DSG Ansys R&D Meeting Minutes

Date: August 24, 2023
Time: 2:00 PM – 3:00 PM

Attendees: Aaron Brown, Pablo Campero, Tyler Lemon, and Marc McMullen

1. NPS thermal analysis with Ansys Mechanical

Aaron Brown, Brian Eng, and Tyler Lemon

1. Redoing plots of Ansys transient thermal simulation results
   - Made new plot with exponential fit using the data from Ansys transient simulation results when the ambient temperature increases by 5°C
   - Discussed the table showing slope and rate of change for temperature

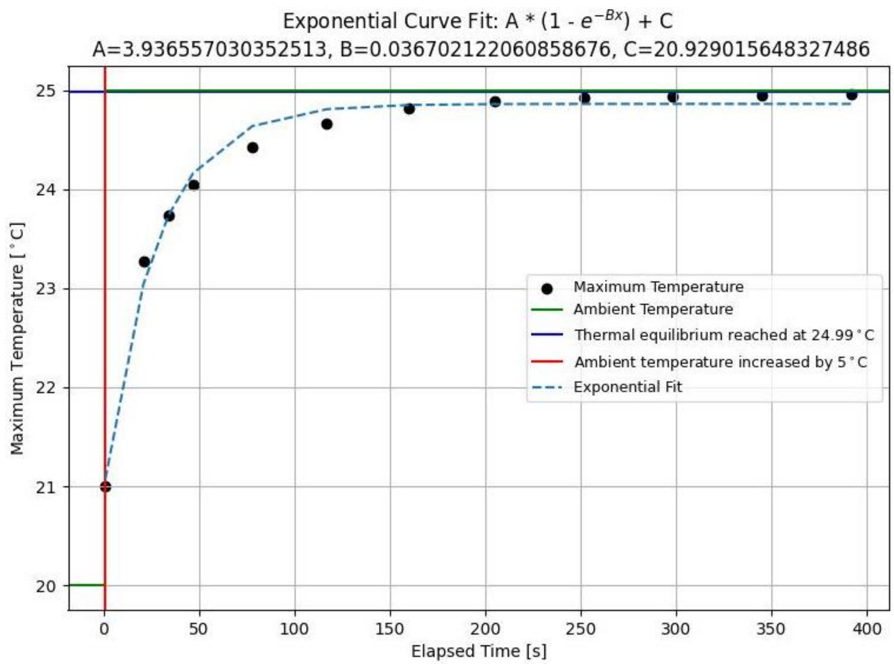

Fig. 1. Exponential fit for 5°C increments

t [s]	T [C]	m (C/s)	M (C/s^2)
2001	20.998		
2021	23.268	0.1135	
2034.4	23.74	0.035224	-0.00584
2047.8	24.05	0.023134	-0.0009
2078.5	24.426	0.012248	-0.00035
2117	24.671	0.006364	-0.00015
2160.4	24.818	0.003387	-6.9E-05
2205.9	24.89	0.001582	-4E-05
2252.2	24.925	0.000756	-1.8E-05
2298.9	24.944	0.000407	-7.5E-06
2345.8	24.955	0.000235	-3.7E-06
2392.9	24.962	0.000149	-1.8E-06

Table 1: Slope and rate of change for temperature

2. NPS thermal analysis with Ansys Fluent

Pablo Campero

1. Estimated delivery date for eight 64 GB RAM is September 5
2. Reviewed new software features for recently installed Ansys 2023R1 package in PHYCOMP2 and EXPCAMPERO
    - New CAD modeling software set by default (Discovery)
    - Client Licensing software has new features to monitor server status
    - Issues with Fluent software launcher on PHYCOMP2 computer (application stopped while trying to switch from meshing to solver); issue reported
3. Reducing the number of cells for the mesh without affecting quality of simulation
    - Implemented Body Sizing option for each crystal
    - Generated conformal mesh between crystal and surrounding fluid
    - Had meshing error related to poor quality while trying to mesh heat exchanger fans on the model
4. Worked with Ansys Support to reduce the number of cells
    - Modified model to create separate fluid parts for the volume surrounding the crystal array
    - Named volumes Fluid Array (volume between crystals), and Fluid Array Enclosure (volume that surrounds the entire crystal array including the cooling plate)
    - There are 10 fluid zones in the model

