



Progress on magnets for the HL-LHC insertion regions

E. Todesco, P. Ferracin, J. Carlos Perez, A Foussat, A. Musso, G. Kirby (CERN)

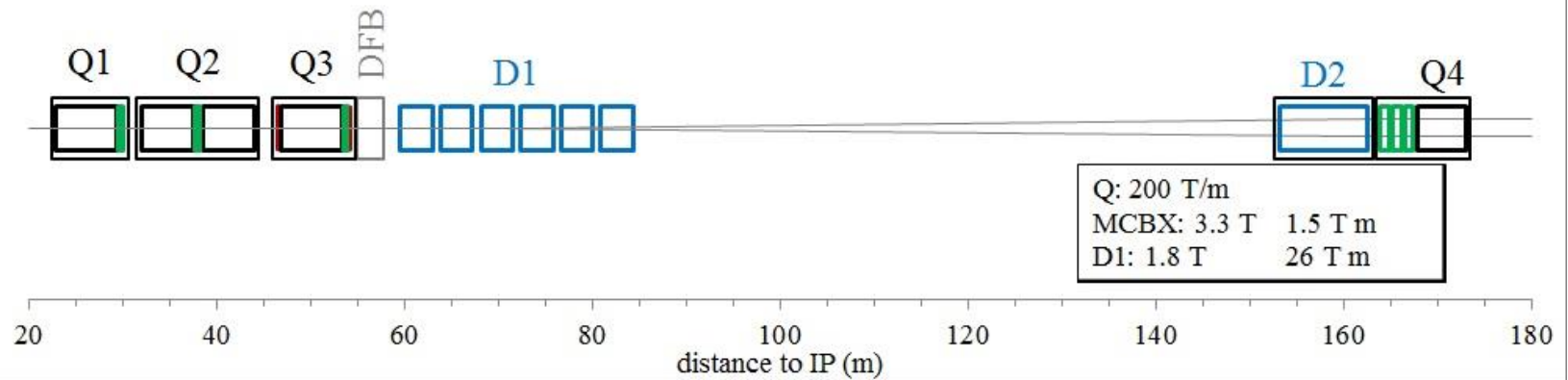
T. Nakamoto (KEK), P. Fabbriatore and M. Sorbi (INFN), F. Toral (CIEMAT), H. Felice (CEA), G. Ambrosio, S. Feher (FNAL), Q. Xu (IHEP)



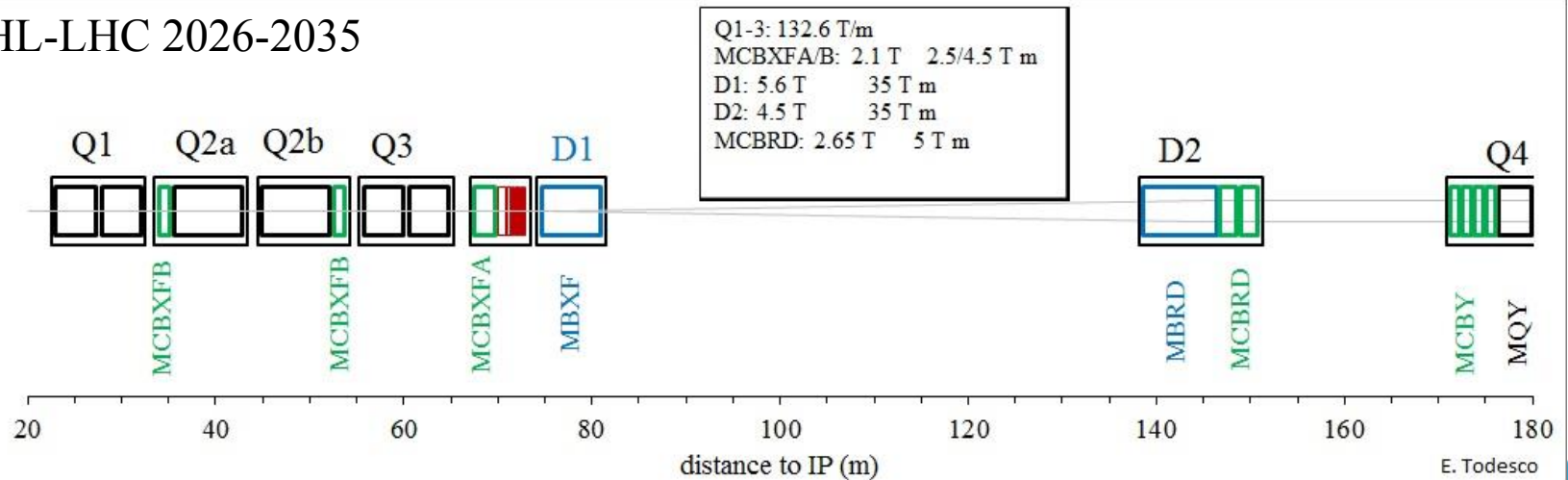
16 October 2018 - Geneve

OVERVIEW

LHC 2008-2022

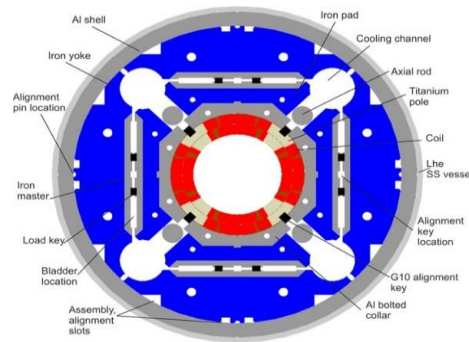


HL-LHC 2026-2035

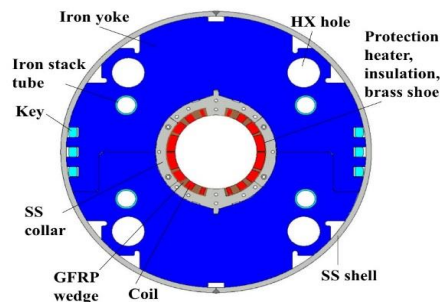


E. Todesco

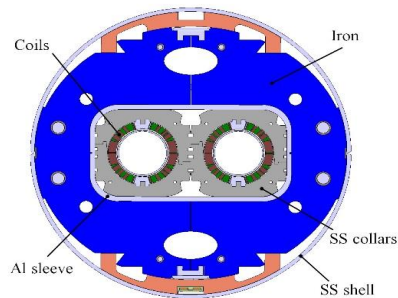
THE MAGNET ZOO



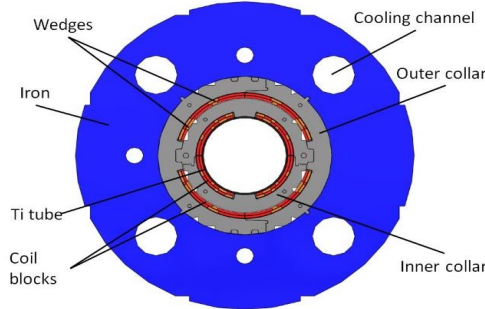
Triplet [G. Ambrosio, S. Feher, P. Ferracin et al.]



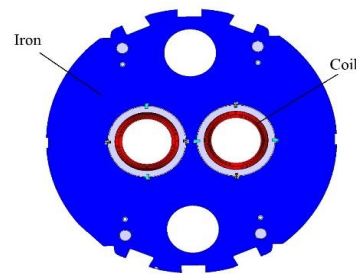
D1 [T. Nakamoto, et al.]



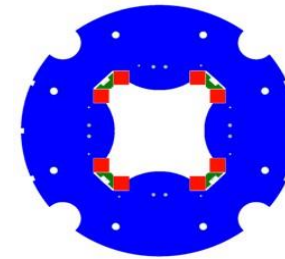
D2 [P. Fabbriatore, S. Farinon, et al.]



MCBXF [F. Toral, et al.]

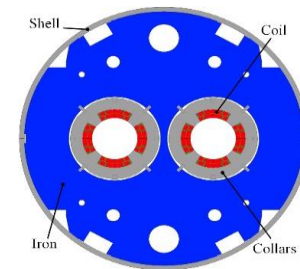


D2 correctors [G. Kirby, Q. Xu, et al.]

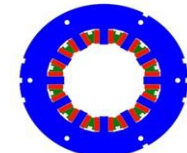


Skew quad

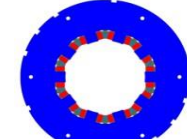
[M. Sorbi, M. Statera, et al.]



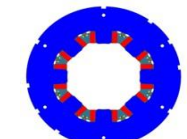
MQYY [H. Felice, et al.]



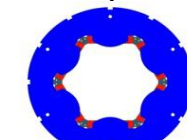
Dodecapole



Decapole

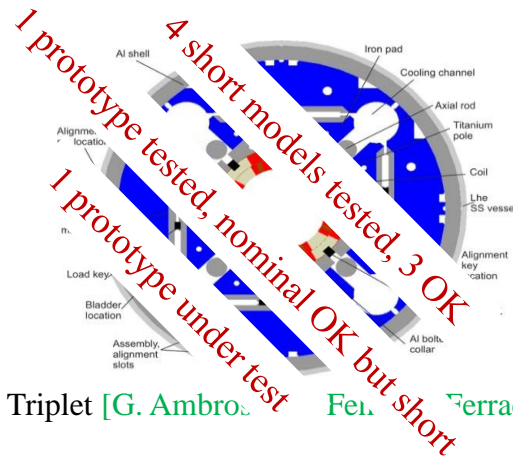


Octupole

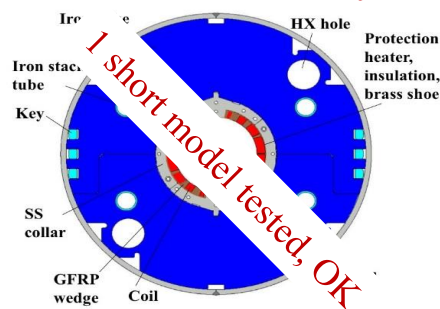


Sextupole

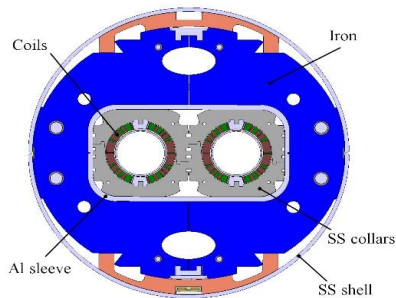
STATUS OF TEST IN FALL 2018



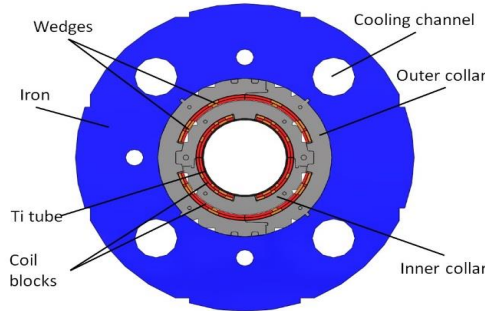
Triplet [G. Ambrosio, Felice, Ferracin et al.]



