

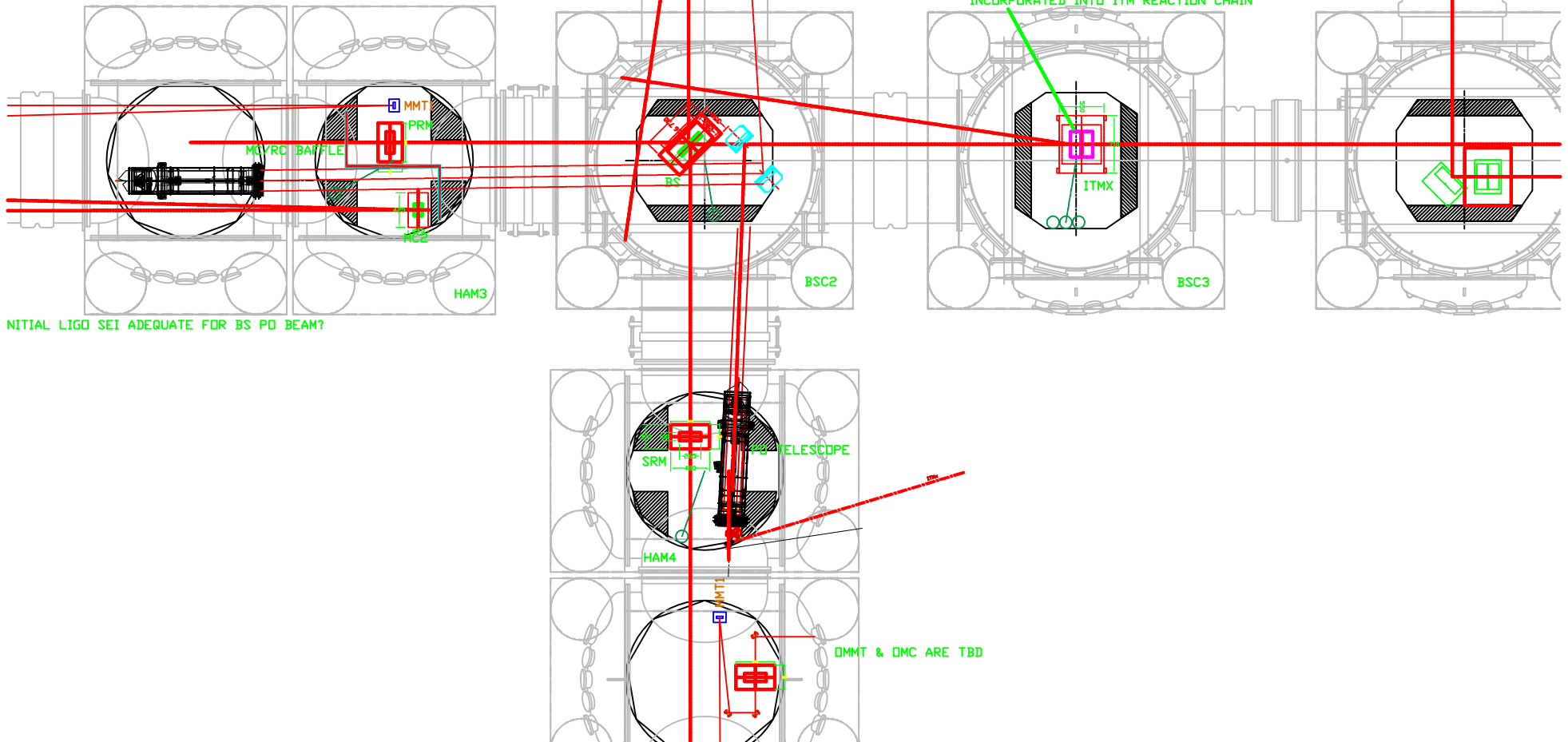
E040136-00  
Seismic Isolation System (SEI)  
Payload Mass Properties

