Progress on alignment

A.Q.Guo, L.H.Wu, L.L. Wang, R. Mitchell

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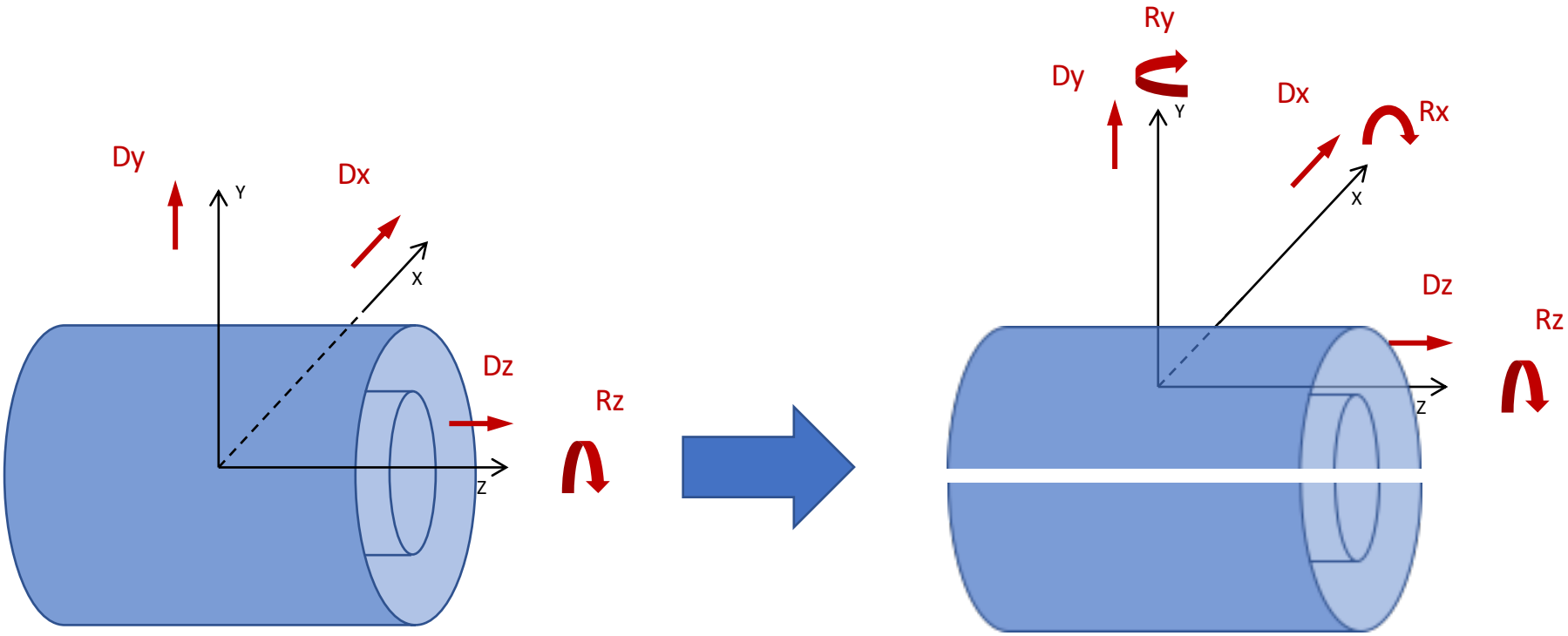
Alignment for Cgem

- Configuration of alignment algorithm for cosmic-ray data
  - **4** layers of Cgem, position of **inner 2 layer** is fixed as reference
  - For each layer, 6 alignment parameters: Dx, Dy, Dz, Rx, Ry ,Rz
  - Dy is also fixed because it is insensitive to cosmic-ray data



Fit results summary

Run10	Dx (mm)	Dz (mm)	Rx (Rad.)	Ry (Rad.)	Rz (Rad.)
L2	-0.3176	-0.9835	0.0051	0.0011	0.0111
L3	0.6658	-1.3040	-0.0067	0.0002	0.0173

Run17	Dx (mm)	Dz (mm)	Rx (Rad.)	Ry (Rad.)	Rz (Rad.)
L2	-0.9514	-1.6501	-0.0006	0.0009	0.0171
L3	1.8454	-2.0144	-0.0019	0.0004	0.0273

- The results from run17 are obviously different to other data-sets
- The mis-alignment effects on the top and bottom part could be different
- The signs of Dx from top and bottom part are opposite

MC test (free all parameters)

Input Dx = 2 mm

Layer	DeltaX(mm)	DeltaY(mm)	DeltaZ(mm)	RX(rad)	RY(rad)	RZ(rad)
L0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L1	-0.0000000	-0.0000000	0.0000000	-0.0000000	0.0000000	0.0000000
L2	0.2201451	0.0000000	-0.1631478	0.0019563	0.0046912	0.0091267
L3	0.1684339	0.0000000	0.0320131	0.0000270	-0.0006295	-0.0151647
L4	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

Input rz = 0.02 rad

layer	DeltaX(mm)	DeltaY(mm)	DeltaZ(mm)	RX(rad)	RY(rad)	RZ(rad)
L0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L1	0.0000000	0.0000000	0.0000000	-0.0000000	-0.0000000	0.0000000
L2	0.0925943	-0.0000000	-0.2183292	0.0026231	0.0058901	0.0129773
L3	-0.0480916	0.0000000	0.1223228	-0.0002877	-0.0009969	0.0184145
L4	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

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MC test (constrain Dx and Rz to be same)

Input Dx = 2 mm

Layer	DeltaX(mm)	DeltaY(mm)	DeltaZ(mm)	RX(rad)	RY(rad)	RZ(rad)
L0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L1	0.0000000	-0.0000000	0.0000000	-0.0000000	-0.0000000	0.0000000
L2	1.4700961	-0.0000000	-0.0458378	0.0003253	0.0054992	-0.0027844
L3	1.4700961	0.0000000	-0.1237438	-0.0000281	0.0006285	-0.0027844
L4	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

Input rz = 0.02 rad

Layer	DeltaX(mm)	DeltaY(mm)	DeltaZ(mm)	RX(rad)	RY(rad)	RZ(rad)
L0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L1	0.0000000	0.0000000	0.0000000	-0.0000000	-0.0000000	-0.0000000
L2	-0.2951428	-0.0000000	-0.2348143	0.0029515	0.0056707	0.0163832
L3	-0.2951428	0.0000000	0.1604880	-0.0004396	-0.0010402	0.0163832
L4	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

