

**Scope:**

- Defining a standard procedure and set of scripts to validate the ISI modules and their control performance.

- Build a template report that can be used for the acceptance documentation of all the modules

**The scripts are saved in**

/HAM-ISI/L1/HAMx/Scripts/Perf\_analysis/

**They are named:**

- Performance\_Test\_1\_Damping\_OFF\_Low\_Gain.m
- Performance\_Test\_2\_Damping\_ON\_Low\_Gain.m
- Performance\_Test\_3\_Damping\_ON\_High\_Gain.m
- Performance\_Test\_4\_Vertical\_Isolation\_ON\_High\_Gain.m
- Performance\_Test\_5\_Vertical\_Isolation\_ON\_High\_Gain.m

(Latest reference are in L1 HAM2 and HAM3 - Forgot to commit them – To be committed)

**Corresponding Data is committed in:**

HAM-ISI/L1/HAM2/Data/Perf\_Analysis/2013-01-22-g/

**The data Created:**

- HAM-ISI\_L1\_HAM2\_Perf\_Analysis\_Parameters\_2013-01-24-a.mat
- HAM-ISI\_L1\_HAM2\_Test1\_2013-01-24-a.mat
- HAM-ISI\_L1\_HAM2\_Test2\_2013-01-24-a.mat
- HAM-ISI\_L1\_HAM2\_Test3\_2013-01-24-a.mat
- HAM-ISI\_L1\_HAM2\_Test4\_2013-01-24-a.mat
- HAM-ISI\_L1\_HAM2\_Test5\_2013-01-24-a.mat

## Changes upon meeting/review recommendation:

- The scripts now check that all the folders necessary for storing data already exist, and create them if they don't
- All the parameters that need to be edited are grouped in the top cell
- The scripts have been made generic using headers (i.e. SYSTEM='HAM-ISI'; IFO='L1'; UNIT='HAM5') that are used all along the scripts to build variable and files names
- They include an option for HAM2-3-6 or HAM4-5 (without or with Stage 0 L4C).
- For the transmissibility, it computes not only the ratios of ASDs but also the transfer functions
- Added the ground to Stage 1 transmissibility (useful for HAM2,3,6 that don't have stage 0 L4C)
- They save png, fig and pdf in corresponding folders if save\_flag=1
  - seismic/HAM-ISI/L1/HAM2/Data/Figures/Perf\_Analysis/2013-01-24-a/fig/
  - seismic/HAM-ISI/L1/HAM2/Data/Figures/Perf\_Analysis/2013-01-24-a/pdf/
  - seismic/HAM-ISI/L1/HAM2/Data/Figures/Perf\_Analysis/2013-01-24-a/png/
- Grouped the plot functions in 1 generic function
- Reworked the plots (Use IDFIG, added the site in the title, specify whether the noise curved are measured...)

## 1) Test 1, Check sensor noise and platform transmissibility

- The script `Performance_Test_1_Damping_OFF_Low_Gain.m`
- It gets 900 seconds of data, decimates, computes ASD and calibrates:
  - The ground STS2 signals
  - The 6 local and cartesian L4C signals
  - The 6 local and cartesian CPS signals
  - The 6 local and cartesian GS13 signals
- It save the processed ASDs in a structure in `/Data/Perf_Analysis/`
- It computes models of transmissibility.
- It plots the local to local sensors so we can compare the sensor response corner per corner.
- It plots the transmissibility.
- It saves the figures.

## Test 1 Procedure/Description:

Goal: Checking sensor noise and platform transmissibility

In MEDM:

- Turn Master switch OFF
- Engage Calib buttons (CPS, L4C and GS13)
- Engage Gain buttons (L4C and GS13)
- Disengage DWH button (GS13)
- Run Performance\_Test\_1\_Local\_ASD\_Low\_Gain.m

The script gets 900 seconds of data for

- The ground STS2 signals
- The 6 local and 6 Cartesian L4C signals
- The 6 local and 6 Cartesian CPS signal
- The 6 local and 6 Cartesian GS13 signals

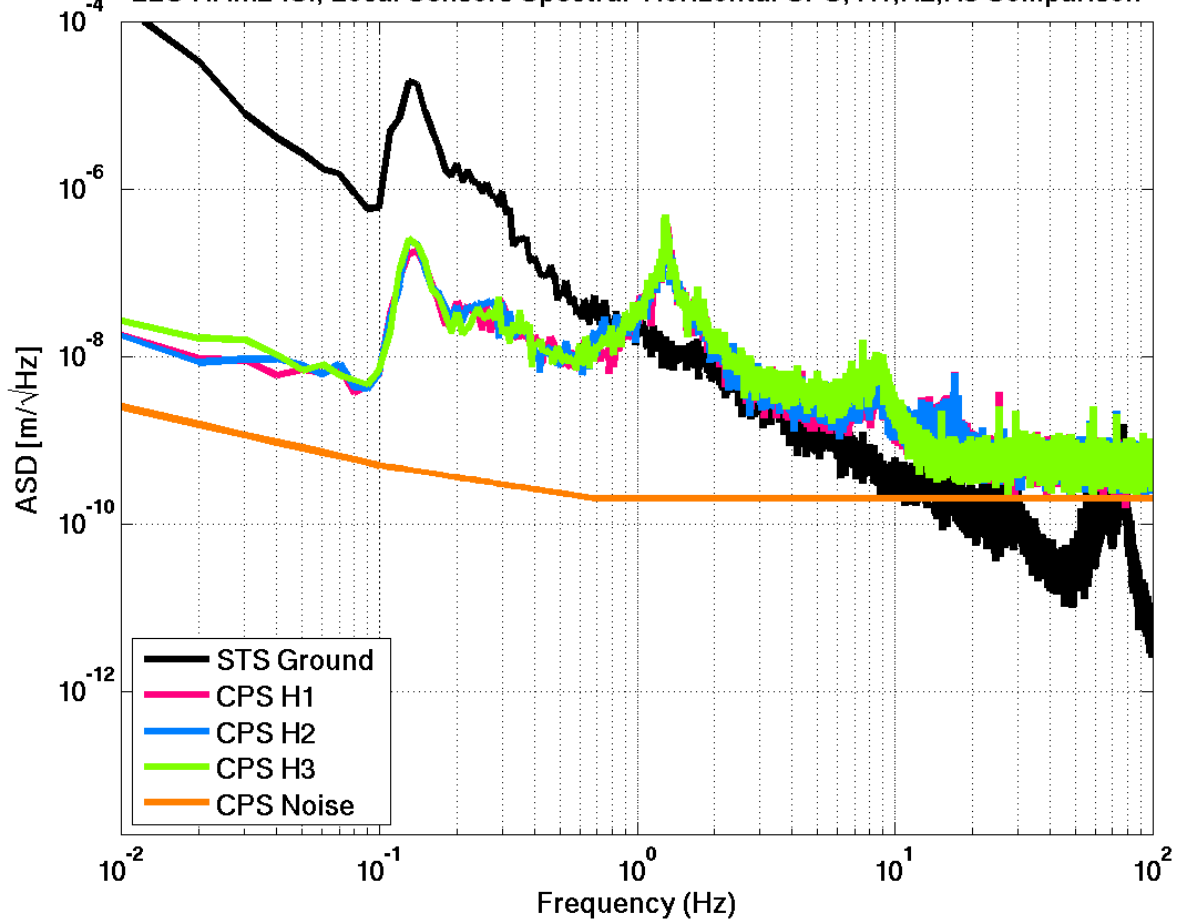
Then it:

- Decimates, computes ASD and calibrates the Loc
- Stores the processed ASDs in a structure saved in /Data/Perf\_Analysis/
- It computes models of transmissibility.

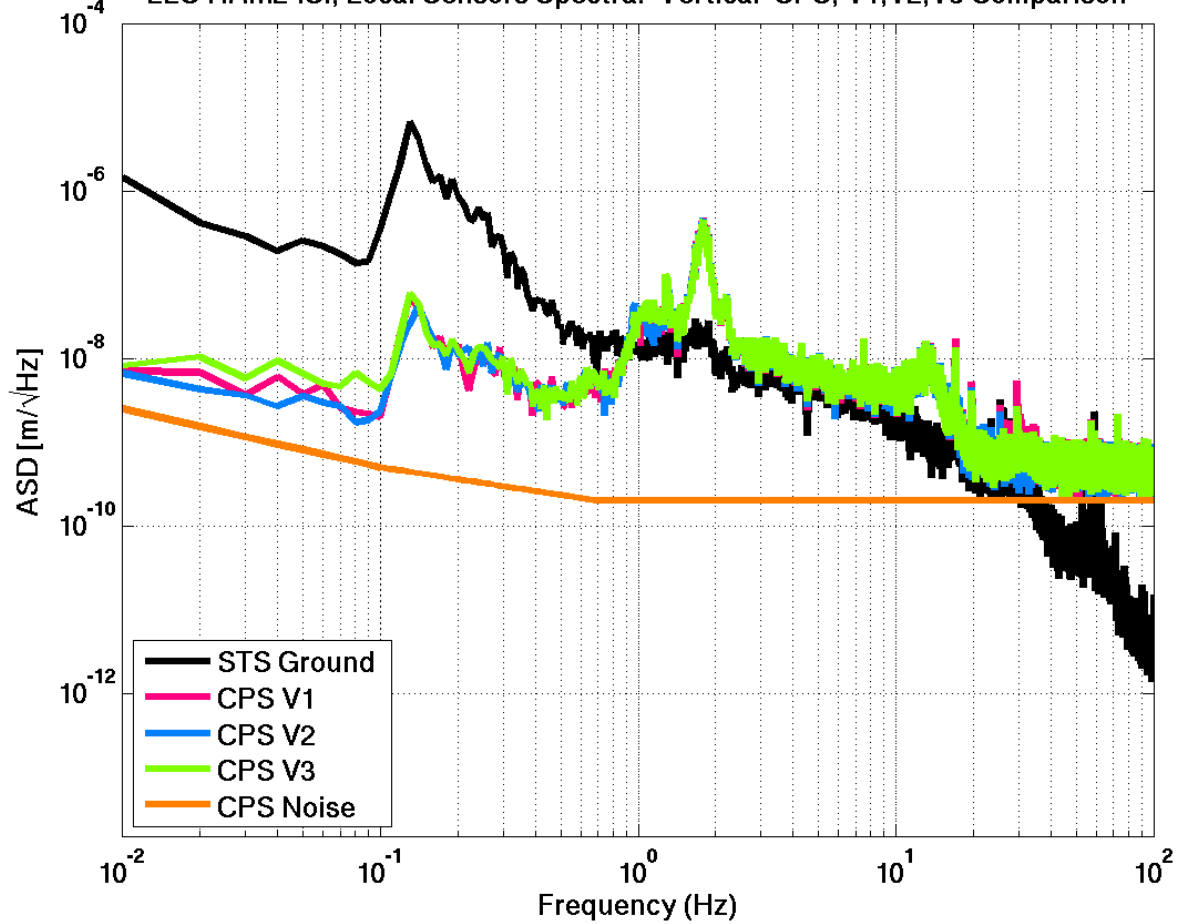
Finally it plots the results and save the figures:

- Plots the local to local sensors so we can compare the sensor response corner per corner.
- Plots the transmissibility.
- Saves the Figures in /Data/Figures/Perf\_Analysis/

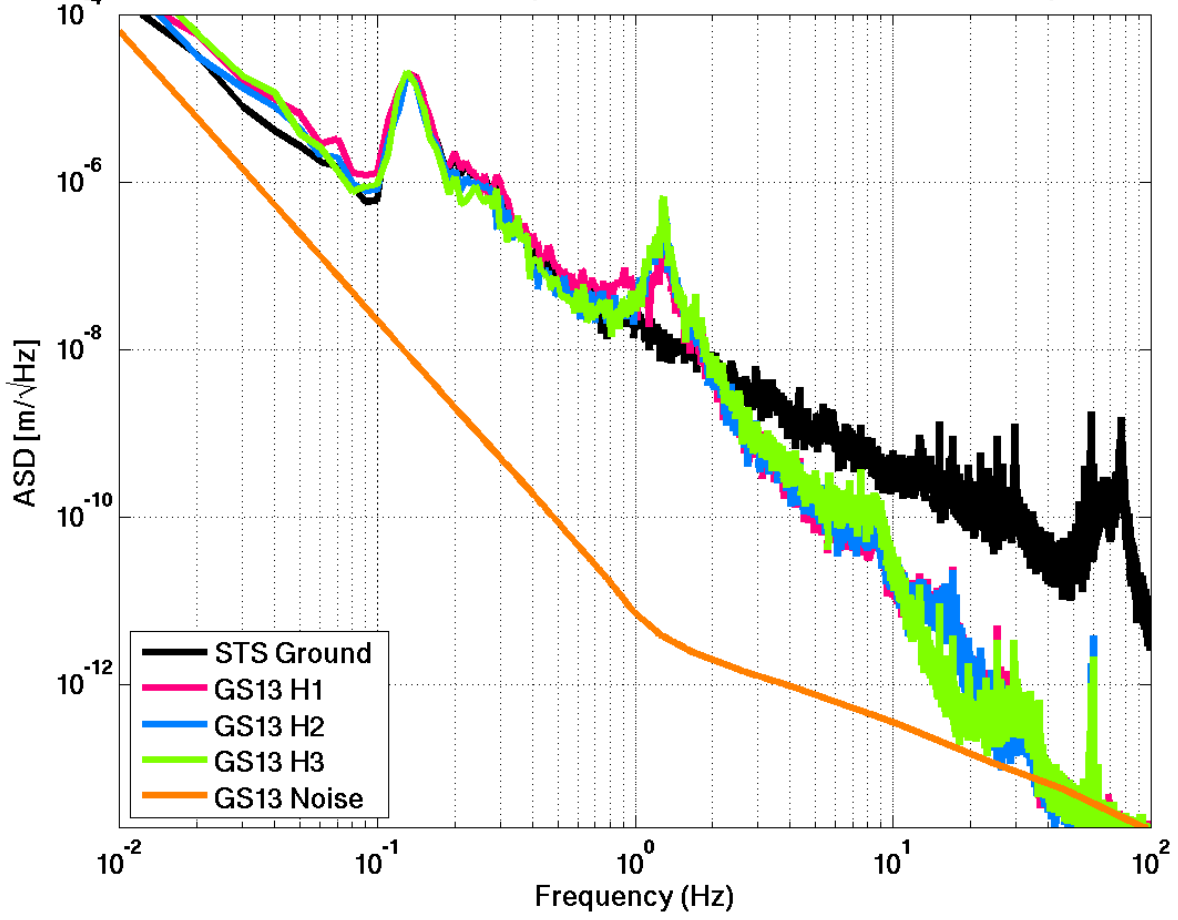
LLO HAM2-ISI, Local Sensors Spectra: Horizontal CPS, H1,H2,H3 Comparison



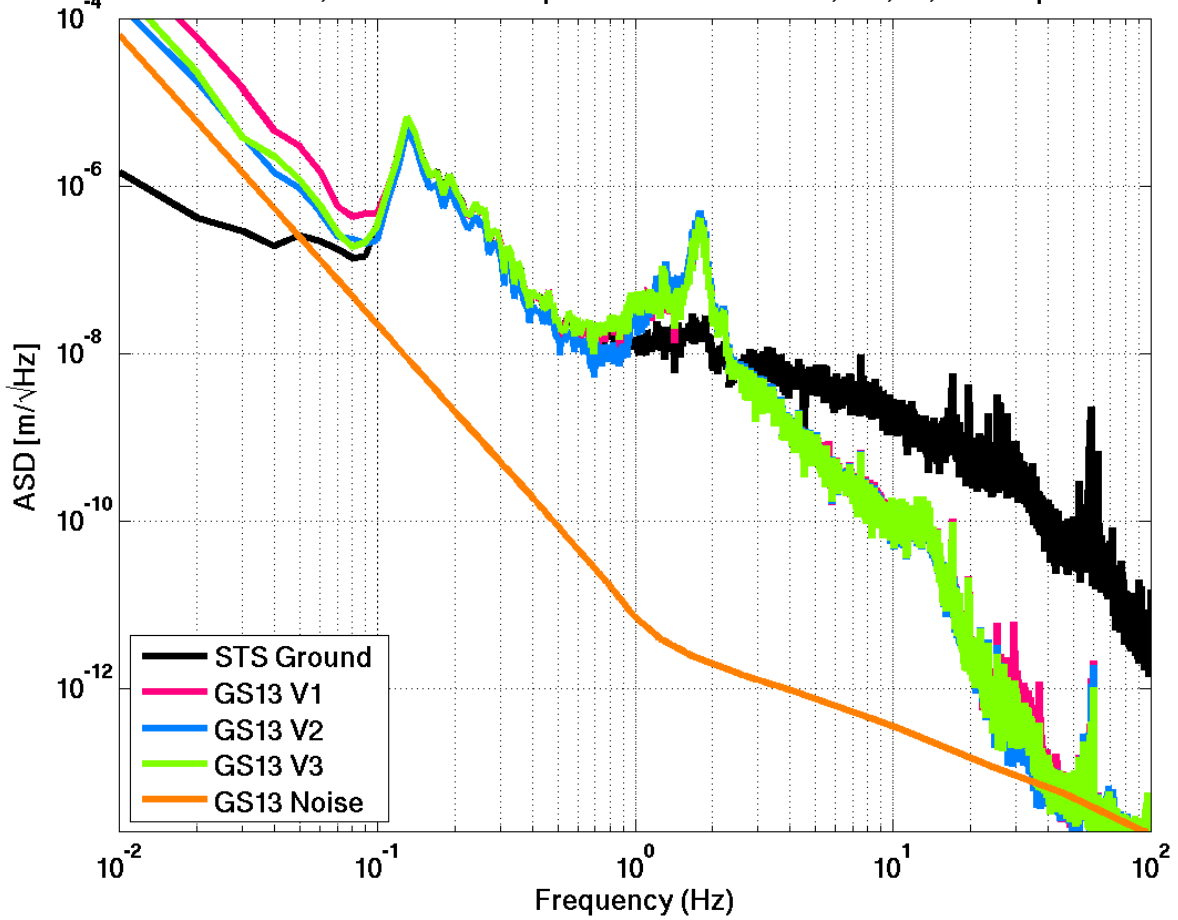
LLO HAM2-ISI, Local Sensors Spectra: Vertical CPS, V1,V2,V3 Comparison

