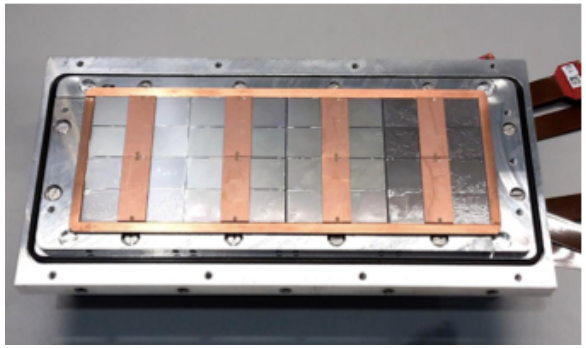
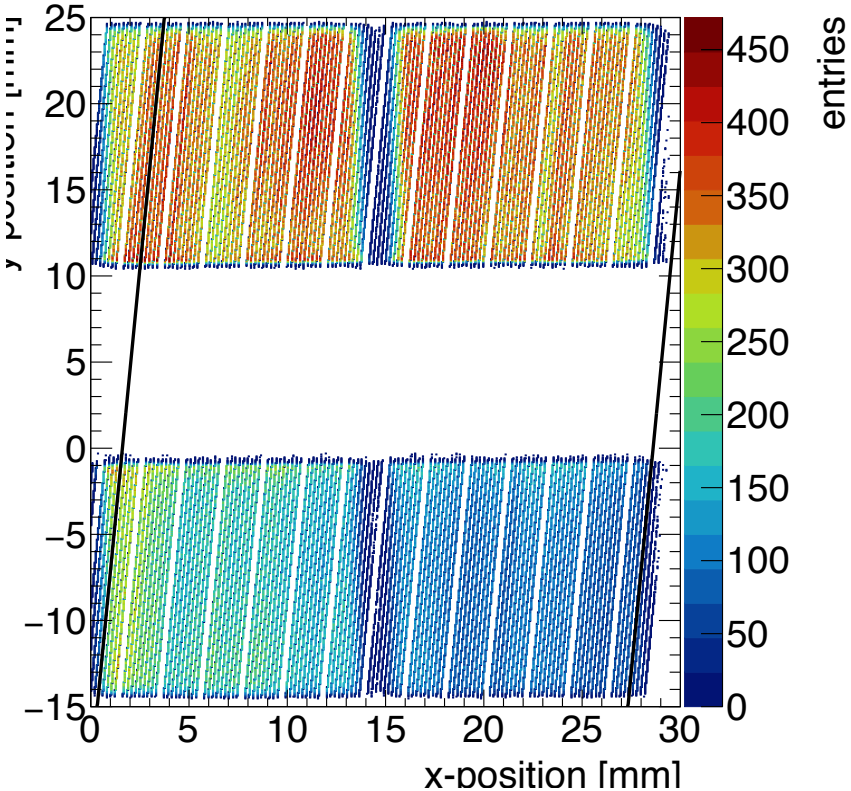
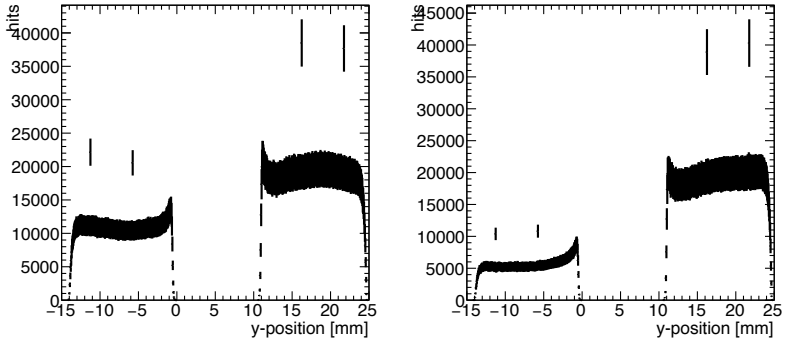
Quad Module

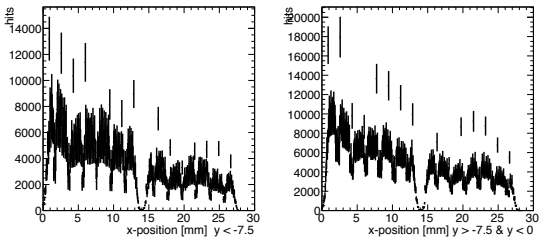


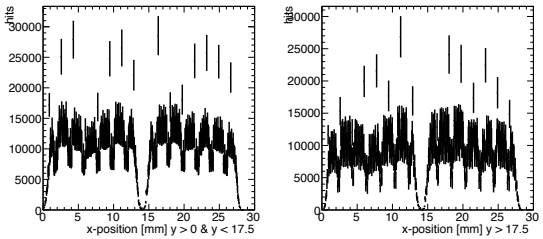
- Laser scan of one quad of the 8-quad module
- Need multiplexer to read out all quads. Not yet ready. So here 1 quad readout.
- Runs 970-984 laser makes a track over two chips; scanning the laser start position in 0.2 mm steps.
- Drift z position fixed at 6 mm from grid

