

2013-12-20 CSPAD DS1 Alignment

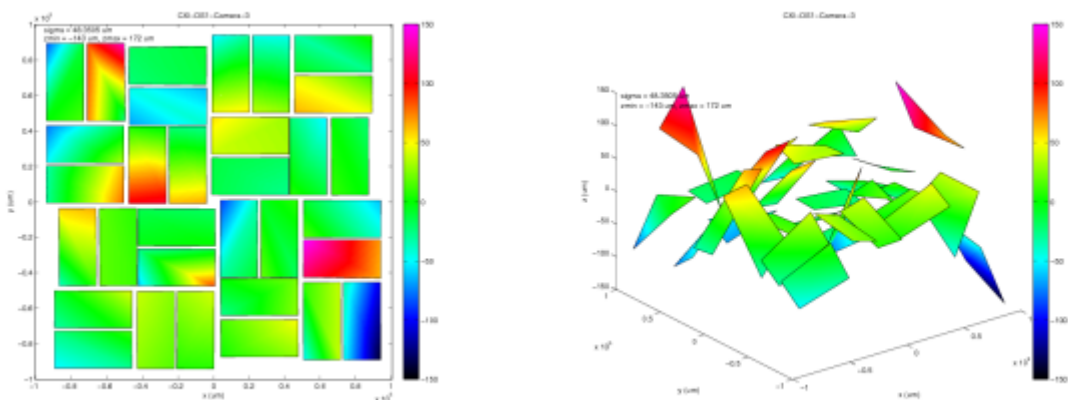
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Optical measurement

- [2013-12-20-CSPAD-CXI-DS1-Metrology.xlsx](#)- file from Gabriel Blaj
- [2013-12-20-CSPAD-CXI-DS1-Metrology.txt](#) - text version of this file
- [2013-12-20-CSPAD-CXI-DS1-Metrology-corr.txt](#) - text file with four corrected measurements (see below)

Plots from Gabriel Blaj:



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

vort = [v21 x v41].

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

dz3 = (v31 * vort) / |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 table for original 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	20913	20911	35	33	43542	43545	-17	-14	0.00078	0.04474	48305
48304	1	2	-3	-15.007							
pair: 1	20907	20911	6	10	43544	43547	-6	-3	0.00018	0.01053	48304
48305	-1	-4	-3	-9.007							
pair: 2	20907	20908	-12	-13	43543	43545	-4	-2	-0.00029	-0.01645	48305
48300	5	1	-2	-20.006							
pair: 3	20914	20915	-21	-22	43552	43561	-19	-10	-0.00049	-0.02828	48313
48321	-8	1	-9	-13.023							
pair: 4	21517	20909	569	-39	43597	43545	23	-29	0.00608	0.34824	48574
48347	227	608	52	149.012							
pair: 5	20904	20898	-24	-30	43557	43544	23	10	-0.00062	-0.03552	48309
48303	6	6	13	57.012							
pair: 6	21711	20934	-256	521	43578	43580	-127	-125	0.00304	0.17419	48344
48687	-343	-777	-2	-3.071							
pair: 7	20912	20942	-33	-63	43550	43548	-23	-25	-0.00110	-0.06315	48315
48317	-2	30	2	-44.030							
Quad 1											
pair: 0	20906	20915	24	33	43541	43541	-13	-13	0.00065	0.03750	48302
48301	1	-9	0	17.006							
pair: 1	20908	20915	-52	-45	43544	43540	24	20	-0.00111	-0.06382	48302
48304	-2	-7	4	-5.998							
pair: 2	20850	20913	-15	-78	43544	43543	-6	-7	-0.00107	-0.06119	48305
48277	28	63	1	-6.022							
pair: 3	20916	20909	-5	2	43543	43543	-2	-2	-0.00003	-0.00197	48303
48305	-2	-7	0	-14.003							
pair: 4	20911	20864	-35	-82	43543	43545	40	42	-0.00134	-0.07697	48306
48282	24	47	-2	17.042							
pair: 5	20911	20900	16	5	43546	43605	-10	49	0.00024	0.01381	48352
48308	44	11	-59	-63.016							
pair: 6	20906	20913	120	113	43550	43550	53	53	0.00268	0.15327	48307
48312	-5	7	0	8.996							
pair: 7	20909	20909	42	42	43515	43548	-13	20	0.00096	0.05528	48277
48307	-30	0	-33	12.977							
Quad 2											
pair: 0	20909	20907	-29	-31	43543	43541	14	12	-0.00069	-0.03948	48300
48302	-2	2	2	50.998							
pair: 1	20921	20912	-177	-186	43548	43563	87	102	-0.00417	-0.23876	48324
48311	13	9	-15	27.997							
pair: 2	20972	21502	-81	-611	43524	43560	-18	18	-0.00794	-0.45515	48597
48294	303	530	-36	-51.477							
pair: 3	20907	20907	-51	-51	43542	43543	-23	-22	-0.00117	-0.06711	48303
48299	4	0	-1	4.999							
pair: 4	20908	20905	127	124	43542	43541	-60	-61	0.00288	0.16514	48300

