Stave QC Weekly Update

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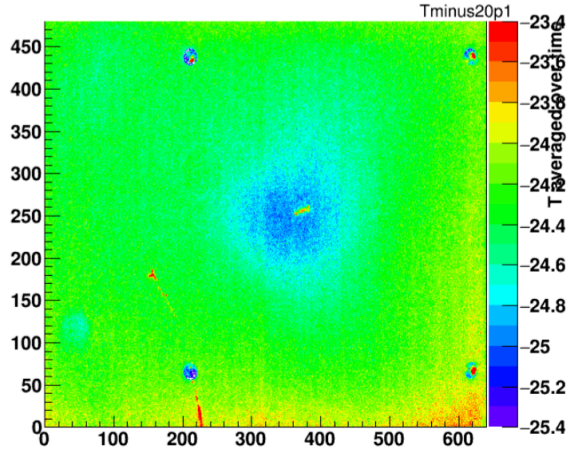
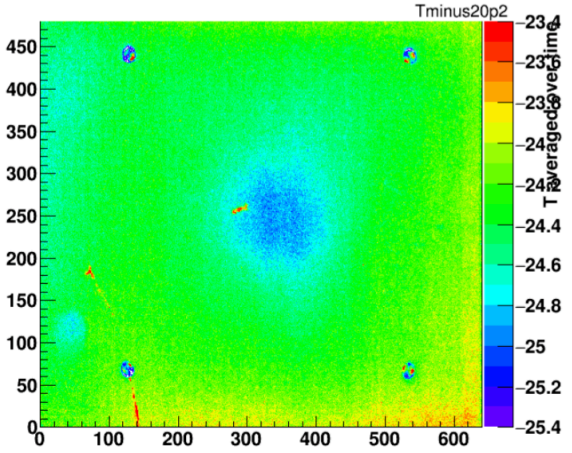
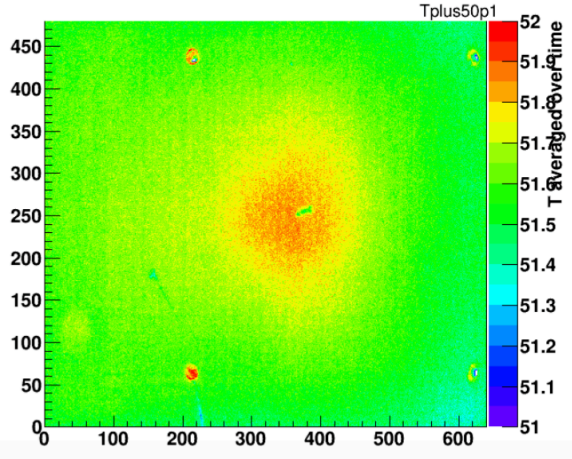
March 25/2016

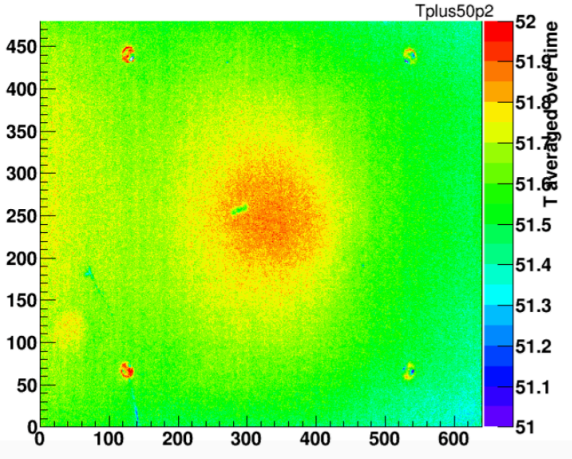
Vignetting

We have seen some effects in the past like Jie's slides of last week and the 'lines' experiment.









The plots on the top are at -20˚C and the ones below at +50˚C. We know from this that the shape changes with the temperature.
From the 'lines' experiment we saw an increasing of temperature from left to right in the FOV of the camera.

Experiment

- GOAL: map the same physical area with different parts of the FOV of the camera (in x- and y-direction) to see the effect of vignetting and create a function to fix it.

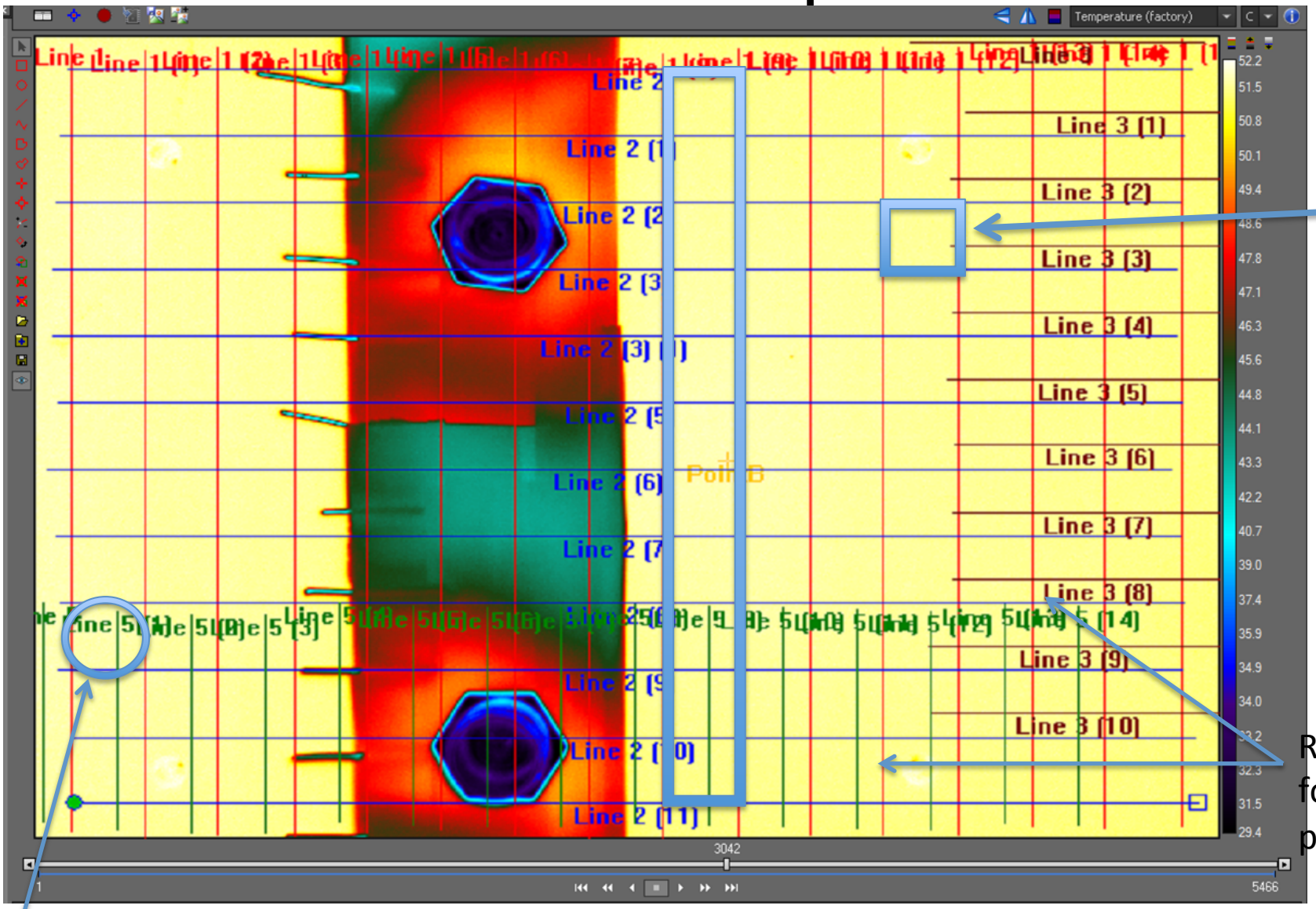
Quick info about the experiment:

Same physical area on the plate's surface was observed with the camera. For this, the camera was moved in both directions until the physical area was in the indicated position of its field of view. Each area was measured for 40 seconds at a frame rate of 6 frames per second => 240 frames per area. Humidity was controlled at 0.0% and the chiller was always at -15˚C.

