ISI with FMY and ITMY (damped) on December 6-7, 2011 HANFORD – H2

1. Instrument changes

After the incident on Tuesday October 18, 2011 (aLOG 1587), testing activities were stopped on BSC8 for few weeks. While SUS were welding fibers on the QUAD, Seismic swapped some geophones.

GS13 and T240 installed for final testing are (E1100740):

Unit	Location GS13	Serial Number	POD
BSC8	H1	Not noted at LLO	33
BSC8	H2	801	31
BSC8	H3	783	16
BSC8	V1	740	79
BSC8	V2	739	94
BSC8	V3	677	26

Table 1 - GS13 installed for final testing

Unit	Location T240	Serial Number	POD
BSC8	Corner 1	112	32
BSC8	Corner 2	118	20
BSC8	Corner 3	101	19

Table 2 - L4C installed for final testing

2. Sensors check

Few ASD were measured to check the sensors and built reference amplitude spectral density.

State	GPS Time
ISI Unlocked	1007321196
ISI Locked	1007334800

Table 3 - ASD - ISI Locked & unlocked

	Time	Tilt	Offset drive
ISI Tilted 1	1007327576	+RX	40000
ISI Tilted 2	1007327824	-RX	-40000
ISI Tilted 3	1007328175	+RY	32000
ISI Tilted 4	1007328449	-RY	-32000
ISI Tilted 5	1007328907		25K RX-25KRY
ISI Tilted 6	1007329120		25K RX+25KRY

Table 4 - ISI Tilted - Different angles

ASD of the unlocked, locked and titled ISI can be found in the SVN at:
/seismic/BSC-ISI/H2/ITMY/Data/Powerspectra/Undamped/
-   LHO_ISI_BSC8_ASD_m_CPS_T240_L4C_GS13_2011_12_07_112621.mat
    (**Unlocked**)
-   LHO_ISI_BSC8_ASD_m_CPS_T240_L4C_GS13_2011_12_07_151305.mat (**Locked**)
-   LHO_ISI_BSC8_ASD_m_L4C_GS13_Stage_Tilted_2011_12_07.mat

