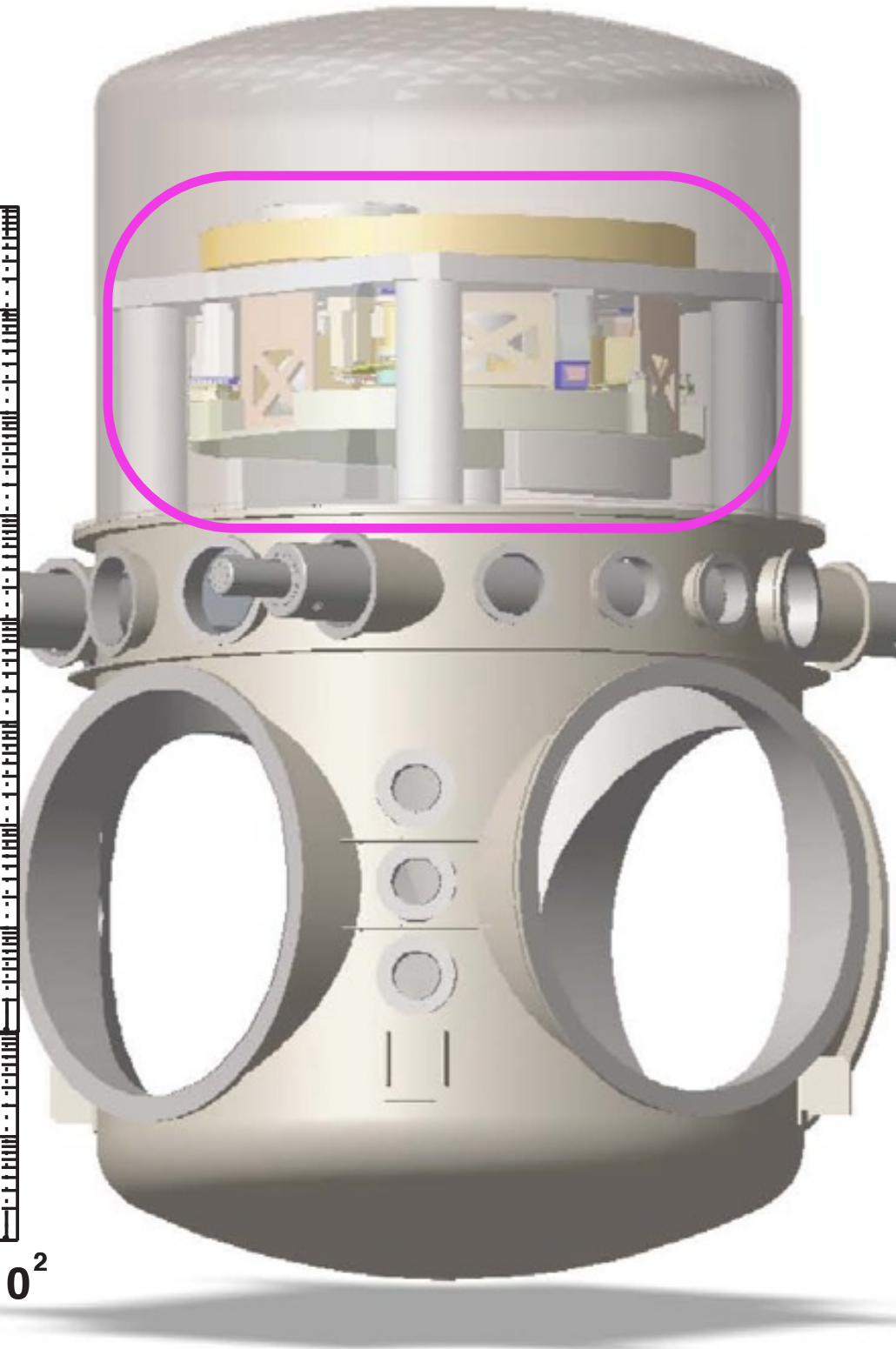
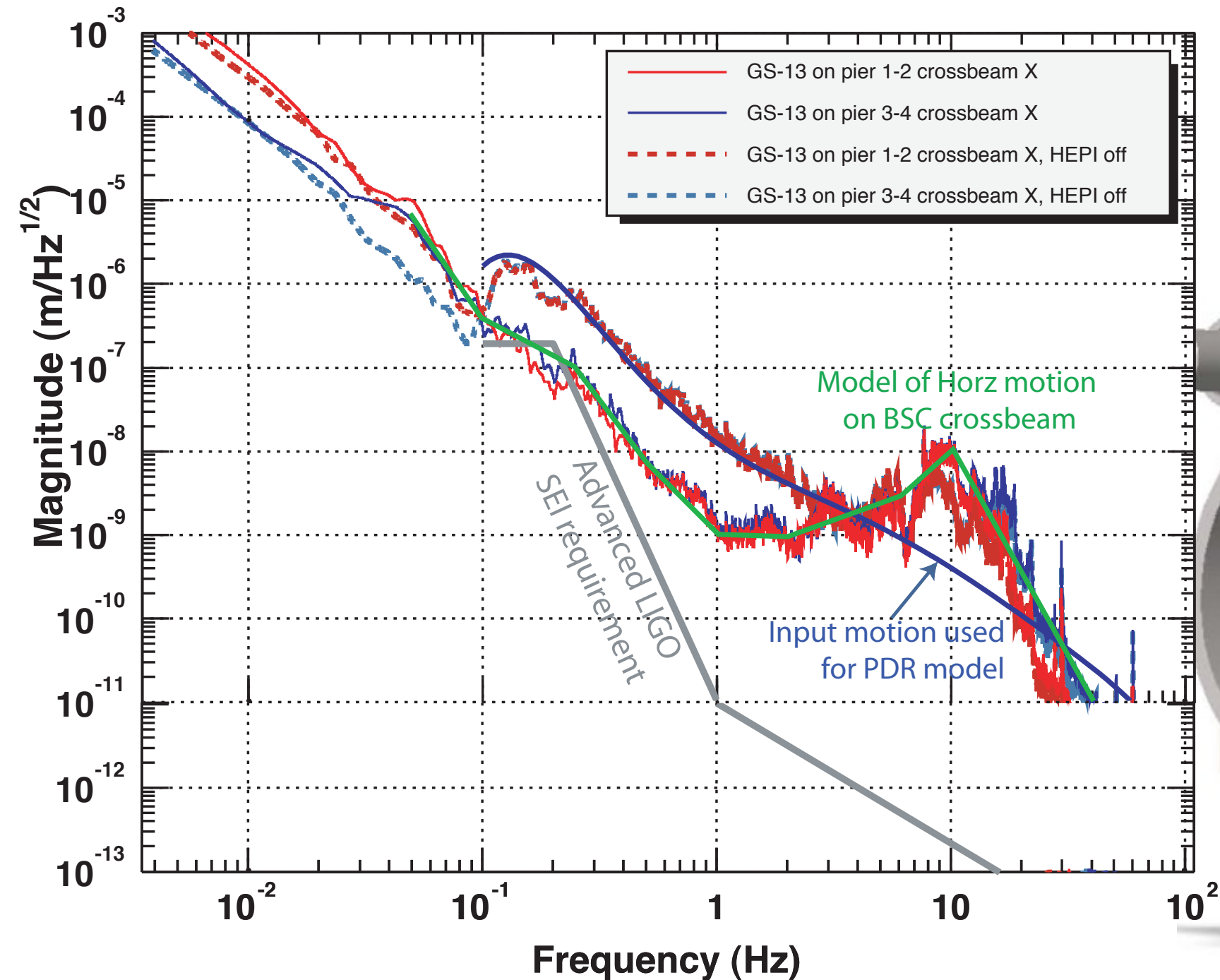


Progress on the Advanced LIGO Seismic Isolation and Alignment System

Presented by Brian Lantz
for the Advanced LIGO SEI team
LSC meeting, Aug. 17, 2005

BSC System for Advanced LIGO

X noise on crossbeams



Overview

Progress towards a successful BSC for Advanced LIGO

3 pieces of news from the ETF Tech Demo

- 1 Hz isolation factor of 100 has been shown
- 1 Hz performance requires improved sensor electronics
- 10 Hz performance limited by tilt & bandwidth