NEW CHANGES

- Calibration every time the camera is moved, avoiding the effect due to off calibration that Jie have seen after more than ten minutes.
- The areas were centered instead of being moved in one direction, i.e., 20 pixels are lost at every edge of the FOV (before was 8 to the left, and 20 to the right).
- A line 16 pixels before the actual area measured was kept to keep the paper at a controllable and consistent position from the area.

FOV and new experiment



Area 40x40

Ref lines for the paper

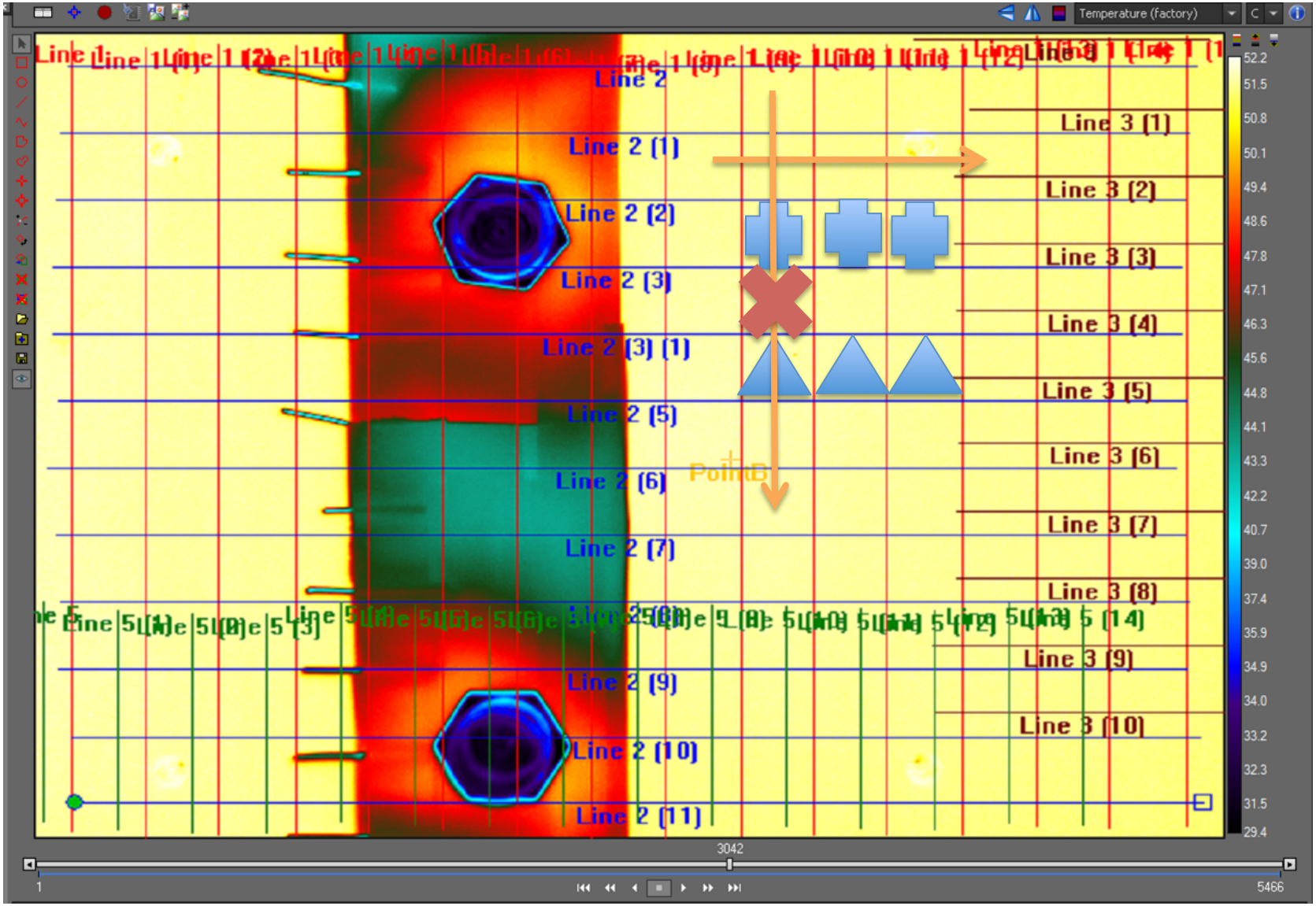
y

x

Where the spot is!
Fills one square

Features of x-experiment

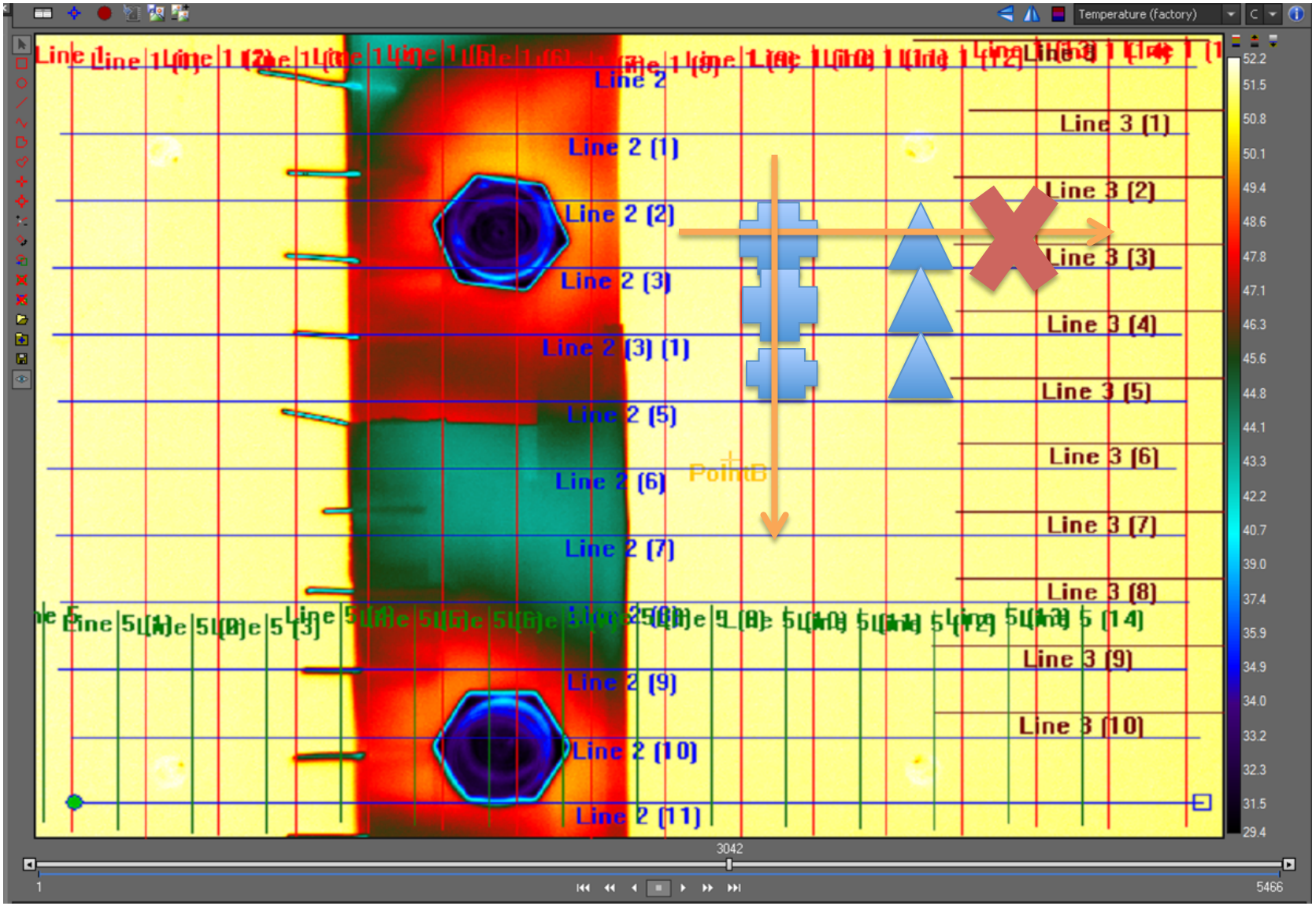
In x-direction is the same physical spot, in y we can have differences due to the plate. Then, we can move freely in x but not in y.

