ITS3 plenary Tuesday 7th March 2022

BBM3: EXPERIMENTAL AND CFD RESULTS

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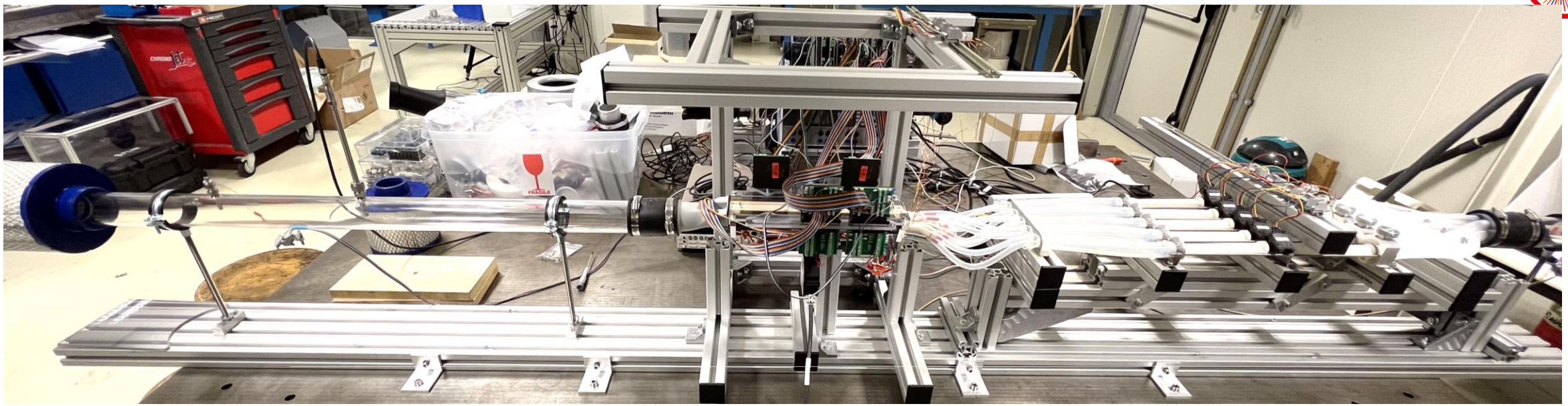
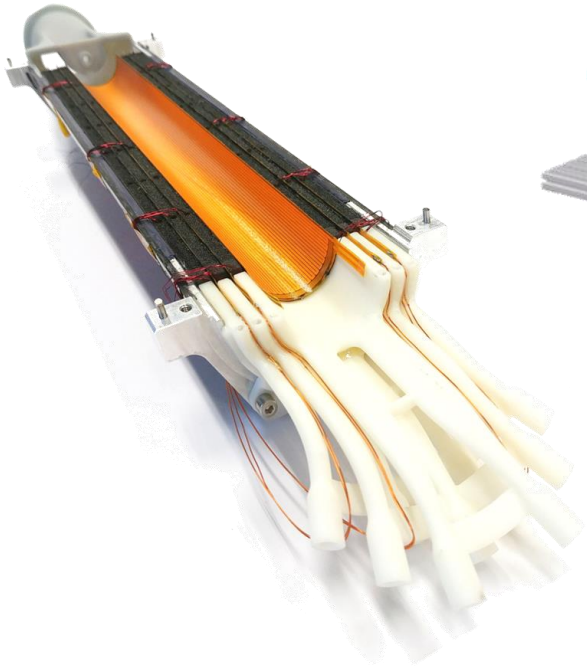
Outline

