Interim Report from Toshiba/Hitachi Studies on Solenoid and Anti-DID

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Introduction

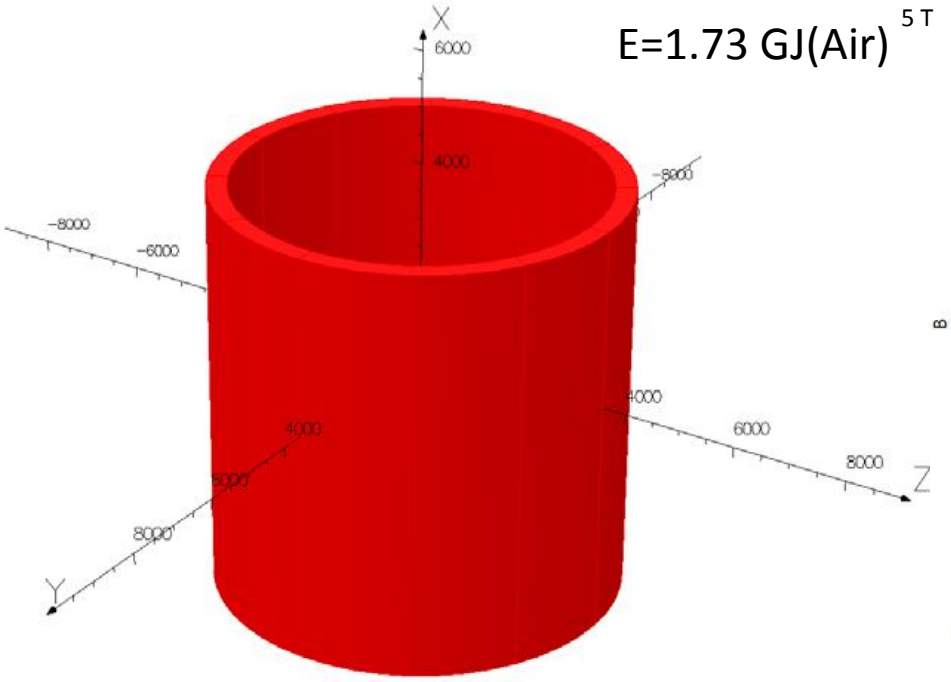
We are discussing with main superconducting magnet manufactures, Toshiba and Hitachi, about ILD solenoid with Anti-DID design from view points as fabrication and transportation. They are proposing some modified design and fabrication process of Anti-DID.

Contents

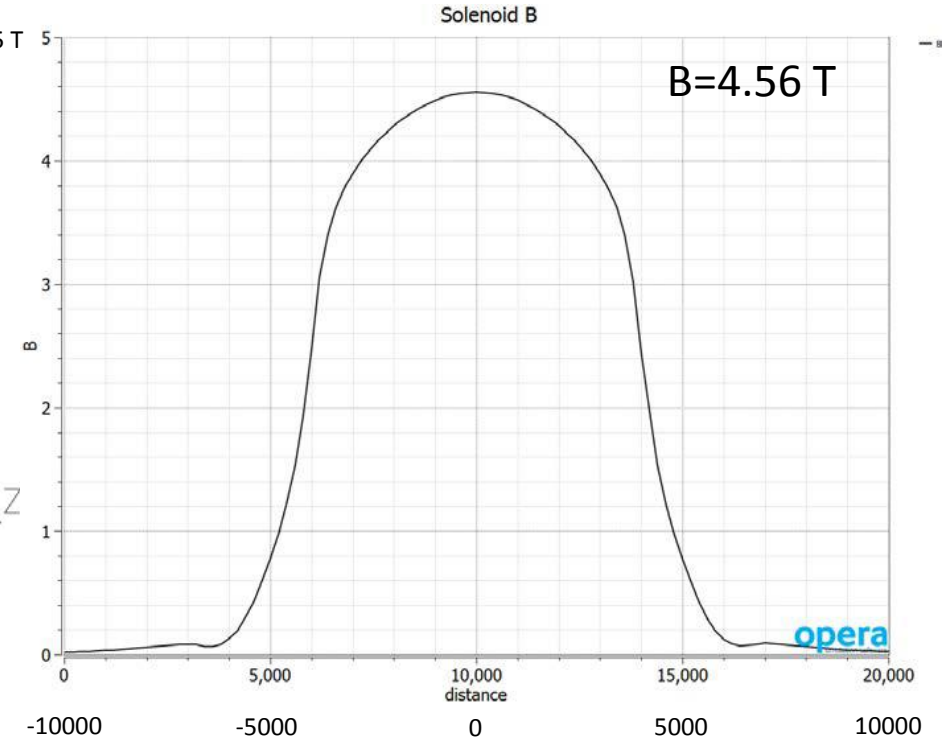
1. Divided Anti-DID design (by T)
    1. Basic Field Calculation Model
    2. EMF on Anti-DID with Solenoid Field
    3. Circumferential divided Anti-DID
2. Some Fabrication Concepts of Anti-DID (by H)

