

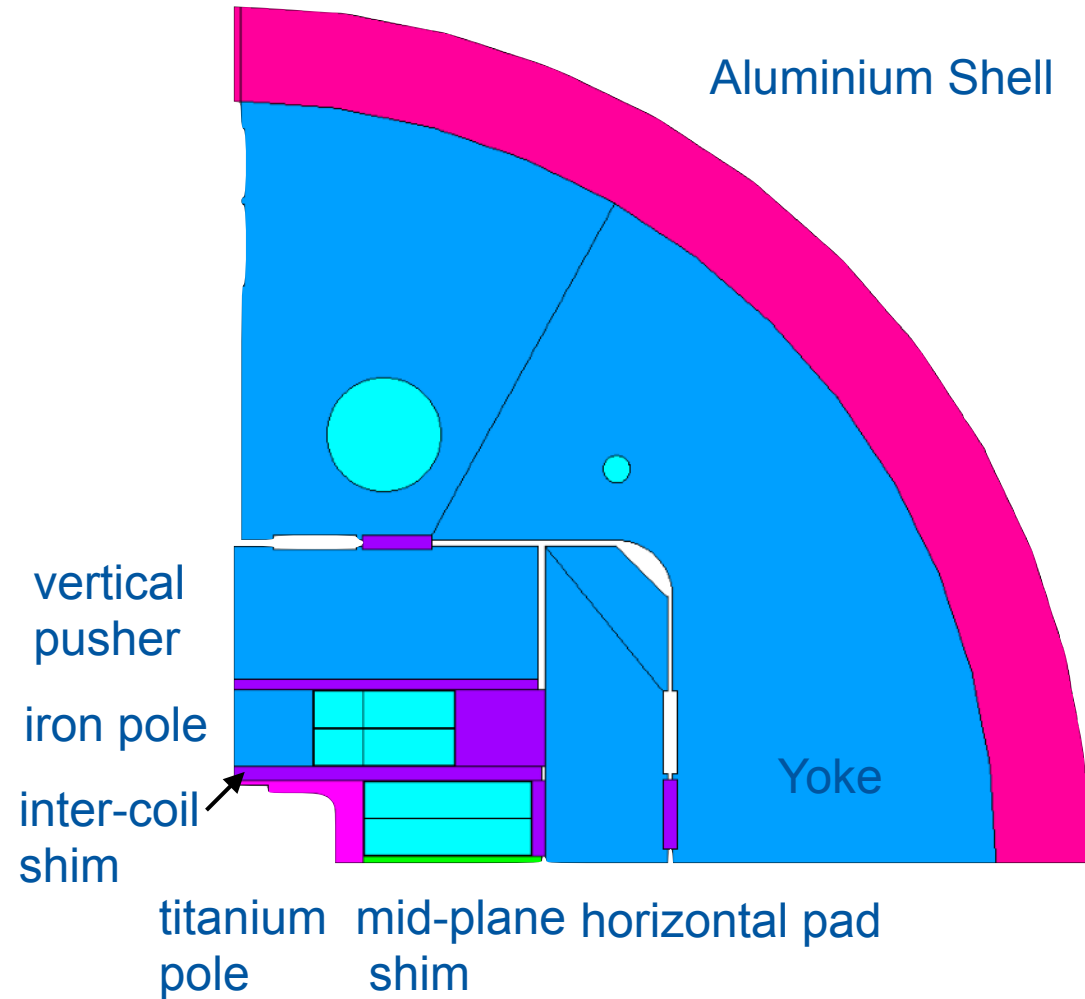
HEPDipo

Further optimization of the 4 coils solution
Bonded and detachable poles
2D results

