

Assembly of Crab Cavities HOMS & field antenna in SM18 clean room

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on behalf of BE-RF-PM section members

With inputs from

Ilan Ben Zvi (BNL)

Thomas Jones (STFC)

Karl Schirm, Alick Macpherson, Giovanna Vandoni, Mathieu Therasse, Gabriel
Pechaud, Max Gourragne, Sauro Bizzaglia (BE-RF-SFR team)

Ofelia Capatina, Pierre Minginette and Teddy Capelli (EN-MME-EDM)

Preamble

All presented proposals have been made with inputs of experts that we wish to thank

Ilan Ben Zvi – BNL

Thomas Jones – STFC

Karl Schirm, Alick Macpherson, Giovanna Vandoni, Gabriel Pechaud, Max Gourragne, Sauro Bizzaglia – BE-RF-SRF SM18 clean room

Ofelia Capatina, Pierre Minginette, Teddy Capelli – EN-MME-EDM

The proposals match with the existing structure of the cleanrooms and any material will be validated by the BE-RF-SRF team

Preamble

The Fundamental Power Coupler team BE-RF-PM will be trained to assist the BE-RF-SFR team during the assembly of the FPC

Romuald Terry did participate in the LHC couplers mounting onto LHC cavities in SM18 cleanroom facilities, and is asked to help the SRF team when needed

Sebastien Calvo did participate in the SPL coupler mounting in CEA l'Orme Les Meurisiens clean room facilities, and in the ESRF couplers in ESRF clean room facilities

Eight other PM team members will be trained in the coming weeks in order to provide help if requested

At any stage, PM team will be 'assisting' SRF experienced experts that will always lead the tasks in clean room



Romuald & Seb



Global Workflow

All parts come from the chemistry (build. 102) degreased and individually bagged in plastic bag

All soldered or EBW parts will always follow a "clean" process (packaging and handling with gloves)

All sets will be re-washed manually before entering baldaquin/cleanroom

Colours define provider groups

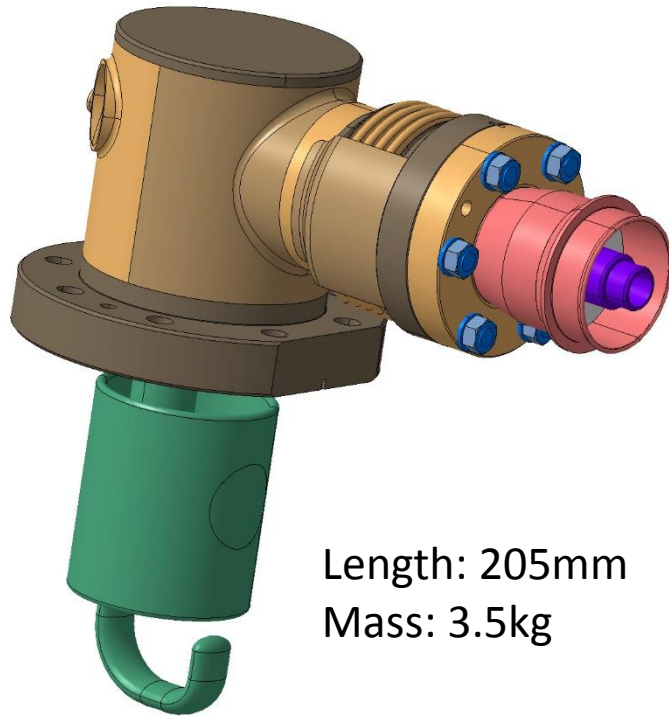
BE/RF/PM

BE/RF/SRF

EN/MME

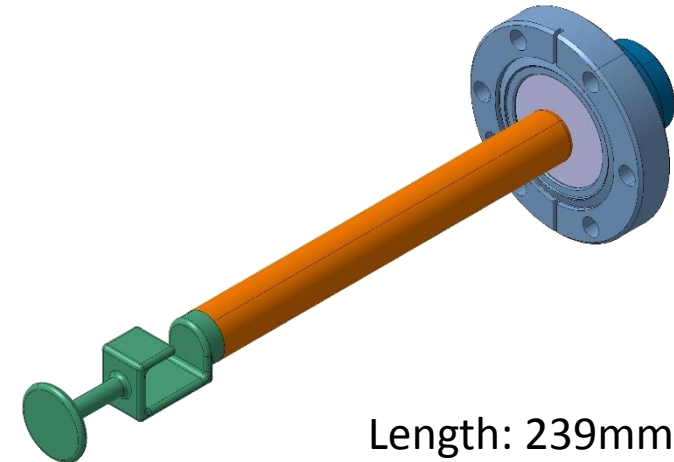
What to be assembled ?

2 x 3 HOMS
(High Order Modes Suppressors couplers)



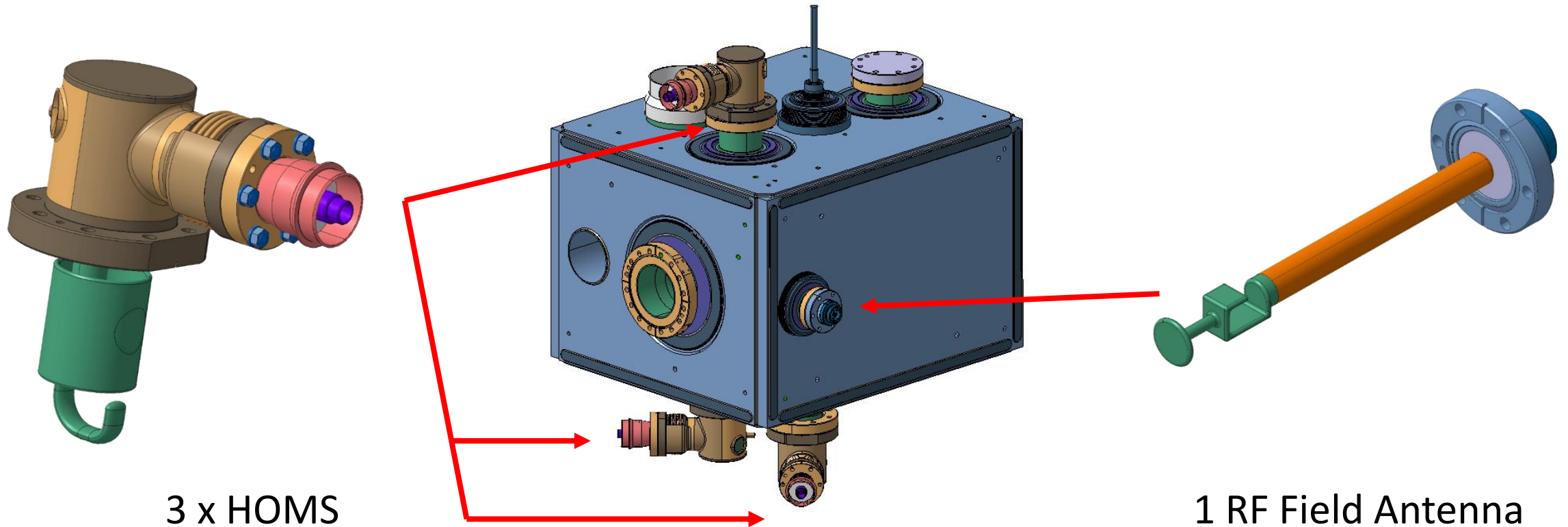
Length: 205mm
Mass: 3.5kg

2 x 1 RF Field Antenna



Length: 239mm
Mass: 0.5kg

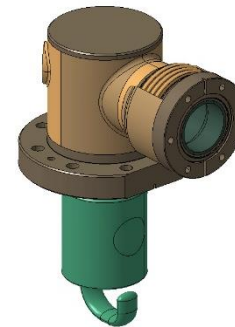
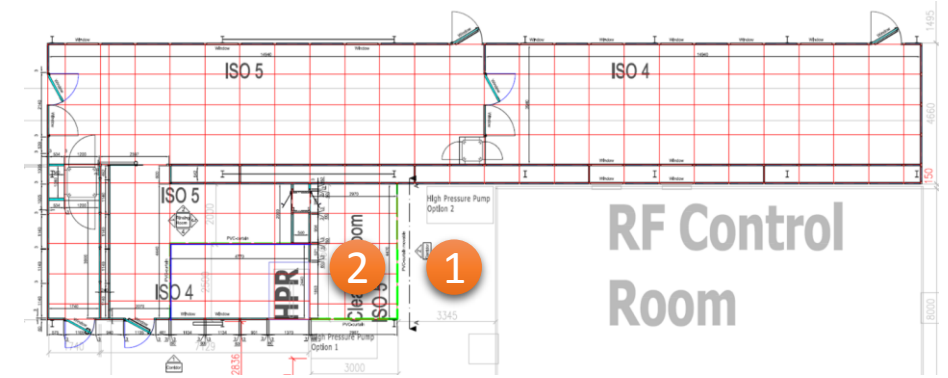
HOMS & RF Field Antenna



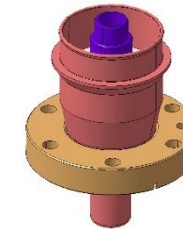
Assembly of devices

Main devices

Description	Area	Time
Delivery of parts packed by the Chemists experts in plastic bag	1	Day1
Blow with pure air	1	
Go to clean room ISO5	2	
Blow with pure air and open the plastic bag	2	



HOMS body



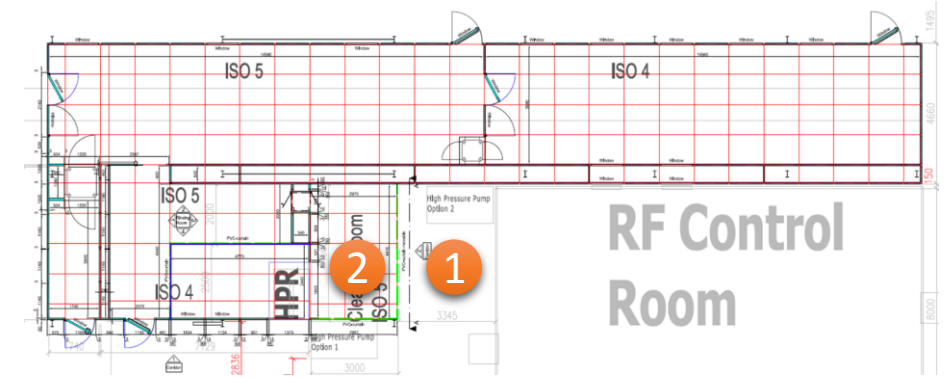
HOMS feedthrough



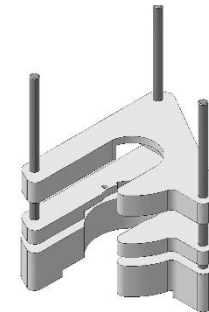
RF Field Antenna

Accessories

Description	Area	Time
Delivery of accessories, nuts, bolts, washers and copper seals... packed by the Chemists experts in plastic bag	1	Day1
Blow with pure air	1	
Go to clean room ISO5	2	
Blow with pure air and open the plastic bag	2	



