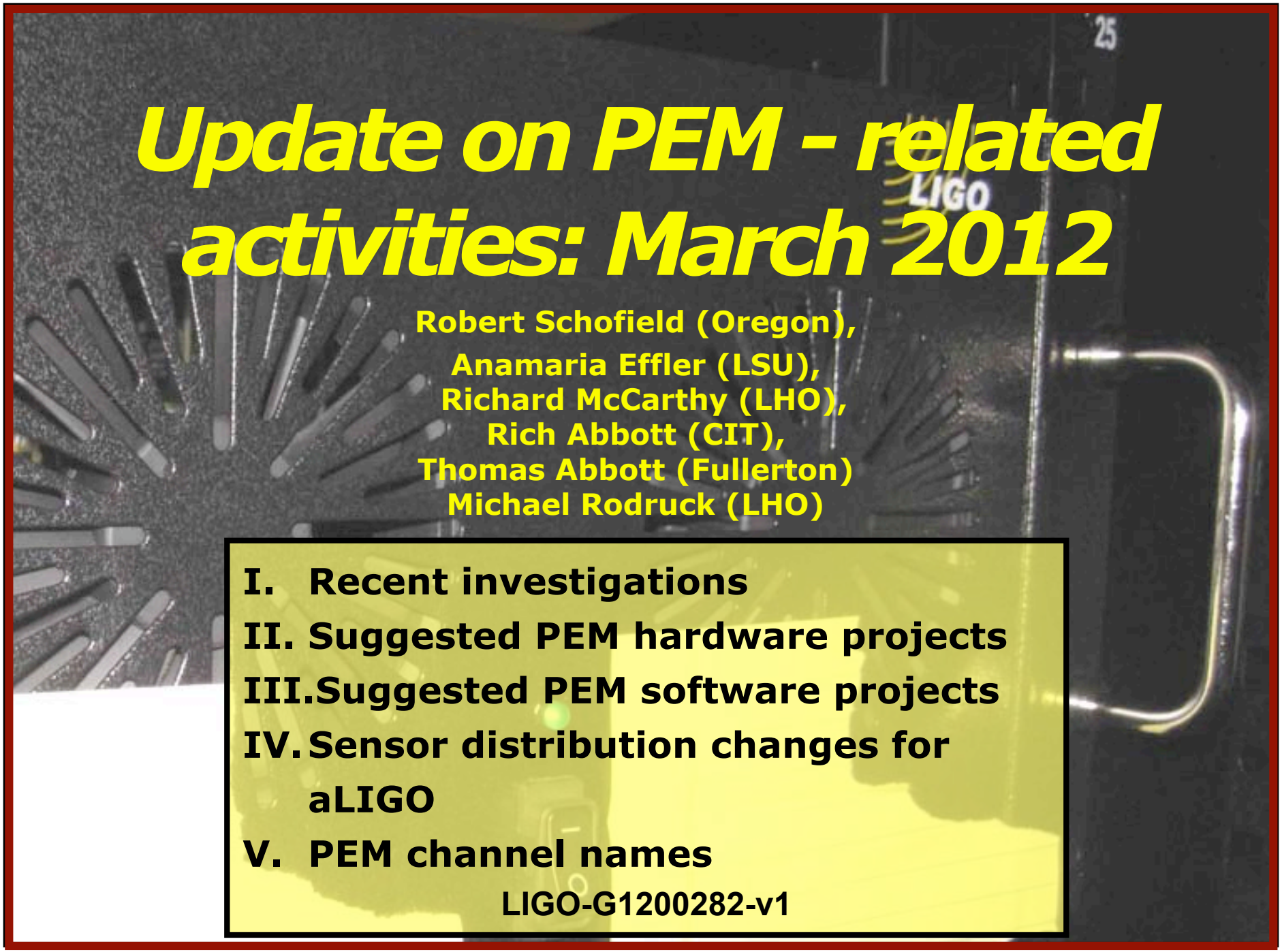


Update on PEM - related activities: March 2012

Robert Schofield (Oregon),
Anamaria Effler (LSU),
Richard McCarthy (LHO),
Rich Abbott (CIT),
Thomas Abbott (Fullerton)
Michael Rodruck (LHO)

I. Recent investigations
II. Suggested PEM hardware projects
III. Suggested PEM software projects
IV. Sensor distribution changes for aLIGO
V. PEM channel names

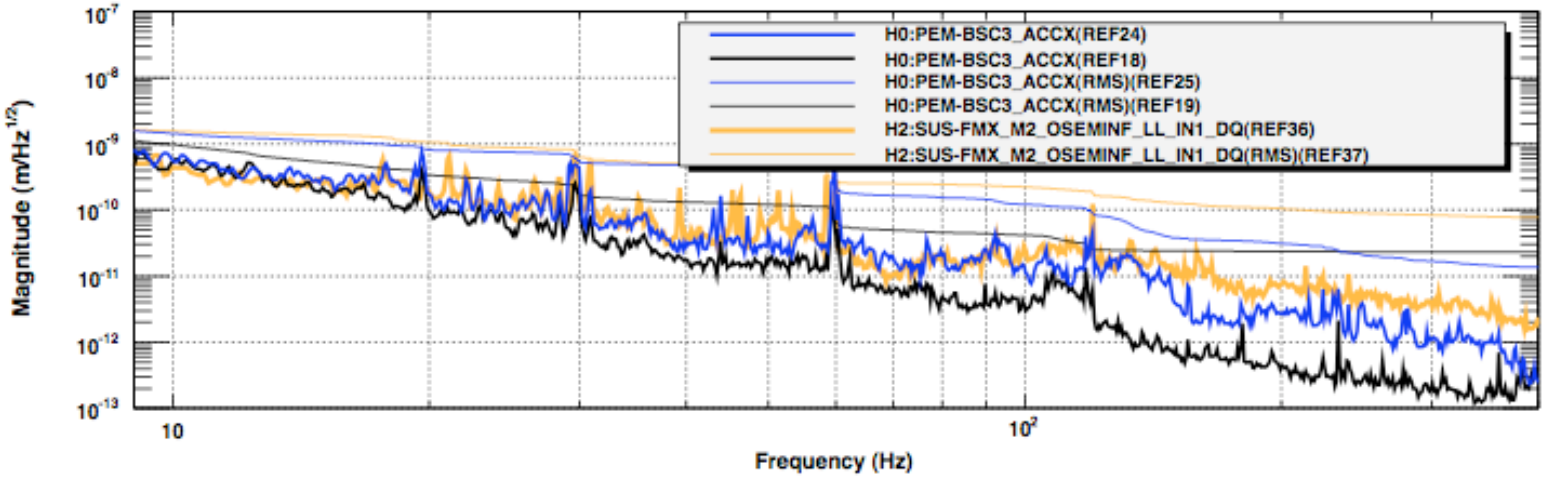
LIGO-G1200282-v1

Recent Investigations

Recent Investigations

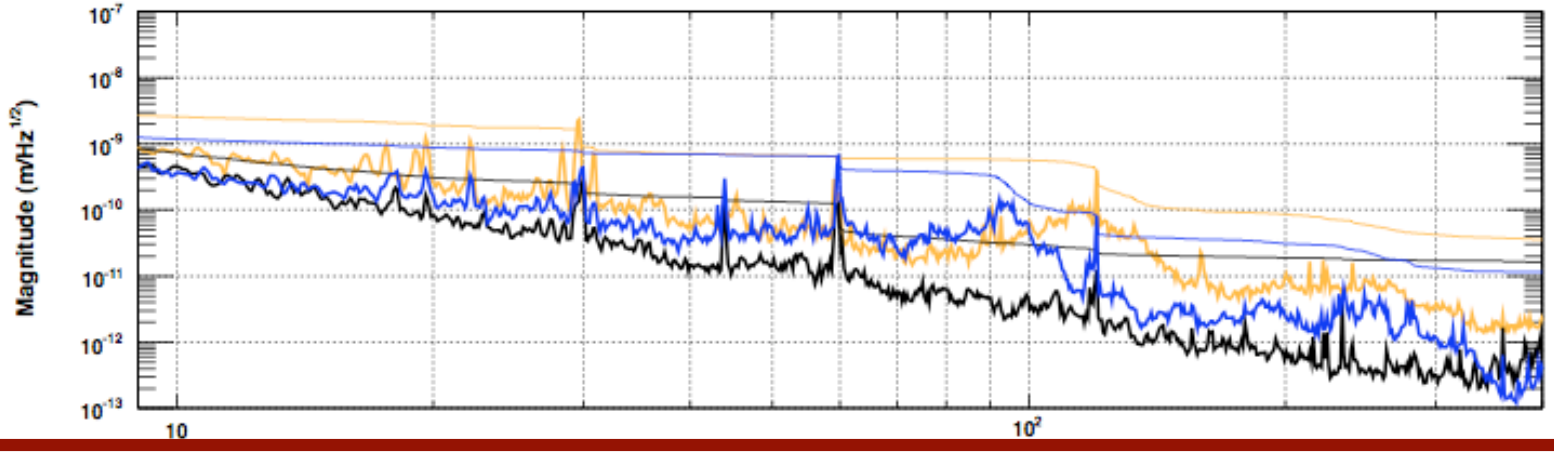
H1 PSL table installation successful: H1 like H2 and…

