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**ENGINEERING
DEPARTMENT**

Mechanical Activities in the EN-MME Workshop and Subcontracting

Simon Barrière on behalf of

Engineering Department (**EN**)

Mechanical & Materials Engineering Group (**MME**)

Outline

- The CERN Engineering department
- EN-MME group: mandate and structure
- The EN-MME Main Workshop
- Subcontracting activities

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Engineering Dept. Structure

Head of Department: *K. Foraz*
Deputy: *M. Nonis*

Access and Alarms
(EN-AA)

Group Leader: *P. Ninin*
Deputy: *R. Nunes*

Accelerator Coordination & Engineering
(EN-ACE)

Group Leader: *J.-Ph. Tock*
Deputy: *S. Chemli*

Planning, Administration & Safety
(EN-PAS)

Group Leader: *M. Nonis*
Deputy: *S. Knoops*

Cooling & Ventilation
(EN-CV)

Group Leader: *I. Ruehl*
Deputy: *S. Deval*

Information Management
(EN-IM)

Group Leader: *D. Widegren*
Deputy: *J. de Jonghe*

Electrical Engineering
(EN-EL)

Group Leader: *N. Bellegarde*
Deputy: *D. Ricci*

Handling Engineering
(EN-HE)

Group Leader: *C. Colloca*
Deputy: *C. Bertone*

Mechanical & Materials Engineering
(EN-MME)

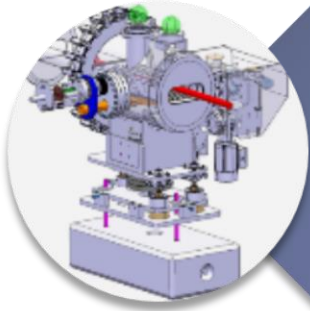
Group Leader: *S. Atieh*
Deputy: *A. Bertarelli*

- Operation
 - Technical Infrastructures
 - Accelerators Maintenance
- Projects
 - Consolidation
 - Upgrades
 - New facilities
 - Design & Manufacturing
- Studies

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EN-MME: Mechanical & Materials Engineering Group



Engineering & Design

- Design Office:
 - 40+ designers and engineers
 - CATIA / SmarTeam, ANSYS, LS-Dyna...
- Experimental Mechanics Lab.



Fabrication

- Mechanical workshop (4000 m²):
 - 50 technicians and engineers
 - CNC machining
 - Assembly & metal forming
 - Welding (TIG, MIG, electron beam, laser, vacuum brazing)
- Technical Subcontracting Service (MME-FS)



Materials & Metrology

- Material science consultancy:
 - metallurgical analyses, microscopy, mechanical tests
- NDT: US, radiography, tomography
- Metrology: 350 m² lab. equipped with CMM.

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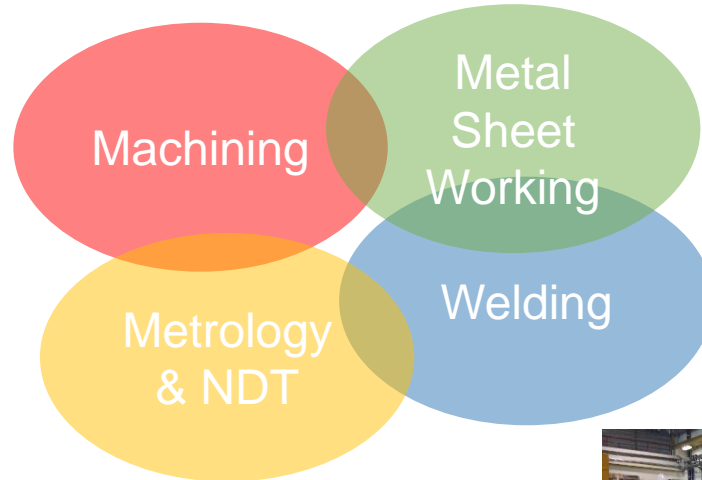
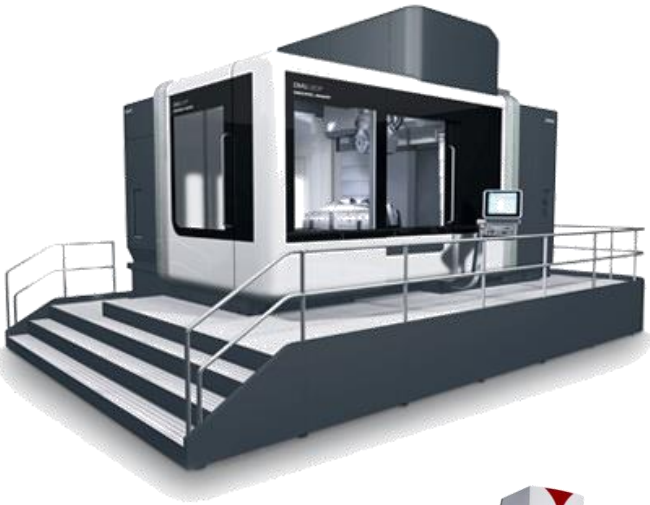
MME Mechanical Workshop

