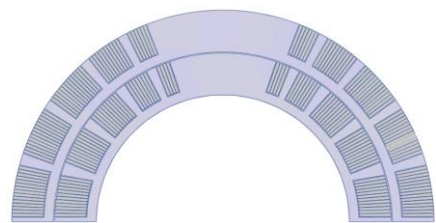


SMCT mirror assembly

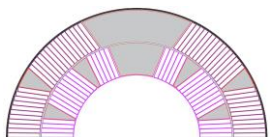
Igor Novitski

4-10-2024

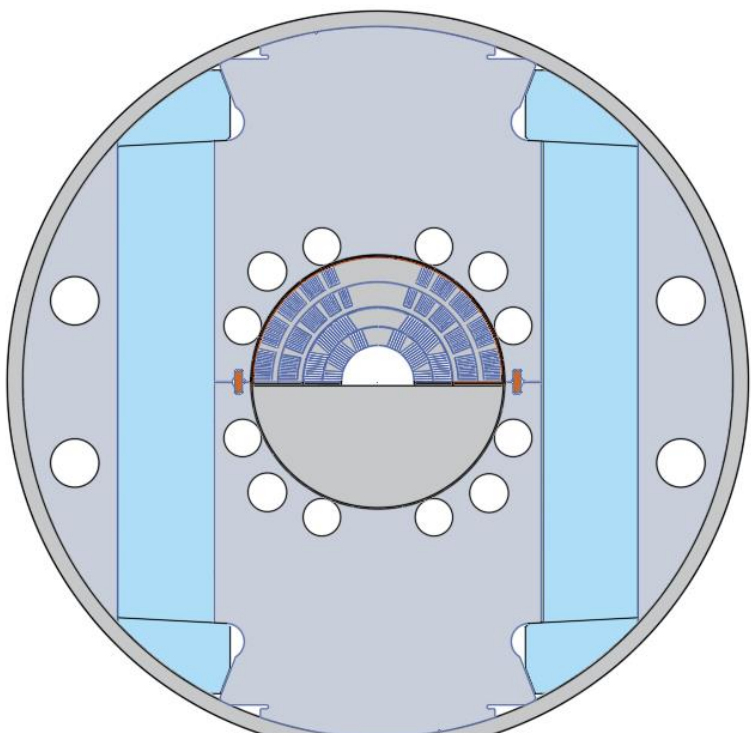