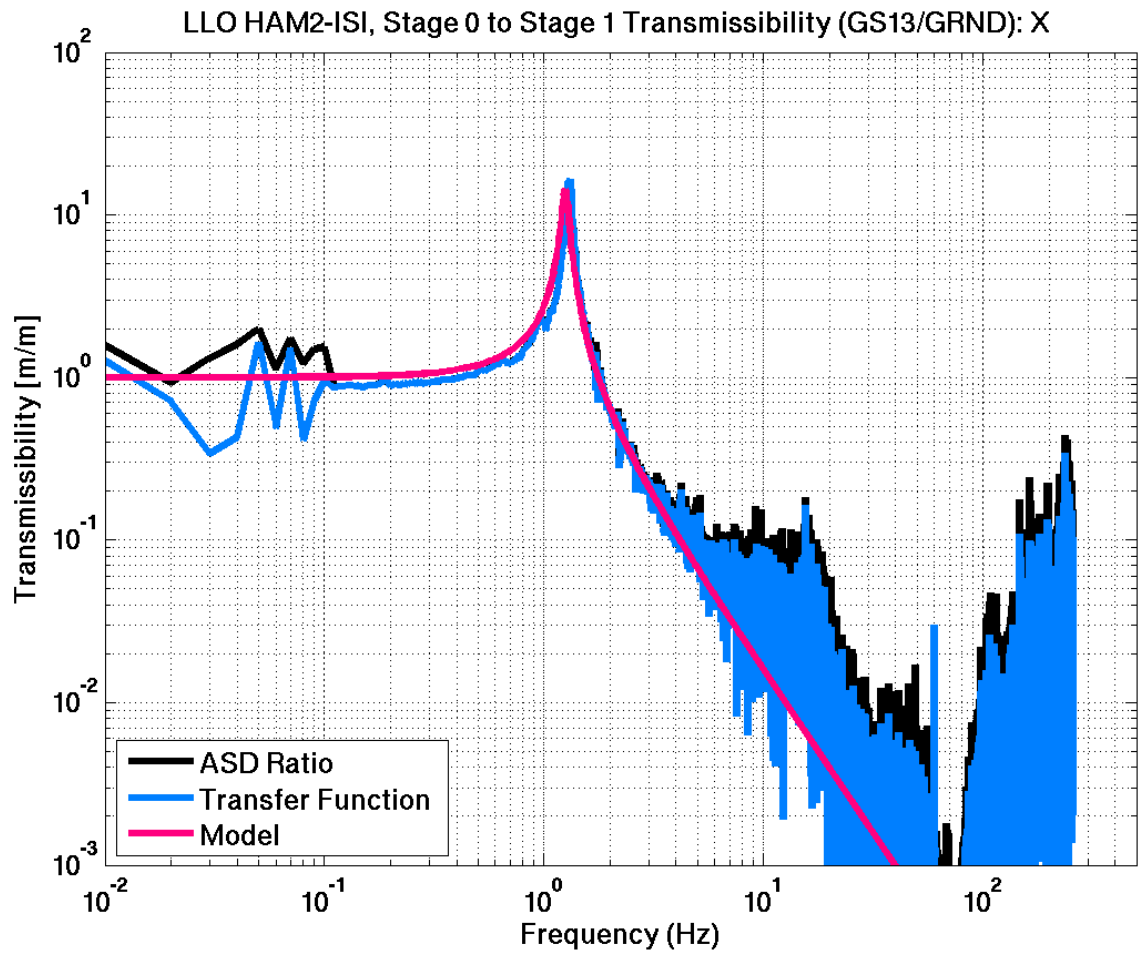


LLO HAM2-ISI, Local Sensors Spectra: Horizontal GS13, H1,H2,H3 Comparison

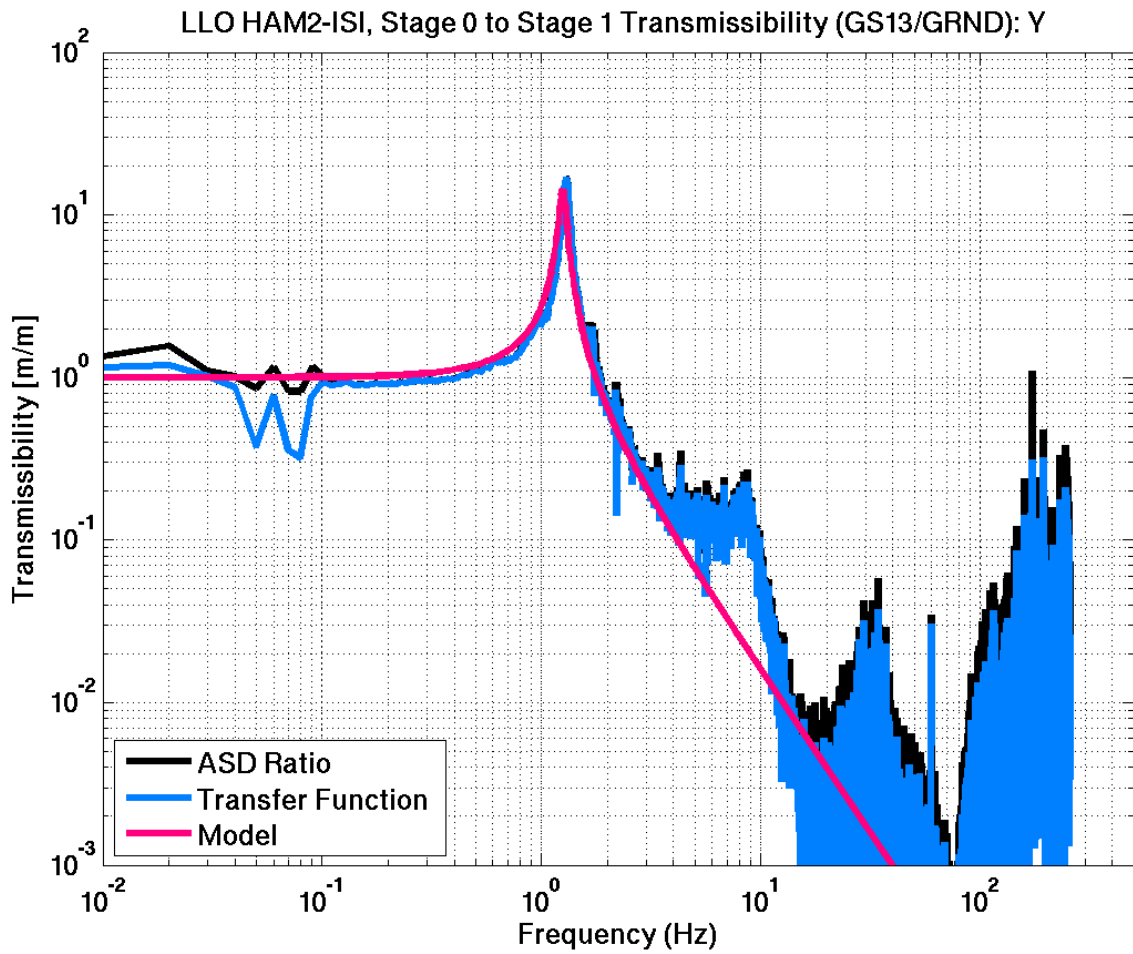


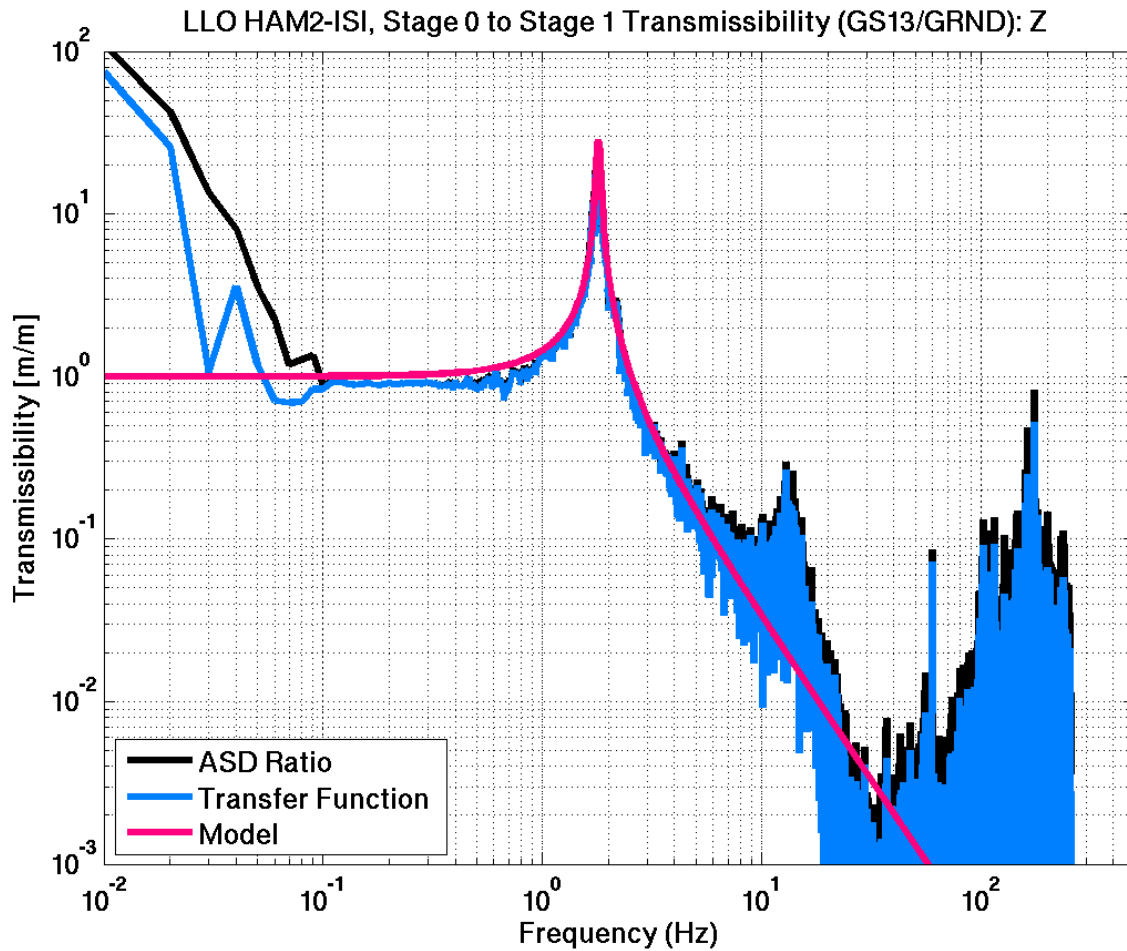
LLO HAM2-ISI, Local Sensors Spectra: Vertical GS13, V1,V2,V3 Comparison





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## 2) Test 2, Check the damping loops

- The script is Performance\_Test\_2\_Damping\_ON\_Low\_Gain.m
- It get and process the same signals in damped state.
- It plots and save figures comparing damped/undamped.
- It compare damped response with predicted response from the control scripts calculations.



## **Test 2, Procedure/Detailed description:**

### **In MEDM:**

- Turn Master switch ON
- Leave Calib buttons Engaged (CPS, L4C and GS13)
- Leave Gain buttons Engaged (L4C and GS13)
- Leave DWH button Dis-Engaged (GS13)
- Turn ON Damping Loops
- Run Performance\_Test\_2\_Damping\_ON\_Low\_Gain.m

### **The script gets 900 seconds of data for**

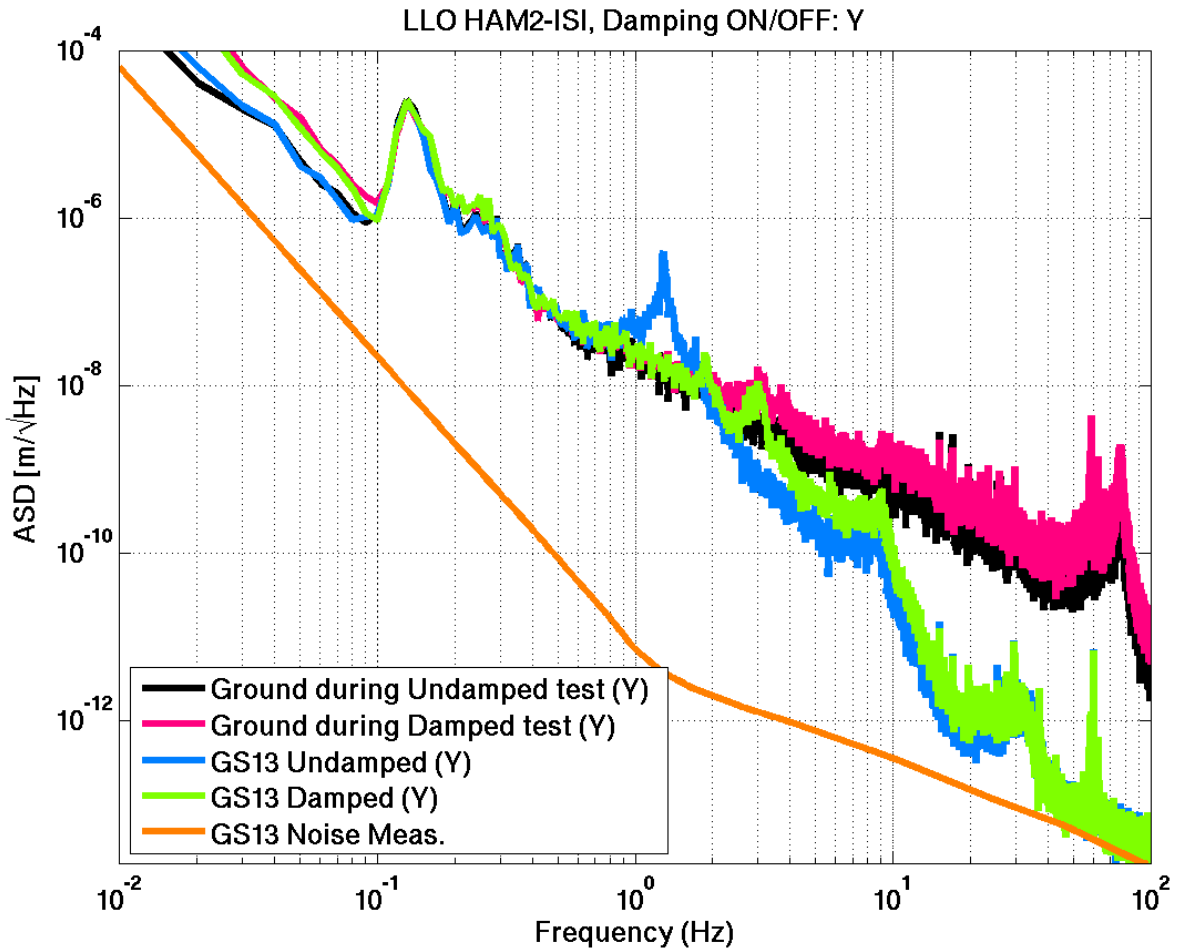
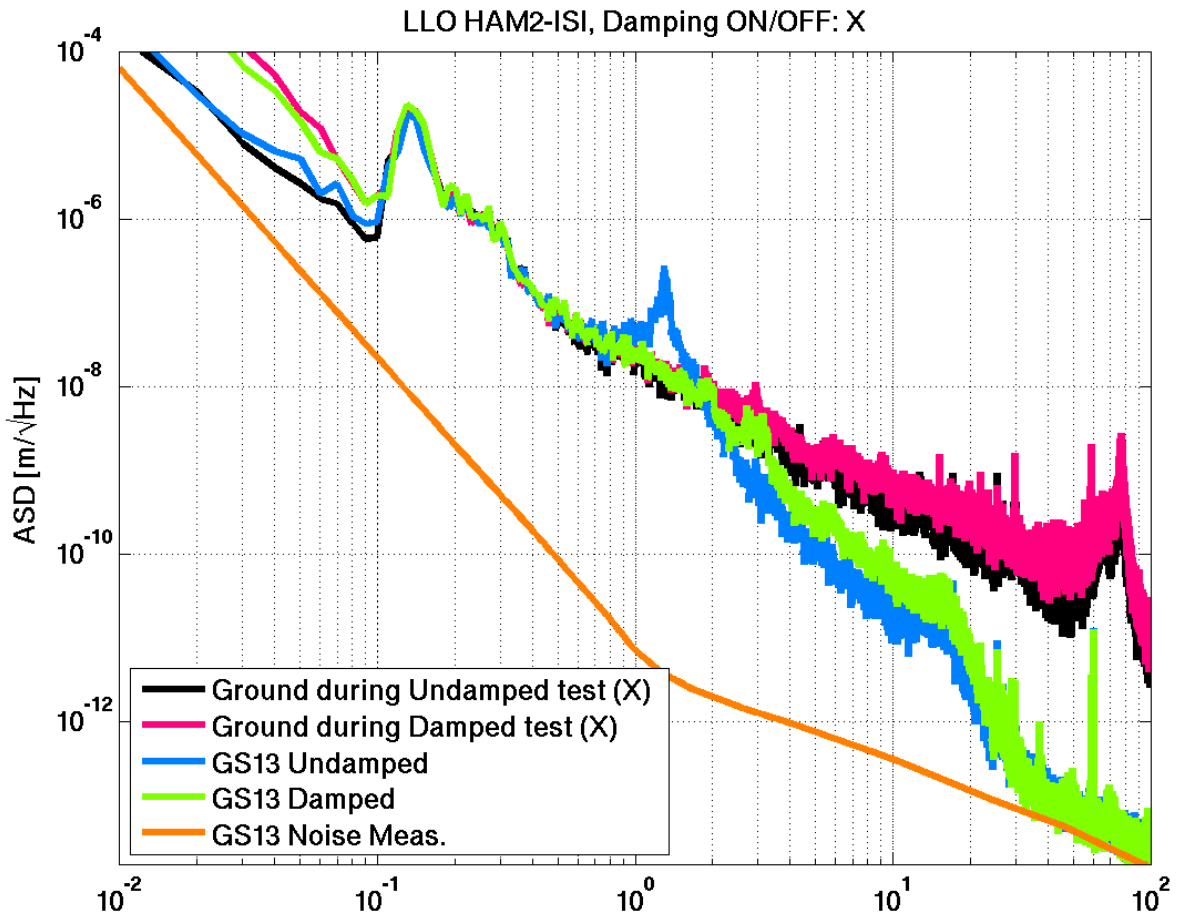
- The ground STS2 signals
- The 6 local and 6 Cartesian L4C signals
- The 6 local and 6 Cartesian CPS signal
- The 6 local and 6 Cartesian GS13 signals

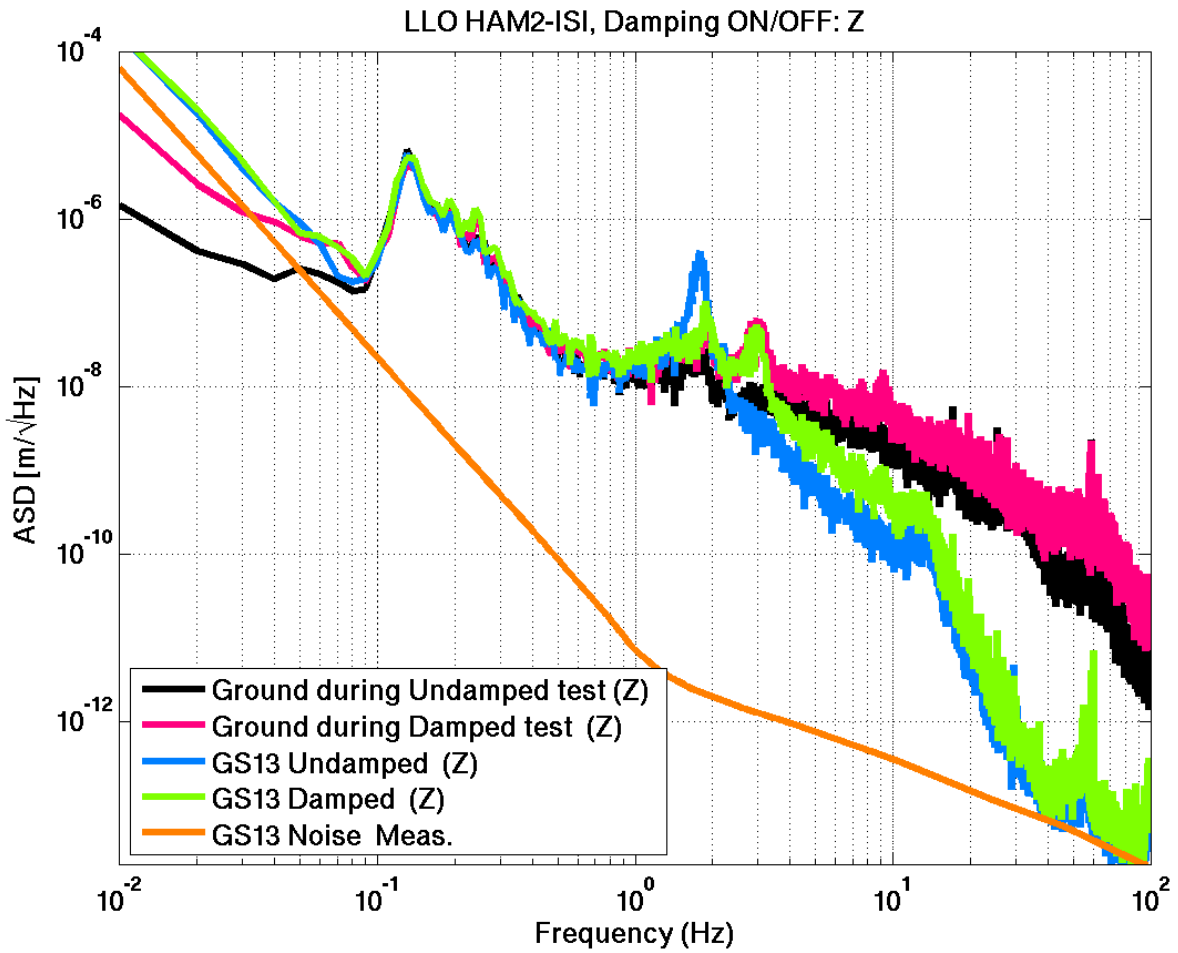
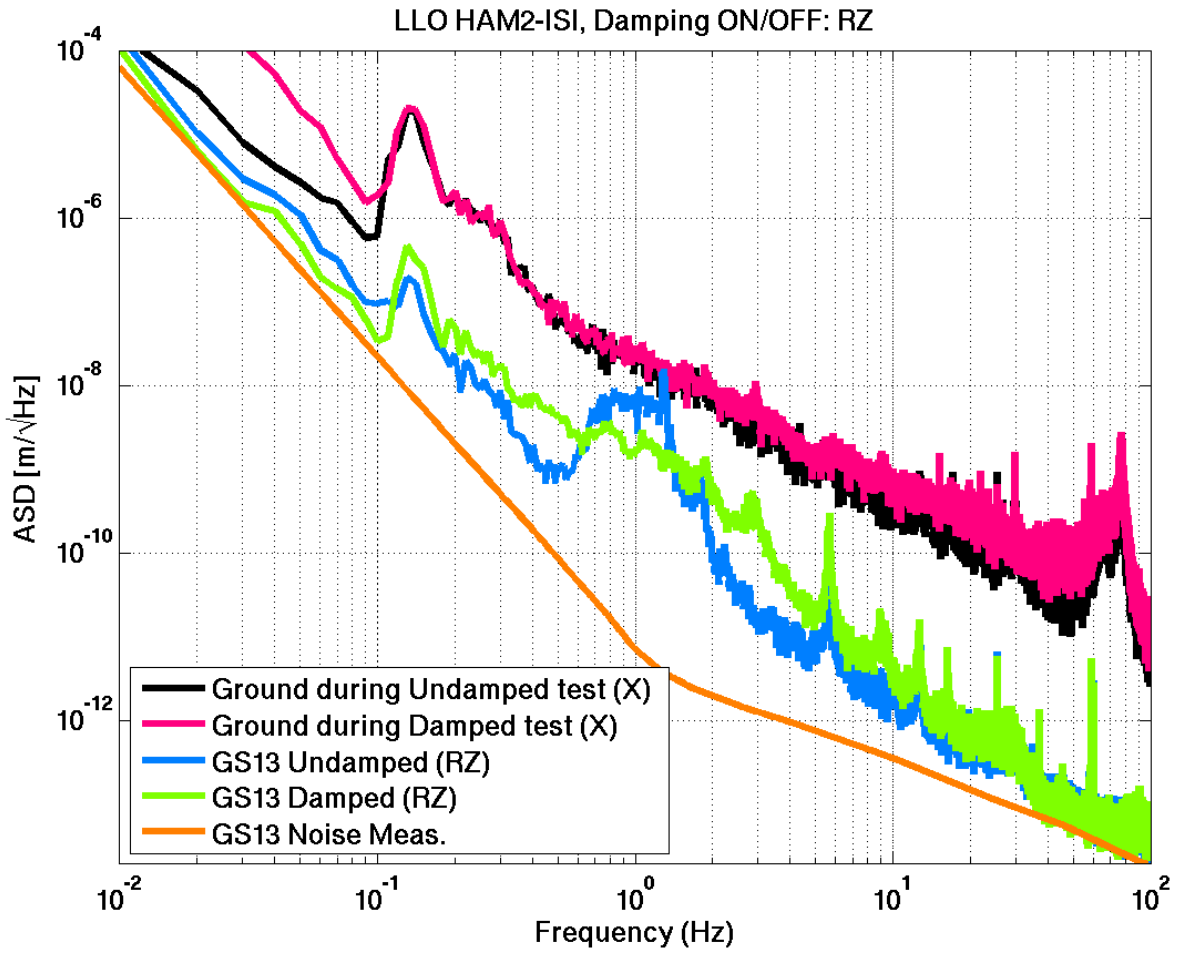
### **Then it:**

- Decimates, computes ASD and calibrates the Loc
- Stores the processed ASDs in a structure saved in /Data/Perf\_Analysis/
- It computes models of sensitivity

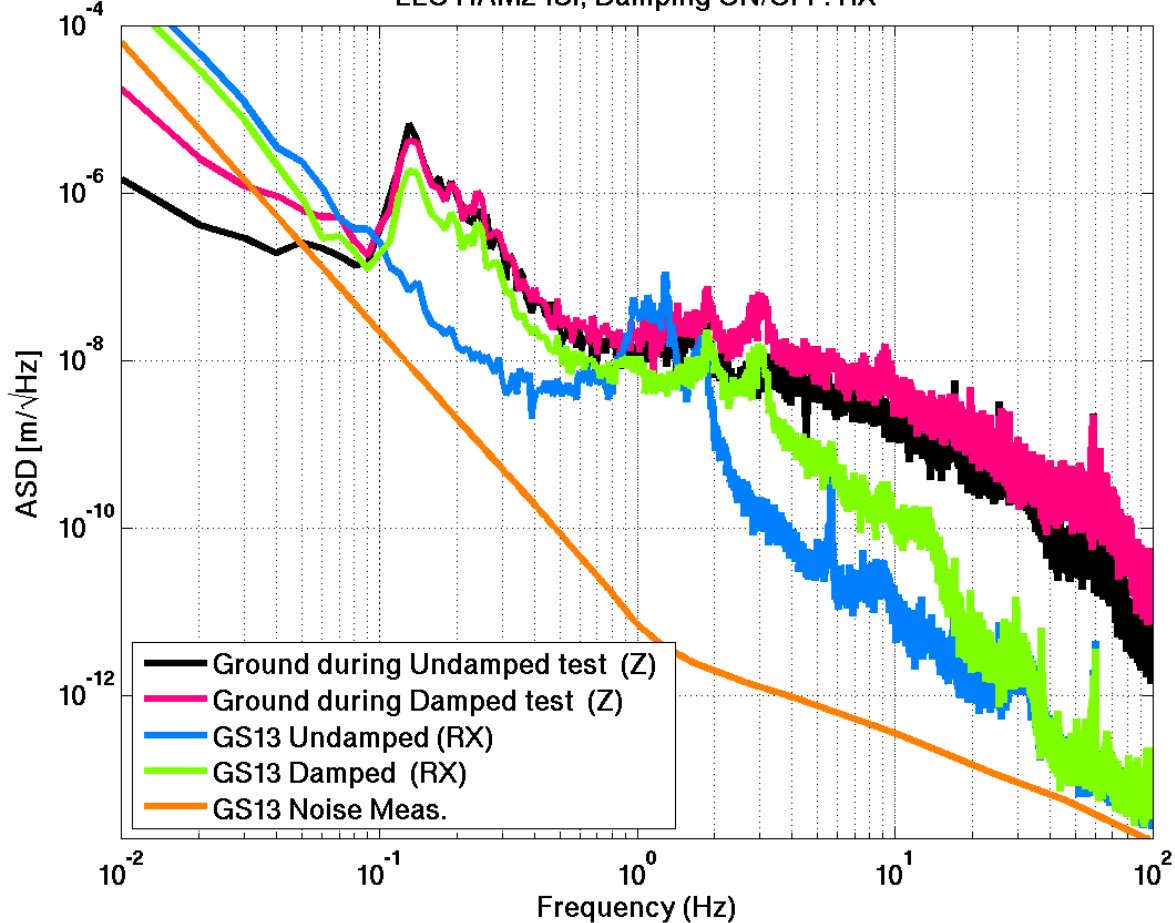
### **Finally it plots the results and save the figures:**

