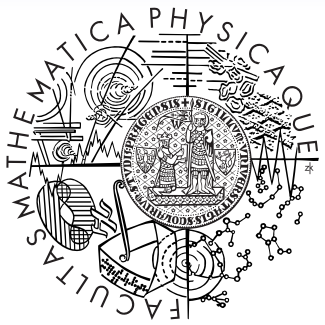

VXD Alignment: Phase II

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Outline

VXD Alignment of Phase II

Alignment validation using collision and cosmic data

Planar deformation and their effects to alignment

Summary

Status of VXD alignment

- The older alignment is published in GT "Calibration_Offline_Development".
- The newer alignment is stored locally only:

`/home/belle2/jkandra/basf2/beam/alignment/phase2/data/cosmicAndBeam/database.txt`

- We are calculate VXD alignment separately to check alignment parameters.
- The both alignments were discussed last week.
- We are focused to validation on collision and cosmic data.
- We will show validation results.
- We will show planar effects to VXD alignment.

VXD Alignment of Phase II

Alignment validation using collision and cosmic data

Planar deformation and their effects to alignment

Summary

VXD Alignment validation procedure

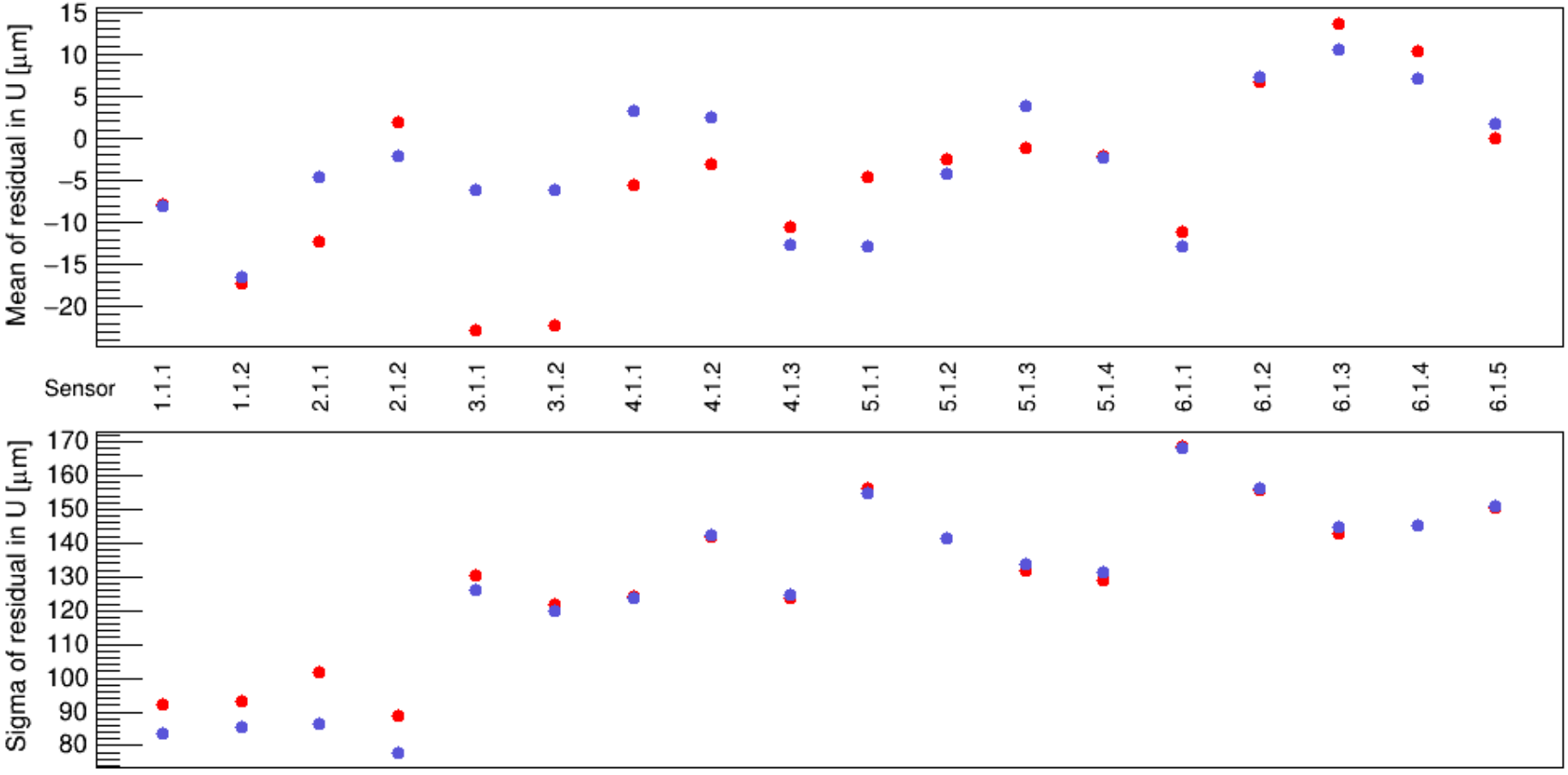
Collision data

- (Experiment 3) Runs [488, 490], 577, 578, 579, 580, 674, 677, 686, [782, 783, 785, 786], 1905, 1928, 1935, 1937, 1938, 1990, 2009, 2022, 2050, 2165, 2180, 2180, 2181, 2184, 2186, 2189 are used for validation VXD alignment.
- PXD was not included in all runs. These runs are marked as [..].
- Tracking information looks very good.
- Applied PXD and SVD masking procedure during reconstruction.

Cosmic rays data

- (Experiment 2 and 3) Runs 904, 905, 906, 919, 920, 938, 1107, 1110, [152, 153], 158, 173, 182, 185, 1512, 1514, 1516, 1516, 1517, [1520, 1525, 1527, 1528, 1529, 1614, 1615] are used for validation.
- Validation VXD alignment on cosmic are worse as on beam, because of extrapolation from CDC, ...
- Means are fine, but dispersion of residual histograms are high.

VXD alignment validation using cosmic rays

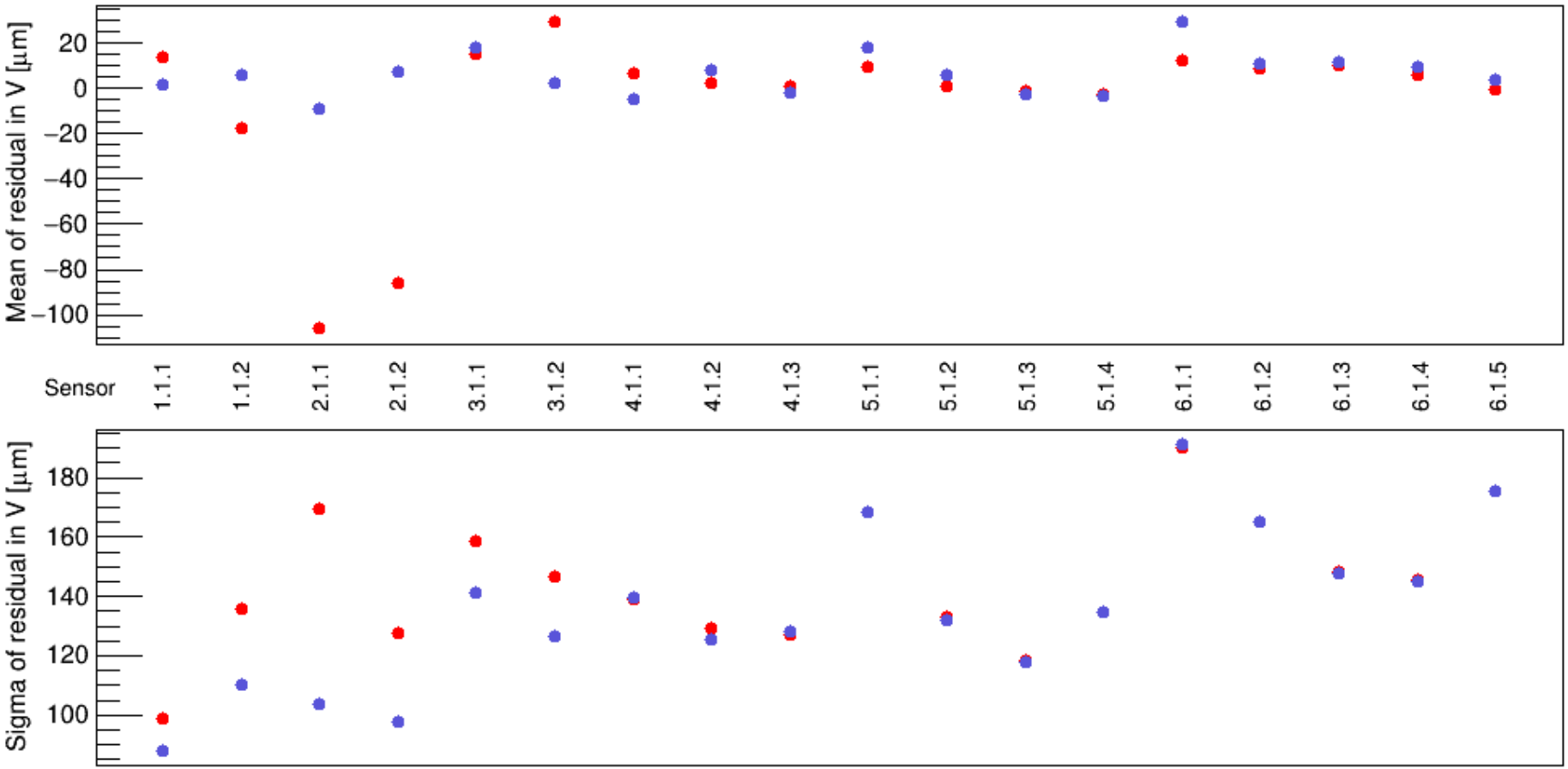


Unbiased residuals for all VXD sensors in phase 2 in U side.

Results calculated using **Global Tag** are marked as **red dots**.

Results calculated using **new alignment** are marked as **blue dots**.

VXD alignment validation using cosmic rays

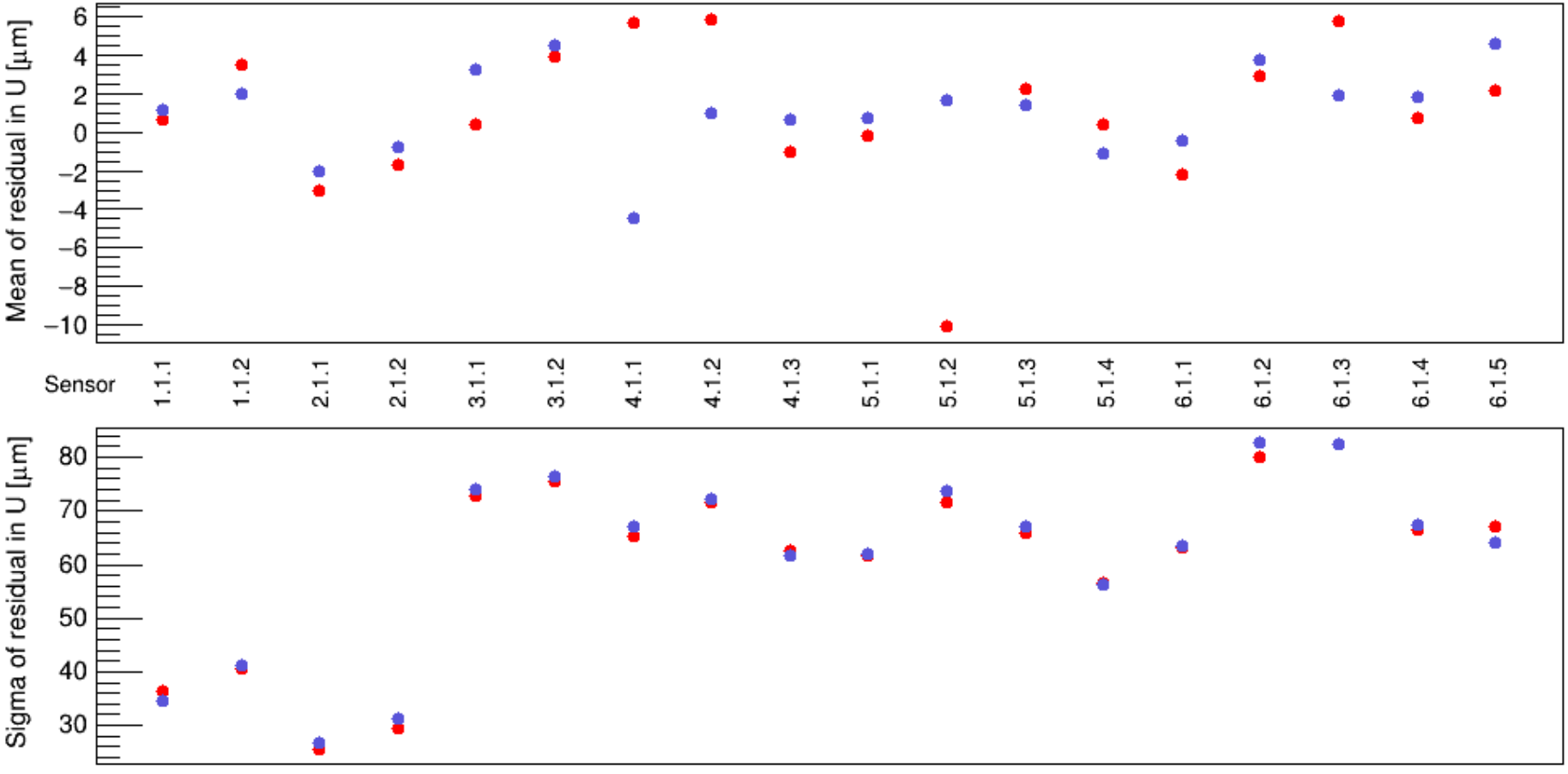


Unbiased residuals for all VXD sensors in phase 2 in V side.

