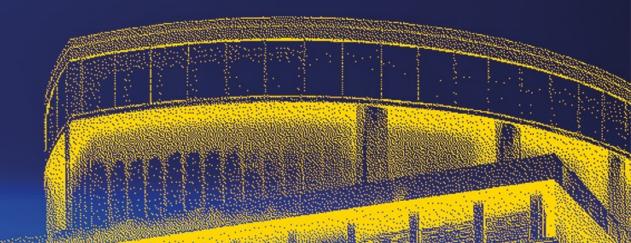


# SVEDISH BIGSCIENCE FORUM



# VACUUM AND CRYOGENICS



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# EUROPEAN SPALLATION SOURCE



# ESS Vacuum System Neutron Instruments

PRESENTED BY DR. MARCELO JUNI FERREIRA VACUUM SYSTEM GROUP LEADER - ESS ERIC

# Agenda



- 1 Introduction: ESS
- 2 ESS Vacuum
- 3 Neutron Instruments
- 4 Examples of experimental chambers

1

Introduction:
European
Spallation Source
(ESS)



## Neutron vision





Movie made by Neutron imaging and Activation Group, ICON Instrument.

Paul Scherrer Institute, CH

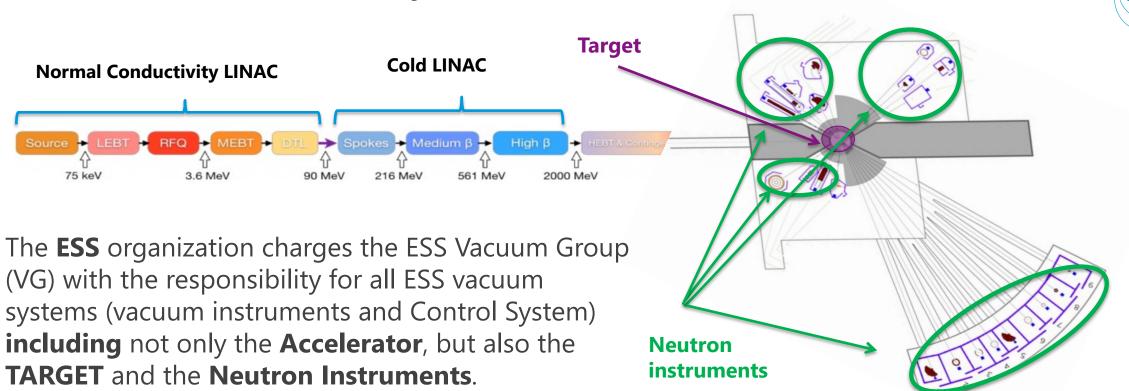
**MONOLITH TARGET WHEEL 2,5 M** TONNES When the accelerated prot PROTONS **5800 TONS NEUTRON BEAMS 4,9 TONS NEUTRONS TUNGSTEN EXPERIMENTAL HALL 1** 602,5 M LABS/OFFICES **ION SOURCE ACCELERATOR TARGET** SAMPLE **EXPERIMENTAL HALL 2 EXPERIMENTAL HALL 3 NEUTRON BEAMS HYDROGEN MOLECULE** EXAMPLE OF CAVITIES 96% OF SPEED OF LIGHT fields are used to generated and guided into the linear accelerator, the Linac. The first part INSTRUMENT PROTON BEAM protons hits the target wheel. MAGNETIC FIELD SUPERCONDUCTING RF **CAVITIES NEUTRONS BRING INFORMATION ABOUT THE MATERIAL'S ELECTROMAGNETIC FIELDS** STRUCTURE AND DYNAMICS (ON A MOLECULAR LEVEL). **ACCELERATE THE PROTONS** (VIA KLYSTRONS)

TARGET MONOLITH

2 ESS Vacuum

# ESS Vacuum System





The **goal** is to have **integrated design of the vacuum system**, common components, reduce maintenance and training, lower number of hardware spare parts, create scale to lower costs (Framework Agreements), simplify interfaces with other sub-systems (EX: ICS, MPS, PSS interface).

It means, support the in-kinds for Accelerator, Target, and Neutron Instrument to work on their specific needs looking from the ESS long term operation in a most cost effective way.

### Vacuum Standardization

### an Integrated Approach

- •Working closely with our partners across the project: our **primary goal** is to promote the use of **common vacuum solutions, equipment and standards**. As a result a Vacuum Standardization meeting was held in February 2014 where equipment suitable for Standardization was agreed and reflected in the **ESS Vacuum Handbook**.
- •An important element is the **Standardization of Procurement Policy** applied for the procurement of all "major" vacuum equipment. This policy ask the partners to participate on a single **Framework Agreement**.
- •The **ESS Vacuum documents** (handbooks, rules or interfaces documents) are the majors documents that covers the requirements for the accelerator, target and instruments and is applicable to all ESS in kind Partners.



Description: ESS Vacuum Handbook Part 1

Document No 0.

Date 23 May 2014

#### 1. INTRODUCTION

The European Spallation Source (ESS) is an accelerator-driven neutron spallation source. The linear accelerator (LINAC) of which is a critical component. The role of the accelerator is to create protons at the ion source, accelerates them to an appropriate energy, and steers them onto the target to create neutrons via the spallation process for use by a suite of research instruments.

#### 2. SCOP

The ESS Vacuum Handbook comprises four (4) parts:

ESS Vacuum Handbook Part 1 – General Requirements for the ESS Technical Vacuum Systems,

ESS Vacuum Handbook Part 2 - Vacuum Equipment Standardization,

ESS Vacuum Handbook Part 3 - Vacuum Design & Fabrication, and

ESS Vacuum Handbook Part 4 - Vacuum Test Manual

This Vacuum Handbook (VH) part 1 provides guidelines, and imposes requirements where necessary, for the definition of equipment and processes associated with the vacuum systems of the Accelerator, Target and Neutron Instruments. The VH is applicable to all vacuum components and systems exposed to a technical vacuum environment.

This VH, a level 2 requirement, is to ensure that consistent standards are employed throughout all the accelerator, target and neutron instrument vacuum systems and hardware.

This VH will be periodically updated throughout the life of the ESS project.

All queries or additional information concerning the contents of this handbook should be addressed to the ESS Vacuum Group Section Leader (VGL).

#### 3. REPONSABILITIES

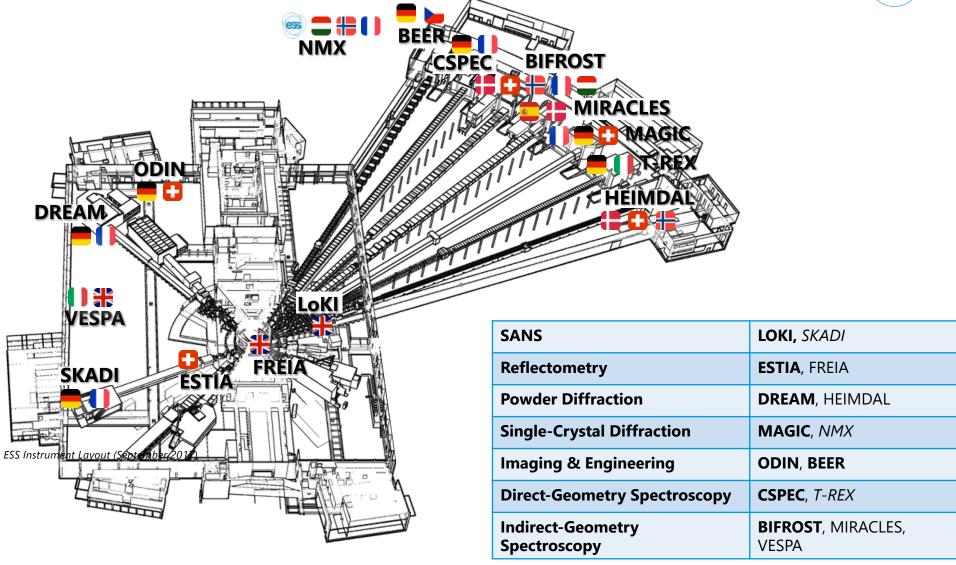
The ESS vacuum team has overall responsibility for all technical vacuum systems used on the Accelerator, Target and Neutron Scattering Instrument Systems and has

