



D2 Design, Status, Plan

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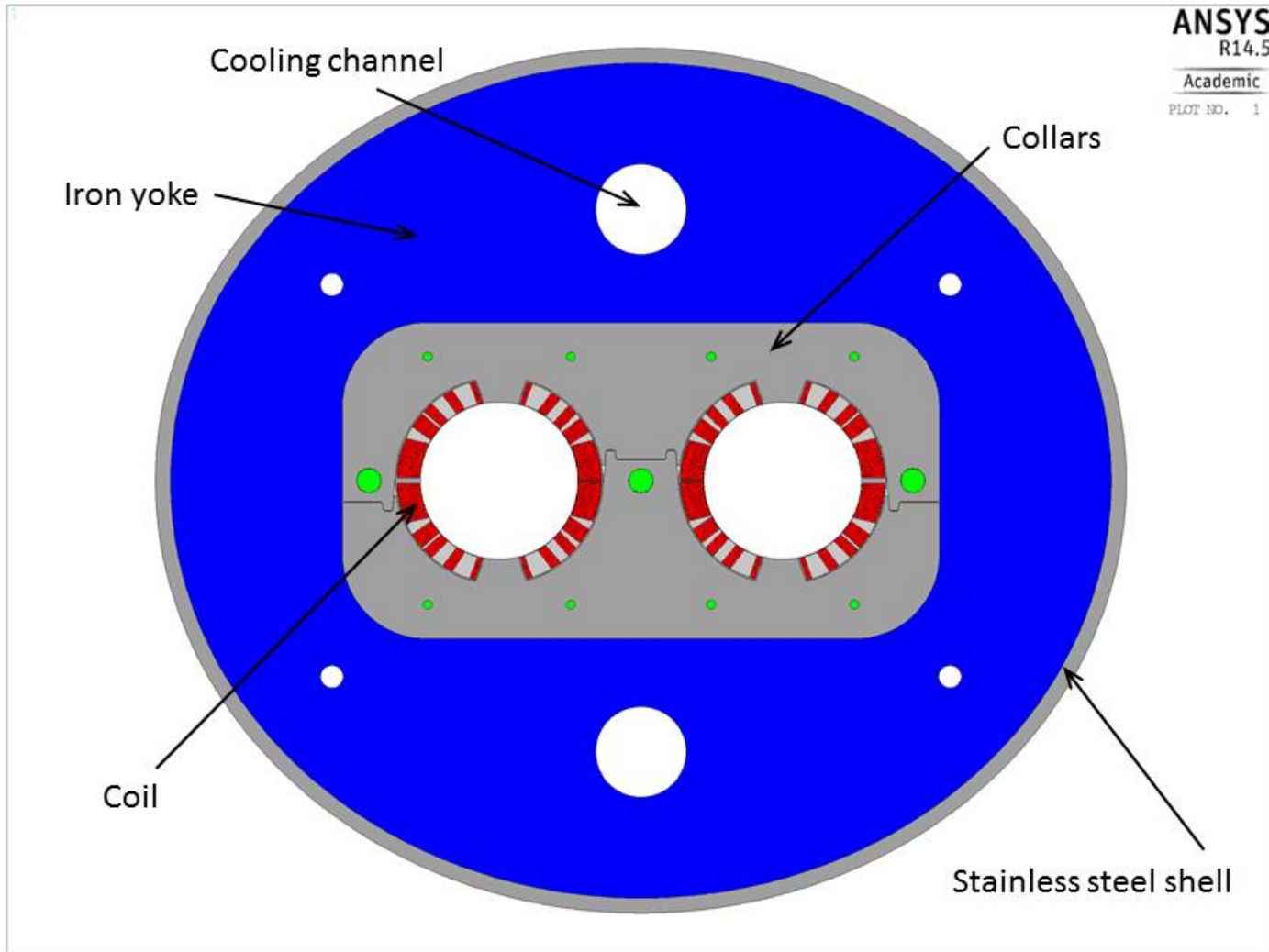
INFN Genova

Presented by E.Todesco (CERN)

