Field quality of HCQQXF_SC002-FL000001 (LMQXFA01 type Q3, with MQXFA03 and MQXFA04)

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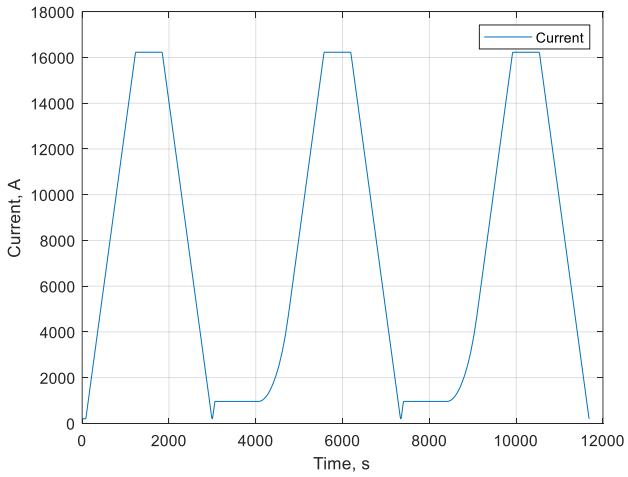
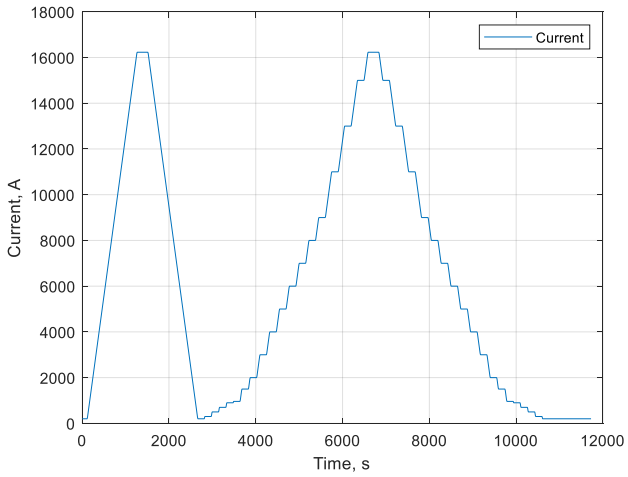
MAB meeting 20/01/2025