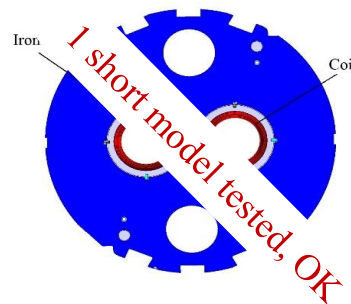
D1 [T. Nakamoto, et al.]



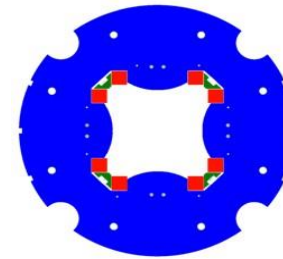
D2 [P. Fabbriatore, S. Farinon, et al.]



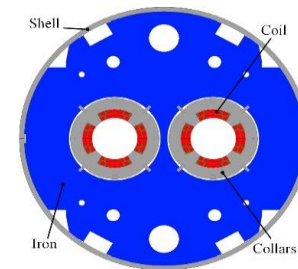
MCBXF [F. Toral, et al.]



D2 correctors [G. Kirby, Q. Xu, et al.]



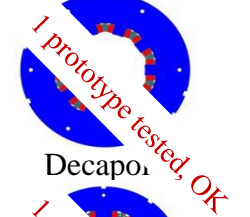
Skew quad
[M. Sorbi, M. Statera, et al.]



MQYY [H. Felice, et al.]



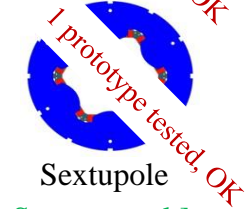
Dodecapole



Decapole

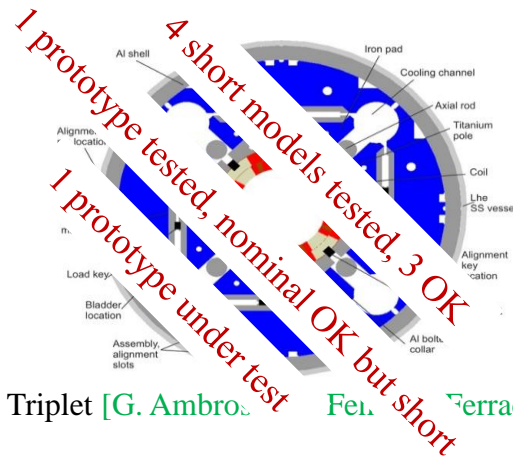


Octupole

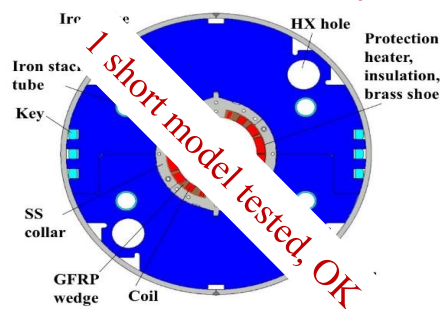


Sextupole

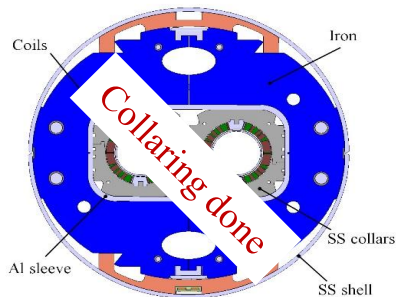
STATUS OF TEST IN FALL 2018



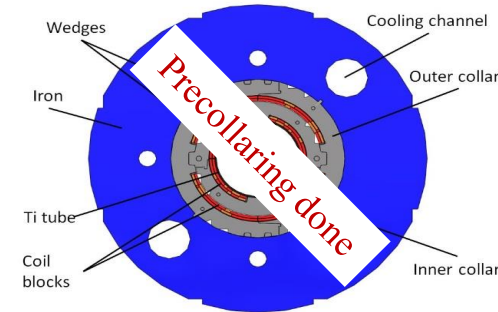
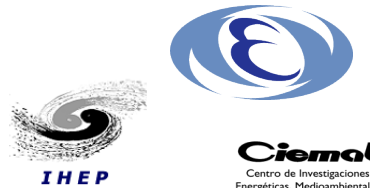
Triplet [G. Ambrosio, Felice, Ferracin et al.]



D1 [T. Nakamoto, et al.]



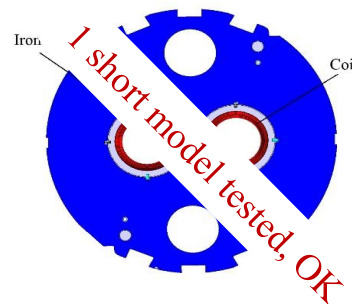
D2 [P. Fabbriatore, S. Farinon, et al.]



MCBXF [F. Toral, et al.]



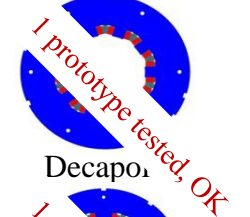
Skew quad [M. Sorbi, M. Statera, et al.]



D2 correctors [G. Kirby, Q. Xu, et al.]



Dodecapole



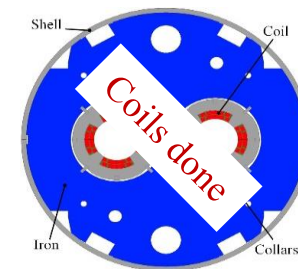
Decapole



Octupole



Sextupole



MQYY [H. Felice, et al.]

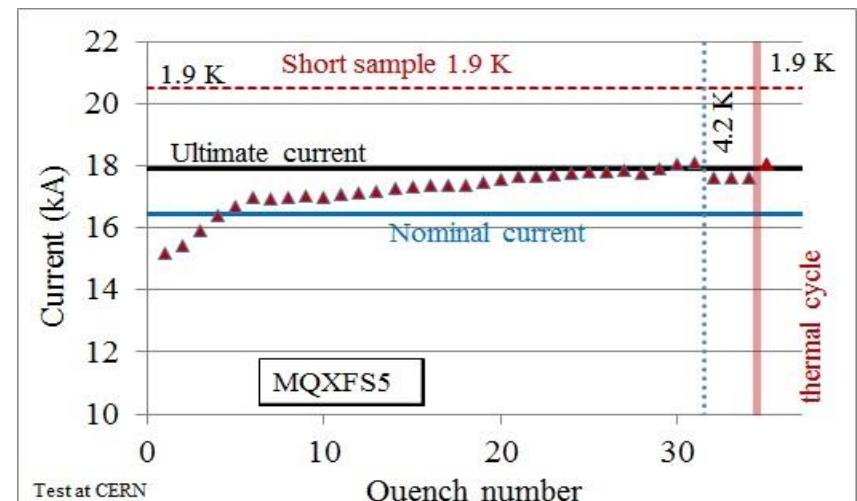
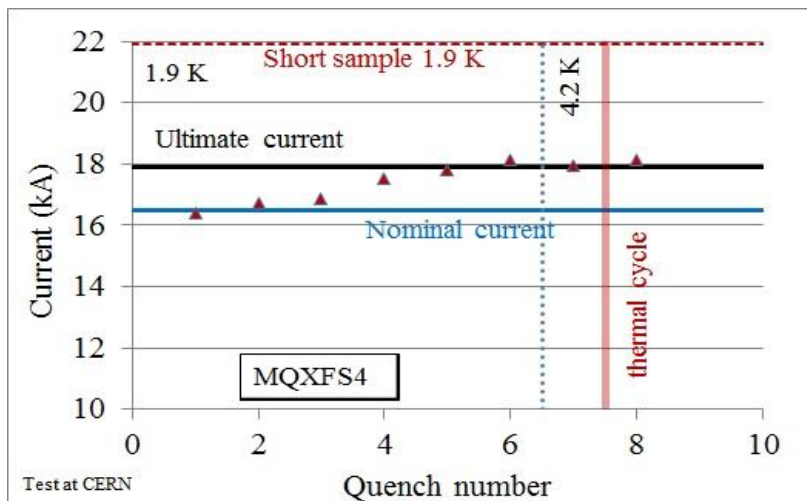
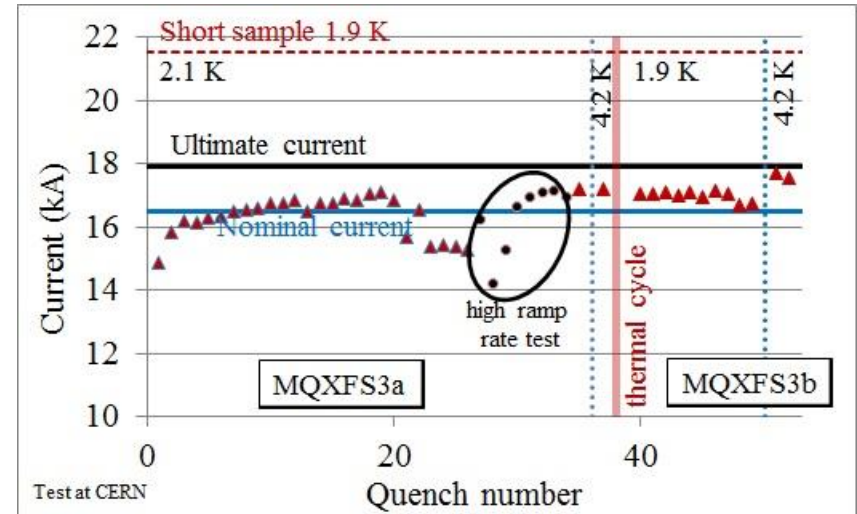
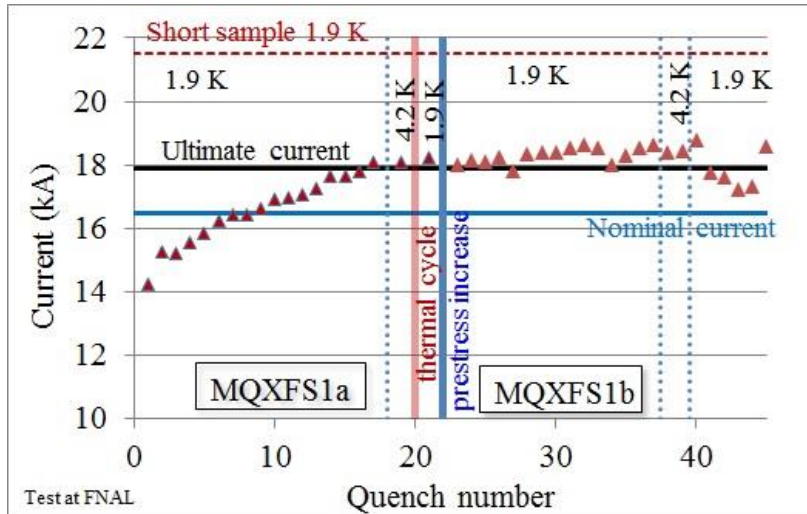
WHAT'S GOING ON RIGHT NOW