1 piece of news from LASTI

- 10 Hz pier amplification persists

ASI implementing design changes to improve 10 Hz isolation

- will give good performance for Advanced LIGO

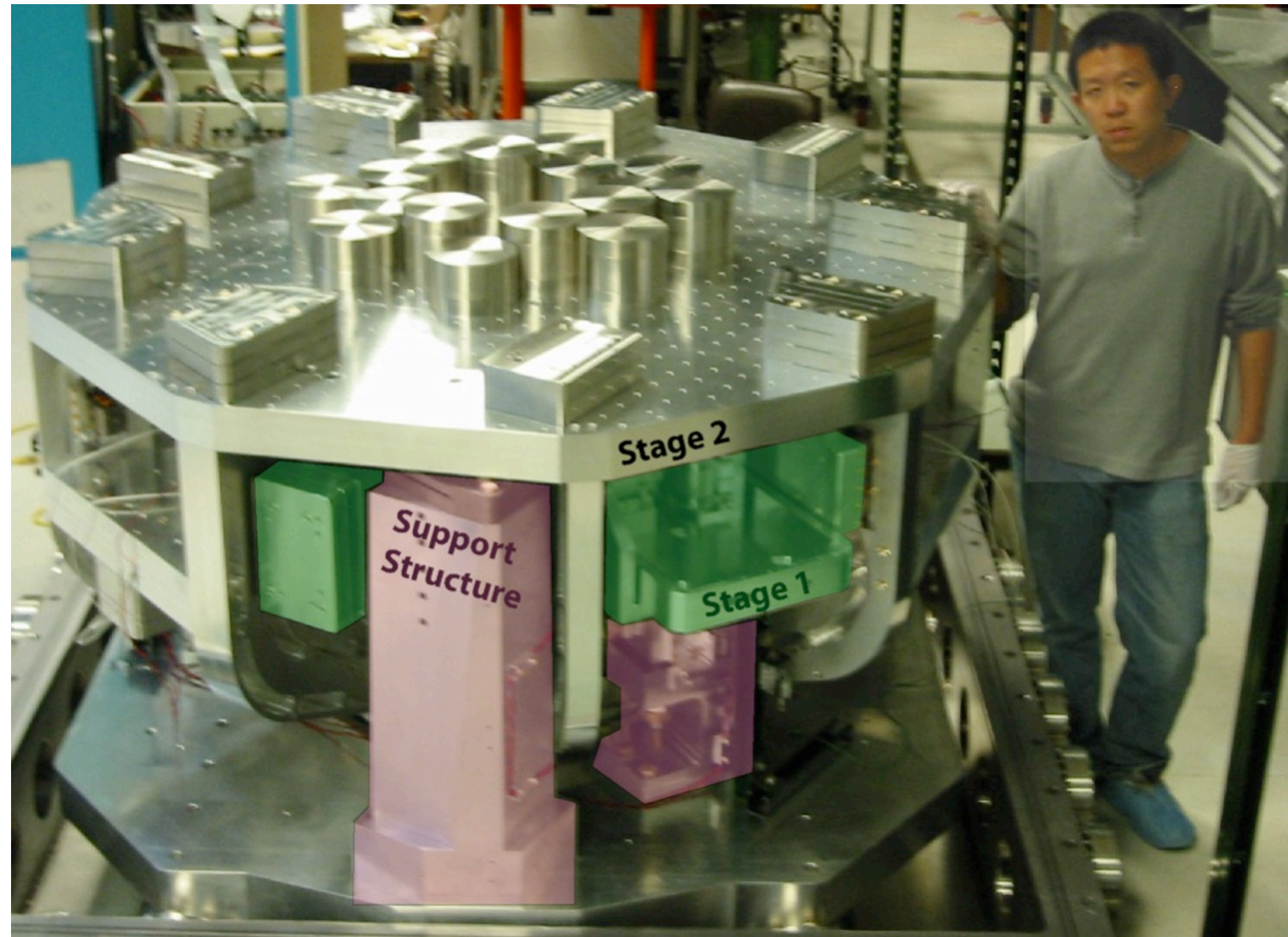
ETF Technology Demonstrator

2 stage isolation and alignment system.

Each stage aligned and isolated in 6 DOF.

Passive isolation above 1 Hz horz, 3 Hz vert

Active isolation below 30 Hz

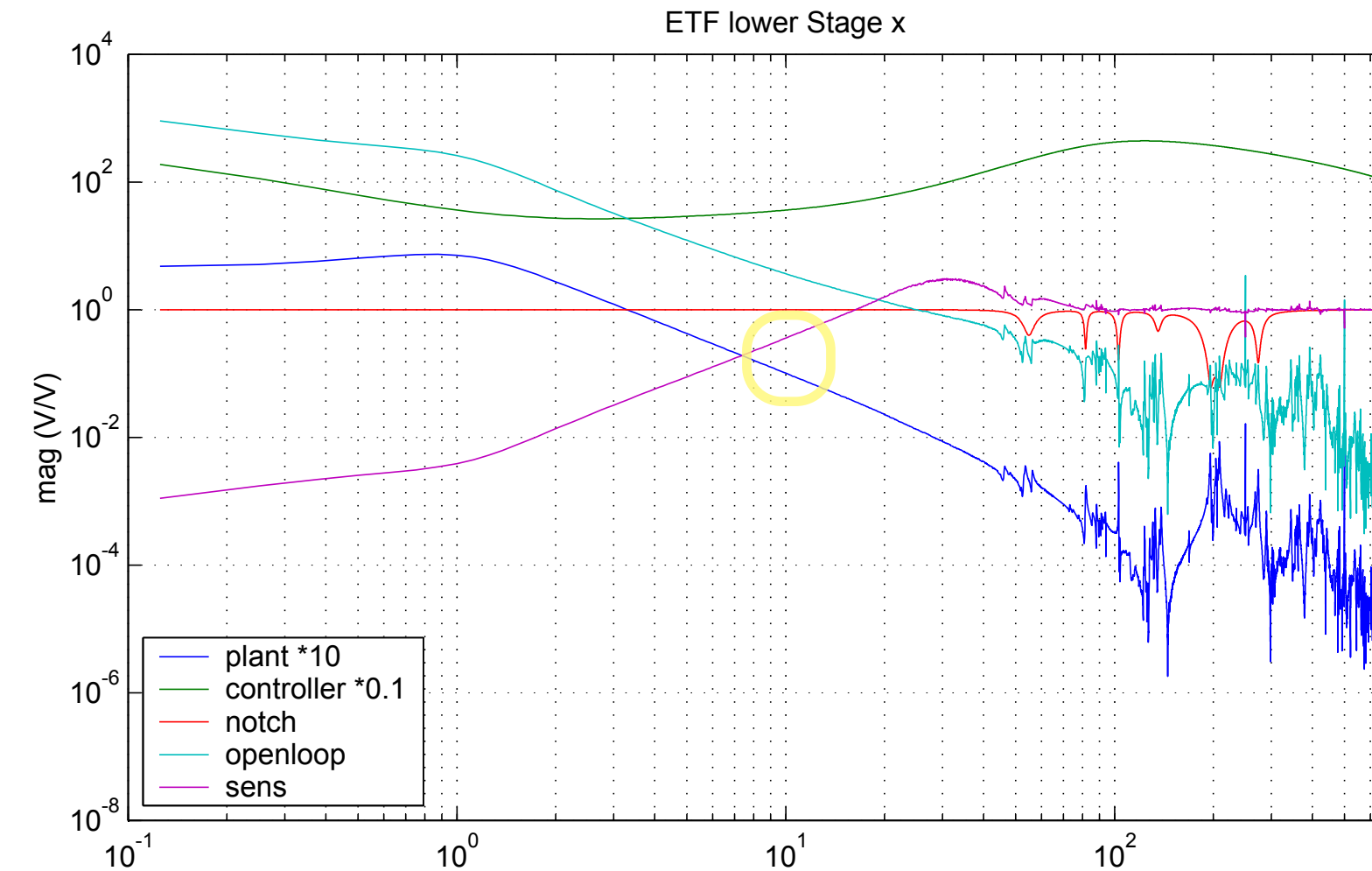
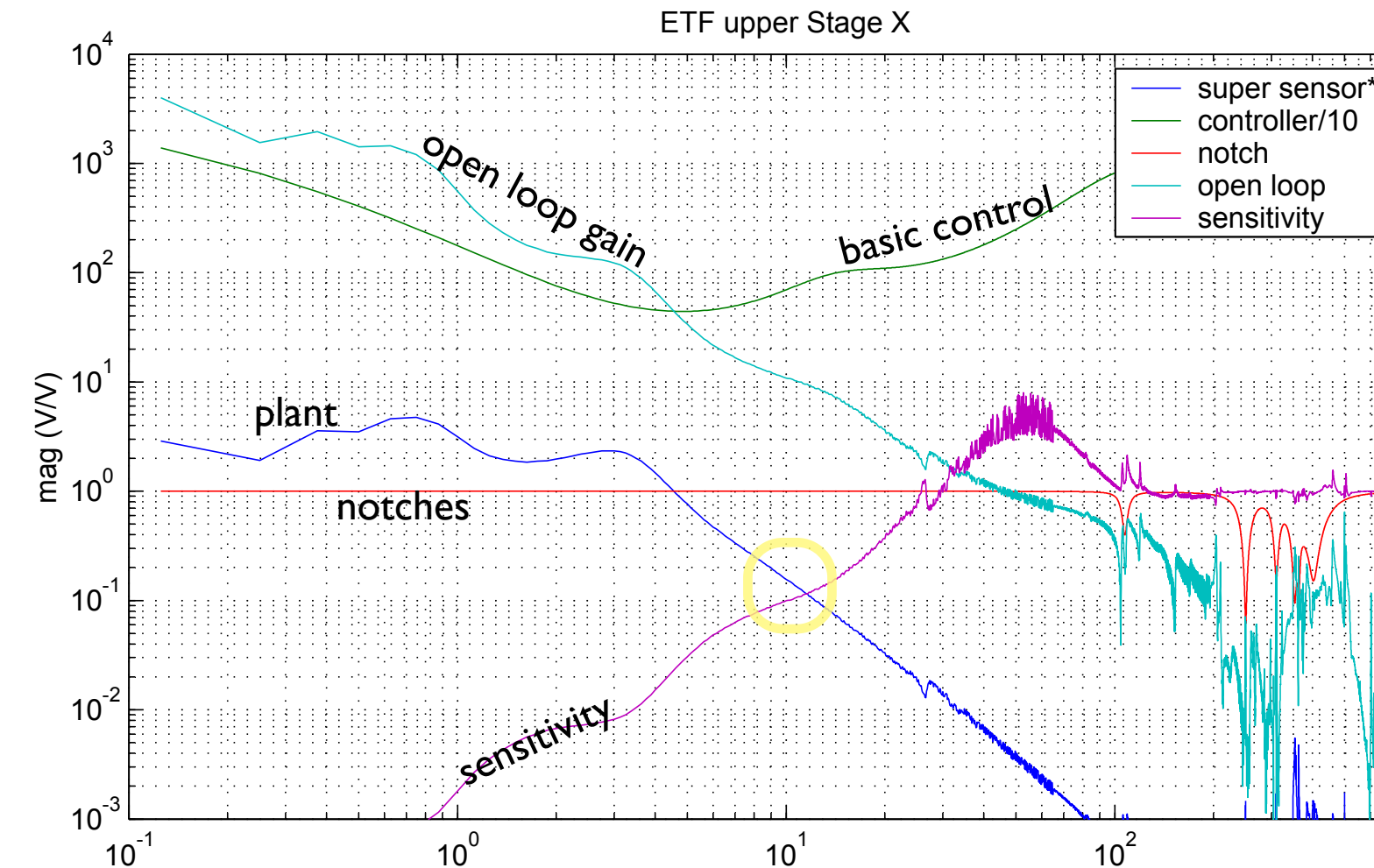


