

Yale Update: Oct 11th

WILLIAM HEIDORN
IOWA STATE UNIVERSITY
ISU WEEKLY STAVE QC MEETING
OCTOBER 11, 2018

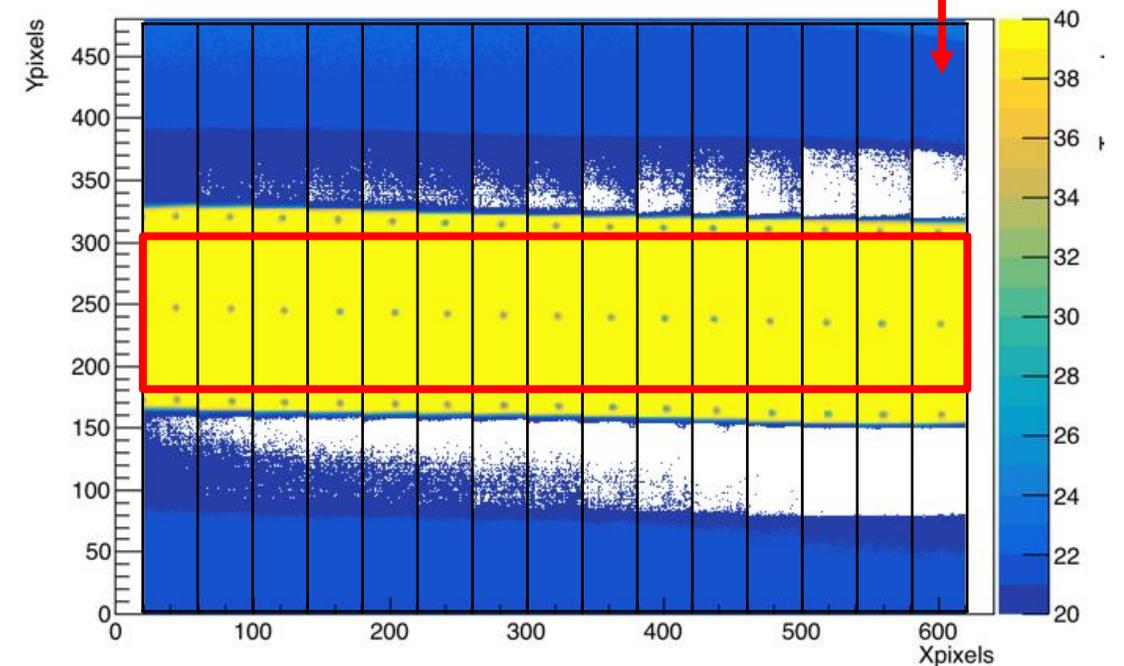
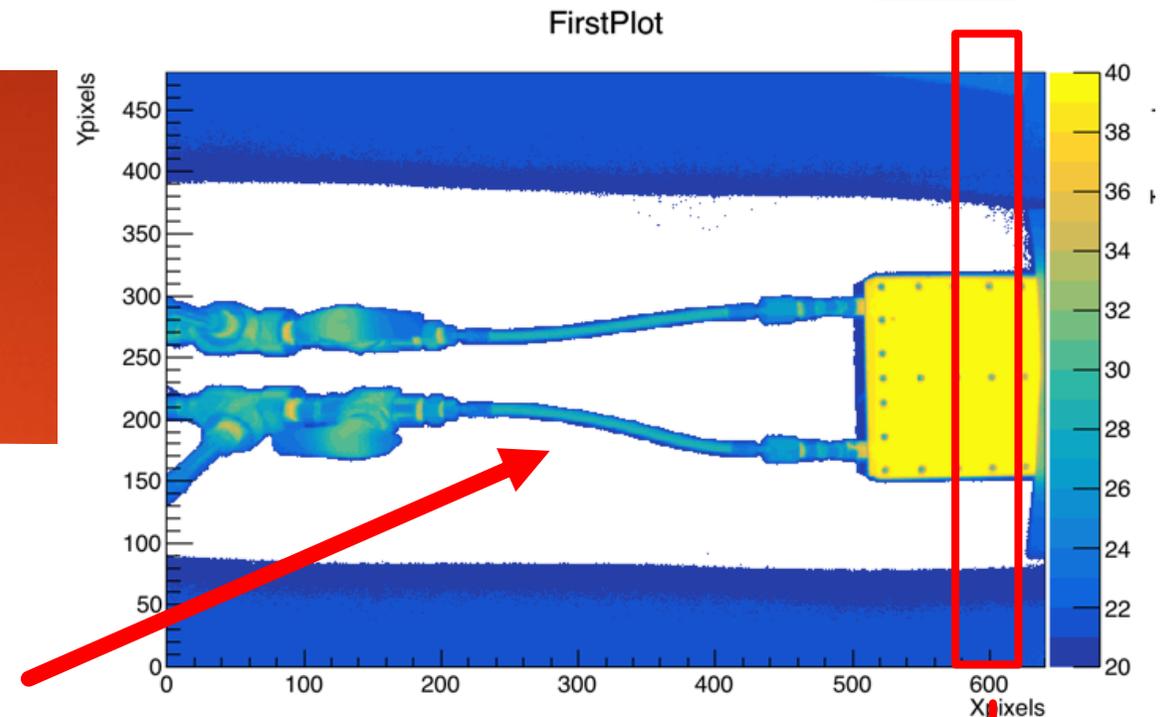


