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Presentation of the Mechanical Workshop EN-MME: Organisation, Activities and Upcoming Industrial Opportunities

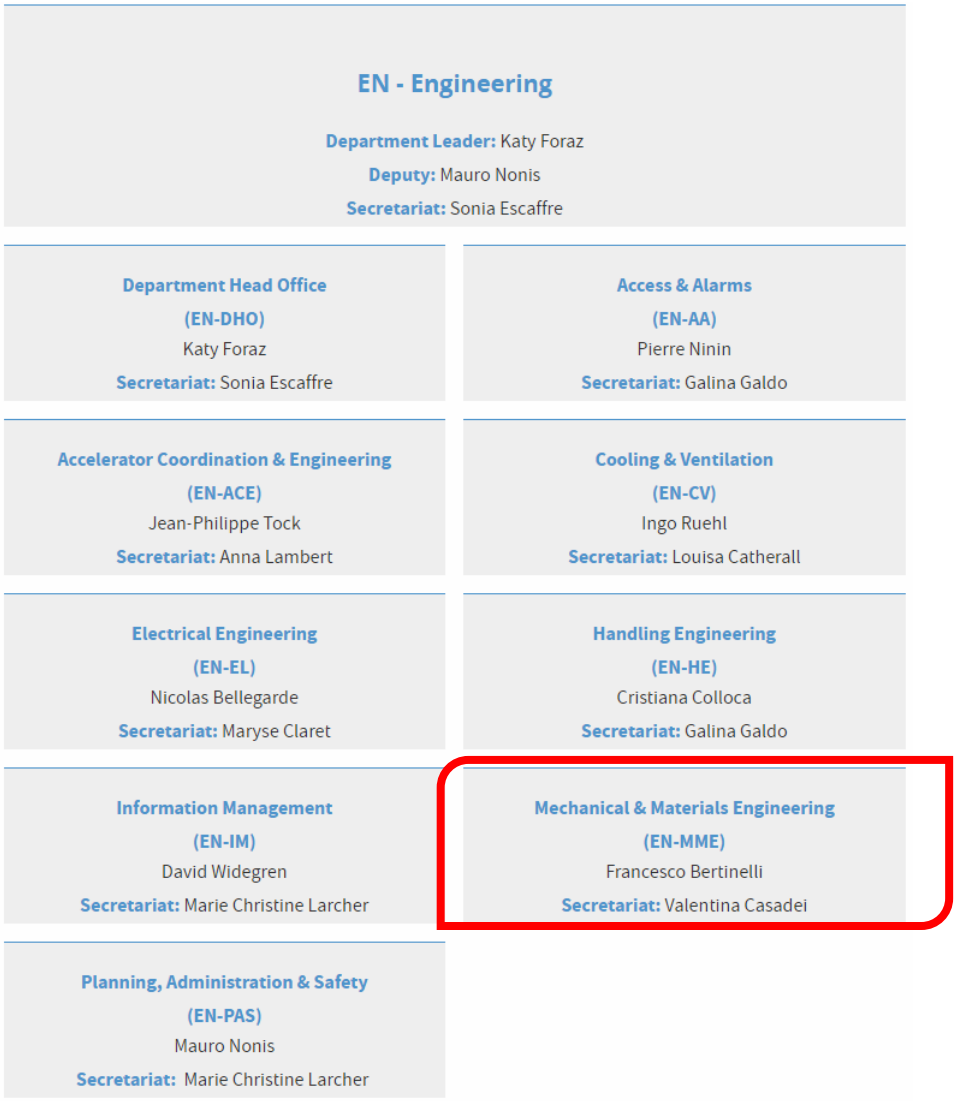
A. Dallocchio on behalf of:

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

Outline

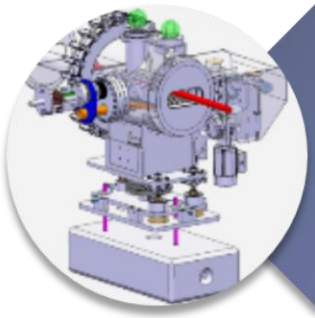
- EN-MME: Mandate and Structure
- EN-MME Mechanical Workshop
- MME Subcontracting Service: Figures and Numbers
- Highlights
- Upcoming Industrial Opportunities

Engineering Dept. Structure



- Infrastructures
  - Management
  - Upgrades
  - Industrial support
- Coordination of Activities
- Engineering services
  - Electrical
  - Mechanical
  - Handling
  - HVAC
  - …

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 m^2):
  - 50 technicians and engineers
  - CNC machining
  - Assembly & metal forming
  - Welding (TIG, MIG, electron beam, laser, vacuum brazing)
- Technical Subcontracting Service (MME-FS)

