Recent CFD Simulations of Thermal Environment in ATLAS

Anna Mueller

TS/CV – DC, CFD Team

ATLAS Muon Plenary meeting. Apr 19, 2005

Outline

➢ What is CFD?

➢ Computational Fluid Dynamics model:
  - Creating model
  - Imposing boundary conditions
  - Analysis

➢ Results

Computational Fluid Dynamics calculation

- Simulation of the air flow and thermal behaviour of the domain.

- Resolution of mass, momentum and energy conservation equations.

- Discretisation of domain is necessary: not known analytical solutions. The domain is divided into finite number of cells.

- Using the Finite Volume Method discretisation we obtain a set of algebraic equations with the unknowns in the center node of each cell. The iterative method is used for solving this set.

- The result is discrete, and it is necessary to postprocess it, produce maps of temperature distribution, velocity etc.
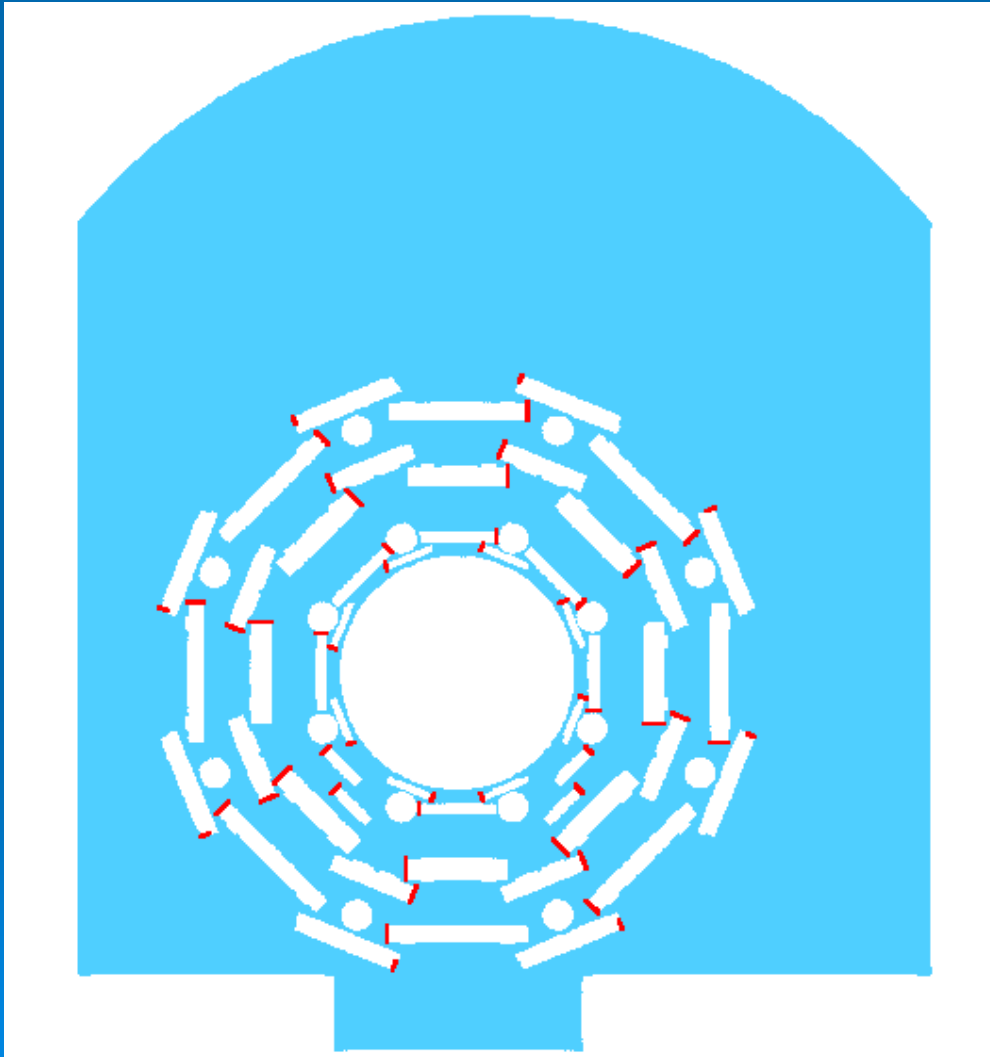
Geometry - mesh
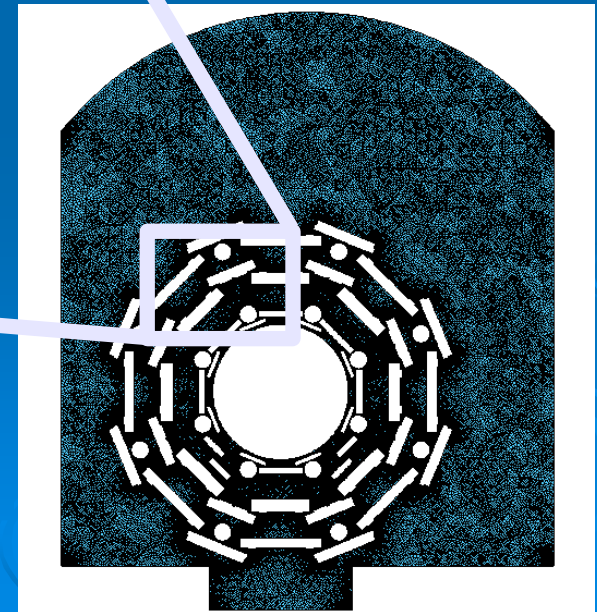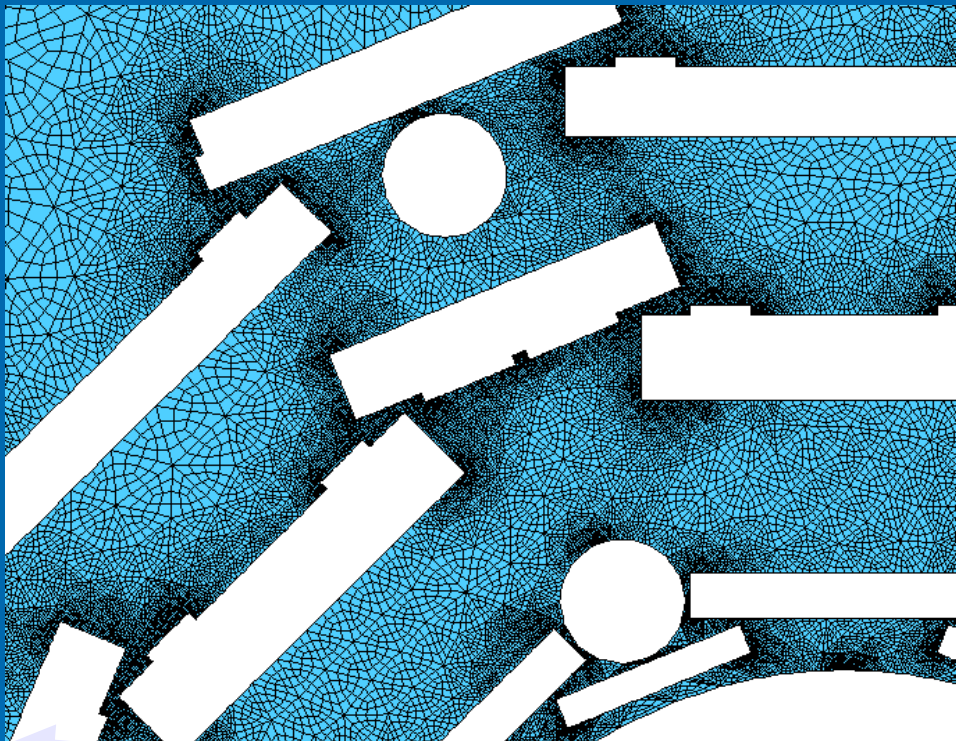
- 2 dimensional crossection,