ETF: X Control

- 10 Hz predicted performance:
- Plant gives ~20
 - Upper unity gain freq is ~ 45 Hz
Constrained by plant resonances
gives x10 improvement at 10 Hz

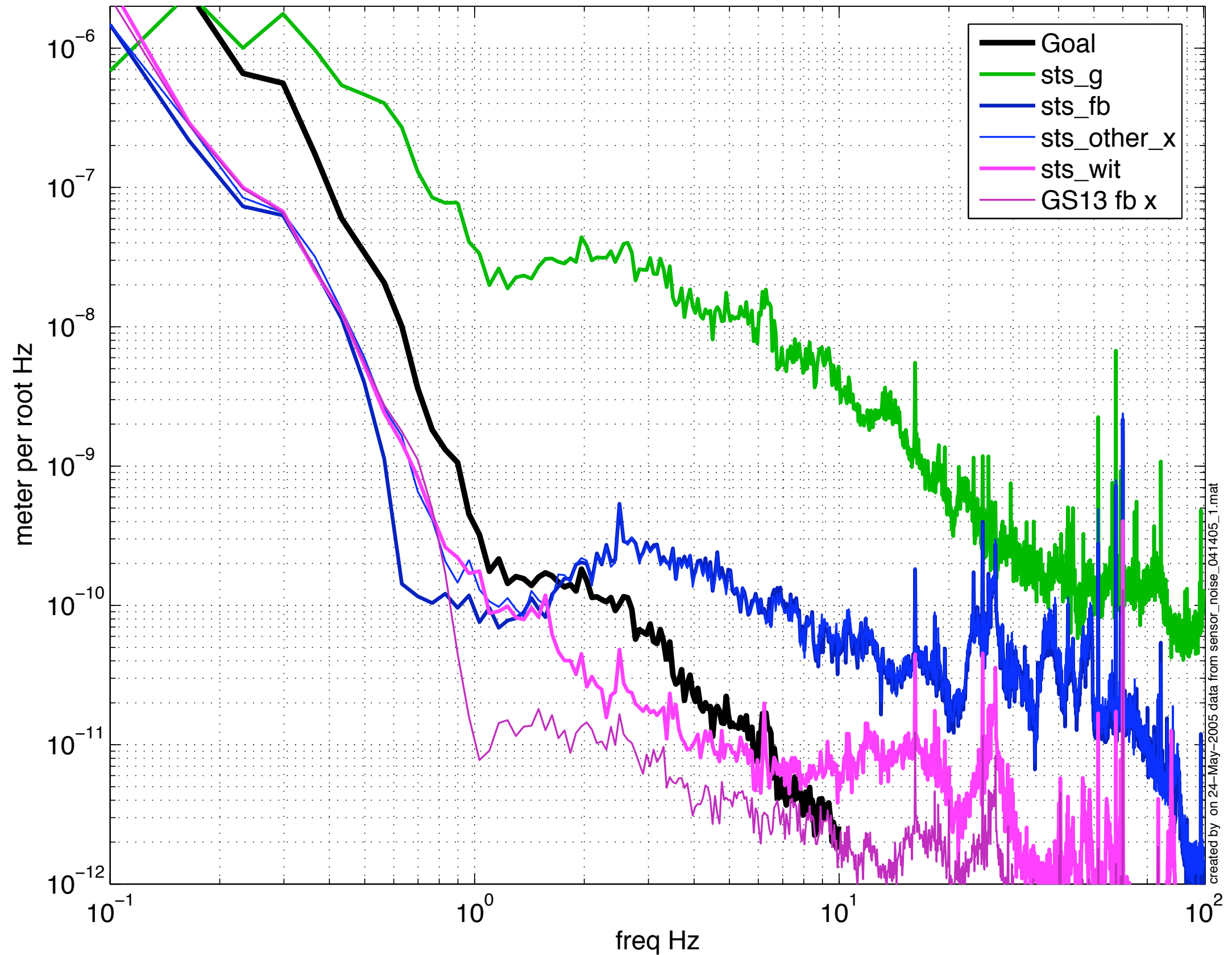
- 10 Hz predicted performance:
- Plant gives ~50
 - Upper unity gain freq is ~ 30 Hz
Constrained by plant resonances
gives x3 improvement at 10 Hz

