

PANDA Fw Endcap EMC, status prototype

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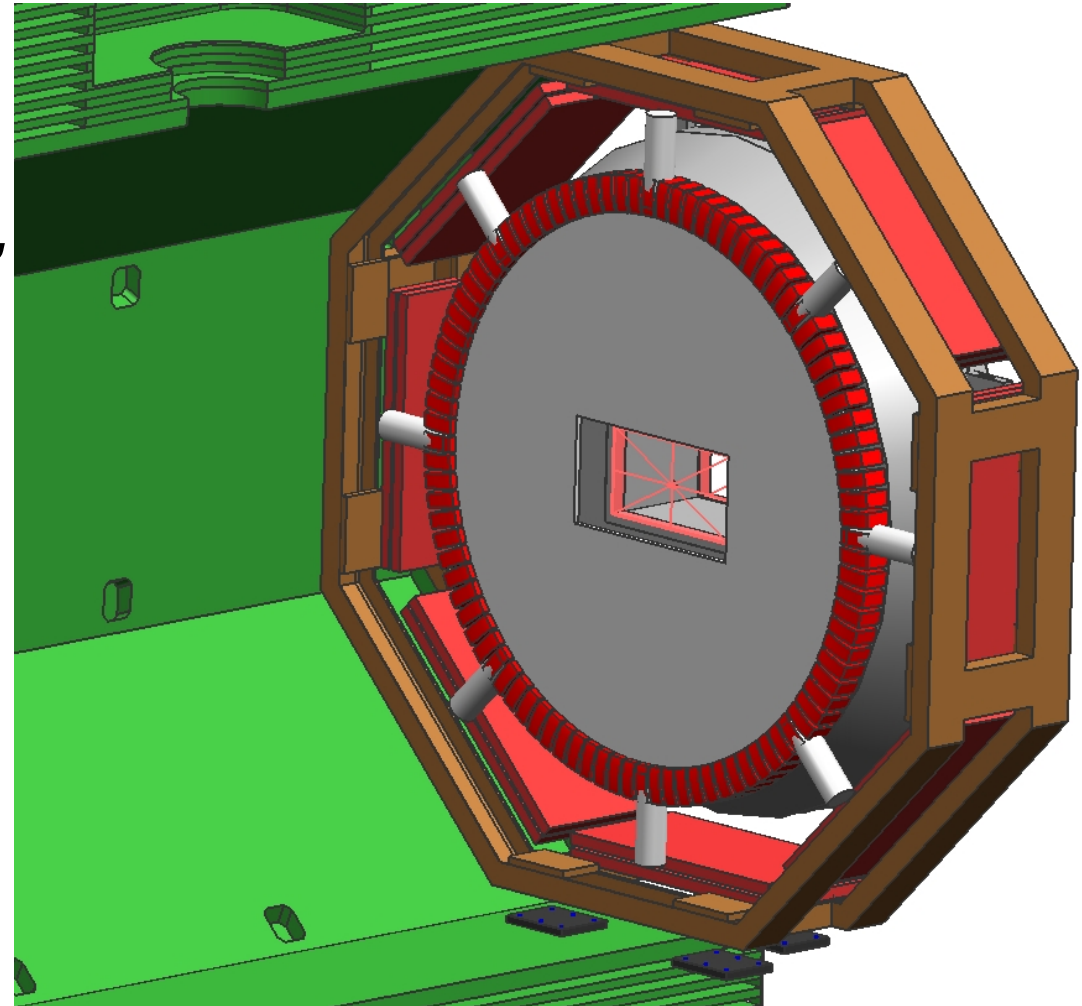
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Annelie Kluttig (research engineer),

KVI Groningen

Unigraphics FEM calculations

thermal insulation and cooling:
front cover,
cold-warm connections

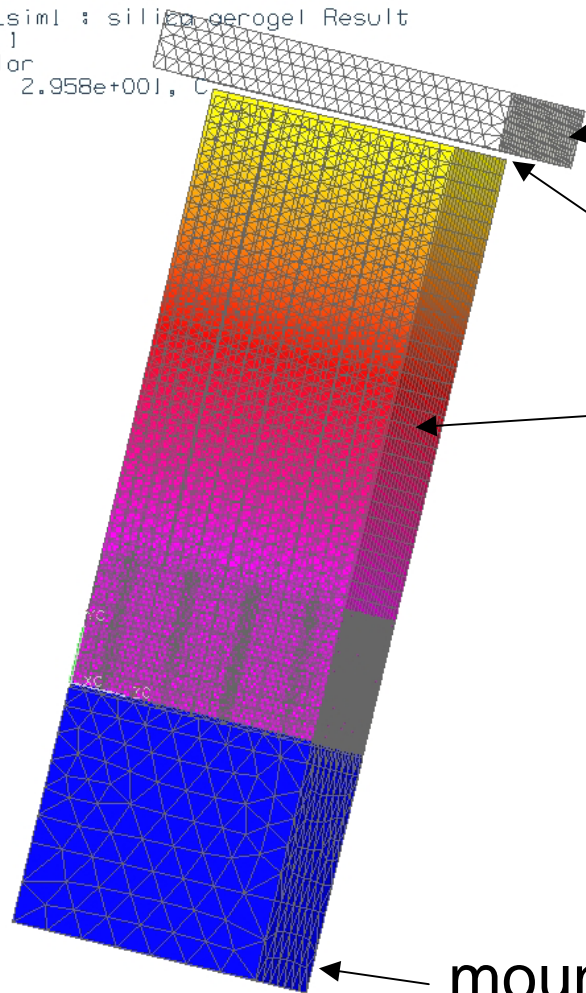


model of complete single alveole



with 16 crystals, VPT and Al mounting structures

Thermal Henk plus shield_sim1 : silica_aerogel Result
Load Case 1, Static Step 1
Temperature - Nodal, Scalar
Min : -2.500e+001, Max : 2.958e+001, C



