

S4 Environmental Disturbances

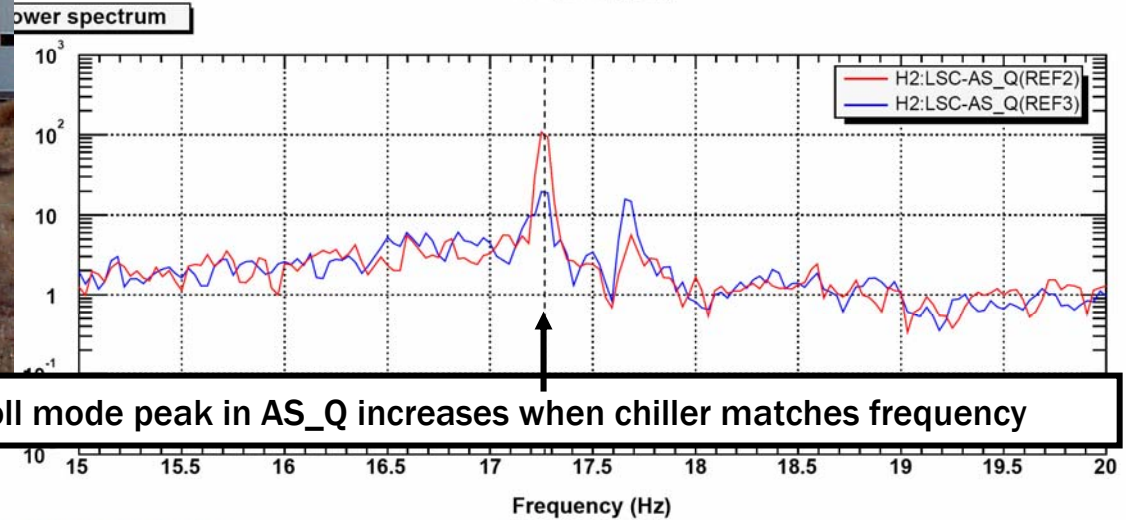
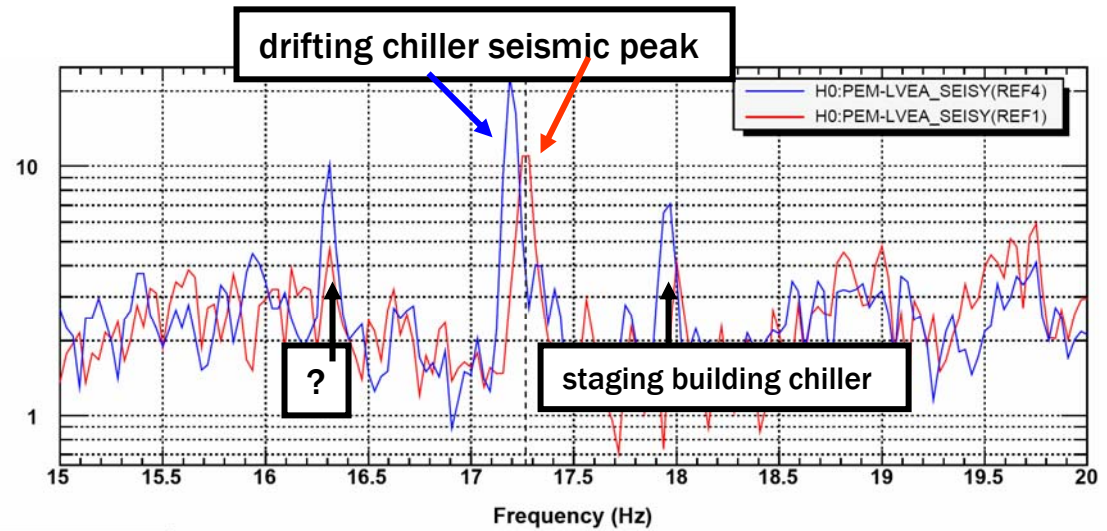
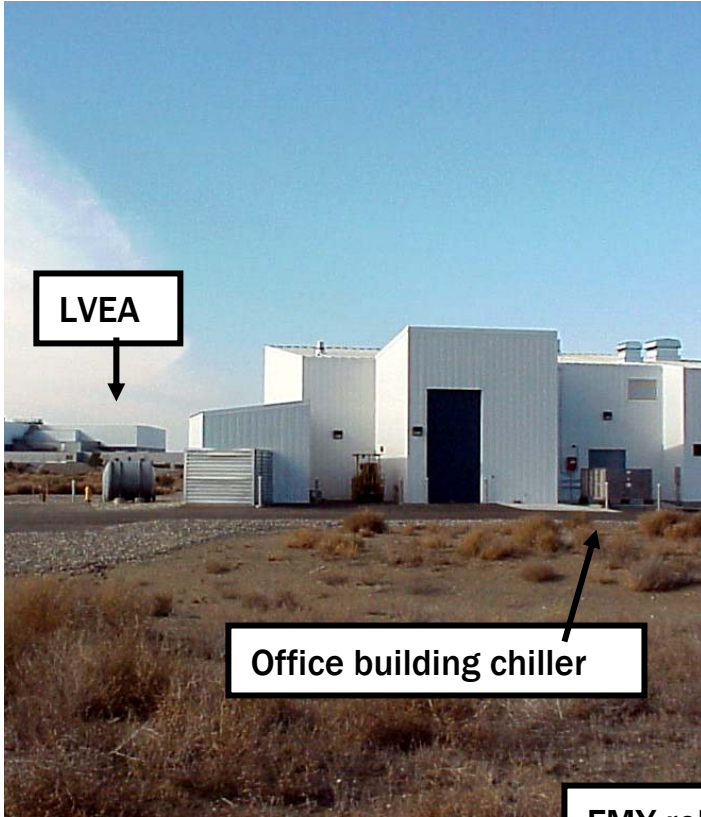
Robert Schofield, U of O

John Worden, Richard McCarthy, Doug Cook, Hugh
Radkins, LHO

Josh Dalrymple, SU

- I. Pre-S4 “fixes”
- II. Some S4 veto issues
- III. Early coupling results from S4 PEM injections

In E12, H2 AS_Q was dominated by FMY roll mode when excited by chiller



*T0=13/02/2005 15:37:31

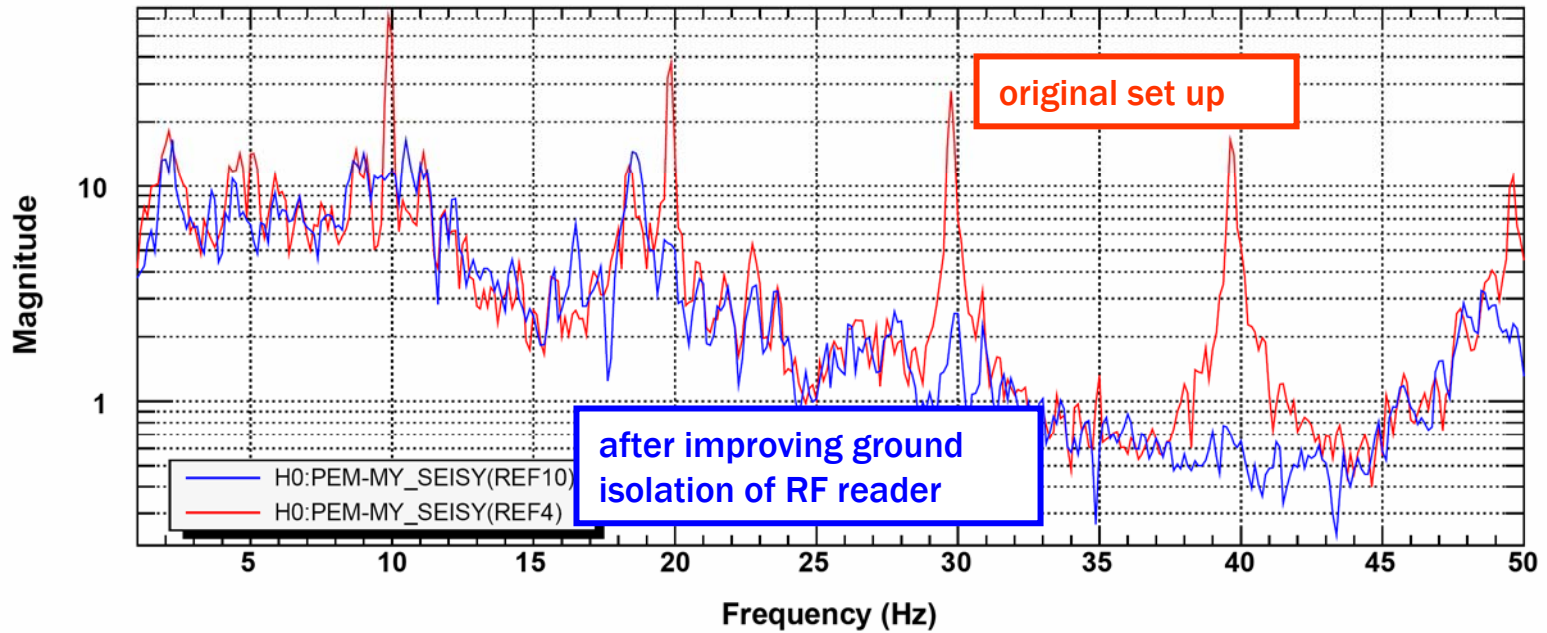
*Avg=133

BW=0.046874

Solution: resonant gain at FMY roll mode, seismic isolation of chiller.
D.Q. flag for 10-100 Hz glitches produced by 16 Hz?