3/18/2004  
presented at the LSC Summit Meeting  
D. Coyne

WILL MOVE PRM & SRM  
TOWARD BS AND ITMS AWAY  
FROM BS TO ALLOW MORE  
ROOM FOR PD MIRROR STRUCTURES

COMPENSATION PLATE  
INCORPORATED INTO ITM REACTION CHAIN

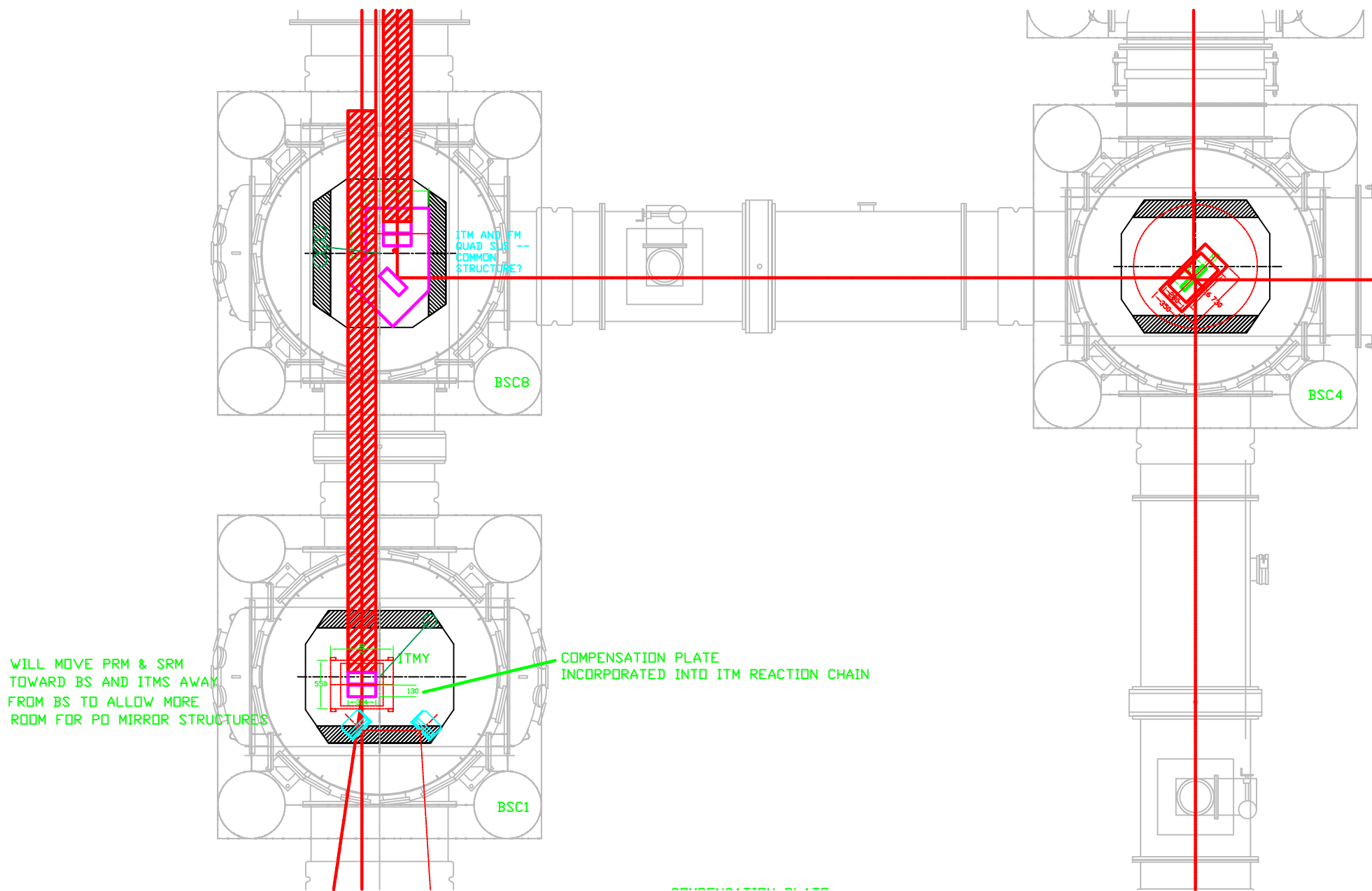
COMPENSATION PLATE  
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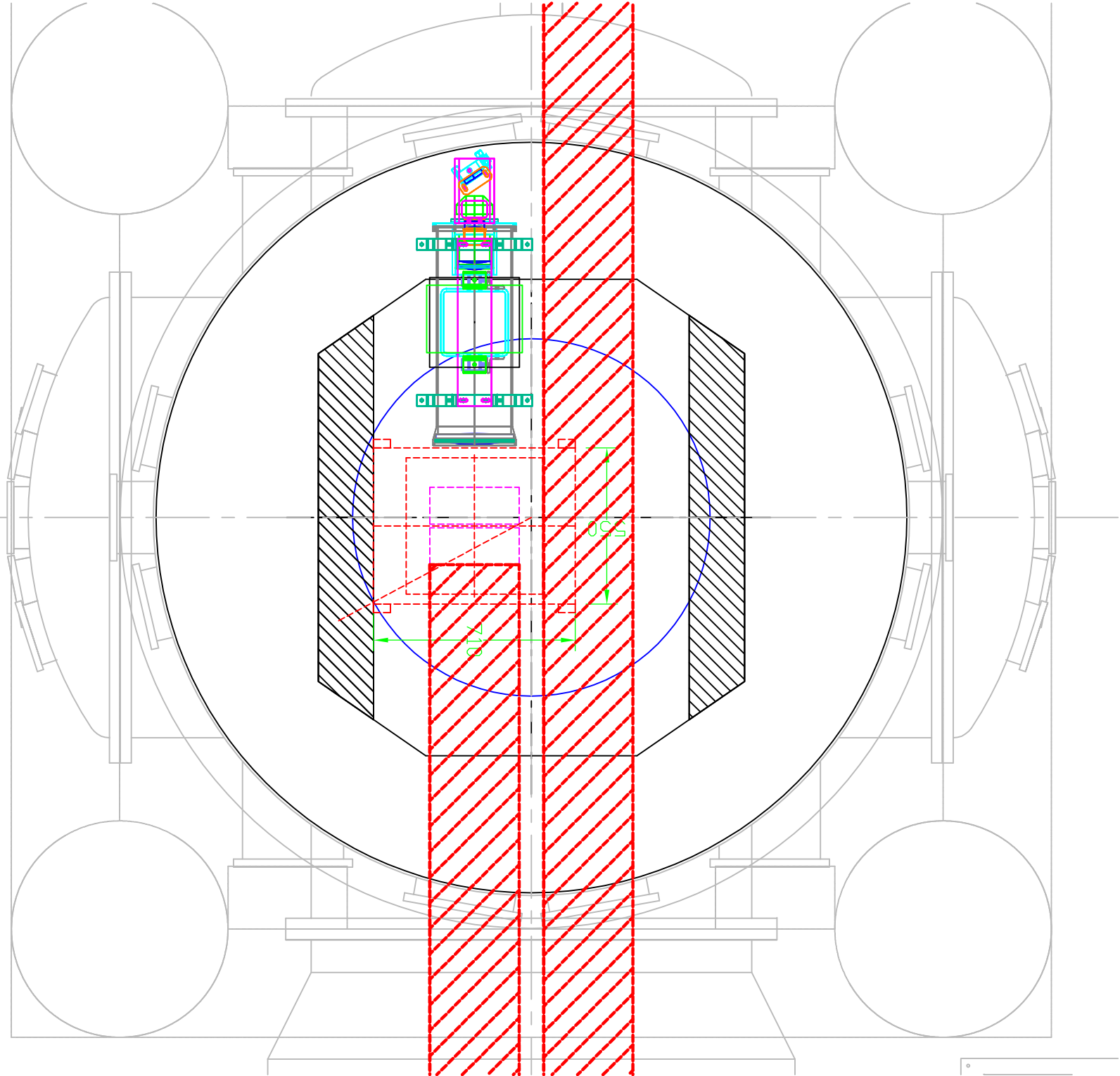


