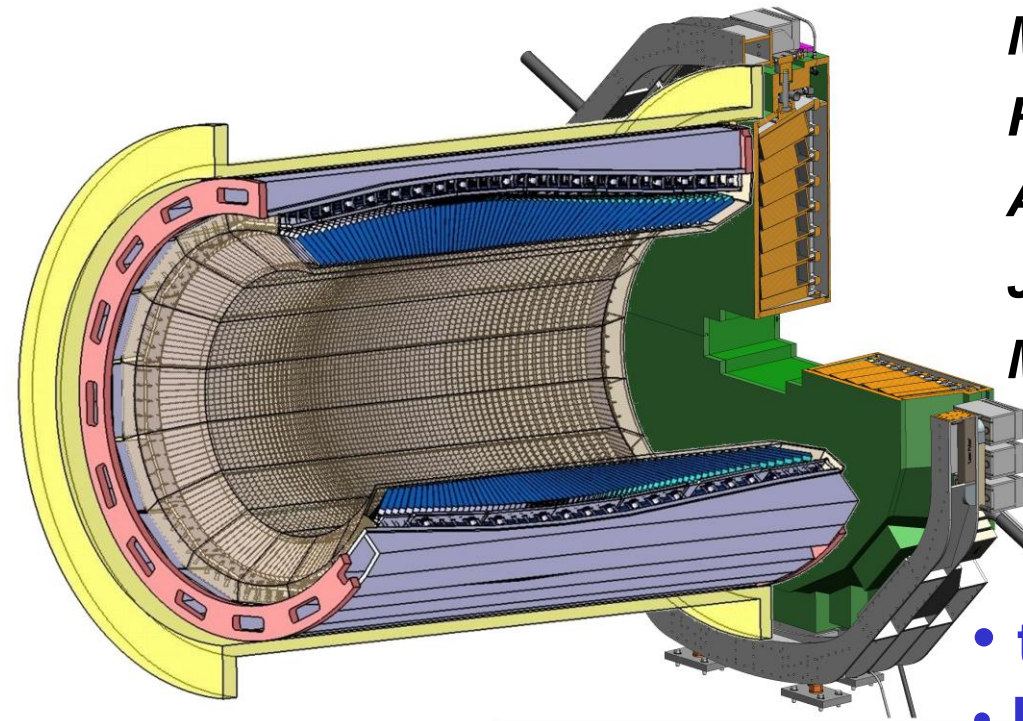
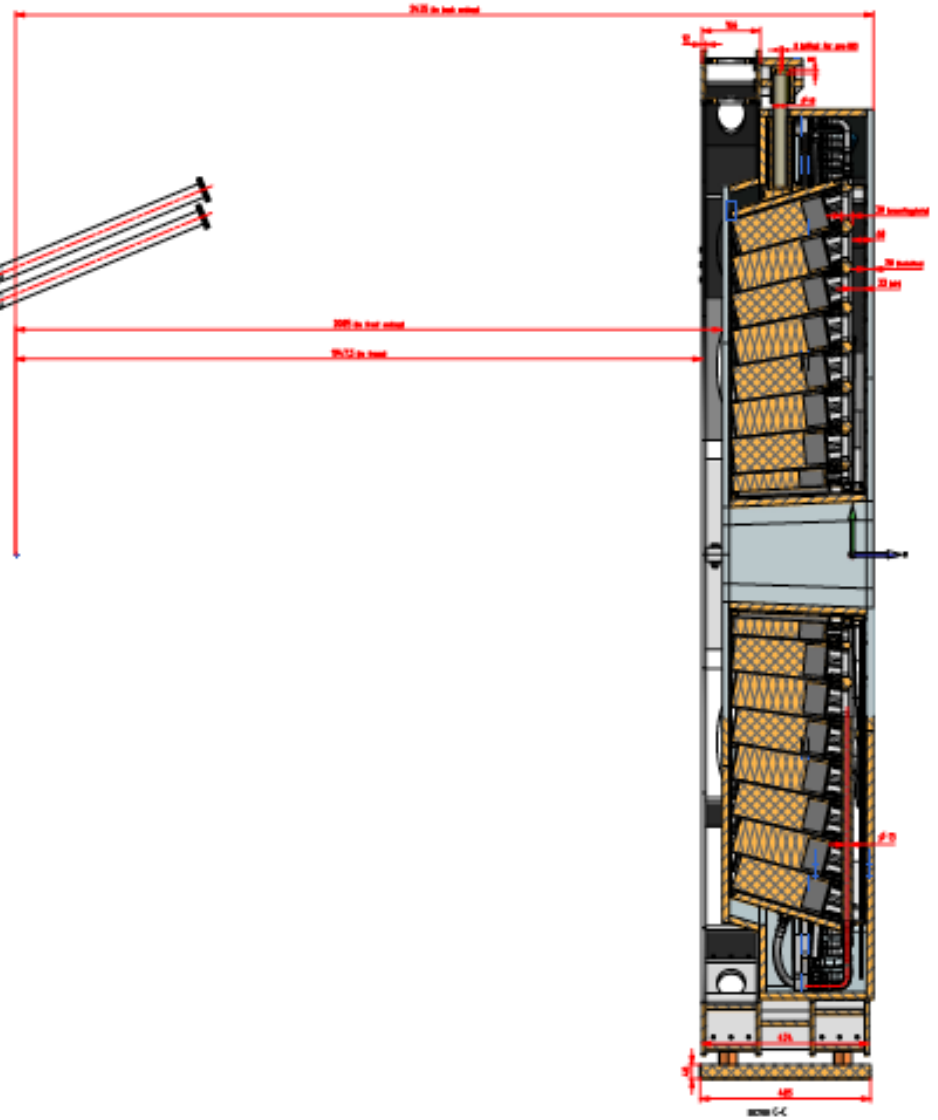
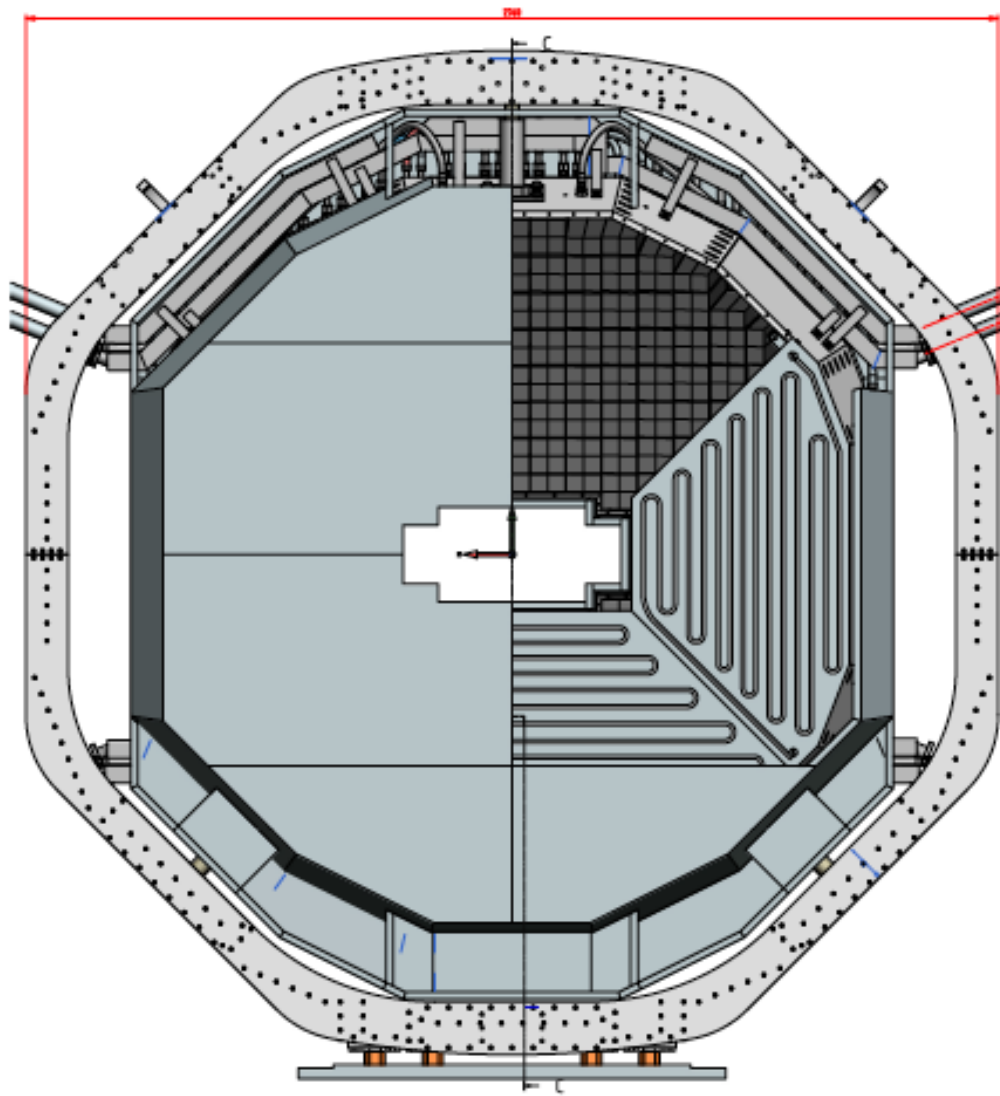


design issues of Fw Endcap calorimeter

*Michel Lindemulder, Henk Smit,
Rick Veenstra (mech. engineering),
Annelie Kluttig, Peter Lemmens,
Jan Mulder, Peter Schakel (engineers),
Myroslav Kavatsyuk, Herbert Löhner,
KVI Groningen*



- thermal insulation material
- FwEndcap support / insertion
- long-hole drilling
- quench → Eddy currents → forces
- flow / temperature homogenization
- Front End Electronics



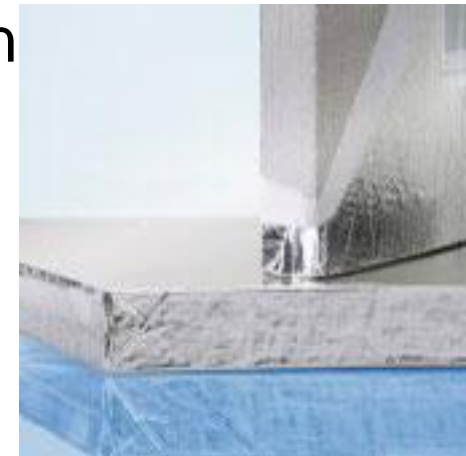
REVISED
11-20-08

DATE	BY	CHK	APP	DESCRIPTION

thermal insulation

va-Q-vip (va-Q-tec AG, Würzburg, Germany, va-q-tec.com)

is an evacuated micro porous thermal insulation with excellent insulating properties.