Remained issues

Issue:

Input Dx = 2 mm

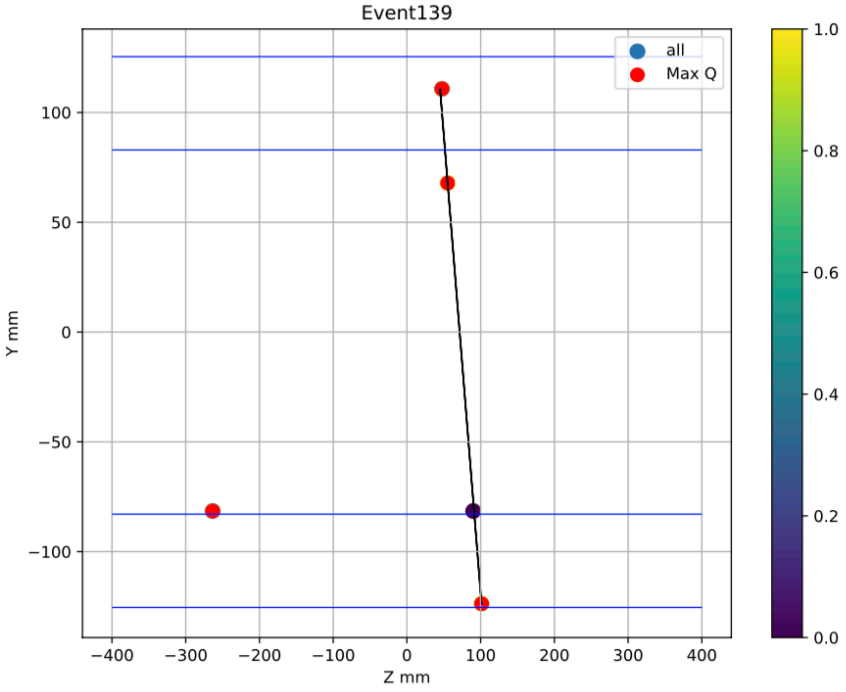
Layer	DeltaX(mm)	DeltaY(mm)	DeltaZ(mm)	RX(rad)	RY(rad)	RZ(rad)
L0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L1	0.0000000	-0.0000000	0.0000000	-0.0000000	-0.0000000	0.0000000
L2	1.4700961	-0.0000000	-0.0458378	0.0003253	0.0054992	-0.0027844
L3	1.4700961	0.0000000	-0.1237438	-0.0000281	0.0006285	-0.0027844
L4	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

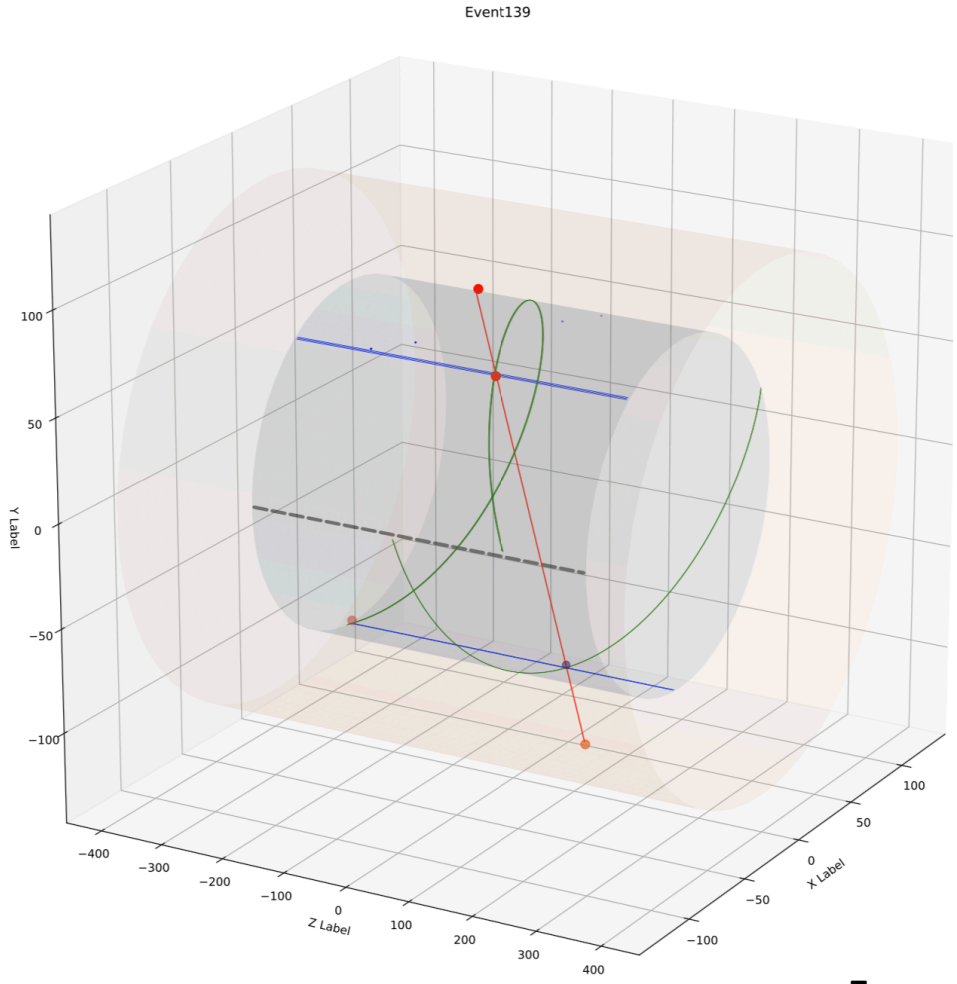
- Why the output is quite inconsistent with the input value?

