HAM ISI PDR
Preliminary Performance Review

Jeff Kissel
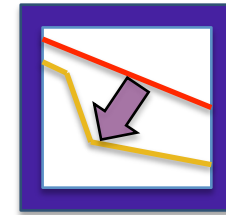
Louisiana State University

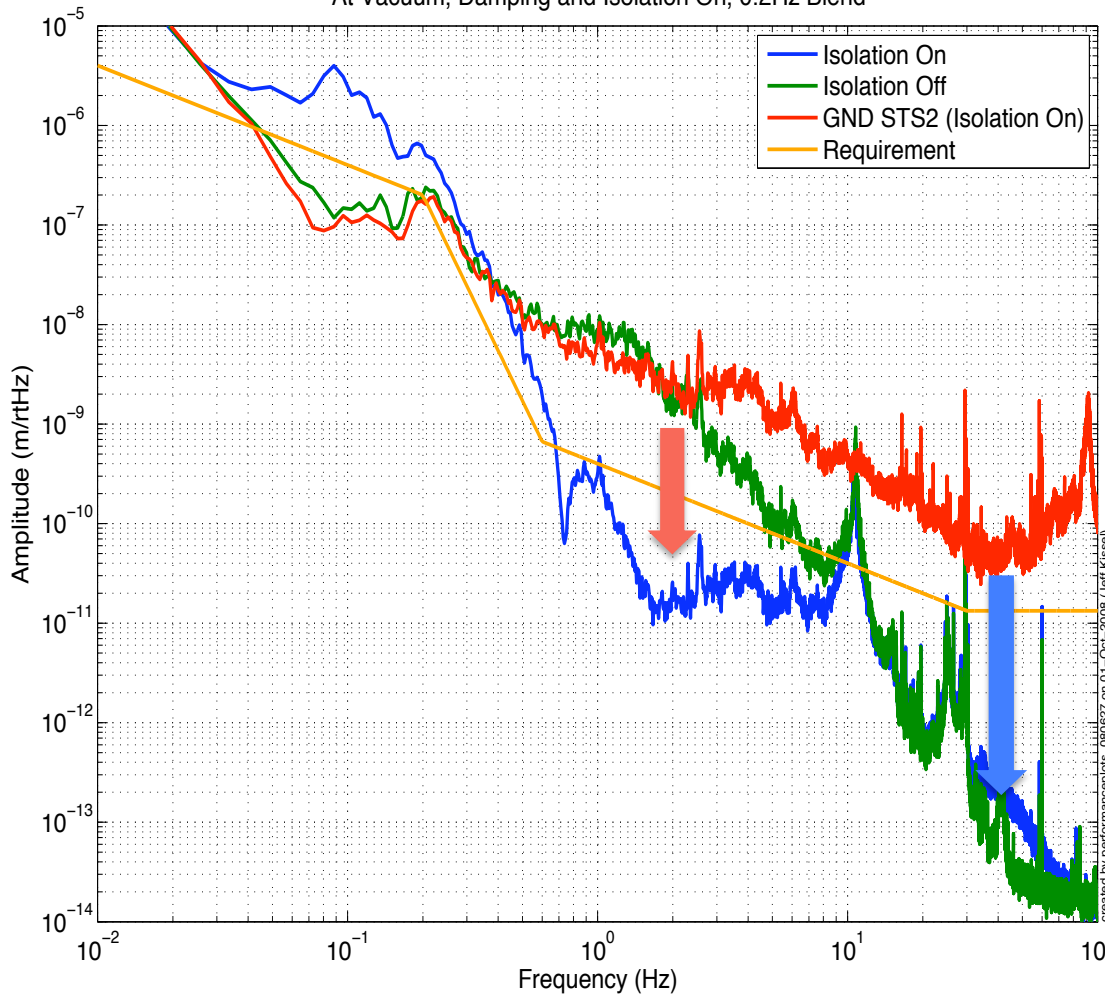October 8 2008

G080570-00-D

The HAM ISI
Initial Isolation Loop Results

LHO HAM6 ISI, June 27 2008
In-loop GEO ASD, Y Direction
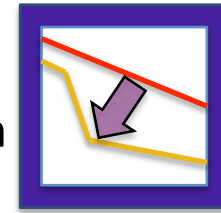At Vacuum, Damping and Isolation On, 0.2Hz Blend

- Isolation On
- Isolation Off
- GND STS2 (Isolation On)
- Requirement

• Commissioning for H1 HAM ISI took place May and June of 2008, and is virtually complete

• Commissioning for L1 HAM ISI started in July and is on going.

• Meets or Beats aLIGO requirements for all 6 dofs at most frequencies

• Passive isolation by factor of 500 @ 50 Hz!

