IBL PROTOTYPE THERMAL TESTS SUMMARY

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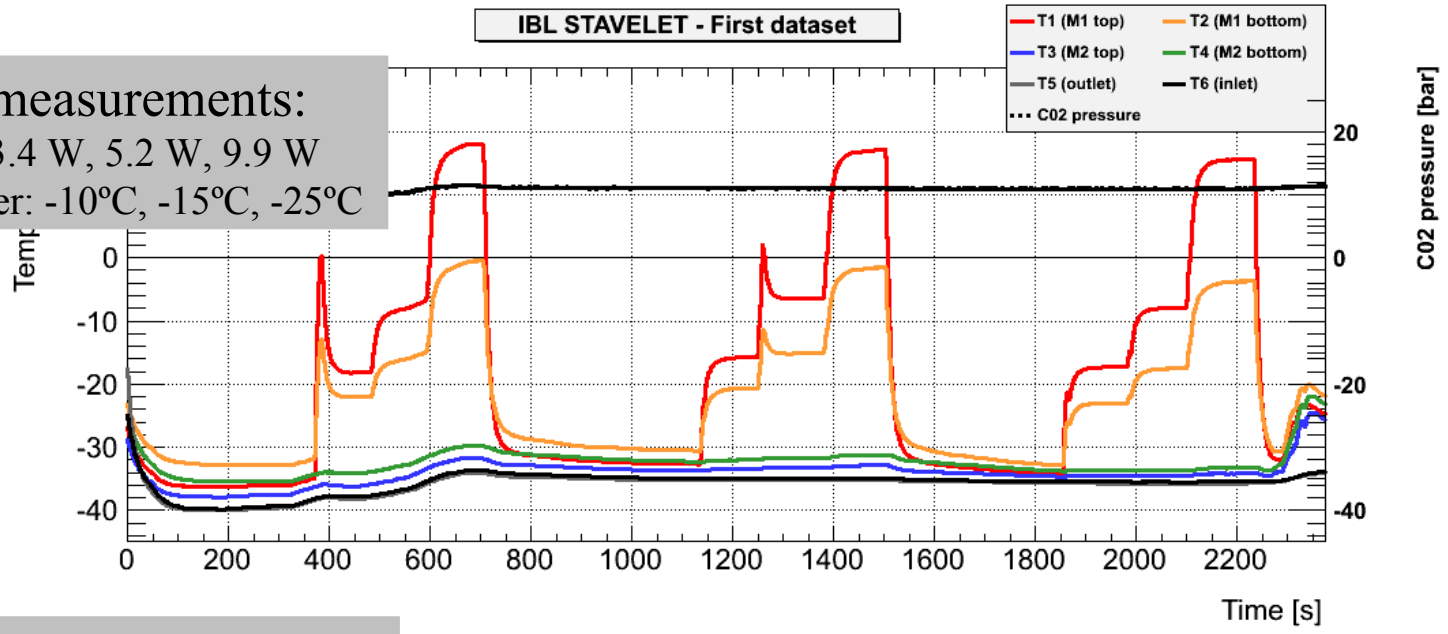
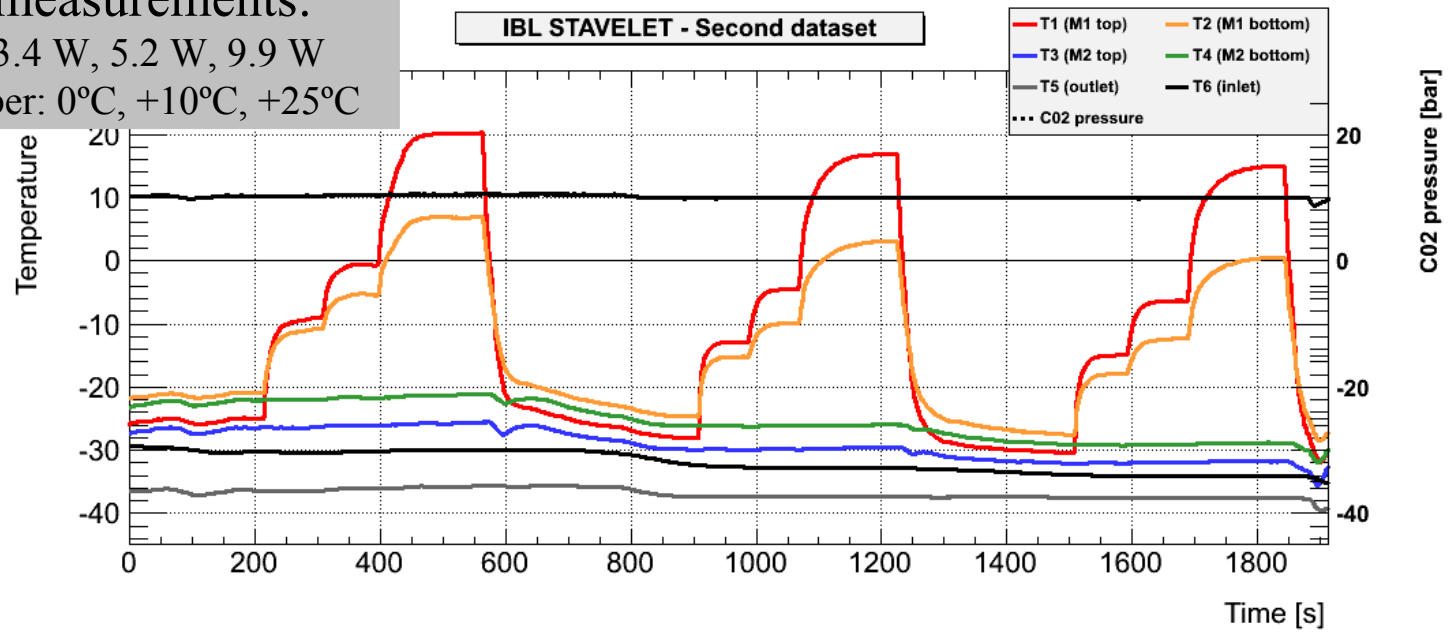
IBL stavelet in climate chamber

