advancedligo

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

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July 25, 2007 (LSC)

Single Stage HAM

- Install 2 for Enhanced LIGO
  1 at Hanford, 1 at Livingston in HAM6.
- Supports the Output Mode Cleaner
- First Articles for Advanced LIGO.
- No HEPI for now.
- Build and air test at HPD in Boulder -
  Sept - Oct 2007.
- First clean installation at LLO in Nov 2007.
- Second clean installation at LHO in Jan 2008.

HAM Design

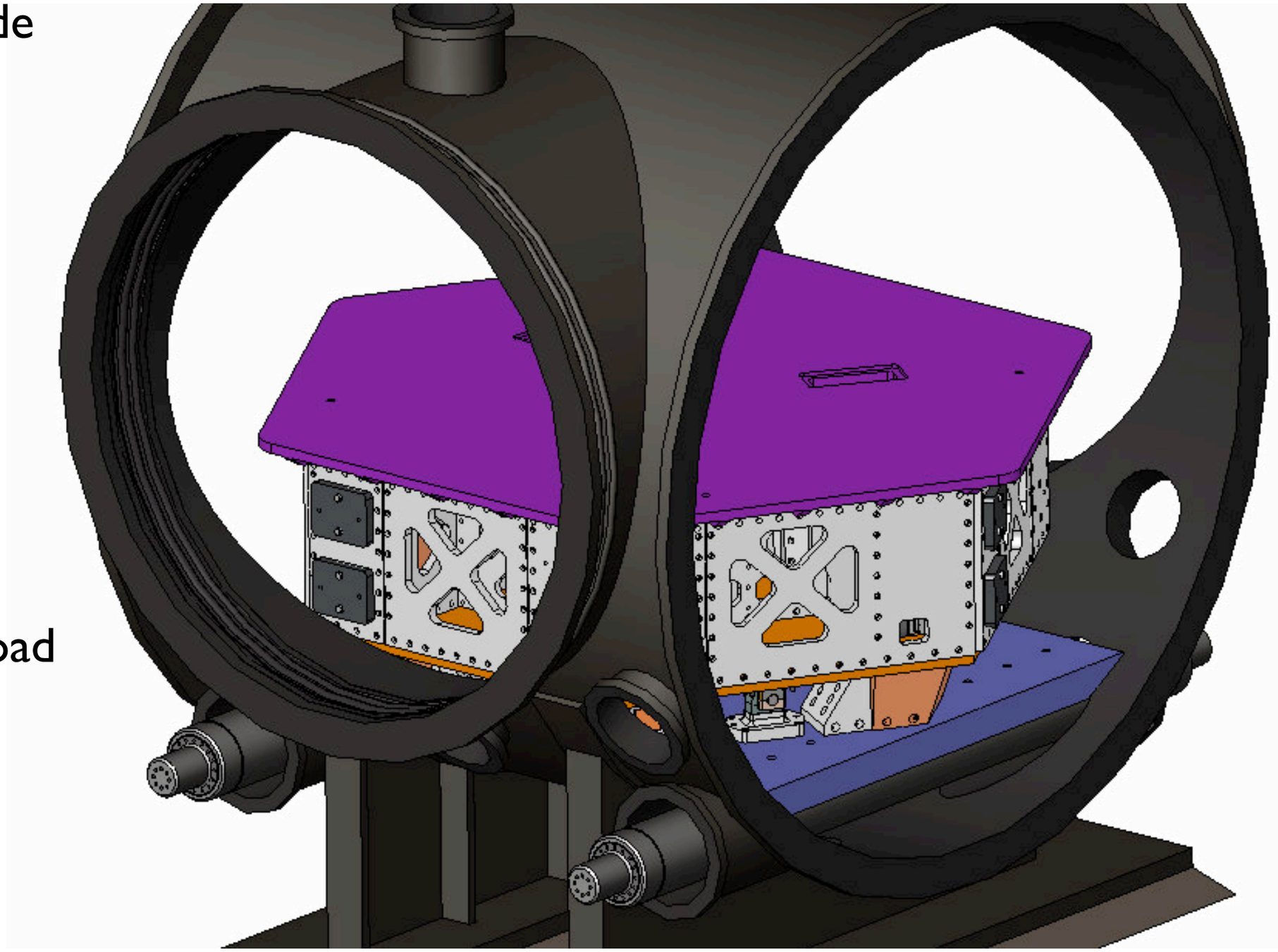
- Bolted aluminum structure
- Suspended by 3 blade springs & "wires"