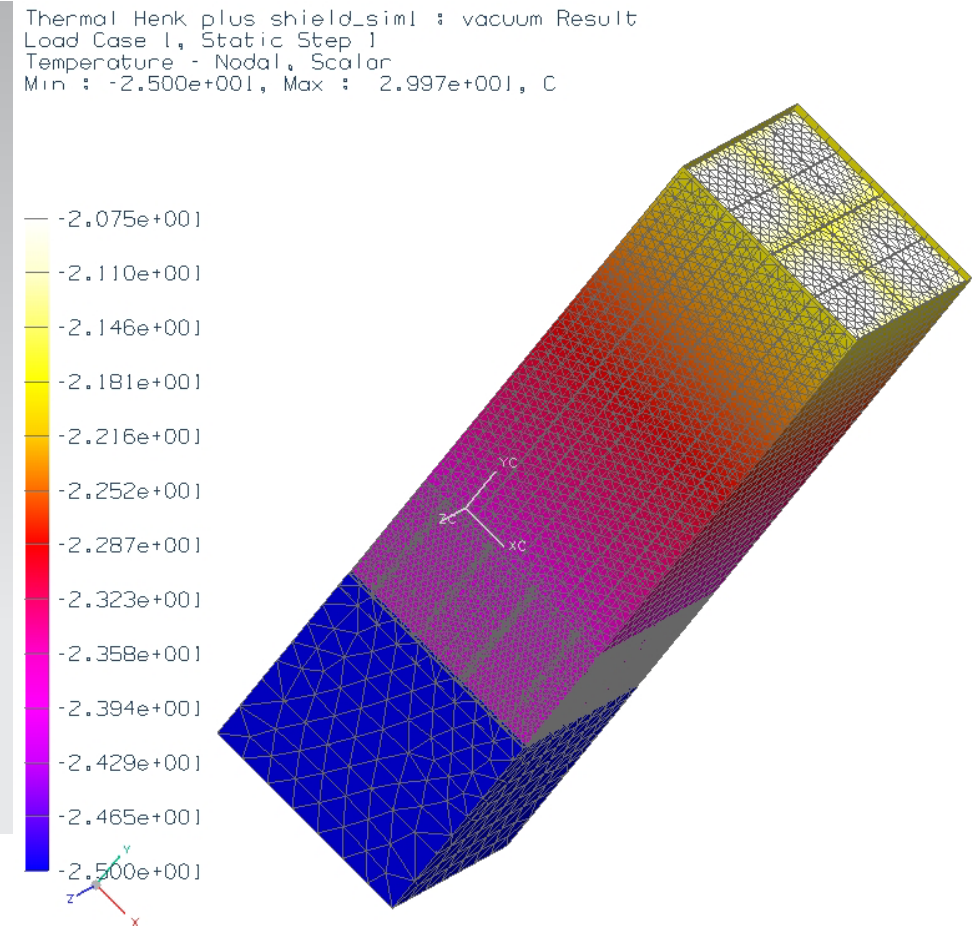
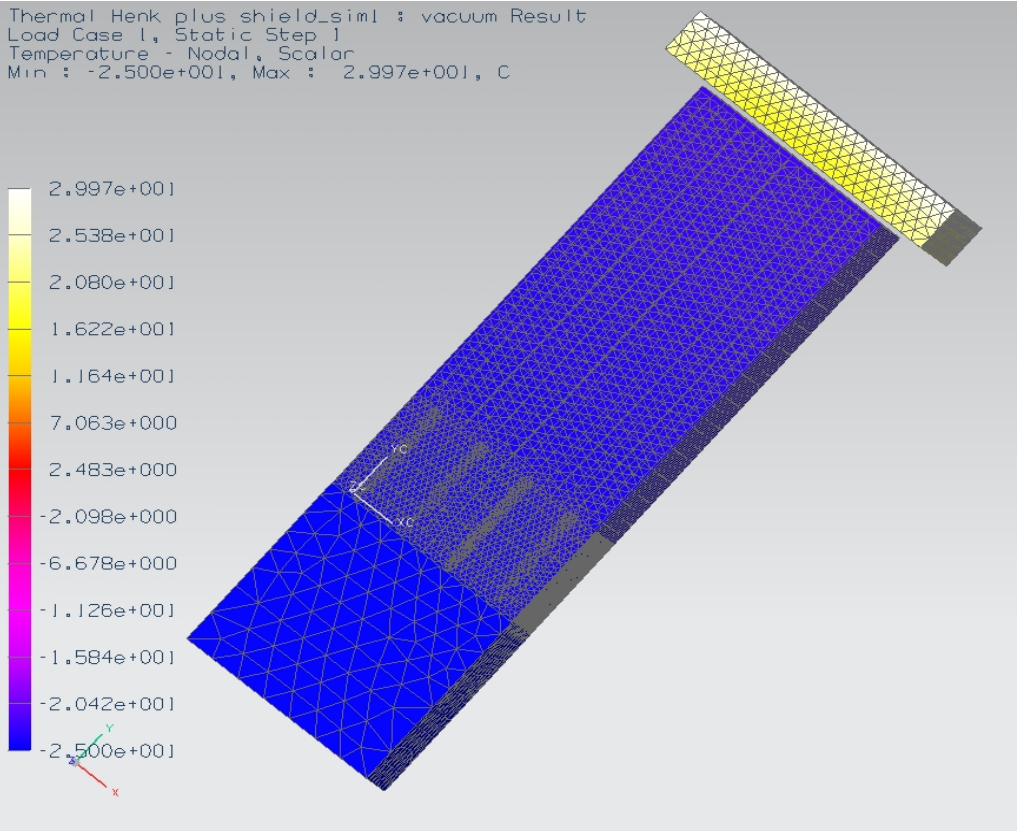
ambient temperature $T=30^{\circ}\text{C}$
silica aerogel insulation,
thermal cond. $k = 0.024\text{ W}/(\text{K m})$
no contact, only radiation

continuous boundary conditions
on the side faces

**too large temperature gradient:
need better insulation**

mounting plate cooled to $T=-25^{\circ}\text{C}$

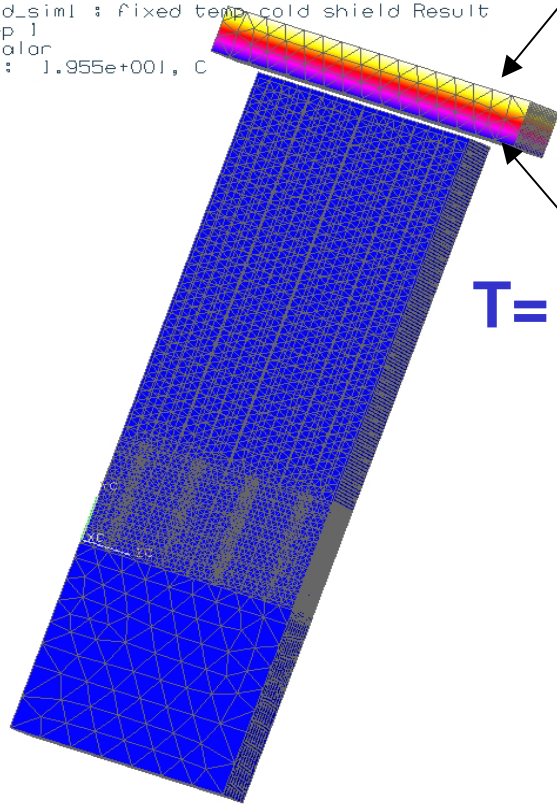
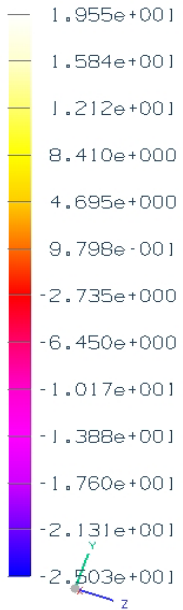
perfect front insulation: vacuum



