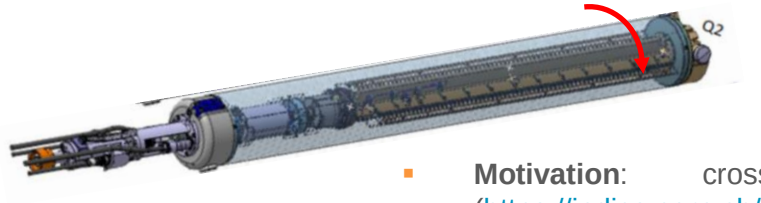
Warm MM of LMQXFA01

Mariano Pentella– TE-MSC

Date: 25/10/2024

Experimental setup

- Measurements performed at room temperature by a **rotating coil scanner (or mole),** at 10 A DC.
- **Standard rotating coil measurement** performed at different longitudinal positions (every 600 mm, 8+8 positions). Measurement with separate and then combined powering.
- Each point obtained by **combining four measurements** to compensate for systematics: ±10 A, CW/CCW rotation direction.
- **PCB leveled to gravity** before each measurement through onboard tilt sensor. Mole held in position via **pneumatic brake** for better stability.
- Same procedure adopted for Q2 (EDMS 2901463)



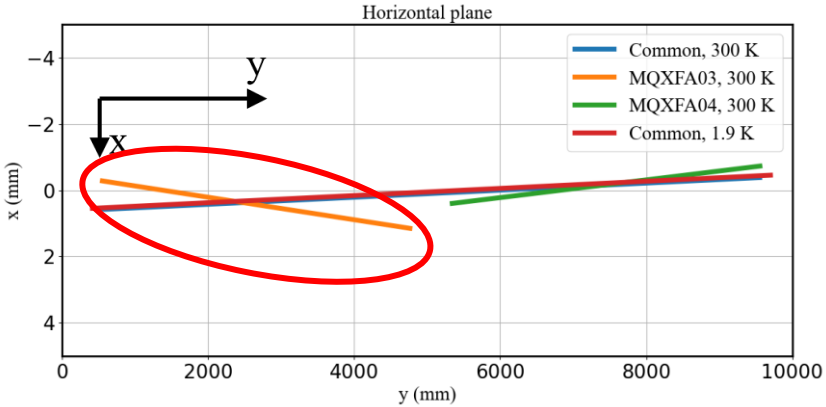
- **Motivation**: cross-check SSW alignment data at warm (https://indico.cern.ch/event/1458312/).

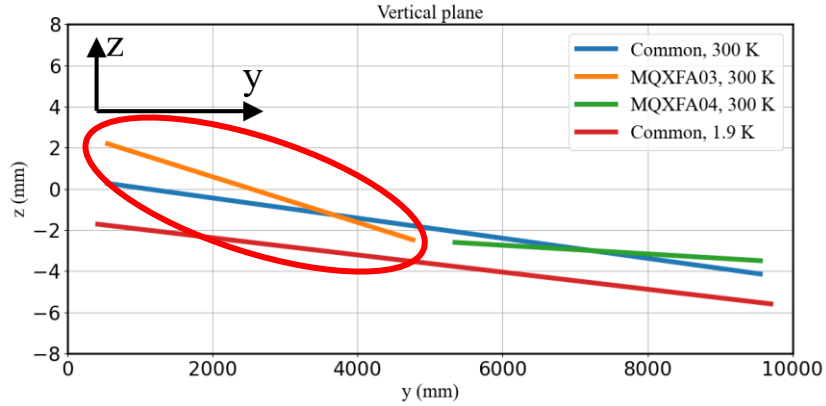
SSW warm measurement

- **Motivation**: cross-check SSW alignment data at warm (https://indico.cern.ch/event/1458312/).

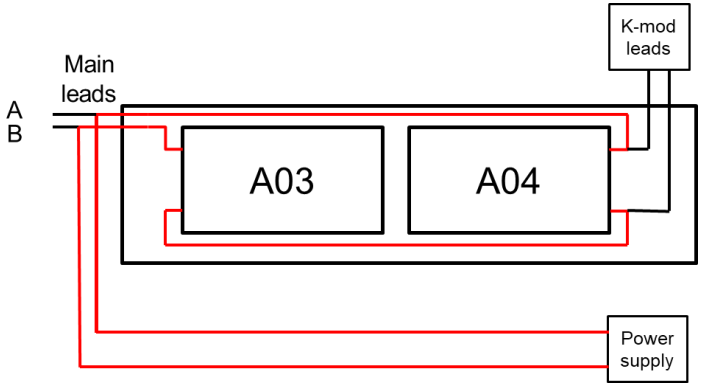
Misalignment w.r.t. common axis (300 K)					
MQXFA03					
		CERN		AUP	
Position		x	z	x	z
NCS	mm	-0.86	1.93	0.17	-0.41
CS	mm	1.02	-0.68	-0.17	0.41
MQXFA04					
		CERN		AUP	
Position		x	z	x	z
NCS	mm	0.33	-0.52	0.58	-0.70
CS	mm	-0.35	0.65	-0.58	0.70