- 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

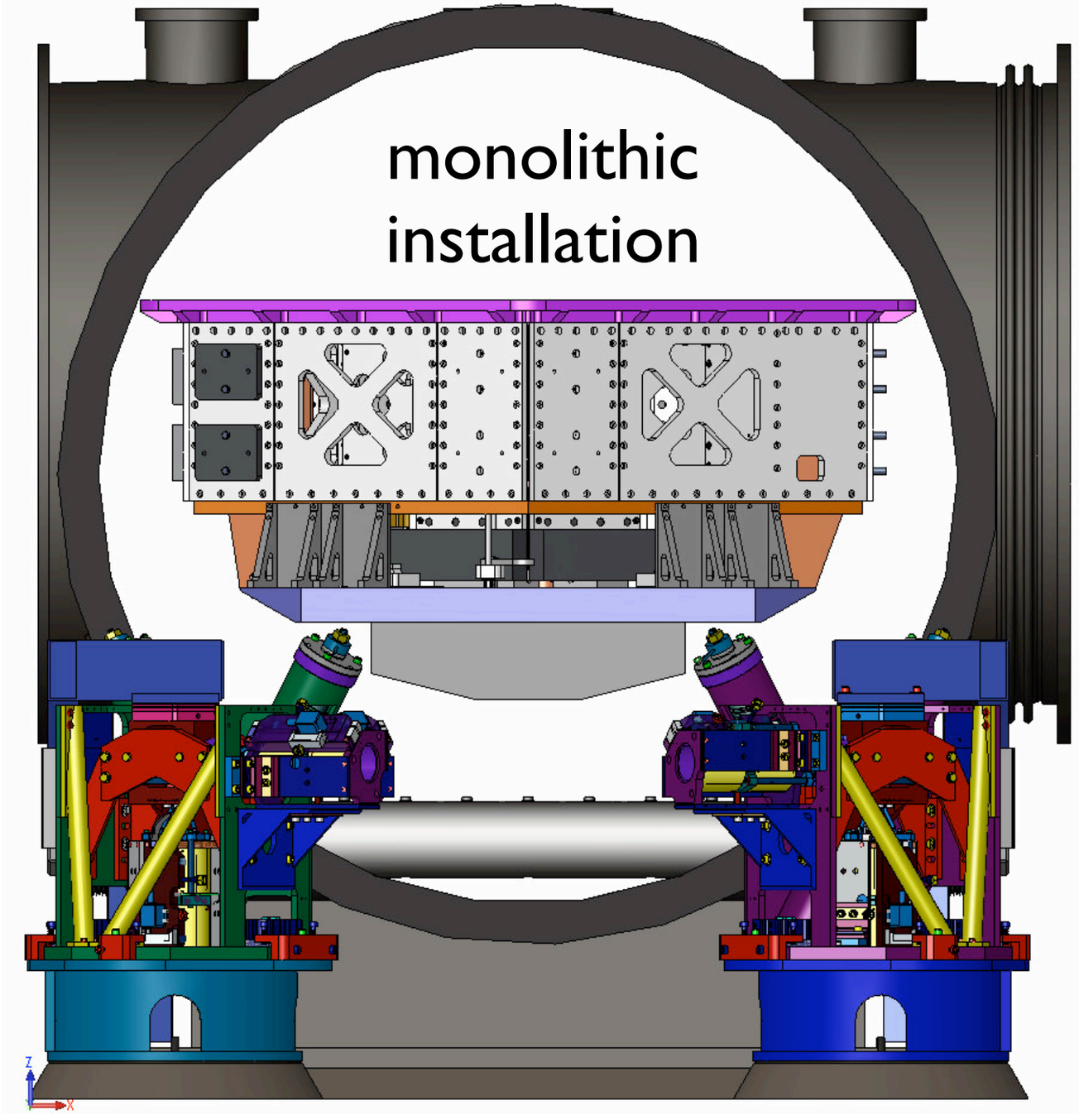
- first bending mode:
  > 250 Hz

- assume servos with unity gain of 27 Hz

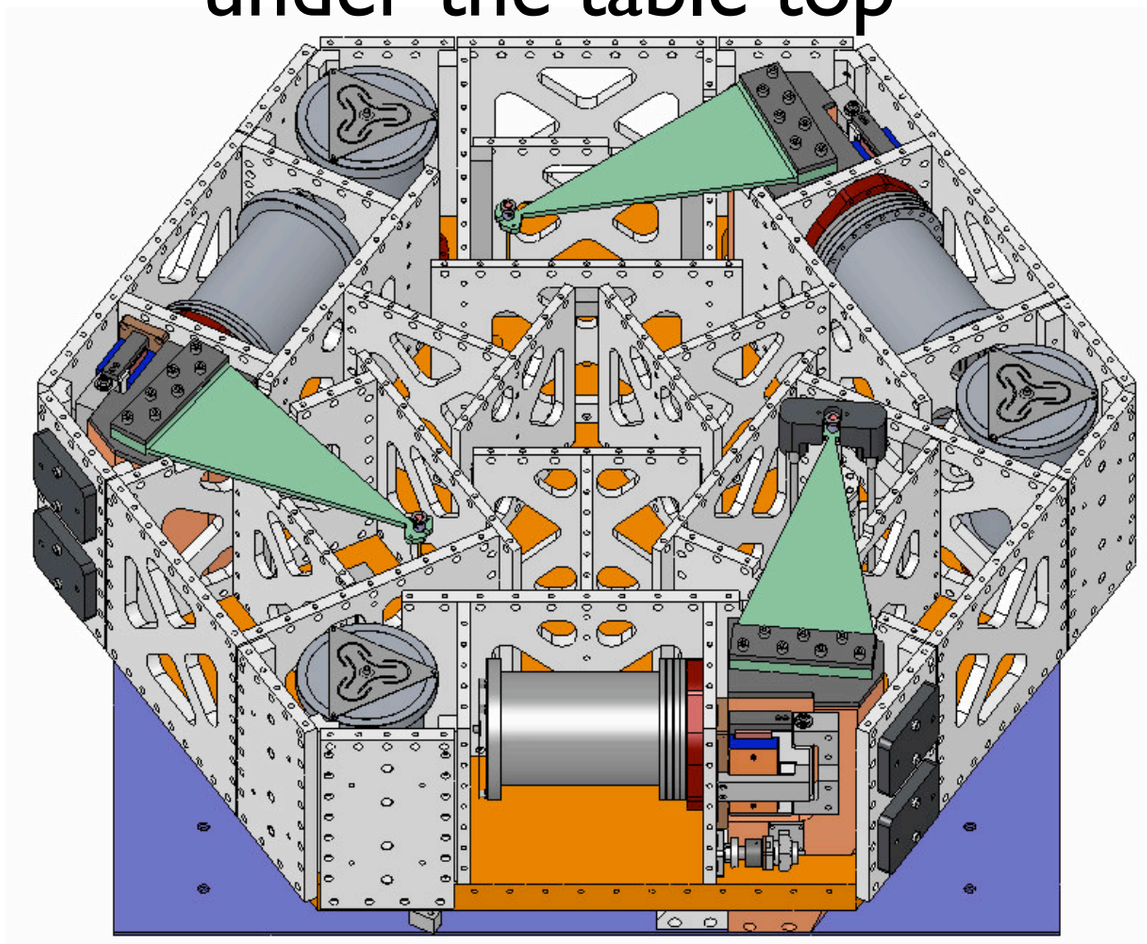


Other views

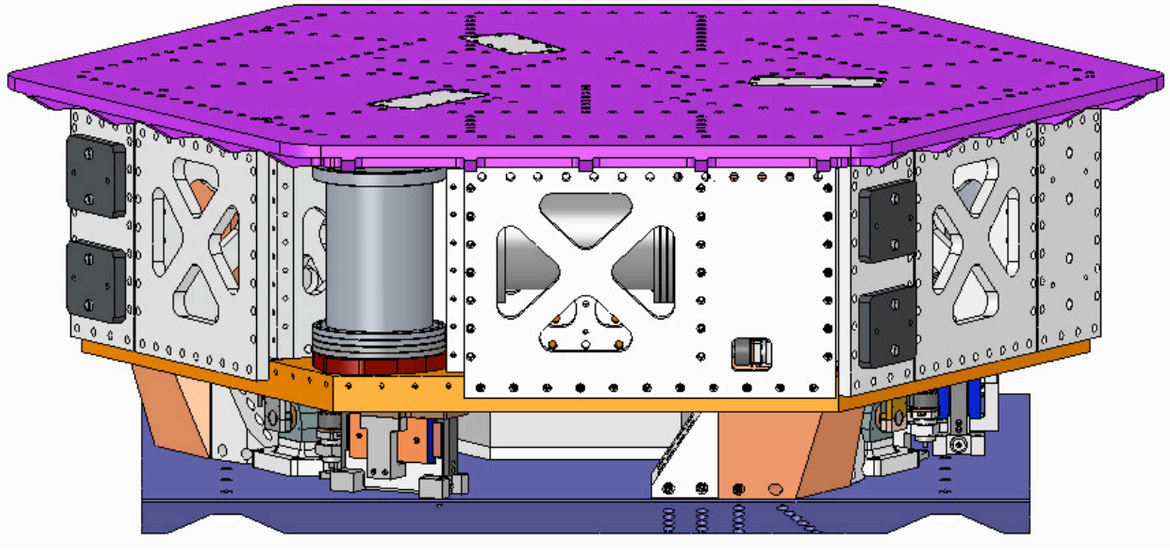
monolithic installation



