

Updates on measuring Spatial distortion at the CPA

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ProtoDUNE-SP DRA meeting

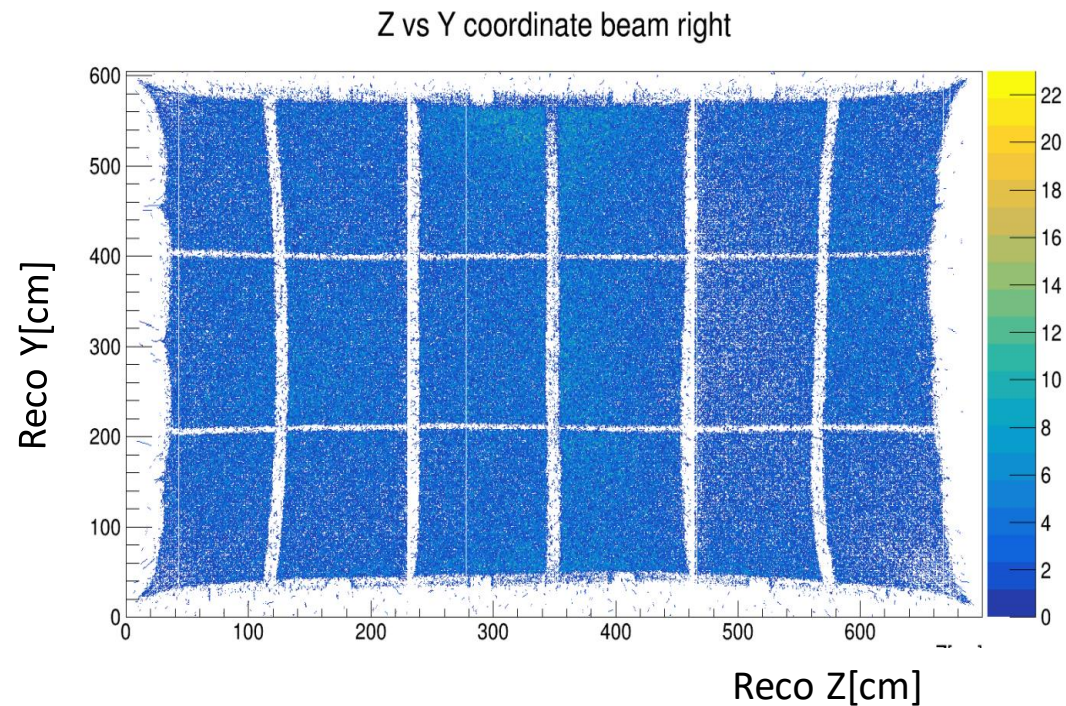
May 13, 2020



Previously: CPA distortions using Anode-Cathode-Anode tracks ([ACA method](#)) :

In this talk:

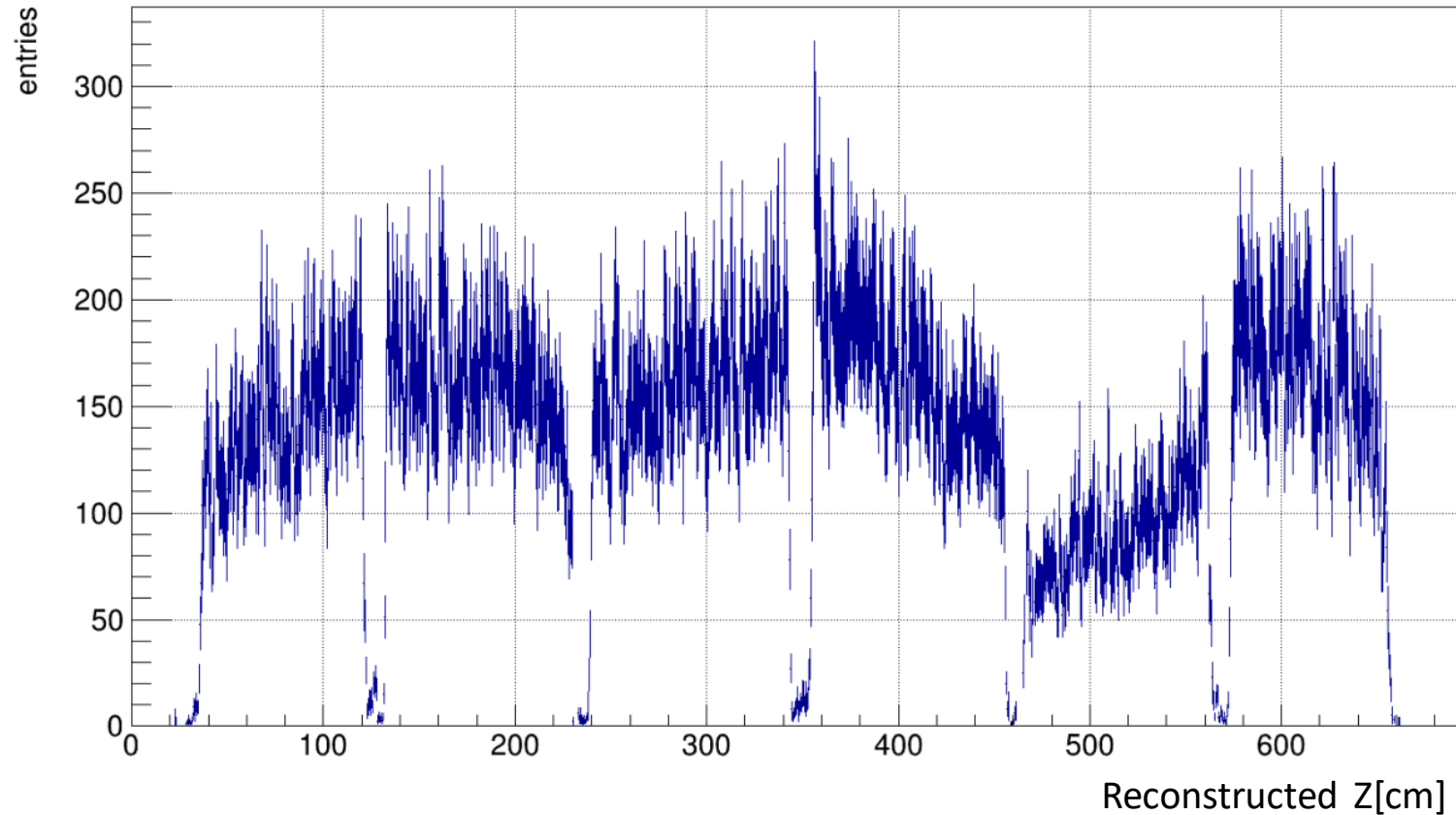
- CPA frames to measure distortions at CPA.
- Comparisons of distortions using the two methods.
- Future plans.



