LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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aLIGO SUS Quad Metal-Build Test Report Template

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Table of Contents

1 Introduction *3*
1.1 Scope 3
1.2 References 3
1.3 Revision History 3
1.4 Acronyms 3
2 Traveler *5*
3 Tests *5*
3.1 OSEM and In-Vacuum Cabling Tests 5
3.2 Open-Light Counts and MEDM Input Screens. 6
3.3 Balancing 6
3.4 OSEM Adjustment 7
3.5 Actuator Sign Test - Top Masses 7
3.6 DOF Output Tests 7
3.7 DOF Input Tests 9
3.8 DOF Open Loop Tests 10
3.9 OSEM Basis Decoupling 10
3.10 DOF open Loop Step Tests 10
3.11 DOF Servo Stability Test 10
3.12 DOF Servo Step Test 10
3.12.1 M0 Servo Damping: 10
3.12.2 R0 Servo Damping: 12
3.13 Transfer Function Tests 14
3.13.1 MO TF 14
3.13.2 R0 TF 16
3.14 Range Tests 18
3.14.1 Pitch 18
3.14.2 Yaw 19
3.15 Post-ECD TF 19
3.15.1 M0 Post-ECD TF 19
3.15.2 R0 Post-ECD TF 21

1 Introduction

1.1 Scope

This document is a report of the tests conducted in order to verify that the metal build of each quad suspension was completed correctly. See E1000494, aLIGO SUS Quad Suspension Metal-Build Testing Procedure.

1.2 References

D080273: AdL SUS BSC Test Stand Wiring

E1000006: aLIGO Quad Suspension Metal-Build Assembly Procedure

E1000494: aLIGO SUS Quad Suspension Metal-Build Testing Procedure

E1000495: aLIGO SUS Quad Suspension Testing and Commissioning Documentation

E1000502: aLIGO SUS Test Stand Shakedown Procedure

E1000516: aLIGO SUS Quad Suspension Assembly Process Travelers

E1000517: aLIGO SUS Quad Suspension Metal Build Test Reports

E1000520: aLIGO SUS Quad Suspension Monolithic Build Testing Procedure

F1000008: Quad Suspension Process Traveler Template

F1100006: aLIGO SUS Quad Transfer Function Modes Template

M1000211: Subsystem-Level and System-Level Testing Requirements

T010007: Cavity Optics Suspension Subsystem Design Requirements Document

T010103: Advanced LIGO Suspension System Conceptual Design

T1000238: Quad Suspension AdvLIGO Test Plan (Obsolete)

T1100117: aLIGO SUS File/Directory Naming Convention

1.3 Revision History

3/2/2011 pre-version 1

1.4 Acronyms

Ag	Silver
aLIGO	Advanced Laser Interferometer Gravitational-Wave Observatory
COS	Core Optics Support
CP	Compensator Plate
DCC	Document Control Center
DOF	Degrees of Freedom
DTT	Diagnostics Test Tool

ERM	End Reaction Mass
LASTI	LIGO Advanced System Test Interferometer
LED	Light Emitting Diode
LHO	LIGO Hanford Observatory
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLO	LIGO Livingston Observatory
mA	milli-Amp
MEDM	Motif-based Display Editor and Manager
OSEM	Optical Sensor Electromagnetic Motor
PD	Photo Diode
PU	Penultimate
PUM	Penultimate Mass
S/N	Serial Number
SS	Stainless Steel
SUS	Suspensions
TBD	To Be Determined
TF	Transfer Function
UI	Upper Intermediate
UIM	Upper Intermediate Mass

2 Traveler

Quad:___N___Traveler Number:___E1000XXX___

3 Tests

3.1 OSEM and In-Vacuum Cabling Tests

Cable P/N:_____S/N:_____

Cable P/N:_____S/N:_____

Cable P/N:_____S/N:_____

Cable P/N:_____S/N:_____

	Pins	Cable 1	Cable 2	Cable 3	Cable 4
RES (Ohms)	1, 14				
LED (V)	15, 2				
PD (V)	3, 16				
RES (Ohms)	4, 17				
LED (V)	18, 5				
PD (V)	6, 19				
RES (Ohms)	7, 20				
LED (V)	21, 8				
PD (V)	9, 22				
RES (Ohms)	10, 23				
LED (V)	24, 11				
PD (V)	12, 25				

Table 1 In-Vacuum Cabling Tests

3.2 Open-Light Counts and MEDM Input Screens.

The absolute value of the open-light counts should be greater than 25,000 Counts.

Record the OSEM serial numbers, open-light counts, the offset and gain applied in MEDM.

Location	BOSEM S/N
M0 Face1	
M0 Face2	
M0 Face3	
M0 Left	
M0 Right	
M0 Side	

Location	BOSEM S/N
R0 Face1	
R0 Face2	
R0 Face3	
R0 Left	
R0 Right	
R0 Side	

Location	BOSEM S/N
UI UL	
UI UR	
UI LL	
UI LR	

Location	AOSEM S/N
PEN UL	
PEN UR	
PEN LL	
PEN LR	

Table 2 OSEM Location and S/N

M0	White Count	Offset	Gain
F1			
F2			
F3			
Left			
Right			
Side			

R0	White Count	Offset	Gain
F1			
F2			
F3			
Left			
Right			
Side			

Table 3 OSEM White Count, Offset, and Gain

3.3 Balancing

M0	Mass (kg)	Height (mm)	Pitch (deg)
Top Mass			
UI Mass			
Pen. Mass			
Test Mass			

R0	Mass (kg)	Height (mm)	Pitch (deg)
Top Mass			
UI Mass			
Pen. Mass			
Test Mass			

Table 4 Mass Location and Pitch

- Need to document trim masses: utilize photography and/or a detailed list with diagram to show location of all trim masses to get new moments of inertia

3.4 OSEM Adjustment

Record the OSEM Dark-Light (minimum) raw counts. Dark-Light counts should be less than 200 Counts.

M0	Dark Count
F1	
F2	
F3	
Left	
Right	
Side	

R0	Dark Count
F1	
F2	
F3	
Left	
Right	
Side	

3.5 Actuator Sign Test - Top Masses

Confirm that sign of step was correct.

	M0		R0
☐	Face 1	☐	Face 1
☐	Face 2	☐	Face 2
☐	Face 3	☐	Face 3
☐	Left	☐	Left
☐	Right	☐	Right
☐	Side	☐	Side

3.6 DOF Output Tests

Include screen capture of each DOF to confirm correct filter settings.

