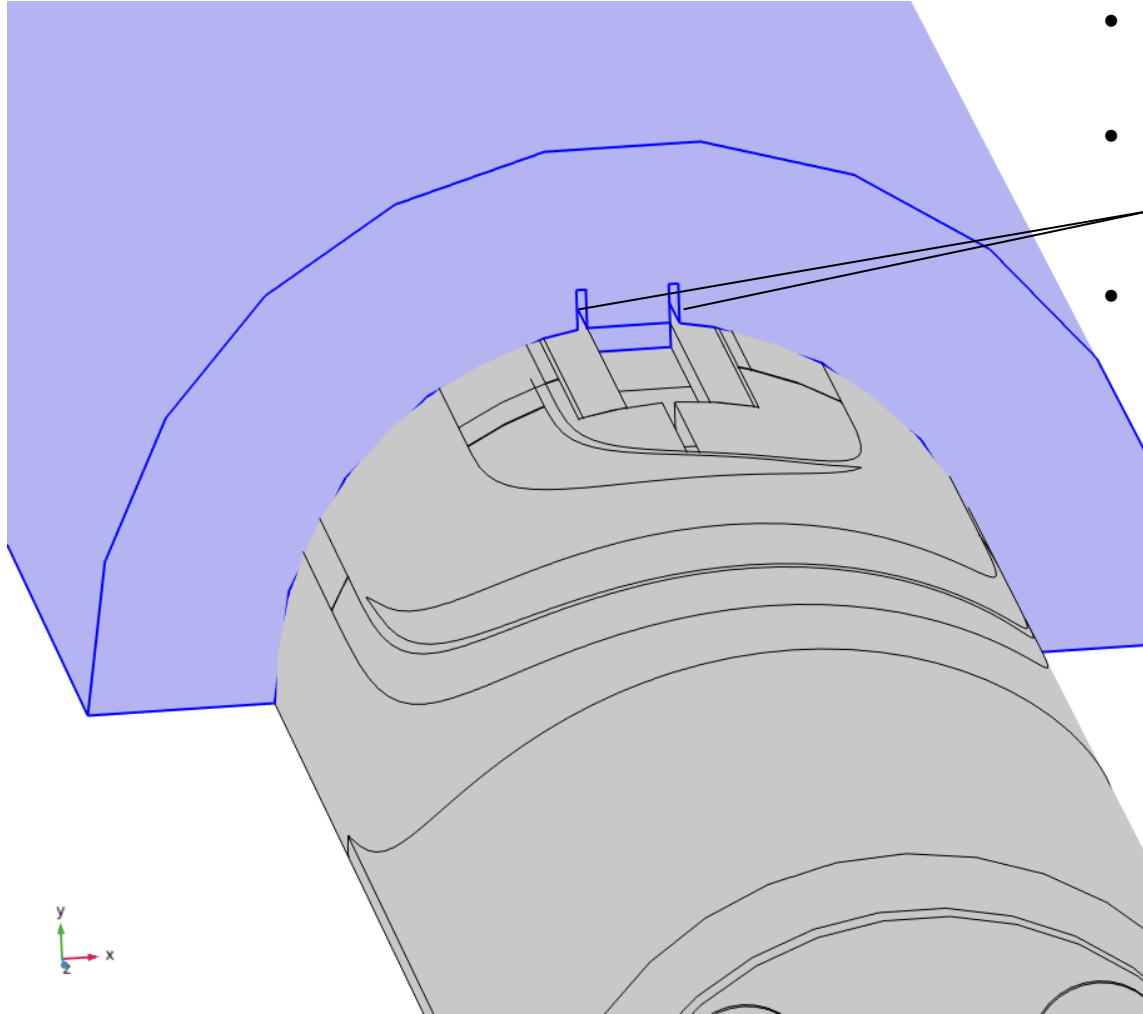




Comparison between measurements and simulation for the 11 T double aperture magnet

Marco Morrone, Cedric Garion

Main modification of the model



- New geometry of the collar nose implemented;
- It reproduced the instrumented collar nose. It takes into account the gap on the sides.
- The measurements of the SP302 (connection side) are taken into account for the comparison.

Collaring

clr(1)=1

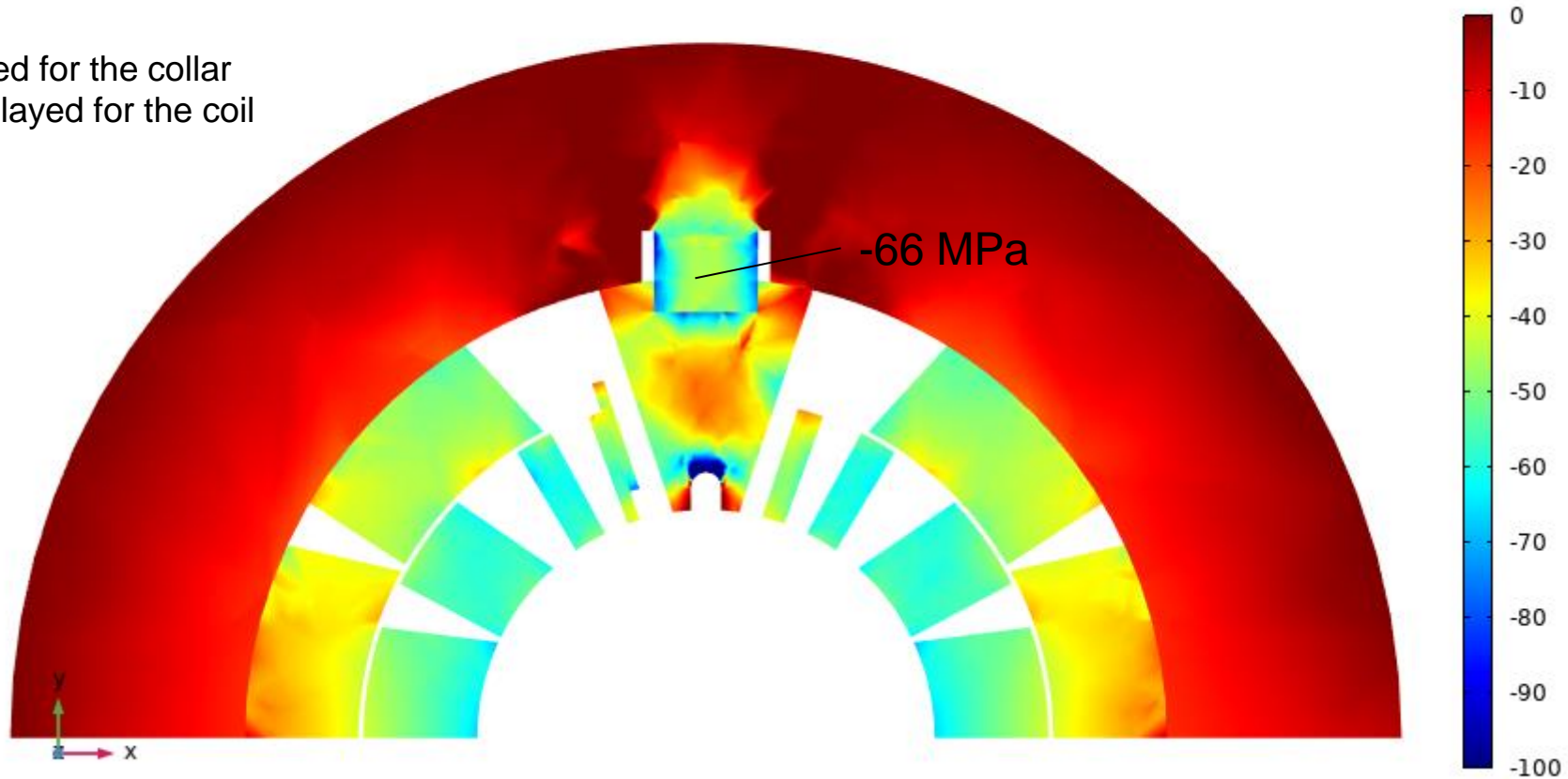
Slice: Stress tensor, local coordinate system, 22-component (MPa)