- During this HL-LHC week, we are having five (5 !) magnets under test
 - In Japan, second short model in the cryostat
 - In US (BNL) second prototype model under test
 - In LASA, first dodecapole having a thermal cycle to test memory
 - In CERN, first D2 prototype in the cryostat at SM18 cooling down
 - In CERN, MQXFS4 under test to see the assembly magnet-beam screen

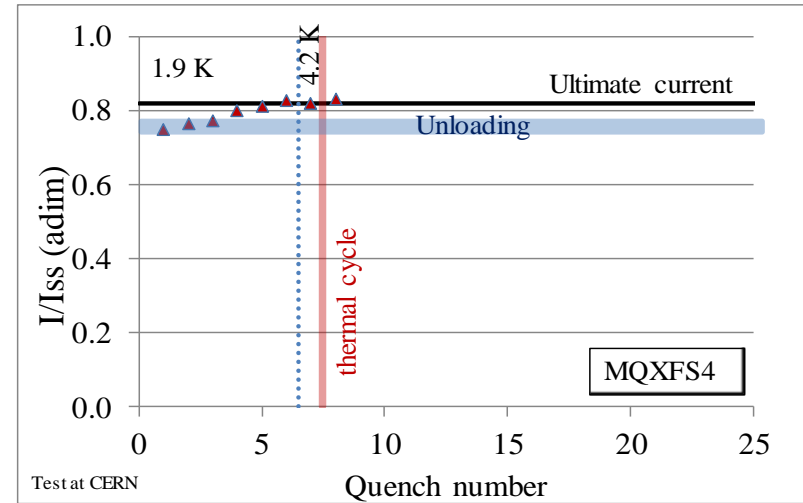
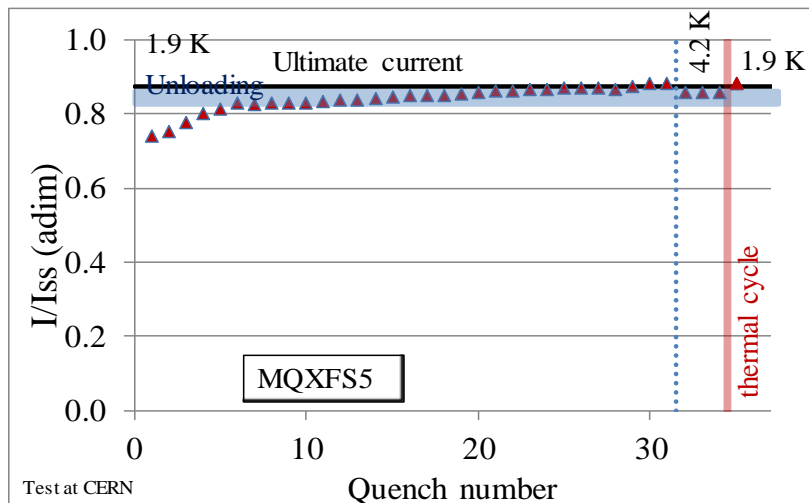
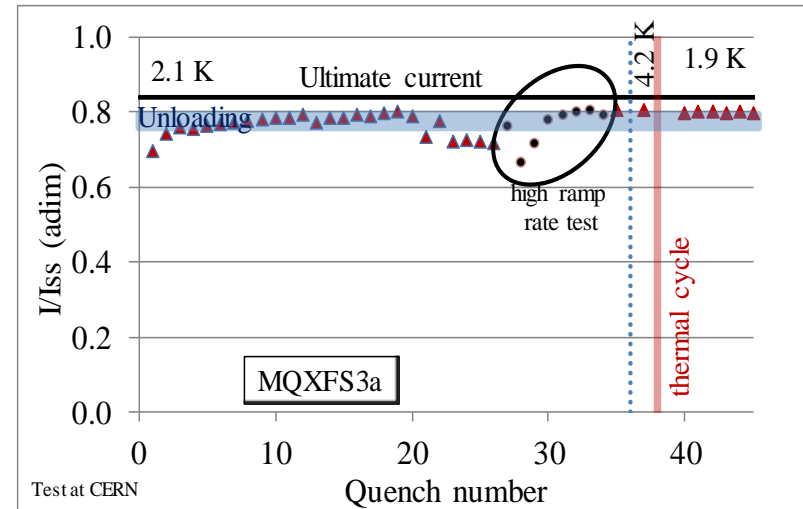
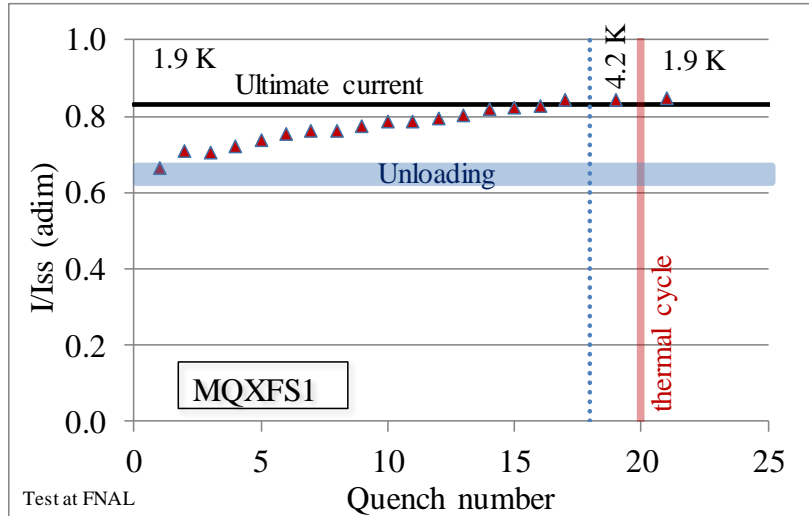
MQXF TRAILER



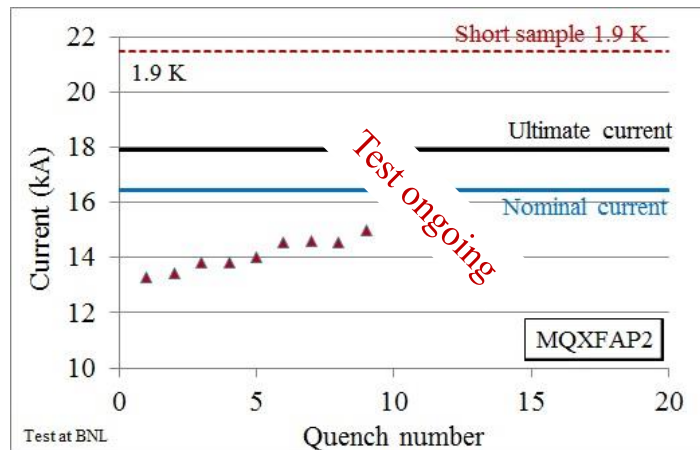
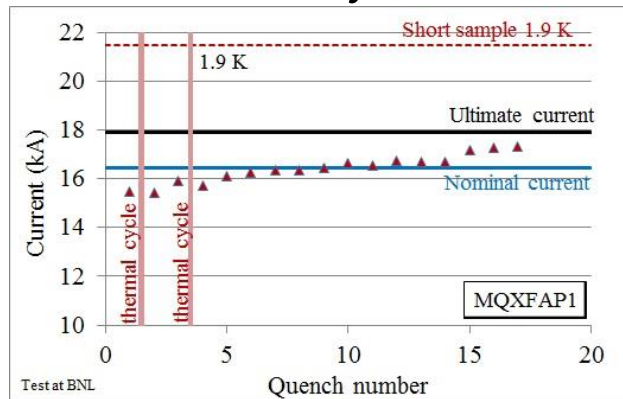
- 3 out of 4 short model reached performance (P. Ferracin talk)



- Establishing the limits of preload – wide window



- Prototypes of MQXFA: one reached nominal but short circuit, the second test is in progress (G. Apollinari talk)
- Prototypes of MQXFB: coils for first prototype ready, first dummy assembly done

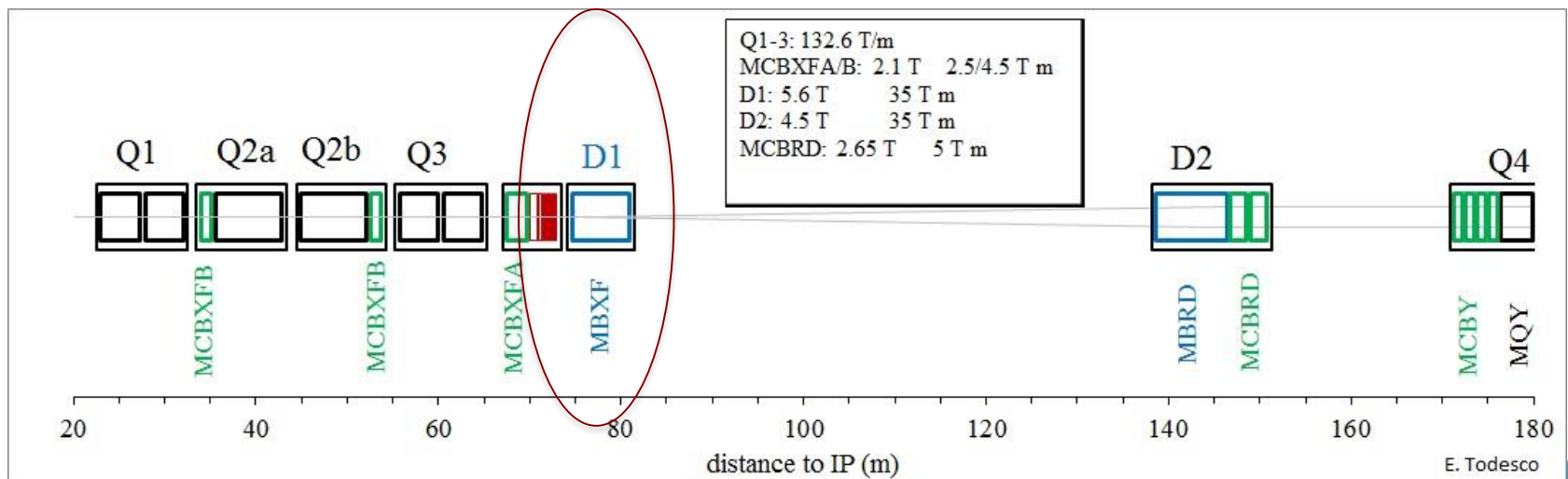
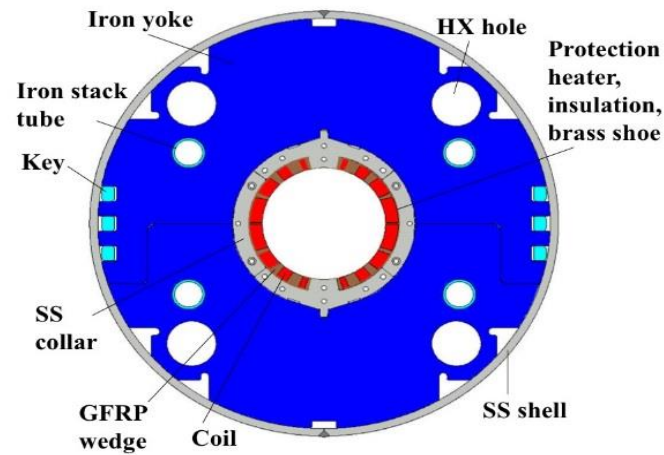


