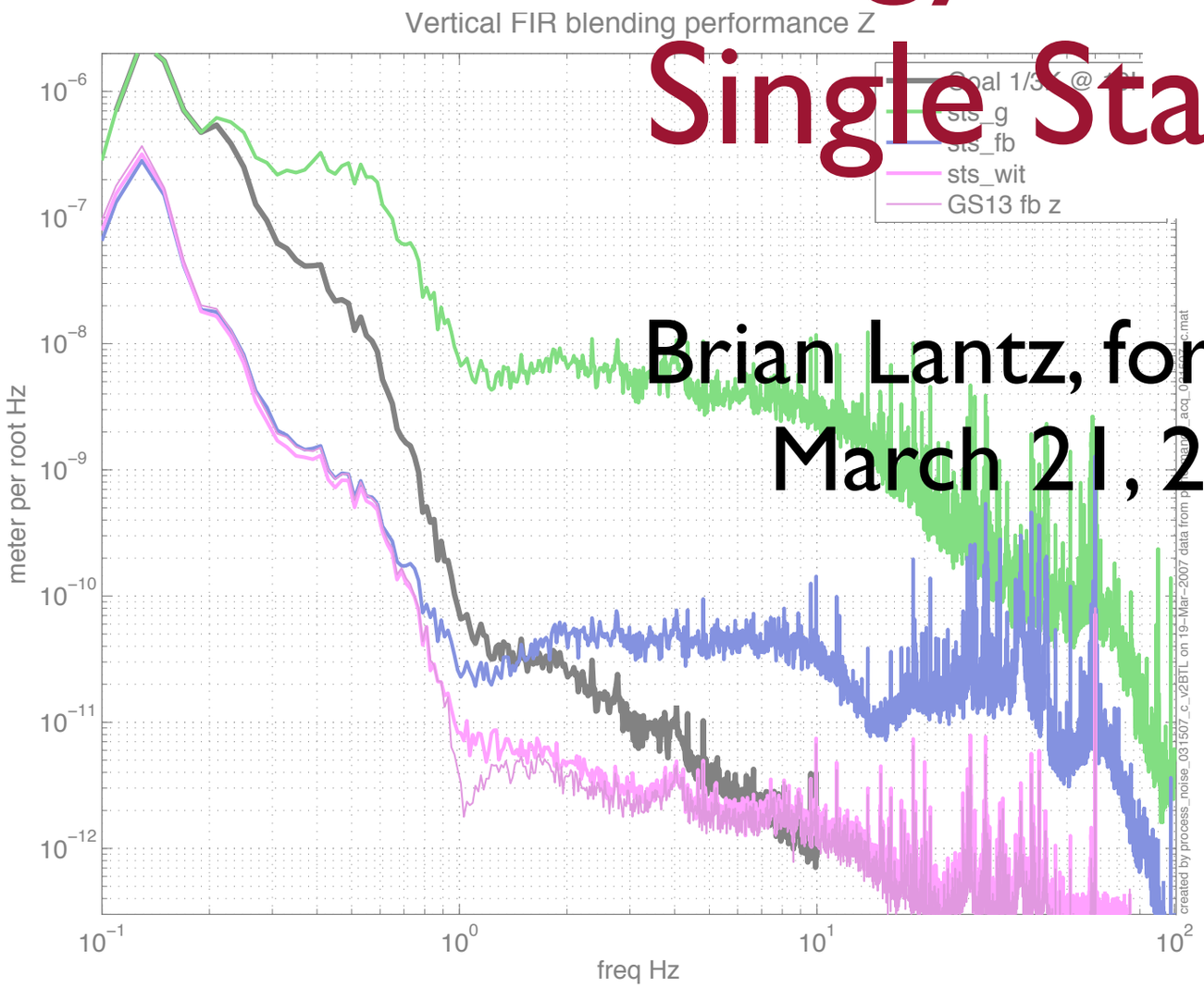
Advanced LIGO Seismic Isolation Update: Technology Demonstrator & Single Stage HAM



Brian Lantz, for the SEI team

March 21, 2007 (LSC)

Tech Demo at Stanford

Technology Demonstrator is a nearly-full scale prototype with 2 active stages. Designed & built by HPD. Now in use at Stanford's Engineering Test Facility.