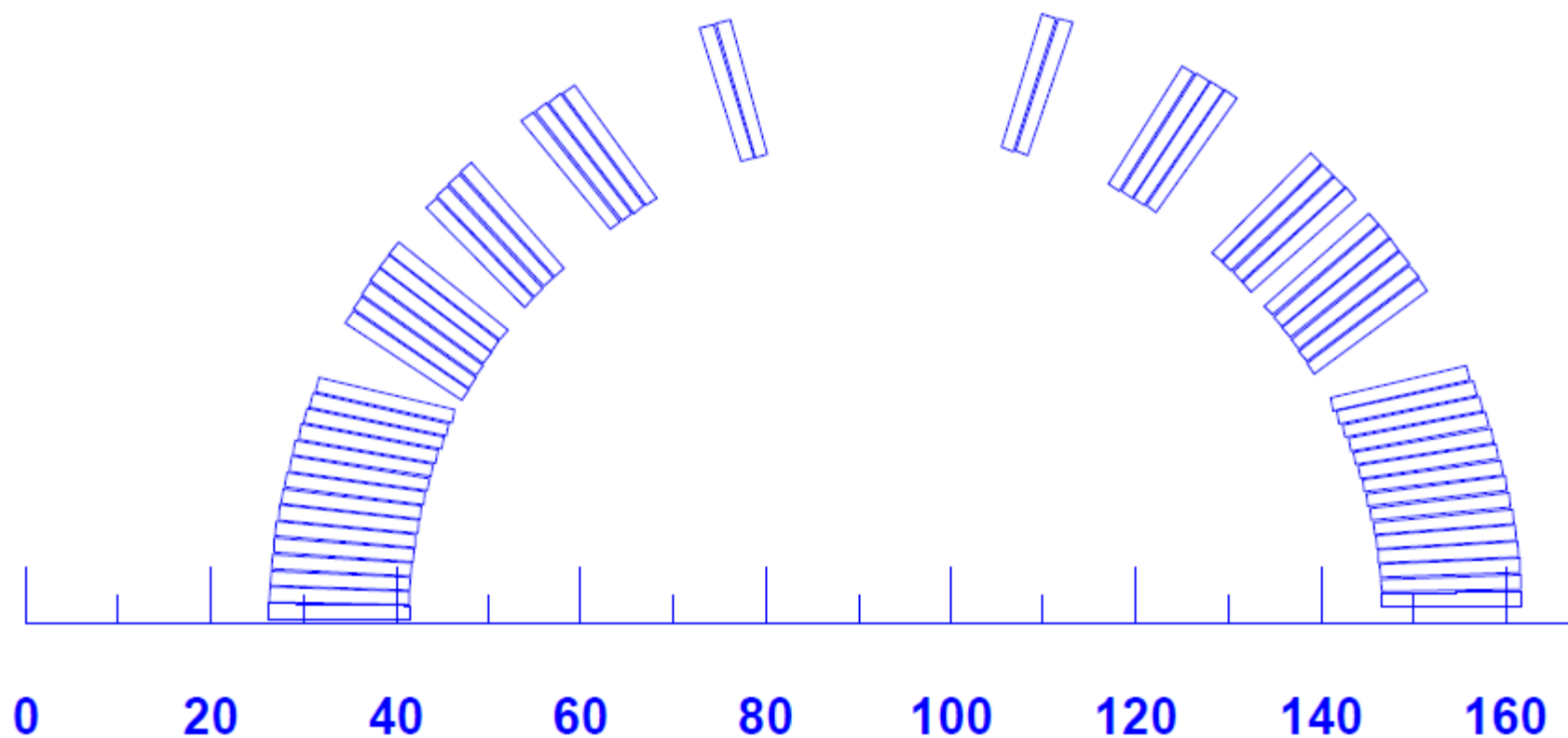


- INFN Genova is working on D2 design since January 2014
- Some configurations of D2 were developed, leading step by step to a final lay-out (called INFN_3) with coils composed of 62 turns with no turns asymmetry (31+31).
- The operating current is 12037 A generating a magnetic field of 4.5 T and a margin on the load line of 65%
- A first approach (one collar for both coils) to 2D mechanical analysis was performed. A second one is under way for an option with one collar per coil.
- A first design of coil ends was done.

Lay-out



Winding Detail



After some iteration with mechanics the coil was optimised with conductor dimensions at 70 MPa