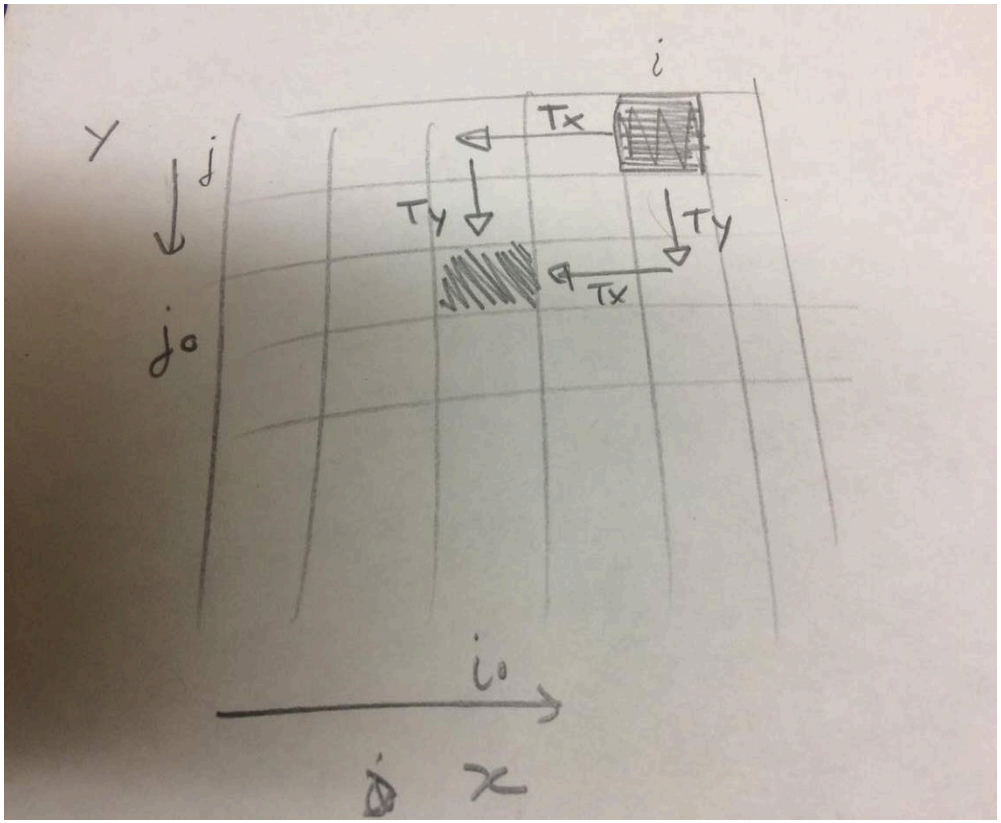


Features of y-experiment

In y is the opposite, we can move freely in y but not in x.

*This photo is the x-experiment but helps to understand the directions allowed.