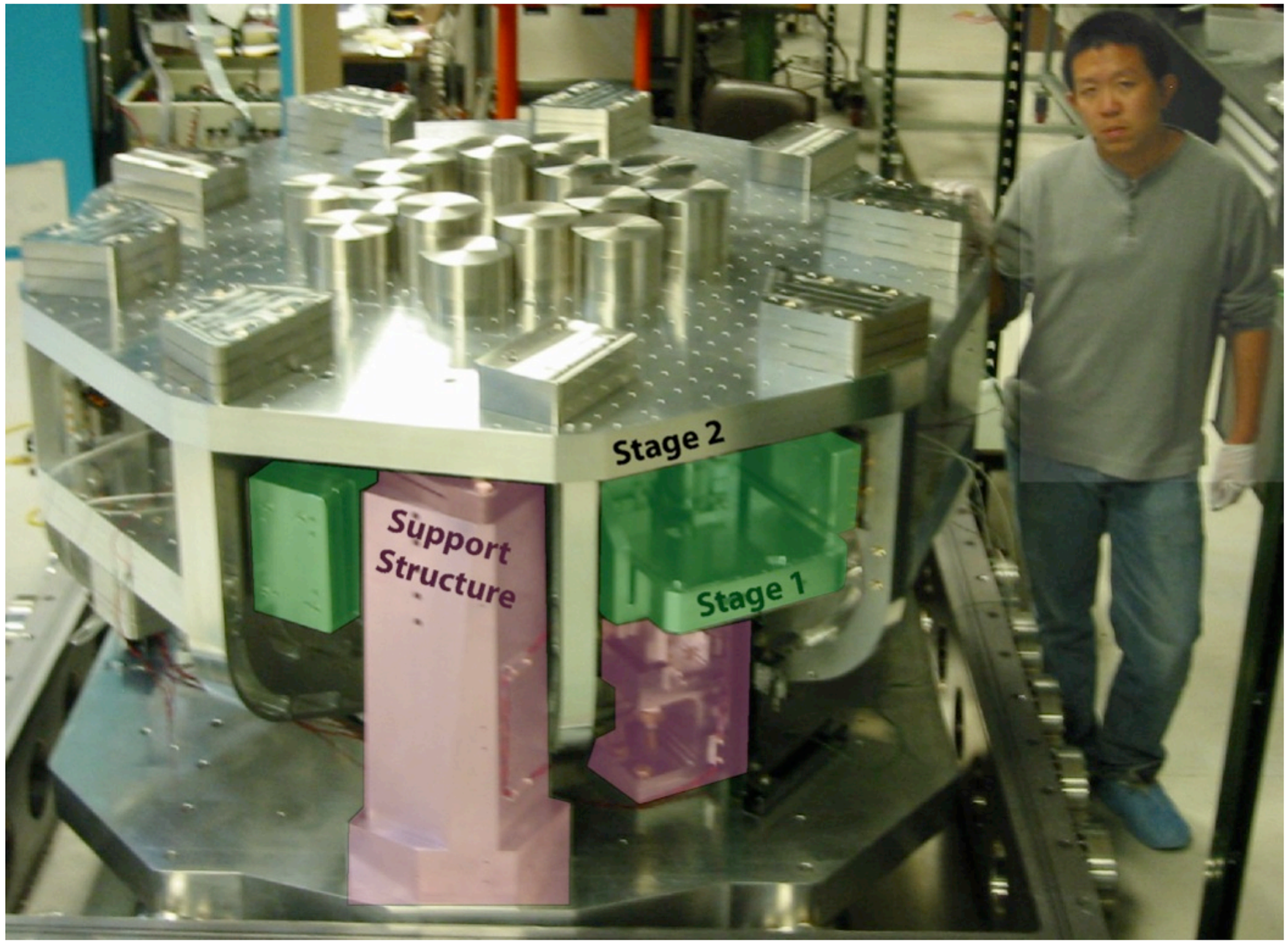
2 stage isolation and alignment system.

Each stage aligned and isolated in 6 DOF.

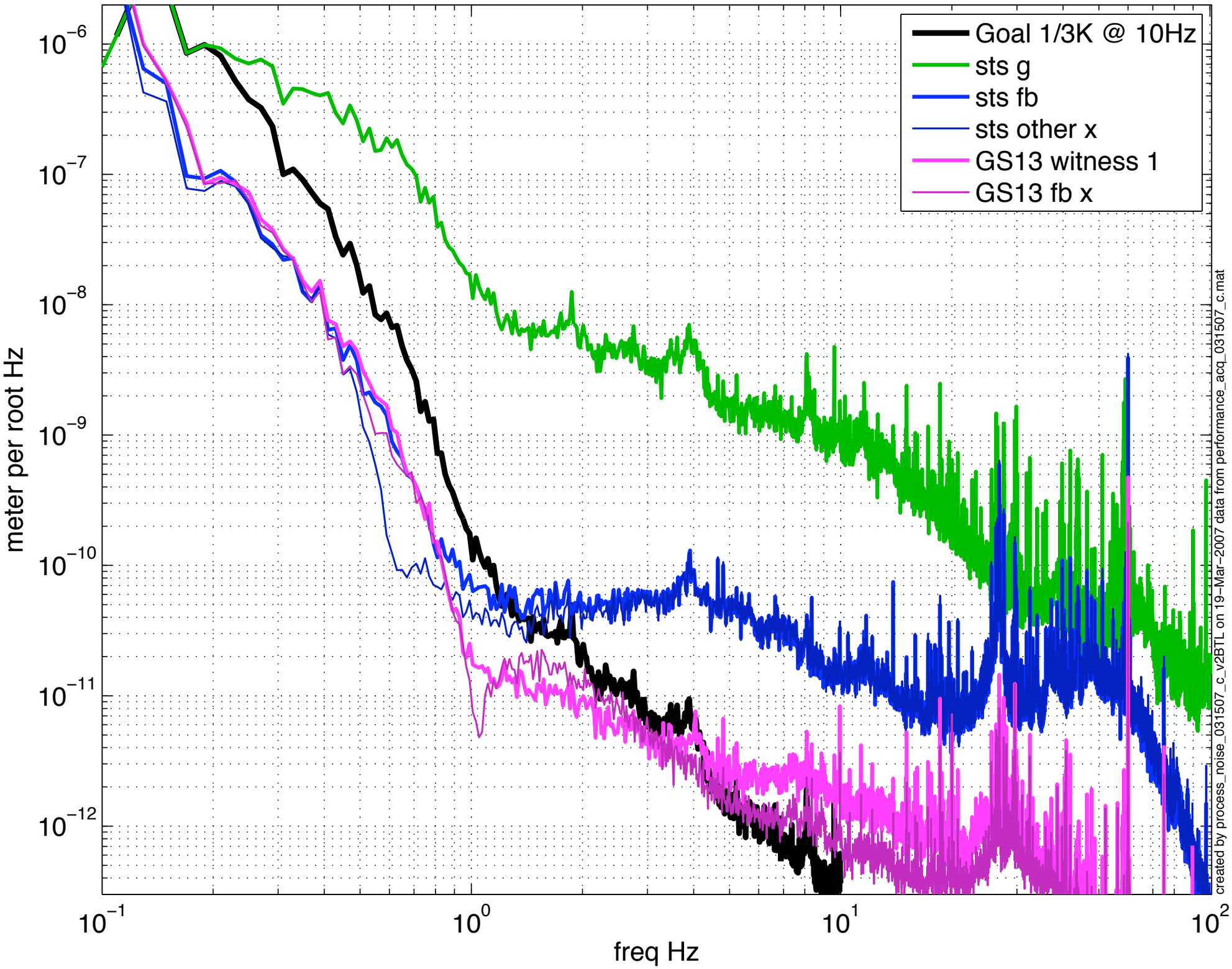
Passive isolation at 1 Hz horz, 3 Hz vert