Dipole mirror with SMCT coil



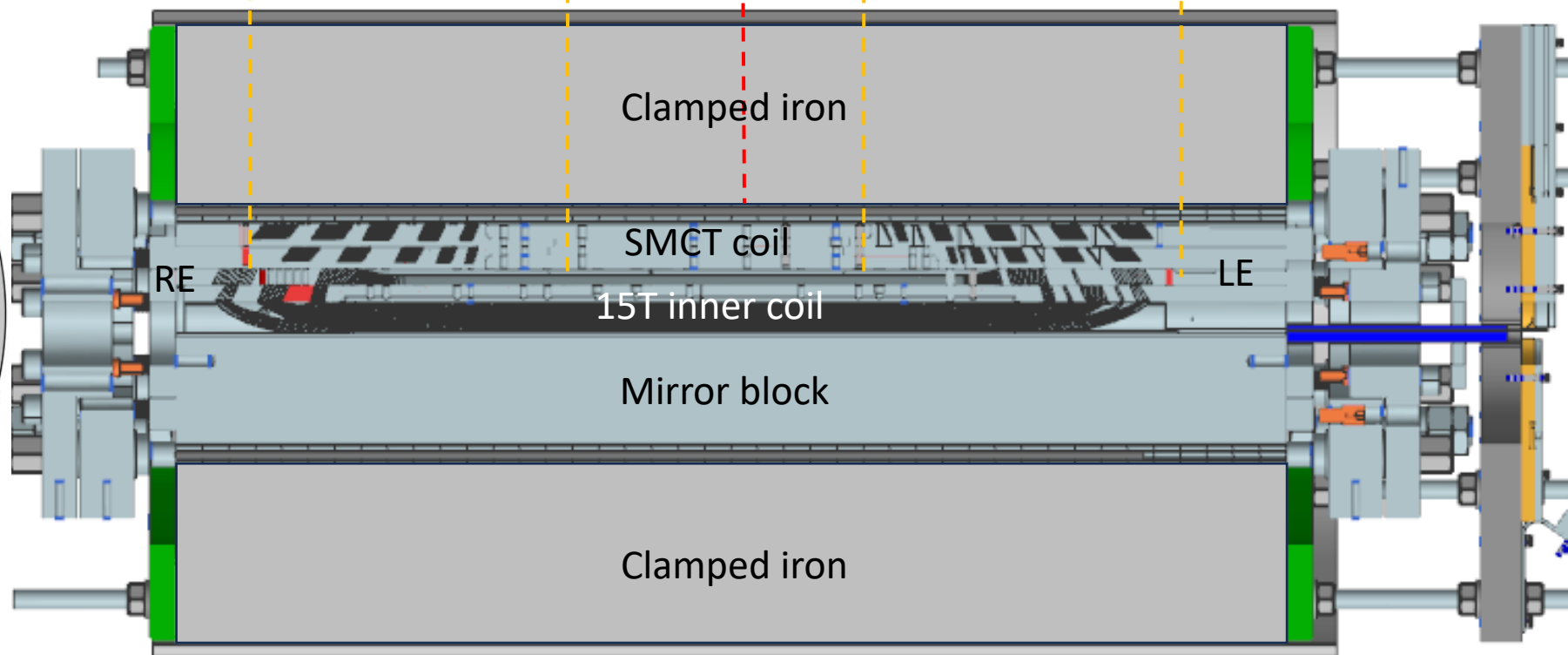
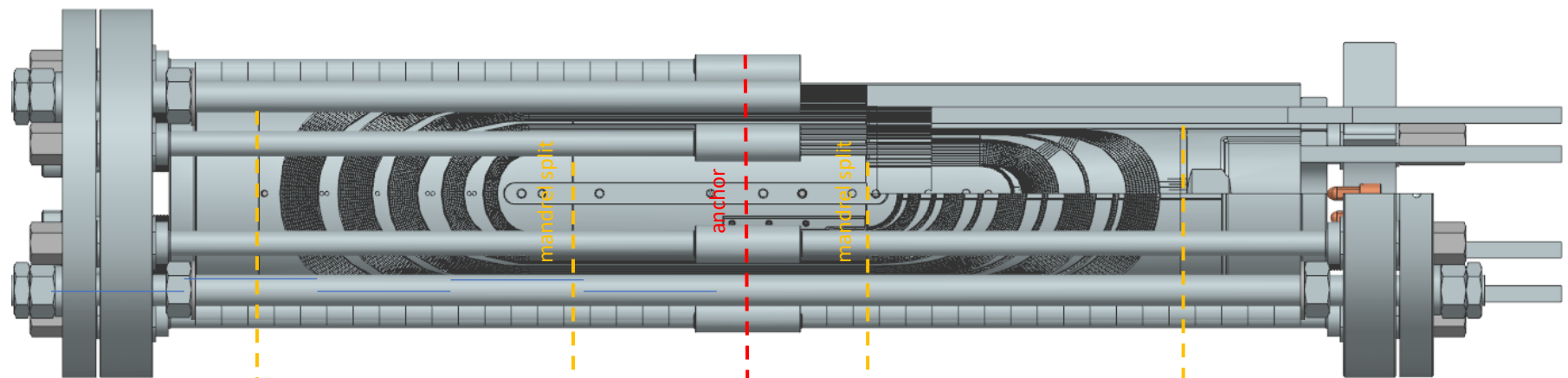
New SMCT coil ID=120 mm