• Active isolation by factor of 50 @ 2 Hz!
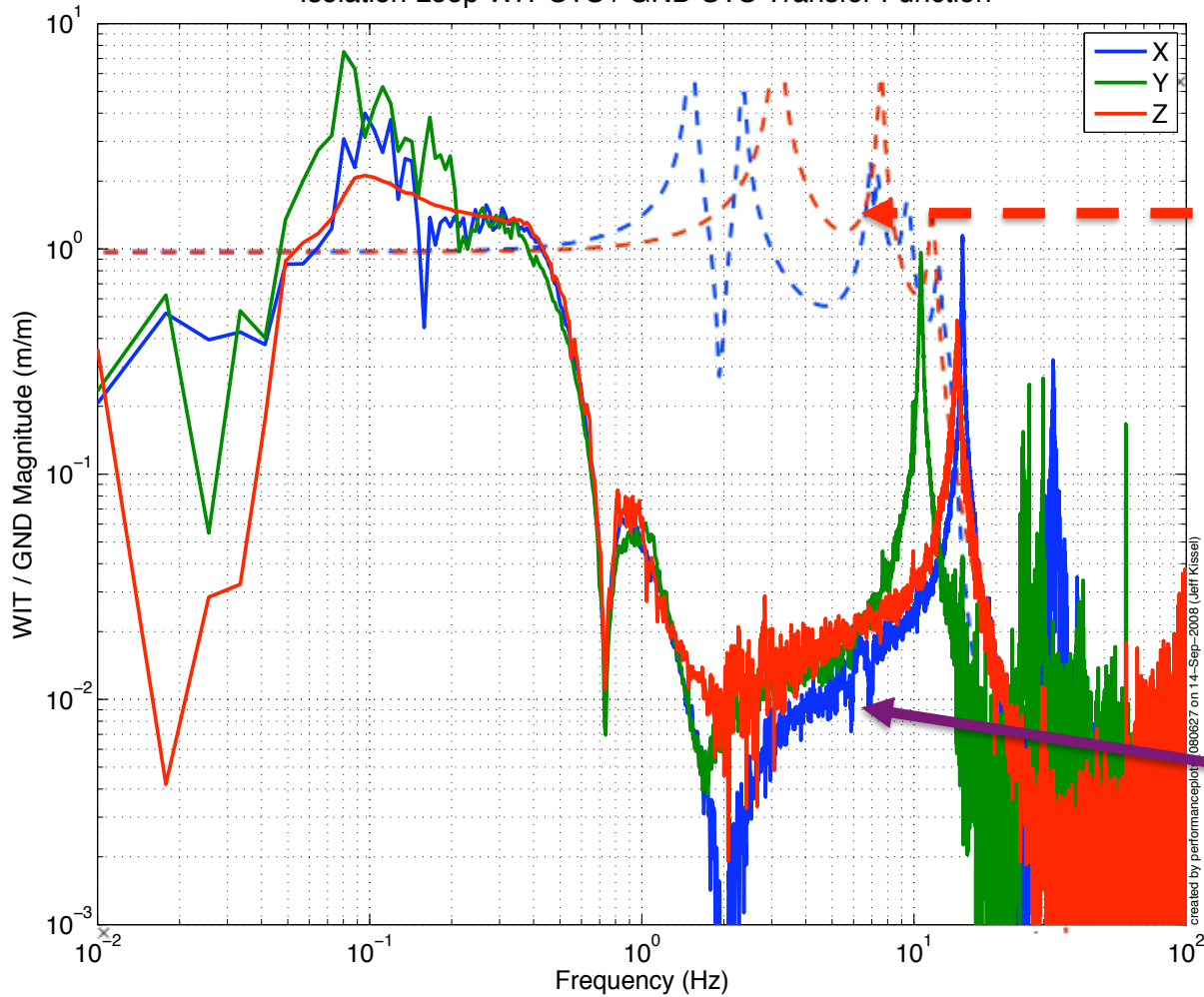
• Performance is still preliminary...

The HAM ISI
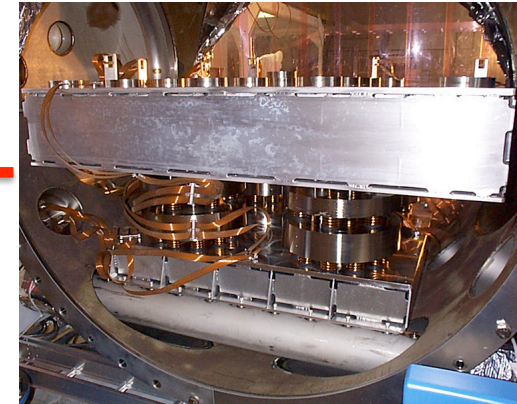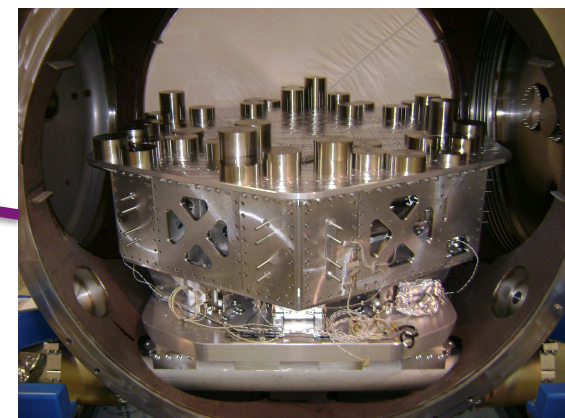## Old vs. New Isolation Comparison