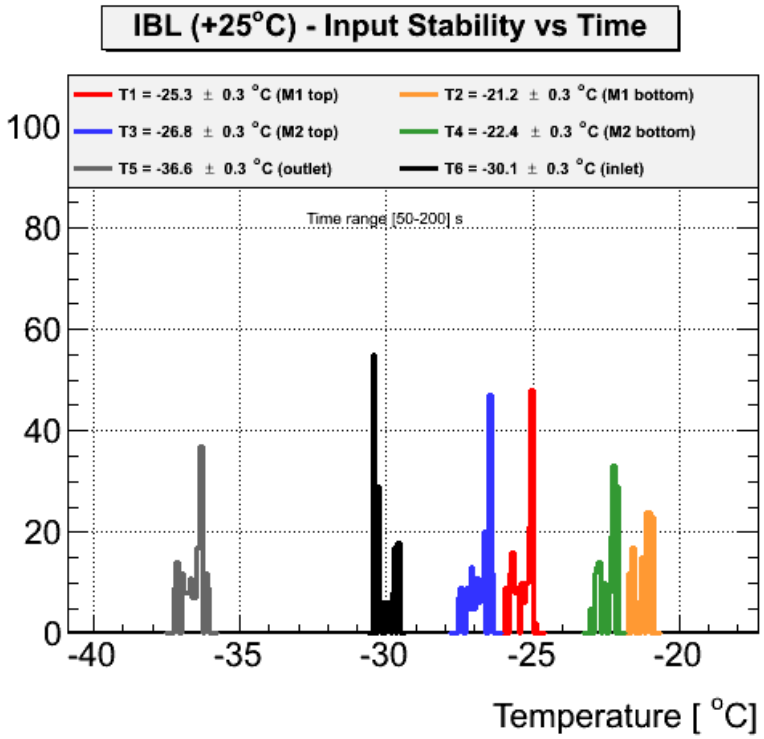
3 sets of measurements:
Heat Loads: 3.4 W, 5.2 W, 9.9 W
Climate Chamber: -10ºC, -15ºC, -25ºC

