

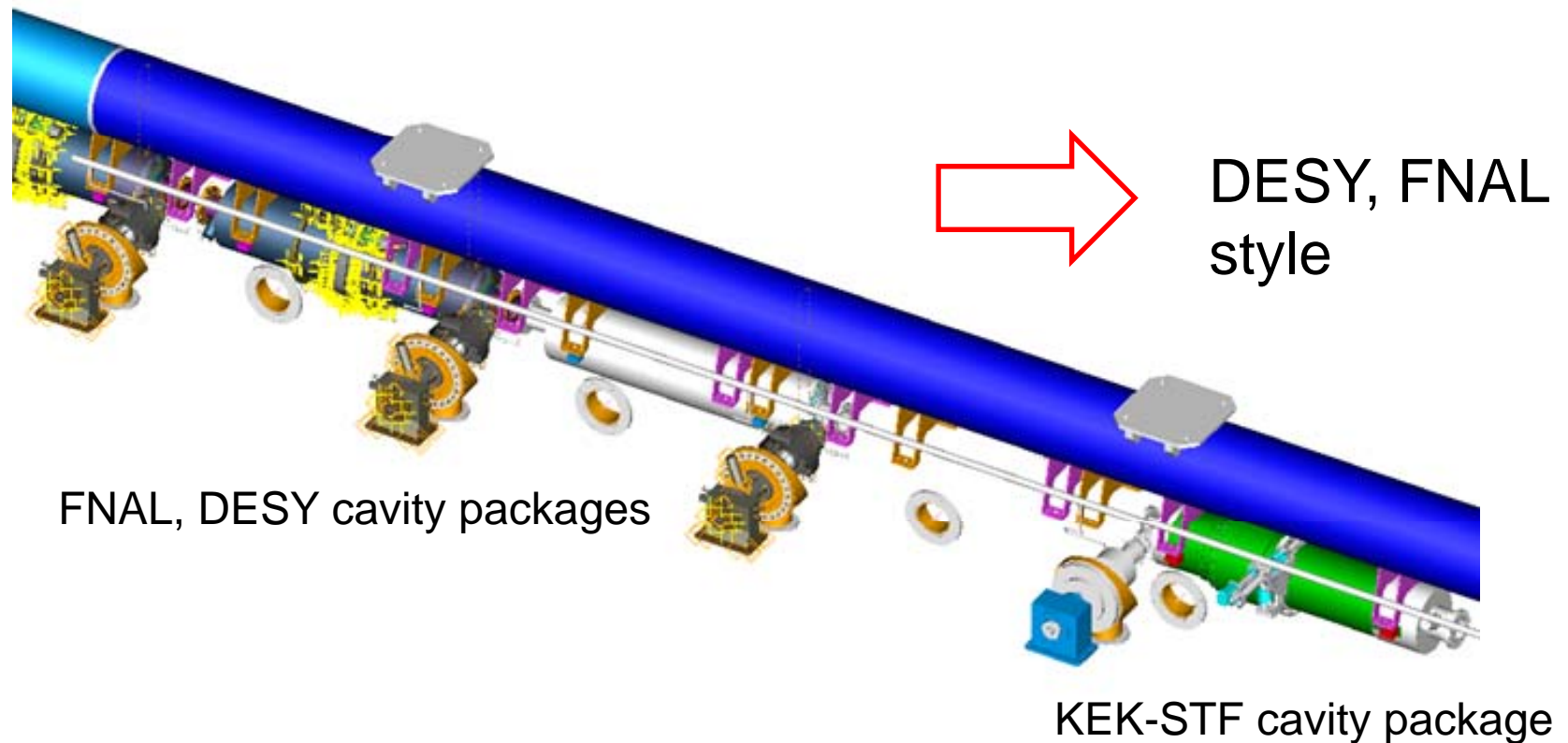
Plug-Compatible Interface of Cryomodule

KEK

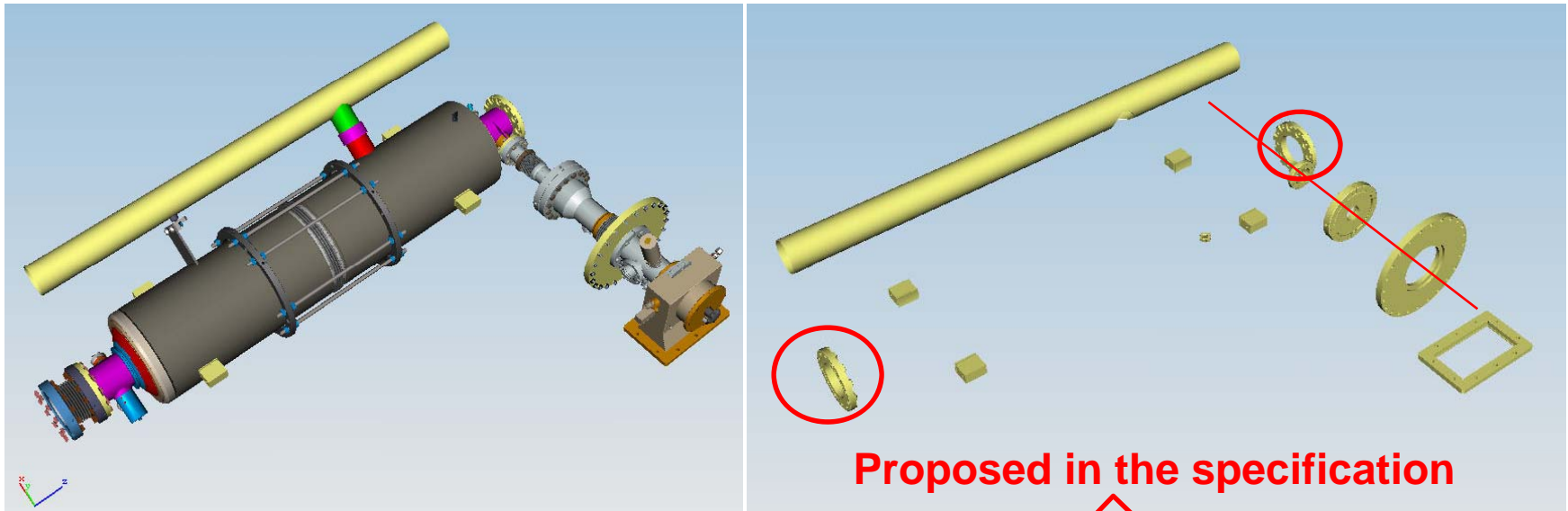
Norihito Ohuchi

Input coupler and cavity jacket

- The direction of input coupler to cavity jacket
 - KEK-STF input couplers connect to beam pipes in the opposite direction with respect to the cavity package.

