

CSPAD2x2 Alignment

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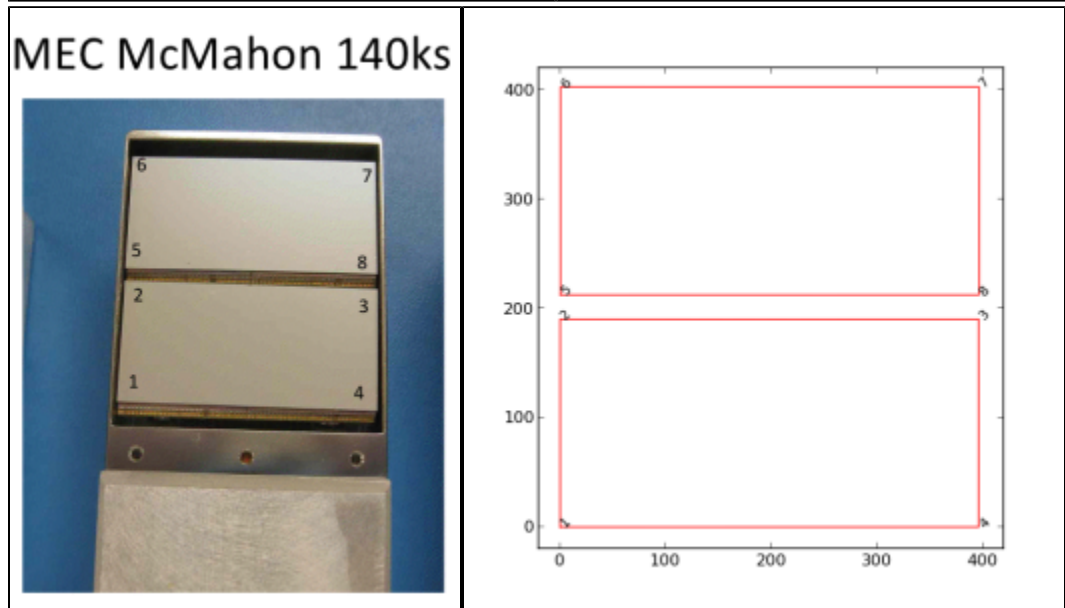
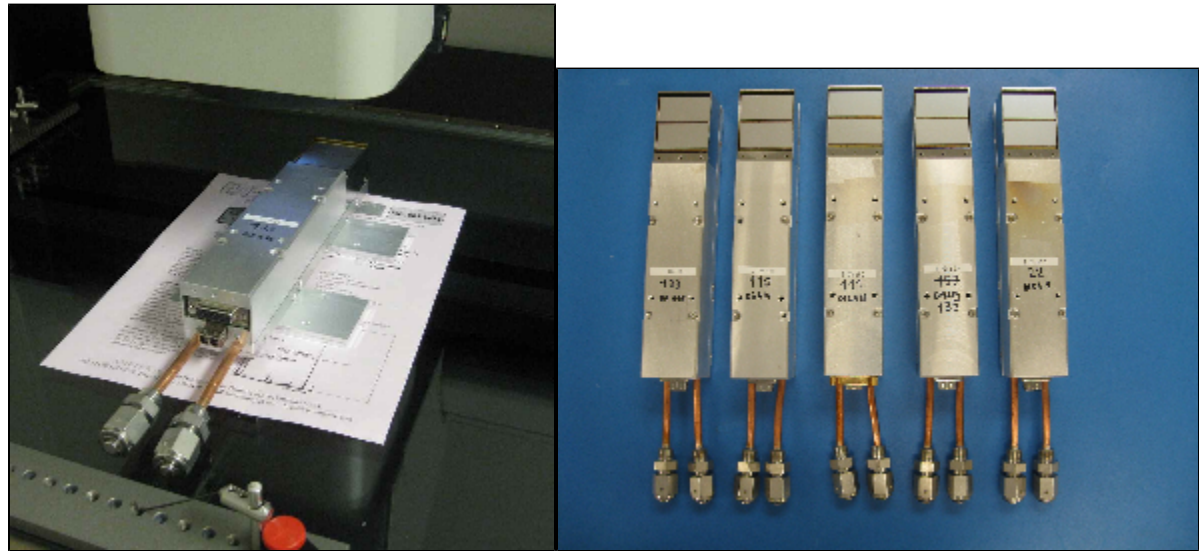
Alignment procedure

Alignment procedure for CSPAD2x2 is very similar to CSPAD alignment for quads described in [CSPAD Geometry and Alignment](#).