48300	0	3	1	-59.003							
pair: 5	20903	20931	76	104	43546	43545	-42	-43	0.00207	0.11842	48309
48308	1	-28	1	20.900							
pair: 6	20911	20910	74	75	43547	43546	37	36	0.00171	0.09802	48307
48306	1	-1	1	9.000							
pair: 7	20918	20925	149	142	43551	43540	80	69	0.00334	0.19144	48315
48306	9	7	11	-30.015							
Quad 3											
pair: 0	20908	20908	-83	-83	43541	43542	38	39	-0.00191	-0.10922	48300
48302	-2	0	-1	130.998							
pair: 1	20908	20908	-104	-104	43545	43545	50	50	-0.00239	-0.13684	48304
48304	0	0	0	9.000							
pair: 2	20913	20912	103	104	43550	43546	53	49	0.00238	0.13617	48310
48307	3	-1	4	2.000							
pair: 3	20734	20915	-131	-312	43547	43565	-84	-66	-0.00508	-0.29135	48306
48250	56	181	-18	-9.111							
pair: 4	20909	20908	-57	-58	43547	43612	30	95	-0.00132	-0.07560	48367
48304	63	1	-65	-9.075							
pair: 5	20914	20940	-15	11	43576	43549	21	-6	-0.00005	-0.00263	48334
48322	12	-26	27	-12.026							
pair: 6	20905	20910	210	205	43544	43580	69	105	0.00476	0.27292	48308
48331	-23	5	-36	39.953							
pair: 7	20918	20914	186	190	43565	43545	91	71	0.00432	0.24731	48308
48325	-17	-4	20	3.996							

Significant deviations are observed in 4 points.

Applied corrections

- Quad 0, pair 4, point 17 Y: 45689 + 608 = 46297
- Quad 0, pair 6, point 32 X: 88753 - 777 = 87976
- Quad 2, pair 2, point 15 X: 44111 - 530 = 43581
- Quad 3, pair 3, point 12 X: 21361 + 181 = 21542

