Early Work to Reduce aLIGO Environmental Coupling

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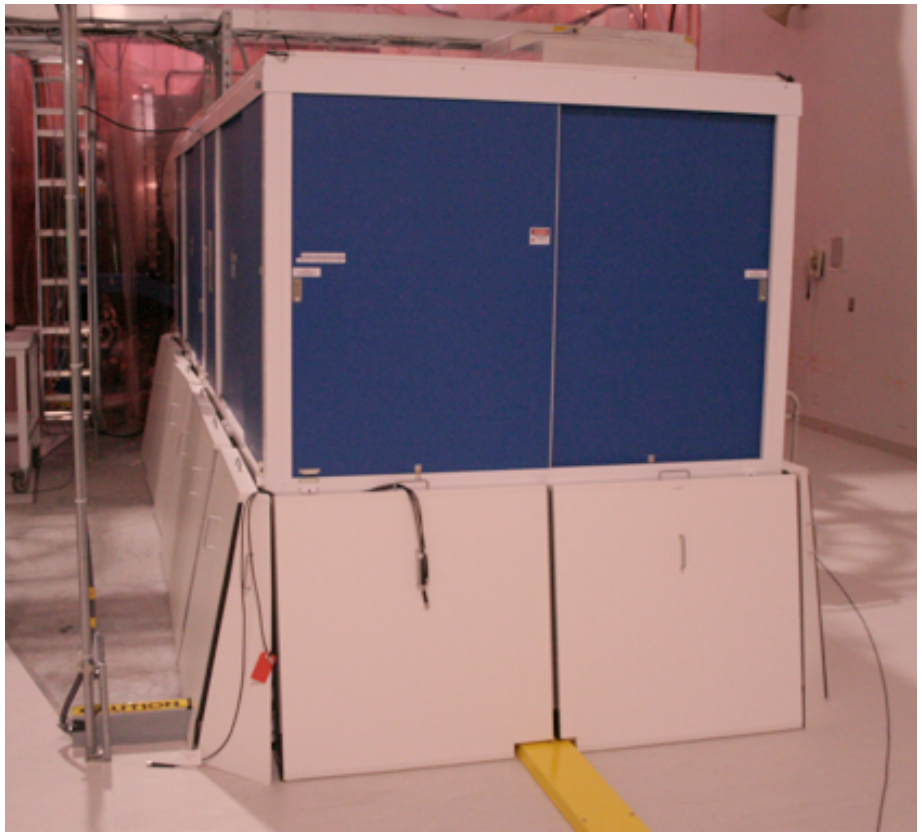
LIGO-G1101041-V1

PSL worst acoustic/hi-f seismic coupling site in eLIGO



Features in DARM from PSL table even with acoustic enclosure at LLO

aLIGO PSL table legs

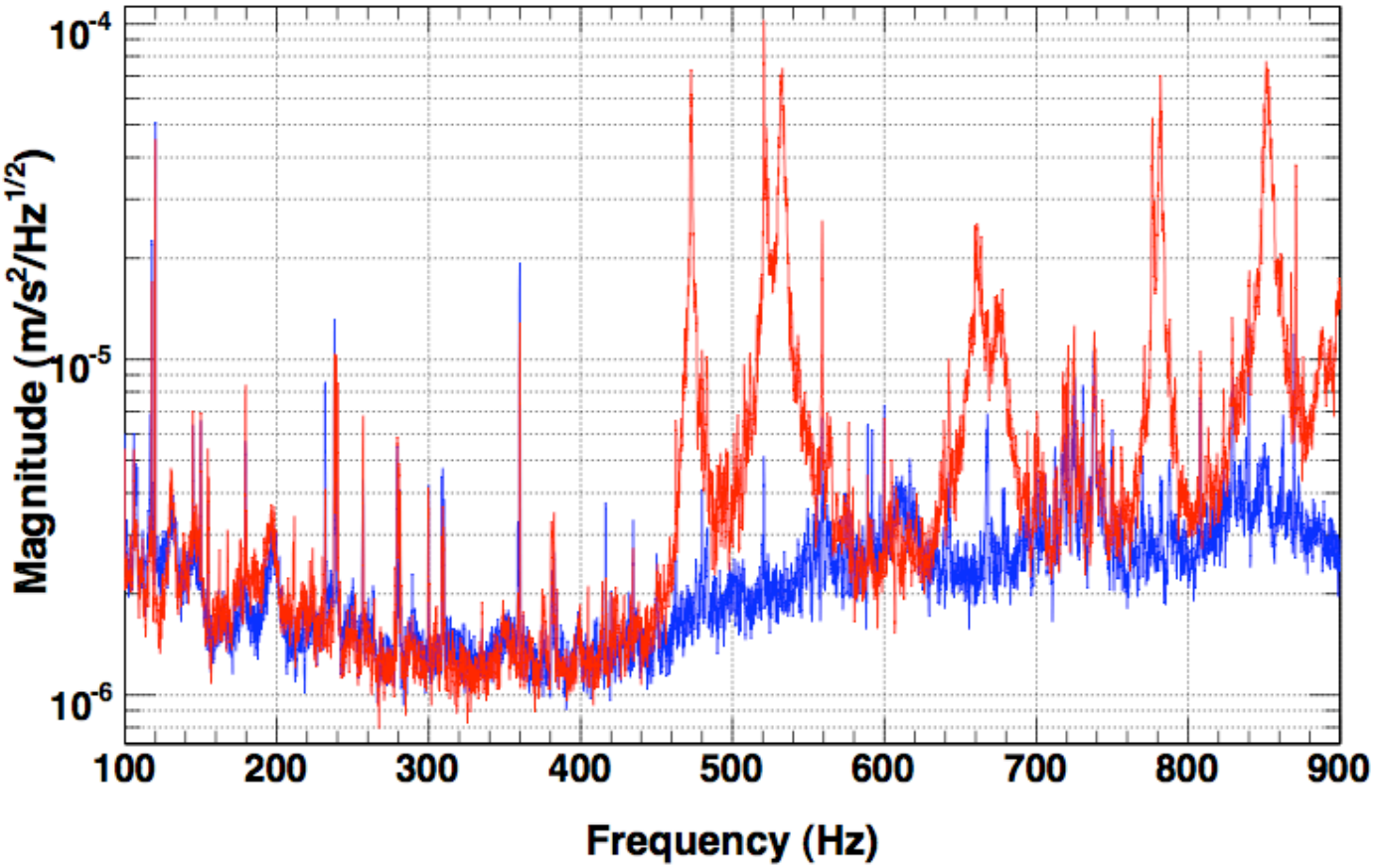
Layers from the ground up

1) cement floor
2) potters soap to prevent sticking
3) Hydro-Stone grouting
4) 6 legs filled with damping beads (tops level to 0.005”)
5) thin plastic wrap to keep epoxy from sticking to legs
6) Epoxy with foam dams. O-ring stock to support table evenly during hardening.
7) plastic wrap to keep epoxy from sticking to table
8) epoxy bosses on table to give horizontal rigidity
9) table

Design: R.Savage R.DeSalvo R.Schofield

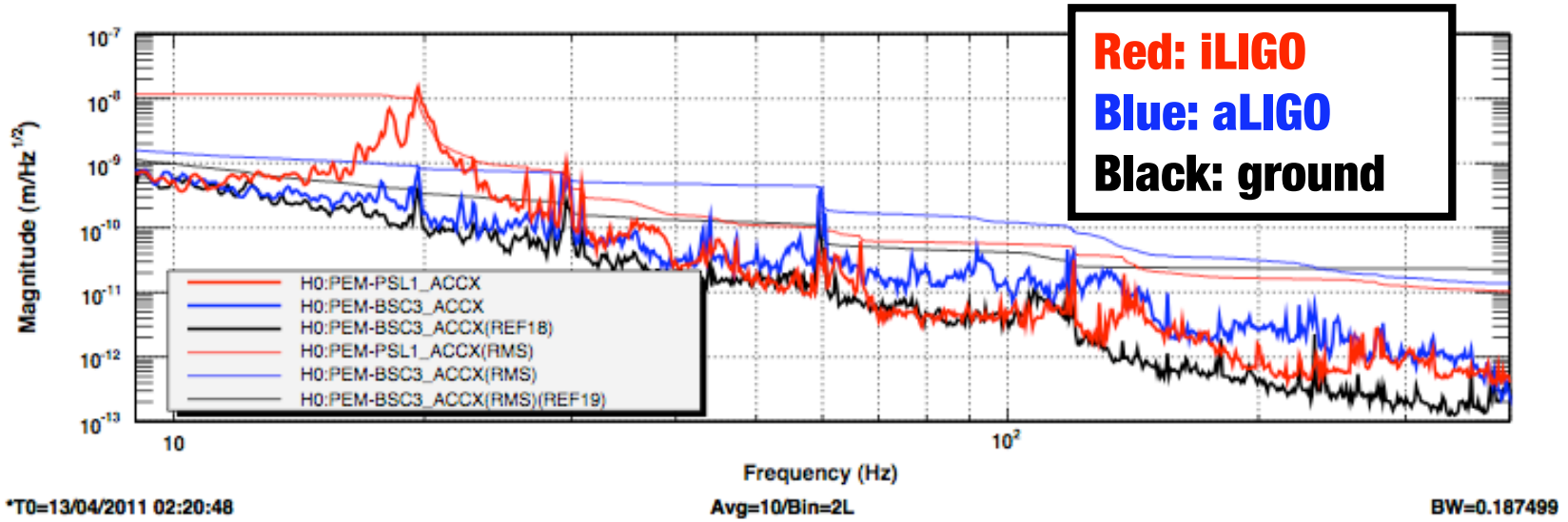
Leg damping

Accelerometer on legs, before (Red) and after (Blue) filling with glass blasting beads.

