

# Debriefing MBHSP101

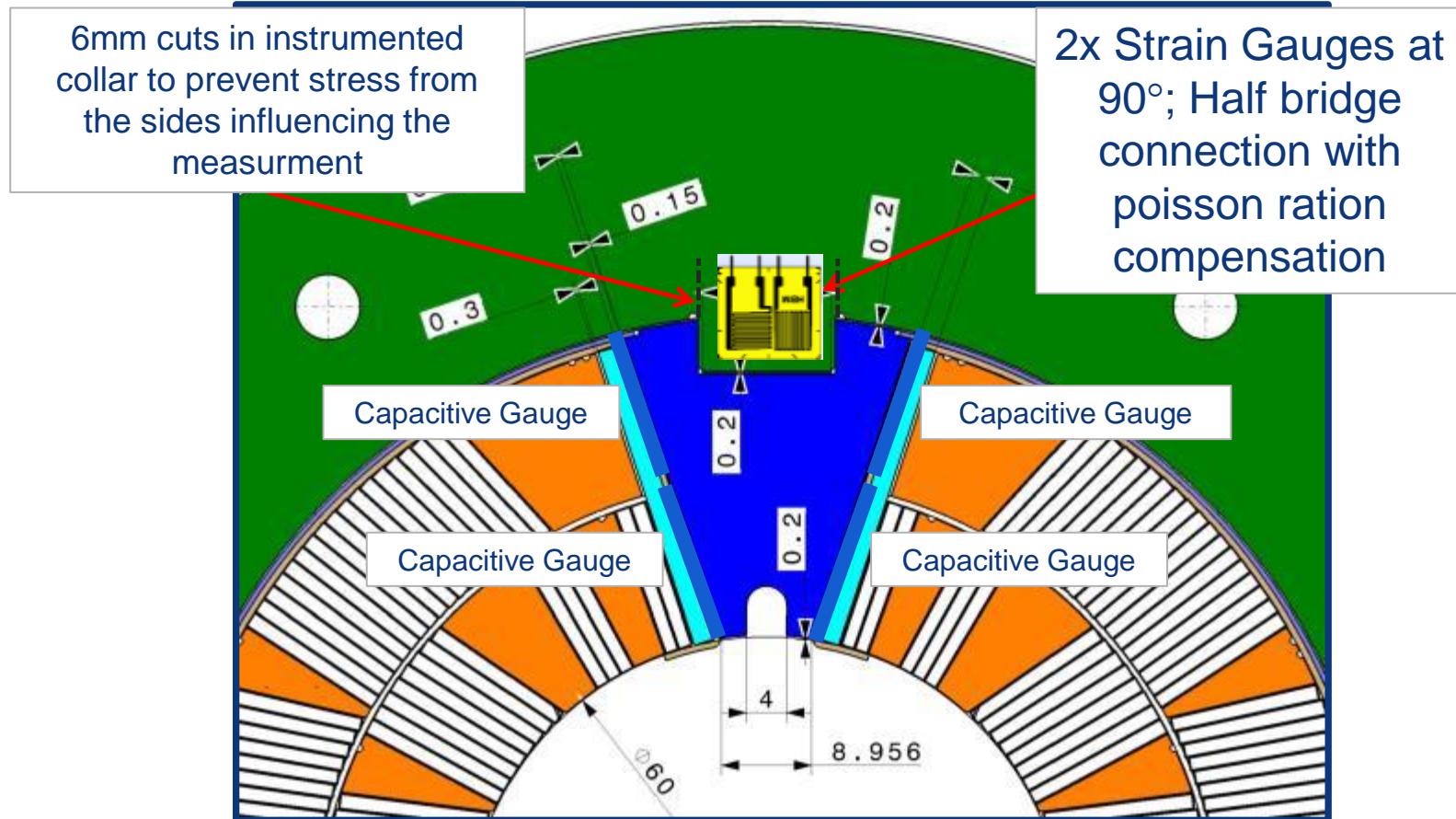
## Mechanical behaviour



Mechanical instrumentation and measurements  
where carried out by our colleagues from EN-MME  
Michael Guichard <[michael.guichard@cern.ch](mailto:michael.guichard@cern.ch)>  
Philippe Grosclaude <[philippe.grosclaude@cern.ch](mailto:philippe.grosclaude@cern.ch)>