even with vacuum insulation: temperature gradient of 4 K

front cooling

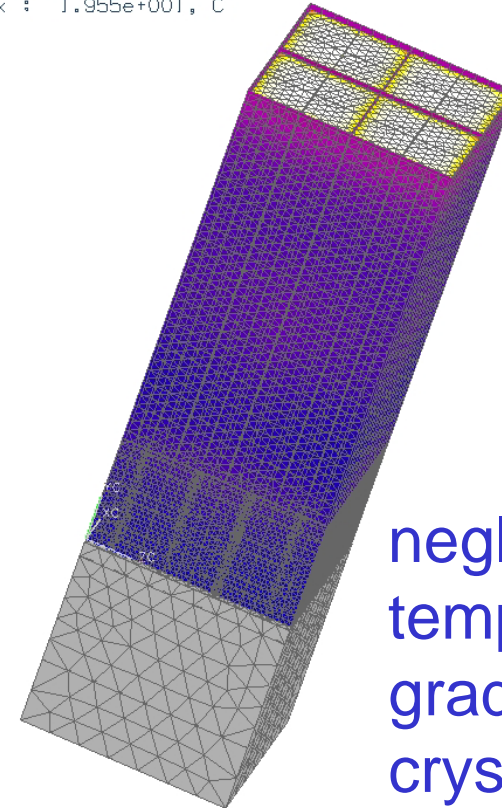
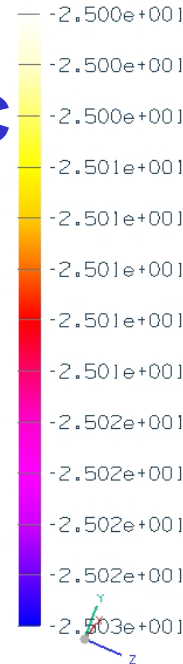
Thermal Henk plus shield_sim1 : fixed temp cold shield Result
Load Case 1, Static Step 1
Temperature - Nodal, Scalar
Min : -2.503e+001, Max : 1.955e+001, C



T= 20°C

T= -25°C

Thermal Henk plus shield_sim1 : fixed temp cold shield Result
Load Case 1, Static Step 1
Temperature - Nodal, Scalar
Min : -2.503e+001, Max : 1.955e+001, C



negligible
temperature
gradient in
crystals

shield facing the crystals kept at -25°C

how can we achieve this?

composite shield

lightweight polymethacrylimide low density rigid foam
 $k=0.03 \text{ W/(K m)}$

25 mm Rohacell

1 mm Al

3 mm N₂ at T=-25°C

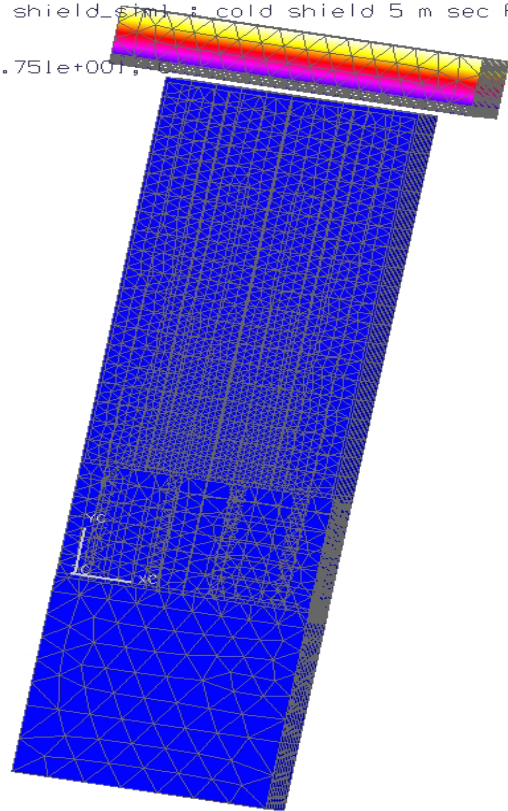
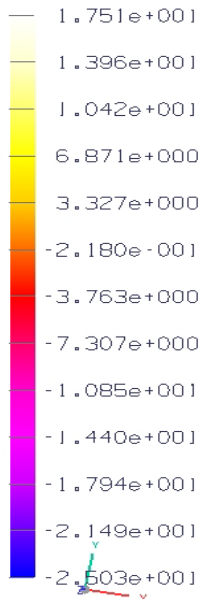
1 mm Al

no contact yet!

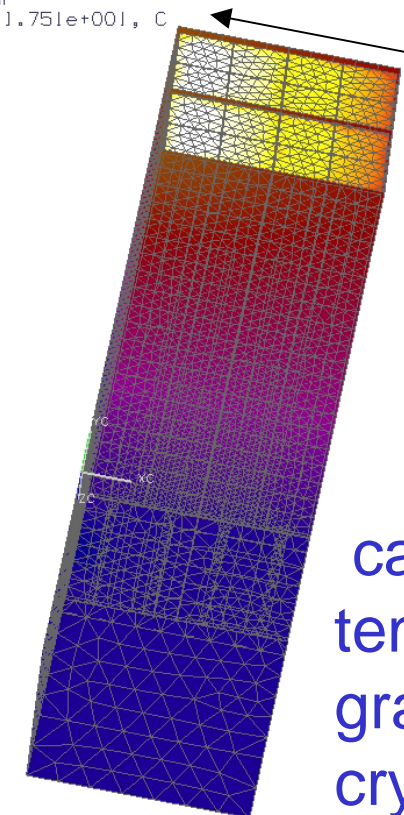
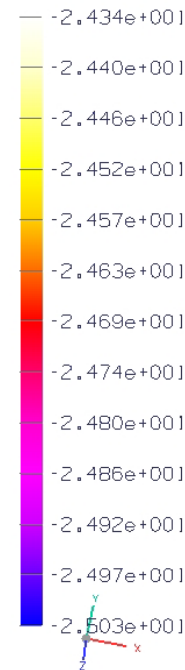
moderate dry N₂ flow in 3 mm gap: 5 m/s

composite shield + front cooling

Thermal Henk plus composite shield_sim1 : cold shield 5 m sec Result
Load Case 1, Static Step 1
Temperature - Nodal, Scalar
Min : -2.503e+001, Max : 1.751e+001, C



