S1 global: thermal analysis

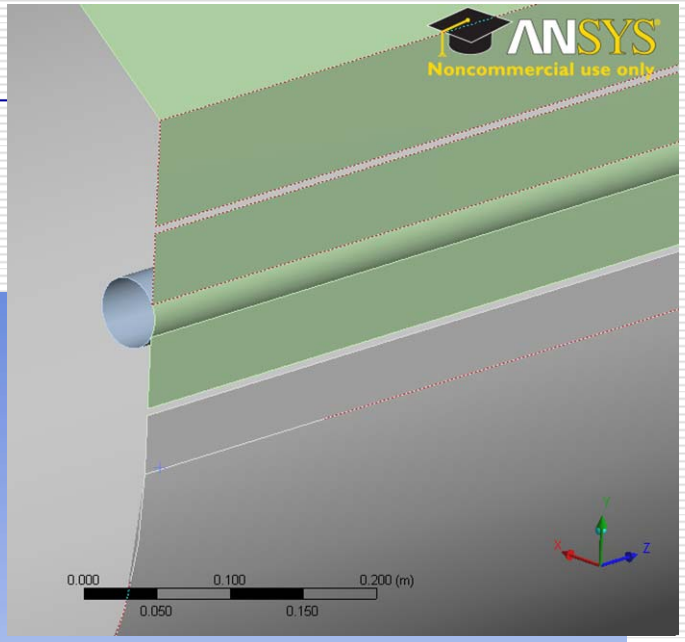
Webex Meeting
March 10th, 2009
Serena Barbanotti

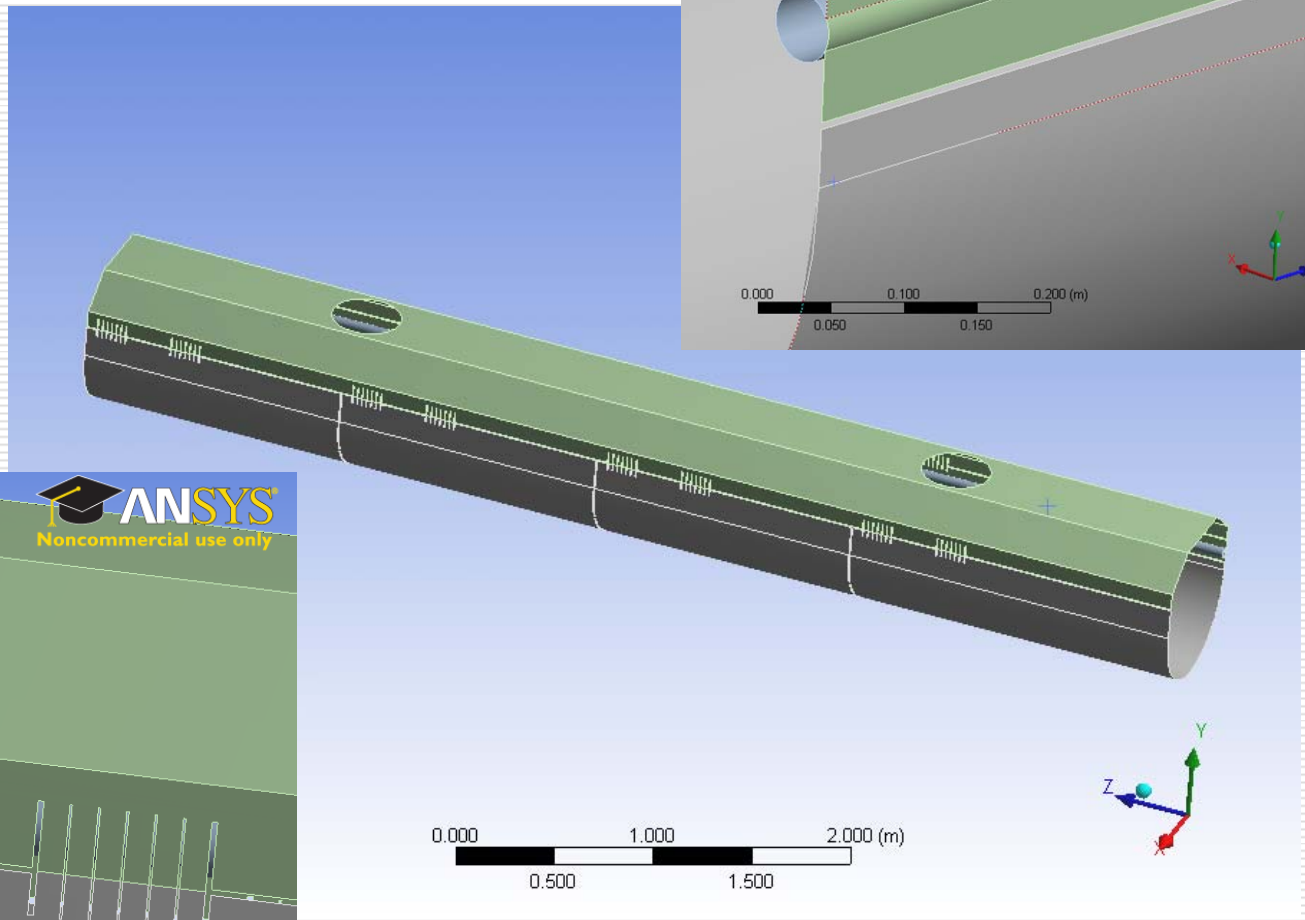
3D model components

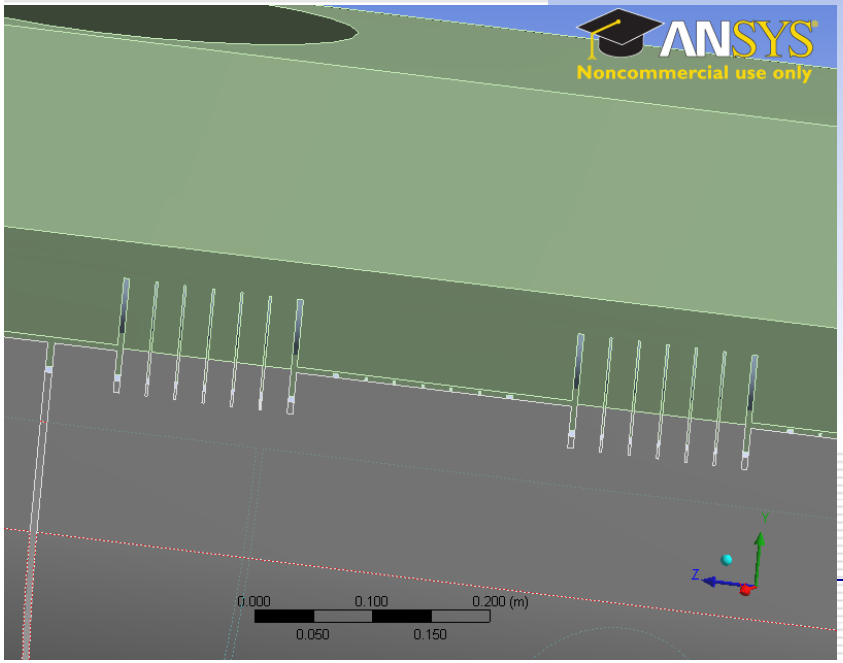
- Starting design: UGS NX4 simplified 3D model