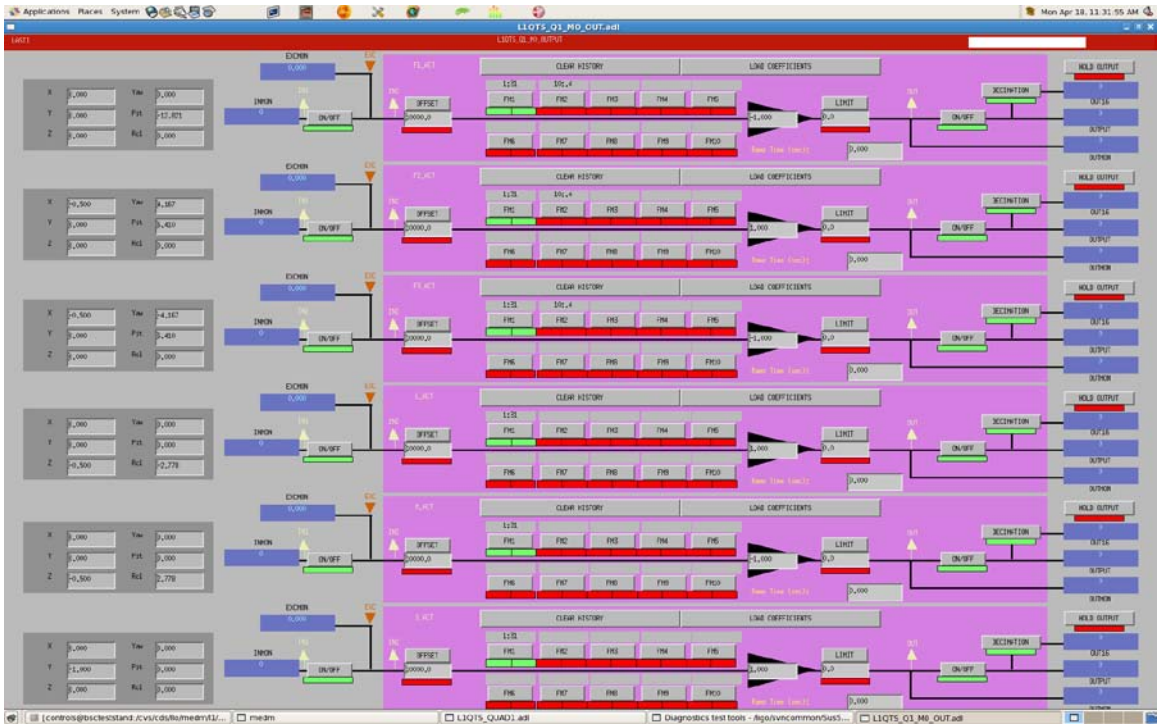

Figure 1 M0 Output Filter

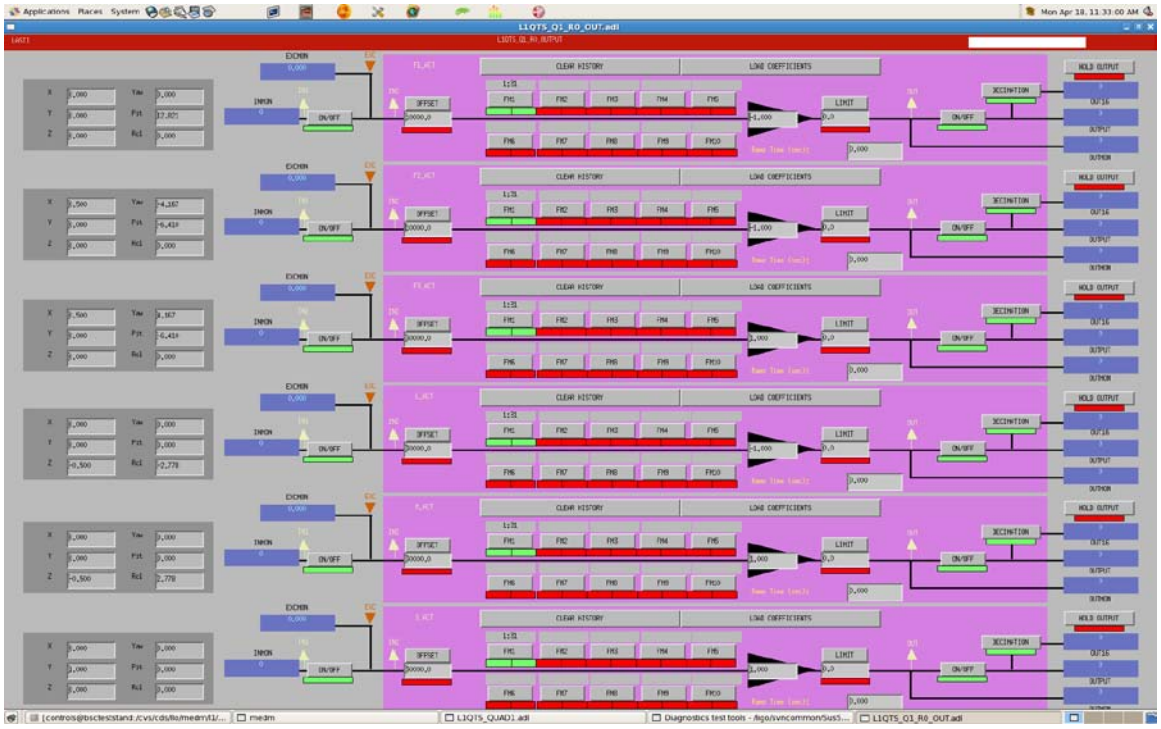

Figure 2 R0 Output Filter

3.7 DOF Input Tests

Include screen capture of each DOF to confirm correct filter settings.

Figure 3 M0 DOF

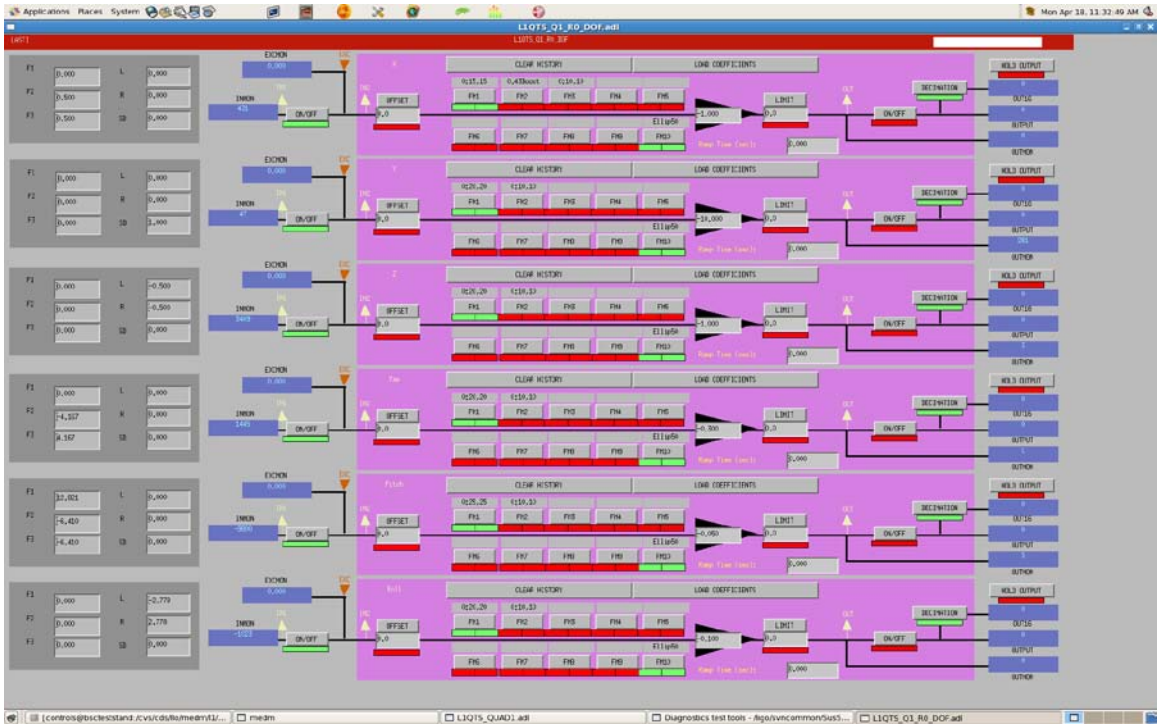

Figure 4 R0 DOF

3.8 DOF Open Loop Tests

Glass build: apply x, y, etc. actuation and monitor sensor equilibrium (DC Response.)

3.9 OSEM Basis Decoupling

Record screen capture of the cursor windows for each axis of decoupling illustrating levels of coupling. (Include screen shot of six OSEM basis' for M0 and R0 driving Yaw, Vertical, and X.)

3.10 DOF open Loop Step Tests

M0	R0
☐ Face 1	☐ Face 1
☐ Face 2	☐ Face 2
☐ Face 3	☐ Face 3
☐ Left	☐ Left
☐ Right	☐ Right
☐ Side	☐ Side

3.11 DOF Servo Stability Test

For each channel confirm that signals remained level and stable as each DOF output filter was disabled.