Where we are...

- ▶ Thermal-
 - ▶ All hardware and computer communication are working.
 - ▶ Most calibration tests have been done
 - ▶ Vignetting
 - ▶ Flow rate
 - ▶ Remaining Issues and tests
 - ▶ Box size... Looking at the test stave I found that the pixel size was smaller(2mm/pixel instead of 2.2mm/pixel)... I found that the big box is a few inches shorter than what is mentioned in the setup guide (not certain if it was a typo on the drawings)
 - ▶ Stave 8 and 2R measurements
- ▶ Laser-
 - ▶ Camera issue- Biggest problem is that the camera purchased was not the same... causing headaches due to different data format and intensity.

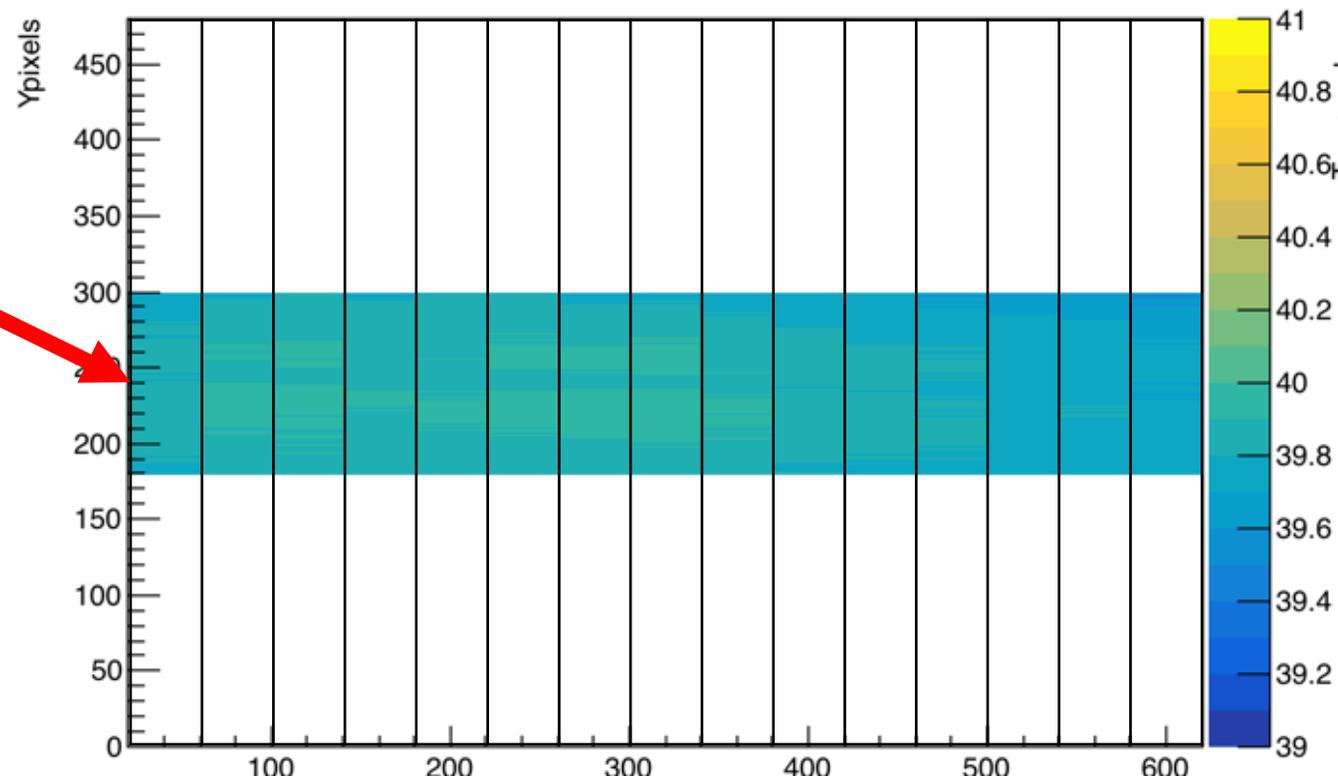
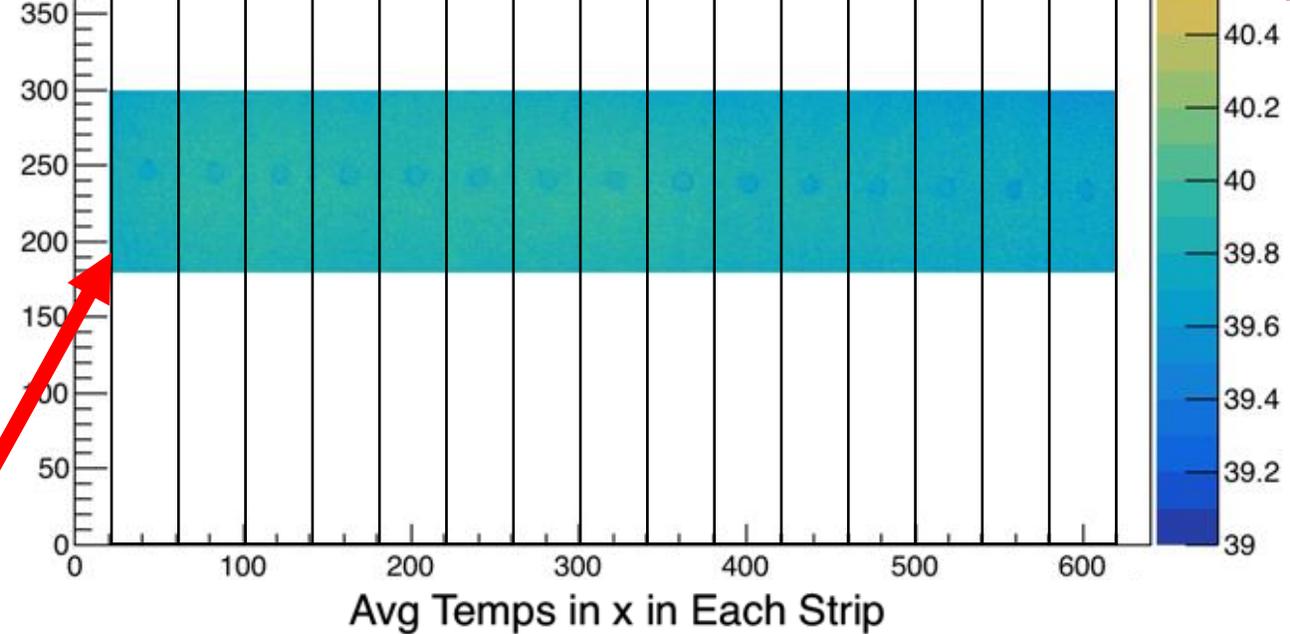
Vignetting

- ▶ The metal block was cooled/ heated to a stable temperature.
- ▶ The camera was focused and observed the plate 15 times. Each time, the same plate portion was observed with a different section of pixels of the camera.
- ▶ Before each image measurement the camera was recalibrated between each image using the NUC (non-uniformity compensation) feature of the camera.
- ▶ Images were taken with 100 frames over 4 seconds and averaged assuming an emissivity of 0.95



