PXD+SVD Thermal Enclosure

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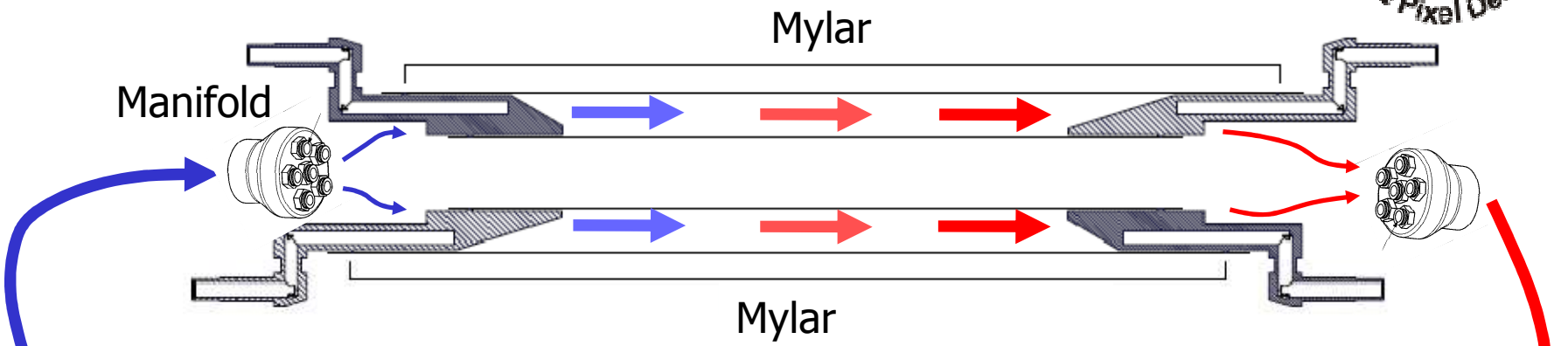
Outline

Reasons why we need a thermal enclosure (TE)

First dummy TE

Future plans

Belle-II PXD Option 1



Cold air gun (down to -30ºC)

Vacuum

- ✓ The flow should be 'more' laminar
- ✓ A similar configuration can be used for the SVD

Hard-plumbing to avoid kinks in the pipes
What about the thermal gradient along the ladder???

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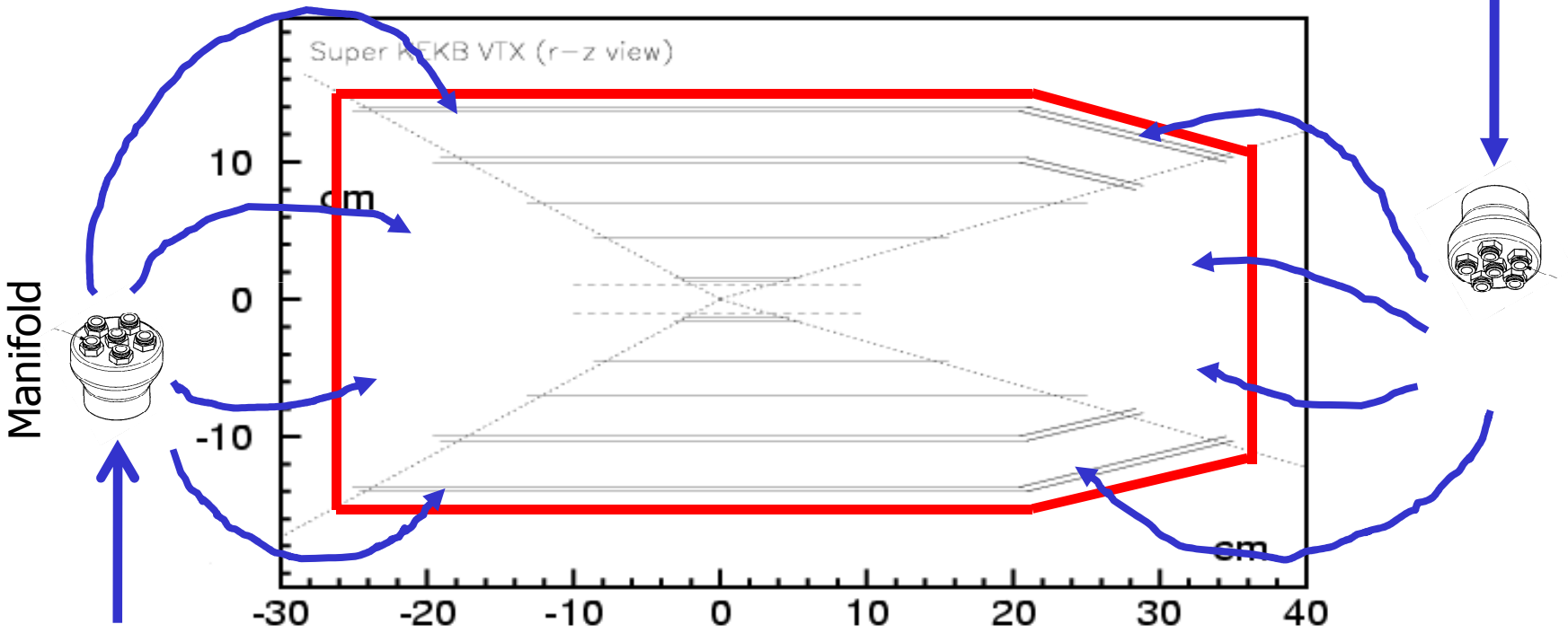
- Belle-II PXD Option 2…