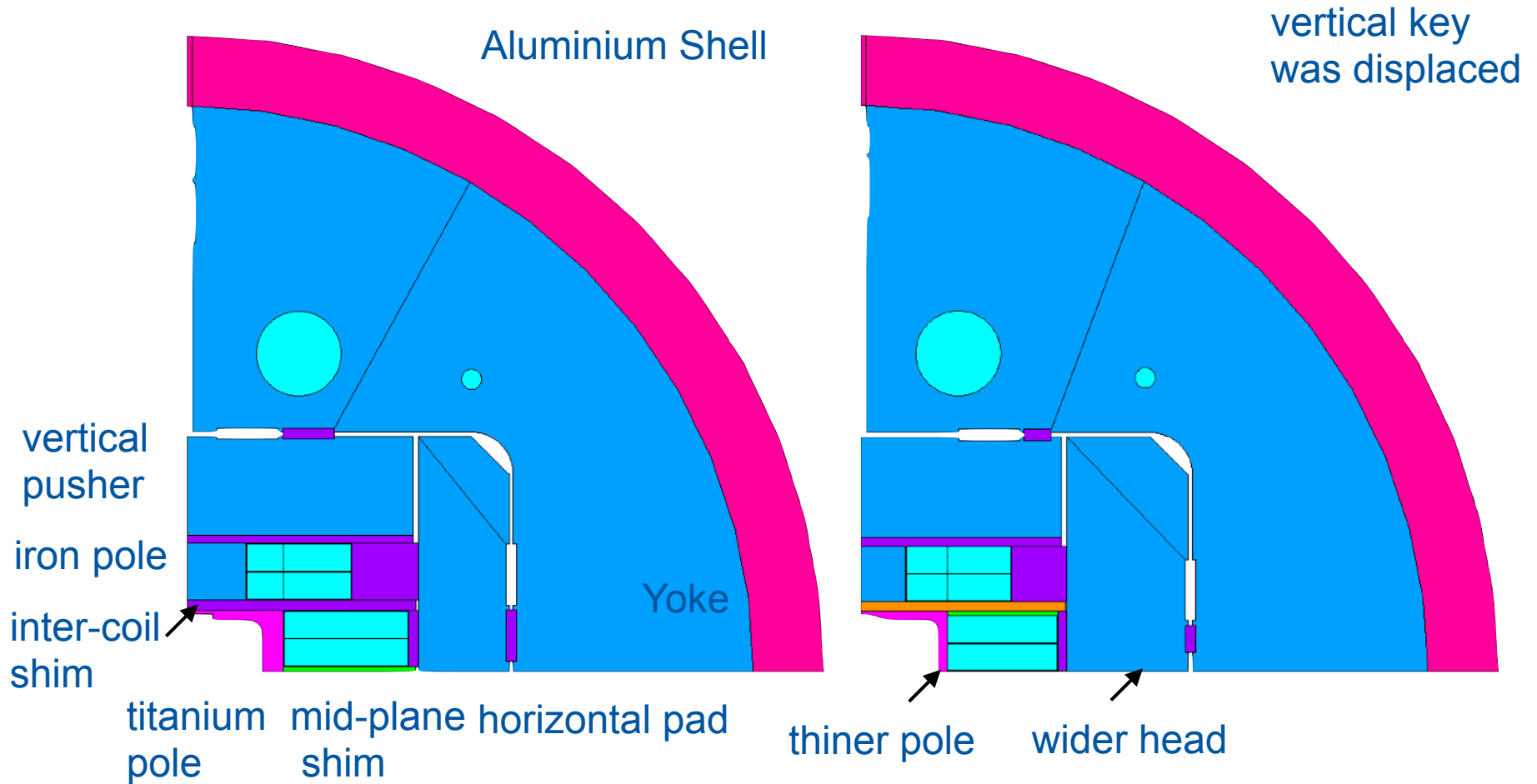
D. Martins Araujo
MSC-MDT

Specification and 4 coils option cross-section

	Goal
B center	15 T
% SS	85% / 77%
temperature	4.2 K / 1.9 K
aperture	'rectangular' 150x100
length	~ 2 m