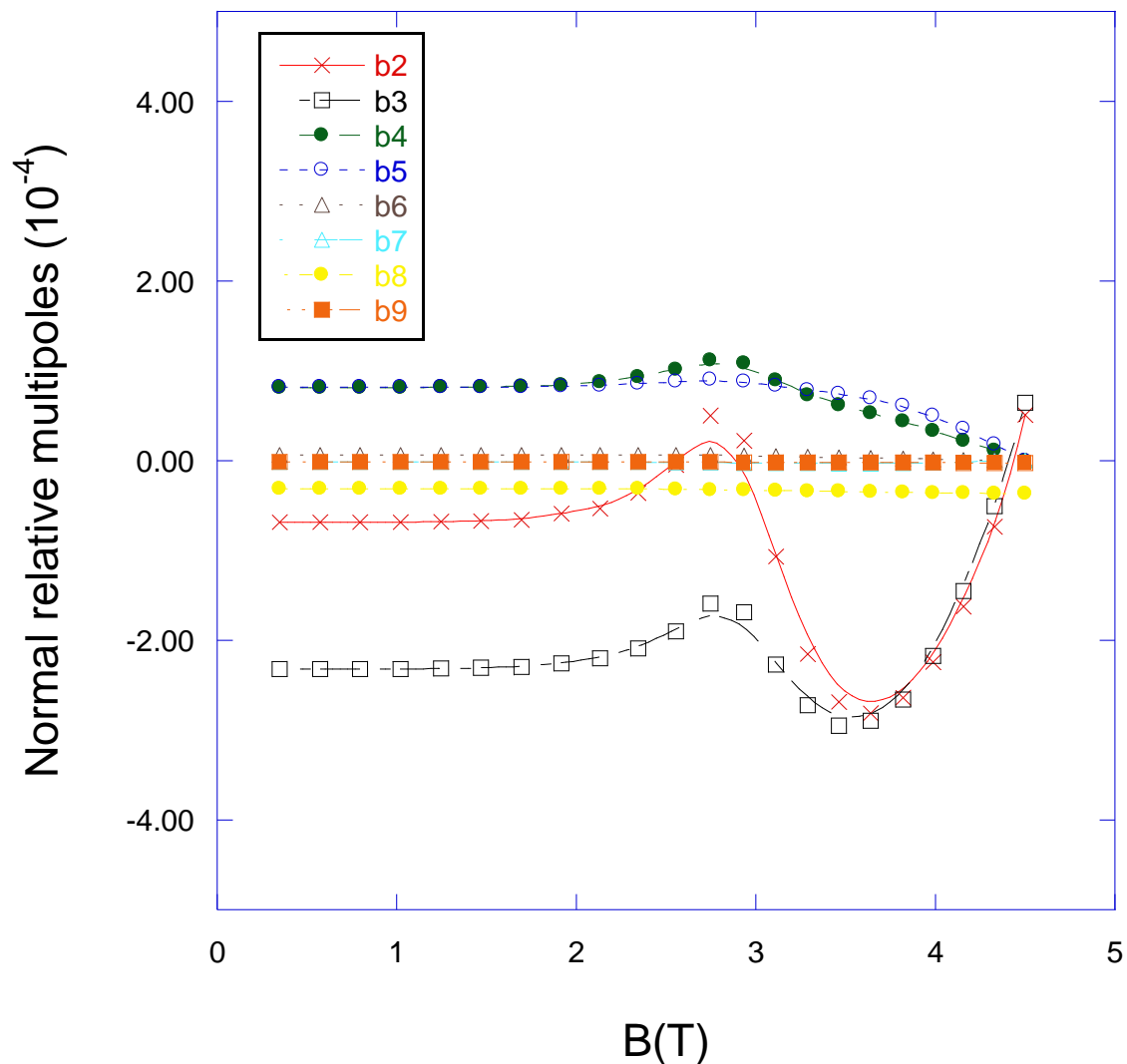
Main Characteristics 1

Characteristics	Units	Value
Aperture	mm	105
Number of apertures		2
Distance between apertures (cold/warm)	mm	188.00/ 188.45
Cold mass outer diameter (min/max)	mm	570/630
Magnetic length	m	7.78
Bore field	T	4.5
Peak field	T	5.20
Current	kA	12.050
Temperature	K	1.9
Loadline margin	(%)	35
Overall current density	A/mm ²	443
Stored energy per meter	MJ/m	0.2807
Differential inductance per meter	mH/m	3.509
Stored energy	MJ	2.18
Differential inductance	mH	27.3

