



# **Update on the field quality of the MCBRD**

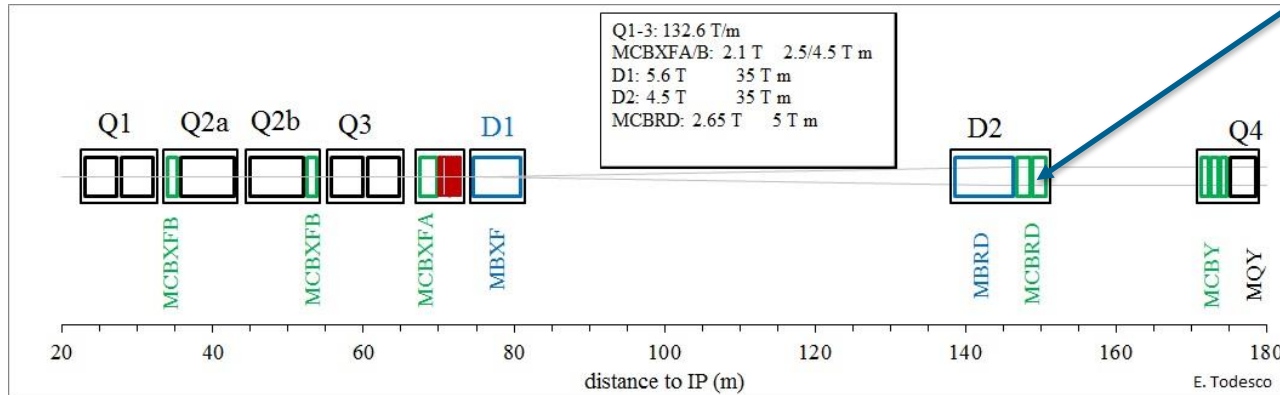
Andrea Musso, Glyn Kirby and Ezio Todesco

Special Joint Hi-Lumi WP2/WP3 Meeting

# Table of contents

- A brief recall of the parameters and design
- Red, Blue, Violet apertures
- Prototype CERN 1 and 1a - results
- Roxie simulations
- Conclusions

# Position



The D2 correctors are two dipole corrector magnets, placed in the D2 cold masses around IP1 and IP5

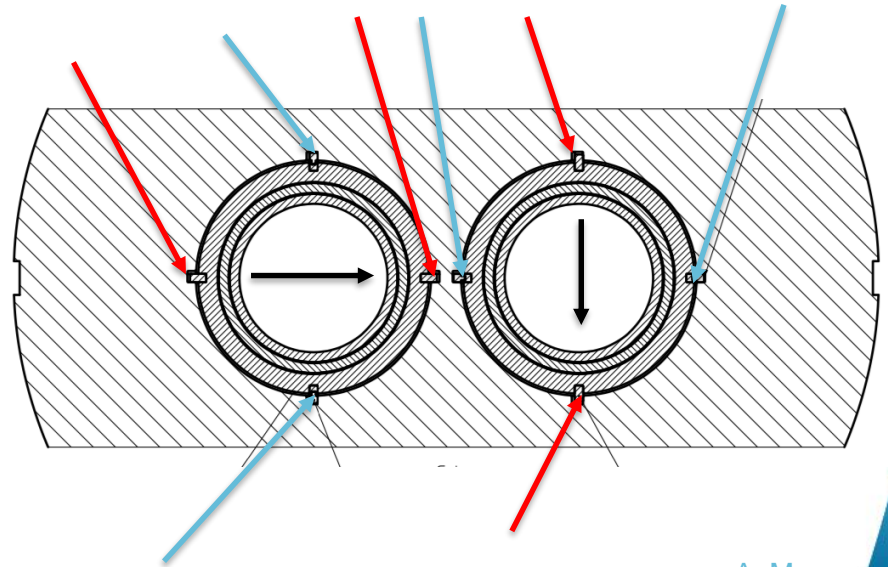
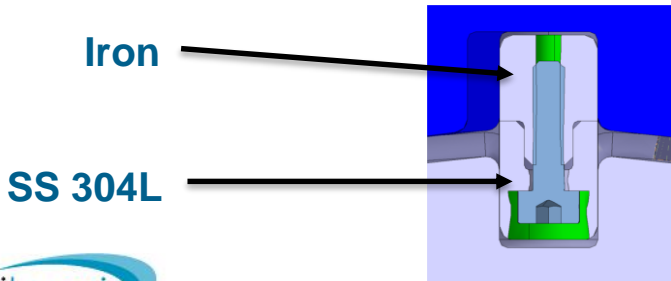
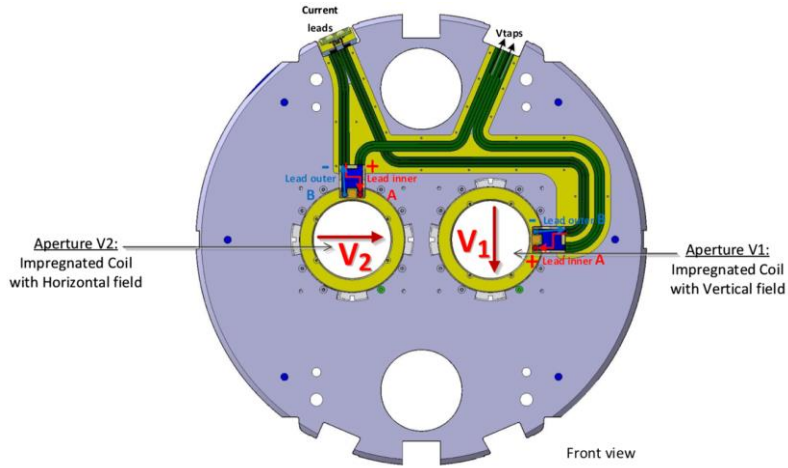
# Parameters