Fill the chamber with cold air…



Cold air gun

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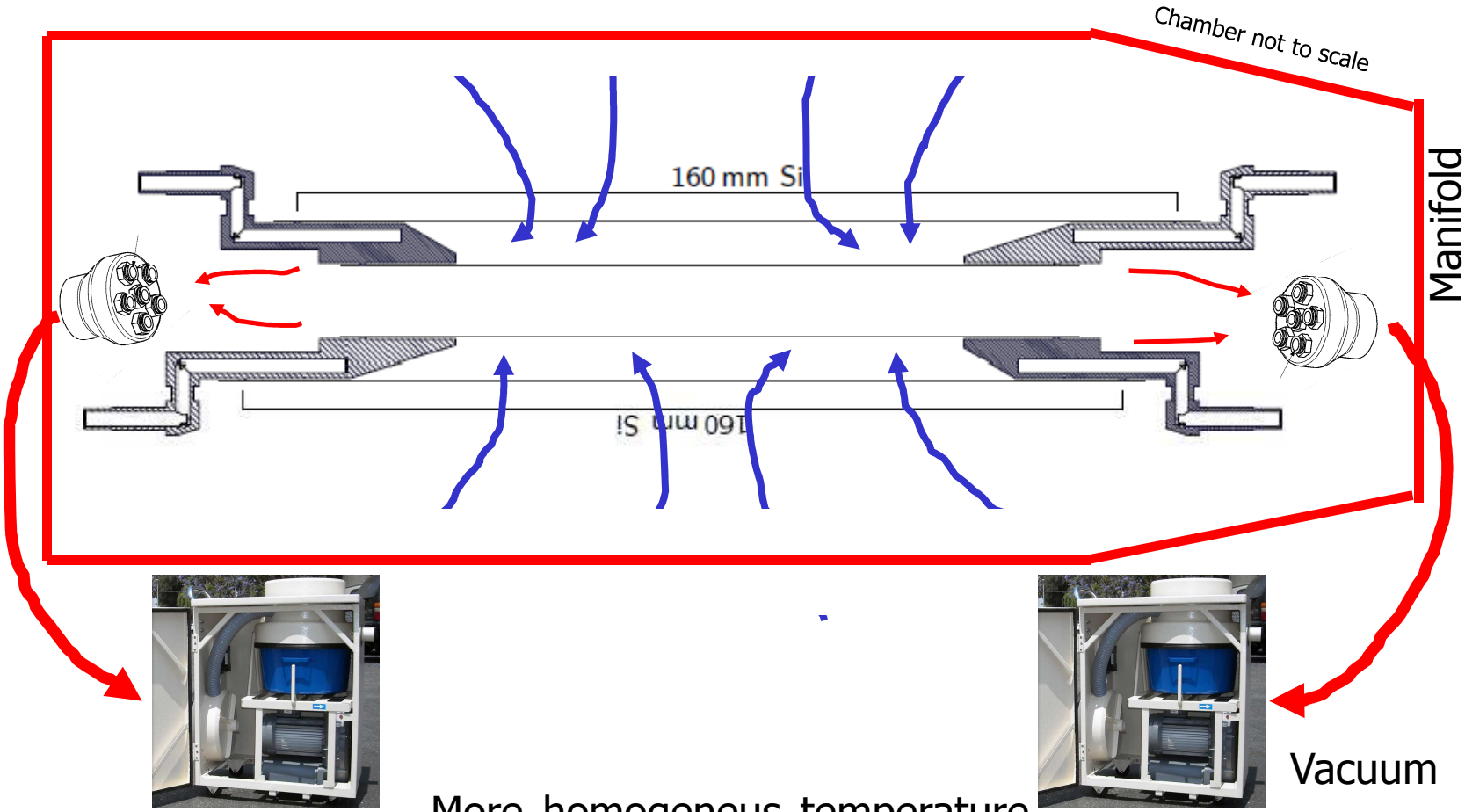
Belle-II PXD Option 2…

And take the air out from both sides, using the holes in the support structure



More homogeneus temperature along the ladder

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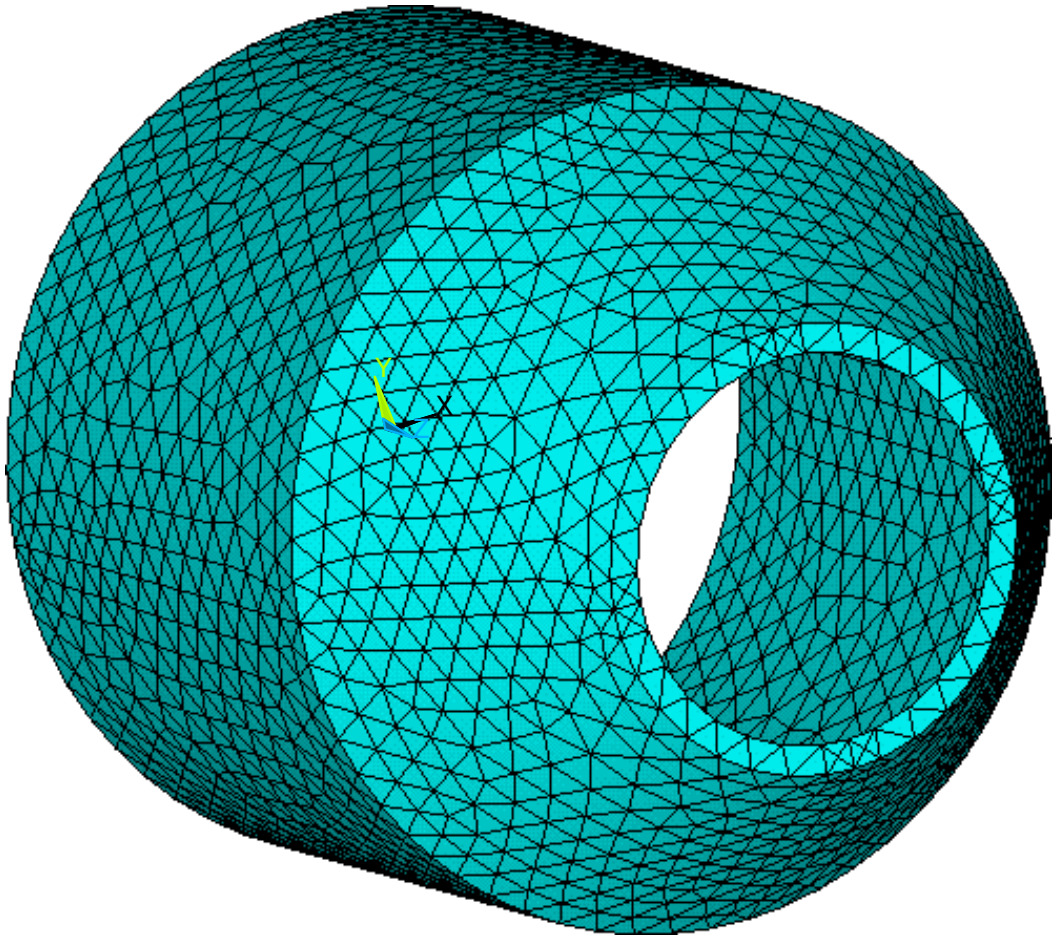
Thermal enclosure



- Mechanical protection
- Thermal insulation between the PXD+SVD (-5ºC) and the CDC (25ºC)
- Contains dry nitrogen atmosphere to avoid condensation
- Moisture barrier
- Electrical shielding (Faraday cage)

