Analysis of Violin Modes Present in S2 data

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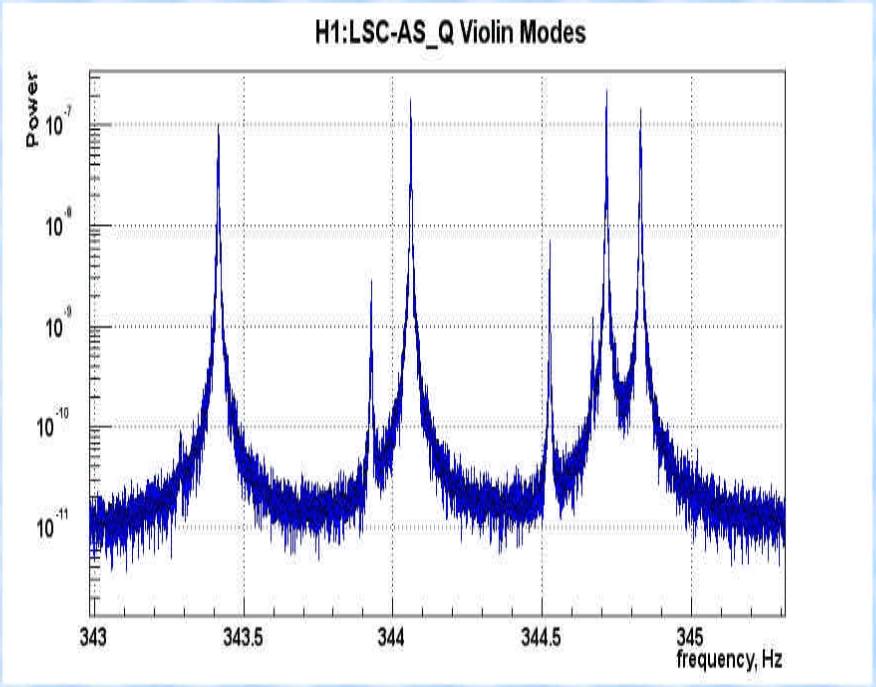
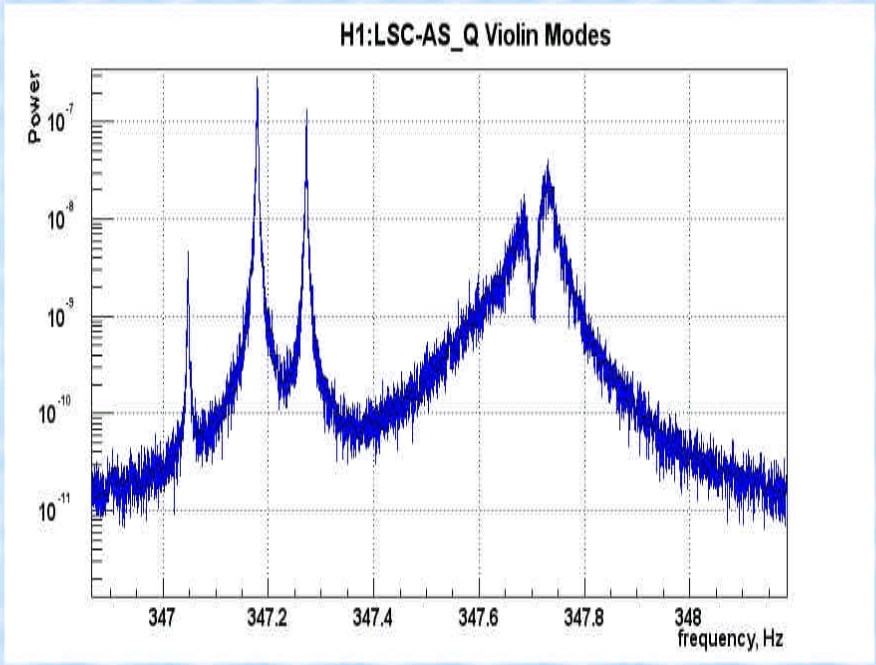
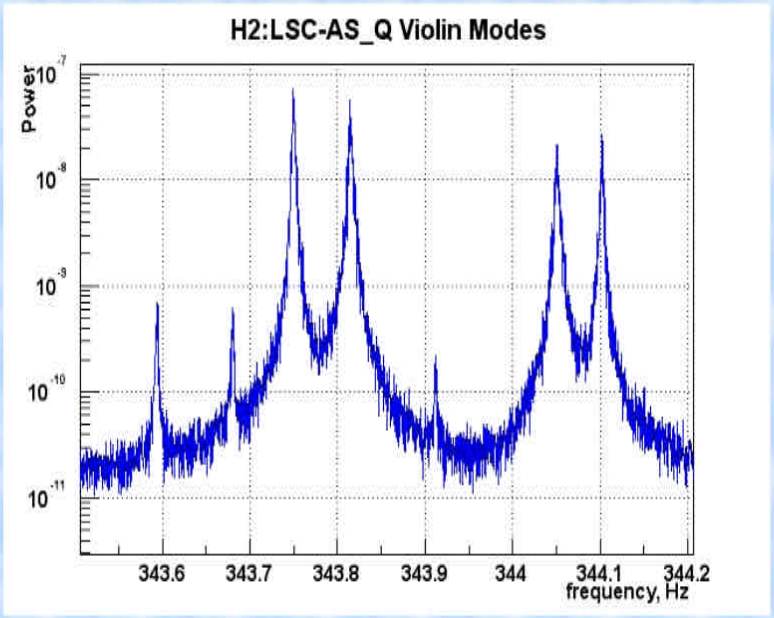
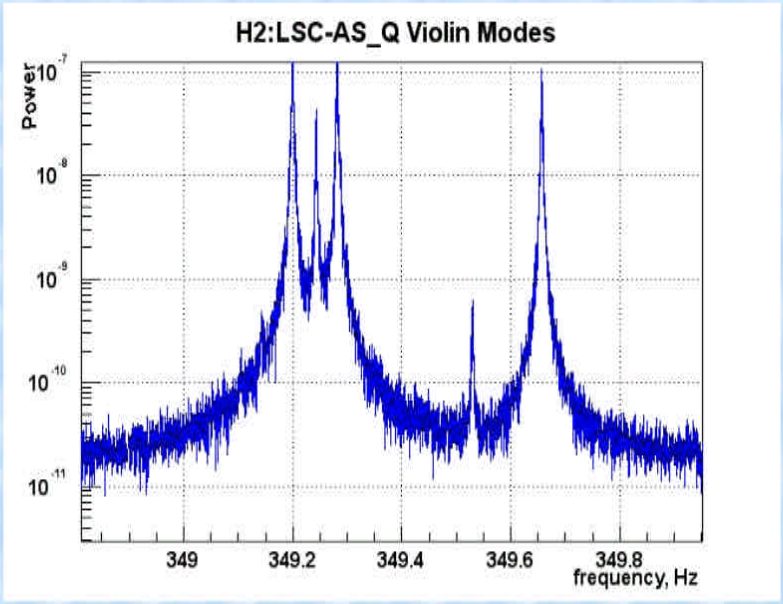
Completed Work