X (long) axis, ORANGE: new H1 PSL, BLUE: new H2 PSL, BLACK: ground for H2



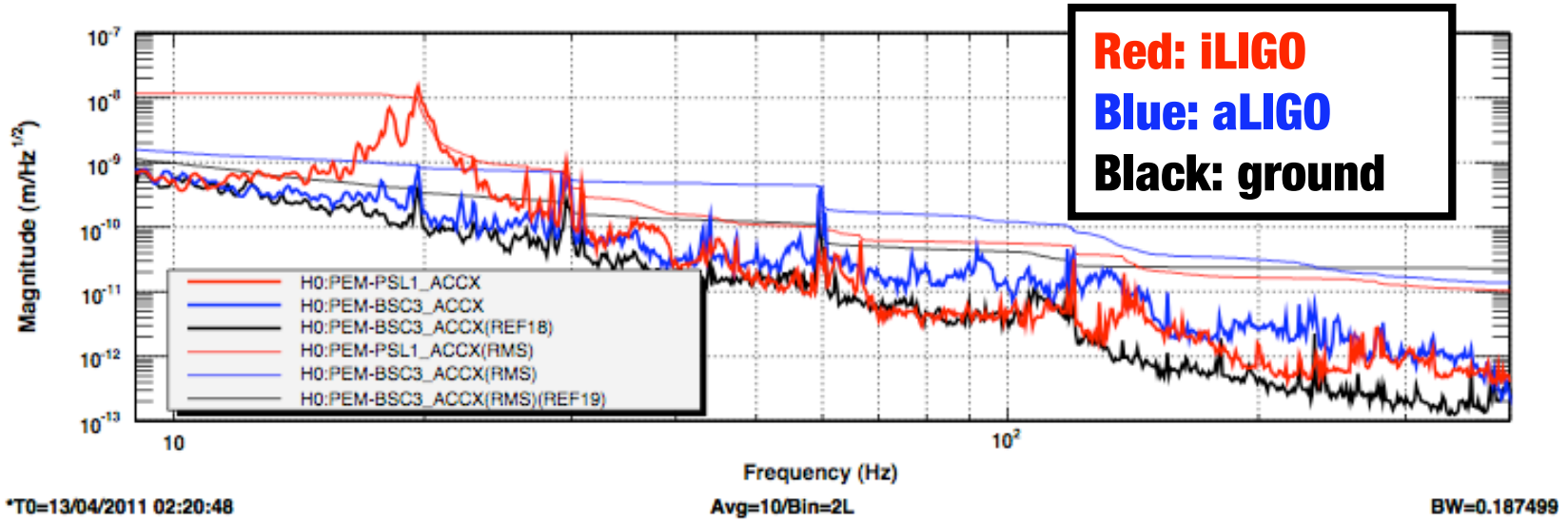
*T0=13/04/2011 02:20:47 *Avg=10/Bin=2L BW=0.187499

Y (short) axis, ORANGE: new H1 PSL, BLUE: new H2 PSL, BLACK: ground for H2

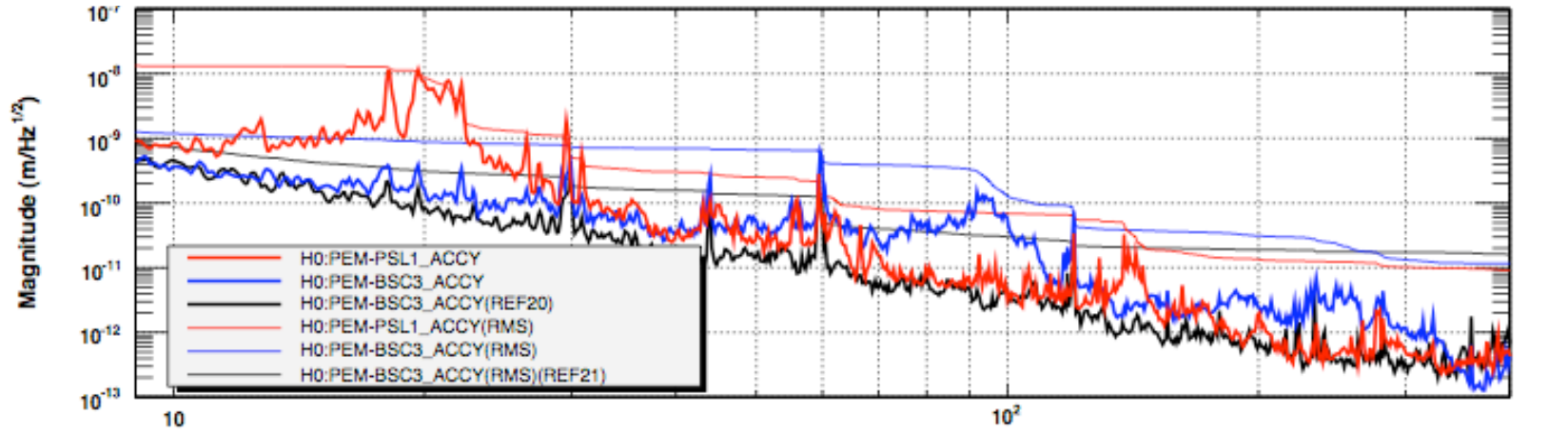


…and H2 table had RMS displacement of about 1/10 that of iLIGO table

Long axis (LHO)

