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aLIGO SUS Quad Metal-Build Test Report Template

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http://www.ligo.caltech.edu/

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# Introduction

## 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.

## References

[D080273](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=9268): AdL SUS BSC Test Stand Wiring

[E1000006](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=8382): aLIGO Quad Suspension Metal-Build Assembly Procedure

[E1000494](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=21686): aLIGO SUS Quad Suspension Metal-Build Testing Procedure

[E1000495](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=21692): [aLIGO SUS Quad Suspension Testing and Commissioning Documentation](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=21692)

[E1000502](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=21711): aLIGO SUS Test Stand Shakedown Procedure

[E1000516](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=21761): aLIGO SUS Quad Suspension Assembly Process Travelers

[E1000517](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=21763): aLIGO SUS Quad Suspension Metal Build Test Reports

[E1000520](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=21796): aLIGO SUS Quad Suspension Monolithic Build Testing Procedure

[F1000008](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=11033): Quad Suspension Process Traveler Template

[F1100006](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=59600): aLIGO SUS Quad Transfer Function Modes Template

[M1000211](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=13964): Subsystem-Level and System-Level Testing Requirements

[T010007](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=127): Cavity Optics Suspension Subsystem Design Requirements Document

[T010103](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=10810): Advanced LIGO Suspension System Conceptual Design

[T1000238](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=11325): Quad Suspension AdvLIGO Test Plan (Obsolete)

[T1100117](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=39202): aLIGO SUS File/Directory Naming Convention

## Revision History

3/2/2011 pre-version 1

## 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

# Traveler

Quad: N Traveler Number: E1000XXX

# Tests

## 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 In-Vacuum Cabling Tests

## 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 |  | Location | BOSEM S/N |  | Location | | BOSEM S/N |  | Location | AOSEM S/N |
| M0 Face1 |  |  | R0 Face1 |  |  | UI UL | |  |  | PEN UL |  |
| M0 Face2 |  |  | R0 Face2 |  |  | UI UR | |  |  | PEN UR |  |
| M0 Face3 |  |  | R0 Face3 |  |  | UI LL | |  |  | PEN LL |  |
| M0 Left |  |  | R0 Left |  |  | UI LR | |  |  | PEN LR |  |
| M0 Right |  |  | R0 Right |  |  |  |
| M0 Side |  |  | R0 Side |  |  |  |

Table OSEM Location and S/N

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| M0 | White Count | Offset | Gain |  | R0 | White Count | Offset | Gain |
| F1 |  |  |  |  | F1 |  |  |  |
| F2 |  |  |  |  | F2 |  |  |  |
| F3 |  |  |  |  | F3 |  |  |  |
| Left |  |  |  |  | Left |  |  |  |
| Right |  |  |  |  | Right |  |  |  |
| Side |  |  |  |  | Side |  |  |  |

Table OSEM White Count, Offset, and Gain

## Balancing

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| M0 | Mass (kg) | Height (mm) | Pitch (deg) |  | R0 | Mass (kg) | Height (mm) | Pitch (deg) |
| Top Mass |  |  |  |  | Top Mass |  |  |  |
| UI Mass |  |  |  |  | UI Mass |  |  |  |
| Pen. Mass |  |  |  |  | Pen. Mass |  |  |  |
| Test Mass |  |  |  |  | Test Mass |  |  |  |

Table 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

## OSEM Adjustment

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| M0 | Dark Count |  | R0 | Dark Count |
| F1 |  |  | F1 |  |
| F2 |  |  | F2 |  |
| F3 |  |  | F3 |  |
| Left |  |  | Left |  |
| Right |  |  | Right |  |
| Side |  |  | Side |  |