Basic Field Calculation Model
Solenoid

Solenoid I.R. (mm)	3215	Axial Turn No.	40
Solenoid O. R. (mm)	3570	Thickness Turn No.	11
Solenoid L (mm)	7350	Current (kA)	22.5
Conductor Size (mm^2)	61.3 × 32.3	Current Density (A/mm^2)	11.4



E=1.73 GJ(Air)

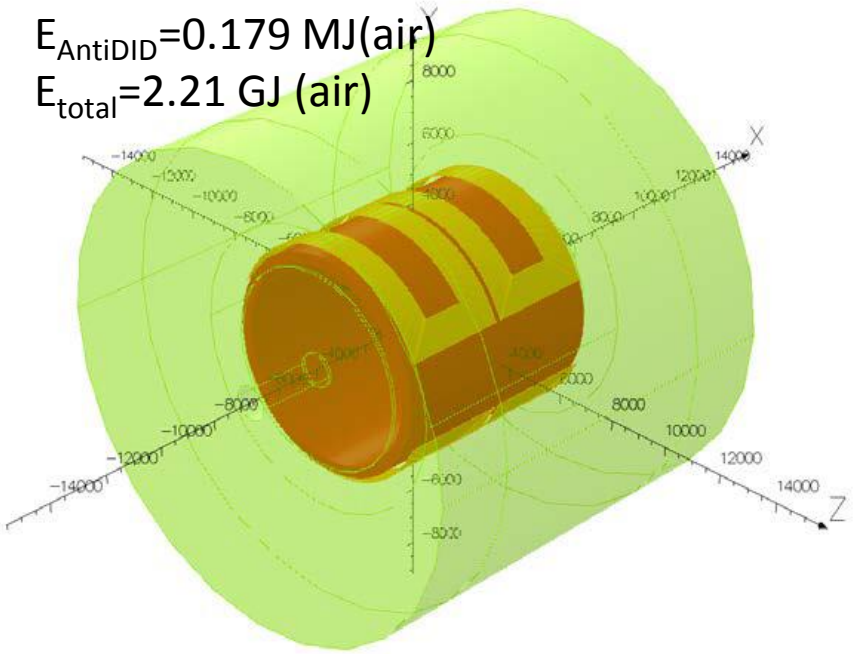


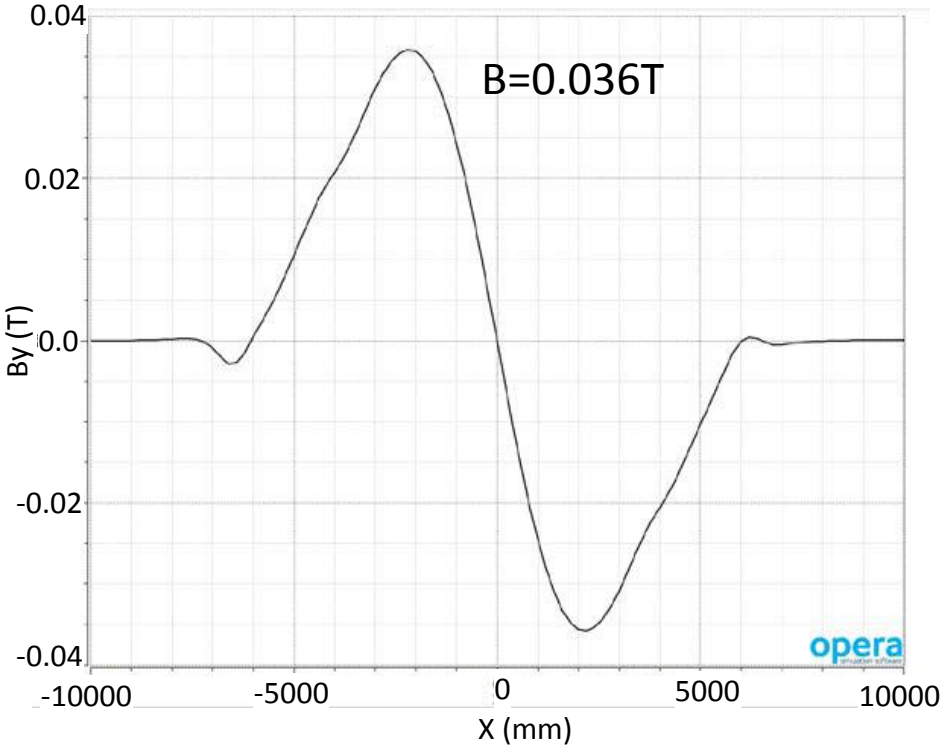
B=4.56 T

Basic Field Calculation Model Anti-DID

Curved S. I. R. (mm)	3760	Thickness Turn No.	2
Curved O.R. (mm)	3768	Width Turn No.	150
Straight L. (mm)	1200	Current (A)	1067
Winding W. (mm)	1000	Current Density (A/mm^2)	40
Winding T. (mm)	8	Iron Yoke I.R. (mm)	4595
Conductor (mm^2)	6.67 × 4	Iron Yoke O.R. (mm)	7755
Elevation Angle of Straight S. (deg)	30	Iron Yoke L. (mm)	13240