A real heritage of CERN (1957-2022)



MME Mechanical Workshop

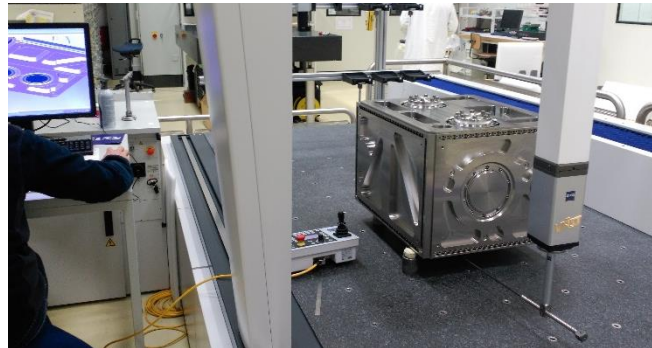
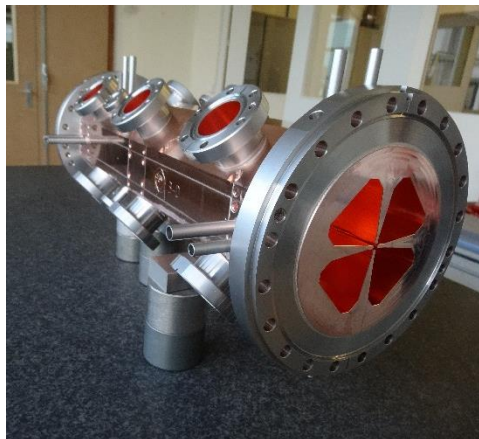
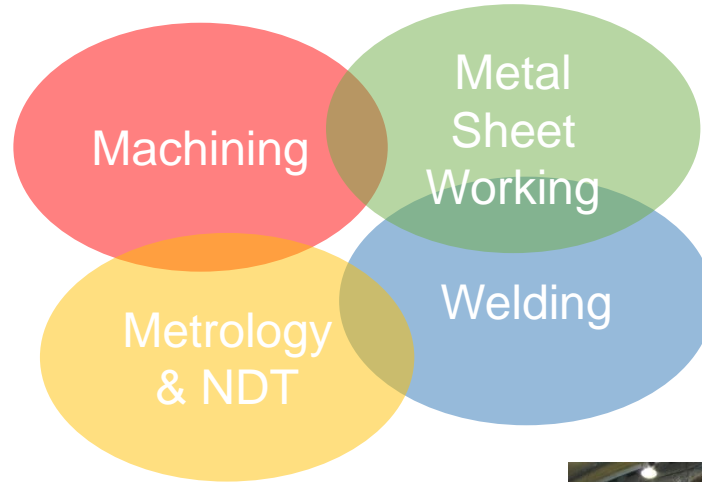
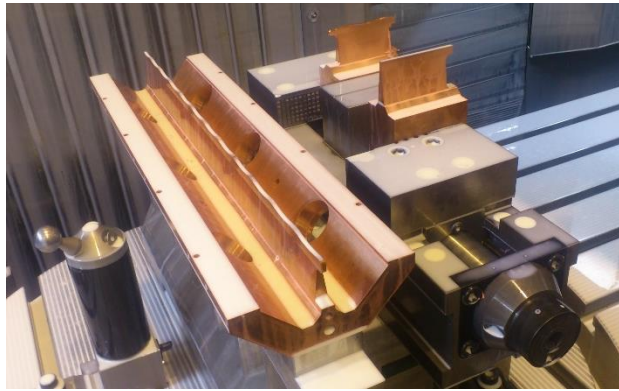
Synergy of multiple areas of competence



MME Mechanical Workshop

Its core mission is to provide service to the Organization for:

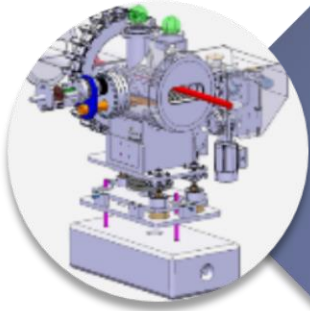
- **Urgent needs** (repairing, tunnel interventions, urgent fabrication...)
- **Prototypes / proof of principle**
- **Multi-technology fabrication projects**



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MME Subcontracting Service:

- in **close collaboration with the CERN Procurement Department**
- strong contribution to **balance the industrial return**
- **2000-2500** contracts/year
 - ~**40% of overall production for mechanical components @ CERN**

