

On Alignment and Fiducial Cuts

MPGD4EIC

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Nine configurations

```
[perez@eic0003 elog]$ cat group_0_00001080.txt
--      0      0
V00a    1      0  Arc02_7030 GEM G2 Elvia 2018
Z03k.A  2      0  ArISO_9505 MM  A1
B01a    3      0  Arc02_7030 uRW NEW,N2
Z03k.A  4    -90  ArISO_9505 MM  A2 Elvia 2019 90DEG CLOCKWISE
B01a    5      0  Arc02_7030 GEM 004-2
Z03k.A  6      0  ArISO_9505 MM  A5 Elvia 2019 Resit 10 M0mh
Z03k.B  7      0  ArISO_9505 MM  B2 Resit 100 k0hm
B00e    8      0  Arc02_7030 GEM G1 TTM 2018
```

0

```
[perez@eic0003 elog]$ cat group_1_00001209.txt
--      0      0
V00a    1      0  Arc02_7030 GEM G2 Elvia 2018
Z03k.A  2      0  Arc02_7030 MM  A1 - Flow AS3 - New Gas - Drift change from 5mm to 12.4mm
B01a    3      0  Arc02_7030 uRW NEW,N2
Z03k.A  4    -90  ArISO_9505 MM  A2 Elvia 2019 90DEG CLOCKWISE
B01a    5      0  Arc02_7030 GEM 004-2
Z03k.A  6      0  ArISO_9505 MM  A5 Elvia 2019 Resit 10 M0mh
Z03k.B  7      0  ArISO_9505 MM  B2 Resit 100 k0hm
B00e    8      0  Arc02_7030 GEM G1 TTM 2018
```

1

```
[perez@eic0003 elog]$ cat group_2_00001250.txt
--      0      0
V00a    1      0  Arc02_7030 GEM G2 Elvia 2018
Z03k.A  2      0  Arc02_7030 MM  A1 - Flow AS3 - New Gas - Drift change from 5mm to 12.4mm
B01a    3      0  Arc02_7030 uRW NEW,N2
Z03k.A  4    -90  ArISO_9505 MM  A2 Elvia 2019 90DEG CLOCKWISE
B01a    5      0  Arc02_7030 GEM 004-2
Z03k.A  6      0  ArISO_9505 MM  A5 Elvia 2019 Resit 10 M0mh
Z03k.B  7      0  ArISO_9505 MM  B2 Resit 100 k0hm
Z03k.A  8      0  Arc02_7030 GEM A6
```

2

```
[perez@eic0003 elog]$ cat group_3_00001291.txt
--      0      0
V00a    1      0  Arc02_7030 GEM G2 Elvia 2018
Z03k.A  2      0  Arc02_7030 MM  A1 - Flow AS3 - New Gas - Drift change from 5mm to 12.4mm
B00e    3      0  Arc02_7030 uRW #1
Z03k.A  4      0  ArISO_9505 MM  A2 Elvia 2019 drift 5mm
B01a    5      0  Arc02_7030 GEM C2
Z03k.A  6      0  ArISO_9505 MM  A5 Elvia 2019 Resit 10 M0mh
B01a    7      0  ArISO_9505 MM  TTM BNL70-2 Metal drift 5mm
Z03k.A  8      0  Arc02_7030 GEM A6
```

3

Nine configurations

```
[perez@eic0003 elog]$ cat group_4_00001293.txt
--      0      0
V00a    1      0  ArC02_7030 GEM G2 Elvia 2018
Z03k.A  2      0  ArC02_7030 MM  A1 - Flow AS3 - New Gas - Drift change from 5mm to 12.4mm
B00e    3      0  ArC02_7030 uRW #1
Z03k.A  4      0  ArISO_9505 MM  A2 Elvia 2019 drift 5mm
Z03k.D  5      0  ArC02_7030 GEM C2
Z03k.A  6      0  ArISO_9505 MM  A5 Elvia 2019 Resit 10 M0mh
B01a    7      0  ArISO_9505 MM  TTM BNL70-2 Metal drift 5mm
Z03k.A  8      0  ArC02_7030 GEM A6
```

4

```
[perez@eic0003 elog]$ cat group_5_00001465.txt
--      0      0
V00a    1  -90  ArC02_7030 GEM G2 Elvia 2018
Z03k.A  2      0  ArC02_7030 MM  A1 - Flow AS3 - New Gas - Drift change from 5mm to 12.4mm
B01a    3      0  ArC02_7030 uRW #2
Z03k.A  4      0  ArISO_9505 MM  A2 Elvia 2019 drift 5mm
B01a    5      0  ArC02_7030 GEM TTM 70um
Z03k.A  6      0  ArISO_9505 MM  A5 Elvia 2019 Resit 10 M0mh
B01a    7      0  ArISO_9505 MM  TTM BNL70-2 Metal drift 5mm
Z03k.A  8      0  ArC02_7030 GEM A6 DISCONNECTED
```

5

```
[perez@eic0003 elog]$ cat group_6_00001619.txt
--      0      0
V00a    1  -90  ArC02_7030 GEM G2 Elvia 2018
Z03k.A  2      0  ArC02_7030 MM  A1 - Flow AS3 - New Gas - Drift change from 5mm to 12.4mm
B01a    3      0  ArC02_7030 uRW #2
Z03k.A  4      0  ArC02_7030 GEM A6 TPC-mode -Rotatable stage-
--      5      0
--      6      0
--      7      0
--      8      0
```

6

```
[perez@eic0003 elog]$ cat group_7_00001637.txt
--      0      0
V00a    1  -90  ArC02_7030 GEM G2 Elvia 2018
Z03k.A  2      0  ArC02_7030 MM  A1 - Flow AS3 - New Gas - Drift change from 5mm to 12.4mm
B01a    3      0  ArC02_7030 uRW #2
Z03k.A  4      0  ArC02_7030 GEM A6 TPC-mode -Rotatable stage-
--      5      0
--      6      0
B01a    7      0  ArIso_9505 Hyb
--      8      0
```

