Spatial resolution of Belle II Silicon Vertex Detector

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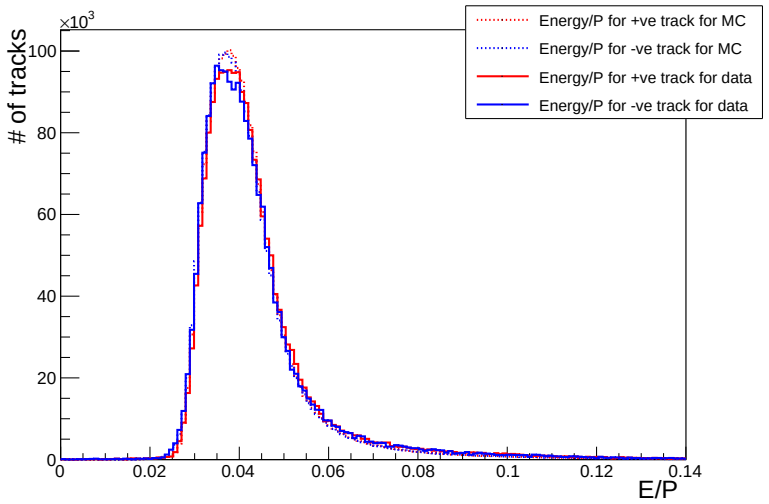
Software

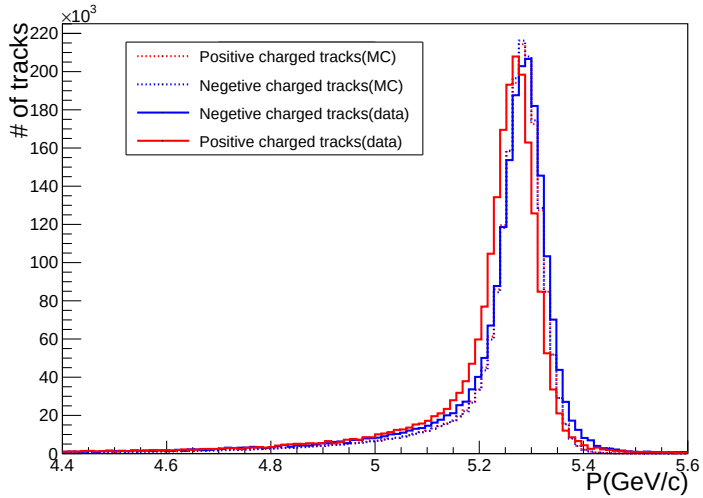
- **hlt_mumu_2trk** skim raw data used from KEKCC(/ghi/fs01/belle2/bdata/Data/release-02-00-01/DB00000425/prod00000005/e0003/4S/r*/all/raw/sub00/raw.physics.hlt_mumu_2trk*)
- The runs without SVD were excluded from analysis
- Details of skim discussed here `https://confluence.desy.de/display/BI/Experiment+3+skims`
- Release used to analysis is **/cvmfs/belle.cern.ch/sl6/releases/releases-02-00-01**

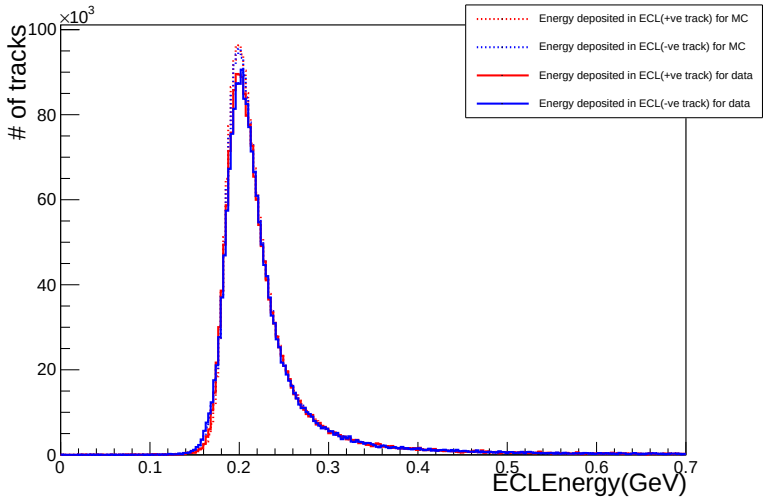
Further Selection criteria applied

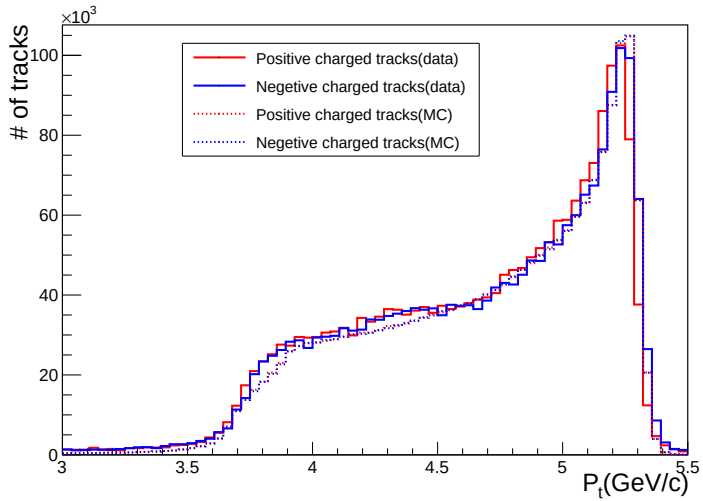
- # of tracks=2
- $35^\circ < \theta < 125^\circ$
- acollinearity$< 10^\circ$
- 0 GeV$<$EClenergy$<$ 0.7GeV
- $|d_0|<$ 2 cm and $|z_0|<$ 4 cm

