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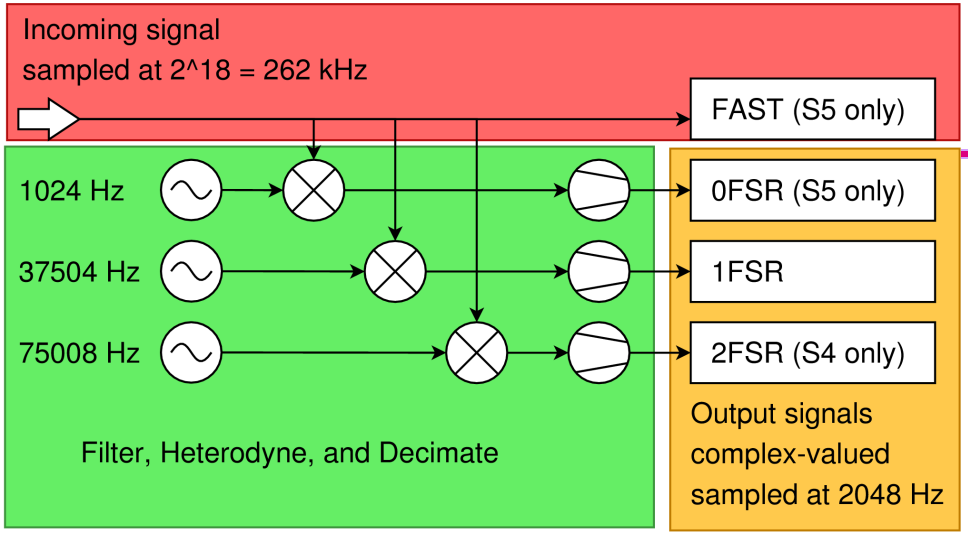
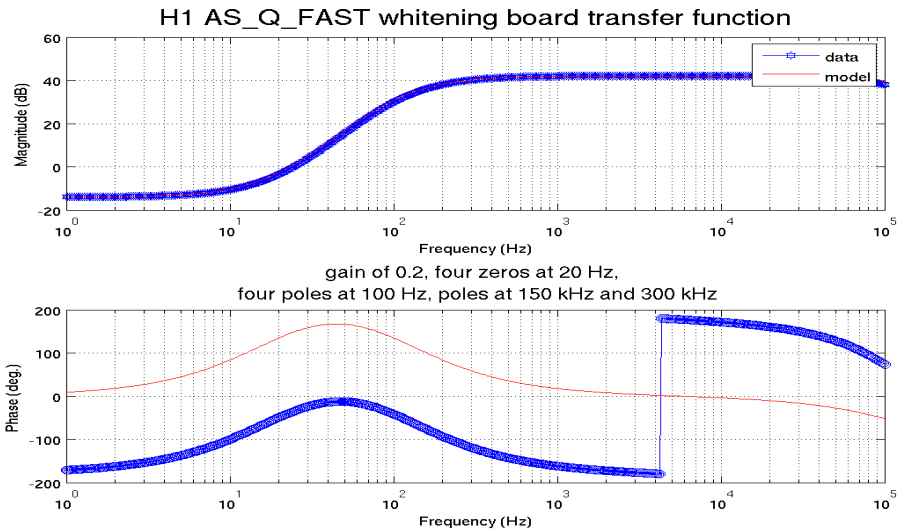
Calibration of Fast Channels

- Hardware configuration in S4
- Calibration measurements
- Generating a response function for the Fast Channels
- Calibrated spectra
- S4 FSR Calibration currently under review (Rick et al)
  http://apex.ligo-wa.caltech.edu/~rick/Calibration/HFcalibration

Fast channel





Differencies between AS_Q/Fast
- AS_Q whitening gain(12dB in H1)
- AS_Q anti-aliasing filter
- ASPDs dig. gains before ADC
- 2^16 cts/20V in ADC in AS_Q

- Its own whitening (on the left)
- x2 at the Demod monitor points
- 2^16 cts/4V in ADC

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Fast Channels in S4

- 2 ASPDs (AS3 & AS4)
- Fast Channels(not archived)
  - H1:DAQ-FAST_CH1_SHORT (AS3_I_FAST)
  - H1:DAQ-FAST_CH2_SHORT (AS3_Q_FAST)
  - H2:DAQ-FAST_CH0_SHORT (AS4_I_FAST)
  - H2:DAQ-FAST_CH1_SHORT (AS4_Q_FAST)

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Heterodyned Channels

- LSC-AS3_ I _1FSR
- LSC-AS3_Q_1FSR
- LSC-AS3_ I _2FSR
- LSC-AS3_Q_2FSR
- LSC-AS4_ I _1FSR
- LSC-AS4_Q_1FSR
- LSC-AS4_ I _2FSR
- LSC-AS4_Q_2FSR

Time series rotation and summation

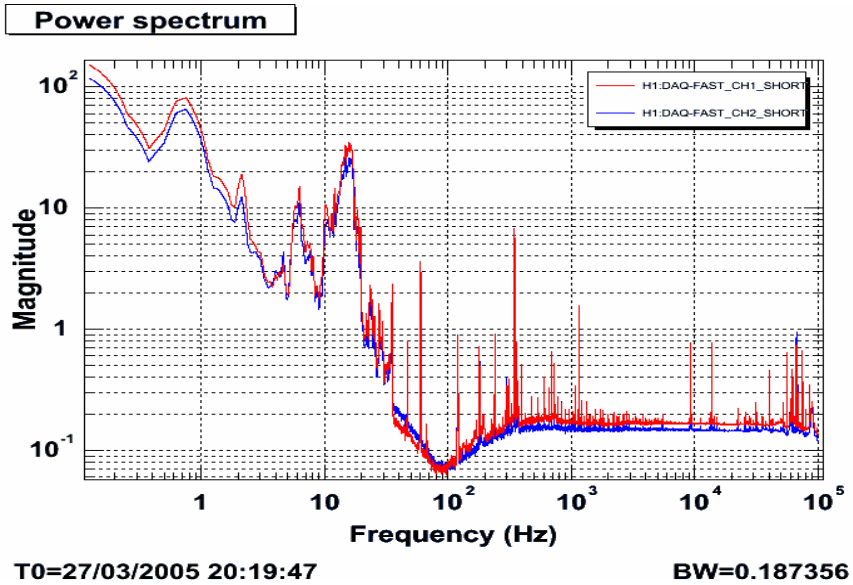
$$AS3 = AS3\_I \sin(\varphi) + AS3\_Q \cos(\varphi)$$

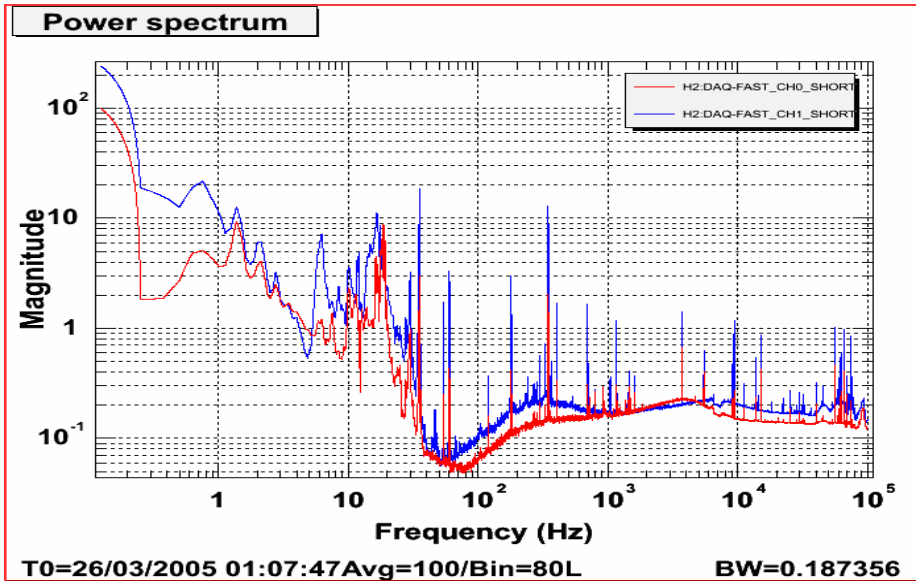
$$AS4 = AS4\_I \sin(\theta) + AS3\_Q \cos(\theta)$$

