Woodstock

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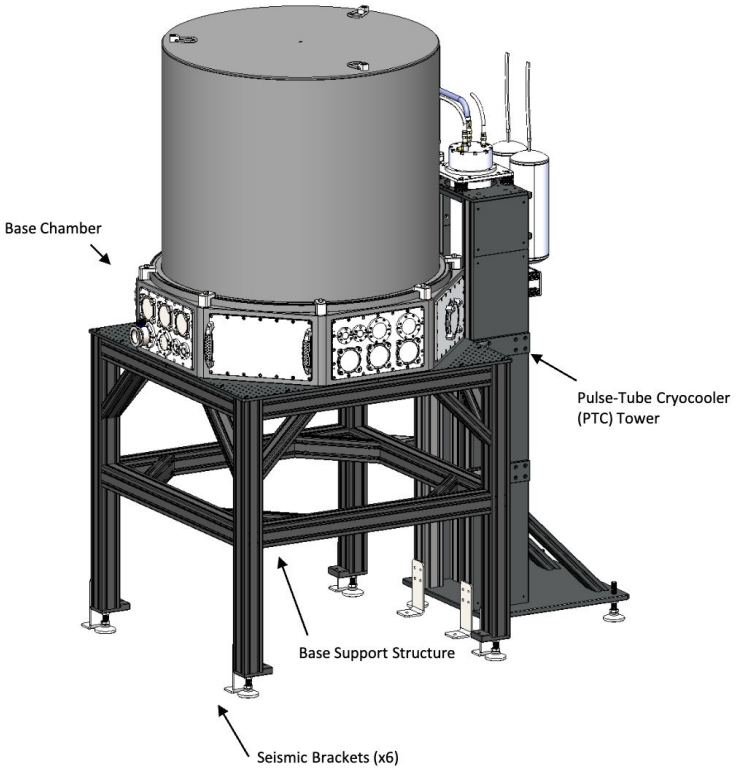
August 5, 2024
DMRadio Collaboration meeting at Stanford, CA

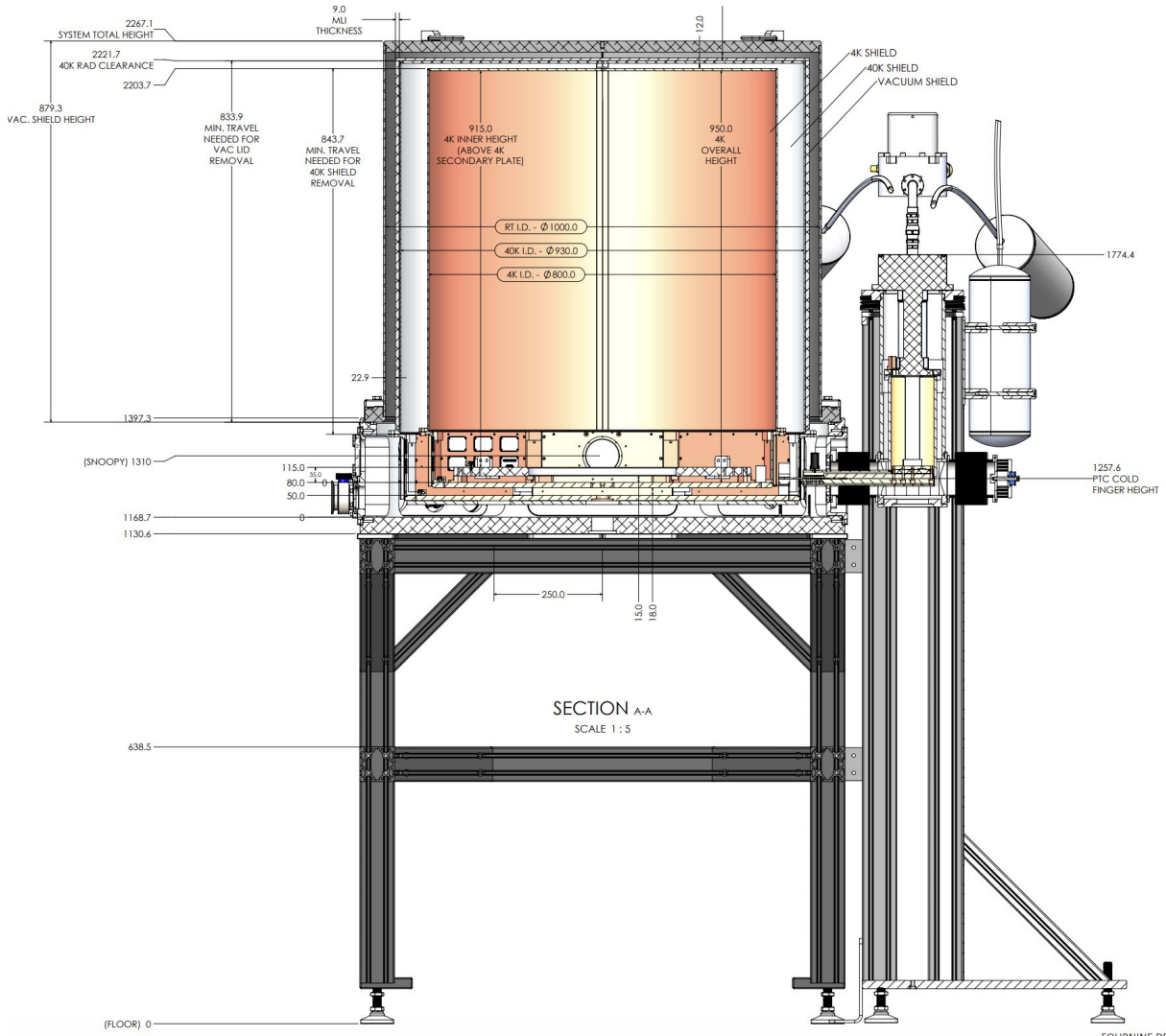
Woodstock is a 4 K cryostat being built by Four Nine Design

- Billings, Montana
- Caleb Schreibeis
- Jerry Schmaig
- DMRadio-50L up to 4 K ring

We have finalized the design of Woodstock (except the 4 K ring itself), and it is currently being manufactured.