- Plots figures comparing damped/undamped..
- Compare damped response with predicted response from the control scripts calculations.
- Saves the Figures in /Data/Figures/Perf\_Analysis/

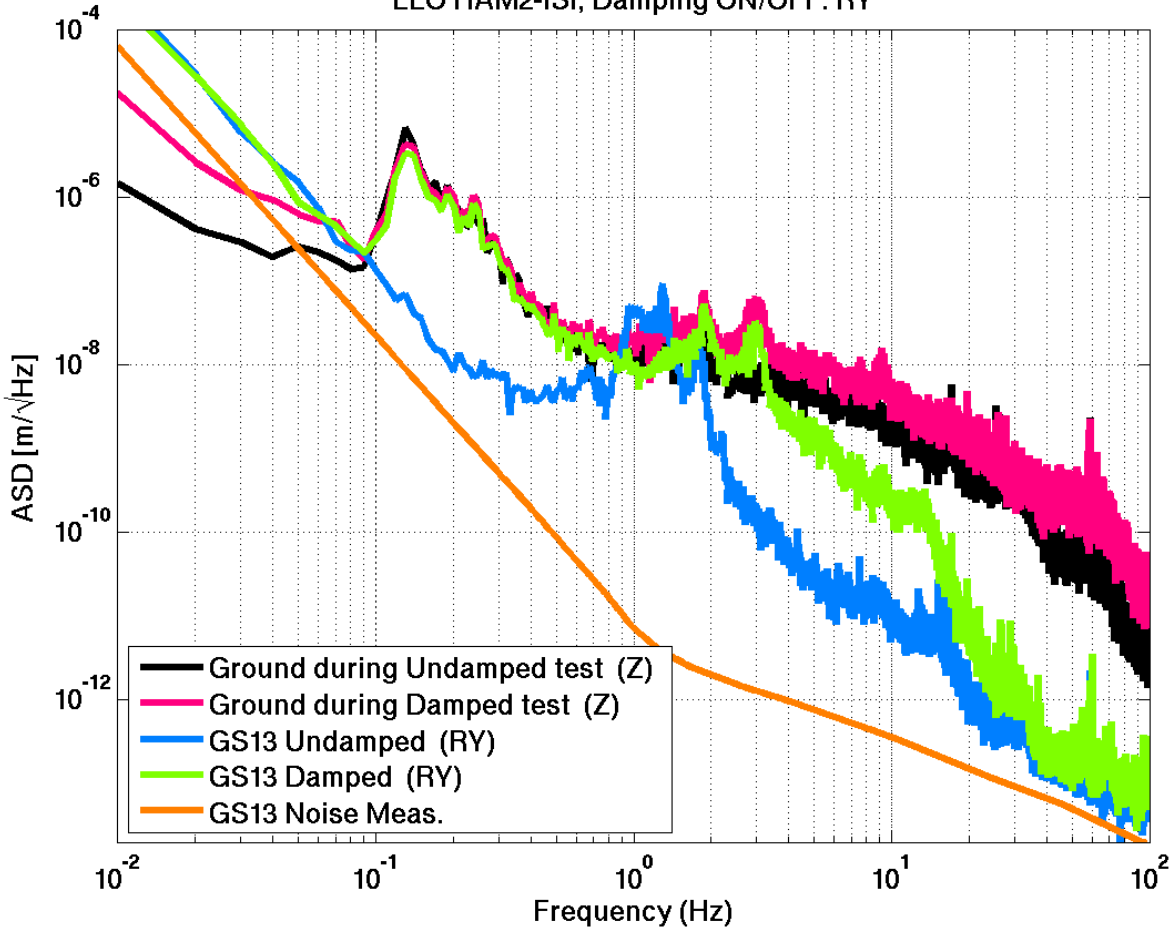


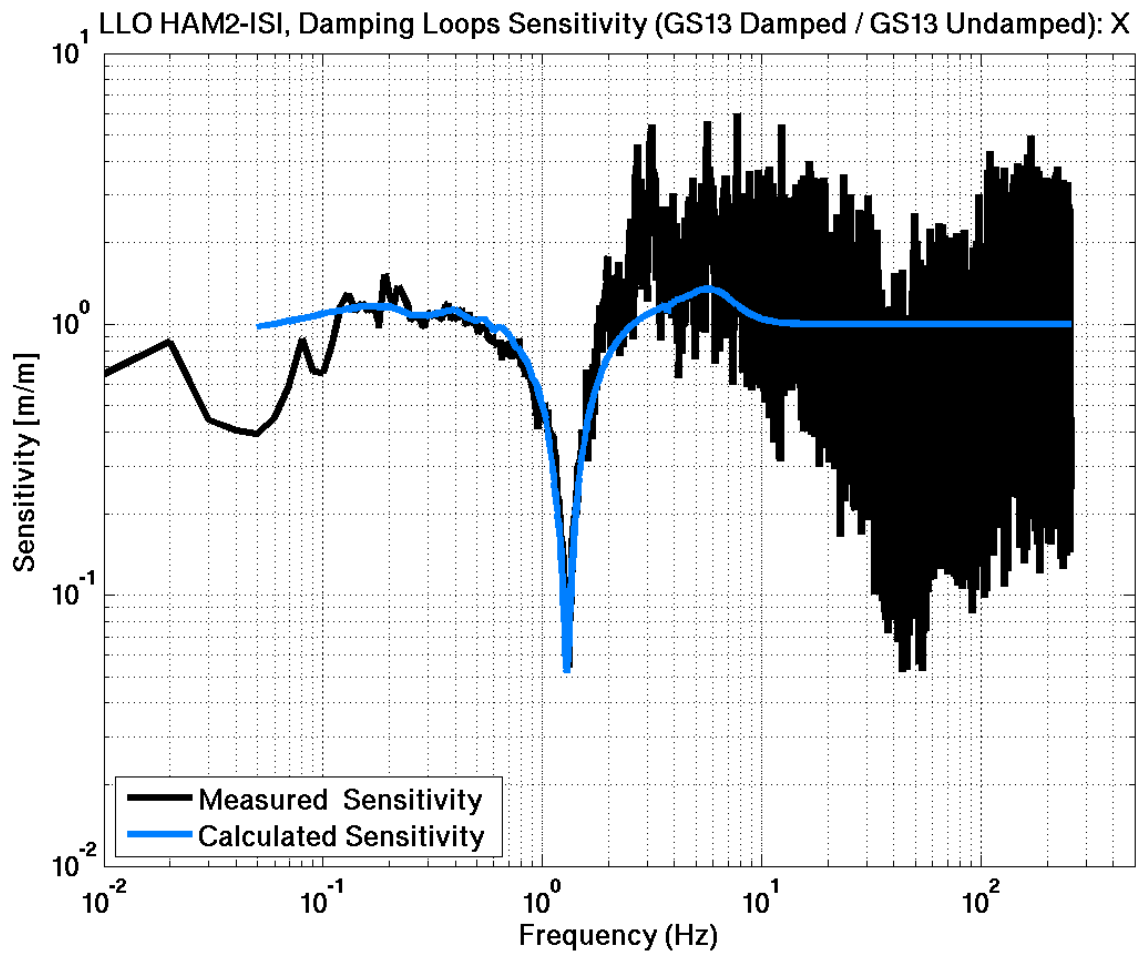


LLO HAM2-ISI, Damping ON/OFF: RX

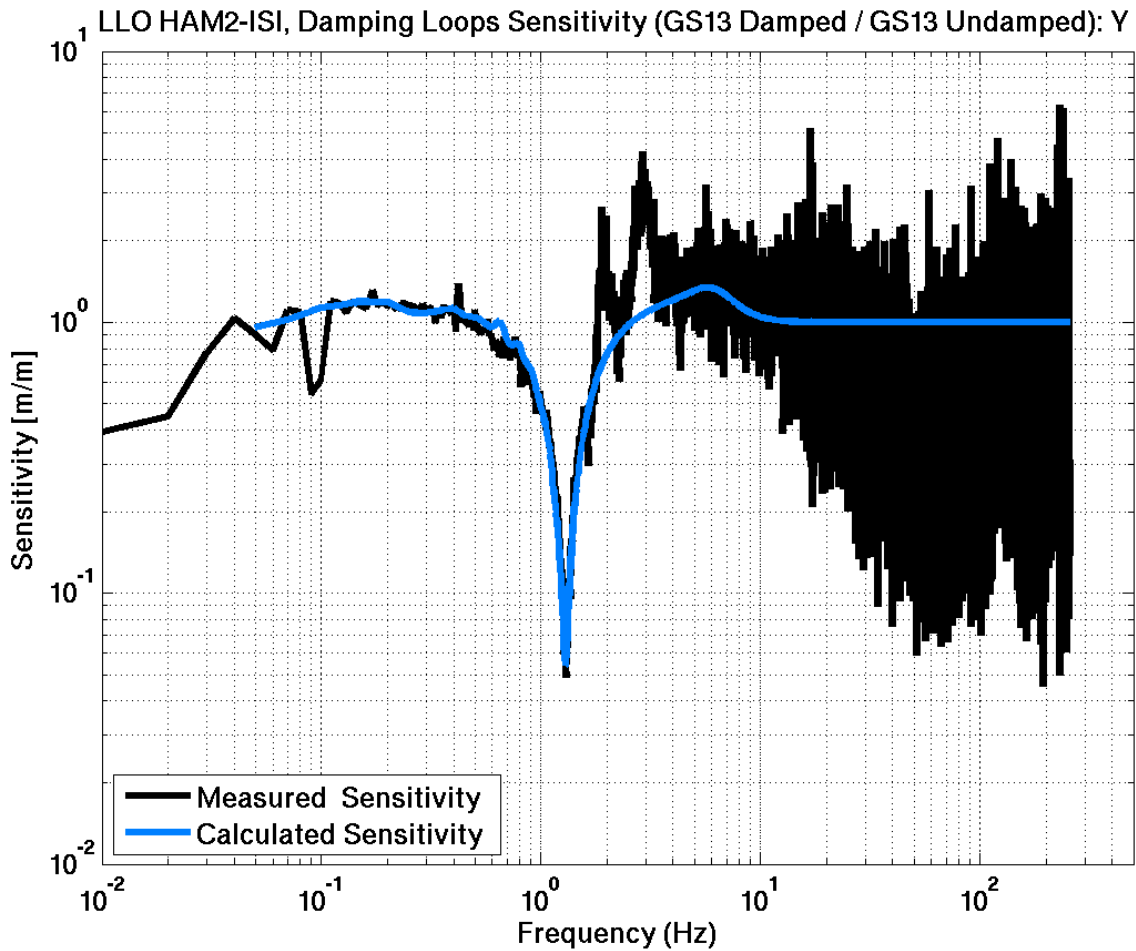


LLO HAM2-ISI, Damping ON/OFF: RY

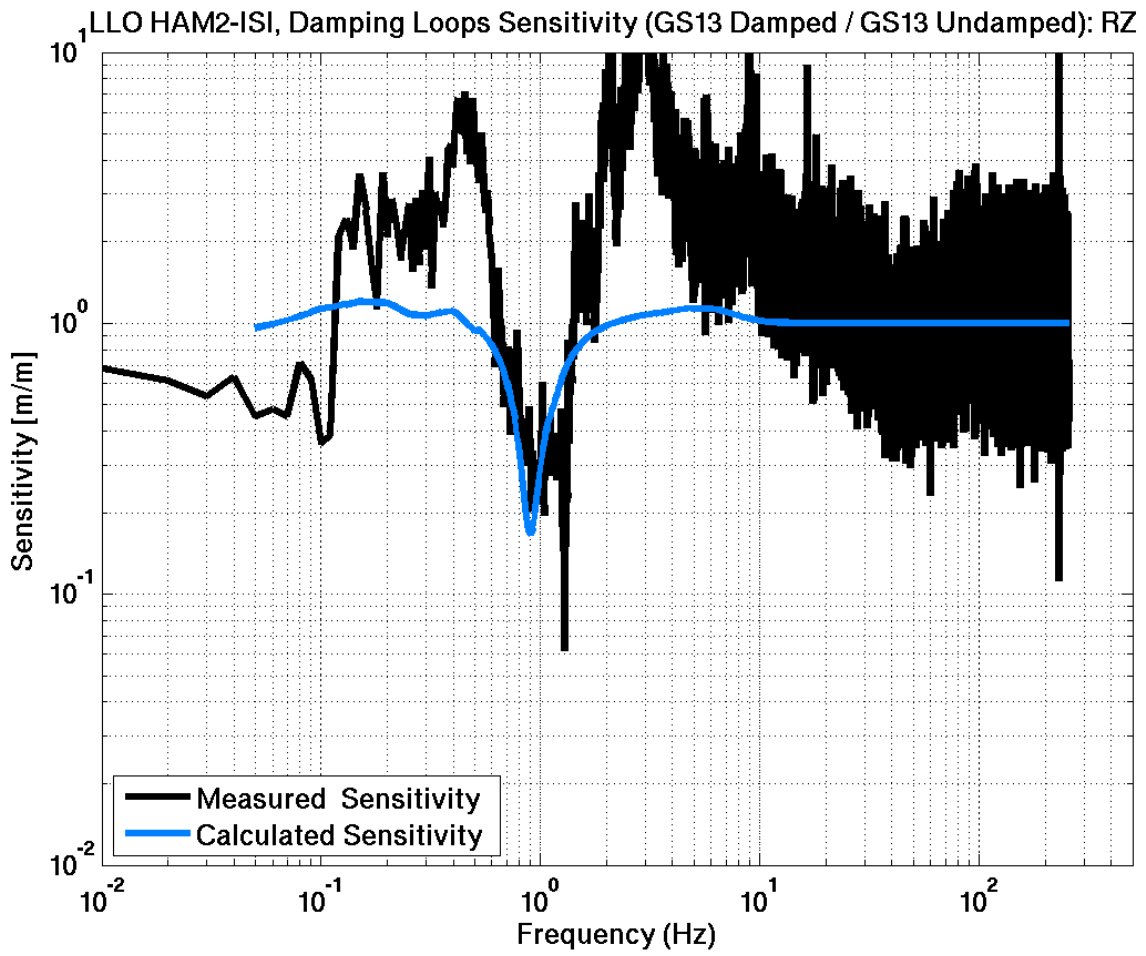




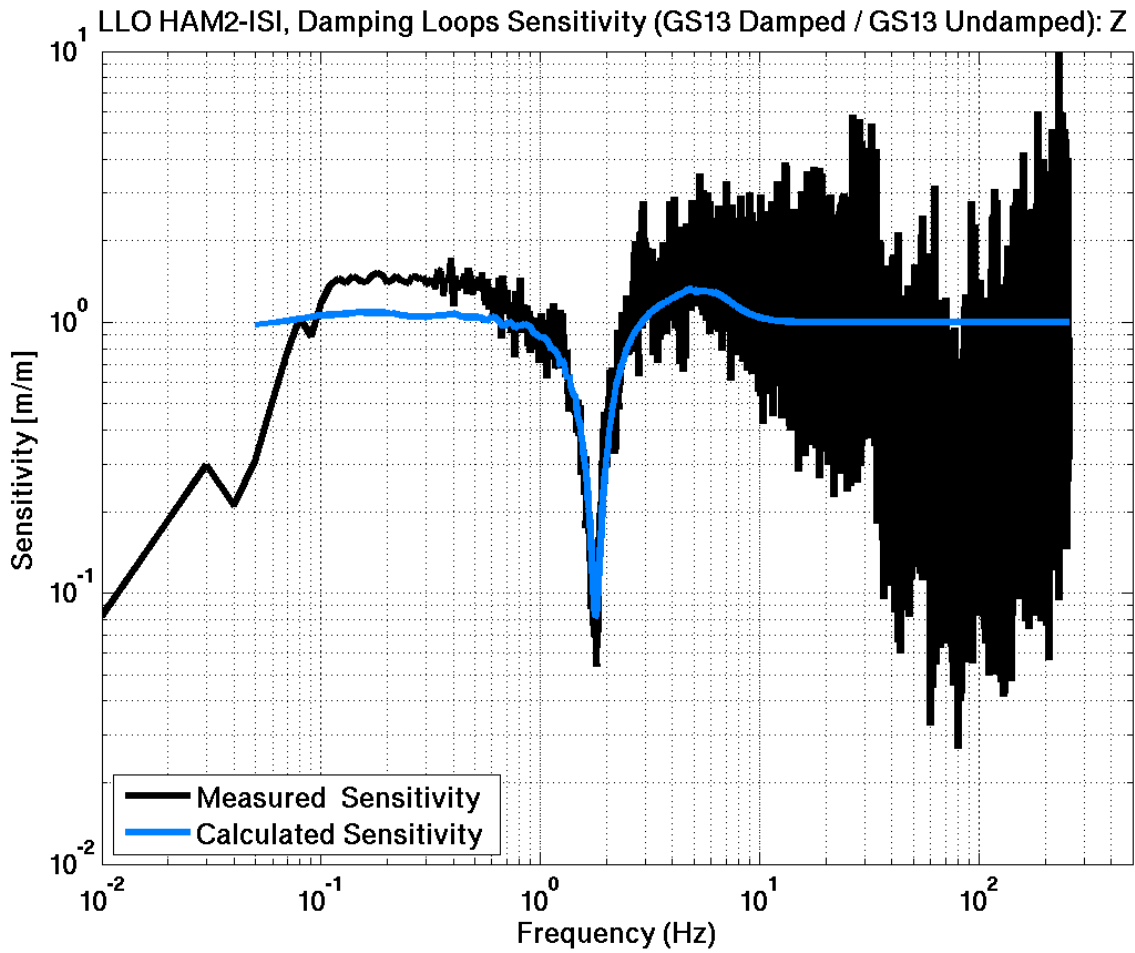
created by Plot\_Performance\_HAM\_ISI on 24-Jan-2013



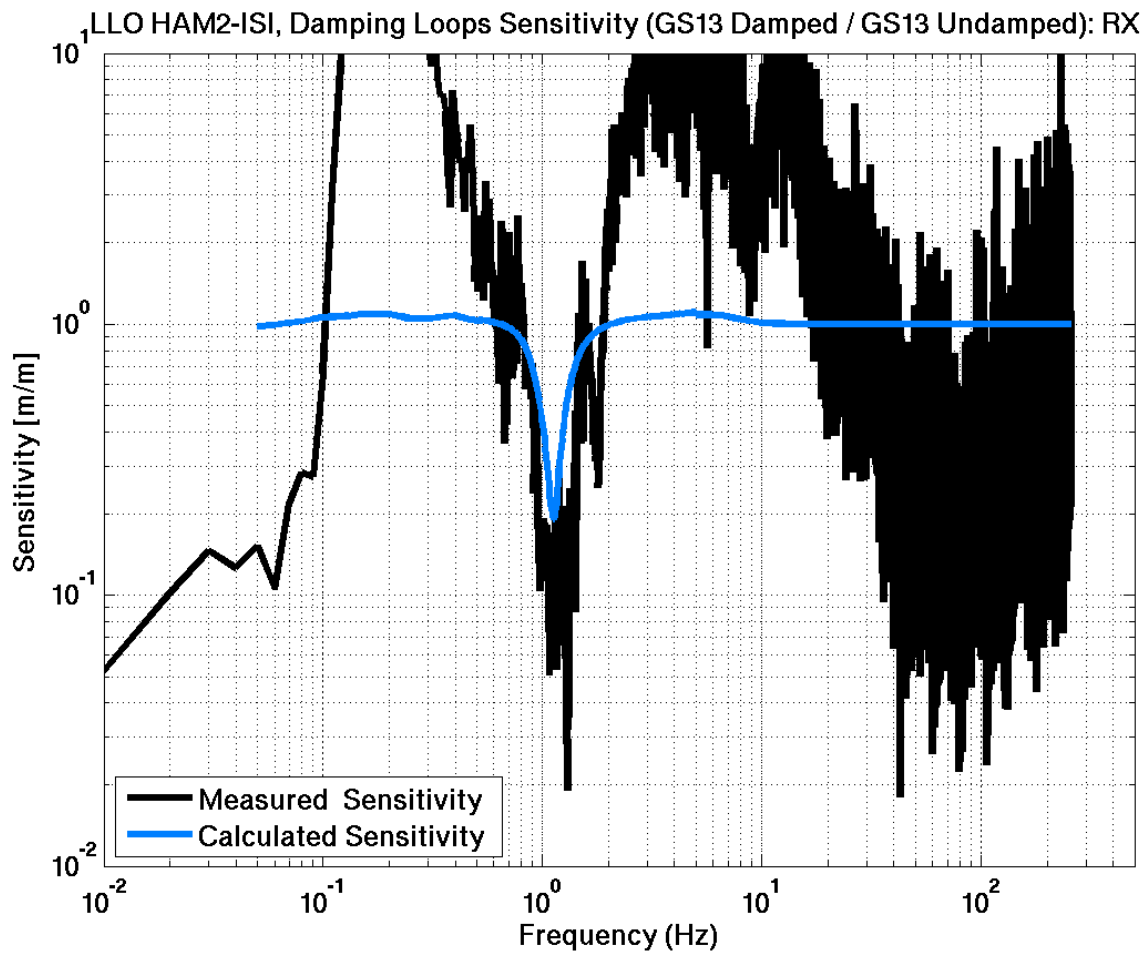
created by Plot\_Performance\_HAM\_ISI on 24-Jan-2013