The HAM ISI

Active Design - Control Loop Structure

Sensor Correction

Displacement Sensors

Blend Filters

Isolation Filters

Super

Sensor

Inertial Sensors

Damping Filters

Software

Hardware

Ground Sensor
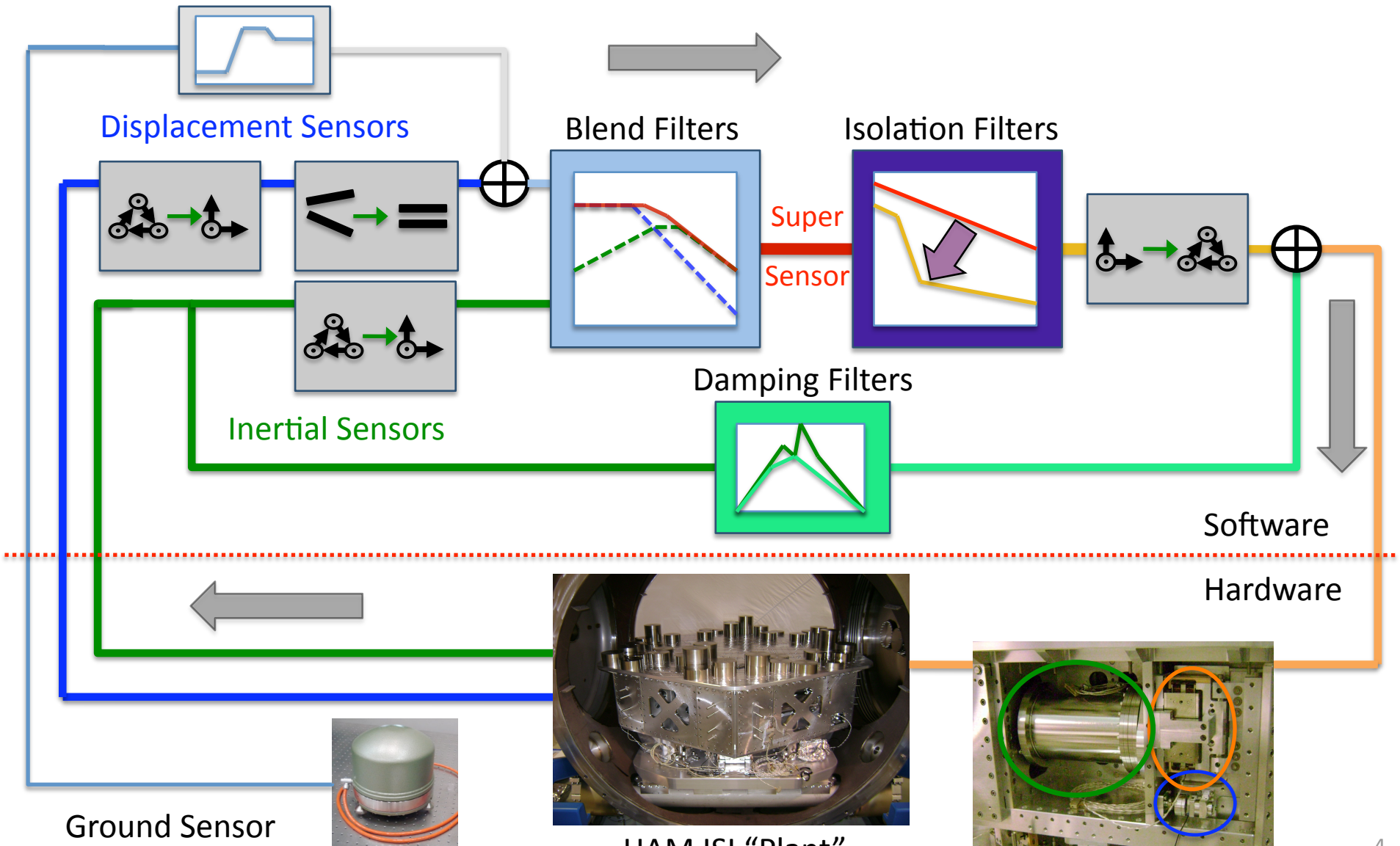
HAM ISI "Plant"

