Comparison of Ansys Thermal Simulations and Analyses Results to Temperature Data of the Current Neutral Particle Spectrometer's Run

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This note compares the temperature data from the current Hall C Neutral Particle Spectrometer (NPS) run to the Ansys Mechanical Steady State and Ansys Mechanical Transient thermal simulations and analyses of the crystal array.

Both Ansys Mechanical Steady State and Ansys Mechanical Transient thermal simulations and analyses [1, 2, 3] of the crystal array showed that the crystal array's temperature depends on the ambient Hall temperature, Fig. 1.

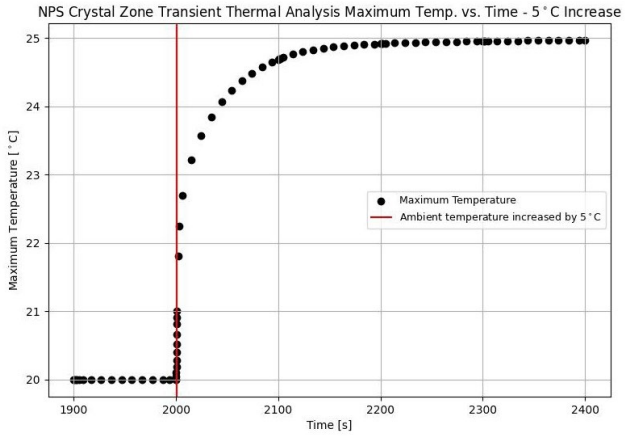

FIG. 1. Plot of Ansys Mechanical Transient Thermal simulation maximum temperature at equilibrium.

The current NPS run's temperature data of crystal 0 were analyzed. Figure 2 shows the temperature data for the front and rear of crystal 0, as well as the ambient temperature of the Hall. The front temperature of crystal 0 runs ~3.5°C higher than the rear temperature, which could be caused by the particle flux. The Pearson correlation coefficient *r* between ambient and front and ambient and rear temperatures is about 0.9, indicating a strong positive linear correlation.

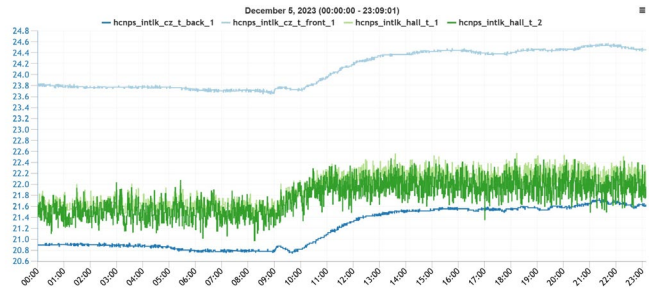

FIG. 2. Crystal 0 front and back temperatures, and ambient Hall temperature.

Figure 3 shows crystal 0's front temperatures plotted against the rear temperatures. As the front temperature of crystal 0 increases, the rear temperature increases linearly. The Pearson correlation coefficient *r* between the front and rear temperatures of crystal 0 is about 0.9990, indicating a strong positive linear correlation. The best-fit line is shown in red.

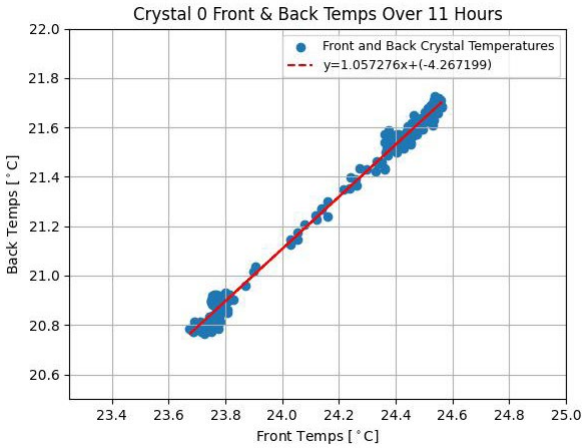

FIG. 3. Front vs. rear temperature plot for crystal 0.

In conclusion, simulation results are confirmed by the data.

[1] A. Brown, et al., *Ansys Steady-State Thermal Analysis of the Engineered Cooling Design for the Hall C Lead Tungstate Crystals of the Neutral Particle Spectrometer,* DSG Note 2022-02, 2022.
[2] A. Brown, et al., *Ansys Steady-State Analysis of the Hall C Lead Tungstate Crystal of the Neutral Particle Spectrometer*, DSG Note 2022-11, 2022.
[3] A. Brown, et al., *Ansys Transient Thermal Analysis of the Hall C Neutral Particle Spectrometer's Lead Tungstate Crystals*, DSG Note 2023-20, 2023.