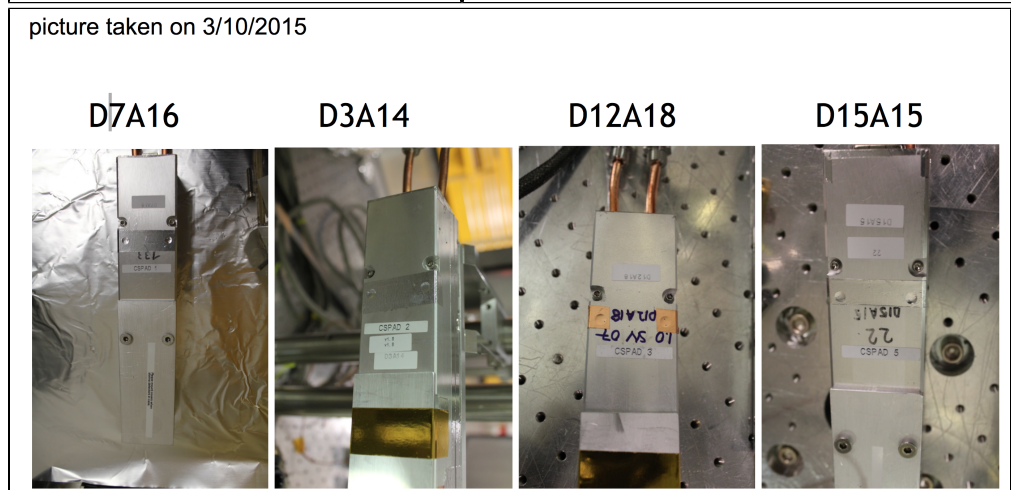
The only difference is that CSPAD2x2 has only two 2x1 sensors, but with different memory model as explained below.

Optical measurements

Photos and charts with numeration of corners in optical measurements:



picture taken on 3/10/2015



Metrology table

Metrology files from different optical measurements are collected in directories with specific dates under

/reg/g/psdm/detector/alignment/cspad2x2/

Example of the 1-st metrology table in xlsx format: [Metrology-140ks-Feb13-2013.xlsx](#)

The xlsx file is converted to tables in text format for 6 CSPad2x2 detectors:

- [CSPad2x2-1.txt](#) Q133 D7A16
- [CSPad2x2-2.txt](#) Q110 D3A14
- [CSPad2x2-3.txt](#) Q111 D12A18
- [CSPad2x2-4.txt](#) Q135 D19A19
- [CSPad2x2-5.txt](#) Q022 D15A15
- [CSPad2x2-6.txt](#) Q157 Used in Run 6

Calibration types

In 2014 new universal detector geometry software is implemented and documented in the [Detector Geometry](#) page. In this approach detector geometry calibration information is located in a single file of type

- **geometry** - contains hierarchical description of all detector components; for example for CSPAD2x2 it has sensors' location and rotation in the detector, detector - in the setup, etc.

Currently all psana modules which deal with image and pixel coordinates can work with calibration type **geometry**.

In earlier version of software, CSPAD2x2 geometry is defined by the two calibration types:

- **center** - x, y, z center position for each two 2x1 in the detector. Obtained from optical measurement.
- **tilt** - two 2x1-tilt angle for the detector in fractional degree. Obtained from optical measurement.

Calibration types **center** and **tilt** are deprecated and supported for backward compatibility.



Type **geometry** is used by default in all current applications.