The HAM ISI
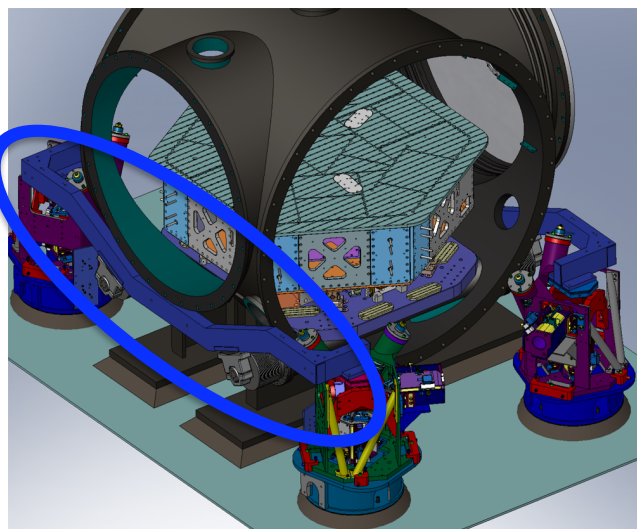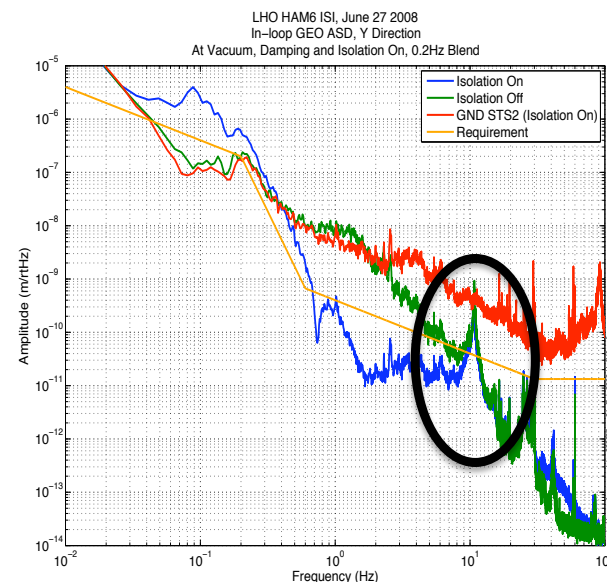## Improving the Performance
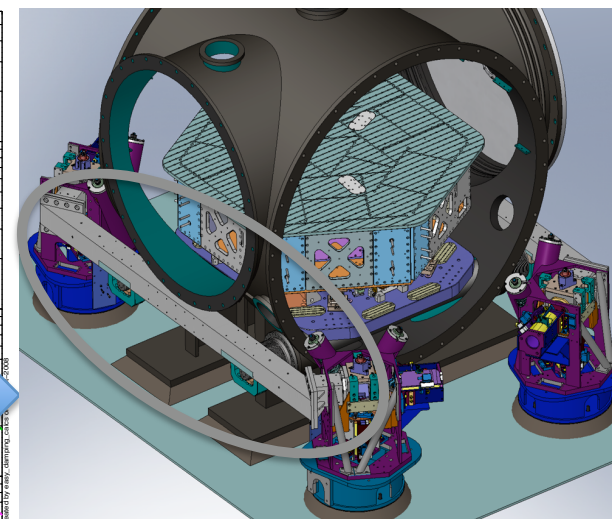
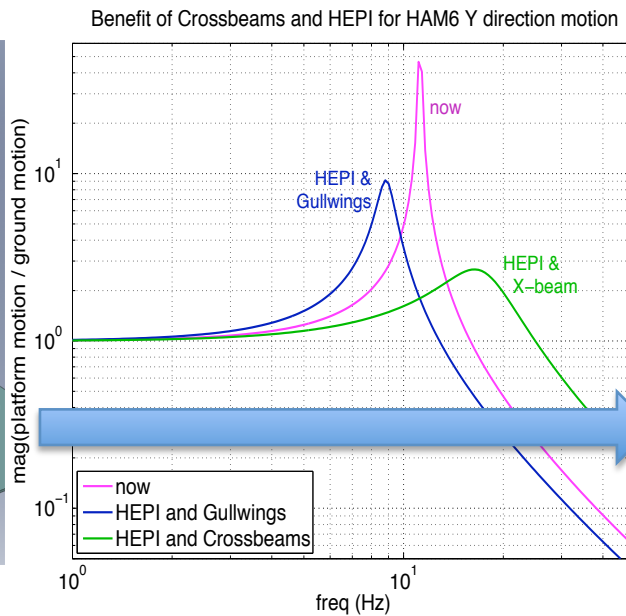Build a better support structure, and add HEPI!

Gullwings ➡️ Crossbeams

• Support structure has been redesigned for aLIGO, have already been purchased!