$$AS\_Q = (n3\ AS3 + n4\ AS4) / 2$$

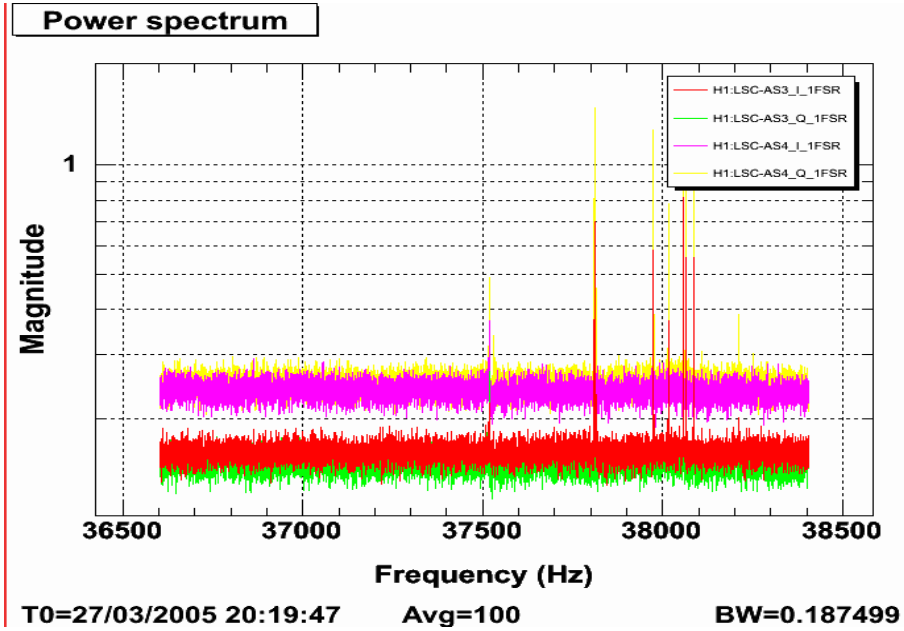
Fast spectra in S4 (Feb. 22 – March 23 2005)

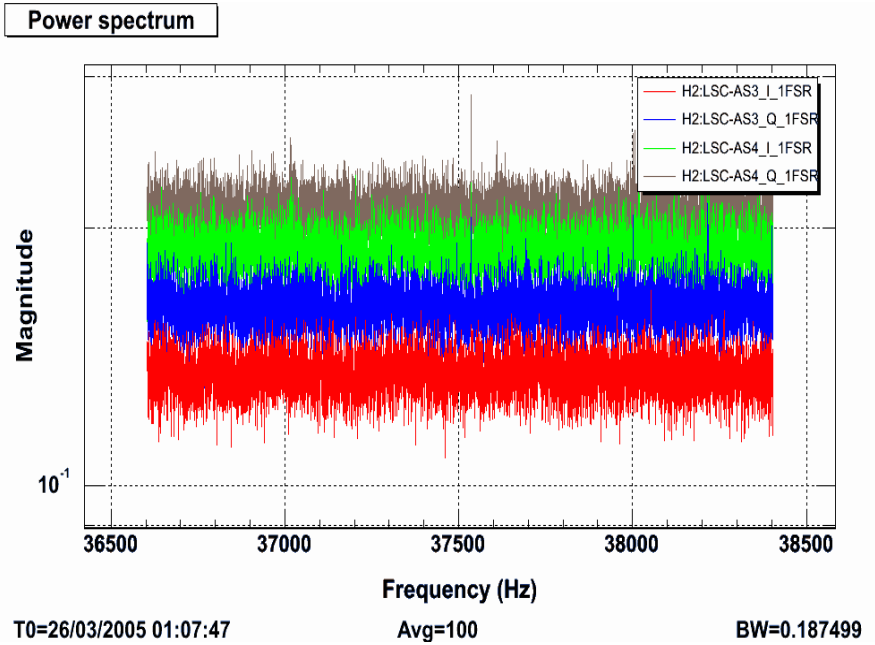
- 2 measurements on March 11 and March 27 2005 (AS3 only)



