

NPS: Crystal Array Thermal Analysis

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2022-02

More on the Thermal Analysis of NPS Crystal Array with Ansys

As mentioned in my previous monthly memo [1], temperature probes were placed on the front and rear faces of each crystal of the NPS crystal array model. These temperature values were extracted from the Ansys thermal simulation solution to a text file using the IronPython script get-results4.py.

The next task was to parse the data file from the Ansys simulation. To do this, I generated a new Python program (parse-temps.py) to remove header information from the text file leaving only the temperature value behind. The purpose for this is to be able to generate plots showing the temperature profile of the crystal faces only and not of the entire system as a whole. This way we can determine the temperature gradient from crystal to crystal.

To plot the crystal face temperature probe data, this new Python program stripped out the header information for each temperature probe. The temperature probe values had to be extracted in the proper order (crystal #0 to crystal #1079) for both front and rear crystal faces since the header information in the text file was to be removed. The remaining data still contained multiple delimiters and extraneous information, Fig. 1.

```
NaN,Time [s],Front Crystal 0 [°C]
1,1.,11.816
NaN,Time [s],Front Crystal 1 [°C]
1,1.,12.694
NaN,Time [s],Front Crystal 2 [°C]
1,1.,13.113
NaN,Time [s],Front Crystal 3 [°C]
1,1.,13.312
NaN,Time [s],Front Crystal 4 [°C]
1,1.,13.554
NaN,Time [s],Front Crystal 5 [°C]
1,1.,13.641
NaN,Time [s],Front Crystal 6 [°C]
1,1.,13.651
NaN,Time [s],Front Crystal 7 [°C]
1,1.,13.778
```

FIG 1. Screenshot of extracted temperature probe values text file

After removing the unnecessary information, the temperature probe values were separated into two arrays (one each for the front and rear crystal face temperature

- **Developed Python code to plot extracted Ansys temperature data**
- **Generated plot of front crystal face temperatures**
- **Determined central crystal region temperature dependent on temperature in hut (22°C); coolant at 10°C affects only crystals on the periphery, simulation results on slide #2**

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probe values). Each array, containing 1080 temperature values, was plotted, Fig. 2, temperature ranges are shown in Table 1

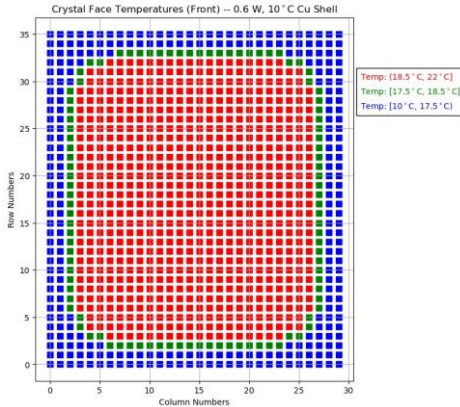


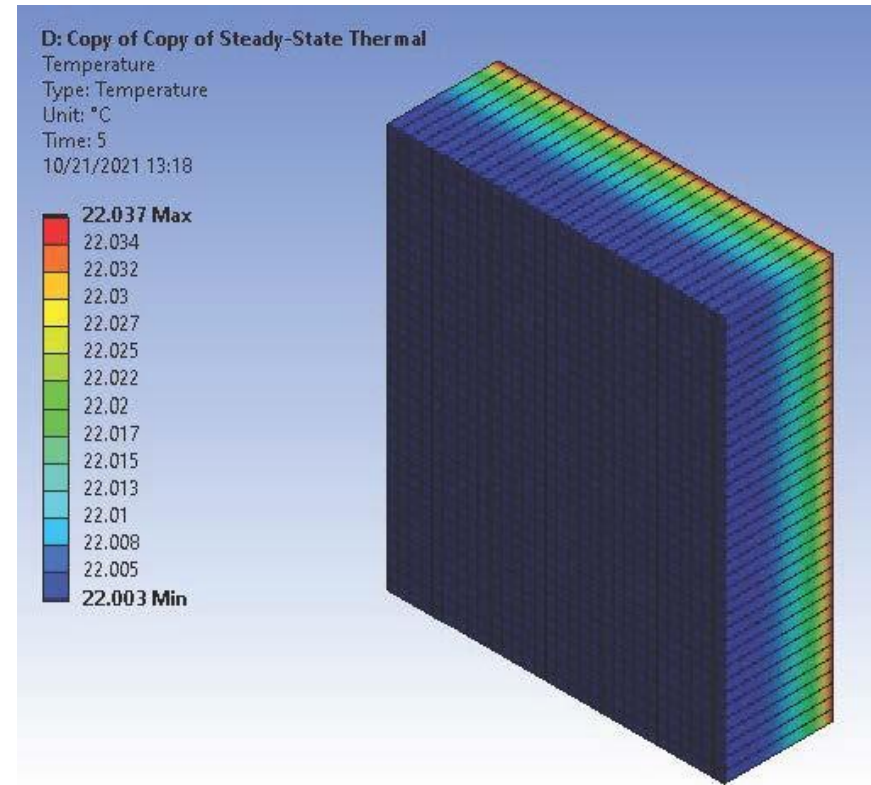
FIG 2. Python plot of front crystal face temperature probe values

Temperature range	Color
[10.00°C, 17.50°C]	Dark Blue
[17.50°C, 18.50°C]	Green
(18.50°C, 22.00°C]	Red

Table 1. Temperature ranges for Python plot of Ansys temperature probe values.

This new Python program, *parse-temps.py*, will be used to plot temperature probe values for future thermal simulations of the NPS crystal array. Eventually, a plot of the temperature gradient from a crystal face to adjacent crystal faces will be generated using the temperature probe values extracted from the simulation solution.

[1] [Brown, Aaron DSG Monthly Memo 2022-01](#)



Snapshot, after 5 s, of thermal conduction along the length of the crystals