

Instrumentation for LHC crab cavities – preliminary definition

Review of instrumentation for HL-LHC
28 January 2020

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Input information

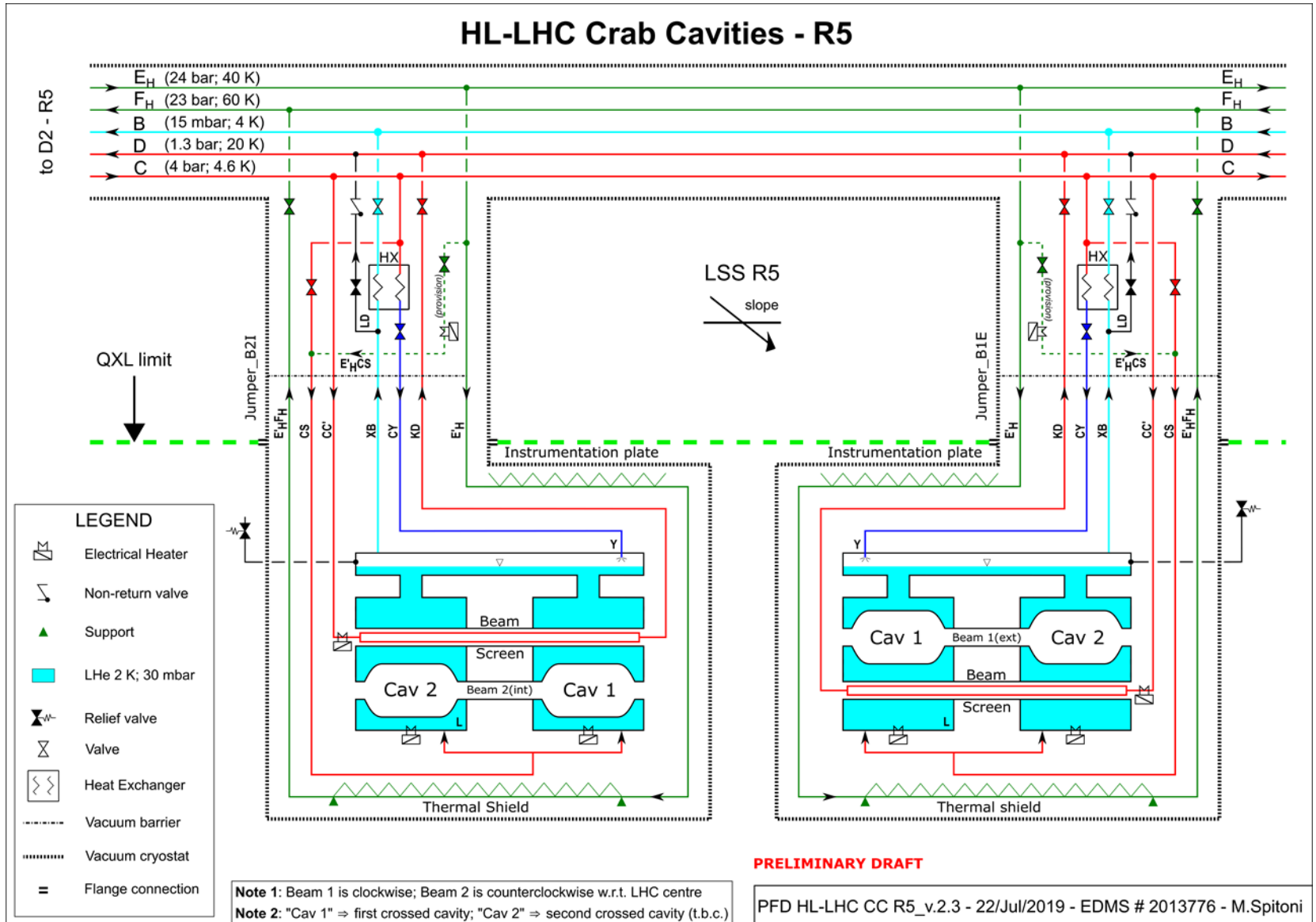
There will be fabricated 10 modules of the crab cavities for HL-LHC → 8 modules to be installed + 2 spare modules. Each module will contain two deflecting RF cavities.

- 4+1 modules will contain DQW cavities (assembly in UK)
- 4+1 modules will contain RFD cavities (assembly in Canada)

The number of instruments presented is treated by a cryomodule i.e. the total number of instruments for HL-LHC needs must be multiplied by factor of 10.

LHC_CC PFD

HL-LHC Crab Cavities - R5



Instrumentation for CC

Instrumentation for one cryomodule of the crab cavities:

instrument type	technology	number
LT	superconductive gauge	2
EH	printed as for the protothype	2
BS heater	not defined yet	1
PT	0-4 bar standard	2
VLPT	VLP transmitter	1
TT	cernox	22+2
TT	PT100	6
vacuum gauge (tbc)	0-1 bara	1

Delivery dates:

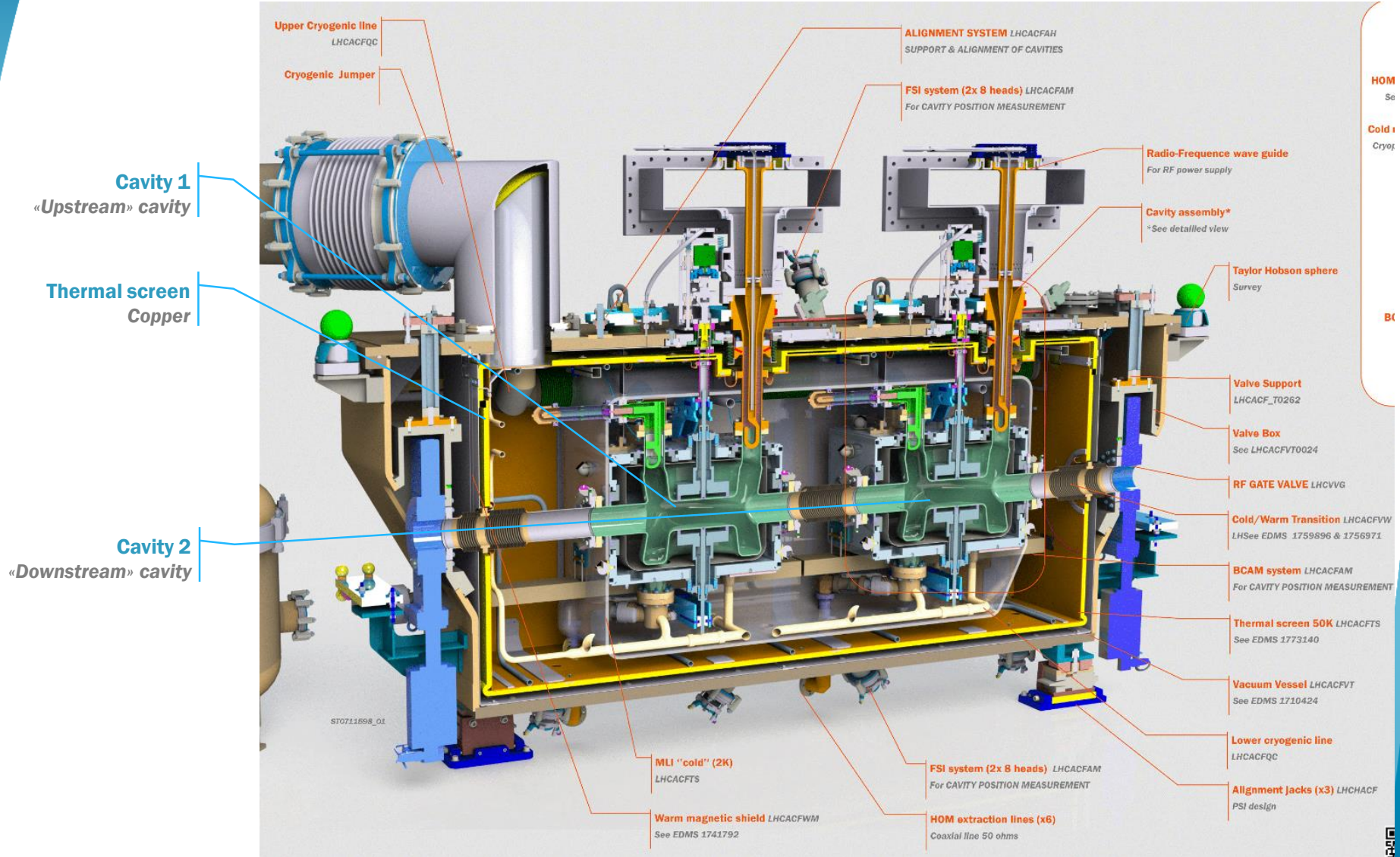
First batch for one cryomodule will be needed in October 2020. The remaining part shall be available during 2021.

Remarks:

- It is considered that pressure measurement for all supply piping will be known from the QXL.
- Installation definition for specific TTs is under definition (screwed or glued), required cable length will be 4 m.
- BS heater is to be non-ferromagnetic – to be discussed.
- Detailed specification of instrumentation will be sent in May 2020 at latest.

Back up slides (by Teddy Capelli for first
DQW prototype)