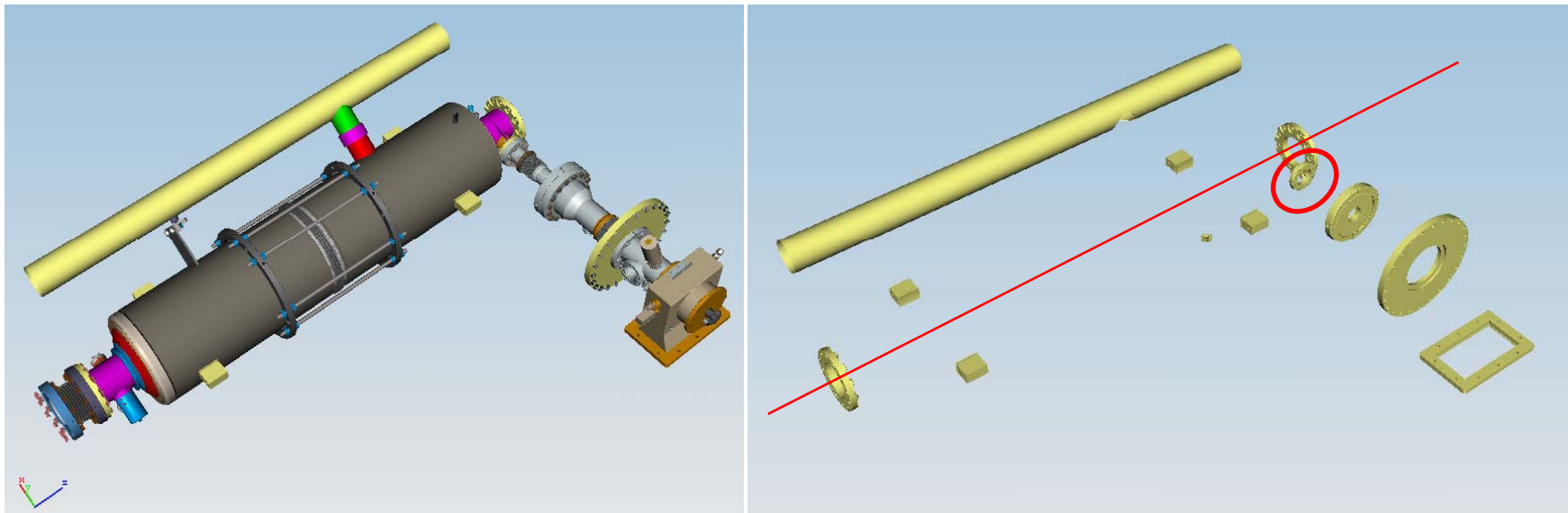


Cavity Package-1



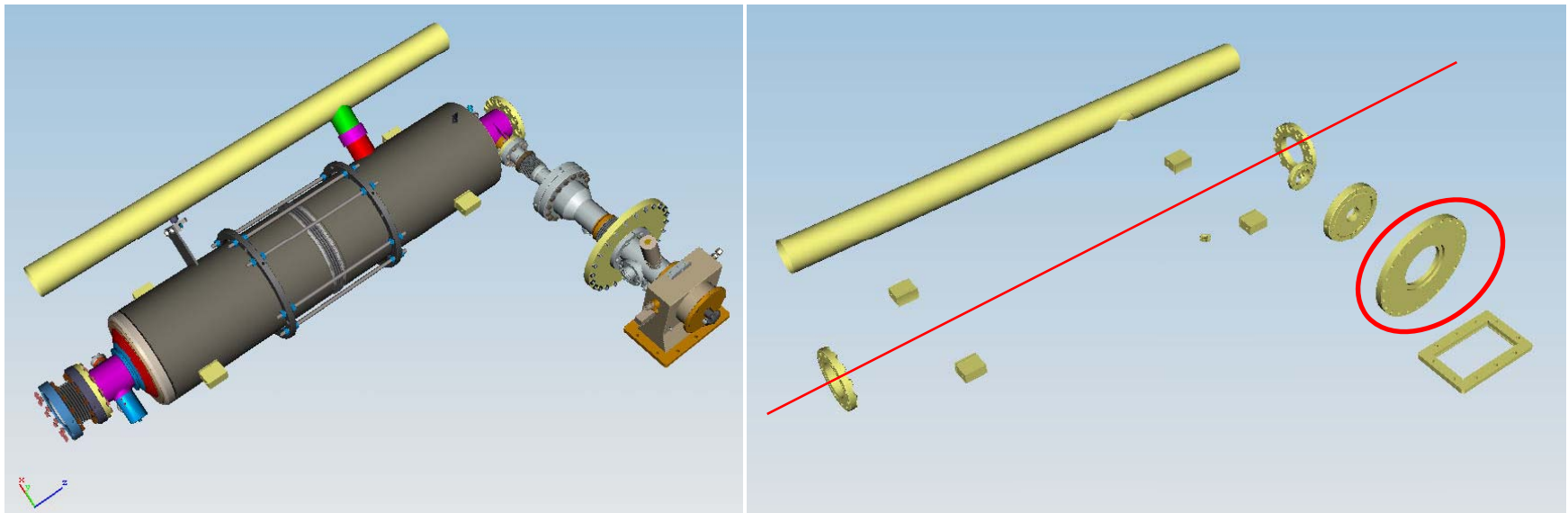
Helium Vessel Body		KEK-STF-BL	KEK-STF-LL	FNAL-T4CM	DESY-XFEL
Helium Jacket	Material	Ti	SUS	Ti	Ti
	Slot length, mm	1337	1337	1326.7	(1382:Type3)
	Distance between beam pipe flanges, m	1258.6	1254.5	1247.4	1283.4
	Distance between bellows flanges, mm	78.4	85.2	80.49 (cold)	
	Outer diameter, mm	242	236	240	240
Beam Pipe Flange	Material	NbTi	Ti	NbTi	NbTi
	Outer diameter, mm	130	140	140	140
	Inner diameter, mm	84	80	82.8	82.8
	Thickness, mm	14	17.5	17.5	17.5
	PCD, bolts	$\phi 115, 16-\phi 9$	$\phi 120, 16-\phi 9$	12, M8 SS studs	12, M8 SS studs
	Sealing	Helicoflex	M-O seal	Al Hex Seals	Hexagonal Al ring
	Distances between the connection surface and input coupler axis	62, -1196.6	58.1, -1213.9	60.6, -1186.8	60.6, -1222.8