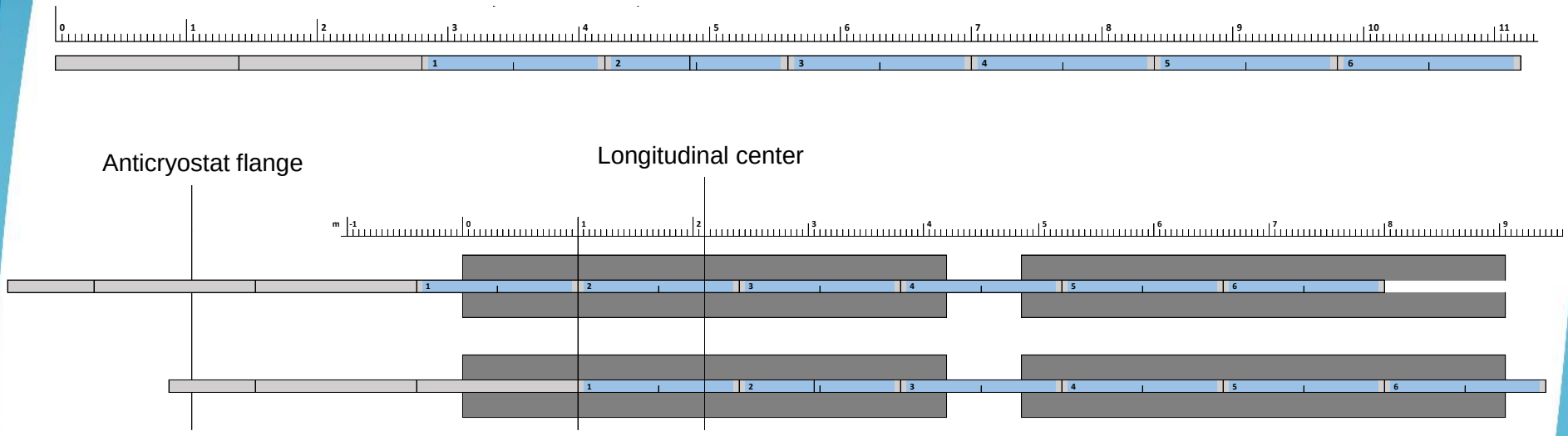
Performed tests

- At 1.9 K
  - Field quality with Rotating Coils
    - Machine cycles and Stair-step cycles
  - Integrated gradient and alignment with Stretched wire
    - Nominal current with both in series, low current for individual powering
- At ambient temperature
  - Longitudinal scan with Rotating Coil





Rotating coils at 1.9 K



Shaft too short to cover at the same time both magnets

- Two measurement positions
- Cycles repeated twice

Main field and magnetic length

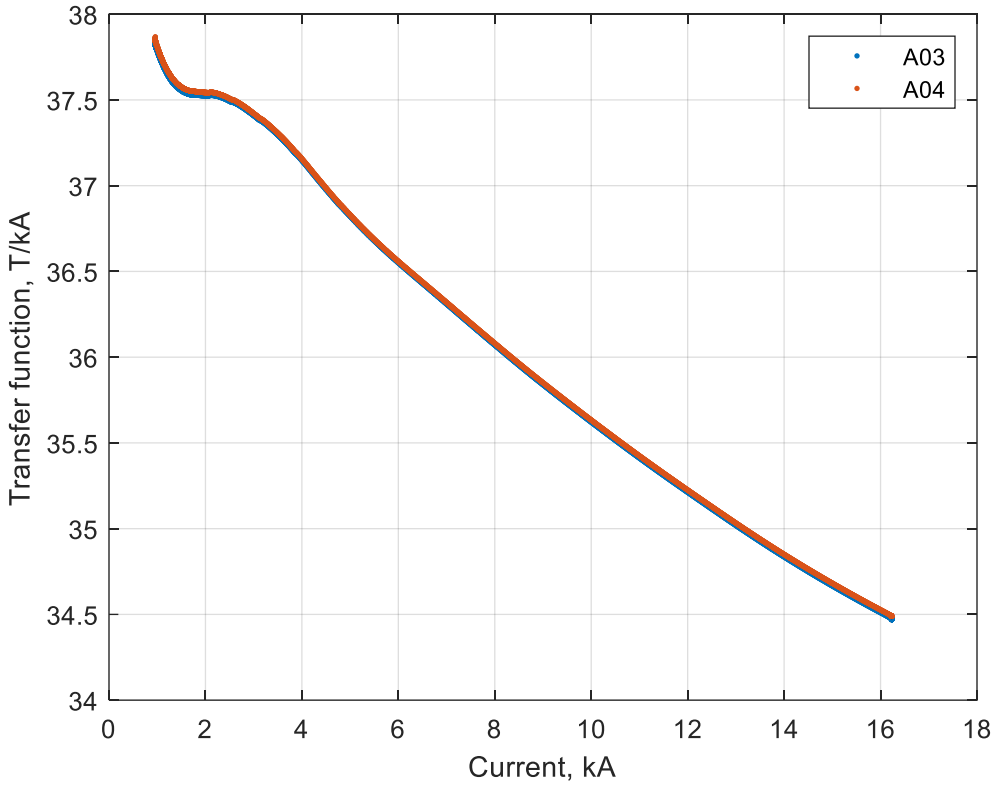
Current	A	16230				
		A03	**A04**	**Integral**		
CERN						
Integrated gradient	T	559.53	559.62	1119.15	SSW	1119.03
Central gradient TF	T/m/kA	8.1790	8.1828			
Lm	m	4.215	4.214			
Nodal distance	m	4.770				
FNAL						
Integrated gradient	T	559.70	559.95	1119.60		
Difference	units	8	1	4		
Nodal distance	m	4.772				
Difference	mm	-2				

