

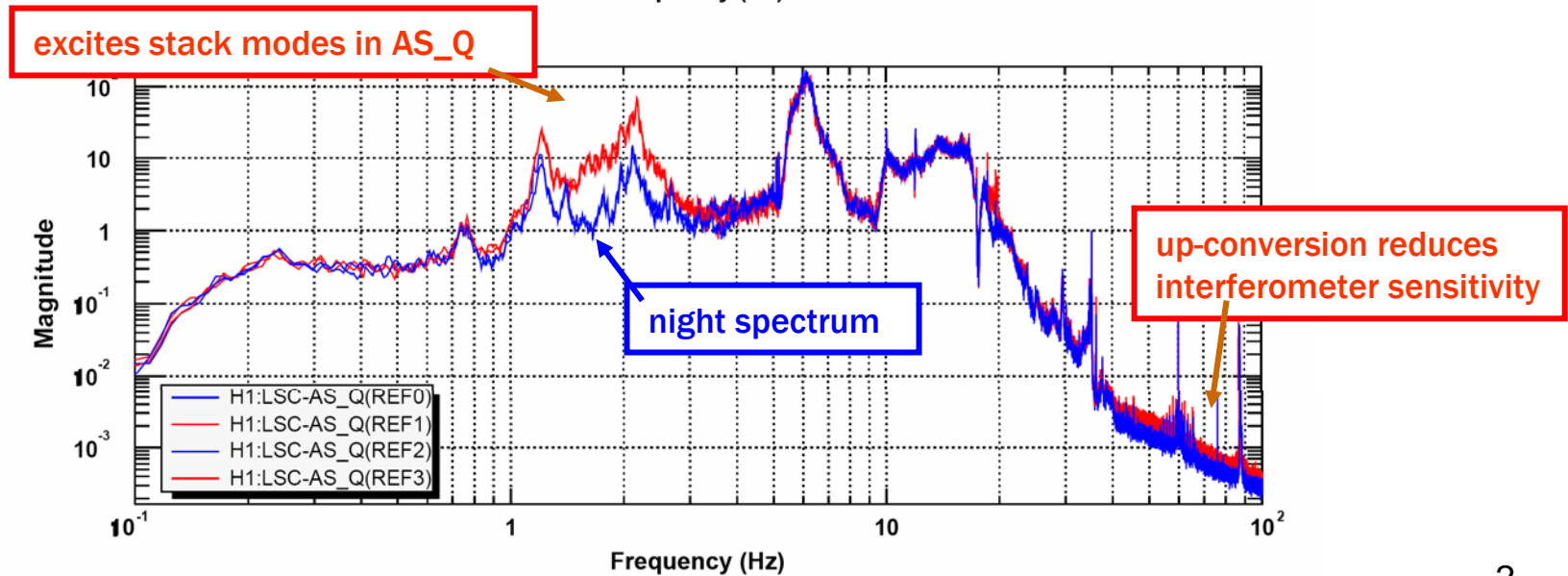
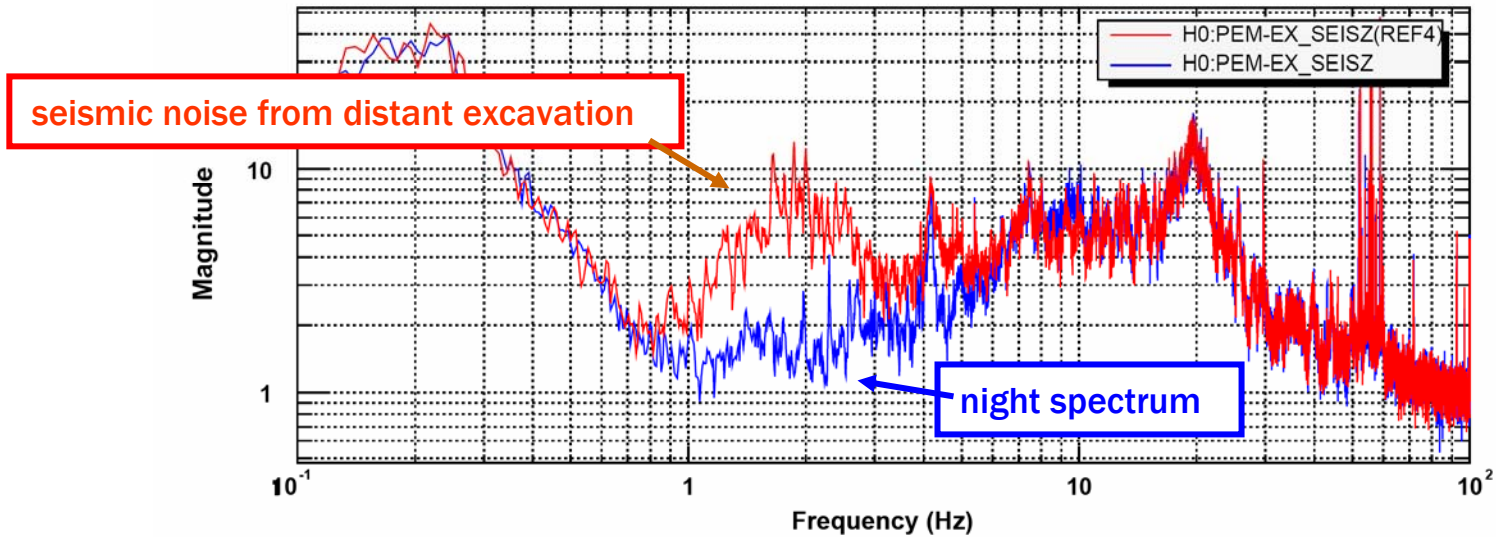
# Environmental Disturbances: S4 and Pre-S5

Robert Schofield, U of O

Doug Cook, Fred Raab, Richard McCarthy, LHO

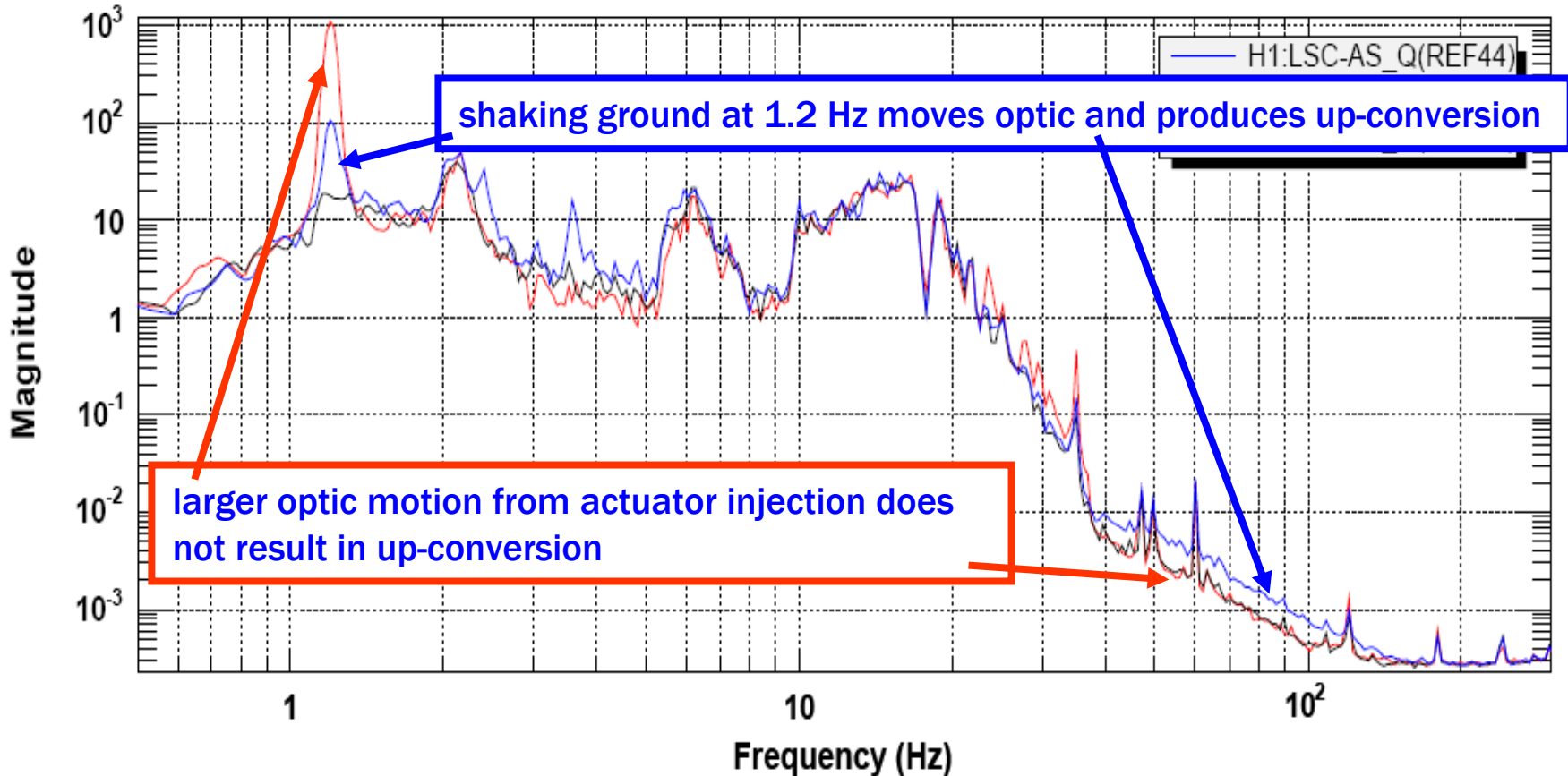
- I. Seismic up-conversion
- II. Some peak identification for upper limits groups
  - VME produced
  - seismic/acoustic
- III. Seismic/acoustic mitigation
  - acoustic enclosures
  - floating the H2 dark port