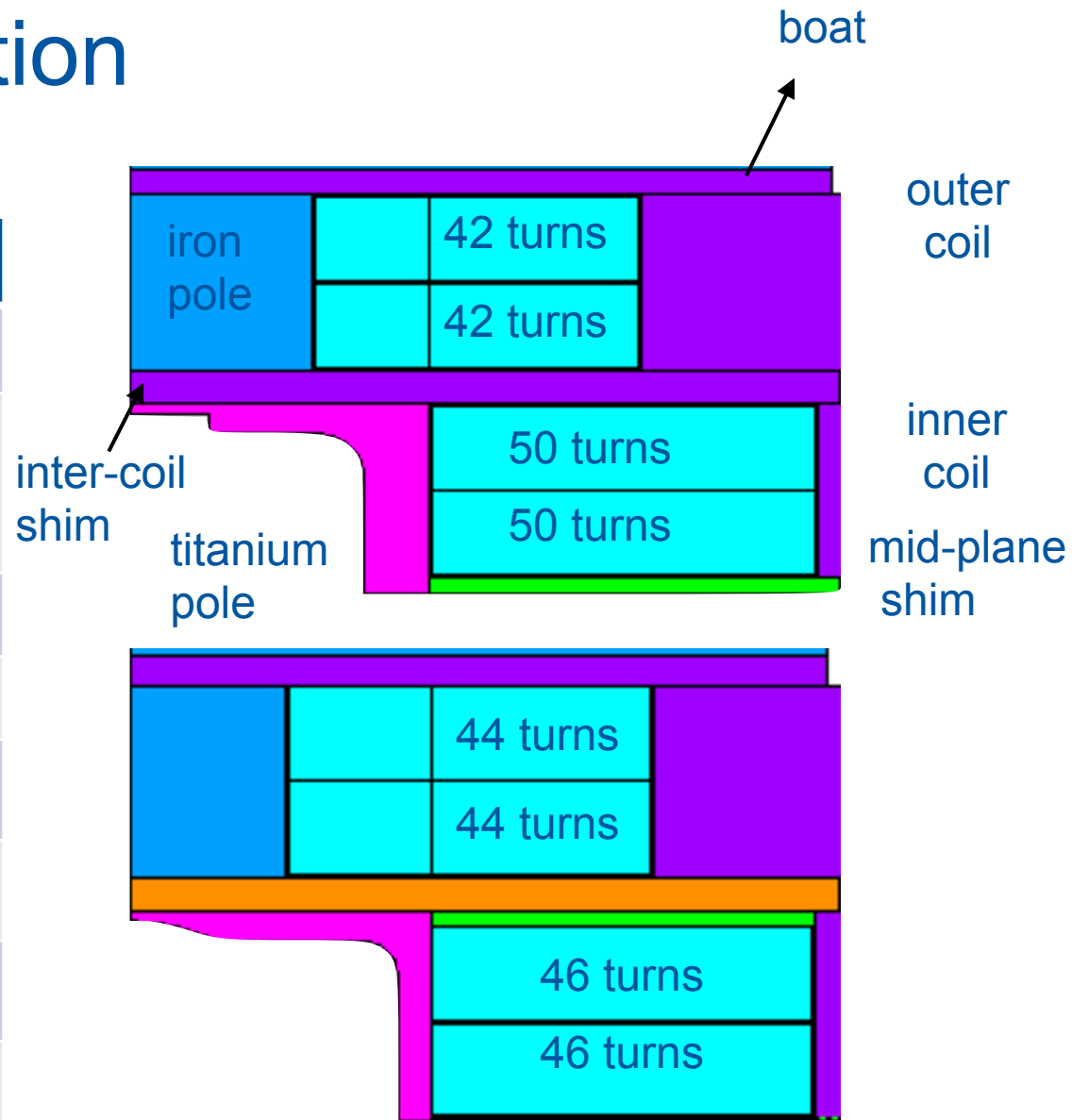


4 coils option update



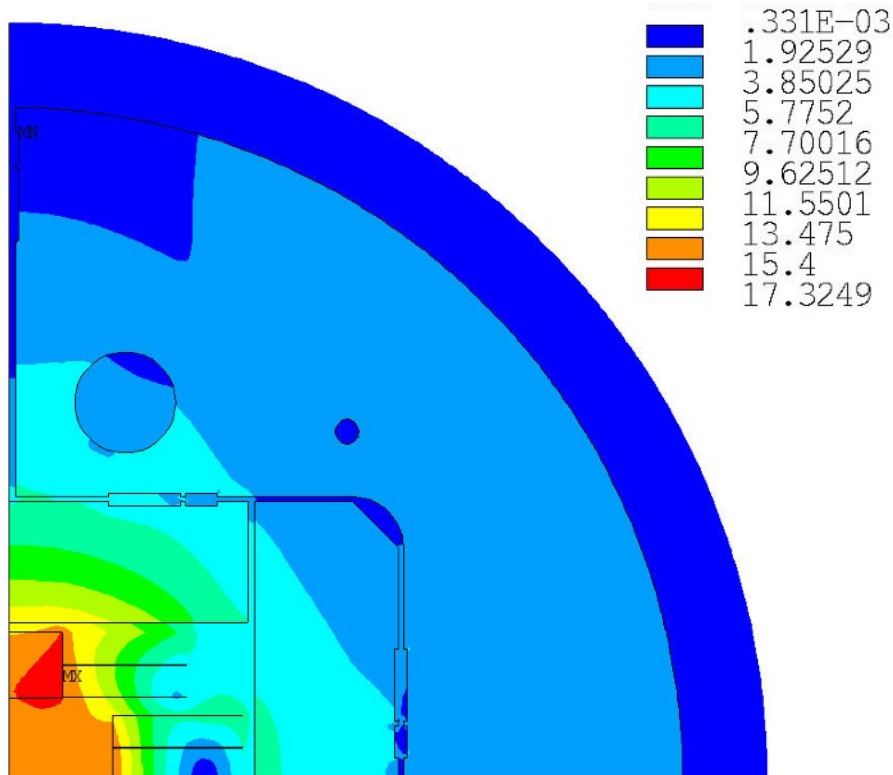
Cable specification

Cable data	
d_strand	1.1 mm
number of strands	44
thickness	1.95 mm
width	26.2 mm
turn insulation thickness	0.20 mm
coil insulation thickness	0.5 mm
Inter-layer insulation	0.5 mm
SC:Cu	1:1