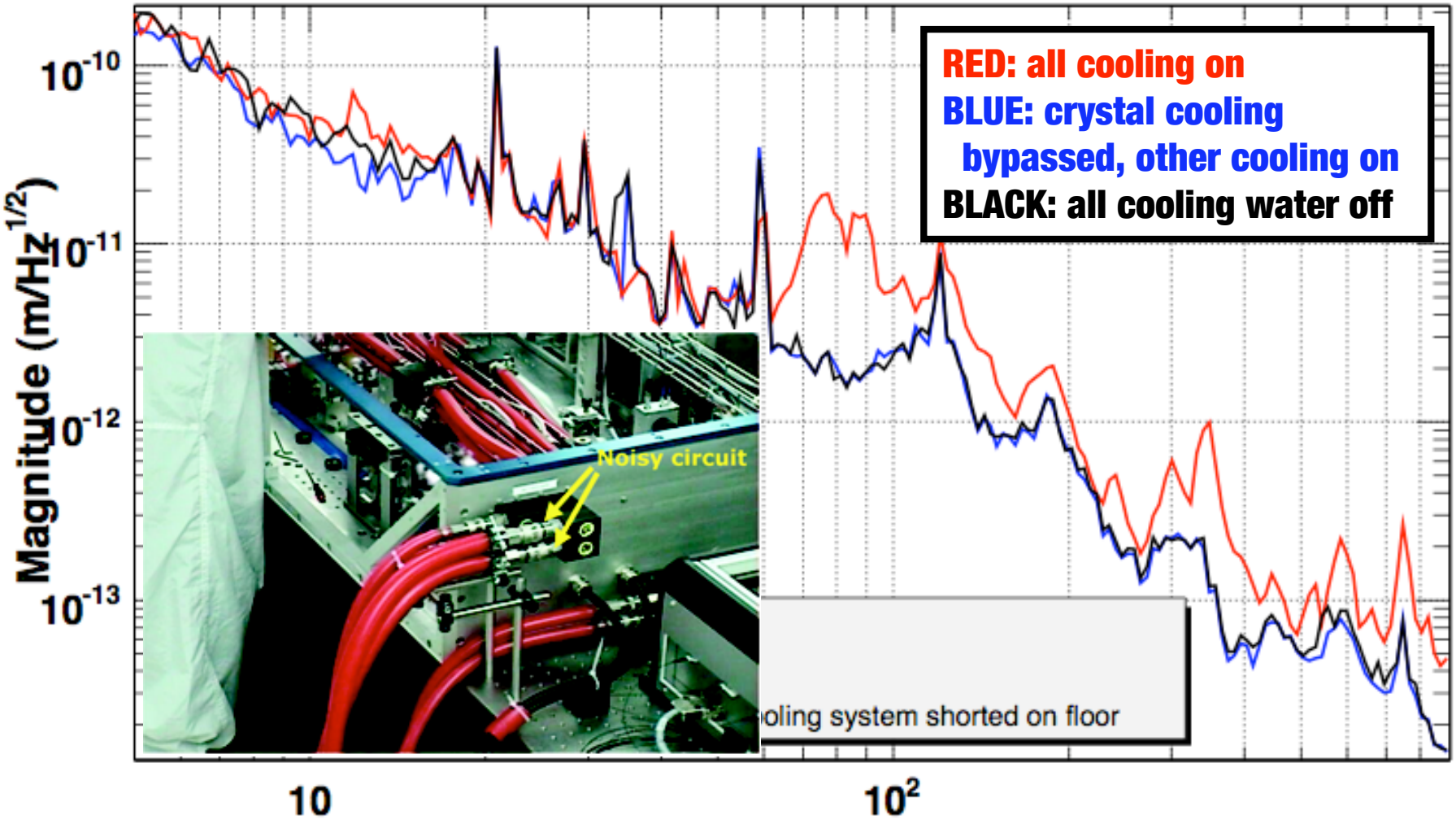


Short axis



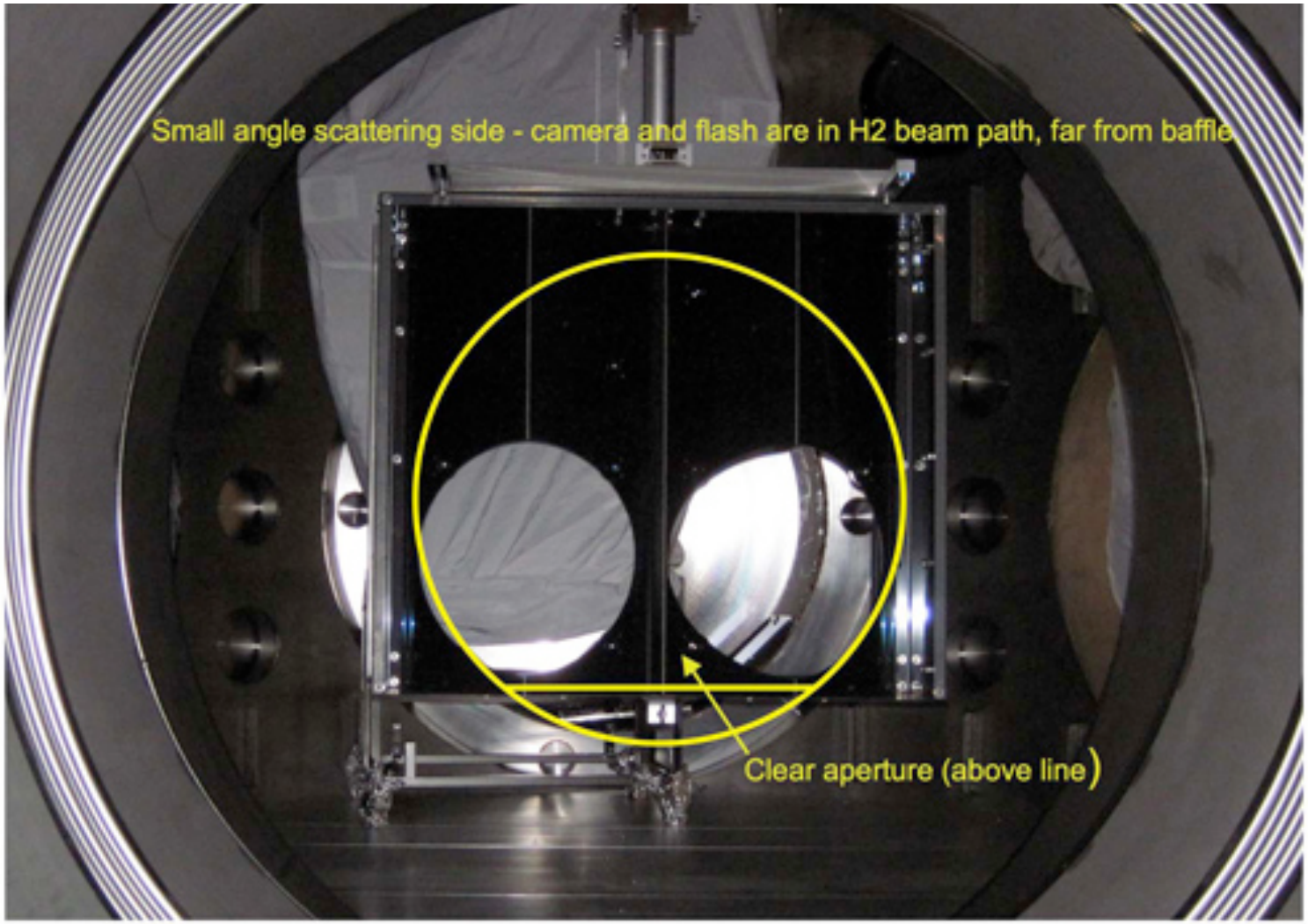
Recent Investigations

PSL amplifier crystal cooling system increases PSL table motion by up to ten. Cooling for beam dumps, 30W laser etc. OK



Recent Investigations

Search for glints associated with ITMX

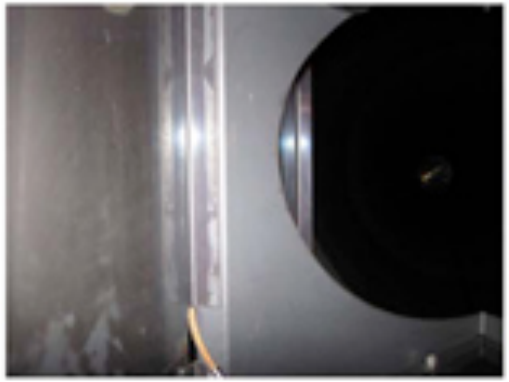


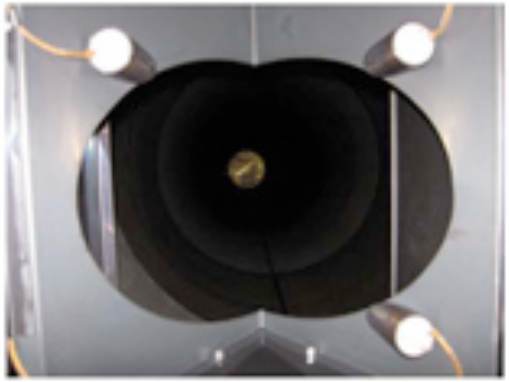
Recent Investigations

Search for glints associated with ITMX

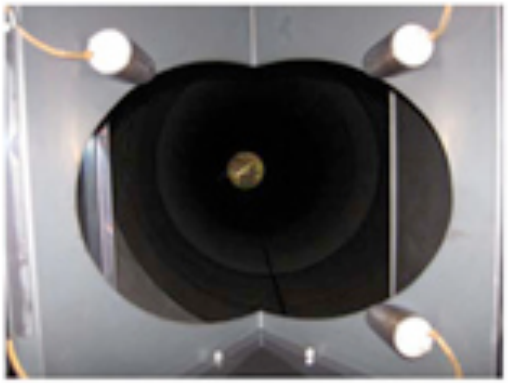
Camera and flash positioned where beam spot would be if test mass were on the left instead of the right side. Shows retro-reflection for wide angle scattering of flash from beam spot position.