# Up-conversion of low frequency seismic noise



# DARM injection does not produce up-conversion.

Blue: 1.2 Hz beam-axis mechanical shaker, Red: DARM injection, Black: normal



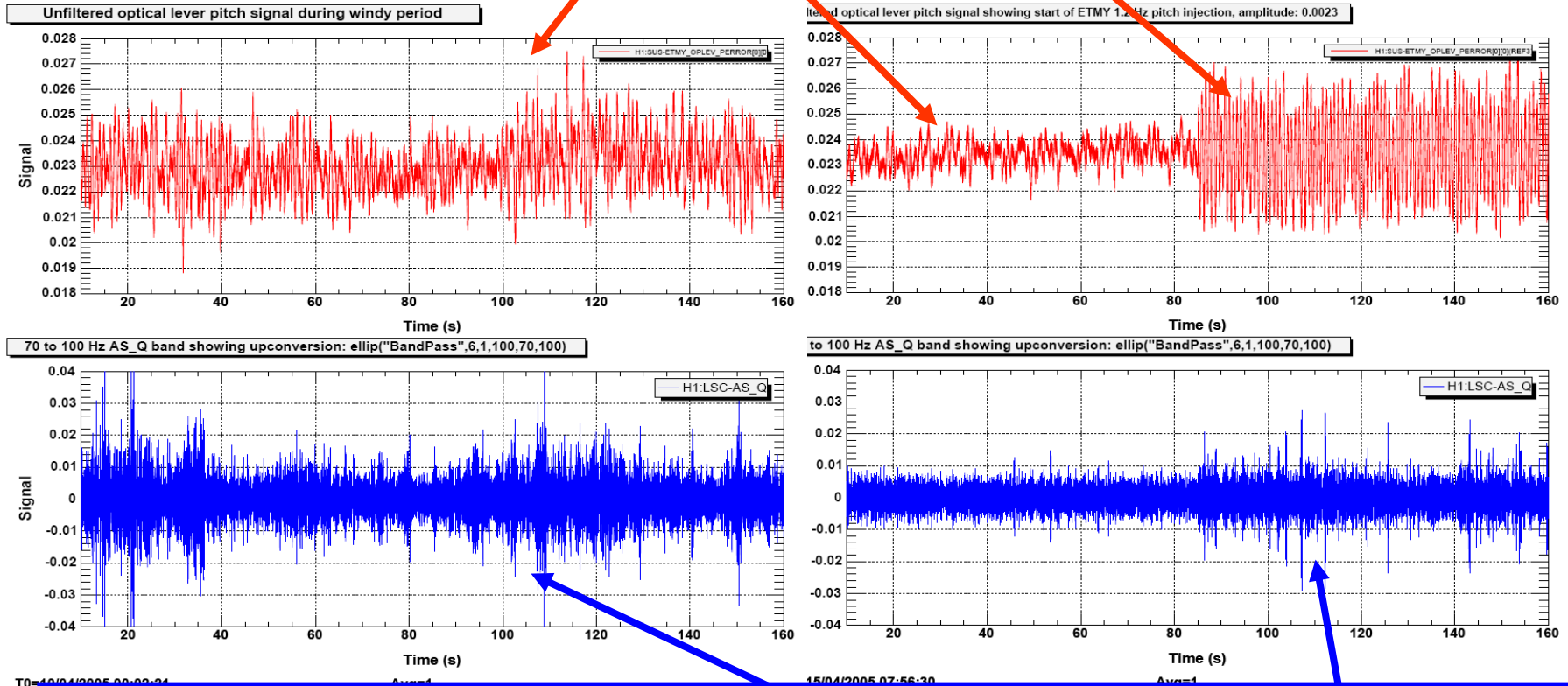
\*T0=03/06/2005 02:59:03

Avg=1/Bin=20L

BW=0.0468742

# Up-conversion with injection to mimic pitch during wind

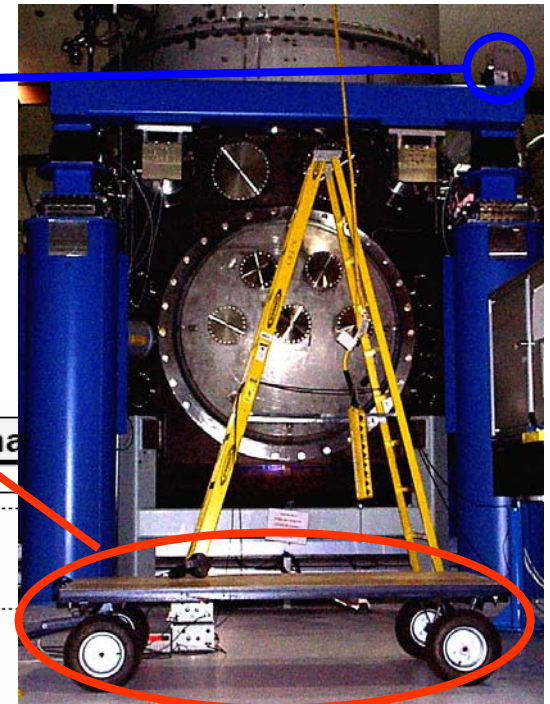
Optical lever during periods of wind, quiet and actuator injections to “match” wind.



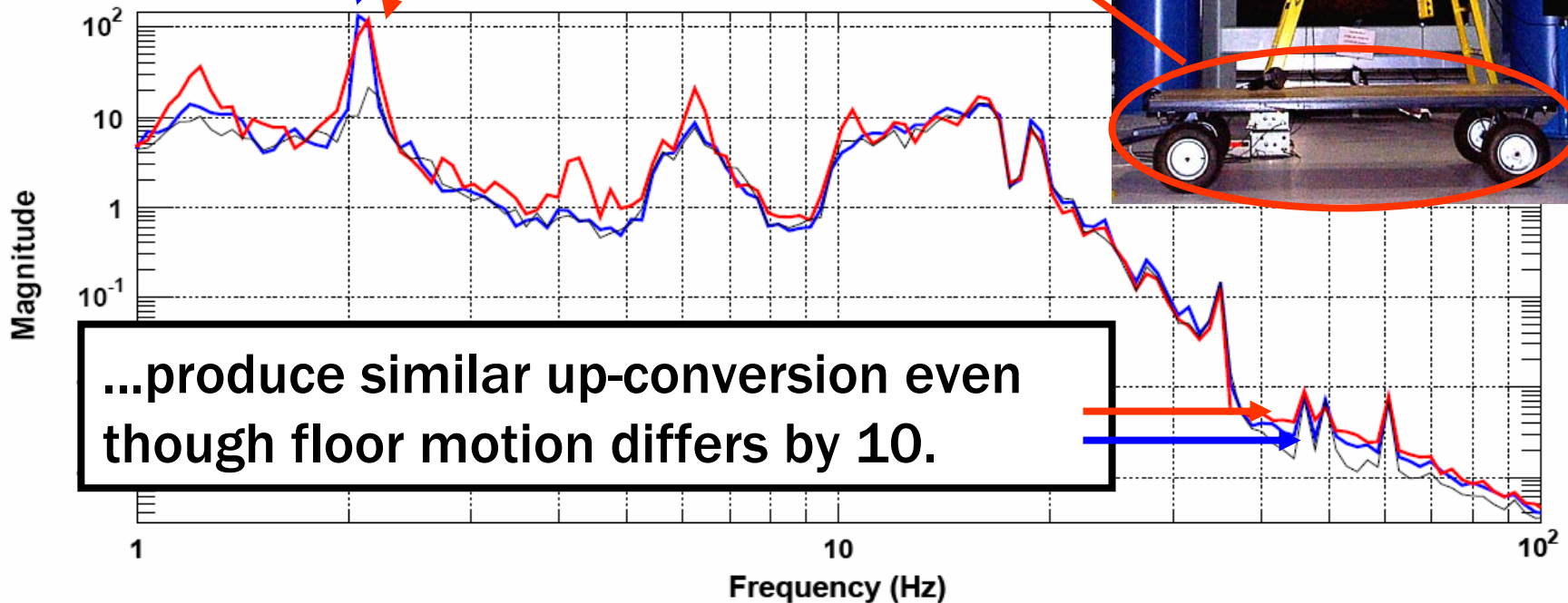
70-100 Hz band in AS\_Q showing up-conversion during wind and actuator injection.

# Up-conversion depends on stack motion not floor motion.

Small shaker on cross-beam  
and large shaker on floor  
adjusted to produce similar  
optic motion...



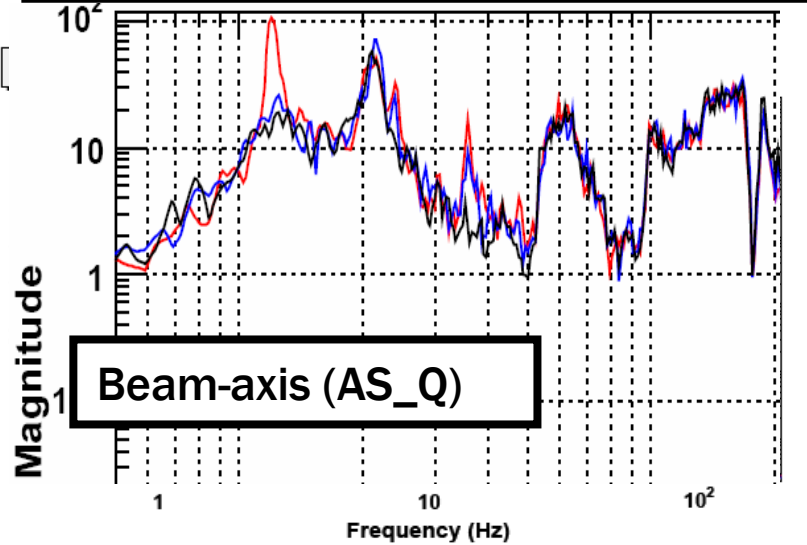
Red: large floor shaker, Blue: small shaker on cross beam, Black: normal



...produce similar up-conversion even  
though floor motion differs by 10.