$$\sim 20 \times 50 \times 10 \times 3 = \sim 30,000$$



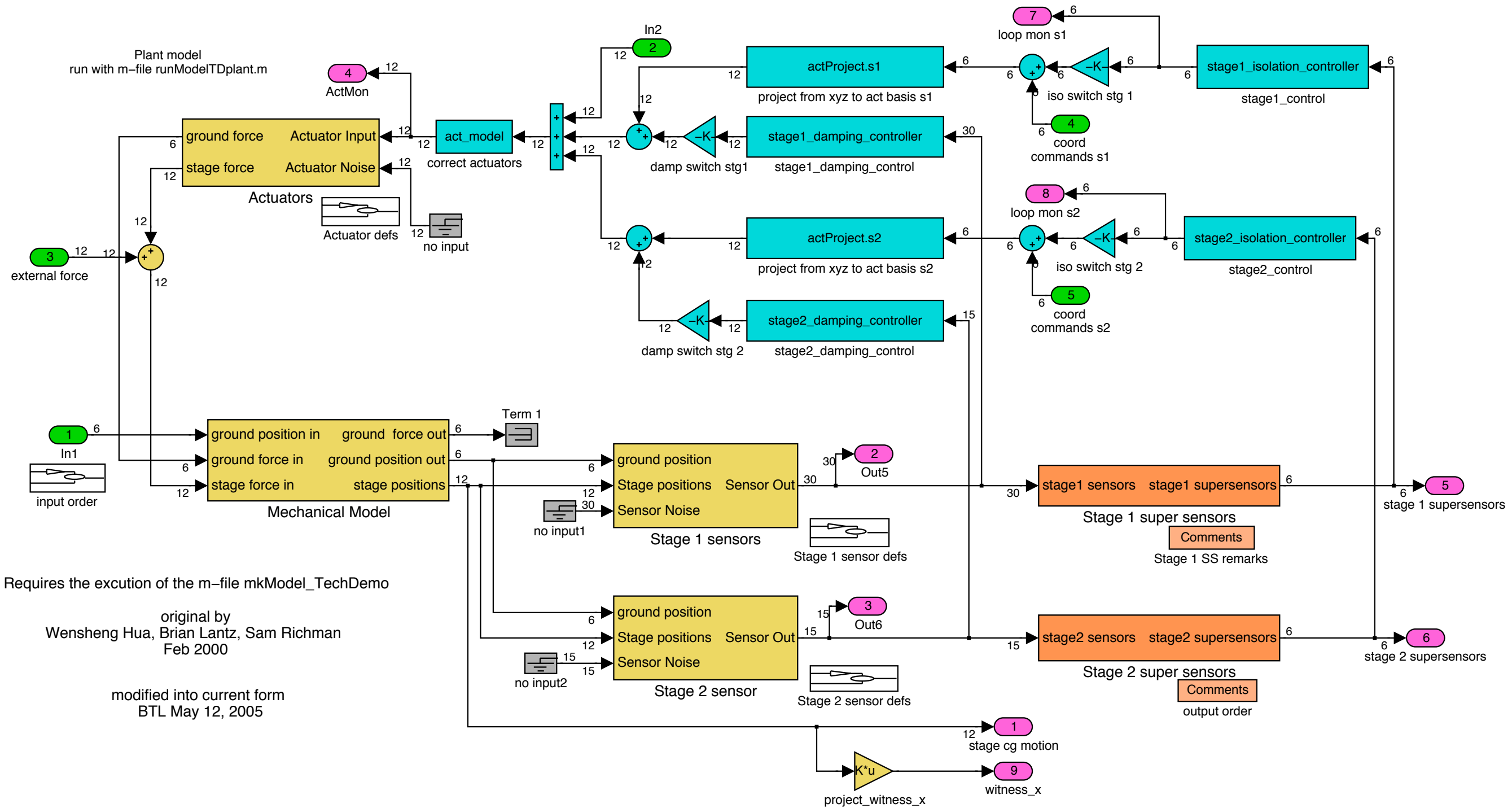
ETF: X Performance

Horizontal FIR blending performance X



Model of the Tech Demo

Advanced LIGO isolation model – 2 Active stages

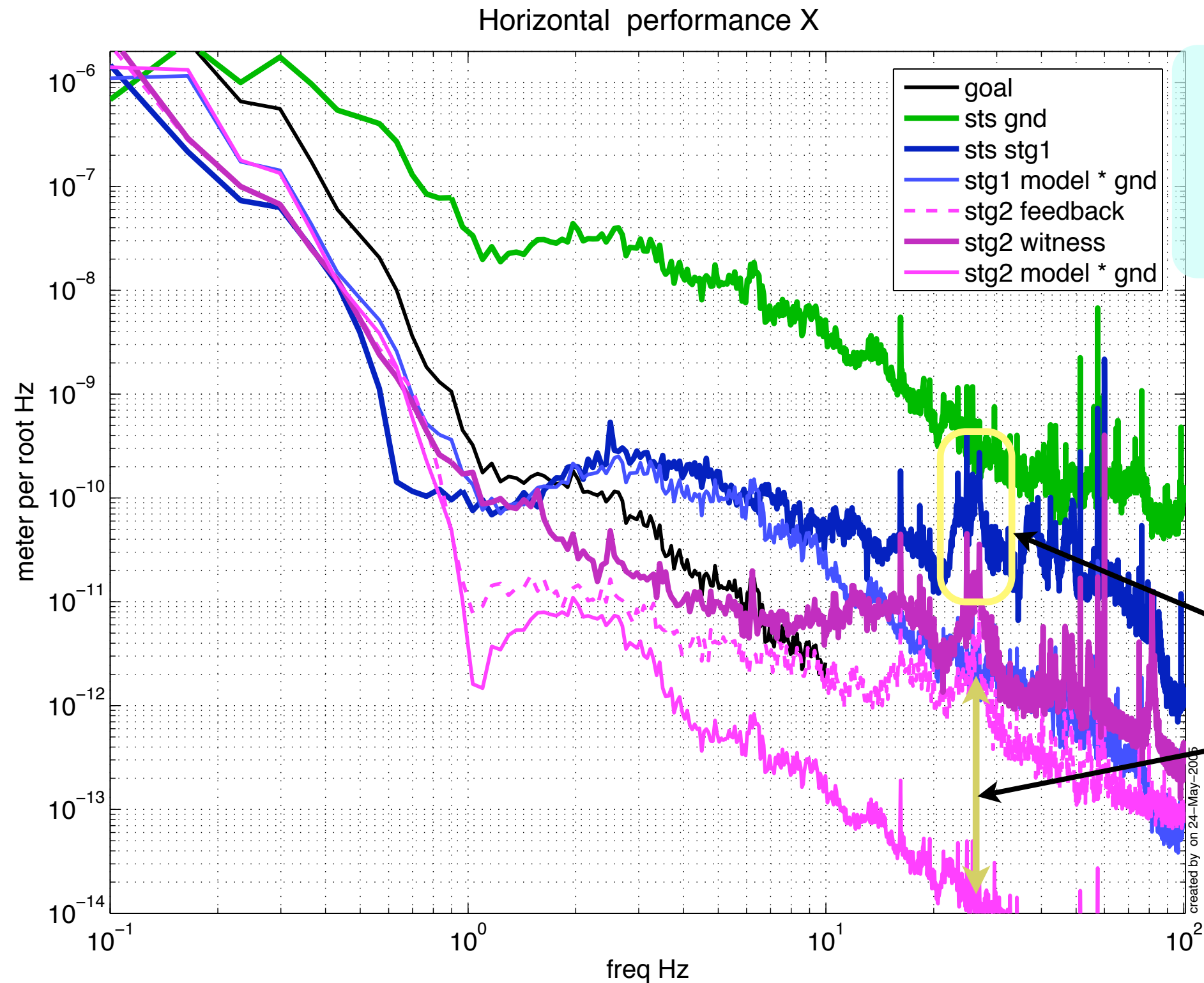


Requires the execution of the m-file mkModel_TechDemo

original by
Wensheng Hua, Brian Lantz, Sam Richman
Feb 2000

modified into current form
BTL May 12, 2005

ETF: X Performance vs. model

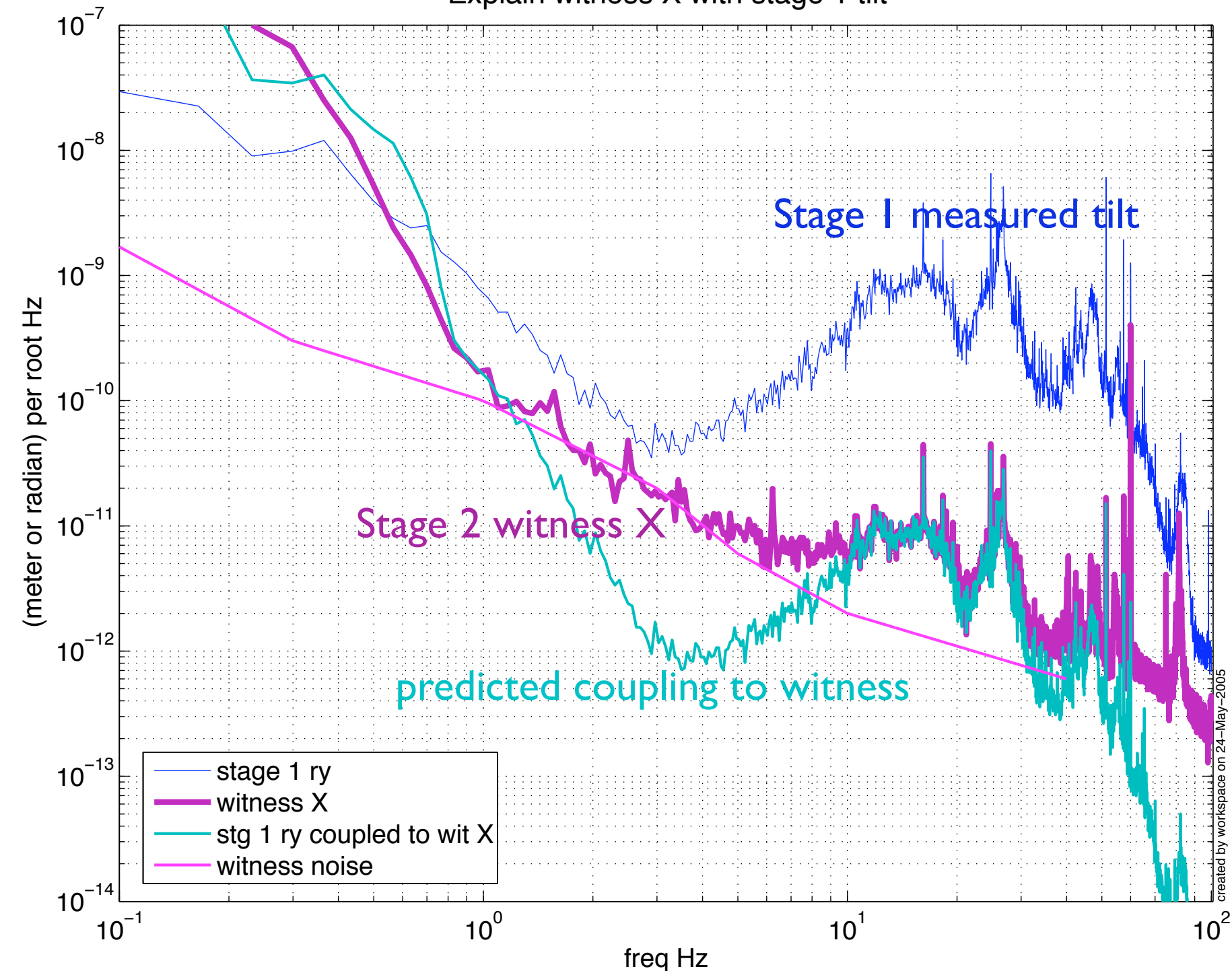


X motion of witness
is **not** caused by
X motion of ground

Where's my
isolation factor?
get ~6,
expect ~100

ETF: Tilt coupling

Explain witness X with stage 1 tilt