Subcontracting:

- ~ **40% of semi-finished parts**
- ~ **60% of finished / turnkey components**

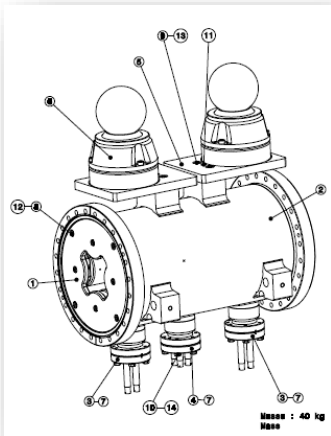
MME Subcontracting Service: Core & Recent Activities

Magnets

Prototypes & small series of different magnets

ELENA – Series production of electrostatic quadrupoles (x60).
Synergy between EN-MME Workshop and EU suppliers.

- *High precision CNC of small to large equipment*
- *Stamping, wire cut of laminations*
- *Cryostats*

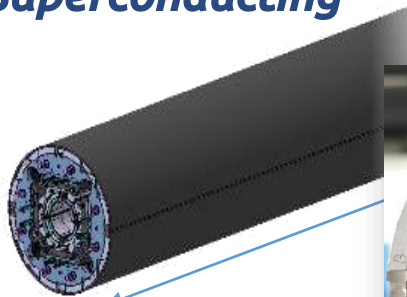


**MQXF
Magnet**

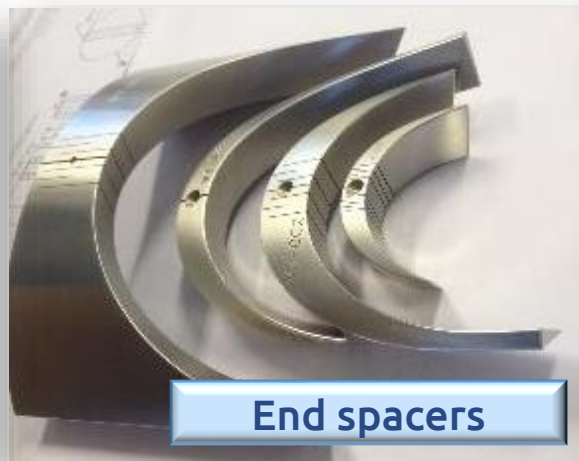
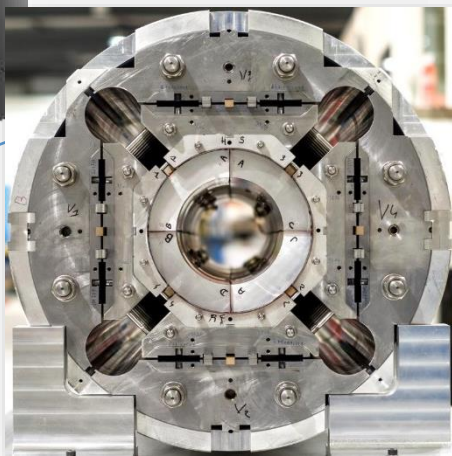
Superconducting

..5 axes CNC machining, turning, EDM..

..Titanium..



L = 7m



End spacers

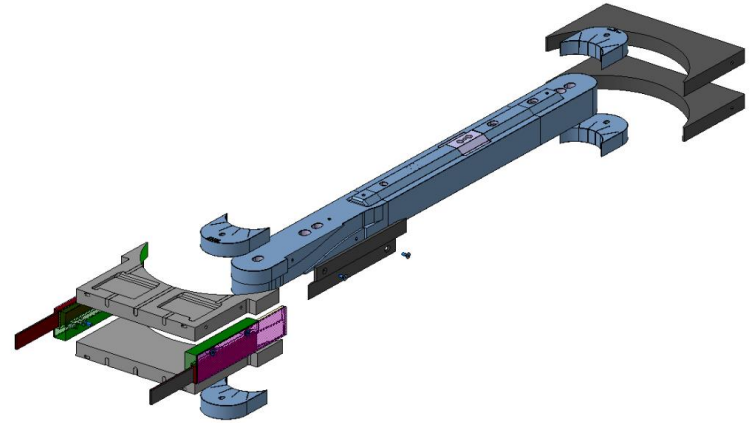
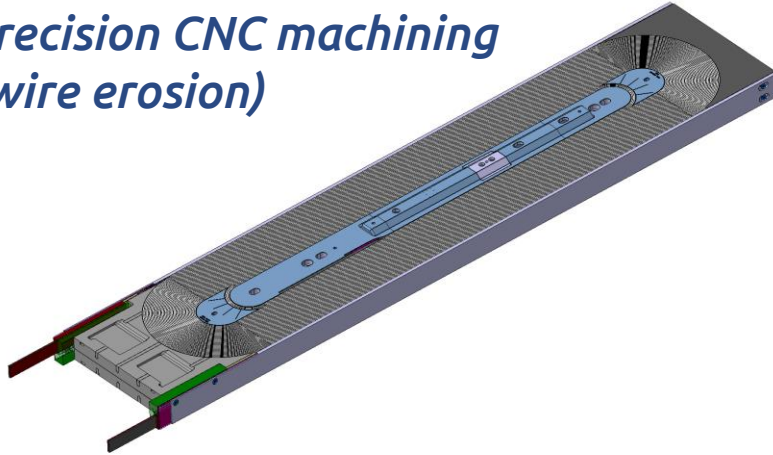