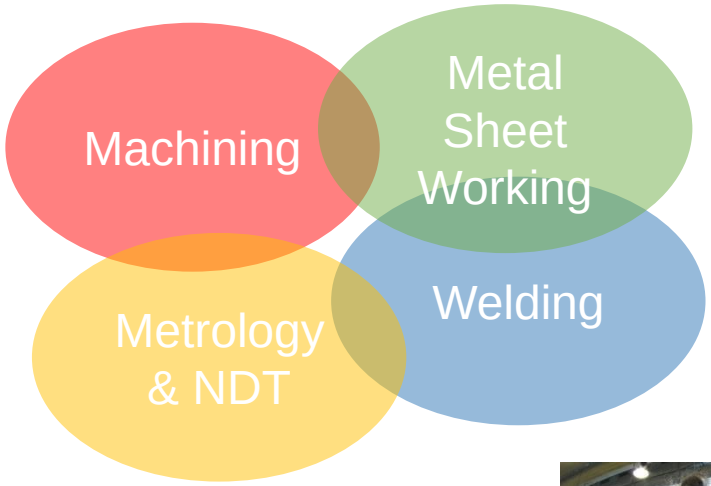
Materials & Metrology

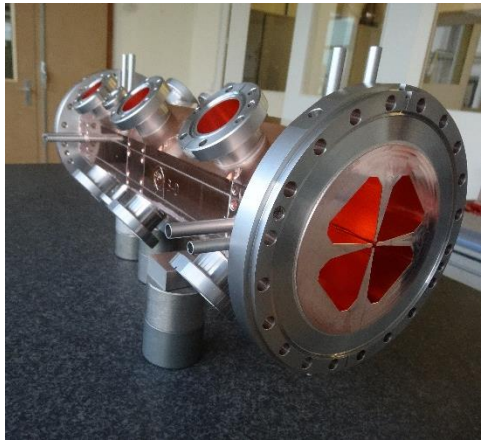
- Material science consultancy:
  - metallurgical analyses, microscopy, mechanical tests
- NDT: US, radiography, tomography
- Metrology: 350 m^2 lab. equipped with CMM.

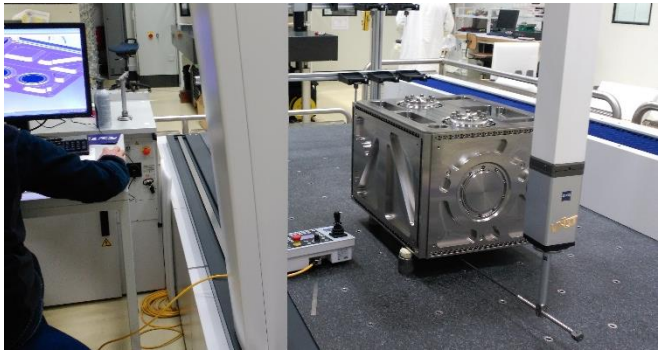
MME Mechanical Workshop

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**

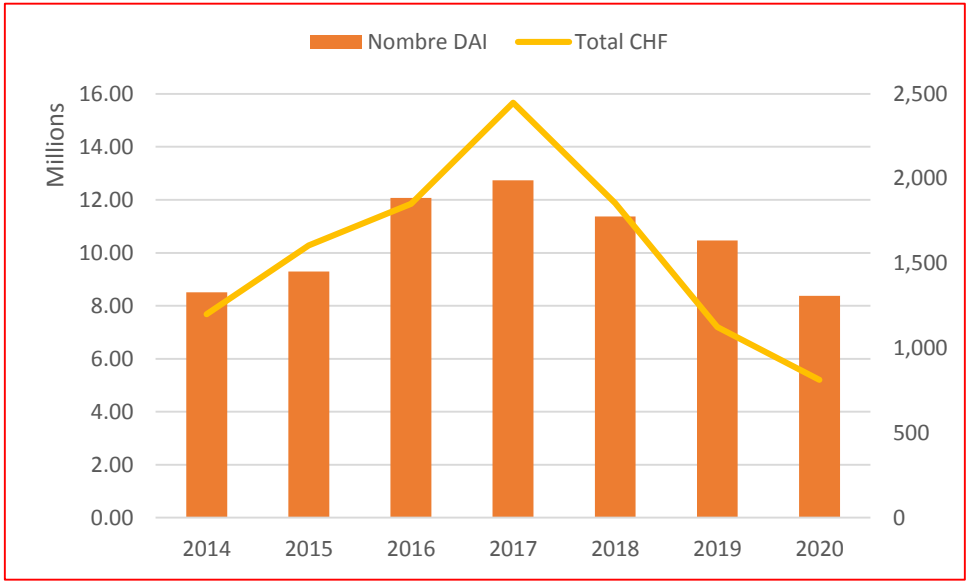






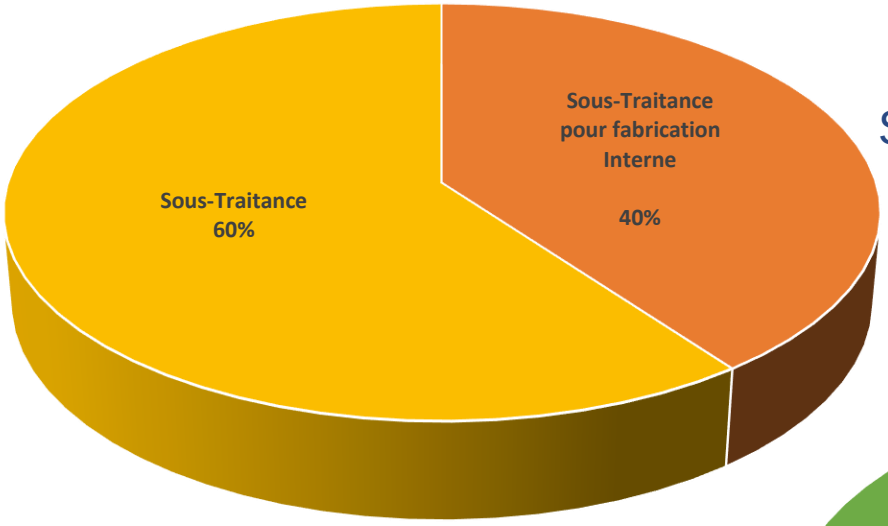
MME Subcontracting Service: Figures and Numbers

- Close collaboration with CERN Procurement Department
- Strong commitment to improve the industrial return balancing
- Averagely 40% of CERN expenditure in the Mechanical Domain
- Averagely 50% of CERN Price Enquiries < 50kCHF