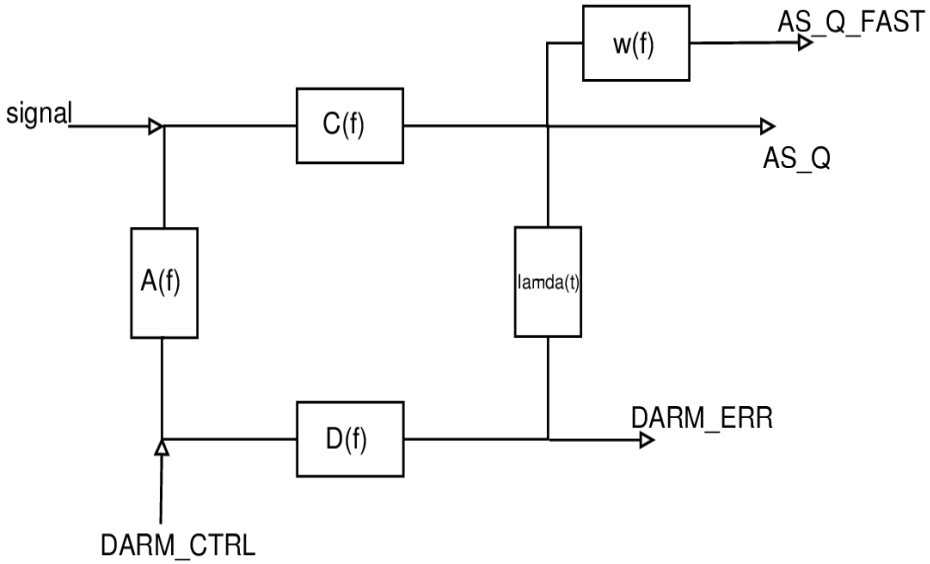


Heterodyned spectra





Block Diagram / AS_Q_FAST response

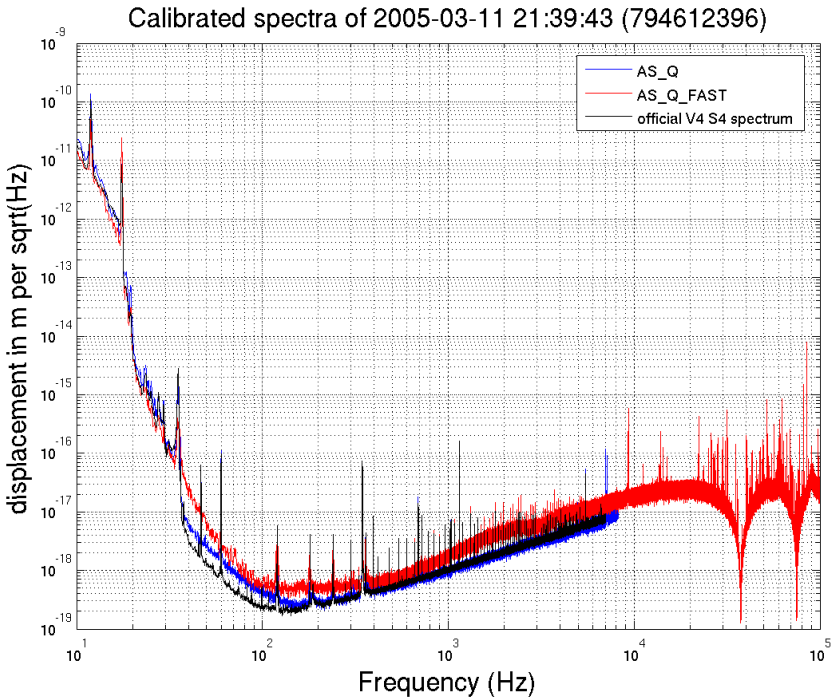


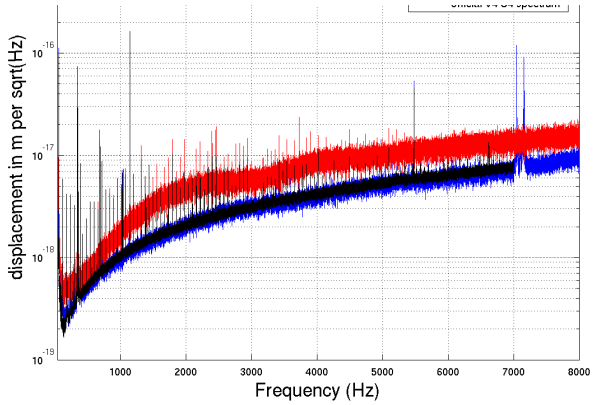
R(f)_fast = (1+G'(f))/C'(f) / w(f)

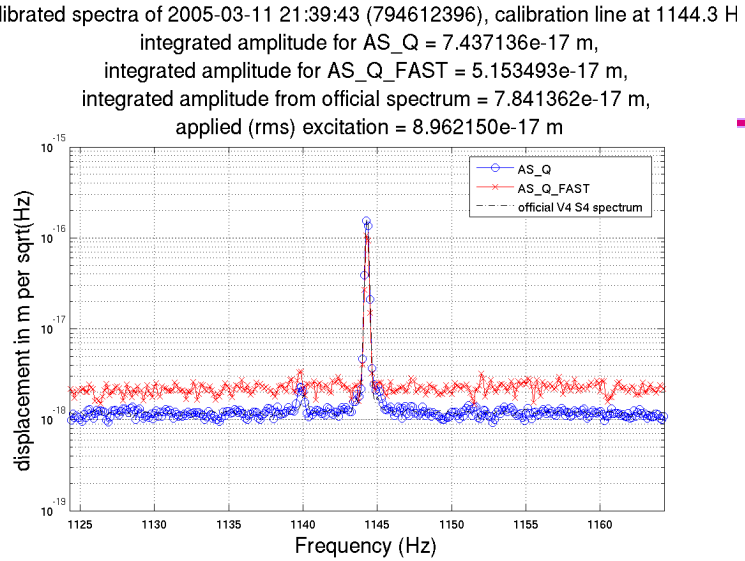
where

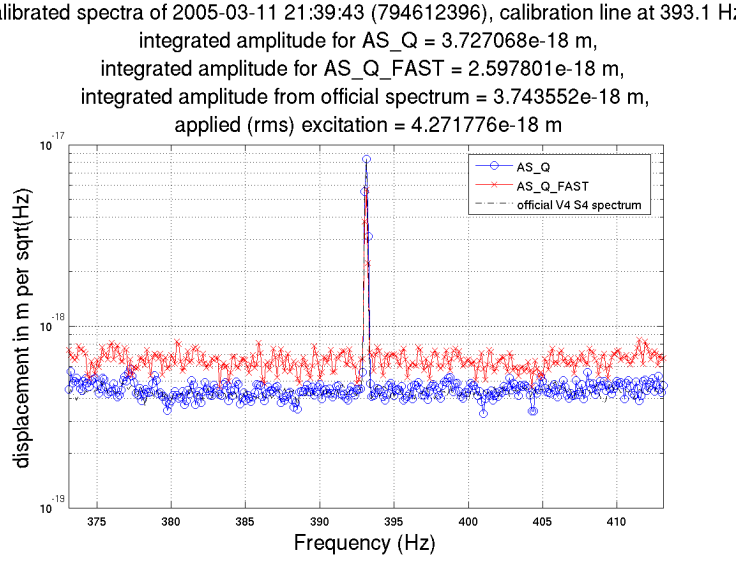
C'(f) = C(f) * time_delay
G'(f) = A(f) * D(f) * C'(f) * aa * k
w(f) the whitening filter