Poles

Magnets

3x RMM prototype Coils for FCC project (R&D)

- High precision CNC machining
- EDM (wire erosion)



Titanium

St. Steel 316L



St. Steel 316L



Magnets Tooling

Large Precise Tools for Magnet assembly

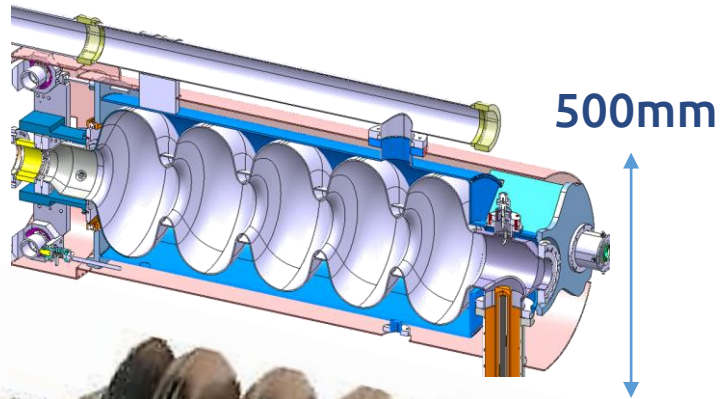
Rotating Table for SC magnets assembly



MQXF & FRESCA Magnet Impregnation & Curing Tools



Superconducting RF Cavities



- *Prototype: .. Precise forming & joining of Niobium sheets (in-house).. Precise Tools*
- *Series: 100% industry*
- *Precision and surface quality of utmost importance for cavity performance*



SPL Cavity

*..Spinning..
EB welding*

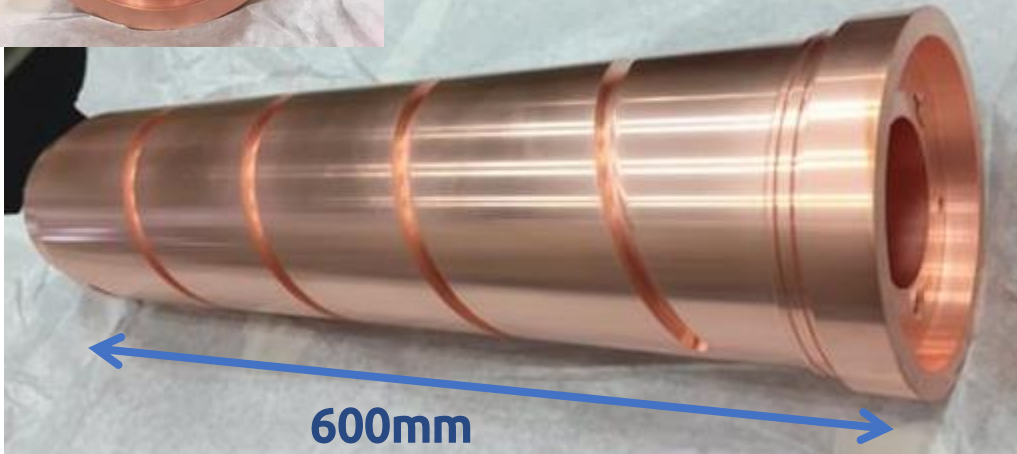
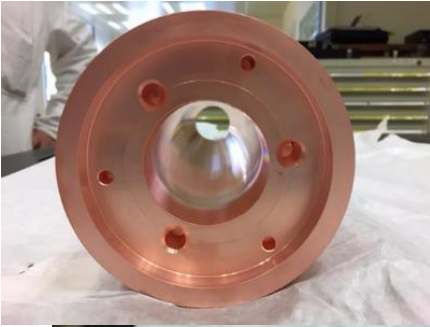
CRAB Cavity