Plot shows Reconstructed Y, Z position of hits with drift times between 4590-4630 ticks

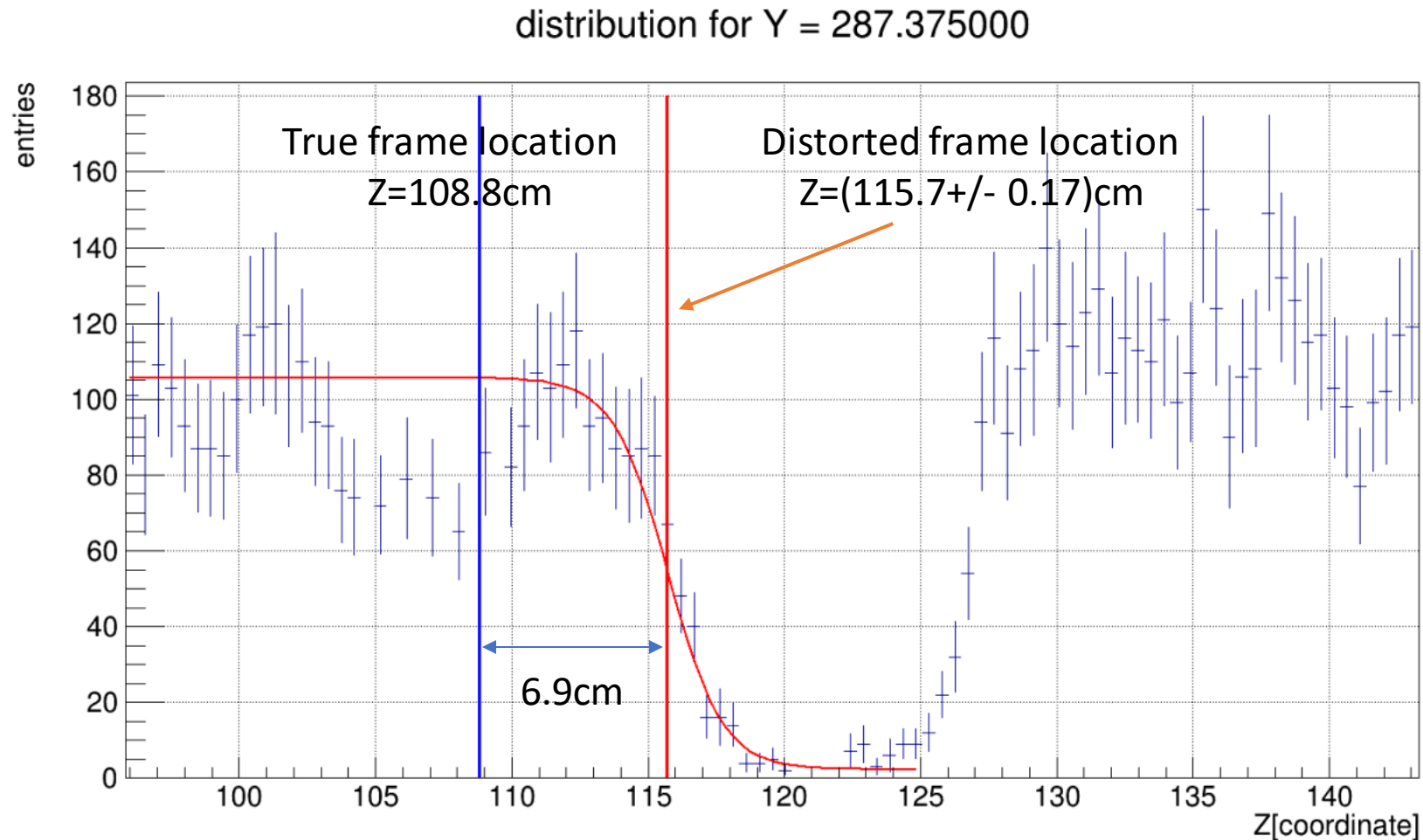
Divided the CPA into 20 bins along Y.
Plotted the number of entries in each bin vs Z coordinate.

Plot below shows one such distribution for Y=332.75-363.0cm



The entries varies with Z as drift times depends on Z coordinate (working on Z dependent drift time cuts). The gaps in the distribution are where the CPA frames are located.

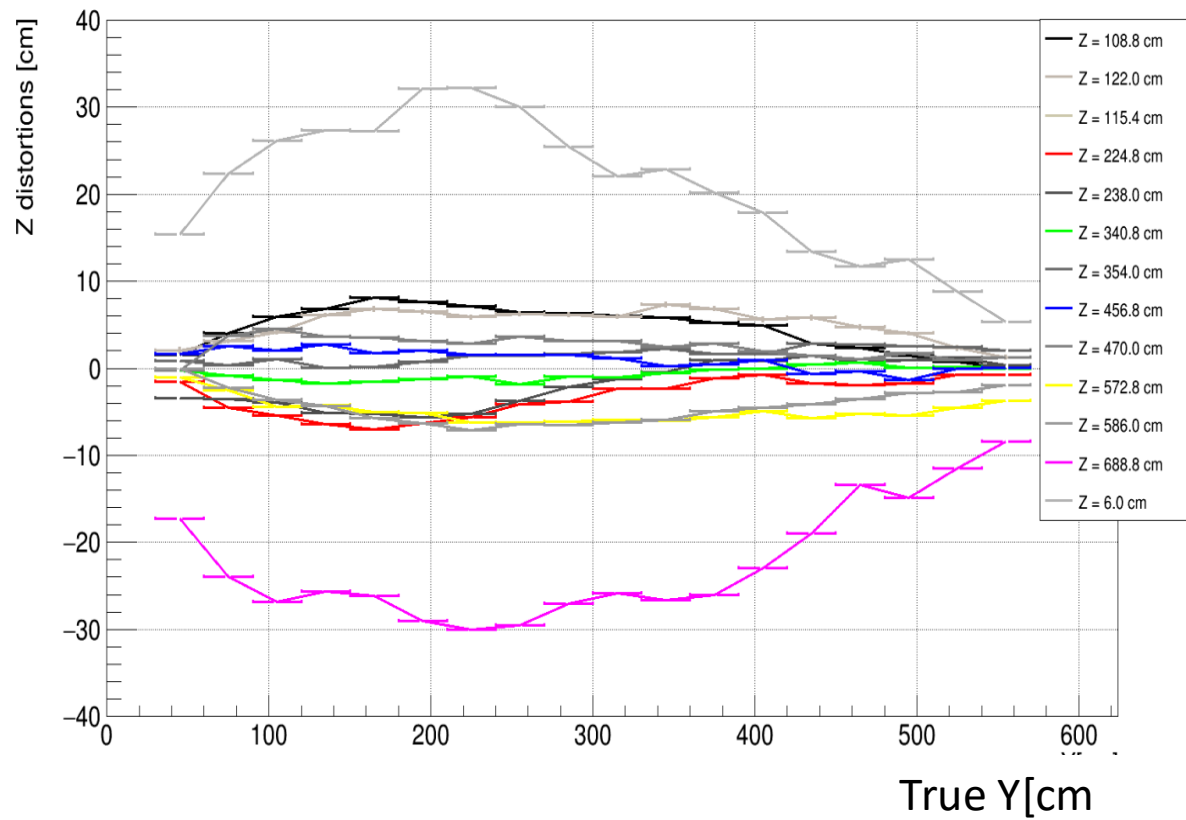
Plot below shows zoomed view near one of the CPA frames