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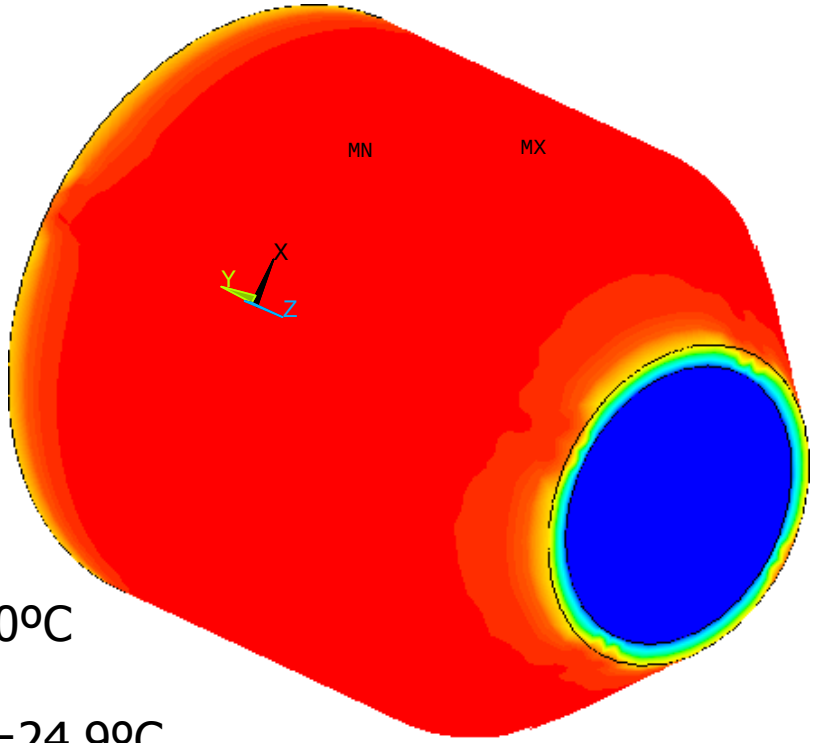
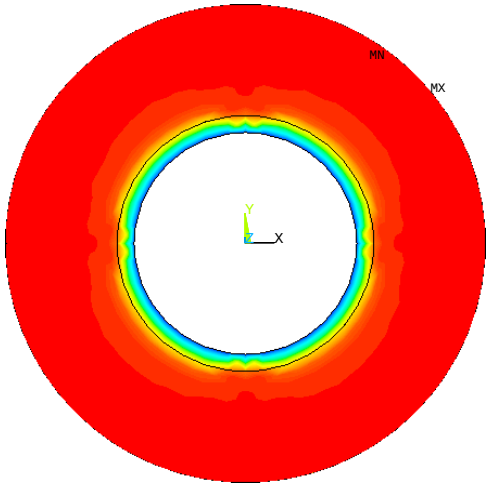
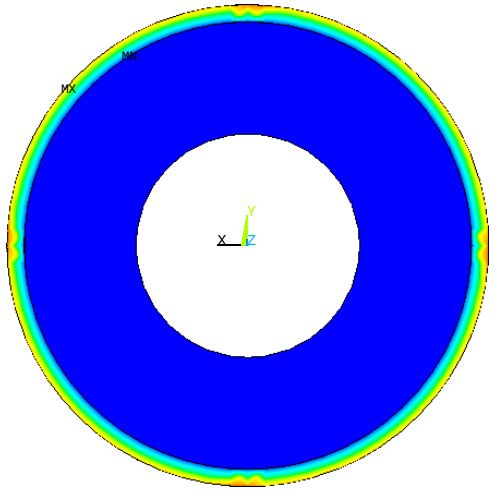
Will this insulation work?

Wall thickness=1cm
Thermal conductiviy=0.039W/mK

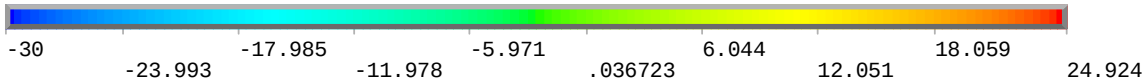






T_{in}=-30ºC

✓ T_{out}=24.9ºC



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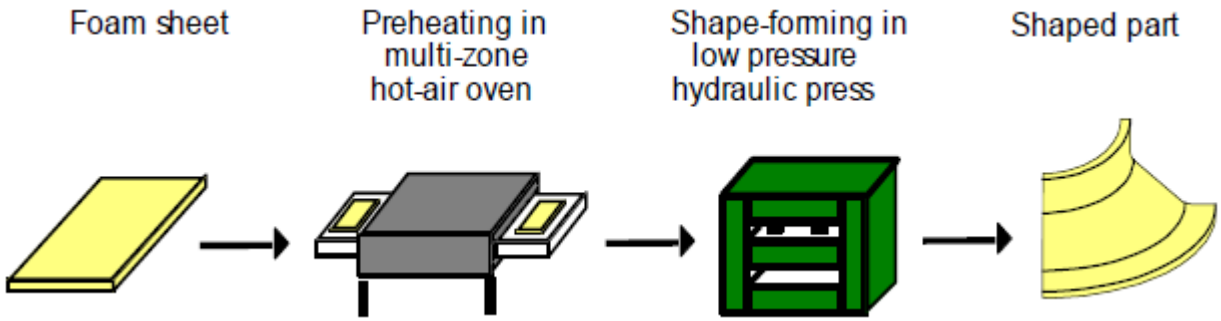
Airex

AIREX®

Thermoformable → No frame needed!



ATLAS TE (Thermal Enclosure) → Airex R82 foam

Used in aerospace science: Cryogenic tanks, insulating panels

Operating temperature from -194°C to +160°C

Thermal conductivity: 0.036W/mK

Low moisture absorption (a few grammes per m^2 when in high humidity)

Low density (60 kg/m^3)