Quality check and alignment parameters

2013-02-13 [CSPAD2x2-1](#) Q133 D7A16

Metrology file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-01-2013-02-13/2013-02-13-CSPAD2X2-1-MEC-Metrology.txt

Quality check

segm:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d
(dS)	d(dL)												
segm: 0	20902	20909	-2	5	-43538	-43539	1	0	-0.00197	48297	48297		
0	-7	1											
segm: 1	20902	20906	-2	2	-43538	-43538	0	0	-0.00000	48296	48296		
0	-4	0											
Old version of quality check:													
pair:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1		
D2	dD	d(dS)	d(dL)										
pair: 0	20909	20902	2	-5	43538	43539	0	1	-0.00006	-0.00329	48297		
48297	0	7	-1										
pair: 1	20906	20902	2	-2	43538	43538	0	0	0.00000	0.00000	48296		
48296	0	4	0										

Calibration files

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-01-2013-02-13/calib/CsPad2x2::CalibV1/MecTargetChamber.0:
Cspad2x2.1/

- geometry/1-end.data
- center/1-end.data

- tilt/1-end.data

2013-02-13 [CSPAD2x2-2](#) Q110 D3A14

Metrology file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-02-2013-02-13/2013-02-13-CSPAD2X2-2-MEC-Metrology.txt

Quality check

segm:	(dS)	S1	S2	dS1	dS2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d
segm: 0	20896	20905	-5	4	-43536	-43536	-2	-2	0.00066	48294	48291			
3	-9	0												
segm: 1	20905	20905	22	22	-43540	-43536	6	10	-0.02895	48299	48294			
5	0	-4												
Old version of quality check:														
pair:	(dS)	S1	S2	dS1	dS2	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1		
D2	dD	d(dS)	d(dL)											
pair: 0	20905	20896	5	-4	43536	43536	-2	-2	0.00001	0.00066	48291			
48294	-3	9	0											
pair: 1	20905	20905	-22	-22	43540	43536	10	6	-0.00051	-0.02895	48294			
48299	-5	0	4											

Calibration file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-02-2013-02-13/calib/CsPad2x2::CalibV1/MecTargetChamber.0:Cspad2x2.2/geometry/0-end.data

2013-02-13 [CSPAD2x2-3](#) Q111 D12A18

Metrology file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-03-2013-02-13/2013-02-13-CSPAD2X2-3-MEC-Metrology.txt

Quality check

segm:	(dS)	S1	S2	dS1	dS2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d
segm: 0	20908	20907	5	4	-43540	-43545	5	0	-0.00592	48301	48302			
-1	1	5												
segm: 1	20907	20904	-421	-424	-43538	-43538	-203	-203	0.55599	48299	48299			
0	3	0												
Old version of quality check:														
pair:	(dS)	S1	S2	dS1	dS2	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1		
D2	dD	d(dS)	d(dL)											
pair: 0	20907	20908	-5	-4	43540	43545	0	5	-0.00005	-0.00263	48302			
48301	1	-1	-5											
pair: 1	20904	20907	421	424	43538	43538	-203	-203	0.00970	0.55601	48299			
48299	0	-3	0											

Calibration file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-03-2013-02-13/calib/CsPad2x2::CalibV1/MecTargetChamber.0:Cspad2x2.3/geometry/0-end.data

2013-02-13 [CSPAD2x2-4](#) Q135 D19A19

Metrology file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-04-2013-02-13/2013-02-13-CSPAD2X2-4-MEC-Metrology.txt

Quality check

segm:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d
(dS)	d(dL)												
segm: 0	20905	20906	8	9	-43540	-43540	3	3	-0.01119	48299	48297		
2	-1	0											
segm: 1	20898	20908	12	22	-43541	-43538	9	12	-0.02237	48295	48299		
-4	-10	-3											

Old version of quality check:

pair:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1
D2	dD	d(dS)	d(dL)								
pair: 0	20906	20905	-8	-9	43540	43540	3	3	-0.00020	-0.01119	48297
48299	-2	1	0								
pair: 1	20908	20898	-12	-22	43541	43538	12	9	-0.00039	-0.02237	48299
48295	4	10	3								

