EuroCirCol WP5 : Work Distribution
June 3rd , 2015

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Reference parameters

FCC

Bore diameter : **40-50 mm**

Dipoles : $\int Bdl \sim 1\ MTm\ (4578\ magnets, 14.3\ m\ long, 16\ T)$

Quadrupoles : $\int Gdl \sim 2\ MT\ (762\ magnets, 6.6\ m\ long, 375\ T/m)$

LHC

Bore diameter : **56 mm**

Dipoles : $\int Bdl \sim 0.15\ MTm\ (1232\ magnets, 14.3\ m\ long, 8.3\ T)$

Quadrupoles : $\int Gdl \sim 0.28\ MT\ (392\ magnets, 3.15\ m\ long, 223\ T/m)$

About a factor of 7!

Conductor

Cost

even in a dream we will never be comparable to that of the LHC in terms of "conductor cost per magnet length".

We can imagine scaling by a factor of 2 due to twice the field and another factor of 2 due to twice the current setting a target of:

10 Euro/kAm @ 4.2K, 16T

Performance

Interesting to remark that @ 16-18T for most of conductors (Nb_3Sn, BSCCO, YBCO, REBCO) $J_{eng} \sim 500$ A/mm^2 is already more or less on reach, though at different cost and with a number of technological limitations..

In the EuroCirCol context we will focus on Nb_3Sn,

considering a realistic hypothesis in the timeframe of the Project

Towards 16T magnets with bore

	D20 1997	HD2c 2009
Coil configuration	cosθ	blocks
Bore (mm)	50	36
Achieved bore field (T)	13.5 @ 1.9K	13.8 @ 4.3K
J_{eng} @ 12T, 4.2K (A/mm^2)	750	1850
J_{eng} @ 16T, 4.2K (A/mm^2)	270	800*
J_{eng} @ 12T, 1.9K (A/mm^2)	1000	2400
J_{eng} @ 16T, 1.9K (A/mm^2)	420	1200

