ITS3 plenary Tuesday 22nd October 2022

UPDATE ON CFD STUDIES

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Outline

ITS3 Work Package 5

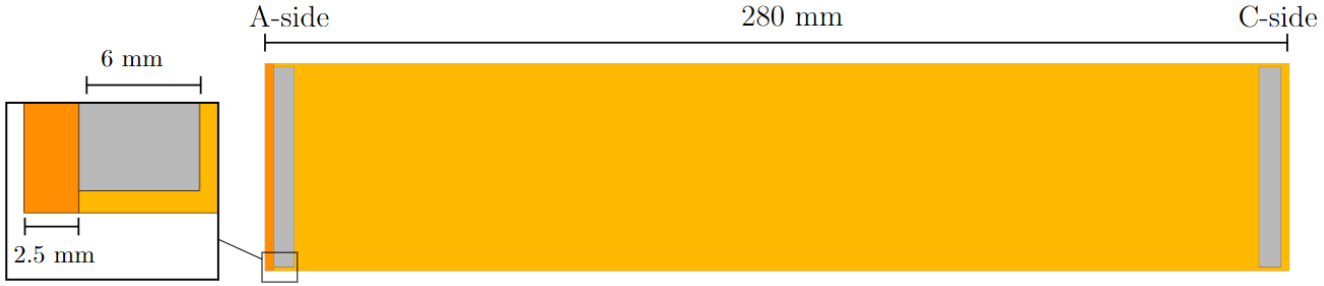
THERMAL ANALYSIS OF THE ITS3

- **BASELINE DESIGN**
- **DESIGN IMPROVEMENTS**
- **FURTHER IMPROVEMENTS AND FUTURE WORK**

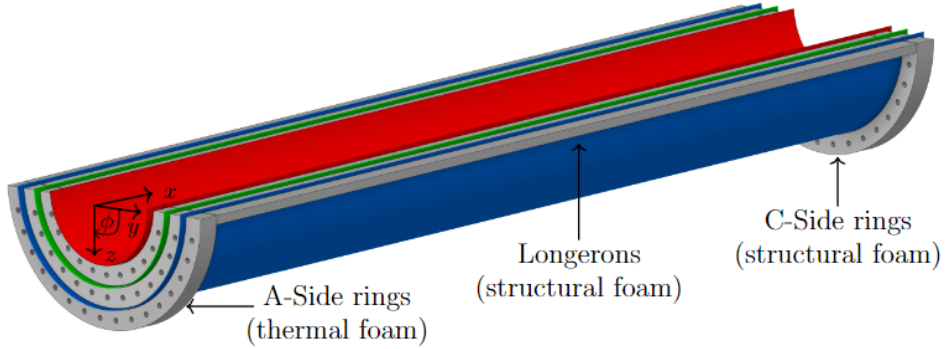
AIR DISTRIBUTION SYSTEM WITH CUPLING WITH THE FPC

ITS3 THERMAL ANALYSIS: BASELINE DESIGN: OVERVIEW

- Baseline design=Layout of BBM3
- Holes of 1.5 mm of diameter
- Foam not in contact with the periphery region



