Project 200
Tests in a CERN cryostat

Dagmar Kreikemeyer
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Project 200 in Octagonal Cryostat

1. Cryocooler
2. Cold finger of cryocooler
3. Flange for electrical feedthroughs
4. Holding structure (G10)
5. Threaded rods to support the setup
6. Cu frame for thermal contact
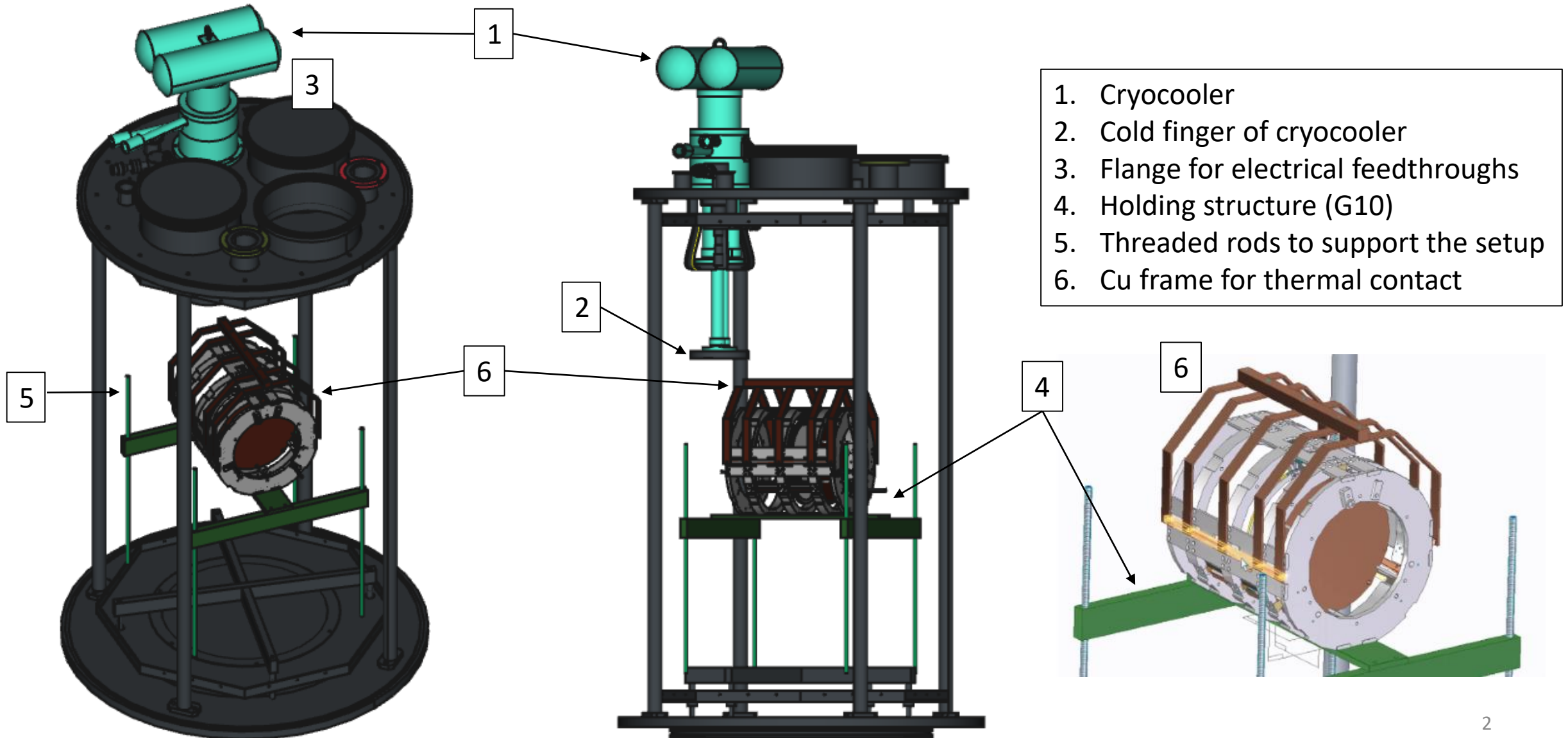
Octagonal cryostat
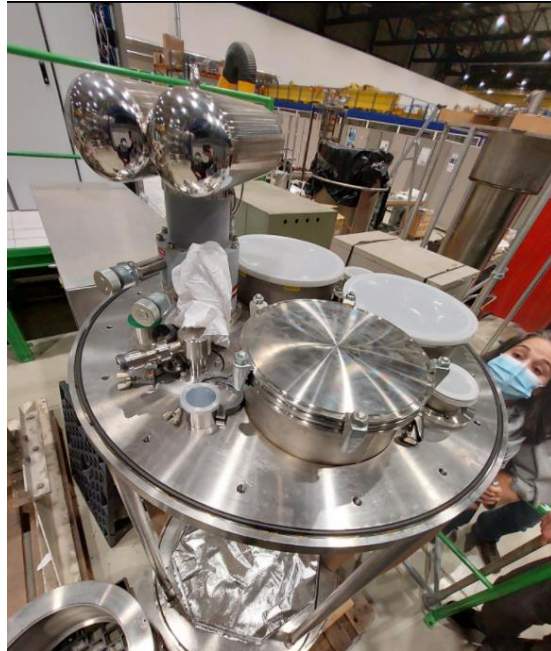
Tests objectives

