

2013-12-10 Qaud MEC Alignment

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Optical measurement

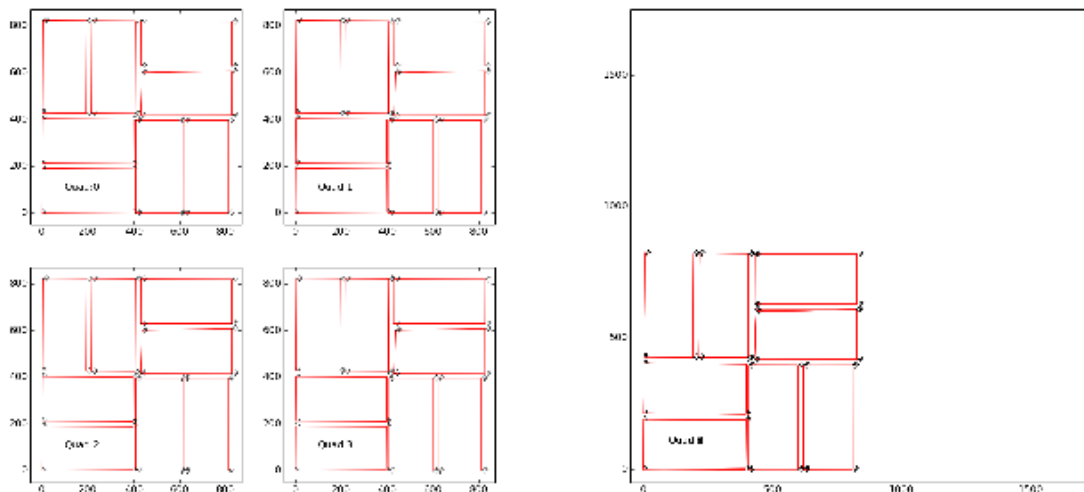
- [2013-12-10-Quad-MEC-Metrology.xlsx](#) - file from Gabriel Blaj
- [2013-12-10-Quad-MEC-Metrology.txt](#) - text version of this file
- [2013-12-10-Quad-MEC-Metrology-corr.txt](#) - text version of corrected metrology file.

New metrology file from 2013-12-20

- [2013-12-10-Quad-MEC-Metrology-improved-Z.xlsx](#) - file from Gabriel Blaj with corrected z,
- [2013-12-10-Quad-MEC-Metrology-improved-Z.txt](#) - text version, the same corrections are applied in x,y coordinates for point 4 and 18

Procedure

- Use script [procOpticalAlignment.py](#) for quality check and to look at constants for **center** and **tilt**
- Plots for non-corrected quad and difference between corrected and non-corrected metrology:



Quality check

Evaluated parameters

We calculate
S1 - 1st short side length of 2x1
S2 - 2nd short side length of 2x1
L1 - 1st long side length of 2x1
L2 - 2nd long side length of 2x1
D1 - 1st diagonal of 2x1 between corners 1 and 3
D2 - 2nd diagonal of 2x1 between corners 2 and 4
dS and dL are the deviations of the 1st and 2nd corner along the short and long sides, respectively. The sign of all dS are chosen in order to provide correct sign for the tilt angle (the same direction for all 2x1 sensors).
<dS/L> - the tilt angle of 2x1 averaged over two sides in radians.
angle(deg) - the same angle in degrees.
dD = D1 - D2
d(dS) = dS1 - dS2
d(dL) = dL1 - dL2
dz3(um) - signed distance from 2x1 sensor plane and corner 3, where the 2x1 sensor plane contains the corner points p1, p2, and p4. This plane is defined by the vectors v21=p2-p1, v41=p4-p1, and their orthogonal vector

$$\text{vort} = [\text{v21} \times \text{v41}].$$

Scalar product with normalization defines the distance from point 3 to the 2x1 plane containing 3 other points:

$$\text{dz3} = (\text{v31} \cdot \text{vort}) / |\text{vort}|.$$

S1=S2, L1=L2 - the 2x1 sides should have equal length and width,
D1=D2 - the 2x1 diagonals should be equal,
dS1 = dS2 (approximately)= (388/185)*dL1 = (388/185)*dL2 - tilt angle should provide consistent deviation for all corners,
dD=0, d(dS)=0, and d(dL)=0 - within precision of measurement.
dz3(um) = 0

Everything, excluding <dS/L> and angle(deg), are in micrometers.