7

Nine configurations

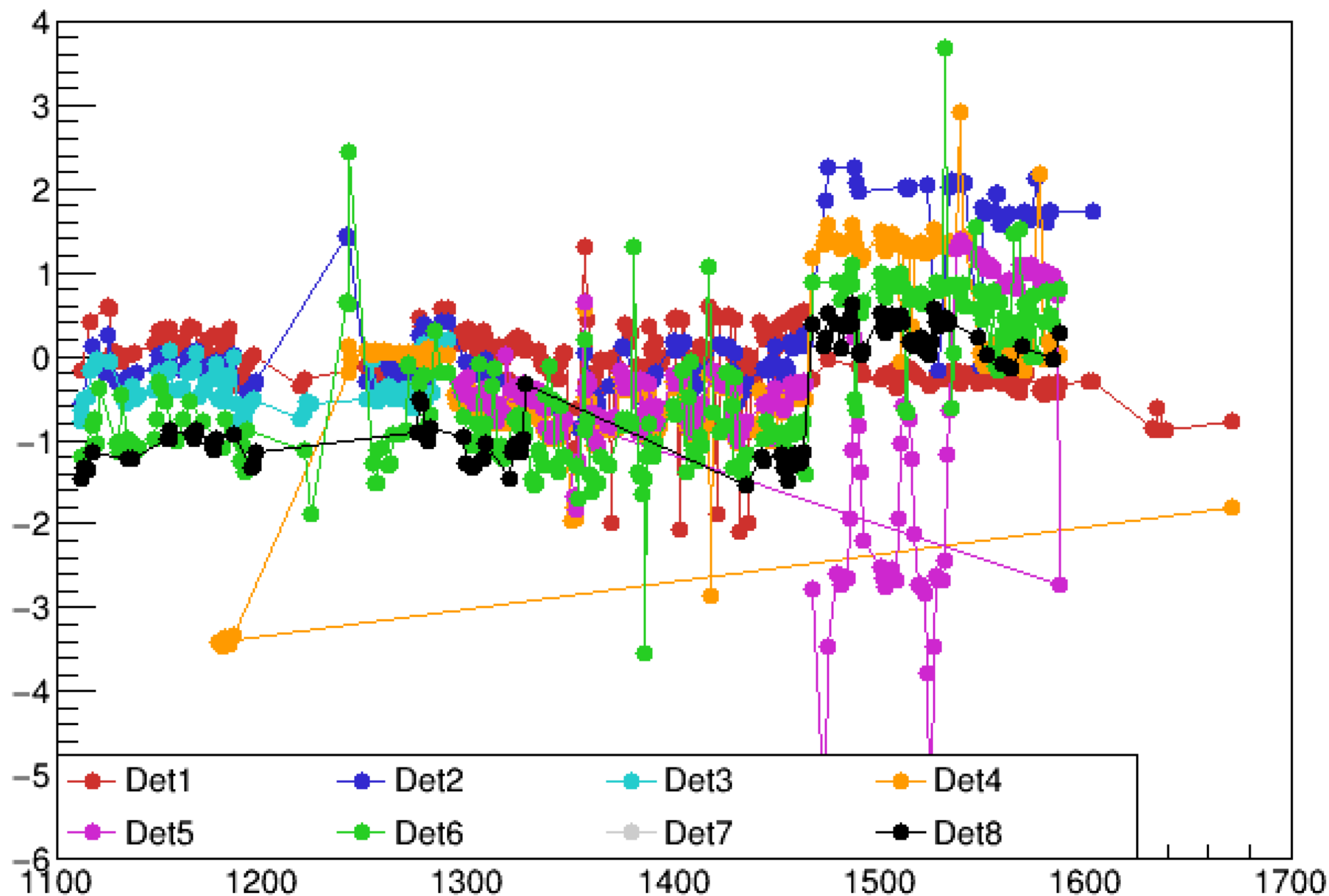
```
[perez@eic0003 elog]$ cat group_8_00001733.txt
--      0      0
V00a    1  -90   CF4      GEM G2 Elvia 2018
Z03k.A  2    0  ArIso_9505 MM  A1 - Flow AS3 - New Gas - Drift change from 5mm to 12.4mm
B01a    3    0   CF4      uRW #2
Z03k.A  4    0   CF4      GEM A6
B01a    5    0   CF4      GEM TTM
--      6      0
B01a    7    0  ArIso_9505 Hyb
--      8      0
```

8

After fiducial cuts

Alignment used for our preliminary results

Mean of residual distribution (mm)



Fiducial cuts and Alignment values calibrated in a per run basis

Proposed a new way to do this:

- **More transparent**
- **Allows for reusability of fiducial cuts in benchtest experiments**
- **Better understanding of pitfall of silicon+aquarium+beam synchronisation**
- **Allows for better preparation for next test beam**

Implementation of fiducial cuts per chamber

GEM_B01a_D1

A	+1.0	+4.0	-3.5	+4.0	-4.0	+4.0
B	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
C	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
D	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
E	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
F	-4.0	+2.0	-4.0	+4.0	-4.0	+4.0
G	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
H	-4.0	+0.0	-4.0	+4.0	-4.0	+4.0
I	-4.0	-5.0	-4.0	+4.0	-4.0	+4.0
J	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0

MM_Z03k.A_D2

A	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
B	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
C	+2.0	+4.0	+5.0	-5.0	-4.0	+4.0
D	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
E	+5.0	-5.0	-4.0	+3.5	-4.0	+4.0
F	+5.0	-5.0	-4.0	+4.0	-4.0	+4.0
G	-4.0	+1.0	-4.0	+4.0	-4.0	+4.0
H	-4.0	+4.0	-4.0	+0.0	-4.0	+4.0
I	-4.0	+0.0	+5.0	-5.0	-4.0	+4.0
J	-4.0	+1.0	+5.0	-5.0	-4.0	+4.0

uRW_B01a_D3

A	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
B	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
C	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
D	+5.0	-5.0	-4.0	+4.0	-4.0	+4.0
E	+5.0	-5.0	-4.0	+4.0	-4.0	+4.0
F	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
G	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
H	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
I	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
J	-4.0	+4.0	-4.0	+3.0	-4.0	+4.0

MM_Z03k.A_D4

A	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
B	+5.0	-5.0	-4.0	+4.0	-4.0	+4.0
C	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
D	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
E	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
F	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
G	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
H	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
I	-4.0	+3.0	-4.0	+4.0	-4.0	+4.0
J	-1.0	+4.0	-4.0	+4.0	-4.0	+4.0

GEM_B01a_D5

A	+1.0	+4.0	-3.5	+4.0	-4.0	+4.0
B	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
C	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
D	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
E	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
F	-4.0	+2.0	-4.0	+4.0	-4.0	+4.0
G	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
H	-4.0	+0.0	-4.0	+4.0	-4.0	+4.0
I	-4.0	-5.0	-4.0	+4.0	-4.0	+4.0
J	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0

Two other variations of chambers used in slot 5 are missing. Work in progress

MM_Z03k.A_D6

A	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
B	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
C	-1.5	+4.0	-3.0	+1.0	-4.0	+4.0
D	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
E	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
F	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
G	+5.0	-5.0	-2.5	+4.0	-4.0	+4.0
H	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
I	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
J	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0

MM_B01a_D7

A	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
B	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
C	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
D	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
E	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
F	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
G	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
H	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
I	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
J	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0

MM_Z03k.B_D7

A	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
B	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
C	+5.0	-5.0	-4.0	+4.0	-4.0	+4.0
D	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
E	-2.0	+4.0	-4.0	+4.0	-4.0	+4.0
F	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
G	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
H	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
I	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
J	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0

