



Proposed LHO Commissioning Activities in May 02

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H2 Status

- It locks again after fixing ETMX problems
- Normal configuration is 5 W in, but low light at AS diode
- Displacement noise $\sim 2e-15$ m/Hz^{1/2} at 100 Hz, about 100X worse than achieved in 40-m interferometer
- A number of electronics noise checks detailed by P. Fritschel (stop-band tests) have cleared much of electronics as low noise contributor
- Above 500 Hz, noise is consistent with dark noise
- Attempts to put more light on AS diode showed decrease in both noise and lock stability, as well as hints of another noise source
- RMS displacement $\sim 2e-12$ m by integrating AS_Q
- WFS 1 and 2 have been engaged



H1 Status

- Locking is touchy, but once locked it tends to stay locked if we don't poke it
- De-whitening filters are ready to be engaged, but knocked IFO out of lock in a few seconds after engagement; maybe too much frequency noise
- Common-mode servo electronics have been checked out and they have worked on a single arm lock, but attempts to engage in full IFO configuration have failed and locking has made tuning difficult
- No WFS
- Parasitic interferometer found before MC?



H1 Tasks

- Extend drive range on ETMs ✓
- Implement common-mode servo
- Switch in de-whitening filters
- Implement WFS1 (at least)
- Increase light into interferometer & onto AS diode
- Noise hunting
- Implement remaining WFS



H2 Tasks

- Hunt noise at low f
- Hunt noise at high f
- Improve stability and lock times
- Investigate non-stationary noise