NITIAL LIGO SEI ADEQUATE FOR BS PD BEAM?

DMMT & DMC ARE TBD







# HAM Payload Summary

			Payload														
IFO	Chamber	COC	Total	Suspend	Non-Susp	Moments (kg-m)											
			Mass (kg)	Mass (kg)	Mass (kg)	Mx	My	min Mz	max Mz								
Non-Folded	H1	IO	496.3	83.8	412.5	0.0	0.0	72.6	92.1								
	H3	PRM	345.5	72.3	273.2	0.0	0.0	55.0	70.2								
	H4	SRM	545.2	56.3	488.9	0.0	0.0	119.1	144.9								
	H5	Detector	<b>TBD</b>														
	H6	OO															
	Folded	H7								IO							
H9		PRM															
H10		SRM															
H11		Detector															
H12		OO															
"MAX"										545.2	83.8	488.9	0.0	0.0	55.0	144.9	
										510.0	75.0	435.0	kg		55.0	145.0	kg-m
										1124.4	165.3	959.0	lbm		4773.8	12585.4	lbm-in
<b>Requirements</b>																	

**CHAMBER: HAM1**

**Layout 1: IMC1, IMC3, IMMT2**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
MC1	32.0	-678.5	385.0	81.3	70.0	-100.0	100.0	-100.0	100.0	-50.0	50.0
MC3	32.3	-176.0	385.0	81.3	70.0	-100.0	100.0	-100.0	100.0	-50.0	50.0
SM1	16.0	679.3	180.0	16.3	0.4	-100.0	100.0	-100.0	100.0	-50.0	50.0
MMT2	-419.9	223.9	158.4	82.7	53.9	-100.0	100.0	-100.0	100.0	-50.0	50.0
IO FI	465.7	679.3	150.0	5.9	5.9	-100.0	100.0	-100.0	100.0	-50.0	50.0
suspended photodiode	-400.0	0.0	150.0	15.3	14.7	-100.0	100.0	-100.0	100.0	-50.0	50.0
2 L2 HAM periscopes	-400.0	0.0	300.0	11.8	5.9	-100.0	100.0	-100.0	100.0	-50.0	50.0
MC baffle			150.0	4.1	4.2	-100.0	100.0	-100.0	100.0	-50.0	50.0
IO beam dumps			150.0	4.1	4.2	-100.0	100.0	-100.0	100.0	-50.0	50.0
cabling			100.0	22.6	22.6	-100.0	100.0	-100.0	100.0	-50.0	50.0
10 DLC mounts & mirrors	-400.0	0.0	150.0	11.0	1.1	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	180.0	33.6	33.6	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	-112.8	-96.7	269.2	370.1	286.3	-167.5	-14.3	-184.2	-31.0	205.9	274.1
						-167.5		-184.2			
						<b>Max (Abs(Xcg))</b>		<b>Max (Abs(Ycg))</b>			
						249.0		-132.3			
						<b>Radius (mm)</b>		<b>Angle (deg)</b>			
Balance mass (on optics table)	491.2	540.0	107.7	126.2	126.2	730.0		47.7			
<b>N.B.: Balast (Z) mass not indicated</b>	<b>total mass (sans balast), kg</b>			<b>496.3</b>	412.5						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	62	68		
Non-Suspended Payload Mass			59	78.5
Optics Table Balance + Payload Mass	0	0	73	92.1

**CHAMBER: HAM3**

**Layout 1: IMC2, IMMT1, PRM**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
MC2	292.8	-425.1	385.0	81.3	70.0	-100.0	100.0	-100.0	100.0	-50.0	50.0
PRM	-49.3	222.0	345.0	120.4	75.4	-100.0	100.0	-100.0	100.0	-50.0	50.0
PRM beam dump	253.6	222.0	180.0	5.9	5.9	-100.0	100.0	-100.0	100.0	-50.0	50.0
MMT1	12.7	679.3	180.0	16.3	0.4	-100.0	100.0	-100.0	100.0	-50.0	50.0
CABLING	-400.0	0.0	100.0	22.6	22.6	-100.0	100.0	-100.0	100.0	-50.0	50.0
5 DLC mounts & mirrors	-400.0	0.0	150.0	5.5	5.5	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	180.0	25.2	25.2	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	30.0	16.5	301.1	277.2	204.9	-10.2	151.3	-64.2	97.3	249.0	323.0
							151.3		97.3		
							<b>Max (Abs(Xcg))</b>		<b>Max (Abs(Ycg))</b>		
							179.9		32.7		
							<b>Radius (mm)</b>		<b>Angle (deg)</b>		
							730.0		212.7		
Balance mass (on optics table)	-614.0	-394.8	58.3	68.3	68.3						
N.B.: Balast (Z) mass not indicated			total mass (sans balast), kg	345.5	273.2						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	42	27		
Non-Suspended Payload Mass			51	66.2
Optics Table Balance + Payload Mass	0	0	55	70.2

