

Analyzing SpacePoint and TrueHit positions

Rudolf Frühwirth, Jakob Lettenbichler, Thomas Madlener

Why are WE doing such an analysis?

How did we get here?

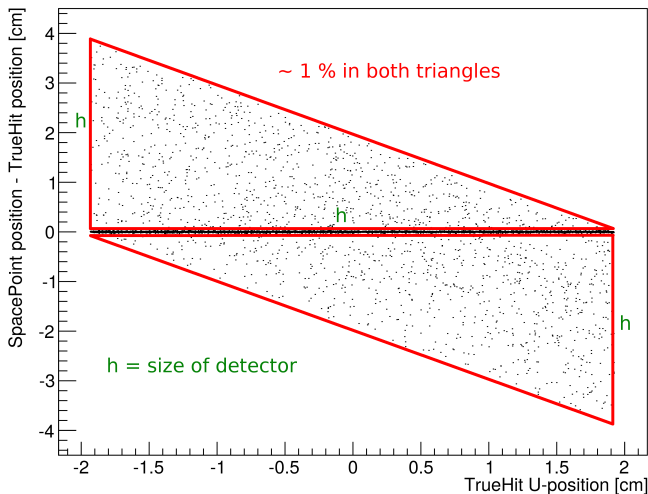
- **Initial idea:** relate SpacePoints and TrueHits
 - > make MC information easily available for SpacePoints if needed
- **Problem:** not so straight forward as anticipated
- **Idea:** Check the positions of both, when we already have both of them at hand
 - > Possibility of discovering some hidden issues
 - > Position is the only information stored in SpacePoint (at the moment)
- **Then:** 'This seems interesting, let's see whats behind it'



Issue presented at F2F in Prague

Position residuals vs. TrueHit position, with 'issue cases':

position residuals vs TrueHit position U, layer 3



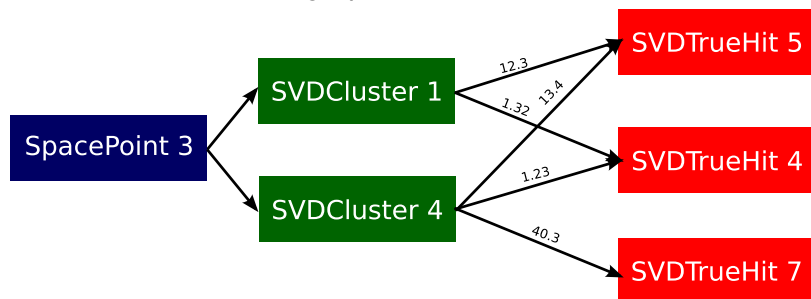
What happened since then (last 2-3 months)

- disentangling of modules (alongside some refactoring work) → relating TrueHits and SpacePoints now in **SpacePoint2TrueHitConnector**
- implementation of algorithm for finding the related TrueHits to a SpacePoint now with multimap (previously done with vectors)
- finding the 'right' TrueHit is **still not straight-forward!** (and there may be new issues!)
- However the **issue** presented in Prague could be tracked down to **stem from Ghosthits!**



Relating TrueHits and SpacePoints

Generic case for relating SpacePoints with TrueHits



Why this took so long

"I SPEND A LOT OF TIME ON THIS TASK.
I SHOULD WRITE A PROGRAM AUTOMATING IT!"

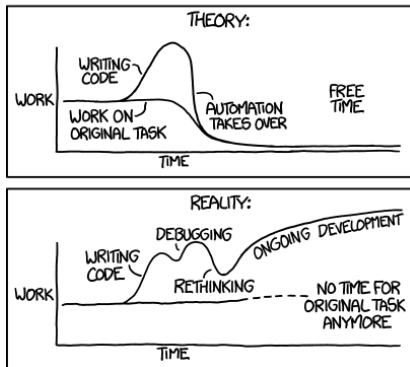


Figure : What happened? (from <http://xkcd.com/1319/>)



Remarks on the Methodology

To have comparable results and some statistics:

- 1 simulate 10k events with EvtGen without digitizing/clusterizing
- 2 digitize/clusterize with different random seeds to identify outliers from digitizing (noise,...)

Recent update of modules for digitizing/clusterizing in SVD (r16619)

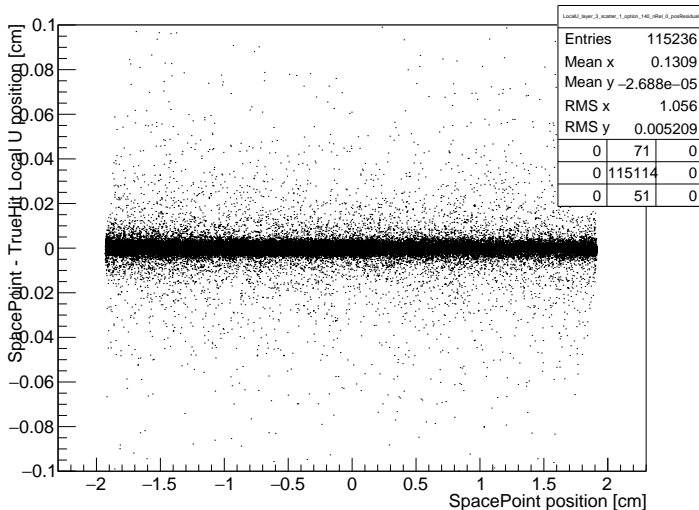
→ step 2 done with 'old' (pre r16619) and 'new' version to see possible changes



Position Residuals

Position Residuals vs. Position, Layer 3 U old Digitizer

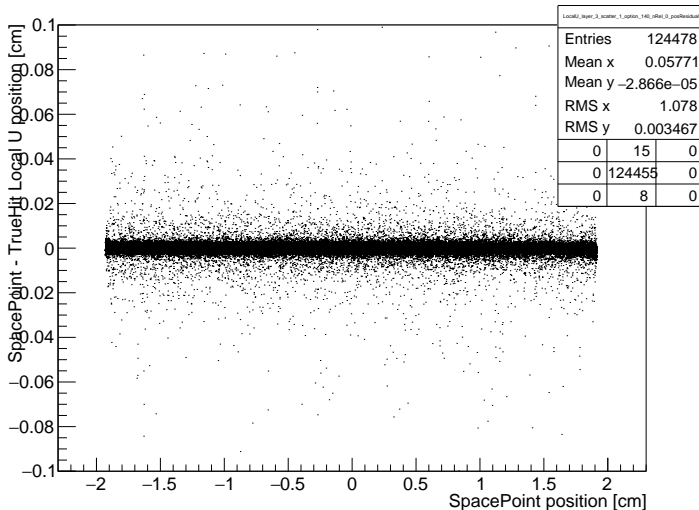
Position Residuals Local U on Layer 3, relation Status: 140



Position Residuals

Position Residuals vs. Position, Layer 3 U new Digitizer

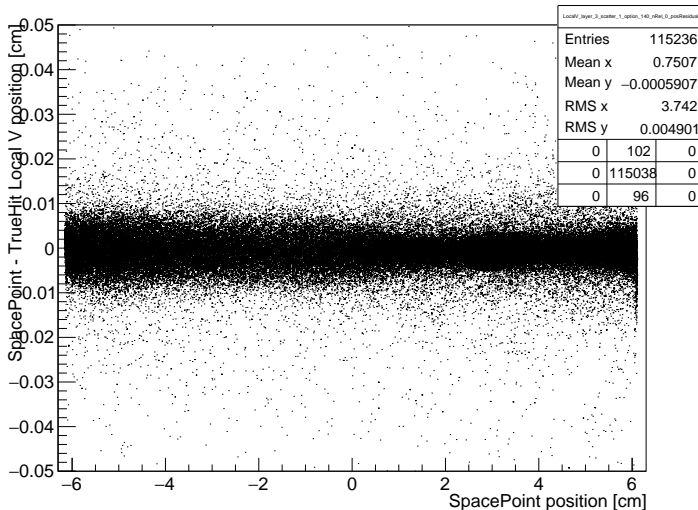
Position Residuals Local U on Layer 3, relation Status: 140



Position Residuals

Position Residuals vs. Position layer 3 V old Digitizer

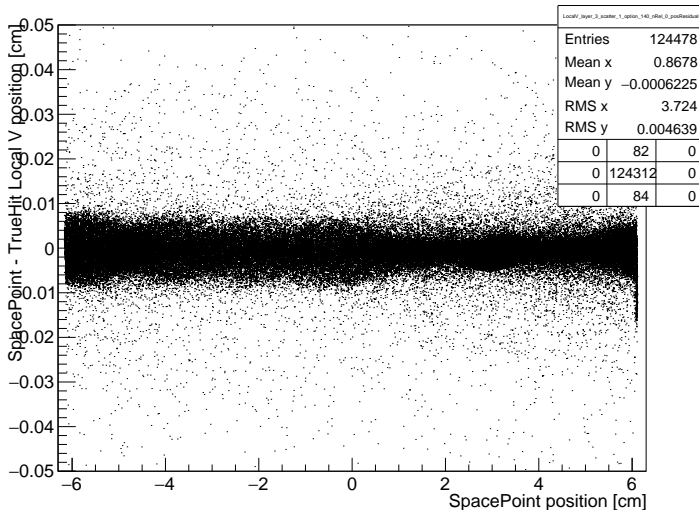
Position Residuals Local V on Layer 3, relation Status: 140