Results calculated using **Global Tag** are marked as **red dots**.

Results calculated using **new alignment** are marked as **blue dots**.

VXD alignment validation using collision data

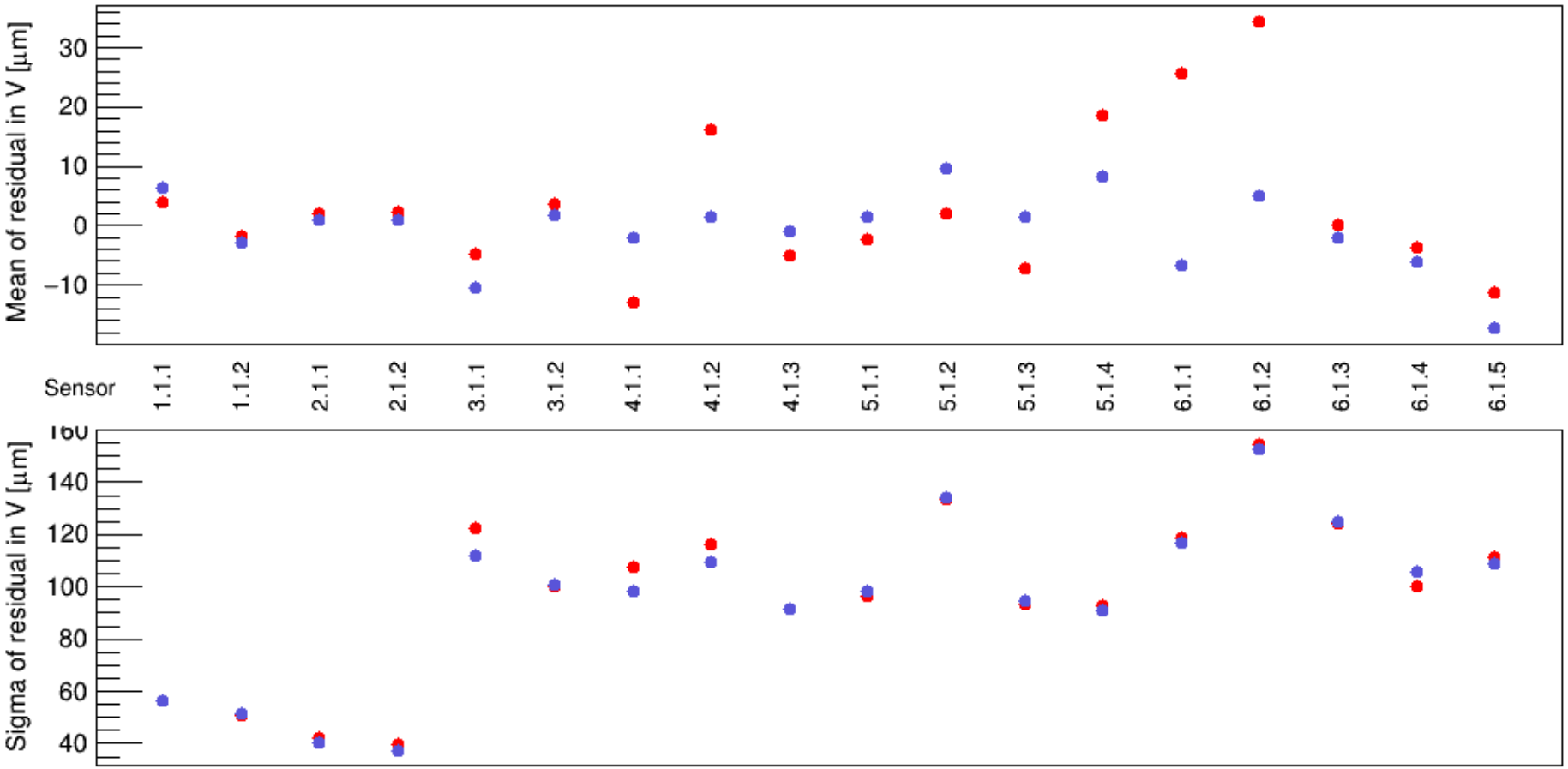


Unbiased residuals for all VXD sensors in phase 2 in U side.

Results calculated using **GT** are marked as **red dots**.

Results calculated using **new alignment** are marked as **blue dots**.

VXD alignment validation using collision data

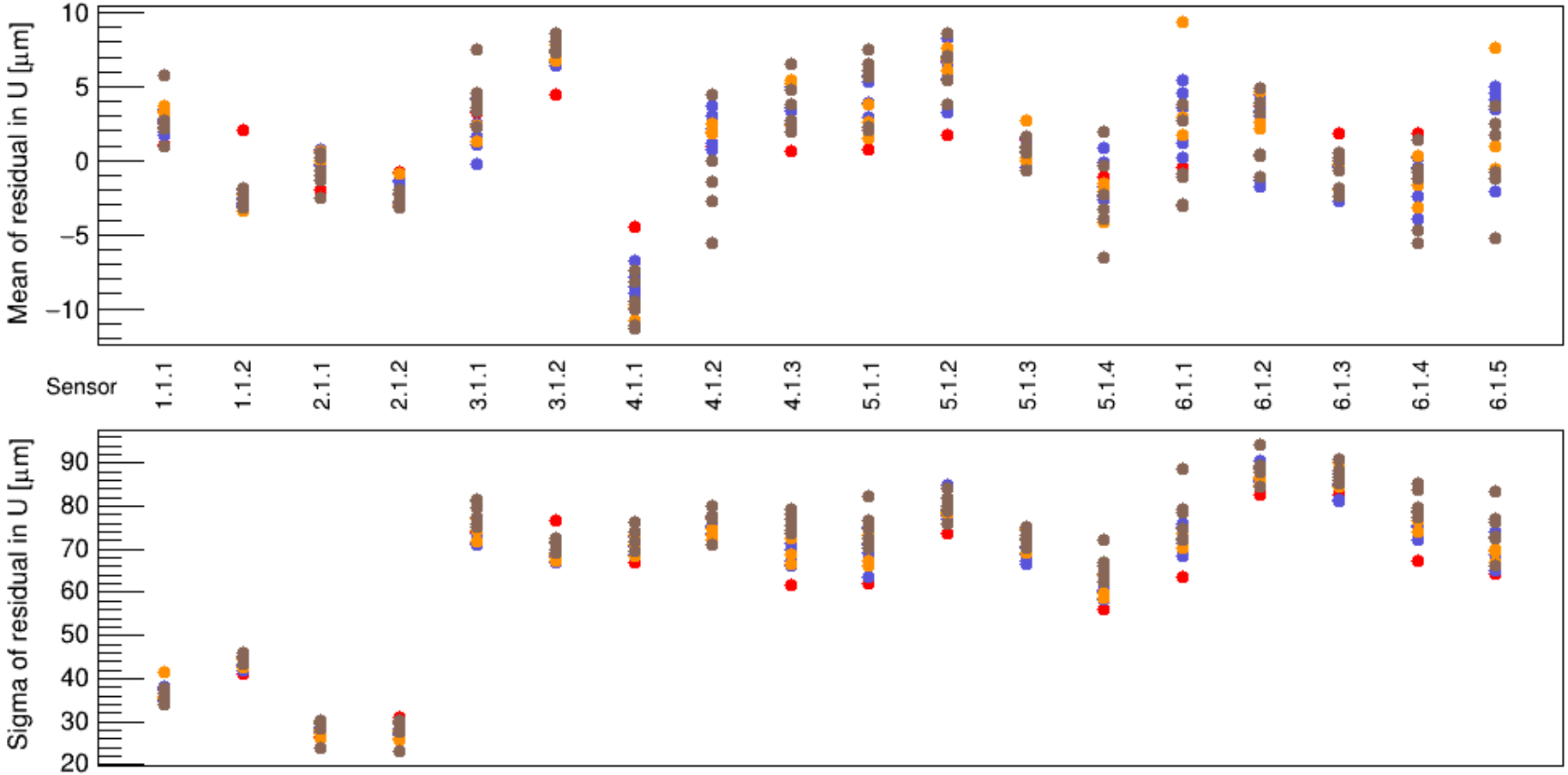


Unbiased residuals for all VXD sensors in phase 2 in V side.

Results calculated using **GT** are marked as **red dots**.

Results calculated using **new alignment** are marked as **blue dots**.

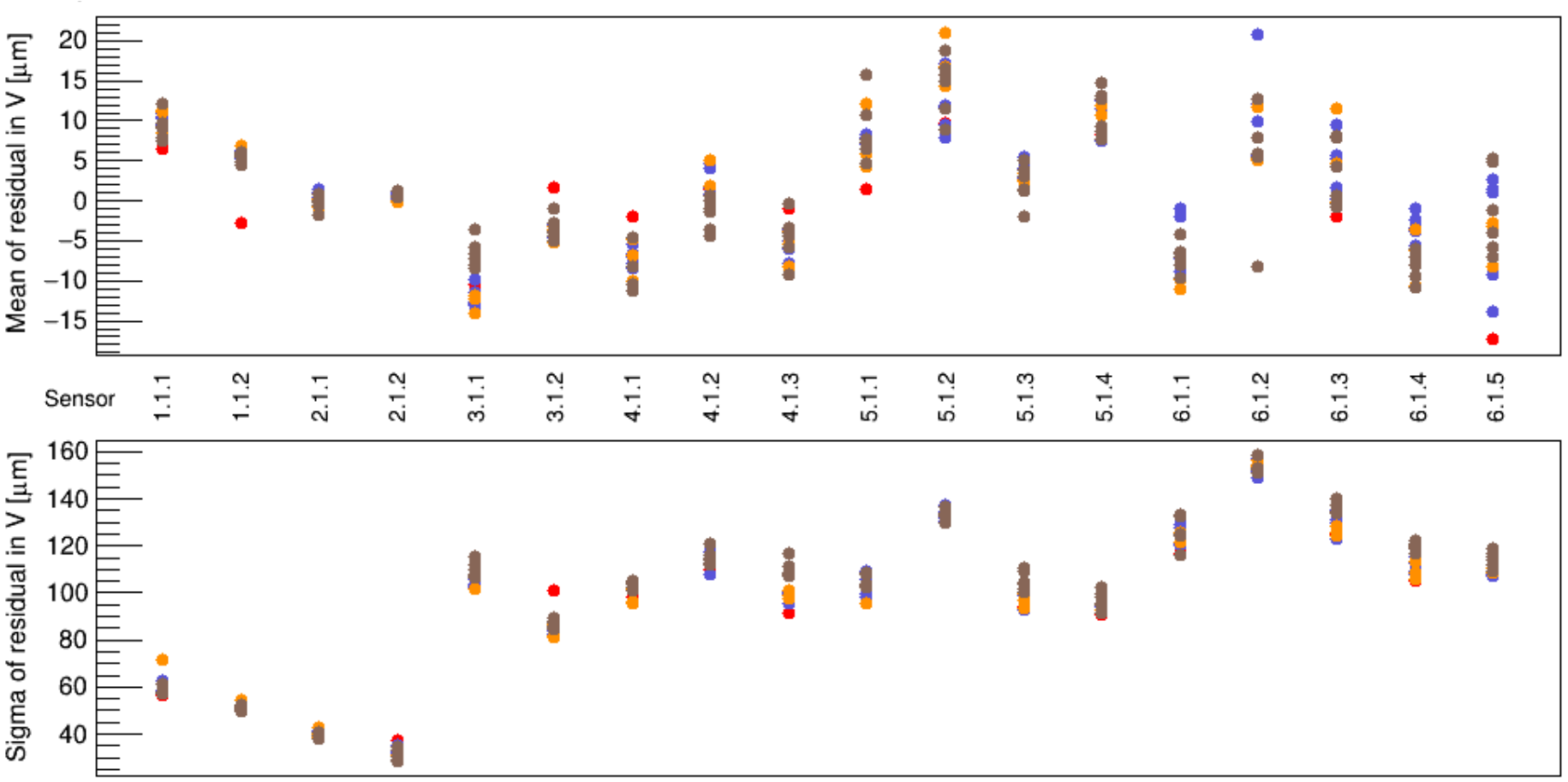
VXD alignment validation using collision data



Unbiased residuals for all VXD sensors in phase 2 in U side.

Residuals for **Aligned runs (red)**, **runs from 1900 to 2000 (blue)**, **runs from 2000 to 2100 (orange)** and **runs from 2100 to 2200 (brown)**.

VXD alignment validation using collision data



Unbiased residuals for all VXD sensors in phase 2 in V side.

Residuals for **Aligned runs (red)**, **runs from 1900 to 2000 (blue)**, **runs from 2000 to 2100 (orange)** and **runs from 2100 to 2200 (brown)**.