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ATLAS EndCap OTE sample

Kapton: 0.017%X_0

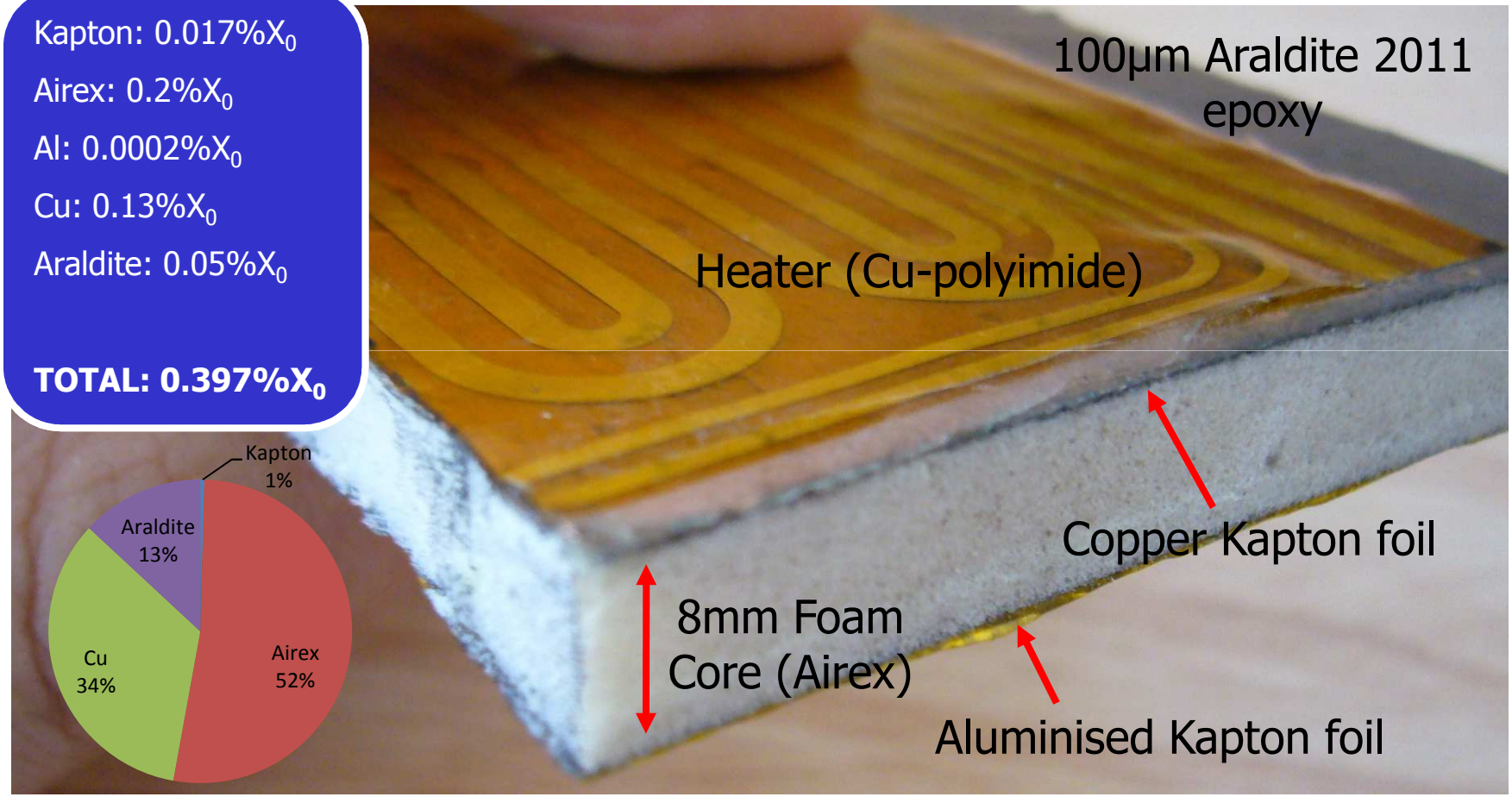
Airex: 0.2%X_0

Al: 0.0002%X_0

Cu: 0.13%X_0

Araldite: 0.05%X_0

TOTAL: 0.397%X_0



Al-Kapton (<1µm Al; 25µm in total): Reduces the radiative heat transfer
Cu-Kapton (18µm Cu; 43µm in total): Electrical shielding

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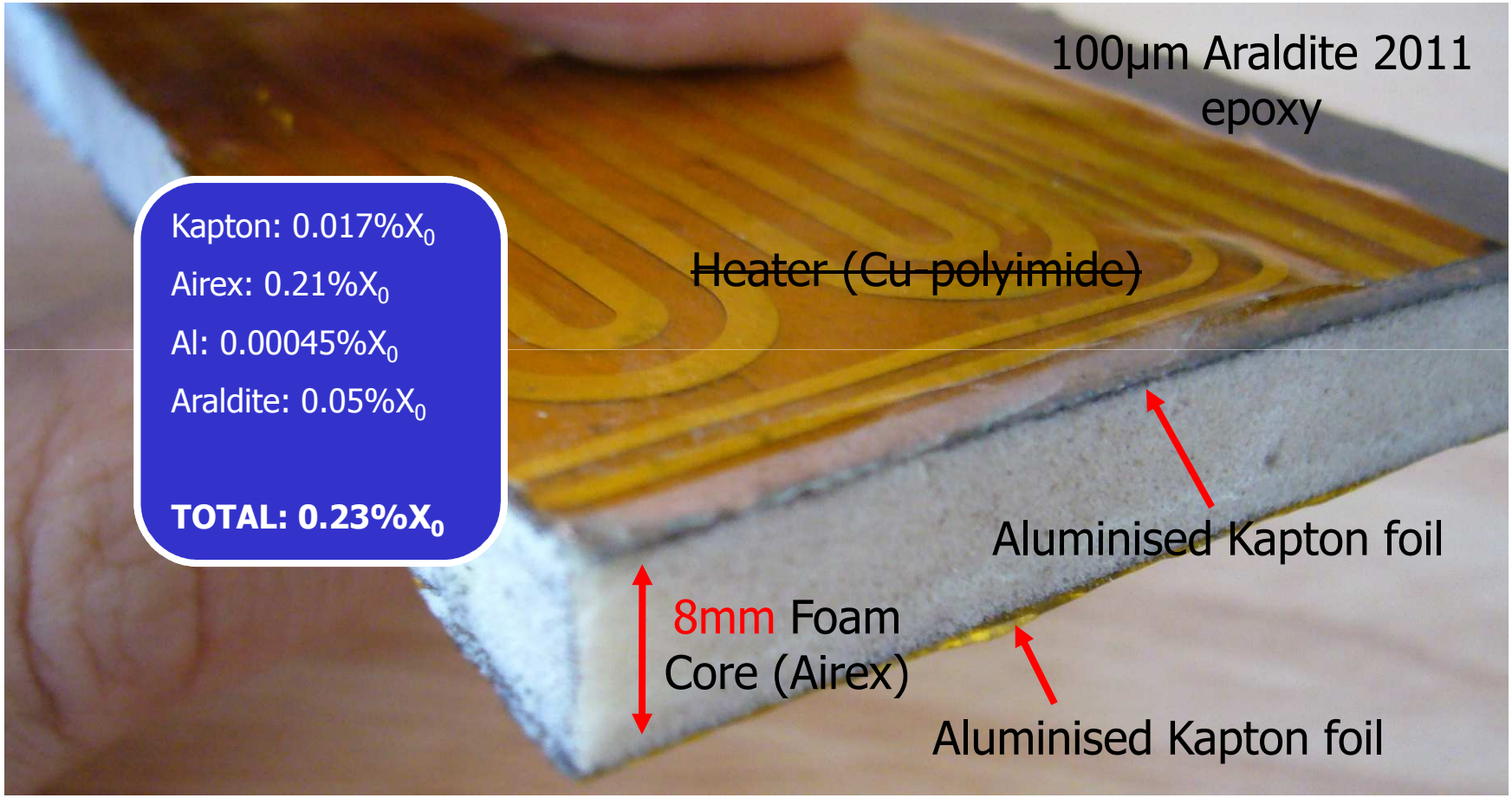
Option 2: Mini-Airex