Tests to be performed at CERN Cryolab in Feb/March 2022:

Temperature:

I. Behaviour of the disc during cool down (temperature gradient and motion /deformation due to shrinkage)
II. Temperature distribution on the disc and mechanics while motors in operation
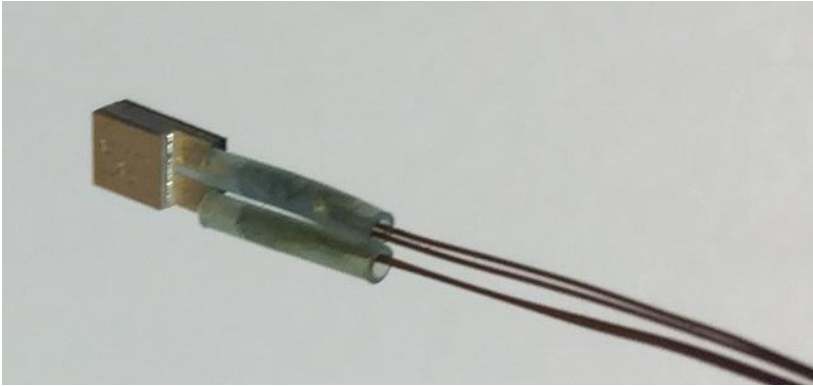III. Thermalisation of the system after motor operation is finished

Motors performance:
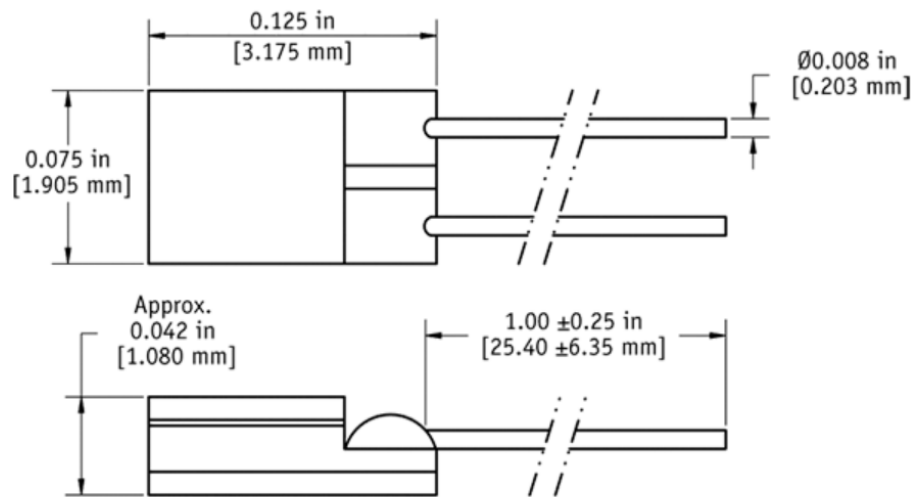
Check piezo motor parameters