QUAD Module hit maps

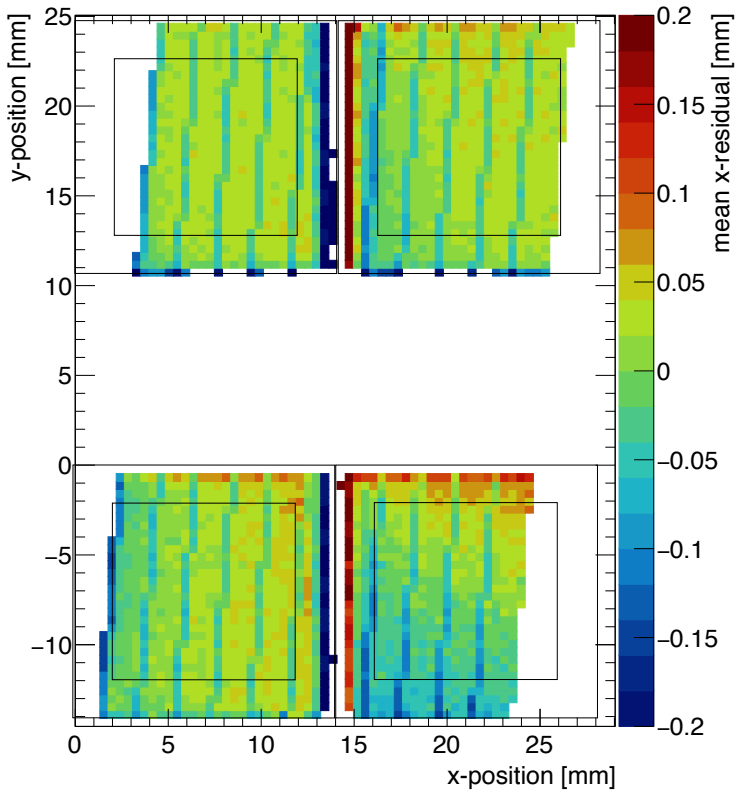






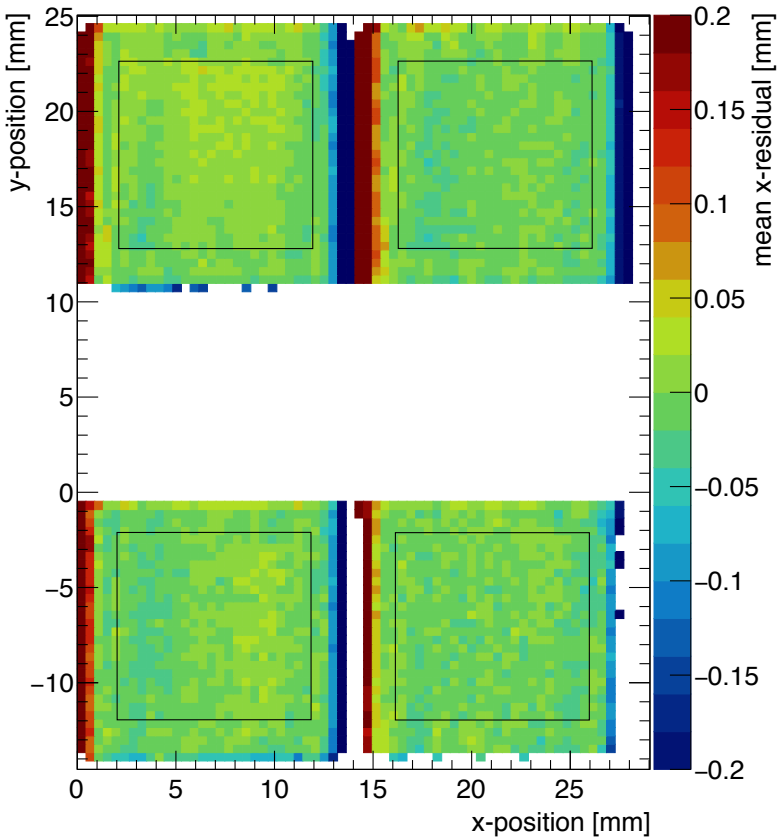


QUAD Module scan problem & solution



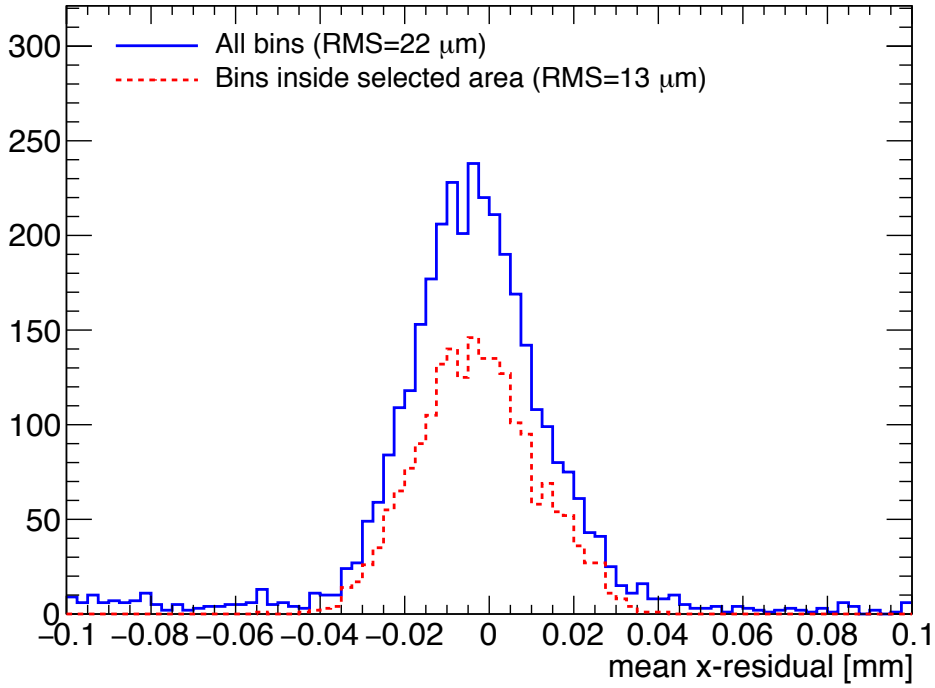
- Looking at the data after a simple alignment gives this residual xy plot for runs 972-982
- There are clear lines along the laser track direction(s)
- This was due to a problem at the last step of the laser before the end of the run; the laser expected position and quad measurement were off by one step 0.2 mm