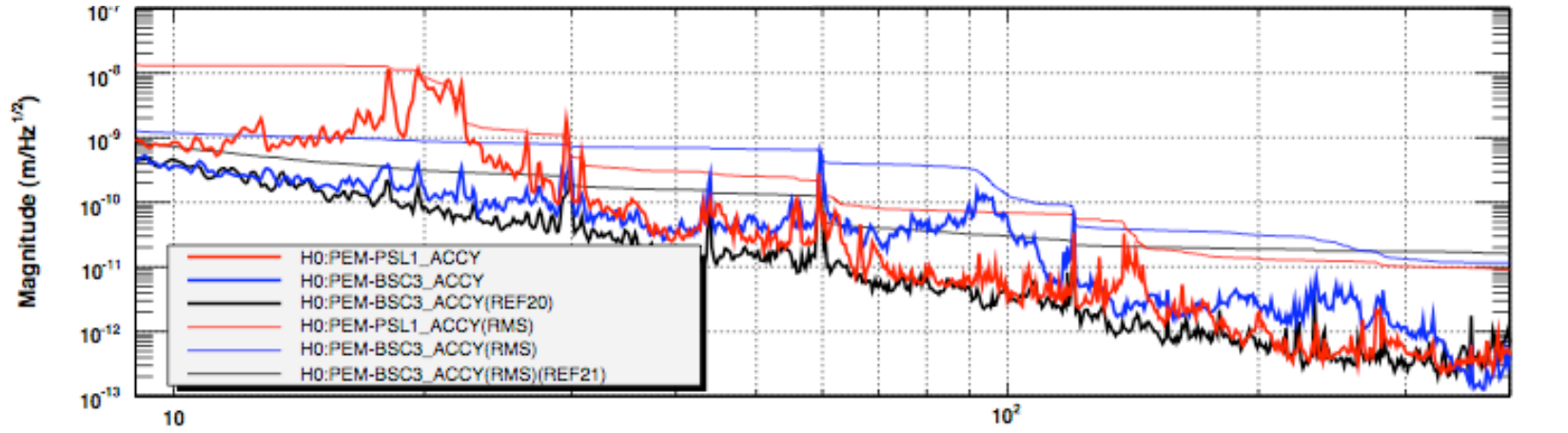


RMS table displacement about 1/10 that of iLIGO table

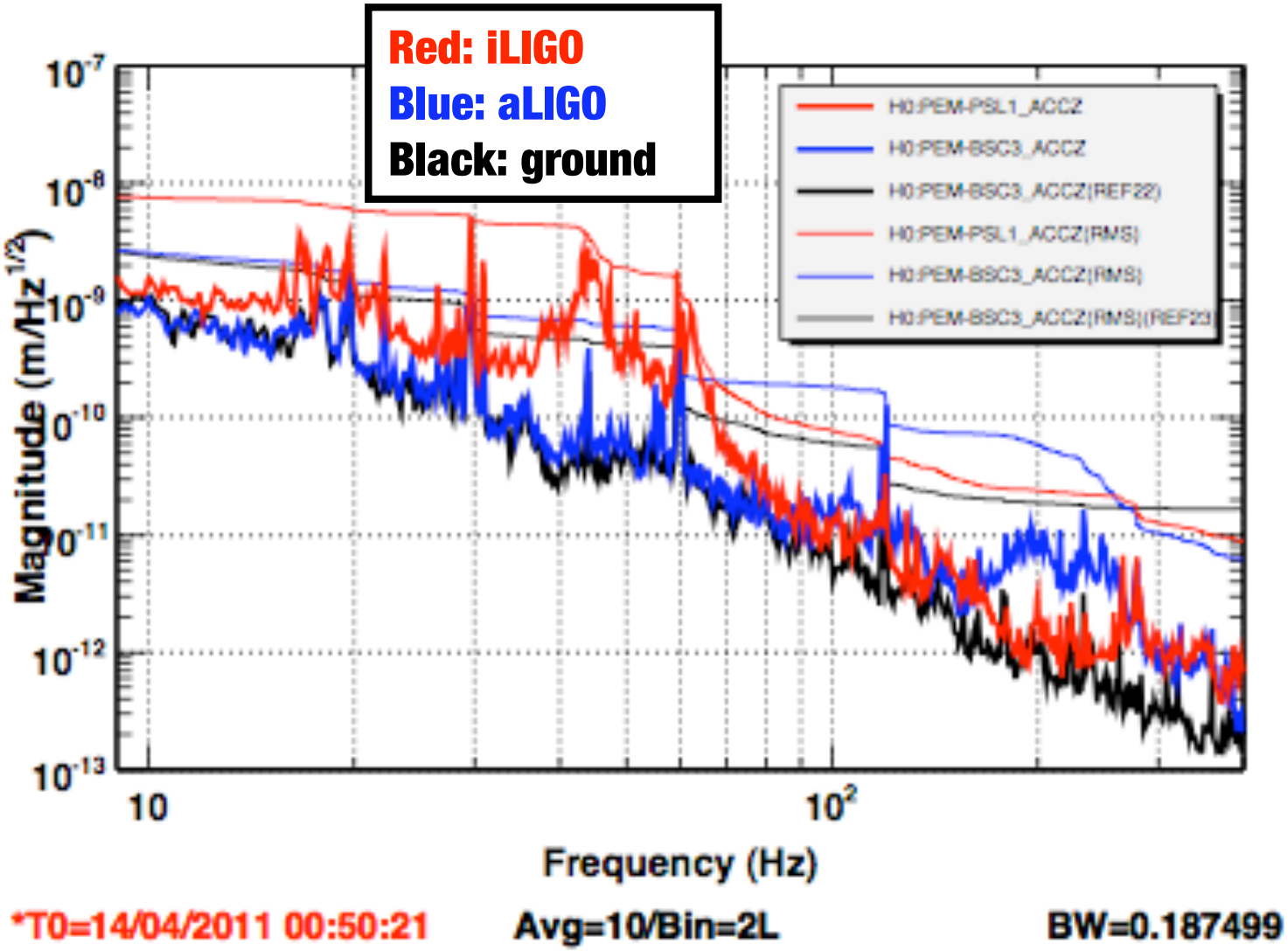
Long axis (LHO)