Product data

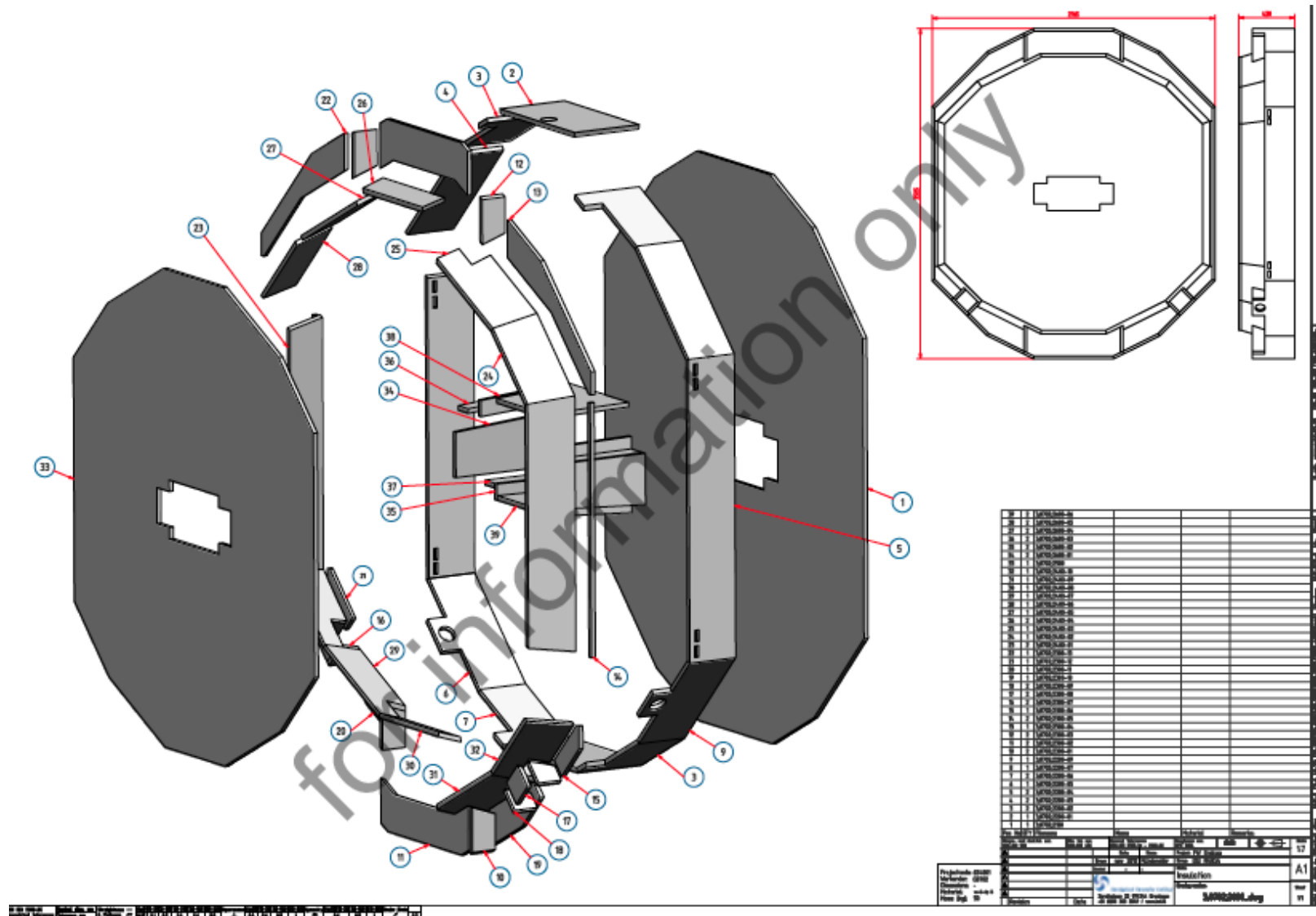
Surface color	Silver
Geometry	Rectangular shape (without protruding flanges*)
Density	180 to 210 kg/m ³

more product data



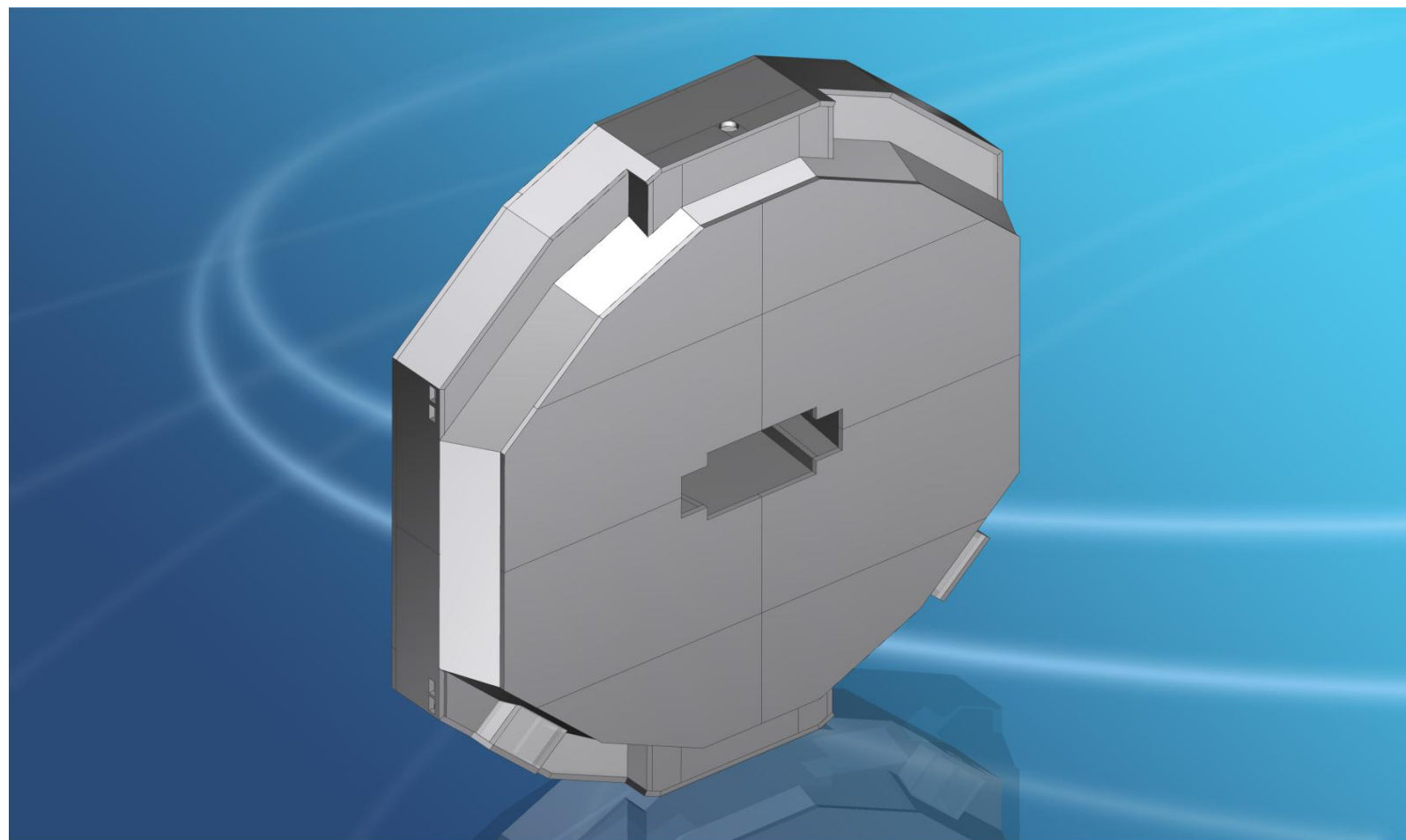
Thermal conductivity	< 0.005 W/mK (at 20 mm thickness)
Temperature stability	-70 °C to +70 °C (due to the film)
Thermal shock resistance	Not sensitive to heat & cold shock in the given temperature range
Humidity stability	0 % to 60 %
Internal gas pressure	< 5 mbar (at delivery)
Increase of gas pressure	approx. 1 mbar/year (at 20 mm thickness & normal room conditions)
Standard dimension (L x W) I & II	I: 1000 mm x 600 mm, II: 500 mm x 600 mm
Nonstandard dimension III & IV	III: Area > 0,10 m ² and < 0,60 m ² , IV: area < 0,10 m ²
Special form	Triangle, trapezium, special shape, corner cut, hole cut and recessed surface
Thickness	10 mm to 50 mm