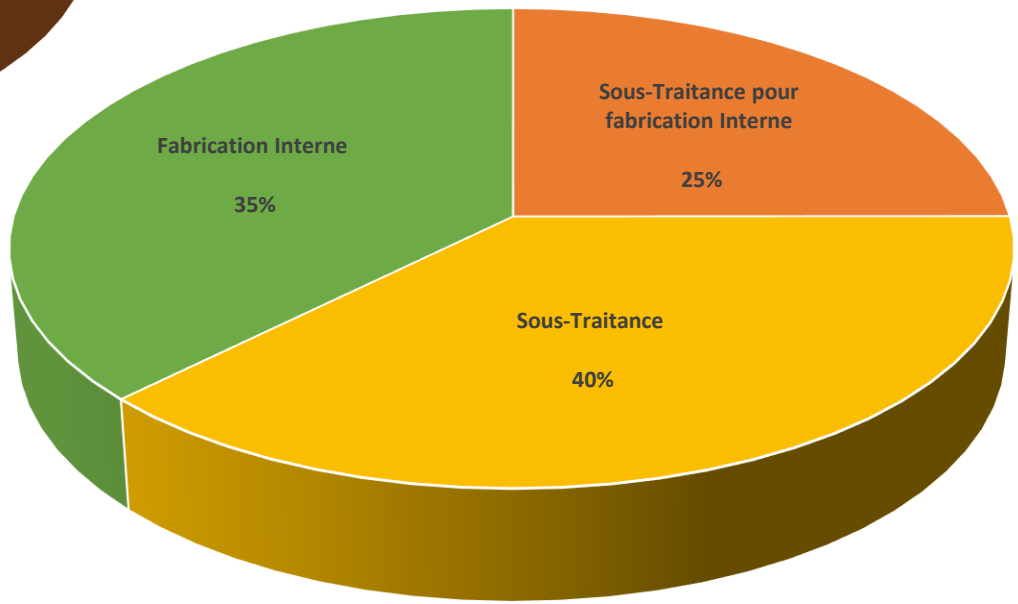
	2014	2015	2016	2017	2018	2019	2020	TOTAL
Nombre DAI	1,329	1,453	1,887	1,990	1,776	1,635	1,309	**11,379**
Total CHF	7,682,843.58	10,279,858.43	11,844,541.31	15,660,752.59	11,868,411.93	7,200,299.69	5,207,871.99	**69,744,579.52**
Montant Moyen / DAI (CHF)	5,780.92	7,074.92	6,276.92	7,869.72	6,682.66	4,403.85	3,978.51	**6,129.24**
Nombre de Fournisseur	232	264	294	346	334	292	262	**934**
Moyenne commande par fournisseur								**74,673.00**

Subcontracting vs. Internal Fabrication

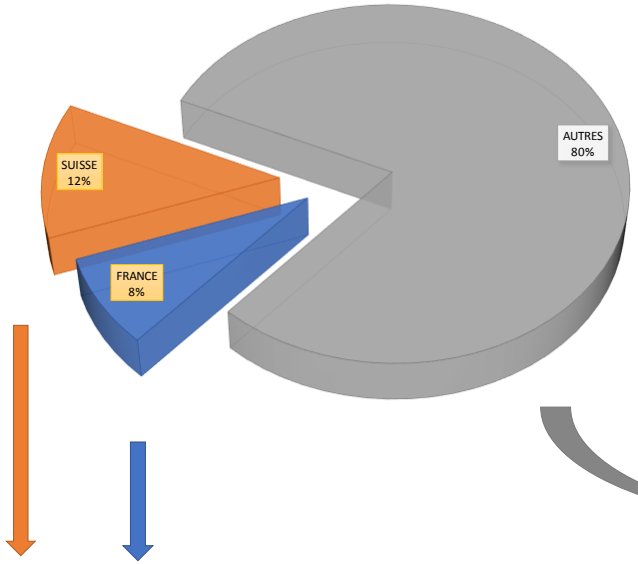


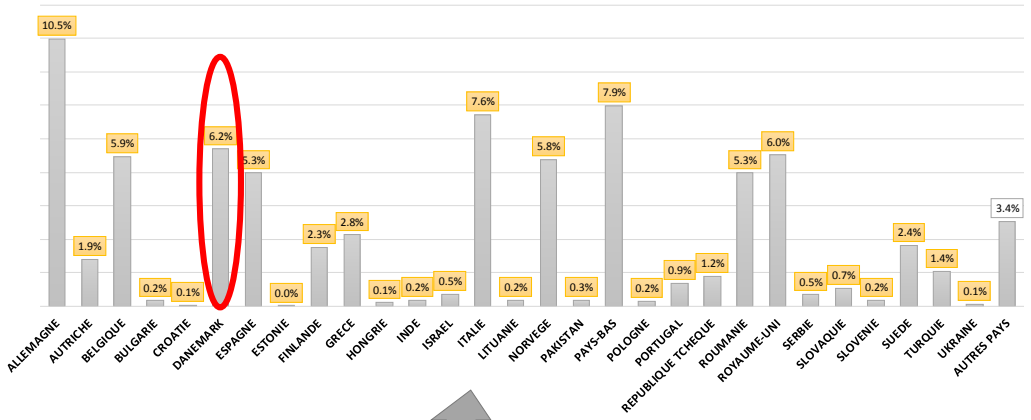
Subcontracting:

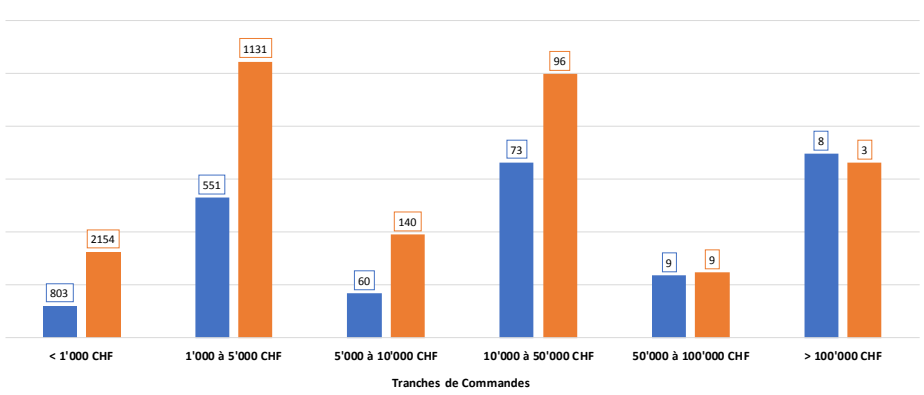
- **~ 40% of semi-finished** parts
- **~ 60% of finished / turnkey** components



MME Subcontracting Service: expenditure distribution 2014-2020



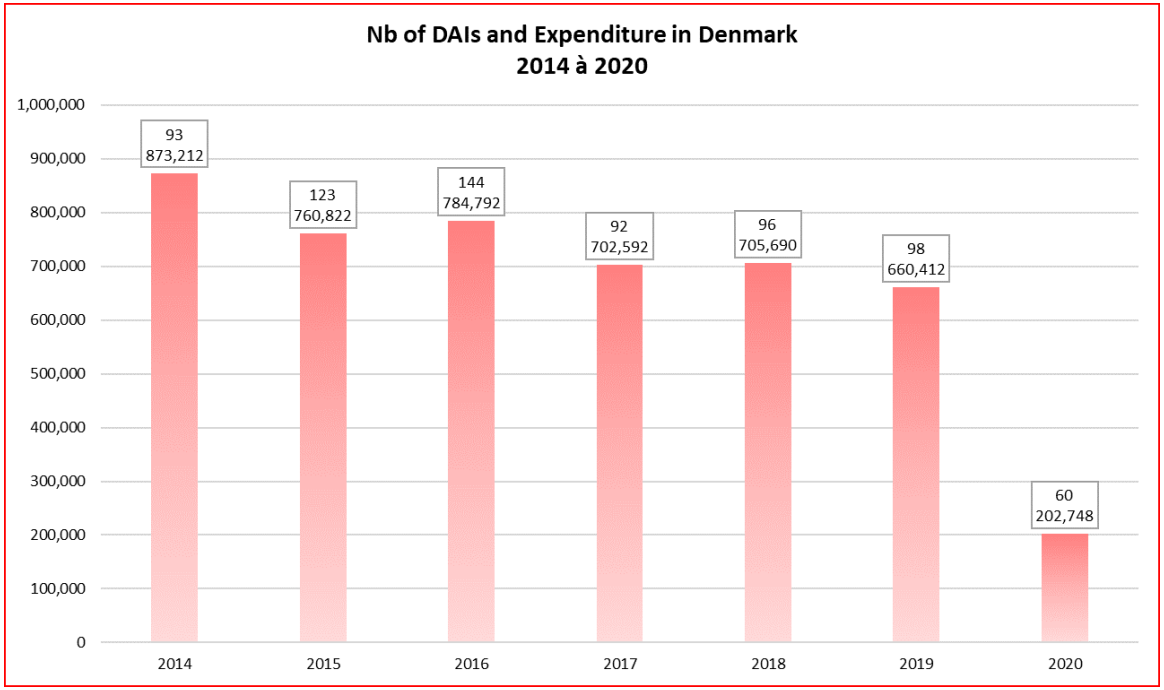




- **Constant effort to well distribute industrial return…**
- **Scouting new firms…**
- **Industrial Partners in Host States mainly for very small contracts…**

MME Subcontracting Service: expenditure DK 2014-2020

DENMARK	2014	2015	2016	2017	2018	2019	2020	Cumul
Nb DAI	93	123	144	92	96	98	60	**706**
Tot Expenditure	873,212	760,822	784,792	702,592	705,690	660,412	202,748	**4,690,267**



MME has worked with more than 40 DK firms over the last years…

MME Subcontracting Service:
Core & Recent Activities

Magnets

- Prototypes & small series of different magnets
- *High precision CNC of small to large equipment*
- *Stamping, wire cut of laminations*
- *Fine Blanking of collars*
- *Cryostats*
- *Diverse materials (Alu, Steel, Stainless, Titanium)*

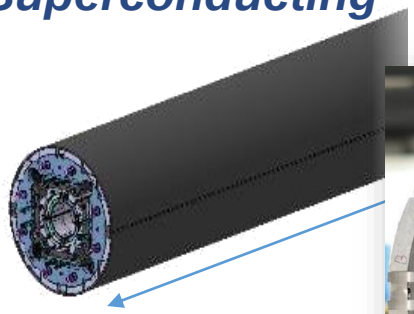
..Stainless Steel..

MQXF Magnet

Superconducting

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

..Titanium..