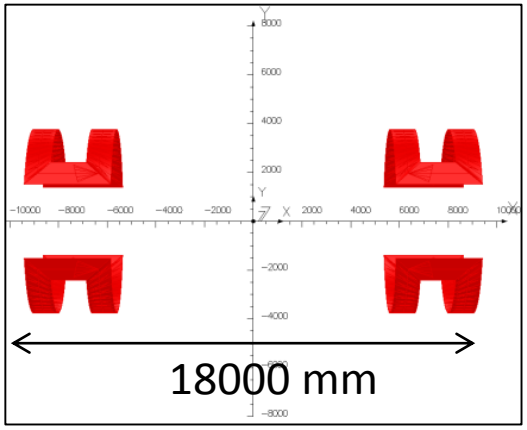
$E_{AntiDID}$=0.179 MJ(air)
E_{total}=2.21 GJ (air)

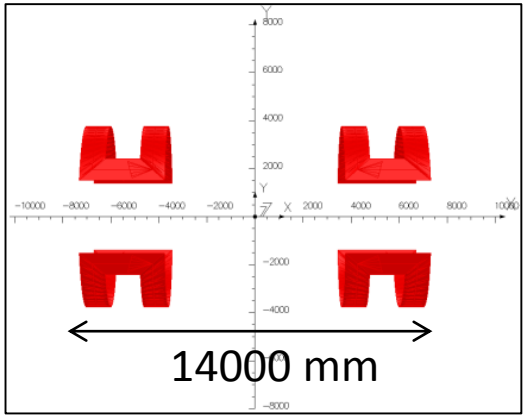


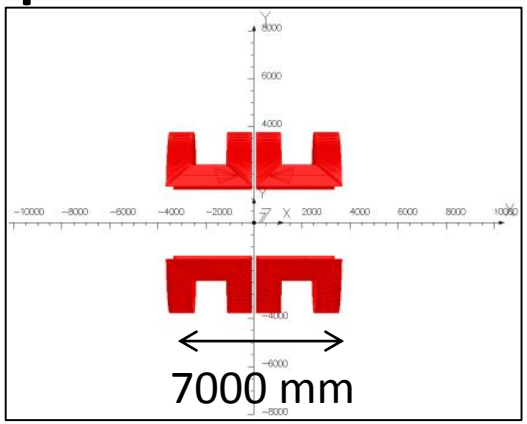


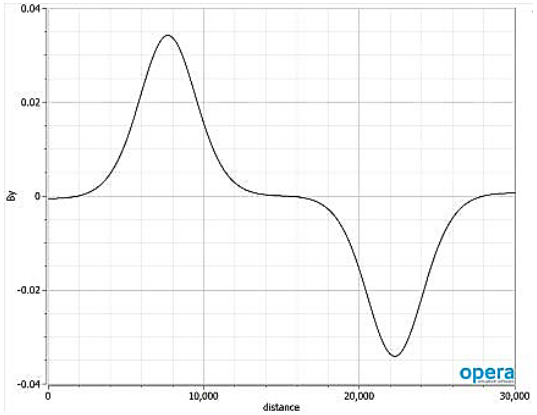
Basic Field Calculation Model Anti-DID

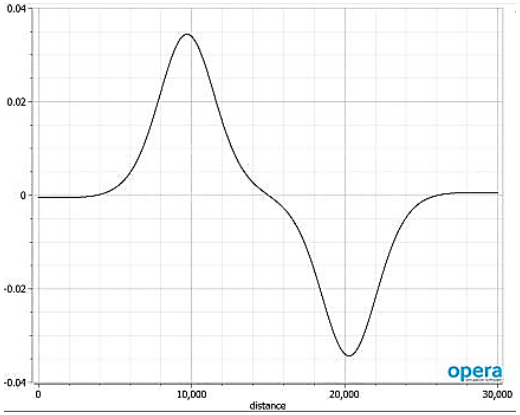
Flattening at collision point

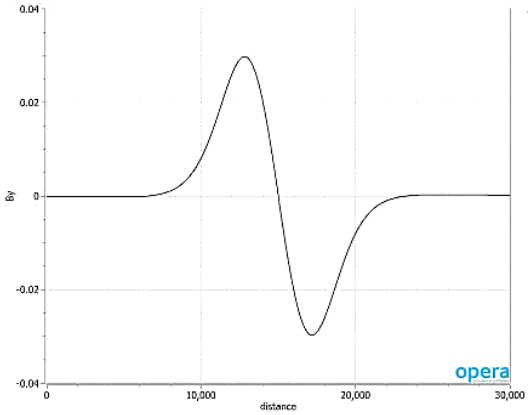








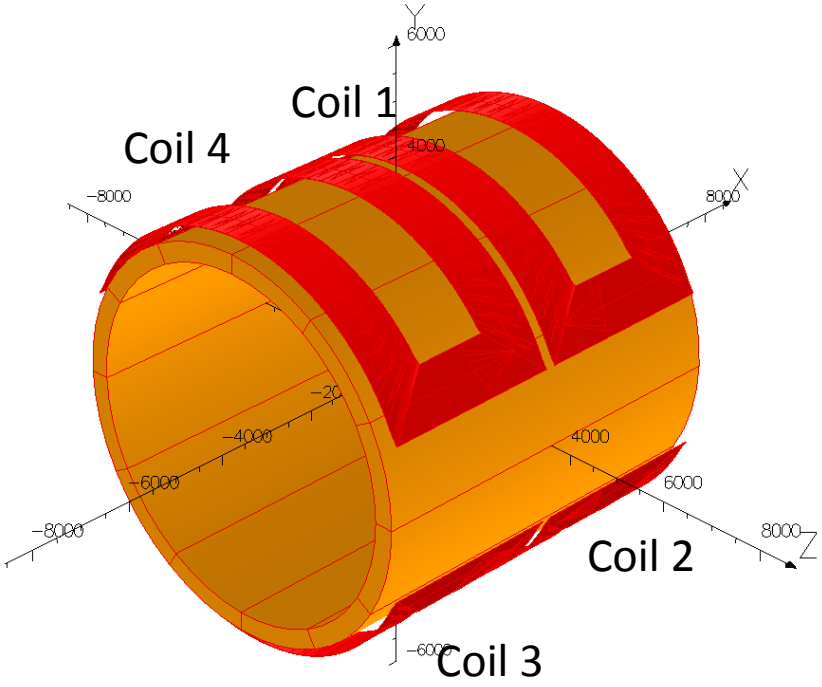




It is hard to flatten the By at the collision point by wider separating the Anti-DID.

Contents

Basic Field Calculation Model
Magnetic Force (w/o Yoke)



	Fx (MN)	Fy(MN)	Fz(MN)
AntiDID-Coil 1	2.61	-0.761	0.0
AntiDID-Coil 2	-2.77	-0.750	0.0
AntiDID-Coil 2	2.77	-0.750	0.0
AntiDID-Coil 2	-2.61	-0.761	0.0
Solenoid	0.0	3.06	0.0

AntiDID structural design and stress analysis are ongoing.

