

LUSI CXI Detector Stage #1 Alignment and Motion

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Detector stage DS1 needed alignment adjustments in the Y axis for the Z axis (parallel to beam) to run true to the vacuum chamber. To achieve correct alignment the stage was shimmed between two plates in the vacuum chamber. This report describes the correction and presents the resulting measured travel.

1. BACKGROUND

Stage was built to satisfy PRD: SP-391-000-28 and ESD: SP-391-000-70. It has six degrees of freedom. Five are achieved with manipulators attached to the vacuum chamber and the sixth (along beamline, Z) with a 20" travel linear stage inside the vacuum chamber. Shown below in Figure 1 is the top view of the CXI detector stage, SLAC drawing SA-391-520-00.

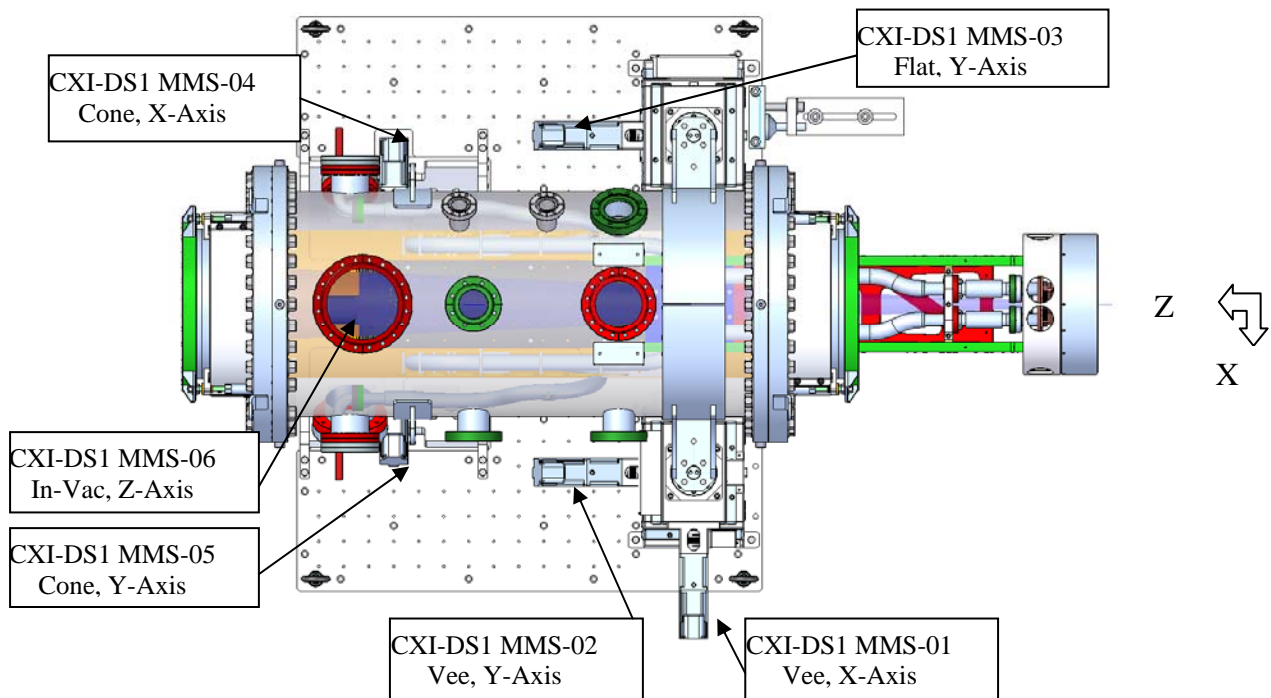


Figure 1: Detector Stage (Assembly SA-391-520-00)

2. DESCRIPTION OF PROBLEM

As the Z axis in vacuum stage extends out of the chamber it was traveling with a downward slope relative to the beam axis. The error is represented by the **RED** line in Figure 2 below. In the 20" of Z travel it went down ~0.140" in Y, passing through the ideal axis. The **BLACK** line represents the ideal path (true to chamber) and the **BLUE** line is the corrected path (~0.065" above ideal, as close to parallel as can be easily achieved). The out of vacuum stages (the other 5 axes of motion) have a limited travel and can correct a translation offset much easier than the measured pitch error.