H1 : March 11 2005

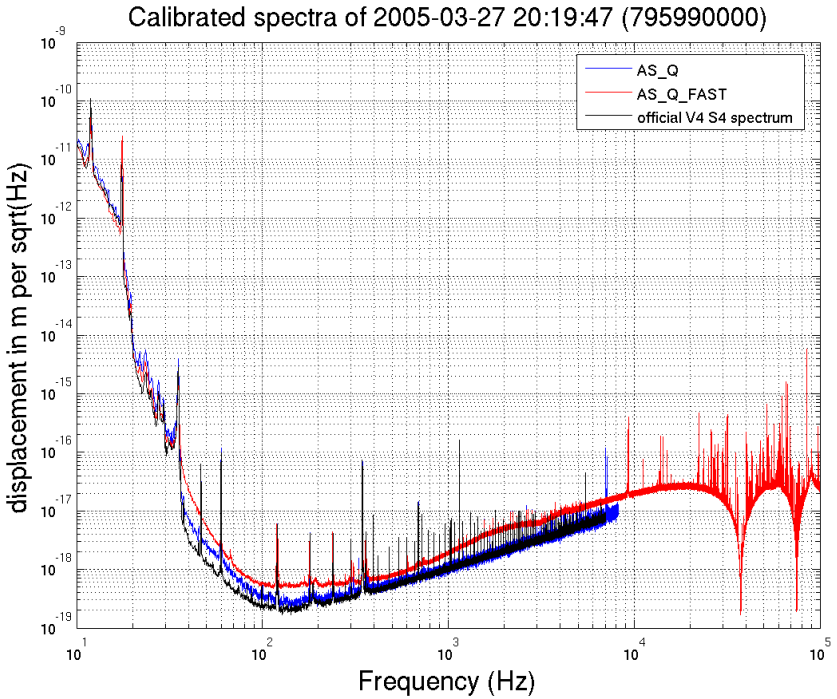


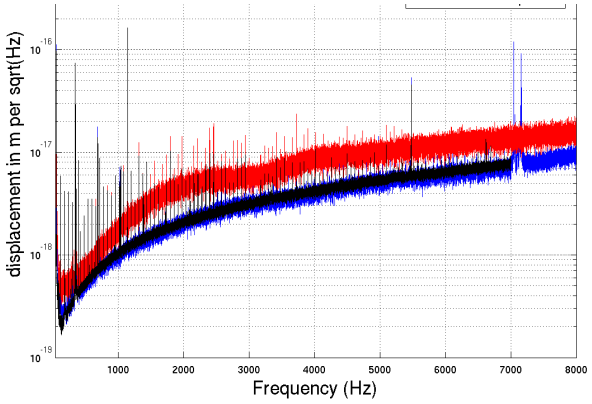




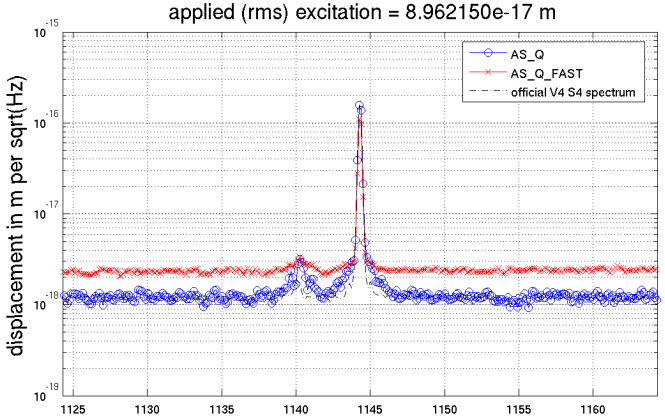


H1: March 27 2005

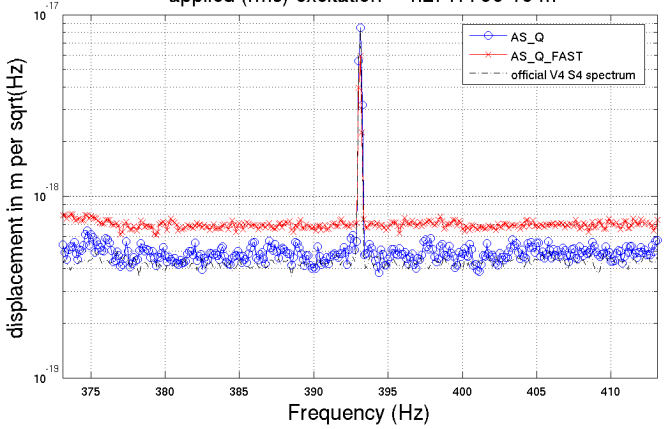




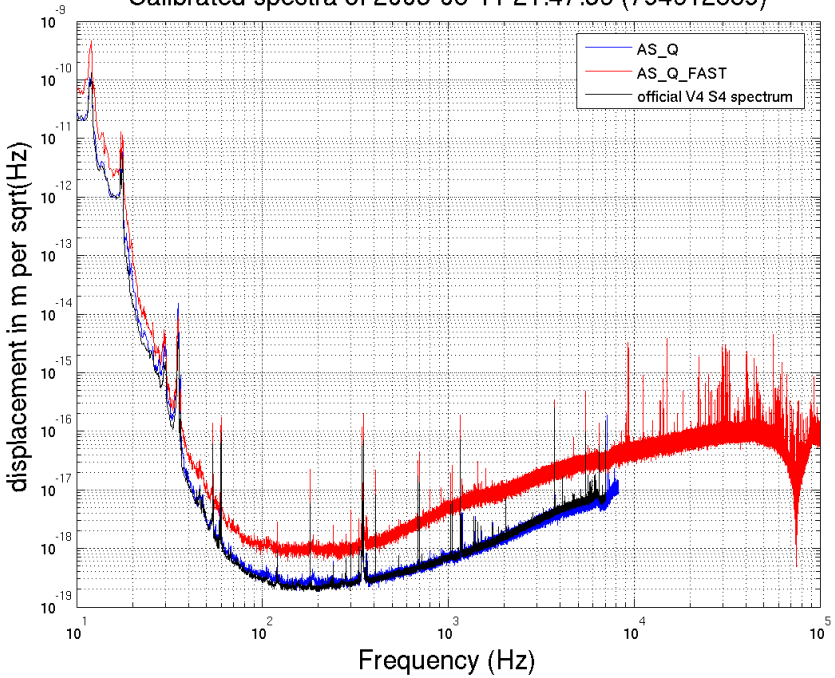
Calibrated spectra of 2005-03-27 20:19:47 (795990000), calibration line at 1144.3 H
integrated amplitude for AS_Q = 7.544061e-17 m,
integrated amplitude for AS_Q_FAST = 5.295310e-17 m,
integrated amplitude from official spectrum = 7.841362e-17 m,
applied (rms) excitation = 8.962150e-17 m

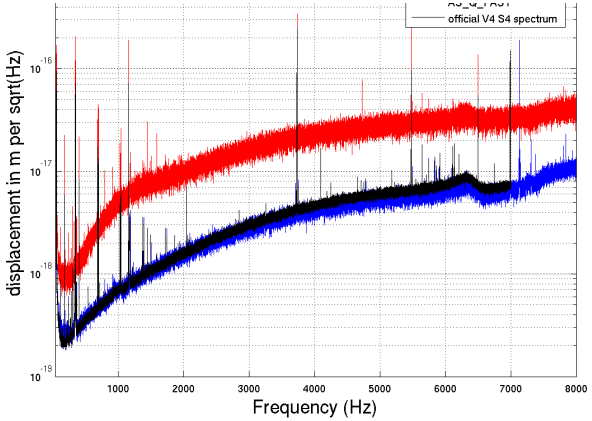


Calibrated spectra of 2005-03-27 20:19:47 (795990000), calibration line at 393.1 H;
integrated amplitude for AS_Q = 3.784739e-18 m,
integrated amplitude for AS_Q_FAST = 2.725831e-18 m,
integrated amplitude from official spectrum = 3.743552e-18 m,
applied (rms) excitation = 4.271776e-18 m

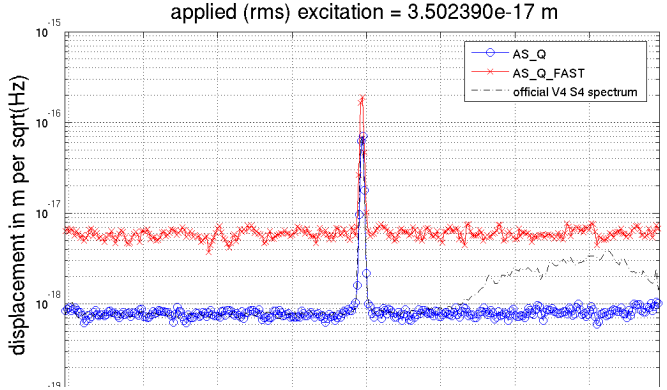


H2: March 11 2005

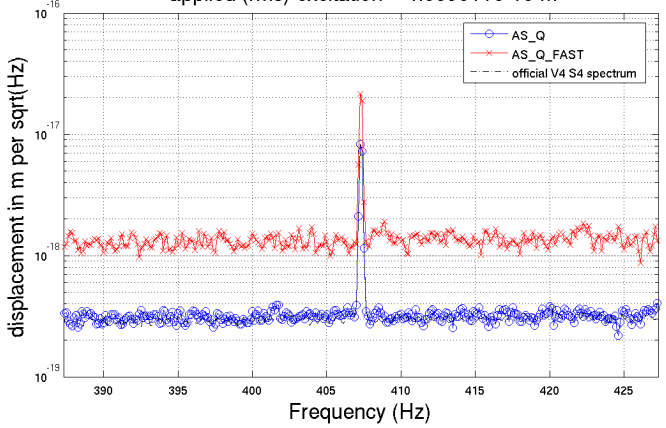




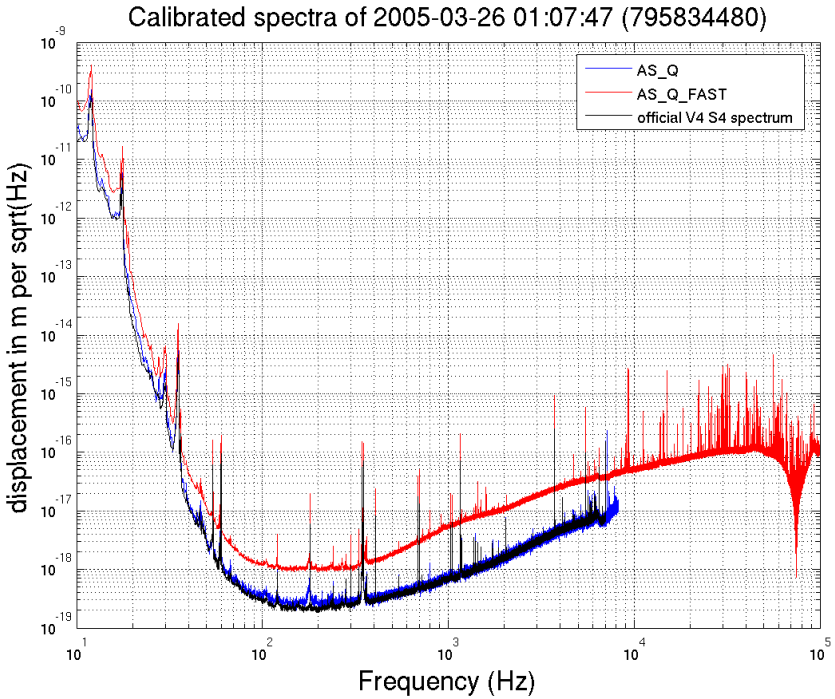
Calibrated spectra of 2005-03-11 21:47:56 (794612889), calibration line at 1159.7 H
integrated amplitude for AS_Q = 3.401380e-17 m,
integrated amplitude for AS_Q_FAST = 9.102334e-17 m,
integrated amplitude from official spectrum = 3.439733e-17 m,
applied (rms) excitation = 3.502390e-17 m