possible shapes of insulation parts

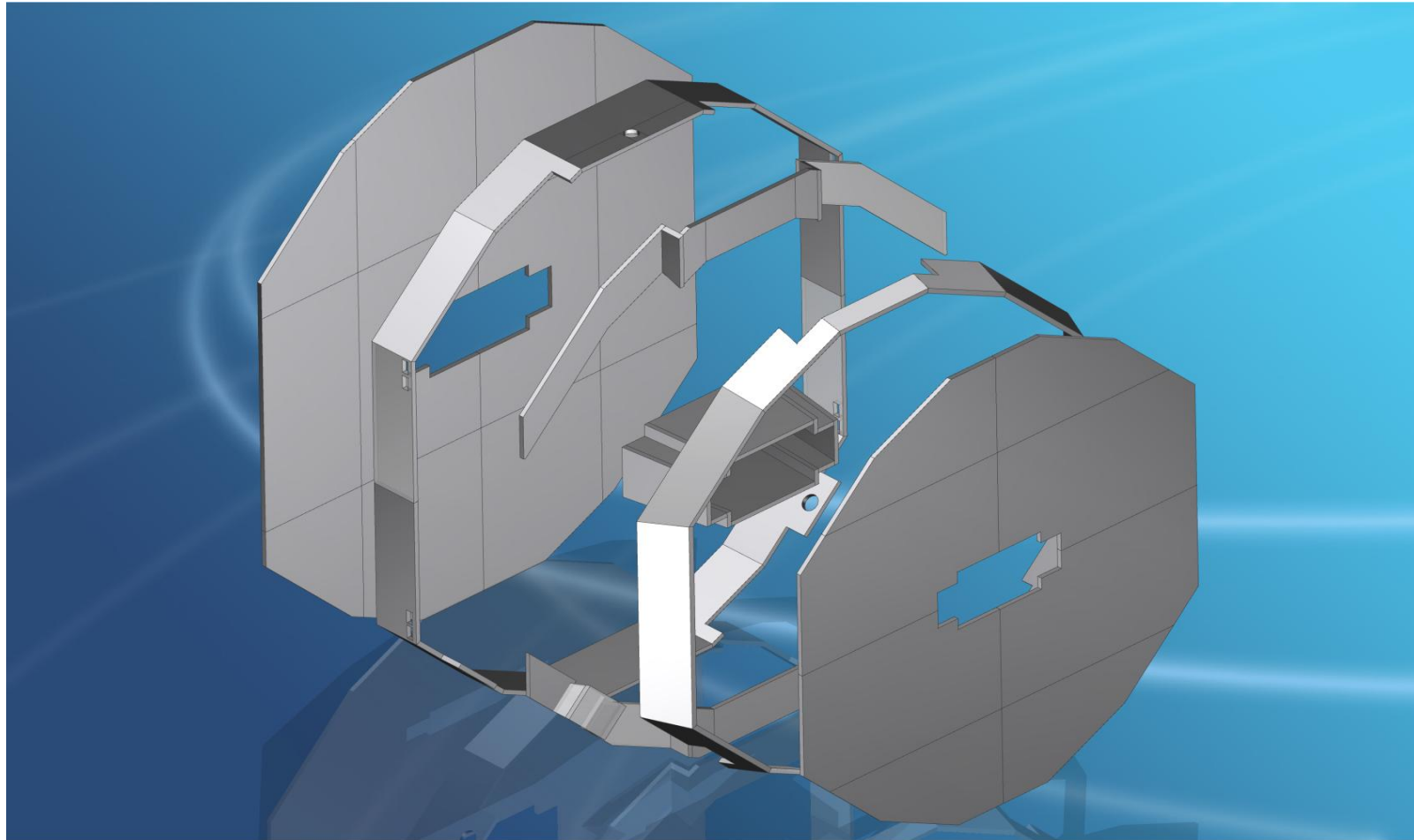


Part No.	Part Name	Material	Quantity	Unit
1	Shield Plate	Al	1	pc
2	Bracket	Al	1	pc
3	Central Part	Al	1	pc
4	Bracket	Al	1	pc
5	Bracket	Al	1	pc
6	Bracket	Al	1	pc
7	Bracket	Al	1	pc
8	Bracket	Al	1	pc
9	Bracket	Al	1	pc
10	Bracket	Al	1	pc
11	Bracket	Al	1	pc
12	Bracket	Al	1	pc
13	Bracket	Al	1	pc
14	Bracket	Al	1	pc
15	Bracket	Al	1	pc
16	Bracket	Al	1	pc
17	Bracket	Al	1	pc
18	Bracket	Al	1	pc
19	Bracket	Al	1	pc
20	Bracket	Al	1	pc
21	Bracket	Al	1	pc
22	Bracket	Al	1	pc
23	Bracket	Al	1	pc
24	Bracket	Al	1	pc
25	Bracket	Al	1	pc
26	Bracket	Al	1	pc
27	Bracket	Al	1	pc
28	Bracket	Al	1	pc
29	Bracket	Al	1	pc
30	Bracket	Al	1	pc
31	Bracket	Al	1	pc
32	Bracket	Al	1	pc
33	Shield Plate	Al	1	pc
34	Bracket	Al	1	pc
35	Bracket	Al	1	pc
36	Bracket	Al	1	pc
37	Bracket	Al	1	pc
38	Bracket	Al	1	pc