Quality check summary table

Non-corrected metrology file:

pair:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1
D2	dD	d(dS)	d(dL)	dz3(um)							
Quad 0											
pair: 0	20899	20903	-252	-248	43535	43533	117	115	-0.00574	-0.32903	48288
48295	-7	-4	2	-75.003							
pair: 1	20909	20383	261	-265	43538	43555	113	130	-0.00004	-0.00256	48301
48083	218	526	-17	-16.318							
pair: 2	20904	20905	-223	-224	43530	43537	-111	-104	-0.00513	-0.29416	48292
48293	-1	1	-7	-25.002							
pair: 3	20901	20897	-240	-236	43525	43535	-120	-110	-0.00547	-0.31326	48287
48288	-1	-4	-10	267.024							
pair: 4	20220	20893	60	733	43537	42832	685	-20	0.00925	0.52974	48298
47357	941	-673	705	-25.529							
pair: 5	20907	20883	-78	-102	43534	43545	37	48	-0.00207	-0.11843	48293
48294	-1	24	-11	-223.895							
pair: 6	20895	20903	20	12	43543	43537	15	9	0.00037	0.02105	48299
48292	7	8	6	52.031							
pair: 7	20915	20913	-5	-3	43537	43530	-2	-9	-0.00009	-0.00526	48293
48299	-6	-2	7	11.996							

- pair 1 – has 526um difference between short sides (S). Correction: point 4 Y: 261 -> -261
- pair 4 – has large difference in S, L, and D. Correction: point 18: Y+700: 66059 => 66759 X-700: 48012=>47312
- pairs 3 and 5 – have >200um non-flatness

Corrected metrology file:

pair: D2	S1 dD	S2 d(dS)	dS1 d(dL)	dS2 dz3(um)	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1
Quad 0											
pair: 0	20899	20903	-252	-248	43535	43533	117	115	-0.00574	-0.32903	48288
48295	-7	-4	2	-75.003							
pair: 1	20909	20905	-261	-265	43538	43555	113	130	-0.00604	-0.34604	48301
48310	-9	4	-17	-14.975							
pair: 2	20904	20905	-223	-224	43530	43537	-111	-104	-0.00513	-0.29416	48292
48293	-1	1	-7	-25.002							
pair: 3	20901	20897	-240	-236	43525	43535	-120	-110	-0.00547	-0.31326	48287
48288	-1	-4	-10	267.024							
pair: 4	20920	20893	60	33	43537	43532	-15	-20	0.00107	0.06120	48298
48289	9	27	5	-29.069							
pair: 5	20907	20883	-78	-102	43534	43545	37	48	-0.00207	-0.11843	48293
48294	-1	24	-11	-223.895							
pair: 6	20895	20903	20	12	43543	43537	15	9	0.00037	0.02105	48299
48292	7	8	6	52.031							
pair: 7	20915	20913	-5	-3	43537	43530	-2	-9	-0.00009	-0.00526	48293
48299	-6	-2	7	11.996							

- Corrected metrology looks much better...

2013-12-20 Corrected metrology file for Z:

the same corrections are applied in x,y coordinates for point 4 and 18

pair: D2	S1 dD	S2 d(dS)	dS1 d(dL)	dS2 dz3(um)	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1
Quad 0											
pair: 0	20899	20903	-252	-248	43535	43533	117	115	-0.00574	-0.32903	48288
48295	-7	-4	2	40.006							
pair: 1	20909	20905	-261	-265	43538	43555	113	130	-0.00604	-0.34604	48301
48310	-9	4	-17	5.002							
pair: 2	20904	20905	-223	-224	43530	43537	-111	-104	-0.00513	-0.29416	48292
48293	-1	1	-7	-58.011							
pair: 3	20901	20897	-240	-236	43525	43535	-120	-110	-0.00547	-0.31326	48287
48288	-1	-4	-10	18.000							
pair: 4	20920	20893	60	33	43537	43532	-15	-20	0.00107	0.06120	48298
48289	9	27	5	172.899							
pair: 5	20907	20883	-78	-102	43534	43545	37	48	-0.00207	-0.11843	48293
48294	-1	24	-11	11.975							
pair: 6	20895	20903	20	12	43543	43537	15	9	0.00037	0.02105	48299
48292	7	8	6	25.994							
pair: 7	20915	20913	-5	-3	43537	43530	-2	-9	-0.00009	-0.00526	48293
48299	-6	-2	7	1.998							