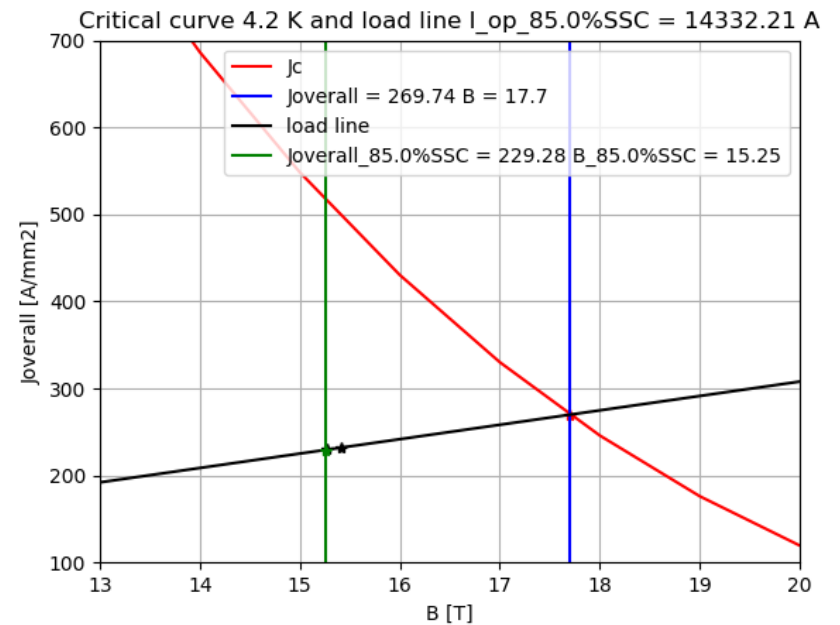
4.2 K - 85% of the load line

Flux density in T

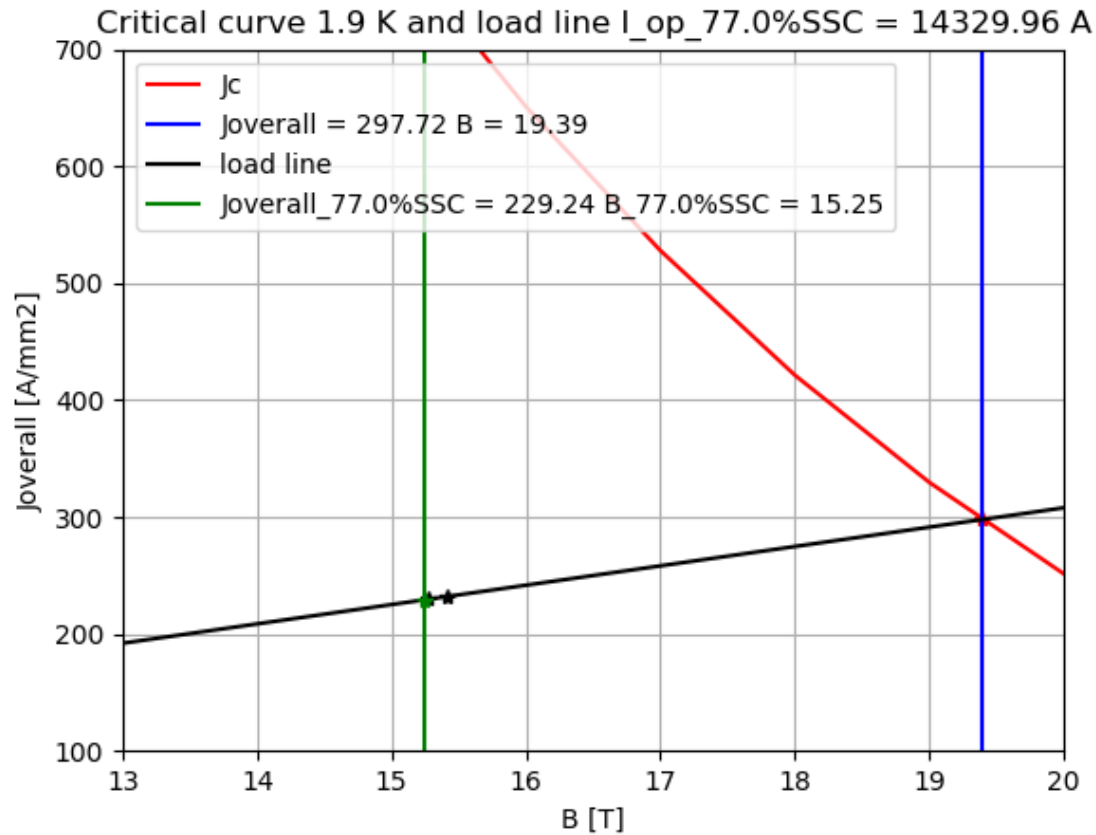


Bore field (B): 14.98 T

Max coil field (B): 15.25 T



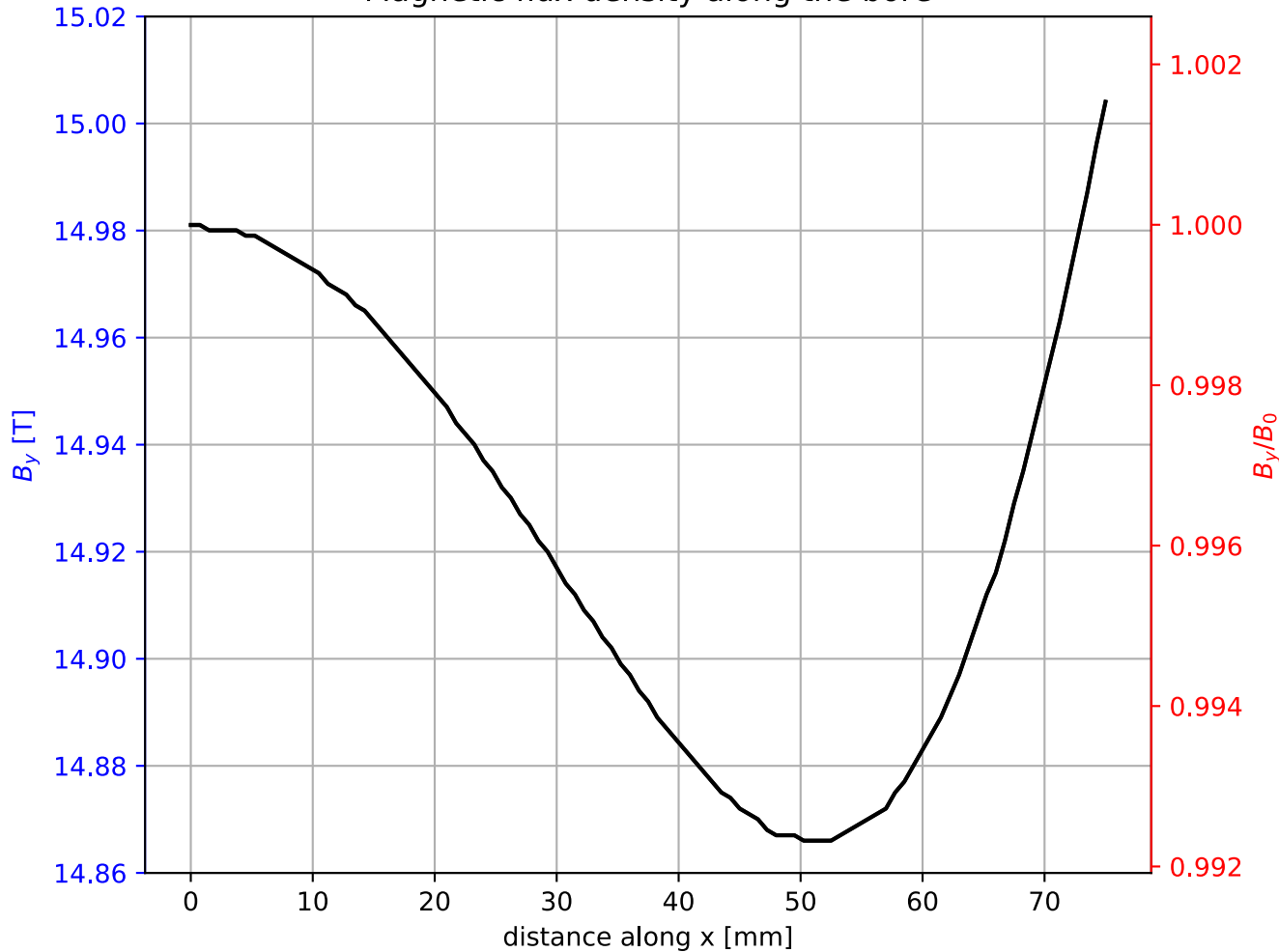
1.9 K - 77% of the load line



Parameter	4 Coils value
Bap - aperture field (T)	14.98
Bpk - Coil peak field (T)	15.25
Bss - short sample - 4.2 K (T)	17.7
Bss - short sample - 1.9 K (T)	19.39
Operational current (kA)	14.332
Margin at 4.2 K	85%
Margin at 1.9 K	77%
Horizontal Lorentz force (1/4) (MN/m)	14.62
Vertical Lorentz force (1/4) (MN/m)	- 7.98

Field quality

Magnetic flux density along the bore



Bore field (B):

14.98 T

Max coil field (B):

15.25 T

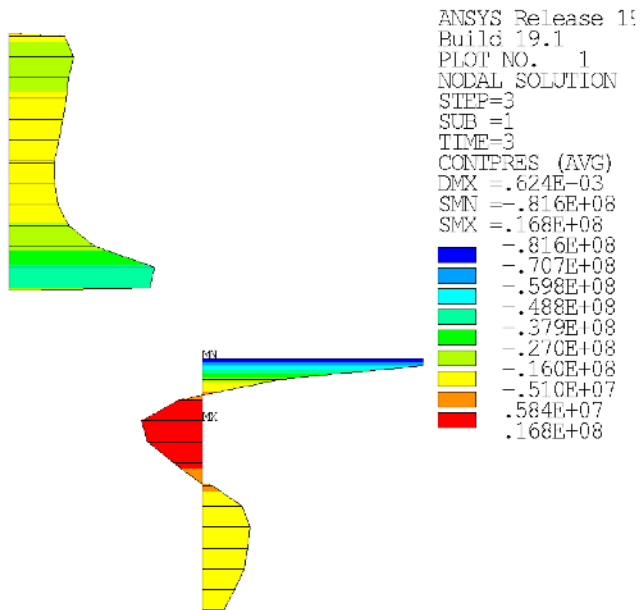
**Distortion of the
field from 0 to 75
mm: 0.75%**

HEPDipo

Contact pressure

4 coils - mech. analysis - contact pressure at nominal field

15 T - 4.2 K - 85% of the LL



Nominal field

Bonded contacts coils

**Outer coil average
contact pressure: - 20 MPa**