2 Al-Kapton (0.8 µmAl; 49.6µm in total): Reduces the radiative heat transfer and prevents delamination

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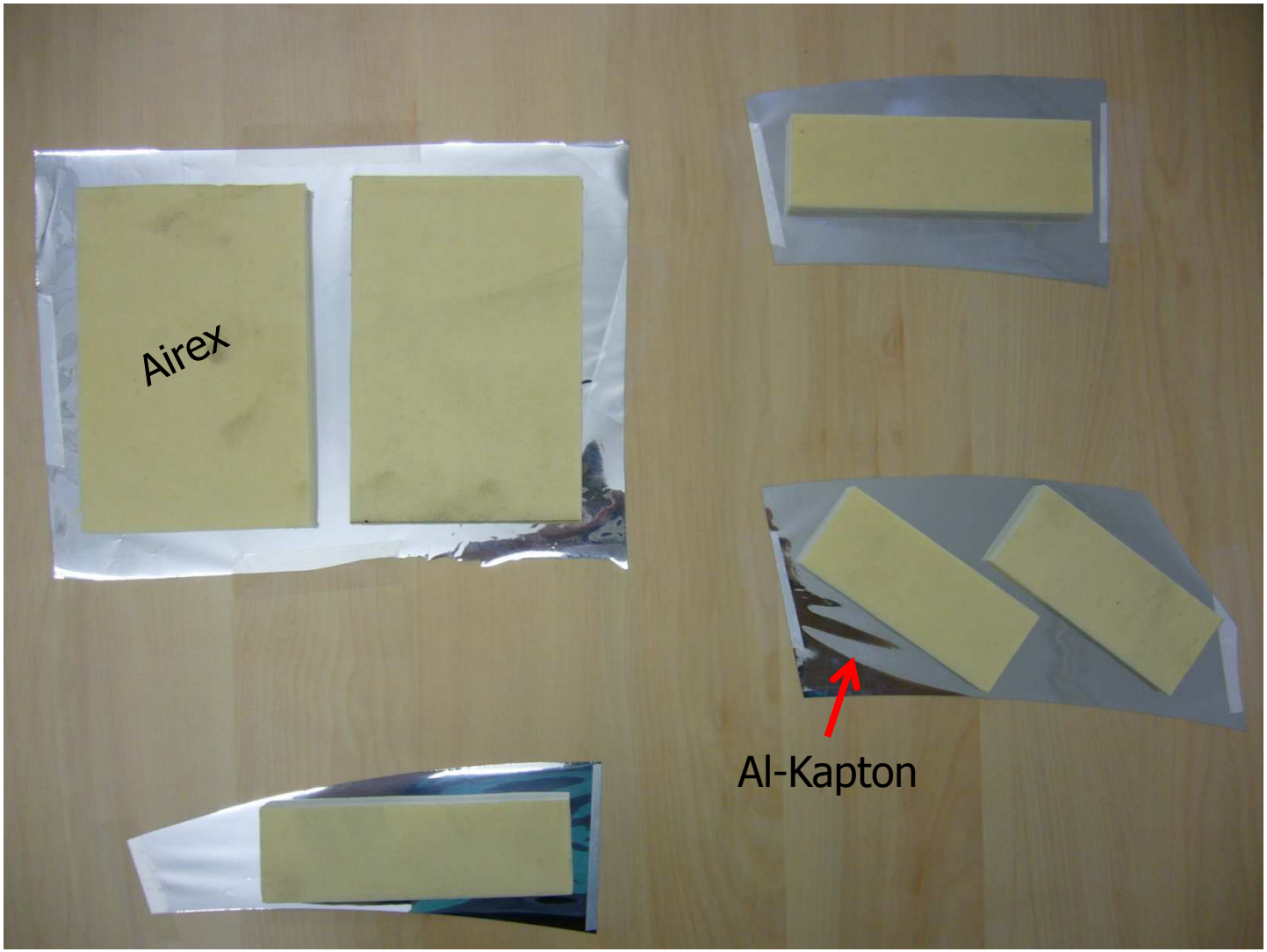
- Dummy TE (just a box)



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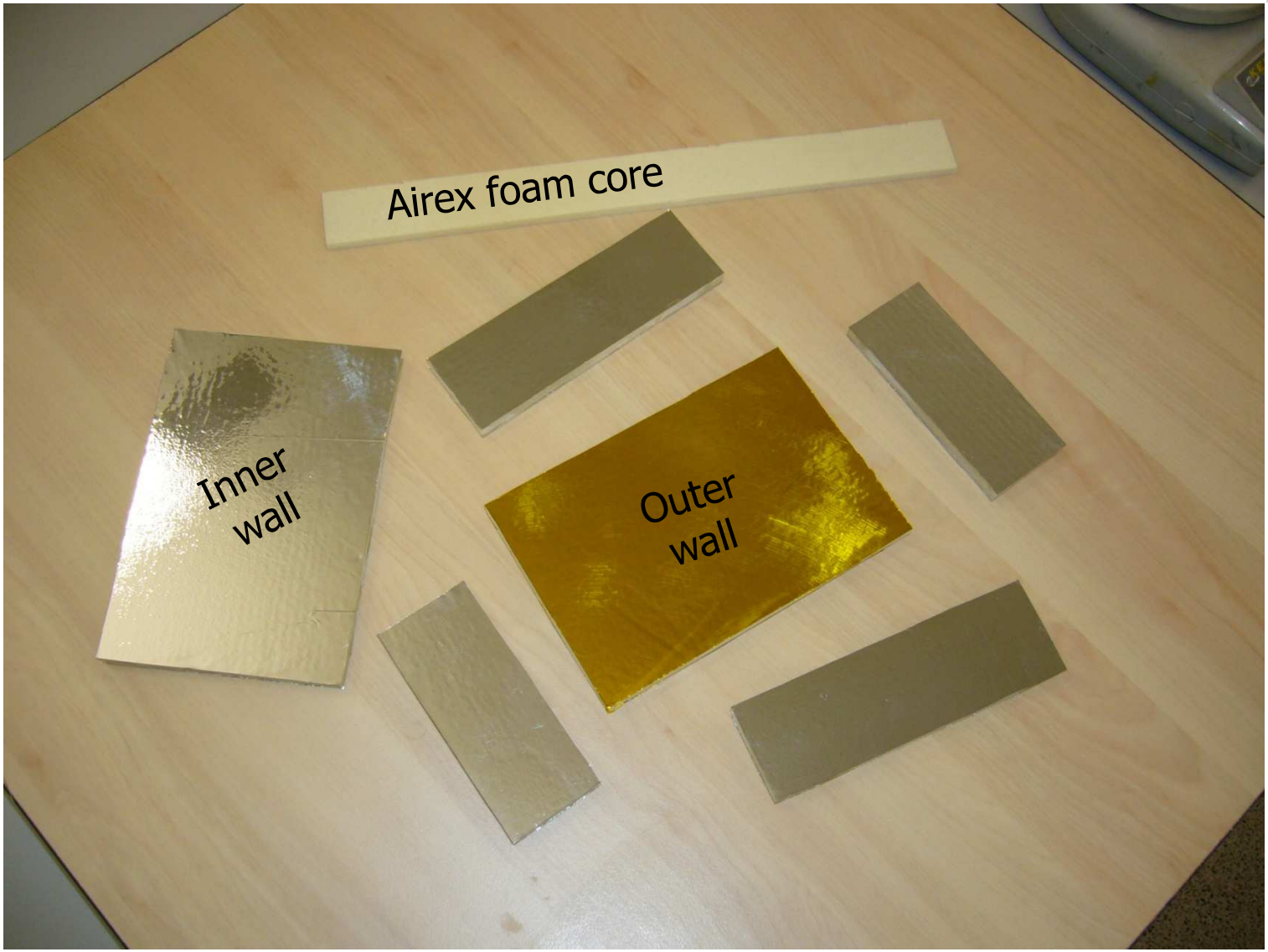
Dummy TE