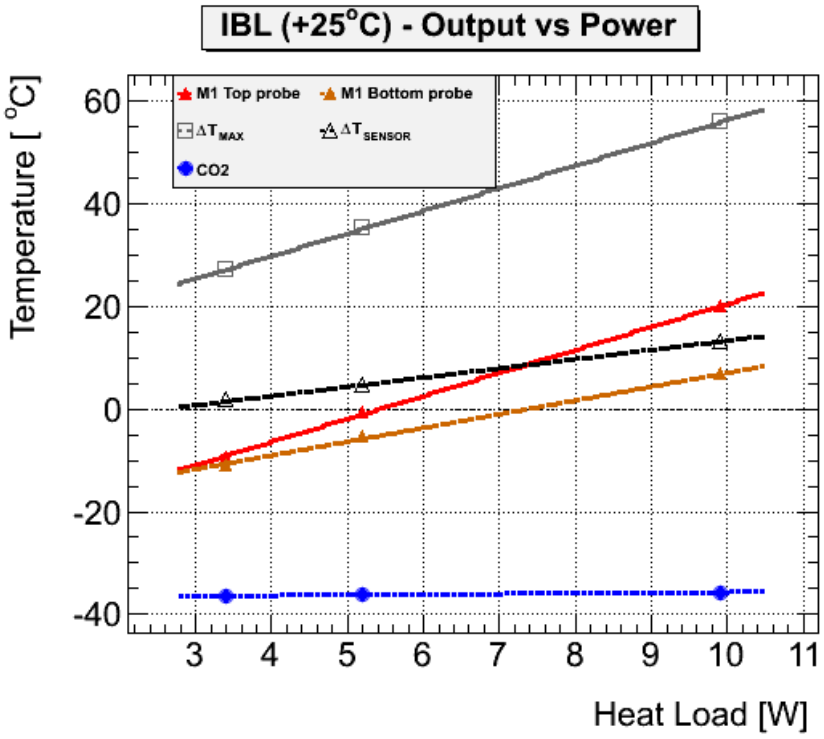


3 sets of measurements:
Heat Loads: 3.4 W, 5.2 W, 9.9 W
Climate Chamber: 0ºC, +10ºC, +25ºC