Figures of these spectra can be found in the SVN at:
/seismic/BSC-ISI/H2/ITMY/Data/Figures/Powerspectra/Undamped/
-   LHO_ISI_BSC8_ASD_m_CPS_T240_L4C_GS13_2011_12_07_112621.fig
-   LHO_ISI_BSC8_ASD_m_CPS_T240_L4C_GS13_2011_12_07_151305.fig
-   LHO_ISI_BSC8_Tilted_ASD_m_ST1_L4C_2011_12_07.fig
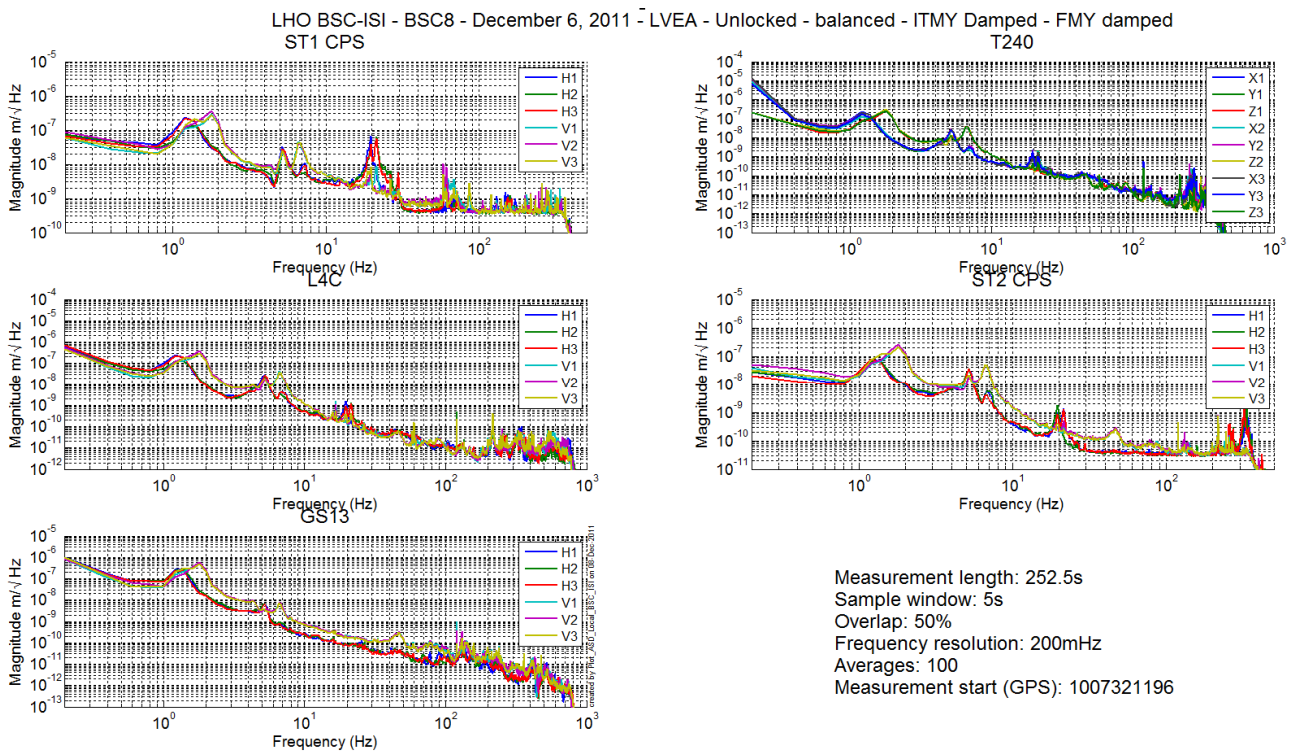-   LHO_ISI_BSC8_Tilted_ASD_m_ST2_GS13_2011_12_07.fig
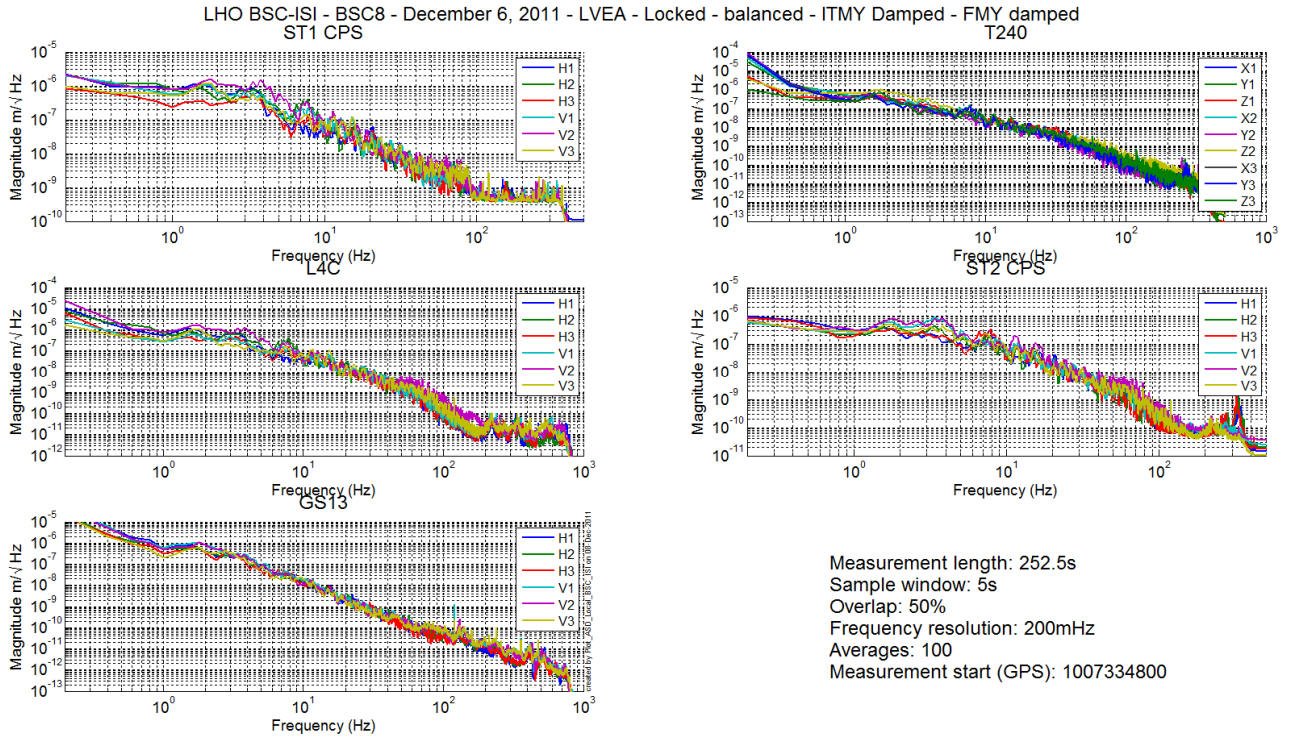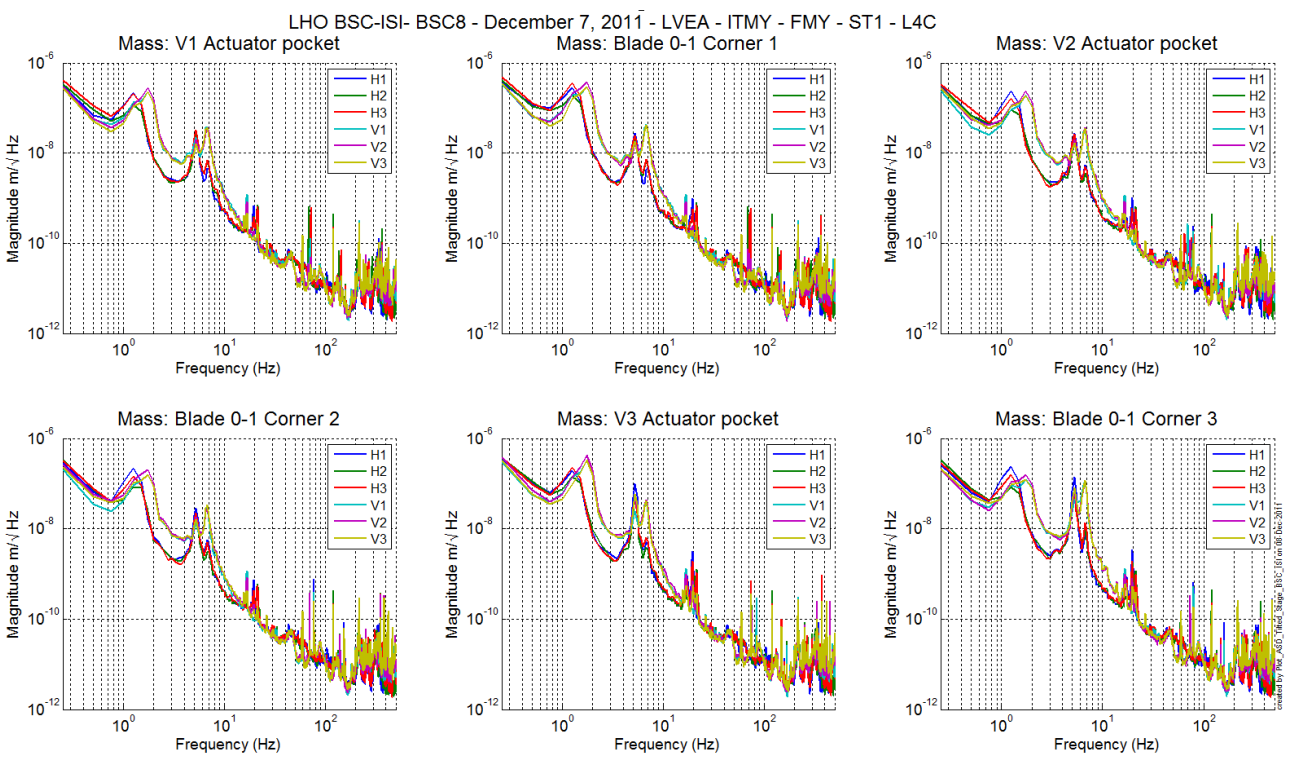