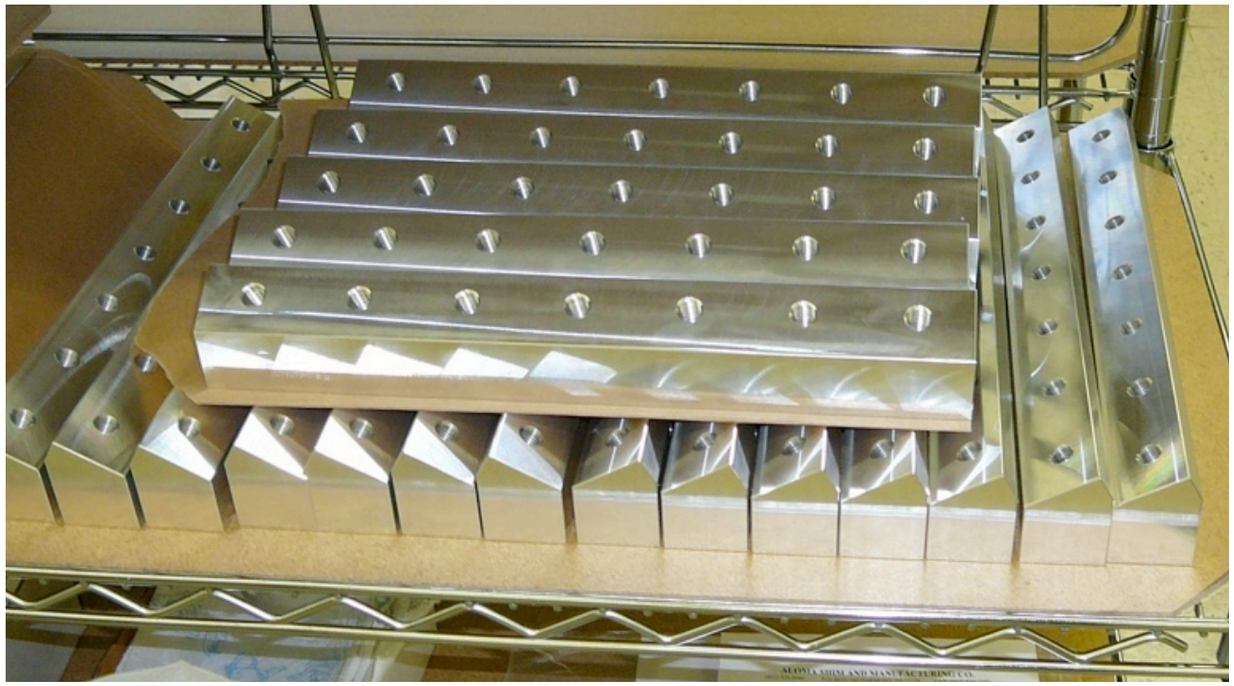
springs and sensors under the table top

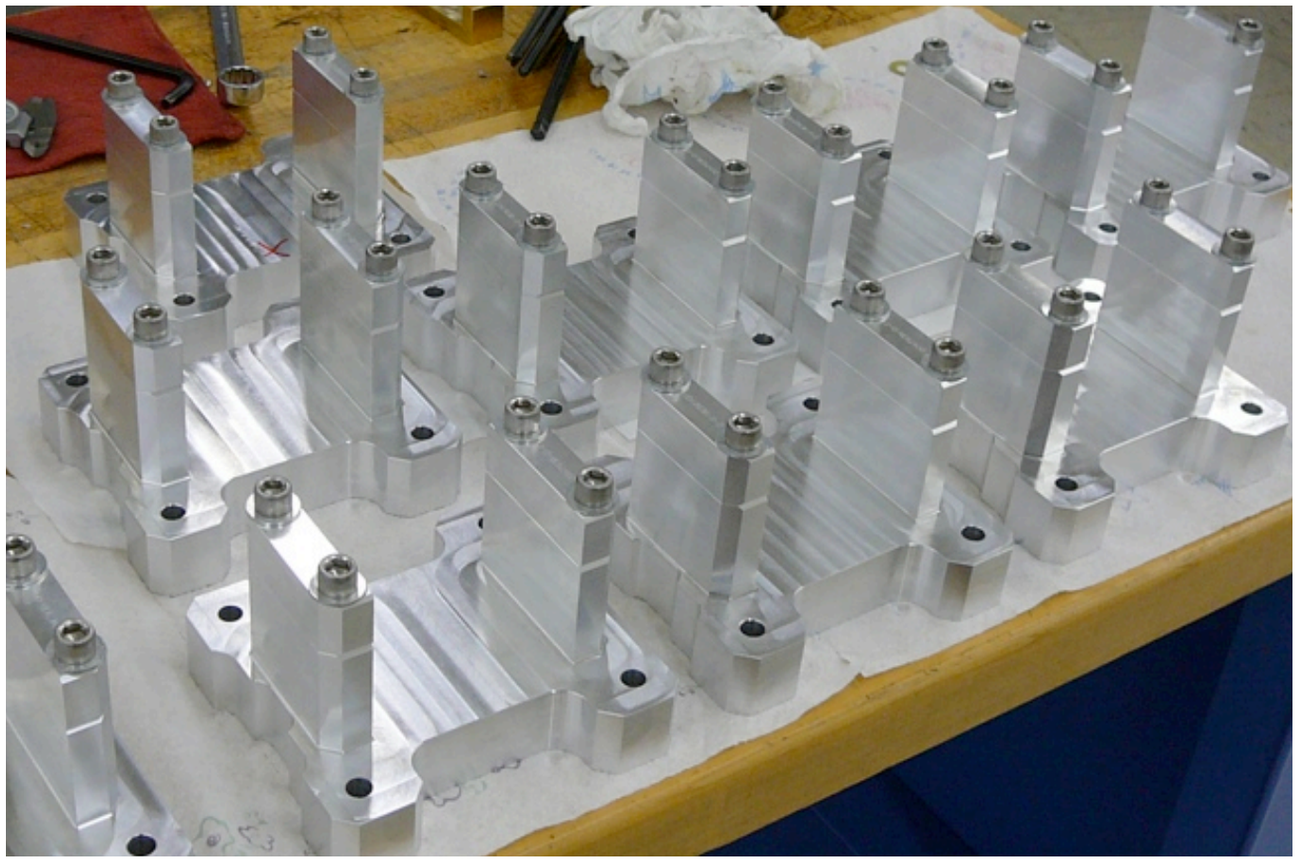


access to a vertical sensor



Hardware in Production





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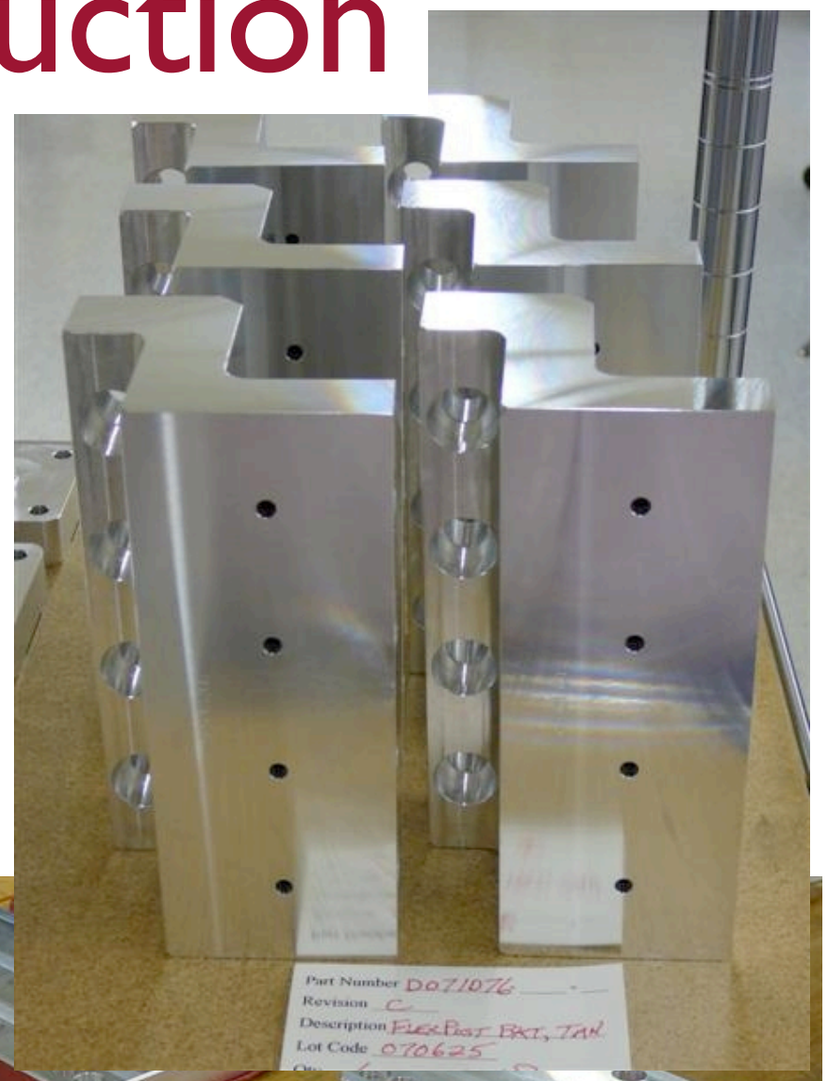