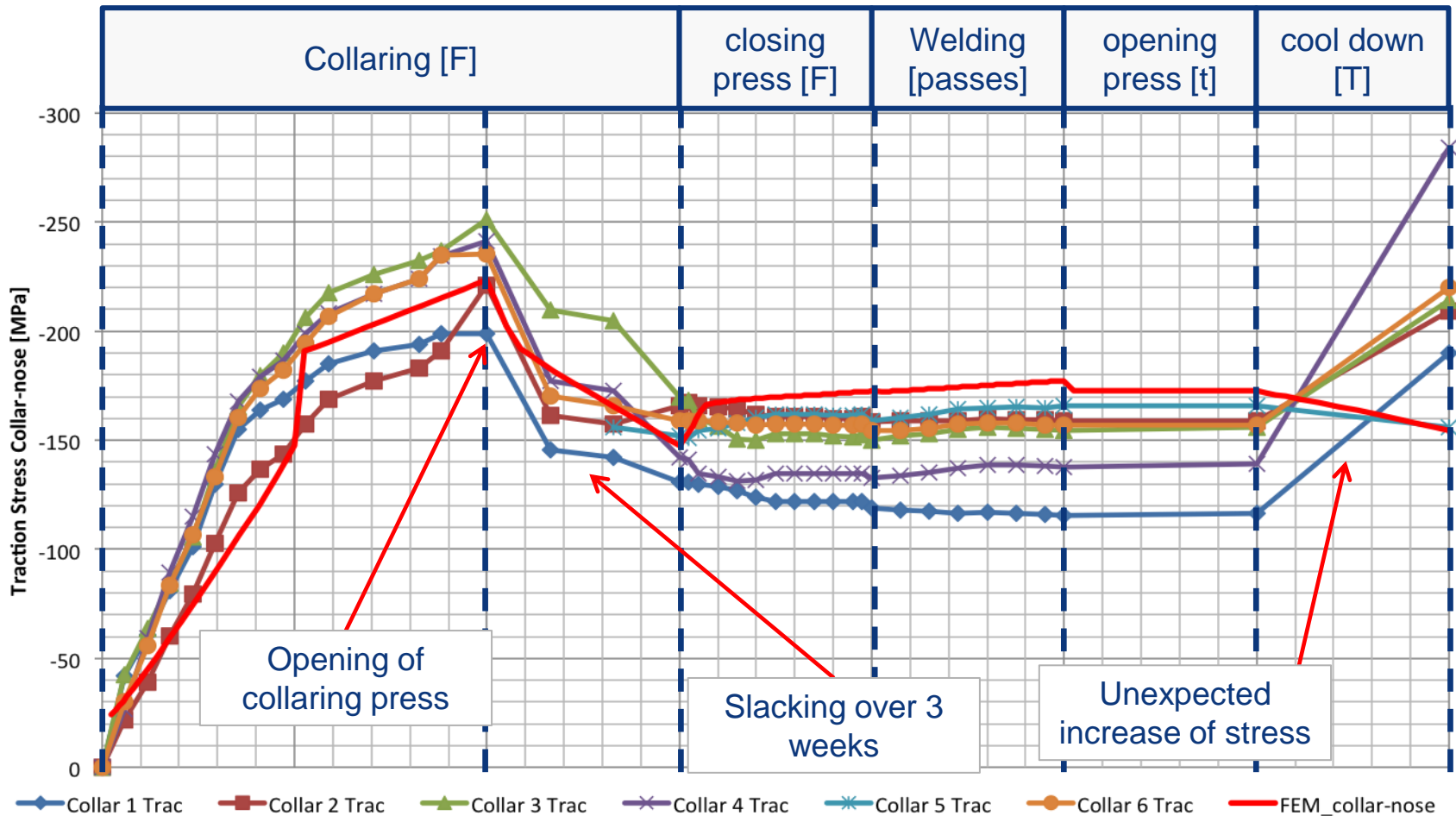
Christian Löffler

# Instrumentation - mechanical

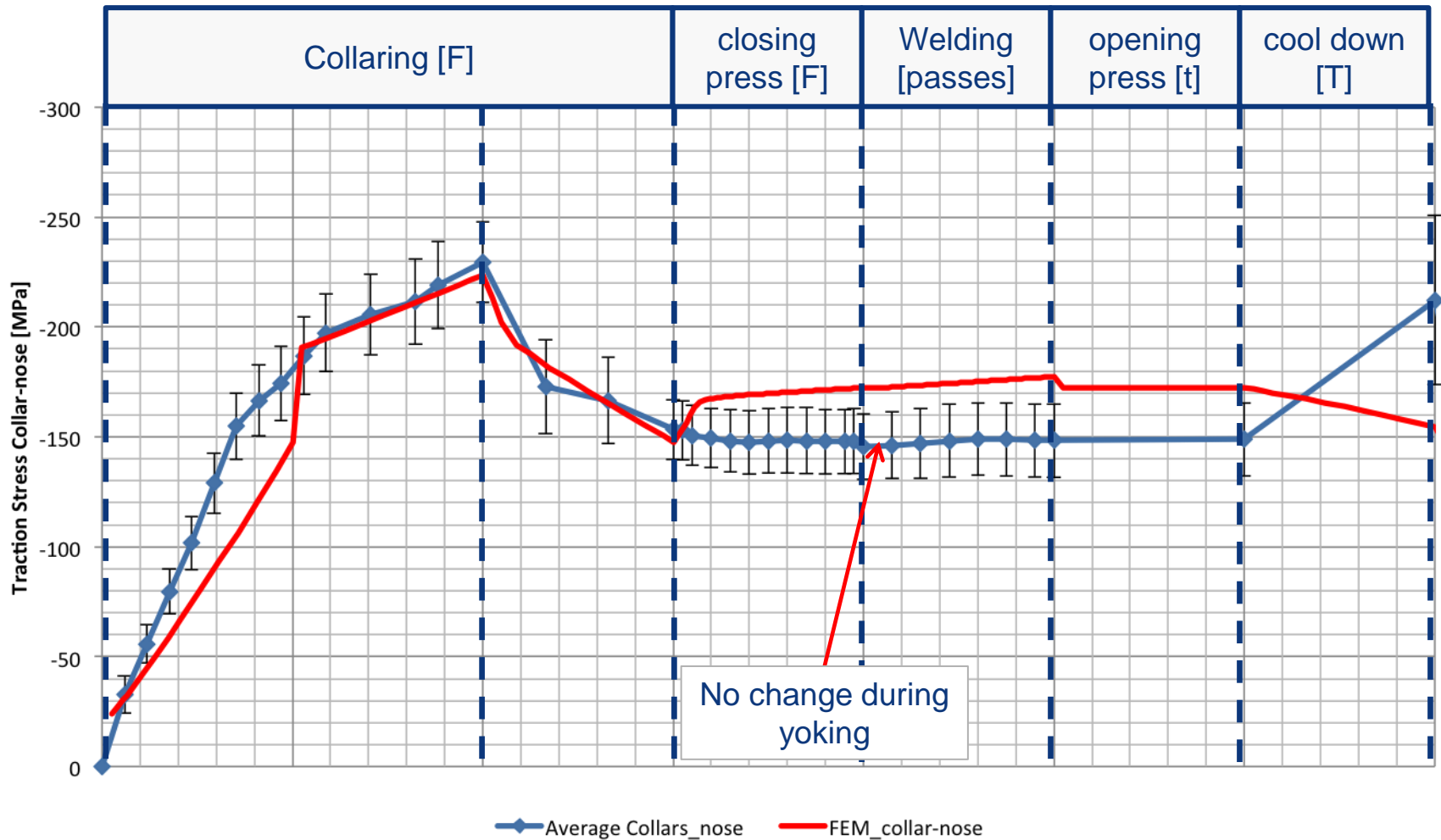


Instrumentation design, assuming only bending and compression on the collar nose

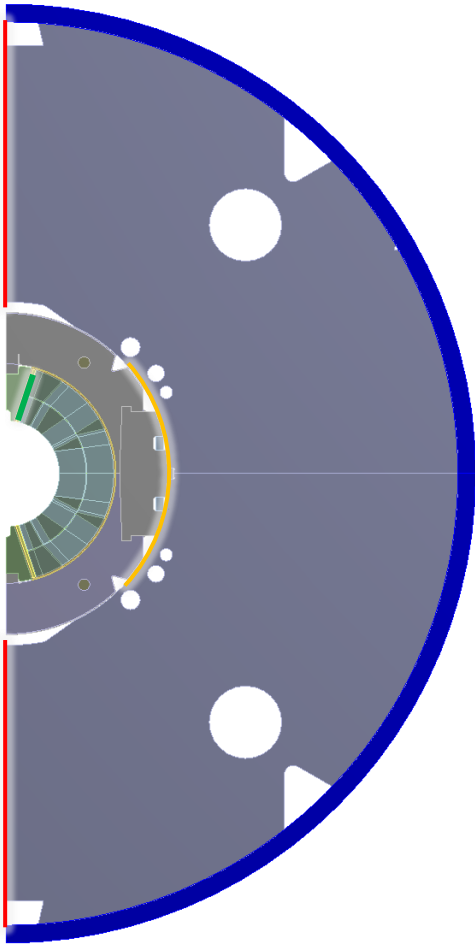
# Collar-noses experimental data



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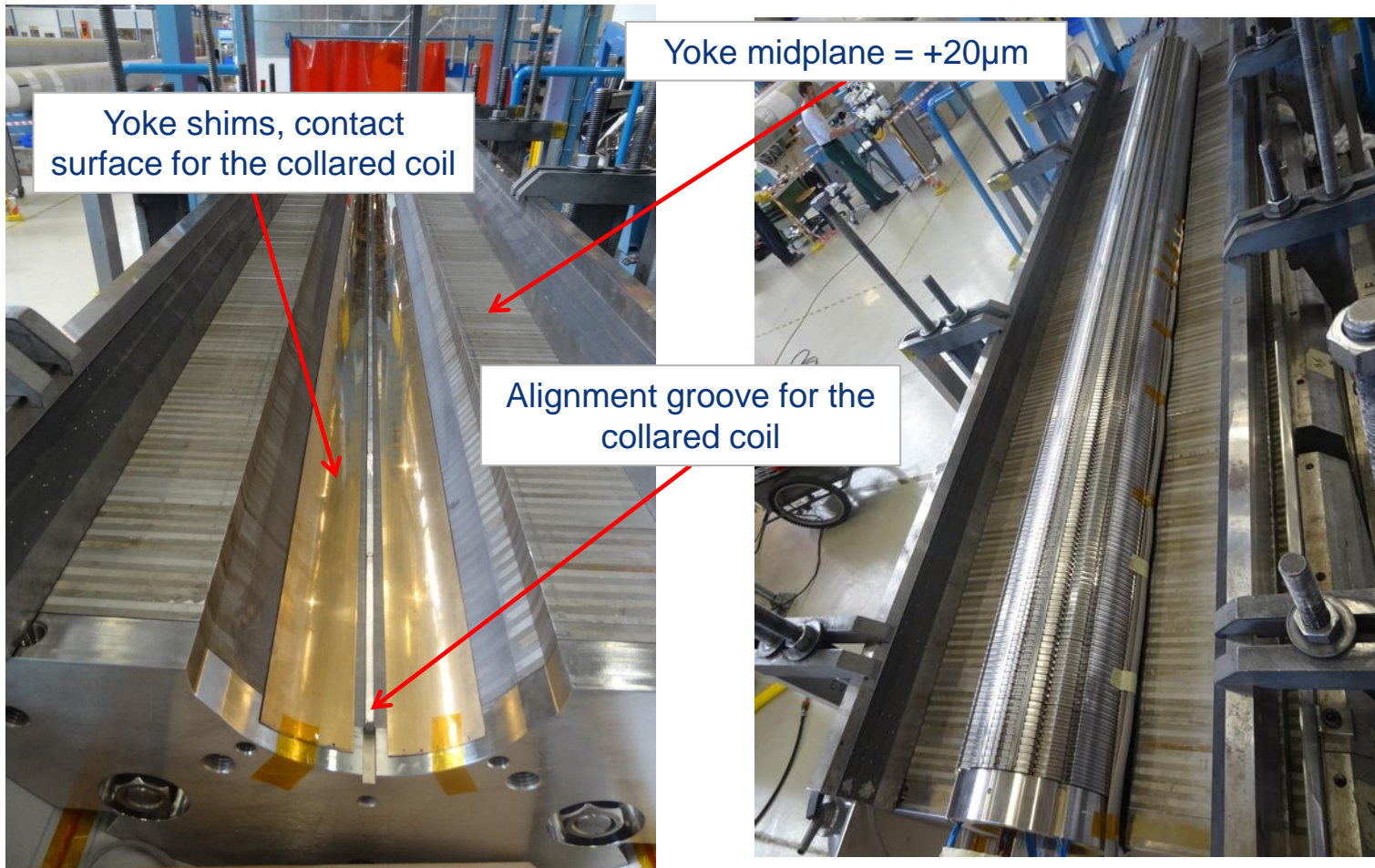