Next step

- More iteration
- Improve the fit procedure: constraining the Dx in L2 and L3 to be same
- Separate run17 to several sub-samples

Combinatory clusters issue





MC test (constrain Dx to be same)

Input Dx = 2 mm

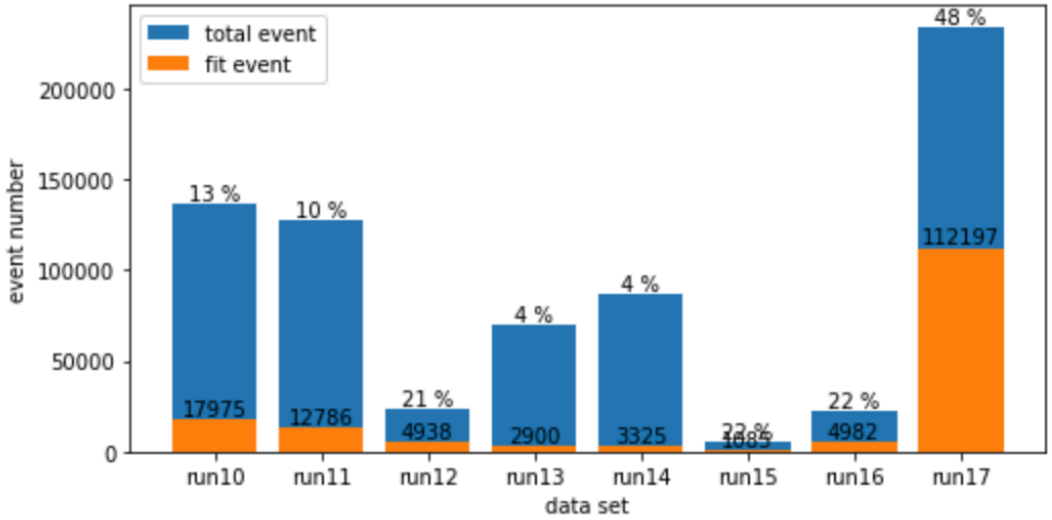
Layer	DeltaX(mm)	DeltaY(mm)	DeltaZ(mm)	RX(rad)	RY(rad)	RZ(rad)
L0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L1	0.0000000	-0.0000000	0.0000000	0.0000000	-0.0000000	0.0000000
L2	2.0337686	-0.0000000	0.0089604	0.0001058	0.0000139	-0.0002619
L3	2.0337686	0.0000000	0.0247800	-0.0002634	-0.0000331	0.0002690
L4	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

Input rz = 0.02 rad

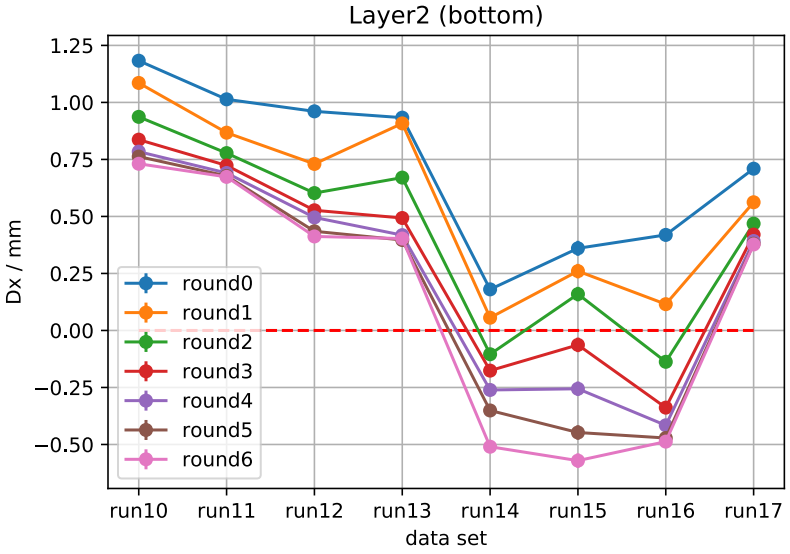
Layer	DeltaX(mm)	DeltaY(mm)	DeltaZ(mm)	RX(rad)	RY(rad)	RZ(rad)
L0	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L1	0.0000000	-0.0000000	0.0000000	0.0000000	-0.0000000	0.0000000
L2	-0.2699060	0.0000000	0.1190310	0.0009186	-0.0001106	0.0218536
L3	-0.2699060	-0.0000000	0.0804385	-0.0013823	-0.0000649	0.0173436
L4	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
L5	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

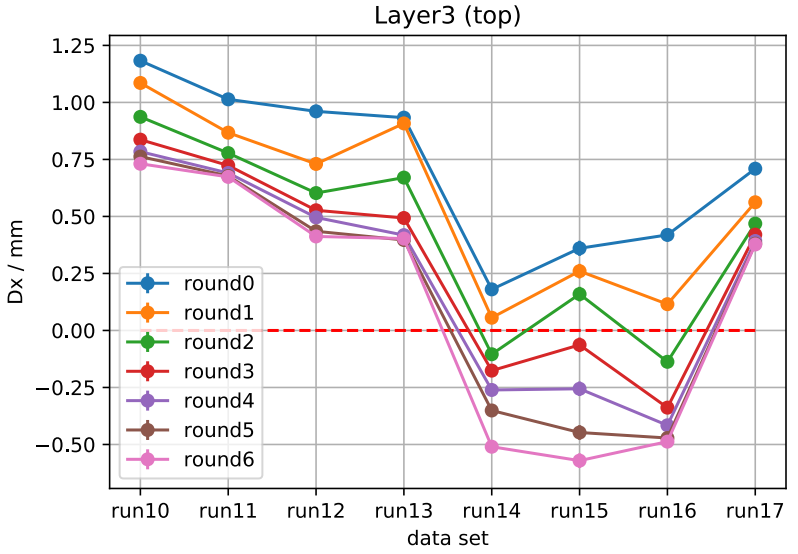
Data set and configuration

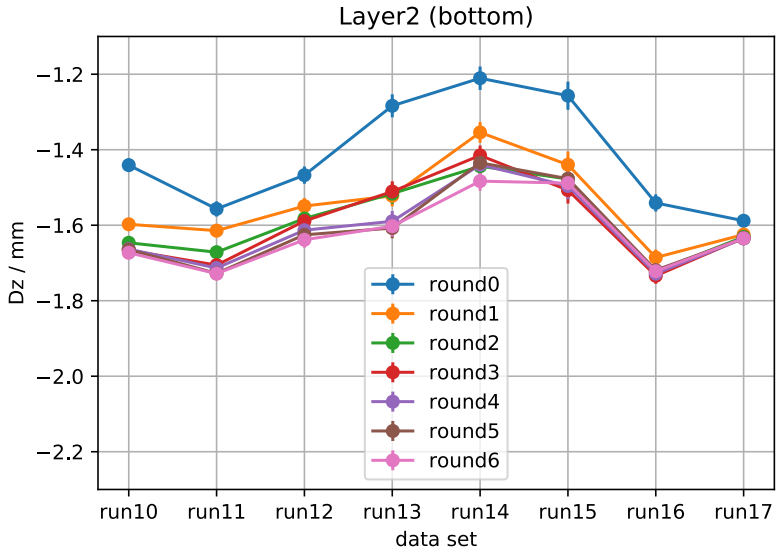
- Run over run10 – run17
  - CgemLineFit: Loop_maxQ, 3 clusters on each sheet
  - Chisq cut: <300 (wo alignment) <100 (w alignment)
  - Check the alignment parameter vs data sets
- Alignment procedure
  - Alignment parameters are obtained by iteration. The fit results from 1st round is used as the input for 2nd round fit
  - Initial parameters: Dx = 0, Dz = 0, Rx = 0, Ry = 0, $Rz = 0$
  - Iterate the procedure until parameters are converged