Position Residuals

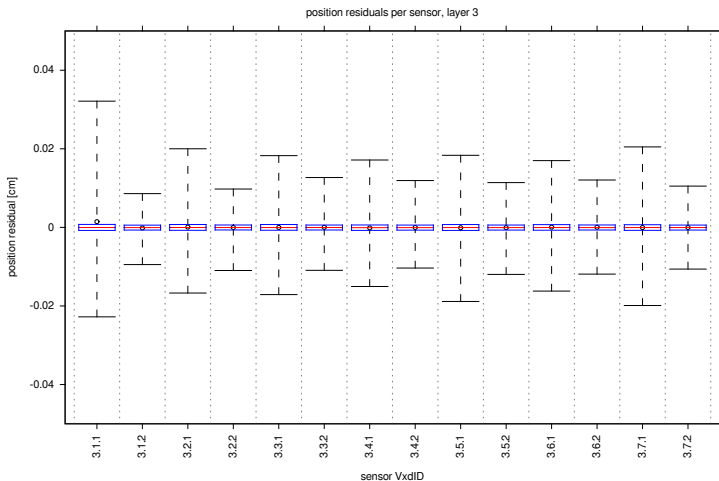
Position Residuals vs. Position layer 3 V **new Digitizer**

Position Residuals Local V on Layer 3, relation Status: 140



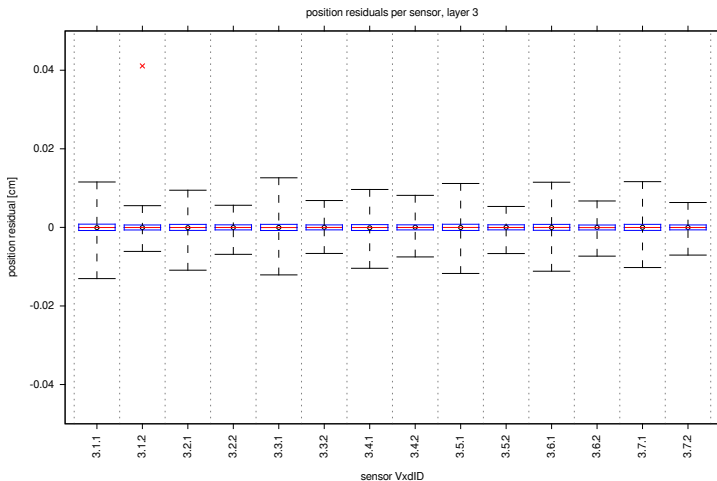
Position Residuals

distribution per sensor, layer 3 U old Digitizer



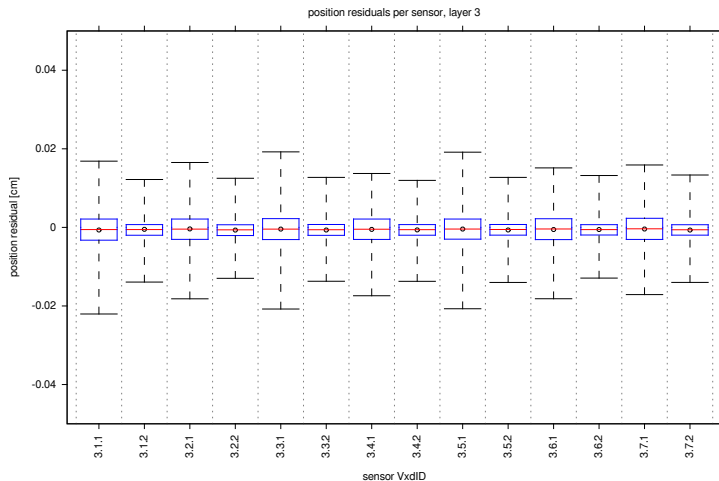
Position Residuals

distribution per sensor, layer 3 U new Digitizer



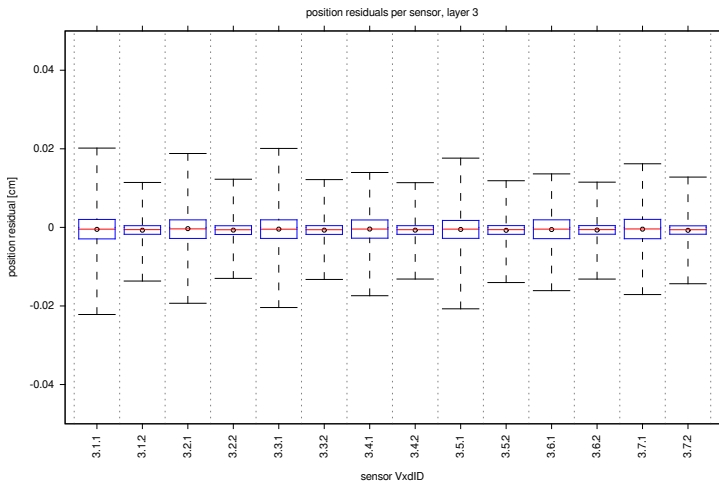
Position Residuals

distribution per sensor, layer 3 V old Digitizer



Position Residuals

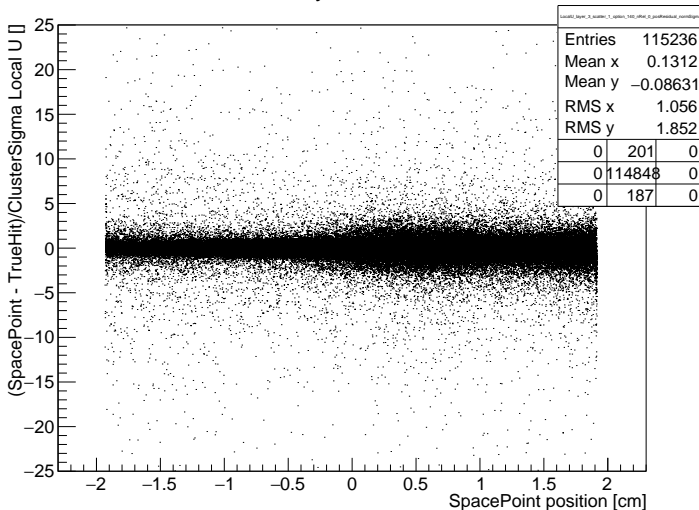
distribution per sensor, layer 3 V new Digitizer



Pulls

Pulls vs. Position, Layer 3 U old Digitizer

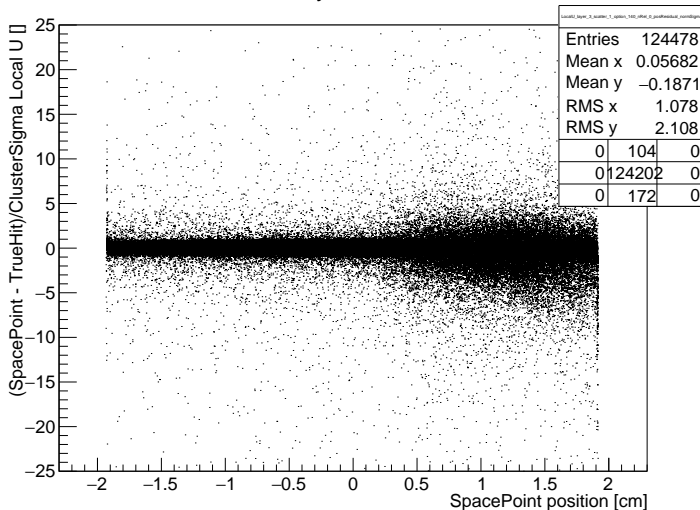
Pull Local U on Layer 3, relationStatus: 140



Pulls

Pulls vs. Position, Layer 3 U new Digitizer

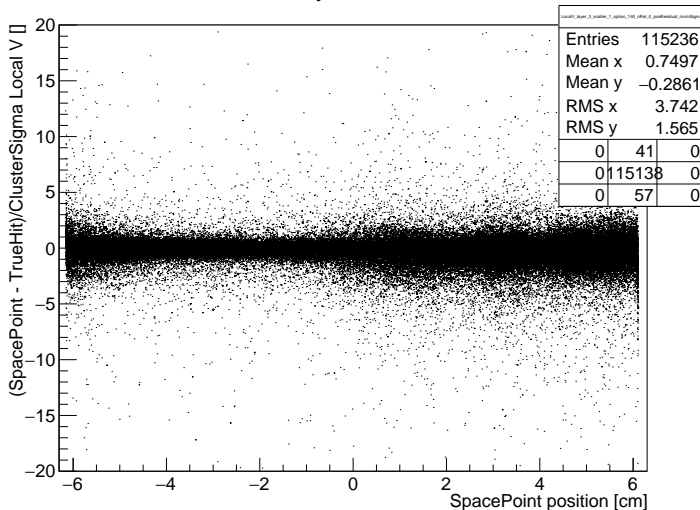
Pull Local U on Layer 3, relationStatus: 140



