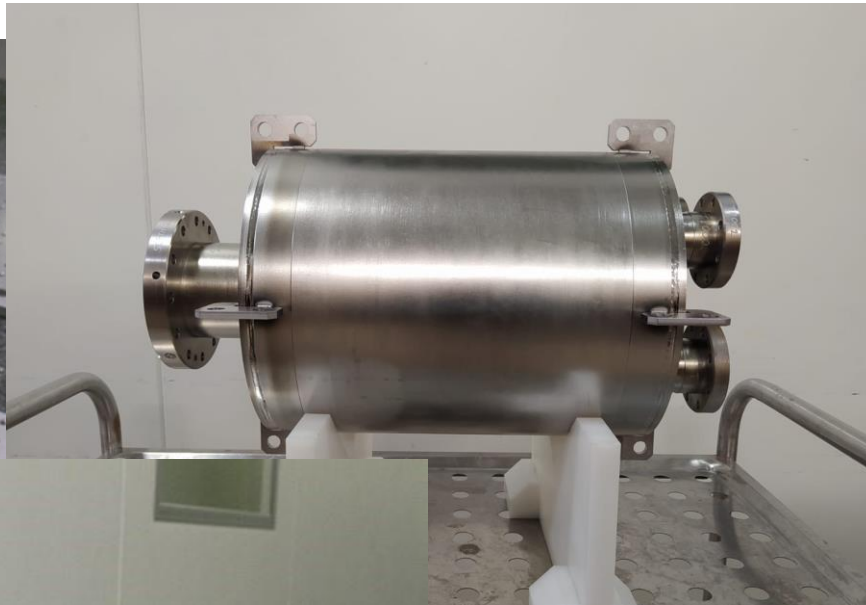


Ambra Gresele

# Elliptical SRF Cavities (more than 600!)



# SRF Gun cavity but not only accelerating cavities ...



A) Manufacture and final treatment of **420 units** of the 9 cells , 1,3GHz SC cavities

**Scope of work has included :**

- Manufacture of the 1,3GHz cavities / Manufacture of their Titanium Helium tanks
- Integration of the cavities into their tank /Treatments and Surface cleaning treatments
- Components manufacture and certification according to PED (Pressure Equipment Directive)
- Delivery production rate 4 units/week

B) Manufacture and final treatment of **20 units** of the 9 cells , 3.9GHz SC cavities

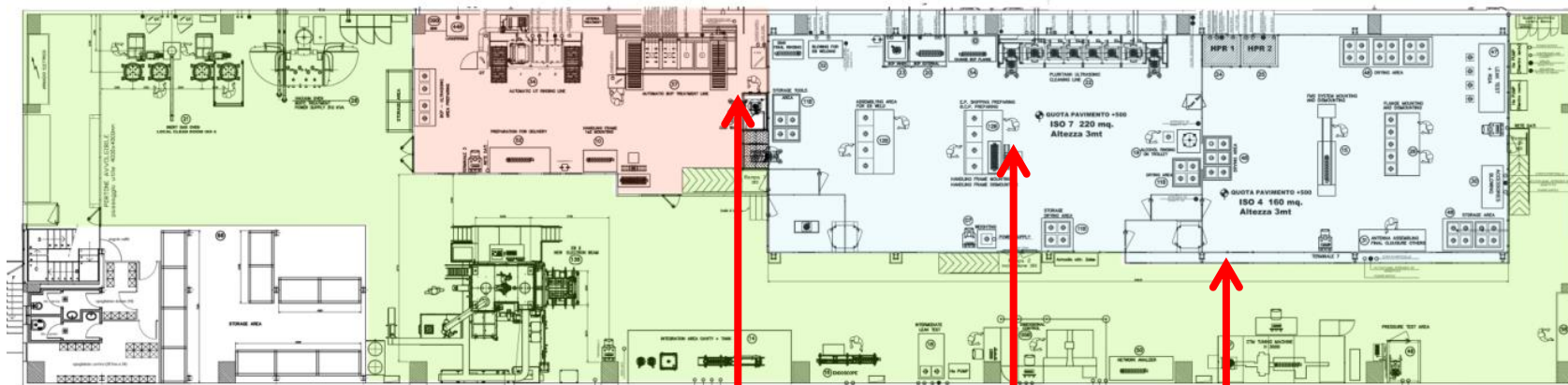
**Scope of work has included :**

- Manufacture of the 3,9 GHz cavities / Manufacture of their Titanium Helium tanks
- Integration of the cavities into their tank /Treatments and Surface cleaning treatments
- Components manufacture and certification according to PED (Pressure Equipment Directive)

