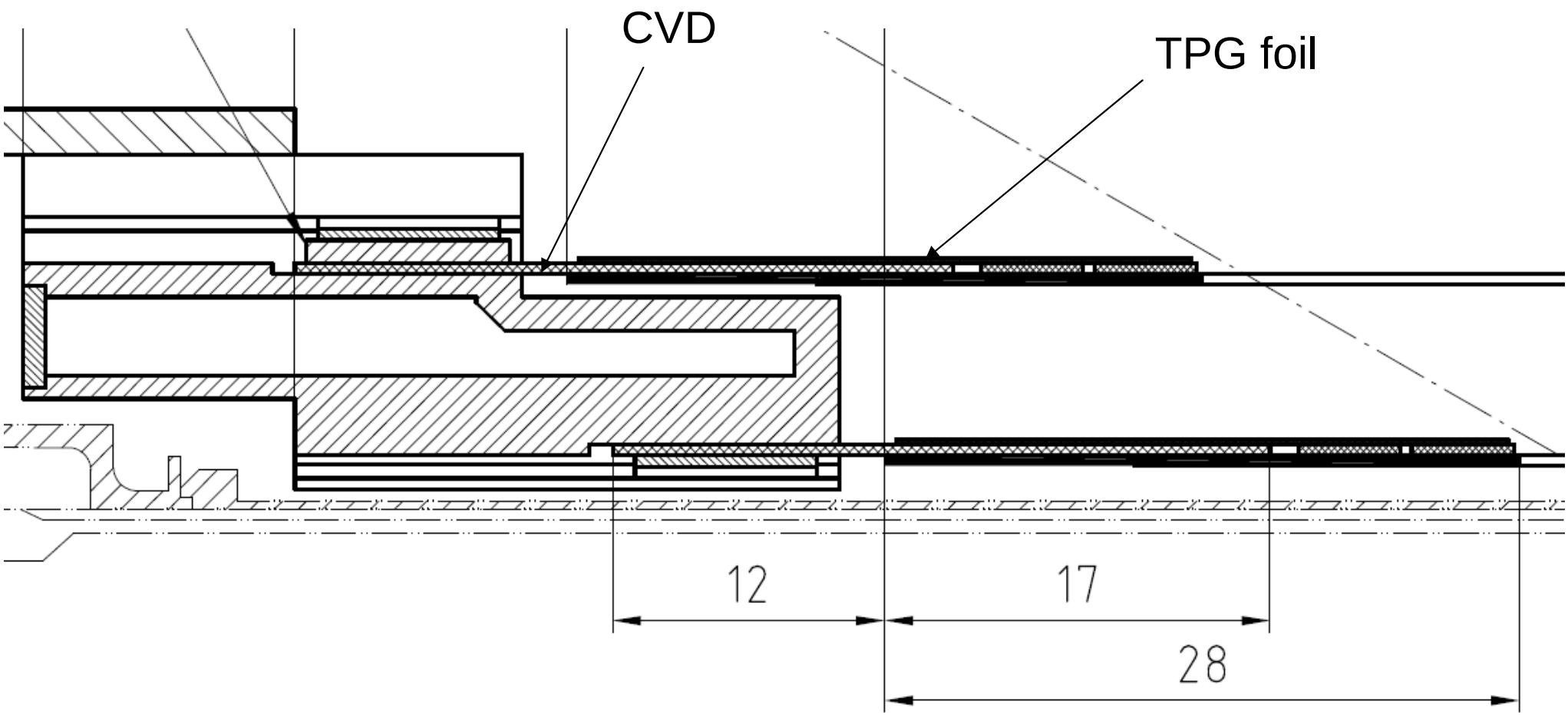
Status of Thermal Studies at MPI

C. Kiesling

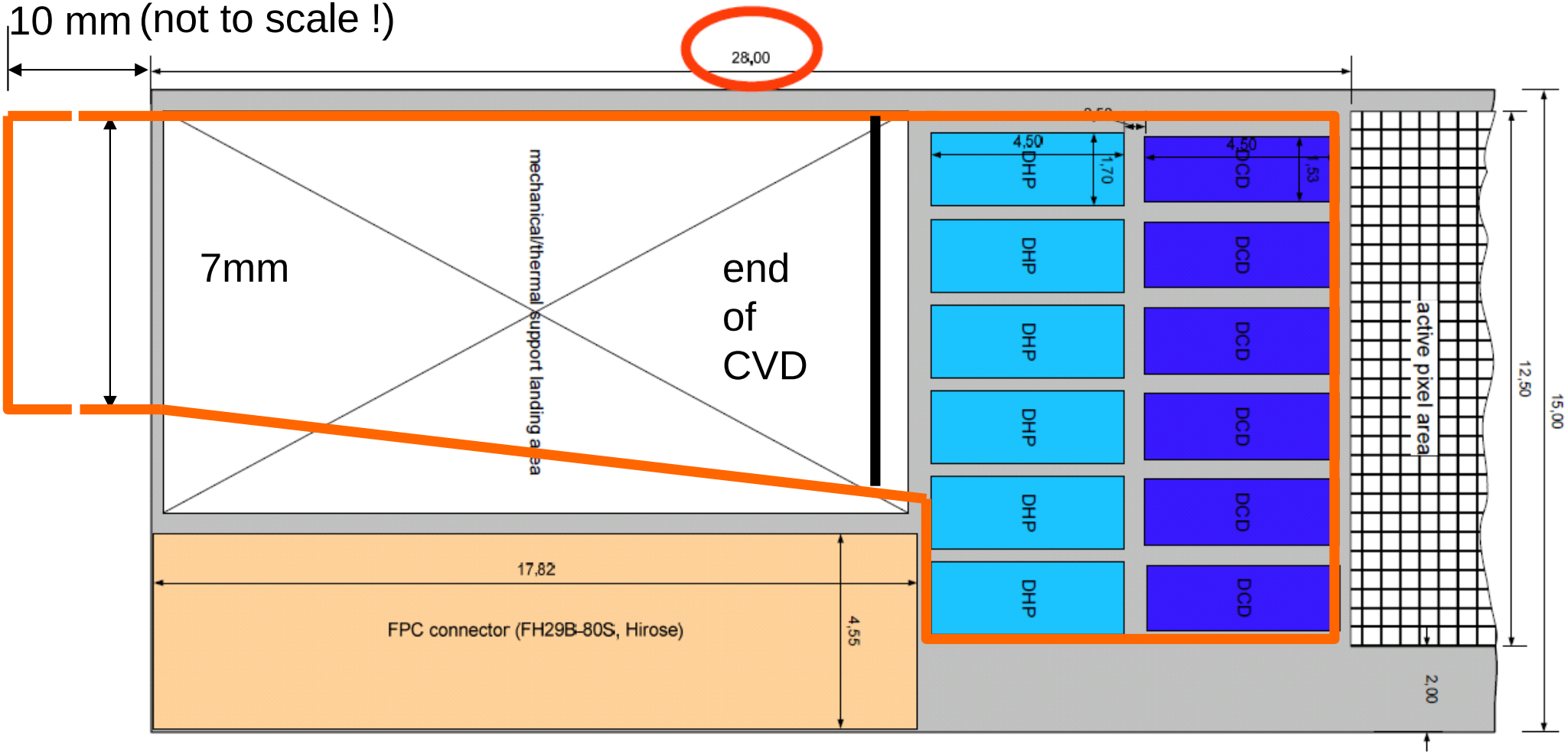
(for Holger Wetteskind)

VERY PRELIMINARY !!!

End Section of the DEPFET Sensor (Sideview)