- Non-uniform mesh used – in order to increase accuracy in the confined regions.
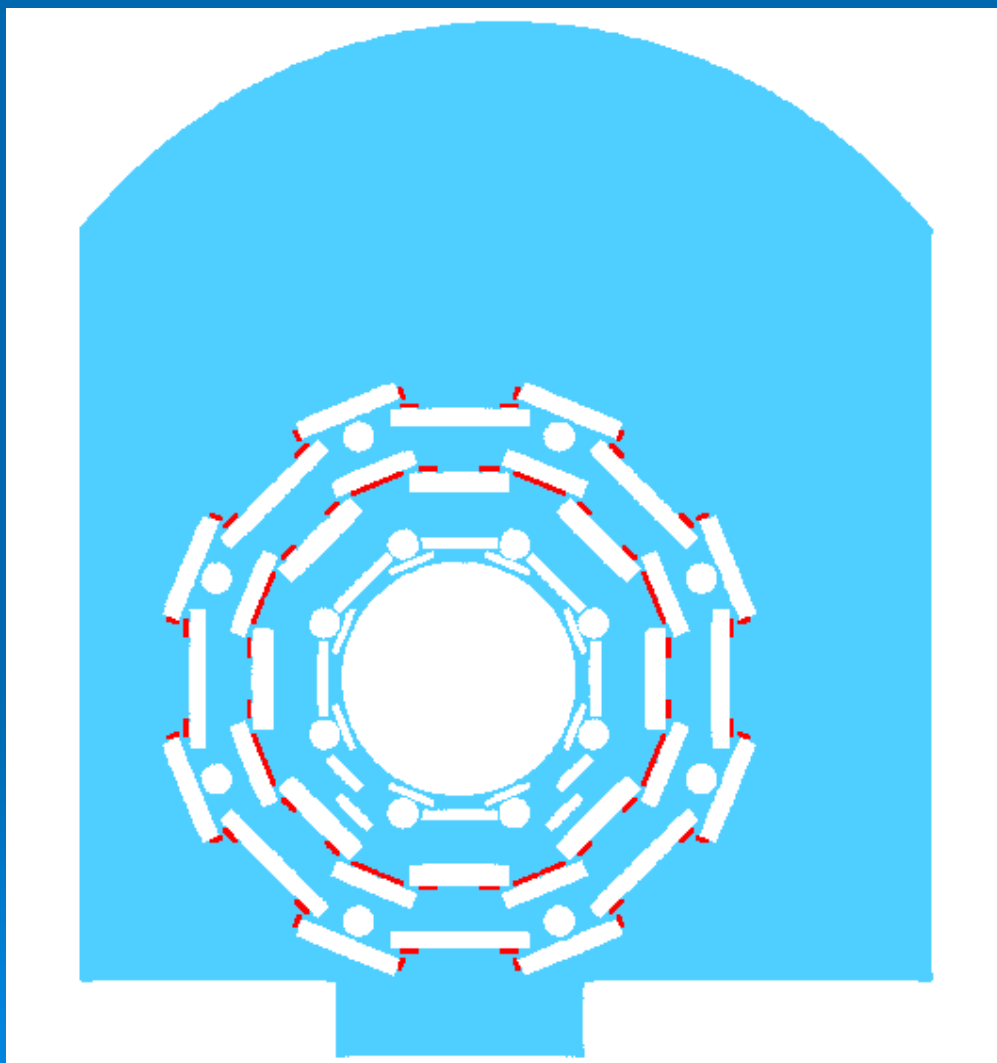
Simplifications