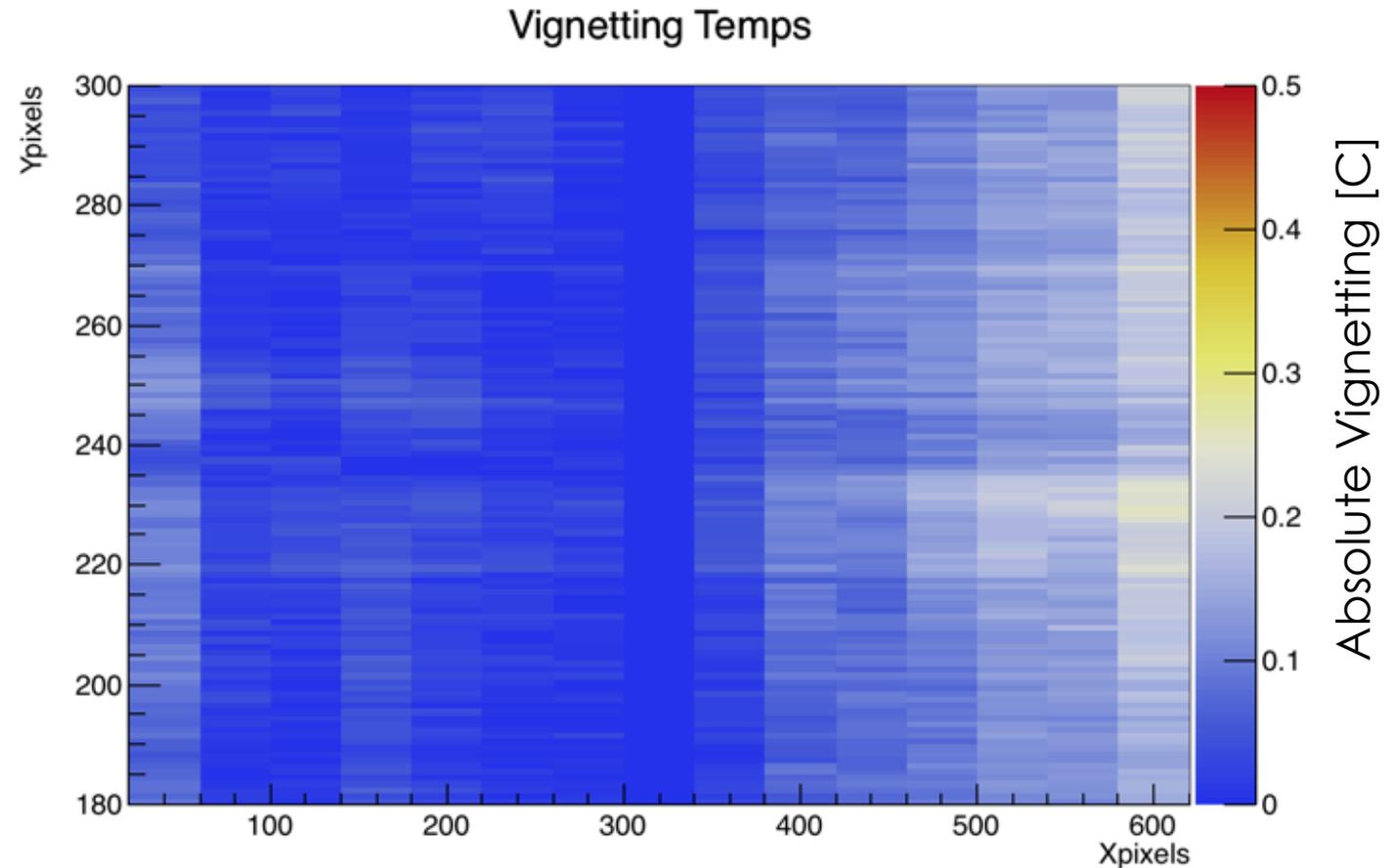
Vignetting cont.

- ▶ The image is smoothed within the region in which the stove will reside in measurements
 - ▶ Find average throughout the strip area and remove any temperatures outside one standard deviation and replace them with the average
- ▶ The temperature is next averaged along the x direction in each strip
- ▶ Finally the central strip is subtracted from the rest to give the vignetting