10 Hz seismometer (etc.) peaks from RF card reader

Power spectrum



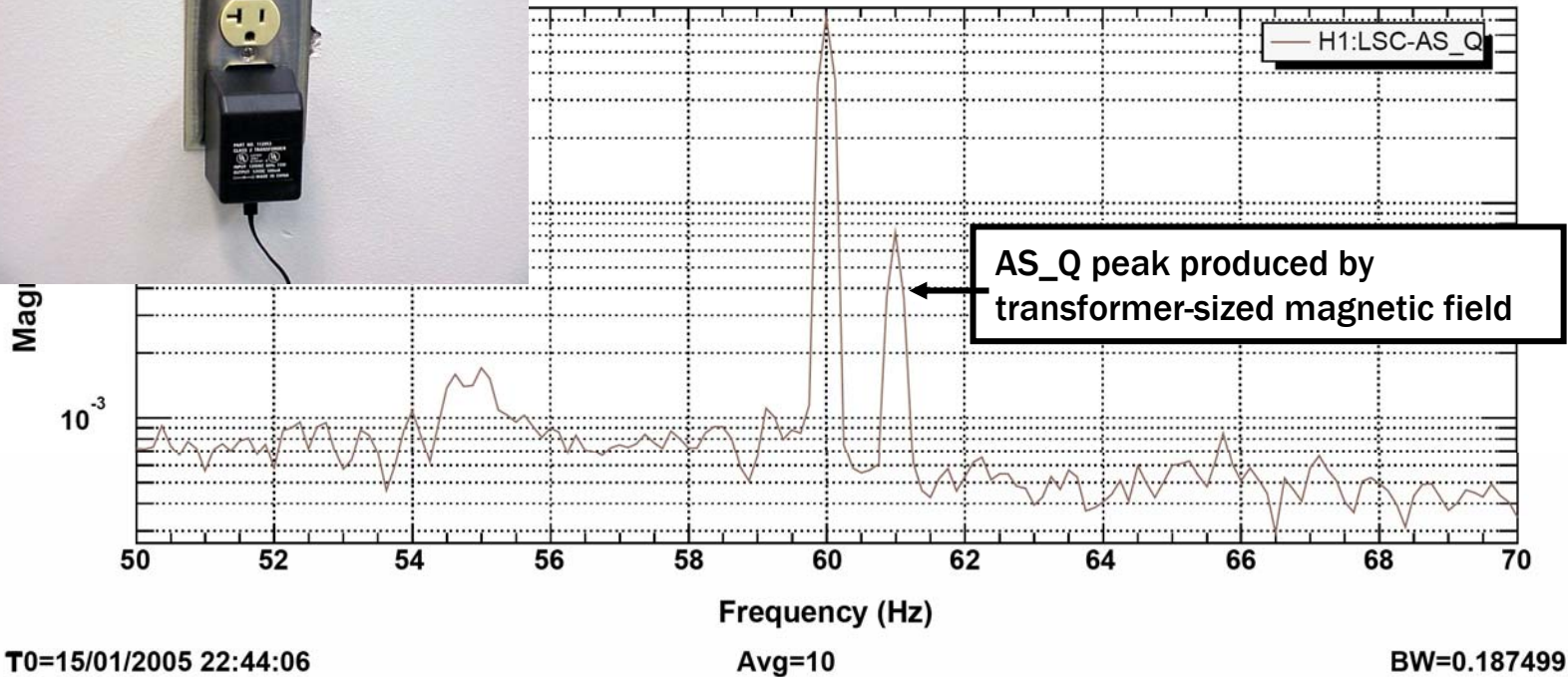
*T0=11/10/2004 22:14:44

Avg=1

BW=0.1875

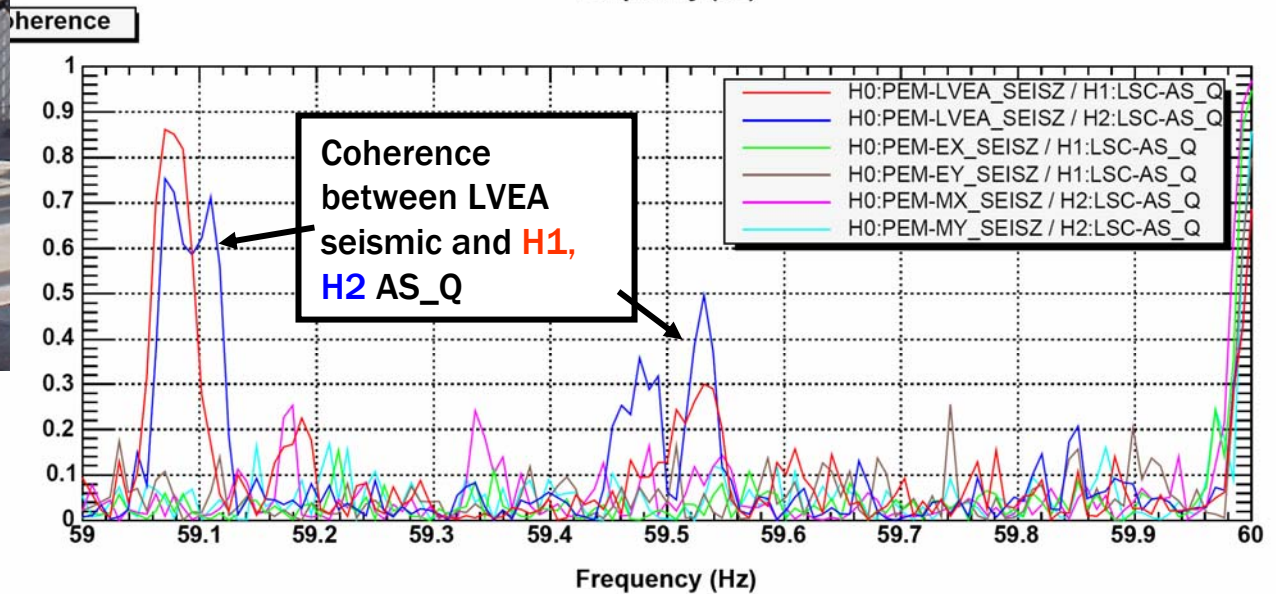
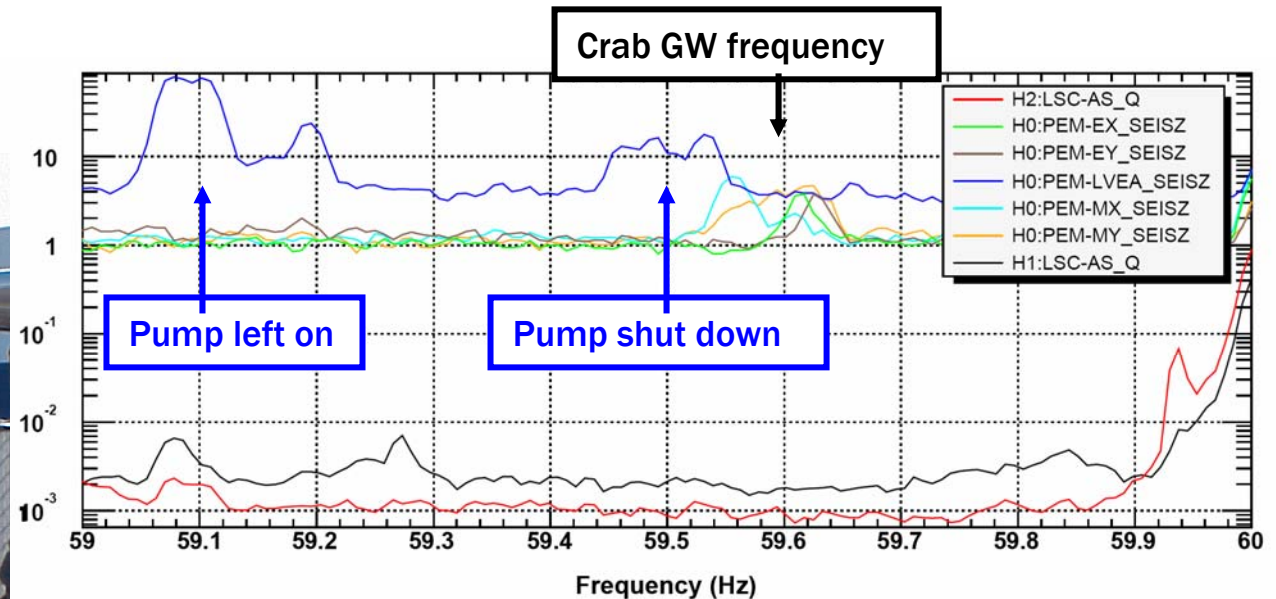