# New parameters

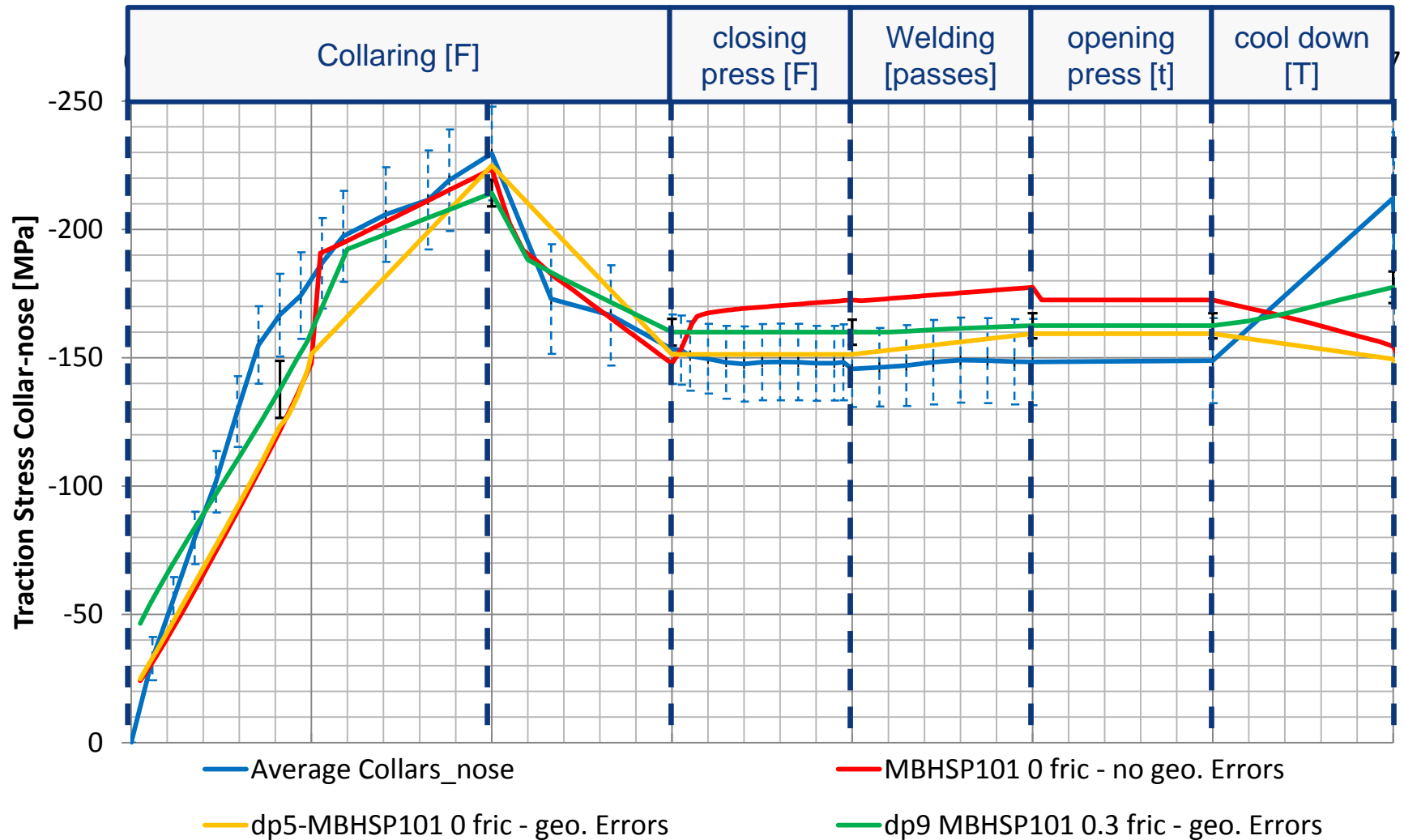


- Yoke midplane +20 $\mu\text{m}$
- Collar outer radius -40 $\mu\text{m}$
- Friction between loading pole and coil  $\rightarrow \mu=0.3$
- Friction between collared coil and yoke  $\rightarrow \mu=0.3$

# Collar-noses experimental data



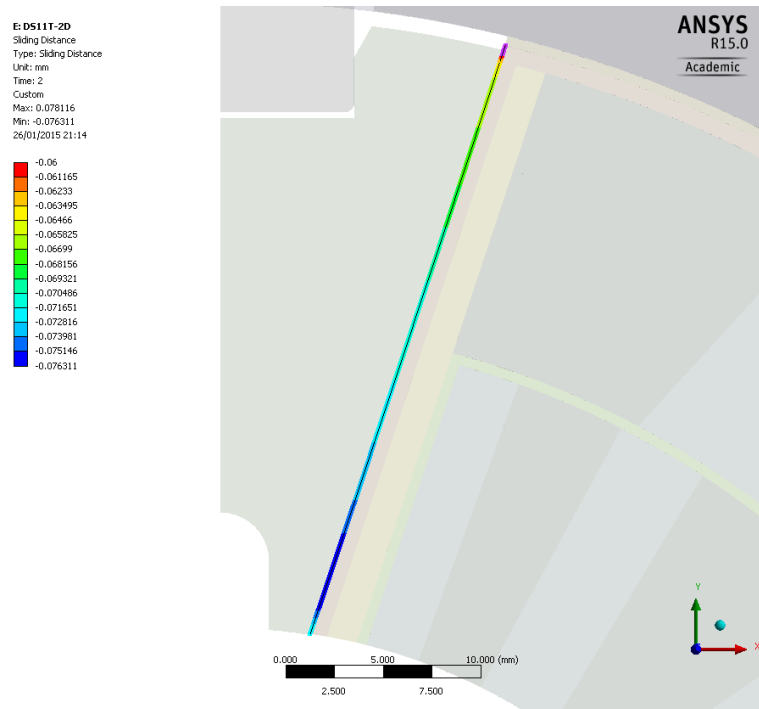
# Collar-noses experimental data



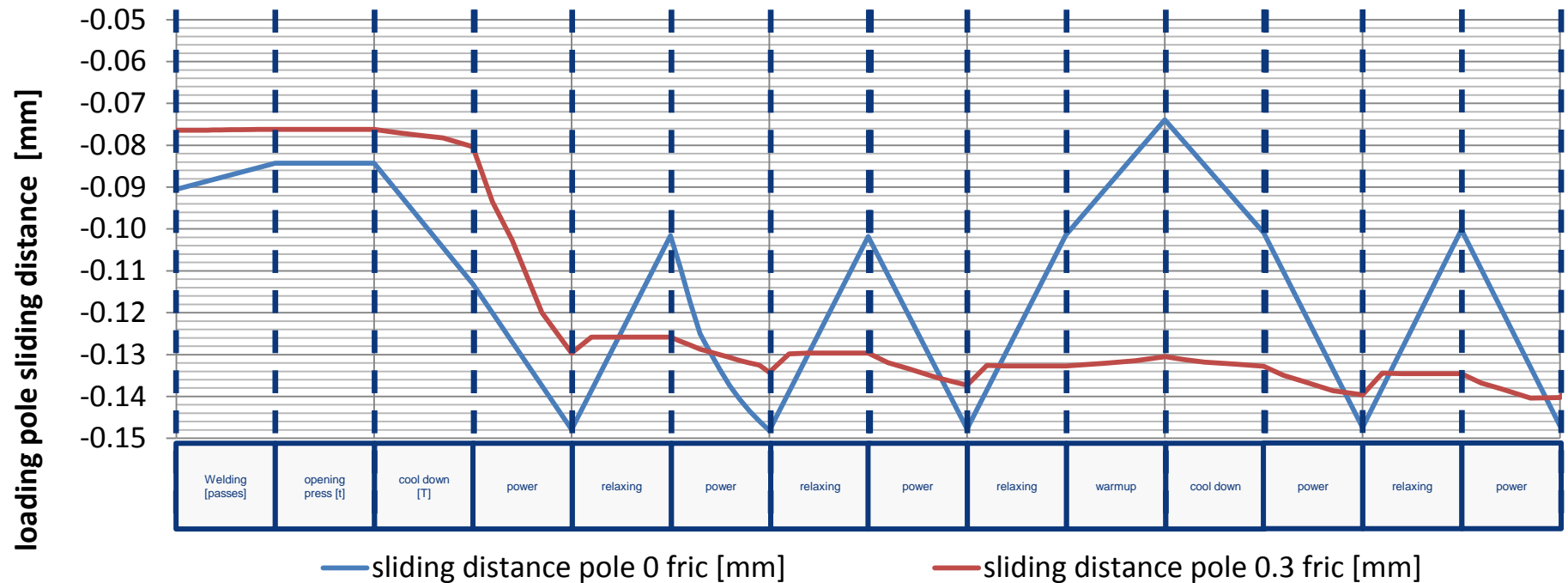


# Cool down - instr. behaviour

- Pole movement during cool down dependence on friction
- Sliding distance → negative closer to the center (for top pole)



# Cool down - instr. behaviour

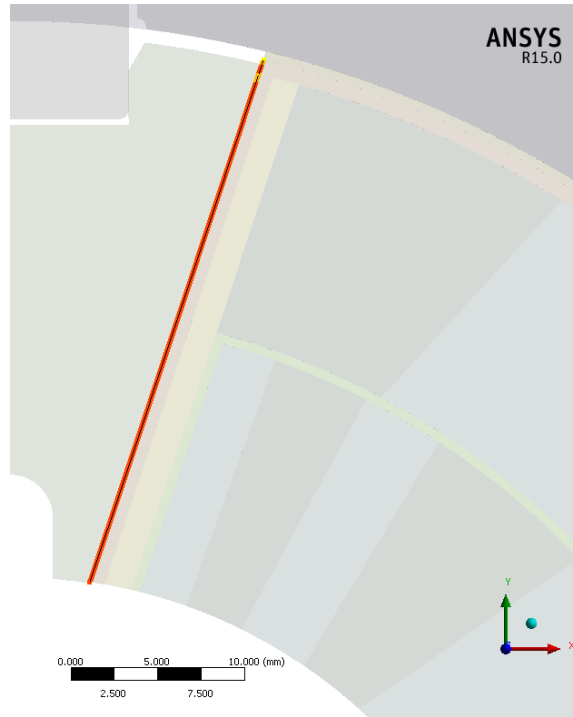


- During cool down the pole gets stuck
- Due to reduction of the friction force during powering it moves closer to the center