C) Manufacture and testing of **45 units** of XFEL Cryomodules

**Scope of work has included**

- Vacuum vessel and cold-mass prefabrication and testing
- Delivery to the assembly site ( CEA-France)



The building is organized  
in three main areas

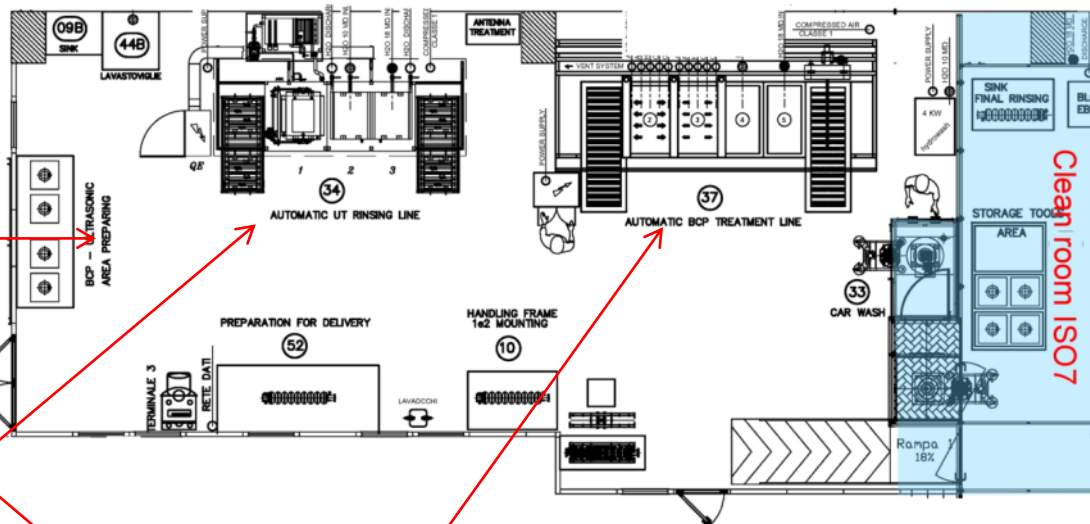
- A) Chemical treatment area
- B) Clean room ISO7/ISO4
- C) Controls, Integration,  
heat treatments and testing area