VXD Alignment of Phase II

Alignment validation using collision and cosmic data

Planar deformation and their effects to alignment

Summary

Planar deformation of sensors

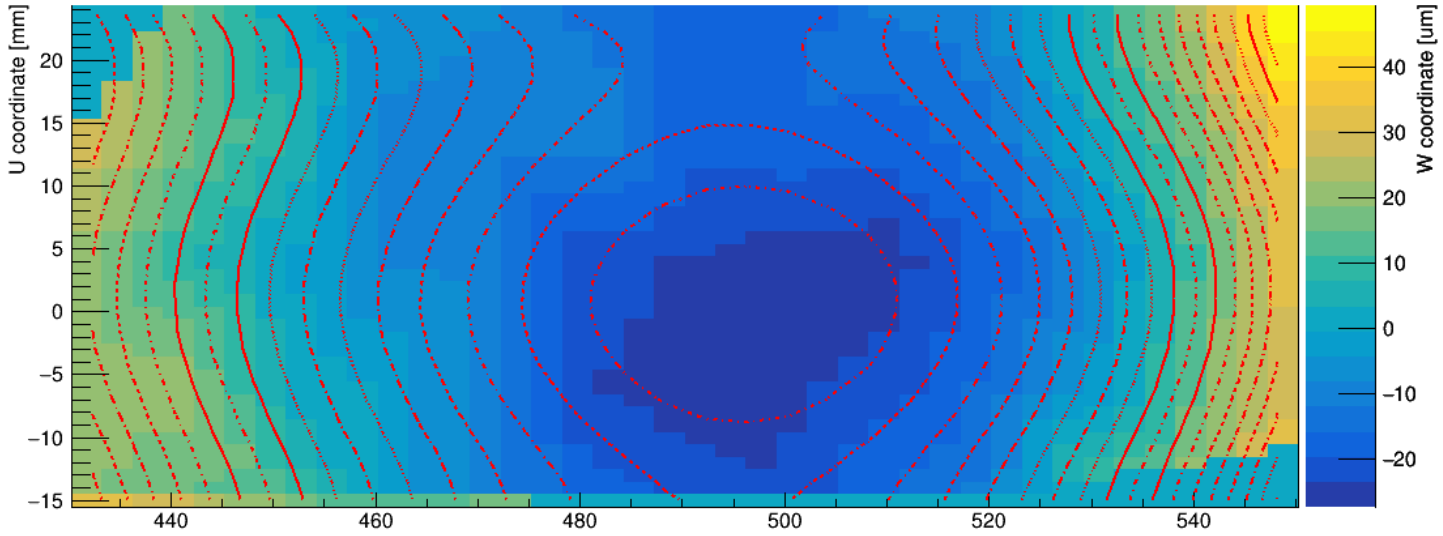
- We are looking for dependence of residuals (in U or V direction) as function of U and V coordinate of hits.
- We are looking for extrapolation from residuals to W coordinate.
- We are using formula [Claus]:

$$du = \frac{\partial u}{\partial w} dw, dv = \frac{\partial v}{\partial w} dw$$

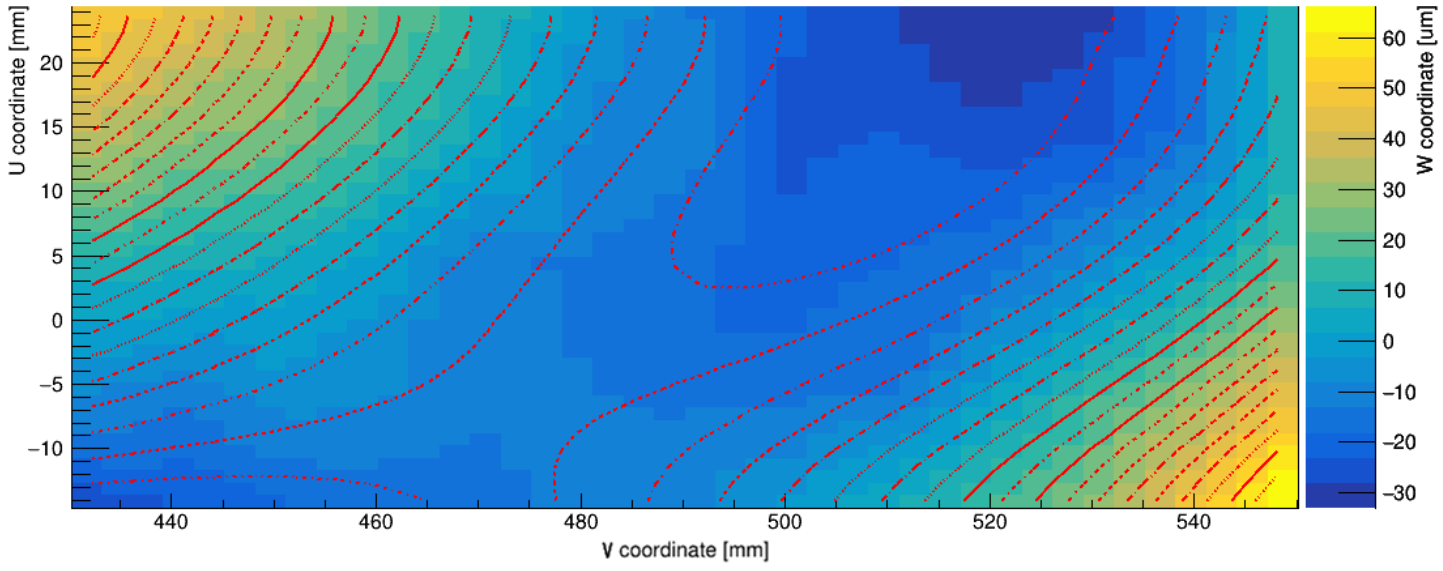
  where $\partial\{u, v\}/\partial w$ is slope (stored in basf2).
- We selected residuals smaller than 500 μm and without $\partial\{u, v\}/\partial w = 0$.
- The plots are weighed using $(\partial\{u, v\}/\partial w)^2$.
- We produce plots for all sensors, but only some of them will be shown.
- All plots can be found in back-up

Survey measurements (mounting phase 3)

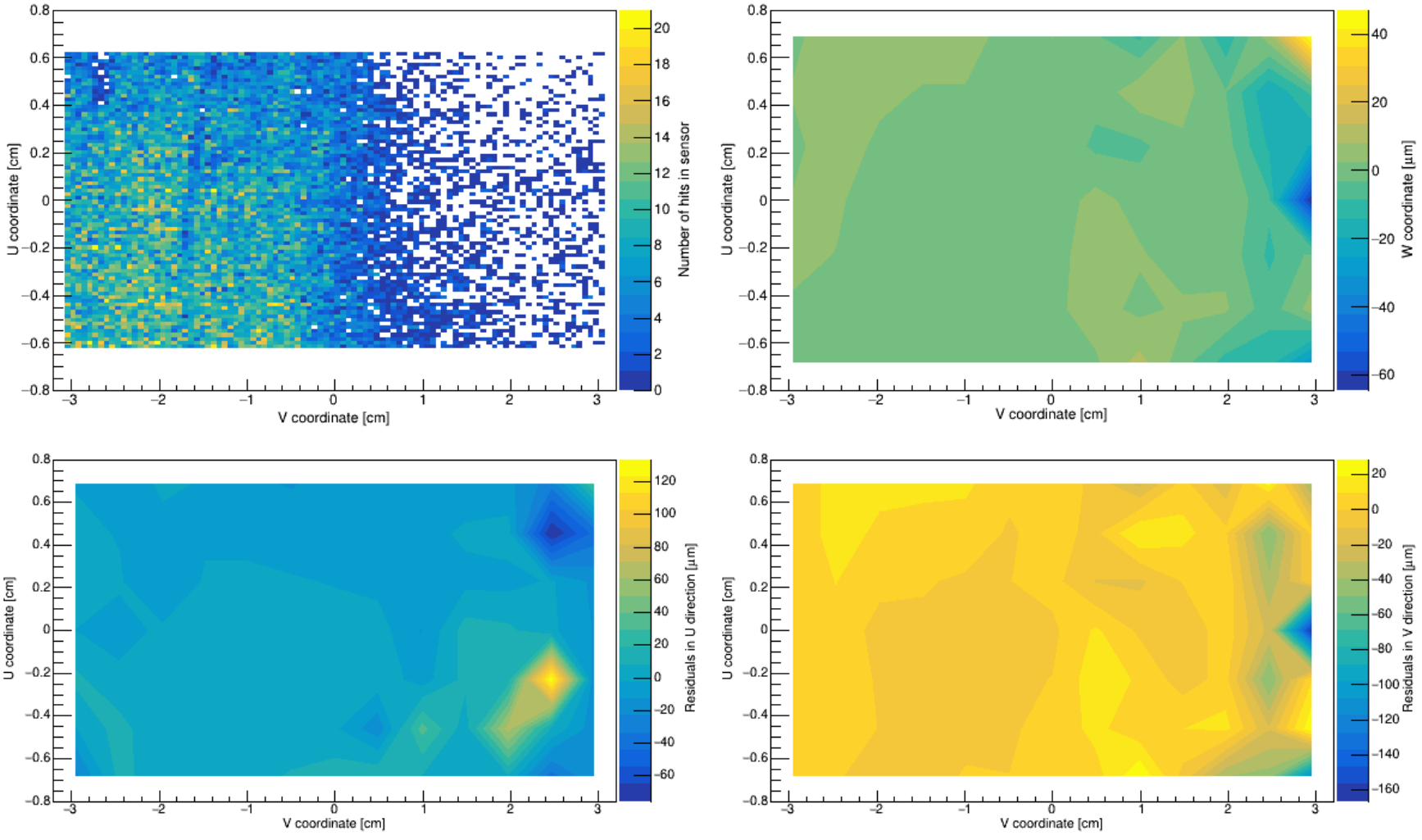
Planarity of 3.7.1 sensor



Planarity of 3.3.1 sensor



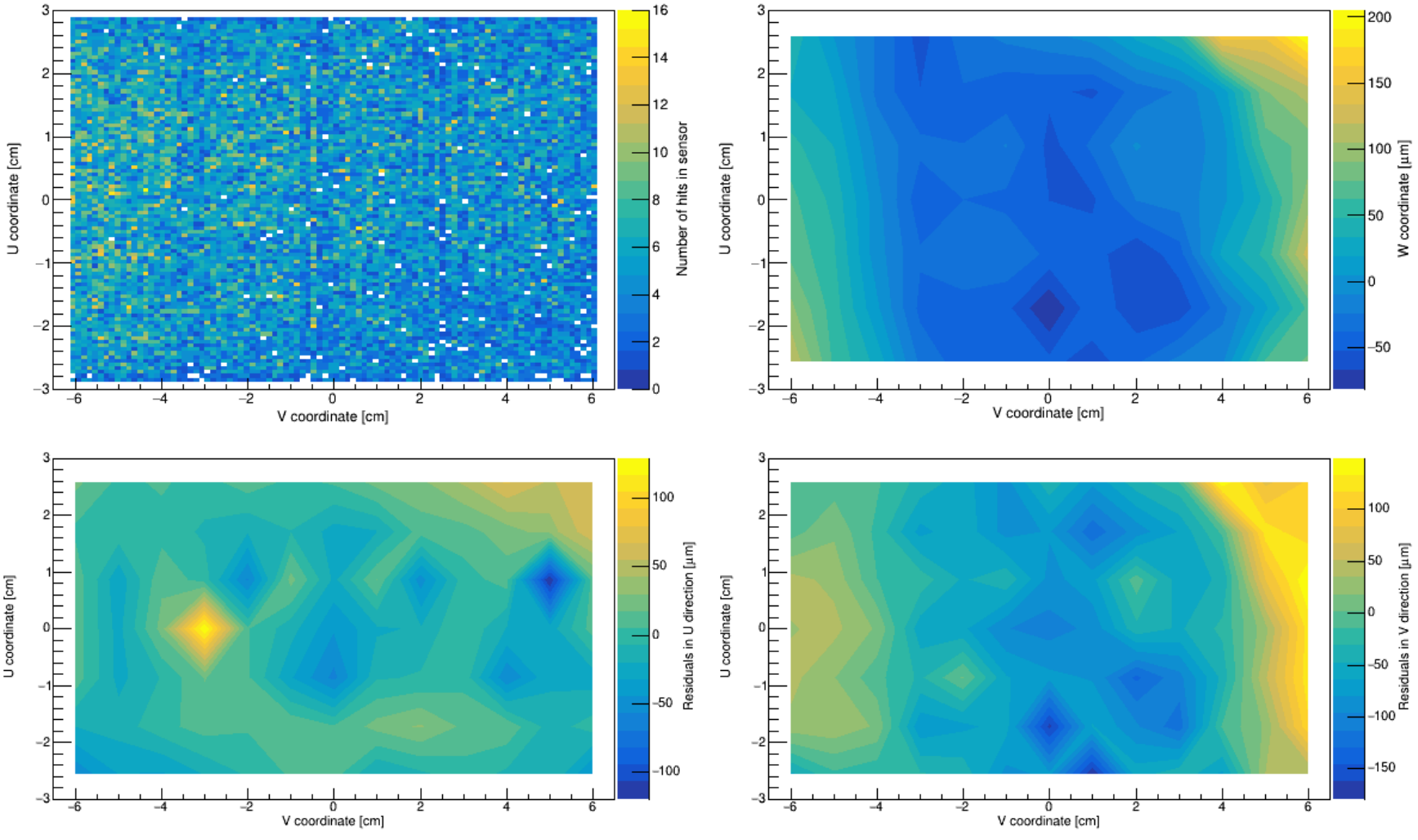
Planar (non-)deformation of sensor 2.1.1



Some sensors are really smooth as software expects.