For HOMS

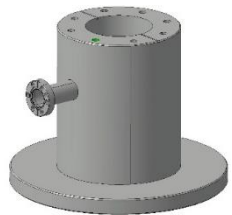


For Field Antenna



Positioning system design on going
 Accura 25 qualified (Mathieu) & Stainless Steel
 Sliding parts as far as possible from the aperture
 System still to be tested and qualified

Copper RF & Vac seal
 Screws A4.100 M6x45
 Studs A4.100 M6x25
 Washers 6x12
 Bolts A4.100 M6



Vacuum support for HOMS



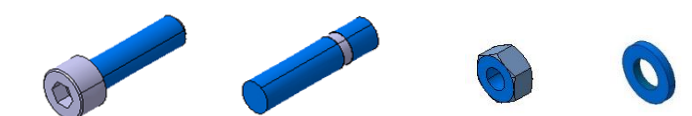
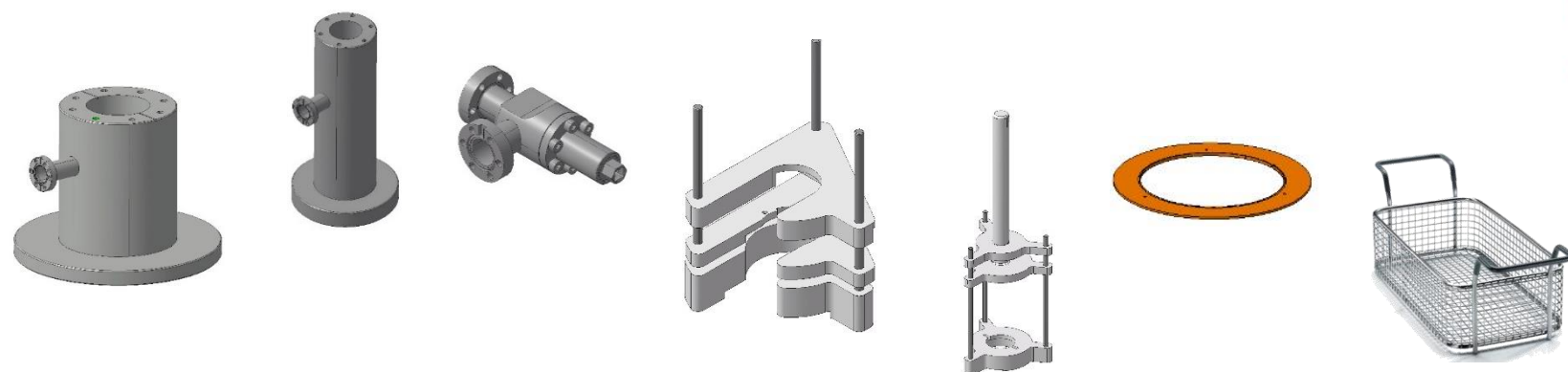
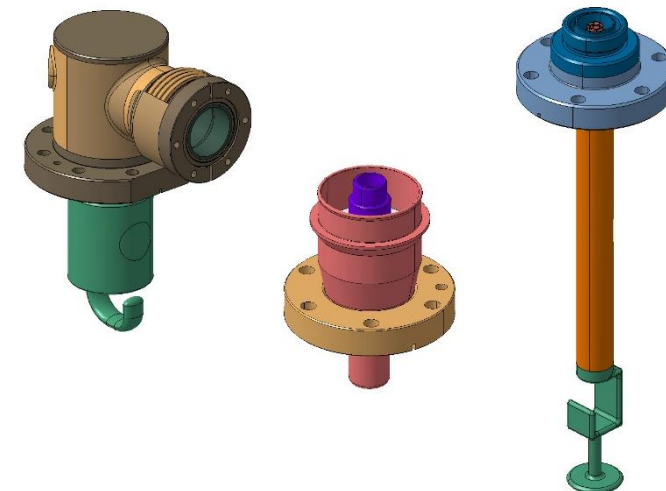
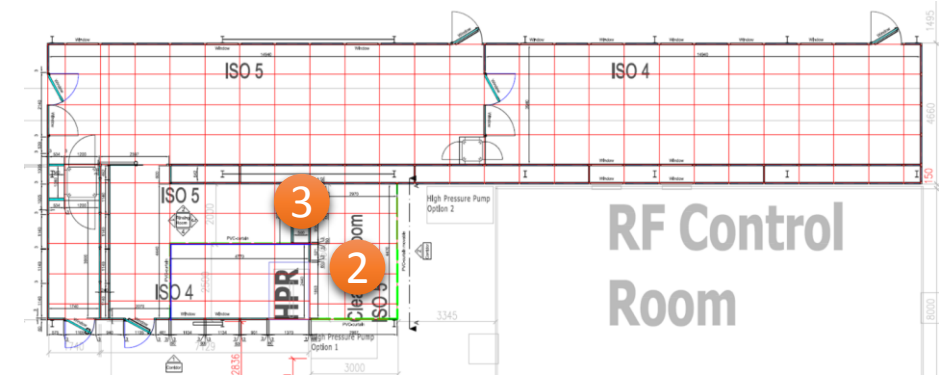
Vacuum support for antenna



DN16 valve

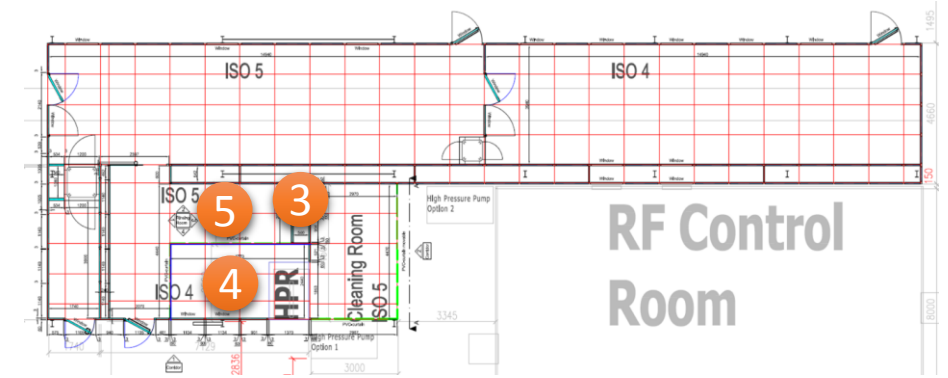
Particles counting

Description	Area	Time
Dry with pure air	2	Day1
Keep under laminar flux	2	Night 1
Blow and particles counting	2	Day2
Put all devices in the SAS	3	

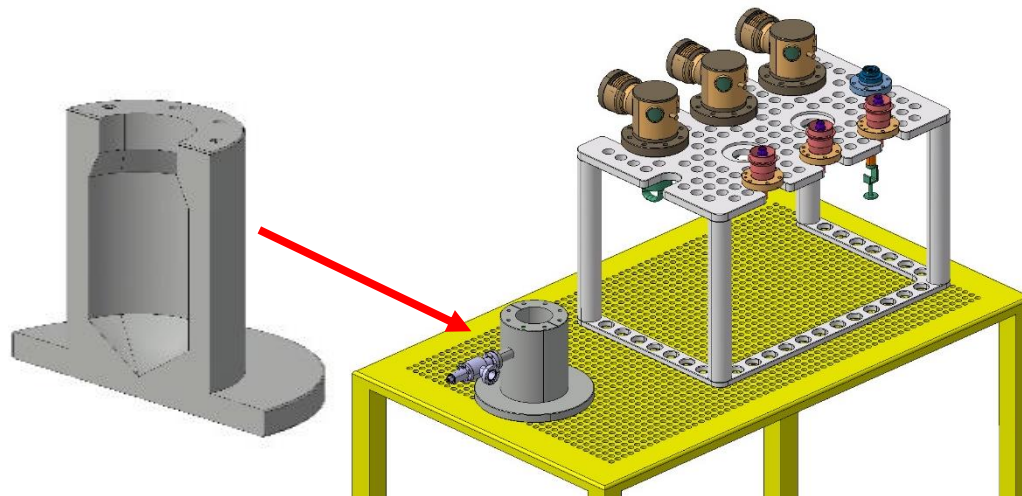


Moving to ISO4

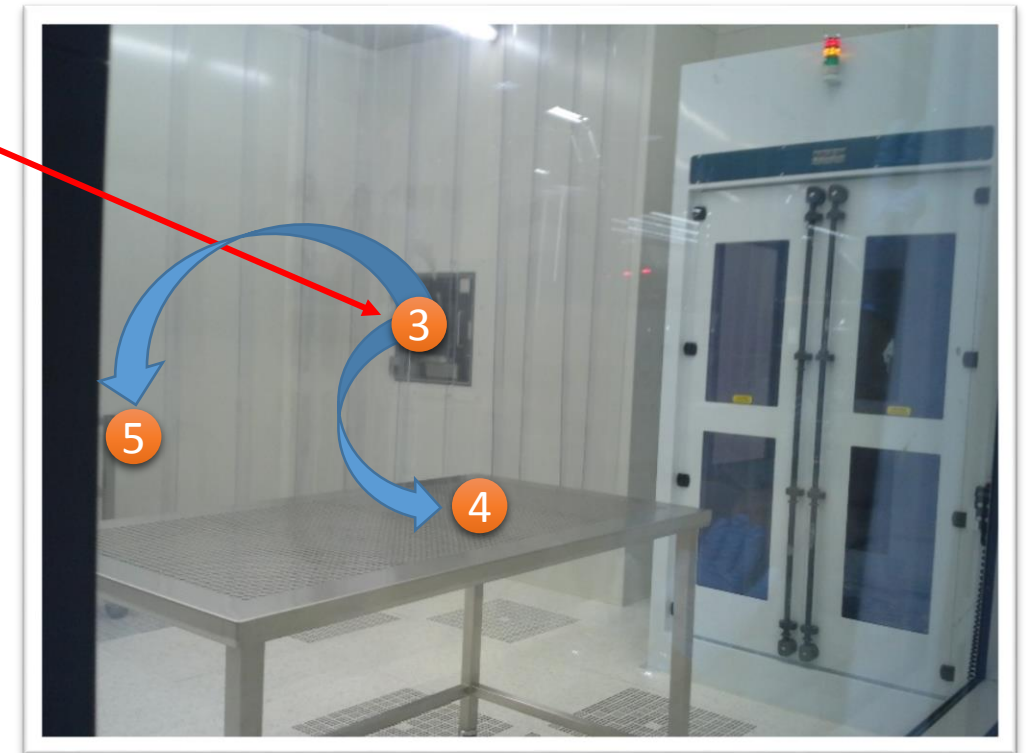
Description	Area	Time
Move all components to be assembled from the SAS to ISO4 area	4	Day3
Store the other components in storage ISO5 area	5	