Cryomodule preview



Cavity Layout

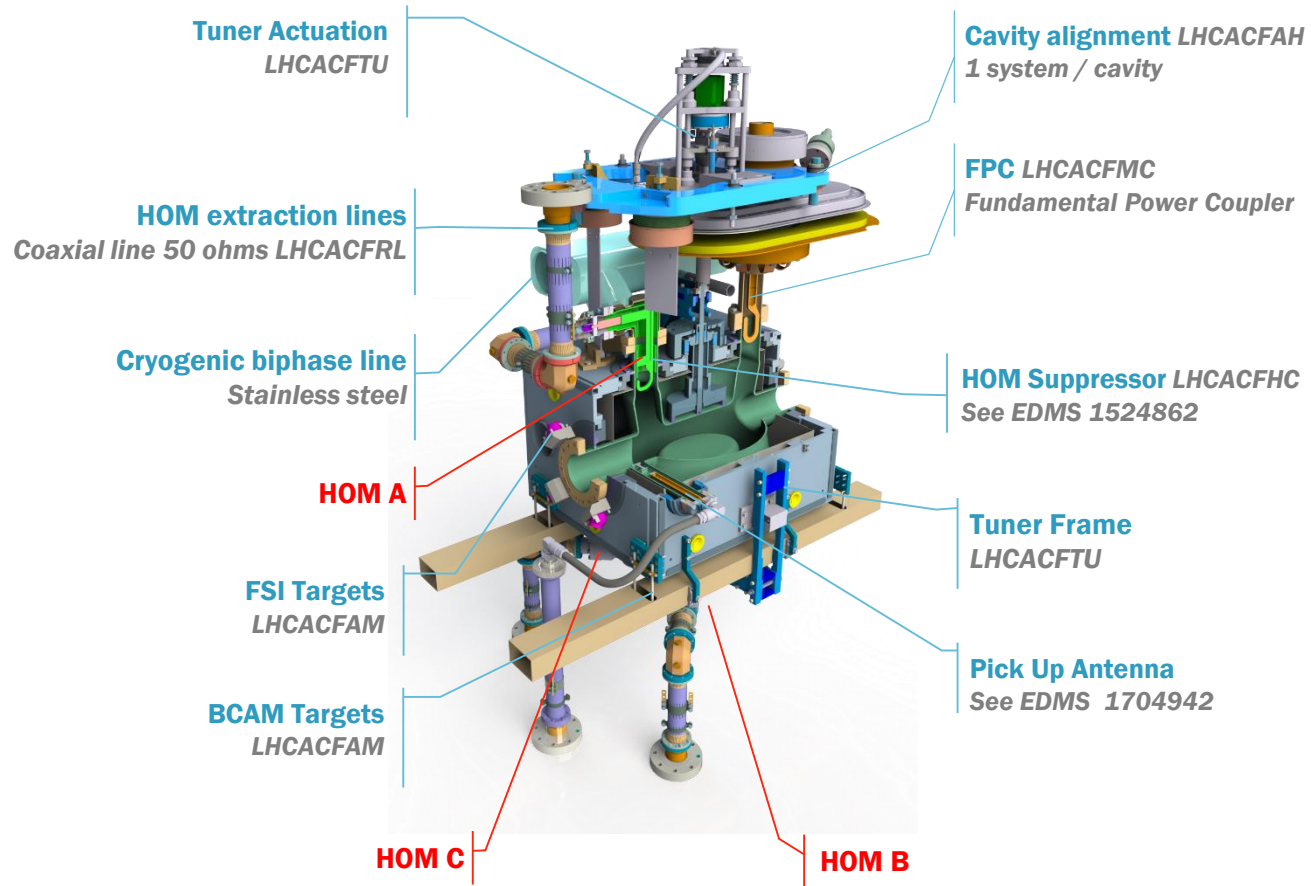


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Tag	Type of gauge	Location	Nominal operation conditions	Range of measurement	Remarks	Installation during step X
TT810	PT100	HOM A cavity 1 coaxial line "warm"	150 K	300 – 100 K	Glued on Ø41mm	Step 11 / Step 12
TT811	cernox	HOM A cavity 1 coaxial line "thermalisation"	70 K	300 – 40 K	Glued on Ø41mm	Step 11 / Step 12
TT812	cernox	HOM A cavity 1 coaxial line "cold"	30 K	300 – 10 K	Glued on Ø41mm	Step 11 / Step 12
TT820	cernox	Helium tank 1- bottom	2 K	300 – 1.5 K	Bolted with copper support	Step 3.8 / Step 8
TT821	cernox	Helium tank 1-middle height	2 K	300 – 1.5 K	Bolted with copper support	Step 3.8 / Step 8
TT822	cernox	Helium tank 1 top	2 K	300 – 1.5 K	Bolted with copper support	Step 3.8 / Step 8
TT823	cernox	Helium tank 2 – bottom	2 K	300 – 1.5 K	Bolted with copper support	Step 3.8 / Step 8
TT824	cernox	Helium tank 2 – middle	2 K	300 – 1.5 K	Bolted with copper support	Step 3.8 / Step 8
TT825	cernox	Helium tank 2 – top	2 K	300 – 1.5 K	Bolted with copper support	Step 3.8 / Step 8
TT813	cernox	HOMS A CF63 cavity 1	2 K	300 – 1.5 K	Glued on flange CF63	Step 3.8 / Step 8
TT814	cernox	HOMS B CF63 cavity 1	2 K	300 – 1.5 K	Glued on flange CF63	Step 3.8 / Step 8
TT815	cernox	HOMS C CF63 cavity 1	2 K	300 – 1.5 K	Glued on flange CF63	Step 3.8 / Step 8
TT816	cernox	HOMS A CF63 cavity 2	2 K	300 – 1.5 K	Glued on flange CF63	Step 3.8 / Step 8
TT817	cernox	HOMS B CF63 cavity 2	2 K	300 – 1.5 K	Glued on flange CF63	Step 3.8 / Step 8
TT818	cernox	HOMS C CF63 cavity 2	2 K	300 – 1.5 K	Glued on flange CF63	Step 3.8 / Step 8
TT819	cernox	HOM (deported TT)	~4 K	300 – 3 K	Glued on flange CF40	Step 3.8 / Step 8
TT831	cernox	Pick up measure (antenna) cav. 1	2 K	300 – 3 K	Glued on flange CF40	Step 3.8 / Step 8
TT832	cernox	Pick up measure (antenna) cav.2	2 K	300 – 3 K	Glued on flange CF40	Step 3.8 / Step 8
TT801	PT100	FPC top 1	300 K external	300 – 220 K	Glued on pipe	Step 3.8
TT802	cernox	FPC 1 thermalization	70 K	300 – 40 K	Glued on pipe	Step 3.8
TT803	cernox	FPC middle 1	50 K	300 – 30 K	Glued on pipe	Step 3.8
TT804	cernox	FPC bottom 1	4 K	300 – 2 K	Glued on flange CF63	Step 3.8
TT805	cernox	FPC middle 2	50 K	300 – 30 K	Glued on pipe	Step 3.8
TT840	PT100 flex	Cold warm tansiston cavity 1	70K		Glued on copper screen	Step 12
TT841	PT100 flex	Cold warm tansiston cavity 2	70K		Glued on copper screen	Step 12

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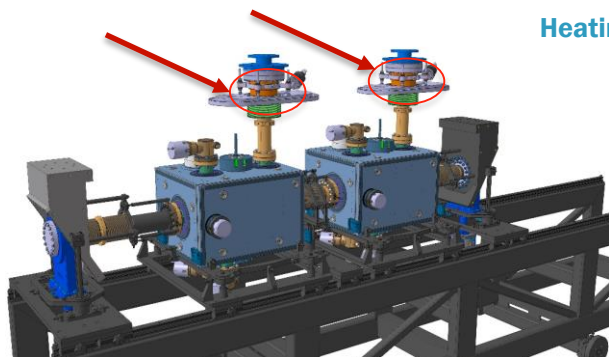
Tag	Type of gauge	Location	Nominal operation conditions	Range of measurement	Remarks	Installation during step X
PT870	Pressure trans.	Pumping line	30 mbara	2 bara – 10 mbara	Installed in Helium guard	Step 12 / step 14
LT821	sc	Helium tank 1	2 K (30 mbara)	0 – 100%	DQW : 720mm	Step 7
LT822	sc	Helium tank 2	2 K (30 mbara)	0 – 100%	DQW : 720mm	Step 7
EH821	Resistive glued printed foil	Helium tank 1	4.5 K	100 W	Max 160x250 mm	Step 8
EH822	Resistive glued printed foil	Helium tank 2	4.5 K	100 W	Max 160x250 mm	Step 8
EH851 and 851	Cartridge	FPC 1 and 2 flanges	~250-300 K 2x 4x heaters	75 W each	Diam 6.5 mm, length 23 mm	Step 1
EH861 and 862	Cartridge	TUNER	~250-300 K x 2 heaters	75 W each	Diam 6.5 mm, length 23 mm	Step 14
EH863	Cartridge	BLADES	~250-300 K x 4 heaters	75 W each	Diam 6.5 mm, length 23 mm	Step 14