I. Stepsize
II. Maximum speed
III. Positioning accuracy (spec: +/- 10 μm)
IV. Repeatability
V. Drift (after 1s, 10 s, 1 min,…)
VI. Tilt of the disk
VII. Different functionalities, e.g., step-and-settle

Temperature sensors

Temperature sensors → 8 x Si-diodes from LakeShore: 4x SD packaging (glue), 4x CU packaging (M3 screw)

CX-SD

0.125 in [3.175 mm]

Ø0.008 in [0.203 mm]

0.075 in [1.905 mm]

Approx. 0.042 in [1.080 mm]

1.00 ±0.25 in [25.40 ±6.35 mm]

General tolerance of ±0.005 in [±0.127 mm] unless otherwise noted

CU

Ø0.313 in [Ø7.950 mm]

0.030 in [0.762 mm]

Ø0.116 in [Ø2.946 mm] thru-hole

36.0 in [914.4 mm]

Ø0.005 in [Ø0.127 mm]

0.171 in [4.343 mm]

36 AWG Quad-Lead™ phosphor-bronze wire (36 in [914.4 mm] long)
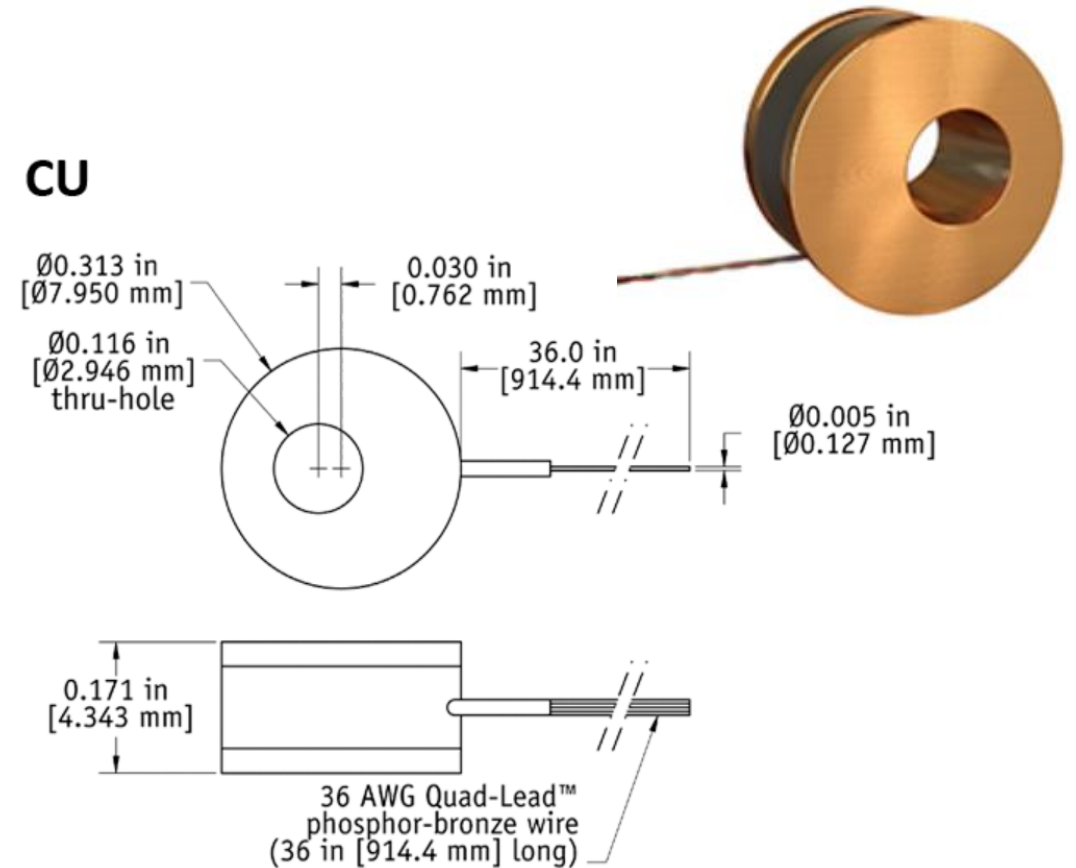
General tolerance of ±0.005 in [±0.127 mm] unless otherwise noted