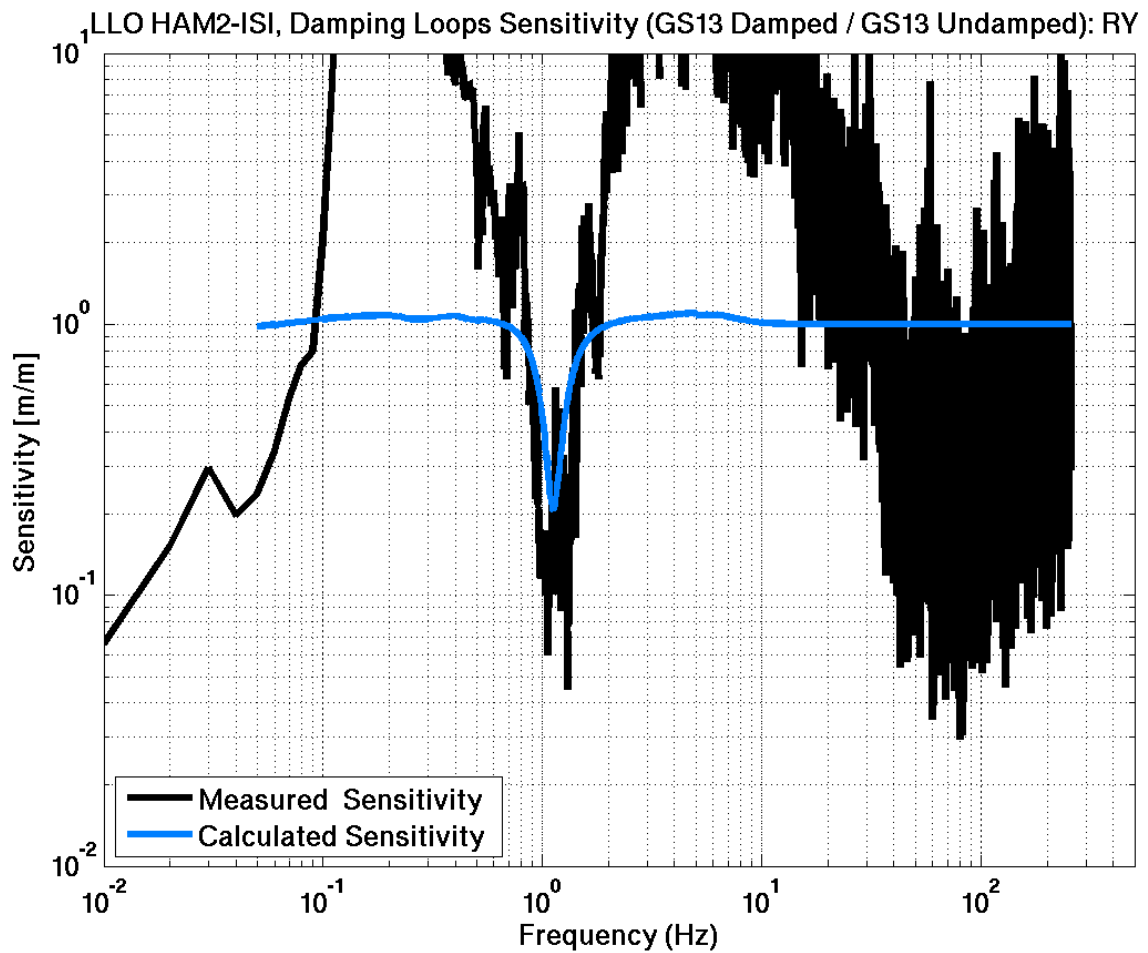
created by Plot\_Performance\_HAM\_ISI on 24-Jan-2013



created by Plot\_Performance\_HAM\_ISI on 24-Jan-2013



created by Plot\_Performance\_HAM\_ISI on 24-Jan-2013



created by Plot\_Performance\_HAM\_ISI on 24-Jan-2013

### **3) Check analog/digital switchable filter**

The script is Performance\_Test\_3\_Damping\_ON\_High\_Gain.m

The platform remains in damping mode. The analog gain and whitening filters are turned on, such as their digital counterpart.

The script take, process and plot data to check this is working as it should.

#### **Procedure:**

Check analog/digital switchable filter

#### **In MEDM:**

- Leave Master switch ON
- Leave Damping Loops ON
- Leave Calib buttons Engaged (CPS, L4C and GS13)
- Dis-Engaged Gain buttons (L4C and GS13)
- Engaged DWH button (GS13)
- Run Performance\_Test\_3\_Damping\_ON\_High\_Gain.m

#### **The script gets 900 seconds of data for**

- The ground STS2 signals
- The 6 local and 6 Cartesian L4C signals
- The 6 local and 6 Cartesian CPS signal
- The 6 local and 6 Cartesian GS13 signals

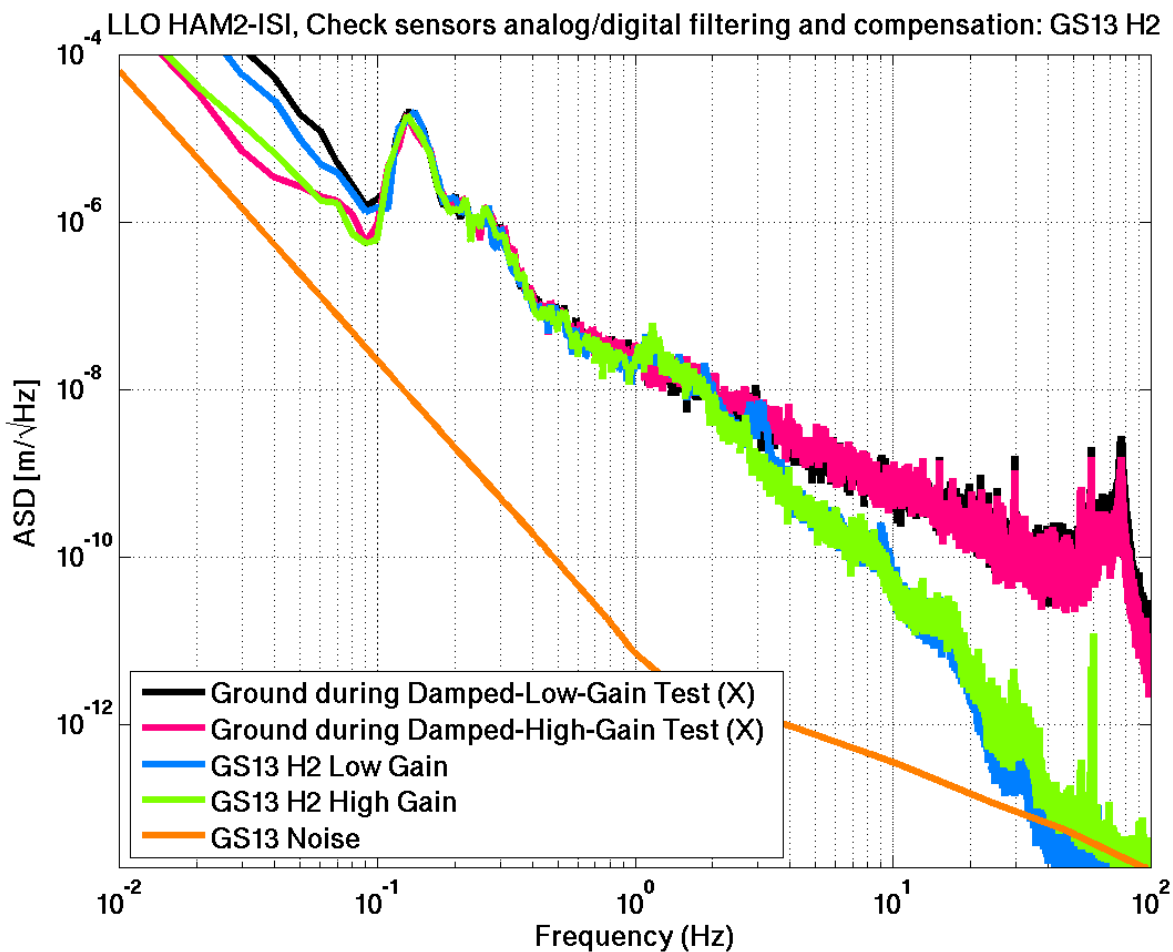
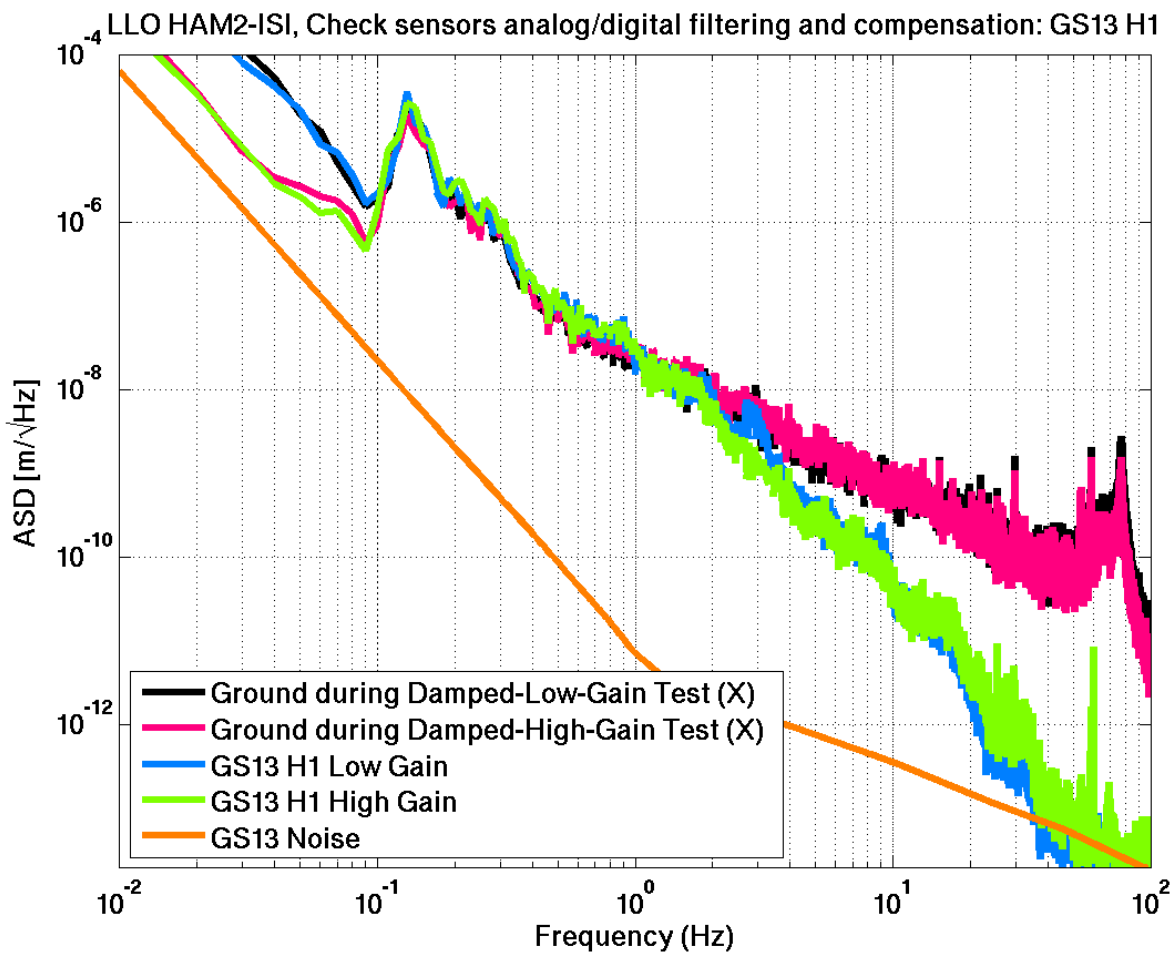
#### **Then it:**

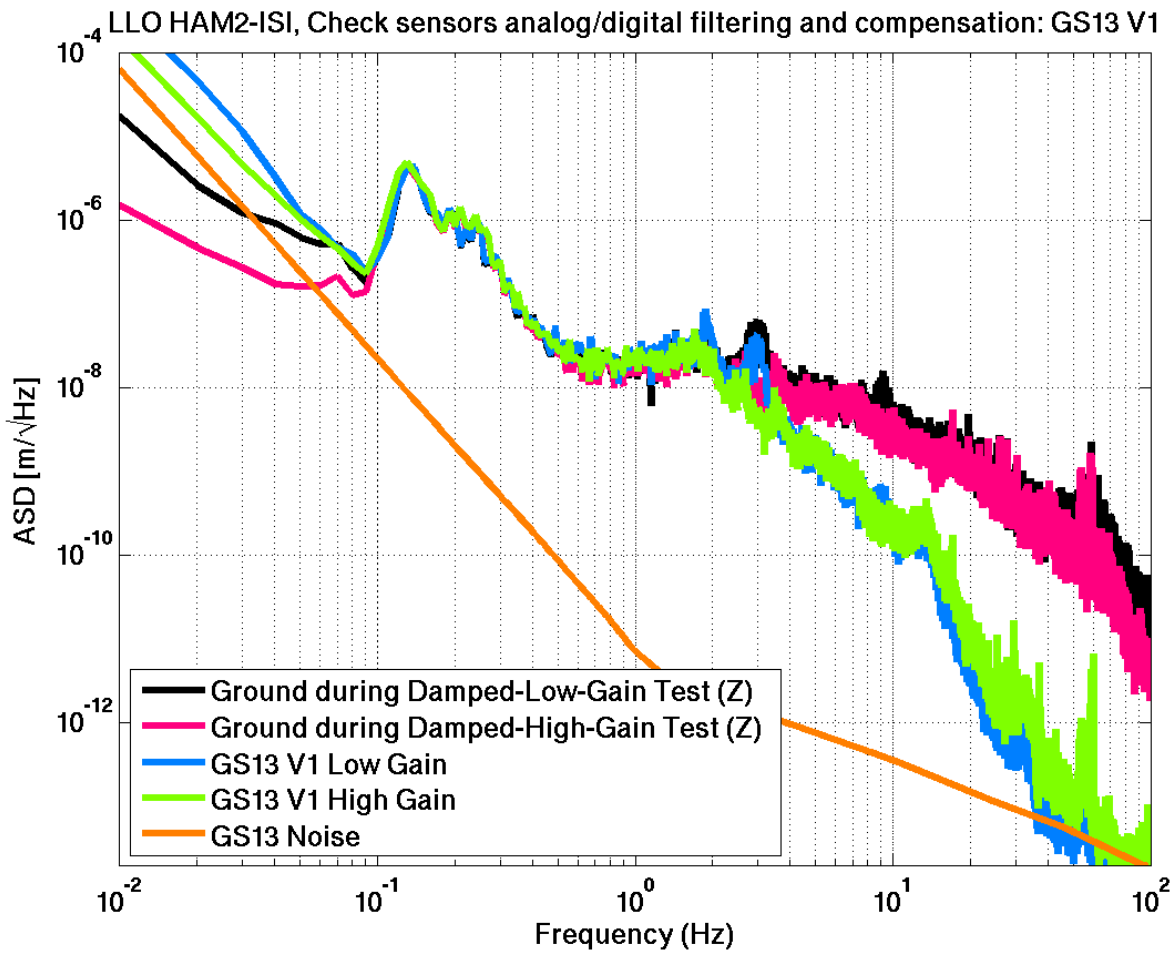
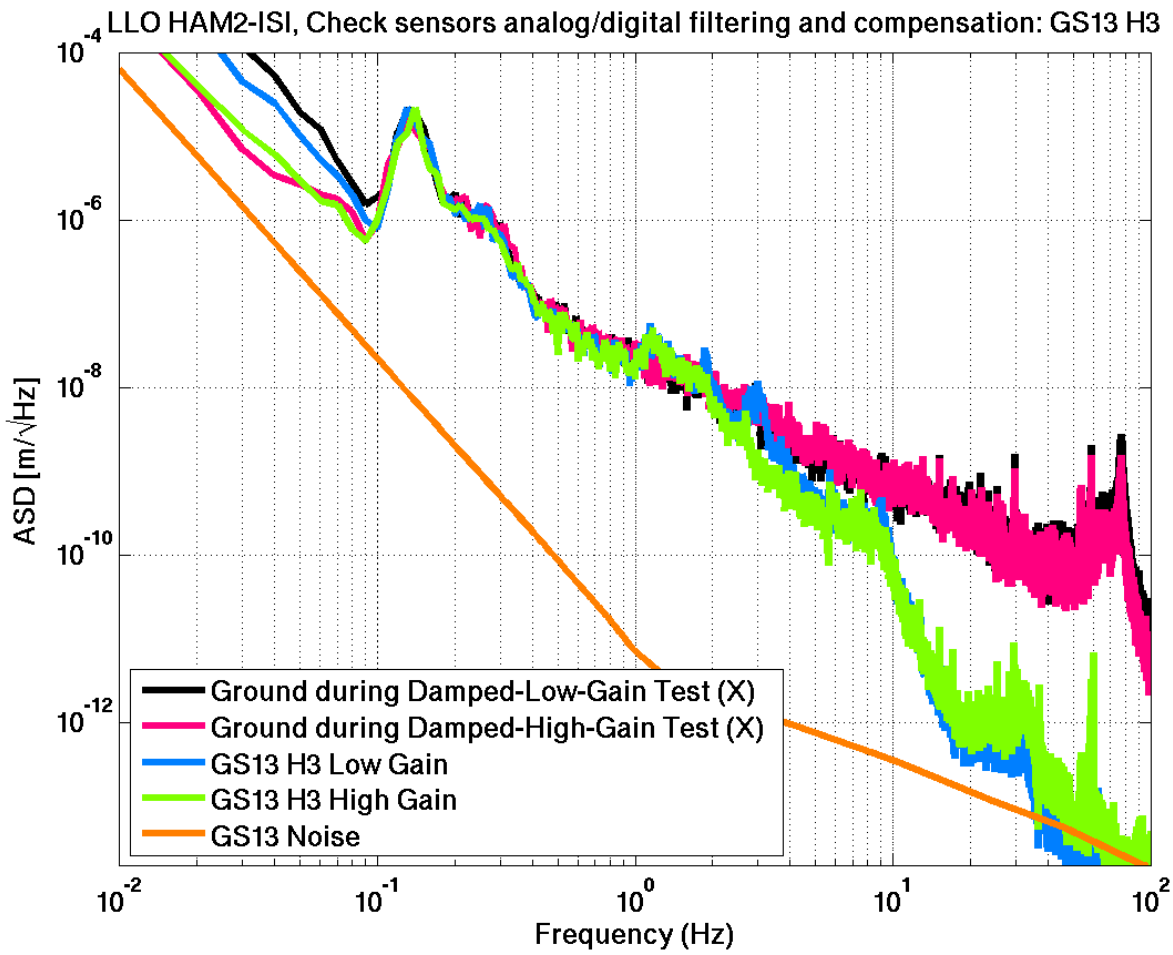
- Decimates, computes ASD and calibrates.
- Stores the processed ASDs in a structure saved in /Data/Perf\_Analysis/

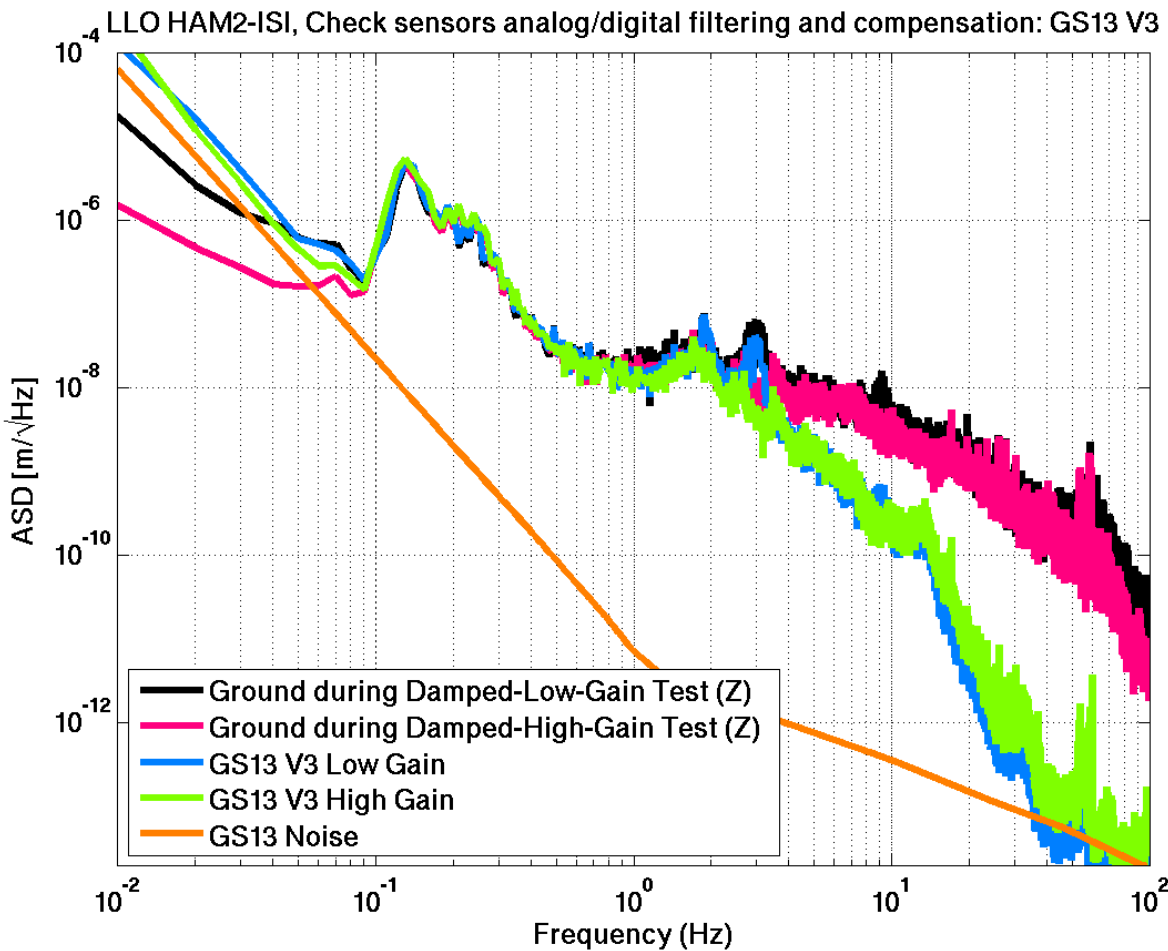
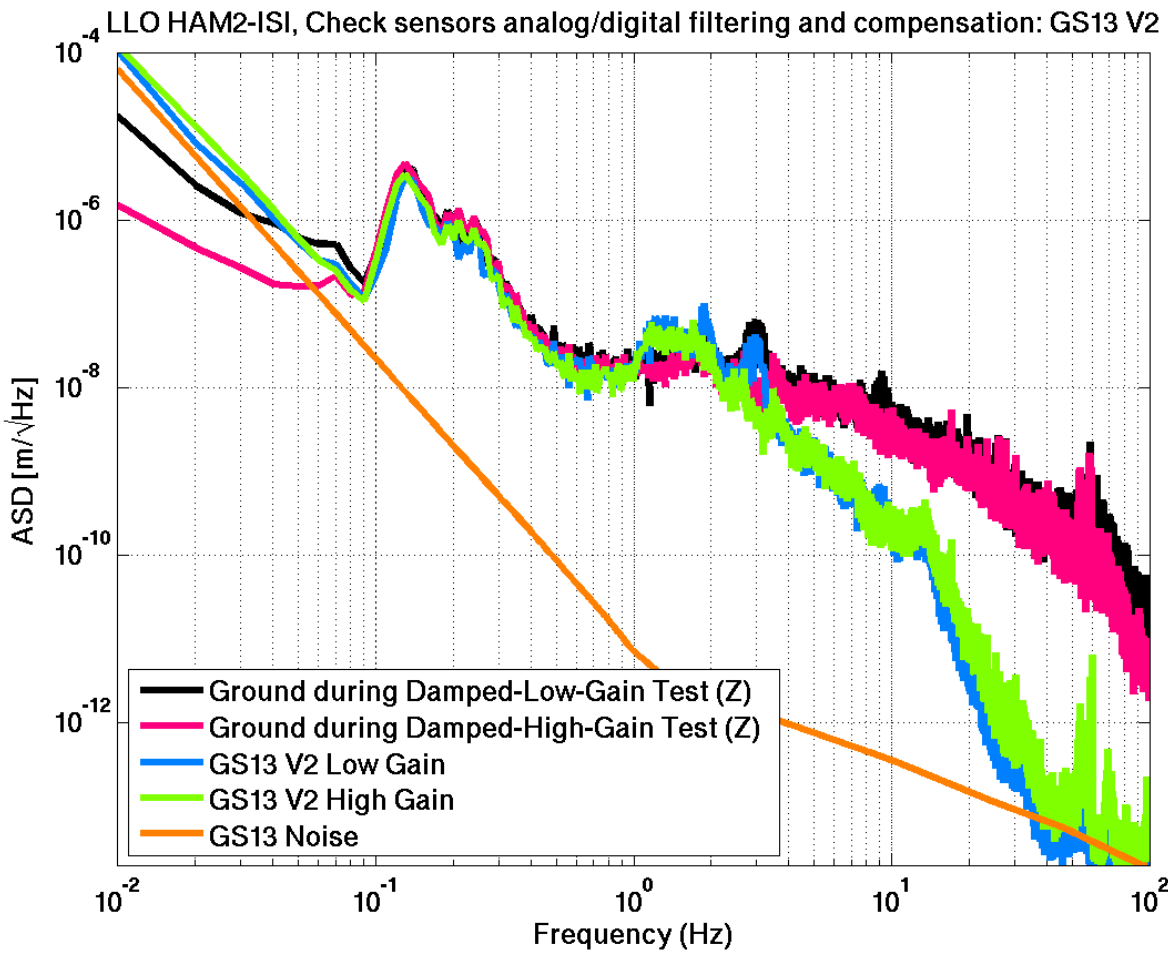
#### **Finally it plots the results and save the figures:**