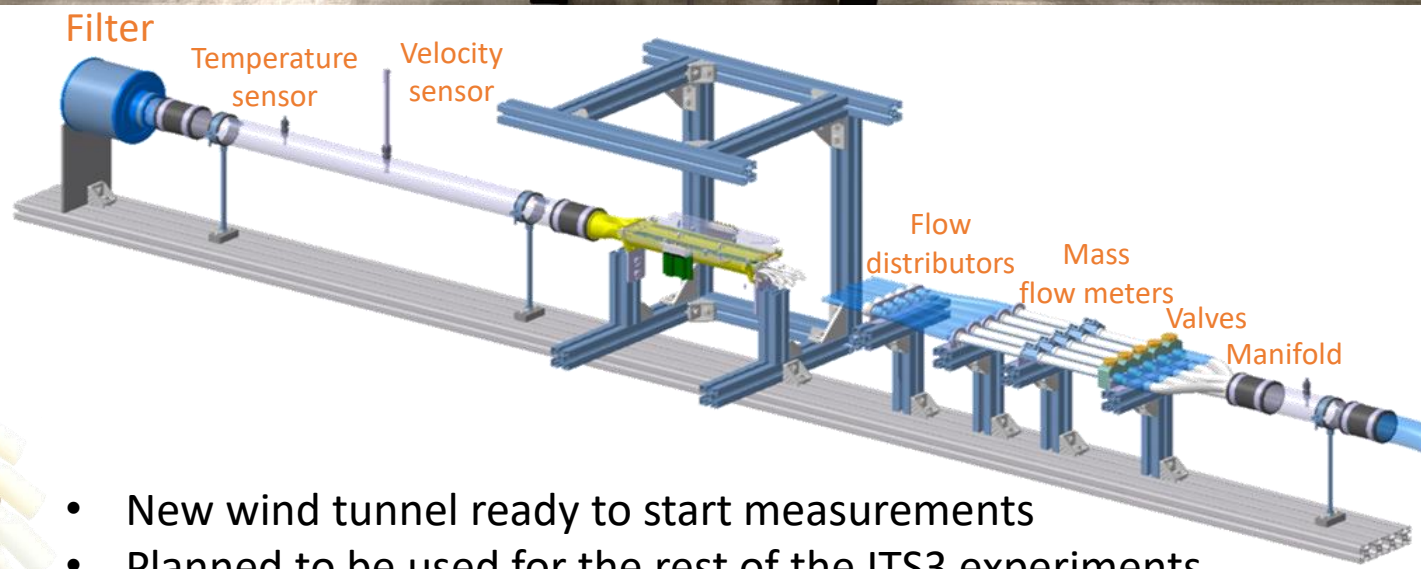
BBM3

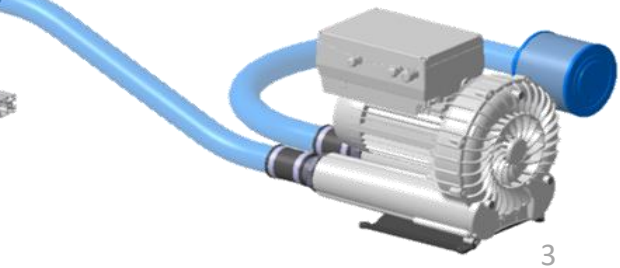
- **BASELINE CASE: COMPARISON OF EXPERIMENTS WITH CFD**
- **INFLUENCE OF THE POWER DISSIPATION IN THE ENDCAP**
- **INFLUENCE OF THE POWER DISSIPATION IN THE BEAM PIPE**
- **FUTURE WORK**