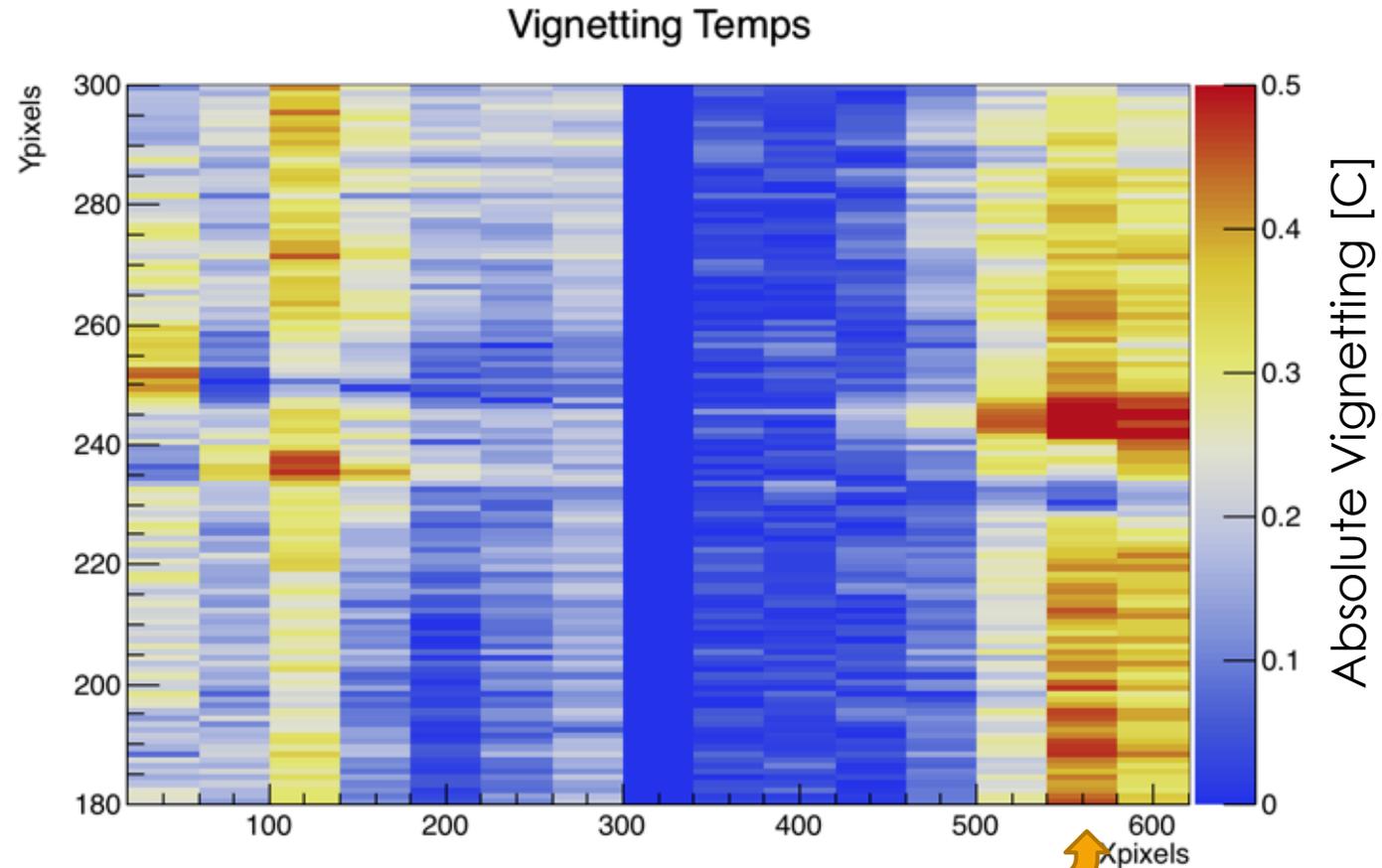
Vignetting +40C Block

- ▶ To the right you see the vignetting map
 - ▶ Max Vignetting: 0.26 C
 - ▶ Avg Vignetting: 0.07 C
- ▶ This is quite impressive given that the measurement is taken over a 10 min period