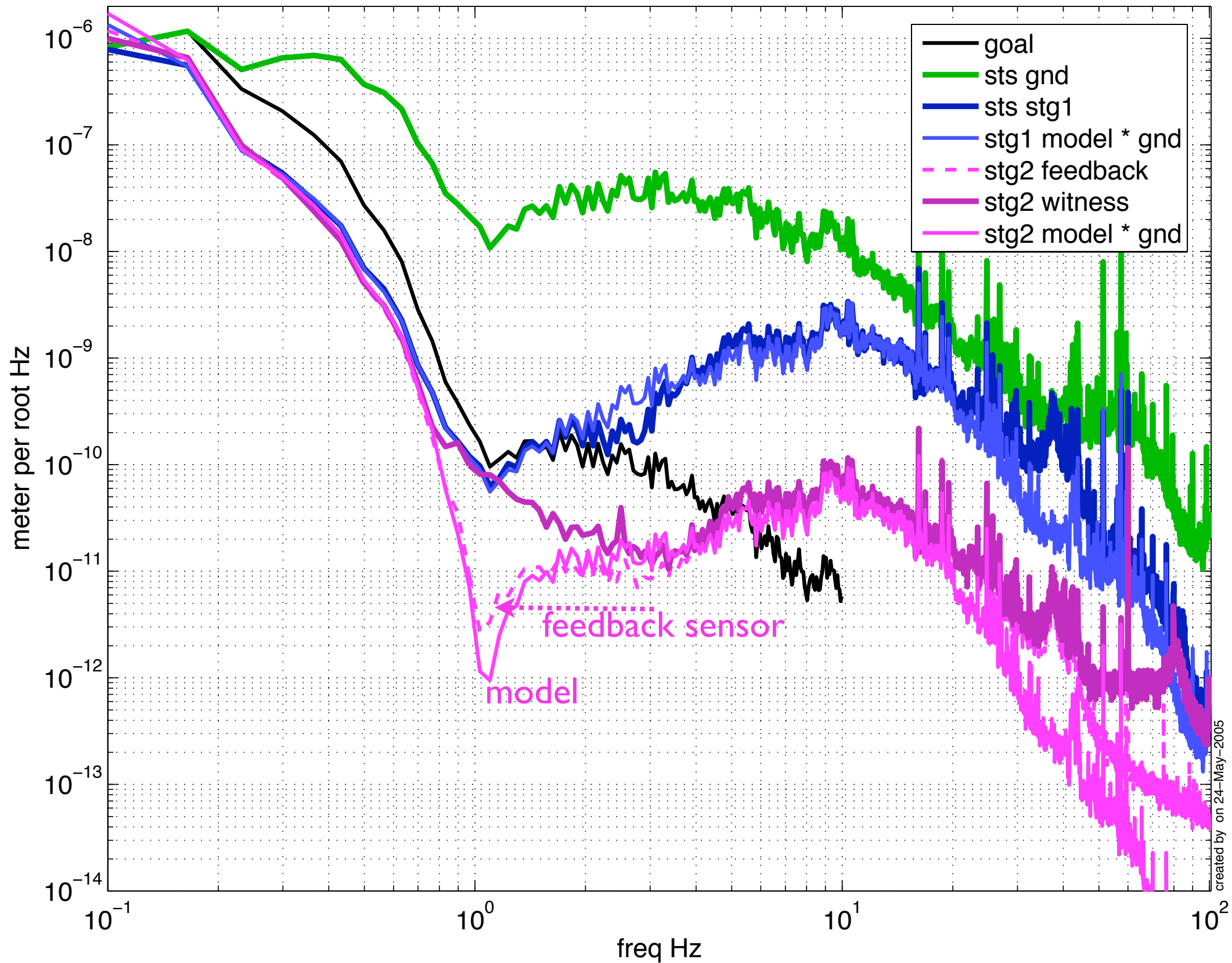
Stage 2 horizontal motion result of tilt coupling.

- SO -

To get better horizontal performance, improve (differential) vertical isolation

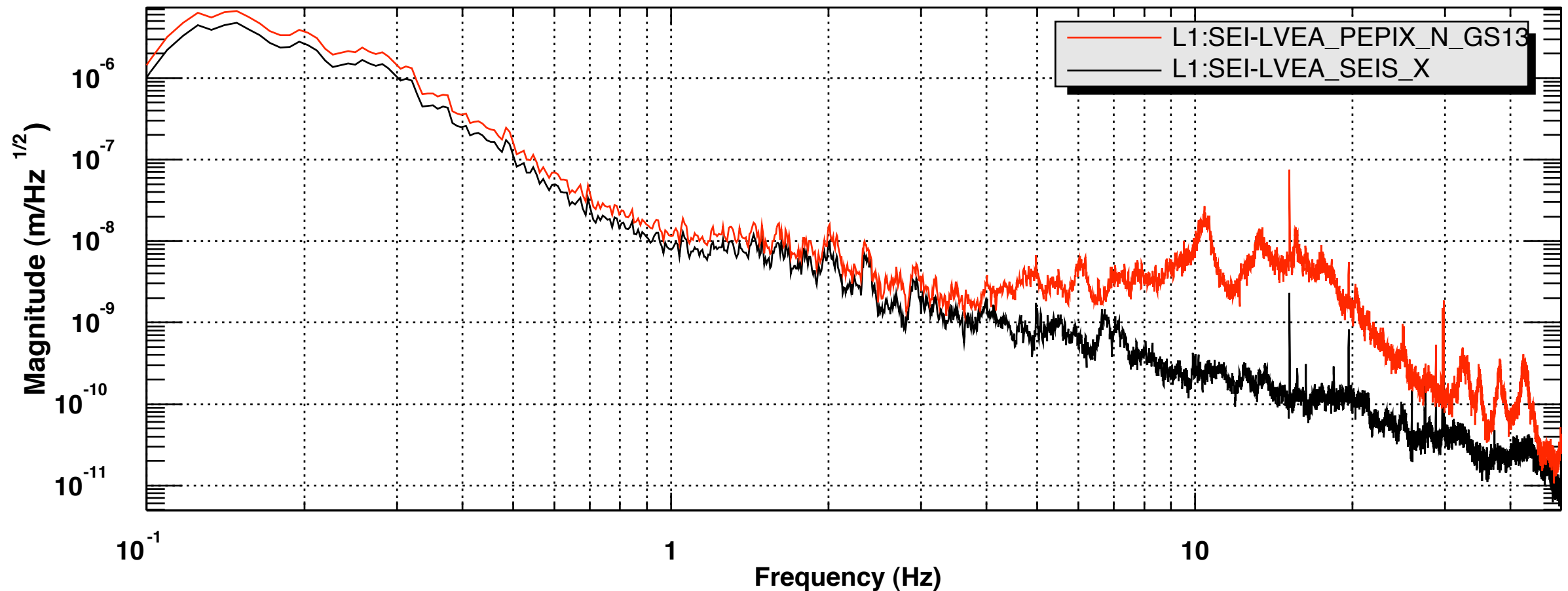
ETF: Vertical Performance

Vertical performance Z



LASTI: 10 Hz pier amplification

At 10 Hz, LIGO crossbeams move more than ground.



Rich Middleton leading work at LASTI to study pier.

- is it from the stack?
- what will it look like for Ad LIGO?

LASTI: 10 Hz pier amplification

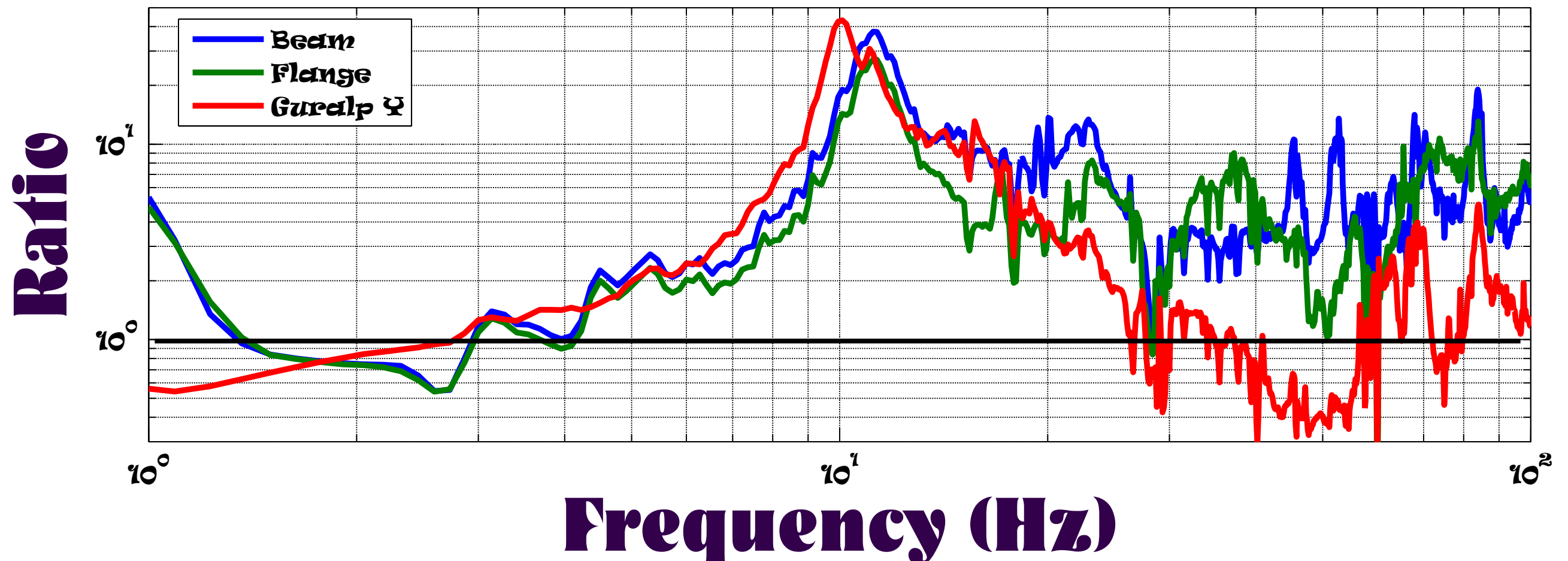
Stacks removed, amplification still present

Best guess: resonance of BSC chamber with floor,
drags piers along.