Figure 1 - ASD ISI Unlocked

Figure 2 - ASD ISI Locked

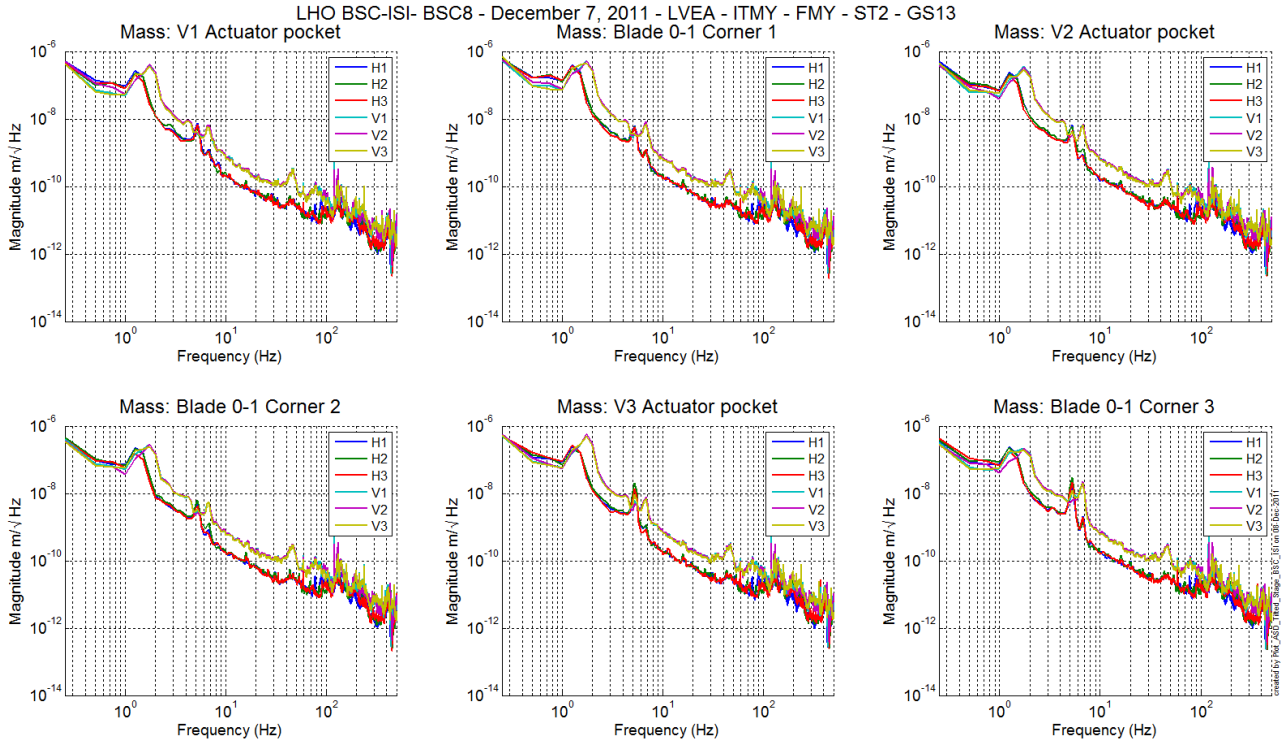**Figure 3 - ASD of L4C when the stage 2 is tilted**

Figure 4 - ASD GS13 when the stage 2 is tilted

3. Mass budget

The mass budget is presented in the tables below.

Stage 1

Mass Type	Location	Weight (lb)	Weight (Kg)
D0902612	C1-1	12	5.5
D0902616-1,2,2,3	C1-2	21.1	9.7
D0902612	C2-1	12	5.5
D0902616--1,1,2	C2-2	11.1	5.1
D0902612	C3-1	12	5.5
D0902616--5	C3-2	20.1	9.2
	Total	88.3	40.4

Table 5 – Stage 1 – Mass budget

Stage 2

Mass type	Quantity	Total Weight (lb)	Total Weight (lb)	Location
D1003136	12	600	272.2	On Keel
D071200-06	1	27.2	12.3	On Keel
D071200: 6,5,5;4,4,3,2,2,2;1,1,1,0	13	89.2	40.5	Corner1 SideWall
D071200:6,3,3,1,0;5,1;1	8	55.7	25.3	Corner2 SideWall
D071200:-;4,4;-	2	9	4.1	Corner3 SideWall
	Total	**781.1**	**354.3**	

Table 6 - Stage 2 - Mass budget

Stage 2

Mass Type	Quantity	Weight	Total weight (Kg)	Total weight (lb)	Location
D1003163	6	10	60.0	132.3	Optical Table
D1003164	6	5	30.0	66.1	Optical Table
D1003123	6	3	18.0	39.7	Optical Table
D1003166	6	1	6.0	13.2	Optical Table
D1003167	6	0.5	3.0	6.6	Optical Table
D1003168	12	0.25	3.0	6.6	Optical Table
		Total	120.0	264.6	

Table 7 - Stage 2 - Mass budget

4. Balancing check

The balancing of the ISI is evaluated by measuring the difference of the CPS offsets when the ISI is locked and unlocked.