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# Neutron Instruments

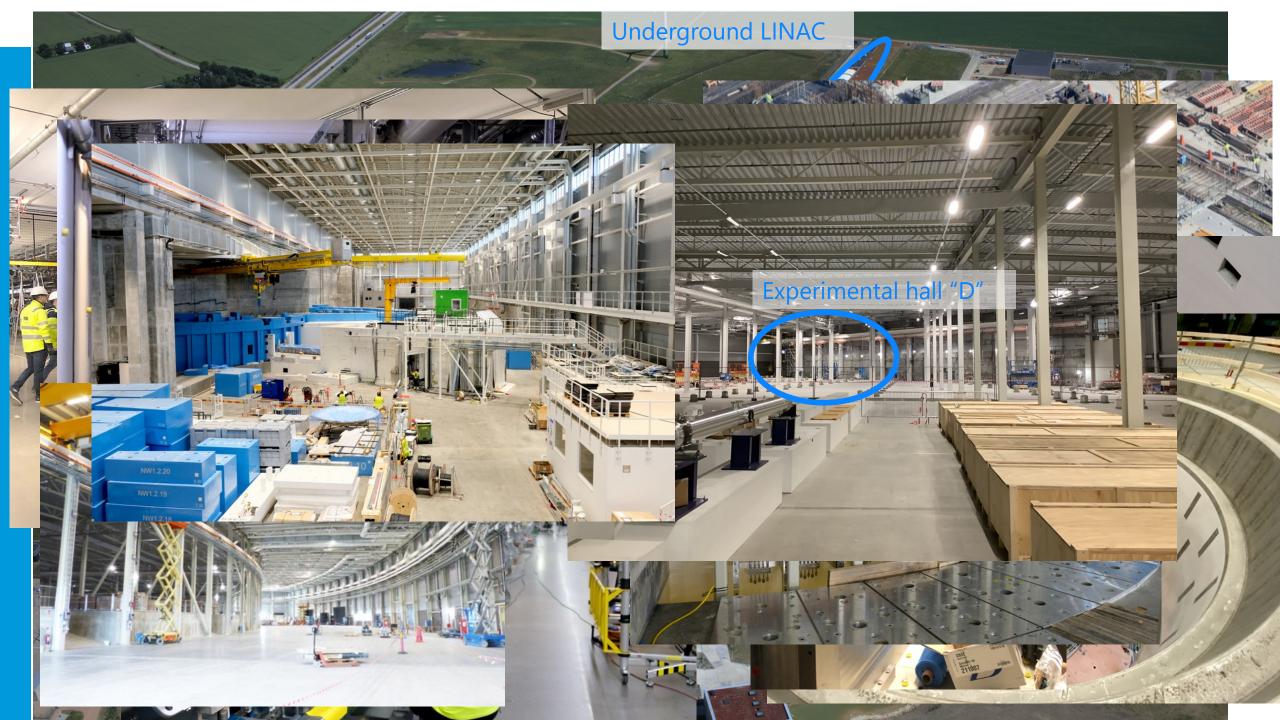
### Neutron Instrument Suite





4

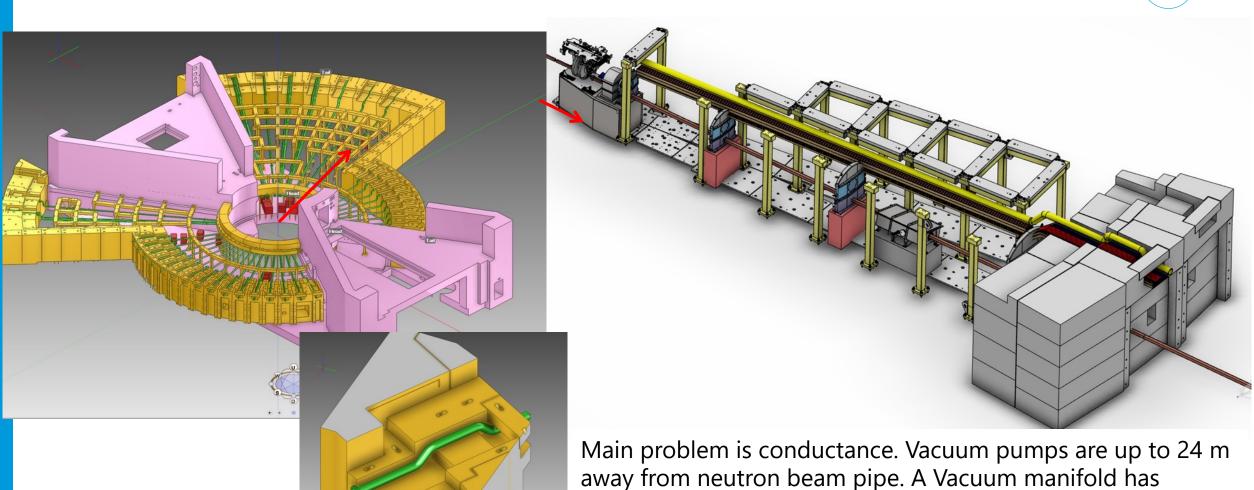
# Examples





# Vacuum Modeling Bunker



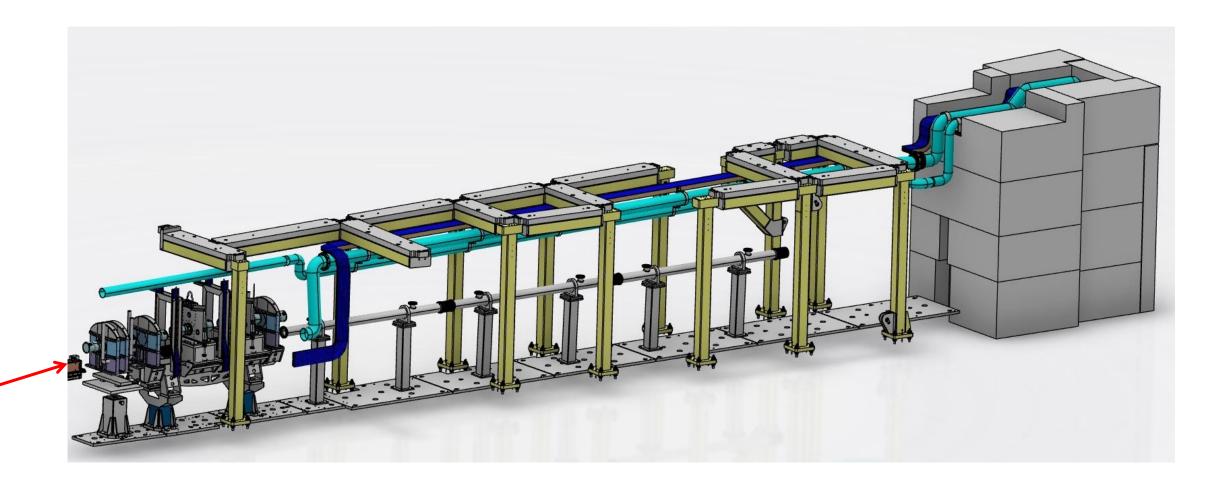


away from neutron beam pipe. A Vacuum manifold has limited space to go through the bunker wall. Vacuum specification equivalent to UHV, same as particle accelerators including material limitations on the chambers sealing due high activation by neutrons.

# Vacuum Modeling Bunker

### **BEER** instrument

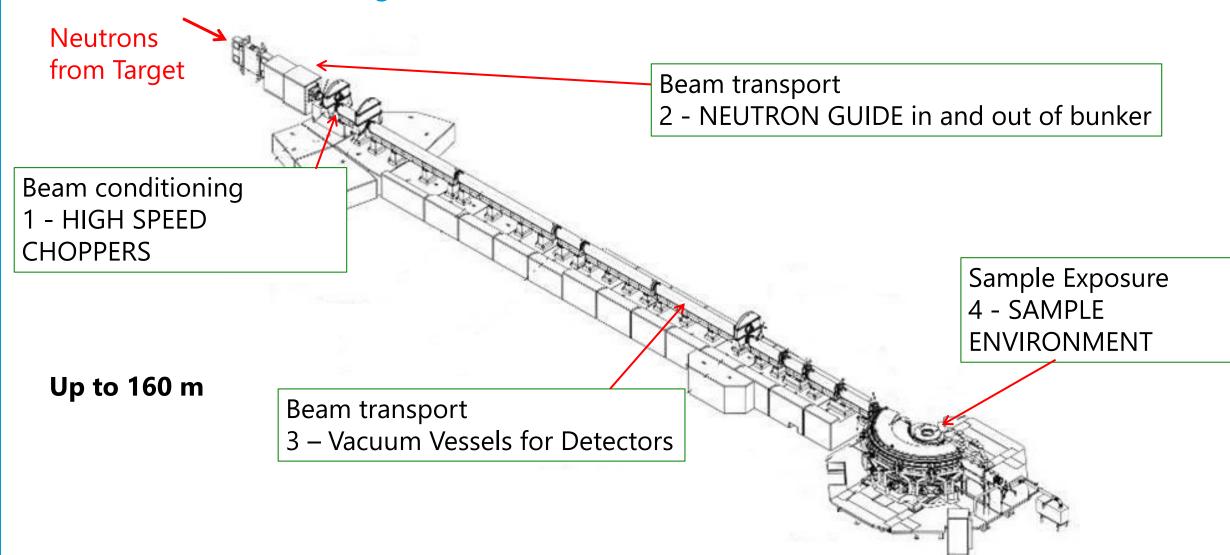




## Typical vacuum system Instruments

ess

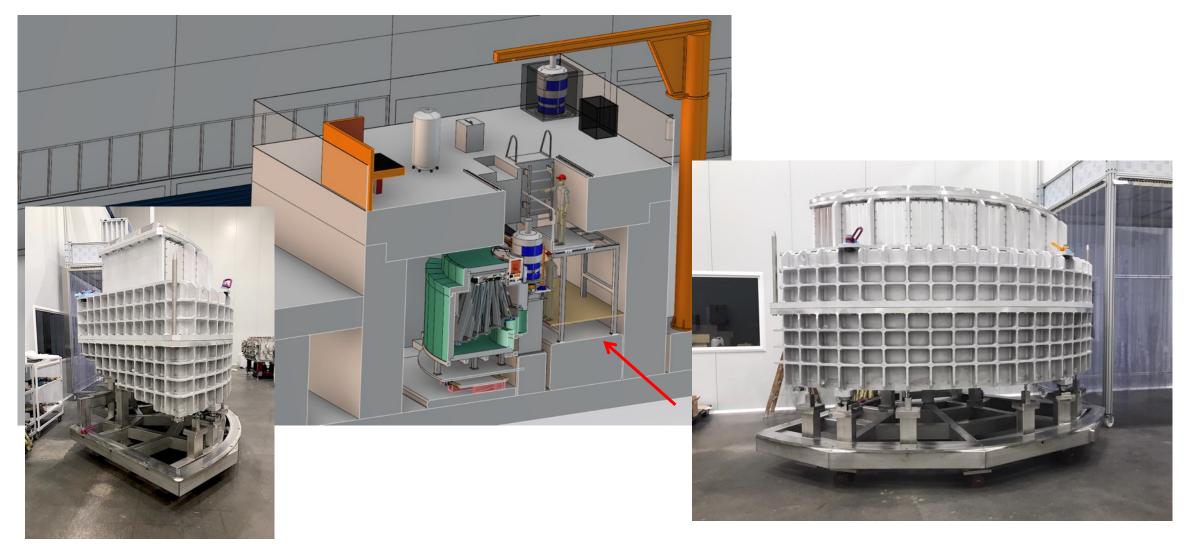
Sub-headline to strengthen the headline above