Pulls

Pulls vs. Position layer 3 V old Digitizer

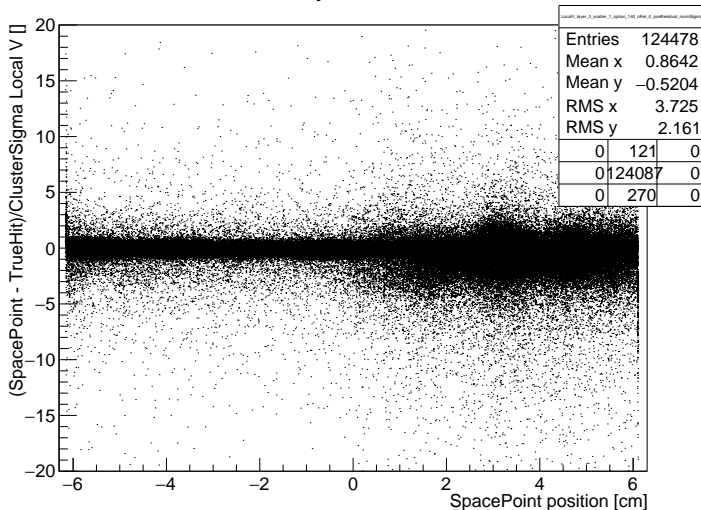
Pull Local V on Layer 3, relationStatus: 140



Pulls

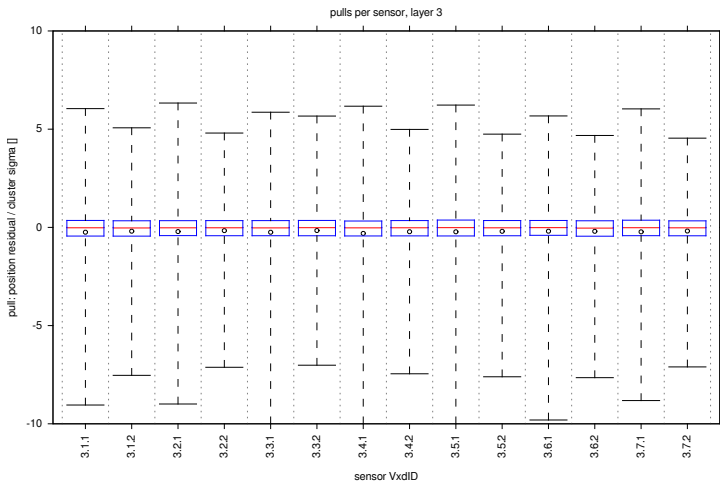
Pulls vs. Position layer 3 V **new Digitizer**

Pull Local V on Layer 3, relationStatus: 140



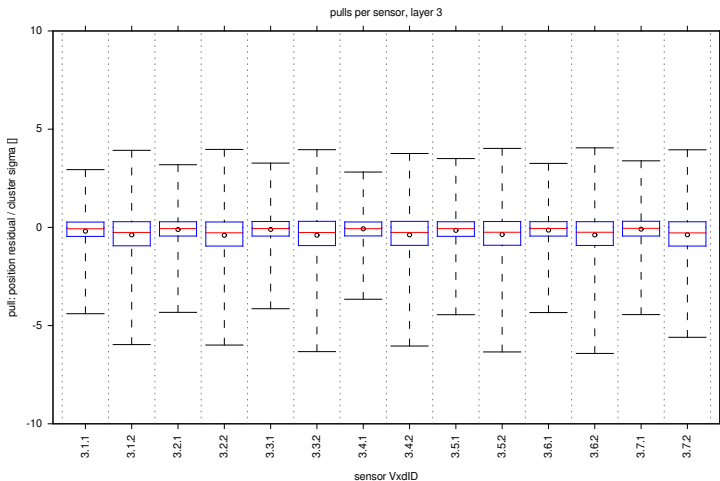
Pulls

distribution per sensor, layer 3 U new Digitizer



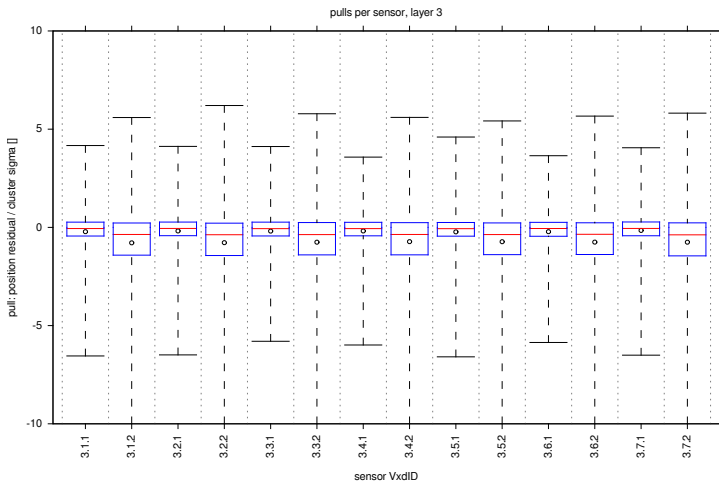
Pulls

distribution per sensor, layer 3 V old Digitizer



Pulls

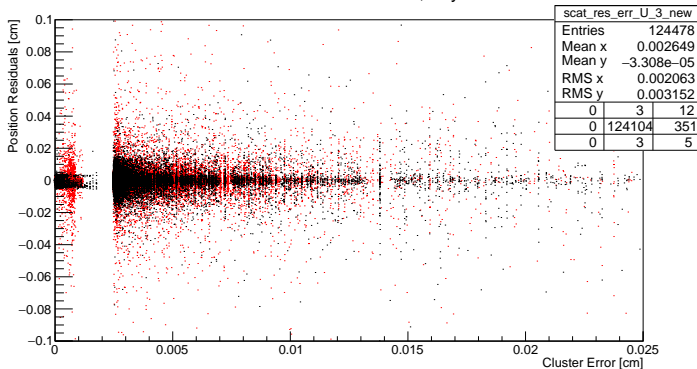
distribution per sensor, layer 3 V new Digitizer



Two classes of errors in SVD?

Position Residuals vs. Errors

Position Residuals vs. Error, Layer 3 U



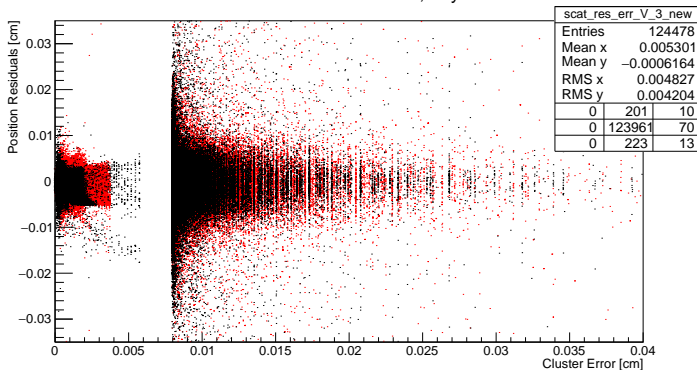
comparing **old Digitizer** and new Digitizer



Two classes of errors in SVD?

Position Residuals vs. Errors

Position Residuals vs. Error, Layer 3 V



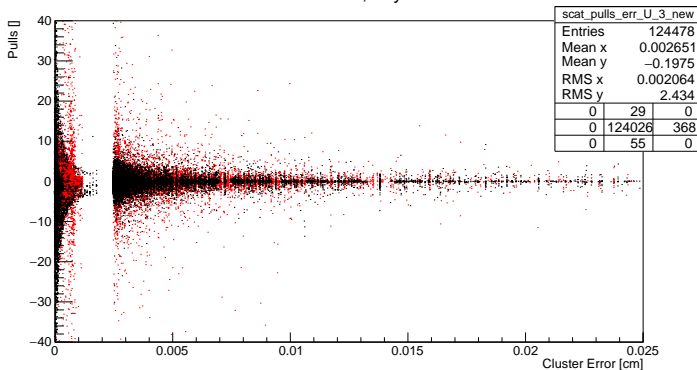
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Pulls vs. Errors

Pulls vs. Error, Layer 3 U



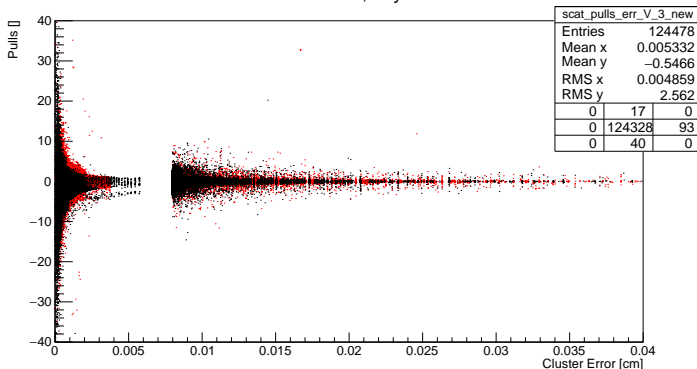
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Pulls vs. Errors

Pulls vs. Error, Layer 3 V



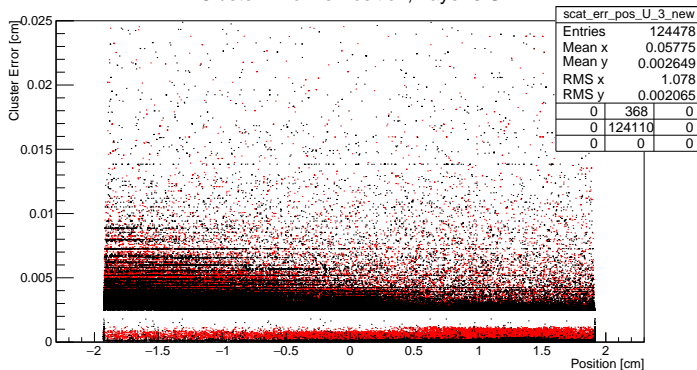
comparing **old Digitizer** and new Digitizer



Two classes of errors in SVD?