BBM3: Overview





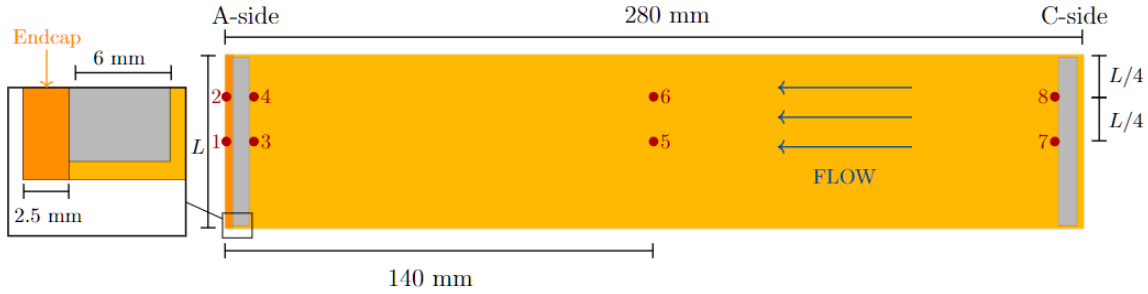




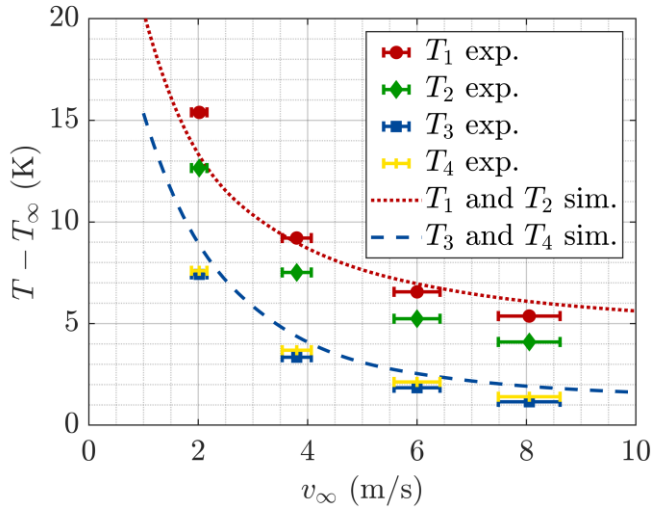
- New wind tunnel ready to start measurements
- Planned to be used for the rest of the ITS3 experiments
- First checks of the sensors and leaks done
- First thermal results expected next week

COMPARISON OF EXPERIMENTAL DATA WITH CFD: ENDCAP

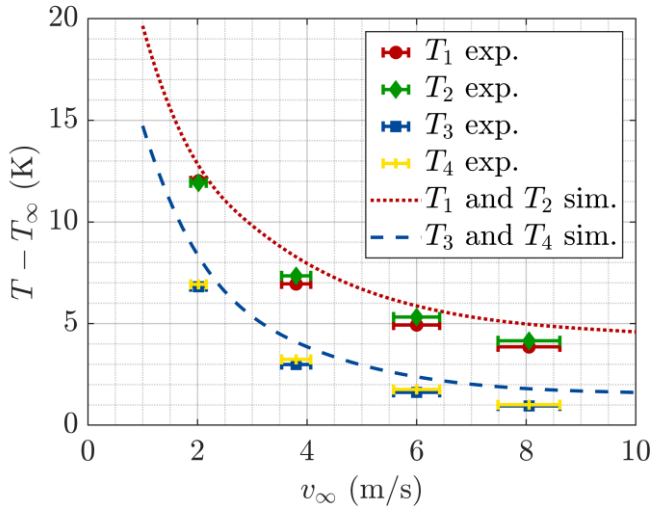
- $q_m = 25$ mW/cm^2, $q_e = 1000$ mW/cm^2
- Same velocity in all layers



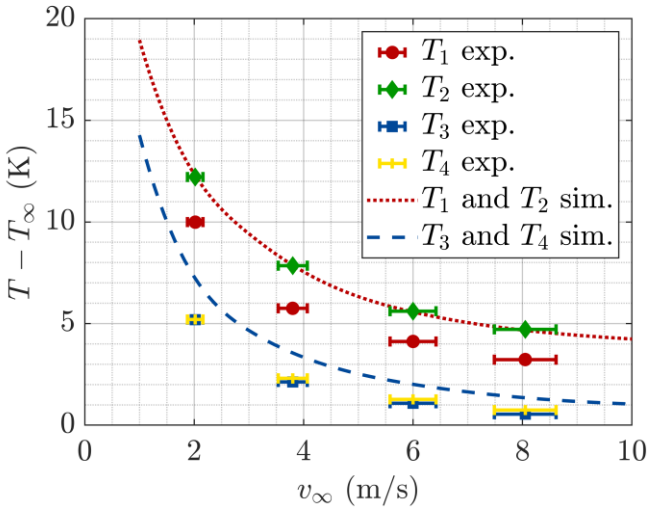
Temperature variation in sensors TX-0, TX-1, TX-2, and TX-3



