4-k LHO IOO global coordinates

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These tables give the positions, unit normals, and the input rays for the IOO optics of the 4-k LHO interferometer. The co-ordinates are in the global coordinate system; dimensions are in mm.

In arriving at these, we've checked the mode-matching calculation, put in the wedge angles and refraction angles in the transmissive optics, and included the tilt of the global coordinate system relative to the horizontal tables. The coordinate axes for LHO are defined by "Determination of Global and Local Coordinate Axes for the LIGO Sites," LIGO-T980044-A. Table 4 shows the following for the global coordinates at the Hanford site:

xG: Angle relative to local horizontal at Vertex: -6.195×10^{-4} radian

yG: Angle relative to local horizontal at Vertex: $+1.25 \times 10^{-5}$ radian

In other words, as viewed from the vertex, the LHO x axis slopes downward by 0.619 mrad, and the y axis slopes upward by 0.012 mrad. Thus, WHAM 1 is 8.5 mm higher (compared with local level) than WHAM 2 and WHAM 1 is 10.1 mm higher (compared with local level) than WHAM 3.

We used the following parameters in the calculation:

SOS height	139.7
tan(x-axis angle)	0.000619
tan(y-axis angle)	0.000013
Riser for MC2	8.5
Mode cleaner half-length	12245.4
Riser for MMT2	42
Height of MMT2 (above table)	181.6
Height of MMT3 (above table)	225.3

WHAM table locations are taken from the 10/26/97 version of `coorloc.xls` except that the table centers are 200 mm below the global x, y plane.

	Global Coordinates		
	x	y	z
Center of WHAM1	-20119.5	0.0	-200.0
Center of WHAM2	-6400.1	0.0	-200.0
Center of WHAM3	-3831.0	0.0	-200.0

The global coordinates of the centers of all the optical surfaces are in the next table.

	Global Coordinates		
	x	y	z
Fixed SM 1	-19274.8	-462.2	-59.8
Fixed SM 2	-19370.7	-740.7	-59.8
MC1 AR side	-19377.2	-273.0	-59.8
MC1	-19359.9	-255.4	-59.8
MC2	-7209.9	-161.1	-52.3
MC3	-19359.9	-65.4	-59.8
MC3 AR side	-19377.1	-48.2	-59.8
Wave plate	-19375.6	360.0	-59.8
SM1	-19375.2	481.1	-59.8
Polarizer, 1st	-19569.8	454.4	-60.0
Polarizer, 2nd	-19589.7	452.3	-60.0
Faraday, 1st	-19631.7	446.6	-60.0
Faraday, 2nd	-19651.6	443.9	-60.0
Wave plate	-19699.1	437.3	-60.0
Polarizer, 1st	-19727.8	433.4	-60.1
Polarizer, 2nd	-19747.5	430.0	-60.1
MMT1	-20055.2	387.8	-60.3
MMT2	-6508.8	16.2	-18.4
MMT3	-20883.6	209.8	25.3
IOO Handoff	-4692.0	212.0	27.8
RM back sfe	-4690.6	212.0	27.8

The next table gives the unit normals for the suspended optics.

	Unit normal		
	n_x	n_y	n_z
MC1	0.704357	0.709845	0.000436
MC2	-1.000000	0.000058	-0.000620
MC3	0.704316	-0.709886	0.000436
SM1	-0.658645	-0.752454	-0.000408
MMT1	0.998517	0.054409	0.001859
MMT2	-0.999791	0.020445	-0.000026
MMT3	0.999977	-0.006666	-0.001443

In the next table, the first nummeric column is the distance the input ray has come from the previous optic; the next 3 are the components of the input ray unit vector.

	Input ray	Input unit vector		
	$\|u\|$	u_x	u_y	u_z
Fixed SM 2	294.6	-0.325483	-0.945548	-0.000201
MC1 AR side	467.8	-0.013992	0.999902	-0.000009
MC1	12150.4	-0.999970	-0.007761	-0.000620
MC3	190.0	0.000000	1.000000	0.000000
MC2	12150.4	0.999969	-0.007876	0.000620
SM1	529.3	0.003590	0.999994	0.000002
Polarizer, 1st	196.4	-0.990718	-0.135931	-0.000613
Polarizer, 2nd	20.0	-0.994478	-0.104945	-0.000616
Faraday, 1st	42.4	-0.990916	-0.134481	-0.000613
Faraday, 2nd	20.1	-0.990921	-0.134447	-0.000613
Wave plate	48.0	-0.990484	-0.137625	-0.000613
Polarizer, 1st	29.0	-0.990893	-0.134651	-0.000613
Polarizer, 2nd	20.0	-0.985431	-0.170074	-0.000610
MMT1	310.6	-0.9907258	-0.135875	-0.000613
MMT2	13551.6	0.9996192	-0.027421	0.003091
MMT3	14376.1	-0.9999047	0.013467	0.003039
IOO Handoff	16191.6	1.0000000	0.000136	0.000153
RM back sfe	1.4000	1.0000000	0.000136	0.000153

Mirror balance angles, calculated by transforming to local coordinates, are in the next table. All angles are in radians. The first four mirrors (MC and SM) are balanced level. The MMT mirrors are balanced to the angles given below. The angle is the angle that the surface normal makes with the local horizontal. A positive angle means output beam is pitched upwards, assuming level input beam. The angle that the output beam is deflected (for level input beam) is *TWICE* the angles given.

MC1	0.000000
MC2	0.000000
MC3	0.000000
SM1	0.000000
MMT1	0.001240 (1.2 mrad)
MMT2	0.000593 (0.6 mrad)
MMT3	-0.001767 (-1.8 mrad)

Please send comments, questions to `tanner@phys.ufl.edu`.