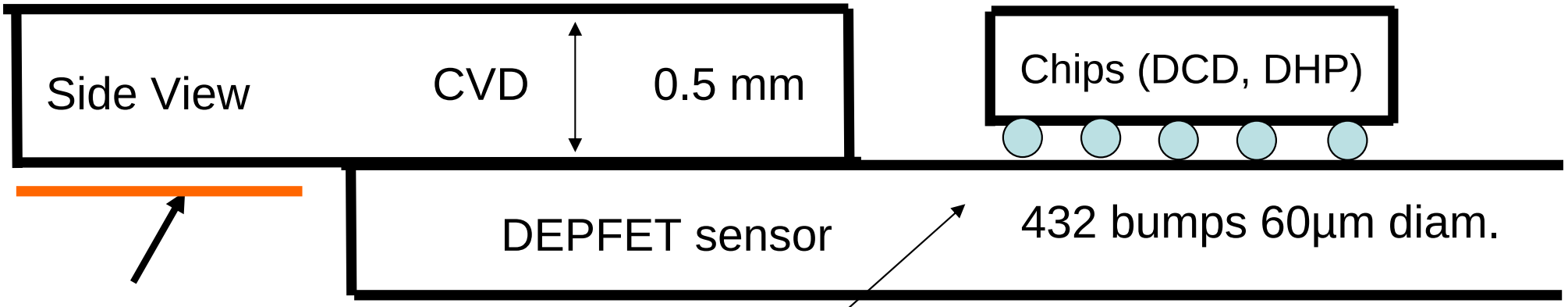
End Section with Electronics



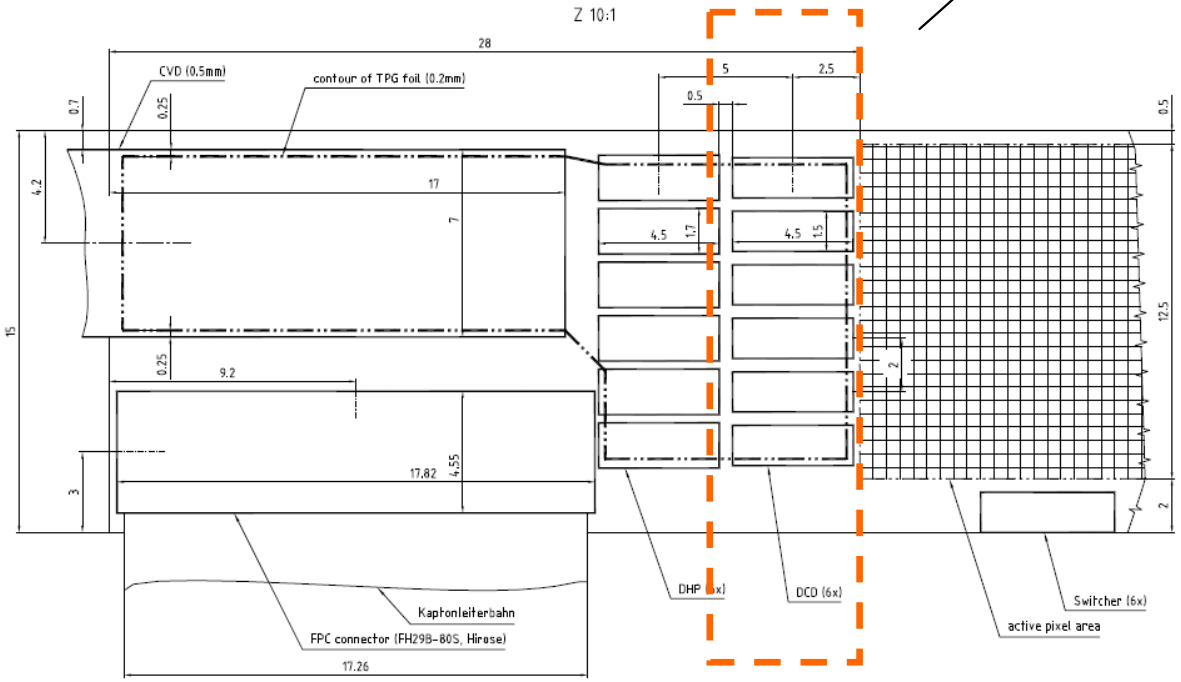
CVD (diamond) support extends 12 mm beyond the ladder (to the left), ends at the black line (shape is proposal, subject to discussion)

red: contour of TPG foil (glued to the CVD from the black line to the left)