Active isolation below 30 Hz

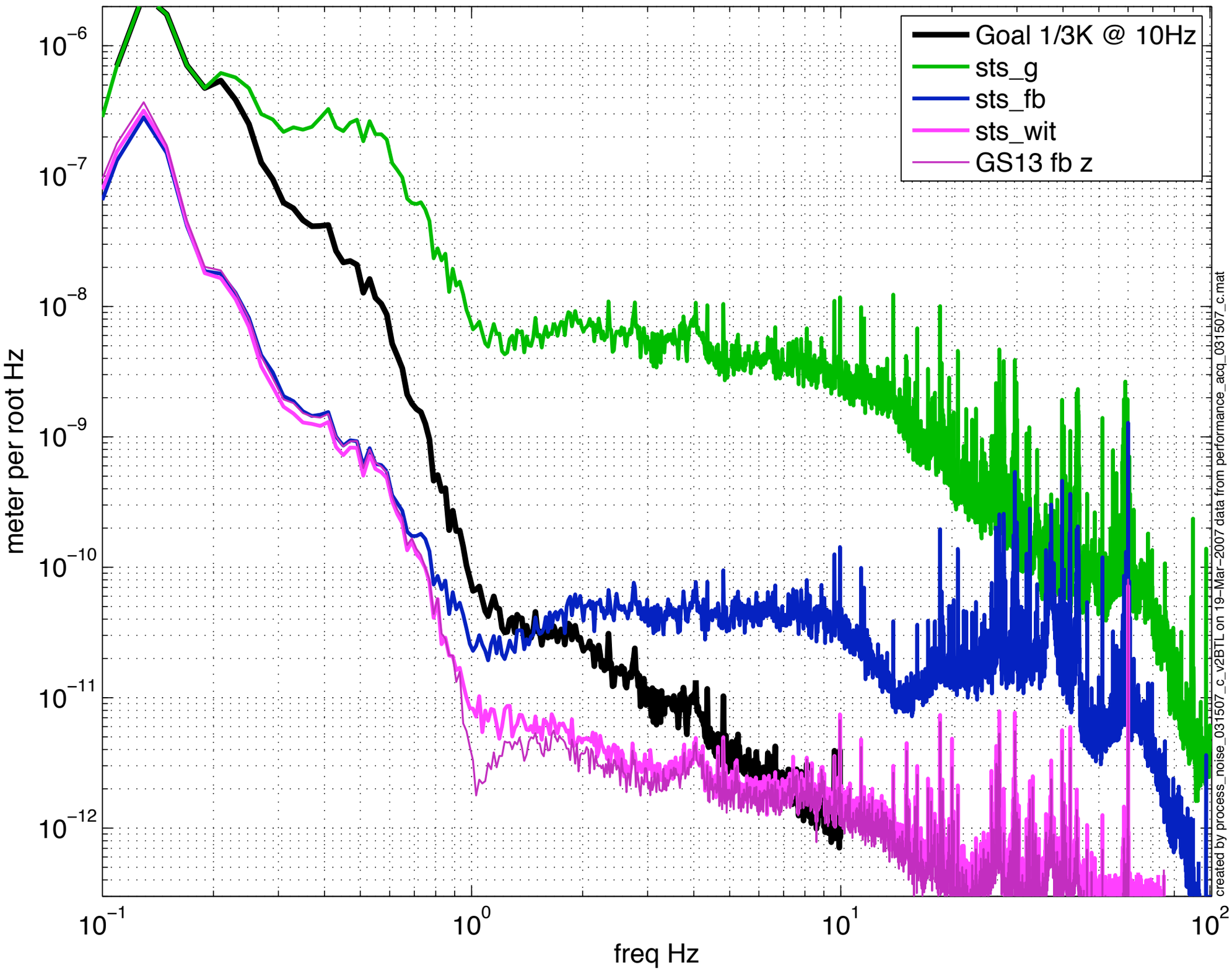
Feedforward added by Matt DeGree.



Performance X



Performance Z



Single Stage HAM

- History of the single stage HAM, new baseline for Advanced LIGO.
- Summer ’05, Peter Fritschel held a meeting at Caltech to discuss new, relaxed requirements for HAM chamber optics - can we use a single stage?
- April ’06 we presented a conceptual design to a review committee, and the single stage was adopted as the new baseline for the HAM.
- November ’06 we awarded a design contract to HPD, with a construction option.
- Final Design Review in April ’07
- Plan to build 2 for Enhanced LIGO in August ’07, plus 1 more for LASTI.

HAM Design (nearly final)