Left side

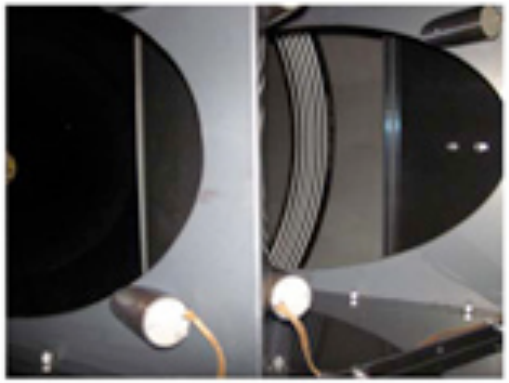


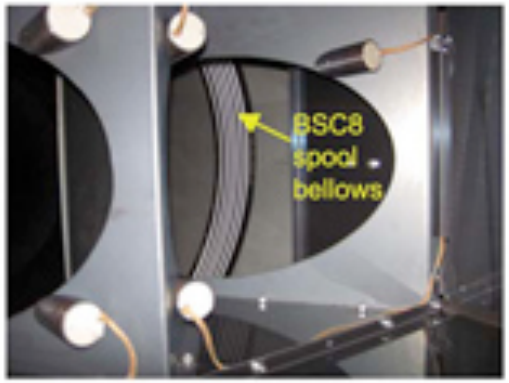


Center



Center



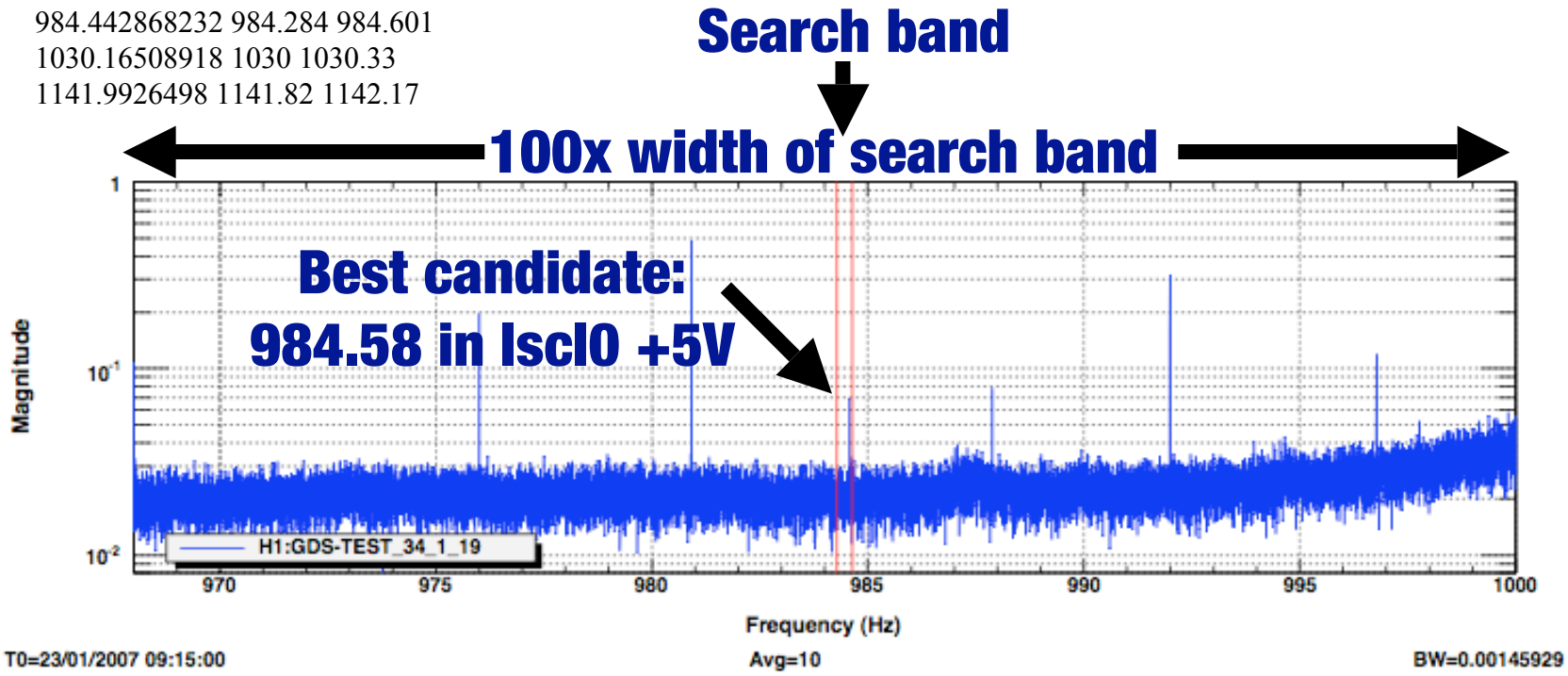


Right side

"Recent" investigations

Search for E@H outliers in S5 power supply ripple data and rack magnetometer data

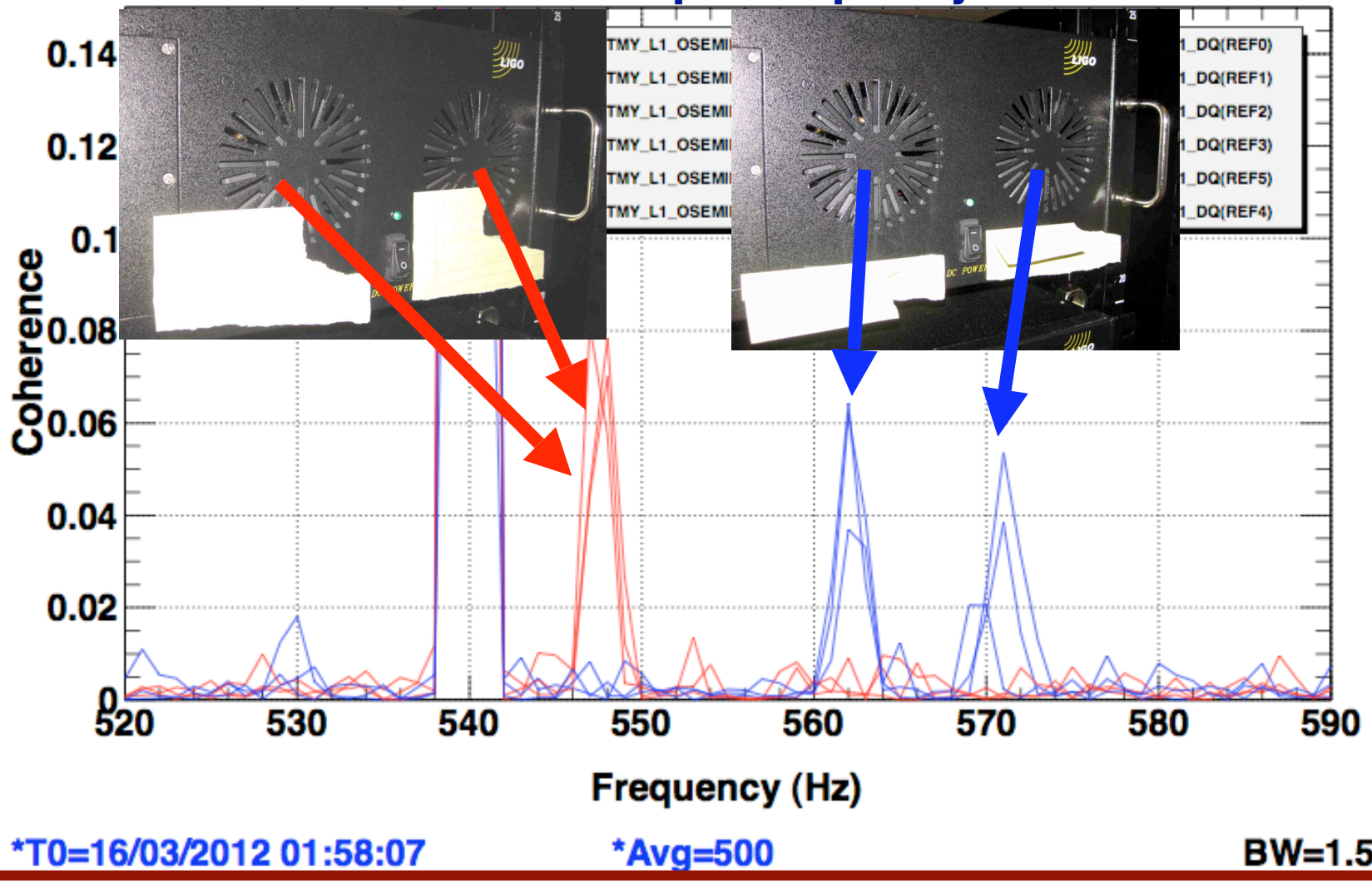
80.8918161866 80.8237 80.9599
96.5810995975 96.5114 96.6508
144.743218107 144.669 144.818
434.098864207 433.995 434.202
677.478827965 677.351 677.607
932.369487035 932.216 932.523
984.442868232 984.284 984.601
1030.16508918 1030 1030.33
1141.9926498 1141.82 1142.17



Recent Investigations

I/O chassis (adc/dac) fans show up in channels

Coherence between magnetometer (signal has fan frequency) and OSEM channel in chasis. Peaks move when fan ports are partially covered.