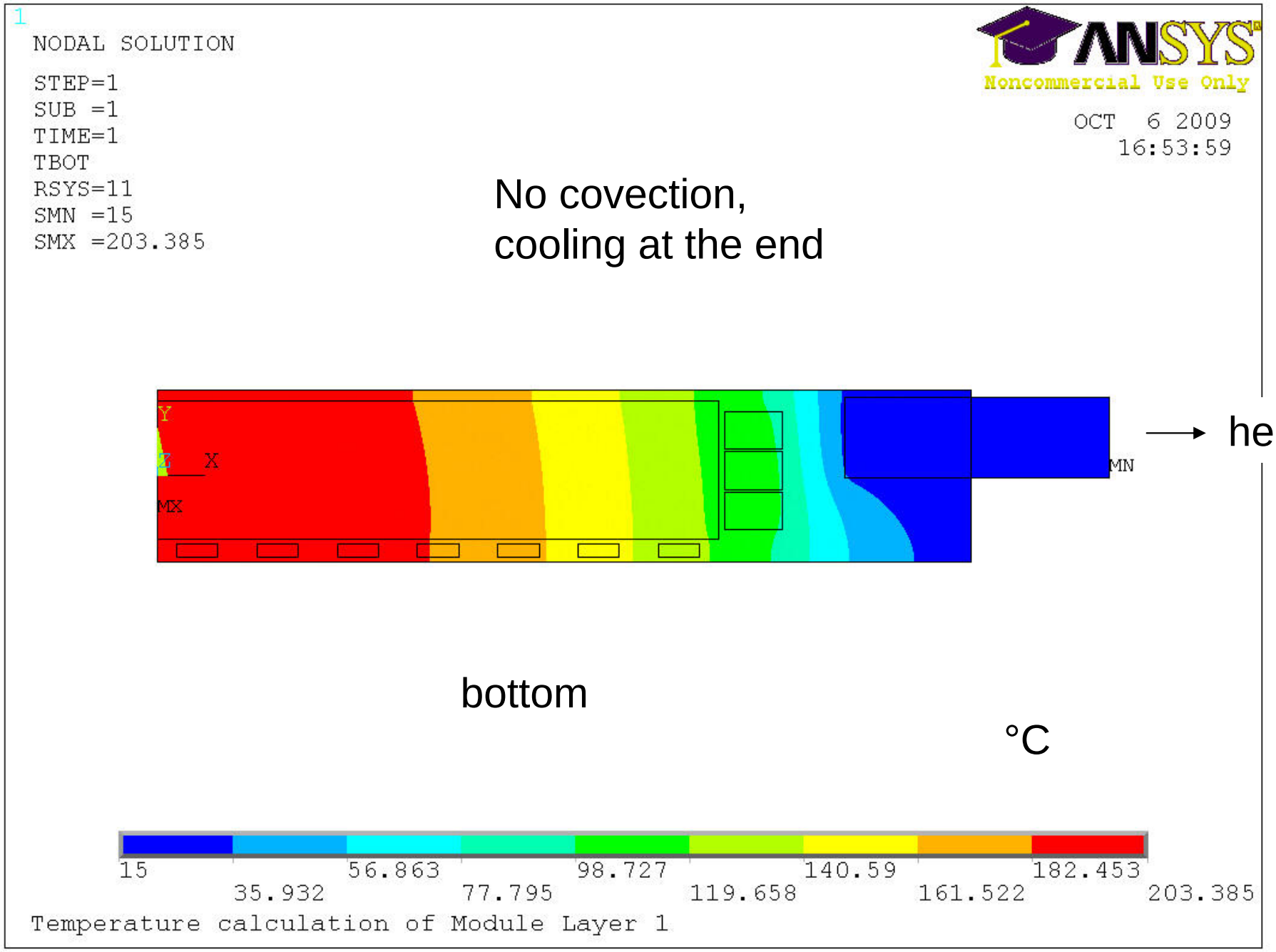
Model for the End-of-Stave + Chip



kept at T=const

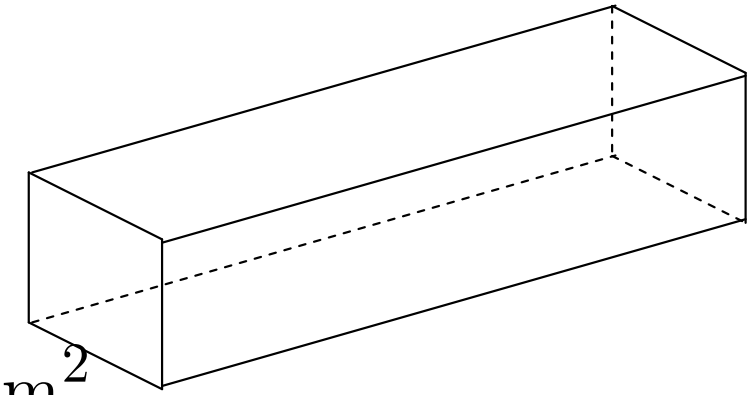


- 8 W produced in DCD/DHP, but all concentrated in the DCD
- 1Watt (switches + sensor)
- Cold surface below the CVD (red line)
- Convection 500 W/(m²K)


1
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
TBOT
RSYS=11
SMN =15
SMX =203.385
ANSYS
Noncommercial Use Only
OCT 6 2009
16:53:59
No covection,
cooling at the end
Y
Z X
MX
MN
heat
bottom
°C
15
35.932
56.863
77.795
98.727
119.658
140.59
161.522
182.453
203.385
Temperature calculation of Module Layer 1