Position temperature sensors

1. Center of the disc
2. Disc (R/2)
3. Disc support ring
4. Motor carriage
5. Backbone structure
6. Backbone structure
7. Backbone structure
8. Cu-block cryostat
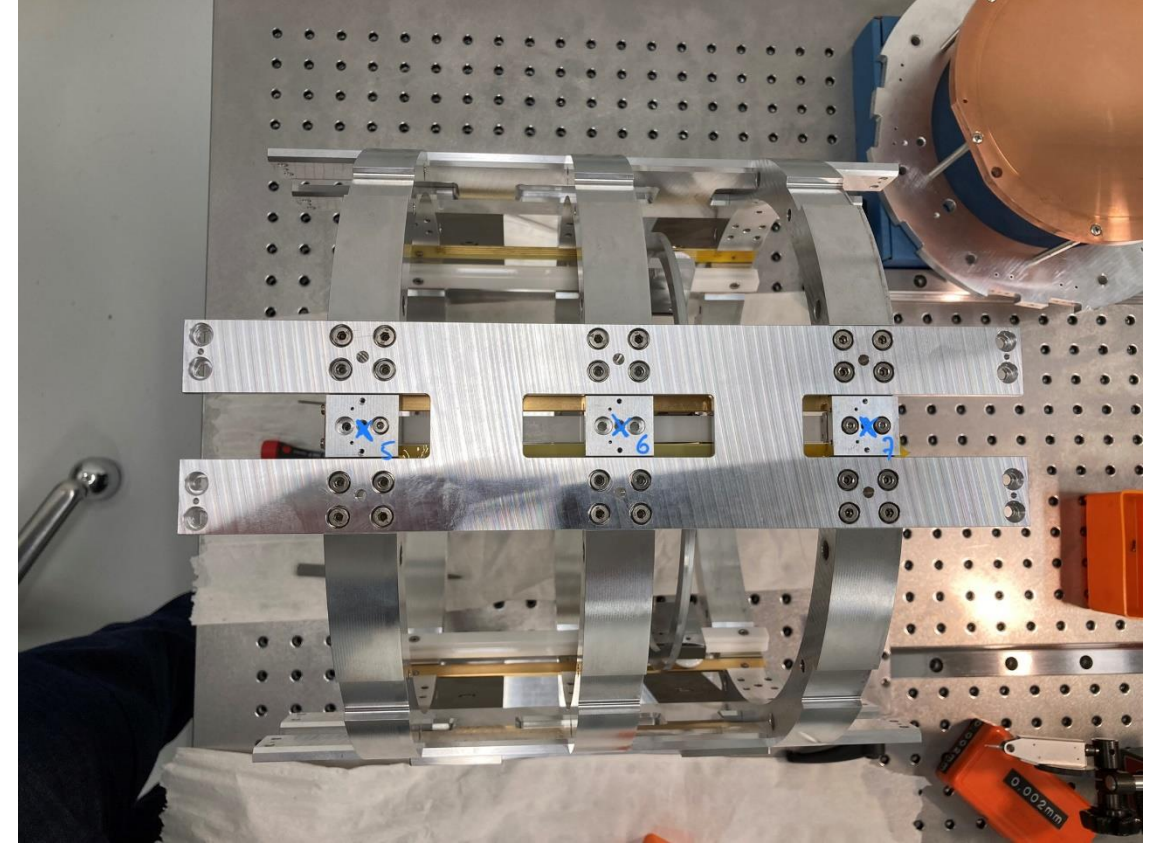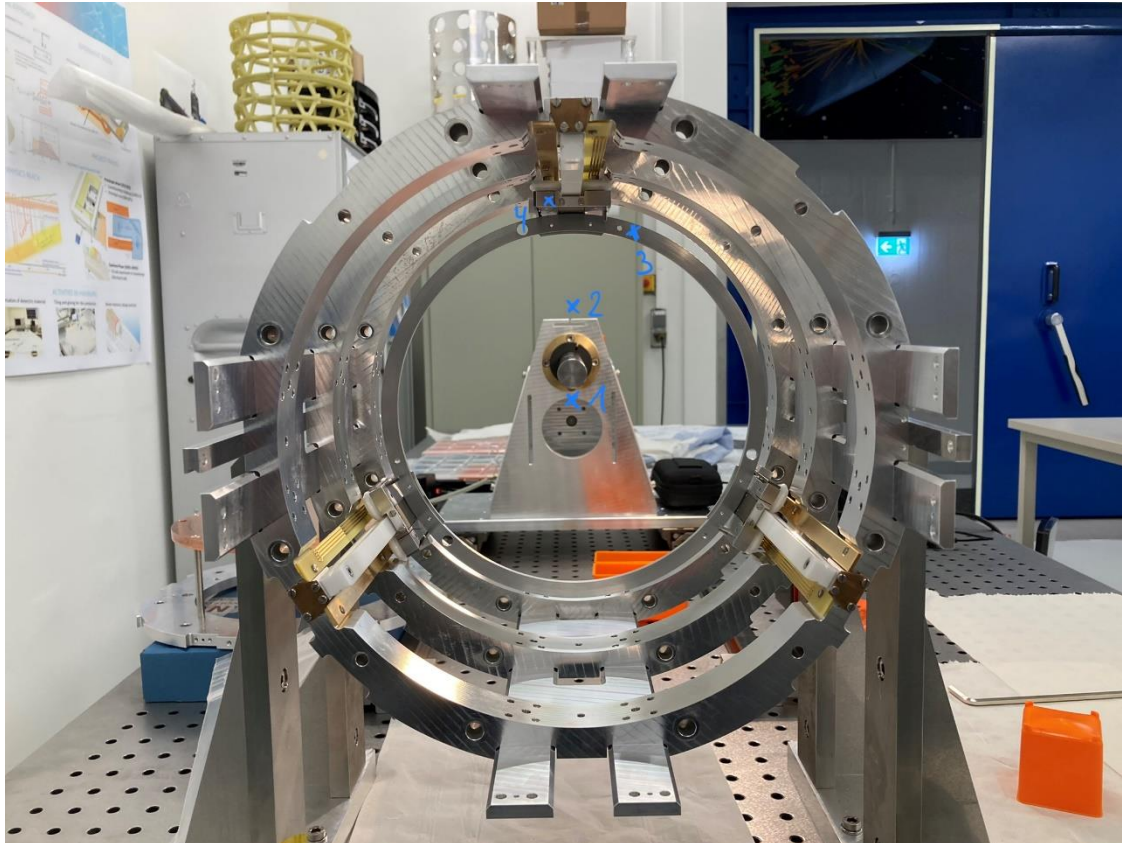
Feedthroughs & connections