* Corresponds to FCC target, though with too high magnetization and cost

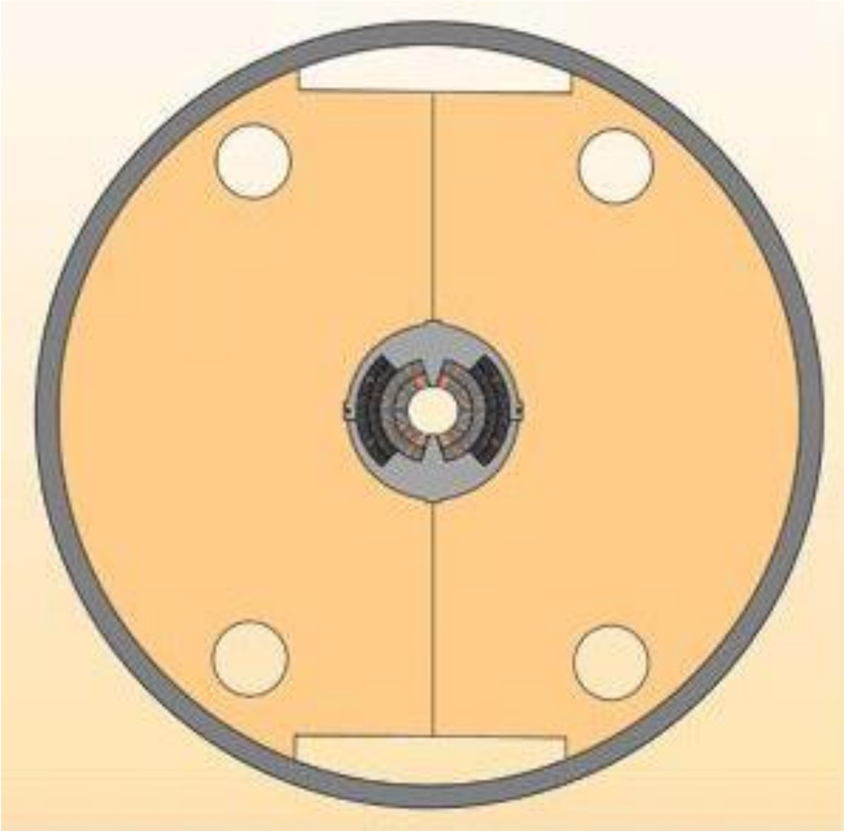
$J_{eng} = J_{strand}$

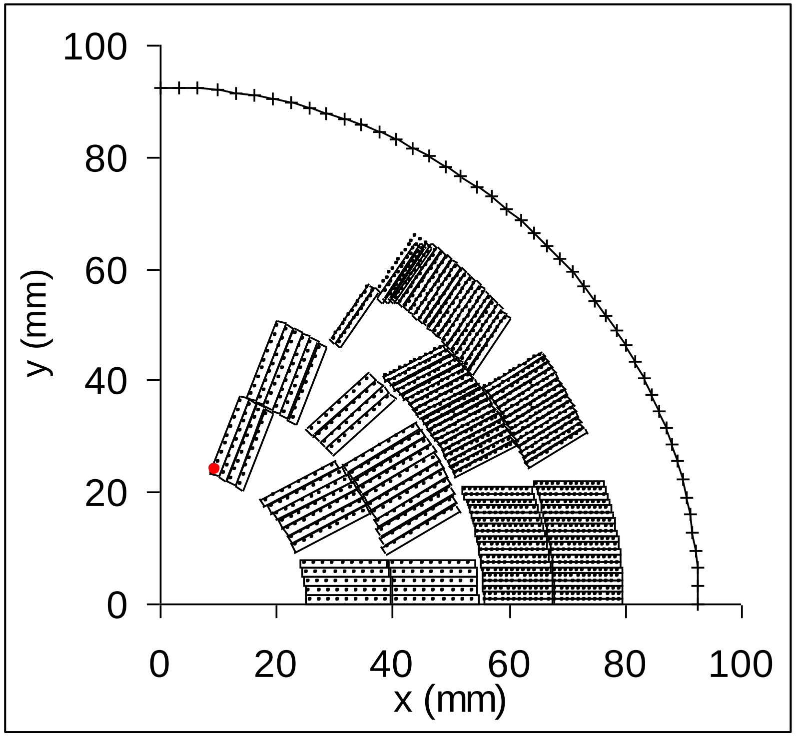
HD2c Cu/Sc=0.85-0.95
D20 Cu/Sc=0.4 on inner layer

Many thanks to Paolo Ferracin for help in retrieving information on D20 and HD2

D20

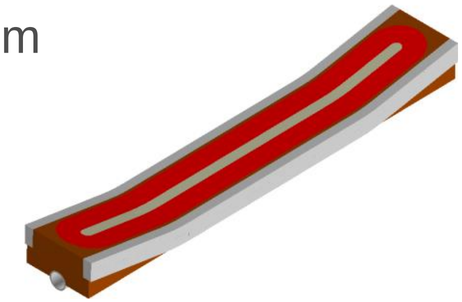
50 mm bore
4 layers, 13 blocks
Yoke outer radius: 381 mm
Shell thickness: 25 mm