# Vacuum Modeling Experiment

### BiFrost instrument



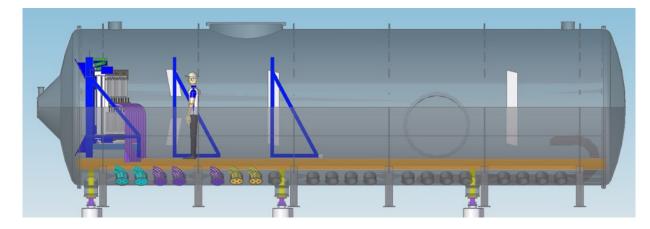


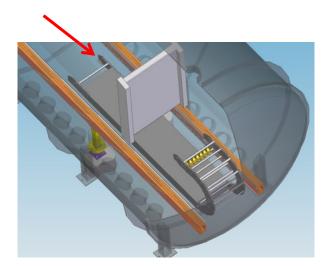
# Vacuum Modeling Experiment

LOKI instrument, similar to SANS at PSI





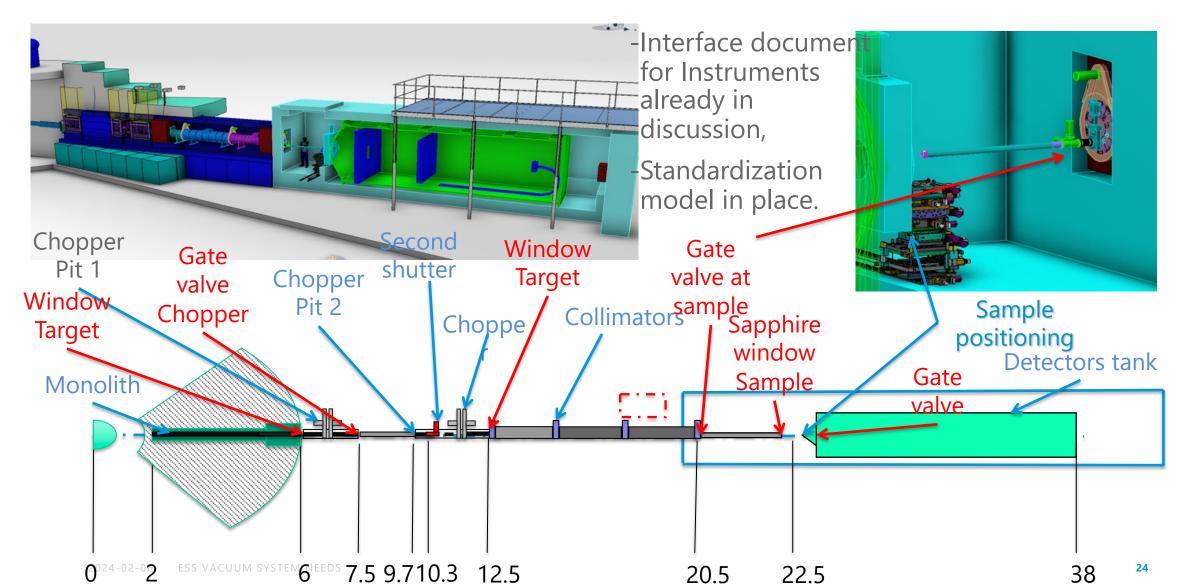






### LoKI – SANS Instrument









# Tack. Thank you.

Marcelo Juni Ferreira Vacuum Group Leader – ESS ERIC

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# VACUUM AND CRYOGENICS



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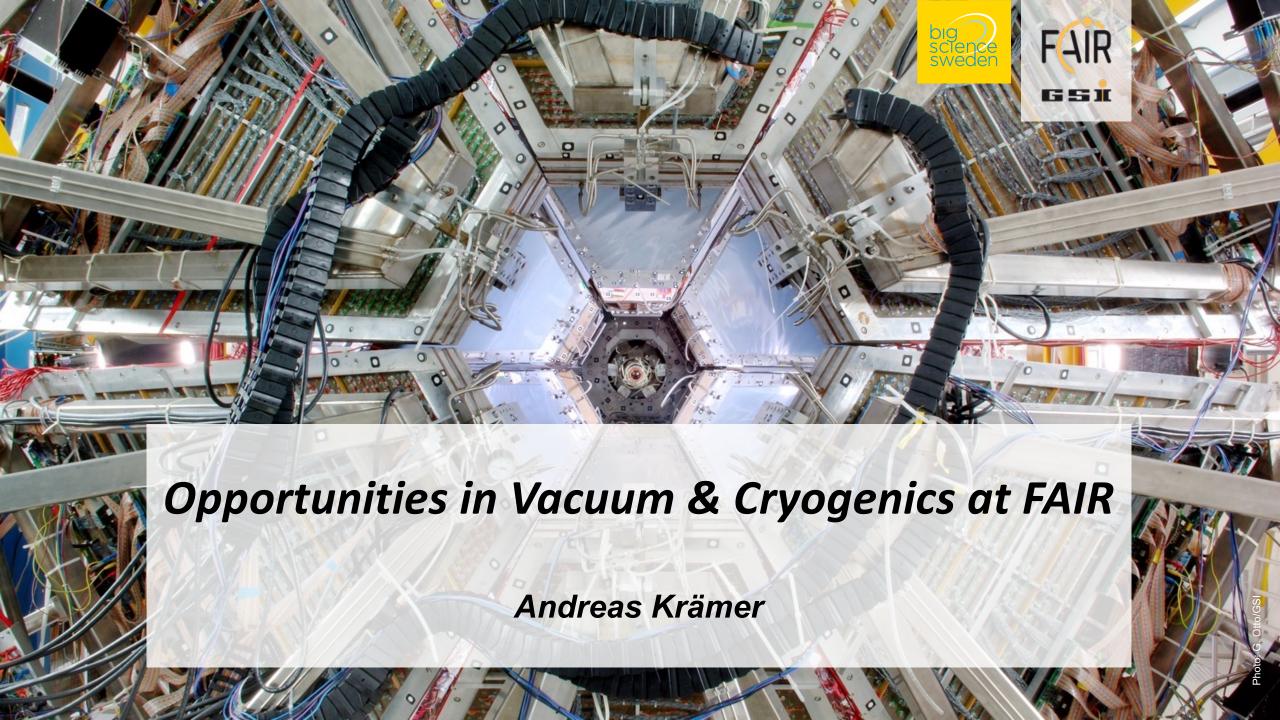
Head of Vacuum

Department

FAIR/GSI



Raúl Morón Ballester
Technical Project Officer
FUSION FOR ENERGY, F4E





### **FAIR Vacuum Requirements**

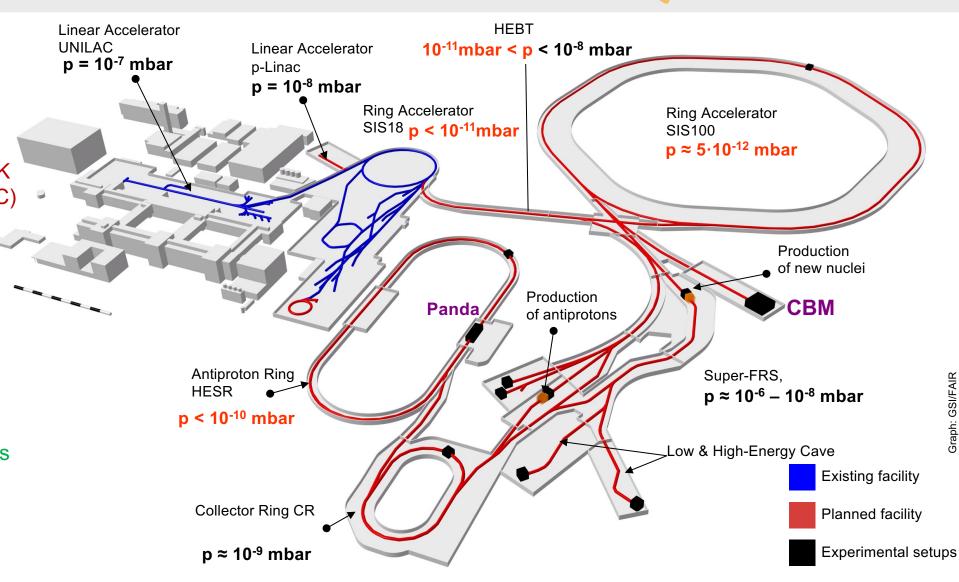
### Beam Vacuum System:

- Total length: ~ 3.9 km
- Volume: ~ 65 m<sup>3</sup>
- Vacuum: 10<sup>-6</sup> 10<sup>-12</sup> mbar
- Cryogenic sections with operating temperatures of 5-20 K
- Bakeable sections (up to 300°C)

operated at room temperature

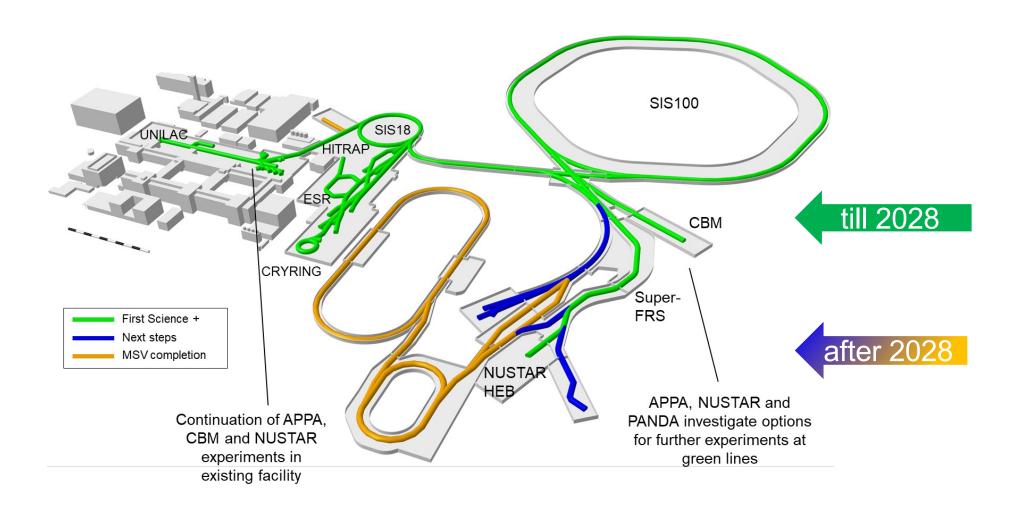
Insulation Vacuum System for superconducting magnets in SIS100 & SuperFRS and cryogenic transfer & bypass lines

- Total length: 2.8 km
- Volume: ~ 300 m<sup>3</sup>
- Vacuum: <10<sup>-6</sup> mbar





### **FAIR** stepwise approach towards MSV



### FAIR's vacuum procurement needs **HEBT: Special Chambers**



- Quantity needed: 2 pieces (First Science (FS)) / 3 pieces (FS+)
- Geometry: length ~2100 mm, height ~500mm, width ~500mm;
- Flanges: 4x DN160CF (two are pumping ports), 1x DN400CF

### Vacuum Properties

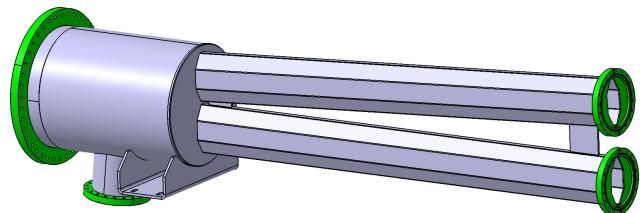
- Integral Leak rate ≤ 1 · 10<sup>-10</sup> mbar l/s
- Outgassing rate: ≤ 5 · 10<sup>-10</sup> mbar l/ s cm<sup>2</sup>
- Chamber: material according to EN 10088: 1.4304, 1.4404, 1.4306, 1.4429 or 1.4435 or higher quality
- Flange material: material according to EN 10088: 1.4301, 1.4306 or 1.4307 or higher quality
- Flange material pumping port according DIN EN 10088: 1.4429ESR
- Residual gas composition as acceptance criteria
- UHV suitable cleaning required
- non-bakeable

### Mechanical requirements:

- Check of welding seam according to DIN EN ISO 9712,
- quality class DIN EN ISO 5817 B
- Surface quality Rz=25

### Additional Request:

- Final design/engineering by manufacturer
- Vacuum, mechanical and magnetic requirements to be proven by FAT from manufacturer
- Full documentation of design/engineering and FAT tests



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# FAIR's vacuum procurement needs SIS100: Thin-Walled Magnet Chambers



### Cryogenic rib-reinforced quadrupole chambers with star-shaped cross section and LHe cooling tube circuit

- 8 pieces, two length types
- lengths: 1.5 m and 2m
- sophisticated chamber design
- star-shaped aperture: 140 mm x 140 mm
- thin-walled, thickness: (0.4 ... 0.5) mm
- material: stainless steel grades P506, 1.4404, 1.4435
- flanges: DN160CF; 1.4429 ESR
- $\mu_{rel} \le 1,01$  at room temperature
- LHe cooling tube circuit according to the requirements of the Pressure Equipment Directive (PED)
   2014/68/EU

### **UHV** requirements:

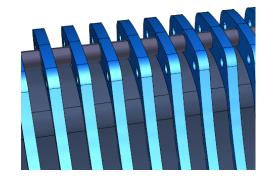
- integral leak rate: ≤ 1x10<sup>-10</sup> mbar l/s
- outgassing rate (after bake-out): ≤ 1x10<sup>-11</sup> mbar l/s/cm<sup>2</sup>
- UHV suitable cleaning
- bakeable up to 150 °C
- bake-out cycle at 150°C for acceptance test required

### Mechanical requirements:

- welding: ISO 9712, ISO 5817 B
- brazing: ISO 18279 level B
- surface quality:  $R_z$  < 6.3



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# FAIR's vacuum procurement needs SIS100: Magnet Chambers



### **Star-shaped Quadrupole chambers**

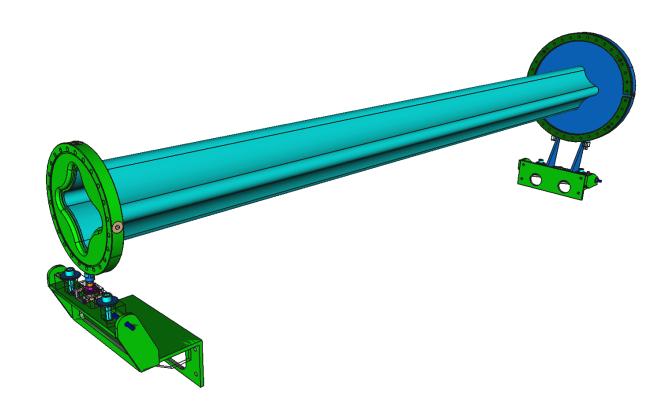
- 2 pieces
- length: 2.1 m
- star-shaped aperture: 164 mm x 164 mm
- wall thickness: 3 mm
- material: 1.4429, 1.4435
- flanges: DN200CF, DN350CF; 1.4429 ESR
- $\mu_{rel} \le 1,01$
- standard vacuum firing @ 950 °C
- NEG coating (TiZrV)
- thin (8-10 mm) bake-out jackets and chamber supports part of delivery

### **UHV** requirements:

- integral leak rate:
  - $\leq$  1x10<sup>-10</sup> mbar l/s
- outgassing rate (after bake-out):
  - $\leq 1x10^{-12}$  mbar l/s/cm<sup>2</sup>
- UHV suitable cleaning
- bakeable up to 300 °C
- bake-out cycle for acceptance test required

### Mechanical requirements:

- welding: ISO 9712, ISO 5817 B
- surface quality: R<sub>z</sub> = 10 μm



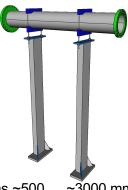
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### FAIR's vacuum procurement needs SIS100: Straight Tubes / Bellows



### Straight beam pipes



- ~ 25 pieces
- ~ 5 types with different lengths ~500 ... ~3000 mm
- round tube DN160
- wall thickness: 2 mm
- material: 1.4306, 1.4307, 1.4404, 1.4429, 1.4435
- flanges: DN160CF, DN200CF; 1.4429 ESR
- standard vacuum firing @ 950 °C
- bake-out jackets and chamber supports part of delivery

#### **UHV** requirements:

- integral leak rate:
  - $\leq$  1x10<sup>-10</sup> mbar l/s
- outgassing rate (after bake-out):
  - $\leq 1x10^{-12}$  mbar l/s/cm<sup>2</sup>
- UHV suitable cleaning
- bakeable up to 300 °C
- bake-out cycle for acceptance test required

### Mechanical requirements:

- welding: ISO 9712, ISO 5817 B
- surface quality:  $R_z = 10 \, \mu \text{m}$

### **Bellows**



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- ~ 50 pieces
- ~ 10 types with different lengths: ~100 ... 300 mm
- DN160, corrugated (hydroformed), single-walled, wall thickness 0.3 mm
- material: 1.4404, 1.4406, 1.4435, 1.4541, 1.4571
- flanges: DN160CF, DN200CF;
  - 1.4429 ESR
- standard vacuum firing @ 950 °C (bellows @ 500 °C)
- bake-out jackets part of delivery

### **UHV** requirements:

- integral leak rate:
  - $\leq 1x10^{-10} \text{ mbar l/s}$
- outgassing rate (after bake-out):
  - $\leq$  1x10<sup>-12</sup> mbar l/s/cm<sup>2</sup>
- UHV suitable cleaning
- bakeable up to 300 °C
- bake-out cycle for acceptance test required

#### Mechanical requirements:

- welding: ISO 9712, ISO 5817 B
- surface quality:  $R_z = 10 \, \mu \text{m}$

### **Bellows for cryogenic sections**



- ca. 120 pieces
- ca. 5 types with different lengths: ~ 100 ... 300 mm
- DN160, corrugated (hydroformed), single-walled, wall thickness 0.3 mm
- material: 1.4404, 1.4406, 1.4435, 1.4541, 1.4571
- flanges: DN160CF; 1.4429 ESR
- no vacuum firing required
- no bake-out jackets required

#### **UHV** requirements:

- integral leak rate:
  - $\leq$  1x10<sup>-10</sup> mbar l/s
- outgassing rate (after bake-out):
  - $\leq 1x10^{-12}$  mbar l/s/cm<sup>2</sup>
- UHV suitable cleaning
- operational temperature: < 20 K
- bake-out cycle for acceptance test required