Convection: Speed of Air Stream

$A =$ $1.2\ \mathrm{cm}^2$



$$\Delta T = 20°\mathrm{C}$$

$$\lambda = 500\left[\frac{W}{m^2 K}\right]$$

$$J\left[\frac{W}{m^2}\right] = \Delta T \cdot \lambda\left[\frac{W}{m^2 K}\right]$$

$$J = 2\left[\frac{W}{A}\right] = 2\times 10^4\left[\frac{W}{m^2}\right]$$

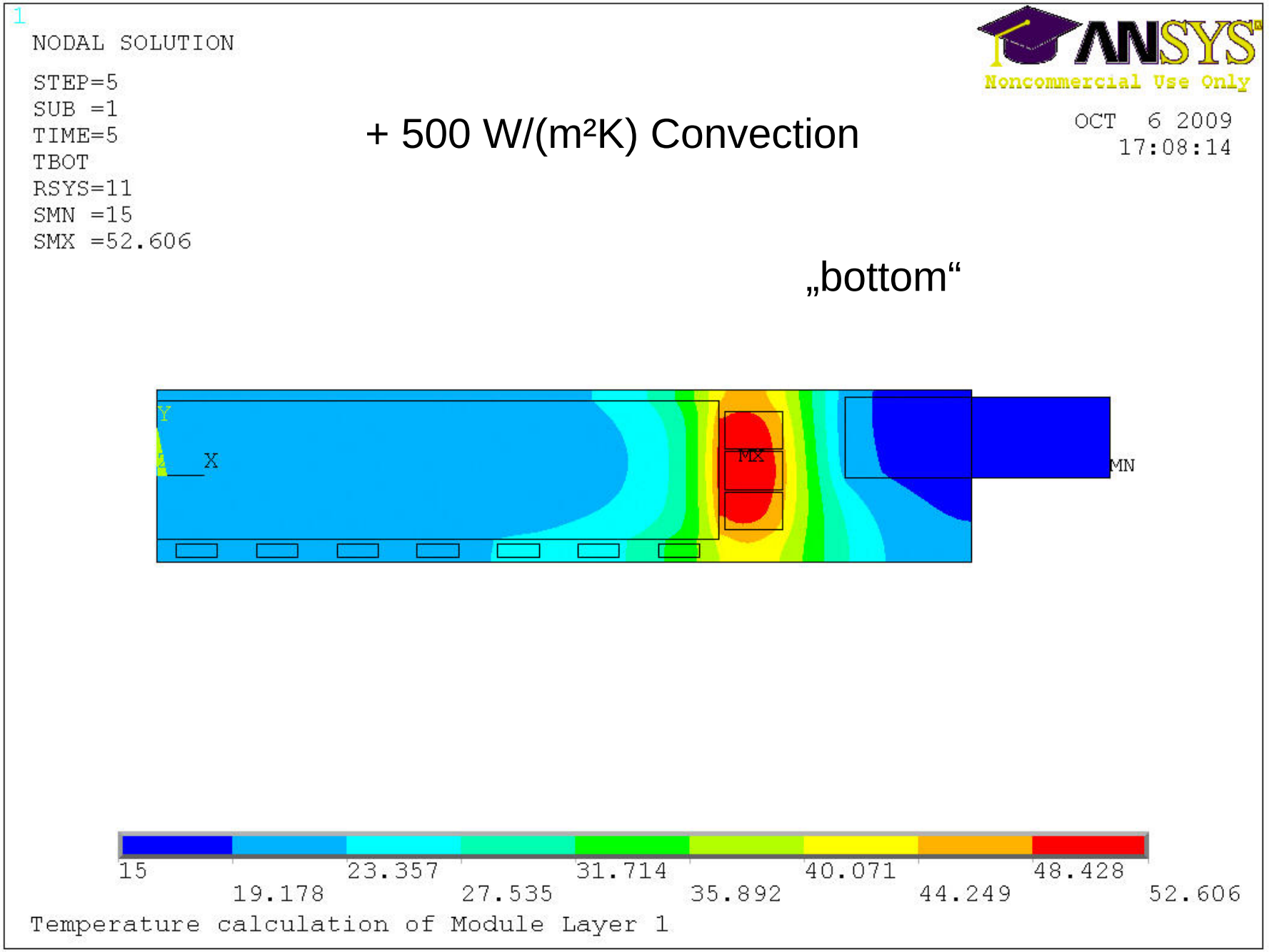
(switcher + DEPFET)