Instrumentation layout

HEATERS 1/4

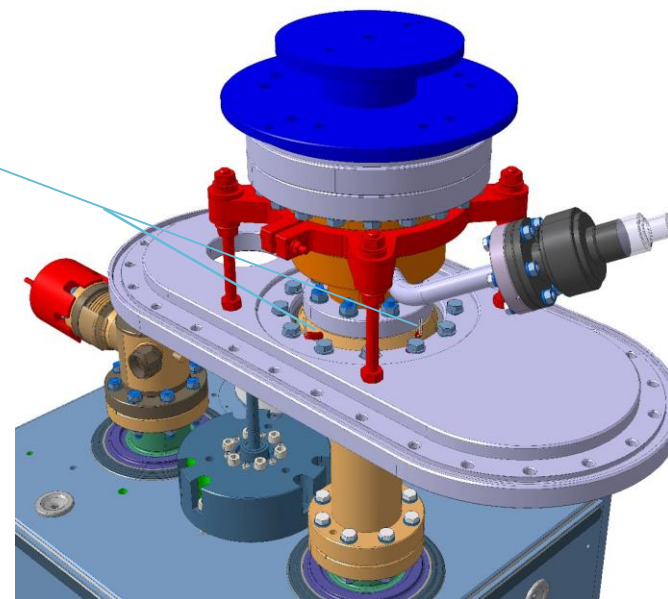
FPC HEATERS (8x – 4/FPC)

- Location

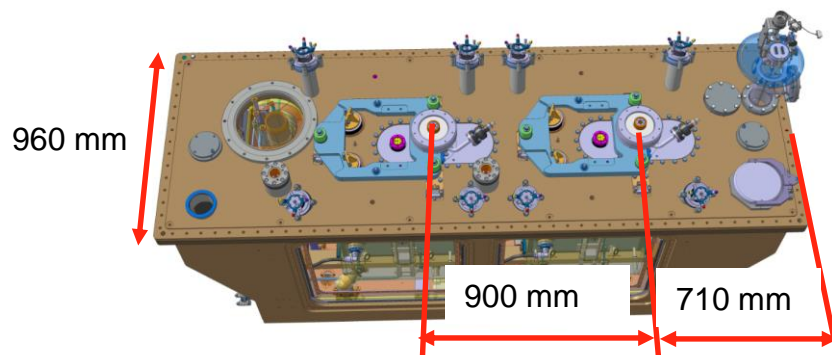


Heating cartridge (x4/FPC – 8 in total)
Ø6.5mm – L25mm – 75W
Installed outside of the cryomodule

Installed during step 1 of assembly sequence)



- Labels : EH851 and 852
- Distance on the top plate :



Instrumentation layout

HEATERS 2/4

Helium tank HEATERS (2x – 1/Cavity)

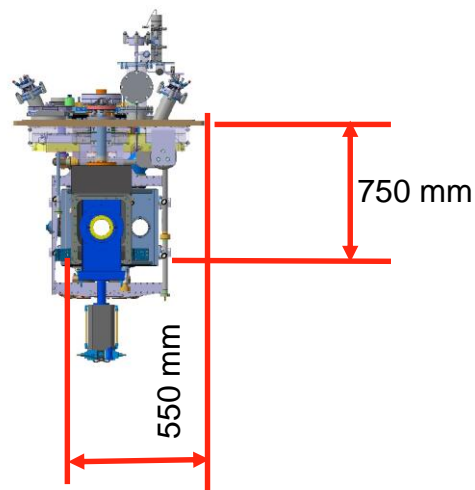
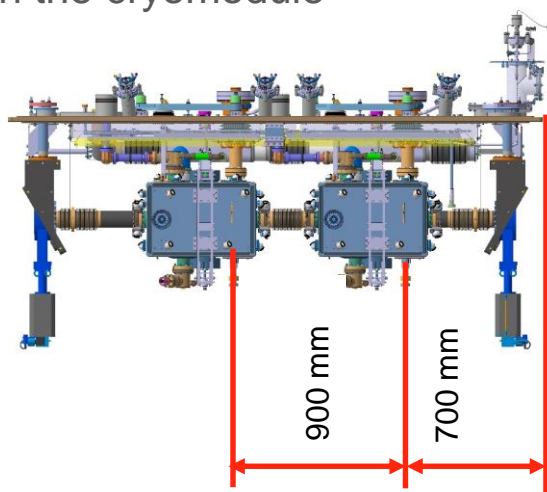
- Location

Resistive glued printed foil
100W



Installed during step 8 of assembly sequence)