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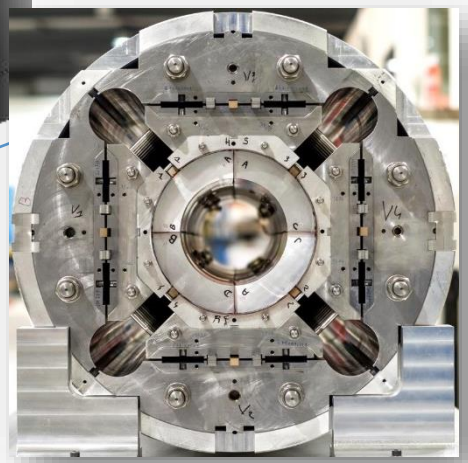


End spacers

Poles

Magnets Tooling

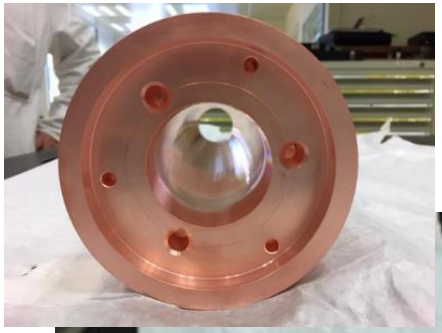
Large Precise Tools for Magnet assembly

MQXF & FRESCA Magnet Impregnation & Curing Tools

Rotating Table for SC magnets assembly

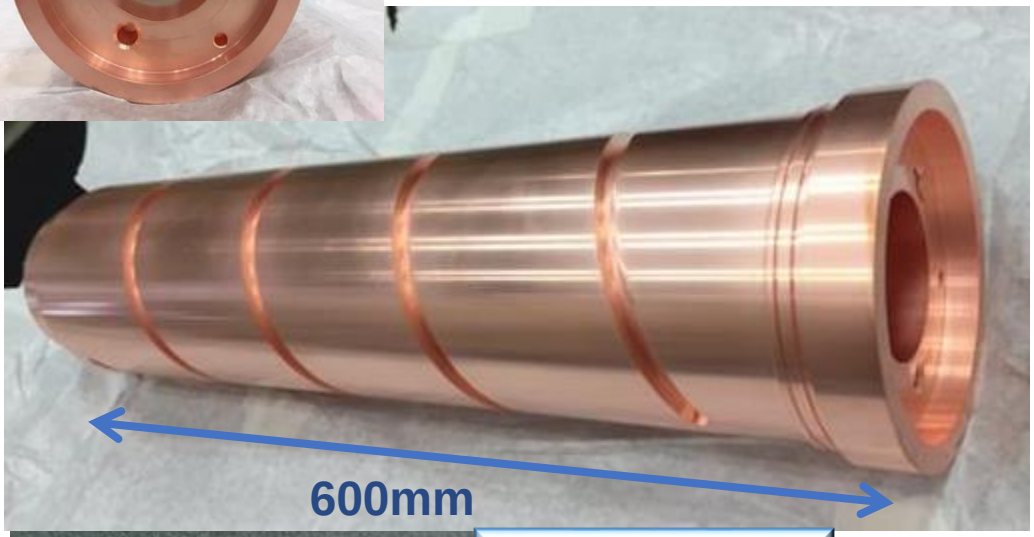
« Warm » RF Cavities

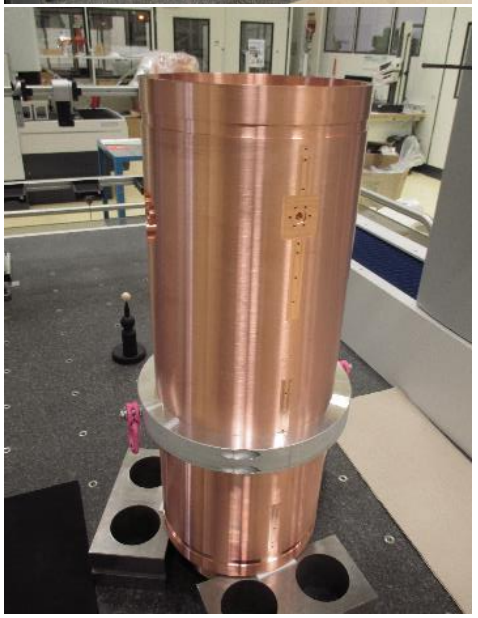
HIE- Isolde Cavities

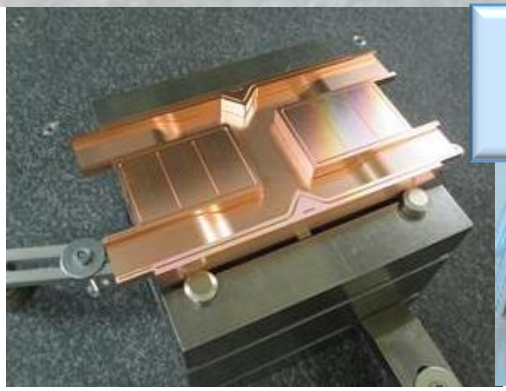


RF Pulse Compressor

Turn/mill process on Cu OFE 3D forged
From High precision to Ultra-High Precision