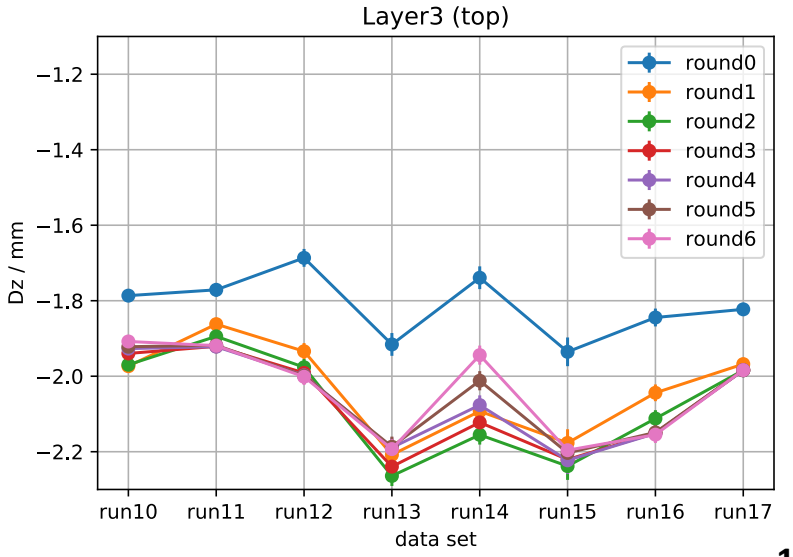


Fit results: Dx and Dz

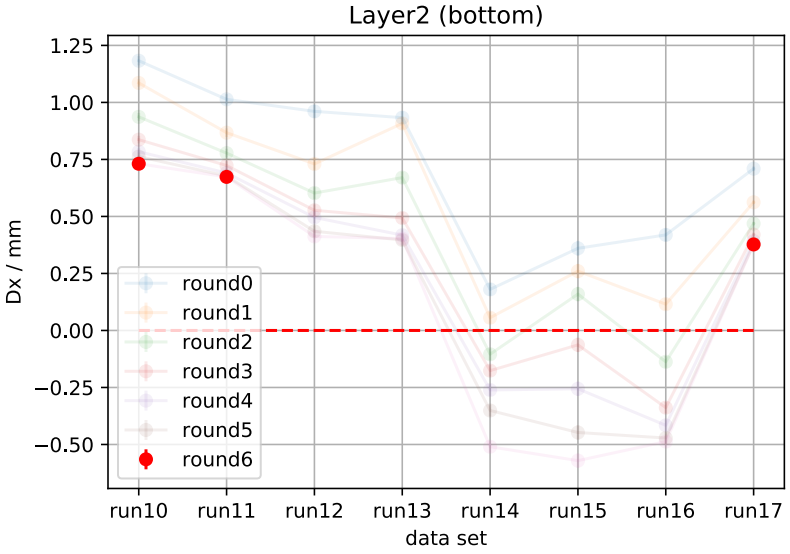


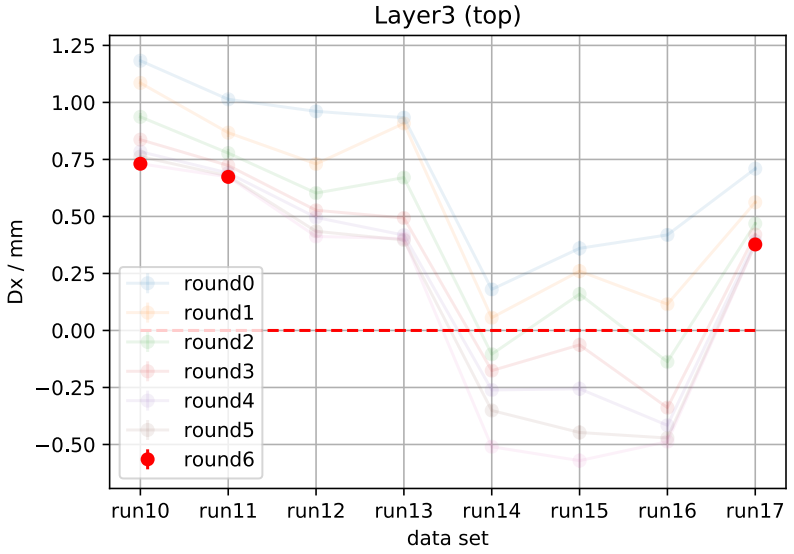


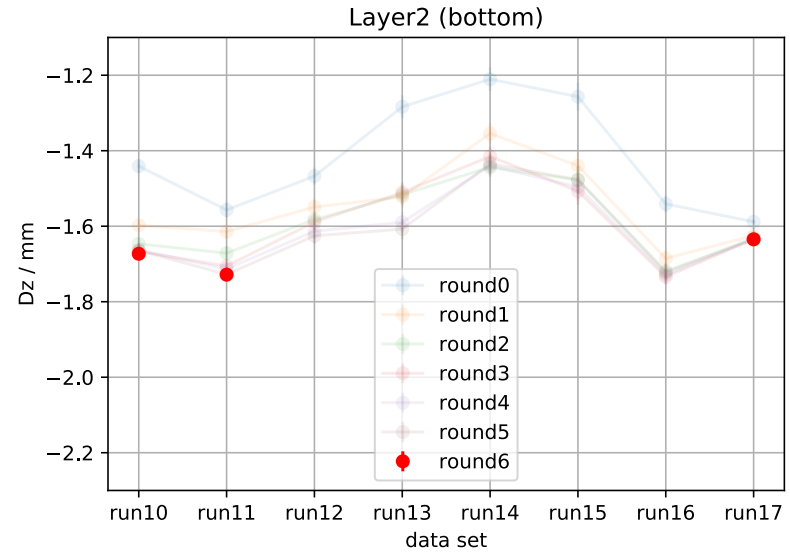


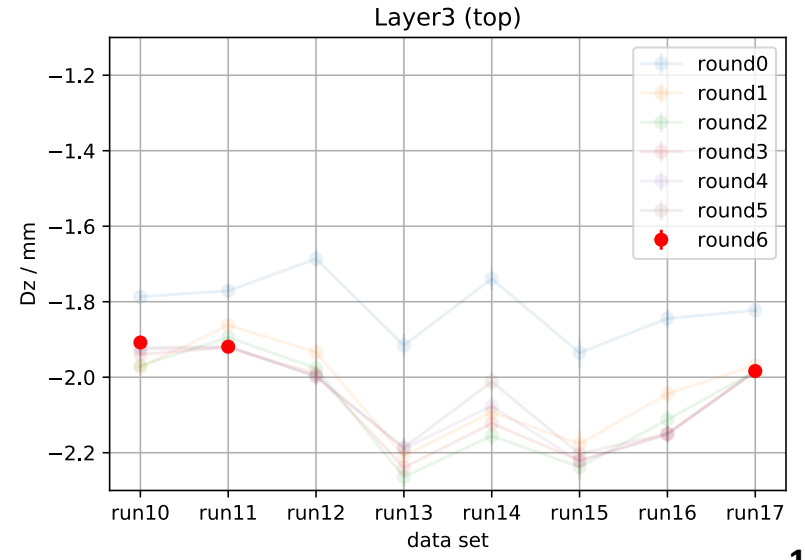


Fit results: Dx and Dz

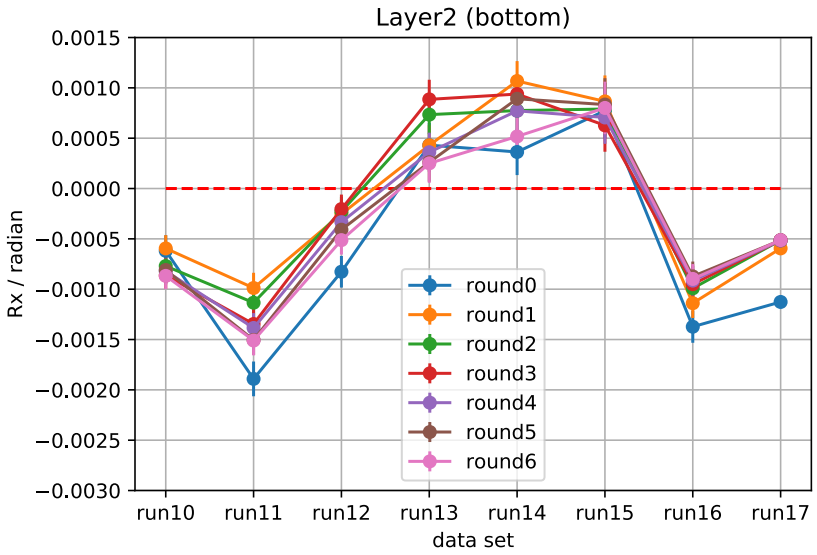


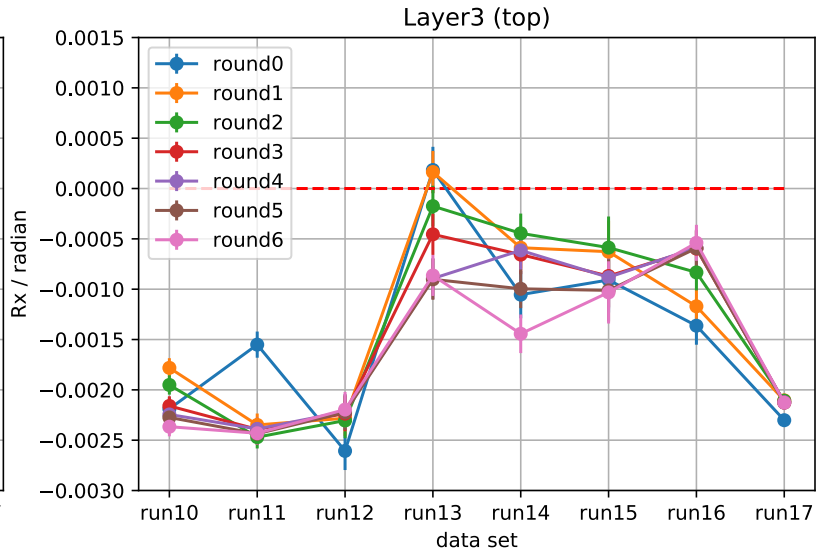


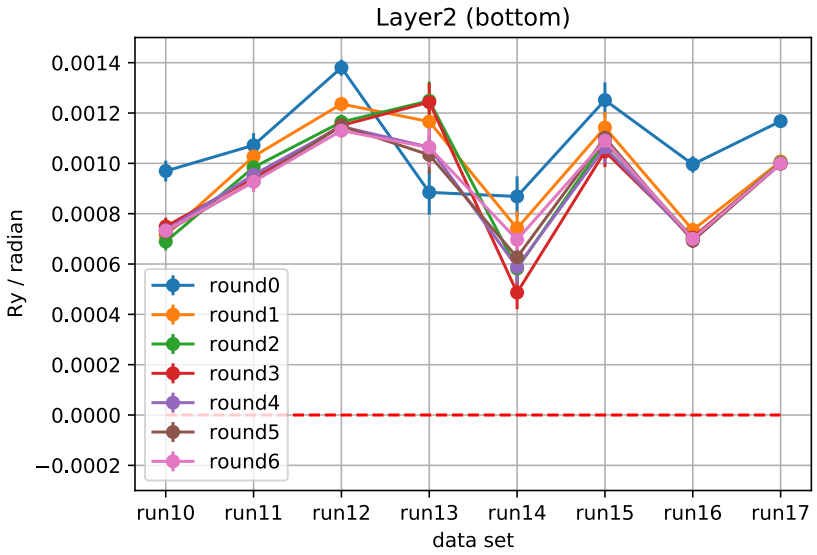


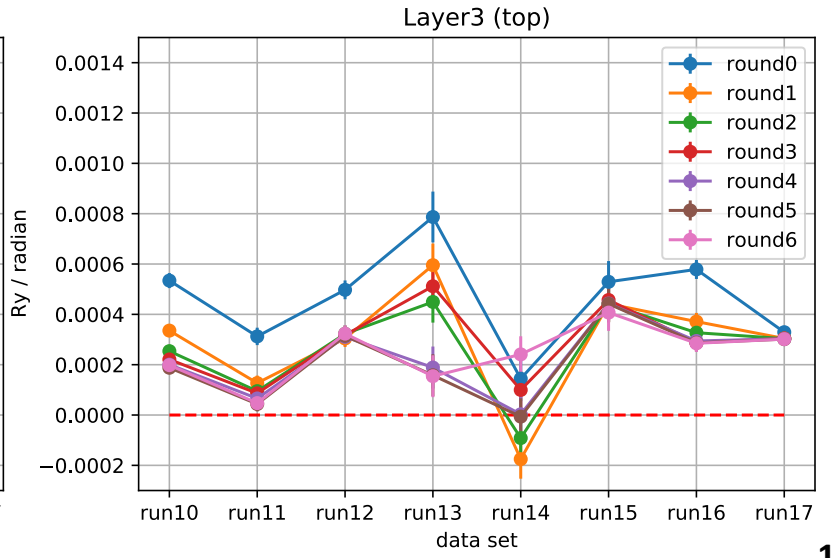


Fit results: Rx, Ry