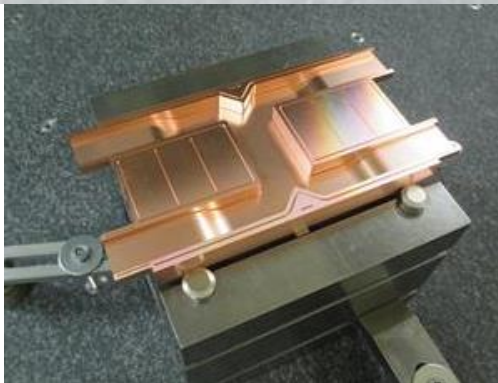
« Warm » RF Cavities

RF Pulse Compressor

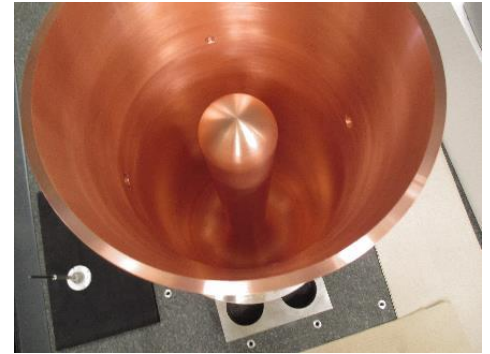
*Turn/mill process
on Cu OFE 3D
forged*



Copper
Waveguide
Coupler



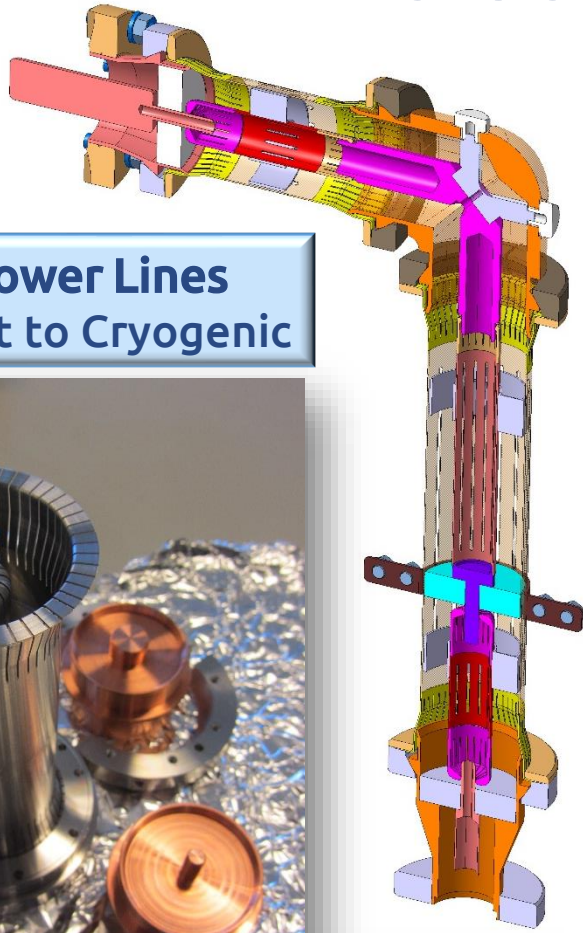
HIE- Isolde Cavities



- *Long Overhang Machining from Monoblock Copper*
- *D320 x L900*
- *Tolerances in the tenth of mm..*