➢ The real shapes of the Muon Chambers envelopes were assumed,

➢ The only material simulated is air,

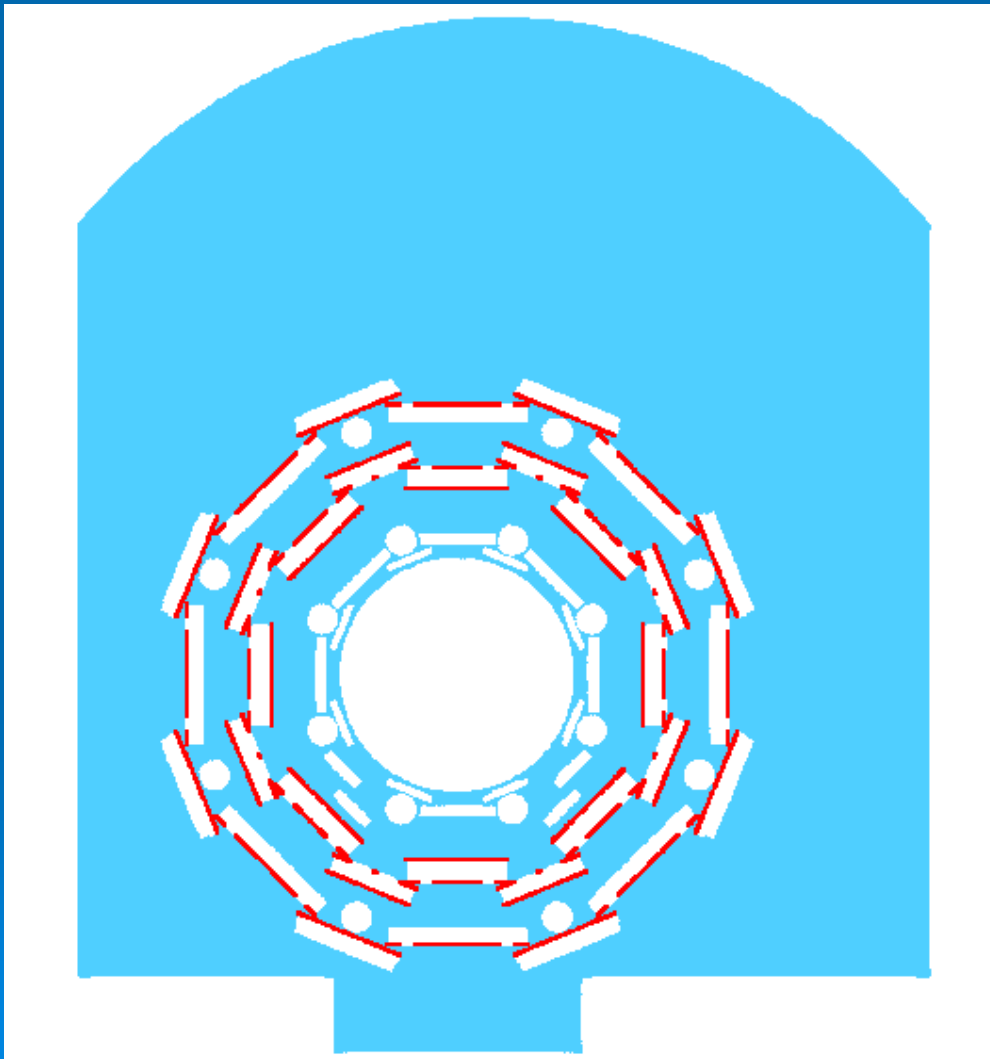➢ Solids are represented as empty volumes with the fixed surface heat flux.

MDT:

- Inner layer   –   6 kW,
- Middle layer –   5 kW,
- Outer layer   –   7 kW,

- TOTAL – 18 kW.

Boundary conditions

RPC (trigger & splitter):

- Inner layer   –   0 kW,
- Middle layer –   17 kW,
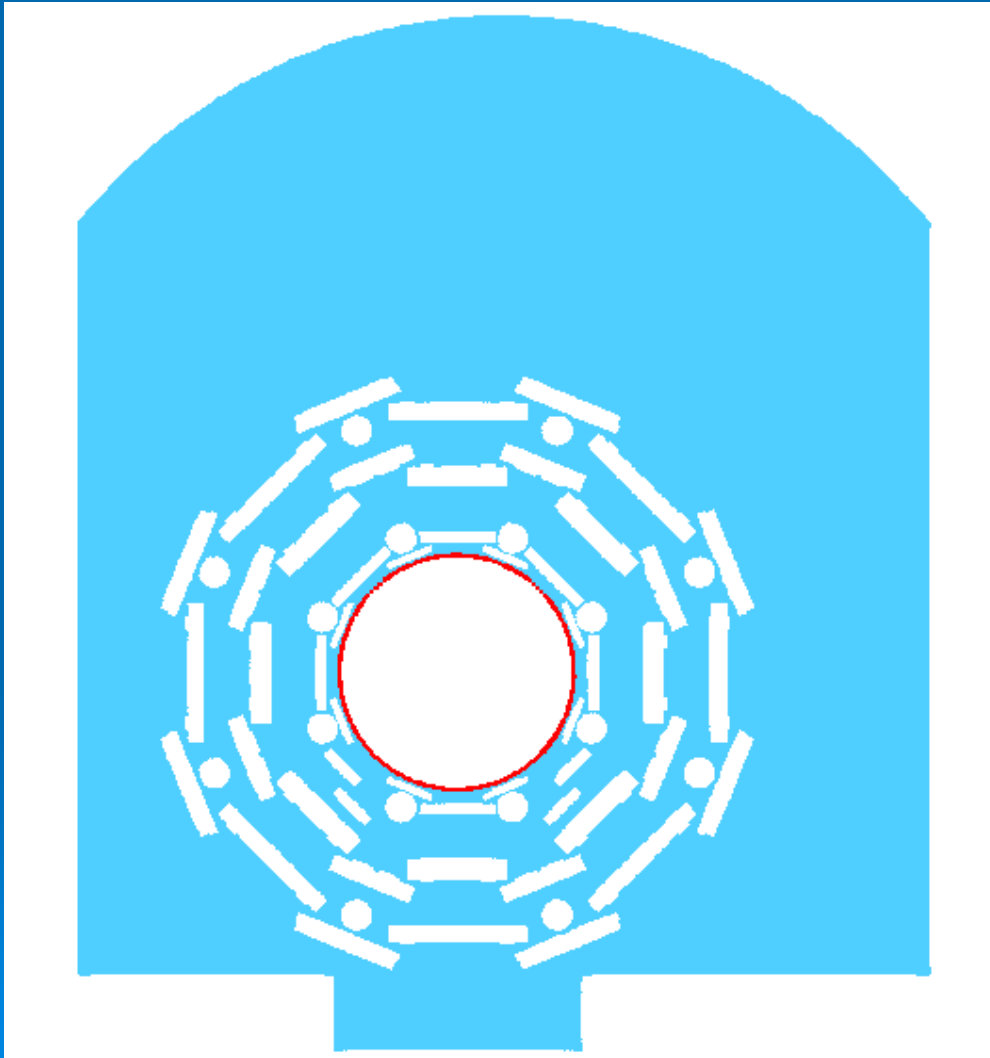- Outer layer   –   17 kW,