Transformers near test-masses contribute to 60 Hz AS_Q peak

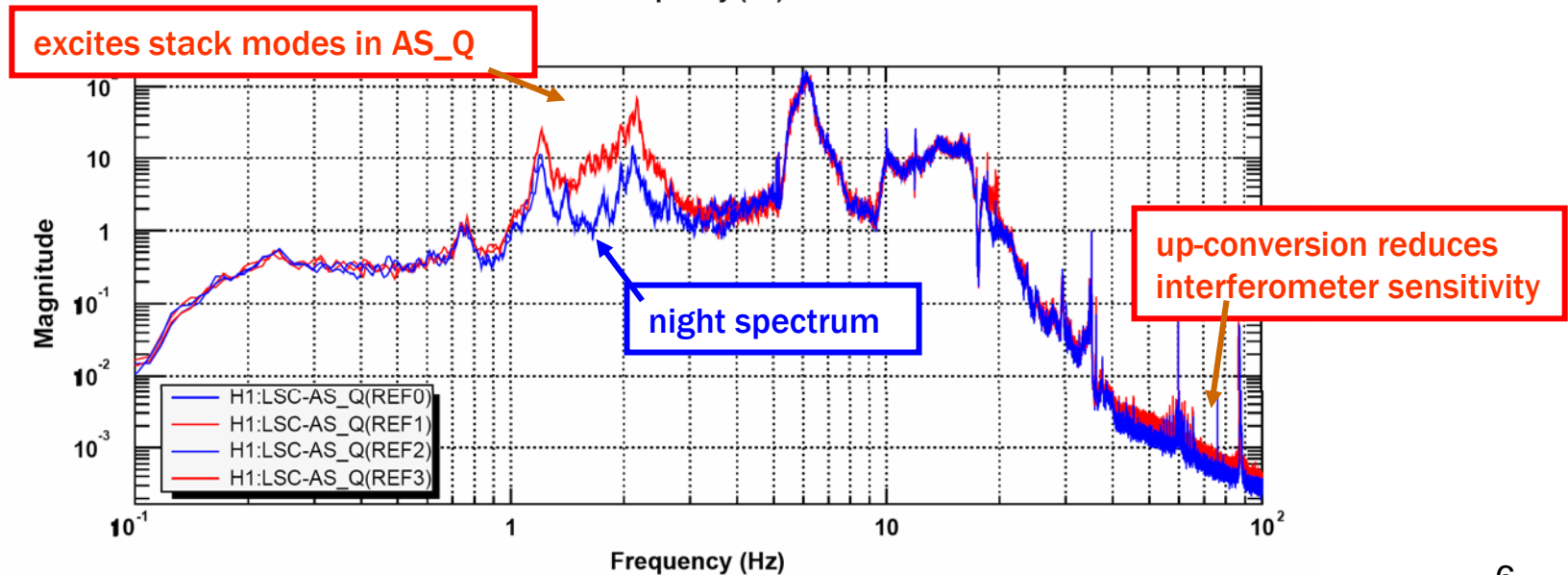
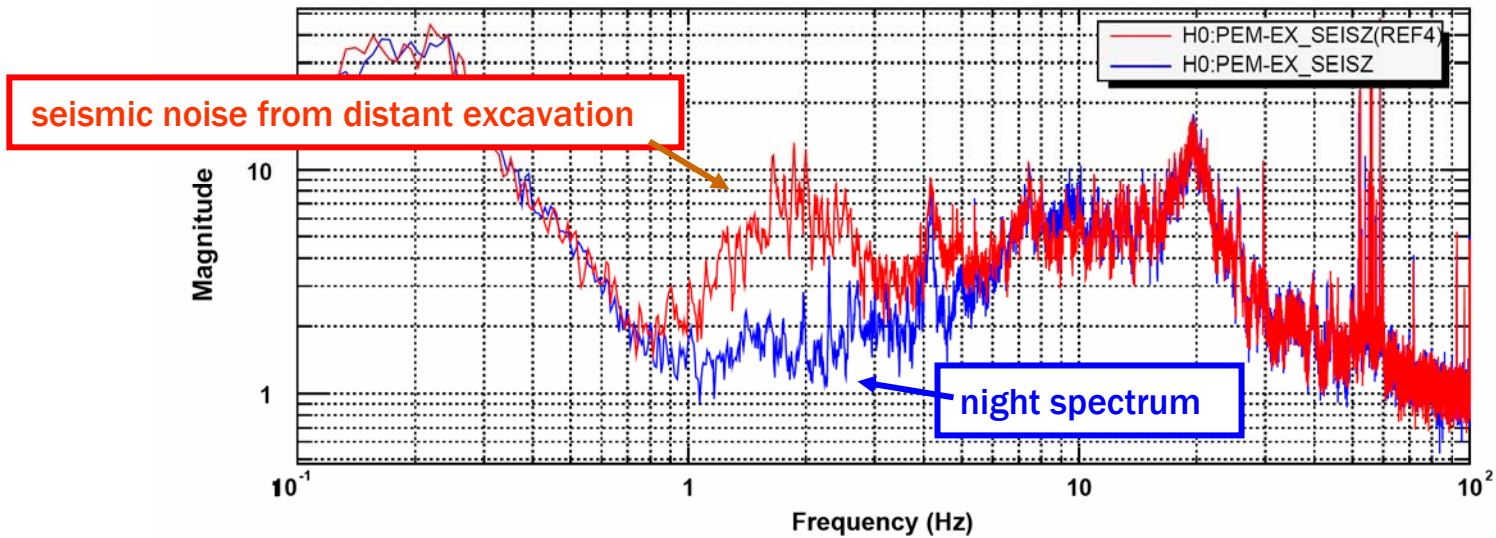


Recommendation: keep transformers at least 15 feet away from chambers (annulus ion pumps?).

