Sensor's alignment

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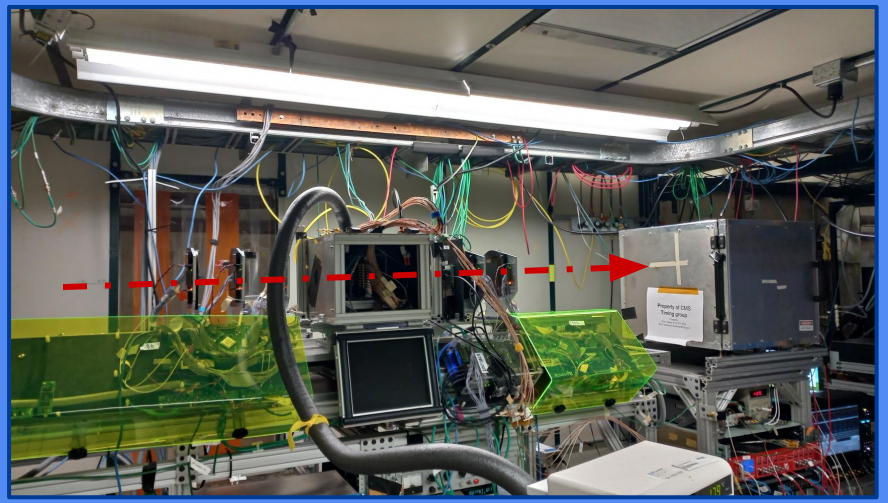
Context

- The sensors under test were placed in a central box, in the middle of a tracking system composed of strip and pixel's layers.
- This tracking system (a.k.a. Telescope) is used for estimating the position of the hit of a proton in the sensor's surface.
- In order to interpolate the hit position, we need to correctly solve any misalignment of the sensor, i.e. consider possible tilts around the 'perpendicular-to-the-beam' position.



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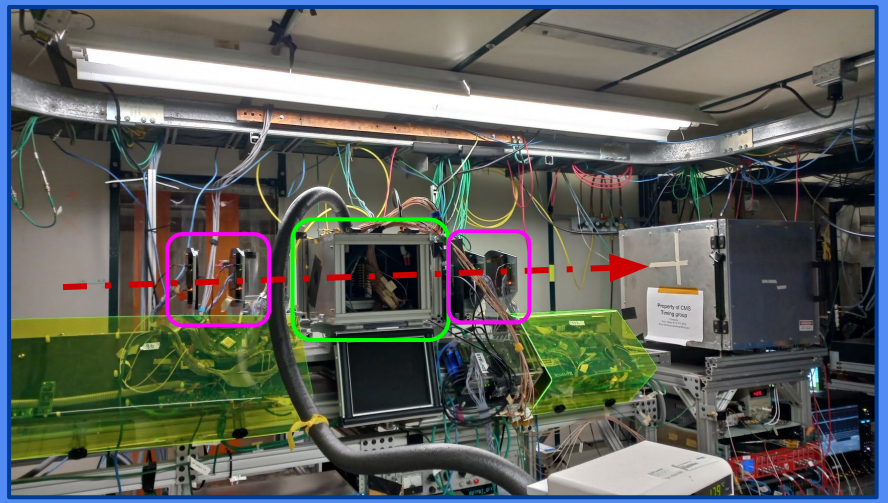
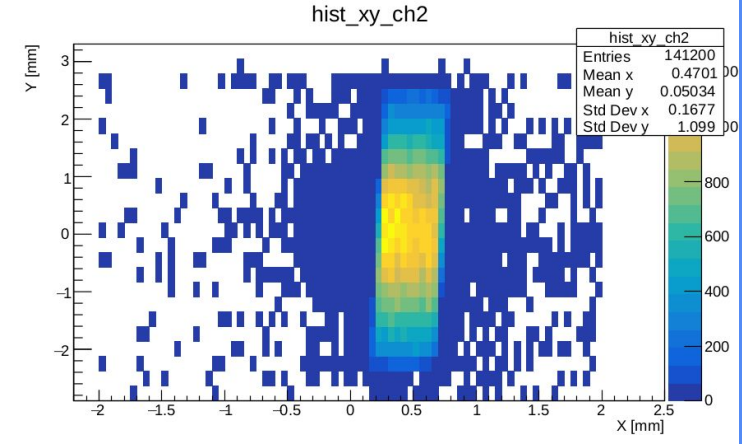
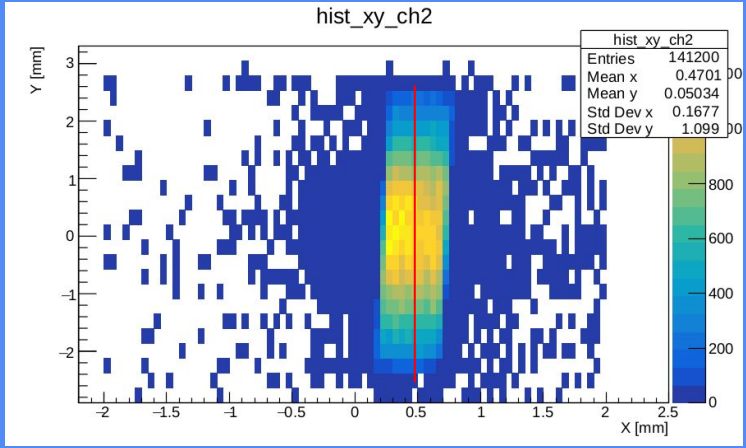