- Labels : EH821 & 822
- Distances in the cryomodule



Instrumentation layout

HEATERS 3/4

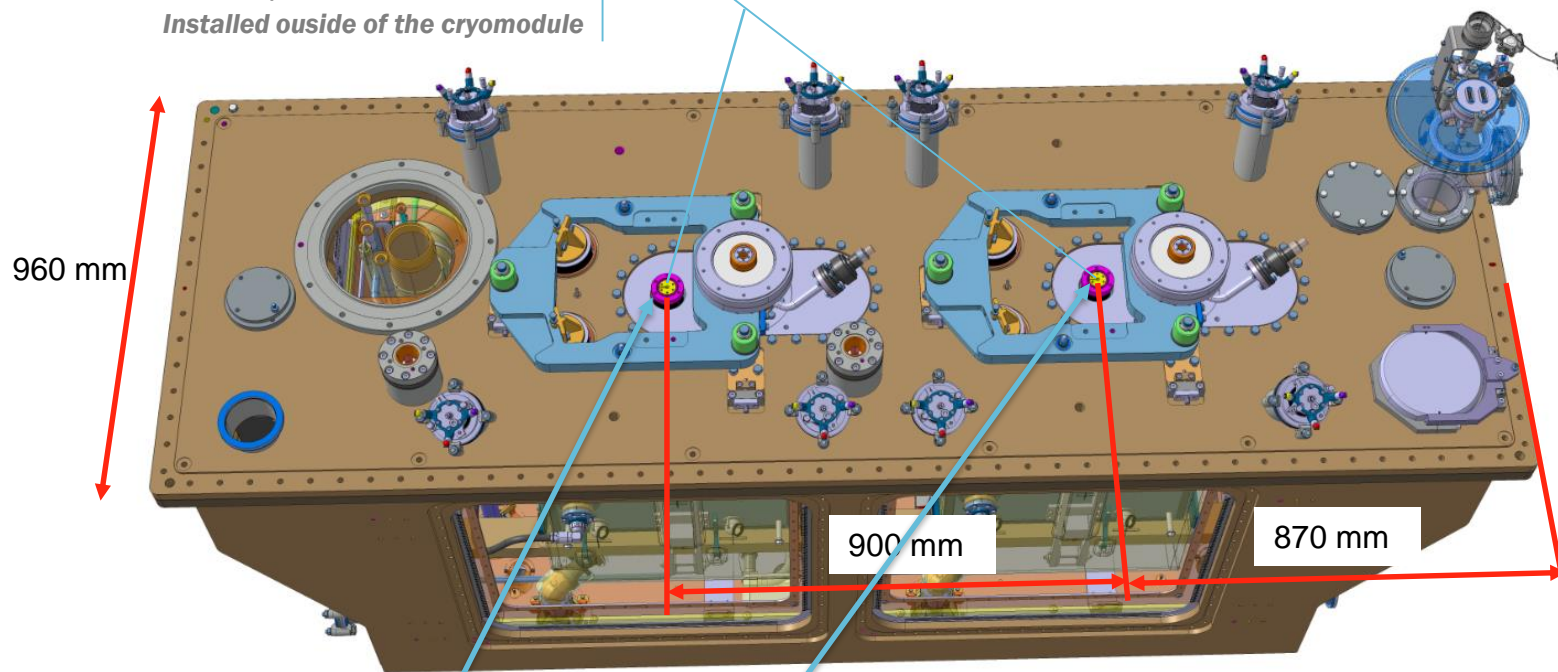
Tuner HEATERS (2x – 1/Tuner)

- Location and distances

Heating cartridge (x1/Tuner – 2 in total)

Ø6.5mm – L25mm – 75W

Installed outside of the cryomodule



Installed during step 14 of assembly sequence)

- Labels : EH861 and EH862

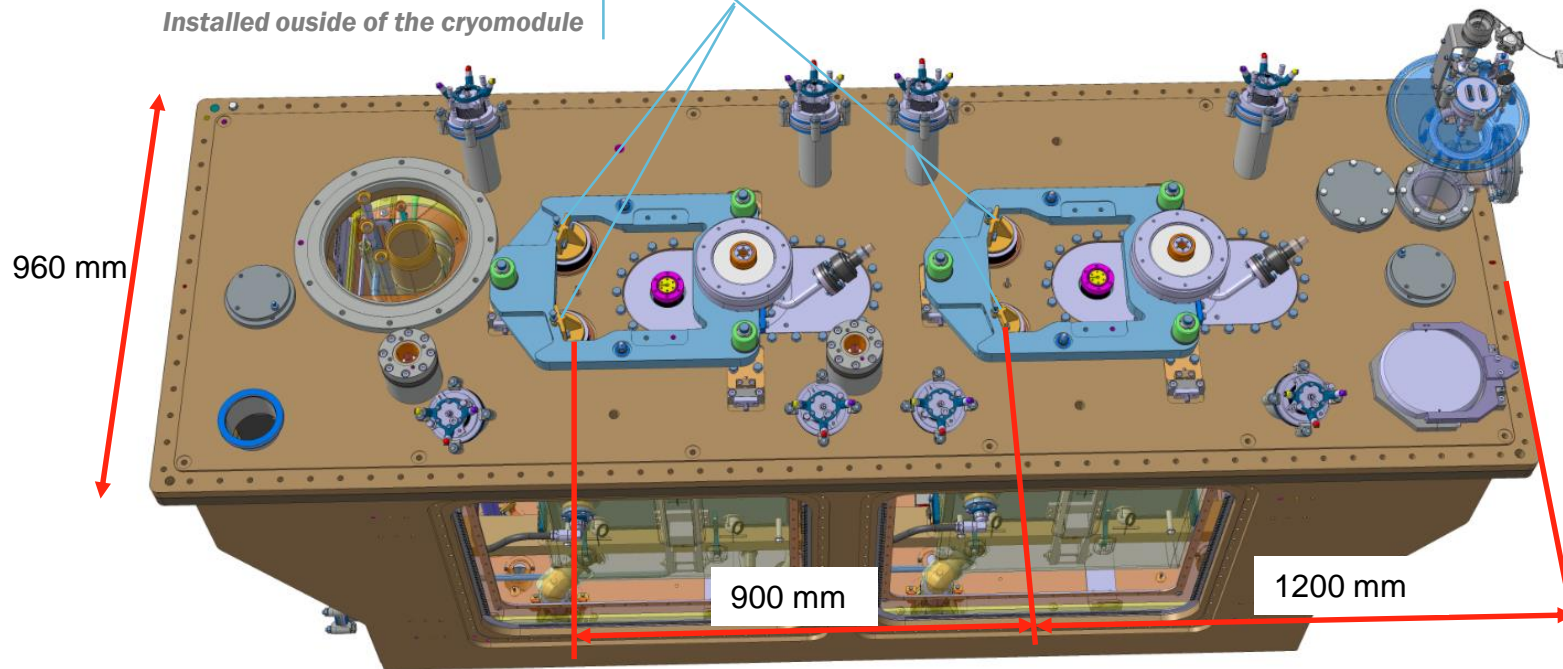
Instrumentation layout

HEATERS 4/4

Blade HEATERS (4x – 1/Blade)

- Location and distances

Heating cartridge (x1/blades – 4 in total)
Ø6.5mm – L25mm – 75W
Installed outside of the cryomodule