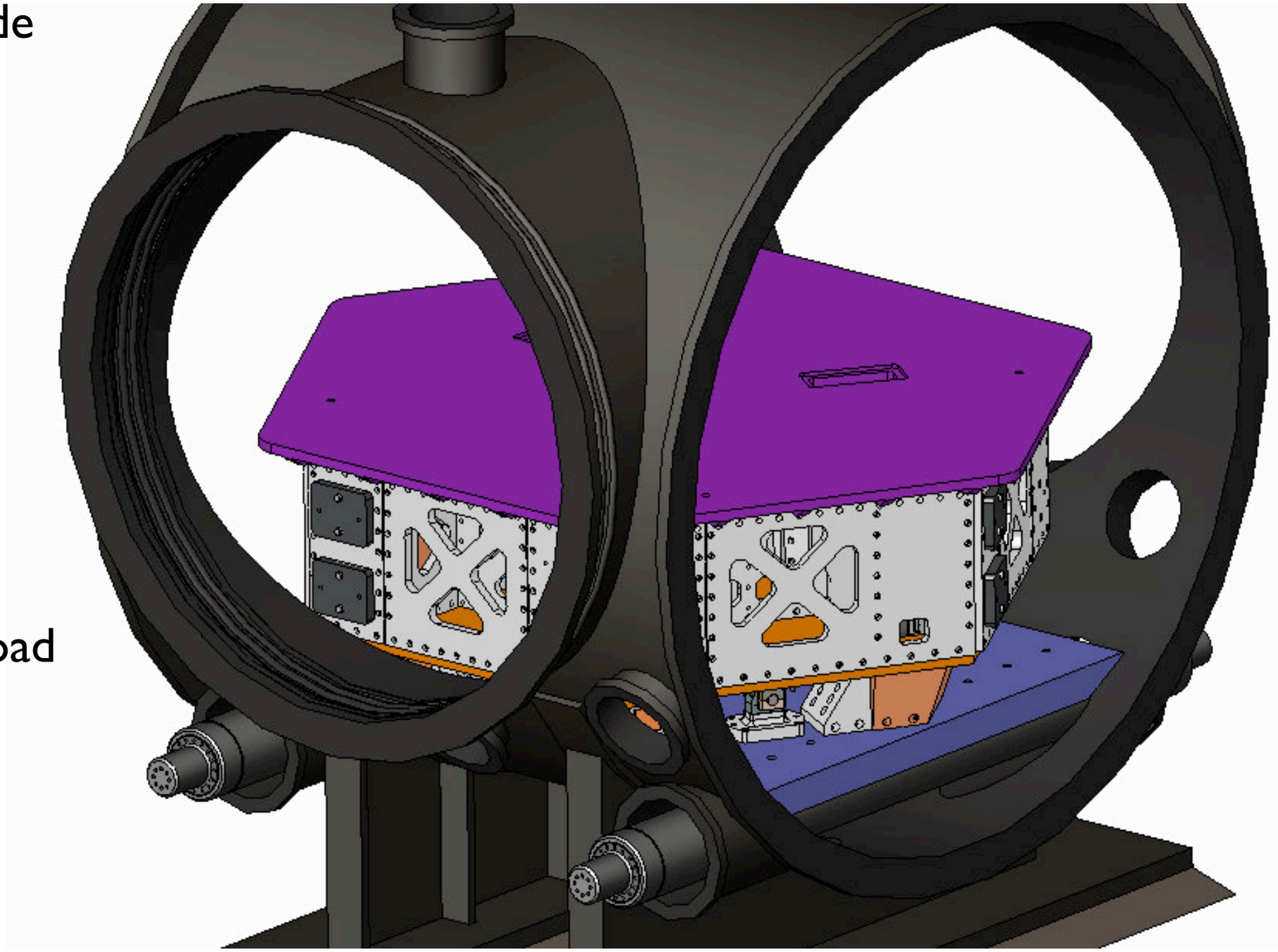
- Bolted aluminum structure
- Suspended by 3 blade springs & "wires"