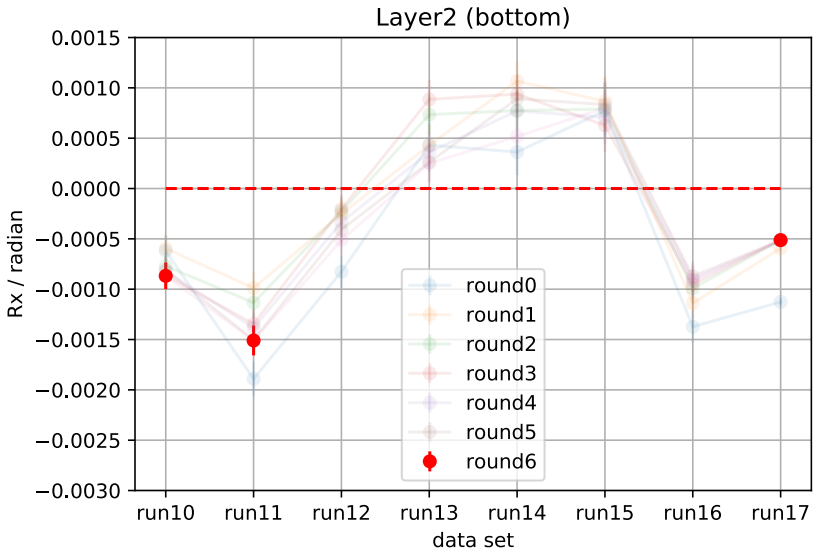


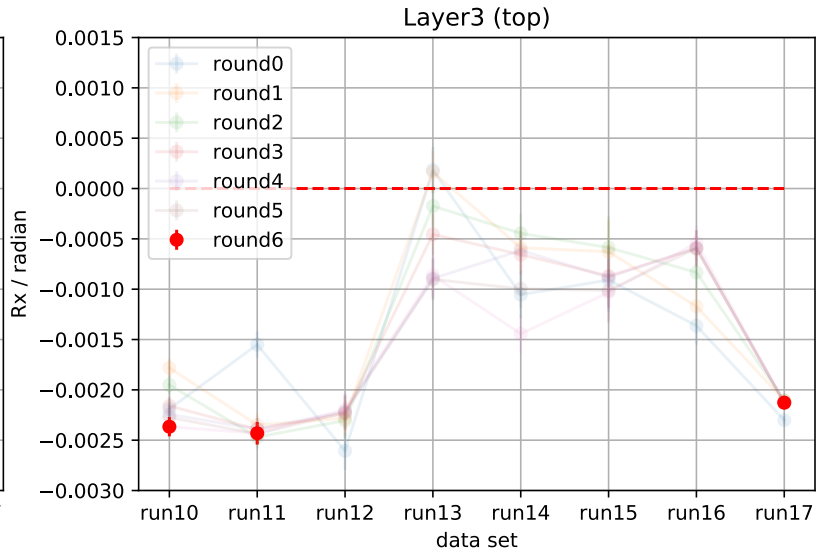


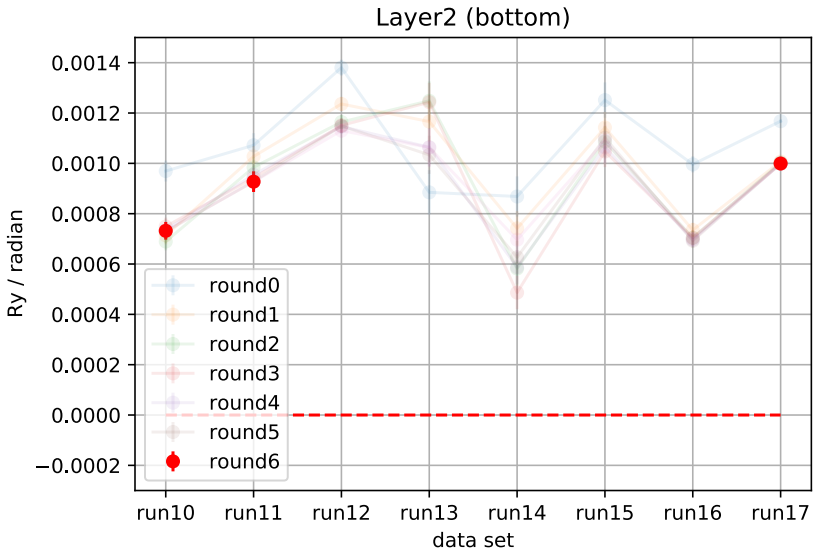


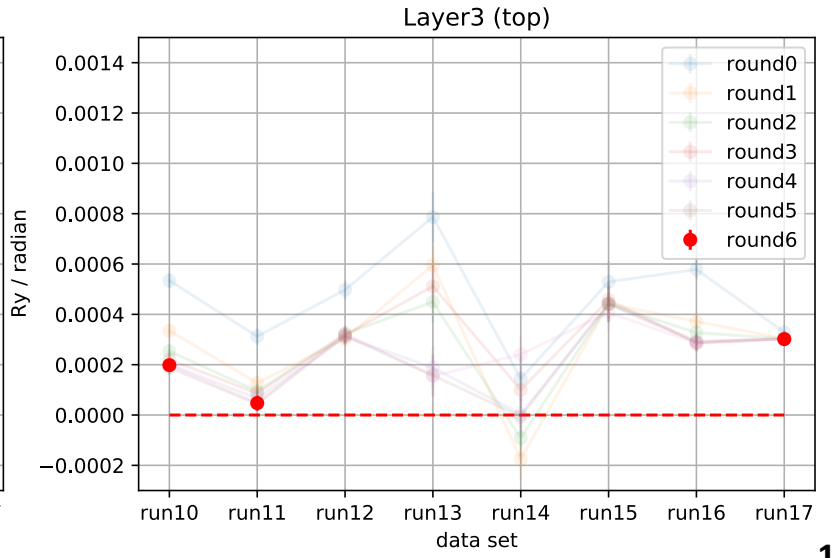


Fit results: Rx, Ry

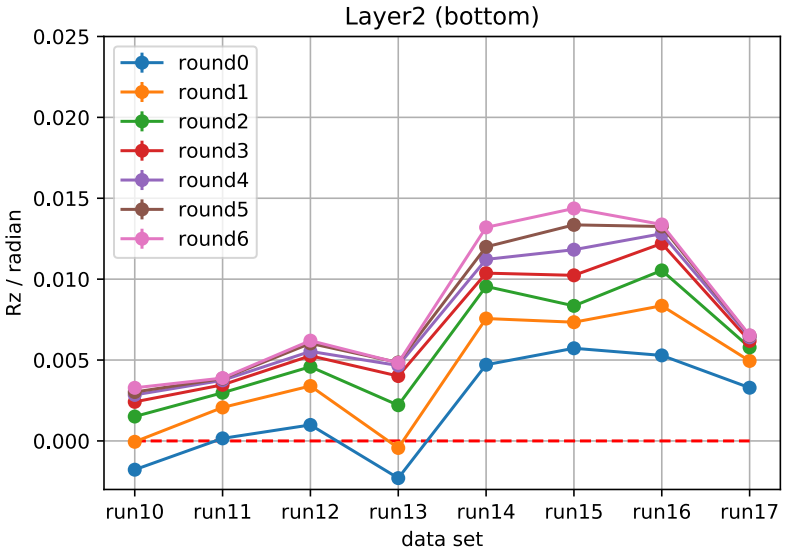


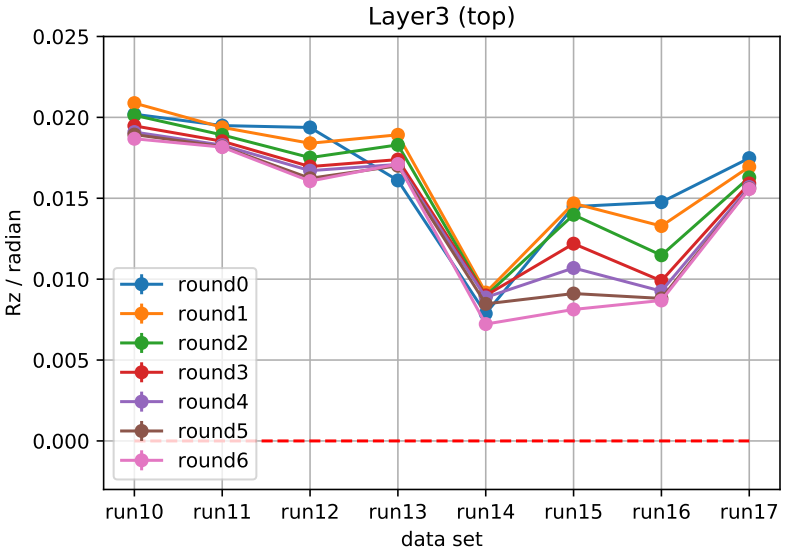




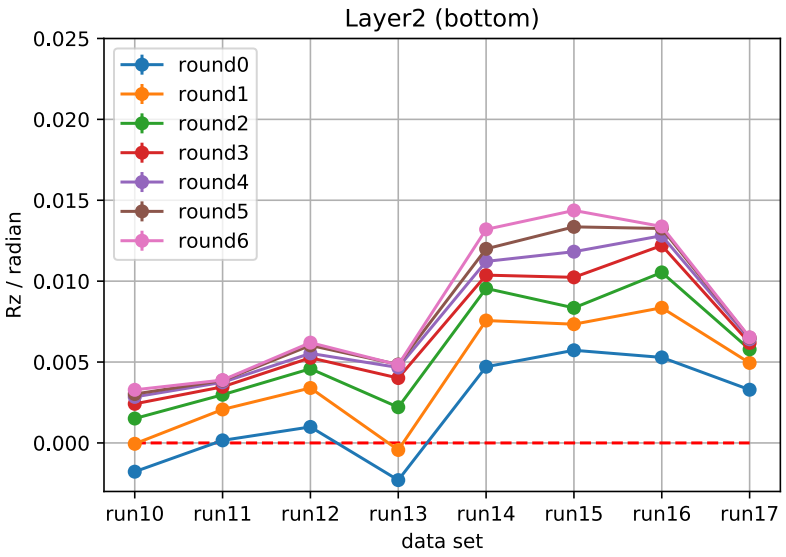


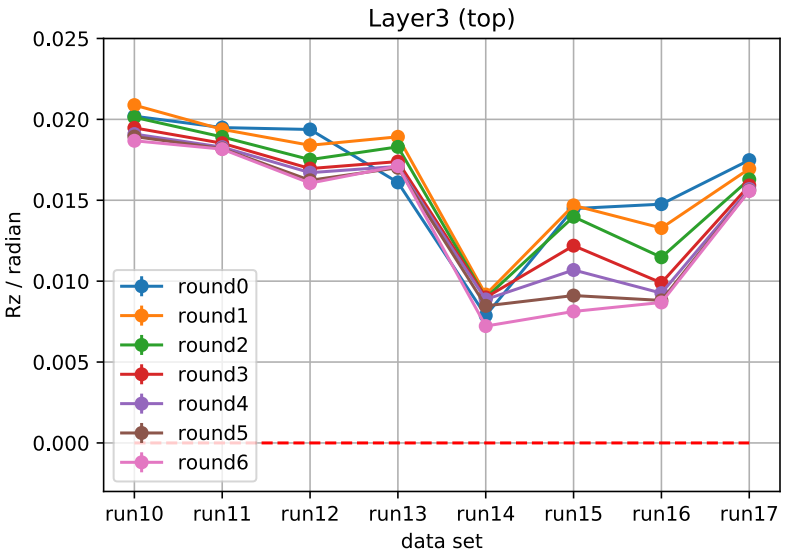
Fit results: Rz





Fit results: Rz





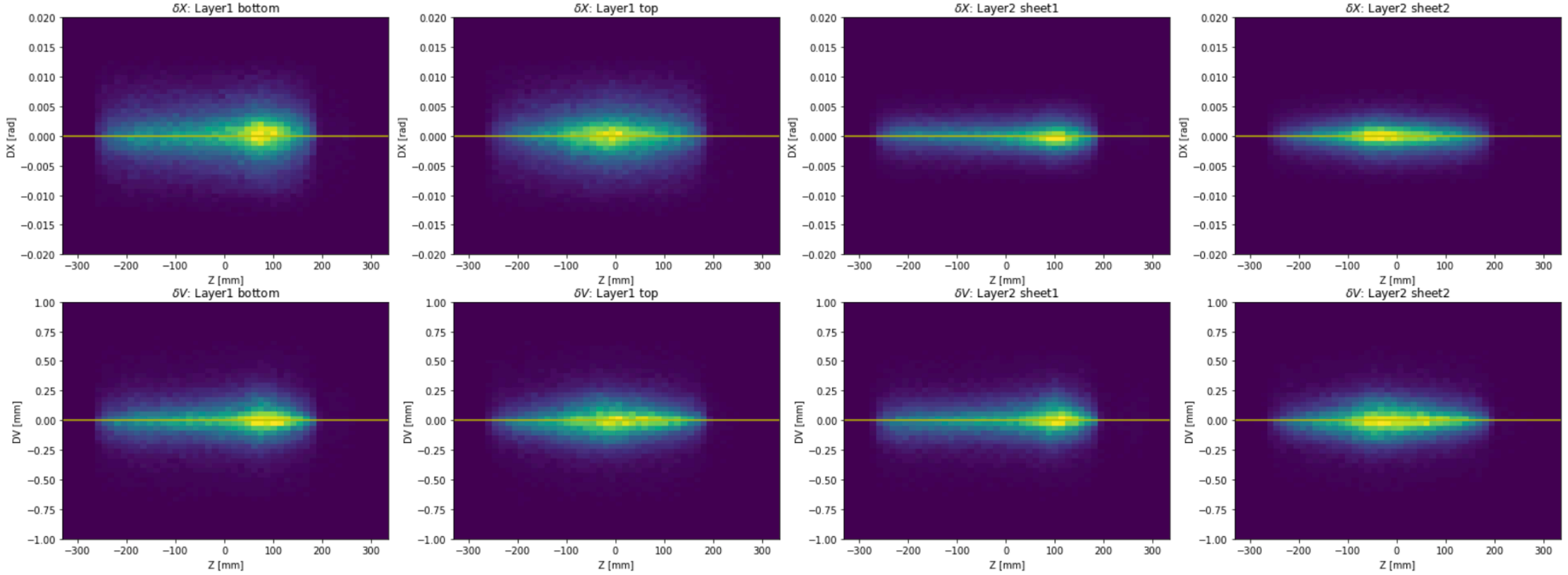
Previous results

