Progress and prospects in thermo-mechanical activities at Valencia

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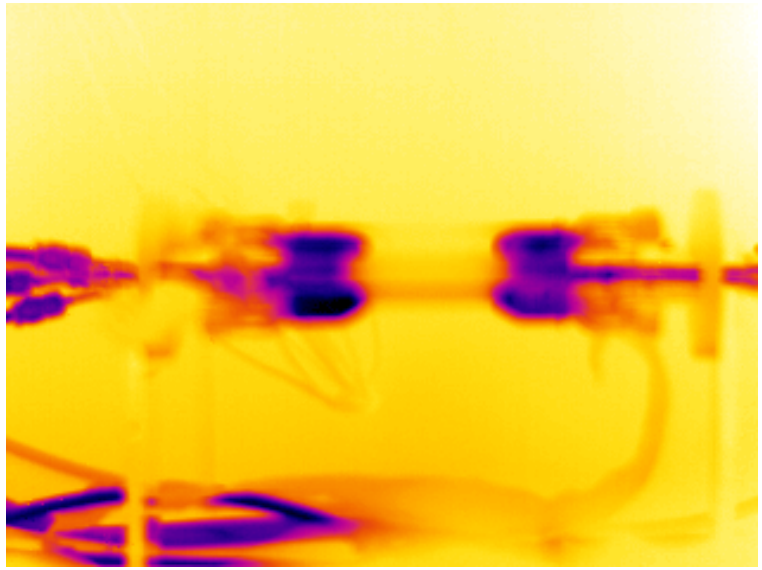
(IFIC - Valencia)



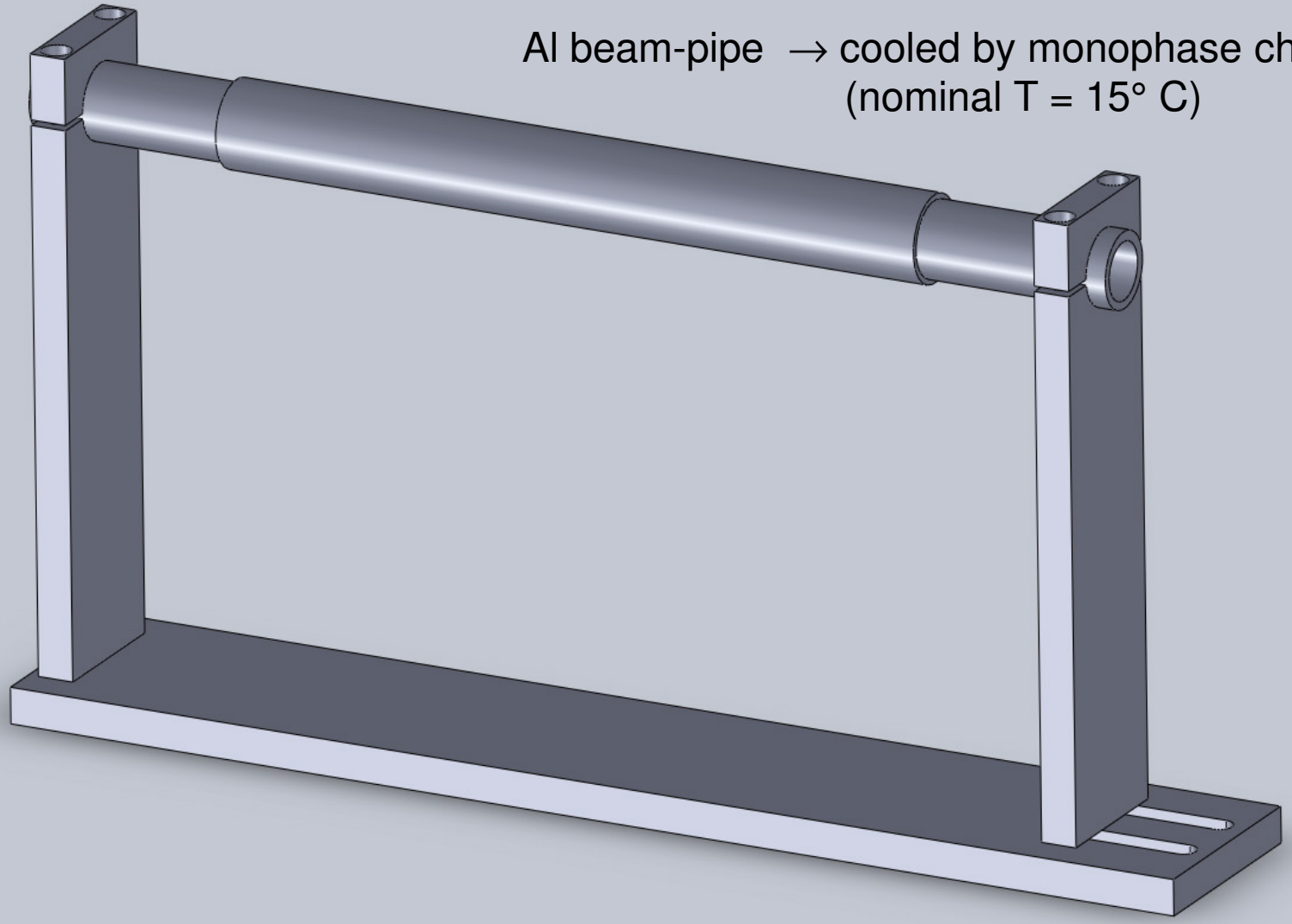
Outline

- Thermal mock-up (reminder)
- First studies of cooling:
  - Effect of beam pipe temperature on the inner ladder
  - Effect of air flow cooling on the inner and on the outer ladders
- Outlook

Thermal Mock-up

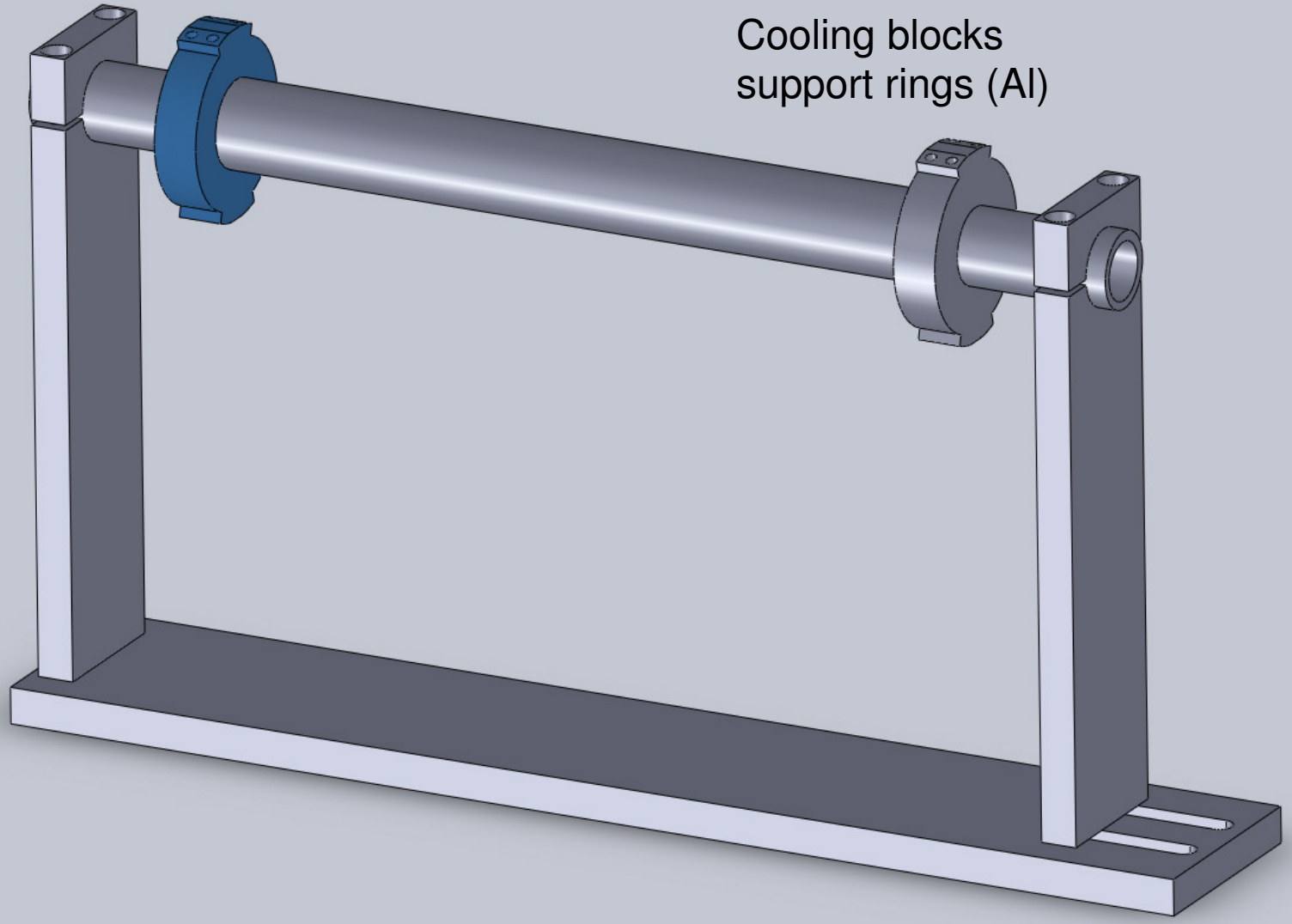
Thermal mock-up

Al beam-pipe → cooled by monophase chiller
(nominal T = 15° C)