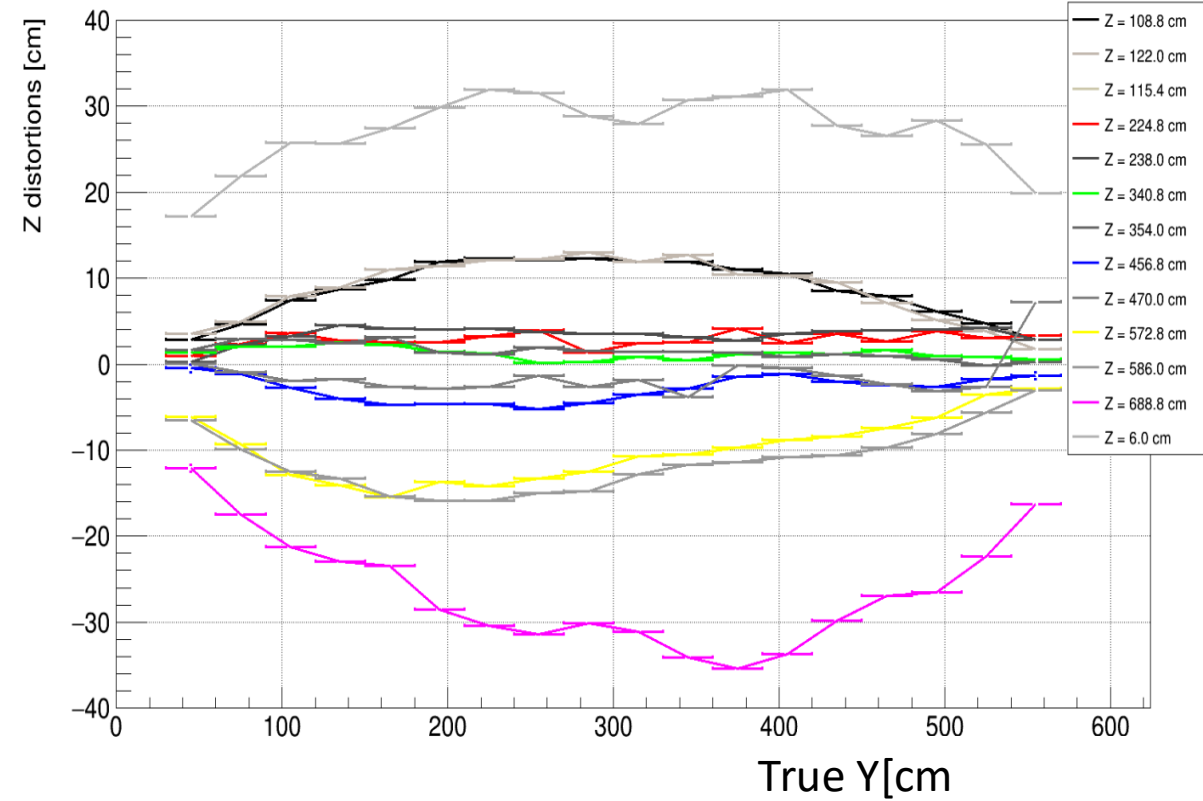
Fit function: $f(x)=a/(1+\exp(x-b))+c/(1+\exp(b-x))$, parameter b gives the distorted Z position (half height value of the sigmoid).

Zdistortion is calculated at different vertical frame locations and upstream and downstream CPA edge.

Z distortion at different Y values for X>0

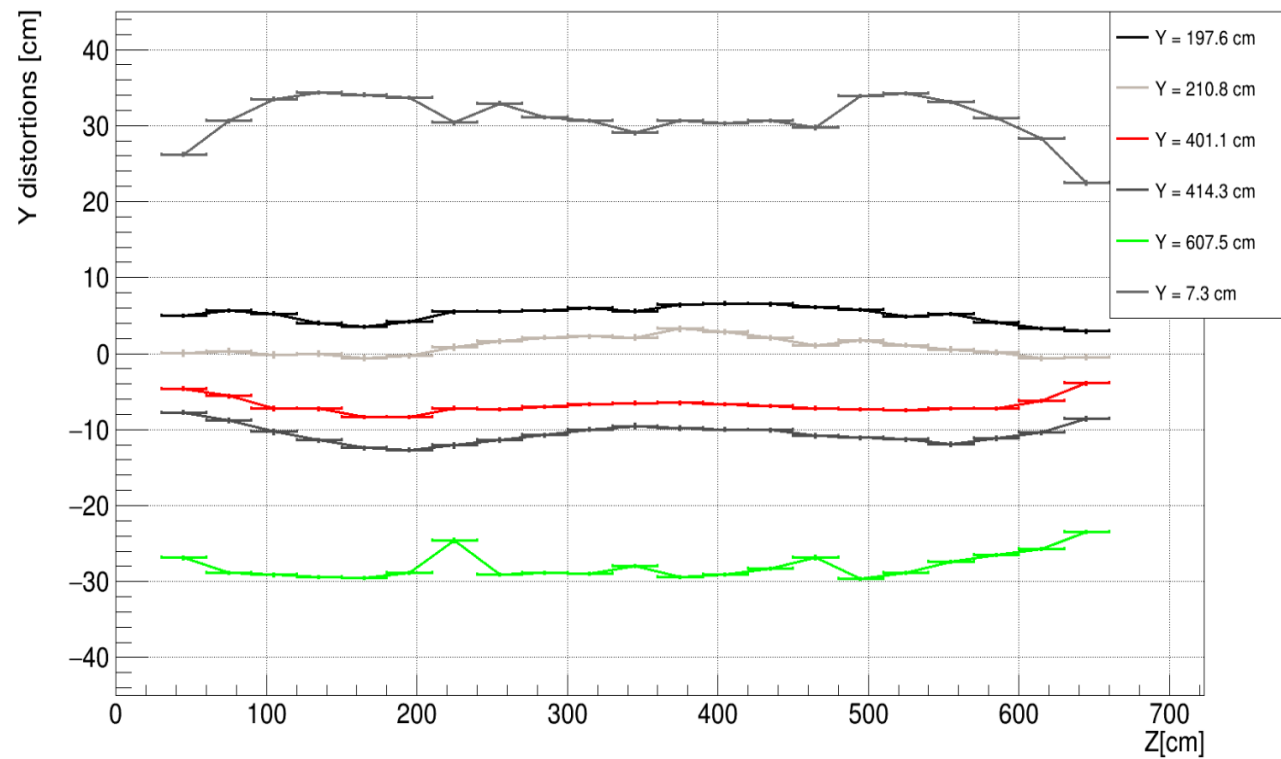


Z distortion at different Y values for X<0

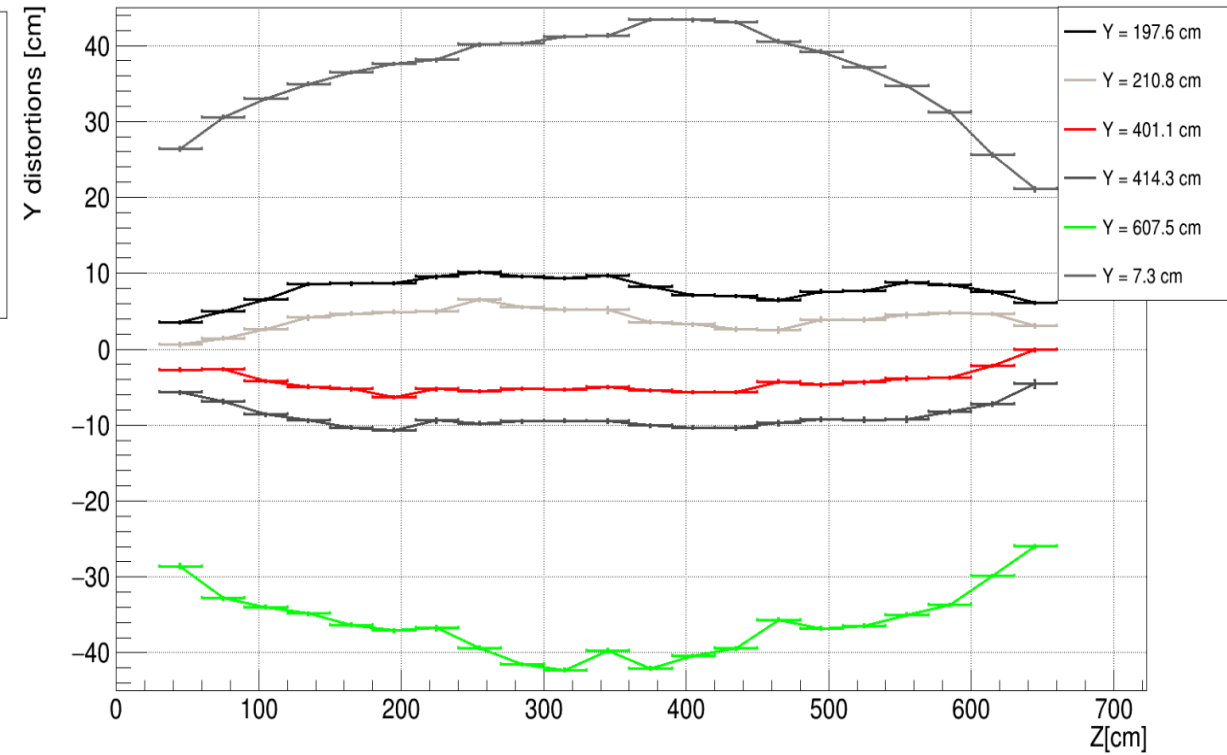


Similarly, Y distortion is calculated at different horizontal frame locations and top and bottom CPA edge.