		MCBRD	
		Nominal	Ultimate
Current	(A)	394	422
Central field	(T)	2.60	2.79
Peak field in the coil	(T)	2.94	3.15
Ratio peak field/central field	(adim)	1.129	1.129
Strand current density	(A/mm)	733	786
Insulated coil current density	(A/mm)	368	394
Transfer function	(T/kA)	6.599	6.599
Integrated transfer function	(T m/ kA)	12.69	12.69
Magnetic length	(mm)	1.920	1.920
Stored energy	(kJ)	143	166
Linear inductance at 0 A	(mH)	920	
Differential inductance	(mH)	920	920
Loadline fraction	(%)	47%	50%
Temperature margin at 1.9 K	(K)	4.2	
Short sample current at 1.9 K	(A)	838	
Short sample current at 4.2 K	(A)		
Mechanical length magnet	(mm)	2158	
Magnet mass	(kg)	4000	

Ref. Engineering Specification:

[EDMS 2085323](#)

# Cross section (design)



# Produced magnets

@CERN: 3 apertures were produced:

- Prototype 1a (apertures **RED** and **BLUE**)
- Prototype 1b (apertures **RED** and **VIOLET**)

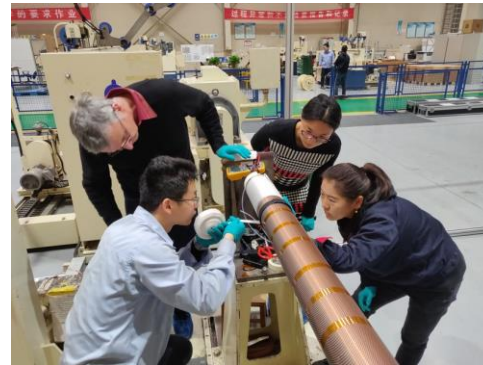
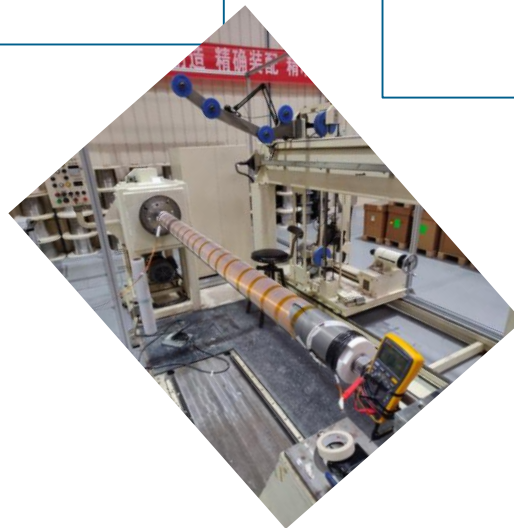
@WST (IHEP, China): 1 prototype was produced

