

# CSpad alignment

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*Mikhail Dubrovin*

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- Alignment using optical measurement
- Quad alignment w.r.t. the beam center

# Derived parameters of pads

- Updated table
  - Now includes all angular displacement of ASIC corners
- Optical measurement precision is  $8\mu\text{m}$
- That gives tilt angle precision  $0.011^\circ$

Sequence of measu.	ASIC pair	Pad length $L (\mu\text{m})$	Pad width $W (\mu\text{m})$	$\alpha W (\mu\text{m})$	$\alpha L (\mu\text{m})$	Tilt angle $\alpha (^\circ)$	$\alpha - \bar{\alpha} (^\circ)$	My $(^\circ)$
1	02-03	43970	21420	8	7	$0 \pm 0.011$	0.466	0.7
		43974	21427	4	0			
2	00-01	43979	21449	121	-243	$-0.322 \pm 0.011$	0.144	0.2
		43983	21445	117	-239			
3	06-07	43967	21442	-234	505	$-0.658 \pm 0.011$	-0.186	0.1
		43957	21439	-244	508			
4	04-05	43987	21438	-188	382	$-0.498 \pm 0.011$	-0.049	-0.1
		43972	21440	-203	380			
5	10-11	43964	21430	300	-622	$-0.810 \pm 0.011$	-0.338	-0.4
		43971	21428	307	-620			
6	08-09	43968	21427	291	-586	$-0.763 \pm 0.011$	-0.291	-0.4
		43971	21438	294	-597			
7	14-15	43969	21449	-128	254	$-0.331 \pm 0.011$	0.135	0.1
		43960	21442	-137	261			
8	12-13	43961	21434	-129	266	$-0.347 \pm 0.011$	0.119	0.1
		43961	21432	-129	268			
Mean		43969.6	21436.3			$-0.466 \pm 0.011$	0	
Dispers.		8.3	8.4			0.271	0.271	