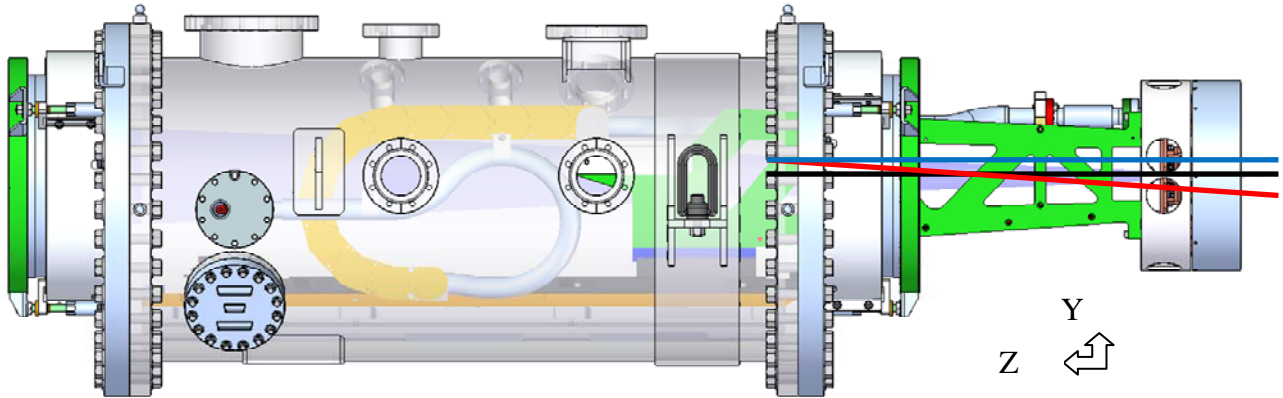


Figure 2: Detector Stage Chamber (Assembly SA-391-520-02), Side View
Showing Skew Through Z Travel

3. SOLUTION

3.1. Shims

To correct the angle of the Z axis stage shims of varying thicknesses were tried in the location shown in Figure 3 below. The final shim was a 0.060" thick stainless steel washer on each side of the front of the chamber, on top of the bosses on the "Optical Bench" SLAC drawing number PF-391-520-56 (grey plate labeled 1, below). This would move the front of the plate on top of the shims (PF-391-520-09, orange plate labeled 2, below).