Cavity Package-2



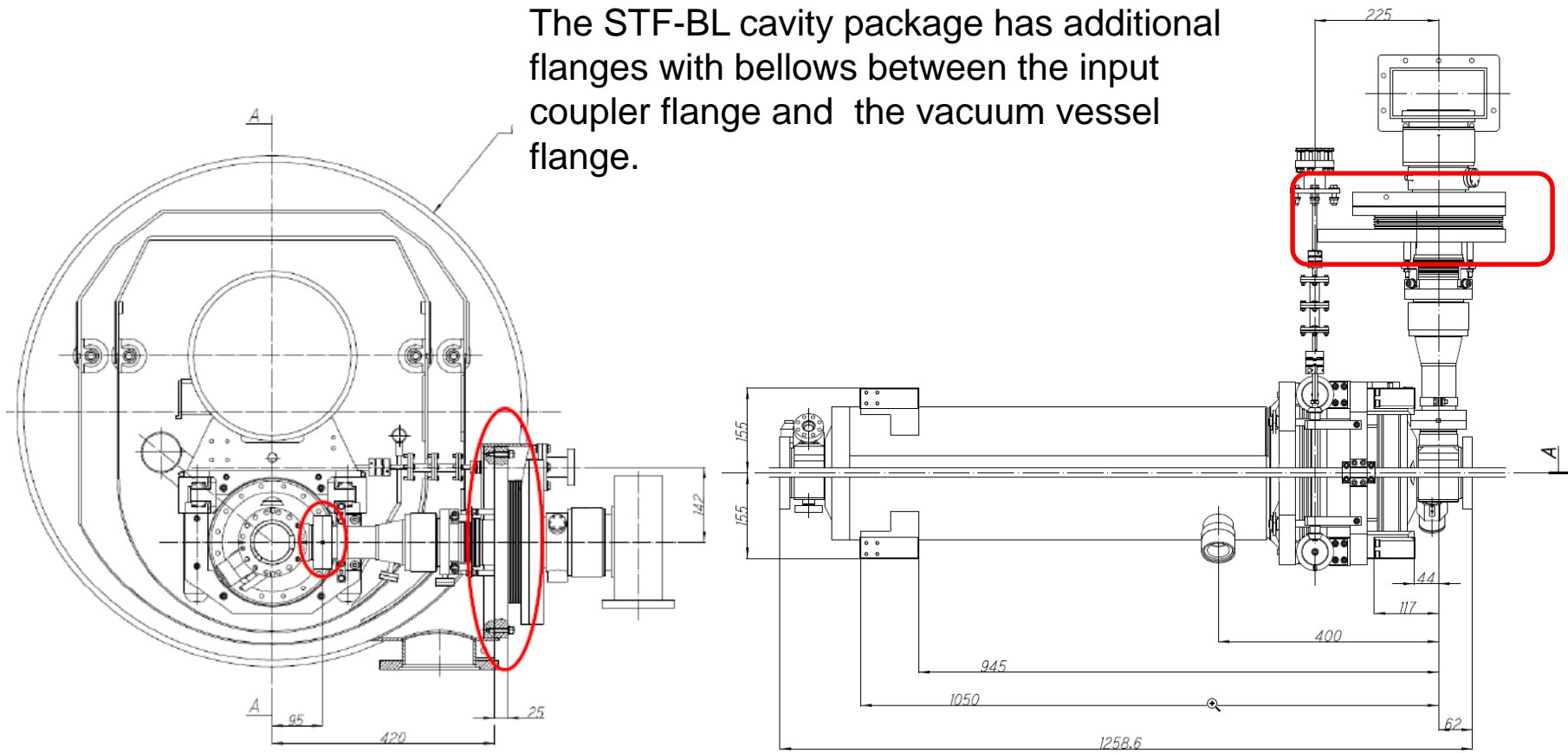
Input Coupler		KEK-STF-BL	KEK-STF-LL	FNAL-T40M	DESY-XFEL
Connection flange	Material	SUS316L	SUS316	316LN S.S.	316LN S.S.
on Input Coupler	Outer diameter, mm	102	76	~79.75	~79.75
	Inner diameter, mm	60	40	40	40
	Thickness, mm	14	21	14.7/12.7 w overlap	14.7/12.7 w overlap
	PCD, bolts	$\phi 86, 12-\phi 8.6$	$\phi 27, 6-M4$	8, M6 S.S. Studs	8, M6 S.S. Studs
Connection Flange	Material	NbTi	Ti	NbTi	NbTi
on beam pipe	Outer diameter, mm	102	76	76	76
	Inner diameter, mm	60	40	44	44
	Thickness, mm	13	15	12.7	12.7
	PCD, bolts	$\phi 86, 12-\phi 8.6$	$\phi 63.5, 8-\phi 7$	8, M6 SS Studs	8, M6 SS Studs
	Sealing	Helicoflex (Cu coated by In)	M-O seal (Al gasket)	Al hex seal	Al hex seal
	Distance between the connection surface and cavity axis	95	88	88	88