Y distortion at different Z values for X>0



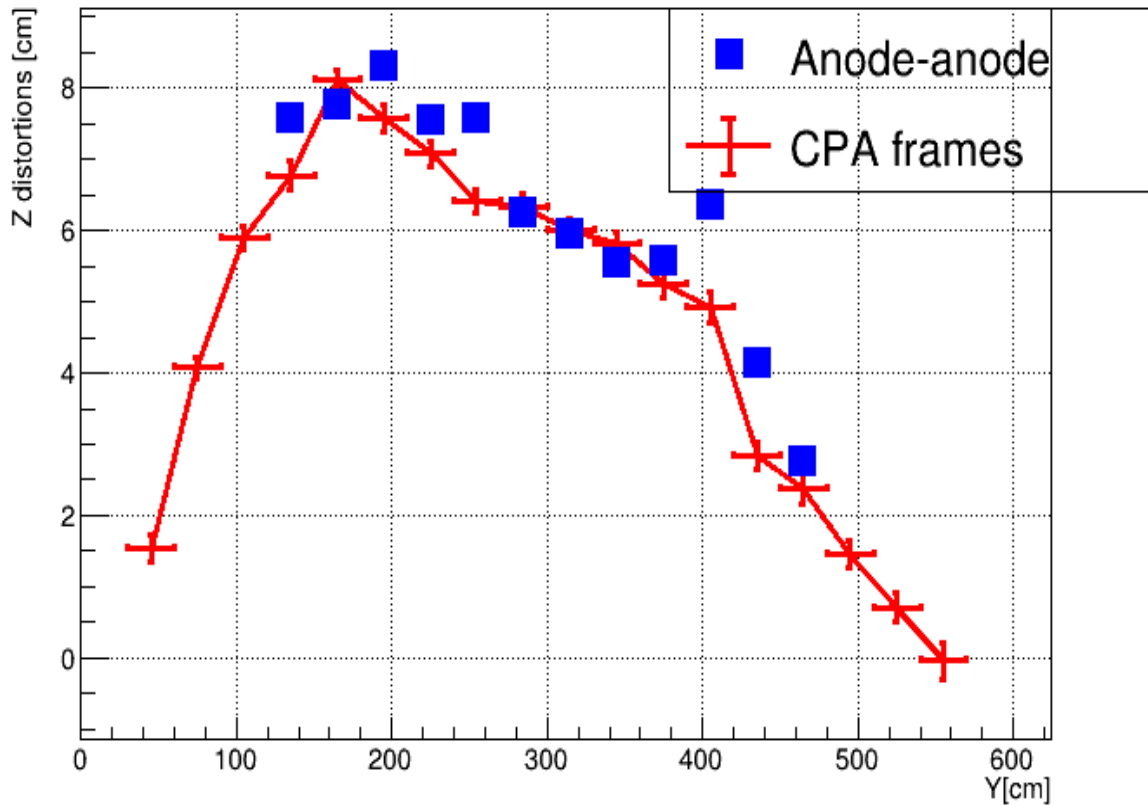
Y distortion at different Z values for X<0



Comparing measured Z distortions using Anode-cathode-anode tracks to CPA frame method