GEM_Z03k.A_D8

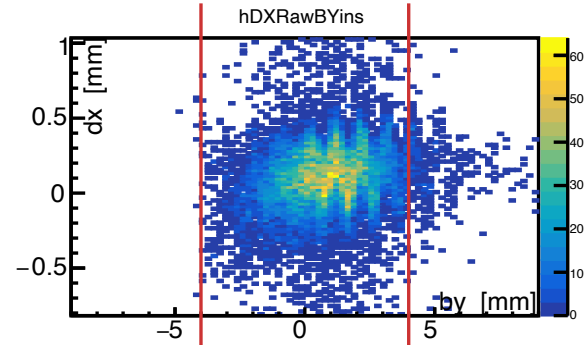
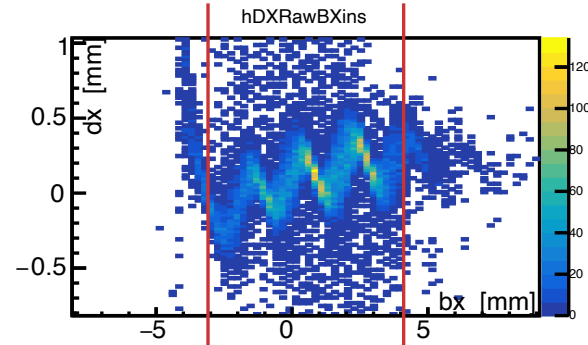
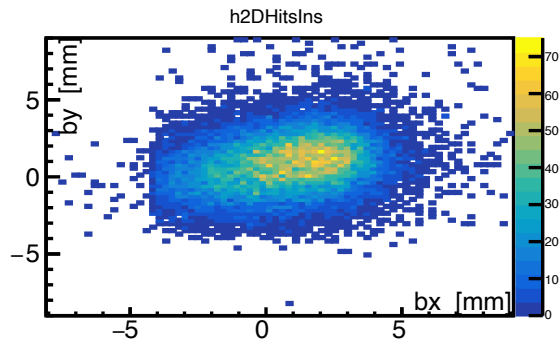
A	-1.0	+4.0	+5.0	-5.0	-4.0	+4.0
B	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
C	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
D	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
E	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
F	-4.0	+4.0	+5.0	-5.0	-4.0	+4.0
G	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
H	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
I	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
J	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0

GEM_B00e_D8

A	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
B	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
C	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
D	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
E	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
F	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
G	+5.0	-5.0	+5.0	-5.0	-4.0	+4.0
H	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0
I	+5.0	-5.0	-4.0	+4.0	-4.0	+4.0
J	-4.0	+4.0	-4.0	+4.0	-4.0	+4.0

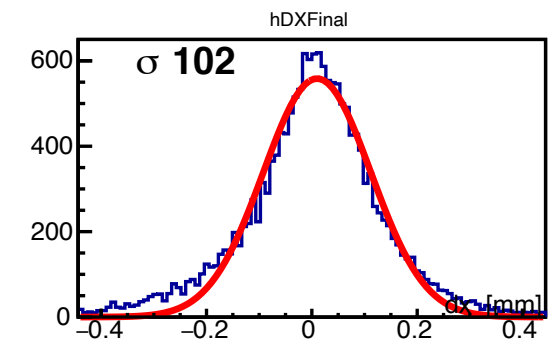
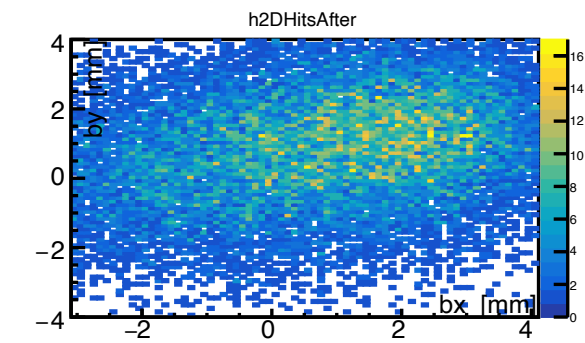
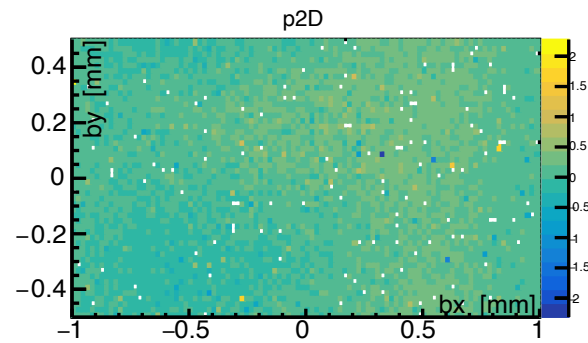
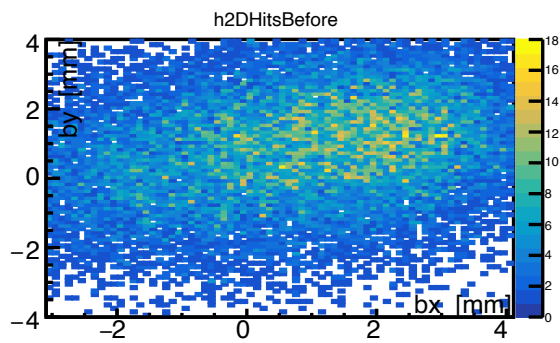
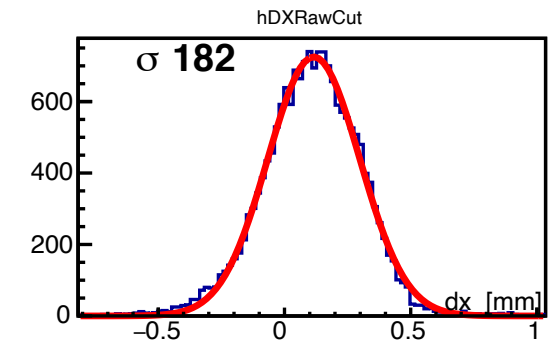
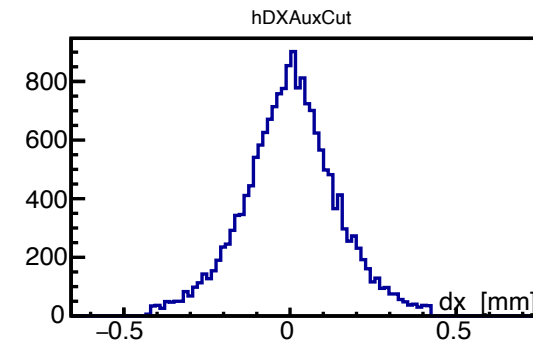
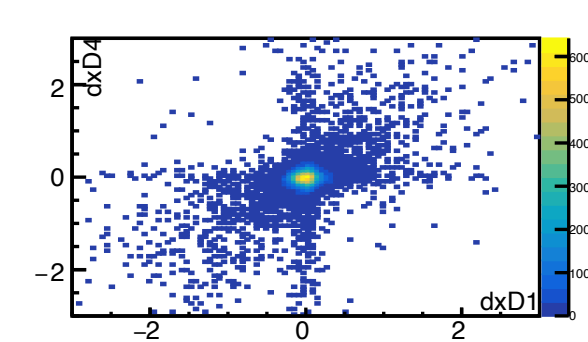
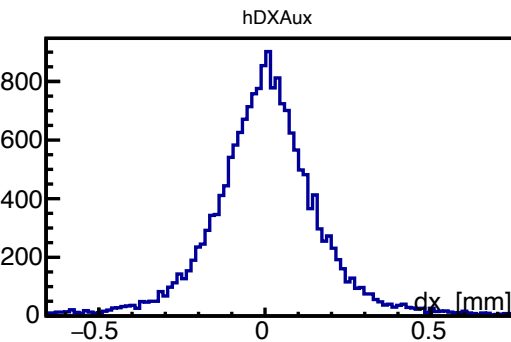
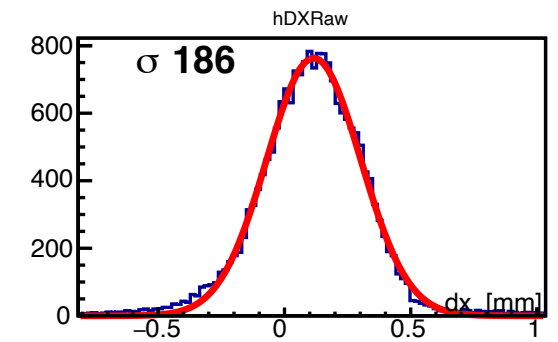
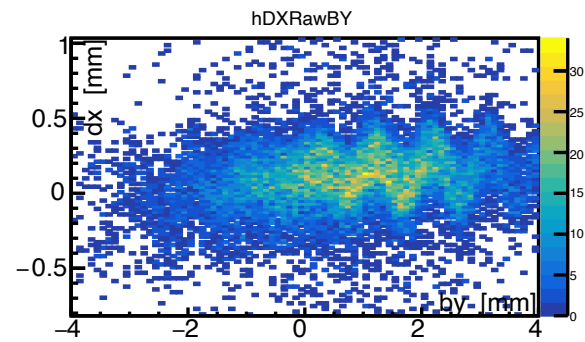
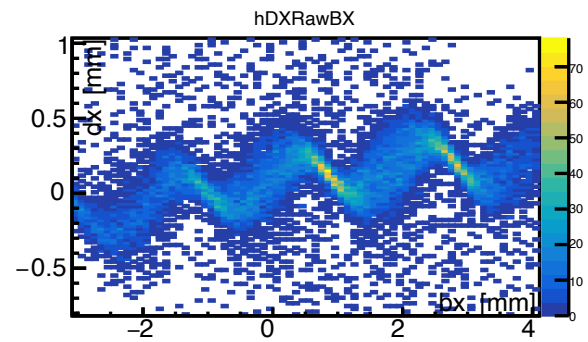
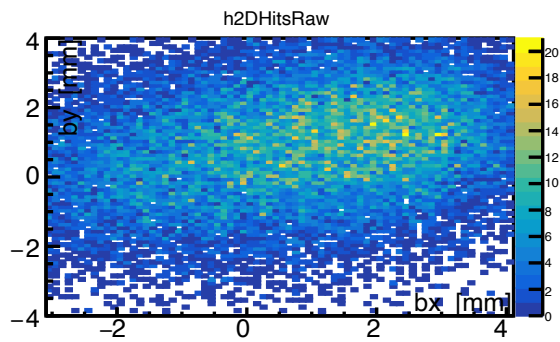
First two columns: cut in X from center of cell (bottom side 0-4)
Next two columns: cut in X from center of cell (top side 5-9)
Last two columns: cut in Y from center of cell

