

TDR Part 2:

3.3 Cavity Integration

(10 pages)

Baseline Design based on the SCRF-BTR@KEK meeting discussion

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Write-up contents will be;

3.3 Cavity integration

3.3.1 Coupler design

TTF-III coupler design

3.3.2 Tuner design

Blade tuner design

3.3.3 He Jacket and interface

Ti jacket, bellows in-between support tabs

magnetic shield inside

Nb-Ti flange with aluminum hexagonal seal

3.3.4 Plug compatible design

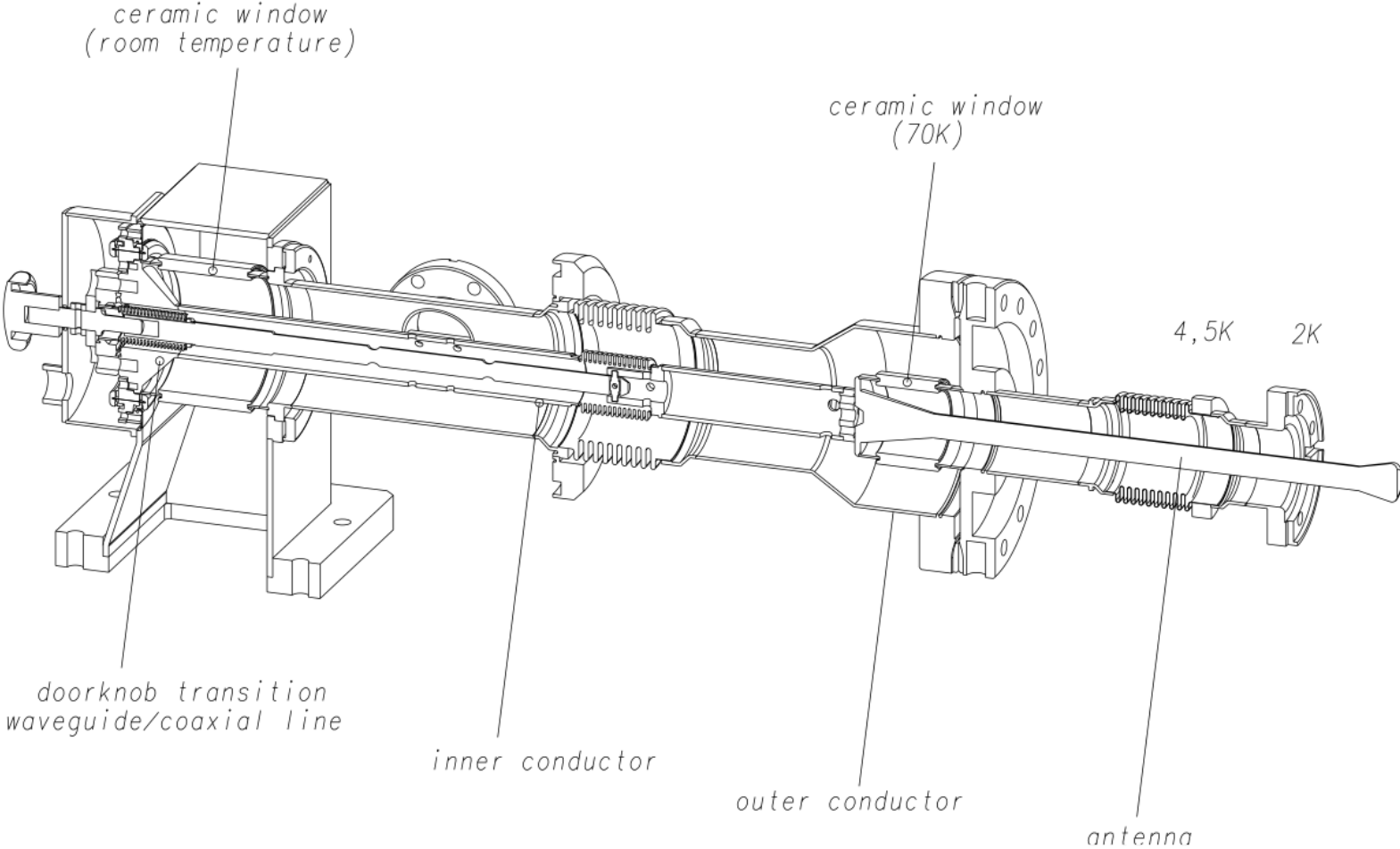
3.3.4.1 Plug compatible performance specification