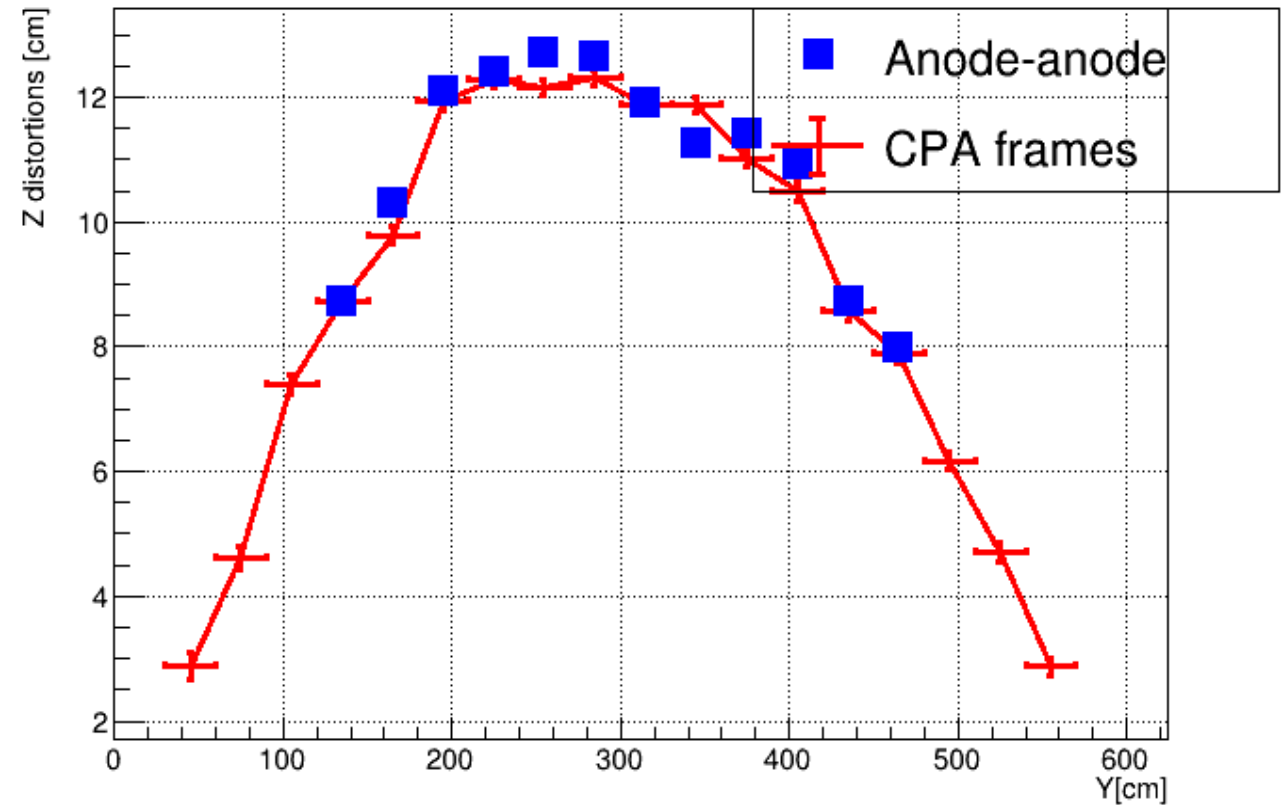
X>0

Z distortions at Z = 108.8 and different Y values



X<0

Z distortions at Z = 108.8 and different Y values



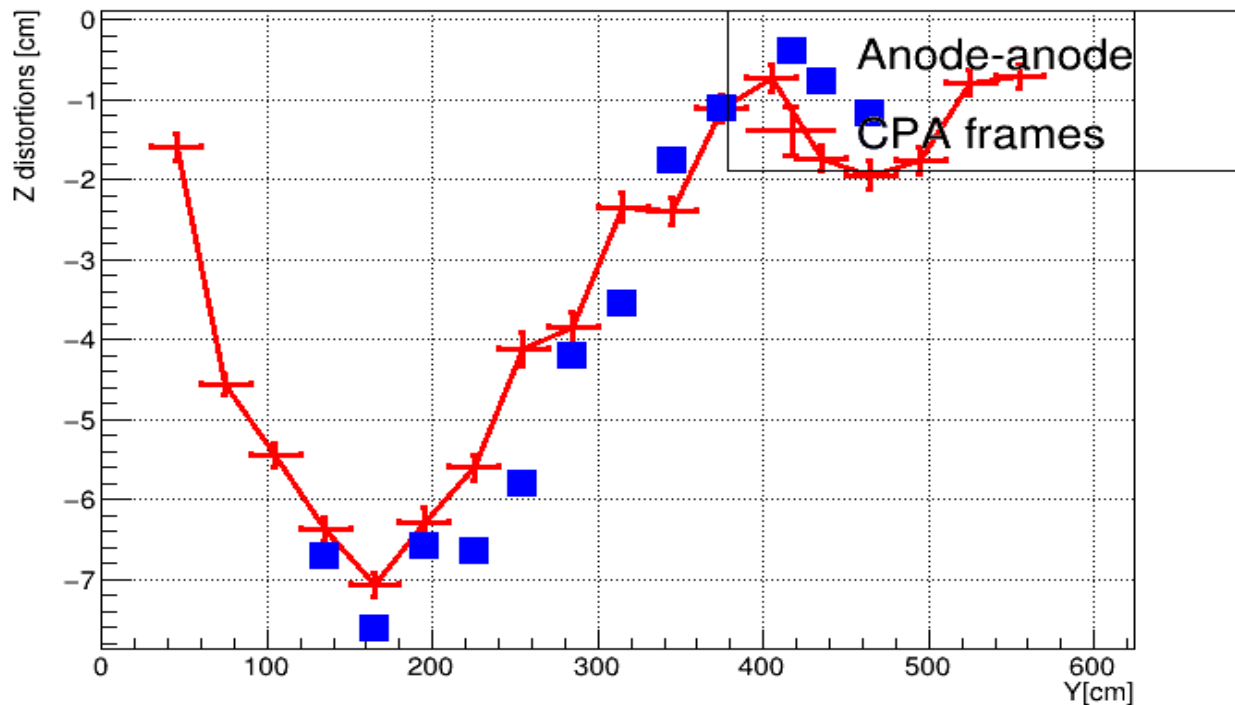
The two methods shows a good agreement.

Anode-Anode method has lower coverage near the TPC edges.

Distortions near APA boundary

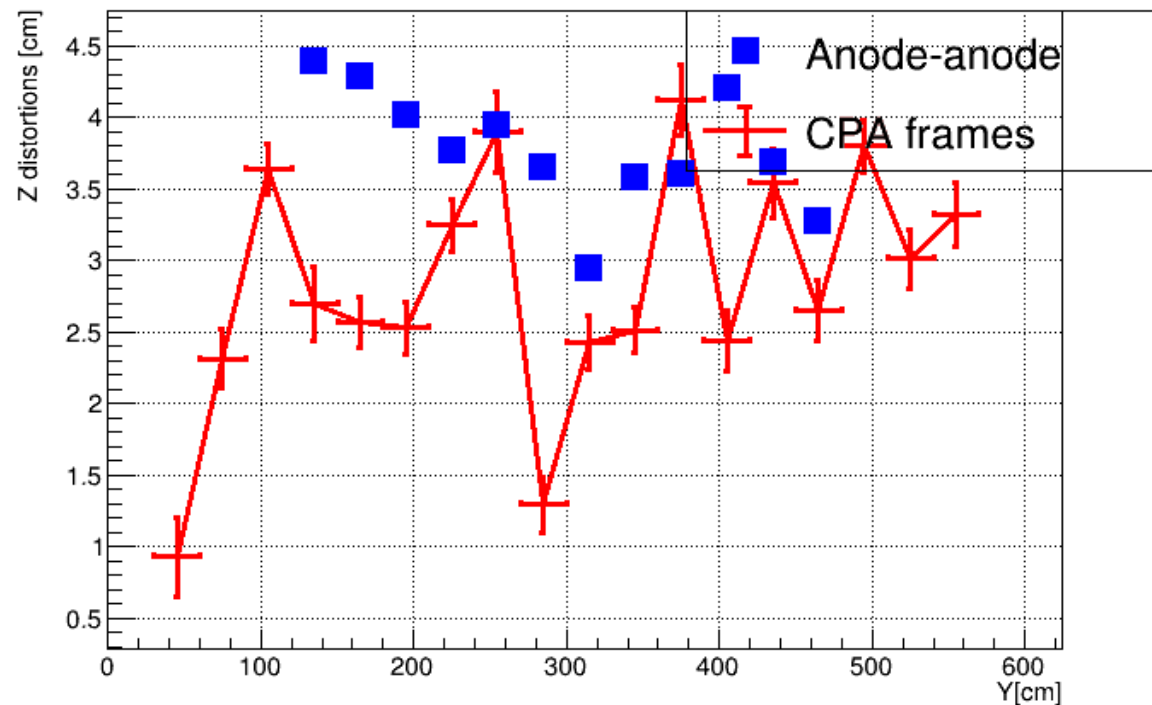
$X > 0$

Z distortions at $Z = 224.8$ and different Y values



$X < 0$

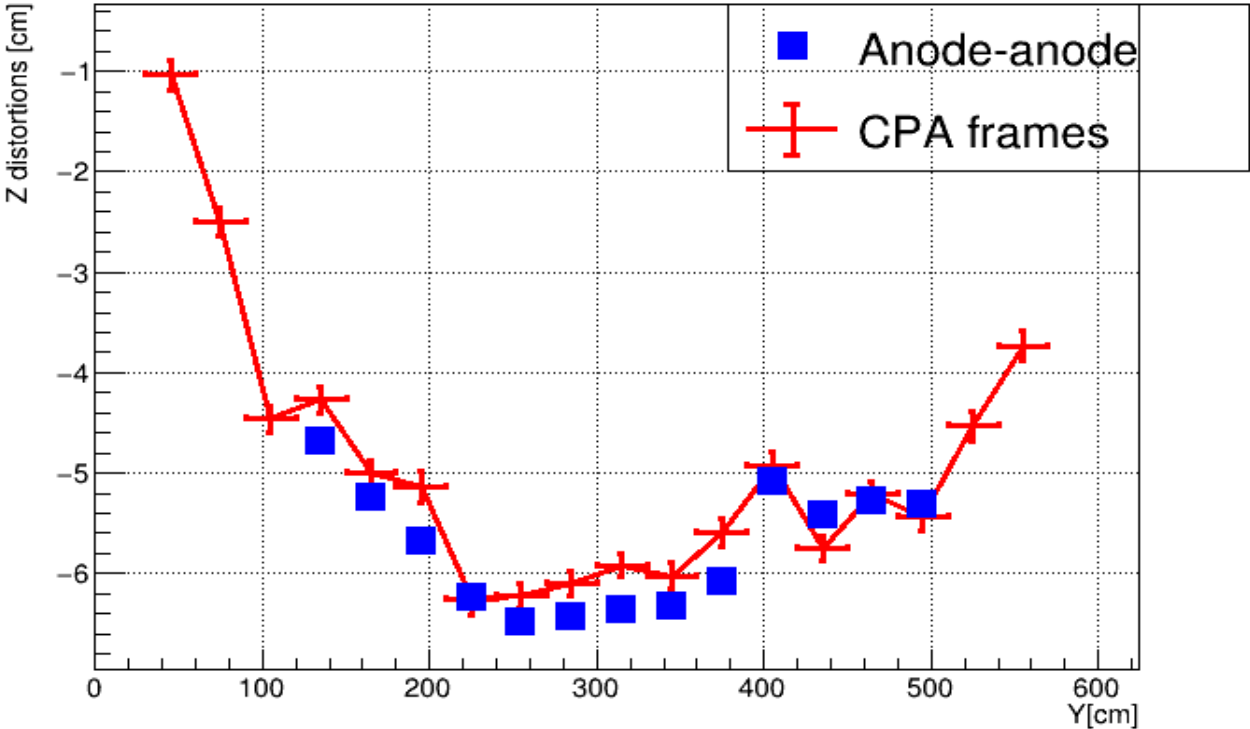
Z distortions at $Z = 224.8$ and different Y values