Inner volume of the HOMS body support is much larger than needed to avoid any contact

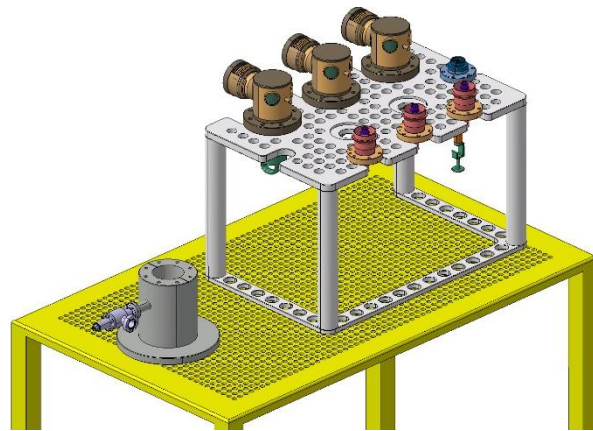
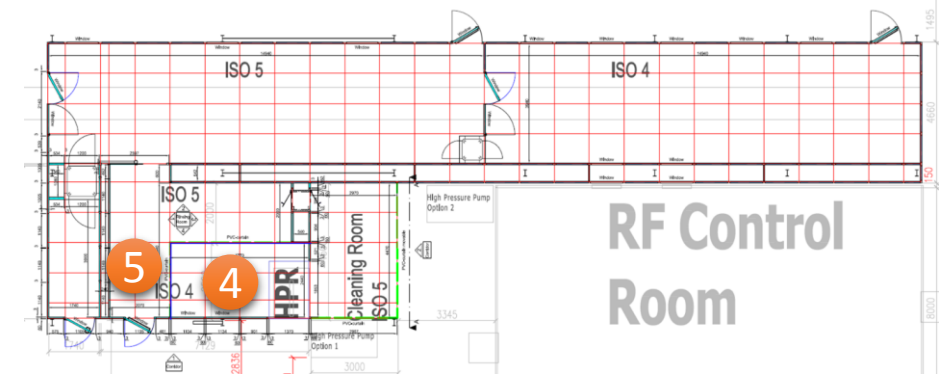


SAS

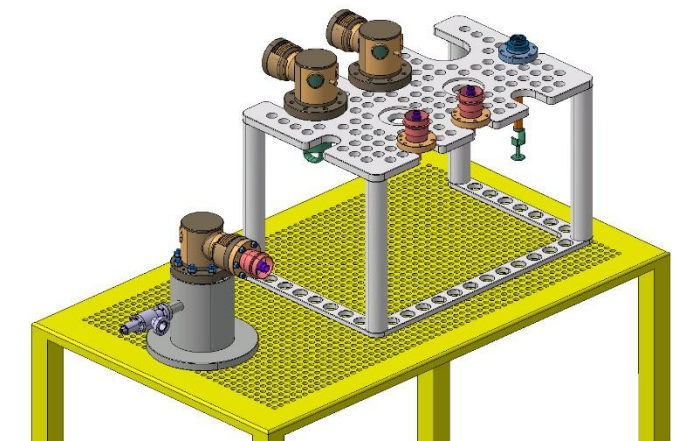
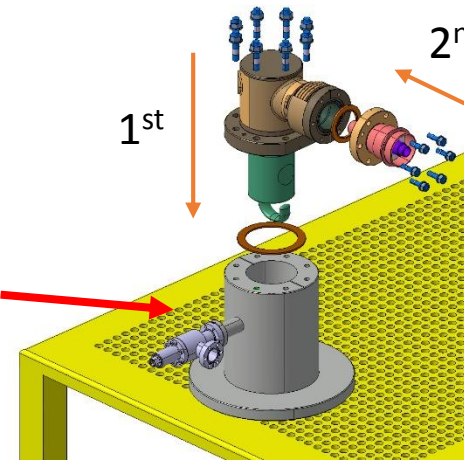


HOMS assembly

Description	Area	Time
Manually assemble the HOMS, seals and feedthrough	4	Day3
Tighten until no gap between flanges, cross and circle	4	
Store in ISO5	5	

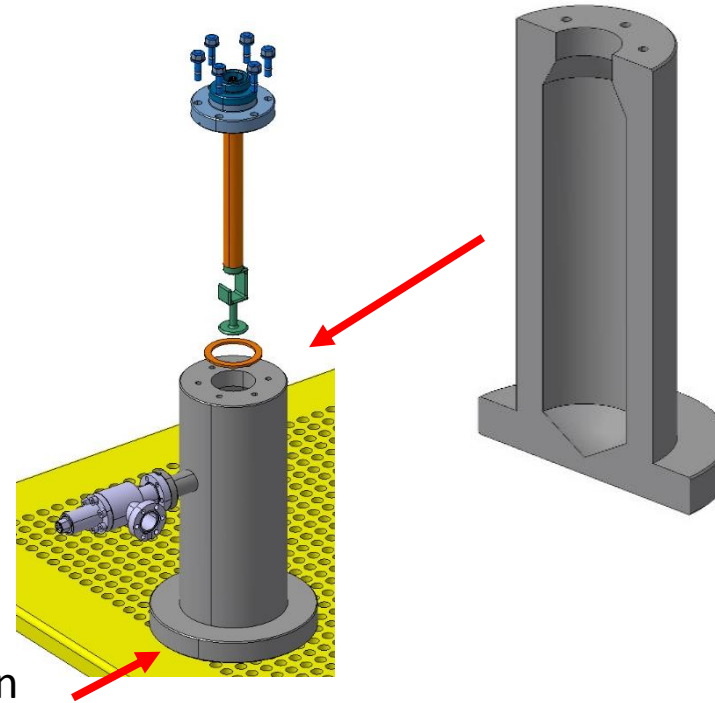
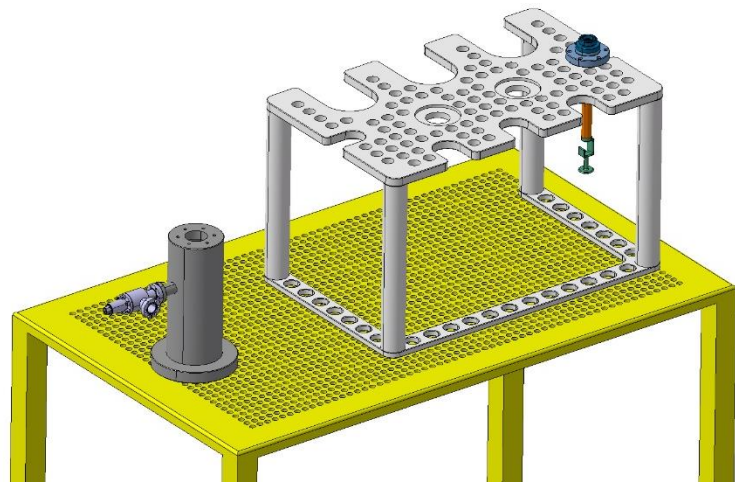
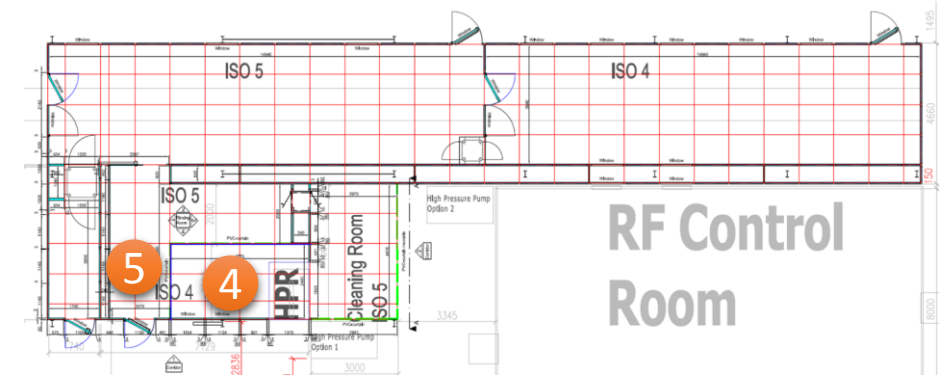


Support
clamped on
the table

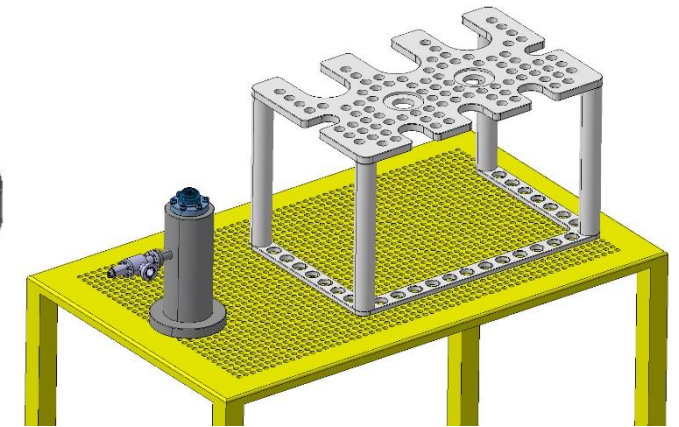


Field Antenna assembly

Description	Area	Time
Manually assemble the Field Antenna	4	Day3
Tighten until no gap between flanges, cross and circle	4	
Store in ISO5	5	