Quality check table for 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	20913	20911	35	33	43542	43545	-17	-14	0.00078	0.04474	48305
48304	1	2	-3	-15.007							
pair: 1	20907	20911	6	10	43544	43547	-6	-3	0.00018	0.01053	48304
48305	-1	-4	-3	-9.007							
pair: 2	20907	20908	-12	-13	43543	43545	-4	-2	-0.00029	-0.01645	48305
48300	5	1	-2	-20.006							
pair: 3	20914	20915	-21	-22	43552	43561	-19	-10	-0.00049	-0.02828	48313
48321	-8	1	-9	-13.023							
pair: 4	20909	20909	-39	-39	43597	43545	23	-29	-0.00090	-0.05128	48308
48347	-39	0	52	151.804							
pair: 5	20904	20898	-24	-30	43557	43544	23	10	-0.00062	-0.03552	48309
48303	6	6	13	57.012							
pair: 6	20934	20934	-256	-256	43578	43580	-127	-125	-0.00587	-0.33658	48344
48349	-5	0	-2	-3.001							
pair: 7	20912	20942	-33	-63	43550	43548	-23	-25	-0.00110	-0.06315	48315
48317	-2	30	2	-44.030							
Quad 1											
pair: 0	20906	20915	24	33	43541	43541	-13	-13	0.00065	0.03750	48302
48301	1	-9	0	17.006							
pair: 1	20908	20915	-52	-45	43544	43540	24	20	-0.00111	-0.06382	48302
48304	-2	-7	4	-5.998							
pair: 2	20850	20913	-15	-78	43544	43543	-6	-7	-0.00107	-0.06119	48305
48277	28	63	1	-6.022							
pair: 3	20916	20909	-5	2	43543	43543	-2	-2	-0.00003	-0.00197	48303
48305	-2	-7	0	-14.003							

pair: 4	20911	20864	-35	-82	43543	43545	40	42	-0.00134	-0.07697	48306
48282	24	47	-2	17.042							
pair: 5	20911	20900	16	5	43546	43605	-10	49	0.00024	0.01381	48352
48308	44	11	-59	-63.016							
pair: 6	20906	20913	120	113	43550	43550	53	53	0.00268	0.15327	48307
48312	-5	7	0	8.996							
pair: 7	20909	20909	42	42	43515	43548	-13	20	0.00096	0.05528	48277
48307	-30	0	-33	12.977							
Quad 2											
pair: 0	20909	20907	-29	-31	43543	43541	14	12	-0.00069	-0.03948	48300
48302	-2	2	2	50.998							
pair: 1	20921	20912	-177	-186	43548	43563	87	102	-0.00417	-0.23876	48324
48311	13	9	-15	27.997							
pair: 2	20972	20972	-81	-81	43524	43560	-18	18	-0.00186	-0.10659	48364
48294	70	0	-36	-50.086							
pair: 3	20907	20907	-51	-51	43542	43543	-23	-22	-0.00117	-0.06711	48303
48299	4	0	-1	4.999							
pair: 4	20908	20905	127	124	43542	43541	-60	-61	0.00288	0.16514	48300
48300	0	3	1	-59.003							
pair: 5	20903	20931	76	104	43546	43545	-42	-43	0.00207	0.11842	48309
48308	1	-28	1	20.900							
pair: 6	20911	20910	74	75	43547	43546	37	36	0.00171	0.09802	48307
48306	1	-1	1	9.000							
pair: 7	20918	20925	149	142	43551	43540	80	69	0.00334	0.19144	48315
48306	9	7	11	-30.015							
Quad 3											
pair: 0	20908	20908	-83	-83	43541	43542	38	39	-0.00191	-0.10922	48300
48302	-2	0	-1	130.998							
pair: 1	20908	20908	-104	-104	43545	43545	50	50	-0.00239	-0.13684	48304
48304	0	0	0	9.000							
pair: 2	20913	20912	103	104	43550	43546	53	49	0.00238	0.13617	48310
48307	3	-1	4	2.000							
pair: 3	20915	20915	-131	-131	43547	43565	-84	-66	-0.00301	-0.17232	48306
48328	-22	0	-18	-9.014							
pair: 4	20909	20908	-57	-58	43547	43612	30	95	-0.00132	-0.07560	48367
48304	63	1	-65	-9.075							
pair: 5	20914	20940	-15	11	43576	43549	21	-6	-0.00005	-0.00263	48334
48322	12	-26	27	-12.026							
pair: 6	20905	20910	210	205	43544	43580	69	105	0.00476	0.27292	48308
48331	-23	5	-36	39.953							
pair: 7	20918	20914	186	190	43565	43545	91	71	0.00432	0.24731	48308
48325	-17	-4	20	3.996							