Diverse RF Equipment

RF Power Lines
Ambient to Cryogenic

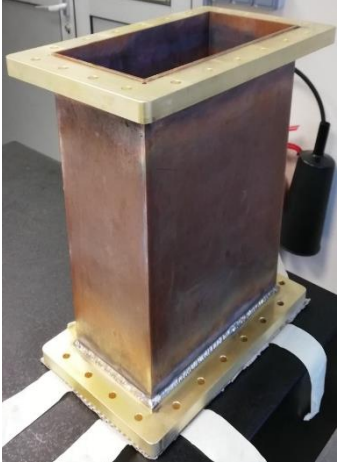


Crab Cavity:
RF Feedthrough



- *EB welding & Ceramic brazing in reduced volume*
- *Machining*

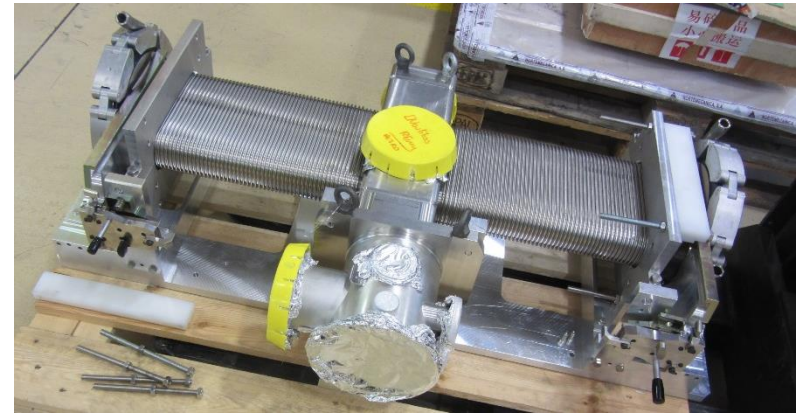
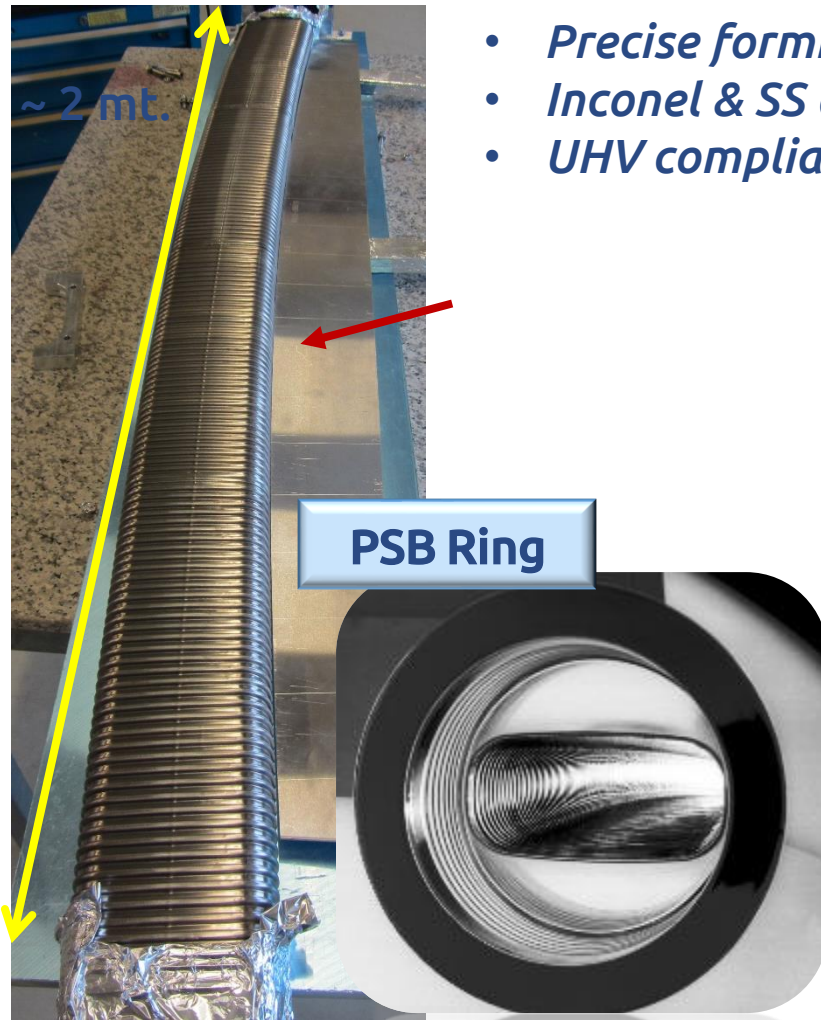
RF waveguides
Brass flanges



Vacuum Chambers

- *Precise forming into chambers of different sizes*
- *Inconel & SS alloys*
- *UHV compliant fabrication*

PSB Injection



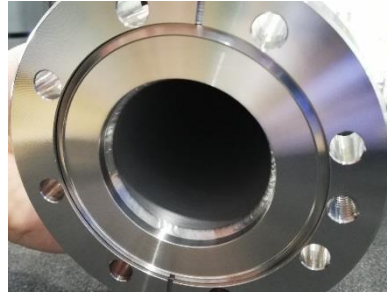
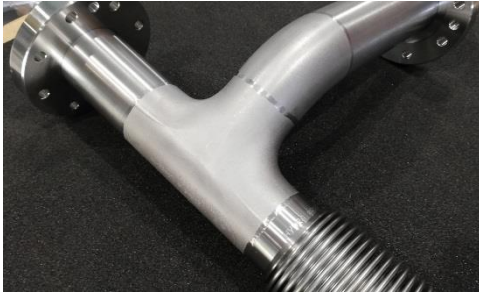
Hippodrome edge-welded bellows

High Vacuum Components

Pumping bypass for LHC



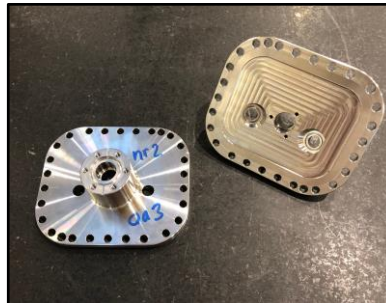
- *High precision CNC machining*
- *Bellows*
- *TIG welding*