Cavity Package-3

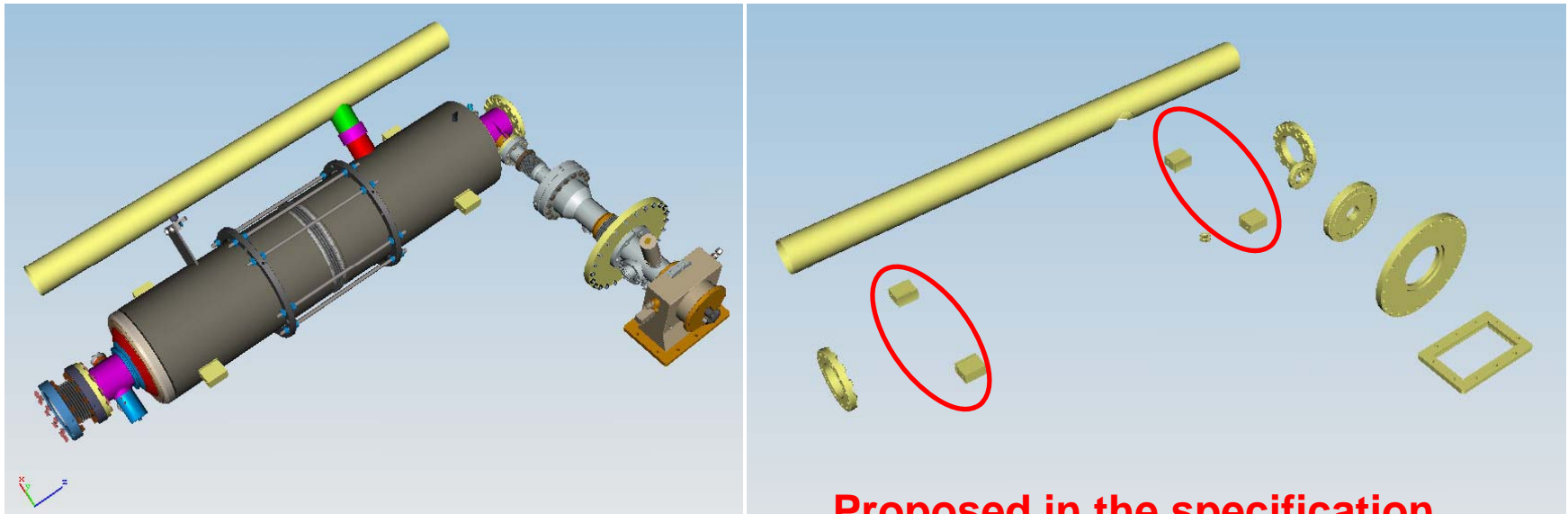


Input Coupler		KEK-STF-BL	KEK-STF-LL	FNAL-T4CM	DESY-XFEL
Connection flange	Material	SUS316L	SUS316	316L S.S.	316L S.S.
to vacuum vessel	Outer diameter, mm	185	265	260	260
	Inner diameter, mm	104	212.5		
	Thickness, mm	16	21	16	16
	PCD, bolts	$\phi 144, 16-M8 \times 10/8$	$\phi 245, 12-\phi 8.5$	24, M8 SHCS S.S.	24, M8 SHCS S.S.
	Sealing	O-Ring (G-165)	O_Ring	O_Ring	O_Ring
	Distance between the connection				
	surface and cavity axis	485	488	473.5	473.5

The STF-BL cavity package has additional flanges with bellows between the input coupler flange and the vacuum vessel flange.



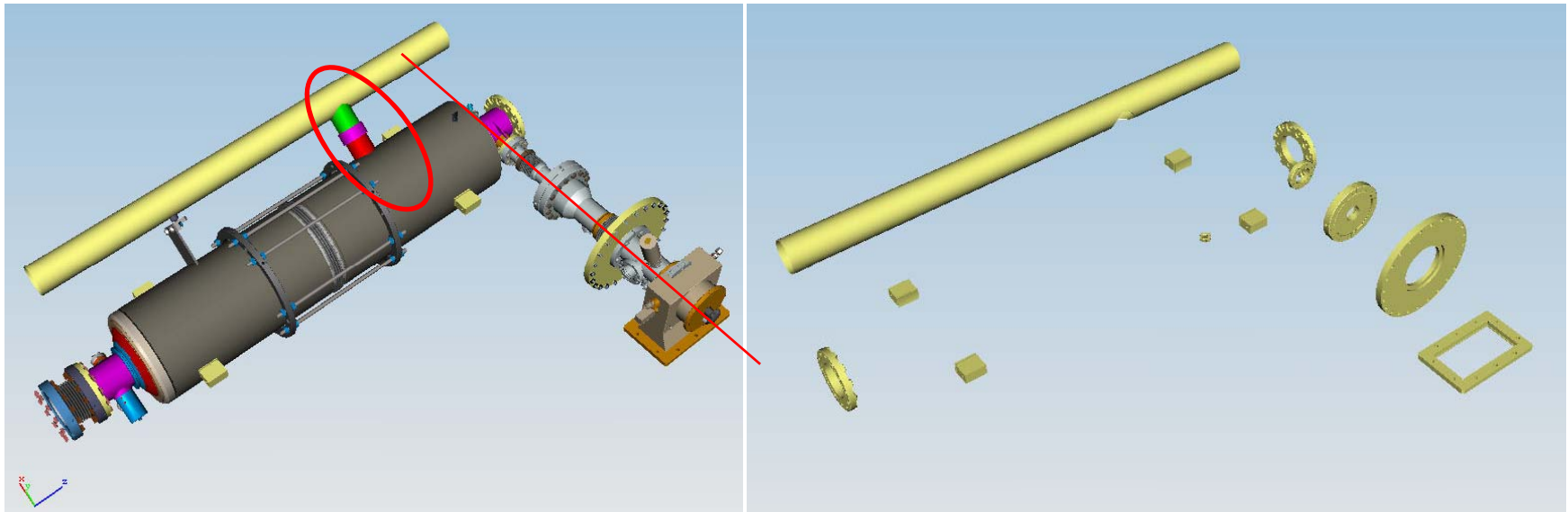
Cavity Package-4



Proposed in the specification

		KEK-STF-BL	KEK-STF-LL	FNAL-T4CM	DESY-XFEL
Support Lug (front)	Material	SUS316	SUS316	Ti	Ti
	Horizontal positions from input coupler axis and wide, mm	Z=-77.5, W=67	Z=-141.9, W=50	Z=-947.51, W=50	Z=-946.87, W=40
	Horizontal positions from beam axis and wide, mm	X=155, W=38	X=161, W=38	X=161, W=41	X=161, W=35.82
	Vertical positions from cavity center and thickness, mm	Y=160, T=24	Y=0, T=24	Y=0, T=24	Y=0, T=24
Support Lug (backward)	Material	TP340	SUS316	Ti	Ti
	Horizontal positions from input coupler axis and wide, mm	Z=-997.5, W=105	Z1=-1013.9, W=50	Z=-197.51, W=50	Z=-196.87, W=40
	Horizontal positions from beam axis and wide, mm	X=155, W=38	X=161, W=38	X=161, W=41	X=161, W=35.82
	Vertical positions from cavity center and thickness, mm	Y=160, T=24	Y=0, T=24	Y=0, T=24	Y=0, T=24