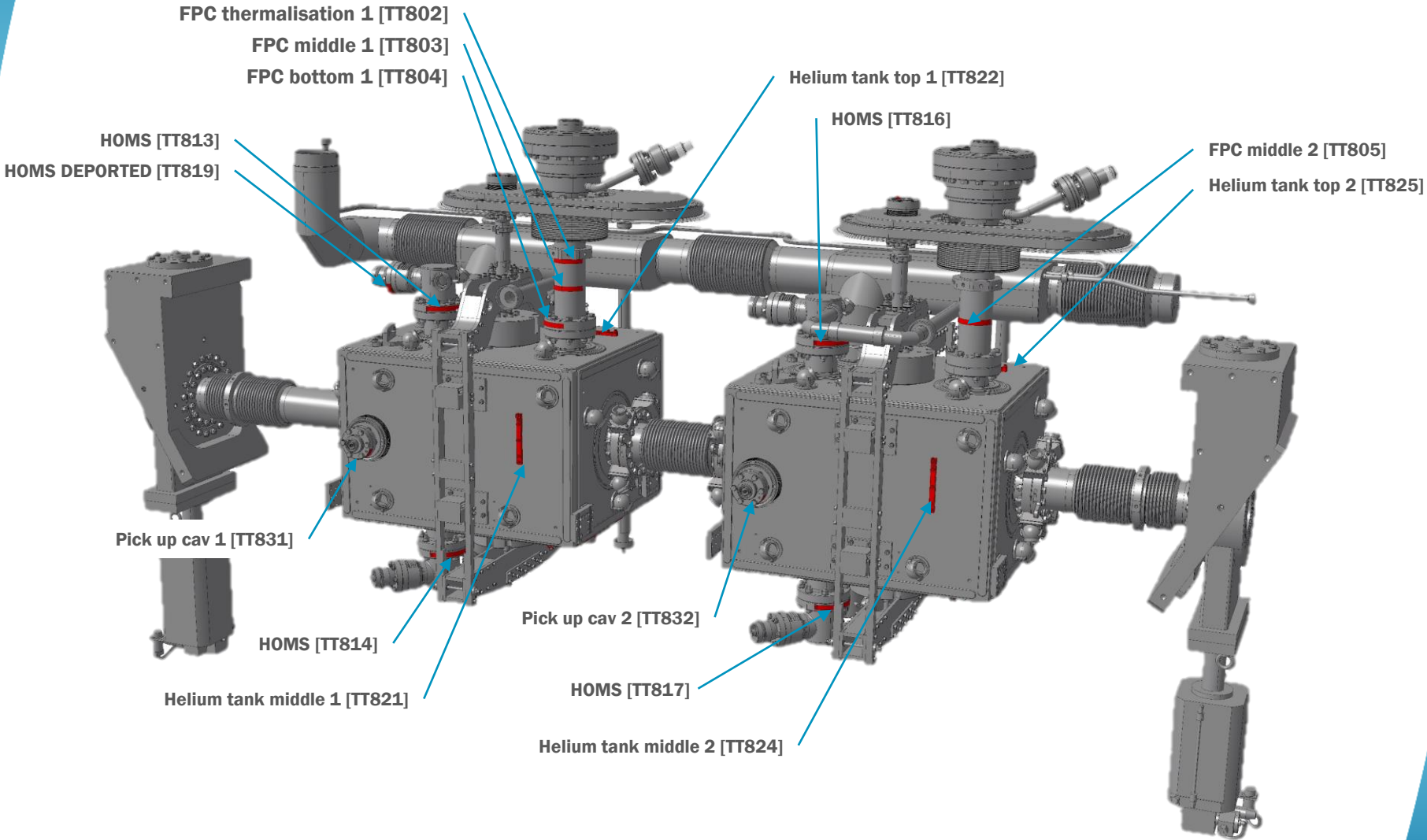


Installed during step 14 of assembly sequence)

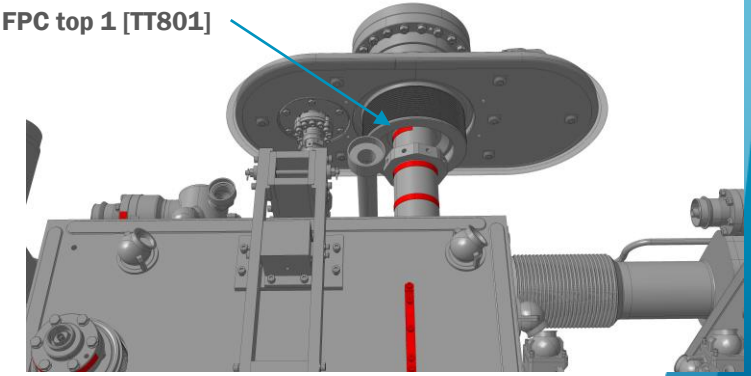
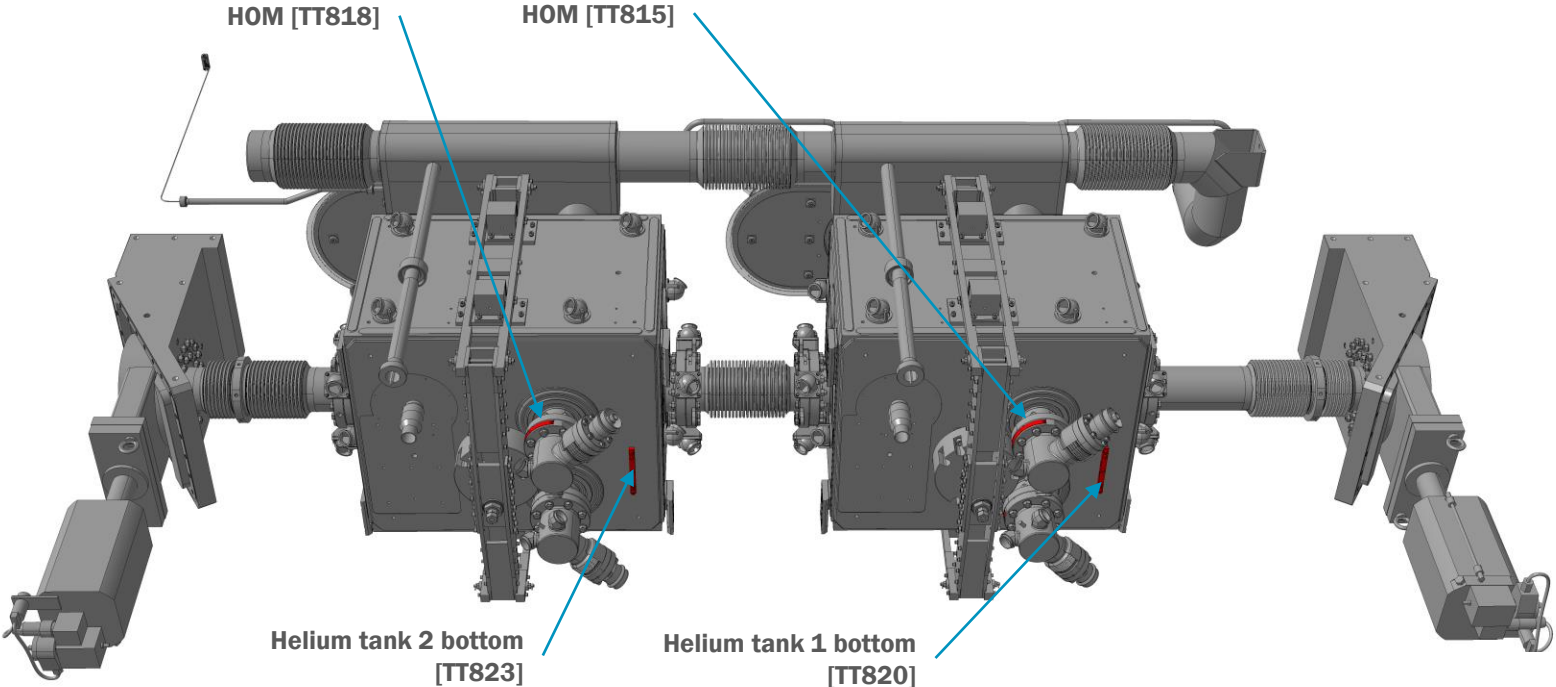
- Labels : all 4 with one tag EH863