Calibration file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-04-2013-02-13/calib/CsPad2x2::CalibV1/MecTargetChamber.0:Cspad2x2.4/geometry/0-end.data

2013-02-13 [CSPAD2x2-5](#) Q022 D15A15

Metrology file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-05-2013-02-13/2013-02-13-CSPAD2X2-5-MEC-Metrology.txt

Quality check

segm:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d
(dS)	d(dL)												
segm: 0	20904	20904	-2	-2	-43536	-43536	-1	-1	0.00263	48294	48294		
0	0	0											
segm: 1	20909	20908	-122	-123	-43540	-43545	-56	-61	0.16119	48302	48302		
0	1	5											

Old version of quality check:

pair:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1
D2	dD	d(dS)	d(dL)								
pair: 0	20904	20904	2	2	43536	43536	-1	-1	0.00005	0.00263	48294
48294	0	0	0								
pair: 1	20908	20909	122	123	43540	43545	-61	-56	0.00281	0.16119	48302
48302	0	-1	-5								

Calibration file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-05-2013-02-13/calib/CsPad2x2::CalibV1/MecTargetChamber.0:Cspad2x2.5/geometry/0-end.data

2013-02-13 [CSPAD2x2-6](#) Q157

Metrology file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-06-2013-02-13/2013-02-13-CSPAD2X2-6-MEC-Metrology.txt

Quality check

segm:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d
(dS)	d(dL)												
segm: 0	20900	20903	-59	-56	-43541	-43539	-29	-27	0.07567	48298	48297		
1	-3	-2											
segm: 1	20977	20979	-49	-47	-43707	-43705	-22	-20	0.06292	48478	48482		
-4	-2	-2											

Old version of quality check:

pair:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	<dS/L>	angle(deg)	D1
D2	dD	d(dS)	d(dL)								
pair: 0	20903	20900	59	56	43541	43539	-27	-29	0.00132	0.07567	48296
48297	-1	3	2								
pair: 1	20979	20977	49	47	43707	43705	-20	-22	0.00110	0.06292	48481
48477	4	2	2								

Calibration file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-06-2013-02-13/calib/CsPad2x2::CalibV1/MecTargetChamber.0:Cspad2x2.0/geometry/0-end.data

2014-04-25 [CSPAD2X2-3](#) (1.0 SN07 D12A18)

Metrology file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-03-2014-04-25/2014-04-25-CSPAD2X2-3-MEC-Metrology.txt

Original metrology file from Gabriel Blaj: [2014-04-25-CSPAD2X2-3-MEC-Metrology.xlsx](#)

This should be used for any experiment AFTER April 25th 2014 (until further notice).

Quality check

Quality check in XY plane:

segm:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d
(dS)	d(dL)												
segm: 0	20979	20982	0	3	-43695	-43689	-2	4	-0.00197	48468	48468		
0	-3	-6											
segm: 1	20981	20981	123	123	-43701	-43695	51	57	-0.16127	48478	48469		
9	0	-6											

Quality check in Z:

segm:	SA	LA	XSize	YSize	dZS1	dZS2	dZL1	dZL2	dZSA	dZLA	ddZS	ddZL	dZX	dZY
angXZ(deg)	angYZ(deg)	dz3(um)												
segm: 0	20980	-43692	43692	20980	18	5	-2	-15	11	-8	13	13	-8	11
-0.01049	0.03004	-13.001												
segm: 1	20981	-43698	43698	20981	-4	-8	0	-4	-6	-2	4	4	-2	-6
-0.00262	-0.01639	-4.000												

Calibration file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-03-2014-04-25/calib/CsPad2x2::CalibV1/MecTargetChamber.0:Cspad2x2.3/geometry/0-end.data

2015-04-02 [CSPAD2X2-3](#) (1.0 SN07 D12A18)

Note from Gabriel and Philip

Philip and I inspected the CSPAD 140Ks that we received last week (CSPAD 1,2,3,5):

- CSPADs 1, 2 and 5 have the same metrology as that on February 13, 2013.
- CSPAD 3 has been fixed meanwhile (initially it contained 2x2 module #111, which is the one in your metrology file). Now its 2x2 module is replaced with #7 (metrology file attached). This metrology file should be applied in all experiments that took place after the service date. To find out this date, we will consult with you further.
- CSPAD 4 is only a mechanical assembly (see other e-mail sent a few weeks ago).