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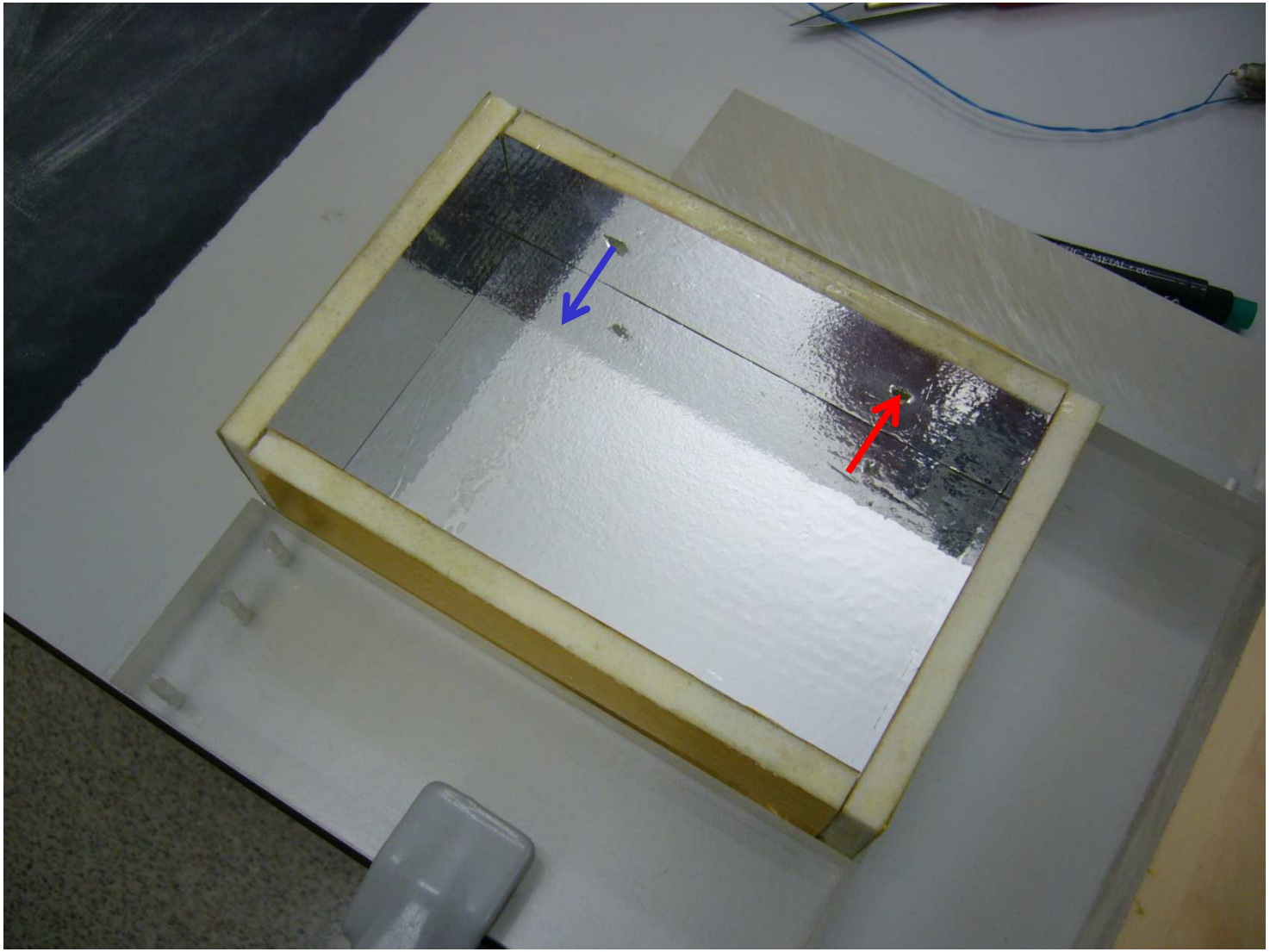
Dummy TE