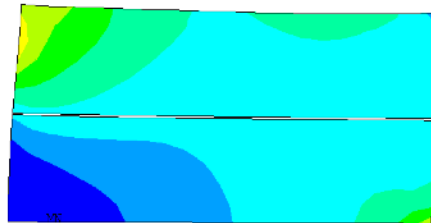
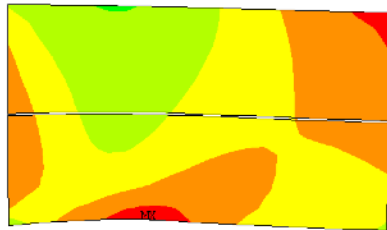
**Inner coil average
contact pressure: - 6.3 MPa**

Horizontal key interference: 1.9 mm

Additional interference (outer coil): 0.2 mm

4 coils - mech. analysis - at cold and nominal field - coil - seqv

4.2 K

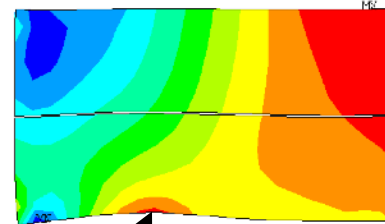


```
ANSYS Release 15
Build 19.1
PLOT NO. 1
NODAL SOLUTION
STEP=2
SUB =1
TIME=2
SEQV (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.001013
SMN =.661E+07
SMX =.119E+09
.661E+07
.191E+08
.315E+08
.440E+08
.564E+08
.689E+08
.813E+08
.938E+08
.106E+09
.119E+09
```

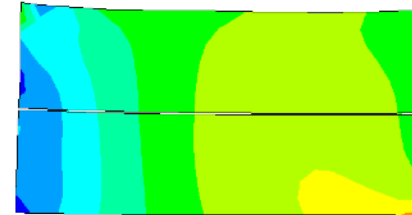
Cool-down

Peak of 119 MPa of eqv stress

15 T - 4.2 K - 85% of the LL



125 MPa



```
ANSYS Release 15
Build 19.1
PLOT NO. 1
NODAL SOLUTION
STEP=3
SUB =1
TIME=3
SEQV (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.996E-03
SMN =.313E+07
SMX =.135E+09
.313E+07
.177E+08
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.908E+08
.105E+09
.120E+09
.135E+09
```