**RED** Aperture: OK no problem

**BLUE** Aperture: Long training, but OK after thermal cycle

**VIOLET** Aperture: OK no problem

Some minor difference in assembly but same magnetic design



# Magnetic Measurements

@Warm

RED Aperture without Iron @warm	
n	bn
2	-1.32
3	0.36
4	-0.34
5	-0.59
6	-0.05
7	-0.38
8	-0.01
9	-0.03
10	0.01
11	0.01
12	0.00
13	0.00
14	0.00
15	0.00

RED Aperture with Iron @warm

n	bn
2	0.66
3	-10.50
4	0.34
5	1.94
6	0.04
7	-0.95
8	0.01
9	0.13
10	0.01
11	-0.03
12	0.01
13	0.00
14	0.00
15	0.00

@cold

RED Aperture @cold (400 A)

n	bn
2	4.04
3	-10.93
4	0.18
5	0.24
6	0.08
7	-0.40
8	-0.01
9	0.01
10	0.00
11	-0.01
12	0.00
13	0.00
14	0.00
15	0.00

# Magnetic Measurements

@cold

RED Aperture @cold (400 A)	
n	bn
2	4.04
3	-10.93
4	0.18
5	0.24
6	0.08
7	-0.40
8	-0.01
9	0.01
10	0.00
11	-0.01
12	0.00
13	0.00
14	0.00
15	0.00

BLUE Aperture @cold (400 A)	
n	bn
2	1.02
3	-7.14
4	0.86
5	0.88
6	0.06
7	-0.30
8	-0.02
9	0.02
10	0.00
11	-0.01
12	0.00
13	0.00
14	0.00
15	0.00

VIOLET Aperture @cold (393 A)	
n	bn
2	2.48
3	-11.69
4	0.27
5	0.57
6	-0.07
7	-0.24
8	-0.01
9	0.01
10	-0.01
11	-0.02
12	0.00
13	0.00
14	0.00
15	0.00

B=2.63 T (@393 A)



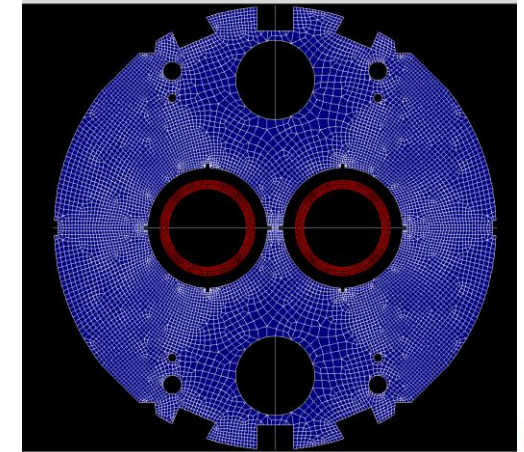
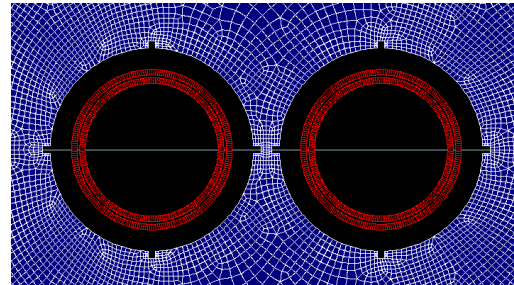
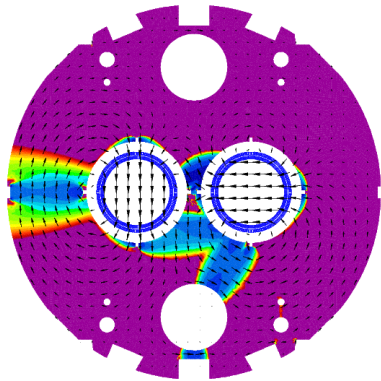
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# Roxie simulations