## 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 |

## DOF Output Tests

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

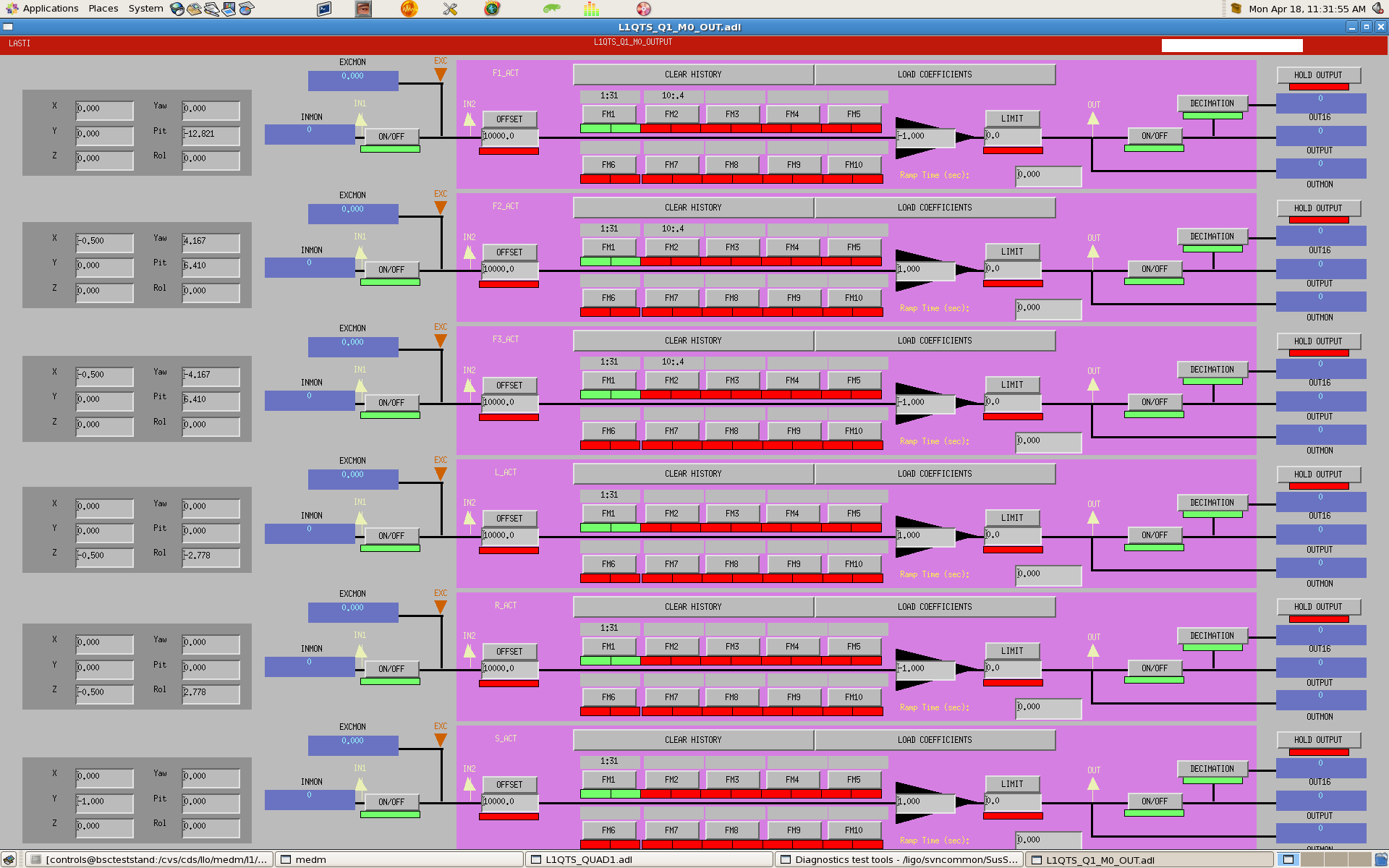


Figure M0 Output Filter

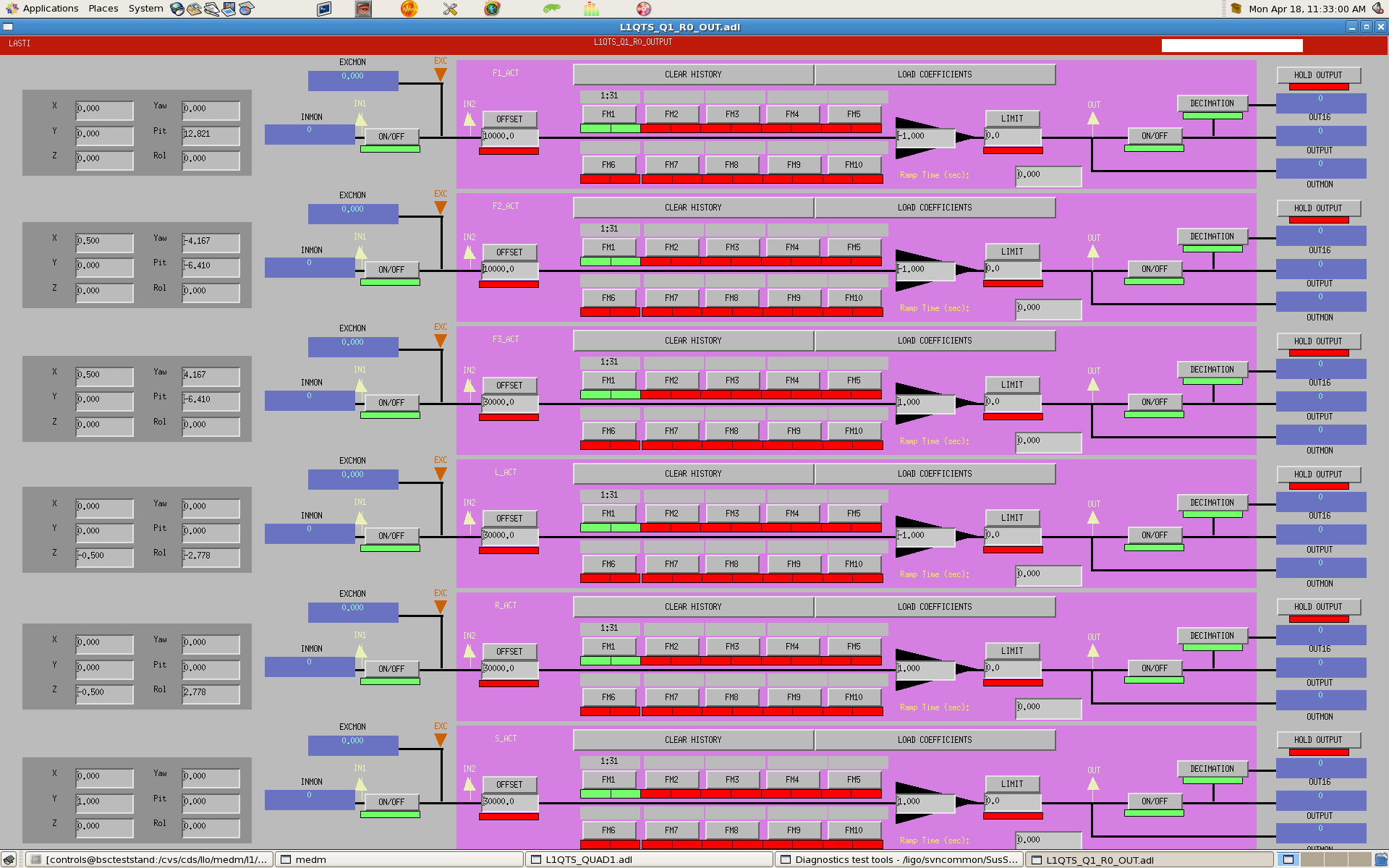


Figure R0 Output Filter

## DOF Input Tests

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

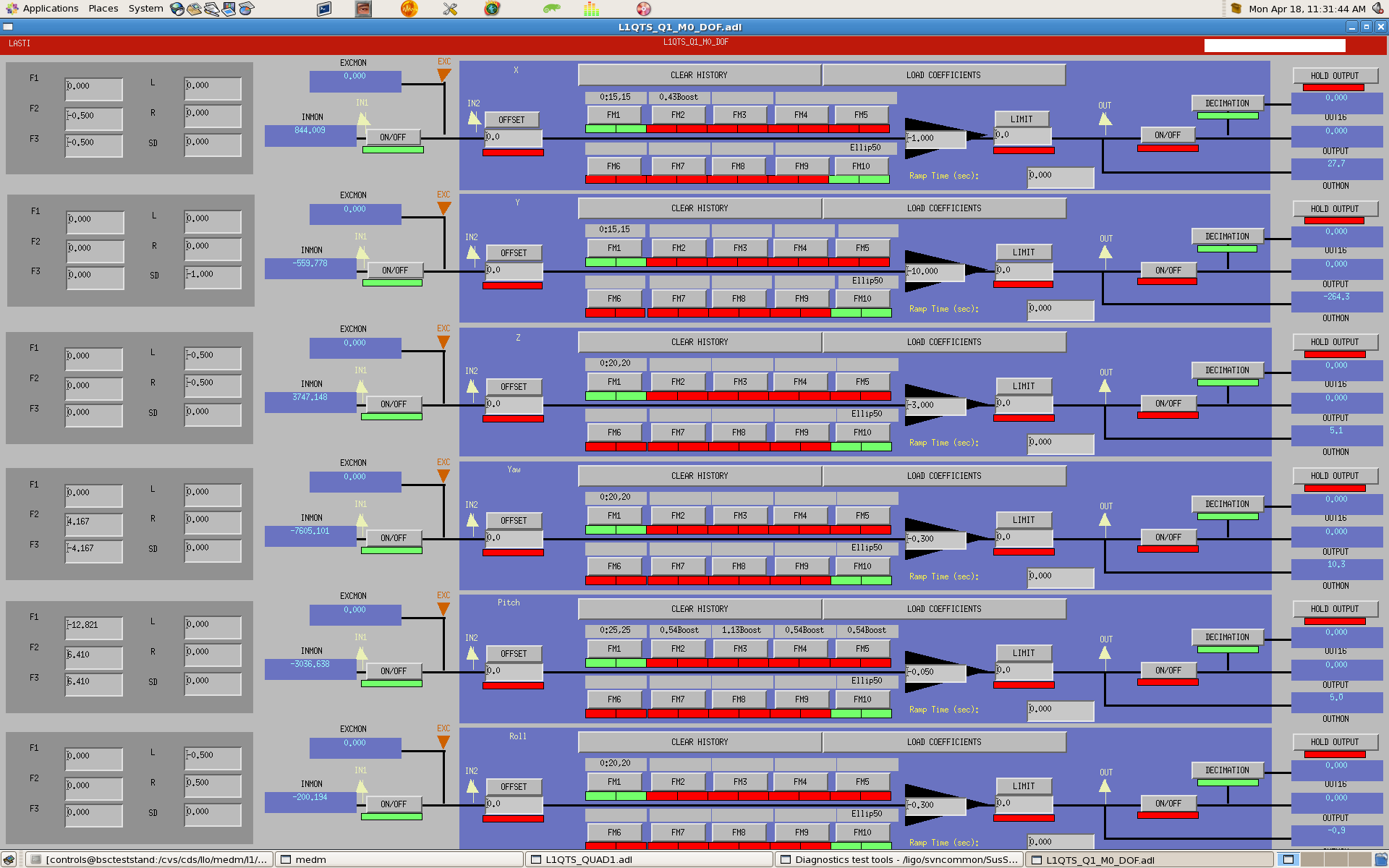


Figure M0 DOF

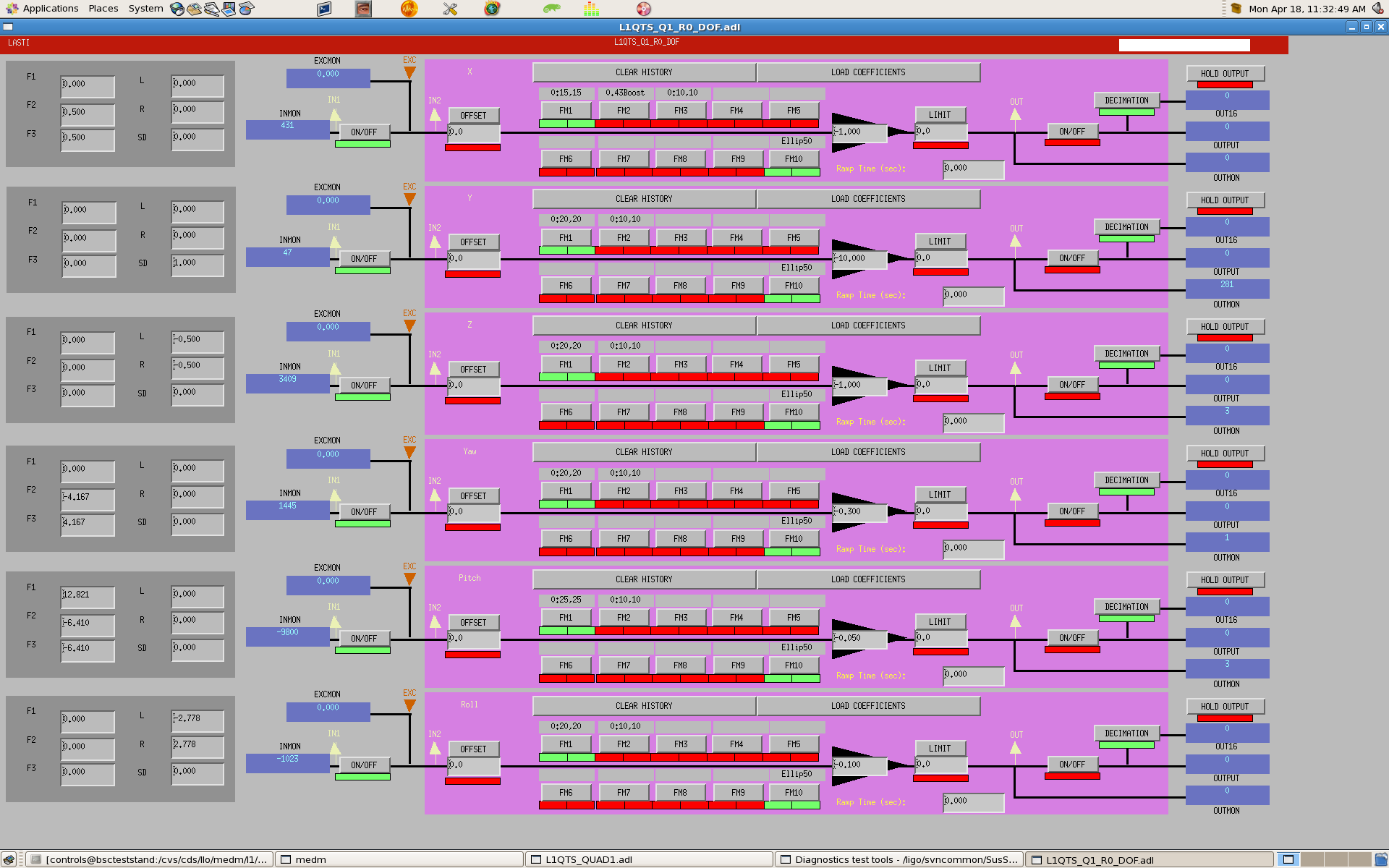


Figure R0 DOF

## DOF Open Loop Tests

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

## 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.)

## 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 |

## DOF Servo Stability Test

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

## 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

### M0 Servo Damping:

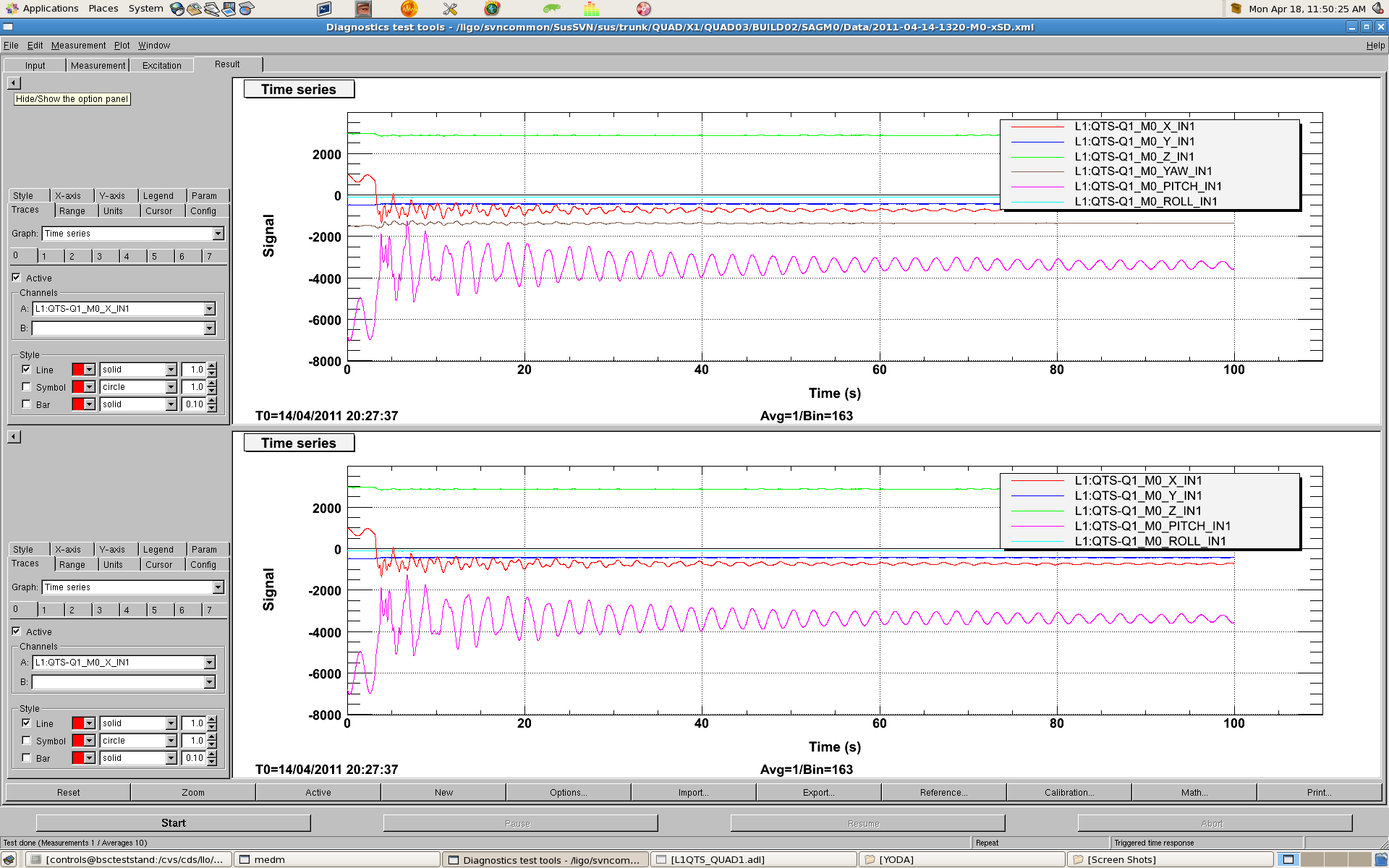


Figure YYYY-MM-DD-HHMM-M0-xSD



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

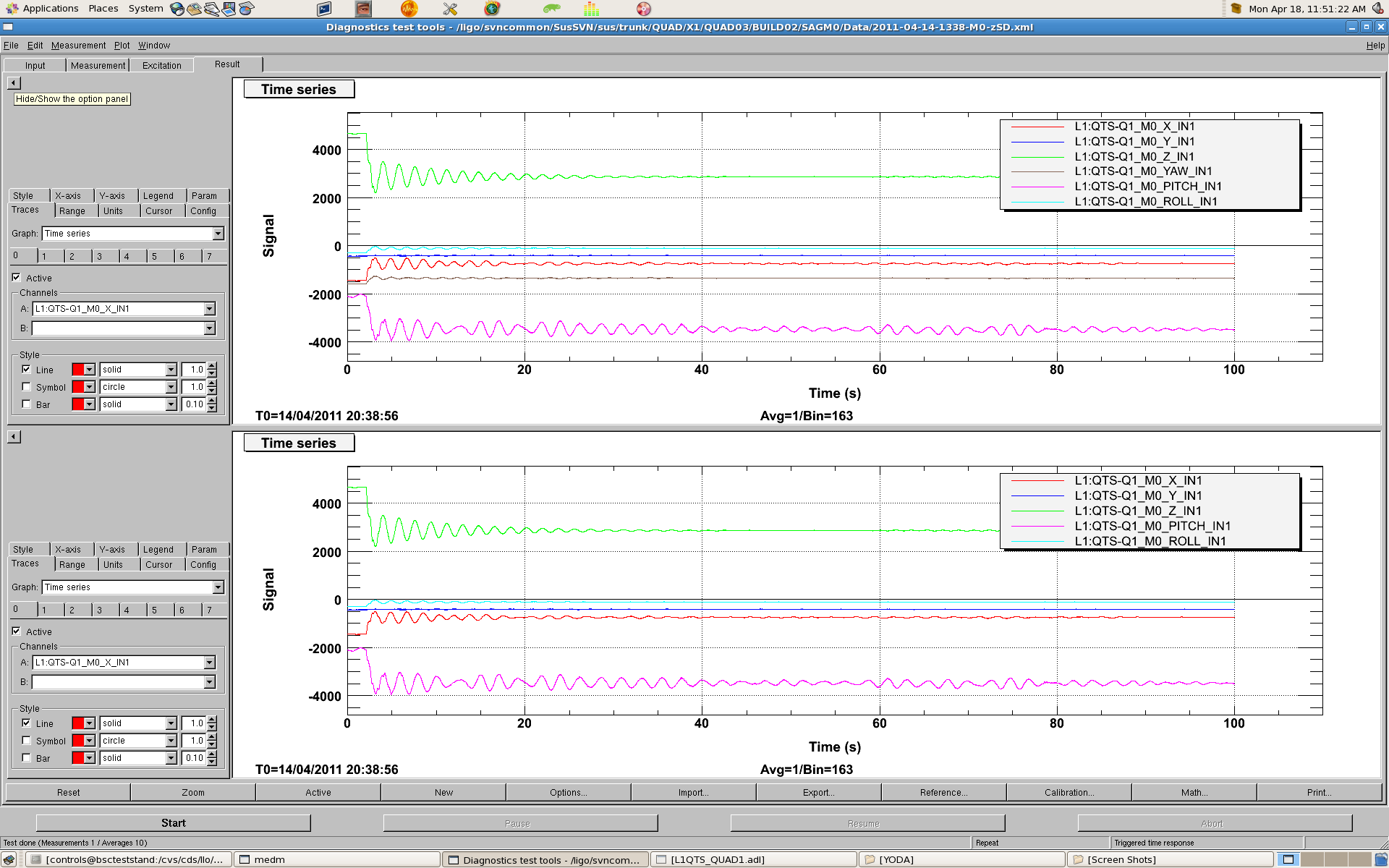


Figure YYYY-MM-DD-HHMM-M0-zSD

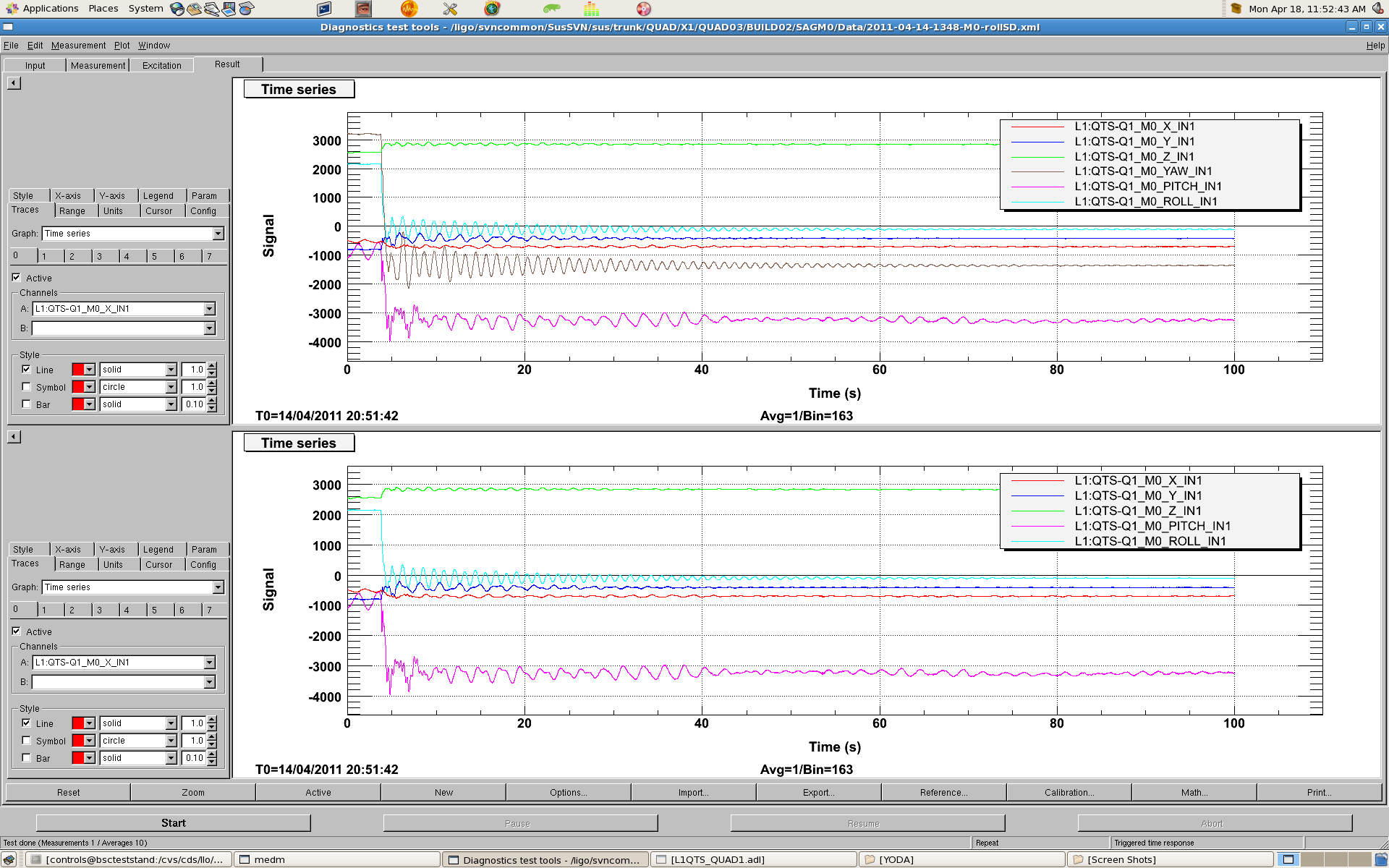
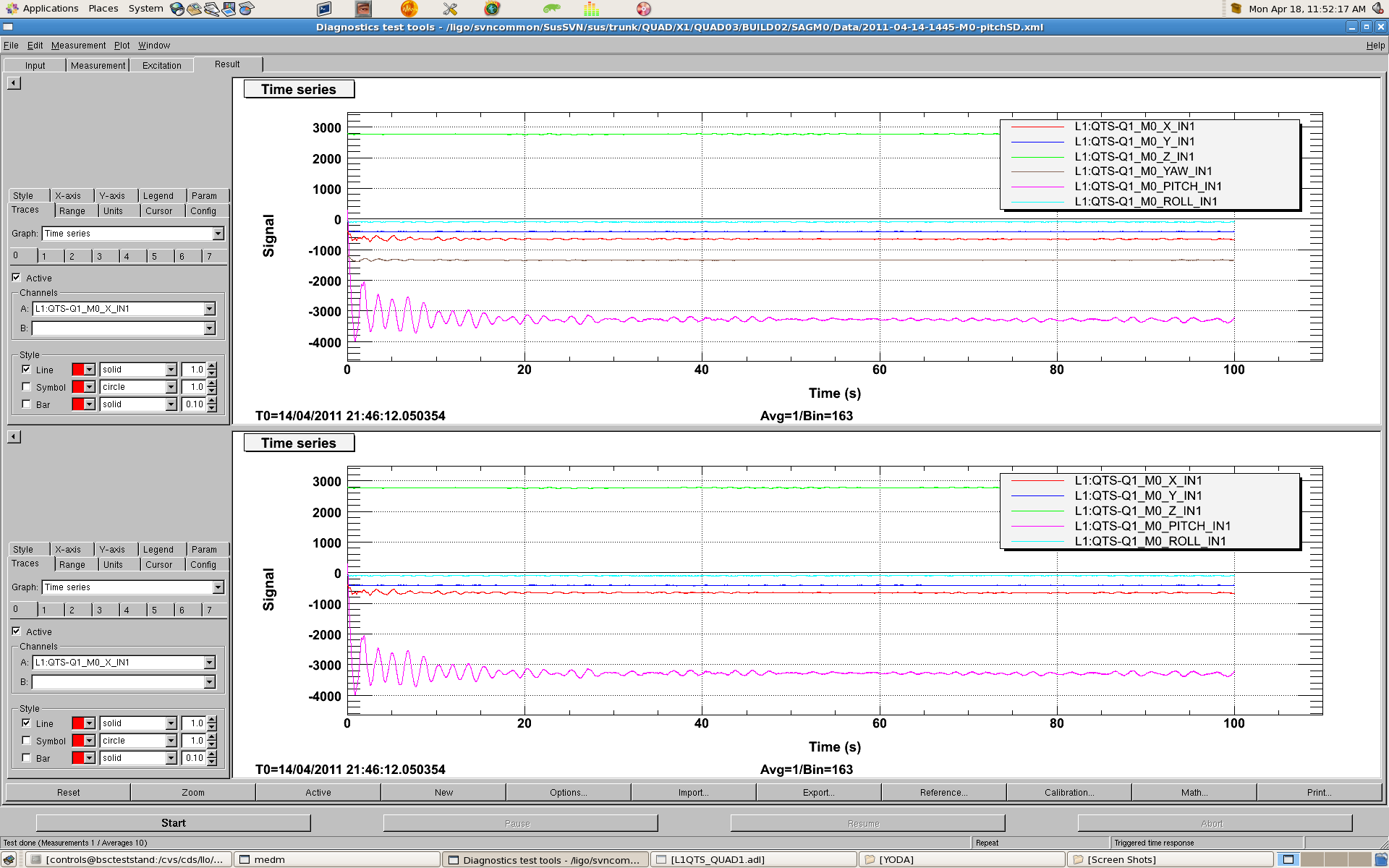