Layer 0



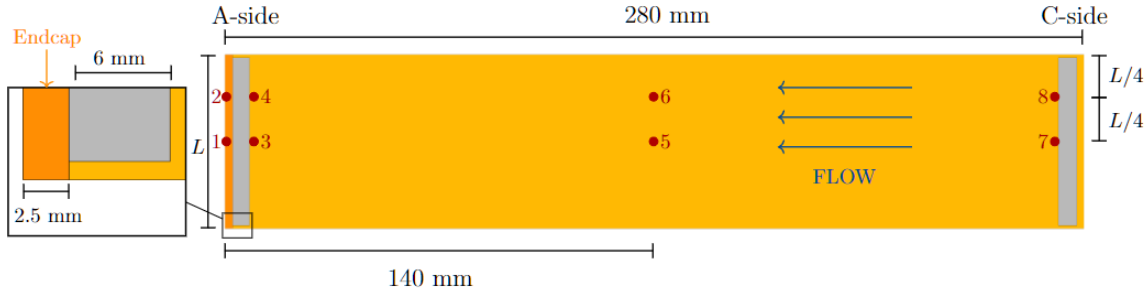
Layer 1



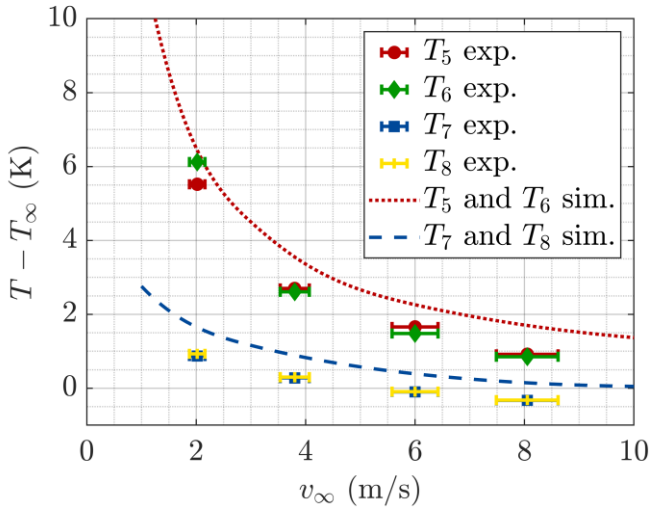
Layer 2

COMPARISON OF EXPERIMENTAL DATA WITH CFD: MATRIX

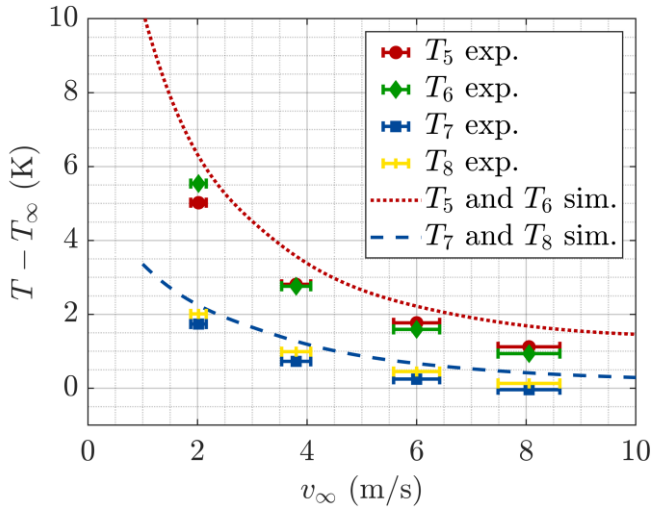
- $q_m = 25$ mW/cm^2, $q_e = 1000$ mW/cm^2