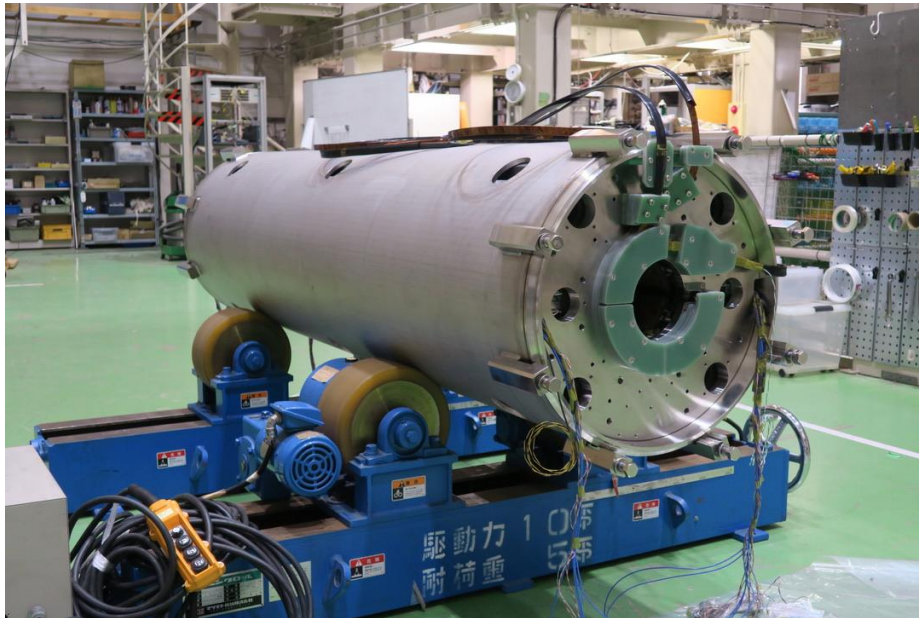
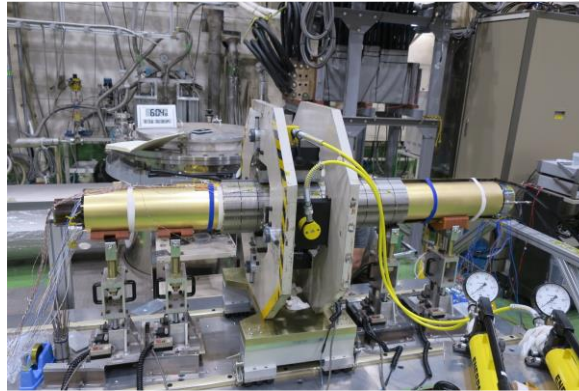
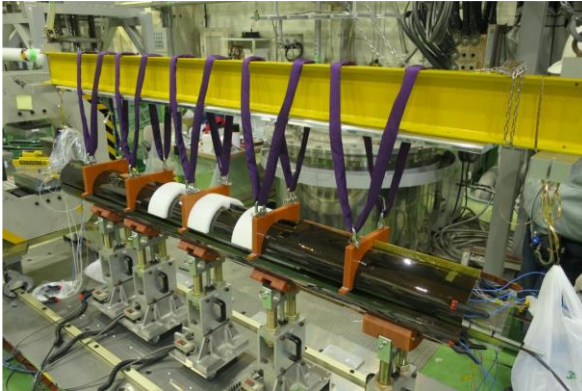
7.15 m long coil ready for assembly in 180
(F. Lackner, P. Ferracin)

CONTENTS

- Overview
- Focus on Nb-Ti magnets

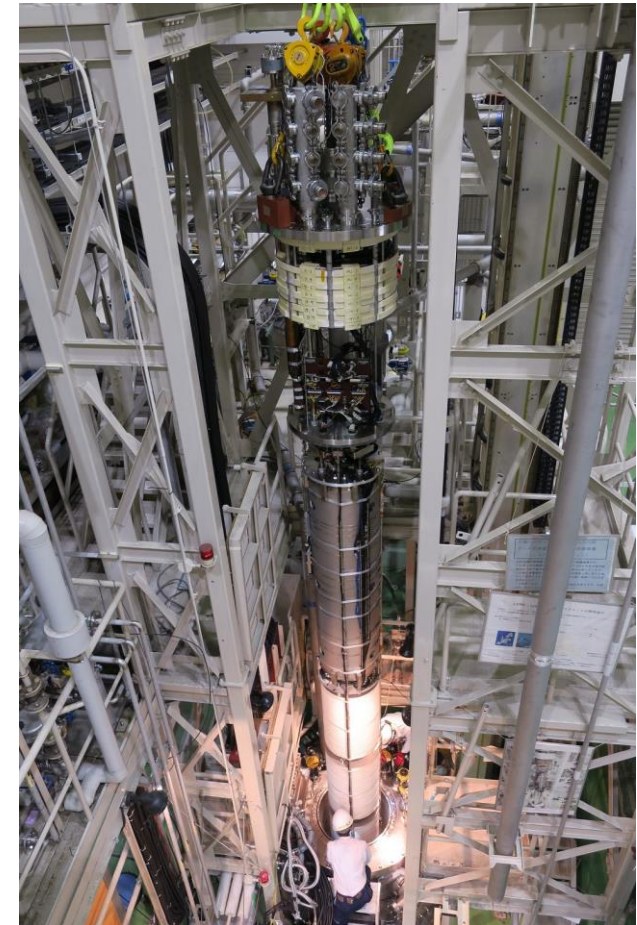
D1



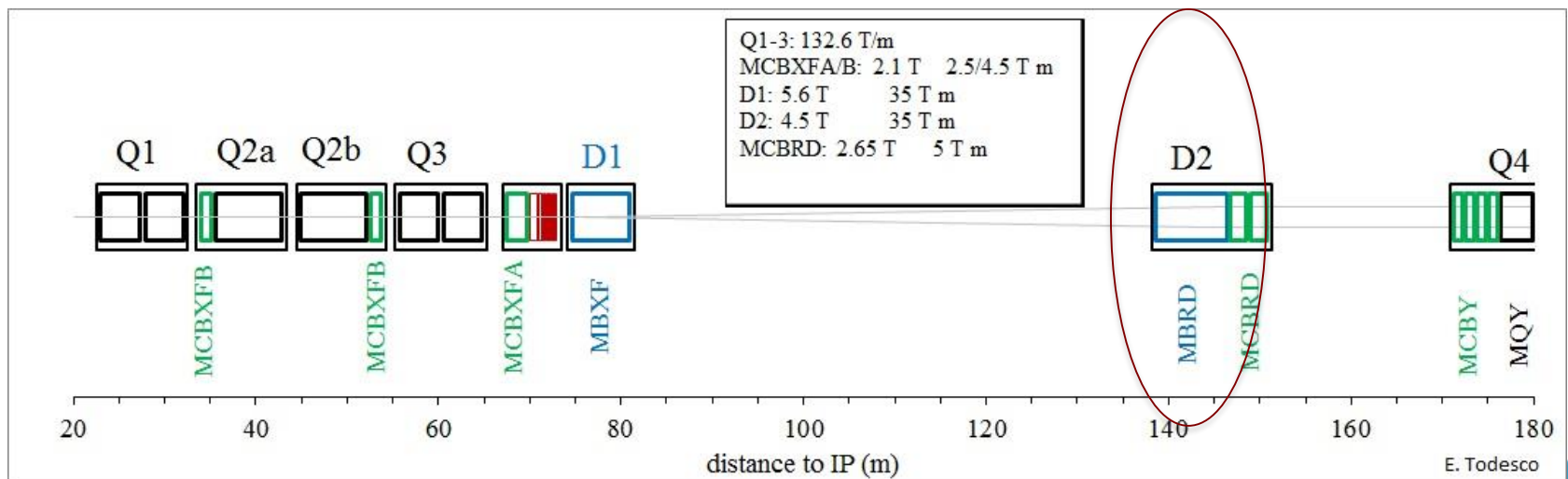
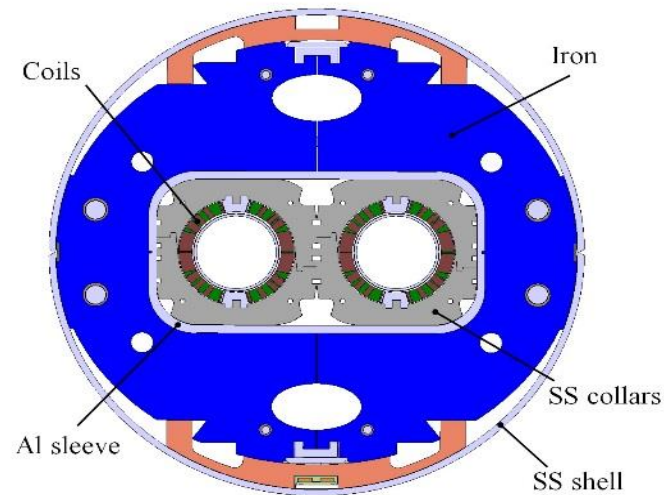


- Second short model magnet assembly completed
(M. Yamauchi and T. Nakamoto talks)

- Test is ongoing, first quench on Thursday (T. Nakamoto talk)
- Collaboration agreement signed for the prototype and series
 - Prototype test expected for early 2020