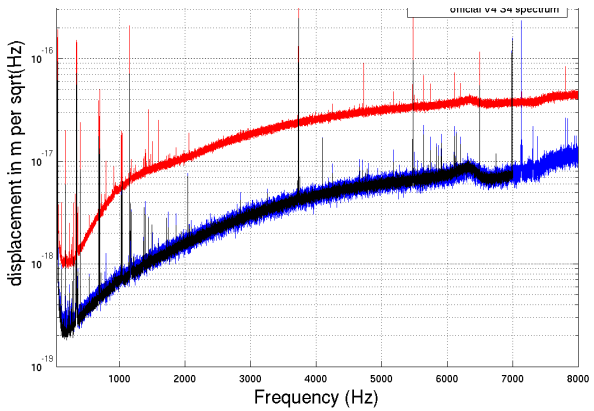


Calibrated spectra of 2005-03-11 21:47:56 (794612889), calibration line at 407.3 H;
integrated amplitude for AS_Q = 3.983484e-18 m,
integrated amplitude for AS_Q_FAST = 1.041711e-17 m,
integrated amplitude from official spectrum = 3.999059e-18 m,
applied (rms) excitation = 4.069811e-18 m

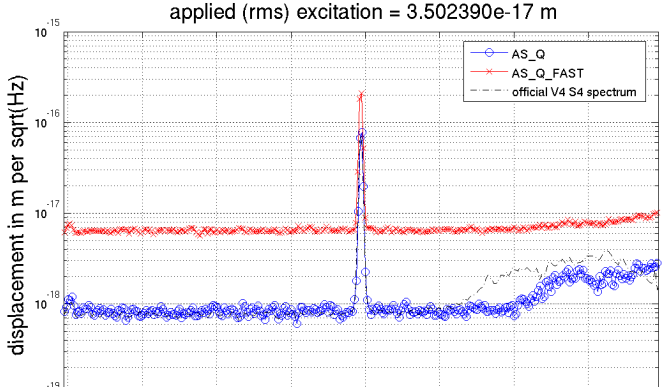


H2: March 26 2005

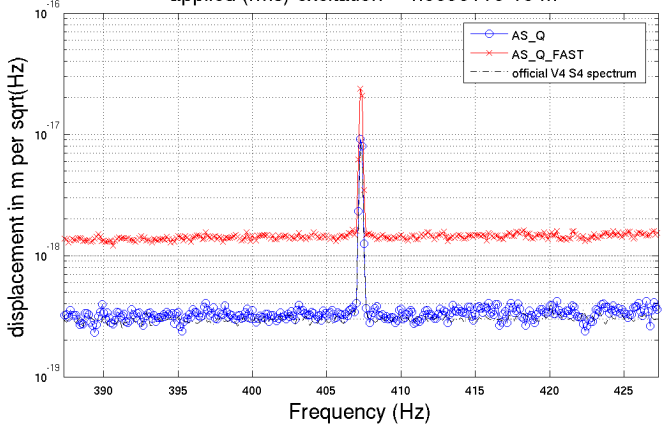




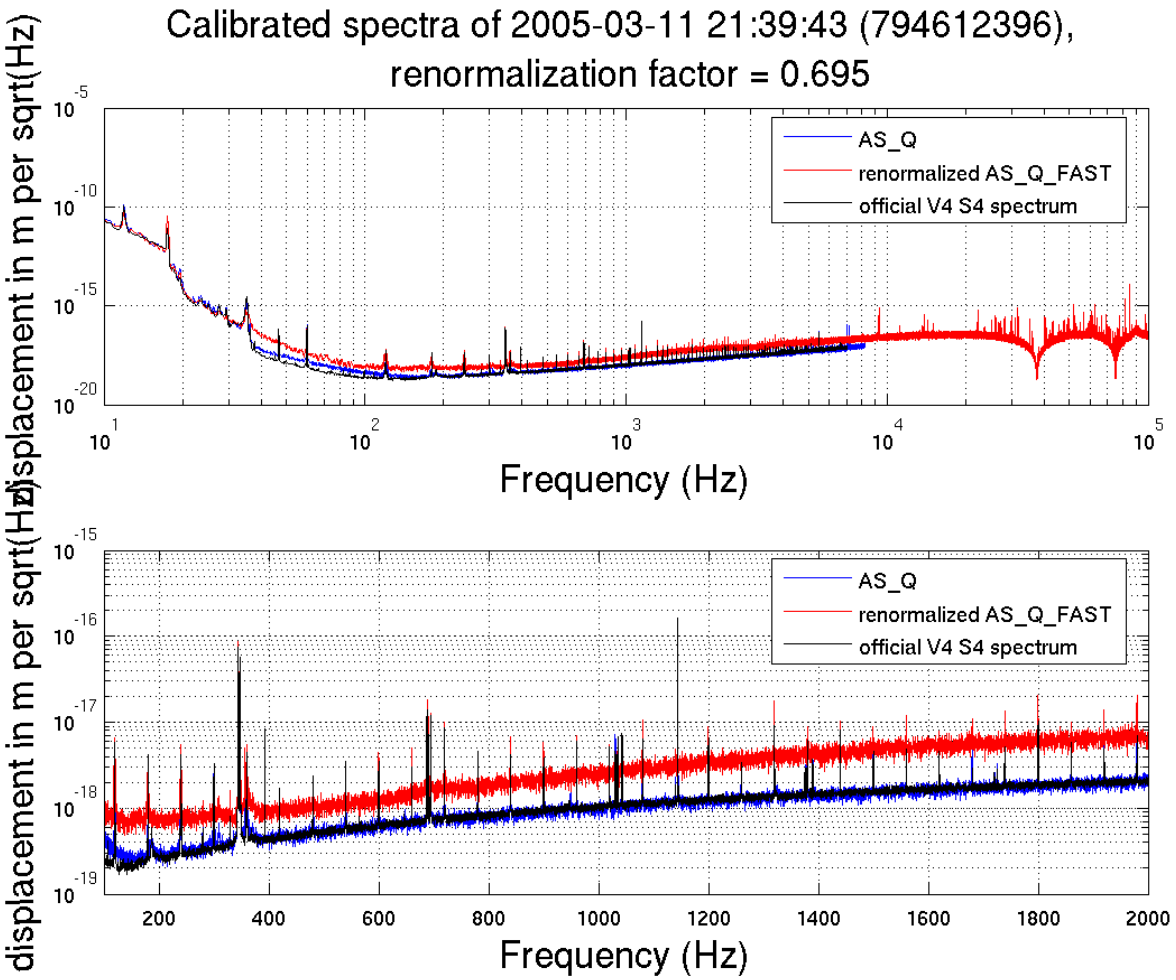
Calibrated spectra of 2005-03-26 01:07:47 (795834480), calibration line at 1159.7 H
integrated amplitude for AS_Q = 3.740194e-17 m,
integrated amplitude for AS_Q_FAST = 1.004805e-16 m,
integrated amplitude from official spectrum = 3.439733e-17 m,
applied (rms) excitation = 3.502390e-17 m