Slice: Stress tensor, local coordinate system, 11-component (MPa)

Please note:

Radial stress is displayed for the collar

Azimuthal stress is displayed for the coil



at $z = 2.354$ m
(strain gauge
location)

Cooldown

clr=1, wld=1, blt_u=1, cld=1

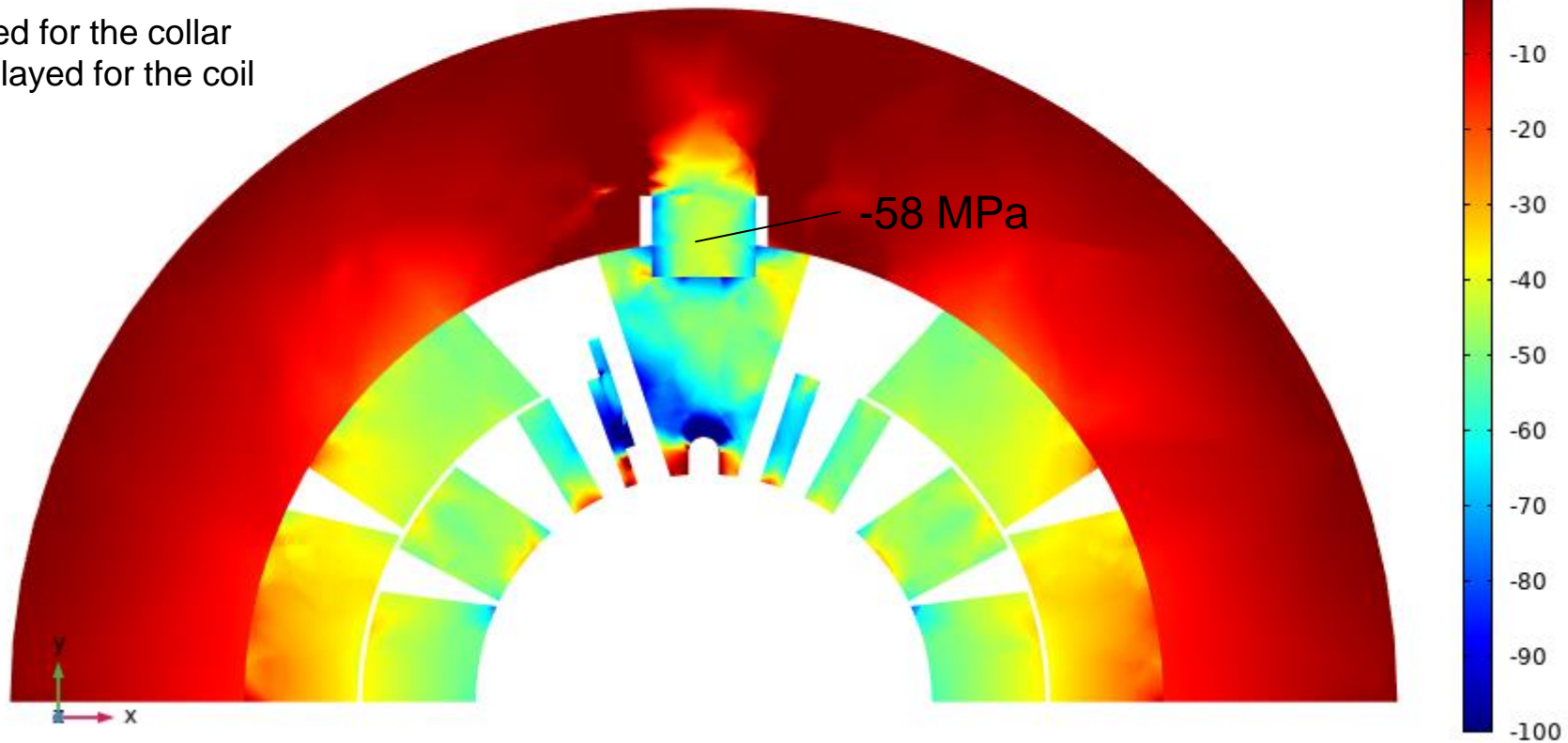
Slice: Stress tensor, local coordinate system, 22-component (MPa)

Slice: Stress tensor, local coordinate system, 11-component (MPa)

Please note:

Radial stress is displayed for the collar

Azimuthal stress is displayed for the coil



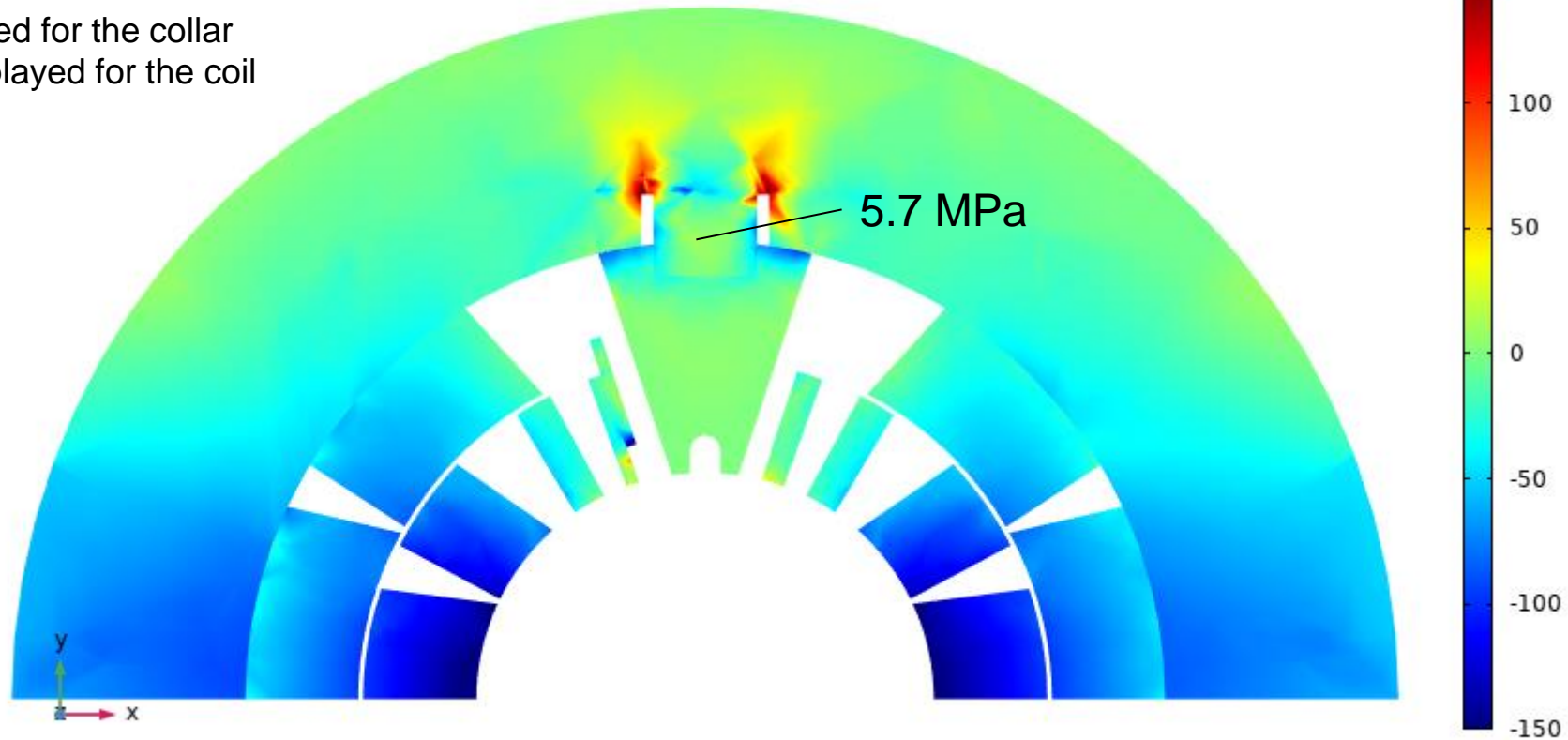
at $z = 2.354$ m
(strain gauge
location)

Powering

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Slice: Stress tensor, local coordinate system, 22-component (MPa)
Slice: Stress tensor, local coordinate system, 11-component (MPa)

Please note:

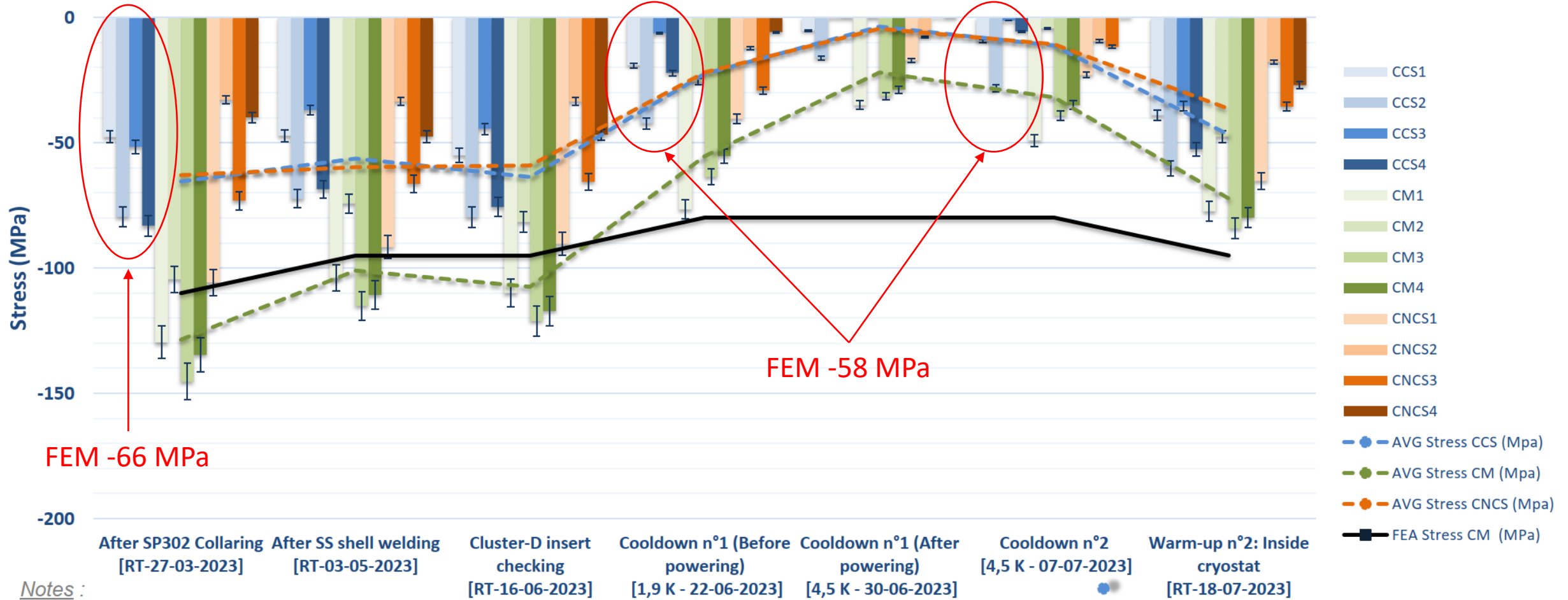
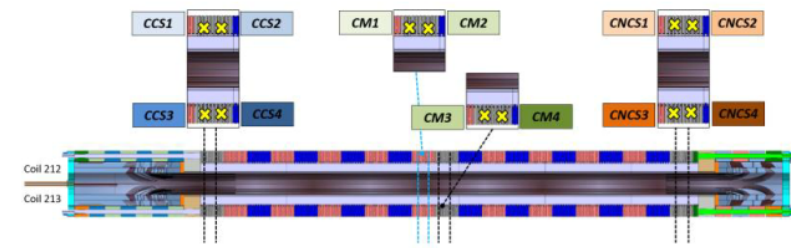
Radial stress is displayed for the collar
Azimuthal stress is displayed for the coil



at $z = 2.354$ m
(strain gauge
location)