D2

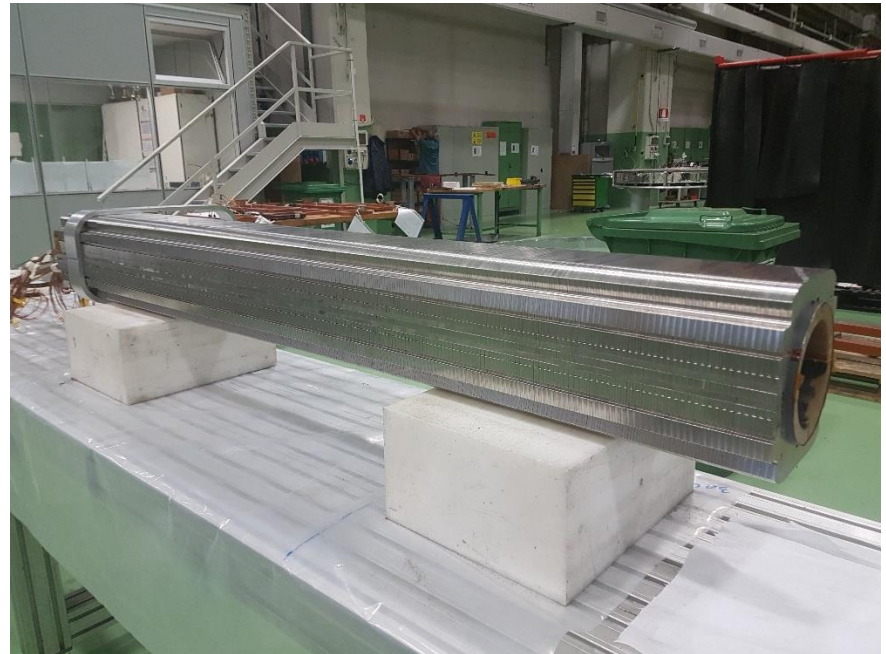
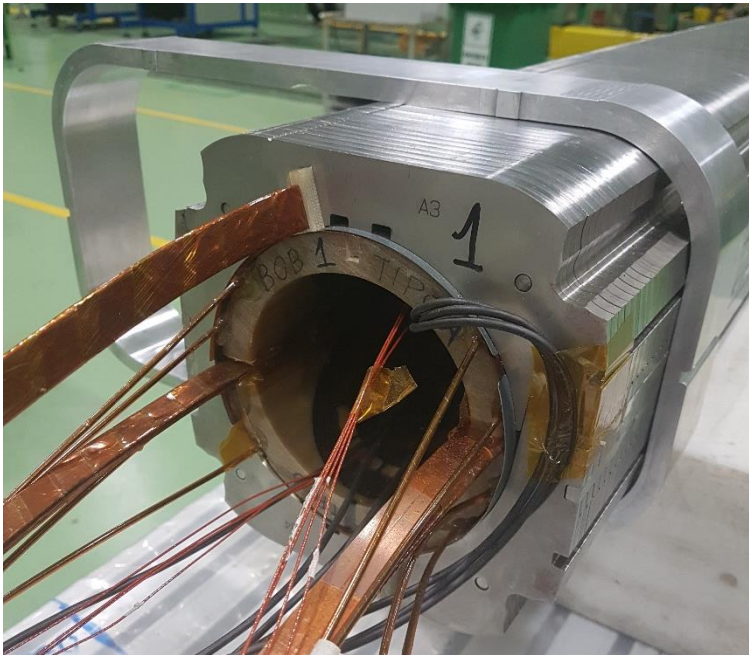


E. Todesco

- Short model: coil fabrication completed
- Collaring of the two apertures done in August
 - Short detected in first aperture thanks to magnetic measurements
 - Decollaring, problem cured, new collaring
 - Second aperture is OK

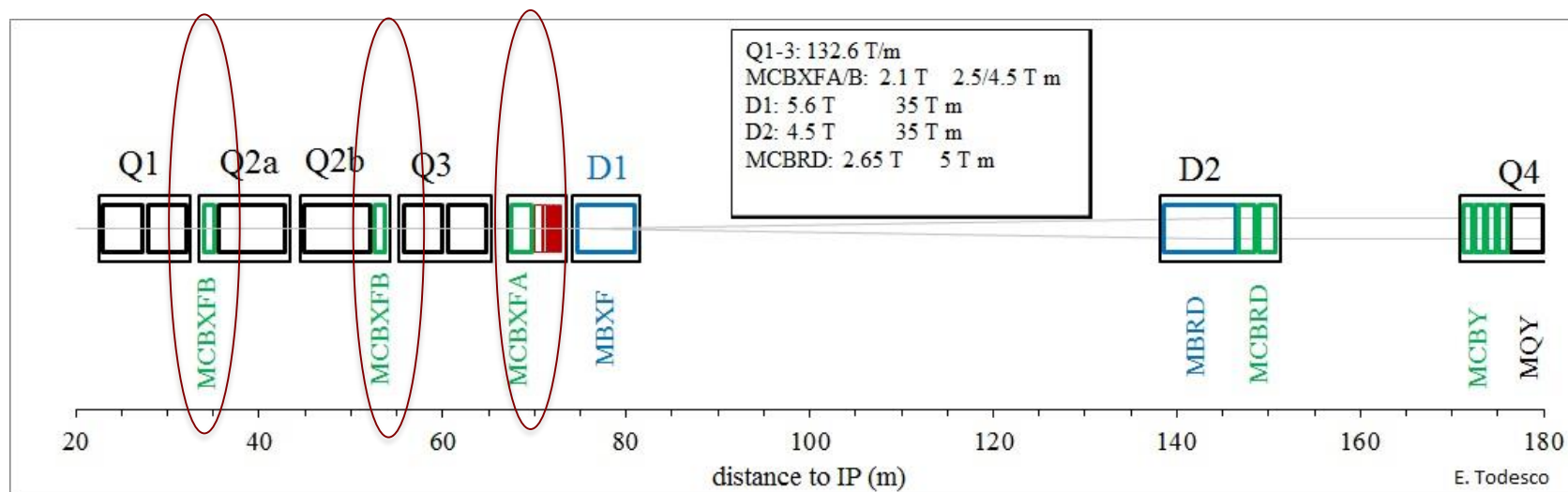
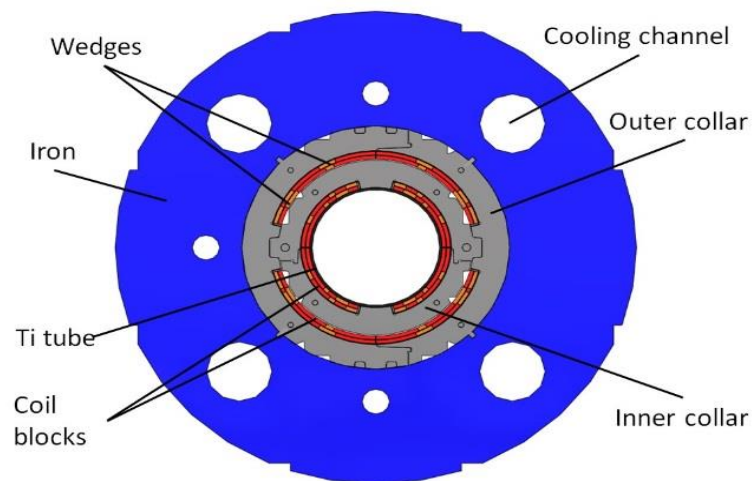
			b2	b3	b4	b5	b6	b7	b8	b9
1st aperture	measurements		-200	224	-35,3	-8,03	-2,88	7,95	-2,10	-1,38
	simulations		-208	169	-37,2	0,66	-1,64	-0,05	-0,55	0,11
2nd aperture	measurements		187	184	36,4	7,57	4,41	1,35	-0,91	0,26
	simulations		208	169	36,8	0,67	1,92	-0,05	0,42	0,12
		a1	a2	a3	a4	a5	a6	a7	a8	a9
1st aperture	measurements	0,62	41,3	-1,45	-27,3	2,39	12,4	0,93	-3,26	-0,24
	simulations	-1,92	0,16	-0,27	-0,01	-0,07	-0,05	-0,10	-0,04	-0,07
2nd aperture	measurements	-1,81	-4,08	-6,47	-4,67	0,79	3,25	2,16	0,19	-0,65
	simulations	-1,05	0,10	0,23	0,03	-3,52E-02	-0,05	-0,12	-0,04	-0,06

- Short model assembly is ongoing (P. Fabbriatore talk)



- Call for tender for prototype has been done, including an option for the series

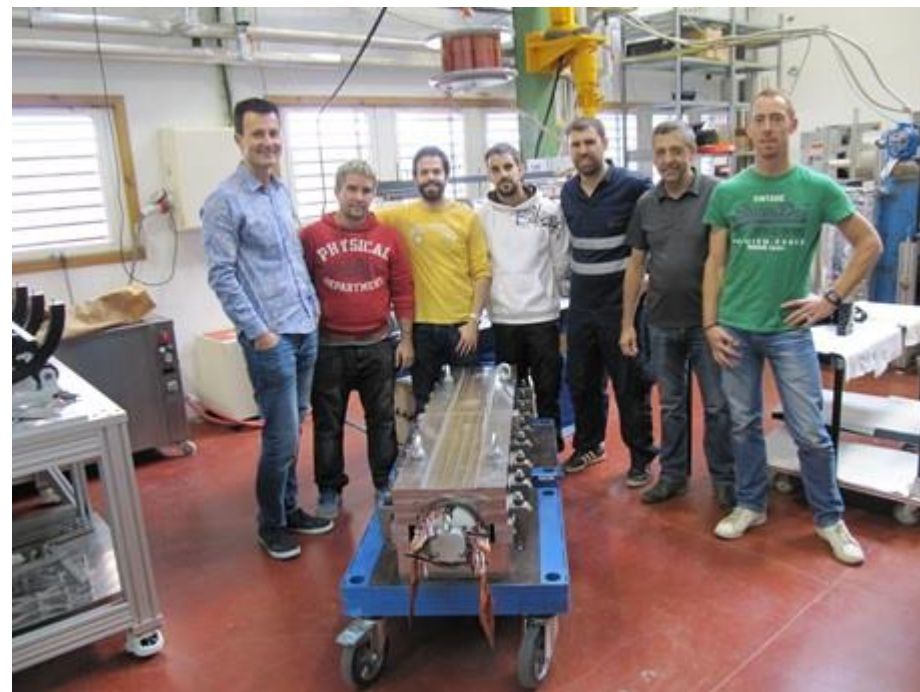
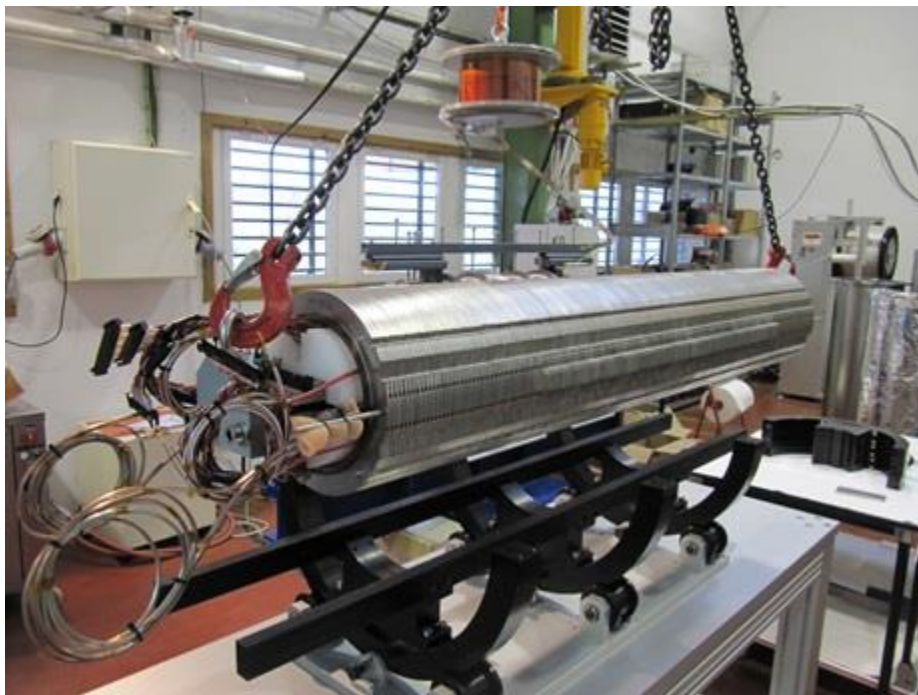
MCBXF (NESTED CORRECTOR)