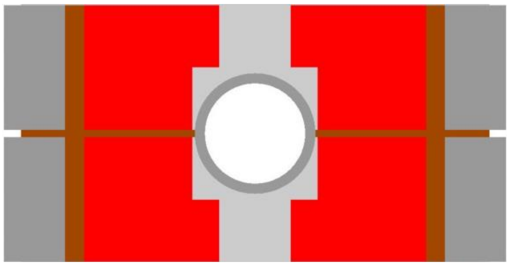


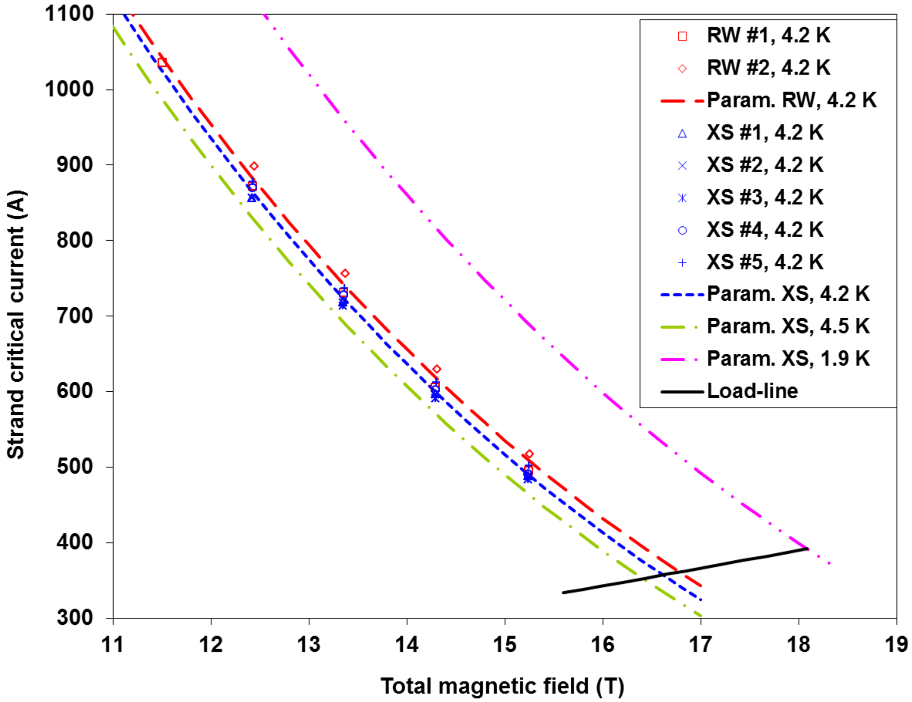


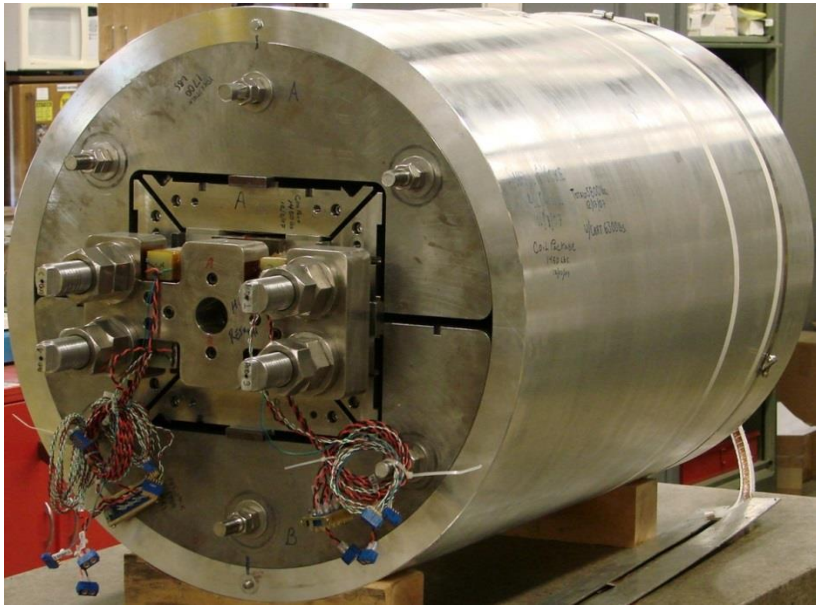
HD2c

36 mm bore
2 layers, 2 blocks
Yoke outer radius: 311 mm
Shell thickness: 41 mm









WP5: Sub-Work-Packages

As in H2020-INFRADEV-1-2014-1

Scope is: engineering design of a 16T accelerator dipole, based on LTS @ 4.5K
A parallel «Magnets Technologies» program is being organized