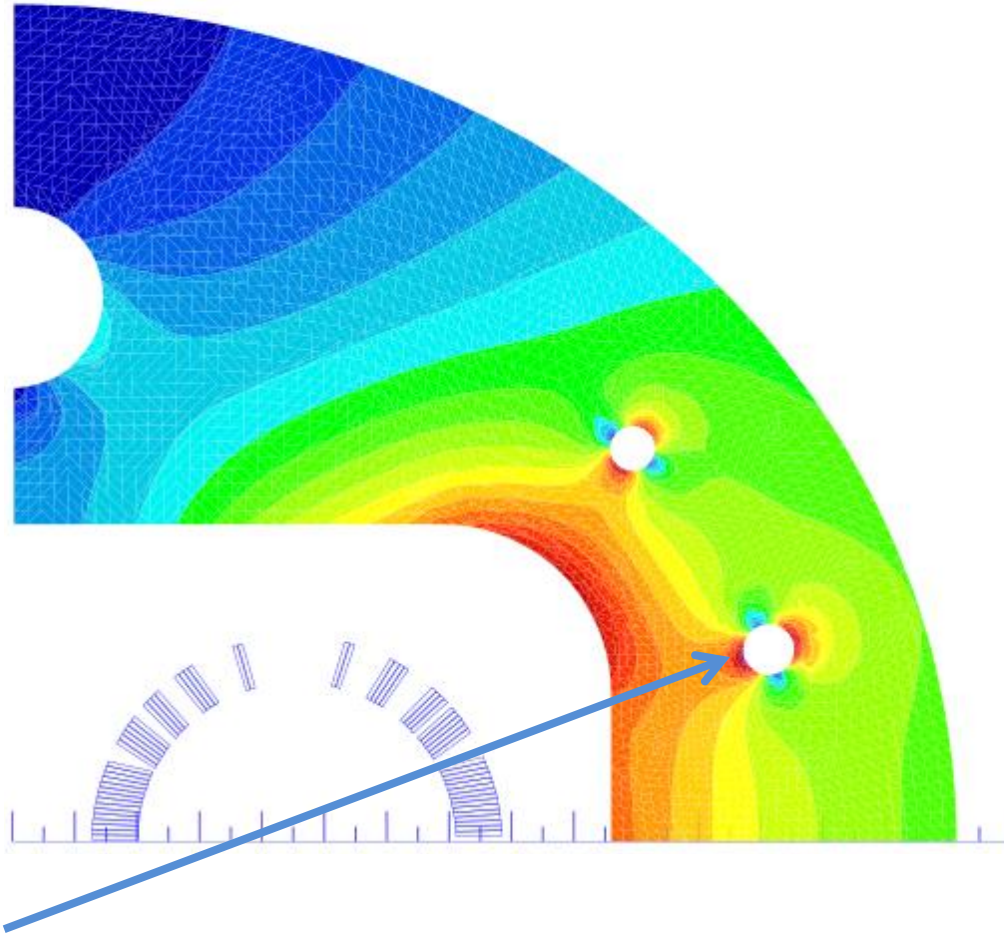
Main Characteristics 2

Characteristics	Units	Value
Superconductor		Nb-Ti
Strand diameter	mm	0.825
Cu/No Cu		1.95
RRR		>150
Superconductor current density at 10 T, 1.9 K	A/mm ²	2100
Number of strands per cable		36
Cable bare width	mm	15.1
Cable bare mid thickness	mm	1.480
Keystone angle	degrees	0.90
Insulation thickness per side radial	mm	0.160
Insulation thickness per side azimuthal	mm	0.145
Number of layers		1
Number of turns		31=15+6+4+4+2
Cable unit length	m	520
Coil physical length	m	8.2
Magnet physical length	m	8.5
Cold mass weight	t	17
Heat exchanger hole diameter	mm	40
Heat exchanger angle	degrees	90
Heat exchanger distance from centre	mm	237
F _x (per quarter, per aperture) [left right]	MN/m	0.60/0.68
F _y (per quarter, per aperture)	MN/m	-0.40

b2 and b3 optimised at a B field slightly lower than 4.5 T (4.4 T)