- TOTAL – 34 kW.

RPC (analog part):

- Inner layer   –   0 kW,
- Middle layer –   12 kW,
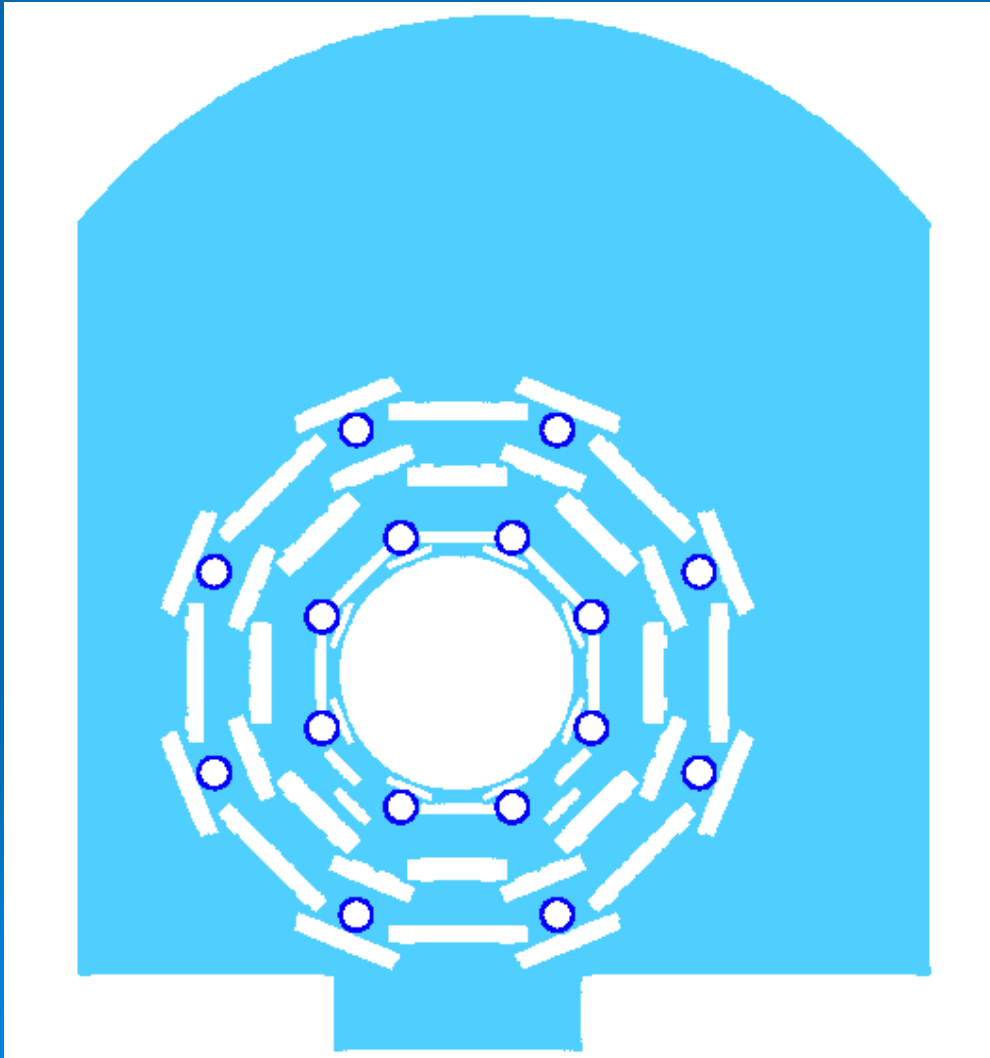- Outer layer   –   6 kW,

- TOTAL – 18 kW.