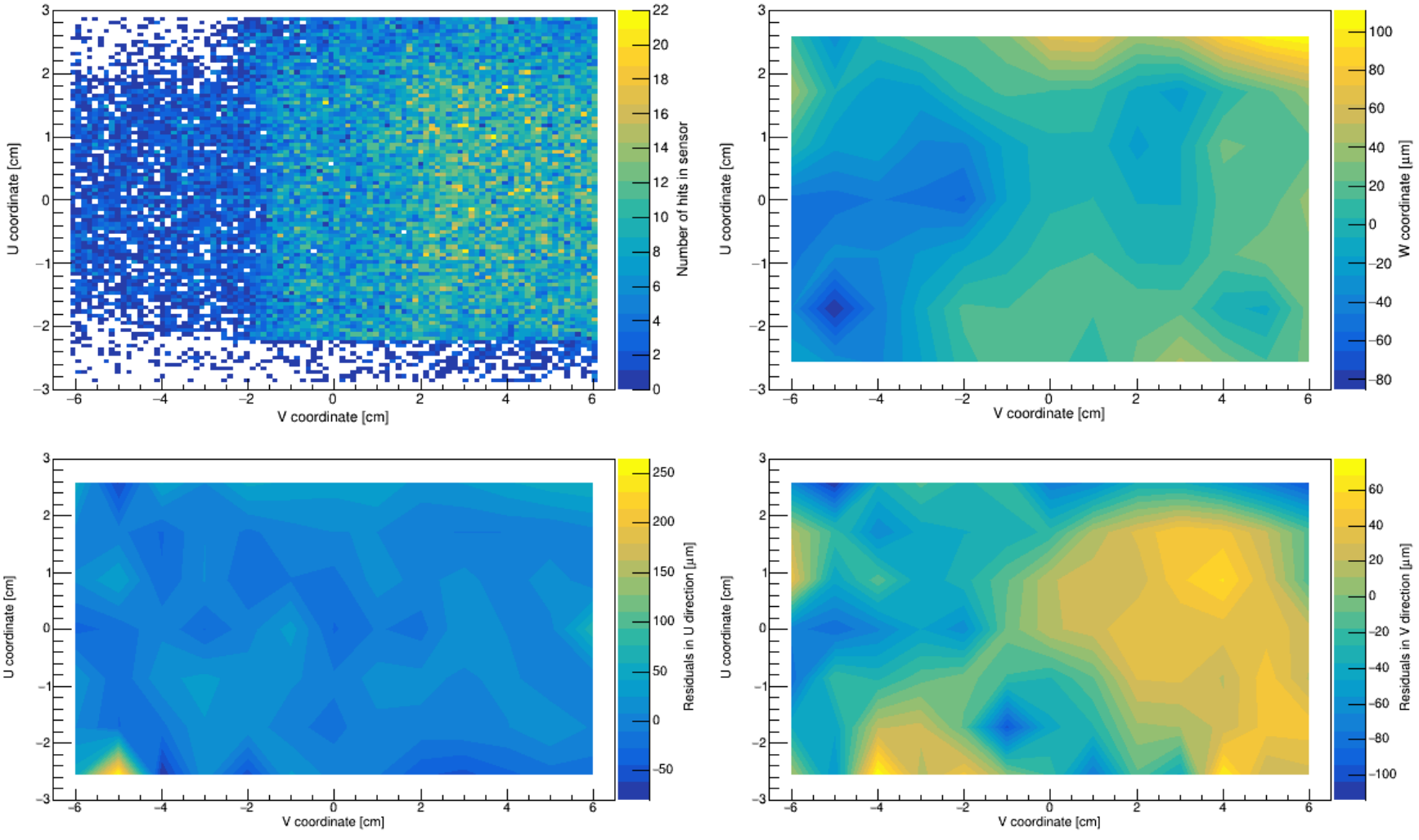
The validation results are stable with minimal dispersion.

Planar deformation of sensor 5.1.3



Huge deformation of sensor, calculated from observed residuals.
Validation is affected by this planar deformation.

Planar deformation of sensor 4.1.3



Huge deformation of sensor, calculated from observed residuals.
Validation is affected by this planar deformation.

Discussion of planar deformation

- We will fit measured deformation for comparison with survey measurements.
- For fitting we use Legendre polynomials from second to fourth order (12 parameters).
- The software framework should be extended for application planar deformation (creating JIRA ticket?).
- Then alignment procedure can be extended to calculate of planar deformation.
- Before extension it is impossible to get better alignment as shown.
- If validation shows worse results, we can re-aligned VXD sensors.

Summary

- We were calculate two independent alignment for checking alignment procedure.
- One of them is published in GT ”Calibration_Offline_Development” (back-up)
- Second is stored locally only

`/home/belle2/jkandra/basf2/beam/alignment/phase2/data/cosmicAndBeam/database.txt`

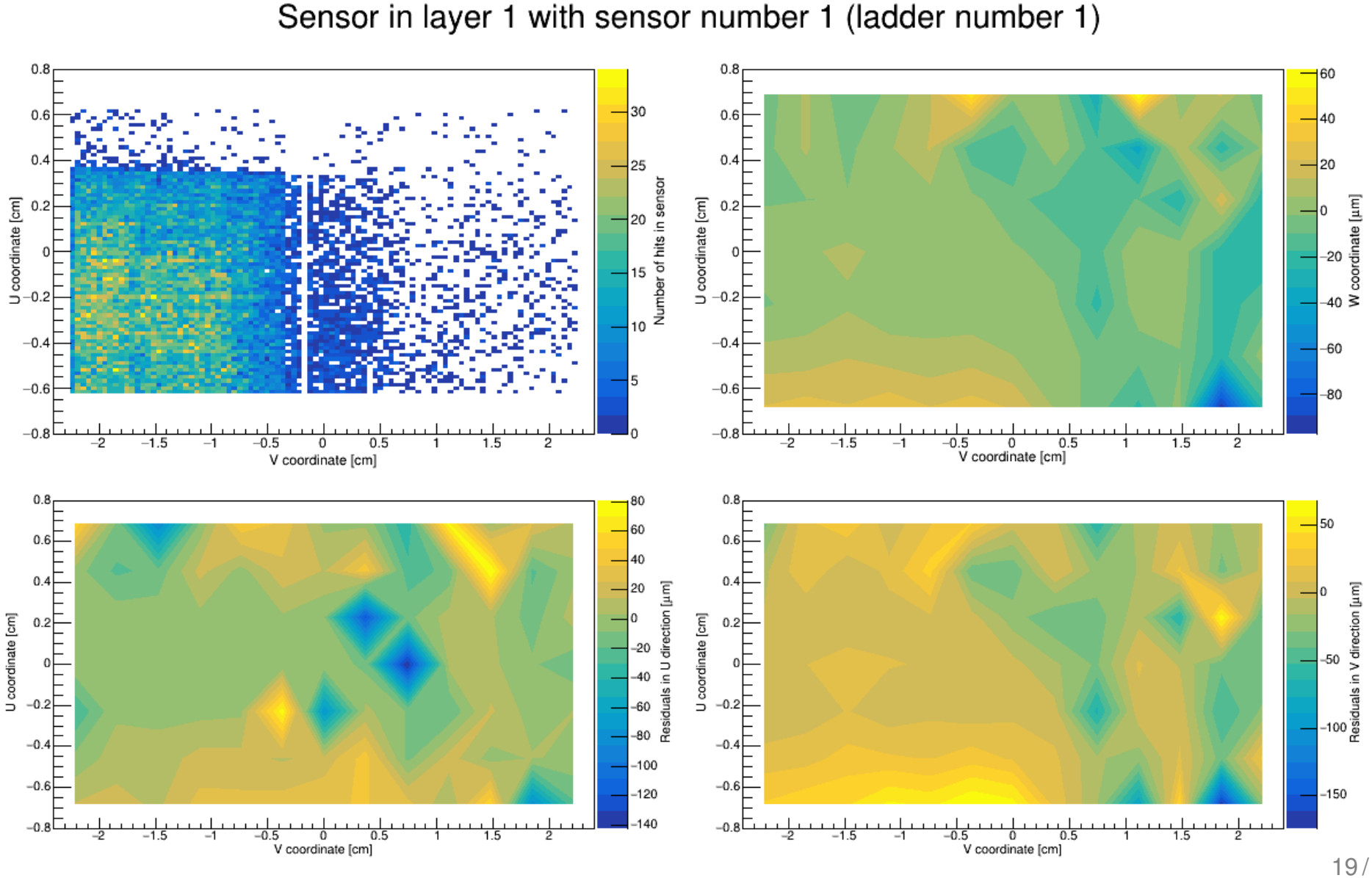
- Systematic and statistical errors are $\approx$ 100 um and 1.0 mrad.
- Alignment constants are validated using cosmic rays and collisions.
- Time dependent analysis of validation variables (residuals).
- Planar deformation studies shows limits of alignment procedure.
- For better alignment we need some software updates.

Plans for next weeks

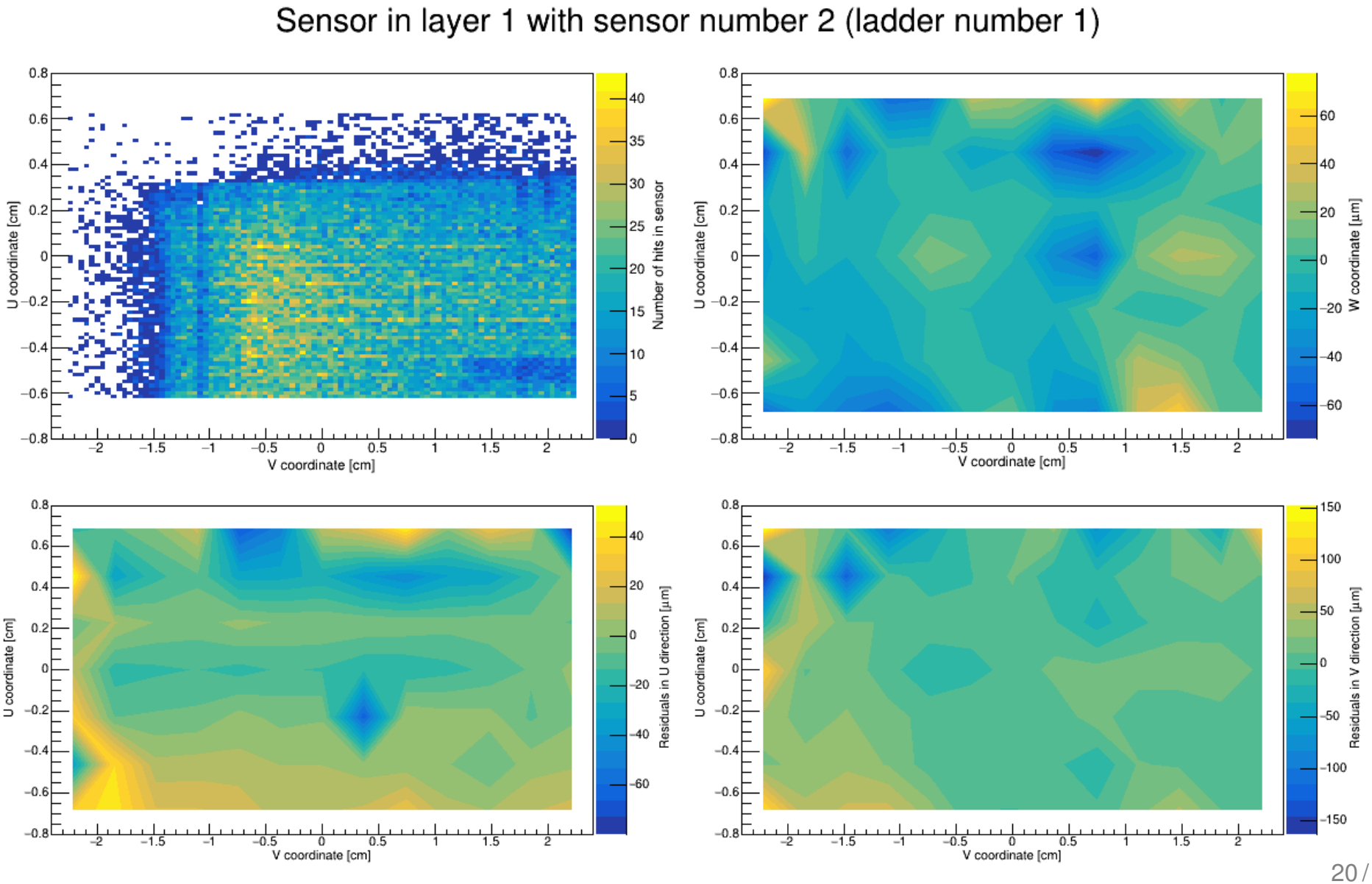
- We will validate VXD alignment with possibility re-aligned data.
- The second alignment parameters will be updated to GT soon.