**CHAMBER: HAM4**

**Layout 1: IMC1, IMC3, IMMT2**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
OMC2	297.2	-528.3	385.0	81.3	70.0	-100.0	100.0	-100.0	100.0	-50.0	50.0
SRM	-179.7	473.8	345.0	120.4	75.4	-100.0	100.0	-100.0	100.0	-50.0	50.0
SRM beam dump	-179.7	830.6	345.0	5.9	5.9	-100.0	100.0	-100.0	100.0	-50.0	50.0
PO telescope	350.5	584.2	453.6	94.8	94.8	-100.0	100.0	-100.0	100.0	-50.0	50.0
2 periscopes	375.9	-330.2	301.8	11.8	11.8	-100.0	100.0	-100.0	100.0	-50.0	50.0
CABLING	-609.6	-177.8	300.0	22.6	22.6	-100.0	100.0	-100.0	100.0	-50.0	50.0
5 DLC mounts & mirrors	-400.0	0.0	150.0	5.5	5.5	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	180.0	34.2	34.2	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	61.5	176.6	360.2	376.5	320.2	11.8	172.5	117.3	277.9	296.1	376.7
						172.5		277.9			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						327.1		58.2			
						Radius (mm)		Angle (deg)			
Balance mass (on optics table)	-384.9	-620.3	144.0	168.7	168.7	730.0		238.2			
N.B.: Balast (Z) mass not indicated						total mass (sans balast), kg		545.2		488.9	

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	65	105		
Non-Suspended Payload Mass			95	120.6
Optics Table Balance + Payload Mass	0	0	119	144.9



## BSC Payload Summary

IFO	Chamber	COC	Layout #	Payload							
				Total Mass (kg)	Suspend Mass (kg)	Non-Susp Mass (kg)	Moments (kg-m)				
				Mx	My	min Mz	max Mz				
Non-Folded	B1	ITMy	1	659.0	304.0	355.0	101.9	179.2	-284.6	-178.7	
			2	755.5	299.2	456.3	166.0	270.6	-409.2	-247.8	
	B2	BS	1	525.9	131.9	393.9	46.9	90.3	-313.9	-195.4	
			2	525.9	131.9	393.9	131.7	70.8	-247.3	-159.5	
	B3	ITMx	1	495.7	258.0	237.7	26.7	124.5	-143.9	-99.5	
			2	755.5	299.2	456.3	36.8	195.2	-409.2	-247.8	
	B9	ETMx	1	580.5	285.7	294.8	249.2	107.1	-190.0	-145.6	
	B10	ETMy	1	580.5	285.7	294.8	131.0	110.6	-194.9	-120.9	
	Folded	B4	BS	TBD							
		B7	ITMx, FMx	TBD							
B8		ITMy, Fmy	1	806.4	348.0	458.4	145.5	169.0	-291.6	-199.5	
B5		ETMx	TBD								
B6		ETMy	TBD								
"MAX"				806.4	348.0	458.4	249.2	270.6	-409.2	-99.5	
kg				800.0	350.0	450.0	270.0	270.0	-410.0	-100.0	kg-m
lbm				1763.7	771.6	992.1	23435.0	23435.0	-35586.4	-8679.6	lbm-in
<b>Requirements</b>											

**CHAMBER: BSC1**

**Layout 1: ITMy/CP Combined, 2 BS POMs (nominal layout)**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
ITMy with integral CP	-200.0	-81.0	-570.0	428.0	170.0	-20.0	20.0	-100.0	100.0	-124.0	124.0
POM_BS1	-259.0	-549.0	-1000.0	74.3	51.3	-50.0	50.0	-50.0	50.0	-300.0	300.0
POM_BS2	523.0	-549.0	-1000.0	74.3	51.3	-50.0	50.0	-50.0	50.0	-300.0	300.0
CABLING, misc	-678.2	-363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	59.9	59.9	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	-123.4	-188.8	-652.4	659.0	355.0	-154.5	-92.3	-271.9	-105.7	-801.5	-503.2
						-154.5		-271.9			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						312.7		-119.6			
						Radius (mm)		Angle (deg)			
						700.0		60.4			
Balance mass (on optics table)	345.9	608.5	-251.2	294.4	294.4						
N.B.: Balast (Z) mass not indicated			total mass (sans balast), kg	953.5	649.5						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	102	179		
Non-Suspended Payload Mass			-285	-178.7
Optics Table Balance + Payload Mass	0	0	-359	-252.6