Contents

Circumferential divided Anti-DID

Curved S. I. R. (mm)	3760	Thickness Turn No.	2
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Straight L. (mm)	1200	Current (A)	1067
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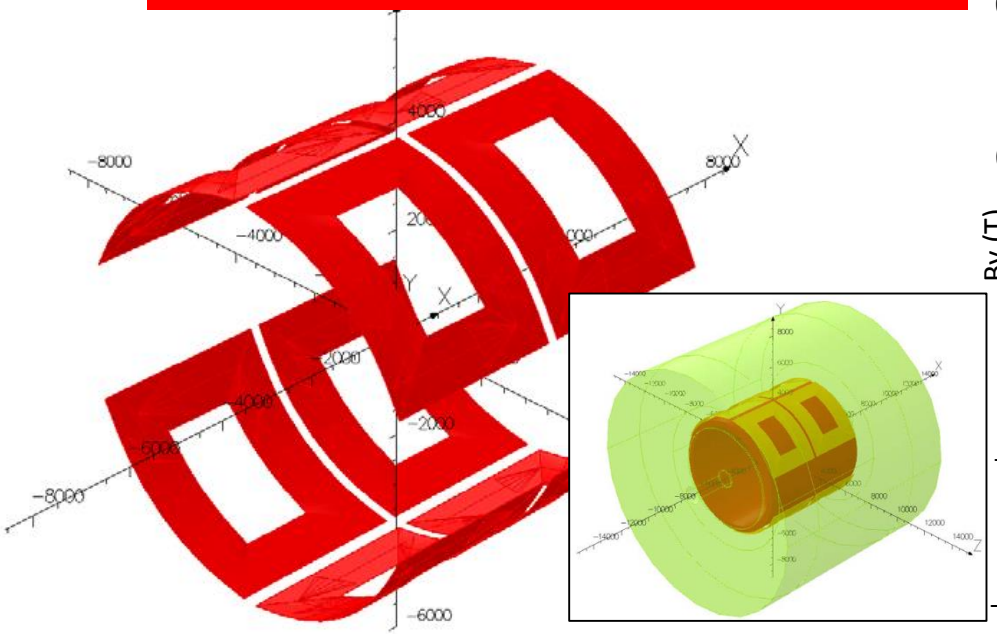
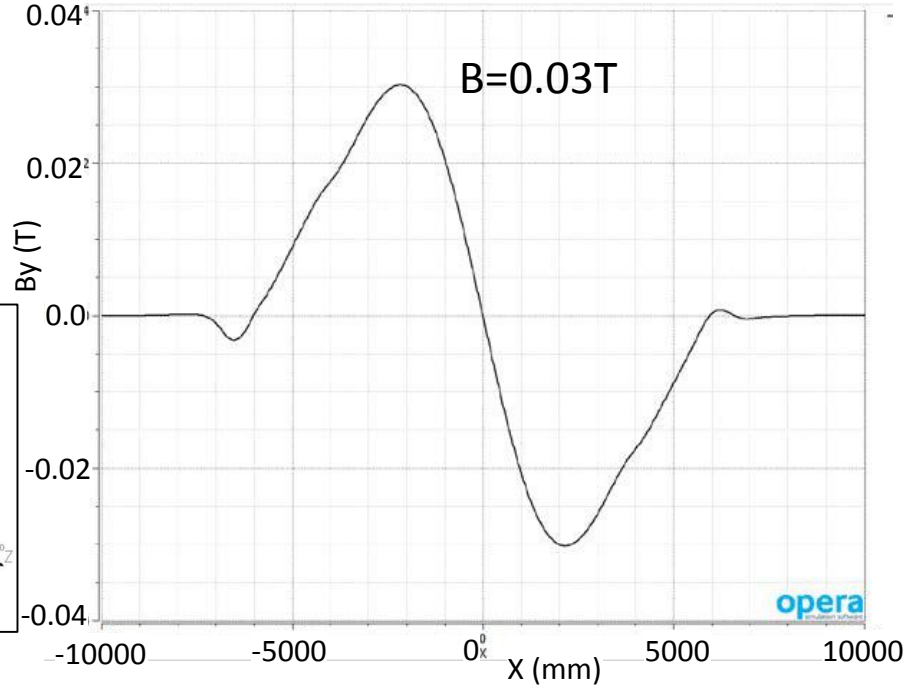
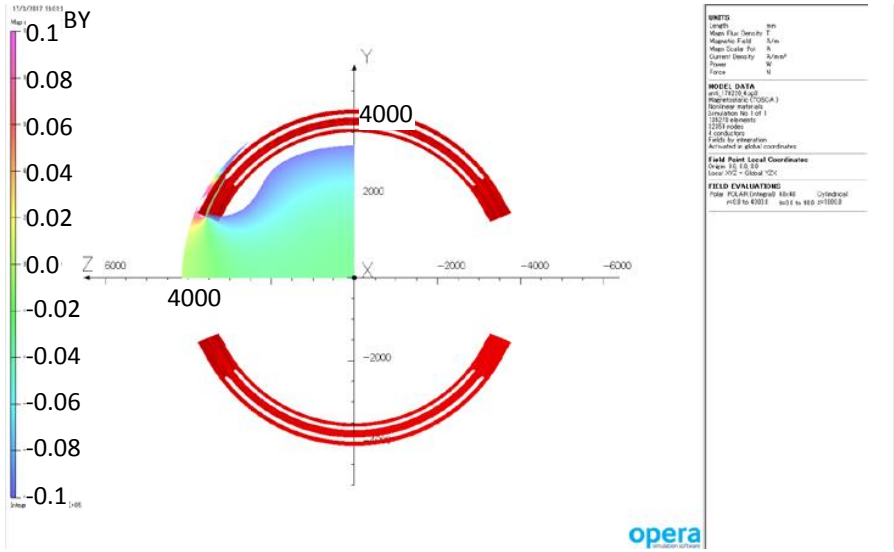
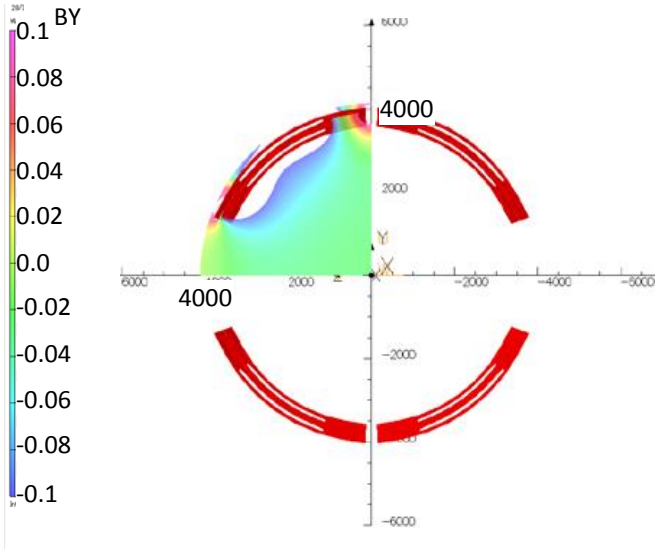
Smaller Coil Size -> Easy Transportation