Errors vs. Position

Cluster Error vs Position, Layer 3 U



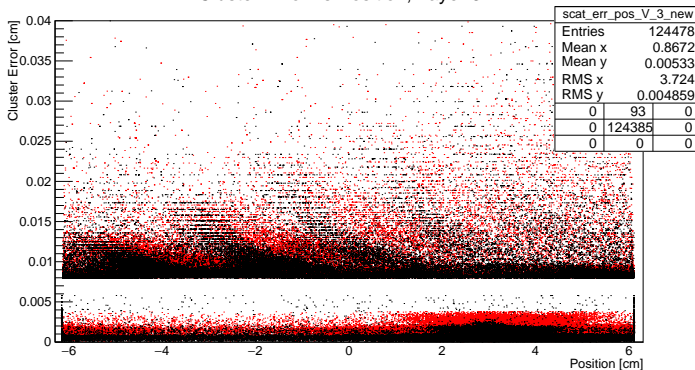
comparing **old Digitizer** and new Digitizer



Two classes of errors in SVD?

Errors vs. Position

Cluster Error vs Position, Layer 3 V



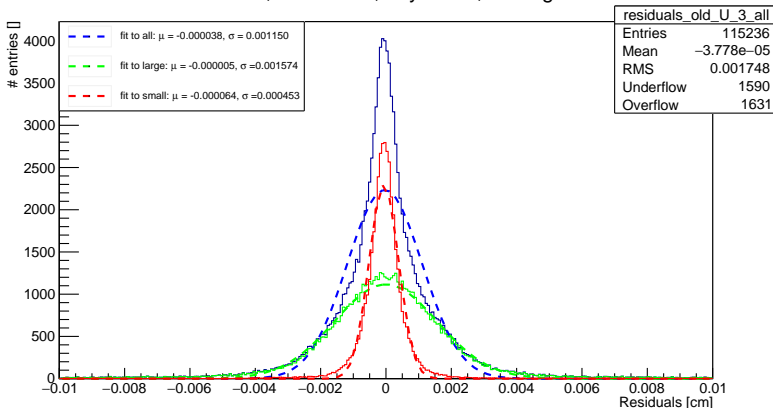
comparing **old Digitizer** and new Digitizer



Two classes of error in SVD?

old Digitizer

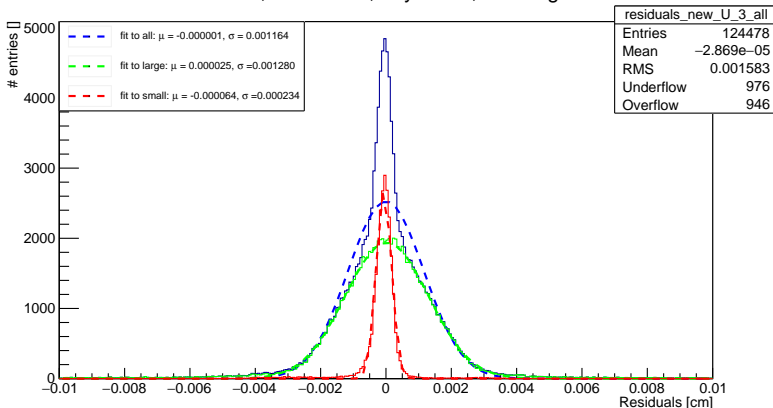
Residuals, all classes, Layer 3 U, old Digitizer



Two classes of error in SVD?

new Digitizer

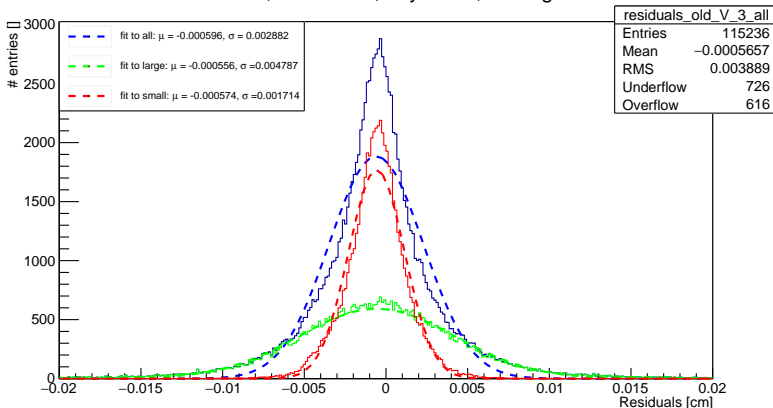
Residuals, all classes, Layer 3 U, new Digitizer



Two classes of error in SVD?

Position Residuals old Digitizer

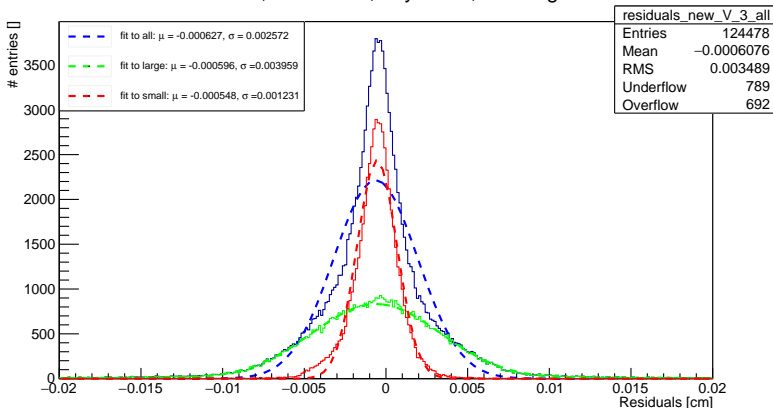
Residuals, all classes, Layer 3 V, old Digitizer



Two classes of error in SVD?

Position Residuals new Digitizer

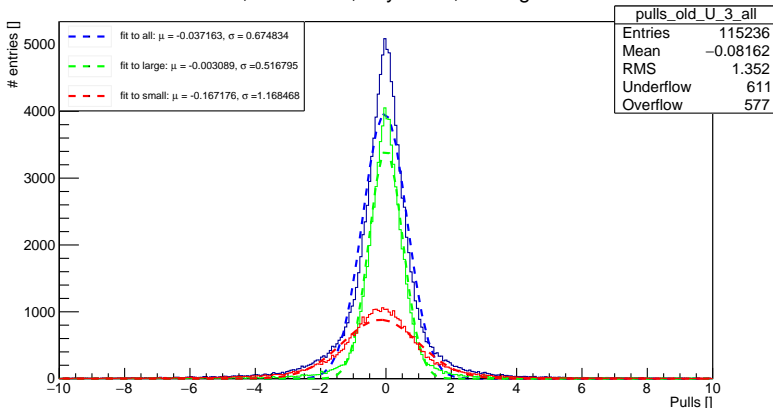
Residuals, all classes, Layer 3 V, new Digitizer



Two classes of error in SVD?

Pulls old Digitizer

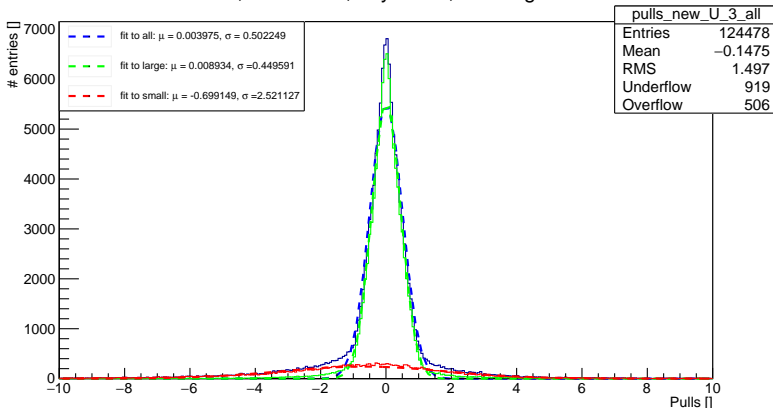
Pulls, all classes, Layer 3 U, old Digitizer



Two classes of error in SVD?