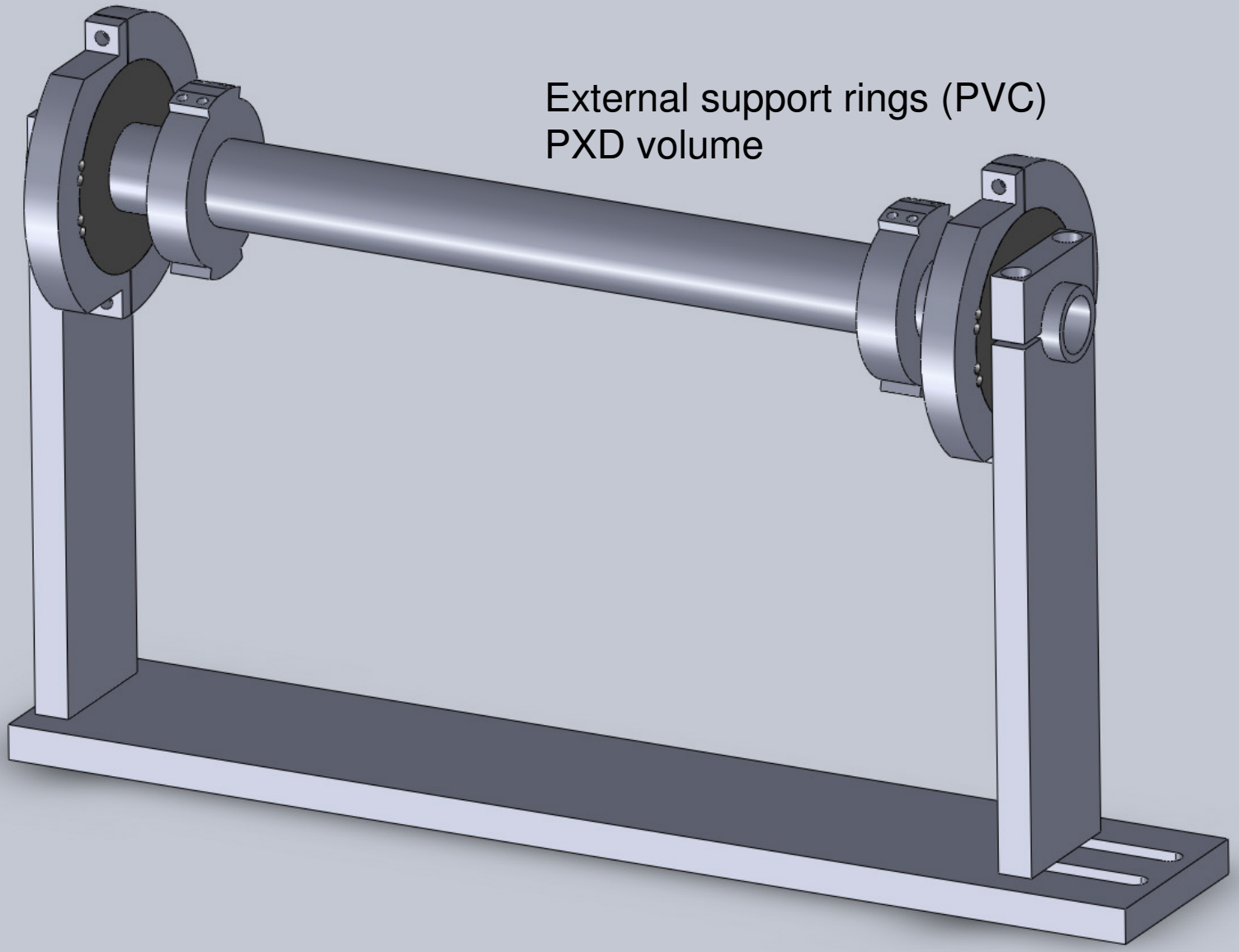


Thermal Mock-up

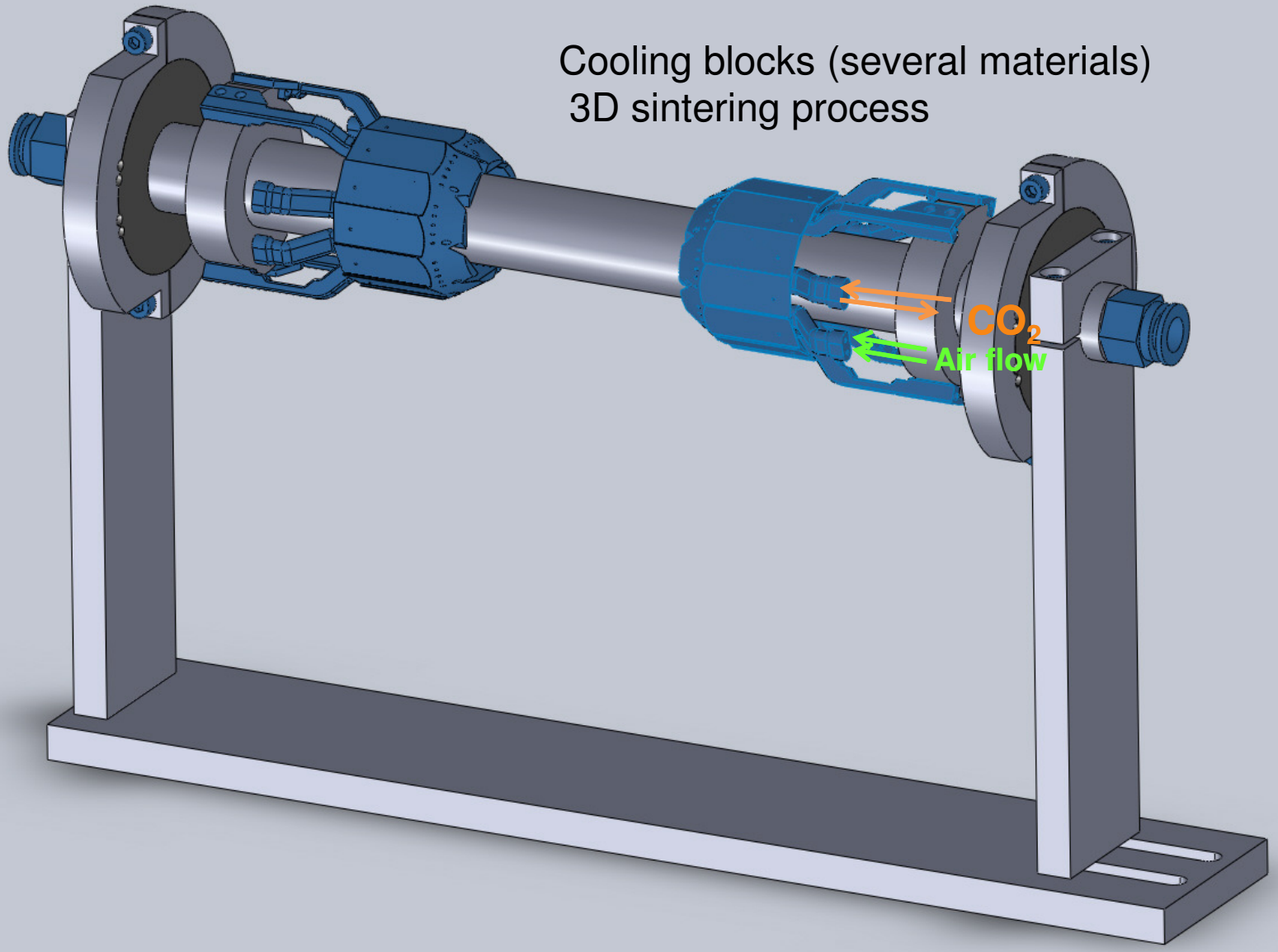
Thermal mock-up



Thermal Mock-up

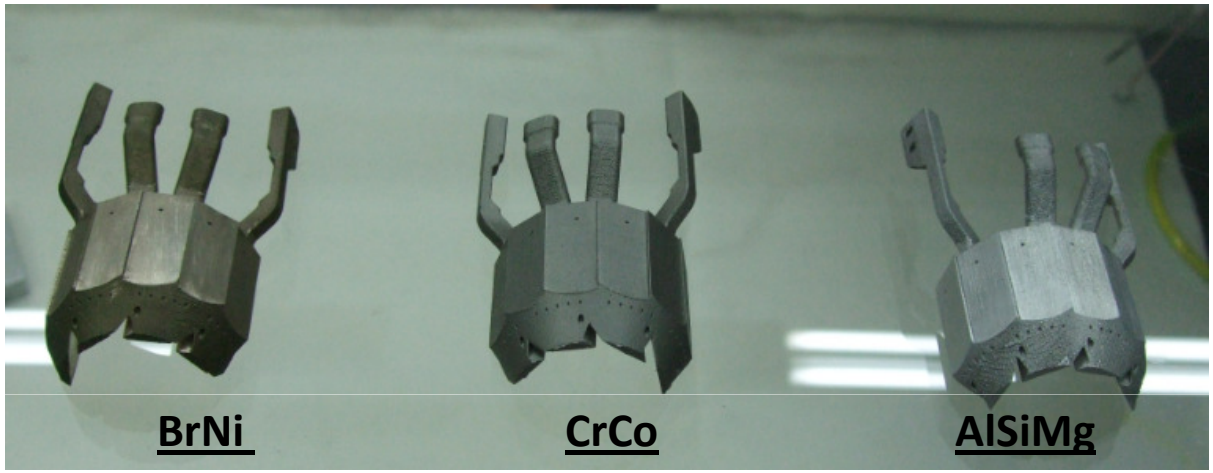


Thermal Mock-up



Thermal Mock-up

- Cooling block materials:



→ Going to MPI for pressure tests

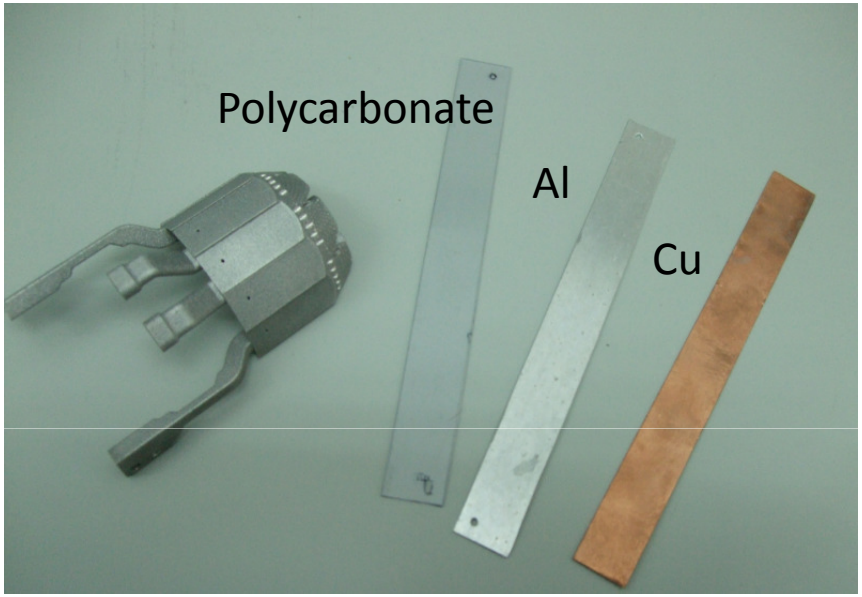
Stainless steel

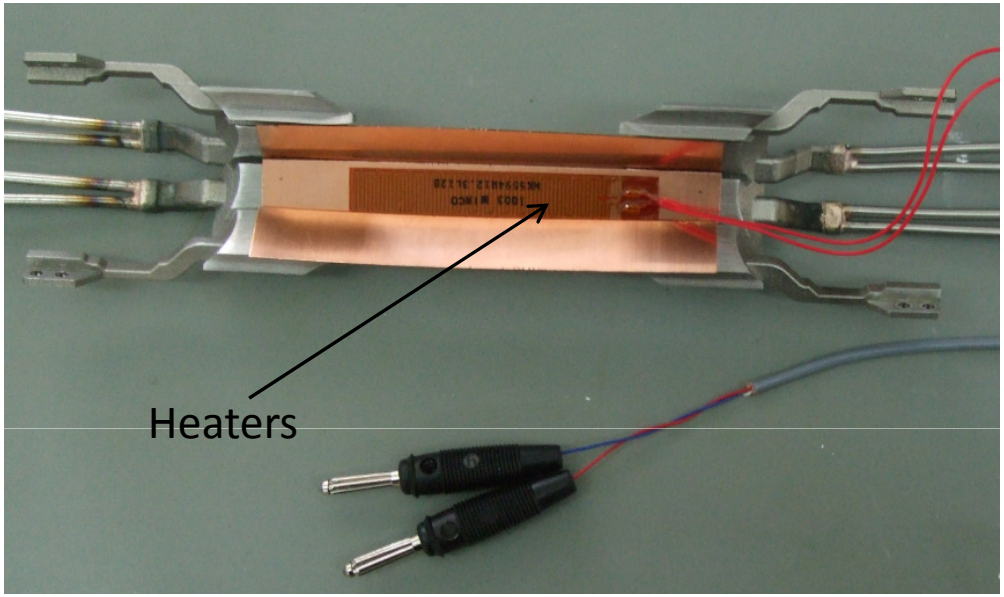
Properties:

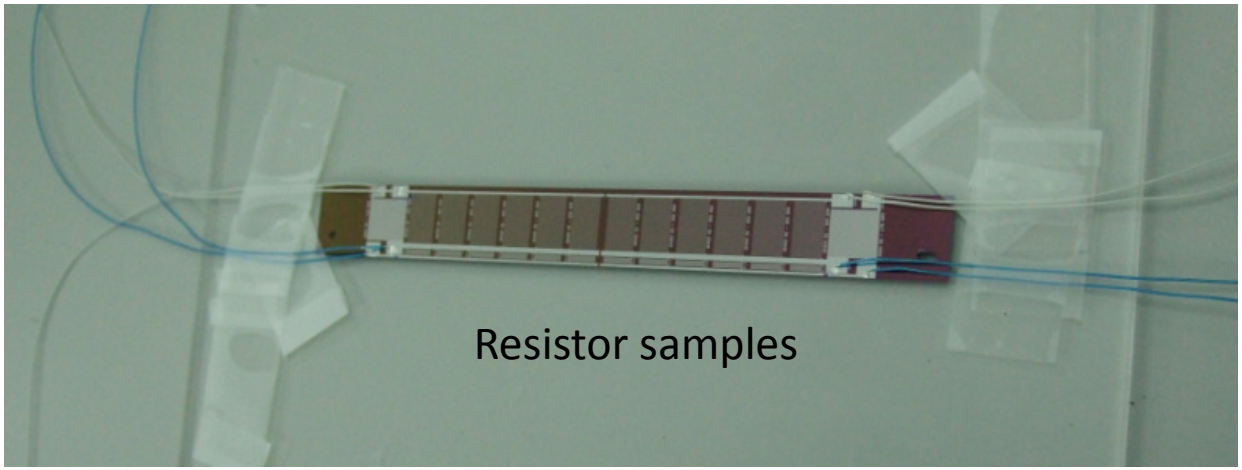
Therm. conduct. (W/mK):	30	13	140	15
CTE (um/m°C):	18	14	21	17
Resistence (N/mm²):	400	1200	310 (?)	650
Comments :	Residual magnetism Porous (!)	- Difficult to machine (polish, drill, etc.) - Non magnetic	-"malleable" (to drill, polish…) -Non magnetic	Pores and leaks in our samples (leaks by manipulation)

Thermal Mock-up

- Dummy ladders:

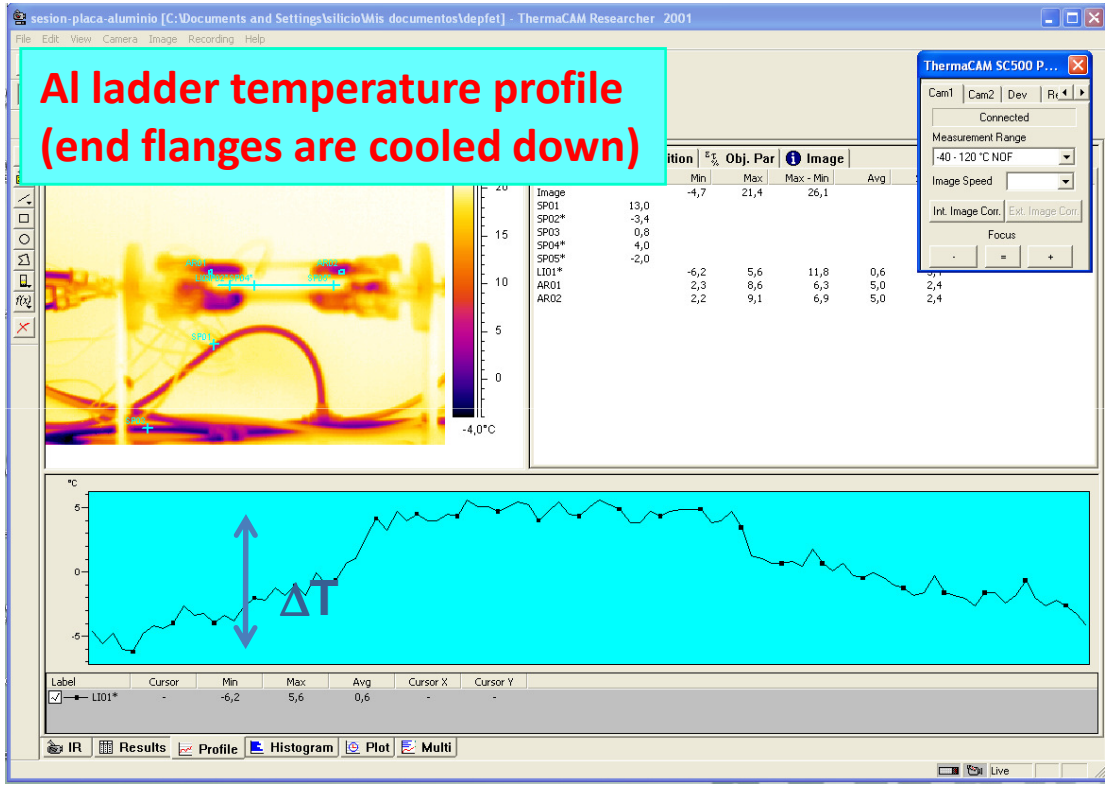


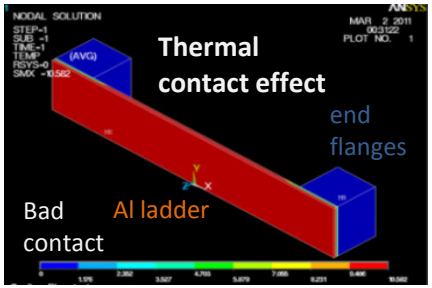


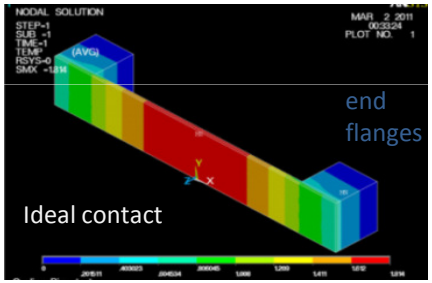


Thermal Mock-up

- Thermal contact between cooling block and ladder





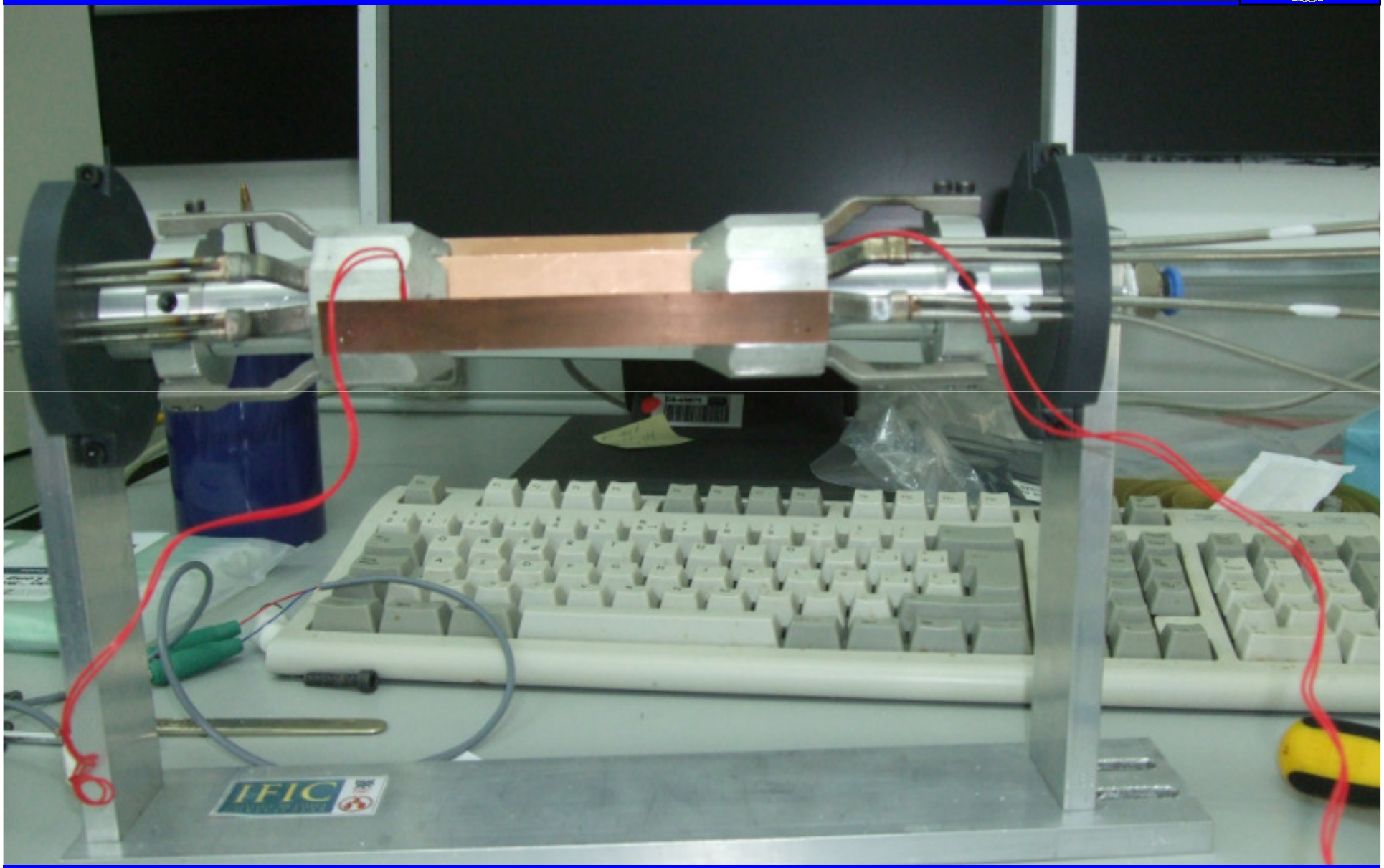


→ΔT strongly depends on the thermal contact

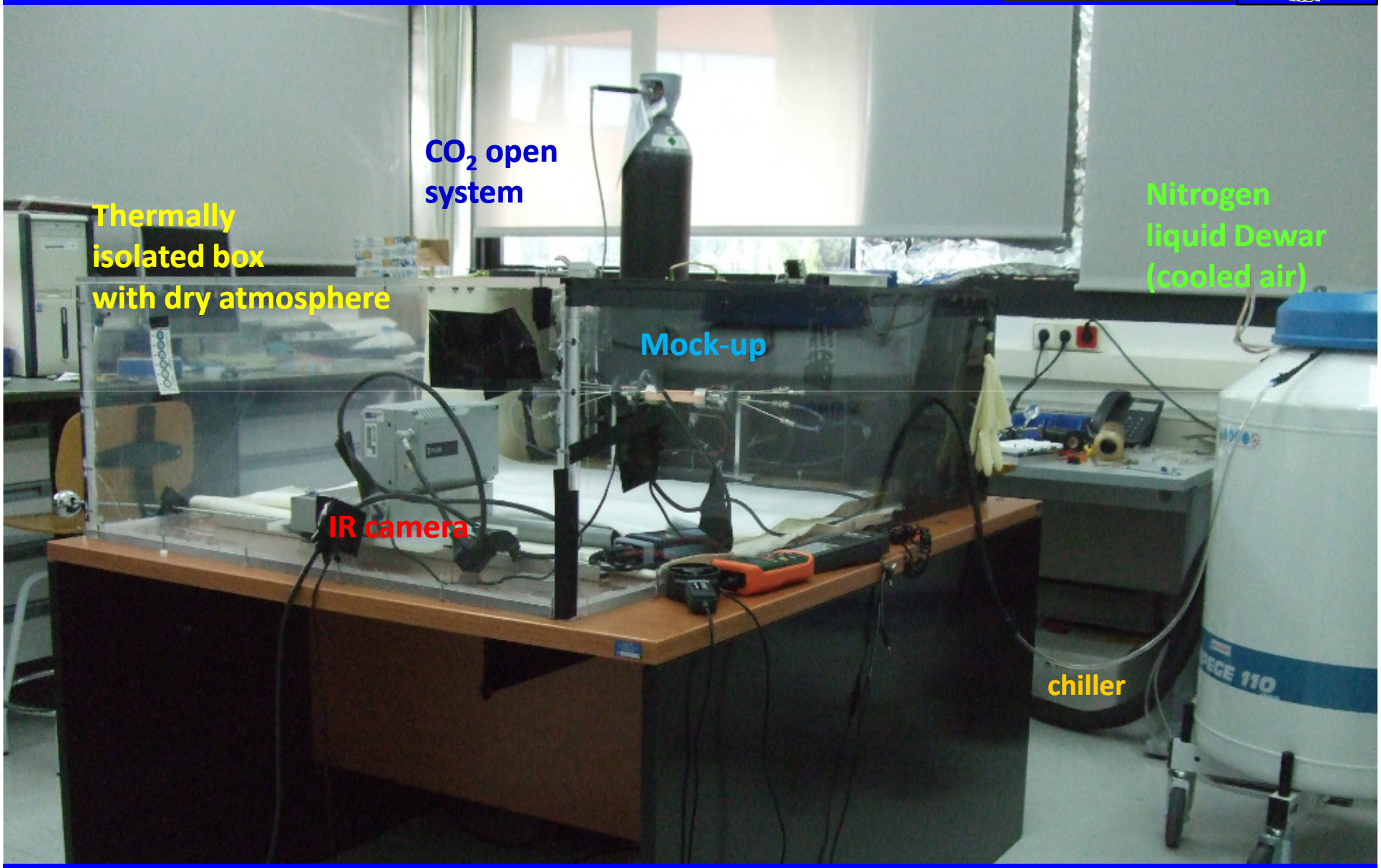
→ Thermal paste + screws

→Quite difficult to thread on CrCo, at present using double sided thermal tape (thermal conductivity = 0.8 W/mK)