## Chemical treatment area

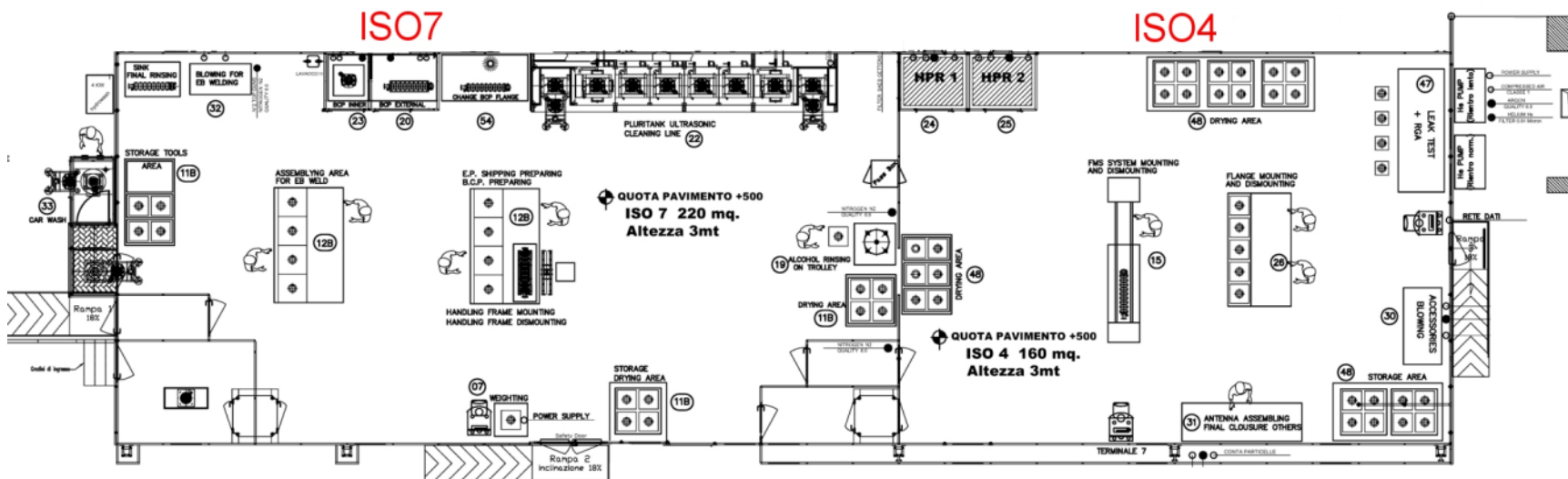
Preparation and drying areas

Automatic pluritank station for US cleaning, rinsing water 10 MΩcm and 18 MΩcm

Automatic BCP treatment line  
2 cooled acid baths for Niobium and Nb-55-Ti  
1 bath first rinsing, 1 bath final rinsing water 10 MΩcm and 18 MΩcm  
protection tunnel, fumes extraction to the scrubber



## Clean room ISO7/ISO4



Dedicated to clean assembly, final surface treatments,  
final assembling for the RFcold test.