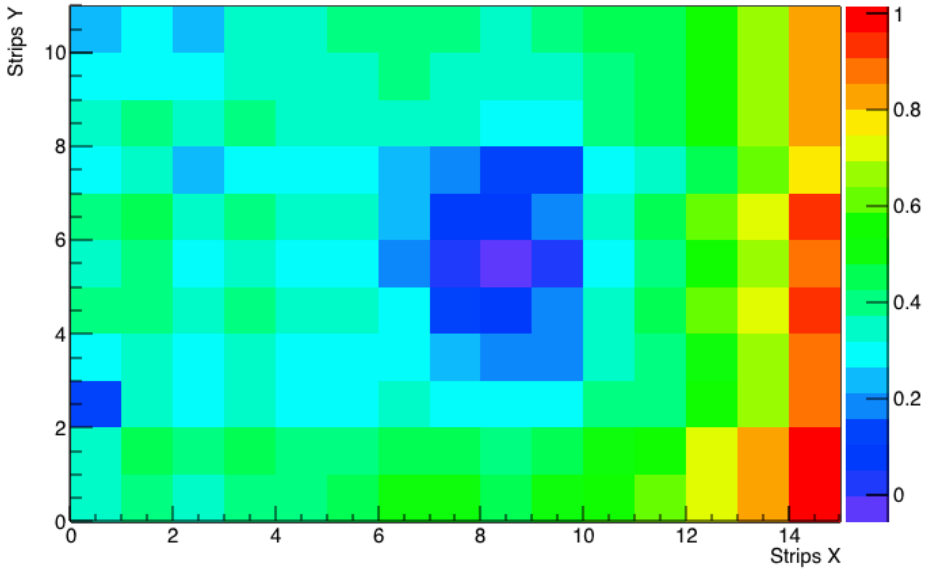


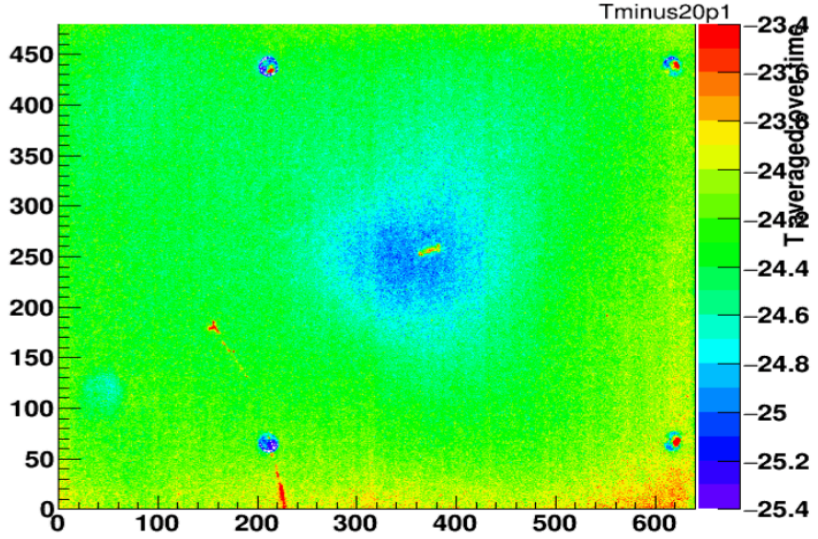


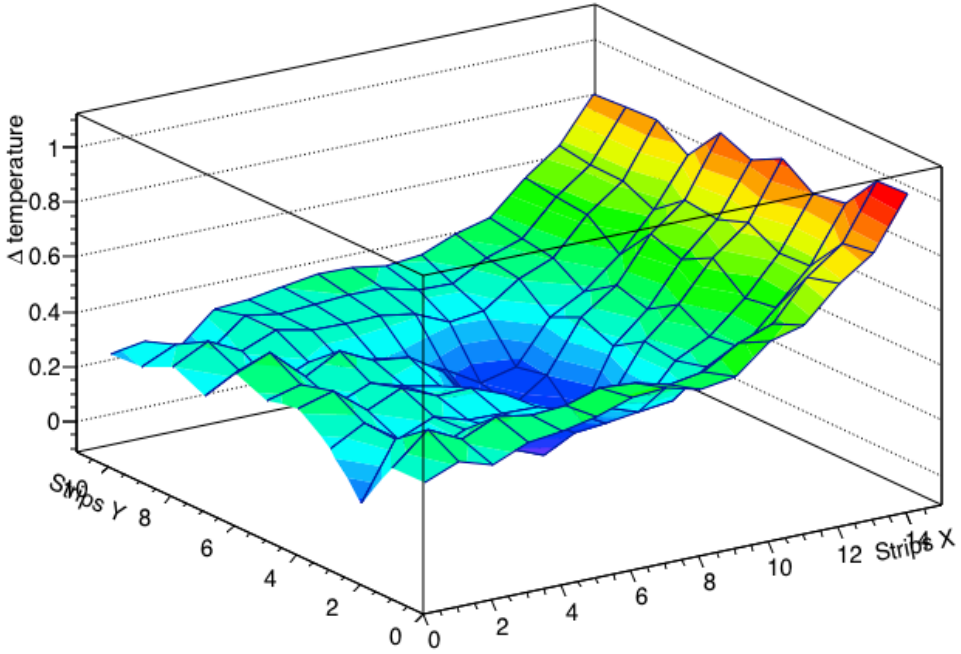
If we take T_x as temperature in the x-direction experiment and T_y for y, we can express these two paths as (with respect to a reference point as the center area):

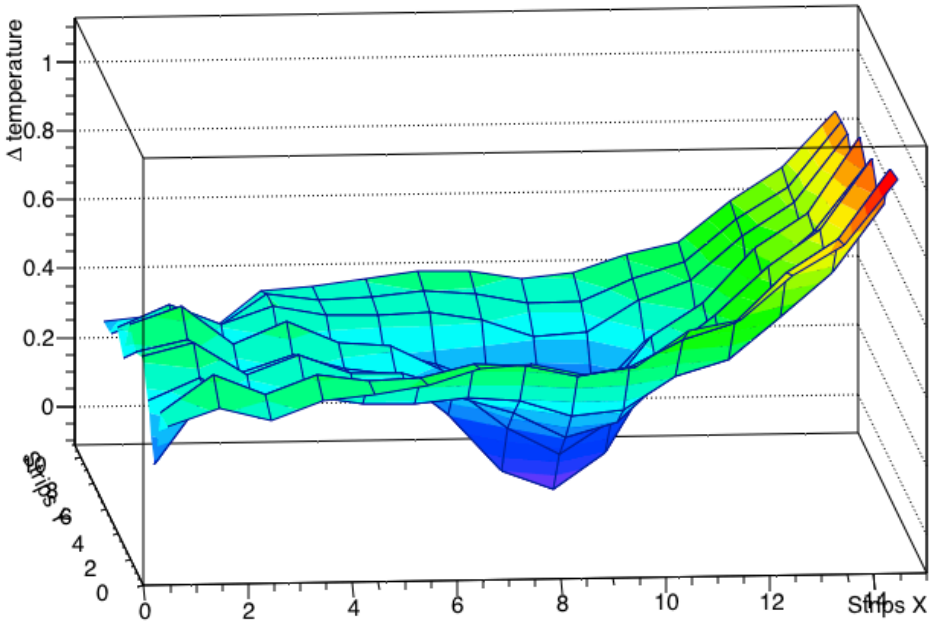
$$\Delta T(i,j) = \frac{1}{2}\left(T_x(i,j) + T_y(i,j) - T_x(i_0,j_0) - T_y(i_0,j_0)\right)$$