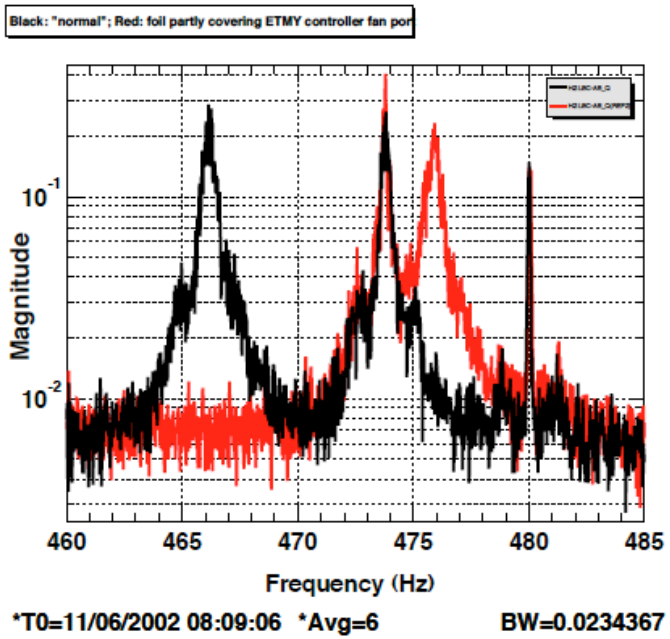


Recent investigations

Similar situation in S1!

Peaks Movable

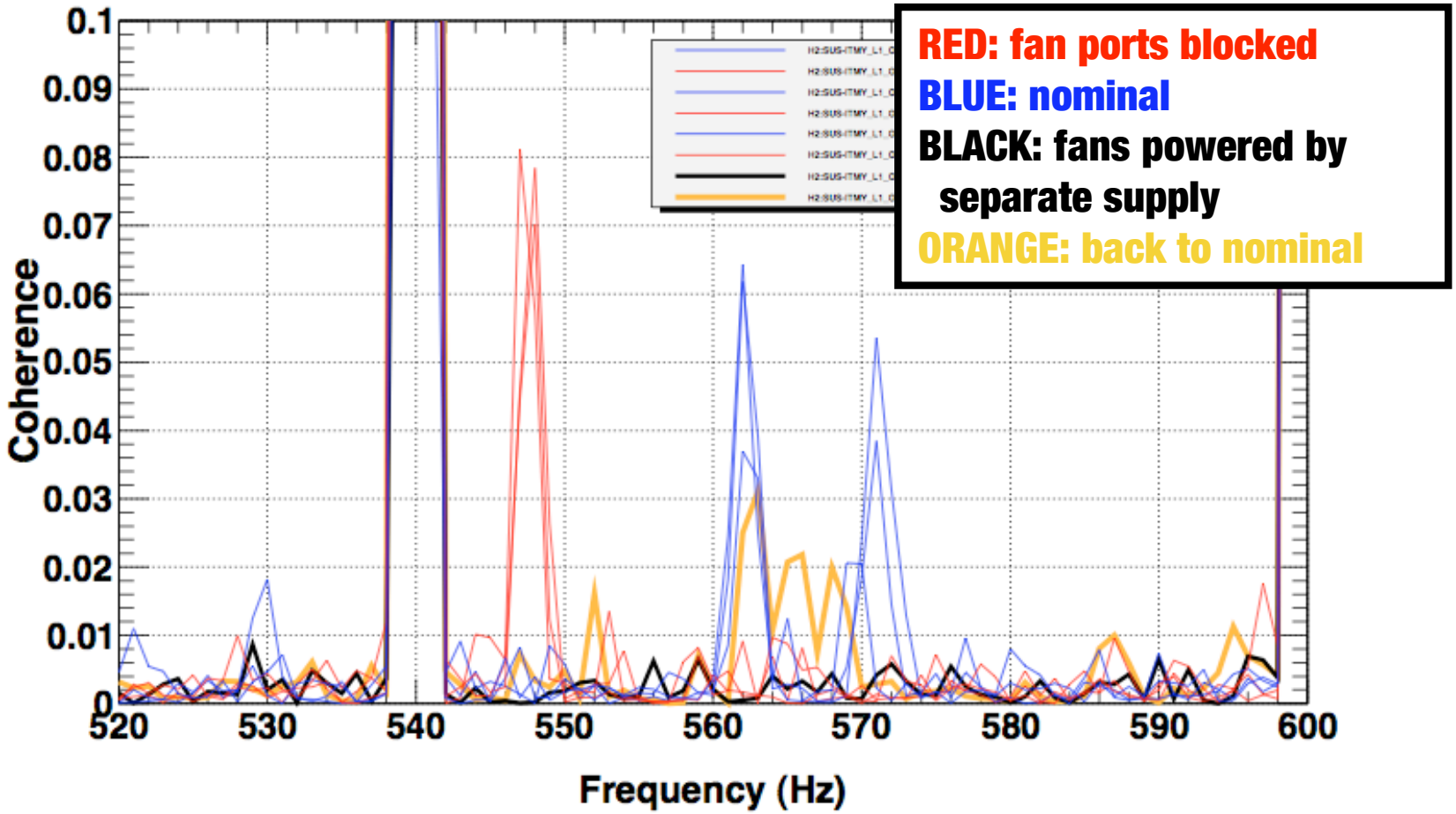
by partially covering fan port of test mass controller with foil



Separate fan power supply removed peaks - fans probably caused power supply ripple

Recent investigations

Coherence not evident when fans are run on separate power supply
Indicating that problem is voltage fluctuations produced by fan.

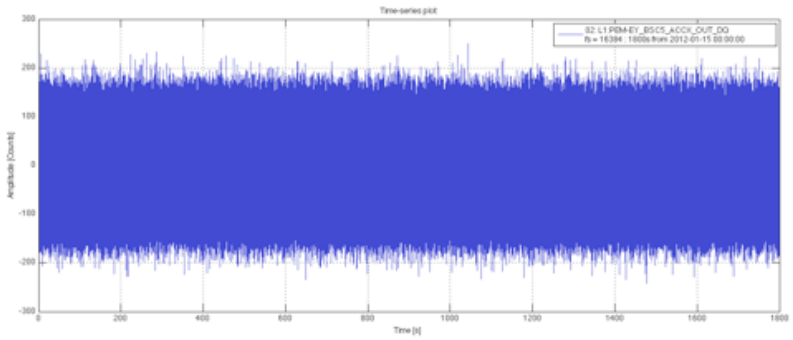


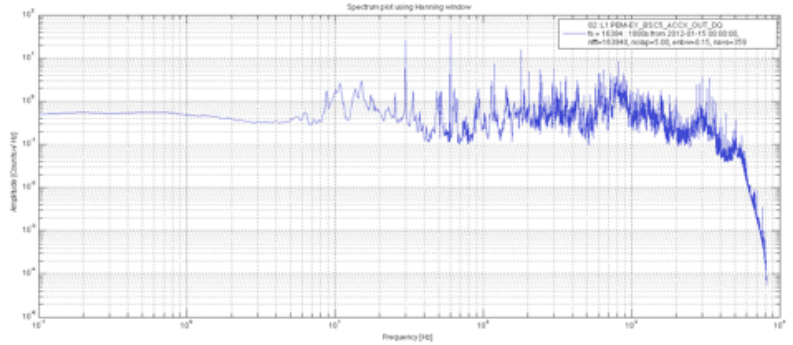
Recent Investigations

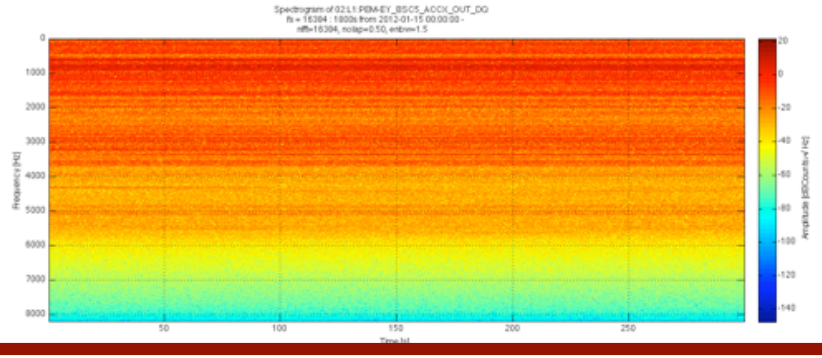
Channel snapshots, Thomas Abbott (Fullerton)

L1: EY Accelerometers

L1:PEM-EY-BSC5_ACCX_OUT_DQ







PEM Hardware Projects

RF

1) **Power meters for roof radio monitors.** Monitor RF in modulation frequency bands (e.g. 9MHz 45MHz) etc. A unit would monitor 6 frequencies at once and output 6 analog signals proportional to the power in the band.