• HEPI will be installed under HAMs, redesigned to use the new crossbeams

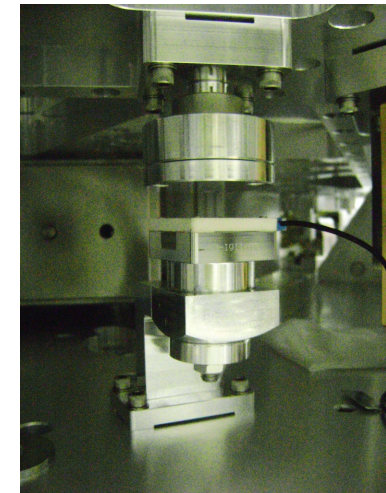LHO HAM6 ISI, June 27 2008
In-loop GEO ASD, Y Direction
At Vacuum, Damping and Isolation On, 0.2Hz Blend

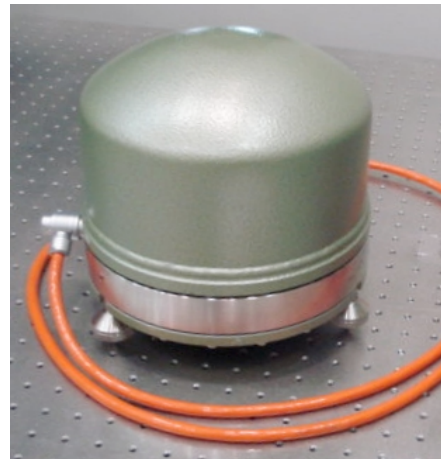Benefit of Crossbeams and HEPI for HAM6 Y direction motion
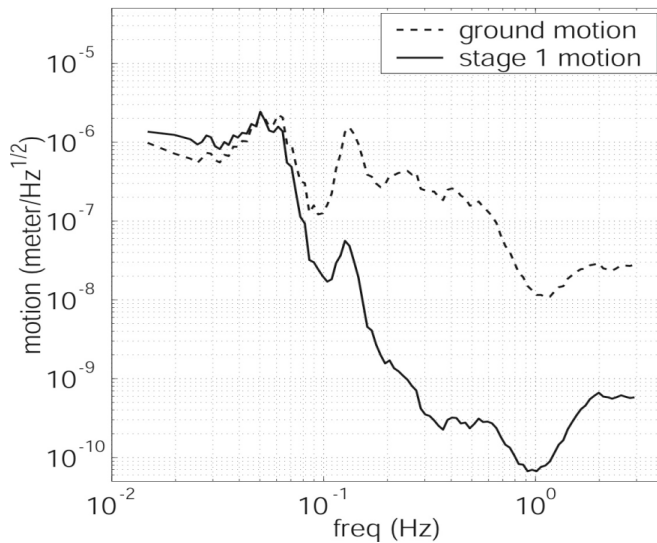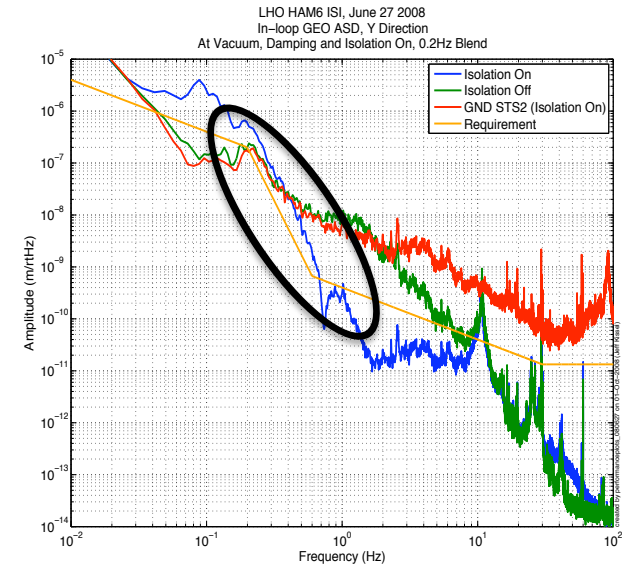
The HAM ISI

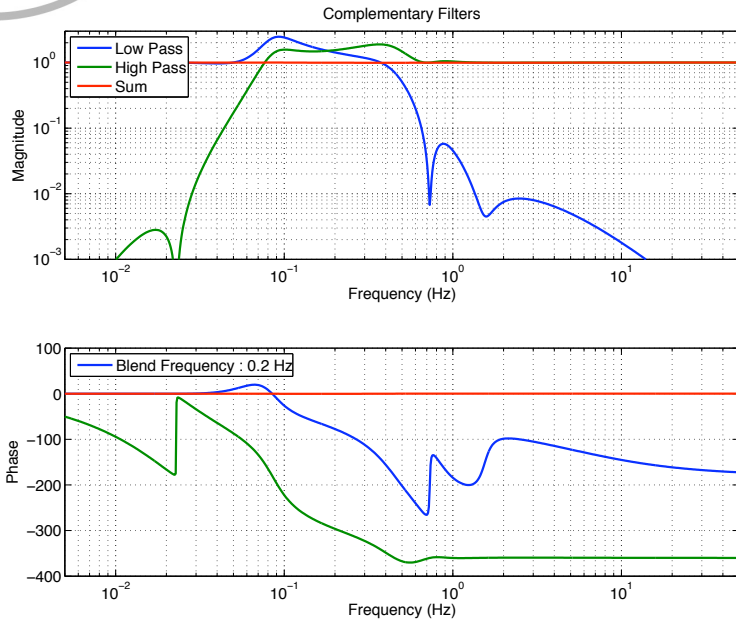## Improving the Performance

Add Sensor Correction!