- Natural freq's
  x & y: 1.35 Hz
  z: 1.8 Hz
  tip/tilt: 1.07 Hz
  yaw: 0.9 Hz

- mass:
  stage 1 ~ 1500 kg
  plus 510 kg of payload

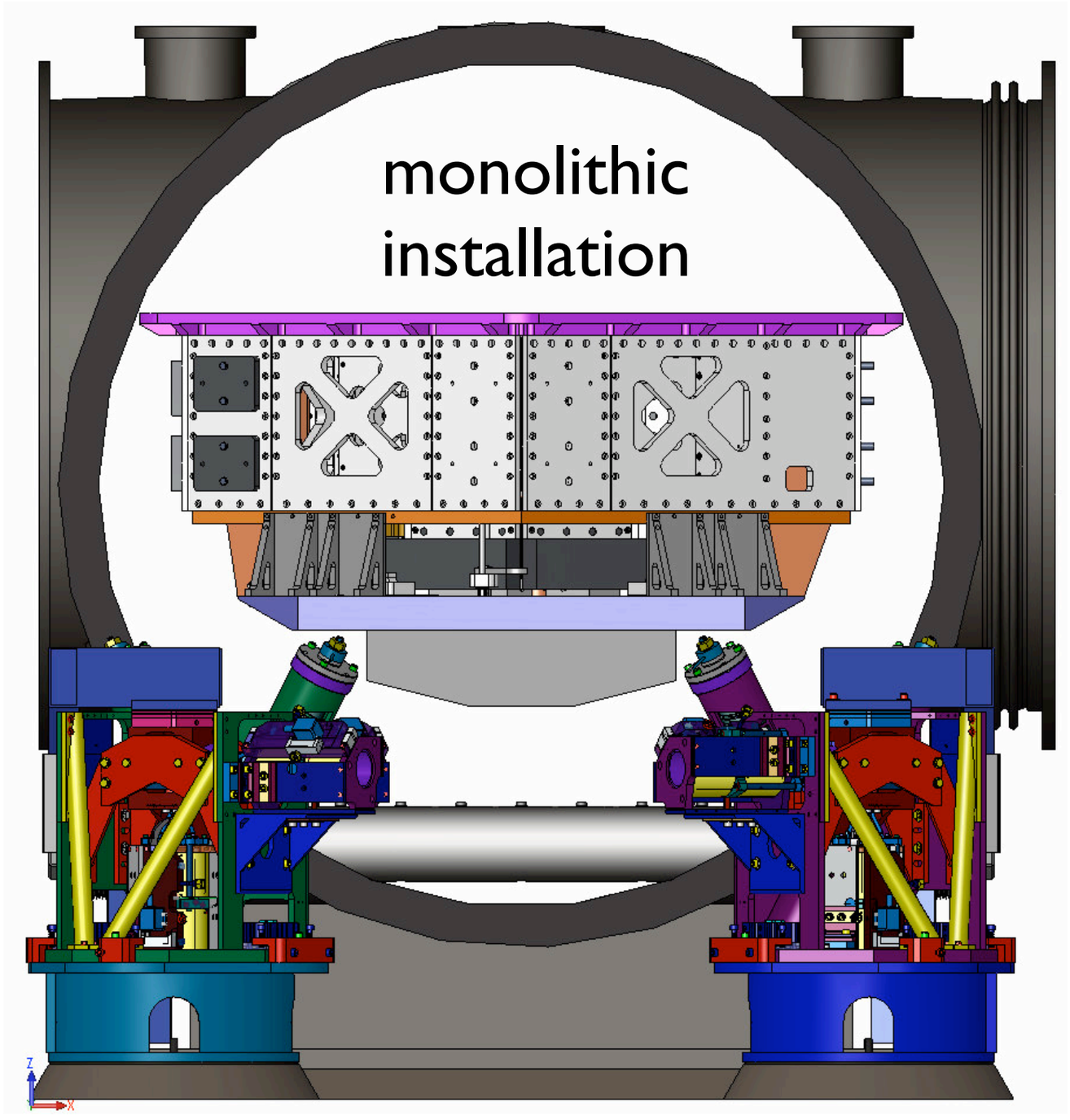
- first bending mode:
  > 250 Hz

- assume servos with unity gain of 27 Hz