Vignetting shape



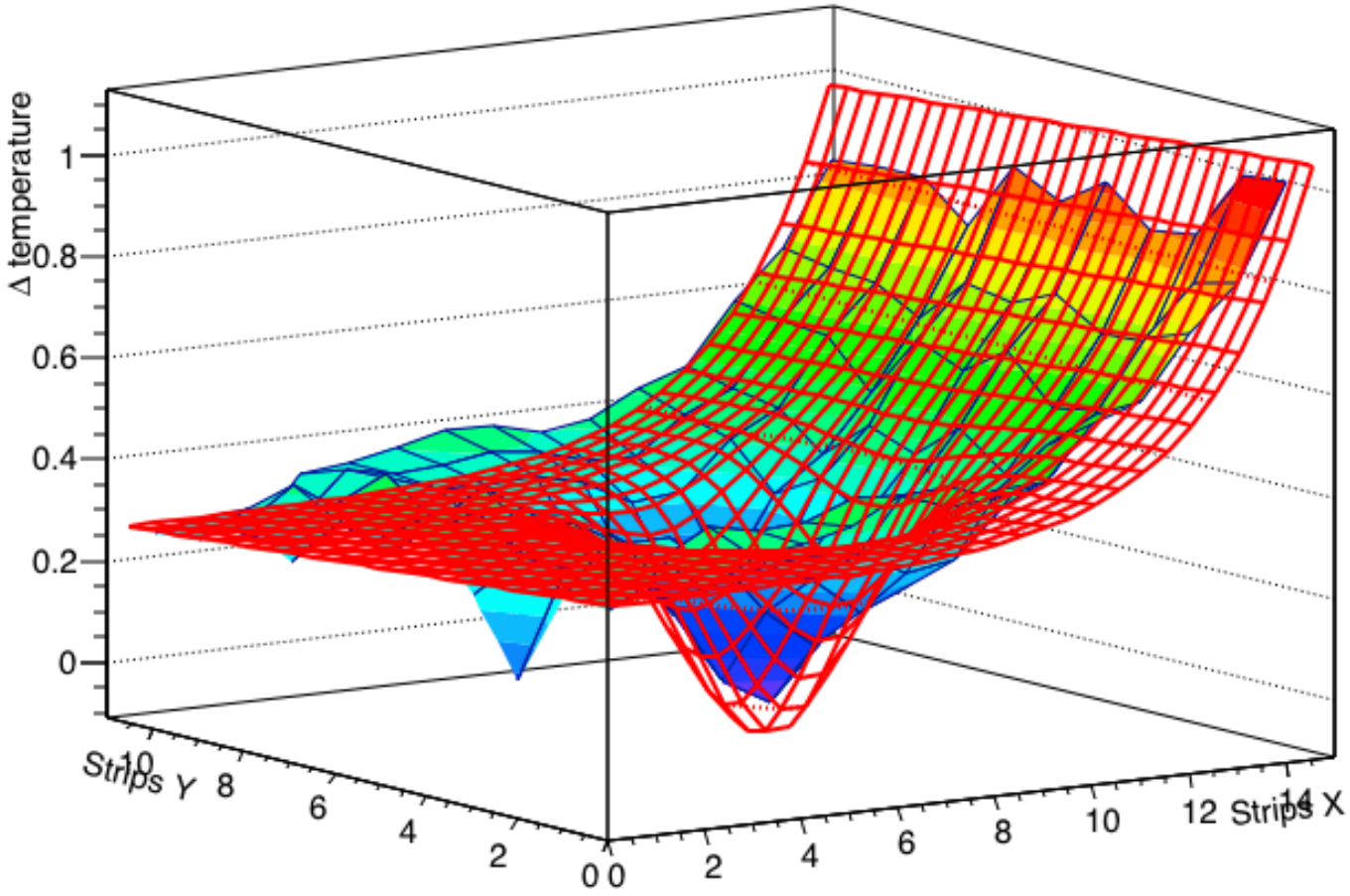






First observations and Fit

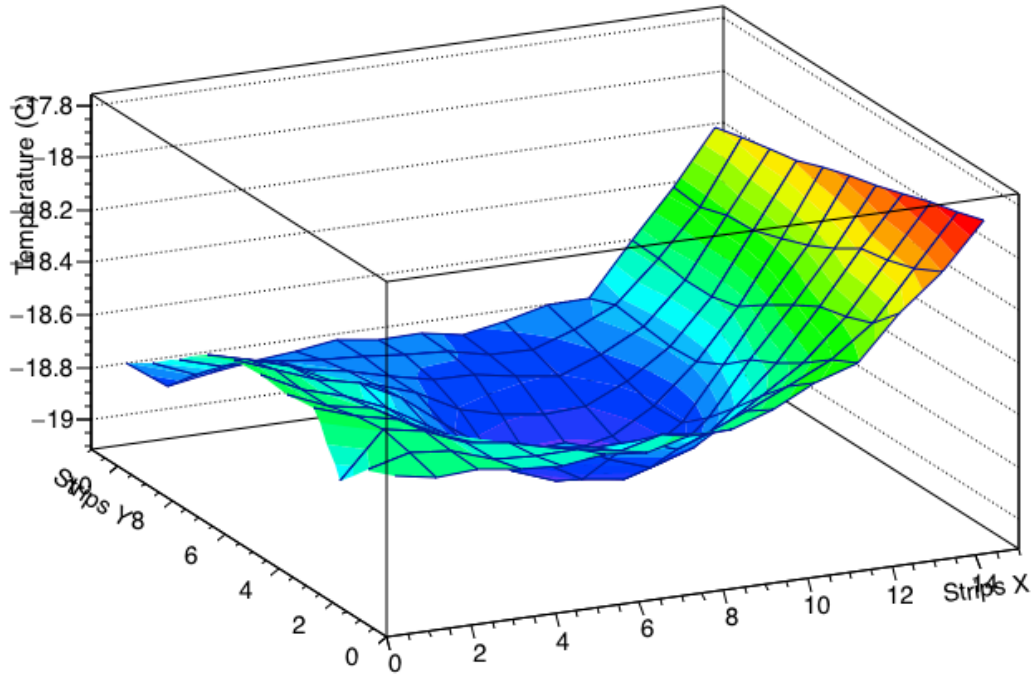
- Agrees (at least by eye) with Jie's results.
- Also explains the 'line' experiments, but gives a better understanding of the problem. The 'center' spot is not at the center -> it is at x=9, y=6 instead of x=8 and y=6.
- The bad spot is very easy to identify.

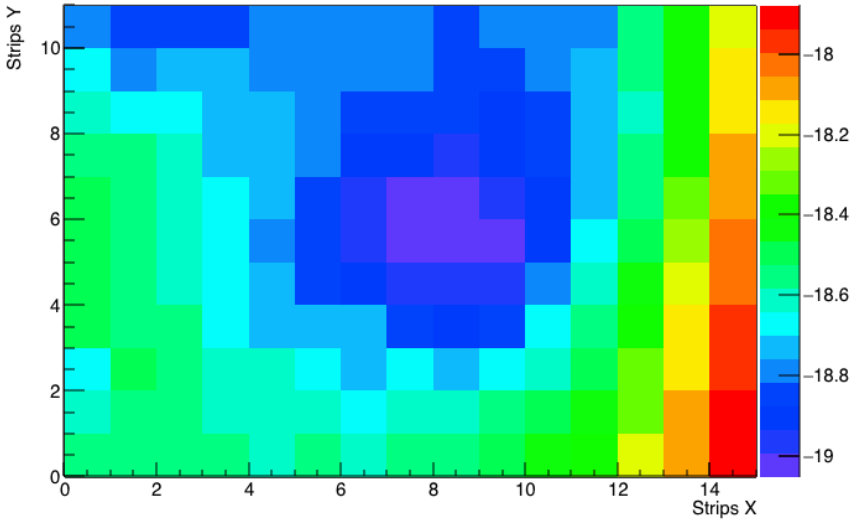


$$\Delta T(x,y) = 0.3589 - 0.0064y + 0.00074e^{0.4589x} - 0.4257e^{-.3\left((x-8.559)^2+(y-5.619)^2\right)}$$

Validation of the vignetting function

To see if the functions is right, I took a minute of data at 6 frames per second of an empty FOV at -15˚C.