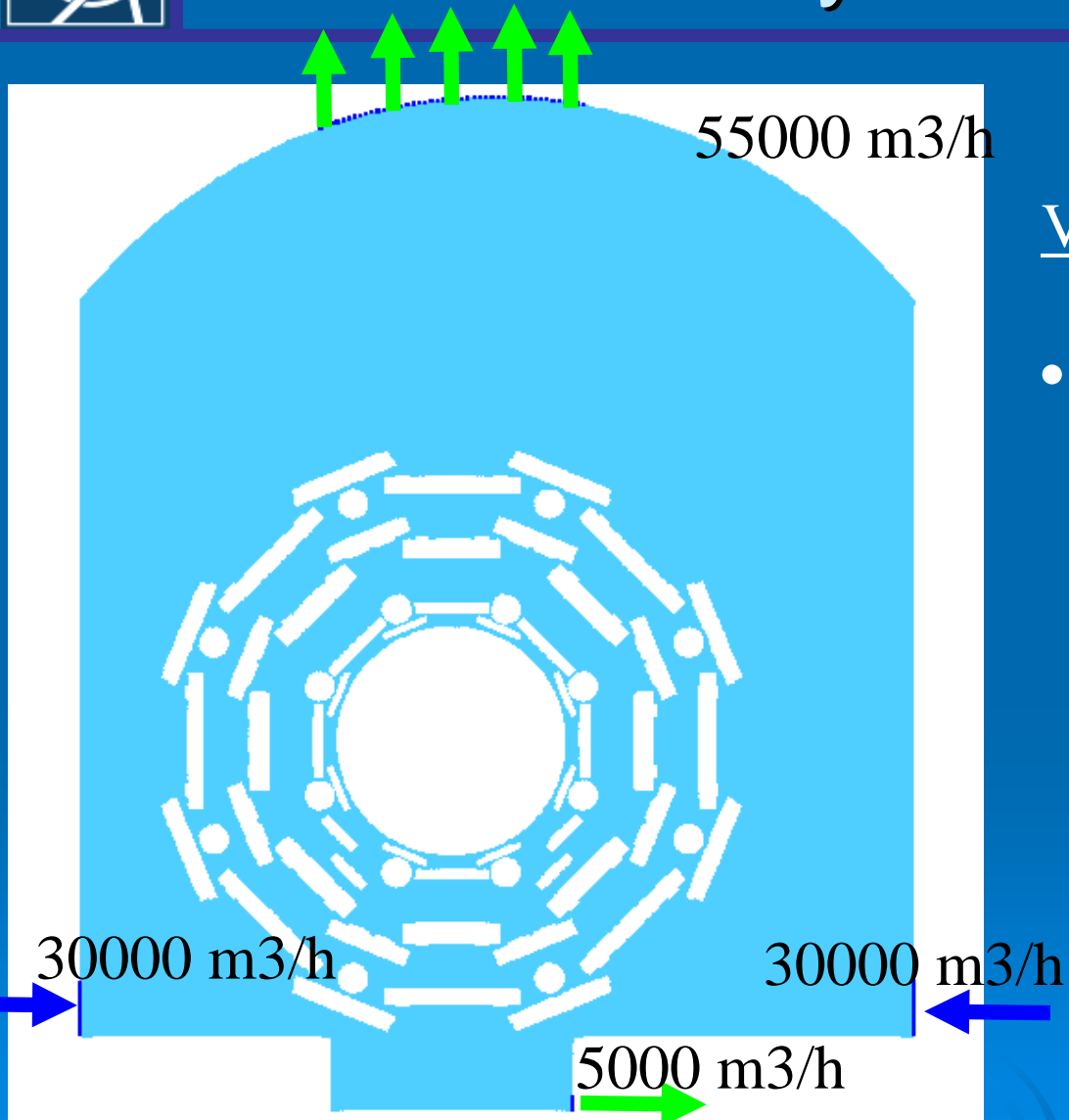# Boundary conditions

Calorimeter:

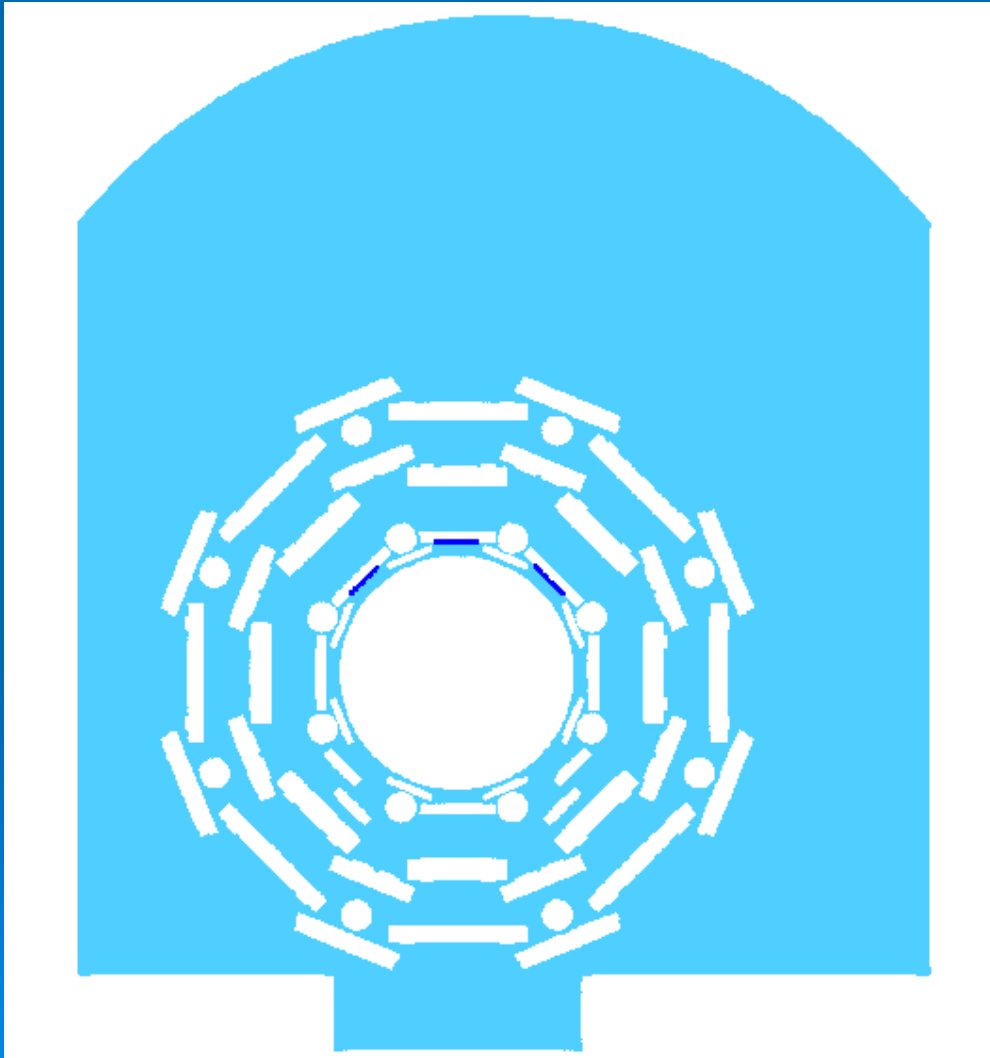- TOTAL – 20 kW.