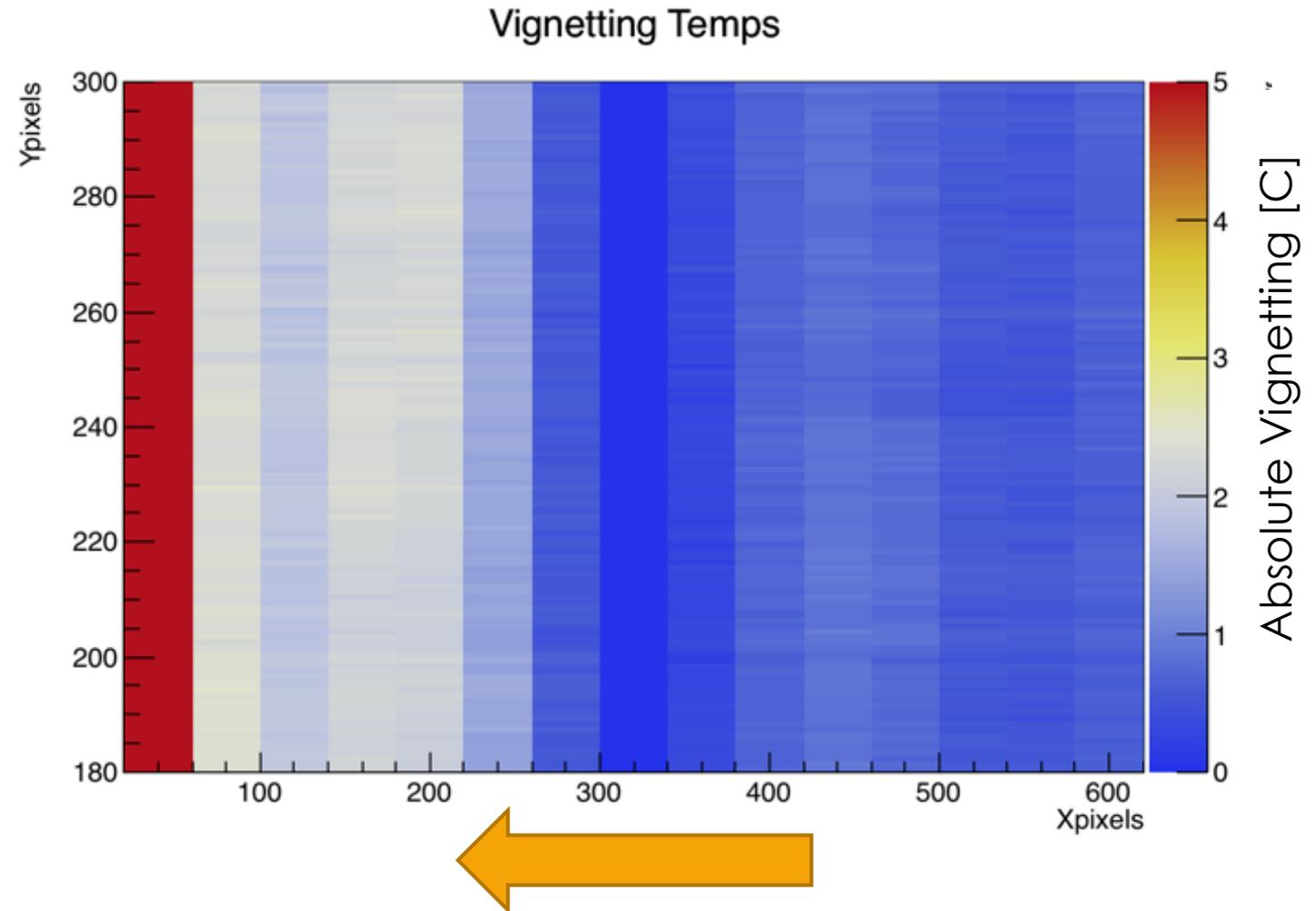
Vignetting -40C Block

- ▶ To the right you see the vignetting map
 - ▶ Max Vignetting: 0.63 C
 - ▶ Avg Vignetting: 0.17 C
- ▶ This is quite impressive given that...
 - ▶ The measurement is taken over a 10 min period
 - ▶ Alignment of metal was not right for one line



First Yale Trip -40C Block

- ▶ No NUC utilized during this run
- ▶ Similar to what we saw at ISU (~3 max)
- ▶ Vignetting worsens over time (orange arrow)
- ▶ Error in the last row