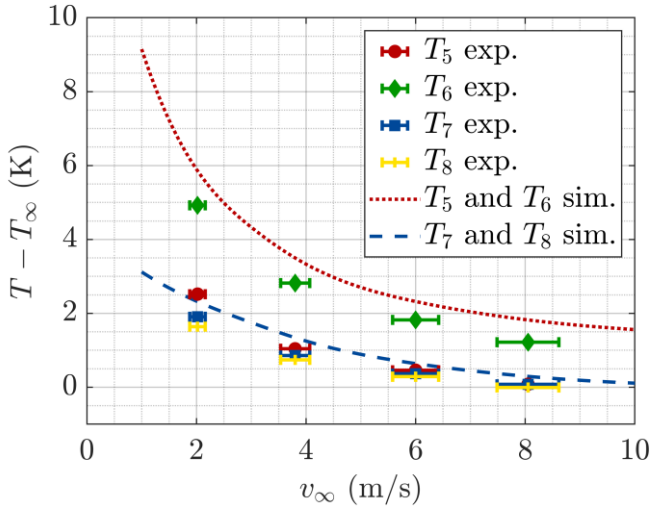
Temperature variation in sensors TX-4, TX-5, TX-6, and TX-7



Layer 0



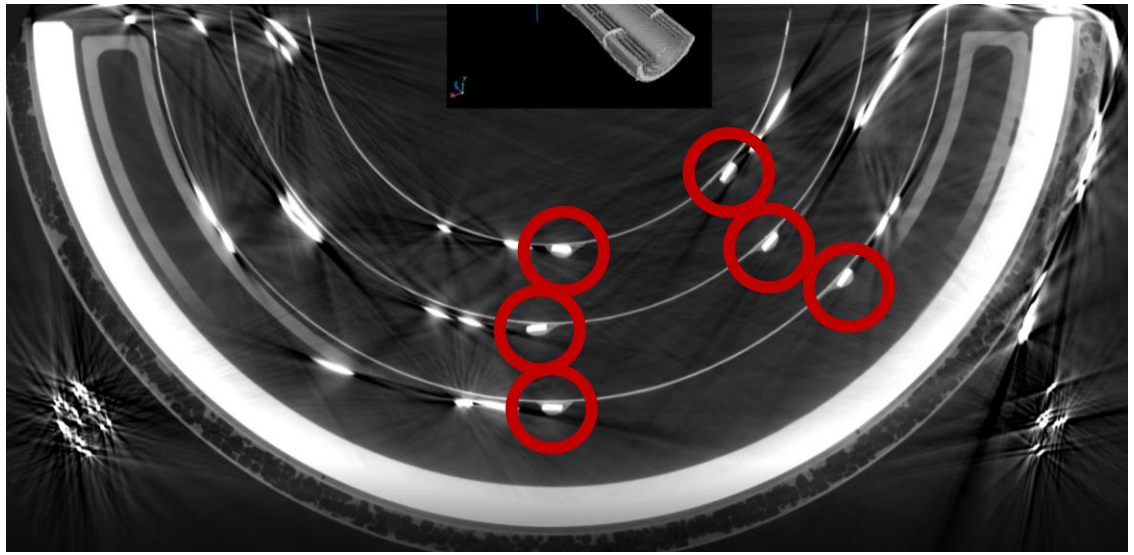
Layer 1



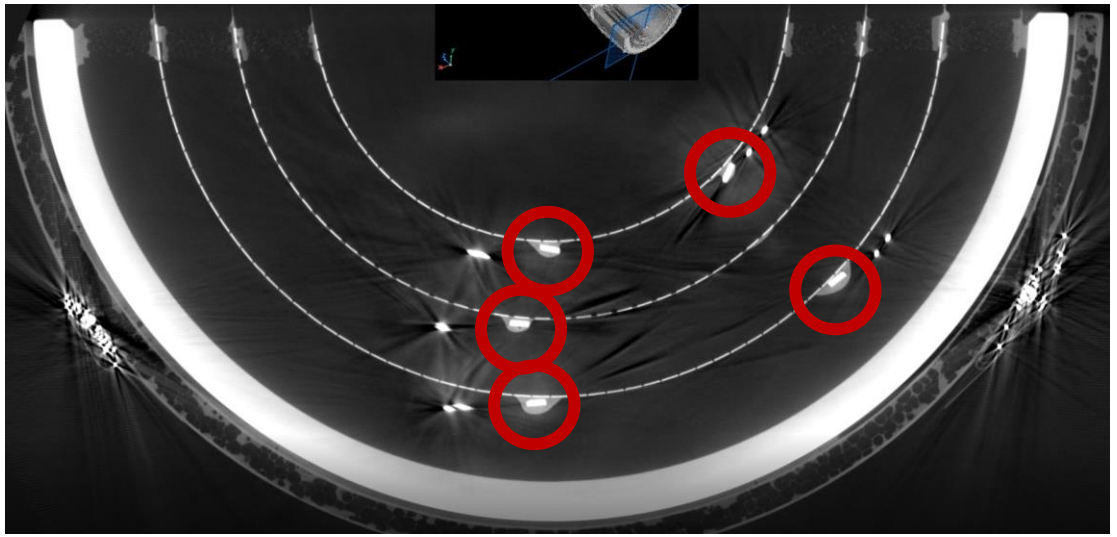
Layer 2

- The CFD results overpredict the temperature differences in all cases
- **Negative ΔT in some of the experiments!!**