3.12 DOF Servo Step Test

/ligo/svncommon/SusSVN/sus/trunk/QUAD/Xnn/QUADnn/BUILDnn/SAGM0/DATA

/ligo/svncommon/SusSVN/sus/trunk/QUAD/Xnn/QUADnn/BUILDnn/SAGR0/DATA

3.12.1 M0 Servo Damping:

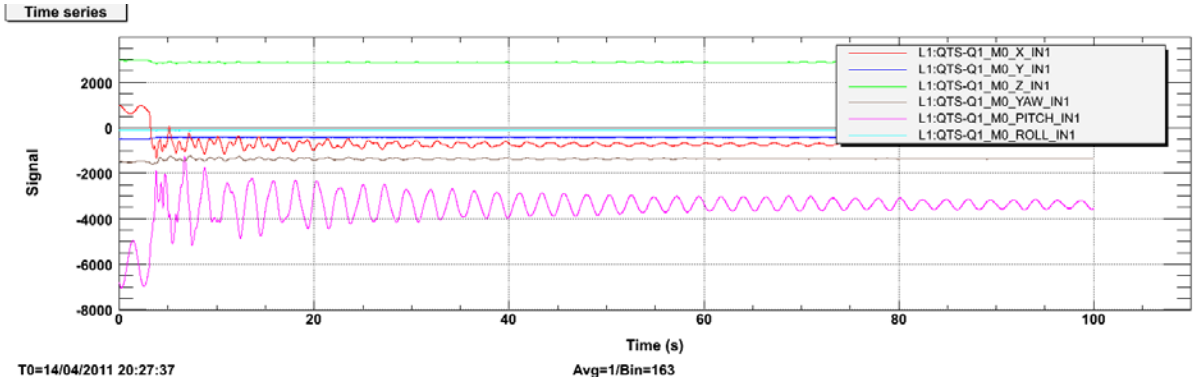

Figure 5 YYYY-MM-DD-HHMM-M0-xSD

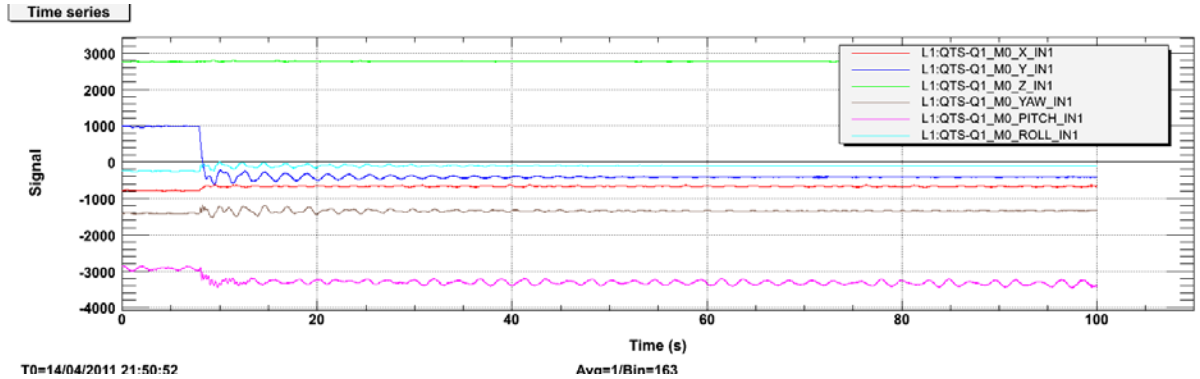

Figure 6 YYYY-MM-DD-HHMM-M0-ySD

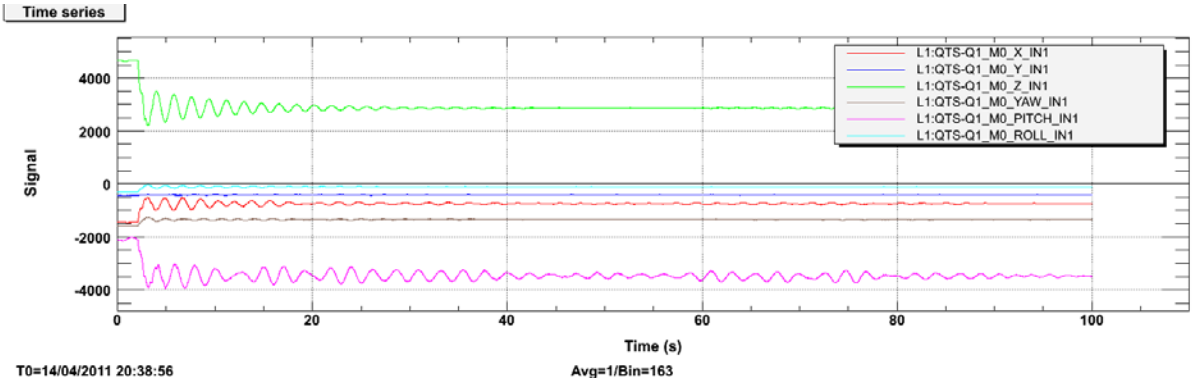

Figure 7 YYYY-MM-DD-HHMM-M0-zSD

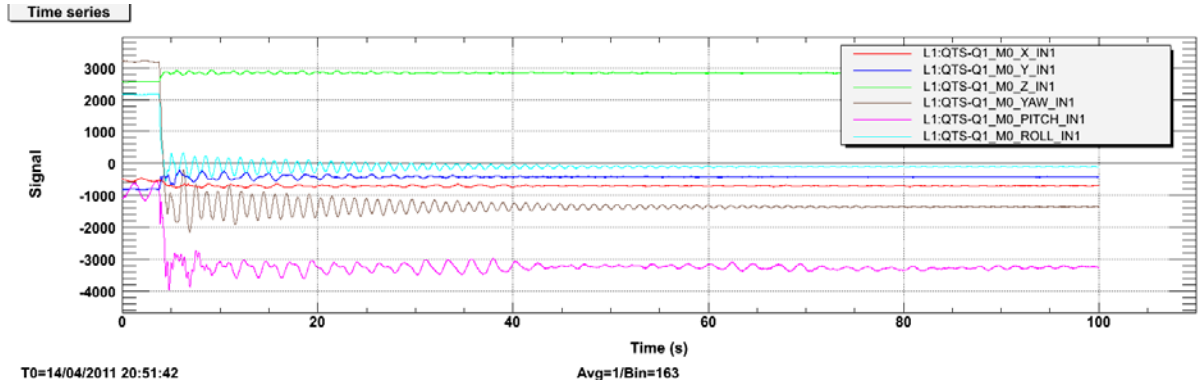

Figure 8 YYYY-MM-DD-HHMM-M0-rollSD

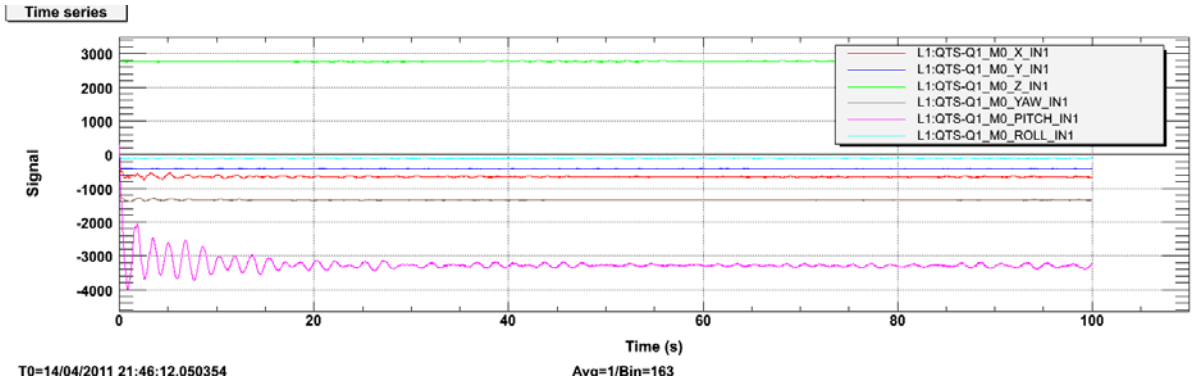

Figure 9 YYYY-MM-DD-HHMM-M0-pitchSD

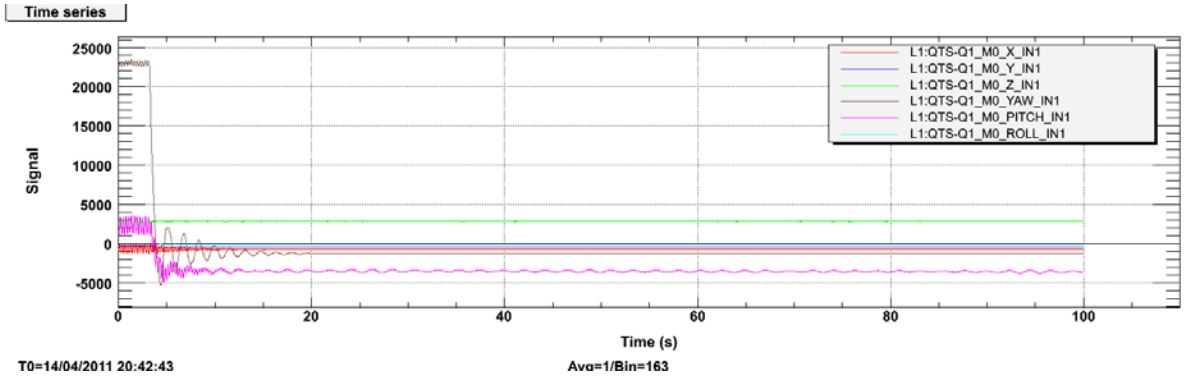