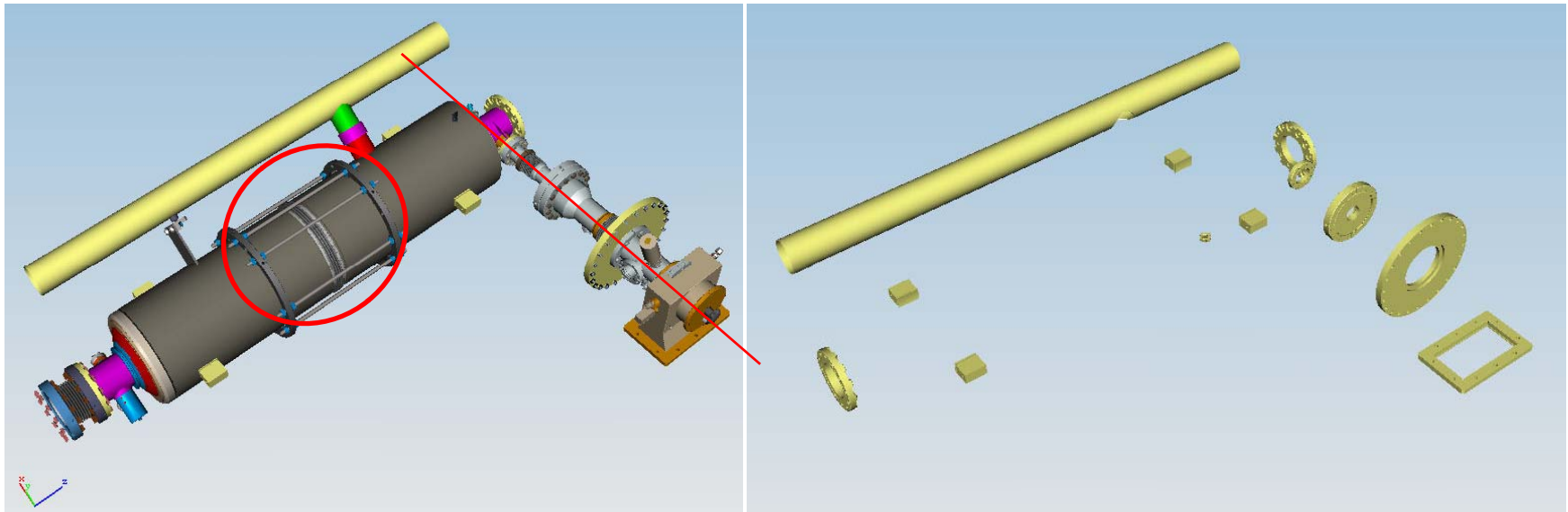
Cavity Package-5



		KEK-STF-BL
Cross connect pipe to	Material	Ti and Ti-SUS junction
LHe supply pipe	Outer diameter, mm	$\phi 55$ (Vessel side), $\phi 60.5$ (Junction), $\phi 60.5$ (S.P. side)
	Angle to the horizontal phase, degree	39
	Pipe length, mm	111
	Location from input coupler axis, mm	Z=-400

KEK-STF-LL	FNAL-T4CM	DESY-XFEL
SUS316	bi-metallic Ti - SS	Ti
$\phi 76.3$ (Vessel side), $\phi 60.5$ (S.P. side)	60.3	60.3
39	38.7	38.7
114	105.5	105.5
-800	-328	Z=-842.87

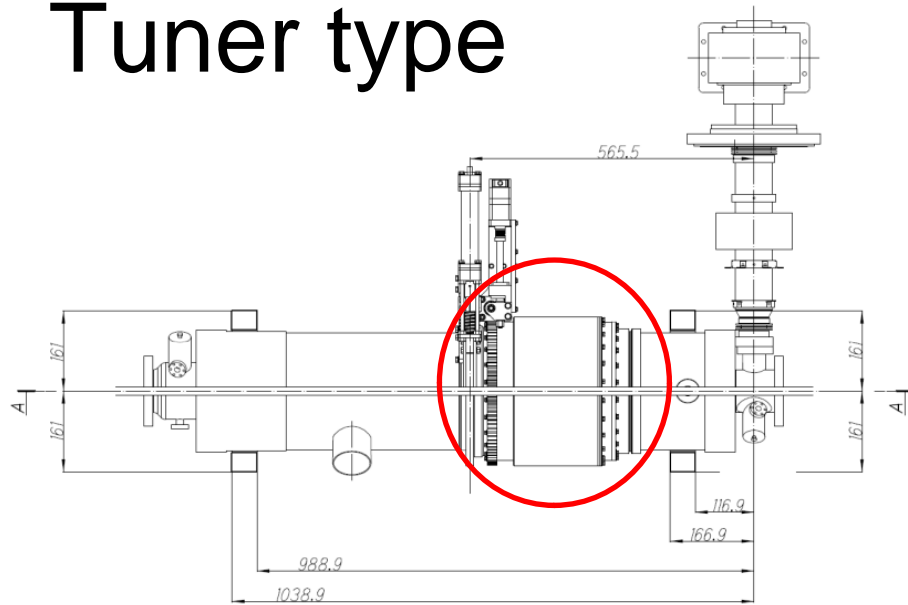
Cavity Package-6



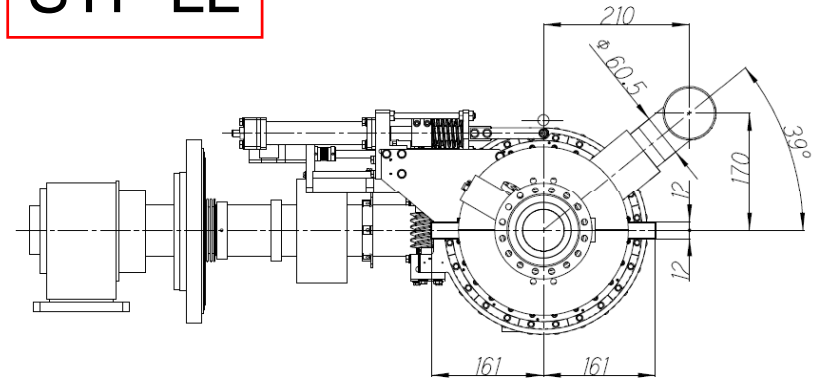
Frequency Tuner		KEK-STF-BL
Tuner Type		Slide jack type
Motor		outside of vacuum vessel
Driving motor shaft		Y=142, Z=-225
Occupied volume		Volume (-135.5<X<135.5, -135<Y<140, -130<Z<-290)