Data-MC agreement

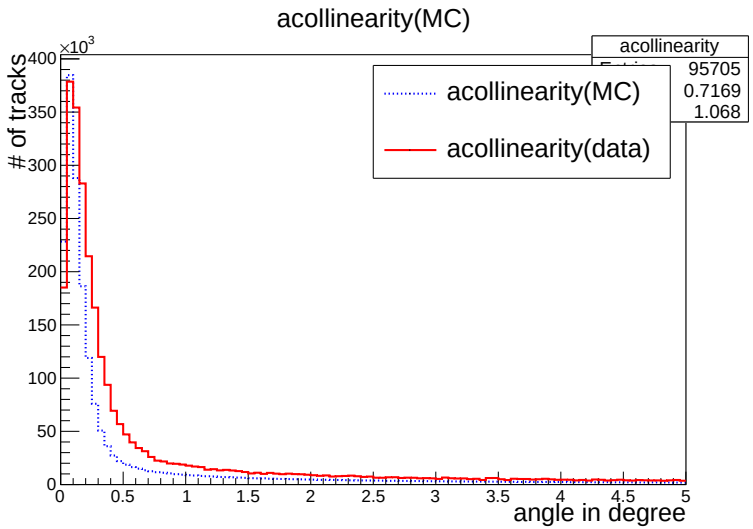


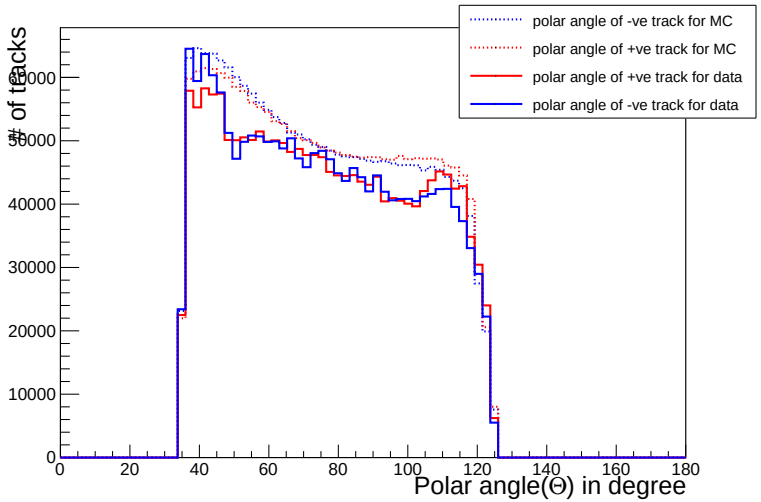






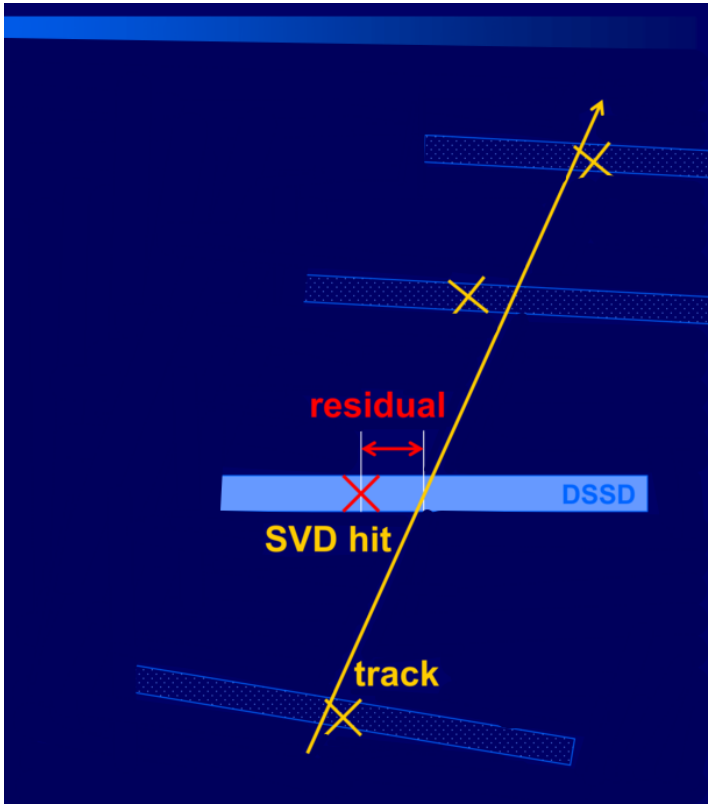
Data-MC agreement





Finding residual

- Fit track without the clusters of a layer for which residual wish to calculate(to remove biasness)
- **Residual = (SVD_Cluster_position − SVD_Intercept_position)** where SVD_Intercept_position is position of extrapolation of track to SVD



Residual plot and efficiency

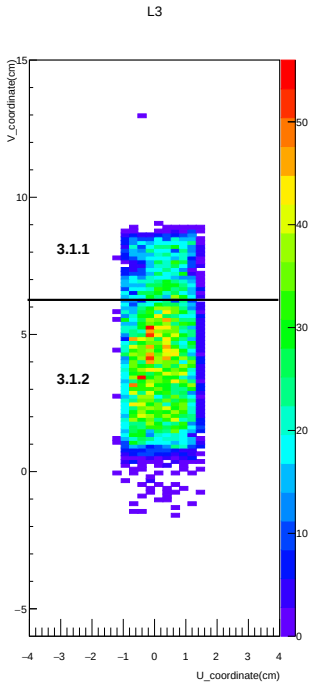
1) Loop on SVD_Intercepts
2) Continue the loop if it does not satisfy following criteria
   => the intercept is within 10 strips from sensor edge
   => the intercept having at least one pxd hit and at least two svd hits

   i) Loop on all the clusters(which are inside ROIs) in the event and
      - > If layer, ladder, sensor matches with SVD_Intercept then residual calculated as **Residual = (SVD_Cluster_position − SVD_Intercept_position)**
      - > For multiple clusters on same sensor, same side(U/V) that cluster is taken as an entry of residual plot for which residual is minimum

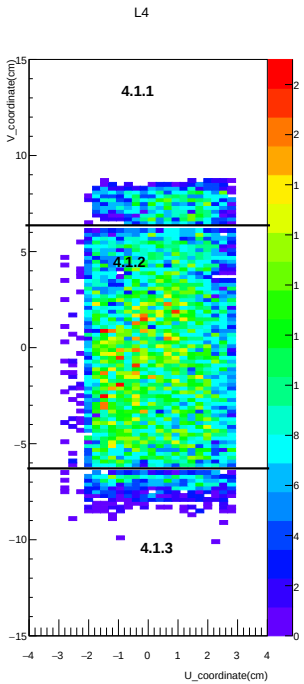
- Efficiency$=\frac{\#\text{ of cluster within } \pm 0.05cm \text{ in residual plot}}{\#\text{ of intercepts}}$