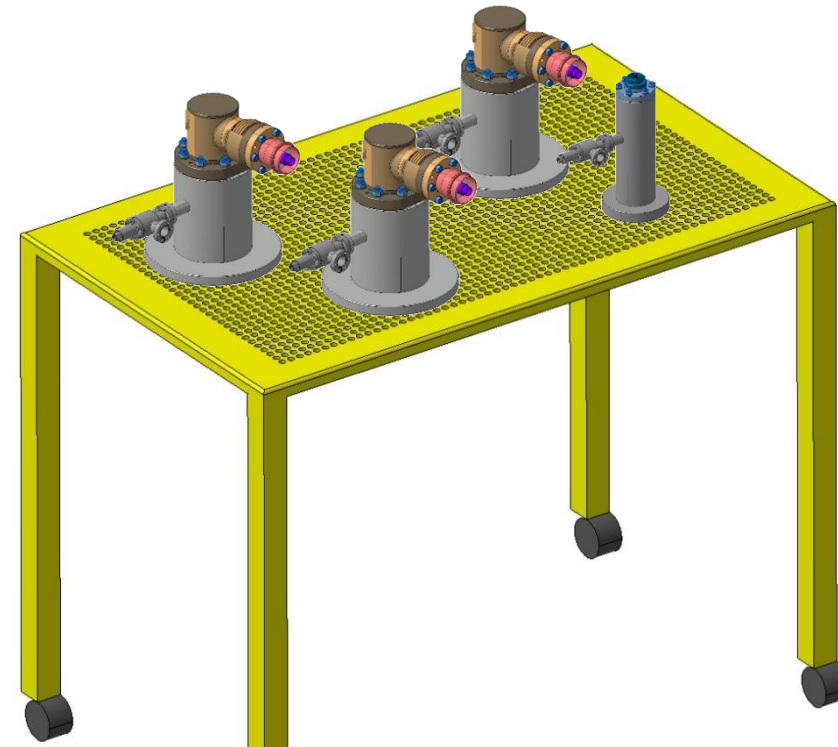
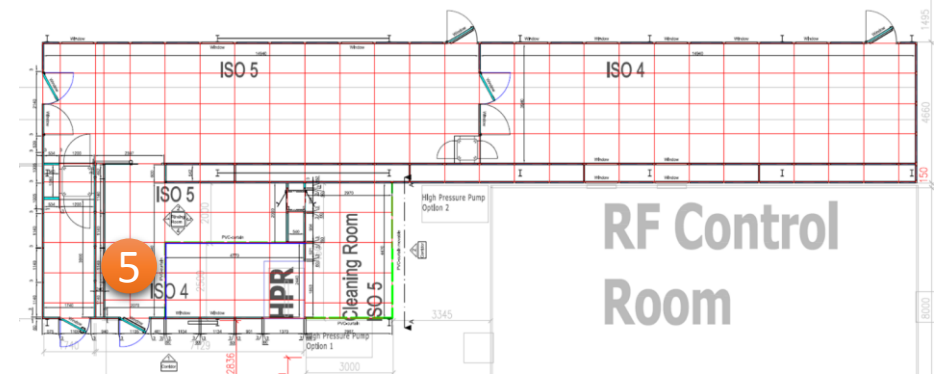


Support
clamped on
the table



Vacuum leak detection

Description	Area	Time
Leak detection to verify a leak rate $< 1 \times 10^{-10}$ mbar l/s	5	Day4
Store all devices in ISO5	5	

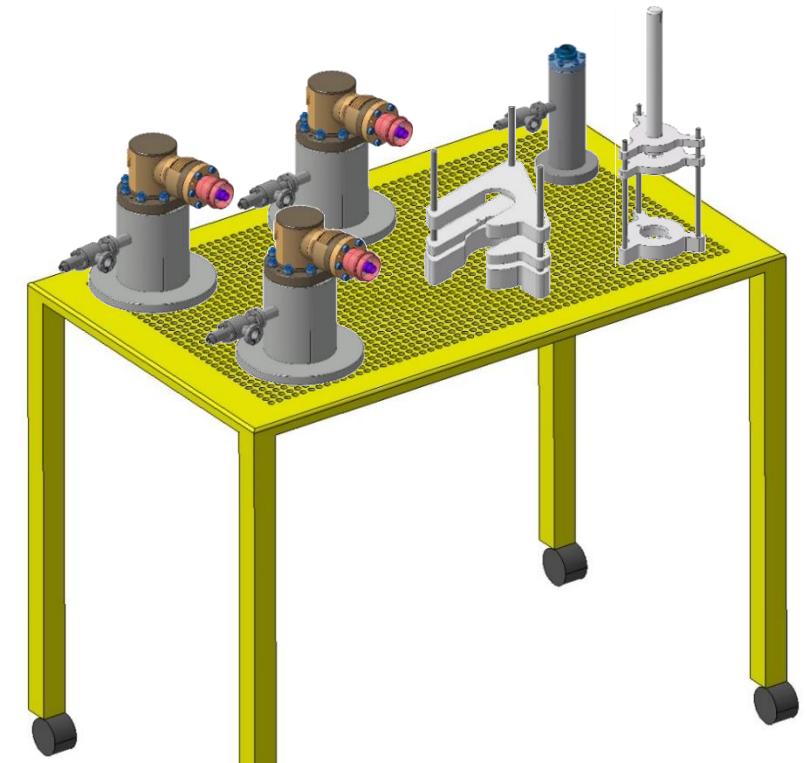
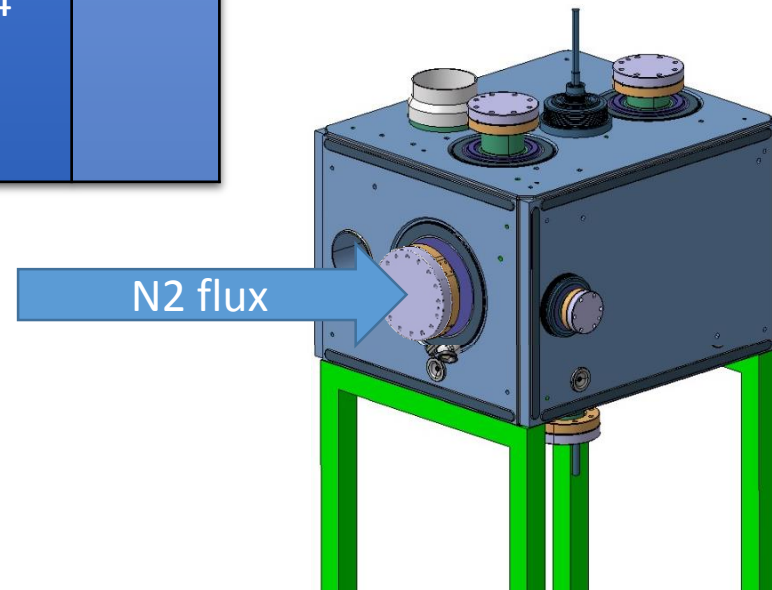
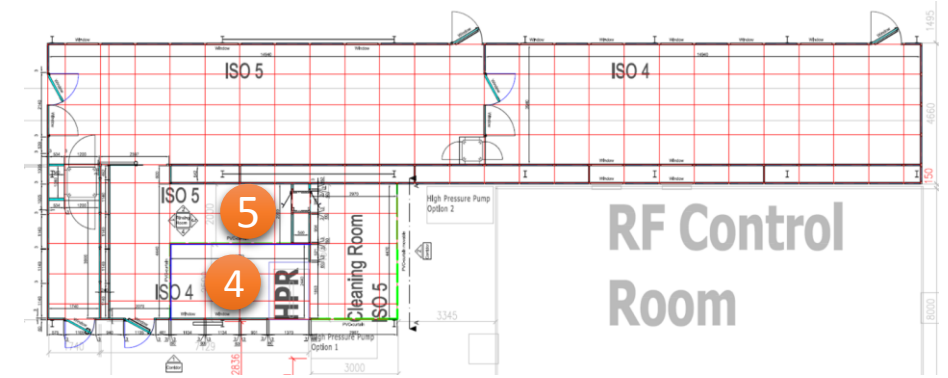


All supports
clamped on
the table

Assembly on CRAB cavity

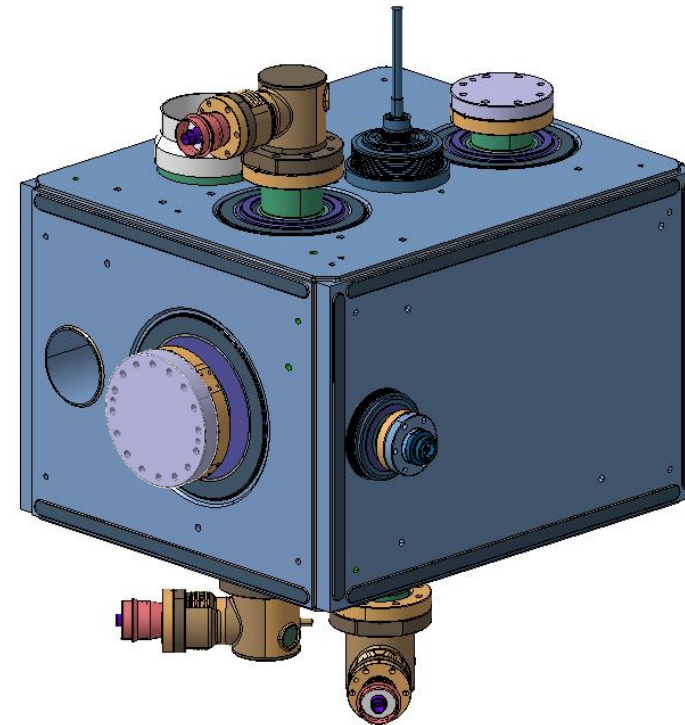
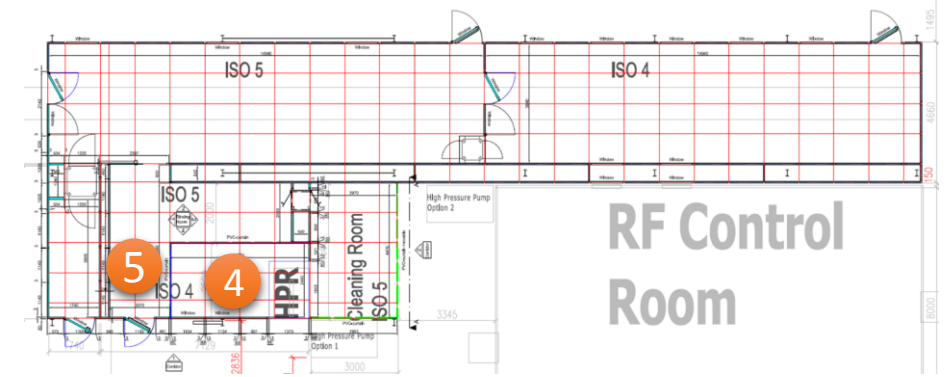
Back to ISO4