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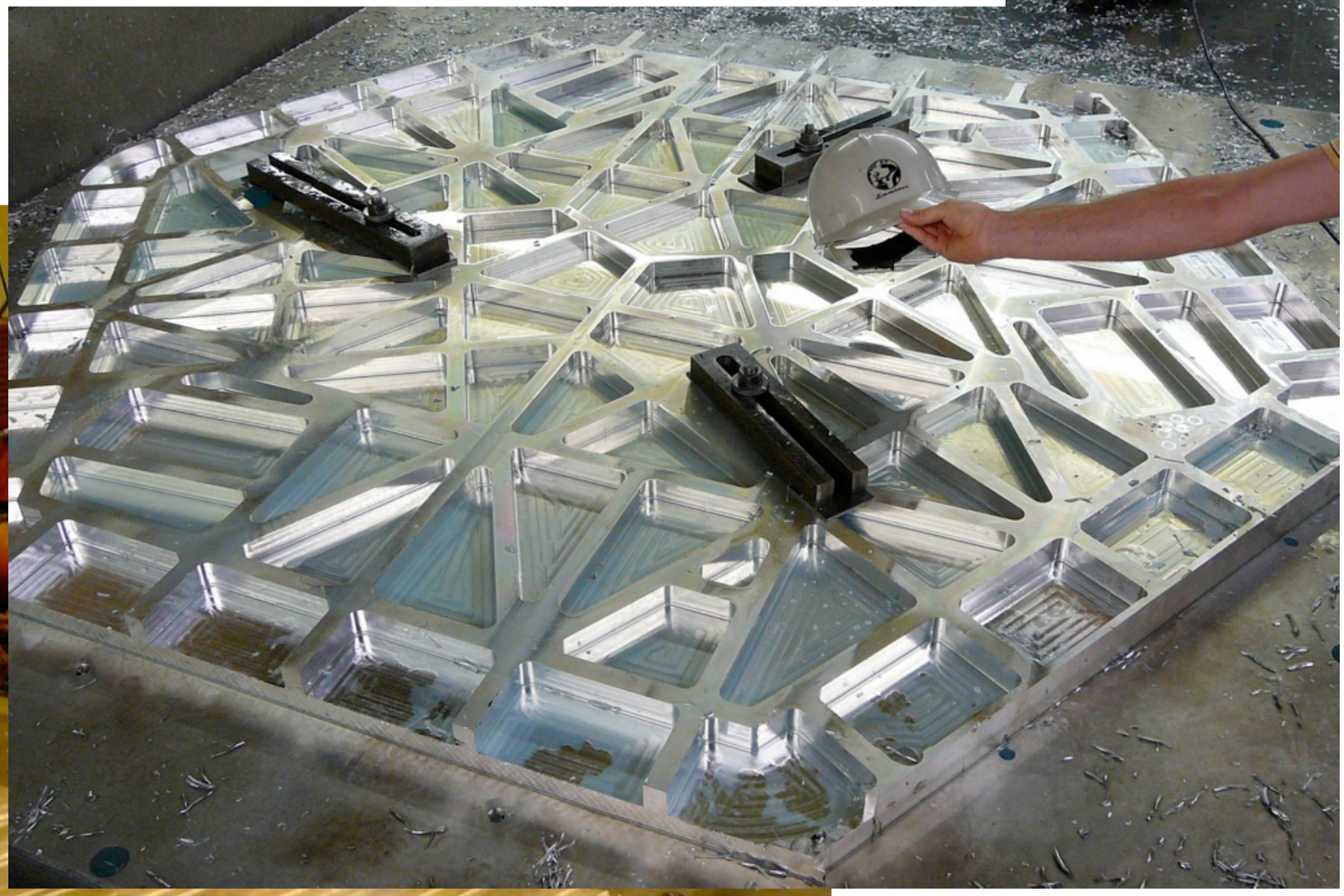
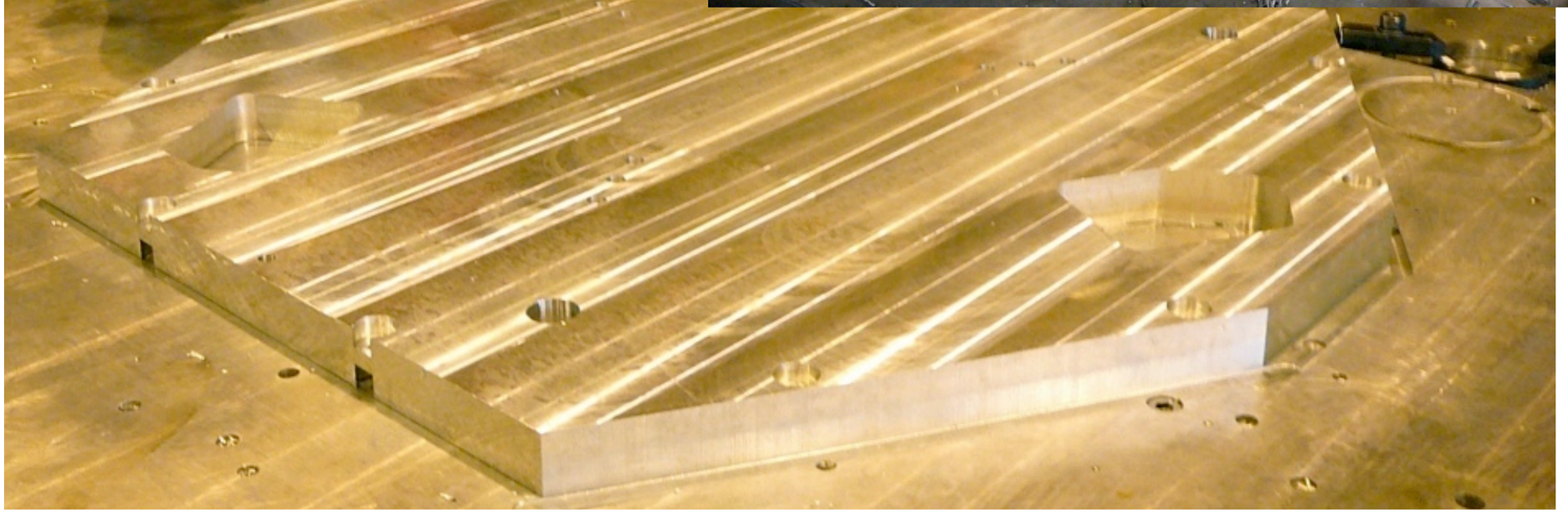




Tech Demo at Stanford

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.

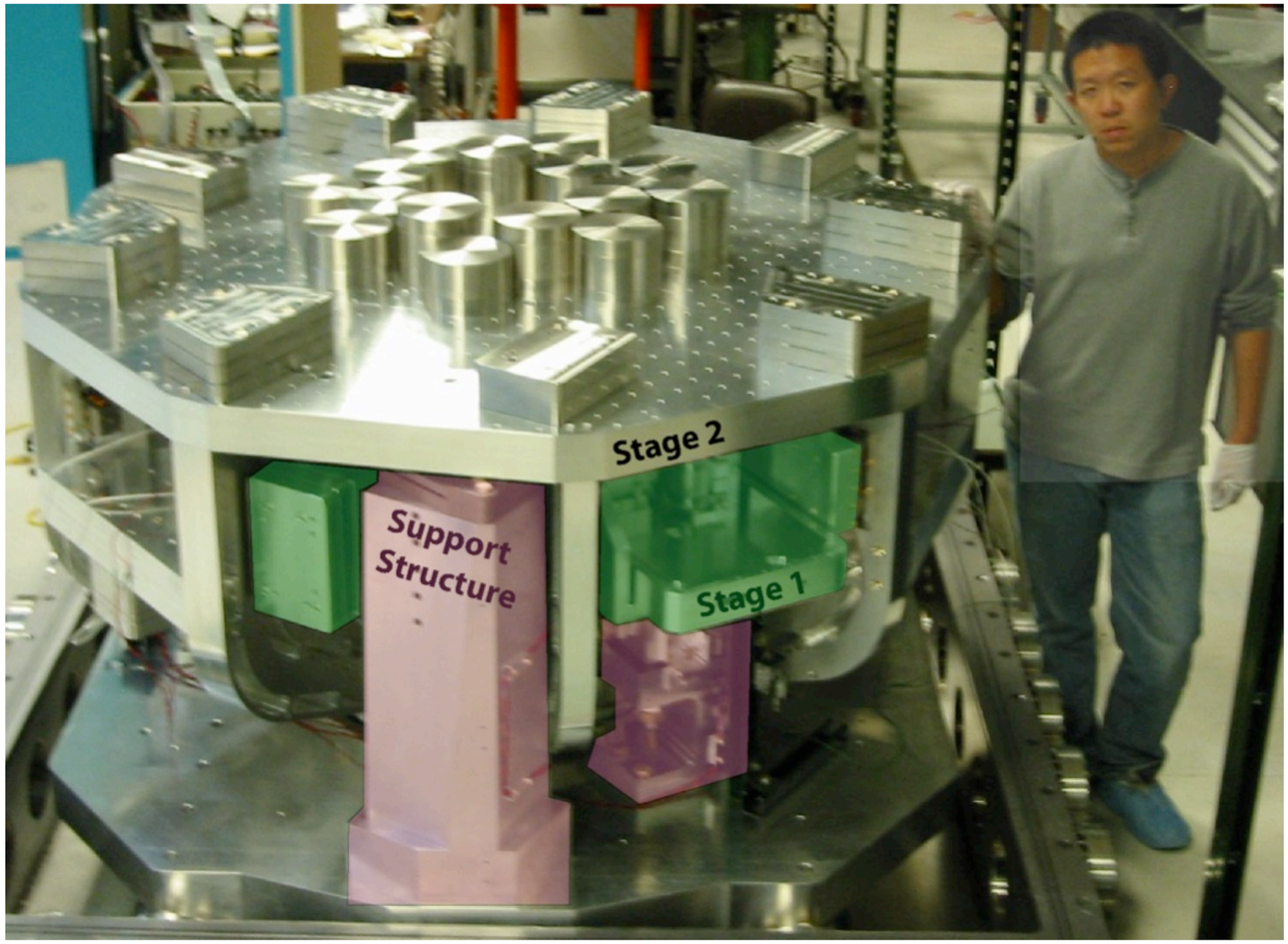
2 stage isolation and alignment system.

Each stage aligned and isolated in 6 DOF.