Thermal Henk plus composite shield_sim1 : cold shield 5 m sec Result
Load Case 1, Static Step 1
Temperature - Nodal, Scalar
Min : -2.503e+001, Max : 1.751e+001, C



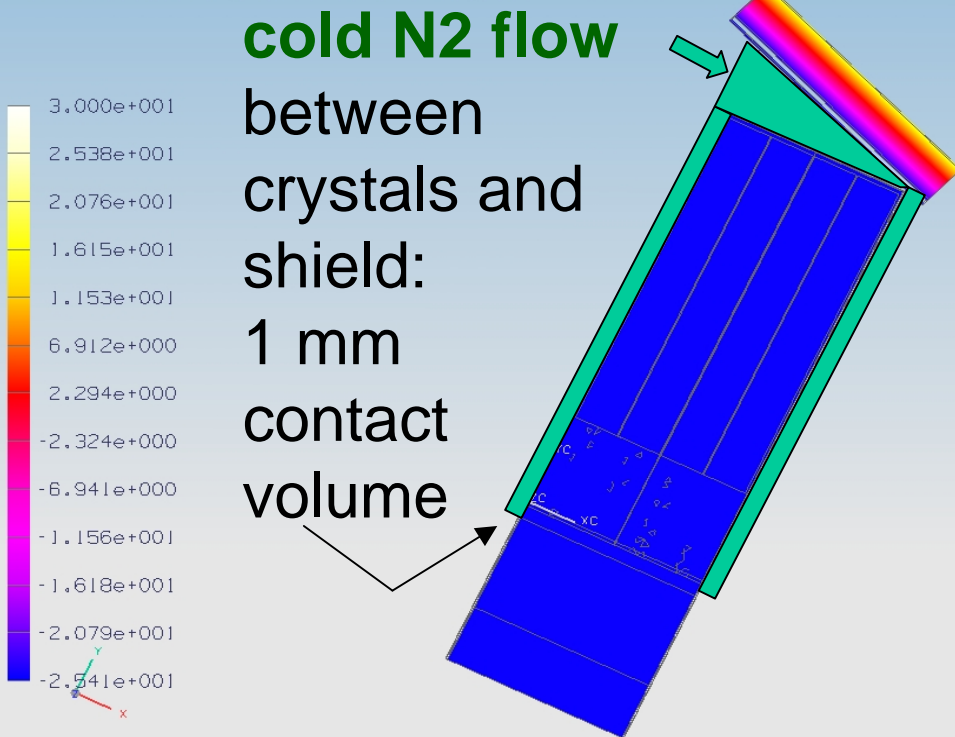
N2 flow

ca. 1 K
temperature
gradient in
crystals

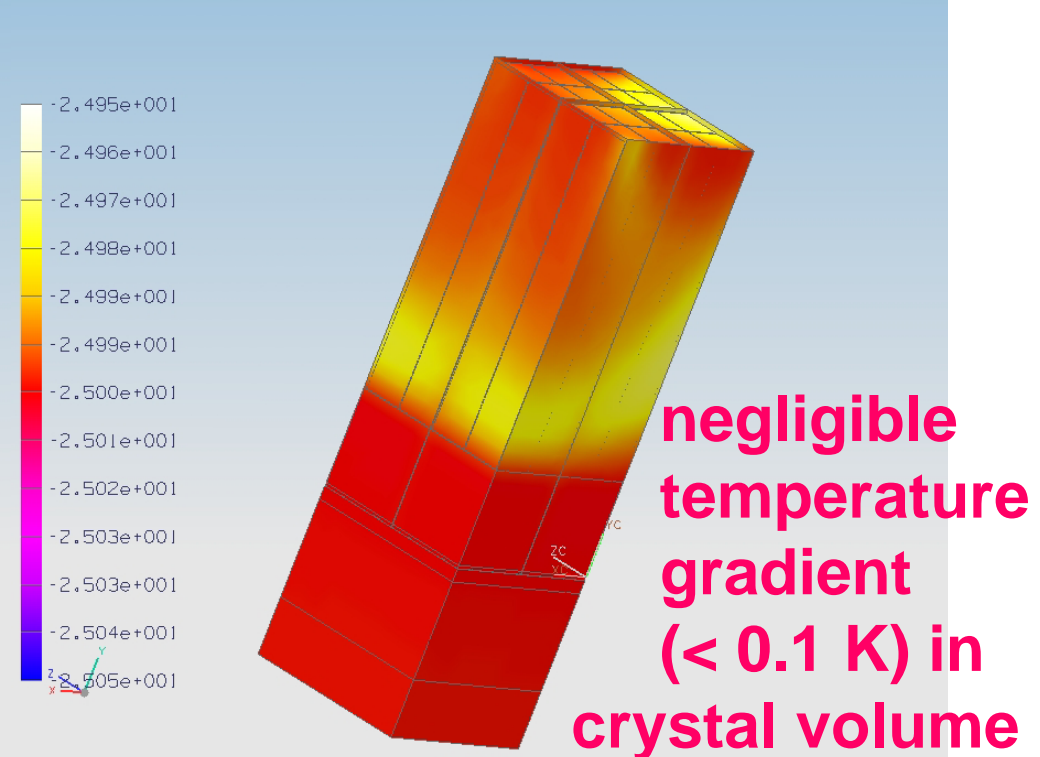
composite thermal shield:
25 mm Rohacell, 3mm dry N₂ at T=-25°C between 2x 1mm Al

cold N₂ contact volume: conduction and convection

Thermal Henk plus angled composite shield_sim1 : cold shield 5 m sec Result
Load Case 1, Static Step 1
Temperature - Nodal, Scalar
Min : -2.541e+001, Max : 3.000e+001, C



Thermal Henk plus angled composite shield_sim1 : cold shield 5 m sec Result
Load Case 1, Static Step 1
Temperature - Nodal, Scalar
Min : -2.505e+001, Max : 3.000e+001, C