- The solution – work around - consisted in removing this point from the data sets

QUAD Module alignment



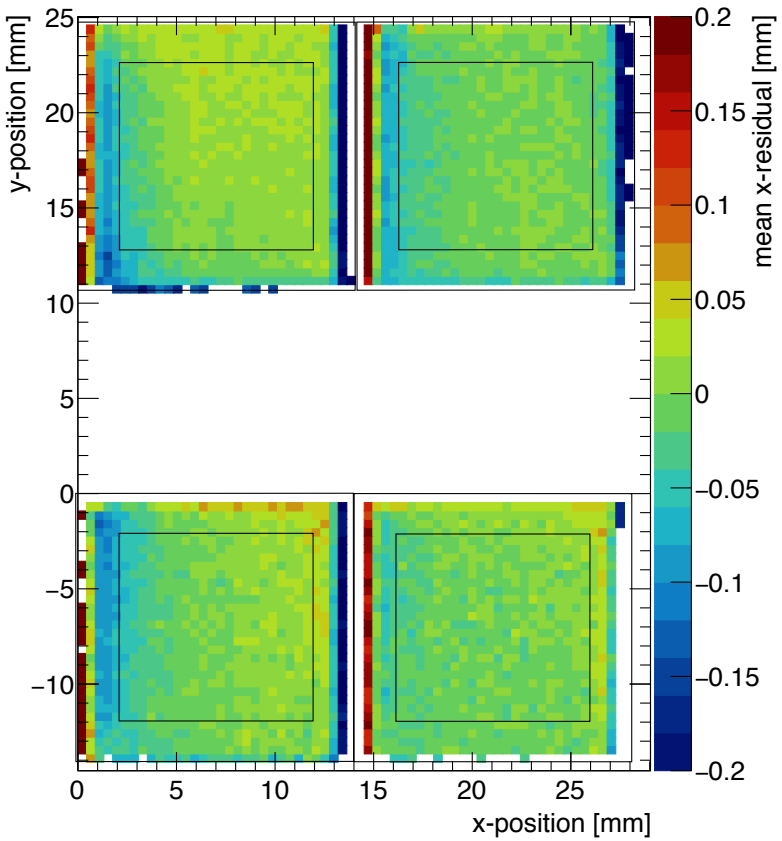
- The lines are gone
- The data is treated in the following way:
  - The sign of the residual is randomized in the area out side the box (no acceptance cut needed)
- Alignment is done in steps:
  - Quad position and angle
  - Single chip positions
  - Single chip positions and angles
- The result in the expected local x-y frame is shown; binning 8x8 pixels; minimum 500 entries per bin