Passive isolation at 1 Hz horz, 3 Hz vert

Active isolation below 30 Hz

Stage 2 similar to new HAM design



Tech Demo at Stanford

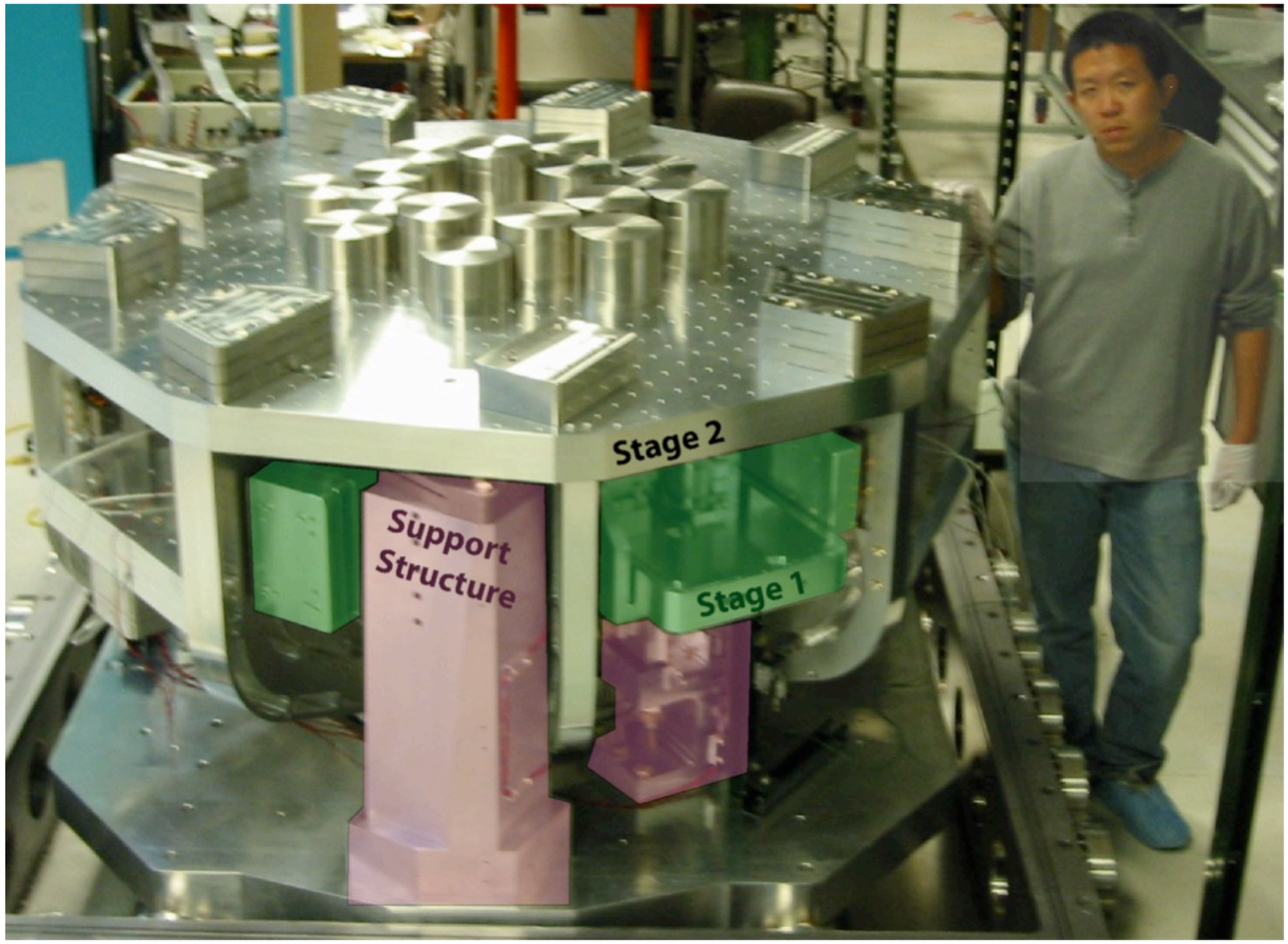
Use the Tech Demo to develop the controllers for the Enhanced LIGO HAM

Make stage 1 move like the ground at LLO

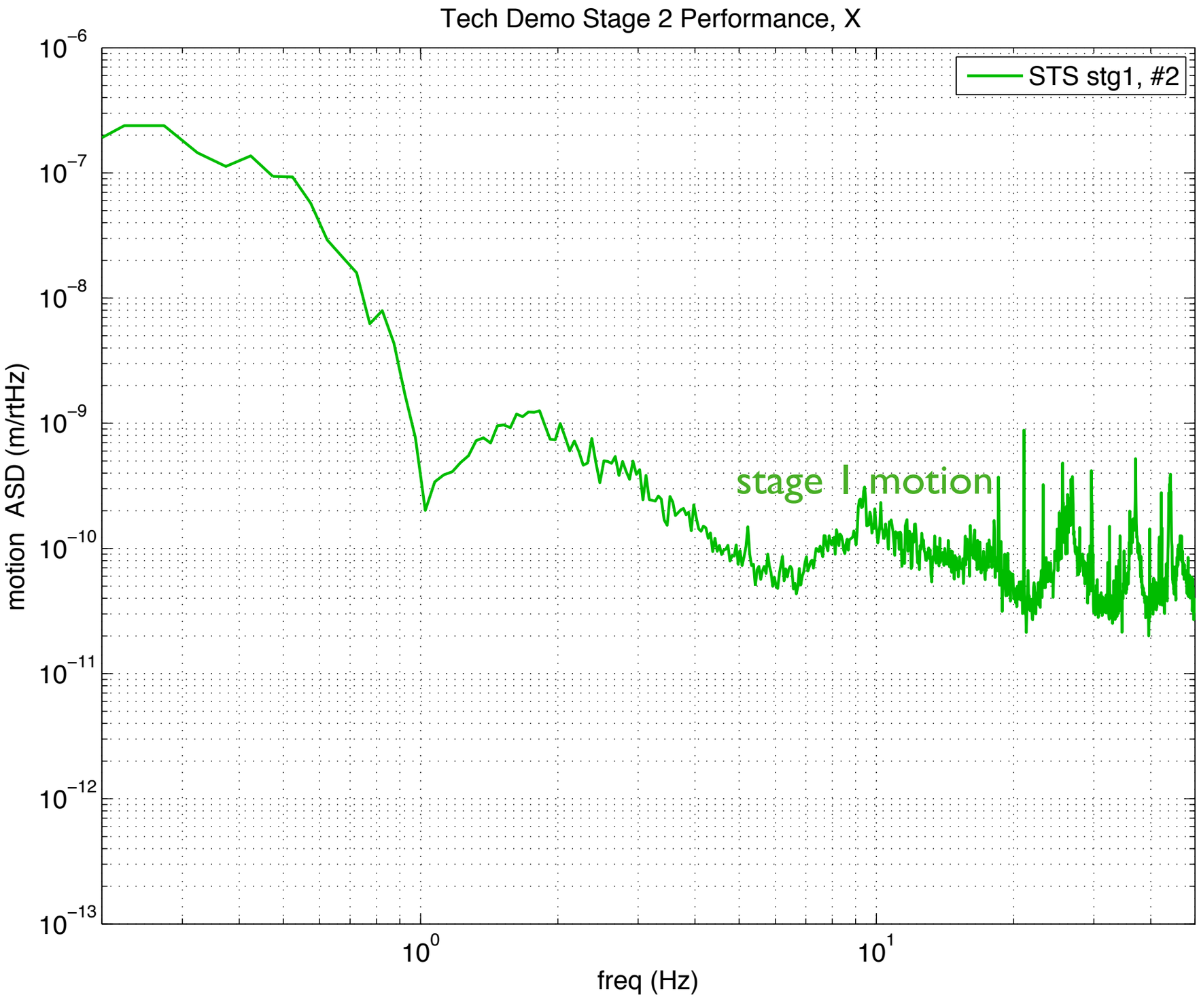
Stage 2 and new HAM
- same sensors,
- similar dynamics

Put new control machine on stage 2.

At very early stages...
- 6 DOF damping on
- 3 DOF isolation on
- no sensor correction
- other tools in process