SP302 collars compression stress

MBHDP301 - Collars MBHSP302 - Compression Stress

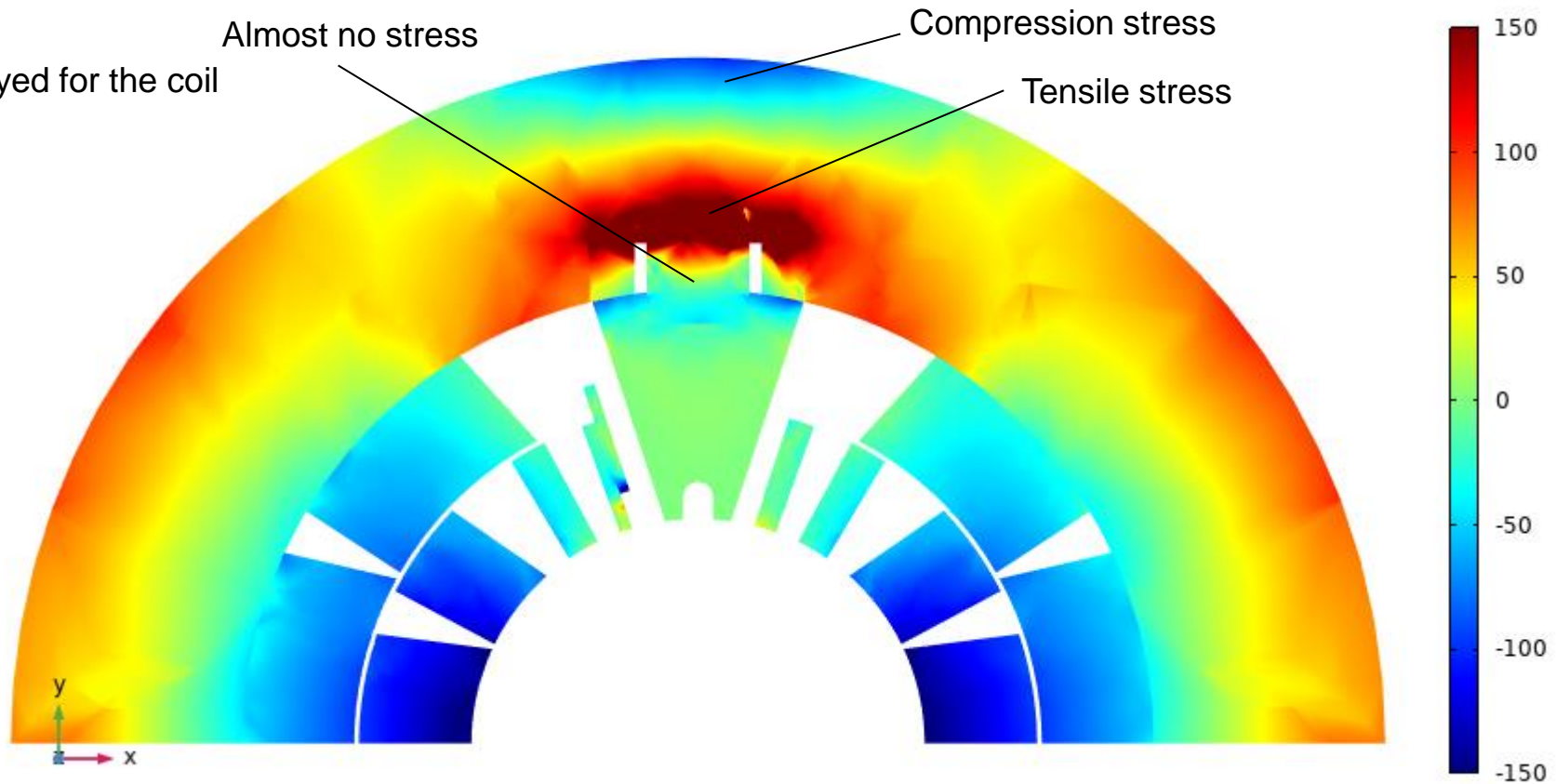


Notes :
 - No data at RT after TC#01 (only 245 K achieved)
 - Warm-up n°2 : Magnet not in steady state temperature conditions (around 283 K)

Powering

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Slice: Stress tensor, local coordinate system, 22-component (MPa)
Slice: Stress tensor, local coordinate system, 22-component (MPa)

Please note:
Azimuthal stress is displayed for the coil
and for the collar

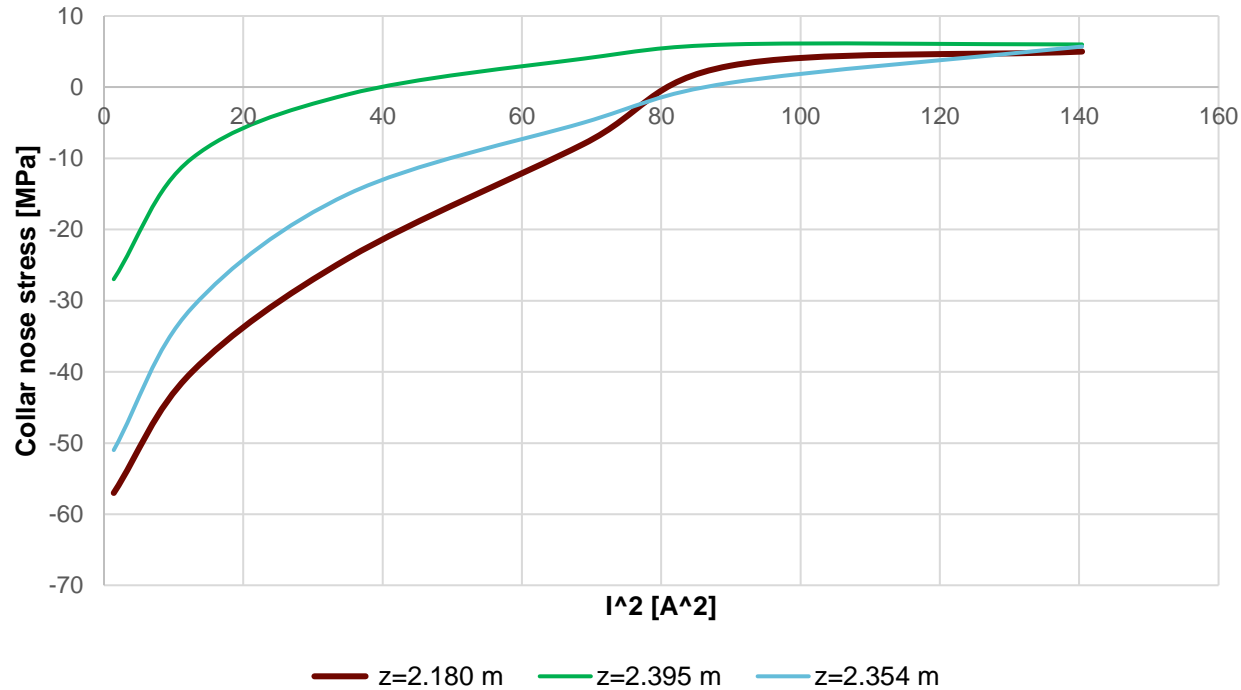


at $z = 2.354$ m
(strain gauge
location)