Protecting sensitivity to the crab pulsar

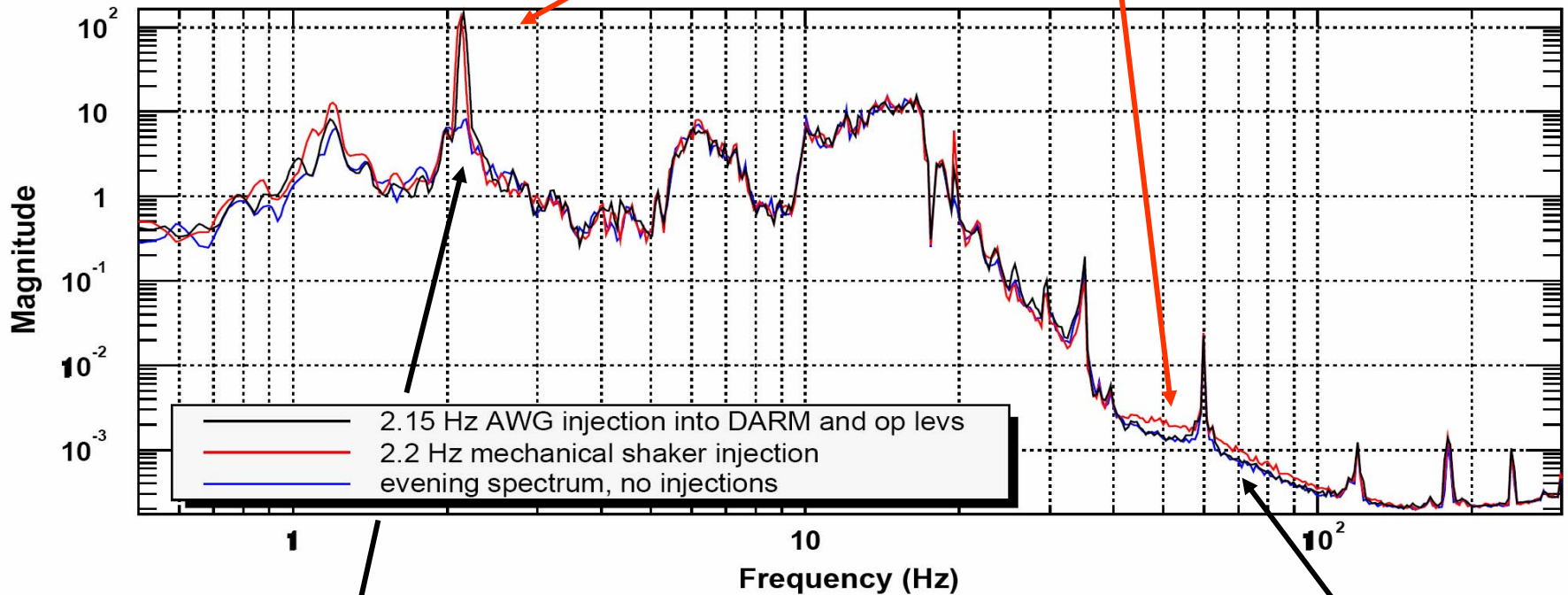


Up-conversion of low frequency seismic noise



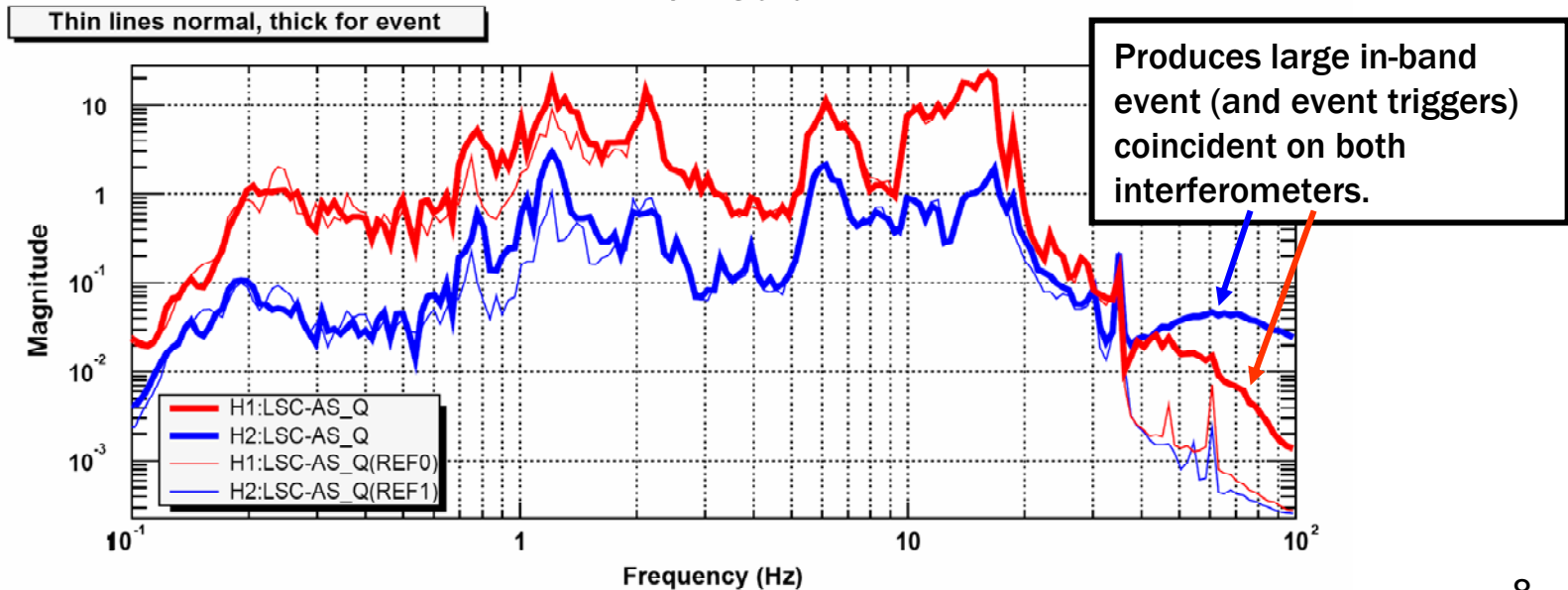
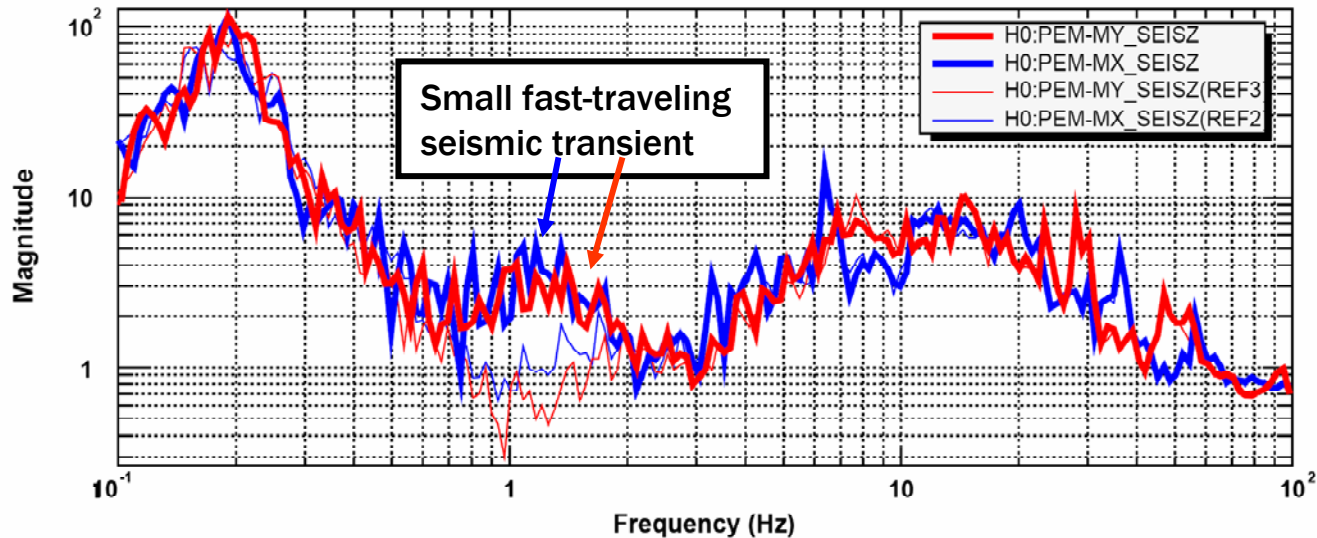
Up-conversion experiments

Mechanical shaker at EX produces up-conversion in AS_Q

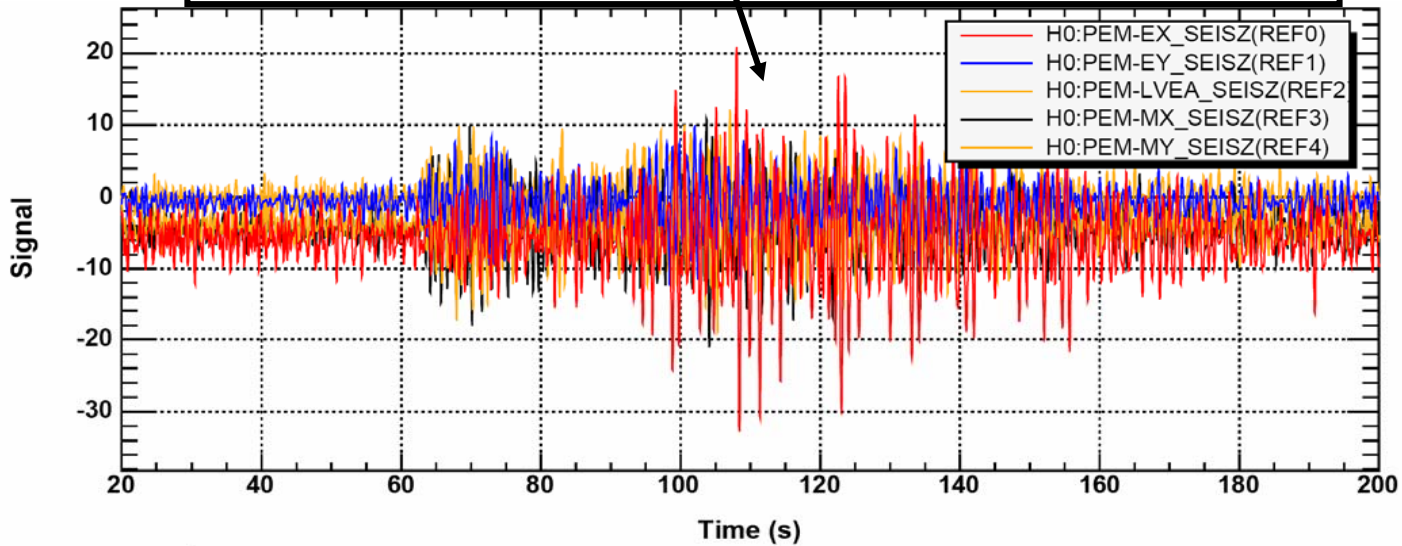


But matched injection into DARM and optical lever servo (pitch and yaw) does not produce up-conversion. This suggests that up-conversion is not produced in servo systems or by optic motion.