Figure YYYY-MM-DD-HHMM-M0-rollSD

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

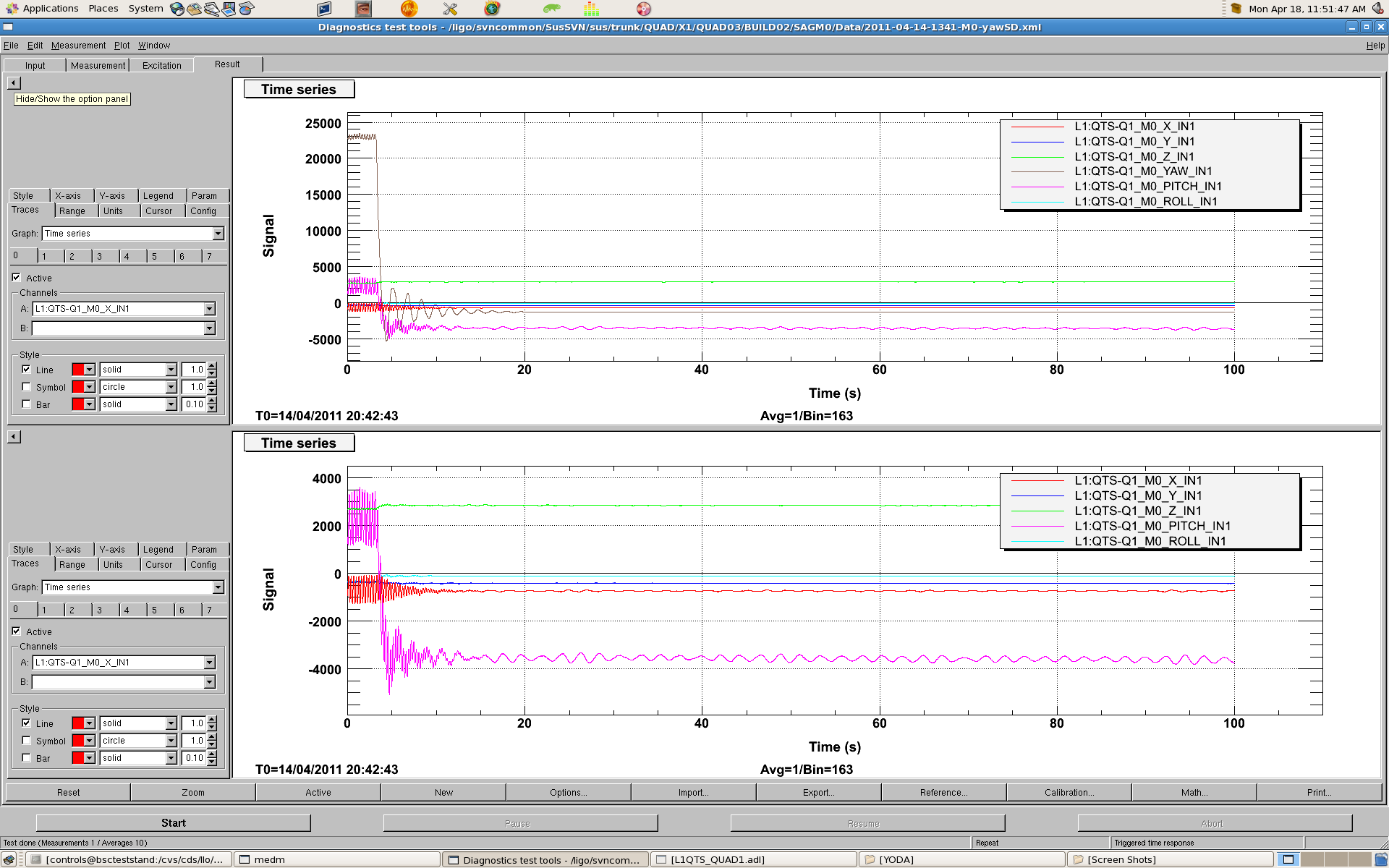


Figure YYYY-MM-DD-HHMM-M0-yawSD

### R0 Servo Damping:

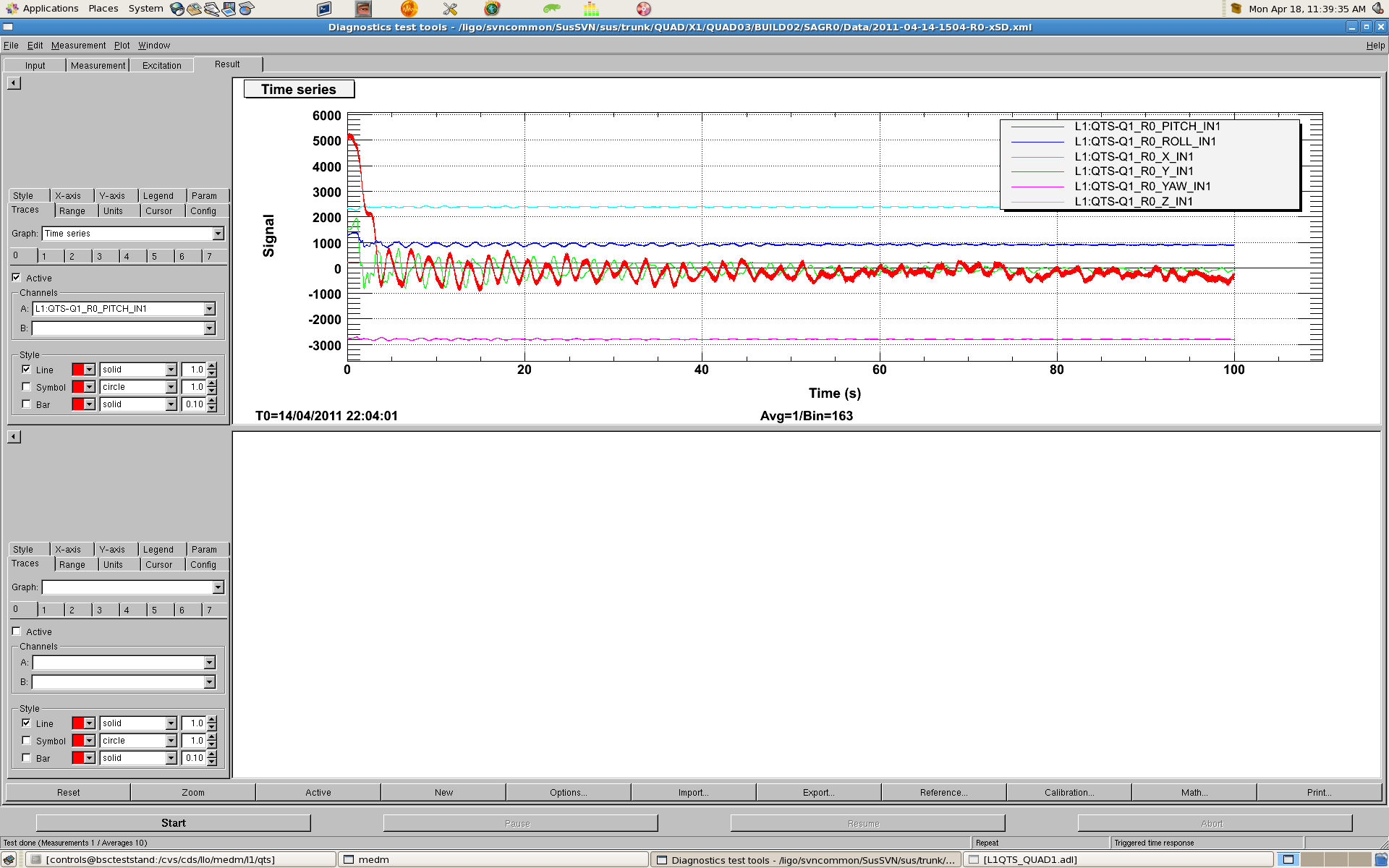


Figure YYYY-MM-DD-HHMM-R0-xSD

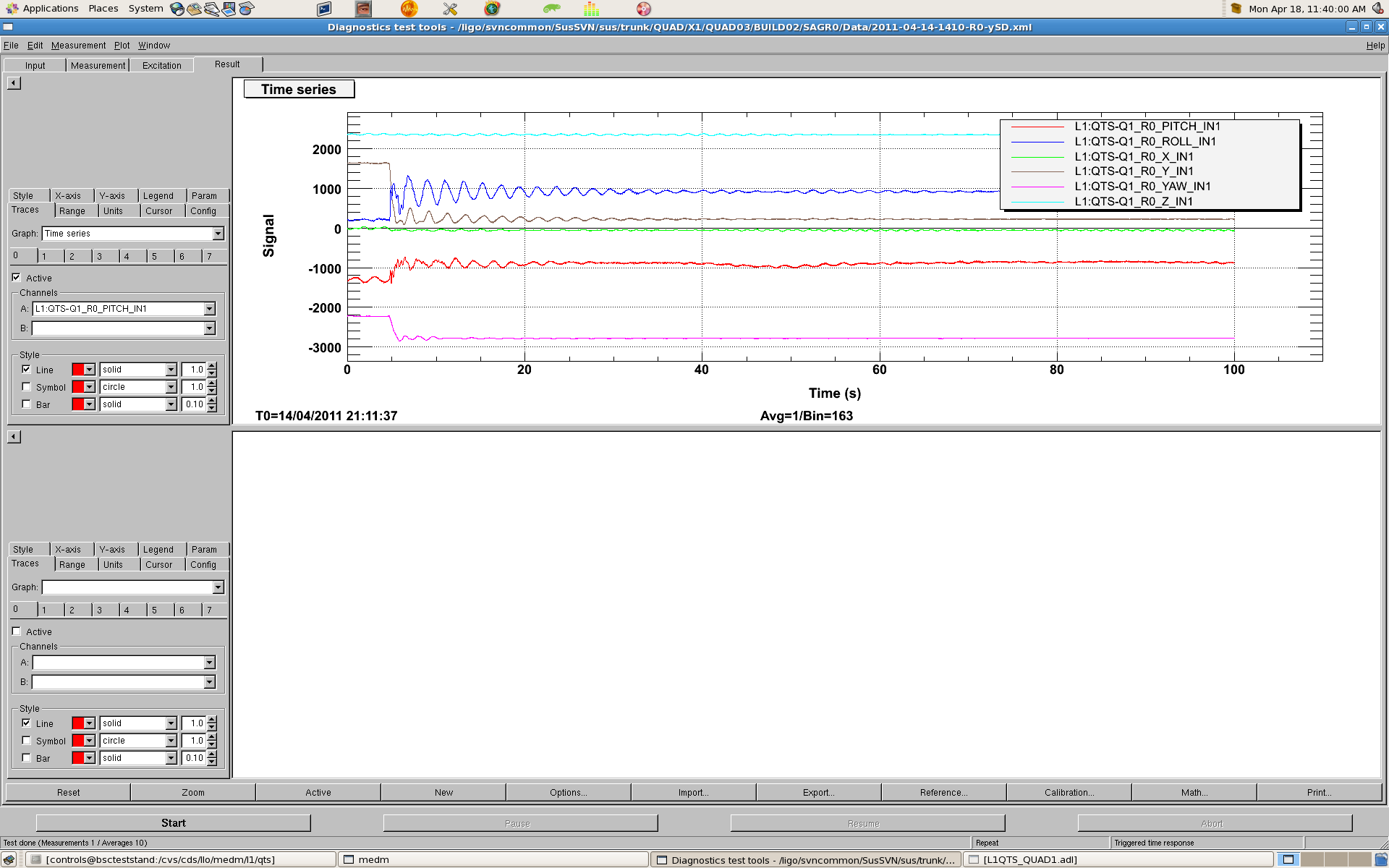
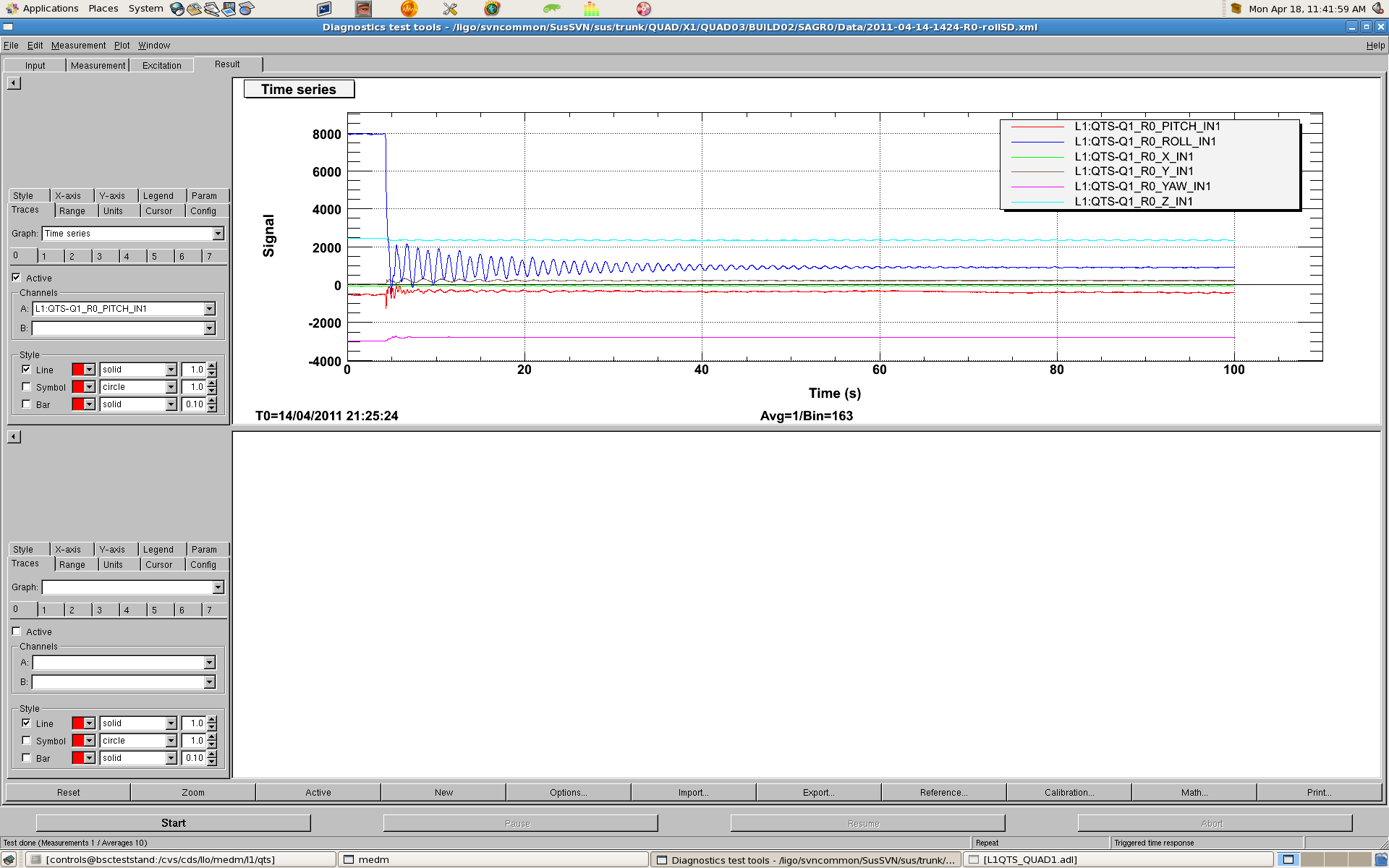