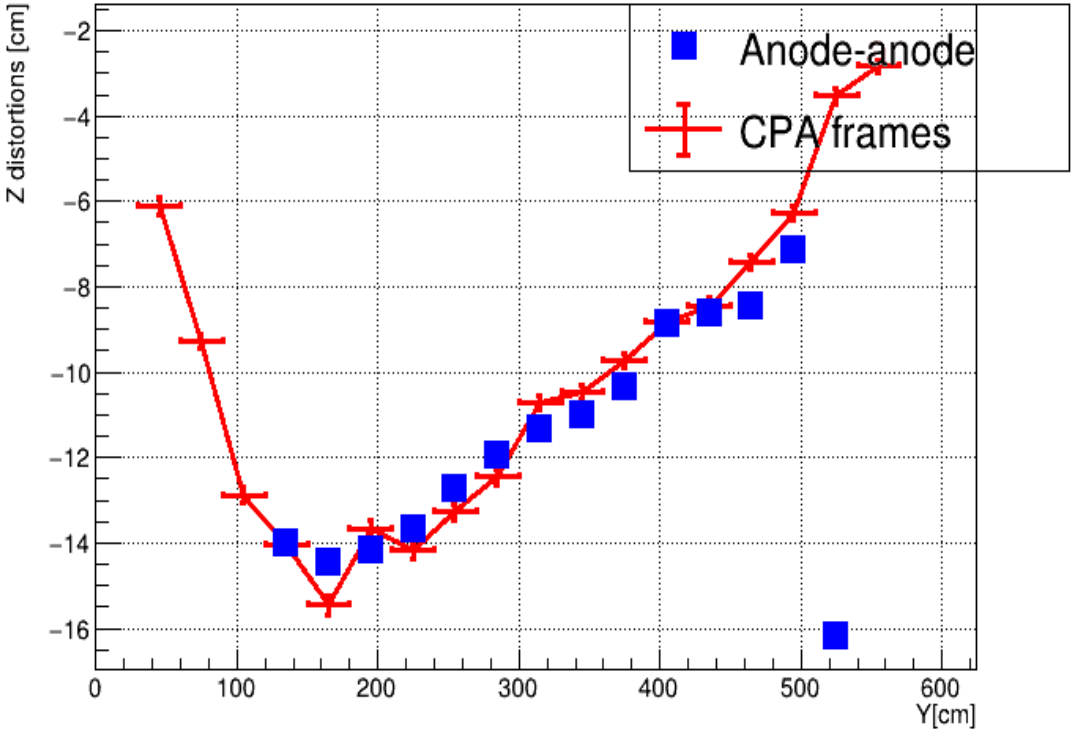
$X < 0$ shows big fluctuation. This is possibly due to the presence of electron divertors.

Another examples of Z distortion comparison, which shows reasonably good agreement.

Z distortions at Z = 572.8 and different Y values

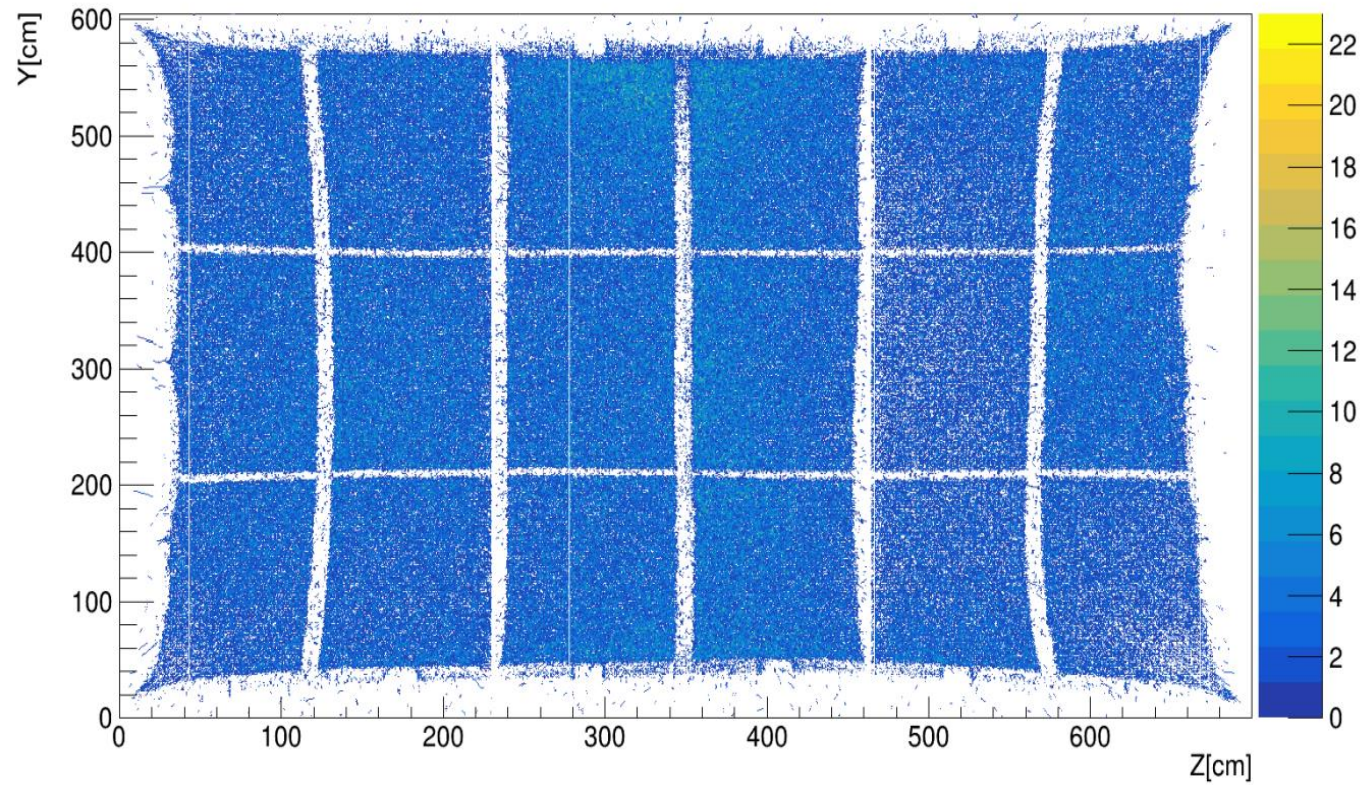


Z distortions at Z = 572.8 and different Y values



Comparing Y distortions at the two horizontal frames (Next slide)