- Feed forward ground signal using FIR filters

- Reduce ground coupling into displacement sensors
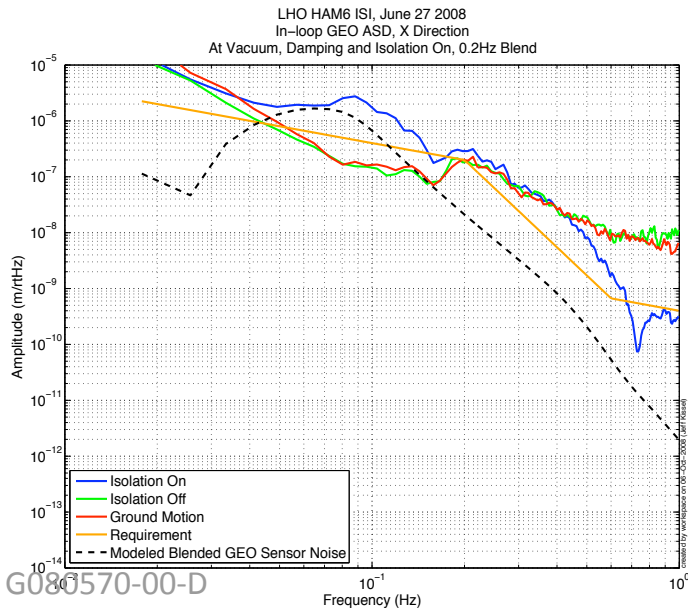
- Reduces Tilt, improves performance around Microseism

LHO HAM6 ISI, June 27 2008
In-loop GEO ASD, Y Direction
At Vacuum, Damping and Isolation On, 0.2Hz Blend

Rapid Prototype Performance with Sensor Correction

The HAM ISI
Improving the Performance

Complementary Filters

$$\frac{tilt}{translation} = \frac{g}{\omega^2}$$

LHO HAM6 ISI, June 27 2008
In–loop GEO ASD, Y Direction
At Vacuum, Damping and Isolation On, 0.2Hz Blend

LHO HAM6 ISI, June 27 2008
In–loop GEO ASD, X Direction
At Vacuum, Damping and Isolation On, 0.2Hz Blend
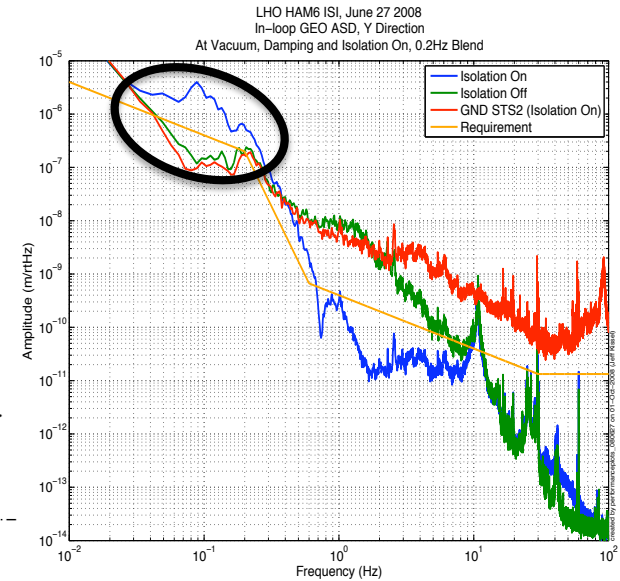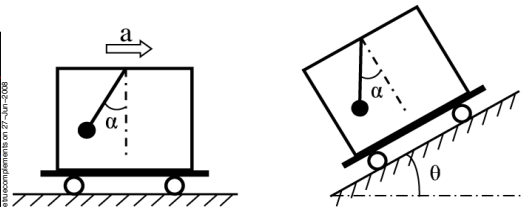
Tune blend filters!

• Found that noise in vertical GS-13s is misconstrued as differential motion >> TILT

• TILT couples into horizontal motion degrades performance

The HAM ISI
Conclusions

- Commissioning is virtually finished for H1's HAM ISI, with L1's HAM ISI about 60% finished

- Still some areas to work on,
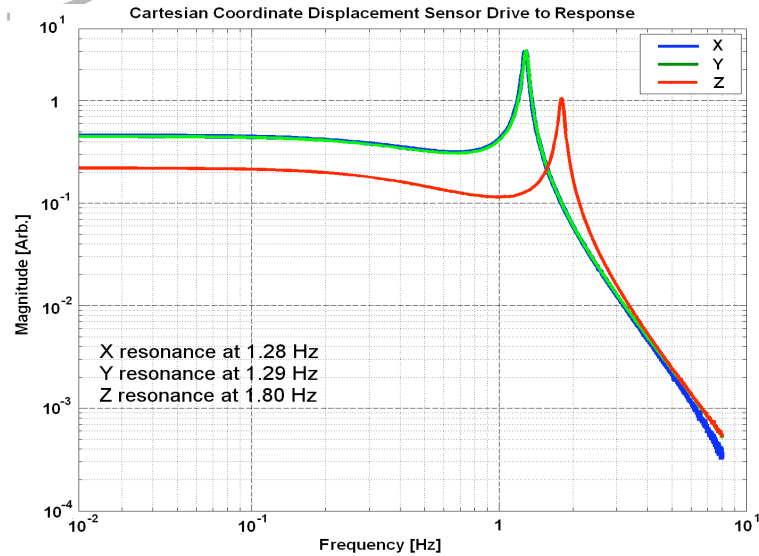 - Crossbeam redesign is complete, prototypes have arrived at LASTI, will be tested when they get their HAM ISI
  (Issue External to HAM ISI)