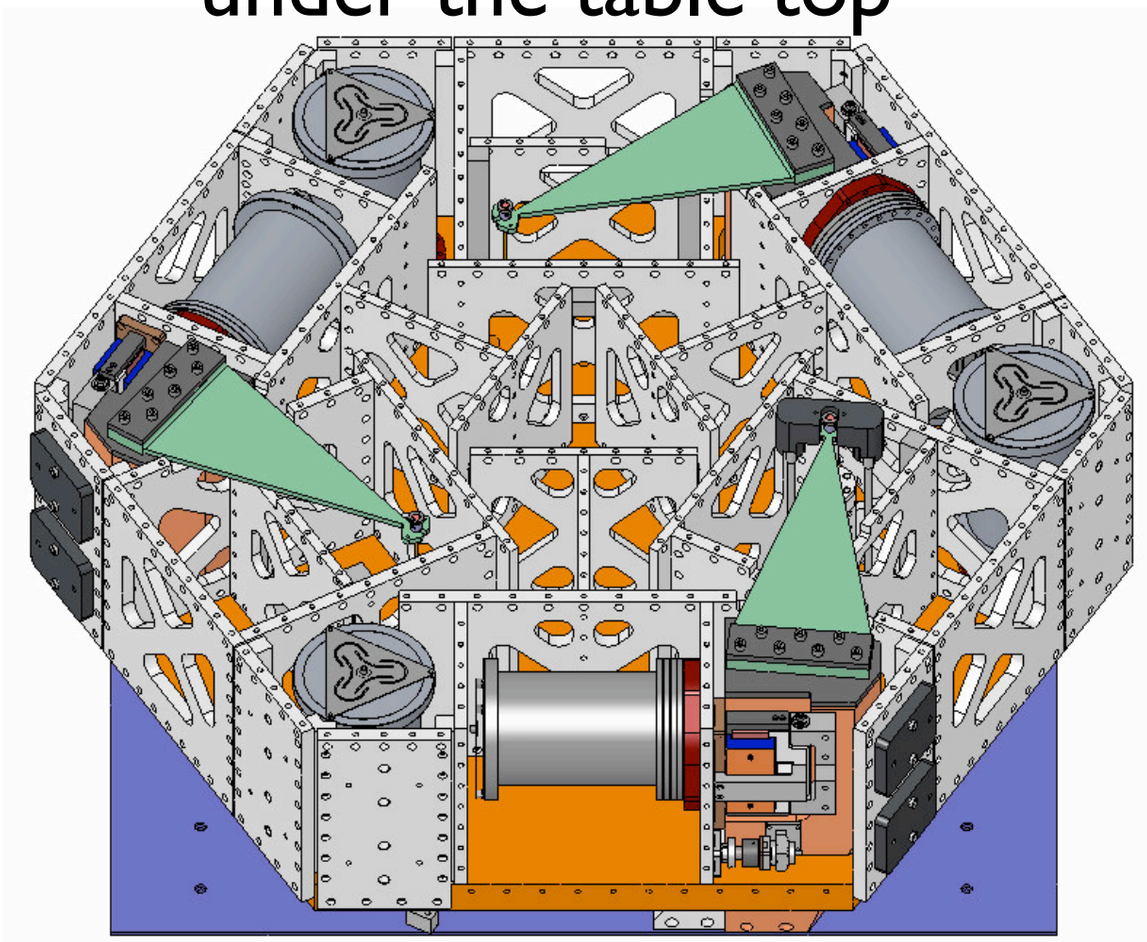


Other views

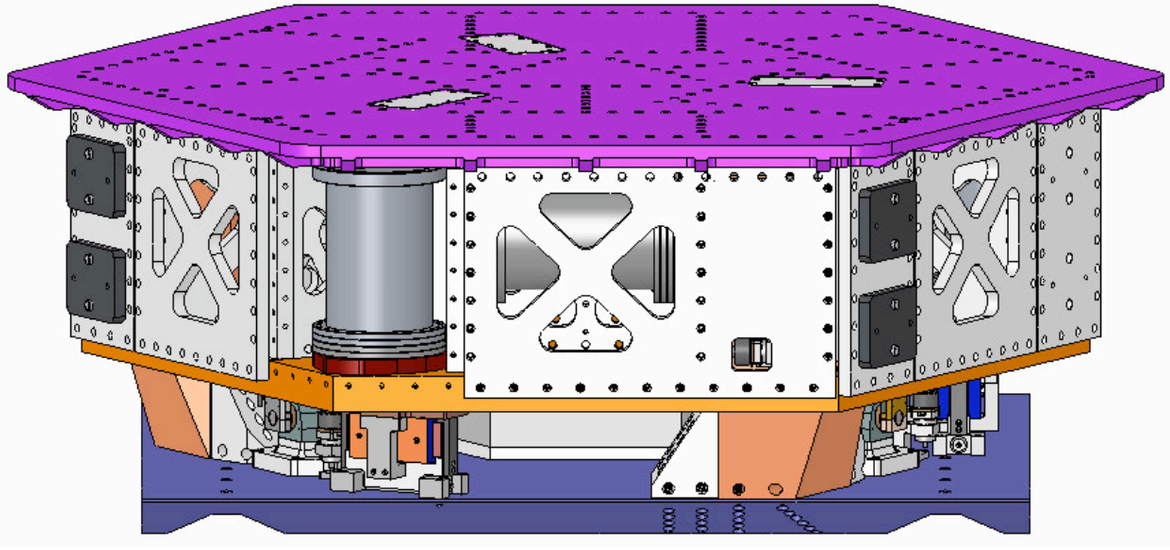
monolithic installation



springs and sensors under the table top



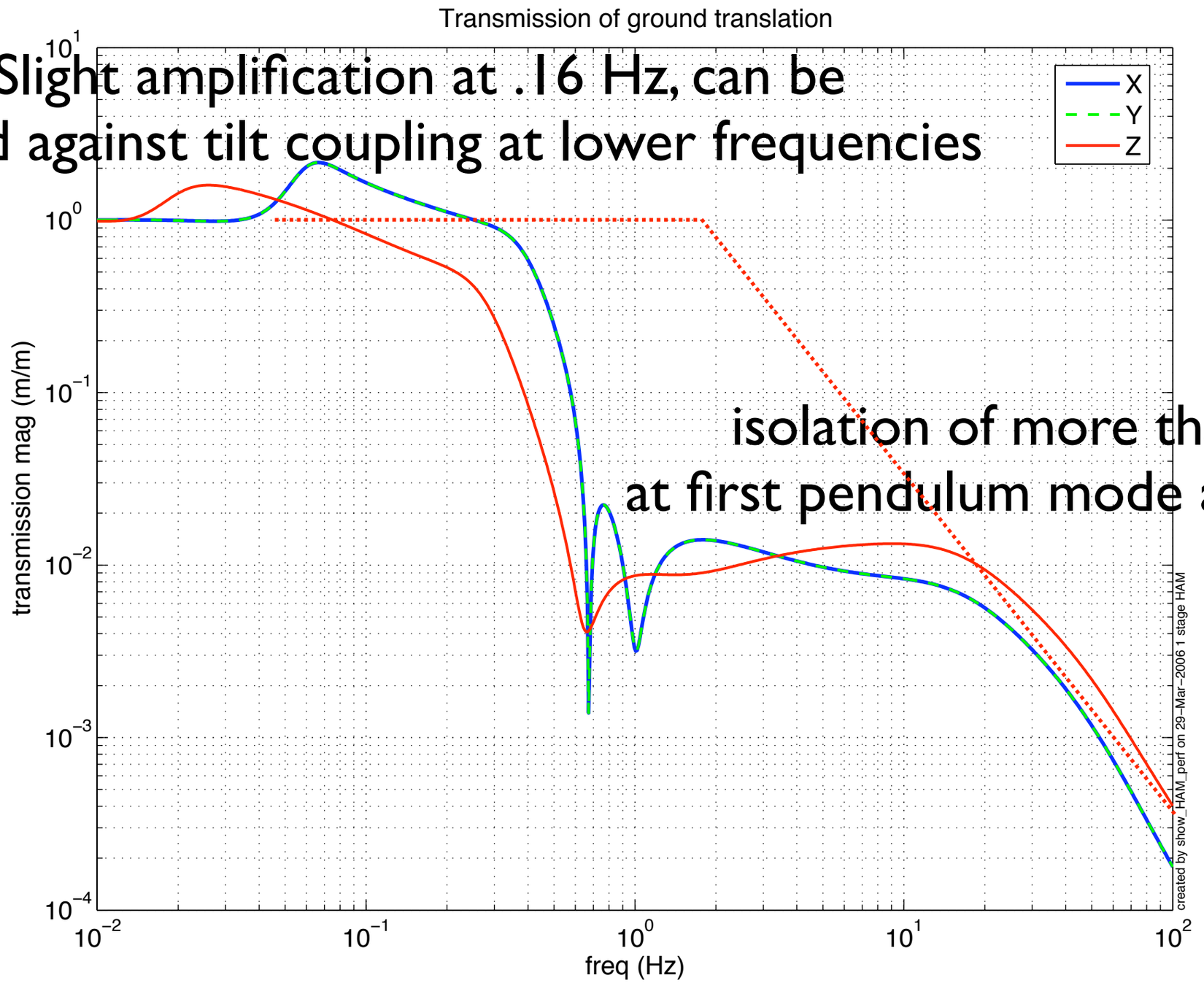
access to a vertical sensor



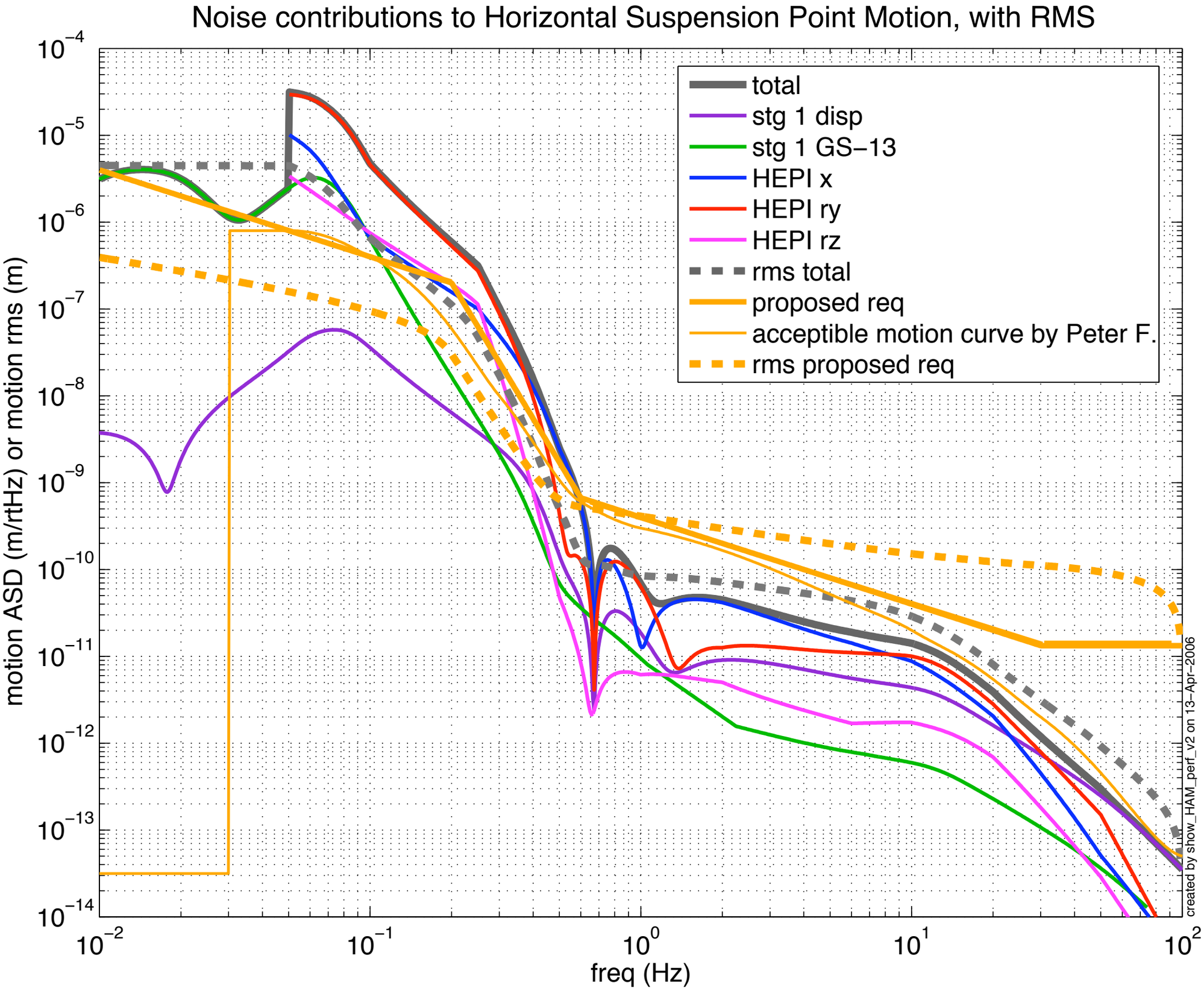