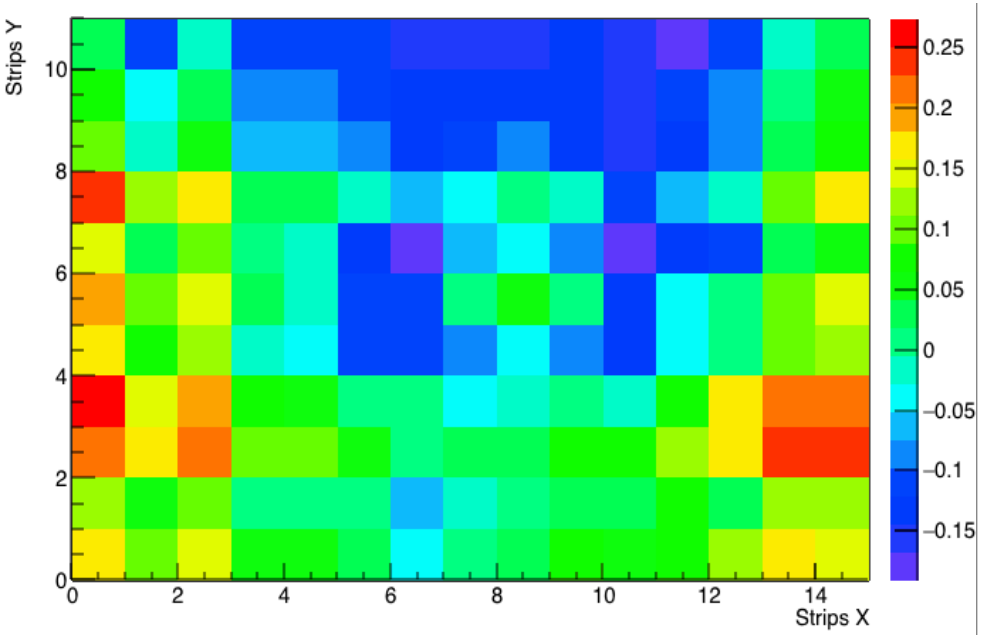




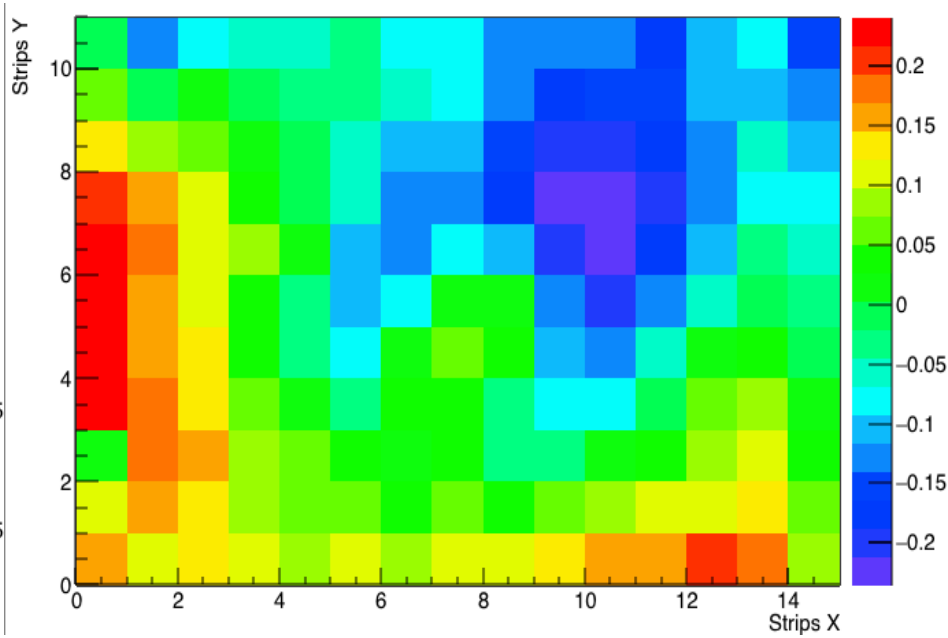
There are places with one degree differences across the entire FOV of the camera.

Temperature measured – vignetting function

NOT FIT



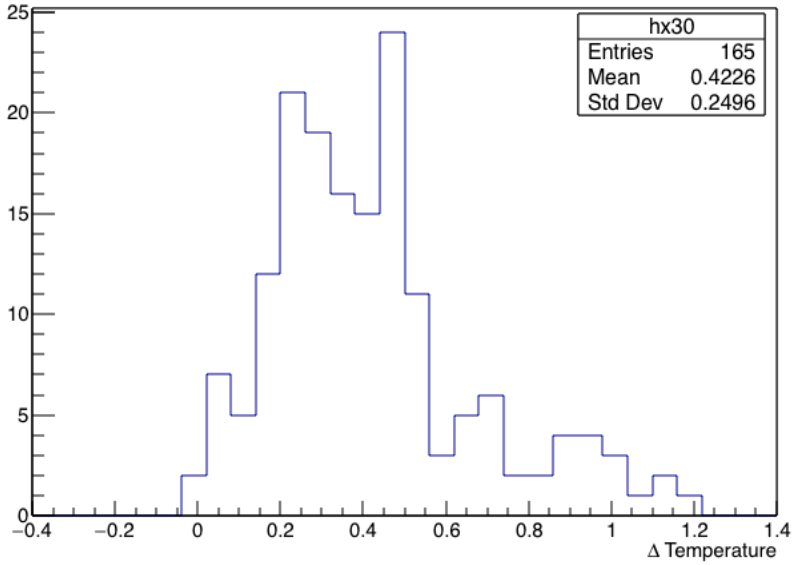
FIT



We can see the difference in temperature is reduce and the bigger differences between pixels is the 0.4˚C. Also, the central deep has been reduced.

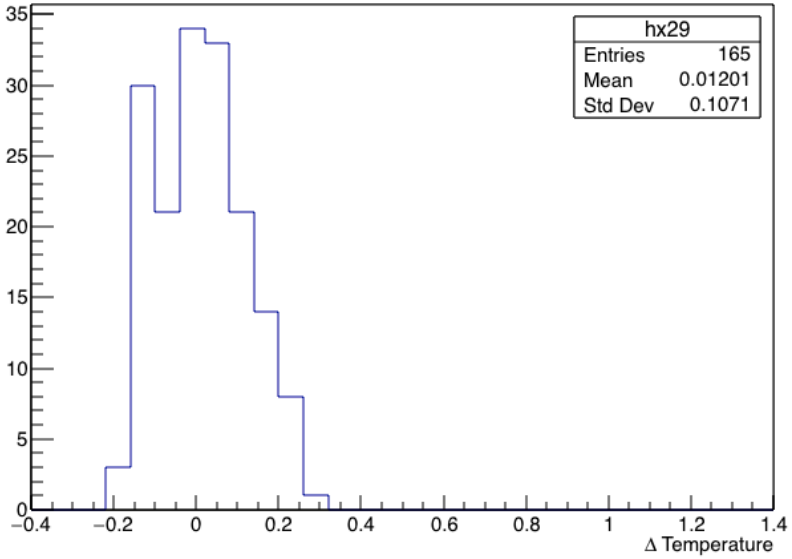
Histogram (area – central area)

Original Distribution

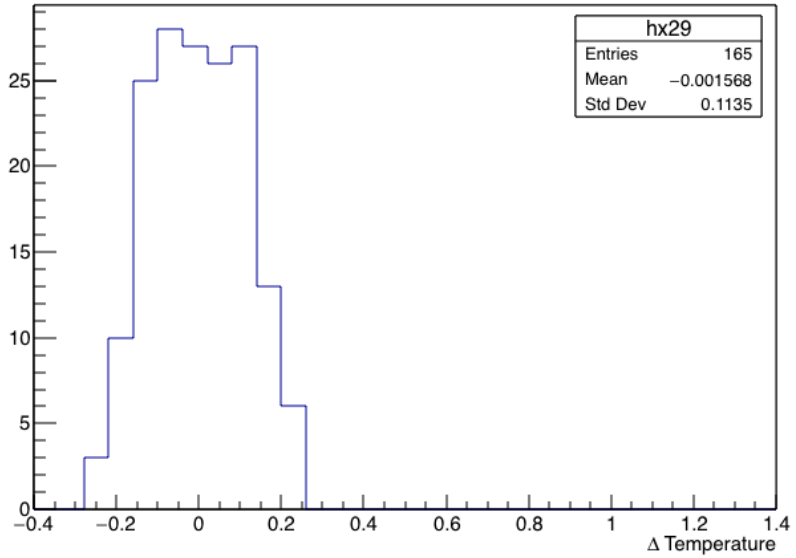


The tail in the original distribution disappeared, and moved the mean close to zero instead of 0.4226.
The range in x is the same for all to help the comparison between the plots.

Original distribution minus vignetting function.