Backup

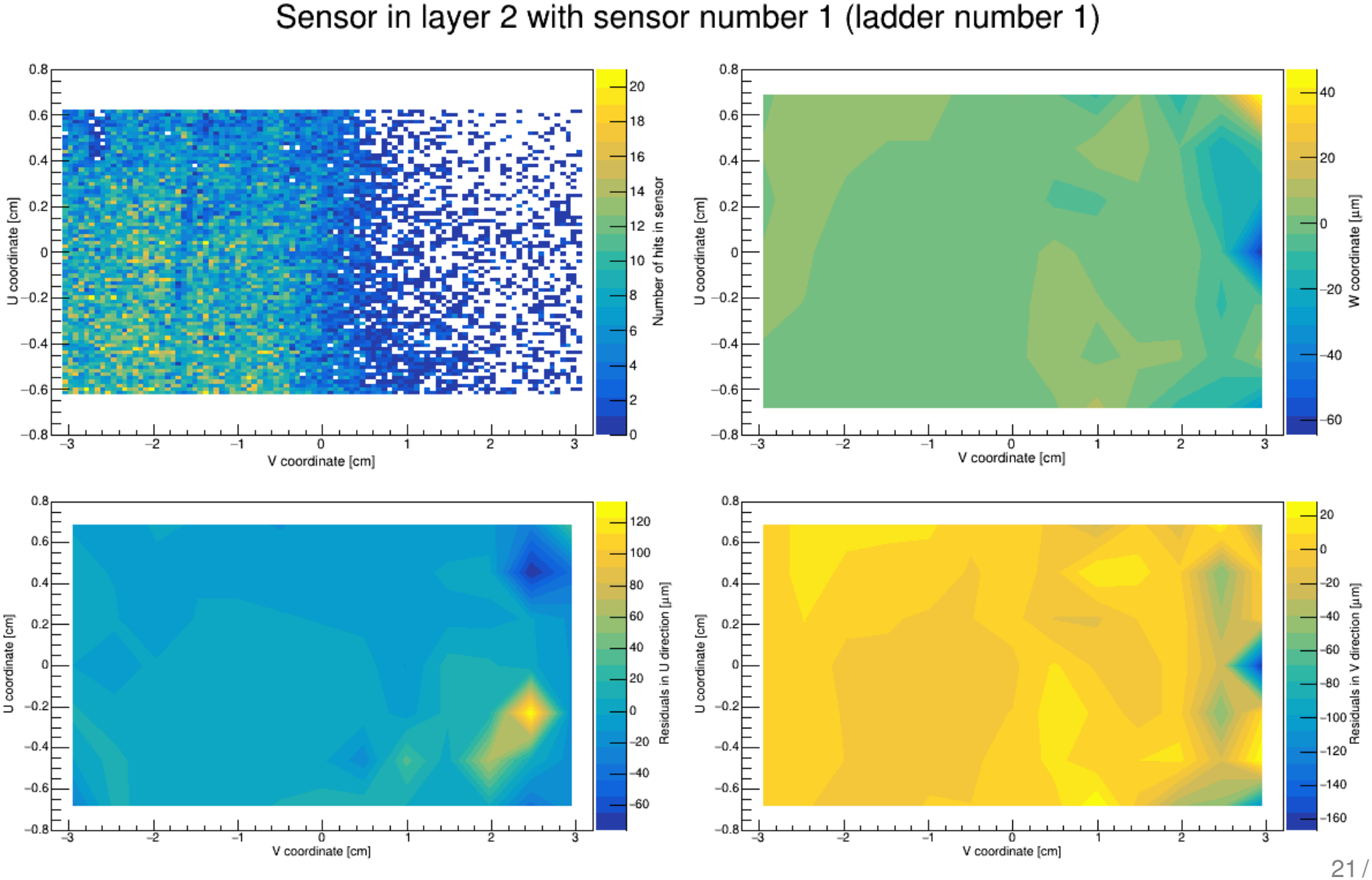
Planar deformation in collision data



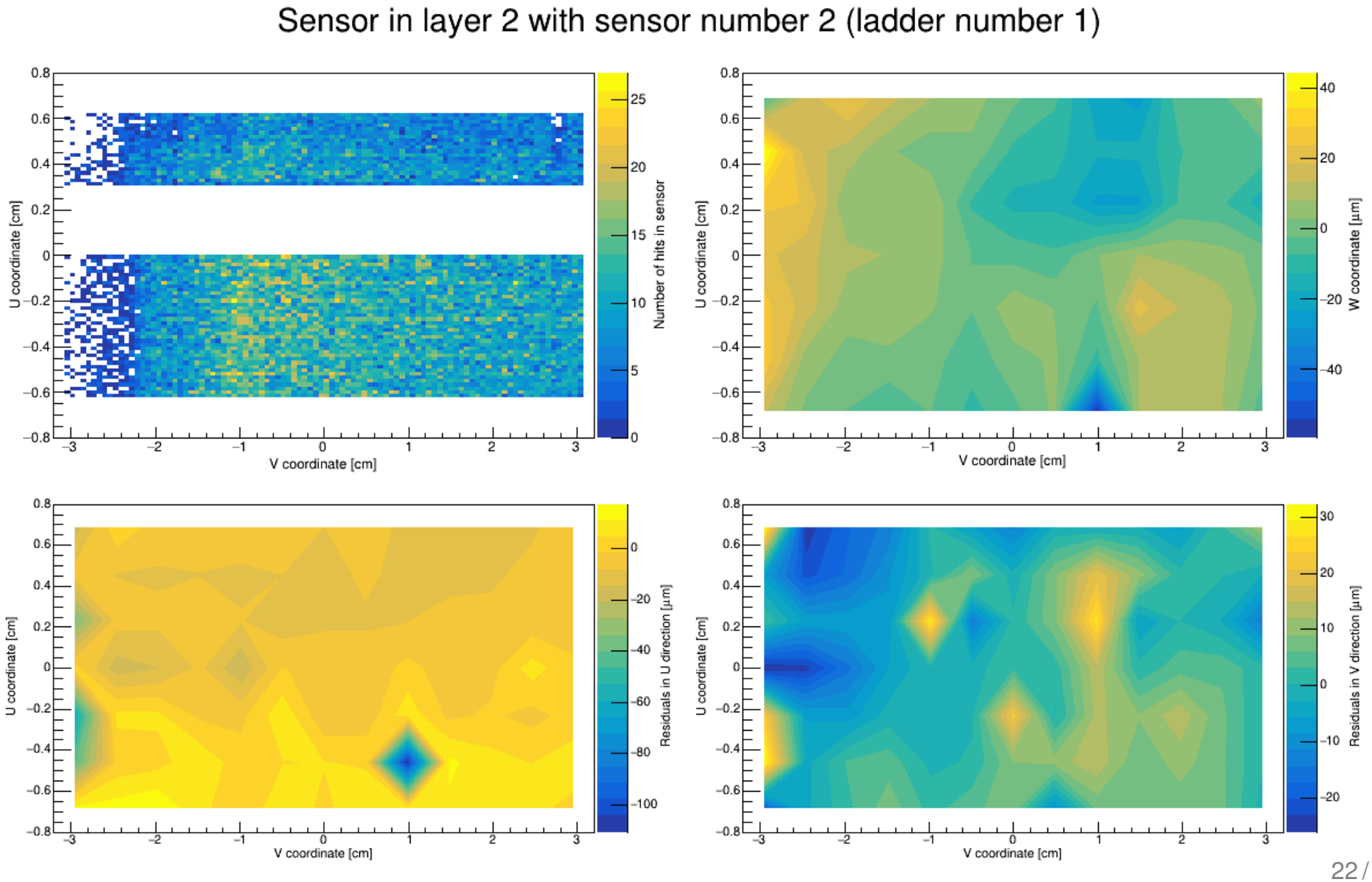
Planar deformation in collision data



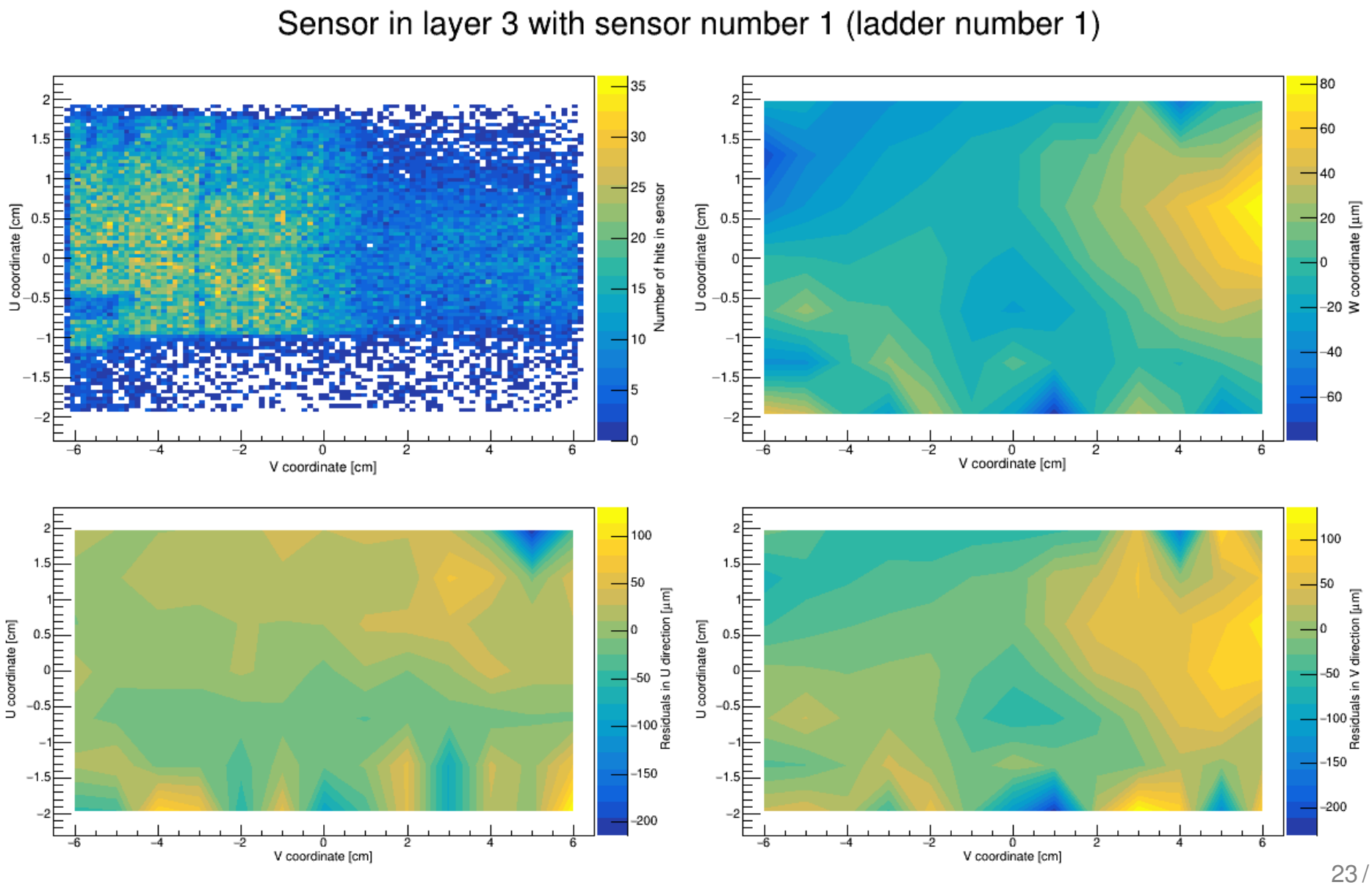
Planar deformation in collision data



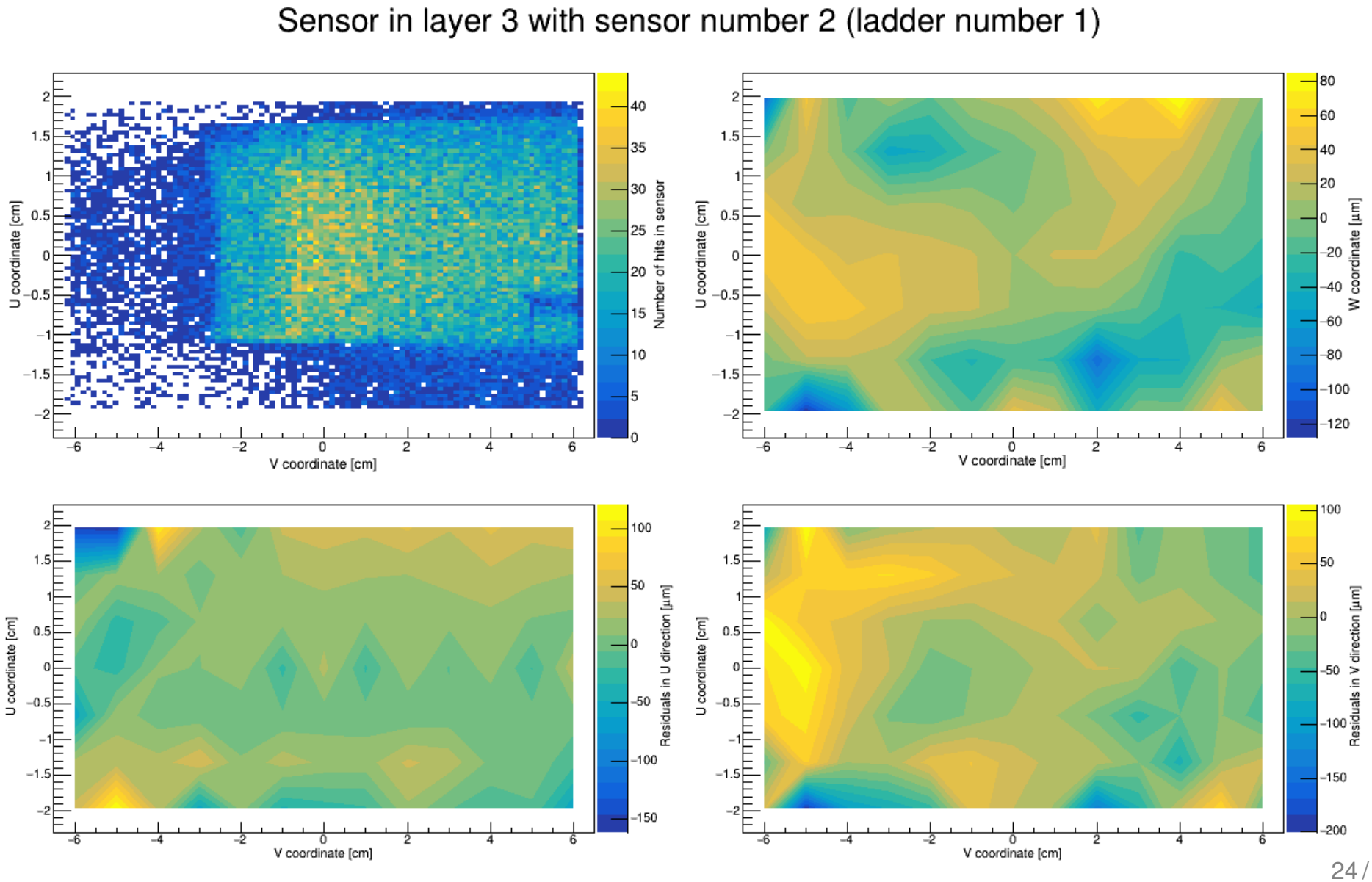
Planar deformation in collision data