Strip position improvement

We can see what's the effect of correcting the sensor's reconstructed position.





Strip position improvement

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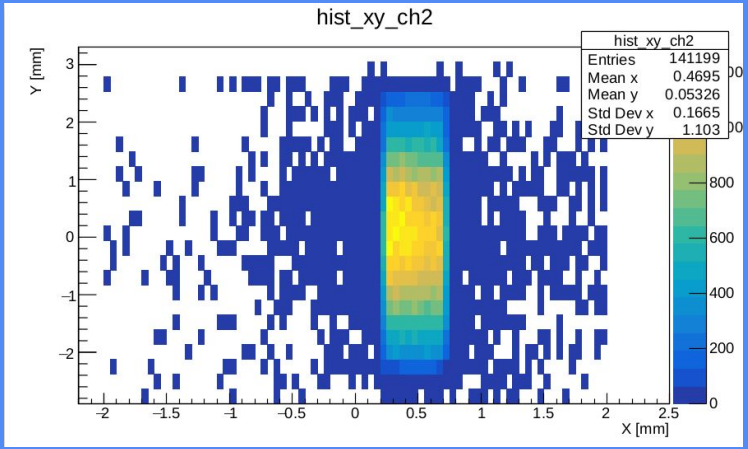
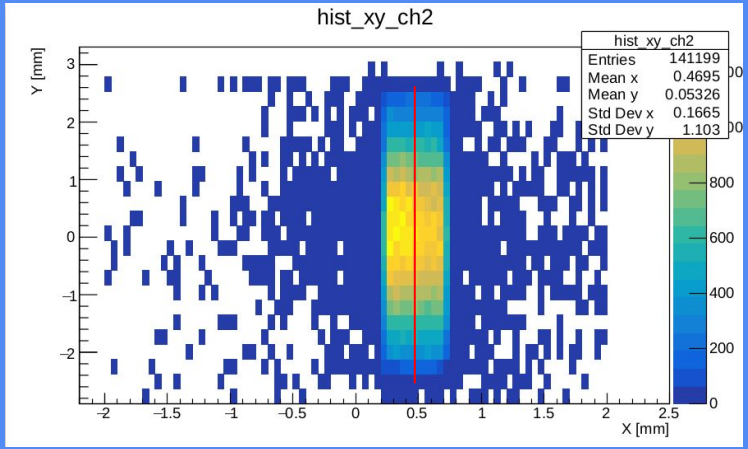
The red line (strip center) is important for computing the position resolution!