QUAD Module alignment



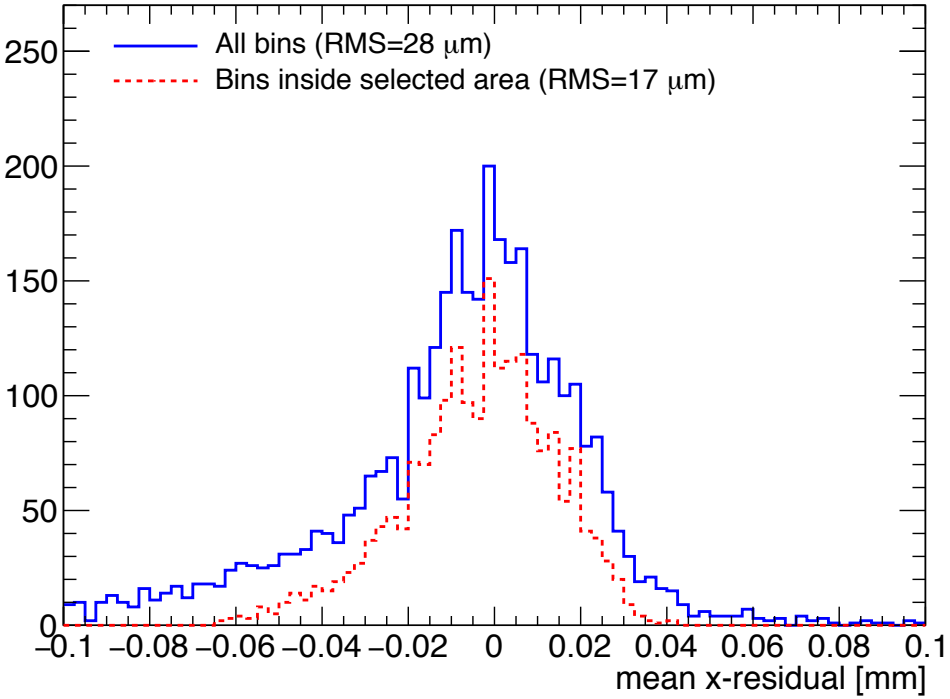
- Sampling over the bins one gets the following plot for the mean x residual.
- Only the red – inside - area is unbiased and shows the alignment quality
- The rms is 13 microns; so excellent

QUAD Module full area



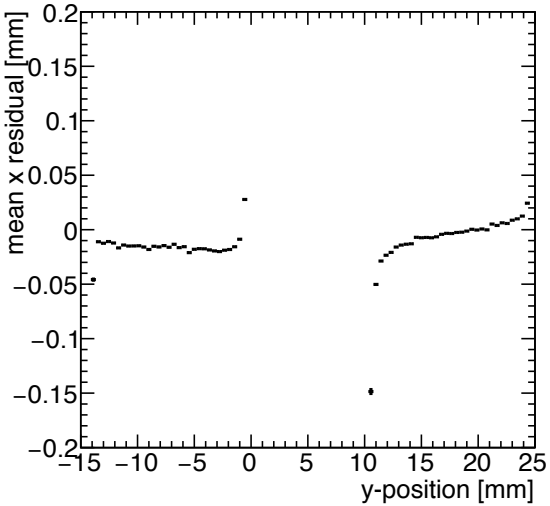
- With the alignment results, the residuals (without randomizing the sign) are calculated and show in the distribution.
- In the area outside the black box, deformations are now visible
- One can observe a field deformation on the left side of the chips on top or bottom left.
- One the right side this deformation is much smaller
- Between the chips where the guard wire is running, the field distortions look small. One mainly observes the acceptance bias.

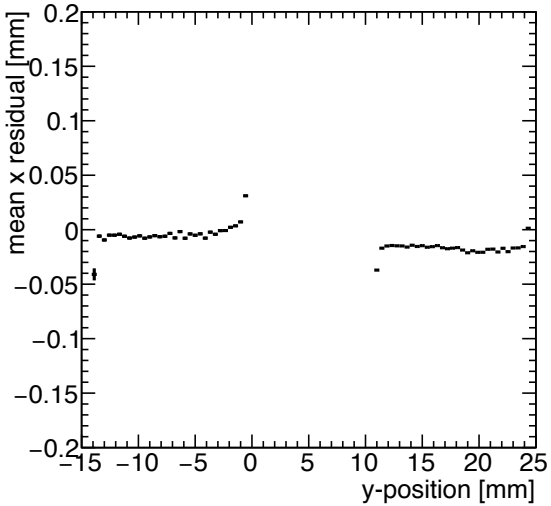
QUAD Module full area



- Sampling over the bins one gets the following plot for the mean x residual.
- Inside the area the rms is goes from 13 to 17 microns; due to residual deformations
- Outside the area the deformations on the left side of the quad increase the rms to 28 microns.