- X-Y precision of measurements is about 60um
- Tilt angles are in range from -0.33 to 0.27 degree
- Z deviations from flatness are in the range from -63 to 152um

Geometry parameters

✓ center/O-end.data (pixel)

197.94	198.05	304.45	97.98	623.08	623.74	706.30	498.64
198.22	198.17	304.58	97.25	622.90	623.09	708.37	495.18
197.22	198.51	300.71	96.77	621.46	620.95	709.39	496.88
198.80	198.29	304.26	101.44	625.93	625.40	705.81	497.16
301.22	95.14	621.13	621.36	516.12	724.42	197.91	196.12
303.12	94.88	619.87	620.29	515.50	722.83	197.13	196.76
301.51	94.34	622.96	623.24	519.67	725.08	198.86	198.69
300.50	94.63	621.71	622.07	515.69	722.61	196.56	195.96
0.47	0.17	-0.25	0.17	0.65	-0.19	-0.14	-0.50
0.36	-0.16	-0.07	0.03	0.38	-0.13	-0.04	-0.18
0.01	-0.37	0.95	-0.22	0.08	-0.75	0.21	0.05
-0.05	-0.08	0.25	0.19	0.03	-0.21	0.21	0.12

or the same in um

21757	21769	33464	10769	68489	68561	77637	54810
21788	21783	33479	10689	68469	68489	77863	54430
21678	21820	33054	10637	68310	68254	77976	54617
21851	21796	33444	11150	68801	68743	77582	54648
33110	10457	68275	68299	56732	79628	21754	21558
33319	10429	68135	68182	56664	79453	21668	21628
33141	10369	68476	68506	57121	79700	21858	21839
33030	10402	68338	68378	56684	79429	21605	21540
51	18	-28	18	71	-20	-15	-54
39	-18	-7	3	41	-14	-4	-20
1	-40	104	-24	9	-82	23	6
-5	-8	27	20	2	-23	23	13

✔ tilt/0-end.data (degree)

0.04474	0.01053	-0.01645	-0.02828	-0.05128	-0.03552	-0.33658	-0.06315
0.03750	-0.06382	-0.06119	-0.00197	-0.07697	0.01381	0.15327	0.05528
-0.03948	-0.23876	-0.10659	-0.06711	0.16514	0.11842	0.09802	0.19144
-0.10922	-0.13684	0.13617	-0.17232	-0.07560	-0.00263	0.27292	0.24731