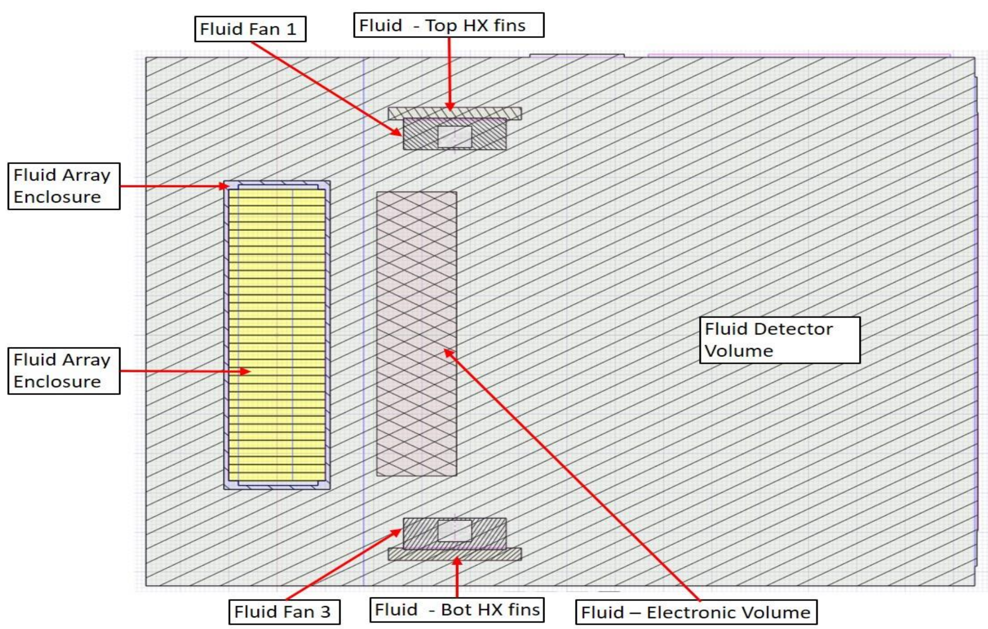

Fig. 2. Right side, cross-section of the detector model showing partition of fluid zones

- Completed surface and volume mesh
- Reduced number of cells for the model's mesh from ~100 M cells to ~ 13 M cells; system is operational but the mesh between crystals needs to be improved
- Improved mesh for the fluid between crystals resulting in 17 M cells
- Working on outer face separation for each crystal so the Shell Conduction options can be applied to simulate thermal effect of the carbon fiber and mu-metal dividers

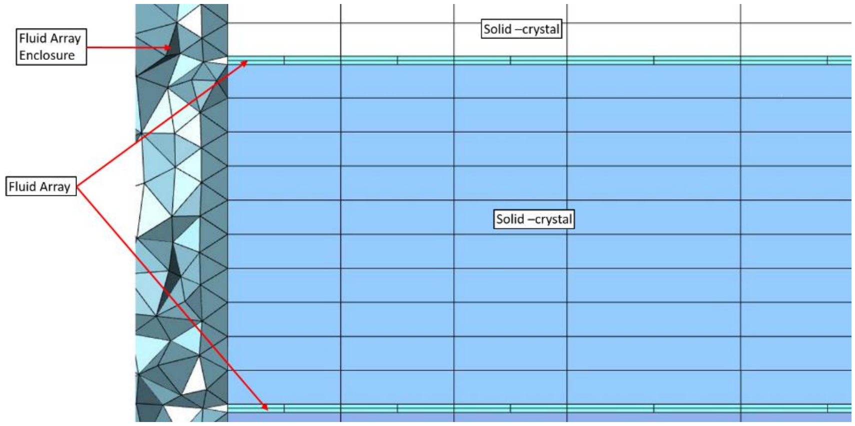

Fig. 3. Right side, cross-section, close-up of the fluid surrounding the crystal array in its upper right section. Model has 17 M cells with two layers for the fluid between each crystal.

3. EIC beampipe thermal analysis with Ansys Fluent

Pablo Campero and Brian Eng

1. For initial simulations, modeled the beryllium pipe as straight, without the actual conical deformation on its length
2. Made two models—pipe inner volume, pipe, and insulator (model 1) and pipe inner volume (model 2)
3. Completed mesh for model 2
    - Encountered issues meshing model 1 because of thin components
    - Did not include the pipe (0.76 mm thick) and the Kapton insulator (0.39 mm thick) in the meshing process
4. Performed simulations on model 2
    - Noted that more than one layer can be added to a fluid wall (air flowing inside the pipe) using the Shell Conduction option
    - Shell Conduction allowed the simulation of the material thermal properties and also the thickness for the pipe and Kapton

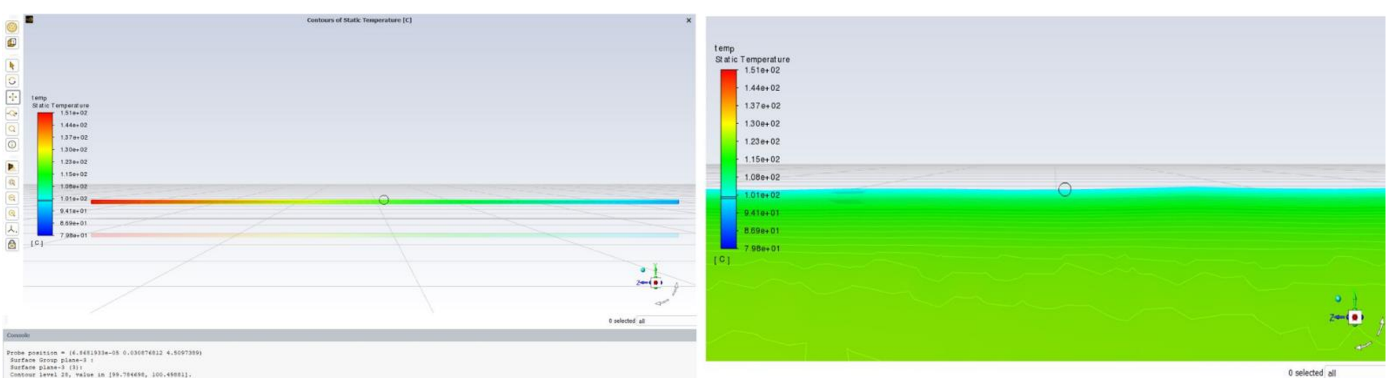

Fig. 4. Left: Temperature profile of beampipe when the inlet air flow is set at ~151°C with a velocity of 5 m/s; with air at this temperature, the central section reached ~100°C, Right: Right side, cross section, zoomed view of the beryllium pipe central section with the probe (in black circle) placed at its inner surface

5. Plan to run simulation with inlet air at 100°C with a velocity of 1 m/s and 10 m/s