Total surface of about 450 m<sup>2</sup>

ISO7 area 220m<sup>2</sup> - ISO4 area 200m<sup>2</sup>

Operators dressing rooms, air showers

Metallic floating floor

Customized treatment stations

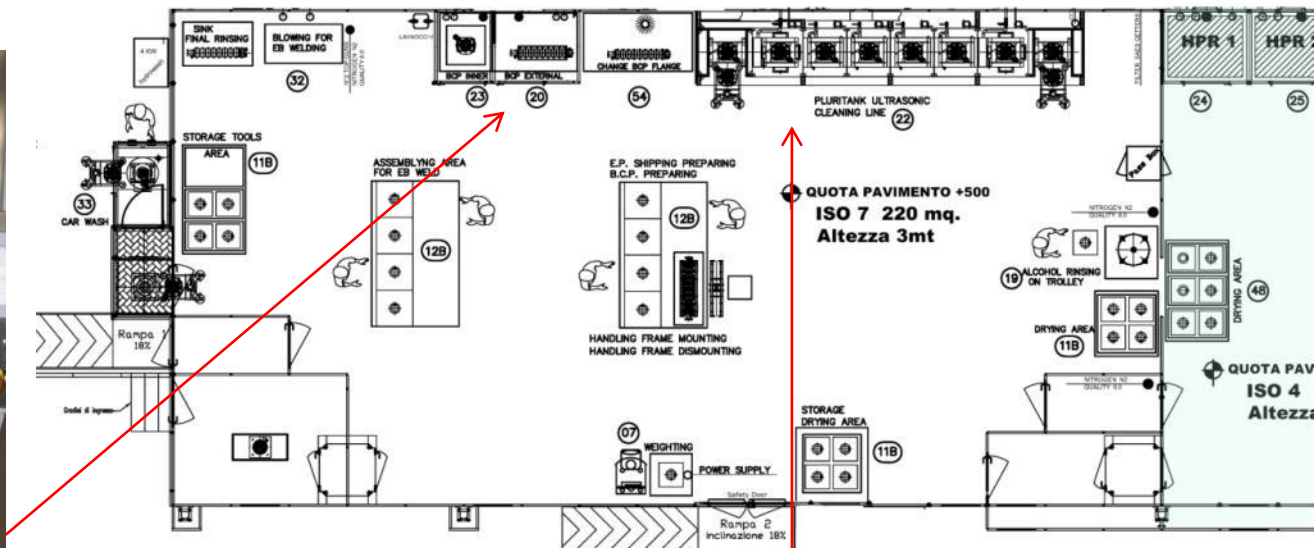


# FACILITIES & EQUIPMENT

## Clean room ISO7



Cabinets for BCP  
close circuit  
of the inner / outer  
cavity surfaces

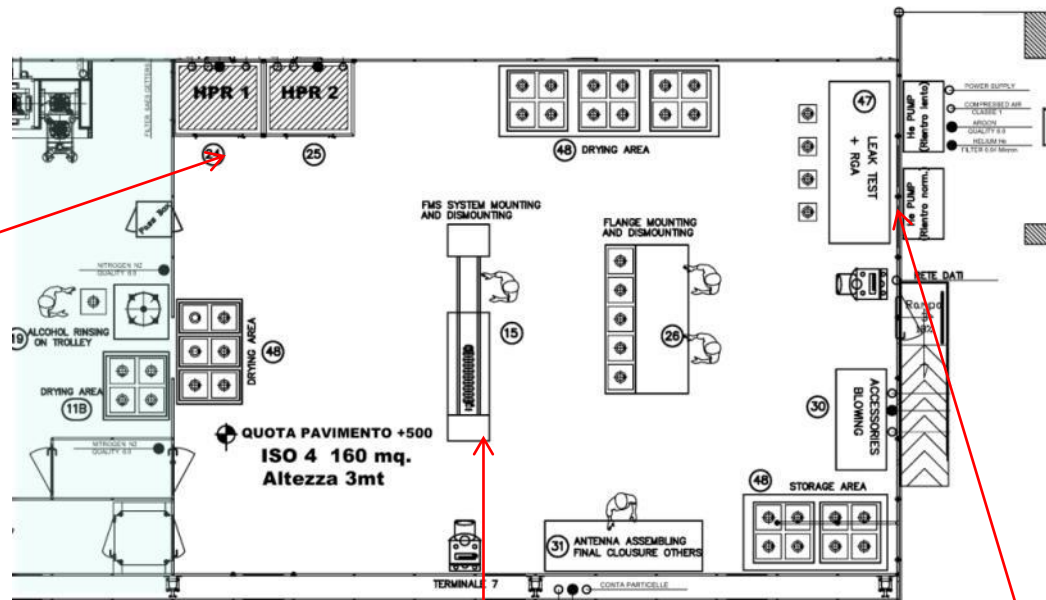


Automatic pluritank  
station  
for  
UT cleaning and  
rinsing baths  
water 10 MΩcm  
and 18 MΩcm

Alcol rinsing , Others

## Clean room ISO 4

N° 2 cabinet for final HPR  
UPW 18 MΩcm water  
p>100bar , 1.5m³/h  
Cavity's rotation , vertical  
translation Nitrogen overlay