Toroid:

- Heat - sink = - 4.8 W/m2.

Boundary conditions

55000 m3/h

Ventilation:

• Air at temperature 17 degr. C.

30000 m3/h   30000 m3/h

5000 m3/h

Thermal screens:

- Heat - sink = 20 degr. C

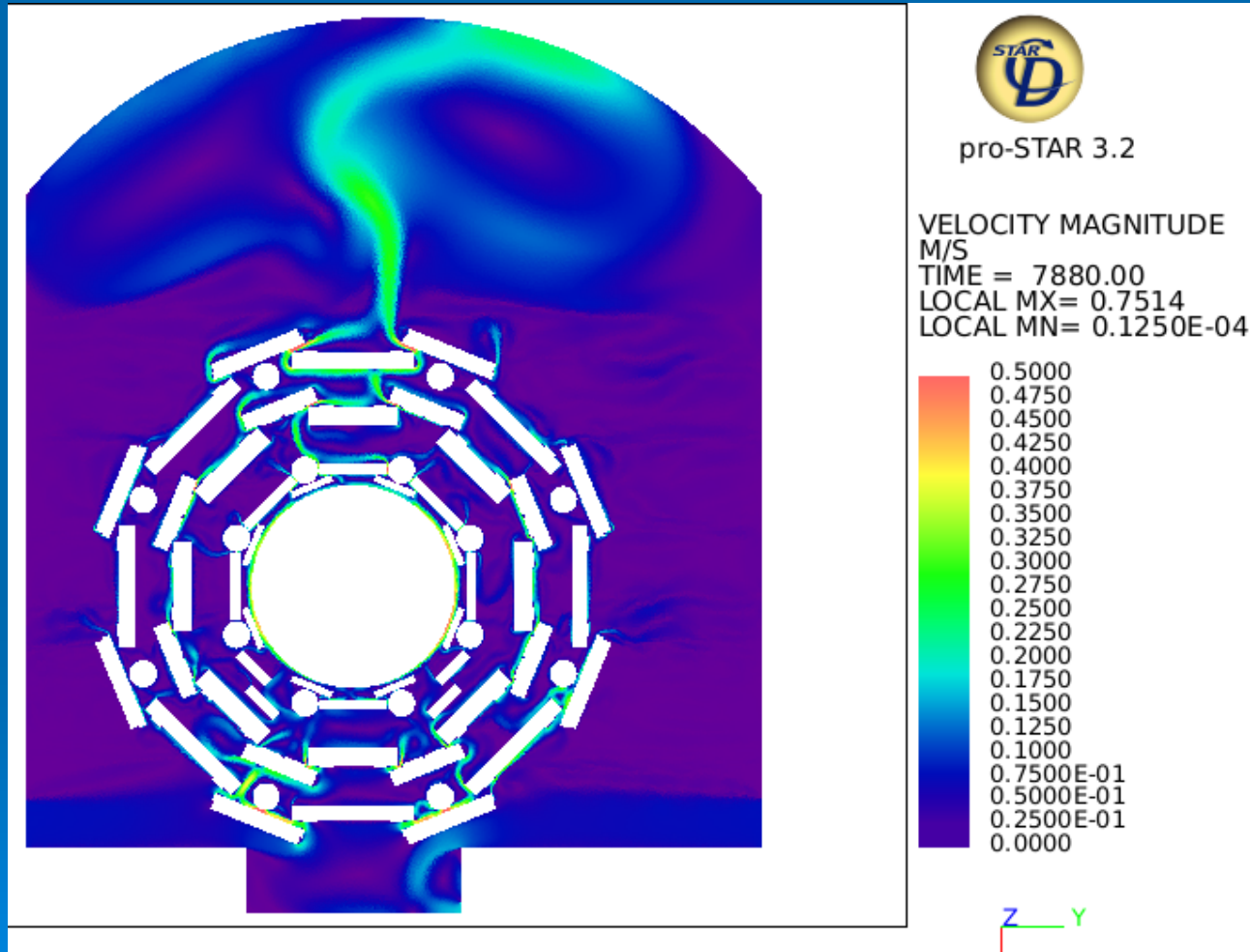# Boundary conditions

Summary

90 kW of power dissipated

+

Barrel Toroid taking away 4.8 W/m2

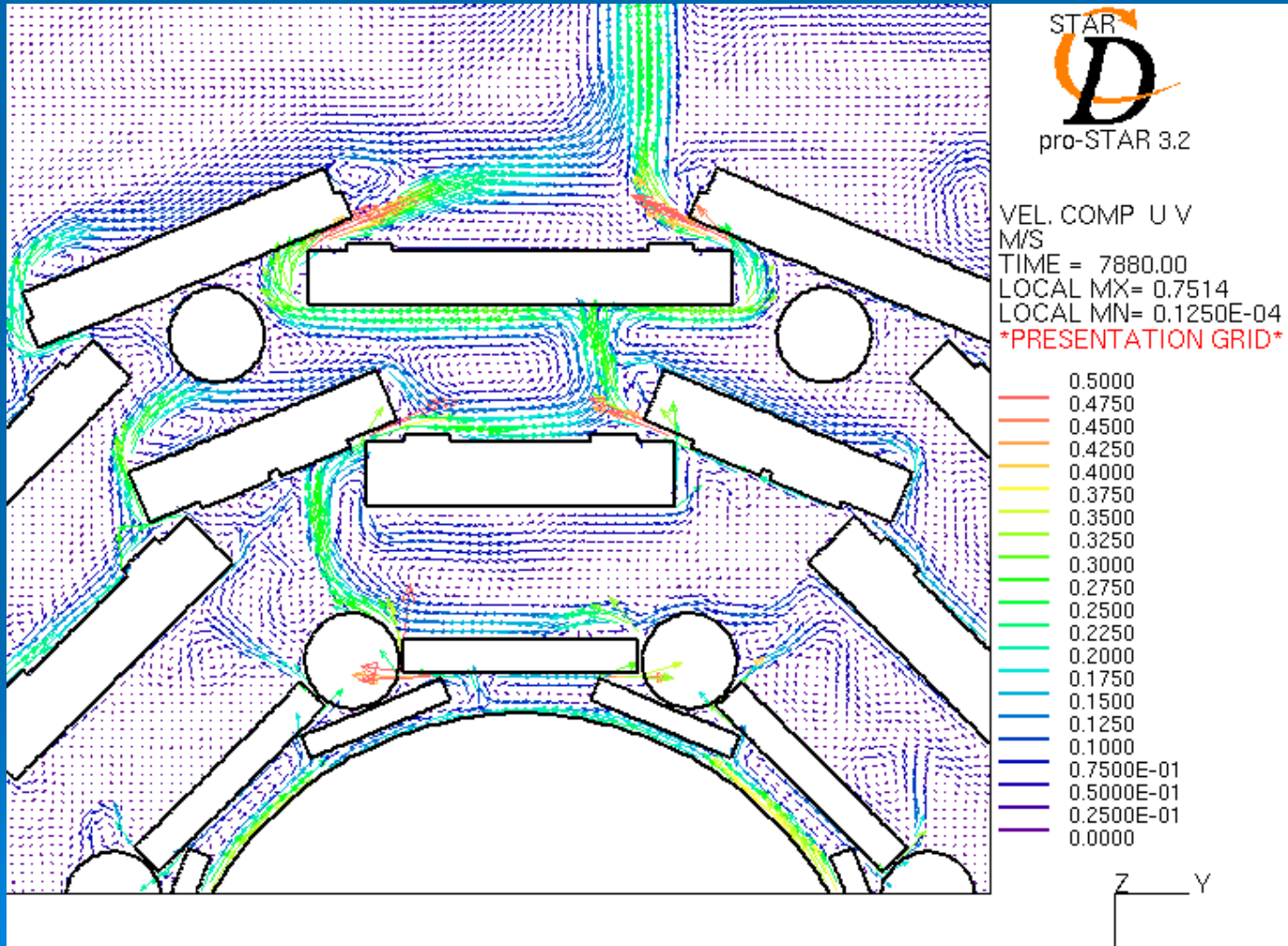Ventilation 60000 cubic m/h at 17 degrees C