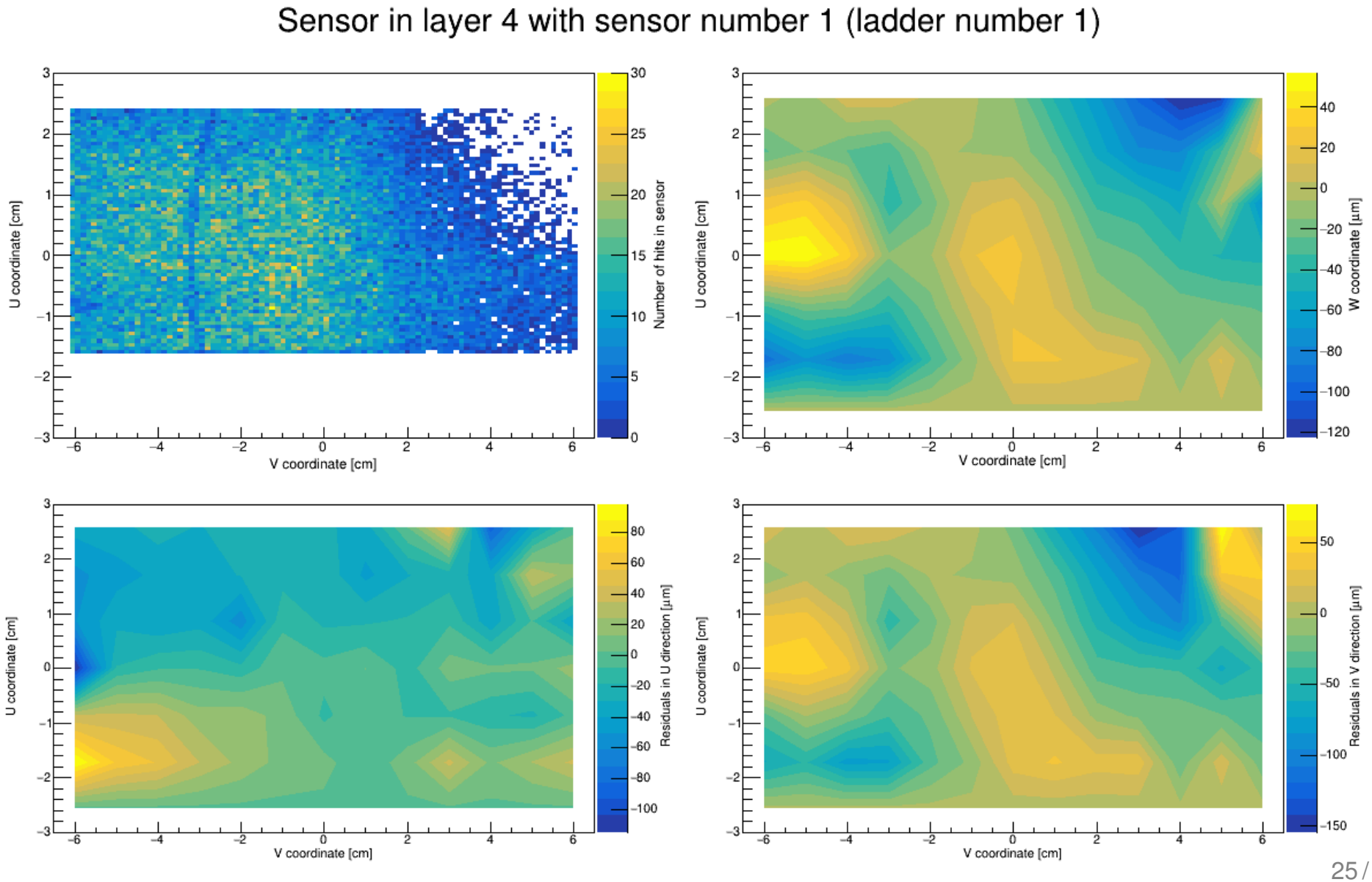
Planar deformation in collision data



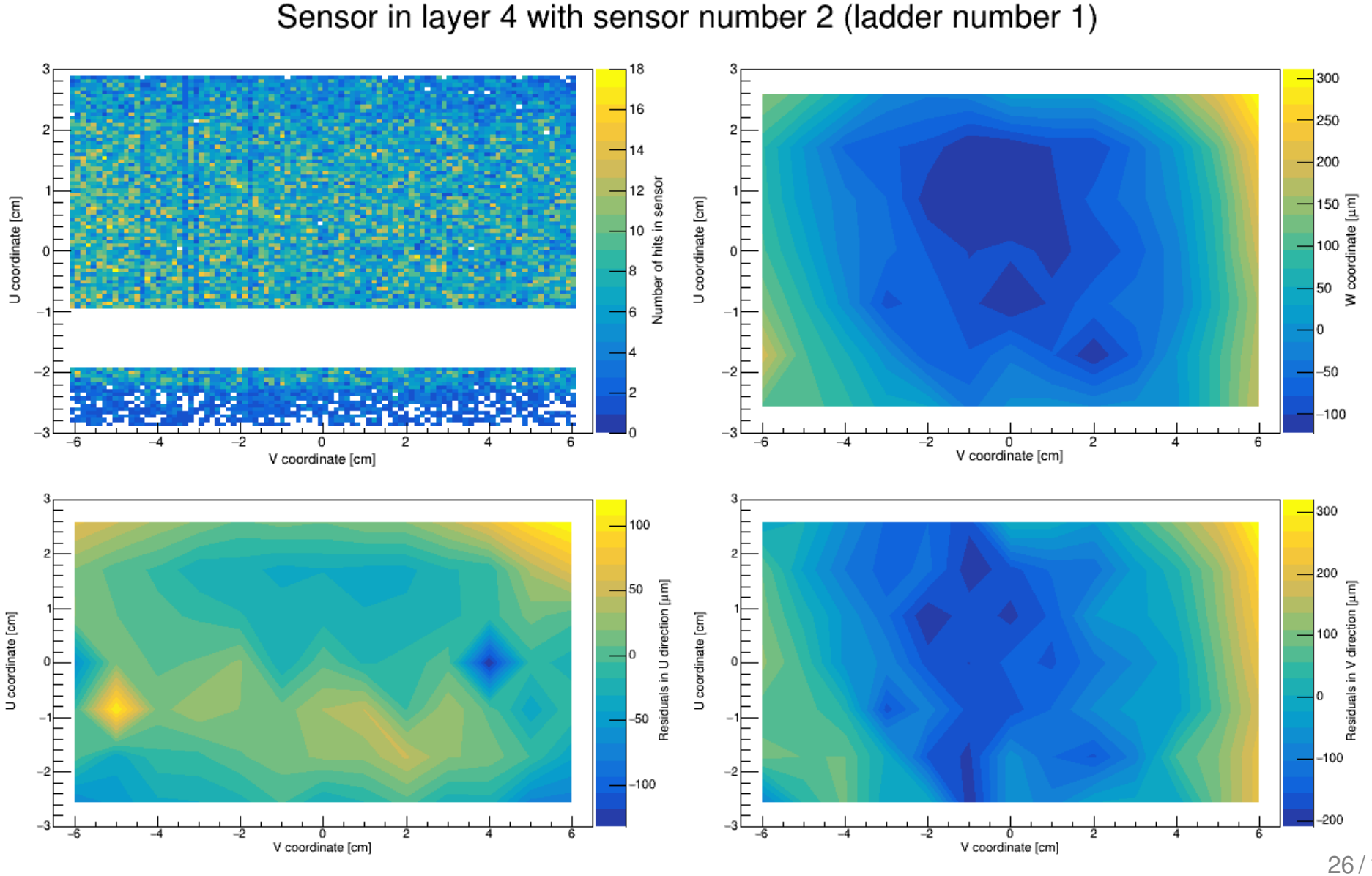
Planar deformation in collision data



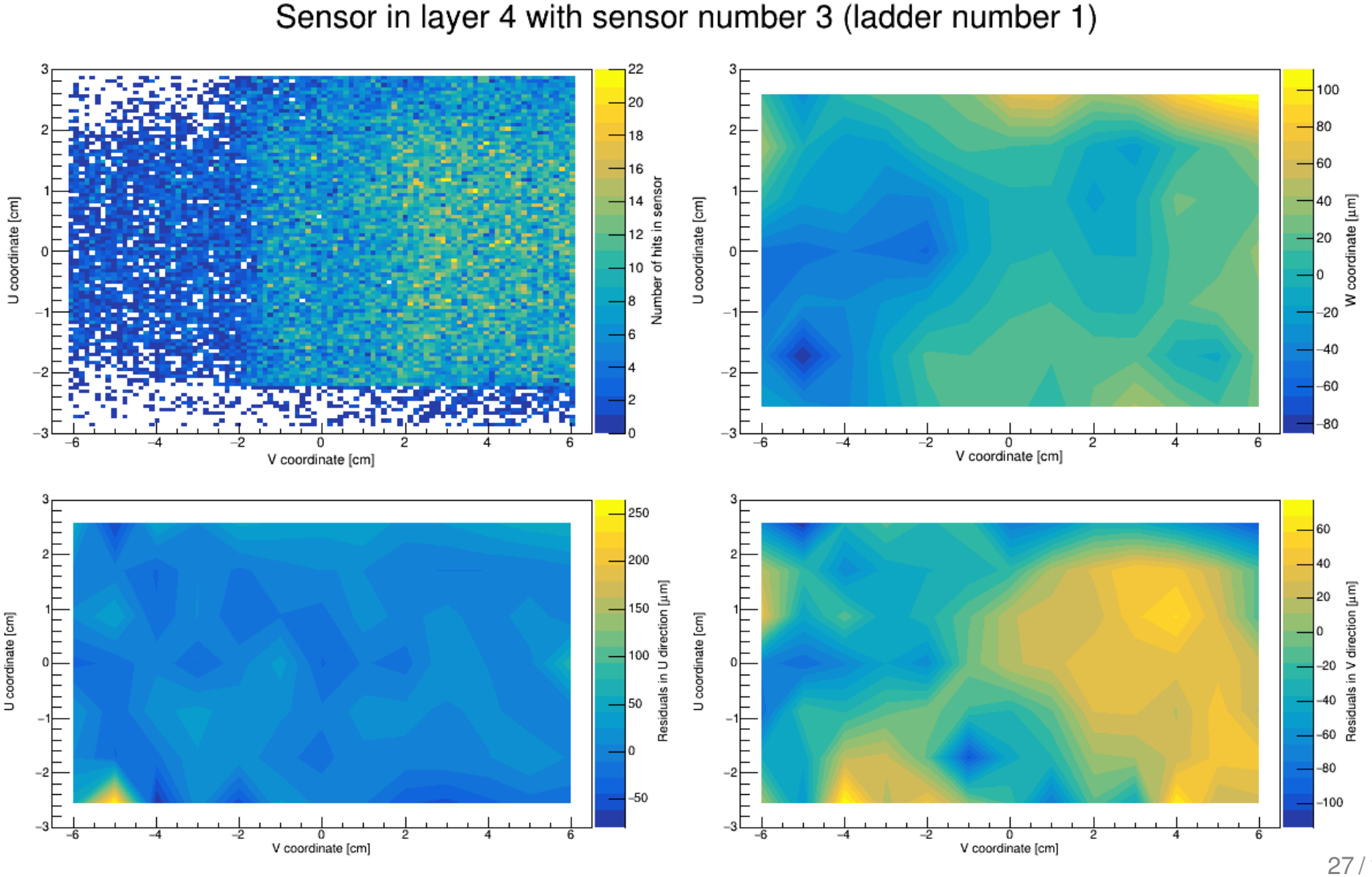
Planar deformation in collision data



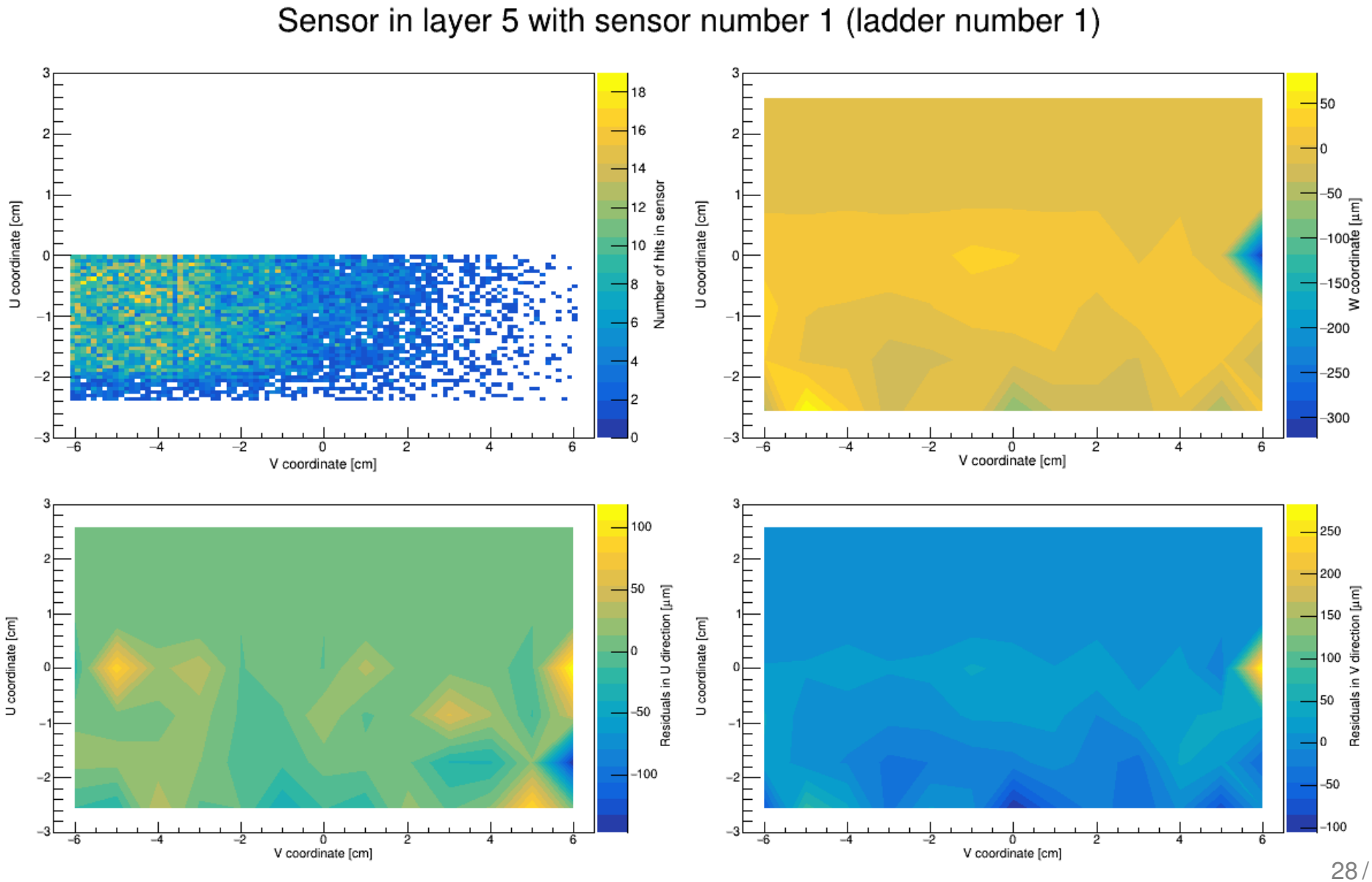
Planar deformation in collision data