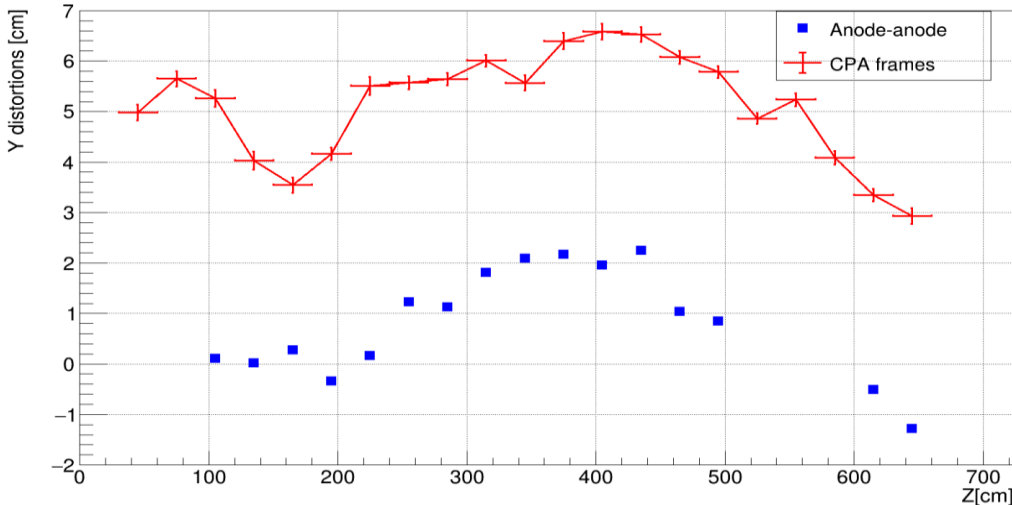
Z vs Y coordinate beam right



Click to add text

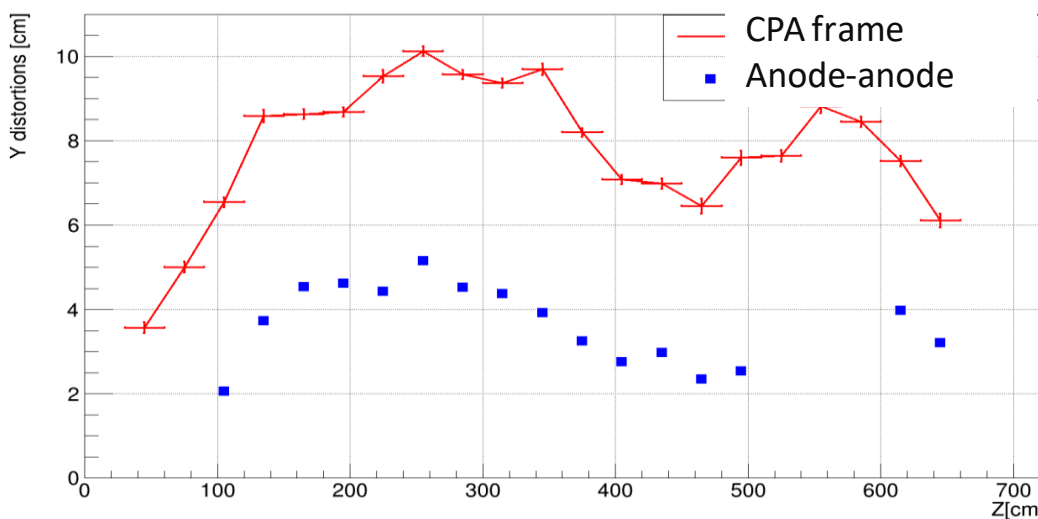
$X > 0$

Y distortions at $Y = 197.6$ and different Z values



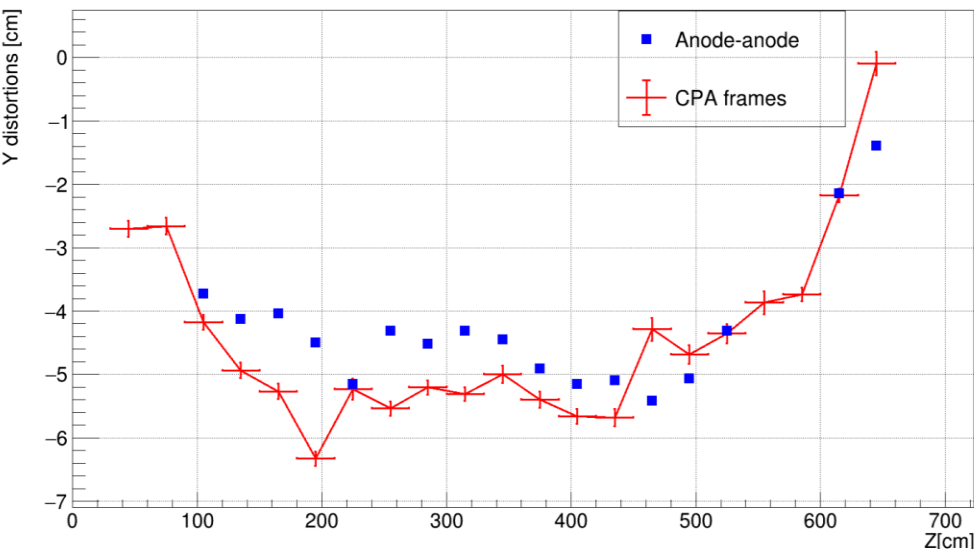
$X < 0$

Y distortions at $Y = 197.6$ and different Z values



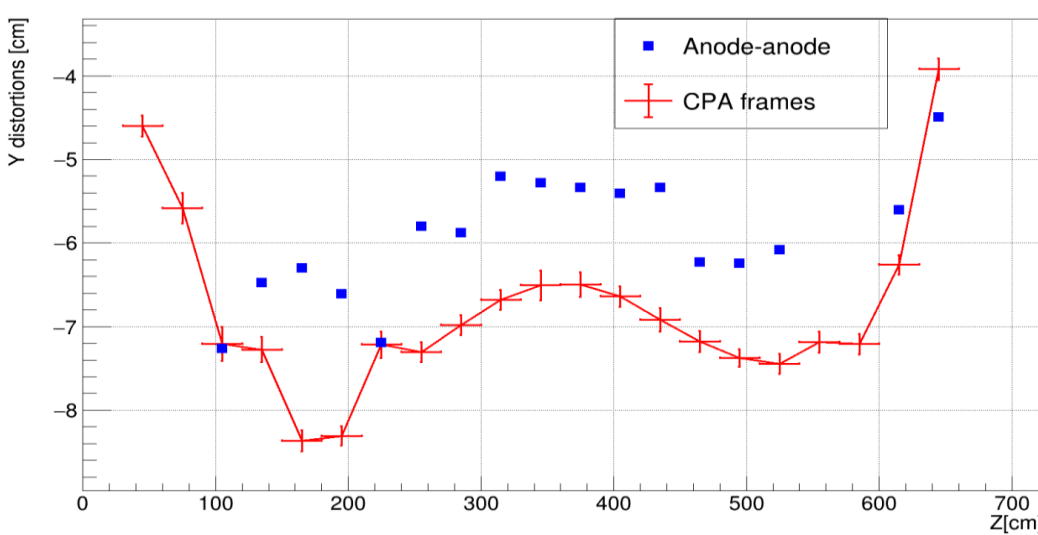
$X > 0$

Y distortions at $Y = 401.1$ and different Z values



$X < 0$

Y distortions at $Y = 401.1$ and different Z values



Summary and future works:

- The agreement between the two methods looks good for Z distortion, while Y distortions shows possible offset. Working on understanding the discrepancy and improving the agreement.
- Possible reasons for disagreement:
CPA displacement: It affects the true X, Y and Z values at the cathode.
Thermal contraction of the CPA and APA and the support structure.