COMPARISON OF EXPERIMENTAL DATA WITH CFD: DISCREPANCIES



TX0 and TX1 temperature sensors



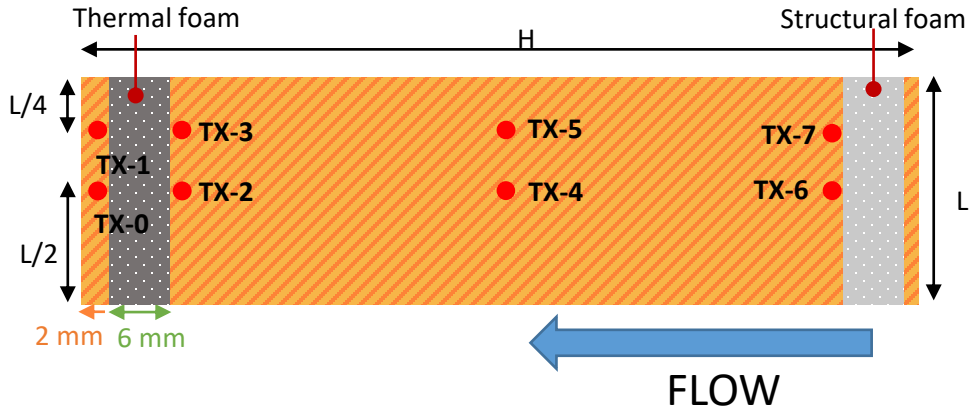
TX6 and TX7 temperature sensors

- The sensors are covered by a glue layer (not considered in the CFD)
- The contact surface is not flat, which adds additional thermal resistance