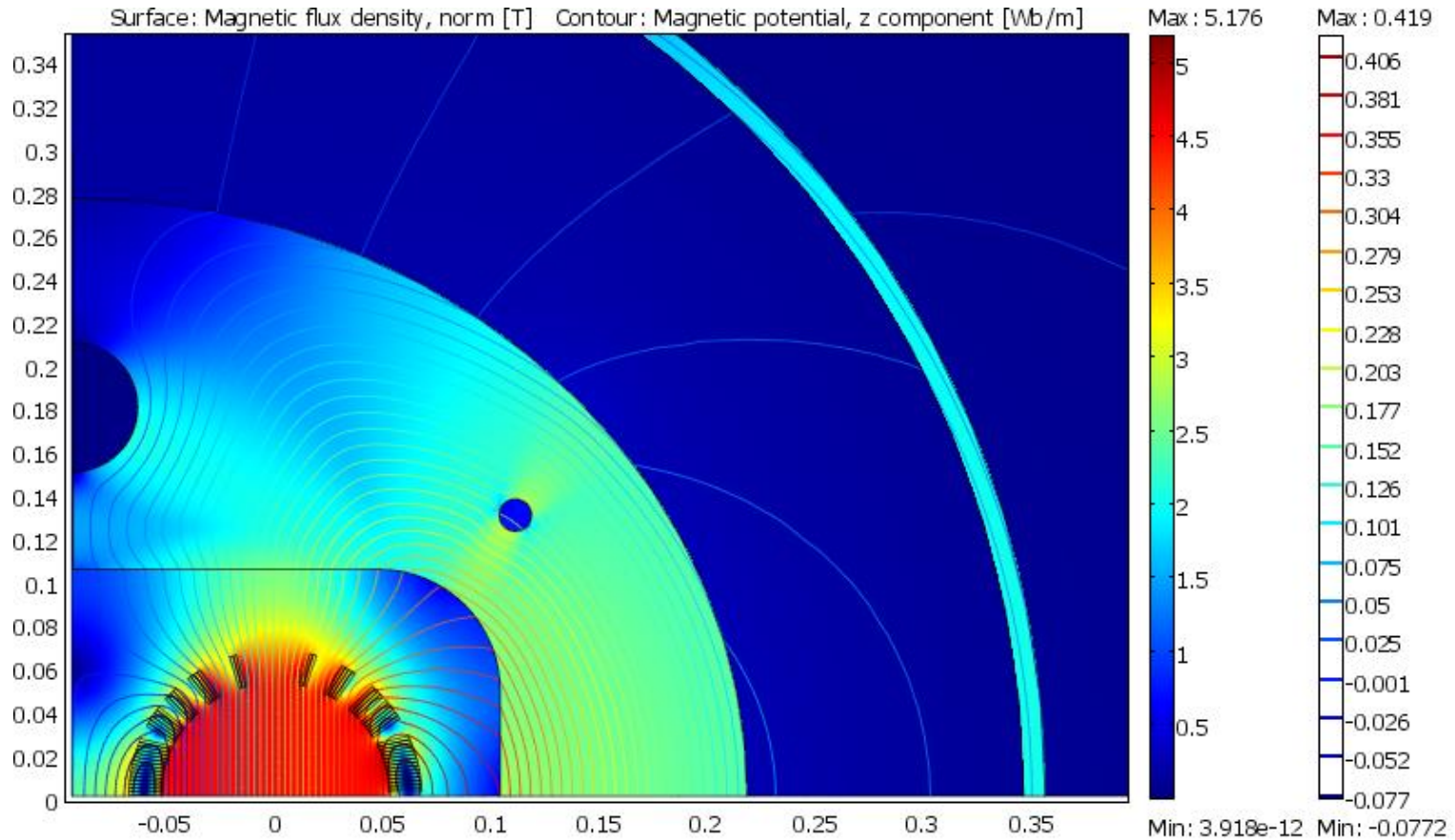


b2 and b3 fine shim



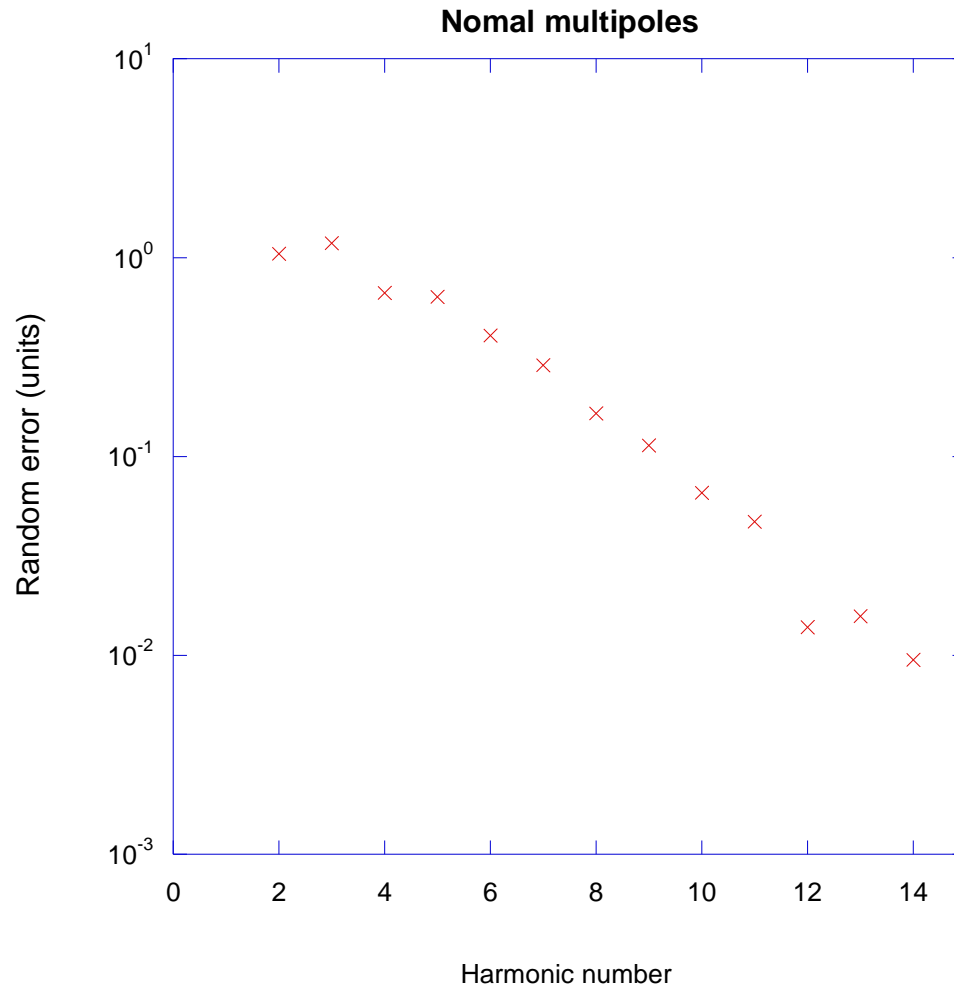
Adding a second hole, b2 and b3 are lowered of 2 and 1 unit respectively. This second hole could be filled with iron if not required