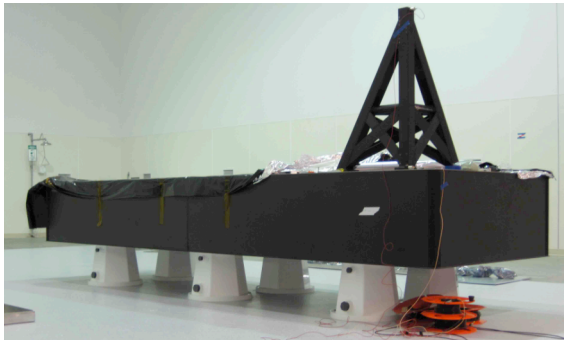


Short axis



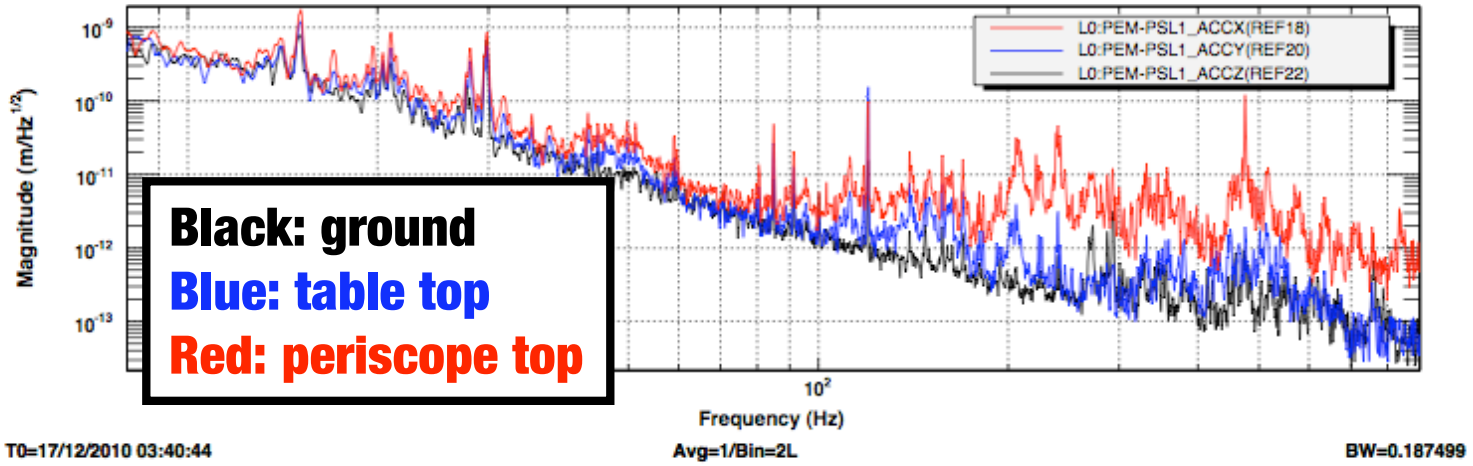
Vertical axis



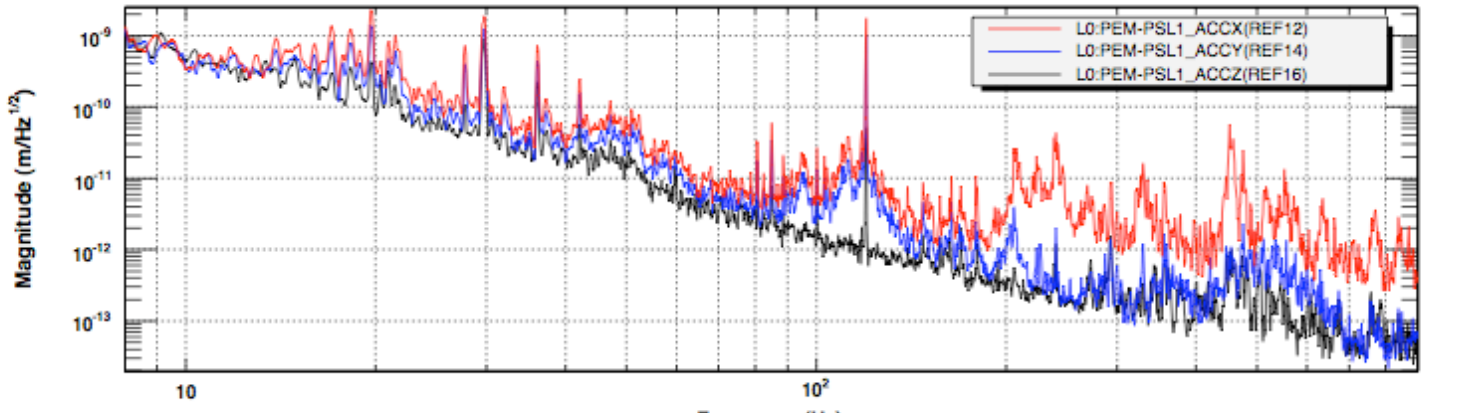


Lowest table and periscope peaks don't overlap

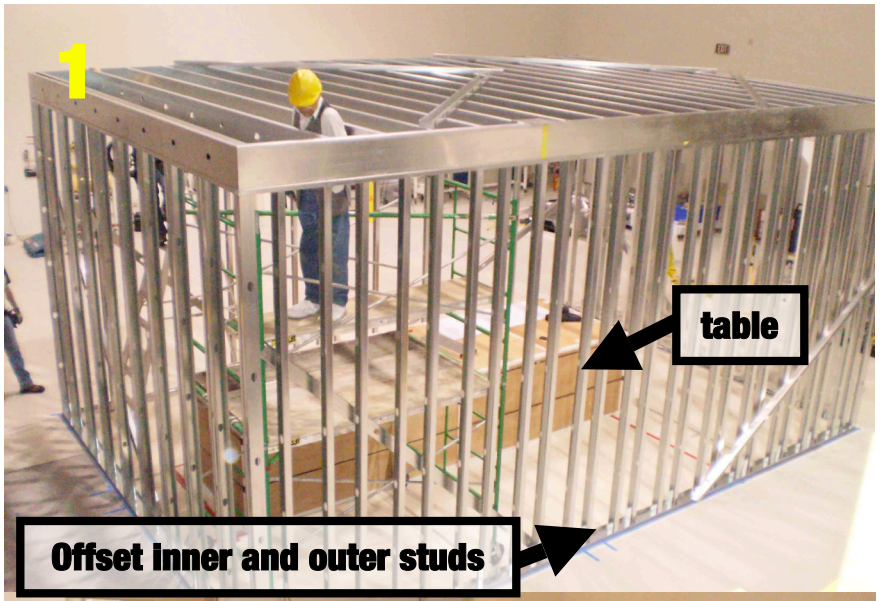
Long axis (LLO)