Performance with new computer



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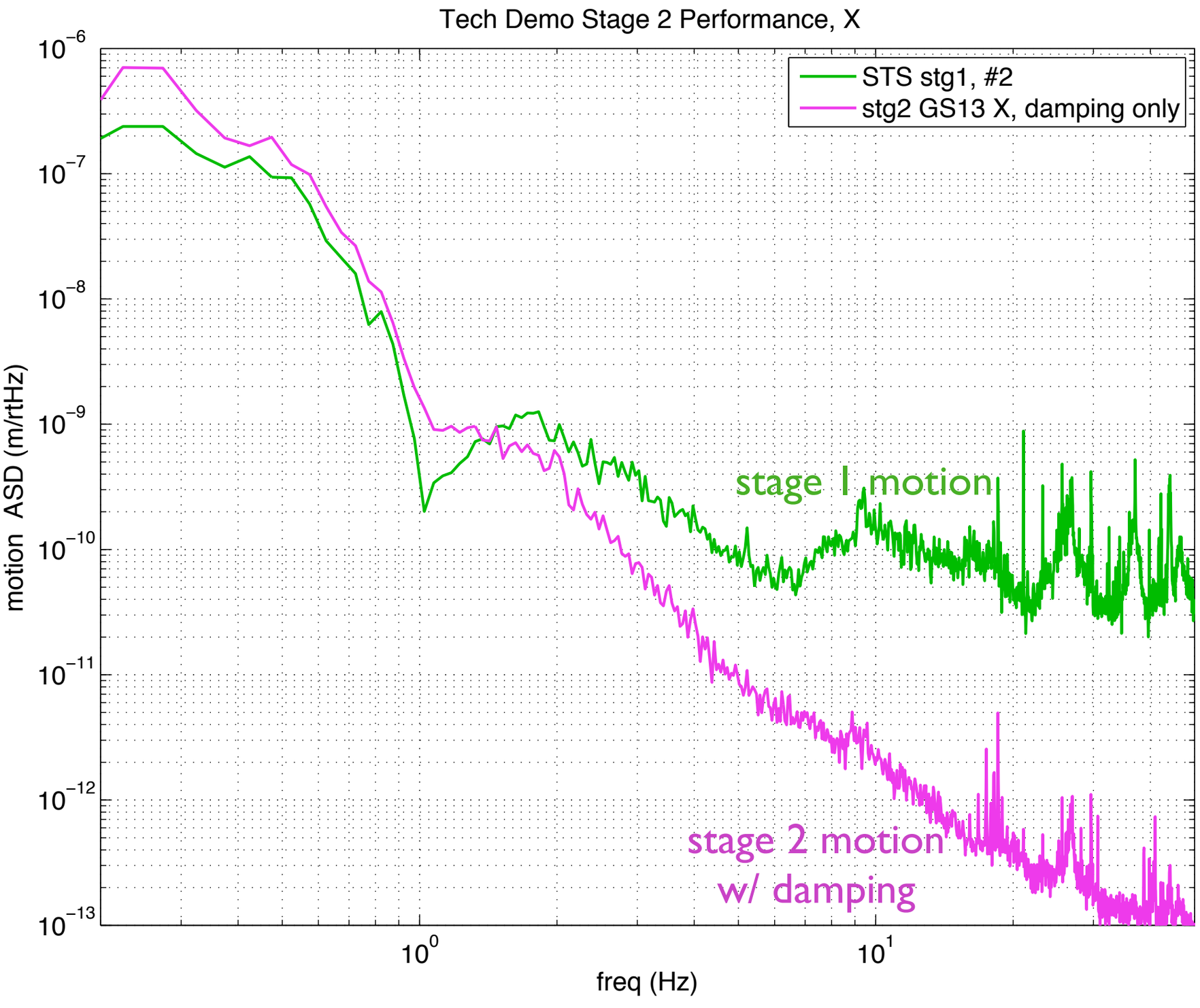

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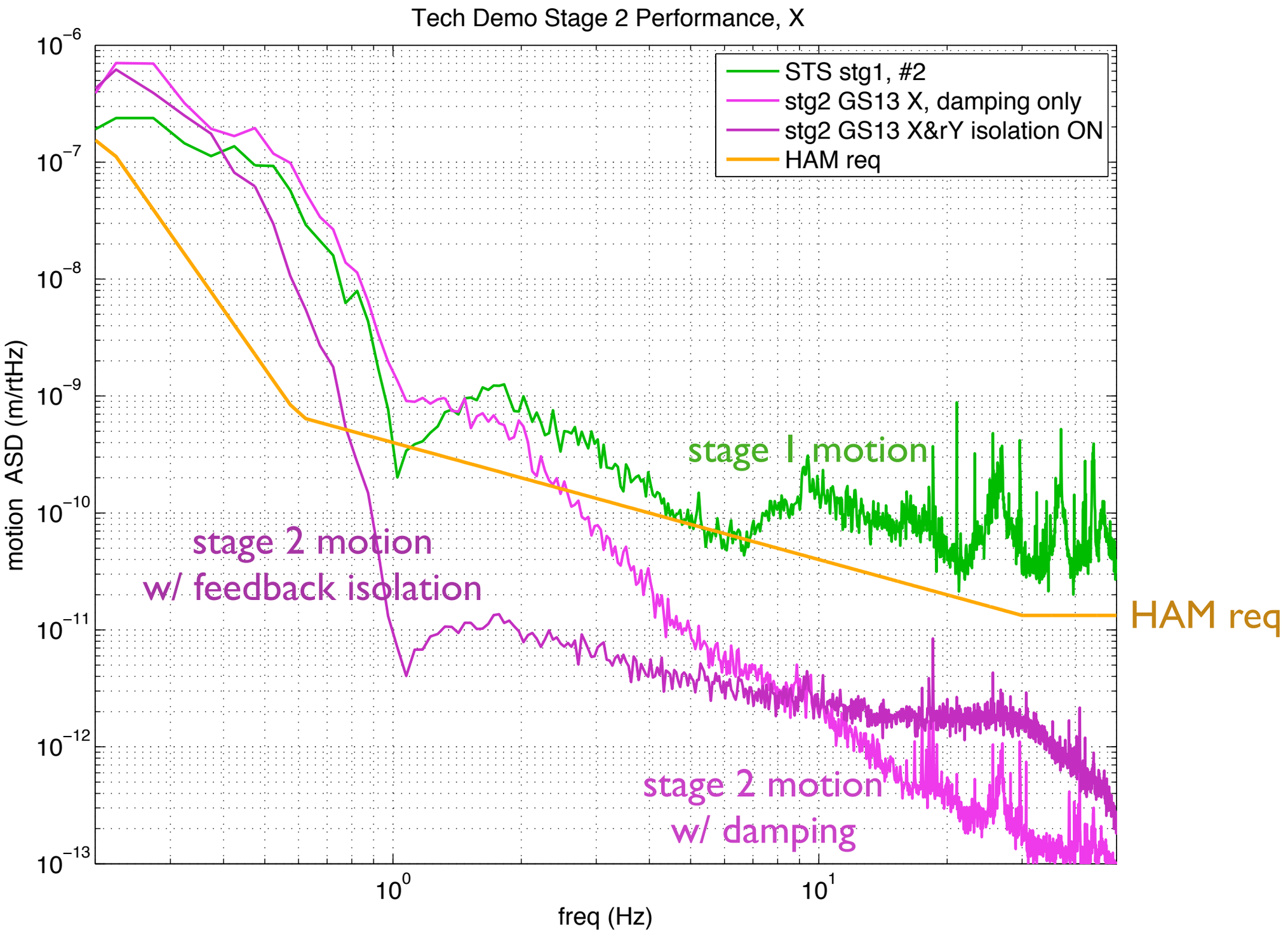


Conclusions

- Mechanical system coming along well.
- Control system coming together.
- Tight schedule for Enhanced LIGO installation, but so far, so good...