N.B: size of roi is 2.5x2.5 cm^2

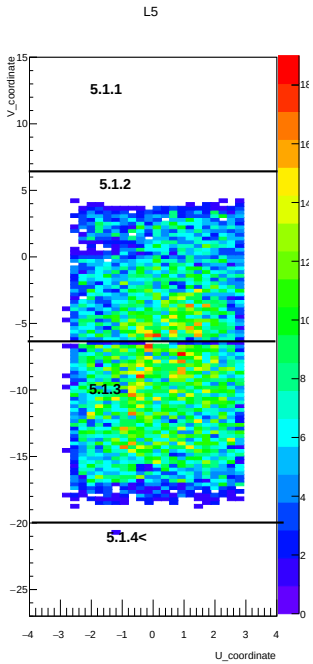
Intercept V_coordinate vs U_coordinate



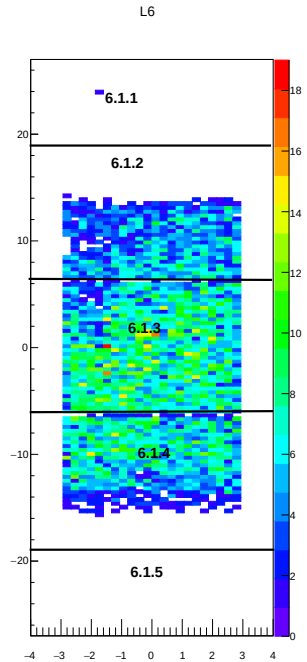
L3



L4



L5

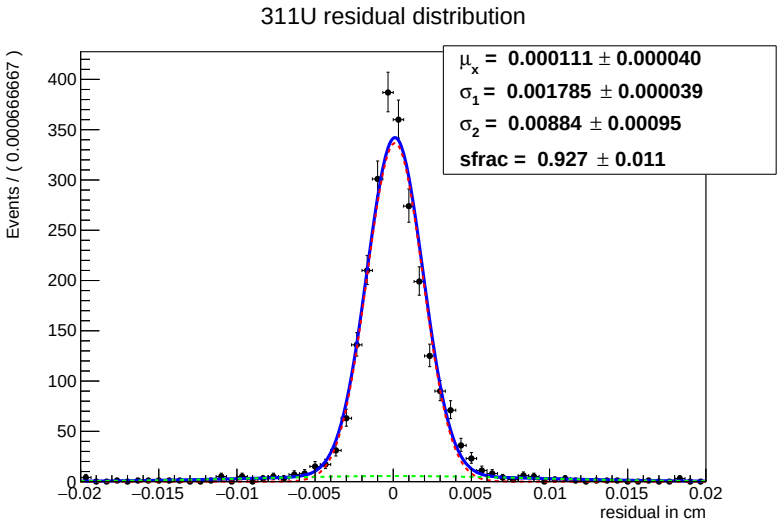


L6

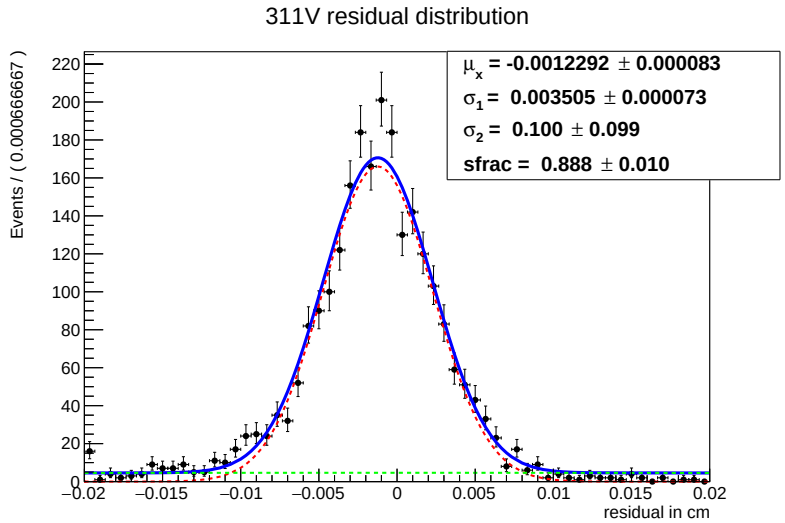
Misalignment issue solved by doing little modification in a class under tracking package.

311 DATA

of intercepts 2468



312U residual distribution



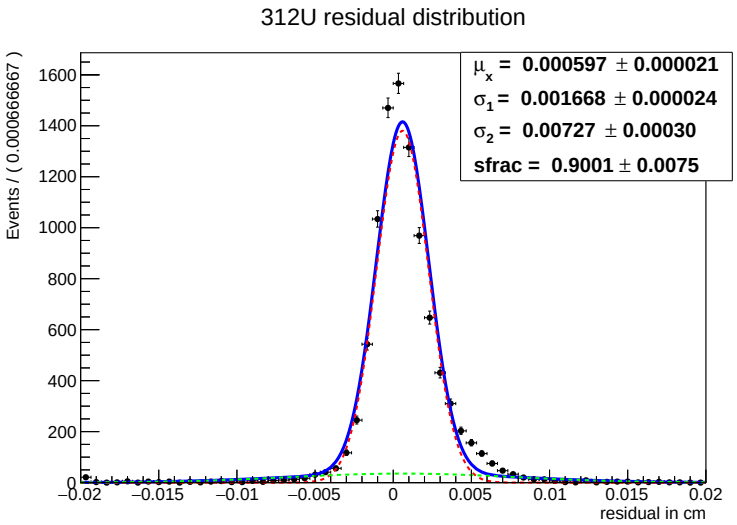
312V residual distribution

- Efficiency=98.58%

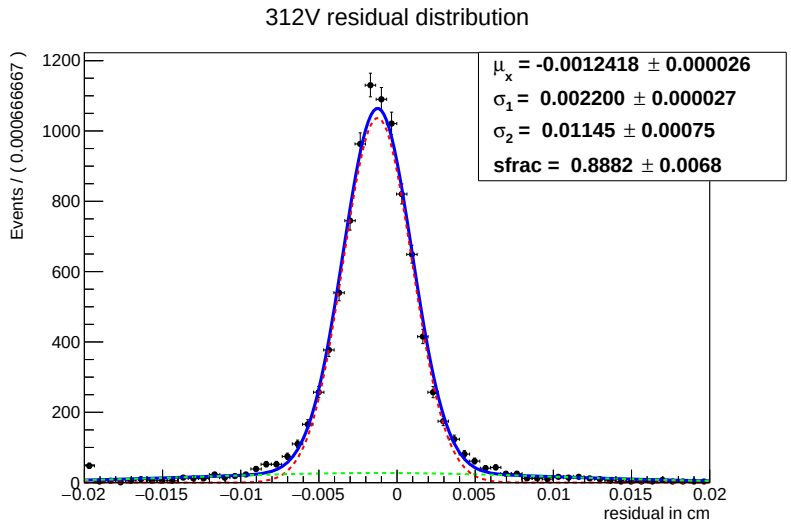
- Gaussian is shifted left side
- Efficiency=99.51%