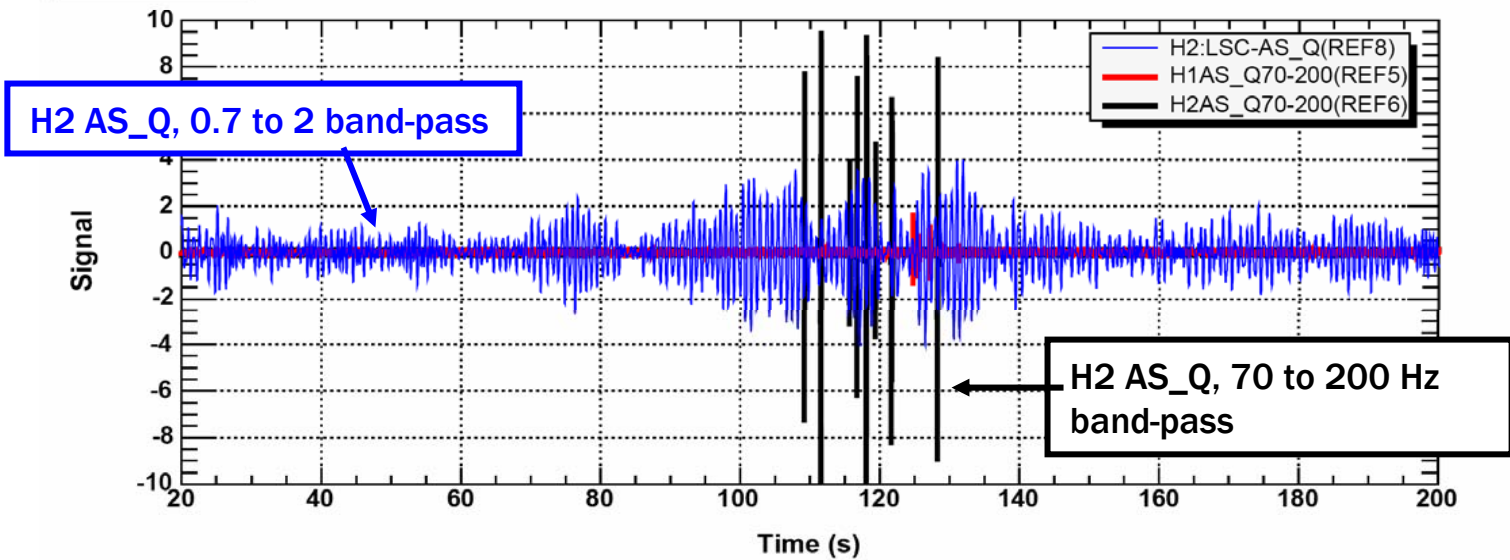
Up-conversion of low frequency seismic transients



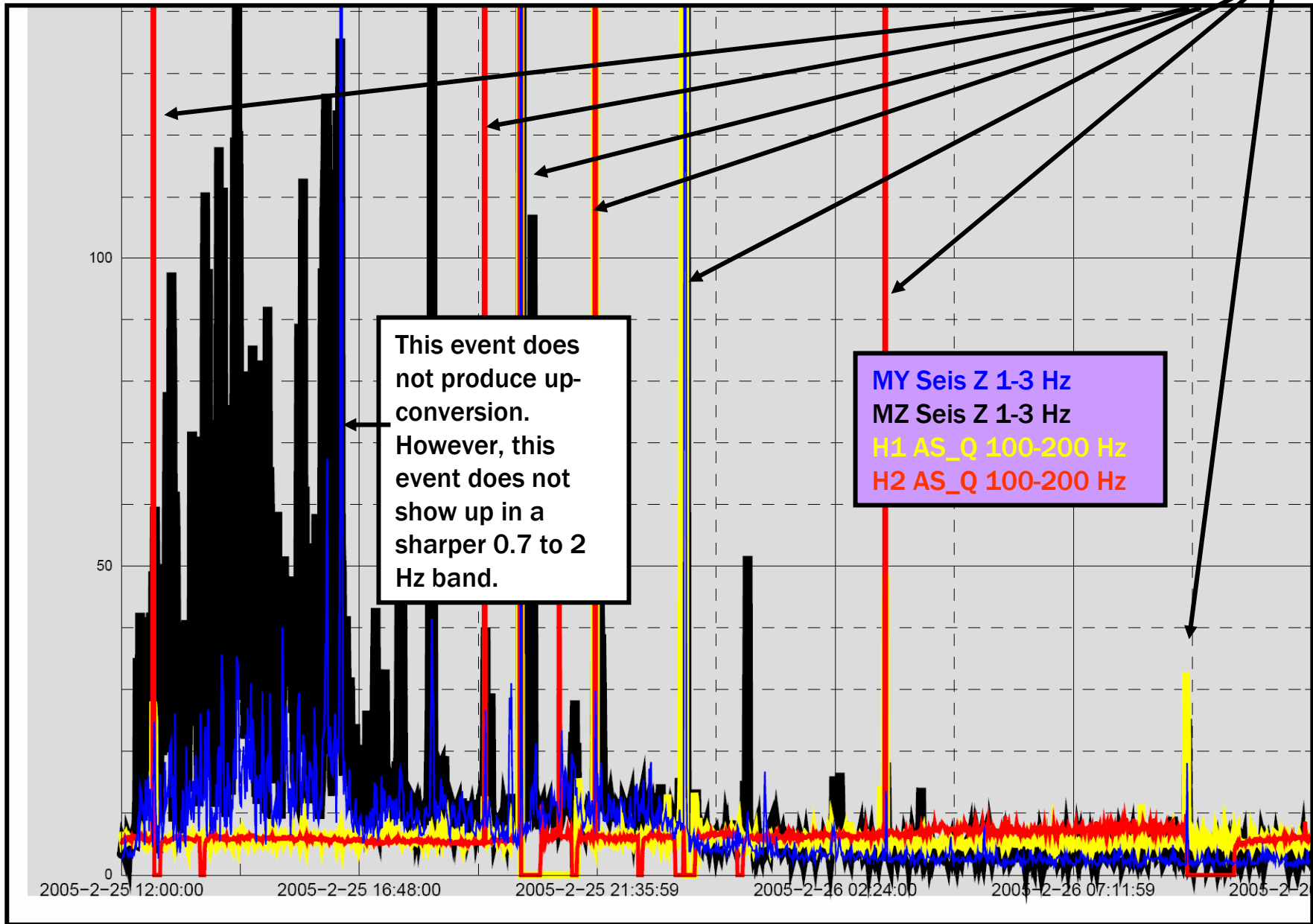
time series of same transient, 0.7 to 2 Hz steep band-pass,
seismometers at all stations



Time series



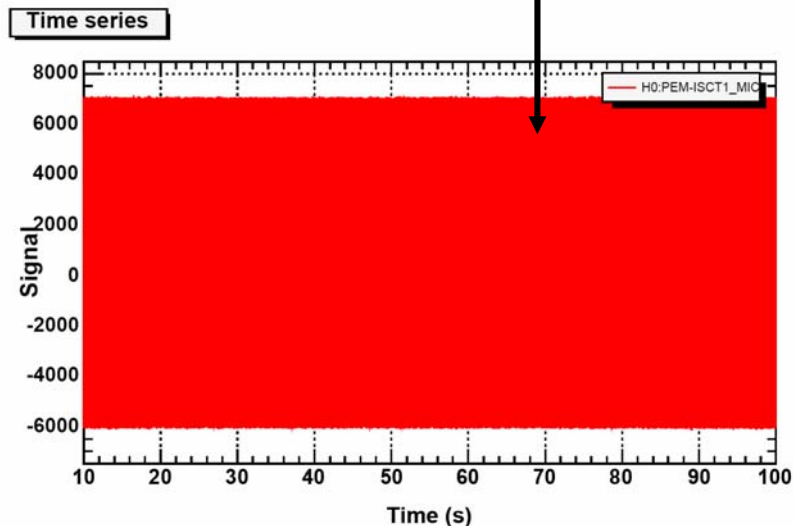
Coincident 1-3 Hz seismic, and 100-200 Hz AS_Q spikes



Why are airplanes signals so bursty in AS_Q?

Continuous acoustic sources can produce 5x bursts in AS_Q.