**Layout 2: ITM & CP separate, no POMs**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
ITMy	-200.0	-81.0	-570.0	418.0	170.0	-20.0	20.0	-100.0	100.0	-124.0	124.0
CP	-200.0	-640.0	-1000.0	246.2	195.0	-20.0	20.0	-100.0	100.0	-300.0	300.0
CABLING, misc	-678.2	-363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	68.7	68.7	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	-196.1	-264.3	-719.9	755.5	456.3	-219.7	-172.6	-358.2	-170.4	-896.8	-543.0
						-219.7		-358.2			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						420.2		-121.5			
						Radius (mm)		Angle (deg)			
						700.0		58.5			
Balance mass (on optics table)	366.0	596.7	-387.0	453.5	453.5						
N.B.: Balast (Z) mass not indicated			total mass (sans balast), kg	1209.0	909.8						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	166	271		
Non-Suspended Payload Mass			-409	-247.8
Optics Table Balance + Payload Mass	0	0	-585	-423.3

**CHAMBER: BSC2**

**Layout 1: BS SUS and 2 POMs for BS & ITMx POs (nominal layout)**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
BS	-150.0	172.3	-570.0	306.9	221.0	-20.0	20.0	-100.0	100.0	-124.0	124.0
POM BS3	784.0	-223.0	-1000.0	74.3	51.3	-50.0	50.0	-50.0	50.0	-300.0	300.0
POM ITMx	431.0	263.0	-1000.0	74.3	51.3	-50.0	50.0	-50.0	50.0	-300.0	300.0
CABLING, misc	-678.2	-363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	47.8	47.8	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	54.8	90.6	-646.4	525.9	393.9	20.4	89.2	9.5	171.7	-796.9	-495.9
						89.2		171.7			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						193.5		62.5			
						Radius (mm)		Angle (deg)			
Balance mass (on optics table)	-322.8	-621.1	-124.0	145.3	145.3	700.0		242.5			
N.B.: Balast (Z) mass not indicated	total mass (sans balast), kg			671.2	539.3						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	47	90		
Non-Suspended Payload Mass			-314	-195.4
Optics Table Balance + Payload Mass	0	0	-332	-213.4

**Layout 2: BS SUS and 2 POMs for ITMx & ITMy Pos**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
BS	-150.0	172.3	-570.0	306.9	221.0	-20.0	20.0	-100.0	100.0	-124.0	124.0
POM ITMy	-784.0	-223.0	-1000.0	74.3	51.3	-20.0	20.0	-100.0	100.0	-300.0	300.0
POM ITMx	431.0	263.0	-1000.0	74.3	51.3						
CABLING, misc	-678.2	-363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	47.8	47.8	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	-166.6	90.6	-646.4	525.9	393.9	-250.5	-204.3	-27.6	134.5	-627.8	-404.8
						-250.5		134.5			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						284.4		151.8			
						Radius (mm)		Angle (deg)			
Balance mass (on optics table)	616.7	-331.2	-182.3	213.6	213.6	700.0		331.8			
N.B.: Balast (Z) mass not indicated	total mass (sans balast), kg			739.5	607.6						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	132	71		
Non-Suspended Payload Mass			-247	-159.5
Optics Table Balance + Payload Mass	0	0	-286	-198.4

**CHAMBER: BSC3**

**Layout 1: ITMx/CP Combined (nominal layout)**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
ITMx/CP	67.7	199.4	-570.0	428.0	170.0	-20.0	20.0	-100.0	100.0	-124.0	124.0
CABLING, misc	-678.2	-363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	45.1	45.1	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	27.5	155.6	-512.0	495.7	237.7	1.1	53.9	60.1	251.1	-605.4	-418.5
						53.9		251.1			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						256.8		77.9			
						Radius (mm)		Angle (deg)			
Balance mass (on optics table)	-146.9	-684.4	-155.2	181.8	181.8	700.0		257.9			
N.B.: Balast (Z) mass not indicated				total mass (sans balast), kg	677.5						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	27	124		
Non-Suspended Payload Mass			-144	-99.5
Optics Table Balance + Payload Mass	-6.18456E-11	0	-172	-127.7

**Layout 2: ITM & CP Separate**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
ITMx	200.0	199.4	-570.0	418.0	170.0	-20.0	20.0	-100.0	100.0	-124.0	124.0
CP	-200.0	199.4	-1000.0	246.2	195.0	-20.0	20.0	-100.0	100.0	-300.0	300.0
CABLING, misc	-678.2	-363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	68.7	68.7	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	25.2	164.4	-719.9	755.5	456.3	1.6	48.7	70.5	258.3	-896.8	-543.0
						48.7		258.3			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						262.9		79.3			
						Radius (mm)		Angle (deg)			
Balance mass (on optics table)	-129.8	-687.9	-242.1	283.7	283.7	700.0		259.3			
N.B.: Balast (Z) mass not indicated				total mass (sans balast), kg	1039.3						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	37	195		
Non-Suspended Payload Mass			-409	-247.8
Optics Table Balance + Payload Mass	0	0	-478	-316.5