Fringe Field



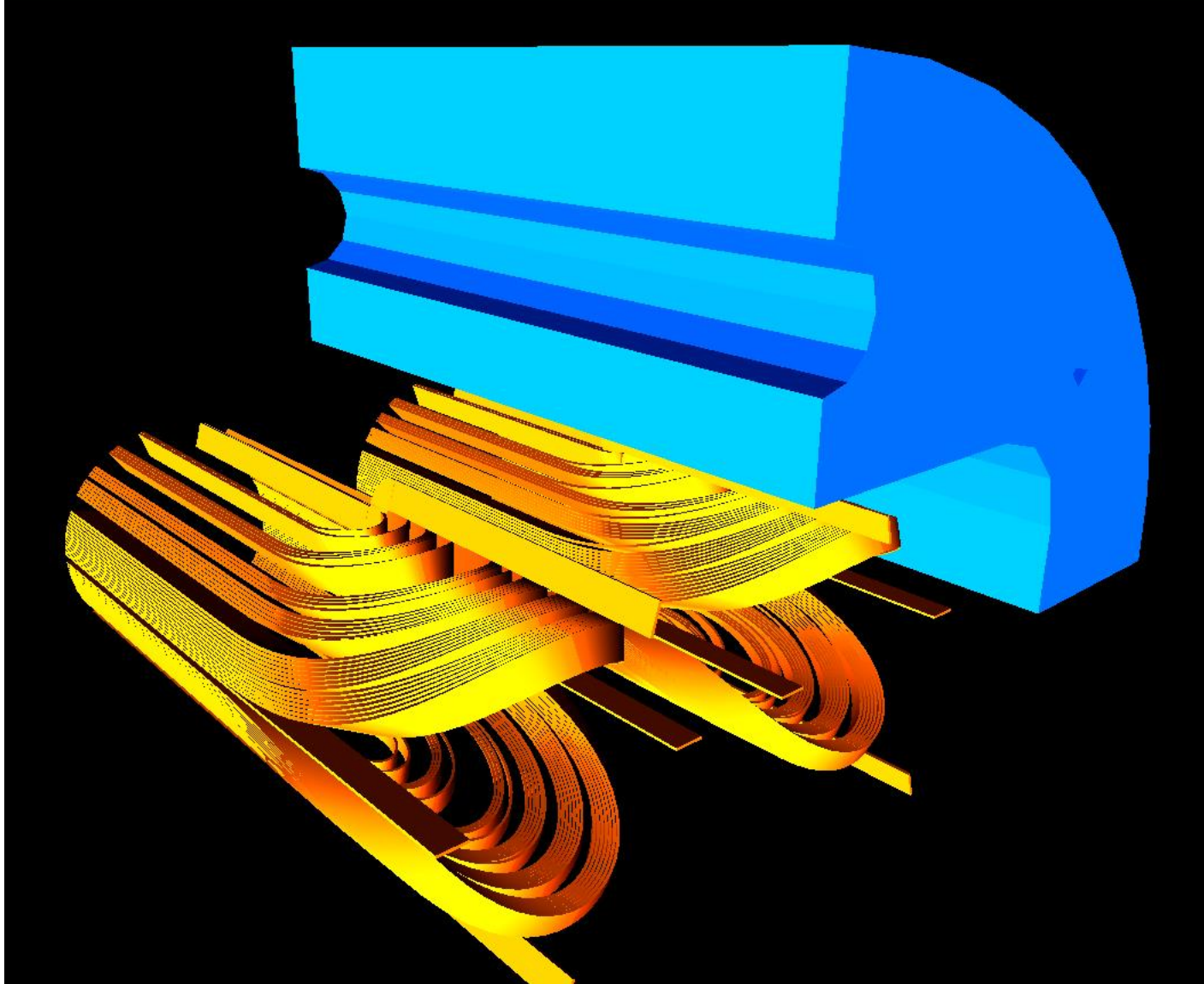
At the external surface of the cryostat ($Y=0$) $B= 100$ mT