Figure 10 YYYY-MM-DD-HHMM-M0-yawSD

3.12.2 R0 Servo Damping:

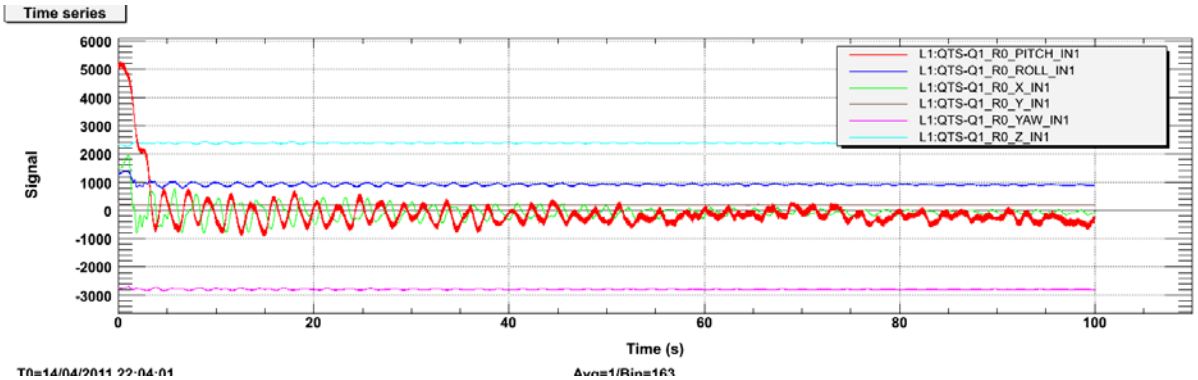

Figure 11 YYYY-MM-DD-HHMM-R0-xSD

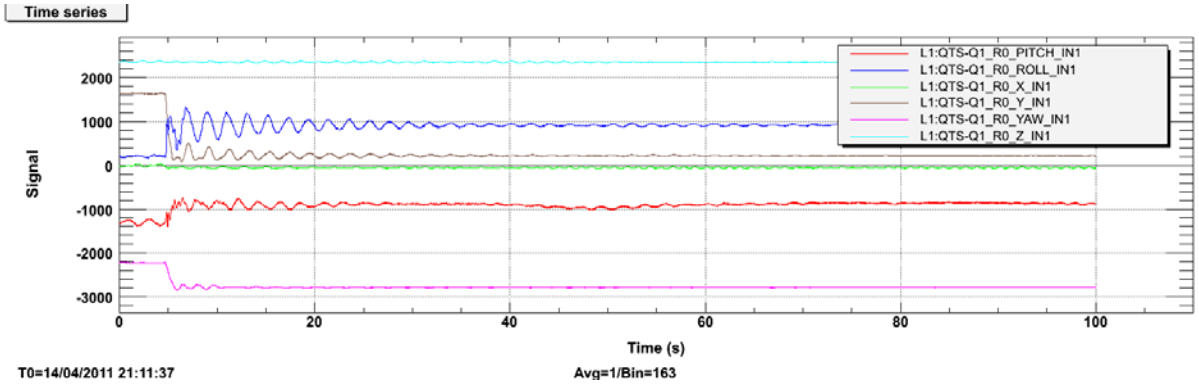

Figure 12 YYYY-MM-DD-HHMM-R0-ySD

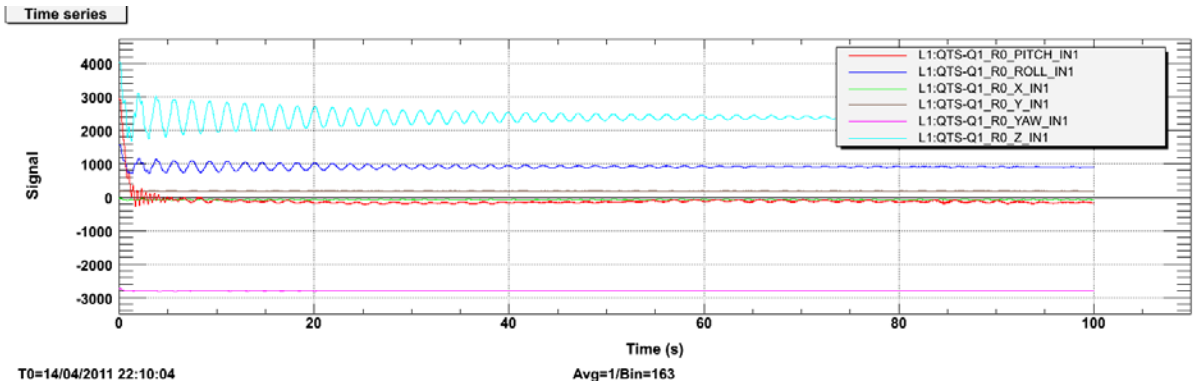

Figure 13 YYYY-MM-DD-HHMM-R0-zSD

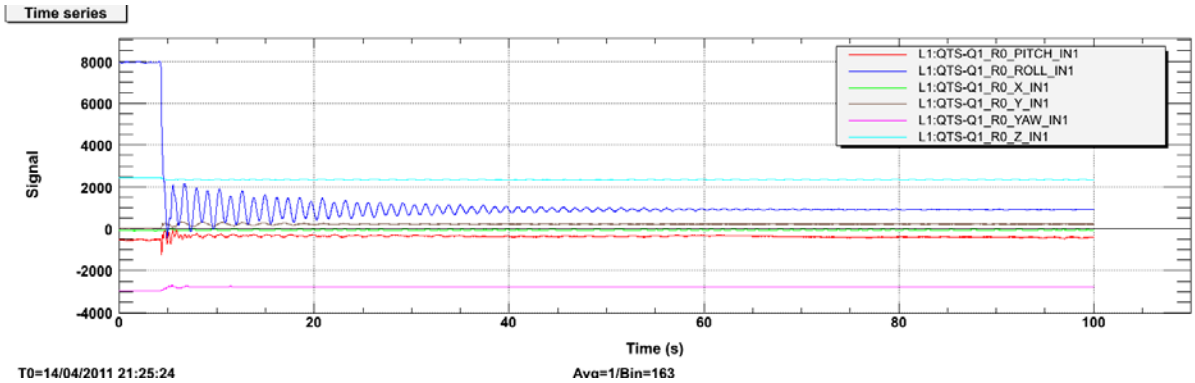

Figure 14 YYYY-MM-DD-HHMM-R0-rollSD

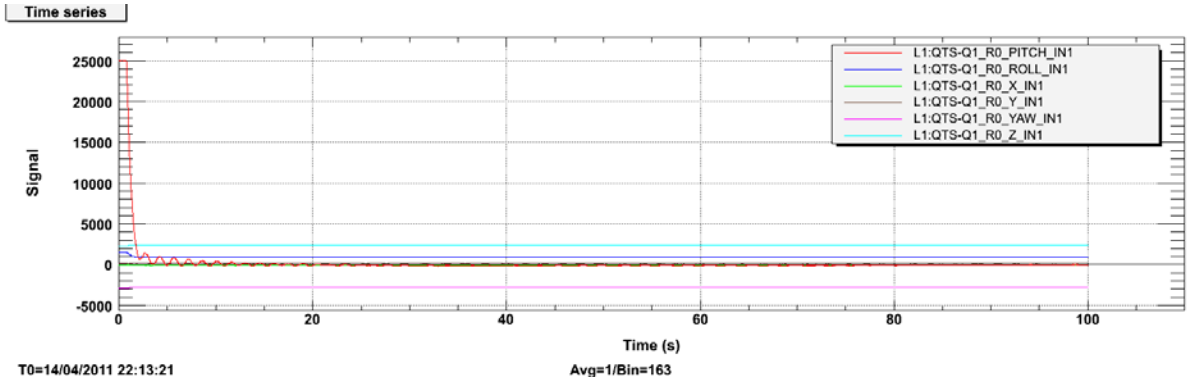

Figure 15 YYYY-MM-DD-HHMM-R0-pitchSD

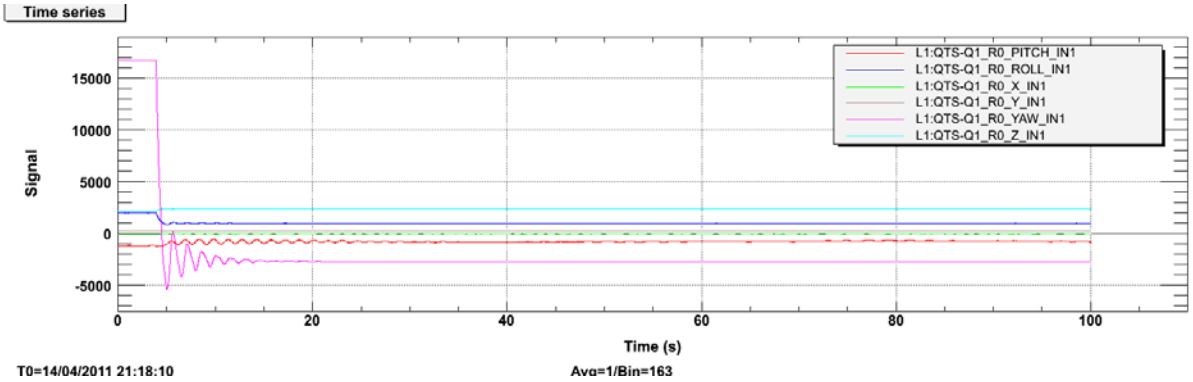

Figure 16 YYYY-MM-DD-HHMM-R0-yawSD

Include XML copies of each DOF on both chains on SVN and in a compressed directory on DCC.