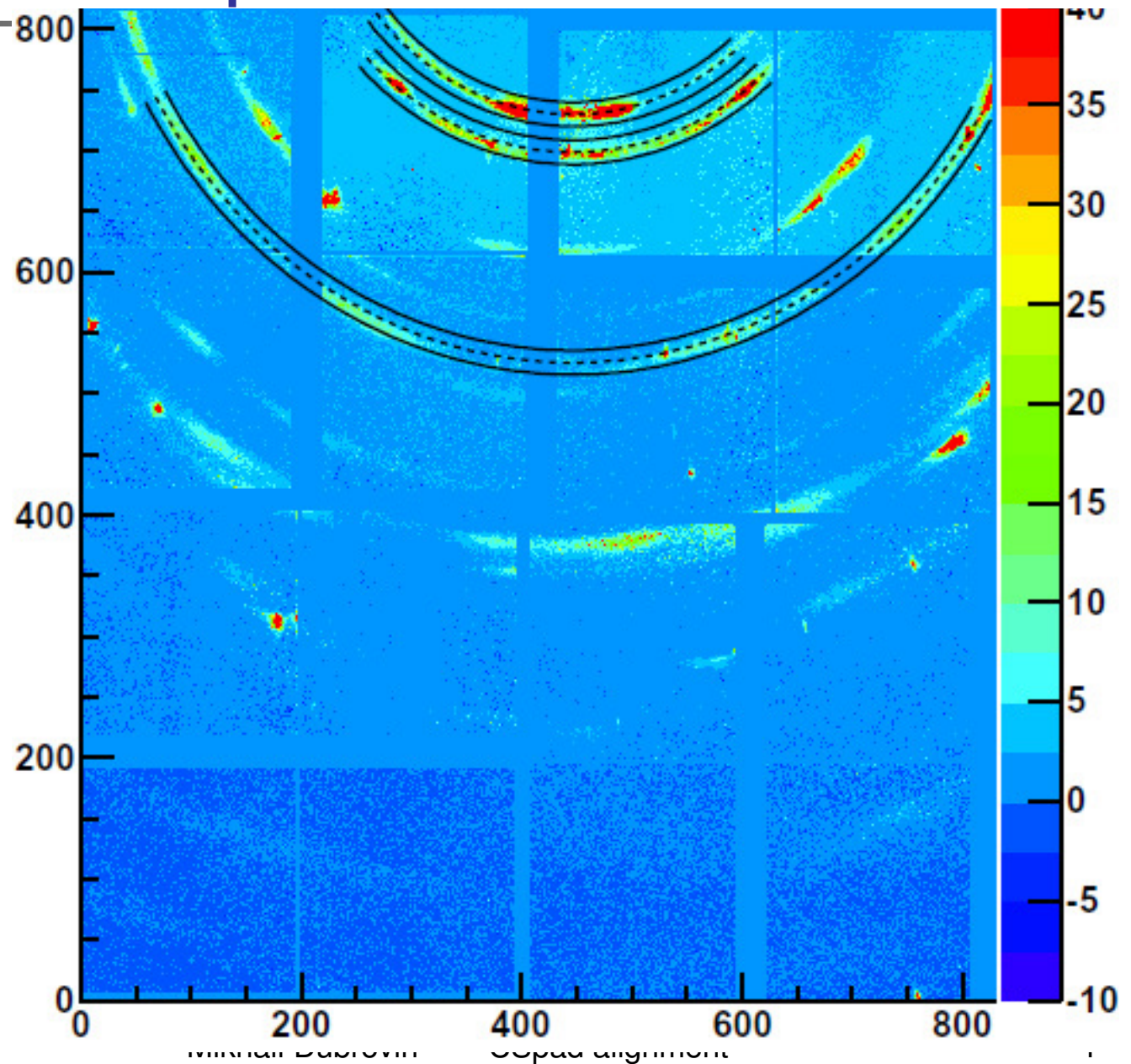
# Configuration parameters

- Common rotation angle between two alignments  $\sim 3^\circ$  is not accounted.
- Difference between ASIC coordinates in two alignments is  $\sim 10$  pixels...
- Pads' geometry based on optical alignment is not completely perfect on images...

ASIC	Optical measurement			Image-based alignment		
	orientation ( $^\circ$ )	$x_c$ (pixel)	$y_c$ (pixel)	tilt ( $^\circ$ )	$x_c$ (pixel)	$y_c$ (pixel)
00	0 +0.144	15.76	932.65	+0.1	15.76	932.65
01	0 +0.144	15.76	932.65-gap	+0.1	15.76	932.65-gap
02	0 +0.466	-197.73	933.95	+0.6	-200.19	930.88
03	0 +0.466	-197.73	933.95-gap	+0.6	-200.19	930.88-gap
04	270 -0.049	423.53	713.17	-0.2	422.26	716.34
05	270 -0.049	423.53-gap	713.17	-0.2	422.26-gap	716.34
06	270 -0.186	426.16	924.98	0.0	412	926
07	270 -0.186	426.16-gap	924.98	0.0	412-gap	926
08	180 -0.291	206.91	512.75-gap	-0.5	220.84	494.37-gap
09	180 -0.291	206.91	512.75	-0.5	220.84	494.37
10	180 -0.338	419.73	509.46-gap	-0.5	414.12	512.26-gap
11	180 -0.338	419.73	509.46	-0.5	414.12	512.26
12	270 +0.119	-9.82	318.53	0.0	26.95	303.53
13	270 +0.119	-9.82-gap	318.53	0.0	26.95-gap	303.53
14	270 +0.135	-7.74	531.40	0.0	11.13	517.40
15	270 +0.135	-7.74-gap	531.40	0.0	11.13-gap	517.40