# Cool down - instr. behaviour

E:DS11T-2D  
Status  
Type: Status  
Time: 7  
26/01/2015 19:04

Over Constrained  
Far  
Near  
Sliding  
Sticking



E:DS11T-2D  
Status  
Type: Status  
Time: 8  
26/01/2015 19:02

Over Constrained  
Far  
Near  
Sliding  
Sticking



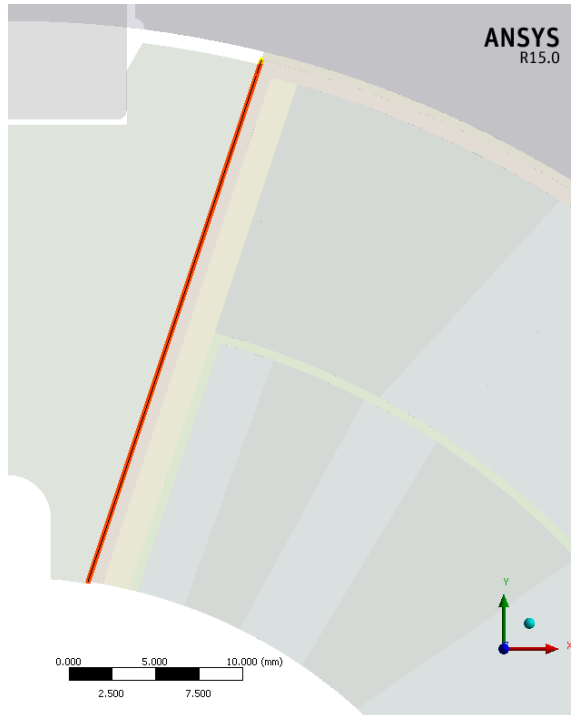
**After first cool down – 0 powerings**

**First powering**

# Cool down - instr. behaviour

E:DS11T-2D  
Status  
Type: Status  
Time: 9  
26/01/2015 19:02

Over Constrained  
Far  
Near  
Sliding  
Sticking



E:DS11T-2D  
Status  
Type: Status  
Time: 10  
26/01/2015 19:03

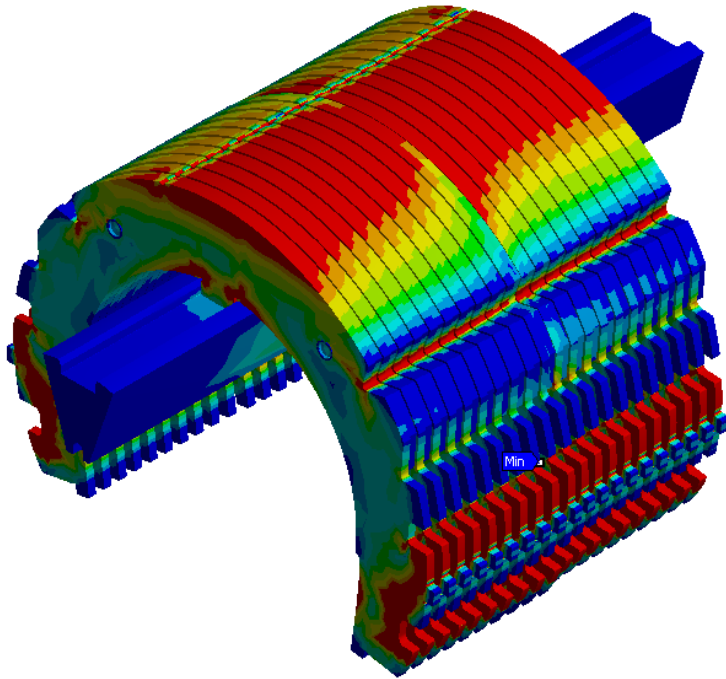
Over Constrained  
Far  
Near  
Sliding  
Sticking