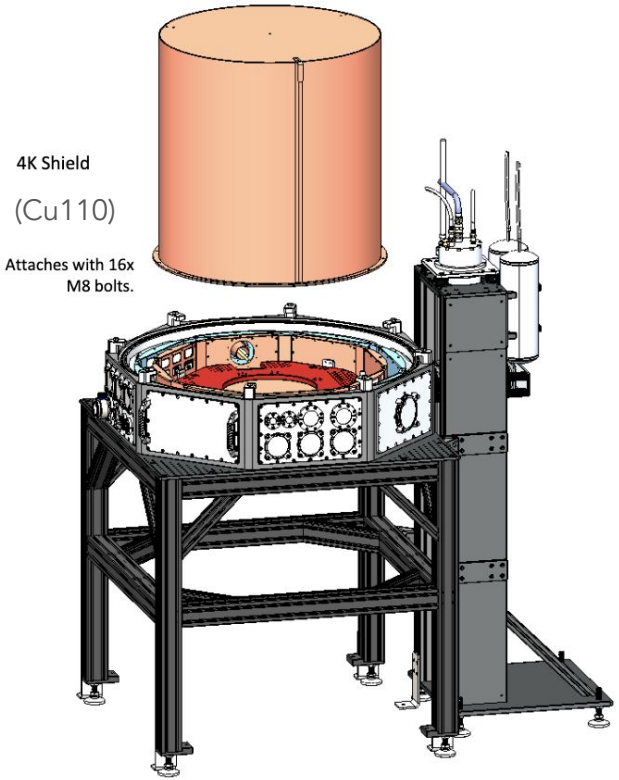
We will know soon a detailed timeline, but expecting Woodstock to be complete by November.

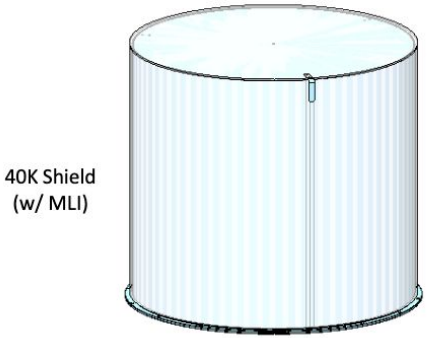


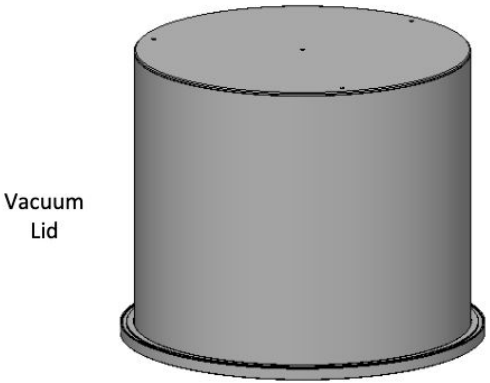

9.0
MLI
THICKNESS
2267.1
SYSTEM TOTAL HEIGHT
2221.7
40K RAD CLEARANCE
2203.7
879.3
VAC. SHIELD HEIGHT
833.9
MIN. TRAVEL
NEEDED FOR
VAC LID
REMOVAL
843.7
MIN. TRAVEL
NEEDED FOR
40K SHIELD
REMOVAL
915.0
4K INNER HEIGHT
(ABOVE 4K
SECONDARY PLATE)
950.0
4K
OVERALL
HEIGHT
12.0
4K SHIELD
40K SHIELD
VACUUM SHIELD
RT I.D. - Ø1000.0
40K I.D. - Ø930.0
4K I.D. - Ø800.0
1774.4
22.9
1397.3
(SNOOPY) 1310
115.0
35.0
80.0
50.0
0
1168.7
1130.6
1257.6
PTC COLD
FINGER HEIGHT
250.0
15.0
18.0
SECTION A-A
SCALE 1 : 5
638.5
(FLOOR) 0

Dim. in mm.

Woodstock radiation shields







Estimates of masses that Woodstock needs to support

		baseline		upgrade
		baseline material	mass (kg)	upgrade? mass (kg)
20 mK plate	corset	Al	1.4	4.5
	wings	Al	4	4
	ind frame (top and bottom)	Al	0.6	1.8
	ind frame (rods)	sapphire	0.5	0.5
	capacitor	Nb, vacuum	6.25	6.25
	SQUIDs / TT	N/A	1	1
	pogo stick	Nb	0.095	0.095
	copper rod for cold finger connection	Cu	5	5
			18.845	**23.145**
1 K ring	20 mK plate	Cu	5.47	5.47
	1 K plate	Al + bottom Nb sheet	9.05	9.05
	1 K SC shield	Al + top Nb sheet	10.76	29.46
	inv top hat	Al	0.67	2.13
	copper rod for cold finger connection	Cu	5	5
			49.795	**74.255**
4 K ring	1 K ring	Al	2.73	2.73
	magnet	Al, Cu, alumina, epoxy	74.6	74.6
	connector bracket	Al	7.74	7.74
	sheath	Nb	22	22
	magnet support legs (with sheet and rir	aluminum	4.7	4.7
	magnet cold legs	copper	4.4	4.4
			165.965	**190.425**
				upgrade: change to Nb