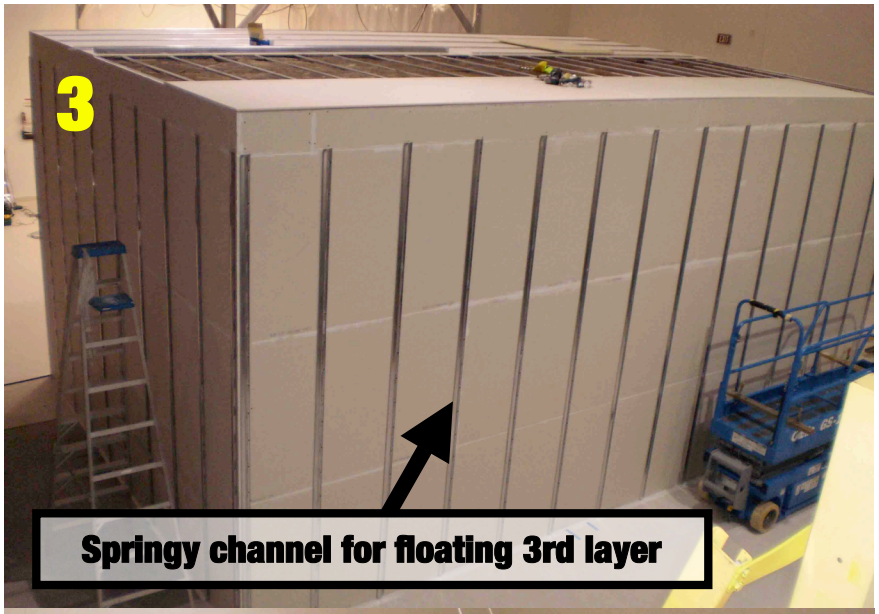


Short axis



PSL enclosure construction

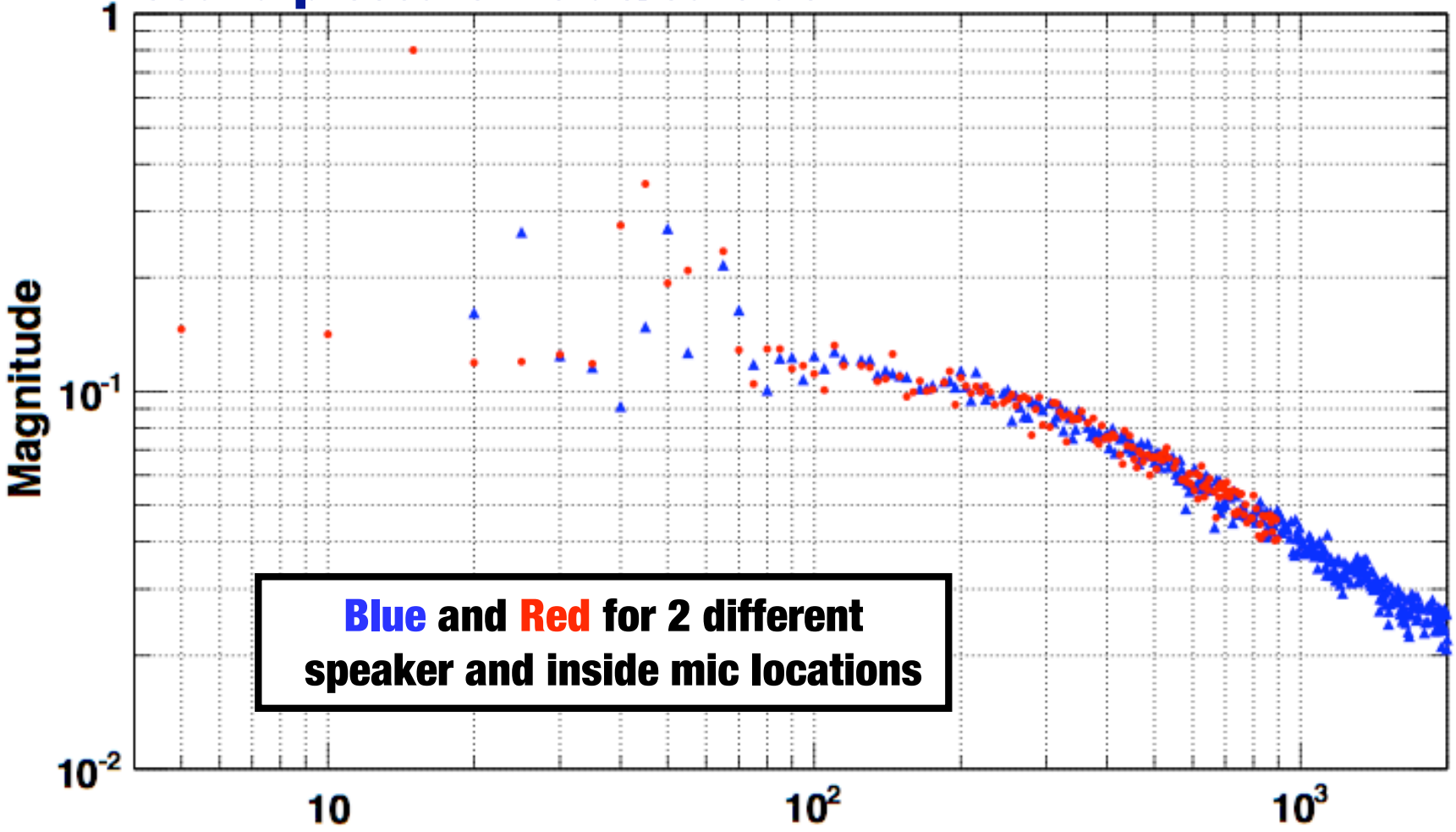




Photos: M. Rodruck

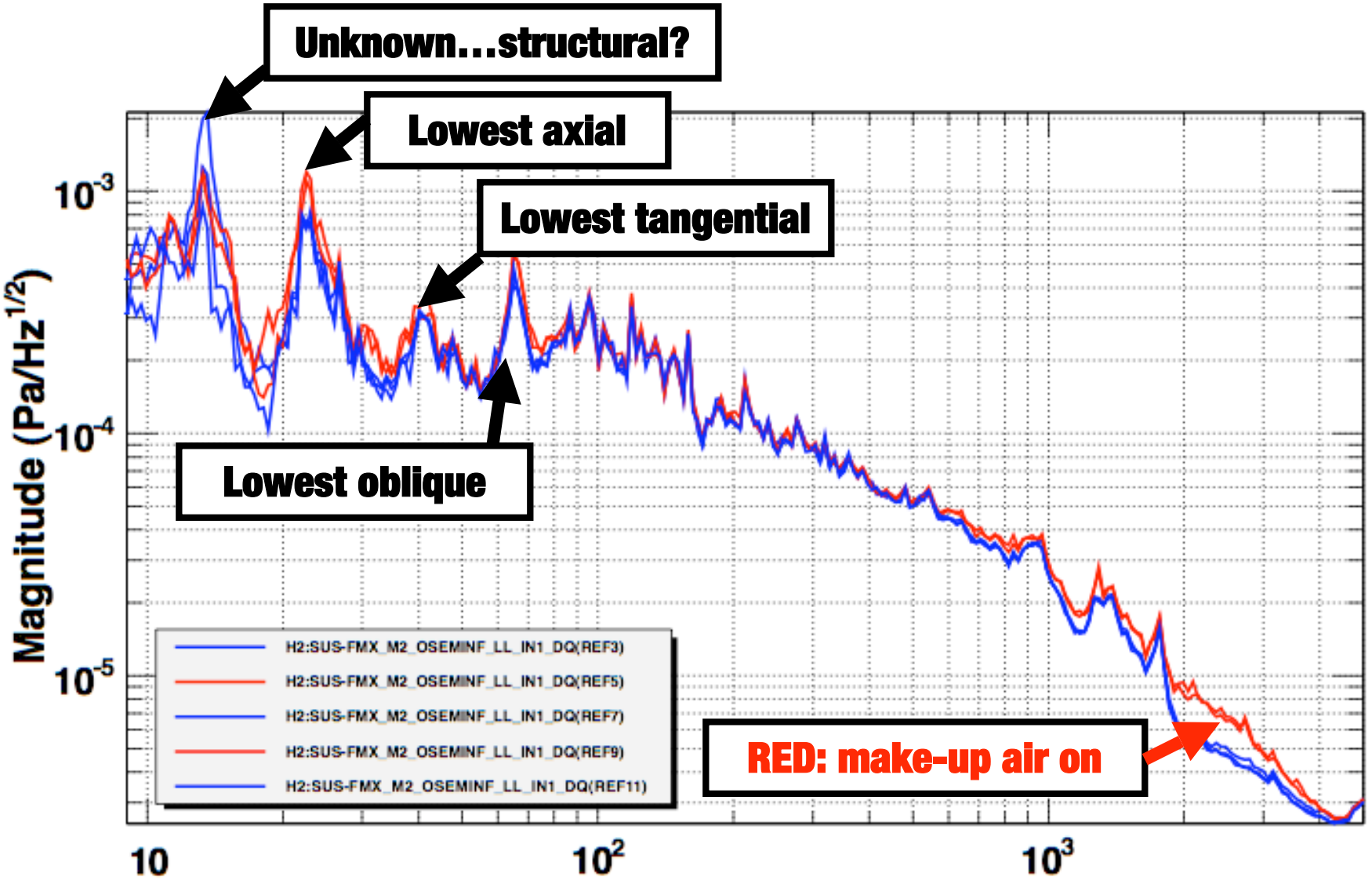
Initial LHO enclosure performance

Sound pressure inside/outside



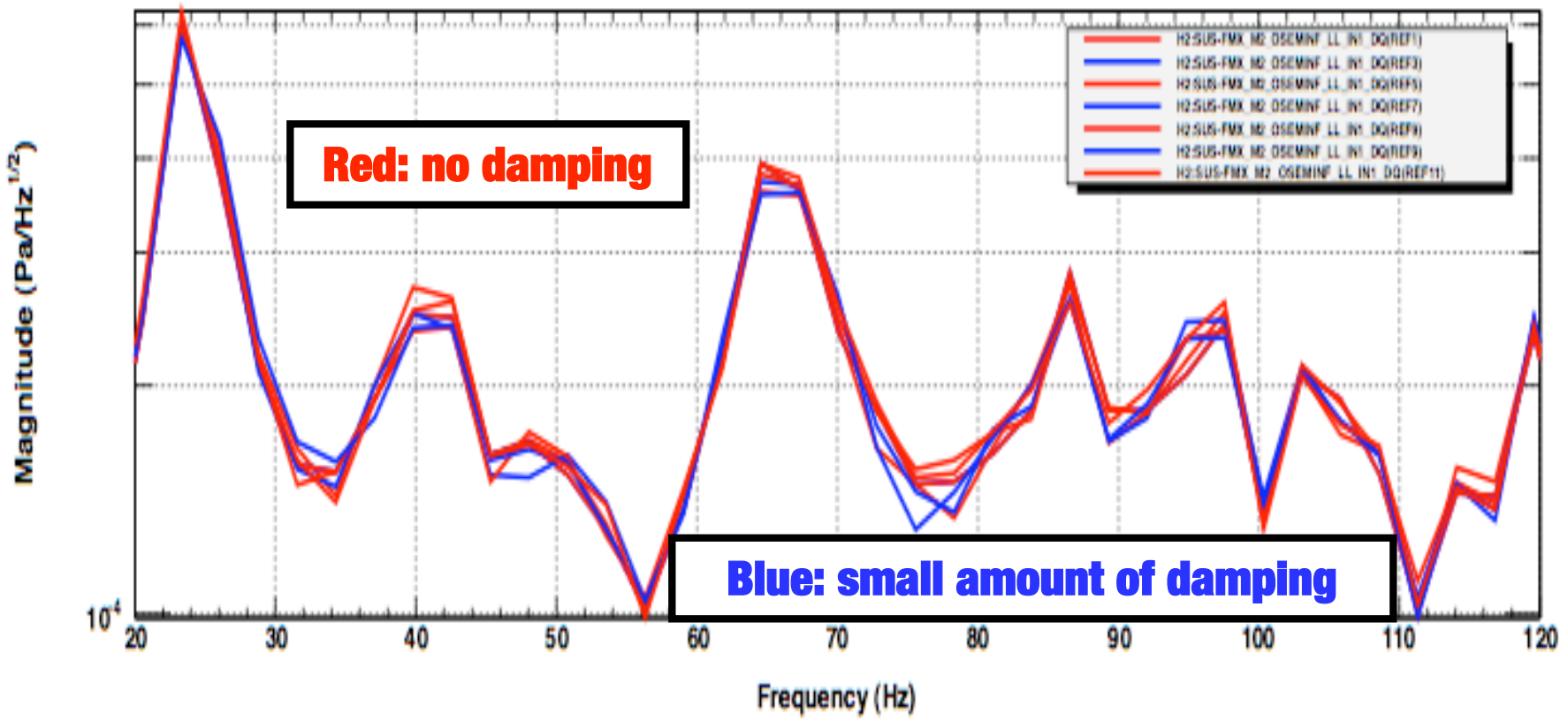
We wanted 0.1 down to 10 Hz: close except for room modes.