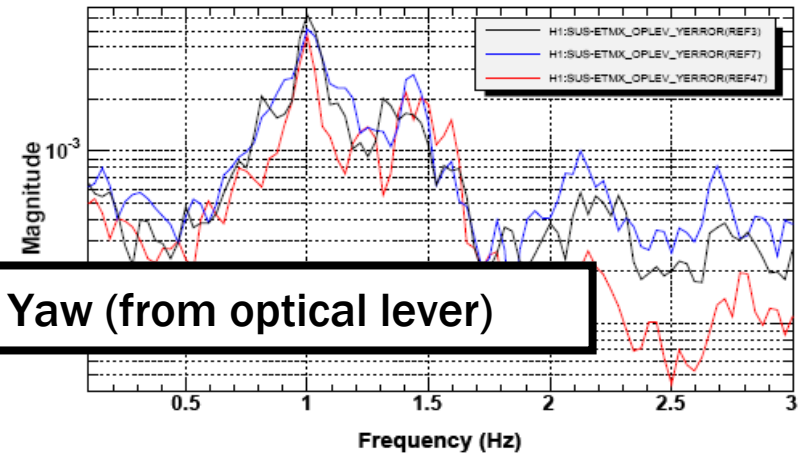
# Ground shaking to excite specific motions

**Red: mainly beam-axis; Blue: mainly side-to side; Black: no shaking**



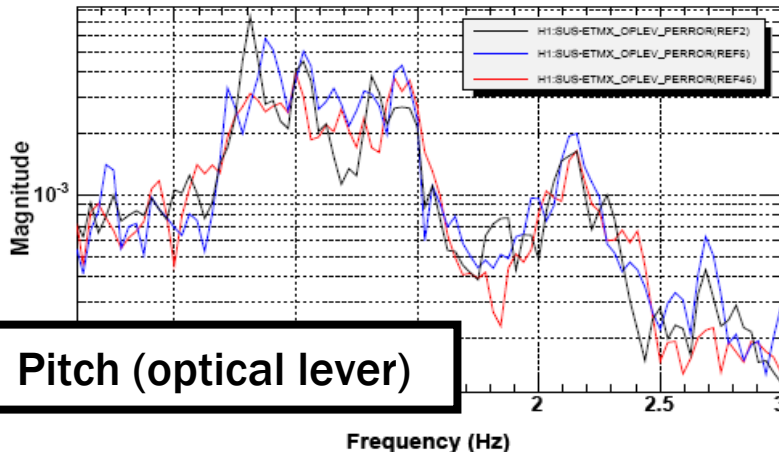
\*T0=03/06/2005 02:17:14 Avg=1/Bin=15L BW=0.0468742

**Yaw, same color scheme**



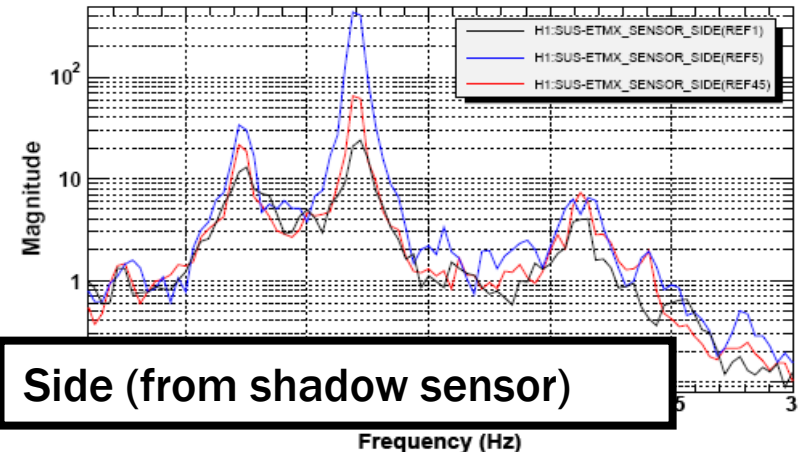
\*T0=03/06/2005 02:17:14 Avg=1 BW=0.0468742