#### Mechanical requirements:

- welding: ISO 9712, ISO 5817 B
- surface quality:  $R_z$  < 6,3 µm

# FAIR's vac procurement needs: SIS100: Cold Warm Transitions (BV-CWTs)



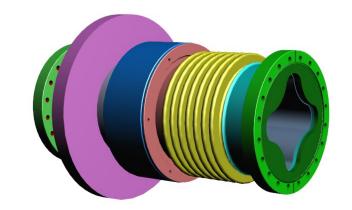
- ~ 50 pieces
- 9 types
- Length: ~0.5 m
- Elliptically/star-shaped aperture of inner tube: 133 x 65 mm<sup>2</sup>
- Chamber material according to EN 10088: 1.4306, 1.4307, 1.4404, 1.4429 or 1.4435
- Corrugated (hydroformed) round bellows, single-walled, wall thickness ~0.3mm
- Bellow material according to EN 10088: 1.4404, 1.4406, 1.4435, 1.4541, 1.4571
- Flanges DN160CF, material according to EN 10088: 1.4429 ESR
- Additional Helicoflex type seal
- Bake-out jackets (on warm side) part of delivery

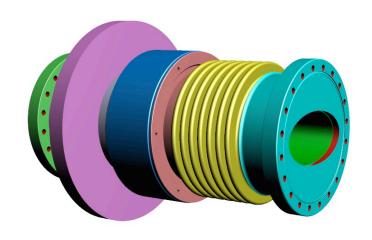
### Vacuum requirements:

- Integral leak rate ≤ 1x10<sup>-10</sup> mbar l/s
- Outgassing rate (after bake-out) ≤ 1x10<sup>-12</sup> mbar l/(s cm<sup>2</sup>)
- Operational temperature (on cold side) < 20 K</li>
- UHV suitable cleaning
- Bakeable up to 300°C
- Bake-out cycle for acceptance test required

### Mechanical requirements:

- Check of welding seams according to ISO 9712, quality class ISO 5817 B
- Surface quality Rz<6.3



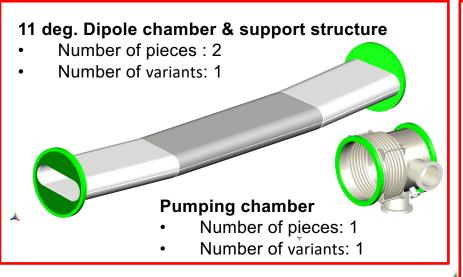


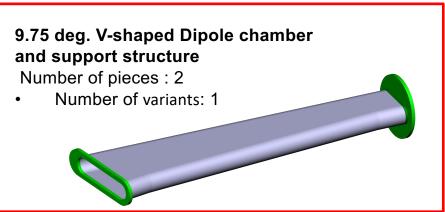
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### FAIR's vacuum procurement needs **SFRS: SC Dipole Chambers**

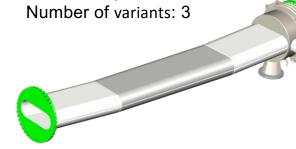






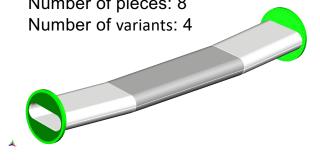
### 9.75 deg. Dipole chamber with Integrated pumping chamber and support structure

Number of pieces: 6



### 9.75 deg. Dipole chamber without Integrated pumping chamber and support structure

Number of pieces: 8



### **Vacuum requirement**

Ultra high vacuum, outgassing rate 1x10<sup>-9</sup>mbar l/s cm<sup>2</sup>, leak rate 1x10<sup>-9</sup>mbar l/s

### **Material Properties (Required magnetic permeability)**

### **Chamber body**

Required relative magnetic permeability < 1.01

### **Flanges**

Required relative magnetic permeability: < 1.05

DN400CF

Material: DIN EN10088: 1.4306, 14307 or higher quality

Racetrack/rectangular flanges

Type: metallic sealing (e.g. HELICOFLEX)

### **Support structure**

Parts of dipole vacuum chamber support structure placed at a distance from yoke edge larger than magnetic gap: < 1.05 Parts of dipole vacuum chamber support structure placed at a distance from yoke edge less than magnetic gap: < 1.01

### Following material can be provided by FAIR/GSI Stainless steel 1.4429 ESU Sheets

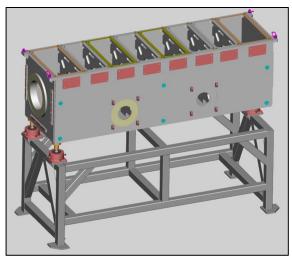
Size: 10 mm thick plates of 200 cm × 100 cm Size: 8 mm thick plates of 200 cm × 100 cm Size: 6 mm thick plates of 200 cm  $\times$  100 cm

# FAIR's vacuum procurement needs SFRS: Focal plane chambers



Nomenclature	Maximum	Evaluated weight, (without inserts)
	length× width× height	
	mm³	Kg
FPF2DK1	3460×960×1130	2800
FPF3DK1	1034×960×970	900
FMF2DK1	2434×960×970	2100
FMF2DK2	1040×960×970	1000
FMF2DK3	2276×960×1130	2000
FMF3DK1	1000×960×970	900
FHF1DK1a	634×1000×960	600
FHF1DK1b	1514×960×970	1200
FHF1DK2	3460×960×1130	2800
RefDK1	2434×960×970	2100
RefDK2	2434×960×970	2100





Vacuum requirement: Ultra high vacuum, outgassing rate 1x10<sup>-9</sup>mbar l/s cm<sup>2</sup>, leak rate 1x10<sup>-9</sup>mbar l/s

Number of Items: 11, Variants: 11

Additional items: Support frame for each chamber, Set of blind flanges

**Material requirement:** 

stainless steel of any type (without specified magnetic permeability) such as 1.4301, 1.4306, 1.4307, 1.4404,1.4435 or

1.4429. (must follow DIN EN 10088)

Task for the contractor: Design, Production

**Comments:** 

- Thick top plate required: approximately 40 mm
- High requirements on overall flatness of the top plate (0.1 mm)

# FAIR's vacuum procurement needs SFRS: Other Beam vacuum elements

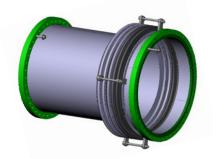


### **Material:**

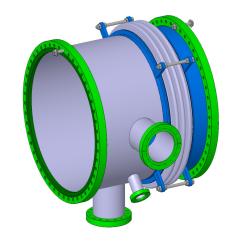
stainless steel of any type (without specified magnetic permeability) such as 1.4301, 1.4306, 1.4307, 1.4404, 1.4435 or 1.4429. (must follow DIN EN 10088)

### **Vacuum Requirements:**

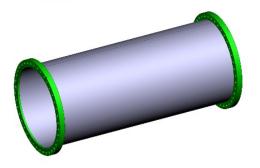
- outgassing rate 1x10<sup>-9</sup>mbar l/s cm<sup>2</sup>
- leak rate 1x10<sup>-9</sup>mbar l/s,
- special RGA acceptance criteria



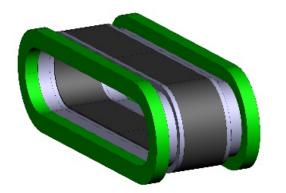
Hydroformed bellows
One fixed and one rotatable
DN400CF flanges



Pumping chambers: DN400 pipes with one fixed and one rotatable DN400CF flanges
Hydroformed bellows
2 × DN150CF ports
1 × DN40CF port



Beam pipes: DN400 pipe One fixed and one rotatable DN400CF flanges



Race track bellows Edge-welded type 680mm X 140 mm Helicoflex type flanges

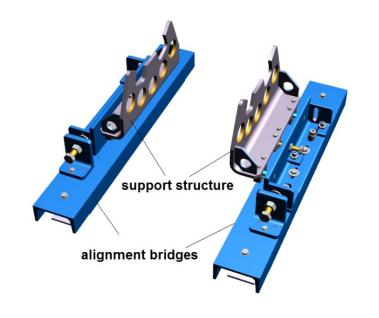
### FAIR's vacuum procurement needs SFRS: Beam vacuum elements supports

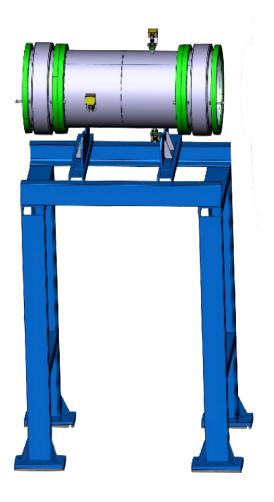


#### Number of supports (of various types): 25

- Constructional steel grade: (DIN) EN 10025-2
- Design: Hollow sections accordance with (DIN) EN 10210-2 and (DIN) EN 10219-2.