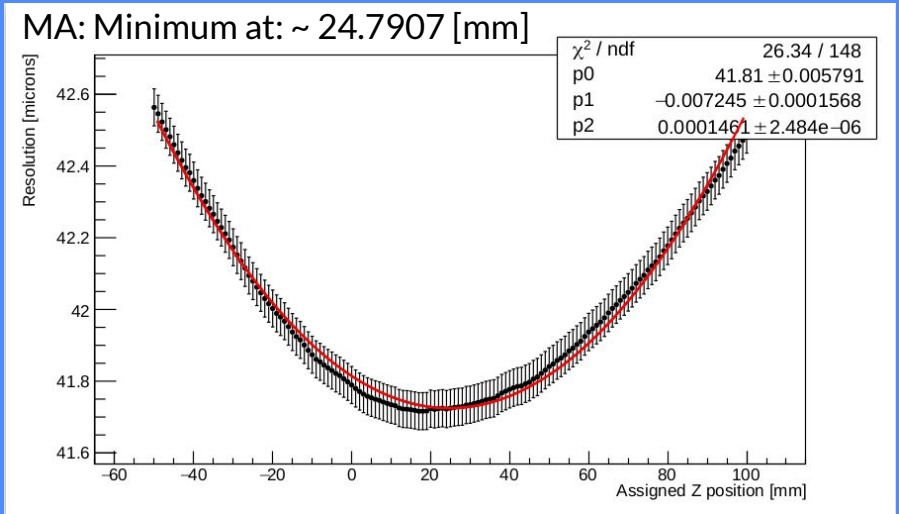




Comparing Z Scan

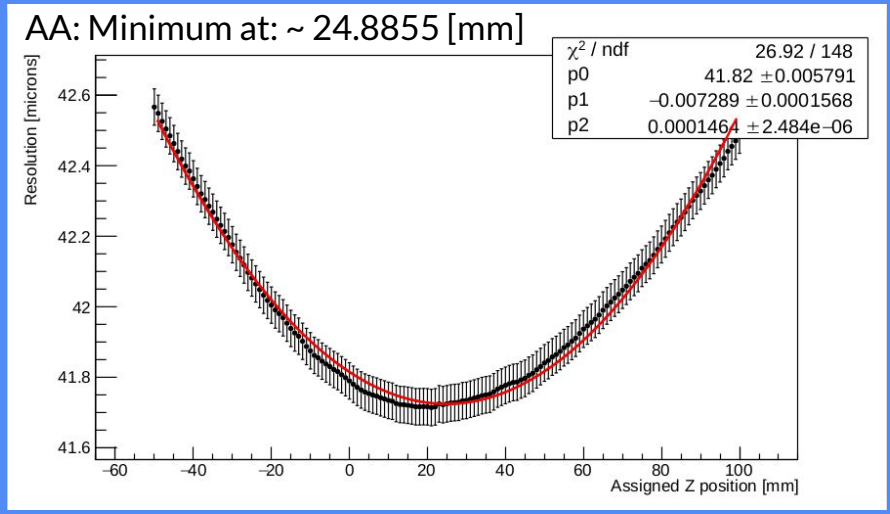
This testing analysis was made for the **EIC_W1_0p5cm_500um_300um_gap_1_4_245V** sensor.

MA: Minimum at: ~ 24.7907 [mm]



Multidimensional alignment (MA):
Z = 28.41878 [mm], α = 0°, β = 0°, γ = 90°

AA: Minimum at: ~ 24.8855 [mm]