Description	Area	Time
Move all needed devices to ISO4	4	Day1
Insert ISO4 filtered Nitrogen (N2) in the cavity ATM + 0.2bars with a pressure reducer and an output flow through the port of around 20 l/min	4	

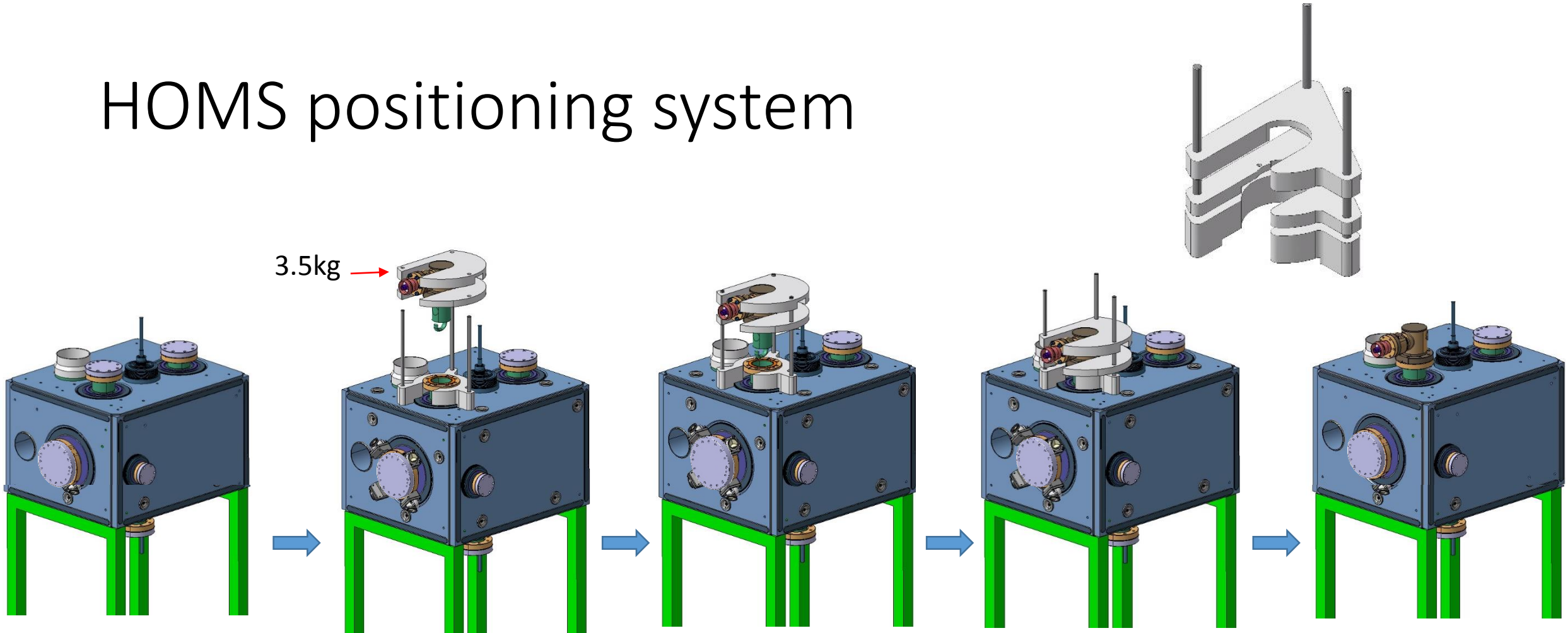


Assembly flowchart

Description	Area	Time
Mount the centring device Remove the blank flange Assemble the device (see next slides)	4	Day1
Mount washers and screws	5	
Tighten until no gap between flanges, cross and circle	5	
Leak detection to verify a leak rate $< 1 \times 10^{-10}$ mbar l/s	5	

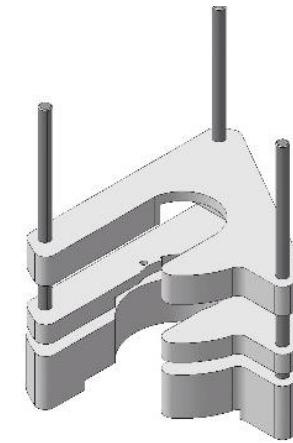


HOMS positioning system

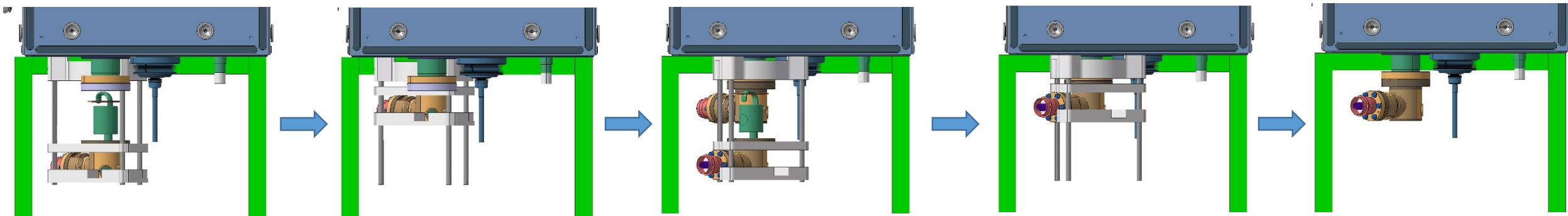


Positioning system design on going
Accura 25 qualified (Mathieu) & Stainless Steel
Sliding parts as far as possible from the aperture
System still to be tested and qualified

HOMS positioning system



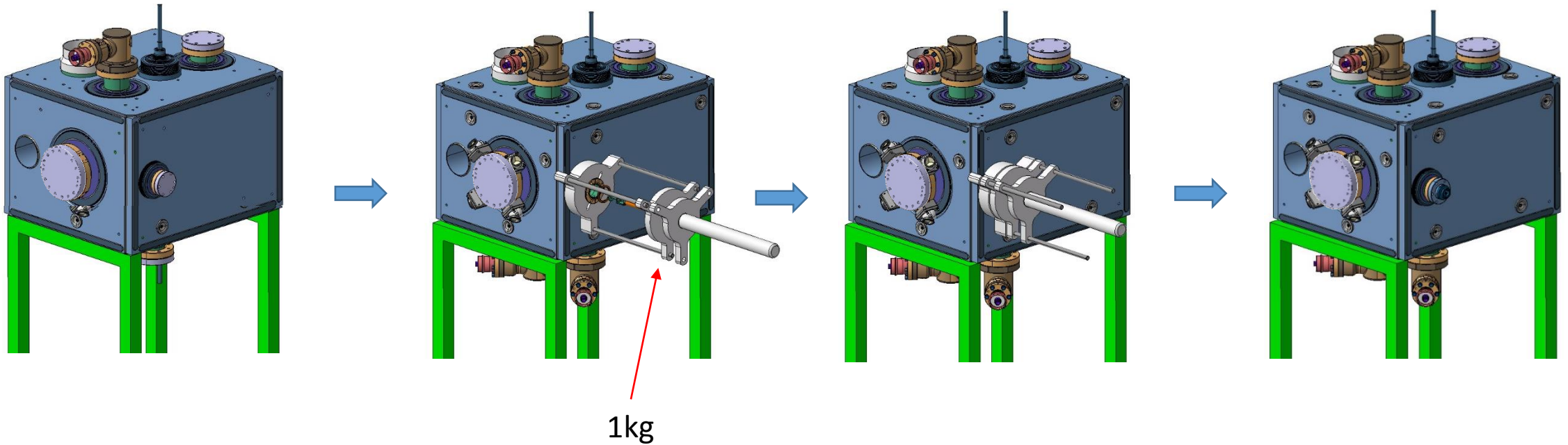
If the flip option is provided by the Lifting Device, will be from the top