Transmission of translational input motion HEPI motion -> table cg motion

Slight amplification at .16 Hz, can be traded against tilt coupling at lower frequencies

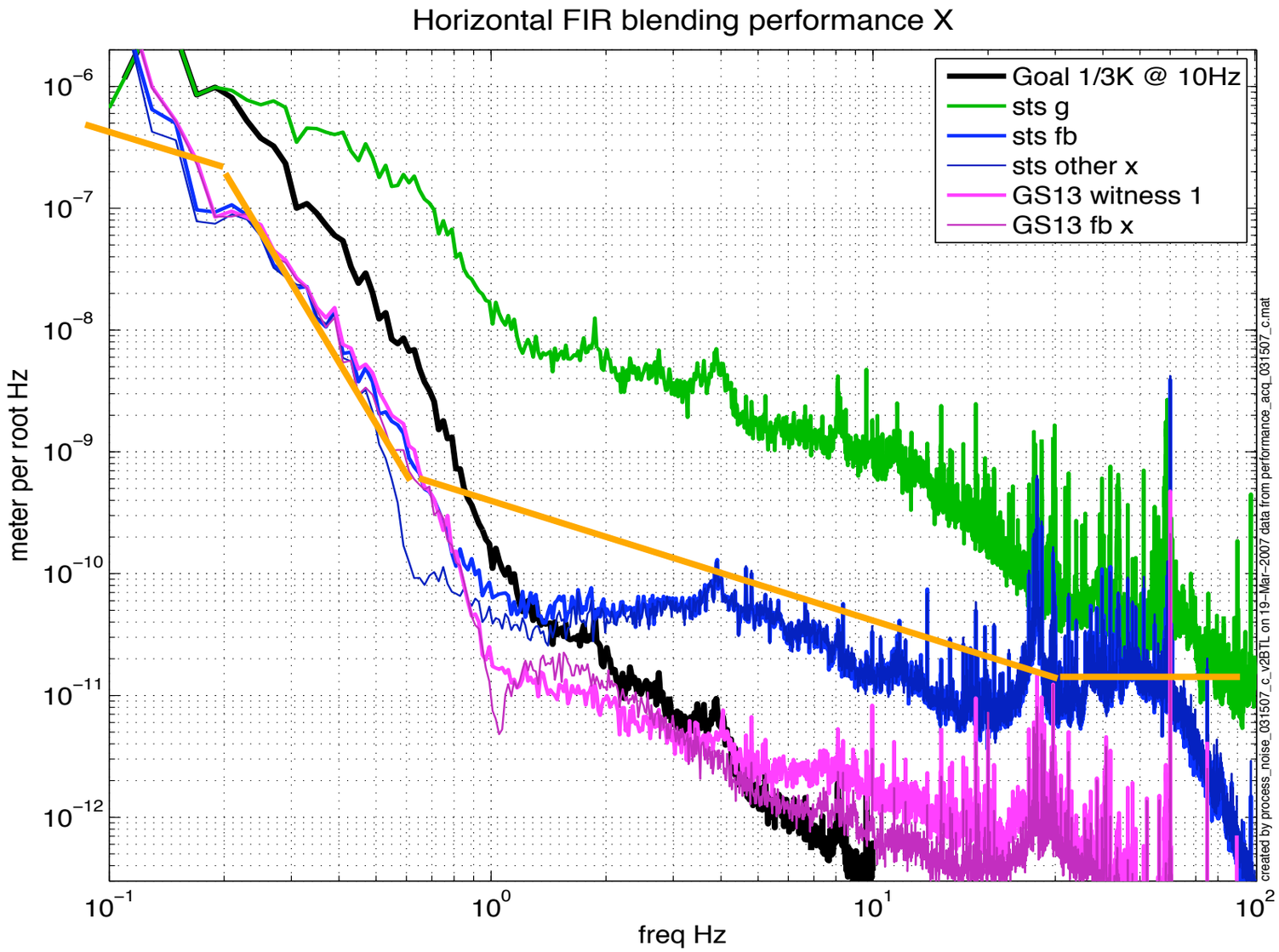
isolation of more than 50 at first pendulum mode and above