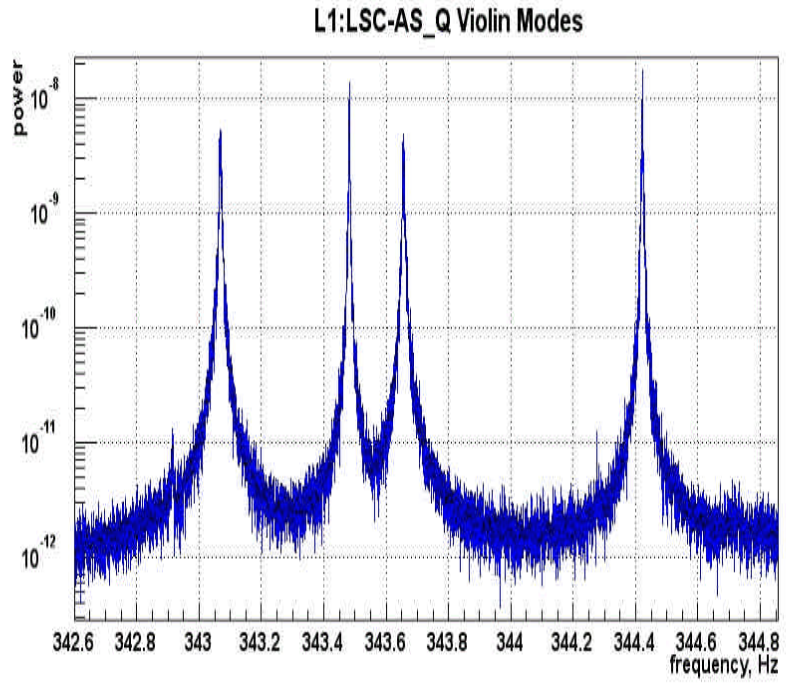
- Wrote program using frame library and fftw library to process 1 hour segments of data stored on server in frame files.(no down sampling!)
- Processed 10 hours from each interferometer LSC-AS_Q channel.
- Calculated the average power.
- Took measurements up to the third harmonic in L1 and H1, and up to the fifth harmonic in H2.
- Calculated Q values using $Q = \frac{\Delta \omega}{FWHM}$.