The CPS offsets in the two configurations can be found in the SVN at:
/seismic/BSC-ISI/H2/ITMY/Data/Static_Tests/
- LHO_ISI_BSC8_Locked_20111207.mat
- LHO_ISI_BSC8_Unlocked_20111207.mat

Sensors	Table locked		Table unlocked		Difference locked - unlocked	
	Offset (Mean)	Std deviation	Offset (Mean)	Std deviation	Offset (Mean)	mil
ST1 - H1	260.6	36.6	417.3	62.7	-156.7	-0.19
ST1 - H2	-219.0	22.4	106.2	40.9	-325.2	-0.39
ST1 - H3	-100.5	16.4	569.4	73.0	-669.9	-0.80
ST1 - V1	-160.9	75.5	78.7	71.4	-239.7	-0.29
ST1 - V2	-60.9	138.5	-312.7	93.0	251.8	0.30
ST1 - V3	-112.0	46.8	287.3	69.3	-399.3	-0.48
ST2 - H1	-138.1	25.3	591.0	98.3	-729.1	-0.22
ST2 - H2	857.1	66.9	835.4	97.7	21.7	0.01
ST2 - H3	-345.3	48.4	836.2	59.0	-1181.5	-0.35
ST2 - V1	923.6	35.6	1020.2	209.1	-96.6	-0.03
ST2 - V2	706.3	55.7	468.9	244.2	237.4	0.07
ST2 - V3	-470.1	54.0	-147.2	203.4	-322.9	-0.10

Table 8 - Range of motion

5. Static test – Local Basis

The results of the static test in the local basis are located in the SVN at:
seismic/BSC-ISI/H2/ITMY/Data/Static_Tests/
- LHO_ISI_BSC8_Offset_Local_Drive_20111206.mat

		Sensors					
		ST1 - H1	ST1 - H2	ST1 - H3	ST1 - V1	ST1 - V2	ST1 - V3
Actuators	**ST1 - H1**	3836	1537	1535	19	-8	-9
	ST1 - H2	1519	3756	1509	0	15	-4
	ST1 - H3	1517	1515	3756	2	-5	13
	ST1 - V1	59	-130	87	2892	-496	-468
	ST1 - V2	78	30	-144	-479	2909	-500
	ST1 - V3	-146	79	16	-506	-467	2918

		Sensors					
		ST2 - H1	ST2 - H2	ST2 - H3	ST2 - V1	ST2 - V2	ST2 - V3
Actuators	**ST2 - H1**	2146	318	323	-27	-17	-17
	ST2 - H2	321	2147	318	-19	-13	-27
	ST2 - H3	338	333	2237	-20	24	-7
	ST2 - V1	62	110	-174	2609	370	4
	ST2 - V2	-184	59	89	10	2606	303
	ST2 - V3	106	-178	61	299	25	2585

Table 9 – Static Test – Local drive – Offsets in the local basis

6. Static Test – Cartesian Basis

The results of the static test in the Cartesian basis are located in the SVN at:
seismic/BSC-ISI/H2/ITMY/Data/Static_Tests/
- LHO_ISI_BSC8_Offset_Cartesian_Drive_20111206.mat

		ST1 - X	ST1 - Y	ST1 - Z	ST1 – RX	ST1 - RY	ST1 - RZ
Actuators	**ST1 - X**	1523	2	-7	-12	-7	31
	ST1 - Y	-7	1506	-25	11	-9	3
	ST1 - Z	27	-1	656	5	5	-7
	ST1 - RX	5	305	0	2469	-6	-10
	ST1 - RY	-291	19	-2	-1	2472	-9
	ST1 - RZ	14	2	-1	1	0	2884

	ST2 - X	ST2 - Y	ST2 - Z	ST2 – RX	ST2 - RY	ST2 - RZ
ST2 - X	1229	-19	57	25	5	15
ST2 - Y	0	1234	-27	7	1	-42
ST2 - Z	9	3	964	10	15	-3
ST2 - RX	3	-6	-5	3755	-1	-11
ST2 - RY	21	2	-15	11	3747	-2
ST2 - RZ	12	-33	-27	-5	16	2341

(left label: **Actuators**)

Figure 5 - Static Test – Cartesian Drive – Offsets in the Cartesian Basis

	Sensors					
	ST1 - H1	ST1 - H2	ST1 - H3	ST1 - V1	ST1 - V2	ST1 - V3
ST1 - X	1548	-730	-736	28	-1	-7
ST1 - Y	-25	1298	-1272	12	19	0
ST1 - Z	-48	-7	-23	649	657	657
ST1 - RX	-17	127	-146	-2367	2015	369
ST1 - RY	-181	78	58	-936	-1580	2541
ST1 - RZ	2787	2758	2764	5	-4	-5

(left label: **Actuators**)

	Sensors					
	ST2 - H1	ST2 - H2	ST2 - H3	ST2 - V1	ST2 - V2	ST2 - V3
ST2 - X	617	-1211	630	-36	-1	23
ST2 - Y	1056	1	-1083	-15	8	13
ST2 - Z	6	8	4	948	979	972
ST2 - RX	-247	-3	238	-2198	2227	-38
ST2 - RY	145	-268	152	-1341	-1211	2546
ST2 - RZ	1612	1613	1661	-18	18	21

(left label: **Actuators**)

Table 10 - Static Test – Cartesian Drive – Offsets in the Local Basis

7. Pressure sensors check

The pressure readout are located in the SVN are:
seismic/BSC-ISI/H2/ITMY/Data/Static_Tests/
-   LHO_ISI_BSC8_Pressure_Sensors_Check_20111206.mat

Sensors	Pressure (counts)		
	Corner 1	Corner 2	Corner 3
ST1-L4C-D	37	124	231
ST1-L4C-P	24642	24647	24589
ST1-GS13-D	625	1165	4065.0
ST1-GS13-P	24425	24324	24266
ST1-T240-P	14073	13642	13829

Figure 6 - Pressure sensor readout

8. Range of motion test

The results of the range of motion test are located in:
- seismic/BSC-ISI/H2/ITMY/Data/Static_Tests/LHO_ISI_BSC8_Range_Of_Motion_20111206.mat