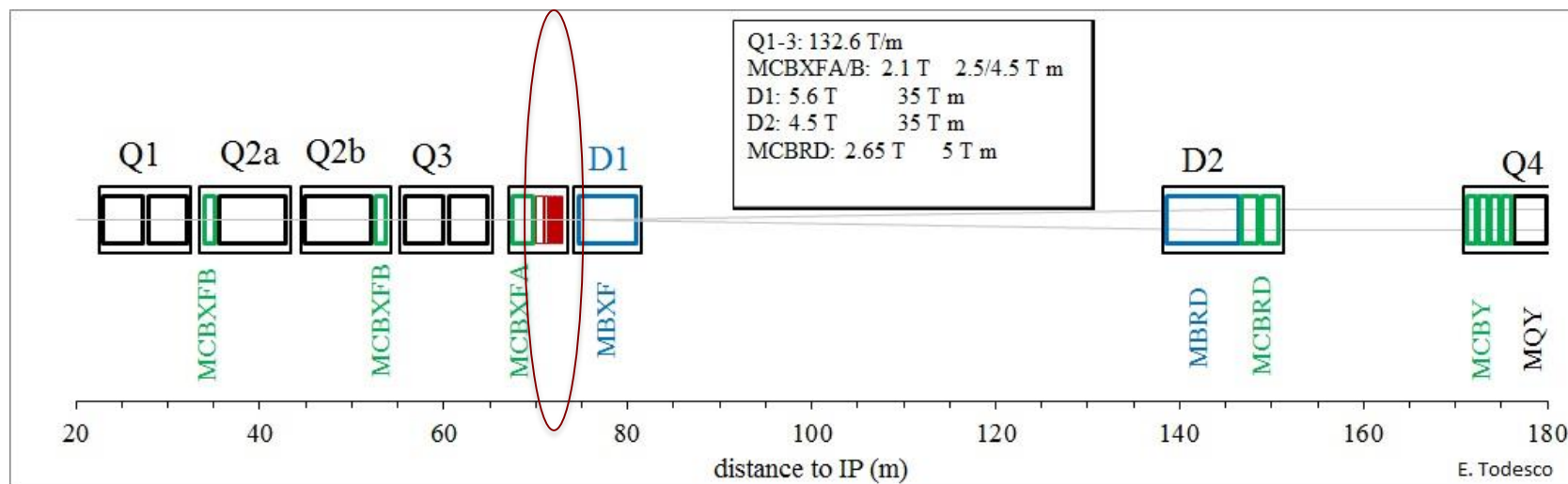
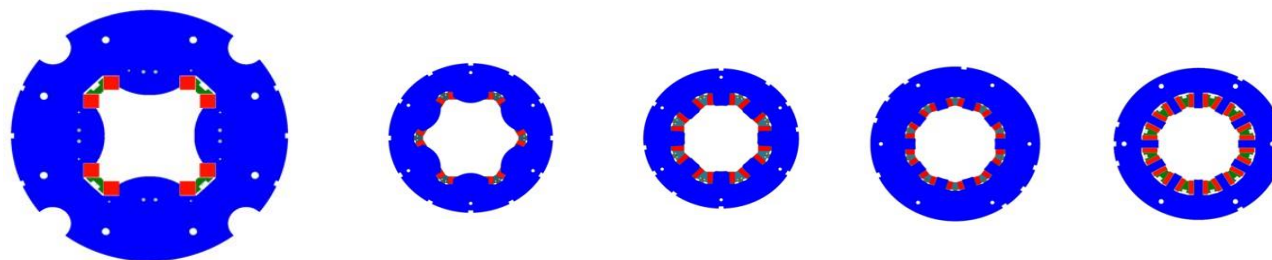
MCBXF (NESTED CORRECTOR)

- Coils of inner dipole completed, pre-collaring completed
- Collaring at CERN in November, test in December
- Winding outer dipole started in CIEMAT

(C. Alejaldre and F. Toral talks)



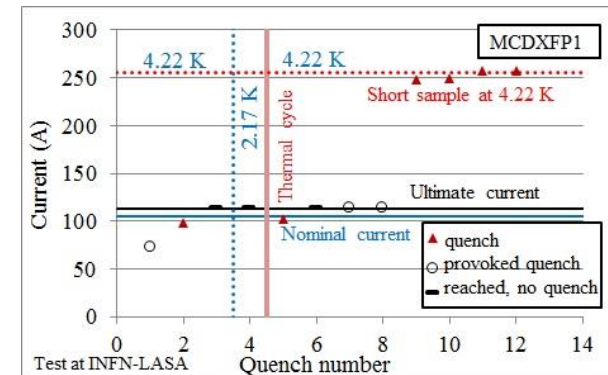
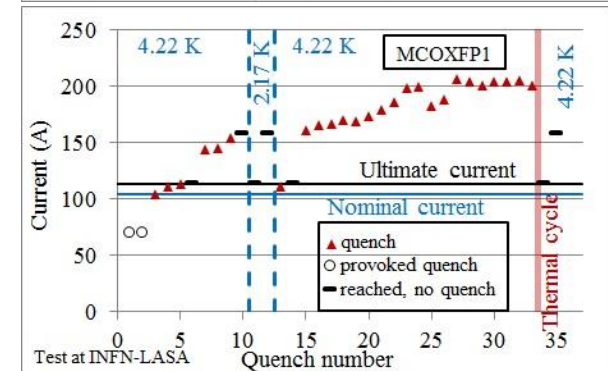
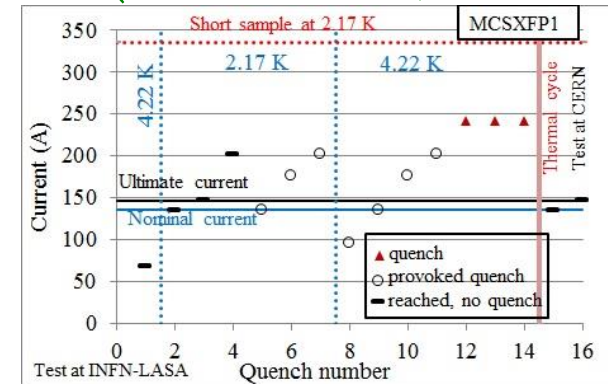
HO CORRECTORS



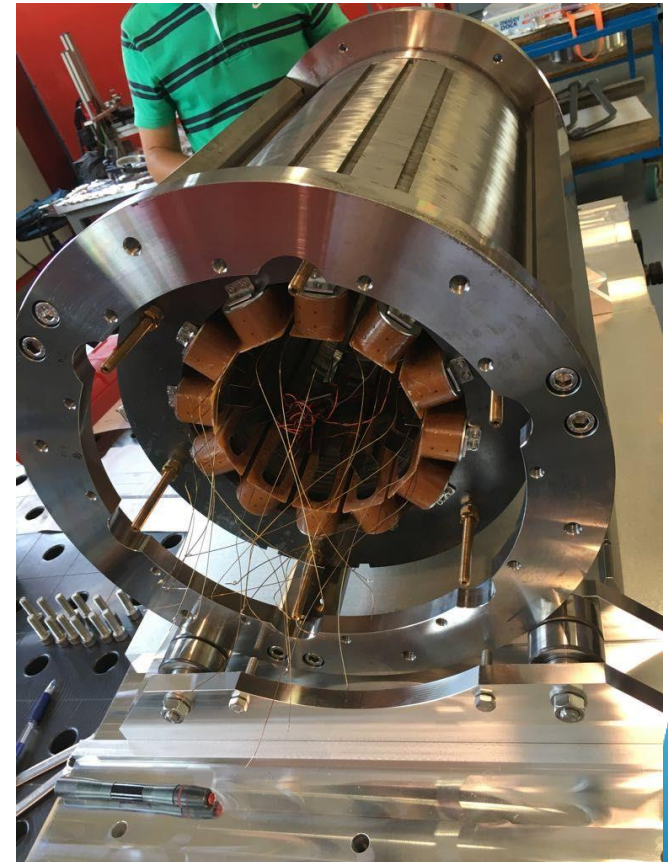
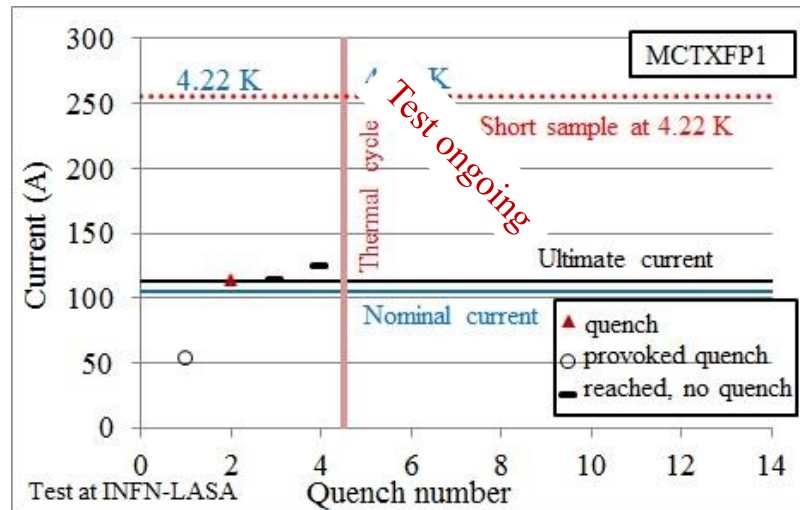
HO CORRECTORS

■ Construction program in LASA finished (M. Sorbi talk)