  - Blend filters must be tuned to minimize noise coupling
  (Issue commissioned in Software)

  - Sensor correction has to be implemented
  (Issue commissioned in Software)

- For the most part the prototype HAM ISI's meet or beat Advanced LIGO requirements

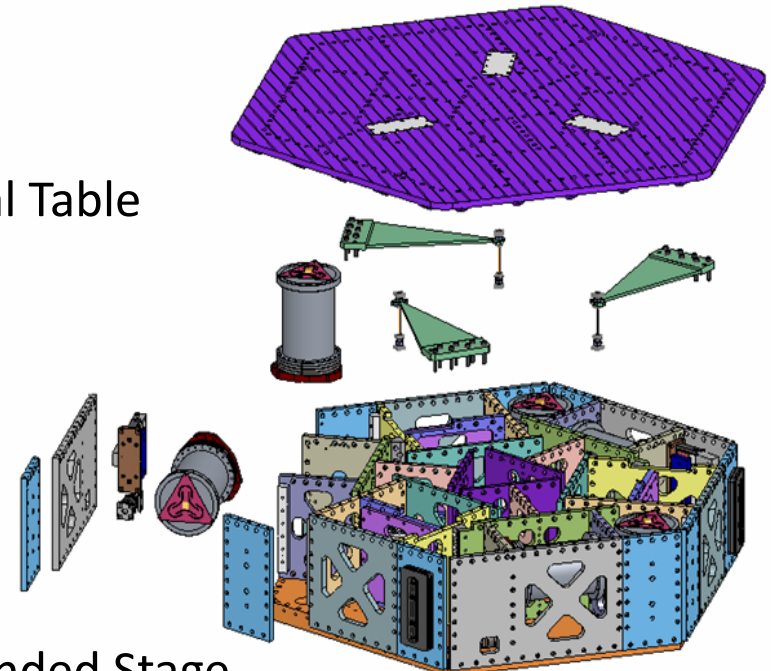- **No major physical design changes are needed!**

The HAM ISI
Passive Design Results

Cartesian Coordinate Displacement Sensor Drive to Response

X resonance at 1.28 Hz
Y resonance at 1.29 Hz
Z resonance at 1.80 Hz

Optical Table

Suspended Stage

L1 H1

Support Stage

Resonant Frequencies	Specified (Hz)	FEA Modeled (Hz)	Measured (Hz)
X Horizontal Translation	1.0 - 1.4	1.32	1.28
			1.25
Y Horizontal Translation	1.0 - 1.4	1.32	1.29
			1.25
Z Vertical Translation	1.3 - 1.9	1.80	1.80
			1.85
RX Tip and Tilt	0.8 - 1.1	1.07	0.95
			1.05
RY Tip and Tilt	0.8 - 1.1	1.07	1.05
			1.10
RZ Yaw	0.8 - 1.2	0.90	0.80
			0.85