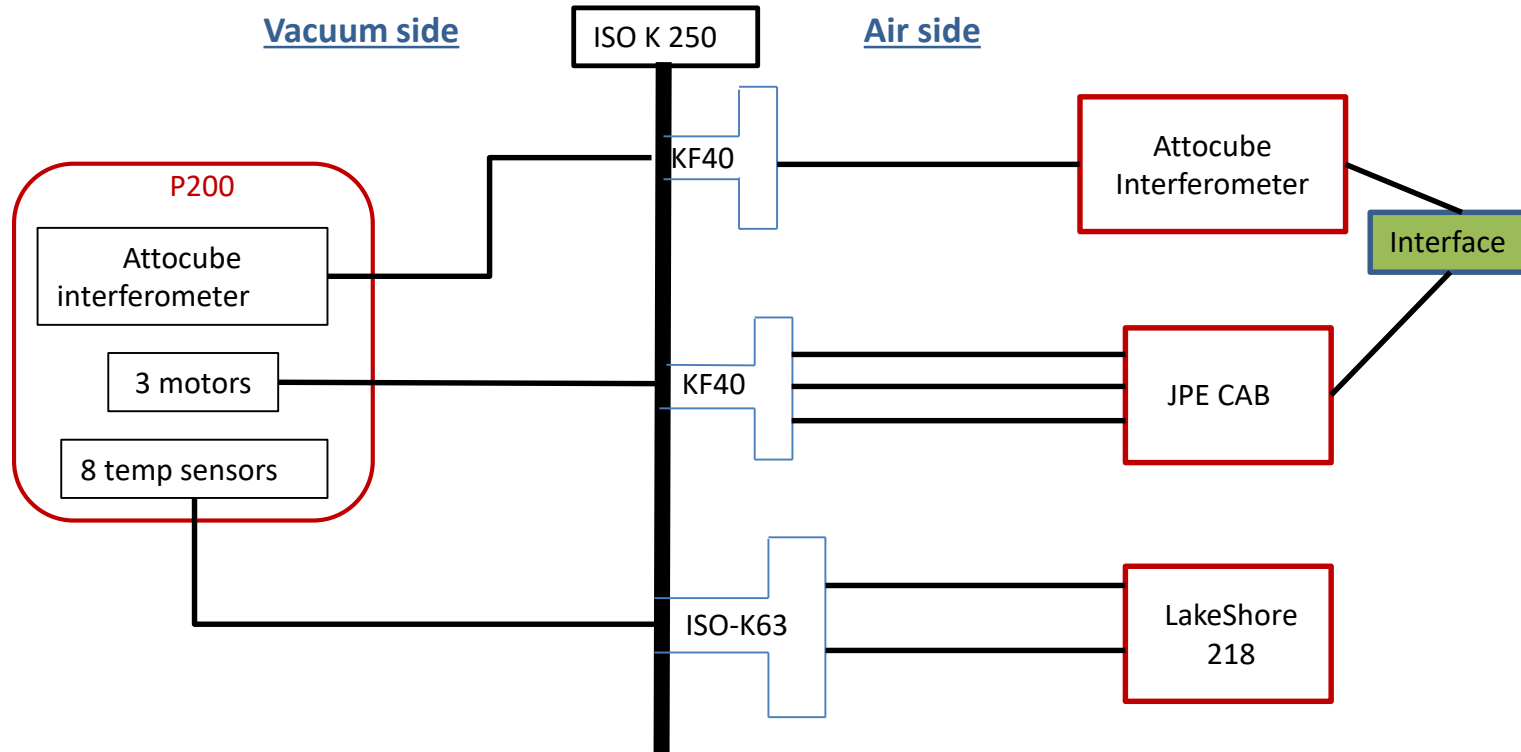
- KF40 → 3 motors → 6 wires → D-Sub 9
- KF40 → interferometer fibers
- ISO-K 63 → 8 T-sensors → 32 wires → 2x D-Sub25