Field quality

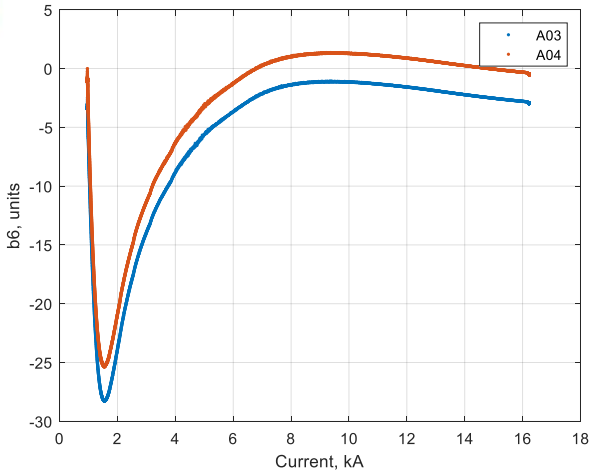
	EDMS Test Report 3192078				
	MQXFA03		MQXFA04		
	At I_{inj}	At I_{nom}	At I_{inj}	At I_{nom}	Unit
I	960	16230	960	16230	A
Main Field	36.324	559.47	36.328	559.56	T
ML	4.205	4.215	4.203	4.214	m
Nodal distance	4.783 at ambient temperature / 4.770 at 1.9 K				m
FD	2.46				mrad
b3	1.30	0.35	-1.14	1.44	Units at 50 mm
b4	-1.03	-1.23	-0.52	-0.16	
b5	1.04	1.43	0.97	-0.48	
b6	-3.33	-2.91	-0.95	-0.48	
b7	-0.13	0.25	0.15	-0.20	
b8	0.16	0.09	0.16	0.19	
b9	0.18	0.15	-0.02	0.10	
b10	2.90	0.33	2.60	0.28	
b11	0.09	0.12	0.01	0.09	
a3	-2.40	1.32	-0.32	-1.32	
a4	0.36	1.93	-1.88	1.98	
a5	0.97	1.75	-0.07	-0.92	
a6	-0.25	-0.26	-1.14	-1.18	
a7	-0.57	-0.17	0.06	0.10	
a8	-1.04	-0.57	-1.50	-1.48	
a9	-0.20	0.09	0.04	-0.08	
a10	0.03	-0.01	-0.22	-0.14	
a11	0.04	0.05	0.00	0.02	

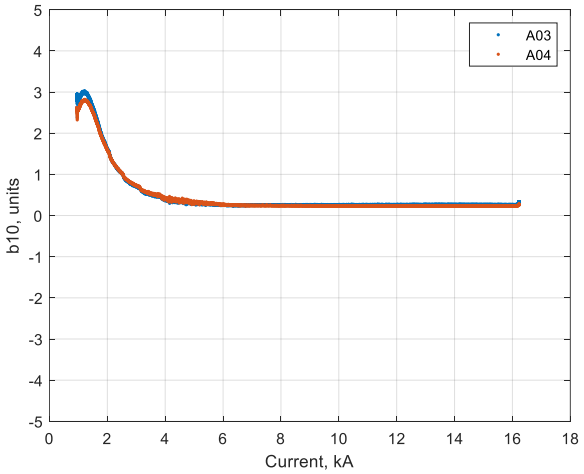
Harmonics are given in units at the reference radius of 50 mm

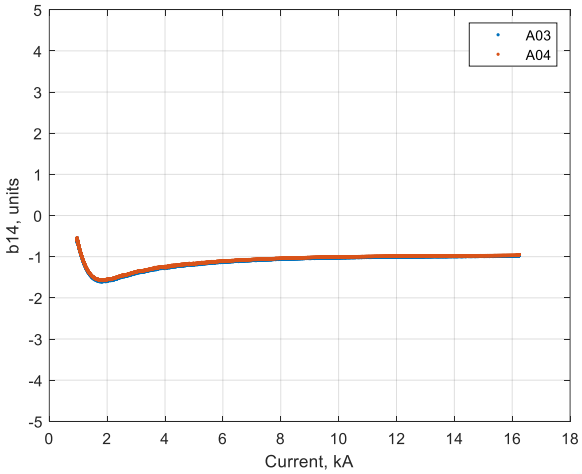
TF vs current - ramp-up of machine cycle