Foam placement



Baseline design

MODEL

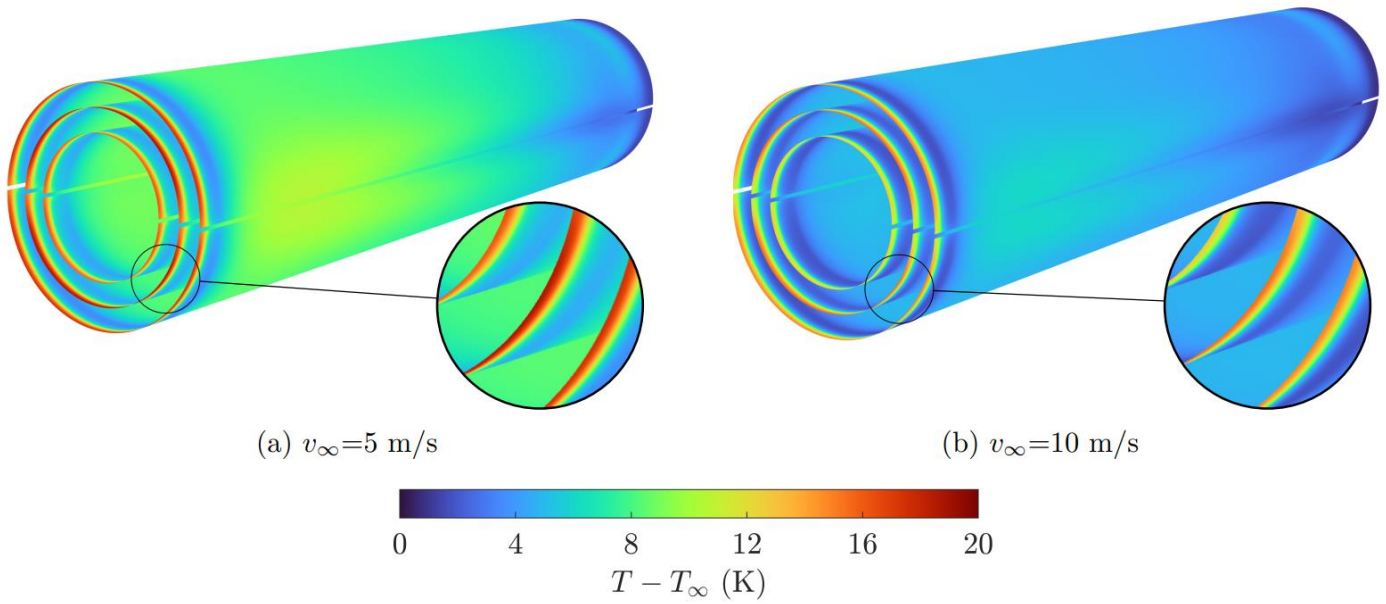
- Full detailed geometry is considered (two half-barrels, no assumptions)
- Pressure loss, thermal conductivity, heat transfer coefficient, glue modeling obtained from previous work on foam characterization

POWER DISSIPATION

- $q_m = 15 - 50$ mW/cm^2, $q_p = 1000 - 2000$ mW/cm^2
- Conservative approach. In all of the simulations, $q_m = 50$ mW/cm^2, $q_p = 2000$ mW/cm^2

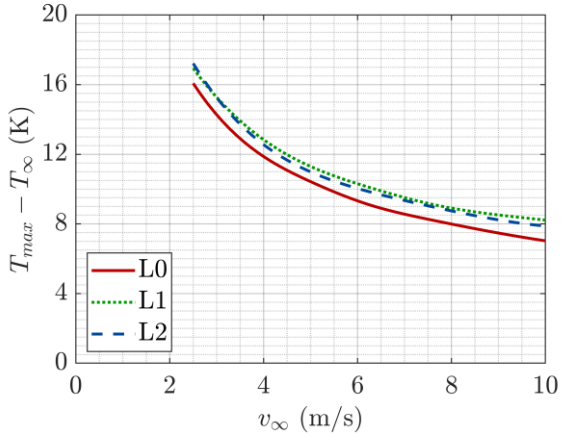
ITS3 THERMAL ANALYSIS: BASELINE DESIGN - RESULTS

- High ΔT at the periphery even for 10 m/s
- Foam losses effectiveness if not placed in the periphery region
- Higher power dissipations can be accepted in the matrix region

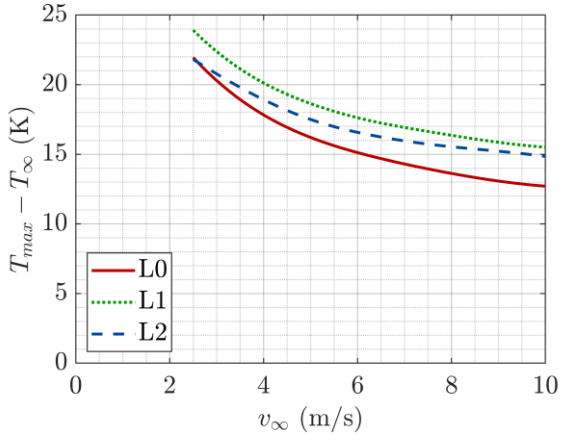


Temperature variation in the layers

- Not significant increase in the performance for v > 10 m/s
- Modifications are required to reduce ΔT at the periphery