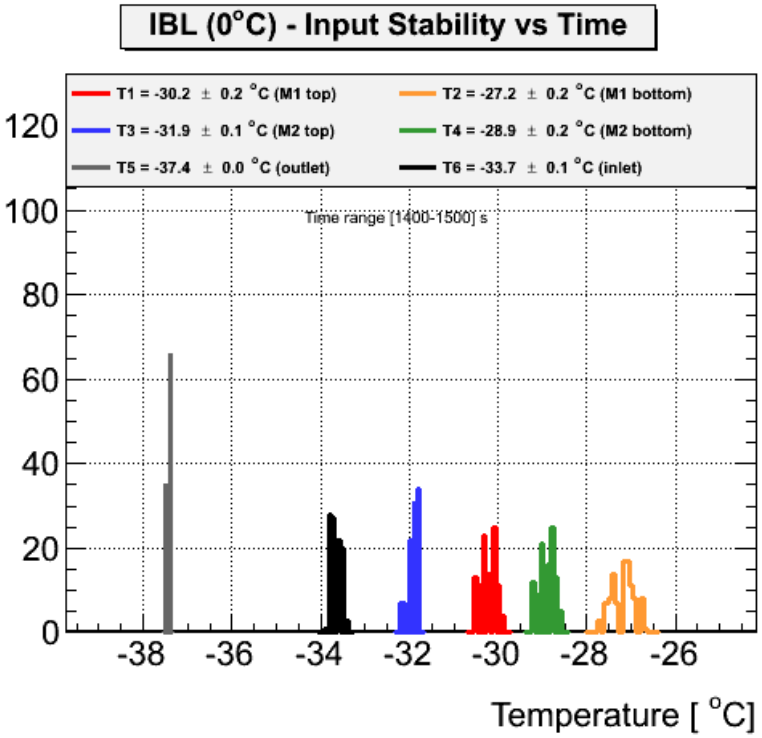


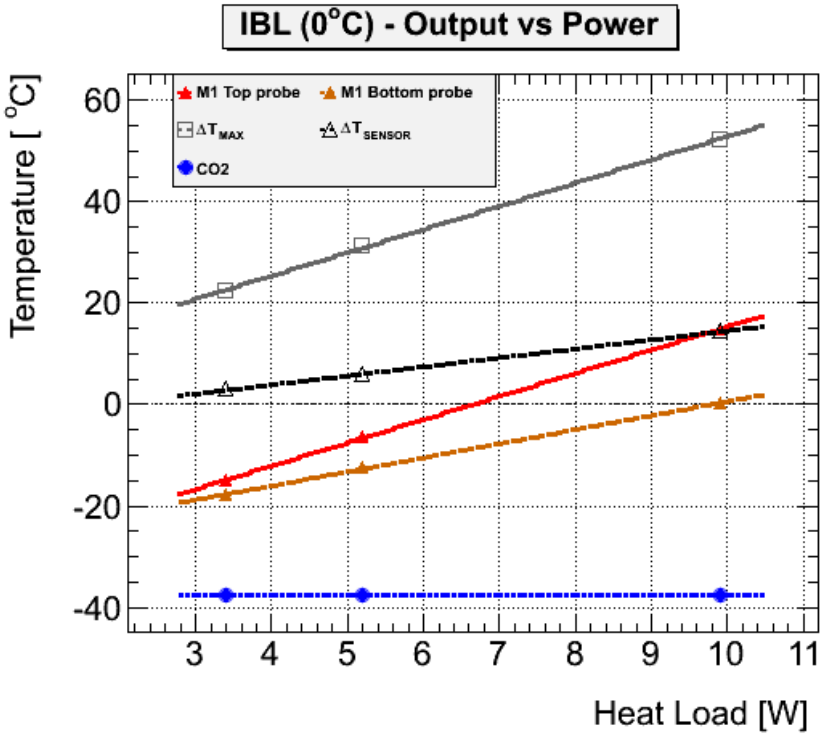
Climate Chamber +25ºC



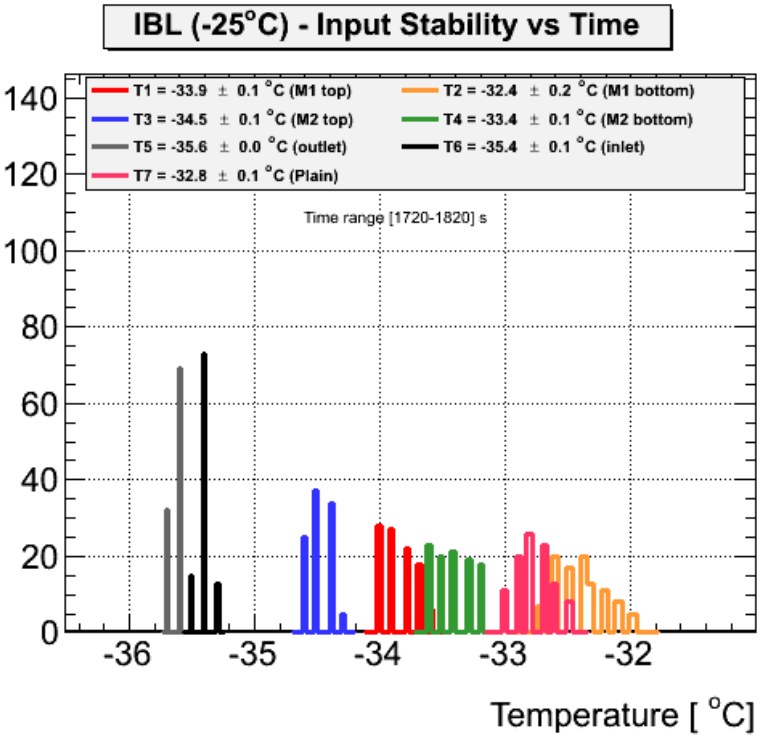