3.13 Transfer Function Tests

/ligo/svncommon/SusSVN/sus/trunk/QUAD/Xnn/QUADnn/BUILDnn/SAGM0/DATA

/ligo/svncommon/SusSVN/sus/trunk/QUAD/Xnn/QUADnn/BUILDnn/SAGR0/DATA

3.13.1 MO TF

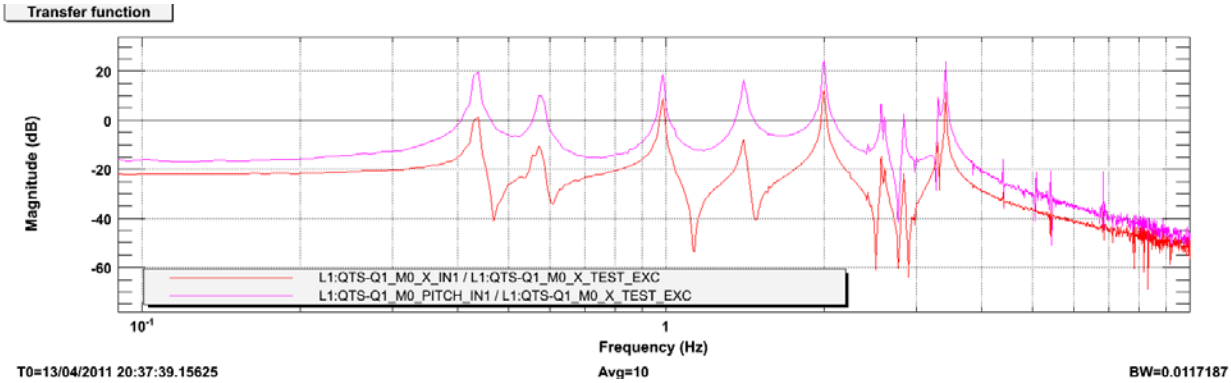

Figure 17 YYYY-MM-DD-HHMM-M0-xTF

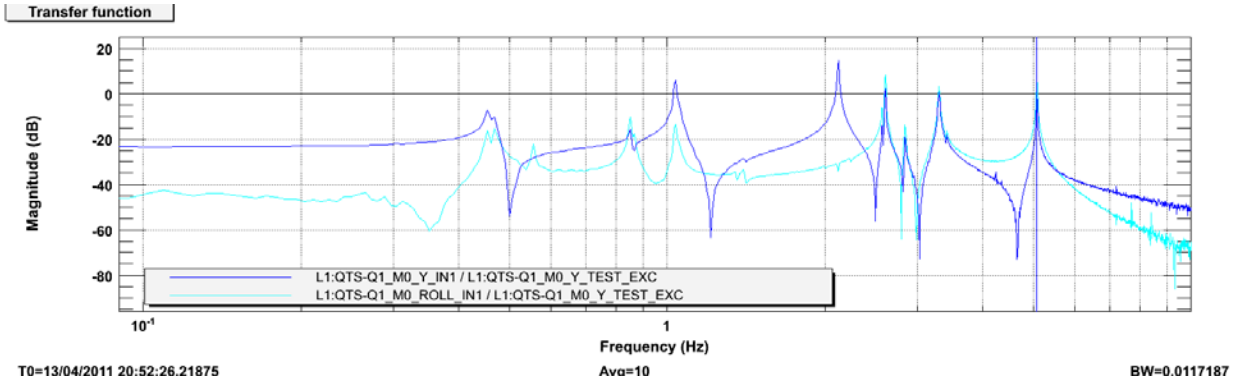

Figure 18 YYYY-MM-DD-HHMM-M0-yTF

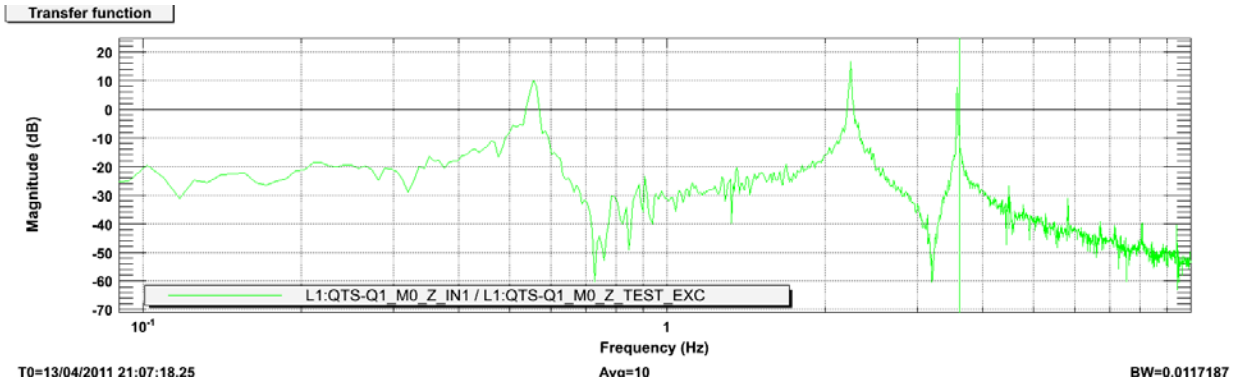

Figure 19 YYYY-MM-DD-HHMM-M0-zTF

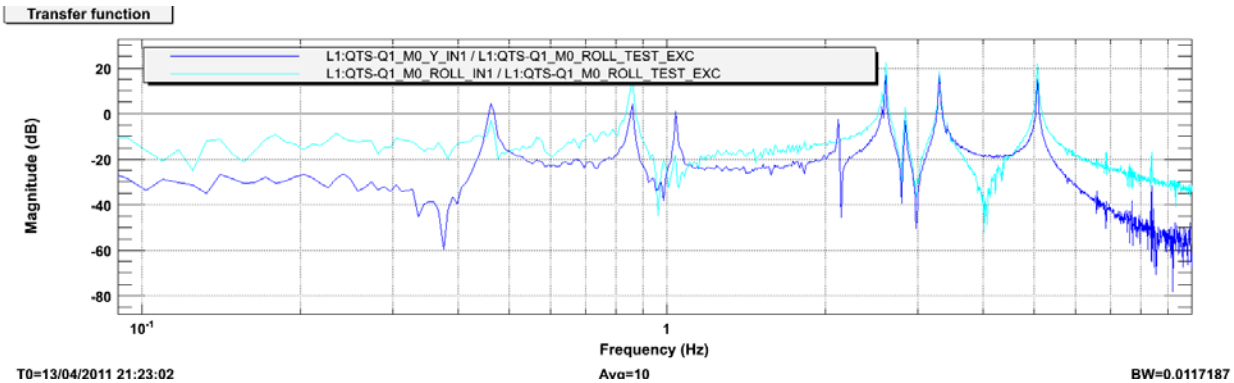

Figure 20 YYYY-MM-DD-HHMM-M0-rollTF

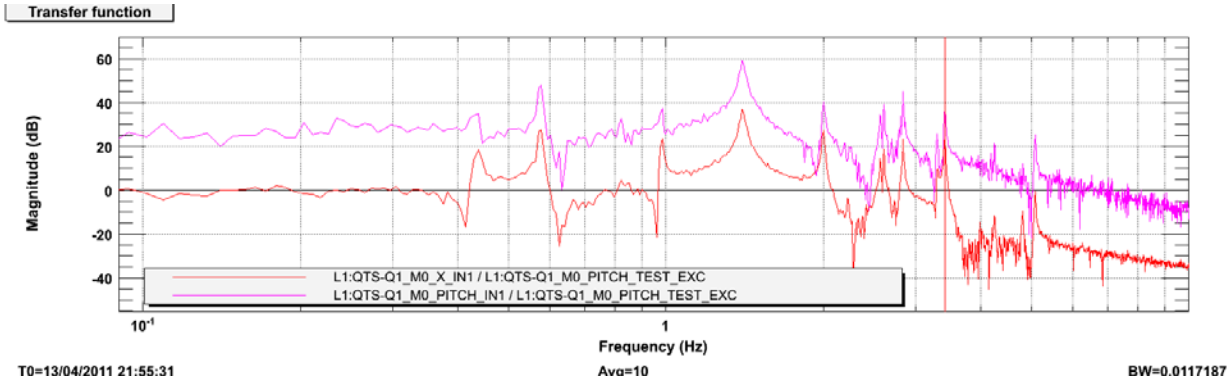

Figure 21 YYYY-MM-DD-HHMM-M0-pitchTF

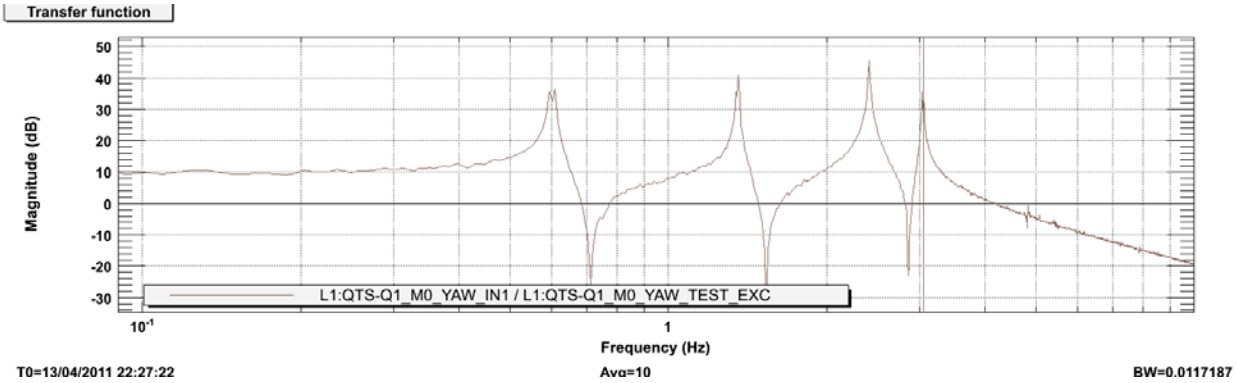

Figure 22 YYYY-MM-DD-HHMM-M0-yawTF

3.13.2 R0 TF

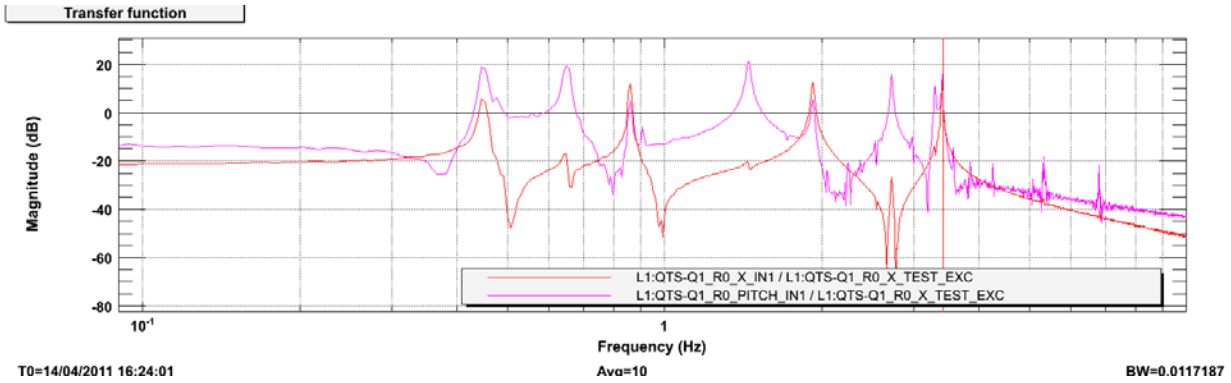

Figure 23 YYYY-MM-DD-HHMM-R0-xTF

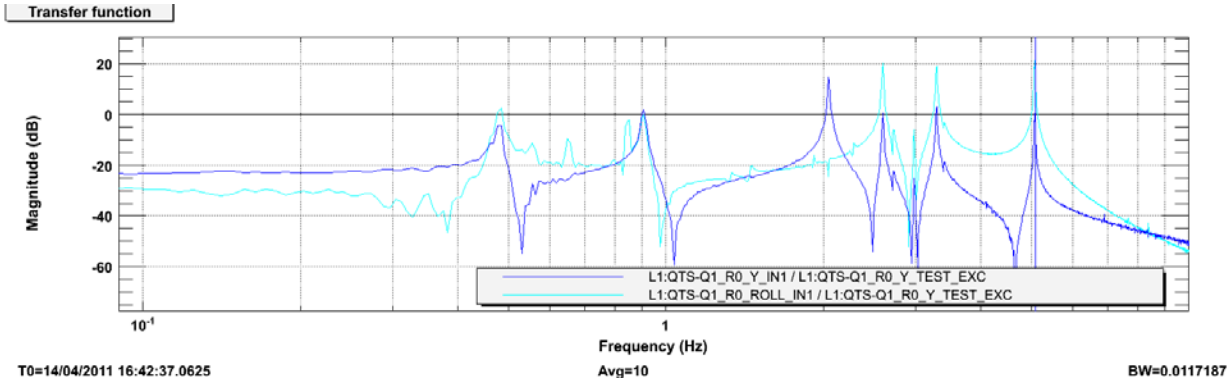