⊖ offset/0-end.data

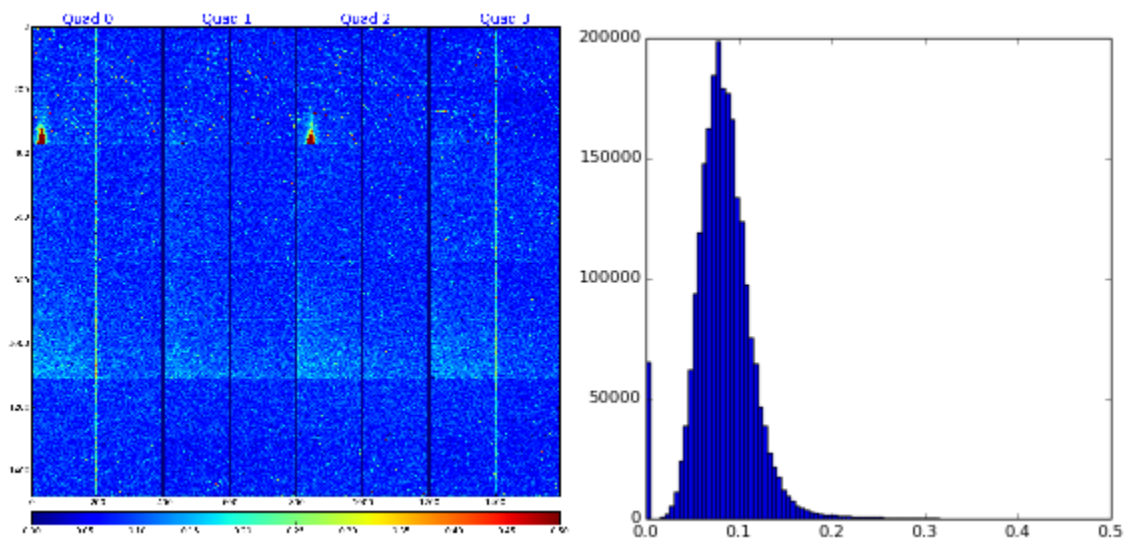
0	0	820	820
0	820	820	0
0	0	0	0

2014-03-05 Alignment of Quads

Data for alignment

In order to get cspad geometry parameters for experiment cxib6714 Jason Koglin suggested to use cxi83714 runs 17,18, 127, 128, 130-132, 135, 136.

CSPAD array with subtracted pedestal and threshold $4 \times \text{rms}(\text{per pixel})$ is averaged over 5000 events of run 136.



Parameters from latest optical measurement

center and tilt are used from /reg/neh/home1/dubrovnik/LCLS/CSPadAlignment-v01/calib-cxi-ds1-2013-12-20

Tuned calibration parameters

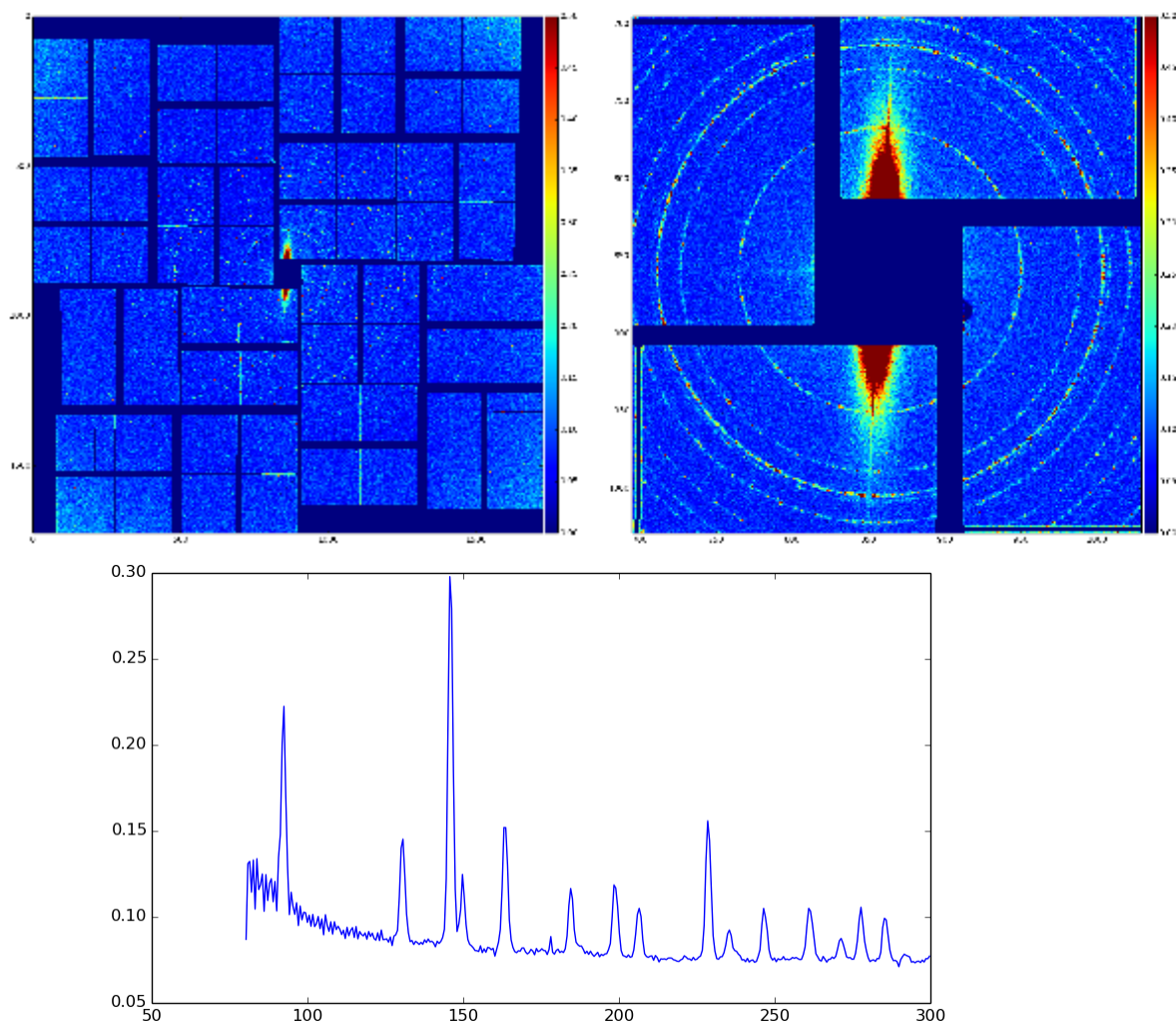
offset_corr/0-end.data :

```
0  0  4  4
0  4  1  1
0  0  0  0
```