- Included components:
  - 2 support posts
  - 70 K shield (upper and lower parts, pipe)
  - 5 K shield (upper and lower parts, pipe)
  - Gas Return Pipe (pipe, shapes, cavity supports)
  - Invar rod (with fixing point to central shape and cavities)
  - Helium tanks
  - Beam pipe between tanks with coupler ports

70 K shield


ANSYS
Noncommercial use only
0.000
0.100
0.200 (m)
0.050
0.150


0.000
1.000
2.000 (m)
0.500
1.500
Y
Z
X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Noncommercial use only
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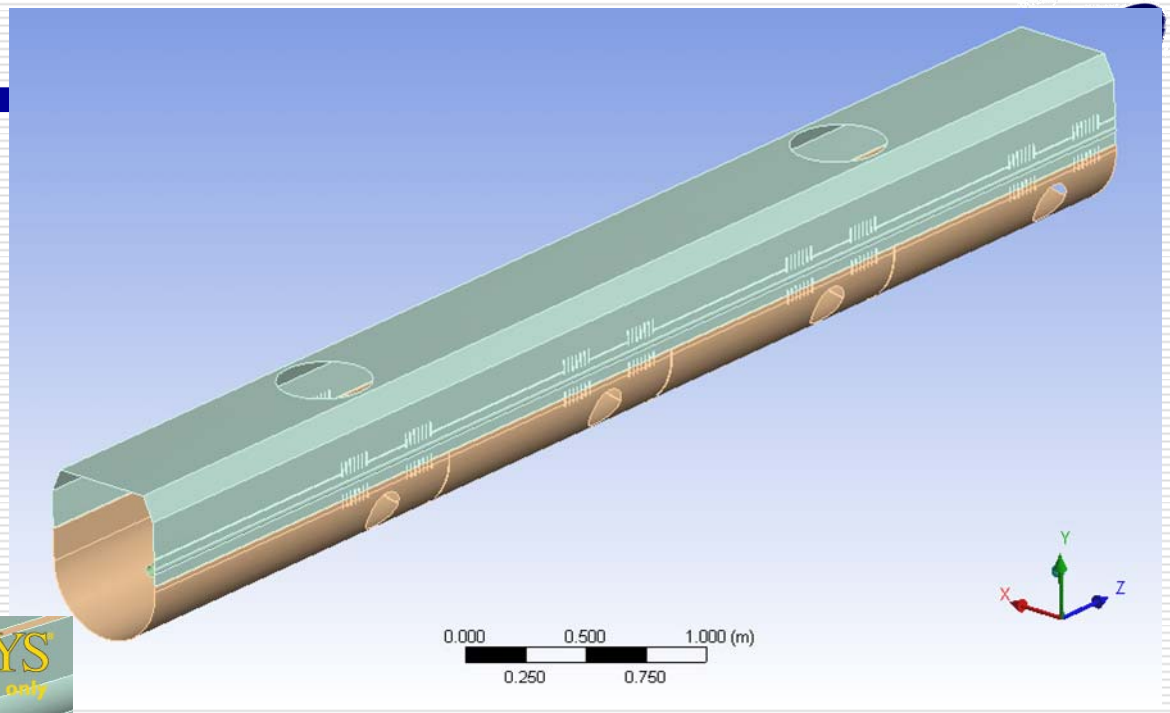
0.200 (m)
0.050
0.150
Y
Z