KEK-STF-LL	FNAL-T4CM	DESY-XFEL
Coaxial ball screw	INFN Bladetuner	Sacley tuner
inside vacuum vessel	inside vacuum vessel	inside vacuum vessel
Volume (R<149, -275<Z<-586.9)		

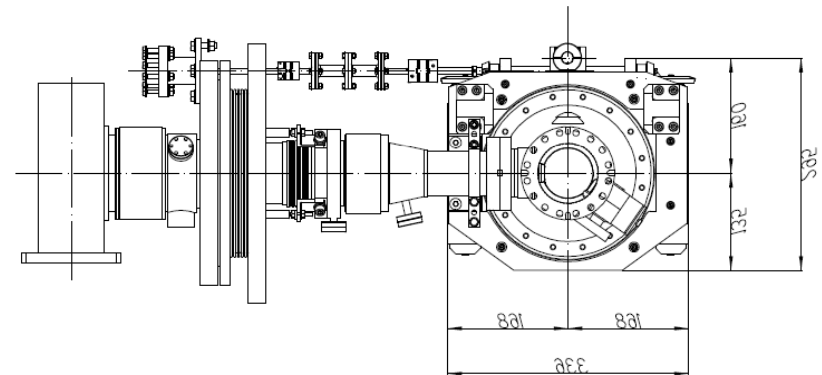
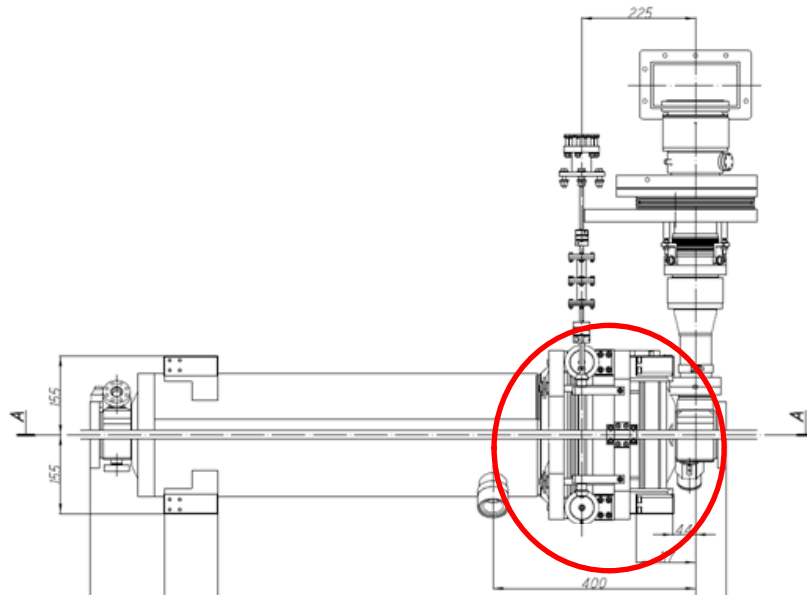
Tuner type



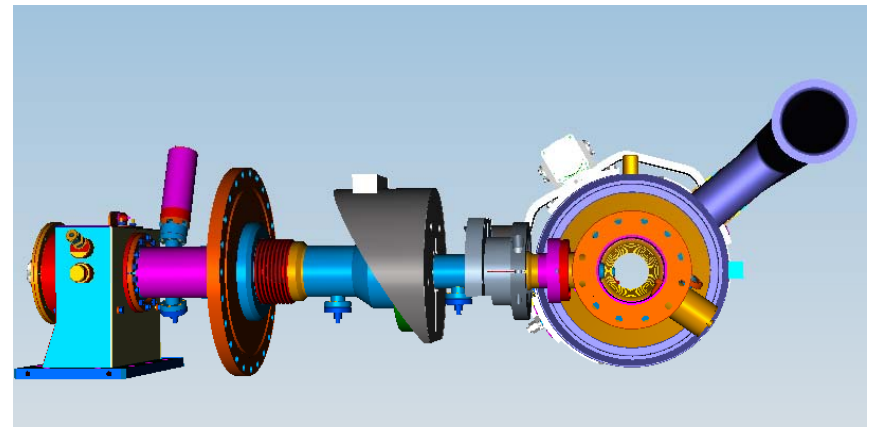
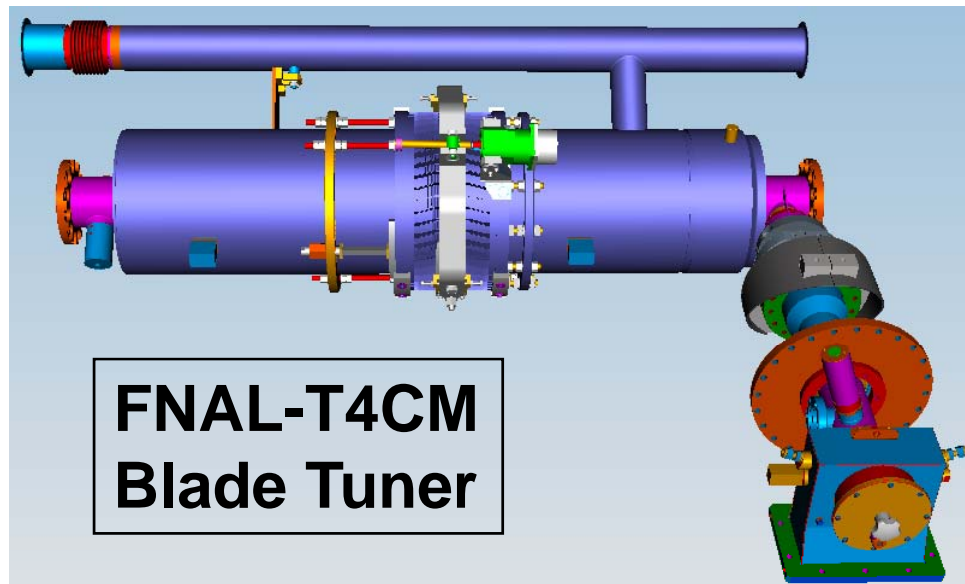
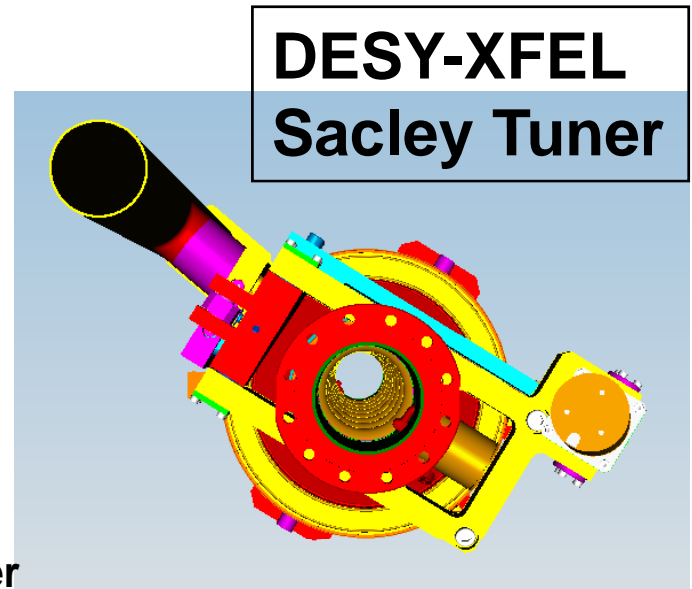
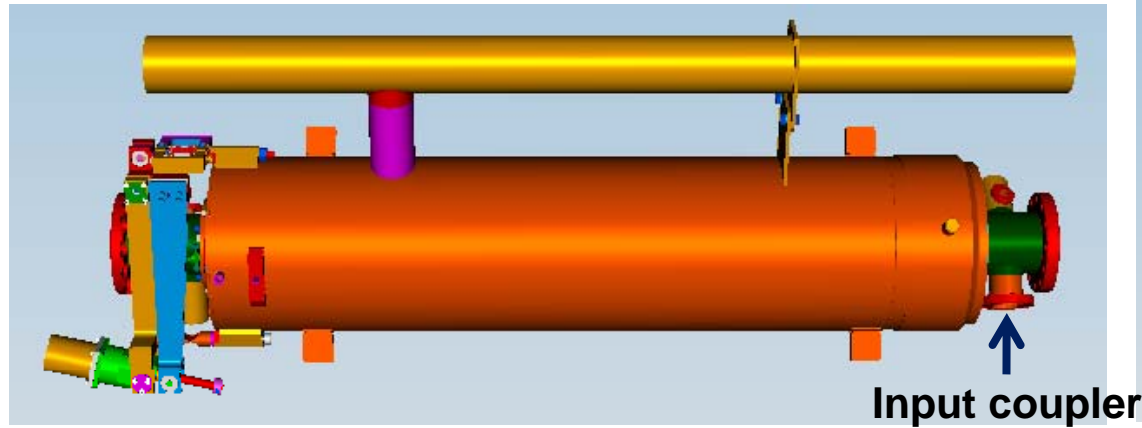
STF-LL