Pulls new Digitizer

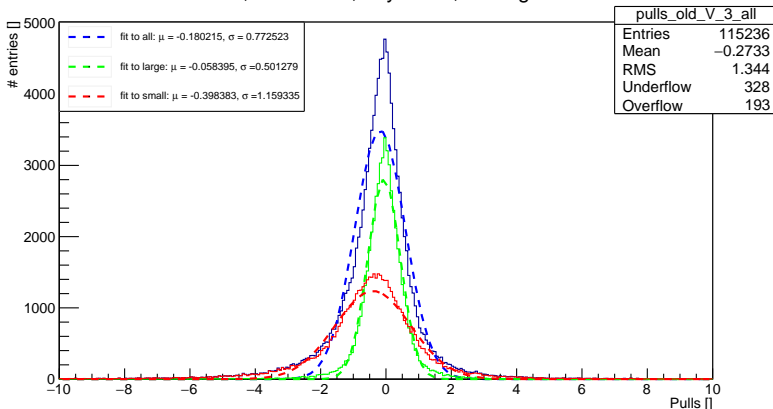
Pulls, all classes, Layer 3 U, new Digitizer



Two classes of error in SVD?

Pulls old Digitizer

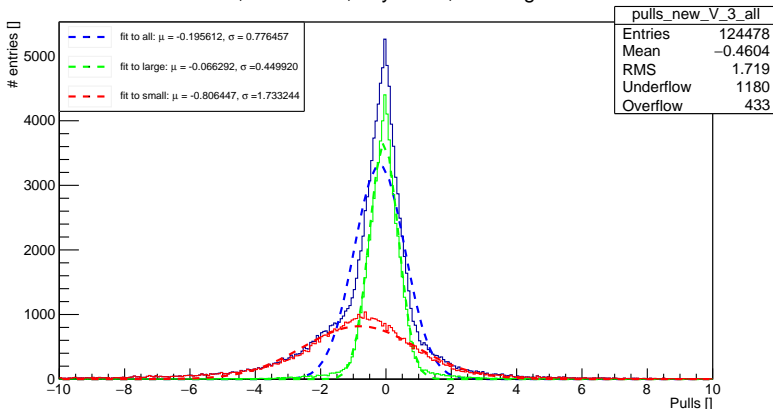
Pulls, all classes, Layer 3 V, old Digitizer



Two classes of error in SVD?

Pulls new Digitizer

Pulls, all classes, Layer 3 V, new Digitizer



Findings and Open Questions

- Position Residuals do look reasonable
- Pulls seem off → looks like this is because of error estimates
- There seem to be errors in the SVD that are larger than the digital resolution
- Small errors seem underestimated, large errors seem overestimated
- Errors seem quantized some how → bug or feature?



Conclusion and Outlook

Avoid 'going down the rabbit hole' if possible in the future

Focus on thesis/actual work again

→ hand this over to the hands of the experts

Start of first tests on how neural networks can help creating an advanced SectorMap



Thank You!

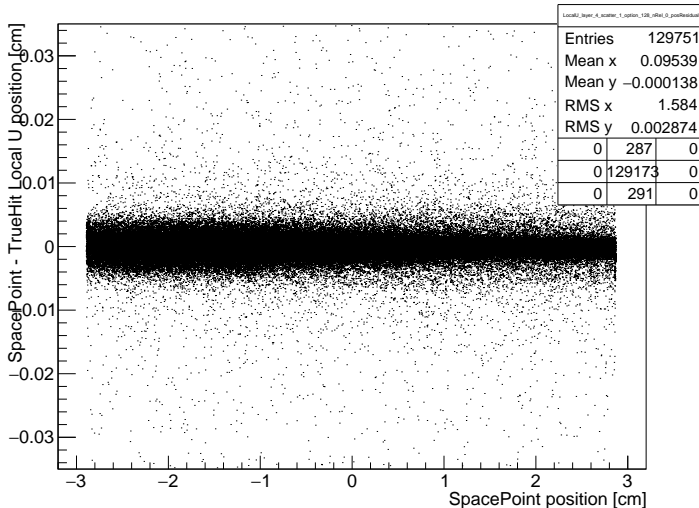
Supplementary



Position Residuals

Position Residuals vs. Position, Layer 4 U old Digitizer

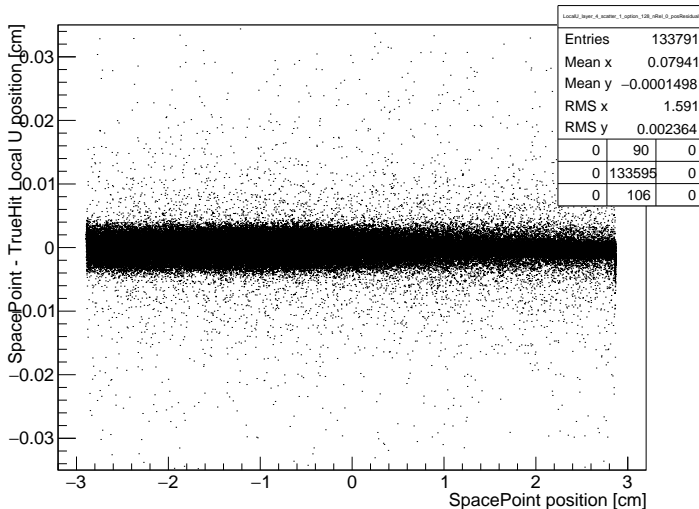
Position Residuals Local U on Layer 4, relation Status: 128



Position Residuals

Position Residuals vs. Position, Layer 4 U new Digitizer

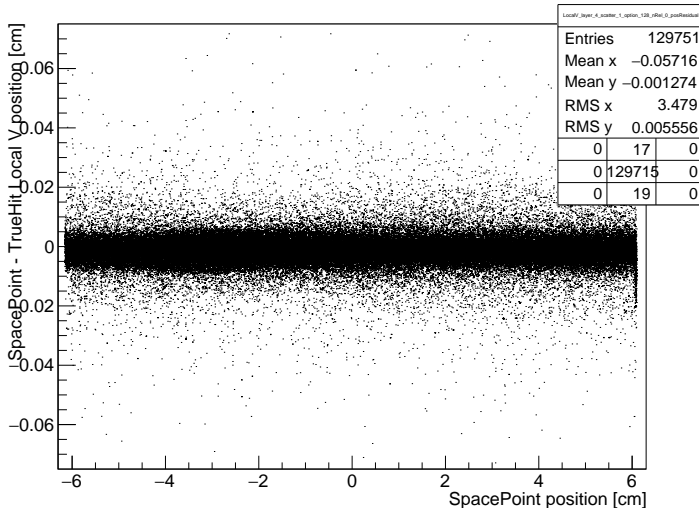
Position Residuals Local U on Layer 4, relation Status: 128



Position Residuals

Position Residuals vs. Position layer 4 V old Digitizer

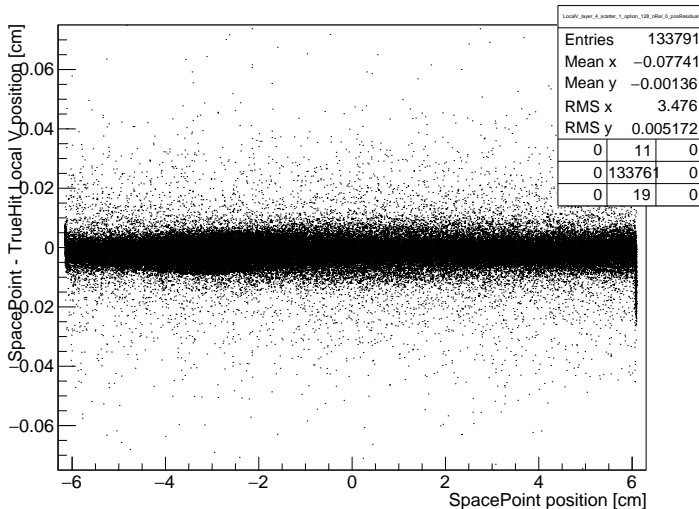
Position Residuals Local V on Layer 4, relation Status: 128



Position Residuals

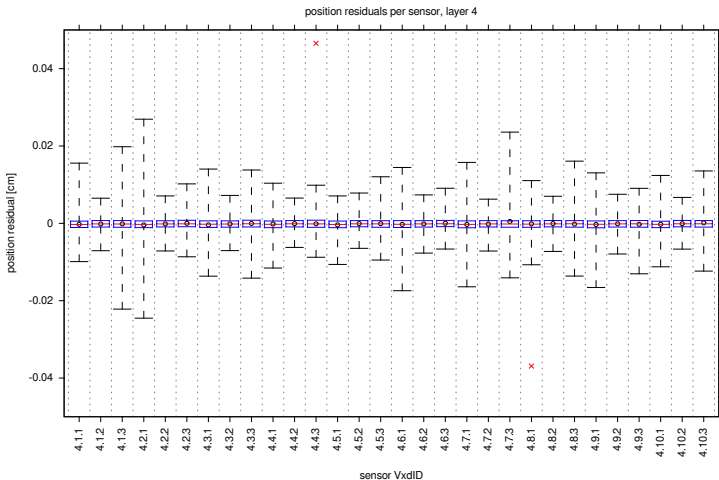
Position Residuals vs. Position layer 4 V new Digitizer