- Compares the Local Sensors in Low Gain and High Gain mode
- Saves the Figures in /Data/Figures/Perf\_Analysis/









#### 4) Check Vertical control loop performance

- Performance\_Test\_4\_Vertical\_Isolation\_ON\_High\_Gain.m
- This script take and process data with the vertical loops engaged. The ISI must be under the blend filterinr that we are going to select and make "official" (blend filters tuned during the LLO IMC test).
- Control loops will be in level 2.
- The scripts compare the GS13 response Damped and controlled to check the performance.
- It also plots the CPS to check the low frequency motion amplification due to sensor noise injection.
- it check the measured suppression matches with calculated suppression.

#### Procedure

In MEDM:

- Leave Master switch ON
- Leave Damping Loops ON
- Leave Calib buttons Engaged (CPS, L4C and GS13)
- Leave Gain buttons Dis-Engaged (L4C and GS13)
- Leave DWH button Engaged (GS13)
- Switch the Vertical Blend to 400 mHz standard blend
- Turn on the vertical isolation loops (Level 2)
- Run Performance\_Test\_4\_Vertical\_Isolation\_ON\_High\_Gain.m

The script gets 900 seconds of data for

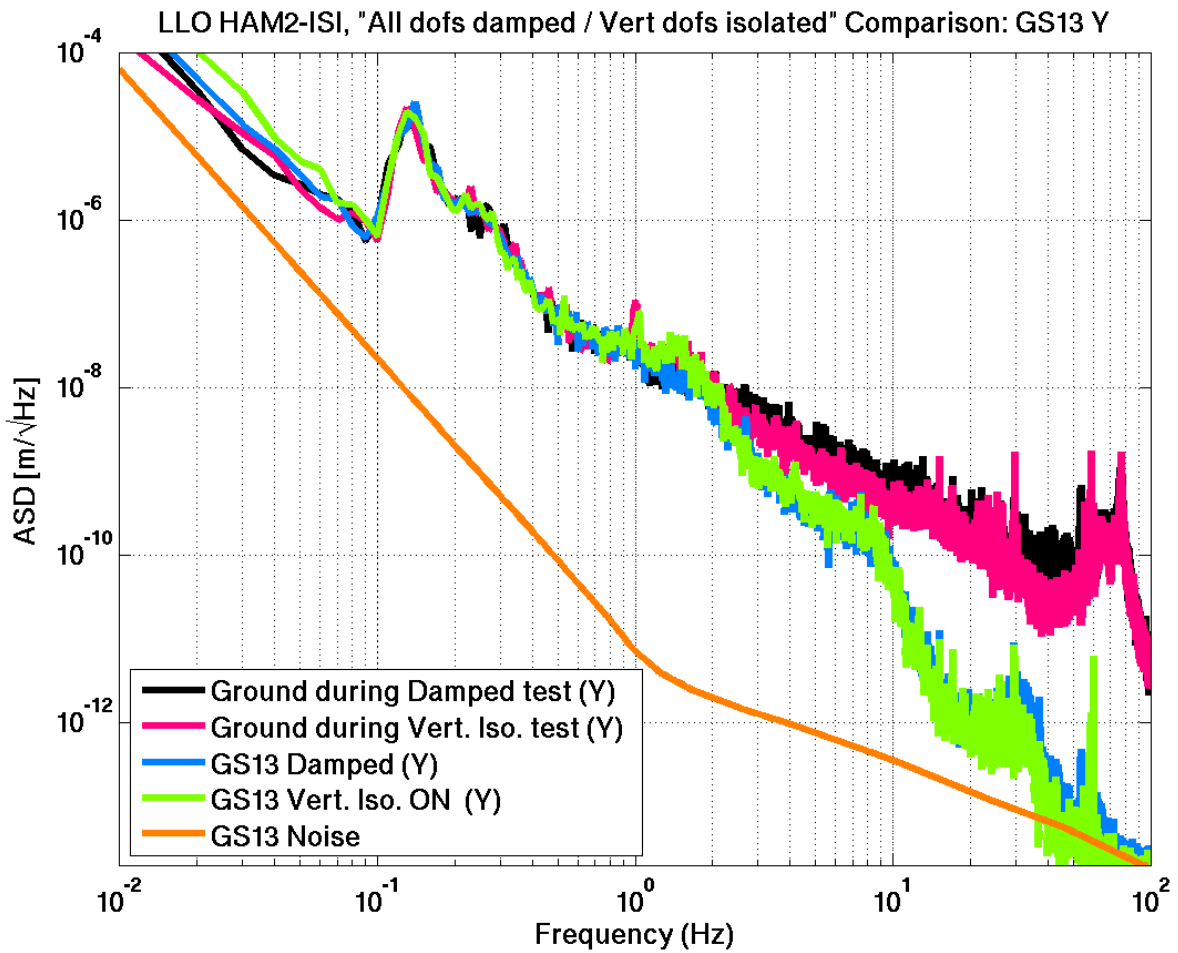
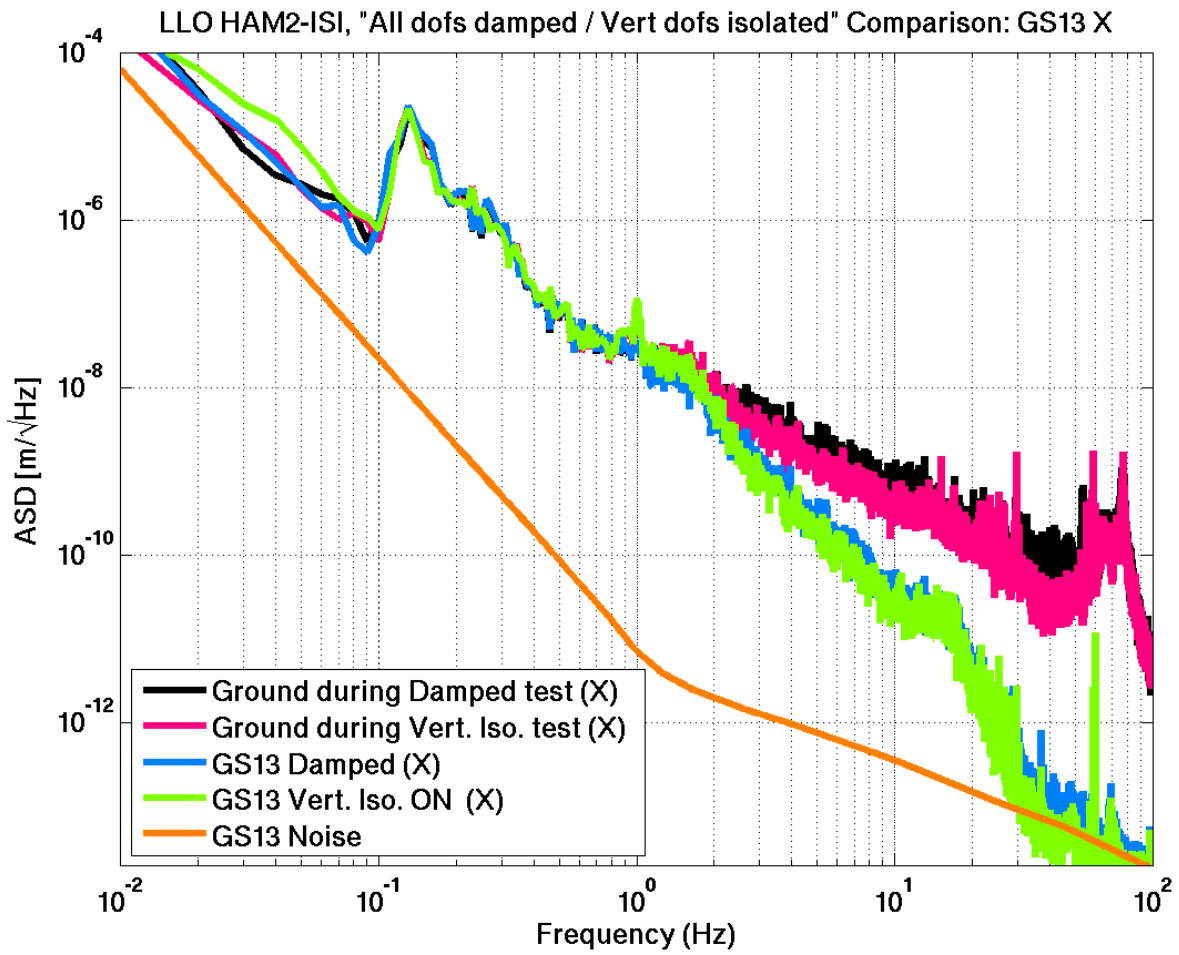
- The ground STS2 signals
- The 6 local and 6 Cartesian L4C signals
- The 6 local and 6 Cartesian CPS signal
- The 6 local and 6 Cartesian GS13 signals

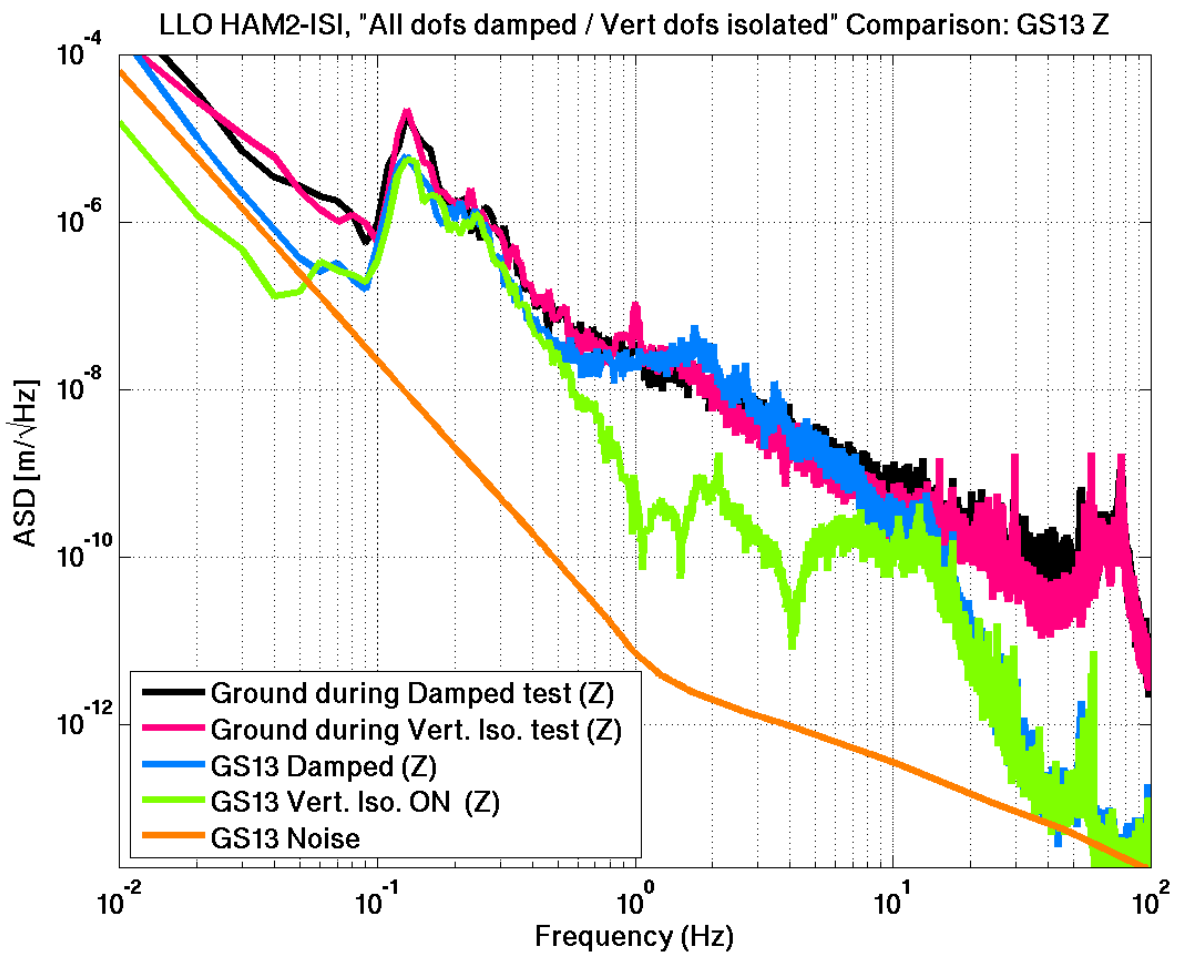
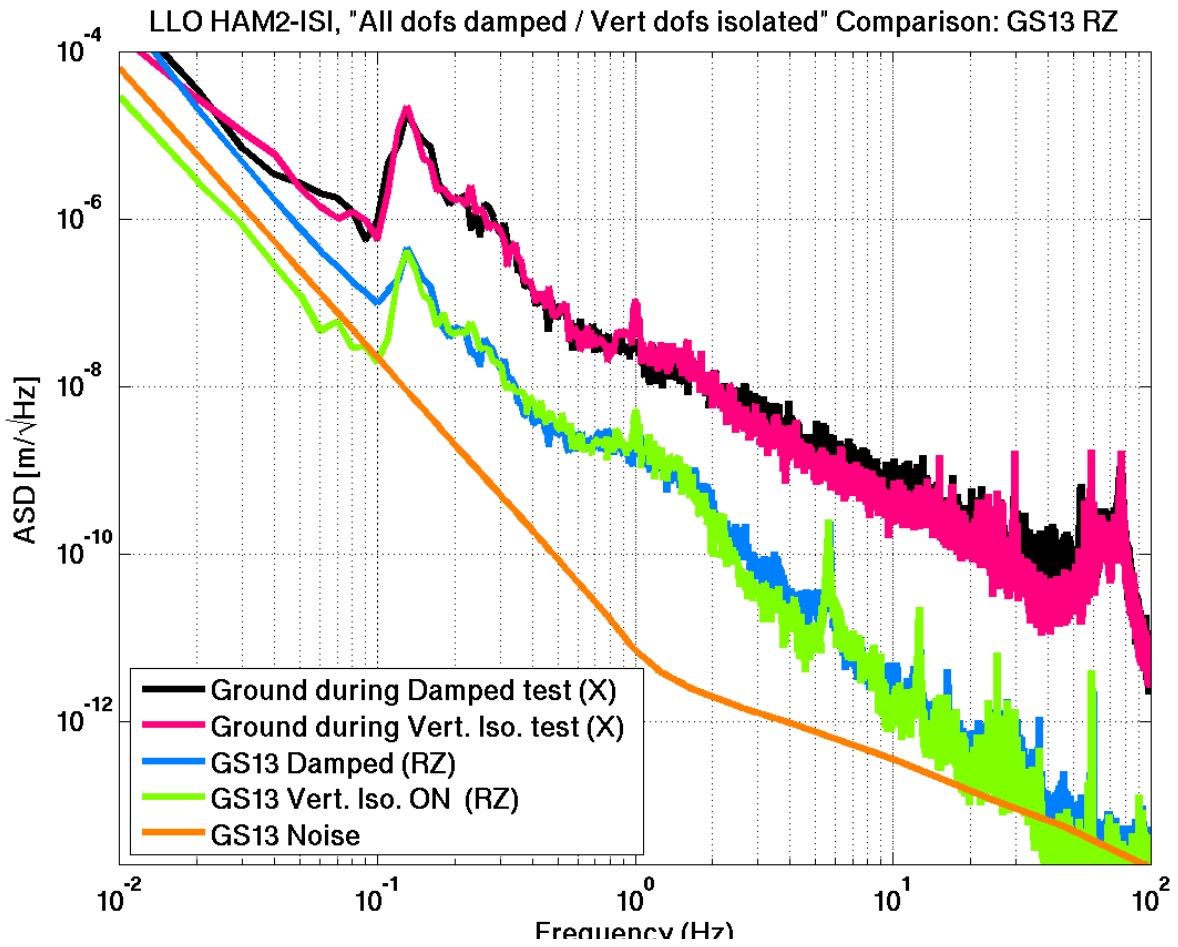
Then it:

- Decimates, computes ASD and calibrates.
- Stores the processed ASDs in a structure saved in /Data/Perf\_Analysis/

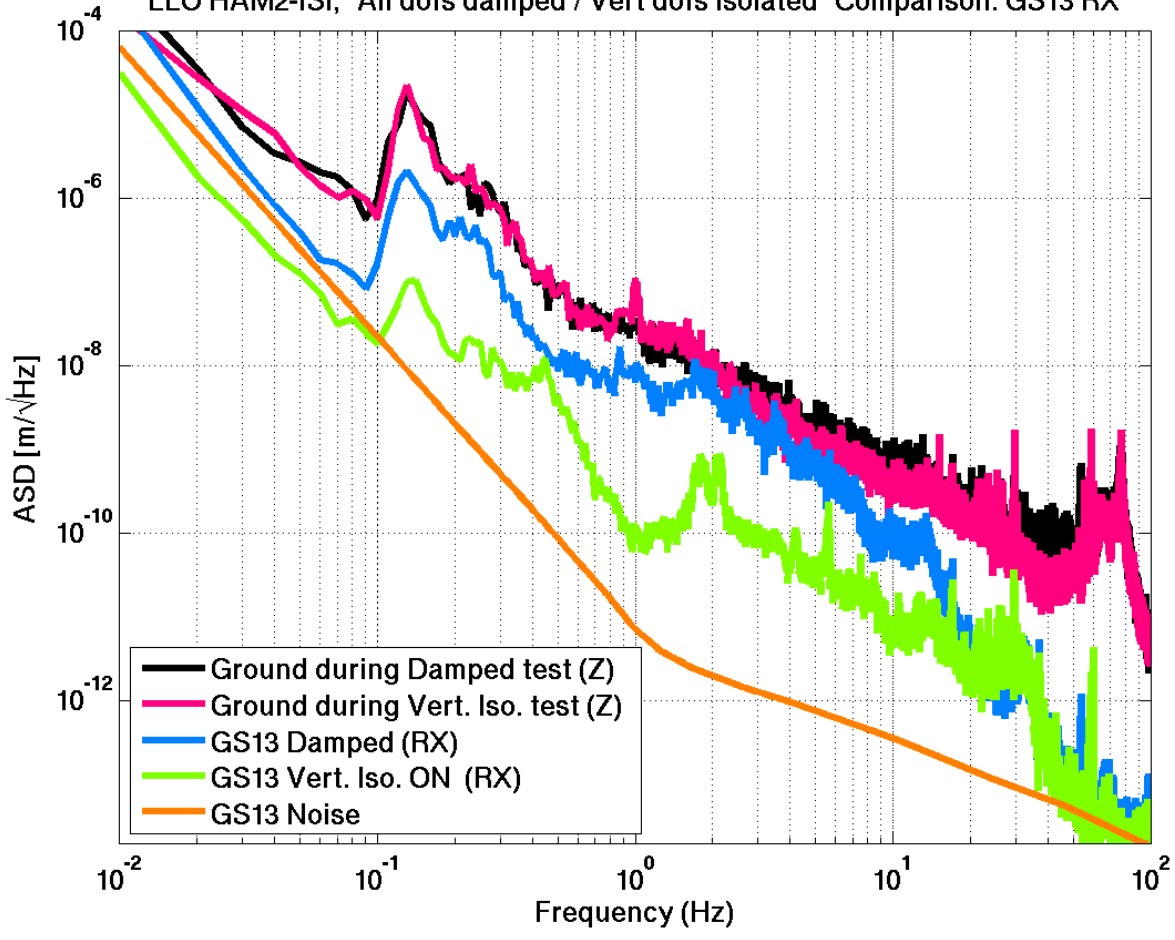
Finally:

- The scripts compare the GS13 response Damped and controlled to check the performance.
- It plots the CPS to check the low frequency motion amplification due to sensor noise injection.
- It check the measured suppression matches with calculated suppression.
- It Saves the Figures in /Data/Figures/Perf\_Analysis/