Thermal Mock-up



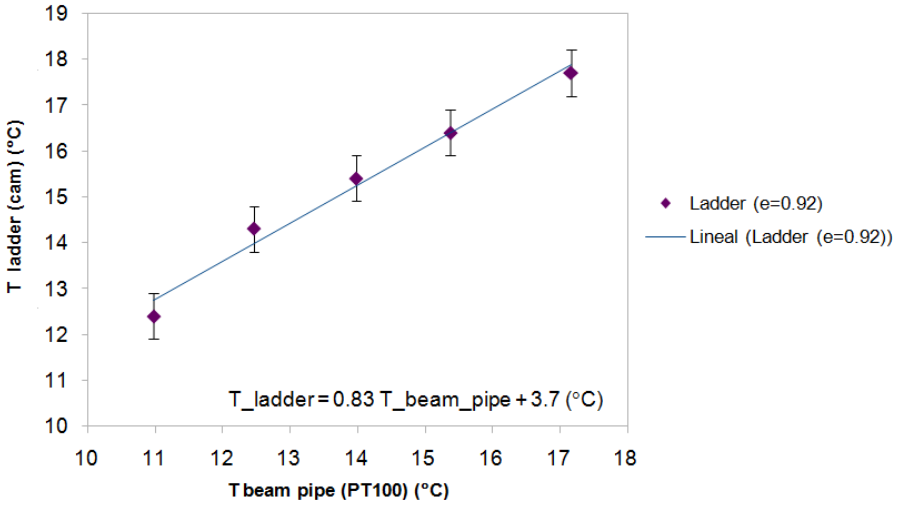
Thermal Mock-up

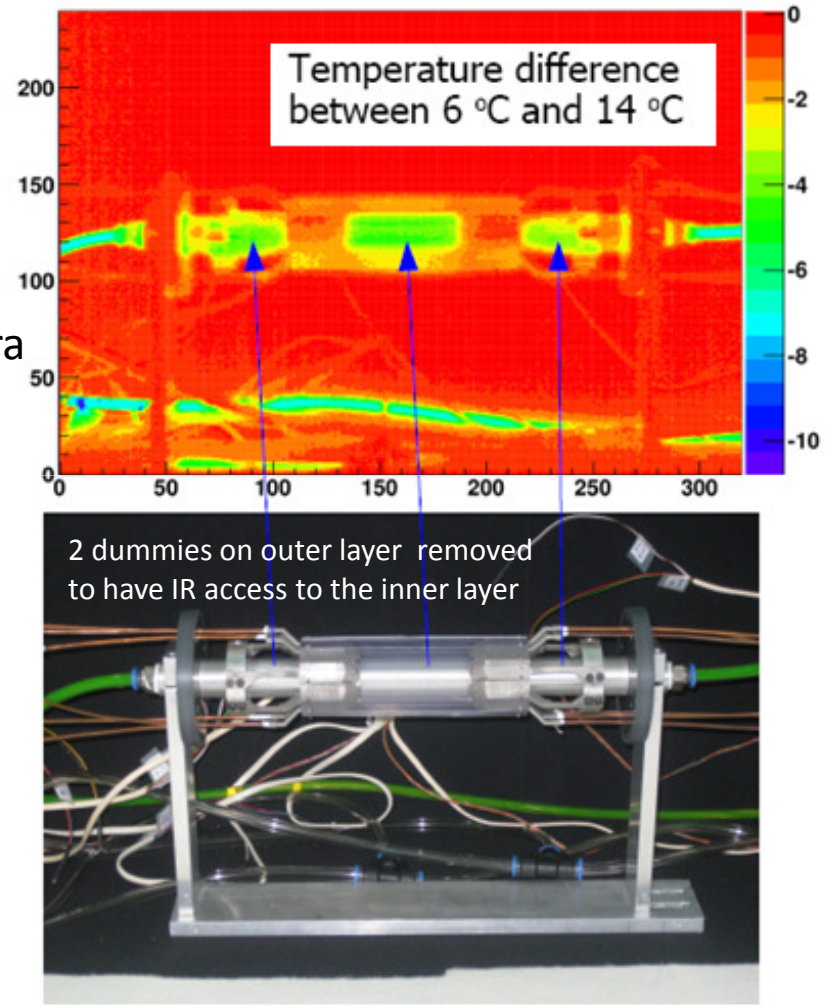


Cooling studies

- Effect of beam-pipe temperature on the inner layer

- Cooling beam pipe with chiller
- End flanges at room temperature (stainless steel)
- Transparent polycarbonate dummies
- Measure temperature on first layer with IR camera (calibrated with PT100s)



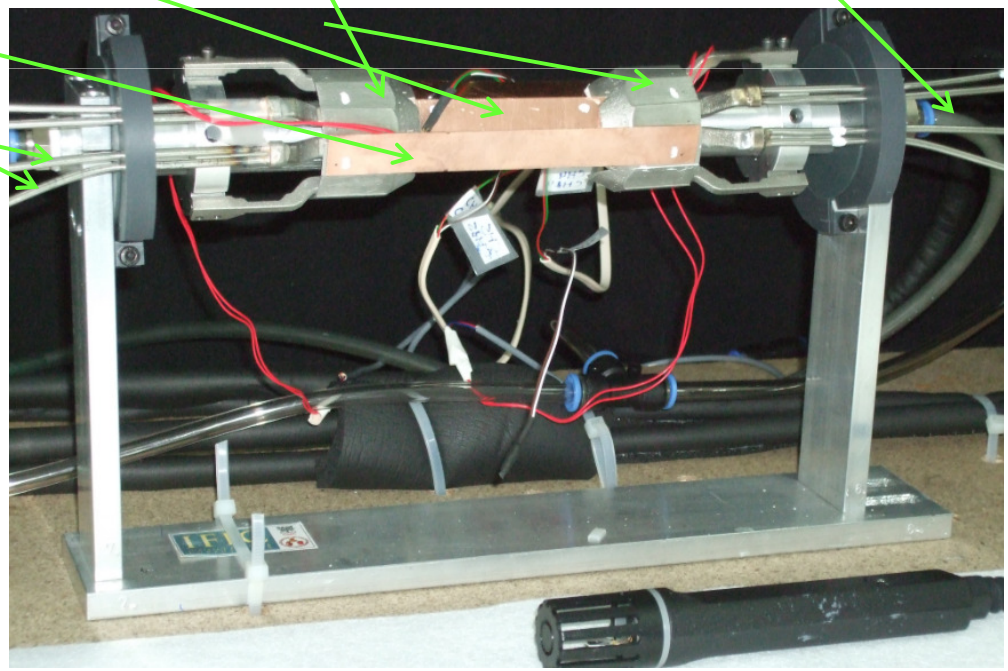


→ **Impact of several degrees on first layer (under these conditions)**

Cooling studies

- Effect of air flow cooling

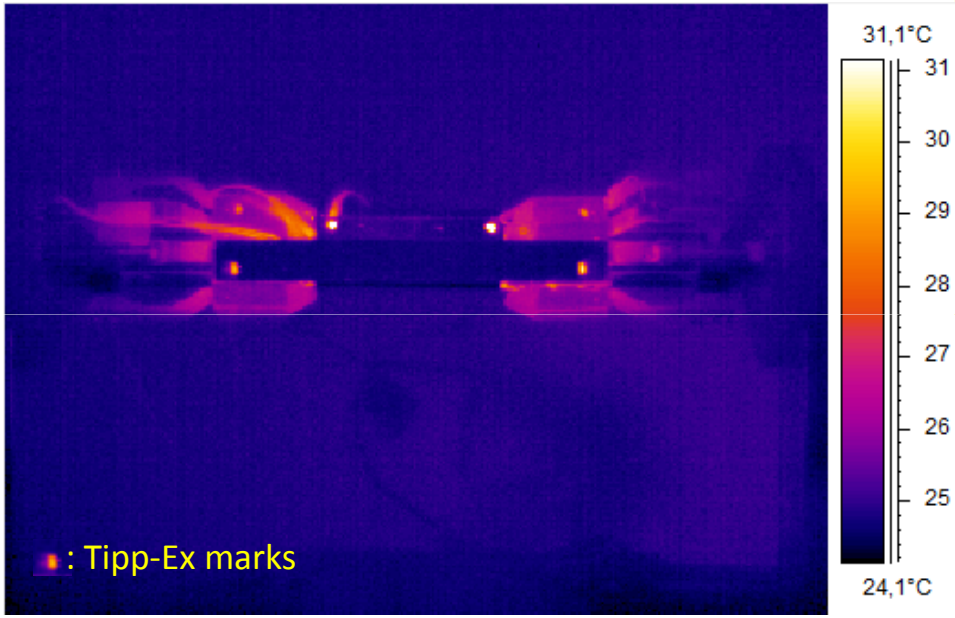
- Beam pipe at room temperature (can be cooled with chiller → 15 °C)
- CrCo end flanges (2), cooled down with CO_2 (~12bar)
- Cu ladders with heaters:
  - Power dissipated along ladder: 1W → T ~ 30°C;
  - 4 inner ladders, only one with heater
  - 1 outer ladder with heater
- Air flow: dry air at ~ room temperature (20°C) or cooled down with liquid N_2
- Measure temperature on inner and outer ladders with IR camera, calibrated with PT100s and Tipp-ex marks (ε=0.95)
- Room: T=24° C, Humidity=8%



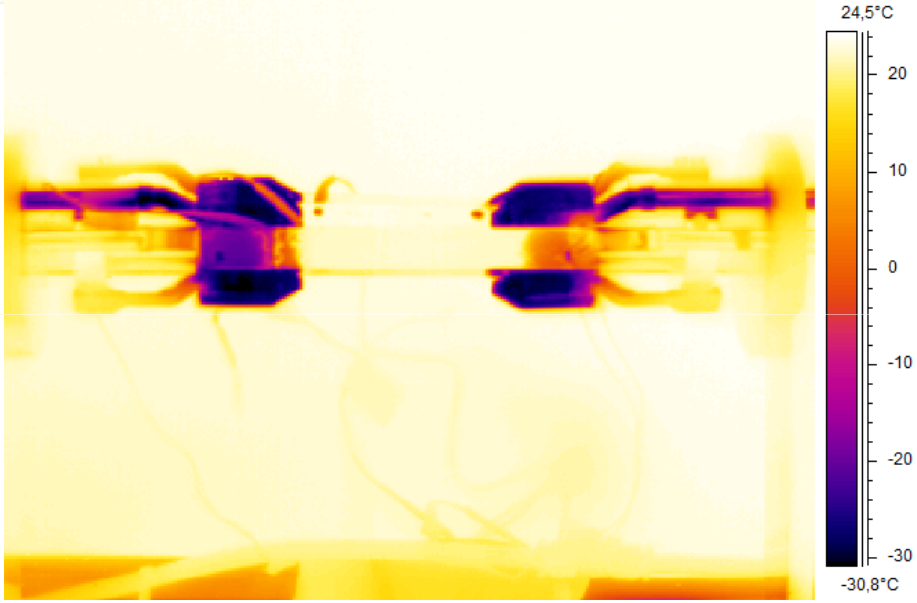
Cooling studies

Thermal images:

Switching the heaters on



Cooling down the end flanges with CO_2



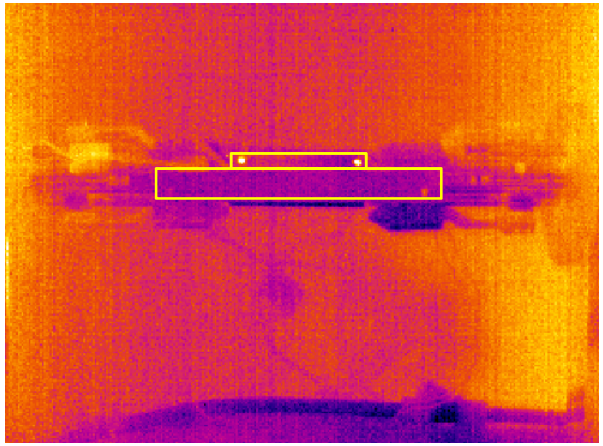
→ Real temperature given by Tipp-ex marks (ε=0.95) (global image emissivity)

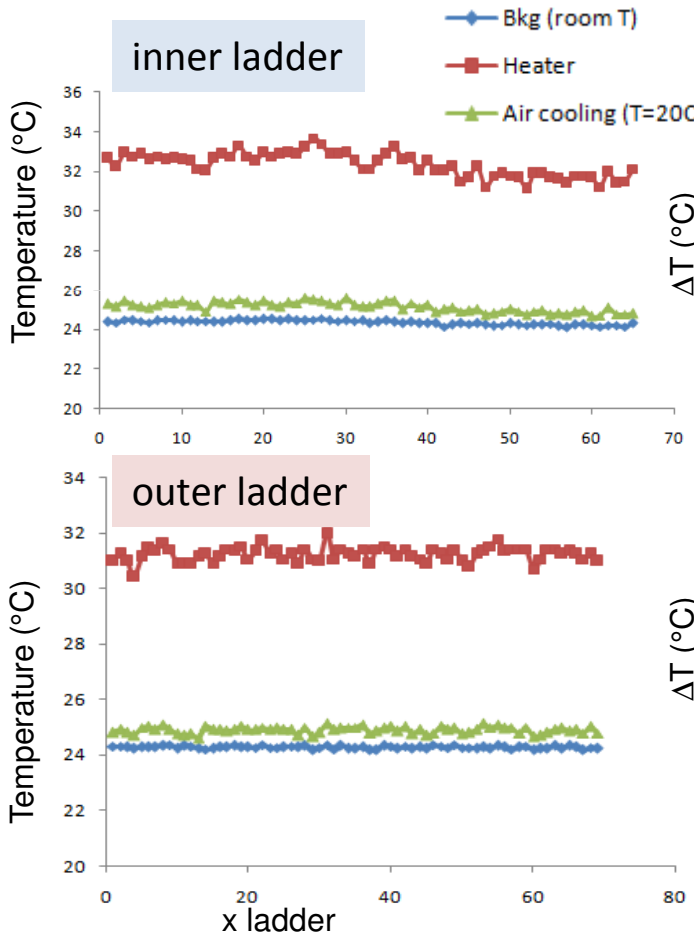
→ Emissivity of other materials have to be corrected

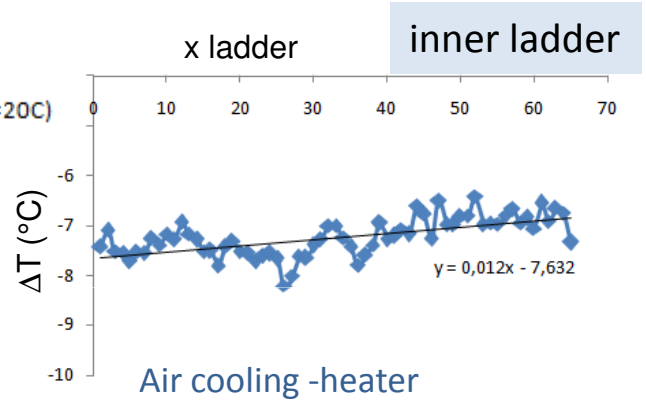
[→ Ice emmisivity ~ 0.97 → frost (slightly, H=8%) give approximate temperature]

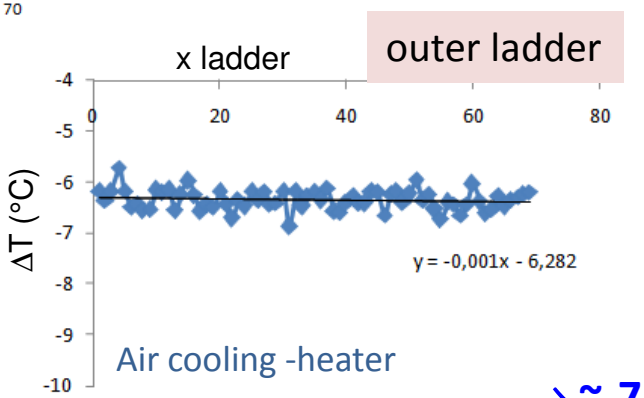
Cooling studies

- Heaters on
- Air flow at 20 °C (~2m/s)
- Cooling blocks at room T





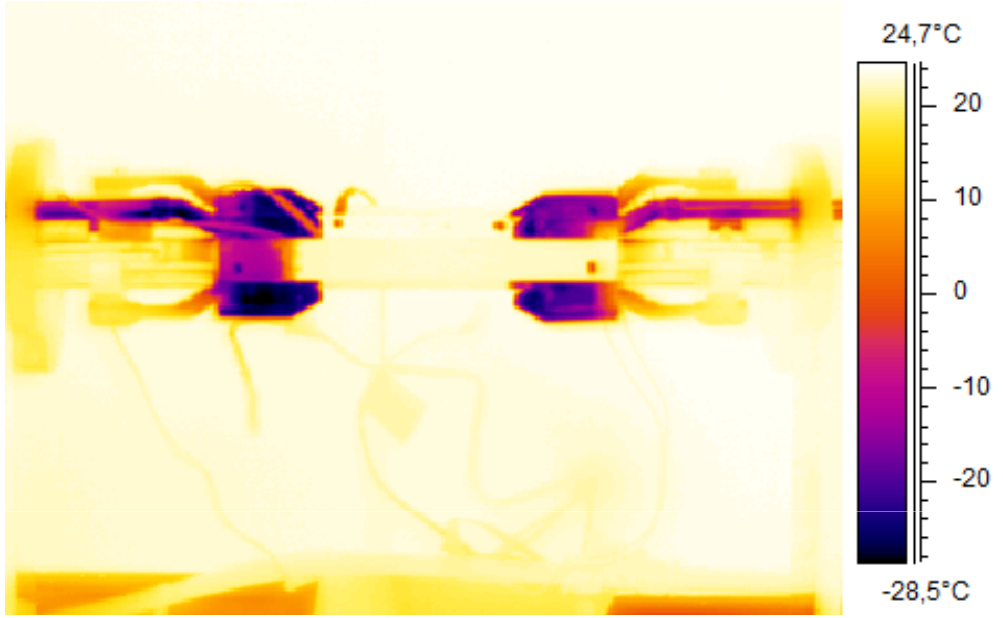




→ **~-7 °C in both ladders**

Cooling studies

- Heaters on
- Air flow at 20 °C
- Cooling blocks with CO_2 (12bar)