Room modes


Unknown…structural?
Lowest axial
Lowest tangential
Lowest oblique
RED: make-up air on
Magnitude (Pa/Hz^1/2)
10^-3
10^-4
10^-5
10
10^2
10^3
H2:SUS-FMX_M2_OSEMINF_LL_IN1_DQ(REF3)
H2:SUS-FMX_M2_OSEMINF_LL_IN1_DQ(REF5)
H2:SUS-FMX_M2_OSEMINF_LL_IN1_DQ(REF7)
H2:SUS-FMX_M2_OSEMINF_LL_IN1_DQ(REF9)
H2:SUS-FMX_M2_OSEMINF_LL_IN1_DQ(REF11)

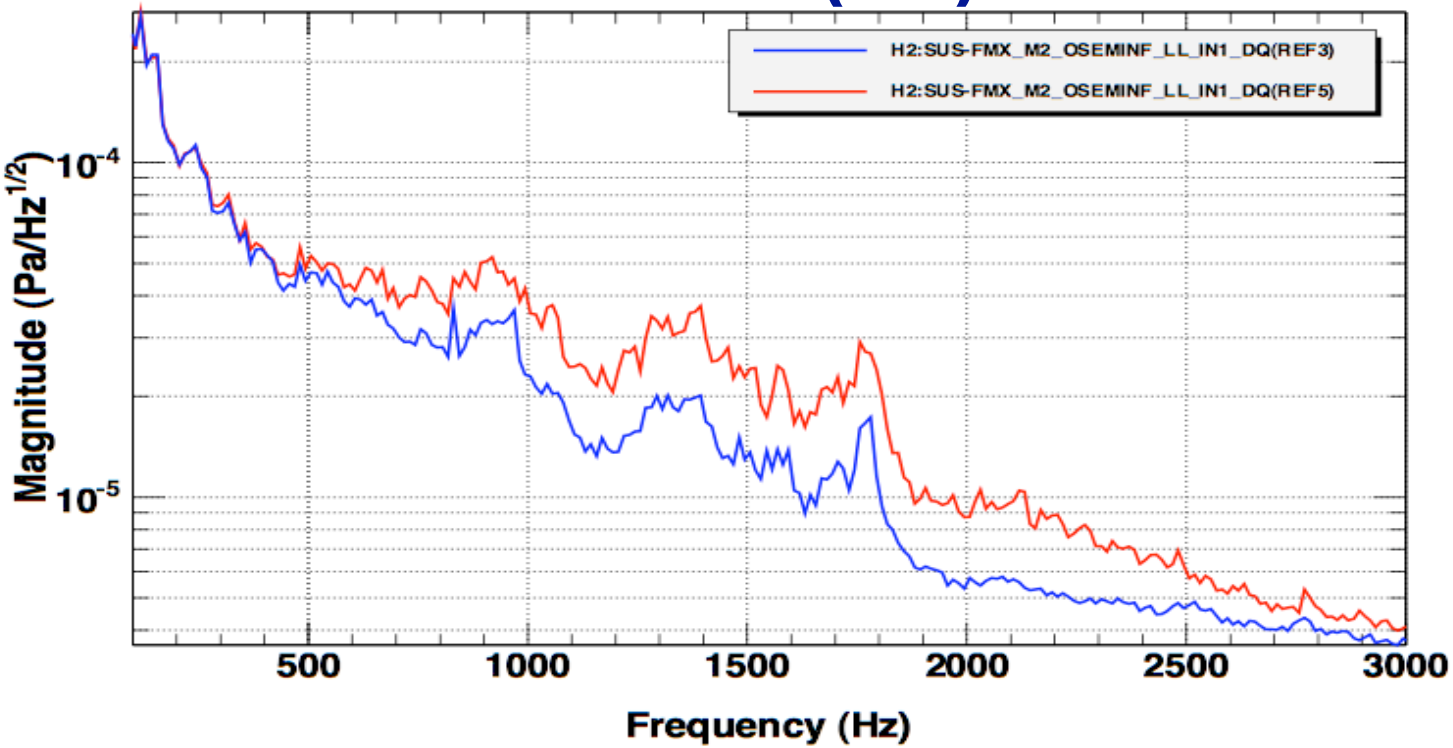
Damping proof of principle

Inside microphone



LHO acoustic door will be replaced

Microphone near door, as is (red), and with cracks stuffed with foam (blue).



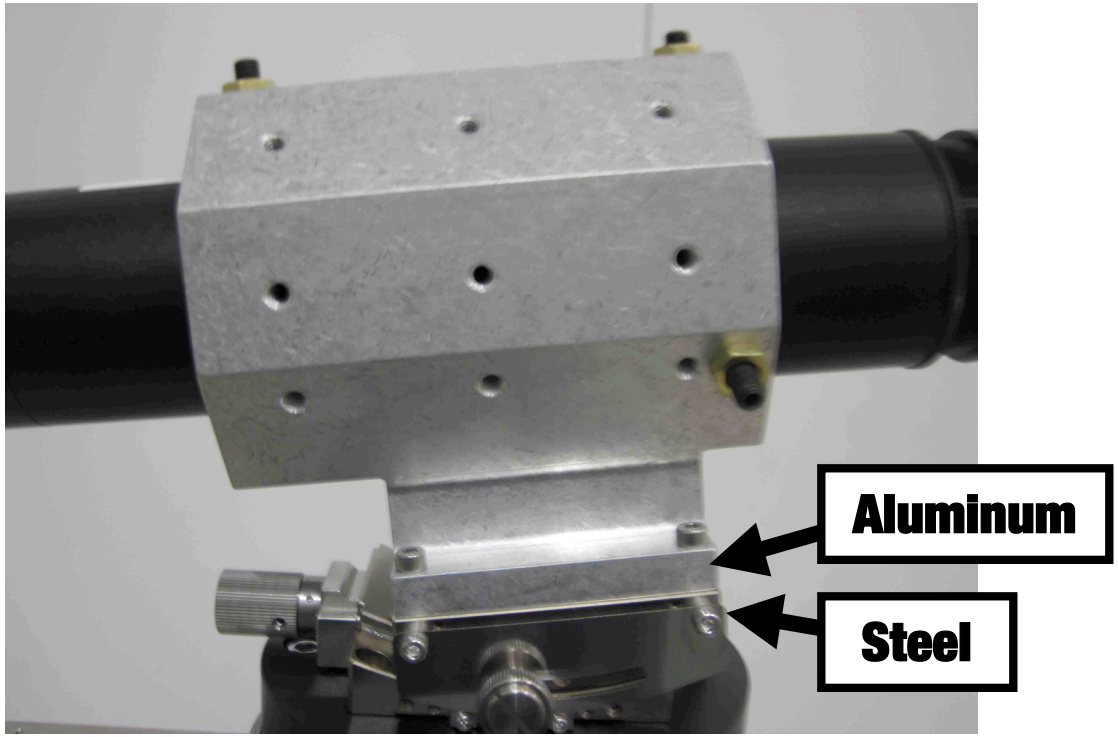
Check of resonances for new optical lever pylon

Equipment on pylon	Lowest frequency (Hz)
Diode assembly and photon calibrator (nominal)	34.9
Diode assembly only	36.4
Photon calibrator only	38.1
Nothing on pylon	38.1

Pier design led by R.DeSalvo

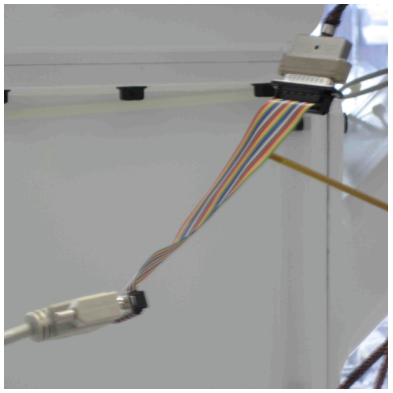
Compare to ~25Hz iLIGO

Potential main source of thermal drift in optical lever transmitter



After removing warm finger from the aluminum-steel interface, we saw large thermal drifts on optical lever signal.