2) **RF monitors at the main modulation frequencies for inside the LVEA.** These would use signals from the RF distribution system as the local oscillators. They would be attached to lamda/2 antennas in the LVEA.

3) **An RF spectrum monitoring system that sweeps from a few KHz to a couple of GHz.** It would monitor the RF environment and output spectrograms using a spectrum analyzer and a laptop. The motivation for this is that coupling can occur at frequencies outside our 100kHz bands (e.g. 10 MHz).

4) **An audio frequency RF system (1 Hz to 10,000 Hz).** Would use a Marconi antenna and audio amp into the DAQ system.

PEM Hardware Projects

Non-RF

1) **6 more coil magnetometers.** One in each building, would reproduce design of vault coil magnetometers.

2) **Eotvos infrasound microphones.**

3) **A temporary monitor for electrostatic fields inside the BSCs.** Would be connected to a dead-end wire that goes into the BSC.

4) **Develop mounting system for chamber accelerometers.**

PEM Software Projects

1) **Dead channel monitor (Carleton leads)**
2) **Channel snapshots (Thomas Abbott started)**
3) **Modify DAQ system to produce channels containing the sum in quadrature for all 3-axis sensors.** The quadrature channels would each replace 3 single-axis channels in the RDS.
4) **More sophisticated channel monitor - statistical changes.** (Started by Carelton, Columbia interest)
5) **Channel directory entries.** Take responsibility for describing channels in channel directory.
6) **Channel location documentation web page.** Enter channel name to light up sensor location on sensor map, also shows photos of sensor in its location.
7) **Channel calibration documentation (Columbia?)**
8) **Direction to source finder.** Uses propagation delays to point in source direction.

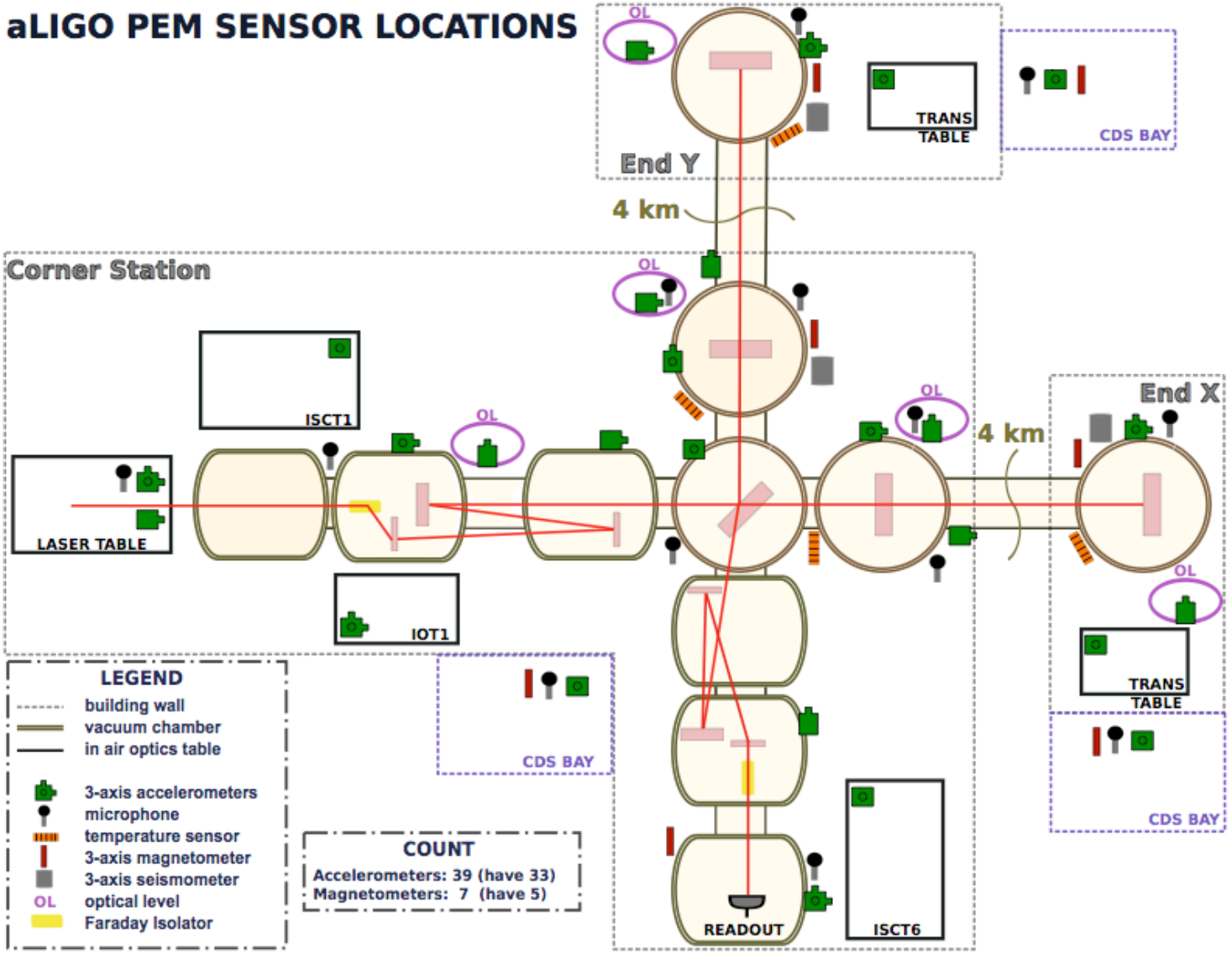
PEM Software Projects

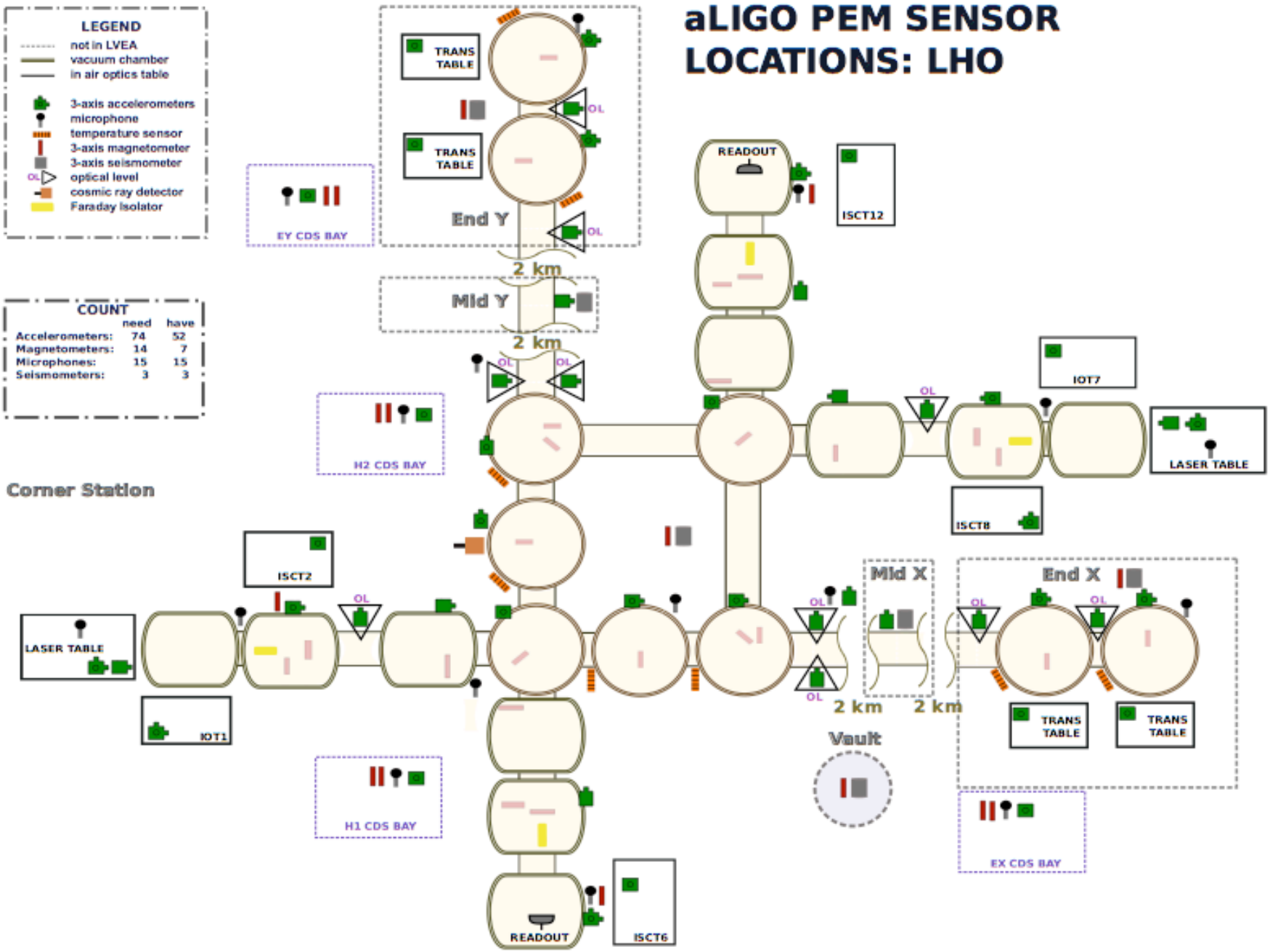
With emphasis on stochastic and CW searches