312 DATA

of intercepts 9727



312U residual distribution



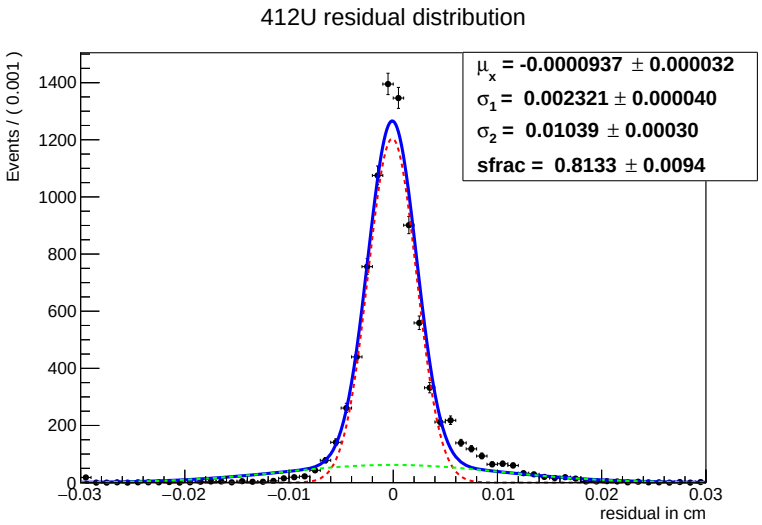
312V residual distribution

- Asymmetric tail in positive side
- Efficiency=98.77%

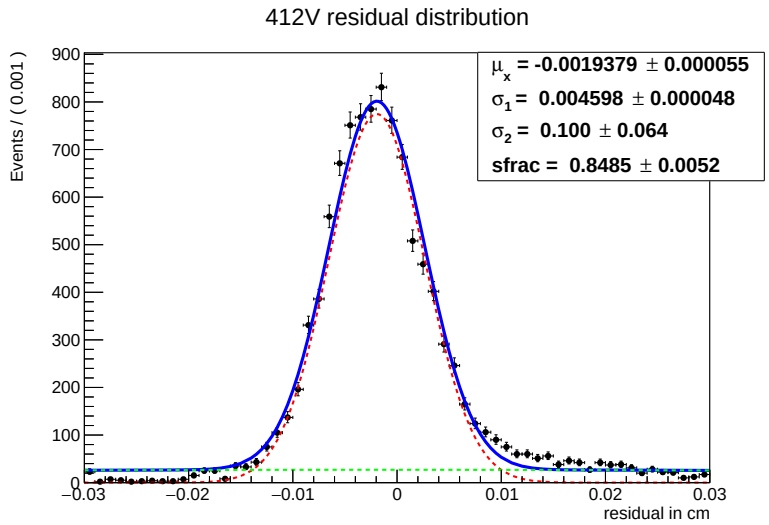
- Gaussian is shifted left side
- Efficiency=99.08%