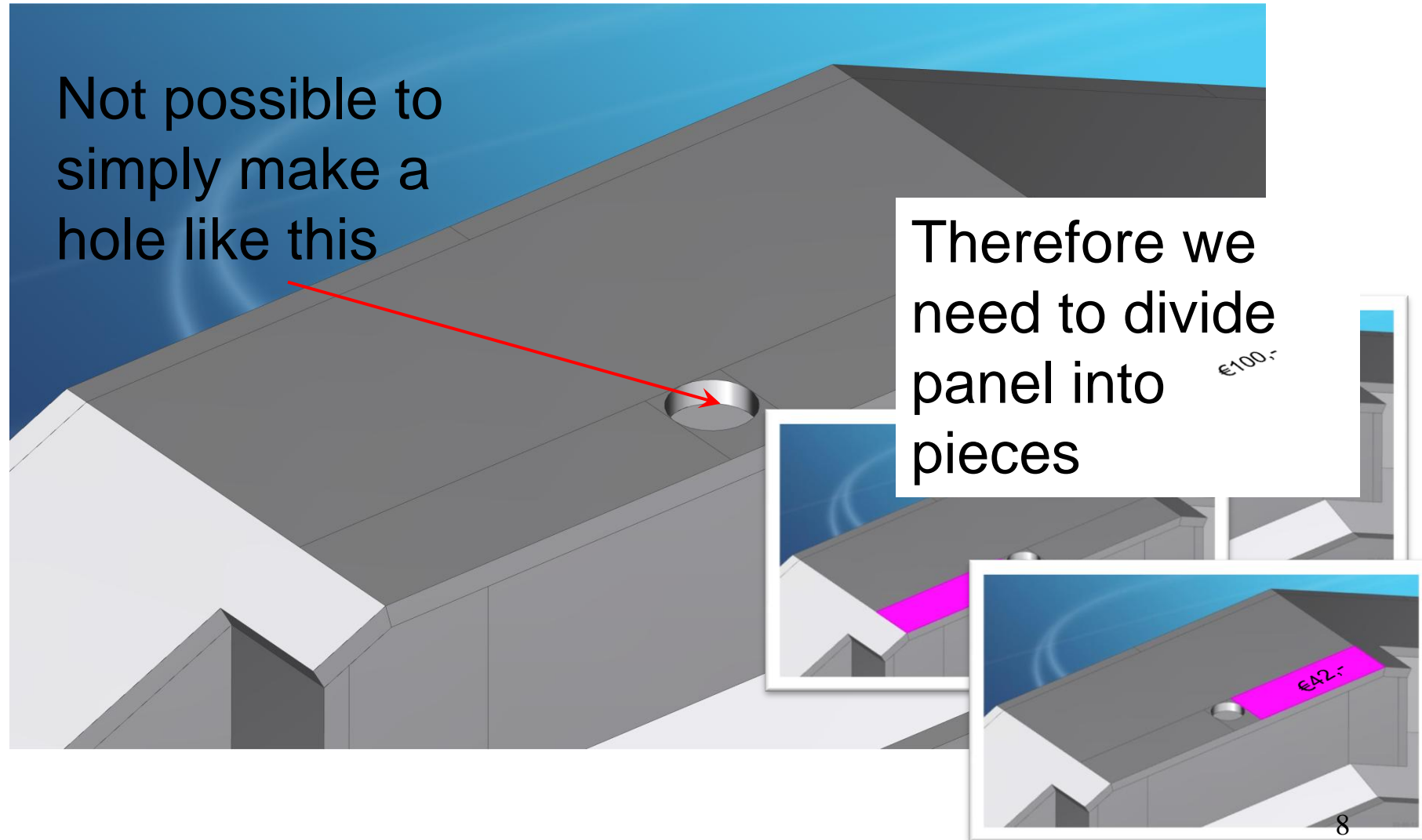
FwEndcap insulation view



Exploded view of insulation parts



No holes in insulation panels

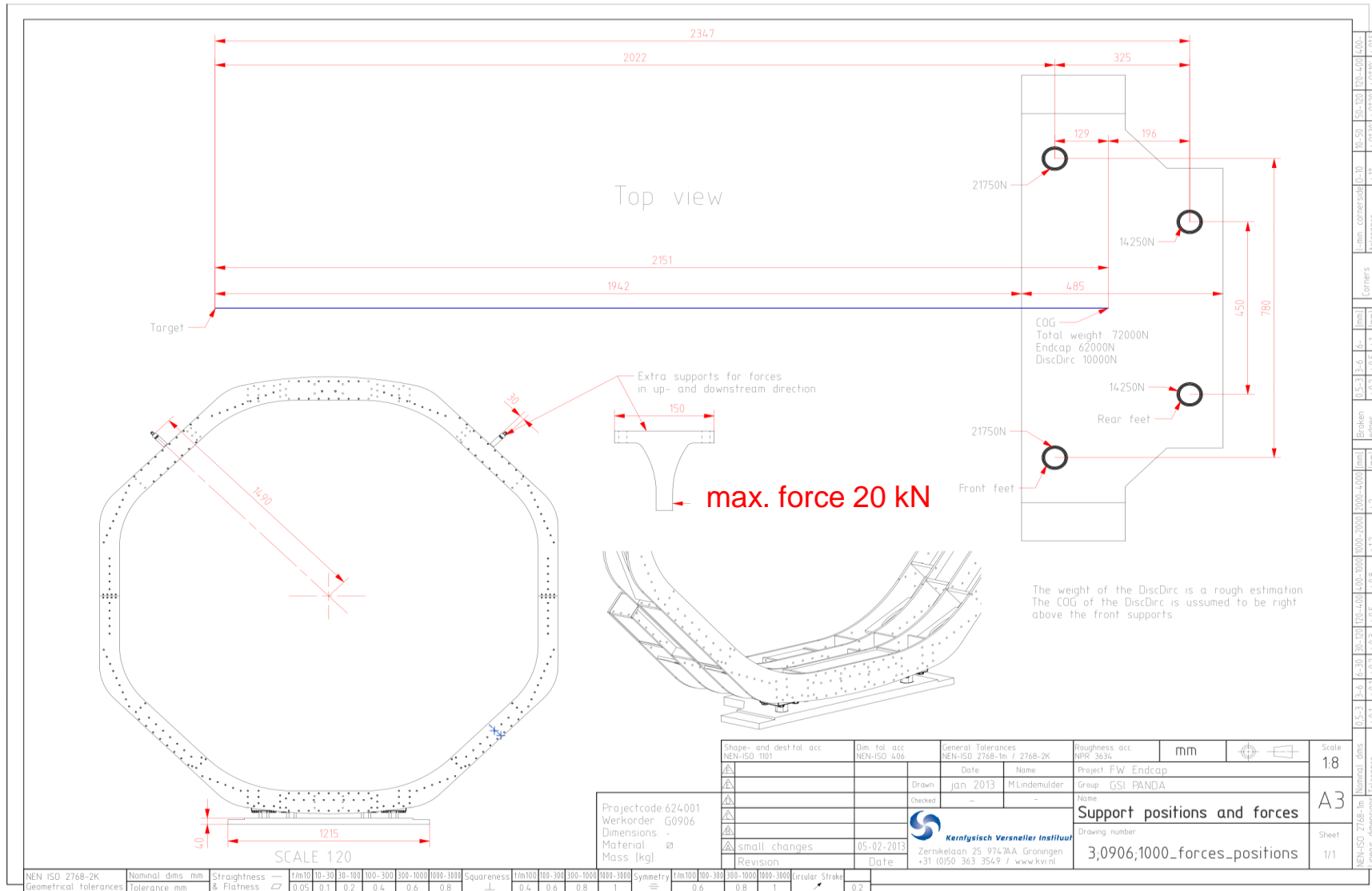


Next step

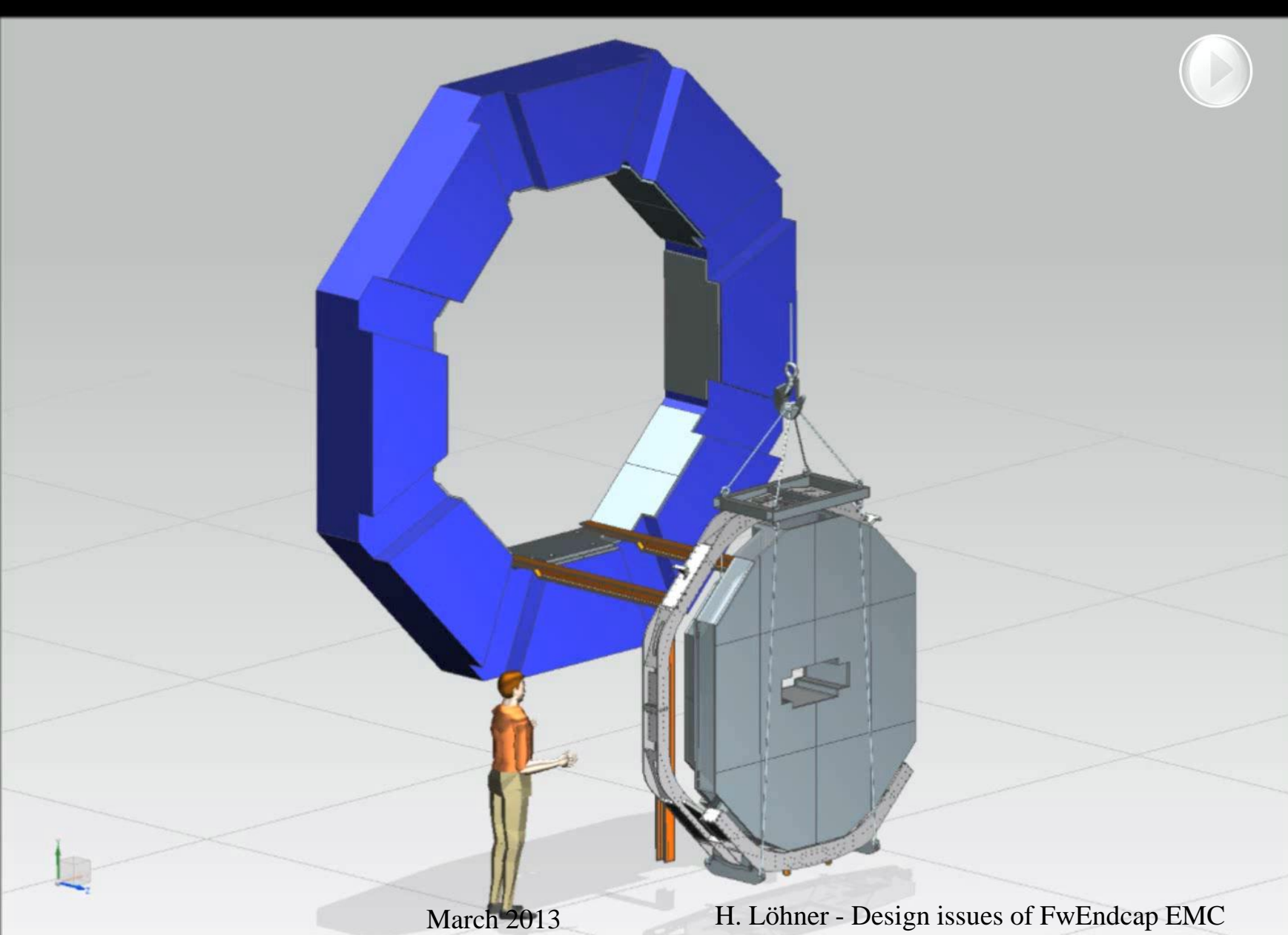


We will construct a test box
with typical panel elements
to verify the insulation characteristics
at critical edges, corners, connections