L1 HAM6 ISI
RY Isolation Loop and Predicted OLG
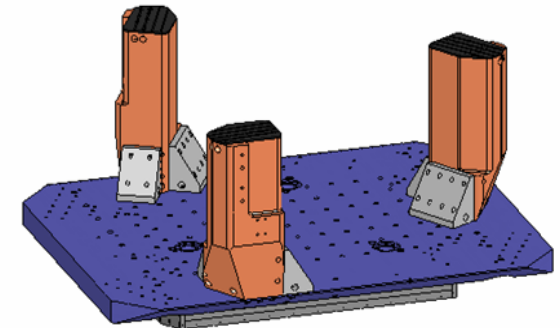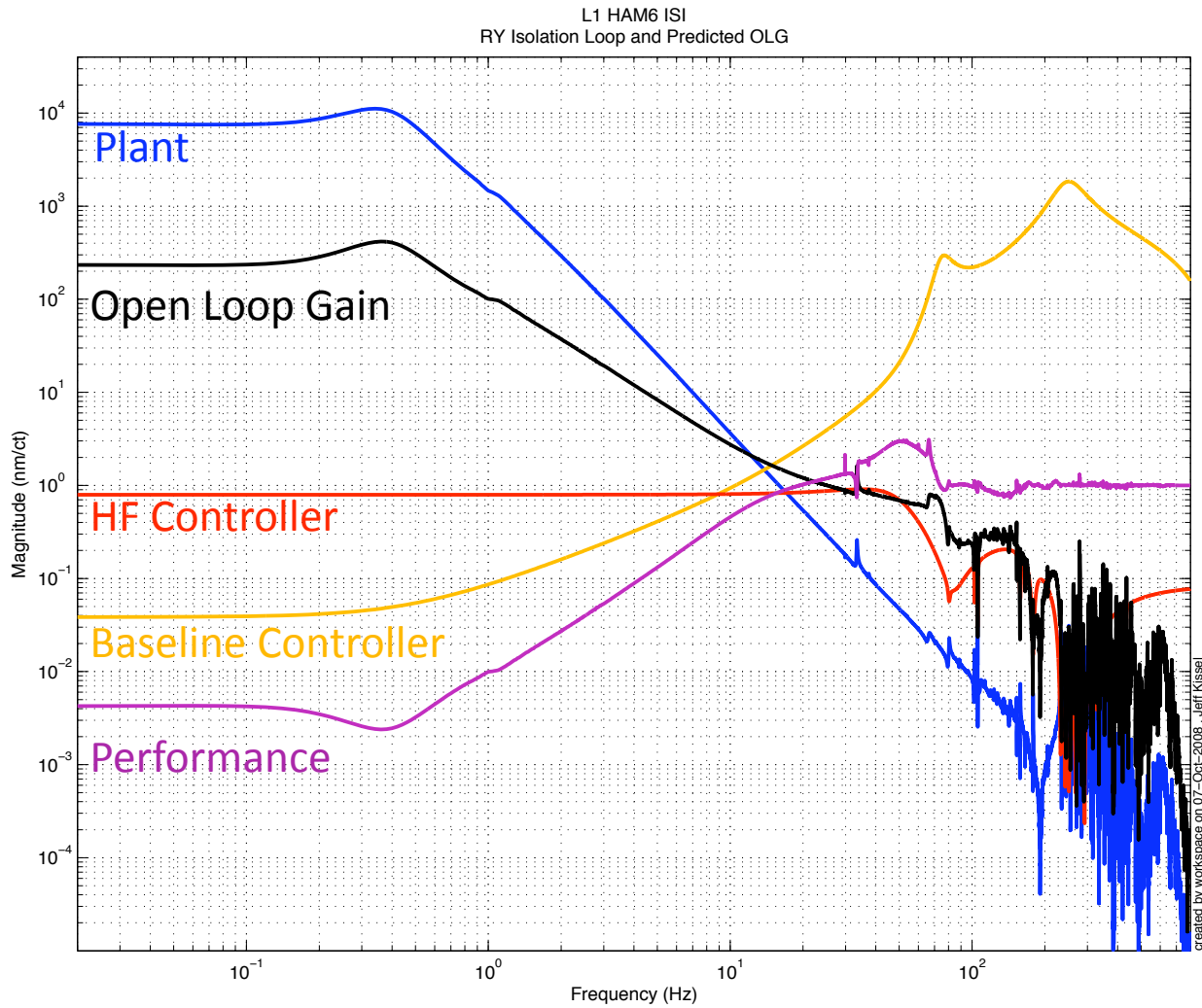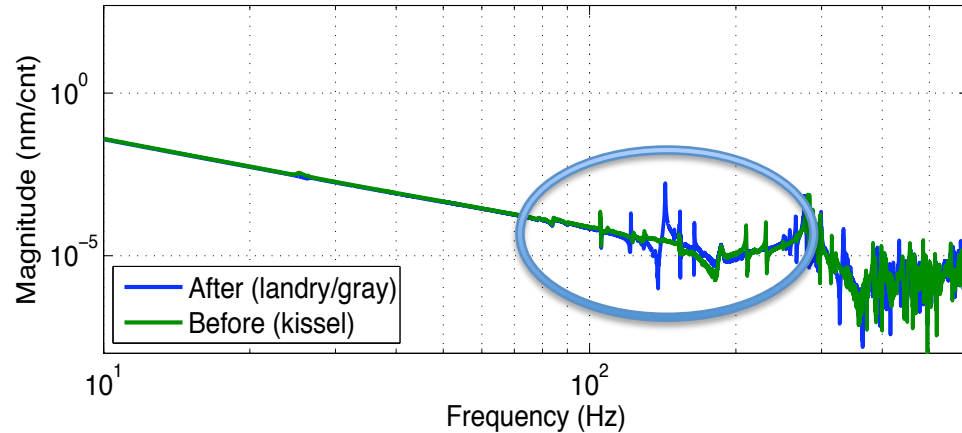
The HAM ISI
With Payload

Before (080611) and After (081002) OMC Install
SUPER SENSOR RX direction
At Vacuum, All Damping On, Isolation Controllers/Sensor Corr OFF, OMC "Orig" location

- Noticeable change in the plant at high frequencies

- Requires re-tuning of isolation filters

- Will be different for every payload