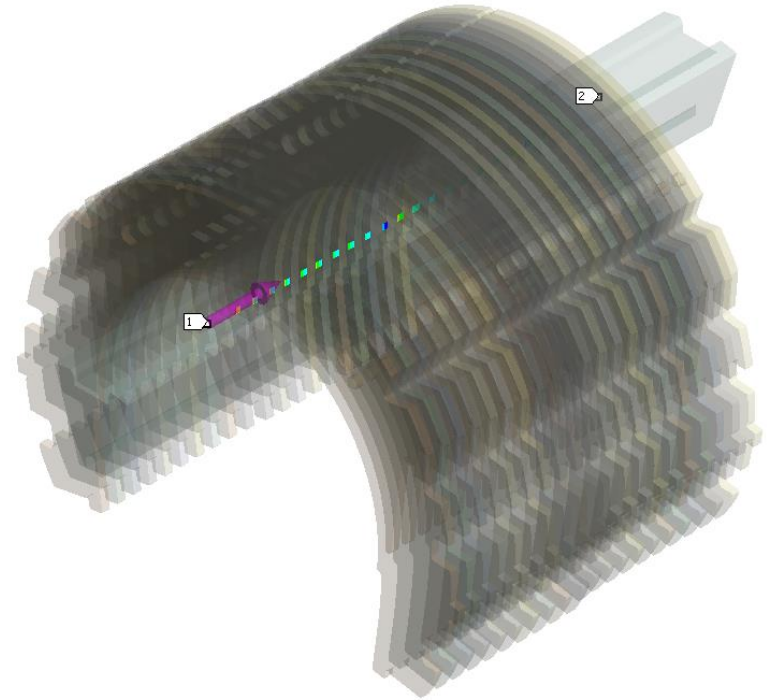
After first powering

2nd powering

# Cool down - instr. behaviour

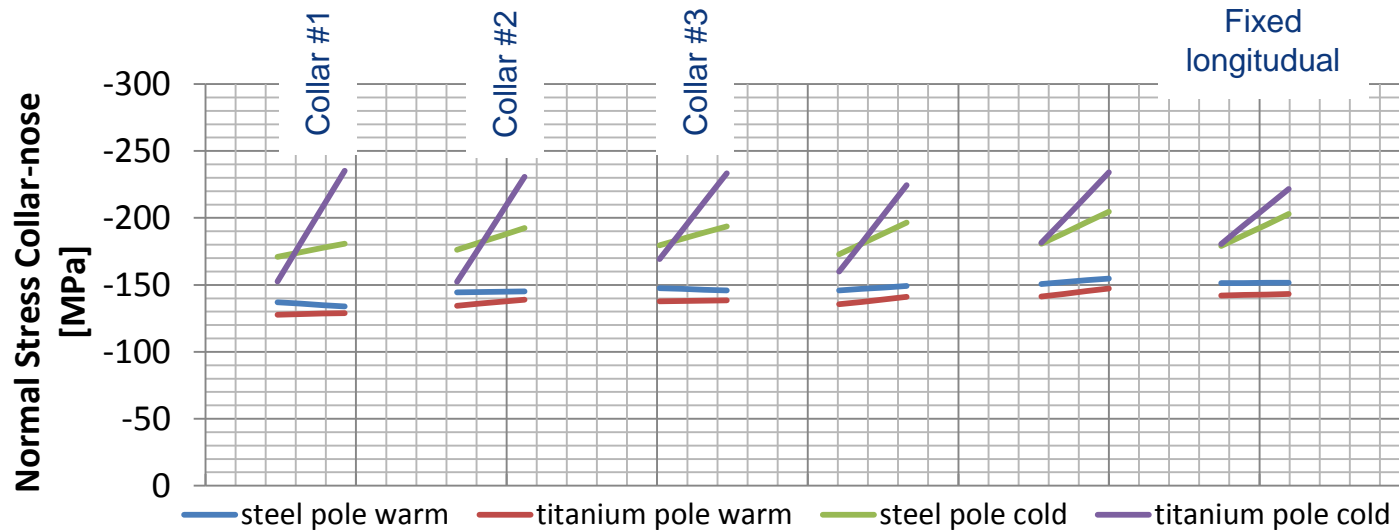


**Pole + collar pack**

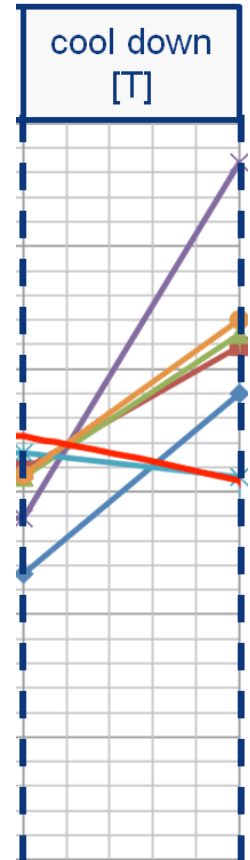


**Measured instrumentation  
region**

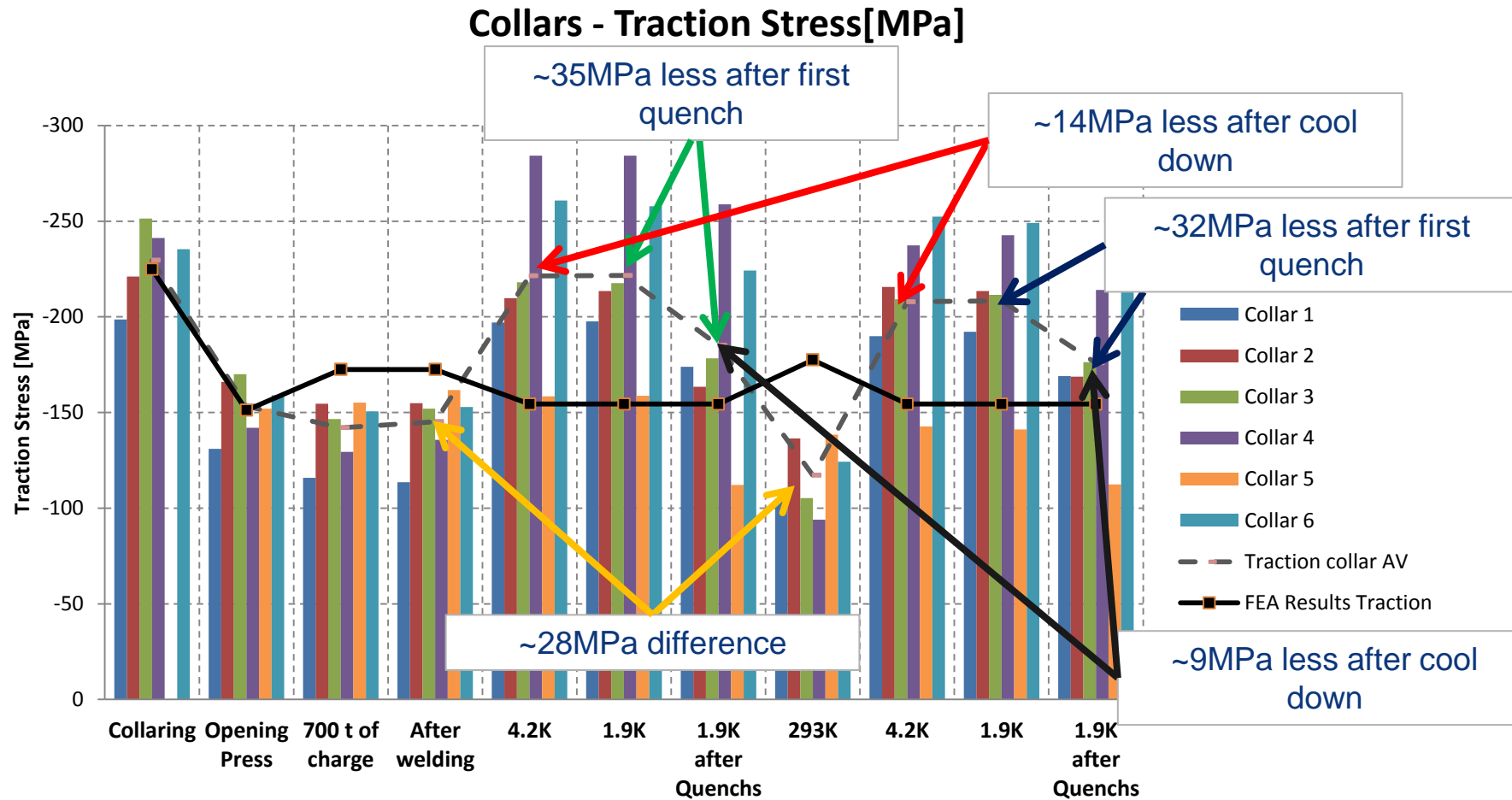
# Cool down - instr. behaviour



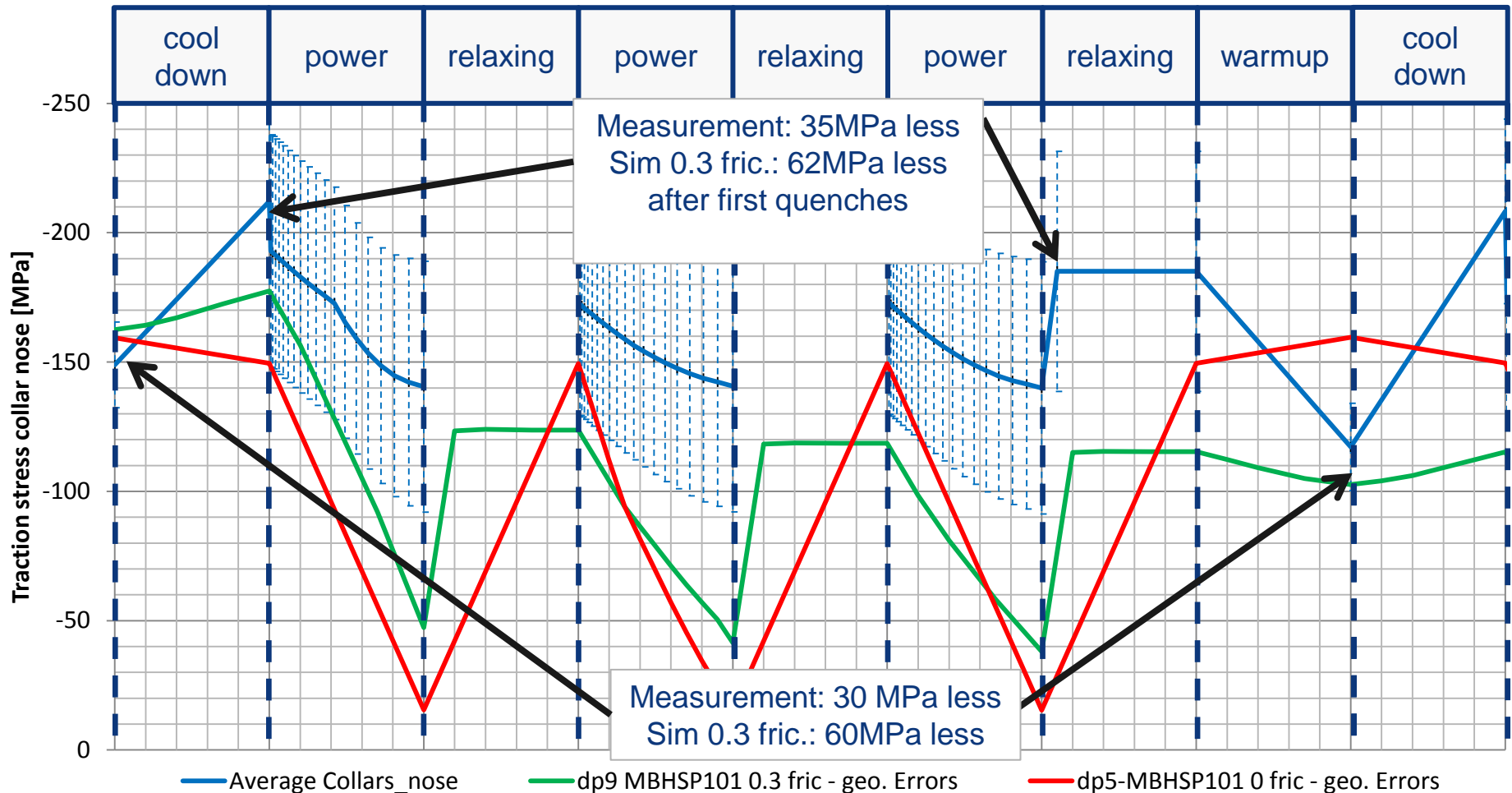
- the different thermal contraction between pole and collar might bend the collar noses during cool down.