Woodstock expected heat loads on 4 K and 40 K plates

4 K:

Simulation Inputs and Estimates (based on worst case scenario):

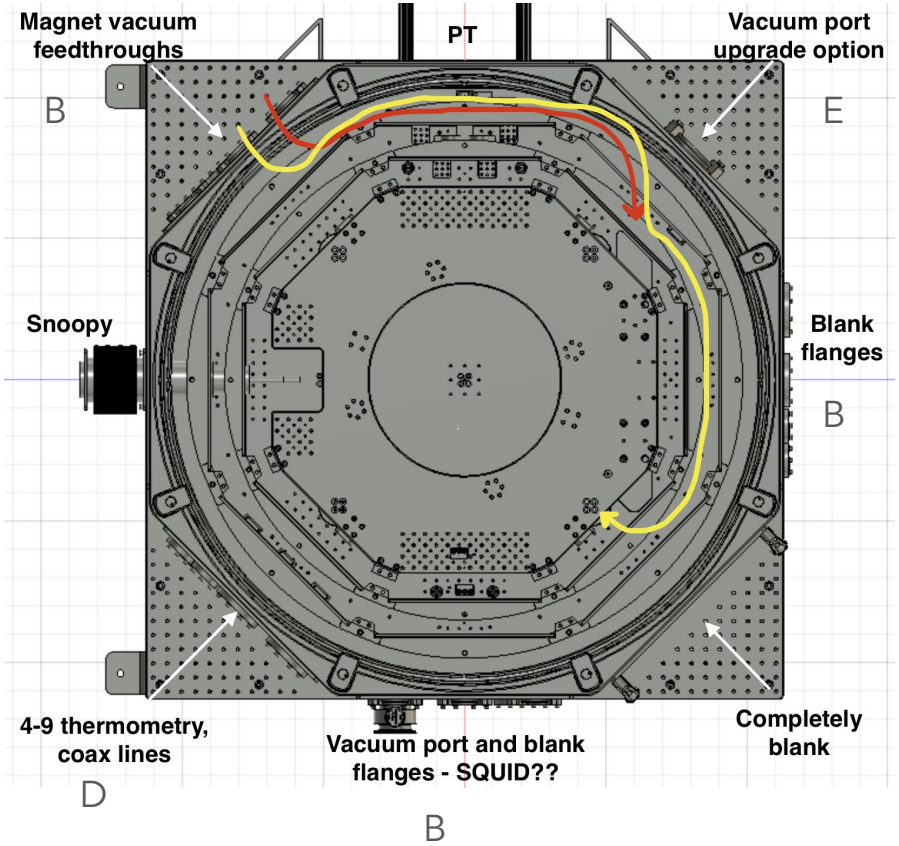
1.	4K Cold Plate Material:	Copper(RRR100), C101	
2.	Temperature at thermal link attachment point:	3.59K	
3.	Total heat load from 40-4K thermal standoffs:	.071W	
4.	Total heat Input from upper 40K Radiation:	.10W	(E_{hot}=.15 E_{cold}=.15)
5.	Total heat Input from lower 40K parallel plate radiation:	.02W	(E_{hot}=.15 E_{cold}=.15)
6.	Total heat Load from HTS leads:	.08W	
7.	Total parasitic heat Loads on SW Panel: 24DC, 4x RF	.02W	
8.	Total parasitic heat Loads on SE Panel:	.01W	
9.	Total heat Load from (future) floating 4K ring standoffs	.05W	

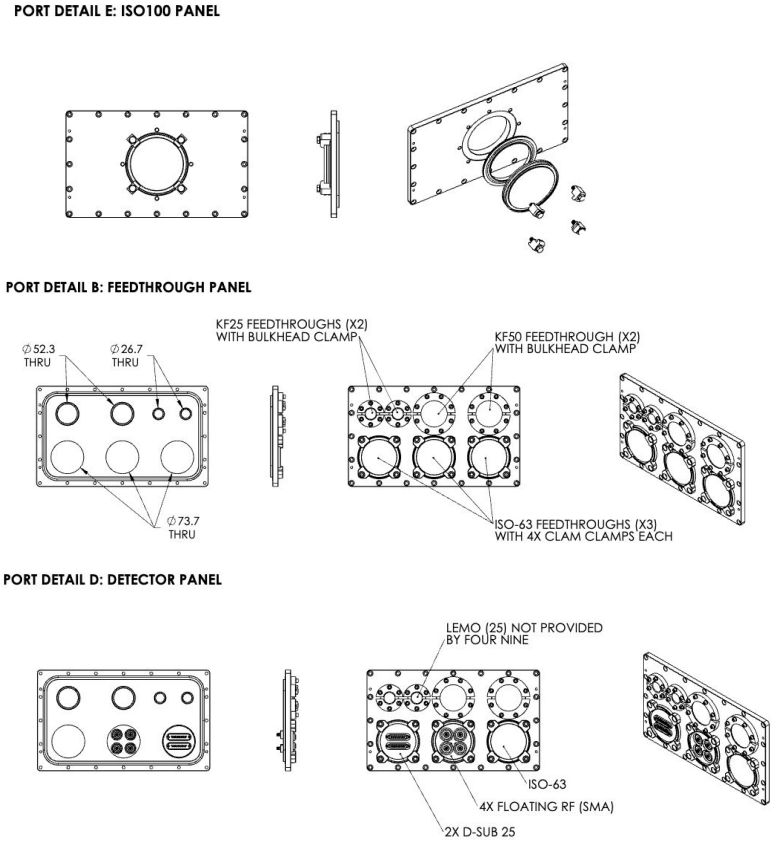
40 K:

Simulation Inputs and Estimates (based on worst case scenario):

1.	40K Cold Plate Material:	C110 Copper	
2.	Temperature at thermal link attachment point:	42.6K	
3.	Total heat load from 300-40K thermal standoffs:	.8W	
4.	Total radiation heat load on interface panel layer:	10.64W	(E_{hot}=.1 E_{cold}=.05)
5.	Total radiation heat load on top and bottom MLI layers:	.65W	(E_{hot}=.1 E_{cold}=.001)
6.	Total radiation heat load on cylinder MLI layer:	1.16W	(E_{hot}=.1 E_{cold}=.001)
7.	Total heat Load from HTC leads:	7W	
8.	DC Wiring Estimate:	.2W	
9.	RF Wiring Estimate:	.07W	

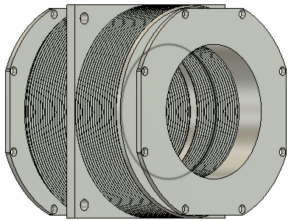
Woodstock interfaces: feedthroughs



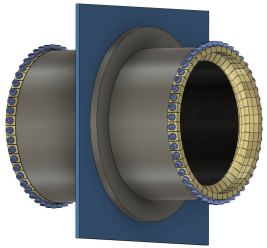


Woodstock interfaces: cold snout

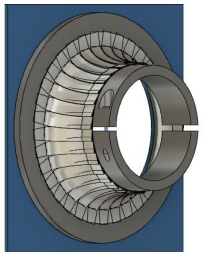
Flexible bellows

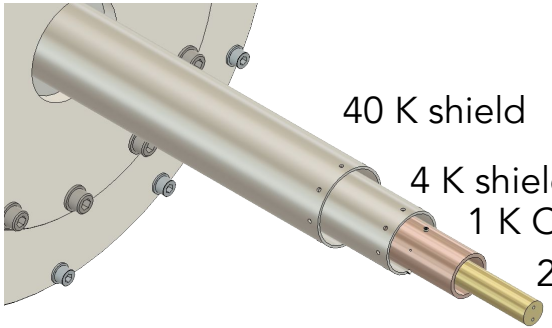


Flexible 40 K connection: fingerstrips

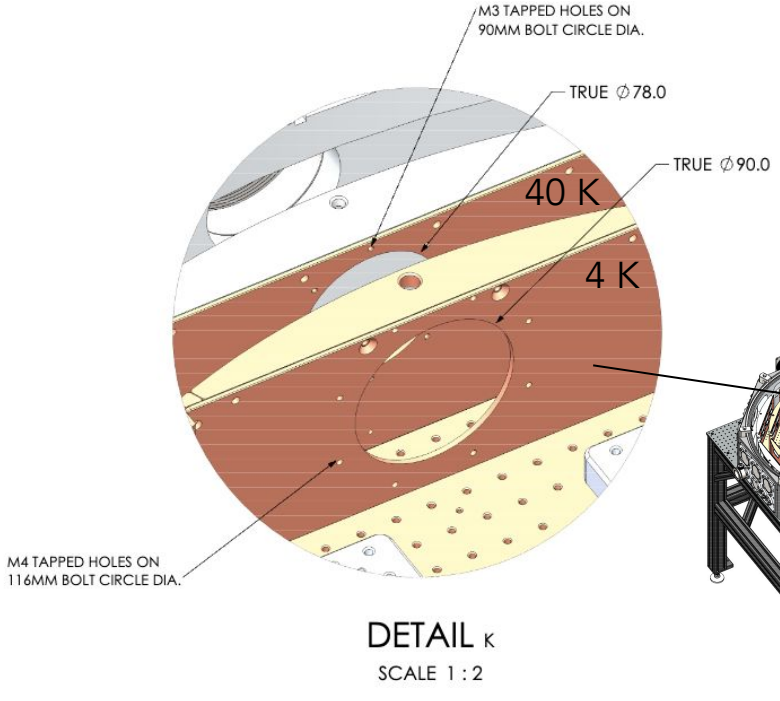


Flexible 4 K connection: Al strips



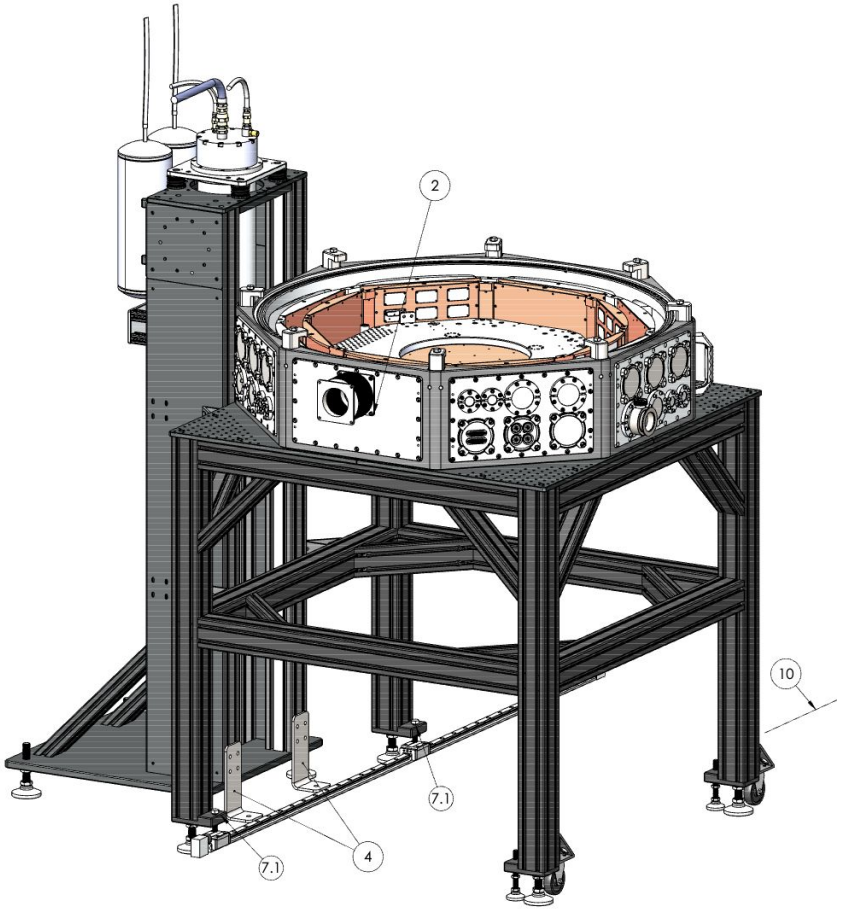


Mating areas in Woodstock



Assembly thoughts

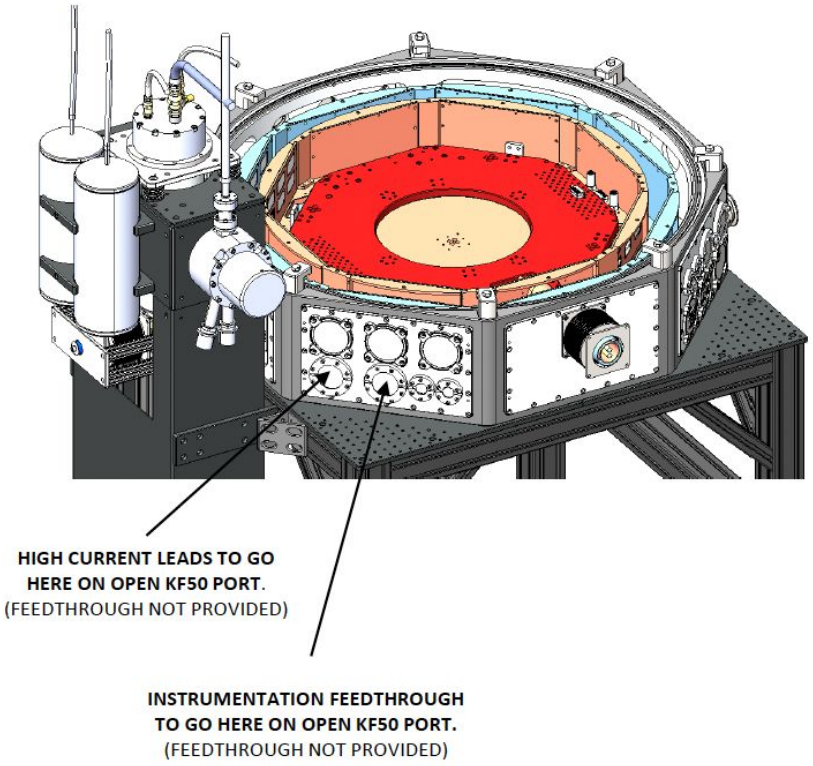
Woodstock will sit on a translation system.



Woodstock interfaces: magnet (300 K)