Lots of work put into this by Mittleman & Mason

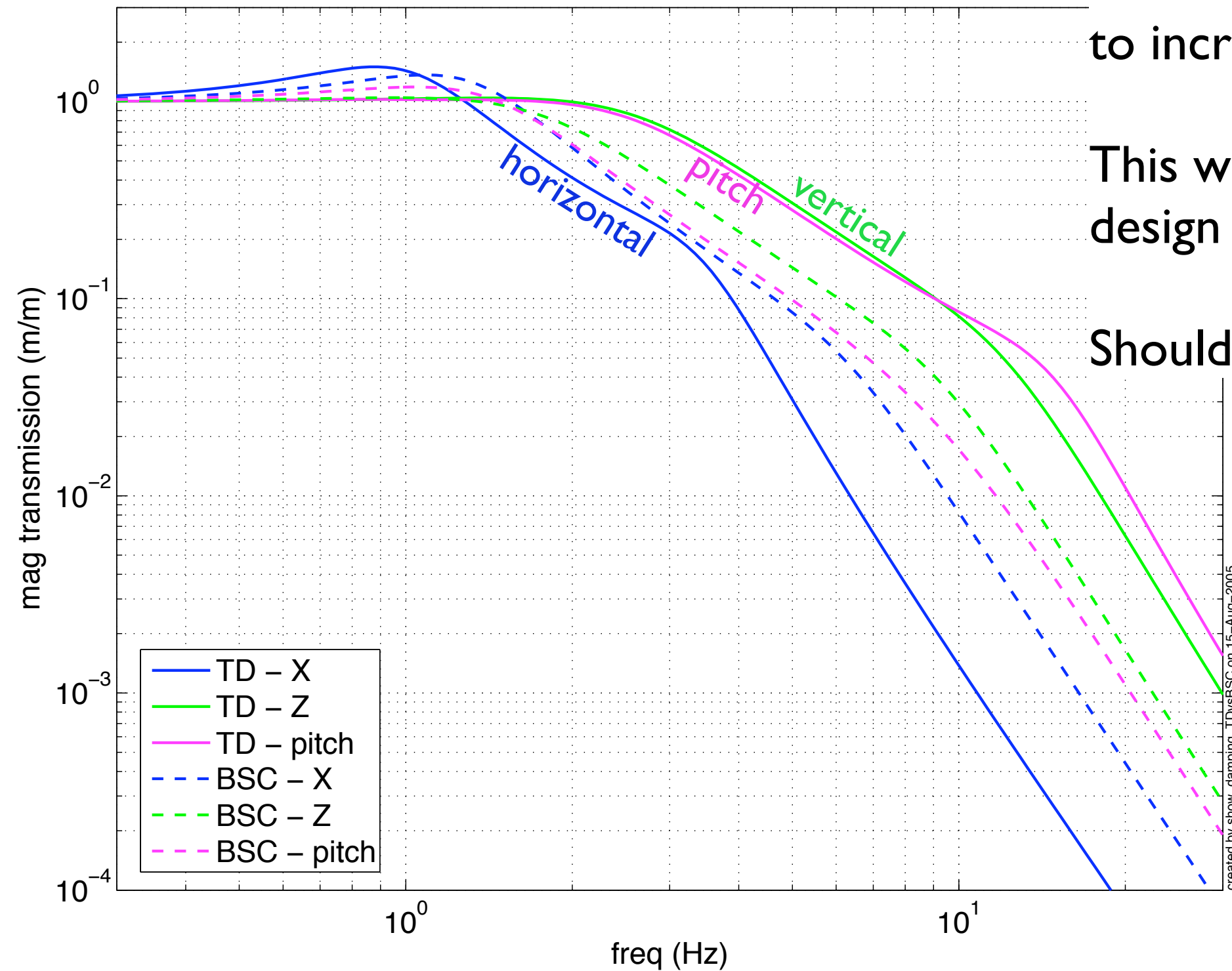
1) Work is ongoing, 2) 10 Hz is problematic

Amplification of ground motion, Y direction



New system from ASI

Passive Transmission (diagonal)



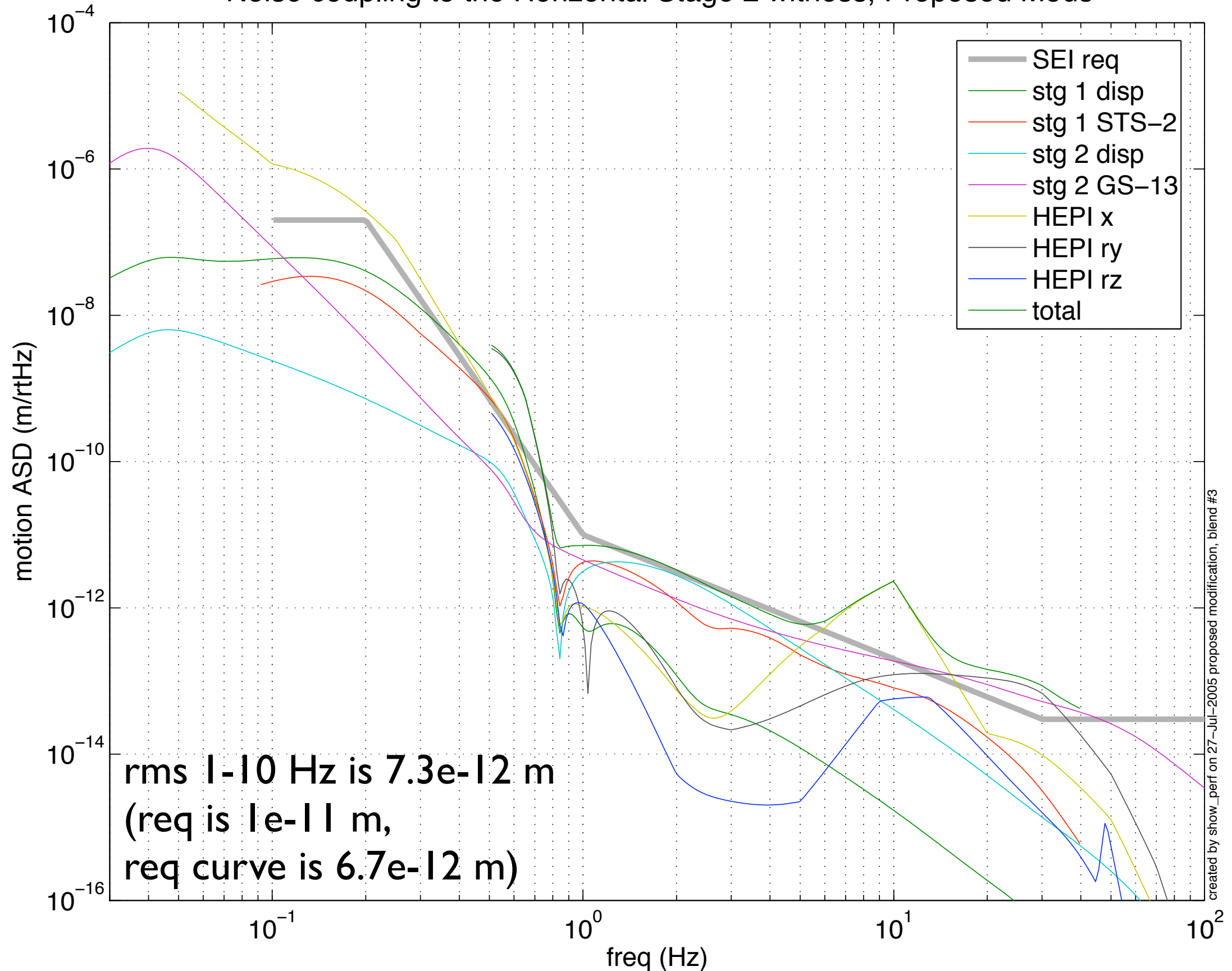
Modifications made to the plant to increase the passive isolation

This was a minimal change in design as received.