**Pitch, same color scheme**



\*T0=03/06/2005 02:17:14 Avg=1 BW=0.0468742

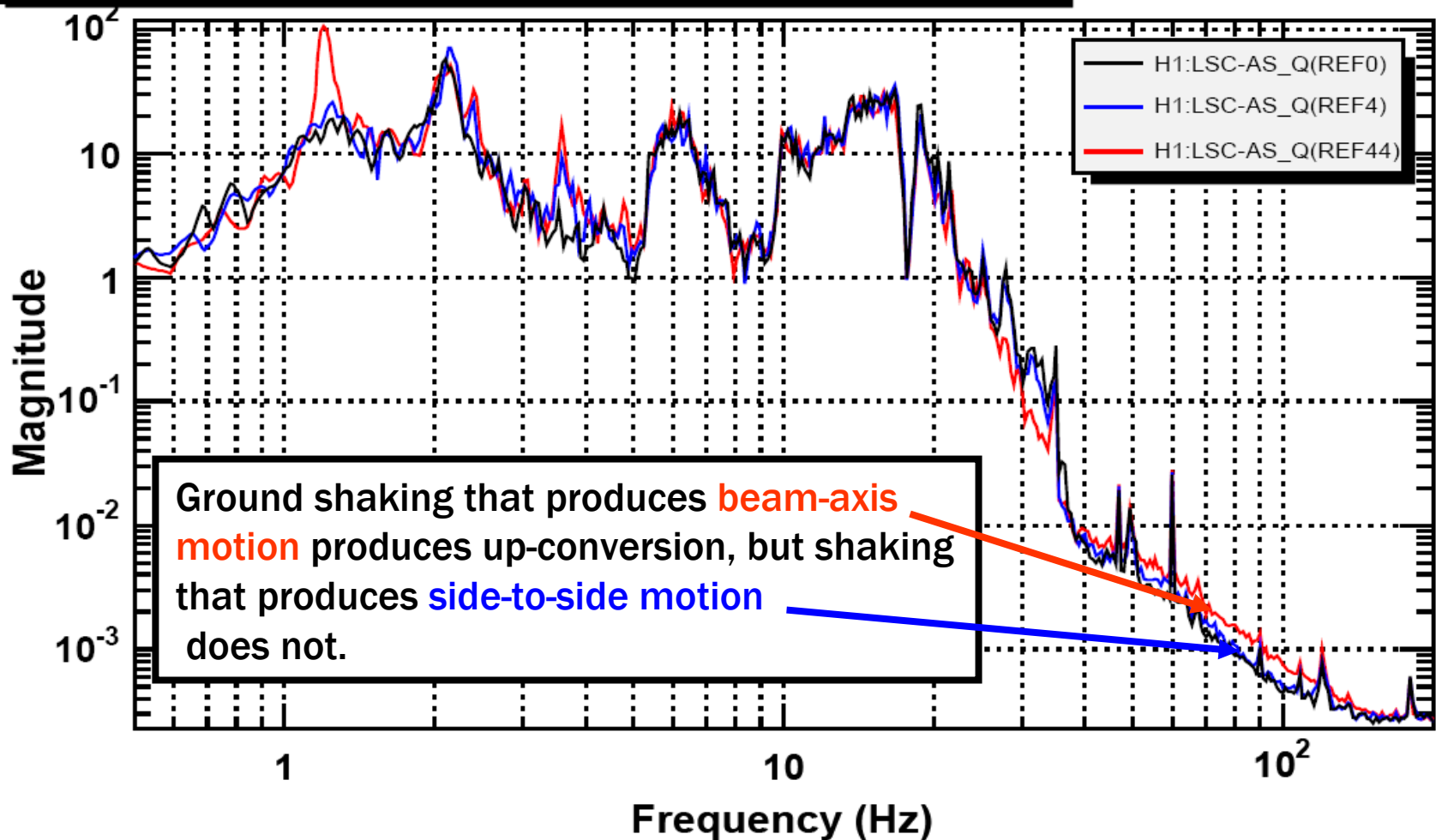
**Side, same color scheme**



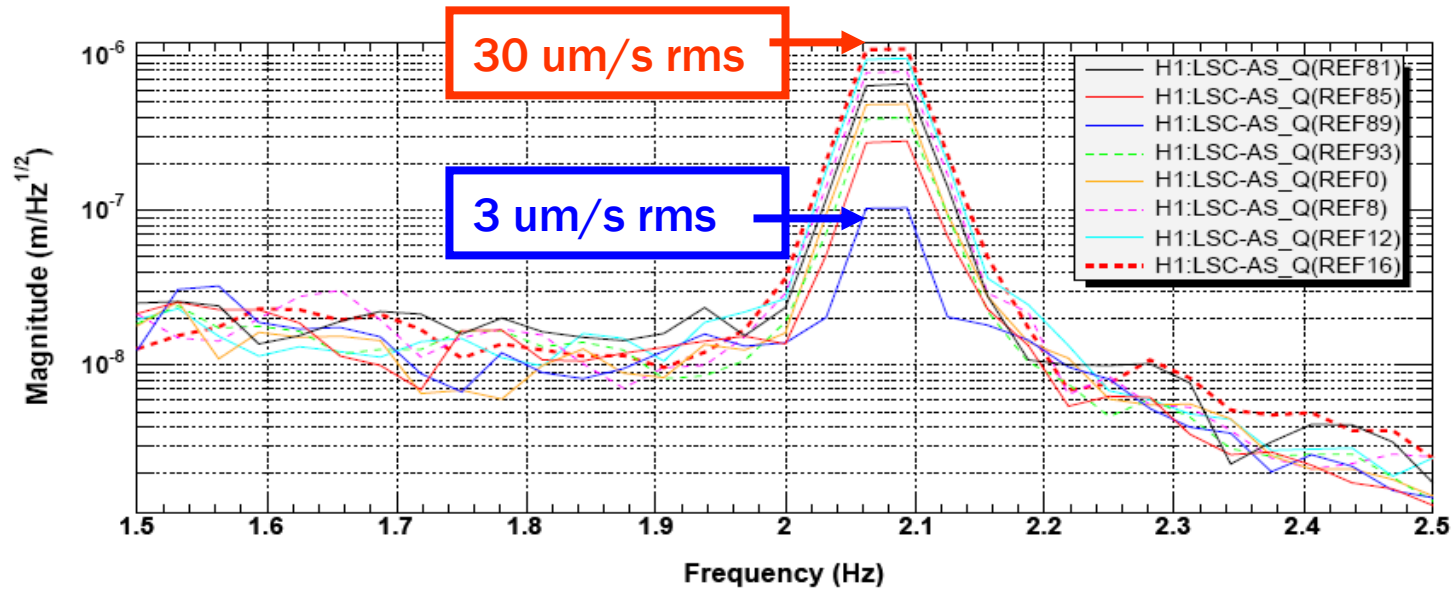
\*T0=03/06/2005 02:17:14 Avg=1 BW=0.0468742

# Side-to-side shaking does not produce up-conversion.

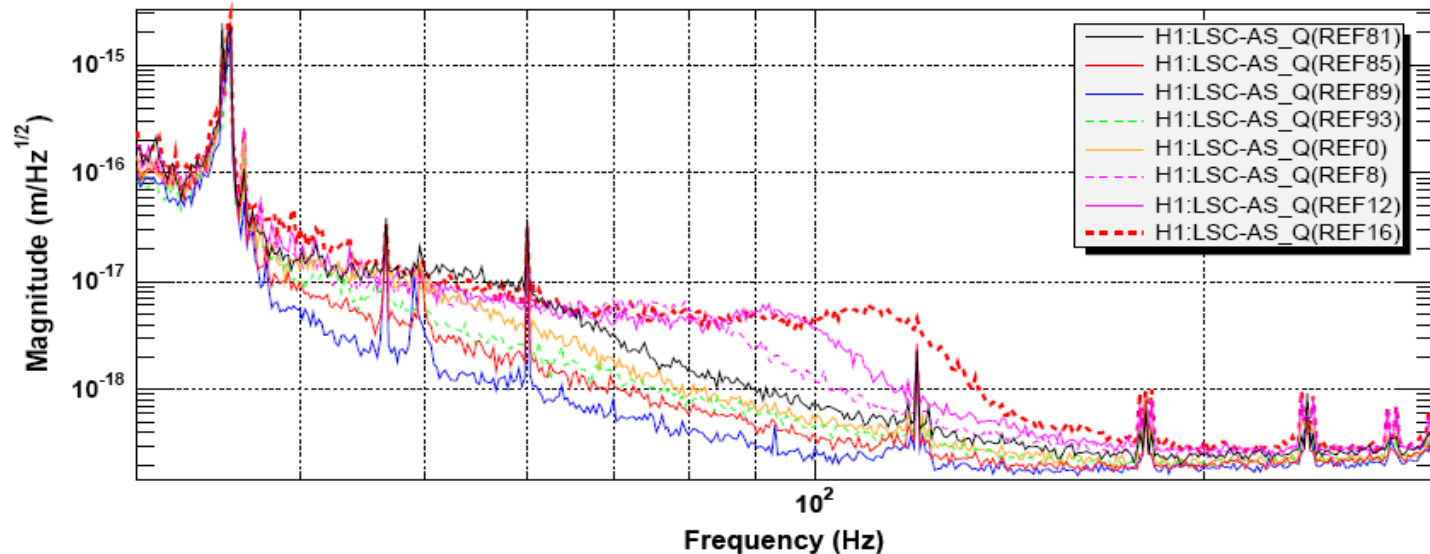
Black: no excite, Blue and Red: 1.2 Hz horizontal shaker at different positions



