E1400205

IAS LHO Primary Optics As Built Alignment Summary

Optic	X Axis (mm)				Y Axis (mm)				Z Axis (mm)				Pitch (µrad)[1]				Yaw (mrad)[2]			
	Actual	Target	Error	Tolerance	Actual	Target	Error	Tolerance	Actual	Target[3]	Error	Tolerance	Actual	Target	Error	Tolerance	Actual	Target	Error	Tolerance
BS	-203.1	-202.7	-0.4	±3.0	-183.7	-183.8	0.1	±1.0	-82.5	-82.9	0.4	±1.0	-440	-447	7	±55	784.926	784.874	0.052	±0.190
ITMx	5012.6	5012.9	-0.3	±3.0	-199.8	-200.0	0.2	±1.0	-83.1	-83.1	0.0	±1.0	574	619	-45	±50	-0.017	0	-0.017	±0.050
CPx[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2043	1945	98	±1400	-0.533	0	-0.533	±1.400
ITMy	-200.8	-200.0	-0.8	±1.0	4982.7	4983.1	-0.4	±3.0	-79.2	-79.8	0.6	±1.0	14	-13	27	±50	-0.017	0	-0.017	±0.050
CPy[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	833	1296	-463	±1400	0.031	0	0.031	±1.400
PRM	-20189.4	-20189.7	0.3	±3.0	-629.6	-628.0	-1.6	±2.0	-81.8	-82.5	0.7	±1.0	N/A[5]	7		±100	N/A[5]	5.877		±0.100
PR2	-3581.1	-3581.4	0.3	±3.0	-530.6	-530.4	-0.2	±1.0	-84.3	-82.6	-1.7	±1.0	-45	0	-45	±100	-8.140	-8.092	-0.048	±0.100
PR3	-19737.3	-19740.1	2.8	±3.0	-174.4	-173.9	-0.5	±3.0	-80.3	-82.7	2.4	±3.0	-37	0	-37	±50	-11.329	-11.284	-0.045	±0.050
SRM-s[6]	303.8	305.3	-1.5	±4.6	-19874.5	-19875.8	1.3	±3.0	-113.6	-114.5	0.9	±3.0	-545	-625	80	±520	56.809	57.119	-0.310	±0.820
SR2	-595.4	-594.2	-1.2	±5.1	-4161.1	-4161.5	0.4	±3.0	-104.3	-104.7	0.4	±3.4	-5	0	-5	±520	42.289	42.169	0.120	±0.820
SR3	-174.2	-174.2	0.0	±3.0	-19616.1	-19615.9	-0.2	±3.0	-94.1	-95.0	0.9	±3.0	-131	0	-131	±560	13.972	13.857	0.115	±0.200
ETMx[7]	3999485.0	3999498.0	-13.0	±3.0	-200.3	-200.0	-0.3	±1.0	-80.0	-80.0	0.0	±1.0	20	8	12	±50	-0.030	0	-0.030	±0.050
ERMx[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2027	1404	623	±1470	1.170	0	1.170	±1.470
ETMy[8]	-200.0	-200.0	0.0	±1.0	3999455.7	3999455.4	0.3	±3.0	-79.7	-80.0	0.3	±1.0	665	639	26	±50	0.020	0	0.020	±0.050
ERMy[4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2851	1965	886	±1470	-0.320	0	-0.320	±1.470

1: Pitch sign convention follows the standard SUS convention for pitch, i.e. positive = down, negative = up (see E1000617, E1100108, & E1100109)

2: Yaw sign convention follows the standard SUS convention for yaw, i.e. positive = counterclockwise, negative = clockwise (see E1000617, E1100108, & E1100109). Yaw is reported as the angle from the axis closest to the HR surface normal of the optic

3: All Z axis target positions are reported in coordinates local to the building that houses the optic. I.E. the BS Z axis is local to the LHO corner station, while the ETMx Z axis is local to the LHO End X station.

4: SUS sets the position of the CPx, CPy, ERMx, and ERMy. IAS is only repsonsible for aligning the pitch and yaw of these optics so that is all that is recorded here. The pitch/yaw of these optics is set so the optic is parallel with the AR surface of their associated TM.

5: Due to the PRM radius of curvature (>11m, convex) and the distance IAS equipment was set up from PRM (>18m), IAS was unable to align PRM by our normal means. While we rigged a workaround at LLO to align the PRM by the AR surface via the PLX periscope, this was after LHO had closed HAM2 and HAM3 so we were unable to do the same here. The H1 PRM pitch/yaw was aligned by the commissioning team using cavity flashes.

6: This is the SRM surrogate optic that is being used in the early low power stages of aLIGO commissioning. The real SRM optic will be installed and aligned at a later date.

7: While aligning the X axis position of the ETMx we found a -9mm error in the X axis position of the WBSC9 chamber. This combined with leftover error from the cartridge alignment and error in placement of the cartridge in the chamber left the ETMx 13.0mm short of the desired position. Due to restricted access adjustment was difficult so it was decided by SYS to leave the ETMx where it was, accept the shortened arm length, and adjust the position of the ETMy so the lengths of the arms match.

8: The original Y axis target position for ETMy was 3999468.1 mm, but due to the issue with ETMx mentioned in 5 this was changed to the listed value so the H1 Y arm length matched that of the H1 X arm.