+

Additional thermal screens installed on BIL 03, 05, 07
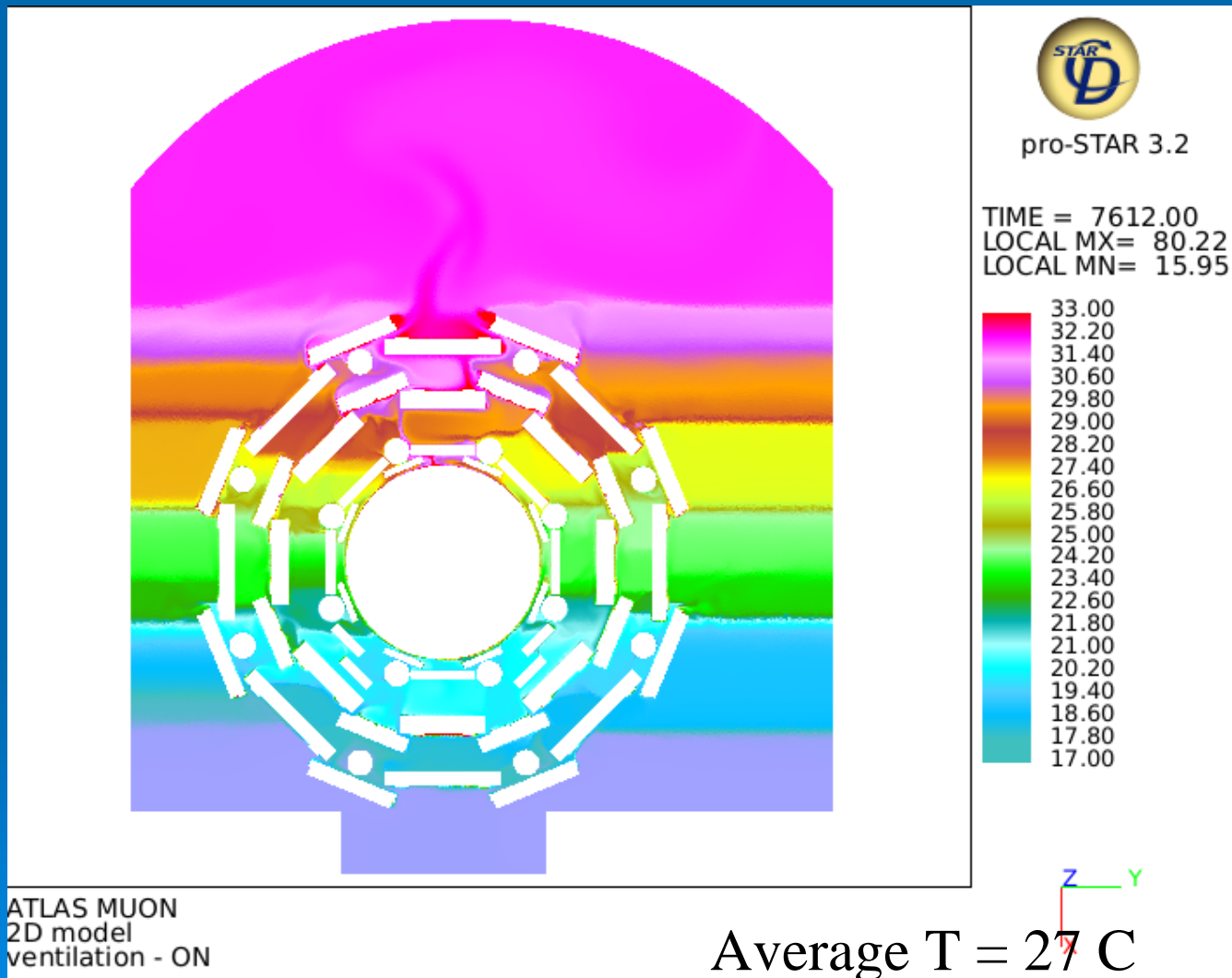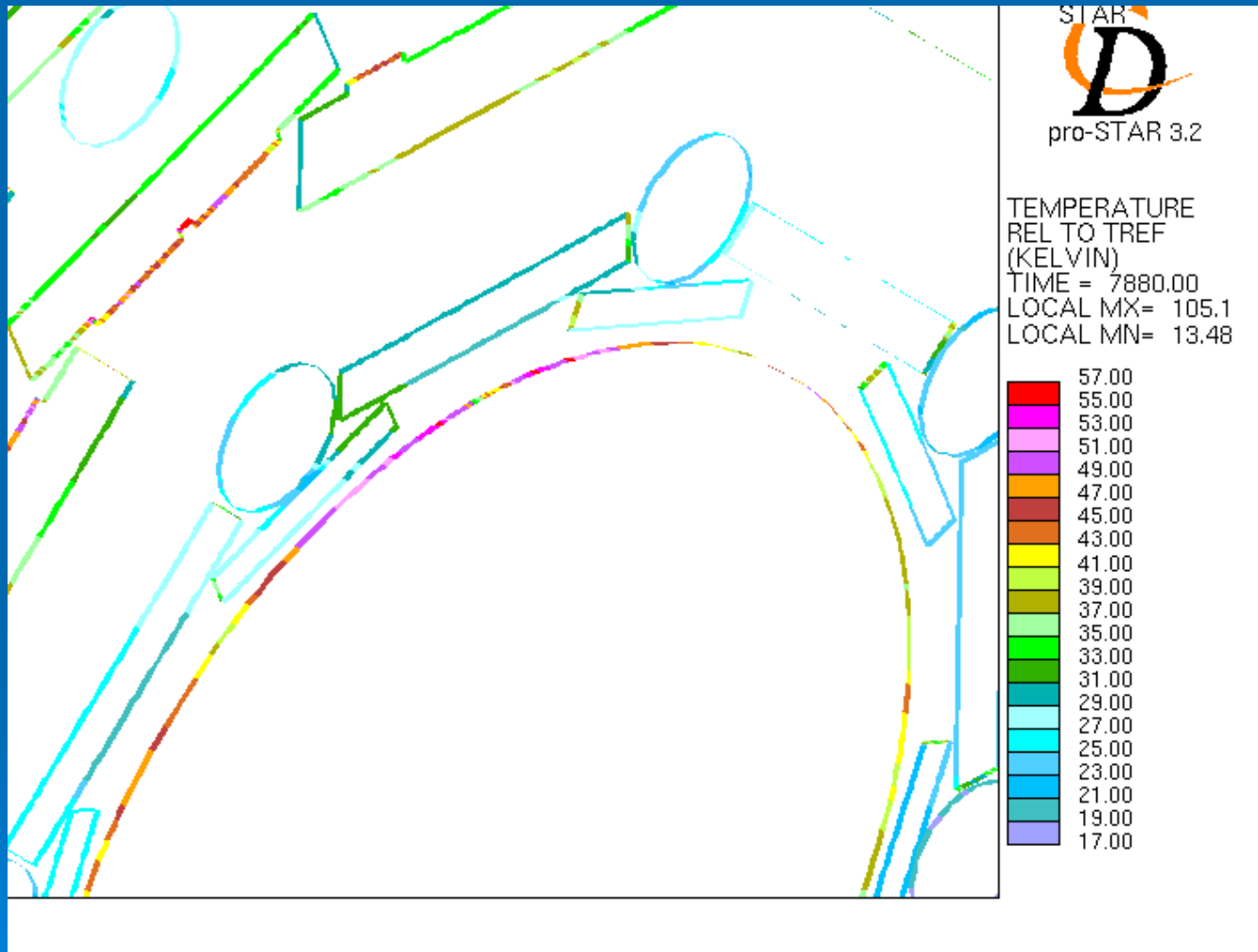
Results - velocity.

Results - velocity.

Results - temperature.

Heat screen takes away 2% of total heat load in the model.

Follow-up

➢ The resulting temperature & velocity fields will be used by group from Snezhinsk, Russia to refine their detailed model of the chambers,

➢ The next model will include the solid materials with the thermal properties supplied by the Russian team.