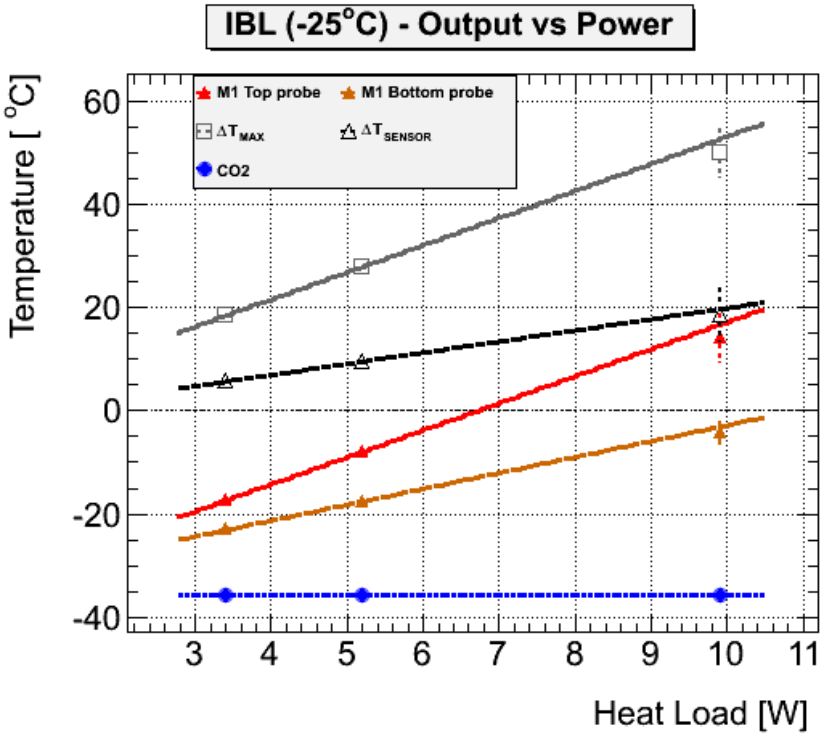
Climate Chamber 0ºC



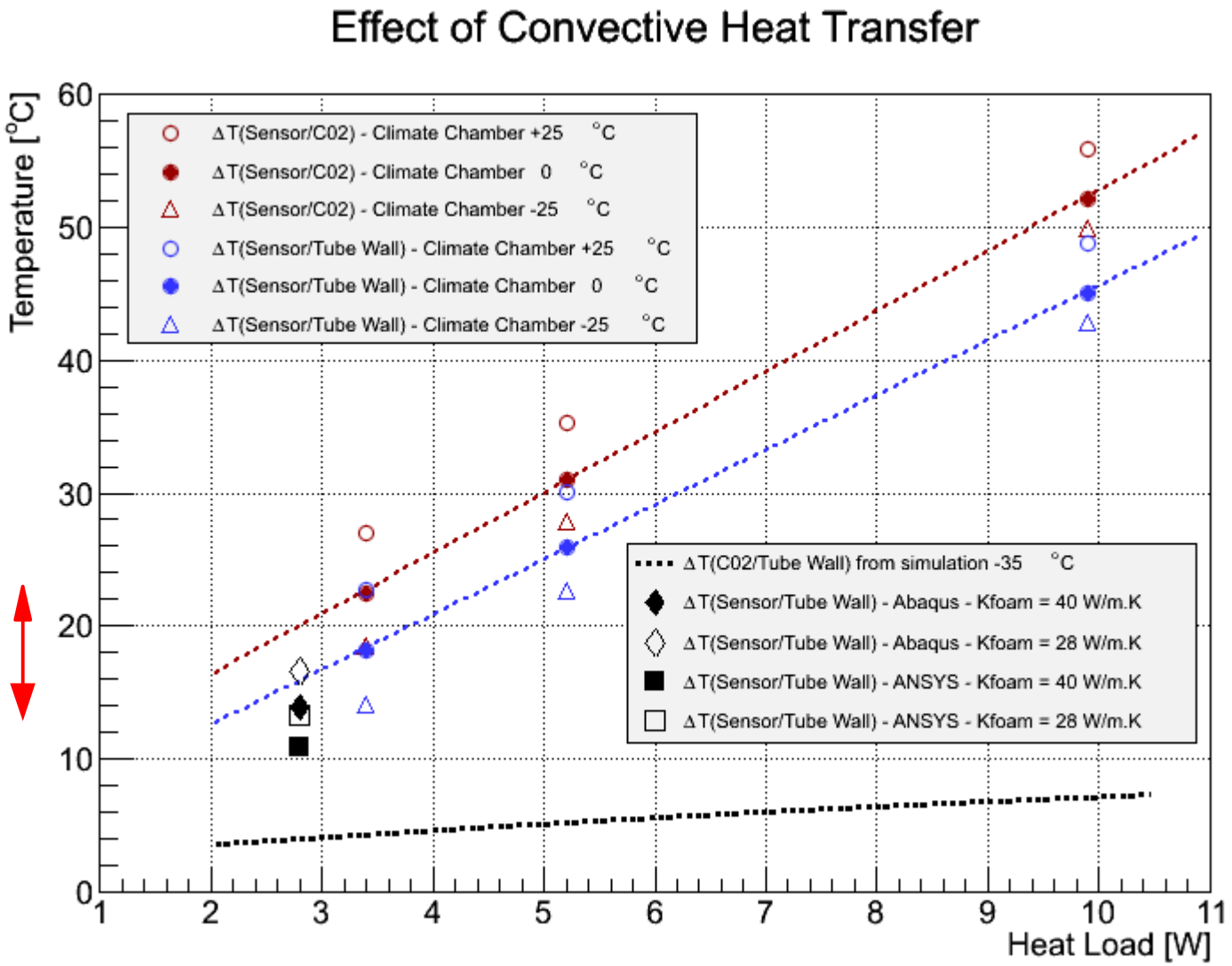