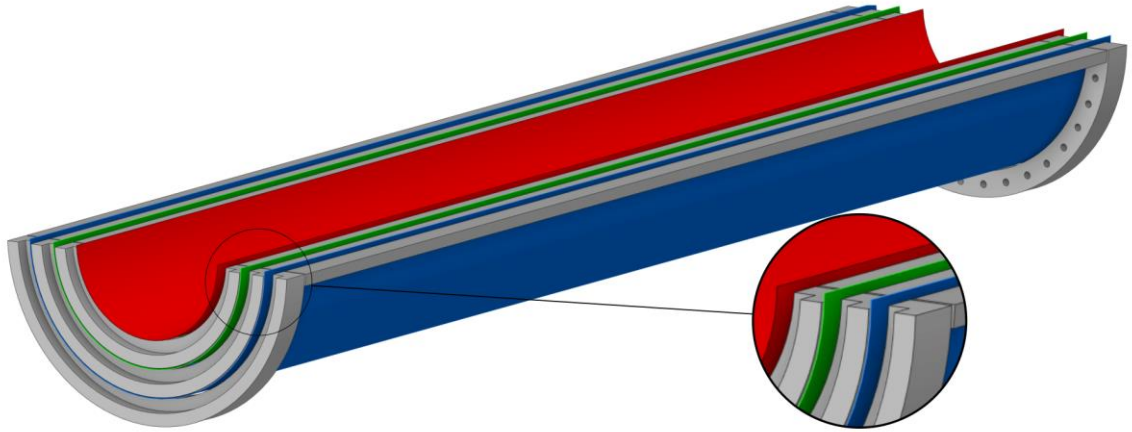
Matrix



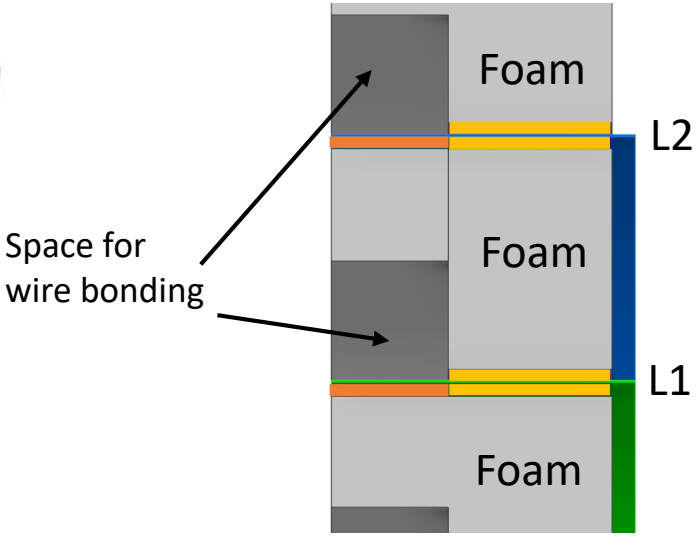
Periphery

Maximum temperature variation in the layers

ITS3 THERMAL ANALYSIS: MODIFICATION 1



First modification to the baseline design

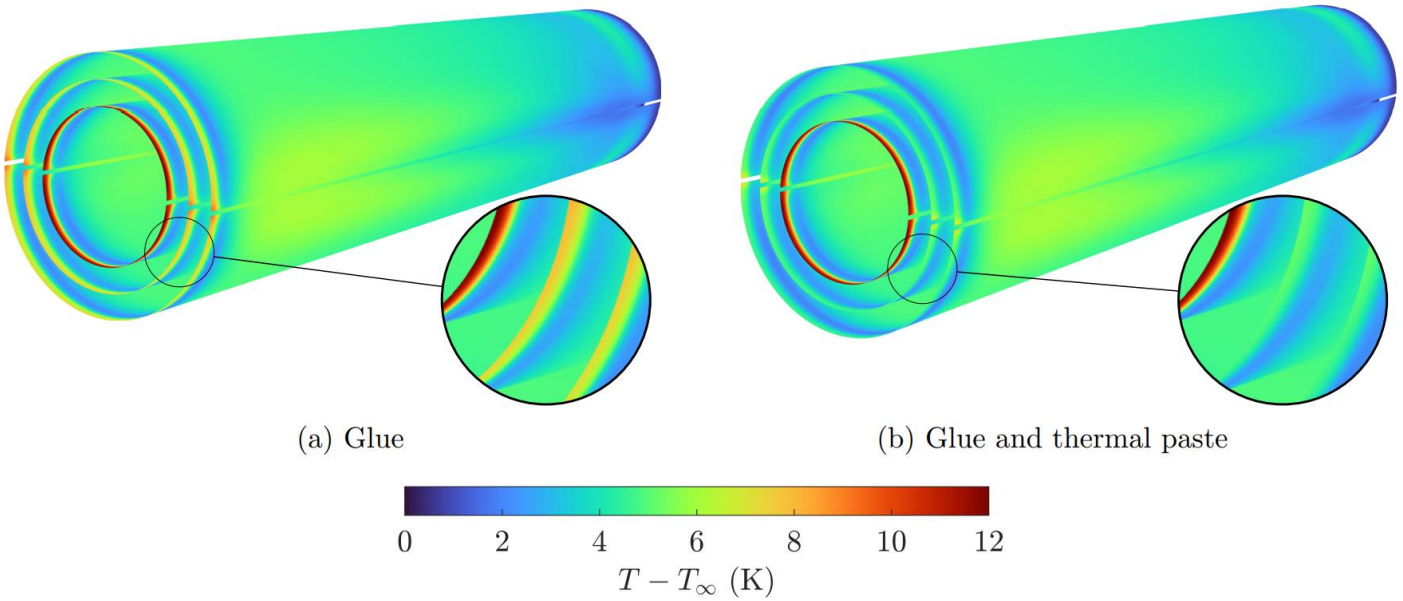


Yellow: Interface with the matrix
Orange: Interface with the periphery

Thermal interfaces at the periphery

- Same longerons and C-side rings
- A-side rings are modified: no holes, 2 contact surfaces with the periphery
- Two variants: one with glue at all interfaces (orange and yellow), and other including thermal paste ($k = 4$ W/(m*K), tests performed by CMS) just in the periphery contact (orange)

ITS3 THERMAL ANALYSIS: MODIFICATION 1 - RESULTS