# Conf. from optical measurement

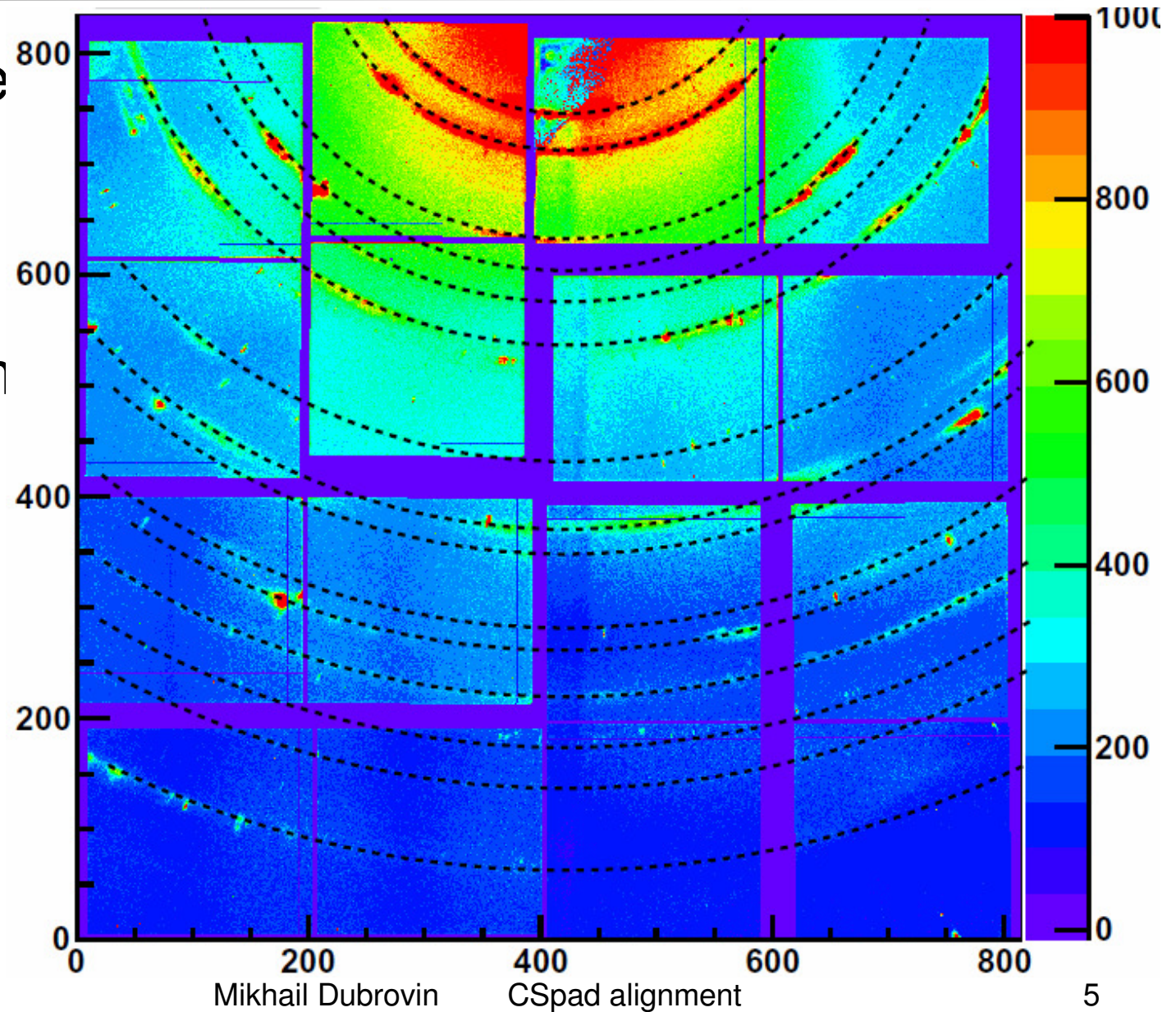
- Beam search algorithm based on ring-image





# Result of alignment using ring-image

- Ring-image based alignment, for comparison



# Summary

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- Have defined the configuration parameters from optical measurement.
- Optic measurement has a precision of  $8\mu\text{m}$  or 0.07 of pixel size.
- Ring-image based alignment has statistical precision  $\sim 0.2$  pixel size. Syst. uncertainty strongly depends on ring image quality. It was estimated as  $\sim 1-2$  pixels.
- Difference between ASIC coordinates in two alignments is  $\sim 10$  pixels, though common rotation angle between two alignments  $\sim 3^\circ$  is not accounted.
- Have completed the beam center search algorithm for entire quad (using ring-image).