Roll angles			
Magnet	unit	CERN	AUP
MQXFA04, RT	mrad	1.67	1.16
MQXFA03, RT	mrad	4.08	3.83
Common, RT	mrad	2.53	2.50
Common, 1.9 K	mrad	2.44	2.64

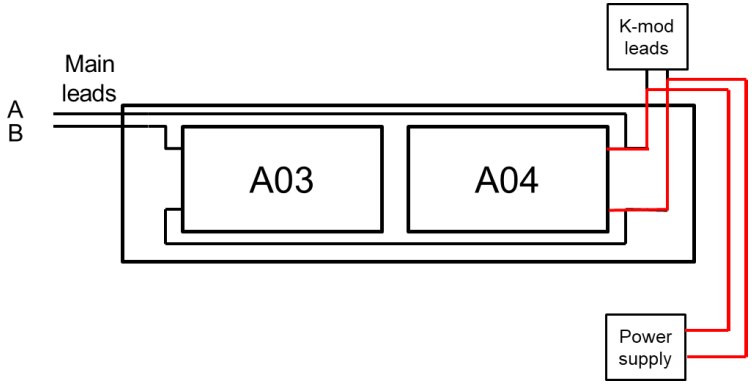




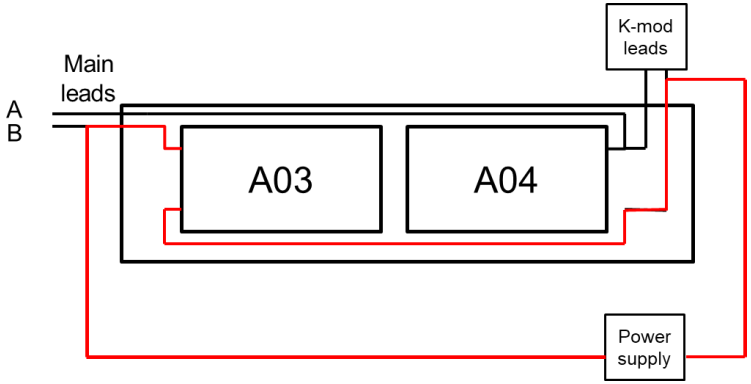
Powering schemes



Common powering



Single powering of A04



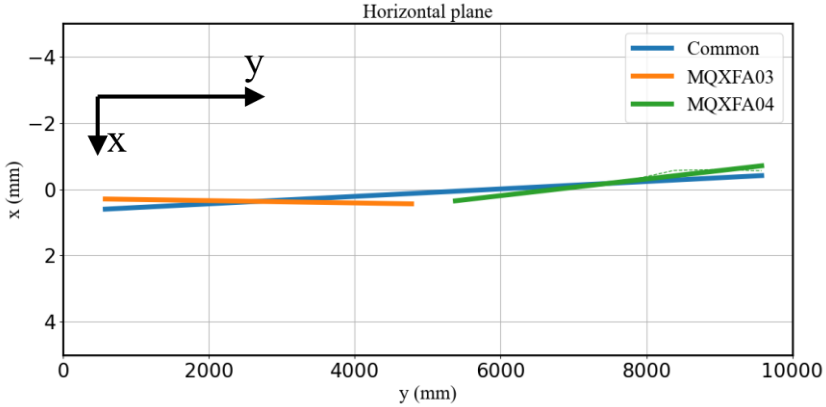
Single powering of A03

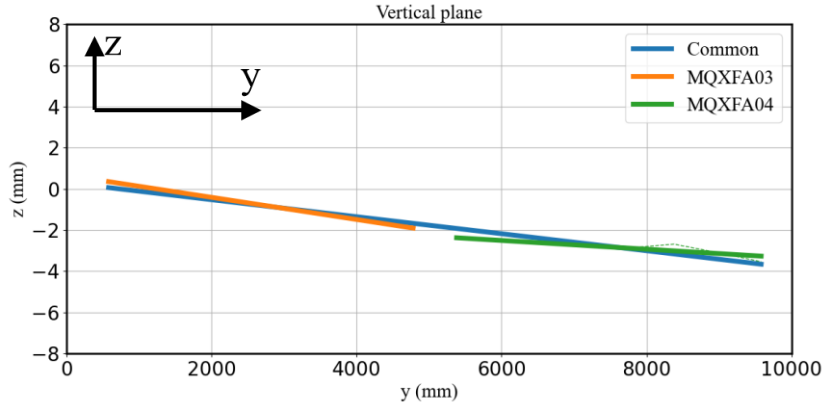
RCS alignment results

Disclaimer: combined powering

Misalignment w.r.t. common axis (300 K)					
MQXFA03					
		CERN		AUP	
Position		x	z	x	z
NCS	mm	0.31	-0.23	0.17	-0.41
CS	mm	-0.31	0.29	-0.17	0.41
MQXFA04					
		CERN		AUP	
Position		x	z	x	z
NCS	mm	0.29	-0.45	0.58	-0.70
CS	mm	-0.30	0.39	-0.58	0.70

Roll angles				
Magnet	unit	SSW	RCS	AUP
MQXFA04, RT	mrad	1.67	1.52	1.16