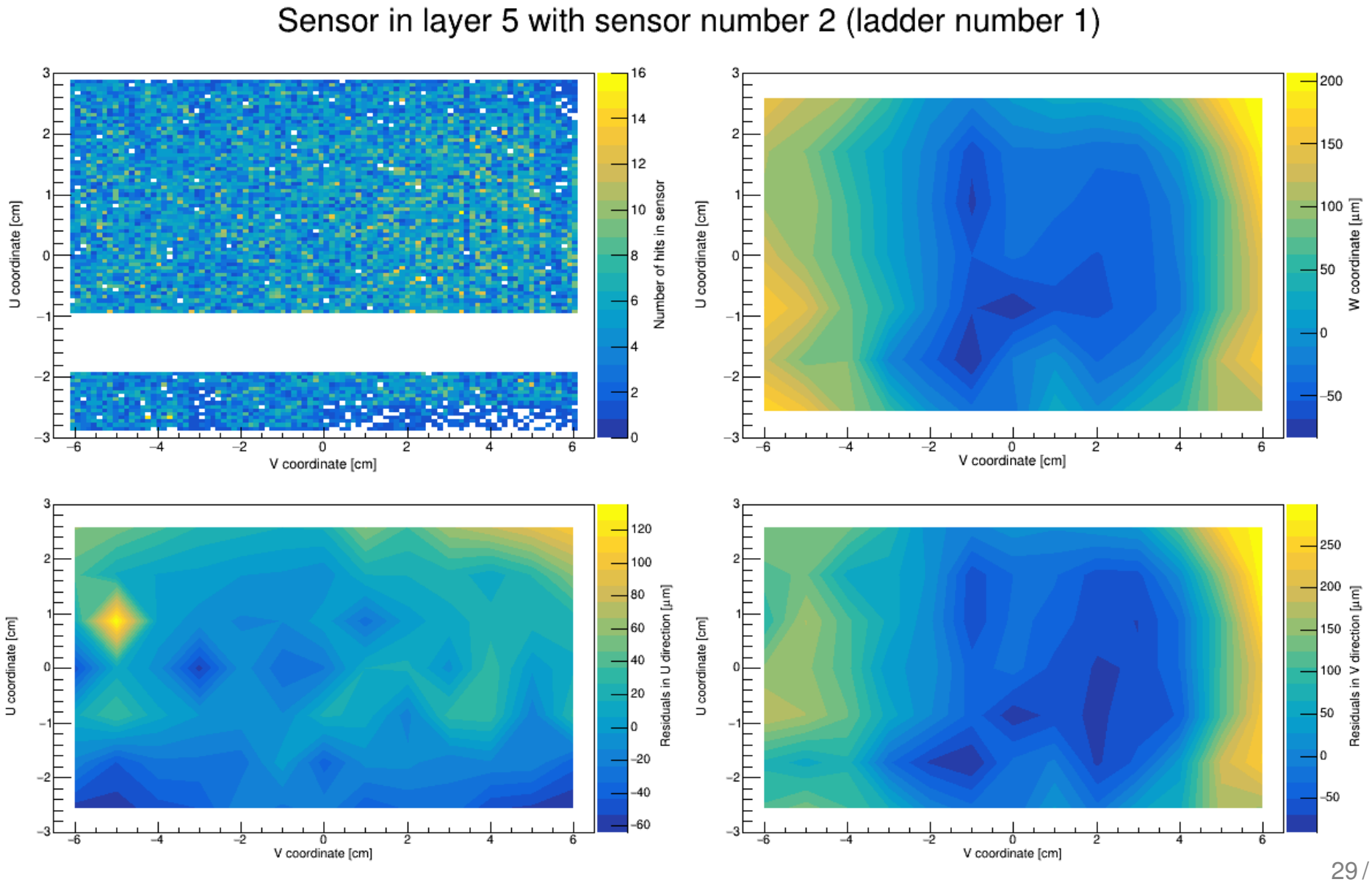
Planar deformation in collision data



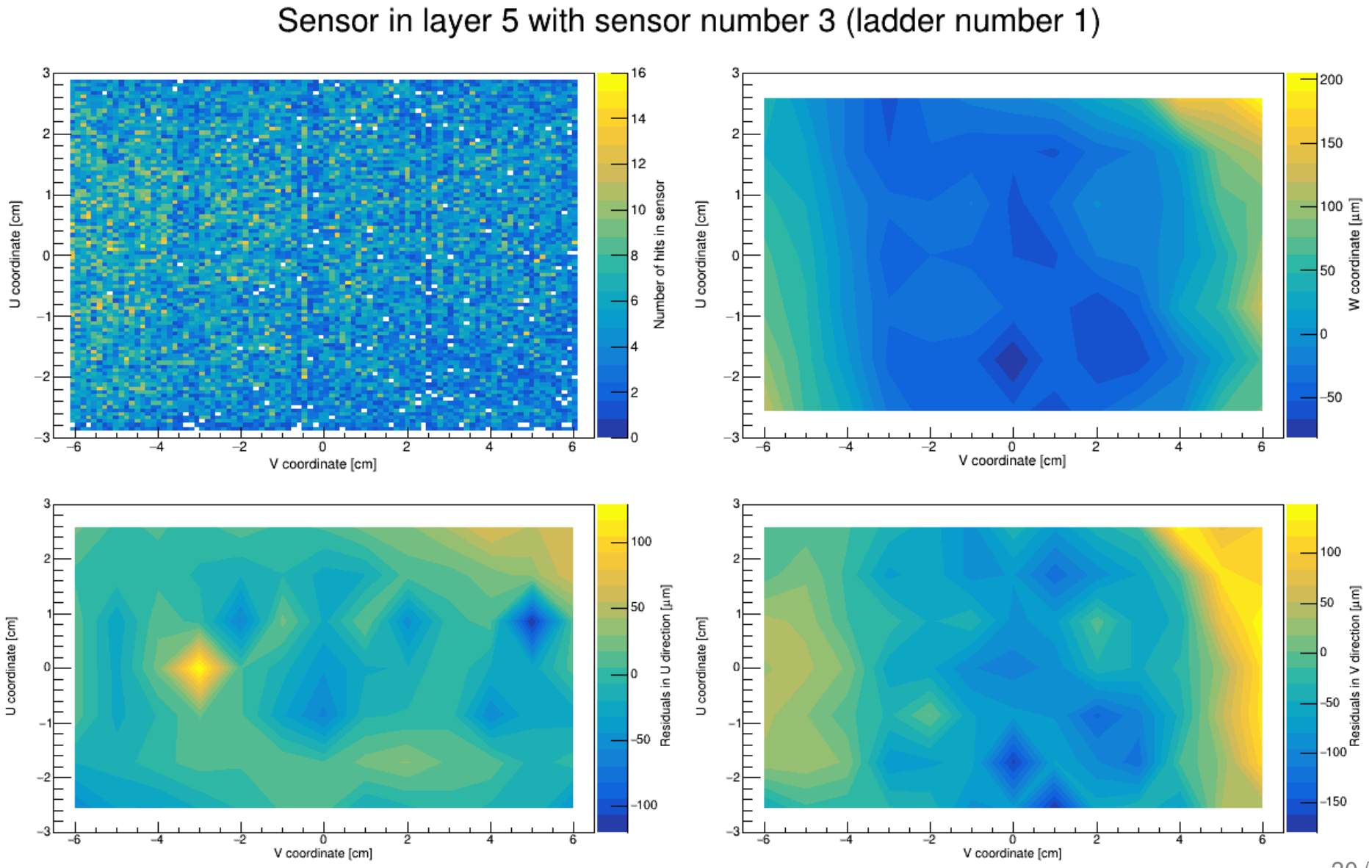
Planar deformation in collision data



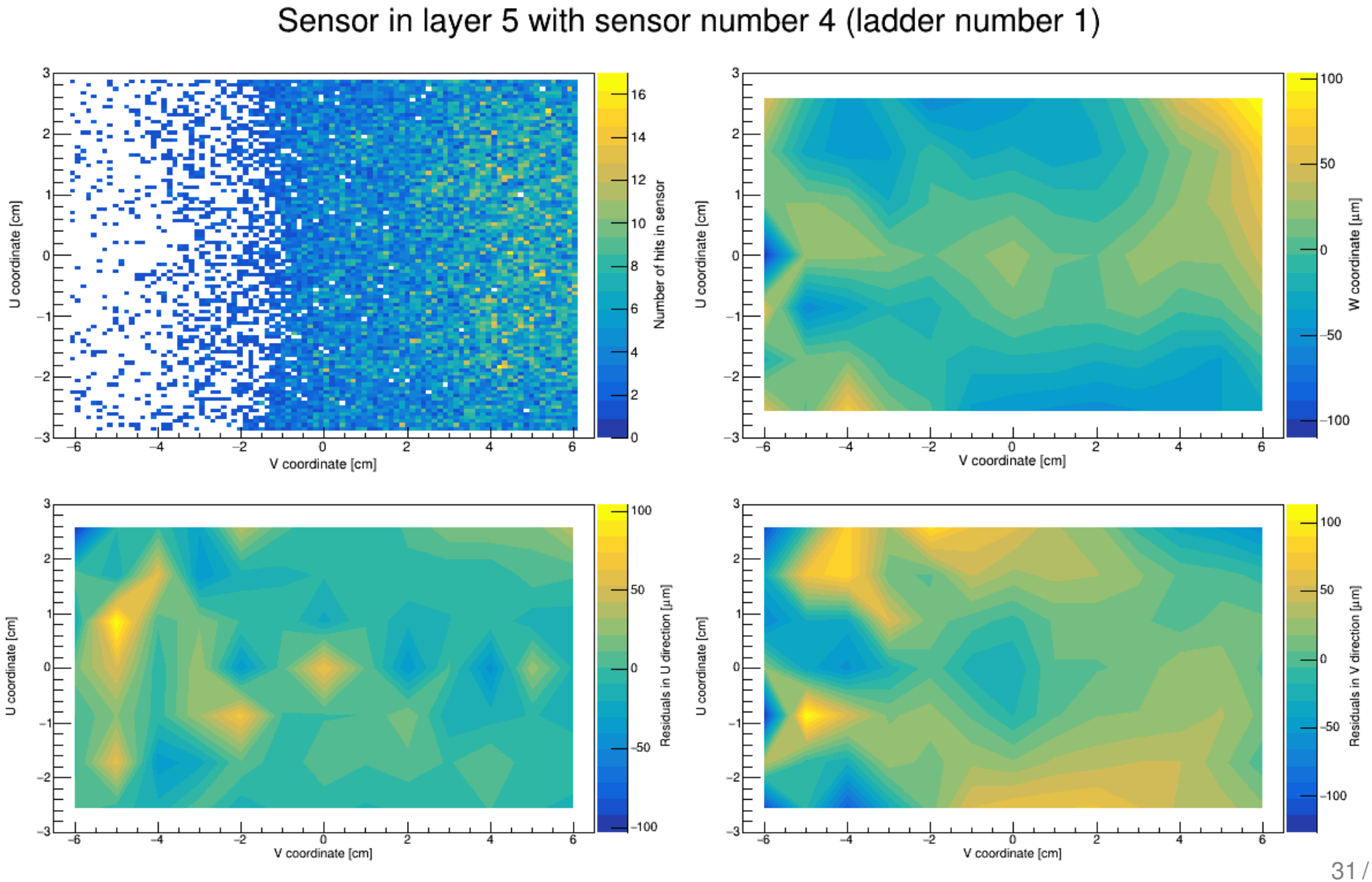
Planar deformation in collision data



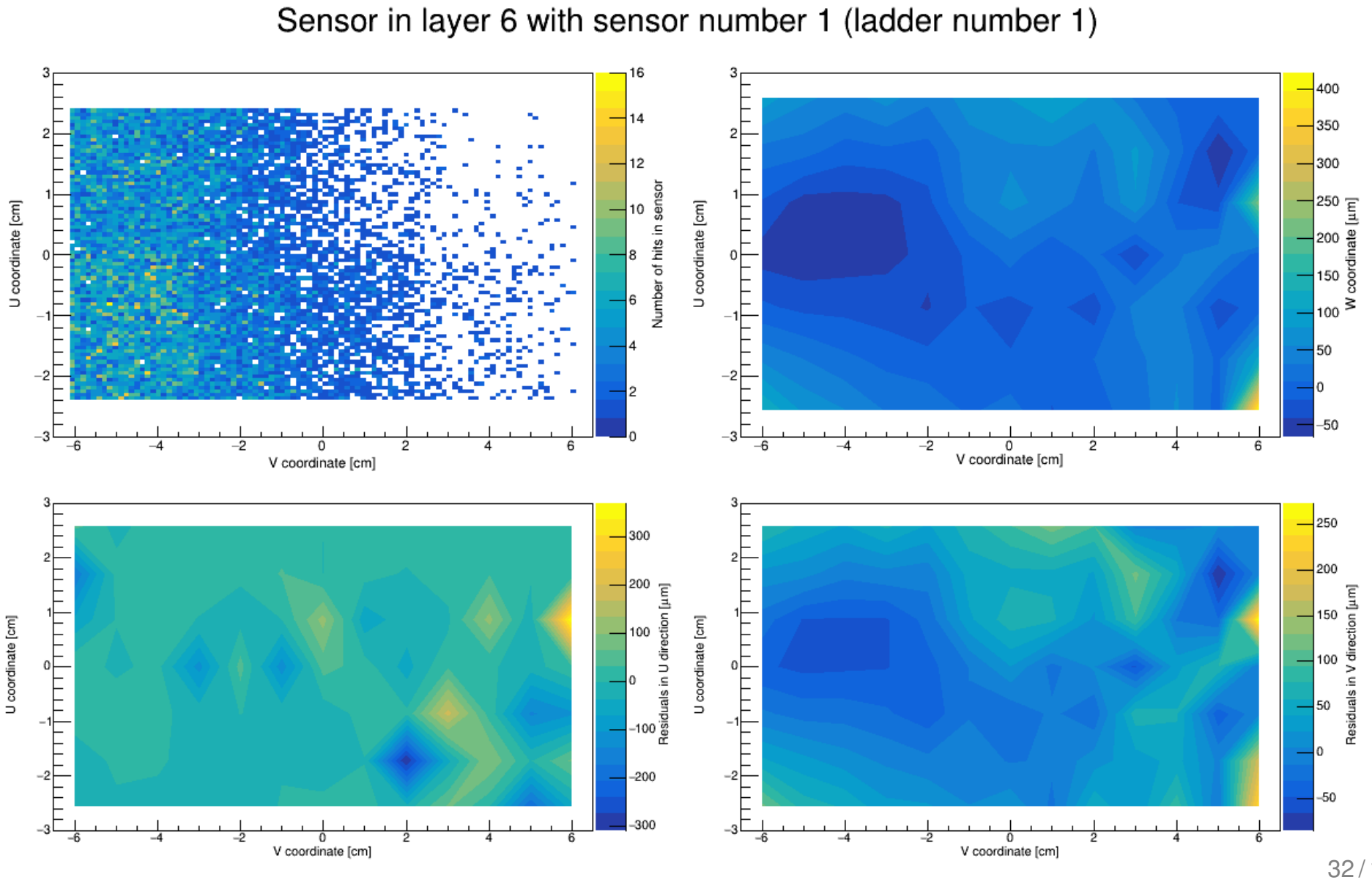
Planar deformation in collision data



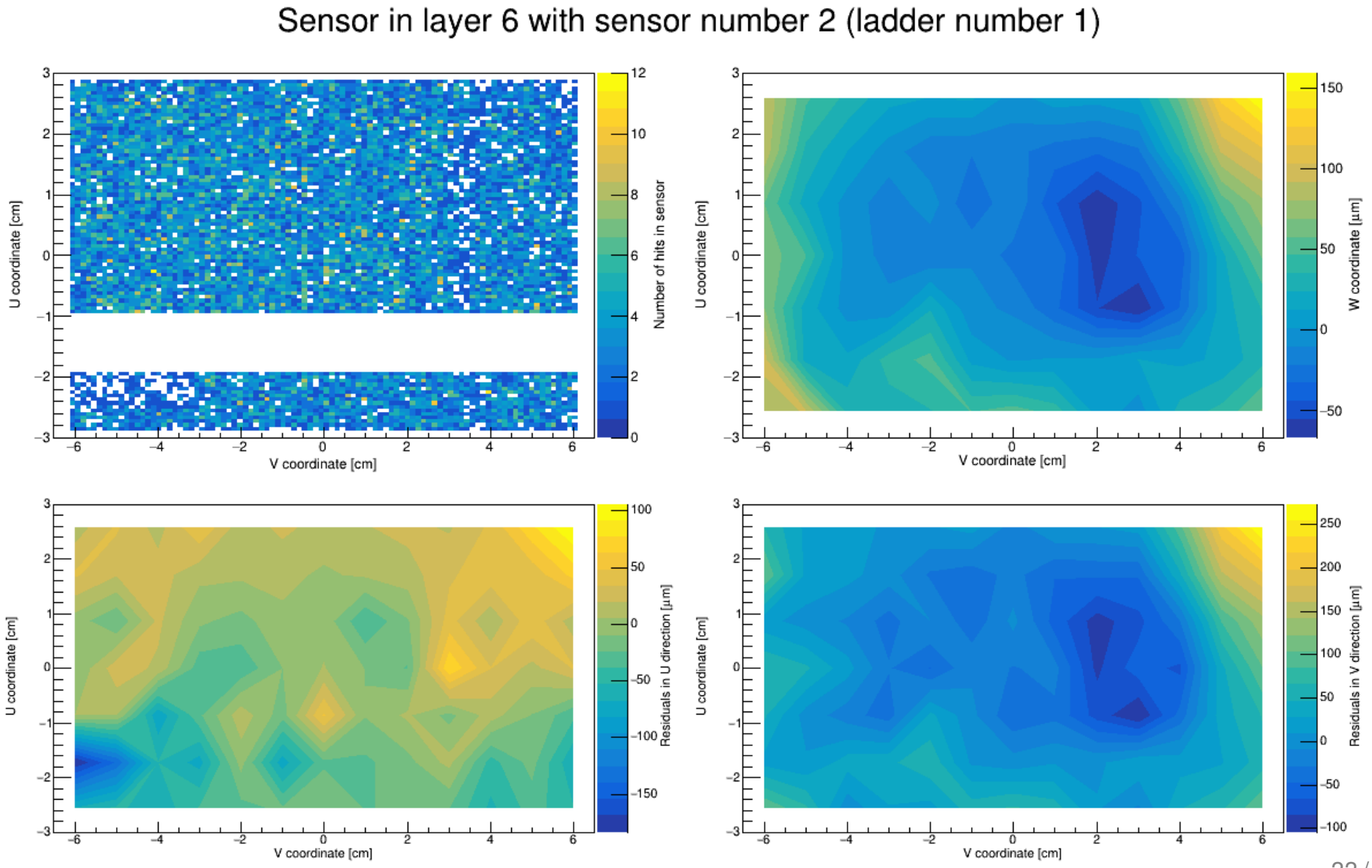