Powering

FEM

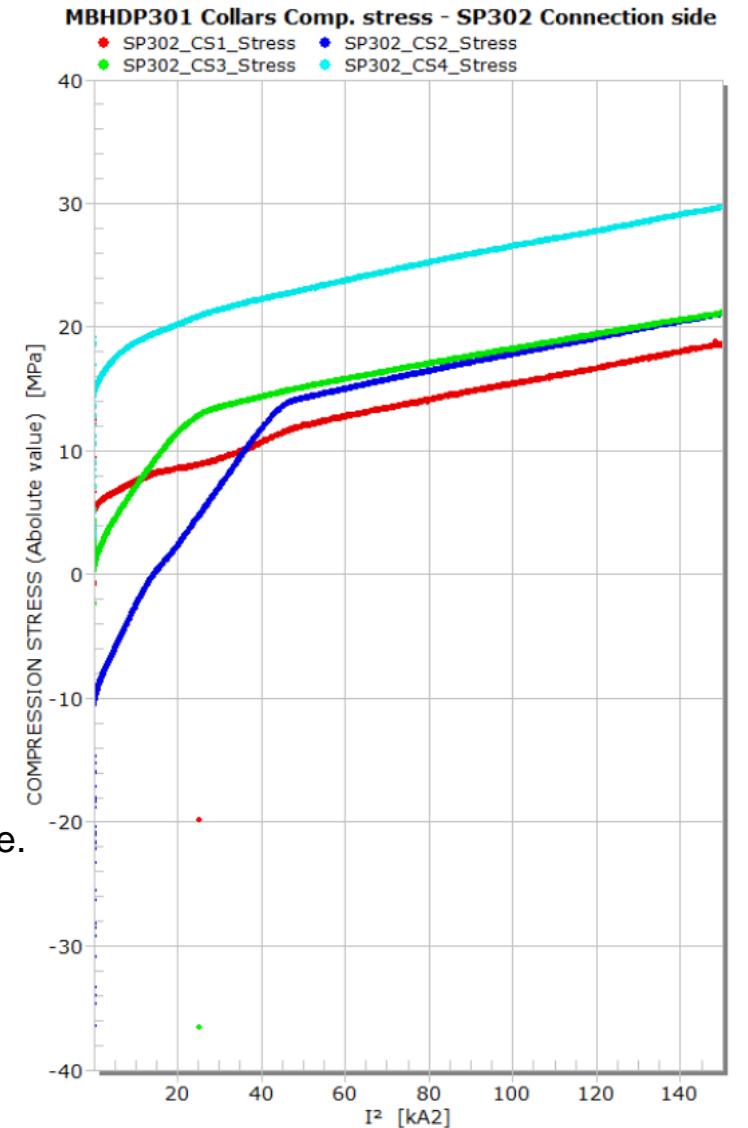
Collar nose stress at various sections



The simulated collar nose stress vs I^2 at various sections has a similar profile to the measured one. The slope in the simulations changes at around 10 kA^2 and then it flattens at around 80 kA^2 . The slope of the measurements changes between 10 and 45 kA^2 .

A possible explanation of this stress relief is shown in the next slide.

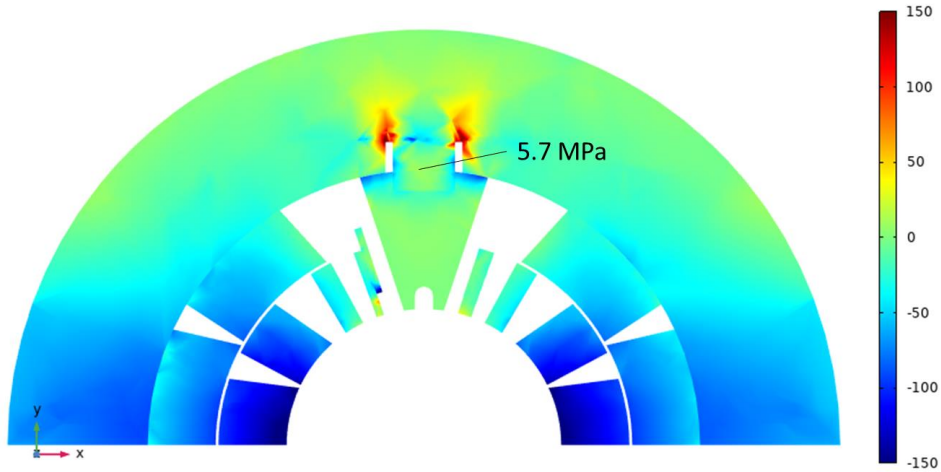
Measurements



Please note:

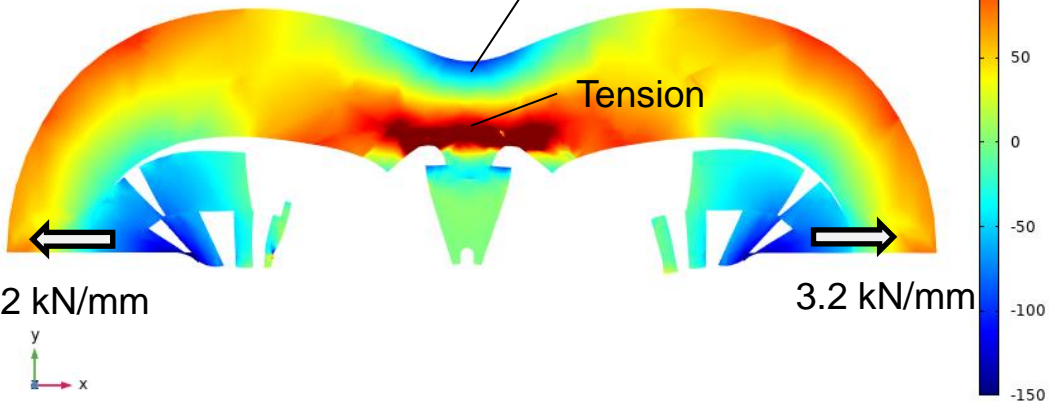
Radial stress is displayed for the collar
Azimuthal stress is displayed for the coil

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Slice: Stress tensor, local coordinate system, 22-component (MPa)
Slice: Stress tensor, local coordinate system, 11-component (MPa)



clr=1, wld=1, blt_u=1, cld=1, pwr=1 Slice: Stress tensor, local coordinate system, 22-component (MPa)
Slice: Stress tensor, local coordinate system, 22-component (MPa)