Instrumentation layout

Temperature sensors 1/4

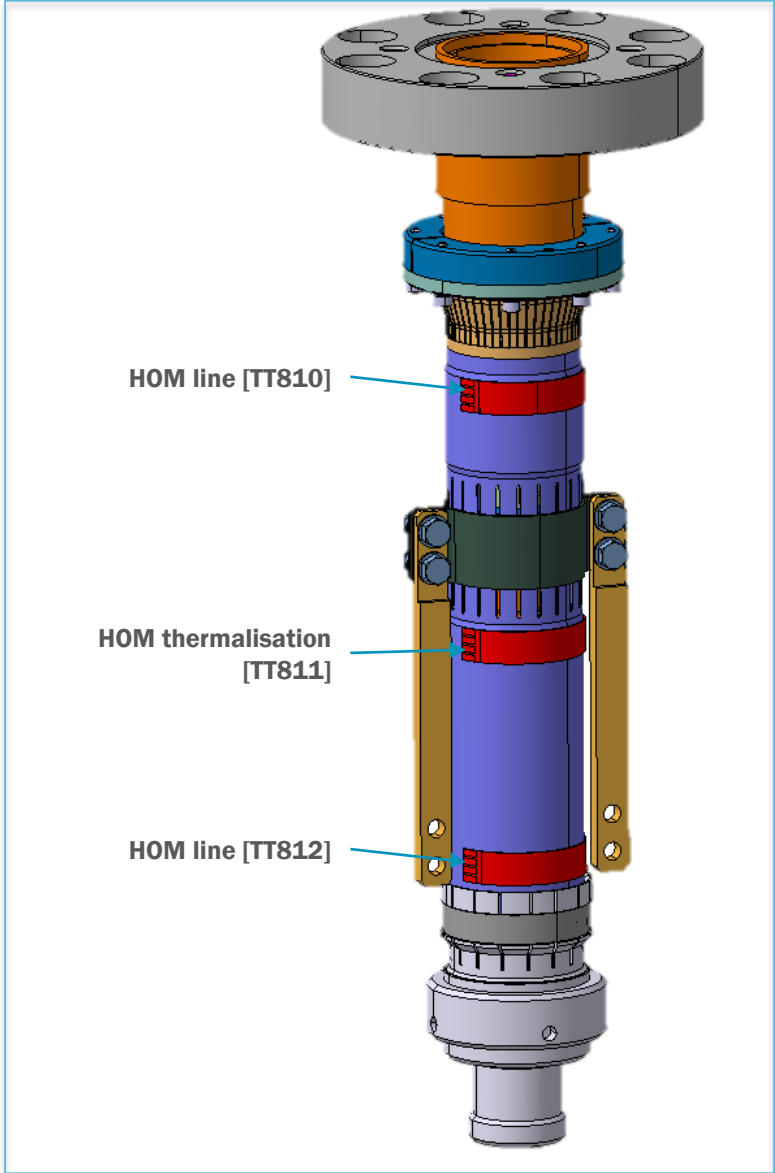
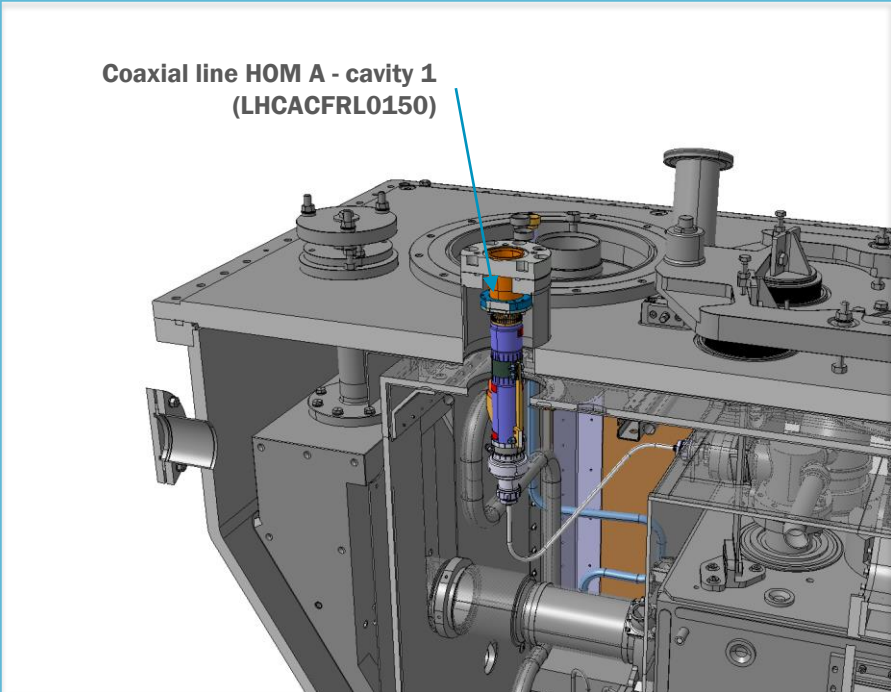