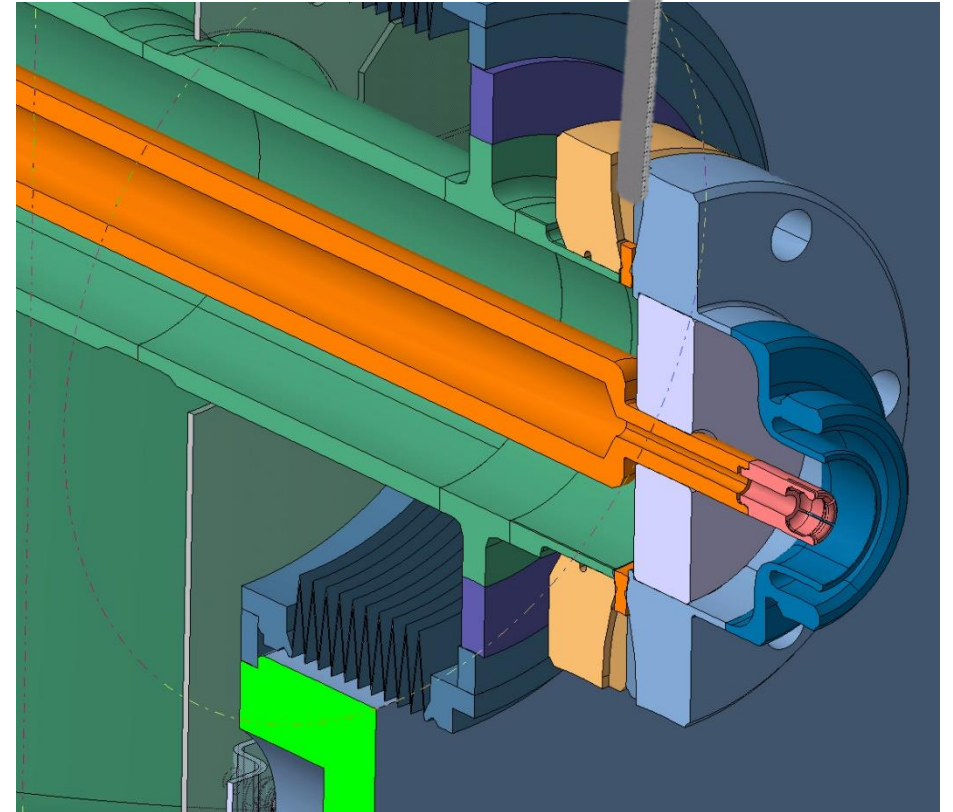
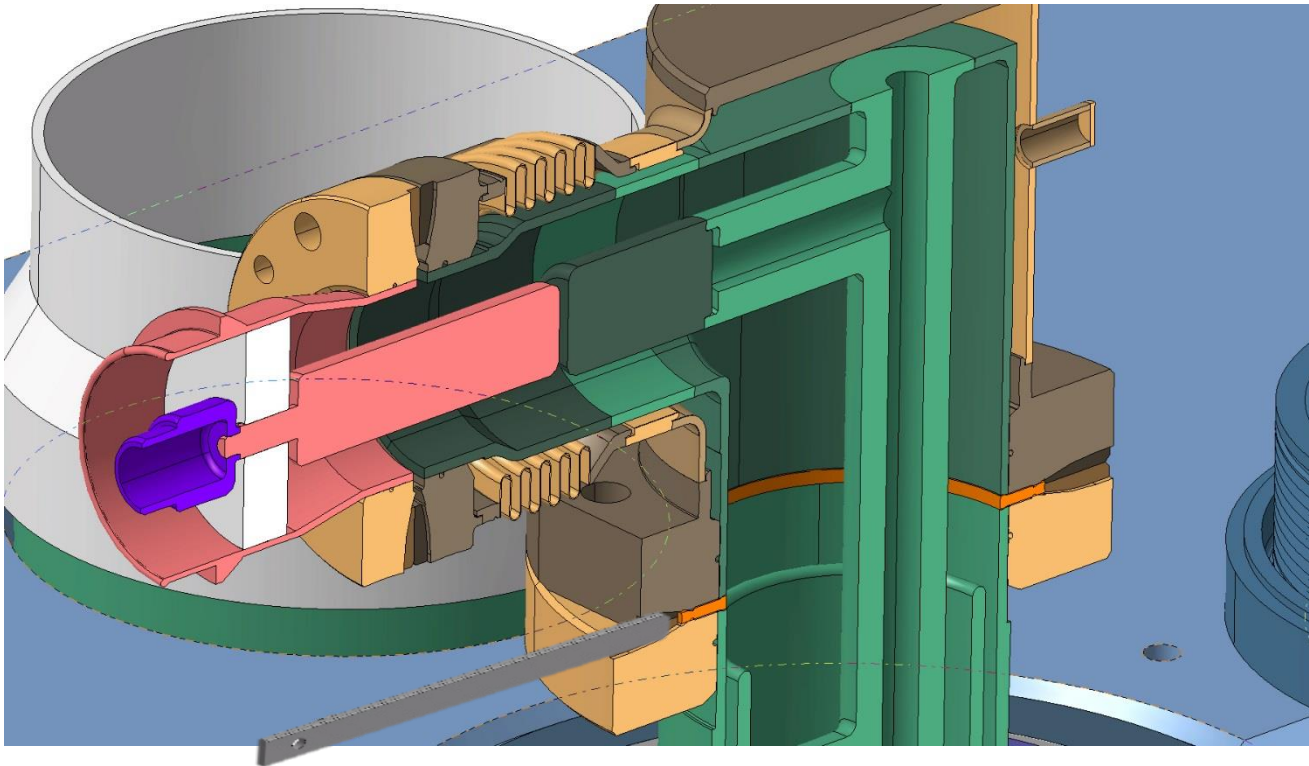
Positioning system design on going
Accura 25 qualified (Mathieu) & Stainless Steel
Sliding parts as far as possible from the aperture
System still to be tested and qualified

Field Antenna positioning system

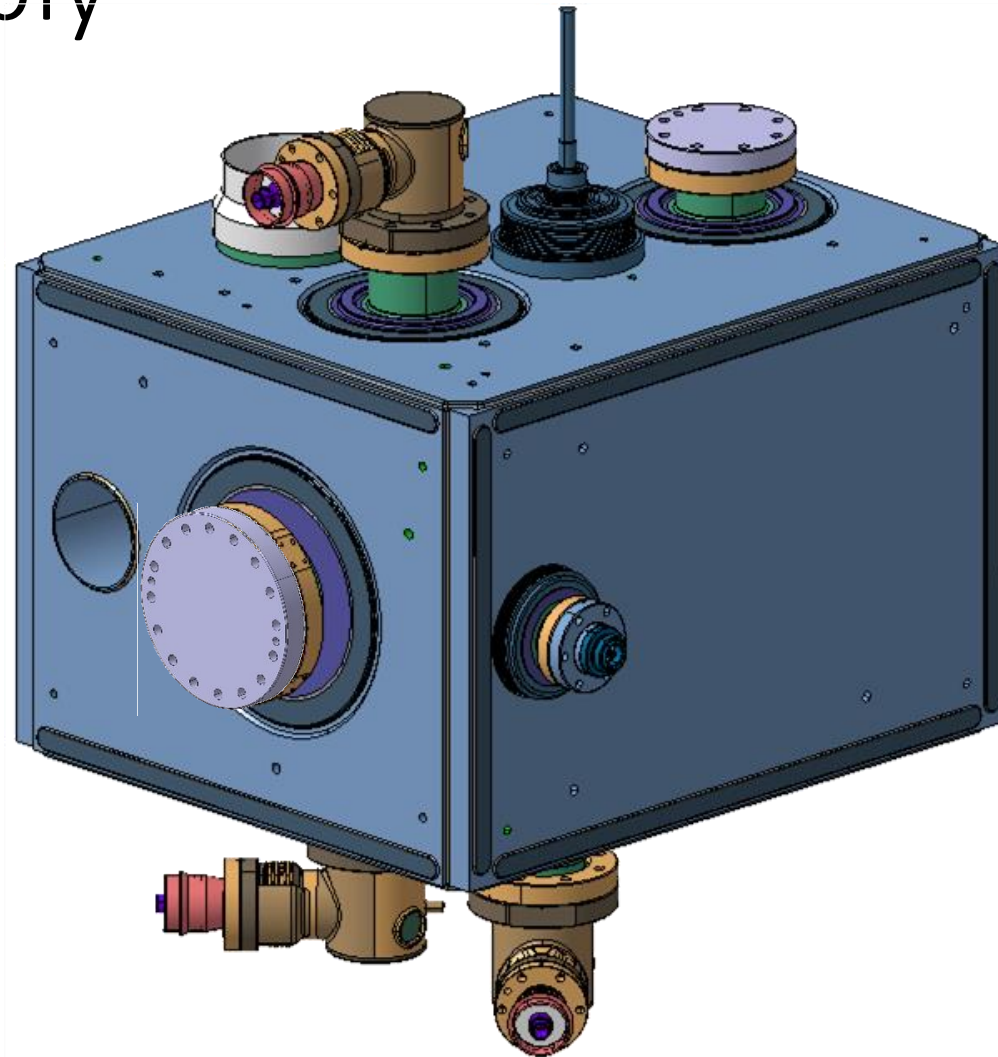
From the side under laminar flux



Fine angle positioning system



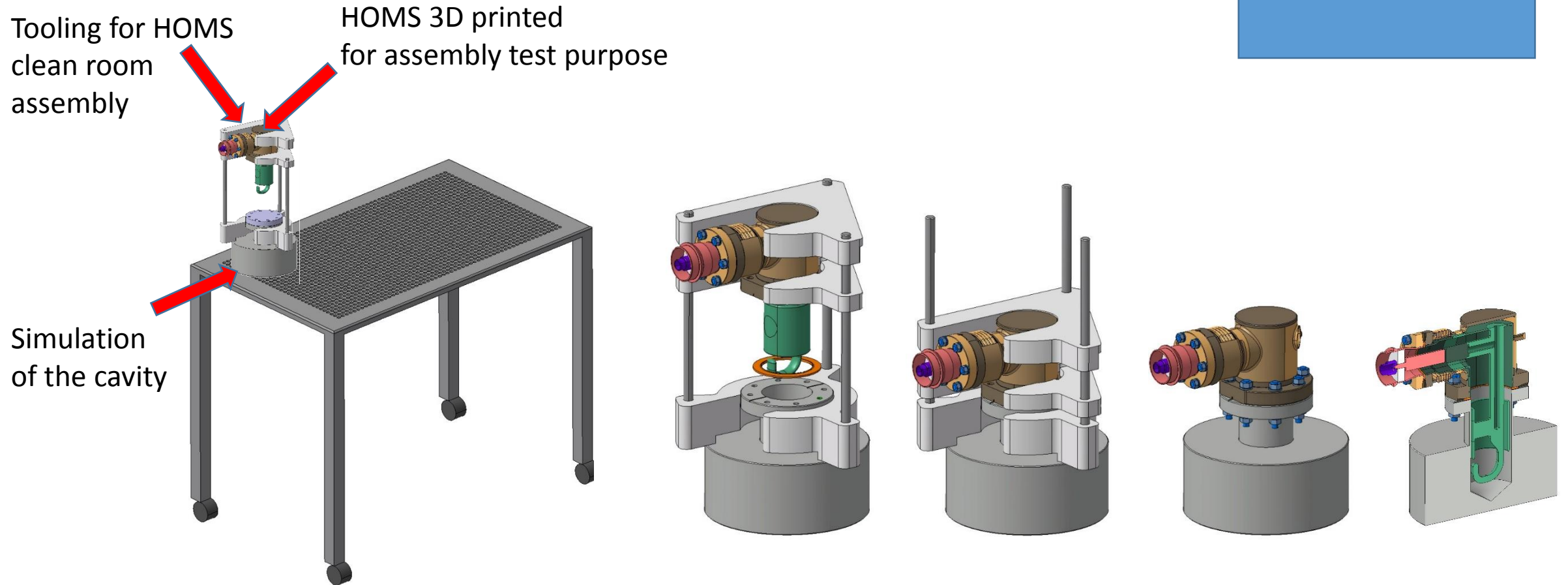
Final assembly



HOMS assembly tests

Before we mount these assemblies in clean room, we will do some pre-mounting in our mechanical laboratory in order to test all our tools and in order to train the colleagues