Random errors

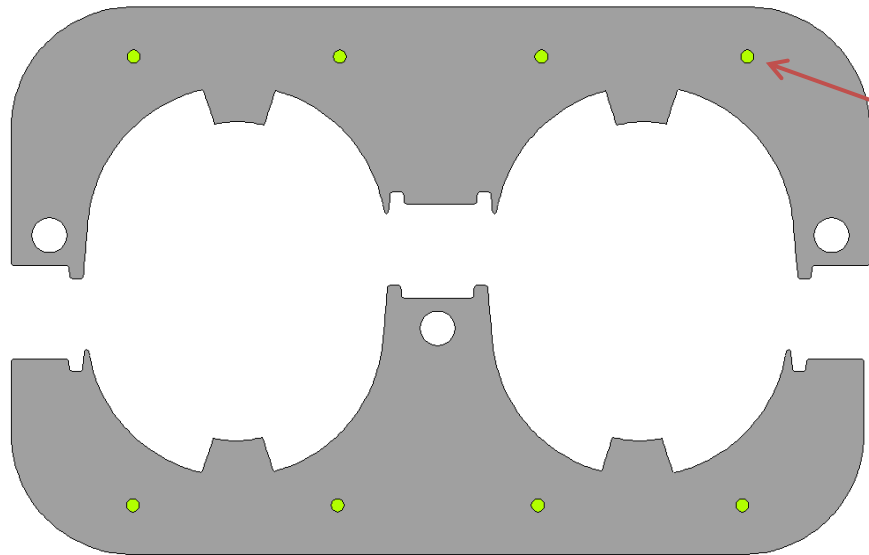


40 μm displacement

Coil end design is progressing



2D Mechanical Design: one collar option (version INFN3_3_3)