Working fine with TB data



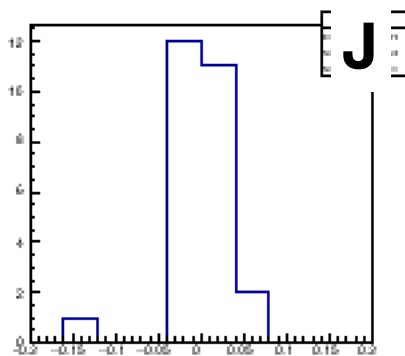
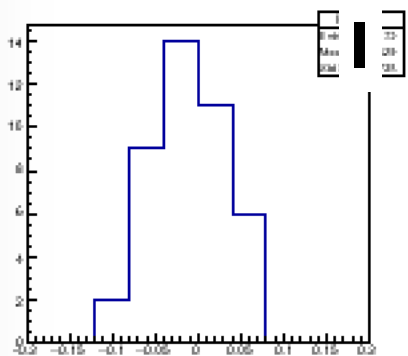
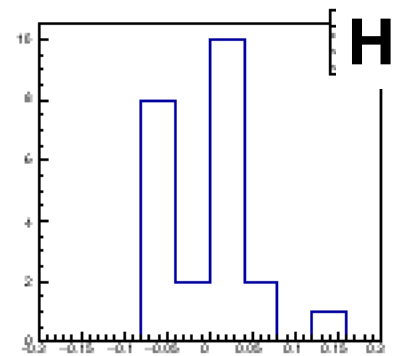
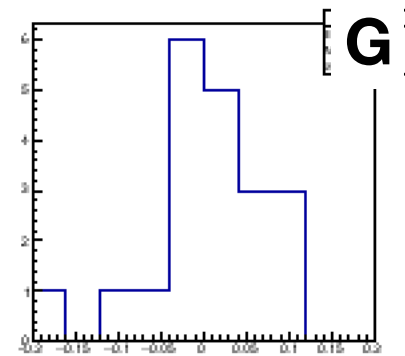
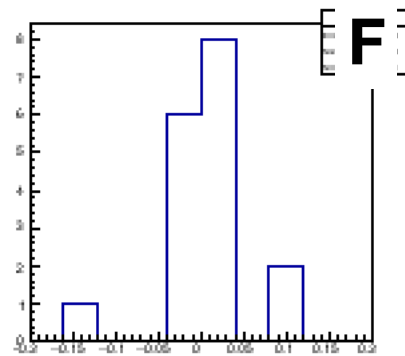
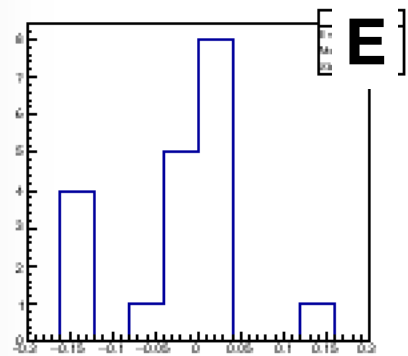
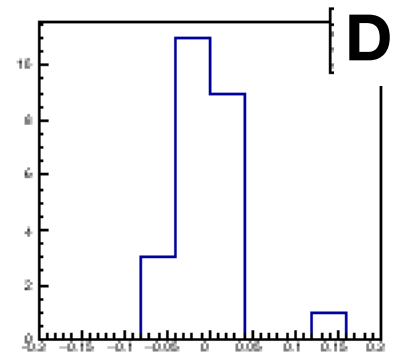
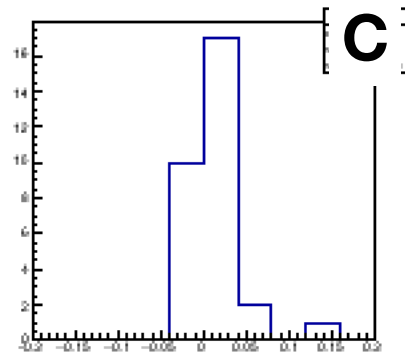
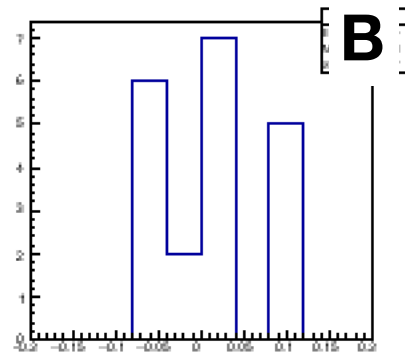
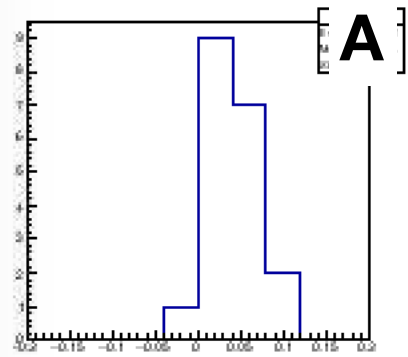
Target Det1 1293
GEM V00a A0
XP 2.00 YP 1.00 ST -25 (4,2
[-3.1:4.1] [-4.0:4.0]