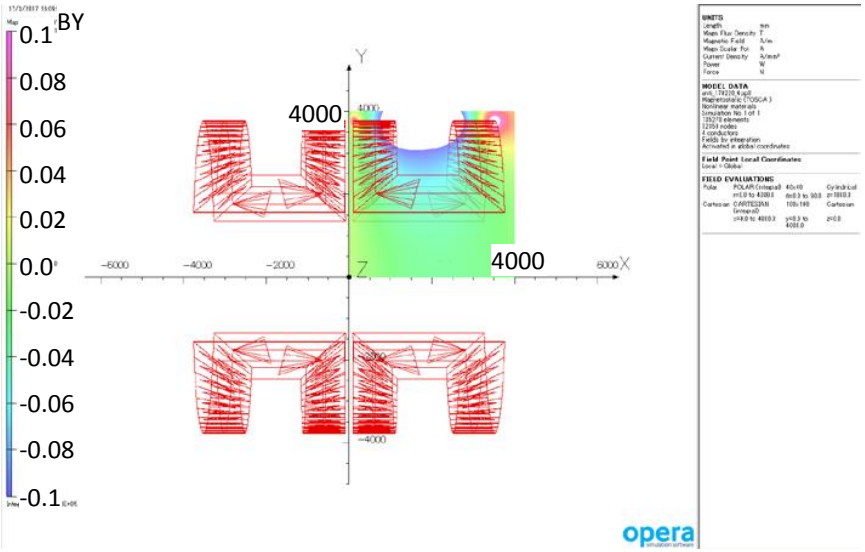


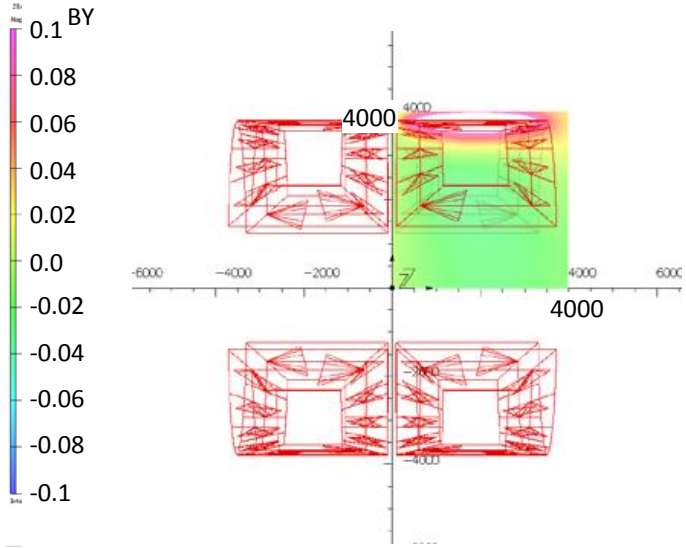


Circumferential divided Anti-DID Field Map









Original Anti-DID

Circumferential divided Anti-DID

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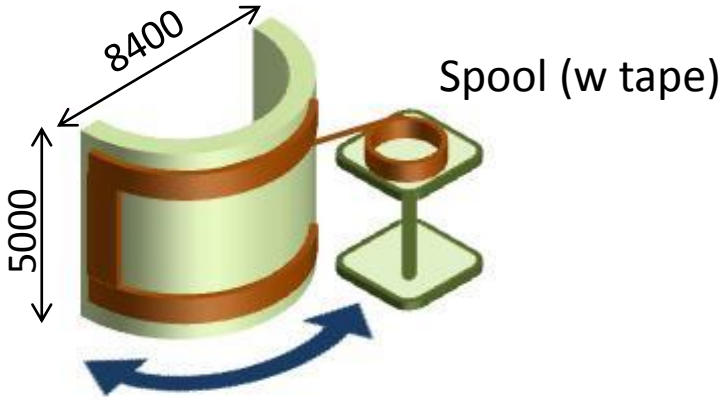
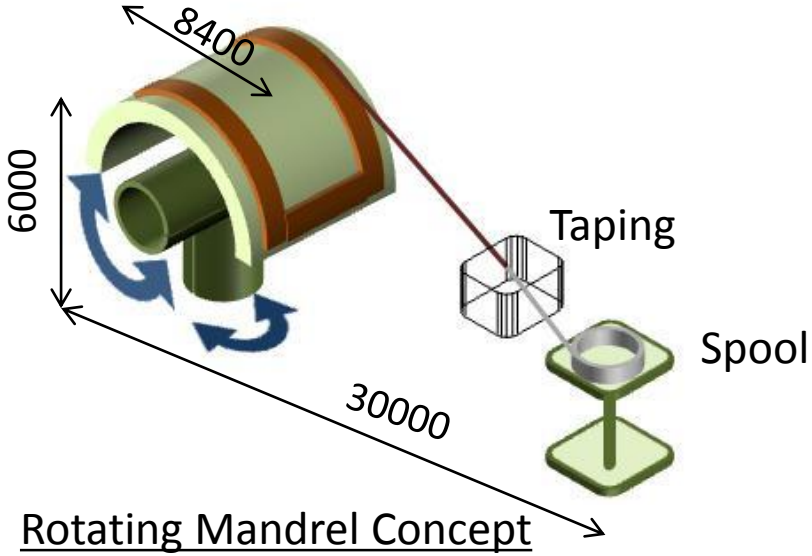
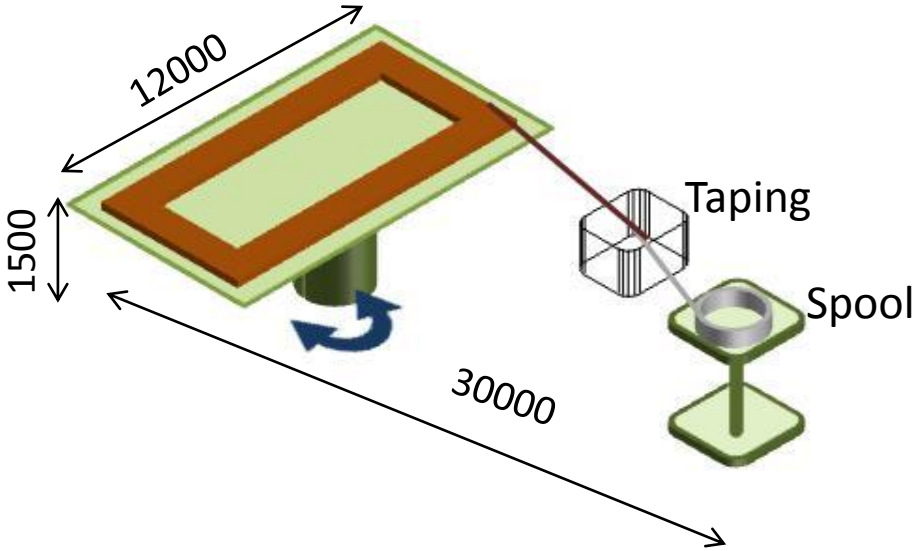
Fabrication Methods of Anti-DID