Microphone signal (BP) from sound injection at REFL port

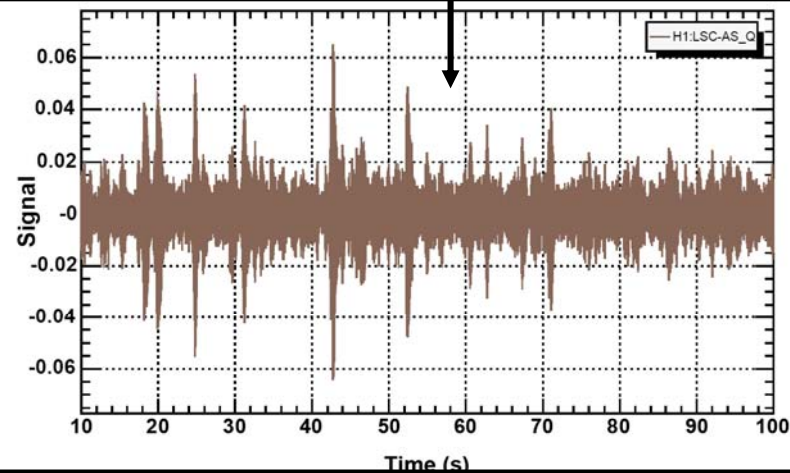


T0=05/12/2004 04:50:59

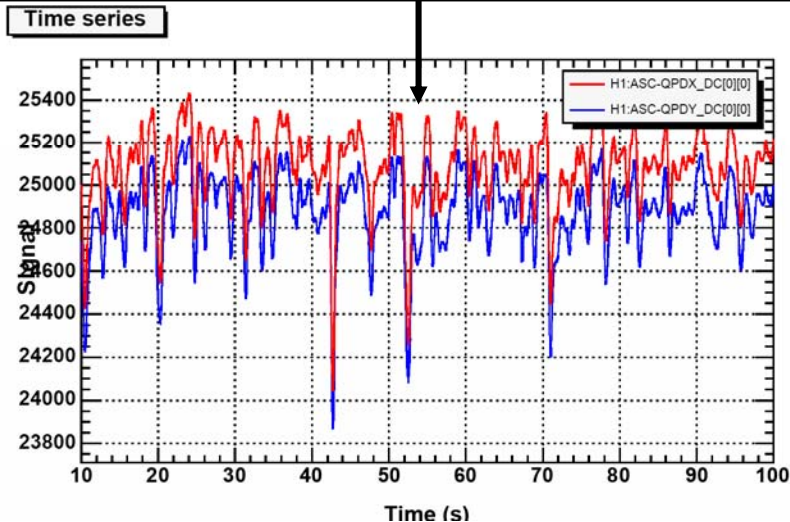
Avg=1

Makes vetoing more complex!

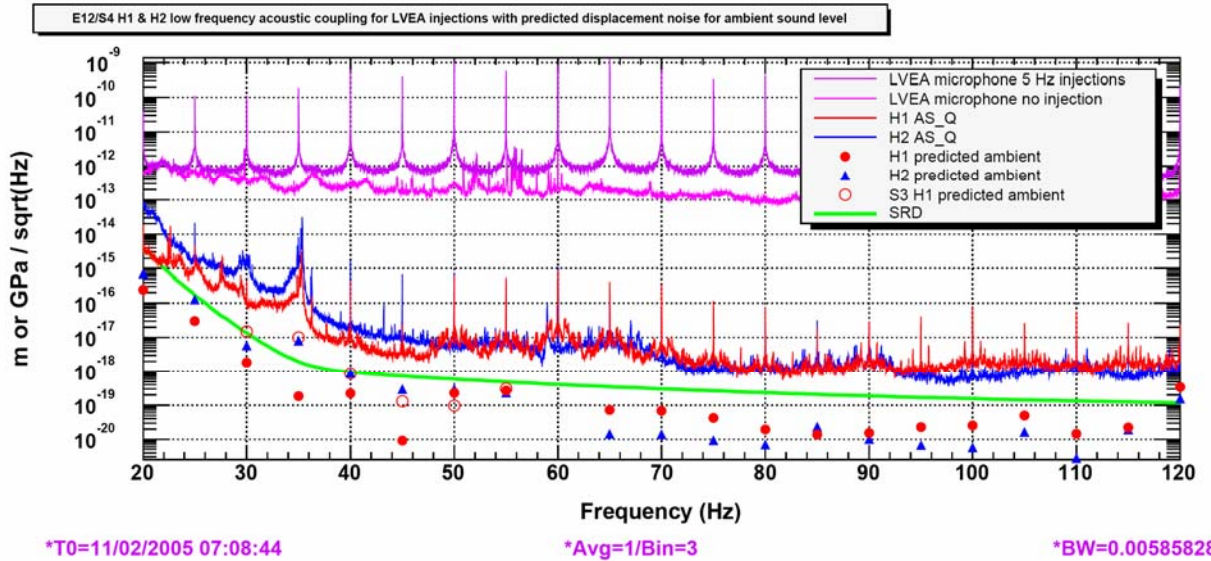
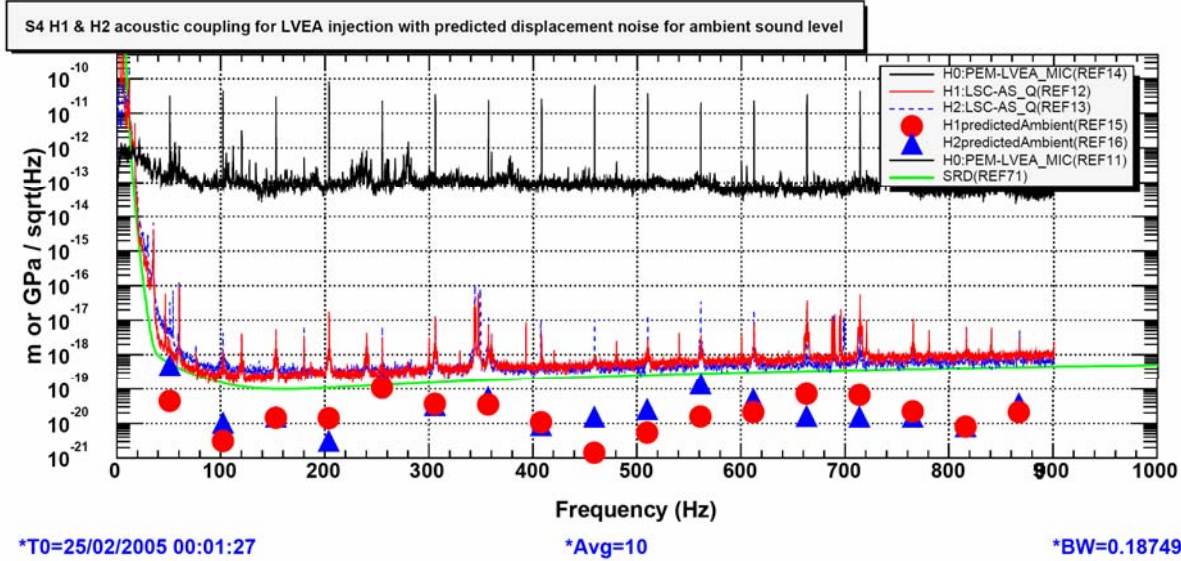
Band Pass on resulting acoustic peak in AS_Q



Bursts correspond with slight drops in arm power

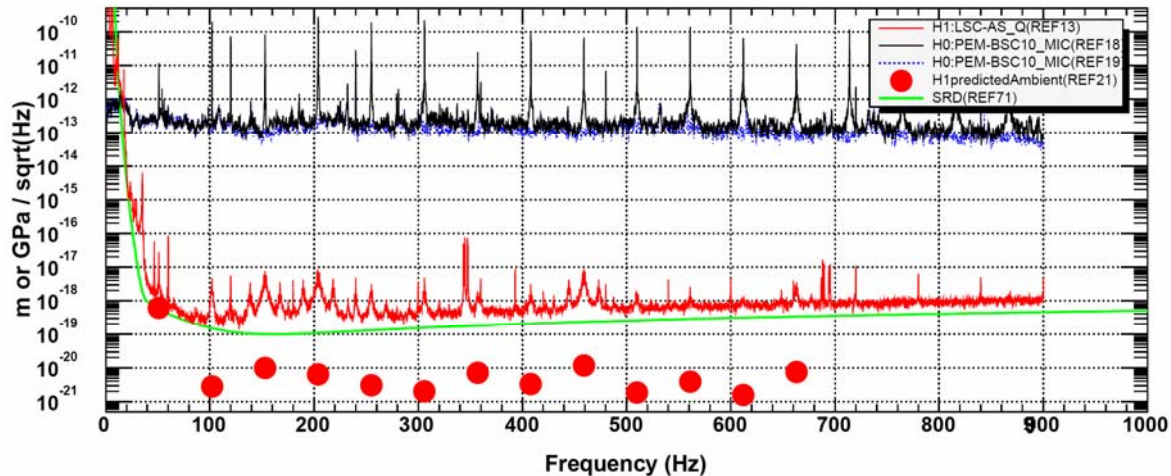


S4 LHO LVEA acoustic coupling from PEM injections



S4 LHO out-station acoustic coupling

S4 H1 acoustic coupling for EY injections with predicted displacement noise for ambient sound level