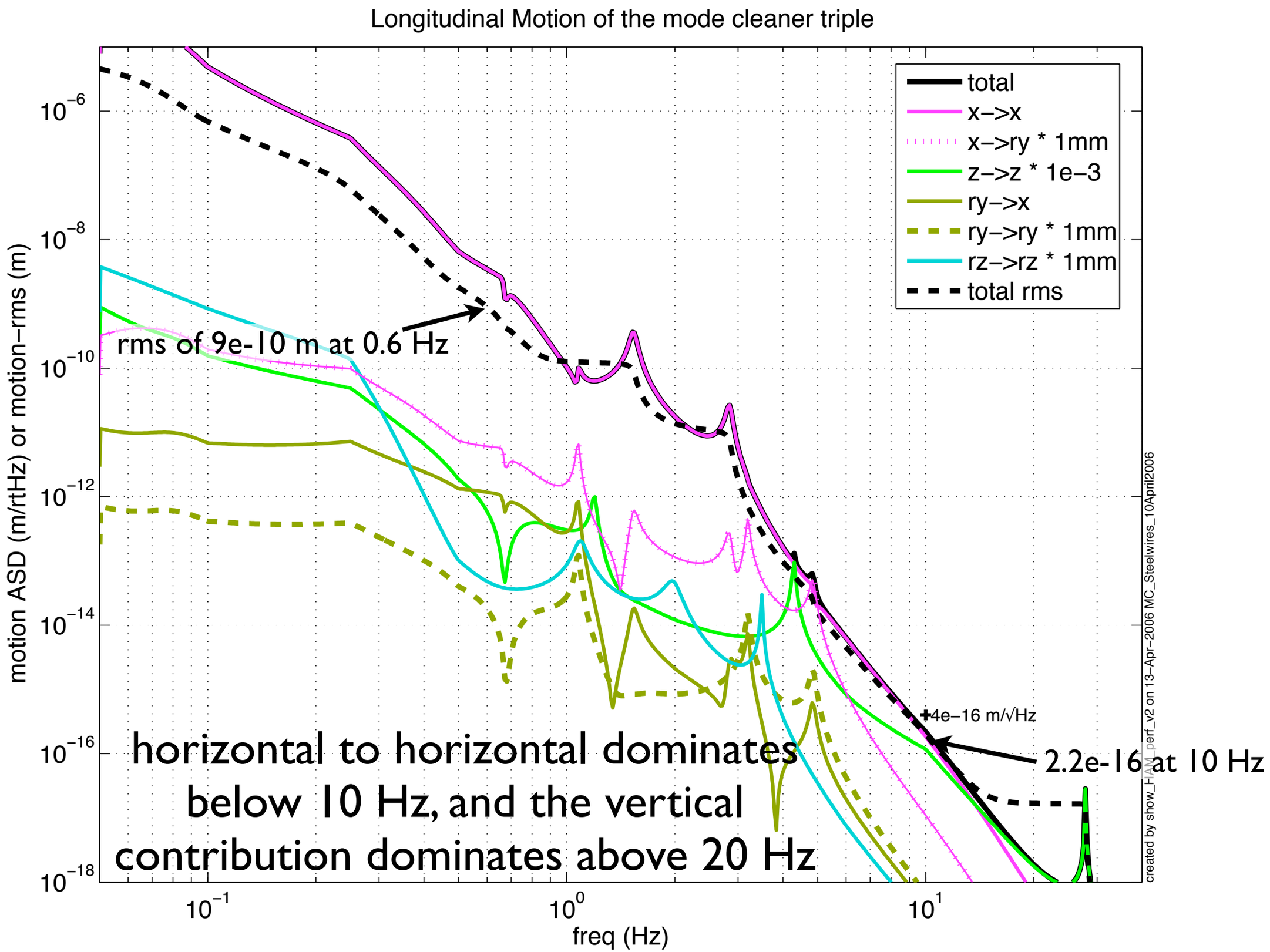
Performance predictions



Performance predictions



Performance Predictions



Conclusions

- Working hard to be ready for ELI and Advanced LIGO.
- Optimistic about the commissioning of the Single stage HAM for the Enhancement.
- Performance of the Tech Demo gives us confidence that the BSC ISI controls should work well when it gets back from cleaning.

Tech Demo experience
Passive Isolation