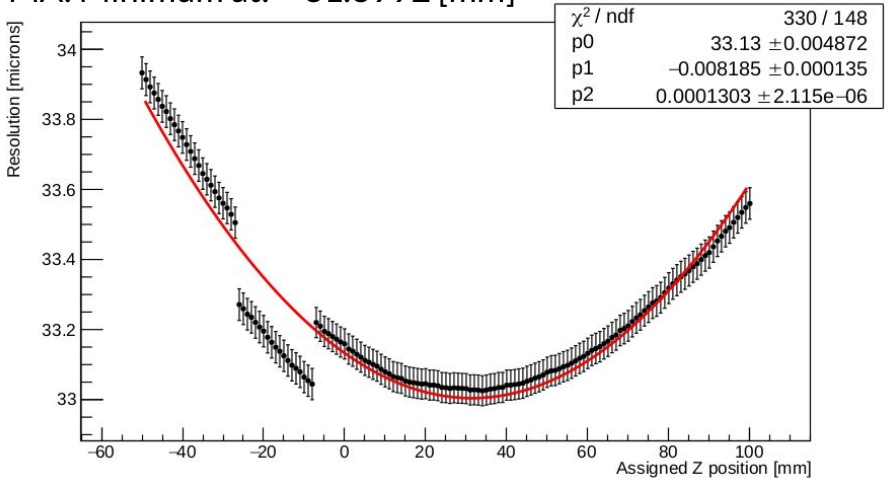
Actual alignment (AA):
Z = 28.41878 [mm], α = 0°, β = 0°, γ = 90°

Comparing Z Scan (cont'd)

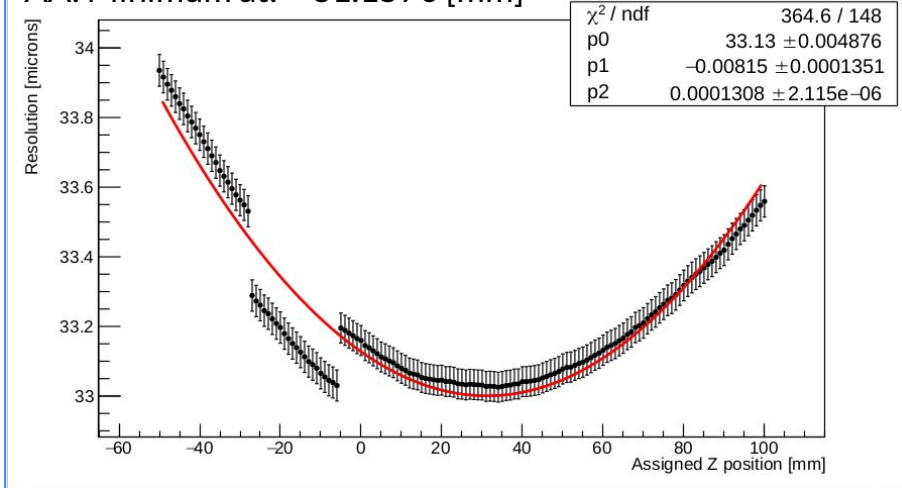
When the complete new geometry parameters are used, say, amplitude corrections + new strip centers + new position reconstruction parameters, we obtain an even better (but curious) result. What might be creating this discontinuity in the distribution?

The small differences might come from small differences in cuts. These effects are almost negligible.

MA: Minimum at: ~ 31.3992 [mm]



AA: Minimum at: ~ 31.1570 [mm]