Figure YYYY-MM-DD-HHMM-R0-ySD



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

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

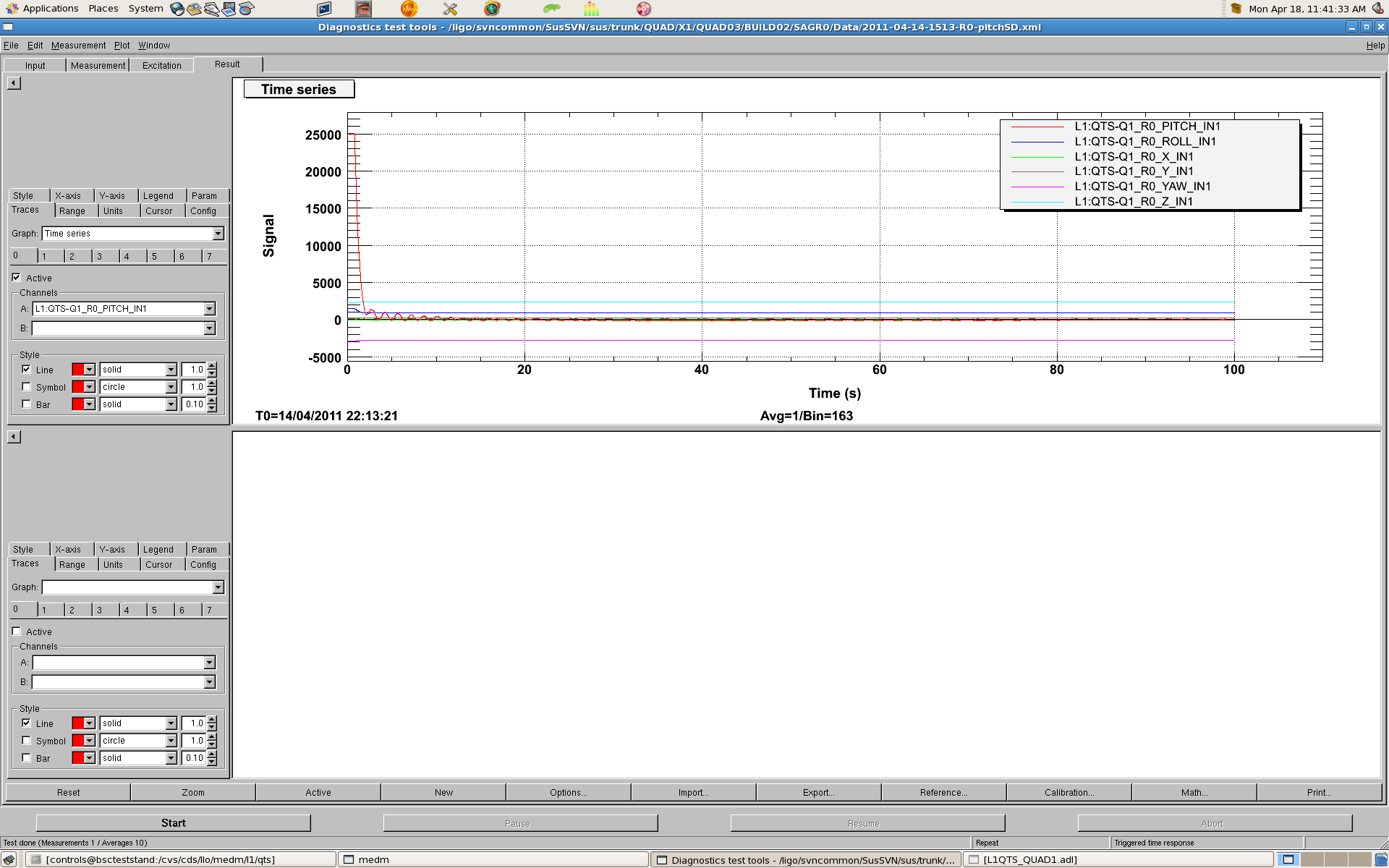


Figure YYYY-MM-DD-HHMM-R0-pitchSD

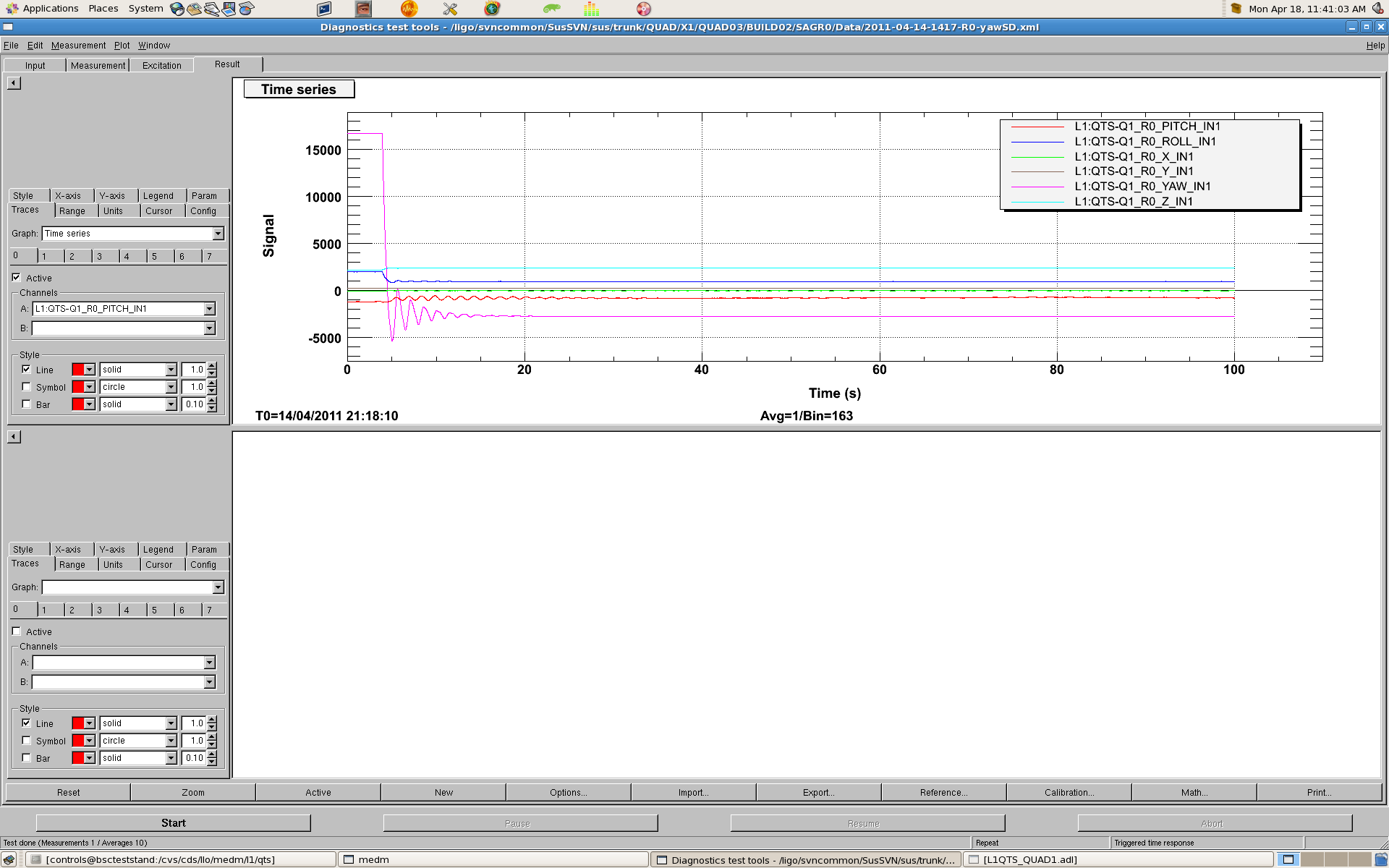


Figure YYYY-MM-DD-HHMM-R0-yawSD

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

## 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

### MO TF

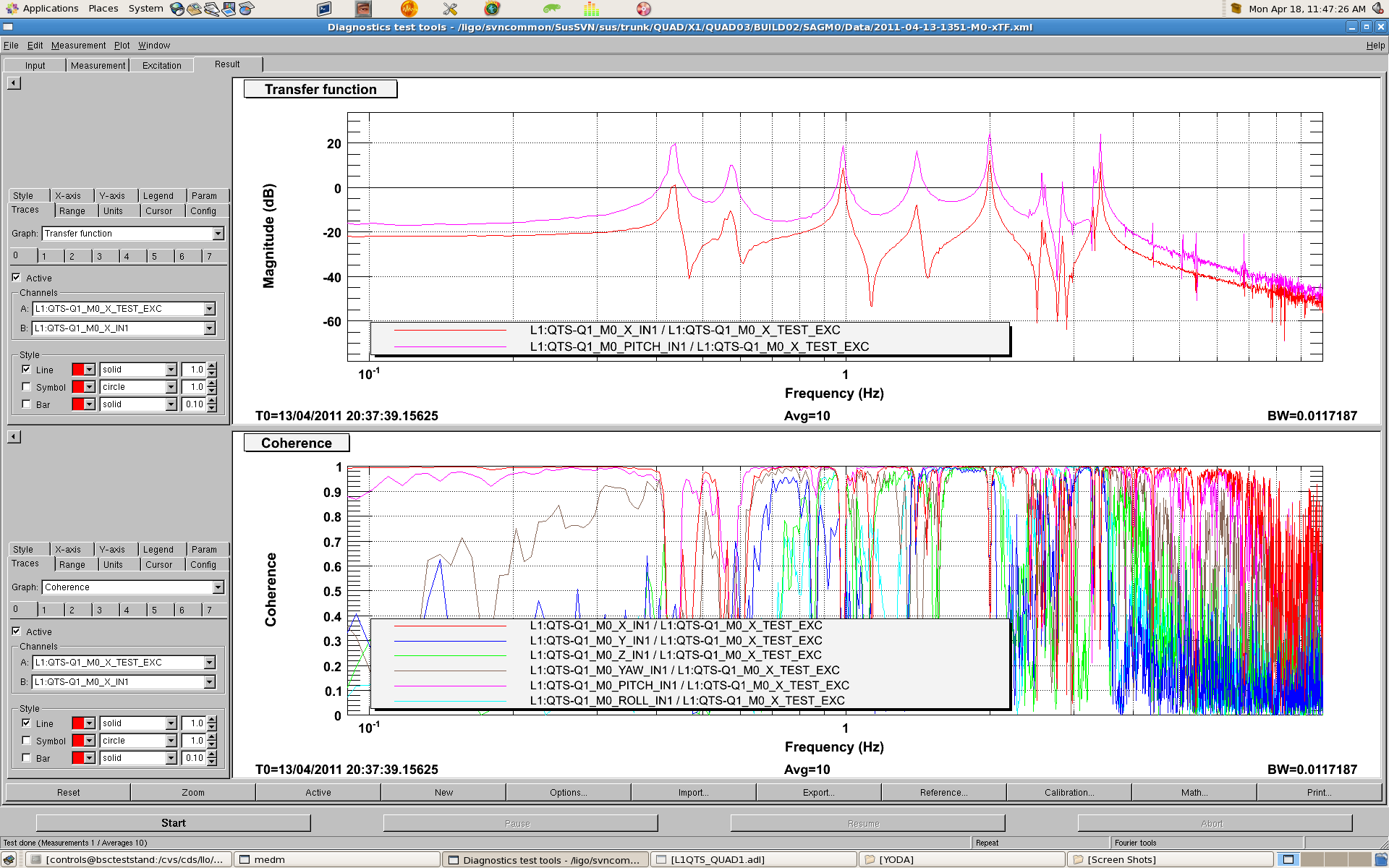


Figure YYYY-MM-DD-HHMM-M0-xTF

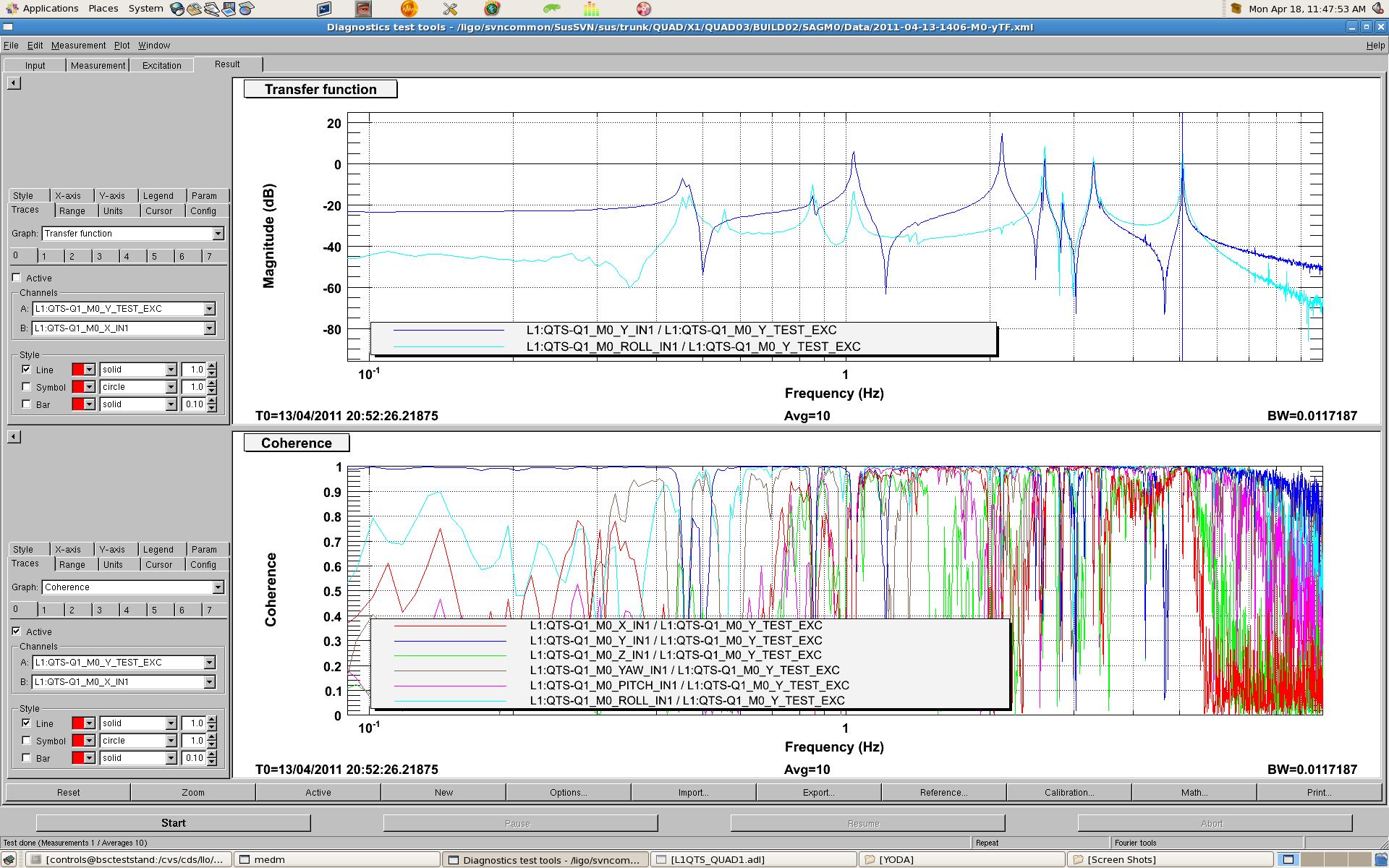


Figure YYYY-MM-DD-HHMM-M0-yTF