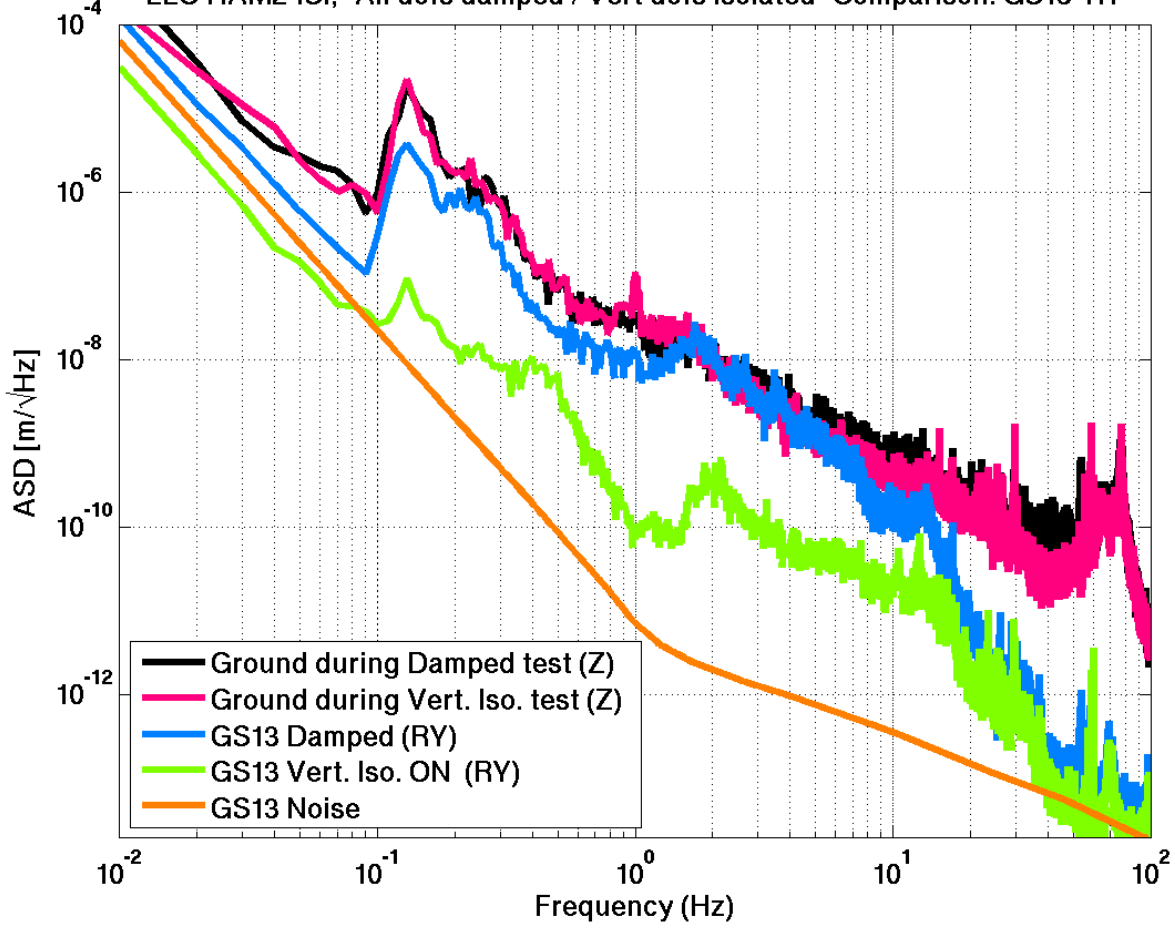




LLO HAM2-ISI, "All dofs damped / Vert dofs isolated" Comparison: GS13 RX

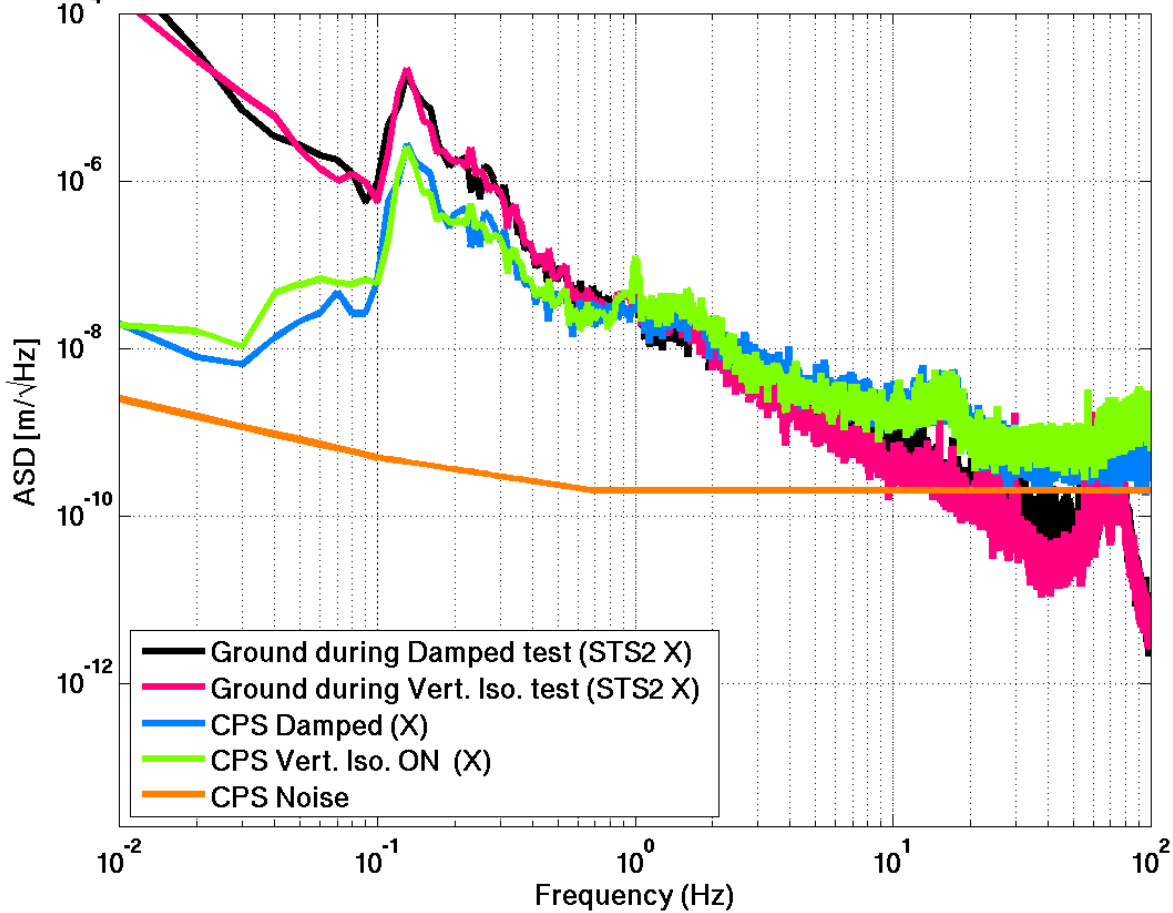


LLO HAM2-ISI, "All dofs damped / Vert dofs isolated" Comparison: GS13 RY

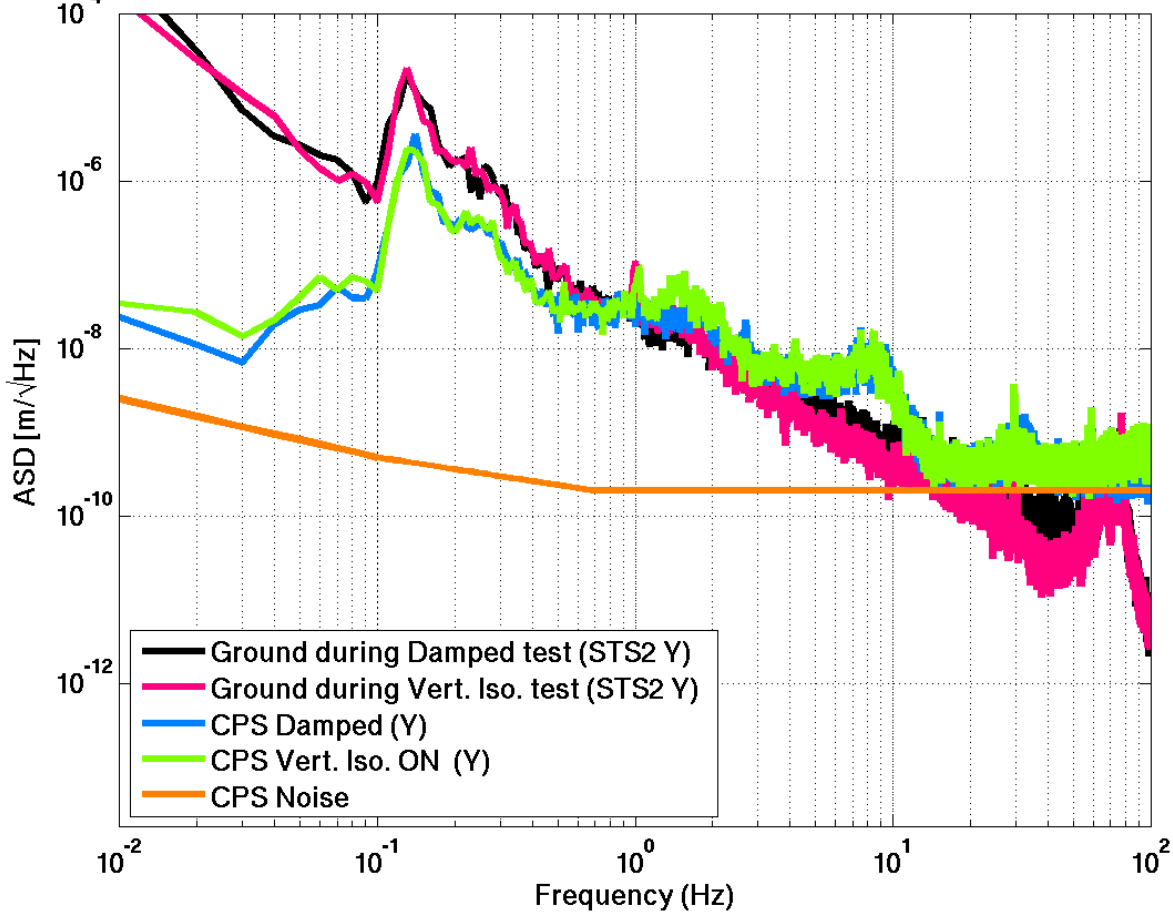


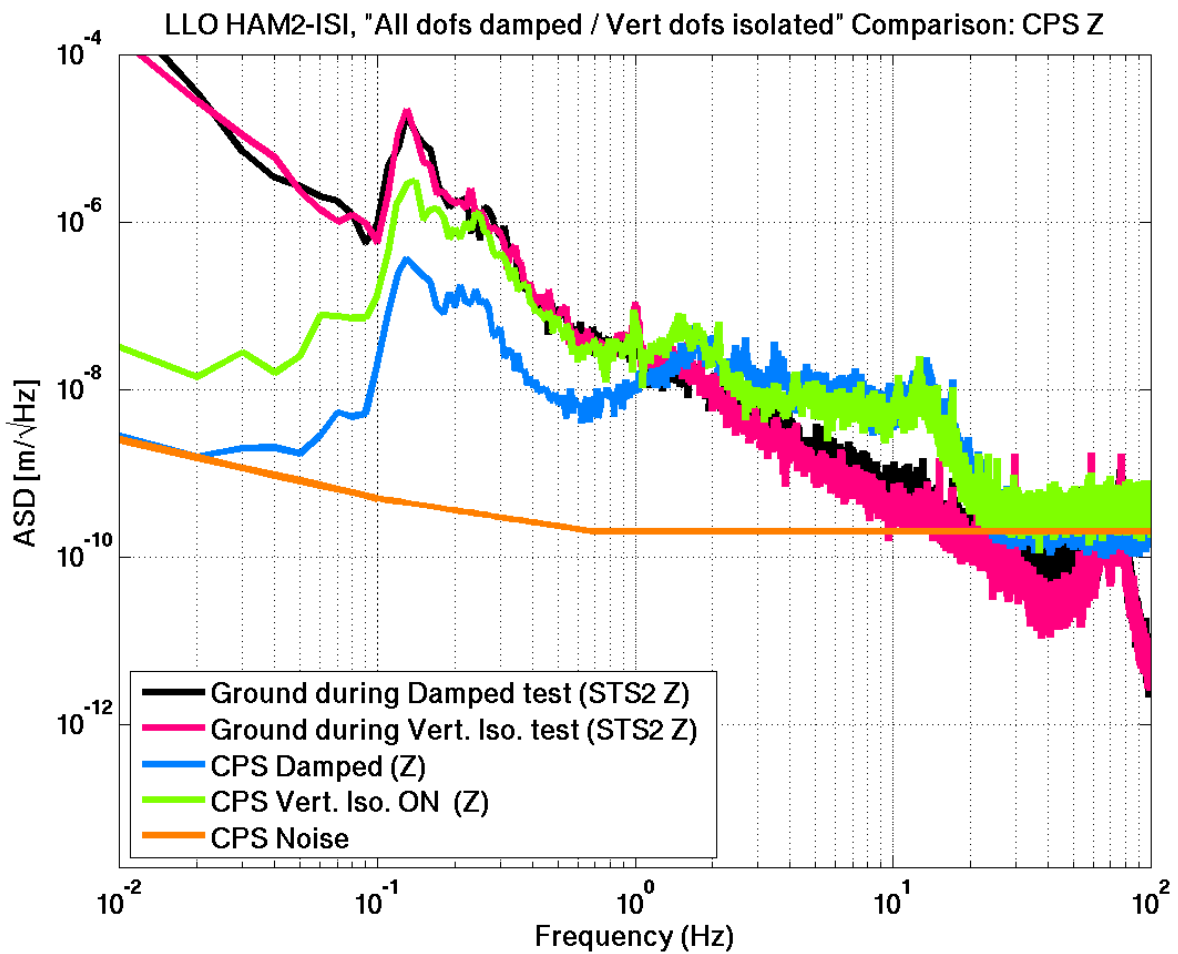
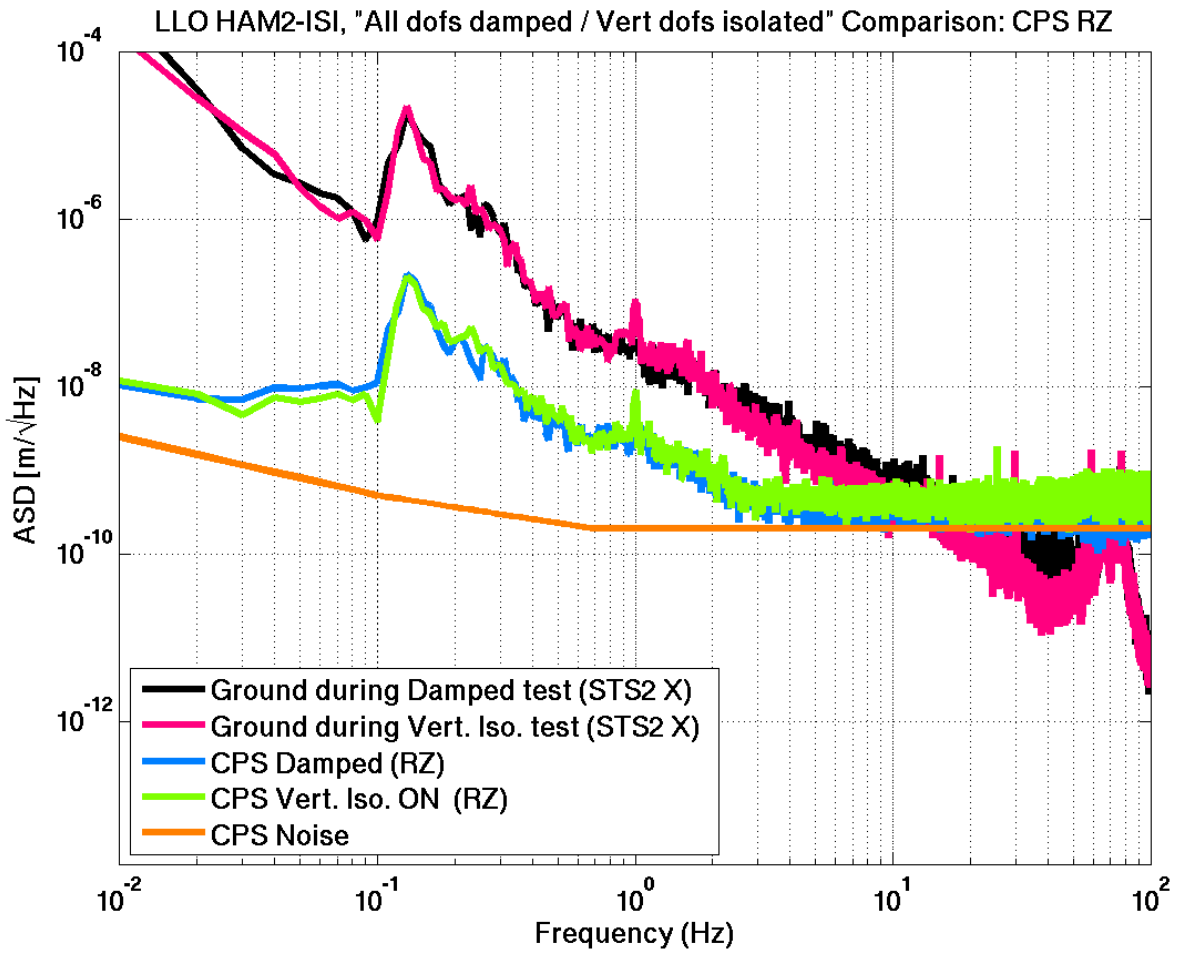


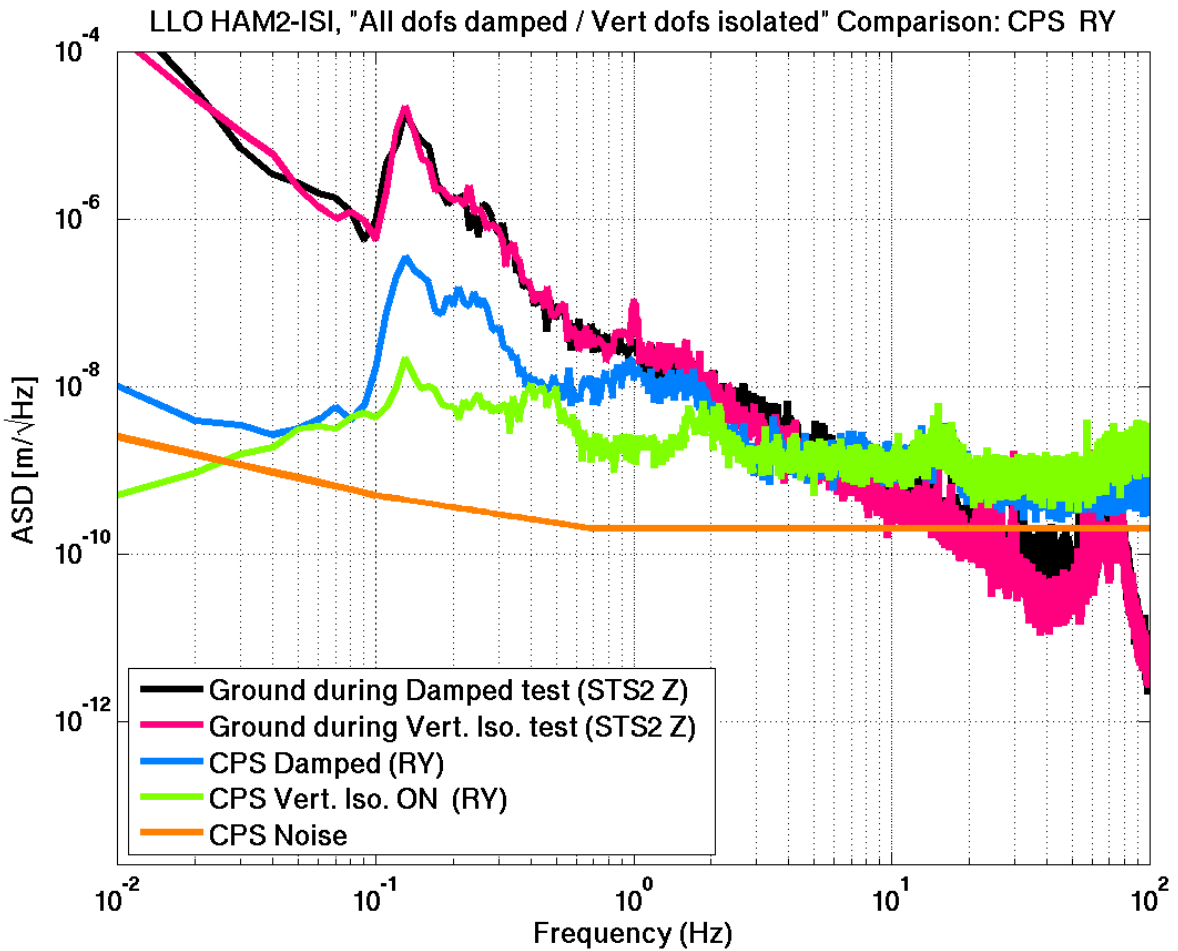
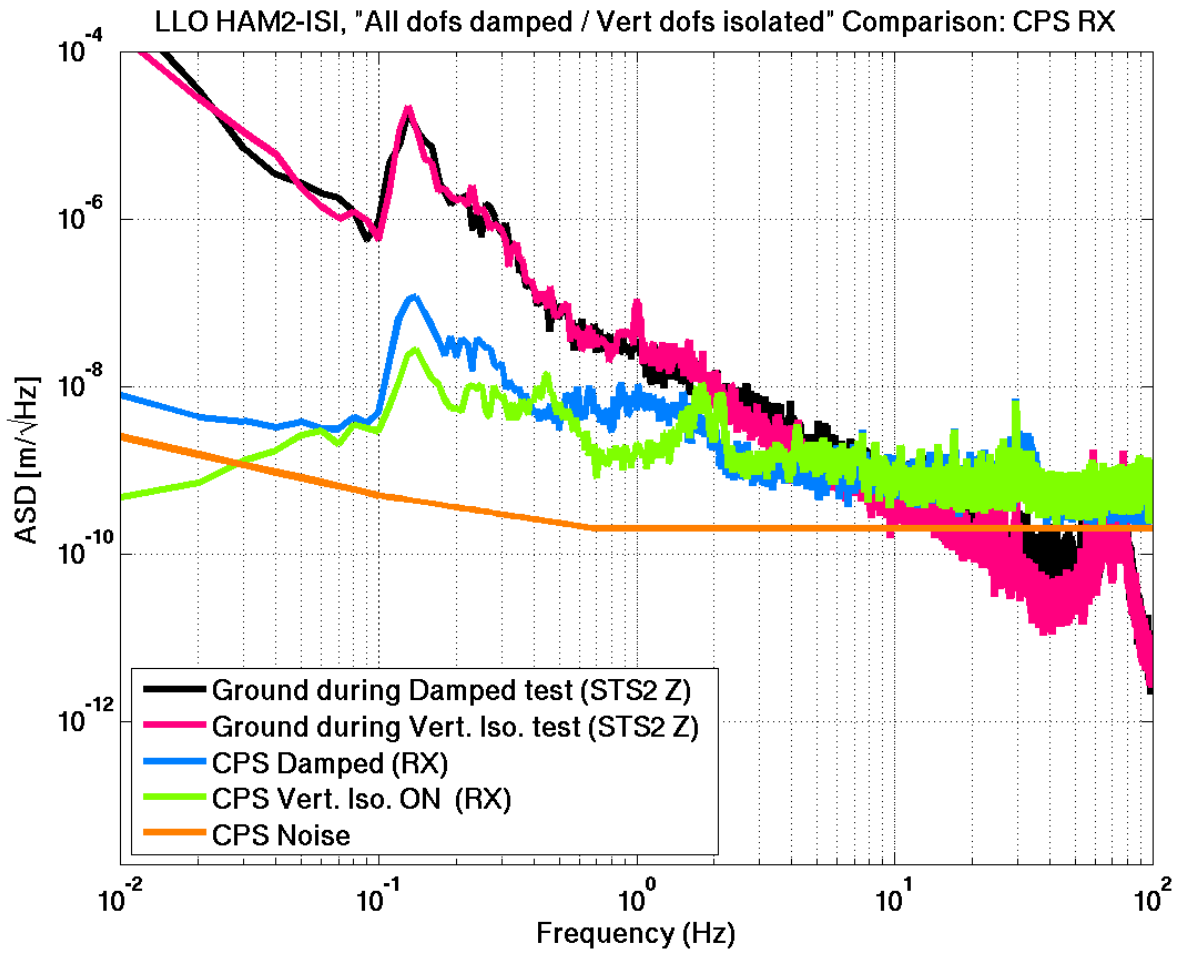
LLO HAM2-ISI, "All dofs damped / Vert dofs isolated" Comparison: CPS X



LLO HAM2-ISI, "All dofs damped / Vert dofs isolated" Comparison: CPS Y







## 5) Check Horizontal control loops performance

Performance\_Test\_5\_Vertical\_Isolation\_ON\_High\_Gain.m

Similar to Step 4 for horizontal loops.