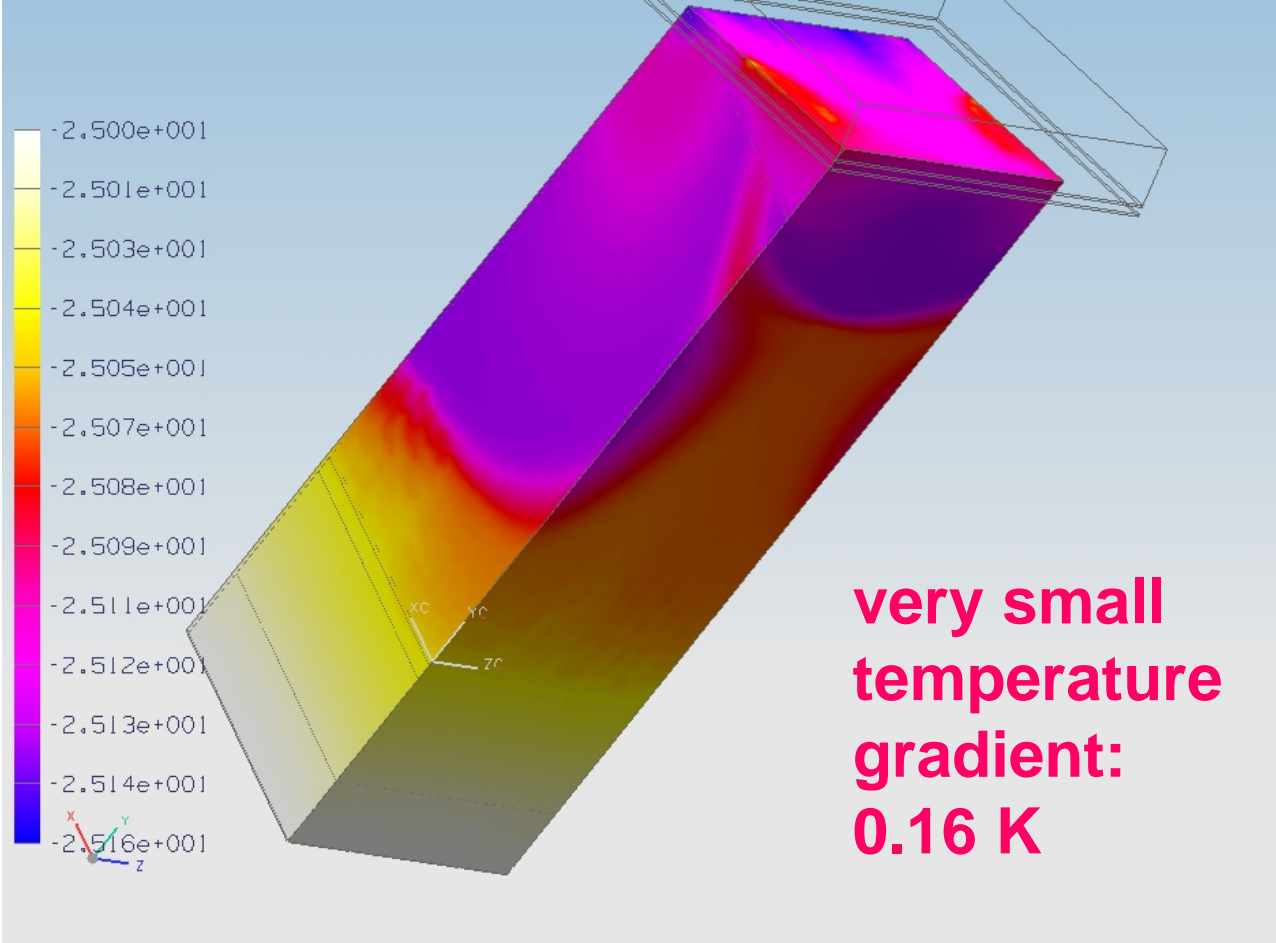


planar Endcap setup:

staggered arrangement of alveoli with triangular gaps: max. angle 20°,
filled with cold dry N₂ at T=-25°C (flow 5 m/s)

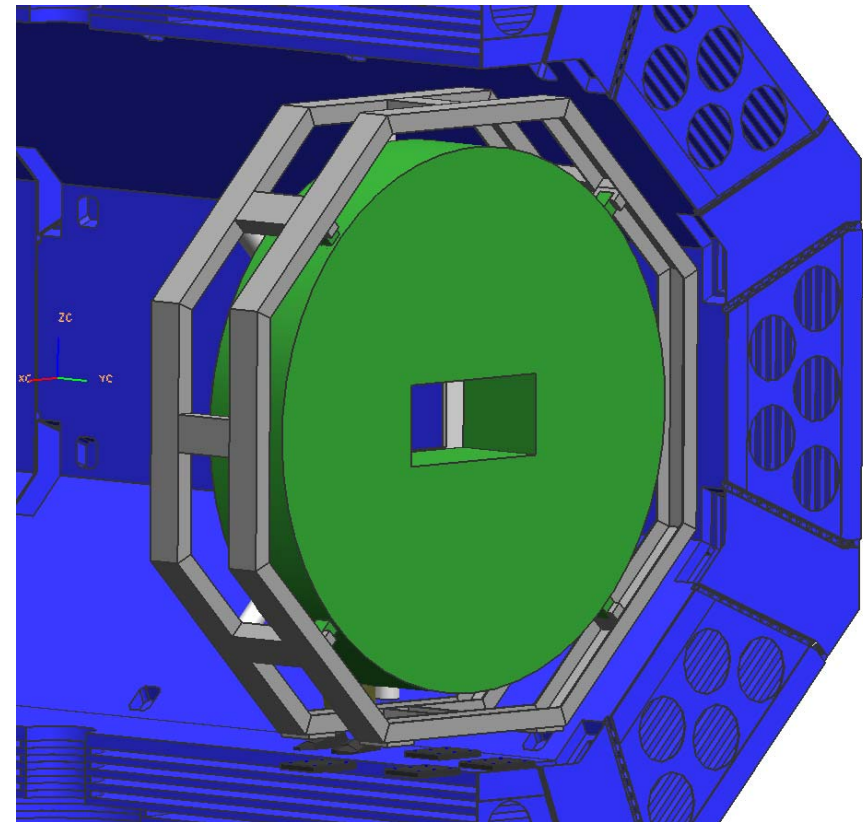
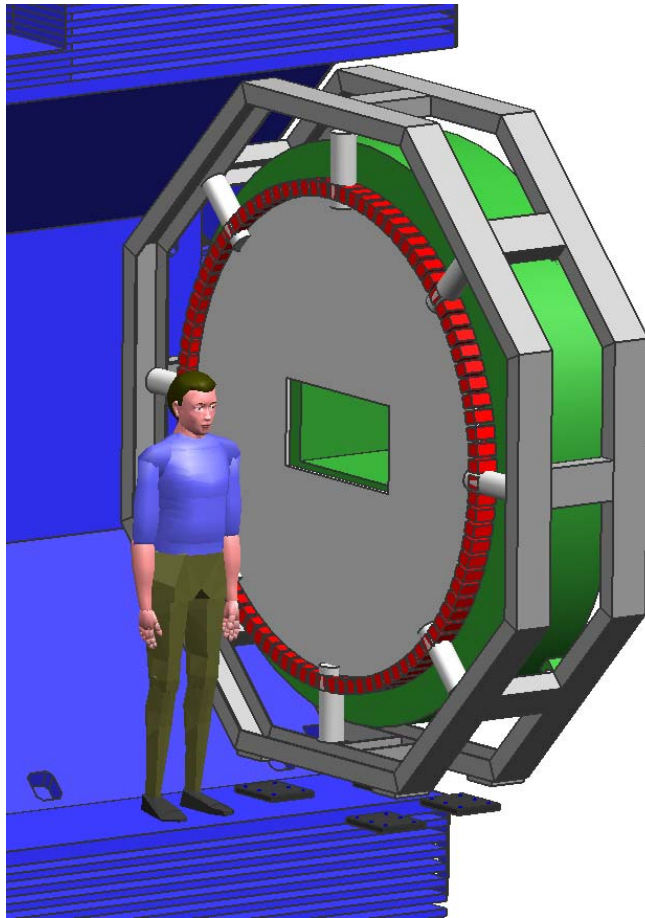
temperature distribution in N₂ volume