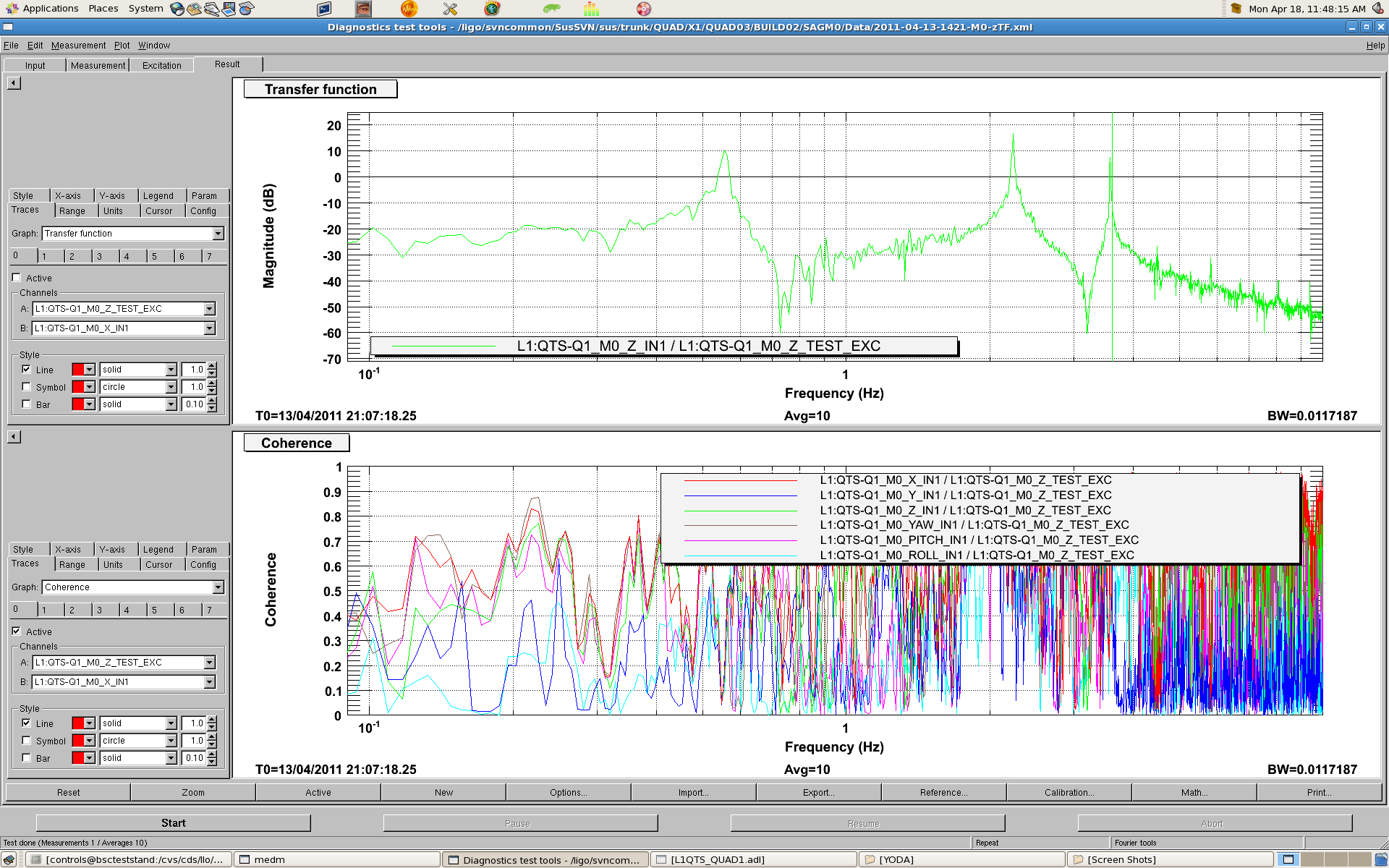


Figure YYYY-MM-DD-HHMM-M0-zTF

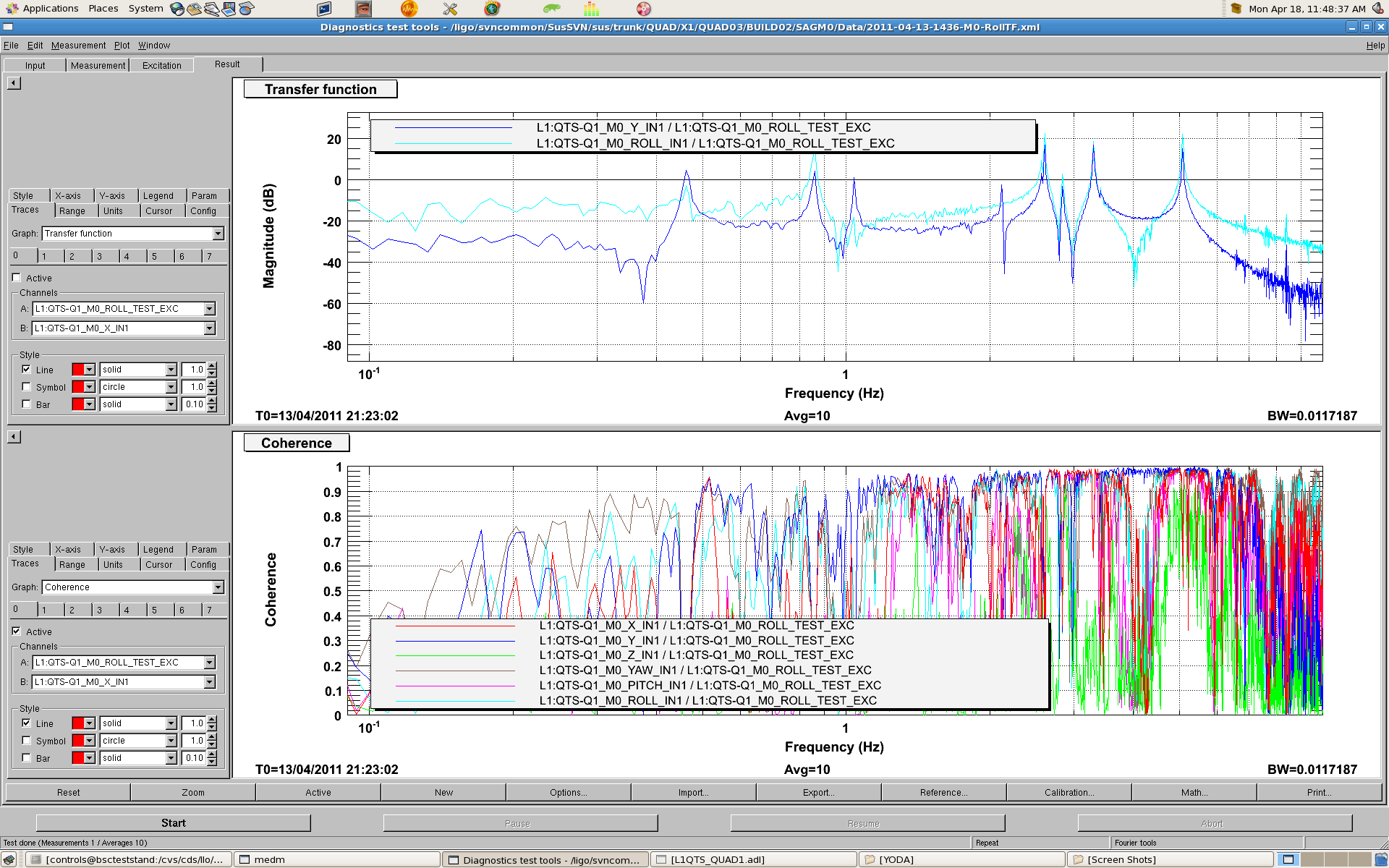


Figure YYYY-MM-DD-HHMM-M0-rollTF

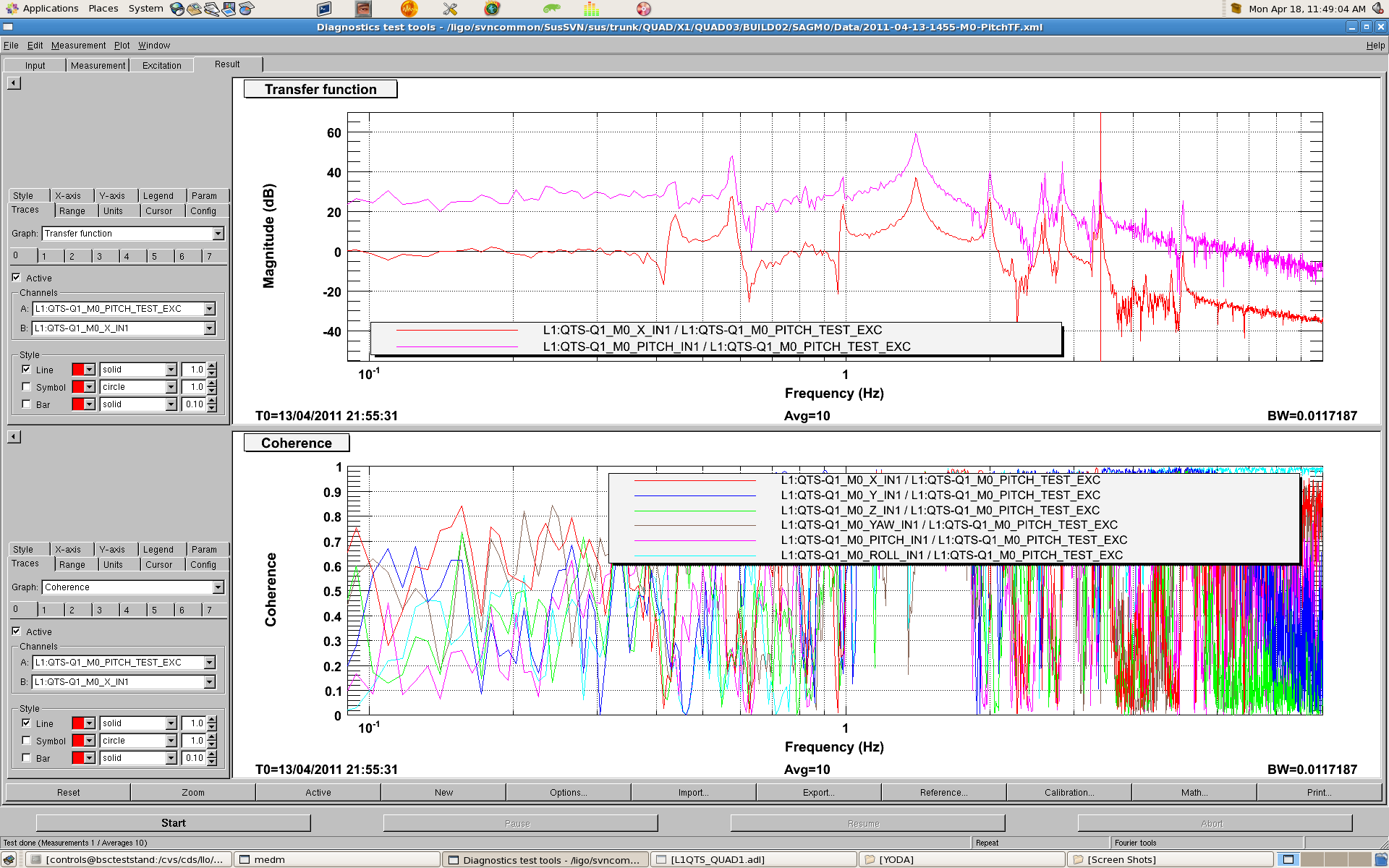


Figure YYYY-MM-DD-HHMM-M0-pitchTF

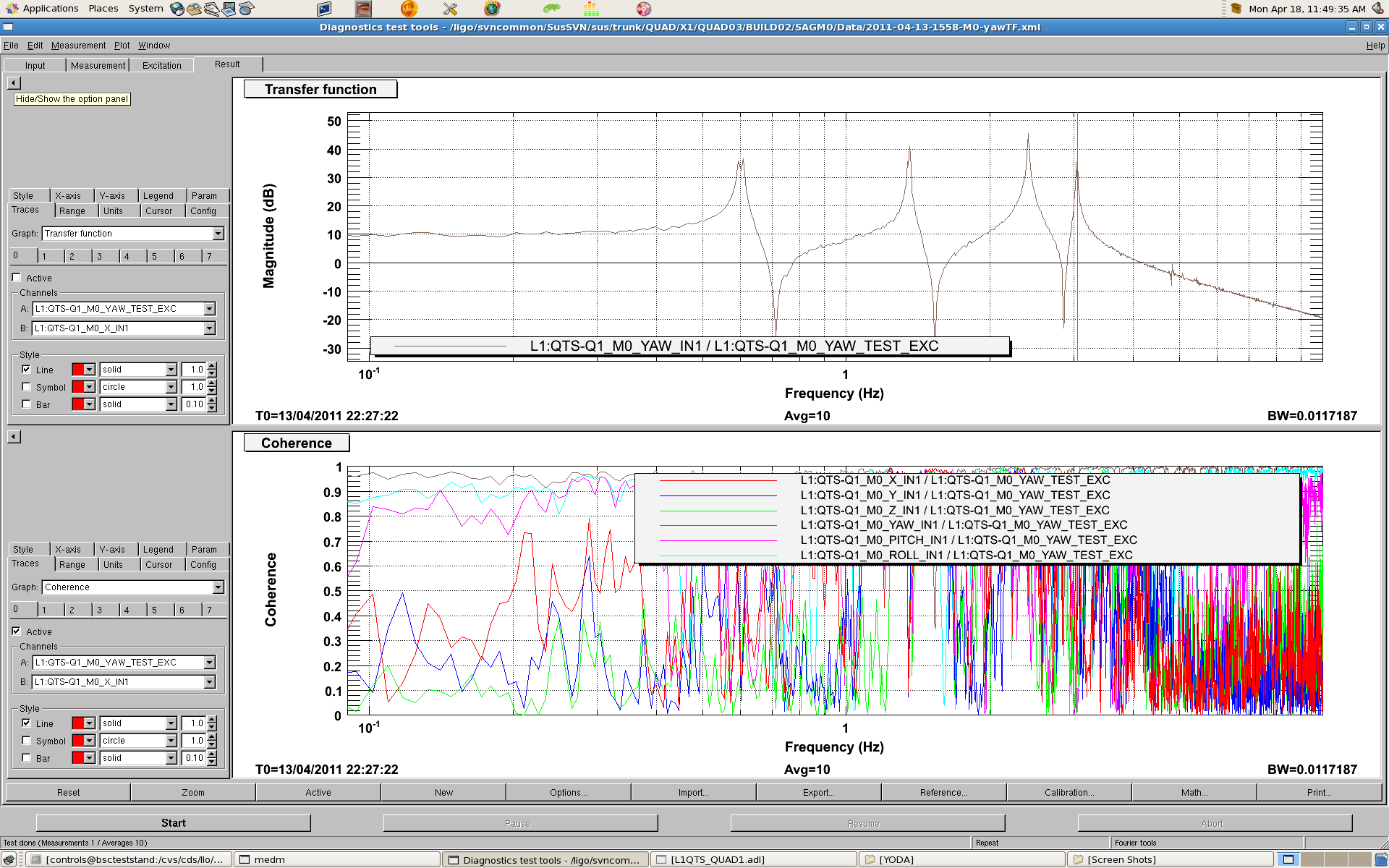


Figure YYYY-MM-DD-HHMM-M0-yawTF

### R0 TF

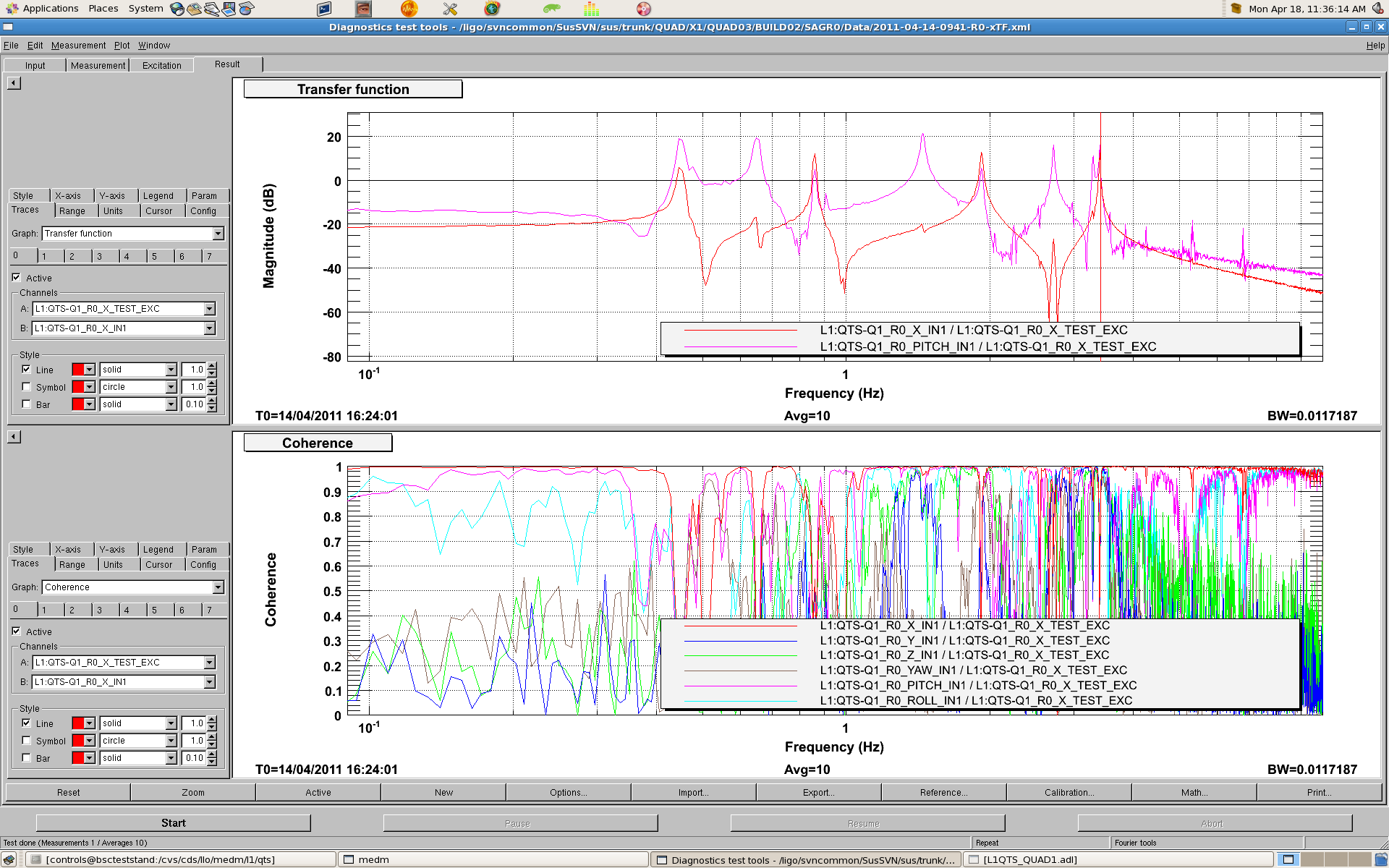


Figure YYYY-MM-DD-HHMM-R0-xTF

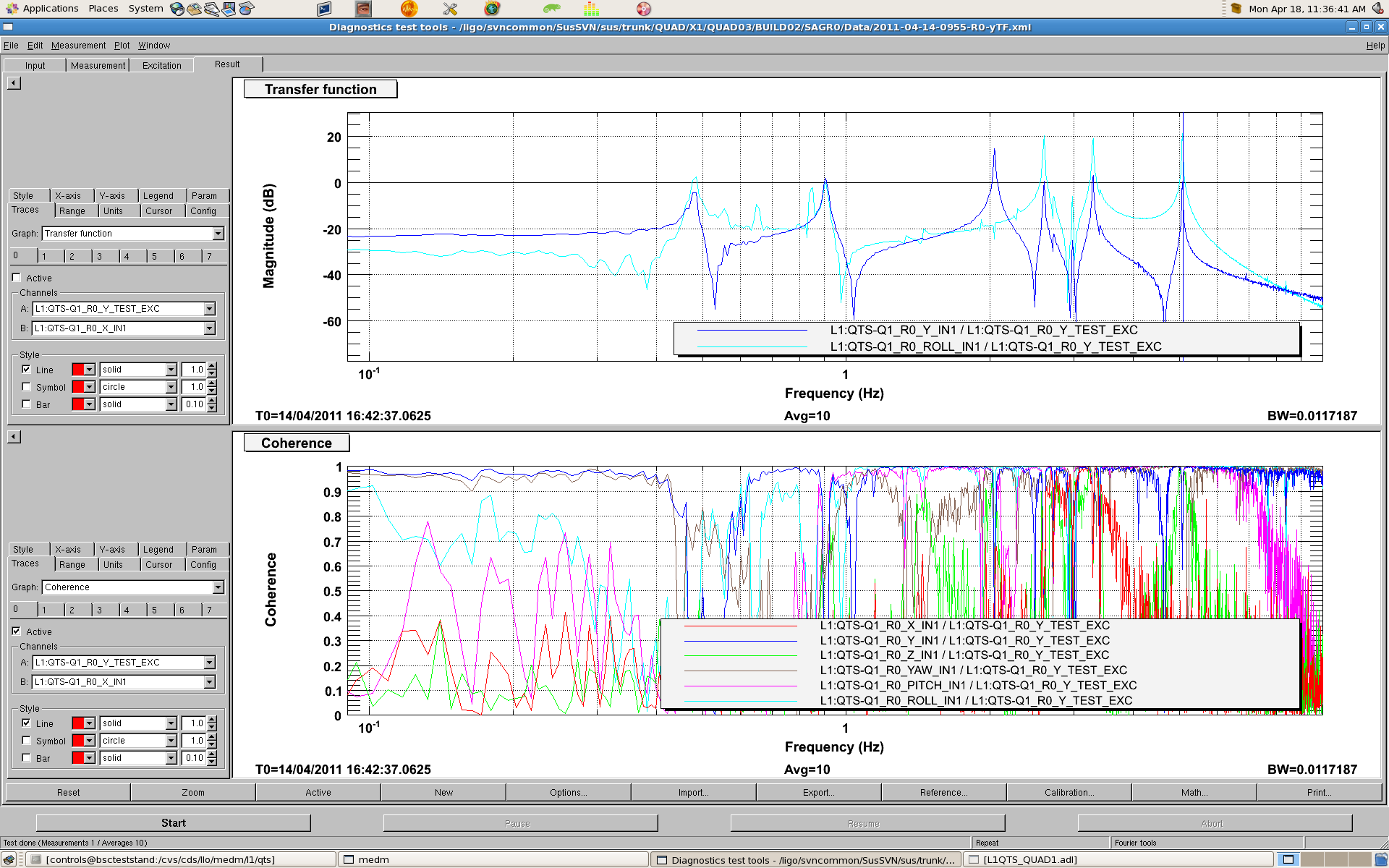


Figure YYYY-MM-DD-HHMM-R0-yTF

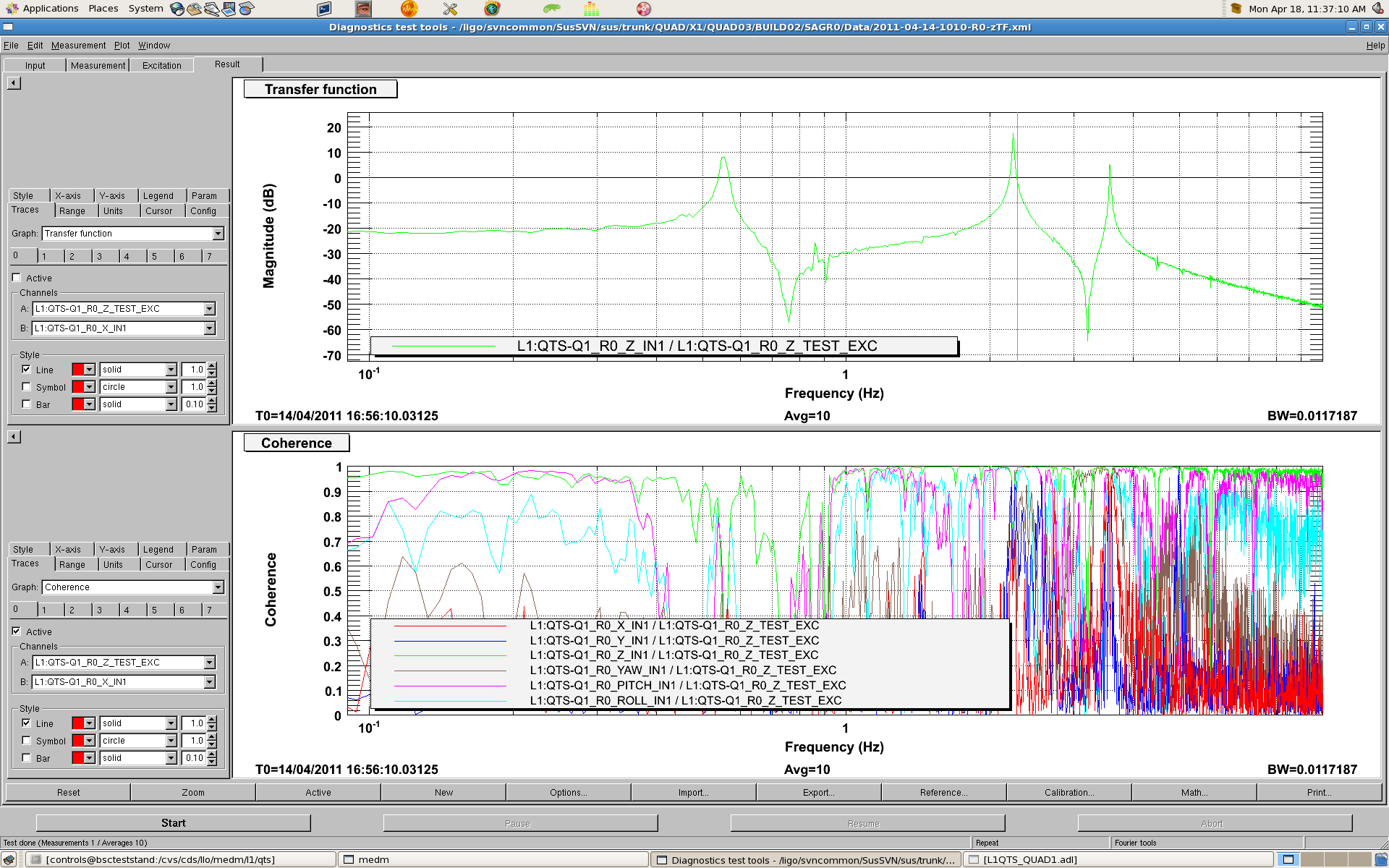
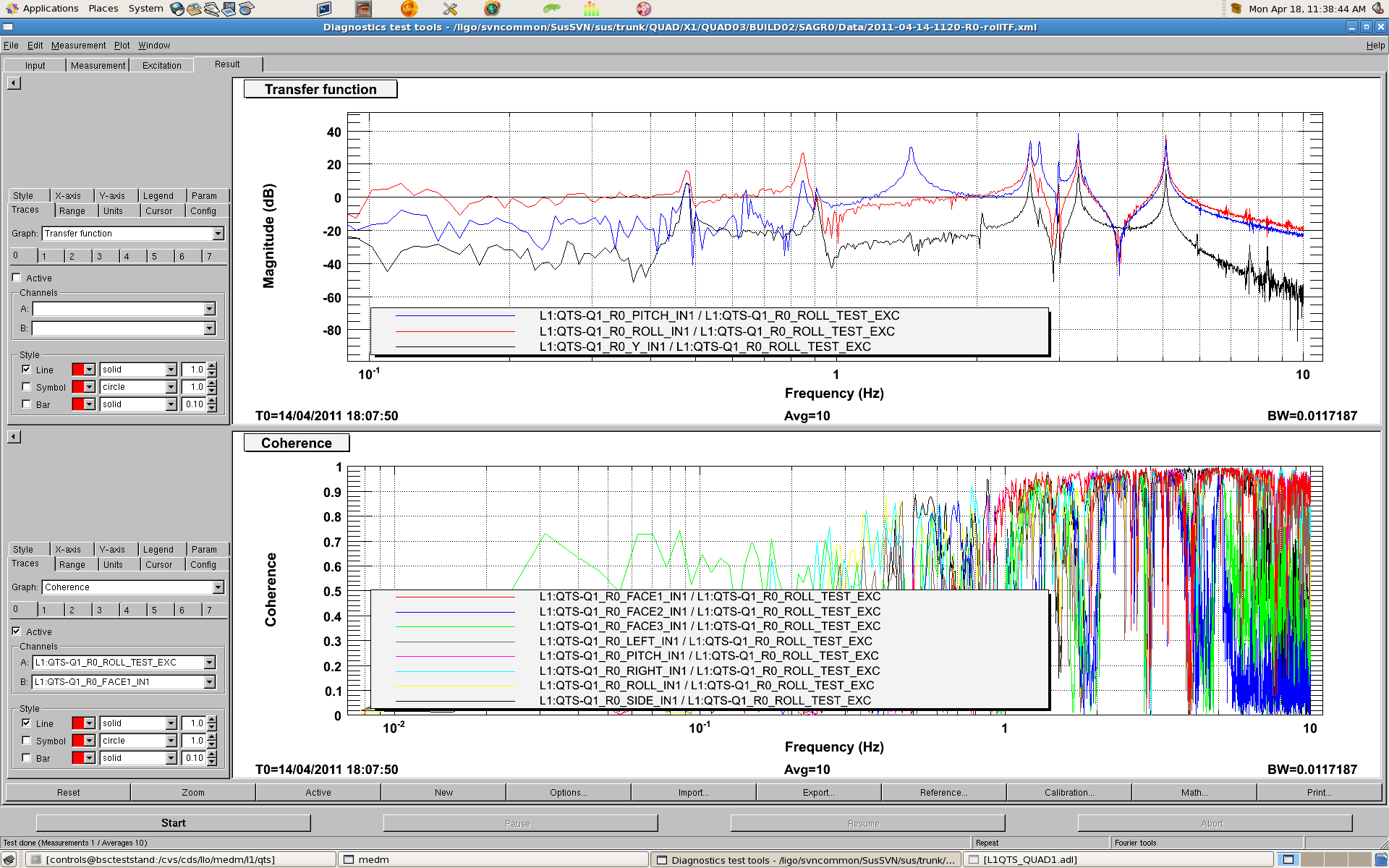