412 DATA

of intercepts 10775



412U residual distribution

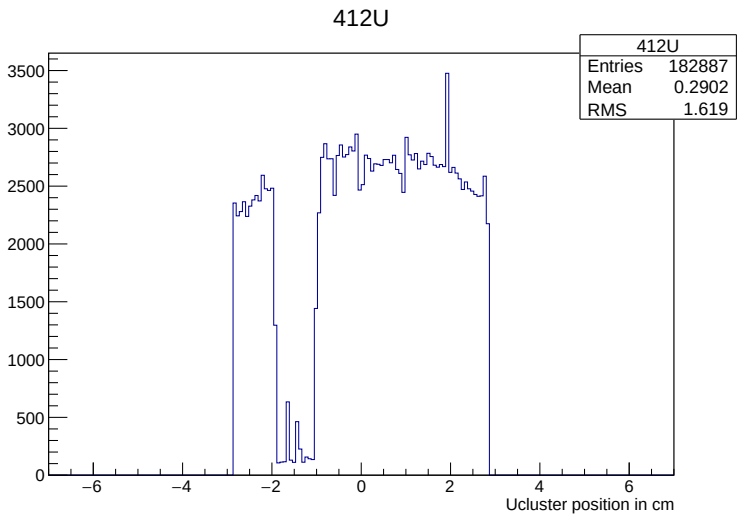


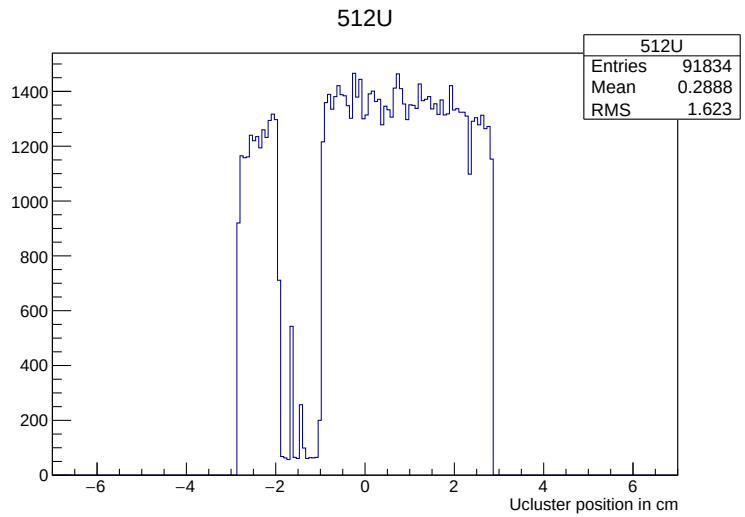
412V residual distribution

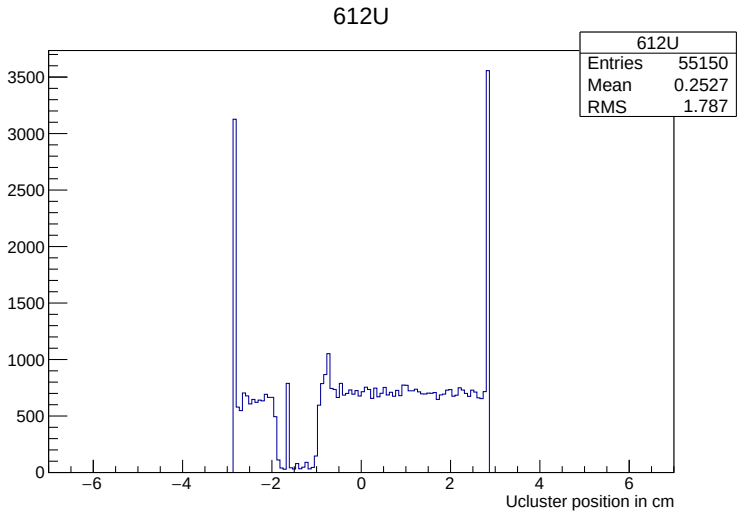
- Efficiency=79.38%
- Recalculated Efficiency=98.51%

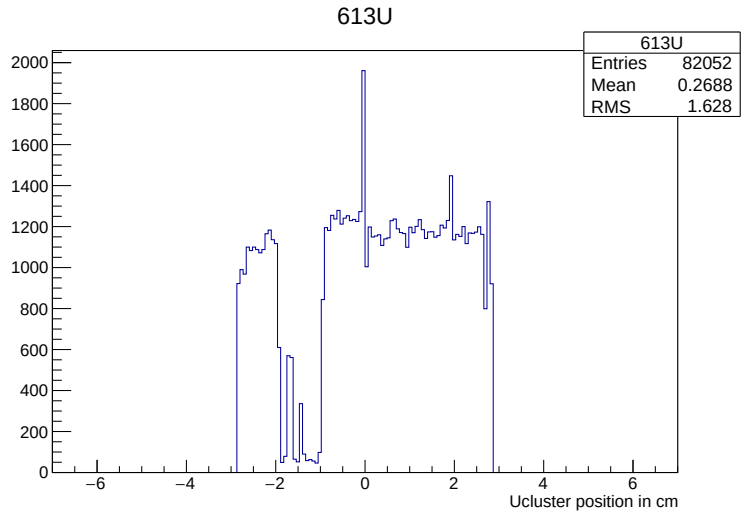
- Gaussian is shifted left side
- Efficiency=97.36%

Cluster position distribution







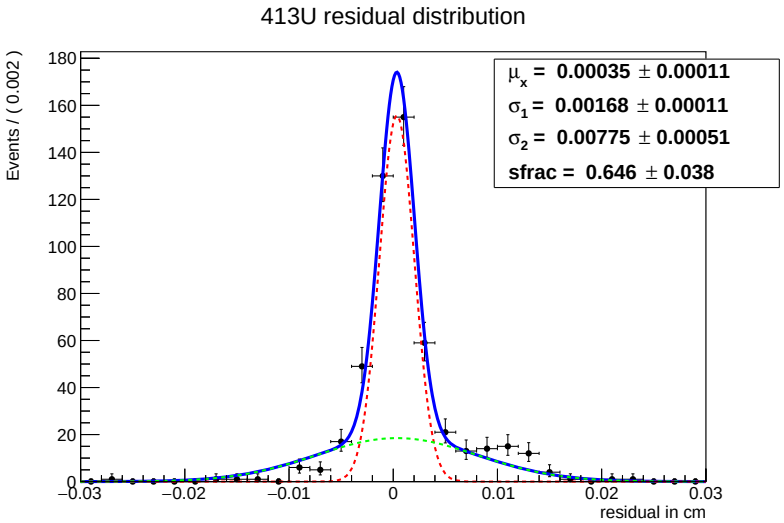


Recalculating efficiency for above sensors

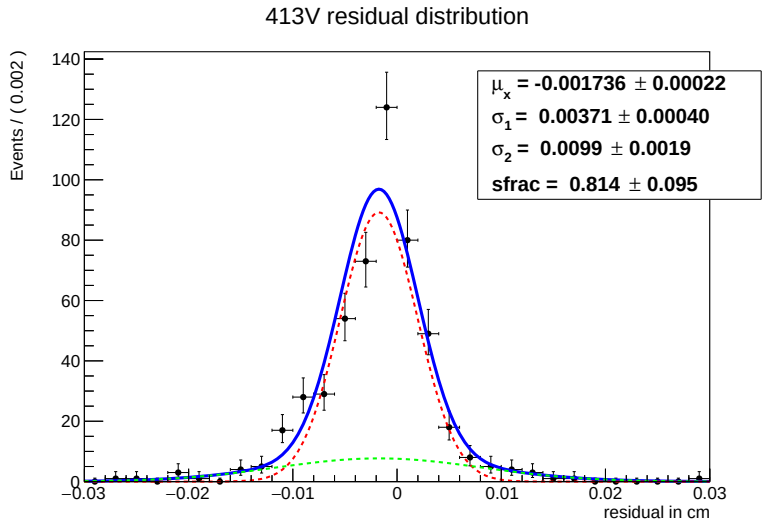
- For above sensors one APV was masked for most of runs. That's why I have recalculated efficiency excluding intercepts lie their.