specification tables

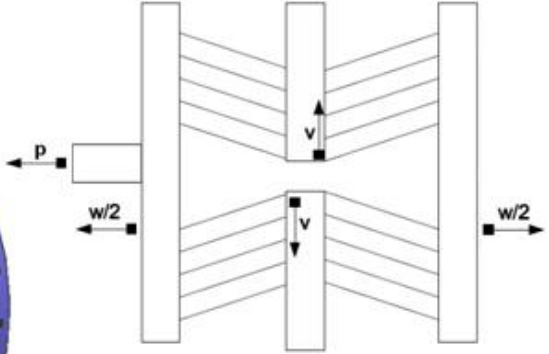
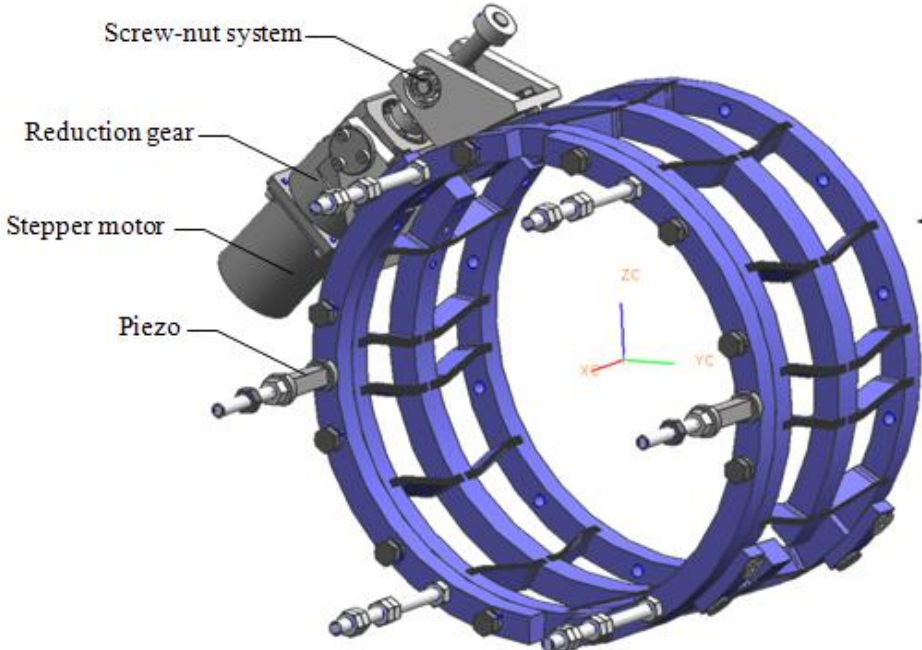
3.3.4.2 Interface definition

interface drawings

TTF-III coupler (baseline)



Blade tuner (baseline)



cavity	specification item	specification	unit and comments	further comments
RF properties	Frequency	1.30	GHz	
	Number of cells	9.00	cells	
	Gradient	31.50	MV/m	operational
		35.00	MV/m	Vertical test
	Q0	0.80	10¹⁰	at 35
		1.00	10¹⁰	at 31.5
	HOM damping		Q	decide later
			R/Q	decide later
Short range wake			decide later	
Operating temperature	2.00	K		
Physical properties	Length	1247	mm	TESLA-short length
	Aperture		mm	must be compatible with beam dynamics
	Alignment accuray	300.00	um	rms
	Material	Niobium		
	Wall thickness	2.80	mm	
	Stiffness			decide later
	Flange/Seal system		Material	decide later
	Maximum overpressure allowed		2bar	
	Lorentz force detuning over Flat-top at 35 MV/m	1.00	kHz	maximum
	Outer diameter He vessel	230.00	mm(inner diameter)	Mag shield outside, decide later for precise number
		230.00	mm(inner diameter)	KEK Mag shield inside, decide later for precise number
	Magnetic shielding		inside/outside	decide later