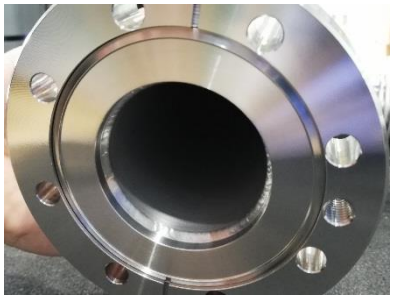


CuWaveguide Coupler

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

High Vacuum Components

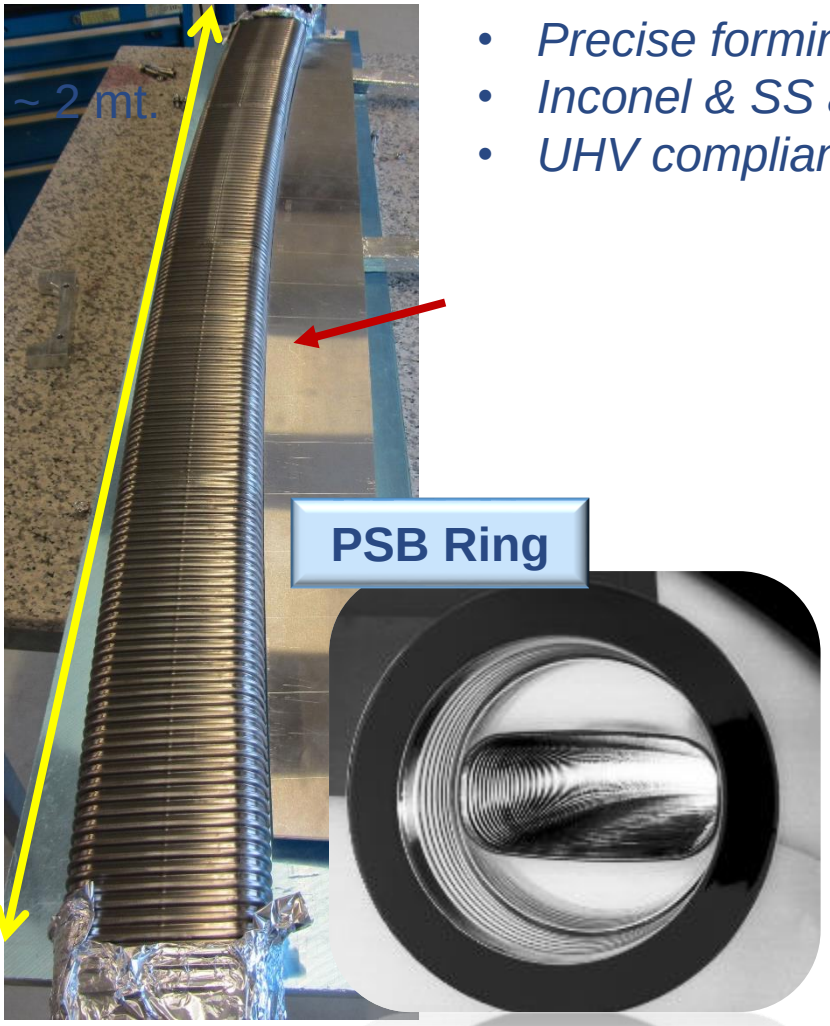
Pumping bypass for LHC



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

PSB Wire Scanner Vacuum Tank

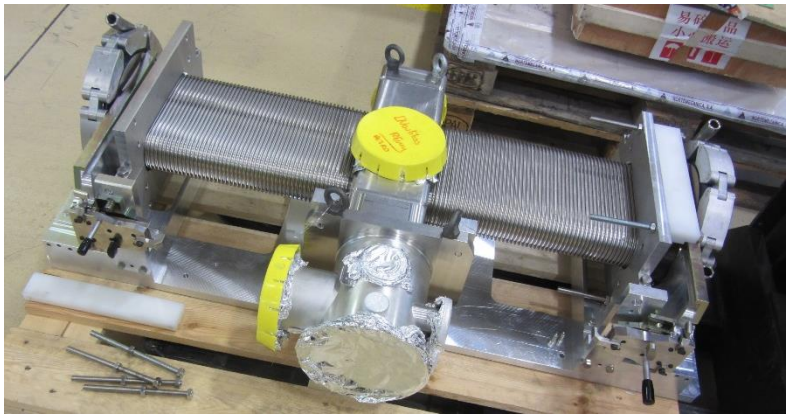
Vacuum Chambers



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

PSB Ring

PSB Injection



Hippodrome edge-welded bellows

Handling, Lifting Equipment, Heavy Structures

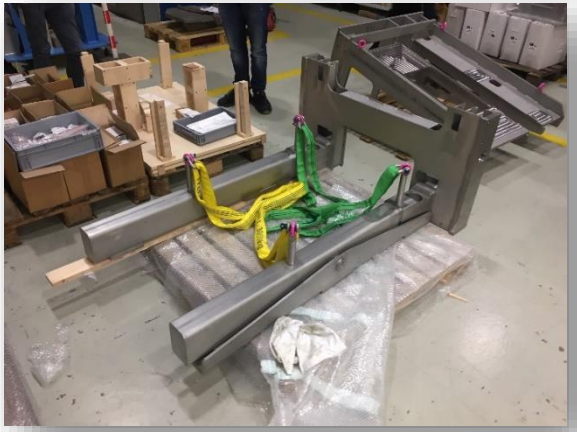
Handling Tools ATLAS

DUNE Support Structures

Lifting Equipment for WOW Cavity

Handling Tools ATLAS

AD Remote Handling Trolley

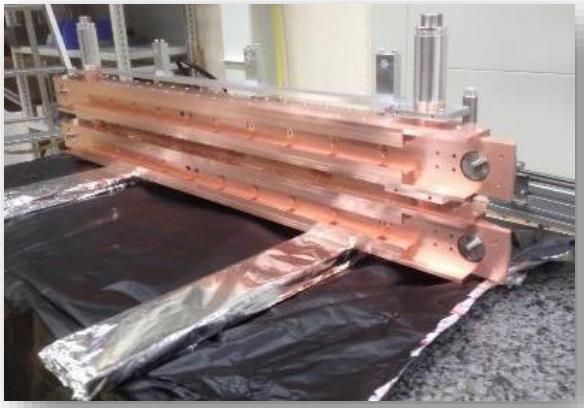


Always on the lookout for:
Precision Vacuum Components

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

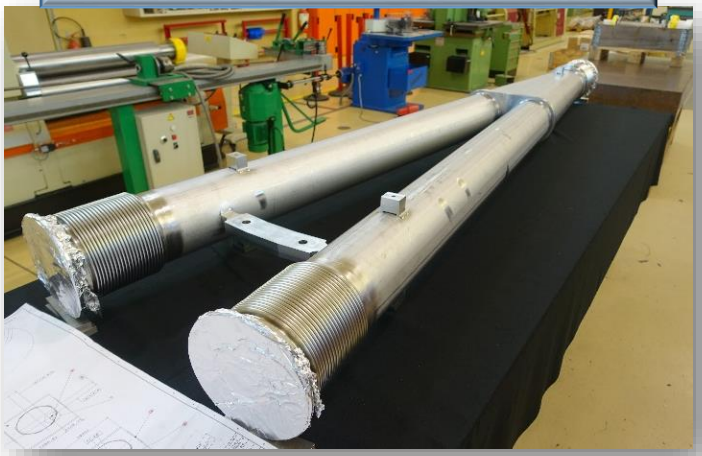
Materials:
- *Stainless Steel*
- *Inconel*
- *Titanium*
- *Aluminum*