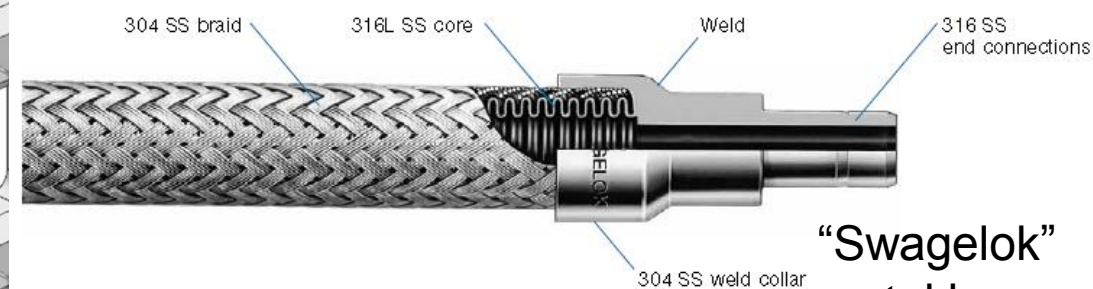
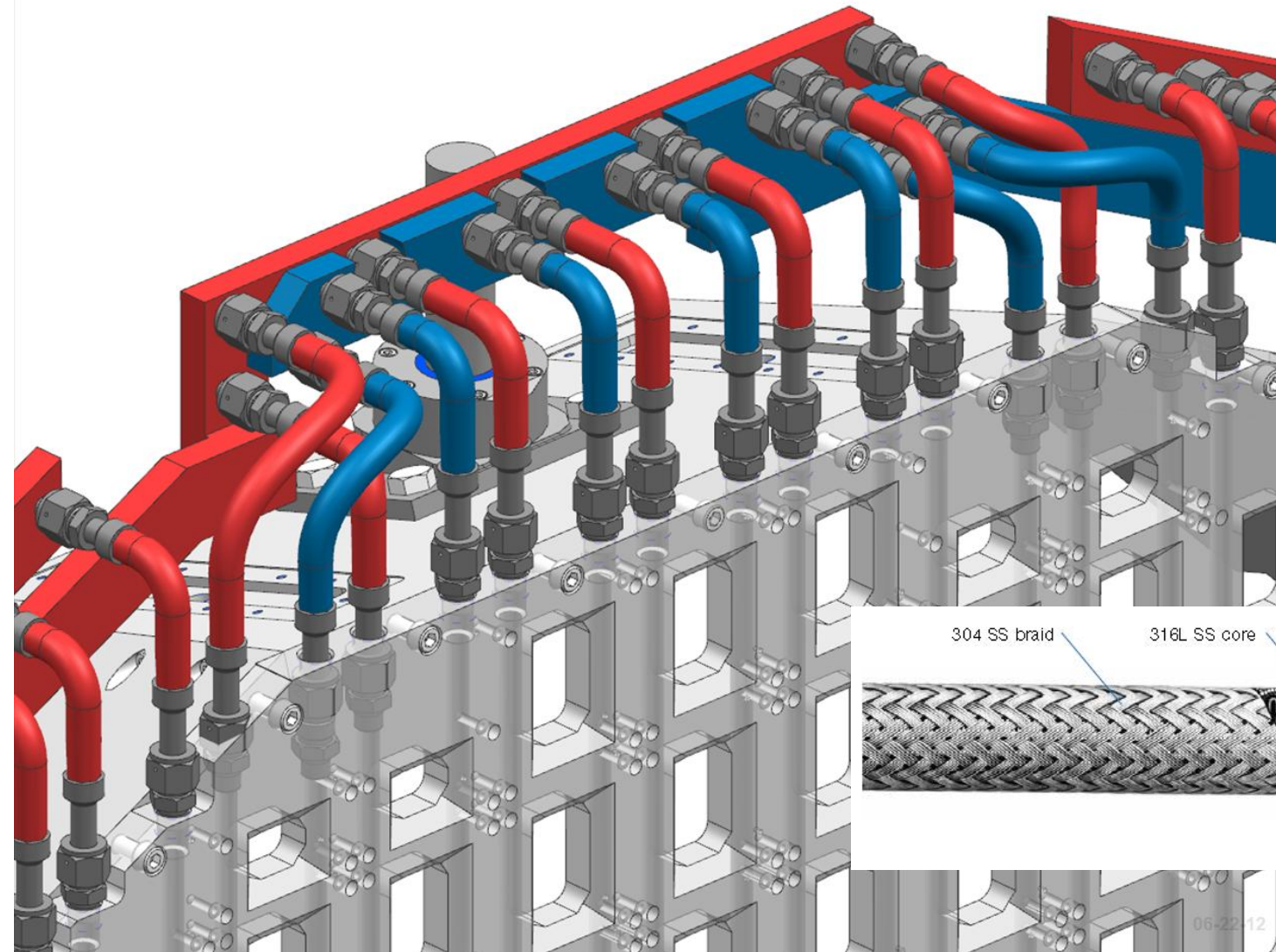
FwEndcap support



FwEndcap insertion into solenoid



“Swagelok” tube fittings for cooling circuit



“Swagelok”
metal hose
tube fittings

test of long-hole drilling for FwEndCap Mounting Plate

in 30 mm thick Al plate:
13 mm diam.
2000 mm long:
1000 mm drilled from 2 sides
→ max deviation from
intended position:
0.5 mm over 1 m guaranteed
≈ 0.2 mm likely achieved (will cut
the plate for exact value)
2 mm still acceptable



Eddy currents at quench

(obtained basic info from Renzo Parodi, Joost Lühning)

Simplified FEM-model, only one half of an octagon (16-fold symmetry)

Boundary conditions:

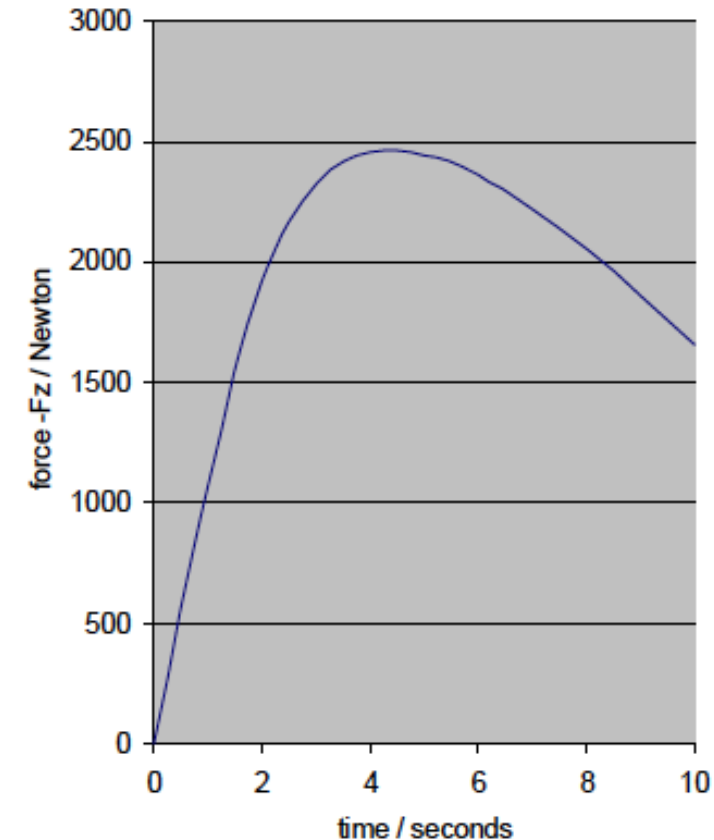
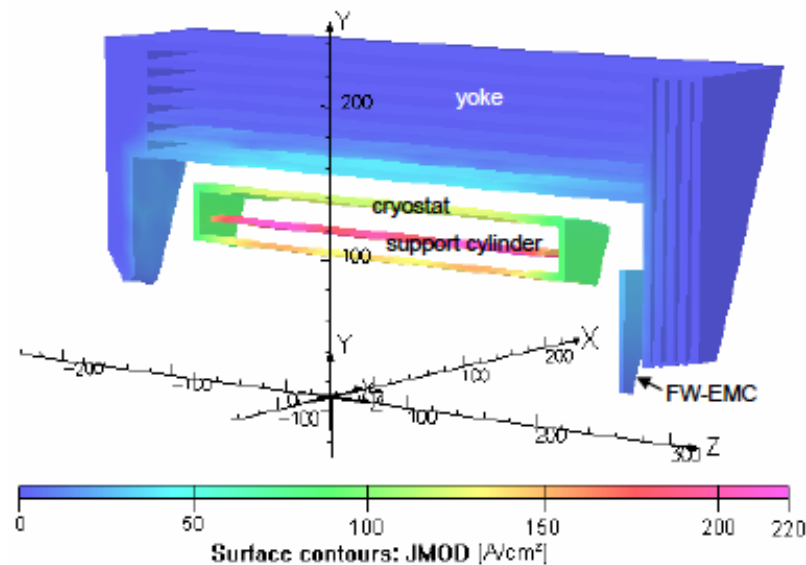
Ramp-down time 17 seconds

Resistivity of cryostat 40 nΩm (AL-6061)

Resistivity of cold support cylinder 30 nΩm (AL-5083)

Resistivity of FW-EMC mounting-plate 80 nΩm (AL-6061, thickness 3cm, area fraction of mounting holes 50%)

Resistivity of steel 100 nΩm

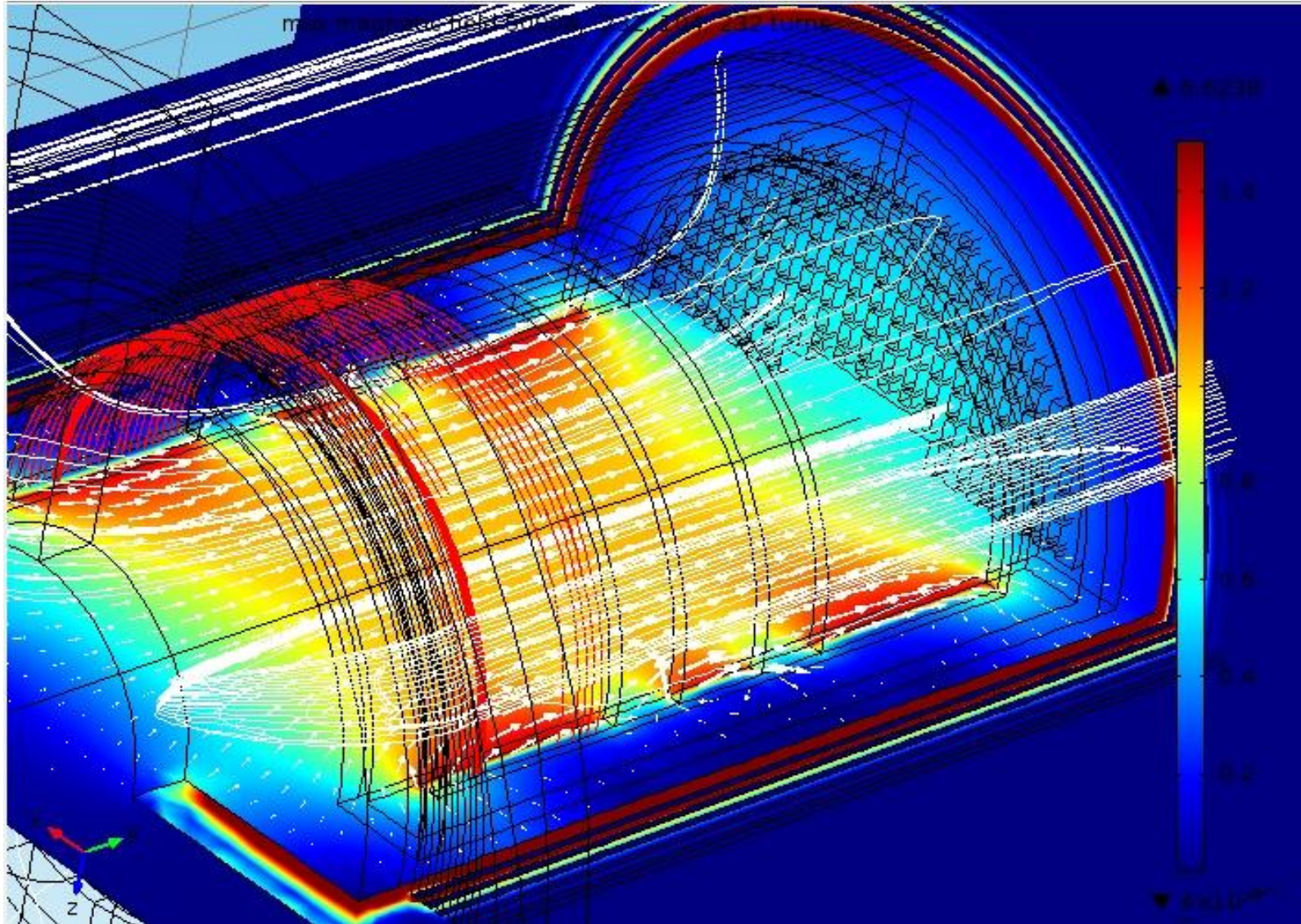


The maximum of the force on the FW-EMC mounting-plate is reached after 4 seconds (~ a quarter of a ton upstream)