* yellow boxes indicate 'not fixed'

tuner	specification item	specification	unit and comments	further comments
Slow tuner	Tuning range	>600	kHz	
	Hysteresis in Slow tuning	<10	µm	
	Motor requirement	step-motor use, Power-off Holding, magnetic shielding		
	Motor specification	ex) 5 phase, xxA/phase, ...	match to driver unit, match to connector pin assignment,...	decide later
	Motor location	inside 4K? / outside 300K? / inside 300K accessible from outside?	need availability discussion, MTBF	decide later
	Magnetic shielding	<20	mG at Cavity surface, average on equator	
	Heat Load by motor	<50	mW at 2K	
	Physical envelope	do not conflict with GRP, 2-phase line, vessel support, alignment references, Invar rod, flange connection,...		cable connection, Mag shield
	Survive Frequency Change in Lifetime of machine	~20 Mio. steps	could be total number of steps in 20 years,	

* yellow boxes indicate 'not fixed'

Fast tuner	Tuning range	>1	kHz over flat-top at 2K	
	Lorentz detuning residuals	<50	Hz at 31.5MV/m flat-top	(LD and microphinics? or LD only?) :decide later
	Actuator specification	ex) low voltage piezo 0-1000V, ...	match to driver unit, match to connector pin asignment, ...	decide later
	Actuator location	insdie 4K?/inside 4K accessible/inside 100K? accesible / inside 300K accessible from outside?		decide later
	Magnetic shielding	<20	mG at Cavity surface average	
	Heat Load in operation	<50	mW	
	Physical envelope	do not conflict with GRP, 2-phase line, vessel support, alignment references, Invar rod, flange connection,...		
	Survive Frequency Change in Lifetime of machine	>10¹⁰	number of pulses over 20 years, (2x10⁹:operational number)	

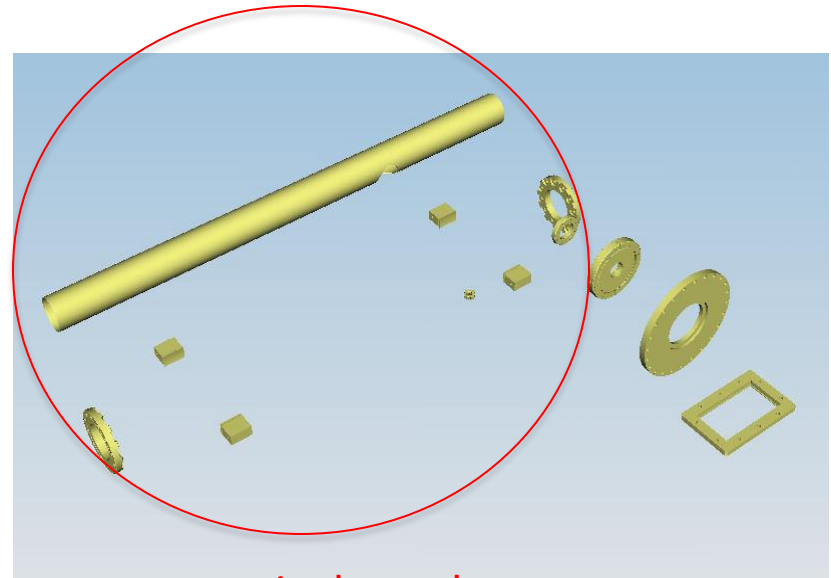
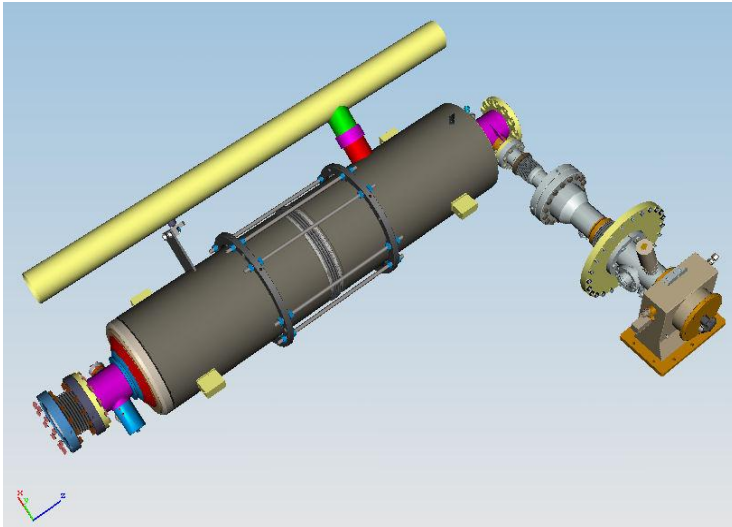
* yellow boxes indicate 'not fixed'