Vacuum Vessels



Pulled-nozzle chambers

Y-chambers



Always on the lookout for: **Bellows**

…UHV, cryogenics, pressure equipment…

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

Edge-welded	Avg. per year (2014÷2017)	Peak year (2016)
Number of POs	13	15
Envelope (kCHF)	70	130

Hydroformed	Avg. per year (2014÷2017)	Peak year (2016)
Number of POs	18	30
Envelope (kCHF)	160	290

Always on the lookout for: **Plastics & Composites**

	Avg. per year (2014÷2017)	Peak year (2017)
Number of POs	115	160
Envelope (kCHF)	370	460

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

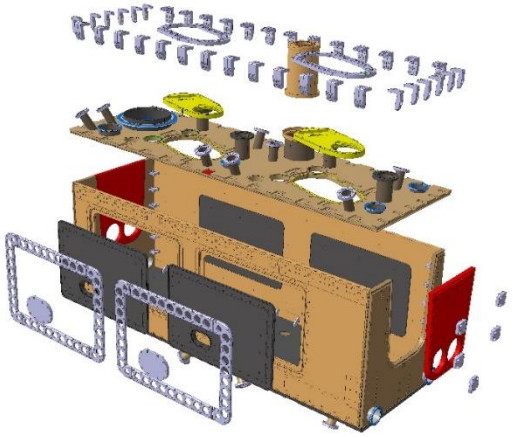
Materials:
- POM, PP, Plexi, PVC
- PE at different densities
- PEEK, PTFE, PVDF, VESPEL
- EPGCxxx

Some Upcoming Opportunities

Hi-Lumi Current Leads

Procurement of raw materials:

OFE Copper, 316LN stainless steel (bars, 3D forged blanks…)

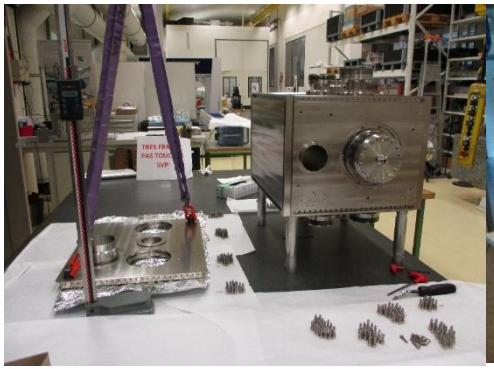


HL-LHC WP4 Vacuum Vessel *for DQW Pre-Series Cryomodule*

- **When**: Q4 2021
- **Manufacturing Technology** : Machining medium Size, GTAW welding, Ultra High Vacuum requirements, Stainless steel

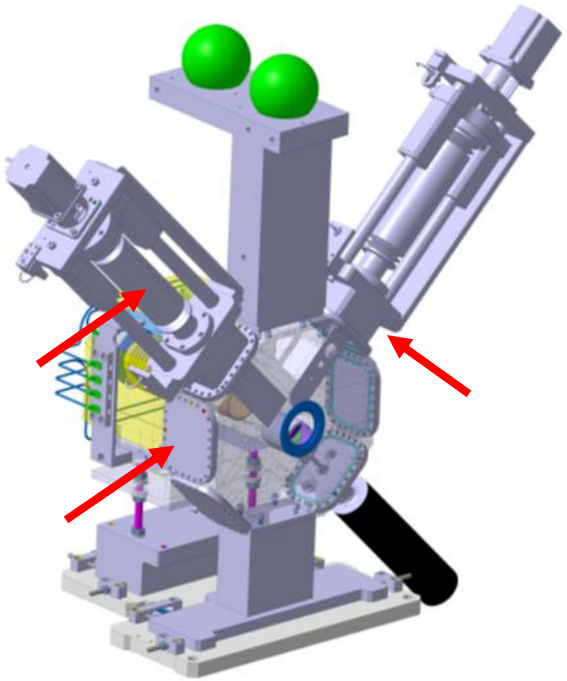
HL-LHC WP4 Titanium components for DQW Pre-Series Cryomodule

- **WHEN**: Q2÷Q4 2021
- **Manufacturing Technology** : Milling/Turning/Erosion of small/medium size Titanium parts