Climate Chamber -25°C





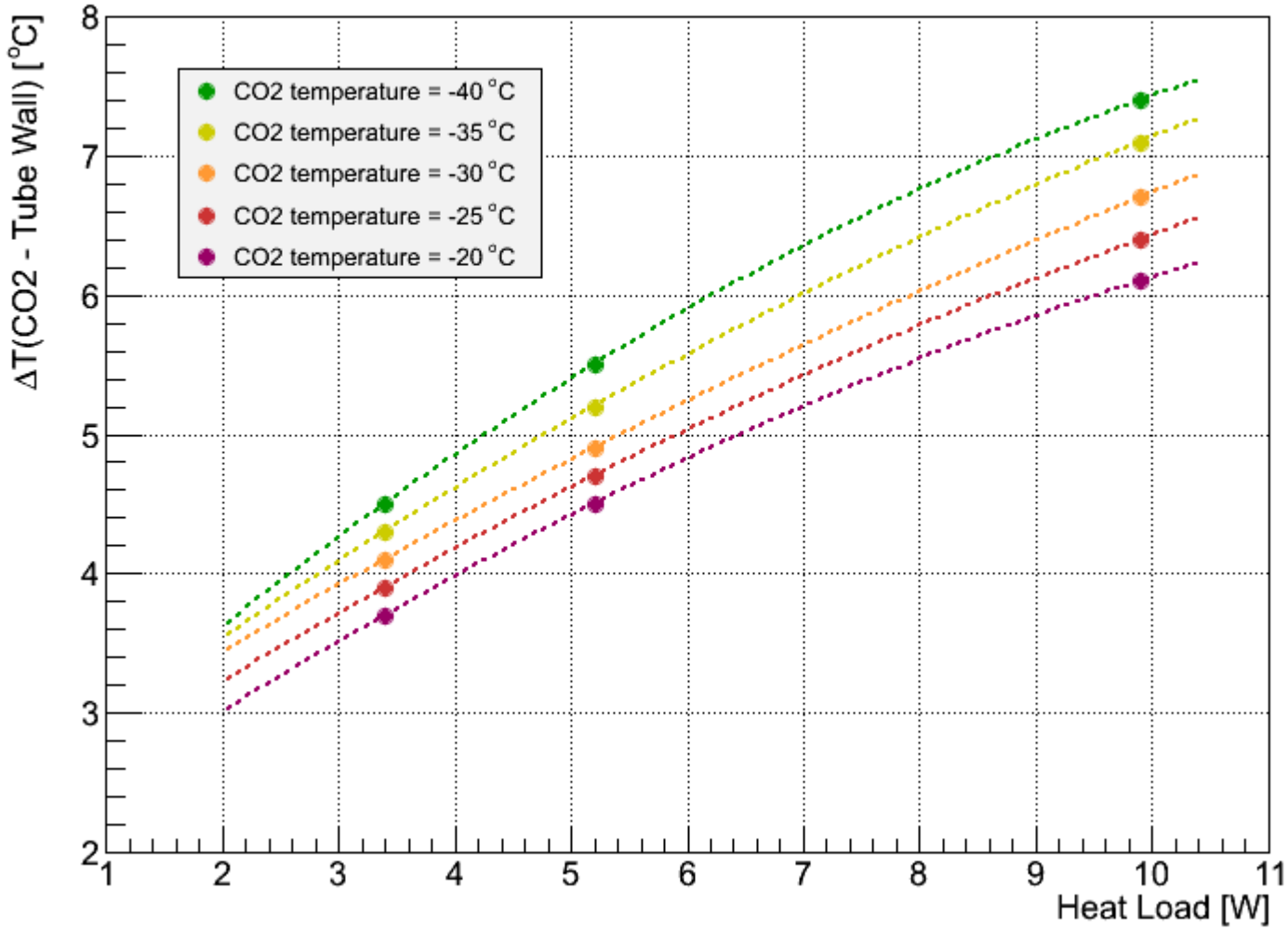
"Raw" comparison with simulations to estimate bias from heat leaks