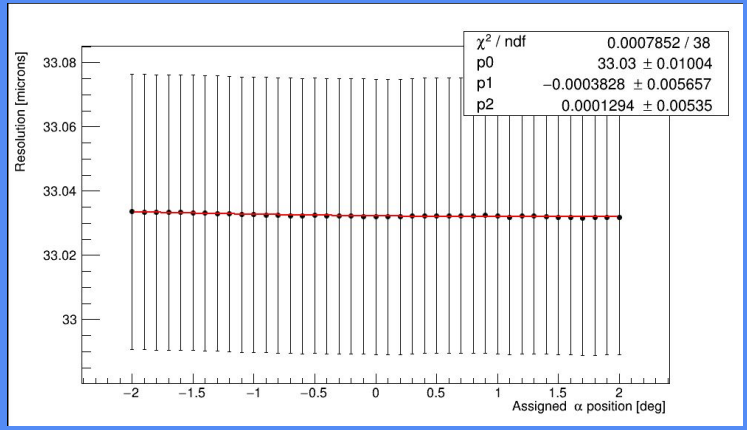


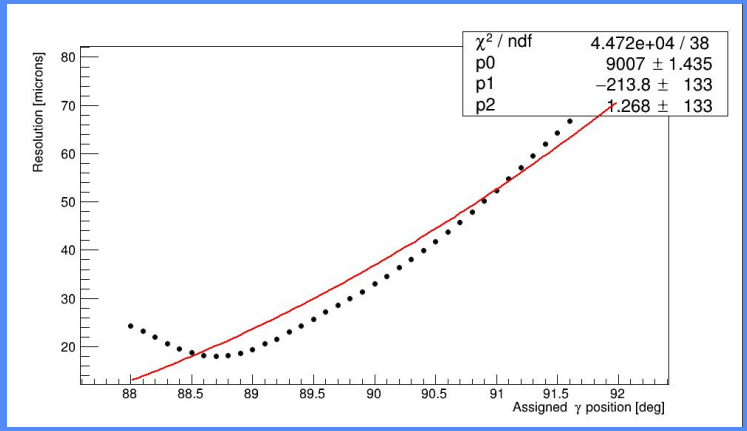
Angles' Scan

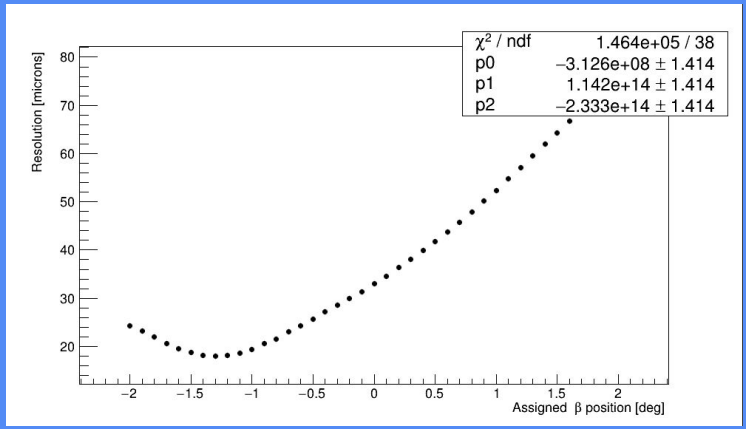
This is the first result obtained for the angles' scan.

The fits are clearly not well implemented, but we'll use an approximation of the minimum in both β and γ distributions, hoping to get better results with smaller ranges.

Minima values selected -> α = -0.1°, β = -1.3°, γ = 90°
(α was set as different from zero to check its impact, and γ was left untouched, so we can see its relation with β.)