Auxiliary Det4
MM Z03k.A A0
XP 2.00 YP 0.50 ST 5 (4,4)
[-4.0:4.0] [-4.0:4.0]

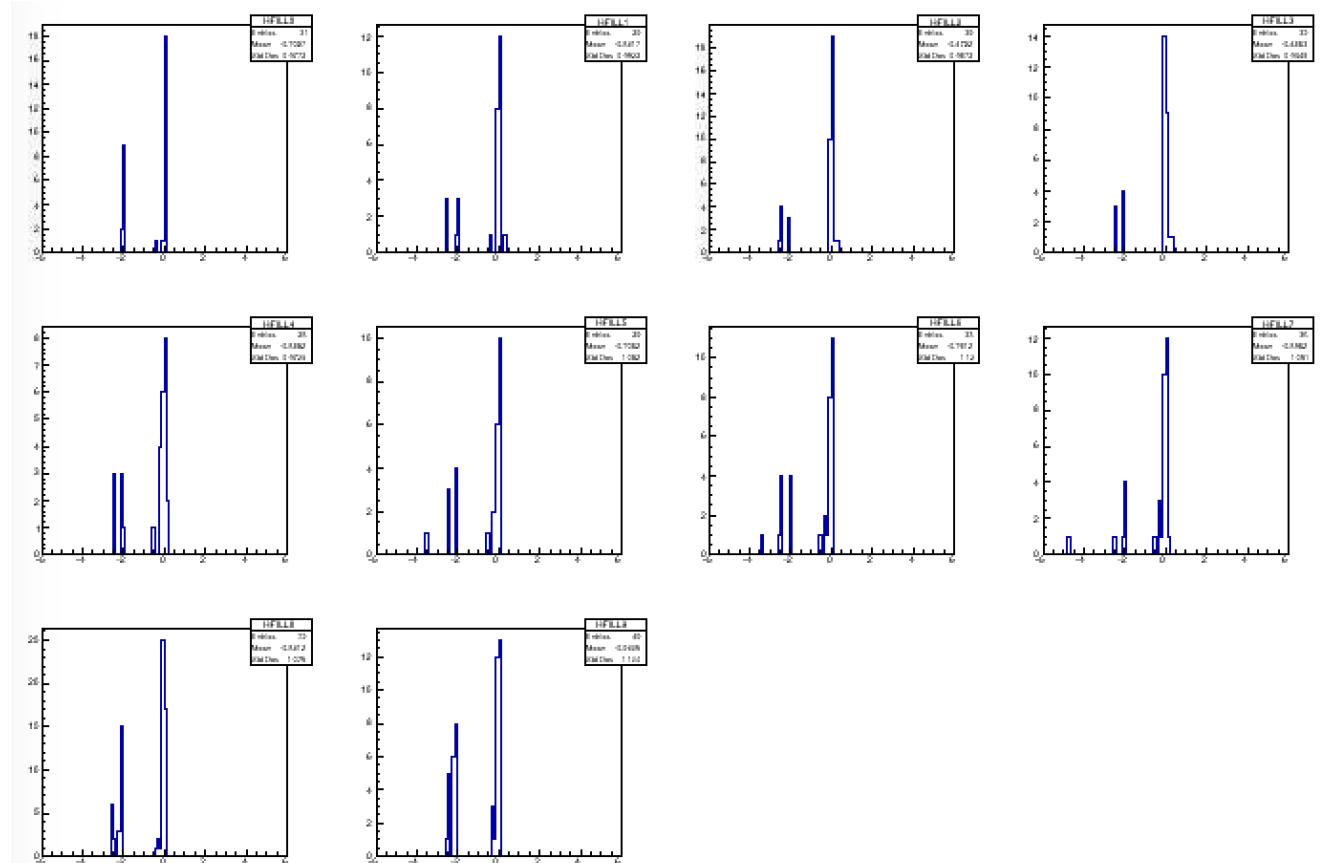


Implementation of better alignment using encoder

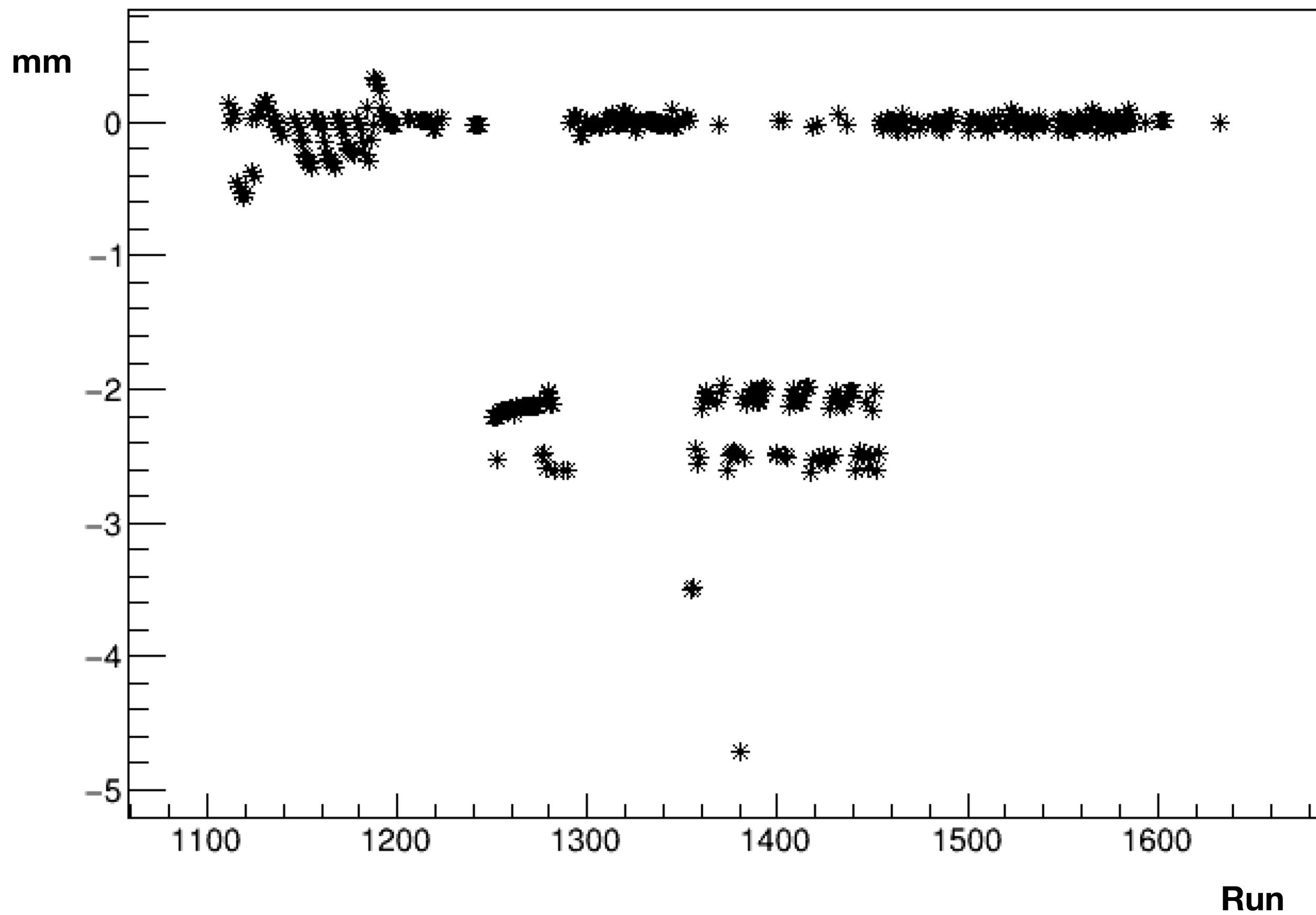
Encoder - Motor



400 μm



12 cm

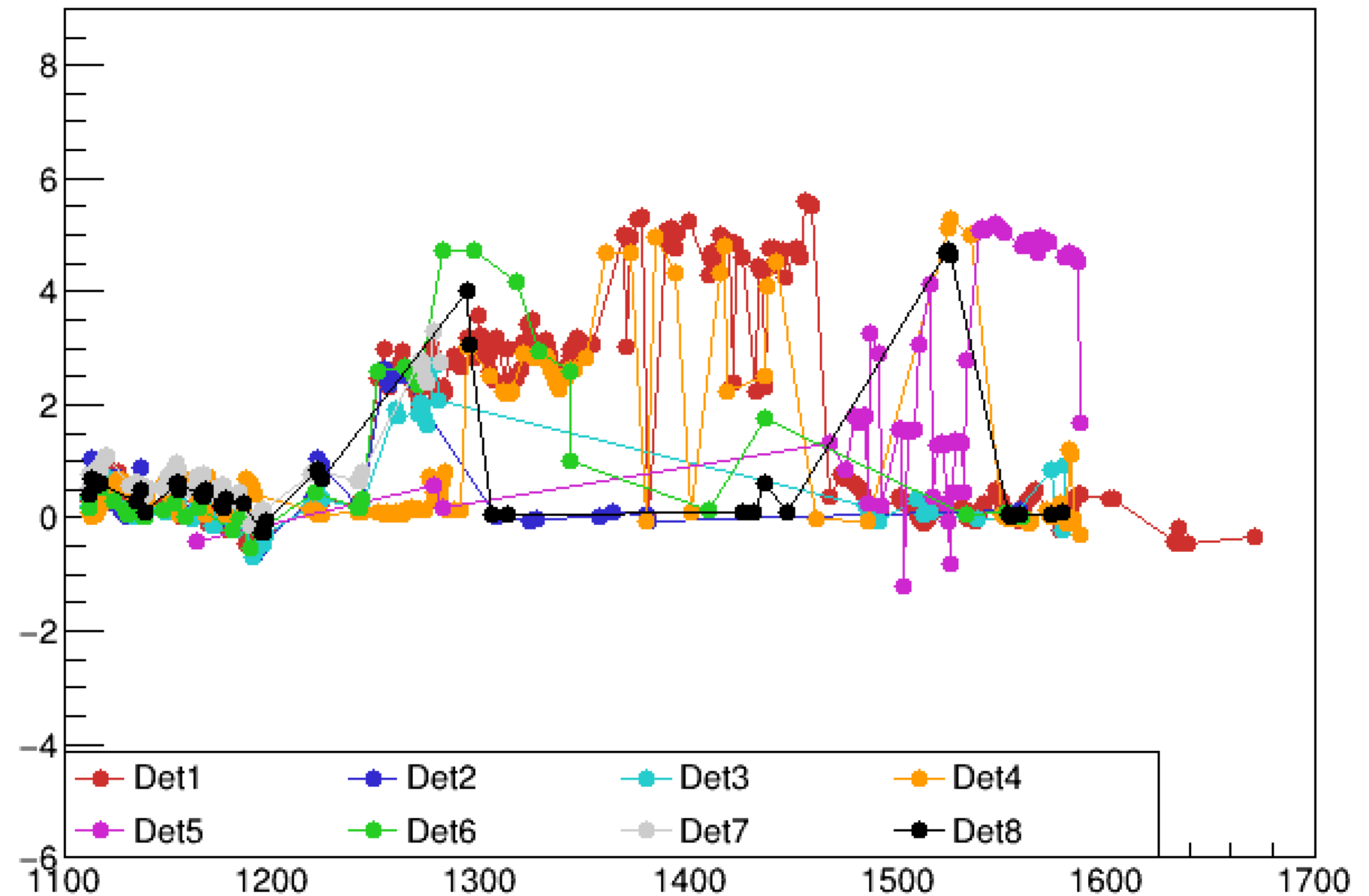


Residual for static alignment

Motor

```
[perez@eic0004 ~/mpgdMar2019]$ cat config/D?.txt
```

```
1000 2000 -12.0 -23.0 -210 8.1
1000 2000 -11.8 -23.0 -135 8.1
1000 2000 -11.6 -23.0 -60 8.1
1000 2000 -11.4 -23.0 15 8.1
1000 2000 -11.2 -23.0 90 8.1
1000 2000 -11.0 -23.0 165 8.1
1000 2000 -10.8 -23.0 240 8.1
1000 2000 -10.6 -23.0 315 8.1
```