Thermal Henk plus angled composite shield_sim1 : cold shield 5 m sec Result
 Load Case 1, Static Step 1
 Fluid Temperature - Element-Nodal, Unaveraged, Scalar
 Min : -2.516e+001, Max : -2.393e+001, C



insulating endcap mounting

self-supporting endcap frame, resting on bottom layer of solenoid

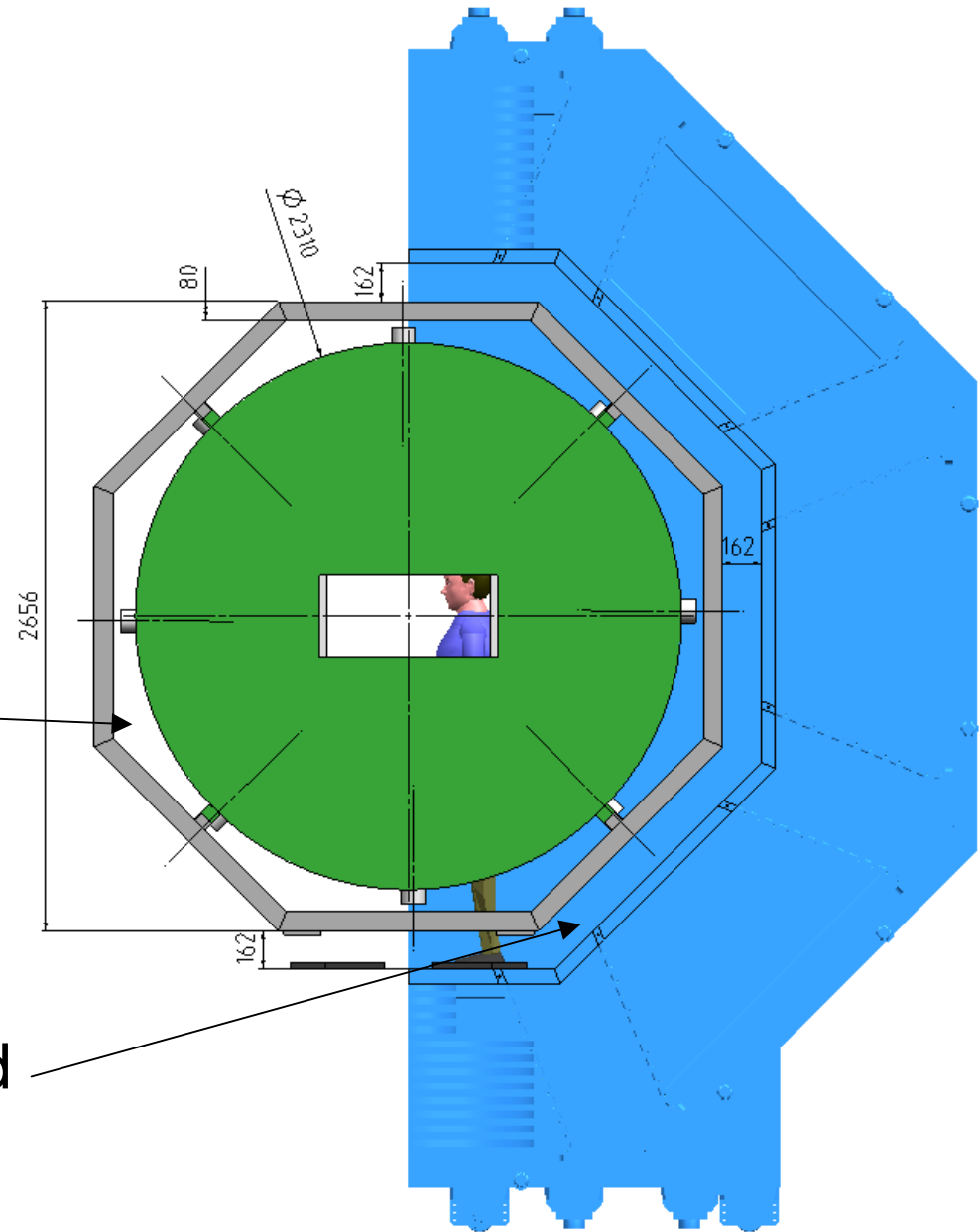


current frame size

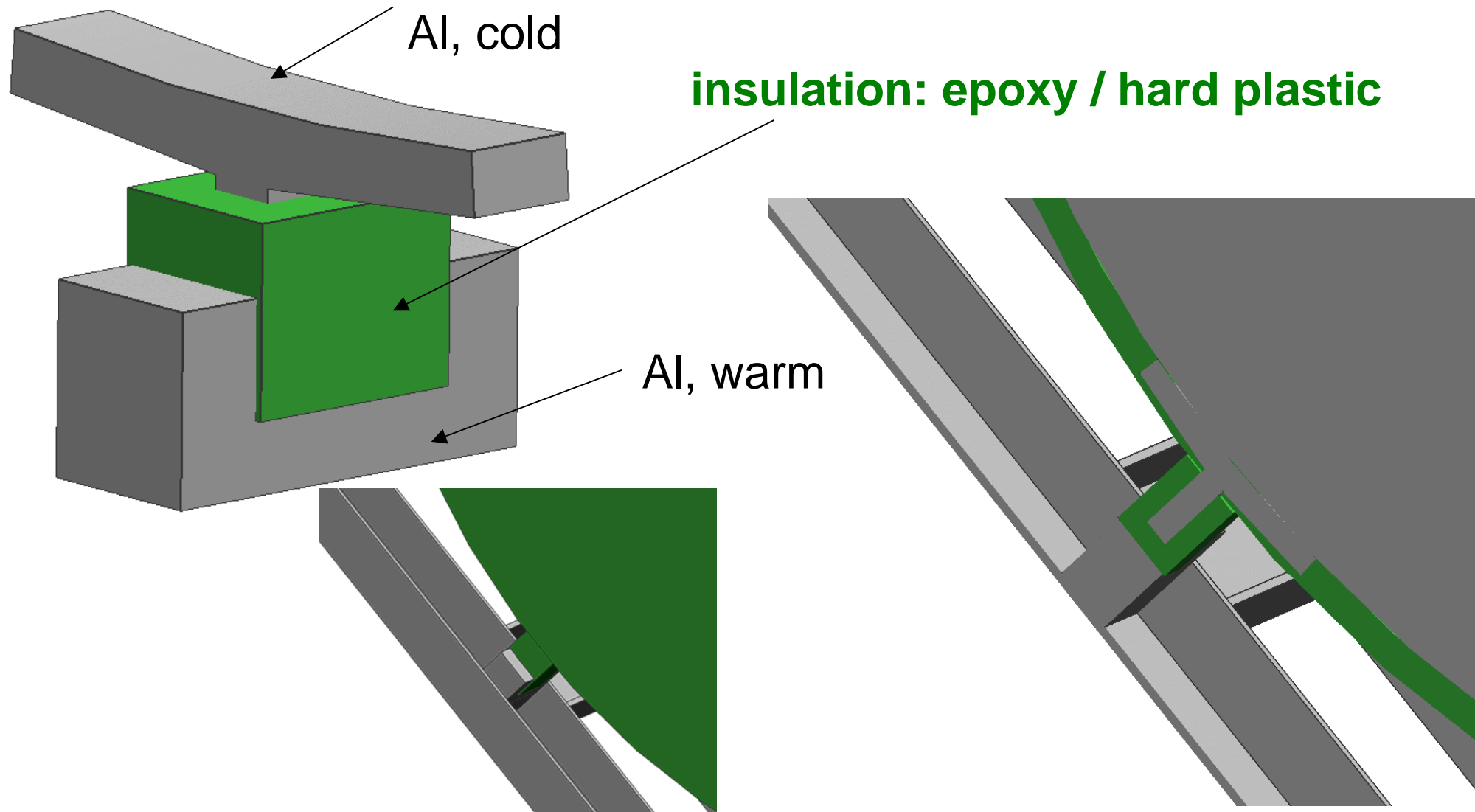
with space available for

electronics
between endcap and
mounting frame

and mounting frame and solenoid



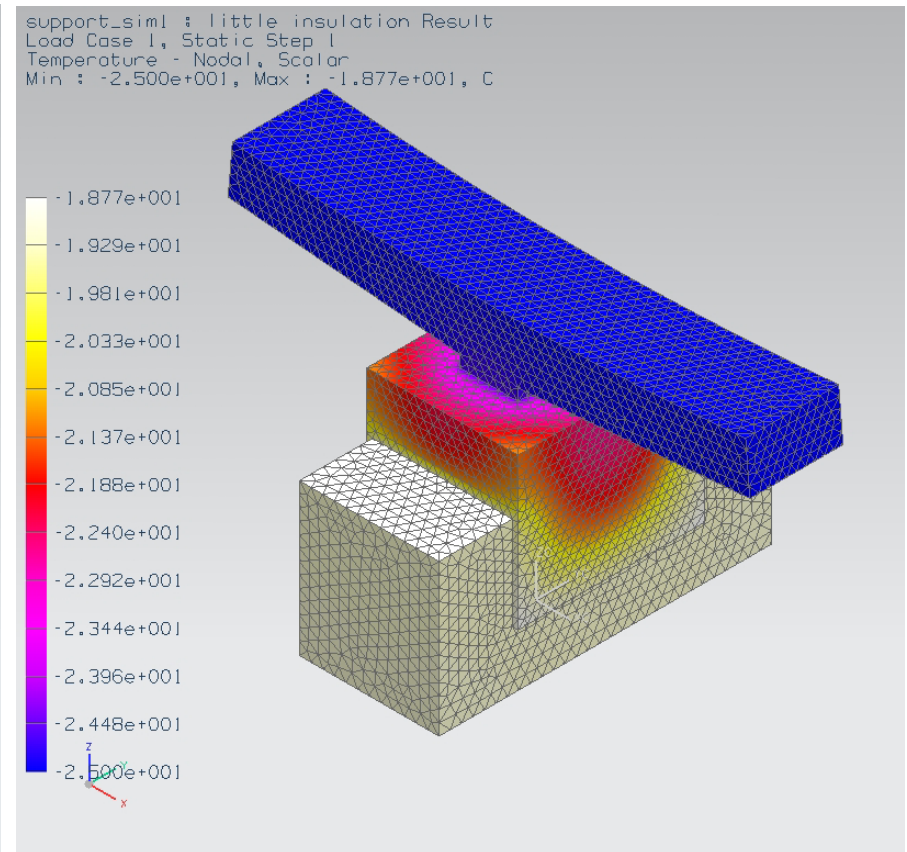
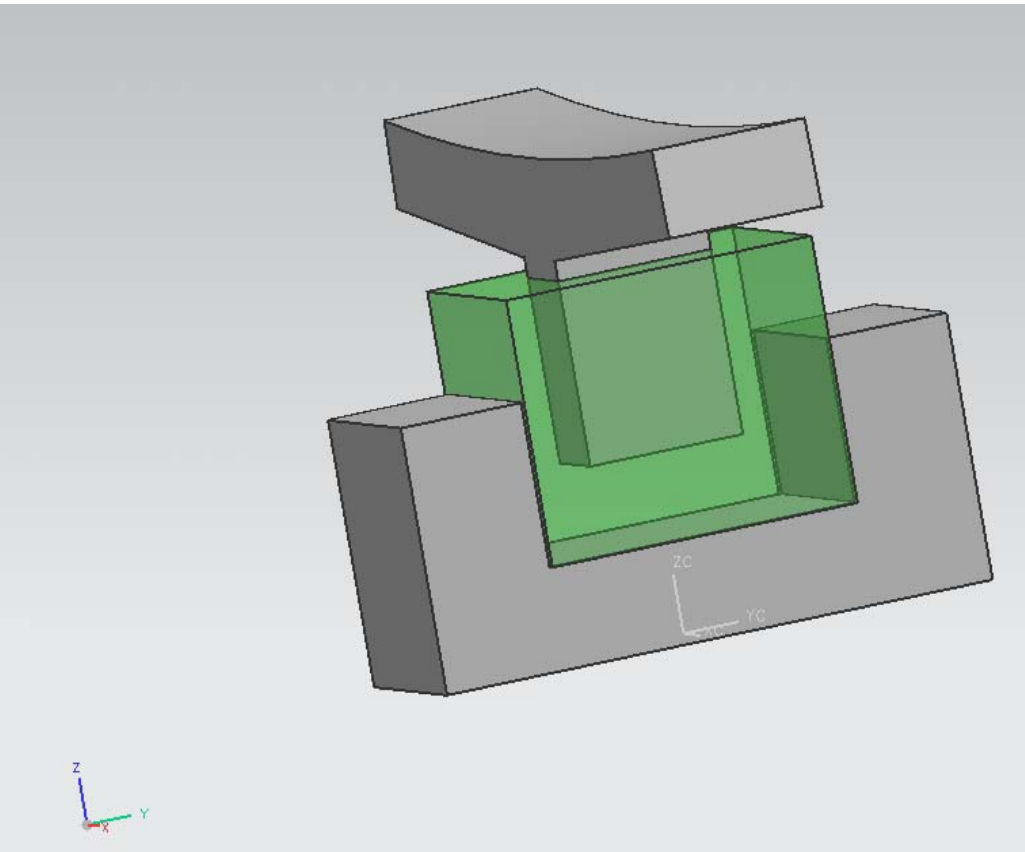
contact points cold - warm