Sensor readout (counts)	Negative drive	no drive	Positive drive	Amplitude count	mil
ST1 - H1	-15865	357	16290	32155	38.3
ST1 - H2	-16123	21	15849	31972	38.1
ST1 - H3	-15596	562	15304	30900	36.8
ST1 - V1	-12525	-30	12483	25007	29.8
ST1 - V2	-12793	-354	12069	24862	29.6
ST1 - V3	-12064	321	12668	24732	29.4
ST2 - H1	-8794	539	9846	18640	5.5
ST2 - H2	-8512	814	10166	18678	5.6
ST2 - H3	-8431	800	10025	18456	5.5
ST2 - V1	-10135	983	12128	22263	6.6
ST2 - V2	-10512	512	11492	22004	6.5
ST2 - V3	-11252	-95	11035	22287	6.6

Figure 7 - Range of motion

9. Linearity-hysteresis test

The linearity-hysteresis test enables to detect cable contacts. It is started before measuring long transfer functions.

The data measured in this test are located in the SVN at:
/seismic/BSC-ISI/H2/ITMY/Data/Linearity_Test/
- LHO_ISI_BSC8_Linearity_test_20111206.mat

The figure of the linearity test is located in the SVN at:
/seismic/BSC-ISI/H2/ITMY/Data/Figures/Linearity_Test/
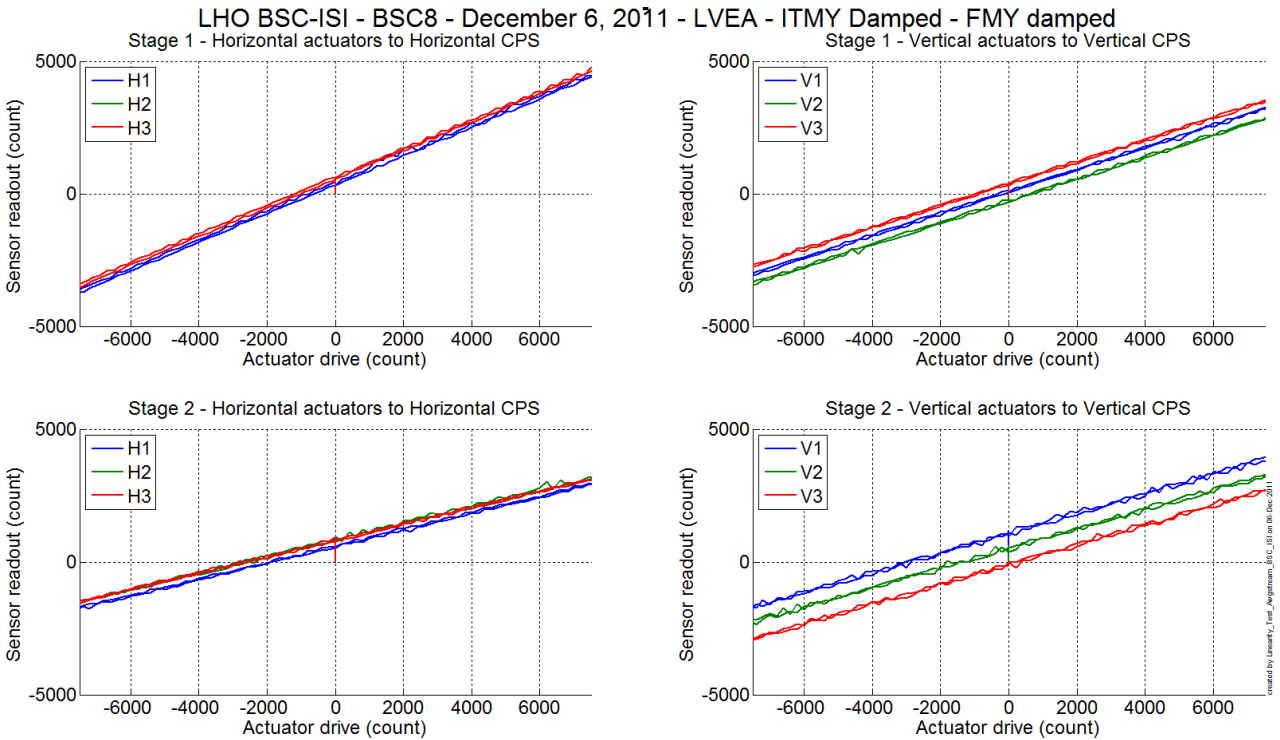- LHO_ISI_BSC8_Linearity_test_20111206.fig

Figure 8 - Linearity Test

10. Transfer function measurements

The segmented transfer functions are located in the SVN at
seismic/BSC-ISI/H2/ITMY/Data/Transfer_Functions/Measurements/Undamped/:
- LHO_ISI_BSC8_Data_L2L_10mHz_100mHz_ST1_ST2_20111206-052309.mat
- LHO_ISI_BSC8_Data_L2L_100mHz_700mHz_ST1_ST2_20111205-235951.mat
- LHO_ISI_BSC8_Data_L2L_700mHz_10Hz_ST1_ST2_20111206-191136.mat
- LHO_ISI_BSC8_Data_L2L_10Hz_100Hz_ST1_ST2_20111205-212245.mat
- LHO_ISI_BSC8_Data_L2L_100Hz_500Hz_ST1_ST2_20111205-200228.mat
- LHO_ISI_BSC8_Data_L2L_500Hz_1000Hz_ST1_ST2_20111205-185743.mat

The transfer functions are concatenated in one data structure located in the SVN at:
seismic/BSC-ISI/H2/ITMY/Data/Transfer_Functions/Simulations/Undamped/:
- LHO_ISI_BSC8_TF_L2L_Sym_10mHz_1000Hz_2011_12_06.mat