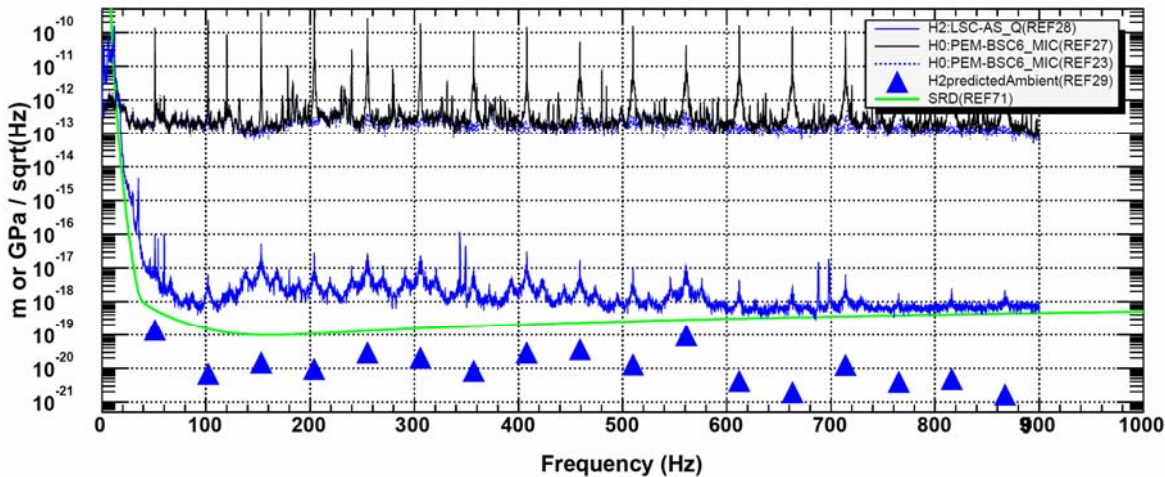


*T0=25/02/2005 06:39:30

*Avg=1

*BW=0.187499

S4 H2 acoustic coupling for MY injection with predicted displacement noise for ambient sound level

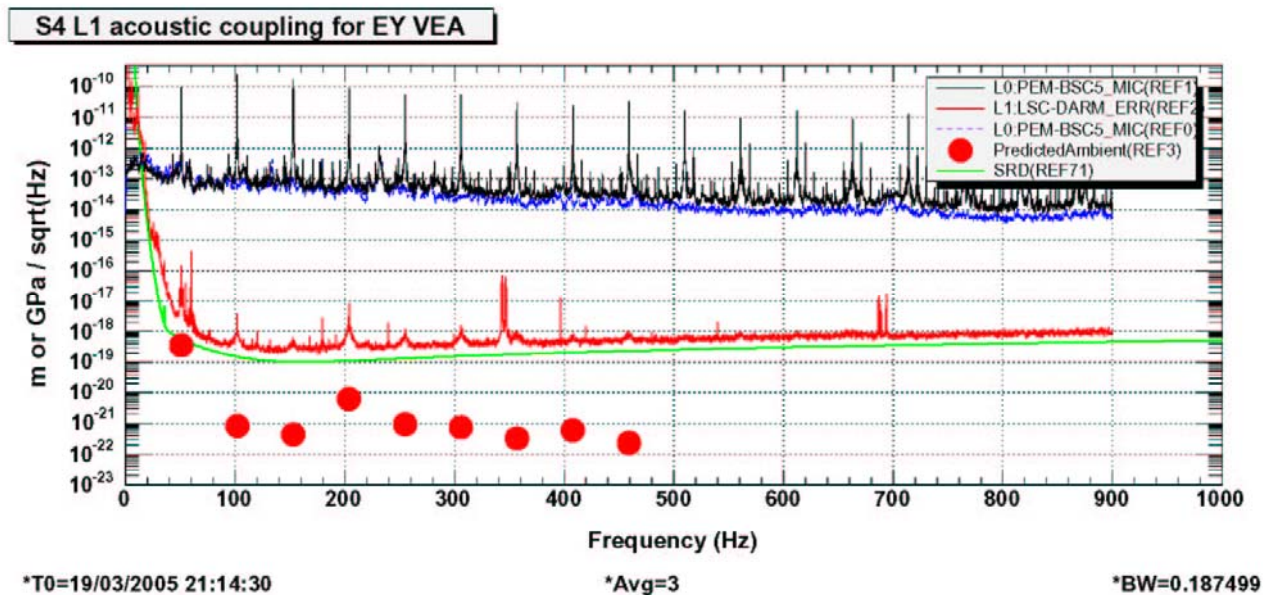
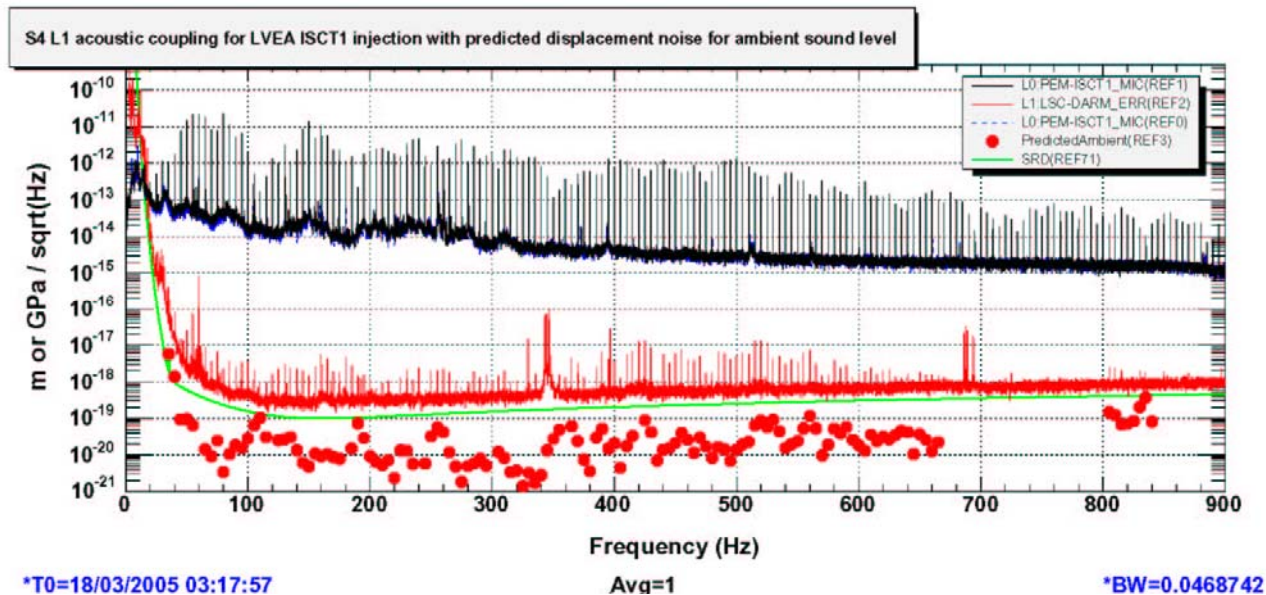


LIGO-G0502 *T0=25/02/2005 07:23:30

*Avg=1

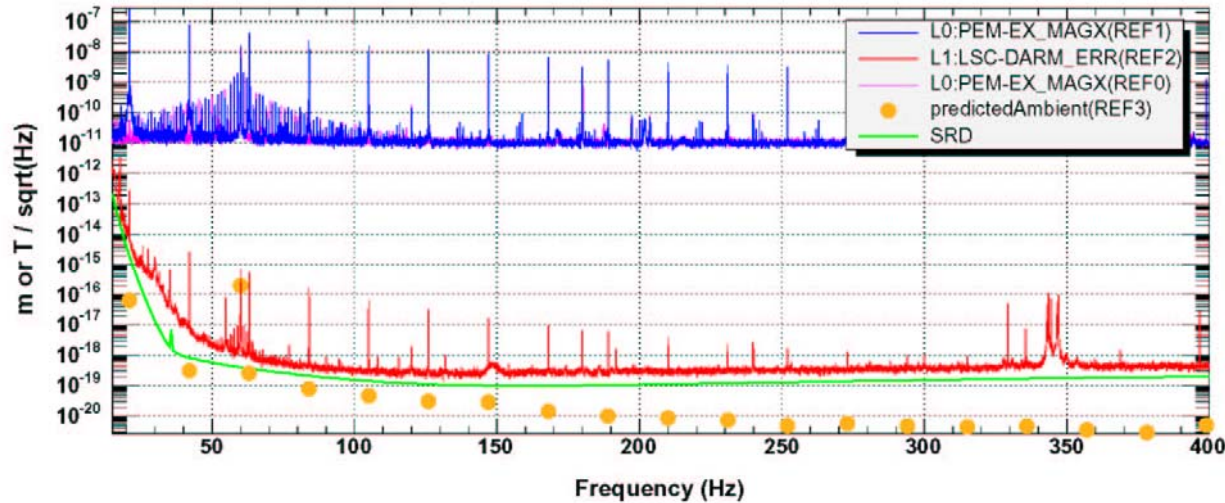
*BW=0.187499

S4 LLO corner and EY acoustic coupling



S4 LHO EX, EY magnetic coupling

With predicted upper limits to displacement noise from coupling of ambient fields.