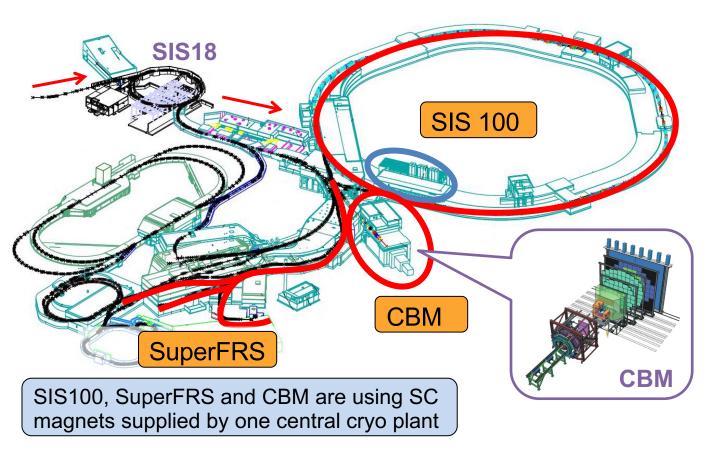


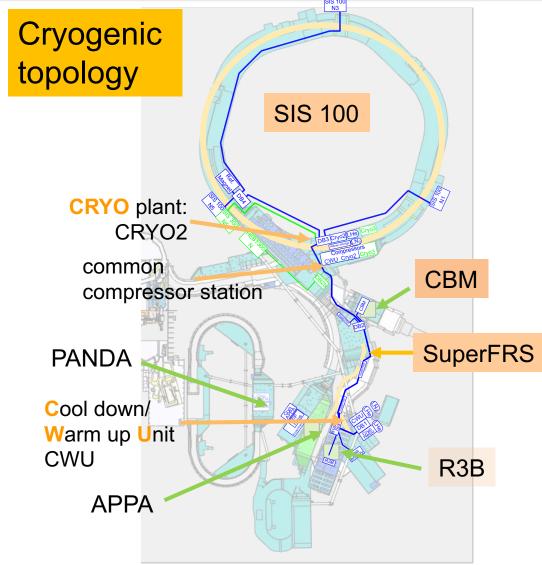




#### **FAIR Cryogenics Overview**

#### Major FAIR Cryogenic Users





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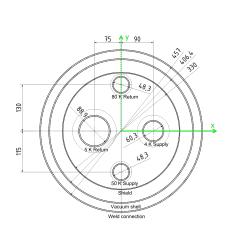
### FAIR's Cryogenic Procurement Needs SFRS Local Cryogenics

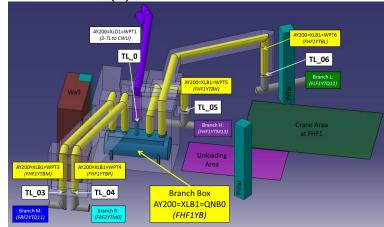


#### Transfer lines of branch B – central link

Branch B is the central distribution Branch of the Super-FRS Helium Cryogenic system: **Three Transfer Lines** connect the Branch Box to the neighbouring branches (incl. installation). A fourth line supplies GLAD.

- Three pieces of vacuum-insulated helium cryogenic transfer lines
  - 62 m total length
  - Vacuum jacket DN 400
  - Active thermal shield
  - 4 process headers (DN80, DN50, DN40, DN40)
  - Design Pressure PS = 20 bar(a)





Branch B of Super-FRS Local Cryogenics system: 3 Transfer Lines (yellow) connect the Branch Box to neighbouring Branches (M, R, L)

#### Transfer line branch box - GLAD (R3B) Early Sciene

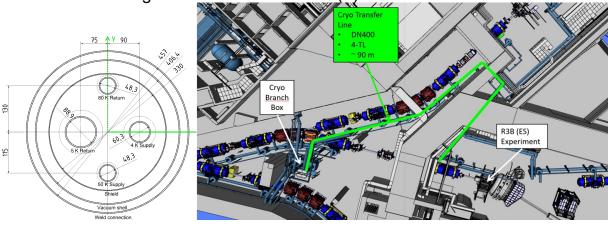
The GLAD magnet is also supplied via the branch box. Due to radiation protection, there is no direct routing, but a complicated meandering.

- one vacuum-insulated helium cryogenic transfer lines
  - 90 m total length

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- Vacuum jacket DN 400
- Active thermal shield
- 4 process headers (DN80, DN50, DN40, DN40)

Design Pressure PS = 20 bar(a)



Transfer line from BB to GLAD magnet

### **FAIR's Cryogenic Procurement Needs SFRS Local Cryogenics**



#### **Capillary Piping for remote pressure sensors**

Cryogenic Valve Boxes located in the Super- FRS beam tunnel are exposed to radiation

Sensitive pressure sensors need to be placed remotely on racks in service rooms

- Connections to:
  - 63 Feed Boxes, 7 End Boxes, 1 Branch Box
  - 22 remote racks, to host the pressure sensors
- ~500 capillary pipes required
  - → 6x1 mm (stainless steel or copper)
  - → 20-100 m individual lengths
  - → in total ~16 km of piping
  - → Design Pressure PS = 20 bar(a)
  - → Incl. design, production and installation

#### **Cryogenic North-South-Link**

About 200 m of cryogenic helium transfer line DN500 (vacuum insulated with 4 inner process lines: 4K supply/return, 50 K supply/return), one vacuum insulated line DN 200, three warm gas lines PN20 with DN100, DN150, and DN300

Cryogenic distribution box DB2 build as two connected valve boxes including 4K recooler

#### Requirements:

- Design along predefined installation space according to 3D model
- Maximum allowed pressure drop and heat load given

#### Additional Request:

Complete design/engineering by manufacturer

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- Vacuum and mechanical requirements to be proven by FAT from manufacturer
- Full documentation of design/engineering and FAT tests
- Complete installation of the system on the FAIR construction site, finalized by vacuum/welding tests as SAT



### **FAIR's Procurement Needs**

#### Misc.



There will be more to come in the next years, like

- Dry roughing pumps
- KF-parts
- Small valves for venting
- CF-parts like blank flanges, adapter flanges, ...
- Bake-out jackets
- •

FAIR GmbH Purchasing Department: https://fair-center.eu/business-partners/purchasing-department

Current call for tenders can be found at: https://www.gsi.de/en/start/business\_industry



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## VACUUM AND CRYOGENICS



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Vacuum Group Leader
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Head of Vacuum

Department

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Technical Project Officer
FUSION FOR ENERGY, F4E

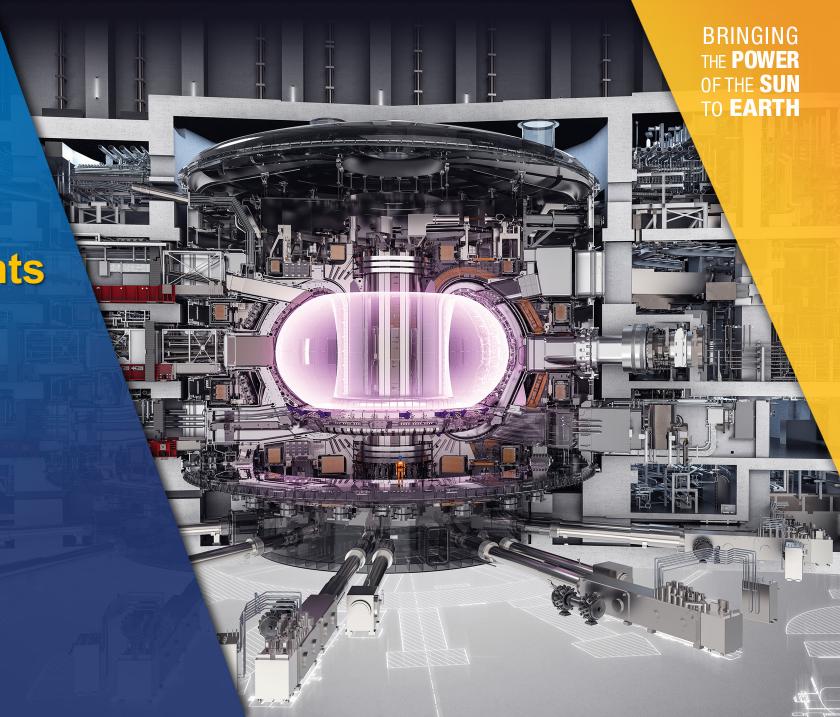


Vacuum components at ITER

Raúl Morón Ballester

Fusion for Energy (F4E)

**14 November 2023** 



#### **Outlook**



- Context
- Vacuum at ITER Main figures
- Examples of Vacuum components (upcoming tenders)
- Questions?

#### **Context – What is F4E?**



- European Joint Undertaking set up for 2007-2042
- Composed of 28 Member States (EU27 + Switzerland) + Euratom
- Headquarters: Barcelona, Spain

Offices: Cadarache, France

Garching, Germany Rokkasho, Japan

- Members of staff: 460 (mostly engineers)
- Budget: €6600m 2007-2020 (2008 values)
   €6070m proposed for 2021-27 (current values)

GOAL: To deliver EU contributions to ITER (45.6% of ITER) & three other fusion projects







DEMO

\* Credits: Samuli Heikkinen (F4E)

#### **Context – F4E contribution to ITER**



#### F4E contributions to ITER (45.6%) involve a wide range of cutting edge technologies











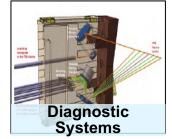














\* Credits: Samuli Heikkinen (F4E)

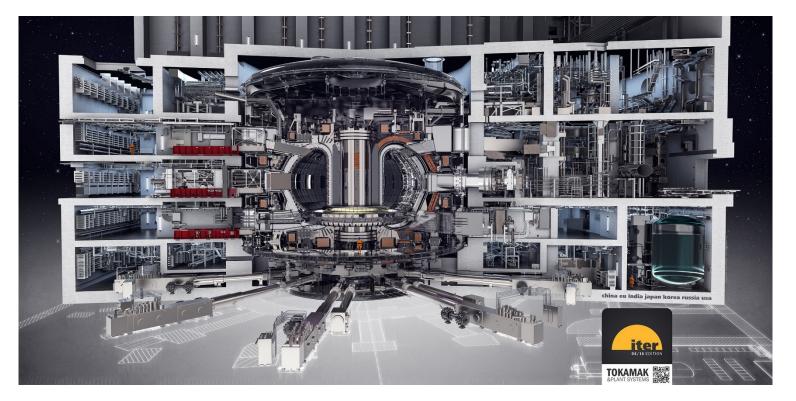
#### **Context – What is ITER?**



- World's biggest fusion energy research project, being designed and built by 7 members.
- Objective: to demonstrate the scientific and technological feasibility of fusion power.
- Being built in Cadarache, France.









#### Why do we need vacuum at ITER?

#### **Cryostat**

Insulate the cryogenic (4.5K) superconducting magnet system

#### **Cryogenic Guard Vacuum System**

Insulate cryo-lines, feeders, cryogenic valve box, etc.