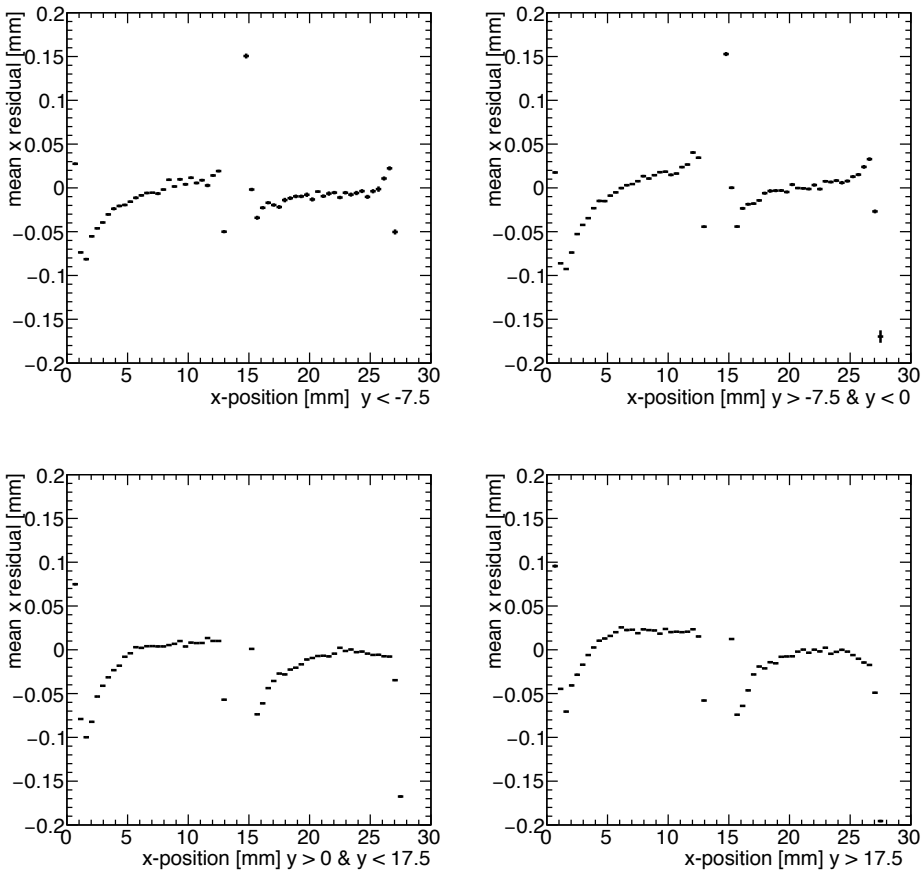
QUAD Module full area





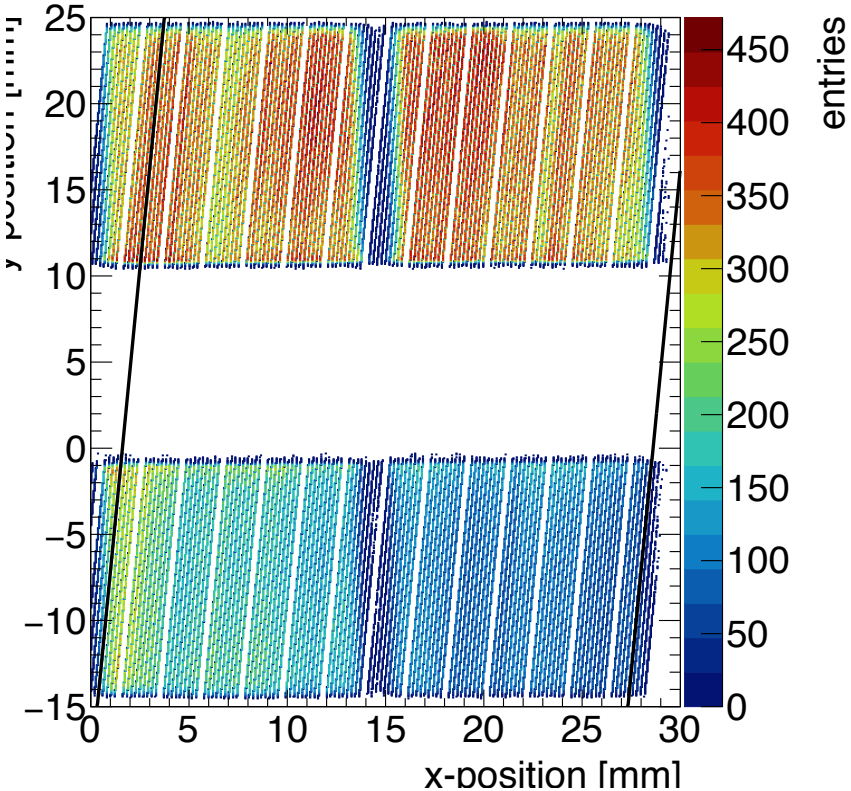
- Here two projections for the left and right chips
- Clearly deformations are very small
- On the edge near the guard there is an acceptance effect
- At the outer y edge of the quad deformations are small