Figure 24 YYYY-MM-DD-HHMM-R0-yTF

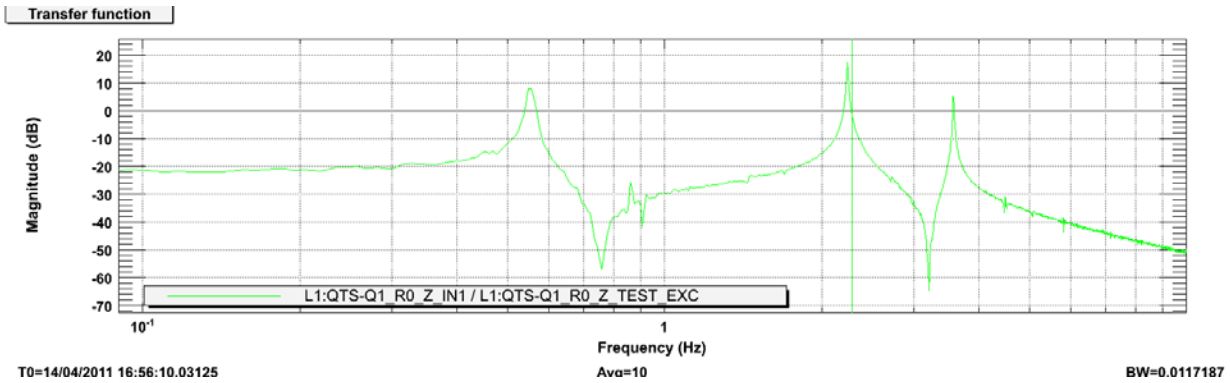

Figure 25 YYYY-MM-DD-HHMM-R0-zTF

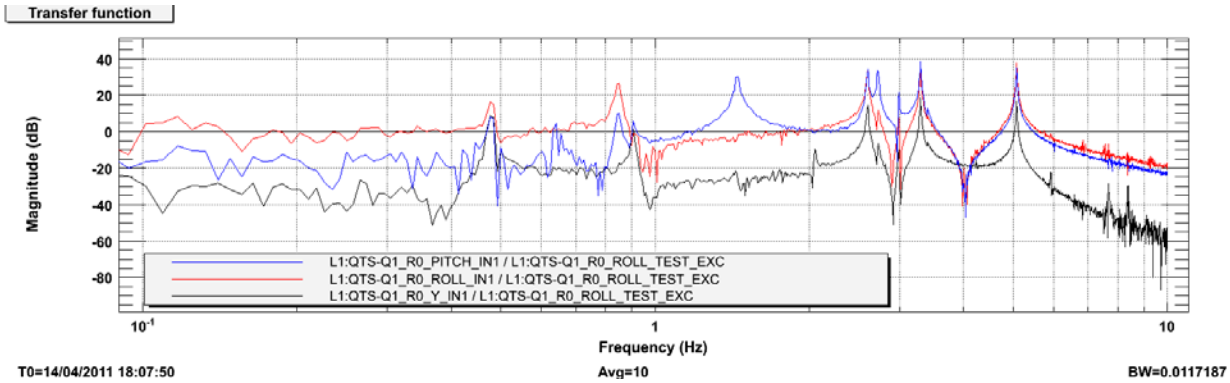

Figure 26 YYYY-MM-DD-HHMM-R0-rollTF

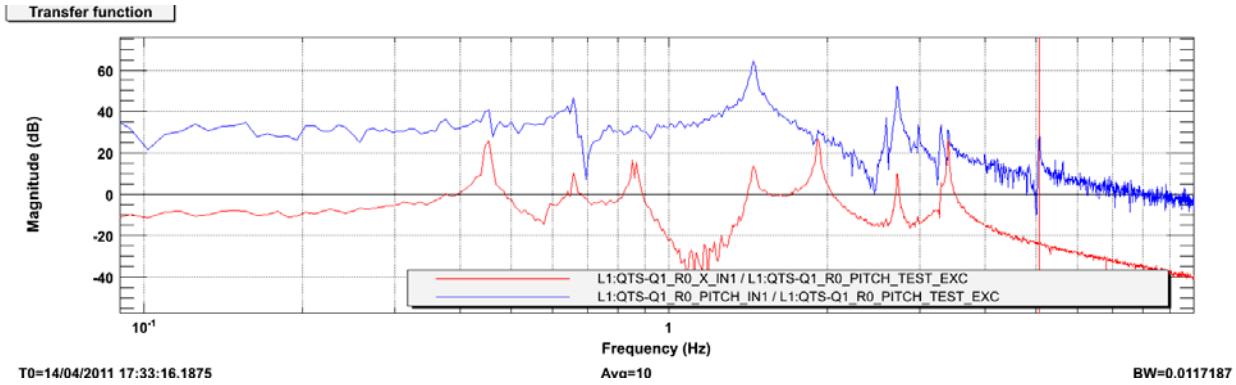

Figure 27 YYYY-MM-DD-HHMM-R0-pitchTF

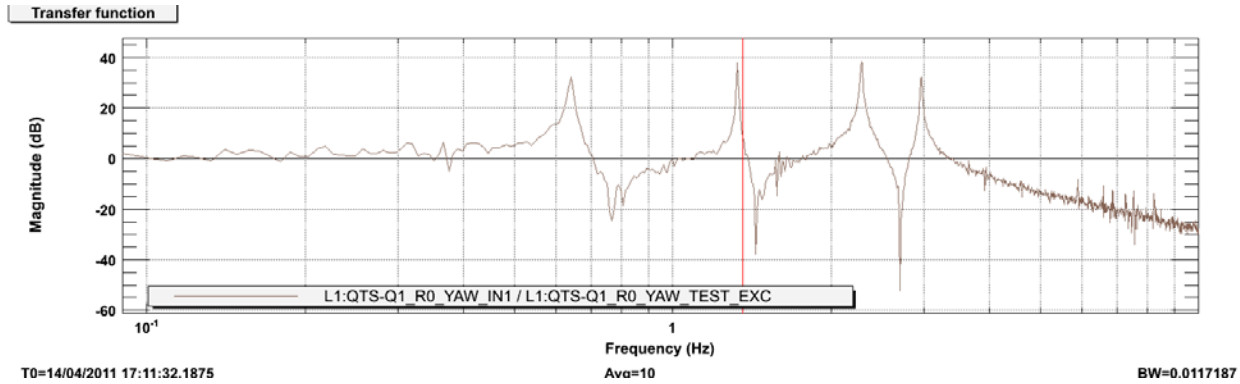

Figure 28 YYYY-MM-DD-HHMM-R0-yawTF

Imbed an XML copy of the transfer function results for each DOF on SVN and in a compressed directory on the DCC.

- Include Quad Specific version of F1100006 aLIGO SUS Quad Transfer Function Modes spread sheet with TF peaks for all DOF.

  Note: Correct (4 for yaw, 3 for vertical, 8 for longitudinal/pitch and 7 for transverse/roll).

- Fundamental pitch mode is above the fundamental pendulum mode?