The figures that show the transfer functions with ITMY and FMY are located in the SVN at:
seismic/BSC-ISI/H2/ITMY/Data/Figures/Transfer_Functions/Measurements/Undamped/
- LHO_ISI_BSC8_TF_L2L_Raw_from_ST1_ACT_to_ST1_CPS_2011_12_06.fig
- LHO_ISI_BSC8_TF_L2L_Raw_from_ST1_ACT_to_ST1_T240_2011_12_06.fig
- LHO_ISI_BSC8_TF_L2L_Raw_from_ST1_ACT_to_ST1_L4C_2011_12_06.fig
- LHO_ISI_BSC8_TF_L2L_Raw_from_ST2_ACT_to_ST2_CPS_2011_12_06.fig
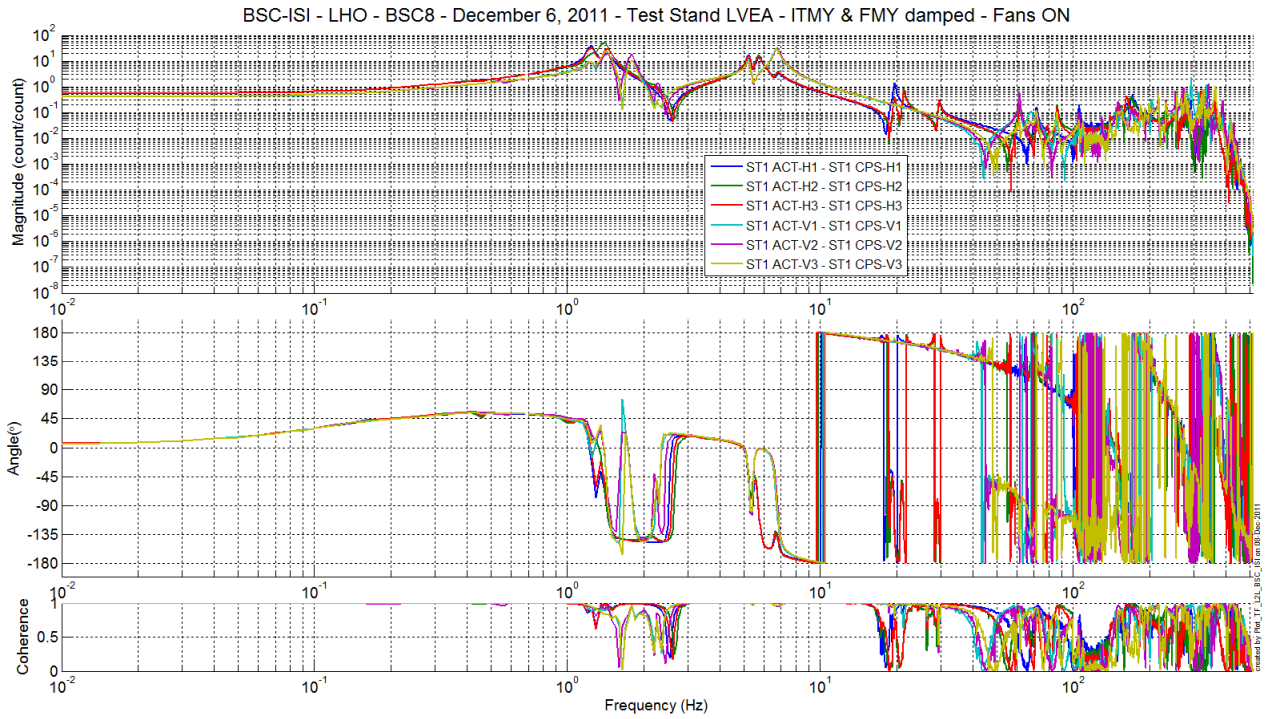- LHO_ISI_BSC8_TF_L2L_Raw_from_ST2_ACT_to_ST2_GS13_2011_12_06.fig

Figure 9 – Transfer functions – With Damped QUAD and FMY – ST1 ACT to ST1 CPS
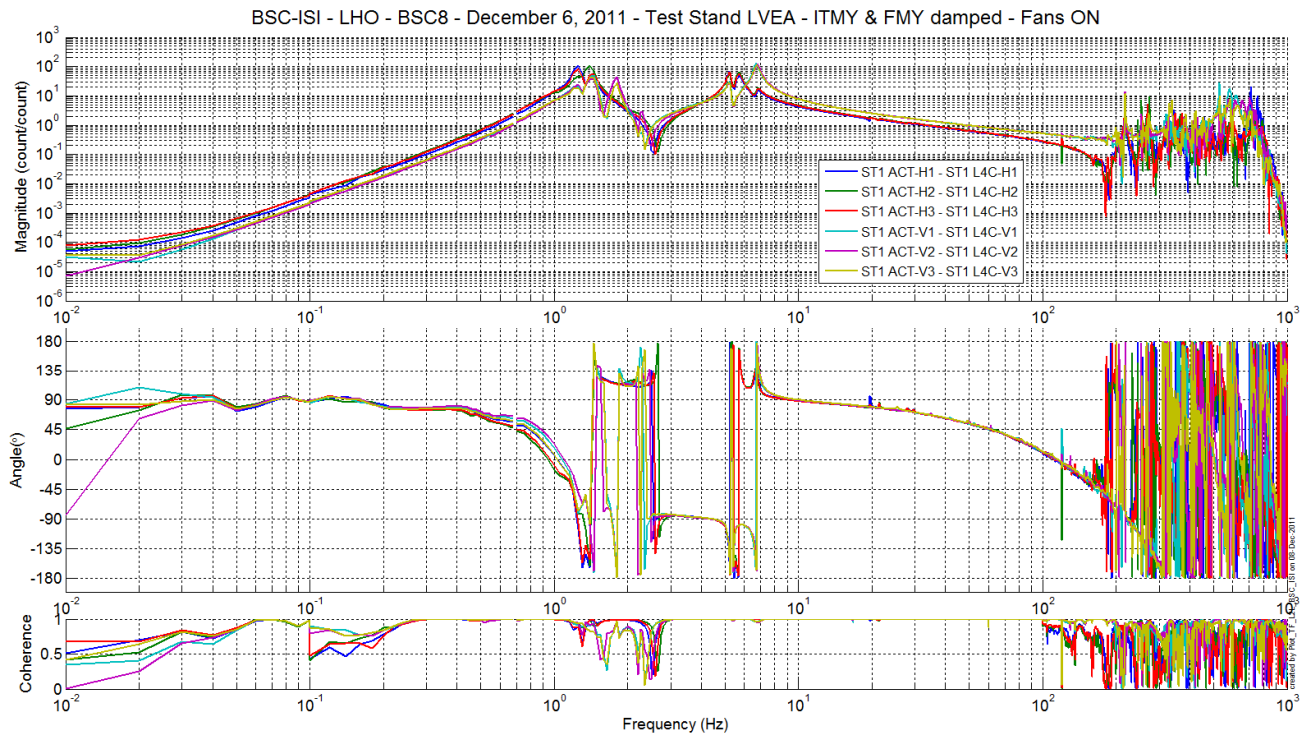