Run17	Dx (mm)	Dz (mm)	Rx (Rad.)	Ry (Rad.)	Rz (Rad.)
L2	-0.9514	-1.6501	-0.0006	0.0009	0.0171
L3	1.8454	-2.0144	-0.0019	0.0004	0.0273

New results

Run17	Dx (mm)	Dz (mm)	Rx (Rad.)	Ry (Rad.)	Rz (Rad.)
L2	0.3771	-1.6346	-0.0005	0.0009	0.0065
L3	0.3771	-1.9837	-0.0021	0.0003	0.0155

Residual distribution vs Z



Results of sub-samples from Run17 (1st iteration)

- Run17 is divided to 3 sub-samples. Around 80000 events per sample

Sub-sample1

Run17	Dx (mm)	Dz (mm)	Rx (mRad.)	Ry (mRad.)	Rz (mRad.)
L2	**0.73 ± 0.02**	**-1.59 ± 0.01**	**-1.1 ± 0.06**	**1.1 ± 0.01**	**3.1 ± 0.1**
L3	**0.73 ± 0.02**	**-1.84 ± 0.01**	**-2.1 ± 0.07**	**0.3 ± 0.01**	**17.7 ± 0.1**

Sub-sample2

Run17	Dx (mm)	Dz (mm)	Rx (mRad.)	Ry (mRad.)	Rz (mRad.)
L2	**0.71± 0.02**	**-1.58 ± 0.01**	**-1.0 ± 0.06**	**1.1 ± 0.01**	**3.2 ± 0.1**
L3	**0.71± 0.02**	**-1.80 ± 0.01**	**-2.5 ± 0.06**	**0.3 ± 0.01**	**17.4 ± 0.1**

Sub-sample3

Run17	Dx (mm)	Dz (mm)	Rx (mRad.)	Ry (mRad.)	Rz (mRad.)
L2	**0.67± 0.02**	**-1.59 ± 0.01**	**-1.2 ± 0.06**	**1.1 ± 0.01**	**3.6 ± 0.1**
L3	**0.67± 0.02**	**-1.83 ± 0.01**	**-2.2 ± 0.06**	**0.3 ± 0.01**	**17.2 ± 0.1**

Summary

- More MC validation is done
- Fit procedure is improved
- Investigation of run17

Recommended alignment parameters

Run17	Dx (mm)	Dz (mm)	Rx (mrad)	Ry (mrad)	Rz (mrad)
L2	0.377±0.008	-1.635±0.005	-0.512±0.033	0.999±0.006	6.528±0.064
L3	0.377±0.008	-1.984±0.005	-2.127±0.040	0.302±0.007	15.572±0.064