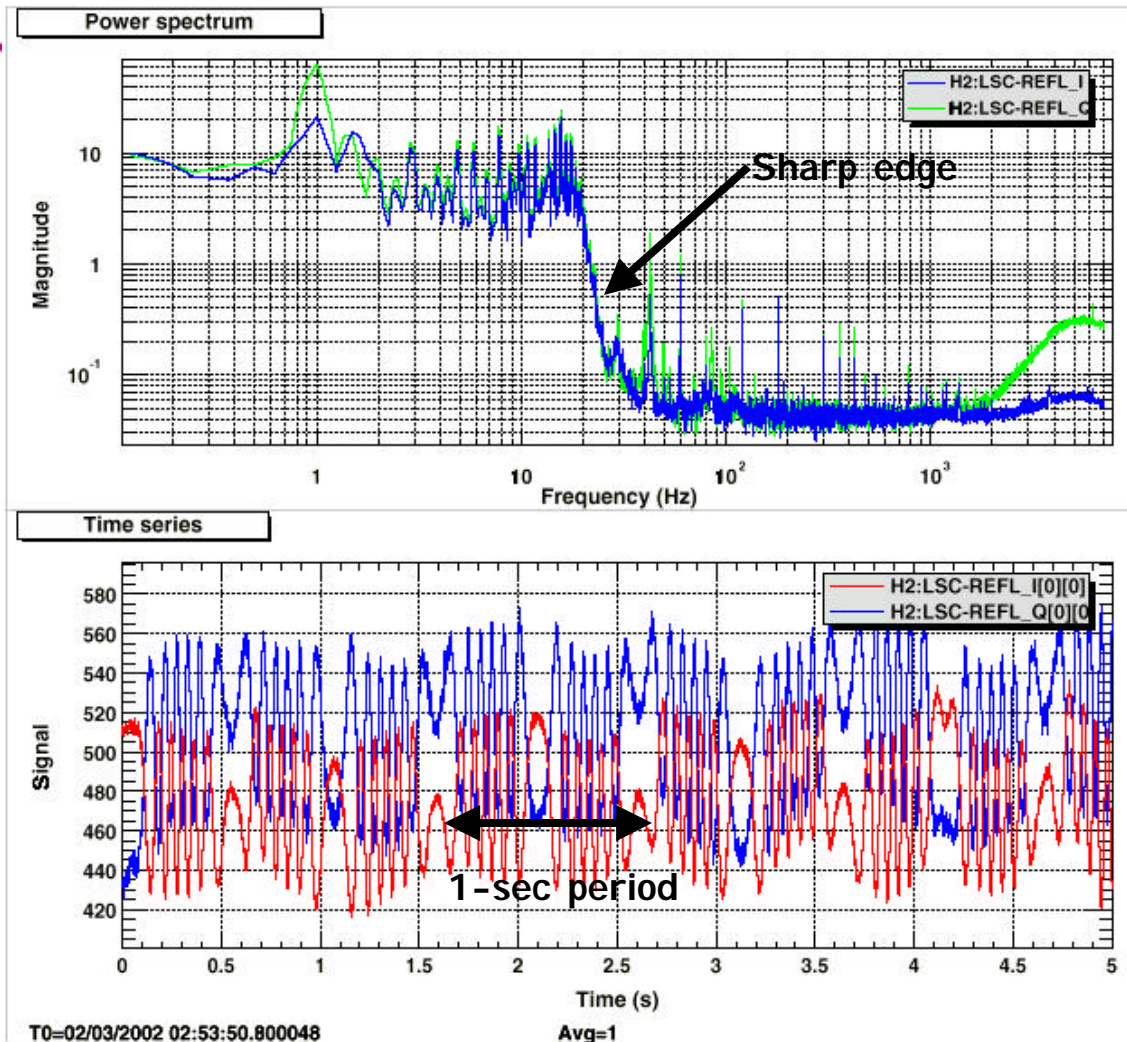


Track Down Source of Low-f Noise

- Most, but not all electronics noise cleared
 - » Should inject notched noise at analog front end
 - » Will check all coils and document
- Unlikely to be real displacements
 - » Structureless
 - » Suspensions too similar to 40-m for creep
 - » Pendulum thermal noise has different f distribution and measured Q s are way too good
- Laser light delivered by IO appears good in checks so far
 - » Laser Intensity noise
 - » RF amplitude noise
 - » Beam jitter
 - » Parasitic interferometers?