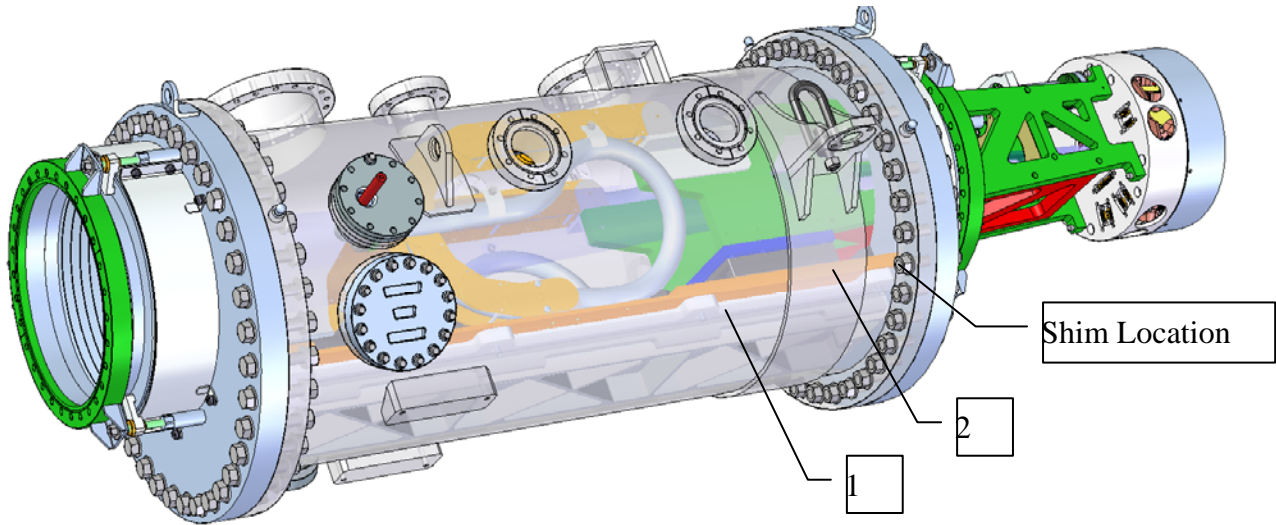


Figure 3: Detector Stage Chamber (Assembly SA-391-520-02) Showing Shim Location Detail

3.2. Adjusted motion profile

The shim corrected motion is shown below in Table I. Data was taken by the SLAC Alignment group using their Faro laser tracker device measuring holes on the Interface ring of the CS-PAD detector. The nominal locations of these holes are noted in Table I relative to the chamber center (determined by Alignment using the 22 1/8" wire seal flanges on either end of the chamber). Since the chamber was aligned to the beam as well, this also represents the travel relative to beam. Figure's 4 through 9 show the data from Table I graphically.

Table I: SLAC Alignment Data

Name	Plus X			Minus X			Bottom (-Y)		
	ΔZ [in]	ΔX [in]	ΔY [in]	ΔZ [in]	ΔX [in]	ΔY [in]	ΔZ [in]	ΔX [in]	ΔY [in]
D0	NaN	NaN	NaN	-23.974	-4.088	2.910	-23.983	-2.884	-3.988
D1	NaN	NaN	NaN	-24.974	-4.085	2.910	-24.983	-2.882	-3.987
D2	-25.988	2.829	4.112	-25.974	-4.075	2.911	-25.984	-2.882	-3.988
D3	-26.985	2.823	4.117	-26.974	-4.092	2.912	-26.983	-2.884	-3.987
D4	-28.001			-27.976	-4.084	2.908	-27.984	-2.884	-3.987
D5	-28.990	2.813	4.107	-28.976	-4.080	2.910	-28.983	-2.873	-3.987
D6	-29.989	2.821	4.111	-29.976	-4.084	2.909	-29.983	-2.873	-3.985
D7	-30.990	2.822	4.113	-30.979	-4.076	2.907	-30.985	-2.878	-3.984
D8	-31.989	2.822	4.114	-31.978	-4.069	2.912	-31.985	-2.879	-3.983
D9	-32.990	2.820	4.115	-32.979	-4.077	2.908	-32.984	-2.867	-3.984
D10	-33.989	2.824	4.116	-33.979	-4.077	2.905	-33.983	-2.866	-3.984
D11	-34.990	2.820	4.113	-34.980	-4.073	2.904	-34.984	-2.869	-3.986
D12	-35.991	2.818	4.113	-35.982	-4.067	2.905	-35.984	-2.877	-3.987
D13	-36.991	2.819	4.114	-36.982	-4.063	2.906	-36.984	-2.866	-3.985
D14	-38.012			-37.987	-4.059	2.898	-37.985	-2.875	-3.987
D15	-39.000	2.819		-38.983	-4.070	2.903	-38.985	-2.875	-3.990
D16	-39.994	2.828	4.112	-39.983	-4.068	2.903	-39.985	-2.874	-3.989
D17	-40.995	2.826	4.110	-40.983	-4.068	2.905	-40.985	-2.863	-3.987
D18	-41.995	2.830	4.111	-41.983	-4.069	2.904	-41.985	-2.863	-3.988
D19	-42.997	2.831	4.108	-42.986	-4.070	2.899	-42.986	-2.866	-3.990
	AVG:	2.823	4.112		-4.075	2.906		-2.874	-3.987
	NOMINAL:	2.839	4.055		-4.055	2.839		-2.839	-4.055
	AVG ERROR:	-0.016	0.057		-0.020	0.067		-0.035	0.068