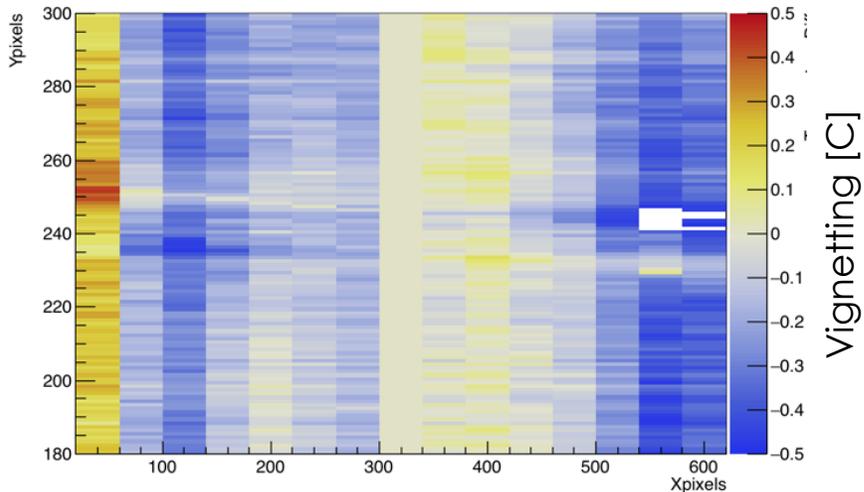


Cold Temperature Fluctuations during Vignetting

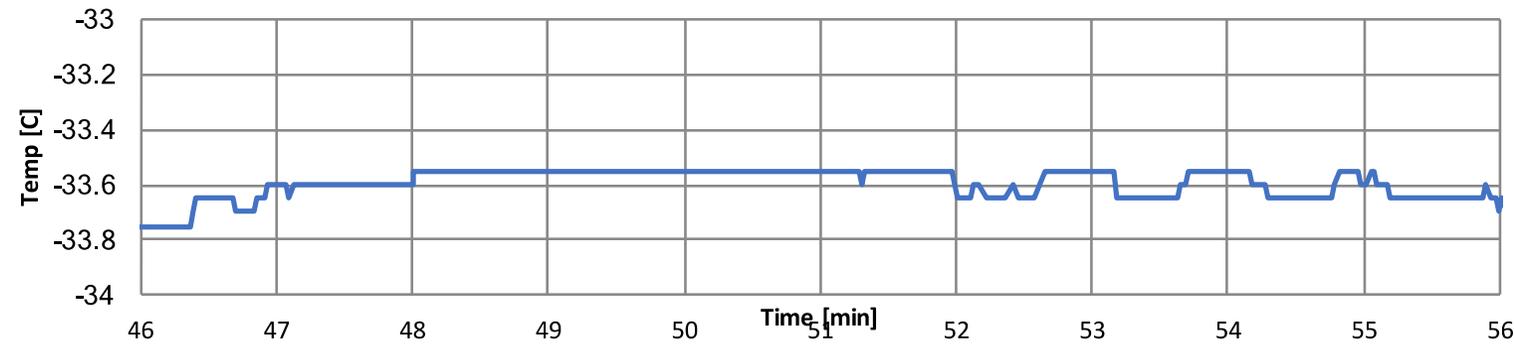
- ▶ For the cold measurement, fluctuations of the temperature are at most 0.2 C
- ▶ Orange arrows display direction of taken data



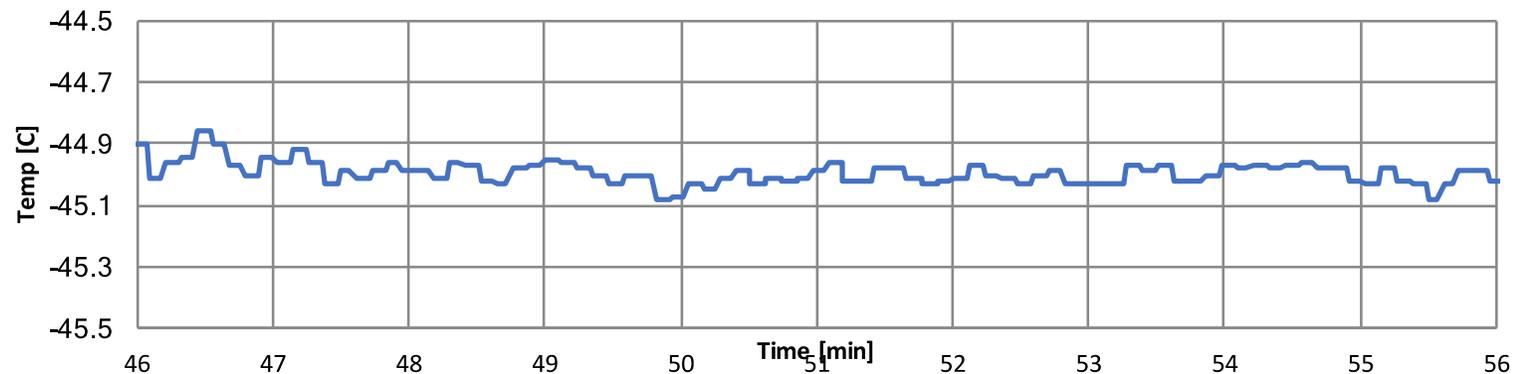
Vignetting Temps



TStave[C]



TRes[C]