Inner coil for 15T dipole ID=60 mm

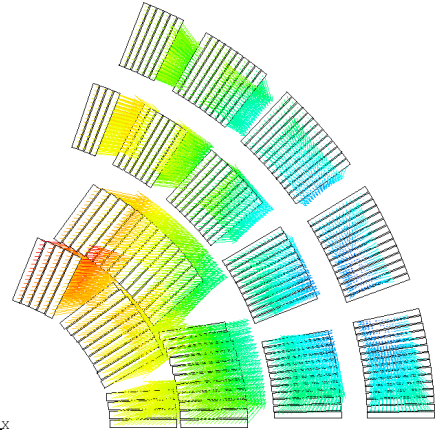
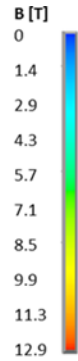
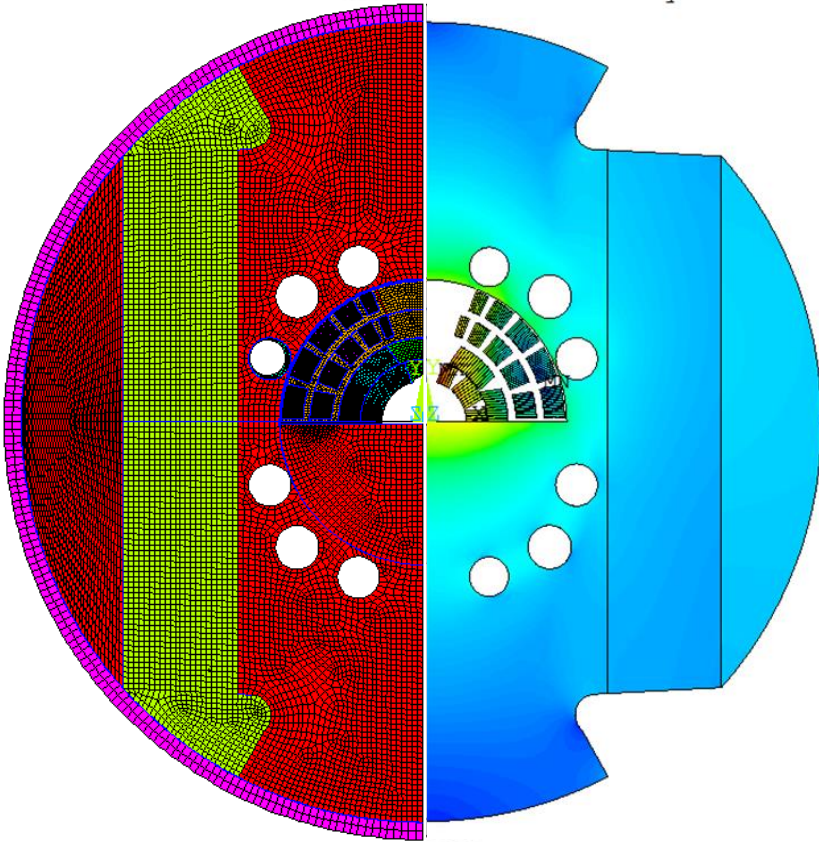


Cos-theta dipole mirror

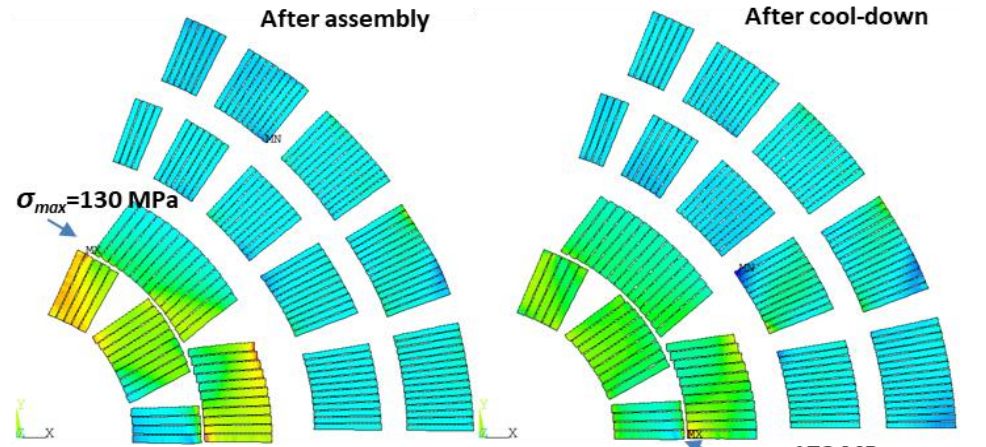


2D FEA for SMCT mirror magnet

Current=10000 A $B_0=9.49345$ T $T=2$ K AN
 CL X1C=195mm X2C=260.384mm
 CL Y1C=135mm Y2C=219.089mm
 Skin ts=12.7mm ty=.6t tc=.4t