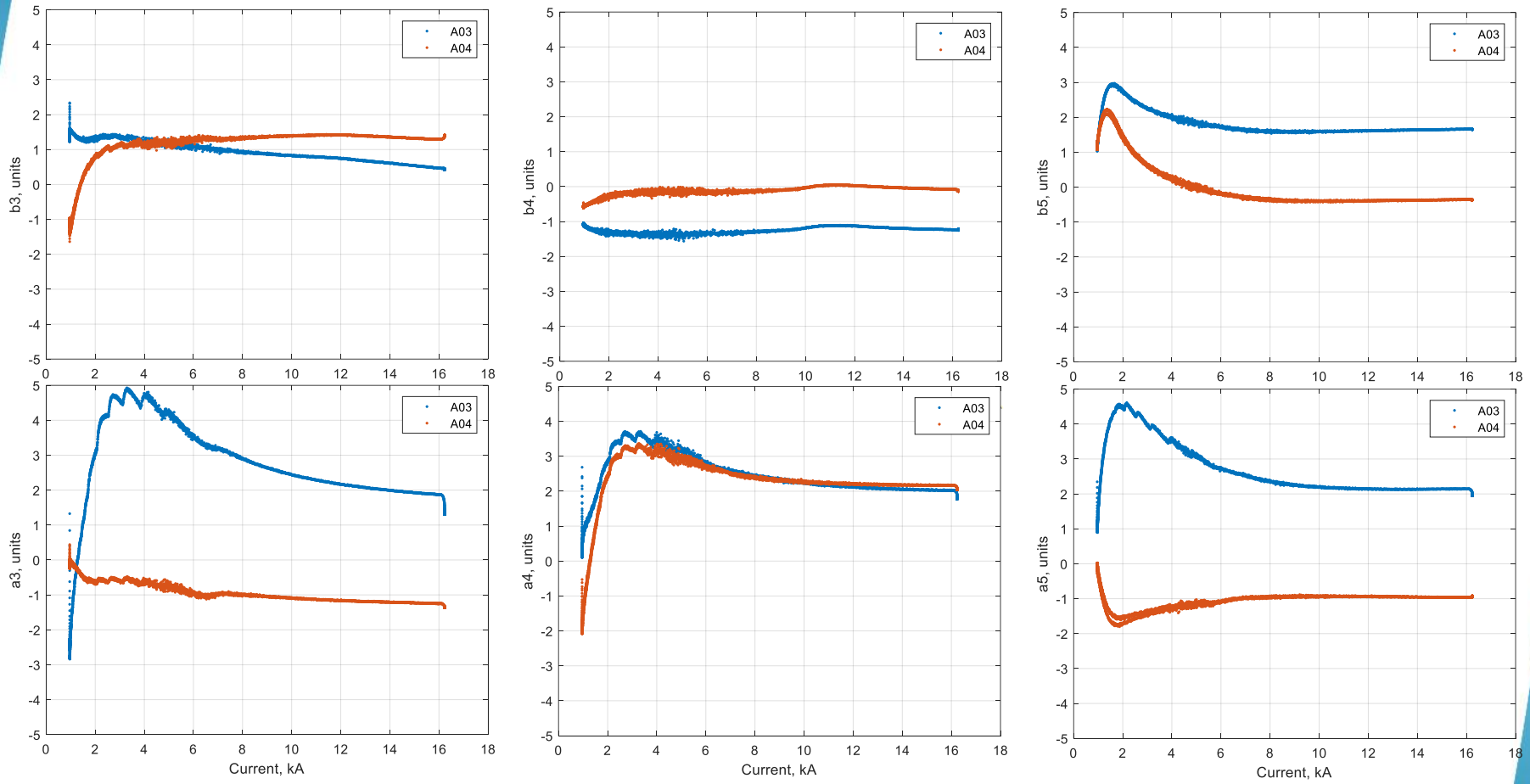
Harmonics vs current - ramp-up of machine cycle