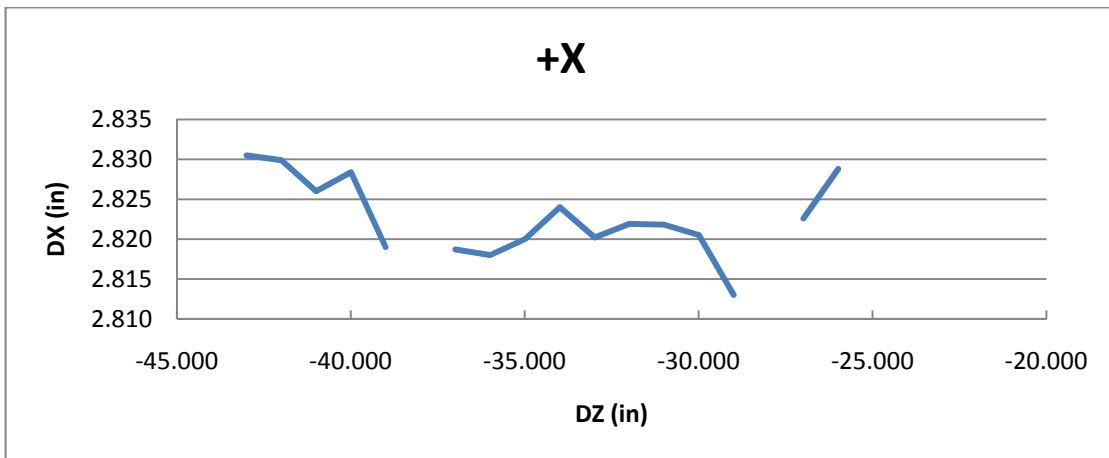


Figure 4: Plus X location on Interface ring, X coordinate data

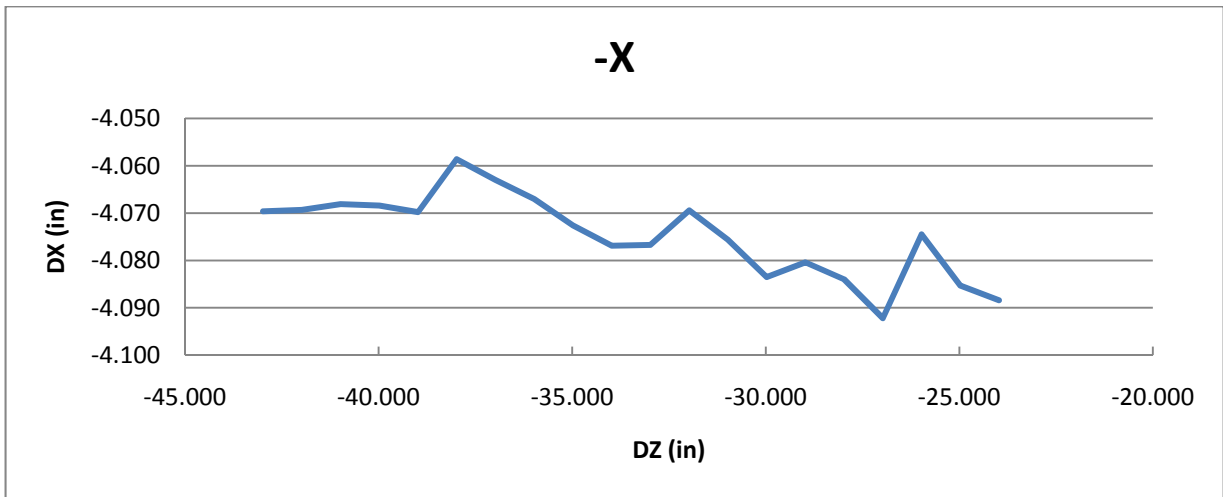


Figure 5: Minus X location on Interface ring, X coordinate data

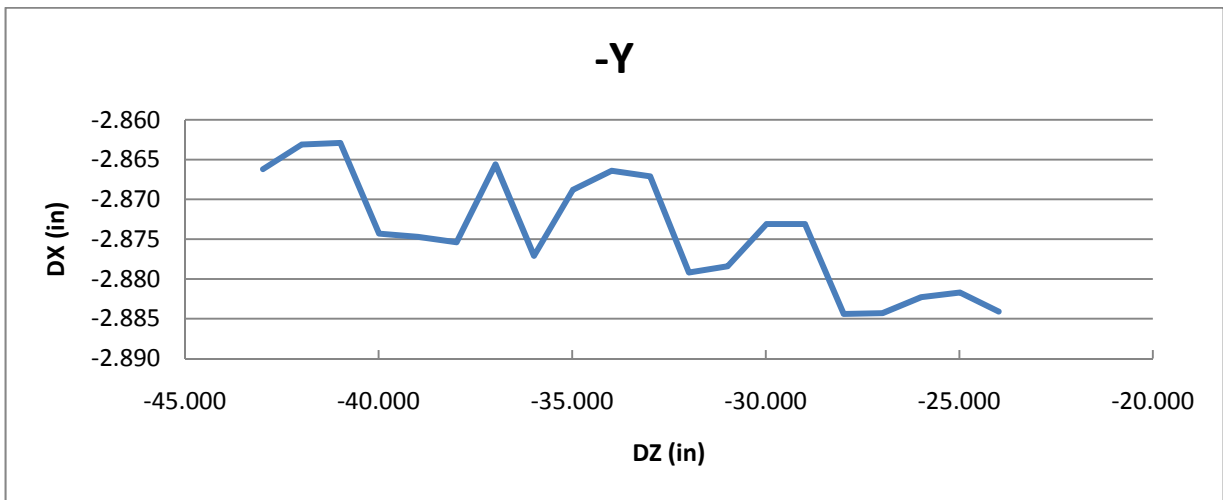


Figure 6: Bottom (-Y) location on Interface ring, X coordinate data