Search for excess magnetic field coupling to LHO H1 ITMY Quad suspension



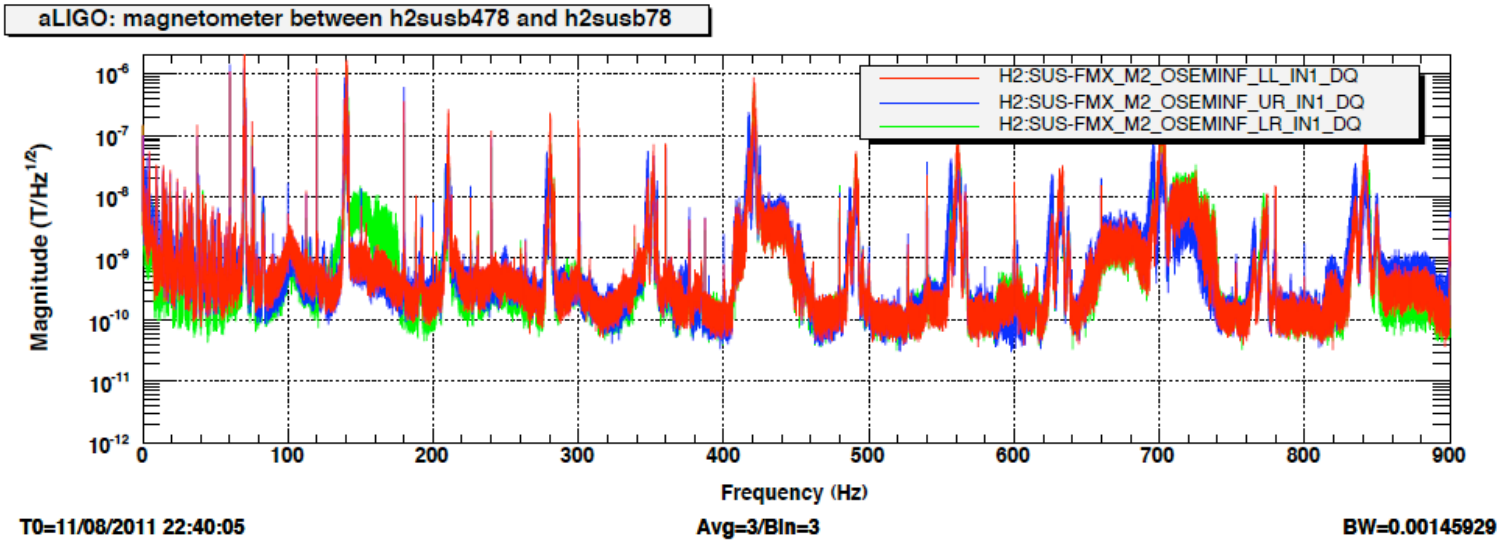
Dominant site was ribbon cable used in place of feed-through

Magnetic fields in electronics racks

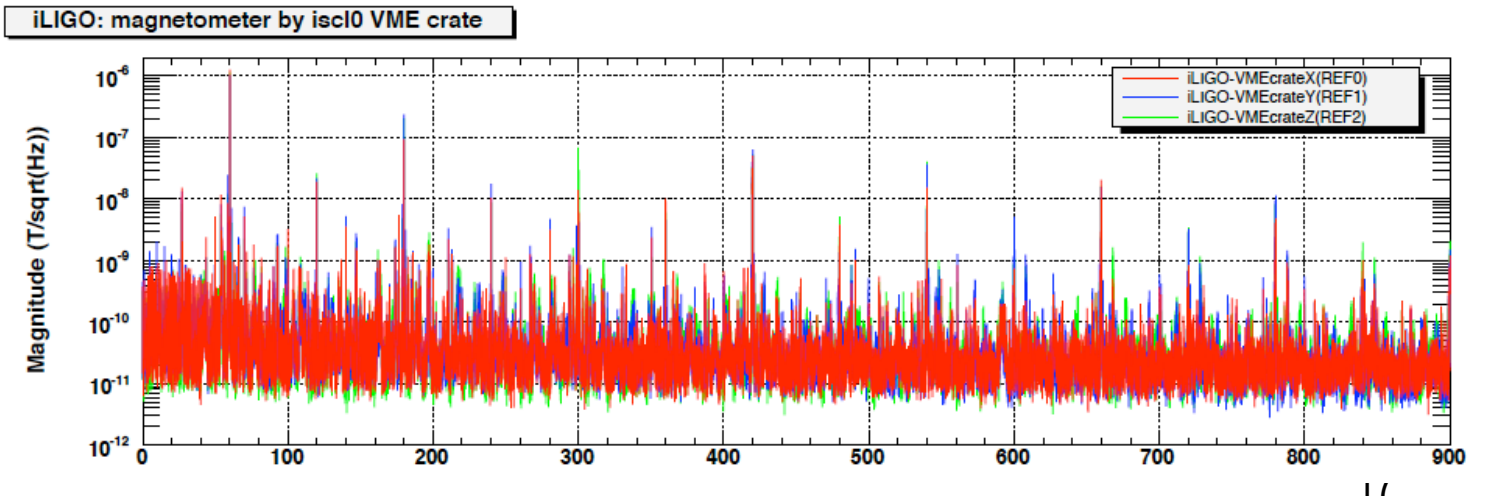
Fields in racks produced spectral features in LIGO. Fields and coupling were studied in aLIGO racks at LHO test stand.