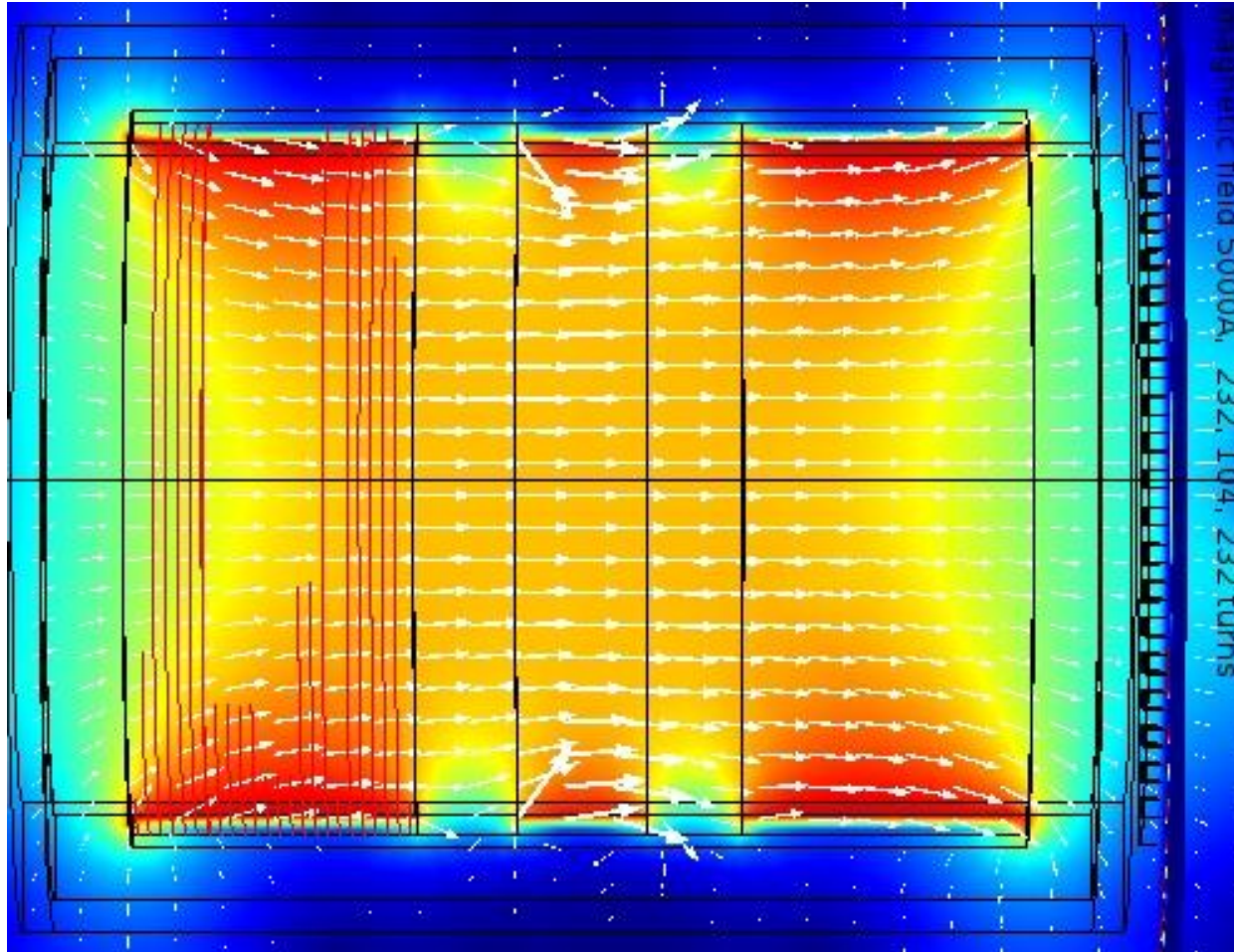
discussed in Magnet Group: obtained field tables

Lühning, 2013-01-09

Field-line distribution at 5 kA (max. 6.4 kA)



Field lines: cut through mid plane

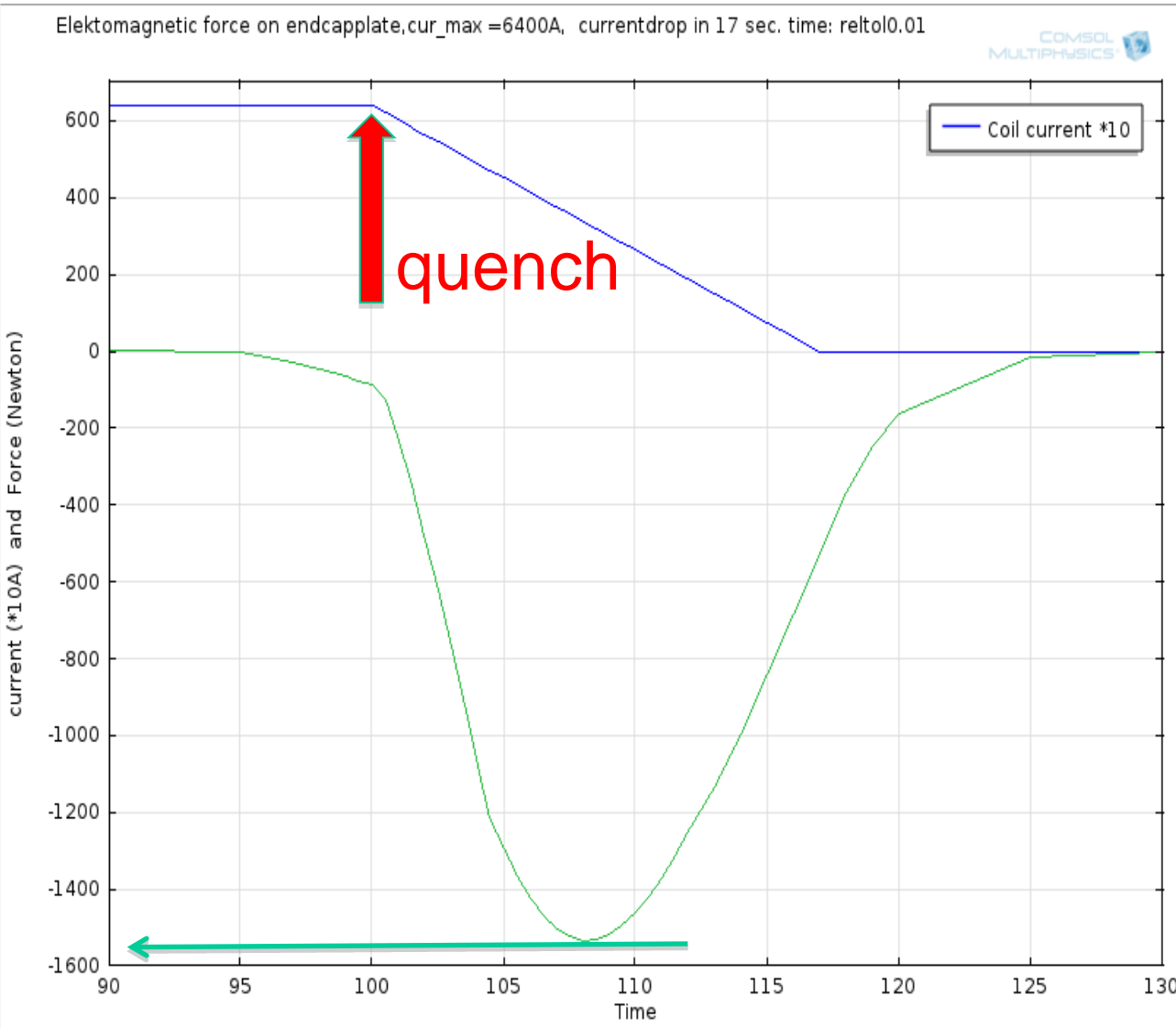


COMSOL FEM
simulation
by Jan Mulder
for
Mounting Plate

inhomogeneous components in endcap region → z-forces

Eddy-current force in beam-direction

Elektromagnetische force on endcapplate, cur_max =6400A, currentdrop in 17 sec. time: reit0.01