Instrumentation layout Temperature sensors 2/4



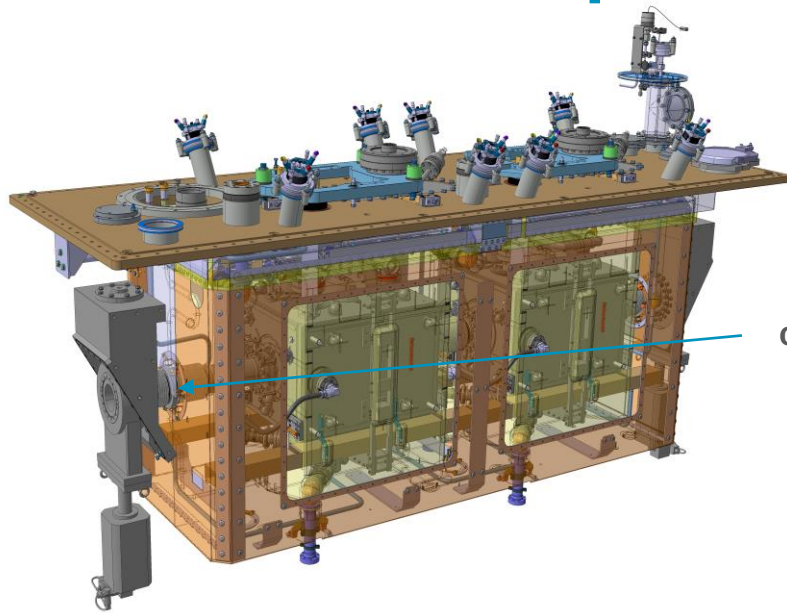
Instrumentation layout

Temperature sensors 3/4

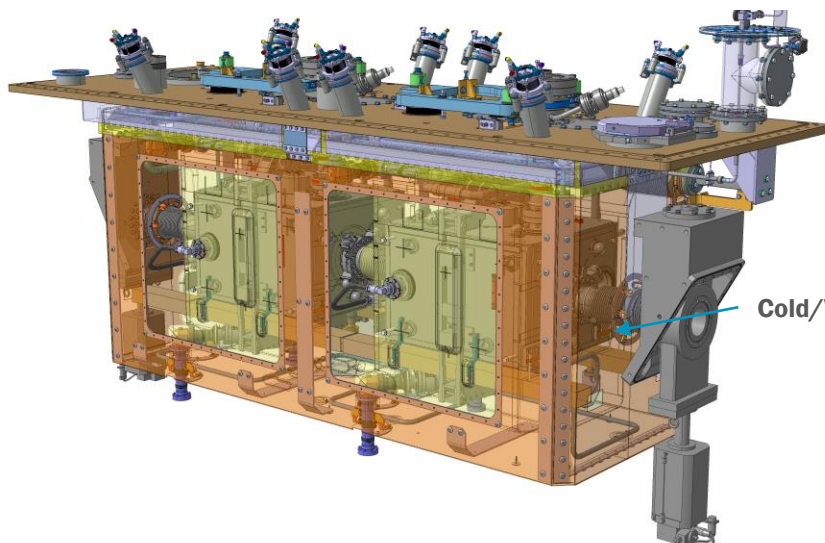
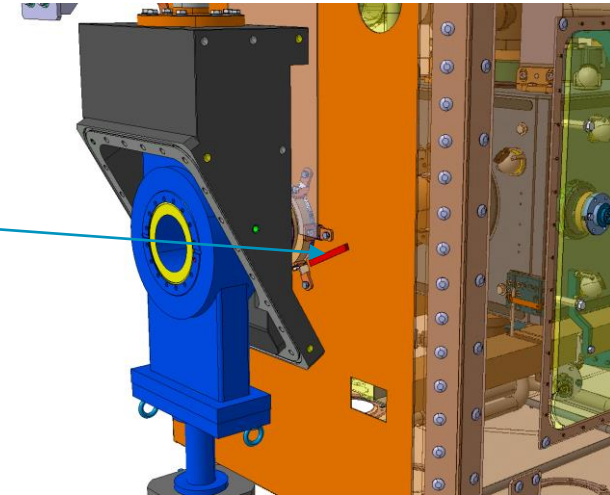


Instrumentation layout

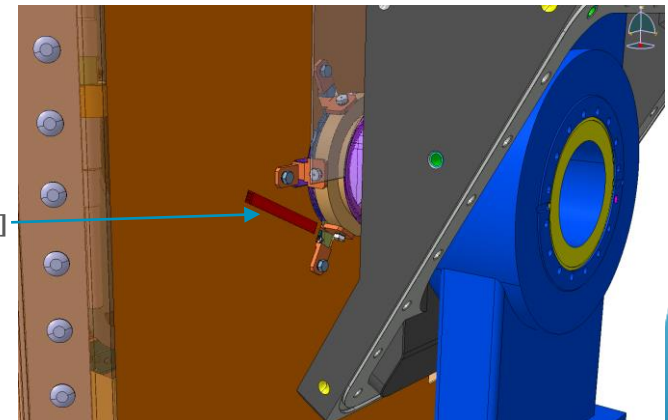
Temperature sensors 4/4



Cold/Warm transition 1 [TT840]



Cold/Warm transition 2 [TT841]



Instrumentation layout

Temperature sensors dimensions

- Distances in the cryomodule for informations