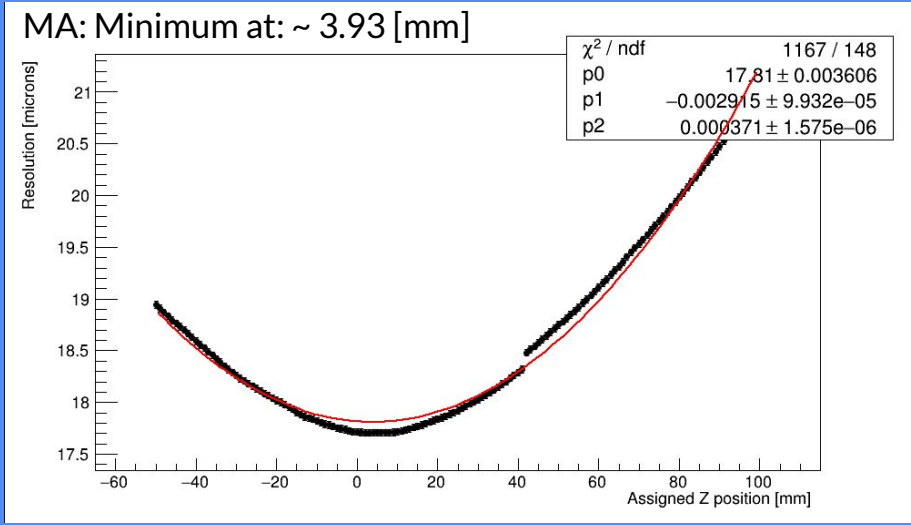


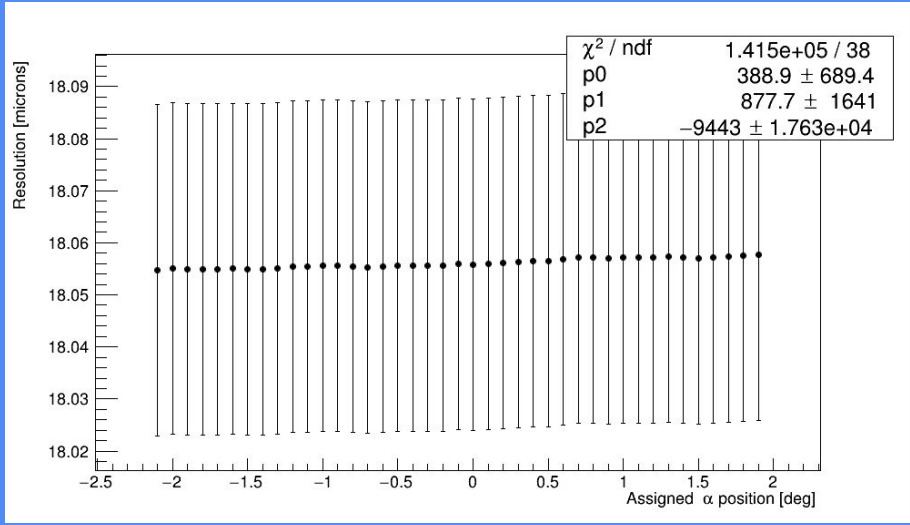


Multi Scan

Following the analysis **with the new geometry parameters**, we again see the same feature for the Z scan, but in other position. Also, a new minimum value was gotten (the difference might come from the new angles chosen.)