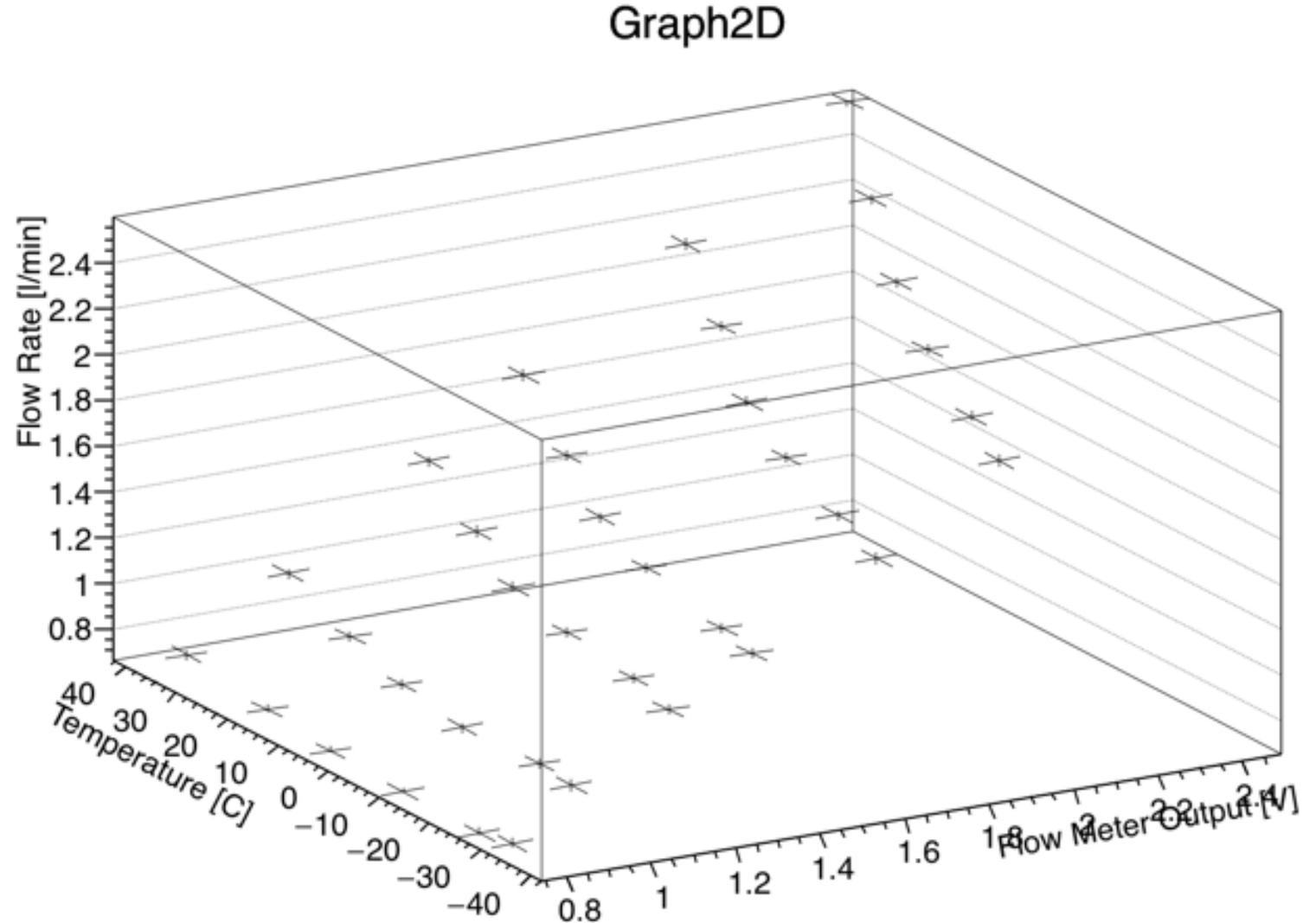


Vignetting Conclusions

- ▶ The actual vignetting of the thermal camera's are much smaller than we had earlier measured.
- ▶ Using the NUC, the camera's maximum vignetting is below 1 C!
 - ▶ +40C Block: Avg Vignetting 0.07C, Max Vignetting 0.27C
 - ▶ - 40C Block: Avg Vignetting 0.17C, Max Vignetting 0.63C
- ▶ These fluctuations may mainly be due to the fluctuation of the temperature of the block during the measurement

Flow Rate Calibration initial plots

- ▶ Novec 7100 fluid was passed through the flow meter with the metal calibration plate in line.
- ▶ The bypass was opened and the fluid was pumped into the 1l graduated cylinder while the time was measured with a stop watch
- ▶ The temperature of the chiller and booster pump were set to varying values
- ▶ Initial plot of the data is shown at the right...
- ▶ I will have nicer plots in the future



Backup Slides