Position Residuals Local V on Layer 4, relation Status: 128



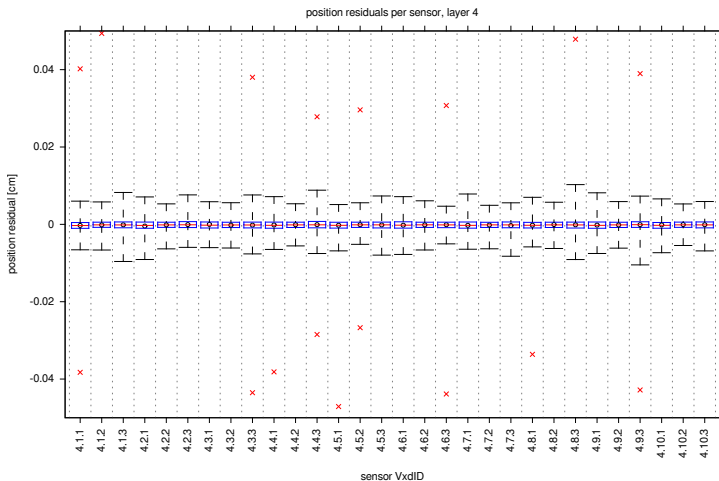
Position Residuals

distribution per sensor, layer 4 U old Digitizer



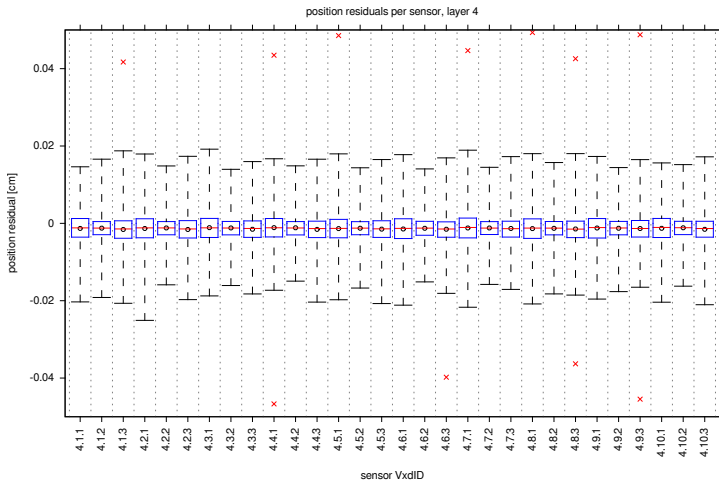
Position Residuals

distribution per sensor, layer 4 U new Digitizer



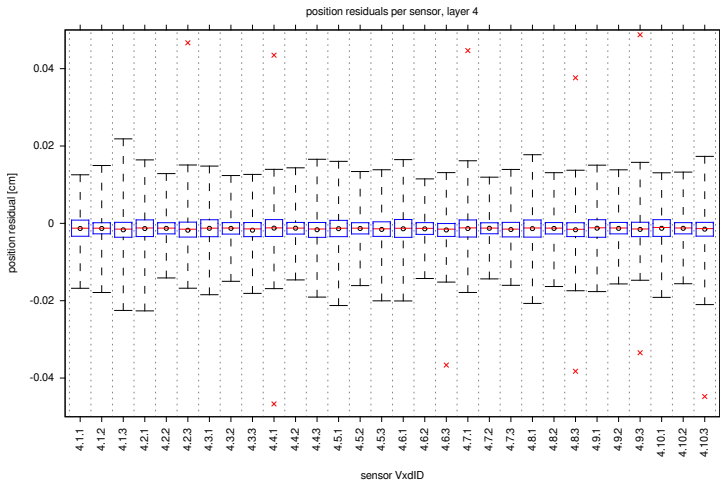
Position Residuals

distribution per sensor, layer 4 V old Digitizer



Position Residuals

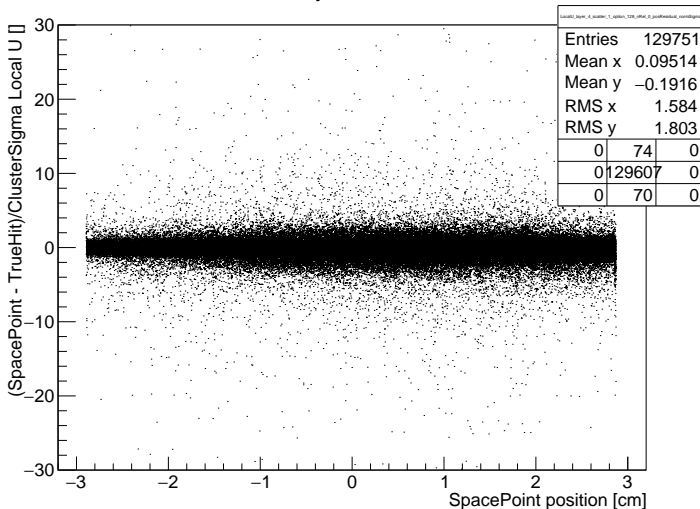
distribution per sensor, layer 4 V new Digitizer



Pulls

Pulls vs. Position, Layer 4 U old Digitizer

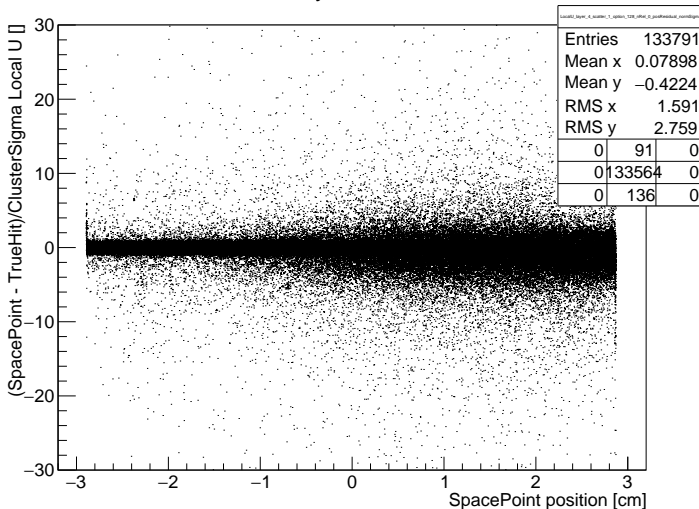
Pull Local U on Layer 4, relationStatus: 128



Pulls

Pulls vs. Position, Layer 4 U new Digitizer

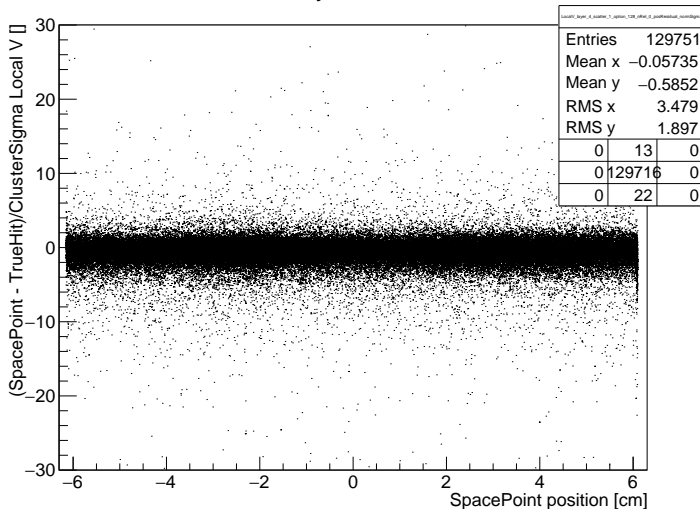
Pull Local U on Layer 4, relationStatus: 128



Pulls

Pulls vs. Position layer 4 V old Digitizer

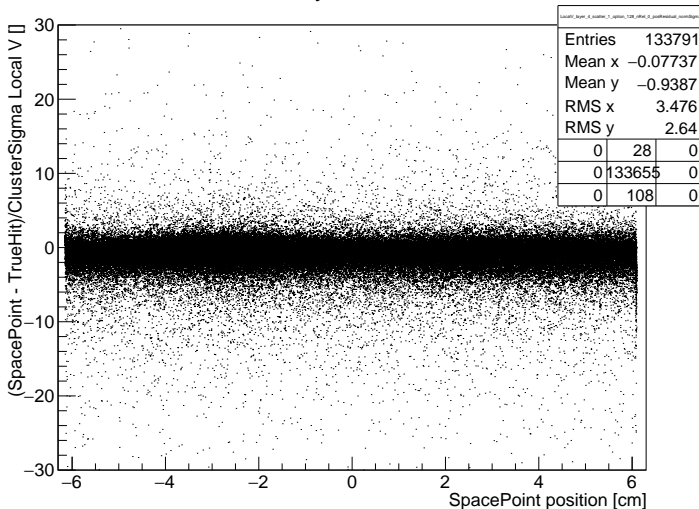
Pull Local V on Layer 4, relationStatus: 128