Coupler	condition	specification	unit and comments	further comments
Power requirements	Operation	>400kW	for 1600 us	
	Processing	>1200kW	upto 400 us	need after vac break, cool-down
		>600kW	larger than 400 us	need after vac break, cool-down
Processing with reflection mode		>600kW	for 1600us	in Test stand
Processing time	warm		<50hours	after installation, definition of power/pulse_width target are the same as 'Power Requirement' above.
	cold		<30hours	after installation, definition of power/pulse_width target are the same as 'Power Requirement' above.
Heat loads /coupler	2K static	< 0.063W		
	5K static	< 0.171W		depend on tunability
	40 K static	< 1.79W		
	2K dynamic	< 0.018W		
	5K dynamic	< 0.152W		
	40K dynamic	< 6.93W		
Cavity vacuum integrity	# of windows	2		
	bias capability	yes		
RF Properties	Qext		tunable	
	Tuning range	1-10	10 ⁶ if tunable	
Physical envelope	Position		compatible to TTF-III	decide later
	Flange		compatible to TTF-III	decide later (to cavity, to cryostat)
	waveguide support		compatible to TTF-III	decide later
			compatible to TTF-III	decide later
Instrumentation	vacuum level	>= 1		
	spark detection		0at window	
	electron current detection		>= 1at coax	
	temperature		>= 1at window	

* yellow boxes indicate 'not fixed'

Cavity boundary

BCD: TESLA-short cavity



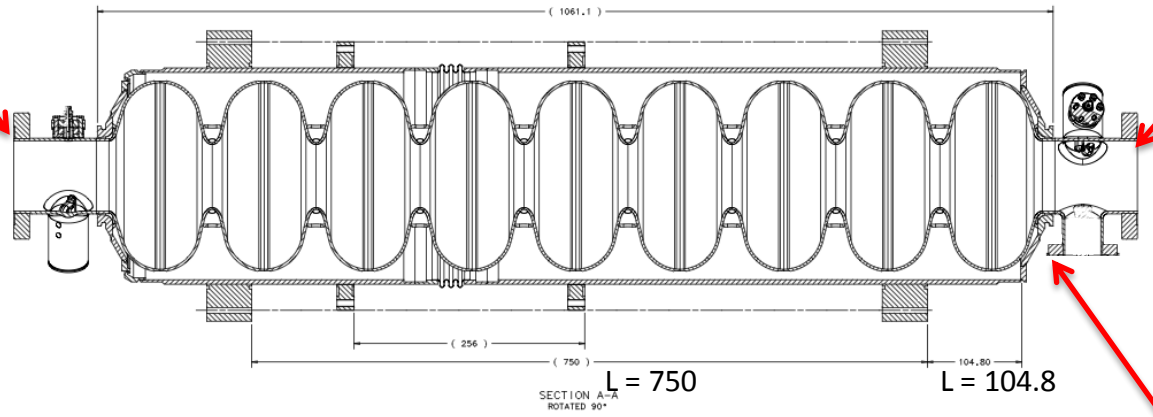
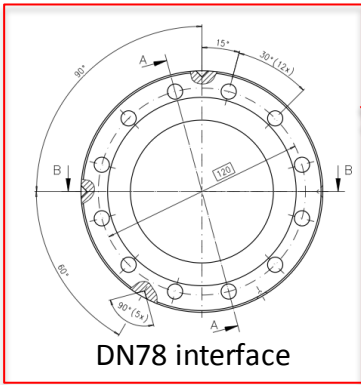
cavity boundary