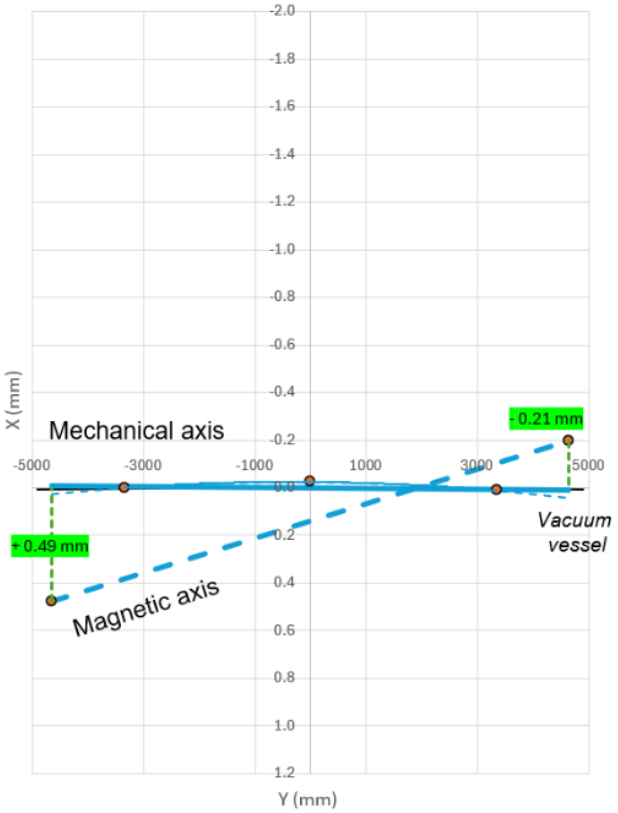


Harmonics vs current - ramp-up of machine cycle

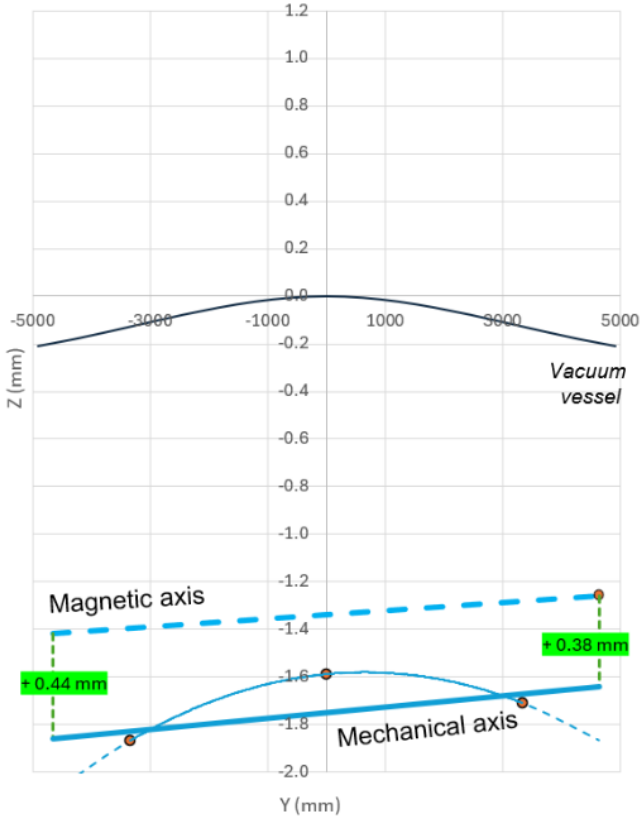


Magnetic common axis (1.9 K)