3.14 Range Tests

3.14.1 Pitch

	+Pitch (mRad)	-Pitch (mRad)
M0		
R0		

3.14.2 Yaw

	+Yaw (mRad)	-Yaw (mRad)
M0		
R0		

3.15 Post-ECD TF

/ligo/svncommon/SusSVN/sus/trunk/QUAD/Xnn/QUADnn/BUILDnn/SAGM0/DATA

/ligo/svncommon/SusSVN/sus/trunk/QUAD/Xnn/QUADnn/BUILDnn/SAGR0/DATA

3.15.1 M0 Post-ECD TF

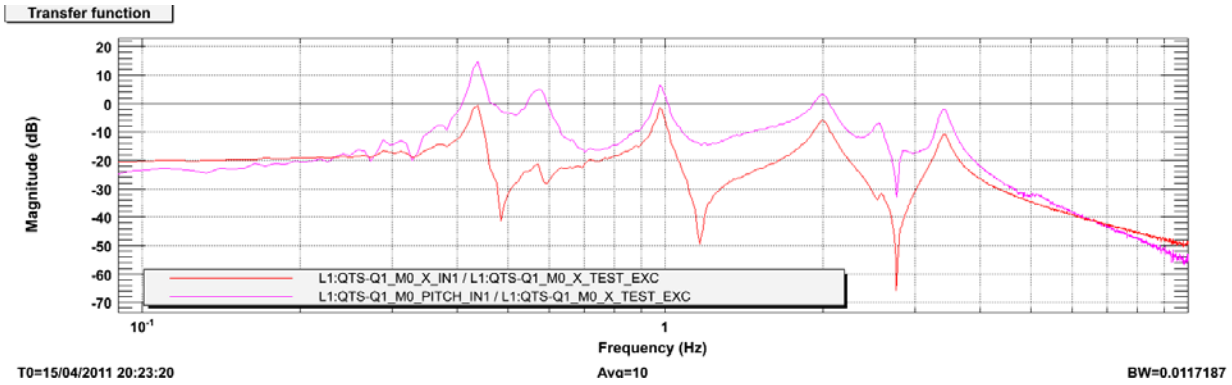

Figure 29 YYYY-MM-DD-HHMM-M0-xTF-pECD

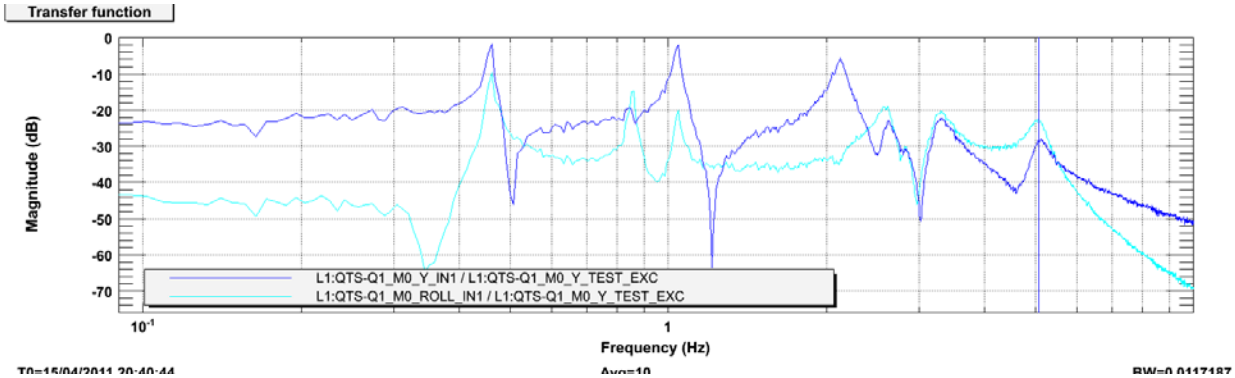

Figure 30 YYYY-MM-DD-HHMM-M0-yTF-pECD

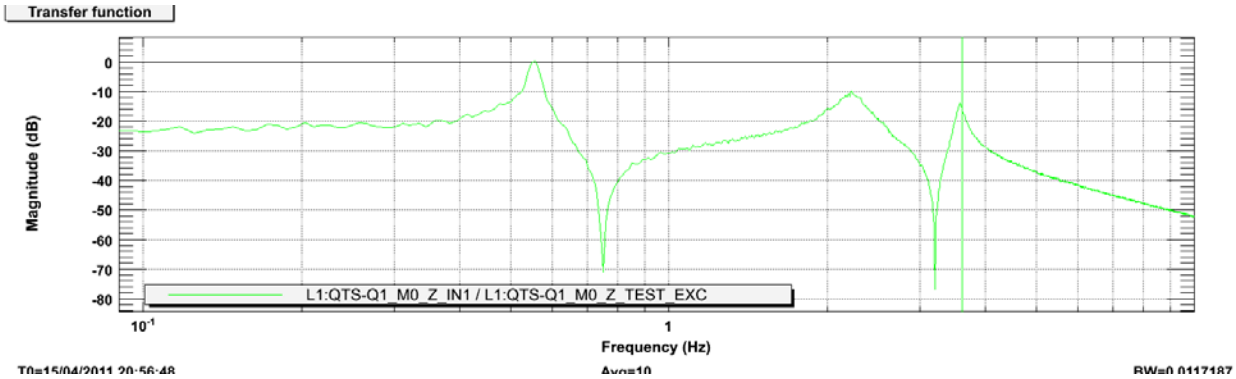

Figure 31 YYYY-MM-DD-HHMM-M0-zTF-pECD

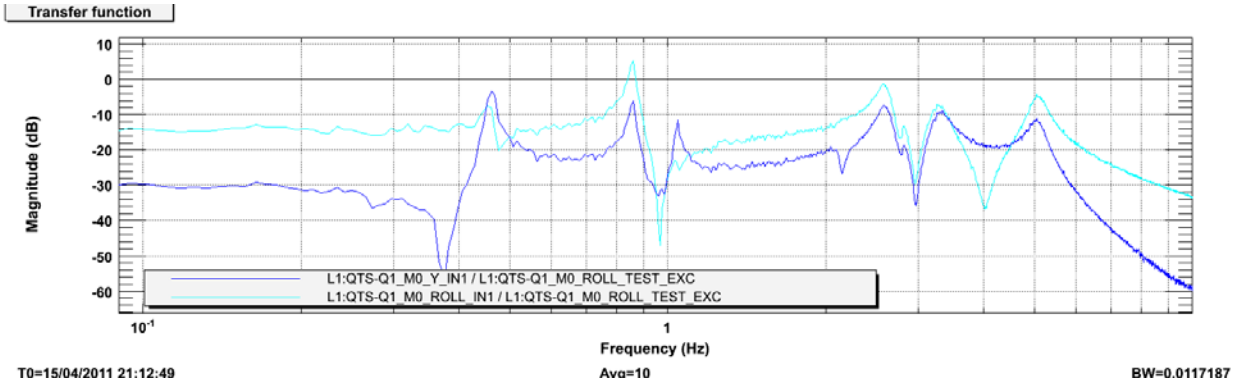

Figure 32 YYYY-MM-DD-HHMM-M0-rollTF-pECD

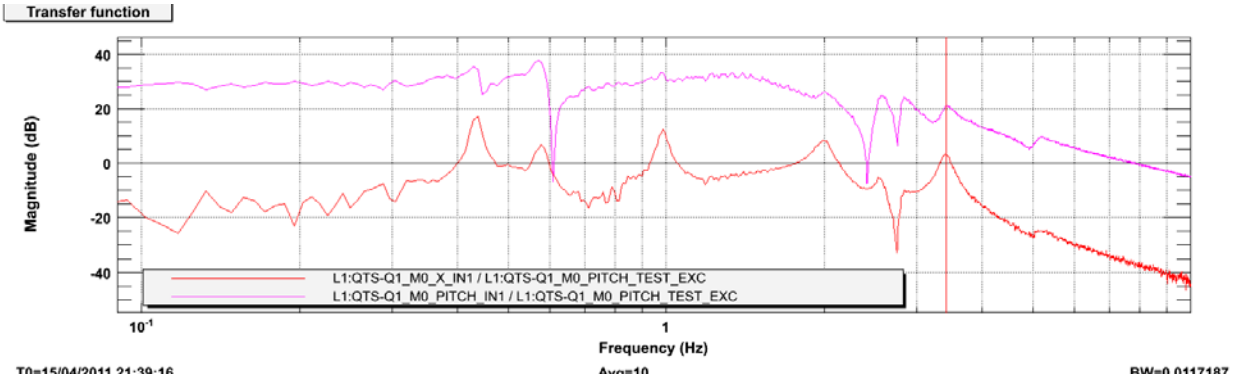