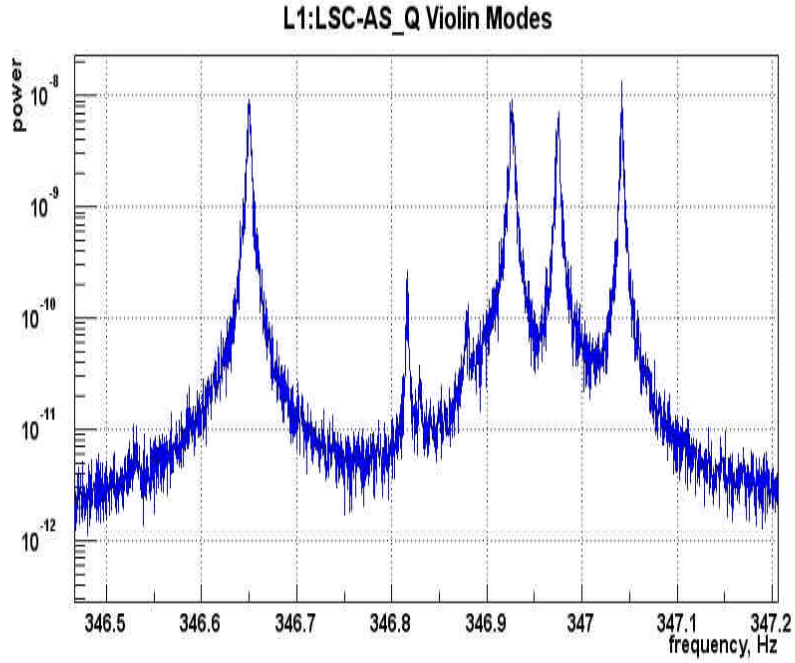

H1:LSC-AS_Q Violin Modes
Power
10^-7
10^-8
10^-9
10^-10
10^-11
343
343.5
344
344.5
345
frequency, Hz


H1:LSC-AS_Q Violin Modes
Power
10^-7
10^-8
10^-9
10^-10
10^-11
347
347.2
347.4
347.6
347.8
348
frequency, Hz


H2:LSC-AS_Q Violin Modes
Power
10^-7
10^-8
10^-9
10^-10
10^-11
343.6
343.7
343.8
343.9
344
344.1
344.2
frequency, Hz


H2:LSC-AS_Q Violin Modes
Power
10^-7
10^-8
10^-9
10^-10
10^-11
349
349.2
349.4
349.6
349.8
frequency, Hz


L1:LSC-AS_Q Violin Modes
power
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
342.6 342.8 343 343.2 343.4 343.6 343.8 344 344.2 344.4 344.6 344.8
frequency, Hz


L1:LSC-AS_Q Violin Modes
power
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
346.5 346.6 346.7 346.8 346.9 347 347.1 347.2
frequency, Hz

Violin Modes and Frequencies (+-0.4 mHz)
resolution of 1/3600 Hz

Widths of First Harmonics(mHz)(+-0.1 mHz)

L1	H1	H2
7.4	3.9	2.5
1.9	3.2	2.7
6.7	1.6	3.8
1.8	3.6	2.5
3.1	2.6	2.6
3.9	1.5	2.3
3.6	19.0	2.3
1.3	21.0	2.0

Q's of First Harmonics(Wo/delta f)

L1	H1	H2
4.636e4	8.806e4	13.750e4
18.088e4	10.752e4	12.734e4
5.129e4	21.545e4	9.054e4
19.135e4	9.579e4	13.764e4
11.182e4	13.353e4	13.431e4
8.895e4	23.151e4	15.184e4
9.638e4	1.830e4	15.186e4
26.695e4	1.656e4	17.483e4

First Harmonics

L1	H1	H2
343.0683	343.4152	343.7501
343.4814	344.0608	343.8149
343.6558	344.7156	344.0508
344.4219	344.8299	344.1018
346.6499	347.1790	349.1996
346.9261	347.2719	349.2428
346.9752	347.6847	349.2817
347.0419	347.7300	349.6566

Second Harmonics

L1	H1	H2
686.1497	686.9169	687.4467
687.0558	688.2850	687.6720
687.3869	689.5115	688.1839
688.8757	689.7416	688.2552
693.4272	694.2828	698.4543
693.9294	694.5960	698.5652
693.9994	695.4199	698.6434
694.0944	695.4811	699.3785

Third Harmonics

L1	H1	H2
1029.4638	1030.5585	1031.3595
1030.7791	1032.5874	1031.6298
1031.2499	1034.4598	1032.4419
1033.5375	1034.8027	1032.5908
1040.3586	1041.6249	1047.8365
1041.0495	1042.1226	1048.0275
1041.1985	1043.3230	1048.1847
1041.2845	1043.4469	1049.2395

Fourth Harmonics

H2
1375.5286
1375.8970
1376.9301
1377.1250
1397.1262
1397.4747
1397.6244
1397.8887

Fifth Harmonics

H2
1719.9970
1720.3925 1720.3945
1721.726
1721.9262
1747.3425
1747.878

Future Steps

- Average the power of at least 20 one hour FFT's, to see higher harmonics.
- Possibly take FFT of ten hour segments of data in order to inspect structure of violin modes.
- Look at accelerometer data to see if changes in tension are affecting the violin mode frequencies and spectral density.
- Compare measurements with current models.