$$v\left[\frac{m}{s}\right] = \frac{J}{\Delta T \cdot \rho \cdot \kappa}$$

density $\left[\frac{kg}{m^3}\right]$ 1.2

spec. heat $\left[\frac{Ws}{kgK}\right]$ 1000

$$v \sim 1\left[\frac{m}{s}\right]$$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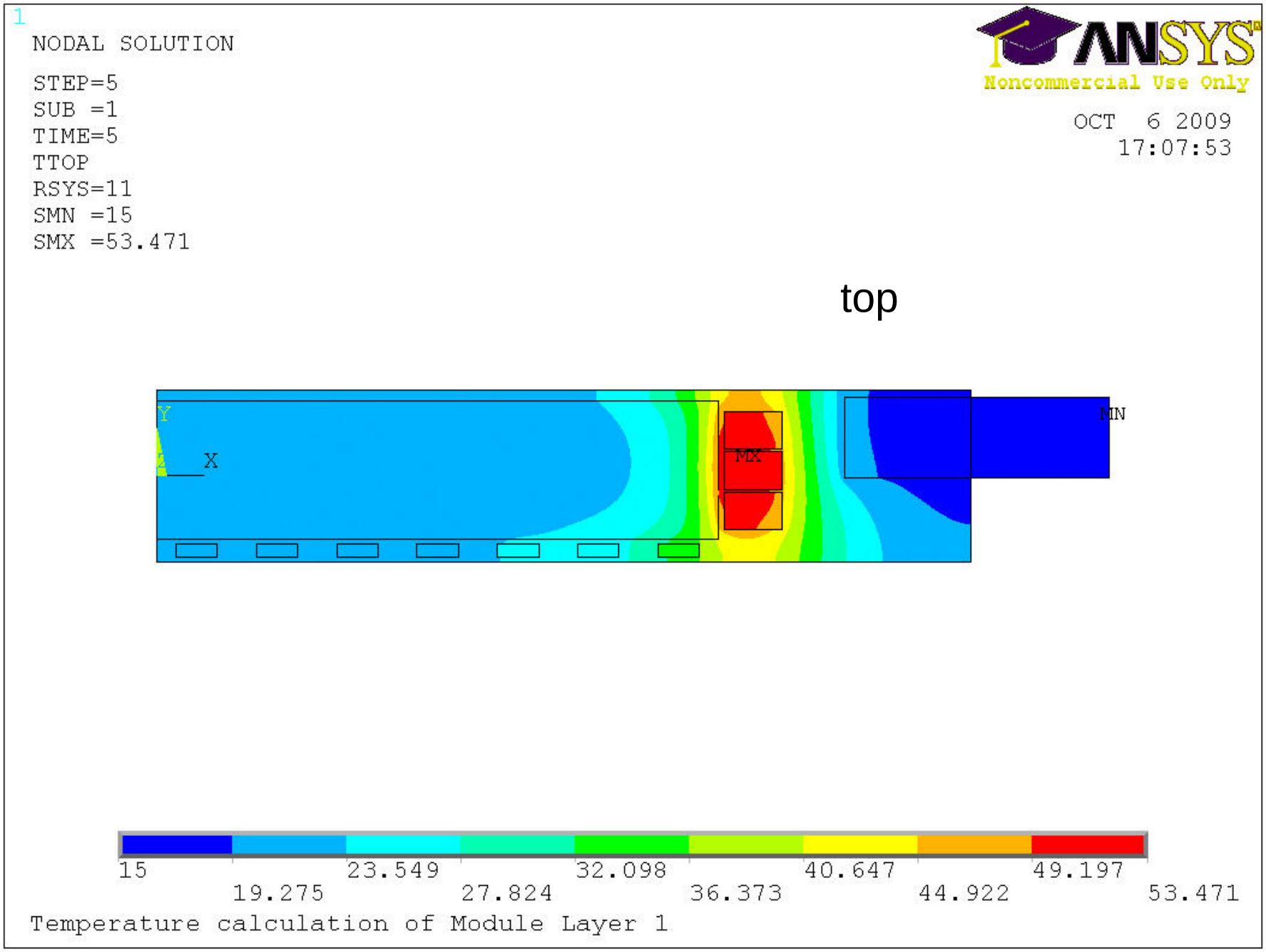
TBOT
RSYS=11
SMN =15
SMX =52.606
ANSYS
Noncommercial Use Only
OCT 6 2009
17:08:14
+ 500 W/(m²K) Convection
„bottom“
Y
X
MX
MN
15
19.178
23.357
27.535
31.714
35.892
40.071
44.249
48.428
52.606
Temperature calculation of Module Layer 1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NODAL SOLUTION
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TIME=5
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RSYS=11
SMN =15
SMX =53.471
ANSYS
Noncommercial Use Only