4 K shield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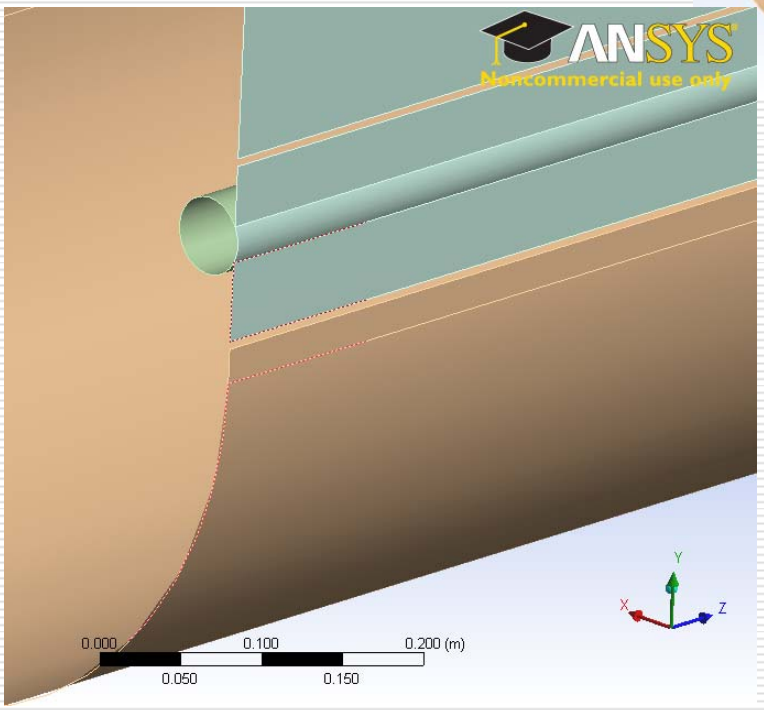
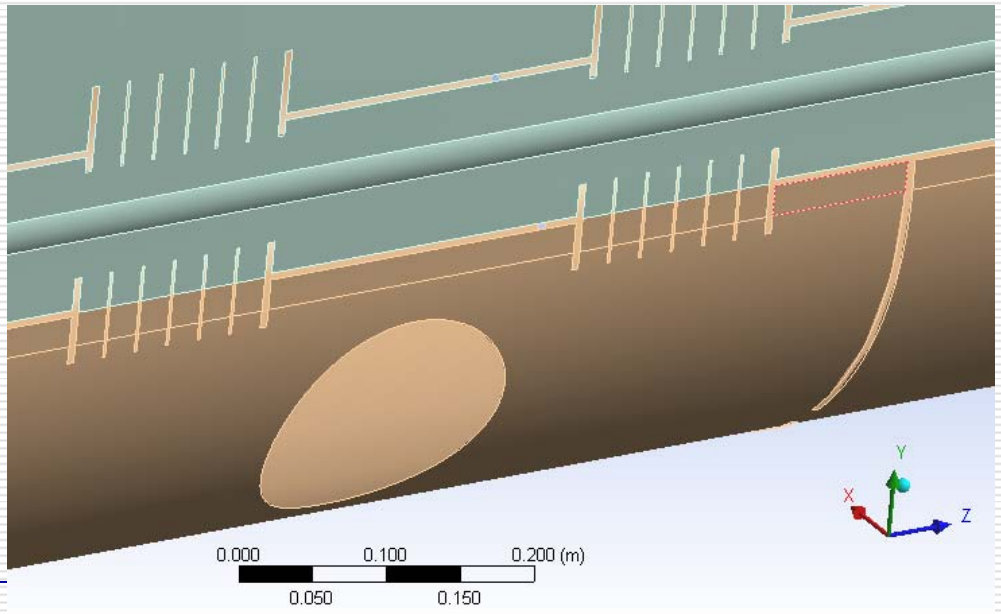
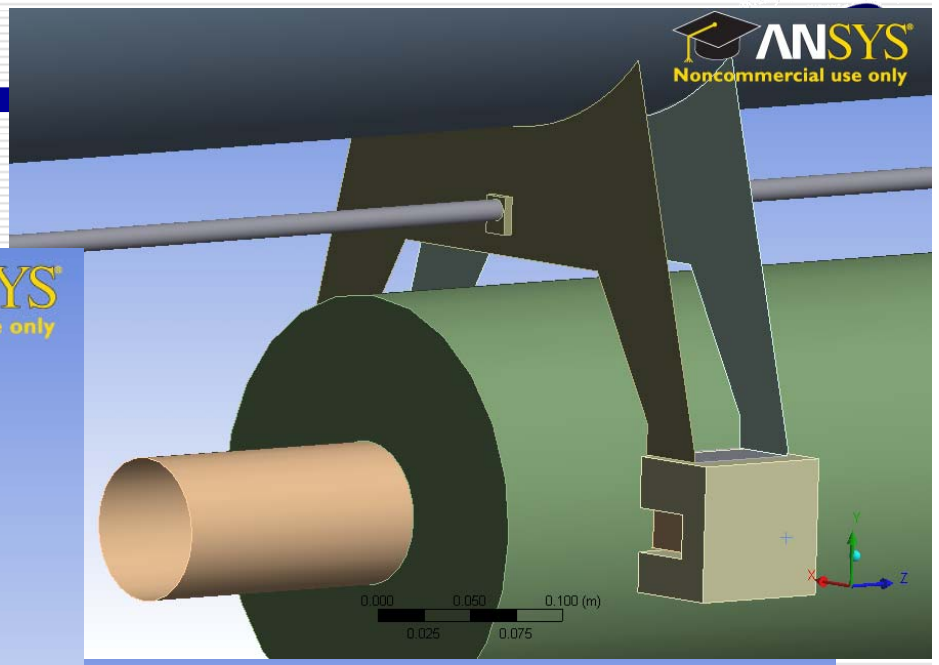
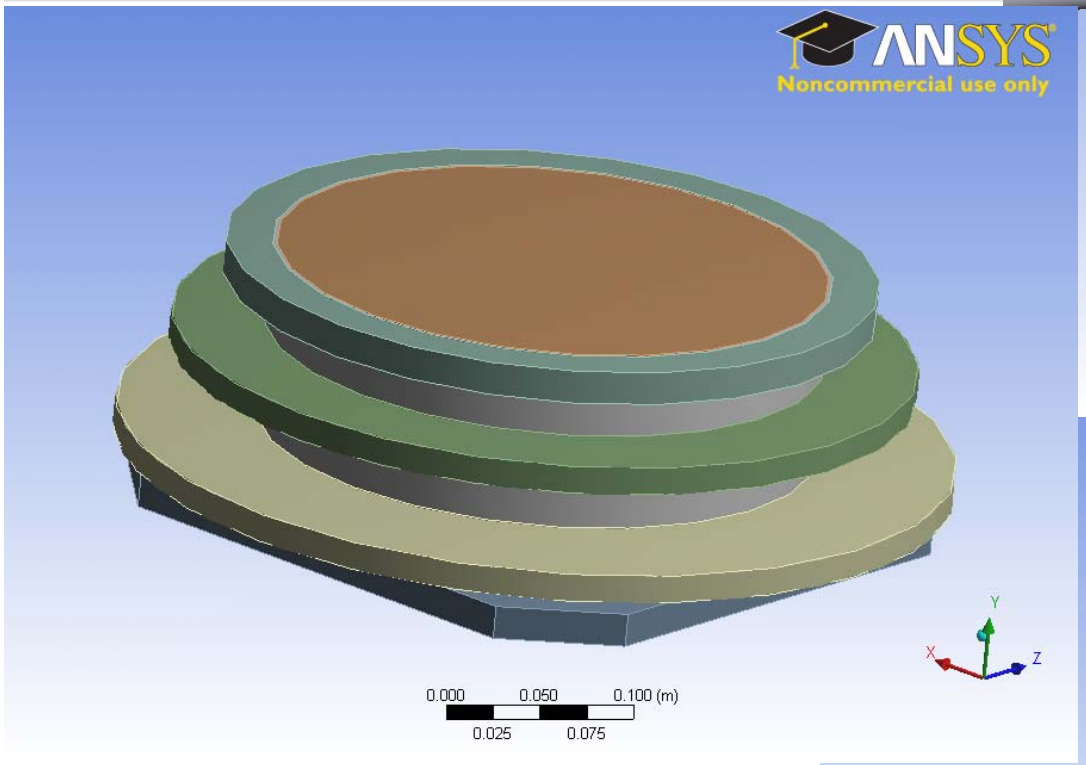
0.500
1.000 (m)
0.250
0.750
Y
X
Z