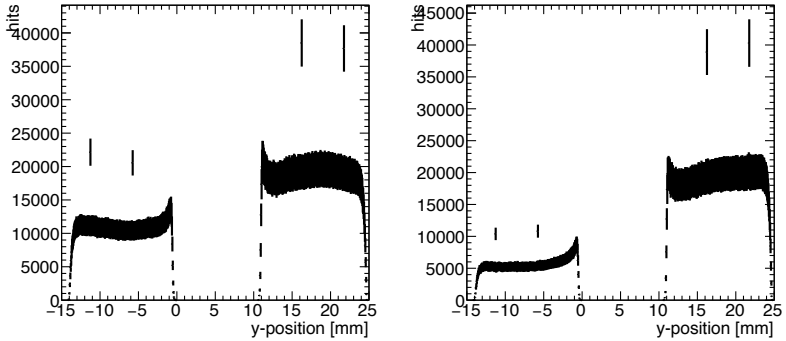
QUAD Module full area



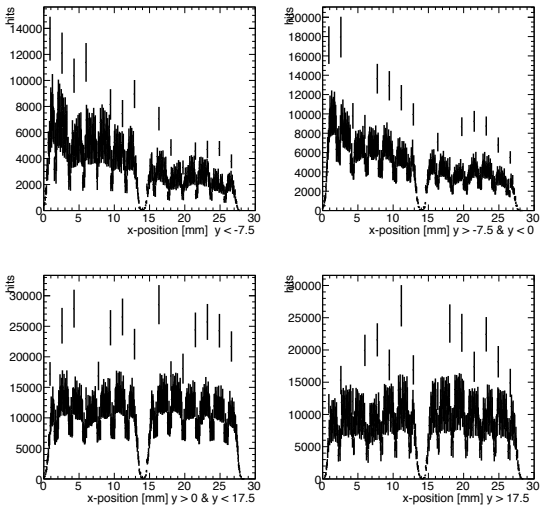
- Here four projections for the left and right chips
- On the outer x edge of the quad one sees deformations: 0.1 mm on the left side. On the right side this is much smaller.
- In between the quads (around x = 15 mm) there is a combination of acceptance and (small) deformations due to a small mismatch of the guard wire voltage.