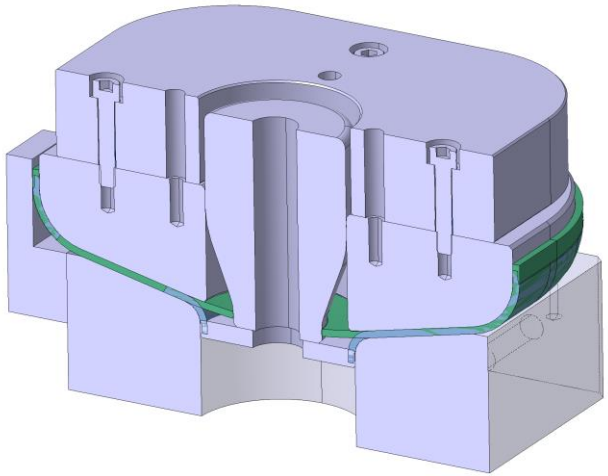
Beam Diagnostic Box for REX-ISOLDE

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



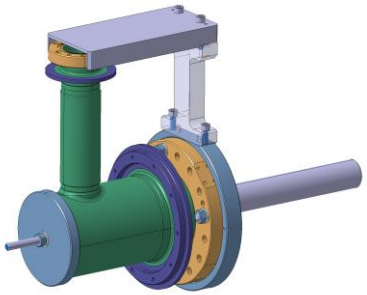
Crab Cavity End Cap Necking-Out Tool

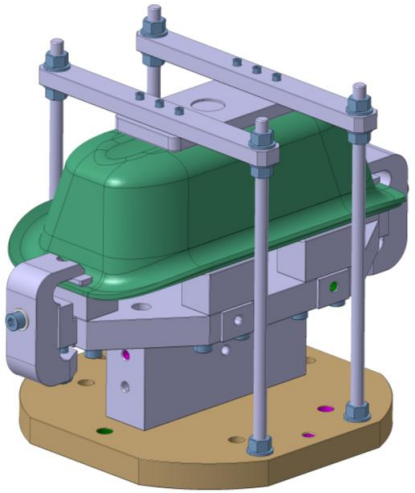
- High-quality finishing on a 3D-shaped surface from a block of tooling steel
- Raw material from supplier (W300 steel)

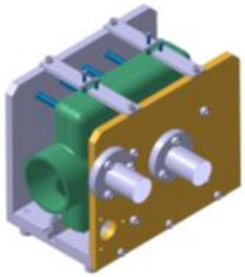


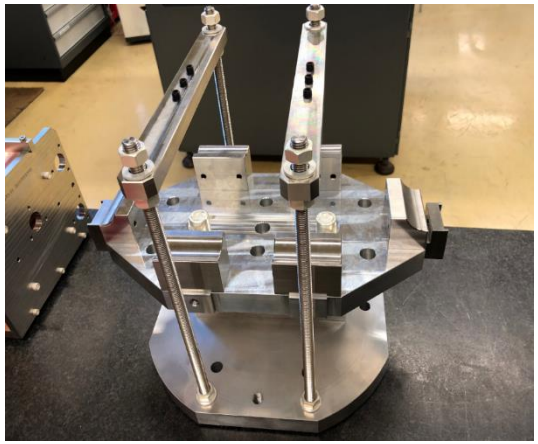
Crab Cavity Fabrication Tooling

- Custom tools for Electron Beam Welding of high-purity Niobium components
- Raw material from supplier



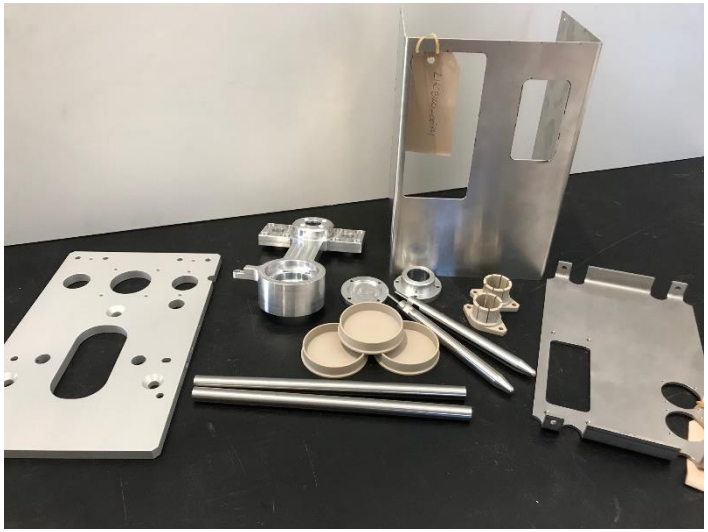






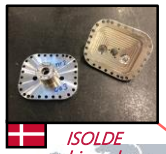
Various parts from DK

- Cryocooler chamber (cryo lab)
- PVDF parts (electric insulators)
- Aluminum and peek parts from BWS



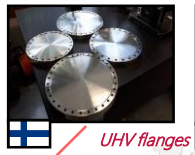
MME Subcontracting Service: industrial partners from all states…

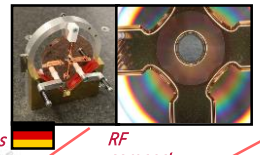

Cryo magnetic shield


ISOLDE hippodrome flanges


FAZIK magnet structure

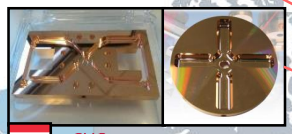

Polyamide expander


UHV flanges

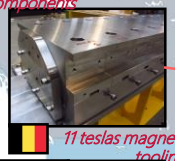

RF compact cavities


Hippodrome bellows


LHC wall bracket


CLIC components


LHCb supports


11 teslas magnets tooling


Hanging system for MQXFB


Electron beam welding tool

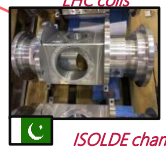
Brazed feedthrough


11T magnets aluminium frame


Contact plates for kickers tanks


Spacers for LHC coils


SPS aluminium pipes


ISOLDE chamber


CLIC components


Antimatter trap


RFD crab cavity calibration tool

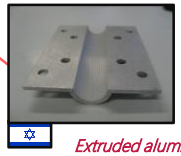

ISOLDE seamless cavity

Rotating table for coils assembly


ISOLDE diagnostic box


CMS structures


Cutting machine for LHC magnets


Extruded aluminium fixtures

MEMBER STATES
ASSOCIATE MEMBER STATES
OBSERVERS
OTHER STATES

Thank you for your attention!

For more info visit:
http://en.web.cern.ch/group/mme


CERN