Azimuthal stress for the coil and collar
Compression
Tension

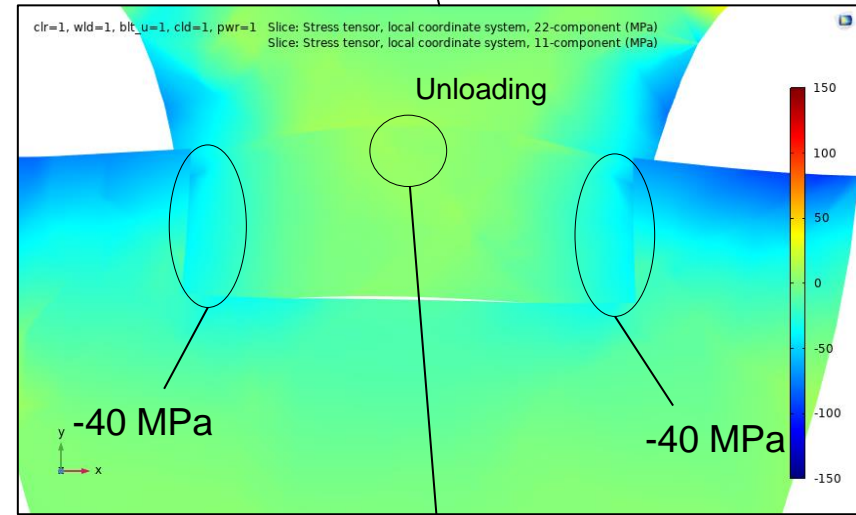
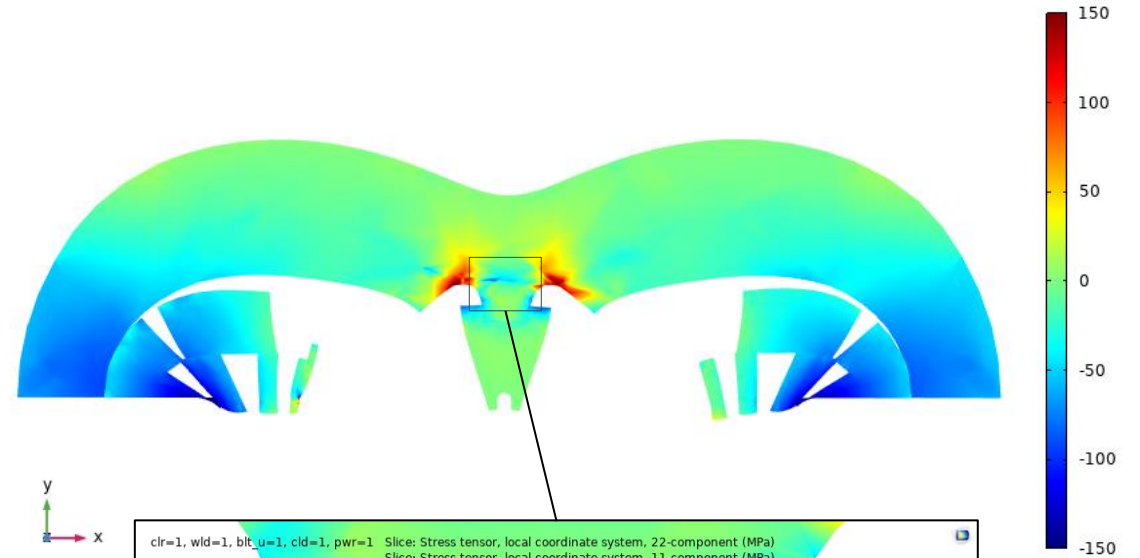


Powering

Please note:

Radial stress is displayed for the collar
Azimuthal stress is displayed for the coil

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Slice: Stress tensor, local coordinate system, 22-component (MPa)
Slice: Stress tensor, local coordinate system, 11-component (MPa)

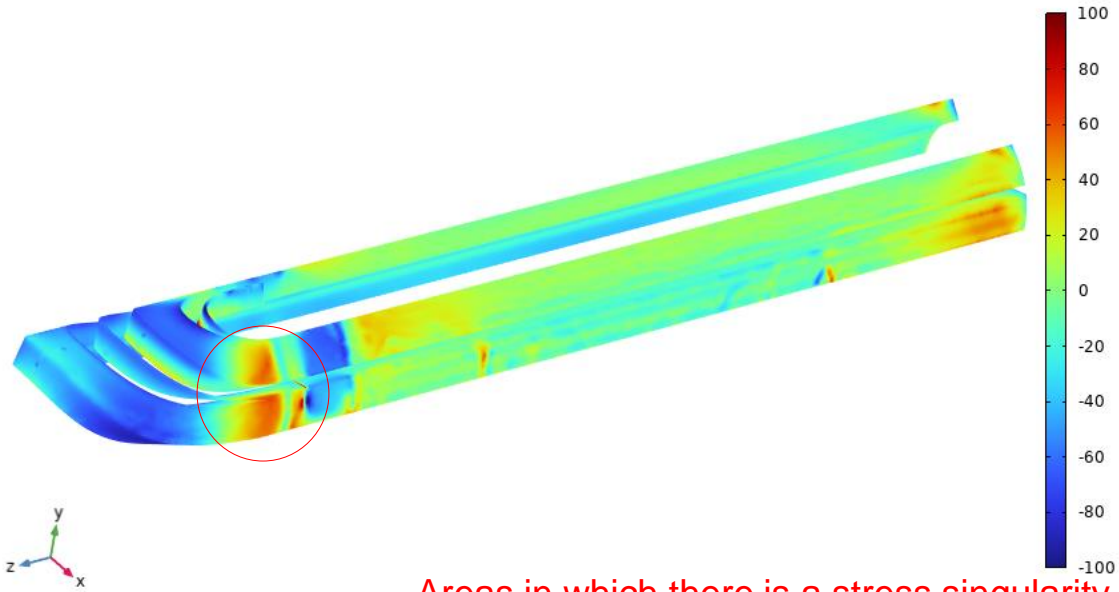


An unloading is observed (because of Poisson effect) in the center of the nose relaxing the stress. However, the nose remains still in contact with the pole on its sides (-33 MPa compression).

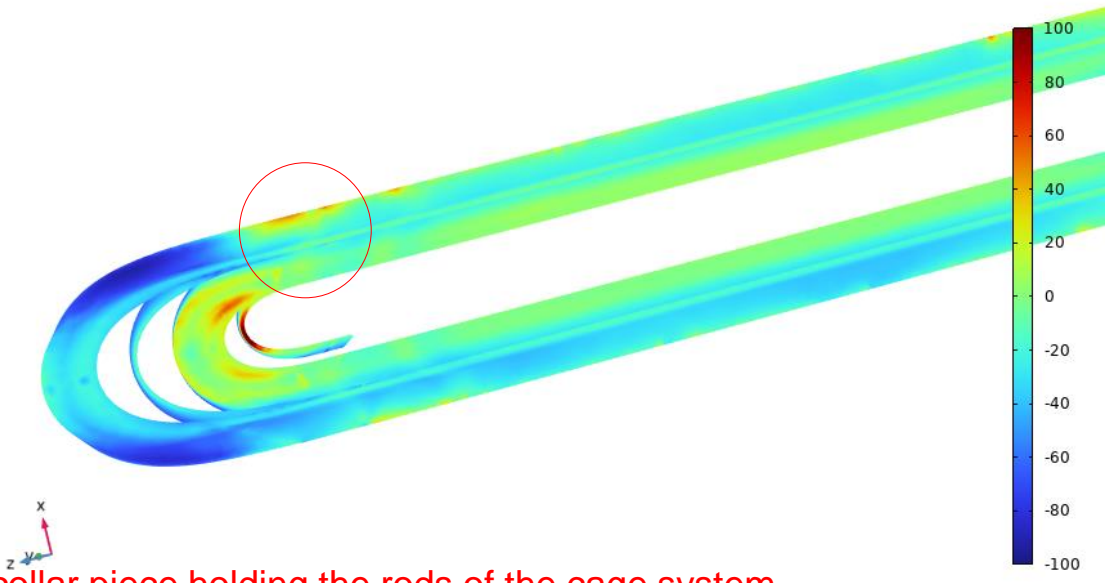
Powering

Outer layer

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 11-component (MPa)