- (1) beam pipe port flange (beam pipe diameter)
- (2) coupler port flange (port pipe diameter)
- (3) 4 support tabs
- (4) He pipes

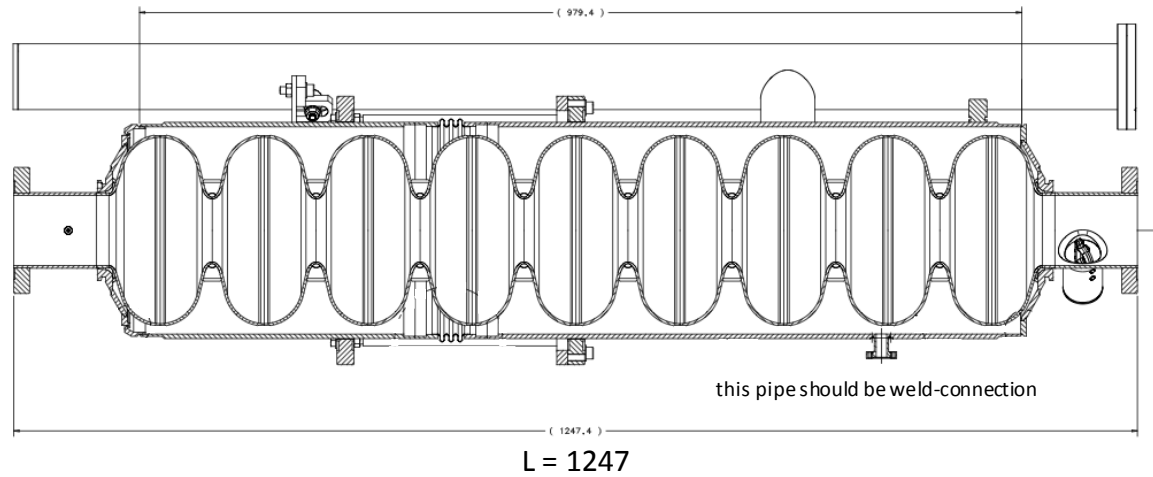
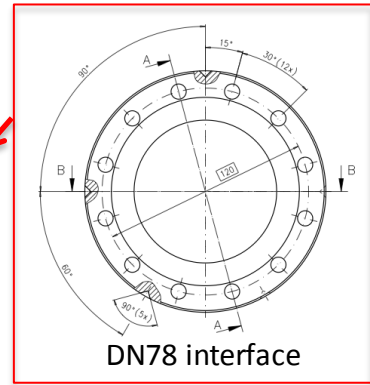
Cavity boundary