# Up-conversion for different shaking amplitudes

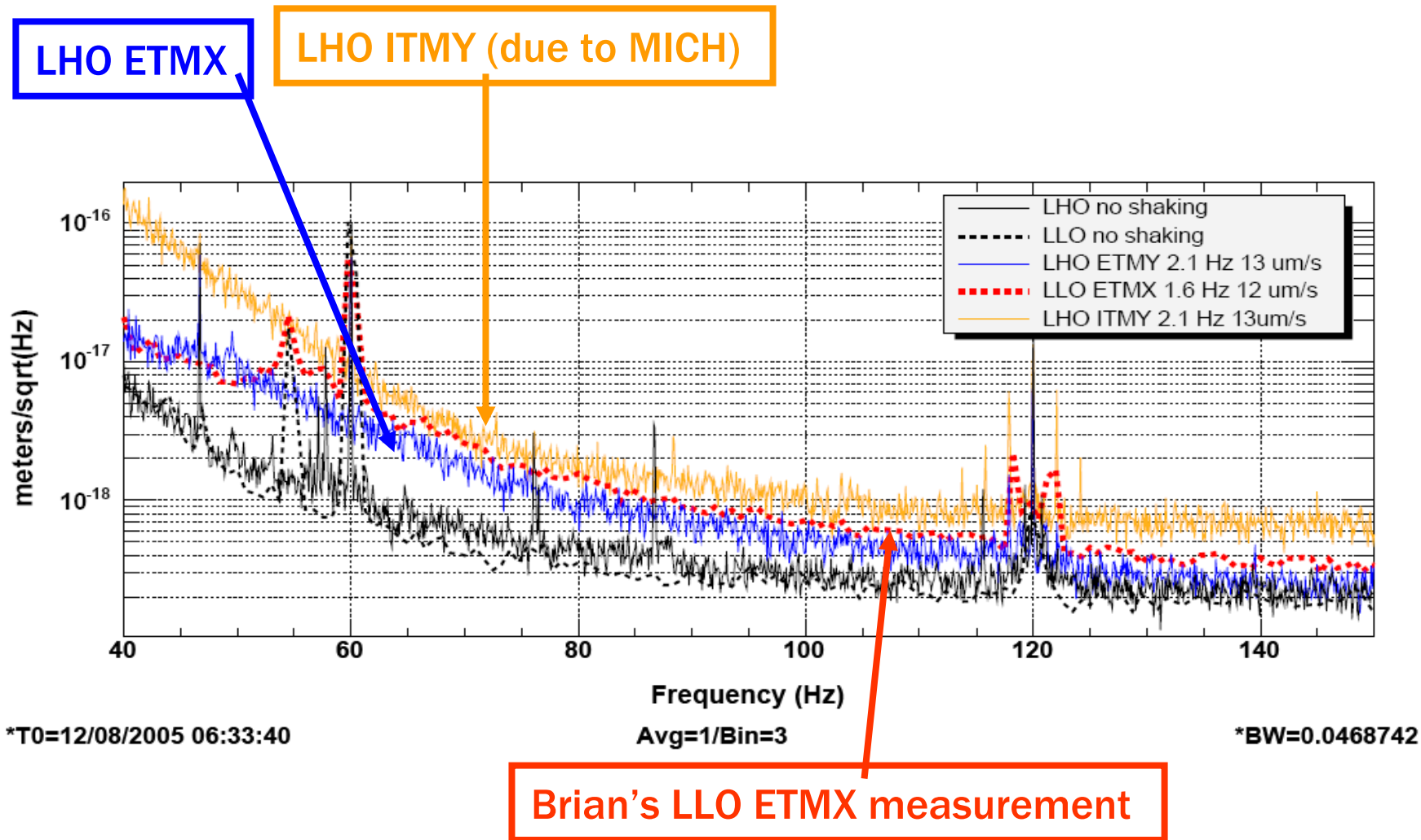


Power spectrum

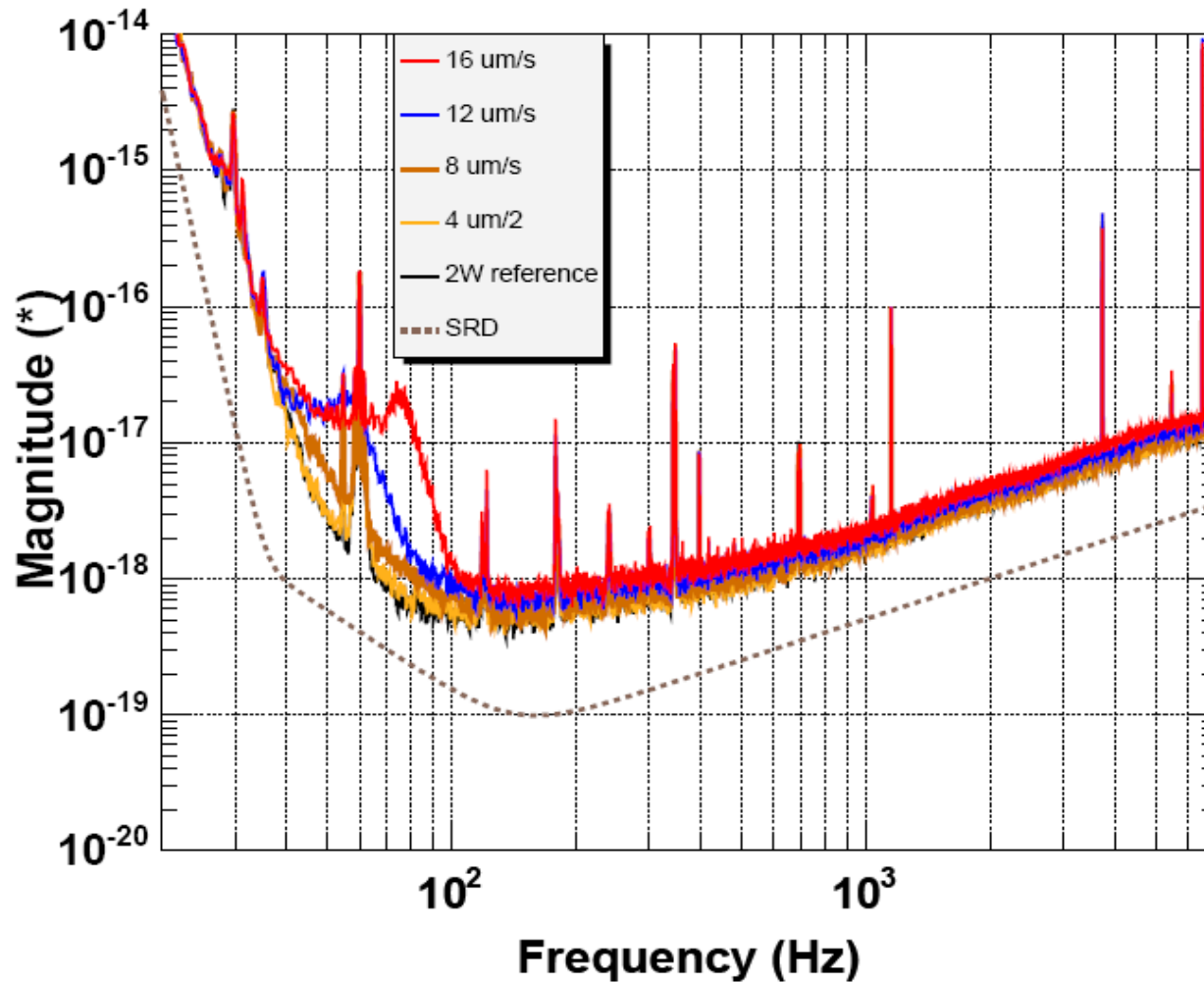




# Up-conversion similar at LHO ETMs; is it similar at ITMs and LLO at similar velocities?



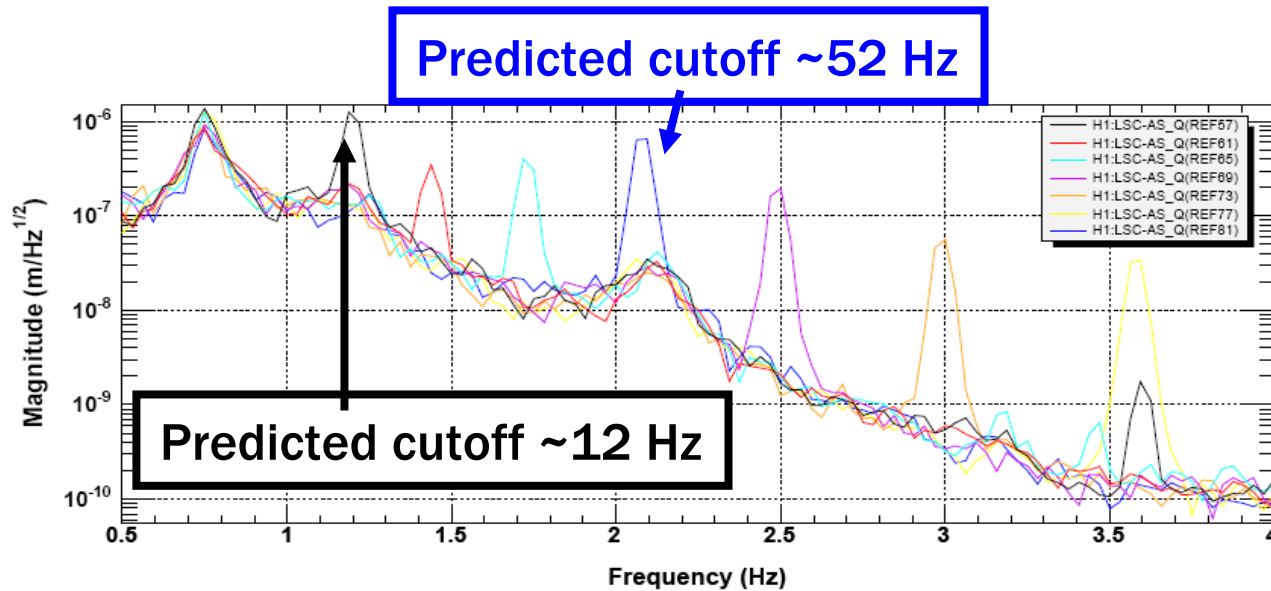
# Brian O'Reilly's recent LLO measurements



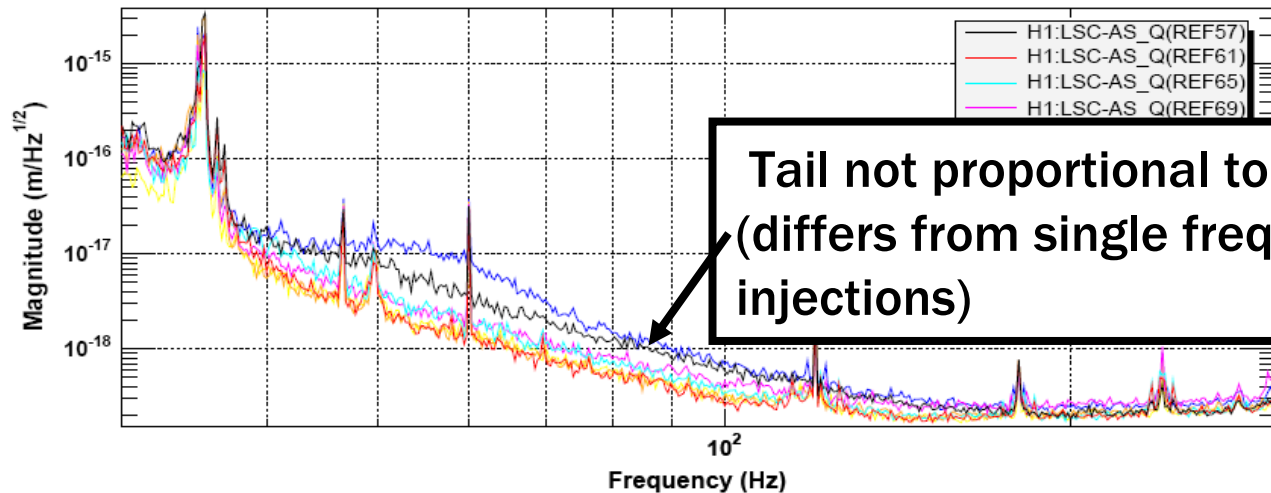
\*T0=16/08/2005 19:38:39 \*vg=1/Bin=2L

\*BW=0.374994

# Simple model doesn't explain tail

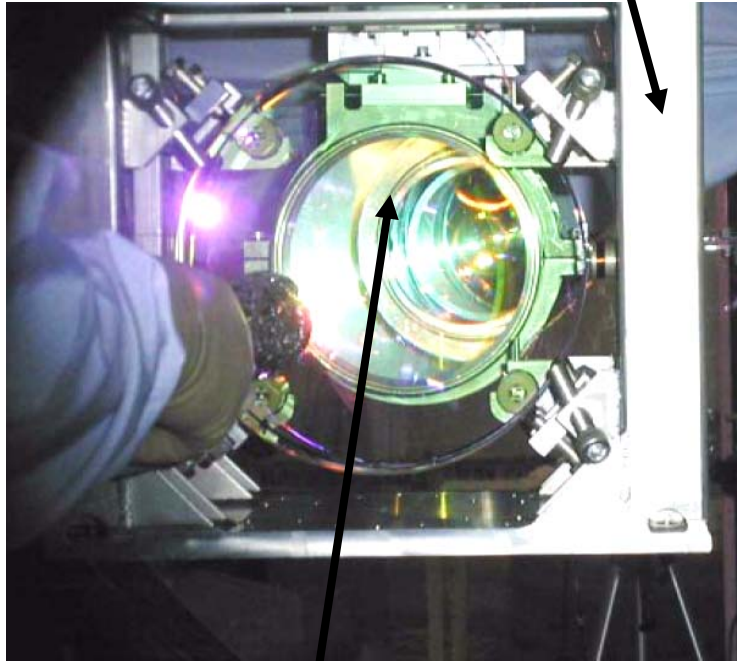


Power spectrum



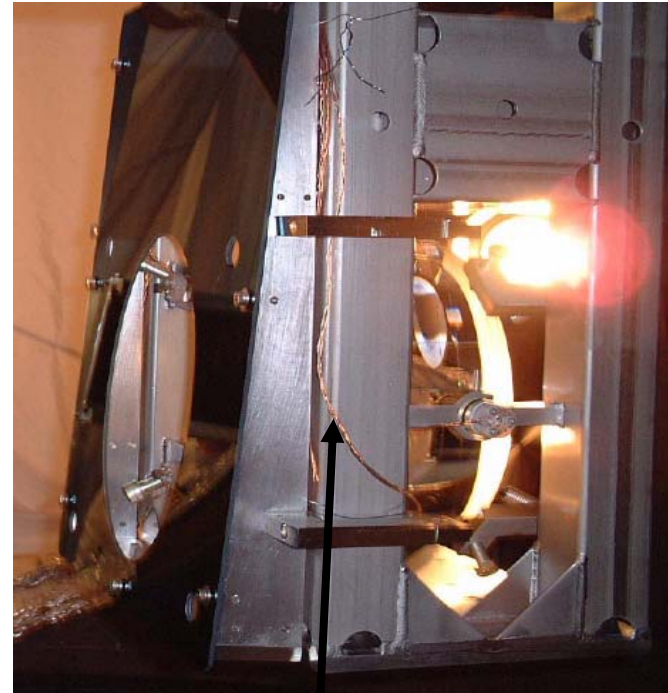
# Possible sources of up-conversion

back-scattering from optic-support structure – but why not also from BSC back wall?