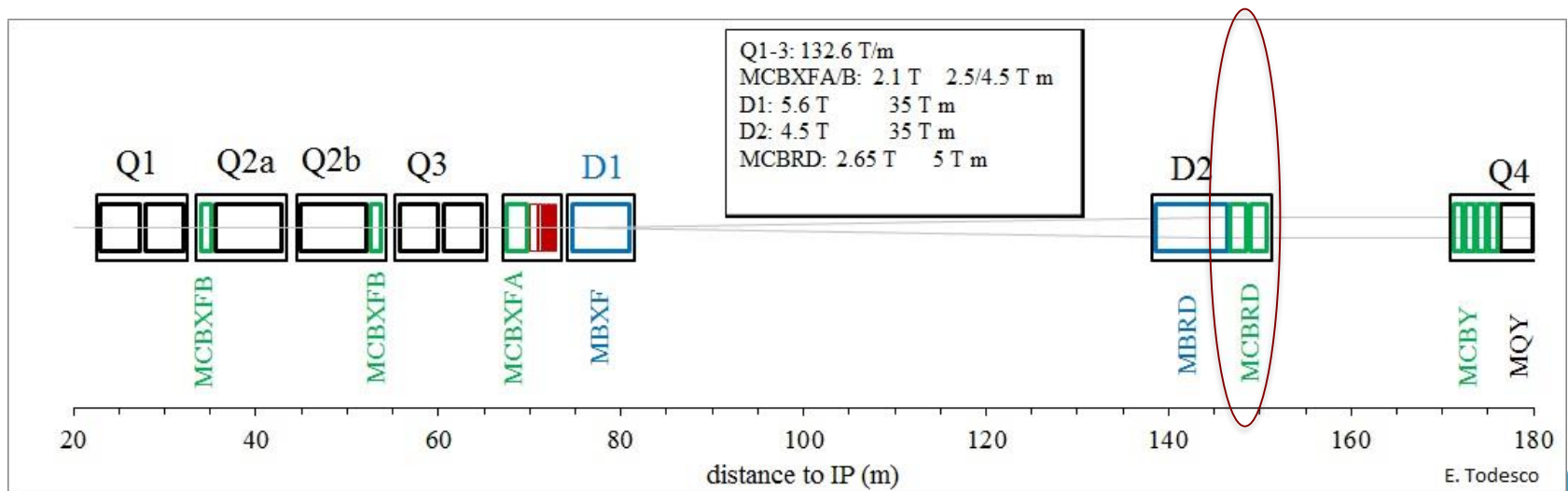
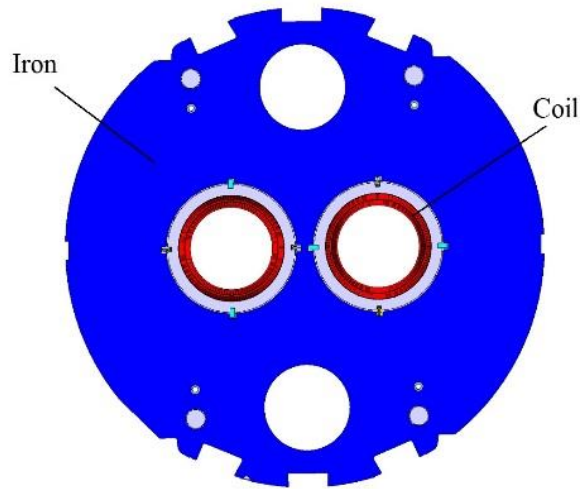
- Sextupole, octupole, decapole, successfully tested
- Magnetic measurement at CERN confirm field quality requirements
- First assembly at CERN of two correctors



- Contract to RIAL SEAS for manufacturing of dodecapole and sextupole prototypes
 - Attributed in September 2017, dodecapole test started in October 2018
 - Ultimate reached, thermal cycle to be done in two weeks
 - First (succesfull) technology transfer of WP3
 - Tender for series ongoing, attribution in December 2018



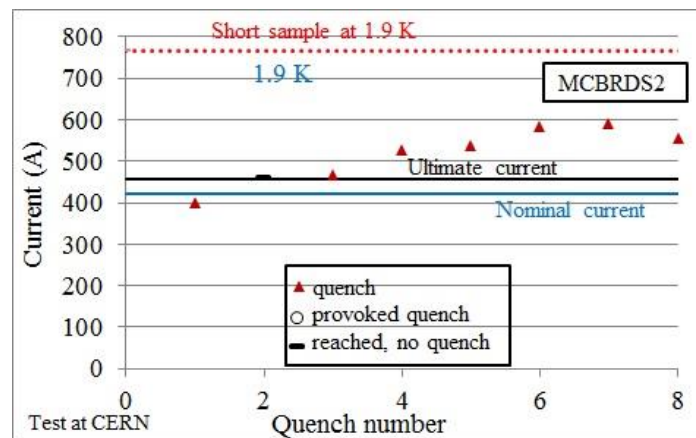
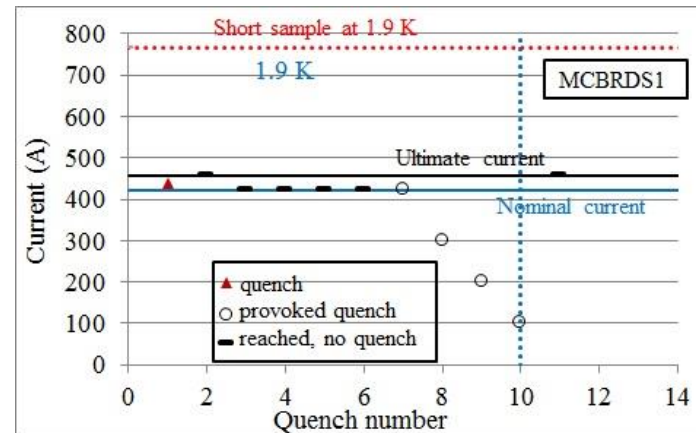
MCBRD (CCT CORRECTOR)



MCBRD (CCT CORRECTOR)



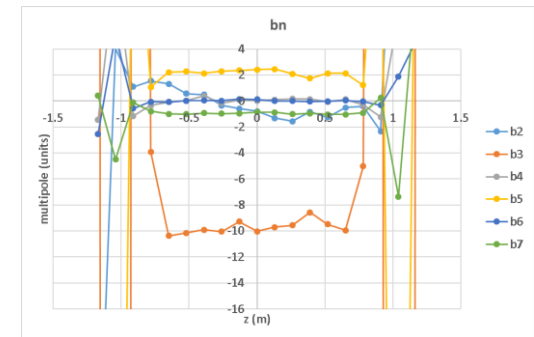
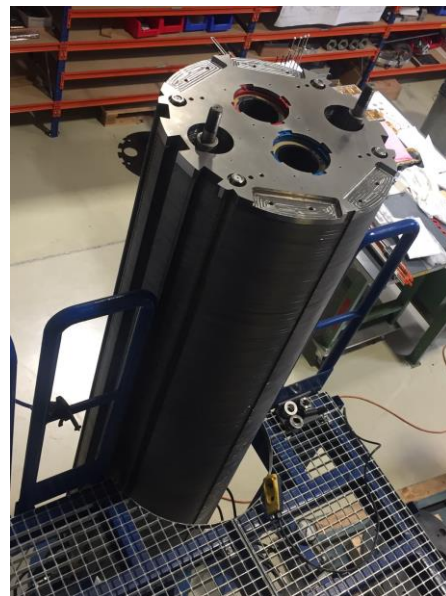
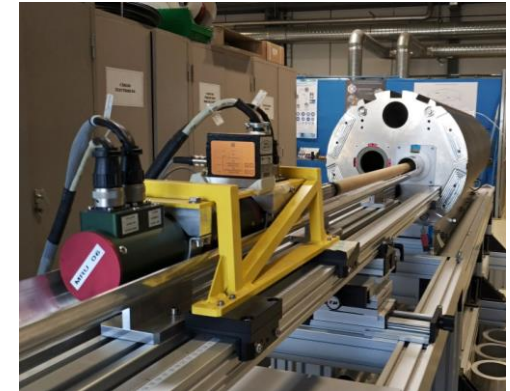
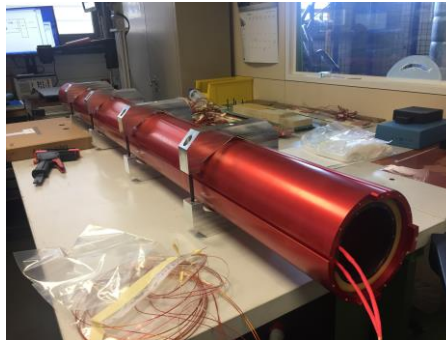
- One short model manufactured and successfully tested
 - Reached performance, no retraining [G. Kirby talk]
 - Reached 80% of short sample with limited training



MCBRD (CCT CORRECTOR)



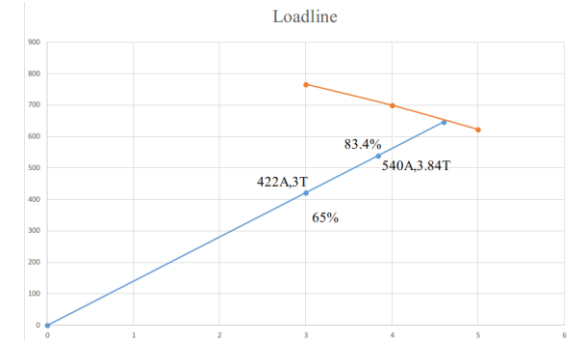
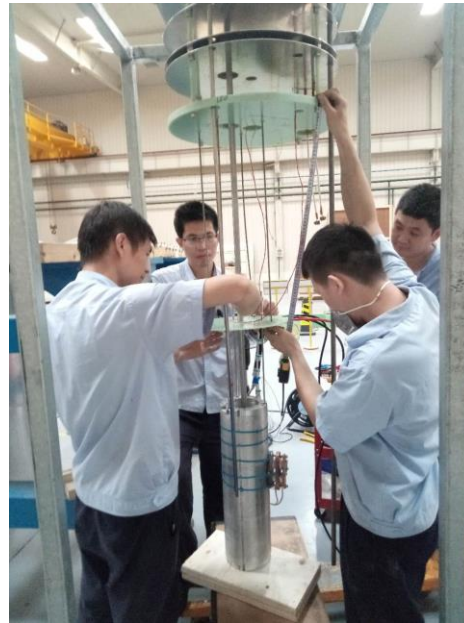
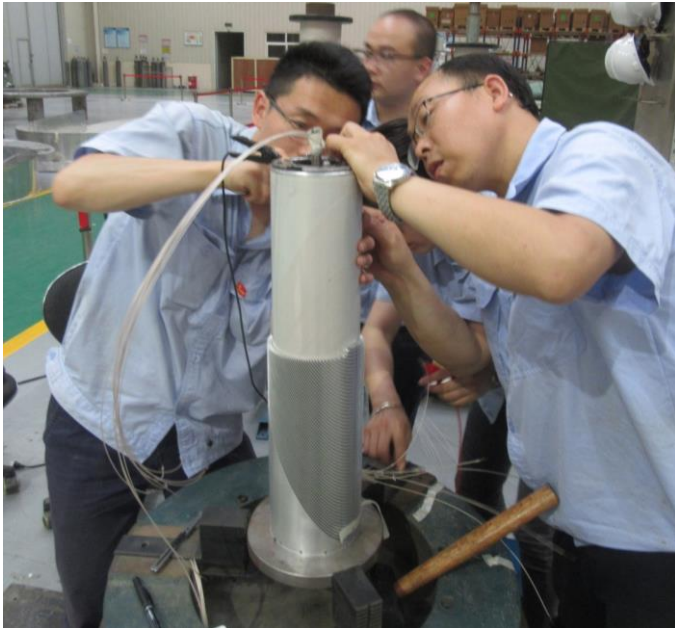
- One prototype manufactured – test is ongoing
 - Field quality issues under analysis (-10 units of b_3)