#### Vacuum Vessel (plasma chamber)

- Minimize gases which are not the intended plasma fuel or gas
- Provide an environment where fuel can be ionized to form plasma
- Provide active gas and dust confinement
- Provide part of the fuel cycle directing the exhaust for processing

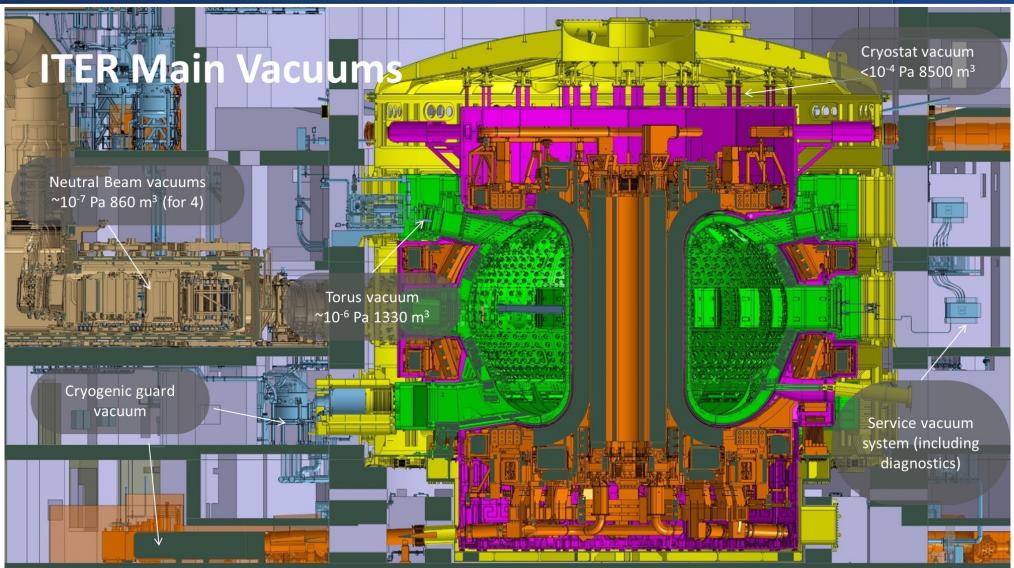
#### **Neutral Injection System**

Provide a gas-free path for energetic neutrals to the plasma

ECRH, ICRH, Diagnostics (various functions)

\* Credits: Robert Pierce (ITER)





\* Credits: Robert Pierce (ITER)



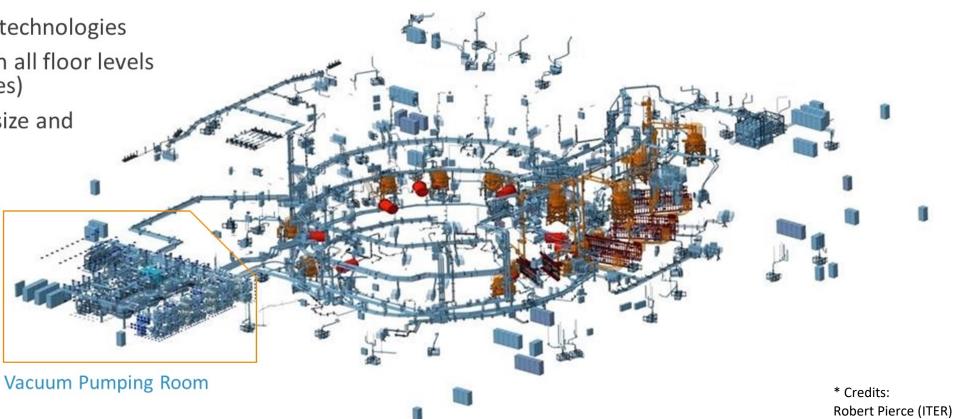
### ITER vacuum systems excluding main vessels

contain 18 large cryopumps and ~ 300 mechanical pumps

use over 10 different technologies

 extend to and through all floor levels (10 km of vacuum lines)

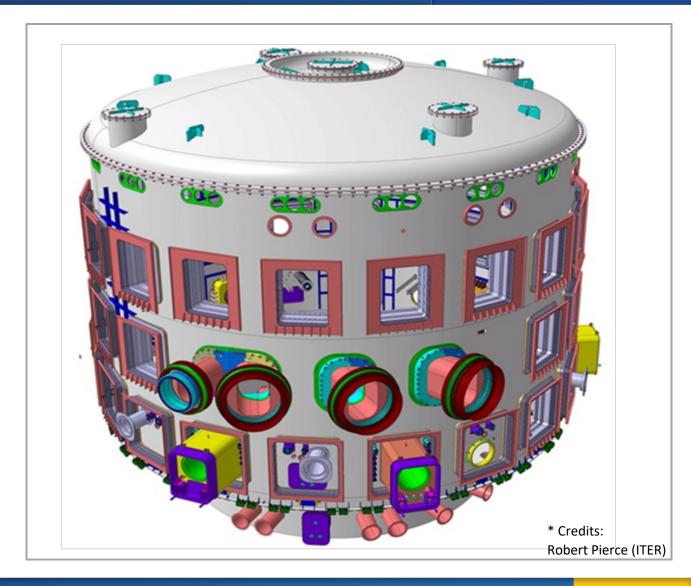
are first-of-a-kind in size and complexity





### The ITER cryostat

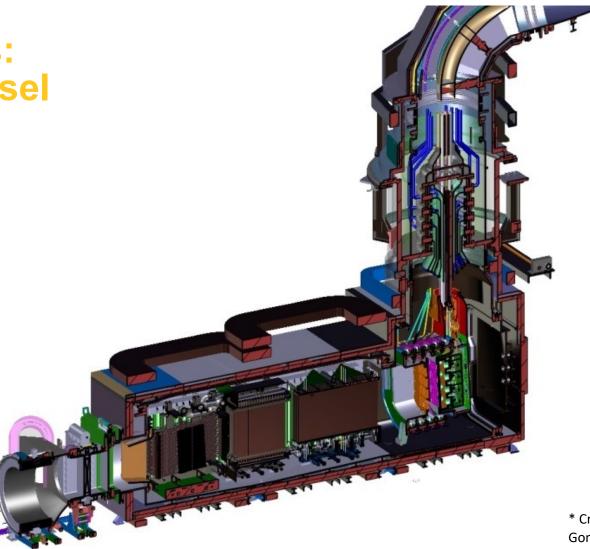
Design base pressure	1×10 <sup>-4</sup> Pa
Cryostat pumping system	Two cryo-sorption pumps cooled by supercritical helium
Required leak rate of completed Cryostat (including inside components)	≤ 1×10 <sup>-4</sup> Pa*m³/s
Cryostat surface area	~3400 m²
Interior free volume	~8500 m³
Interior total volume	~16000 m³





### Vacuum containment systems: Neutral Beam Vacuum Vessel

Design base pressure	1×10 <sup>-7</sup> Pa
Required leak rate of completed Cryostat (including inside components)	≤ 2×10 <sup>-9</sup> Pa*m³/s
Interior free volume	~860 m³



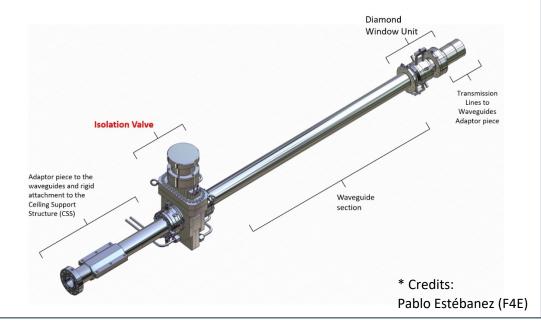
\* Credits: Gonzalo Micó (F4E)



### **Isolation systems: Valves**

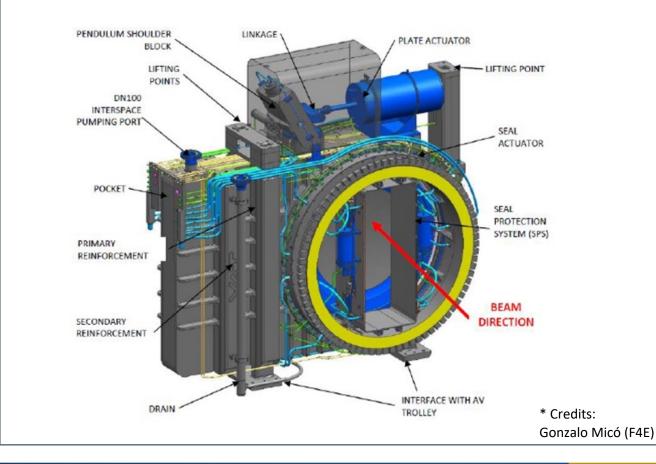
#### **Isolation Valve for Electron Cyclotron Heating system:**

- 50mm opening diameter
- 3 s for vacum closure
- 1 s for optical closure



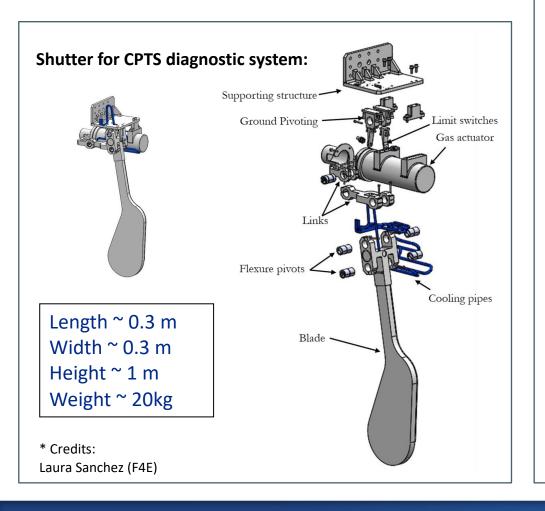
#### **Isolation Valve for Neutral Beam Heating system:**