- x,y coordinates for calibration files did not change
- z coordinates are improved
- New constants for center and tilt are available in
/reg/neh/home1/dubrovin/LCLS/CSPadAlignment-v01/calib-mec-2013-12-10-improved-Z/

Geometry parameters

✓ center/0-end.data (pixel)

```
199.82 198.60 311.21 98.37 628.52 629.03 715.23 503.00 199.82 198.60 311.21 98.37 628.52 629.03 715.23 503.00
199.82 198.60 311.21 98.37 628.52 629.03 715.23 503.00 199.82 198.60 311.21 98.37 628.52 629.03 715.23 503.00
306.55 93.91 623.94 625.19 512.39 724.62 197.79 197.97 306.55 93.91 623.94 625.19 512.39 724.62 197.79 197.97
306.55 93.91 623.94 625.19 512.39 724.62 197.79 197.97 306.55 93.91 623.94 625.19 512.39 724.62 197.79 197.97
-0.41 0.69 -0.64 -0.47 -1.61 -1.34 -1.52 -1.20 -0.41 0.69 -0.64 -0.47 -1.61 -1.34 -1.52 -1.20 -0.41 0.69 -0.64
-0.47 -1.61 -1.34 -1.52 -1.20 -0.41 0.69 -0.64 -0.47 -1.61 -1.34 -1.52 -1.20
```

or the same in um:

```

21964 21829 34207 10812 69086 69143 78618 55289 21964 21829 34207 10812 69086 69143 78618 55289 21964 21829
34207 10812 69086 69143 78618 55289 21964 21829 34207 10812 69086 69143 78618 55289 33696 10323 68583 68721
56322 79650 21741 21760 33696 10323 68583 68721 56322 79650 21741 21760 33696 10323 68583 68721 56322 79650
21741 21760 33696 10323 68583 68721 56322 79650 21741 21760 -44 75 -70 -51 -177 -147 -167 -131 -44 75 -70 -51
-177 -147 -167 -131 -44 75 -70 -51 -177 -147 -167 -131 -44 75 -70 -51 -177 -147 -167 -131

```

✔ tilt/0-end.data (degree)

```

-0.32903 -0.34604 -0.29416 -0.31326 0.06120 -0.11843 0.02105 -0.00526 -0.32903 -0.34604 -0.29416 -0.31326
0.06120 -0.11843 0.02105 -0.00526 -0.32903 -0.34604 -0.29416 -0.31326 0.06120 -0.11843 0.02105 -0.00526
-0.32903 -0.34604 -0.29416 -0.31326 0.06120 -0.11843 0.02105 -0.00526