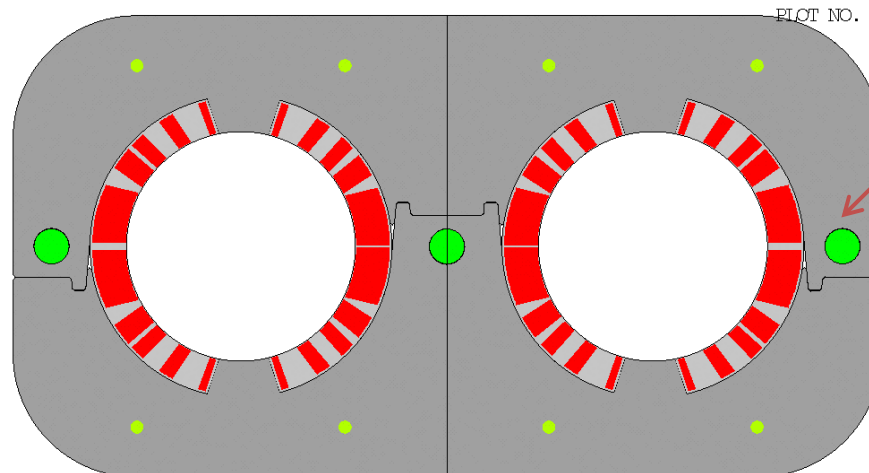


- Packs of collars are kept together by pins

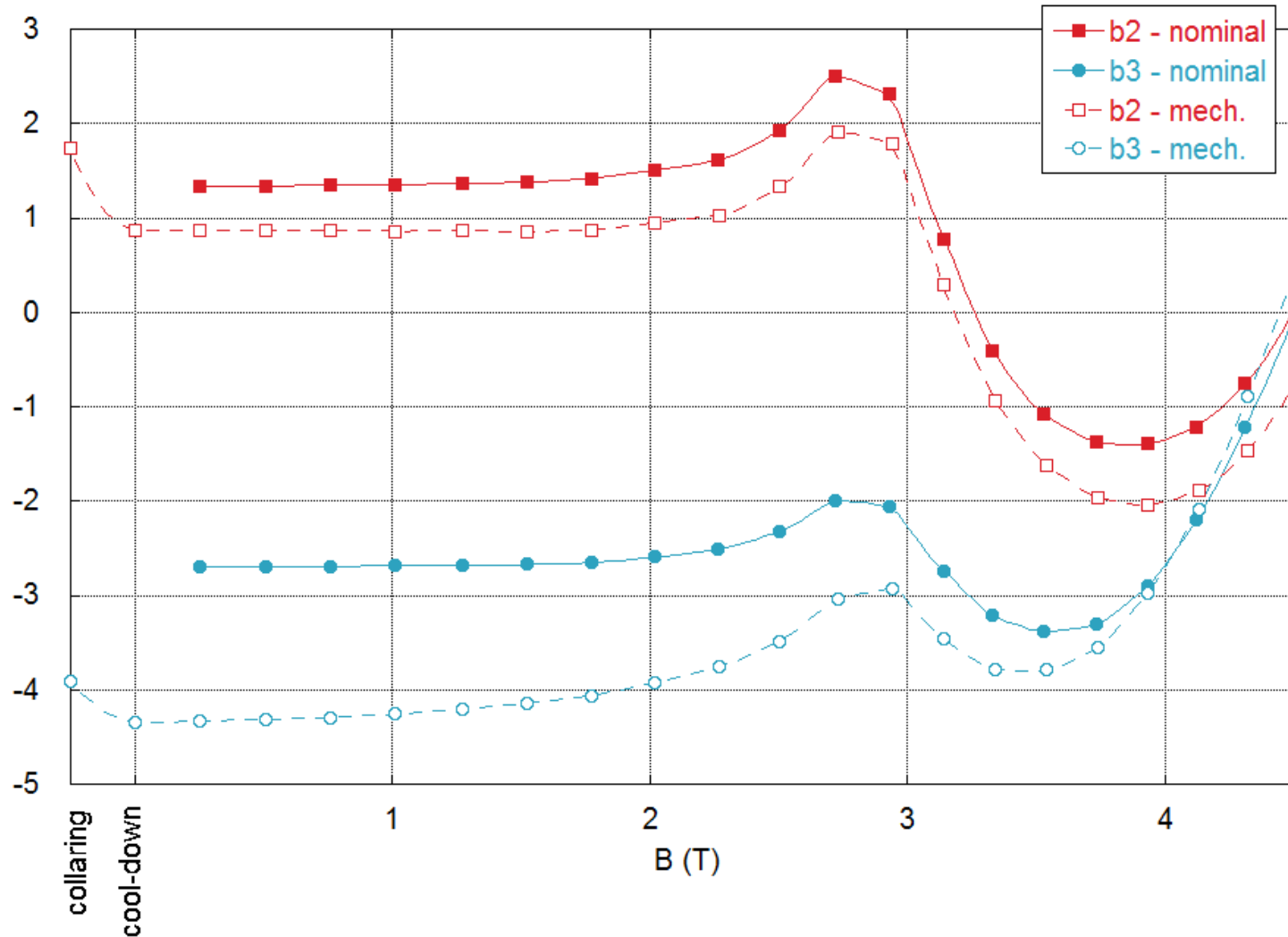
- In each pack, the two different kind of collars are alternating

- The packs of collars are assembled by inserting rods

- Collars, pins and rods are made of stainless steel



Mechanical effects effect on b2/b3 harmonics (version INFN3_3_3)



Activity within an INFN project called MAGIX

- | | |
|--|------------|
| 1) 2D magnetic design | July 2014 |
| 2) 3D magnetic design (coil ends) | Dec. 2014 |
| 2) 2D mechanical design including option one collar per coil for INFN3_3_6 | Dec. 2014 |
| 3) Quench analysis | June 2015 |
| 4) 3D mechanical design (axial pre-stress) | Dec. .2015 |
| 5) Engineering design of a short model | Dec 2015 |
| 6) Engineering Design long | Dec 2016 |

General Schedule

Phase	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Conceptual design			■	■							
Engineering design (short)				■	■						
Short model				■	■	■					
Engineering design (long)					■	■	■				
Prototype						■	■	■			
Production									■	■	
Installation											■

- The version INFN3_3_6 has a simplified lay-out with symmetric turn numbers and turns per block (only different angles).
- Magnetic Field 4.5 T
- Small variation of the multipoles due to saturation : b2 (3 units), b3 (3 units) b4 (1.5 units), b5 (1 units) and all others close to zero. Possibility to fine shim b2 and b3.
- Coil end design well progressing
- Two options for mechanical design under study