- Almost 2m of opening diagonal
- More than 8000 kgs of total weight





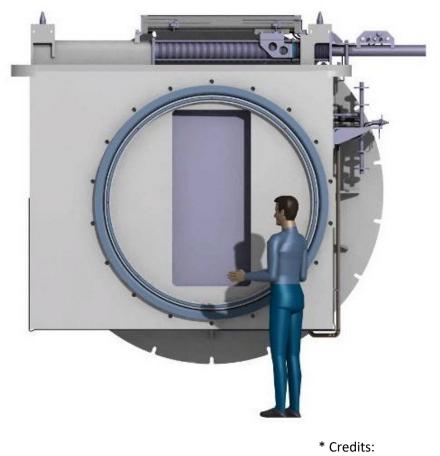
### **Isolation systems: Shutters**



#### **Shutter for Neutral Beam Heating system:**

Length  $\sim$  0.7 m Width  $\sim$  3.3 m Height  $\sim$  2.8 m Weight  $\sim$  13.1 t

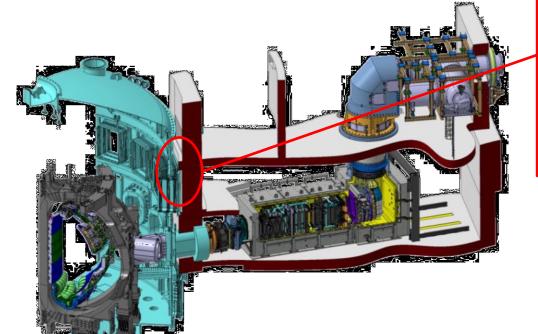




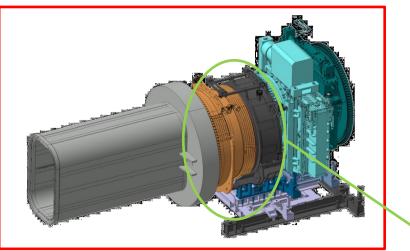
Gonzalo Micó (F4E)



#### **Neutral Beam Drift Duct:**

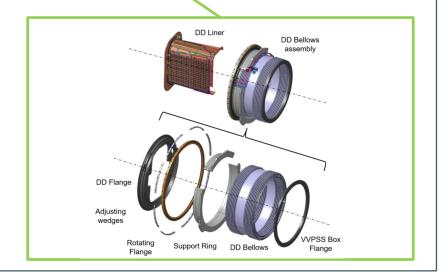


DRIFT DUCTmass (Kg)materialDD bellows4338316LDD liner1960CuCrZr



Target CFT: Q2-Q3 2024

•Skills: Nuclear component manufacturing, High Vacuum, Stainless Steel welding, Brazing of S.S pipes over the CuCrZr plates, NDTs, EBW of CuCrZr.



\* Credits:

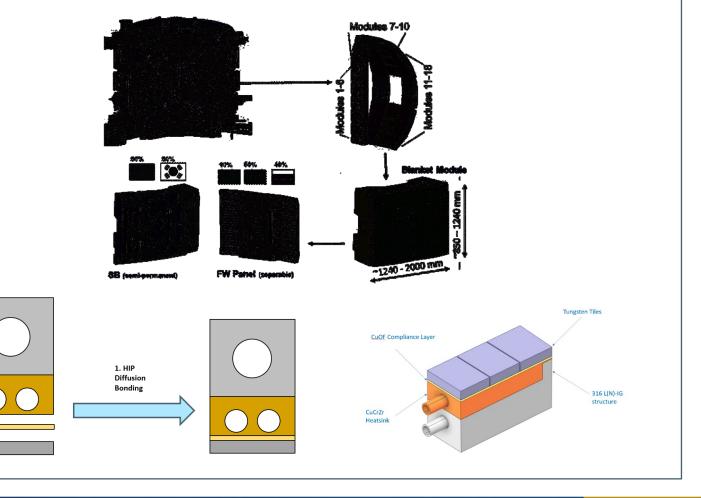
Gonzalo Micó (F4E)

SSt/CuCrZr\_ structure



### Components within the vacuum: Tungsten tiles

- •W tiles supply, machining, Joining, and assembly.
- •About 600 m<sup>2</sup>=> 200-500 k pcs.
- •Market Survey ongoing. See F4E Industry Portal.
- •CFT in Q3 2024.
- •Contract signature: Q3 2025.

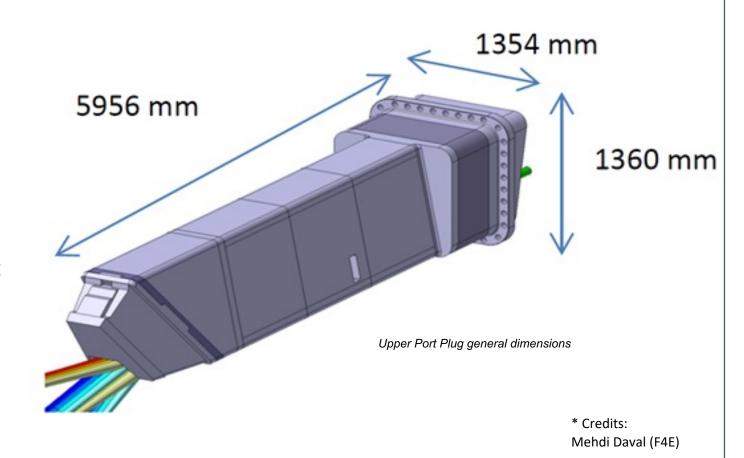


\* Credits: Mehdi Daval (F4E)



### Components within the vacuum: Diagnostic Ports

- •6 Diag PORTS Manufacturing and Assembly.
- •Target => CFT: Q3 2024.
- •316L(N)-IG) Austenitic stainless steel "X2CrNiMo17-12-2 controlled nitrogen" with a concentration of Cobalt, Niobium and Tantalum not exceeding 0.05%, 0.01% and 0.01% weight respectively
- •Polybore HE 430, as neutron shielding blankets for ISS (TBC).
- •B<sub>4</sub>C pellets: sintered B<sub>4</sub>C pellets used to fill the DSMs B<sub>4</sub>C Shielding Chambers, as neutron shielding (about 15 tons).
- •Commercial Off-The-Shelf (COTS) items: bogie wheels, fasteners, flexible metal seals, piping fittings, connectors, etc.
- •Glass To Metal Process with 99% purity N<sub>2</sub> atmosphere.
- •Feedthroughs etc. + TESTING FACILTY





### Thank you for your attention

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#### **Extra slides: Main Contact Persons**



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# Extra slides: IO and F4E ways to engage with Industry



#### **ITER ORGANISATION (IO)**

#### **FUSION FOR ENERGY (F4E)**

#### **International Public Procurement Rules**

Competition, fair treatment, transparency Ultimate authority with ITER Council

Geographical scope: all ITER parties

Threshold for publication: 144 k€ (services)

Publication: website and through DAs http://www.iter.org/proc/overview

Contact: ITER-Procurement@iter.org

Tendering: Mandatory registration on IPROC

www.iter.org/proc/overview

#### **EU General Financial Regulation**

(based on Public Procurement Directive 2014/24/EU) Competition, fair treatment, transparency, proportionality, nondiscrimination

Ultimate authority with European Parliament

Geographical scope: EU (sometimes Worldwide)

Threshold for publication: 144 k€ (services)

Publication: website and TED

https://industryportal.f4e.europa.eu

Contact: mehdi.daval@f4e.Europa.eu

Tendering: Mandatory upload of tenders on EU Supply

https://eu.eu-supply.com/login.asp?B=

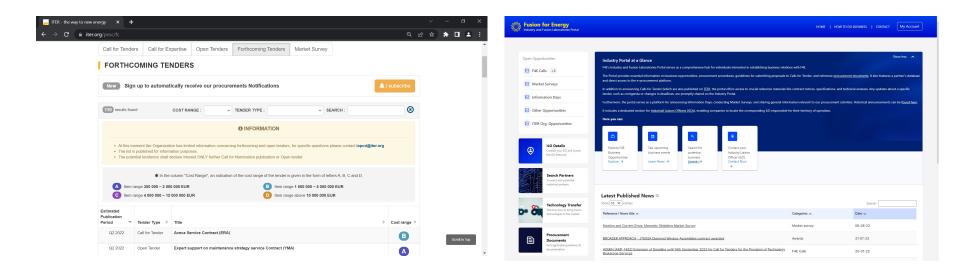
Procurement procedures: open call, restricted call, negotiation, competitive dialogue, etc.

Support to locate staff and facilities near ITER site is provided through *Agence ITER France* and *Welcome Around ITER* partnership http://welcome-around-iter.com

\* Credits: Mehdi Daval (F4E)

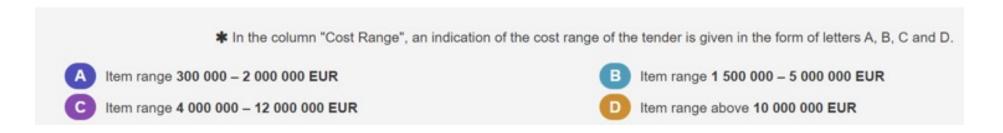
#### **Extra slides: ITER ORG and FUSION FOR ENERGY**





https://www.iter.org/proc/fc

https://industryportal.f4e.europa.eu/



\* Credits: Mehdi Daval (F4E)

## VACUUM AND CRYOGENICS



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# BREAK

Swedish fika - refreshments with opportunities for informal networking and 1-to-1 meetings