α had an almost constant behavior, again. This time the fit didn't work…

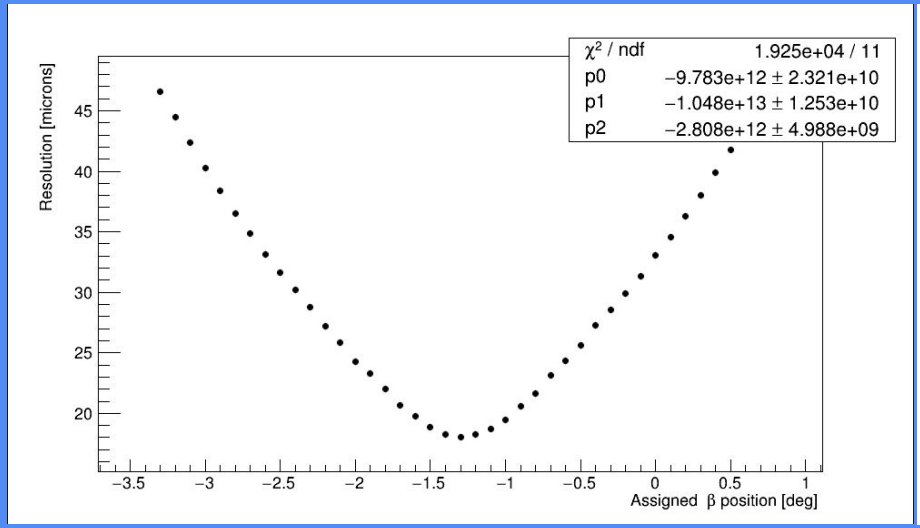


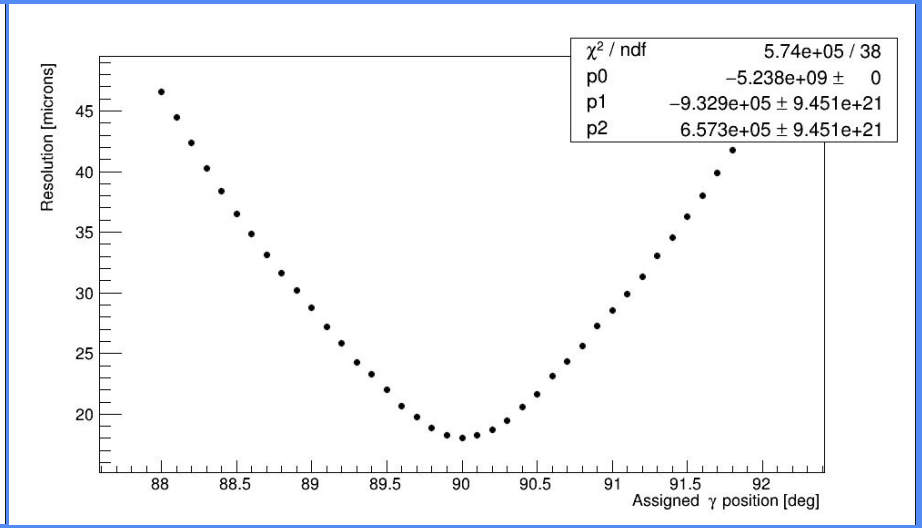


Multi Scan (cont'd)

Both β and γ distributions follow a similar trend, even though we only changed β. The distributions were centered in the values used (β = -1.3° and γ = 90°) and, despite having a bad fit, there seems to be a minimum in the center.

To find a better value, we'll change the distribution's range.

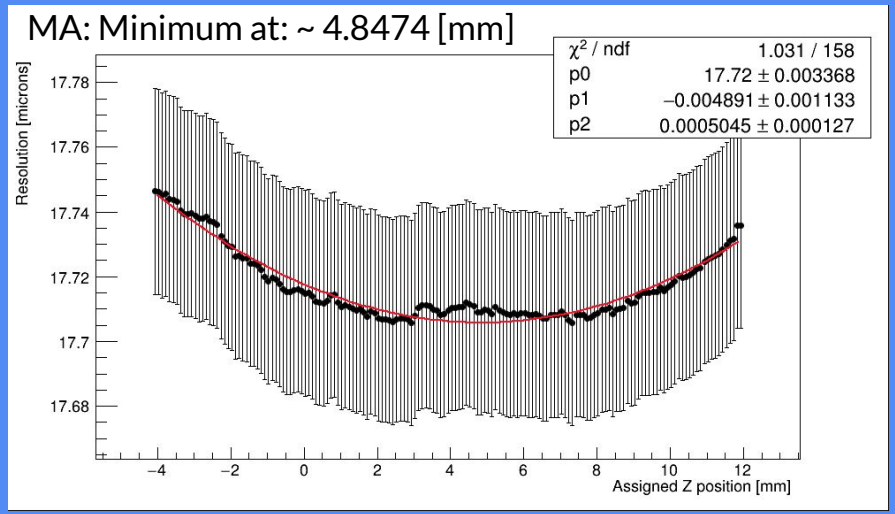


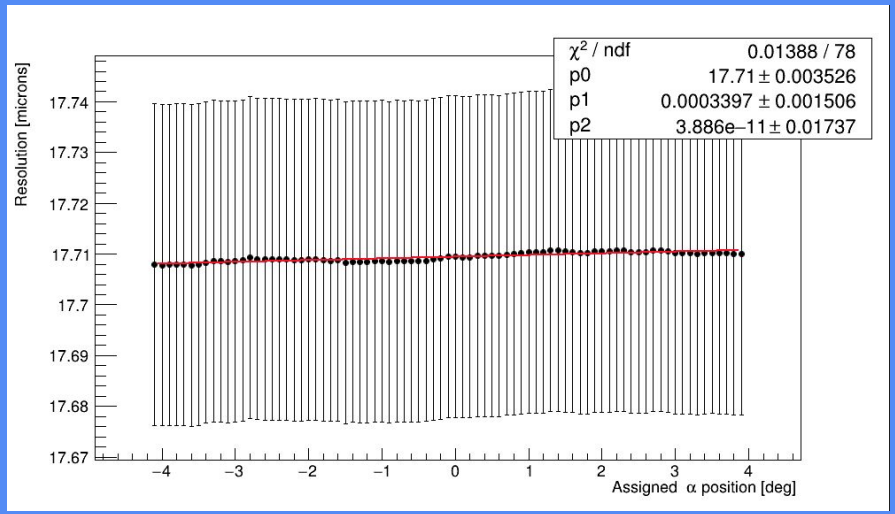


Third iteration

The new range for the Z Scan (~ [-4., 12.]) shows a more defined trend.