Evidence for Single Parasitic Interferometer

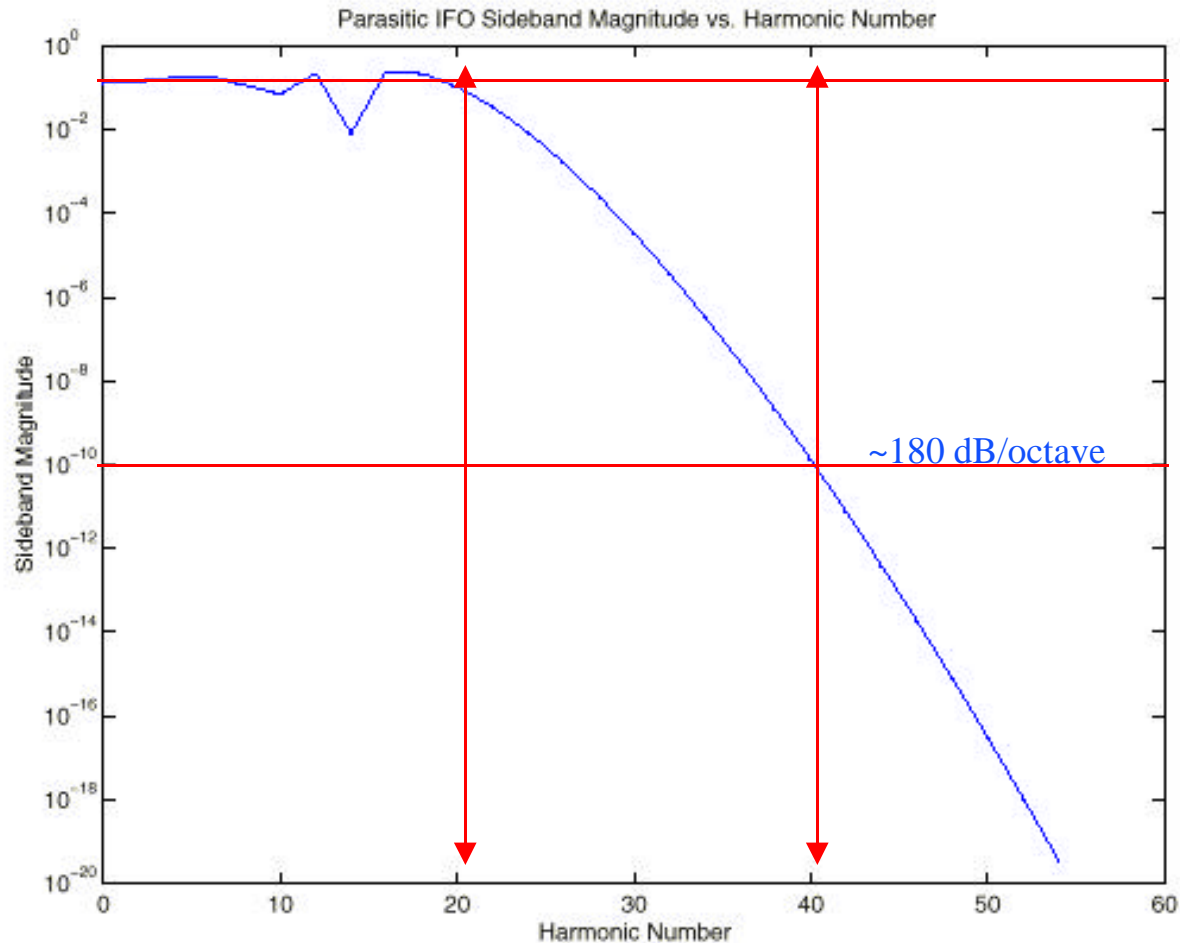


Taken with RM aligned to light; rest of IFO misaligned; 45 dB whitening gain

Design Spec was to place edge below 30 Hz under normal conditions (i.e., LIGO Standard Spectrum)



Parasitic Interferometer Noise Typically Has Sharp Cutoff





Gain Fluctuation Noise Investigation

Read out given by:

$$x(f) = \delta x(f) + x_{\text{static}} \cdot \delta A(f)/A + (\text{bilinear in } \delta x, \delta A/A)$$

- A is total gain, δA the fluctuation
- We have ruled out ($< 1e-7$)
 - » RF power fluctuations at modulator
 - » intensity fluctuations on laser light from input optics
- Not ruled out
 - » Fluctuations of carrier power in arms
 - » Fluctuations of sideband power in PRM
 - » Both fluctuate as much as 20-30%
 - » Fluctuating overlap between sidebands and carrier at AS photodiode
 - » Fluctuations of RF phase



How Bad Could Gain Fluctuation Noise Be on H2?

- Limit on $x_{\text{static}} < 2e-10$ m from laser intensity noise measurement, expect it to be far smaller
- Mostly at pendulum frequencies, but suppose a fraction of the gain noise was distributed like f^{-3}

$f_c(\text{Hz})$	RMS($\delta A/A$)	$\delta A/A _{100 \text{ Hz}} (\text{Hz}^{-1/2})$	fringe offset (m)	$\delta\lambda/\lambda$
10	0.1	7.07E-05	2.83E-11	0.006
20	0.1	4.00E-04	5.00E-12	0.001
10	0.03	2.12E-05	9.43E-11	0.019
20	0.03	1.20E-04	1.67E-11	0.003
20	0.01	4.00E-05	5.00E-11	0.010

No good reason to expect f^{-3} distribution, but should rule it out experimentally



Improve H2 Noise Above 1 kHz

- Daniel believes raising light at AS diode reduces margin for holding lock against RMS fringe motion
 - » Need more gain at intermediate to low f
 - » Rolf has included additional filters in new LSC code
- After reconfiguring gains, increase light at AS diode
- We expect to lock with $\sim 4x$ better sensitivity but we have had hints of another noise source
- Take spectra with good calibrations regularly