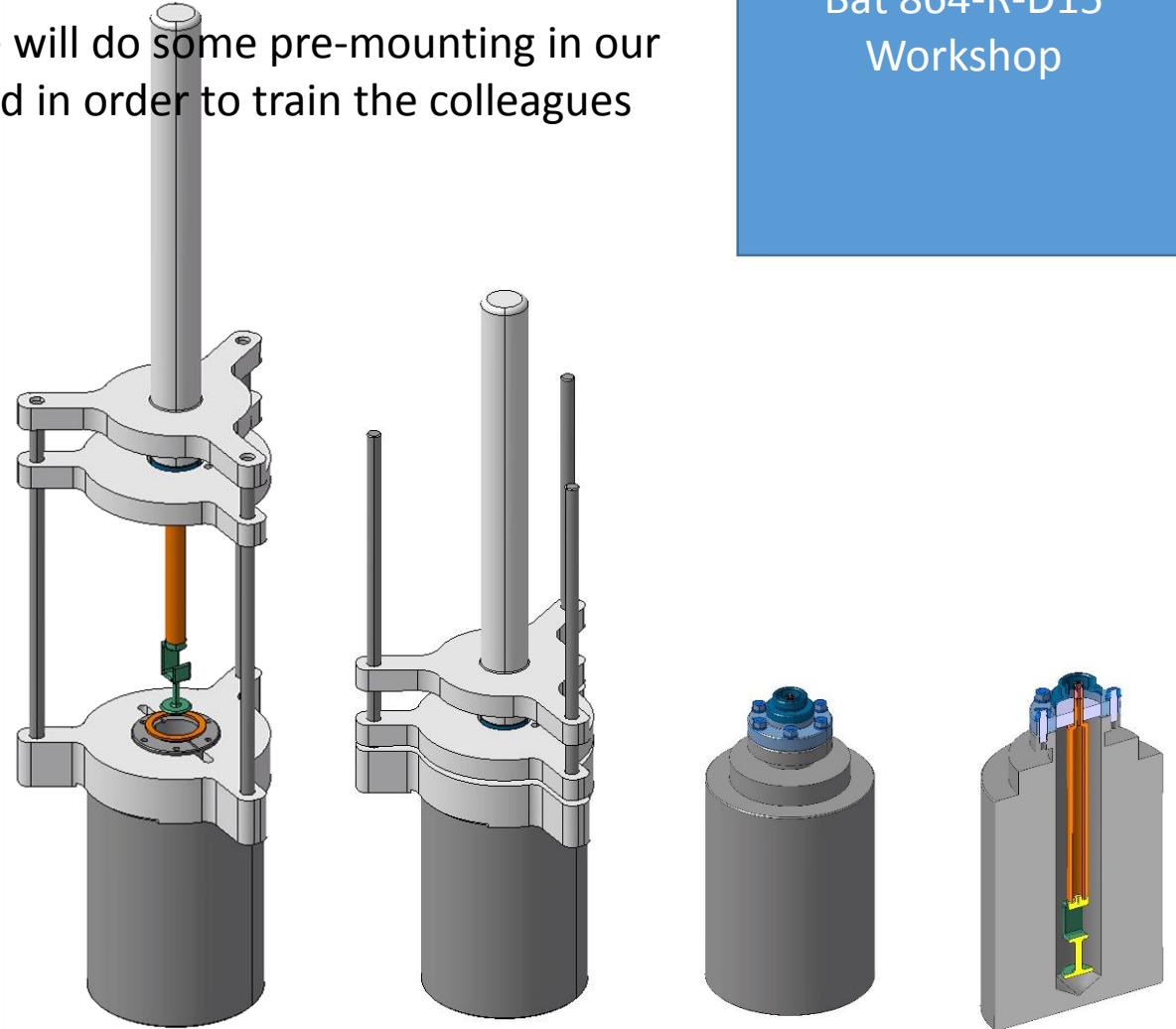
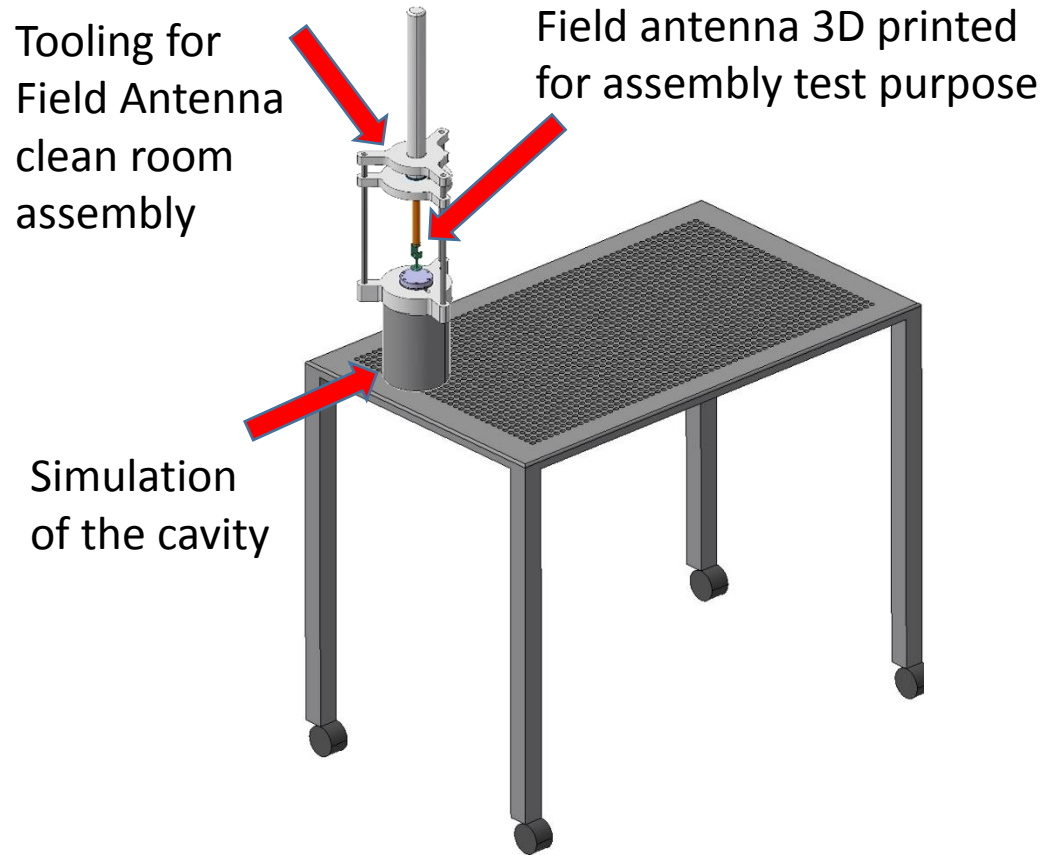
Bat 864-R-D15
Workshop