MCBRD (CCT CORRECTOR)

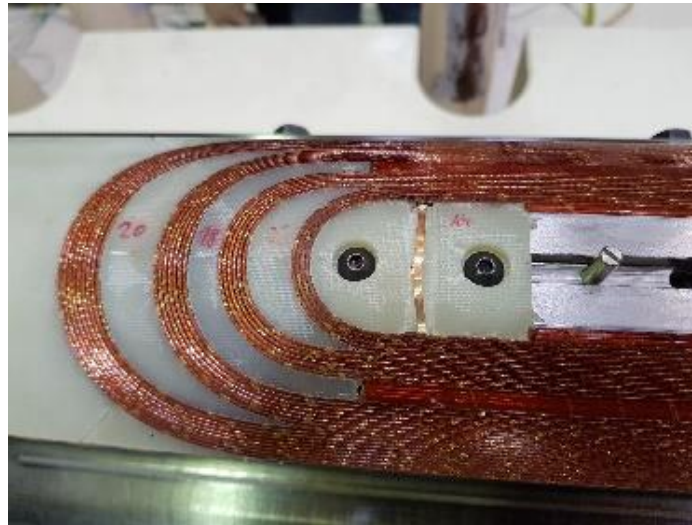


- China will provide the 12 MCBRD correctors (plus one prototype) as in kind collaboration (talk Q. Xu)
 - Activities to transfer the technology started in 2017
 - Short model manufactured in WST, successful test in IMP



- Prototype construction starts now, aiming at test in June 2019

- Coil manufacturing of short model completed
- Assembly will start in 927 in the coming month (talk H. Felice)



- QUACO is making the transition from phase 2 (engineering) to phase 3 (prototype construction) (talk M. Lo Sasso)

CONCLUSIONS

- Advancement on collaboration agreements
 - Prototype and series of D1 from Japan: signed
 - Prototype and series of D2 correctors from China: signed
 - D2 series from INFN: advanced stage of negotiation
- Since last annual meeting
 - One short model tested successfully – 3 out of four reached performance until now, one more coming soon
 - Two prototypes of MQXFA tested / under test
 - Dodecapole tested successfully
 - D2 corrector short model tested successfully, and technology transfer to China
- Right now, four new magnets are in the test station
 - MQXFA second prototype in US
 - Second model of D1 in Japan
 - D2 corrector prototype at CERN
 - Dodecapole prototype in Italy
- Coming soon
 - MCBXF test of first aperture
 - D2 short model test
 - MQXFS6 test (concluding short model program of MQXF)

STRUCTURE



HL-LHC WP3: IR magnets

E. Todesco
P. Ferracin (Deputy)



September 2018

Nb₃Sn magnets

Triplet Q1/Q3

G. Ambrosio, S. Feher (FNAL)
P. Ferracin (CERN WPE)

Triplet Q2

P. Ferracin (CERN WPE)

Nb-Ti correctors

Orbit correctors

F. Toral (CIEMAT)
J. Carlos Perez (CERN WPE)

High order correctors

M. Sorbi (INFN LASA)
A. Musso (CERN WPE)

D2 correctors

Q. Xu (IHEP)
G. Kirby (CERN WPE)

Nb-Ti and resistive main magnets

Separation dipole D1

T. Nakamoto (KEK)
A. Musso (CERN WPE)

Recombination dipole D2

P. Fabbriatore (INFN Genova)
A. Foussat (CERN WPE)

MQYY

H. Felice (CEA)
A. Foussat (CERN WPE)

MBW and MQW

P. Schwarz (CERN WPE)

Q4, Q5, Q10 in IR1 and IR5 Q5 in IR6

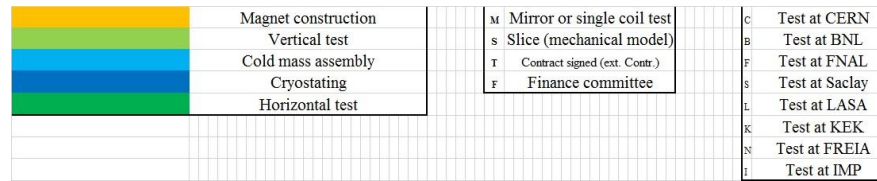
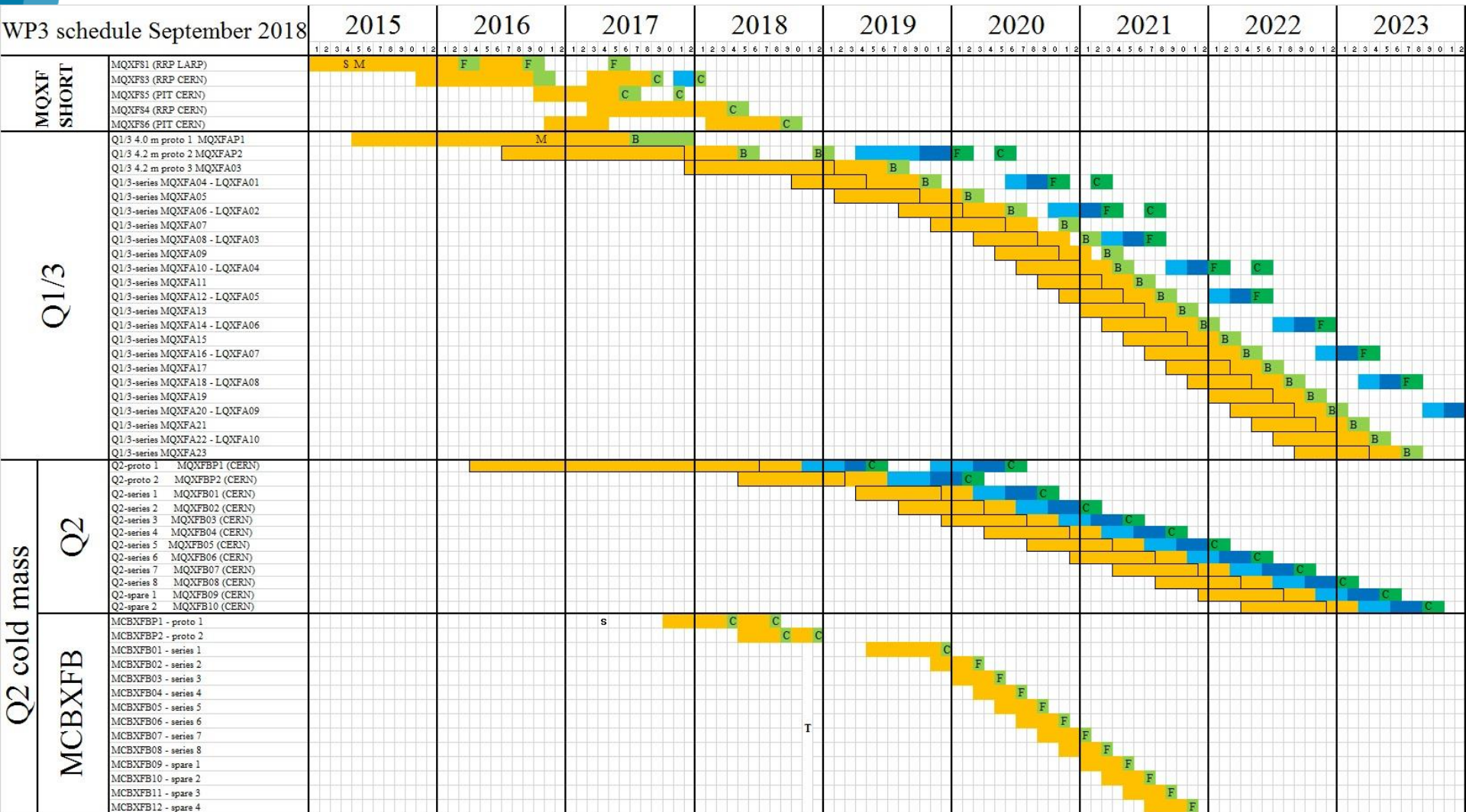
H. Prin (CERN WPE)



<https://edms.cern.ch/document/1865349>

SCHEDULE

WP3 schedule September 2018



SCHEDULE

		2015	2016	2017	2018	2019	2020	2021	2022	2023
Corrector package	MCBXFA									
	MCBXFA1 - proto 1 MCBXFA1 - series 1 MCBXFA2 - series 2 MCBXFA3 - series 3 MCBXFA4 - series 4 MCBXFA5 - spare 1 MCBXFA6 - spare 2									
HO correctors	Sextupole - proto MCSXFP1 Octupole - proto MCOXFP1 Decapole - proto MCDXFP1 Skew quadrupole - proto MCQSXFP1 Dodecapole - proto MCTXFP1 MgB2 corrector - proto N&S Sextupole - series (8+4) N&S Octupole - series (8+4) N&S Decapole - series (8+4) N&S Dodecapole - series (8+4) Skew quadrupole - series (4+2)									
D1	MBXFS1 - short model 1 MBXFS2 - short model 2 MBXFS3 - short model 3 MBXFP1 - prototype MBXF1 - series 1 MBXF2 - series 1 MBXF3 - series 1 MBXF4 - series 1 MBXF5 - spare 1 MBXF6 - spare 2									
D2 cold mass	D2									
	MBRDS1 - short model MBRDP1 - prototype MBRD1 - series 1 MBRD2 - series 2 MBRD3 - series 3 MBRD4 - series 4 MBRD5 - spare 1 MBRD6 - spare 2									
D2 correctors	MCBRDS1 - short model MCBRDS2 - short model double aperture MCBRDP1 - prototype MCBRDP2 - prototype IHEP MCBRD01 - series 1 MCBRD02 - series 2 MCBRD03 - series 3 MCBRD04 - series 4 MCBRD05 - series 5 MCBRD06 - series 6 MCBRD07 - series 7 MCBRD08 - series 8 MCBRD09 - spare 1 MCBRD10 - spare 2 MCBRD11 - spare 3 MCBRD12 - spare 4									
MQYY										

Magnet construction	m	Mirror or single coil test	c	Test at CERN
Vertical test	s	Slice (mechanical model)	B	Test at BNL
Cold mass assembly	T	Contract signed (ext. Contr.)	F	Test at FNAL
Cryostating	f	Finance committee	S	Test at Saclay
Horizontal test			L	Test at LASA
			K	Test at KEK
			N	Test at FREIA
			i	Test at IMP