LF distribution, 4L test

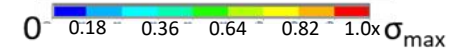


After assembly

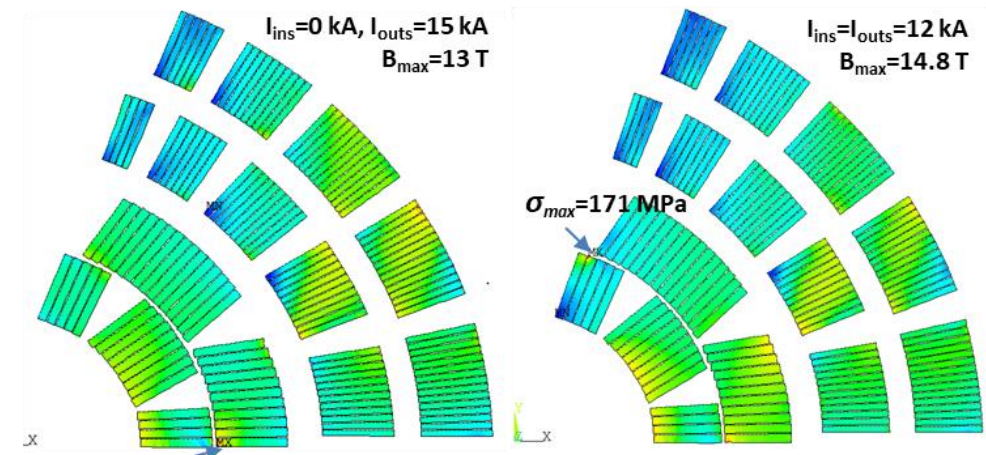
After cool-down

$\sigma_{max}=130$ MPa

$\sigma_{max}=173$ MPa



- Coil loading:
- 2/L for azimuthal load
 - 4/L for radial load
 - 4/L w 35% higher load
 - Scoil-max=173MPa/4K/4L
 - Scoil-max=130MPa/300K