# Collar-noses experimental data



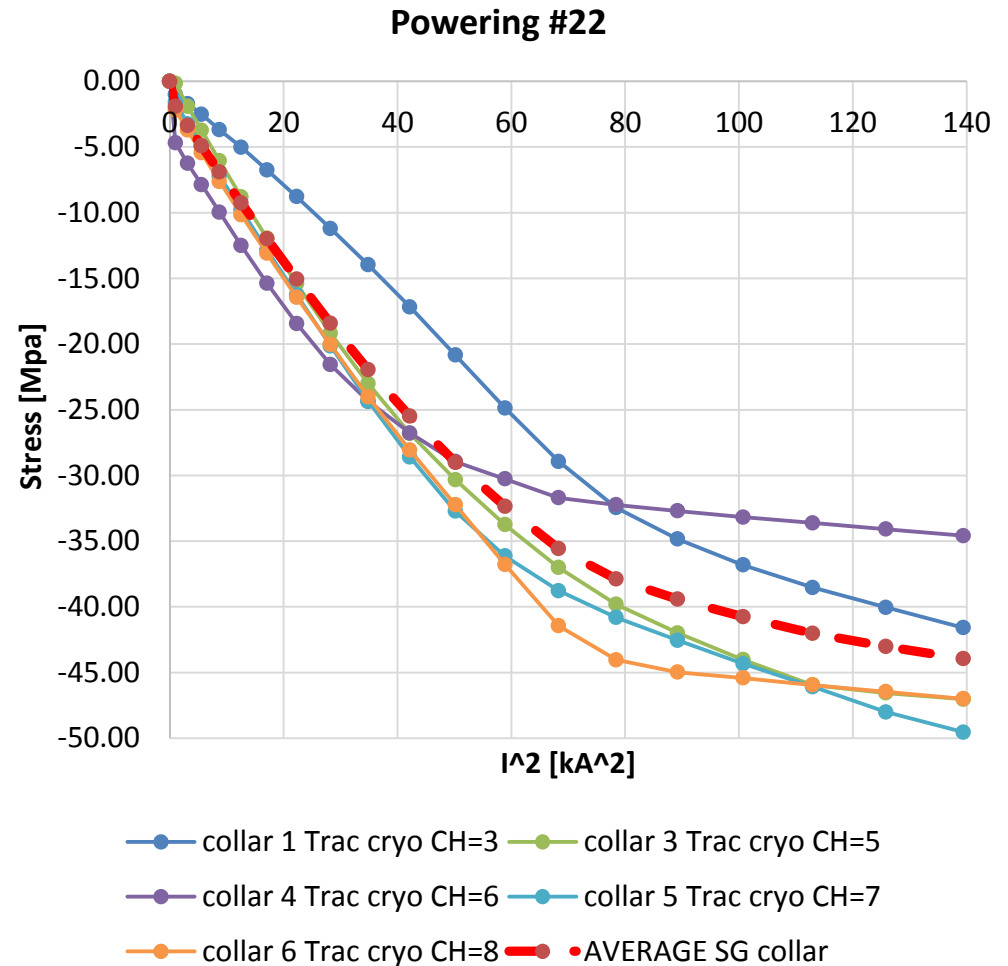
# Collar-nose experimental data



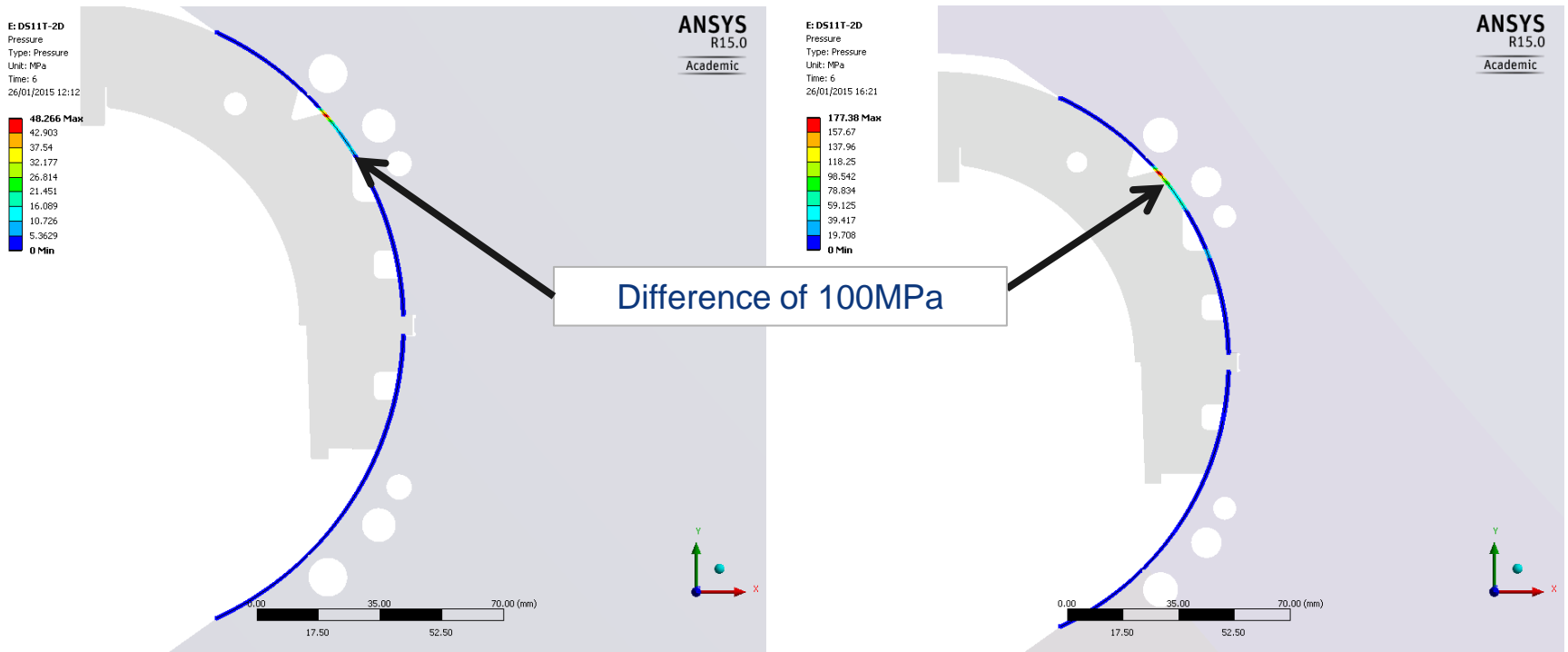


# powering- instr. behaviour

- Normalized over spread from cool down
- Pre-stress decreased by  $\sim 44\text{MPa}$
- ~~According to the FE the stress in the nose should decrease by  $\sim 100\text{MPa}$~~
- Behaviour is not linear compared to  $I^2$