Pulls

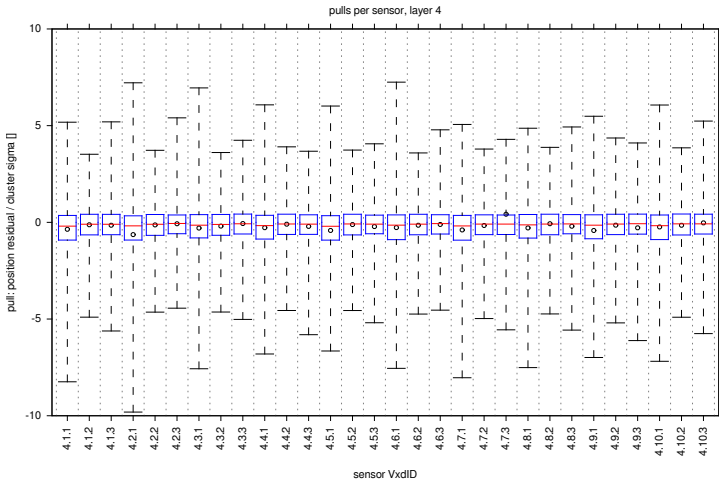
Pulls vs. Position layer 4 V **new Digitizer**

Pull Local V on Layer 4, relationStatus: 128



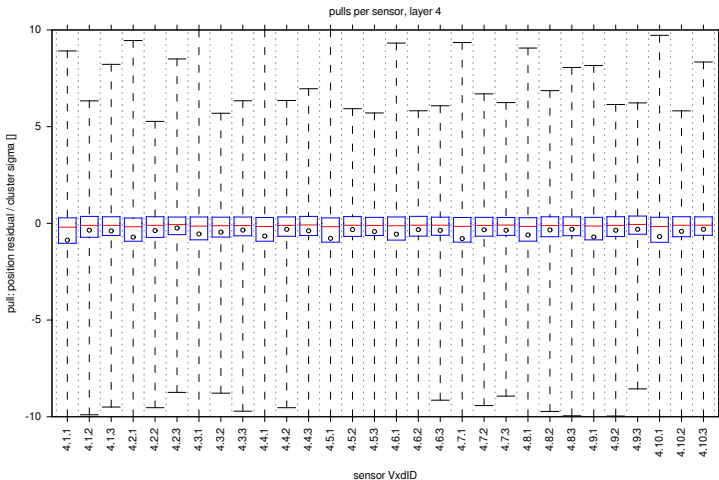
Pulls

distribution per sensor, layer 4 U old Digitizer



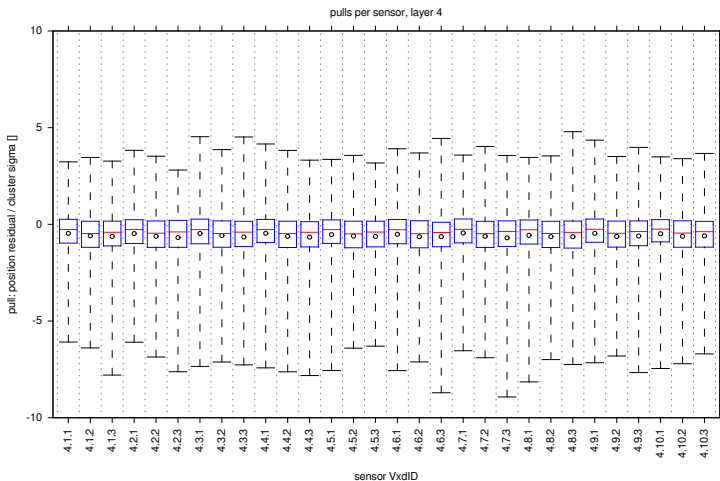
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distribution per sensor, layer 4 U new Digitizer



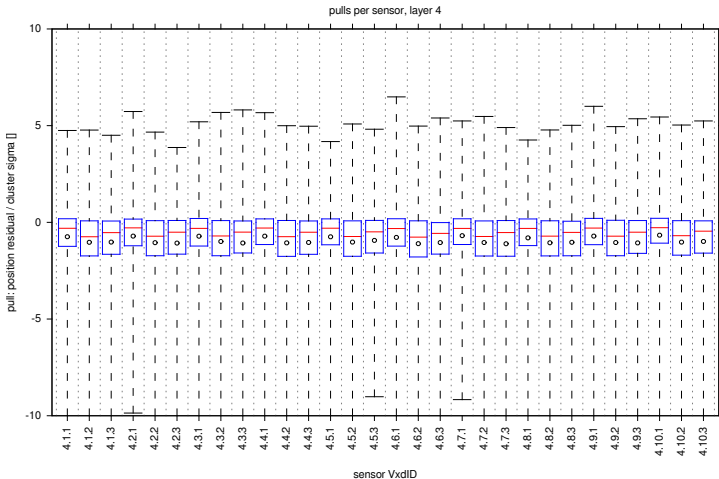
Pulls

distribution per sensor, layer 4 V old Digitizer



Pulls

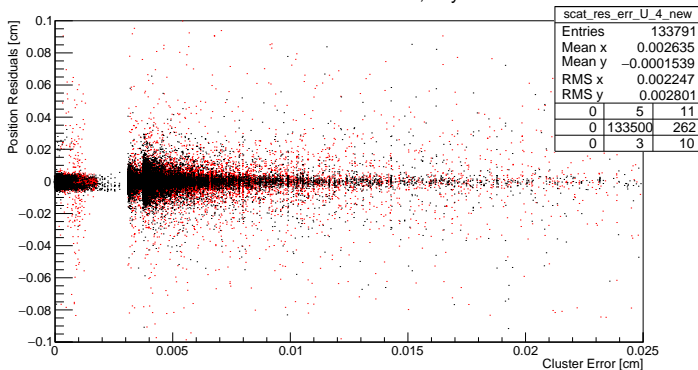
distribution per sensor, layer 4 V new Digitizer



Two classes of errors in SVD?

Position Residuals vs. Errors

Position Residuals vs. Error, Layer 4 U



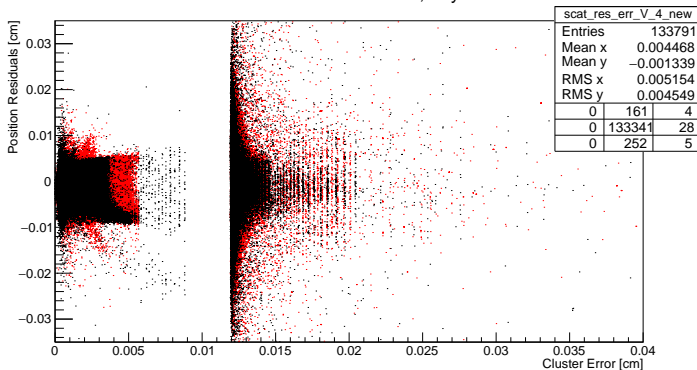
comparing **old Digitizer** and new Digitizer



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Position Residuals vs. Error, Layer 4 V



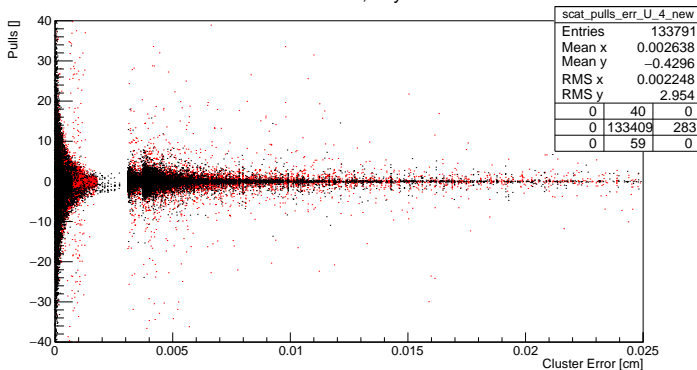
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Pulls vs. Error, Layer 4 U



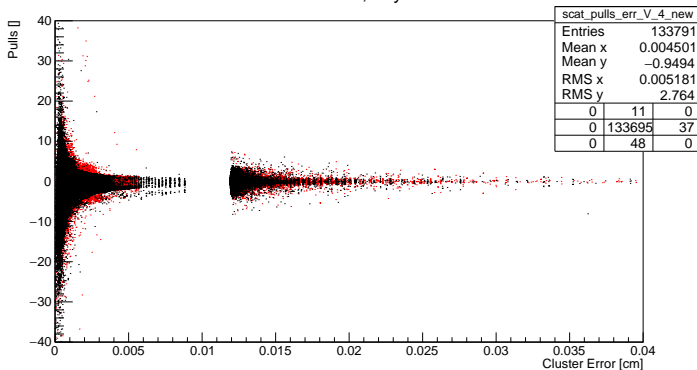
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Two classes of errors in SVD?

Pulls vs. Errors

Pulls vs. Error, Layer 4 V



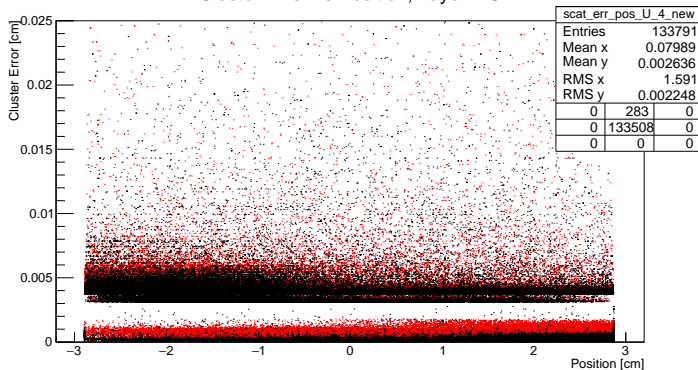
comparing **old Digitizer** and new Digitizer



Two classes of errors in SVD?