$I_{ins}=0$ kA, $I_{outs}=15$ kA
 $B_{max}=13$ T

$I_{ins}=I_{outs}=12$ kA
 $B_{max}=14.8$ T

$\sigma_{max}=162$ MPa

$\sigma_{max}=171$ MPa



SMCT coil fabrication



Coil outer layer mandrel before winding



Completed outer layer winding



Coil leads splicing

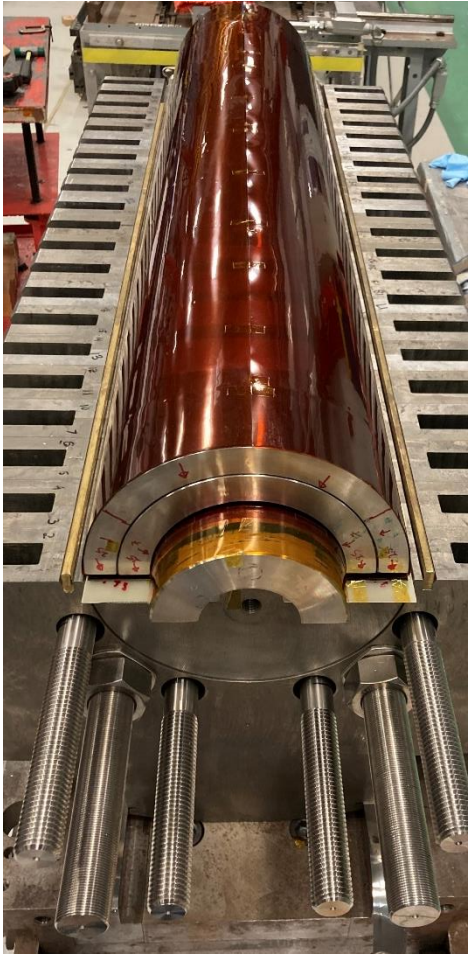


SMCT coil after reaction



Coil view after epoxy impregnation

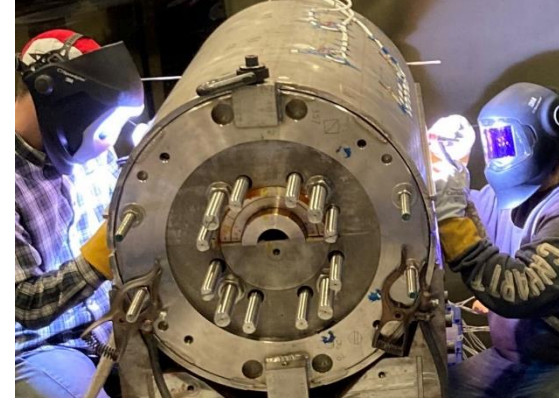
SMCT mirror assembly steps



Iron yoke assembly



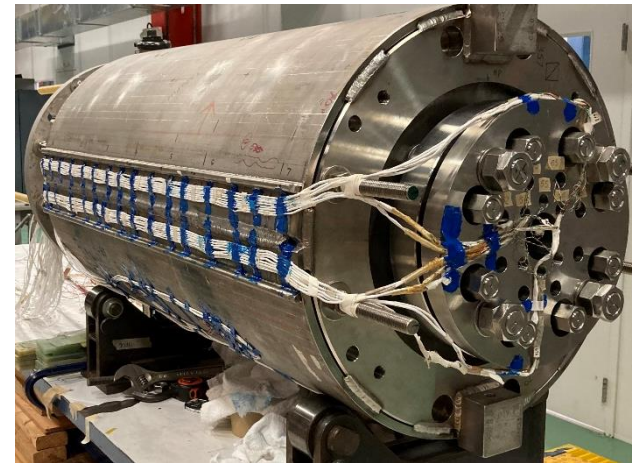
Welding contact tooling for a root pass and weld prep filling