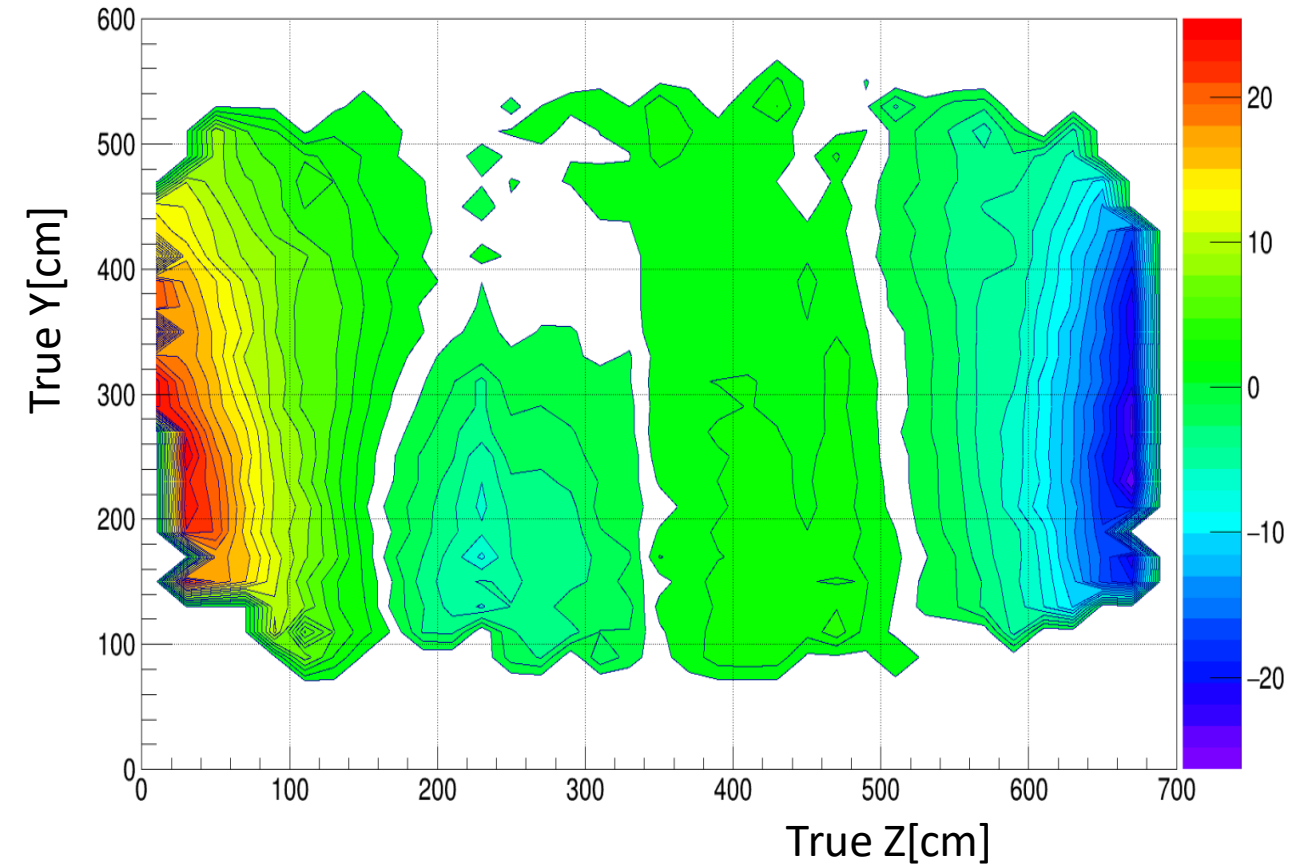
Future Plans (working with Mike Mooney):

- Accounting for CPA displacement and thermal contractions and any other possible source of bias for future analysis.
- Using Z dependent ΔT cuts for cathode-anode tracks selection.

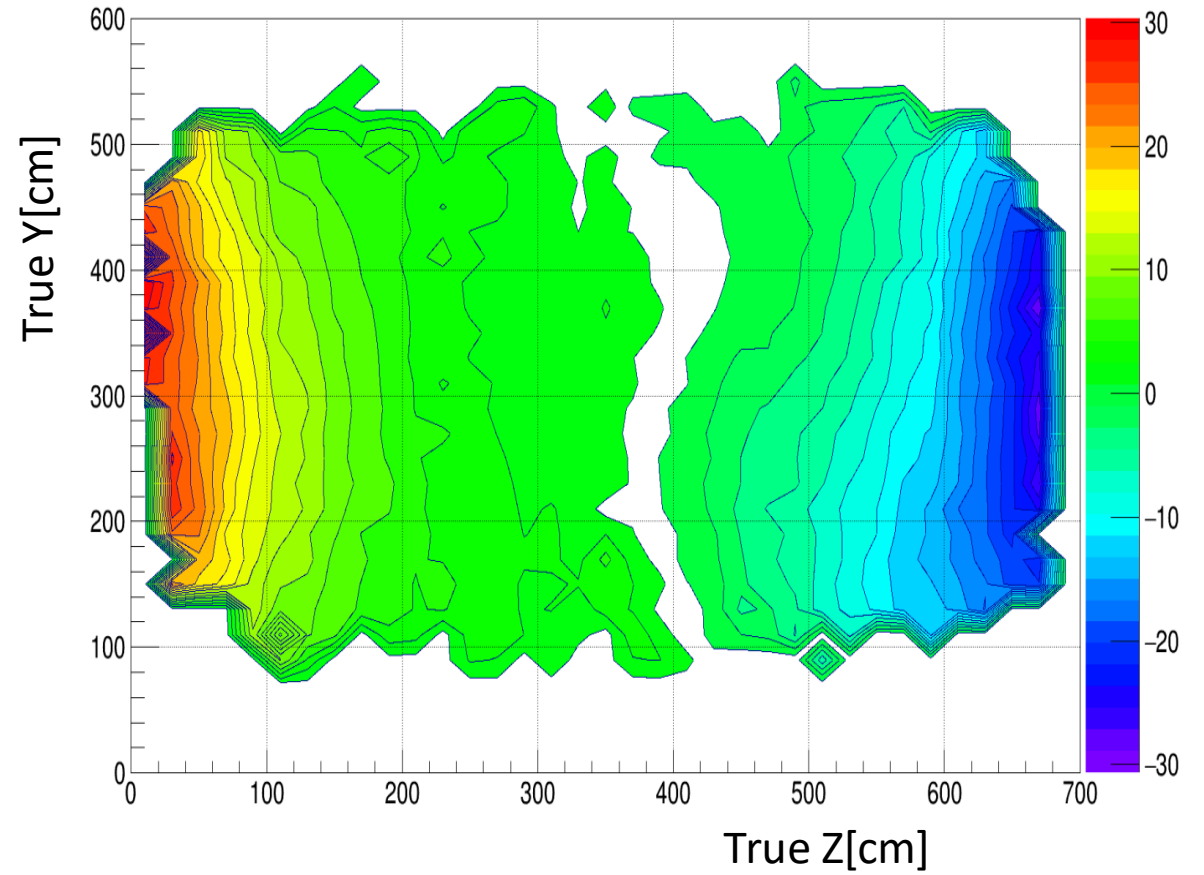
Thank You

Contour maps showing Z distortions as a function of Z and Y coordinate using Anode-Cathode-anode tracks

X>0



X<0



Contour maps showing Y distortions as a function of Z and Y coordinate using Anode-Cathode-anode tracks

X>0

X<0