MQXFA03, RT	mrad	4.08	3.49	3.83
Common, RT	mrad	2.53	2.50	2.50
Common, 1.9 K	mrad	2.44		2.64





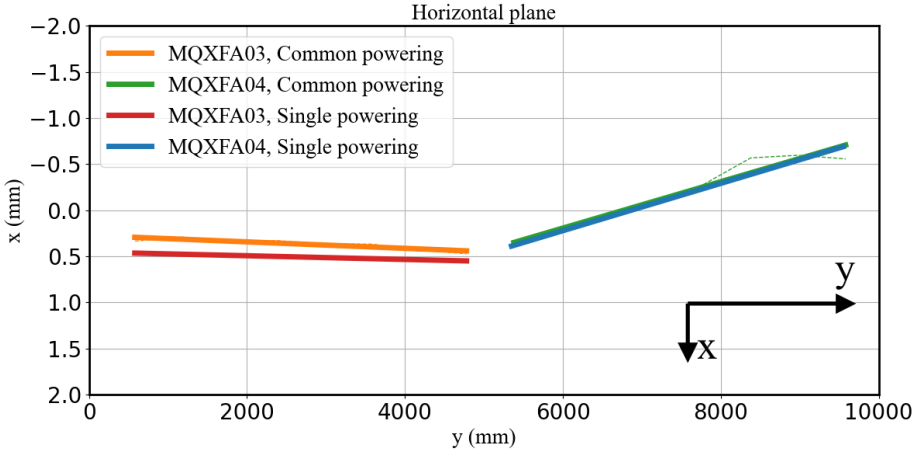
Magnetic center separation: 4783.56 mm

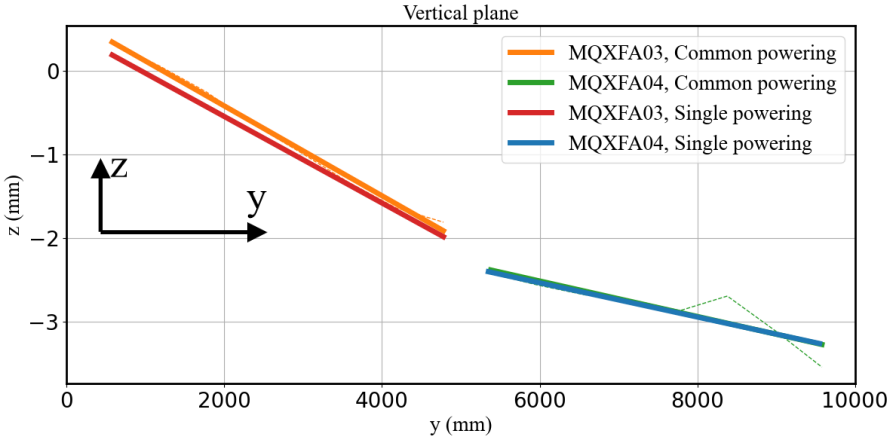
Preliminary investigation

- **Summary**:
  - **Excellent agreement on A04 magnetic axis**
  - Good agreement on common axis. To be checked the uncertainty introduced by the coordinate transfer.
  - No agreement on A03 magnetic axis.

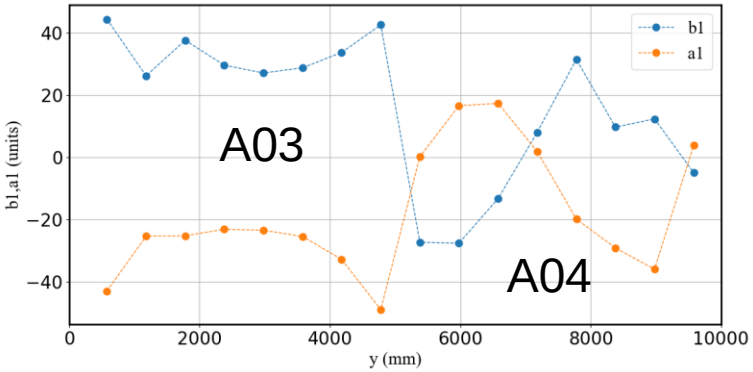
- Data integrity checked. Considering the good agreement among the roll angles and how consistent the measurements at room temperature and 80 K were, the effect seems to be likely magnetic.
- Something interesting was found during rotating coil measurements at warm.