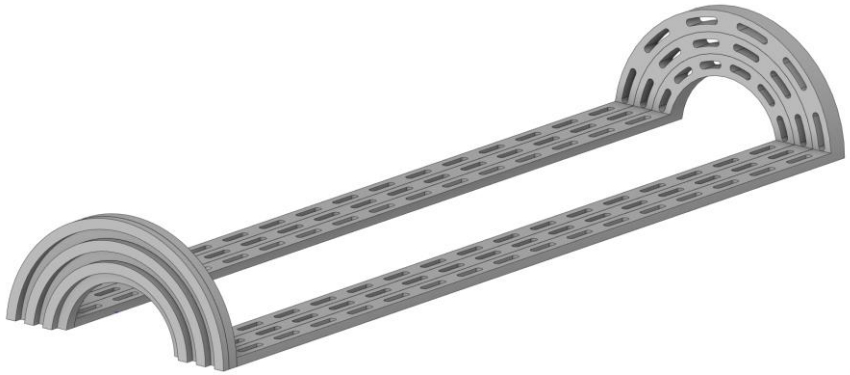


Temperature variation in the layers for v_∞=10 m/s

- Significant improvements in L1 and L2
- The use of the paste leads to additional decrease of 2 K in ΔT
- In L0 still ΔT approx. 12 K. Minor reductions can be achieved with modifications in the hole distribution

ITS3 THERMAL ANALYSIS: FURTHER MODIFICATIONS AND FUTURE WORK

- Modifications of hole distribution to reduce pressure loss
- Reductions of 1-2 K in the L0-P temperature could be obtained



Possible design for the minimization of the pressure loss

FUTURE WORK

- Study the case of two periphery regions
- Consider the (possible) power dissipation in the beam pipe

AIR DUCT SYSTEM WITH COUPLING WITH THE FPC