Thanks,
Gabriel and Philip

Metrology file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-03-2015-04-02/2015-04-02-CSPAD2X2-3-MEC-Metrology.txt

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-03-2015-04-02/2015-04-02-CSPAD2X2-3-MEC-Metrology.xlsx

Quality check

2015-04-02 13:40:57 (info) CalibManager.GUIMetrology: Quality check in X-Y plane:														
segm:	S1	S2	dS1	dS2	L1	L2	dL1	dL2	angle(deg)	D1	D2	dD	d	
(dS)	d(dL)													
Quad	0													
segm: 0	20981	20978	-33	-36	-43703	-43708	-17	-22	0.04523	48482	48477			
5	3	5												
segm: 1	20978	20974	-152	-156	-43707	-43702	-73	-68	0.20189	48474	48480			
-6	4	-5												
2015-04-02 13:40:57 (info) CalibManager.GUIMetrology: Quality check in Z:														
segm:	SA	LA	XSize	YSize	dZS1	dZS2	dZL1	dZL2	dZSA	dZLA	ddZS	ddZL	dZX	dZY
angXZ(deg)	angYZ(deg)		dz3(um)											
Quad	0													
segm: 0	20979	-43705	43705	20979	-1	31	-37	-5	15	-21	-32	-32	-21	15
-0.02753	0.04097		32.009											
segm: 1	20976	-43704	43704	20976	-28	-38	5	-5	-33	0	10	10	0	-33
0.00000	-0.09014		-10.007											

Calibration file

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-03-2015-04-02/calib/CsPad2x2::CalibV1/MecTargetChamber.0:Cspad2x2.3/

- geometry/0-end.data

Calibration files

In archive

- All files for CSPAD2x2 alignment are stored under directory /reg/g/psdm/detector/alignment/cspad2x2/
- Files named as *-Metrology.xlsx and *-Metrology.txt are original metrology and its text version.
- Calibration files are located under /reg/g/psdm/detector/alignment/cspad2x2/calib/ directory.
- Calibration files can be deployed in the experimental calib store using file manager in [Calibration Management Tool](#)

In calib store

✔ Example of the path to calibration files in the experimental calib store

/reg/d/psdm/mec/mec73313/calib/CsPad2x2::CalibV1/	
	MecTargetChamber.0:Cspad2x2.1/<calib-type>/0-end.data
	...
	MecTargetChamber.0:Cspad2x2.1/<calib-type>/0-end.data

where <type> stands for **geometry**, **tilt**, and **center**.

Known detectors

on 2016-06-15:

```

0 : CxiDg2.0:Cspad2x2.0
1 : CxiDg2.0:Cspad2x2.1
2 : CxiDg3.0:Cspad2x2.0
3 : CxiSc1.0:Cspad2x2.0
4 : CxiSc2.0:Cspad2x2.0
5 : CxiSc2.0:Cspad2x2.1
6 : CxiSc2.0:Cspad2x2.2
7 : CxiSc2.0:Cspad2x2.3
8 : CxiSc2.0:Cspad2x2.4
9 : CxiSc2.0:Cspad2x2.5
10 : CxiSc2.0:Cspad2x2.6
11 : CxiSc2.0:Cspad2x2.7
12 : CxiSc2.0:Cspad2x2.8
13 : CxiSc2.0:Cspad2x2.9
14 : MecEndstation.0:Cspad2x2.6
15 : MecTargetChamber.0:Cspad2x2.0
16 : MecTargetChamber.0:Cspad2x2.1
17 : MecTargetChamber.0:Cspad2x2.2
18 : MecTargetChamber.0:Cspad2x2.3
19 : MecTargetChamber.0:Cspad2x2.4
20 : MecTargetChamber.0:Cspad2x2.5
21 : SxrBeamline.0:Cspad2x2.2
22 : SxrBeamline.0:Cspad2x2.3
23 : XcsEndstation.0:Cspad2x2.0
24 : XcsEndstation.0:Cspad2x2.1
25 : XcsEndstation.0:Cspad2x2.2
26 : XcsEndstation.0:Cspad2x2.3
27 : XcsEndstation.0:Cspad2x2.4
28 : XppGon.0:Cspad2x2.0
29 : XppGon.0:Cspad2x2.1
30 : XppGon.0:Cspad2x2.2
31 : XppGon.0:Cspad2x2.3
32 : XppGon.0:Cspad2x2.4