back-scattering from output telescope: consistent with lack of up-conversion for side-to side

optic support wire at clamps



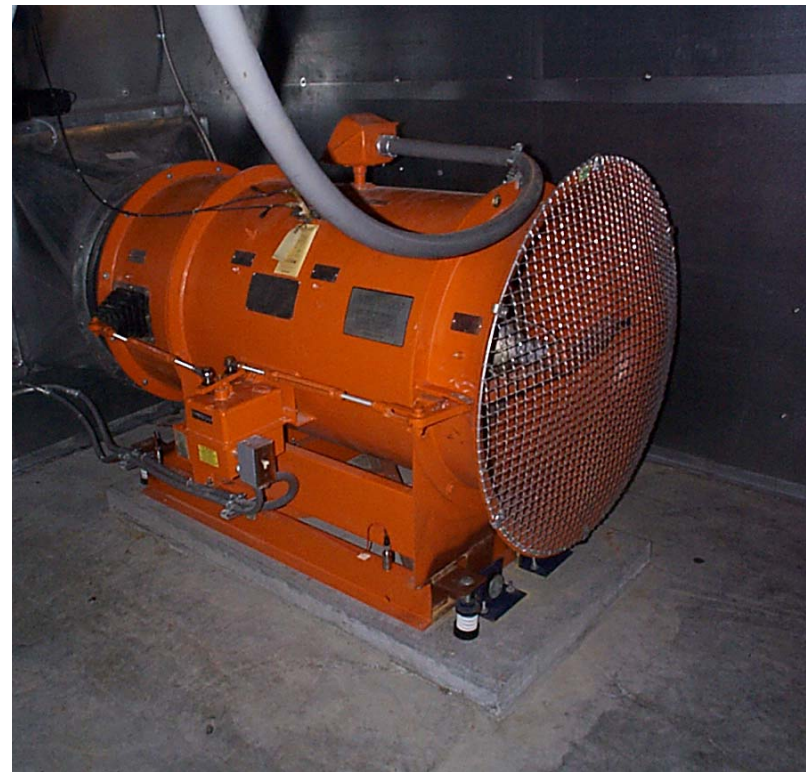
brushing cables on test mass support structure - not consistent with side-to side

# S4 H1-H2 coherence peak identification for stochastic group

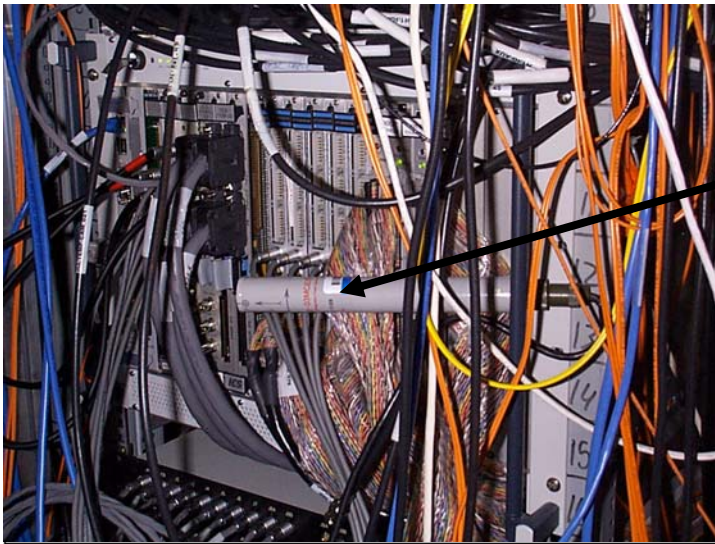
133 Hz: Neslab PSL chillers



330 Hz HVAC turbine SF01



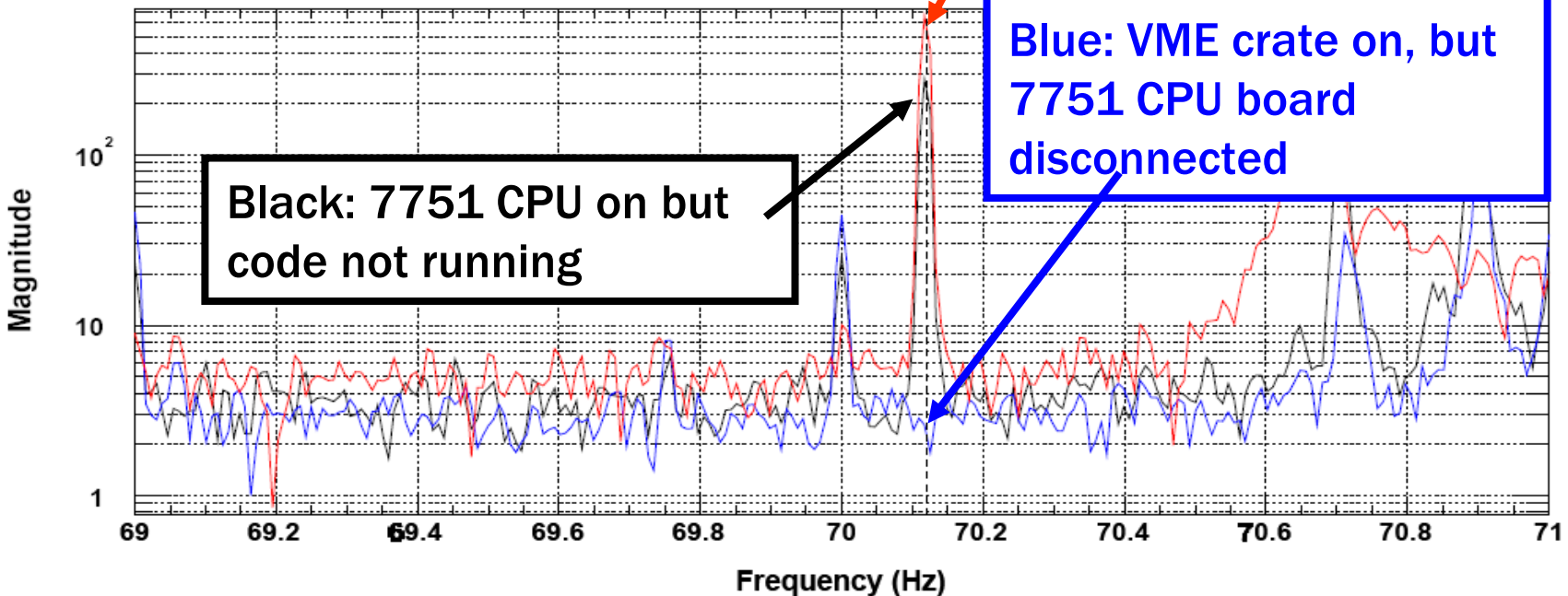
# Pulsars in VME crates (harmonics of 70.12 Hz)



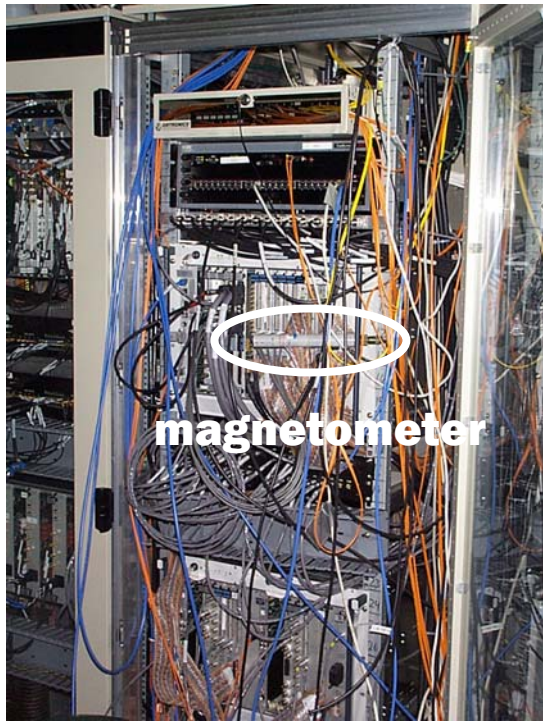
magnetometer near VME crate detects pulsar candidate frequencies. Magnetometers elsewhere don't.