Cryocooler Test Chamber

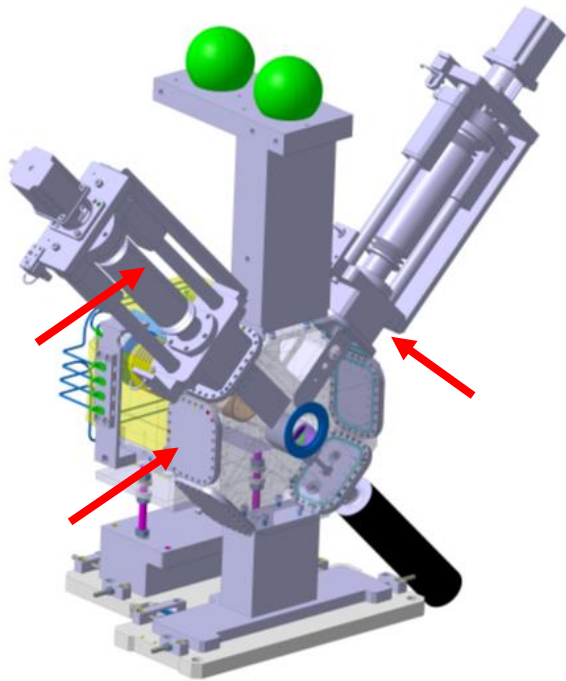


ISOLDE UHV Flanges



Beam Diagnostic Components

- Complex bulk pieces with knife-edges for UHV applications
- Raw material from CERN (316LN 3D forged blanks)
- Manufactured in DK in 2019