Figure 33 YYYY-MM-DD-HHMM-M0-pitchTF-pECD

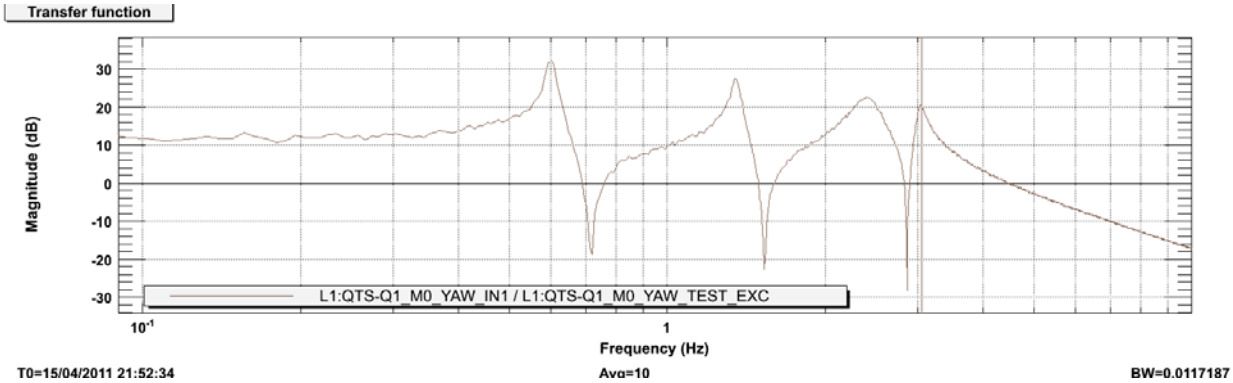

Figure 34 YYYY-MM-DD-HHMM-M0-yawTF-pECD

3.15.2 R0 Post-ECD TF

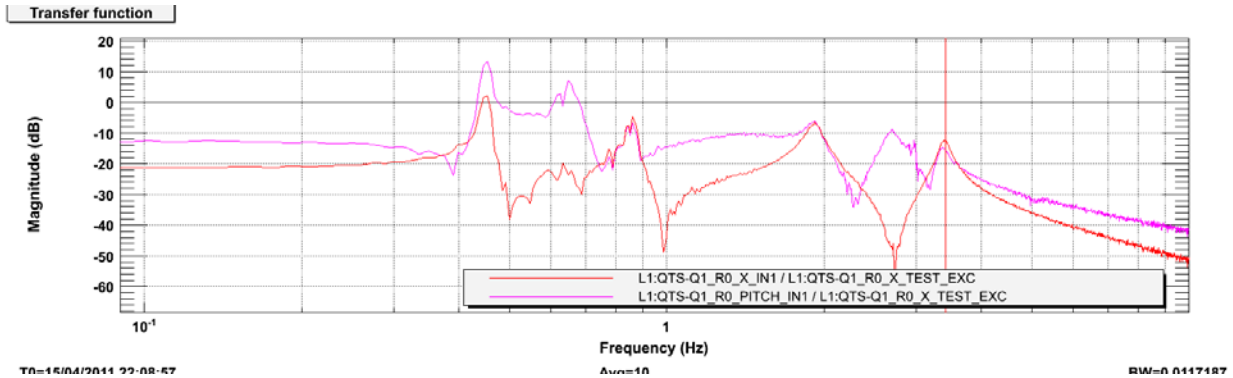

Figure 35 YYYY-MM-DD-HHMM-R0-xTF-pECD

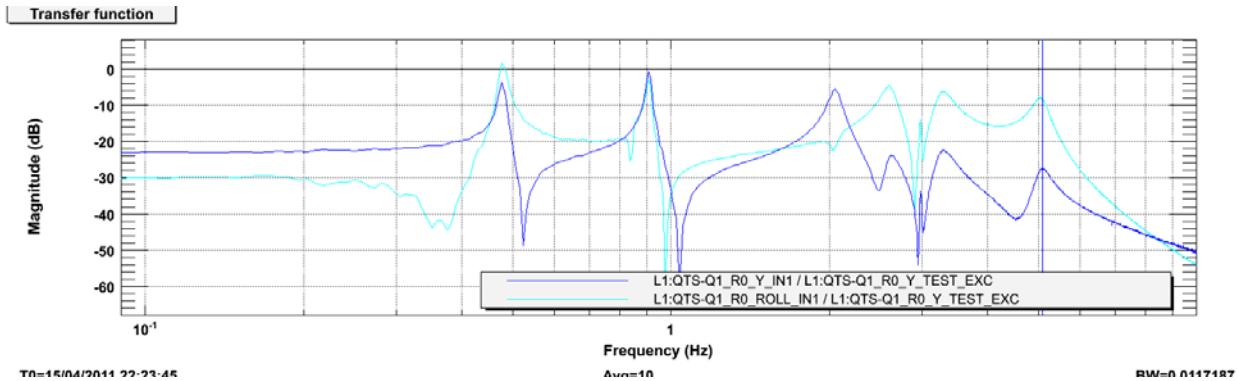

Figure 36 YYYY-MM-DD-HHMM-R0-yTF-pECD

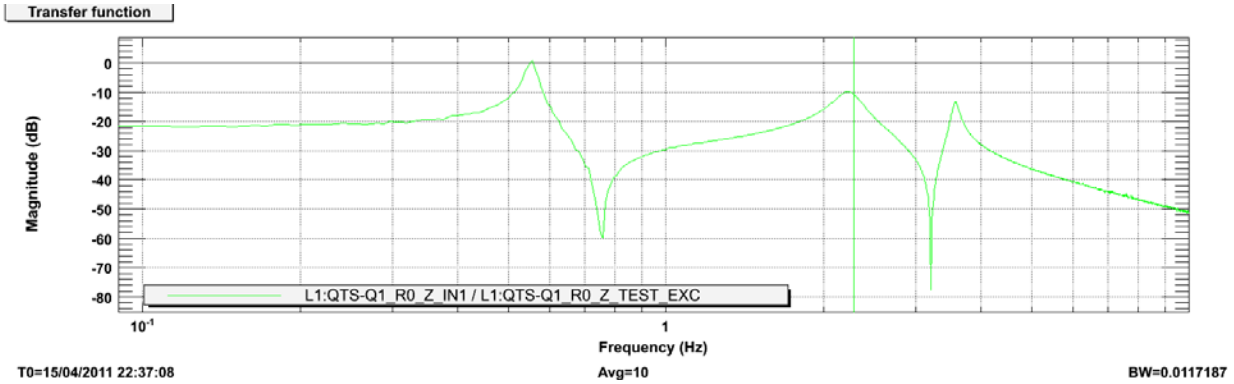

Figure 37 YYYY-MM-DD-HHMM-R0-zTF-pECD

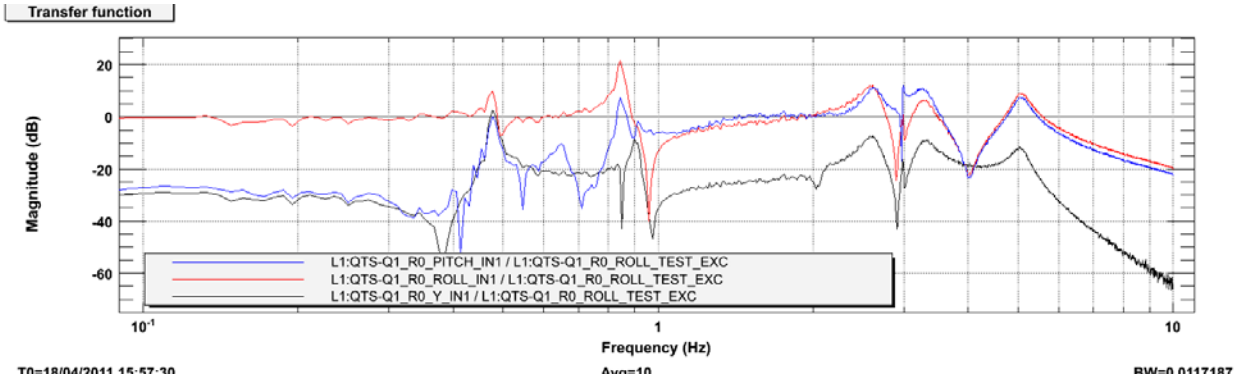

Figure 38 YYYY-MM-DD-HHMM-R0-rollTF-pECD

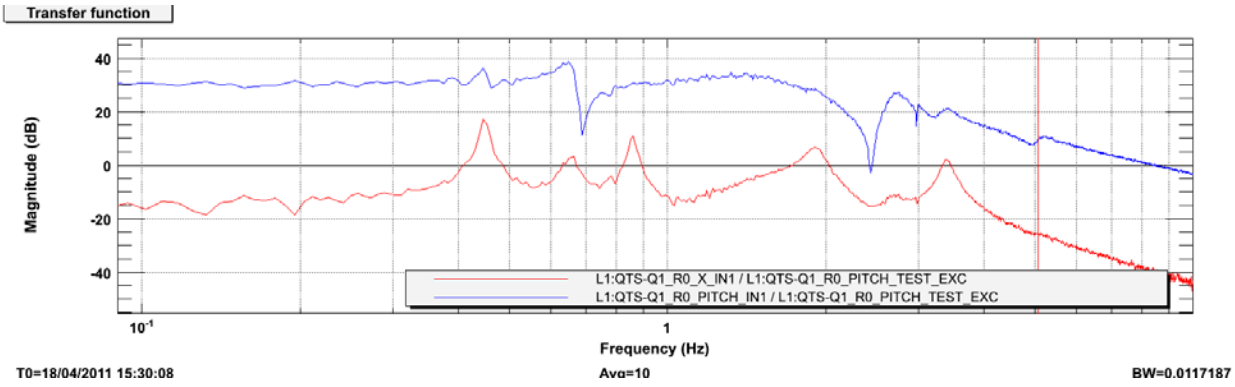

Figure 39 YYYY-MM-DD-HHMM-Ro-pitchTF-pECD

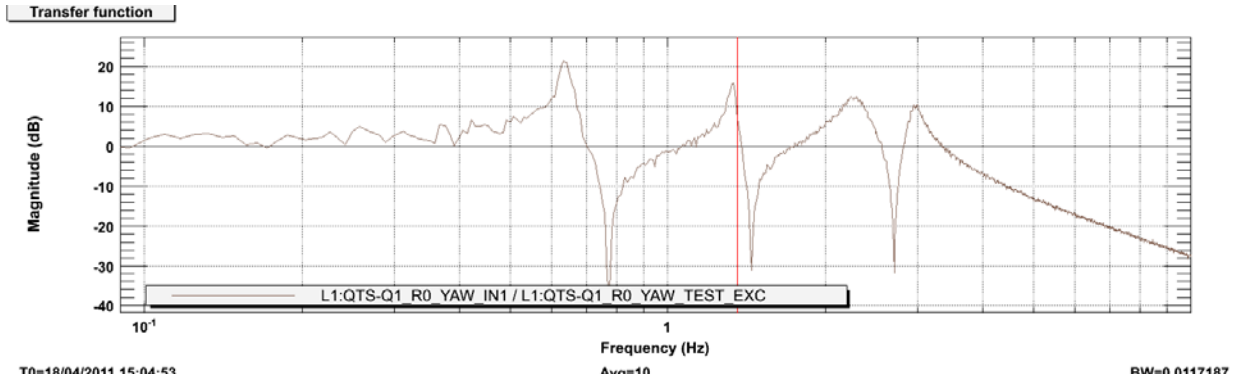

Figure 40 YYYY-MM-DD-HHMM-R0-yawTF-pECD