+/- 4.5

Correction applied to measurements: ΔT(C02 - Tube Wall)

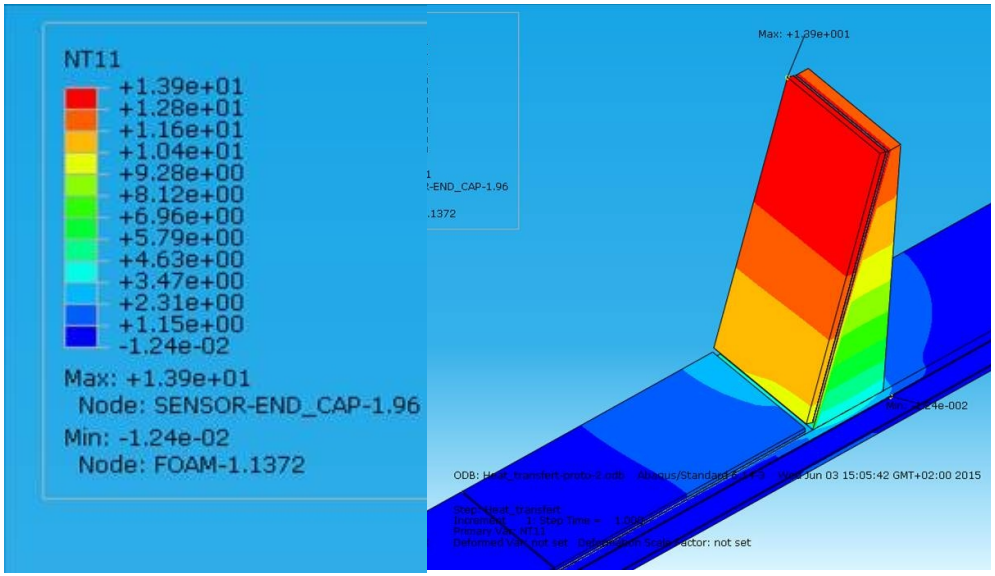
Tube Wall Temperature from C02 Model



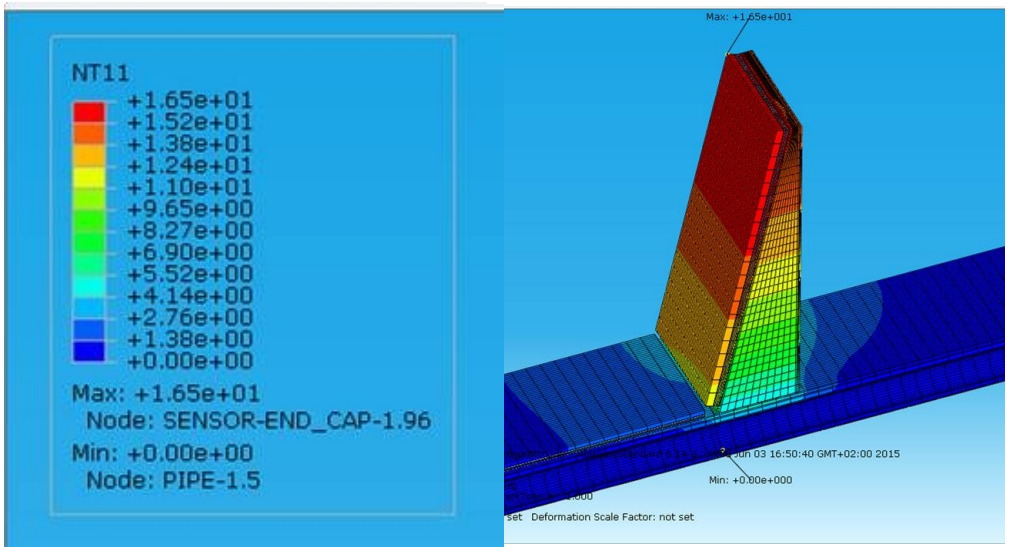
ABAQUS MODEL

Modèle = ½ stavelette
Dimension totale chaufferette : 18.8 x 20.65
Puissance surfacique : 0.72W/cm2
Puissance totale : 2.8 W