QUAD Module hit maps



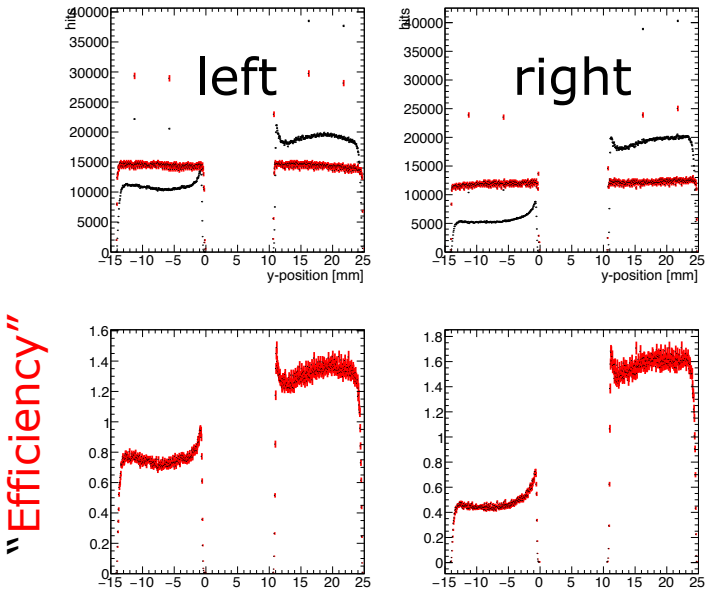


Laser profile is not flat



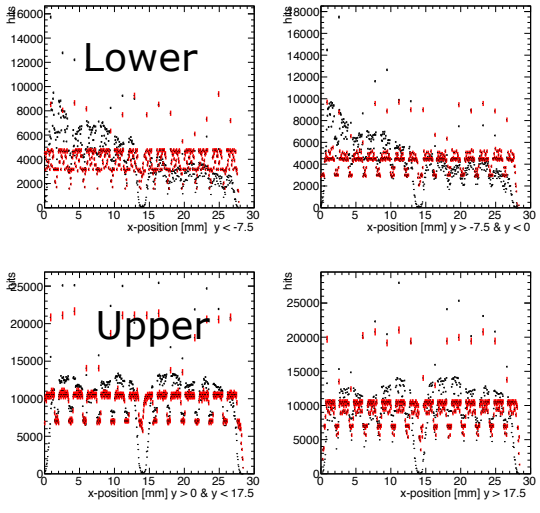
QUAD Module (assumed) flat hit sampling

y coordinate
Data MC flat

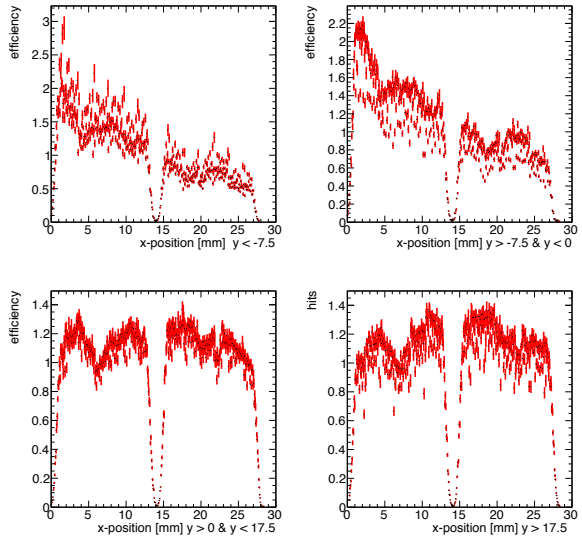


Laser in y rather flat
One can see edges of chips
and migration due to E field

x coordinate
Data MC flat
hits



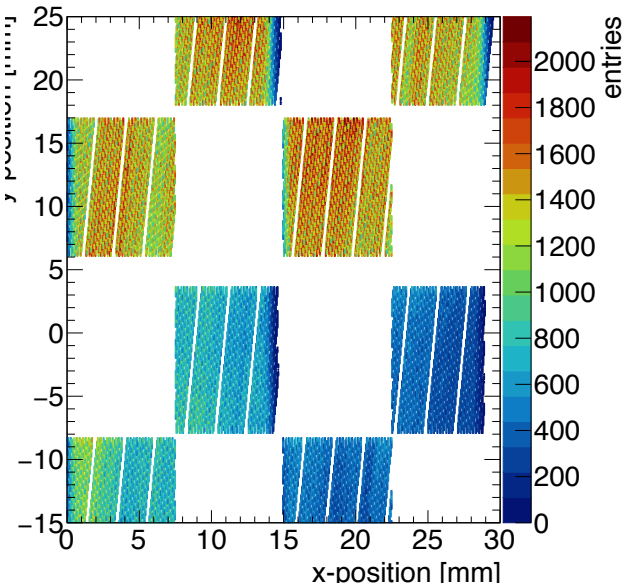
x coordinate
"efficiency"



Laser in x very far from flat
One can see edges of chips

QUAD Module hit sampling model 1

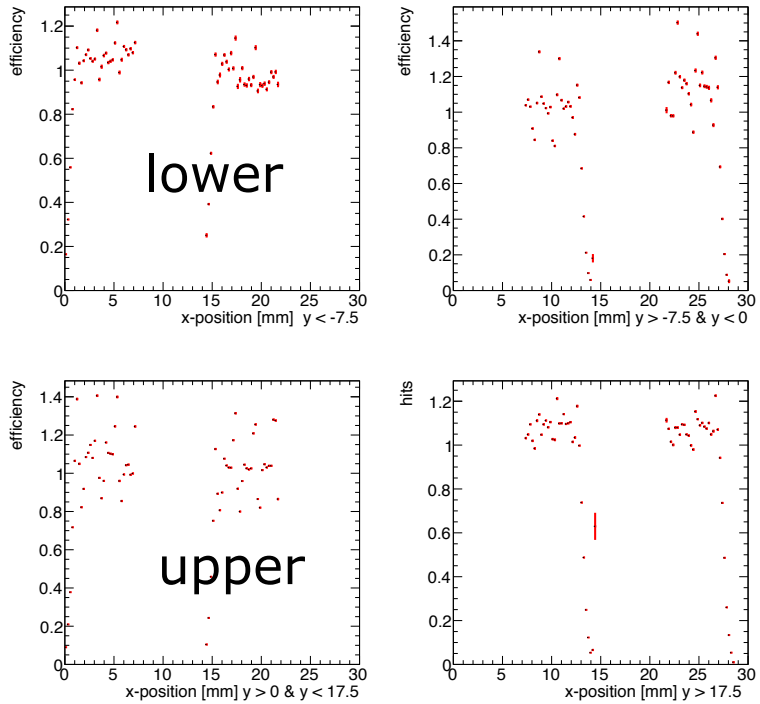
Hit map model 1



Mode1 shift track ±10 x bins
and y follow laser track (4 bins)

x coordinate

"Efficiency"