Cold-warm connection

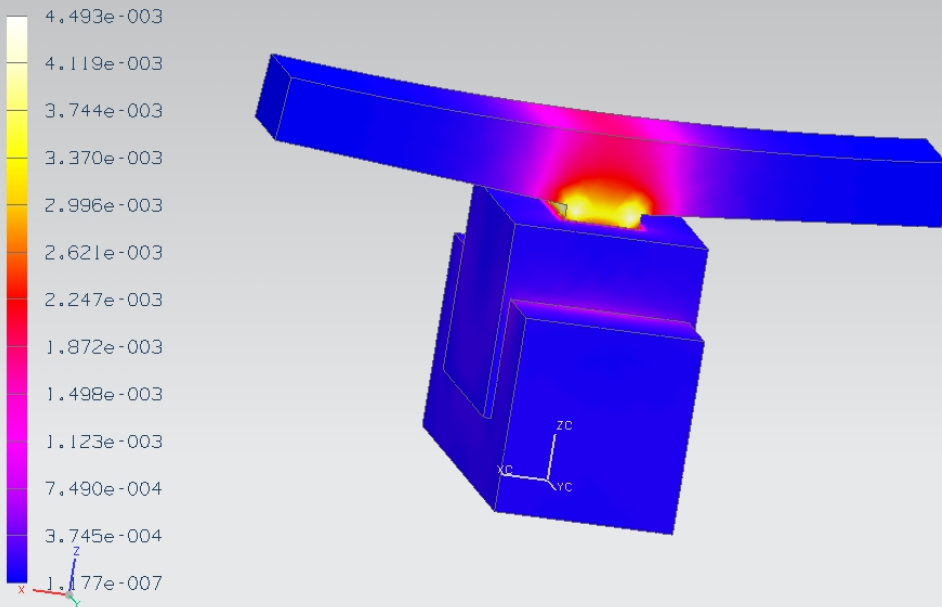
mechanical construction

temperature gradient

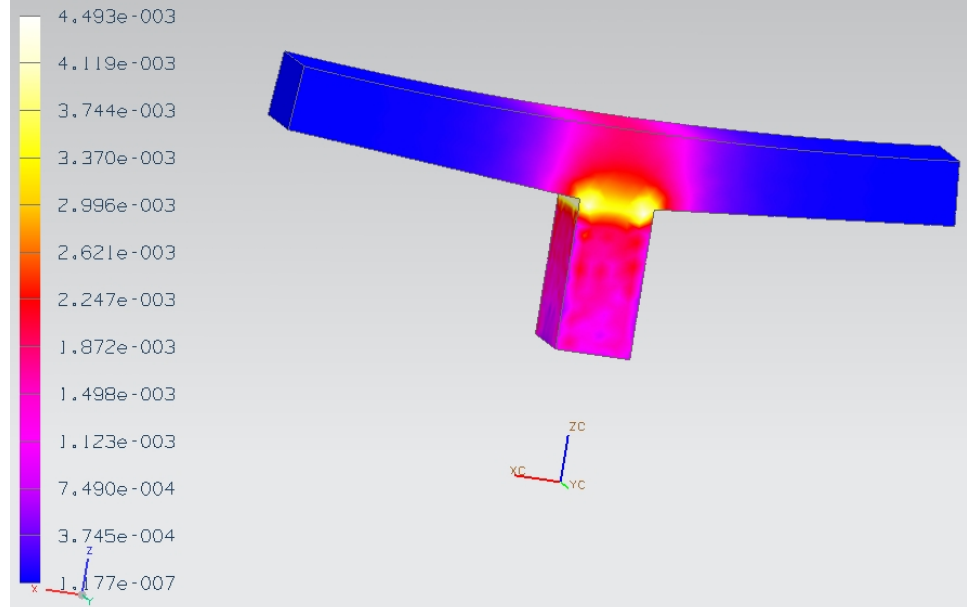


heat flux

support_sim1 : little insulation Result
Load Case 1, Static Step 1
Conductive Flux - Elemental, Magnitude
Min : 1.177e-007, Max : 4.493e-003, W/mmA2



support_sim1 : little insulation Result
Load Case 1, Static Step 1
Conductive Flux - Elemental, Magnitude
Min : 1.177e-007, Max : 4.493e-003, W/mmA2



work in progress, preliminary resultson heat flux:
max. 5 mW /mm² seems acceptable

summary



small temperature gradient (< 0.1 K) can be achieved by composite shield with cooling by moderate internal and external N_2 flow

Al contact pins in insulating epoxy / hard plastic block seem to provide an acceptable heat flux