BCD: TESLA-short cavity

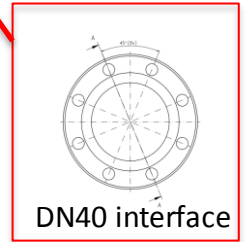
beam port



beam port

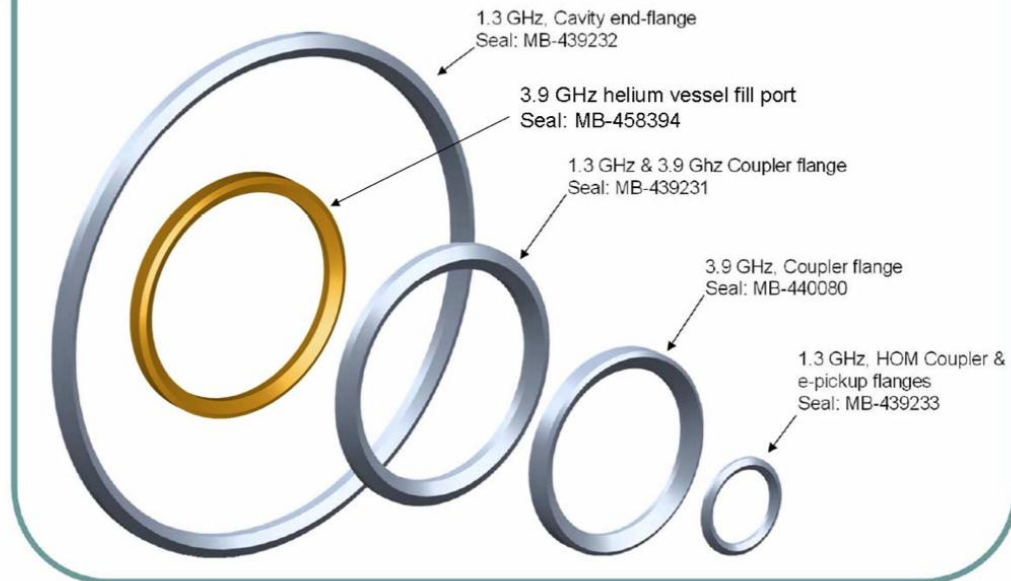


coupler port



1.3 GHz & 3.9 GHz Aluminum Hex Seals

Al hexagonal



Cavity boundary

BCD: TESLA-short cavity

cut-end for bellows welding

cut-end for bellows welding

L = 1247

(1247)

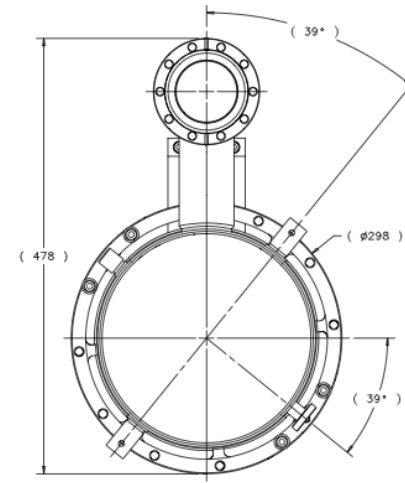
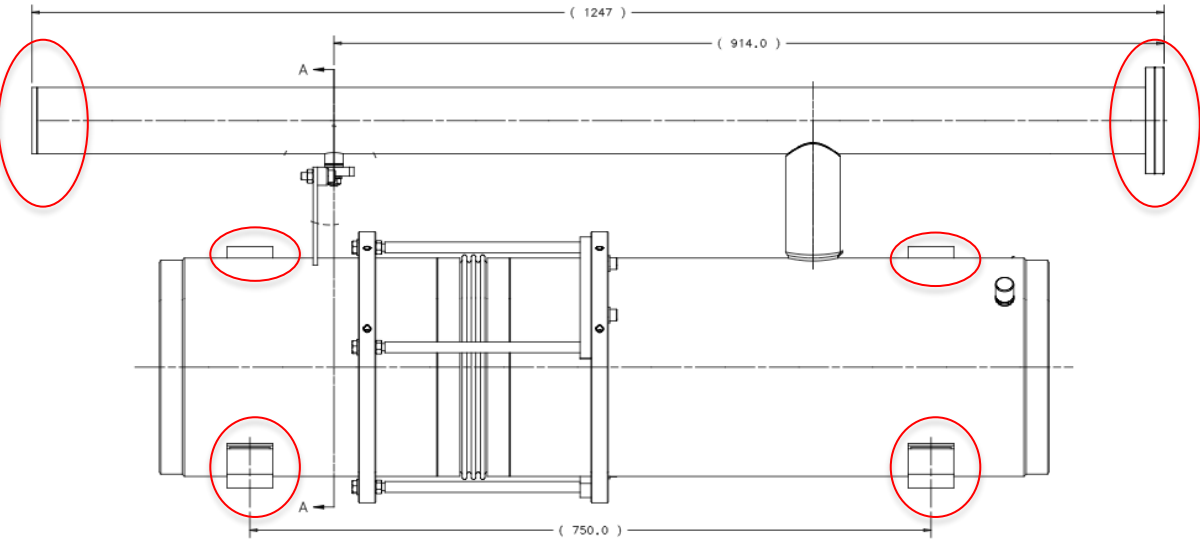
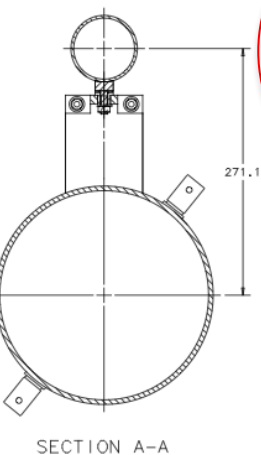
(914.0)