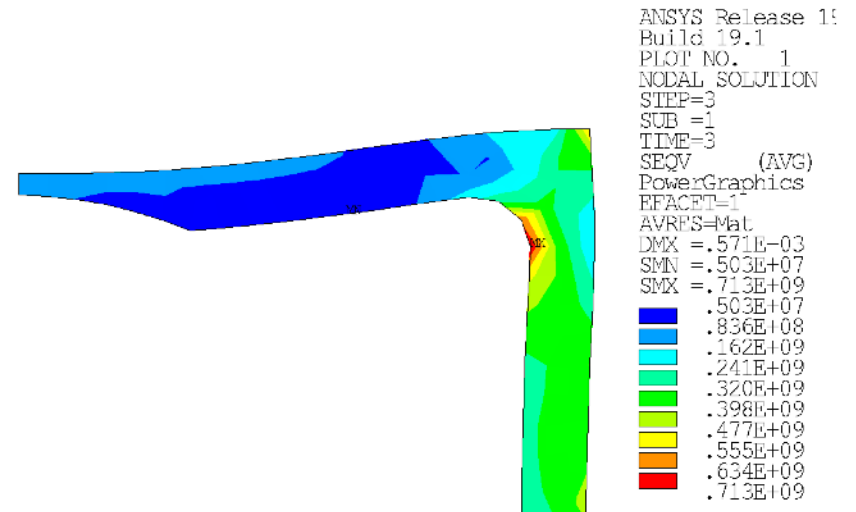
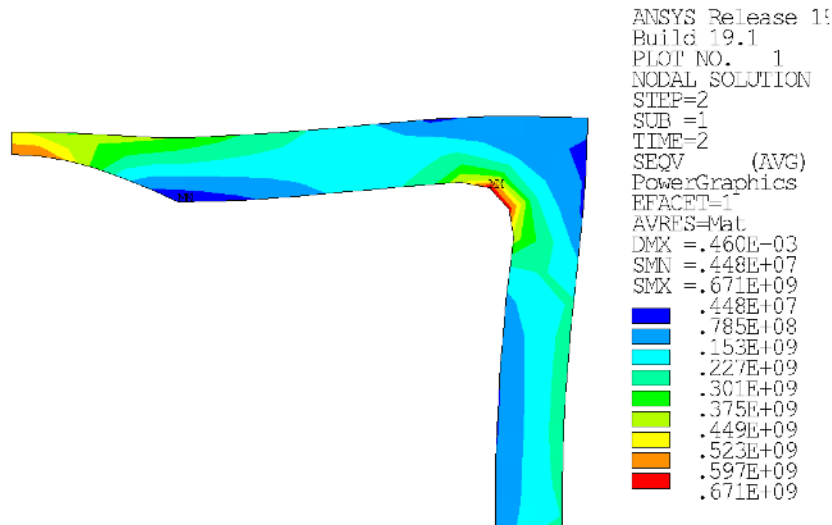
Nominal field

Peak of 135 MPa of eqv stress

4 coils - mech. analysis - at cold and nominal field - Ti pole - seqv

4.2 K

15 T - 4.2 K - 85% of the LL



Cool-down

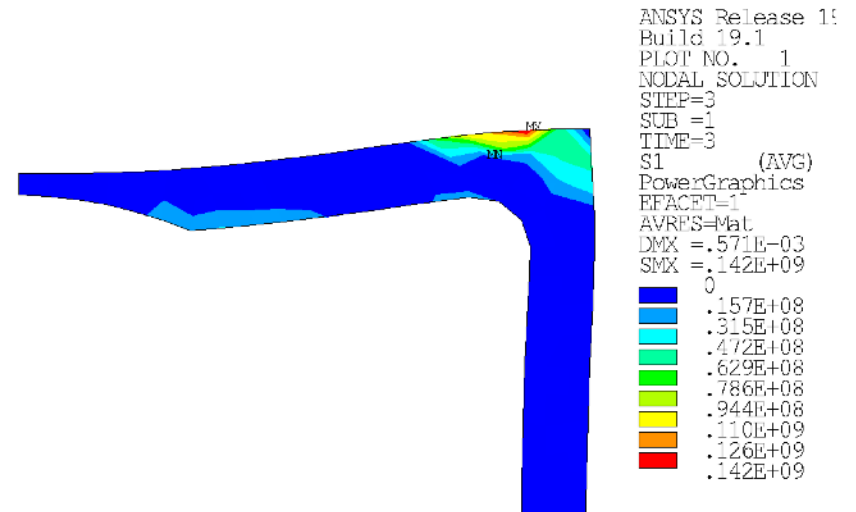
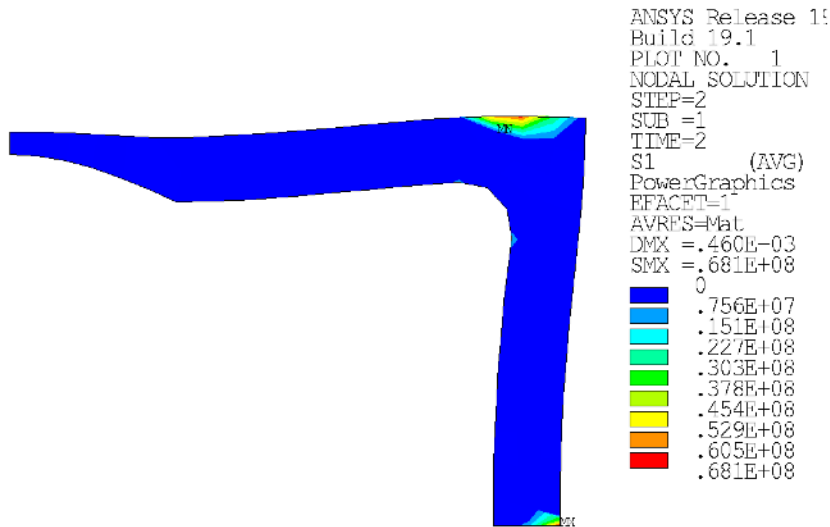
Nominal field