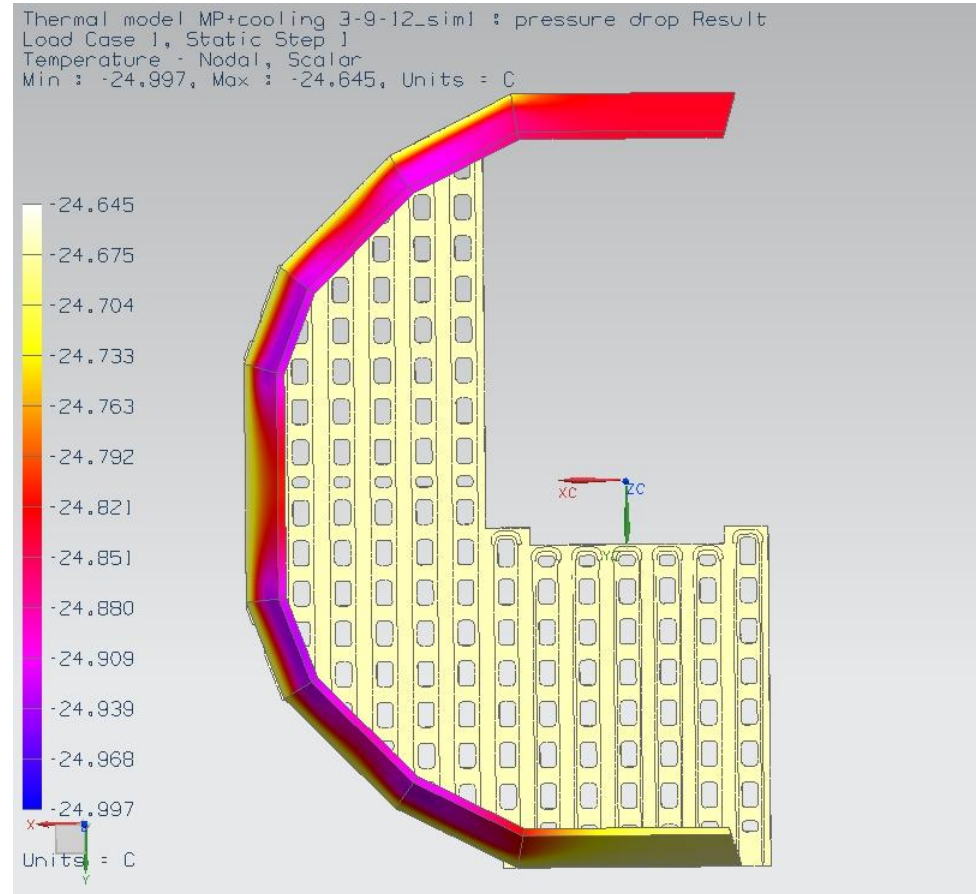
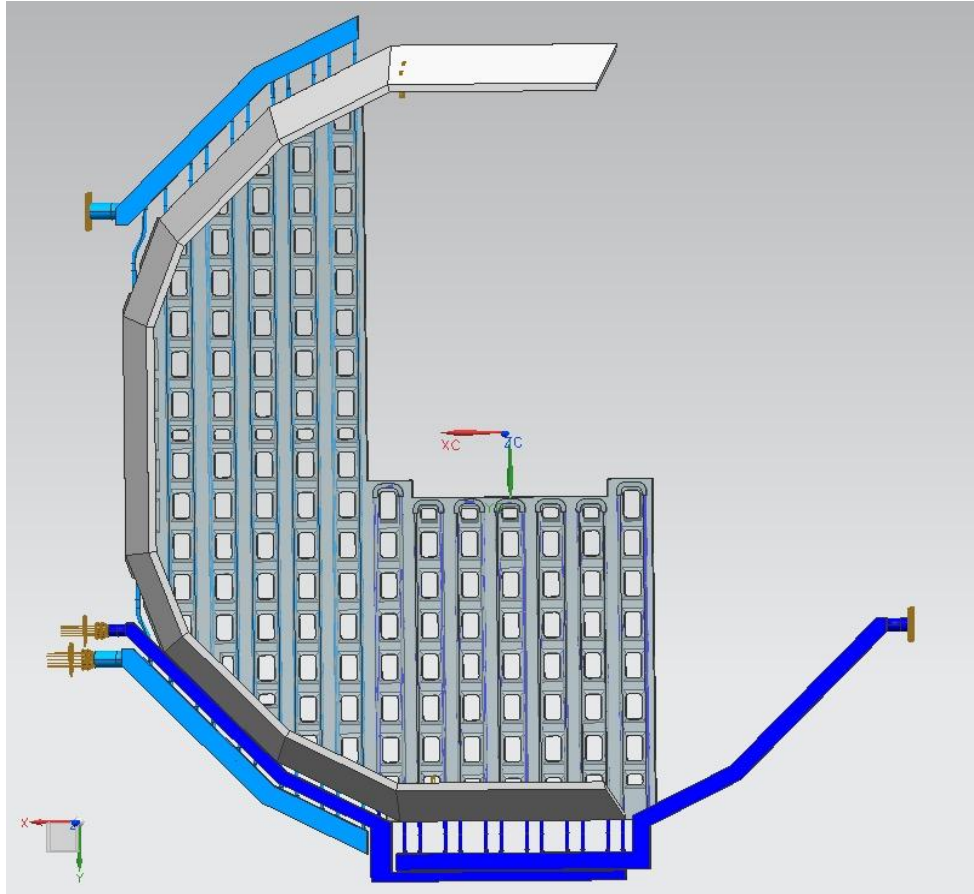
6.4 kA → Eddy's
< 1.6 kN after 15 s

Magnet Group is
not worried about
additional
Earth-quake forces
if Eddy-force < 2.5kN

We will also consider
Al inserts and
2 mm Al plate.

temperature of mounting plate

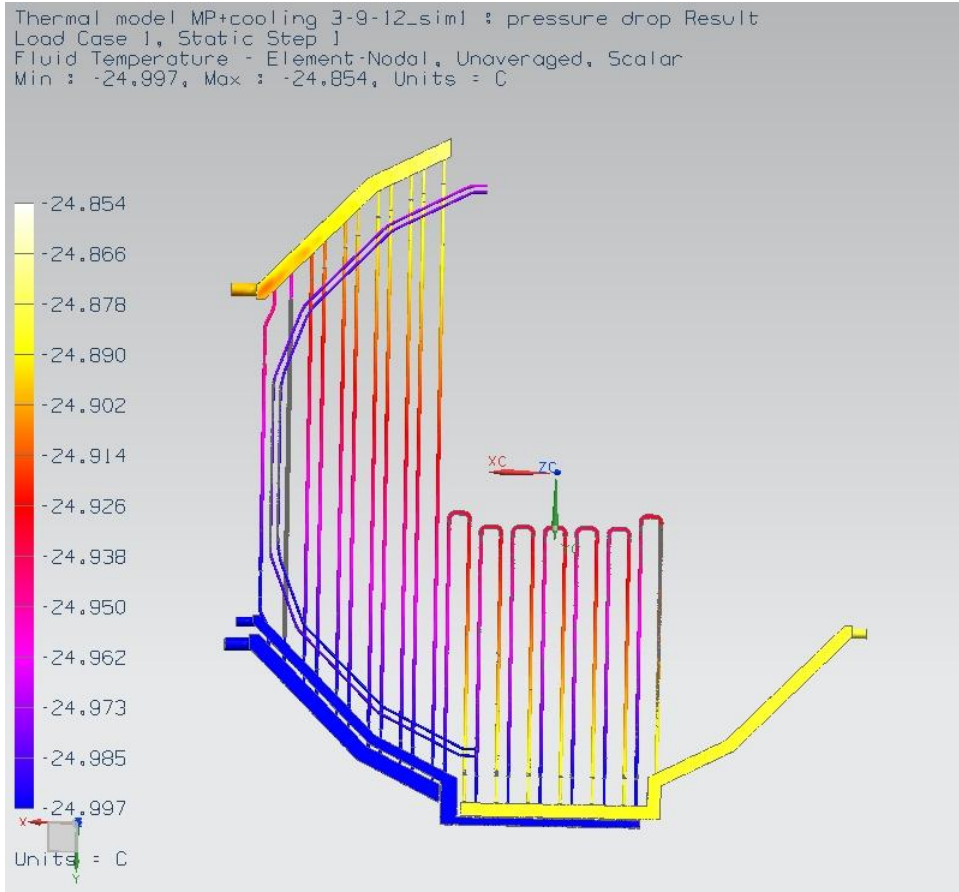
coolant: alcohol/water at -25°C ; pressure drop 0.1 bar;
 heat load: 200 mW for 2 LNP + 40 mW power supply