Planar deformation in collision data



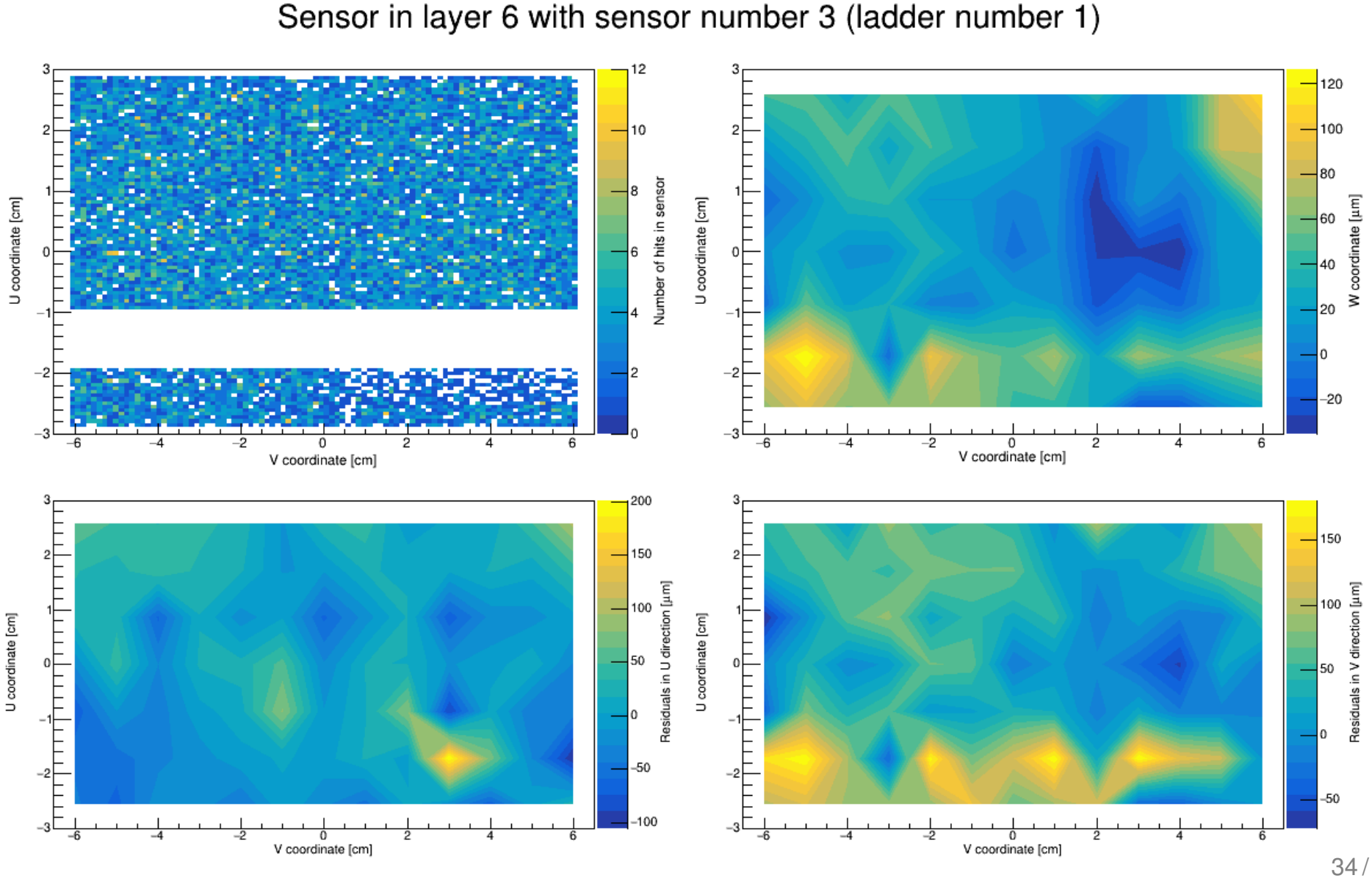
Planar deformation in collision data



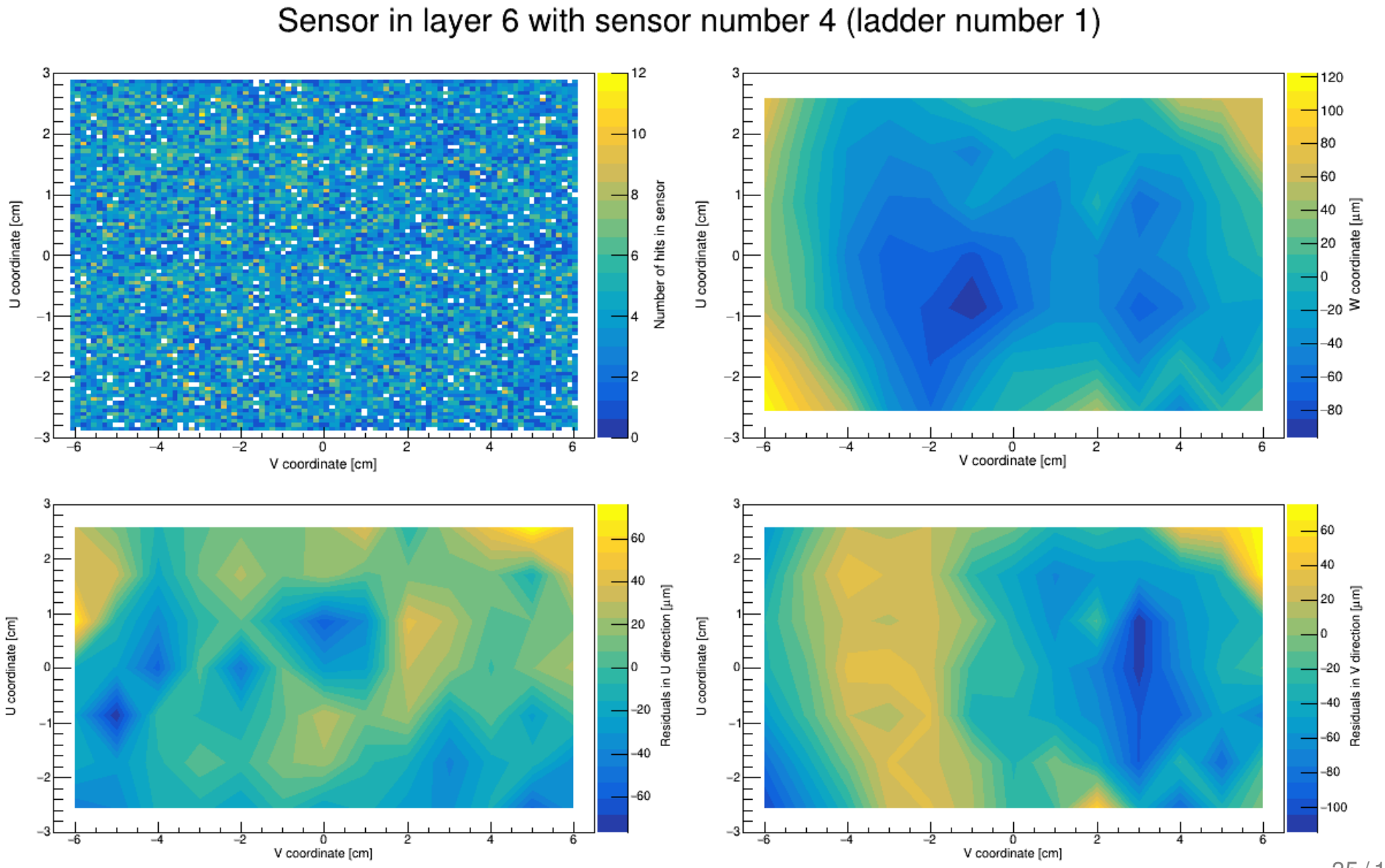
Planar deformation in collision data



Planar deformation in collision data



Planar deformation in collision data



Planar deformation in collision data