Figure YYYY-MM-DD-HHMM-R0-zTF

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

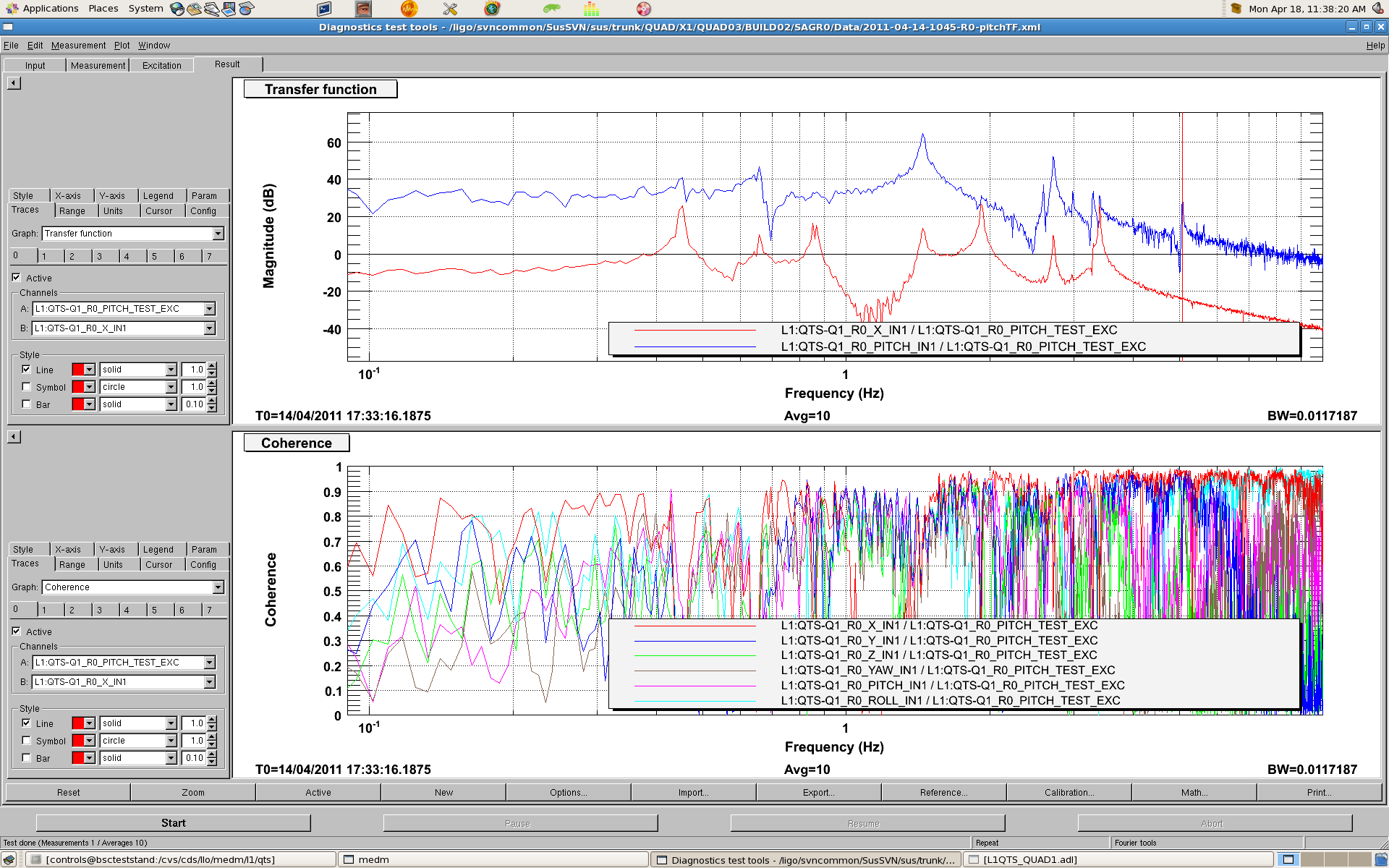


Figure YYYY-MM-DD-HHMM-R0-pitchTF

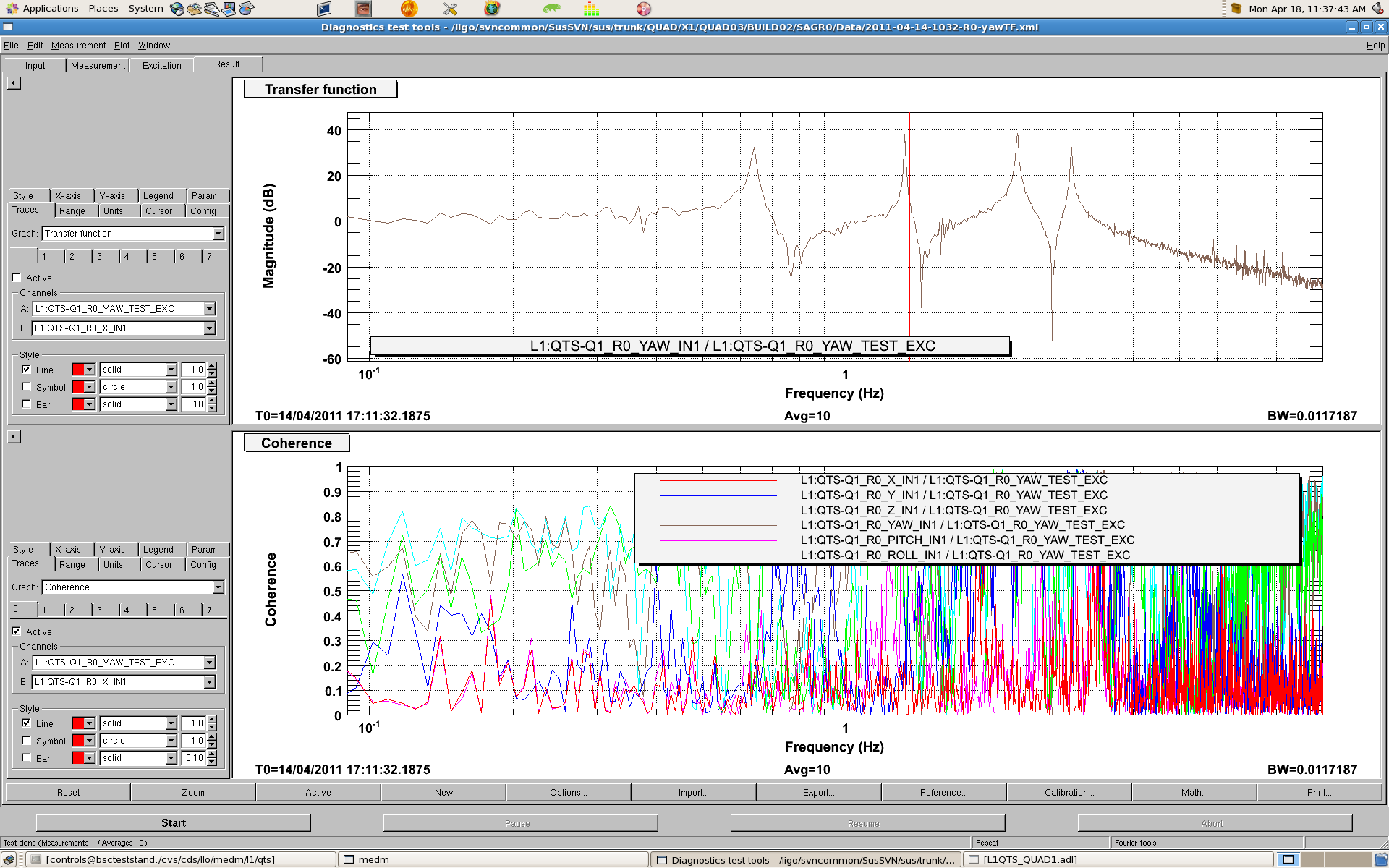


Figure YYYY-MM-DD-HHMM-R0-yawTF

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?