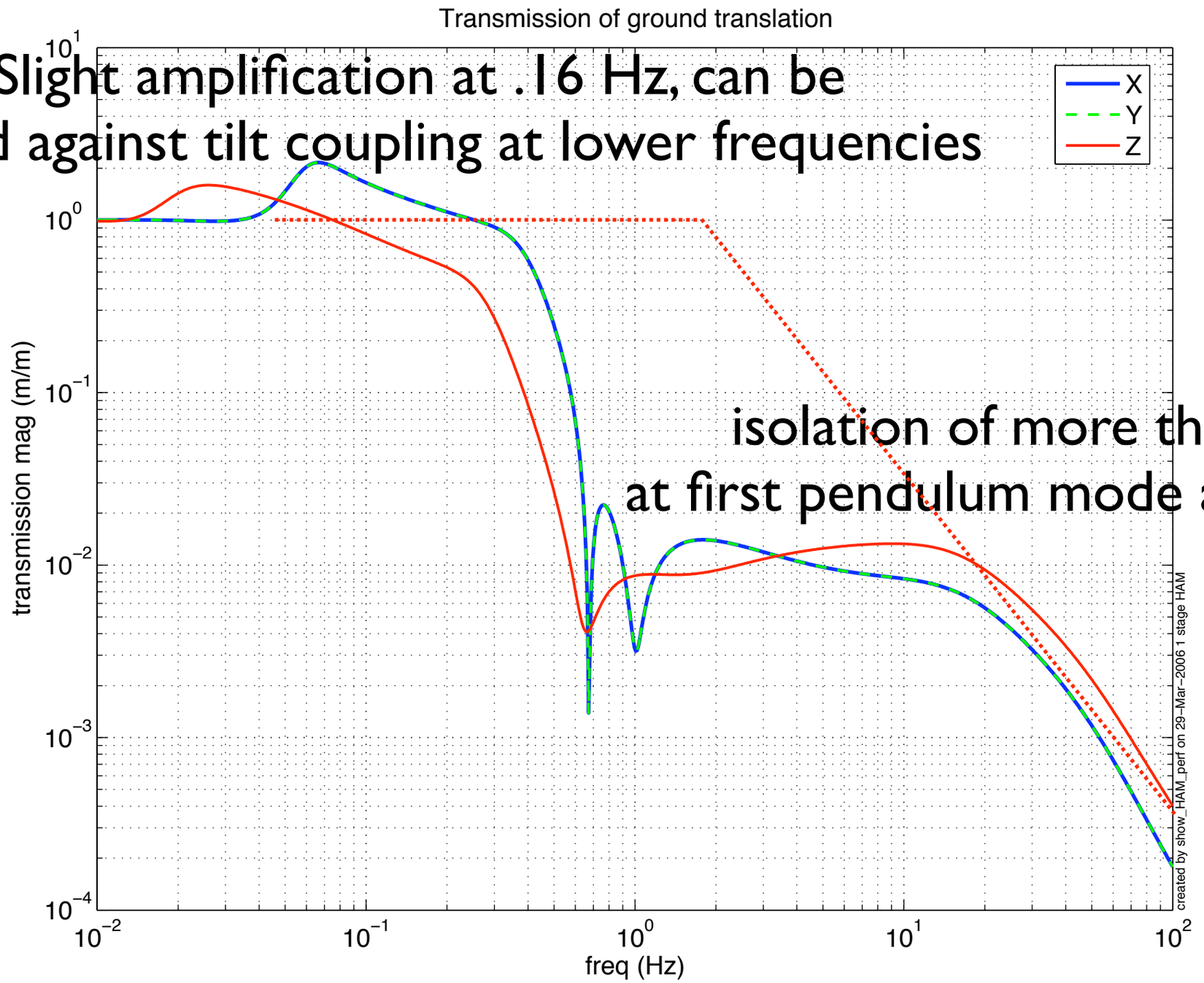
Single Stage HAM

- 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.

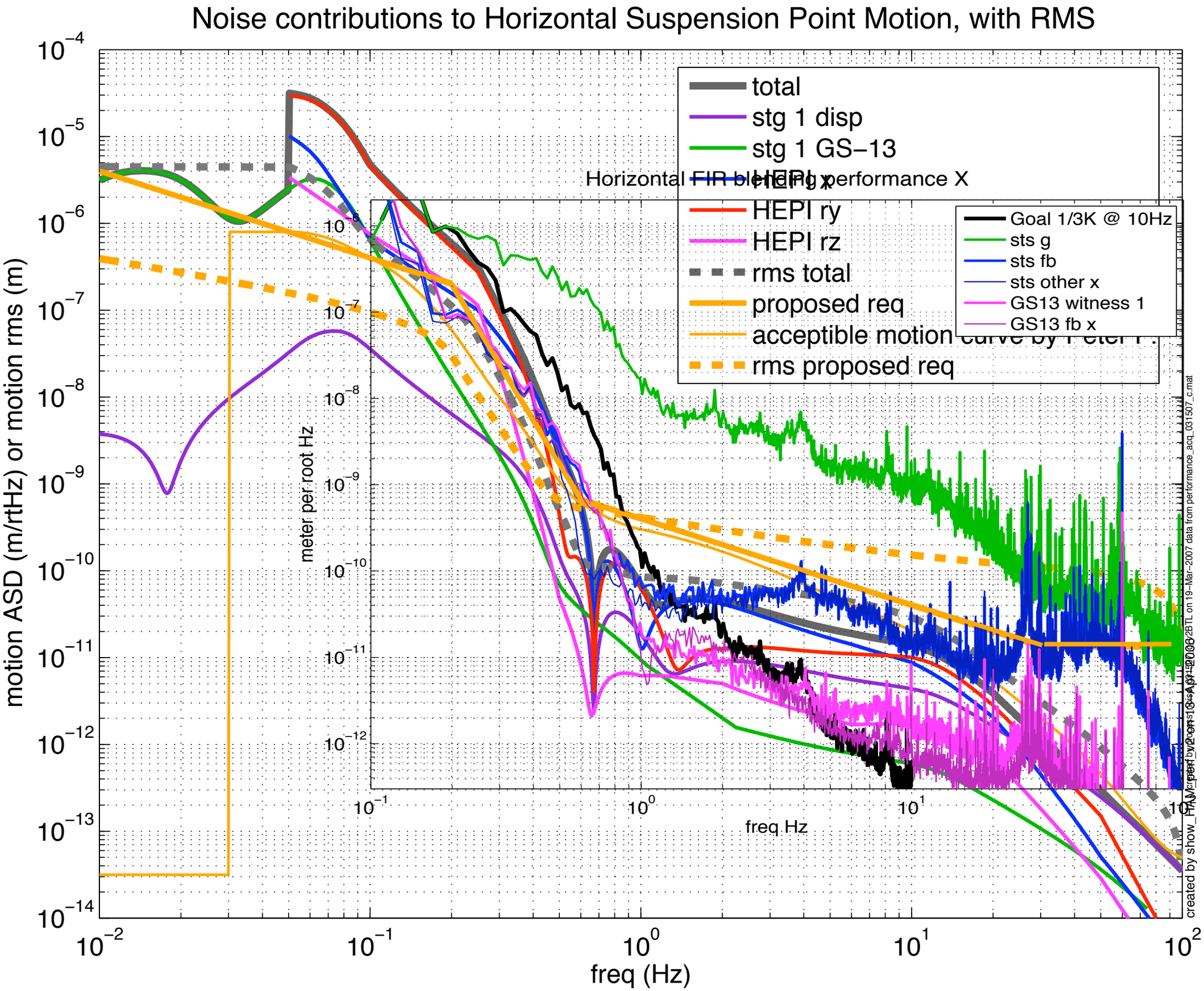
Transmission of translational input motion
HEPI motion -> table cg motion

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

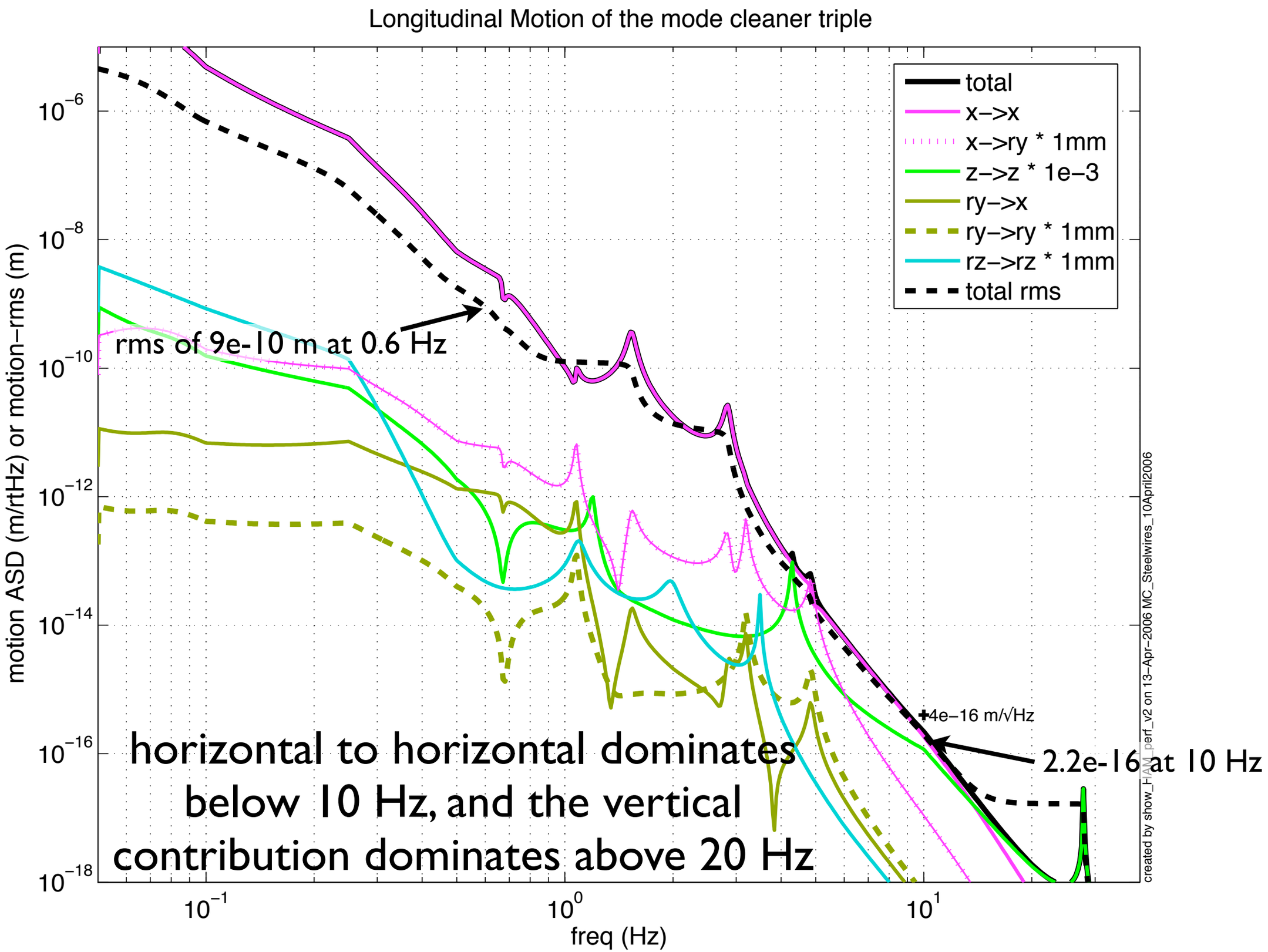
isolation of more than 50 at first pendulum mode and above