```

⊖ offset/0-end.data (use default)

```

0 0 820 820 0 820 820 0 0 0 0 0

```

⊖ offset_corr/0-end.data (use default)

```

0 0 0 0 0 0 0 0 0 0 0 0

```

⊖ marg_gap_shift/0-end.data (use default)

```

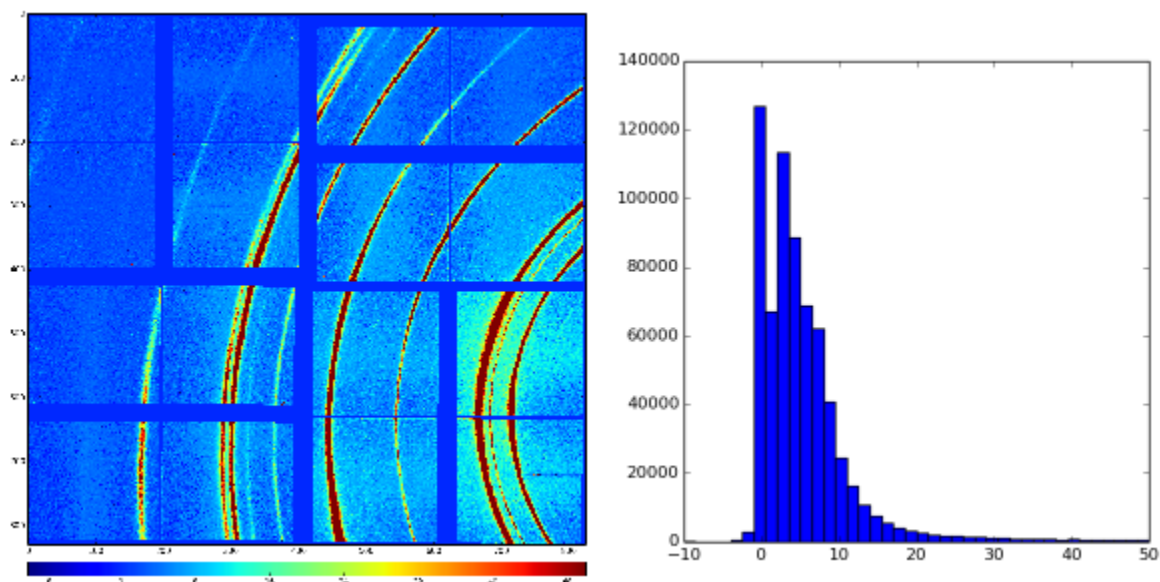
15 40 0 22 15 40 0 22 0 0 0 0

```

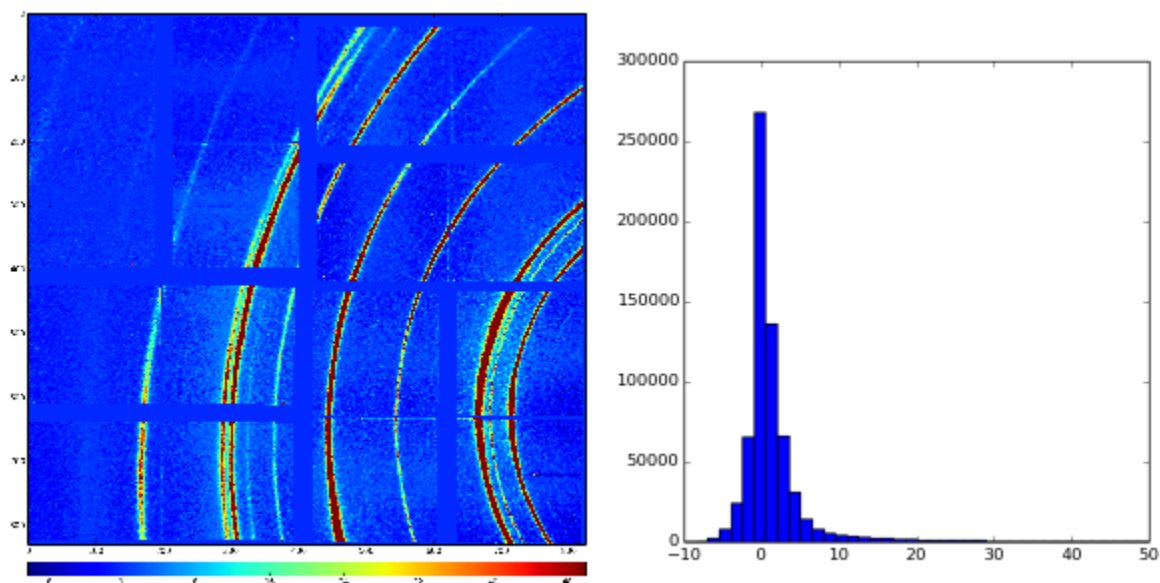
Test plots

Image averaged over 10 events of exp=meca1113:run=376, using psana configuration file: [psana-meca1113-r0376-cspad-rings-img.cfg](#)

Quad image and its spectrum w/o common mode subtraction:



Quad image and its spectrum with common mode subtracted:



Summary

- In conclusion, everything works, intensity correction works fine, alignment looks good to me...

References

- [CSPAD Alignment](#)
- [CSPAD Geometry and Alignment](#)
- [CSPAD Geometry Software](#)
- [CSPAD2x2 Alignment](#)