OCT 6 2009
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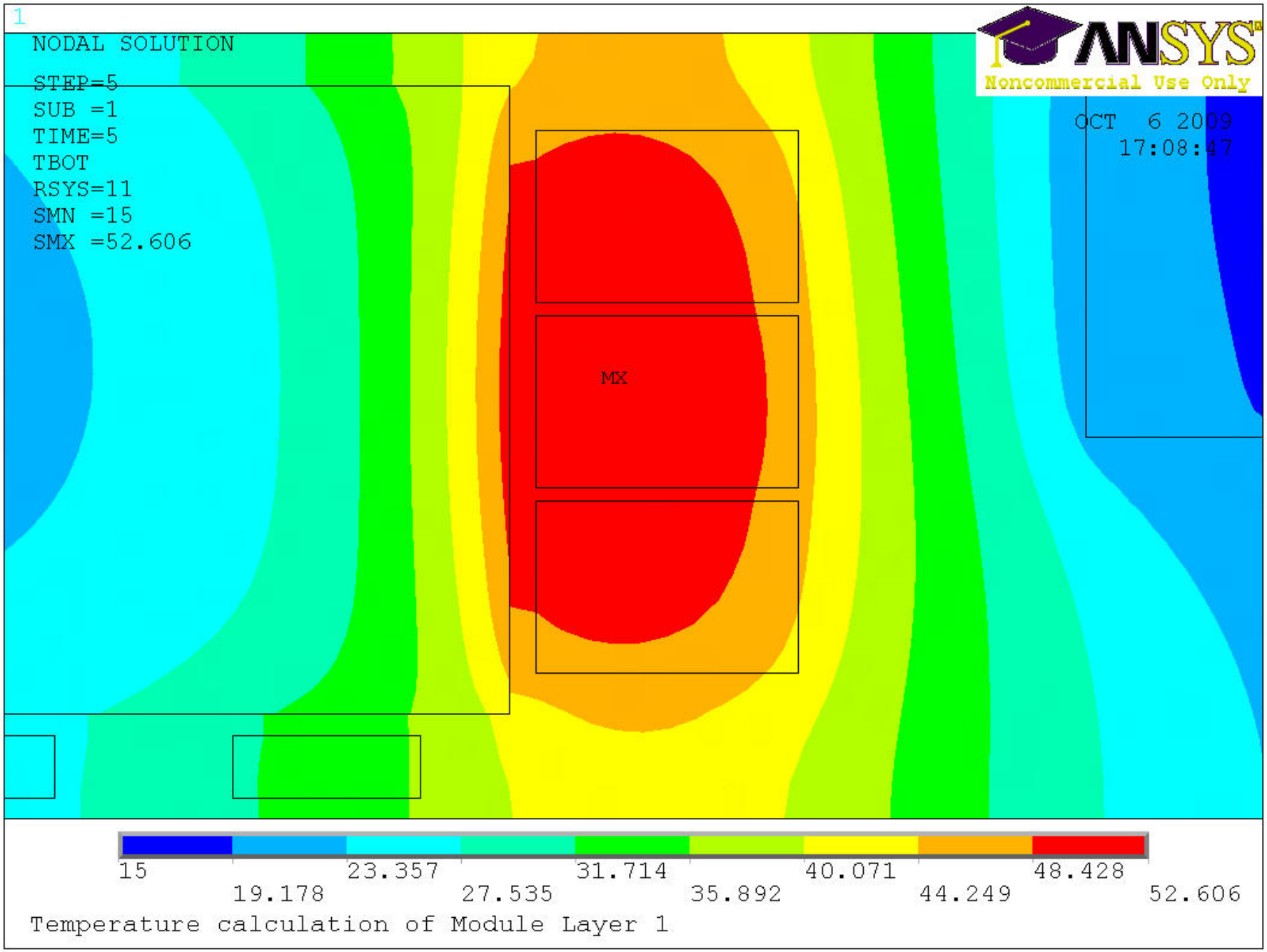
top
Y
X
MX
MN
15
19.275
23.549
27.824
32.098
36.373
40.647
44.922
49.197
53.471
Temperature calculation of Module Layer 1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SMX =52.606
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Noncommercial Use Only
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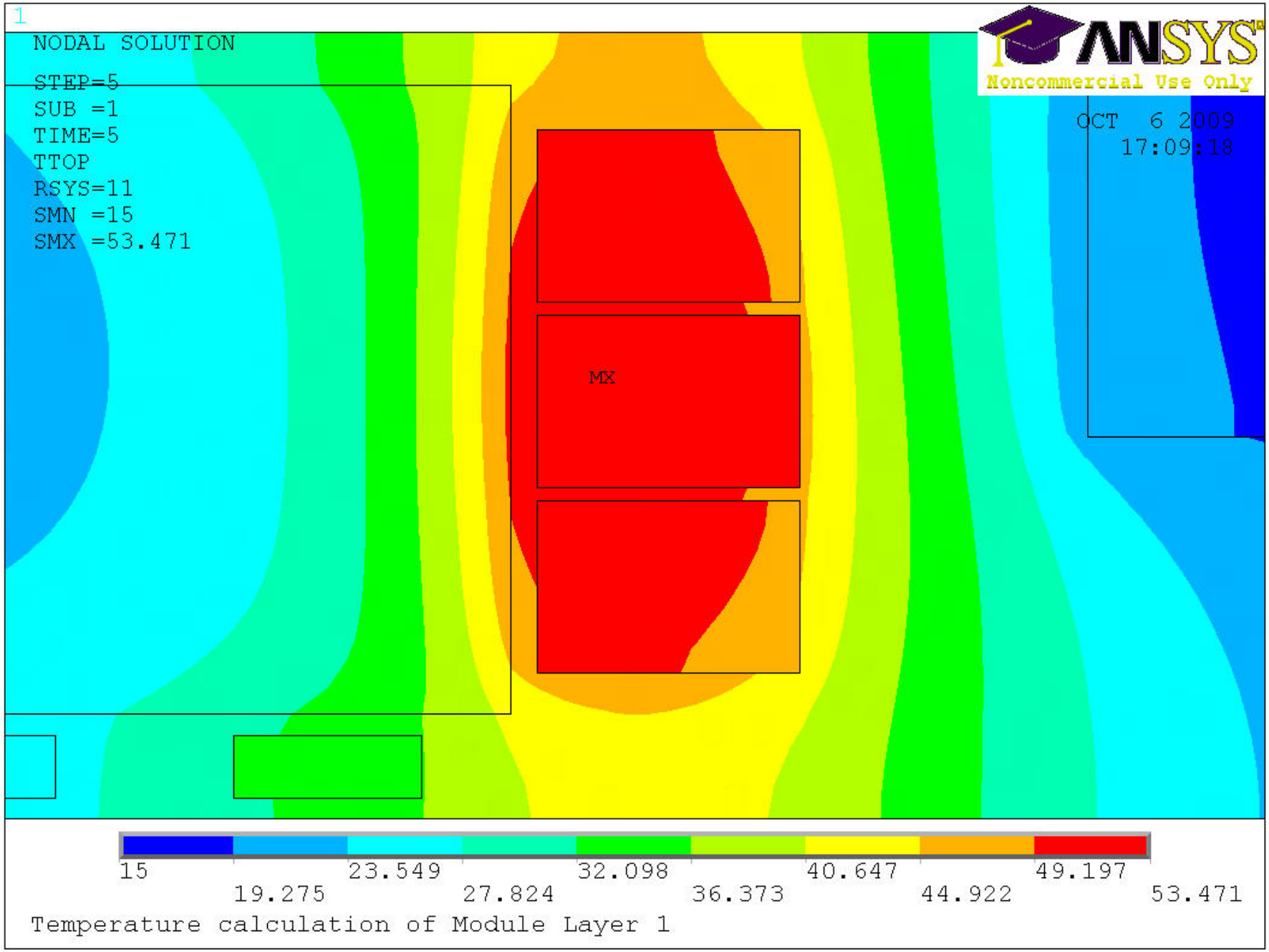
27.535
31.714
35.892
40.071
44.249
48.428
52.606
Temperature calculation of Module Layer 1

bottom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NODAL SOLUTION
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TTOP
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SMN =15
SMX =53.471
MX
ANSYS
Noncommercial Use Only
OCT 6 2009
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15
19.275
23.549
27.824
32.098
36.373
40.647
44.922
49.197
53.471
Temperature calculation of Module Layer 1

top

Conclusion and Outlook

- Full thermal simulation of the ladder with switcher and DCD, bump-bonded (432 with 60 µm diameter, area = 1.2 mm²)
- CVD glued on top of ladder
- Fix cooling at 15 °C on the last 1cm of the CVD
- Cooling through the „feet“ (no TPG yet)
- 2 simulations: without and with convection (1 m/s in 1.2 cm² channel)

→ convection necessary

→ VERY PRELIMINARY results may indicate that a cold spot of 15 °C may be sufficient ???

NEED VERIFICATION + compare to „real“ experiment“ (mockups)

Mechanical Support of the DEPFET Sensors