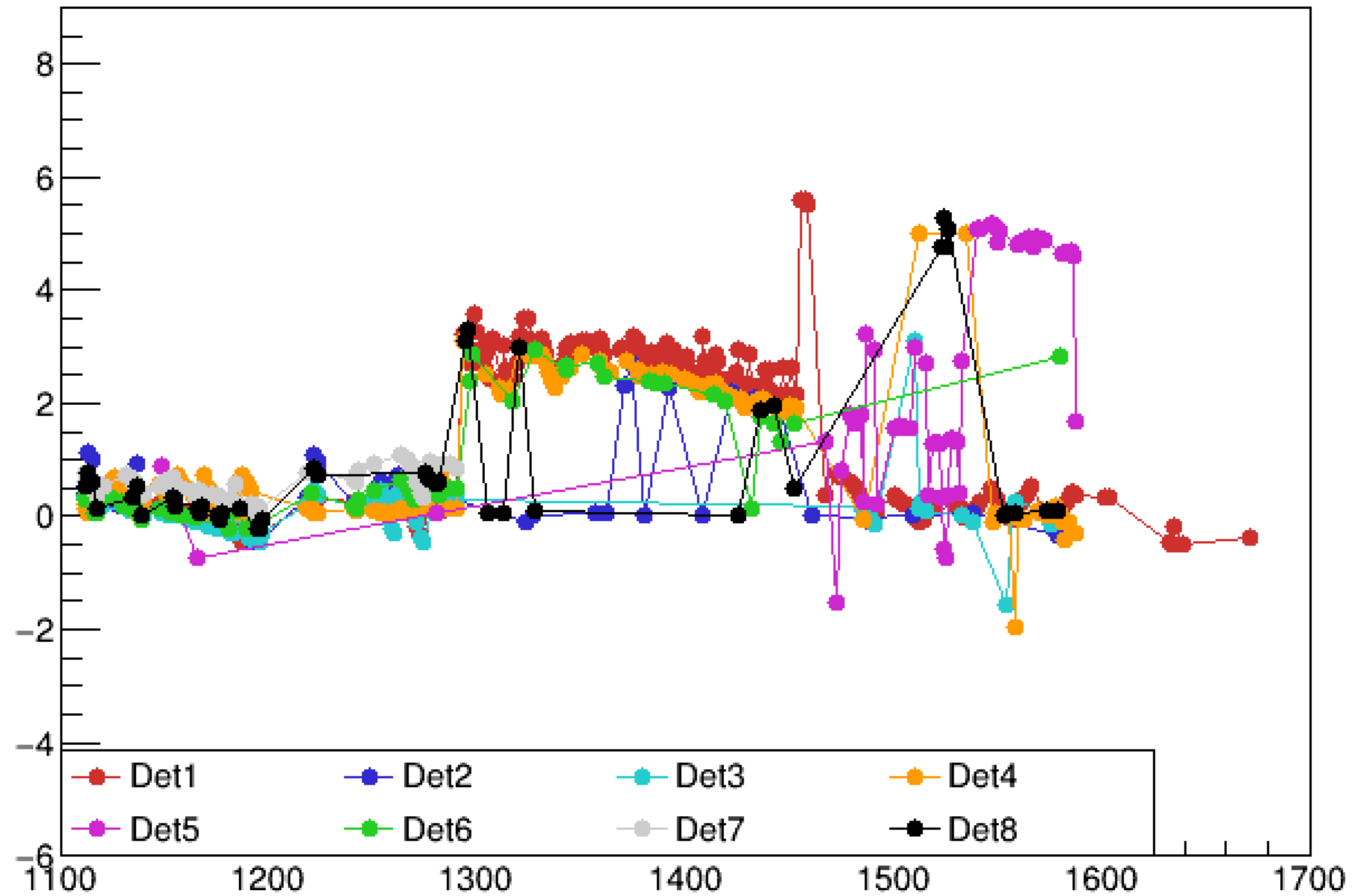


Residual for static alignment

Encoder

```
[perez@eic0004 ~/mpgdMar2019]$ cat config/D?.txt
```

```
1000 2000 -12.0 -23.0 -210 8.1
1000 2000 -11.8 -23.0 -135 8.1
1000 2000 -11.6 -23.0 -60 8.1
1000 2000 -11.4 -23.0 15 8.1
1000 2000 -11.2 -23.0 90 8.1
1000 2000 -11.0 -23.0 165 8.1
1000 2000 -10.8 -23.0 240 8.1
1000 2000 -10.6 -23.0 315 8.1
```