## Range Tests

### Pitch

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

### Yaw

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

## 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

### M0 Post-ECD TF

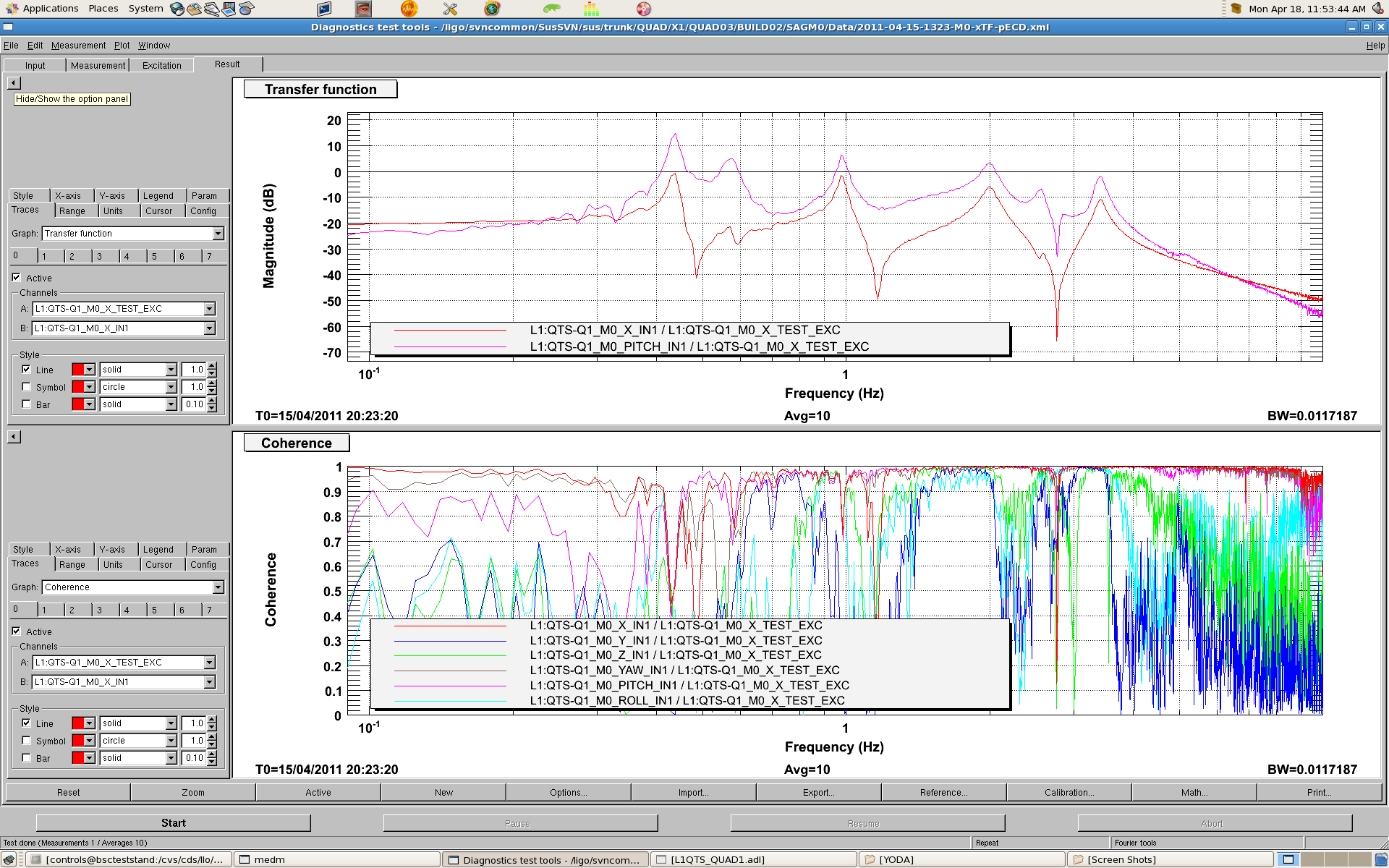


Figure YYYY-MM-DD-HHMM-M0-xTF-pECD

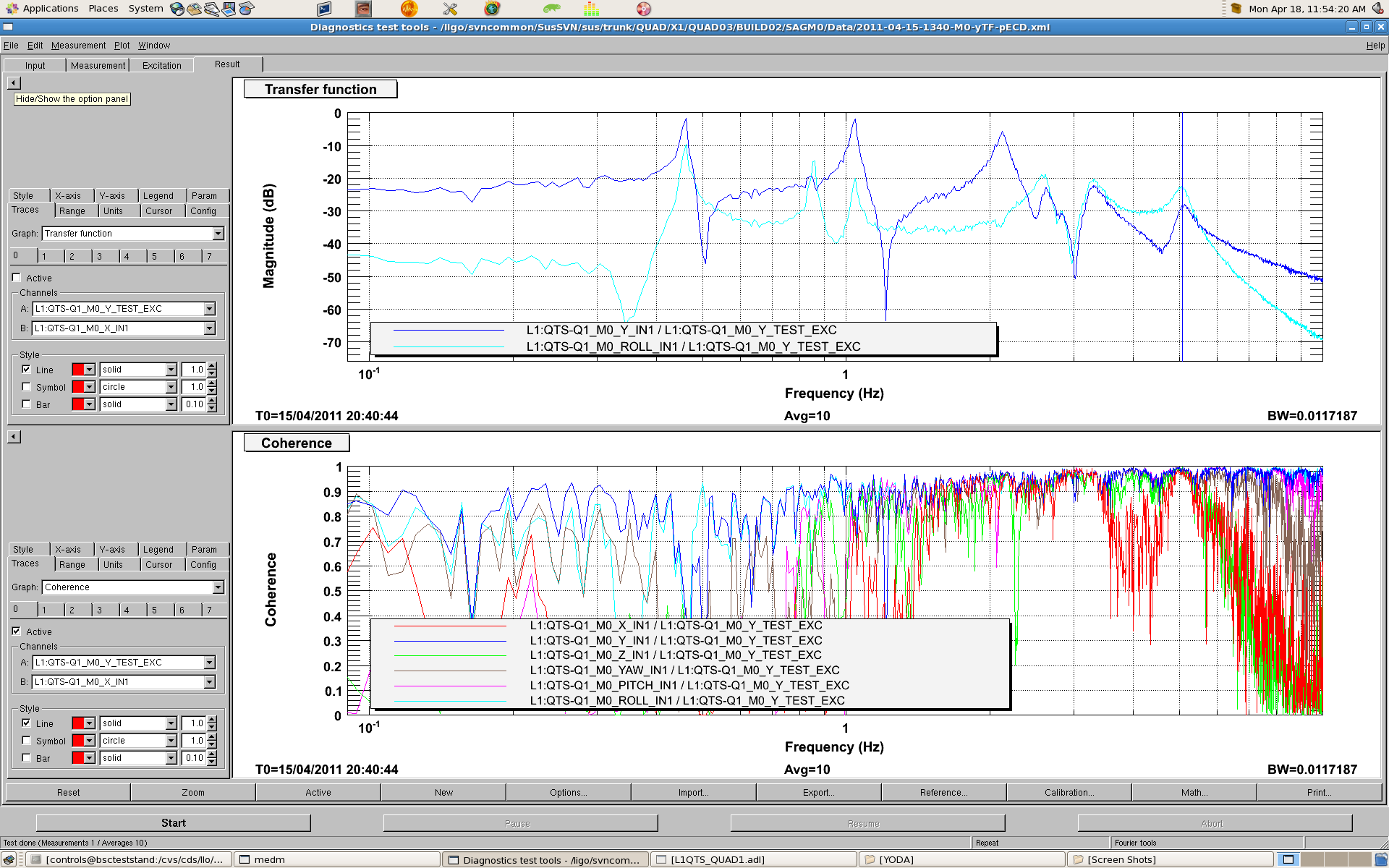


Figure YYYY-MM-DD-HHMM-M0-yTF-pECD

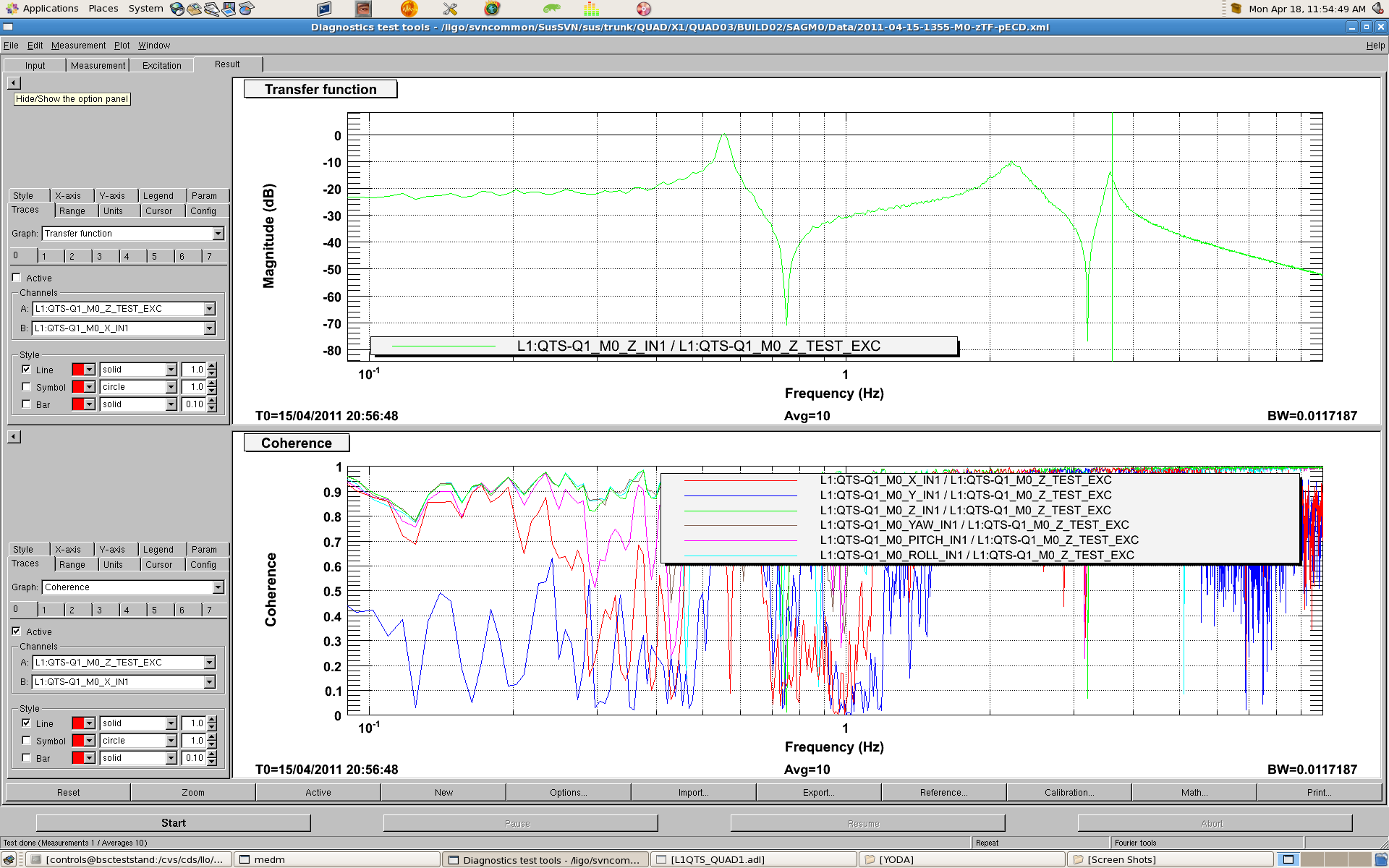


Figure YYYY-MM-DD-HHMM-M0-zTF-pECD

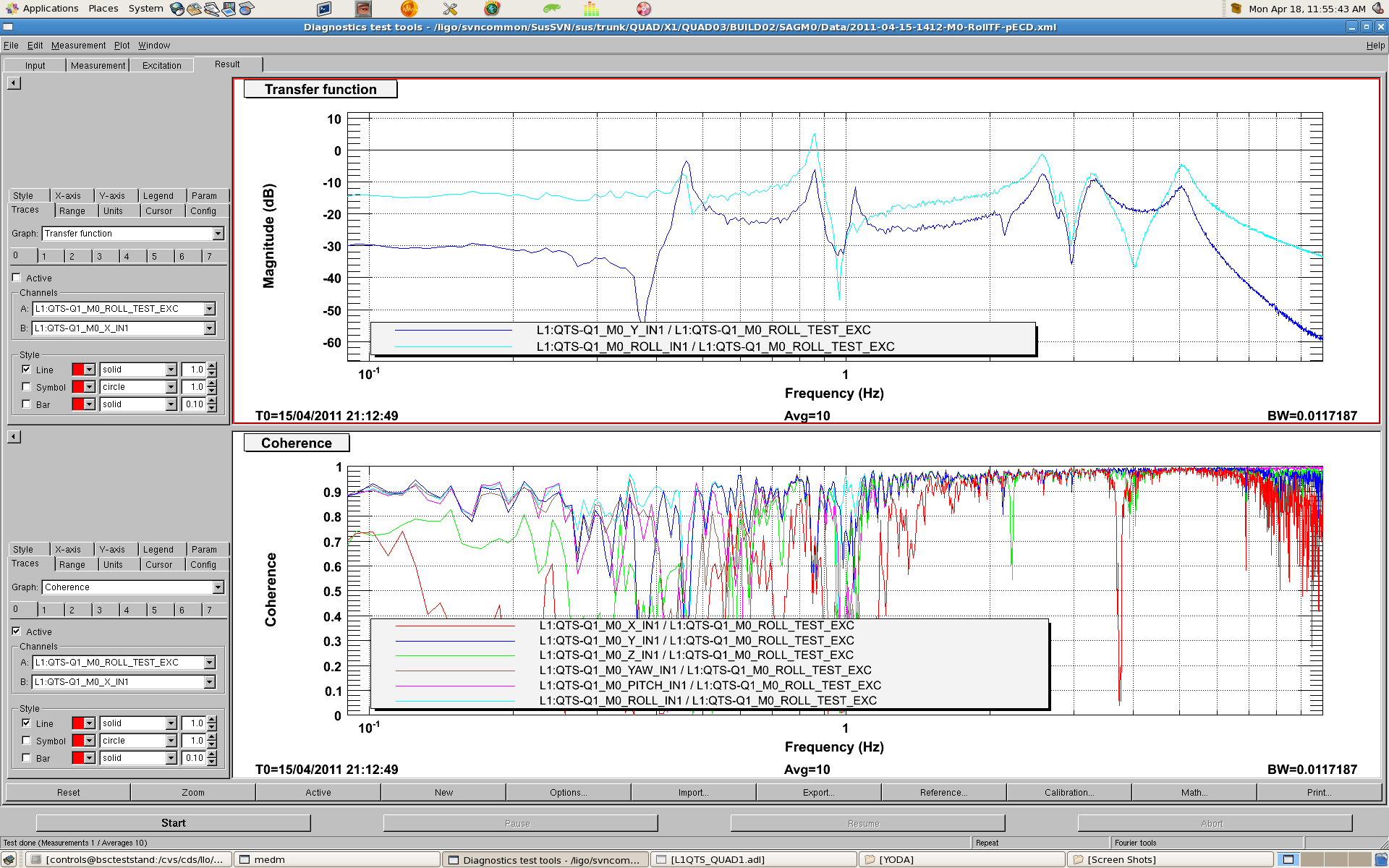


Figure YYYY-MM-DD-HHMM-M0-rollTF-pECD

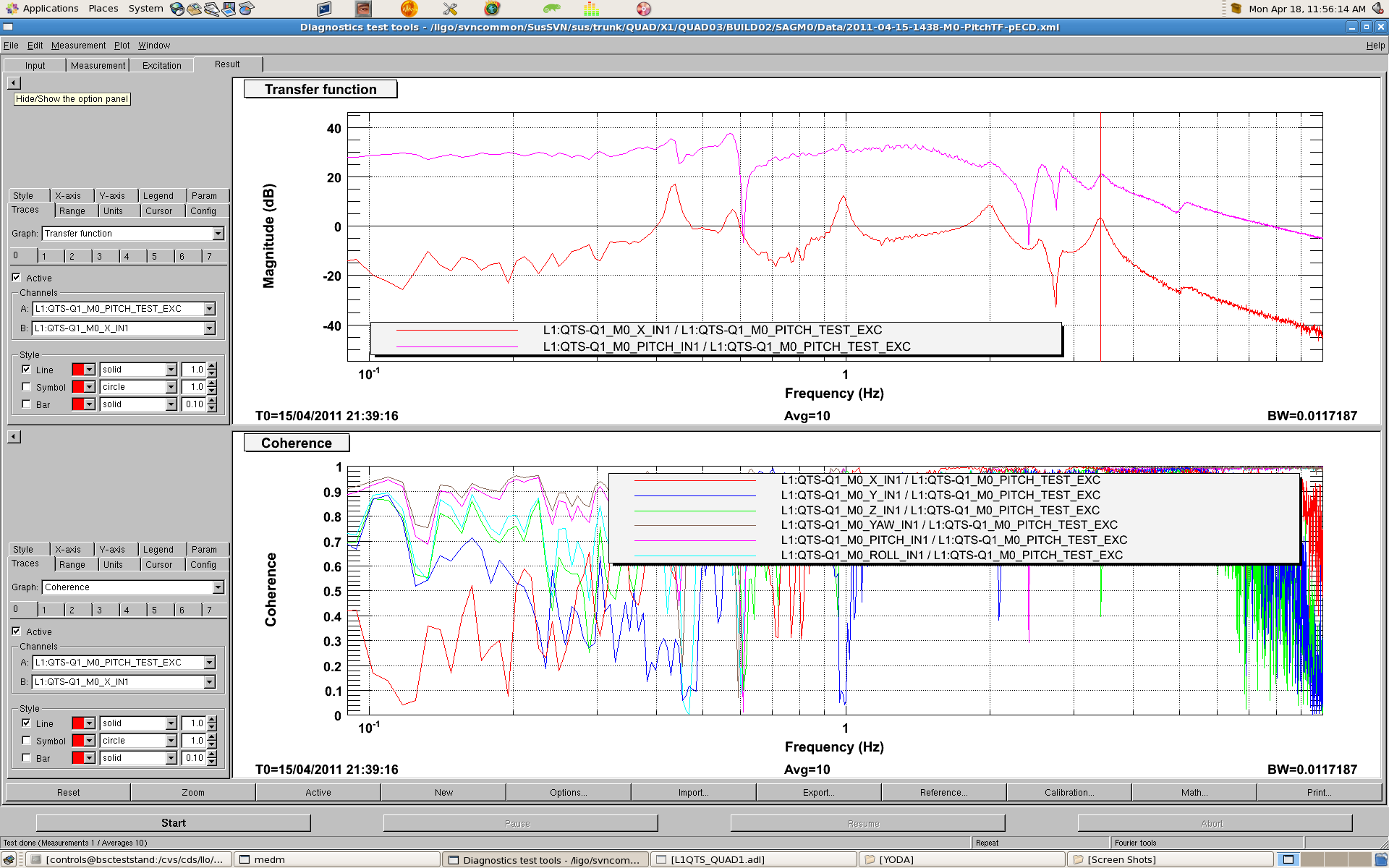