Errors vs. Position

Cluster Error vs Position, Layer 4 U



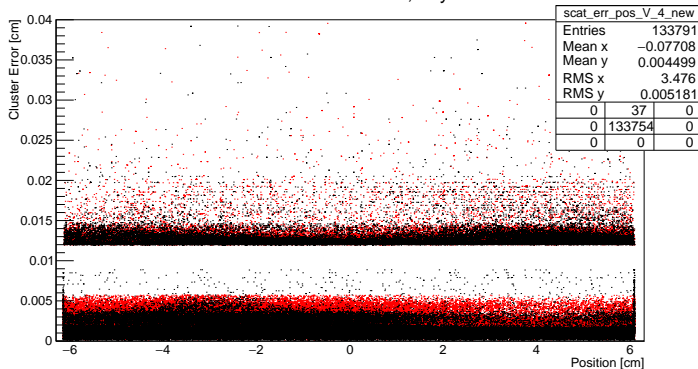
comparing **old Digitizer** and new Digitizer



Two classes of errors in SVD?

Errors vs. Position

Cluster Error vs Position, Layer 4 V



comparing **old Digitizer** and new Digitizer



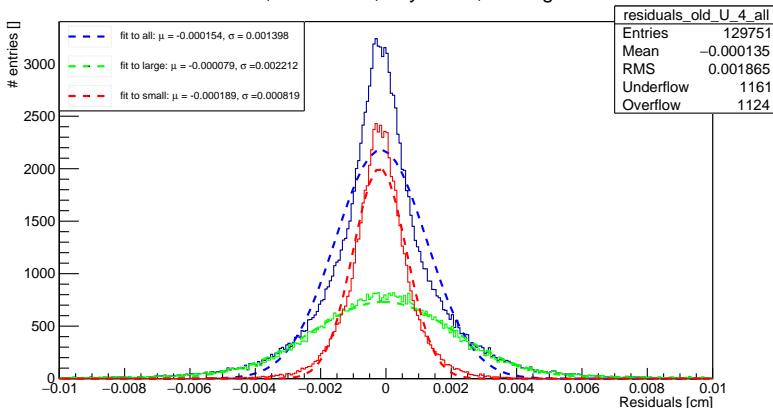
second structure in large errors in U direction (compare with plots for layer 3 in U direction) that look like another class of errors stem solely from slanted parts!



Two classes of error in SVD?

old Digitizer

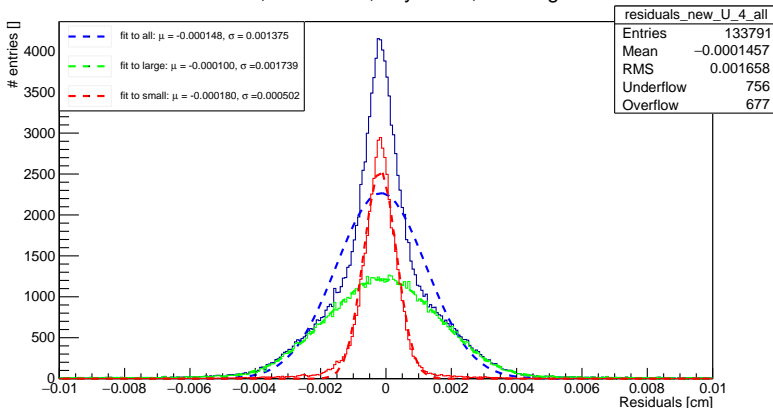
Residuals, all classes, Layer 4 U, old Digitizer



Two classes of error in SVD?

new Digitizer

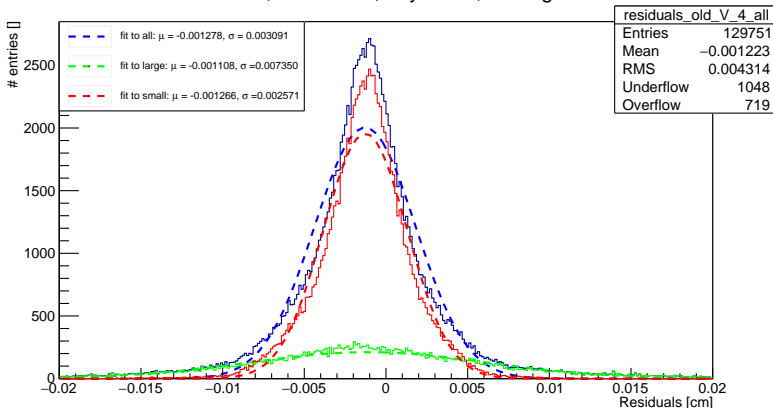
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Two classes of error in SVD?

Position Residuals old Digitizer

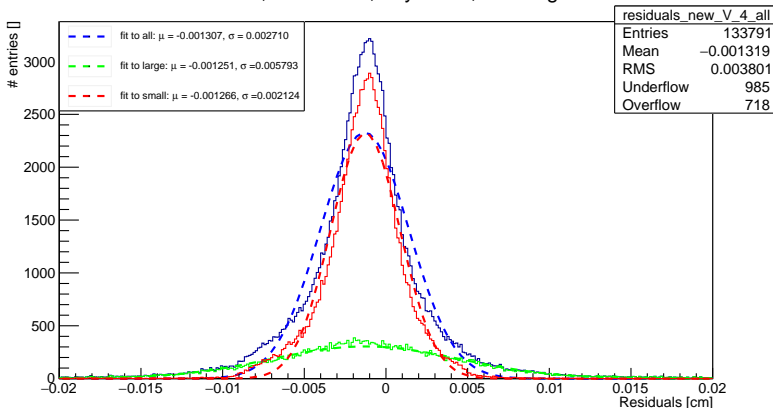
Residuals, all classes, Layer 4 V, old Digitizer



Two classes of error in SVD?

Position Residuals new Digitizer

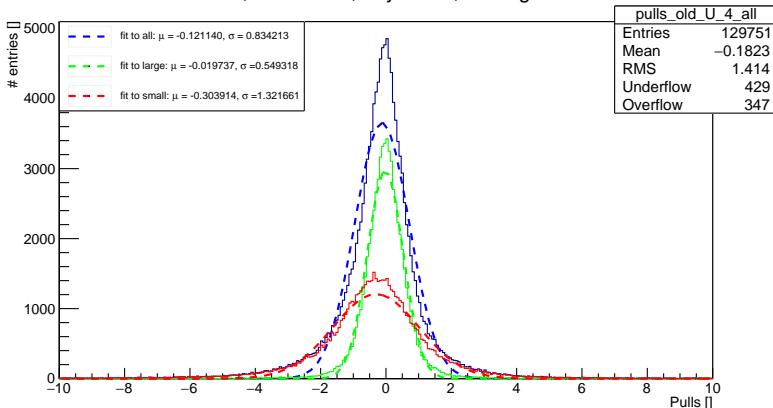
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Two classes of error in SVD?

Pulls old Digitizer

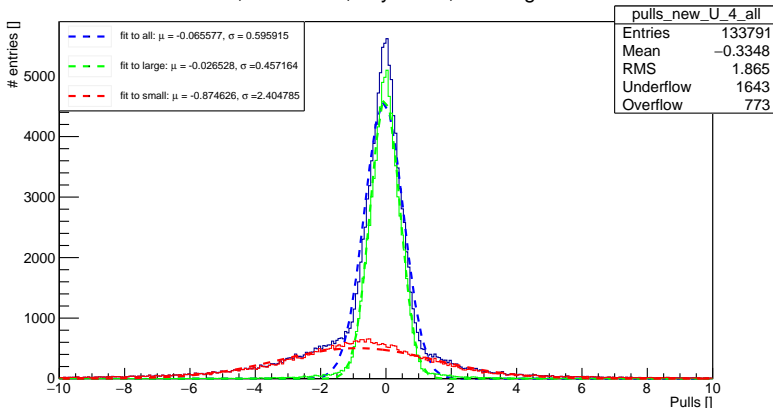
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Two classes of error in SVD?

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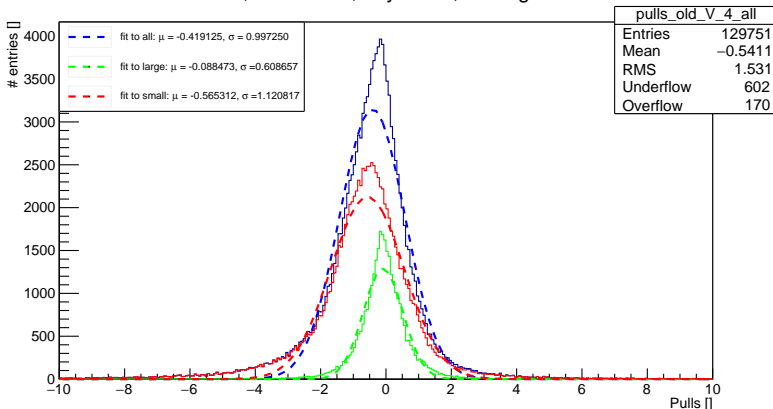
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