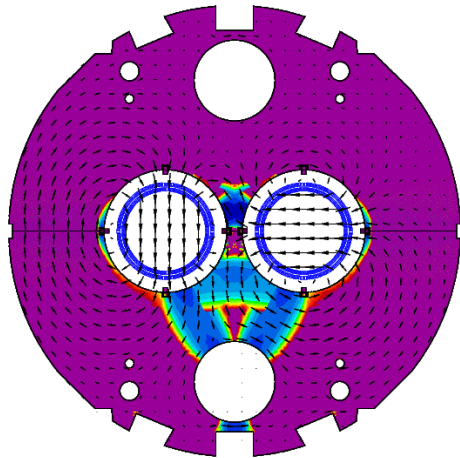
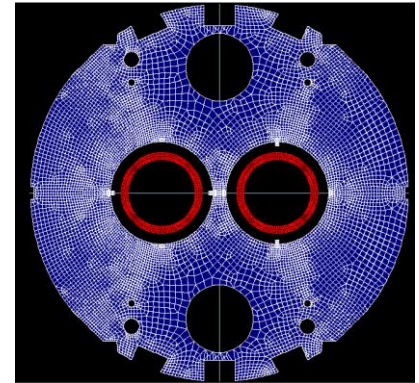
No Keys	b2	b3	b4	b5	b6	b7	
	Ap1	-4.70	-1.76	-0.46	-1.63	-0.02	0.19
	Ap2	11.40	-3.34	-0.06	0.31	-0.10	0.04
No Keys	a2	a3	a4	a5	a6	a7	
	Ap1	6.84	2.70	1.16	0.50	0.18	0.06
	Ap2	12.20	-6.26	0.64	-1.38	0.09	-0.22

No keys



# Roxie simulations

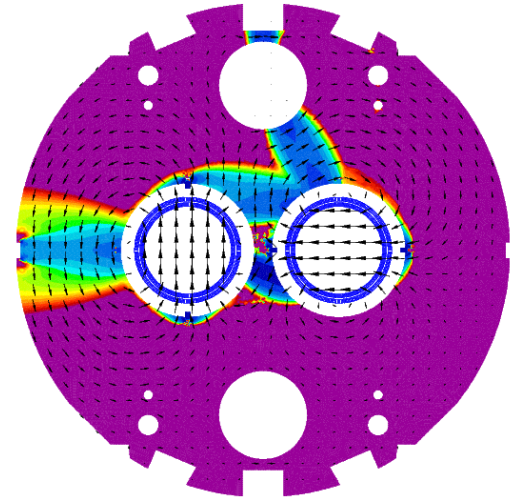
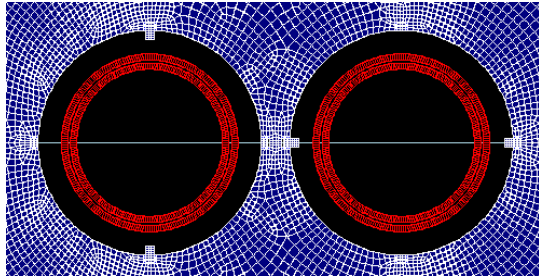
Hybrid keys as design	b2	b3	b4	b5	b6	b7	
	Ap1	-4.41	-3.59	-0.45	-0.38	0.04	0.08
	Ap2	9.53	-2.98	-0.17	0.48	-0.18	0.04
Hybrid keys as design	a2	a3	a4	a5	a6	a7	
	Ap1	7.71	3.37	1.50	0.66	0.26	0.11
	Ap2	12.67	-3.85	0.46	-0.25	0.12	-0.70