**CHAMBER: BSC9**

**Layout 1: ETMx and ETMx Telescope (nominal layout)**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
ETMx	297.0	199.4	-570.0	418.0	170.0	-100.0	100.0	-20.0	20.0	-124.0	124.0
ETMx Telescope	980.0	199.4	-855.0	87.1	49.4	-100.0	100.0	-20.0	20.0		
CABLING, misc	-678.2	-363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	52.8	52.8	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	334.5	159.3	-569.2	580.5	294.8	239.7	429.3	134.1	184.5	-644.5	-493.8
						429.3		184.5			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						467.3		23.3			
						Radius (mm)		Angle (deg)			
Balance mass (on optics table)	-643.1	-276.5	-330.7	387.5	387.5	700.0		203.3			
N.B.: Balast (Z) mass not indicated	total mass (sans balast), kg			968.0	682.3						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	249	107		
Non-Suspended Payload Mass			-190	-145.6
Optics Table Balance + Payload Mass	0	0	-318	-273.7

**CHAMBER: BSC10**

**Layout 1: ETMy and ETMy Telescope (nominal layout)**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
ETMy	-200.0	-29.6	-570.0	418.0	170.0	-20.0	20.0	-100.0	100.0	-124.0	124.0
ETMy Telescope	-200.0	686.0	-855.0	87.1	49.4	-20.0	20.0	-100.0	100.0	-100.0	500.0
CABLING, misc	-678.2	363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	52.8	52.8	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	-200.5	95.8	-569.2	580.5	294.8	-225.7	-175.3	1.0	190.6	-661.3	-410.0
						-225.7		190.6			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						295.4		139.8			
						Radius (mm)		Angle (deg)			
Balance mass (on optics table)	534.8	-451.7	-209.0	244.9	244.9	700.0		319.8			
N.B.: Balast (Z) mass not indicated	total mass (sans balast), kg			825.4	539.7						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	131	111		
Non-Suspended Payload Mass			-195	-120.9
Optics Table Balance + Payload Mass	0	0	-246	-172.1

**CHAMBER: BSC8**

**Layout 1: ITMy and FMy in common structure (nominal layout)**

Components (with contingency)	Local Coordinate Frame (table center)			Total MASS (kg)	Nonsusp MASS (kg)	C.G. Position Uncertainty (mm)					
	X (mm) TM	Y (mm) TM	Z (mm) NM			- X	+ X	- Y	+ Y	- Z	+ Z
ITM, FM, CP Combined	200.0	43.0	-570.0	710.5	362.5	-20.0	20.0	-200.0	200.0	-124.0	124.0
CABLING, misc	-678.2	-363.2	-100.0	22.6	22.6	-200.0	200.0	-200.0	200.0	-50.0	50.0
System contingency (10%)	0.0	0.0	-500.0	73.3	73.3	0.0	0.0	0.0	0.0	0.0	0.0
total payload cg (w/o balance mass)	157.2	27.7	-535.6	806.4	458.4	133.9	180.4	-154.1	209.5	-636.1	-435.1
						180.4		209.5			
						Max (Abs(Xcg))		Max (Abs(Ycg))			
						276.5		49.3			
						Radius (mm)		Angle (deg)			
Balance mass (on optics table)	-456.8	-530.4	-271.8	318.5	318.5	700.0		229.3			
N.B.: Balast (Z) mass not indicated	total mass (sans balast), kg			1125.0	777.0						

Mass moments (kg-m):	+/- X	+/- Y	Zmin	Zmax
TotalPayload Mass	145	169		
Non-Suspended Payload Mass			-292	-199.5
Optics Table Balance + Payload Mass	0	0	-378	-286.0