Red: normal operation of VME crate

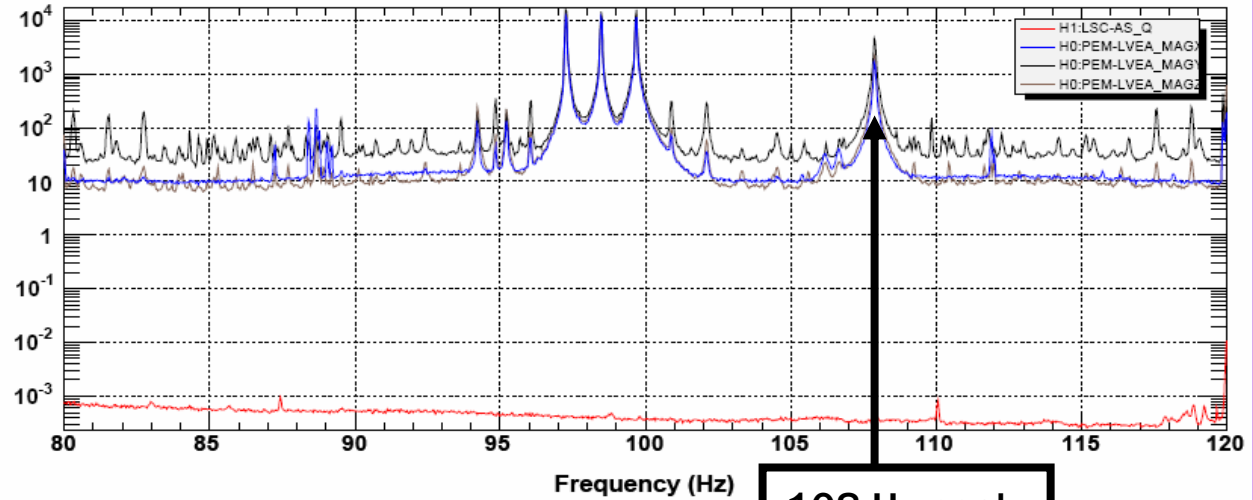
LACK: CPU on but code not running



# Coherence between AS\_Q and VME magnetometer

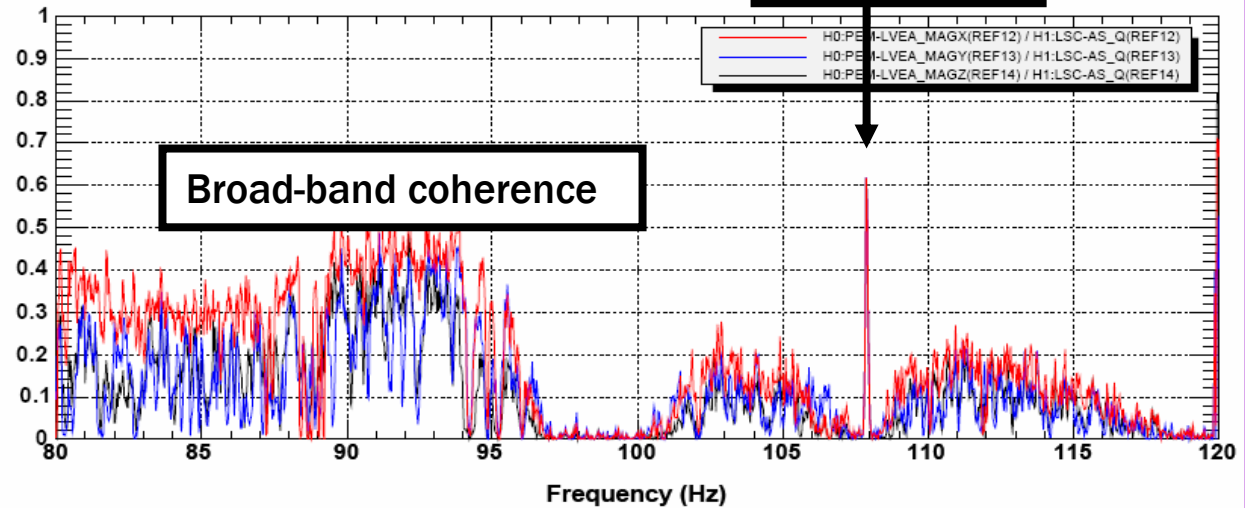


top traces: magnetometer signals from h1dsc13, bottom trace: AS\_Q



coherence between AS\_Q and a magnetometer at h1dsc13

108 Hz peak



Broad-band coherence

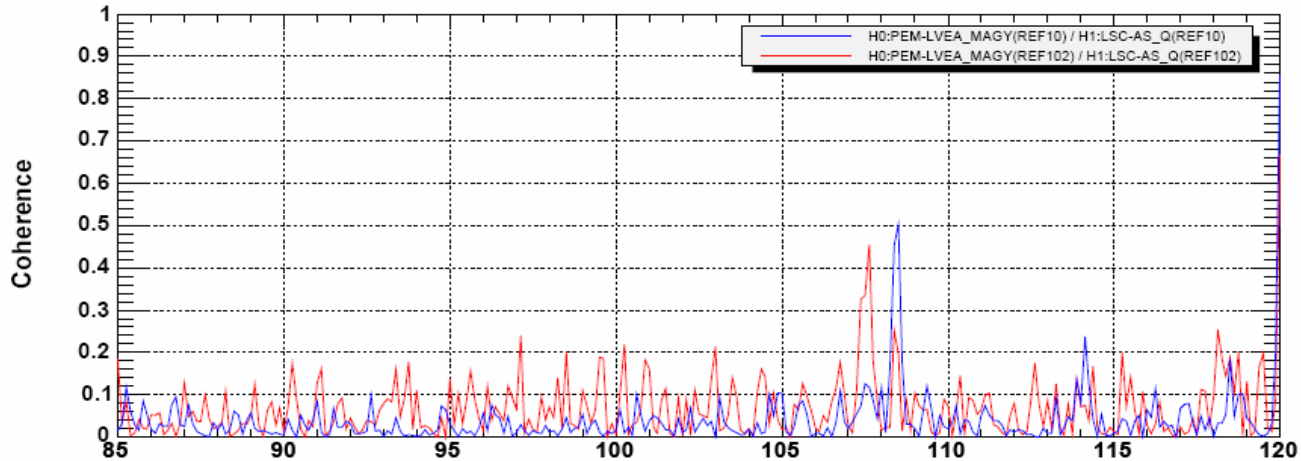
T0=15/05/2005 07:30:25

Avg=1

BW=0.046874

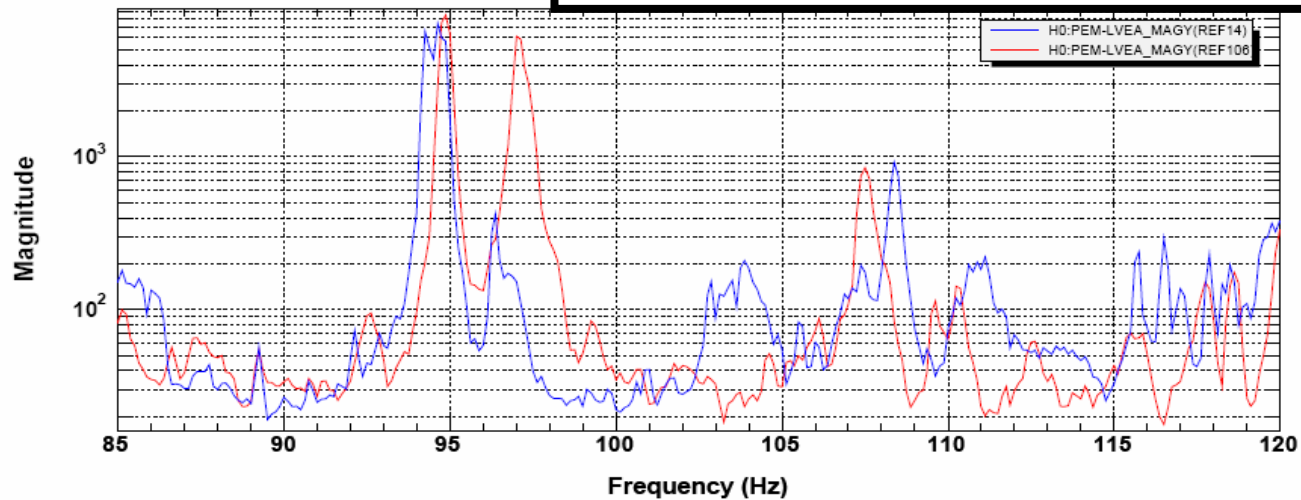
# 108 Hz peak moves with air-flow to fans

blue: normal air flow, red: extra air flow, top plot: AS\_Q-magnetometer coherence