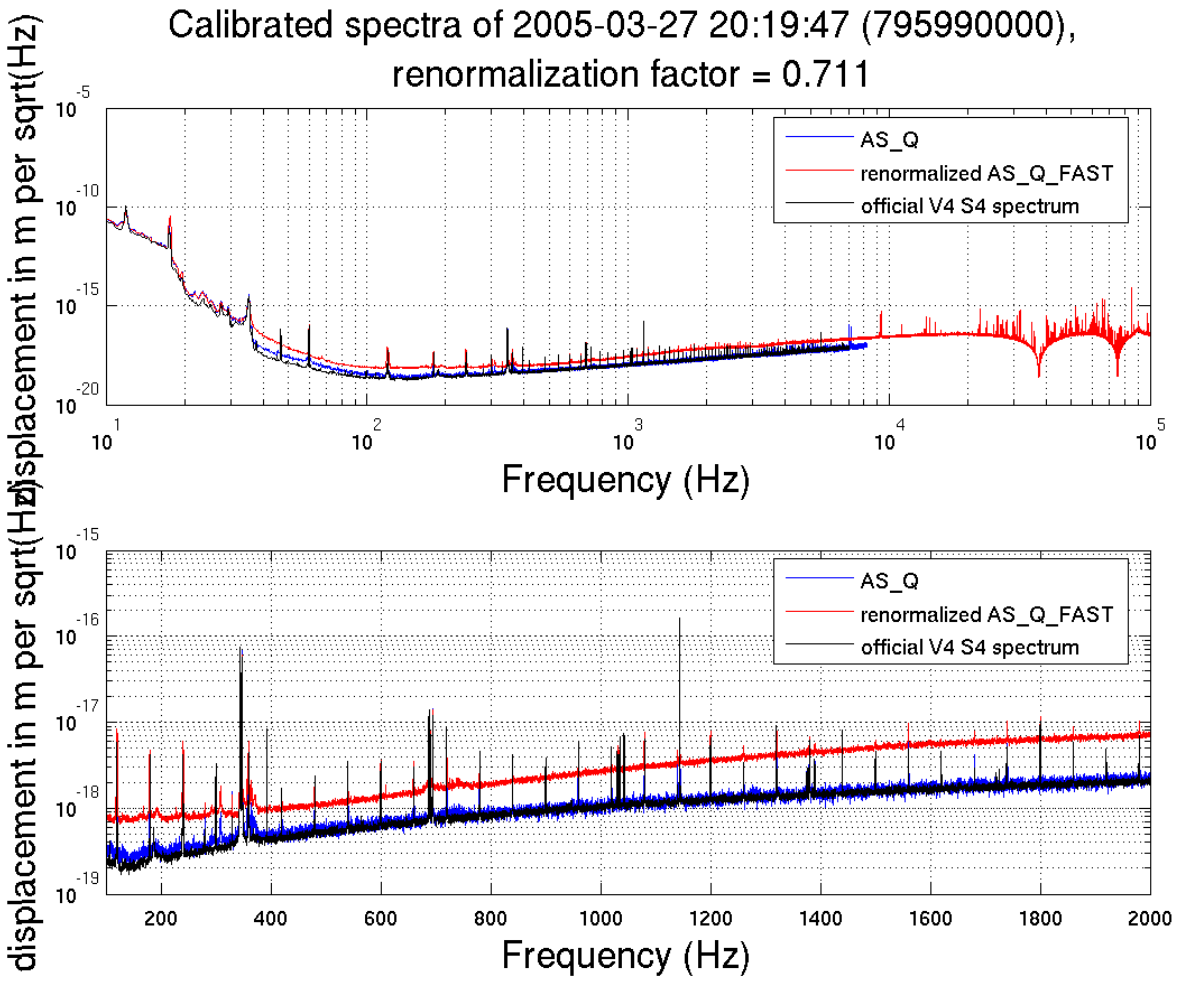
Calibrated spectra of 2005-03-26 01:07:47 (795834480), calibration line at 407.3 H:
integrated amplitude for AS_Q = 4.386246e-18 m,
integrated amplitude for AS_Q_FAST = 1.159224e-17 m,
integrated amplitude from official spectrum = 3.999059e-18 m,
applied (rms) excitation = 4.069811e-18 m



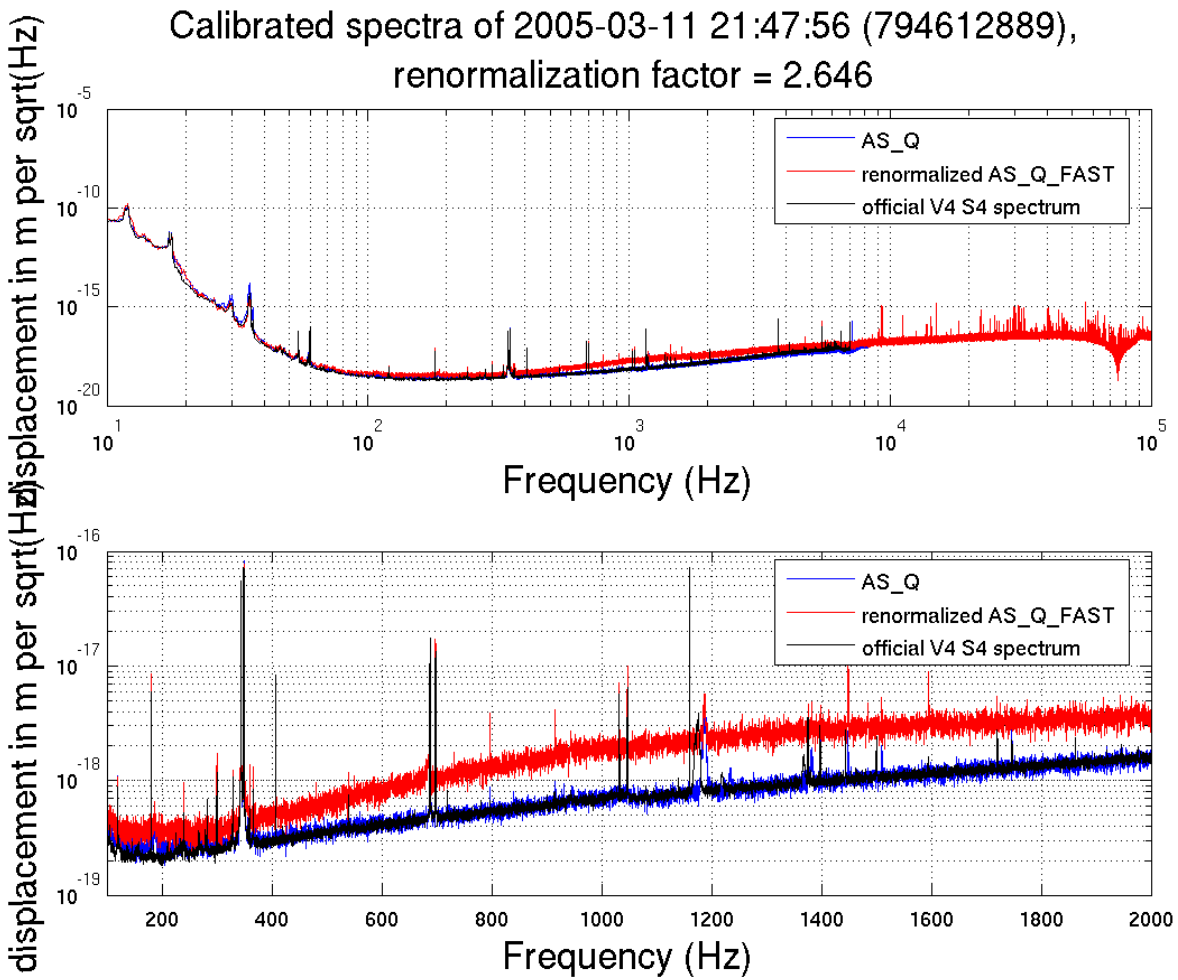
H1: March 11 2005 (renormalized)