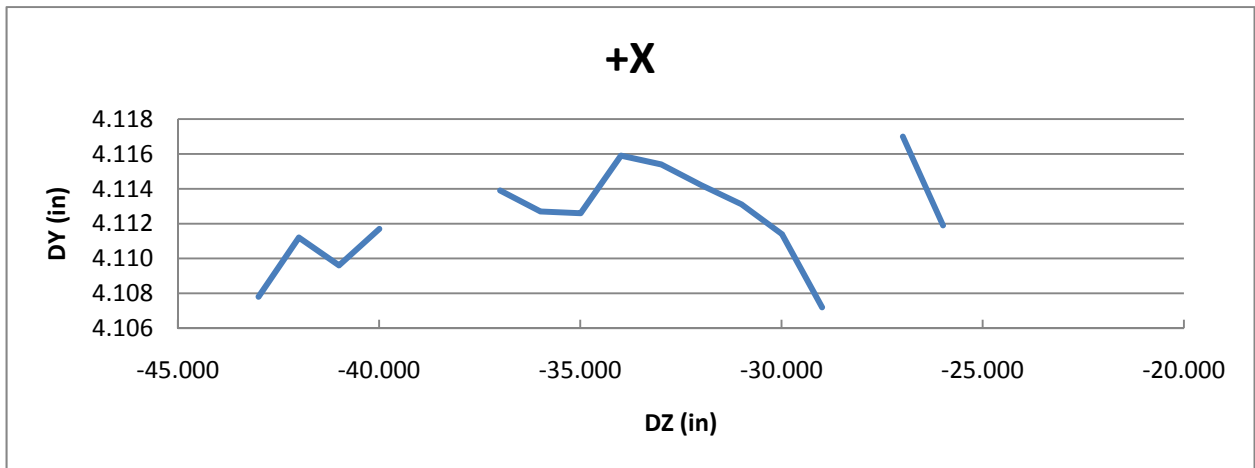


Figure 7: Plus X location on Interface ring, Y coordinate data

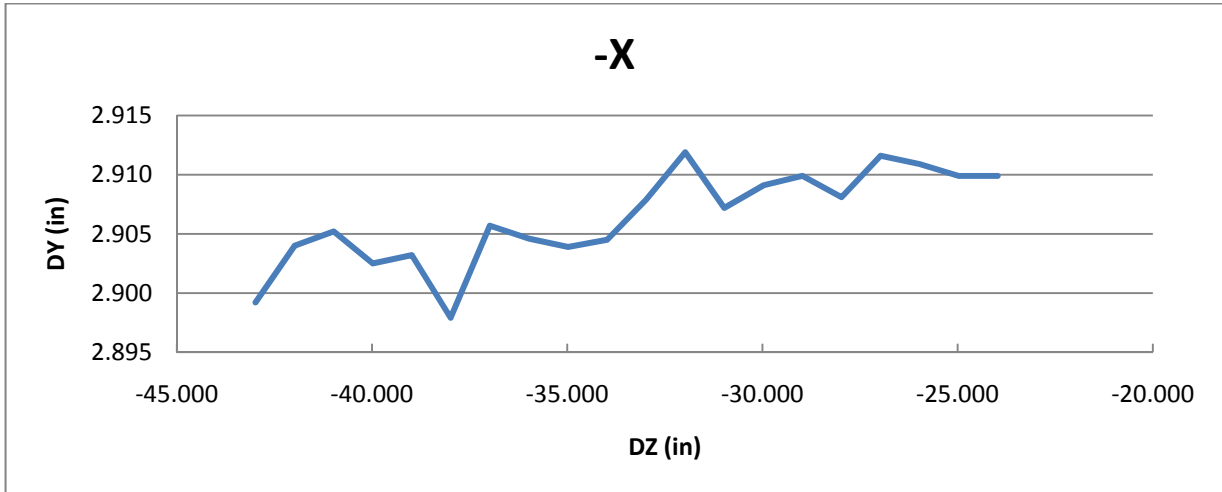


Figure 8: Minus X location on Interface ring, Y coordinate data

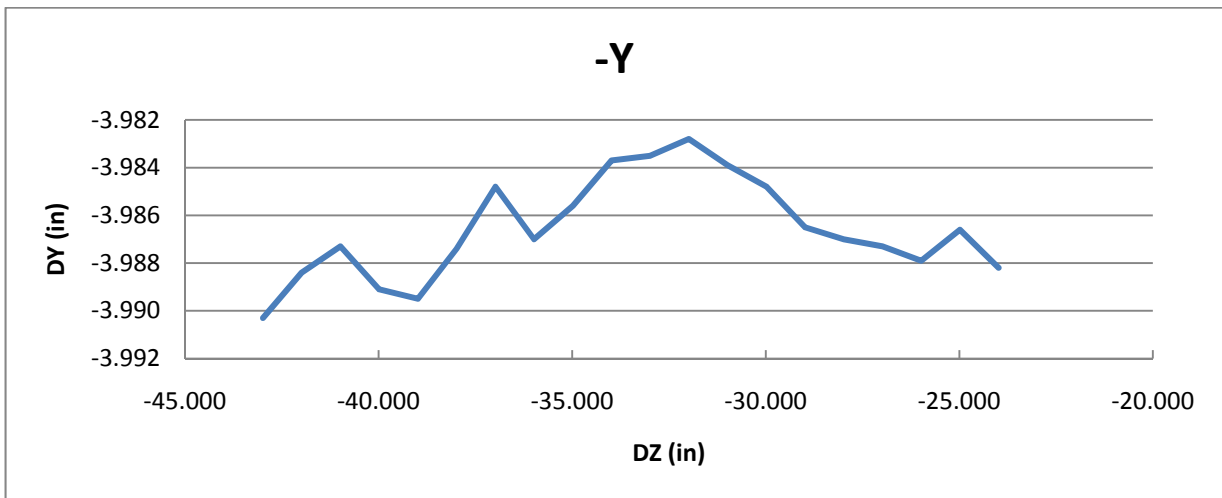


Figure 9: Bottom (-Y) location on Interface ring, Y coordinate data

4. CONCLUSION

Z Axis motion has been corrected to run relatively true to the chamber axis with a bias of $\sim .065''$. The measured irregularities can be canceled actively using the out-of-vacuum stages moving the chamber.