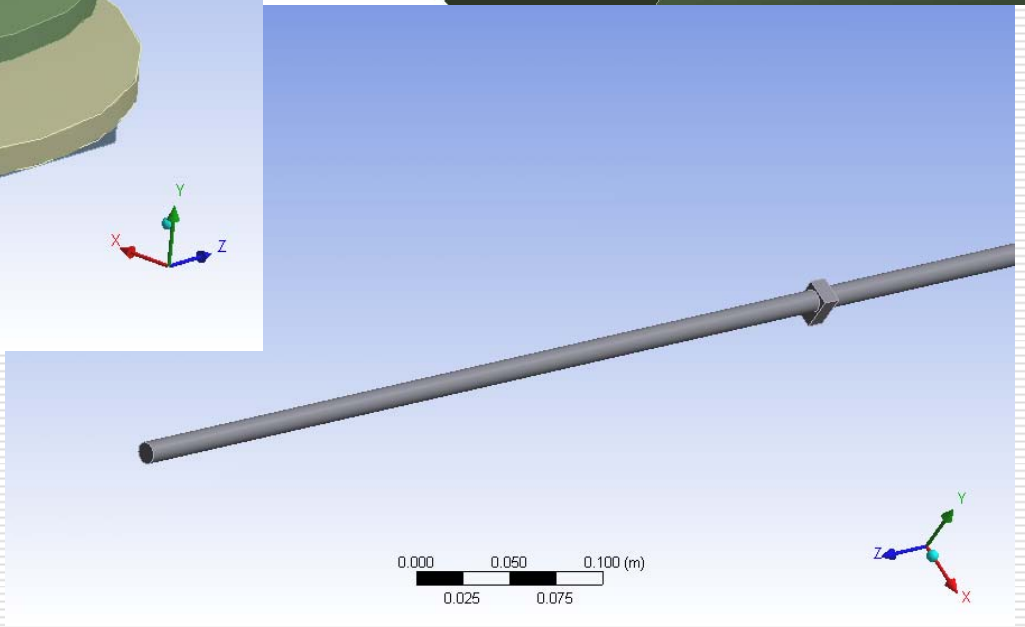

ANSYS
Noncommercial use only
0.000
0.100
0.200 (m)
0.050
0.150
Y
X
Z


0.000
0.100
0.200 (m)
0.050
0.150
Y
X
Z

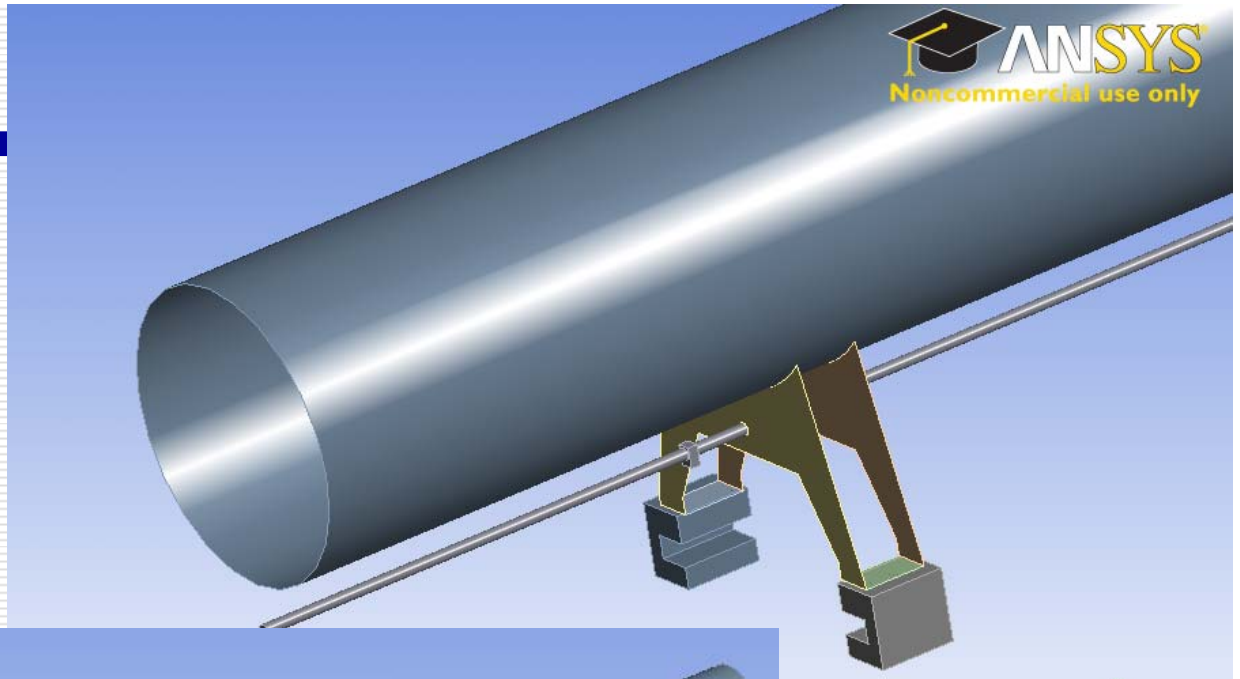
Post and invar rod

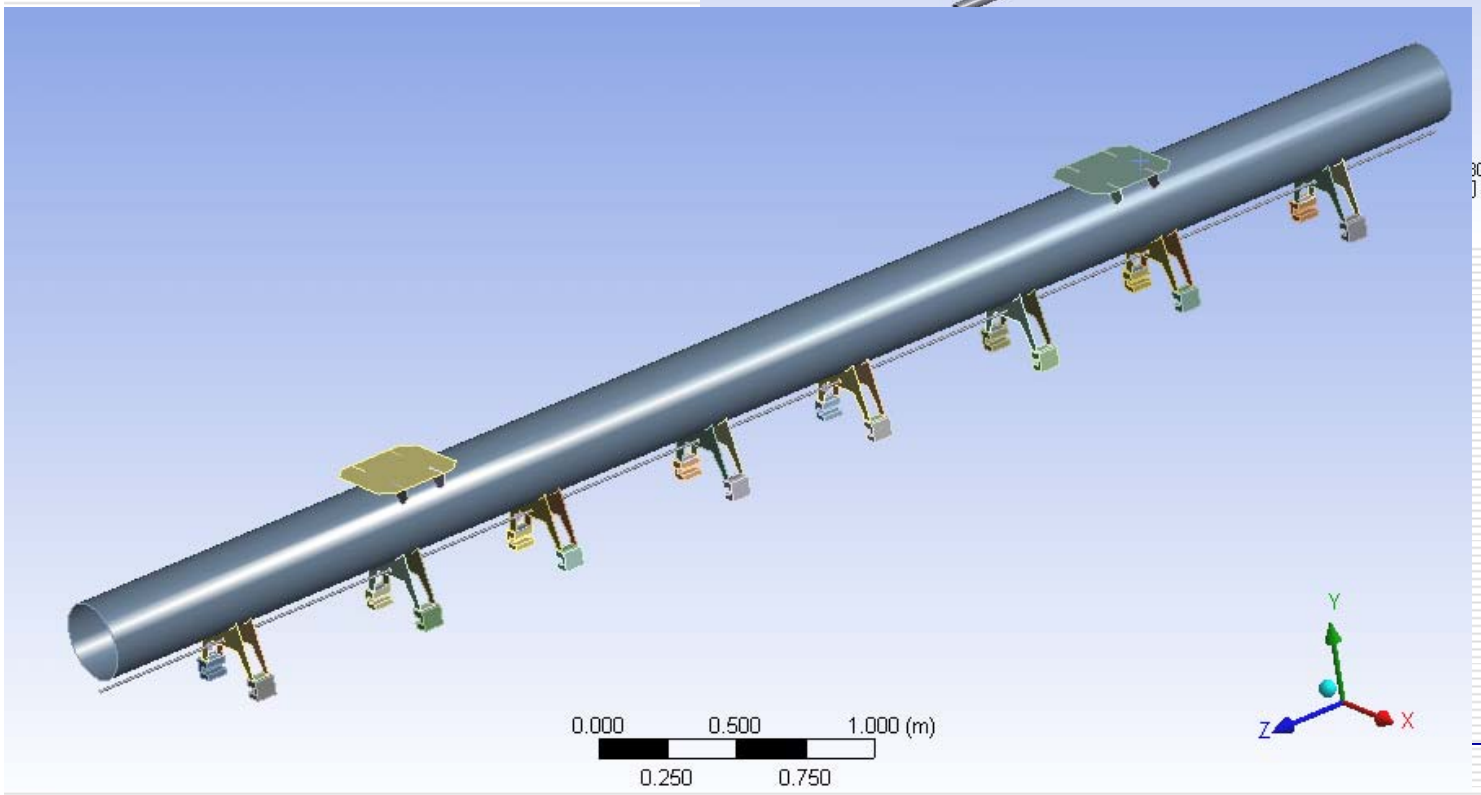




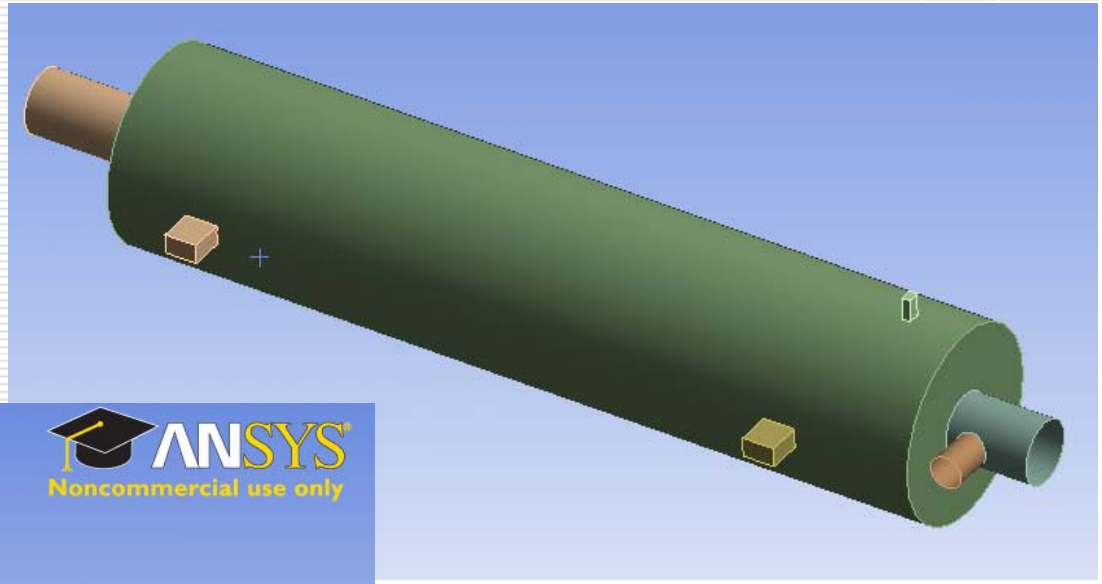


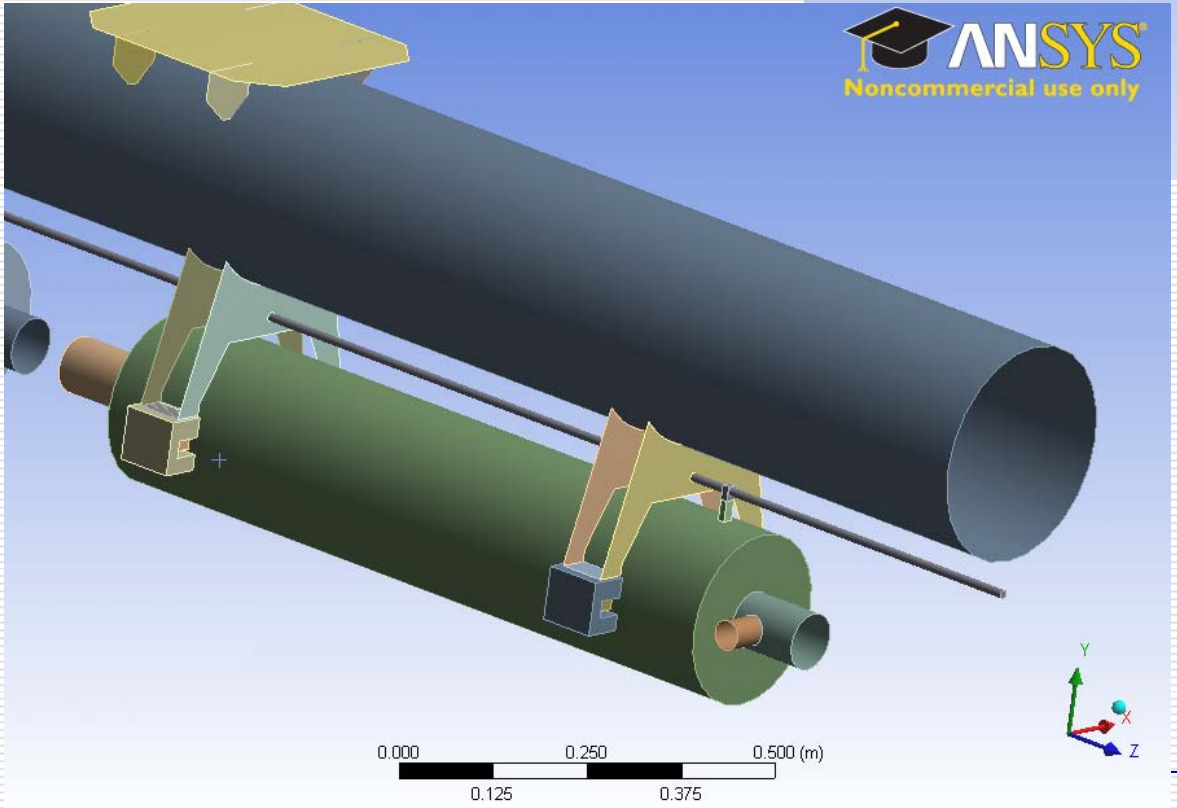
GRP and shapes





Helium tanks, beam pipes and coupler ports





Loads

- Temperatures:
  - 300 K at upper post disk
  - 77 K at finned pipe surface
  - 4 K at finned pipe surface
  - 2 K at GRP and tank surfaces

- Heat flux (radiation):
  - 1 W/m^2 at 77 K shield surface