413 DATA

of intercepts 511



413U residual distribution



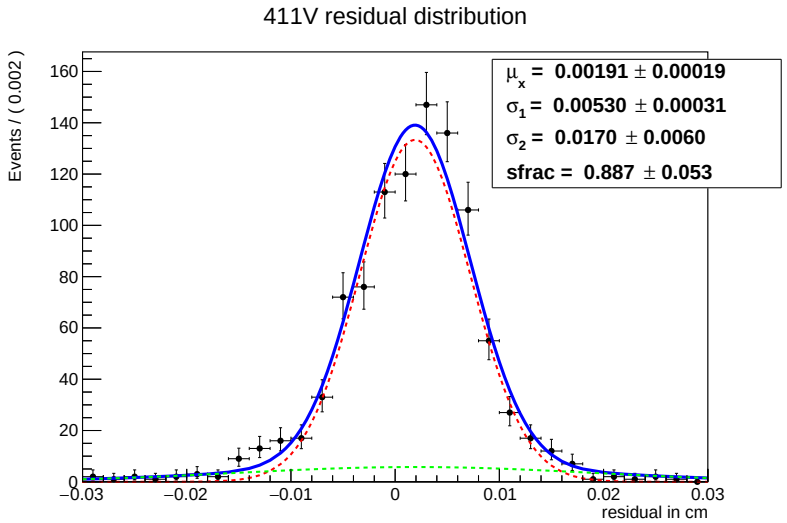
413V residual distribution

- Efficiency=99.21%

- Efficiency=99.28%
- Gaussian is shifted left side

411 DATA

of intercepts 999

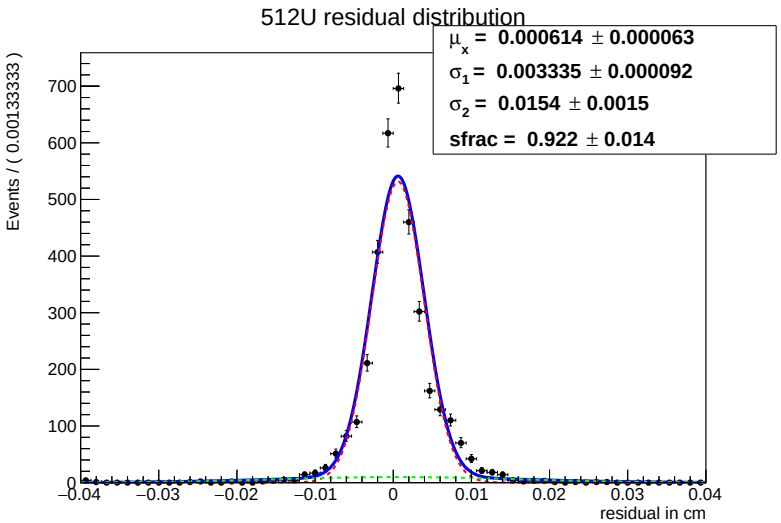


413V residual distribution

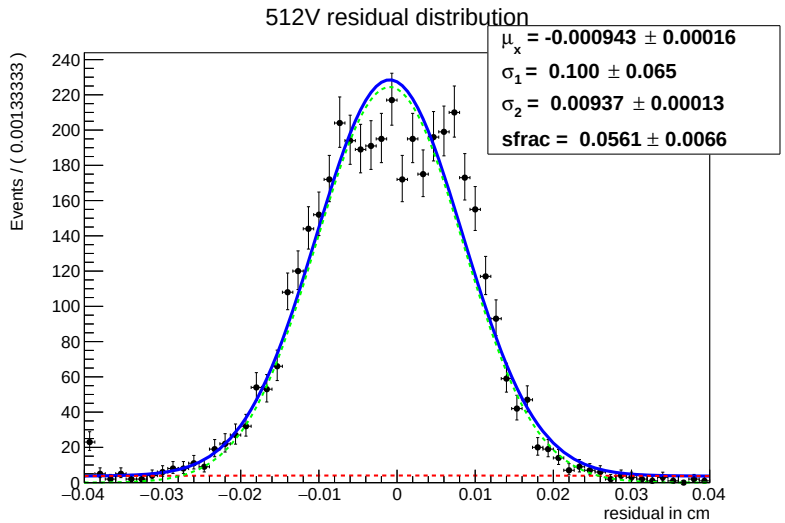
- Efficiency=99.89%
- Gaussian is shifted right side