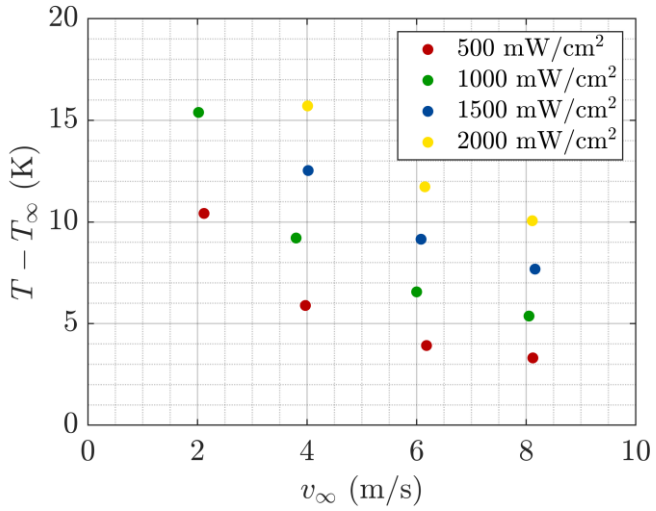
Reasons of negative ΔT

- Accuracy of the temperature sensors. With the experiment not running, there are differences of up to 0.6 °C between the 24 sensorsit
- Differences in time scales. The inlet temperature (due to the heating of the room caused by the fan) changes faster than the TX6 and TX7 sensors.

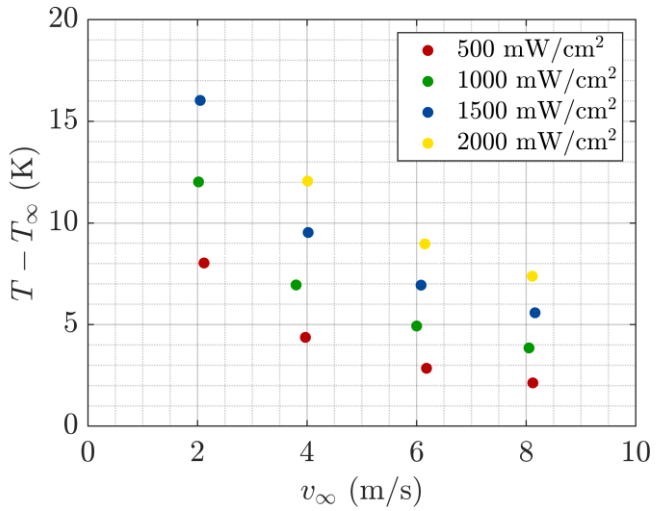
INFLUENCE OF POWER DISSIPATION IN THE PERIPHERY (EXPERIMENTS)



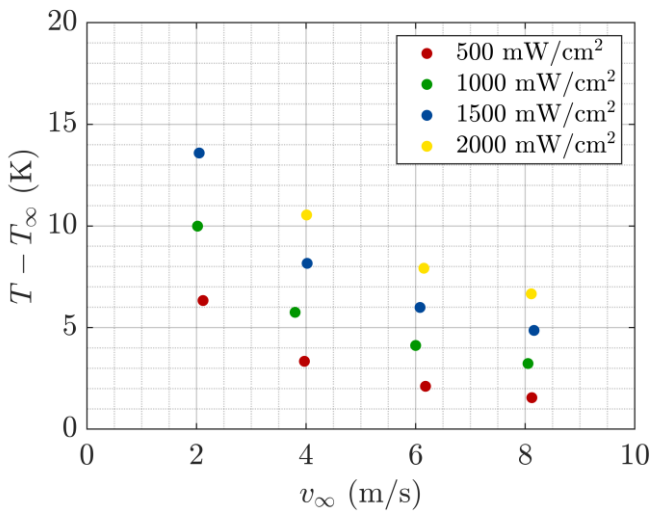
Temperature variation in TX-0 sensor for different q_e (maximum among all sensors)