Should give good performance

Predicted Performance: X

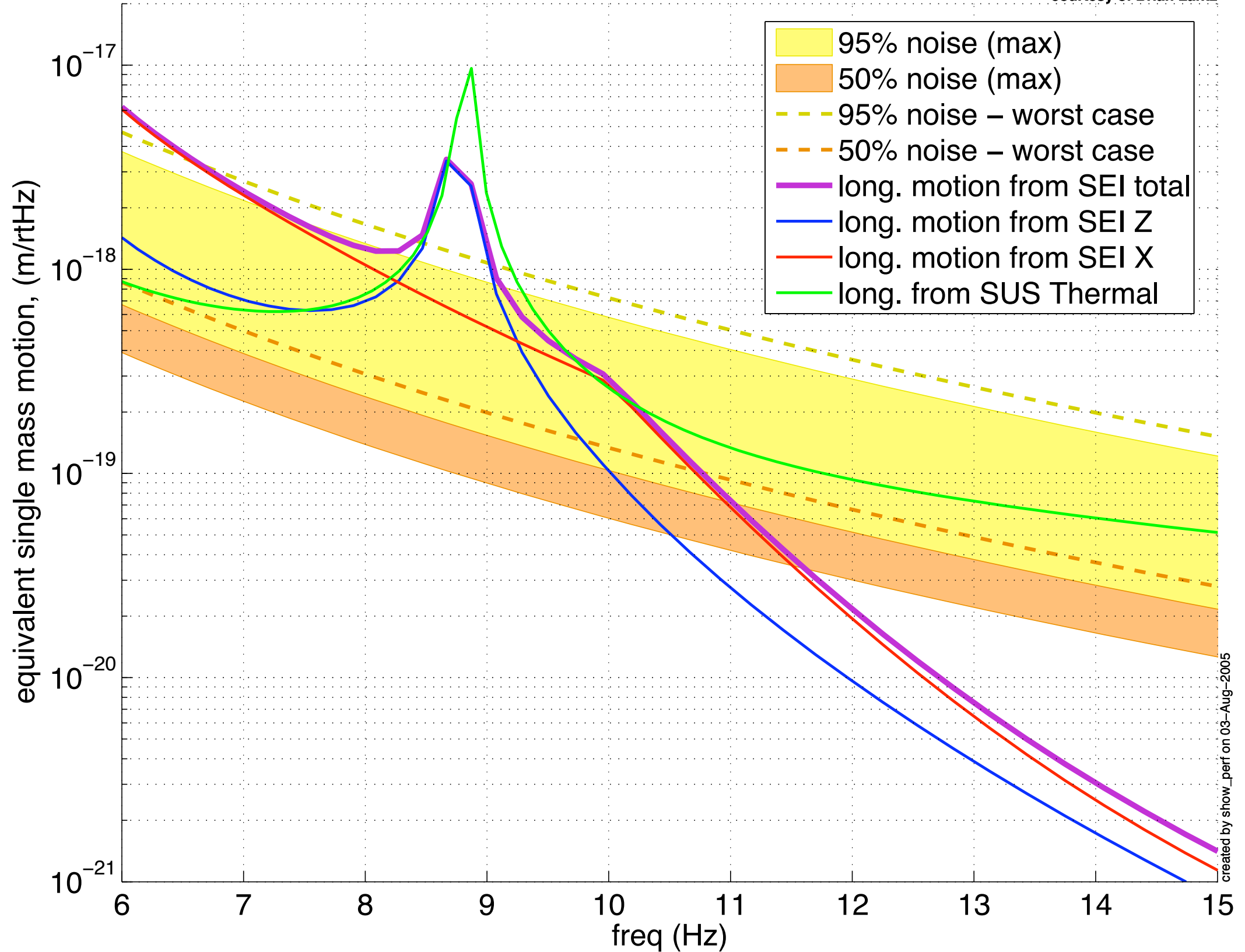
Noise coupling to the Horizontal Stage 2 witness, Proposed Mods



Predicted Performance w/ Pendulum

Motion of the Test Mass with Proposed Mods to ASI design

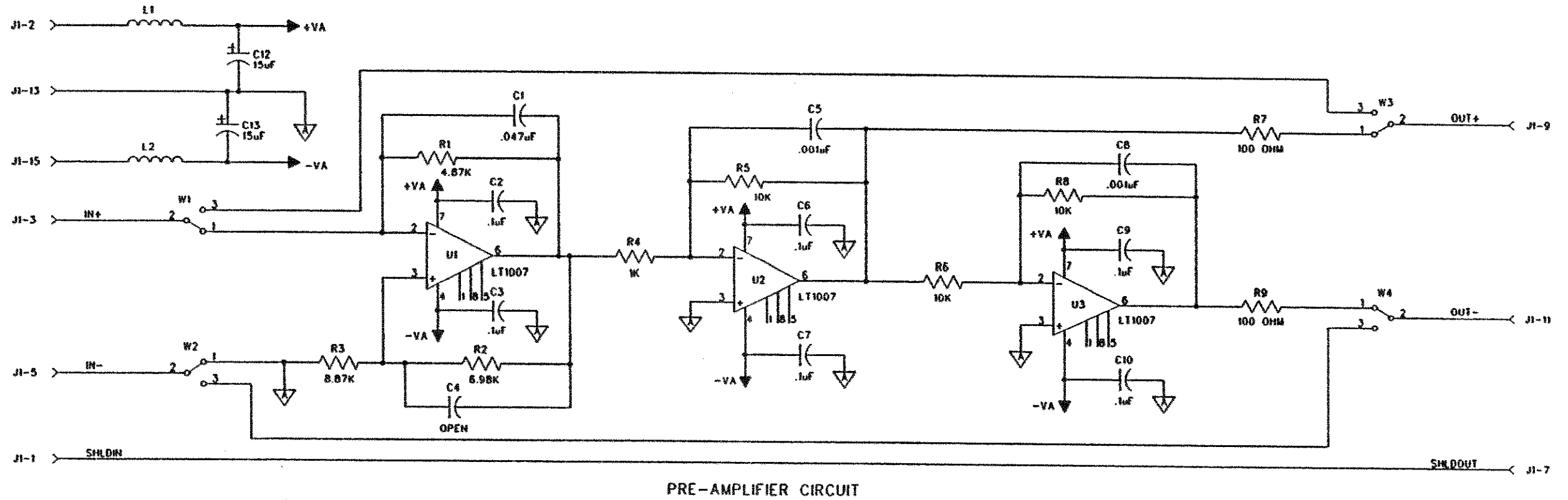
courtesy of Brian Lantz



Conclusions

- Expected performance at 10 Hz not quite as good as we'd originally predicted.
 - Pier amplification troublesome (opportunity)
Has minor impact on system performance.
- 1 Hz performance looks good
- We look forward to getting the prototype into LASTI