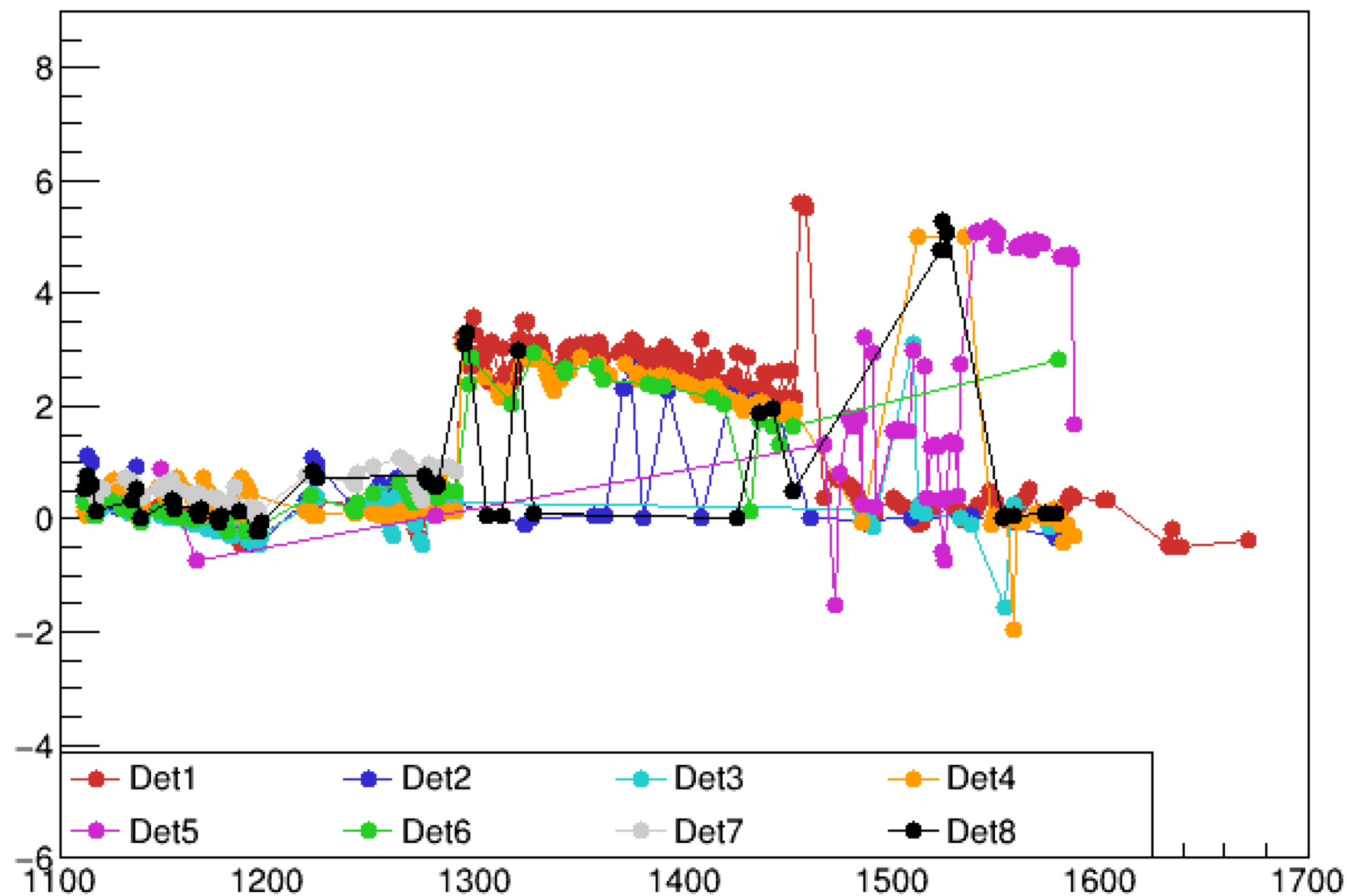


Concluding Notes:

- **Usage of encoder eliminates random jumps and makes a clear trend**
- **Trend downwards (neg x with increasing time) present with both encoder and motor**
 - **Can it be explain by angle difference between encoder magnetic strip and Xaxis?**
 - **Can it be a beam shift as time progresses?**
- **Big jumps per installation still present after using encoder (expected)**
 - **Propose to use four ranges and account for negative slope from fit, in order to fine tune fiducial tables**
 - **Then revisit and decide if good enough or move back to per-run alignment**

Extra

00



```
[perez@eic0004 config]$ cat D1.txt
1080 1208 -12.0 -23.0 -210 8.1
1209 1249 -12.0 -23.0 -210 8.1
1250 1290 -14.0 -23.0 -210 8.1
1291 1355 -15.0 -23.0 -210 8.1
1356 1464 -17.0 -23.0 -210 8.1
1465 1618 -17.0 -23.0 -210 8.1
1619 1636 -17.0 -23.0 -210 8.1
1637 1732 -17.0 -23.0 -210 8.1
1733 2000 -17.0 -23.0 -210 8.1
[perez@eic0004 config]$ cat D2.txt
1080 1208 -11.8 -23.0 -135 8.1
1209 1249 -11.8 -23.0 -135 8.1
1250 1290 -13.8 -23.0 -135 8.1
1291 1355 -14.8 -23.0 -135 8.1
1356 1464 -16.8 -23.0 -135 8.1
1465 1618 -17.0 -23.0 -135 8.1
1619 1636 -17.0 -23.0 -135 8.1
1637 1732 -17.0 -23.0 -135 8.1
1733 2000 -17.0 -23.0 -135 8.1
[perez@eic0004 config]$ cat D3.txt
1080 1208 -11.6 -23.0 -60 8.1
1209 1249 -11.6 -23.0 -60 8.1
1250 1290 -13.6 -23.0 -60 8.1
1291 1355 -14.6 -23.0 -60 8.1
1356 1464 -16.6 -23.0 -60 8.1
1465 1618 -16.7 -23.0 -60 8.1
1619 1636 -16.7 -23.0 -60 8.1
1637 1732 -16.7 -23.0 -60 8.1
1733 2000 -16.7 -23.0 -60 8.1
[perez@eic0004 config]$ cat D4.txt
1080 1208 -11.4 -23.0 15 8.1
1209 1249 -11.4 -23.0 15 8.1
1250 1290 -13.4 -23.0 15 8.1
1291 1355 -14.4 -23.0 15 8.1
1356 1464 -16.4 -23.0 15 8.1
1465 1618 -16.4 -23.0 15 8.1
1619 1636 -16.4 -23.0 15 8.1
1637 1732 -16.4 -223.0 15 8.1
1733 2000 -16.4 -223.0 15 8.1
[perez@eic0004 config]$ cat D5.txt
1080 1208 -11.2 -23.0 90 8.1
1209 1249 -11.2 -23.0 90 8.1
1250 1290 -13.2 -23.0 90 8.1
1291 1355 -14.2 -23.0 90 8.1
1356 1464 -16.2 -23.0 90 8.1
1465 1536 -16.1 -23.0 90 8.1
1537 1636 -16.1 -23.0 90 8.1
1637 1732 -16.1 -23.0 90 8.1
1733 2000 -16.1 -23.0 90 8.1
[perez@eic0004 config]$ cat D6.txt
1080 1208 -11.0 -23.0 165 8.1
1209 1249 -11.0 -23.0 165 8.1
1250 1290 -13.0 -23.0 165 8.1
1291 1355 -14.0 -23.0 165 8.1
1356 1464 -16.0 -23.0 165 8.1
1465 1618 -15.8 -23.0 165 8.1
1619 1636 -15.8 -23.0 165 8.1
1637 1732 -15.8 -23.0 165 8.1
1733 2000 -15.8 -23.0 165 8.1
[perez@eic0004 config]$ cat D7.txt
1080 1208 -10.8 -23.0 240 8.1
1209 1249 -10.8 -23.0 240 8.1
1250 1290 -12.8 -23.0 240 8.1
1291 1355 -13.8 -23.0 240 8.1
1356 1464 -15.8 -23.0 240 8.1
1465 1618 -15.5 -23.0 240 8.1
1619 1636 -15.5 -23.0 240 8.1
1637 1732 -15.5 -23.0 240 8.1
1733 2000 -15.5 -23.0 240 8.1
[perez@eic0004 config]$ cat D8.txt
1080 1208 -10.6 -23.0 315 8.1
1209 1249 -10.6 -23.0 315 8.1
1250 1290 -12.6 -23.0 315 8.1
1291 1355 -13.6 -23.0 315 8.1
1356 1464 -15.6 -23.0 315 8.1
1465 1618 -15.2 -23.0 315 8.1
1619 1636 -15.2 -23.0 315 8.1
1637 1732 -15.2 -23.0 315 8.1
1733 2000 -15.2 -23.0 315 8.1
```