Preliminary investigation



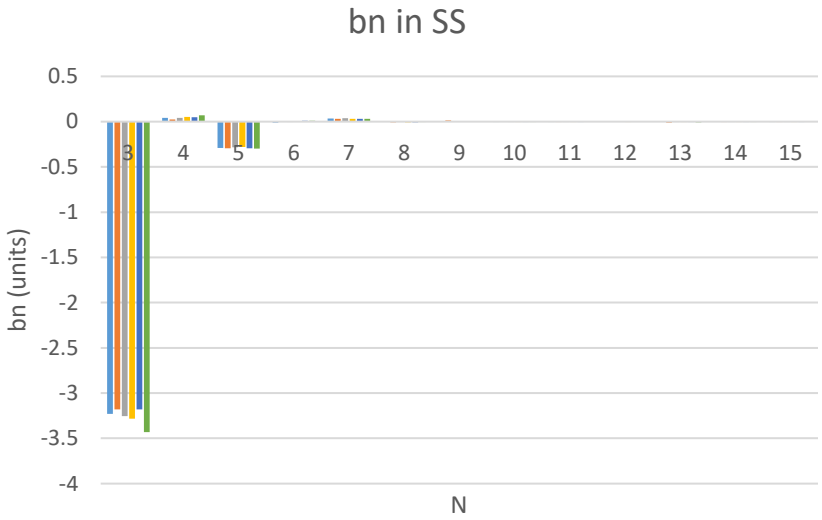


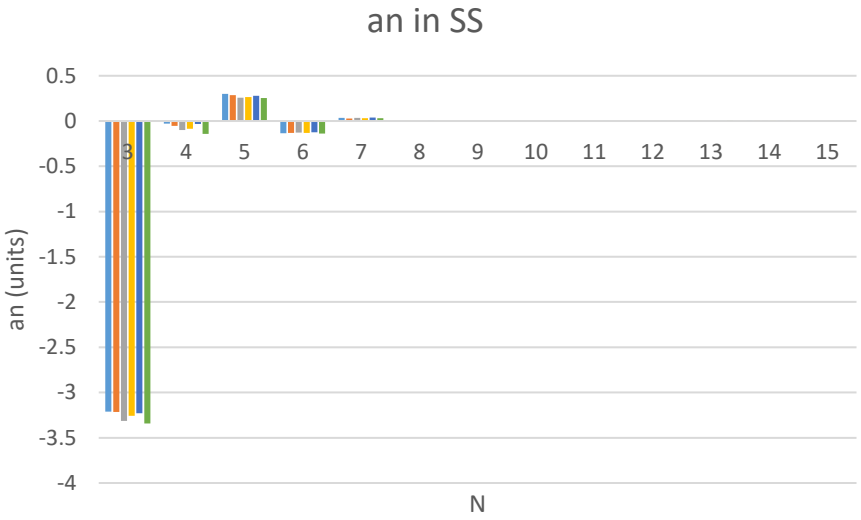
- When powered through the k-mod leads, the axis of A03 is shifted by about 0.12 mm along *x* and *z*.
- This corresponds to an additional dipole contribution pointing at 45°. The integrated amplitude is about 44 units (module).



Preliminary investigation

- Also harmonics are impacted. b3,a3 (3.3 units) and b5, a5 (0.3 units) visible.





- Harmonics not impacted on magnet A04.

Preliminary investigation

- Rotating coil less sensitive to this problem, since the axis is evaluated at several positions.
- This additional dipole contribution might explain what we see with wire measurements. Since the measurement principle is different and can measure only the integral, pitch and yaw angles can be severely affected.
- Additional investigation is being carried out on available data (SSW) and more measurements will be performed as soon as Q1 will be delivered.

Conclusions

- Changing the powering schemes affects the magnetic axis. In particular, singular powering through the k-mod leads introduces a shift of about 0.12 mm on the axis of A03, along both direction.
- This shift, corresponding to an additional dipole component, is likely due to a magnetic loop forming when powering through the k-mod leads.
- Axis measurements, considering the common powering scheme, are consistent with AUP.


HiLumi
HL-LHC PROJECT


CERN