Figure 10 - Transfer functions – With Damped QUAD and FMY – ST1 ACT to ST1 L4C
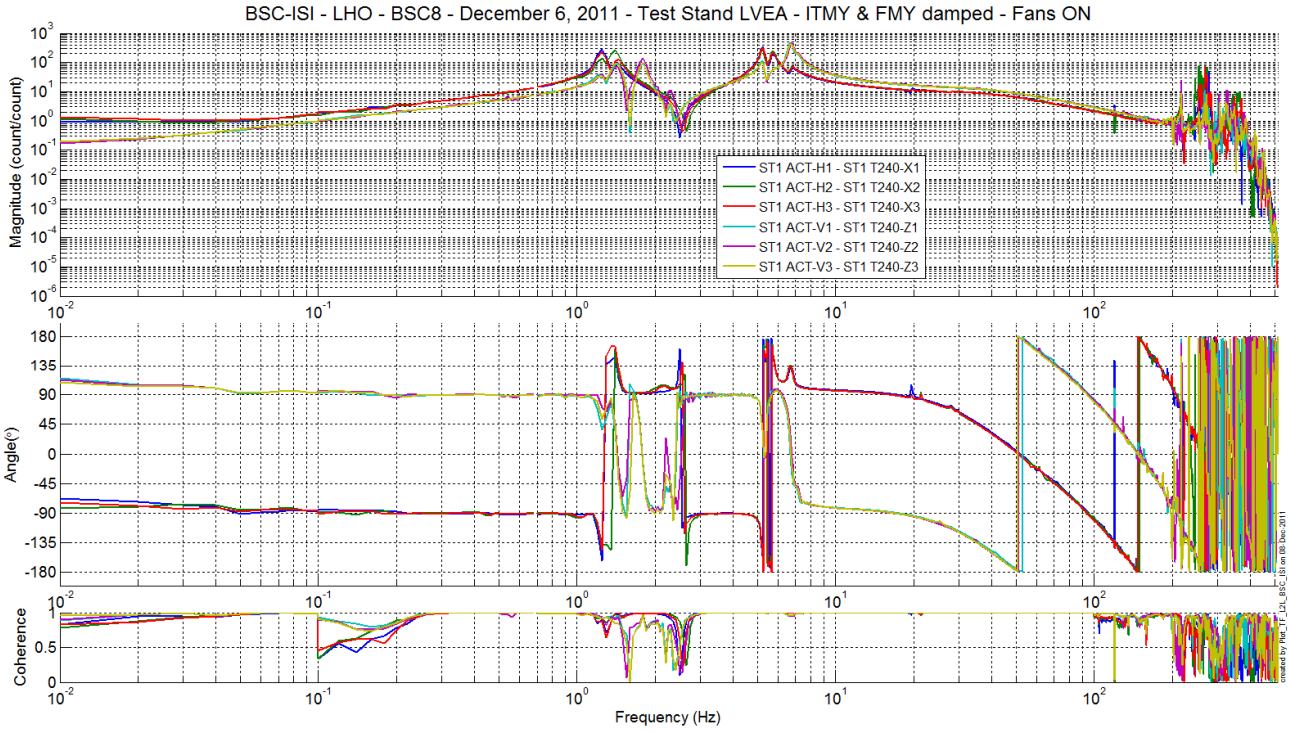
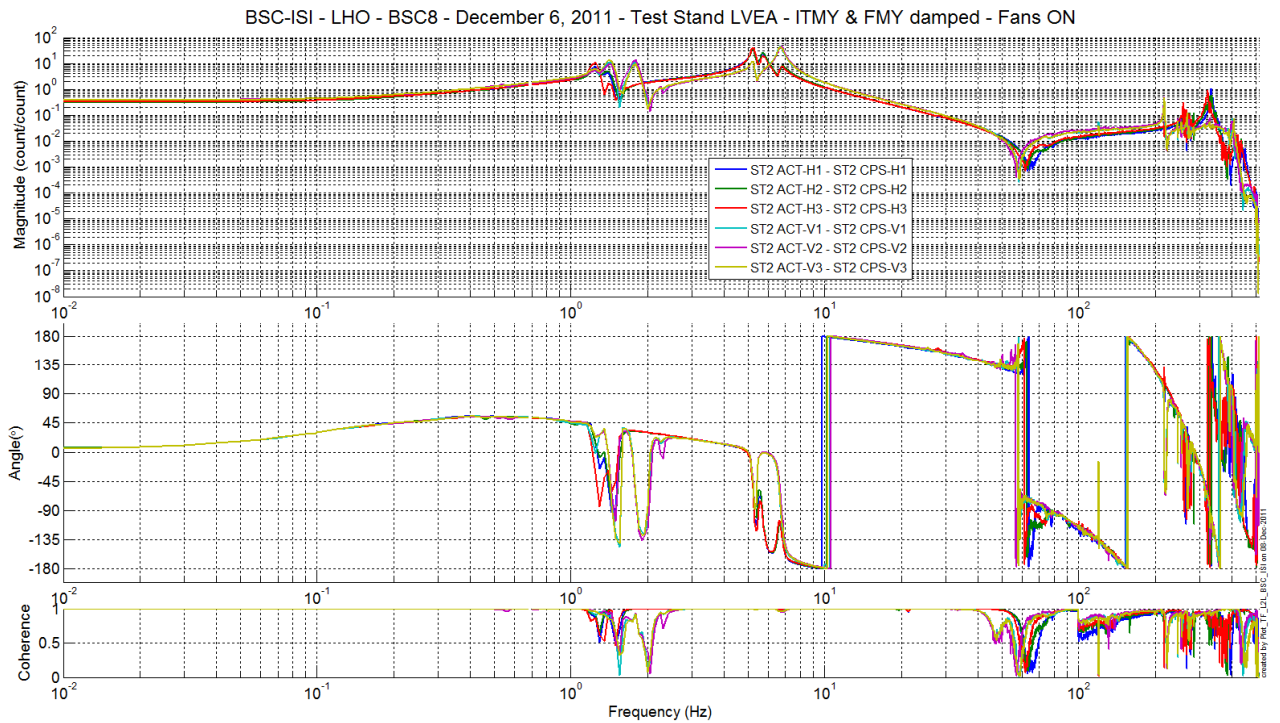**Figure 11 - Transfer functions – With Damped QUAD and FMY – ST1 ACT to ST1 T240**