  - 0.05 W/m^2 at 4 K shield surface

- Heat flow (conduction of RF cables and couplers):
  - 0.5 W at 2 K coupler edge
  - 2.8 W at 4 K coupler opening edges
  - 16.3 W at 77 K coupler opening edges

Loads (summary table)

Radiation	***W/m^2***	**heat flux at shield surfaces**
2K	-	
4K	0.05	
77K	1	
Conduction at couplers	***W***	heat flow on coupler opening edges
2K	0.4	Scaled from Tesla TDR data
4K	1	
77K	10.5	
Conduction of RF cables	***W***	heat flow on coupler opening edges
2K	0.063	Norihito data
4K	1.78	
77K	5.75	
Total load at coupler edges	***W***	**effective heat flow on the model**
2K	0.5	
4K	2.8	
77K	16.3	

Loads: open question

Original data from Tom excel file

Data to be confirmed

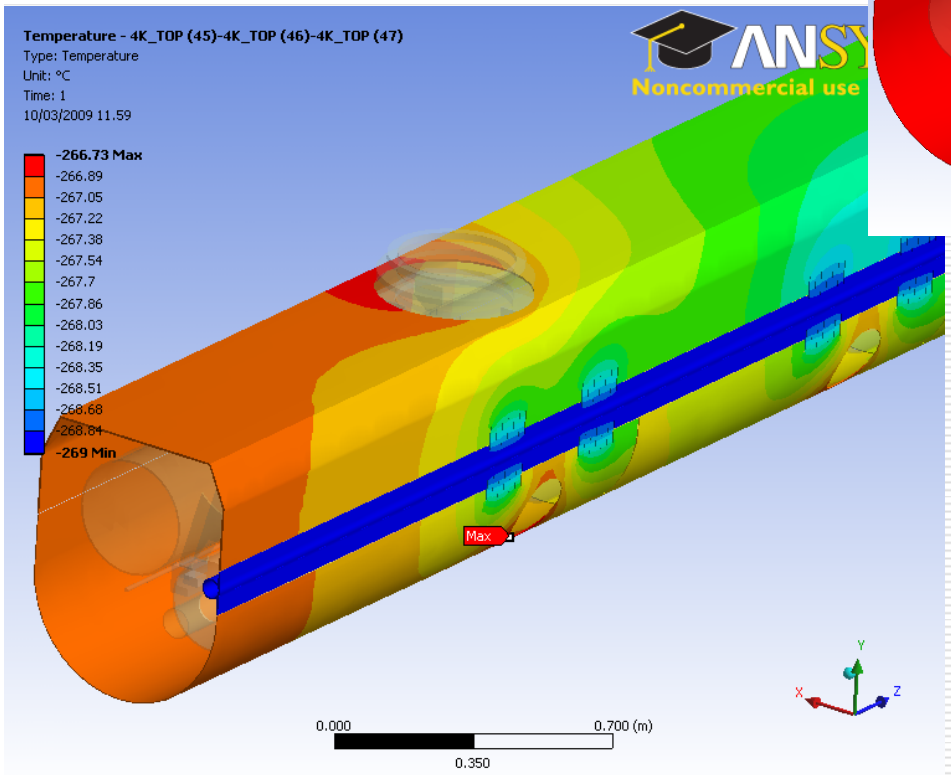
2K	*notes*
RF load	OK: =0 for static
Supports	calculated by ansys
Input coupler	OK
HOM coupler (cables)	OK
HOM absorber	OK: = 0
Beam tube bellows	= 0
Current leads	OK: =0 for no quad
HOM to structure	= 0
Coax cable	= 0
Instrumentation taps	= 0

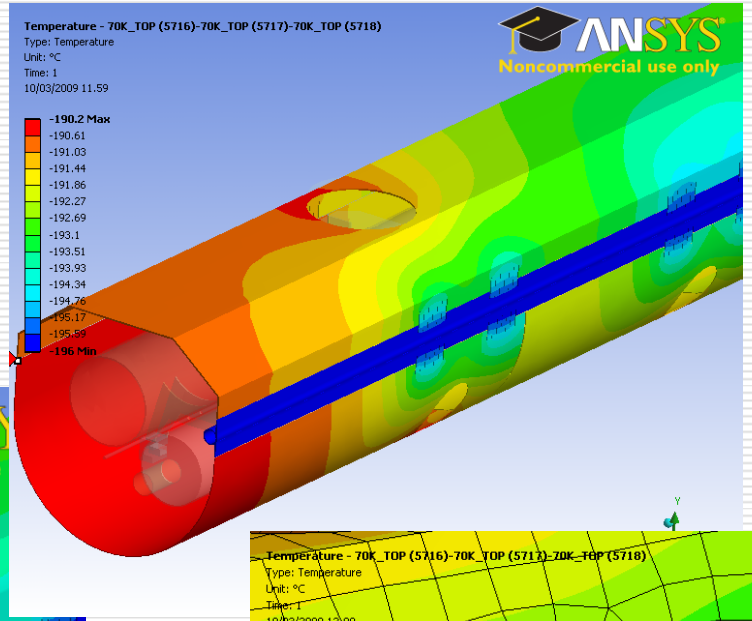
5K / 40K	
Radiation	OK
Supports	calculated by ansys
Input coupler	OK
HOM coupler (cables)	OK
HOM absorber	OK: = 0
Current leads	OK: =0 for no quad
Diagnostic cable	to be calculated