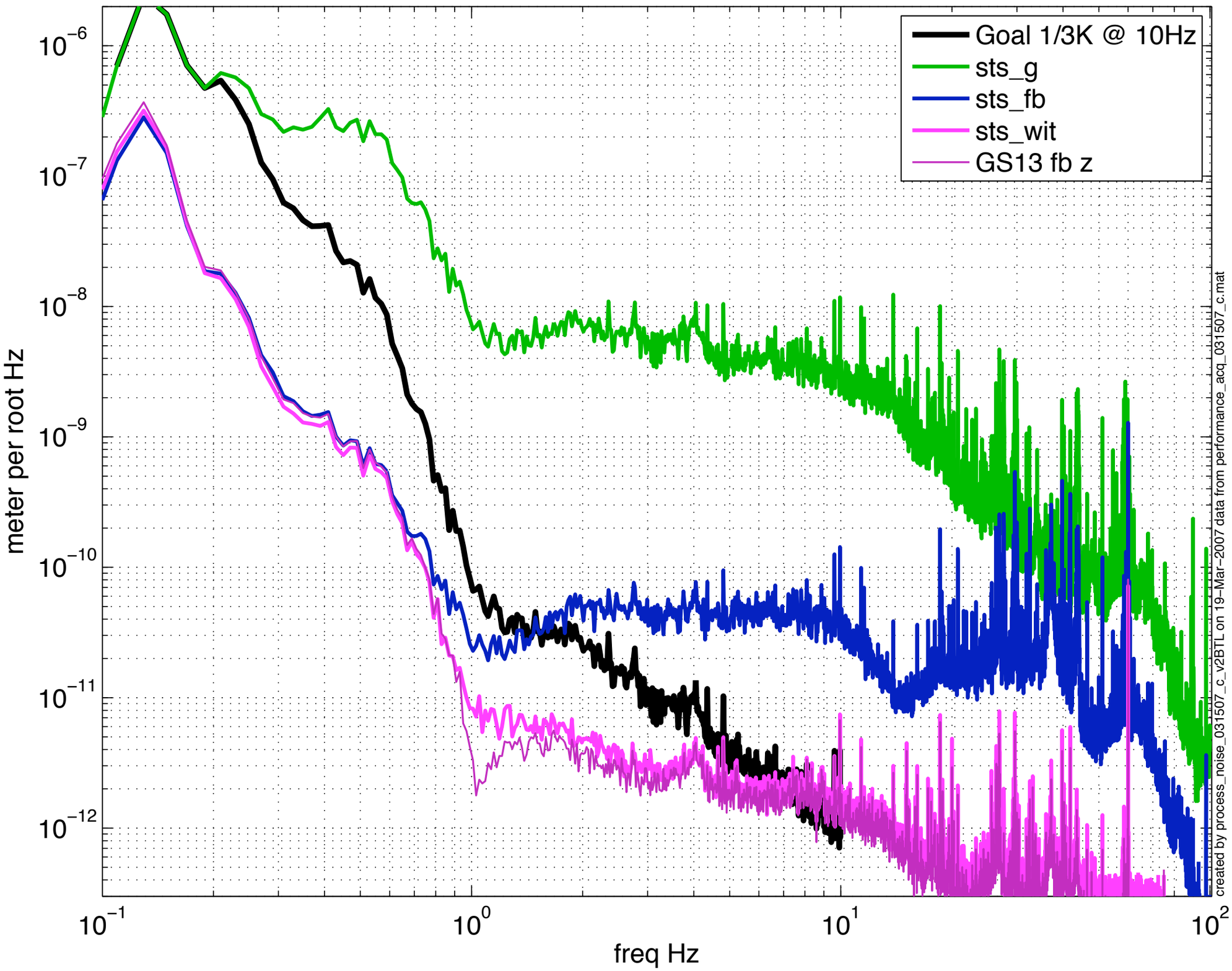
Performance predictions



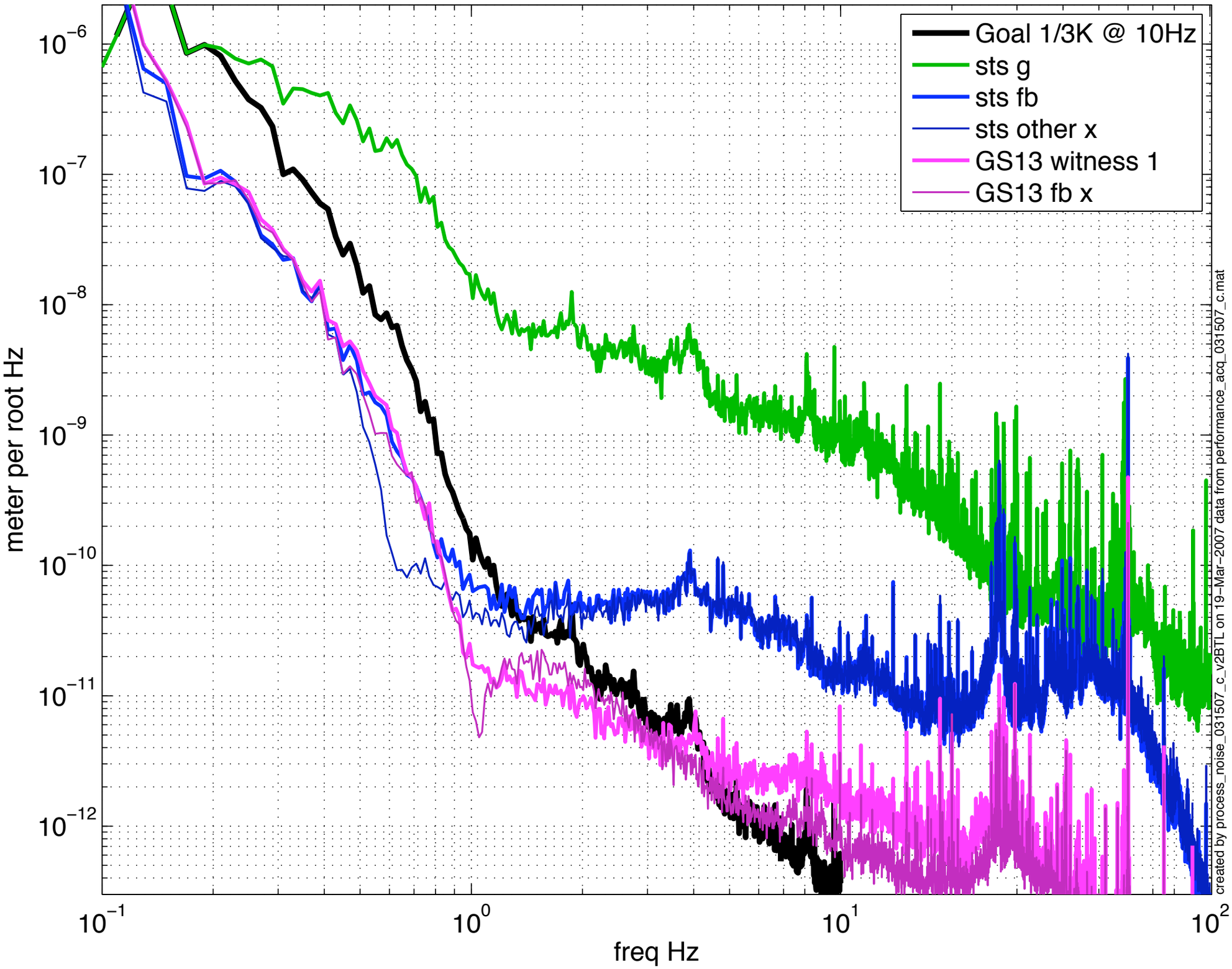
Performance Predictions



Performance Z



Performance X



Tech Demo experience
Passive Isolation