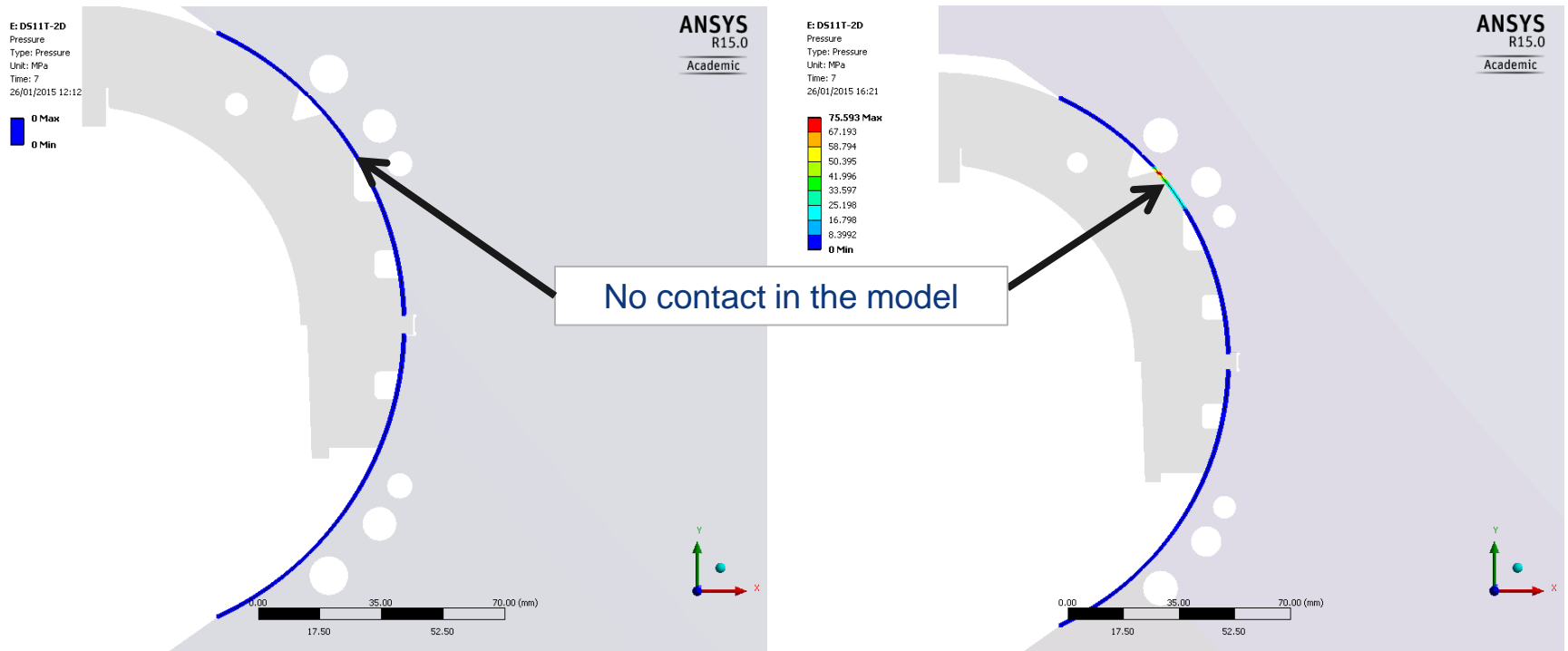
# powering- instr. behaviour



**Welding – MBHSP101**

**Welding – norm**

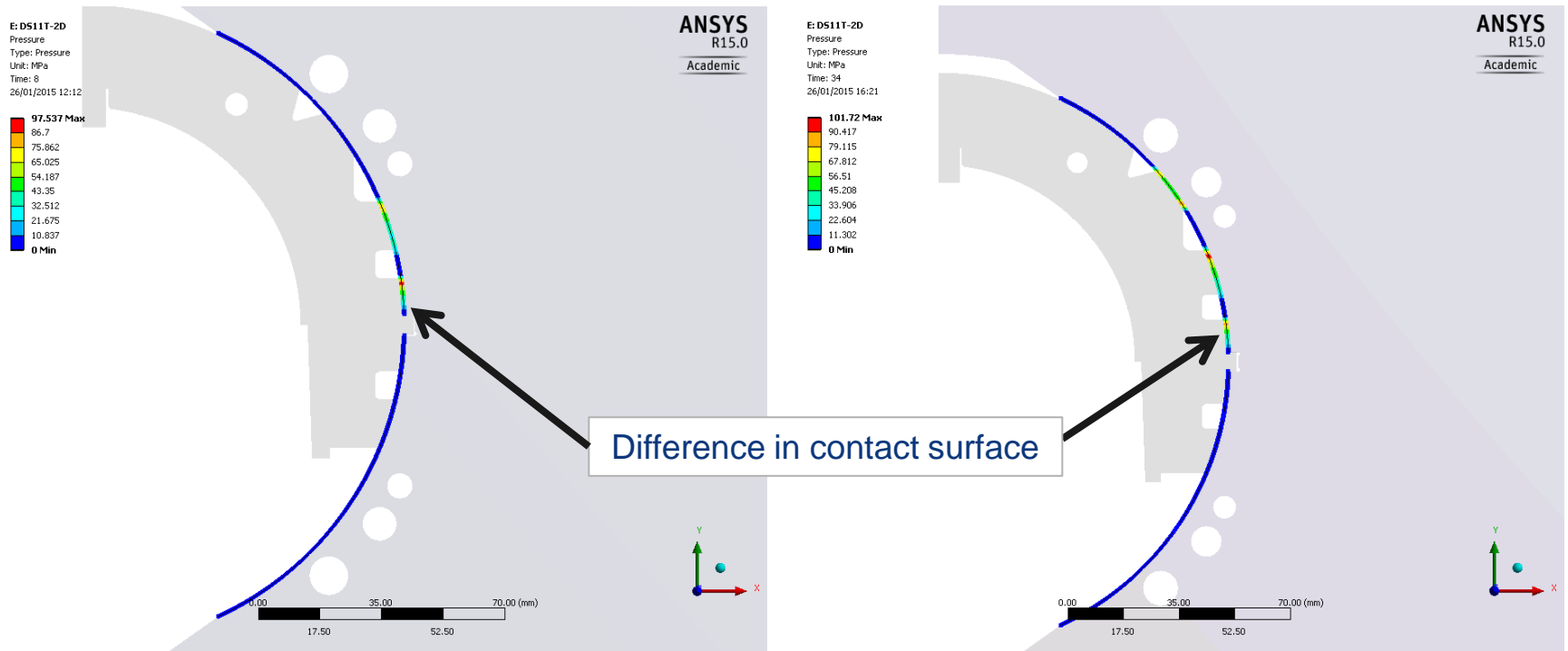
# powering- instr. behaviour



1.9K – MBHSP101

1.9K - norm

# powering- instr. behaviour

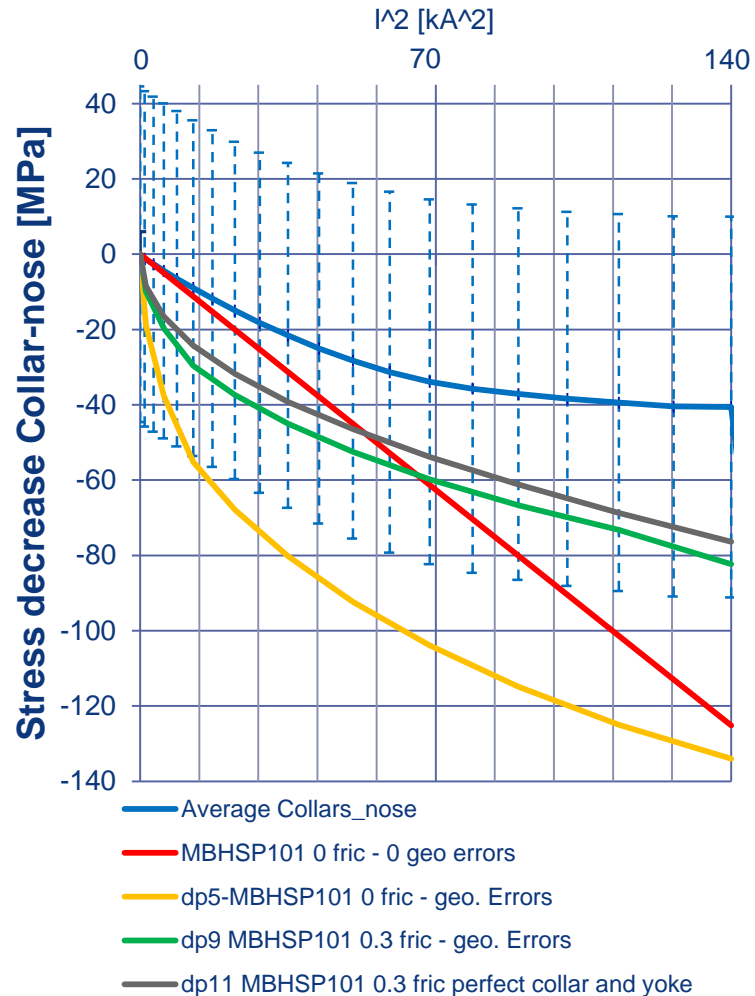


**Powering – MBHSP101**

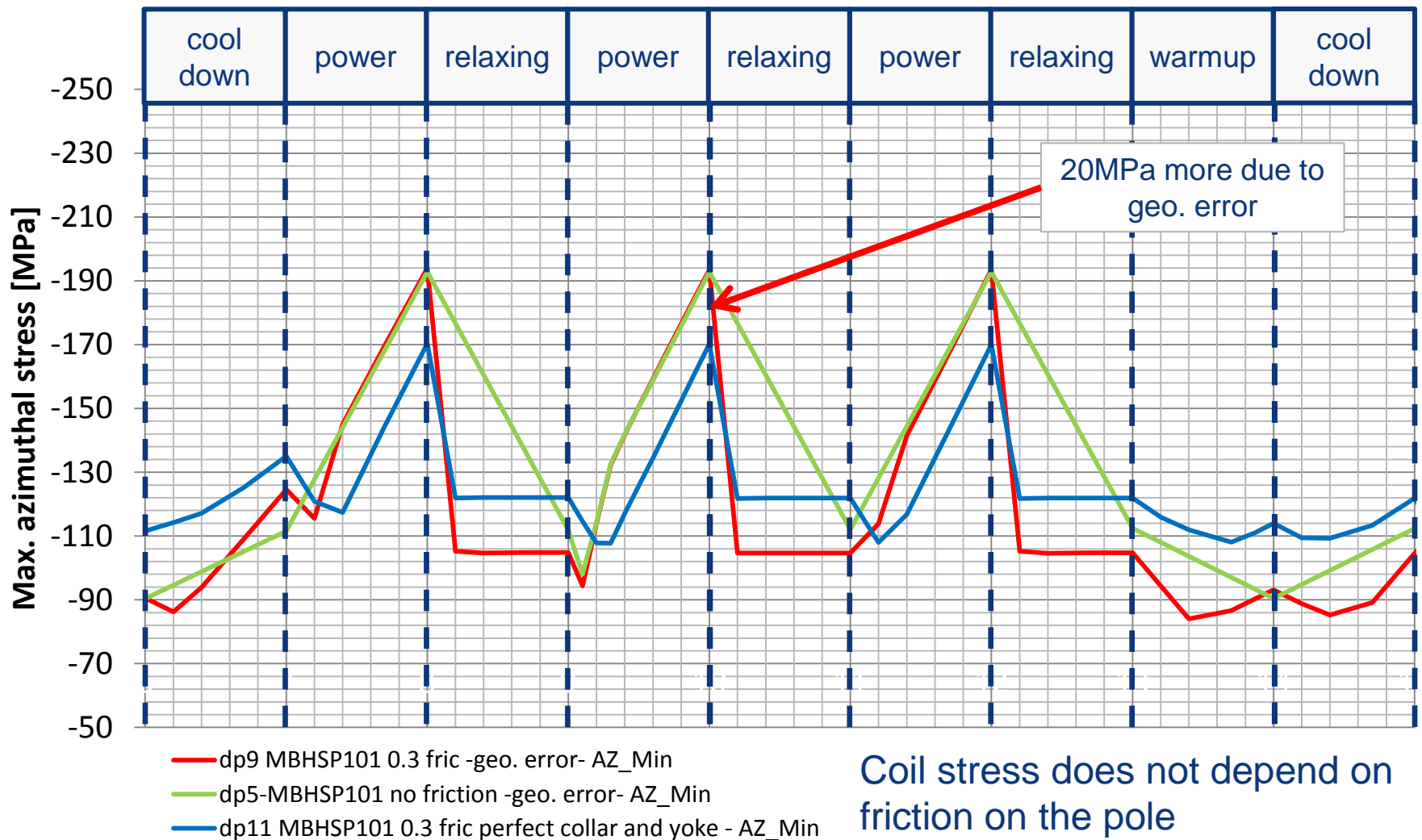
**Powering – norm**

# powering- instr. behaviour

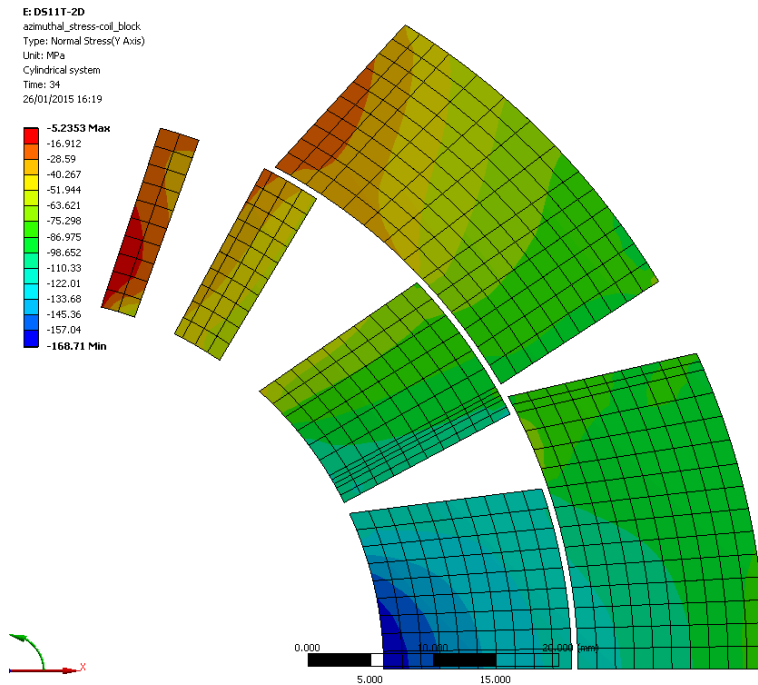
- Normalized at 0kA
- Powering #22
- Not linear behaviour  
dependence on friction  
and geo. errors