→ **Not good thermal contact (thermal tape)**

→ **Cooling blocks at -31 °C**

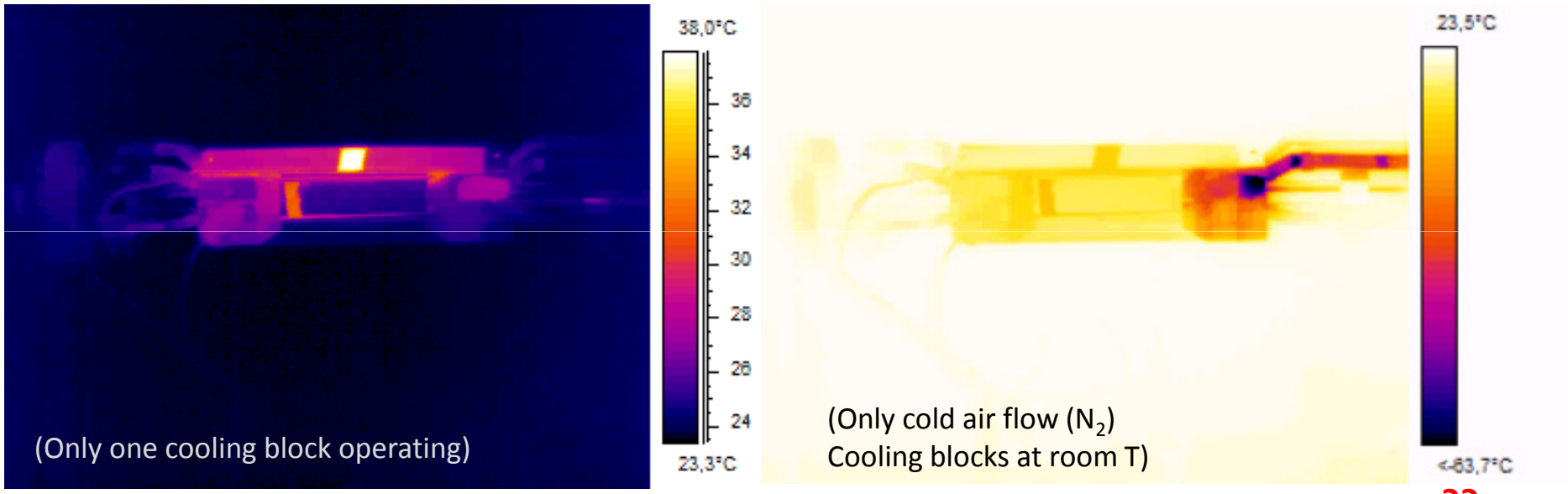
→ **Images still to be analized, PT100s and Tipp-ex marks show a few degrees for inner ladder (IL) (worst thermal contact) and -6 °C for outer ladder (OL).**

→ **Switching off the air flow → - 4 °C (IL) -10 °C (OL)**

→ **Cooling the beam pipe at 15 °C → no effect**

Cooling studies

→ Tests by cooling the air with liquid N_2 → difficult to control the temperature, inner and outer ladders at – few degrees.



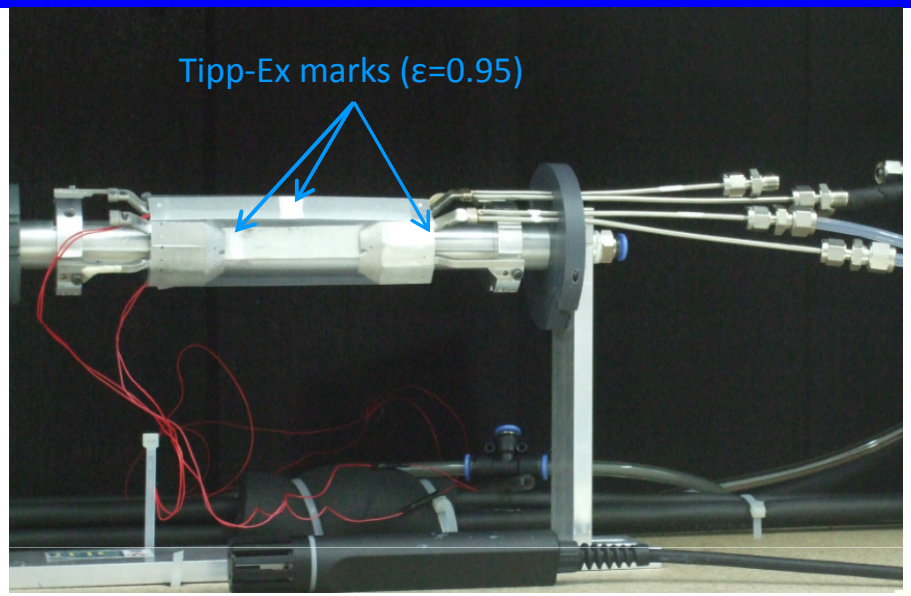
Outlook

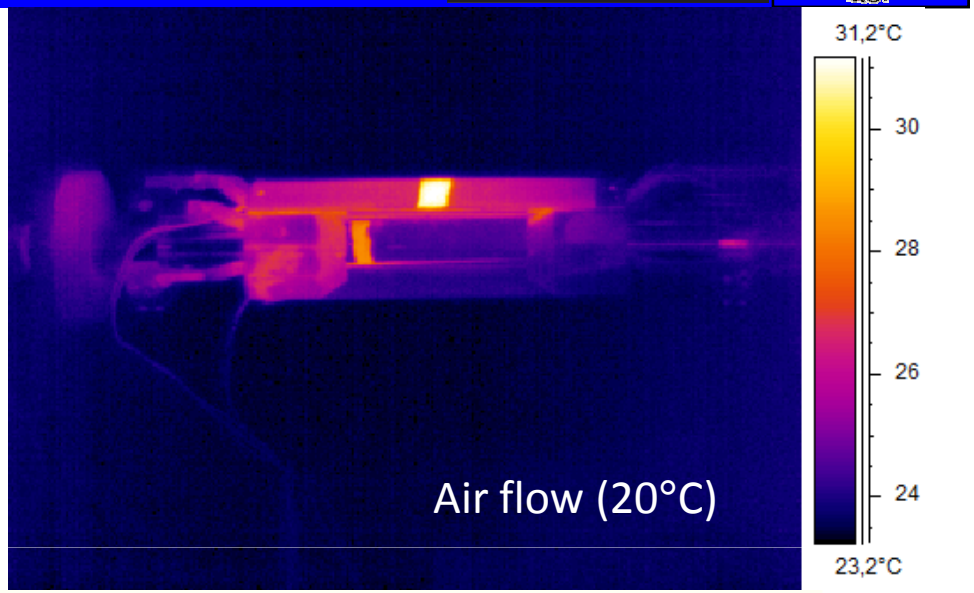
- At present welding pipes for several cooling blocks (AlSiMg and CrCo)
  - AlSiMg: stainless steel pipes cannot be directly welded→ trying with aluminium pipes (resistent to CO_2 pressure??)
  - Problems in the welding process: blocked pipes, have to be removed and re-welded

- Next tests:
  - Cooling with AlSiMg end flanges (CO_2) → ladders screwed, better thermal contact
  - Cold air flow: find a way to control the N_2 liquid coolant → Air flow regime studies
  - Effect of adding heaters, closing the volume

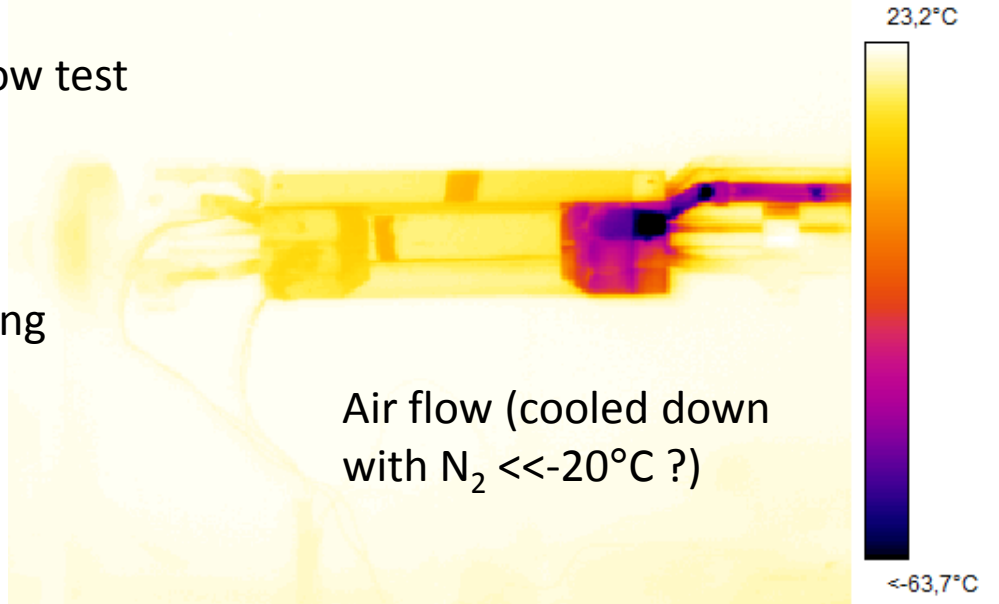
- Improve the thermal contact in the CrCo samples (how to thread the samples, use implants of other materials… ?)