```

Software

Access interface to any detector data and calibration parameters is implemented in Python [Package Detector](#).

CSPAD2x2 memory data model

In contrast to CSPAD which data array shape is (N, 185, 388), the CSPAD2x2 data array has a shape (185, 388, 2); the memory pointer increment by 1 swaps the 2x1 sensor. The (raw,column)=(0,0) is located in corners 4 and 8 of optical measurement scheme for two 2x1 sensors, respectively.

Conversion between these data formats can be done in Python by methods

```

arrTwo2x1 = data2x2ToTwo2x1(asData2x2)
asData2x2 = two2x1ToData2x2(arrTwo2x1)

```

as described in [module-PSCalib.GeometryObject](#)

Geometry access

In 2014 new universal detector geometry software is implemented and documented in the [Detector Geometry](#) page. In this approach detector geometry calibration information is collected in a single file of type

- geometry

which contains hierarchical description of all detector components. For example for CSPAD it has sensors' location and rotation in the quads, quads - in the detector, detector - in the setup, etc.

By default these files reside under the calib directory with full path like

- /reg/d/psdm/<instrument>/<experiment>/calib/<calib-soft-version>/<data-source>/geometry/<run-range>.data

Whenever necessary image can be generated by the psana [Module CSPadPixCoords::CSPad2x2ImageProducer](#), which access geometry calibration data automatically, generates 2-d image and saves it in the event store for further processing.

Python modules for CSPAD2x2 geometry

Detector geometry software, described in [Detector Geometry](#), has a Python interface which is recommended to use in new code development.

Alternatively, Python modules for CSPAD2x2 geometry are available in the package PyCSPadImage documented in [CSPAD pixel coordinates and image producer in Python](#). They provides an interface for getting

- ✓ Calibration parameters from DB and local directory,
- ✓ Pixel coordinates,
- ✓ Image producer

References

- [Calibration Management Tool](#)
- [Package Detector](#)
- [Detector Geometry](#)
- [CSPAD Alignment](#)
- [CSPAD Geometry and Alignment](#)
- [CSPAD pixel coordinates and image producer in Python](#) (older version [CSPAD image producer in Python](#))

Deprecated

C++ classes and modules for psana

- ✓ data types are implemented in the package pdslibdata as CsPad2x2* modules:

- CsPad2x2CenterV1
- CsPad2x2TiltV1
- CsPad2x2PedestalsV1
- CsPad2x2PixelGainV1
- CsPad2x2PixelStatusV1

- ✓ Access methods are implemented in the package PSCalib in CSPad2x2CalibPars module. Example of access is in PSCalib/test/ex_cspad2x2_calib_pars.cpp.

- ✓ Automated access to the cspad2x2 geometry parameters is implemented in packages:

- Package CSPadPixCoords generates and returns the CSPad2x2 pixel coordinates, taking into account geometry alignment parameters, if available in the expected place under /reg/d/psdm/<instrument>/<experiment>/calib directory.
- Module CSPadPixCoords::CSPad2x2ImageProducer produces CSPad2x2 image, accounting for correct geometry, if available.

Calibration files

/reg/g/psdm/detector/alignment/cspad2x2/calib-cspad2x2-03-2015-04-02/calib/CsPad2x2::CalibV1/MecTargetChamber.0:Cspad2x2.3/

- center/0-end.data
- tilt/0-end.data