magnetometer

Blue: normal air; Red: extra air



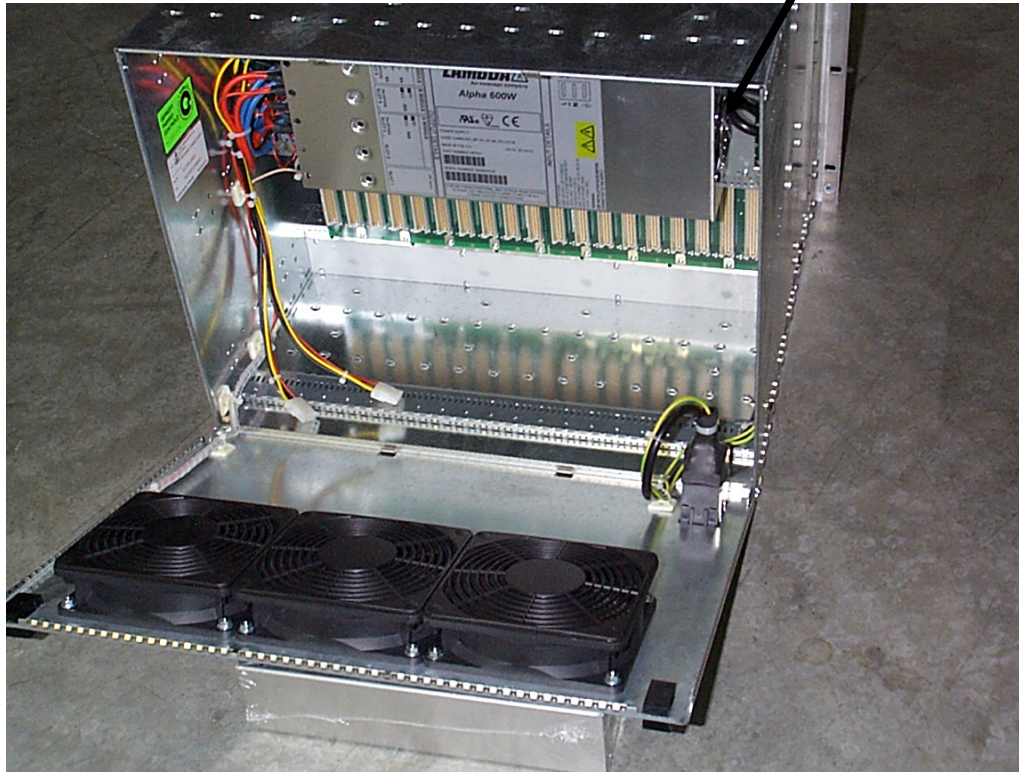
\*T0=10/06/2005 23:55:20

Avg=1

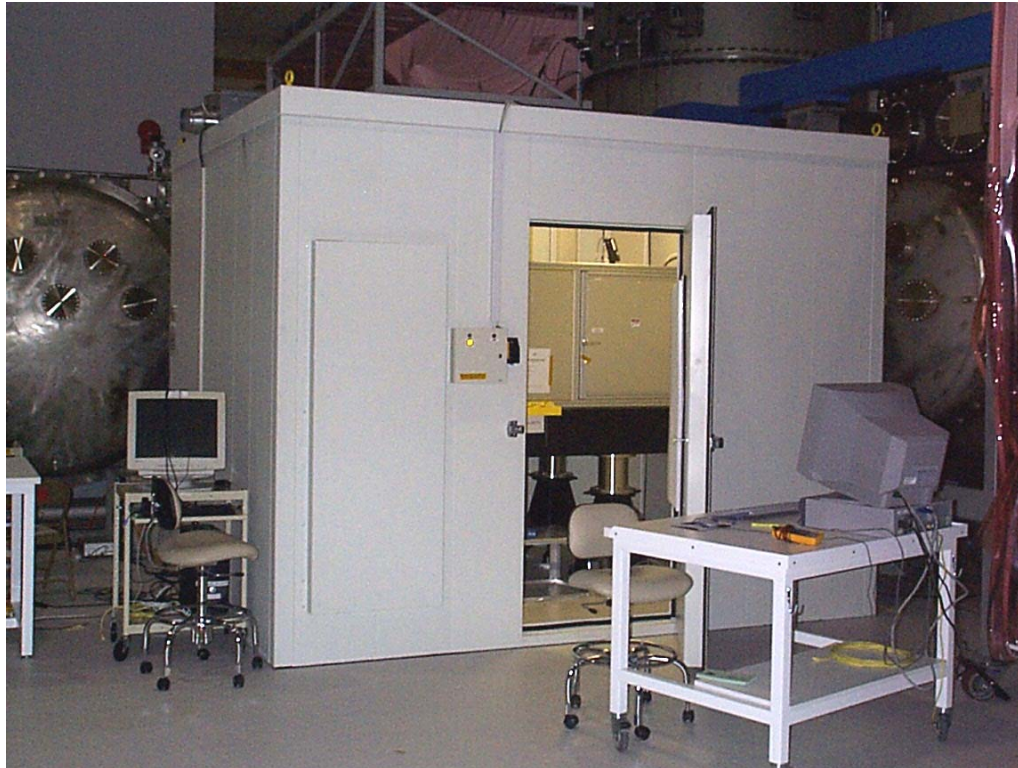
BW=0.187499



**108 Hz peak goes away when power supply fan disconnected.**



# Acoustic enclosures for LHO reflected port by S5

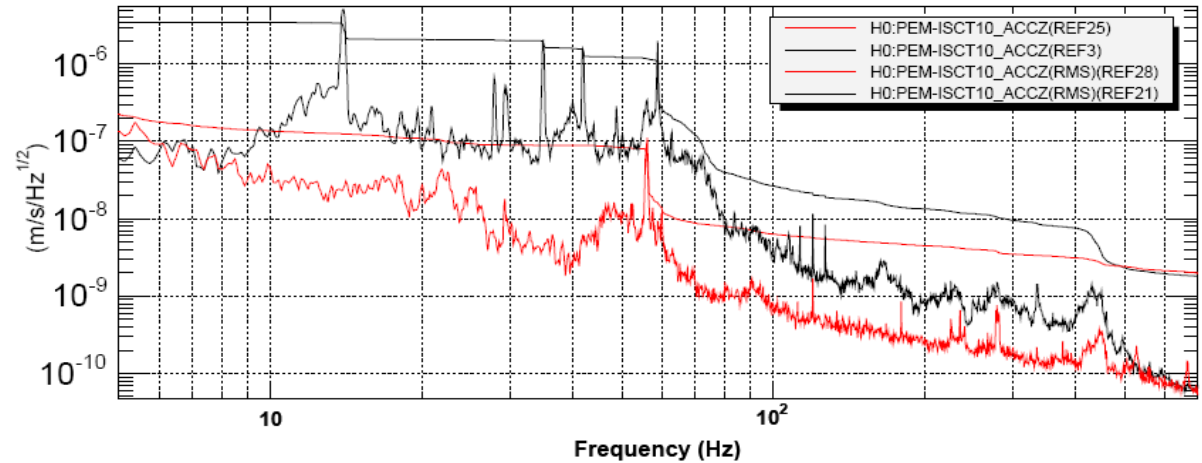


Acoustic coupling at ISCT4 was reduced beyond expectations, making it worth while to enclose what was the second worst coupling site – the reflected port. We have also ordered an enclosure for the H2 REFL port, though we don't expect improvement.

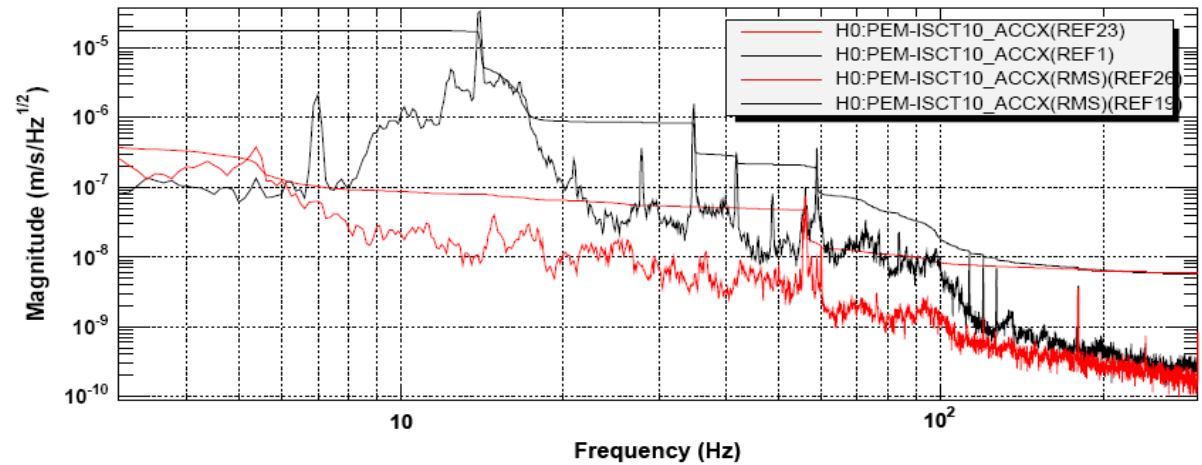
# ISCT10 floated yesterday, velocity down more than 10



Black: before , Red: float, Z axis



Black: before, Red: float, X axis



\*T0=16/08/2005 08:00:26.009277

Avg=8

BW=0.187499

# Summary

## **I. Seismic Up-conversion**

- a. several types, focus on the anthropogenic type characterized by b.**
- b. not reproduced by DARM injections**
- c. not produced by side-to-side motions; possibly not by yaw (n=1)**
- d. looks like back-scattering, at least at large amplitudes**
- e. similar at LHO ETMX and ETMY, as well as LLO ETMX, MICH noise dominates LHO ITMY**
- f. at least at LHO noise starts showing up at a few times background, which is not atypical of seismic transients**

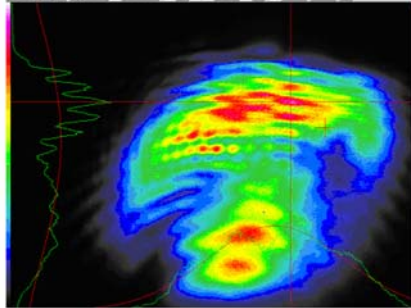
## **II. Peak identification**

- a. 70.12 from crate controller**
- b. 108 from crate power supply fan**
- c. 133 from chiller**
- d. 330 from HVAC turbine**

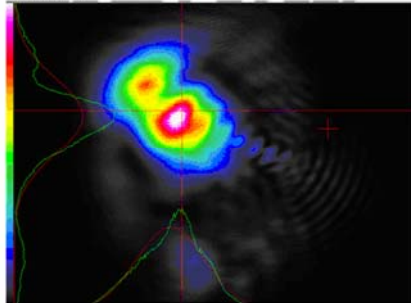
## **III. Acoustic/seismic mitigation**

- a. acoustic enclosures for LHO dark port are on their way**
- b. H2 dark port is now floating – more than 10 reduction in velocity, should reduce H1-H2 coherence, range increased 0.5 Mpc**

H1-detect



H2-detect



H2-detect same attenuation as for H1