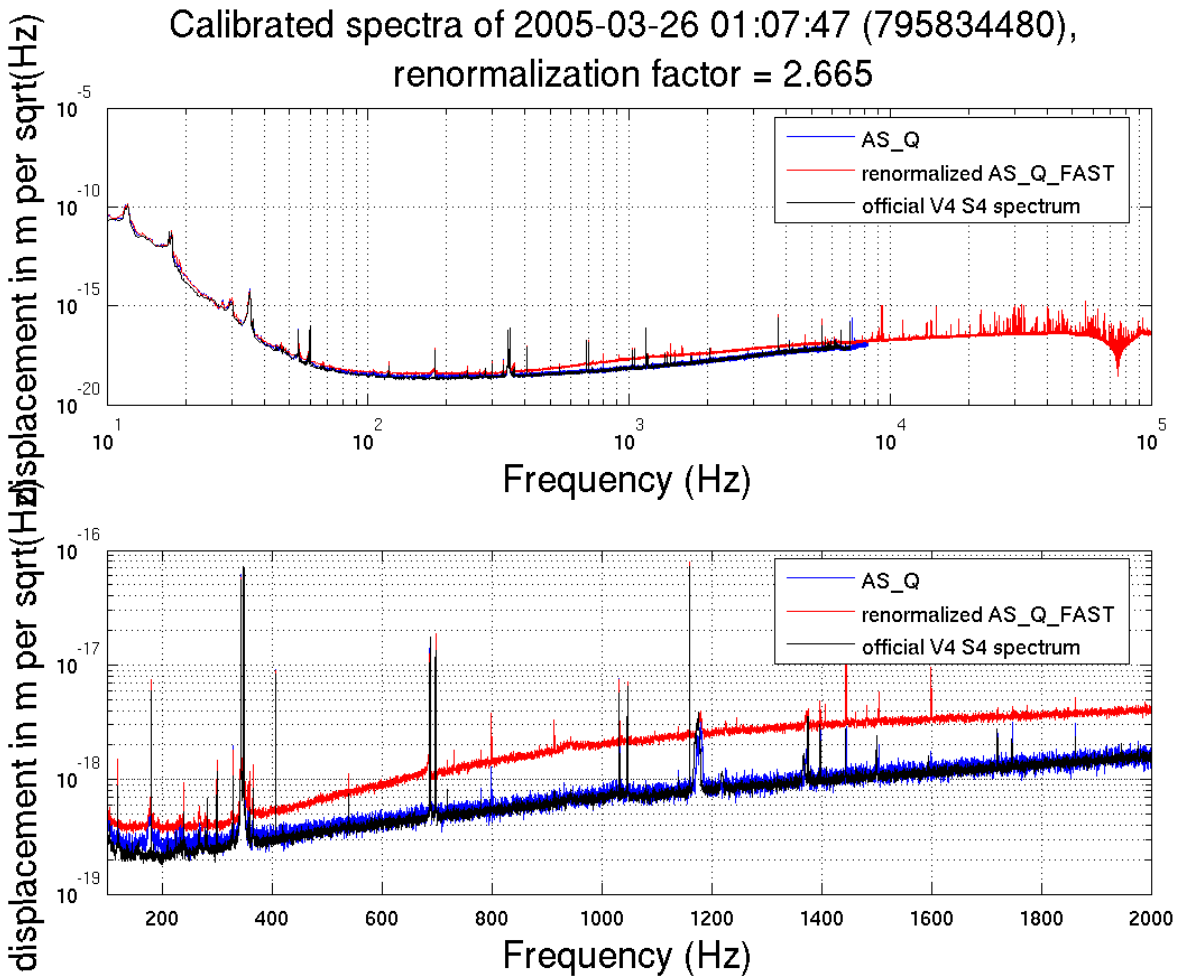
H1: March 27 2005 (renormalized)



H2: March 11 2005 (renormalized)

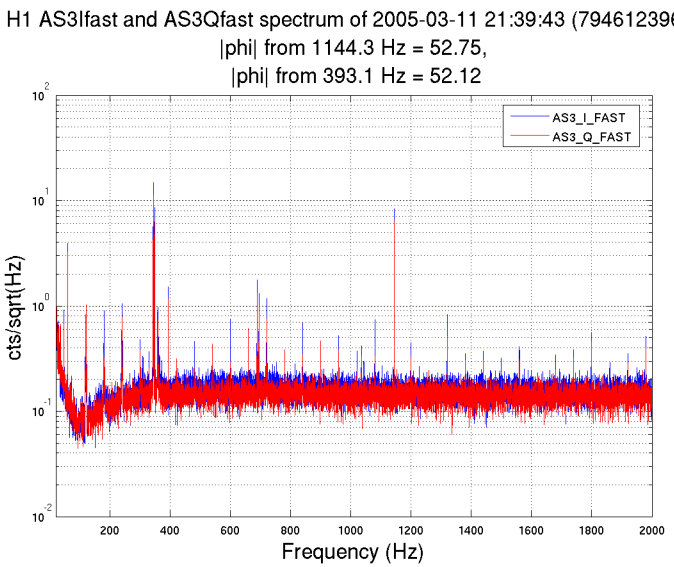


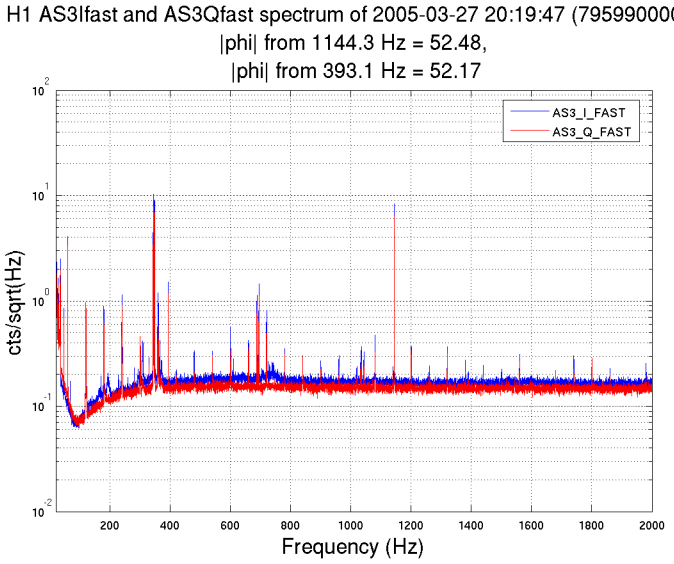
H2: March 26 2005 (renormalized)

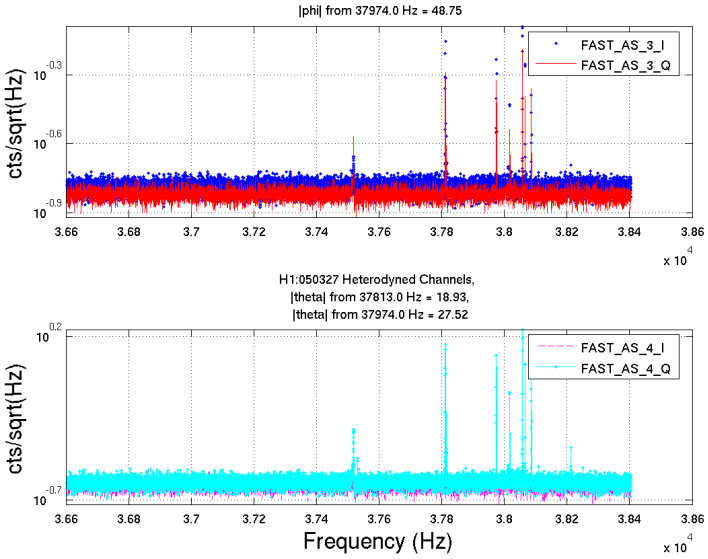


Rotation angles (Demod phases)