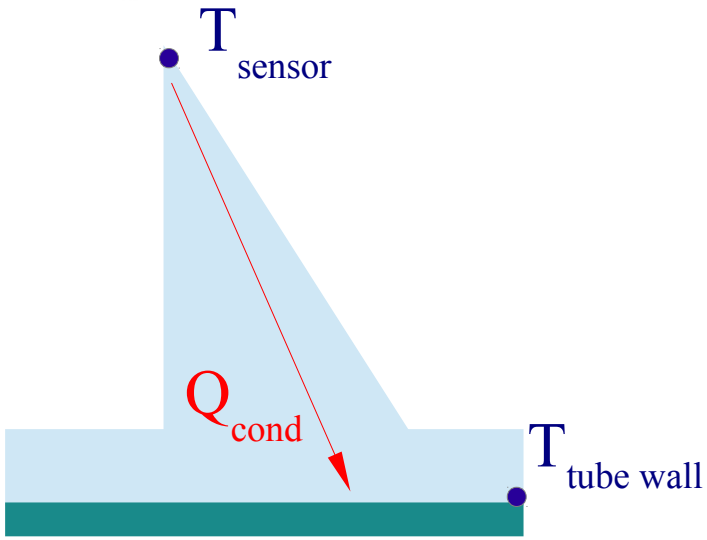
Kfoam = 40 W/m.K
Tmax = 13.9 ºC



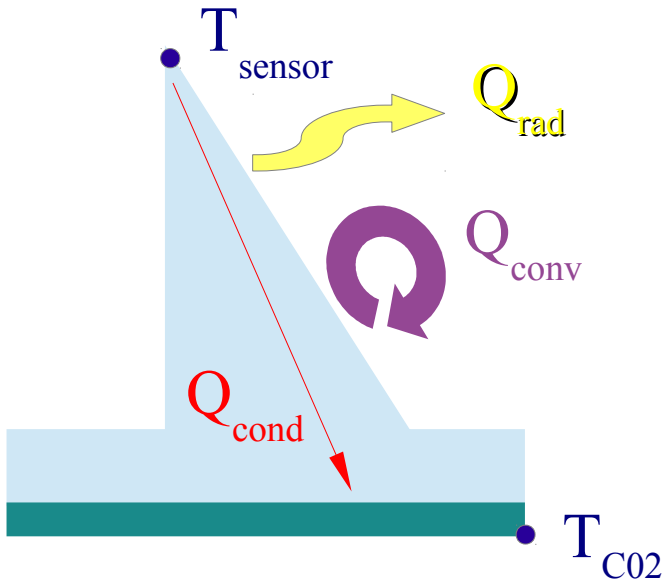
Kfoam = 28 W/m.K (measured for IBL)
Tmax = 16.5 ºC



Difference Model / Measurements



$\Delta(T_{tube\ wall} - T_{sensor}) \sim Q_{cond}$



$\Delta(T_{CO2} - T_{sensor}) \sim Q_{CO2} + Q_{cond} + Q_{rad} + Q_{conv}$

$Q_{rad} = \sigma.T^4.A \sim 5.7\ 10^{-8} * (273+15)^4 * 0.001^2 * 18.8 * 20.7 \sim 0.2\ W$

We can not simply compare the simulations and the measurements

1) First Correction applied to compute $\Delta(T_{CO2} - T_{tube})$ (applied)

2) 5W applied to the heater correspond to 4.8W effective (not applied)

3) We need to correct for Q_{conv} (not applied)

Conclusion

- Significant convective heat transfer

  → need to improve insulation box

  → possibility to use a vacuum bag ?

- Even if convective part is reduced, it will never be zero

  → need to estimate the effect on each probe in order to properly compare with the simulation results

  → Idea: apply small heat loads on heaters with CO2 cooling turned off , for 3 different climate chamber temperature values ?