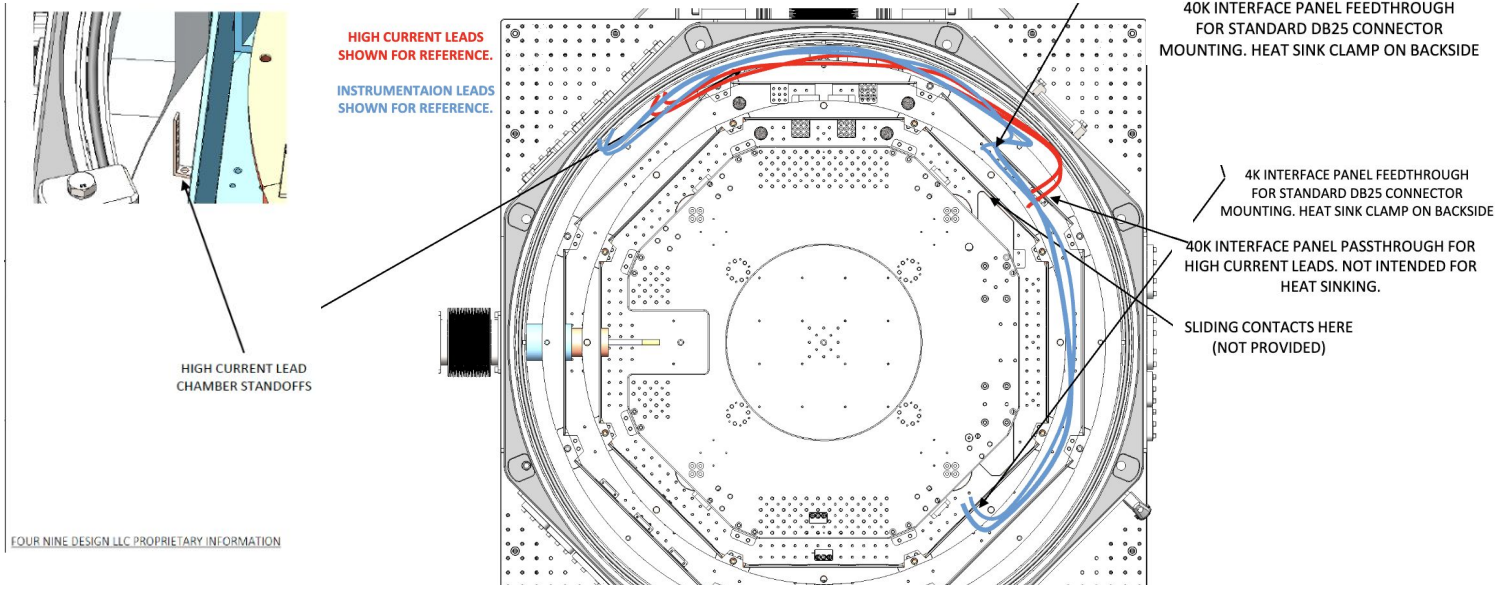
Vacuum feedthroughs

- High current leads on a KF50 port (two leads)
- Instrumentation wires on a separate KF50 port (SSI usually use a 15 pin connector and use 12 pins on it for thermometers and heaters)



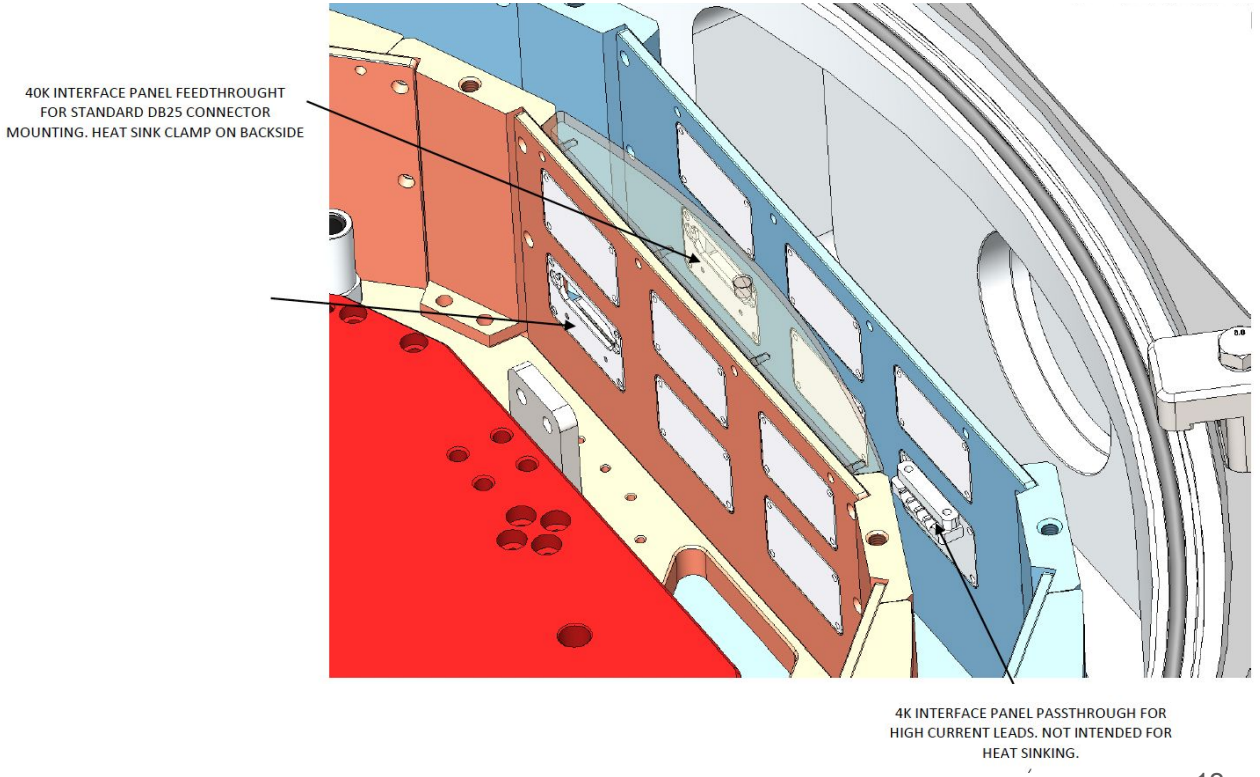
Woodstock interfaces: magnet (300 -> 40 K)

- Instrumentation wires and magnet leads are routed from the NW panel to the NE panel of the cryostat, passing under the Four Nine 40 K and 4 K cold fingers
- Magnet leads are supported by insulating standoffs from the base chamber, each lead is made of a pair of gauge 8 leads insulated with kapton and fiberglass
- Instrumentation wires are twelve copper 32 AWG wires, four for heaters and eight for thermometers