H1



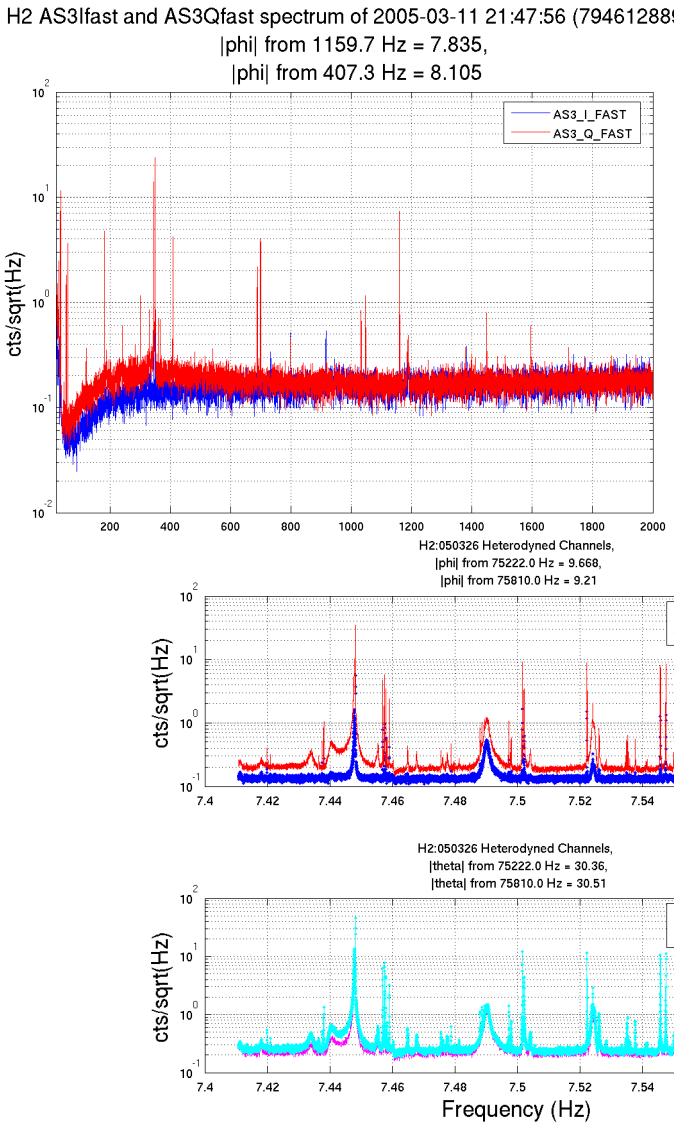


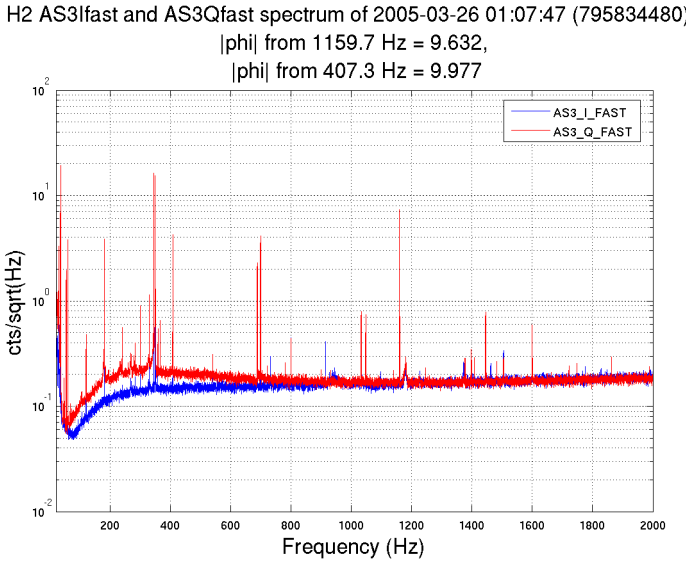


$|\varphi| \sim 52.4$ (51.4)

$|\theta| \sim 18.9$ (17.2)

H2



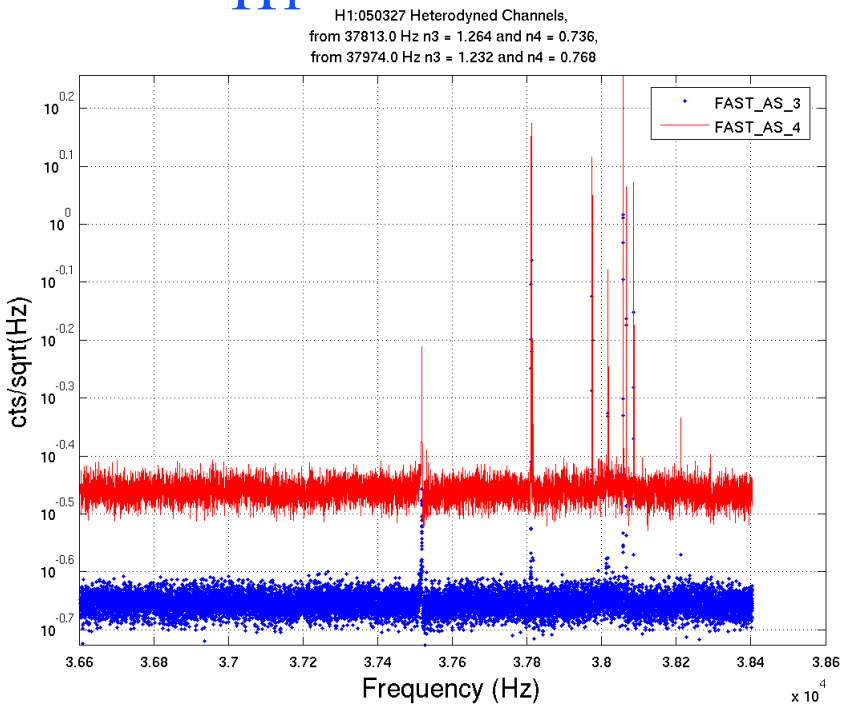


$|\varphi| \sim 8.88$ (175)

$|\theta| \sim 30.36$ (27)

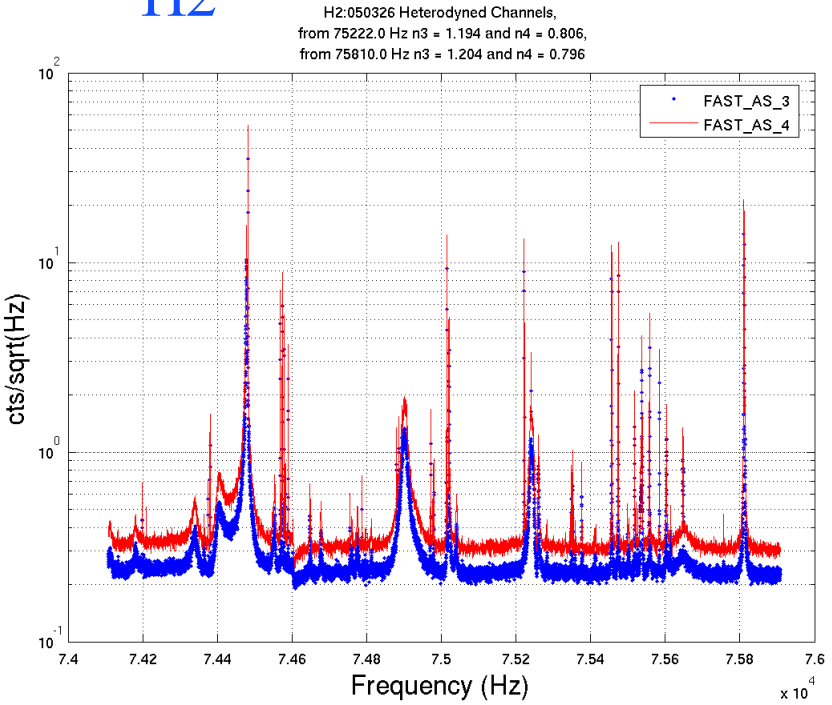
n3 / n4 ASPDs weigths

H1



n3 ~ 1.25
n4 ~ 0.75

H2



n3 ~ 1.2
n4 ~ 0.8

H1 Fast Channel shot noise measurement in S4