Magnetic fields greater near aLIGO IO chasis than near LIGO VME crate

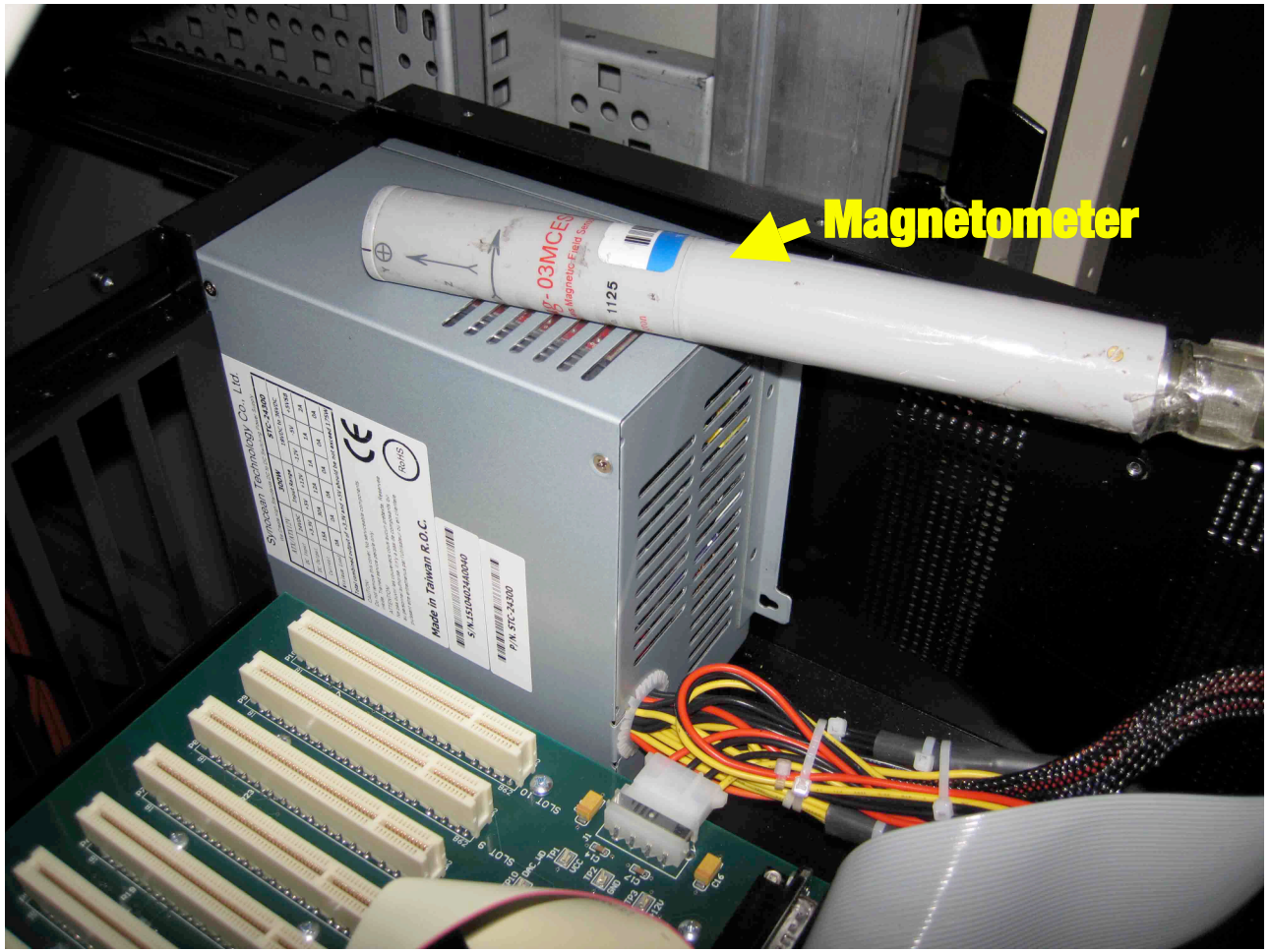
aLIGO



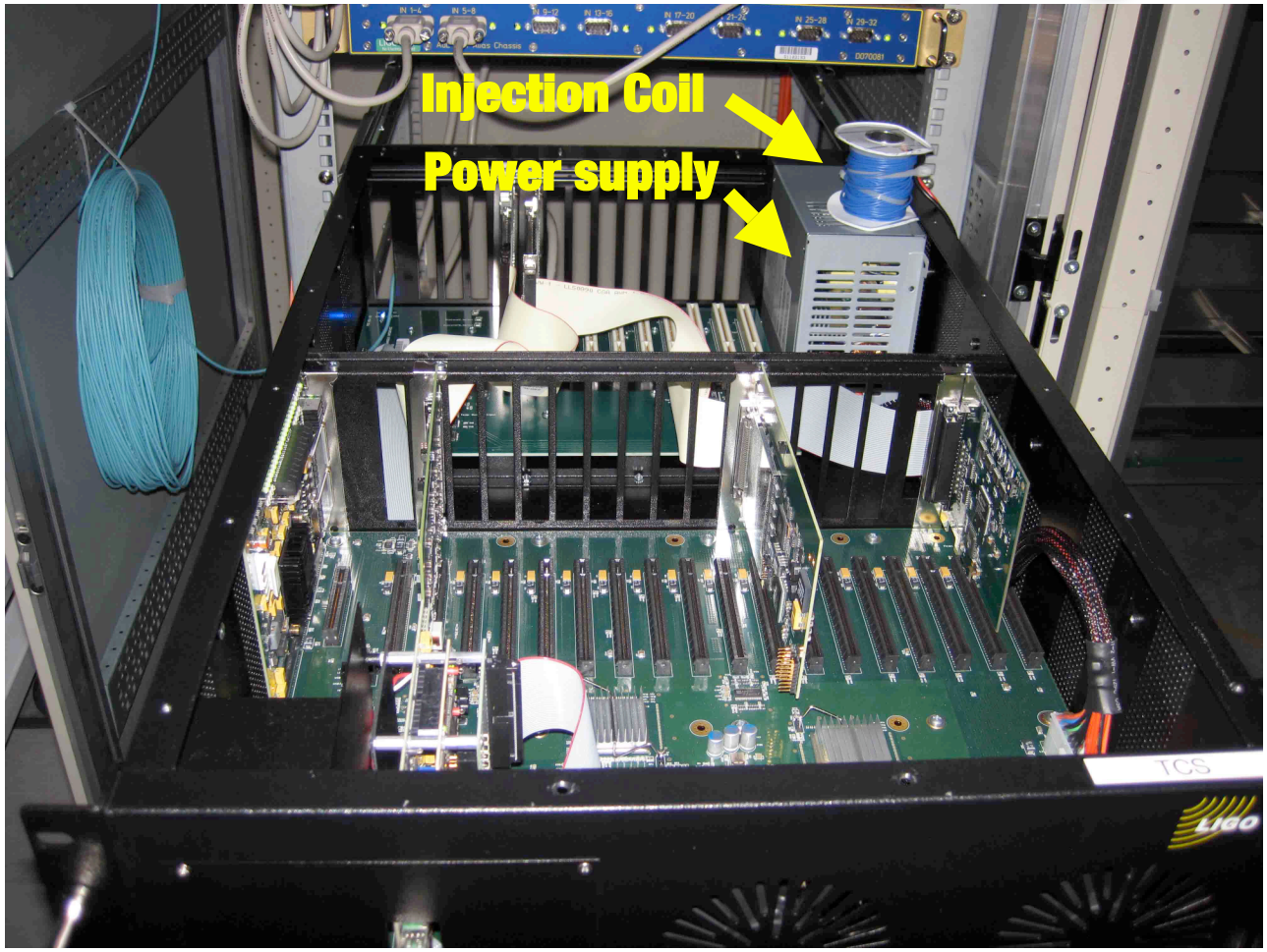
LIGO



Magnetic field strongest at switching power supply for IO chasis



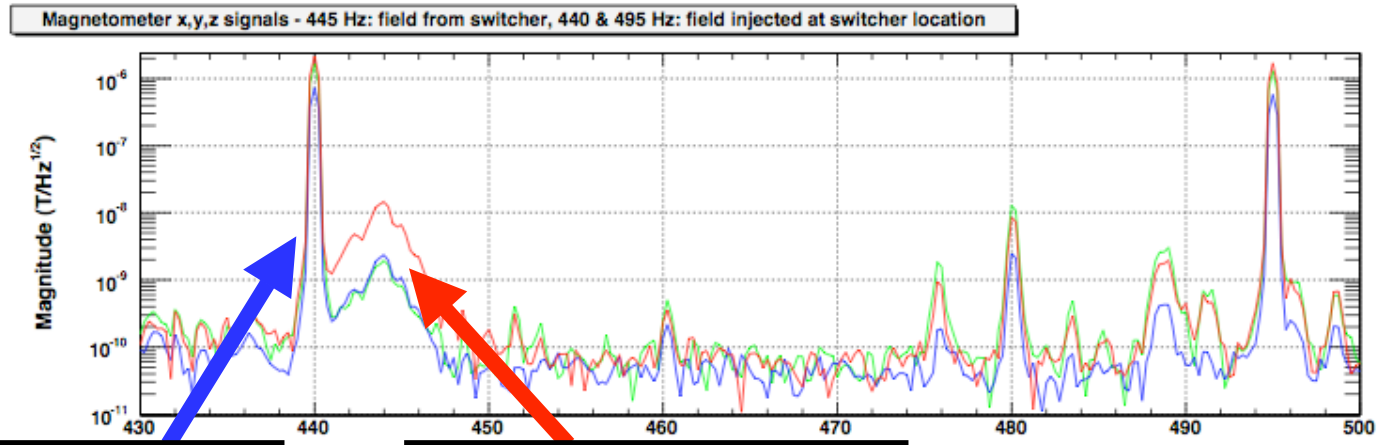
Test field injected at power supply to measure coupling



Checked that test and switcher fields dropped off similarly with distance.

Injected field shows up on OSEM channels etc.