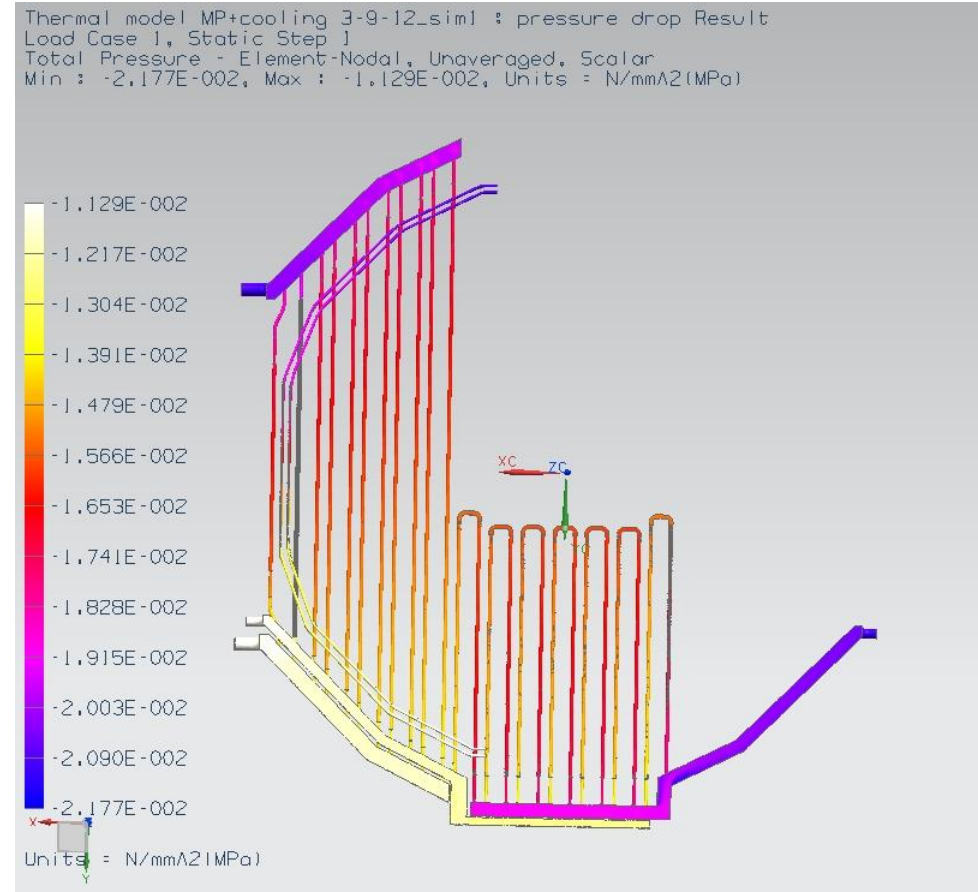
homogeneous mounting-plate temp. -24.7°C

Cooling circuits

temperature variations
max. 0.14°C



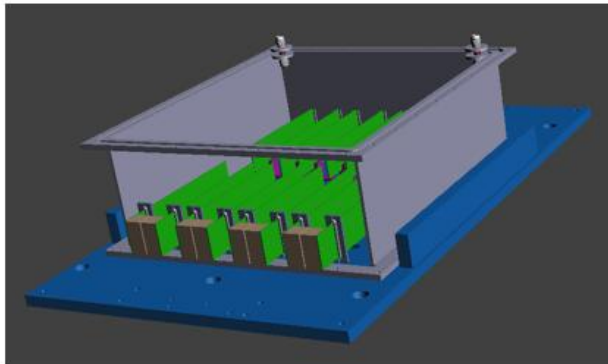
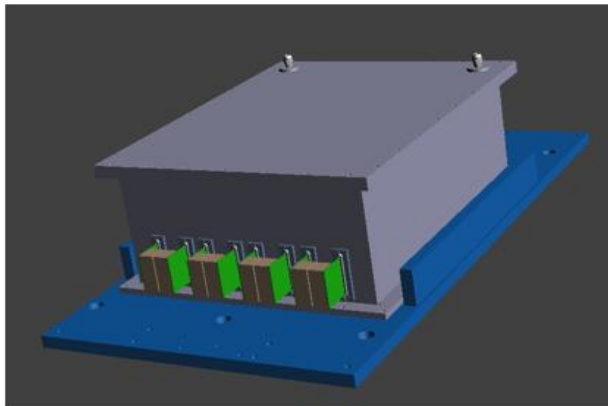
pressure variations
max. 0.1 bar



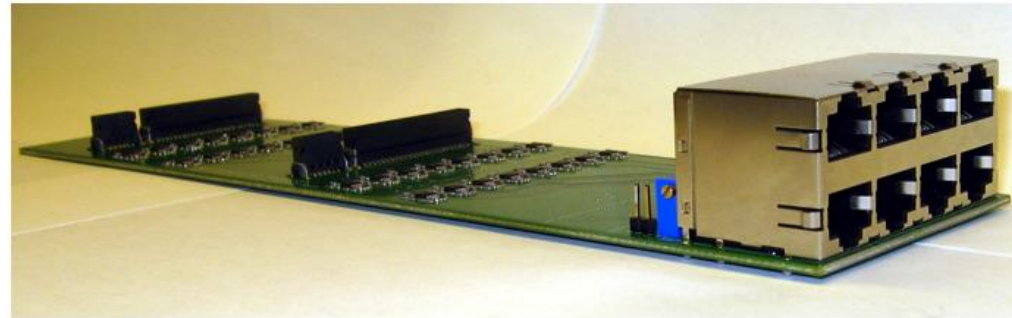
PROTO120 Line-driver board

- APFEL ASIC does not have a proper line driver (to reduce power consumption) → can not drive signal over long cables (>20 cm)
- Dedicated line-driver board has been designed and tested at KVI

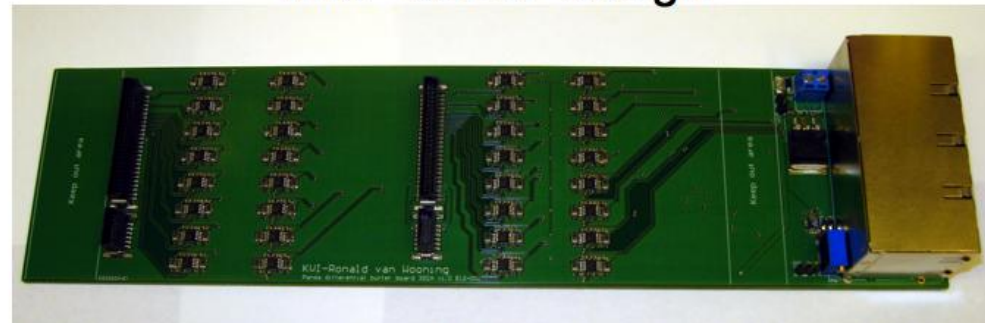
PROTO 120, top view



Line-driver board
(32 diff. Channels → 4 ASICS)



Channel density can be increased for final “barrel” design



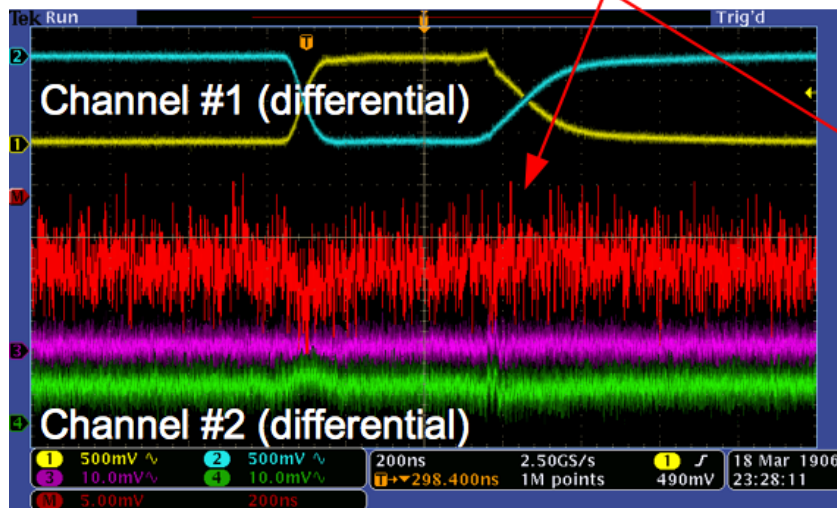
Line-driver board: cross talk

Measurement (worst case):

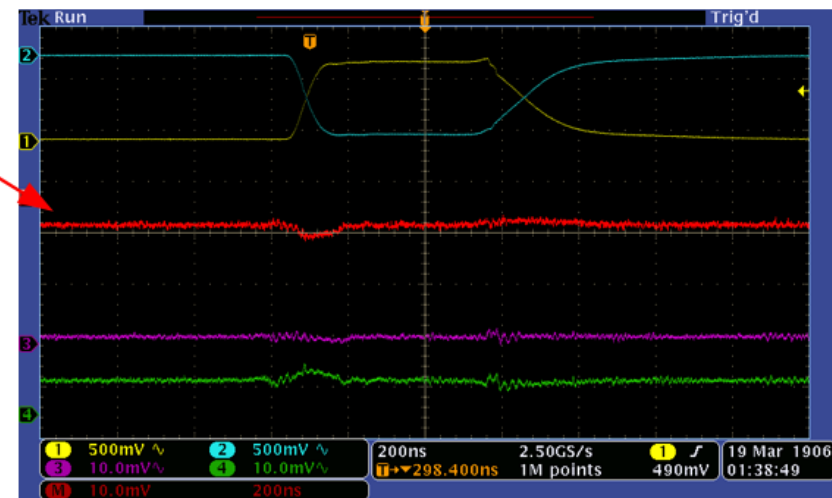
- Clipped ASIC signal in channel #1 (maximum amplitude)
- Open input at neighbouring channel #2 (better performance with terminated input)

Oscilloscope snapshot

Subtracted signal



Averaging over 300 pulses



Worst cross-talk is on the level of noise → small enough

EMC digitizer and readout

Digitizer prototype v2



- Stable links between all ADCs and FPGAs are established
- Feature-extraction firmware ported and in debugging stage
- Optical-link connection has to be established (in progress)

↓ Once done (April)

Ready to use with existing test readout (EMC only, no external triggers for tests)

Development of SODA source, time-distribution network (SODANET) and new compatible data concentrator (based on TRB v3 board) is ongoing

↓ Once done (summer)

Common tests with other subsystems; on-line event building; possibility of external triggering

summary

- **successful long-hole drilling**
- **almost ripe ideas for insulation panels**
- **refined cooling simulations**
- **Eddy-currents at quench pose no serious problem**
- **Line-driver board with tolerable cross talk**
- **EMC digitizer in debugging stage → ready April**