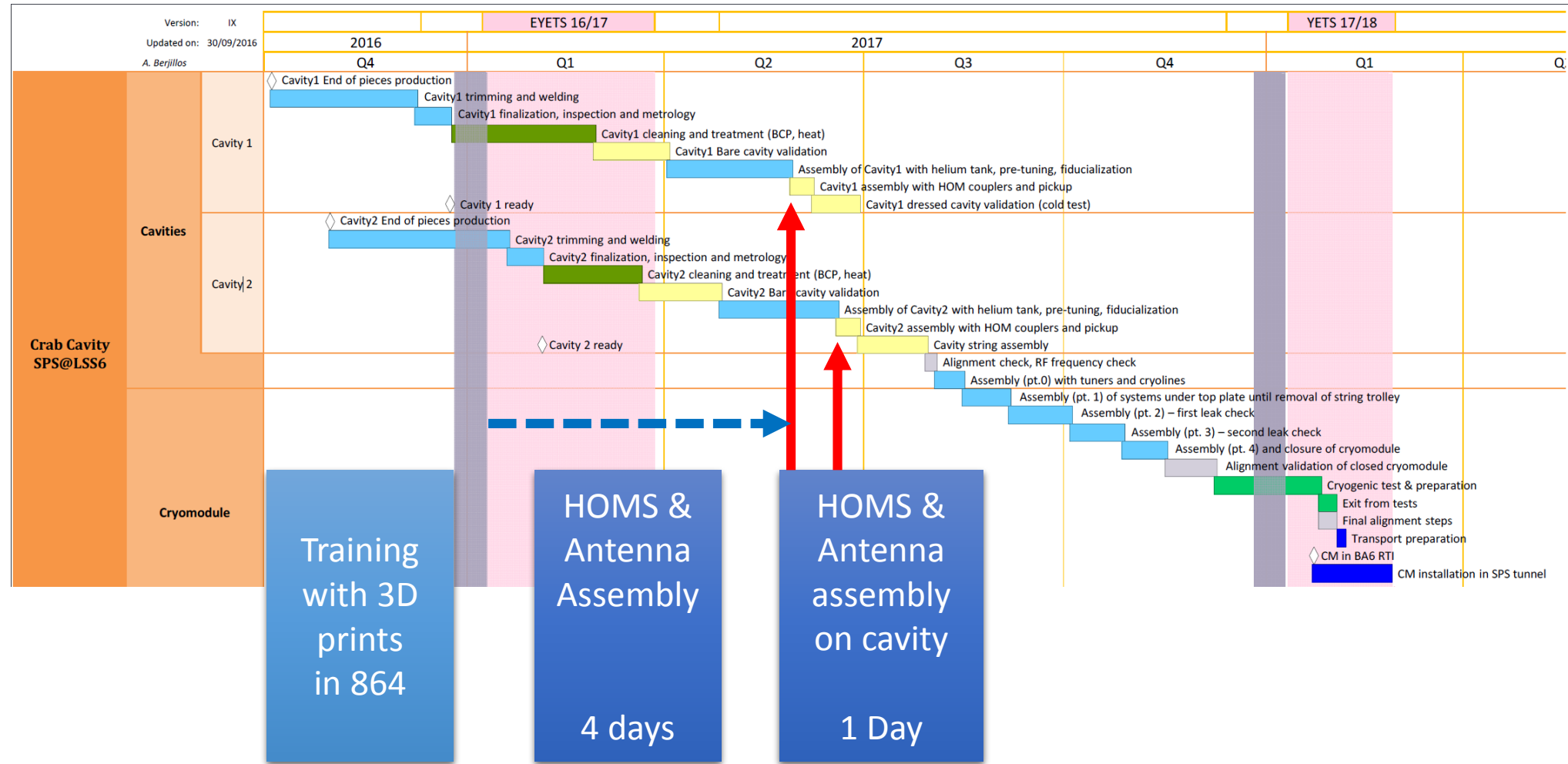
Field Antenna assembly tests

Before we mount these assemblies in clean room, we will do some pre-mounting in our mechanical laboratory in order to test all our tools and in order to train the colleagues

Bat 864-R-D15
Workshop



Planning



ANNEXES

Total mounting tolerances

After mounting tolerances hoped:

Off-center tolerances DN63 = mini -0.05mm maxi 0.25mm

- Seal tolerance DN63 : $\varnothing 82.4 \rightarrow \pm 0.05$
- Flange tolerance DN63 : $\varnothing 82.5 \rightarrow 0.1/0$ (x2)

Total angles tolerances mini -0.15mm maxi 0.1mm $\rightarrow \sim 0.15^\circ$

- Ungasing slot tolerance : $1.5 \rightarrow \pm 0.1$ (x2)
- Angle positioning tool tolerance : $1.4 \rightarrow 0/-0.05$

Asked positioning for FPC assembly:

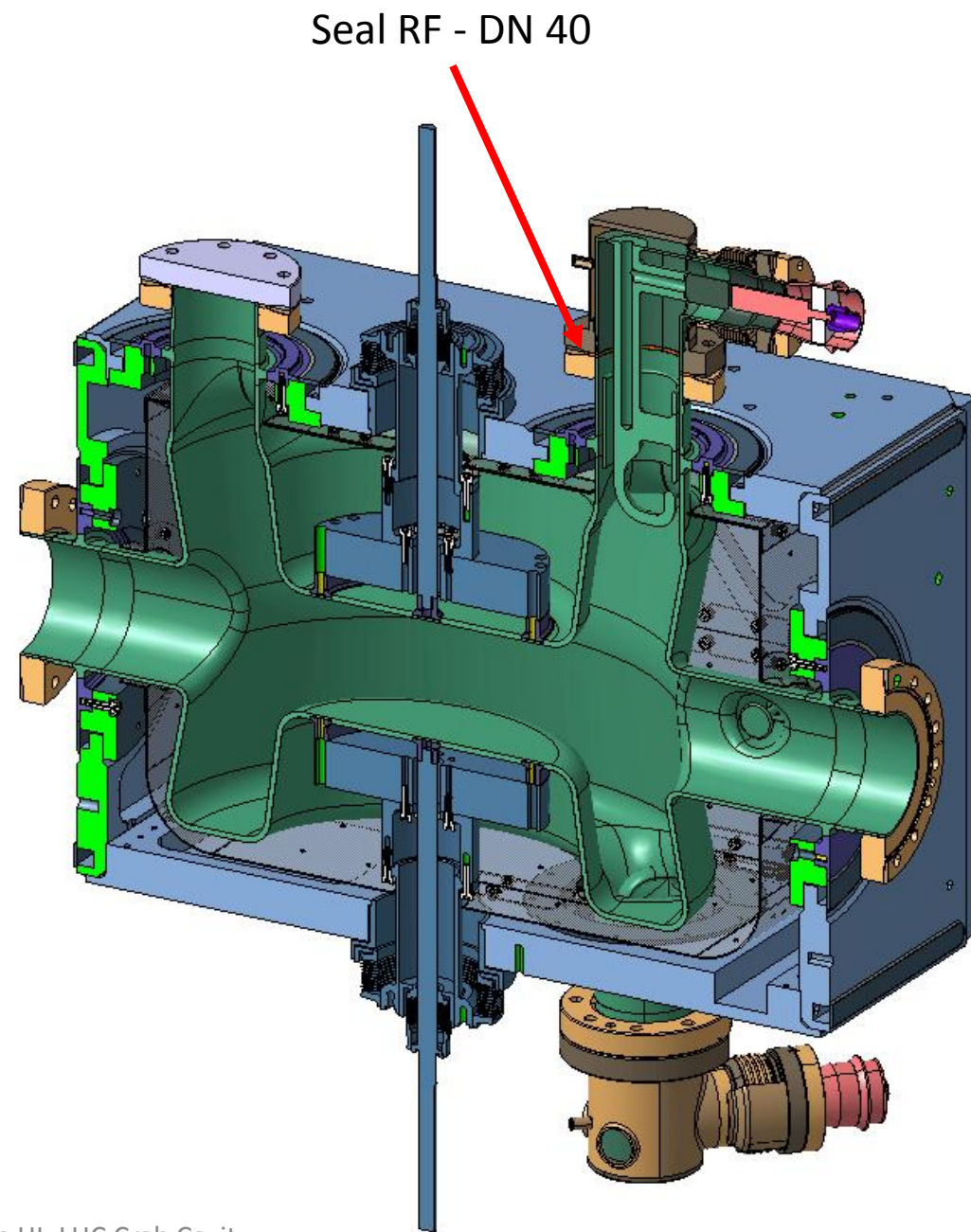
Axials tolerances ± 1 mm

Angles tolerances $\pm 1^\circ$

what we can have with the accumulated tolerances max:

Axials tolerances $+0.25$ mm/ -0.05 mm

Angles tolerances $\pm 0.15^\circ$



Particulate counting Accura 25 3D printing

Test place: SM18

Cleanroom: Softwall clean room ISO 5

Particle counter: SOLAIR 3200

Operator: S. Benvenuti, C. Duval, M. Therasse

Sample: Accura 25

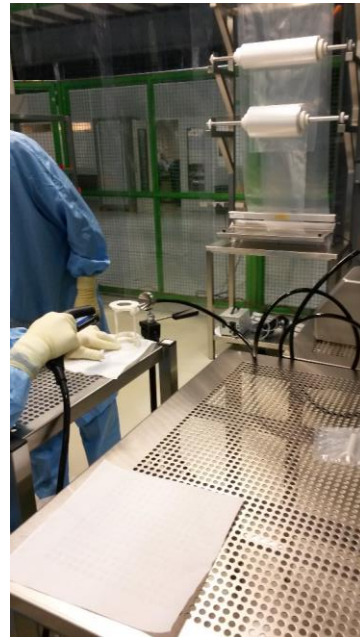
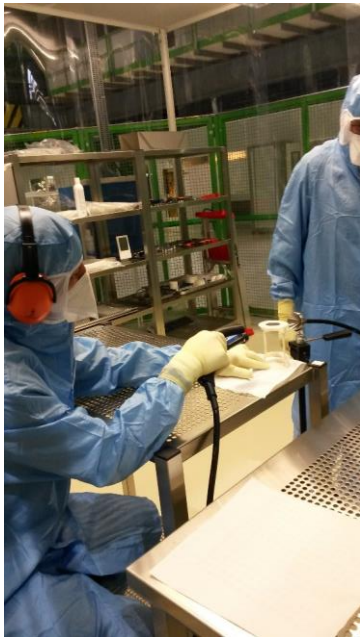
Setup:

Sample degreased with standard process (bldg. 102).

Sample cleaned with dust tissue with alcohol, and blew with filtered N2 gas.

Calibration of the particle counter with a calibrated filter.

The sample is blown in different positions with filtered N2 gas (ionizing air gun) in front of the particle counter.



Sample Test table:

Timestamp	Sample Time(s)	Volume(L)	0.3	0.5	1	3	5	10	Alarm
20/09/2016 12:20	60	56.6	302	190	150	54	21	10	None

eric.montesinos@cern.ch
sebastien.calvo@cern.ch

20/09/2016 14:55	60	56.6	2	0	0	0	0	0	None
20/09/2016 14:57	60	56.6	404	312	228	63	24	15	None
20/09/2016 14:58	60	56.6	263	211	160	60	25	13	None
20/09/2016 15:00	60	56.6	563	370	254	74	28	12	None
20/09/2016 15:01	60	56.6	800	498	295	91	36	15	Yes
20/09/2016 15:02	60	56.6	14	9	4	0	0	0	None
20/09/2016 15:03	60	56.6	53	23	14	2	1	0	None
20/09/2016 15:04	60	56.6	76	50	40	18	14	11	None
20/09/2016 15:06	60	56.6	4	2	2	2	1	1	None
20/09/2016 15:08	60	56.6	129	88	59	17	5	1	None
20/09/2016 15:09	60	56.6	44	32	21	5	1	0	None
20/09/2016 15:10	60	56.6	69	49	31	13	6	3	None
20/09/2016 15:11	60	56.6	28	18	14	8	4	3	None
20/09/2016 15:12	60	56.6	64	21	7	0	0	0	None
20/09/2016 15:13	60	56.6	363	286	207	53	18	7	None

Results:

Sample compatible with ISO4.

Pay attention on the surface roughness. Probably due to the 3D printing process.

The surface and angles have to be machined to be smoother (For cleaning and manipulation).

Positioning system design on going
Accura 25 qualified (Mathieu) and Stainless Steel
Sliding parts as far as possible form the aperture
System still to be tested and qualified