512 DATA

of intercepts 4211



512U residual distribution



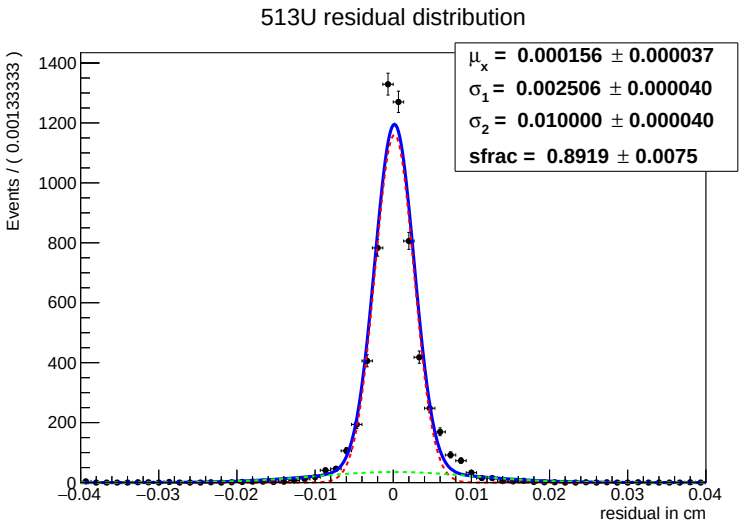
512V residual distribution

- Efficiency=85.30%
- Recalculated Efficiency=98.82%

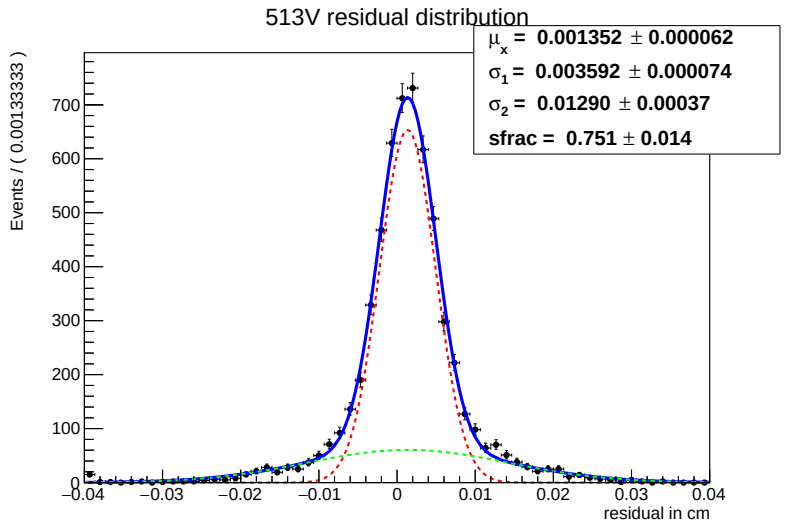
- Efficiency=99.28%

513 DATA

of intercepts 6232



513U residual distribution



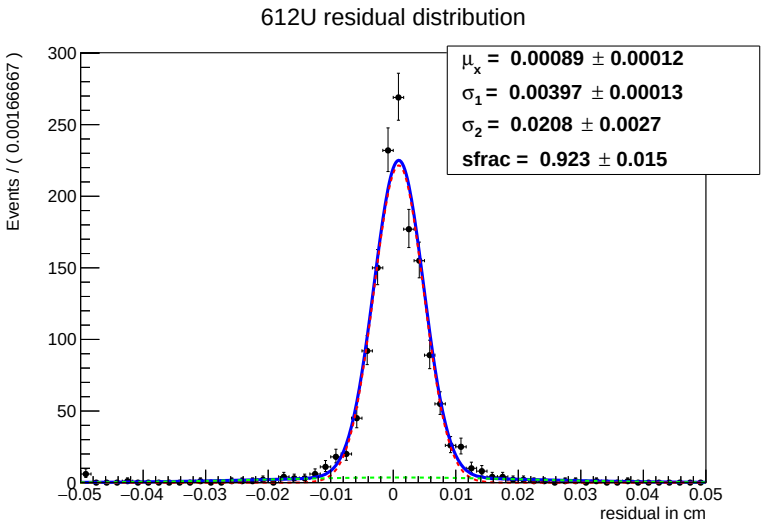
513V residual distribution

- Efficiency=97.63%

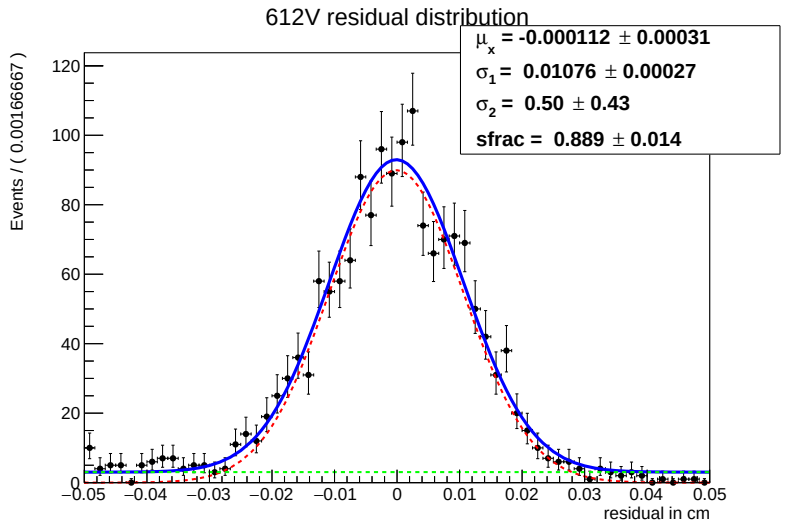
- Efficiency=93.91%
- Gaussian shifted in positive direction