Peak of 713 MPa of eqv stress Yield is about 1450 MPa

4 coils - mech. analysis - at cold and nominal field - Ti pole - s1

4.2 K

15 T - 4.2 K - 85% of the LL



Cool-down

Nominal field

Peak of 142 MPa of max principal stress

4 coils - mech. analysis

Parameter	4 Coils value (MPa)
	Room temperature / cooling down / 15 T
Inner coil	59 / 90 / 112
Outer coil	83 / 119 / 134
Iron pole (S1)	12 / 13 / 166
Horizontal pad (S1)	172 / 178 / 179
Vertical pad (S1)	167 / 109 / 101
Yoke (S1)	151 / 154 / 166
titanium pole (Von Mises)	365 / 671 / 713
Shell (Azimuthal)	184 / 281 / 283

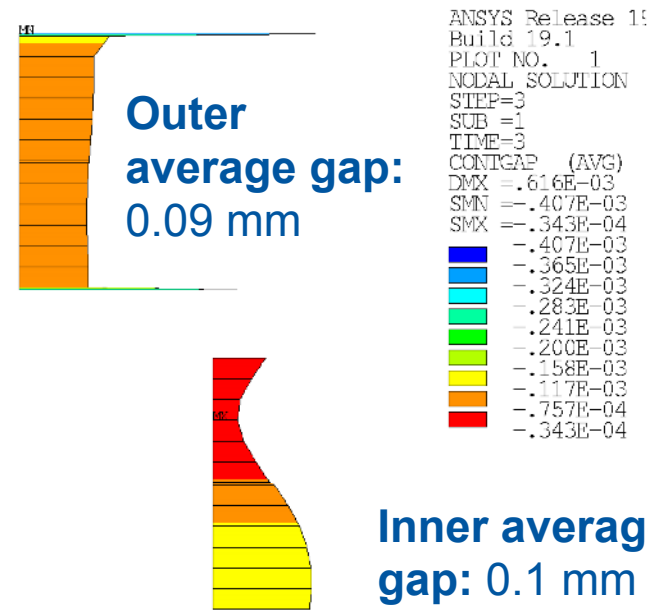
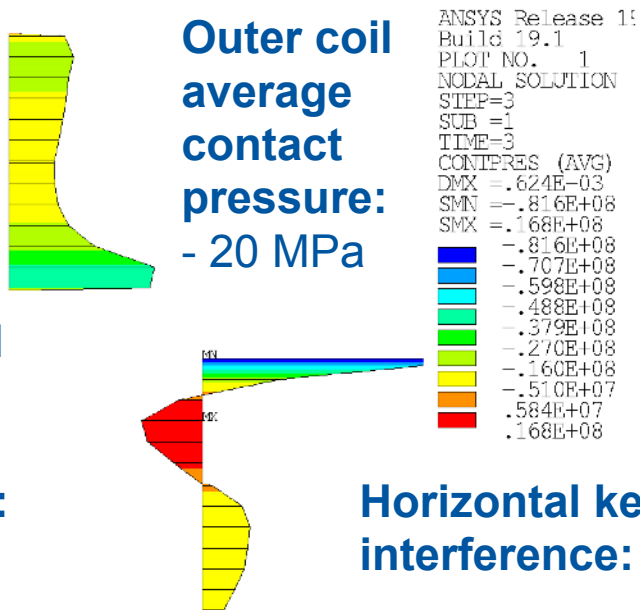
HEPDipo

Detachable poles

4 coils - mech. analysis - contact pressure at nominal field vs gap of the detachable solution