Description	CERN	TUT	CEA	INFN	UT	CIEMAT	KEK	UNIGE
FTE months	80	40	36	36	38	48	12	24
5.1 Work Package Coordination	X							
5.2 Design options	X		X				X	
5.3 Magnet cost model	X		X			X		
5.4 Electromagnetic design				X	X	X		
5.5 Mechanical design			X	X	X	X		X
5.6 Quench protection		X		X				
5.7 Manufacturing folder	X		X					

- Carry two options in parrallel till the end?
- Group electromagnetic+structural design?
- Introduce 3D design?

Responsibilities

As in H2020-INFRADEV-1-2014-1

WP	ID	Description
5.2	CEA	Qualification of alternative options
	CERN	Review of alternatives
	KEK	Explore potential of Nb_3Al
5.3	CERN	The model will take into account the experience in the LHC (dipoles + quadrupoles)
	CEA	
	CIEMAT	
5.4	INFN	Analysis of field quality and transient effects
	UT	Experimental data about DC and AC magnetization, non-linear and transient effects
	CIEMAT	Design of the coil cross section
5.5	CIEMAT	Development of the coil and structure concepts
	CEA	2D and 3D coil stress analysis
	INFN	Analysis of the structure and the assembly
	UT	Cable behaviour and limits
	UNIGE	Strand behaviour and limits
5.6	TUT	Quench protection of a string of magnets
	INFN	Quench protection of a single magnet
5.7	CEA	Participation in the execution of the drawings. Definition of assembly procedures.
	CERN	Participation in the execution of the drawings. Organization of archiving.

Milestones & Deliverables

As in H2020-INFRADEV-1-2014-1

Milestones	
MS-5.1 WP group established and hiring complete	5
MS-5.2 Baseline specifications and assumptions for accelerator magnet	10
MS-5.3 Specifications for conductors and conductor configurations	34
MS-5.4 High-field accelerator dipole conceptual design report	46
MS-5.5 Report on recommended follow-up R&D	47

Deliverables	
D-5.1 Overview of magnet design options	17
D-5.2 Identification of preferred dipole design options and cost estimate	26
D-5.3 Cost model (optimistic, likely and conservative)	39
D-5.4 Manufacturing folder for reference design short model	46

Proposed strategy

✓ Forum “Towards 16T Accelerator Magnets” sharing information between:
- EuroCirCol
- A companion “technology development program”
- Other programs (US, JP, RU …)

For EuroCirCol

✓ Trim responsibilities in the WP descriptions (this meeting)
✓ Define a planning with deliverables (this meeting)
✓ “Coffee video-meetings” with open participation
✓ “Advancement video-meetings”
✓ Two workshop-meetings per year

	2015			2016		
	Sept 02	Oct 14	Nov 25	Feb 10	Apr FCC Y	Jun 01
Coffee	X			X		
Advancement		X			X	
Workshop			X			X

WP5 Coordination Meeting : Agenda

Wed 14:00 – 15h30 room 30/6-019 (Vidyo)
WP5 : Scope and methods

Wed 16:00 – 17h30 room 6/R-012
Common session, basic parameters

- WP2 (Arc Design and Lattice Integration)
- WP3 (Experimental Insertion Region Design)
- WP5 (High Field Accelerator Magnet Design)

Thu 09:00 – 10h30 room 30/7-018 (Vidyo)
WP5 : Distribution of the work

Thu 11:00 – 12h30 room 112/R-028
Common session, basic parameters

- WP4 (Cryogenic Beam Vacuum System Conception)
- WP5 (High Field Accelerator Magnet Design)

Thu 14:00 – 15h30 room 112/R-028
WP5 : Tentative planning

Thu 16:00 – 17h30 room 6/R-012
Plenary conclusion

Thank you for your attention