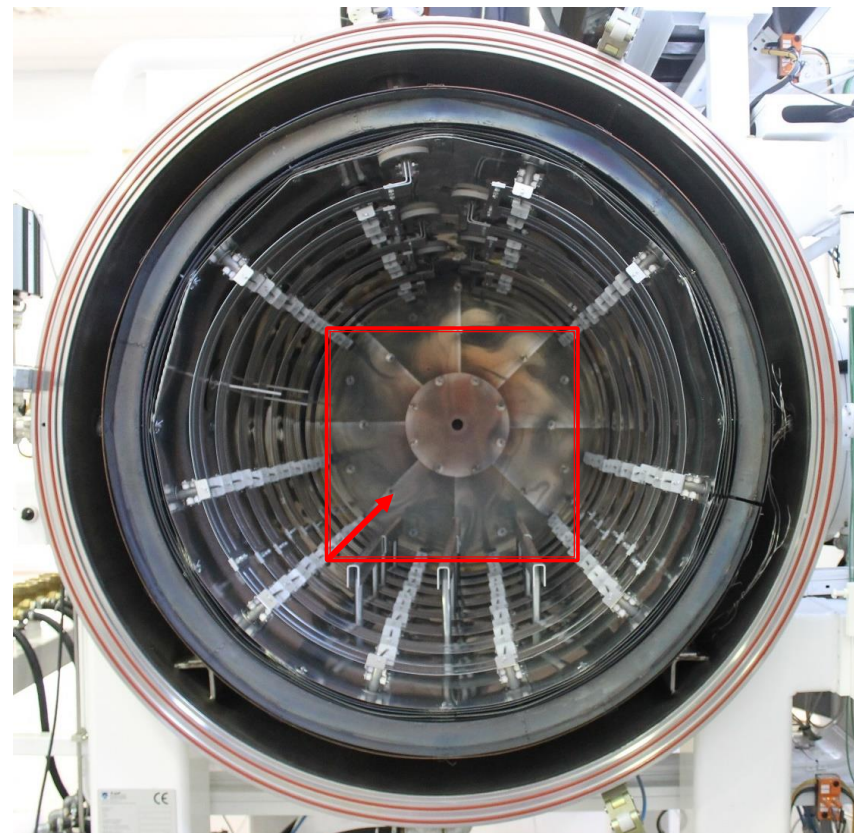
Station for final leak test  
special equipments for  
slow-controlled venting  
of the cavity

Assembling stations for  
FMS installation - RF antennas  
assembly



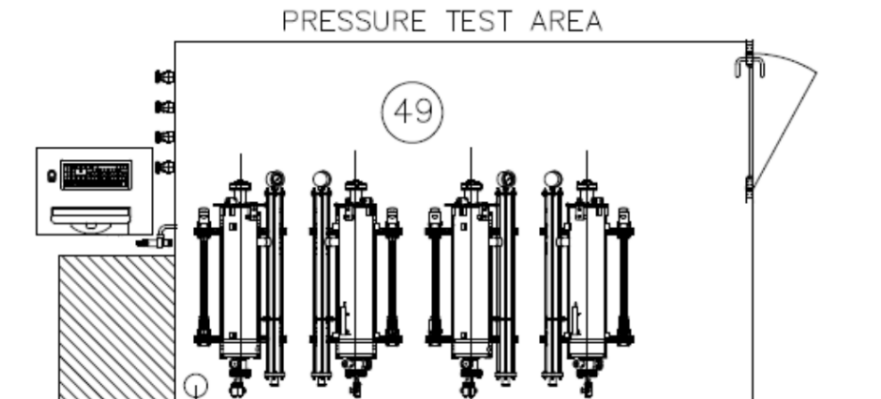
## UHV oven

- ▶ Max working temp: 1250°C
- ▶ Temperature uniformity:  $\pm 5^{\circ}\text{C}$
- ▶ Temperature control: over 3 zones
- ▶ Chamber: Stainless steel
- ▶ Chamber is actively water cooled
- ▶ 1st and 2nd thermal shield layer: Molybdenum
- ▶ Heaters: Molybdenum
- ▶ Load temp control: 10 K-type tc
- ▶ Chamber temp control: 4 S-type tc (3 + overtemp safety)
- ▶ Usable working space: 600 x 600 x 1300 mm



## Pressure test area

- ▶ Realized with 10 mm thick steel walls
- ▶ Pressure monitored via webcam in real time
- ▶ Capable of testing up to four units at once
- ▶ Test pressure up to 8 bar g
- ▶ Gauges calibrated every three months