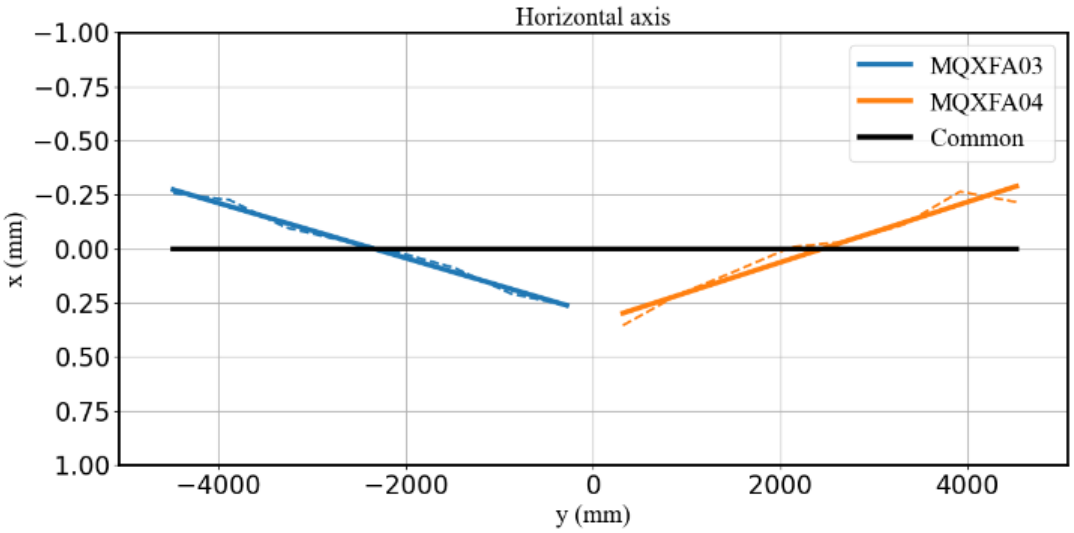
COLD NOMINAL SM18
Common axis measured
Radial measurement

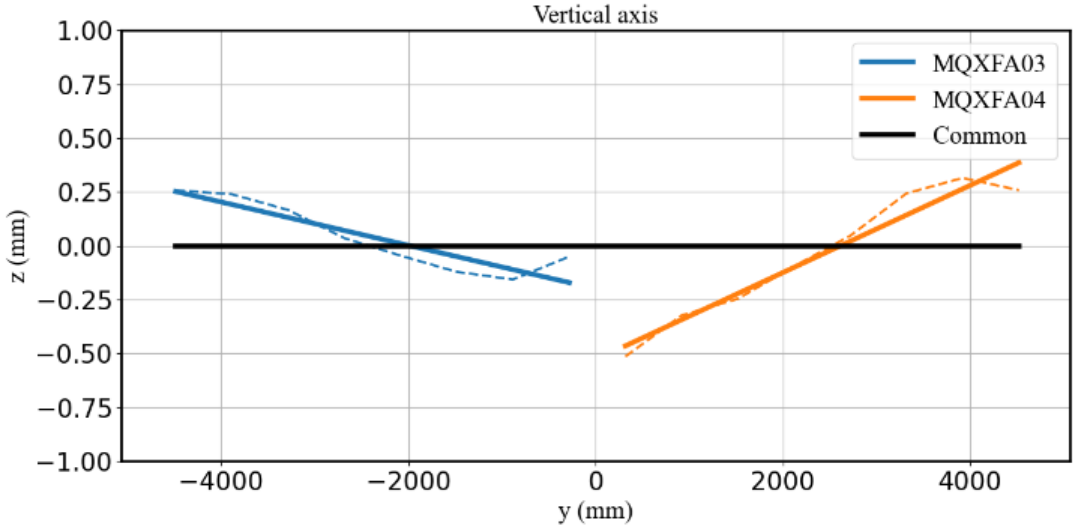


COLD NOMINAL
Common axis measured
Vertical measurement



Relative magnetic axis (ambient temperature)