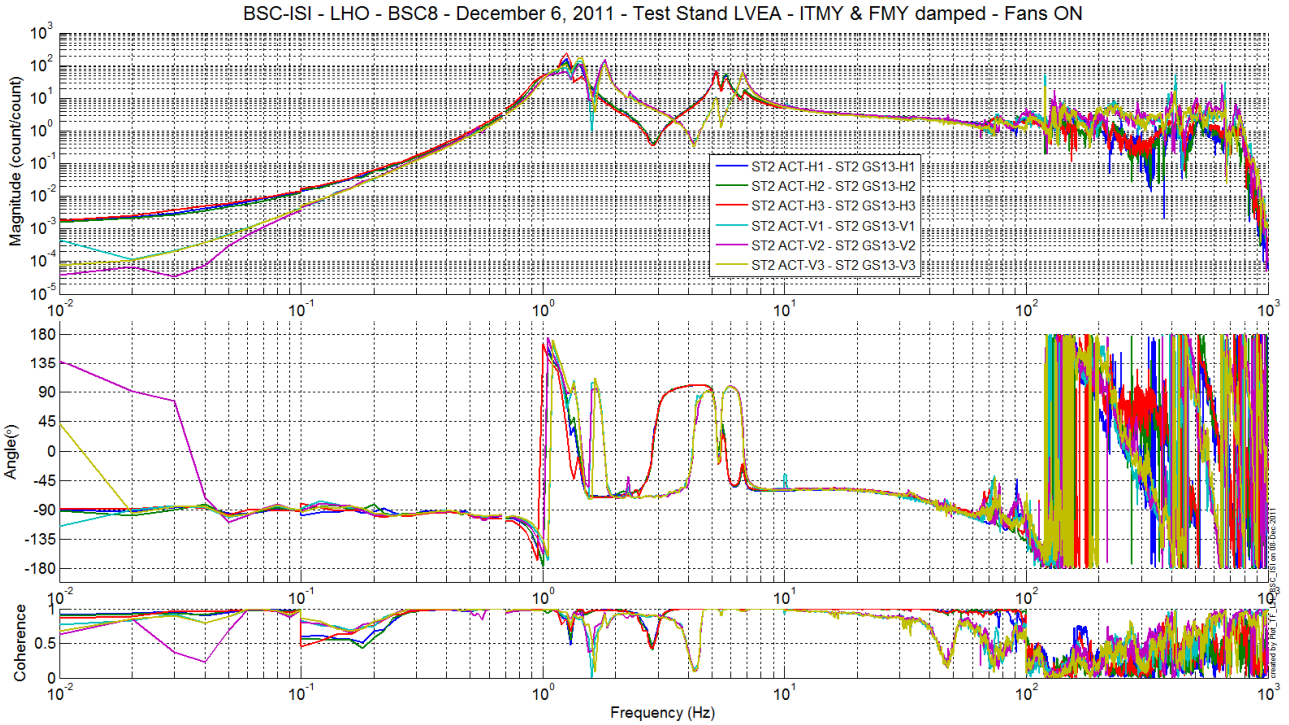**Figure 12 - Transfer functions – With Damped QUAD and FMY – ST2 ACT to ST2 CPS**

Figure 13 - Transfer functions – With Damped QUAD and FMY – ST2 ACT to ST2 GS13

11. Damping loops

The damping filters were designed using BSC-ISI transfer functions without FMY and ITMY.
The goal of this test was to show the robustness of the damping filters (Payload change).

State	GPS Time
ISI with the Damping Loops	1007316891
ISI Unlocked	1007321196

Table 11 - GPS Time - Damping loops ON and OFF

The ASD can be found in the SVN at:
/seismic/BSC-ISI/H2/ITMY/Data/Powerspectra/Damping/
-   LHO_ISI_BSC8_ASD_m_L4C_GS13_Undamped_vs_Damping_2011_12_07_101436. mat

The figure of the ASD when the ISI is damped and undamped can be found in the SVN at:
/seismic/BSC-ISI/H2/ITMY/Data/Figures/Powerspectra/Damping/
-   LHO_ISI_BSC8_ASD_m_ST1_L4C_Undamped_vs_Damping_2011_12_07_101436.fig
-   LHO_ISI_BSC8_ASD_m_ST2_GS13_Undamped_vs_Damping_2011_12_07_101436.fi g

Figure 14 - Damping Loops stage 1

Figure 15 - Damping Stage 2