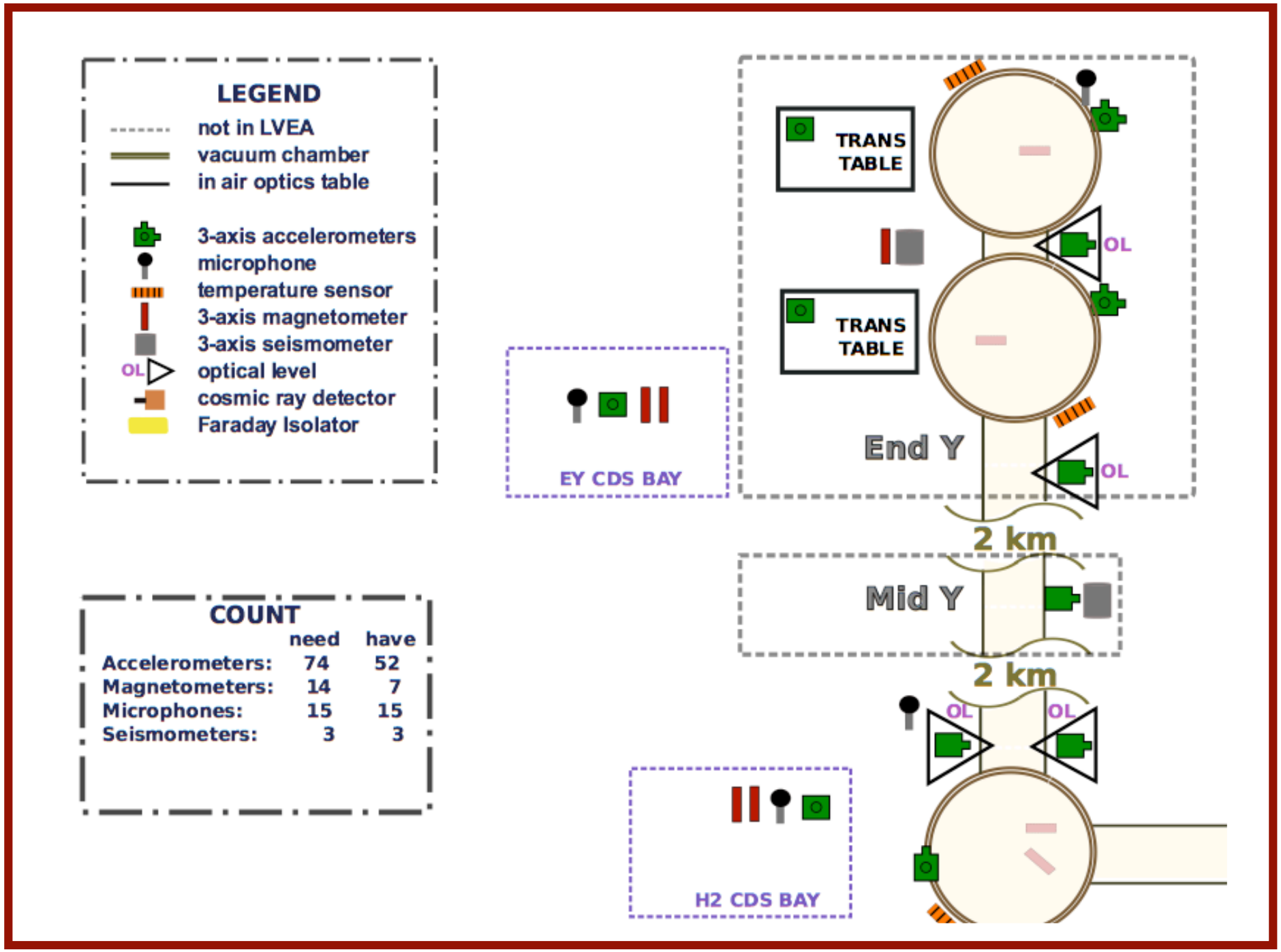
9) **Search for pulsars in selected auxiliary channels with modified all-sky and/or specific pulsar search code.**
10) **Modify stochastic code to search for signal between aux channels.** Compare empty channels between sites, coil magnetometer channels, and other aux channels.
11) **Add significance FOM to Carleton DARM-aux coherence line monitor.**
12) **Modify coherence code to look between auxiliary channels instead of just DARM-aux.**
13) **1Hz (and other) comb monitor.** Searches for combs in DARM and auxiliary channels and monitors f-dependent amplitude.

PEM Sensor Maps

Anamaria's LLO map




aLIGO PEM SENSOR LOCATIONS: LHO
LEGEND
not in LVEA
vacuum chamber
in air optics table
3-axis accelerometers
microphone
temperature sensor
3-axis magnetometer
3-axis seismometer
optical level
cosmic ray detector
Faraday Isolator
COUNT
need have
Accelerometers: 74 52
Magnetometers: 14 7
Microphones: 15 15
Seismometers: 3 3
Corner Station
TRANS TABLE
TRANS TABLE
End Y
EY CDS BAY
2 km
Mid Y
2 km
H2 CDS BAY
READOUT
ISCT12
IOT7
LASER TABLE
ISCT8
ISCT2
LASER TABLE
IOT1
H1 CDS BAY
READOUT
ISCT6
Mid X
End X
2 km
2 km
Vault
TRANS TABLE
TRANS TABLE
EX CDS BAY
OL