STF-BL

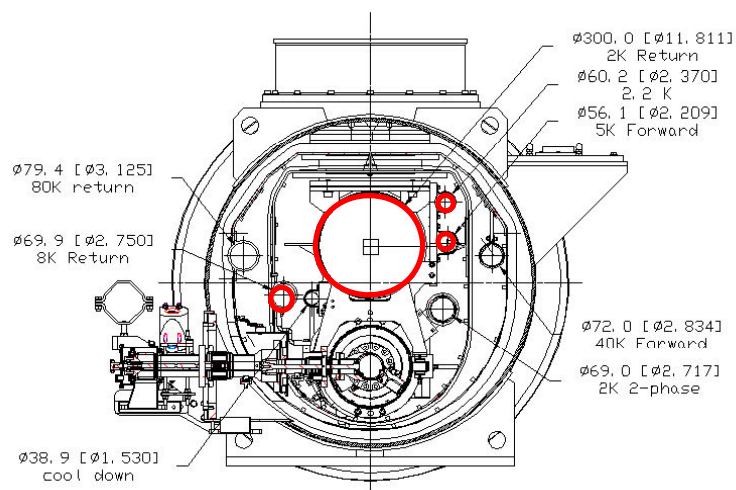
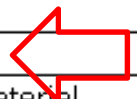


Tuner type



Cooling Pipes

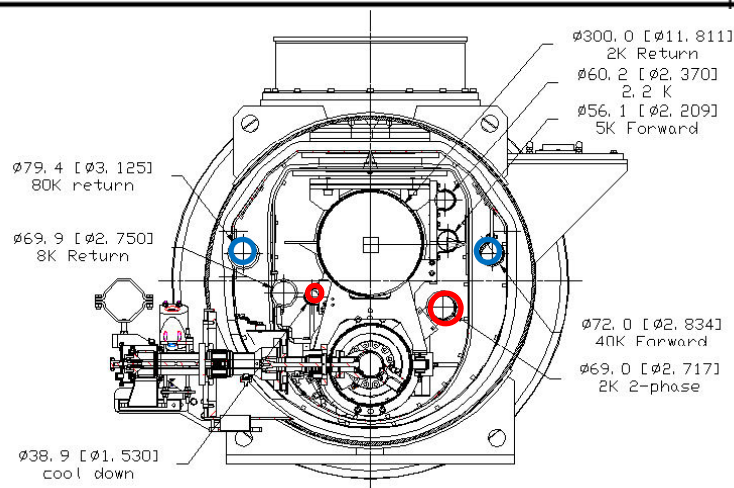
Cooling pipes		
2.2 K subcooled supply pipe	Material	SUS
	Inner diameter , mm	60
	Maximum design pressure , bar	20
	Position w.r.t. the cavity center (x,y)	(219, 481.5)
Major return header (GRP)	Material	SUS
	Inner diameter , mm	300
	Maximum design pressure , bar	2 at warm (4 at cold)
	Position w.r.t. the cavity center (x,y)	(0., 356)
5K shield and intercept (supply)	Material	Al 1050 or equivalent material
	Inner diameter , mm	56.1
	Maximum design pressure , bar	20
	Position w.r.t. the cavity center (x,y)	(225.5, 362.5)
8K shield and intercept (return)	Material	Al 1050 or equivalent material
	Inner diameter , mm	70
	Maximum design pressure , bar	20
	Position w.r.t. the cavity center (x,y)	(-252, 210)



The beam line (cavity axis) locates in the position of (0, -247) with respect to the center of vacuum vessel)..