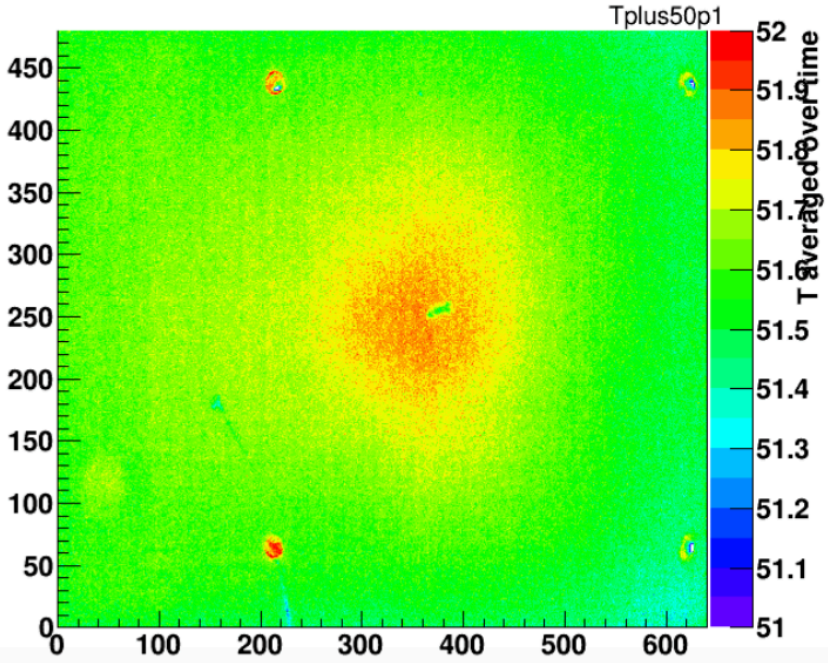
No FIT



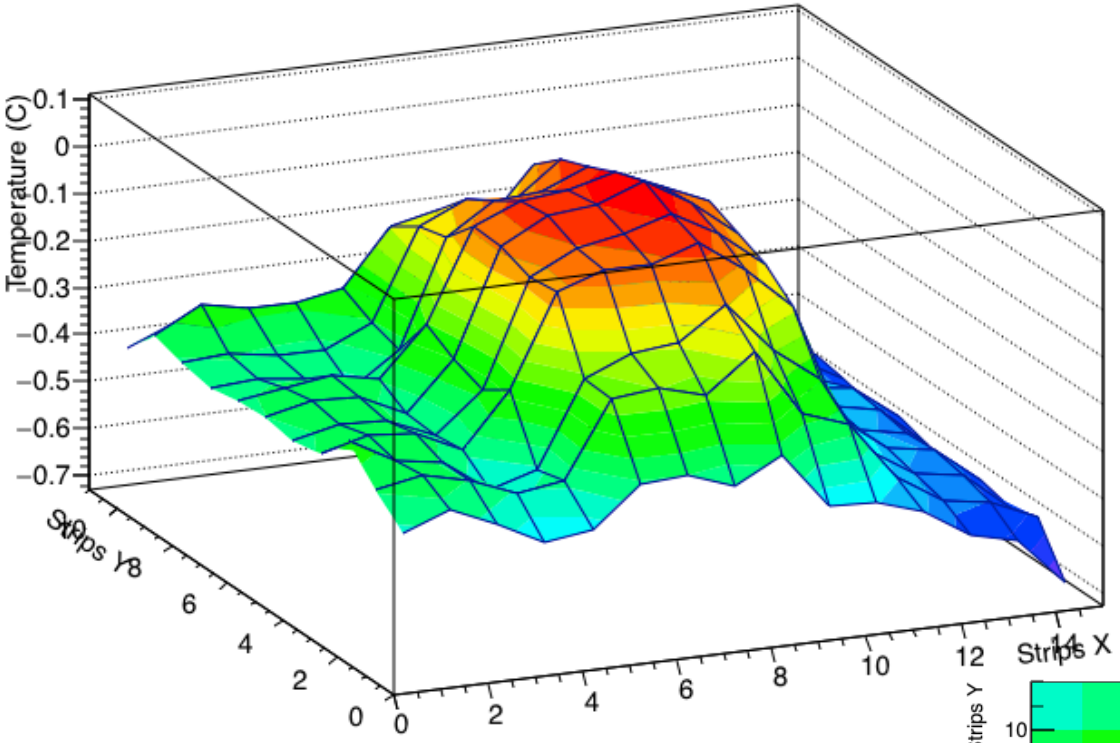
FIT

Same process at +50˚C

We know the effect of the vignetting is depending of the temperature, but we have now the ‘recipe’ to find the vignetting function for any temperature. Then, the same proceed was apply at +50˚C and compare with the Jie’s old results again. In this case, some of the things are flip such as the slope in x and the deep now points upward.