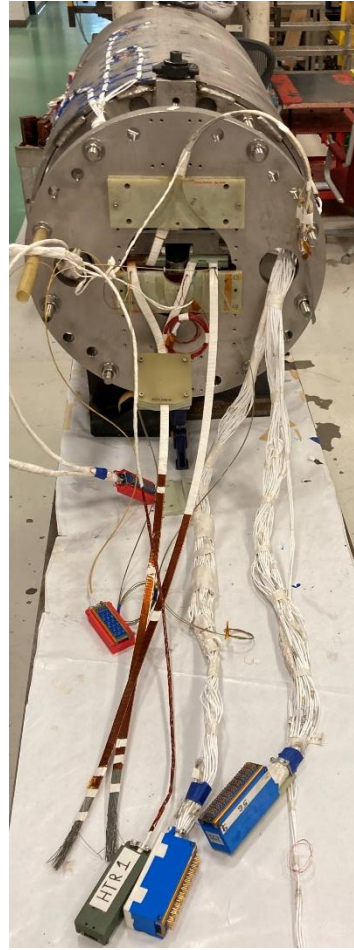
Clamping contact tooling



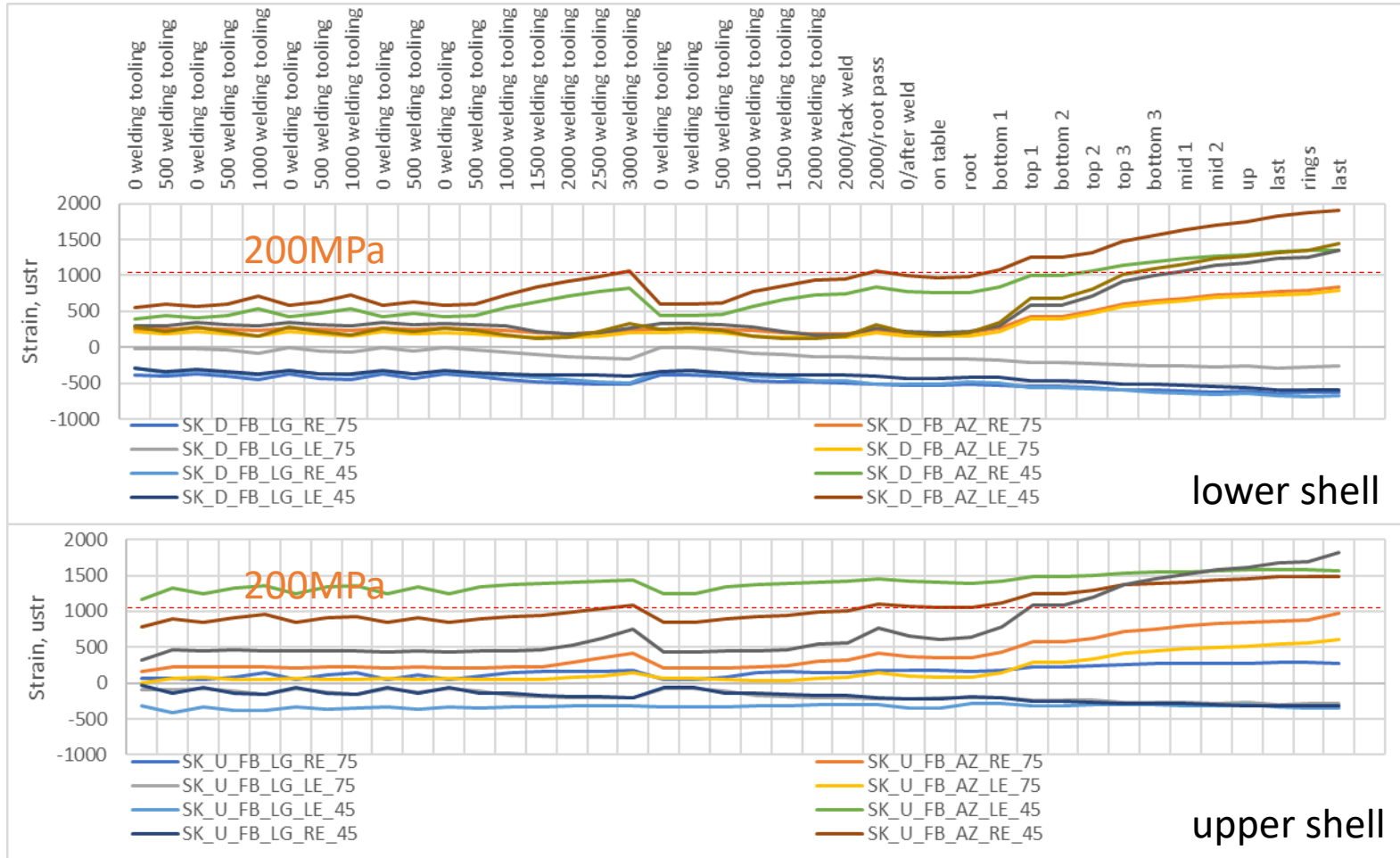
Clamped Iron yoke



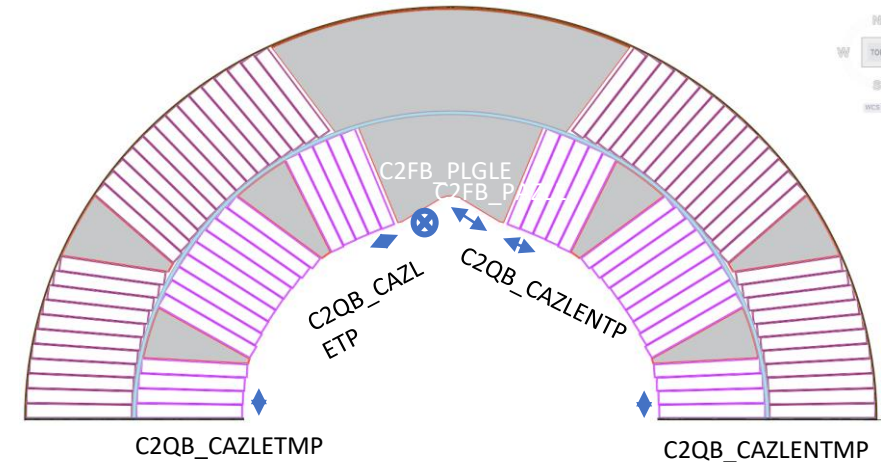
Ends loading and electrical connections



SG's data after assembly steps



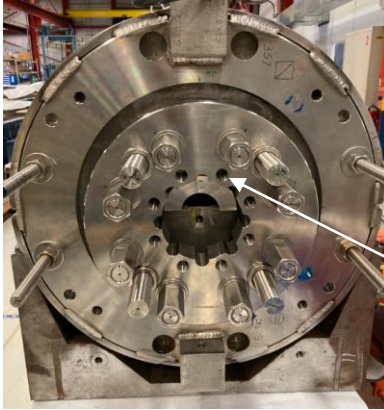
SG location on the inner coil ID



Avr. Inner coil stress after skin welding in MPa

	FEA	LE	RE
Coil Pole	-100	-47	-93
Coil MP	-50	-60	-50
Pole AZ	-170	-165	-40

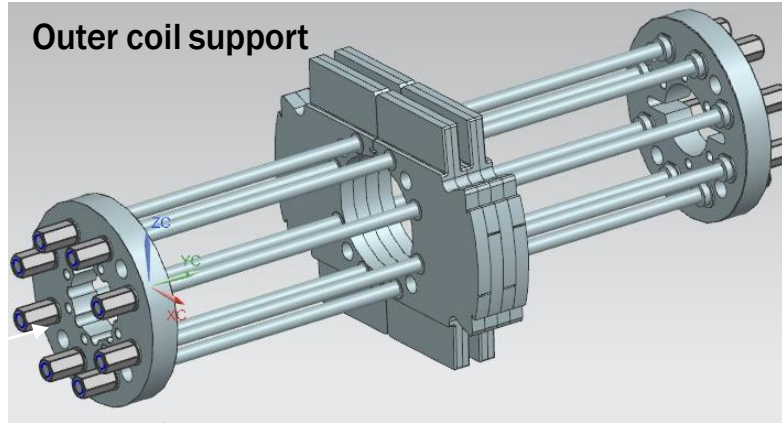
Magnet end load



RE end plate for the SMCT coil



Bullet with SGs

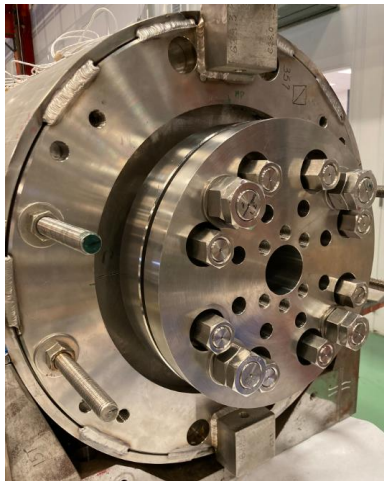


Outer coil support

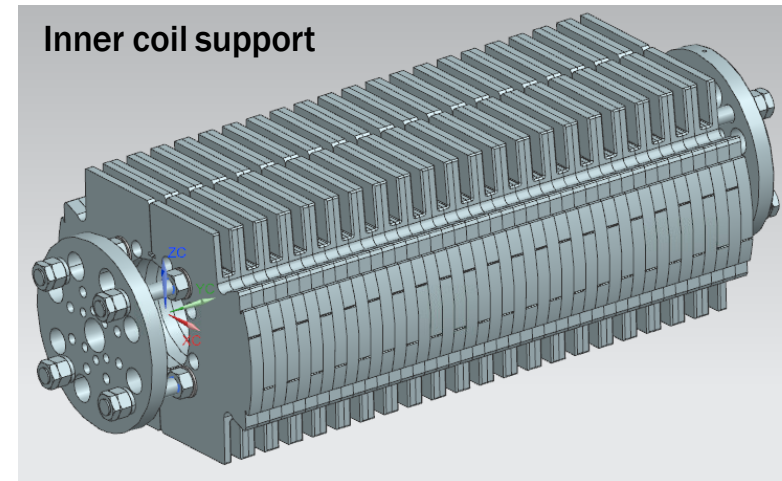
- 8x \varnothing 24mm rods with the middle anchors
- 50mm-thick end plates with instrumented bullets



LE end plate for the SMCT coil

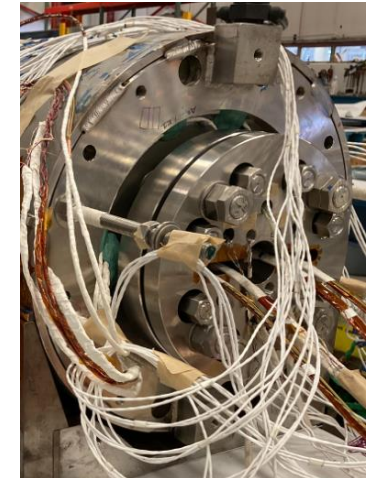


RE end plate for the inner coil



Inner coil support

- 4x \varnothing 30mm rods with the iron-end anchors
- 35-50mm-thick end plates with instrumented bullets



LE end plate for the inner coil

	LEin	LEout	LEtotal	REin	REout	REtotal
	kN	kN	kN	kN	kN	kN
IB3	-7.6	-11.5	-19.1	-16.8	-7.4	-24.2

SMCT coil issues related to production

Winding:

- One turn less in pole blocks

Reaction:

- Non uniform OD support along the coil length => uneven OD surface

Impregnation:

- Unfilled voids in L1 grooves at the ends due to inaccessibility

Magnet assembly:

- conservative prestress wrt FEA results and similarity to 15T magnet
- custom OD and MP shims due to uneven surface of SMCT coil
- mirror block insertion and clamping operation may preserve warm longitudinal gaps between iron laminations

All issues had been addressed by second coil design and tooling modification for reaction/impregnation