612 DATA

of intercepts 1649



612U residual distribution



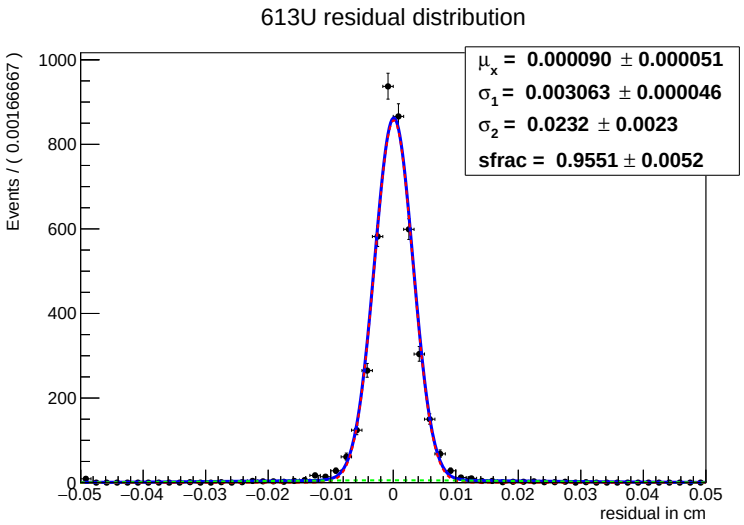
614V residual distribution

- Efficiency=86.29%
- Recalculated Efficiency=99.40%

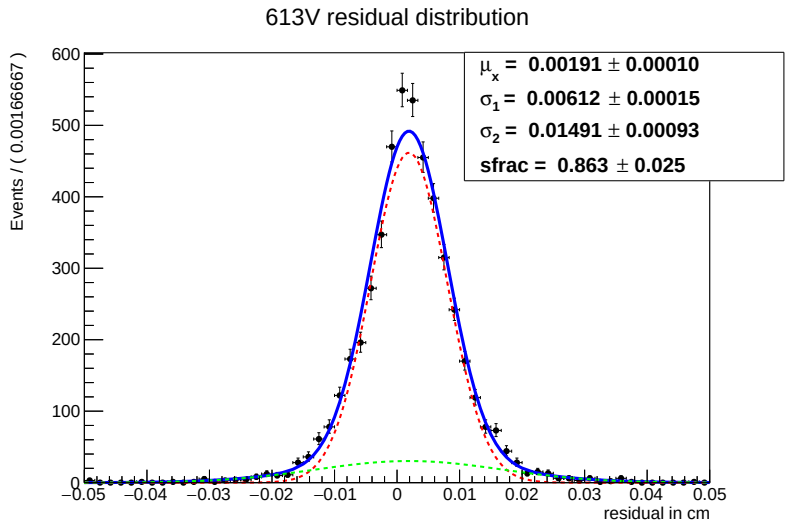
- Efficiency=98.54%

613 DATA

of intercepts 4957



613U residual distribution



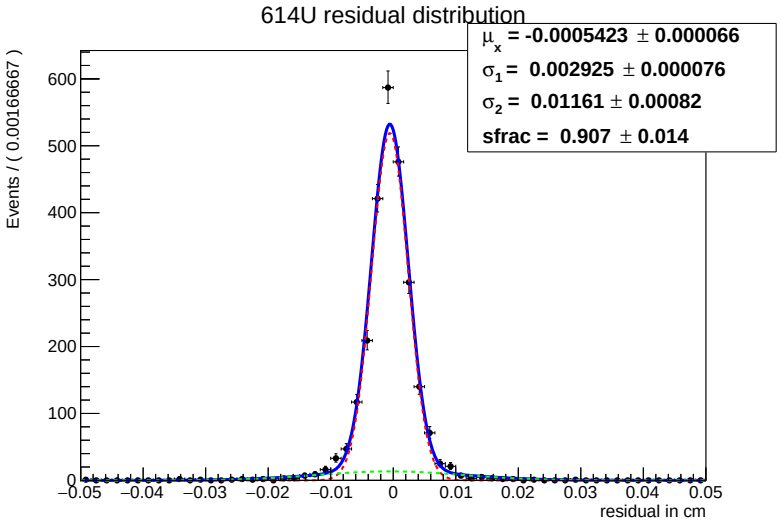
613V residual distribution

- Efficiency=82.93%
- Recalculated Efficiency=98.91%

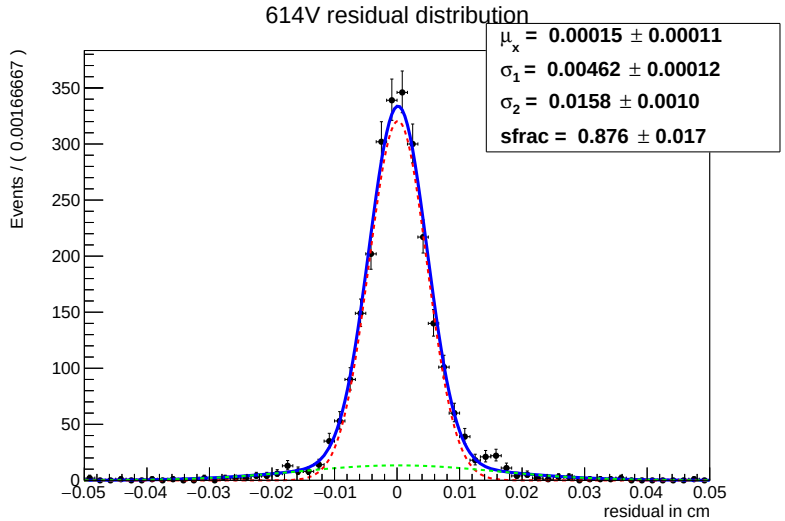
- Efficiency=98.54%

614 DATA

of intercepts 2564



614U residual distribution

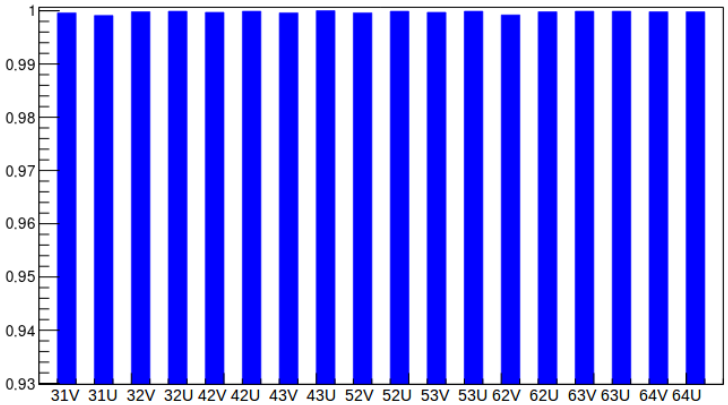


614V residual distribution

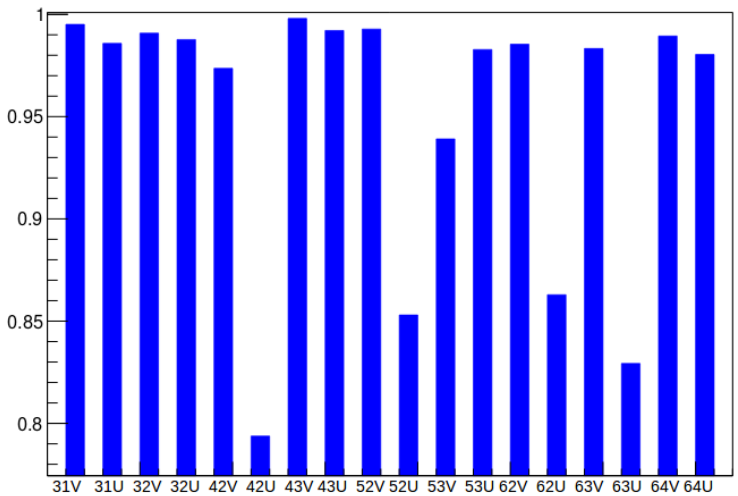
- Efficiency=98.04%

- Efficiency=98.94%

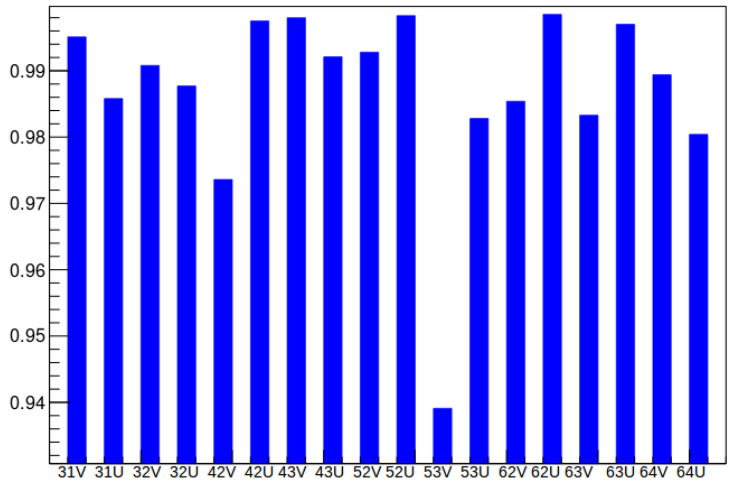
Efficiencies



MC efficiency



Efficiency using data



Efficiency using data(modified)

Conclusion and Future prospects

- 5.1.3 V has low efficiency without any apparent reason
- These efficiency is higher than whatever showed by Giulia because I reconstruct cluster for S/N $>$ 5 for all layers
- Check some residual distribution is asymmetric or sometimes shifted ?
- Try to extract spatial resolution if possible.

THANK YOU