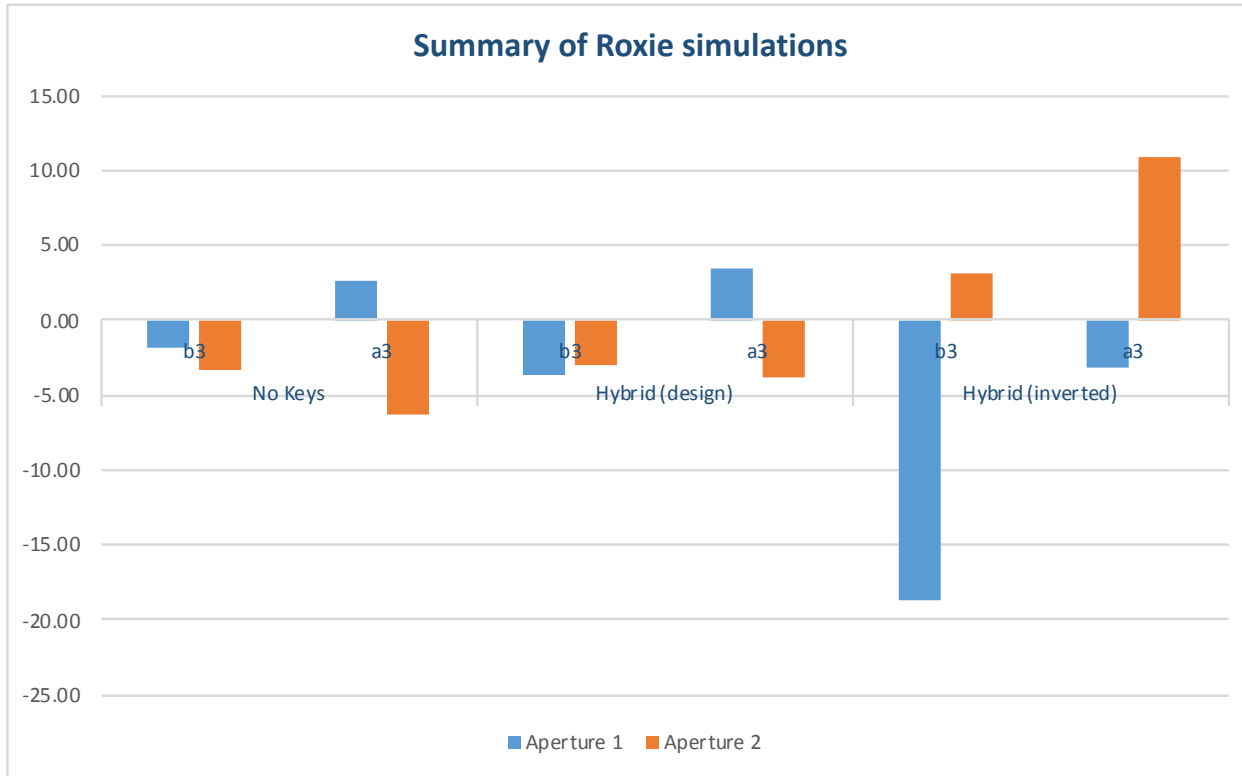
Hybrid keys as design

Both apertures powered  
Hybrid keys “inverted”

Hybrid keys “inverted”	b2	b3	b4	b5	b6	b7	
	Ap1	-4.66	-18.68	-0.48	3.72	0.02	-1.07
	Ap2	-10.09	3.09	0.14	-0.44	0.17	-0.05
	a2	a3	a4	a5	a6	a7	
Ap1	-7.53	-3.10	-1.36	-0.58	-0.22	-0.08	
Ap2	12.74	10.84	0.62	3.87	0.10	1.07	



# Summary



# Conclusions

There is not (yet) enough statistic on measurements at this stage, but:

- We observe a high  $b_3$  value, at the limit of specification (10 units max.)
- Preliminary results are not confirming simulations; investigation in progress
- There is margin for improvement
- In some weeks we will have measurements at cold of IHEP prototype
- Discrepancy on  $b_3$  values is compatible with iron edge at 83 mm radius and eventually with hybrid keys inverted

Thank you...