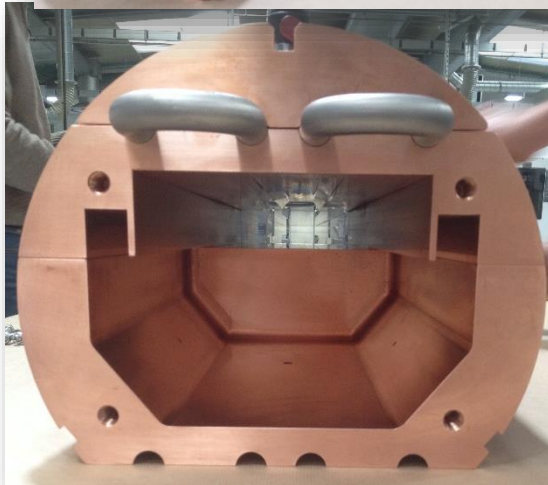


Beam Intercepting Devices: TIDVG4

Copper blocks: *Large CNC milling*



*Assembling
..welding and
tests in house..*



Assembly inside tunnel

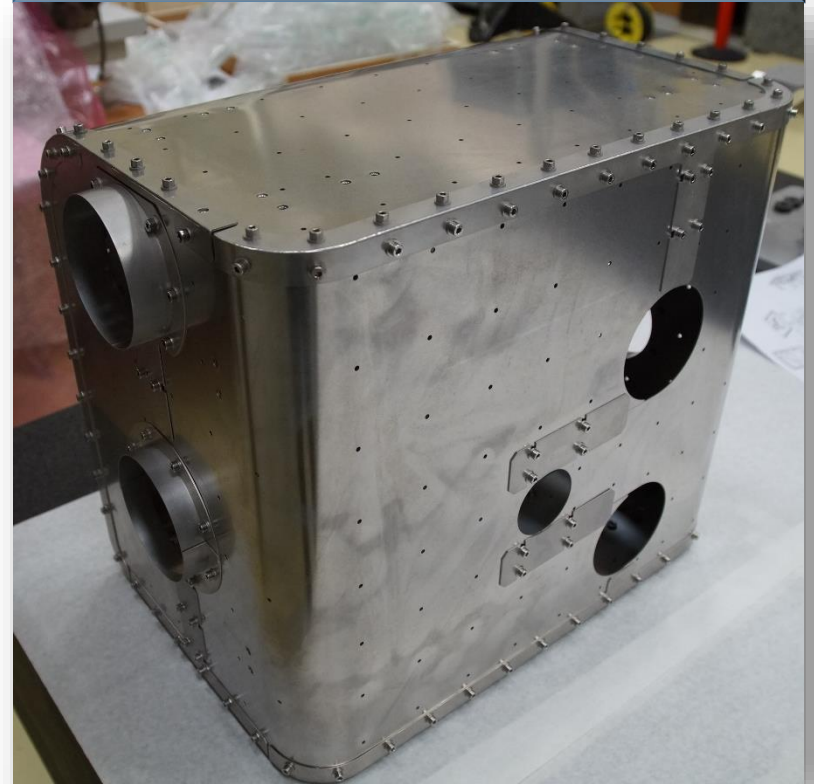


Magnetic Shields



Warm Magnetic Shield
MuMetal, 2m wide

Cryo Magnetic Shield
Cryophy, precise forming and thermal treatment



Handling, Lifting, Assembly Equipment

Handling Tool for Chemical Etching



Lifting Equipment for WOW Cavity

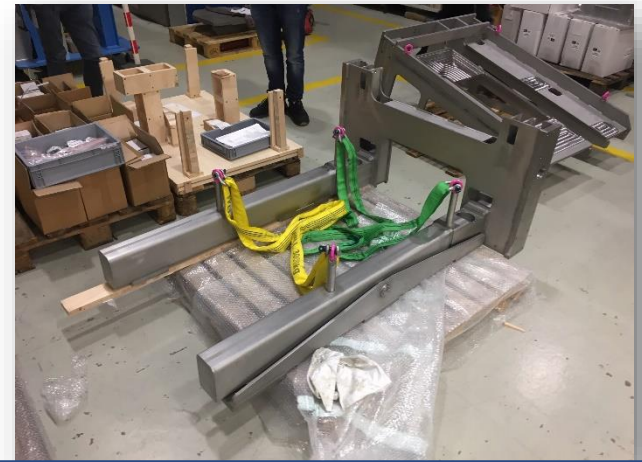


Bespoke Mechanical Lifting Equipment

Remote Handling System for LHC Collimators



AD Remote Handling Trolley



Always on the lookout for: Precision Vacuum Components

- *Precision forming
(Rolling, Bending, Extrusions..)*
- *Vacuum brazing & heat treatments*
- *Electron beam welding*
- *Precise machining*
- *Metrology*
- *UHV capabilities*

Materials:

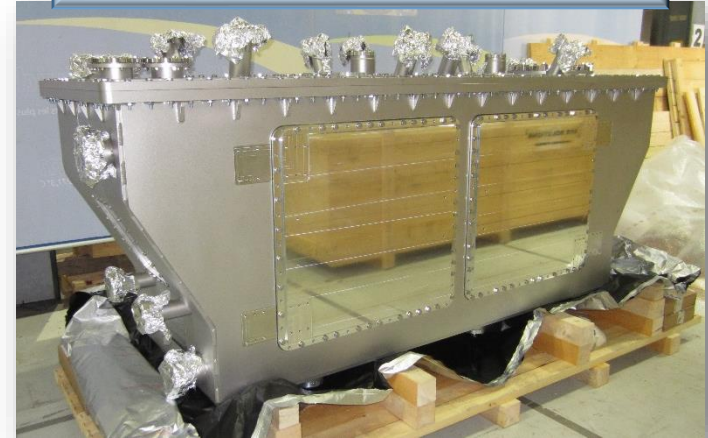
- *Stainless Steel*
- *Inconel*
- *Titanium*
- *Aluminum*



Pulled-nozzle chambers



Vacuum Vessels



Y-chambers



Always on the lookout for: Bellows

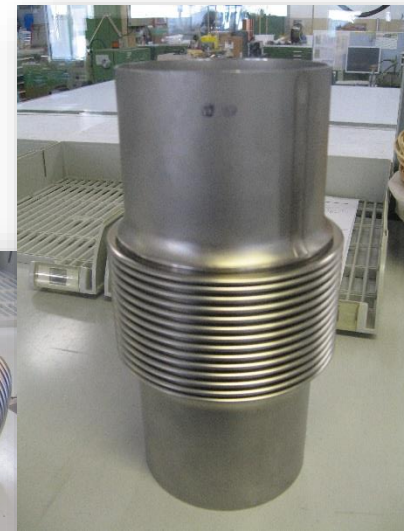
...UHV, cryogenics, pressure equipment...

Typical Dimensions: ~ Ø60, Ø80÷Ø120, ~Ø160

Edge-welded



Hydroformed

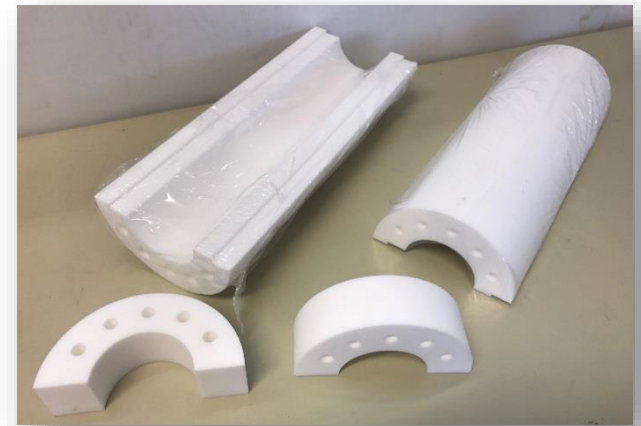


Always on the lookout for: Plastics & Composites

- Magnet shims
- Insulators, spacers
- Standard components (washers, screws)
- Tools for assembly and protection
- ...

Materials:

- POM, PP, Plexi, PVC
- PE at different densities
- PEEK, PTFE, PVDF, VESPEL
- EPGCxxx



Thank you for your attention!



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