Relative alignment – data from AUP

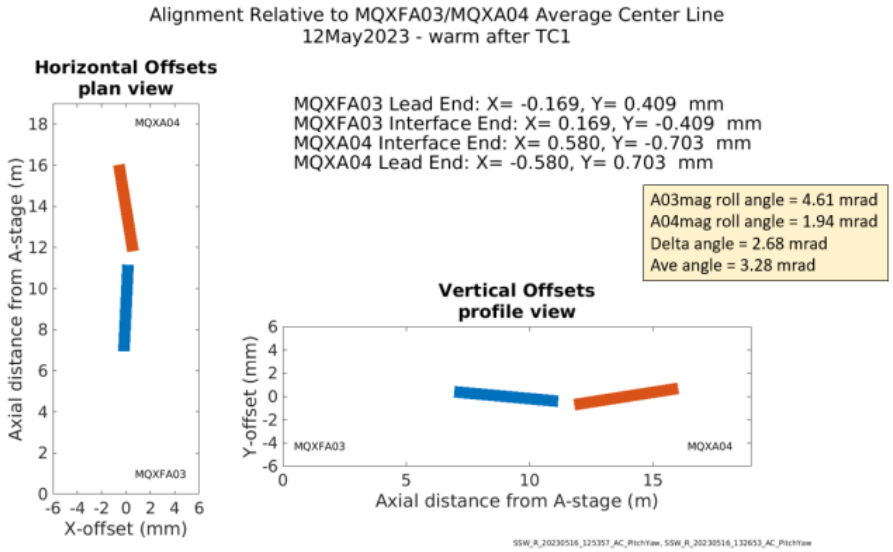


Fig. 10: Warm SSW measurement before TC2

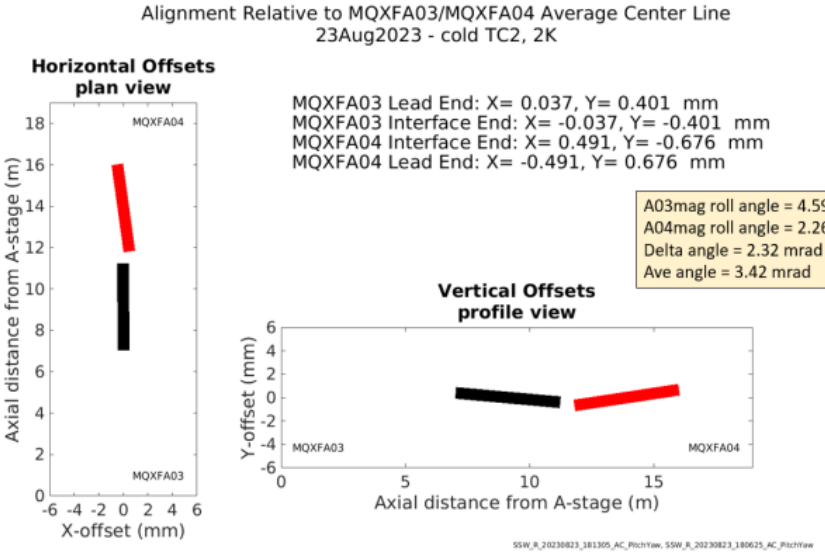
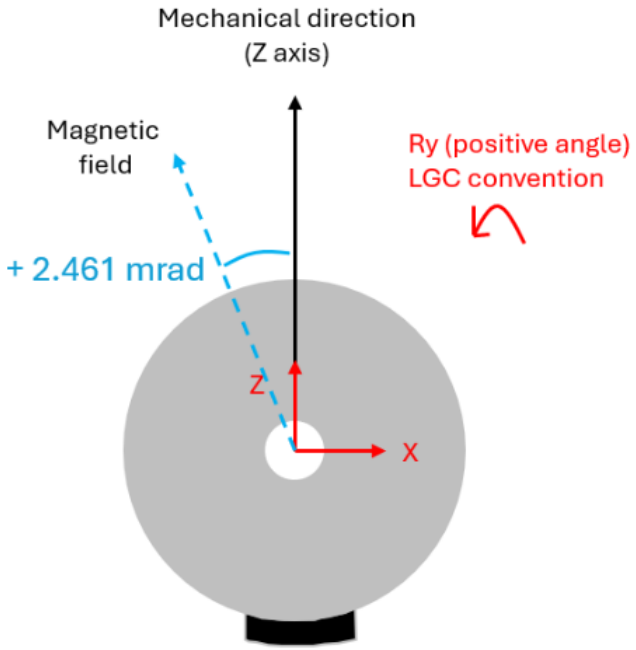


Fig. 11: SSW measurements TC2 at 1.9K

Field direction

COLD : SM18
Magnetic field



	LGC conv.
Delta Roll. (mrad) meca → magn	+ 2.461

Relative angle measured at ambient temperature:
1.99 mrad

Conclusions

- Transfer function of the two magnet is within 5 units
- In agreement with results from AUP (~5 units)

- Results of field quality are confirmed as well:
  - Only a8 slightly out of expected range (-1 units for MQXFA04)

- Magnetic axis
  - Common axis measured at 1.9 K
  - Relative axis measured only at ambient temperature
  - Relative angle at the limit (2.0 mrad)