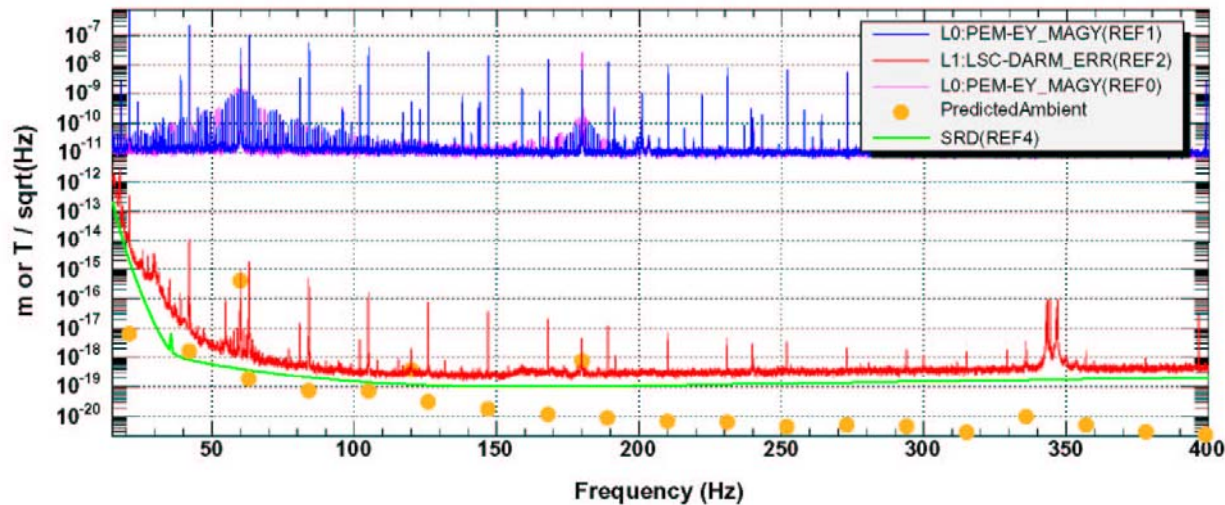


*T0=19/03/2005 00:03:09

*Ava=20

*BW=0.0468742

Power spectrum



*T0=19/03/2005 20:56:24

*Avg=20

*BW=0.0468742

PEM burst injection logs (also in elog)

LHO

BURST INJECTIONS

Injections began Feb. 24 at 23:00:00 and ended on Feb. 25 at 7:45:00

Location	Start Time	Stop Time	Spacing (seconds)
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-----Acoustic/Seismic-----

LVEA

ISCT4 area	23:13:00	23:15:00	5
ISCT7 area	23:29:00	23:32:00	5
ISCT10 area	23:34:00	23:36:00	5
ISCT1 area	23:38:00	23:41:00	5
sitting quiet	23:47:00	23:52:00	5

EX	06:47:00	06:51:00	5
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MX	07:07:00	07:10:00	5
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MY	07:26:00	07:29:00	5
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EY	07:42:00	07:45:00	5
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quiet times for end-stations when injections at mid-stations
 quiet times for mid-stations when injections at end-stations

RF at 2k carrier frequency + 100 Hz

LVEA

10ms long	4:28:30	4:30:30	5
100ms long	4:30:30	4:32:30	5

LLO

BURST INJECTIONS

Location	Start Time (UTC)	Stop Time (UTC)	Spacing (s)
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-----Acoustic/Seismic-----

LVEA

MC area	3/19 17:48:01	17:51:01	5
Dark port area	3/19 17:54:01	17:54:31	5
	3/19 18:29:01	18:31:01	5
X-manifold area	3/19 18:11:01	18:14:01	5
Y-manifold area	3/19 18:17:01	18:17:36	5

EX	3/19 20:17:01	20:20:01	5
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EY	3/19 21:09:01	21:12:01	5
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-----RF 24482700 Hz-----

LVEA	3/19 18:56:01	18:58:01	5
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-----Magnetic-----

LVEA	3/18 22:54:02	22:56:02	5
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Summary

I. Pre-S4 **partial** fixes

- a. Wandering chiller seismic peak (D.Q. flag for 16 Hz?)
- b. 10 Hz from RFID
- c. Transformers near test masses (ion pump supplies?)
- d. Crab protection (LHO out-stations, LLO?)

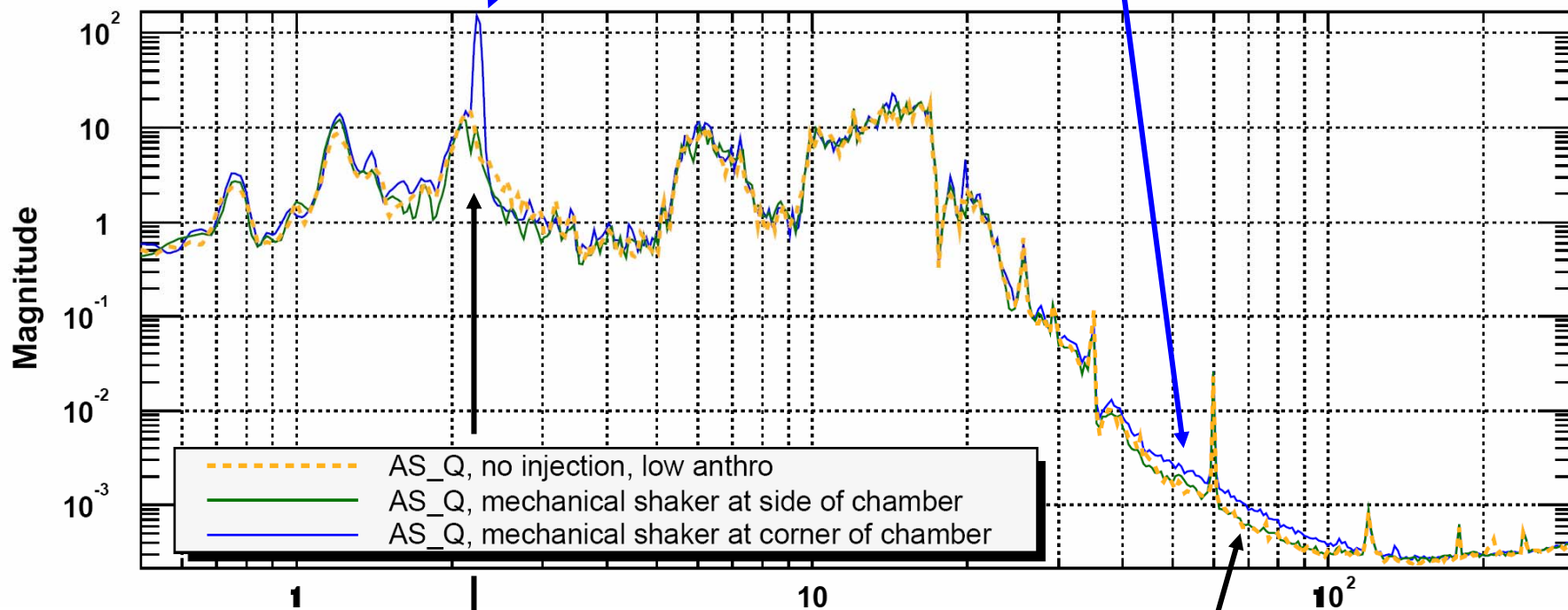
II. Some S4 Issues

- a. Up-conversion of low frequency “continuous” seismic noise
- b. Veto up-converting 0.7-2 Hz seismic transients
- c. Continuous environmental sources can produce AS_Q bursts

III. Preliminary coupling results from S4 PEM injections

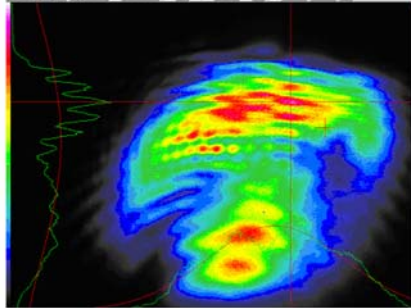
- a. LHO LVEA ambient sound level **generally** less than 1/5 SRD above 60 Hz
- b. LHO out-station ambient sound level **generally** less than 1/10 SRD
- c. 60 Hz peak in AS_Q may be dominated by direct coupling of ambient magnetic fields

Mechanical shaker near corner of chamber produces pitch, yaw and displacement motion as well as causing up-conversion in AS_Q.

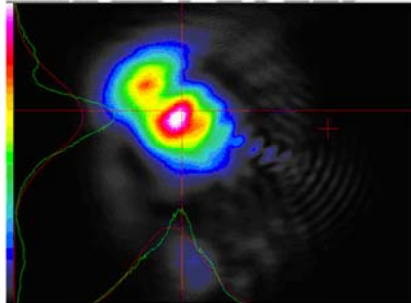


Mechanical shaker beside chamber produces side motion, but little pitch, yaw or displacement, and does not produce up-conversion.

H1-detect



H2-detect



H2-detect same attenuation as for H1