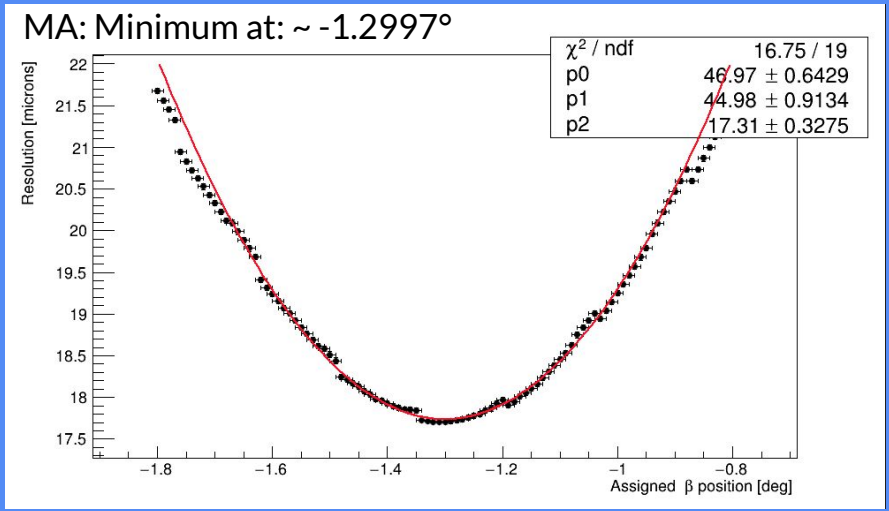
For α's, we see what would be a constant slope, but it's still too small and doesn't impact the resolution (do we need to care about it?)

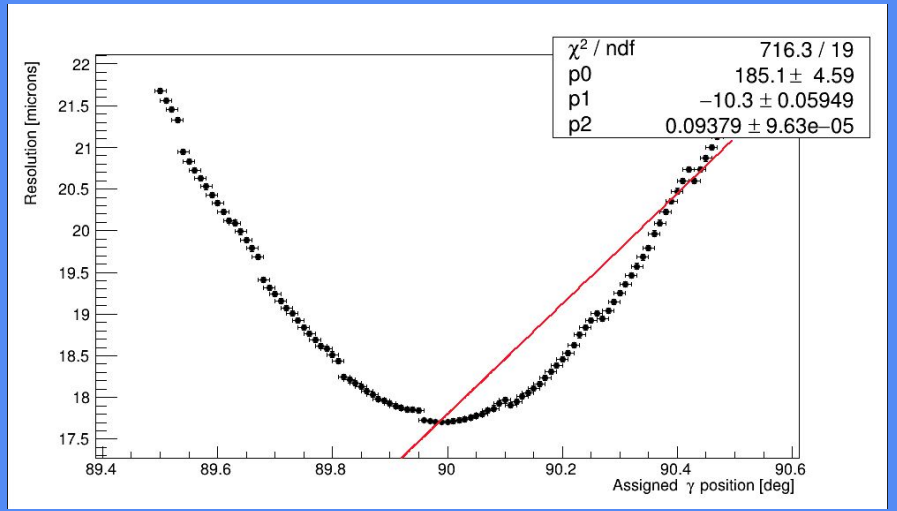




Third iteration (cont'd)

Again, we see a clear correlation between the β and γ distributions. With this 'higher precision' range, a similar effect to the one saw in Z can be observed (discontinuities.) Might these come from a correction, like the amplitude correction per strip?





Conclusions

- Tuning correctly these parameters is crucial to achieve the best performance of the sensors (there are differences as big as 20 microns in the resolution.)
- The highest impact on the resolution is given by the β and γ angles. But the α dependency was expected to be relevant.
- Further improvements must be made to the alignment procedure in order to make the scan in an easier way.
- The clear correlation between the β and γ angles need to be carefully considered.

Thanks!