## 120°C baking stand

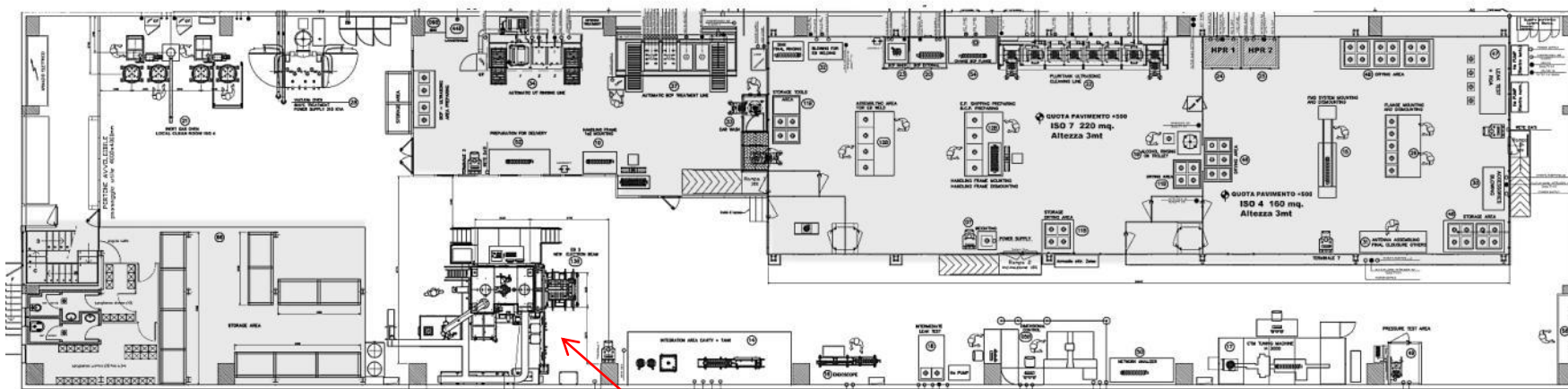
EZ built in house two stands for EXFEL, adaptable to other cavities:

- ▶ Pumping system with LD for efficient and clean leak detection
- ▶ Pumping system supported by UPS to avoid power failures
- ▶ Connection/disconnection in ISO5 local clean room
- ▶ Operations monitored w/particle counter
- ▶ Capable of treating two cavities at once
- ▶ Heating in inert atmosphere ( $N_2$ )



## EB welding and testing area

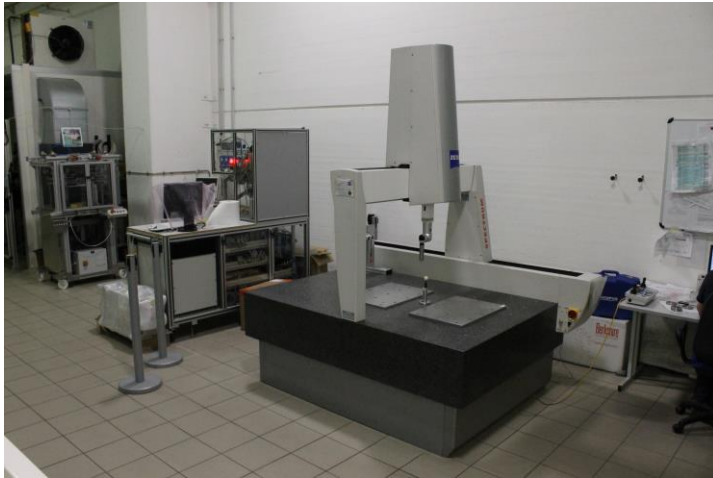
The area is organized to suit part of the production and control operations  
(good clean environment , not classified)