marg_gap_shift/0-end.data :

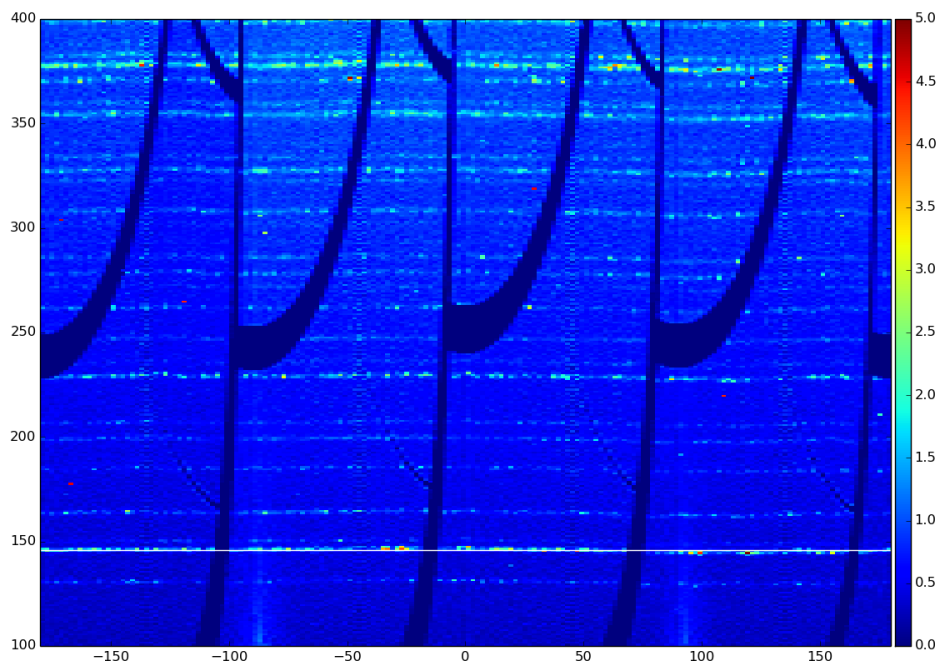
```
15  40  4  40
15  40  4  40
0   0   0   0
```

Results



2014-03-26 quads alignment with semi-automatic algorithm for ring center finding

R-phi presentation of the image using previous alignment



shows that manual quads alignment is done with precision about ± 1 pixel but can be improved.

Slightly better results for quads alignment were obtained with semi-automatic ring center finder by changing parameters

offset_corr/136-136.data :

1	1	4	4
0	5	2	2
0	0	0	0