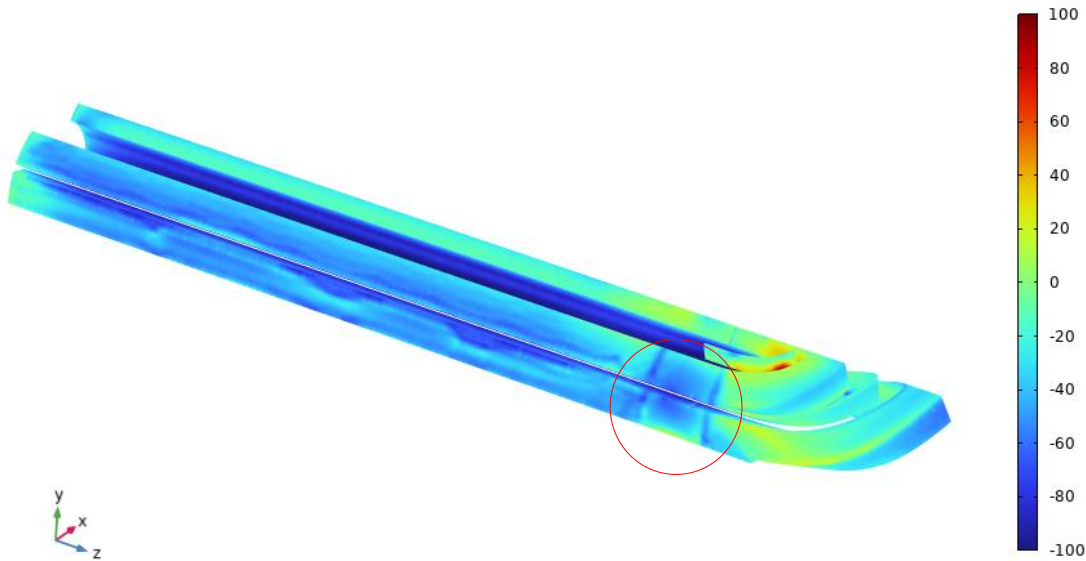


clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 11-component (MPa)

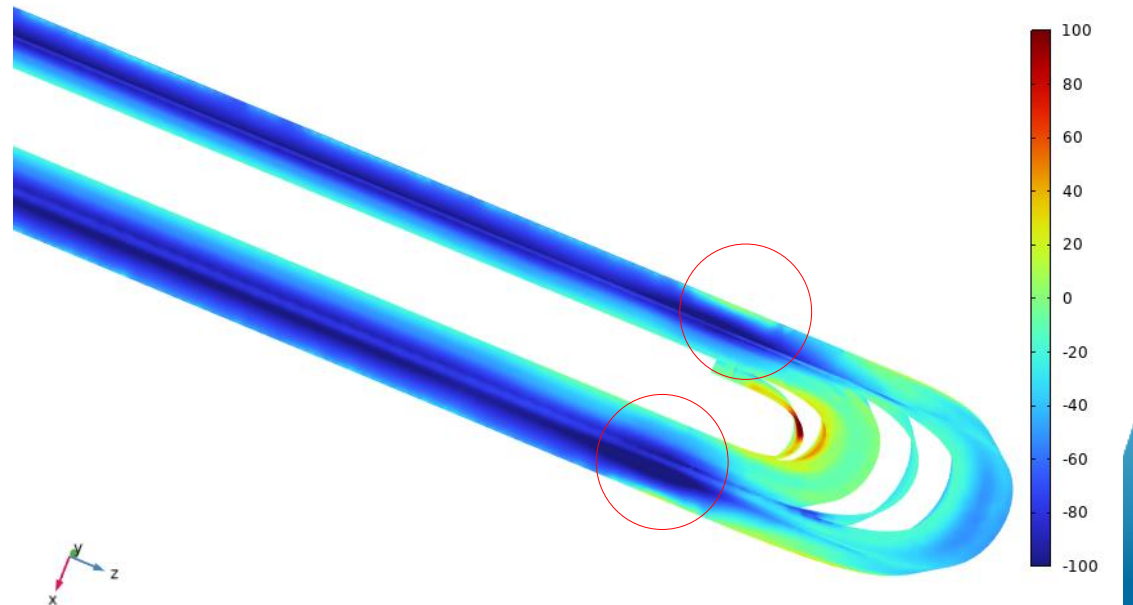


Areas in which there is a stress singularity around the collar piece holding the rods of the cage system.

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 22-component (MPa)

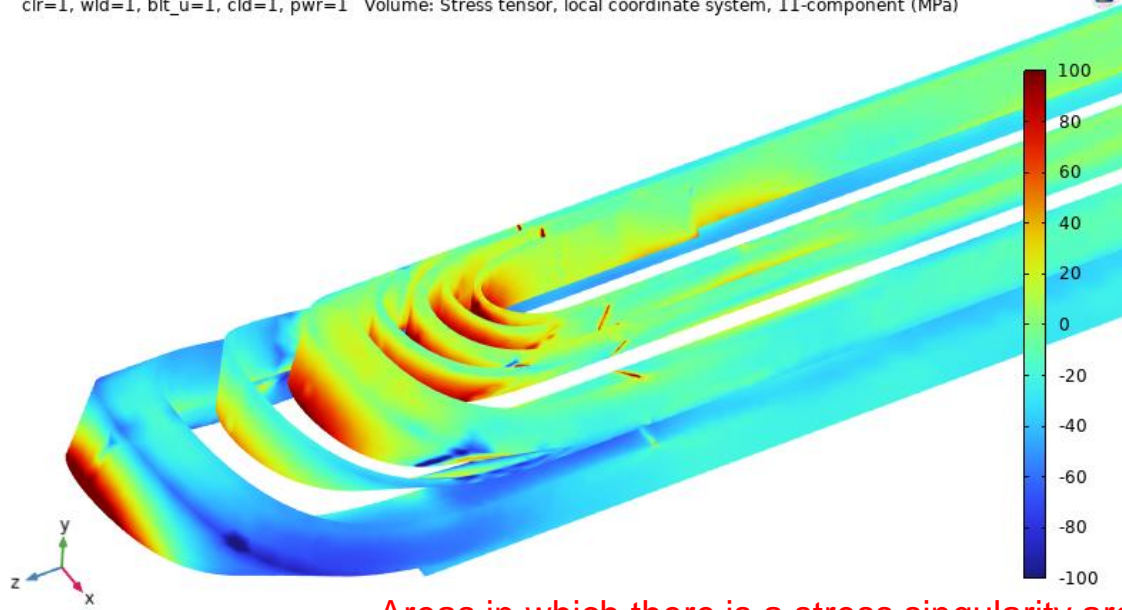


clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 22-component (MPa)