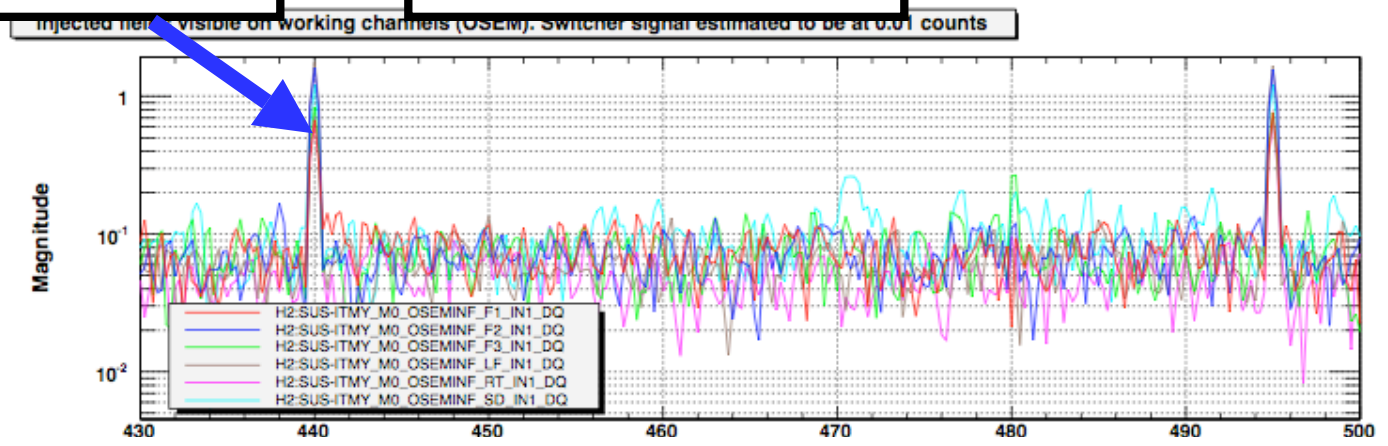
Magnetometer



Injected field

Power supply field

OSEM



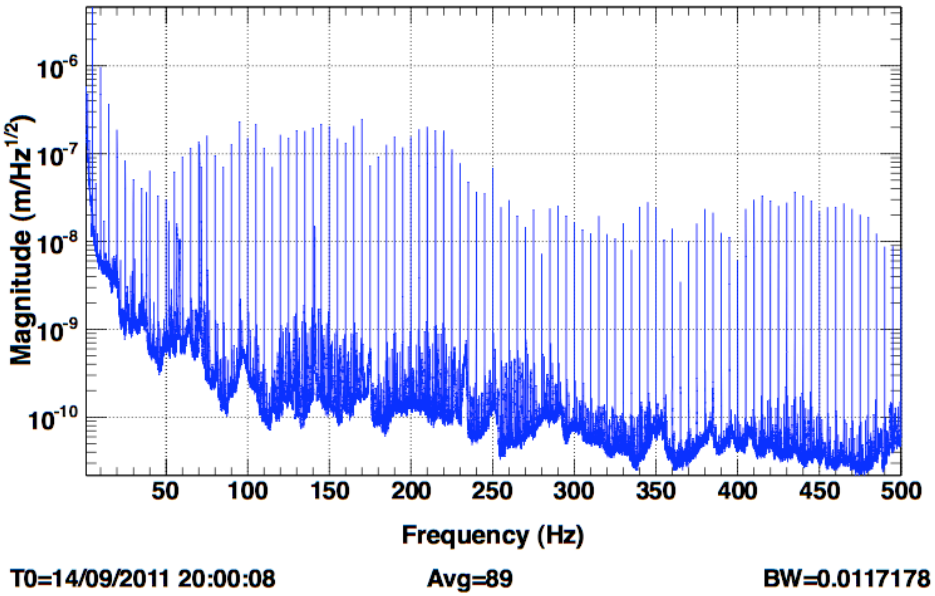
Switcher signal expected at 0.01 counts, 1/6 noise floor

Suggested to CDS that a different power supply should be used

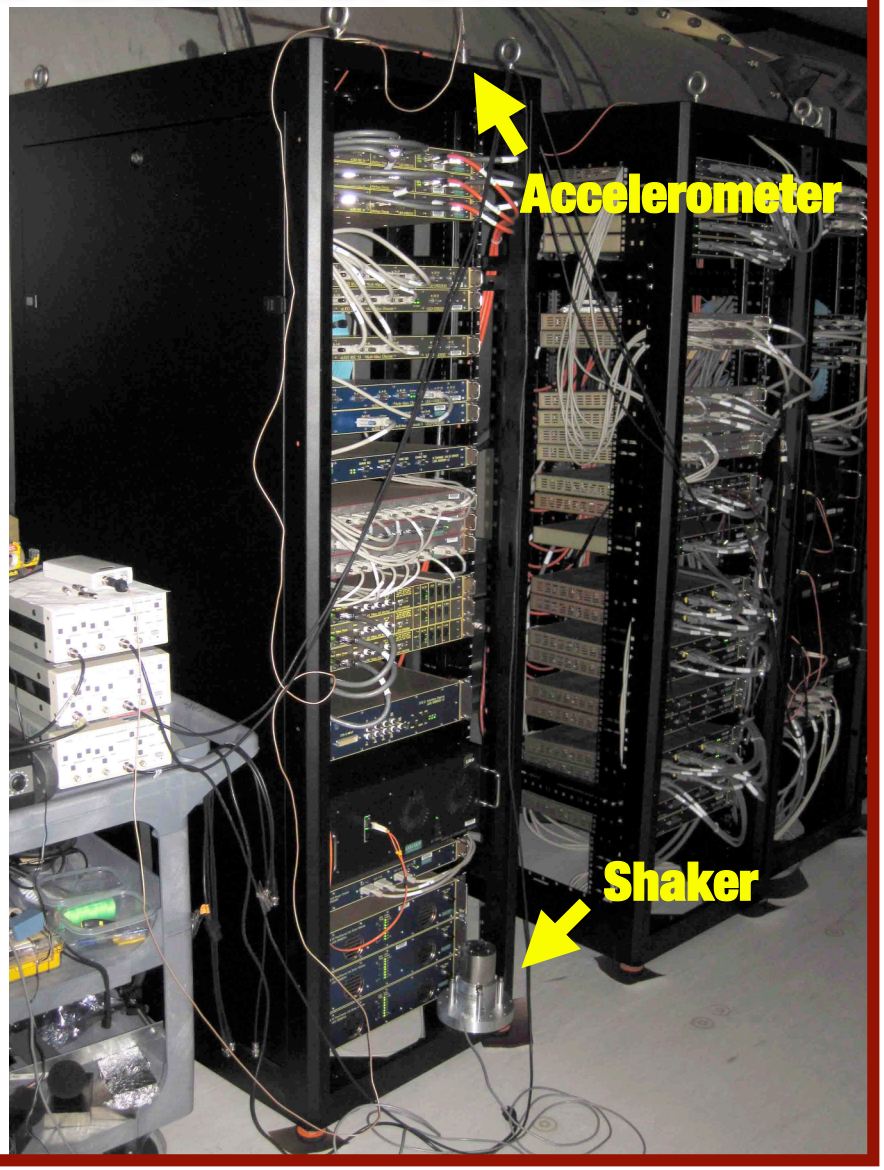
1) Coupling could be greater to other channels, I.e. DARM
2) other Synocean power supplies may be noisier
3) this supply was not providing maximum current
4) quieter supplies in LIGO VME crates produced DARM features

A search for microphonic electronics using a shaker and accelerometer

5 Hz comb from shaking is orders of magnitude above vibration b.g. in accelerometer signal

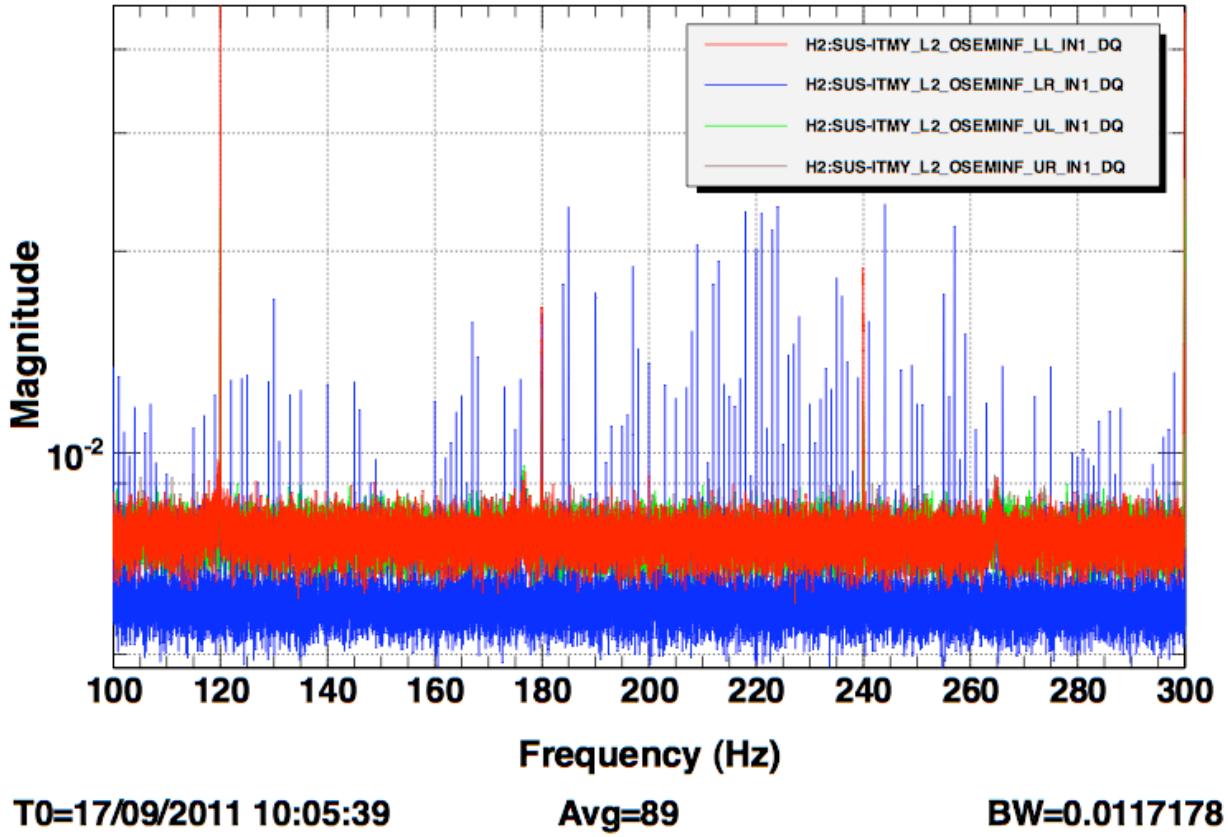


Comb not seen in other channels (good job CDS)



The first of many future puzzles

Strong 1 Hz comb appearing in only 1 of several close channels (1 ITMY OSEM channel)



IRIG-B?