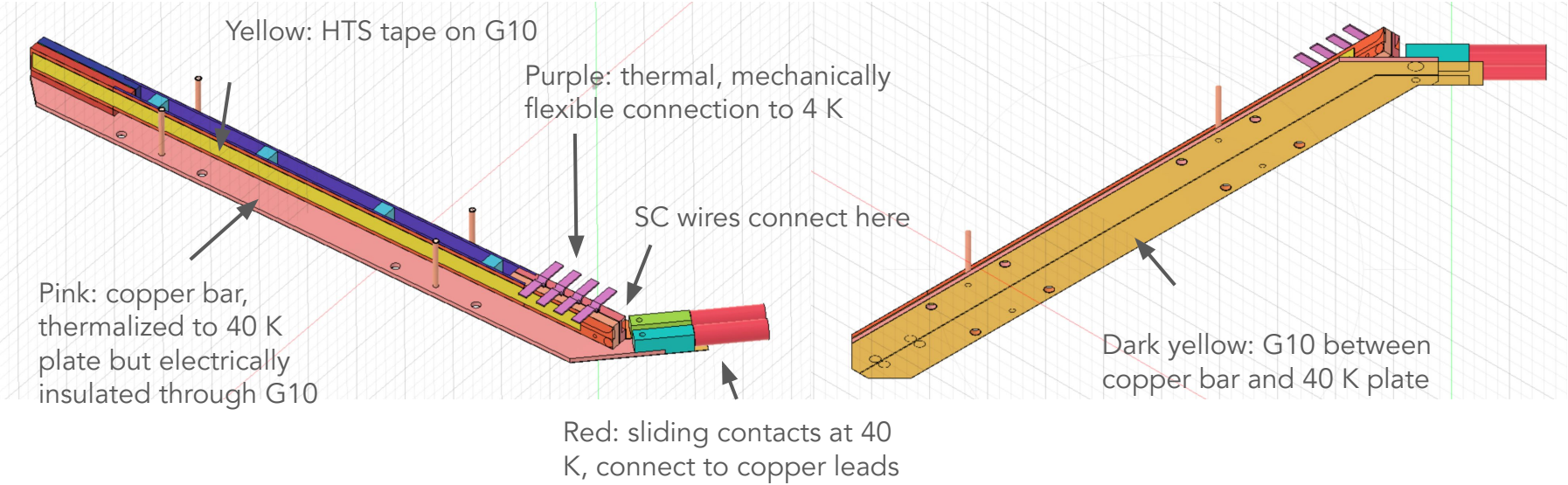


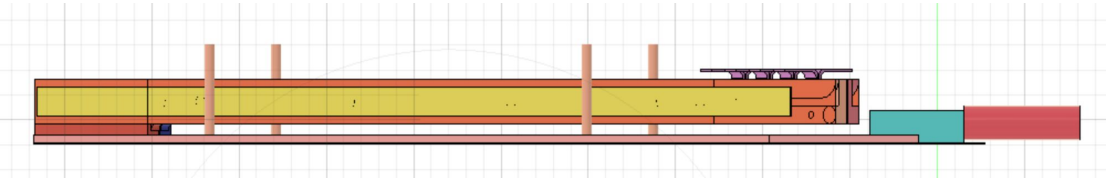
Woodstock interfaces: magnet (40 K)

- Magnet leads pass through 40 K flat panel, but not thermalized to the flat panel - they are thermalized by the base of the HTS lead assembly to the 40 K plate
- Sliding contacts to HTS lead assembly are below the 4 K plate
- Instrumentation wires need to be thermalized at 40 K flat panel feedthrough