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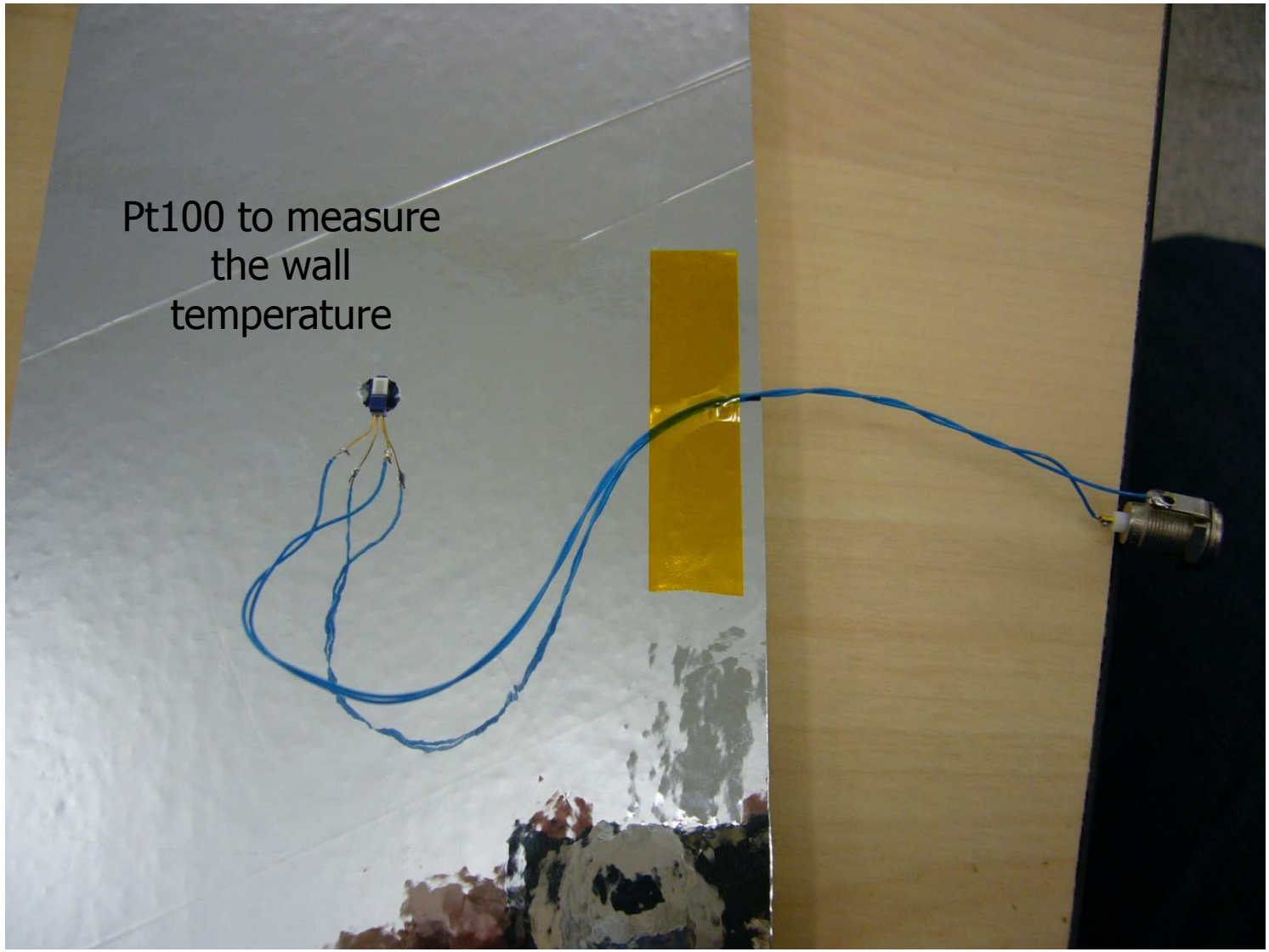

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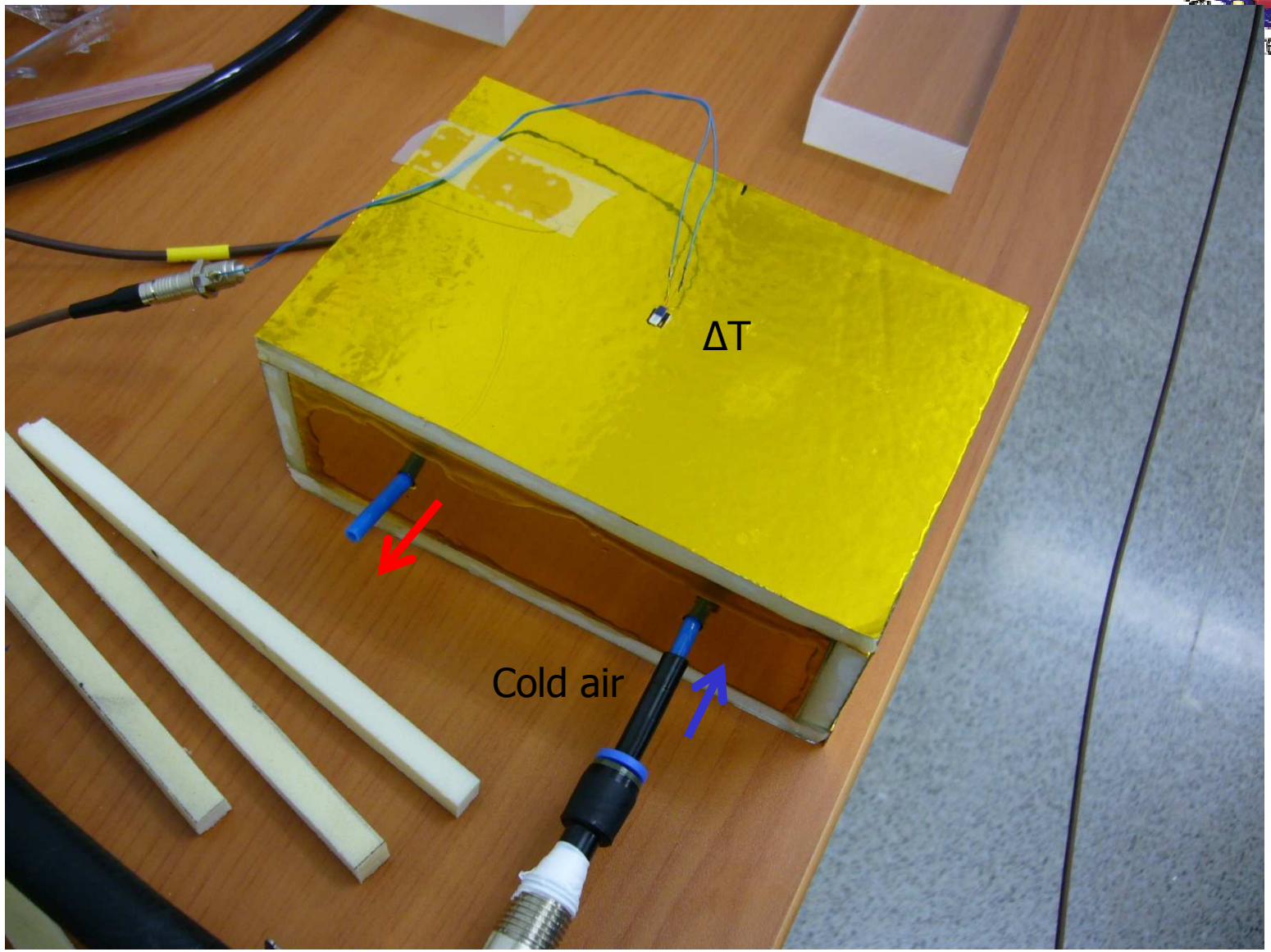