LEGEND
not in LVEA
vacuum chamber
in air optics table
3-axis accelerometers
microphone
temperature sensor
3-axis magnetometer
3-axis seismometer
OL
optical level
cosmic ray detector
Faraday Isolator
COUNT
need have
Accelerometers: 74 52
Magnetometers: 14 7
Microphones: 15 15
Seismometers: 3 3
TRANS TABLE
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End Y
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2 km
Mid Y
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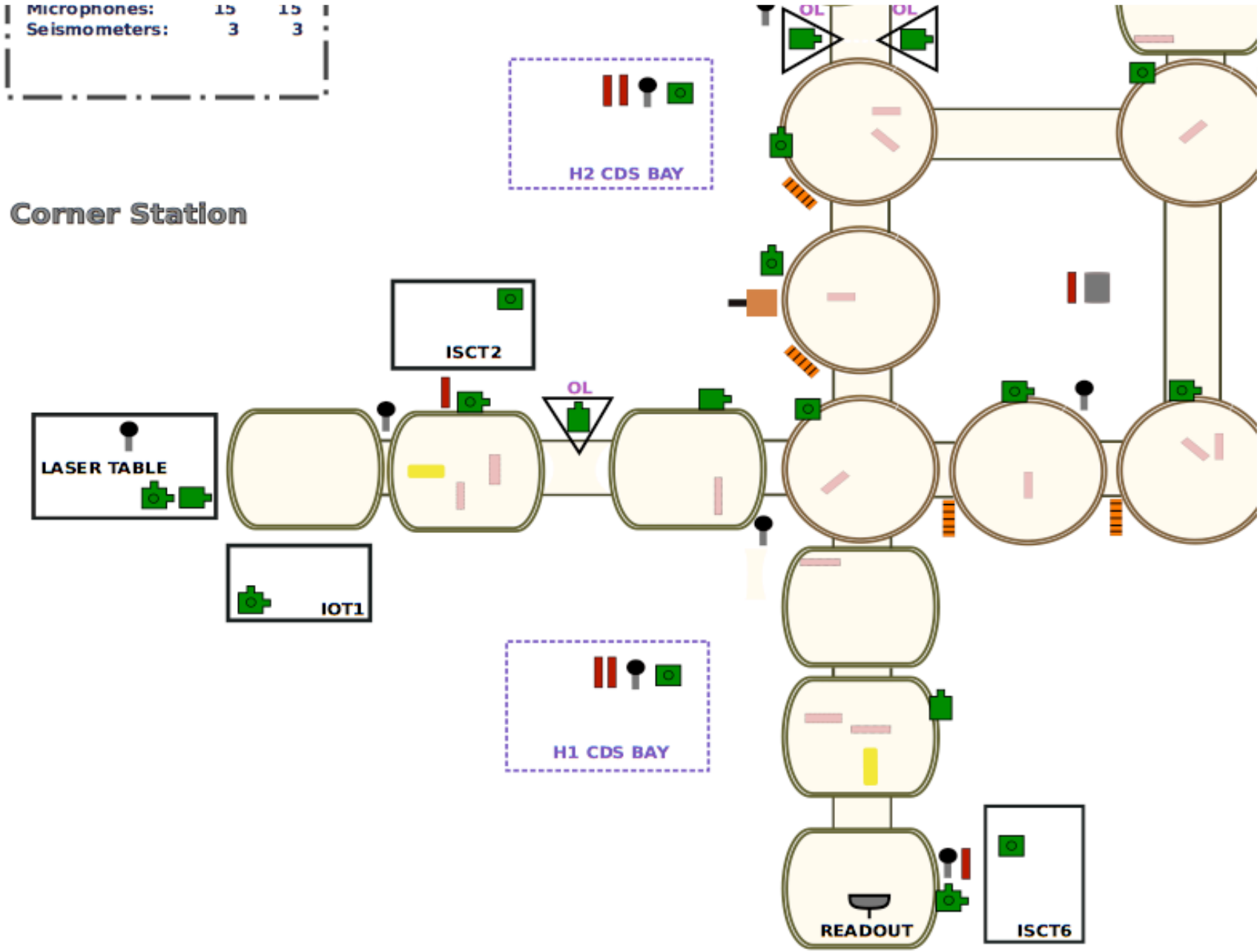
H2 CDS BAY


Microphones: 15 15
Seismometers: 3 3
Corner Station
H2 CDS BAY
ISCT2
OL
OL
OL
LASER TABLE
IOT1
H1 CDS BAY
READOUT
ISCT6

PEM changes

1) Electronics rack magnetometers
2) Only 1-axis accelerometer on optical tables that are beam-free during science mode, 3-axis on others
3) Accelerometers directly on chamber walls, not on support tube plates
4) Accelerometers on floor of electronics bays
5) Mid-station accelerometers for scattering, seismometers for propagation studies
6) Optical lever accelerometers

PEM Channel Names

Up to 55 characters. My favorite:

1) System:subsystem-location_(sublocation_)(explanation_)sensor

H1:PEM-EY_BSC9_ETMX_ACCX	H1:PEM-LVEA_ISCT1_REFL_ACCZ
H1:PEM-LVEA_ROOF_RADIO1	H1:PEM-EX_ETMXOPLEV_ACCX
H1:PEM-EX_SEISX	H1:PEM-LVEA_HAM2_PR3_ACCX

Alternatives:

2) No chamber names, Anamaria's favorite:

H1:PEM-EY_ETMX_ACCX
H1:PEM-LVEA_PR3_ACCX

4) Original

H1:PEM-BSC9_ACCX
H1:PEM-CS_radio1

3) All names 6 parts, none optional

H1:PEM-EX_VEA_GURALP_SEISX
H1:PEM-LVEA_ROOF_44.9MHz45.1MHz_RADIO1
H1:PEM-EX_ETMXOPLEV_PD_ACCY

5) Combinations or ?

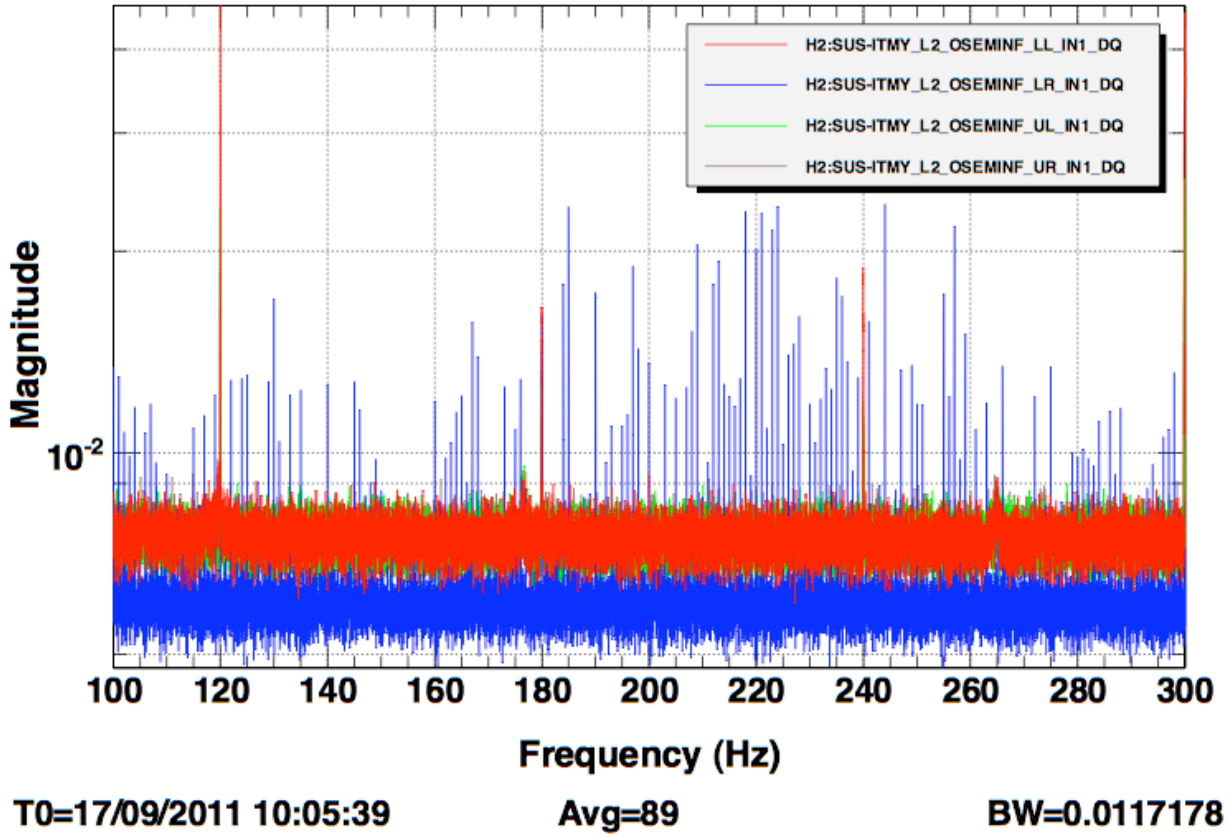
Problems:

No H0: only H1: or H2:

Multiple important objects H1:PEM-LVEA_HAM2_PR3_ACCX or _HAM2_MC1_ACCX

The first of many future puzzles

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



IRIG-B?

PEM: other possibilities

1. In-chamber magnetometers
2. High-frequency magnetometers and microphones
3. Low frequency accelerometers
4. Develop mounting system for chamber accelerometers.
5. RF coupling at end stations?
6. Do we need static electric field sensors? What kind?

Recent investigations

ITMY fiber break after 50 minutes of rogue shaking:

Large amplitude ~14 Hz (possibly roll mode) just before break.
This large of amplitude not see in 300s examined before break.