Wire routing 40 -> 4 K: HTS lead assembly

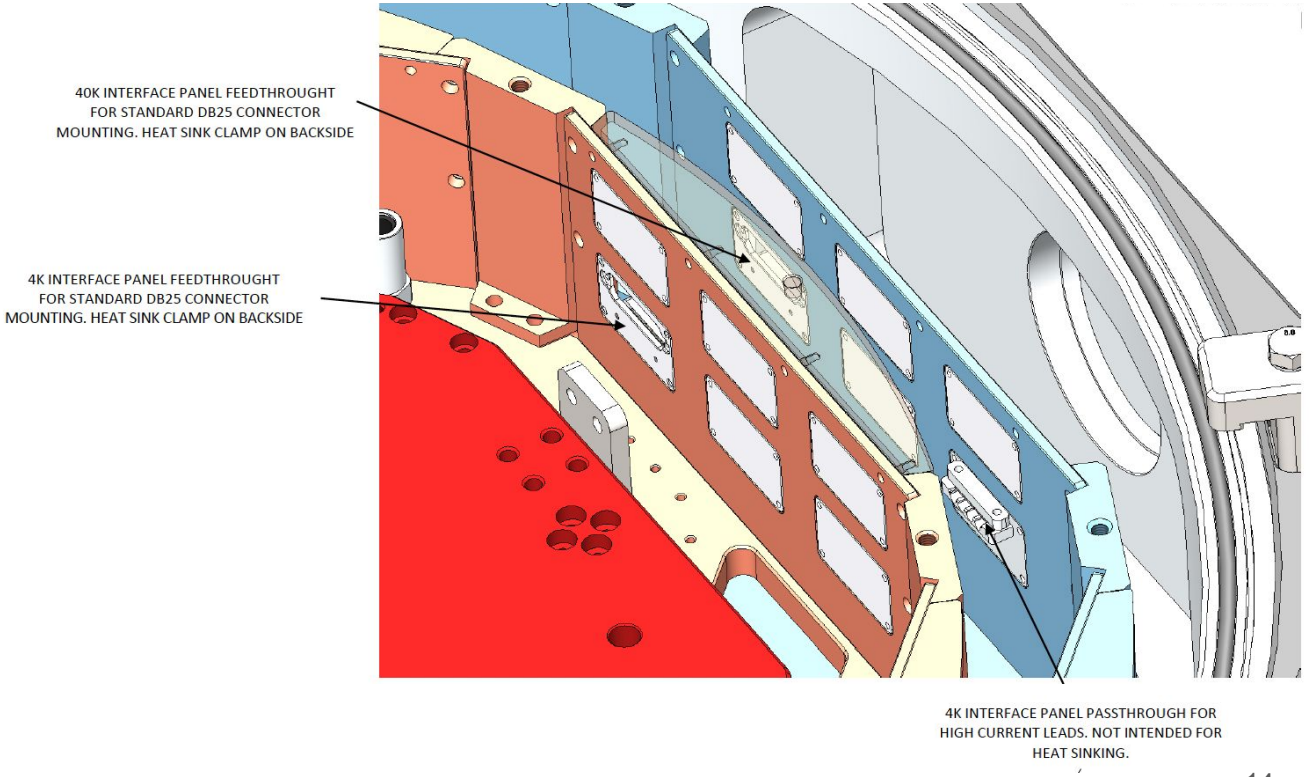




Wire routing 40 -> 4 K: Instrumentation wires

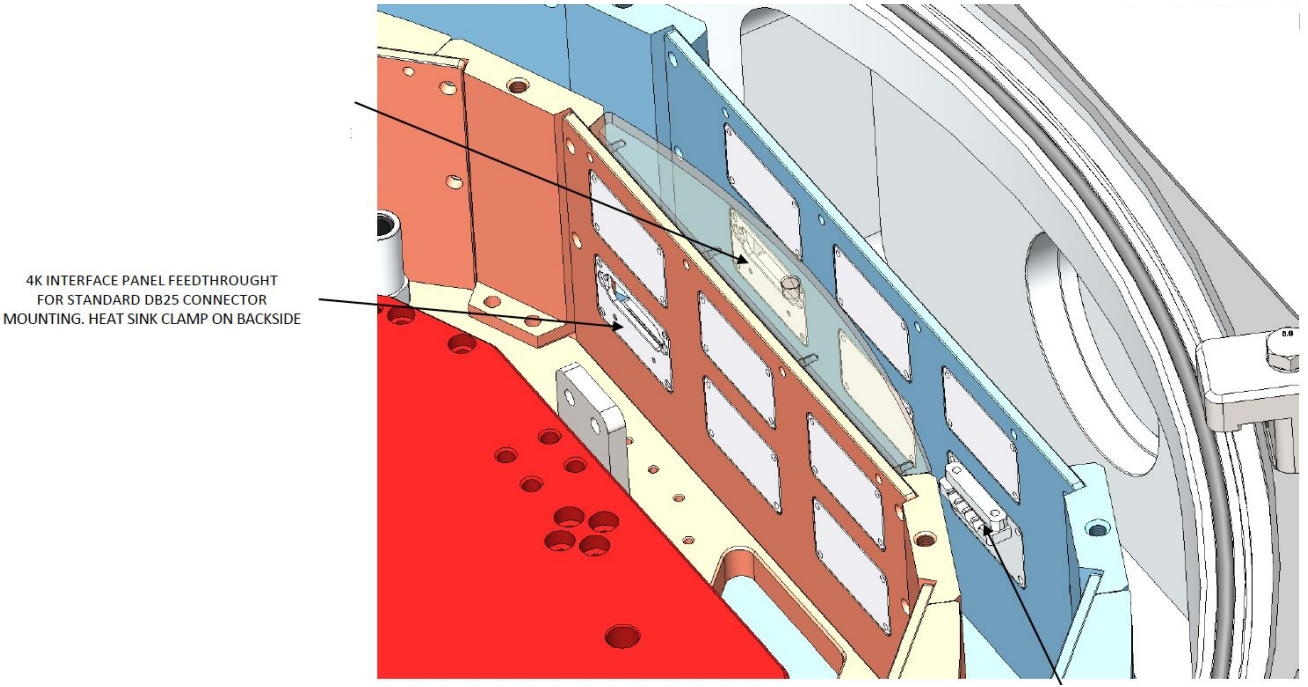
- CuNi for thermometers
- Copper for heaters - these need to be ~1 m long, will carry ~1 A of current when in use

  (during magnet charging)



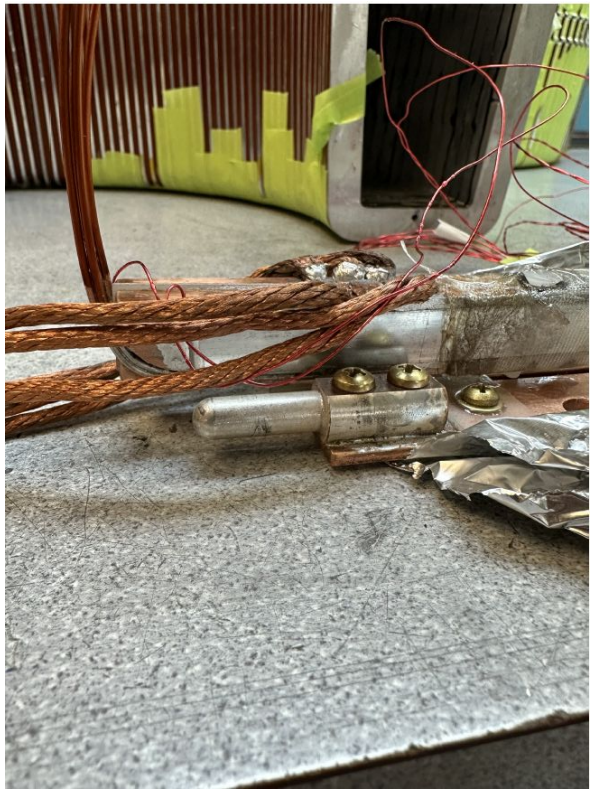
4 K feedthrough: Instrumentation wires

- Instrumentation wires need to be thermalized at 4 K flat panel feedthrough



4 K feedthrough: HTS assembly and SC wires

- 4 K cover above HTS assembly
- SC leads go through two holes in the 4 K cover
- HTS assembly thermalized to 4 K plate by flexible thermal attachment



end.