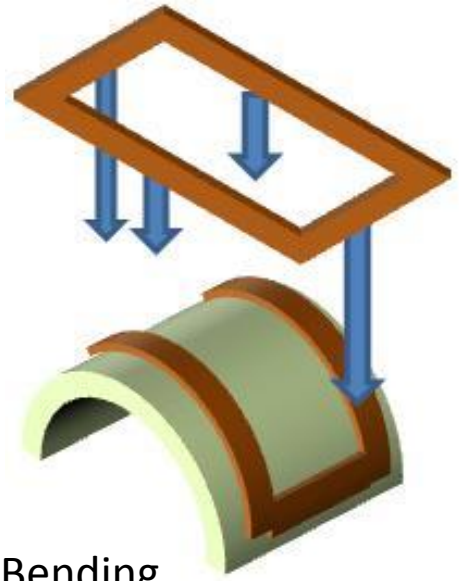


Moving Spool Concept



Rotating Mandrel Concept

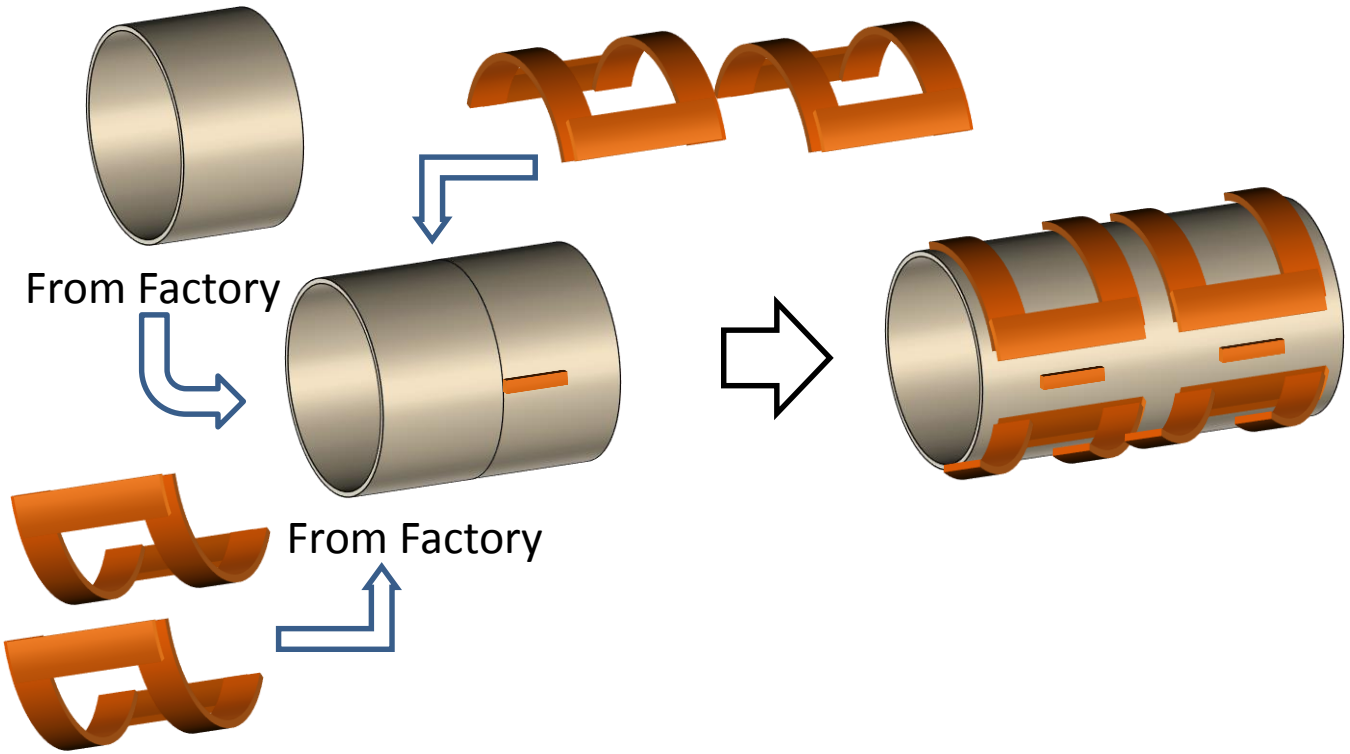




Racetrack winding and Coil Bending

Setting Anti-DID on Solenoid

Anti-DID Coils are Directly fastened on Solenoid Shell



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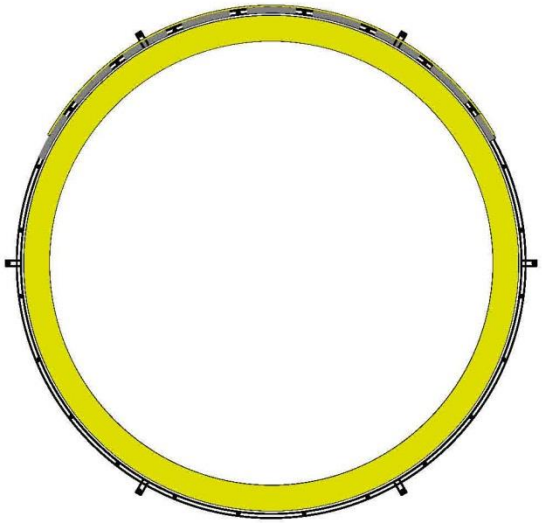

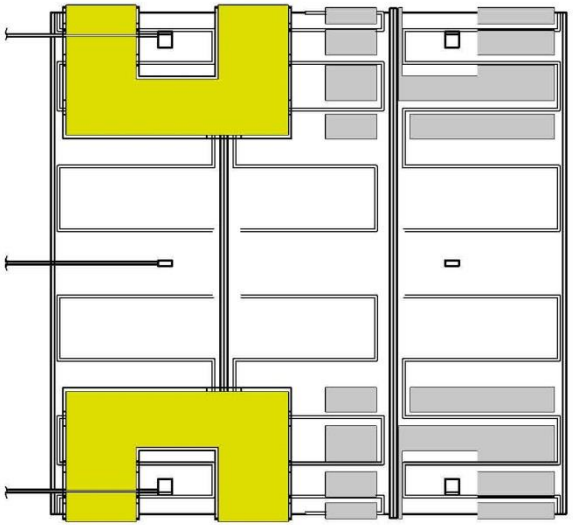

Cooling Pipe
Forced Flow Scheme
Thermo-siphon Flow
is also Possible

Both factories have a large turning stage where each support cylinder is set and end-mill machined.

Cooling Pipe
ID 30, OD 36

Anti-DID
IR 3710, OR 3720

Axial Support
PCD 7600

Solenoid
ID 6430, OD 7140

Summary

- Some smaller and divided Anti-DID coil configuration are being considered from view point of easy transportation.
- Are these approaches accepted ?
- Anti-DID coil structures are able to be mounted onto the outer surface of solenoid support cylinder.