Figure YYYY-MM-DD-HHMM-M0-pitchTF-pECD

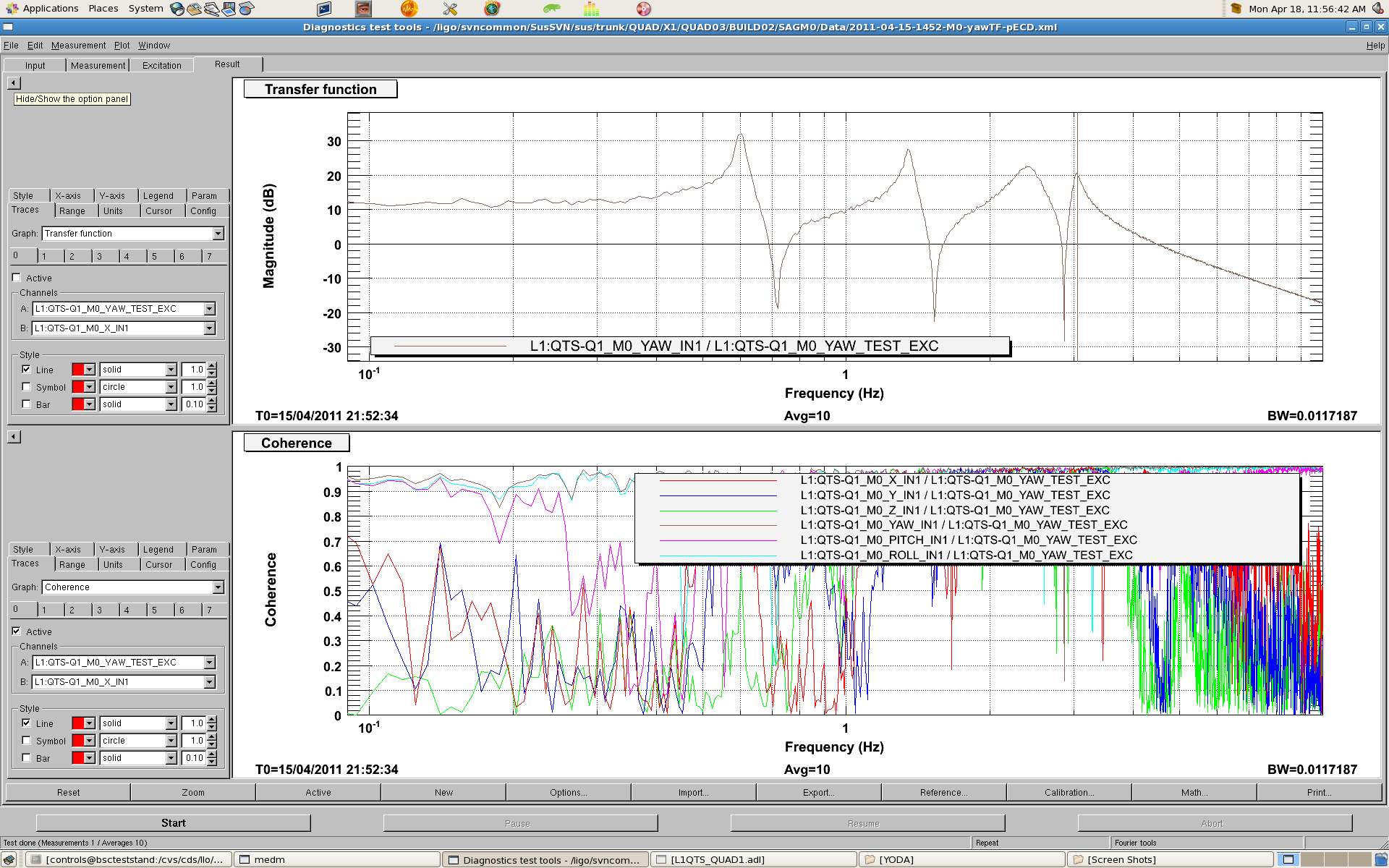


Figure YYYY-MM-DD-HHMM-M0-yawTF-pECD

### R0 Post-ECD TF

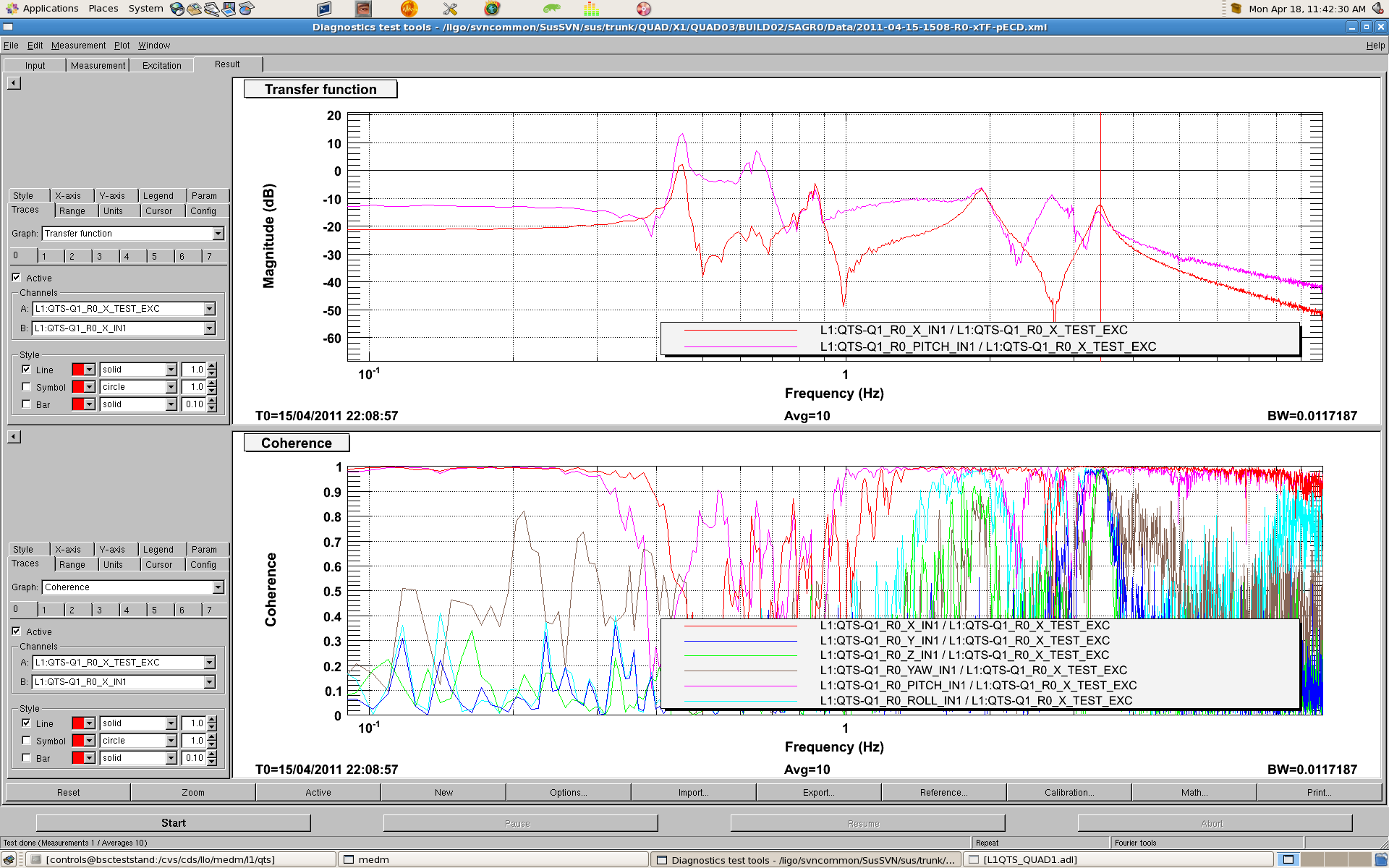


Figure YYYY-MM-DD-HHMM-R0-xTF-pECD

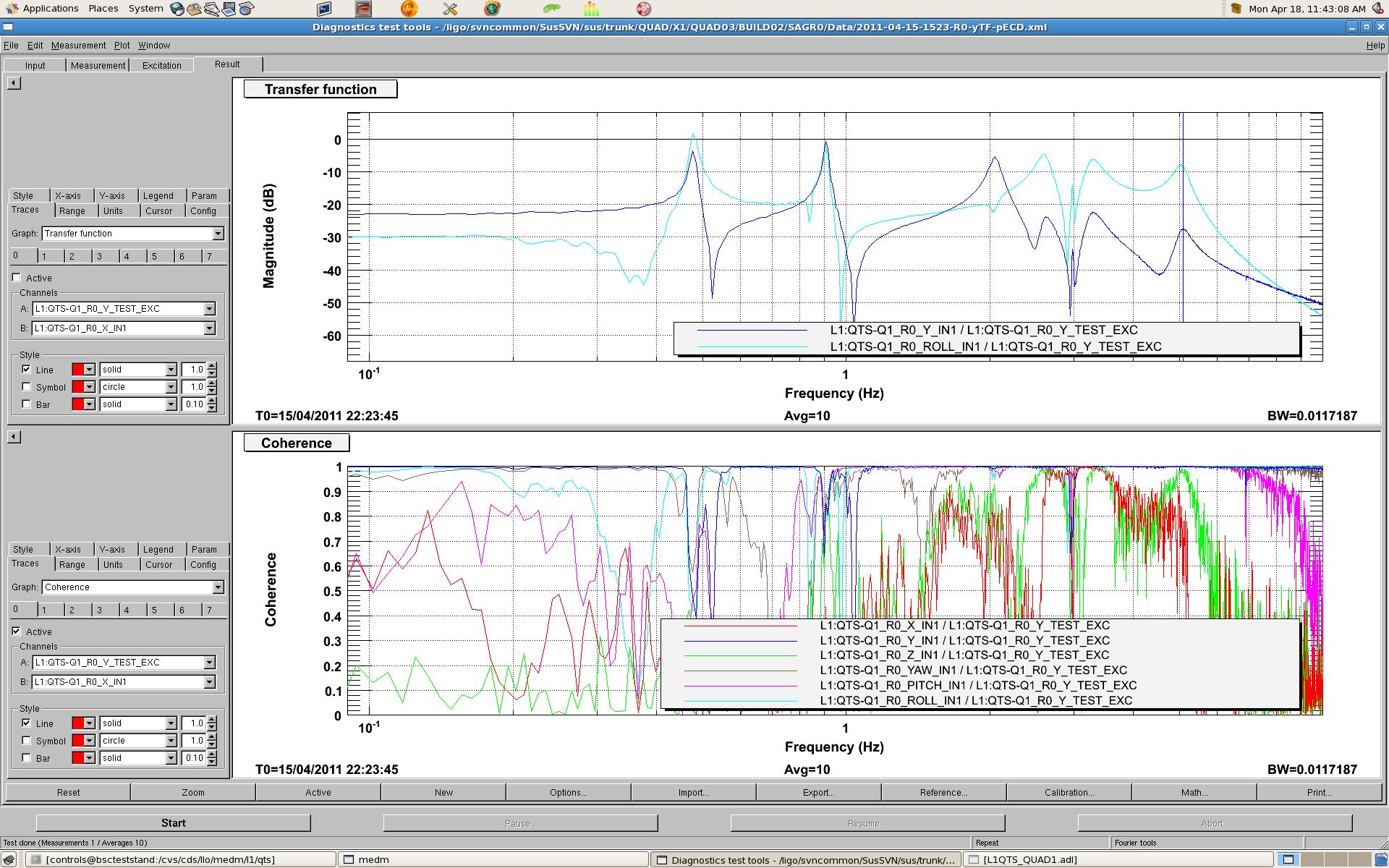


Figure YYYY-MM-DD-HHMM-R0-yTF-pECD

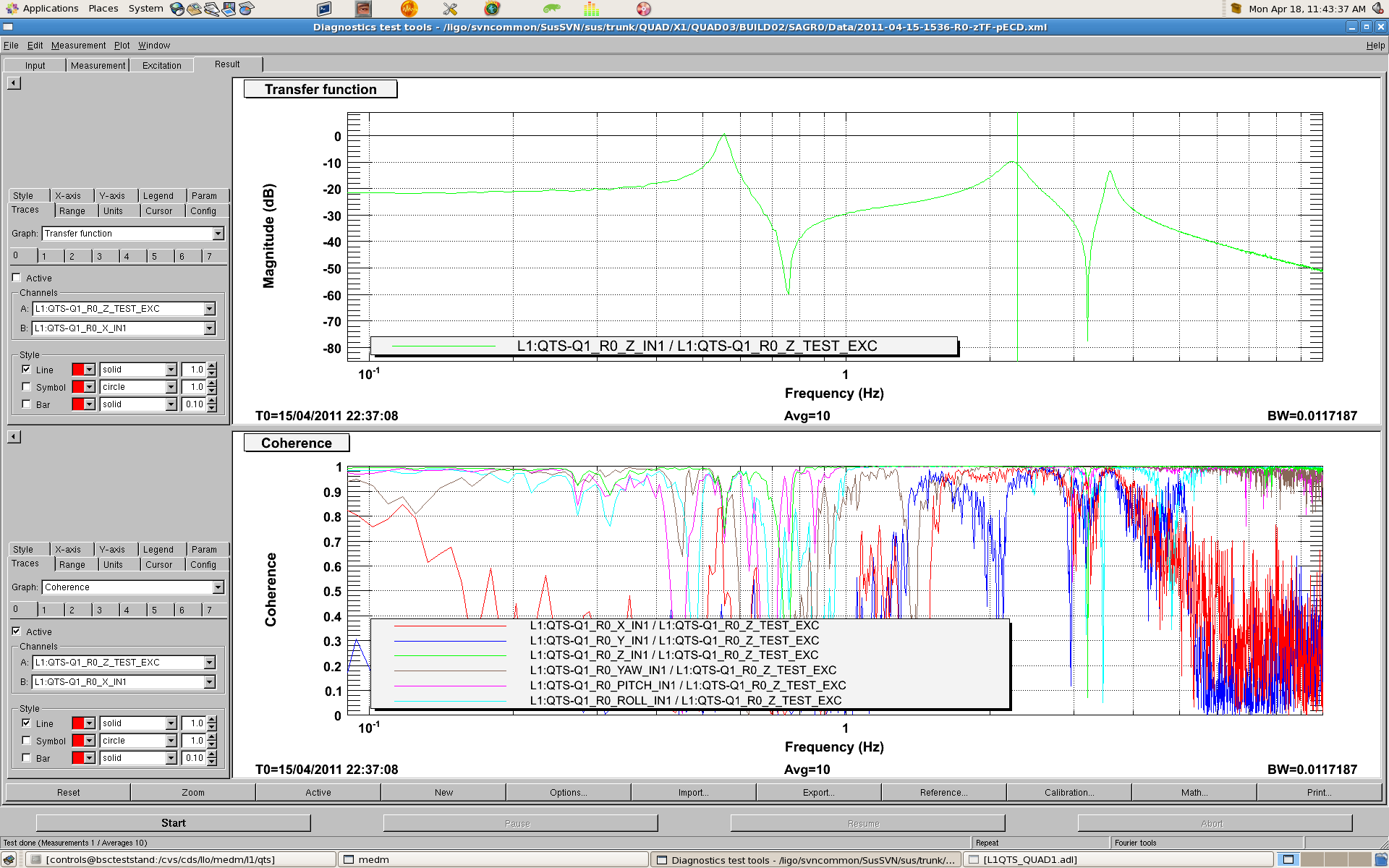


Figure YYYY-MM-DD-HHMM-R0-zTF-pECD

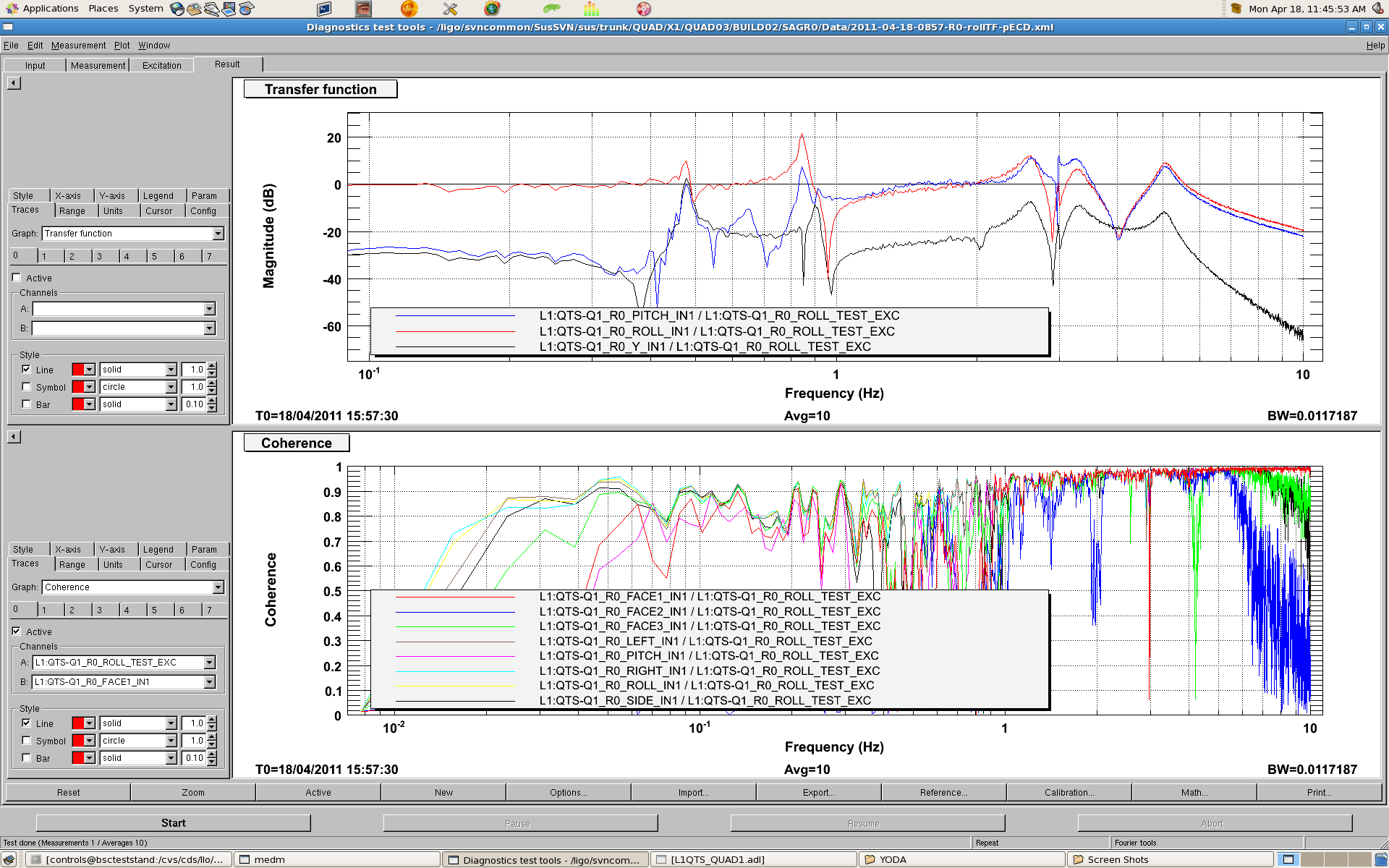


Figure YYYY-MM-DD-HHMM-R0-rollTF-pECD

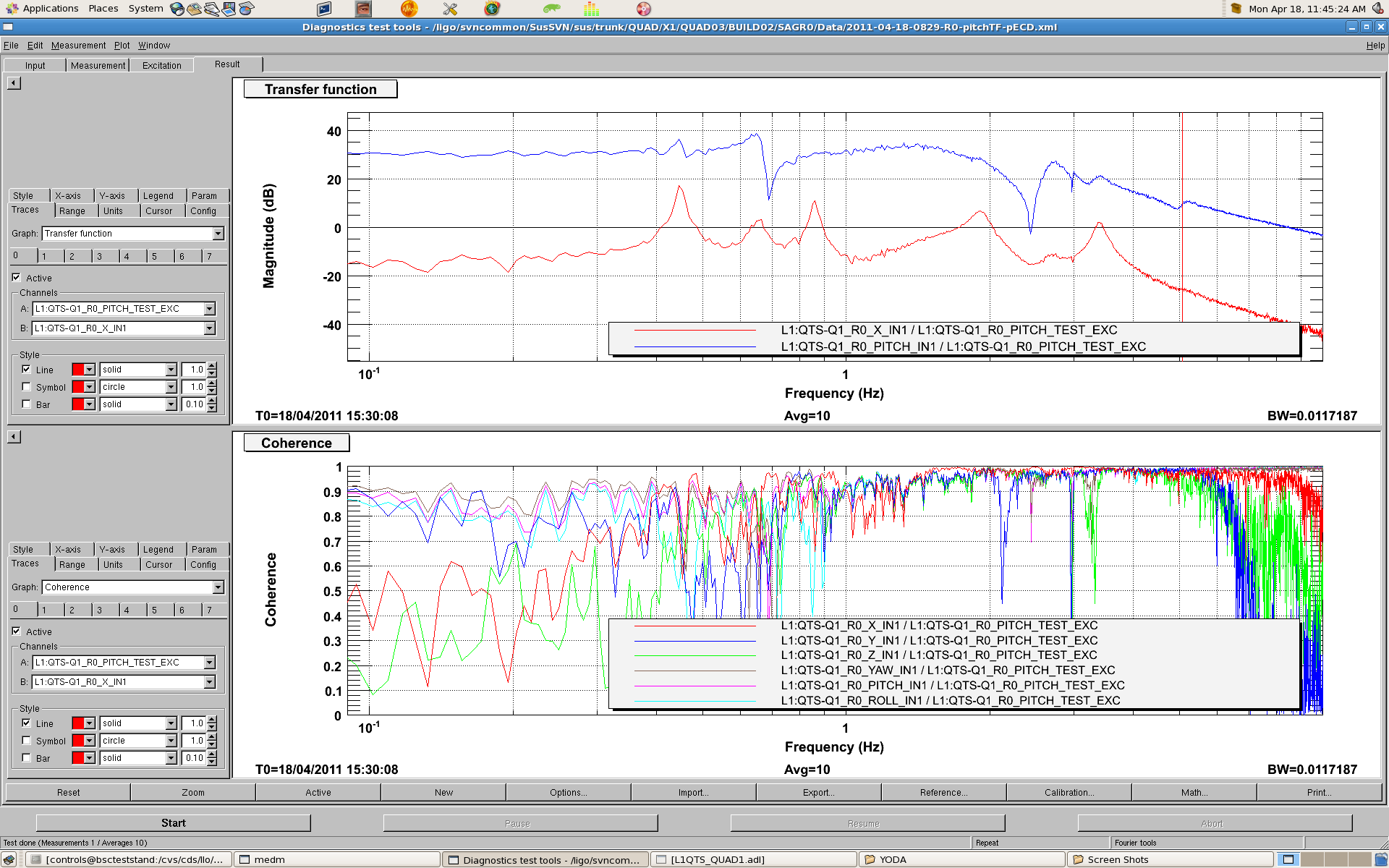


Figure YYYY-MM-DD-HHMM-Ro-pitchTF-pECD

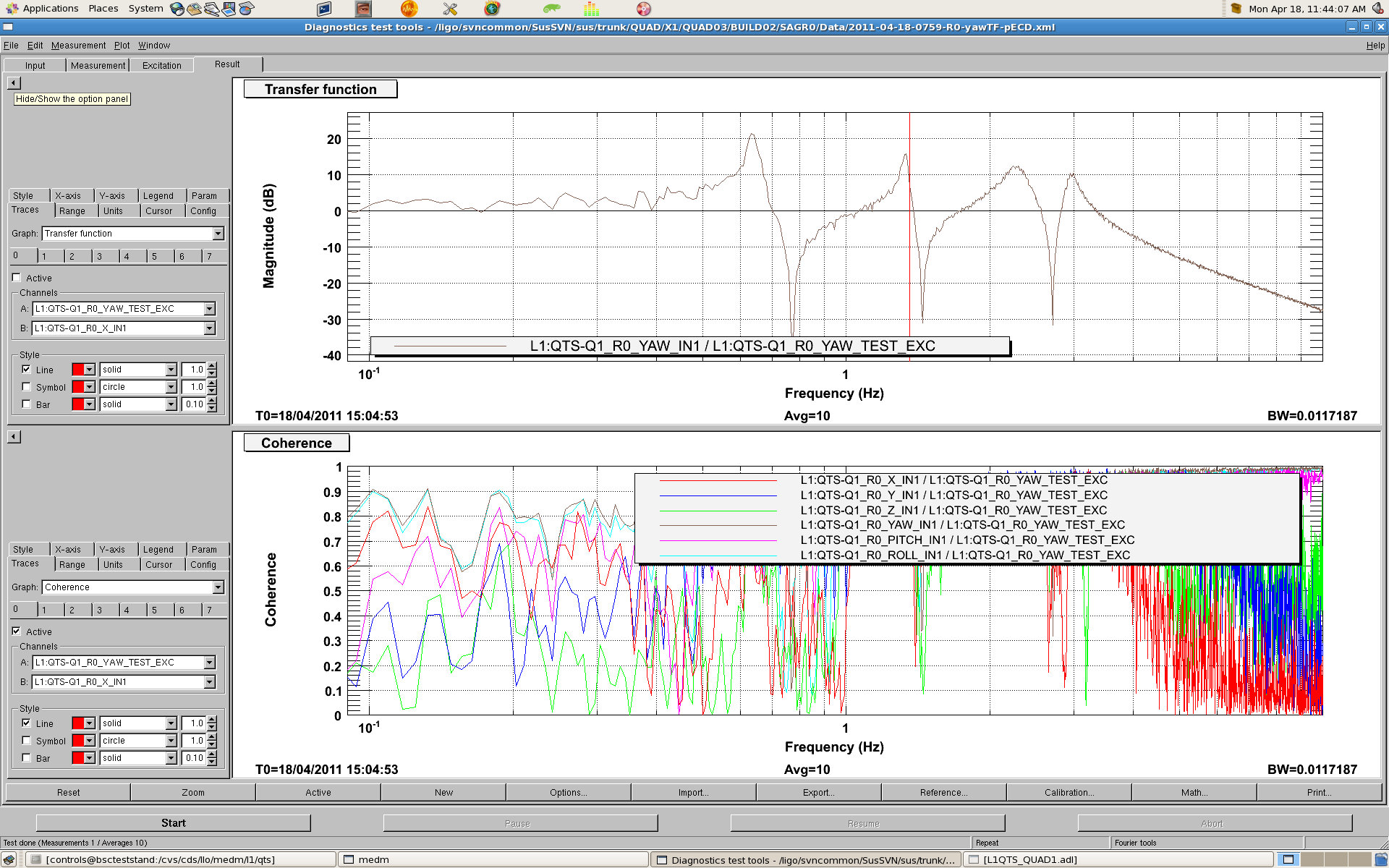


Figure YYYY-MM-DD-HHMM-R0-yawTF-pECD