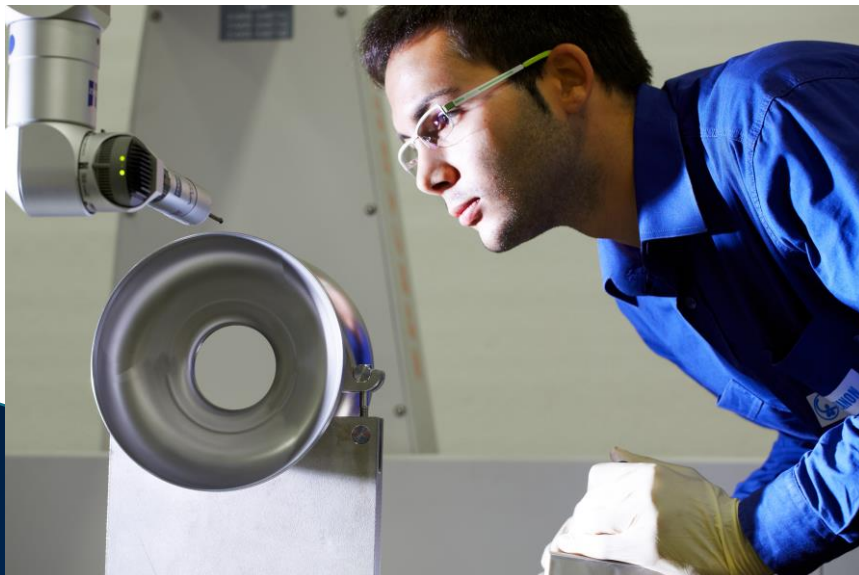
New EB welding plant : S.S. Chamber ,  
size 3,4x2x2 m , oil free pumping group  
with cryogenic pump  
( $3 \times 10^{-5}$  mbar 35 minutes)  
nitrogen venting , RGA



## 3D METROLOGY



## VACUUM LEAK TESTS



## RADIOFREQUENCY TEST & FINAL TUNING

Dedicated DESY equipment for sub-component RF control and cavity final tuning



## RADIOFREQUENCY TEST & FINAL TUNING

Dedicated semi-automatic equipment for tuning and RF measurement of 700 MHz and 650 MHz cavities

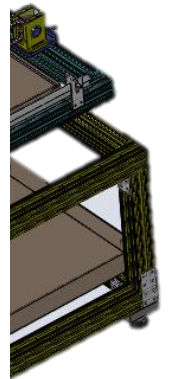




- ▶ Aluminum cathode 99.5% purity:



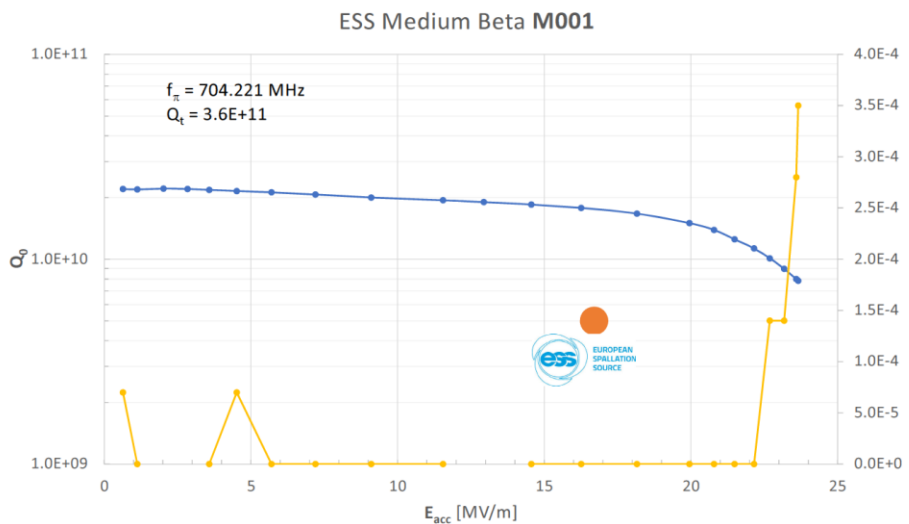
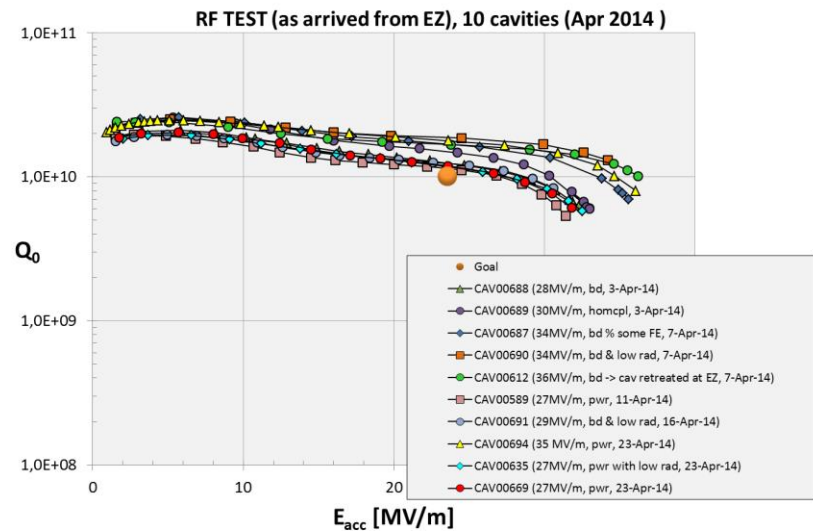
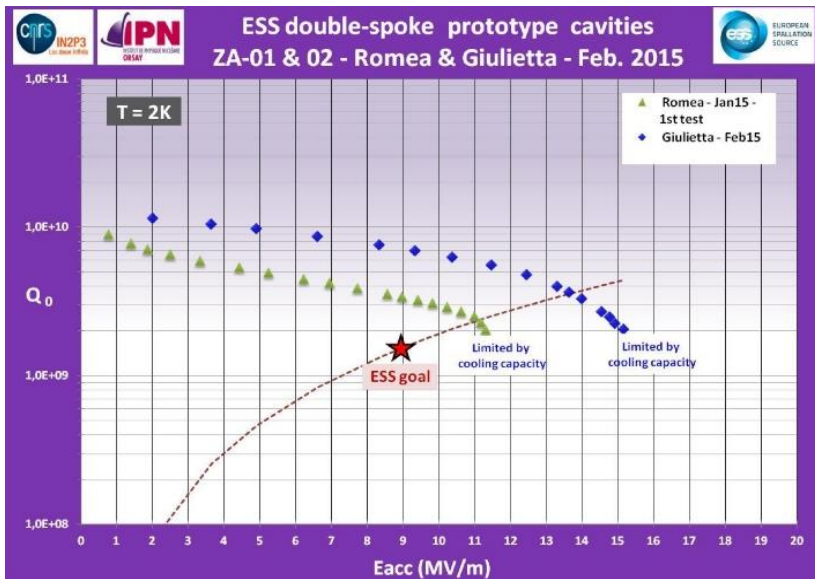
**A new facility but for  
the horizontal  
rotational BCP is under  
construction!!!!**



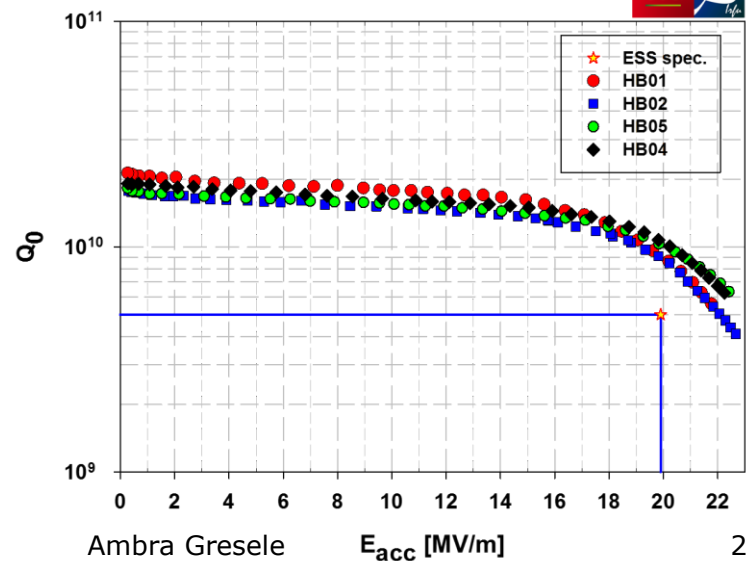
3D drawing



# ... SOME ZANON RESULTS



## High Beta cavities (CW@2K)



**Zanon has the infrastructure,  
the qualified staff,  
the production capacity and the  
interest to support ILC program!**





**Thank you  
for your attention**



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