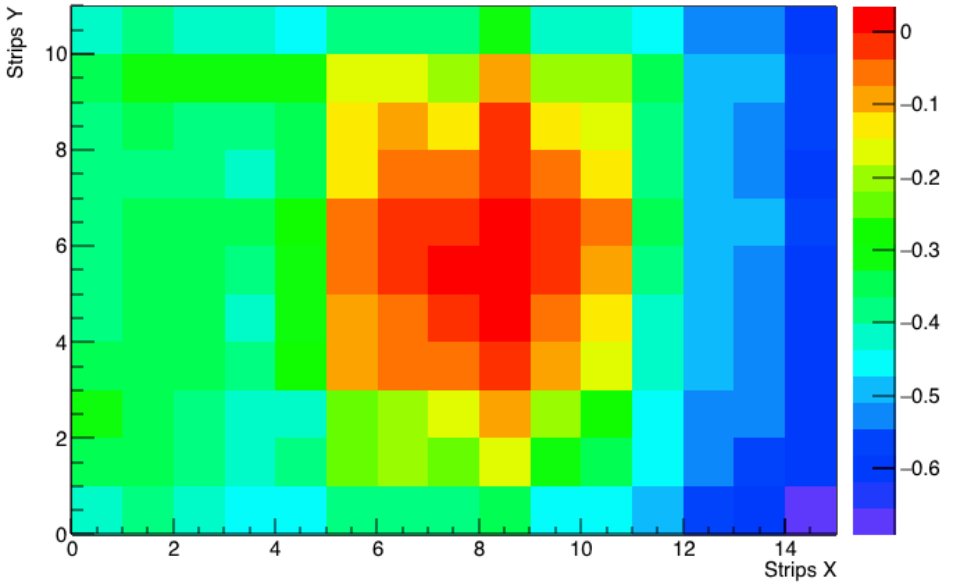


Vignetting Function



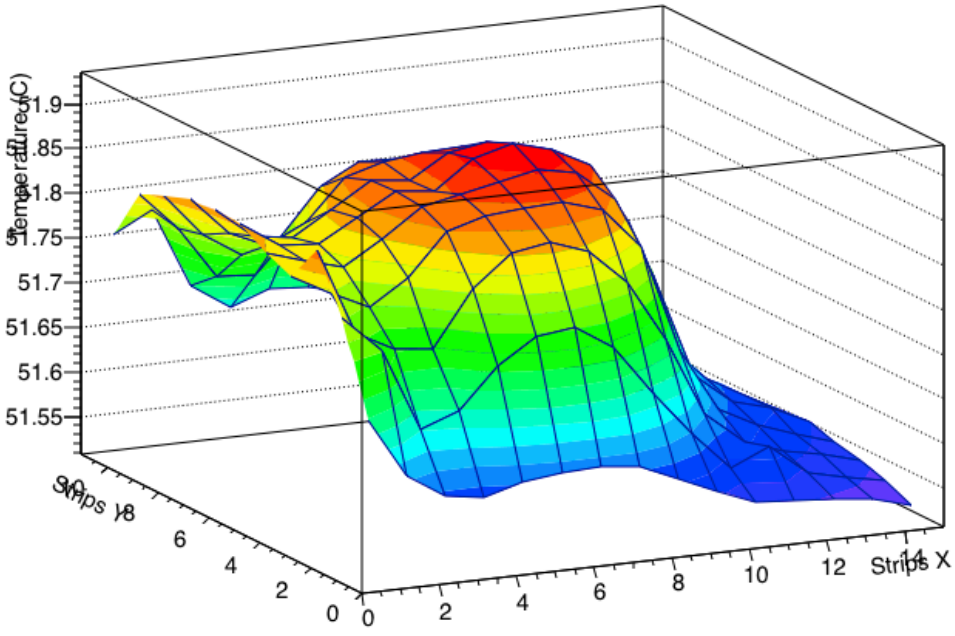
The function has a different behavior than at -15˚C, but agrees with what Jie saw earlier.

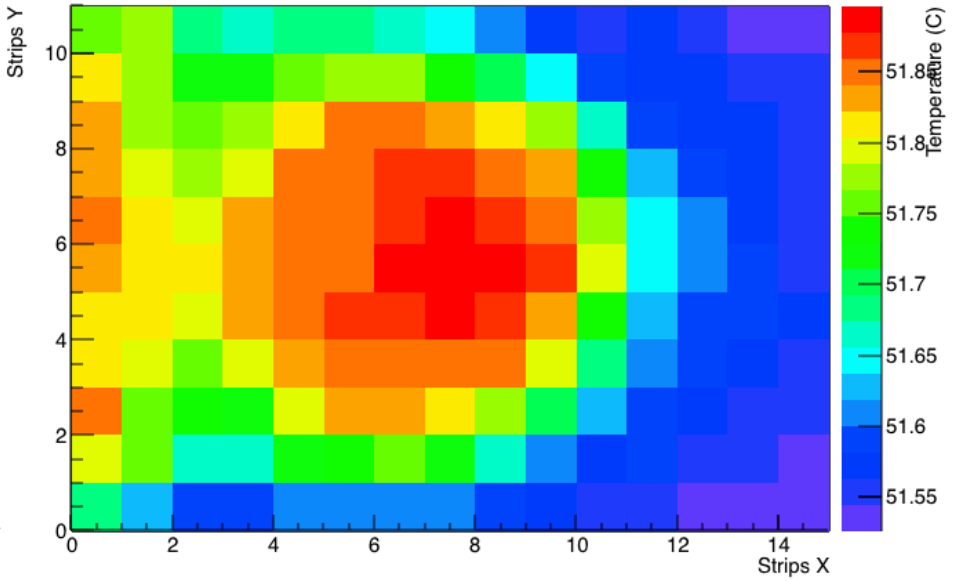
The center still at x=9 and y=6.



Validation of the vignetting function

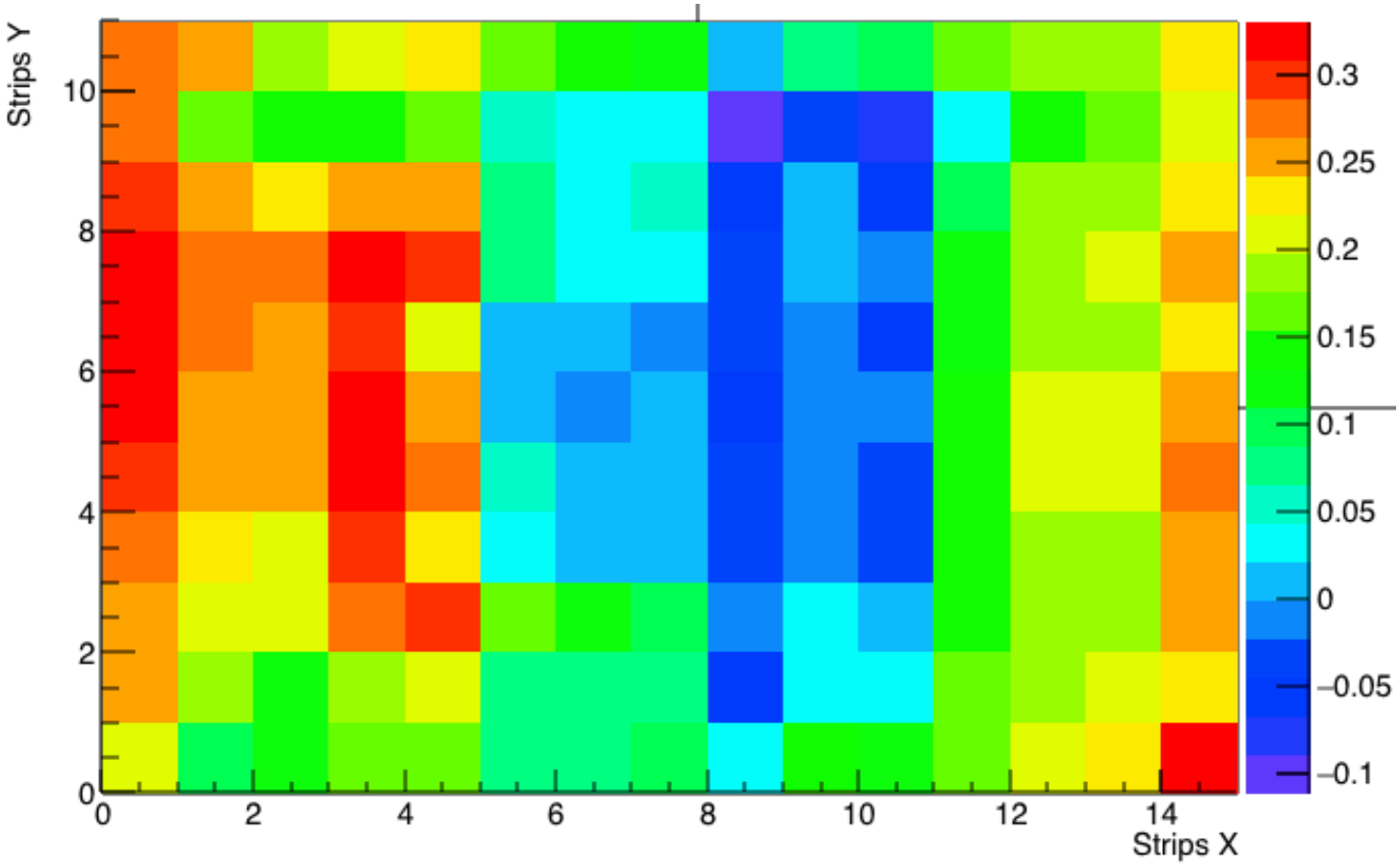
To see if the functions is right, I took a minute of data at 6 frames per second of an empty FOV at 50˚C.





In this case, the difference between pixels is not as large as in cold temperature, but we know there is more uncertainty at colder temperatures. The difference seems to be about 0.3 and it has a shape.

Temperature measured – vignetting function



What we observed in this case more than a reduction of noise is the elimination of the shape. A fit for the vignetting function is still in process.