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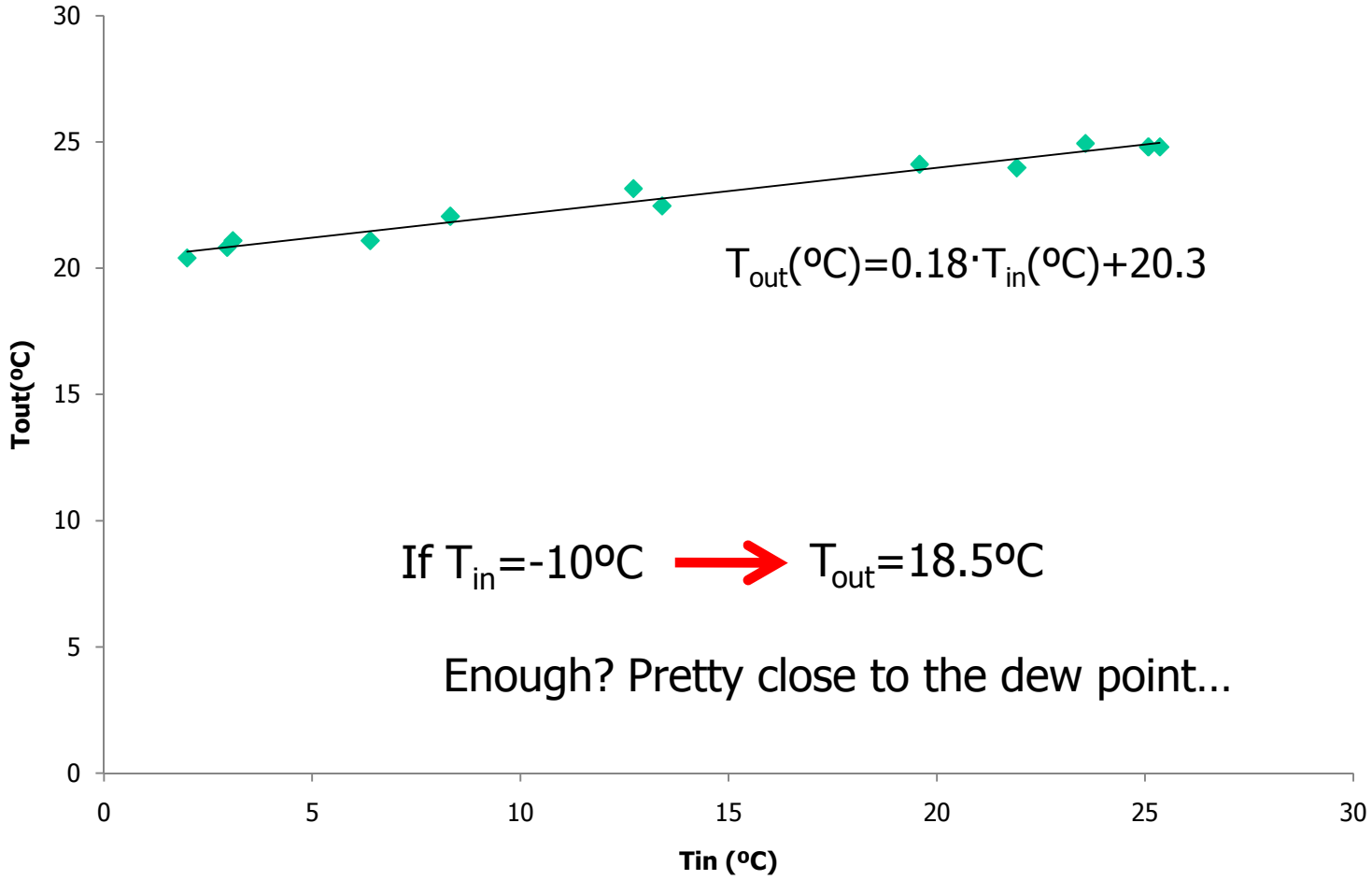
Dummy TE



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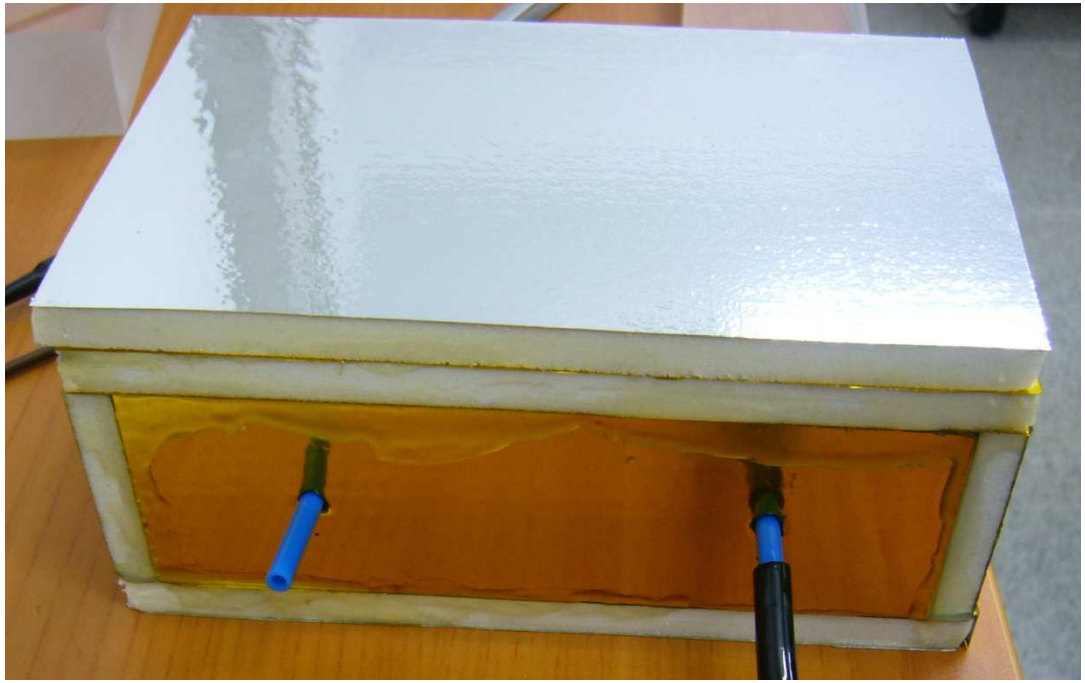
Strategies

1.- Multilayer structure (Al.Kapton-Airex (8mm)-Al.Kapton-Airex (5mm)-Al.Kapton) (0.4%X_0)



2.- Heater outside (material budget? heat the air inside?)

3.- New materials (Pyrogel or Nanopore) with lower thermal conductivity (already used in ATLAS)

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Thank you very much!

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