Cooling Pipes-2

40K-80K shield and intercept (supply)	Material	Al 1050 or equivalent material
	Inner diameter , mm	72
	Maximum design pressure , bar	20
	Position w.r.t. the cavity center (x,y)	(355, 325)
40K-80K shield and intercept (return)	Material	Al 1050 or equivalent material
	Inner diameter , mm	80
	Maximum design pressure , bar	20
	Position w.r.t. the cavity center (x,y)	(-367, 326)
2-phase pipe	Material	SUS or Ti
	Inner diameter , mm	72.1
	Maximum design pressure , bar	2 at warm (4 at cold)
	Position w.r.t. the cavity center (x,y)	(210.6, 170.6)
Cooldown and Warmup	Material	SUS
	Inner diameter , mm	38.9
	Maximum design pressure , bar	2 at warm (4 at cold)
	Position w.r.t. the cavity center (x,y)	(-170, 200)
Helium vessel to 2-phase pipe cross-connect	Material	SUS or Ti
	Inner diameter , mm	54.9
	Maximum design pressure , bar	2 at warm (4 at cold)



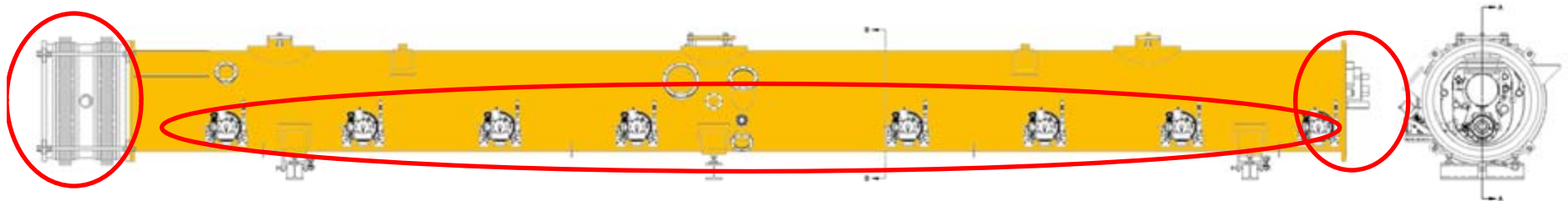
Vacuum Vessel

Vacuum vessel	Cryomodule slot length	12679.6	12679.6
	Material (demagnetized)	Carbon Steel	Carbon Steel
	Length (+ vacuum bellow length)	11829.6 (+850)	11829.6 (+850)
	tolerance of length	± 3	± 3
	Outer diameter	965.2	965.2
	Inner diameter	955.7	955.7
	Height of vessel center axis from the support base level	832	832
	Input coupler port	8	9
	Main Coupler #1 z position	-4744.1	-4744.1
	Main Coupler #2 z position	-3417.4	-3417.4
	Main Coupler #3 z position	-2090.7	-2090.7
	Main Coupler #4 z position	-764	-764
	Main Coupler #5 z position	(Quadrupole PKG)	562.7
	Main Coupler #6 z position	1889.4	1889.4
	Main Coupler #7 z position	3216.1	3216.1
	Main Coupler #8 z position	4542.8	4542.8
	Main Coupler #9 z position	5869.5	5869.5
	(Tuner driver-shaft port)	8	9
	Port for current leads	1	0
	current lead terminals (quadrupole, 2 dipoles)	6	0
	Port for signal wires	2	2
	Port for vacuum	2	2
	Residual magnetic field on the beam line	< 0.1 Gauss	< 0.1 Gauss



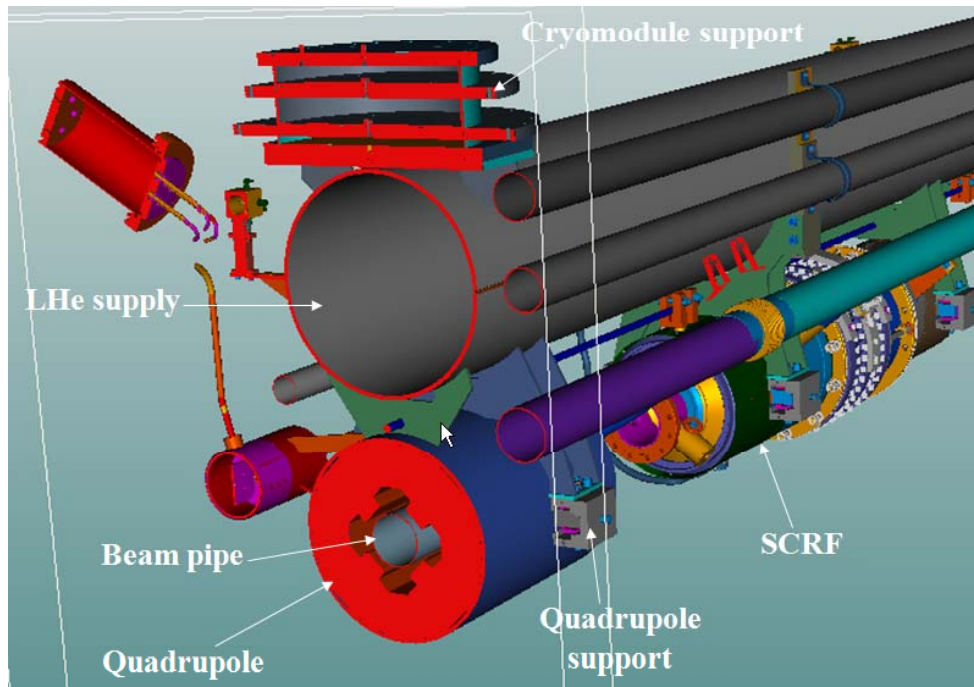
Interface

1. Connection flange and vacuum bellow:
T4-CM design
2. Main coupler flanges on the vessel:
Locations defined in Spec. Table
Design need to be studied



Quadrupole Package

Quadrupole Package (Quadrupole, correctors, BPM)	Quadrupole package slot	same as the cavity slot
		Maximum allowable outer radius, mm
	Beam pipe flange	same as the cavity flange
	Connection to GRP (under the center support post)	same as the cavity support mechanism
	2K-2phase pipe connection	Connection design
	Precooling pipe connection	Connection design
	Feedthrough for current leads	Connection design



Quadrupole design
by FNAL