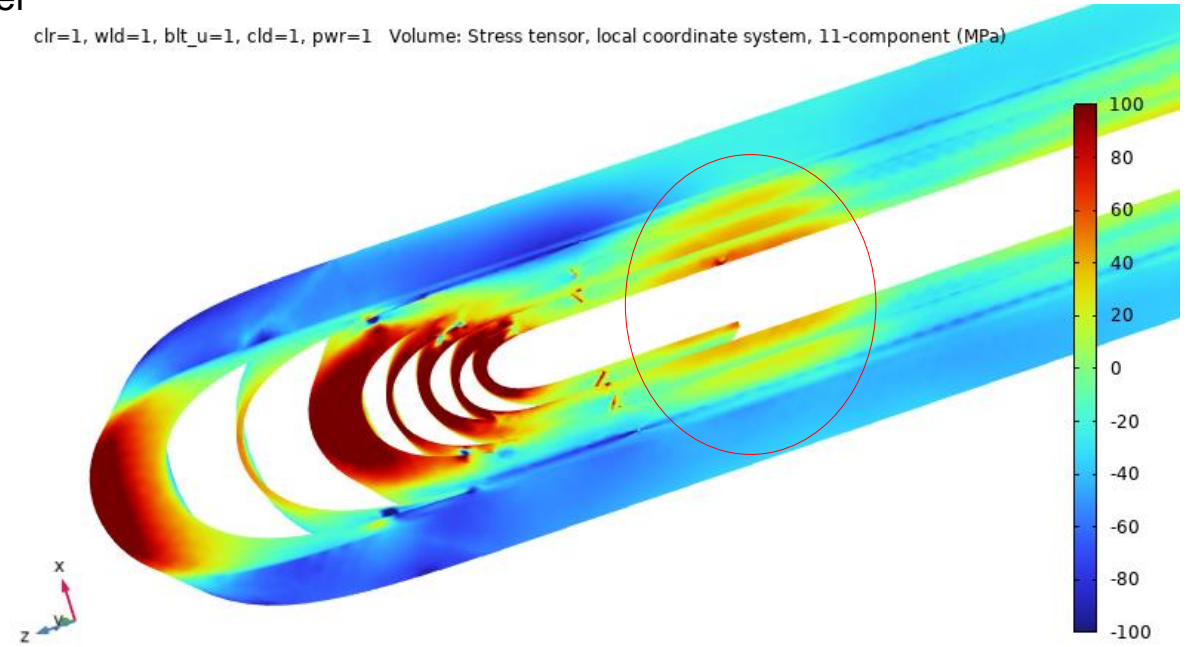


Powering Inner layer

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 11-component (MPa)

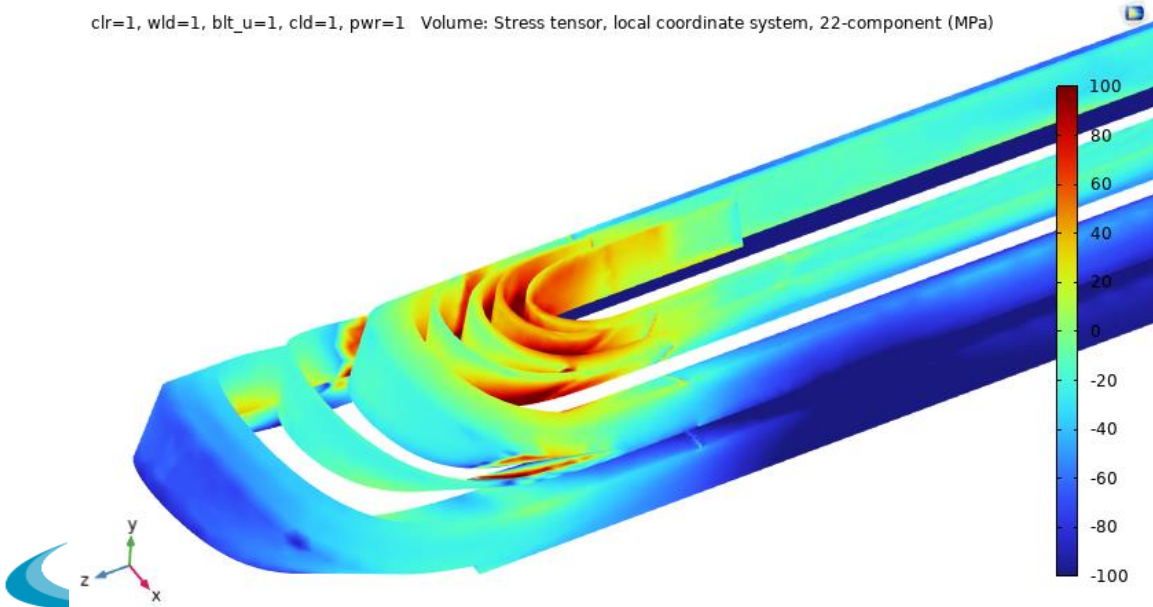


clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 11-component (MPa)



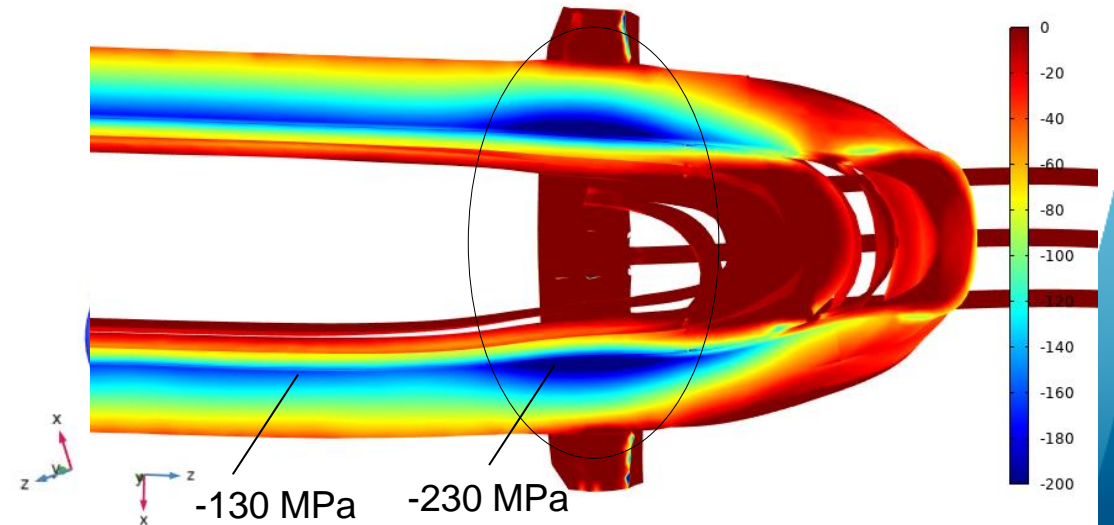
Areas in which there is a stress singularity around the collar piece holding the rods of the cage system.

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 22-component (MPa)



clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 22-component (MPa)

clr=1, wld=1, blt_u=1, cld=1, pwr=1 Volume: Stress tensor, local coordinate system, 22-component (MPa)



Thank you