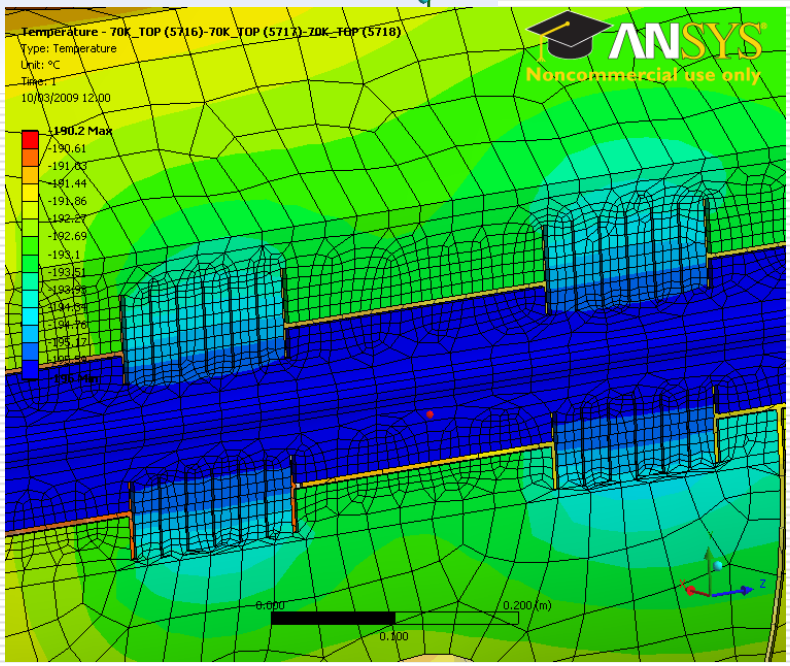
Preliminary results: reactions

- At 2 K: 0.5 W
- At 4 K: 5.8 W
- At 77 K: 50.7 W
- At 300 K: 21.8 W

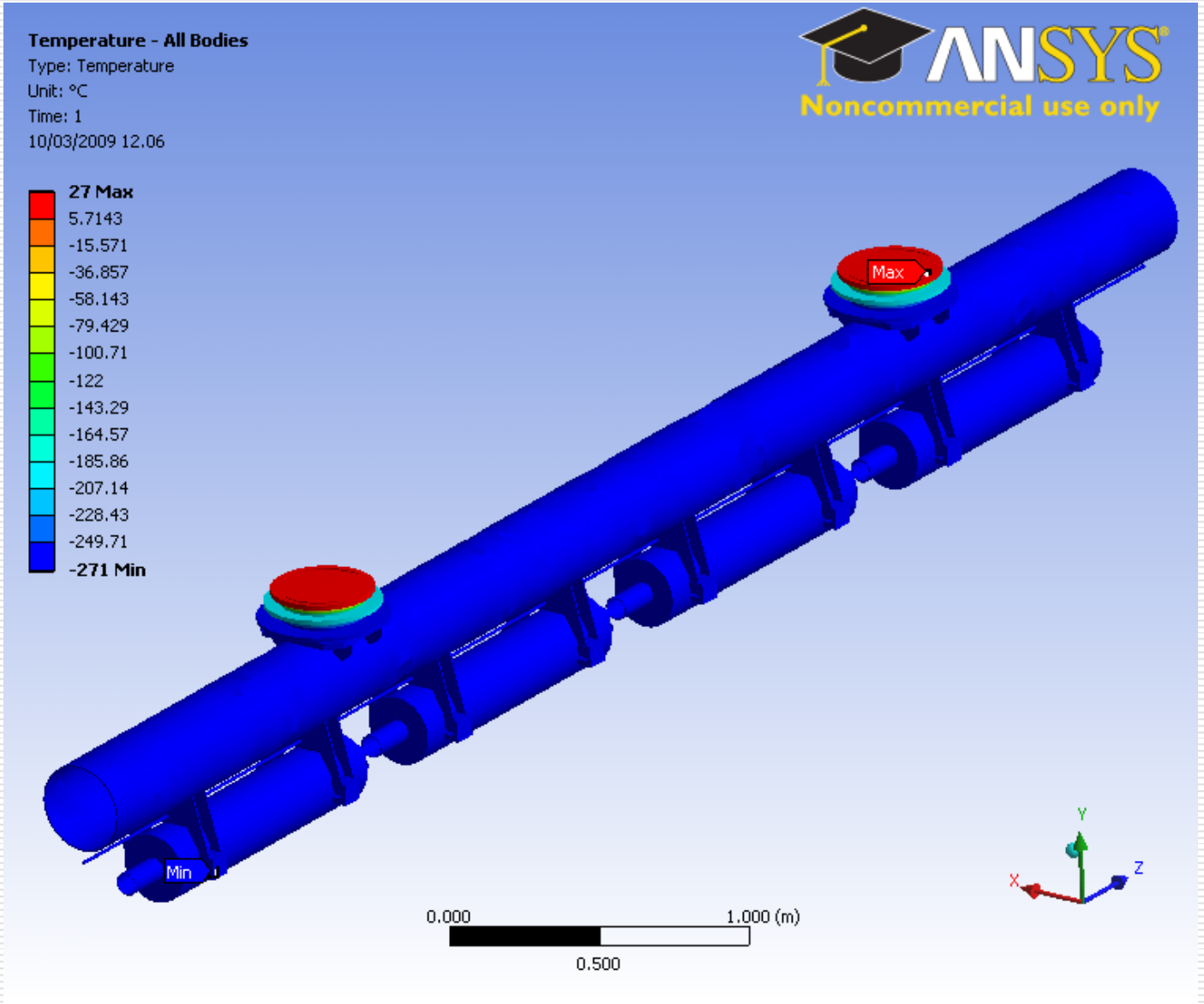
Results: shields



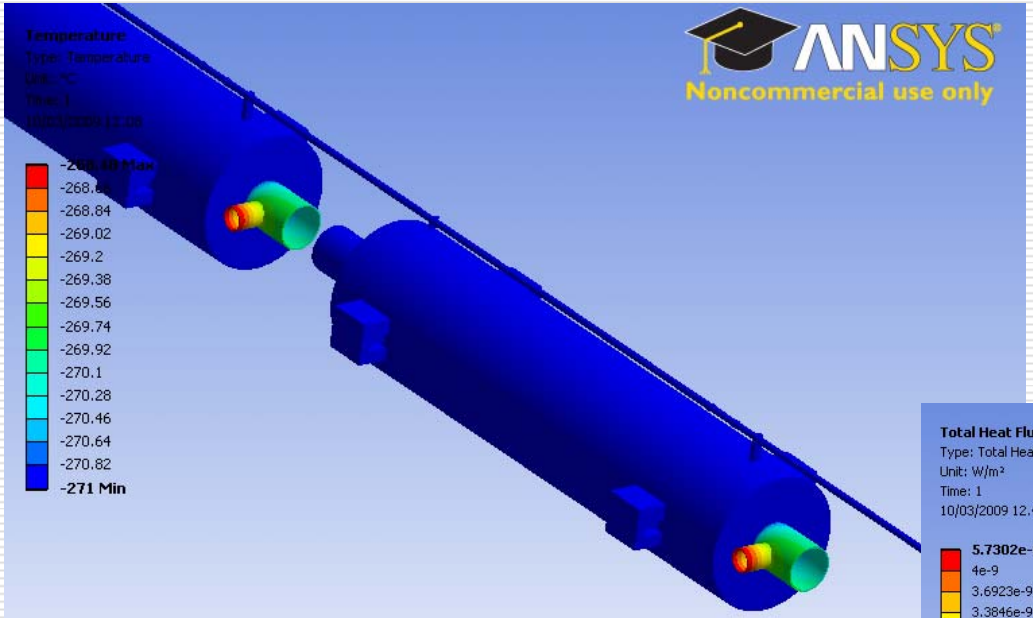


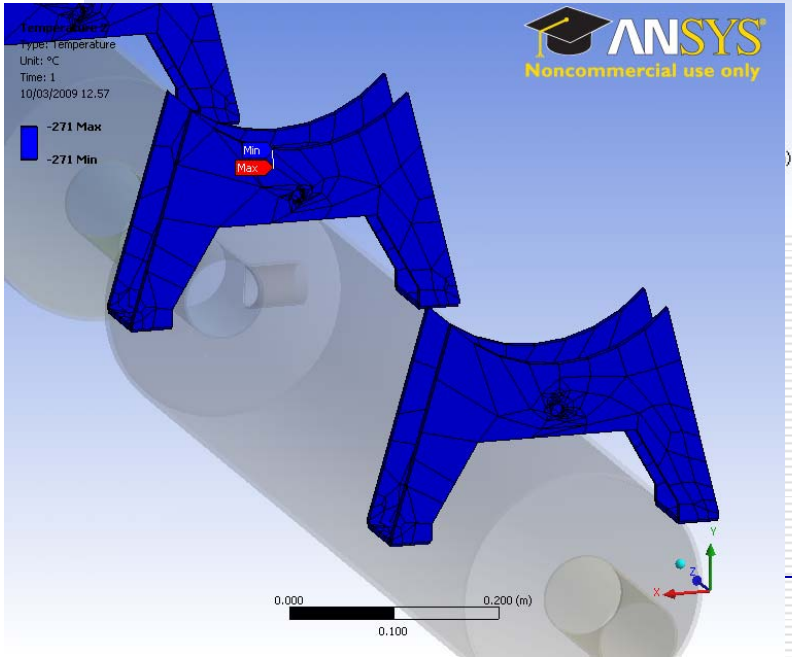


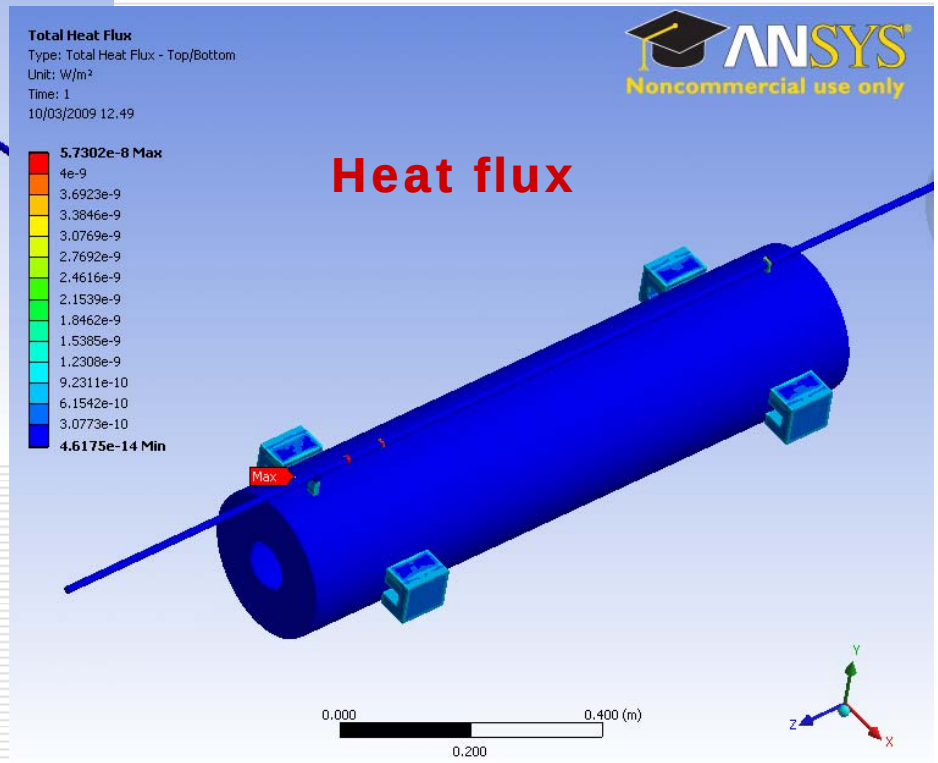
Results: GRP, shapes, posts



Results: cavity string







Heat flux

Next steps

- Verify heat loads for the static simulation (fill Tom table with S1 global data and confirm RF cables design)
- Implement cool down and warm procedure at the KEK facility for the transient simulation
- Verification of calculated data with experimental data collected by KEK