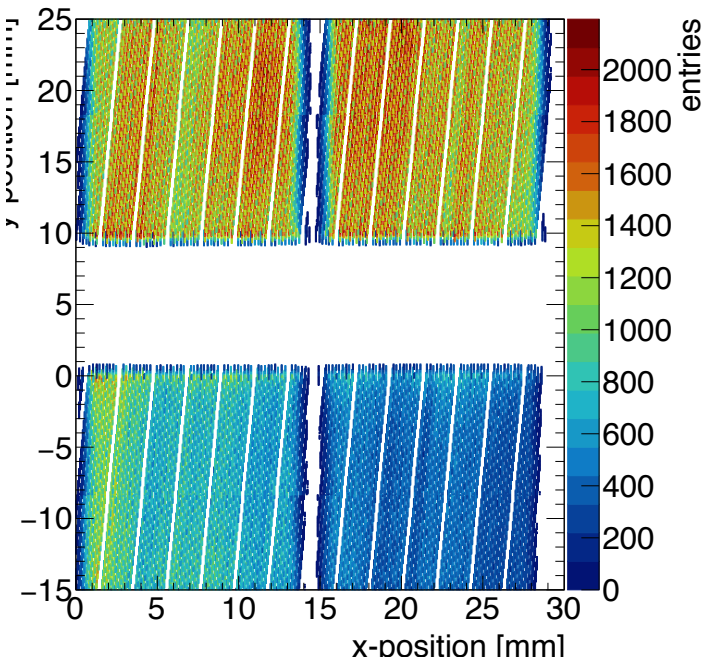
Efficiency x:

Jitter is 10%

one can observe edges of chips

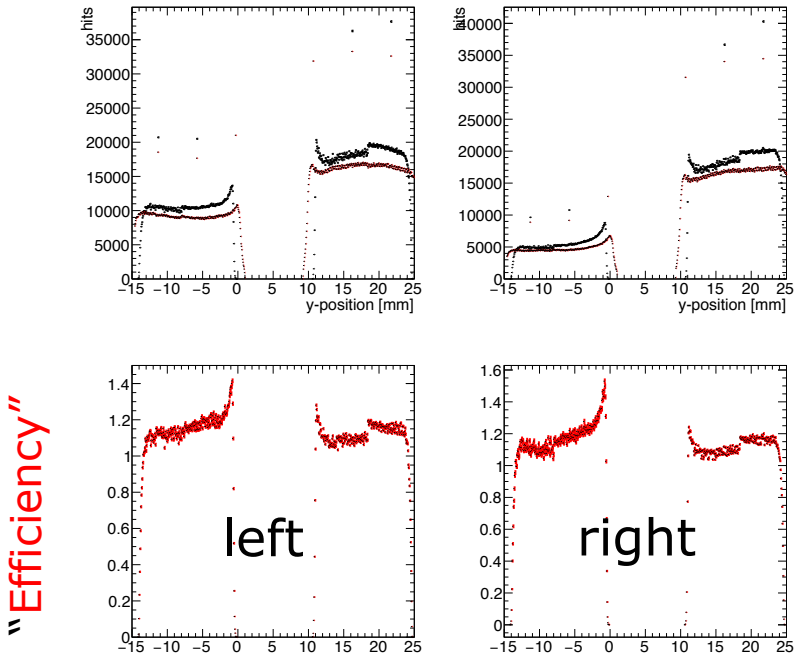
QUAD Module hit sampling model 2

Hit map model 2



Model 2 shift track ±20 y bins
x follows track

y coordinate
Data model hits



One can observe

edges of chips

migration due to
E field near
central guard

QUAD Module conclusions

- In general the quad module looks pretty good
- The laser scanning can be improved (1 scan point /10 rejected)
- The laser homogeneity can be improved; intensity varies over chips
- The alignment of the core chips (central area) is excellent; rms 10 microns
- There are indications of some field deformations (slide 9)
  - On the outside left side of the quad -100 μm-> surrounding guard
  - On the inner left side (quard wire) -30-80 μm-> guard wire
  - From the y efficiency plot (slide 13) one can conclude that the central guard has deformations (along track) -> central guard