ADVANCED LIGO											
Component	Subsystem	Mass (lbs)	Total Mass (kg)	Nonsusp Mass (kg)	Nonsusp Z cg (mm)	Conting	Budget Mass (kg)		Optics		Comment
							Total	Nonsuspended	Thk, mm		
DLC Mount & Mirror	AOS	2.2	1.0	1.0		10%	1.1	1.1	5.0		same as L1 DLC Mount & Mirror
MC	SUS		65.0	56.0	385.0	25%	81.3	70.0	75.0		C. Torrie estimate from SolidWorks model (2/26/2003 email). However the structural modes are low; a stiffer/heavier structure is needed. Coyne estimates another 25 kg is needed
SM	SUS	30.0	13.6	0.3	180.0	20%	16.3	0.4	25.0		modified L1 SOS
MMT1	SUS	30.0	13.6	0.3	180.0	20%	16.3	0.4	25.0		modified L1 SOS
MMT2	SUS	152.0	68.9	44.9	265.0	20%	82.7	53.9	100.0		modified L1 LOS
HAM periscope	AOS	10.0	4.5	4.5	(1) 152, (1) 304	30%	5.9	5.9	0.0		guess
IO FI	IO	10.0	4.5	4.5	140.0	30%	5.9	5.9	N/A		based on L1 COS FI
OO FI	AOS	10.0	4.5	4.5	140.0	30%	5.9	5.9	N/A		based on L1 COS FI
SUS-PD	SUS	26.0	11.8	11.3	180.0	30%	15.3	14.7	25.0		based on L1 SOS
SRM	SUS	220.0	96.3	60.3	345.0	25%	120.4	75.4	100.0		large triple pendulum estimated by J. Romie & C. Torrie
PRM	SUS	220.0	96.3	60.3	345.0	25%	120.4	75.4	100.0		large triple pendulum estimated by J. Romie & C. Torrie
ETM Trans Tel	AOS		67.0	38.0	-855.0	30%	87.1	49.4	N/A		same as L1 but with long stiff structure to support at proper height; Coyne rough estimate for suspended & scaled initial LIGO version
MC baffle	AOS	7.0	3.2	3.2		30%	4.1	4.2	N/A		
IO beam dump	AOS	7.0	3.2	3.2		30%	4.1	4.2	N/A		
RM beam dump	AOS	10.0	4.5	4.5		30%	5.9	5.9	N/A		
RC baffle	AOS	10.0	4.5	4.5		30%	5.9	5.9	N/A		
PO mirror	AOS		64.0	41.0	-1000.0	25%	74.3	51.3	60.0		Need to extend the L1 PO mirror considerably; Probably single suspension with eddy current damping
cabling & clamps	SEI	40.0	18.1	18.1	-100.0	25%	22.6	22.6	N/A		estimate per chamber (connector bracket, cabling, fasteners)
Comp Plate SUS	AOS/SUS		189.4	150.0	-1000.0	30%	246.2	195.0	75.0		incl. Thermal corrector. WAG based on 3/5/2003 telecon with M. Zucker, D. Ottaway, G. Billingsley
PO TEL	AOS	160.8	72.9	72.9	365.0	30%	94.8	94.8	N/A		redesigned L1, same length, larger diameter, estimate 1.3 x L1 weight
ETM	SUS		384.0	136.0	-570.0	25%	418.0	170.0	130.0		N. Robertson estimate (2/26/2003 email): primary chain assuming FS optics: 22,22, 40,40 plus reaction chain: 22,22, 40,40 L. Jones 3/6/2003 email: quad structure sketch design 114 kg, hase 145 Hz 1st resonance by analysis, so take 120 kg as structure mass Note by L. Jones: the 120 kg needs further increase to account for other nonsuspended items: coils, tablecloth, etc.: 25 kg? 2 Sep 2003 T030137-04
ITM	SUS		384.0	136.0	-570.0	25%	418.0	170.0	130.0		N. Robertson estimate (2/26/2003 email): primary chain assuming FS optics: 22,22, 40,40 plus reaction chain: 22,22, 40 2 Sep 2003 assume thermal compensator is at the bottom of the ITM reaction chain and the ITM = ETM
FM & ITM & CP	SUS		638.0	290.0	-570.0	25%	710.5	362.5	118.0		N. Robertson estimate of optic masses 4 x 25 kg primary chain plus 3 x 25 kg reaction chain (2/26/2003 email) P. Willems (3/14/2003): no need for reaction chain on the FM
BS	SUS		236.1	170.0	-570.0	30%	306.9	221.0	60.0		Coyne's WAG 7.7,12.7,12.7 plus reaction chain 7.7,12.7, plus larger structure mass than quad, say 150 kg