# Mechanical stress

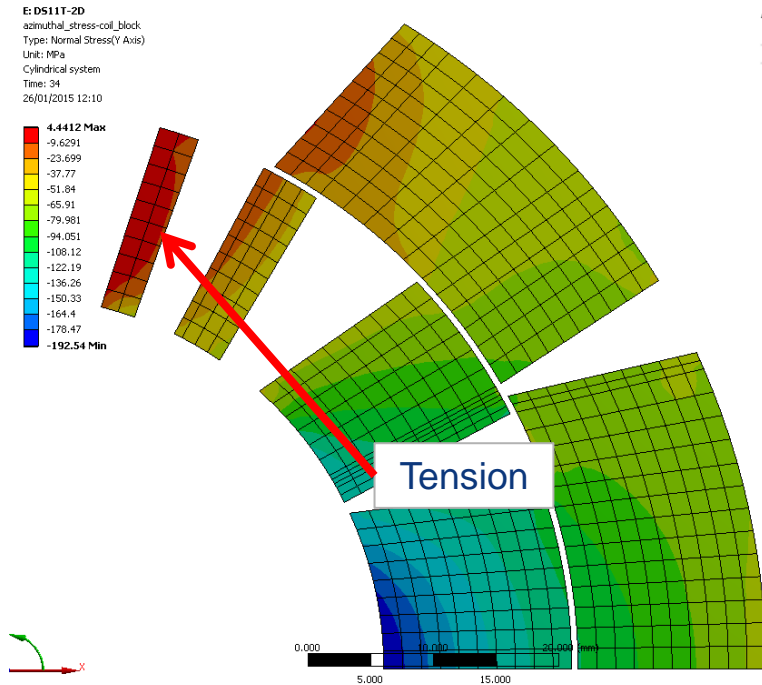


# Mechanical stress-during powering



**Perfect collar-yoke  
contact**

ANSYS  
R15.0  
Academic



**Collar-yoke contact with  
error (MBHSP101)**

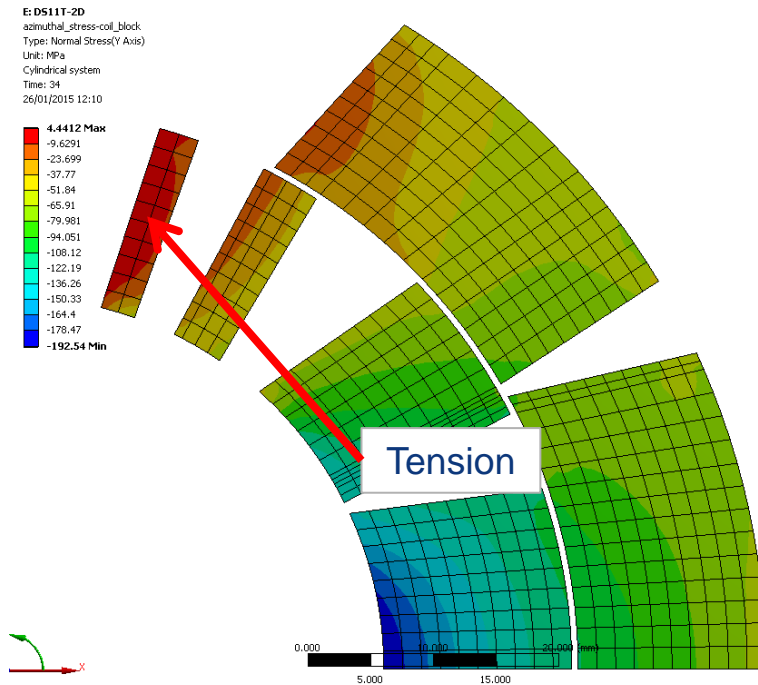
# Behaviour in the transition region



- Reduced top-shimming by 0.14mm
- Staircase shimming to gradually reduce the loading
- Possible creeping of kapton

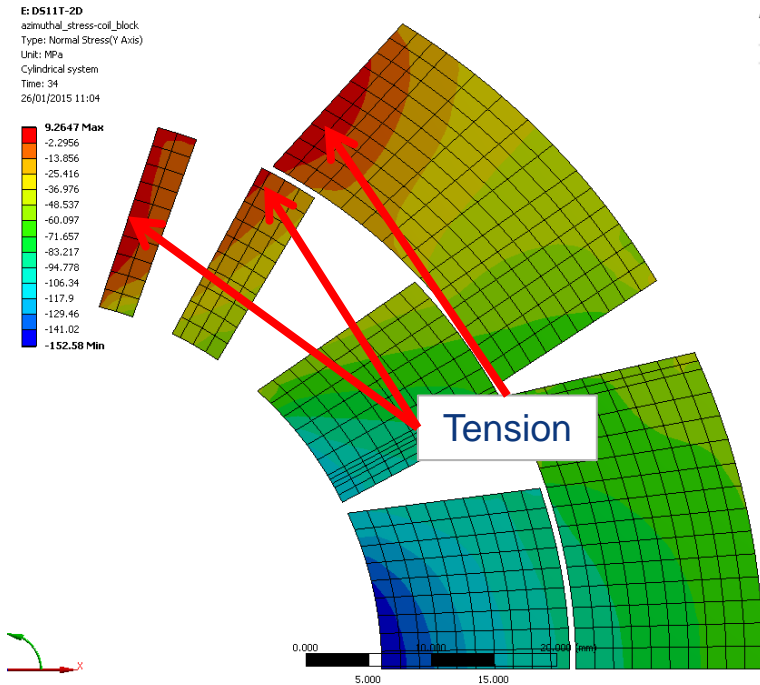


# Behaviour in the transition region



**Centre of magnet + geo.  
errors**

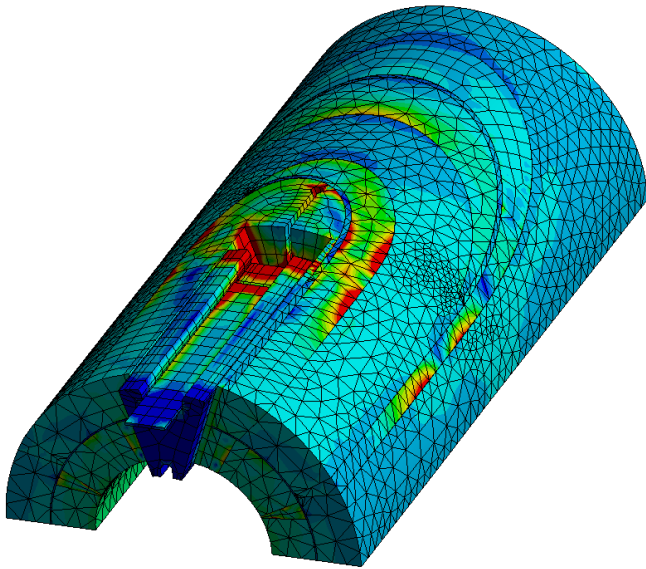
ANSYS  
R15.0  
Academic



**Transition Region – smaller  
midplane + reduced shimming  
+ geo. errors**

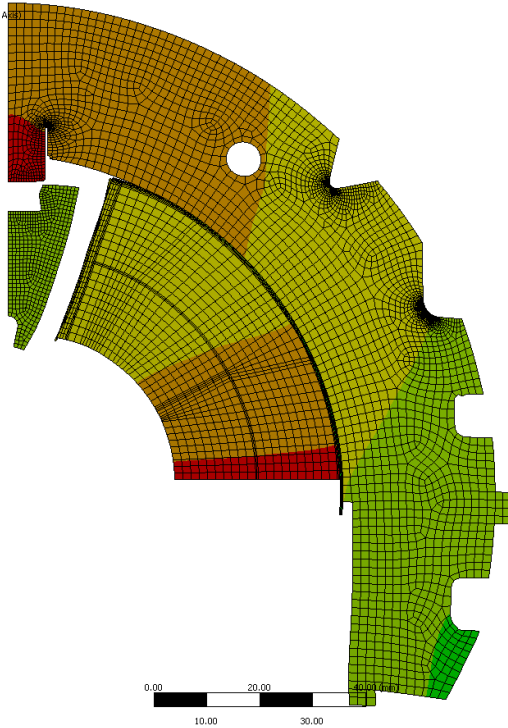
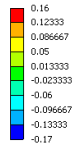
# Behaviour in the transition region

- Work is in progress for a 3d-model of the transition region



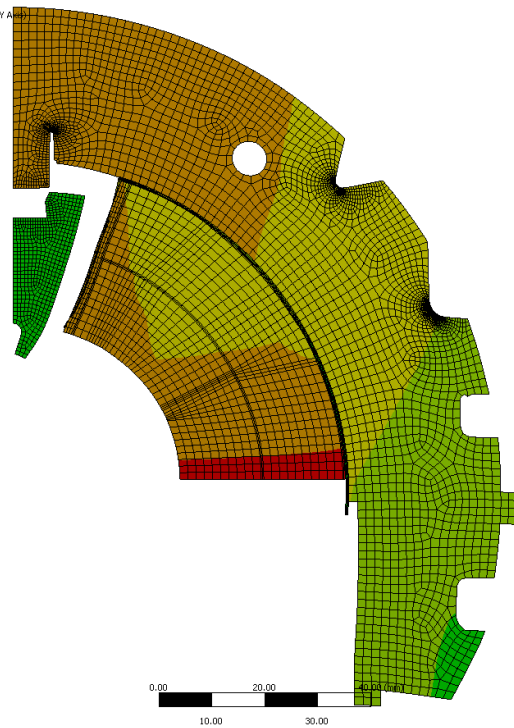
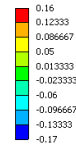
# Deformation in Y before and after testing

E: DS11T-2D  
after assembly  
Type: Directional Deformation(Y Axis)  
Unit: mm  
Global Coordinate System  
Time: 6  
Custom  
Max: 0.1368  
Min: -0.017212  
27/01/2015 12:36



ANSYS  
R15.0  
Academic

E: DS11T-2D  
after testing  
Type: Directional Deformation(Y Axis)  
Unit: mm  
Global Coordinate System  
Time: 36  
Custom  
Max: 0.1345  
Min: -0.01799  
27/01/2015 12:37



ANSYS  
R15.0  
Academic

After assembly

After testing

# Summary

- No increase of stress in the collar-nose might be due to geometrical errors
- measured behaviour:
  - Decrease in stress in the collar-nose during the testing
  - Increase in stress during cool-down
- Can be explained with friction in the model



# Geometrical data MBHSP101