Logistics

What to take to CERN:
- P200 setup
- Setup to attach P200 to the cryostat
- Frame for thermal contact
- Flange for feedthroughs
- JPE motor controller
- Temperature sensors
- Lakeshore controller (T-sensors)
- Interface Box
- Attocube interferometer
- Cables
- MLI, Apiezon, Stycast blue
- Alu-tape, Kapton tape, …
- Notebook, PC?

Team:
- Christoph Krieger
- Dagmar Kreikemeyer
- Pascal Pralavorio
- Erika Garutti (?)
- Anton Ivanov (?)
- ?

Rough schedule

Date	Duration (days)	Task	People	Comments
		FIRST RUN (Feb/March 2022)		
14-Feb-22	2	Travel to CERN		most probably by car
16-Feb-22	12	Installation and commissioning of P200 in octagonal cryostat	DKr, ChKr, PPr	Installation & commissioning of the system at room temperature
		connect and test all sensors		connect sensors, connect with the controller, etc.
		Install and test interferometer		NO DISC Installed
		Test motors at RT		
28-Feb-22	1	Cool down cryostat to ~6K		log T and position, does the position change while cooling down?
1-Mar-22	1	Cool down of P200 (wait until setup is 6K)		cooldown time depends on the heat transfer through copper braids
2-Mar-22	2	Test motor at ~6 K, temperature investigation		
		qualify performance of the motors		stepsize, positioning accuracy, drift
4-Mar-22	2	Warm up of the cryostat		measure velocity (?) as a function of Temp
6-Mar-22	3	Adjust/modify/repair setup		Install the disc. Adjust the setup according to the results.
9-Mar-22	1	Cool down cryostat to ~6K		
10-Mar-22	2	Cool down of P200 (wait until 6K)		
12-Mar-22	4	Test motor at ~6 K, temperature investigation		2nd measurements run with the disc
16-Mar-22	2	Warm up of the cryostat		
18-Mar-22	2	Disassembly		
20-Mar-22		End of the run		
TOTAL:	34			

Test sequence

TEST SEQUENCE PER COOLDOWN - P200 IN OCTAGONAL CRYOSTAT							
PARAMETER	DESCRIPTION	Freq.(Hz)	RSS (%)	dir.	rep.	t (min)	comments
1.STEPSIZE	move single steps	50	100	1	5	2	commissioning!
		50	100	2	5	2	
		50	80	1	5		
		50	60	1	5		t~30 min
	move 100 steps in one direction, move 100 steps back, measure position as a fn of time						measure at different positions on the rail. t_total = approx. 1 hour.
		50	100	/	5	15	
		50	80	/	5	15	
		50	60	/	5	15	
		40	100	/	5	15	
2. SPEED	move "long" travel range (full range), both directions, from traveled distance and time--> calculate v						t_total = approx. 1 hour.
		50	100	/	5	20	
		40	100	/	5	20	
		30	100	/	5	20	

Test sequence

TEST SEQUENCE PER COOLDOWN - P200 IN OCTAGONAL CRYOSTAT							
PARAMETER	DESCRIPTION	Freq.(Hz)	RSS (%)	dir.	rep.	t (min)	comments
3. POSITIONING ACCURACY + REPEATABILITY	move several steps towards a desired position, always from the same direction, look at the position and the dispersion						estimated time ~ 6 hours
	move long range	50	100	1	20		move back, total time ~30 min
		40	100	1	20		t~40 min
		100	80	1	20		t~30 min
		50	100	2	20		
		40	100	2	20		
		100	80	2	20		
	move medium range	50	100	1	20		
		40	100	1	20		
		100	80	1	20		
		50	100	2	20		
		40	100	2	20		
		100	80	2	20		
	move short range	50	100	1	20		
		40	100	1	20		
		100	80	1	20		
		50	100	2	20		
		40	100	2	20		
		100	80	2	20		

Test sequence

TEST SEQUENCE PER COOLDOWN - P200 IN OCTAGONAL CRYOSTAT							
PARAMETER	DESCRIPTION	Freq.(Hz)	RSS (%)	dir.	rep.	t (min)	comments
4. DRIFT	move randomly, stop, measure position during 60s						is there drift after 1s, 10s, 60s? t ~1 hour
		50	100	/	20		
		40	100	/	20		
		30	100	/	20		
		50	80	/	20		
5. TILT	measure the tilt after positioning						calculate from the indivudual motor positions
		50	100	/	20		
		40	100	/	20		
		30	100	/	20		
		50	80	/	20		

Open points

1. Starting date

2. Travel details, rental car, lodging, …

3. Team

4. Measurements: other ideas or wishes?

Repeatability vs accuracy

High Accuracy AND High Repeatability | Low Accuracy BUT High Repeatability | Medium Accuracy AND Medium Repeatability | Low Accuracy AND Low Repeatability

Image taken from PI USA

Octagonal cryostat

Threaded rod, G11