Backup

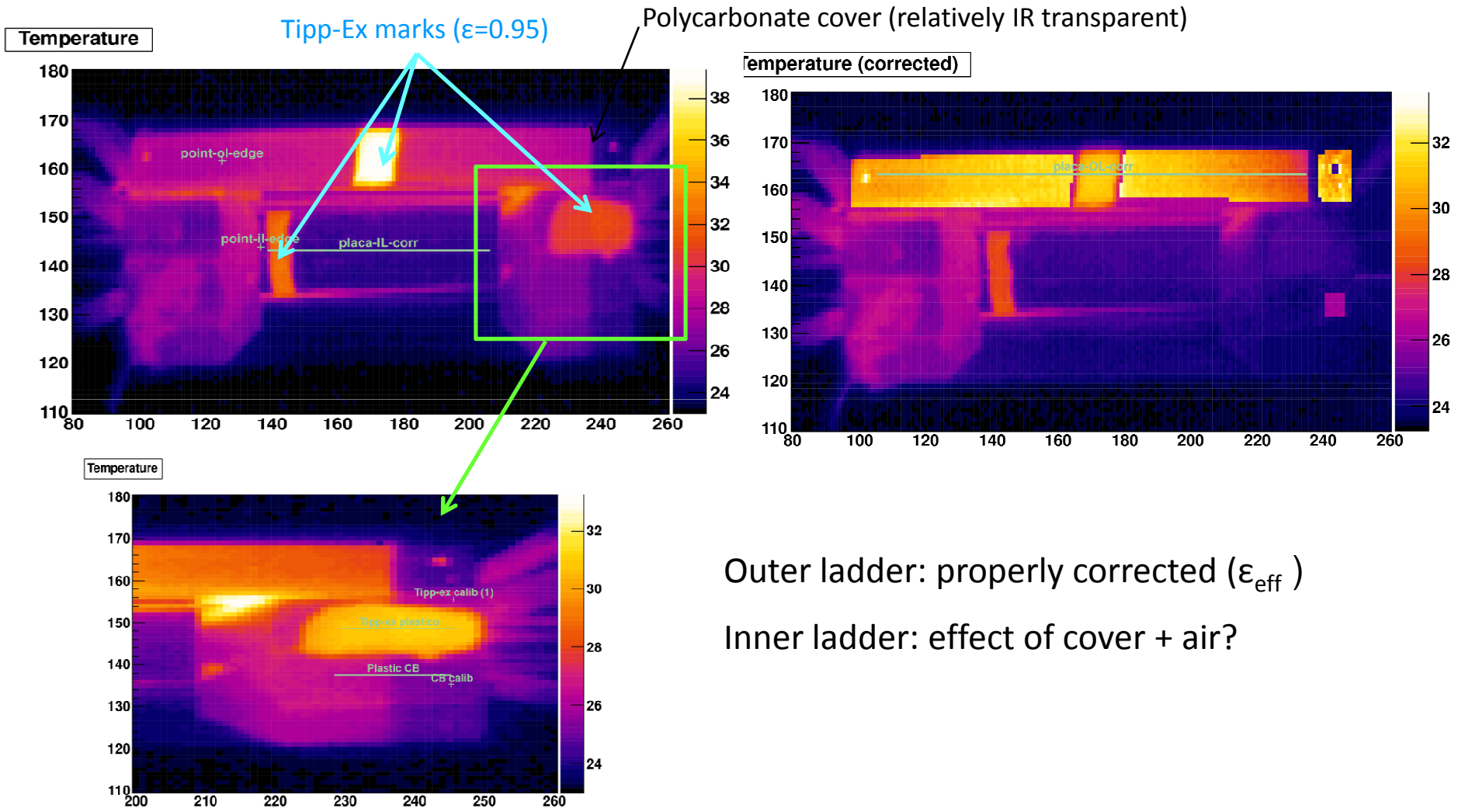




- Only 1 CrCo operating end flange → air flow test
- Aluminium ladders with heaters (1W);
  - 1 inner ladder with heater
  - 1 outer ladder with heater
- IR transparent polycarbonate sheet covering
- Dry air at ~ room temperature (20°C) or cooled down with liquid N_2
- IR pictures, Tipp-ex marks calibration



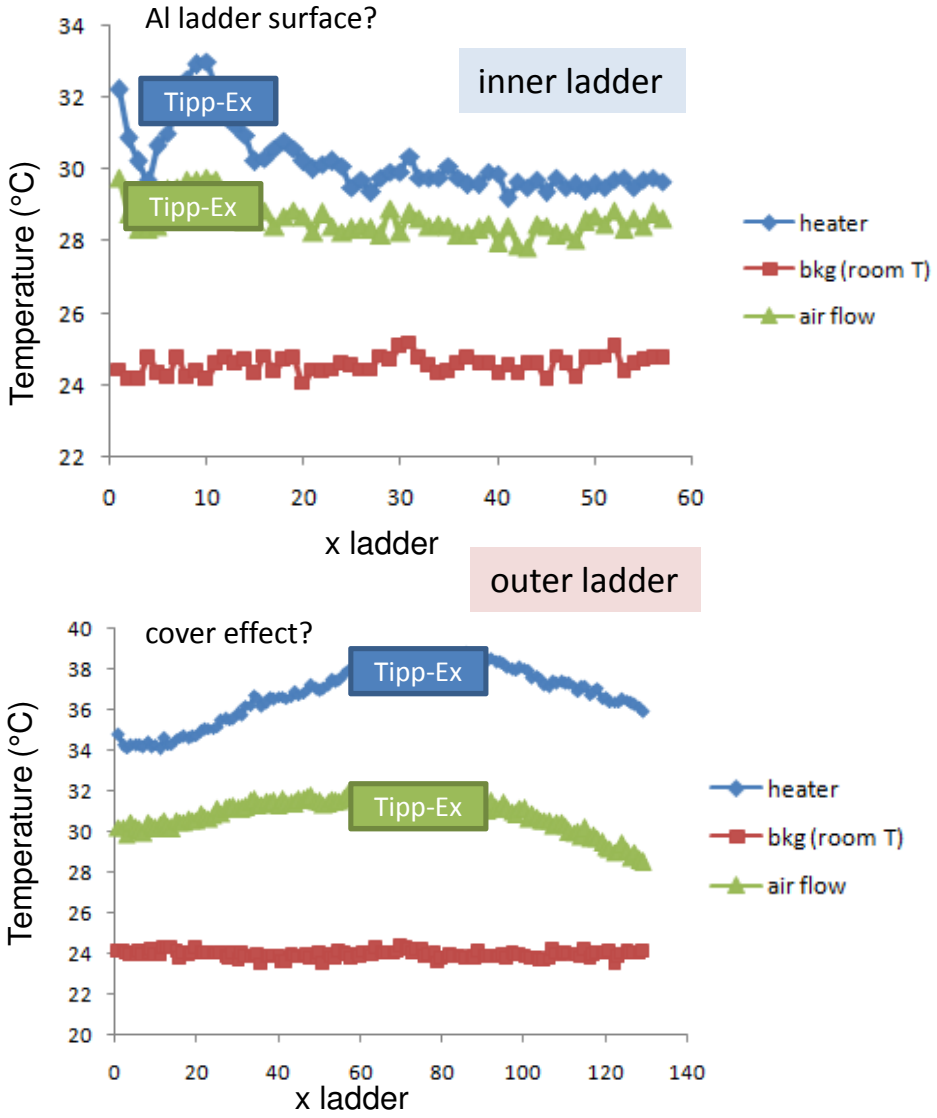
Backup

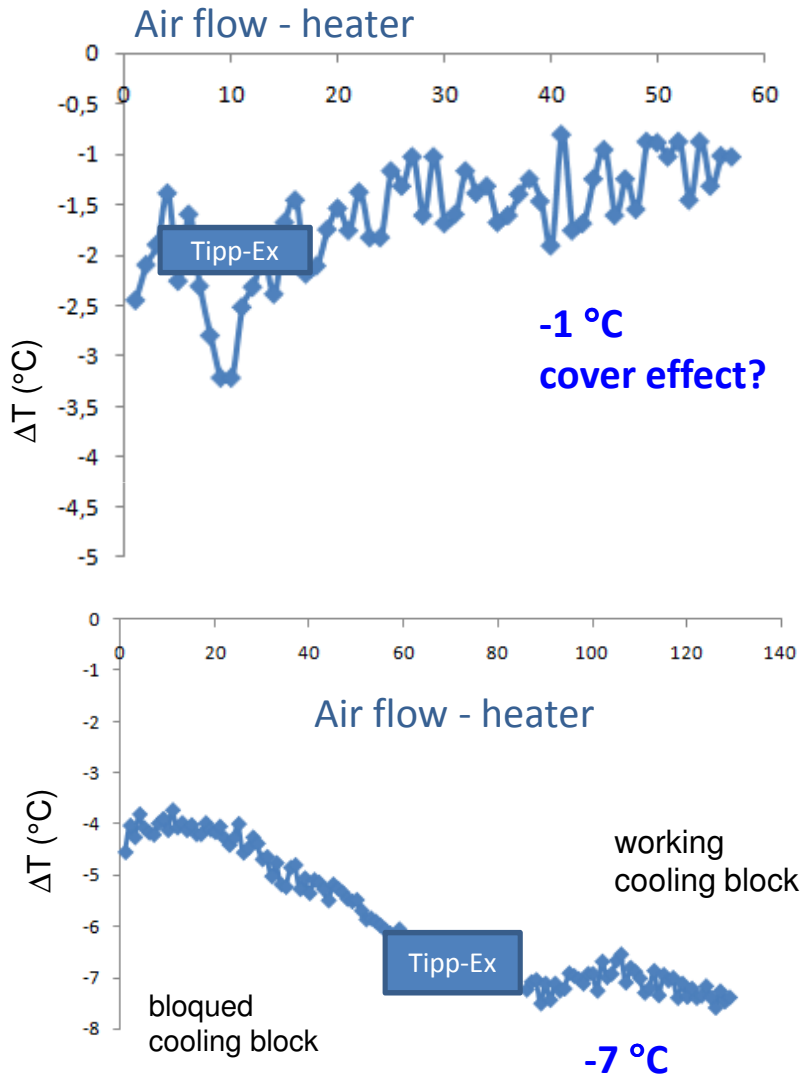


Outer ladder: properly corrected (ε_{eff})

Inner ladder: effect of cover + air?

Backup


Al ladder surface?
inner ladder
Tipp-Ex
Tipp-Ex
heater
bkg (room T)
air flow
Temperature (°C)
x ladder
outer ladder
cover effect?
Tipp-Ex
Tipp-Ex
heater
bkg (room T)
air flow
Temperature (°C)
x ladder


Air flow - heater
Tipp-Ex
-1 °C
cover effect?
ΔT (°C)
Air flow - heater
working
cooling block
Tipp-Ex
bloqued
cooling block
-7 °C
ΔT (°C)

Backup