L = 750

(750.0)

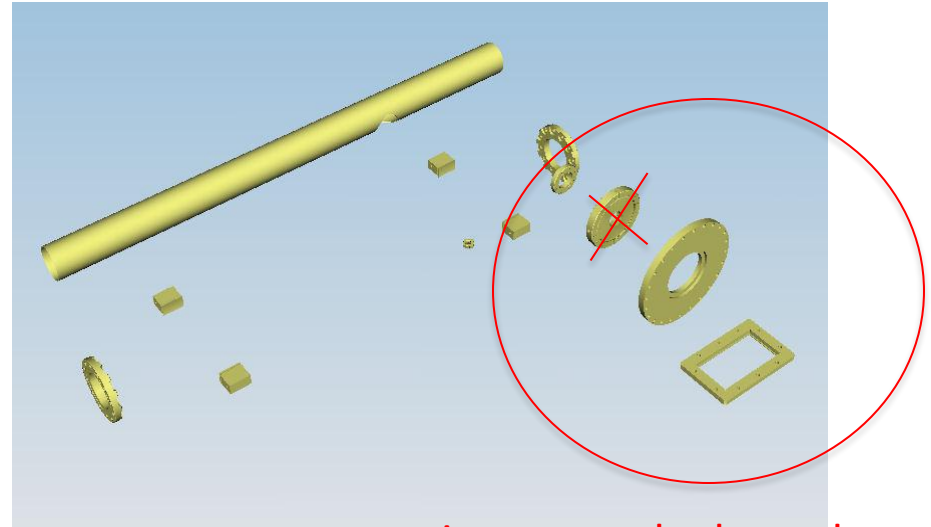
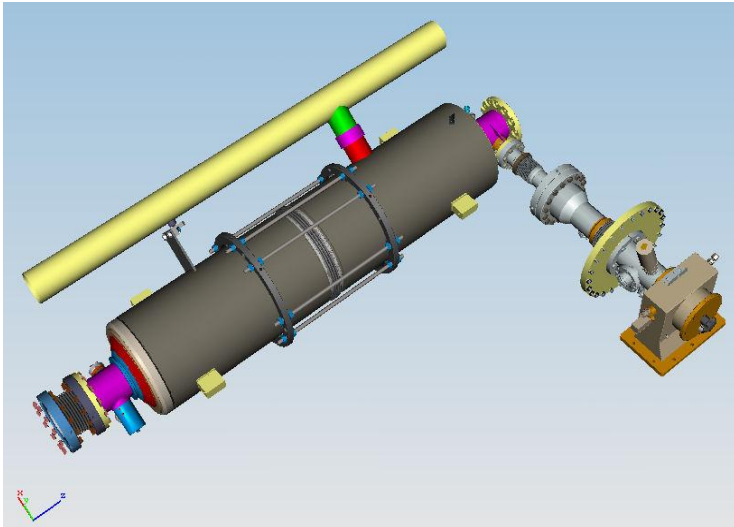
support tab

support tab



Input coupler boundary

BCD: TTF-III coupler



input coupler boundary

- (1) cavity port flange (port diameter)
- ~~(2) cold/warm part interface flange~~
- (3) cryostat vessel flange
- (4) waveguide flange