15 T - 4.2 K - 85% of the LL

15 T - 4.2 K - 85% of the LL



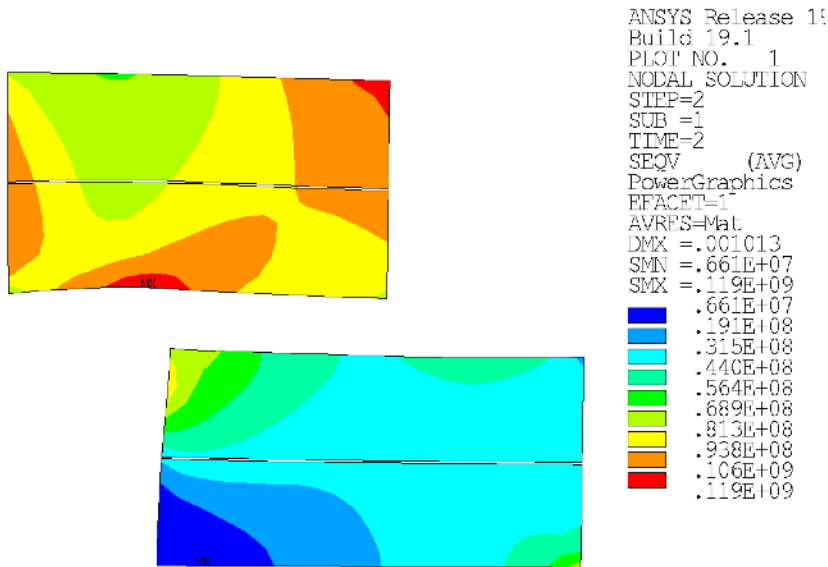
Nominal field

Bonded contacts coils

Sliding contacts coils

4 coils - mech. analysis - at cold - coil - seqv

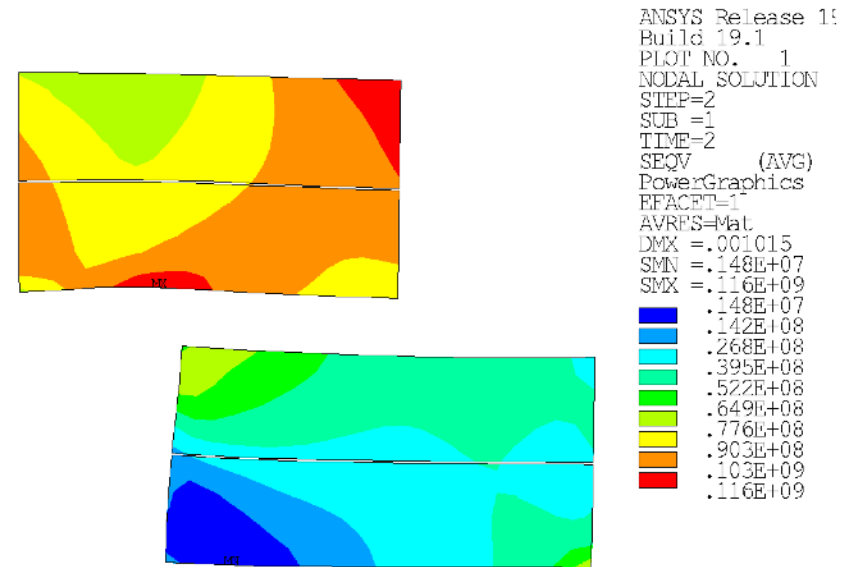
Bonded coils



Cool-down

Peak of 119 MPa of eqv stress

Detachable poles

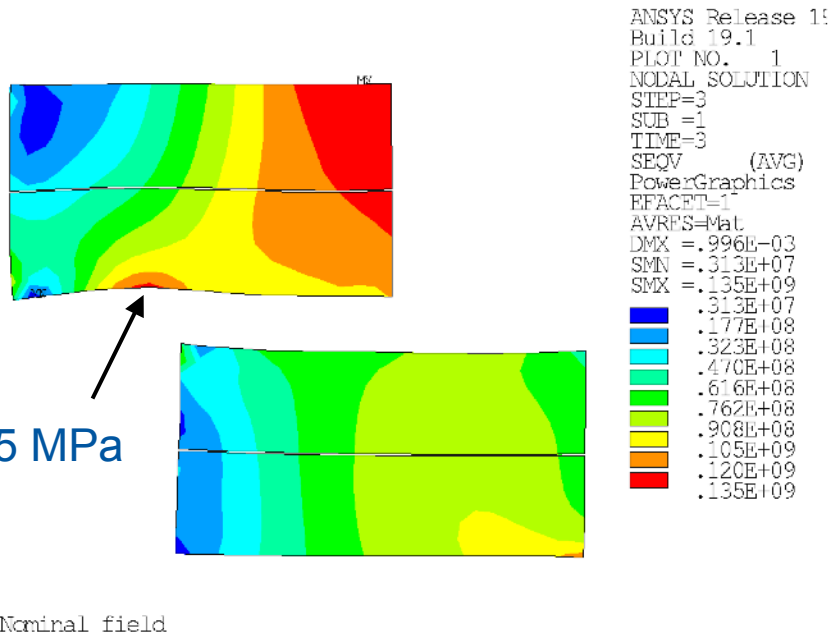


Cool-down

Peak of 116 MPa of eqv stress

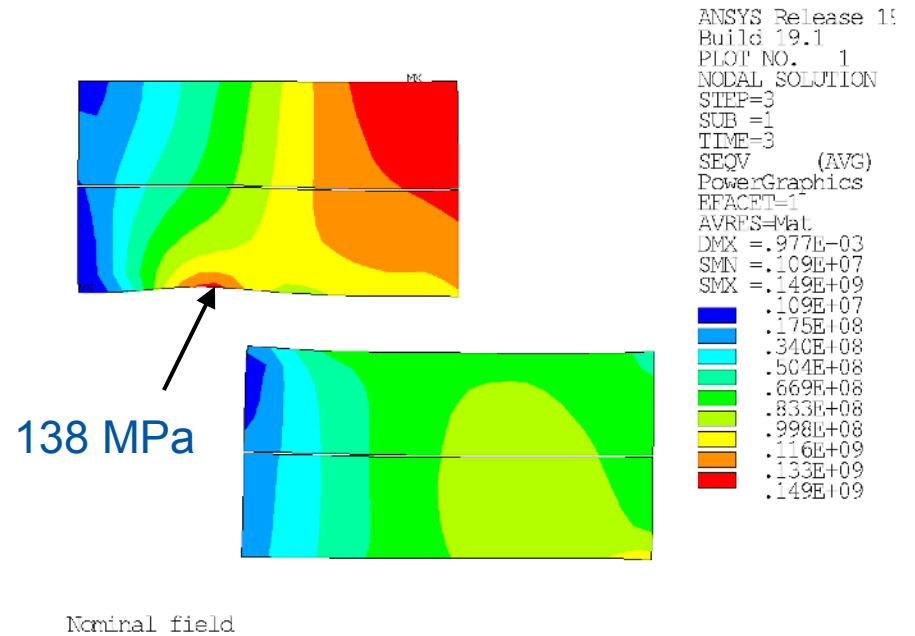
4 coils - mech. analysis - at nominal field - coil - seqv

Bonded coils



Peak of 135 MPa of eqv stress

Detachable poles



Peak of 149 MPa of eqv stress