I have attached a few figures illustrating the first three steps (I am not commenting the results here, just presented the general idea).

The series of test will reviewed and adjusted with the SEI team to make sure it is comprehensive.

Then we'll adapt it to HEPI, and we'll use it to validate HAM2 and HAM3 modules for the acceptance review.

### Procedure:

In MEDM:

- Leave Master switch ON
- Leave Damping Loops ON
- Leave Calib buttons Engaged (CPS, L4C and GS13)
- Leave Gain buttons Dis-Engaged (L4C and GS13)
- Leave DWH button Engaged (GS13)
- Leave the Vertical Blend on 400 mHz standard blend
- Leave the vertical isolation loops ON (Level 2)
- Switch the horizontal Blend to 250 mHz standard blend
- Turn on the horizontal isolation loops (Level 2)
- Run Performance\_Test\_5\_Vertical\_Isolation\_ON\_High\_Gain.m

The script gets 900 seconds of data for

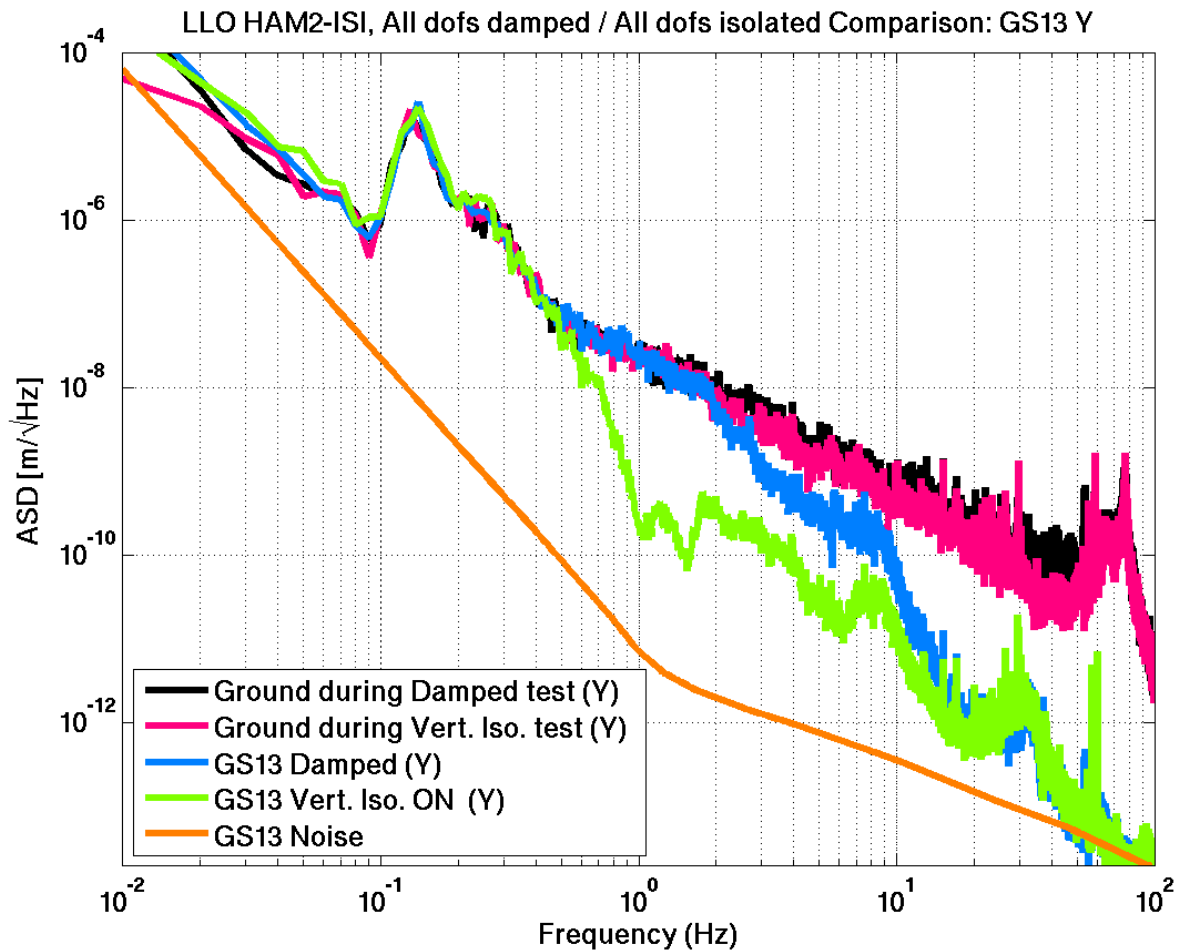
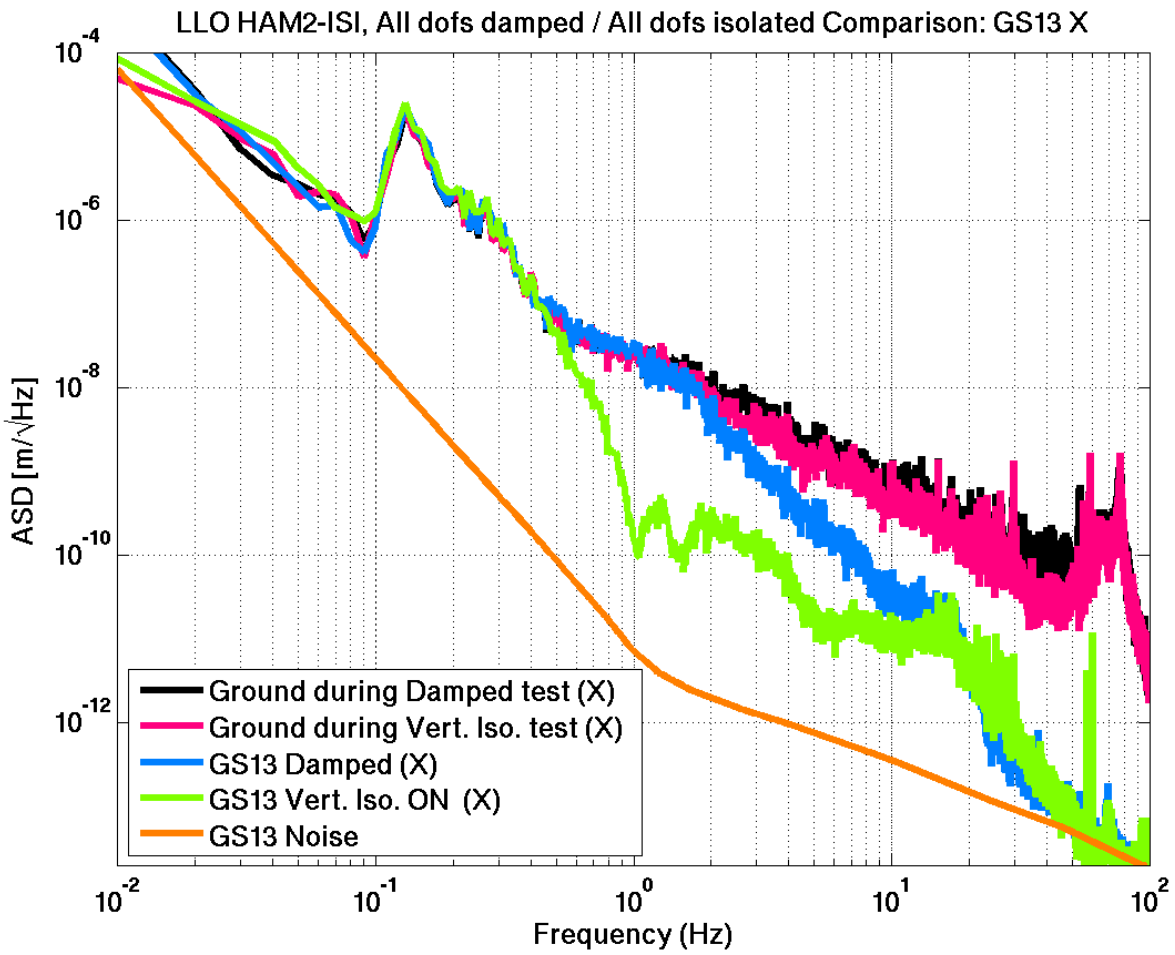
- The ground STS2 signals
- The 6 local and 6 Cartesian L4C signals
- The 6 local and 6 Cartesian CPS signal
- The 6 local and 6 Cartesian GS13 signals

Then it:

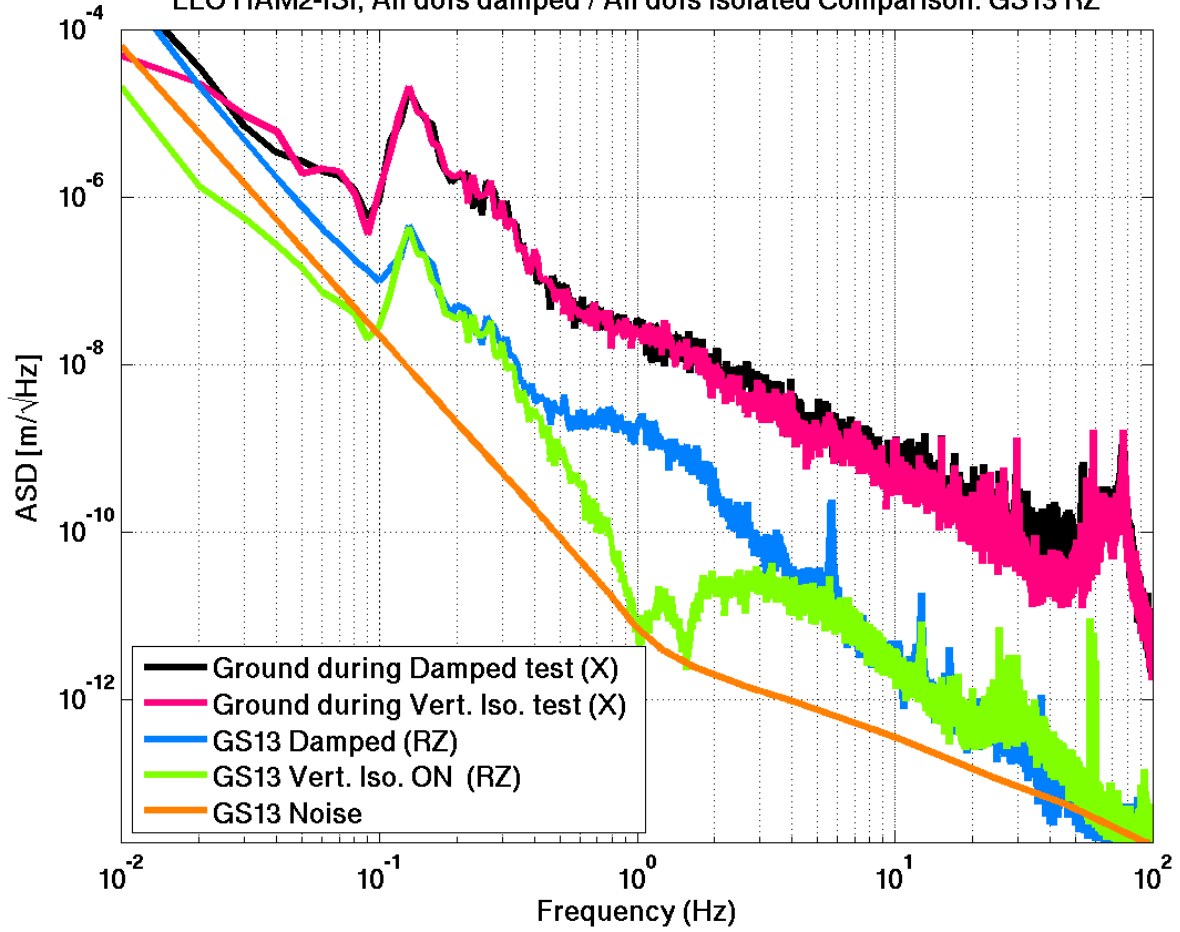
- Decimates, computes ASD and calibrates.
- Stores the processed ASDs in a structure saved in /Data/Perf\_Analysis/

Finally:

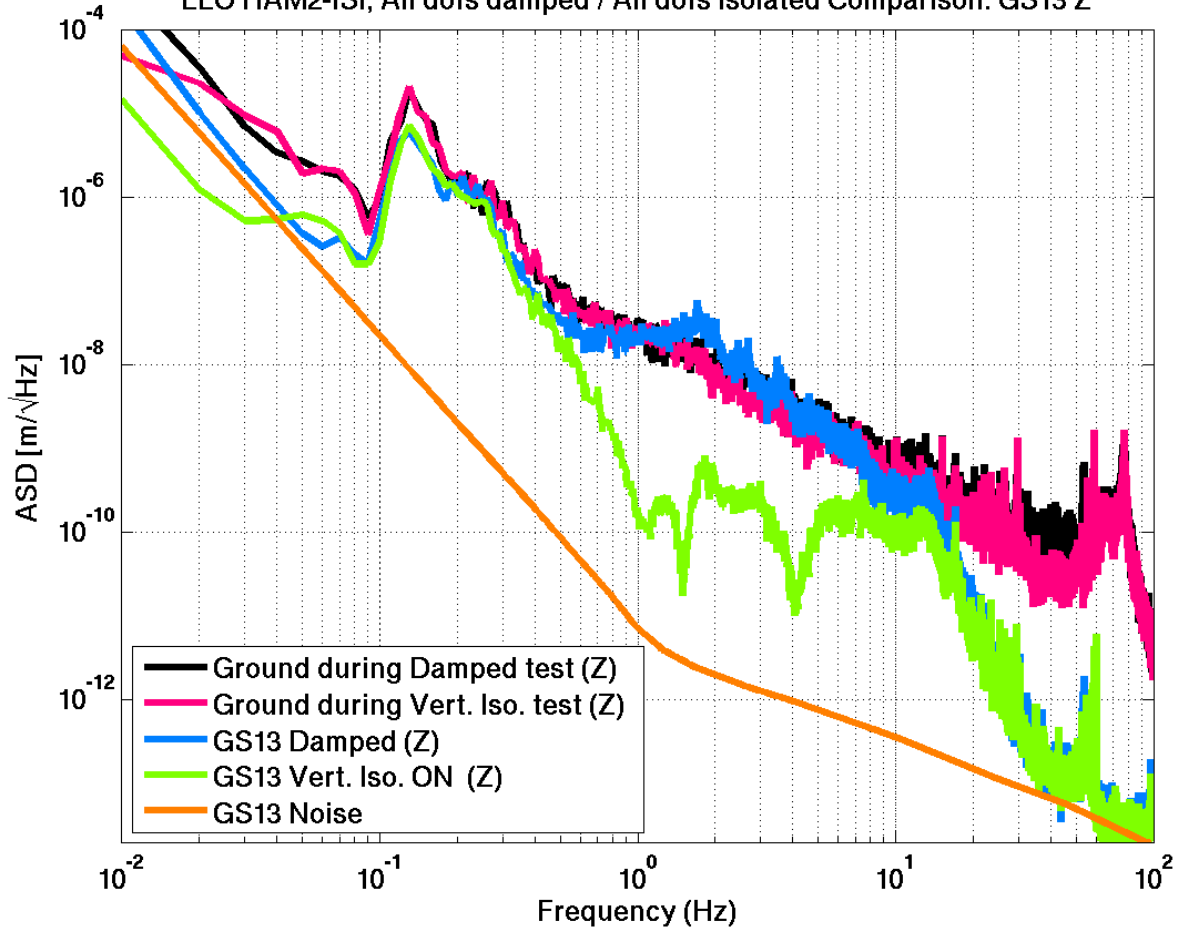
- The scripts compare the GS13 response Damped and controlled to check the performance.
- It plots the CPS to check the low frequency motion amplification due to sensor noise injection.
- It check the measured suppression matches with calculated suppression.
- It Saves the Figures in /Data/Figures/Perf\_Analysis/



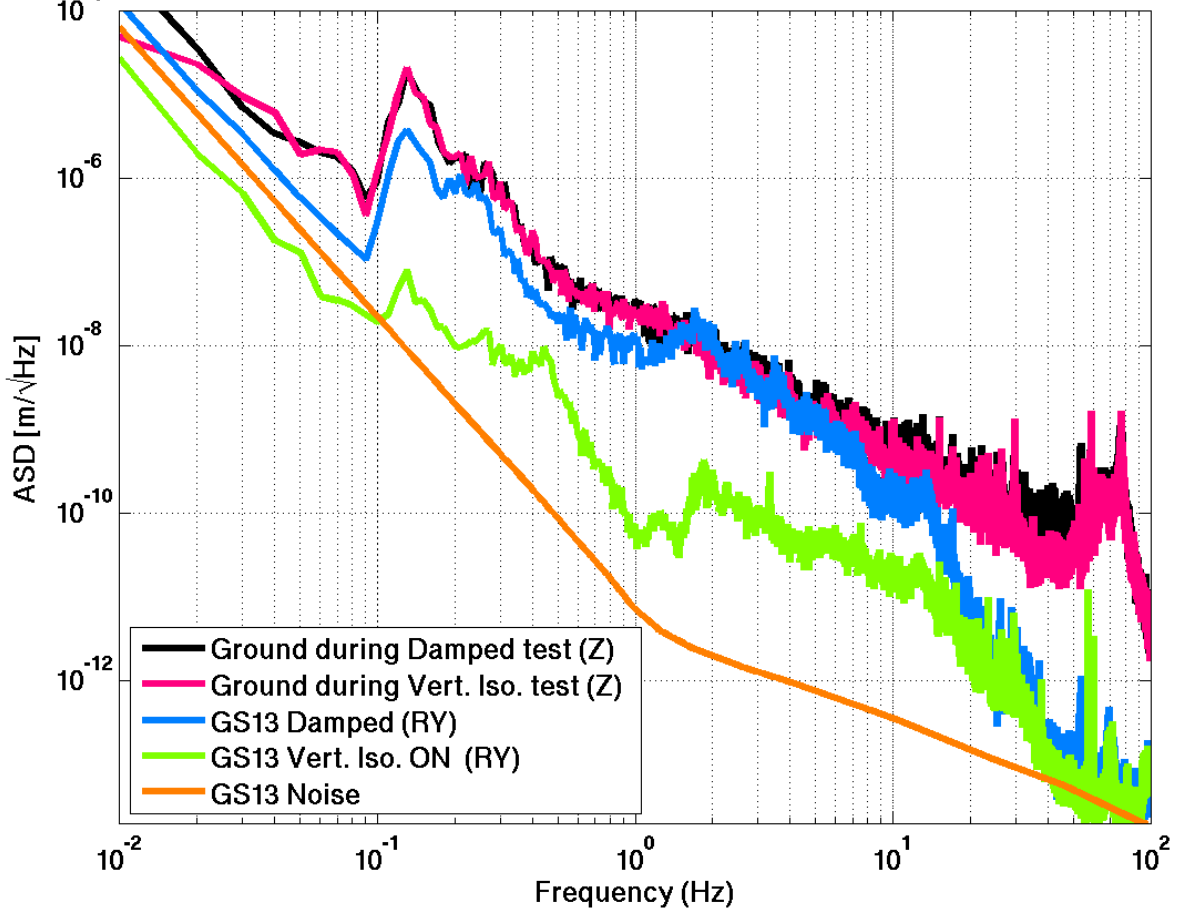
LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: GS13 RZ



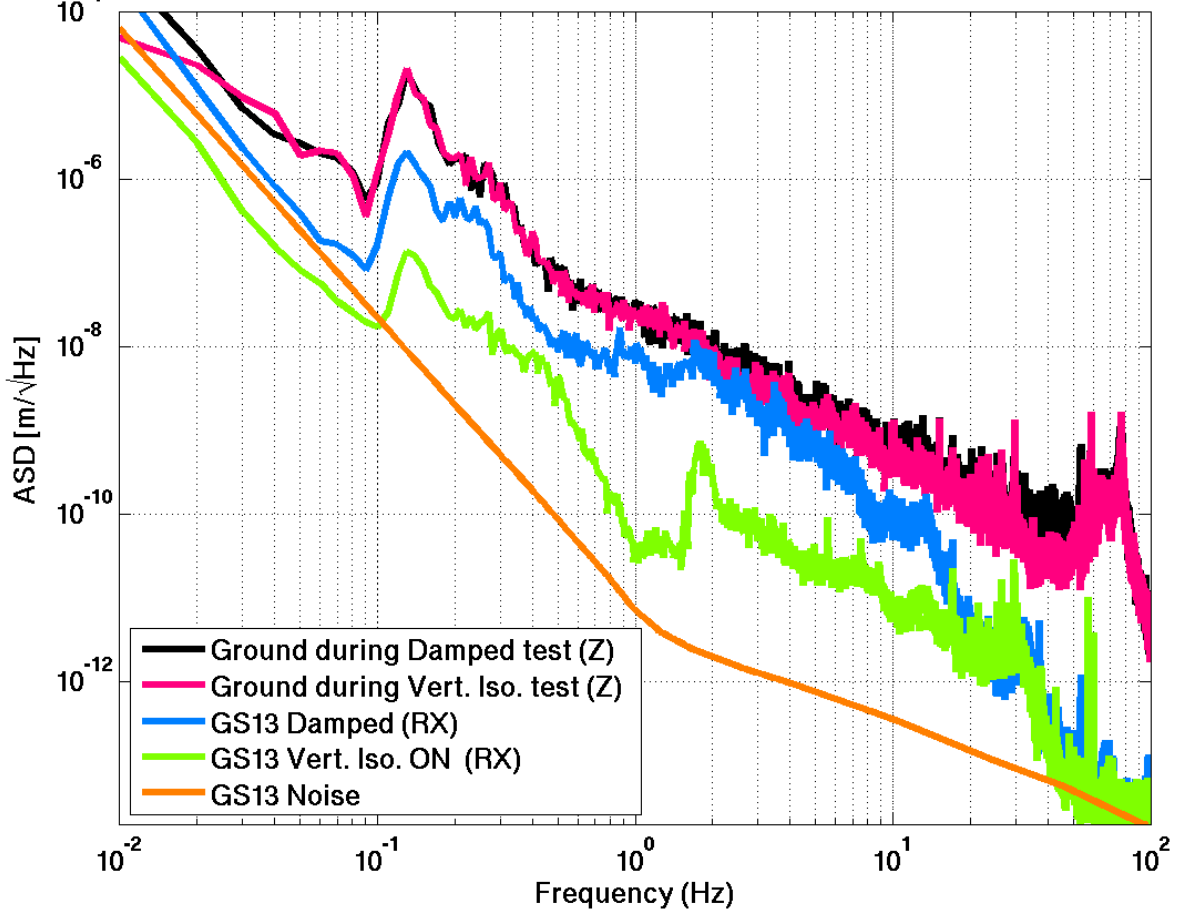
LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: GS13 Z



LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: GS13 RY

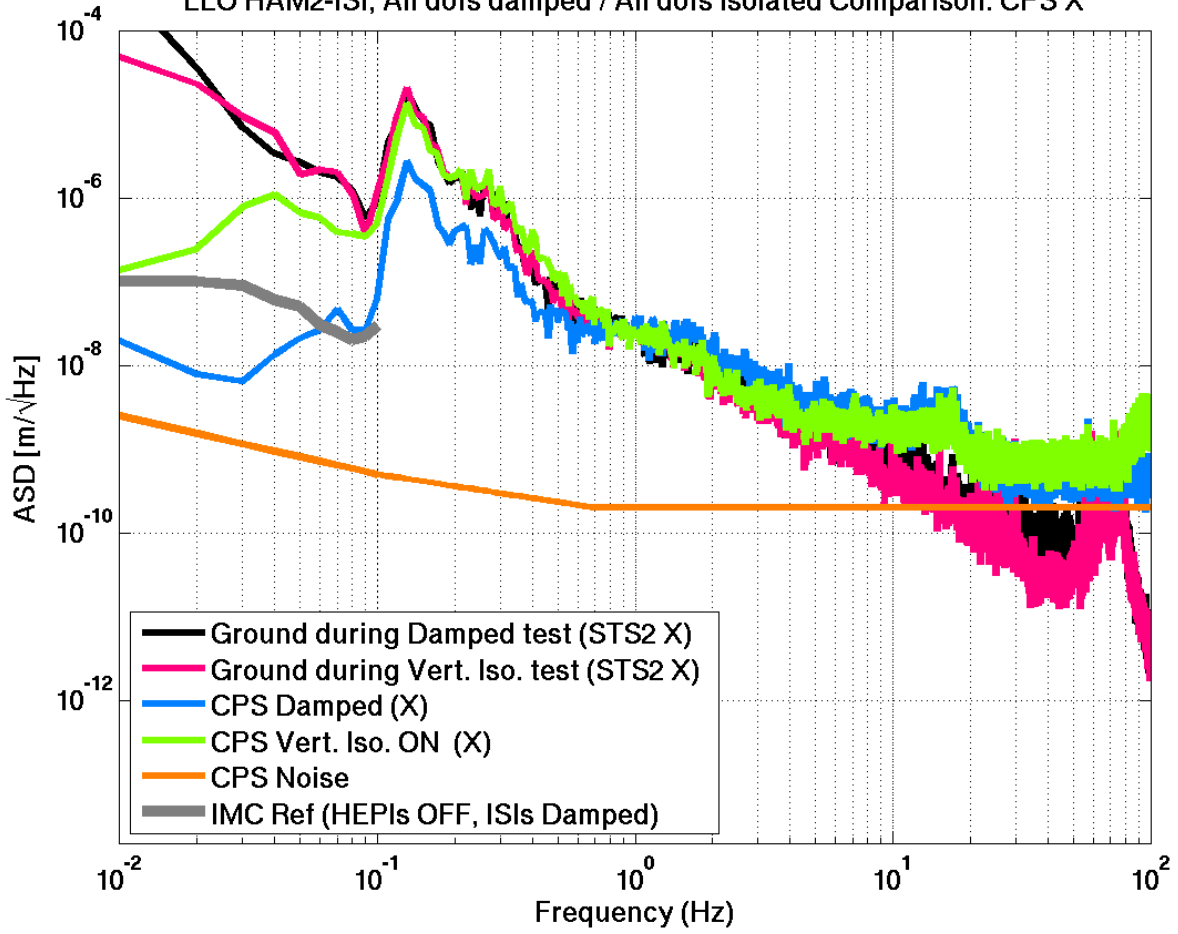


LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: GS13 RX

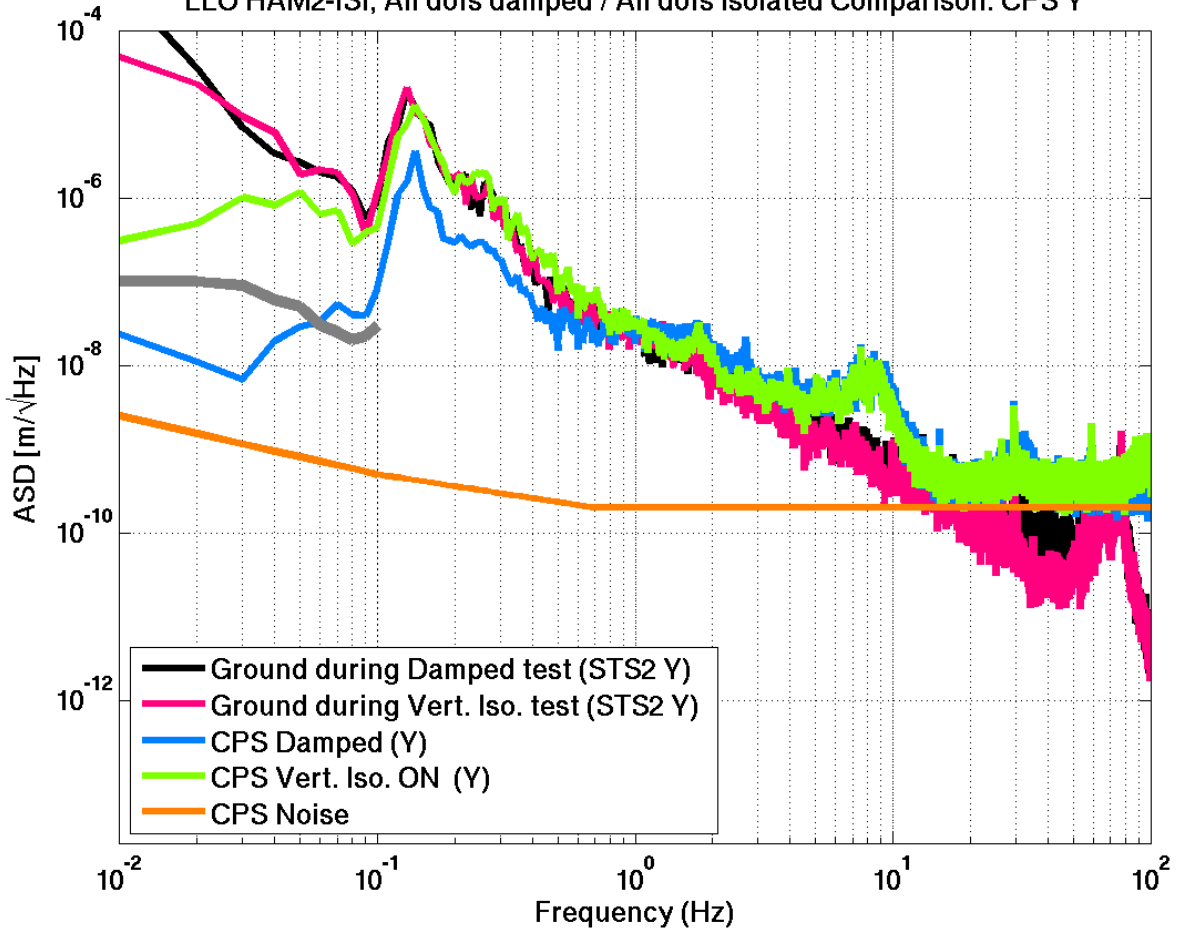




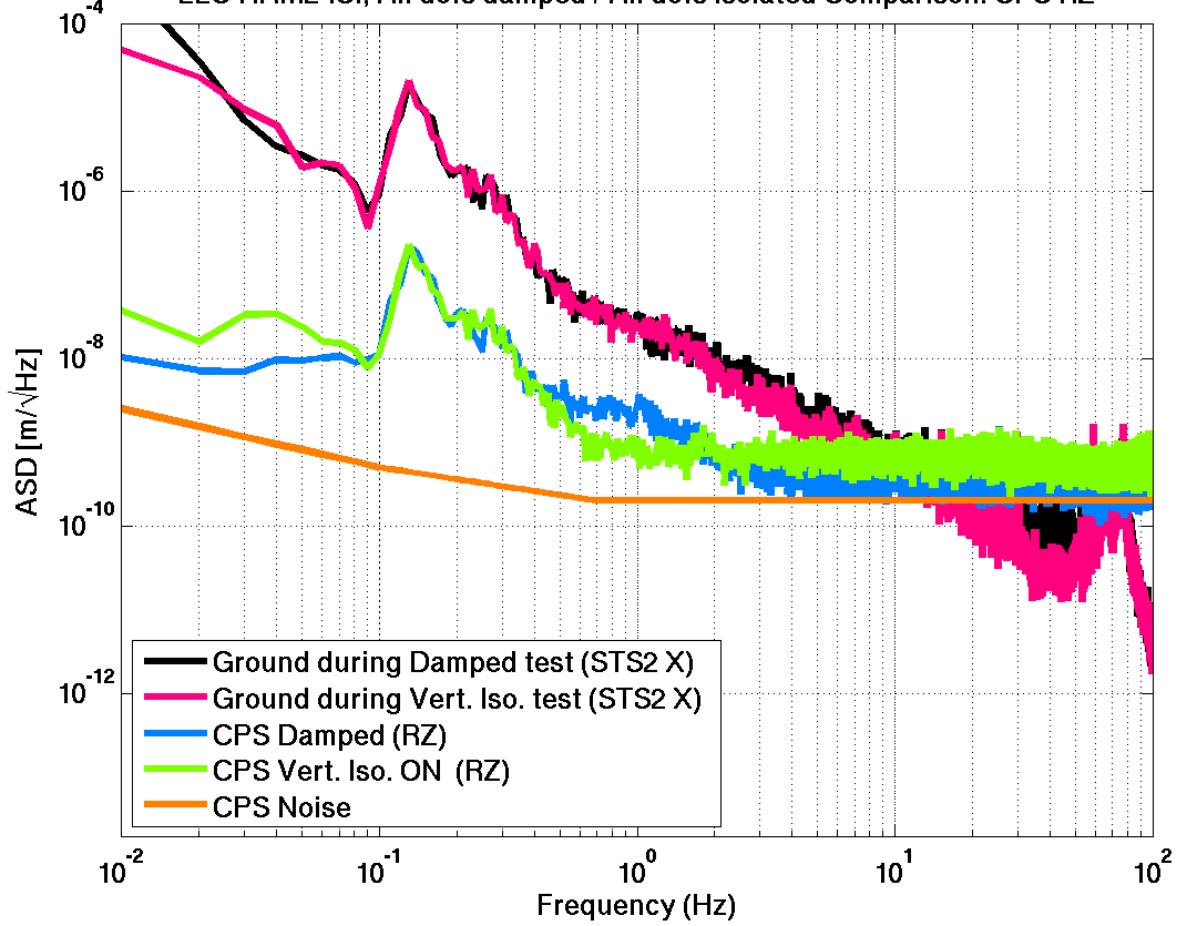
LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: CPS X



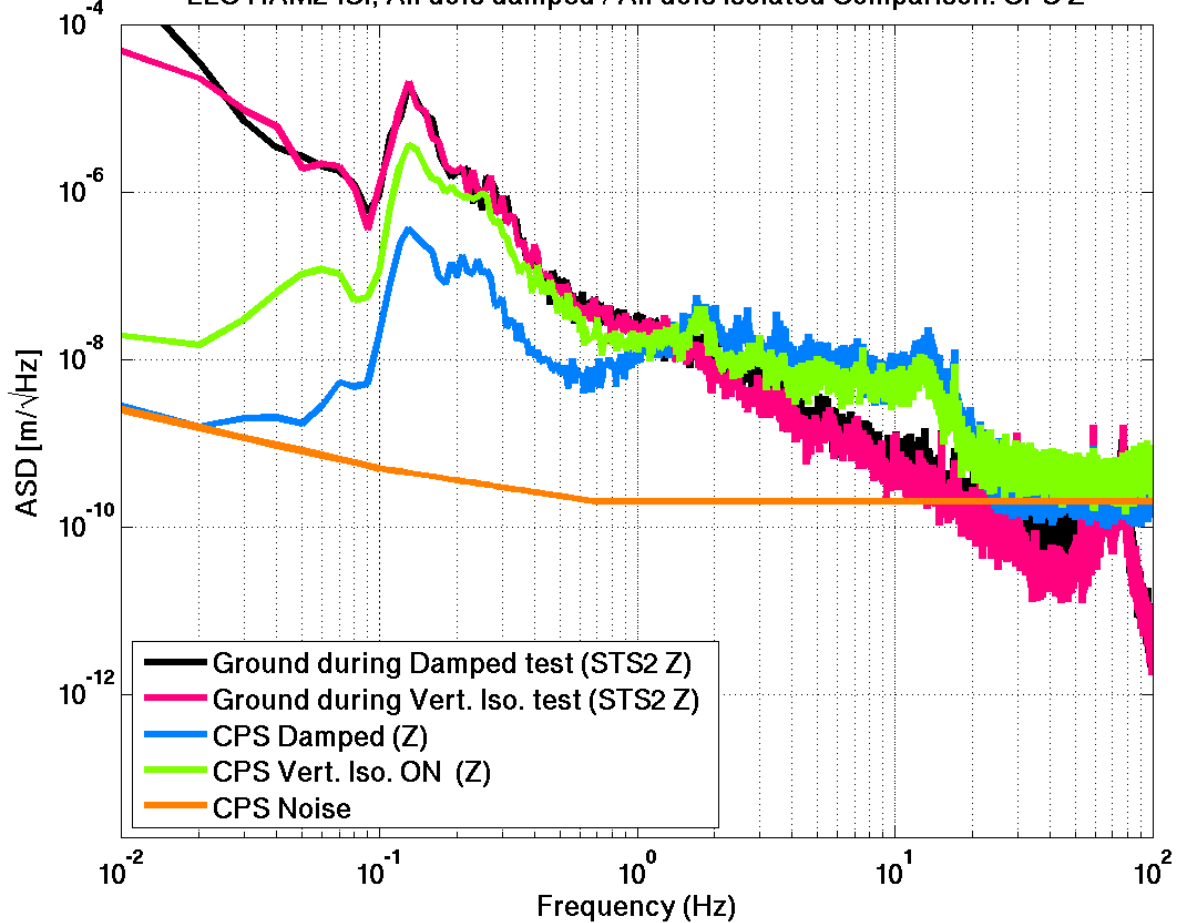
LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: CPS Y



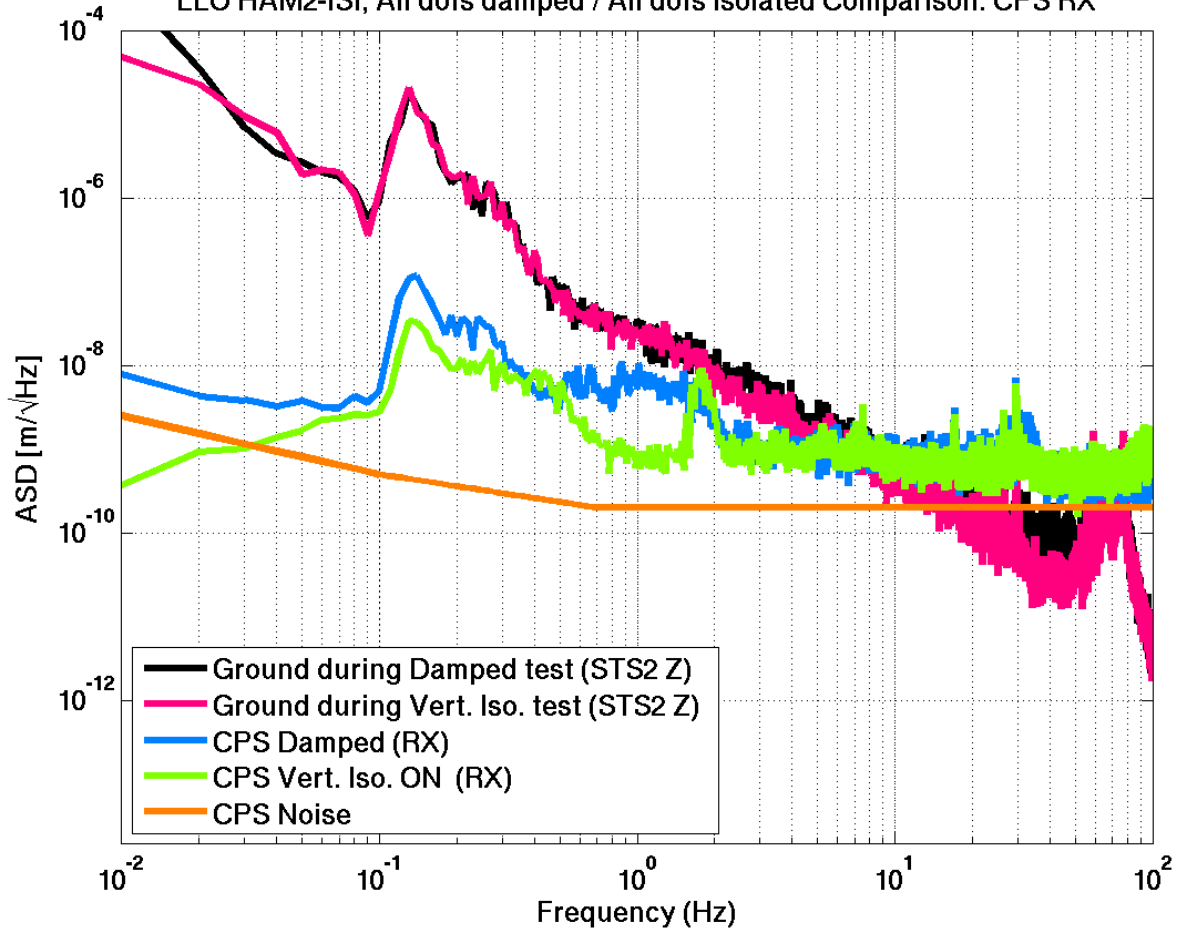
LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: CPS RZ



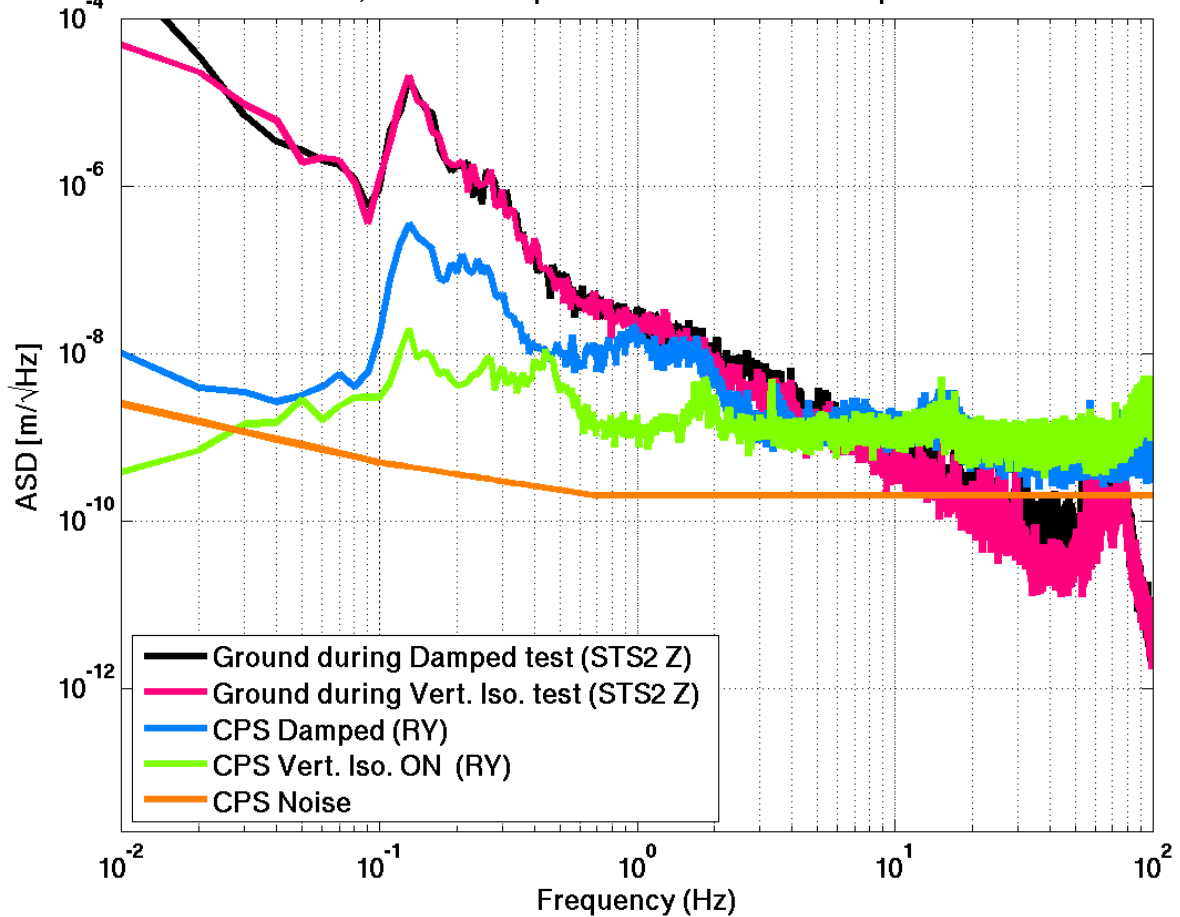
LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: CPS Z



LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: CPS RX



LLO HAM2-ISI, All dofs damped / All dofs isolated Comparison: CPS RY



**Conclusion/to be done:**

- RX, RY Damping Loops amplification
- Curves of sensitivity (Comparison measured and predicted)