Layer 0



Layer 1

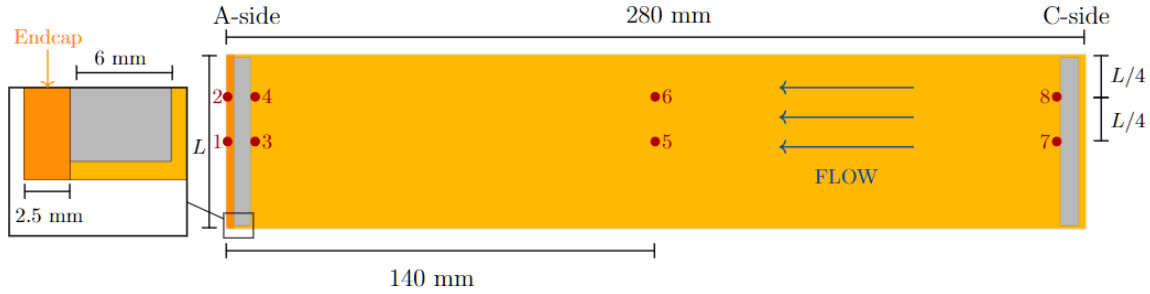


Layer 2

- $\Delta T_{max} \sim q_p$ as expected from previous analyses

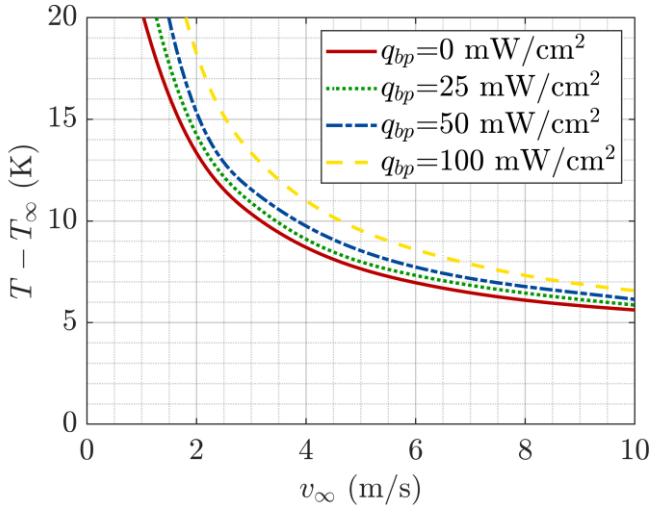
INFLUENCE OF POWER DISSIPATION IN THE BEAM PIPE (SIMULATIONS)

- A heater is modeled in the simulations with two Kapton layers of 40 microns and a copper layer of 5 microns.
- $q_m = 25$ mW/cm^2, $q_e = 1000$ mW/cm^2

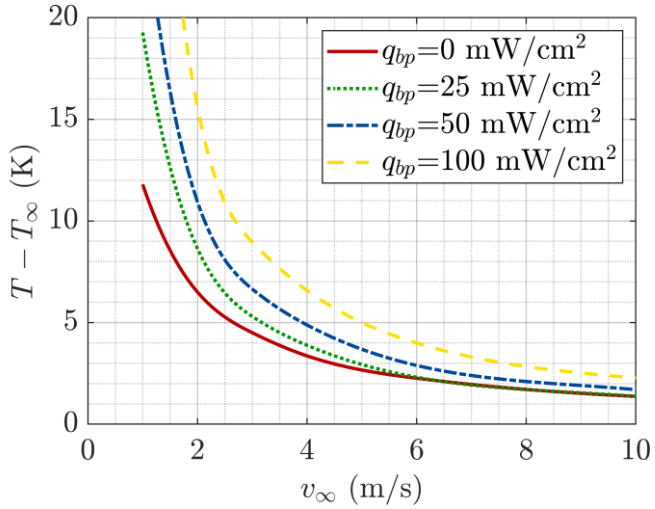


FLOW

Temperature variation in Layer 0



T1 sensor (endcap)



T5 sensor (matrix)

- Not significant differences. In the matrix temperatures are not high, while in the endcap the variation is around 1K for v= 8 m/s

FUTURE WORK

- Simulate real configuration (no heaters, just silicon)
- Study of the influence of the strip areas (preliminary study done before)
- Influence of the power dissipation in the beam pipe (similar result expected)
- Influence of the endcap length