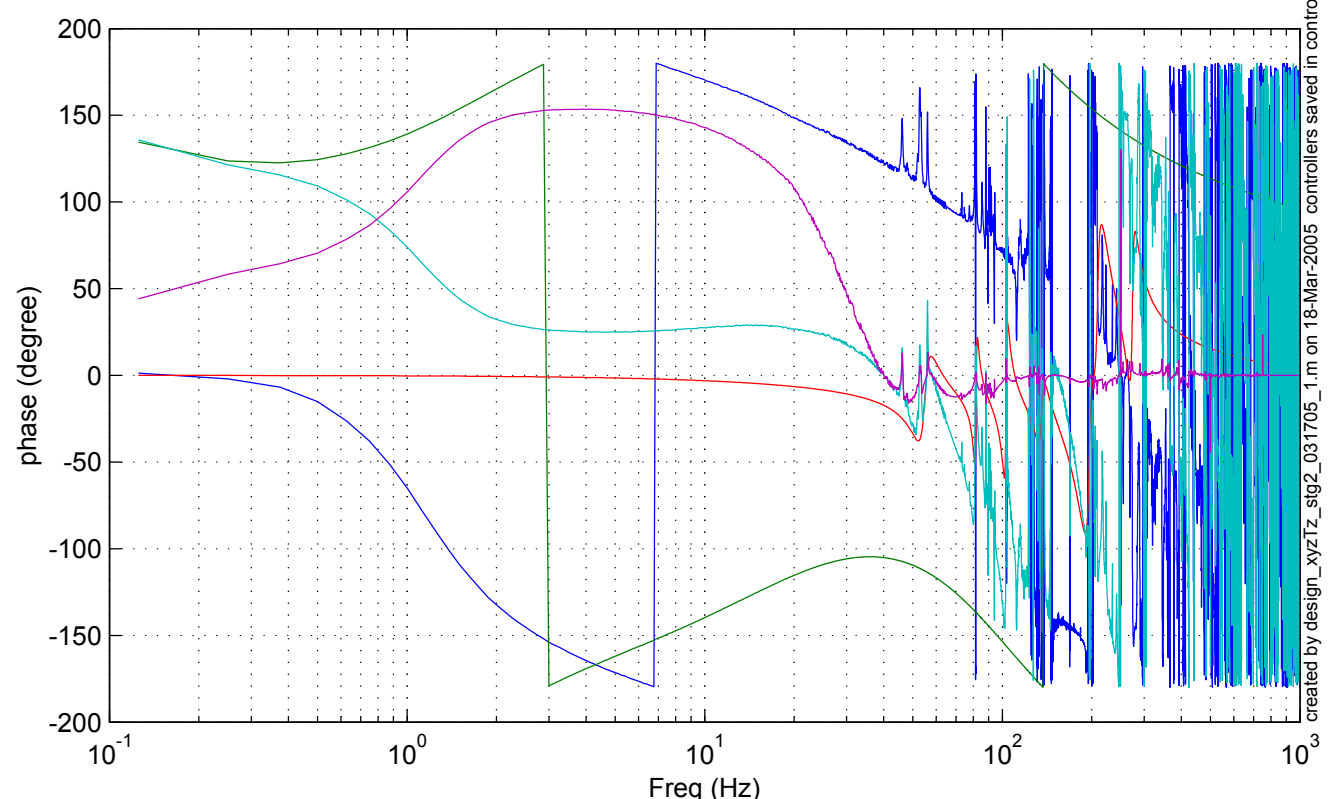
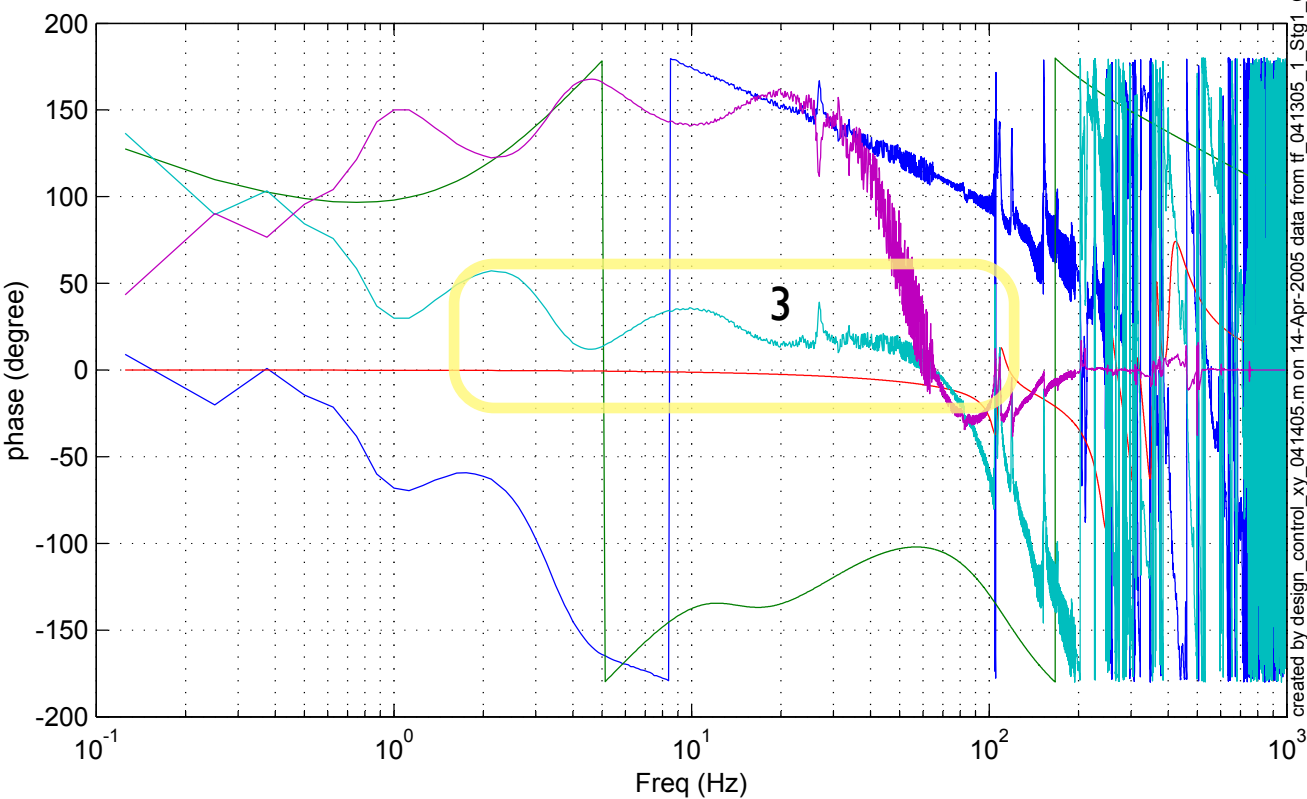
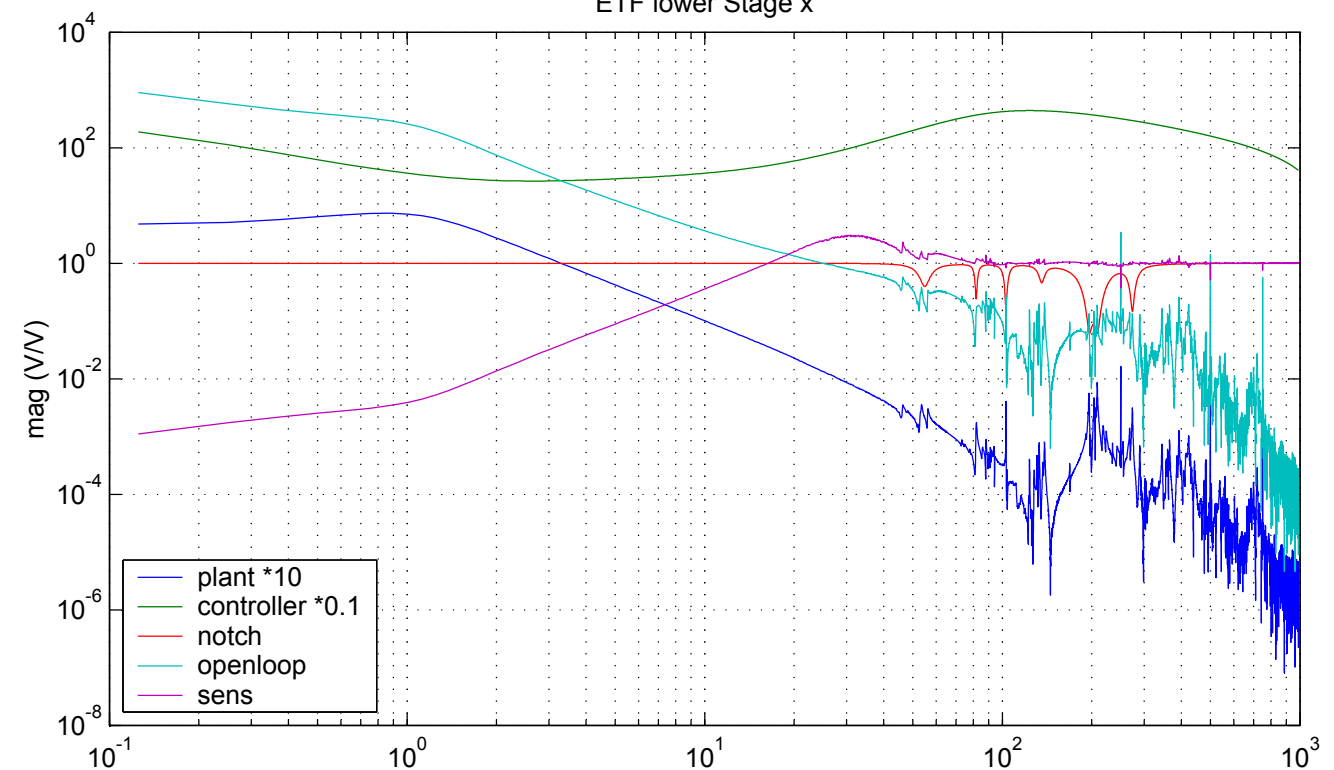
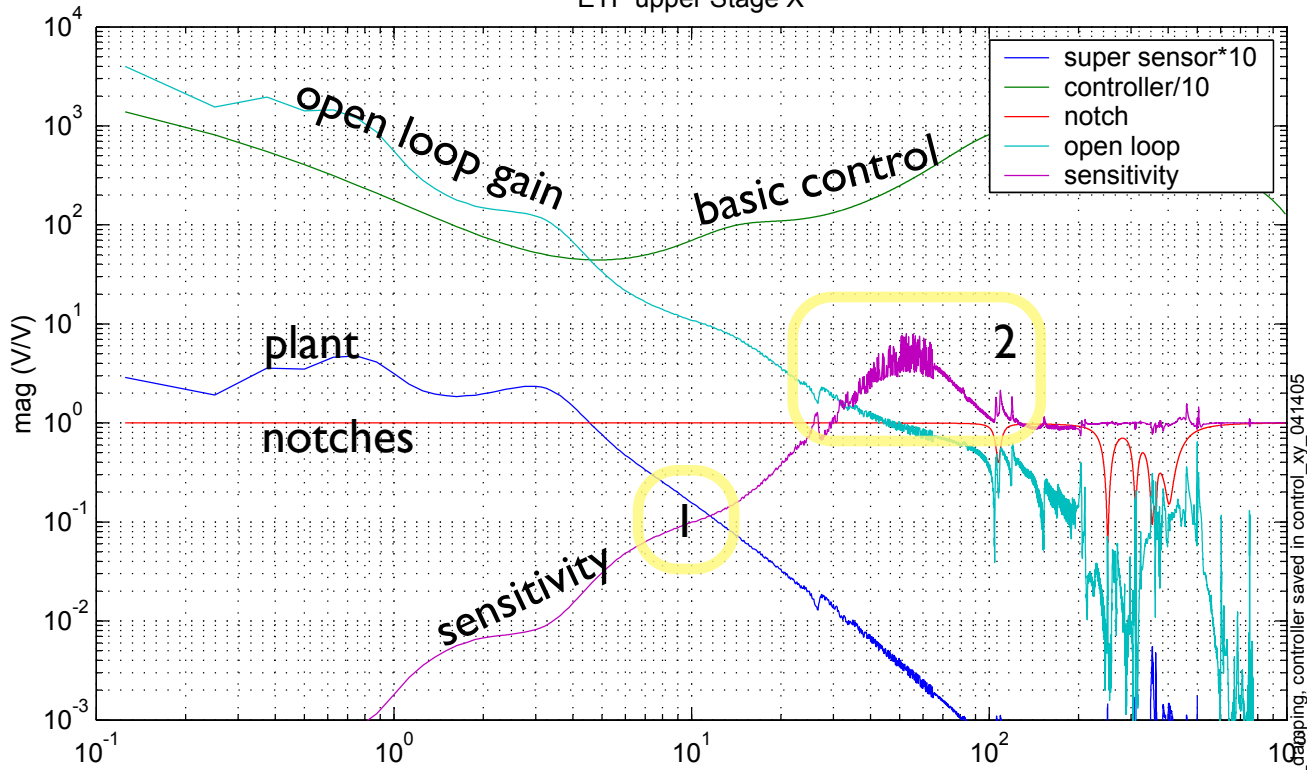
GS-13 -03 preamp



ETF: X Control

ETF upper Stage X

ETF lower Stage x



created by design_control_xy_041405.m on 14-Apr-2005 data from tf_041305_1_Sig1_Cen_1xyzON_xyzOFF_gapping_controller saved in control_xy_041405

created by design_xyzTz_stg2_031705_1.m on 18-Mar-2005 controllers saved in control_stg2_x_031705.mat

10 Hz pier amplification

